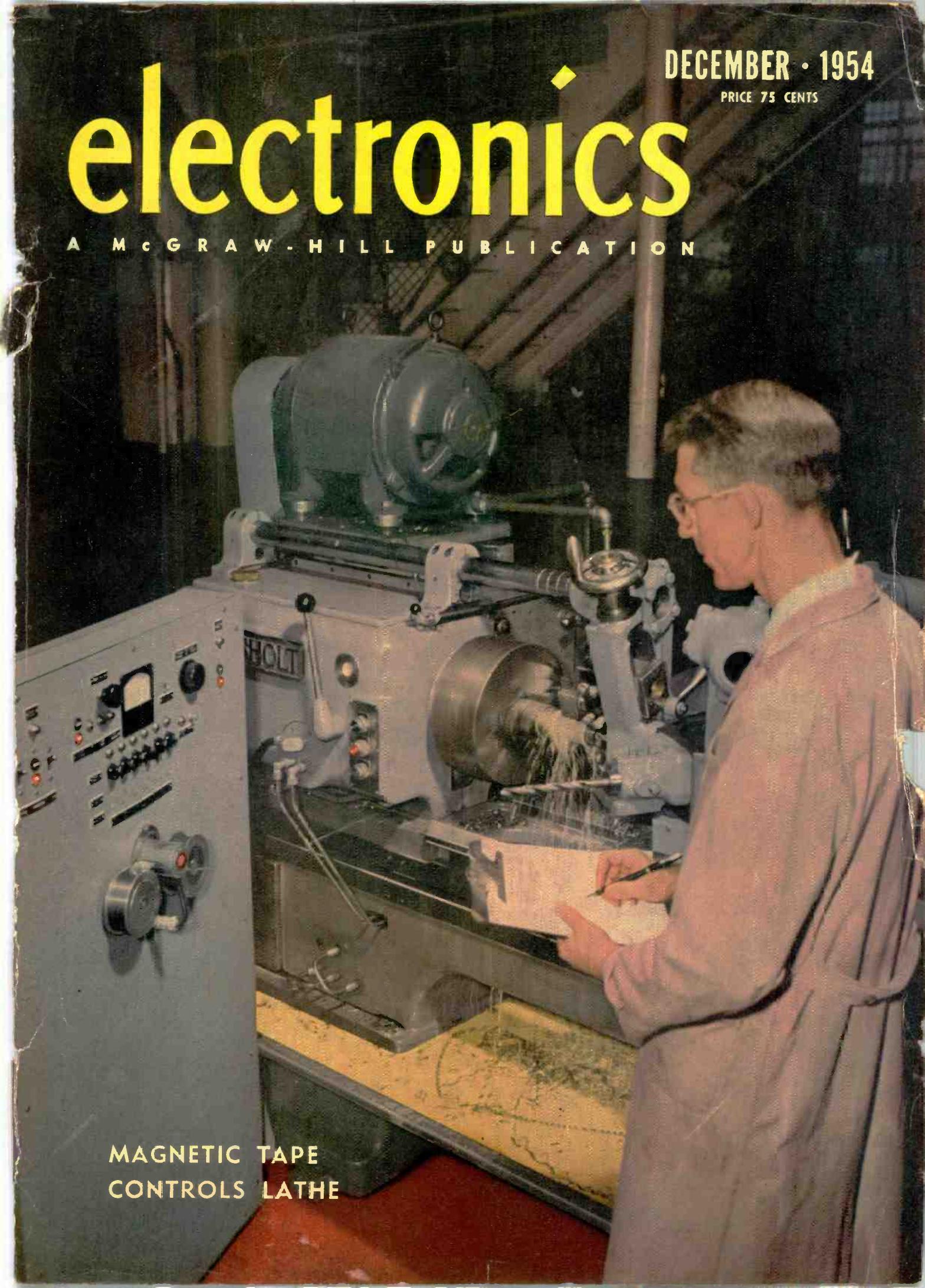


DECEMBER • 1954

PRICE 75 CENTS

# electronics

A MCGRAW-HILL PUBLICATION

A black and white photograph of a man in a lab coat operating a lathe. The man is on the right, wearing glasses and a light-colored lab coat, looking at a control panel on the left. The control panel has a gauge, several buttons, and a large knob. The lathe is a large industrial machine with a rotating workpiece. The background is a dark, industrial setting.

MAGNETIC TAPE  
CONTROLS LATHE

LARGEST PRODUCERS IN THIS FIELD FOR TWO DECADES...

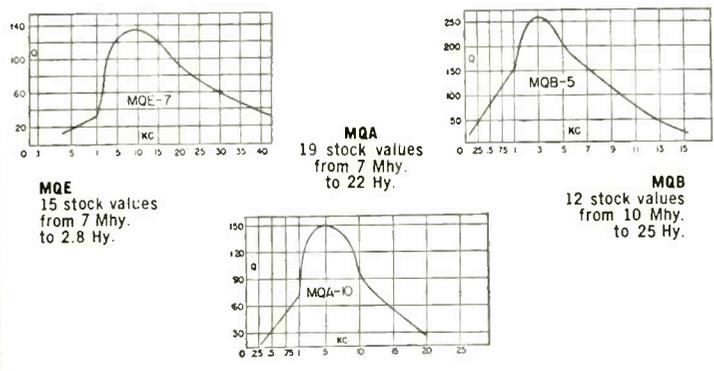
# HIGH Q INDUCTORS FOR EVERY APPLICATION



FROM STOCK... ITEMS BELOW AND 650 OTHERS IN OUR CATALOGUE B.

### MQ Series Compact Hermetic Toroid Inductors

The MQ permalloy dust toroids combine the highest Q in their class with minimum size. Stability is excellent under varying voltage, temperature, frequency and vibration conditions. High permeability case plus uniform winding affords shielding of approximately 80 db.



**MQ drawn case structure.**

	Length	Width	Height
MQE	1/2	1-1/16	1-7/32
MQA	11/16	1-9/32	1-23/32
MQB	1-5/16	2-9/16	2-13/16

**VIC case structure**

Length	Width	Height
1-1/4	1-11/32	1-7/16

Type	Mean Hys.	Type	Mean Hys.
VIC-1	.0085	VIC-12	1.3
VIC-2	.013	VIC-13	2.2
VIC-3	.021	VIC-14	3.4
VIC-4	.034	VIC-15	5.4
VIC-5	.053	VIC-16	8.5
VIC-6	.084	VIC-17	13.
VIC-7	.13	VIC-18	21.
VIC-8	.21	VIC-19	33.
VIC-9	.34	VIC-20	52.
VIC-10	.54	VIC-21	83.
VIC-11	.85	VIC-22	130.

### VIC Variable Inductors

The VIC Inductors have represented an ideal solution to the problem of tuned audio circuits. A set screw in the side of the case permits adjustment of the inductance from +85% to -45% of the mean value. Setting is positive. Curves shown indicate effective Q and L with varying frequency and applied AC voltage.

**MQL Low Frequency High Q Coils**

The MQL series of high Q coils employ special laminated Hipermalloy cores to provide very high Q at low frequencies with exceptional stability for changes of voltage, frequency, and temperature. Two identical windings permit series, parallel, or transformer type connections.

MQL-1	2.5/10 Hys.
MQL-2	5/20 Hys.
MQL-3	50/200 Hys.
MQL-4	100/400 Hys.

**MQL case**  
1-13/16 dia. X 2-1/2" H.

### DI Inductance Decades

These decades set new standards of Q, stability, frequency range and convenience. Inductance values laboratory adjusted to better than 1%. Units housed in a compact die cast case with sloping panel ideal for laboratory use.

DI-1	Ten 10 Mhy. steps.
DI-2	Ten 100 Mhy. steps.
DI-3	Ten 1 Hy. steps.
DI-4	Ten 10 Hy. steps.

**DI DECADE**

Length	4 1/2"
Width	4 3/8"
Height	2 3/8"

### HVC Hermetic Variable Inductors

A step forward from our long established VIC series. Hermetically sealed to MIL-T-27... extremely compact... wider inductance range... higher Q... lower and higher frequencies... superior voltage and temperature stability.

Type No.	Min. Hys.	Mean Hys.	Max. Hys.
HVC-1	.002	.006	.02
HVC-2	.005	.015	.05
HVC-3	.011	.040	.11
HVC-4	.03	.1	.3
HVC-5	.07	.25	.7
HVC-6	.2	.6	2
HVC-7	.5	1.5	5
HVC-8	1.1	4.0	11
HVC-9	3.0	10	30
HVC-10	7.0	25	70
HVC-11	20	60	200
HVC-12	50	150	500

**HVC case structure.**

Width	Length	Height
25/32	1-1/8	1-7/32

**SPECIAL UNITS TO YOUR NEEDS**  
Send your specifications for prices.

## UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "ARLAB"

Lloyd Smith

# electronics

DECEMBER • 1954

A McGRAW - HILL  
PUBLICATION

**MAGNETIC TAPE CONTROLS LATHE**—Multitrack tape on control panel acts through Maico Co.'s Factrol servo system to control spindle speeds, saddle and tool positions and tape rewind on Gisholt lathe. Details on p 144... COVER

Figures of the Month .....	4
Industry Report .....	5
Manufacturing Grown Junction Transistors .....	by Frank H. Bower 130
Light-Beam Telemetry .....	by H. J. Strickland 135
Echo-Location for the Blind .....	by C. M. Witcher and L. Washington, Jr. 136
Sine-Squared Pulses Test Color-TV Systems .....	by Ralph C. Kennedy 138
High-Frequency Coils Use New Core Materials .....	by Frank Rockett 140
Magnetic Tape Controls Machine Tools .....	by John W. Hogan 144
Keying VLF Transmitters at High Speed .....	by M. I. Jacob and H. N. Brauch 148
Manometer Recorder for Physiological Pressures .....	by W. E. Gilson 152
Dark-Trace Display Tube Has High Writing Speed .....	by Seymour Nozick, Norman H. Burton and Sam Newman 154
Silicon Power Rectifier Handles 1,200 Watts .....	by E. F. Losco 157
Hardness Tester Sorts Auto Engine Parts .....	by Milton J. Diamond 160
Direct VSWR Readings in Pulsed R-F Systems .....	by L. A. Rosenthal and G. M. Badoyannis 162
Predicted-Wave Radio Teleprinter .....	by M. L. Doelz 166
Pulling-Figure Tester for Microwave Oscillators .....	by E. Dyke and J. Cohn 170
Microphotometer Scans Spectrum Photographs .....	by D. E. Billings, R. H. Cooper, J. W. Evans and R. H. Lee 174
Radar Doppler Nomograph .....	by Allen H. Schooley 180
Annual Index, Volume 27 .....	418
Crosstalk .....	129
Electrons at Work .....	182
Production Techniques .....	228
New Products .....	264
Plants and People .....	310
New Books .....	360
Backtalk .....	372
Index to Advertisers .....	411

**W. W. MacDONALD**, Editor; **VIN ZELUFF**, Managing Editor; John Markus, Alexander A. McKenzie, John M. Carroll, Associate Editors; William P. O'Brien, William G. Arnold, David A. Findlay, Haig A. Manoogian, Edmund B. Palmquist, Assistant Editors; Gloria J. Filippone, Susan Daniels, Arlene Schlip, Editorial Assistants; Keith Henney, Consulting Editor; Gladys T. Montgomery, Washington Editor; Harry Philips, Art Director; Eleanor Luke, Art Assistant

**H. W. MATEER**, Publisher; **WALLACE B. BLOOD**, Manager; R. S. Quint, Buyers' Guide Manager; Frank H. Ward, Business Manager; H. E. Hilty, Classified Manager; D. H. Miller, James Girdwood, New York; Wm. S. Hodgkinson, New England; James T. Hauptli, Philadelphia; Charles Gardner, Bruce Winner, Chicago; J. L. Phillips, Cleveland; T. H. Carmody, R. C. Alcorn, San Francisco; Carl W. Dysinger, Los Angeles; Wm. D. Lanier, Atlanta



DECEMBER, 1954

ELECTRONICS

Member ABC and ABP

Vol. 27, No. 12



Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office, 99-129 North Broadway, Albany 1, N. Y.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42 St., New York 36, N. Y., Longacre 4-3000. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Executive Vice-President. Publication Division: Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

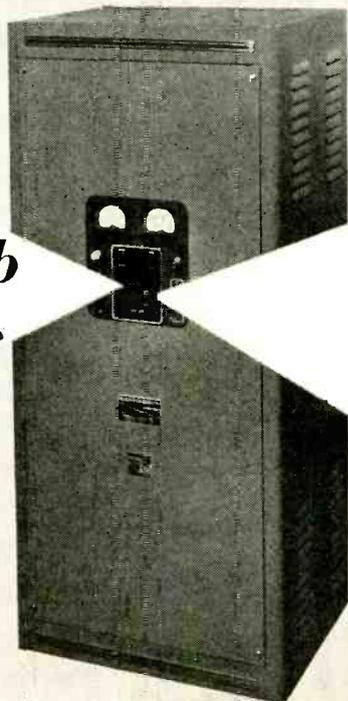
Subscriptions: Address correspondence to Electronics—Subscription Service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from persons engaged in theory, research, design, production, maintenance and use of electronic and industrial control components, parts and end products. Position and company connection must be indicated on subscription orders.

Single copies 75¢ for United States and possessions, and Canada; \$1.50 for Latin America; \$2.00 for all other foreign countries. Buyers' Guide \$3.00. Subscription rates—United States and possessions, \$6.00 a year; \$9.00 for two years. Canada, \$10.00 a year; \$16.00 for two years. Other western hemisphere countries and the Philippines, \$15.00 a year; \$25.00 for two years. All other countries \$20.00 a year; \$30.00 for two years. Entered as second-class matter August 29, 1936, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U.S.A. Copyright 1954 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; McGraw-Hill House, London, E.C. 4; Washington, D. C. 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; 1321 Rhodes-Haverty Bldg., Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

Here's the versatile, regulated DC source  
you've been looking for -

# NOBATRON\* *Ranger*

*turning  
this knob  
gives you...*



100-300VDC at 1-10 amps  
(model SR2)  
5-135VDC at 1-10 amps  
(model SR100)  
5-30VDC at 3-30 amps  
(model SR30)  
with  $\pm 0.25\%$   
regulation accuracy!

The Sorensen Nobatron-Ranger is essentially an adaptation of the proved Nobatron circuit\*\*, with the added feature of continuously adjustable output voltage over a wide range. This makes the RANGER an exceptionally good investment for the many laboratories and test installations where a multi-purpose DC source can be used to advantage.

#### ELECTRICAL CHARACTERISTICS

<b>Input voltage range</b>	95-130VAC, 1 $\phi$ , 50-60~ for models SR30 and SR100 190-260VAC, 1 $\phi$ , 50-60~ for model SR2
<b>Output voltage and load range</b>	5-30VDC at 3-30 amps in model SR30 5-135VDC at 1-10 amps in model SR100 100-300VDC at 1-10 amps in model SR2
<b>Regulation accuracy</b>	$\pm 0.25\%$ at any output voltage setting with an input between 105 and 125VAC. The accuracy will be slightly less at the extreme value of the input.
<b>Ripple</b>	1% RMS max. of output setting

All RANGERS are 22" wide by 17 $\frac{1}{4}$ " deep by 47 $\frac{1}{4}$ " high. They are self contained in handsome cabinets, equipped with casters for easy mobility. Meters are furnished as standard equipment, and there is adequate protection against overload, overvoltage, and tube filament failure.

Write for further information, and for your free copy of the new Sorensen general catalog, to Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. In Europe, please correspond directly with Sorensen A.G., Gartenstrasse 26, Zurich 2, Switzerland.

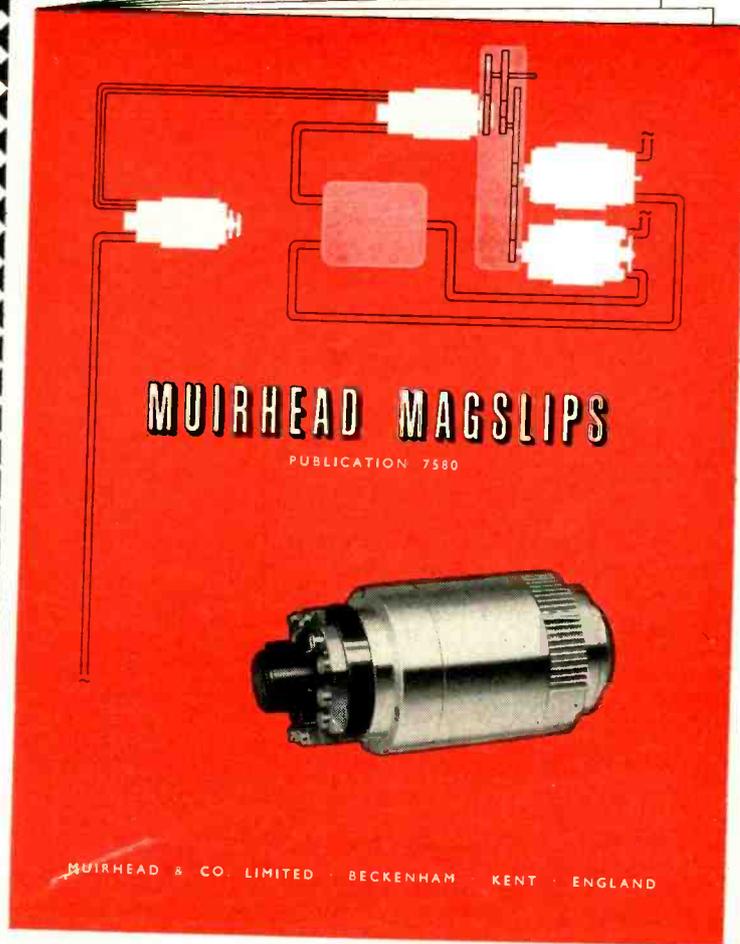
# SORENSEN

375 FAIRFIELD AVENUE  
STAMFORD, CONNECTICUT

\*Reg. U. S. Pat. Off./\*\*Model SR2 uses a circuit device patented by Wm. J. Brown.

# THIS BROCHURE DESCRIBING **MUIRHEAD MAGSLIPS**

IS ISSUED FREE ON REQUEST

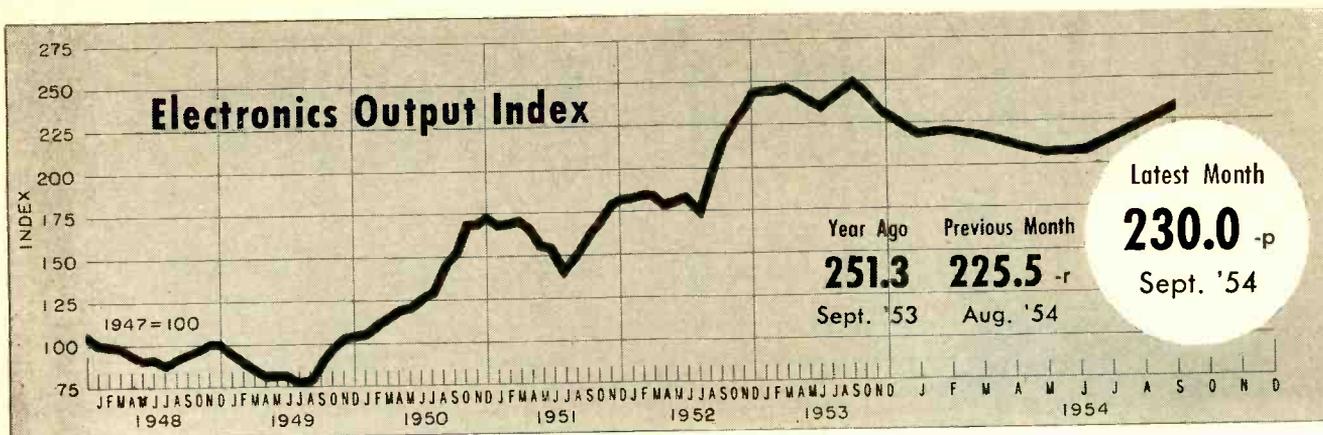


WRITE UNDER YOUR BUSINESS LETTERHEAD  
FOR PUBLICATION 7580

**MUIRHEAD & CO. LIMITED · BECKENHAM · KENT · ENGLAND**

MAKERS OF HIGH GRADE PRECISION ELECTRICAL INSTRUMENTS

129



## FIGURES OF THE MONTH

	Latest Month	Previous Month	Year Ago		Latest Month	Previous Month	Year Ago
<b>RECEIVER PRODUCTION</b>				<b>TV AUDIENCE</b>			
(Source: RETMA)	Sept. '54	Aug. '54	Sept. '53	(Source: NBC Research Dept.)	Oct. '54	Sept. '54	Oct. '53
Television sets, total	947,796	633,387	770,085	TV Homes, total	31,674,000	31,274,000	25,690,000
With UHF	136,613	93,404	193,212	<b>BROADCAST STATIONS</b>			
Color sets	14,538*	N.R.	—	(Source: FCC)	Oct. '54	Sept. '54	Oct. '53
Radio sets, total	932,323	785,499	1,216,525	TV stations on air	431	428	315
With F-M	17,644	15,936	39,873	TV stations CPs—not on air	147	150	230
Home sets	352,499	280,607	529,427	TV stations—applications*	167	167	424
Clock radios	207,226	155,171	182,417	A-M stations on air	2,627	2,616	2,497
Portable sets	76,271	74,713	147,355	A-M stations CPs—not on air	126	121	106
Auto sets	296,327	275,008	357,326	A-M stations—applications*	137	137	187
				F-M stations on air	558	559	566
				F-M stations CPs—not on air	10	14	20
				F-M stations—applications*	2	2	5

	Latest Month	Previous Month	Year Ago
<b>RECEIVER SALES</b>			
(Source: RETMA)	Sept. '54	Aug. '54	Sept. '53
Television sets, units	986,136	484,533	753,953
Radio sets (except auto)	763,589	447,025	650,898

	Latest Month	Previous Month	Year Ago
<b>RECEIVING TUBE SALES</b>			
(Source: RETMA)	Sept. '54	Aug. '54	Sept. '53
Receiv. tubes, total units	40,966,063	35,167,272	38,929,539
Receiv. tubes, value	\$28,953,592	\$24,002,391	\$27,401,566
Picture tubes, total units	1,149,791	855,191	875,712
Picture tubes, value	\$23,892,469	\$17,941,034	\$20,524,677

	Latest Month	Previous Month	Year Ago
<b>SEMICONDUCTOR SALES</b>			
	Aug. '54	July '54	Aug. '53
Germanium diodes	1,156,114	608,446	836,334
Silicon diodes			

	Quarterly Figures		
	Latest Quarter	Previous Quarter	Year Ago
<b>INDUSTRIAL TUBE SALES</b>			
(Source: NEMA)	2nd '54	1st '54	2nd '53
Vacuum (non-receiving)	\$9,851,020	\$8,971,335	\$10,400,000
Gas or vapor	\$3,987,036	\$4,589,239	\$3,300,000
Phototubes	N.R.	N.R.	\$700,000
Magnetrons and velocity modulation tubes	\$16,429,553	\$16,135,274	\$10,500,000
Gaps and T/R boxes	\$1,914,313	\$1,517,426	\$1,700,000

	Latest Month	Previous Month	Year Ago
<b>COMMUNICATION AUTHORIZATIONS</b>			
(Source: FCC)	Oct. '54	Sept. '54	Oct. '53
Aeronautical	39,900	40,695	42,427
Marine	47,882	47,360	42,931
Police, fire, etc.	16,308	16,109	14,094
Industrial	22,339	22,132	18,868
Land transportation	7,012	6,982	6,201
Amateur	123,163	121,762	113,909
Citizens radio	8,229	8,143	3,987
Disaster	306	305	251
Experimental	607	600	476
Common carrier	1,730	1,699	1,327

	Latest Month	Previous Month	Year Ago
<b>EMPLOYMENT AND PAYROLLS</b>			
(Source: Bur. Labor Statistics)	Aug. '54	July '54	Aug. '53
Prod. workers, comm. equip.	357,800-p	340,400-r	424,800
Av. wkly. earnings, comm.	\$69.03 -p	\$67.64 -r	\$67.73
Av. wkly. earnings, radio	\$67.83 -p	\$67.20 -r	\$65.36
Av. wkly. hours, comm.	39.9 -p	39.1 -r	40.8
Av. wkly. hours, radio	39.9 -p	39.3 -r	40.1

	Latest Month	Previous Month	Year Ago
<b>STOCK PRICE AVERAGES</b>			
(Source: Standard and Poor's)	Oct. '54	Sept. '54	Oct. '53
Radio-tv & electronics	360.4	349.4	272.1
Radio broadcasters	400.7	381.6	272.2

p—provisional; r—revised  
N.R.—not reported \*9 mos.

## FIGURES OF THE YEAR

Television set production	4,733,315	5,524,370	-14.3	7,214,787
Radio set production	7,042,442	10,149,163	-30.6	13,368,556
Television set sales	4,645,063	4,300,360	+ 8.0	6,375,279
Radio set sales (except auto)	4,032,704	4,526,186	-10.9	7,064,485
Receiving tube sales	266,050,907	347,152,450	-23.3	437,091,555
Cathode-ray tube sales	6,476,566	7,552,862	-14.3	7,582,835

	1954	1953	Percent Change	1953 Total
Television set production	4,733,315	5,524,370	-14.3	7,214,787
Radio set production	7,042,442	10,149,163	-30.6	13,368,556
Television set sales	4,645,063	4,300,360	+ 8.0	6,375,279
Radio set sales (except auto)	4,032,704	4,526,186	-10.9	7,064,485
Receiving tube sales	266,050,907	347,152,450	-23.3	437,091,555
Cathode-ray tube sales	6,476,566	7,552,862	-14.3	7,582,835

# INDUSTRY REPORT

electronics—December • 1954

## Control Board Planned To End Airport Delays

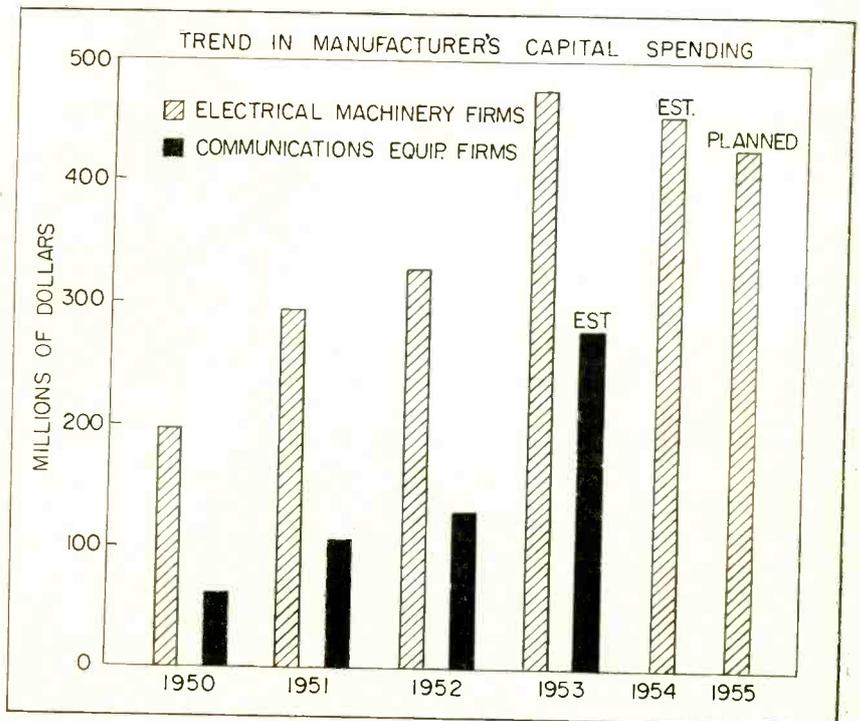
WHEN developed as an operating unit, the mock-up board shown may eliminate much of the paperwork of air traffic control. The board is under development at Bell Labs for the CAA.

The plane's location, determined from radar contact, is pinpointed on the lower board—a ppi-type of display with an airplane map overlay. Altitude information, transmitted from the plane by voice radio, is inserted manually and causes a second pip to appear on the upper board.

► **Flight Plans**—When the dark line or cursor lines up the plane's position and altitude pips, information such as identity, type, destination and ETA can be flashed on the tote board in the center. This information may be derived either from teleprinter reports or from flight plans stored in a magnetic-drum calculator.



Full-scale mock-up of proposed air traffic control board demonstrates operation



## Industry Maps Capital Spending

**Firms in the electronics field may spend somewhat less next year to enlarge facilities**

LEVELING out of electronics manufacturers' expenditures for new plants and equipment in 1955 is indicated in the results of a survey of American industry's preliminary plans for capital spending in 1955 by the McGraw-Hill department of economics. According to the survey, manufacturing companies in the electrical machinery field, which include electronics firms, will spend about \$30 million less in 1955 or \$431 million compared to \$461 million in 1954, a six-percent drop. The estimated amount spent this year was \$20 million less than was spent in 1953, a drop of four percent.

► **Chart**—As can be seen in the graph, the portion of electrical ma-

chinery capital expenditures accounted for by communications equipment firms is large and has averaged about 39 percent of the total. Thus they have accounted for much of the rise in this classification of expenditures for new plant and equipment and have probably been responsible for lessening the foreseen decline.

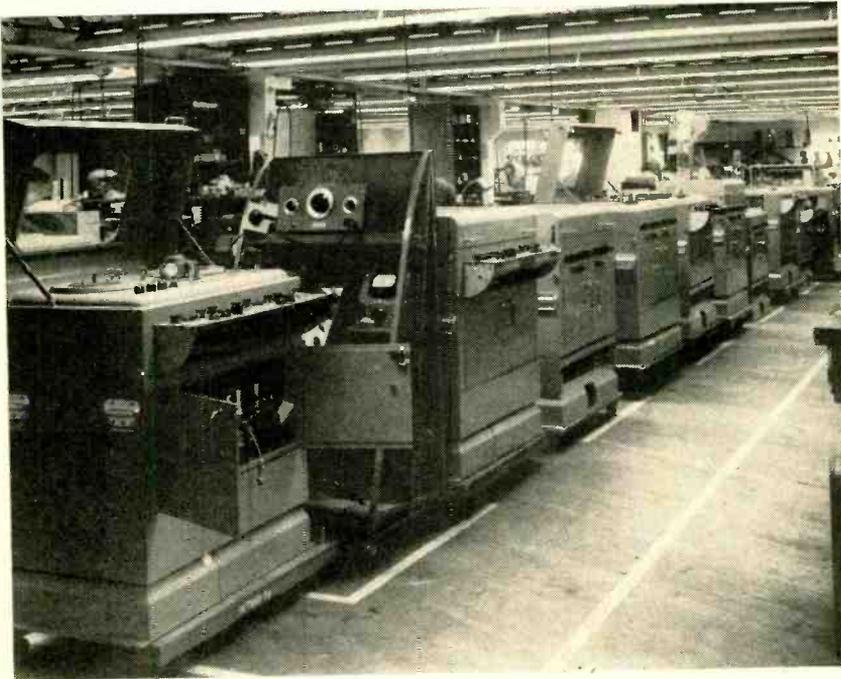
► **Status**—The survey shows that U. S. manufacturers as a whole have preliminary plans to spend about 7 percent less for new plants and equipment in 1955 than in 1954. However, the range in planned expenditures is wide extending from a 23 percent increase for stone, clay and glass firms to a 48 percent decrease for beverage manufacturers.

► **Future**—According to the survey, most firms in the electrical

machinery field expect capital spending in 1956 to remain about the same as for 1955. A total of 66 percent of the electrical firms surveyed indicated that their preliminary investment plans were about the same as for 1955. About 21 percent of the firms expected their investment to go down and 13 percent planned higher expend-

itures for plant expansion.

Although plans for 1956 are highly tentative, past surveys have indicated that companies are inclined to underestimate their capital spending for more than one year in advance. Thus the prospects are favorable for capital spending in the industry at a level at least as high in 1956 as in 1955.



DATA tape machines roll off Ampex production line as . . .

## Magnetic Tape Hits High Level

**Volume in all phases of the field hits record highs as more companies enter the market**

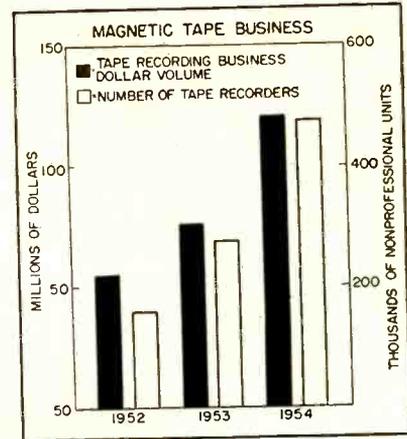
THE magnetic tape business has increased an estimated 60 percent this year and firms in the field see further future gains in the making.

► **Growth**—As shown in the chart, the estimated volume of business done in the tape recording field this year tops the \$120 million mark. This includes sales of tape, tape machines of all types and related accessories and represents a \$45 million increase over last year's business.

Biggest portion of the volume

this year is accounted for by nonprofessional or home recording. It is estimated that about 450,000 home units will be sold this year for a dollar volume of over \$76 million. In the professional field, about 20,000 units are expected to be sold for a dollar volume in the neighborhood of \$30 million.

► **Tape**—Recording tape alone has become a volume business. Minnesota Mining and Manufacturing estimates that over \$9 million in tape will be sold by tape makers this year compared to \$8 million last year. The biggest market for tape is represented by the professional field which includes broadcasting, motion pictures and



phonograph record companies.

The instrumentation field is growing in importance and it is estimated that now about 5 percent of total magnetic tape volume is used in this field. Major use in instrumentation is in telemetering aircraft and guided missiles.

► **Companies**—In the past year, nearly 75 manufacturing companies have entered some phase of the magnetic recording field. Growth in the number of tape and equipment makers is indicated by Armour Research Foundation of the Illinois Institute of Technology which owns more than 250 patents relating to magnetic recording equipment and sound recording tape. It lists 64 companies throughout the world that are now licensed to use ARF magnetic recording patents compared to about 25 before 1952.

## Defense Business Upswing Continues

**Contracts for electronics in the third quarter are nearly double last year's**

RISING trend in military contract awards evident in the second quarter of 1954 (ELECTRONICS, p 10, Aug. 1954) continued in the third quarter. As shown in the chart, p 8, about \$83 million was spent in contracts compared to \$46 million in the third quarter of 1953. Although this total is a substantial drop from second quarter

(Continued on page 8)

# NOW SYLVANIA PRESENTS

# a Full Line of **PENCIL TUBES**

5675



These improved Sylvania tubes are manufactured and quality controlled for highest dependability. Now for the first time they enable circuit engineers to meet precisely the ever-widening range of today's application requirements.

**5675** a low Mu tube for CW operation to 3000 cycles as an amplifier, oscillator, or frequency multiplier in either lumped, constant, or external cavity-type circuits. Delivers 300 mw average power at 1700 megacycles.

**5794** designed for continuous wave operation, this tube oscillates inside a cavity tuned to a fixed frequency of 1680 megacycles. This low Mu tube with its special heater at 5.2 volts is capable of delivering a power of 300 milliwatts.



5794

**5876** is a high Mu triode designed for continuous wave operation up to 3000 megacycles in either lumped, constant, or external cavity-type circuits.

**5893** for pulse operation to 3400 megacycles. Will deliver .750 KW peak minimum at maximum frequency with .001 duty cycle.

**6263** a low Mu high power tube for application as an amplifier, oscillator to 1700 megacycles. Plate input power is 22 watts and plate dissipation is 13 watts.

**6264** a medium Mu frequency multiplier version of the 6263 with the same plate characteristics.

5876



The attached coupon brings you full engineering data and characteristics of Sylvania's complete pencil tube line.

*"Another reason why it pays to specify Sylvania."*

5893



6263



6264



# SYLVANIA

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building  
St. Catherine Street, Montreal, P. Q.



Sylvania Electric Products Inc.  
Dept. 4E-1612, 1740 Broadway  
New York 19, N. Y.

Please send me complete engineering data sheets covering the full line of Sylvania Pencil Tubes.

Name \_\_\_\_\_

Street \_\_\_\_\_

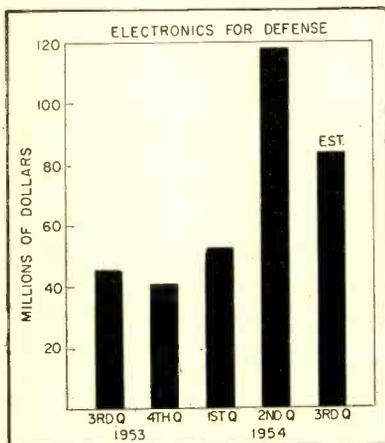
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

spending, it is still nearly twice that spent in the third quarter of 1953.

► **Breakdown**—The amount spent by the military on electronics may be actually 4 or 5 times as much as indicated by Pentagon breakdowns shown in the chart because contracts for equipment such as ships, planes and missiles include money for associated electronic equipment.

Increased contract awards for these items also mean more business for electronics manufacturers. Estimates of defense contracts for these equipments in the third quarter are \$1.2 billion for aircraft, \$292 million for ships and \$44 million for guided missiles. If

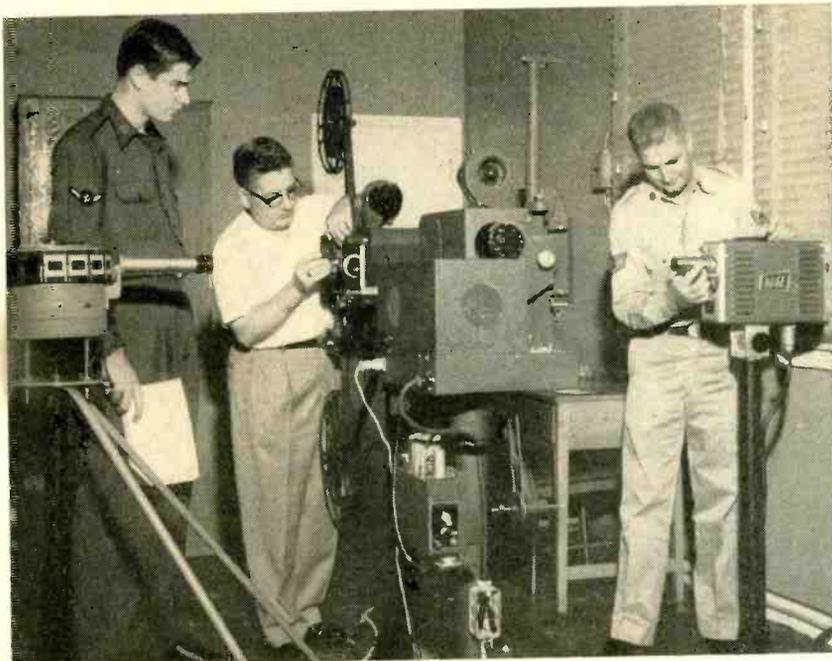


only 10 percent of these total contracts go for electronic equipment, it will mean an additional \$150 million in business for the field.

The importance of electronics, dollarwise, in military end equipment is indicated in recent contract awards. The Navy recently awarded one electronics manufacturer a \$24.6-million contract for sonar detection devices. Two recent contracts for guided missiles have meant over \$200 million in business for electronics firms.

► **Subcontractors**—There will be substantial new business for small electronics subcontractors as a result of the increased spending.

Air Force, in a sampling of its electronics subcontractors made last year, found that between 40 to 54 percent of the dollar value of electronic prime contracts were going to subcontractors.



AIR Transport Station in Azores installs tv equipment while . . .

## Military Telecasting Increases

### Air Force personnel buy second low-power television station for entertainment use

PLANS to provide television entertainment to military personnel in areas in the U. S. and abroad where regular telecasting is unavailable are being stepped up in the Armed Forces. Dage division of Thompson Products recently supplied a \$50,000 system for the U. S. military air transport station on Terceira Island in the Azores. It is the second tv system supplied to the military for entertainment use. A \$34,000 station supplied by RCA is presently operating at the Air Force base in Limestone, Maine.

Both stations are owned and operated by military personnel and were purchased with PX and movie proceeds or welfare funds.

► **Equipment**—Both of the Air Force stations have low power ratings. The Azores station equipment includes a Dage dual Vidicon chain, a 50-watt Gates transmitter and two Holmes 16-mm tv projectors and other studio equipment. The transmitter's peak visual output of 50 watts is fed into a

simple ring-type antenna with a gain of approximately 0.8.

► **Policy**—According to the Air Force, such military tv stations will be operated only in areas where it is not possible to receive tv programs from commercial outlets. The stations will be located primarily in bases where dependents of personnel also live.

It has been indicated that if the present stations prove successful, the Armed Forces will standardize on the type of equipment used.

### Electronics Business Picks Up

Although some segments of the industry are behind last year, all exceed 1952 business

ELECTRONICS manufacturers are keeping company with U. S. industry as a whole in the upsurge in business that took shape as the last quarter of 1954 got underway. Although total output as measured by the *Electronics Output Index* is considered likely to remain below

(Continued on page 10)

# only Sprague makes them all!

## YOU CAN CHOOSE FROM 5 DIFFERENT STYLES OF TANTALEX\* CAPACITORS

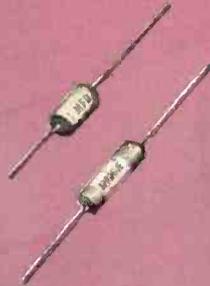
Looking for tantalum electrolytic capacitors? You'll save time and trouble by checking Sprague's complete selection *first*. Sprague makes more types of tantalum capacitors than *any other manufacturer*.

Sprague Tantalex capacitors provide maximum capacitance in minimum space . . . exhibit no shelf aging under long testing periods . . . have extremely low leakage current. And most important, they give unusually *stable* performance, because they're made with tantalum, the most stable of all anodic film-forming materials.

There's a complete range of sizes and ratings available in Tantalex capacitors . . . from the ultra-miniature 10 mf, 4 volt unit in a case only  $\frac{1}{8}$ " in diameter by  $\frac{3}{16}$ " long . . . to the 7 mf, 630 volt unit in a case  $1\frac{1}{8}$ " in diameter by  $2\frac{1}{32}$ " long. As for case styles, Sprague makes them all, from tiny tubular and cup units to the large cylindrical types.

For complete details relating to your miniaturization or high temperature problems, write Sprague Electric Co., 35 Marshall St., North Adams, Mass.

Sprague, on request, will provide you with complete application engineering service for optimum results in the use of tantalum capacitors.



### NEW! TYPE 101D for low-cost transistor circuitry

Especially useful for filter, coupling, and bypass applications in transistor electronics, these foil type miniature Tantalex capacitors were intended for use in hearing aids, pocket radios, and similar uses. Operating temperature range is  $-20$  to  $+65^{\circ}\text{C}$ . Request Engineering Bulletin 353.



### NEW! TYPE 102D for $-55^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ operation for military use

Here are tubular capacitors hermetically sealed in cases of silver plated copper. Intended for applications from 3 to 150 vdc, their small capacitance drop-off at extremely low temperatures, extremely low leakage current, and low power factor are of particular interest. Request Engineering Bulletin 351.



### NEW! TYPE 103D ultra-miniature capacitors for transistor circuitry

Only  $\frac{1}{8}$ " in diameter, and from  $\frac{3}{16}$ " to  $\frac{1}{2}$ " in length, these are the smallest electrolytics made. Providing relatively large values of capacitance in the very minimum of space in bypass, coupling, and filter applications, they are ideally suited for transistor hearing aids and military amplifiers in which small size is all-important.

Request Engineering Bulletin 352.



### NEW! TYPE 104D miniature "cup" capacitor for military use

These low-voltage units consist of a sintered porous tantalum anode housed in a miniature silver thimble, which serves as both cathode and container for the electrolyte. Volume is less than  $\frac{1}{10}$  cubic inch; operating temperature range  $-55$  to  $+85^{\circ}\text{C}$ , and up to  $100^{\circ}\text{C}$  with a voltage derating of 15%. Request Engineering Bulletin 354.



### TYPE 100D for $-55$ to $+125^{\circ}\text{C}$ operation for military use

These hermetically sealed capacitors are available in voltage ratings up to 630 volts at  $85^{\circ}\text{C}$  or 560 volts at  $125^{\circ}\text{C}$ . They are of the sintered porous tantalum anode type, with internal construction to withstand high g shock, severe vibration, and thermal cycling. Request Engineering Bulletin 350A.

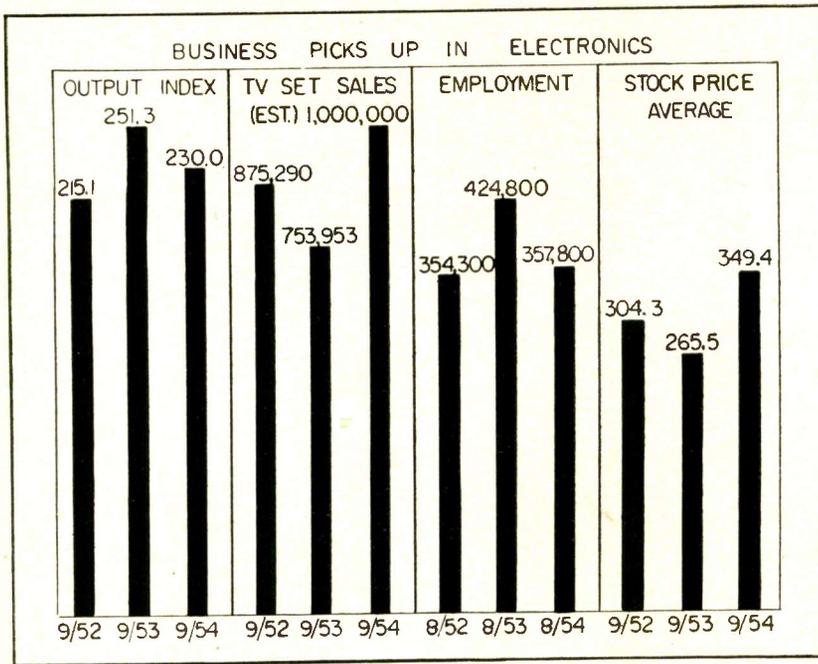
WORLD'S LARGEST CAPACITOR MANUFACTURER

# SPRAGUE

\*Trademark

Export for the Americas: Sprague Electric International Ltd., North Adams, Mass.

CABLE: SPREXINT



last year's records, indications are that output in the last three months will exceed that of 1953's last quarter.

► **Chart**—As shown in the graph, the *Electronics Output Index* took a decided rise in September of 1954, far above the output for September, 1952. The provisional figure of 230.0 may be revised even higher now that final tv production figures are in.

RETMA has announced that nearly one million tv receivers were produced in September to establish a new high in monthly output for the product. During the five-week period production totaled 947,796 units compared with 633,387 produced in August and 770,085 sets manufactured in September of 1953. The previous record high was established in December, 1952 when 921,086 sets were manufactured in a statistical period which extended over six weeks.

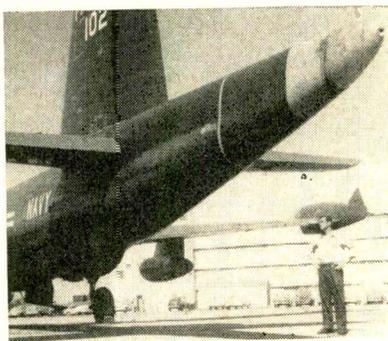
Television set retail sales have also increased to a record volume, as shown in the chart. During the month of September 986,136 tv sets were sold, exceeding the month's total in 1953 and 1952 and bringing this year's nine-months total to approximately 4.6 million units.

► **Employment**—Mirroring the industry's increased output are fig-

ures on production worker employment. Even though latest reports cover August figures, the upswing is apparent. Employment of production workers reached 357,800 in August of 1954, compared to 354,300 in August of 1952. With the high output of nearly one-million tv sets in September, it is likely that employment totals have increased substantially.

► **Future**—Financial observers point out that the stock market has provided some indication of the future business prospects for an industry. If that holds true for present electronics stock price averages, the industry can look forward to increasing business next year.

### Tail Tattles On Subs



Protuberance resembling a giant wasp's stinger that appears on this Navy Neptune contains a magnetic airborne detector which spots submarines by registering disturbances in the earth's magnetic field

## Business Sizes Up Electronic Computers

Users and prospects foresee expanding future for office equipment but urge careful study

MORE than a quarter century ago, Bell System executives gave the green light to automatic dialing when studies predicted a future dearth of telephone operators. General business stands at the same threshold. Management men realize the tempo and complexity of modern business must one day outstrip pencil-pushing methods.

The question is, "How soon will my office have to go electronic?" This past month several management specialists offered varying opinions:

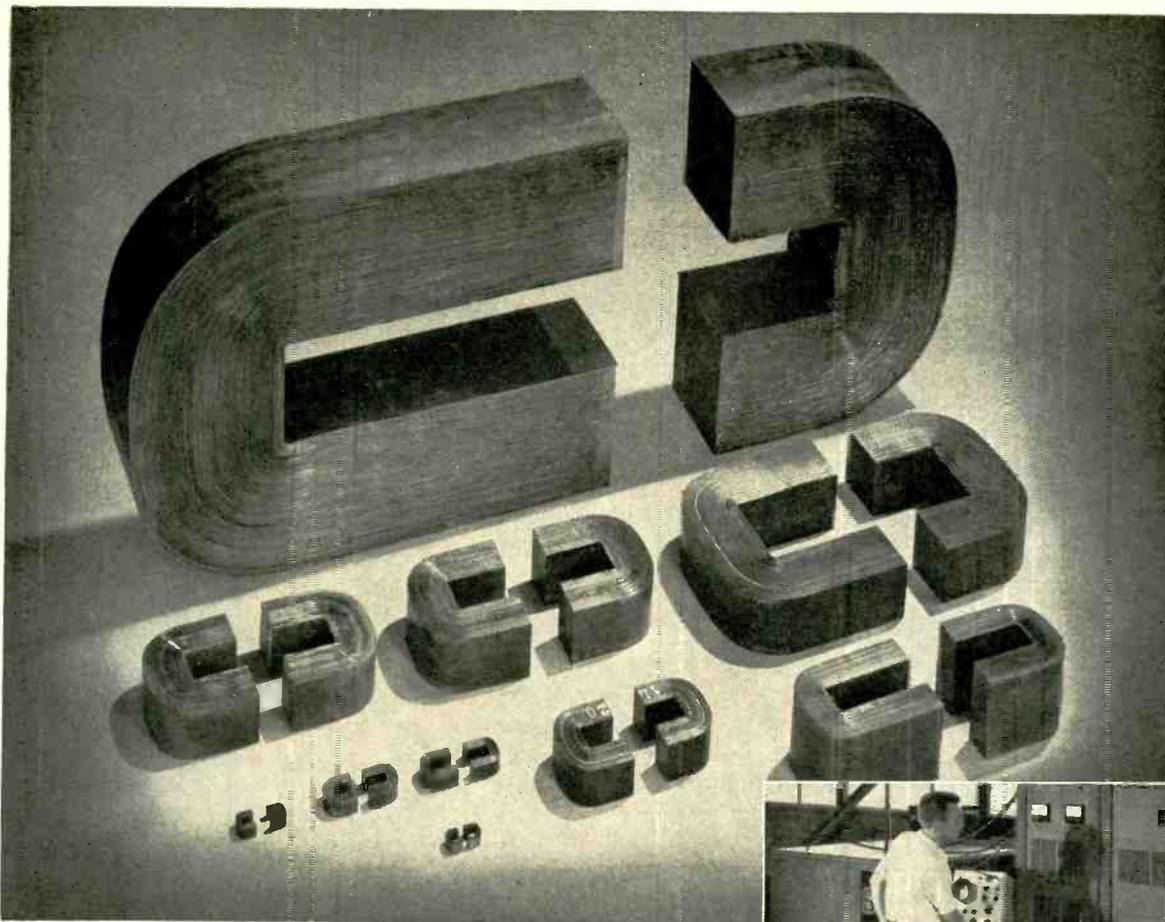
► Electronic computers are destined to be recognized as the most powerful management tool yet developed—predicted W. W. Smith, senior procedures analyst for General Electric's major appliance division. He indicated that GE was saving \$100,000 annually through assembly-line studies at Appliance Park.

► The complete automatic office made up of only sexless and shapeless machinery will never come even if large-scale electronic systems become common in offices—asserted J. D. Elliott, superintendent of customer billing for Detroit Edison.

► Large companies that do not enter into an electronic program voluntarily in the very near future will be forced into it when they are no longer able to meet the low cost of operation and prompt service provided their competitors—said A. C. Vanselow, Franklin Life Insurance Co.'s assistant v-p in charge of planning. He announced that computer techniques were saving his company \$425,000 annually in salaries.

► Business still has a long way to go in learning how to plan the

(Continued on page 12)



## *Arnold Pulse Transformer Cores are individually tested*

### *under actual pulse conditions*

W&D 5238

**WRITE  
for your  
COPIES**



#### **"MAGNETIC MATERIALS CATALOG"**

General information on all Arnold magnetic materials: permanent magnets, tape-wound and powder cores, types "C" and "E" cut cores, etc.

#### **"ARNOLD SILECTRON CORES"**

52 pages of valuable data covering a complete range of core shapes, sizes, tape gauges, etc.

**ADDRESS DEPT. E-12**

The inset photograph above illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux density of 2500 gauss. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400

pulses per second, at a peak flux density of 10,000 gauss.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

This is just another of Arnold's facilities for better service on magnetic materials of all description.

● Let us supply *your* requirements.

## **THE ARNOLD ENGINEERING COMPANY**



SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd.

Boston: 200 Berkeley St.

efficient use of computers—stated E. F. Cooley, associate director of methods research, Prudential Life Insurance Co. of America.

► **Computing Center**—Computer manufacturers indicated that use of computing-center facilities is one way to approach the electronic office. Reasons for patronizing the centers include: learning the advantages of computer operation to justify buying or renting one, help during peak-load times and carrying out projects left in the bottom-left desk drawer for want of free time.

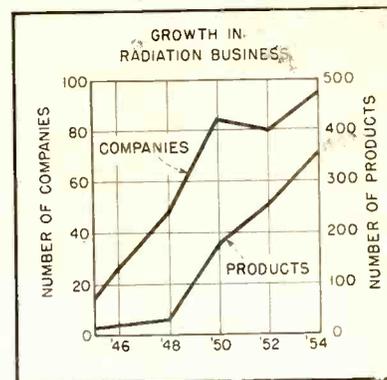
► **Procedures Study**—Systems and procedures experts agree that all large-scale business should investigate use of computers in their operations. Even if a computer is not indicated, the study should reveal some worth-while ways to

streamline operations for efficiency and economy.

► **New Equipment**—Integrated data processing, as announced by a maker of business forms, refers to a system of machines talking to machines through the common language of punched paper tape. This system is designed to tie existing business and communications equipment in with electronic computers in a complete system.

National Cash Register recently demonstrated a medium-sized computer selling for \$89,500 to \$140,000, depending on the precise application. Basically a scientific calculator, it occupies two free-standing cabinets and control console.

A smaller computer, about the size of a standard office desk has been introduced by Burroughs. It sells for \$32,500.



known to have volumes greater than \$1 million.

► **Markets**—In addition to the growing new instrument market, there is a large market in replacements. The Atomic Energy Commission reports that 25 percent of its annual instrumentation cost is for improved instruments. The AEC's estimate of \$6 million in expenditures for nuclear instrumentation in 1953 is expected to reach a level of \$12 million by 1960. This provides a potential market of \$45 million over the next five years.

Over 5,000 new medical users of radioisotopes are expected to enter the field in the next five years. The instrumentation required by these and present users provides a five-year market of \$20 million. Civil defense requirements for the same period are estimated to be 50,000 survey meters and over 1,500,000 dosimeters at a cost of over \$30 million.

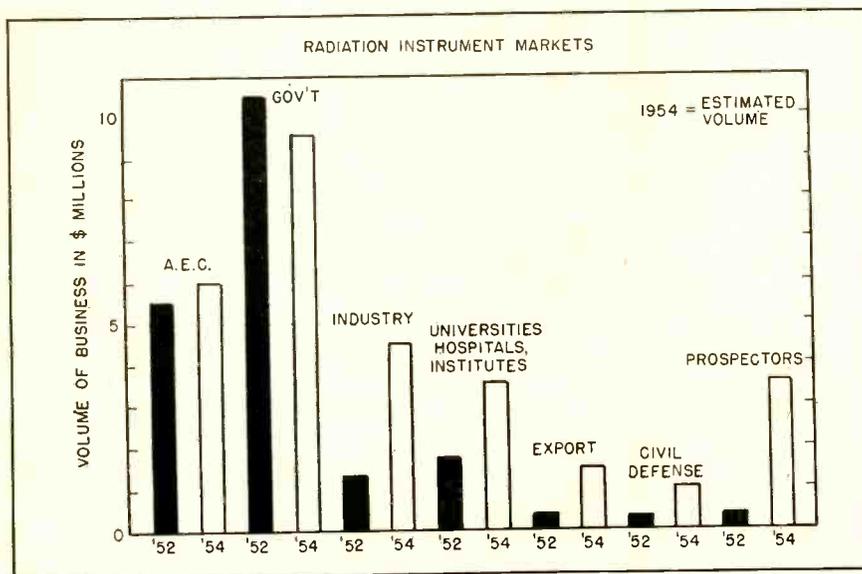
## New York Surveys Its Electronics Industry

MANUFACTURE of electronic equipment is steadily expanding in New York State. New plants have been built by firms such as GE, Sonotone, Westinghouse, Sylvania, CBS-Hytron, IBM and Remington Rand.

The Empire State produces a significant share of the national electronic output, according to a study by the New York State Department of Commerce.

► **Workers**—The state has occupied an important position in the industry's production and employment for a number of years. Be-

(Continued on page 14)



## Atom Sparks Instrument Sales

Expanding use of the atom provides \$50 million in potential markets by 1960

INSTRUMENTATION for nuclear energy operations has been a steadily growing business since the beginning of the atomic energy program and is expected to continue its expansion. The field comprised three companies manufac-

turing nuclear instruments in 1943 and has expanded to 96 companies in ten years. Their business volume for 1953 is estimated at \$25 million. By 1960 this volume is expected to reach \$50 million.

Most of these companies are small—85 percent are doing business in the neighborhood of \$300,000 or less. Only six of these nuclear instrument companies are

# ENCAPSULATION IN GLASS

*of diodes, transistors, and  
other crystal semi-conductors*

**is now available with Kahle  
equipment and know-how!**

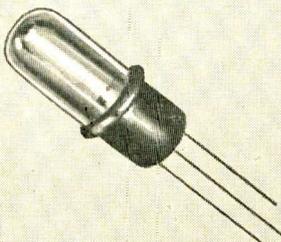
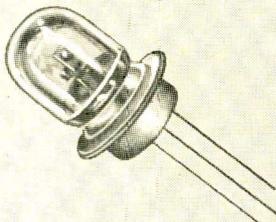
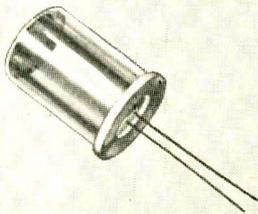
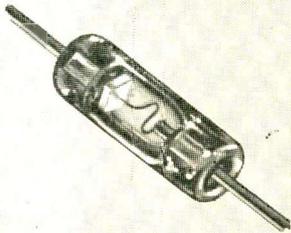
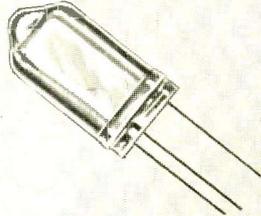
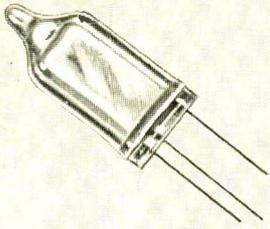
*glass has these advantages:*

- 1** It offers a true, life-time hermetic seal.
- 2** It offers almost unlimited flexibility as to size and shape. It answers the need for miniaturization.
- 3** It is transparent. In cases where limited transparency, or translucency, or color opacity are desired, glass can be perfectly adapted.
- 4** Glass is available in a wide range of physical and chemical characteristics for special purpose applications.
- 5** It is inexpensive and lends itself to automation.
- 6** It is readily cleansed and sterilized.

*With Kahle machinery and methods  
you can obtain high speed, low speed, or  
laboratory production to meet any encapsulation  
production requirements.*

**for complete details write today to**

***Kahle*** ENGINEERING COMPANY  
1310 SEVENTH STREET • NORTH BERGEN, N. J.



tween 1939 and 1947, the number of production workers manufacturing radios, television sets and related electronic products increased 341 percent in the state, compared with a national gain of 213 percent.

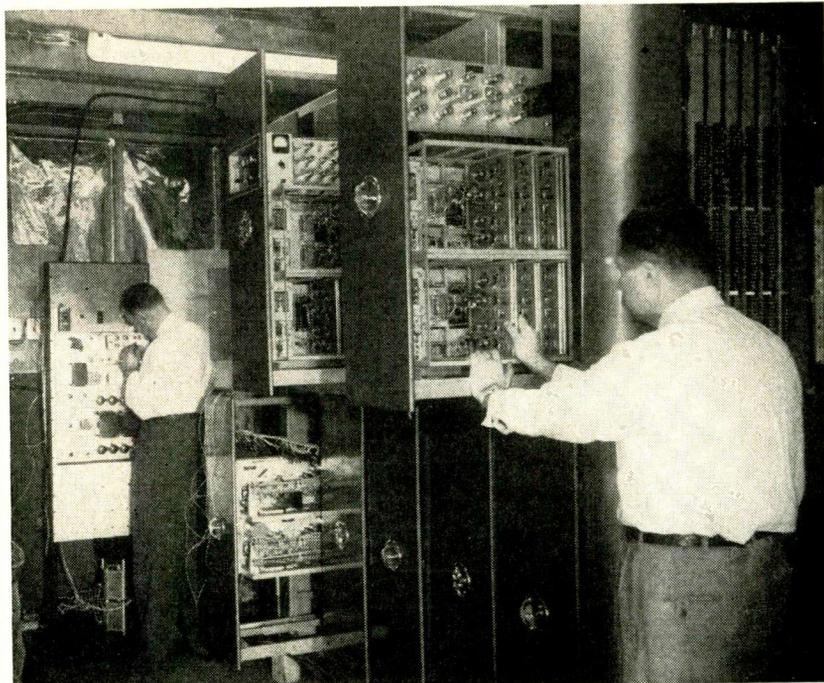
While nation-wide employment in the field gained little from 1947 to 1950, the increase in New York was 20 percent, according to the Department. In electronics, peak employment was reached in October of last year when 73,000 workers were employed. Approximately one-fifth of the nation's workers in the industry are employed in New York State.

► **Where**—Over one-third of the industry's workers in the state are employed in New York City plants. Other concentrations are to be found on Long Island and in Syracuse, Rochester, Poughkeepsie and Buffalo. Many small enterprises have been set up in Westchester County, outside of New York City.

A number of the plants recently established or under construction have been located in areas where the industry has not previously been important. For example, GE has enlarged its Utica factory and is also operating in Johnson City. Westinghouse has completed large plants at Bath and Horseheads. Sylvania has opened new facilities at Batavia and many small enterprises have been set up throughout the Hudson River Valley.

► **Why**—Among the reasons for the State's position in the industry is its immediately available mass consumer and industrial markets. In addition, a technical labor supply has developed in the state and there are more than 90 commercial laboratories that conduct research in electronics.

The Department points out that an estimated 30 to 40 million people make up the consumer market and the industrial Northeast is the location of some of the nation's largest manufacturers. Access to these markets has been improved through New York State's highway building program which is expected to open new markets and building sites to state's growing electronics industry.



DATA recording system is designed and built by The Austin Co. as . . .

## Plant Builders Look To Electronics

AN industrial plant construction firm is in the electronics manufacturing business and there are signs that others may soon join the industry either through acquisition of existing electronic companies or the establishment of electronics divisions. One of the main reasons for construction company interest in electronics is the increasing use of specialized electronic automatic production equipment in plants being built.

► **Firm**—Although there are several construction firms engaged in building electronically instrumented plants, the Austin Company is actually producing electronic equipment. The company, through its special devices division, has manufactured and sold a wide variety of electronic devices. The division's sales volume exceeded \$3 million last year. It has built and sold several computers to industry, mainly to machine tool builders, and eighteen \$75,000 data recording machines like the one shown.

Although most of the division's sales have been to the military, an increasing number of devices are being sold to industry. Some

business has come from the electronics industry as a result of the company's many plant building contacts with the field. The firm estimates that it has built approximately 60 percent of the buildings for tv stations now on the air and a large number of electronics production plants.

► **Equipment**—The range and extent to which Austin is already in the electronics business can be seen in the following list of some of the systems that have been designed and built by its special devices division: color-tv tape recorder, analog and digital computers, radiation detection devices, electronic color scanners, sonar devices and automatic data processing and recording systems.

Printed circuits are used extensively by the company in its data processing equipment. One recent installation is a computer for an aircraft engine manufacturer to control the machine cutting of jet turbine blades. It is from the automatic production field, that The Austin Co. expects a large share of its future business.

(Continued on page 16)

## Barry Engineers Report on Design Methods

Technical articles written by Barry engineers over the past several years on the protection of electronic apparatus against damage by vibration and shock are now available. The information presented covers both the theoretical and the practical aspects of shock and vibration protection—for aircraft, naval, mobile, and industrial equipment.

Engineers who wish copies of these reports may obtain them by asking for them by number; requests should be addressed to Mr. A. S. Chivers, Barry Corporation, Watertown, Mass.

### Designing for Shock Resistance

By Charles E. Crede and Miguel C. Junger. Reprinted from "Machine Design", Jan. 1951.  
Bulletin R-511

### Shock Testing of Airborne Equipment

By Charles E. Crede. Reprinted from "Tele-Tech", July-August 1951. Bulletin R-518

### How to Evaluate Shock Tests

By Charles E. Crede. Reprinted from "Machine Design", Dec. 1951. Bulletin R-521

### Toned-Down Noise Tunes Up Operation

By Charles E. Crede. Reprinted from "Steel", Feb. 25, 1952.  
Bulletin R-523

### Mounting Keeps Vibration in its Place

By William C. Gallmeyer. Reprinted from "Steel", May 18, 1953. Bulletin R-535

### Shock or Vibration Isolators?

By J. Markowitz. Reprinted from "Product Engineering" June, 1953. Bulletin R-536

### Mock-ups for Vibration and Shock Testing

By Charles E. Crede. Reprinted from "Product Engineering" July, 1953. Bulletin R-537

### Vibration Isolators speed up plant changes

By Harold Wrigley. Reprinted from "Plant Engineering" Jan. 1954. Bulletin R-541

### The Role of Shock Testing Machines in Design

By Charles E. Crede. Reprinted from "Mechanical Engineering" July, 1954. Bulletin R-544

### Vibration and Shock Isolators

By Charles E. Crede. Reprinted from "Machine Design", August 1954. Bulletin R-546

### Machine Mobility

By E. A. Johnson. Reprinted from "Automation", September, 1954. Bulletin R-547

for control of

# SHOCK and VIBRATION

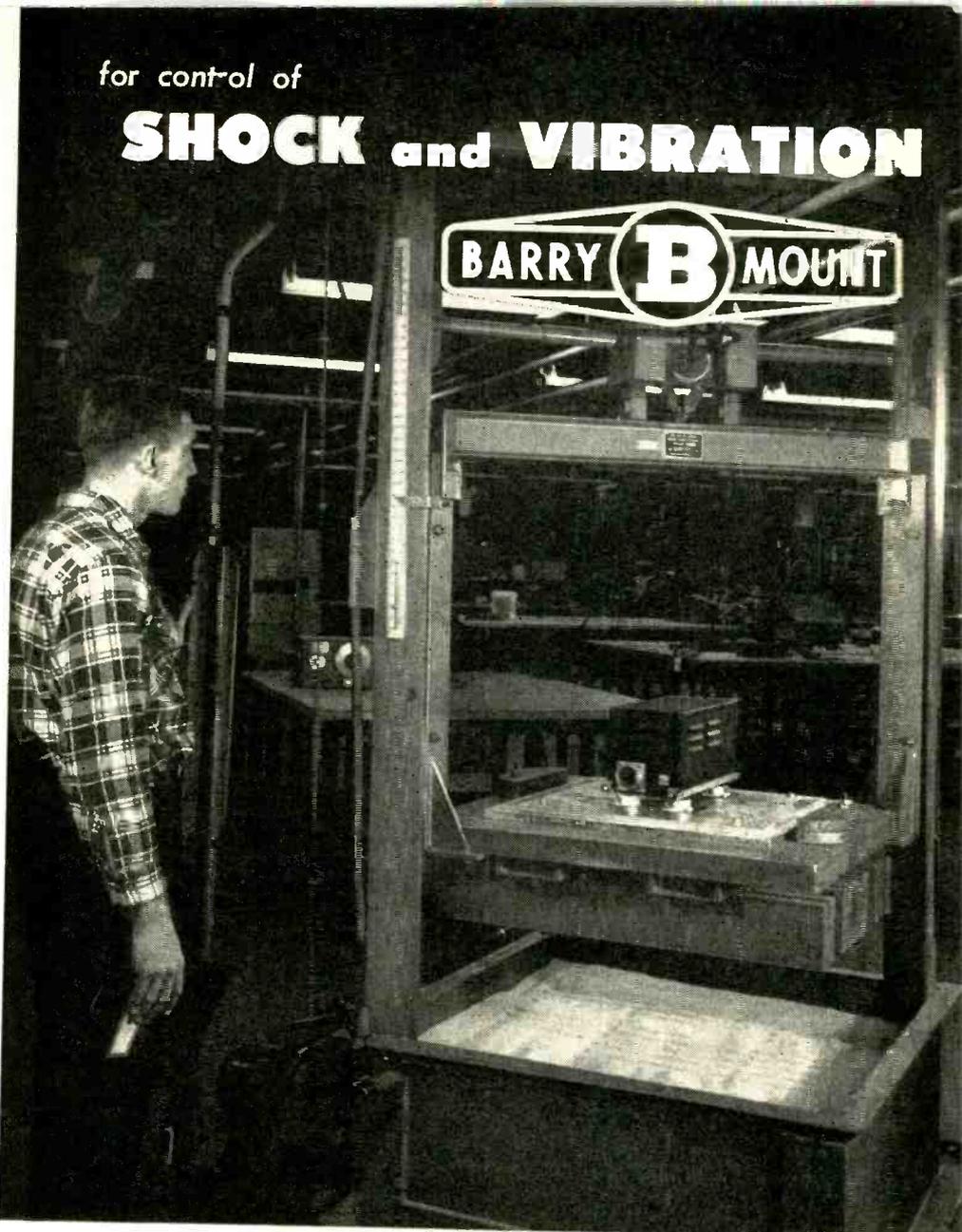


Photo courtesy Bell Aircraft Corporation

## How to assure the operation of a pilotless bomber

One way — used by Bell Aircraft Corporation — is to subject every component to a multitude of tests so as to minimize possibility of failure. Barrymounts® that protect delicate electronic equipment, and Barry VD impact-shock machines that provide high accelerations for tests, play an important part in the production of the guided missiles that Bell Aircraft has designed and is manufacturing.

For assured protection of your electronic devices, we can furnish standard Barrymounts® or can develop and manufacture special units for your particular needs. And we can furnish shock-testing equipment for your use or we can conduct your tests in our shock and vibration laboratory. Write for Bulletin BA-54.

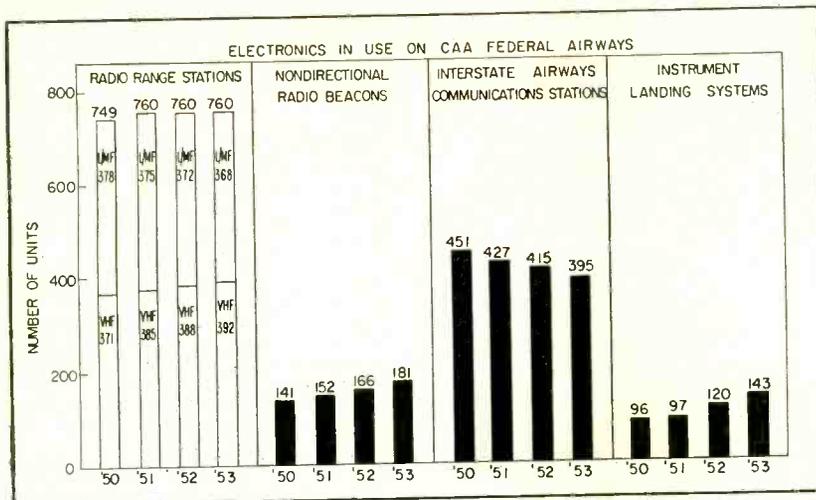
British Licensee: Cementation (Muffelite), Ltd., London, England



THE **BARRY** CORP.

707 PLEASANT STREET  
WATERTOWN 72, MASS.

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES



## CAA Takes On More Electronics

Installation of newer aids for civil air navigation increases. Budget for '55 rises

SPENDING by the government for civil-aviation electronic aids represents substantial business for some manufacturers. This can be seen in the table below of CAA appropriations for electronics in the fiscal years indicated. Funds do not include money for relocation of facilities.

► **Gear**—As shown in the graph, vhf radio-range stations are gradually replacing low and medium-frequency radio-range stations. The number of nondirectional radio beacons is also increasing steadily. A decrease in interstate airways communications stations has been evident since 1950. In 1949 there were 464 such stations but as aircraft radio equipment has improved the need for these stations has decreased so that at the beginning of 1954 there were only 395.

Biggest increase percentagewise in CAA aids to navigation was in

instrument landing systems with a total of 23 installed last year bringing the total to 143. Precision approach radar remained at 10 while airport surveillance radar increased from 10 to 17 systems during the year.

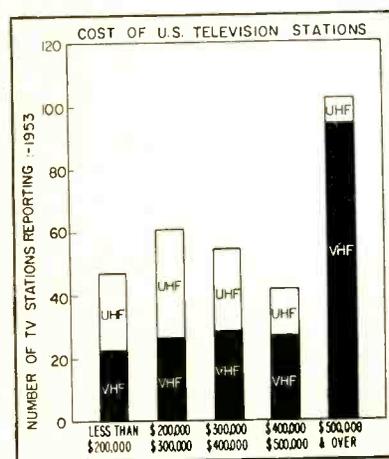
► **Future**—According to CAA, the vhf omnirange (VOR) gear with its complementary unit, distance measuring equipment, is meeting the need for greater reliability and utility in navigation. Progress in the installation of this equipment is indicated by the fact that a total of 454 DME's will be installed by CAA by June 30, 1955 although not all of them will be operating. There are at present 230 units in operational use, 34 operating "off and on" and 186 "under test" leaving 4 DME's not yet assigned.

► **Abroad**—Recommended by International Civil Aviation Organization (ICAO) is the establishment of Consol beacon stations at Iceland, Southern Greenland, the Azores, Newfoundland, Labrador, Nantucket and Atlantic City.

Consol, developed by the British from the German wartime Sonne

system, is attractive in that it has a daytime range of 1,000 miles and requires only a low-frequency receiver and a watch with a second hand to provide navigational information. Four transmitting stations are presently operating in Europe.

The United States, which would bear the lion's share of the financial burden in erecting and operating such facilities, is inclined to accept Consol as an interim navigational aid. Two developmental stations are to be operated soon at Nantucket and Atlantic City.



## FCC Reports On TV Broadcasters' Profits

Final figures for 1953 show that tv revenues increased 33 percent

DESPITE wide variations in individual station income, the final tv broadcast financial data for 1953, recently released by FCC, shows that tv broadcasters as a whole enjoyed record sales and profits last year. Total tv broadcast revenues for the field in 1953 were \$432.7 million, 33 percent above 1952's \$324.2 million. This includes revenues from the sale of time, talent and program material to advertisers. Net income before Federal income tax for the broadcasters, comprised of 4 tv networks and 334 tv stations, was \$68.0 million or almost 23 percent above 1952's \$55.5 million.

(Continued on page 18)

Item	1953		1954		1955		Total Amt.
	No.	Amt.	No.	Amt.	No.	Amt.	
VOR			7	\$679,897	24	\$2,495,908	\$3,175,805
Remote comm.	1	\$58,893			8	331,321	390,214
Stations towers	23	856,446	33	1,781,804	1	31,689	2,669,999
Radar control rooms					1	24,351	24,351
Air-ground station	1	27,579					27,579
Remote transmitter			2	118,100			118,100
100 wpm telecomm.		2,015,019					2,015,019
VHF, A/G comm.	265	517,617					517,617
<b>Totals</b>		<b>\$3,475,554</b>		<b>\$2,579,861</b>		<b>\$2,883,269</b>	<b>\$8,938,684</b>

# Basic

## LABORATORY INSTRUMENTS

For High Performance  
at Moderate Cost

The G-R UNIT INSTRUMENT line, started some years ago, offers the educational laboratory a wide variety of basic instrumentation with high-grade performance.

The G-R Unit Instrument idea is the economical design of single instruments incorporating one basic function with simple, rugged and compact construction; all unnecessary refinements are omitted in the interest of maximum performance at minimum price; no concessions are made in either electrical characteristics or reliability.

The unit instruments plug into one another, connect to one another or can be used with each other or auxiliary accessories to form assemblies and systems for a wide variety of specific measurements.

Separate, plug-in Unit power supplies are available for those instruments not having built-in power sources.

For complete descriptions of these and other G-R Unit Instruments,

write for the UNIT INSTRUMENT Bulletin



## UNIT INSTRUMENTS

RANGE	TYPE NO.	PRICE
<b>OSCILLATORS</b>		
500 kc to 50 Mc	1211-A	\$295.00
50 Mc to 250 Mc	1215-A	190.00
65 Mc to 500 Mc	1208-A	190.00
250 Mc to 920 Mc	1209-A	235.00
10-100-1,000 kc and harmonics to 1,000 Mc	1213-A	130.00
400 c and 1,000 c	1214-A (Built-In Power Supply)	66.00
<b>AMPLIFIERS</b>		
Wide Range 3 w: 20 c to 50 kc 1.5 w: 10 c to 100 kc 0.5 w: 250 kc	1206-B	85.00
30 Mc IF Amplifier Bandwidth: 0.7 Mc-3 db down 9.5 Mc-60 db down	1216-A (Built-In Power Supply)	365.00
<b>NULL DETECTOR</b>		
20 c to 5 Mc— On-scale Range 120 db	1212-A	145.00
<b>PULSE GENERATOR</b>		
Durations: Continuous 0.2 to 60,000 $\mu$ sec	1217-A	225.00
<b>POWER SUPPLIES</b>		
<p>★ NOTE: The Type 1203-A Unit Power Supply will furnish power for all of the above, except Types 1214-A and 1216-A which have built-in supplies.</p>		
OUTPUT: a-c 6.3 v, 3 a max. d-c 300 v, 50 ma max.	1203-A	40.00
OUTPUT: a-c 6.3 v, 3 a max. d-c 0 to 300 v, 100 ma max. no-load: 400 v	1204-B	90.00

We sell direct. Prices shown are NET,  
f.o.b. Cambridge or W. Concord, Mass.

**Type 1217-A Unit Pulser . . . \$225.00**  
(shown with 1203-A Unit Power Supply)

Pulse Durations: 0.2 to 60,000  $\mu$ sec  
Rise Time: 0.05  $\mu$ sec with minimum overshoot  
Repetition Rates: 30 c to 100 kc in 12 steps  
Variable Amplitude: 0 to 20 v, open circuit

Output Impedance: 200 ohms for plus pulses,  
1500 for negative

External Synchronization: pulses or sine waves  
can be used for continuous locking from 15 c  
to 100 kc

Sync Signal for Scope: leads pulse by 1/10  $\mu$ sec  
—leading edge will be visible in scope

Power Supply: Plug-in Type 1203-A: \$40.00

*One of the Newest  
and Most Popular  
G-R Instruments . . .*

# GENERAL RADIO Company



275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

90 West Street NEW YORK 6  
8055 13th St., Silver Spring, Md. WASHINGTON, D. C.  
920 S. Michigan Avenue CHICAGO 5  
1000 N. Seward Street LOS ANGELES 38

ADMITTANCE METERS	MODULATION METERS	SIGNAL GENERATORS
AMPLIFIERS	MOTOR CONTROLS	SOUND & VIBRATION METERS
COAXIAL ELEMENTS	NULL DETECTORS	STROBOSCOPES
DISTORTION METERS	OSCILLATORS	TV & BROADCAST MONITORS
FREQUENCY MEASURING APPARATUS	PARTS & ACCESSORIES	U-H-F MEASURING EQUIPMENT
FREQUENCY STANDARDS	POLARISCOPES	UNIT INSTRUMENTS
IMPEDANCE BRIDGES	PRECISION CAPACITORS	VARIACS®
LIGHT METERS	PULSE GENERATORS	V-T VOLTMETERS
MEGOhmmeters	R-L-C DECADES	WAVE ANALYZERS
	R-L-C STANDARDS	WAVE FILTERS

► **Networks**—Revenues of the tv networks including their 16 owned and operated stations in 1953 totaled \$231.7 million compared to \$170.3 million in 1952. This left a net profit before federal income taxes for the networks of \$18 million compared to \$9.9 million in 1952. The tv profit of \$18 million was almost double the \$9.4 million received from a-m radio in 1953.

► **Stations**—Of the 108 prefreeze stations, including network owned and operated stations, 97 reported profitable operations for 1953 compared to 94 in 1952. Thirteen of the 97 reported profits before Federal income tax between \$1 million and \$1.5 million and 13 others had profits of more than \$1.5 million.

There were 11 prefreeze stations with losses last year compared to 14 in 1952. Eight were located in New York and Los Angeles, the two 7-stations markets in the U.S. Of the 11 stations, 6 had losses of less than \$200,000, 1 had a loss between \$200,000 and \$400,000 and 4 had losses of \$400,000 to \$800,000.

► **Freeze**—A total of 240 post-freeze stations had commenced commercial operations by the end of 1953. Reports from 226 of these stations showed that 114 vhf stations had total revenues of \$16.1 million, expenses of \$20.3 million and a loss of \$4.2 million.

A total of 112 uhf stations reported revenues of \$10.4 million, expenses of \$16.7 million and a loss of \$6.3 million. The average post-freeze station had been in operation less than five months at the end of 1953.

► **Equipment**—A total of \$233.1 million had been invested by 325 stations at the end of 1953 in tangible broadcast property which includes land, building and equipment. Of this amount, \$71.6 million was invested by networks and their 16 owned and operated stations; \$87.4 million by 91 prefreeze stations; \$40.9 million by 109 post-freeze vhf stations and \$33.2 million by 109 post-freeze uhf stations.

As shown in the chart on p 16, 104 stations, including 21 post-

freeze vhf and 8 post-freeze uhf reported an investment in tangible broadcast property of \$500,000 and over; 47 stations including 21 post-freeze vhf and 24 uhf reported an investment of less than

\$200,000. As can be seen, the largest number of uhf stations, 35, have invested between \$200,000 and \$300,000 for station property while most vhf stations have invested \$500,000 and over.

## Radar Brain Subdues Railway Jolts

### Automatic yardmaster can cut freight damage costs by controlling car speed

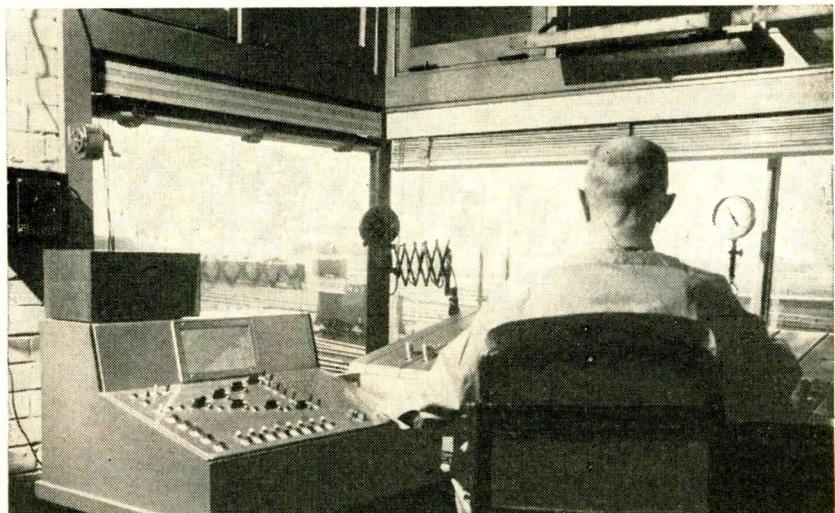
DAMAGE CLAIMS paid last year by American railroads for freight loss amounted to more than \$111 million. A considerable fraction of this sum resulted from current practice in train make-up yards. Here, a string of cars for various destinations is pushed up over a hump or artificial hill and each car is cut loose to coast onto an appropriate classification track. In the old days, a brakeman rode the car, slowing it down expertly with the hand-brakewheel just before it coupled onto the train being made up.

Nowadays, a towerman operates a series of electropneumatic car retarders that grip the wheels and slow the car. But once a car has passed beyond control of the retarders it may travel so slowly it

doesn't couple or it may smack into its neighbor with consequent damage to itself or its contents.

► **Automatic Judgment**—Union Pacific and Reeves Instrument engineers have recently combined radar, a computer and the remotely controlled car retarder into a sure-fire control that will permit automatic humping of 4,000 freight cars in 24 hours. Whether the car is to roll two-thirds of a mile or a few hundred feet, the electronic computer sets the retarders so that coupling is at a speed no greater than three miles an hour.

The radar speed meter senses a car's progress and the computer sends the retarders instructions for light or heavy braking. Switching instructions for as many as 120 cars can also be fed into the computer by the yardmaster as soon as he receives a teleprinted listing of the makeup of a train and destination of each car.



Electropneumatic car retarders are remotely controlled from this yardmaster's tower above Union Pacific North Platte, Neb., yards. Human judgment as to proper speed of car is removed by computer (not shown) that is fed radar information and directions as to which classification track the rolling freight car must enter

(Continued on page 20)

# low microphonics?

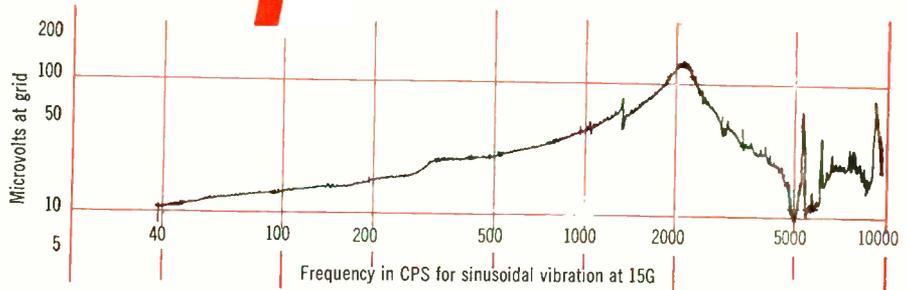
**THIS IS IT!**



**CK 6533**

a new guided missile

**RELIABLE  
SUBMINIATURE  
TRIODE**



Pictured is the vibration output voltage of a typical CK6533 tube over a wide frequency range, in terms of microvolts at the grid when the tube is vibrated at 15G and operated at  $E_p = 120V$ ,  $R_k = 1500$  ohms.

The CK6533 is designed and manufactured to meet the latest military specifications for guided missile application.

Mutual conductance is 1750 umhos.

Amplification factor is 53.

Plate current is 0.9 ma.

# superior stability?

for DC AMPLIFIER and COMPUTER service



**CK 5755**

**RELIABLE  
TWIN TRIODE**



**THIS IS IT!**

- electrical **stability**
- mechanical **stability**
- low microphonic output
- low grid current
- fine balance between sections

These characteristics are *designed into* the CK5755, making it the ideal tube for precision DC amplifiers, computers, highly stable regulated power supplies and many other critical applications.

Grid current		$10^{-9}$ amp. maximum
Plate current balance (E1c-E2c)	(typically 0.05V)	0.3V maximum
Plate current drift (Ec after 5 min.)		2.0mV maximum
Plate current drift (Ec after 16 hours)		5.0mV maximum
Mechanical stability (Ec after 400-600G shock)		25.0mV maximum



**RAYTHEON MANUFACTURING COMPANY**

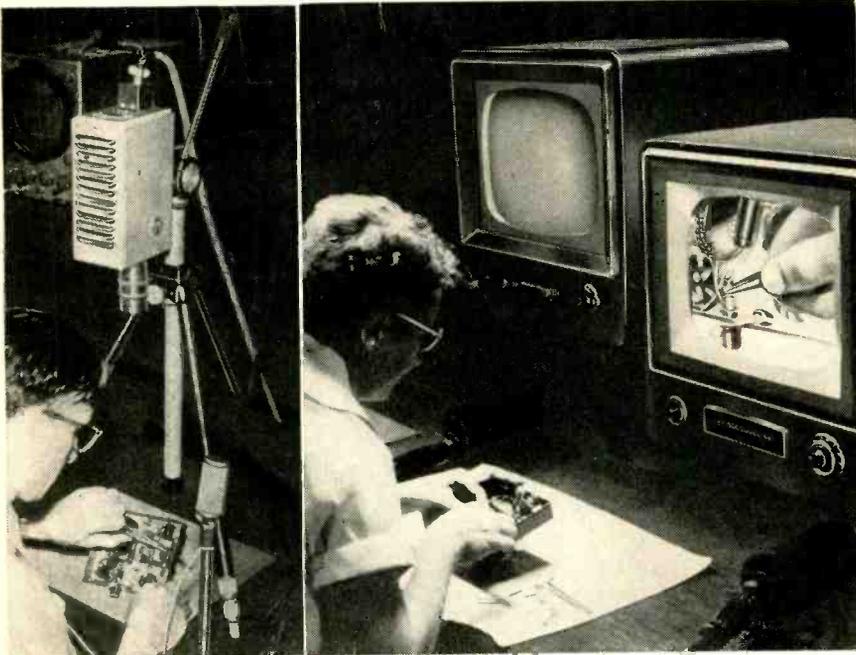
*Excellence in Electronics* Receiving Tube Division — Home Office: 55 Chapel St., Newton 58, Mass. Bigelow 4-7500

For application information write or call the Home Office or: 4935 West Fullerton Avenue, Chicago 39, Illinois, NAional 2-2770

589 Fifth Avenue, New York 17, New York, PLaza 9-3900 • 622 South La Brea Ave., Los Angeles 36, California, WEBster 8-2851

RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES



CAMERA aimed at specialist feeds monitor receivers on assembly line when . . .

## Industrial TV Cuts Training Time

Operators follow the leader by watching screens of tv sets and listening to his instructions

TO MEET a rush deadline, ten identical electronic assemblies were produced simultaneously in a few hours by workers with no previous instruction on that job. An emergency proved the usefulness of industrial television equipment in producing small quantities of electronic equipment in minimum time, with no preliminary worker instruction, no instruction sheets and no training time whatsoever for the particular job. The Radio Corporation of America needed ten identical assemblies of new theater sound control circuits to meet rush deadlines for openings in theaters.

► **How It Was Done**—Camera on tripod was placed right on top of a bench, aimed downward at the hands of a specialist who knew how to do the job. Alongside of him on a stand was the microphone. The camera fed video signals to ten 17-inch tv sets, each in front of an assembly worker. Each duplicated the actions of the spe-

cialist by watching his hands on the screen and listening to his instructions, so that all ten theater sound system control units were put together simultaneously in a few hours.

► **Potentialities** — The technique appears applicable to almost any type of intricate electronic assembly job, because the tv camera gets a much better view of the expert's work than could even be obtained by looking right over his shoulder. For small runs, where the quantity needed is equal to or less than the number of workers and monitor sets, just one run cleans it up.

► **Quantity Production** — Larger jobs can be handled with two or three runs by the specialist. For still larger quantities, the system can be used as an efficient training medium combined with immediate production, so that a line gets up to speed almost immediately in situations where simultaneous assembly is feasible. As yet it does not seem likely that industrial television can be adapted to sequential assembly lines, where each production worker is doing a different task.

## Financial Roundup

SURVEY of the profit reports of 21 radio, tv and electrical-equipment firms by the National City Bank of New York for the first nine months of this year shows that total net profits of these companies are 15 percent above those for the same period in 1953. Total net profit of \$277.5 million was reported by 21 companies for the period, compared to \$241.6 million for the same period in 1953.

Following are the net profits of 19 firms in the electronics field for the fiscal periods indicated:

Company	Net Profit	
	1954	1953
AMF 9m . . . . .	\$2,832,000	\$3,324,000
AT&T 12m . . . . .	466,040,000	403,688,160
Bendix Av. 9m . . . . .	17,901,493	12,618,552
Clarostat 6m . . . . .	68,182	
Clevite 9m . . . . .	1,980,501	2,771,221
Daystrom 6m . . . . .	757,813	488,475
T. A. Edison 9m . . . . .	500,873	977,847
GE 9m . . . . .	140,691,000	116,386,000
Gen. Prec. Equip. 9m . . . . .	3,602,640	2,283,830
Hoffman Radio 9m . . . . .	1,139,421	1,115,533
IBM 9m . . . . .	33,575,088	24,092,078
Minnesota Mining 9m . . . . .	17,594,981	13,708,826
Pyramid Electric 6m . . . . .	313,568	138,433
RCA 9m . . . . .	27,557,000	25,152,000
Stromberg-Carlson 9m . . . . .	1,316,204	1,328,391
Sylvania 9m . . . . .	6,166,226	7,562,941
Thompson Products 9m . . . . .	8,812,107	7,463,109
Tung Sol 9m . . . . .	1,478,493	1,423,284
Westinghouse 9m . . . . .	62,644,000	53,219,000

► **Securities** — Tung-Sol Electric filed with SEC covering 100,000 shares of convertible preferred stock, \$50 par value. Proceeds of the sale will be used for general corporate purposes. Since January of 1952 the company has spent \$4 million in improving and expanding manufacturing facilities and expects to spend approximately \$5 million for expansion over the next two years. Plans are to use about \$2.5 million of the amount to provide production facilities for color-tv picture tubes.

Daystrom purchased 22,713 shares of the capital stock of Weston Instrument at \$25 per share. Acquisition of these shares gives Daystrom voting control of 49.5 percent of Weston stock. Daystrom now holds outright 95,892 shares of Weston and has voting rights to an additional 116,000 shares under an agreement with an investment group.

(Continued on page 22)

# MULTI-GATE®—A Proven Data Transmission “Pipeline”

for

**C**\*  
**ENTRALIZED**  
**O**  
**PERATIONS**  
**C**  
**ONTROL**

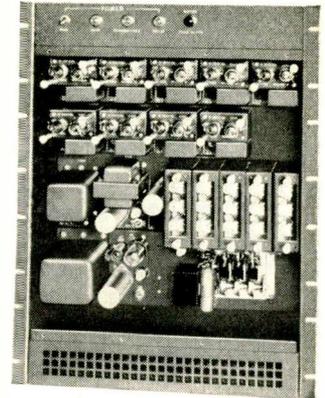
Control Engineers tell us the most important part of any remote supervisory control system is the “pipeline”—the means by which data is sent from control point “A” to operating point “B”. And these same control engineers tell us our MULTI-GATE Systems have proven themselves as compact, efficient, and dependable “pipelines.”

The MULTI-GATE system provides complete “on-off” or “raise-lower” control and report-back indication of practically an unlimited number of remote switches for valves, pumps, lights, power transfer and other functions, as well as alarm indication. Pipelines, refineries, chemical plants, railroads, public utilities and many other industries are finding MULTI-GATE an efficient, money-saving tool. All their control operations can be performed over a single communications circuit.

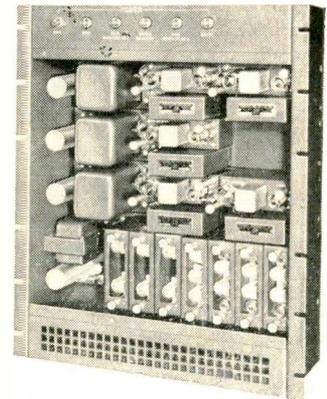
When used with telemetering equipment, *simultaneous control and remote metering* of such quantities as flow, temperature, pressure and electrical quantities are available over the same circuit—radio, microwave, wire or carrier—because all operations are performed by audio tones.

The transmitter and receiver terminals pictured at the right are typical of Hammarlund MULTI-GATE equipment. These units, designed for a 42 function system (21 “on-off” operations), take little space and are readily accessible when mounted in a standard 19-inch rack.

For details write The Hammarlund Manufacturing Co., Inc., 460 West 34th Street, New York 1, N. Y.  
Ask for Bulletin 125.



Multi-Gate Transmitter



Multi-Gate Receiver

**C**\*  
**ENTRALIZED**  
**O**  
**PERATIONS**  
**C**  
**ONTROL**

(trademarks pending)

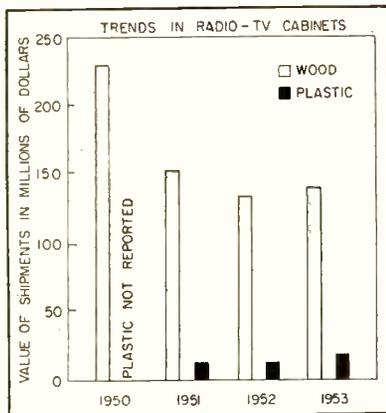
\* Hammarlund's systems for completely controlling and metering of any number of remote functions from central operation points for efficiency, speed and economy.

# HAMMARLUND

Since 1910

Beckman Instruments registered with SEC covering 150,000 shares of its \$1 par common stock at a price to be related to market price when it is offered. Net proceeds will be applied as follows: \$1 million for the retirement in full of all short-term unsecured notes. The balance is to added to general funds some of which may be used for the possible purchase of certain assets of Specialized Instruments Corp. and of Spingo Co., both in Belmont, Calif.

Square Root Industries filed with SEC covering 1 million shares of common stock (par 10 cents) to be offered at 30 cents per share. Net proceeds will be used to increase working capital.



## Radio-TV Cabinet Business Changes

SALES trend as indicated in the chart, shows the dip in the value of shipments in 1952 for both plastic and wood cabinets. But both types regained lost ground in 1953 as set production increased.

► **Wood**—Over 4.7 million tv cabinets and 7.0 million radio housings were used in the first 9 months of this year. Most radio cabinets were made of plastic while wood is most popular for tv. Hardboard made of pressed wood fibers has steadily increased its share of the wood tv cabinet business in the past few years, because of lower cost and a short supply of veneers.

The plastic cabinet market reached an all-time high in 1953.

## MEETINGS

Nov. 28–DEC. 3: 1954 Annual Meeting, ASME, Hotels McAlpin & Governor Clinton, New York, N. Y.

Nov. 29–DEC. 2: First International Automation Exposition, 244th Coast Artillery Armory, New York, N. Y.

Nov. 30–DEC. 2: First Electronic Computer Clinic, 244th Regiment Armory, New York, N. Y.

DEC. 8–10: Eastern Joint Computer Conference & Exhibition, Bellevue-Stratford Hotel, Philadelphia, Sponsors, IRE, AIEE, ACM.

DEC. 28–29: Fourth Conference on Scientific Manpower sponsored by the National Science Foundation, National Research Council, Engineering Manpower Commission, Scientific Manpower Commission and American Association for the Advancement of Science, Berkeley, Calif.

JAN. 12–15, 1955: World Symposium On Applied Solar Energy, Westward Ho Hotel, Phoenix, Ariz.

JAN. 17–19, 1955: Fourth Biennial Conference On High Frequency Measurements, IRE, AIEE, URSI, NBS, Washington, D. C.

JAN. 20–21, 1955: RETMA Symposium On Printed Circuits, University of Pennsylvania Auditorium, Philadelphia, Pa.

FEB. 10–12, 1955: Seventh Annual Conference and Electronics Show, Southwestern region of IRE, Baker Hotel, Dallas, Texas.

FEB. 10–13, 1955: Los Angeles Audio Fair, Hotel Alexandria, Los Angeles.

FEB. 20–28, 1955: Institute of Surplus Dealers' Fourth Annual Trade Show and Convention, 212th AAA Armory, New York, N. Y.

FEB. 1955: Western Computer Conference, California, sponsored by IRE, AIEE and ACM.

MARCH 21–24, 1955: 1955 IRE National Convention, Waldorf Astoria Hotel & Kingsbridge Armory, New York, N. Y.

MAY 2–5, 1955: Third Annual Semiconductor Symposium of the Electrochemical Society, Cincinnati, Ohio.

MAY 6, 1955: American Association of Spectrographers Sixth Annual Conference, Chicago, Ill.

MAY 16–19, 1955: Electronic Parts Distributors Show, Conrad Hilton Hotel, Chicago.

## Industry Shorts

► **First uhf-tv application and grant by FCC to station intending not to originate its own programs was made to Cascade Broadcasting Co. of Yakima, Wash. Station will rebroadcast pictures and sound from KIMA-TV, 60 miles distant.**

► **Interim use of tv frequencies between 680 and 890 mc has been proposed by AT&T for telephone and international tv service between Florida and Cuba. Comments pro and con must be filed with the Commission by Dec. 3.**

► **New monthly publication, "U. S. Government Research Reports" indexes U. S. and foreign research projects by industry classification is available from Superintendent of Documents, Washington 25, D. C., \$6.00 per year.**

► **National Lumber Manufacturers Association is reported to be con-**

sidering whether to seek a special FCC hearing on diathermy regulations because of effects on wood-working companies that use electronic gluing machines.

► **Reduction of \$50 a pound has been made in the price of Du Pont's pure silicon bringing its cost down to \$380 a pound.**

► **Date for filing formal comments on FCC rules governing restricted radiation devices has been extended to February 3, 1955 by the Commission.**

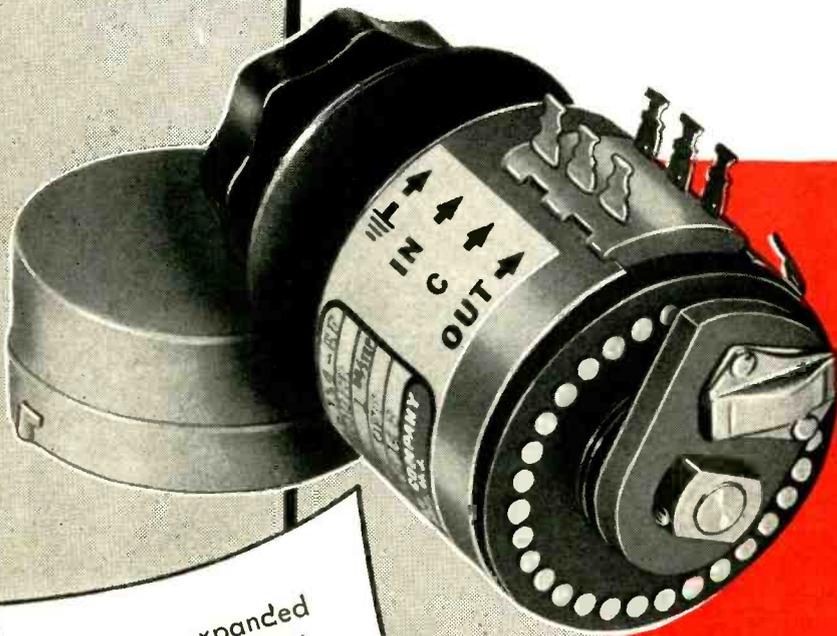
► **More powerful image tube which operates at 20,000 volts as compared with the previous 4,000-volt tube is being used in a new sniper-scope developed by the Army.**

► **Japanese portables made by Matsushita Electric of Osaka that feature a single earphone in addition to a regular loudspeaker, are on the U. S. market.**

THESE ARE THE

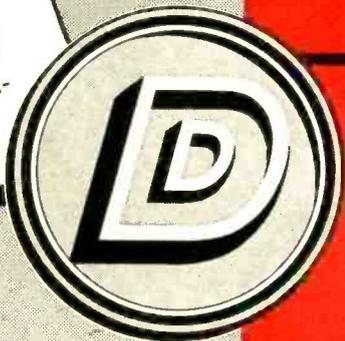
# REASONS

WHY **DAVEN** IS THE  
LEADER IN THE  
AUDIO ATTENUATOR  
FIELD



Greatly expanded production facilities enable Daven to make delivery from stock on a large number of standard attenuator types.

LA-130 Series,  
Ladder Network  
30 Steps, 1 3/4 Diameter



- 1 "KNEE-ACTION" ROTOR . . . gives positive contact and low contact resistance under all conditions.
- 2 BRASS CASE OF 2-PIECE CONSTRUCTION . . . gives excellent shielding and allows more compact equipment design.
- 3 "LOCK-TITE" DUST COVER . . . designed to withstand severe vibration and at the same time allow easy accessibility.
- 4 ENCLOSED ROLLER-TYPE DETENT MECHANISM . . . gives positive indexing, but does not increase depth of unit.
- 5 LOW-LOSS MOLDED TERMINAL BOARD . . . has high resistance to leakage.

Write for complete catalog data.

THE **DAVEN** CO.

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

191 Central Ave., Newark 4, N. J.

*The Reader*



*His Mark*

**T**HE ABC SYMBOL, which appears at the head of this page, is your brand—the reader's brand—on this magazine. It stands for Audit Bureau of Circulations. It means that this magazine will stay in business only so long as it continues to serve its readers to their satisfaction.

That Bureau—known for short as ABC—is a voluntary, nonprofit, cooperative association founded in 1914 by a group of publishers, advertisers and advertising agencies who wanted to establish and maintain higher standards of publishing practices than then prevailed. Its primary and specific purpose was to set up yardsticks to appraise circulation values and to verify the claims of publishers as to their circulations. For the buyer of advertising space this provides an effective means to take some of the guesswork out of buying and to reconcile the conflicting claims of competing publishers. *BUSINESS WEEK* magazine has aptly described ABC as “the publisher's conscience—and cop.”

**B**UT IN DOING that job, ABC performs another function of high importance to the readers of ABC member publications. It provides a constant pressure on the publishers to keep alive in their staffs a sense of primary responsibility to their readers. That is because the most simple and direct method of making a publication responsible to its readers is to place upon it a purchase price, whether by subscription or newsstand purchase. The right to purchase or to refrain from purchasing a publication gives to the reader and to no one else the power to pass effective judgment on the publisher's success in serving the reading public. Each paid publication will grow or languish, will prosper or fail, in proportion as it wins or loses the following of thousands or millions of readers. The readers, by their patronage, record their judgments as to whether the publisher and his publication are measuring up to their responsibility to them.

And that is where the ABC comes into the reader's picture. The newspaper or magazine that carries the ABC symbol on its masthead must in the first place be a paid circulation publication. Moreover, it must conform to the high standards set up by the Bureau as to terms of payment and accounting methods. And again it must open all of its books to the auditors of the Bureau on demand.

**S**INCE THE INFORMATION thus determined by thorough and impartial audit is periodically made public through the ABC statements and audit reports, it is constantly available to and universally used by advertisers who are considering the purchase of space in an ABC publication. These reports show the circulation trend, as verified and certified by ABC, and thus put the advertisers in a position to know whether or not the publisher is rendering satisfactory service to his readers.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner that he recognizes his primary obligation is to his readers and that he owes his standing to a voluntary demand by those readers. It follows that the editors of ABC publications must be exceptionally alert to the desires of their readers and responsive to their needs, since any decline in circulation will soon show up in the ABC statements and audit reports.

**T**HAT IS WHY we describe the ABC symbol as the reader's brand. It shows that a publication must be primarily responsive to him and that he holds in his own hands its success or failure. And that ABC symbol is not only a constant reminder to him of that fact, but also an equally constant reminder to all concerned that the reader's willingness to pay for the ABC publication is the acid test of its value to him and to the advertiser.

*McGraw-Hill Publishing Company, Inc.*

Another

# ERIE

First

## a NEW "HI" in QUALITY

### HI-RELIABILITY CERAMICONS®

with a failure potential approaching  
only 1 part in 10,000!

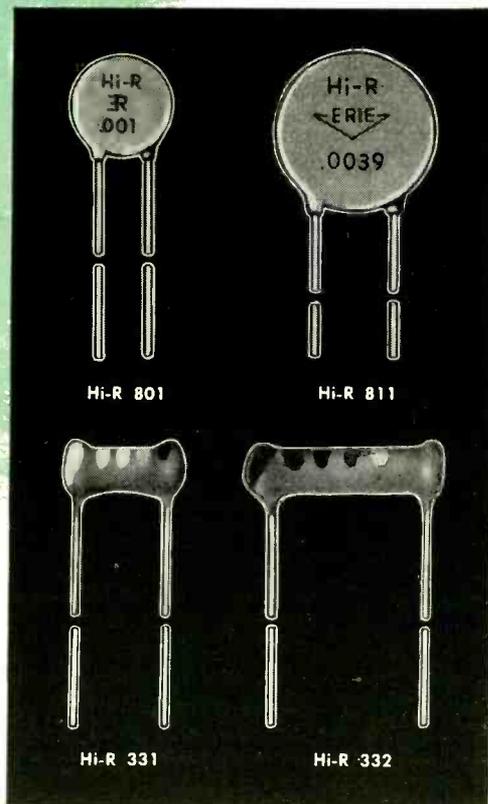
ERIE has met the demands for capacitors that set new records for reliability. The new "Hi-R" line of HI-RELIABILITY CERAMICONS has established a failure rate that crowds zero -- approaching only 1/100 of 1 per cent!

This "Hi-R" Premium Line includes Temperature Compensating and Hi-K Types in both Disc and Tubular Ceramic Styles. It has been designed for manufacturers of highly complex military and commercial electronic equipment where continuous operation is essential.

Produced of the very best material, under ideal conditions, and thoroughly tested to insure the required reliability, these Custom Designed Ceramic Capacitors offer:

- Extreme moisture resistance
- Stability maintained throughout life
- Unequaled low failure rate
- Remarkable performance at 125°C

Because these capacitors are Custom Designed and Specially Manufactured, ERIE is able to offer a wide variety of designs tailored to meet your particular reliability problem. Write regarding your needs for Hi-Reliability Ceramicons.



#### APPLICATIONS FOR HI-RELIABILITY CERAMICONS

- Guided Missiles
- Military and Civilian Communications
- Scientific and Business Computers
- Industrial Controls
- Aviation Equipment
- Radar Equipment



ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices and Factories: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Camden, N. J. • Chicago, Ill. • Detroit, Mich. • Cincinnati, Ohio • Fort Wayne, Ind. • Los Angeles, Calif. • Toronto, Ontario

Manufacturing Subsidiaries:

HOLLY SPRINGS, MISS. • LONDON, ENGLAND • TRENTON, ONTARIO

# AIRPAX

## C747 MIDGET

### 400 CYCLE CHOPPER

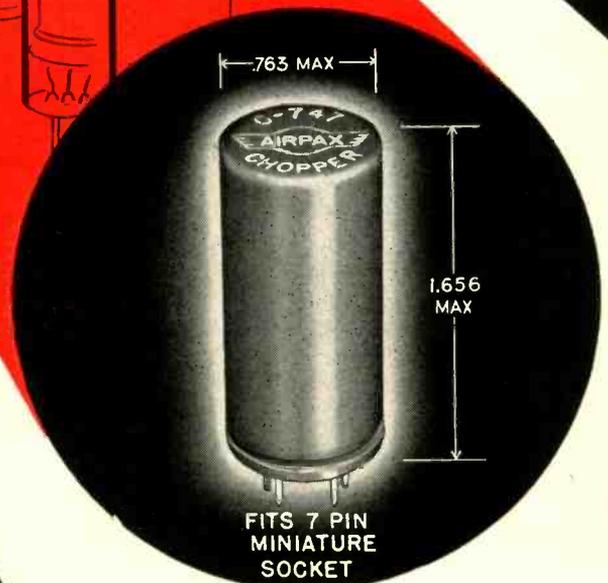
**PROVEN PERFORMANCE**  
in large volume production  
is your best guarantee  
of quality!

*✓ note  
these facts...*

- AIRPAX has built nearly 1/4 million choppers
- AIRPAX maintains an engineering staff constantly striving to improve choppers
- AIRPAX has ample capacity for large volume production of choppers
- And AIRPAX choppers have proven performance life and reliability



MIDDLE RIVER BALTIMORE 20, MD.



Weights less than 1 oz.

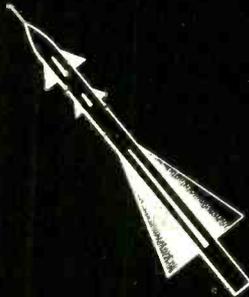
# AIRPAX

presents

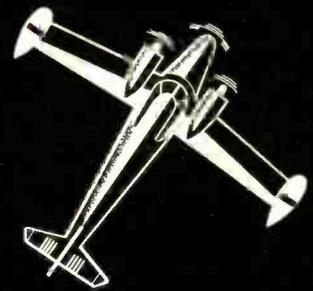
## A NEW 400 CYCLE VIBRATOR

Model A 500, Completely New,  
Completely Different, Opens  
New Fields of Performance  
Offers a High Order of  
Reliability with the  
Big Saving of Weight  
Space and Cost  
Resulting From  
High Frequency  
Operation

Reliable Short  
Duty Performance  
of as High as  
200 Watts From  
One Vibrator!



Continuous Duty  
Performance of up to  
30 Watts for a  
Safe 500 Hours!



Hermetically Sealed,  
Provides an Efficient  
Source of 400 Cycle  
Power to Handle Small  
Motors, Gyros and Selsyns



Provides Ideal  
Source of Power  
For Mobile  
Applications.  
Reliability Plus a  
Very Small  
Power Supply



MIDDLE RIVER BALTIMORE 20, MD.

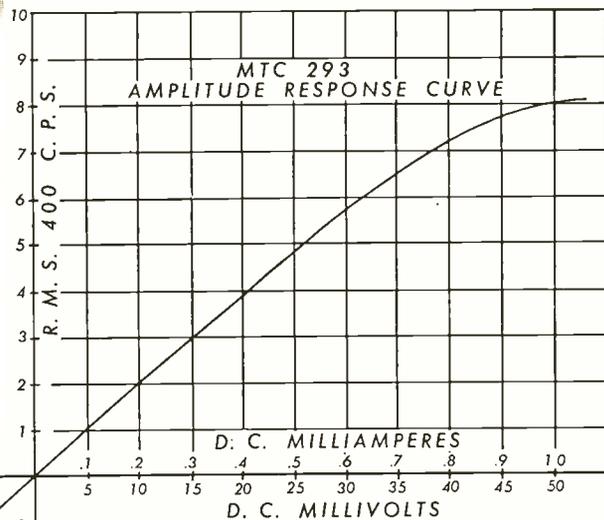
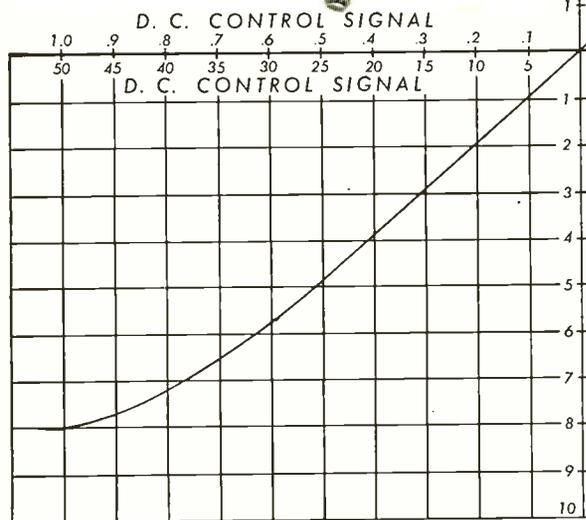
# GENERAL MAGNETICS INC. Introduces to the Temperature Control Field MTC 293

## MAGNETIC THERMOCOUPLE CONVERTER-AMPLIFIER



ACTUAL SIZE

THE GENERAL MAGNETICS THERMOCOUPLE CONVERTER IS DESIGNED TO CONVERT AND AMPLIFY LOW LEVEL DUAL POLARITY DC SIGNALS INTO 400 CYCLE SINUSOIDAL AC VOLTAGES OF CORRESPONDING AMPLITUDE AND PHASE SENSE.



- Input Signal Resolution — Less than 5 microvolts
- Greater Stability with Temperature
- Higher Gain
- Extremely Low Hysteresis
- Negligible Time Delay
- Clean Output Wave Form
- No Moving Parts or Contacts to Fail
- Practically Unlimited Life
- Operation in Temperature Ambients from  $-70^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$
- No Internal Rectifiers
- High Shock and Vibration Resistant

### SPECIFICATIONS

1. Excitation: 12 V. RMS  $\pm 10\%$  @ 400 CPS  $\pm 10\%$
2. AC input impedance — About 2500 Ohms
3. Output Impedance — About 10,000 Ohms
4. No load voltage gain — 250
5. Output at null: 30mV max. RMS (Composed of even and odd harmonics)
6. Output phase:  $0$  or  $180^{\circ} \pm 10^{\circ}$
7. Harmonic distortion in signal range: About 15%
8. Overall dimension  $1\frac{1}{8}'' \times 1\frac{1}{8}'' \times 2''$  high

We specialize in control systems and magnetic amplifier components for Automatic Flight Control — Analog Computers — Fire Control and Armament — Guided Missiles — Nuclear Applications — Magnetic Voltage Regulators and Power Supplies.

Write on your letterhead for further details



MAGNETIC MODULATORS AND AMPLIFIERS

VOLTAGE REGULATORS

CONTROL SYSTEMS

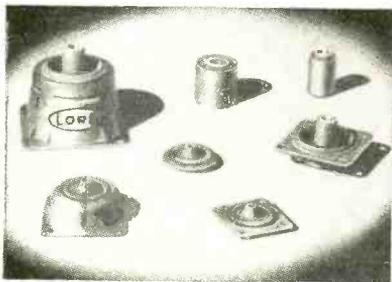
135 Bloomfield Ave., Bloomfield, N. J.

ADVERTISEMENT

**Lord Vibration Control Mountings . . . The Most Effective Protection For Electronic Equipment**

In the rapidly advancing field of electronics, the control of destructive vibration and isolation of damaging shock are prime factors in the consideration of design engineers. Lord, Headquarters for Vibration Control, is constantly working with electronics engineers to improve the methods for protecting sensitive mechanisms.

For instance, Varo Static Converters which change alternating to direct current for aircraft with less than 1% voltage ripple are protected against shock and vibration by Lord Mountings. High fidelity Audio frequency electronic equipment such as Collins Radio Company manufactures is protected from vibration and shock through the use of Lord Mountings. The 212A-1 Broadcast Station Speech Input Console by Collins requires 28 Lord square Plate Form Mountings to protect each amplifier stage individually. This prevents mechanical interaction between stages and lessens acoustical feed-back effects.

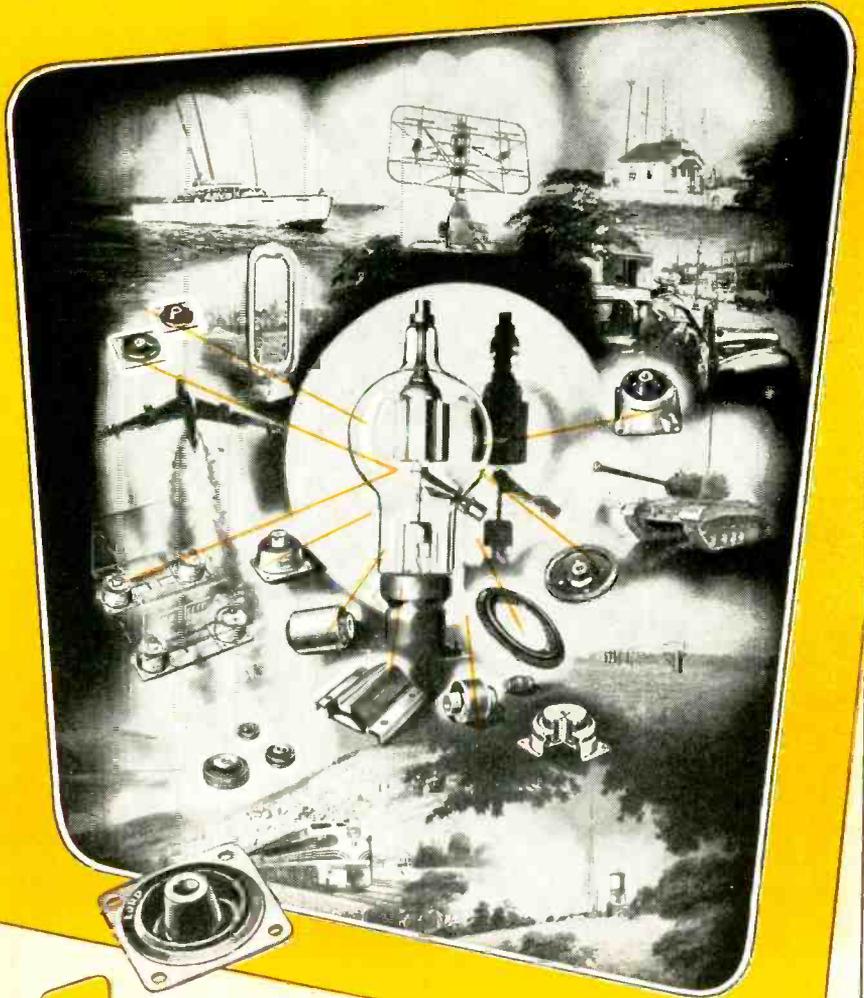


Again the Agnew Spark Plug Welder by Agnew Electric Company uses Lord Mountings to support the electronic weld timers to prolong the useful service life of Mercury Vapor Tubes.

Lord Mountings, which you see illustrated in the accompanying advertisement, are used in a wide diversity of applications to protect electronic equipment and sensitive instruments. Business machines and such sensitive mechanisms, the accuracy of which must be perfect, are improved in operation and protected from damaging vibration and shock by Lord Mountings.

The Lord Manufacturing Company, Erie, Pa., offers a vast reservoir of recorded experience in the solution of vibration and shock problems. Your request for help on your own problem is welcomed.

**LORD MOUNTINGS PROTECT INSTRUMENTS and ELECTRONIC EQUIPMENT from VIBRATION and SHOCK DAMAGE . . .**



**V**IBRATION and shock are natural enemies of electronic equipment and precision instruments . . . To control the damage which these enemies can do, Lord Vibration Control Mountings and Bonded Rubber Parts are used to very profitable advantage. More than a quarter century's experience in dealing with vibration and shock is yours when you take advantage of Lord engineering assistance. The result of such consultation is full protection for electronic units and sensitive instruments by correctly designed and precisely manufactured Lord Mountings and Bonded-Rubber parts.

- |   |  |   |   |
|---|--|---|---|
| <b>DETROIT 2, MICHIGAN</b><br>311 Curtis Building           | <b>LOS ANGELES 28, CALIFORNIA</b><br>7046 Hollywood Blvd.              | <b>CHICAGO 11, ILLINOIS</b><br>520 N. Michigan Ave.         | <b>CLEVELAND 15, OHIO</b><br>811 Hanna Building |
| <b>PHILADELPHIA 7, PENNSYLVANIA</b><br>725 Widener Building | <b>NEW YORK 20, NEW YORK</b><br>630 Fifth Avenue<br>Rockefeller Center | <b>DALLAS, TEXAS</b><br>313 Fidelity Union<br>Life Building | <b>DAYTON 2, OHIO</b><br>410 West First Street  |

**LORD MANUFACTURING COMPANY • ERIE, PA.**

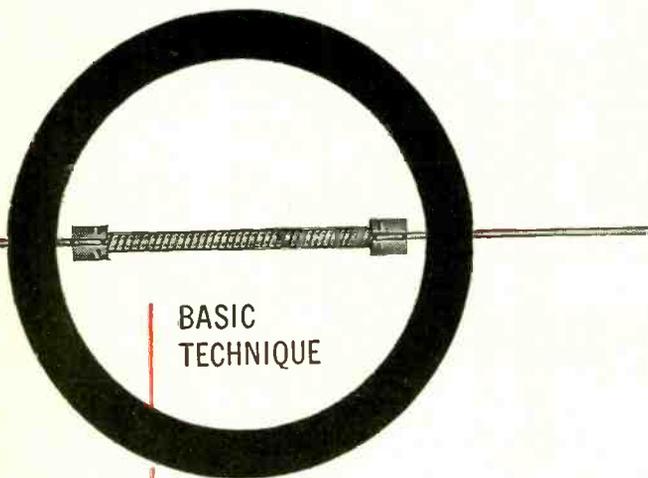


*Headquarters for*  
**VIBRATION CONTROL**



Precision, high-speed winding equipment for IRC elements

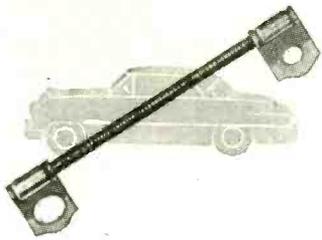
## ONLY IRC WINDING SKILL OFFERS



### BASIC TECHNIQUE

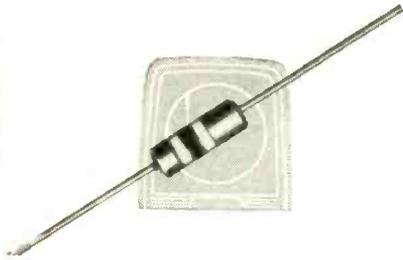
Wire element is uniformly and tightly wound on an insulated core. Axial leads or other terminations are secured to element by automatic machinery. Insulated housing may be used or omitted.

If you seek savings in component costs, IRC's winding skill may serve your need. IRC's mastery of winding wire elements dates back more than 25 years. Today, it provides a wide variety of unique units that offer realistic possibilities for savings. Cost-conscious IRC engineers will gladly analyze your requirements.



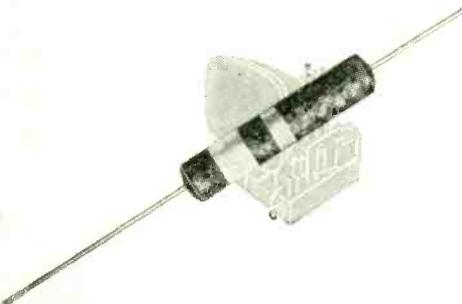
**14c savings per car**

Type AW Wire Wound resistors save automobile manufacturers an average of 14c per car. For quantity requirements, these low-cost windings can be made specially to suit individual designs. This adaptability has proved profitable to numerous appliance manufacturers.



**low cost—low wattage**

Type BW insulated wire winds offer excellent stability in low ranges—at low prices. Leading instrument manufacturers attest to their superiority. 1/2, 1 and 2 watt sizes are equivalent to Jan types RU-3, RU-4 and RU-6.



**50% savings**

IRC Insulated Chokes offer savings up to 50% over ordinary types. Available in two sizes, they are fully protected against humidity, abrasion, assembly damage and danger of shorting to chassis. A favorite source of savings for TV and radio set manufacturers.

**THESE SAVINGS**



**inexpensive solution**

4-watt Insulated Power Wire Wounds with axial leads can save several cents over conventional power resistors. Inorganic core and high-temperature plastic housing allow safe operation up to 165° C. Widely used in toys, juke boxes and amusement devices.

**NEW**  
*encapsulated*  
**precision**  
**resistors**



- Epoxy Resin Compound Used For Both Winding Form and Seal.
  - Exclusive Molding Process Avoids Air Pockets And Assures Uniform Distribution Of Resin.
  - Exceed MIL-R-93A Specifications In 1%, 0.5%, 0.25%, 0.1% Tolerances.
- SEND COUPON FOR DATA BULLETIN**

Boron & Deposited Carbon Precisors • Power Resistors • Voltmeter Multipliers • Low Wattage Wire Wounds • Insulated Composition Resistors • Volume Controls •

*Wherever the Circuit Says*

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals •



**INTERNATIONAL RESISTANCE CO.**  
403 N. Broad St., Philadelphia 8, Pa.

*In Canada: International Resistance Co., Ltd., Toronto, Licensee*

Send Technical Bulletins on:  Encapsulated Precision Wire Wounds;  Insulated Chokes;  BW Resistors;  4-Watt Power Resistors.

Name \_\_\_\_\_  
Title \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

# KEPCO

# VOLTAGE REGULATED POWER SUPPLIES



## MODEL 615

OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-600	0-300 Ma.	0.5%	5 Mv.
2	0-150 Bias	0-5 Ma.	*	5 Mv.
3	6.3 AC	10 Amp.	†	

## MODEL 815

OUTPUT	VOLTS	CURRENT	REGULATION	RIPPLE
1	0-600	0-200 Ma.	0.5%	5 Mv.
2	0-150 Bias	0-5 Ma.	*	5 Mv.
3	6.3 AC	10 Amp.	†	

KEPCO Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.

**REGULATION:** As shown in table for both line fluctuations from 105-125 volts and load variations from minimum to maximum current.

\***REGULATION FOR BIAS SUPPLIES:** 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

†All AC Voltages are unregulated.

## ▶ 30 MODELS

AVAILABLE FROM STOCK  
COMPLETE CATALOG ON REQUEST  
WRITE DEPT. 246

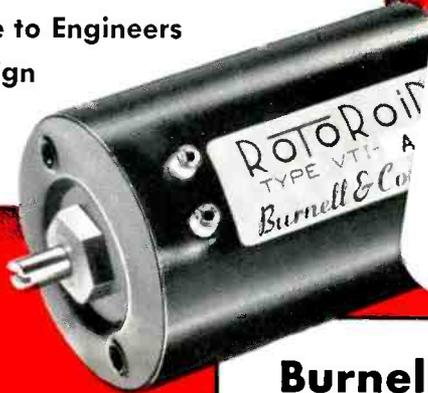


# KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, N. Y. • INDEPENDENCE 1-7000

# An Announcement

of the Utmost Importance to Engineers  
Doing Research and Design  
Work in the Entire Audio  
Frequency Range.



# BURNELL

**Burnell and Co., Inc.**  
is proud to announce the development  
of an entirely new product—

# ROTOROID®

## a Variable Toroidal Inductor (patent applied for)

ROTOROID will prove to be a valuable aid in the solution of many engineering problems—in research and design—and opens new possibilities for production which were previously impractical or impossible.

### ROTOROID

*Now 4:1*

- . . . is a continuously variable, stepless toroidal inductor which can provide a 3:1 range of maximum to minimum inductance in 180° rotation of a shaft.
- . . . employs no mechanical resistance contacts and is therefore free of noise and wear.
- . . . requires no DC saturating currents and thereby eliminates the need for circuitry.
- . . . is applicable over the entire audio range (from approximately 300 cps). ROTOROID is not limited to any stock value of nominal inductance. It is available in any value of inductance now available in regular toroids.
- . . . is hermetically sealed and is virtually vibration and shock-proof, can be chassis or panel mounted.



Write Department *for further information.*

*Now Available*

**Burnell & Co., Inc.**

Yonkers 2, New York

PACIFIC DIVISION: 720 Mission Street, South Pasadena, California

An outstanding feature of ROTOROID is that, at maximum inductance, it provides the full Q of the toroid it contains. Thus, the user is at once able to take advantage of the high Q characteristics of toroids while at the same time having available a variable inductor not previously available in a toroid.

**Applications: Virtually unlimited. Just a few of the many possible uses of ROTOROID are:**

- Tunable Audio Oscillators
- Variable Z Devices
- Servo Systems
- Telemetering
- Adjustable Selective Networks
- Variable Phase Shift Networks
- Variable Filters
- Electro-Mechanical Control Systems

Availability: Immediately available: ROTOROIDs VTI-A and VTI-B which are equivalent in electrical characteristics to Burnell toroids TC-16 and TC-3 in cases 2 1/4" in diameter, 3-1/16" long. Soon to be available: two miniature types, VTI-C and VTI-D, equivalent to Burnell toroids TCO and TC-6.

**FIRST IN TOROIDS AND RELATED NETWORKS**

# 3 BIG REASONS

to check

**BURNELL**

**first!**

## 3 EXTRA REASONS TO CHECK BURNELL FIRST!

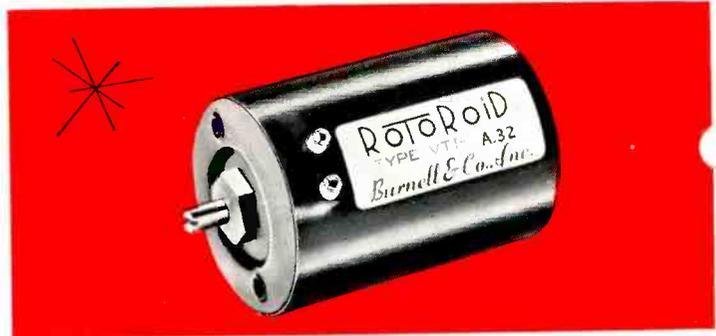
- \* Proven Top Quality
- \* Competitive Prices
- \* Prompt Deliveries

Write Department  
for Catalog 102A



**BURNELL & CO., INC.**  
Yonkers 2, New York

PACIFIC DIVISION: 720 Mission Street, South Pasadena, California



**ROTOROIDS®** A continuously variable, stepless toroidal inductor which can provide a 3:1 range of maximum to minimum inductance in 180° rotation of a shaft. Write for new brochure which gives complete technical data.



**TOROIDS** Combining the advantages of toroidal type winding with the molybdenum permalloy dust core and other specially selected materials, these toroids provide higher Q than any other structure. They also provide greater stability of inductance vs. temperature and level in a smaller space. Their self-shielding properties permit compact assemblies of coils with a minimum of deleterious effects. Supplied to an inductance accuracy of 1%. Available in standard, miniature and sub-miniature sizes. Also in a wide variety of finishes, including *for the first time toroids molded in a new special material.*

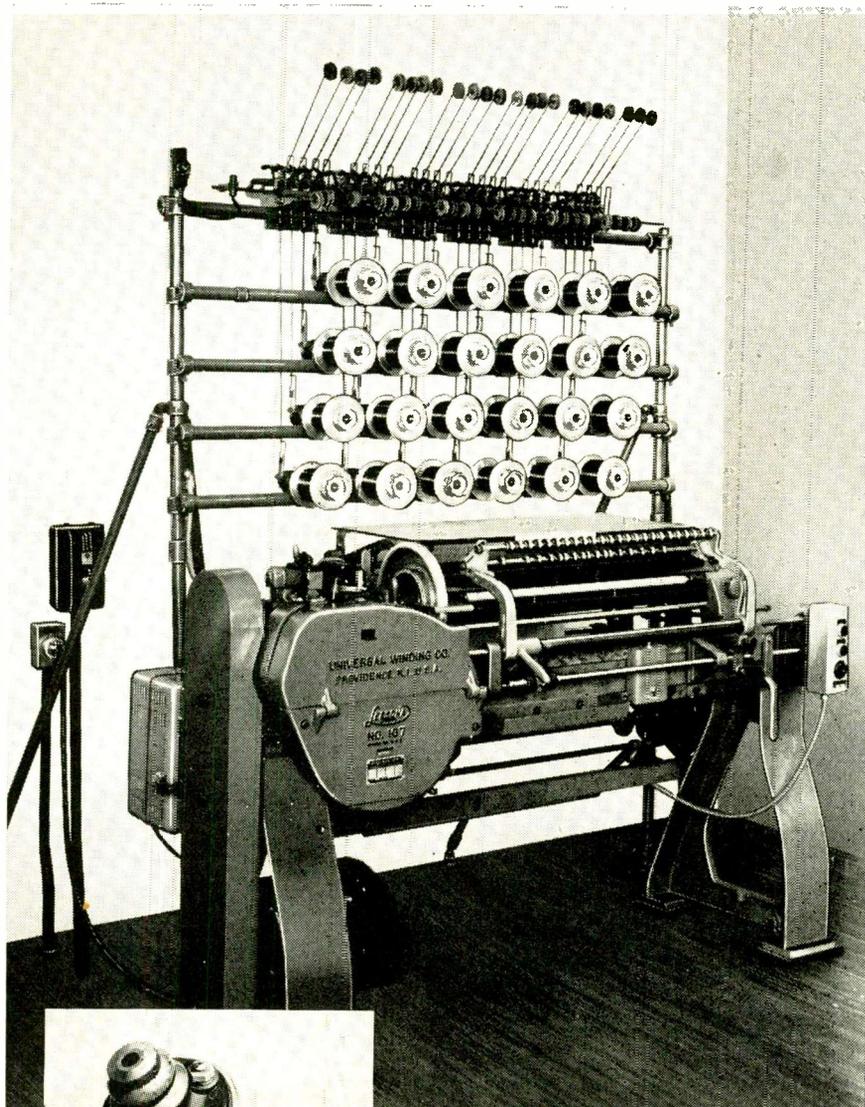


## TELEMETERING FILTERS

Band pass filters available for every channel ranging from 400 to 70,000 cycles for band width between 15 - 40%. Low pass filters available for operation in either unbalanced or balanced line, and range in cut off frequency from 6 up to 10,500 cycles. Also, miniaturized filters that do not sacrifice attenuation characteristics, save up to 80% space.

**FIRST IN TOROIDS  
AND  
RELATED NETWORKS**

# New Coil Winders Aid Production Flow



*Standard Motor Products Inc. uses Leesona No. 107 Automatic Coil Winders to integrate production output*

Once again Leesona Coil Winders prove their ability to deliver faster, more efficient performance.

Here is what H. A. Rosenstein, V.P., of Standard Motor Products Inc., Long Island City, N. Y., has to say about their No. 107 Coil Winders:

*"Perfect timing with our production schedule has been achieved by the installation of Leesona No. 107 Automatic Coil Winders for winding our ignition secondaries. Results have lived up to every expectation. The new Leesona No. 107 Machines are great performers. Their automatic operation gives us exactly the precision accuracy we want — plus perfect coordination with our general production flow."*

Reports like this are familiar stories wherever plants have modernized with Leesona No. 107 Coil Winders. And they give you a good idea of how these advanced machines can benefit your own coil winding operations.

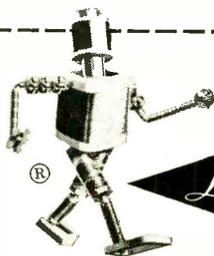
### *Get All The Facts*

on the Leesona No. 107 Coil Winder. Send the coupon for a new, illustrated bulletin describing how every feature is designed to produce compact, uniform paper-insulated coils — in fastest time — with minimum operator attention — at lowest cost.

Read how you can step up your coil winding production to new, profit-boosting efficiency — with the machine that's the last word in automatic coil winder design. The coupon also lists other helpful coil winding information. Why not check and mail it today?



The Leesona No. 107 Automatic Coil Winder winds 4 to 30 paper-insulated coils in stick form simultaneously. Handles wire sizes from No. 19 to No. 42 (B&S). Automatic operation eliminates human error, and the smooth electronic drive reduces wire breakage to a minimum. Standard Motor Products' installation of fast, accurate No. 107 machines is speeding production of Blue Streak and Standard ignition coils (inset).



FOR WINDING COILS  
IN QUANTITY... ACCURATELY  
... AUTOMATICALLY... USE  
UNIVERSAL WINDING MACHINES

## UNIVERSAL WINDING COMPANY

P. O. BOX 1605, PROVIDENCE 1, RHODE ISLAND, Dept. 112

Please send me

- Bulletin on the Leesona No. 107 Automatic Coil Winder.
- Condensed catalog of Leesona Winders.
- Bulletin on the new Leesona Pay-As-You-Profit Plans for purchasing or leasing modern coil winding machinery.

Name.....Title.....

Company.....

City.....Zone.....State.....

*Andrew*  
CORPORATION  
363 EAST 75th STREET · CHICAGO 19

## PERFORMANCE GUARANTEED\* SYSTEMS

### FEATURING

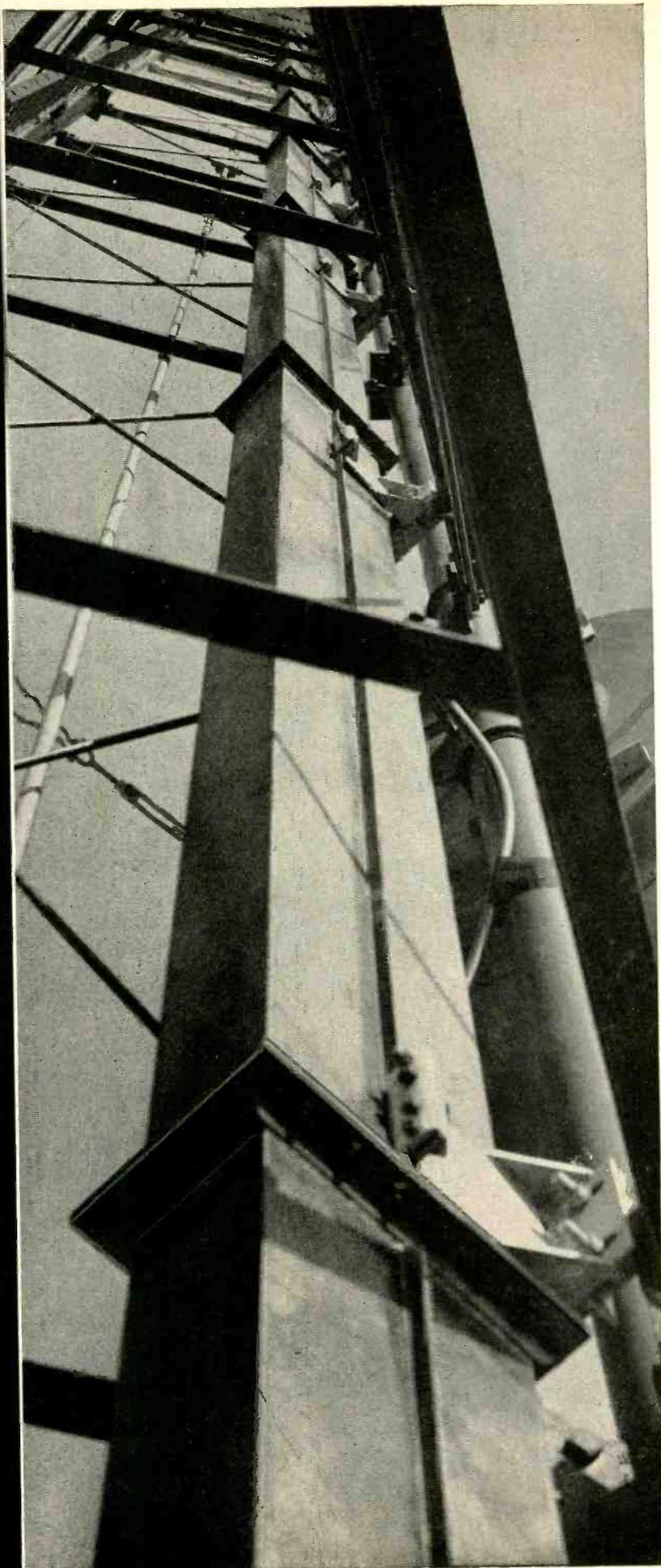
VSWR low enough for color television

- *New Andrew copper clad steel waveguide*
- *Andrew UHF Coaxial line*
- *Andrew high efficiency Steatite line for VHF*

Andrew transmission systems for today's TV will not be obsoleted by tomorrow's colorcasting—

\* Our high technical standards are backed by a 20 year record of accepting *systems* responsibility, and we invite you to write for a copy of our guarantee policy.

Andrew will design and engineer a complete system for your station *now*—and accept a contingent order to be placed through your transmitter manufacturer at a later date.



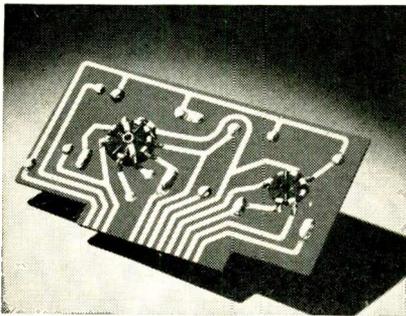
Get better printed circuits... lower costs... fewer rejects

# with NEW C-D-F METAL CLADS

All manufacturers of metal clad stock for printed circuitry have made considerable progress in improving their product—a material with a metal foil surface bonded to a non-conducting base. How this has been done by one leading manufacturer, the Continental-Diamond Fibre Company, illustrates some of the problems involved in buying this type of material and in understanding its design potentials.

## C-D-F CONSOLIDATED GRADES

At first, small test lots of Dilecto laminated plastic with copper surfaces were made. Almost every core material was used. Finally the number of practical grades for printed circuit work narrowed down to these few grades which retained to a large degree the inherent electrical qualities of their base material and resin at high temperatures:



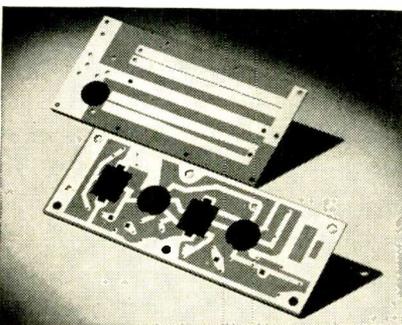
**COPPER CLAD  
GRADE XXXP-26**

A laminate with excellent electrical and mechanical properties. High moisture resistance and dimensional stability. Recommended for applications where

high heat and high insulation resistance plus low dielectric loss under high humidity is needed. Low cold flow characteristics. Can be hot punched to 1/8". Good flexural strength. Natural green color.

This is one of the improved C-D-F Dilecto laminates. Advances in resins and manufacturing techniques makes this grade almost homogeneous, with improved impregnation of the filler. Thorough impregnation eliminates entrapped moisture and air, giving greater moisture resistance and better dielectric properties.

Any metal clad is no better than its base and the care taken in laminating. With the cost of material high, compared to labor and inspection, the purchase of a uniform metal clad material, like this C-D-F grade, becomes vital.



**COPPER CLAD  
GRADE XXXP-24**

Similar to grade XXXP-26 in electrical and moisture resistance properties, but not quite as strong mechanically. Equal cold flow and punching characteristics. Natural brown.

## COPPER CLAD GRADES GB-112S AND GB-261S

These silicone grades use a glass fabric laminate with a copper foil surface on one or both sides. Recommended where high heat resistance and low dielectric loss properties are required. For certain tuners and inductances the

low dielectric loss factor of this grade makes its higher cost acceptable. A continuous filament (Grade GB-112S) is used for thicknesses 1/32 to 1/16". A staple filament (Grade GB-261S) is used for thicknesses over 1/16".

## COPPER CLAD GRADE GB-116T

A glass base laminate using duPont's tetrafluoroethylene resin, Teflon, for outstanding resistance to high heat with extremely low dielectric loss properties. A fine weave continuous filament glass fabric cloth is used for superior mechanical strength and good machining qualities. In spite of its high cost, this C-D-F grade has demonstrated that it can save money and do a job that no other single material can in microstrip high-voltage, high-frequency circuit elements. Remember, C-D-F is a major supplier of sheets, tapes, rods, tubes of Teflon, has valuable experience in its manufacture and fabrication. Write for samples.

## C-D-F INCREASED BOND STRENGTH

By developing a special thermo-setting adhesive particularly suited for metal clads, C-D-F was able to increase the bond strength of their laminates considerably above their original figures. Bond or peel strength, the amount of pull required to separate the foil from the core material, is one of the most important physical properties. Therefore, the purchaser should compare his source of supply with these C-D-F average test values:

BONDING STRENGTH—FOIL TO LAMINATE	
MATERIAL	Average or Typical Value Lbs. pull per 1" width of foil to separate
XXXP-24 or XXXP-26 plus 0.0014" copper	5 to 8
XXXP-24 or XXXP-26 plus 0.0028" copper	7 to 9
GB-116T plus 0.0014" copper	5 to 12
GB-112S plus 0.0014" copper	6 to 8
GB-261S plus 0.0014" copper	7 to 10

These values are based on tests at prevailing room temperature (20-30°C.)

## C-D-F INCREASED HEAT RESISTANCE

Special efforts by C-D-F technicians to increase the heat resistance of all C-D-F Metal Clads have resulted in certain special grade variations able to withstand higher soldering temperatures without damage. As production methods change, C-D-F offers materials to meet your requirements.

## NOW . . . HOW ABOUT YOUR STORY?

Notice how we have talked about C-D-F and what we have done to improve quality and uniformity of metal clad products. Much of this has been accomplished with the guidance and cooperation of leading users of printed circuit stock. No one company knows all the answers . . . but C-D-F, a big reliable source of supply, can help you get better printed circuits . . . lower costs . . . fewer rejects. Look up the address of your nearest C-D-F sales engineer in Sweets Design File, write us for samples you can test in the lab and on the production line, technical bulletins, help on your specific project. We want to work with you!



*Continental-Diamond Fibre*

CONTINENTAL-DIAMOND FIBRE COMPANY  
NEWARK 16, DELAWARE

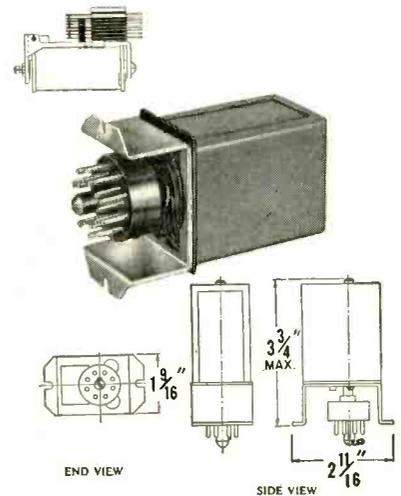
# Phil-trol

# Data

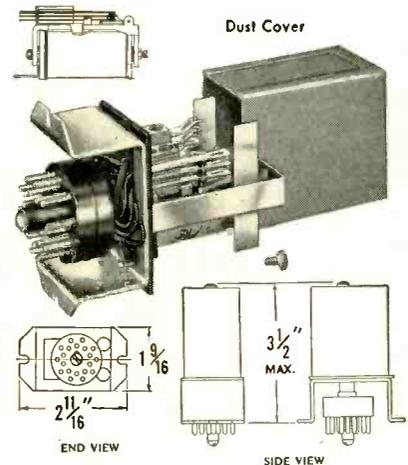
## Standard Plug-In and Dust Covered Relays Now Available in Three General Types

### Lock Base Holds Relay Structure Firm Removing Stress From Plug

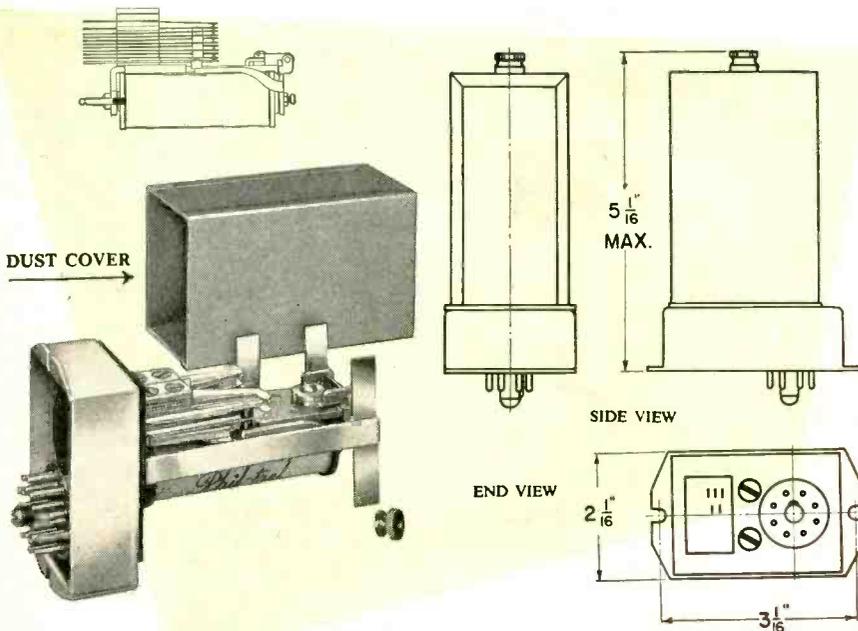
The almost universal demand for a relay having the plug-in feature and a well secured dust cover has created need for the following design. This design is now available in the three basic multiple-contact relays illustrated—namely, types 2, 6, and 8. This design consists of a plug-in arrangement having many different combinations of plugs, from 4 to 20 circuits per relay, and is equipped with a bracket, which itself is secured by two screws, thus removing the stress from the conducting plug. The cover assembly itself is fitted over a bracket, which is so designed as to protect the contacts of the relay, eliminating the possibility of damage to contact springs when the cover is either removed or replaced. The cover is held on by means of a knurled nut or screw, and is securely held against a rubber gasket. This method assures maximum protection from dust and dirt and provides uniformity of mounting.



The Phil-trol type 6QA relay is extremely efficient, more compact than the type 2QA, and has similar performance characteristics.



The Phil-trol type 8QA relay is one of our latest newly developed relays. It is equipped with special features which make it extremely fast operating. It is equipped with twin contacts for maximum reliability of contact closure, and has an extremely long life expectancy.



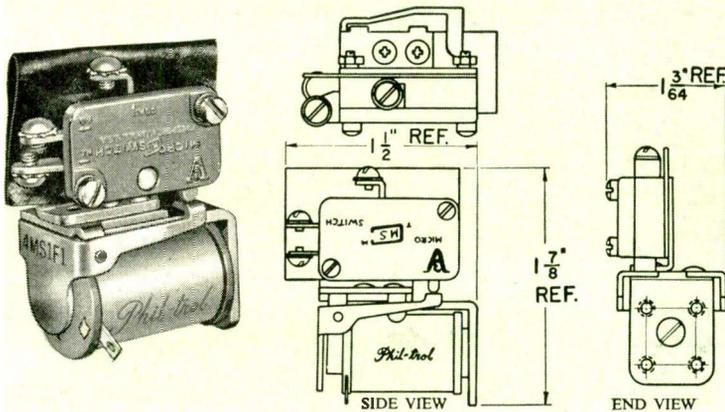
The Phil-trol type 2QA (Quick Acting) relay, is commonly known as the standard telephone type, providing fast closing and opening of a maximum number of circuits. Its long-coil construction permits the use of high resistance coils. The time delay models, known as types 2SO (slow-operate), and 2SR (slow-release), are also available, providing time delays of as much as .010 second operate and .500 second release. This plug-in cover arrangement is also available for the 2AC relay.

**Phillips Control Corporation** JOLIET, ILLINOIS  
A THOR CORPORATION SUBSIDIARY

# for Relay Users

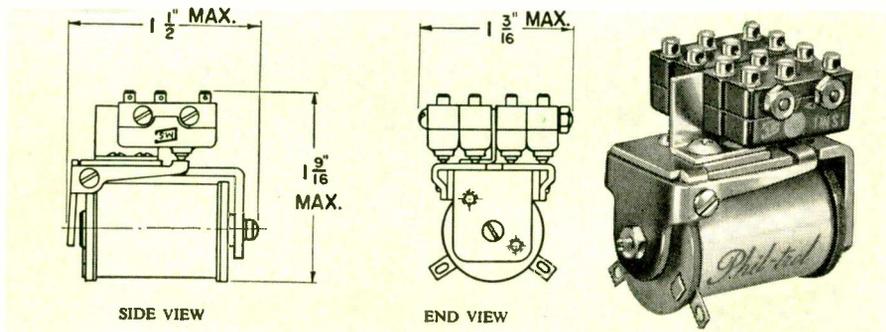
## New Phil-trol Miniature Micro Switch Relays Now Available

Compact snap-action contacts of the miniature variety are utilized in the new Type 4MS and 4BMS series relays.



**TYPE 4MS RELAY ASSEMBLY**

This assembly, at left above, features a fast, light weight, highly sensitive and low cost miniature unit, with Micro Switch style V3-101, operating on approximately 1 watt power input. It may be engineered to operate on as little as .005 amps. Available SPDT or DPDT. Contact terminals are of screw type.



**TYPE 4BMS RELAY ASSEMBLY**

This sub-miniature unit provides for as many as four miniature Micro Switches on one relay. (4PDT) Type 1SM1, rated at 5 amps., 250V A.C. is used. Stud terminal connections are provided.

### Phil-trol Sales-Engineering Offices COAST-TO-COAST

#### Phillips General Offices:

59 W. Washington St.,  
Joliet, Illinois.  
Tel: JOliet 3-3431

CALIFORNIA, Los Angeles 36,  
5410 Wilshire Blvd.  
Tel: WEBster 3-6405

CALIFORNIA, Palo Alto,  
180 University Ave.  
Tel: DAVenport 3-3288

CALIFORNIA, Santa Monica,  
2910 Nebraska Ave.  
Tel: Van Nuys, STate 9-4887

COLORADO, Denver 20,  
3014 So. Cherry Way  
Tel: SKYline 6-2555

GEORGIA, Atlanta 3,  
311-315 Georgia Savings Bank Bldg.,  
84 Peachtree St., N.W.  
Tel: CYprus 7381

MICHIGAN, Detroit 27,  
12812 Puritan Ave.  
Tel: UNiversity 1-7311

NEW YORK, Buffalo 3,  
833 Ellicott Square Bldg.  
Tel: MADison 3306

NEW YORK, New York 17,  
2044 Graybar Bldg.,  
420 Lexington Ave.  
Tel: MURray Hill 5-9103

OHIO, Cleveland 6,  
12417 Cedar Road.  
Tel: ERie View 1-0054

PENNSYLVANIA, Philadelphia,  
Western Savings Fund Bldg.  
Broad and Chestnut.  
Tel: KINGSley 6-2480

WASHINGTON, Seattle 9,  
216 First Ave., N.  
Tel: ELiot 6981



Let Phil-trol Progress  
Help Solve Your  
Relay Problems

Plants at Joliet, Illinois,  
Santa Monica, California,  
and Santurce, Puerto Rico

### PHILLIPS CONTROL CORP., Dept. E, 10, Joliet, Ill.

Gentlemen: Please send me your General Catalog

I am personally interested in:

Dust Covered Relays of Type  Micro Switch Relays of Type

Name \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

WHEN YOU SPECIFY  
Permalloy\*  
POWDER  
CORES  
SPECIFY

**MAGNETICS inc.**  
*Performance -  
Guaranteed*

**HERE'S WHY...**

The Magnetics, Inc. "Performance-Guarantee" on molybdenum permalloy Powder Cores is a revolutionary concept in the communications and electronics industries, and opens the way to substantial savings in your production and assembly operations. The guarantee of performance to your specifications is your assurance that these Powder Cores are standardized to meet your circuit requirements.

These Performance-Guaranteed Powder Cores cost no more—indeed, despite the fact that you have a guarantee of performance, they are sold at prices standard in the industry. You can't afford not to investigate Magnetics, Inc. molybdenum permalloy Powder Cores.

**Keep in Mind These Advantages of Powder Cores...**

1. Low hysteresis and eddy current losses;
2. High electrical resistivity;
3. Constant permeability over widely varying flux densities;
4. Magnetic stability with dc magnetization.

**WANT THE COMPLETE STORY?...**

Write us... on your company letterhead... we'll be delighted to send you literature, delighted to answer specific questions. No obligation, of course....

\*Manufactured under a license agreement with Western Electric Co.

**MAGNETICS inc.**

DEPT. E-13 BUTLER, PENNSYLVANIA

# NEW! PORTABLE DIRECT READING SPECTRUM ANALYZER



- 10 TO 22,000 MCS
- ONLY 3 R. F. HEADS
- SINGLE DIAL TUNING



MODEL  
TSA

Now, a new Polarad spectrum analyzer only 21 inches high that covers the entire frequency range 10 to 22,000 mcs with but 3 interchangeable R-F tuning heads. The model TSA operates simply—single dial frequency control—with utmost frequency stability. It provides highest accuracy, and reliability for observation and true evaluation of performance over the entire R-F spectrum—saving engineering manhours.

This instrument is designed for maximum utility and versatility in the laboratory and on the production line providing an easy-to-read 5 inch CRT display of the R-F spectrum.

The model TSA Spectrum Analyzer has these exclusive Polarad design and operating features:

- Single frequency control with direct reading dial. No klystron modes to set. Tuning dial accuracy 1%.
- Only three interchangeable R-F tuning units for the entire frequency range 10 to 22,000 mcs.
- Temperature compensation of Klystron Oscillator.
- Swept IF provides 250 kc to 25 mc display independent of R-F frequency setting.
- Internal R-F attenuator.
- Frequency marker for measuring frequency differences from 100 kc to 25 mc.

Write today to your nearest Polarad representative, or directly to the factory for complete information.

Model No.	Equipment
Model TSA.....	Spectrum Display and Power Supply
Model STU-1...	R-F Tuning Unit 10-1,000 mc.
Model STU-2...	R-F Tuning Unit 910-4,560 mc.
Model STU-3...	R-F Tuning Unit 4,370-22,000 mc.

#### SPECIFICATIONS:

Frequency Range:	10 mc to 22,000 mc
Frequency Accuracy:	1%
Resolution:	20 kc
Frequency Dispersion:	Electronically controlled, continuously adjustable from 50 kc/in. to 7 mc/in.
Input Impedance:	50 ohms
Over-all Gain:	120 db
Attenuation:	RF...Internal: 120 db continuously variable IF...60 db continuously variable
Input Power:	400 watts

**Polarad**

**ELECTRONICS CORPORATION**

100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

REPRESENTATIVES • Albuquerque • Atlanta • Boston • Chicago • Cleveland • Fort Worth • Kansas City • Los Angeles • New York  
Philadelphia • San Francisco • Seattle • St. Paul • Syracuse • Washington, D. C. • Canada, Arnprior — Export: Roche International Corporation

**NOW, A REMARKABLE "READY-TO-SOLDER"**

# PHELPS DODGE

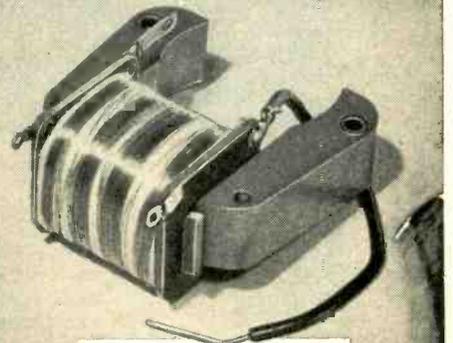
**MANY NEW APPLICATIONS POSSIBLE**



Universal wound TV choke coil



Magnet coil



AC-DC motor coil



Transformer coil



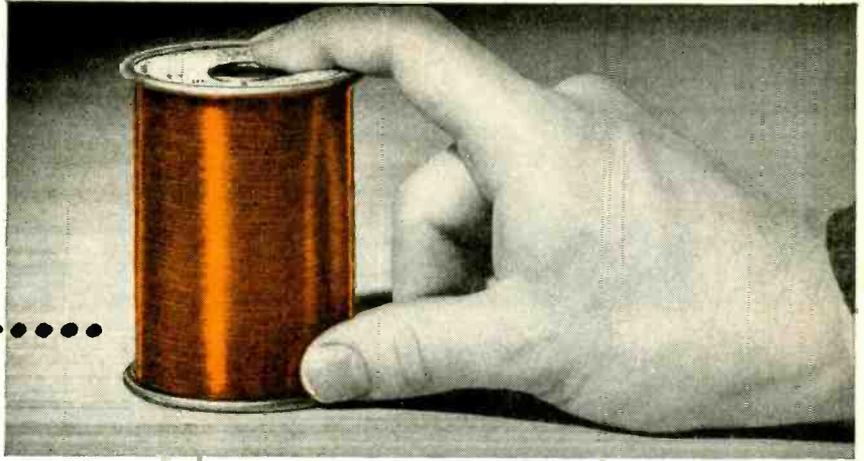
Solenoid coil



IF-RF coil

*First for Lasting Quality—from Mine to Market!*

**MAGNET WIRE.....**



# NEW SODEREZE!

- \* **Instant Soldering Without Stripping**
- \* **Improved Moisture Resistance**
- \* **Good Electrical Properties**
- \* **Excellent Flexibility and Toughness**

New Sodereze represents a spectacular advance in ready-to-solder magnet wire. It's a new and typical Phelps Dodge development designed to keep pace with industry's growing need for wires that handle easily, save time, reduce overall costs and satisfy a variety of different operat-

ing conditions. The versatility and outstanding properties of New Sodereze not only permit its use wherever solderable wire has been *proved* practical and dependable but suggest its application in unlimited other electronic and electrical fields to replace conventional wires.

*Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer.*

\*SODEREZE is a Phelps Dodge Trademark.



REG. U. S. PAT. OFF.

**PHELPS DODGE COPPER PRODUCTS  
CORPORATION**

**INCA MANUFACTURING DIVISION  
FORT WAYNE, INDIANA**

# Durability against vibration assured by SPERRY designers

... with a shake-testing program on  
**MB VIBRATION EXCITERS**

COMPANIES quick to take advantage of newest techniques for development and testing are generally also those known for outstanding products. Such a concern is the Sperry Gyroscope Company. It maintains well-equipped vibration testing laboratories where searching tests are performed on all designs subjected to vibration in service. Vibration is ruled out as a trouble-maker in vital products and components.

## VIBRATION TESTING SPEEDS DATA

With vibration now recognized as an archenemy of product life and performance, it pays to learn early in the game whether corrections in design are needed. MB Shakers can help you to do just that. In a few short hours, the equipment can reproduce the ravages of years of vibratory service conditions. Within minutes, it can show you visually the vibratory response of a product to a whole range of frequencies.

The result: *savings in engineering time and work, and a better product.*

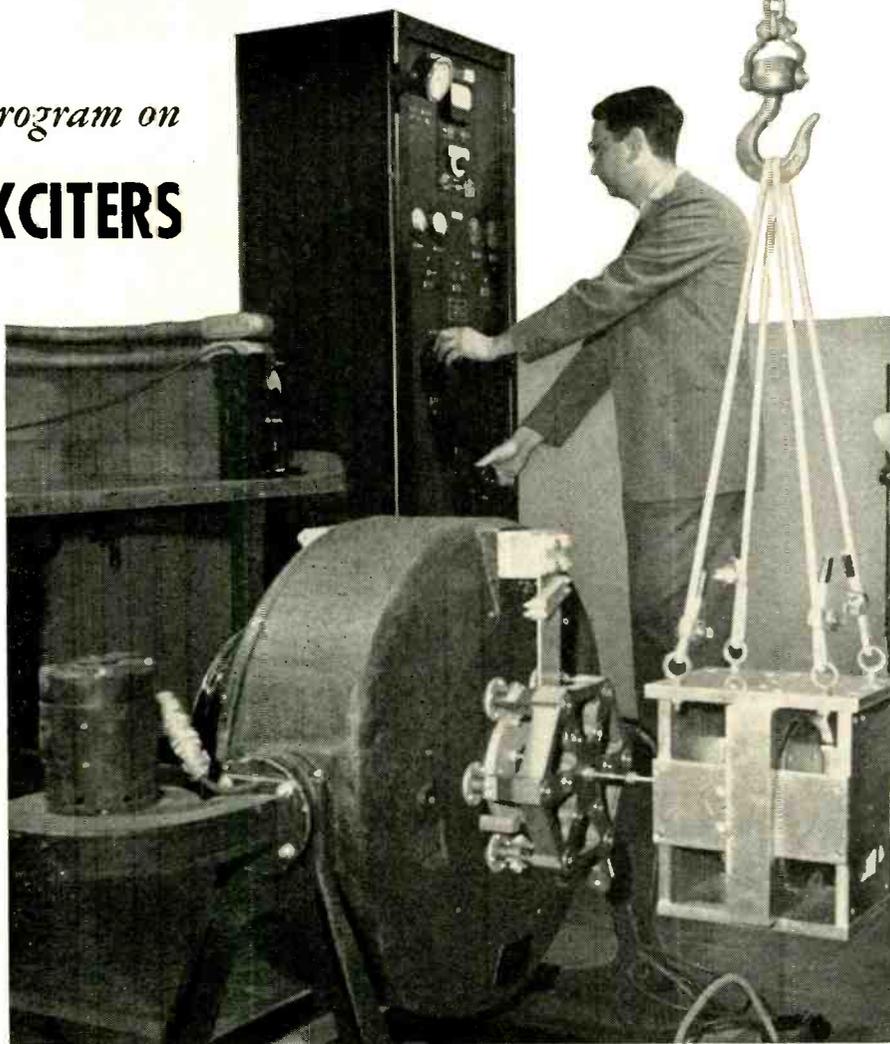
## WHY MB VIBRATION EXCITERS?

Engineered by vibration specialists to deliver maximum perform-

ance, MB Shakers can be counted on for pure table motion and dependable operation to full rated capacity. Moreover, MB's line of vibration testing "tools" is complete—from small specialized-duty shakers to the largest in existence

today; also automatic cycling systems, vibration pickups, meters and other accessories.

Like so many well known companies, why not make MB your headquarters on vibration?



In a Vibration Test Section of Sperry Gyroscope Company, an MB Vibration Exciter Model C-5 is being used to fulfill requirements of MIL-E-5272 and other specification tests.

**THE MB MANUFACTURING COMPANY, INC.**  
1060 STATE STREET, NEW HAVEN 11, CONN.

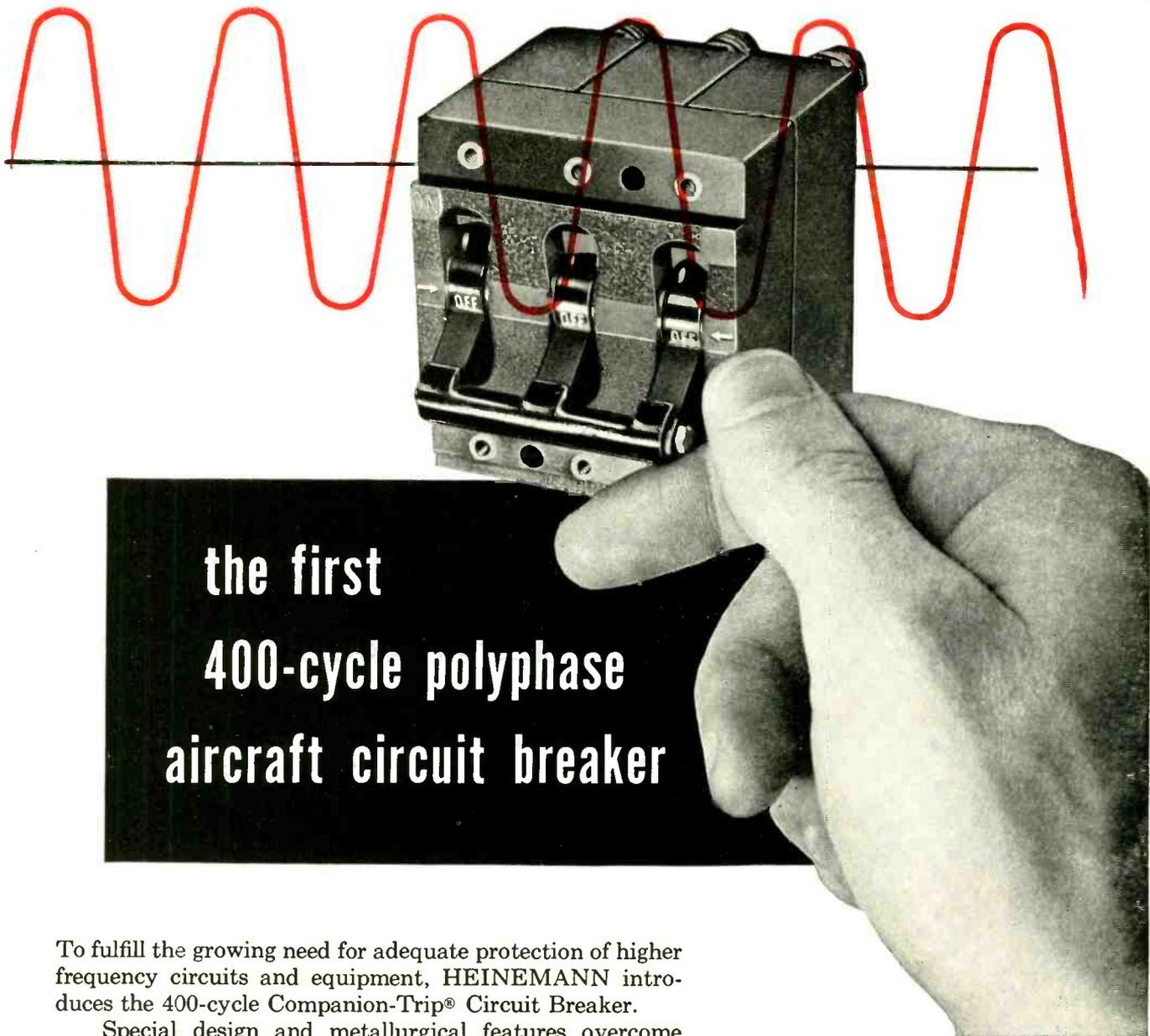


## BULLETIN TELLS MORE

Contains specifications, operating information and helpful hints on usages of the complete line of MB Exciters. Write for Bulletin 1-VE-5.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION...TO EXCITE IT...TO MEASURE IT

# ANNOUNCING...



## the first 400-cycle polyphase aircraft circuit breaker

To fulfill the growing need for adequate protection of higher frequency circuits and equipment, HEINEMANN introduces the 400-cycle Companion-Trip® Circuit Breaker.

Special design and metallurgical features overcome previous limitations, and Companion-Trip—a new principle—provides complete phase isolation.

The new aircraft type circuit breaker is hydraulic-magnetic, of course. Current carrying capacity and set tripping points are completely unaffected by ambient temperature.

Moreover, a selection of time delay response curves permits overload protection to be fitted to the precise requirements of your equipment.

*For complete information, request Bulletin T-3301.*

**HEINEMANN**  
*Circuit breakers*



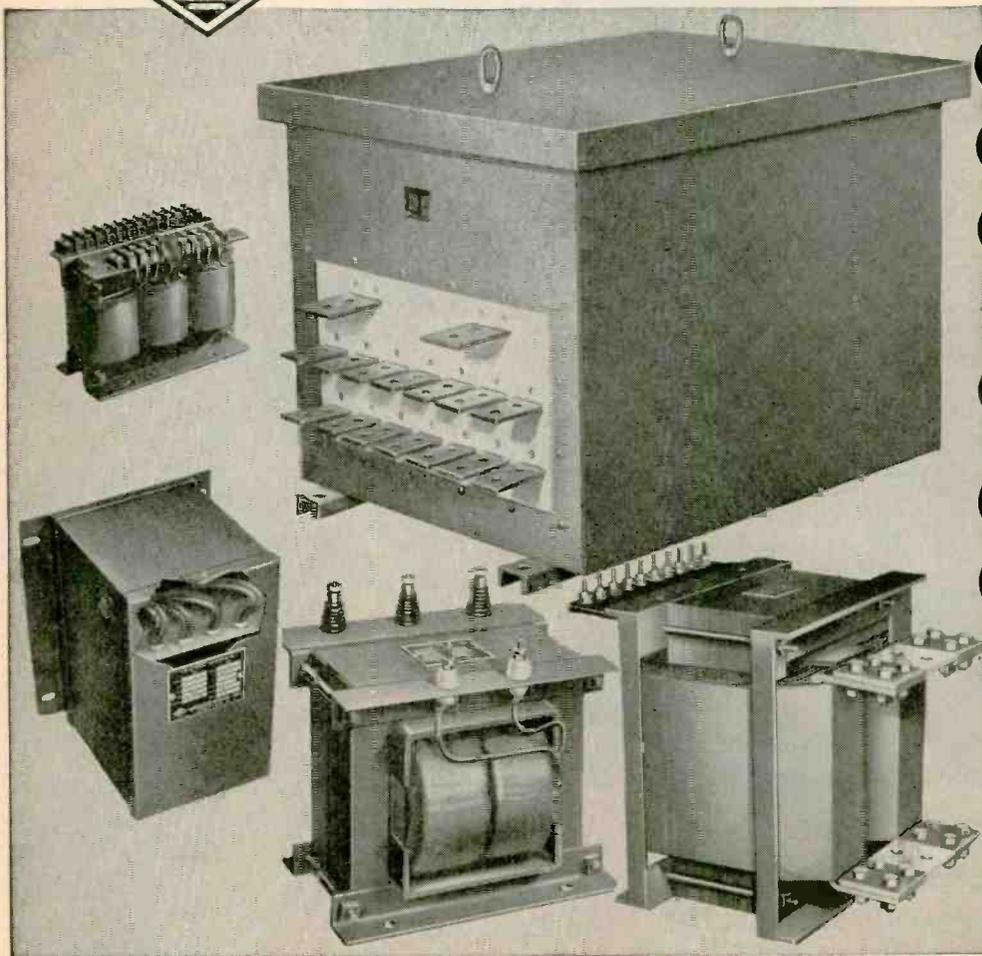
**HEINEMANN ELECTRIC COMPANY**  
97 Plum Street • Trenton 2, New Jersey

# SIX GOOD REASONS

for the superior performance

-OF-

## NOTHELPER TRANSFORMERS



- 1** All coils vacuum pressure impregnated.
- 2** All connections over 5 Amperes silver soldered.
- 3** Grain Oriented Steel in sizes above 1 KVA, and conservative copper assures high efficiency and low losses.
- 4** All units individually tested to assure quality performance.
- 5** Only the highest quality materials used.
- 6** We sincerely believe NWL Transformers are superior, and we have built our business on this policy.

### TRANSFORMERS FOR:

Heating, Testing, Power, Electronic, Electric Furnace, Special Welding, Phase Changing, Precipitation, Controlling, Research, Lighting, Industrial, Measuring, Signaling, High and Low Voltage.

**OUR 34th YEAR**

SEND FOR 8 PAGE BULLETIN  
No Charge At Any Time For  
Design Service



ESTABLISHED 1920

MEMBER



*Nothefner* WINDING LABORATORIES  
Manufacturers of Electrical Transformers—  
Testing Equipment

11 ALBEMARLE AVE. TRENTON, NEW JERSEY

MEMBER



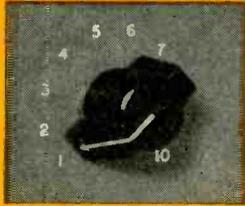
MEMBER

In automatic positioning

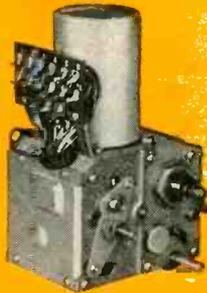
# Collins AUTOTUNE\*

leads the field

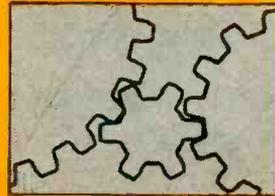
Select the channel



to Activate Autotune



Your Mechanism is Positioned



The Collins AUTOTUNE\* is the standard of the world in automatic positioning systems. Its superior performance has been proven for both remotely and locally controlling automatic tuning of high quality military and commercial communication equipment. Collins AUTOTUNE is also applied to many other equipments which require precision positioning.

The system can be actuated by either a remote or local selector switch having one position for each selector channel. Settings on any selector channel can be changed in a few seconds, giving the operator complete re-set control.

Standard AUTOTUNE heads — both Single-turn and Multi-turn — are available to industry. The Type 496A packaged unit illustrated is an example of a particularly compact AUTOTUNE system for use where minimum weight and space allocations exist. It has a re-set accuracy of 0.05 angular degrees which means approximately 1/10,000 inch on a quarter inch diameter shaft.

Write for complete information, or advise us of your design problems. We are confident that we can supply an AUTOTUNE to meet your positioning requirements.

\*Registered U. S. Patent Office

## COLLINS RADIO COMPANY

Cedar Rapids, Iowa,

261 Madison Avenue, NEW YORK 16

1930 Hi-Line Drive, DALLAS 2

2700 West Olive Avenue, BURBANK

Collins Radio Company of Canada Ltd.

74 Sparks Street, OTTAWA, ONTARIO



Send this coupon for a fully descriptive, 16-page brochure on Collins AUTOTUNES.

**COLLINS RADIO COMPANY**  
855 35th St. NE, Cedar Rapids, Iowa

Gentlemen: Please send me your 16-page brochure on Collins Autotunes.

Name \_\_\_\_\_

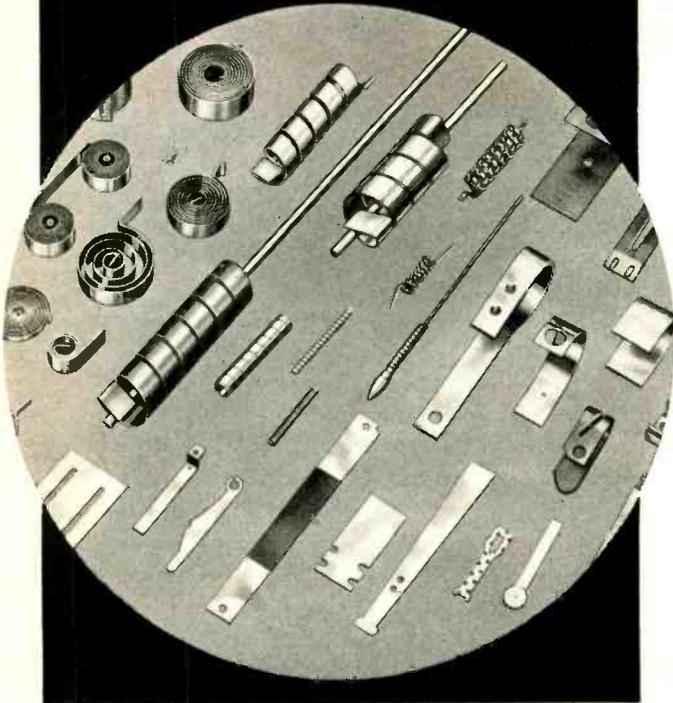
Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

# In Any Form

**Fabricated Assemblies**



**Strip Stock**



## **General Plate TRUFLEX® Thermostat Metals Give Accurate Temperature Response... Cut Costs**

General Plate *Truflex* Thermostat Metals provide a sure way to get reliable performance and at the same time cut costs of products requiring temperature control, indication or compensation.

Advanced General Plate production methods coupled with the best equipment available insure close tolerances on all properties and dimensions. This maintains positive consistency in thermal, mechanical, and electrical performance. With no variation from lot to lot rejects are eliminated, costly adjustments are minimized.

General Plate *Truflex* fabricated assemblies are engineered and manufactured to your

specifications, ready for installation into your products. They eliminate costly fabrication problems . . . needless special equipment . . . experimental work and expensive calibration.

However, if you prefer to make your own assemblies, General Plate *Truflex* Thermostat Metals are available as strip in extra long coils or flat cut lengths manufactured to your material specifications.

Write for information and engineering assistance.

**You can profit by using  
General Plate Composite Metals!**

**METALS & CONTROLS CORPORATION  
GENERAL PLATE DIVISION**

312 FOREST STREET, ATTLEBORO, MASS.

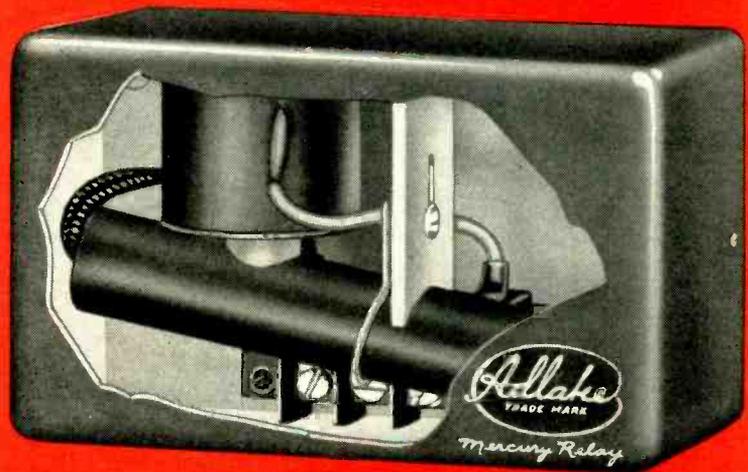
# EASY

to see why leading industries specify  
**ADLAKE Mercury Relays**  
wherever sensitivity and dependability are vital!

**ADLAKE Mercury Relays** have won their place by *proven dependability* in jobs which conventional relays can do in an uncertain manner at best. For instance, they have proved their ability to stand up under the most adverse conditions of temperature and moisture . . . normal line voltage fluctuations or ambient temperatures from  $-38.8^{\circ}$  to  $+200^{\circ}$  F. have no material effect on their time-delay characteristics.

**What's more**, every ADLAKE Relay is hermetically sealed . . . absolutely maintenance-free . . . always silent and chatterless. And ADLAKE's mercury-to-mercury contact provides an ideal snap action.

**Yes**, wherever sensitivity and dependability are required, ADLAKE Mercury Relays can do the job best! Send for the ADLAKE Relay catalog today . . . no obligation, of course. The Adams & Westlake Company, 1171 N. Michigan, Elkhart, Indiana. In Canada, address Powerlite Devices, Ltd., Toronto.



Type 5000 Adlake Relay

## EVERY ADLAKE RELAY GIVES YOU THESE PLUS FEATURES:

**HERMETICALLY SEALED**—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation.

**SILENT AND CHATTERLESS • REQUIRES NO MAINTENANCE • ABSOLUTELY SAFE**

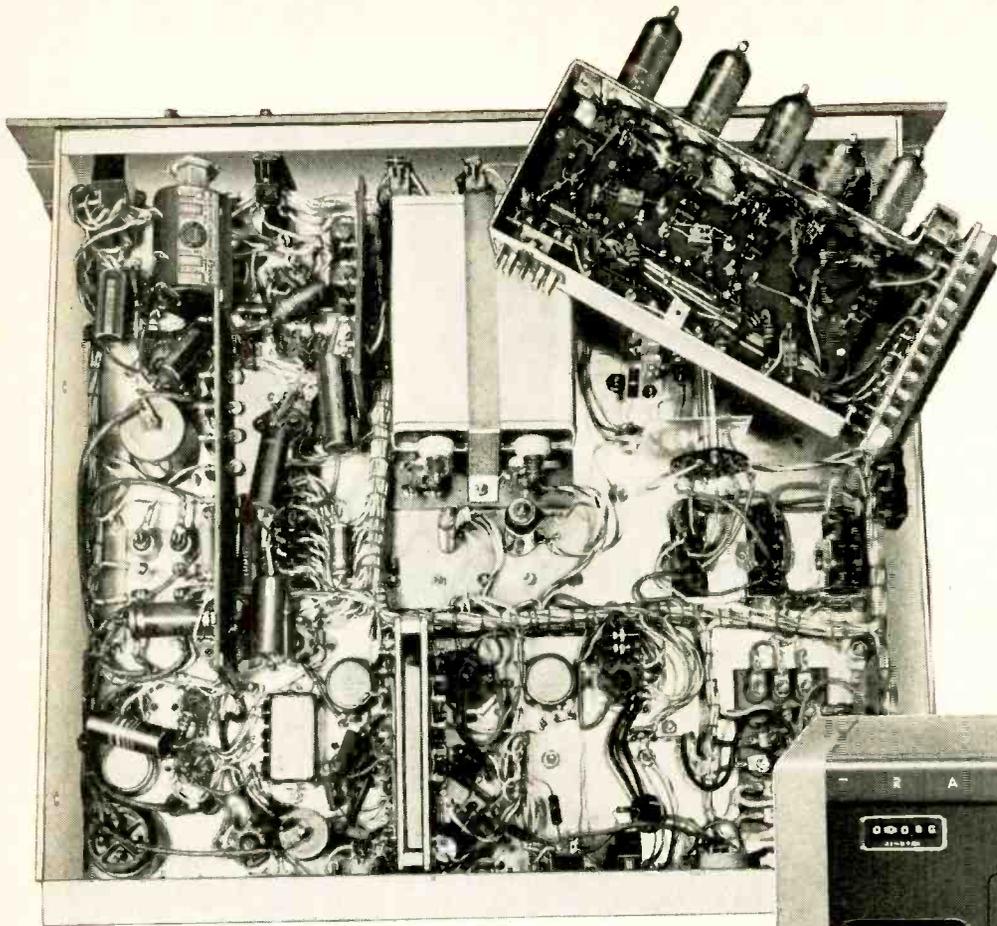
**MERCURY-TO-MERCURY CONTACT**—prevents burning, pitting and sticking.

And every ADLAKE Relay is tested—and guaranteed—to meet specifications!

THE **Adams & Westlake** COMPANY

Established 1857 • ELKHART, INDIANA • New York • Chicago  
Manufacturers of ADLAKE Hermetically Sealed Mercury Relays





At left—Plug-in unit of Tracerlab Superscaler mounted on a miniature chassis. It can be plugged into the front of the Superscaler. Various types of plug-in units are available for special electronic functions. Bradley units are standard in this Superscaler assembly.

# Tracerlab Superscaler

equipped with  
Bradley units and Bradleyometers  
for maximum dependability

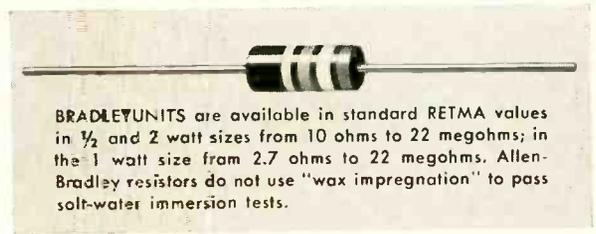


The Tracerlab Superscaler is a fast-counting instrument for Geiger, proportional, or scintillation pulses, featuring both preset count and preset time operation.

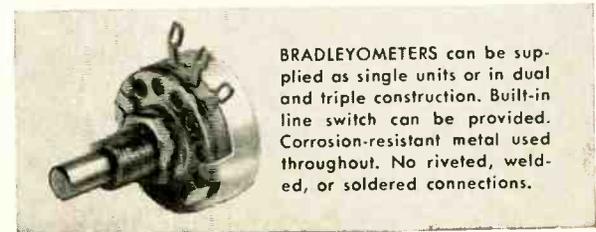
Bradleyometers are used in this Superscaler for dependable potentiometer adjustments. The resistor element is molded to satisfy any resistance-rotation curve. Variations in temperature and humidity do not affect its performance.

Bradleyunits are stable fixed resistors entirely free from erratic variations in resistance, and they have never been found to open circuit in service. The leads are differentially tempered to prevent sharp bends at the resistor body. After carrying full load at 70 C ambient for 1000 hours, the resistance change is less than 6 per cent.

For quality in fixed and adjustable composition resistors, follow the example of leading electronic equipment manufacturers—standardize on Allen-Bradley components. Write for descriptive engineering bulletins, today.



BRADLEYUNITS are available in standard RETMA values in  $\frac{1}{2}$  and 2 watt sizes from 10 ohms to 22 megohms; in the 1 watt size from 2.7 ohms to 22 megohms. Allen-Bradley resistors do not use "wax impregnation" to pass salt-water immersion tests.



BRADLEYOMETERS can be supplied as single units or in dual and triple construction. Built-in line switch can be provided. Corrosion-resistant metal used throughout. No riveted, welded, or soldered connections.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada—Allen-Bradley Canada Limited, Galt, Ont.

# ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS



Better Things for Better Living  
... through Chemistry

# ELECTRICAL ENGINEERING

# NEWS

PROPERTY AND APPLICATION DATA ON THESE  
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"  
"ALATHON," "TEFLON," "LUCITE."

NO. 6

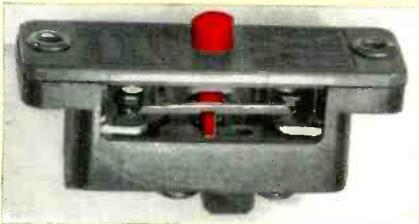
1954

## Properties of Du Pont TEFLON® Make It Ideal Insulation for Electrical Equipment

### Du Pont "Zytel" nylon resin gives improved switch performance

Snap switches for machine tools and basic contact mechanisms on industrial instruments often have buttons and stems molded of "Zytel" nylon resin. This engineering material is used to obtain more efficient production and better performance.

Du Pont "Zytel" is tough and resilient, and resists abrasion. It makes possible the maintenance of critical dimensions. This is particularly important in the manufacture of such parts as timing relays for resistance welding machines, which control the duration of current flow and electrode motion.



These switches feature one-piece buttons and stems of molded Du Pont "Zytel" nylon resin.

The lightness of weight and remarkable strength of "Zytel" in thin sections are important factors in such applications. Mass production by injection molding is economical. One molded part often replaces a complex assembly of many parts.

Perhaps "Zytel" nylon resin can help solve one of your design problems. For further information about this or any other Du Pont engineering resin material, clip and mail the coupon on the reverse side.

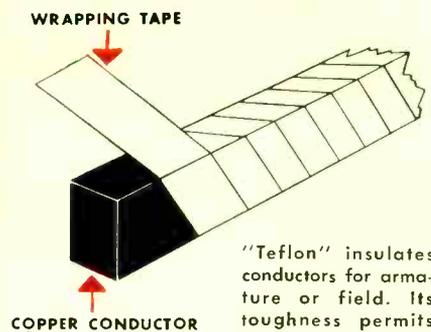
*"Zytel" is the new trade-mark for Du Pont nylon resin.*

### Dielectric and thermal advantages of "Teflon" are unmatched by any other single material

Du Pont "Teflon" tetrafluoroethylene resin is used for insulation in power distribution equipment because of its unusual combination of properties. In tape form, as wire coating, or molded part, "Teflon" withstands hot-spot temperatures, to 500°F. It is not affected by weather or moisture (zero water absorption by ASTM test D570-42). "Teflon" has a power factor of less than .0005 for the tested range of 60 cycles to 10<sup>8</sup> cycles. A part molded of "Teflon", when exposed to an arc, leaves no carbonized path.

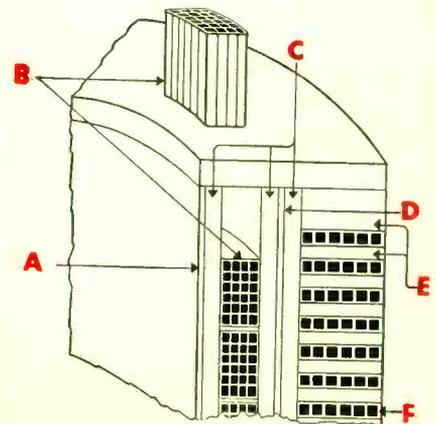
In addition, "Teflon" has high short-time dielectric strength—with values ranging from 1000 to 2000 volts per mil, depending on thickness. (Recommended working stresses: 50 to 100 volts per mil.) And it is inert to all chemicals normally found in industry.

"Teflon" is tough and flexible



"Teflon" insulates conductors for armature or field. Its toughness permits coils to be formed to shape after taping.

over a wide temperature range, from -450°F. to 500°F. "Teflon" can take a lot of abuse, both during assembly and in use. Parts will not



Conductor and layer insulation of "Teflon" in power distribution coils: (A) core insulating barrier (laminate of "Teflon" and glass fiber); (B) low-voltage winding (glass fiber coated with "Teflon"); (C) axial spacers; (D) high-low insulating barrier (laminate of "Teflon" and glass fiber); (E) radial spacers; (F) high-voltage winding (glass fiber coated with "Teflon").

crack if dropped. Cable insulation resists damage from vibration and bending. And tape of "Teflon" conforms easily to sharp corners and odd shapes.

You will find "Teflon" performing with outstanding success . . . not only on power distribution equipment, but in these and other applications as well:

### FOR MOTORS AND GENERATORS

The unusual advantages of "Teflon" become apparent when temperatures are too high or atmospheres are too corrosive for other dielectrics. Tape of "Teflon" is particularly suitable for armature or

OVER

(Continued, column 3, back side)



Better Things for Better Living  
... through Chemistry

# ELECTRICAL ENGINEERING

# NEWS

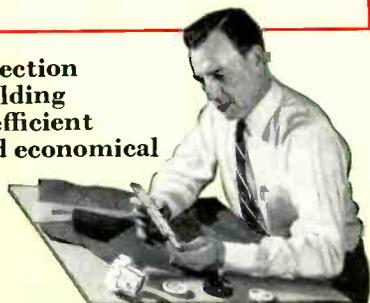
PROPERTY AND APPLICATION DATA ON THESE  
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"  
"ALATHON," "TEFLON," "LUCITE."

NO. 6

1954

## POINTERS ON PROCESSING

**Injection  
molding  
is efficient  
and economical**



Injection molding, as a method of mass-producing parts made of Du Pont engineering resin materials, has been developed mainly within the past ten or fifteen years. And new improved techniques have accompanied that development.

### Investigate Du Pont engineering materials in your product development programs

One of the family of these versatile engineering materials is often a key factor in product improvement or new product design.

The wide range of properties available with "Alathon"\* polyethylene resin, "Lucite"\* acrylic resin, "Teflon"\* tetrafluoroethylene resin, and "Zytel"\* nylon resin are helping solve industrial design problems.

### NEED MORE INFORMATION?

Clip the coupon for additional data on the properties and applications of these Du Pont engineering materials.

Injection molding offers the advantages of high production rates, low unit cost, and usually does away with finishing operations. One important saving which has been effected by injection molding occurs when the molded piece replaces an assembly of two, three or more parts.

### HIGH PRODUCTION RATE

Multi-cavity dies have been made which produce hundreds of identical pieces at a time. Molding time and cycle vary, of course, with the size of the part and its shape. The injection molding process is versatile, and is used to produce a wide variety of quality parts, rapidly and economically.

### LOW UNIT COST

Another positive value of injection-molded parts is the low cost of fabrication per part. While the initial cost of the mold itself is high, a mass-production operation makes the cost per piece low. In addition, loss of molding material is generally low.

### NO FINISHING OPERATIONS

With good molding techniques, pieces can be injection-molded to close tolerances. In many cases, molded pieces require no finishing operations. Thus, large savings in time and expense can often be realized.

### SIMPLIFIED DESIGNS

The versatility of injection molding often permits design simplification.

Du Pont "Zytel" nylon, for example, can be injection-molded into intricate shapes, as well as around metal inserts. Du Pont "Alathon" polyethylene resin and "Lucite" acrylic resin can also be successfully injection-molded into a variety of useful forms. For more information about Du Pont engineering resin materials and how they are being used in industry, clip the coupon.

### Du Pont "Teflon"

*(continued from other side)*

field conductor insulation, coil wrapping, slot lining, lead insulation, and coil separation.

### FOR TRANSFORMERS

"Teflon" makes it possible for transformers to operate at hot-spot temperatures as high as 500°F. "Teflon" is used in transformers for conductor, layer, and ground insulation, and for coil separation. At the present time it is used commercially in electronic transformers and experimentally in distribution and power units.

### FOR CAPACITORS

Where high ambient temperatures and minimum power loss are essential, "Teflon" gives outstanding service. It is used as the dielectric in many wrapped capacitors.

### FOR ELECTRONICS EQUIPMENT

Under conditions of ultra-high frequencies, heavy moisture and concentrated heat, "Teflon" assures efficient operation. Here it takes the form of tape, molded component, or extruded insulation.

Can "Teflon" help you with your design problems? The properties discussed above show why no other single material can match it. And the coupon on the left will bring you whatever further information you need about "Teflon" or any of the other versatile engineering resin materials made by Du Pont.

E. I. DU PONT DE NEMOURS & CO. (INC.)  
Polychemicals Department  
Room 2212, Du Pont Building, Wilmington 98, Delaware

Please send me more information on the Du Pont engineering materials checked:  
 "Zytel";  "Alathon";  "Teflon";  "Lucite". I am interested in evaluating these materials for

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

STREET ADDRESS \_\_\_\_\_

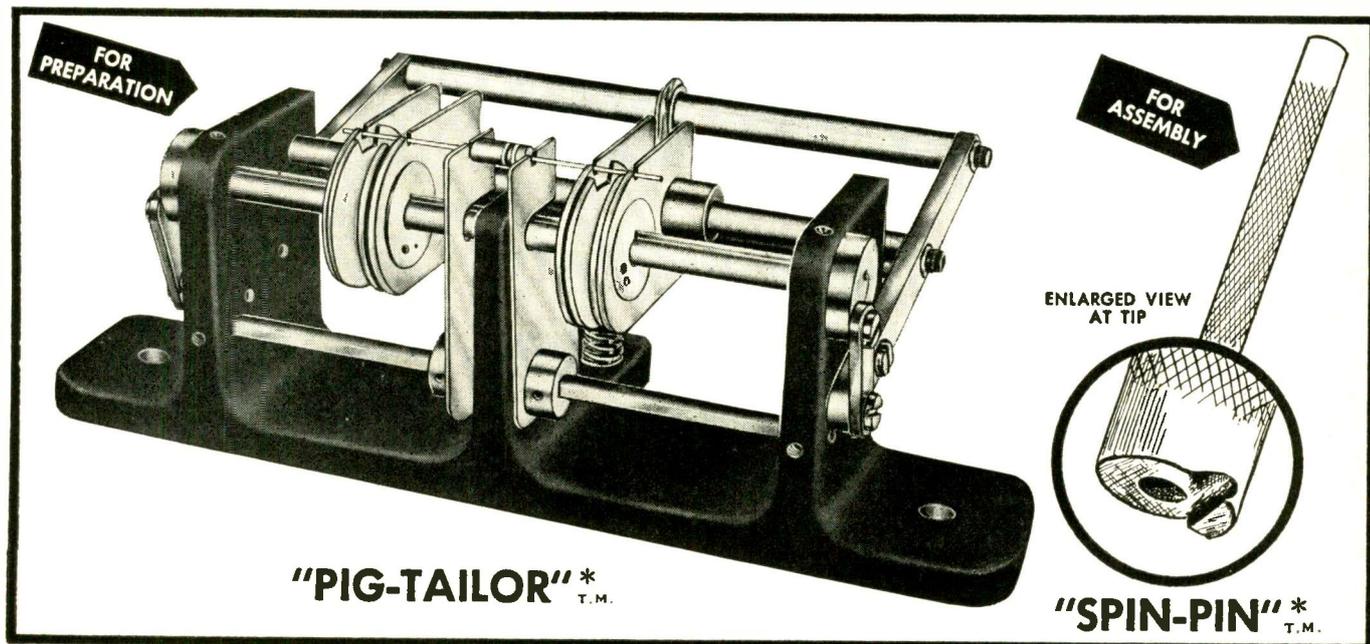
CITY \_\_\_\_\_ STATE \_\_\_\_\_

TYPE OF BUSINESS \_\_\_\_\_

\*"Alathon", "Lucite", "Teflon" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.)  
\*\*"Zytel" is the new trade-mark for Du Pont nylon resin.

# "PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

## PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

## PIG-TAILORING eliminates:

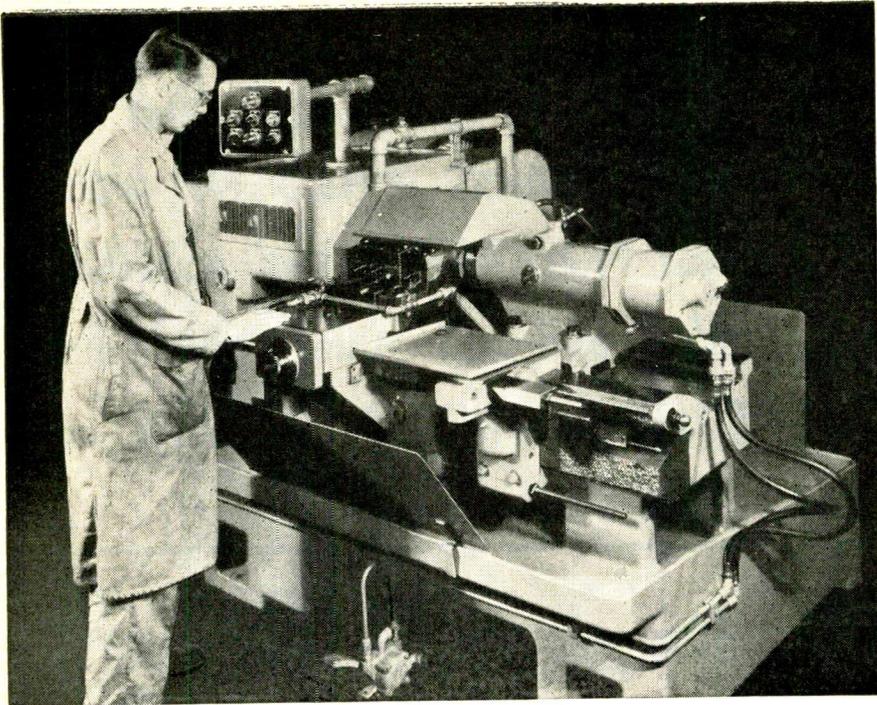
1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!

\* PATENT  
PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. E-12

**BRUNO-NEW YORK INDUSTRIES CORPORATION**  
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT  
460 WEST 34th STREET • NEW YORK 1, N. Y.



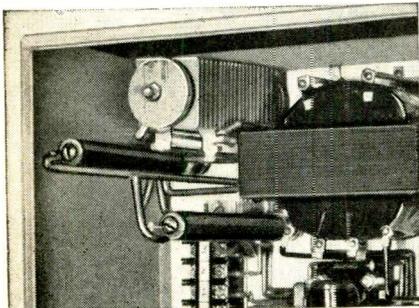


FASTER STARTING AND STOPPING HELPS THIS AUTOMATIC LATHE TO PRODUCE MORE

## General Electric Selenium Rectifiers Help Make This Lathe More Productive

Speeding up starting and stopping operations has increased the productivity of many of today's finest machine tools. In the Sunstrand automatic lathe pictured above, an electric brake and clutch combination starts and stops the machine spindle. Another electric brake provides a fast stop when the tool carriage is advanced to the work, or backed off to the unloading position.

**D-C POWER** to operate the electric brakes and clutch on this lathe is supplied by General Electric selenium rectifiers shown in the smaller photograph. Their high quality (see C.E.



D-C POWER for the lathe's clutch and brakes comes from this selenium rectifier.

Hamann's article at right) makes G-E selenium rectifiers ideal for almost all machine tool applications.

**TOP PERFORMANCE** of G-E selenium rectifiers is the result of a unique "evaporation" process and careful inspection and testing. Besides providing stacks with exceptionally low forward voltage drop and low reverse leakage, this process assures greater uniformity of these characteristics among different stacks. These qualities last in service. On test in the laboratory, and on-the-job in almost every field of application, G-E selenium rectifiers are demonstrating their extremely slow aging.

**OTHER APPLICATIONS** for G-E selenium rectifiers include supplying power to operate d-c relays in various control circuits and as components in electronic equipment. A complete range of ratings is available in either open stacks or various types of sealed cases to meet special operating conditions. Contact your nearest G-E Apparatus Sales Office for complete information, or write Section 461-33, General Electric Company, Schenectady 5, New York.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

## METALLIC RECTIFIER FACTS FOR ENGINEERS

Quality

by C. E. Hamann

One of the most overworked terms used in the selenium rectifier industry is "high quality." Every manufacturer claims "high quality" for his product. Every user wants "high quality" in the selenium components he buys because the quality of the end device can be no higher than that of the components assembled into it.

There are many yardsticks for measuring the quality of a selenium stack. Electrical characteristics, for example: low forward drop and low reverse leakage. Often one is sacrificed in favor of the other.

LOW FORWARD DROP

LOW LEAKAGE

UNIFORMITY

STABILITY

RELIABILITY

Which "yardstick" measures quality?

Real quality insures that both the forward and the reverse characteristics are good.

Uniformity of characteristics is another yardstick. If the characteristics vary from stack to stack the performance of the end equipment will be questionable.

Stability is another important standard in determining quality. The initial characteristics must be good, but they must stay good and not deteriorate with time and use.

Reliability is still another measure of quality. No matter how liberal the manufacturers replacement policy, frequent failures in the field are costly to the equipment manufacturer, and annoying to the equipment user.

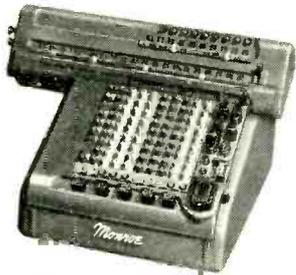
All of these yardsticks must be considered carefully in determining quality. To really earn the title of "high quality" a selenium stack must measure up to a high standard of performance by every one of these yardsticks.

*C. E. Hamann*

General Electric Company

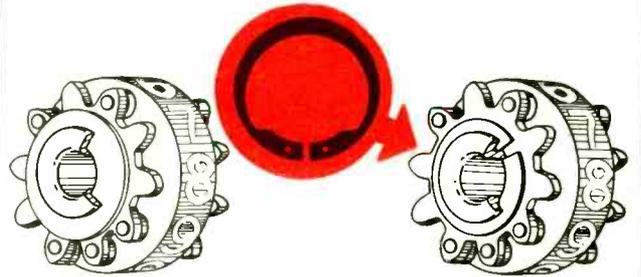
# Waldes Truarc rings replace old-fashioned fasteners... save assembly time...end scrap loss...increase operating efficiency

## This is the Monroe Calculator



...precision-engineered business machine made even more efficient, and less costly to manufacture through the use of Waldes Truarc Retaining Rings.

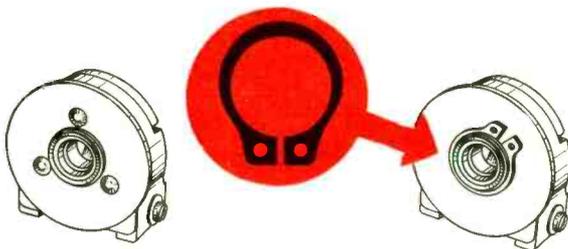
## Multiplier Dial Assembly



**Old Way.** One-piece assembly was spun together. Spinning operation was costly, resulted in high scrap loss.

**Truarc Way.** Two-piece assembly is held together by one Truarc Ring (series 5108). Rejects: practically zero.

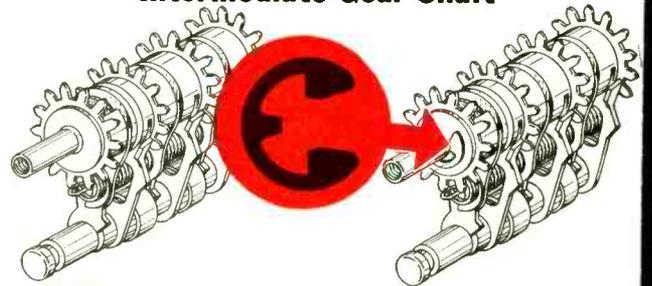
## Electric Motor Governor



**Old Way.** Collector Disc assembly was formerly riveted, requiring skilled labor. Riveted Collector Disc could not be removed in the field.

**Truarc Way.** Truarc Ring (series 5100) replaces rivets, saves labor, material...improves Collector action. Collector Disc is easily replaced.

## Intermediate Gear Shaft



**Old Way.** Washer riveted on end of assembly for zoning control. Costly, troublesome, hard to obtain critical zoning required.

**Truarc Way.** Truarc E-Ring (series 5133) cuts assembly time, virtually eliminates rejects and final assembly and zoning problems.

Monroe Calculating Machine Company, Orange, N. J. uses various types and sizes of Waldes Truarc Retaining Rings. Use of Truarc has helped eliminate scrap losses, saved on material and labor, and resulted in increased operating and servicing efficiency of the product. Monroe plans to use Truarc Rings for every possible fastening operation on their entire line!

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered...quick and easy to assemble and disassemble.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc Engineers for individual attention, without obligation.

For precision internal grooving and undercutting... Waldes Truarc Grooving Tool!

**SEND FOR NEW CATALOG** ➔

**WALDES TRUARC**  
REG. U. S. PAT. OFF.  
**RETAINING RINGS**

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,418,652; 2,420,921; 2,428,341; 2,439,785; 2,441,646; 2,455,165; 2,482,380; 2,483,383; 2,487,802; 2,487,803; 2,491,506; 2,509,081 AND OTHER PATENTS PENDING



For precision internal grooving and undercutting... Waldes Truarc Grooving Tool!

E126

**Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N. Y.**

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

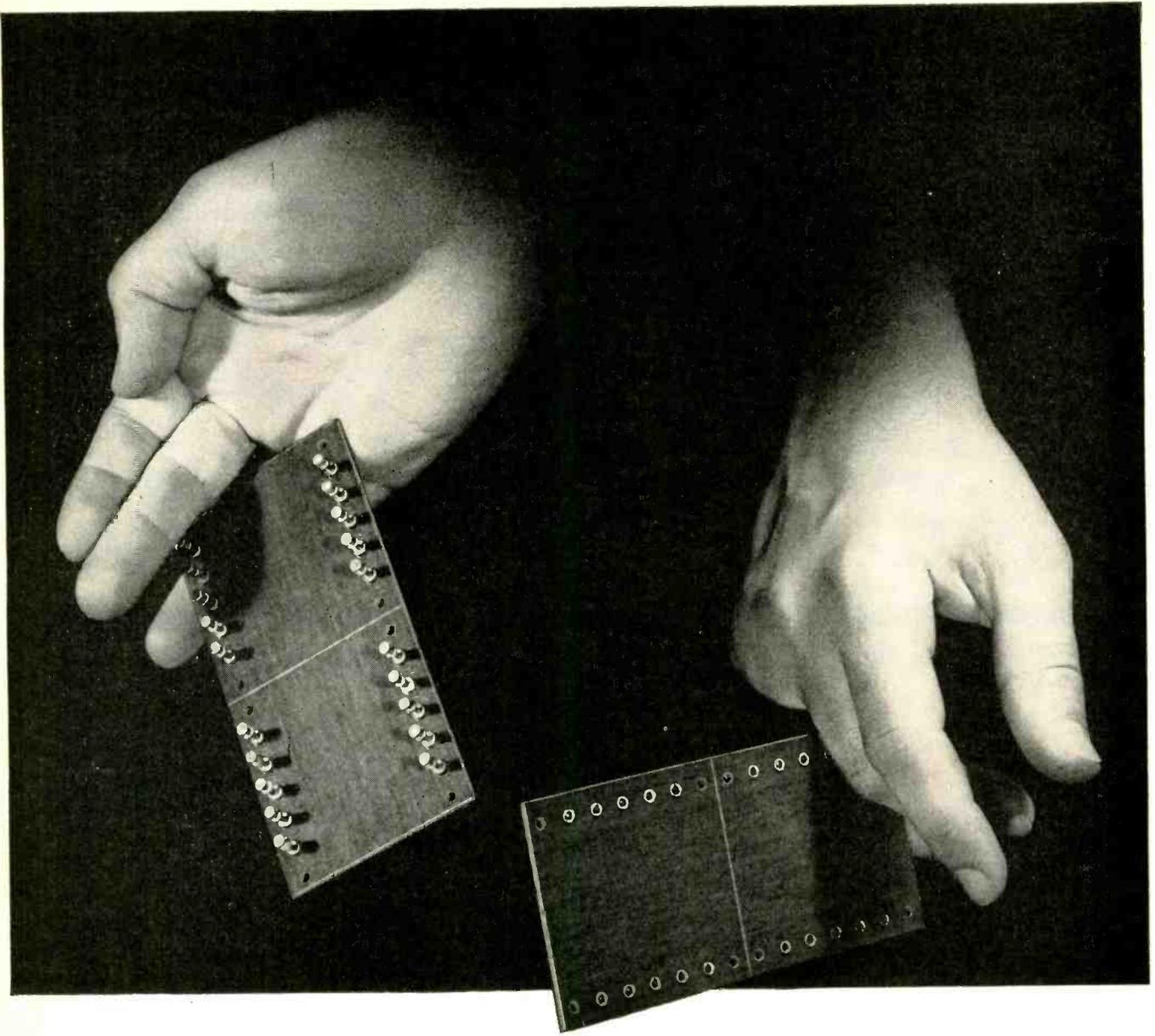
Name .....

Title .....

Company .....

Business Address.....

City..... Zone..... State.....



## No cracks, please

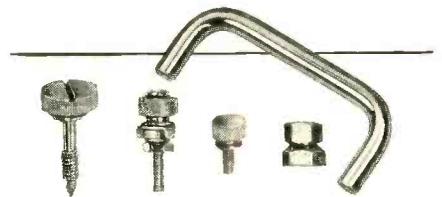
You'll find no radial cracks in C.T.C. terminal boards, or "cracked" rivet shanks on terminals. And there's a good reason for this.

Our swaging machines use tools that we designed ourselves in order to prevent just such damage. Terminals are fastened securely — *and carefully*. You benefit from a board that has no "weak spots" — that can give you the service you have a right to expect. And, of course, you also benefit from all the other quality control details that enable us to offer our customers *guaranteed* components — custom or standard. Coatings are smoothly applied — no wrinkles, no heavy deposits. C.T.C. terminals are made from certified stock that is free from defects. And the terminals themselves are guaranteed, even to the thickness of the coatings.

This C.T.C. quality control is given to all C.T.C. products including insulated terminals, coil forms, coils, swagers, terminals and capacitors. For all specifications and prices, write to

Cambridge Thermionic Corporation,  
437 Concord Avenue, Cambridge 38,  
Mass. West Coast manufacturers contact:  
E. V. Roberts, 5068 West Washington Blvd.,  
Los Angeles 16 and 988 Market St.,  
San Francisco, California.

*Terminal Board Data.* CTC makes both standard boards and to your own specifications. Standard boards in cotton fabric phenolic, nylon phenolic or grade L-5 silicone impregnated ceramic. Custom made in cloth, paper phenolic, melamine, epoxy or silicone fibreglas laminates, imprinted as required and lacquered or varnished to specifications MIL-V-173 and JAN-T-152.



A wide variety of hardware is available at C.T.C. — all of it quality controlled and guaranteed for durability. This hardware includes terminal board brackets, standoff mounts, spacers, tube clamps, panel screws, thumb screws, dial locks, shaft locks, handles and handle ferrules.

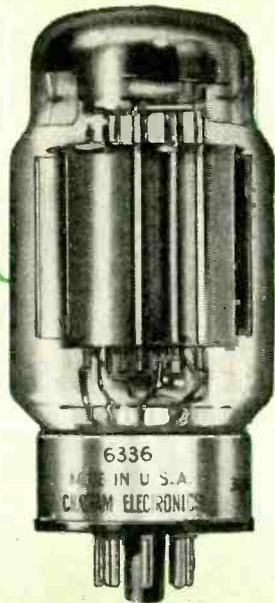
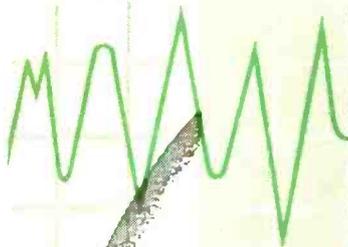
# CTC

**CAMBRIDGE THERMIONIC CORPORATION**

*makers of guaranteed electronic components,  
custom or standard*



# 3 twin power triodes



## CHATHAM TYPE 6336

NEW TWIN TRIODE  
FEATURING HIGH  
PLATE DISSIPATION

The new Chatham Type 6336 is a twin power triode with special suitability for voltage regulating applications. Used as a series tube, it will pass a minimum of 150 milliamperes per section with 40 volts, D.C. plate voltage. Special features include a hard glass envelope, an 8-pin button stem with Jumbo Octal Base.

...for voltage  
regulation

### CHARACTERISTICS (PER SECTION)

- PLATE DISSIPATION: 30 WATTS
- AMPLIFICATION FACTOR: 2.7
- TRANSCONDUCTANCE: 11,000 MICROHMS
- PLATE RESISTANCE: 250 OHMS
- HEATER REQUIREMENTS: 6.3 V., 4.75 AMPS.



## TYPE 6394 TWIN TRIODE

Similar to Type 6336 in every respect except for Heater Requirements which are 26.5 volts, 1.25 amps.

The tubes shown are typical items from the complete Chatham line of general and special purpose tubes. Included in this line are Amplifiers, Mercury and Inert Gas Rectifiers, also Mercury, Inert Gas and Hydrogen Thyratrons.

Most Chatham tubes are available directly from stock and can be supplied promptly. Chatham also designs, develops and manufactures special tubes to exact customer specifications — inquiries are invited.



## CHATHAM TYPE 6A57G IMPROVED TWIN POWER TRIODE —

This Chatham Twin Triode is built to close tolerance — features plate current and GM characteristics held within  $\pm 10\%$ , very low microphonics, improved triode balance, absence of grid current and greatly reduced plate current drift. Plate current is 125 milliamperes at 40 volts, D.C. plate voltage. The characteristics of this tube recommend it especially for voltage regulation circuits. Base is Medium Shell Octal.

### CHARACTERISTICS: (PER SECTION)

- Plate Dissipation: 13 Watts
- Amplification Factor: 2.0
- Transconductance: 7,000 Microhms
- Plate Resistance: 280 Ohms
- Heater Requirements: 6.3 Volts  
2.5 Amps.



## CHATHAM ELECTRONICS CORP.

Executive and General Offices: LIVINGSTON, NEW JERSEY  
Plants and Laboratories: NEWARK and LIVINGSTON, NEW JERSEY

# He's using the telephone that lends an extra hand



"Sure . . . I'm looking up the figures right now!" From busy executives to clerks, people in business can work more easily and efficiently with Bell's new Distant Talking Telephone. Small white rectangle is the loudspeaker.

For people who want to keep *both* hands free when they telephone, Bell Telephone Laboratories engineers have devised a new telephone with a sensitive microphone in its base.

To use it, simply press a button. The microphone picks up your voice and sends it on its way. Your party's voice comes to you through a small loudspeaker. Both hands are left free.

The volume can be adjusted to suit yourself. If privacy is needed, you simply lift the handset; this shuts off the microphone and loudspeaker and you talk just as you would on a regular telephone.

This new development of Bell Laboratories increases the number of ways your local Bell telephone company can serve in businesses and homes.



Pencil points to microphone in base of new telephone. Left-hand button controls volume, center one turns set "on" and lights up while in use. The third is an "off" button.

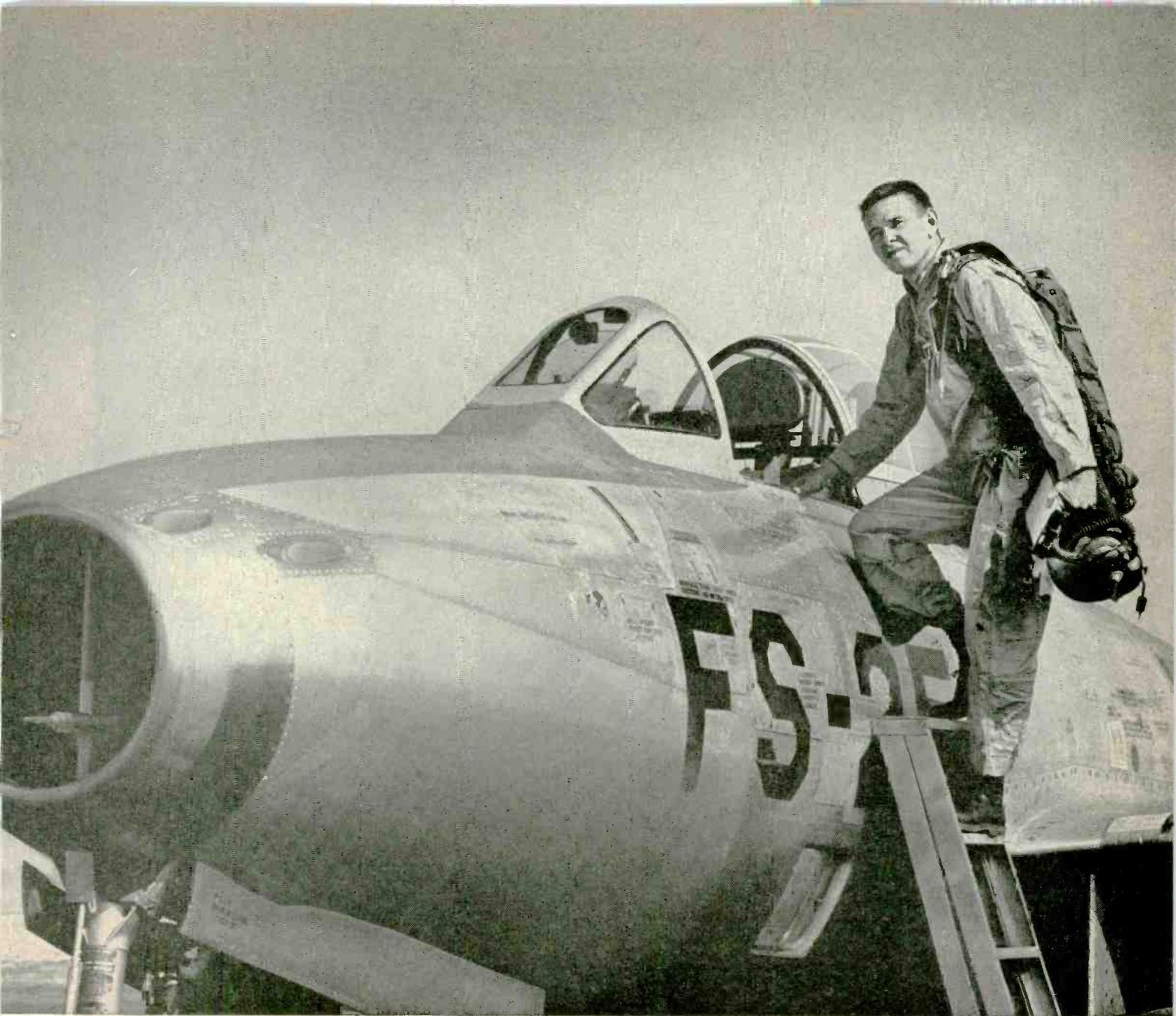
## Bell Telephone Laboratories

*Improving telephone service for America provides careers*

*for creative men in scientific and technical fields.*



Want more information? Use post card on last page.



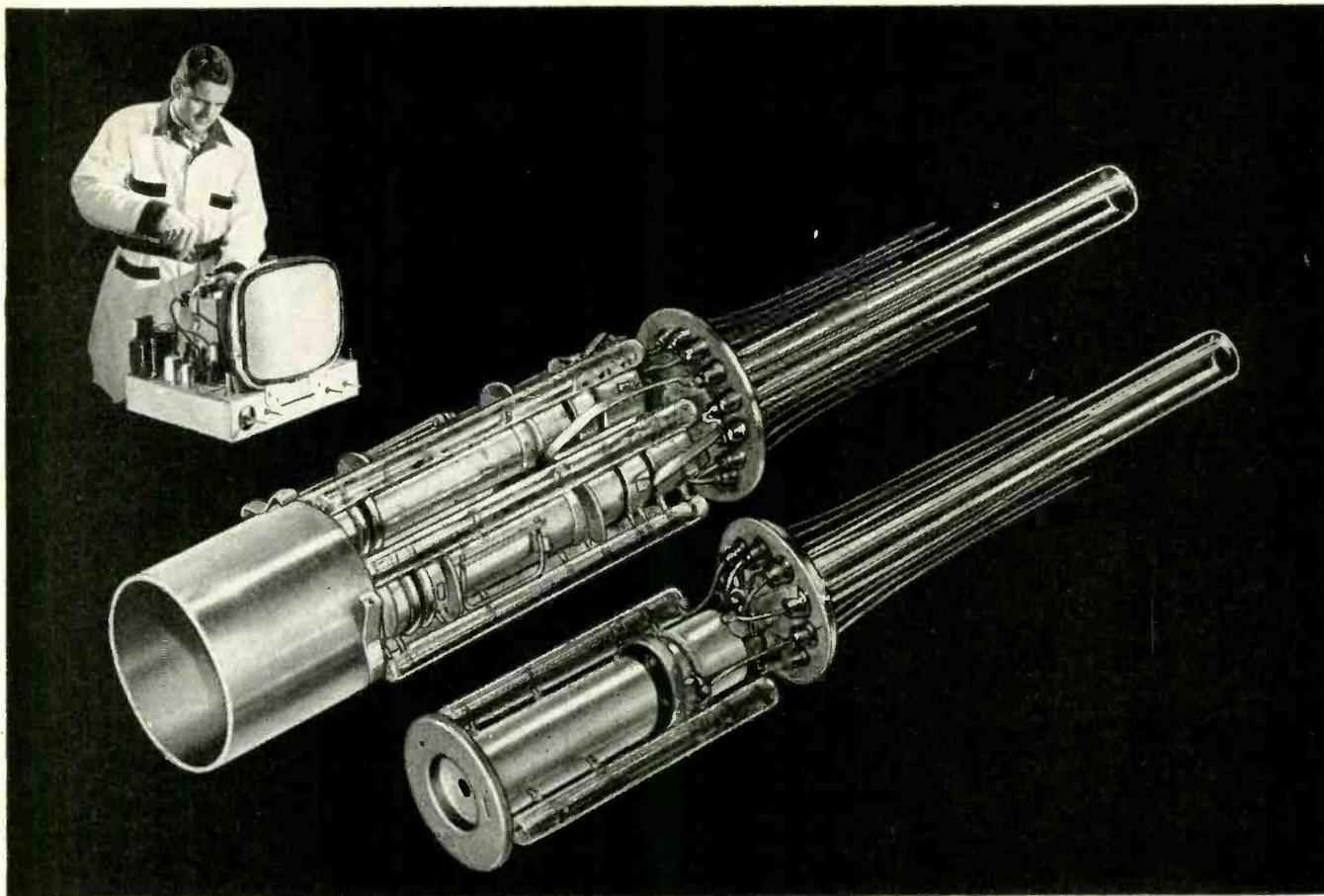
## **This is a Lear engineer designing a new autopilot**

JOHN HARPER, B.S.E. (University of Michigan), is one of ten Lear engineers qualified and actively flying as jet pilots. But please note that these ten engineers are engaged *primarily* in the design, development, and perfection of automatic flight control systems, using their jet piloting skills only as an *engineering* tool.

At Lear, first-hand *in-flight* analysis is an integral part of development. As a result of this program, continuously

checking theory against performance, Lear is exceptionally equipped to offer the most advanced solutions to the challenging and ever-changing problems of automatic flight stabilization.

**LEAR** 



## Miniature TV Tri-color cathode gun solves designer's dilemma

Sometime this year, a fortunate few thousand TV viewers who can pay the freight will relax at home and watch their favorite stars cavort in color. Back of each screen is a triumph of engineering magic—a tri-color cathode ray gun, actually 3 cathodes—one for each primary color.

To bring color TV within pocketbook range of all of us, the heart of future guns will be a miniaturized version of the present disc cathode. The tubular nickel shank of this new disc cathode has been shortened from .312" to .220" and the outside diameter decreased from .121" to .090", resulting in a number of improvements adding to the efficiency of the assembly.

*Cathode surface area is reduced. Smaller and shorter heaters used. Less power required (300-450 milliamps instead of the 600 required in older guns).*

*Lower heat radiation, due to less power, offers a constant heat as well as a cooler continual operation.*

*A smaller shank and cap which will not dish-in offers better transmission of electrons to the TV screen.*

*Smaller guns permit a more compactly assembled 3-gun unit. By moving guns closer together, the deflection of the electron beams is more closely controlled.*

*Miniaturization of the guns means a smaller neck on the finished TV tube. The 3-barrel color tubes take little more space than black and white types, and vital space is conserved for set manufacturers.*

The advantages of the present larger disc cathode for monochrome guns—wide choice of material for cap and shank; close "E" dimension control—are also incorporated in the new design.

If you're interested in more information on materials used in the new disc cathode, and details on Nickel and Nickel Alloy Tubing, mail coupon today for a blueprint and Data Memo 5 and 19. There's no obligation.

Superior Tube Company, 2500 Germantown Ave., Norristown, Pa. Electronics Division.

Please send  Blueprint  Data Memo 5 and 19 on Superior Nickel and Nickel Alloy Tubing.

Name \_\_\_\_\_

Company \_\_\_\_\_

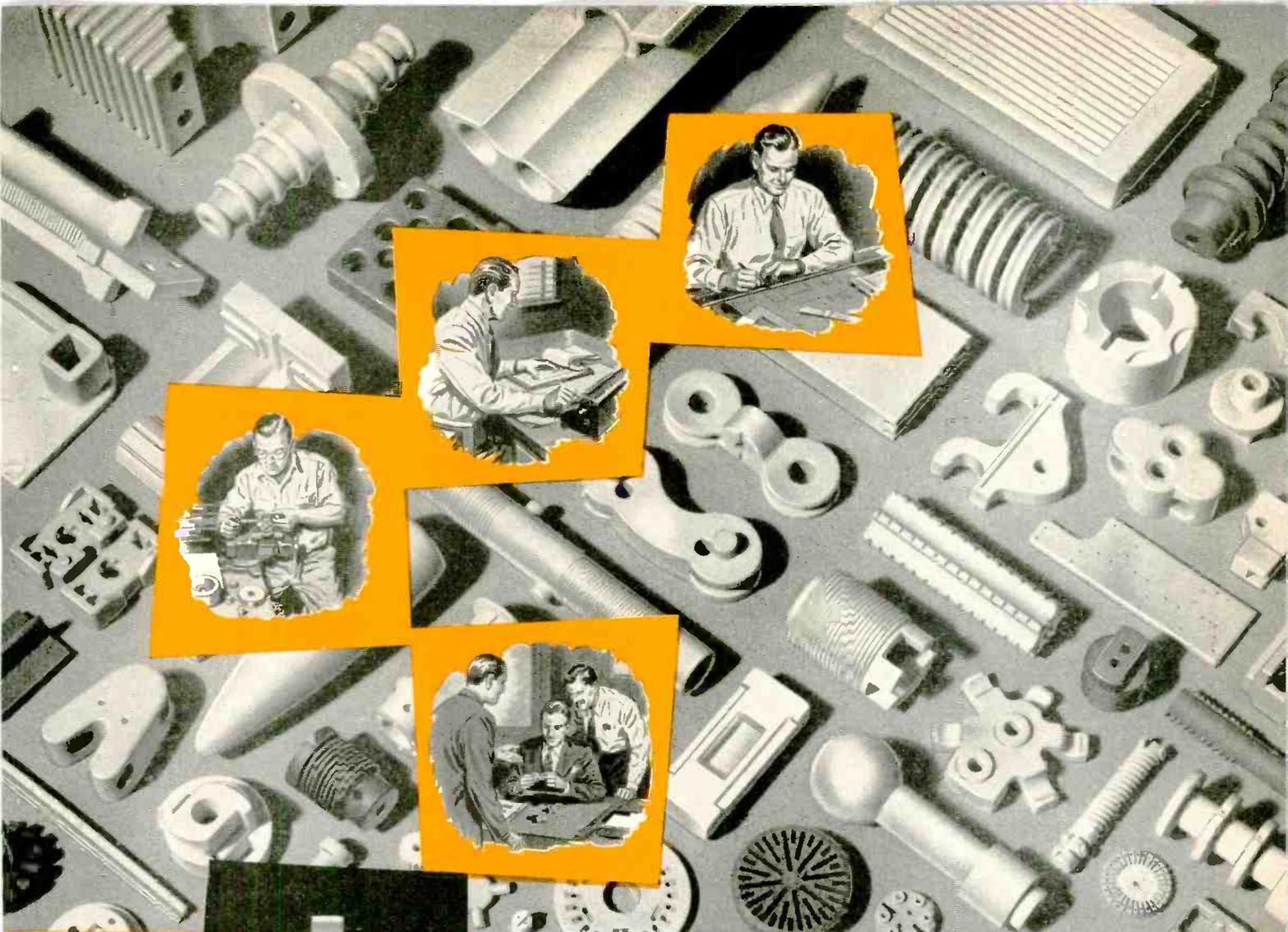
Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# Superior Tube

**The big name in small tubing**

All analyses .010" to 5/8" O.D.  
Certain analyses in light walls up to 2 1/2" O.D.



(another *ALSiMag Extra*)

Our Sample Order Department can quickly make up pieces to any new design that looks promising and let you test them thoroughly. When the final design has been decided upon, parts can be produced to specification in volume to match your requirements.

A blueprint or sample of your present part with outline of operating requirements will bring prompt action . . . which may save you lots of money.

# ALSiMAG<sup>®</sup>

## Redesign Service

for more **ECONOMICAL CERAMICS**

Careful study of designs by our engineering staff (with more than 50 years of specialized experience) often results in recommendations which mean — **Savings** in manufacturing costs, **Savings** in speed and ease of assembly, **Savings** through improved performance, **Savings** from combining two or more parts for still greater economy.

53<sup>RD</sup> YEAR OF CERAMIC LEADERSHIP

## AMERICAN LAVA CORPORATION

A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY

CHATTANOOGA 5, TENNESSEE

Branch offices in these cities (see your local telephone directory):

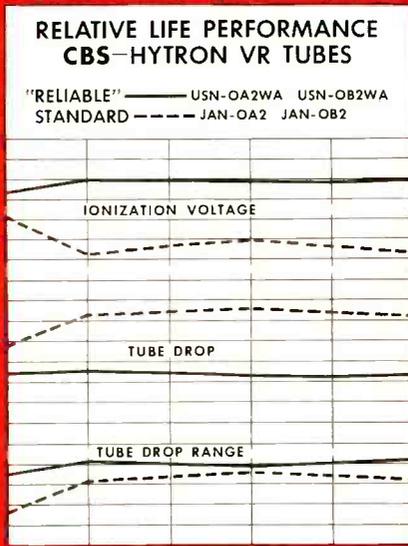
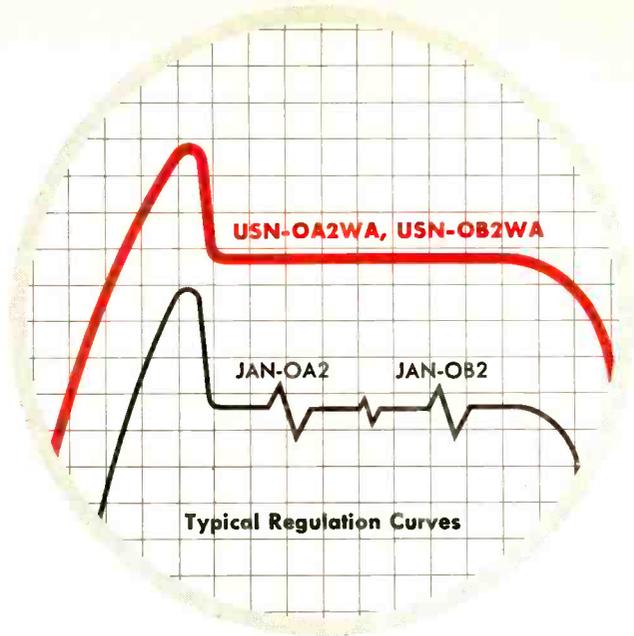
- Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Texas
- Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia-Pittsburgh, Pa.
- St. Louis, Mo. • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla.

# NOW...VR TUBES WITHOUT "PIPS"! ...for Stable Voltage Reference

## NEW "RELIABLE"...DUAL-PURPOSE CBS-HYTRON USN-OA2WA USN-OB2WA\*

CBS-Hytron, the leader in VR tubes, has solved the "unsolvable" VR-tube problem. Has taken those annoying "pips" (sudden discrete voltage shifts) out of two new CBS-Hytron VR developments: The dual-purpose USN-OA2WA and USN-OB2WA. Both are superior, "reliable" voltage regulators. Both also achieve stable voltage-reference performance.

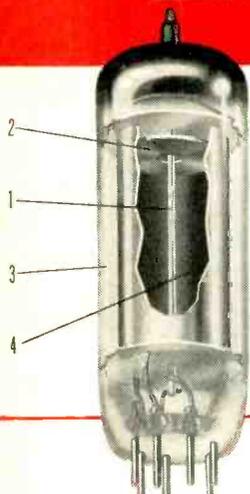
These new tubes are directly interchangeable with the JAN-OA2 and JAN-OB2. But they are manufactured and tested to new, more rigid U. S. N. Bureau of Ships specifications. USN-OA2WA and USN-OB2WA are designed for dependability under severe environmental conditions . . . and for a wide range of applications. Improved construction and tight quality control offer many advantages. Check features, curves, and construction of these versatile tubes.



\* Improved tubes, tested to U. S. N. specifications, not to be confused with earlier JAN "reliable" versions.

### CHECK THESE FEATURES

1. Flat, smooth voltage-current characteristic.
2. Greatly improved voltage repeatability.
3. Stable electrical characteristics.
4. Tested under severe conditions of shock, vibration, temperature, and altitude.



### IMPROVED CONSTRUCTION USN-OB2WA

Note these improvements: 1. New, simplified aluminum-rod anode. 2. New disc-type starting electrode, to minimize gap-spacing variations and give more uniform starting voltage. (In USN-OA2WA, this electrode is located at bottom of mount assembly.) 3. New gas fill with neon body and low argon content. 4. New composite nickel-aluminum cathode work surface. Improvements 3 and 4 make possible operation at 150°C . . . and stable voltage-reference applications.



FREE DATA for both USN-OA2WA and USN-OB2WA. Write for Bulletin E-235.

CBS-HYTRON Main Office: Danvers, Mass.

A Division of Columbia Broadcasting System, Inc.

A member of the CBS family: CBS Radio • CBS Television • Columbia Records • CBS Laboratories • CBS-Columbia • CBS International • and CBS-Hytron

Send for this *Free* **SAMPLE FOLDER...**

*Contains*  
**25**

different Test Samples of  
high-dielectric

**INSULATING  
TUBING and SLEEVING**



INCLUDES SAMPLES AND DESCRIPTIONS OF THE FOLLOWING...

**VARGLAS SILICONE** Class H insulating materials were pioneered by our Laboratory. Retain flexibility, electrical properties and mechanical strength in temperatures ranging from -85°F. to 500°F. Available in tubing, sleeving, lead wire, tying cord.

**PERMAFIL-IMPREGNATED VARGLAS TUBING** Fiberglass braid coated with General Electric's Permafil resin. Extremely tough, resistant to solvents and elevated temperatures, highly flexible. Can be bent or twisted with little or no loss of dielectric strength. Coils and standard 36" lengths.

**VARGLAS SLEEVING AND TUBING** Numerous types and grades—including synthetic-treated, varnished, lacquered, saturated, litewall and others.

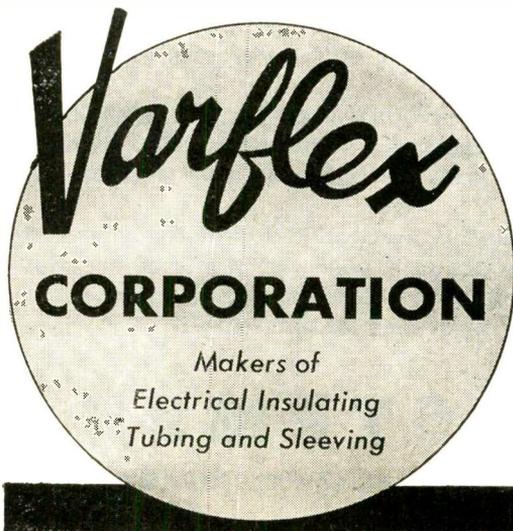
**VARGLAS NON-FRAY SLEEVING** Fiberglass braid normalized to remove all organic impurities. It will withstand temperatures up to 1200°F. Recommended where dielectric properties are not paramount. Three types available.

**VARFLO TUBING AND SLEEVING** Vinyl-coated Fiberglass in full range of sizes, colors and grades. Extremely flexible with excellent heat aging qualities. Low priced.

**VARFLEX COTTON TUBING AND SLEEVING** Varnish or lacquer impregnated—for applications where MIL-I-3190 Class A materials are specified. All NEMA grades.

**SYNTHOLVAR EXTRUDED TUBING** Made in various standard formulations of vinyl polymers. Has high dielectric and tensile strength—will not support combustion nor absorb moisture. Type EG Approved under MIL-I-631A. Several others to meet special requirements.

**NEW! VARGLAS SILICONE RUBBER SLEEVING AND TUBING**—the culmination of 5 years of research—for applications requiring extraordinary flexibility. Details on request.



**MAIL COUPON TODAY FOR SAMPLES!**

**VARFLEX CORPORATION,**  
506 W. Court St., Rome, N. Y.

Please send me free folder containing samples of your electrical sleeving and tubing.

I am particularly interested in insulation for:

NAME.....  
COMPANY.....  
STREET.....  
CITY.....ZONE.....STATE.....

# Simplify Your Access Panel and Door Assemblies...



Fasten them faster with Quick-Lock

Fastening removable access doors and panels need not be a laborious and costly production or assembly operation—not if they're fastened with QUICK-LOCK.

Designed for simple installation, QUICK-LOCK requires no special tools. It speeds up mounting and demounting detachable panels with only a 90° turn required to lock and unlock it *in a jiffy*.

The flexible mounting and tapered stud makes QUICK-LOCK ideal for assembling curved sheets and insures a tight fit when locked. Stud is self-ejecting when unlocked. Minimum deflection is assured—only initial loads are carried by the helical spring. Solid supports take up increased loads.

Industrial and agricultural equipment manufacturers would do well to analyze the cost-saving features of QUICK-LOCK's simple design. A good way would be to call in a Simmons Engineer and discuss the economy of a QUICK-LOCK installation as compared to your present fastening method. Why not send for him today?

## SIMMONS FASTENERS

SIMMONS FASTENER CORPORATION • 1750 NORTH BROADWAY, ALBANY 1, N. Y.



for **TRUE**

**HERMETIC**

**SEALING**

*Canseals* by *cannon*

Hermetically-sealed multi-contact Canseal connectors made by Cannon are really rugged! And . . . they are the only connectors that give you true hermetic sealing under adverse pressure and atmospheric changes. Here's why . . .

Cannon pioneered the first successful hermetically-sealed connector more than six years ago . . . since then has continuously refined and increased the line. All have special steel contacts. Glass insulation . . . fused to both contacts and shell for a perfect permanent seal . . . is stronger than steel, withstands temperatures to 1000° F, and permits the use of the highest conductive steel contacts compatible with any glass fusing operation.

Available in a wide variety of insert layouts for control, relay, power, and instrument applications in Series GS (AN type), KH, RKH, U, DAH, BFH, TBFH, DBH, DCH, KH30 standard, miniature and sub-miniature sizes. Also, special mounting flanges and brazing service to help you obtain a strong and leakproof overall assembly.

**CANNON  
PLUGS**



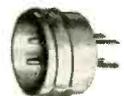
*first in connectors*



DH SERIES



U SERIES



KH SERIES

Please refer to Dept. 120

CANNON ELECTRIC COMPANY, 3209 Humboldt Street, Los Angeles 31, California

Factories in Los Angeles; East Haven; Toronto, Canada; London, England.

Representatives and distributors in all principal cities are at your service.



## *RCA Uses Stokes Vacuum Equipment for Aluminizing TV Tubes*

The new Stokes installation at RCA's Marion, Indiana, plant is a valveless, rugged system capable of aluminizing up to 120 TV picture tubes per hour. Low in operating cost, it is by far the least complex continuous aluminizing system available. It is designed without timers, gadgets or intricate accessories, any of which could fail and stall production. The system is so free of vibration that a five-cent piece can be balanced on the dollies while they are in motion.

Operation is simplicity itself: the operator loads one tube to a cart; pressure is automatically reduced to the required vacuum, the filament is automatically flashed and the completed metallized tube delivered to the operator's station.

For metallizing COLOR or BLACK AND WHITE TV tubes, Stokes designs and installs automatic or semi-automatic in-line systems or stationary units, in standard designs or to customer's requirements.

Send for a NEW 28-page technical brochure on vacuum metallizing.

Overall view of Stokes continuous vacuum metallizing dolly system for aluminizing TV tubes at RCA's Marion, Indiana, plant. Operator is required only to load and unload tubes from the carts.



F. J. STOKES MACHINE COMPANY  
PHILADELPHIA 20, PA.

# STOKES



**COVERS** the **WORLD!**

**618S TRANCEIVER**  
for **WORLD-WIDE** Airborne Communications

...and of course it uses

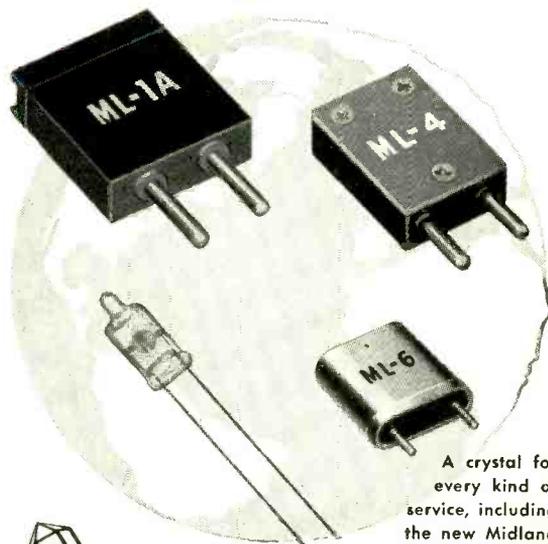
*Midland* **CRYSTALS**

100-WATT POWER ON 144 CHANNELS gives the Collins 618S Tranceiver truly world-wide operation. Collins airborne HF communications equipment is *first choice of most U. S. trans-oceanic airlines*, and of many foreign and domestic carriers, as well as private and military aviation.

*Midland crystals* do the key job of frequency control in the 618S Tranceiver as in all Collins aviation equipment. In this critical service, there can't be any question of stability, precision, and sure-fire performance under toughest conditions.

*Midland Crystals* measure up to Collins' strict standards because every one of the millions of these crystals in use today is a product of Midland Quality Control. This is the system that constantly checks every crystal at every step in processing.

*Midland employs* the finest technical skill and production facilities in the industry to make sure you'll get completely dependable crystal quality and performance.

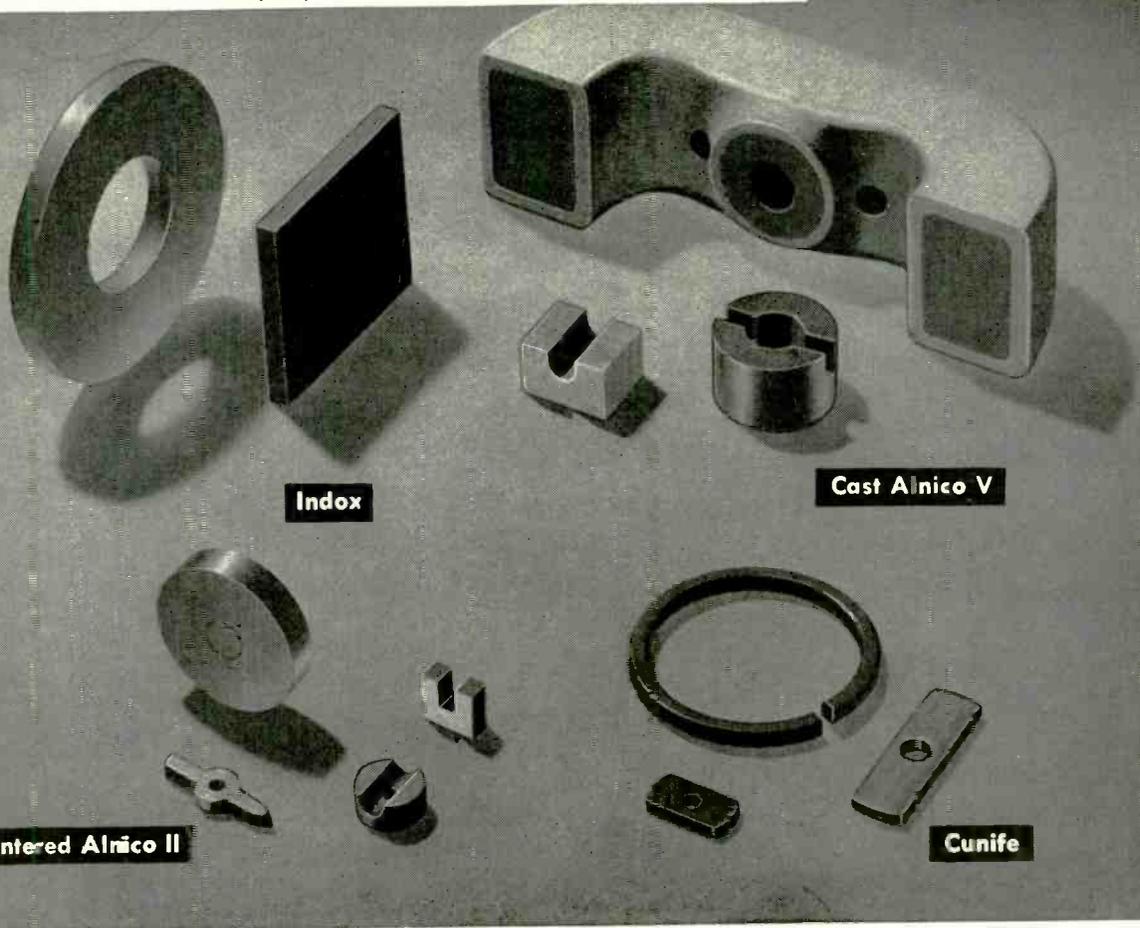


*Whatever your Crystal need, conventional or specialized  
When it has to be exactly right, contact*

*Midland*  
**MANUFACTURING COMPANY, INC.**  
3155 Fiberglas Road • Kansas City, Kansas

WORLD'S LARGEST PRODUCERS OF QUARTZ CRYSTALS

**ONE IN A SERIES** discussing the importance of selecting  
the proper permanent magnet to use in your product



## How the Right\* Permanent Magnet Material Can Benefit Your Product

Of the many permanent magnet materials available—a few of which are shown above—only *one* will permit your product to *function best at the lowest possible cost.*

Which one is it? To help you answer that question properly is part of our job. As specialists in permanent magnets, we have helped to provide manufacturers with the answers for over 35,000 applications. The case of the telephone equipment manufacturer is typical. Perhaps we can assist you, too.

There is no charge . . . or obligation . . . for this service. Just write us, today, giving the details of your particular design problem. Or, ask for our Engineering Design Manual No. 4-A12. We'll be glad to provide both.

### A Typical Case

. . . Is that of a prominent telephone equipment manufacturer who changed from a chrome steel magnet to the use of Alnico III in his polarized relay. The results:

- 70% Savings in initial cost
- Simplified design
- Reduced weight
- Flux increase of 27% —improved performance
- Saving in space
- Less maintenance

\* *The one which will permit your product to function best at the lowest possible cost.*

THE INDIANA STEEL PRODUCTS COMPANY • Valparaiso, Indiana

*World's Largest Manufacturer of Permanent Magnets*

# INDIANA PERMANENT MAGNETS

# LET G-E TUBE SERVICE INCREASE YOUR SHARE OF A FAST-GROWING COMPUTER MARKET



**E**stimates say that the computer market—business, military, and research—will triple in the next five years. Here are substantial sales and profits for computer builders who can meet their customers' demands for fast, efficient equipment.

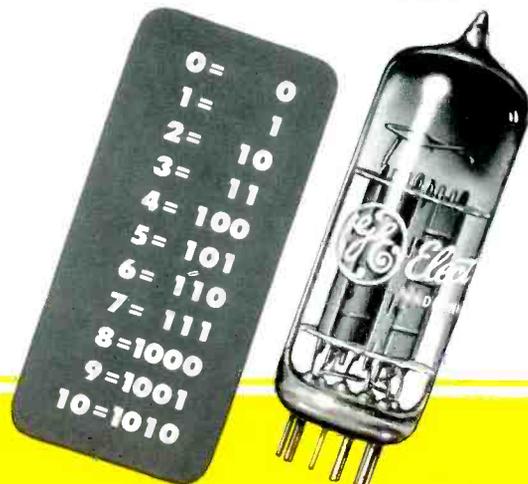
G.E. offers experience and facilities to strengthen your competitive position . . . will analyze your circuit in terms of its specific tube requirements, and select the right types to give you optimum performance. You will receive every help in actually testing G-E tubes in your computer, from the time the latter is still in the "breadboard" stage.

Special computer tubes were pioneered by General Electric.

G.E. is their largest builder. In line with performance requirements that become steadily more advanced, G.E. is devoting extensive research and development to still newer tubes for tomorrow's circuits—types that will be available for *you* when you need them.

G.E. offers you close cooperation at the tube-design level . . . application help by experienced tube engineers . . . local-laboratory help in checking tube performance in your circuits . . . fast order and delivery service from G-E tube warehouses coast-to-coast.

Most important of all, General Electric has ready . . . now . . . a line of special computer tubes for your immediate needs. They are described on the next page.



0=	0
1=	1
2=	10
3=	11
4=	100
5=	101
6=	110
7=	111
8=	1000
9=	1001
10=	1010

# Ready now

## 5 SPECIAL G-E TUBES FOR COMPUTERS...

### DESIGNED FOR HIGH-SPEED CIRCUITS

*Others soon!*

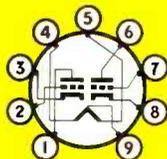
ALSO: 5 important reasons why these G-E computer tubes all do an efficient job . . . reliably:

- High-perveance design.
- Low heater power requirement.
- Balanced, sharp cut-off characteristics.
- Cathodes specially designed for on-off dependability.
- Life-tested under cut-off conditions.

#### GL-6211

9-pin medium-mu twin triode for binary-counter or amplifier applications.

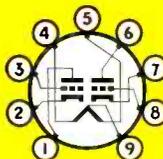
Max cathode current, per section	14 ma
Max dissipation, per plate	1 w
Max tube dissipation	2 w
Grid voltage required to cut off plate current	-10 v
Heater current	.3 amp



#### GL-6463

9-pin high-capacity twin triode for extra-fast computers. Especially suited to frequency-divider circuits.

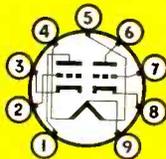
Max cathode current, per section	28 ma
Max dissipation, per plate	4 w
Max tube dissipation	7 w
Grid voltage required to cut off plate current	-11 v
Heater current	.6 amp



#### GL-5965

9-pin twin triode for high-speed computer use as binary-counter or amplifier tube.

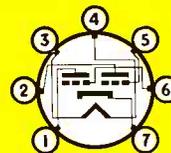
Max cathode current, per section	15 ma
Max dissipation, per plate	2.2 w
Max tube dissipation	4 w
Grid voltage required to cut off plate current	-5.5 v
Heater current	.45 amp



#### GL-5844

Medium-mu twin triode, for use as counter or amplifier tube in moderately high-speed computers.

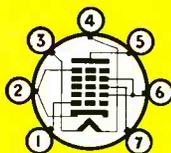
Max cathode current, per section	9 ma
Max dissipation, per plate	.5 w
Max tube dissipation	1 w
Grid voltage required to cut off plate current	-10 v
Heater current	.3 amp



#### GL-5915-A

Dual-control heptode, for use primarily as a coincidence-gating tube.

Max cathode current	20 ma
Grid voltage required to cut off plate current	-10 v
Typical plate current in gating service ("on" condition)	5.8 ma



Get complete information!  
Write to Tube Department,  
General Electric Company,  
Schenectady 5, New York.

*Progress Is Our Most Important Product*

# GENERAL ELECTRIC



# Why it's Good Business to Standardize on BUSS FUSES



Manufacturers and service organizations in increasing numbers are standardizing on BUSS fuses because . . . they know, from their own experience, that BUSS fuses give dependable electrical protection under all service conditions.

In fuses, unfailing dependability is so necessary — for the fuse alone protects when there is trouble on the circuit. And just as important, a fuse should never give a "false alarm" by blowing needlessly.

To make sure that BUSS fuses maintain their 40 year old reputation for highest quality, every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

### **Save designing time on new products.**

When designing new devices that require electrical protection you can save engineering time by turning to BUSS. Our fuse research laboratory and its staff of fuse engineers can help you save time and money in determining the right fuse or fuse mounting for the job . . . and if possible, ones already available in local wholesalers' stocks.

Makers of a complete line of fuses for home, farm, commercial electronic and industrial uses.



**For More Information  
Mail this Coupon**

BUSSMANN Mfg. Co. (Div. McGraw Electric Co.)  
University at Jefferson, St. Louis 7, Mo.

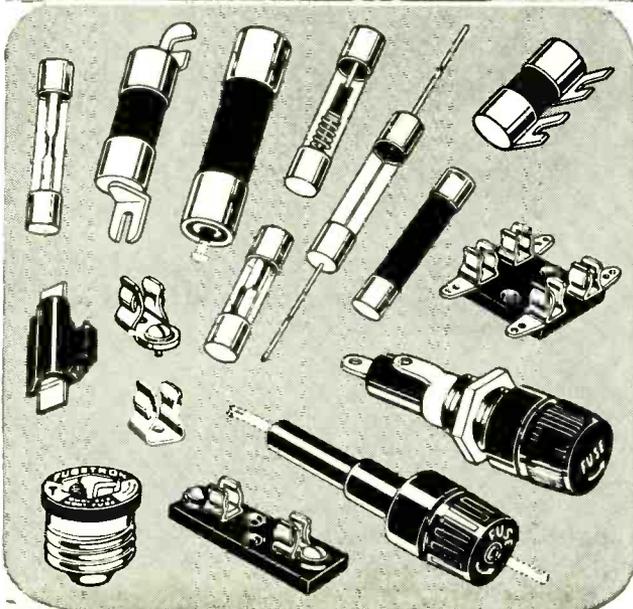
Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

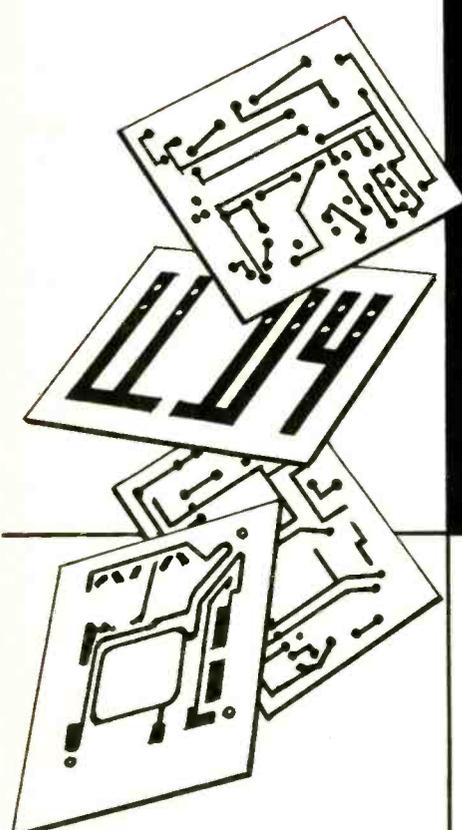
Name.....Title.....

Company.....

Address.....

City & Zone.....State.....ELRC 1254





For superior printed  
or etched circuits  
use copper-clad

**INSUROK T-725**  
and **T-812**  
plastic laminates

For printed circuits, the important consideration is the laminate base since other characteristics are often similar. In buying printed circuits, therefore, it pays to insist on the best—INSUROK T-725 or T-812—because of their outstanding electrical properties which remain remarkably stable under repeated temperature and humidity cycling.

**Laminated INSUROK** Grades T-725 and T-812 have made history ever since they were first introduced to the electronics industry. Possessing a unique combination of properties, they have been used successfully for many years in critical high-frequency applications.

**INSUROK** T-725 and T-812 have high physical strength and low cold flow, and are readily punched into intricate shapes. Richardson also furnishes copper-clad INSUROK in many other grades, in addition to T-725 and T-812.

Experienced Richardson engineers will gladly assist you in the selection and application of copper-clad INSUROK... write or phone your nearest Richardson sales office today.

*The* **RICHARDSON COMPANY**

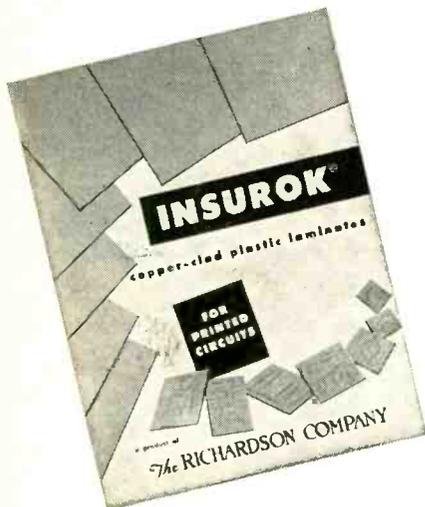
FOUNDED 1858

2797 Lake Street, Melrose Park, Illinois (Chicago District)

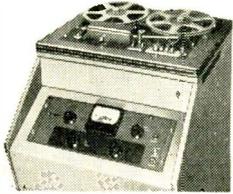
SALES OFFICES IN PRINCIPAL CITIES

ASK FOR BULLETIN  
ON COPPER-CLAD

**INSUROK®**

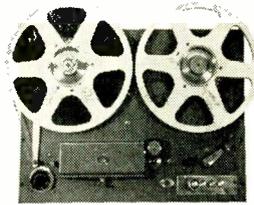


# What's your choice in fine tape equipment?



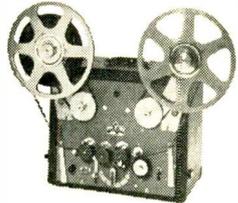
**NEW  
PRESTO  
SR-11**

Complete studio console tape recorder. Never before so much quality, operational ease and value at such a modest price. Embodies the famous PRESTO R-11 tape mechanism, matching amplifier - power supply in sturdy well-designed console cabinet. Three motors for complete flexibility; 15" and 7½" per sec. speeds.



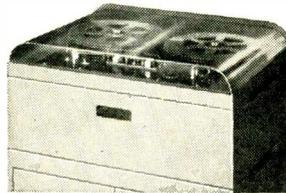
**PRESTO  
R-11**

A tape recording mechanism of truly modern design in engineering and operation. Mechanism includes three-head assembly, solenoid operated brakes and employs the exclusive Capstan drive unit. Tape reels mounted directly on heavy-duty torque motors.



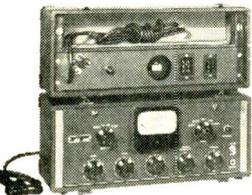
**PRESTO  
R-7**

Rugged, portable tape recorder with separate recording, reproduction, and erasing heads. Built around a sturdy, three-motor drive eliminating friction clutch, the RC-7 contains the same high-quality components found in PRESTO'S fine studio equipment. Heavy-duty construction throughout.



**PRESTO  
PB-17A**

Reliable, long-playing tape reproducing mechanism. Automatically reversible for continuous playback for background music in eight hour cycles. Frequency response uniform from 50 to 8000 cps. Tape speed: 3¾" per sec. Reels up to 14" diam. (4800' of tape) with dual track.



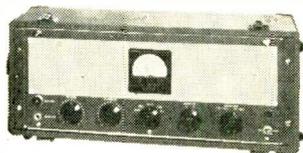
**PRESTO  
900-A**

Precision tape amplifier for portable use or rack mounting. Composed of individual record and reproduce (monitor) amplifiers on a common chassis; separate power supply; three-microphone input, 250 ohm low level mixer; illuminated V.U. meter. Output of reproduce amplifier, 500 ohms, plus 20 db maximum. May be used with any model PRESTO tape recorder.



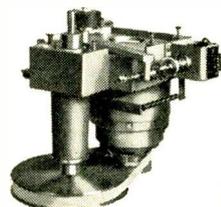
**PRESTO  
TL-10**

Turntable-driven tape reproducer. Unique, low-cost unit that adapts any 16" turntable for reproduction of tape at 7½"/sec. or 15"/sec. with exceptional accuracy. No pre-amplifier required; plugs into standard studio speed input equipment.



**PRESTO A-920**

More compact than the 900-A. In carrying case or for rack mounting. Consists of microphone preamp, a reproduce preamp, power amplifier and power supply - all on a common chassis. Two small speakers mounted behind front panel for playback. Single mike input: 250 ohms. Playback output: 15 ohms, 10 watts.



**PRESTO  
CDR-200  
CAPSTAN  
DRIVE UNIT**

Heart of all Presto tape recorders and reproducers. Motor, capstan and flywheel, pressure pulley and pressure pulley solenoid are mounted on independent cast aluminum chassis. Positive, very quiet tape drive with minimum of parts.

Behind every piece of tape equipment are these PRESTO "extras"—painstaking craftsmanship, years of experience... quality control... and advanced production facilities that guarantee instruments of absolute precision and lifelong dependability.

**PRESTO**

RECORDING CORPORATION  
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.  
Canadian Division: Instantaneous Recording Service,  
42 Lombard Street, Toronto

WORLD'S LARGEST MANUFACTURER OF  
PRECISION RECORDING EQUIPMENT  
AND DISCS

MAIL THIS COUPON TODAY

Presto Recording Corporation  
Tape Equipment Sales Div.  
Paramus, New Jersey

Please send full information and prices on  
the following Presto tape equipment:

- SR-11 Tape Recorder  PB-17A Tape Recorder  
 R-11 Tape Transport  TL-10 Tape Reproducer  
 R-7 Tape Recorder  A-920 Tape Amplifier  
 900-A Tape Amplifier  CDR-200 Capstan Drive

NAME \_\_\_\_\_

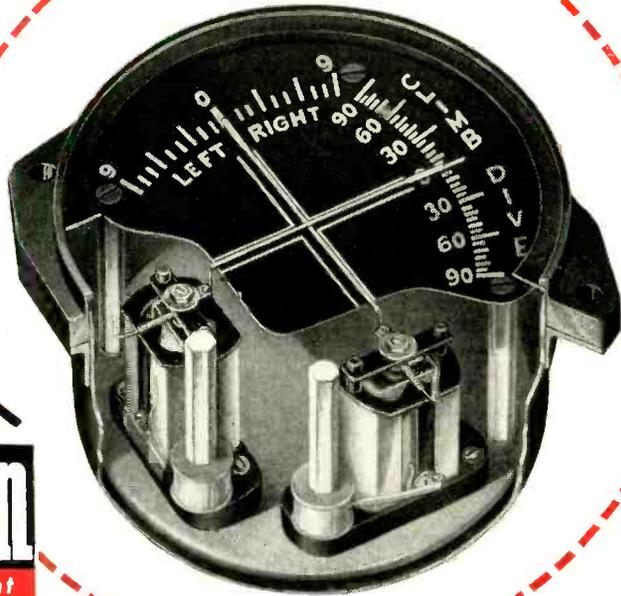
COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

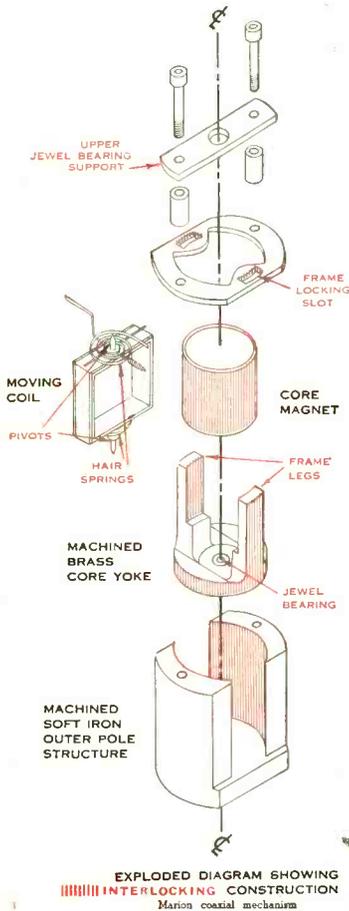
CITY \_\_\_\_\_ ZONE \_\_\_\_\_

STATE \_\_\_\_\_

# MARION COAXIAL\* MECHANISMS MAKE NEW AIRCRAFT INSTRUMENTS LIGHTER, SMALLER, MORE STABLE



**marion**  
advancement  
in instrument  
design



A new AN type multi-element aircraft instrument, incorporating recently developed Marion Coaxial Mechanisms, has greater durability and performance stability than many existing instruments of much greater size and weight. Applications of the new instrument, available with two, three or four elements, include ammeters, voltmeters, temperature indicators and radio navigational instruments. They meet the requirements of Army-Navy Aeronautical Design Standard AND10401 for 2 3/4" dial instruments.

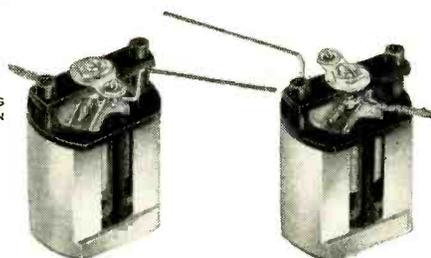
The Coaxial Mechanism making these improvements possible represents a new Marion concept in the mechanical design of moving coil mechanisms. The Coaxial assembly provides a self-shielded magnetic field of great strength, uniformity and stability. Ruggedness and stability are inherent in the basic simplicity of the design. Only two fasteners hold the rigid, interlocked assembly together. All critical dimensions are machined from a common center (the bearing axis), facilitating precise alignment of parts.

## MECHANISMS BY MARION

The Coaxial Mechanism typifies the way each Mechanism by Marion is designed to meet the particular requirements of a specific application — and to provide substantially improved performance, with large reductions in cube and weight. They are not adaptations or variations of standard, conventional mechanisms.

Marion Electrical Instrument Company  
401 Canal Street, Manchester, New Hampshire

\*Trade Mark Patents Pending



**marion meters**

Reg. U. S. Pat. Off.

MANUFACTURERS OF RUGGEDIZED AND "REGULAR" METERS AND RELATED PRODUCTS

Copyright 1954 Marion

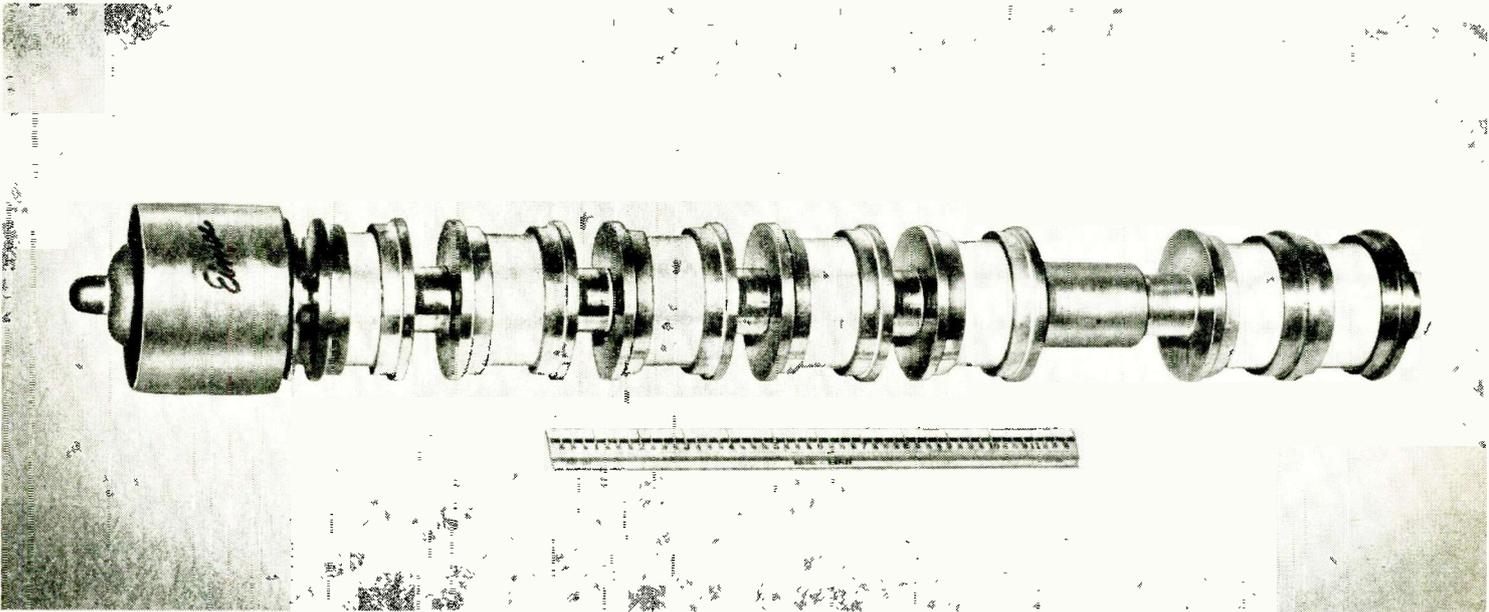
# Eimac Klystron Report

# X566

20kw

modulating anode  
pulse klystron

- High power gain of 53db
- UHF operation — 960-1400mc



**E**IMAC X566 UHF klystrons have consistently obtained peak pulse power outputs of more than 20kw with over 40% efficiency at 960-1400mc. Many times more powerful than any other tube intended for similar operation, such as aircraft navigational aid Distance Measuring Equipment, the air-cooled X566 requires only 100 milliwatts driving power for a 20kw output — a power gain of 53db with bandwidth adequate for most pulse applications. Of special significance is the high average power capability of one kilowatt, allowing the duty cycle to be raised to 5% with a 20kw peak output, or 10% with 10kw output, and so on. Outstanding pulse capabilities of the X566 are made possible through the use of the Eimac modulating anode — an insulated anode between the cathode and drift tube section — permitting the klystron to be pulse modulated with

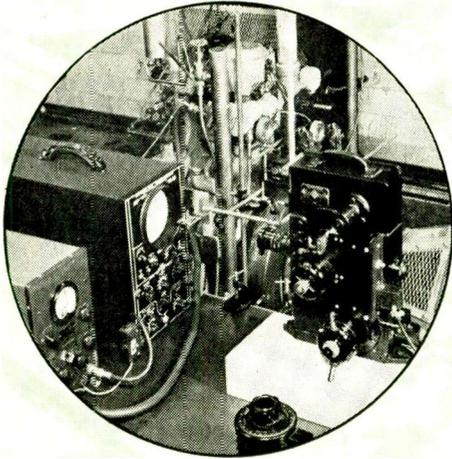
low pulsing power. In Eimac high power amplifier klystrons using ceramic and copper construction, the resonant cavities are completed outside the vacuum system, which is left free of RF tuning devices — permitting easy wide range tuning and uncomplicated input and output coupling adjustment. This simplicity of design and rugged construction minimize replacement costs as well as making the Eimac X566 suitable for mass production techniques.

The X566, another Eimac high power klystron achievement, is now available with circuit components for experimental purposes.

- For additional information, contact our Technical Services Department.

**EITEL-McCULLOUGH, INC.**  
SAN BRUNO • CALIFORNIA

**Eimac**  
THE WORLD'S  
LARGEST MANUFACTURER OF  
TRANSMITTING TUBES



# TECHNOLOGICAL DEVELOPMENTS IN ELECTRONICS

## Bring Industrial Applications to the Foreground



Technological developments in electronic circuitry, components and equipment, the result of the national defense effort, are now being applied to industrial electronic controls.

The use of electronic controls possesses the greatest growth possibilities in this fast growing electronic business. There are countless applications in every type of manufacturing . . . metal working, food processing, candy making, cosmetics, glass, chemical, automotive, aircraft, to mention a few that utilize electronic controls and new equipment.

But the saturation point is as yet completely out of sight.

Alert manufacturers, to insure their share of this vast market, are telling their product story in **ELECTRONICS**. Whether they make components or complete equipment, they are reaching the men who are responsible throughout industry for recommending and selecting electronic controls for industry. These men are the subscriber-readers of **ELECTRONICS**. In the sales pages of **ELECTRONICS**, manufacturers reach the men who control an unlimited market with ALL industry as its future!



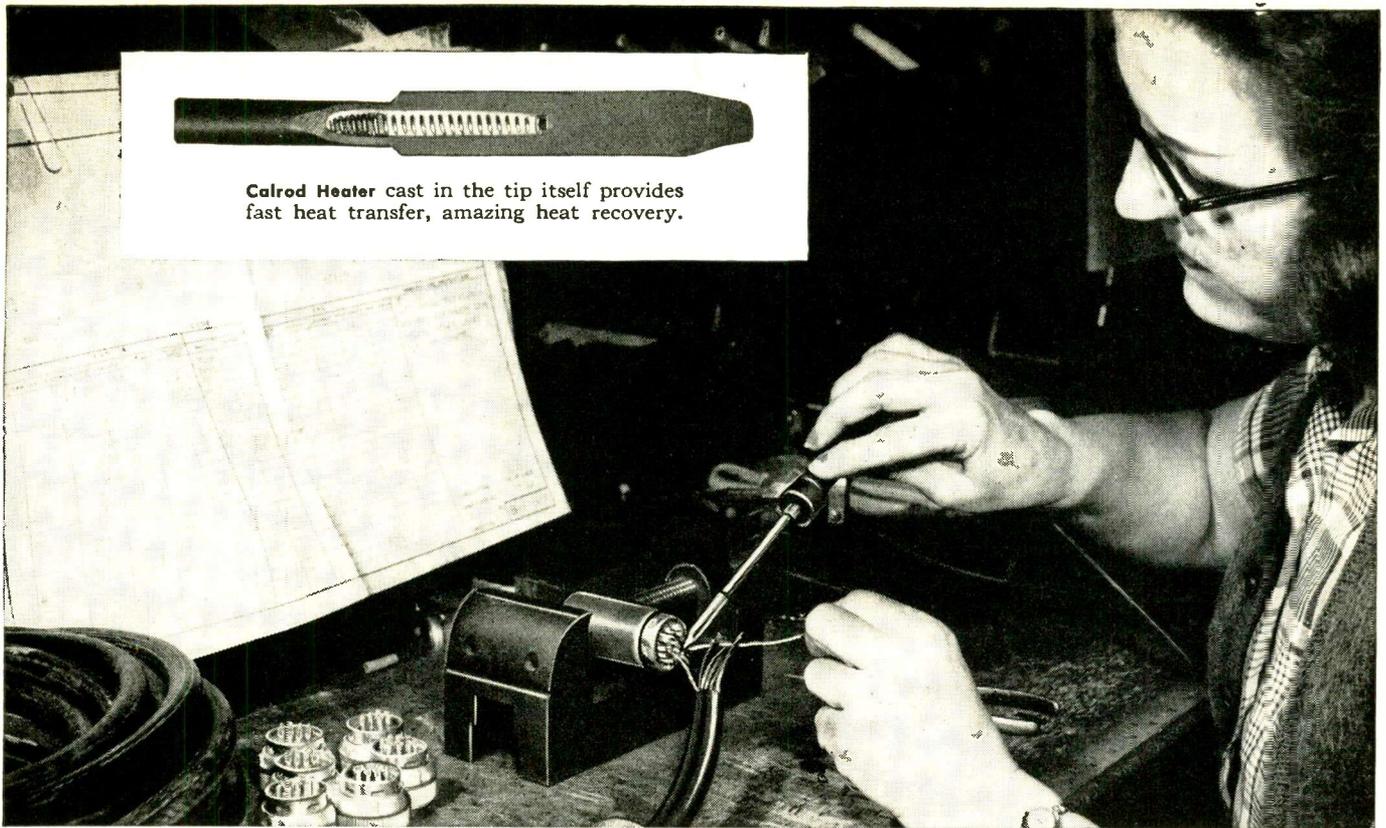
# electronics

A MCGRAW-HILL PUBLICATION



330 West 42nd Street

New York 36, N. Y.



**Calrod Heater** cast in the tip itself provides fast heat transfer, amazing heat recovery.

**MIDGET'S SMALL-DIAMETER TIP** with Calrod\* heater cast in (see inset) is required here for close-quarter soldering. Fourteen delicate

connections are soldered easily and quickly with the General Electric Midget iron. Three tip sizes are available.

# Five Reasons why this Company is sold on the G-E Midget Soldering Iron

**A. E. FINGERHUT, PLANT SUPT., PICKER X-RAY CORP., SAYS:**

"We use General Electric soldering irons one-hundred percent. For close quarter soldering of electronic and x-ray components, we use the G-E Midget and we're completely sold on it."

**1. "We're saving the replacement costs."** Since switching to the G-E Midget five years ago, Picker X-Ray hasn't had a heating element burn out. That's because the Midget offers a long-life Calrod heater installed in the tip.

**2. "We're saving maintenance time."** Because the G-E Midget is equipped with a durable Ironclad tip, Picker X-Ray operators have eliminated tip filing. As a result, the company saves twenty to thirty minutes per day per operator in maintenance time. A Midget iron equipped with an Ironclad tip will give service up to

*ten times longer* than irons equipped with ordinary tips.

**3. "We're realizing increased production."** Weighing only as much as a pack of cigarettes, the G-E Midget helps boost Picker X-Ray's production because operator fatigue is reduced.

**4. "We're cutting damage costs."** Small diameter tips, 1/4 in., 1/8 in., 3/16 in. available with the Midget enable Picker X-Ray operators to solder small connections without burning adjacent wire insulation.

**5. "We're getting the right amount of heat."** Too much heat from a soldering iron causes varying quality in soldered components. Picker X-Ray finds that the G-E Midget produces the right amount of heat for soldering delicate connections.

Picker X-Ray's experience shows how you can profit by using the G-E Midget

soldering iron for precision soldering. And to meet *any* of your soldering requirements, General Electric offers twenty-four different irons with ratings from 25 to 1250 watts. Contact your General Electric Sales Office today for more information. And for a free bulletin on industrial soldering irons, mail the coupon below.

\*Reg. trade-mark of General Electric Co.

**Sect. F720-139, General Electric Co., Schenectady 5, N. Y.**  
**Please send me Bulletin GEA-4519D, Industrial Soldering Irons.**

Name.....

Company.....

Address.....

City..... State.....



# silicon



## semiconductor

## devices

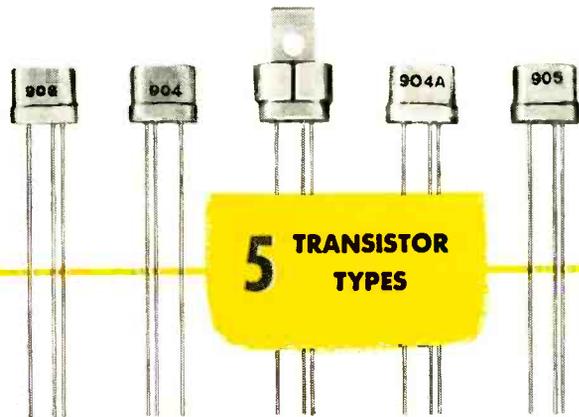
## available

## now in

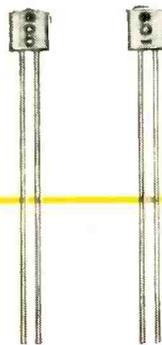
## production

## quantities

**HIGH VOLUME PRODUCTION** of *silicon* semiconductor devices enables Texas Instruments to offer you an enlarged line of five types of silicon transistors and two types of silicon junction diodes . . . all available for immediate delivery in production quantities!



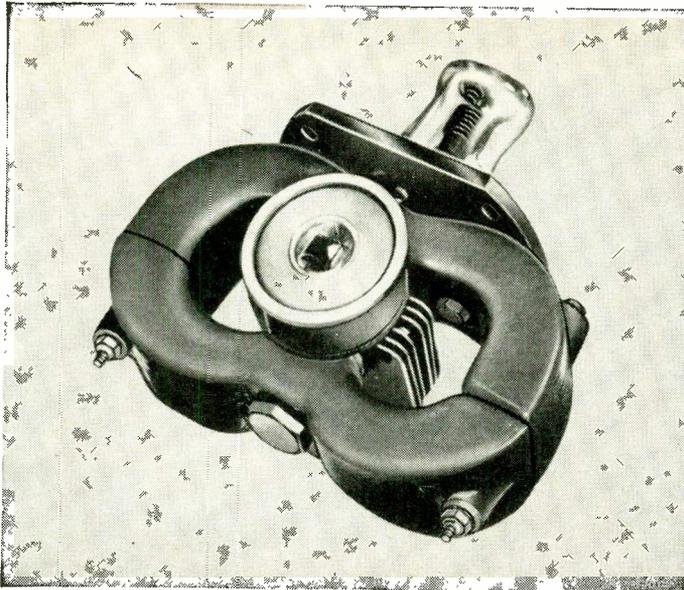
**SILICON TRANSISTORS**—produced commercially by and available *only* from Texas Instruments — are now available with alpha (current amplification factor) to over 0.975 and with alpha cutoff frequency to over 8 megacycles . . . stable to 150° Centigrade (302° F)!



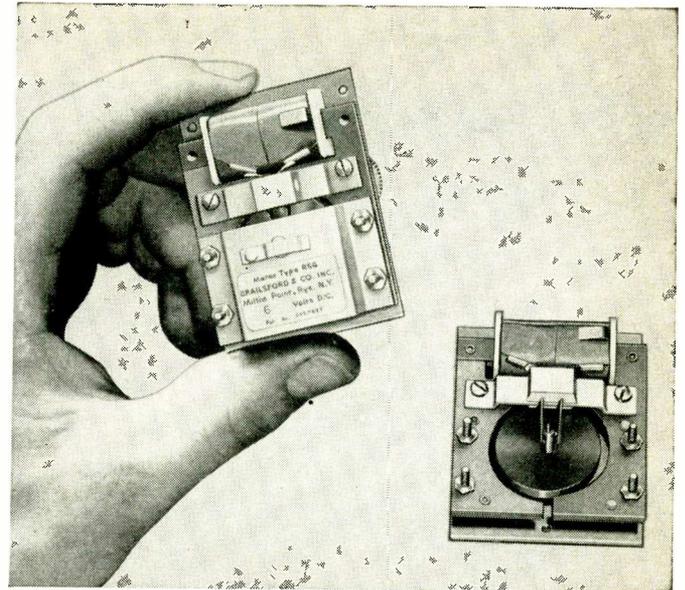
**SILICON JUNCTION DIODES** are also manufactured by Texas Instruments from grown single crystals and feature back currents as low as 0.001 microamp and safe operation to 150° Centigrade! All TI semiconductor devices — *silicon* or germanium; diodes, triodes and tetrodes — are made with glass-to-metal hermetic seals.

**WRITE FOR LITERATURE** on semiconductor devices in the widest range available today!

**TEXAS INSTRUMENTS**  
INCORPORATED  
6000 LEMMON AVENUE DALLAS 9, TEXAS



**Search Radar Magnetron Tube.** Two large Carboly Alnico permanent magnets supply the electron beam control in this Raytheon magnetron. They help reduce size and weight, with no decrease in performance.



**Miniature Electric Motor.** Tiny, powerful Carboly permanent magnet replaces wound electromagnet as rotor. The magnet's self-contained power supply reduces battery drain, requires less power.

# Permanent magnets provide an economical way to convert electrical energy to mechanical motion

Carboly® Alnico permanent magnets provide a low-cost means of simplifying design and reducing size in motors, radar magnetron tubes and hundreds of other products.

In the motor above, a tiny Carboly permanent magnet rotor supplies the motor action; in the magnetron tube, two large Carboly permanent magnets provide electron beam control. Both are examples of permanent magnets' inherent ability to convert electrical energy to mechanical motion. Thousands of other products utilize Carboly permanent magnets' other basic functions (see

below) . . . and realize substantial cost and design savings.

Permanent magnets supply a uniform source of stable, low-cost energy; help eliminate coils, wire and other operating parts. They are available cast, or sintered where closer tolerances and more complex shapes are required.

"Designing-in" permanent magnets will improve your product. Specially trained Carboly Magnet Engineers will work with you in both design and application. Send coupon today, for complete information and technical literature.

## Basic functions of permanent magnets

- |   |   |   |  |   |  |
|---|---|---|--|---|--|
| <b>1</b> Convert electrical energy to mechanical motion | } | Eddy Current Braking<br>Instrument Action<br>Motor Action<br>Acoustic Action<br>Electron Beam Control | <b>3</b> Convert mechanical energy to thermal energy | } | Control of Torque                                |
| <b>2</b> Convert mechanical motion to electrical energy | } | Generator Action<br>Magneto Action<br>Sound Pick-up   | <b>4</b> Mechanical Holding                          | } | Snap Action<br>Separation<br>Holding and Lifting |

# CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

11139 E. 8 Mile Ave., Detroit 32, Michigan

"Carboly" is the trademark for products of the Carboly Department of General Electric Company

**Carboly Department of General Electric Company**  
11139 E. 8 Mile Street, Detroit 32, Michigan

I would like the following:

Information on permanent magnets in \_\_\_\_\_

Permanent Magnet Design Manual, PM-101

Permanent Magnet Standard Stock Catalog, PM-100

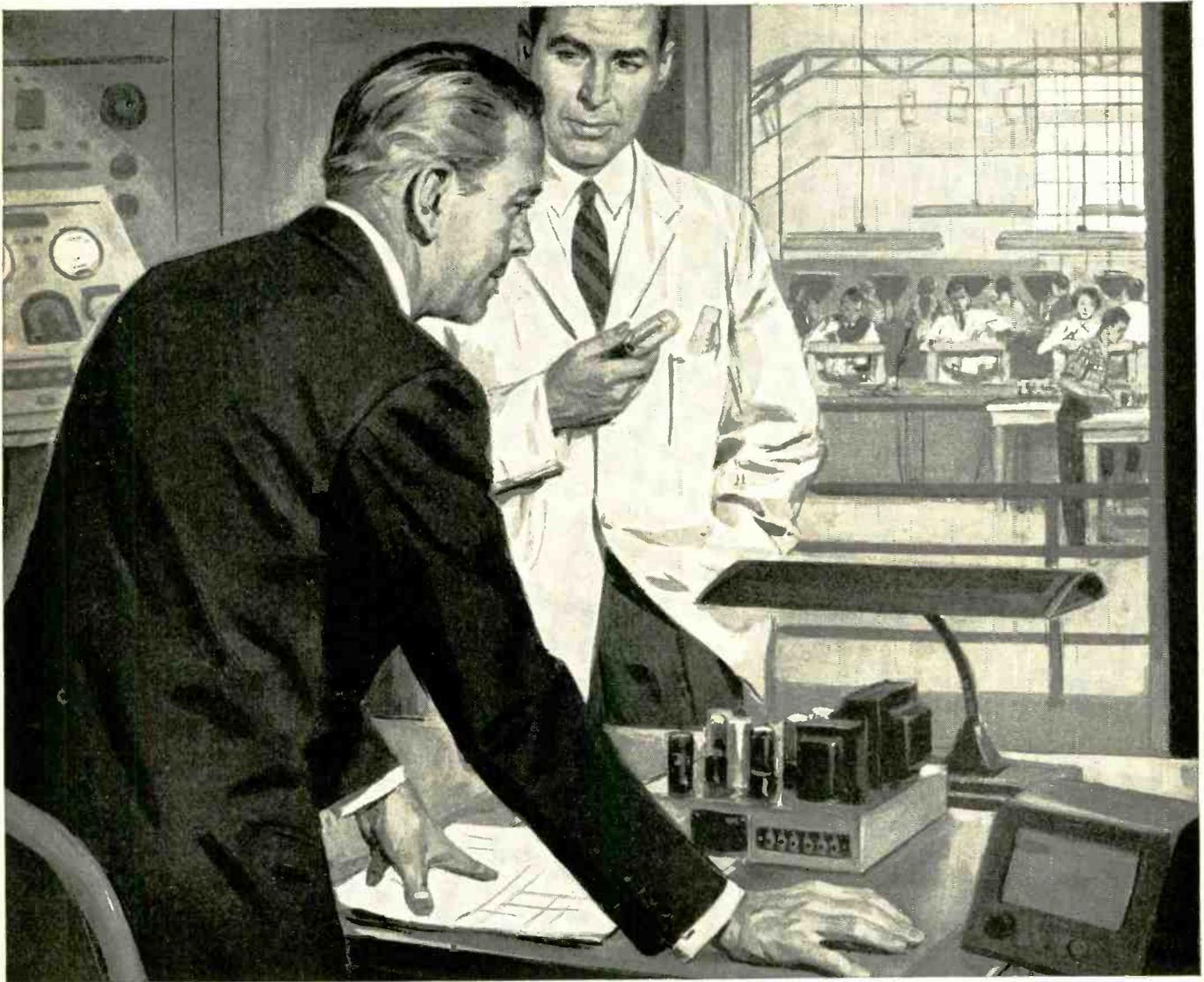
Name \_\_\_\_\_ Position \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

# Protect yourself from production delays



## Ship American Airlines AIRFREIGHT

### American Specializes In Fast Shipments

To be sure parts come in on time, specify delivery by American Airlines Airfreight. With fast and frequent service to all twenty-three leading industrial states, American has space for you at the right places. This means direct one-carrier service, prompt forwarding and dependable on-time deliveries.

It means, too, that you can reduce your inventory requirements; make quicker engineering modifications without obsoleting huge stocks of component parts. Because with suppliers only hours away by air, you can maintain production with much less depth in stock. American Airlines, Inc., Cargo Sales Division, 100 Park Ave., N. Y. C. 17.



AMERICAN AIRFREIGHT ALSO LEADS IN

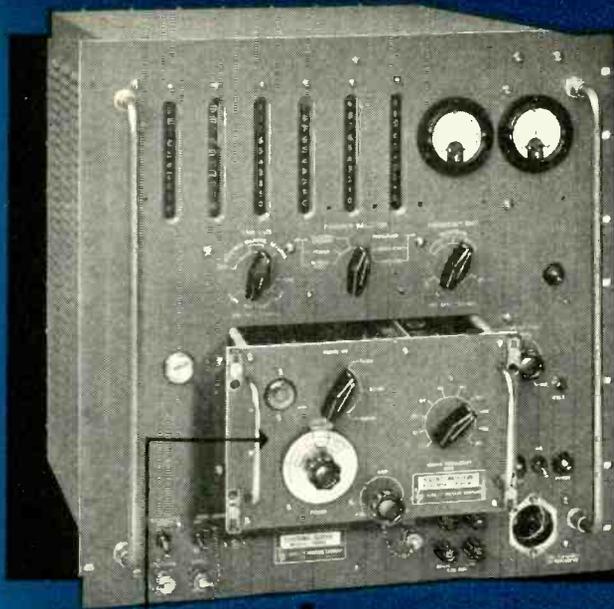
**COVERAGE** — American serves more leading industrial centers in the United States than any other airline.

**CAPACITY** — American has the greatest cargo capacity of any airline with the right space at the right places.

**EXPERIENCE** — first with scheduled airfreight service, American has the experience to provide expert handling.

*America's Leading Airline*

**AMERICAN AIRLINES INC.**

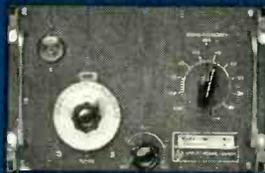


**Frequency 10 cps to 220 mc**  
**Interval 1  $\mu$ sec to 100 days**  
**Period 0 cps to 10 kc**

**measured instantly,  
 automatically, directly by  
 the revolutionary new...**



**-hp- 525A**  
**Frequency Converter**



**-hp- 525B**  
**Frequency Converter**



**-hp- 526A**  
**Video Amplifier**



**-hp- 526B**  
**Time Interval Unit**

## **-hp- 524B ELECTRONIC COUNTER**

Why buy more instrumentation than you need? The new all-purpose *-hp- 524B* Electronic Counter with Plug-In Units gives you *precisely* the frequency, time interval or period measuring coverage you want now. Later, you can add other inexpensive plug-in units to double or triple the usefulness of the Counter.

Model 524B offers direct, instantaneous, automatic readings requiring no calculation, interpolation or complex instrument set-up. It has high sensitivity, high impedance, and its operation is so simple and dependable it can be used readily by non-technical personnel. Resolution is 0.1  $\mu$ sec, and accuracy is  $1/1,000,000 \pm 1$  count. Construction throughout is of highest quality components in a compact militarized design.

The new Counter with Plug-In Units gives you more range, more convenience, smaller size and lower cost than any commercial instrument combination ever offered. With this one compact equipment, you readily measure transmitter and crystal oscillator frequencies, time intervals, pulse lengths, repetition rates, frequency drift; make high accuracy ballistics time measurements or high resolution tachometry measurements, or use as a precision frequency standard giving convenience and flexibility not provided in the usual primary standard.

*Data subject to change without notice. Prices f.o.b. factory*

### **BASIC COUNTER**

The basic *-hp- 524B* Counter unit measures frequency from 10 cps to 10 mc with accuracy of  $\pm 1$  count  $\pm$  stability, reading direct in kc; or measures period from 0 cps to 10 kc with accuracy of  $\pm 0.3\%$  reading direct in seconds, milliseconds or microseconds. Eight-place registration, short term stability  $1/1,000,000$ , display time variable 0.1 to 10 seconds. \$1,890.00

### **COUNTER WITH PLUG-IN UNITS**

**-hp- 525A** Frequency Converter extends Counter's range to 100 mc, maintains accuracy, and increases Counter's video sensitivity to 0.1 volts through basic 10 cps to 10 mc range. \$225.00

**-hp- 525B** Frequency Converter like 525A but extends Counter's range from 100 to 220 mc at 0.25 volts sensitivity. \$225.00

**-hp- 526A** Video Amplifier increases Counter sensitivity between 10 cps and 10 mc to 10 millivolts for low level frequency measurement. \$125.00

**-hp- 526B** Time Interval Unit measures interval 1.0  $\mu$ sec to 100 days with accuracy of 0.1  $\mu$ sec  $\pm 0.001\%$ , reading direct in seconds, milliseconds or microseconds. Start, stop triggering in common or separate channels, through positive or negative going waves. \$150.00 (Plug-in units supplied in aluminum storage case).

*Request complete details today from your  
 -hp- Field Representative, or write direct*

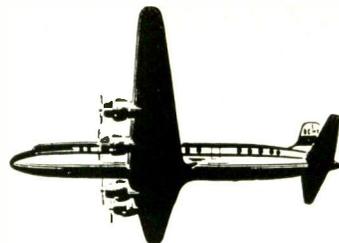
**HEWLETT-PACKARD COMPANY**  
 2998A Page Mill Road • Palo Alto, California, U. S. A.



**INSTRUMENTS**

**COMPLETE  
 COVERAGE**

AEROCOM'S 1046 H. F. TRANSMITTER



# POWER + STABILITY

1000 WATTS

WITH

.003% STABILITY

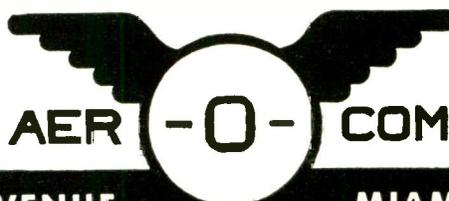
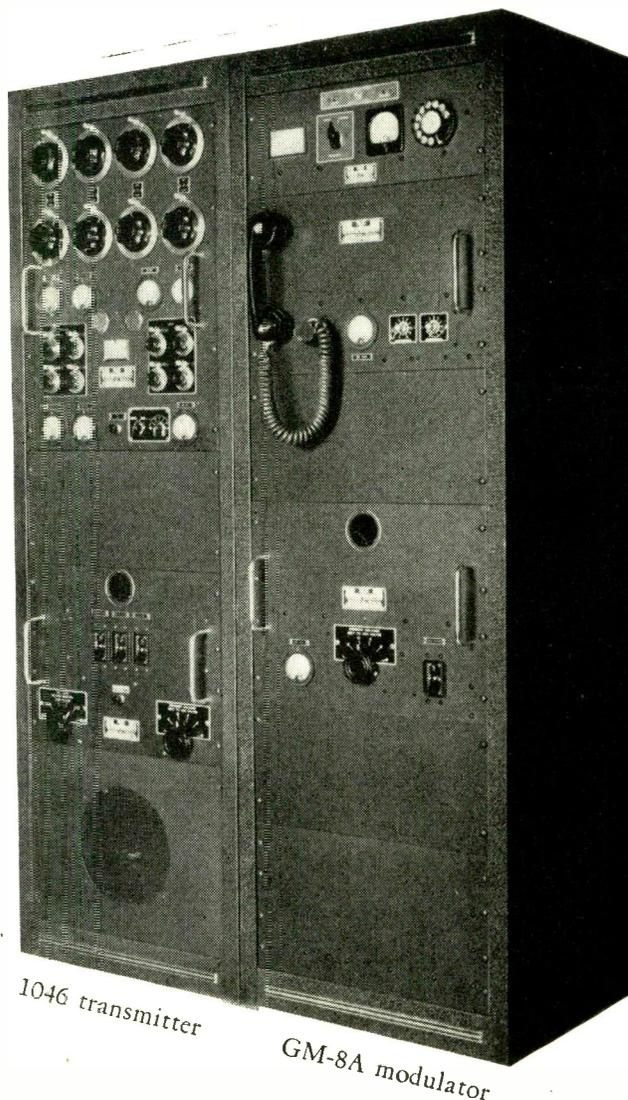
Rugged, versatile general purpose H. F. transmitter—Aerocom's 1046 packs 1000 watts of power and high .003% stability under normal operating conditions (0° to +50°C.). Excellent for point-to-point or ground-to-air communications.

Multi-channel operation on telegraph A1, or telephone A3 with GM-8A modulator... new Aerocom 1046 can be *remotely controlled* with TMC-R at control position and uses only one pair of telephone lines. In A3 operation, the local dial control panel is located in modulator cabinet.

Transmitter cabinet has 8 $\frac{3}{4}$  inch panel space available for either local dial control panel or frequency shift keyer.

Model 1046 operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.0—24 Mcs. Operates on one frequency at a time; channeling time 2 seconds. Operates into either balanced or unbalanced loads. Operates in ambient -35° to +50° C. Power supply: nominal 220 volts, 50-60 cycles, single phase.

*Complete technical data on request*



3090 S. W. 37th AVENUE

MIAMI 33, FLORIDA

# TUNG-SOL

# 6550



## BEAM POWER AMPLIFIER

**HIGH POWER CAPABILITIES** (Up to 100 watts output in pairs) **LOW DISTORTION OUTPUT** • **EXTREMELY UNIFORM CHARACTERISTICS** • **LONG LIFE**

### first in its power range . . designed specifically for audio service

The Tung-Sol 6550 is a brand new and direct approach to the high power design requirements of high fidelity audio amplifiers. For outputs up to 100 watts, two 6550's in push-pull will provide the same power now attained in most existing designs by the use of four or more tubes. In addition to greater audio output, use of the new 6550 results in simplified electrical balance, reduced maintenance and lower cost. The Tung-Sol 6550 is not directly interchangeable with the 6L6, 5881 or KT66 class of tubes. With proper circuitry, however, the 6550 will provide full power output with approximately the same grid voltage drive as the smaller tubes. The 6550 is produced under laboratory conditions with exhaustive quality control to assure premium performance and long life.

**Rugged Construction**—The advanced design features which have made the Tung-Sol 5881 so extremely reliable are embodied in the 6550.

- 1 Glass buttan stem construction is strong and compact and provides a rugged support for the tube structure.
- 2 Micanol wafer and metal shell base provides full lifetime electrical insulation and greater mechanical strength.
- 3 Cathode materials of exceptional stability give more uniform emission with greater life expectancy. Cathode is not poisoned by inactivity during standby periods.
- 4 Maximum control of grid emission achieved by gold plating and carbonizing.
- 5 Triple gettering promotes long, gas-free life. Getters are confined by a spray shield to prevent mica contamination.
- 6 Life tests are made under severe overload conditions to assure adequate safety factor.



The TUNG-SOL engineering which has produced the 6550 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Technical data sheets, or circuitry suggestions for the 6550 may be obtained by writing to Tung-Sol Commercial Engineering Department.

**TUNG-SOL ELECTRIC INC., Newark 4, New Jersey** — Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle  
**TUNG-SOL makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Lamps, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.**

### MECHANICAL DATA

Coated Unipotential Cathode	
Outline Drawing	Bulb—Short St-16
Base	Large Wafer Octal 8-Pin Mical with Metal Sleeve B8-86
Maximum Diameter	2 1/16"
Maximum Overall Length	4 3/4"
Maximum Seated Height	4 7/16"
Pin Connections	Retma Basing 7S
Pin 1—Base Shell	Pin 5—Grid No. 1
Pin 2—Heater	Pin 7—Heater
Pin 3—Plate	Pin 8—Cathode and Grid No. 3
Pin 4—Grid No. 2	
Mounting Position	Any

### ELECTRICAL DATA

(INTERPRETED ACCORDING TO RETMA DESIGN CENTER SYSTEM)

#### DIRECT INTERELECTRODE CAPACITANCES — No Shield

Grid #1 to Plate	0.85 $\mu\text{f}$
Input	14.0 $\mu\text{f}$
Output	12.0 $\mu\text{f}$

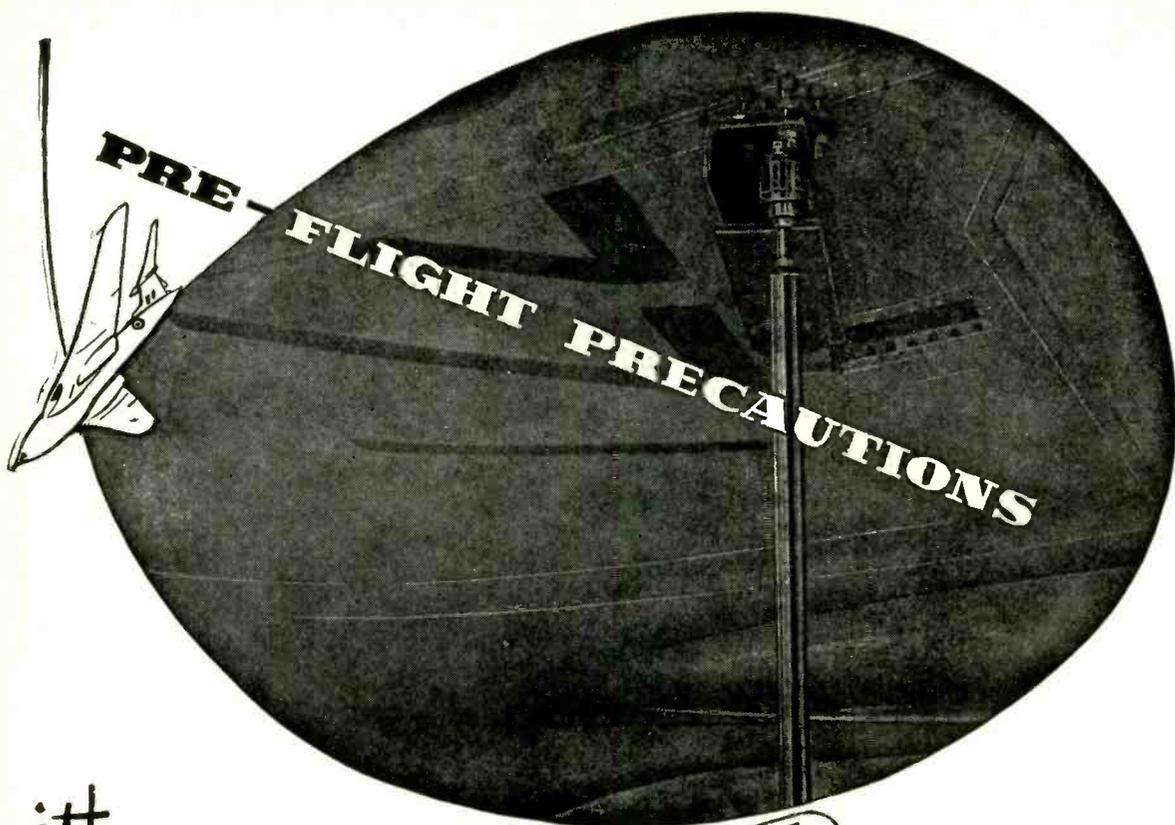
#### RATINGS

Heater Voltage (AC or DC)	6.3 $\pm$ 10% VOLTS
Maximum DC Plate Voltage	600 VOLTS
Maximum Plate Voltage (Triode Connection)	450 VOLTS
Maximum Plate Dissipation (Triode Connection)	40 WATTS
Maximum DC Grid #2 Voltage	400 VOLTS
Maximum Grid #1 Voltage	—300 to 0 VOLTS
Maximum Plate Dissipation	35 WATTS
Maximum Grid #2 Dissipation	6.0 WATTS
Maximum DC Cathode Current	175 MA.
Maximum Heater-Cathode Voltage	
Heater Positive (Peak) (DC not to exceed 100V)	+200 VOLTS
Heater Negative (Peak or DC)	—300 VOLTS
Maximum Grid #1 Circuit Resistance (Fixed Bias)	50 KILOHMS
Maximum Grid #1 Circuit Resistance (Self Bias)	250 KILOHMS
Maximum Bulb Temperature	250 °C

#### HEATER CHARACTERISTICS

Heater Voltage	6.3 VOLTS
Heater Current	1.8 AMP.

# TUNG-SOL® ELECTRON TUBES



with  
**GOODMANS**

PERMANENT  
MAGNET

**SHAKERS**

The flight characteristics of a newly designed aeroplane are the subject of lengthy calculations before the first prototype is built. Whilst the mathematical calculations are themselves accurate, they are based, as in all design work, on several assumptions which have to be verified by a series of pre-flight tests.

One of these essential investigations is the Ground Resonance test, the purpose of which is to determine the various complex modes of vibration of the airframe structure. The frequency of the mode and the dynamic response at remote parts of the aircraft must be accurately determined. The information obtained together with the aerodynamic derivatives is used in predicting the critical 'flutter' speed of the aircraft. The illustration shows one of the two Goodmans Model 8/600 Shakers which were used to excite the Handley Page 'Victor' for this very important test.

For wide frequency range vibration testing and dynamic response investigations, Goodmans Shakers are an obvious choice. These units require no field excitation and provide a faithful reproduction of the input wave form. Industrial applications of controlled vibration are continually increasing; maybe it can serve you—in which case our unique experience is at your service.

Just another of the wide applications of Goodmans Shakers

*The range includes models from the 8/600 shown, developing a force of  $\pm 300$  lb., to the midget model, with a force of  $\pm 2$  lb., for optical cell research and hairspring torque testing, etc.*



----- MAIL THIS COUPON -----

TO GOODMANS INDUSTRIES LIMITED  
AXIOM WORKS, WEMBLEY, MIDDX., ENGLAND

Please mail me your catalogue and technical data sheets in connection with your PERMANENT MAGNET Shakers.

NAME .....

COMPANY .....

CITY ..... ZONE ..... STATE ..... E/U .....

**GOODMANS INDUSTRIES LTD.**  
**AXIOM WORKS • WEMBLEY • MIDDX • ENGLAND**

Cables: GOODAXIOM WEMBLEY, MIDDX.

## THIS IS IT!

This is the actual size of the newest, smallest Blue Jacket — ready now to help solve your production problems!



# NEW... a 3-watt Blue Jacket<sup>®</sup> miniaturized axial-lead wire-wound resistor

This power-type wire wound axial-lead Blue Jacket is hardly larger than a match head *but it performs like a giant!* It's a rugged vitreous-enamel coated job — and like the entire Blue Jacket family, it is built to withstand severest humidity performance requirements.

Blue Jackets are ideal for dip-soldered sub-assemblies . . . for point-to-point wiring . . . for terminal board mounting and processed wiring boards. They're low in cost, eliminate extra hardware, save time and labor in mounting!

Axial-lead Blue Jackets in 3, 5 and 10 watt ratings are available without delay in any quantity you require. ★ ★

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS L (inches) D		MAXIMUM RESISTANCE
151E	3	1 $\frac{1}{2}$ "	1 $\frac{1}{4}$ "	6,000 $\Omega$
27E	5	1 $\frac{1}{2}$ "	3 $\frac{1}{8}$ "	30,000 $\Omega$
28E	10	1 $\frac{1}{4}$ "	3 $\frac{1}{8}$ "	50,000 $\Omega$

Standard Resistance Tolerance:  $\pm 5\%$



WRITE FOR ENGINEERING BULLETIN NO. 111B

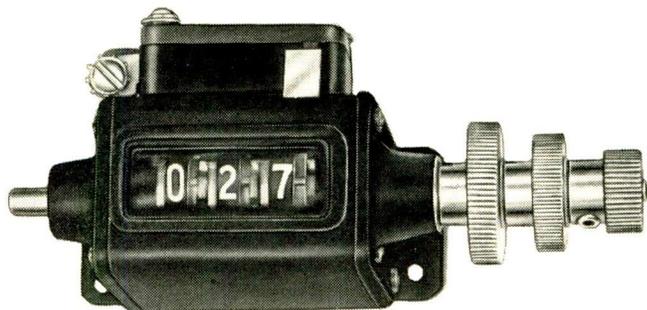
# SPRAGUE



SPRAGUE ELECTRIC COMPANY • 35 MARSHALL ST. • NORTH ADAMS, MASS.

Here's a New  
"TRAFFIC COP"

for short high-speed runs



Added Evidence  
that—

Everyone Can Count on  
**VEEDER-ROOT**

This new small Predetermining Ratchet Counter is set for any run up to 1,000 counts, pieces or other units by the three knurled setting knobs. Then it subtracts to zero, and at that point actuates a contact to light a light, ring a bell or stop the machine. Compact and easy to reset, this counter makes an attractive new selling feature when built into a ma-

chine as a standard integral part. And it's just one of scores of standard and special Veeder-Root Counters for every mechanical and electrical application in any field from atomics to automation. What would you like to count? Let Veeder-Root figure out how to do it. Write:

VEEDER-ROOT INCORPORATED  
HARTFORD 2, CONNECTICUT



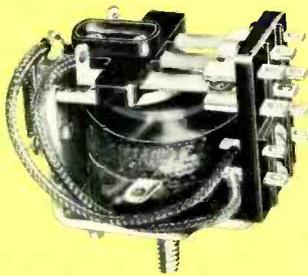
Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.  
Montreal 2, Canada • Dundee, Scotland  
Offices and Agents in Principal Cities

® "The Name that Counts"

# Relay problem - answer -

HIGH QUALITY AT LOW COST

## Potter & Brumfield's New KA • AB • GA Relays



### GENERAL PURPOSE SERIES KA

*Designed for current or voltage actuation. Small overall size, high capacity and many contact combinations make KA series universal in application.*

- Contact capacity up to 10 amperes
- Contact arrangements up to 3 form C (3PDT)
- Winding to 18000 ohms, 1/2 to 230V AC or 110V DC
- Maximum sensitivity 10 MA
- Available open or hermetically sealed
- Meets U. L. insulation requirements (Min. 1/8" through air, 1/4" over surface)
- Dimensions open relay 1" x 1 3/4" x 1 1/8" high

### APPLIANCE SERIES AB

*The AB relay is primarily designed for appliance applications to eliminate noisy and troublesome clapper or solenoid type contactors*

- One piece reinforced molded phenolic base
- No contact bounce capacity up to 20 amps
- Meets underwriter's creepage specifications
- Coils available to 230V AC or 110V DC
- Clip on solderless or screw terminals
- Dimensions 1 3/8" x 2 7/8" x 1 7/8" high mounting single 8-32 screw



### MULTIPLE LEAF SERIES GA

*The GA series permits a wide range of contact combinations for multiple circuit switching of power loads.*

- Contact arrangements up to 4 form C (4PDT)
- Contacts of various materials up to 10 ampere rating
- Patented unique variable magnetic gap structure
- Available with four different types of mounting arrangements
- Dimensions 1" x 1 1/16" x 1 13/16" high

SAMPLES AVAILABLE FOR IMMEDIATE SHIPMENT . . . QUOTATIONS ON REQUEST

**POTTER & BRUMFIELD**

PRINCETON INDIANA

Subsidiary of  New York, N. Y.



EXPORT: 13 East 40th Street, New York, New York  
Sales Offices in Principal U. S. and Canadian Cities



Potter & Brumfield



# Standard Relays

*offer you many advantages*

The extensive line of Potter & Brumfield Standard Relays will meet the circuit requirements of a wide variety of applications. Wherever a P & B standard or slightly modified version can be used to solve your problem you gain these important advantages.

**1 Proven Design**—P & B Standard Relays are the result of more than 20 years experience in relay design and have been completely proven under all kinds of operating conditions. You are assured of long, trouble-free, dependable performance.

**2 Lower Cost**—These relays are already tooled. They are manufactured in production quantities. You gain substantial advantages in costs.

**3 Fast Delivery**—Orders for standard relays can be filled from stock or with a minimum delay.

**4 Sold through Distributors**—Popular types available through P & B franchised Electronic Parts Distributors located in all principal cities.

## A FEW OF THE MORE THAN 110 P&B STANDARD RELAY STRUCTURES



**POWER RELAYS** Two series—heavy and medium duty. For across the line power circuits, high current or high voltage switching. From SPST to 3PDT.



**PLATE CIRCUIT RELAYS** Actuate on a few milliwatts. Easy to adjust. Small—rugged—low in cost. From SPST to DPDT.



**SUPER SENSITIVE RELAYS** Operate on less than 10 MW. Dual coils, 10G vibration resistance. Wide versatility. One Form C-SPDT.



**GENERAL PURPOSE RELAYS** For applications where space and weight are important. Withstand high shock and vibration. From SPST to 3PDT.



**IMPULSE RELAYS** Automatic stop prevents backlash or overtravel. Precise switching regardless of operating speed. DPDT or 4PDT.



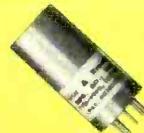
**400 CYCLE AC RELAYS** 15 gram or higher contact pressure. Withstand better than 10G shock. Heavy cast mounting foot. One form A to 2 form C.



**MULTIPLE CONTACT RELAYS** Longer coil gives power to actuate additional contacts and maintain 15 grams pressure. From SPST to 4PDT.



**TELEPHONE RELAYS** Four series meet practically all telephone type relay requirements. Short armature movement, long armature arm. Many contact combinations.



**SUPER MIDGET RELAYS** Tiny and rugged—plug in—one form C. High degree of resistance to vibration and shock.



**MULTIPLE LEAF RELAYS** For temperature, indicating or protective circuits. Heavy, tin-coated phosphor bronze contact springs. From SPST to 4PDT.



**MOTOR STARTING RELAYS** Voltage controlled to insure throwout of starting winding when motor reaches rated speed. Fast acting double break.



**SUBMINIATURE SENSITIVE RELAYS** Standard 7 pin plug-in. Ruggedized for vibration and shock. Operating power 25MW. Contact load 2 amps.



**LATCHING RELAYS** Compact—high utility switching. Coils operate on AC or DC. Voltage or current. From SPST to 4PDT.



**HEAVY-DUTY SHOCK-PROOF RELAYS** Can be mounted in any position. Particularly resistant to vibration and shock. From SPST to DPDT.



**MINIATURE DC POWER CONTACTOR** High current contact capacity and rugged construction. Contact pressure approx. 250 grams. SPST-NO-DM.

ALL P & B STANDARD RELAYS CAN BE SUPPLIED WITH DUST COVERS OR HERMETICALLY SEALED CANS WITH EITHER SOLDER OR PLUG-IN HEADERS

Write home office in Princeton or phone your local P & B Sales Office for new Engineering Guide describing our wide line of basic relay structures, housings and enclosures. Samples, recommendations and quotations promptly furnished on special applications.

P & B Standard Relays available at your local Electronics Parts Distributor

## POTTER & BRUMFIELD

PRINCETON INDIANA

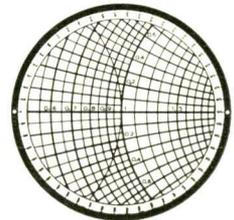
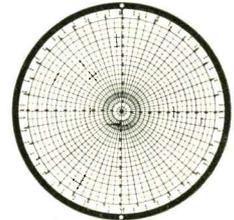
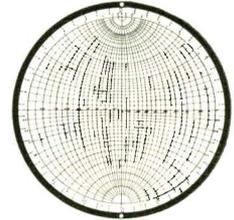
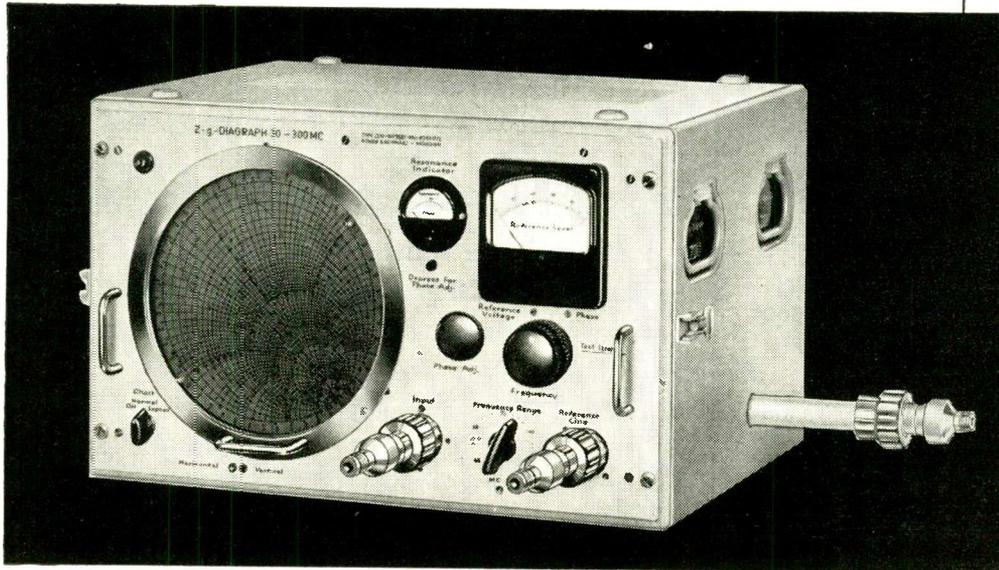
Subsidiary of  New York, N. Y.

# Federal!

introduces the **FIRST** instrument for

## PLOTTING IMPEDANCE instantaneously!

### Z-g DIAGRAPH



*Eliminates complex, time-consuming calculations...  
all measurements read from interchangeable charts*

The Z-g Diagraph, by Rhode and Schwarz—one of West Germany's leading instrument makers—is probably the most unusual device ever developed for fast, high-accuracy impedance and admittance measurements.

The Diagraph indicates results directly on a Smith, or similar, chart. It can obtain an entire broad-band characteristic in a few minutes . . . present it visually . . . without tedious calculating.

Separate, quickly-interchangeable charts permit measuring of reflection coefficient, resistance and reactance (Smith Chart), or magnitude and phase angle of an unknown impedance. Either can be used without recalibration or change in test set-up.

The transmission characteristic of a four-terminal network, such as a filter or attenuator, can also be read directly. The latter feature permits the Diagraph to be used for measuring the phase angle between two voltages of unequal amplitude but of the same frequency.

For further information on the performance and versatility of the Z-g Diagraph, mail the coupon to Federal's Instrument Division.

#### SPECIFICATIONS:

**Frequency Range:** Type ZDU . . . 30 to 300 mc.;  
Type ZDD . . . 300 to 2400 mc.

**Characteristic Impedance:** 50 ohms.

**Measuring Range:** Impedance . . . 1 to 2500 ohms;  
Phase . . . 0 to 360°; Attenuation . . . 0 to 30 db.

**Accuracy:** Amplitude . . .  $\pm 3\%$ ; Phase . . .  $\pm 1.5^\circ$ .

**Terminals:** Type N.

**Power Supply:** 115 volts (or 220 volts), 50 to 60 cycles.

**Weight:** 135 lbs.

**Price:** \$5,950 net, FOB, Clifton, N. J.



# Federal

## Telephone and Radio Company

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION  
INSTRUMENT DIVISION  
100 KINGSLAND ROAD, CLIFTON, N. J.

Federal Telephone and Radio Company  
Instrument Division, Clifton, N. J. Dept. S-113

- Please send further information on the Z-g Diagraph.  
 Please send the latest catalog of Federal Test Equipment.

Name \_\_\_\_\_ Position \_\_\_\_\_

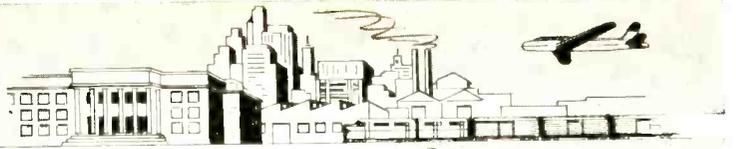
Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

for today...

and for many tomorrows



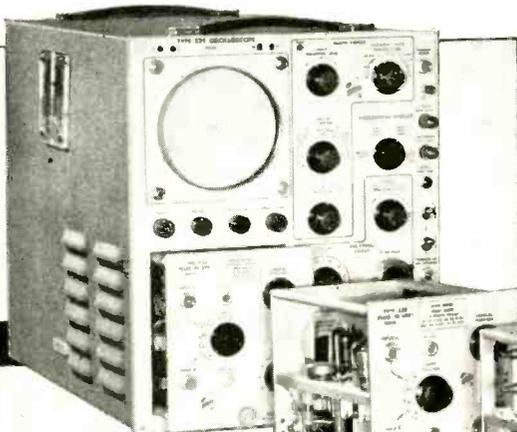
**What do you need in an oscilloscope now?**  
Is it here in one of these oscilloscope and plug-in combinations? What will you need tomorrow—next month—next year? Isn't it likely that you'll find it here, also?

**TYPE 531**—\$995 plus price of desired plug-in units.

**TYPE 535**—same characteristics—plus delayed sweeps. 1  $\mu$ sec to 0.1 sec calibrated delay in 12 ranges, incremental accuracy within 0.2% of full scale. Conventional or triggered operation. \$1300 plus price of desired plug-in units.

Prices f.o.b. Portland (Beaverton), Oregon

Your Tektronix Field Engineer or Representative will gladly arrange a demonstration at your convenience...call him today.



**What about future needs?**

Tektronix is working on that, too! New plug-in units now in development will help you accomplish even more with a single oscilloscope—and help you keep that oscilloscope working for you far longer.

You'll have the best today... and for a long time to come... with a Tektronix Type 531 or Type 535 Oscilloscope.

**Tektronix Model 531 and 535  
OSCILLOSCOPE CHARACTERISTICS**

**Advanced Cathode-Ray Tube**

Entirely new Tektronix crt provides full 6cm x 10cm undistorted viewing area...50% more vertical deflection than previous high-voltage tubes. 10kv accelerating potential permits single-sweep photography at the fastest sweep speed.

**Wide Range of Triggered Sweeps**

0.02  $\mu$ sec/cm to 12 sec/cm, continuously variable. 24 calibrated sweeps from 0.1  $\mu$ sec/cm to 5 sec/cm, accurate within 3%. Accurate 5-x magnification.

**Wide-band Output Amplifier**

DC-coupled amplifier designed for use with all Type 53-series Plug-in Units.

**Balanced Delay Network**

0.25  $\mu$ sec signal delay in vertical amplifier.

**Sensitive Horizontal Amplifier**

0.2 v/cm to 20 v/cm sensitivity.

**Versatile Triggering**

Internal or external, with amplitude level selection or automatic triggering.

**Square-Wave Amplitude Calibrator**

0.2 mv to 100v in 18 steps, accurate within 3%.

**DC-Coupled Unblanking CRT Beam Position Indicators**

**Electronic Power-Supply Regulation**

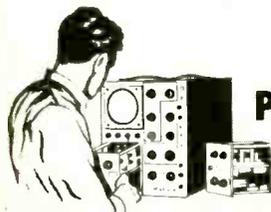
**TYPE 53A**—DC to 10 mc, 0.035  $\mu$ sec risetime; 0.05 v/cm to 50 v/cm, calibrated...\$85

**TYPE 53B**—Same as Type 53A with additional calibrated ac-sensitivity to 5 mv/cm...\$125

**TYPE 53C**—Dual-trace unit. Two identical amplifier channels, dc to 8.5 mc, 0.05 v/cm to 50 v/cm. Electronic switching triggered by oscilloscope sweep... or free running at about 100 kc...\$275

**TYPE 53D**—Differential input, high gain. DC to 350 kc at 1 mv/cm—pass-band increasing to 2 mc at 50 mv/cm. Full range 1 mv/cm to 125 v/cm, \$145

**PLUG-IN UNITS**



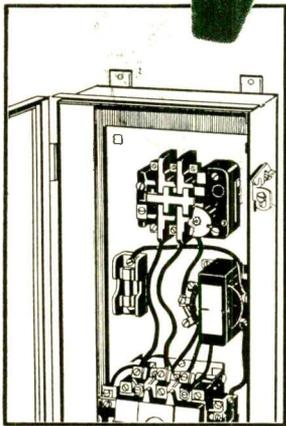
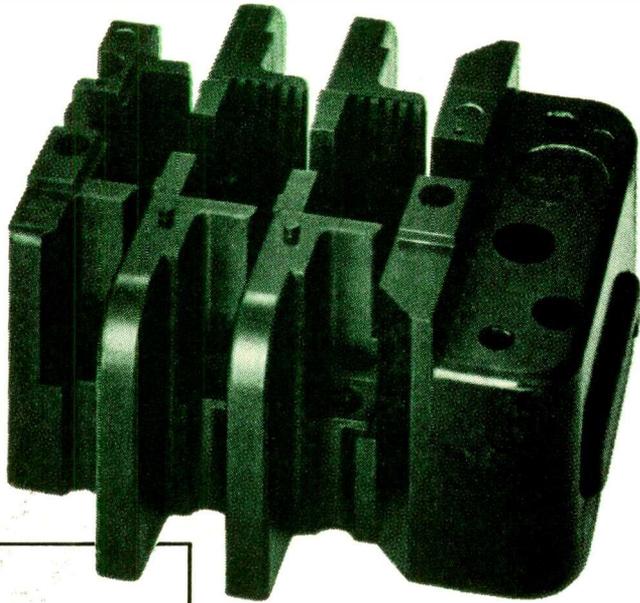
New booklet describing phase-angle measurements with the Type 535 and Type 53C now available. Write for free copy.



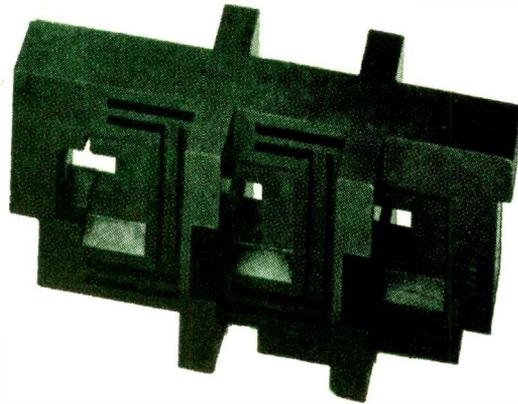
**Tektronix, Inc.**

P. O. BOX 831A, PORTLAND 7, OREGON  
CYpress 2-2611 • Cable: TEKTRONIX

# How would you handle this electrical parts problem?



Combination starter, containing parts molded of Monsanto's Resinox 3700 thermosetting material, manufactured by Arrow-Hart & Hegeman Electrical Co.



**Arrow-Hart  
solved it with  
new**

**RESINOX 3700**

Arrow-Hart & Hegeman Electrical Company of Hartford, Conn. needed a strong, stable, electrical-grade material with high arc-resistance for important parts of their combination starter shown here. They specified Monsanto's new thermosetting molding powder, Resinox 3700. Result: Complete satisfaction!

Resinox 3700 is the ideal all-around material for magneto ignition, motor control and electronic circuits, and other electrical applications.

- 1** It combines high arc-resistance with outstanding dimensional stability. Eliminates undesirable after-shrinkage.
- 2** It has excellent moldability and relatively good impact resistance, plus good transfer molding properties.
- 3** It offers superior heat resistance.

Perhaps Resinox 3700 is exactly what *you* need to solve an electrical equipment problem. Write today for full information!

Resinox: Reg. U. S. Pat. Off.



SERVING INDUSTRY . . .  
WHICH SERVES MANKIND

MONSANTO CHEMICAL COMPANY, Plastics Division, Room 2507, Springfield 2, Mass. Please send me complete information on Monsanto's new Resinox 3700 arc-resistant material.

Name & Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

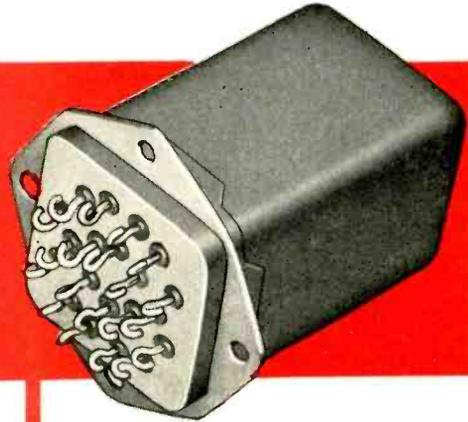
City, Zone, State \_\_\_\_\_



# Presenting THE NEW 5-AMPERE SUB-MINIATURE 6-Pole, Double Throw **GUARDIAN** Series **2005 RELAY**



**Hermetically Sealed**

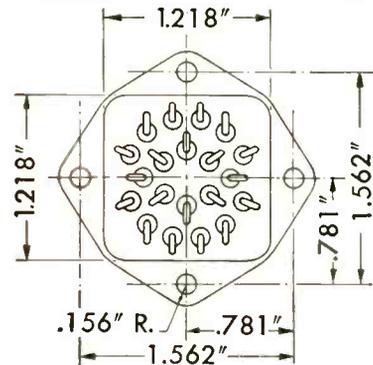


★It's here—a truly great achievement in *sub-miniature* control engineering and hermetic sealing—the new Guardian Series 2005 Relay. And here are the features that design engineers evaluate so highly: (A) de-gassed construction materials prevent contact contamination; (B) extremely high contact pressure in both energized and de-energized positions insures reliable operation at both low and maximum current ratings; (C) internal wiring, limited to two connections from coil terminals to header pins, virtually eliminates breakage of leads. It's easy to see—this new Guardian Series 2005 hermetically sealed sub-miniature relay can equip your product to prevent rejects and reduce service calls. Prompt quotations gladly given upon request.

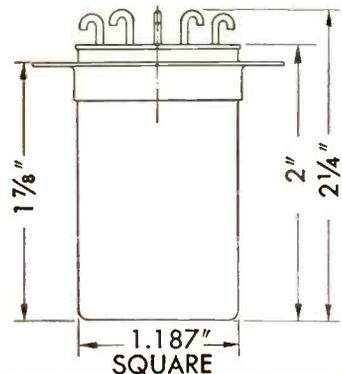
## CHARACTERISTICS:

- Unit meets all requirements of Military Specifications MIL-R-5757-B, Class A and MIL-R-6106-A, Class A.
- Built to withstand 100 G shock. Vibration resistance is 10 G minimum from 75 to 2000 cycles per second in all mounting planes.
- All contacts rated at 5 Amperes, 24 to 30 Volt, Direct Current, resistive load. Nominal coil voltage is 24 to 30 Volts. Unit operates satisfactorily on as low as 16 volts at 25° C., ambient temperature.
- Fine silver contact materials insure extremely low contact resistance.
- Class B relays, per Military Specification MIL-R-5757-B and as in other specifications, such as MIL-R-6106-A, also available upon request.

Guardian Series 2005 Relay



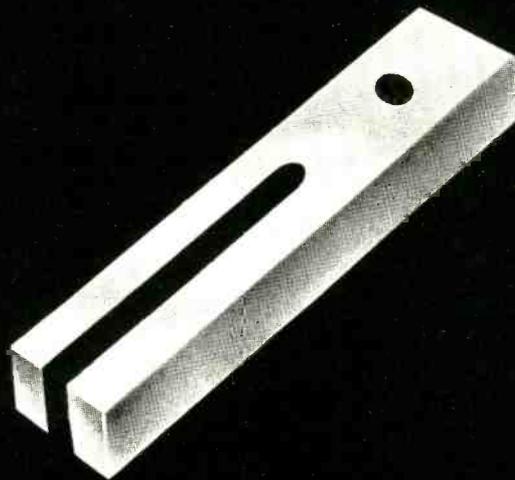
(4) MTG. HOLES .144" DIA.



*Write* FOR SPECIFIC ENGINEERING RECOMMENDATIONS FOR YOUR APPLICATIONS.

**GUARDIAN** **ELECTRIC**  
1625-P W. WALNUT STREET CHICAGO 12, ILLINOIS  
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

*Tuning Fork Resonators,  
the ultimate in precision audio  
frequency control...*



*... phone or write*

for complete information regarding component type  
**Tuning Fork Resonators**, or variously pack-  
aged **Tuning Fork Frequency Standards**.



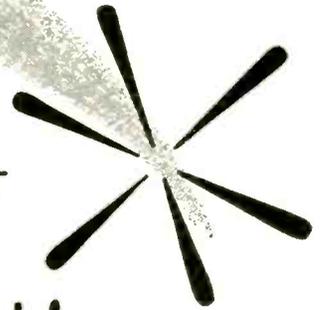
*Philamon Laboratories Inc.*

5717 THIRD AVENUE, BROOKLYN 20, NEW YORK

NYacinth 2-4800



new  
additions



to this comprehensive line of  
**MODERN PRECISION PORTABLES**

### **WESTON 901 LINE**

#### **D-C**

- Voltmeters
- Volt-Ammeters
- Ammeters
- Milliammeters

#### **A-C**

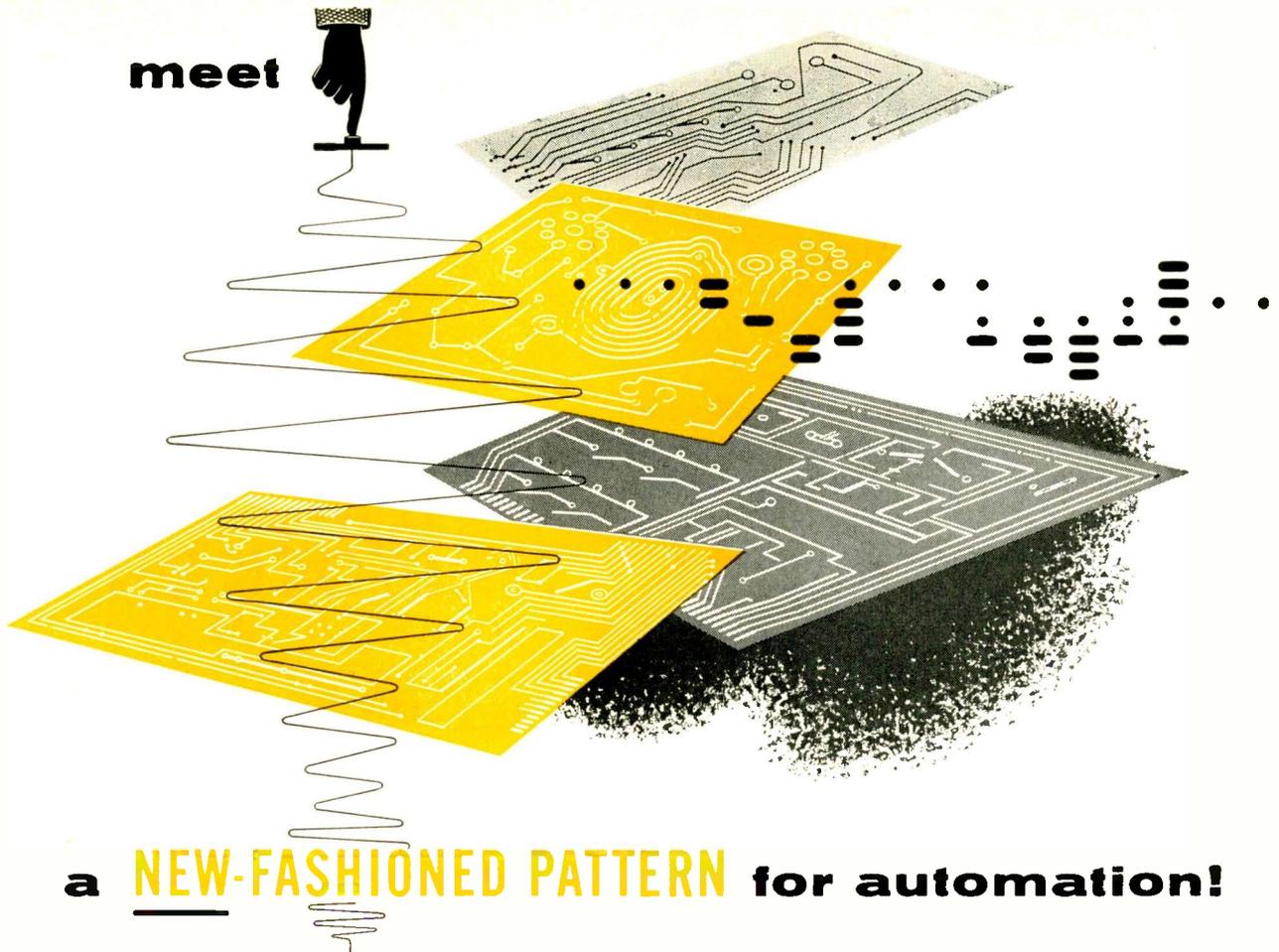
- Voltmeters
- 8 Range Voltmeters\*
- Ammeters
- 7 Range Ammeters\*
- Milliammeters

**A-C and D-C  
single-phase Wattmeters\***

Providing unequalled scale visibility due to wrap-around windows, the same rated accuracy of 0.5% and the same efficient shielding of all other instruments in this famous line, these three new additions make the 901 group the most comprehensive line of precision portables available. Complete specifications and prices available in bulletin form, or from the WESTON representative in your vicinity... WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

**WESTON**  
*Instruments*

meet



## a NEW-FASHIONED PATTERN for automation!

Automation is a sought-for goal today—but, for the electrical and electronic manufacturer, hand wiring and assembly are the stumbling blocks in its achievement. But now a bright entrant in the field, *printed circuitry*, overcomes this obstacle—and provides other equally great gains in addition!

Complicated manual wiring is replaced by a pattern of conductors, coils, resistors, and other components “printed” on a sheet of laminated plastic. Low in cost, uniform in performance, and free of wiring “bugs,” such assemblies are speedily mass-produced. Labor costs are drastically cut two ways—far fewer personnel are needed, and lesser-skilled workers can easily assemble (and service) complex devices with less chance of error. Since exact wiring duplication is achieved, inspection is greatly simplified. Assemblies grow small in size, overhead is reduced, less floor space is needed . . . the whole problem takes a big “easy-does-it” step toward complete automation.

National Vulcanized Fibre Co. is a pace-setter in the development of foil-clad laminates—the basic materials for most printed circuitry. Copper-Clad Phenolite—by National—is recognized as the standard by fabricators everywhere. For Phenolite is a high-quality base laminate that can be *engineered* to fit *your* conditions. It has the high insulation resistance, low electrical loss, and low moisture absorption required in the *right* base material for printed circuits. It is light in weight, easily punched and worked, and withstands effects of the various circuit-printing processes.

No matter which method you use to produce printed circuits, Phenolite clad laminates are the ideal base materials. Whether clad with metal foils, or non-metallic materials (such as rubber, vulcanized fibre, etc.) there is a Phenolite laminate for *your* particular job.

Ask any of our district offices or Wilmington headquarters for details.



**HERE'S HELP FOR YOU**—our new, fact-filled, 12-page bulletin entitled “Mechanize Your Wiring With Copper-Clad Phenolite.” Contains full information and application data on Copper-Clad Phenolite and other metal and non-metal clads. Write for it today! Address Dept. AF-12.



Also manufacturers of Vulcanized Fibre, Vul-Cot Waste Baskets, Peerless Insulation, Materials Handling Equipment and Textile Bobbins



**NATIONAL  
VULCANIZED FIBRE CO.**

WILMINGTON 99, DELAWARE

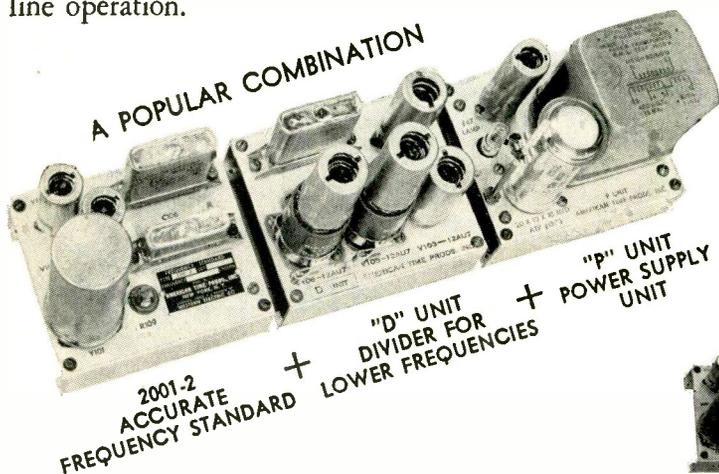
# FREQUENCY STANDARDS

# Modular system

DESIGNED AS A

The Type 2001-2 series provides frequencies from 30 to 30,000 cycles with an accuracy of .001% (at room temperatures) in units suitable for integration with instruments of your own design — or for panel rack mounting with your own power sources — or for line operation.

WHICH WILL MEET YOUR  
**CUSTOM NEEDS**  
FROM A COMBINATION OF  
**STOCK UNITS**



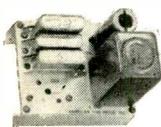
### TYPICAL COMBINATIONS

2001-2	2001-2 + M
2001-2 + L	2001-2 + M + P
2001-2 + L + P	2001-2 + L + P + R
2001-2 + H	2001-2 + H + P + R
2001-2 + H + P	2001-2 + M + P + R

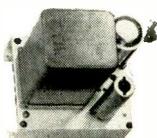
### TYPE "2001-2" FREQUENCY STANDARD

Frequencies, 200 to 3,000 cycles. Output, approximate sine wave at 5 volts.

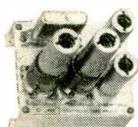
## ACCESSORY UNITS



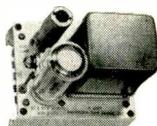
"L" UNIT.  
DIVIDER, (MULTI-VIBRATOR TYPE)  
Provides frequencies from 30 to 200, controlled by the 2001-2 unit.  
Output, approx. 5V. Approx. sine wave.



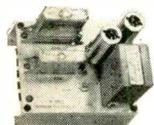
"M" UNIT  
AMPLIFIER  
Provides 2 watts at 6 and 110 volts.



"D" UNIT.  
DIVIDER, (COUNTER TYPE)  
Provides 40 to 200 cycles controlled by the 2001-2 unit. (fail safe)



"P" UNIT  
POWER SUPPLY  
Provides power for combinations of units illustrated, if other sources are inconvenient or not available.



"H" UNIT  
MULTIPLIER  
Provides frequencies from 3,000 to 30,000 cycles, controlled by the 2001-2 unit. Output, approximately 5 volts.



"R" UNIT  
PANEL MOUNTING  
Accommodates up to three units. Standard size is 8¾ inches high, 19 inches long.

For details, please request our "Type 2001-2" Booklet.

# American Time Products, Inc.

580 Fifth Avenue

New York 36, N. Y.

OPERATING UNDER PATENTS OF WESTERN ELECTRIC COMPANY

# Transitron<sup>®</sup>

NOW . . . FROM

**GOLD BONDED**

**SUBMINIATURE  
GLASS DIODES**

*designed for specific applications*

#### HIGH INVERSE VOLTAGE TYPES

The 1N55B with a 150 volt rating, and the T5G with a 100 volt rating are particularly suitable for circuits where high voltages are encountered.

#### HIGH TEMPERATURE TYPES

The T18G and 1N198 diodes are rated, specified, and 100% tested for operation at 75°C. They are specifically intended for use where high inverse resistance and reliable performance is required at elevated ambient temperatures.

#### HIGH CONDUCTANCE TYPES

For applications requiring high forward conductance, types such as the T7G and T25G with over 200 ma at +1 volt provide improved circuit performance.

#### HIGH RESISTANCE TYPES

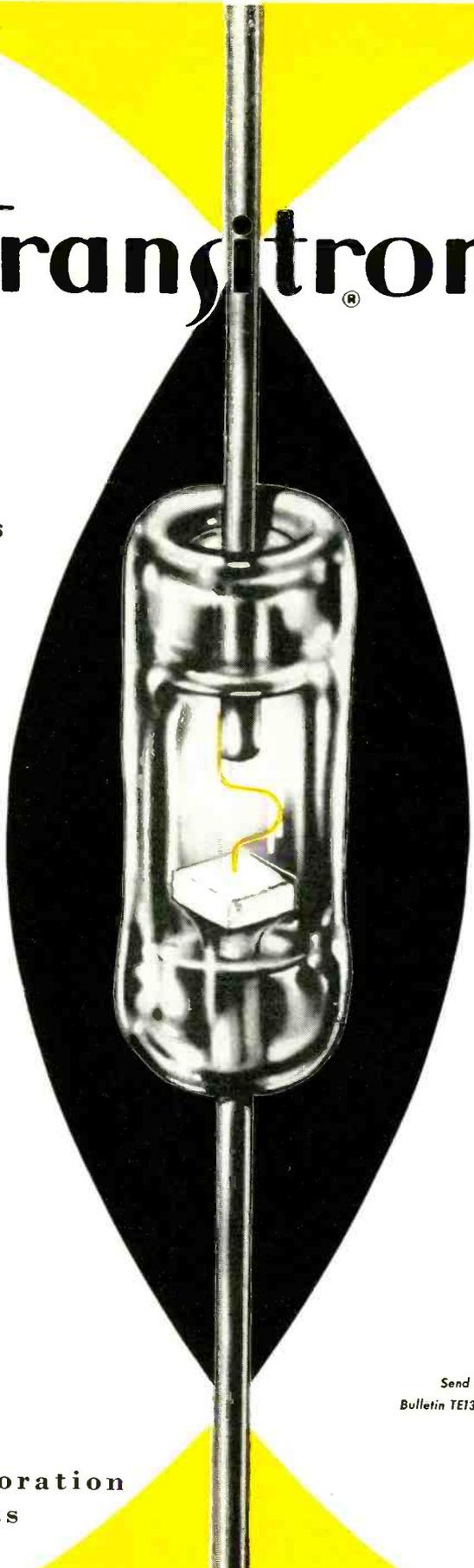
The T8G and T9G offer several megohms inverse resistance and are ideal for critical circuits requiring a minimum of diode loading.

#### COMPUTER TYPES

Specified for recovery time, the T16G, T17G, 1N191, and 1N192 are suited for critical pulse circuitry. Types T7G, T6G, and T25G have been designed especially for fast core switching.

#### JAN TYPES

The 1N126, 1N127, 1N128, and 1N198 are designed and tested to meet all requirements of MIL-E-1B.



*actual  
size*

Send for  
Bulletin TE1319.



**Transitron** electronic corporation  
melrose 76, massachusetts



Power Transistors



Transistors



Germanium Diodes



Silicon Diodes



Quads



SYNCHRO



SERVO MOTOR



RESOLVER

Ketay offers a complete range of sizes and types of rotating components . . . synchros, servo motors, and resolvers. Specifications for 116 of them are contained in an illustrated brochure, available upon request.



Ketay leadership is the result of sound, imaginative engineering. From the design of a specialized component to the fabrication of complete systems, Ketay engineers create the "standards of tomorrow".



Costs, quality, and stringent delivery schedules, are best controlled when critical manufacturing is done "on the premises" . . . under close supervision. Ketay plants are fully equipped with modern machines and equipment. This Heald Borematic Department is but one of many such divisions at Ketay.

# Ketay

. . . leader in the development and manufacture of Synchros, Servo Motors, Resolvers, Amplifiers, Airborne instruments, and Automatic Controls.

Ketay leadership is the result of a combination of research, experience, and outstanding manufacturing facilities. Some of these facilities are pictured here.

Ketay has produced many *firsts* in automatic controls. For example, in Synchros, Ketay was first to produce miniaturized Synchros so remarkable for their high accuracy and unmatched reliability. Ketay was *first* to produce high temperature and corrosion resistant Synchros. Today, Ketay produces literally hundreds of different

Executive Offices  
555 Broadway, N. Y. 12,  
N. Y.

Pacific Division:  
12833 Simms Avenue,  
Hawthorne, Calif.

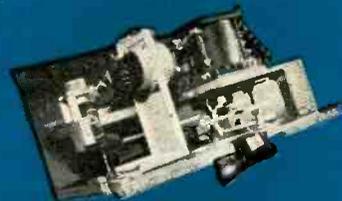
**Ketay**  
Instrument Corporation



MAGNETIC AMPLIFIER



RESOLVER AMPLIFIER



ELECTRO-MECHANICAL ASSEMBLY

Components for complete systems including gear trains and amplifiers of conventional and miniaturized types are available to meet the most demanding of design requirements.



FUEL TOTALIZING INDICATOR



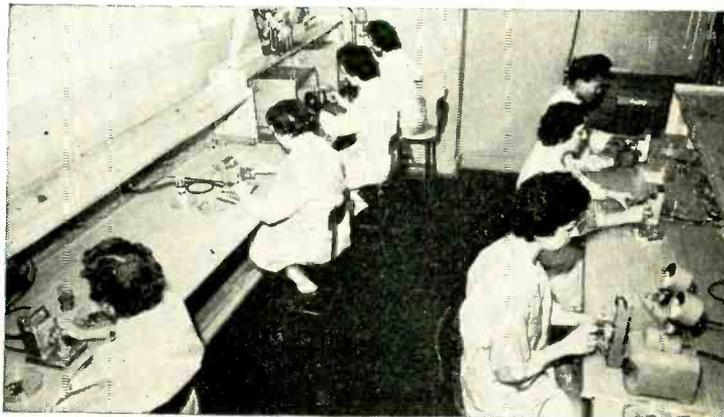
FUEL FLOW TRANSMITTER



DUAL FUEL FLOW INDICATOR

Electronic control devices are among the many instruments Ketay manufactures for aircraft, missiles, marine, ordnance, and civilian application. Special designs to meet the limitations of space and operating conditions.

# Ketay



Inspection of all parts, sub-assemblies, as well as completed instruments, is a fetish at Ketay. For instance, all bearings are inspected with specially developed equipment in air conditioned work space. This is just one of the many techniques that assure maximum performance when Ketay units are specified.

electro-mechanical devices some of which are illustrated on these pages. Currently, original Ketay developments are providing instrument performance far above present standards—many of which were set by earlier Ketay developments.

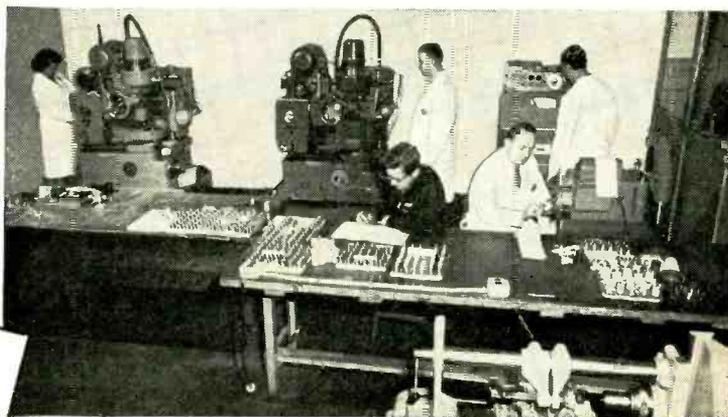
Ketay successfully applies its production facilities and experienced research personnel to specific problems for the leaders in automatic control.

Your interest will be well served by learning fully of the products and services you may obtain from Ketay.

Electronic Instrument Division  
New York Division

Kinetex Instrument Division  
Research & Development Division

*Write, today, for descriptive specifications of those types of Ketay instruments which may be applied to your designs.*



Precision of manufacture is vital in every Ketay unit. To assure continuing reliability for its products, Ketay employs the very latest facilities and techniques. Typical is this "gear room" where modern gear cutting machinery produces gears to the finest of tolerances.



TACHOMETER GENERATOR

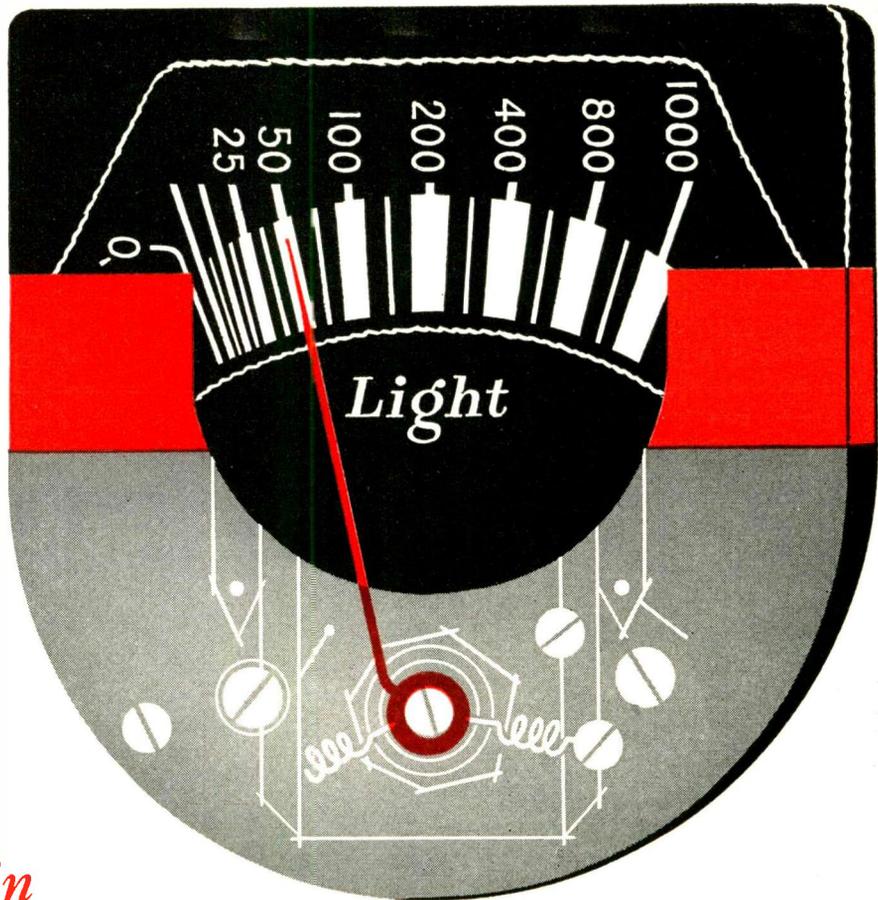


PANCAKE SYNCHRO GYRO PICKOFF



SYNCHRO OVERLOAD TRANSFORMER

Many specialized units have been designed by Ketay engineers and are in quantity production. Custom engineered units for specific application are also available.



*...in  
exposure meters  
too,*

## **CRUCIBLE PERMANENT MAGNETS**

*afford maximum energy...  
minimum size*

It's a fact, Crucible alnico magnets have a *consistently higher* energy product . . . which means more energy from a smaller magnet.

That's why, ever since alnico alloys were developed, Crucible has been producing them for leading manufacturers of voltmeters, watt-hour meters, exposure meters and magnet-equipped devices of all kinds.

Our twenty-years of magnet experience is backed by over a half-century of fine specialty steelmaking. You'll find that whenever you have a magnet application it will pay you to *call Crucible*.



**CRUCIBLE**

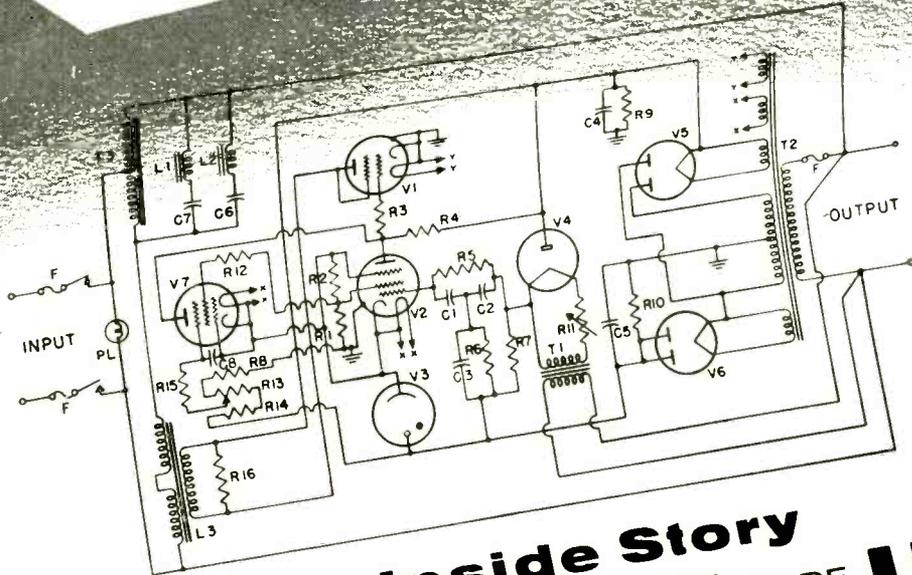
**first name in special purpose steels**

54 years of **Fine** steelmaking

**ALNICO PERMANENT MAGNETS**

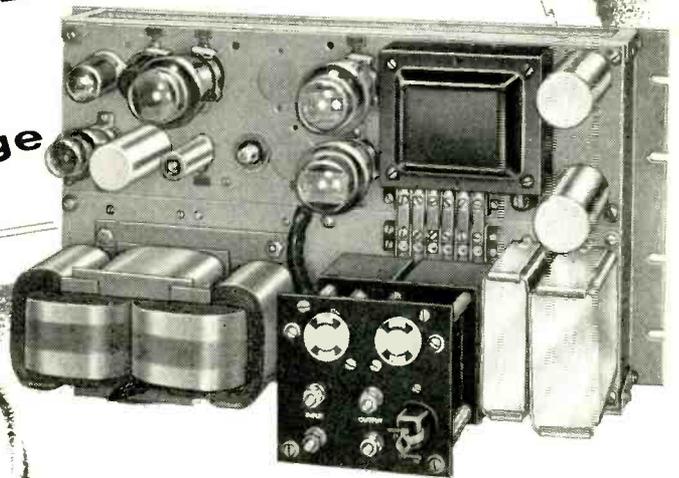
**CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.**

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS  
Canadian Distributor — Railway & Power Engineering Corp., Ltd.



# The Inside Story STABILINE TYPE IE

## Instantaneous Electronic Automatic Voltage Regulators



STABILINE Type IE5101R. Rated 95-135 Volts, 60 cycles input; 115 volts, 1.0 KVA output.

- Instantaneous Correction
- Excellent Regulation and Stabilization
- Minimum Waveform Distortion
- Wide Input Range
- Adjustable Output Voltage
- Insensitivity to Frequency Changes

The circuit diagram shows how the error detector, the amplifier and power control circuit are combined in a STABILINE Type IE to deliver stabilized and regulated a-c voltage.

You will find a combination of circuit simplicity and mechanical ruggedness in STABILINE Automatic Voltage Regulators Type IE. Send us the details of your specific requirements or use the coupon below. Numerous models are offered in capacities from 0.25 to 5.0 KVA.



Visit Superior Electric's Mobile Display when it visits your area.

THE  
**SUPERIOR ELECTRIC  
COMPANY**

212 Clarke Ave., Bristol, Conn.

Manufacturers of: Powerstat Variable Transformers • Stabiline Automatic Voltage Regulators • Voltbox A-C Power Supplies • Powerstat Light Dimming Equipment • Varicell D-C Power Supplies • Superior 5-Way Binding Posts

**THE SUPERIOR ELECTRIC CO.**  
212 Clarke Ave., Bristol, Conn.  
Please send Bulletin S351 on STABILINE Automatic Voltage Regulators.

Name.....  
Position.....  
Company Name.....  
Company Address.....  
City.....Zone.....State.....



# SENSITIVE RELAYS

by **Iron Fireman**

## EXCEED MILITARY SPECS!

At last! A sensitive relay which not only meets but actually exceeds the stiff requirements of military use. For example...

### 0-500 cps at 10g's

Ability to perform dependably under severe vibration conditions is an outstanding characteristic of this relay.

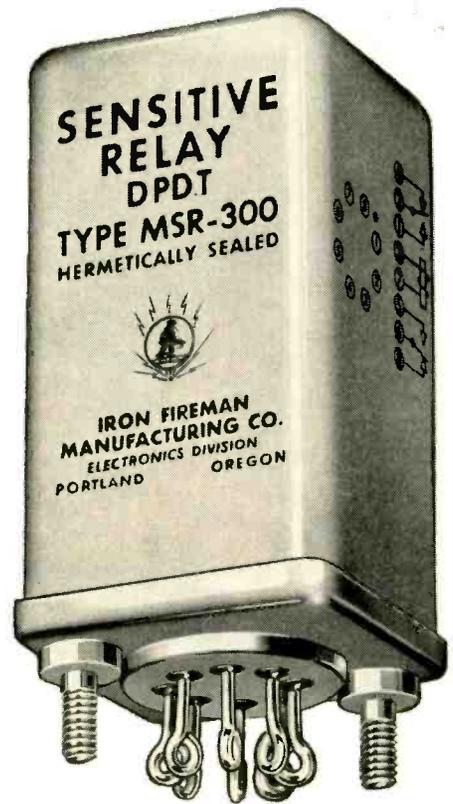
### -55° C to +110° C

Reliable operation is achieved under widely varying changes in ambient temperatures.

### Quarter-million cycles

The life of this relay has consistently been demonstrated to be in excess of 250,000 cycles of operation.

In ALL respects, Iron Fireman sensitive relays meet or exceed the requirements of MIL-E-5272 and MIL-R-5757B specifications.



### Model No. MSR-300

(actual size  $1\frac{1}{8}$ " high, 1" wide)

This small current-sensitive DPDT relay operates positively where very little power is available, such as in vacuum tube circuits. Available in models with coil resistance ranging from 150 ohms to 11,000 ohms, it is especially designed for dependable performance under adverse conditions of vibration, shock and temperature. A variety of header arrangements can be supplied.

For more information on Sensitive Relays as well as High Speed Relays, write now to:



® **Iron Fireman** *Electronics*

2800 S. E. 9TH AVENUE, PORTLAND 2, OREGON

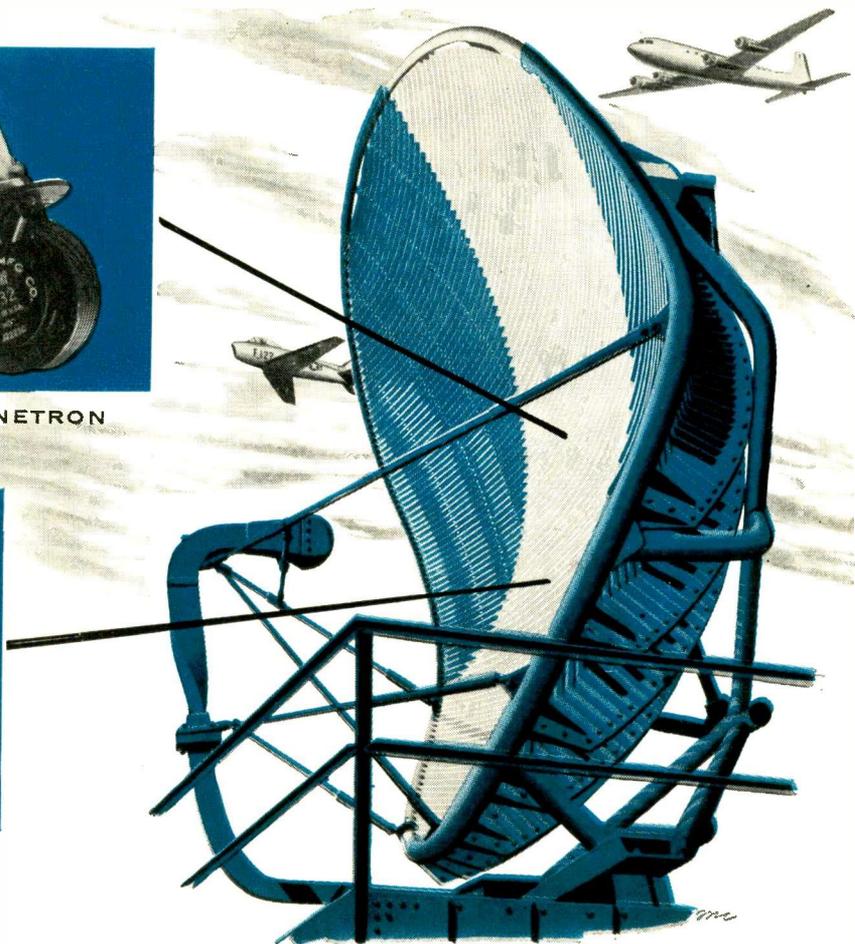
**DIVISION**



2J32 MAGNETRON



2K28 KLYSTRON



## HELPING ESTABLISH RELIABILITY RECORDS

### Raytheon Magnetrons and Klystrons in proved Gilfillan ASR-1 Radar

Civil Aeronautics Administration reports record-breaking reliability of Gilfillan airport surveillance radar. Boston International Airport had 8,760 hours continuous performance with only 7½ hours involuntary outage—less than ¼ of 1%—from their Gilfillan installation.

Check these performance records of Raytheon tubes in the Gilfillan ASR-1. Average life, 2J32 Magnetron: 4,000 hours. Average life, 2K28 Klystron: 2,500 hours.

Your microwave and radar equipment offers extra reliability when you specify Raytheon Magnetrons and Klystrons. Use these rugged, reliable tubes in your present and proposed systems. Contact Power Tube Sales to take advantage of Raytheon's Application Engineer Service, without obligation. Write for free Tube Data Booklets.

Condensed Typical Operating Data							
	Power Output	Frequency Range, mc	Reflector Voltage	Resonator Voltage	Maximum Temp. Coef.	Tuning	Cavity
2K28	140 mw	1200-3750	-140 v. to -300 v.	300 v.	± .15	Mech. Inductive	Ext.
	Power Output	Frequency Range, mc	Anode kv	Anode Amps.	Pulse Width	P.R.R.	
2J32	285 kw min.	2780-2820 Fixed freq.	20	30	1 μsec	1,000	



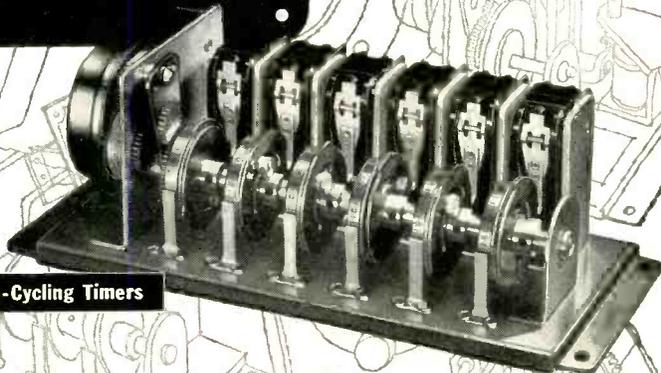
*Excellence  
in Electronics*

# 660 TIMER COMBINATIONS

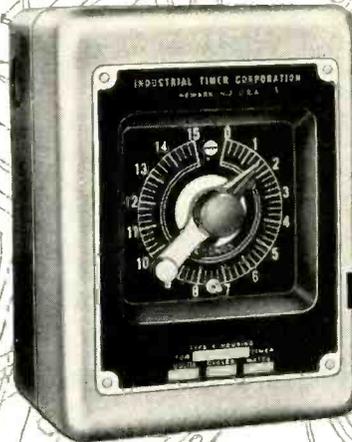
*...So far!*



**Time Delay Timers**



**Re-Cycling Timers**



**Interval Timers**



**Running Time Meters**

## PERHAPS YOUR TIMER WILL BE THE 661st

**H**ow do you know we can supply you with the timer that will do your job best? Because we have 19 years of experience in developing new timers to meet our customers widely varied requirements. If one of our standard timers won't do it—or one of the 660 combinations we have thus far developed from our 17 basic units—our engineers will develop the 661st combination, for your specific needs.

We manufacture a complete line of timers in these 4 broad classifications:

**TIME DELAY TIMERS • INTERVAL TIMERS  
RE-CYCLING TIMERS • RUNNING TIME METERS**

And since we maintain large stocks of our 17 basic units, we can assure you of rapid deliveries—and of good deliveries even on special orders. Automation? We're in it up to our ears...just put your problem up to one of our timer specialists. Your inquiries will receive prompt attention.

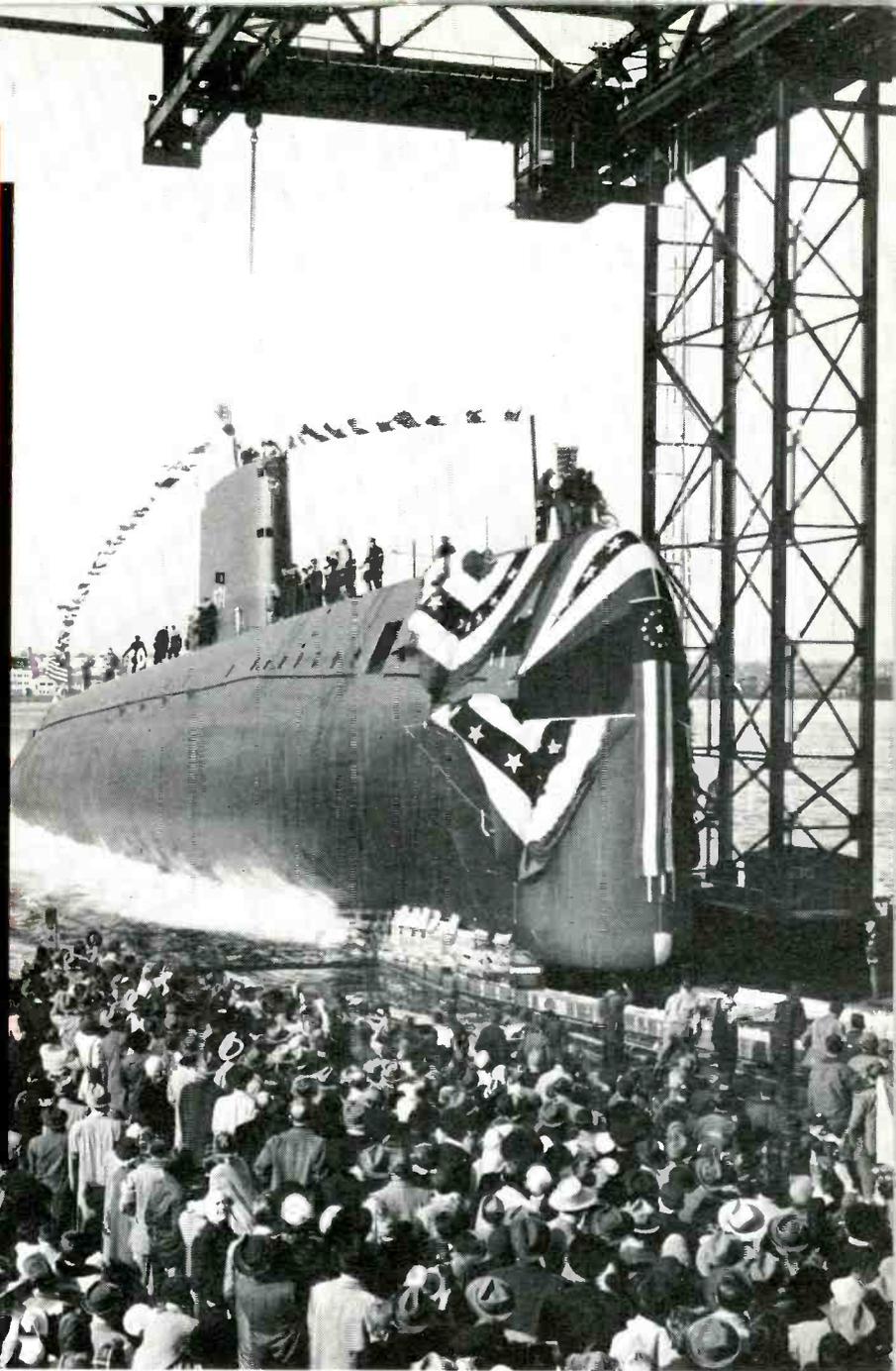
*Timers that Control  
the Pulse Beat of Industry*



**INDUSTRIAL TIMER CORPORATION**  
131 OGDEN STREET, NEWARK 4, N. J.

**THEY'RE  
LAUNCHING  
THE**

**world's  
deadliest  
fish**



It's the revolutionary *U.S.S. Nautilus*, world's first atomic-powered submarine and fastest recruit ever to join America's underseas fleet.

Built by the Electric Boat Division of the General Dynamics Corporation, the *Nautilus* can travel around the world completely submerged, surface to attack the enemy, then dive under water to race away at a speed that defies pursuit.

Naturally, every component of the *Nautilus*, down to

the last bolt, had to meet tough specifications. They weren't too tough, however, for the Ward Leonard electric control components and equipment installed.

Point is, when you want truly dependable performance from an electric control—whether it's for an atomic sub, an electronic computer or a traffic light—take your pick from the complete Ward Leonard line. And check the other side of this page for the story behind the fine reputation of Ward Leonard resistors.

48



**WARD LEONARD  
ELECTRIC COMPANY**  
MOUNT VERNON, NEW YORK



RHEOSTATS



RESISTORS



RELAYS



MOTOR CONTROLS

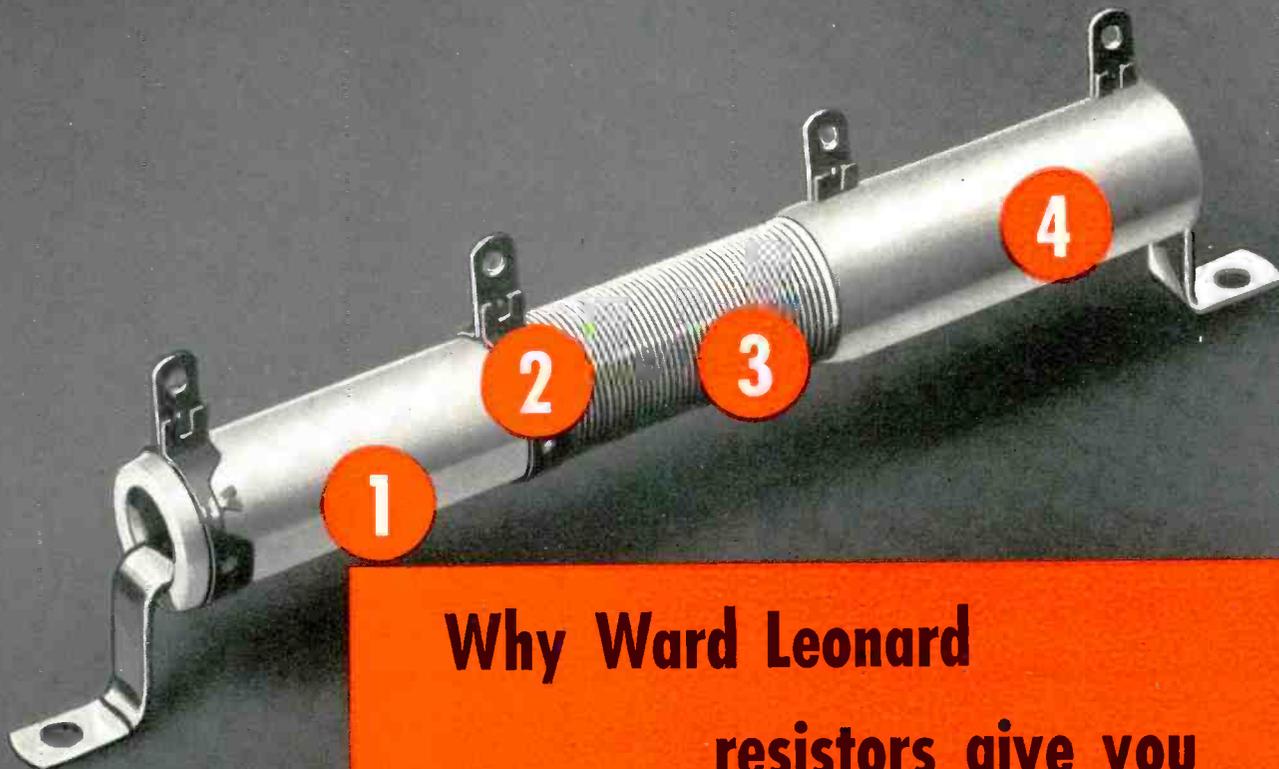


DIMMERS

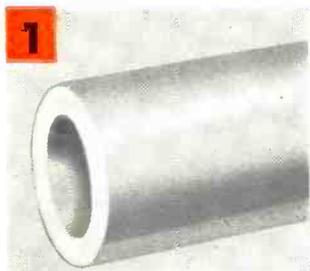


CHROAFLASTER

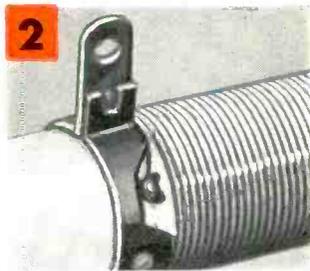
**R**esult-**E**ngineered Controls Since 1892



# Why Ward Leonard resistors give you **MORE FOR YOUR MONEY**



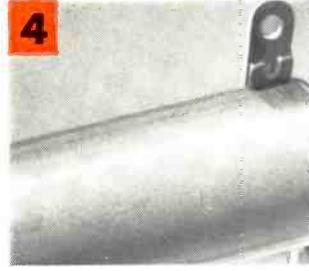
**1**  
**RESISTOR CORE.** Ward Leonard's own manufactured cores are perfectly smooth, cylindrical ceramic bodies of high density, low porosity, and high dielectric strength. The ceramic material has been selected so that its thermal coefficient of expansion is correlated to that of the other components.



**2**  
**TERMINALS.** In Ward Leonard resistors, special alloy terminals insure proper expansion and adherence to the enamel, and are designed to provide strong anchorage. Every wire-to-terminal junction is firmly clamped to the core, then specially silver-brazed for lasting contact.



**3**  
**RESISTANCE WIRE.** All wire is drawn to our own specifications for each particular resistor type. It's capable of withstanding heavy overloads, has a uniformly low coefficient of resistivity. Many of the "bar-gain" resistors are wound with resistance wire of ordinary grade.



**4**  
**COATING.** Vitrohm enamel coating of all Ward Leonard resistors provides a complete hermetic seal — highly resistant to shock, high humidity, extreme temperatures, acids, alkalis, and electrolysis. Unlike most resistor manufacturers, we manufacture our own vitreous enamel.

Our new 64-page Catalog 15 tells you more about the Vitrohm line of power resistors. It also includes many helpful charts and data. Write for it today to Ward Leonard Electric Company, 500 South Street, Mount Vernon, New York.



**WARD LEONARD  
ELECTRIC COMPANY**  
MOUNT VERNON, NEW YORK



RHEOSTATS



RESISTORS



RELAYS



MOTOR CONTROLS



DIMMERS



CHROMASTER

**R**esult-**E**ngineered Controls Since 1892



# Why we choose **Winco** DYNAMOTORS

"Precision airborne communication equipment must have a dynamotor of consistently reliable quality . . . that's why we specify Winco."

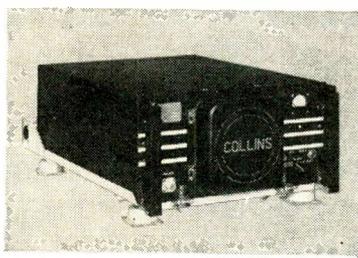
says Mr. Paul Wulfsberg,  
Ass't. Director Engineering and Research

## COLLINS RADIO CO.

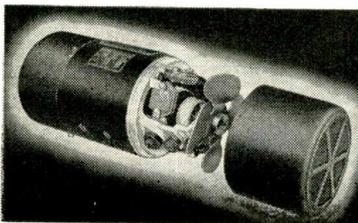
Cedar Rapids, Iowa.

WINCO DYNAMOTORS are manufactured on a wide range of rugged frames that allow for broad design applications. Winco engineers have a decade of experience in successfully designing dynamotors to rigid military and commercial specifications. They tackle each power conversion and/or supply problem individually, either modifying a standard Winco machine, or designing a special unit to meet your exact requirements. Winco specialists then plan its manufacture on a production basis to keep costs down and final performance quality at its best.

Winco dynamotors are lightweight, compact and totally enclosed and ventilated. Precise static and dynamic balance is assured by the most modern machines — each dynamotor is thoroughly tested with periodically calibrated precision meters.



Collins 18S Transmitter/Receiver, used for reliable HF communications in major air-lines and executive aircraft uses a Winco-Engineered Frame 51 Dynamotor.



**SEND THIS COUPON TODAY** for complete information on how Winco can supply you with reliable, efficient dynamotors and power supplies produced in volume at low cost.



**POWER** for the Nation's Mobile Communications

# WINCHARGER CORPORATION

Sioux City 2, Iowa

Subsidiary of **ZENITH** Radio Corporation

To Wincharger Corp., Sioux City 2, Iowa.

Send me the facts on Winco Dynamotors and Power Supplies

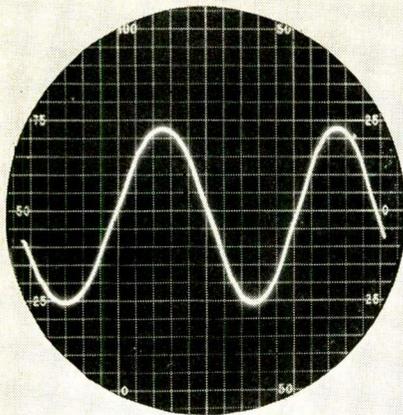
Name \_\_\_\_\_

Company \_\_\_\_\_

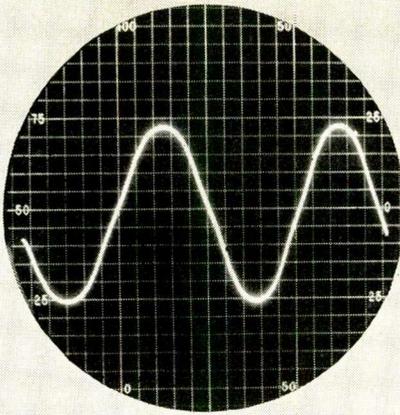
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

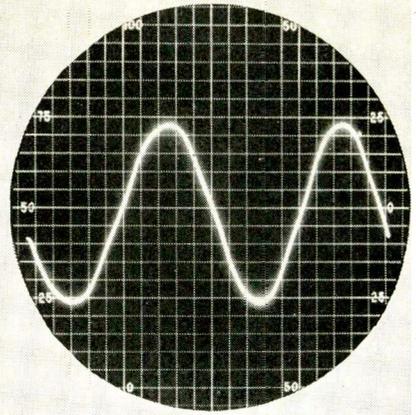
Coupon No. 163



No load



Half load



Full load

**UNRETOUCHED OSCILLOGRAMS OF OUTPUT VOLTAGE:**  
1000va Sola Harmonic-Neutralized Constant Voltage Transformer operating from 110v input and correcting

output to 115v with less than 3% harmonic distortion. "Commercial sine wave" is maintained regardless of load capacity served.

## ±1% static magnetic voltage regulation with less than 3% harmonic distortion

Static magnetic voltage regulation with all its advantages—automatic, continuous operation; instantaneous response; no maintenance; self-protection against short circuits; and input-output circuit isolation—has harmonics in its output voltage. In the case of the Sola Standard CV Regulator, harmonic distortion is held within an average of only 14% at full load. However, even 14% is excessive on some applications.

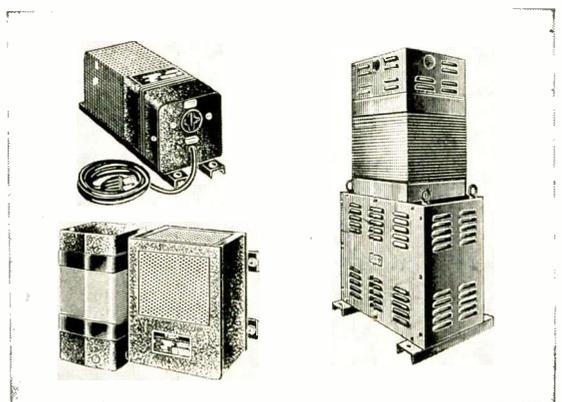
Sola Harmonic-Neutralized Constant Voltage Transformers have the characteristics of the Standard Sola CV Stabilizer *plus* the added advantage of less than 3% harmonic distortion in the output voltage wave.

Sola sinusoidal output stabilizers are ideal for the most exacting applications. They are widely used to provide stabilized undistorted voltage for instruments, production control components, and communication gear. They are especially suitable for input to a rectifier when close regulation of the dc output is required.

Six standard ratings from 60 to 2,000va are immediately available from your electronic distributor's stock. Custom-built designs with ratings from 30 to 15,000va can be ordered in production quantities. A Sola sales engineer will be happy to discuss your specific requirements.

*TYPICAL HARMONIC ANALYSES, TYPE CVH CONSTANT VOLTAGE TRANSFORMER					
	Input Volts	Output Volts	3rd	5th	7th
Full Load	115	115.0	0.77%	1.20%	0.34%
50% Load	115	116.1	1.00	0.70	0.55
No Load	115	116.2	0.65	0.36	0.60

\*On production units, the lowest residual harmonic content may occur anywhere between full load and no load.



**TYPICAL MECHANICAL STRUCTURES:** The two stabilizers on the left are stock units, the transformer on the right is a "special" in the 7,500va size range.

# SOLA *Constant Voltage* TRANSFORMERS

WRITE FOR BULLETIN 7L-CV-200  
FOR COMPLETE DATA

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • LIGHTING TRANSFORMERS for All Types of Fluorescent and Mercury Vapor Lamps. • SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Btshop 2-1414 • BOSTON: 272 Centre Street, Newton 58, Massachusetts • NEW YORK 35: 103 East 125th Street • LOS ANGELES 26: 2025 Sunset Boulevard • PHILADELPHIA: Commercial Trust Building • CLEVELAND 15: 1836 Euclid Avenue • KANSAS CITY 2, MISSOURI: 406 West 34th Street • Representatives in Other Principal Cities

## ADVANCED CAPACITOR DESIGN

... Especially adaptable to your own requirements and specifications

**Good-ALL**  
**CAPACITORS**

## MYLAR\* Dielectric

### METAL ENCLOSED

Hermetically Sealed,  
Miracle X Impregnated.



Types 612 and 613 extended foil construction

612 One End Grounded • 613 Both Ends Insulated



Types 614 and 615 tab construction

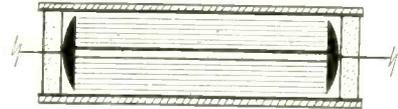
614 One End Grounded • 615 Both Ends Insulated

This MIFILM capacitor is unaffected by severe climatic changes—retains extreme high insulation resistance over complete temperature range of  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ . SUBMINIATURE SIZES OVER THE ENTIRE CAPACITANCE AND VOLTAGE RANGE. Special sizes can be made to withstand even higher temperatures. Tolerances as low as  $\pm \frac{1}{2}$  of 1%. Special shapes available to meet your space requirements.

## MYLAR\* Dielectric

### Commercial Type Construction

Enclosed in thermo-setting plastic impregnated tube or ceramic case.



Type 620 extended foil construction



Type 621 tab construction

A high quality, lower cost capacitor with the same excellent properties obtained in our hermetically sealed metal enclosed Mifilm Capacitor. Miracle X Impregnated (high temperature synthetic oil). Marbelite plastic end seal. Excellent humidity resistance. High insulation resistance. Low capacitance change with temperature. Operating temperature  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . Power factor less than .5%.

\*Du Pont trade-mark for its Polyester film.

We custom-build to your specified sizes. Our engineers are always ready to work with you on any capacitor problem. We invite sample orders for your evaluation. Write for complete catalog covering these and many other types of Good-All long life capacitors.

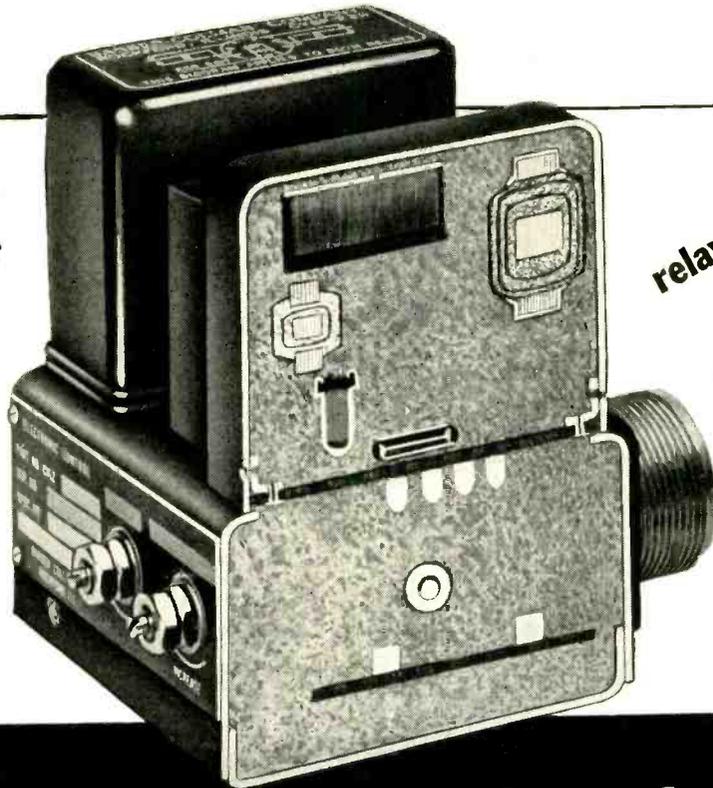
**Good-ALL**  
**CAPACITORS**

SO SUPERIOR they are being specified and used extensively by Electronics, Radio and TV Manufacturers throughout America.

### GOOD-ALL ELECTRIC MFG. CO.

114 West First Street • Good-All Building • Ogallala, Nebraska  
Phone 112 or 113

What's inside this Aircraft Temperature Control?...



resistors

transformers

potentiometers

capacitors

relays

sub-miniature  
vacuum tubes

radio noise  
filter

## BARBER-COLMAN protects these from shock, vibration, humidity with NOPCO® LOCKFOAM

Barber-Colman Company, Rockford, Ill., is well known for its varied line of aircraft temperature and positioning control systems, actuators, air valves, and other accessory equipment. In designing the electronic temperature control shown here, they required a potting material to protect the fragile components and the connecting wiring. It was necessary that the material be both light and strong, have good electrical insulation properties, and be impervious to salt spray and humidity. Curing temperature was not to exceed 250° F., and after curing had to withstand ambient temperatures up to 220° F.

Their search for the right material ended when they tried one of the 50 different formulations of Nopco Lockfoam. "By using Nopco Lockfoam as the potting material," states Barber-Colman, "we were able to meet environmental operating requirements with an economy in manufacturing and assembly time."

These properties of Nopco Lockfoam are finding new applications almost daily—and they are by no means limited to electronics or aviation. Since Nopco Lockfoam is poured-in-place, it exactly fills the configurations you wish to fill. It is consistent and reproducible.

One of the many formulations of Nopco Lockfoam may be the means of improving some product of yours, or even of bringing into being a product that so far exists only on your drafting board. Send for the free informative booklet today.



Plastics Division

**NOPCO**  
CHEMICAL COMPANY



Harrison, New Jersey

4858 Valley Blvd., Los Angeles 32, Calif.



**ONLY THE LEADER**

*always  
sets  
the  
pace*

**FIRST-**



high voltage mica capacitors.

In harness racing as in capacitors you pick the leader by looking at the record. That's why at Cornell-Dubilier, we're mighty proud of our record of new capacitor designs, consistent dependability and outstanding field performance—a record no other company can even come close to approaching. That's the record of

**FIRST-**



super-power tank circuit mica capacitors.

## **C·D...45 YEARS OF FAMOUS FIRSTS**

Typical of these "Famous Firsts" are the examples shown here... just three of the hundreds of money-saving answers in capacitors a C-D engineer can show you. Write to Cornell-Dubilier Electric Corp., Dept. K-124, South Plainfield, N. J.

**FIRST-**



carrier current coupling capacitors



**CONSISTENTLY DEPENDABLE  
CORNELL-DUBILIER CAPACITORS**

PLANTS IN SO. PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY, RADIANT CORP., CLEVELAND, OHIO.

THERE ARE MORE C-D CAPACITORS IN USE TODAY THAN ANY OTHER MAKE

A FEW OF MANY EDO SONAR  
EQUIPMENTS FOR COMMERCIAL AND NAVAL USE

# EDO

*finest name in*

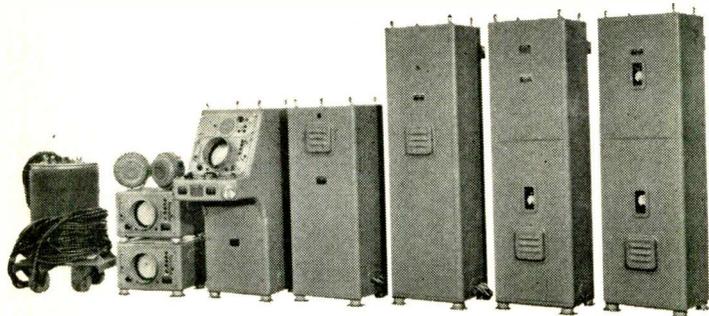
# SONAR

Ingenuity of design, proven performance and superior range with accuracy are the main reasons why EDO is now regarded and recognized as the outstanding leader in the development of echo-ranging equipment.

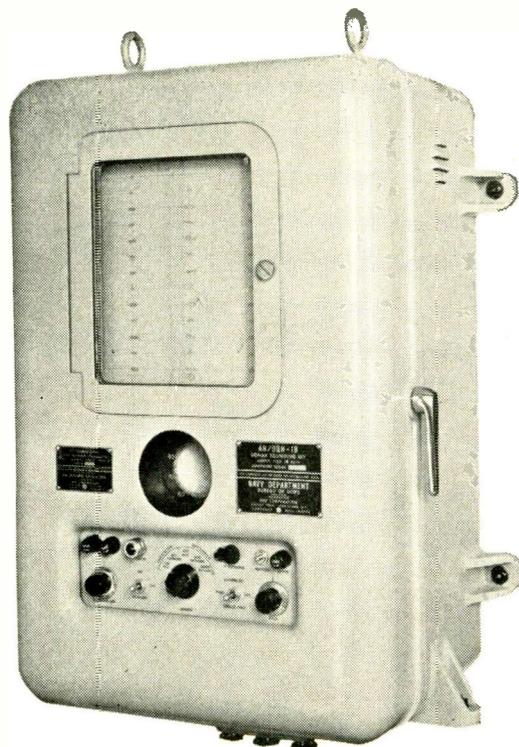
From deep depth sounders for navigation, survey, and ocean bottom exploration to a wide variety of under water detection systems, Edo equipment has made its mark and proven its superiority.

That's why when you see the Edo flying fish emblem on a sonar equipment you can confidently recognize it as a product of brilliant engineering and masterful workmanship—reliable beyond question.

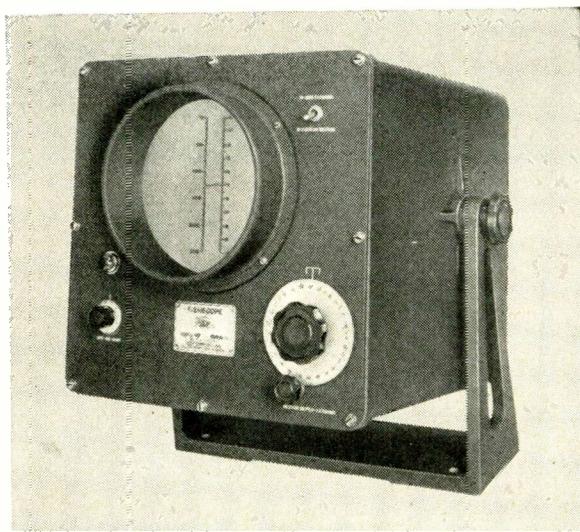
*Just off the press! "The Story of Edo"—24 page book describing Edo's diversified facilities and the company's 29-year old history. Send for your copy today.*



**EDO SCANNING SONAR** a typical example of a complex naval sonar system, developed and built for the U. S. Navy by Edo.



**0 TO 6000 FATHOM DEEP DEPTH SOUNDER** in wide use with U. S. Navy (AN/UQN-1b) now available commercially (Model 185). Gives clear indication of depth on cathode-ray tube in two scales: 0—100 feet; 0—100 fathoms. Records continuously in three scales: 0—600 feet; 0—600 fathoms; 0—6000 fathoms. The finest deep depth sounder available. For complete details send for Model 185 brochure.



**EDO FISHSCOPE.** Most advanced fish finding device available today. Spots fish on cathode-ray tube in 0—250 fathom range, then magnifies any 10-fathom sector 25 times for clearer view. Commercial fishing boats equipped with the Fishscope report better than average hauls in far less time thanks to this Edo development. For full details send for Fishscope brochure.

**EDO CORPORATION** • COLLEGE POINT, L. I., N. Y.



Since 1925



New time-saving AMF Everlock pre-assembled screws and lockwashers. In types, sizes and materials to meet your needs.

**fasten it and forget it...**

*Specify*

Another  Product



Tight, vibration-proof fastenings—for the life of your product.

New AMF Everlock pre-assembled screws and lockwashers give you both . . . fast, one-operation application and vibration-proof tightness. Everlock washers, with the exclusive alternating chisel edges, actually bite into the surface of both screw and part. Even under the most punishing vibration, Everlock fasteners stay secure—for good!

Everlock locknuts spin down finger-free. After contact with work only 1/4 turn gives a sure, permanent 6-way lock. Combine unequalled speed of application with true vibration-proof performance.

On your next order for fasteners, specify AMF Everlock—and fasten it and forget it. Sizes, types and materials to meet any specifications.

Write for information or contact your nearest AMF Everlock Representative.

Kenneth D. DeLaney  
Dayton 3, Ohio

Oscar P. Martin  
Lakewood 7, Ohio

J. Ramsey Reese, Inc.  
New York 7, New York

J. M. Murphy  
Manchester, Connecticut

Russell T. Brosius  
Philadelphia 3, Pa.

Sam T. Keller  
Detroit 1, Michigan

W. L. Barth, Jr.  
Chicago 34, Illinois

C. W. McNeil  
Houston, Texas

Leonard F. Berg  
St. Paul 14, Minnesota

Thom Lundeen  
Moline, Illinois

Forrest Moschner  
St. Louis, Missouri

A. J. Murphy  
DeWitt, New York

Richard C. Dudek  
Beverly Hills, California

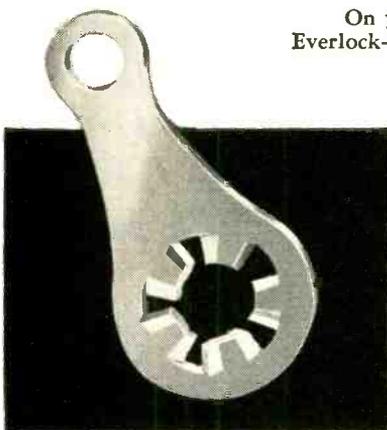
P. L. Robertson  
Milton, Ontario, Canada

Sam T. Gleaves  
Louisville 5, Kentucky

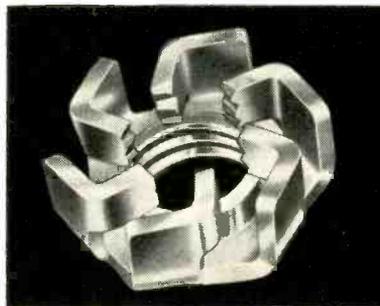
J. J. McIntosh  
Atlanta 6, Georgia

Donald G. Teeling  
Indianapolis 44, Ind.

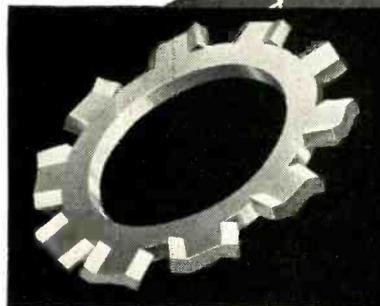
Oregon Indus. Factors  
Portland 1, Oregon



**TERMINALS**  
Plain and lock types.



**LOCKNUTS**  
Both National fine and National coarse threads.



**LOCKWASHERS**  
Internal, external and special types.

**THOMPSON-BREMER & COMPANY**

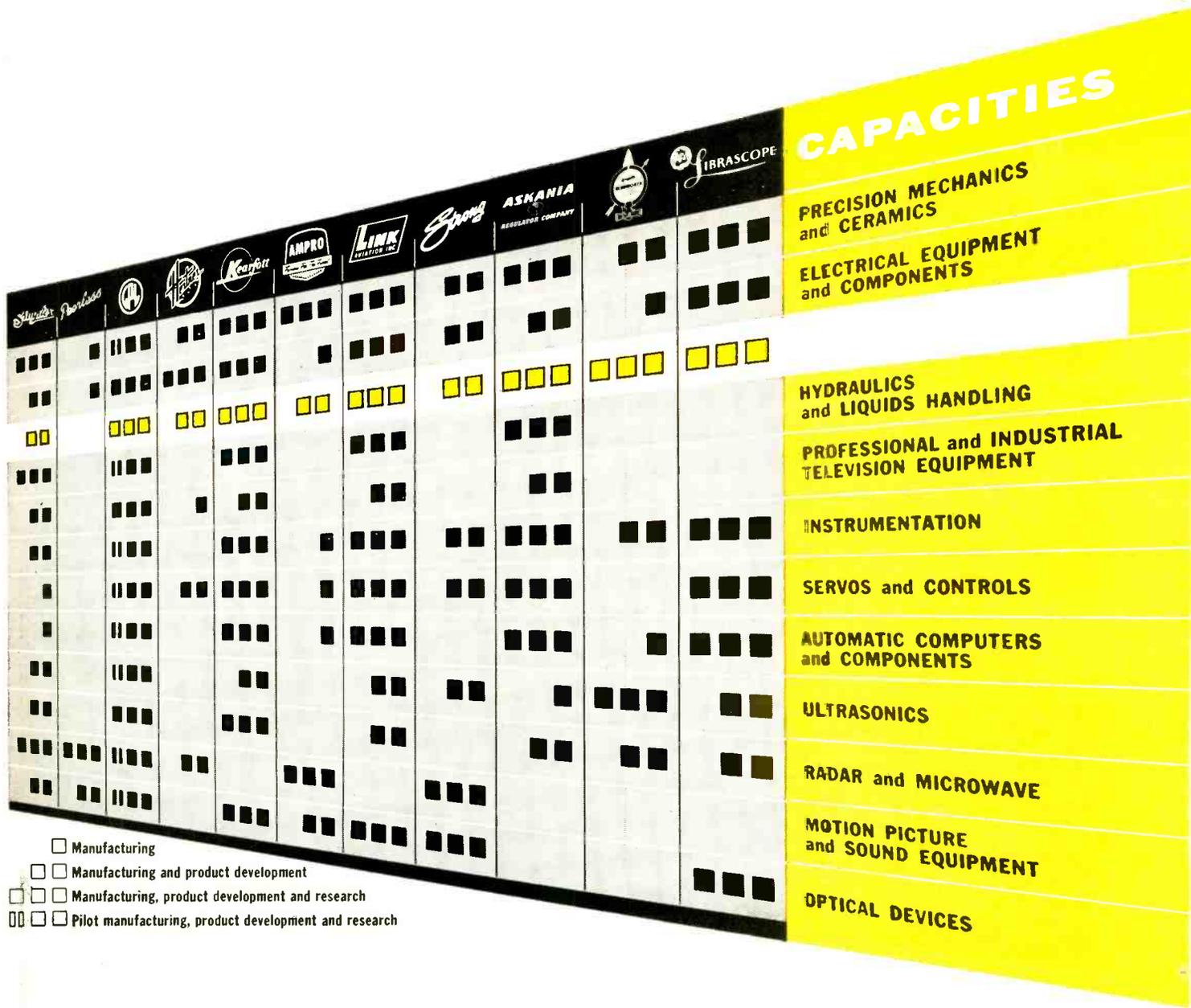
520 North Dearborn Street • Chicago 10, Illinois  
SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY CO., NEW YORK

"EVERLOCK" IS A REGISTERED TRADEMARK OF THOMPSON-BREMER & COMPANY



**SERVES INDUSTRY**

**THROUGH** *coordinated*



THE PRODUCING COMPANIES



*Sturtevant*

*Peerless*



INTERNATIONAL PROJECTOR CORPORATION — BLOOMFIELD, N. J.

J. E. McAULEY MFG CO CHICAGO

GENERAL PRECISION LABORATORY INCORPORATED — PLEASANTVILLE, N. Y.

THE HERTNER ELECTRIC COMPANY — CLEVELAND

KEARFOTT COMPANY, INC. LITTLE FALLS, N. J.

One of a series telling  
how the producing companies of  
General Precision Equipment Corporation  
are contributing to America's progress.

# precision technology

GPE Coordinated Precision Technology is the basic GPE operating policy which inter-relates the research, development and manufacturing facilities, techniques and capabilities of the producing companies of General Precision Equipment Corporation. Thus each company's specialization in its particular areas of competence is supplemented by the application of the resources of the other companies, wherever relevant. A diversified line of advanced precision equipment of superior design and performance has resulted from this application of the newest and most advanced techniques possessed among the companies in every technical capacity.

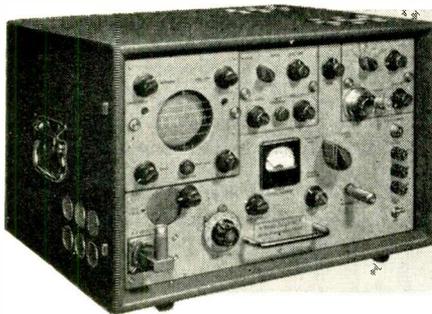
*e.g. in*

## ELECTRONICS

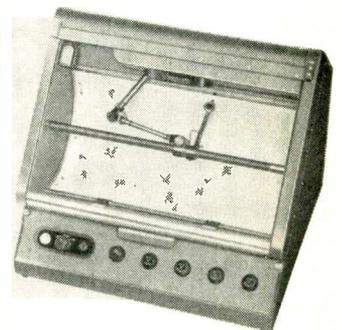
Ten of the GPE Producing Companies work in this important field. These companies were "born in electronics" and pioneered in its development before the word was coined. Their work covers every phase of electronics and GPE coordination relates each new electronic problem to the specialized knowledge and experience which is most valuable. This secures the optimum solution for the customer with minimum expenditure of time and money.

GPE Producing Companies have been re-

sponsible for the research, development and manufacture of a wide range of electronic precision components, equipment and systems, including Theatre Sound Systems, Sonar Equipments, Flight Simulators, Industrial Control Systems, Analogue Computers, Digital Computers and Components, Industrial and Studio Television, Navigation Systems—both airborne and marine. GPE systems, in most instances, are advanced concepts, often employing components specifically developed for the purpose by one of the GPE companies. Of the great number, two are shown.



Kearfott X-band Test Set, frequency range 8,500 to 10,000 MC; a unique all-purpose portable radar test set, comprising a power monitor, spectrum analyzer, wavemeter and signal generator which supplies an accurately calibrated signal of known level with variable amplitude and pulse-width combinations. Also provides FM, square wave and CW output.



Librascope X-Y Plotter and Recorder; automatically displays data derived from punch cards, mechanical or electronic computers or sensing elements; features rapid graphic 2-axis display with provision for 10-fold scale expansion and zero suppression. Used in aero-dynamic and electronic research, as well as in mass data reduction systems for business and industry.

Most advanced technological products which utilize electronics also call for other advanced technological skills. Though space allows only for an outline of GPE's work in electronics, both the capacities chart on the

facing page and most of the products mentioned above serve to suggest the broad coordination of technical capacities in all fields which exists as a result of GPE Coordinated Precision Technology.

Address inquiries to:

## GENERAL PRECISION EQUIPMENT CORPORATION

92 GOLD STREET, NEW YORK 38, NEW YORK



AMPRO CORPORATION  
CHICAGO



LINK AVIATION, INC.  
BINGHAMTON, N. Y.



THE STRONG ELECTRIC  
CORPORATION—TOLEDO



ASKANIA REGULATOR  
COMPANY—CHICAGO



BLUDWORTH MARINE  
NEW YORK



LIBRASCOPE, INCORPORATED  
GLENDALE, CALIFORNIA

# MICRO SWITCH Precision Switches

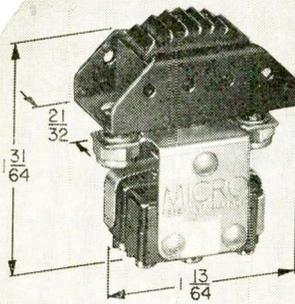
A PRINCIPLE OF GOOD DESIGN

## Why

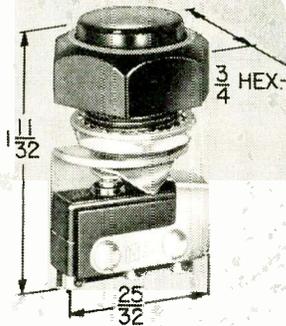
electronic designers turn to  
**MICRO SWITCH**  
for manually operated switch  
components

- Wide variety • Small size
- Light weight • Utmost reliability

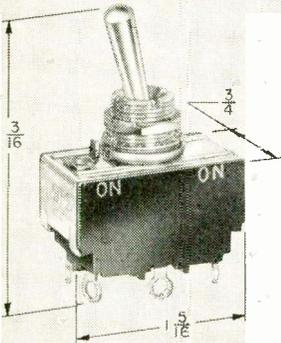
MICRO SWITCH precision switches shown here are typical of hundreds of switches developed to meet the specific requirements of the electronics industry. Whether your requirement is for a slide switch, a push switch, a toggle switch, or a rotary selector switch, consultation with MICRO SWITCH engineers can save you time and money.



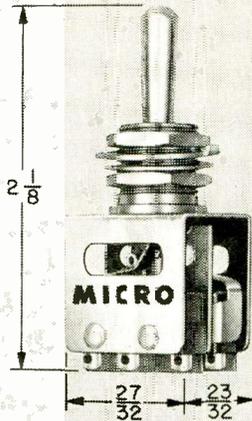
**A Slide Button Switch**



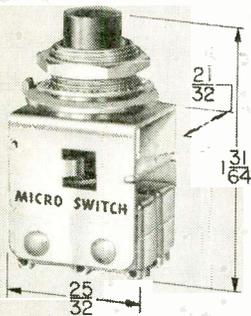
**B Push Button Assembly**



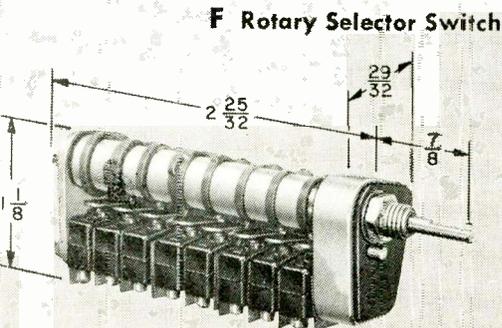
**C Sealed Toggle Switch**



**D Toggle Switch Assembly**



**E Push Button Assembly**



**F Rotary Selector Switch**

- A Slide Button Switch.** Designed for two-circuit control. Two subminiature switches mounted in a three-position, maintained contact, slide-button assembly. Both switches can be wired normally-open, both normally-closed, or one in each position.
- B Push Button Assembly.** For panel mounting with push-button plunger mechanism sealed at the panel, thereby protecting subminiature switch on inside of panel. Extremely small—complete assembly weighs only .04 lb. Operating force may be from 3 to 6 lbs.
- C Sealed Toggle Switch.** Supplied with external panel seal and internal bushing seal below the bat handle. Has bushing for panel mounting and may be equipped with keying tab where desired.
- D Toggle Switch Assembly.** For panel mounting and provides control of as many as 4 circuits. One of two single-pole, double-throw subminiature switches is actuated in each extreme toggle position. Require minimum space behind mounting panel.
- E Push Button Assembly.** Composed of two single-pole, double-throw subminiature switches. Switch provides an improved “feel” and simultaneous make and break of the two circuits.
- F Rotary Selector Switch.** Uses from 2 to 8 single-pole, double-throw subminiature switches to control multiple circuits. It permits 2 to 8 switching positions with spring or manual return to neutral position.

For complete information on these switches  
—or the complete MICRO SWITCH line  
call your nearest MICRO SWITCH  
branch office. Why not do it NOW?

MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

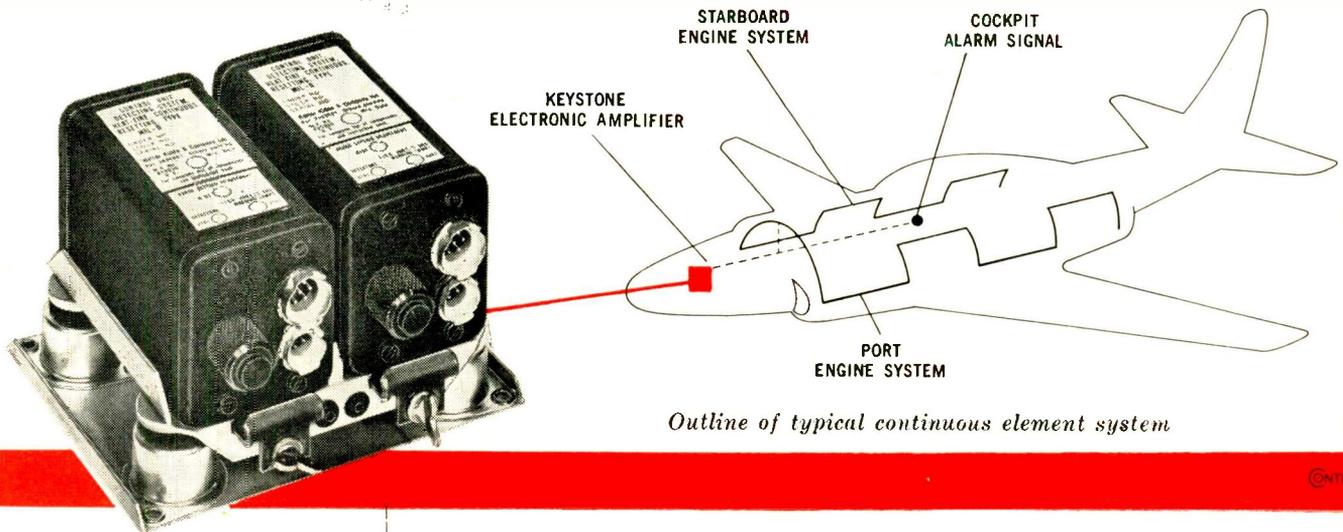
# MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY  
FREEPORT, ILLINOIS



# POWER PACKAGE

for fire detectors



## *Keystone electronic amplifiers power fire detection system in latest jet fighters*

These twin Keystone amplifiers power the continuous resetting fire detection system supplied by Walter Kidde & Company, Inc., for the nation's newest jet aircraft.

Units for each engine provide constant power through the flexible sensing element, which gives immediate warning of fire in any engine zone.

These special purpose, Kidde-designed electronic amplifiers were produced by Keystone to meet military specification MIL-D-7872, and to operate under extreme vibration and temperature changes.

Rigid production control and exhaustive testing assure dependable performance, long life.

This unit is typical of the special electronic and magnetic amplifiers produced by Keystone to meet unusual requirements in military and commercial installations. New applications are constantly making more demands on control and power systems — require new and unique amplifiers to solve individual problems. Whatever your particular need, Keystone can furnish exactly the right amplifier to meet your specifications . . . from design and development through production.

Find out how Keystone can cut your engineering and production time and costs — send an outline of your amplifier needs to the Engineering Department today. If your application involves magnetic amplifiers, send for the handy *Keystone Magnetic Amplifier Reply Sheet*, a quick data sheet which helps Keystone engineers recommend the necessary amplifier promptly and accurately.

Write for further information on electronic and magnetic amplifiers TODAY.

**keystone**

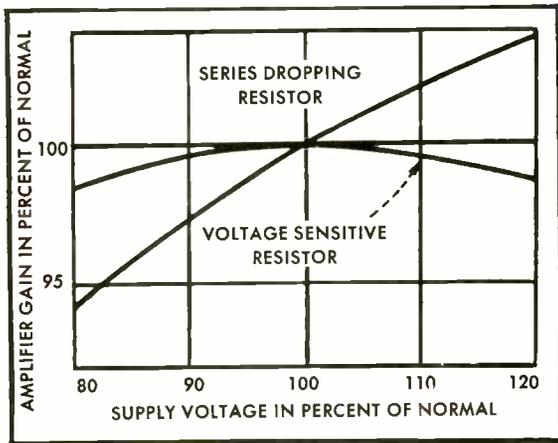
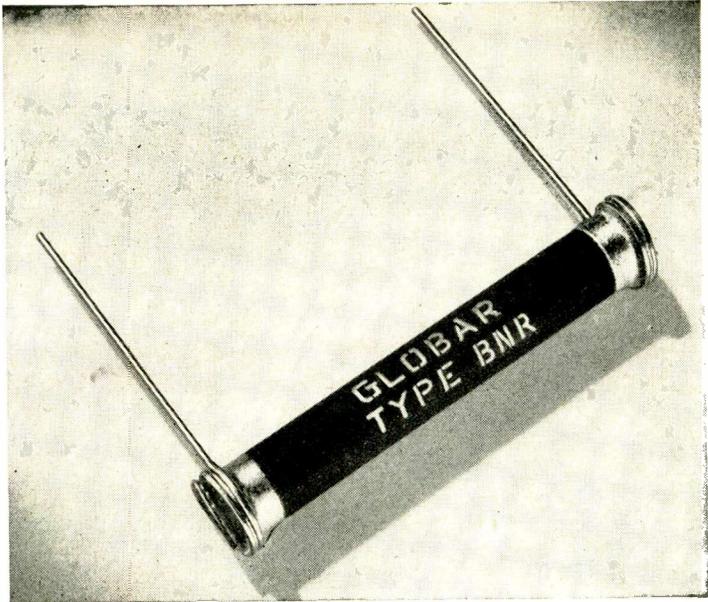


PRODUCTS COMPANY

901 23RD STREET • UNION CITY 2, N. J. • UNION 6-5400

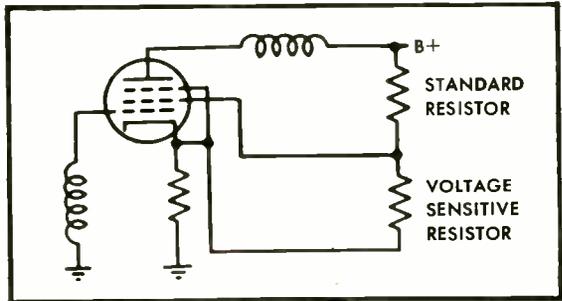
# Stabilize Amplifier Gain with

# GLOBAR<sup>®</sup> TYPE BNR VARISTORS



◀ Variation of gain with supply voltage for 12SK7 pentode in circuit using linear resistors and voltage sensitive (non-linear) resistors.

▶ Circuit using voltage-sensitive resistors has voltage divider returned to ground through cathode resistor.



Varying supply voltages need *not* affect performance of pentode amplifiers. A GLOBAR<sup>®</sup> Type BNR Voltage Sensitive Resistor in the low potential section of the voltage divider—returned to ground through the cathode resistor, as shown in this circuit for a 12SK7—effectively limits gain fluctuations to within  $\pm 0.2\%$  when supply voltage varies from  $-10\%$  to  $+10\%$ . The same supply variation in a conventional circuit, with a regular series dropping resistor, results in fluctuations up to  $\pm 2.5\%$ ... more than 12 times as great.

GLOBAR BNR varistors give similar stabilization with nearly all r-f pentodes—and some beam pentodes. Our engineers will work with you on any voltage stabilization problem you have... without obligation. Write Dept. EL 87-43, The Carborundum Company, Niagara Falls, New York.

## HOW YOU CAN USE GLOBAR TYPE BNR VARISTORS

PRODUCT	APPLICATIONS
<b>Television Receivers, Cathode-ray Oscilloscopes</b>	Automatic picture-width control; surge limitation to protect tubes.
<b>Communications Equipment</b>	Automatic signal-strength control; surge limitation to protect tubes.
<b>Relays, Solenoids, Vibrating Contact Devices, etc.</b>	Reducing surge voltage peaks to limit arcing, insulation stresses.
<b>Small Motors</b>	Surge limitation to reduce arcing of contact points.
<b>Low voltage devices</b>	Spark reduction to lower interference on radio and television.
<b>Electronic circuits</b>	Voltage stabilization; surge limitation; generation of unusual wave shapes, harmonics; DC control of AC resistance; volume compression.

# GLOBAR<sup>®</sup>

# Ceramic Resistors

VOLTAGE SENSITIVE • CONVENTIONAL • TEMPERATURE SENSITIVE

## by CARBORUNDUM

REGISTERED TRADE MARK



For gasketed parts like these . . .

# This FREE BOOK CAN HELP YOU CUT COSTS!

*There's something new in electronics this year . . .*

## IT'S THE DAREX Flowed-in GASKET PROCESS!

And this fact-filled brochure gives you the whole Flowed-in Gasket Story. Here are a few samples of the things you'll read in this informative new book:

### ABOUT COSTS

Using the DAREX Flowed-in Gasket Process, a major electronics manufacturer is saving \$50,000 per year in labor and materials on a single gasketing operation. As a result of this striking cost reduction, the firm has recommended the DAREX Process for several more gasketing operations.

### ABOUT THE PROCESS

The Flowed-in Gasket Process is a new application of a method of sealing developed by Dewey and Almy researchers over 30 years ago, and successfully used in food container manufacture ever since.

The DAREX Flowed-in Gasket Process is more than a sealing compound . . . more than a machine . . . more than an engineering service . . . *it's a complete Process!* So when you switch to Flowed-in Gaskets, you get all three.

**Compounds**—Over 800 formulations available to meet most needs. Or Dewey and Almy chemists will develop a "job-tailored" compound for you.

**Machines**—To apply the compound, Dewey and Almy designs and builds machines based on more than 30 years' field experience.

**Service**—Every machine is precisely adjusted to your specifications before it leaves the shop. When it arrives, a Dewey and Almy Engineer is on hand to install and adjust the machine. Then he trains your operators to full proficiency. And whenever you need him, the Dewey and Almy Man is at your service.



## DEWEY and ALMY Chemical Company

Cambridge 40, Mass..

Offices or subsidiaries in Buenos Aires, Chicago, Copenhagen, London, Melbourne, Milan, Montevideo, Montreal, Naples, Paris, San Leandro (Calif.), Sao Paulo, Tokyo.

## Discover what DAREX "Flowed-in" GASKETS can do for YOU

### MAIL THE COUPON TODAY!

DEWEY and ALMY Chemical Company  
Dept. E-12  
Cambridge 40, Mass.

Please send me the new DAREX Flowed-in GASKET Book.

Name.....

Firm.....

Street.....

City.....State.....

There are 13 paths  
that make one direct route  
to bring your products .....



.....to the purchasing influences  
of the 1955 expanding electronic market

Alert manufacturers of electronic products get greater results from advertising dollars by getting their product stories told directly to the purchasing influences of the industry in the sales pages of . . .

## 12 issues of electronics

where 35,000 subscribers read the editorial pages and re-read them for the very latest developments in product design, circuitry, production techniques and other information vital to their work.



\*The men who design

\*The men who specify

\*The men who buy

These important purchasing influences of the electronic industry have, throughout the years, grown accustomed to using the ELECTRONICS BUYERS' GUIDE as their sole product reference source . . . for fourteen years they have relied on the "Guide" for its complete, accurate and up-to-date information, serving them year upon year in the exacting manner they require. These technicians of the industry *choose and use* the "Guide" as their Breadboard Blue Book . . . that's why manufacturers with electronic products to sell get more results from their advertising dollars by doing a complete year 'round product selling job in 13 issues of ELECTRONICS.

**BUDGET NOW FOR 13 INSERTIONS IN '55!**



**electronics**

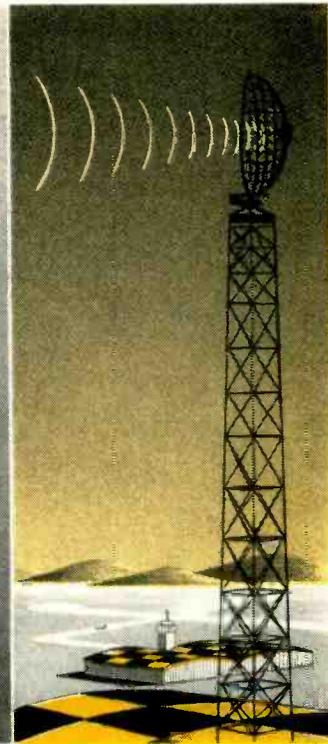
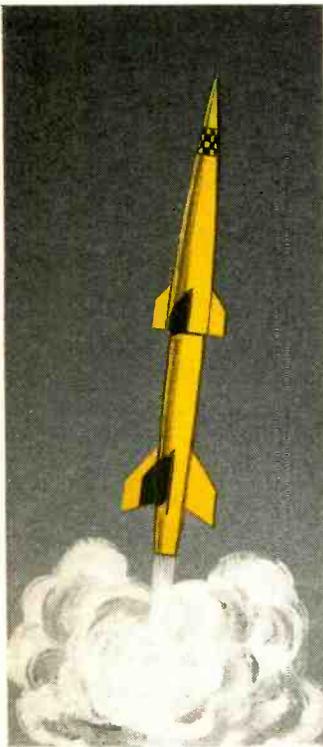
A McGraw-Hill Publication



**BUYERS' GUIDE**

330 West 42nd Street, New York 36





## FOR ALL KU-BAND APPLICATIONS SPECIFY THE FINEST KLYSTRON...

### VARIAN'S NEW VA-94



#### TYPICAL OPERATION

Frequency	16.5 kmc
Resonator Voltage	300 v
Resonator Current	38 ma
Reflector Voltage	-150 v
Power Output (VSWR < 1.1)	40 mw
Electronic Tuning	65 mc

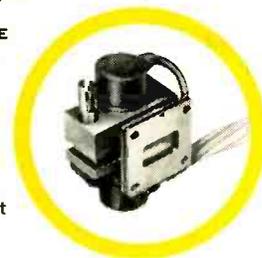
Varian now offers the most advanced reflex klystron ever developed for airborne radar local oscillator and beacon service. *The VA-94* provides a minimum power output of 20 mw throughout its range of 16 to 17 kmc... to give you absolutely reliable operation at any altitude without pressurization.

Exclusive Varian features include a unique brazed-on external tuning cavity... to assure you of excellent frequency stability, extremely low microphonics, slow tuning rate and long tuning life. Its single screw tuner adapts easily to motor tuning. The VA-94 weighs only four ounces and mates directly with standard waveguide flanges.

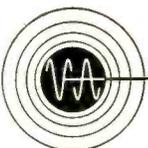
**FOR EXPERIMENTAL APPLICATIONS... SPECIFY THE VERSATILE NEW VA-92.** Varian's VA-92 meets all reflex oscillator requirements in the frequency range 14 to 17.5 kmc... is especially suitable for signal generators and laboratory testing. It gives you the ease of tuning, ruggedness and reliable performance that has made Varian klystrons the first choice among microwave engineers. Special features include linear reflector voltage tracking, wide tuning range and high altitude operation without pressurization.

**FOR OTHER K-BAND APPLICATIONS... SPECIFY V-39, V-40 AND VA-96.**

**FOR COMPLETE SPECIFICATIONS** and technical data on the outstanding new VA-94, and other Varian klystrons, contact our Application Engineering Department.



IN KLYSTRONS,  
THE MARK OF  
LEADERSHIP IS



**VARIAN associates**

PALO ALTO 1, CALIFORNIA

Representatives in all principal cities

# Next Steps in Atomic Progress . . .

## A Challenge to American Industry

The purpose of this editorial is to throw light on the significance for American industry of recent changes in the statutes that control the development of atomic energy.

The need for clear light on the meaning of this new legislation is made more urgent by the political confusion and distortion that marked its course through Congress. The politically inspired charges of "giveaway" that delayed its passage — charges that were almost totally unrelated to the legislation itself — helped to obscure the vital importance of the step finally taken by Congress.

In sober, post-Congressional fact, the principal significance of the new atomic legislation is that it extends to private enterprise responsibility for the development of peaceful uses of atomic energy, whereas heretofore this responsibility has rested in a tight government monopoly. **And this extension is made on terms that emphasize the responsibility far more than they open any opportunity for economic gain in fulfilling it.** The revised Atomic Energy Act provides that:

1. Industry may now own and operate its own nuclear reactors, under license from the Atomic Energy Commission. And it may build and sell nuclear reactors for export.
2. Industry may use — but not own — nuclear materials at the discretion of the Atomic Energy Commission.
3. The Atomic Energy Commission will make available to industry scientific knowledge

that may be useful in developing peaceful applications of nuclear energy.

4. For the first time, industry will have the right to patent inventions in the field of non-military nuclear energy. However, "basic" discoveries must be made available to all companies in the field for a period of five years, after which they, too, will revert to normal patent status.

### Two Kinds of Know-How

These provisions, despite the imposed limitations, represent the first positive step toward development of nuclear energy for peaceful applications in the United States. Potentially useful knowledge, previously locked in the minds of government scientists, will now be available to all those who are willing and able to put it to work for the good of mankind.

The advantages to be gained from enlisting the talents of American industry in the development of peaceful atomic applications are imposing. As *The* (London) *Economist*, Europe's leading economic journal, recently remarked, "The atomic scientists are in a position to surmise how atomic energy can be applied . . . but they lack the specialized knowledge of engineering design and operating technique just as industry itself lacks atomic knowledge." Now the engineers of private industry need no longer lack the atomic knowledge, and there is granted to them at least a restricted freedom to apply it to the solution of their engineering and operating problems.

**But the new opportunity for private industry to find constructive uses for the science of nucleonics carries with it a grave responsibility.** These uses must be so developed that they will benefit the people of all the free nations. It is essential that the United States, which pioneered in developing lethal uses for atomic fission, demonstrate to the world our paramount interest in its peaceful application. It would be a moral set-back to the free world almost beyond calculation if the Communists should be able to offer to the poorer nations of the world the benefit of low cost atomic power—provided by Communist technicians—while we concentrate primarily on building our stockpile of atomic and hydrogen bombs.

### **Race For a Peaceful Victory**

Most of the experts are agreed that it may be many years—perhaps ten, fifteen or more—before the cost of electricity from atomic fission can be reduced to a level that will make it competitive with conventionally produced power in most regions of the United States. But most of the world is not nearly so fortunate as we are in power resources. Electricity, even at a cost far higher than the average that prevails in the United States, would be a blessing in many countries, and the nation that provides the technology to bring it into being will score a great moral victory.

The useful potential of nuclear energy is not restricted to the generation of electric power—although twenty years from now this use will be highly important to the power industry of the United States. Even with the limited research that has been done in this field thus far, the use of radioisotopes—the radioactive products of atomic reactors—is saving American industry an estimated \$100 million a year. Commissioner Campbell of the AEC, who made this estimate, believes that these savings may well reach \$1 billion a year within ten years. Radioisotopes are already at work in industries ranging all the way from paper manufacturing,

where they measure paper thickness, to pipeline transportation, where they mark the dividing lines between shipments of different products (at an estimated saving of \$500,000 a year). Medical applications of these same radioisotopes hold promise of longer and more comfortable lives for those who are stricken by cancer and other diseases.

### **Above All a Challenge**

The new Atomic Energy Act is a crucial stride toward the day when all these benefits—and undoubtedly others not yet revealed by research—will be realized. But it is a step that is essentially permissive. It still leaves it to private industry for the most part to decide what is to be done and how soon.

**The new act is thus, above all, a challenge.** It confers on private industry the responsibility to assume a leading role in the development of peaceful uses for nuclear energy, a step long urged by NUCLEONICS, a McGraw-Hill magazine devoted to atomic energy. To achieve a success in this task that will measure up to the requirement of the national interest, this development must command all the resources and ingenuity that private enterprise can apply—and do so without promise of glittering prizes surely to be won. **But now that the responsibility has been defined and the challenge offered, American industry will, we believe, measure up to its grave and mighty import.**

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.*

*Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.*

*Donald McGraw*  
PRESIDENT

McGraw-Hill Publishing Company, Inc.

**“Retains Flexibility - Resists Abrasion”**



## says Redmond Company of **TEMFLEX**\* 105 Tubing

In making the field connections for the unique TRI-FLUX shaded pole micromotors built by Redmond Company, Inc., Owosso, Mich., a 1¼" length of Irvington's Temflex 105 Tubing is slipped over the lead from one field coil, and the lead is twisted together with the connection from the next field coil. Twisted wires are then welded and bent back, and the Temflex tubing drawn over the welded joint. The entire field is then varnished and baked.

In addition to abrasion resistance and retained flexibility, "resistance to baking heat and high dielectric strength are other reasons for using this material," says Redmond about this flexible plastic tubing. Temflex 105 also carries Underwriters' Laboratories approval for continuous operation in air at 105° C. — and for 90° C. operation *in oil*.

Temflex 105 Tubing is produced by Irvington's Plastics Division in all standard colors, to fit all standard wire sizes. It's identified by the continuously printed name on the tubing surface — look for it when you buy high-temperature tubing. Send for literature and samples.

\*T.M. Reg. U.S. Pat. Off.

Look to  
**IRVINGTON**  
for Insulation Leadership

INSULATING VARNISHES  
VARNISHED CAMBRIC  
VARNISHED PAPER  
VARNISHED WOVEN GLASS  
INSULATING TUBING  
CLASS "H" INSULATION



**IRVINGTON VARNISH & INSULATOR**

DIVISION OF MINNESOTA MINING & MANUFACTURING COMPANY

11 ARGYLE TERRACE, IRVINGTON 11, N. J. • PLANTS: IRVINGTON, N. J.; MONROVIA, CALIF.; HAMILTON, ONTARIO, CANADA

**UNDISTORTED**

**100%**

**MODULATION**

**AM**

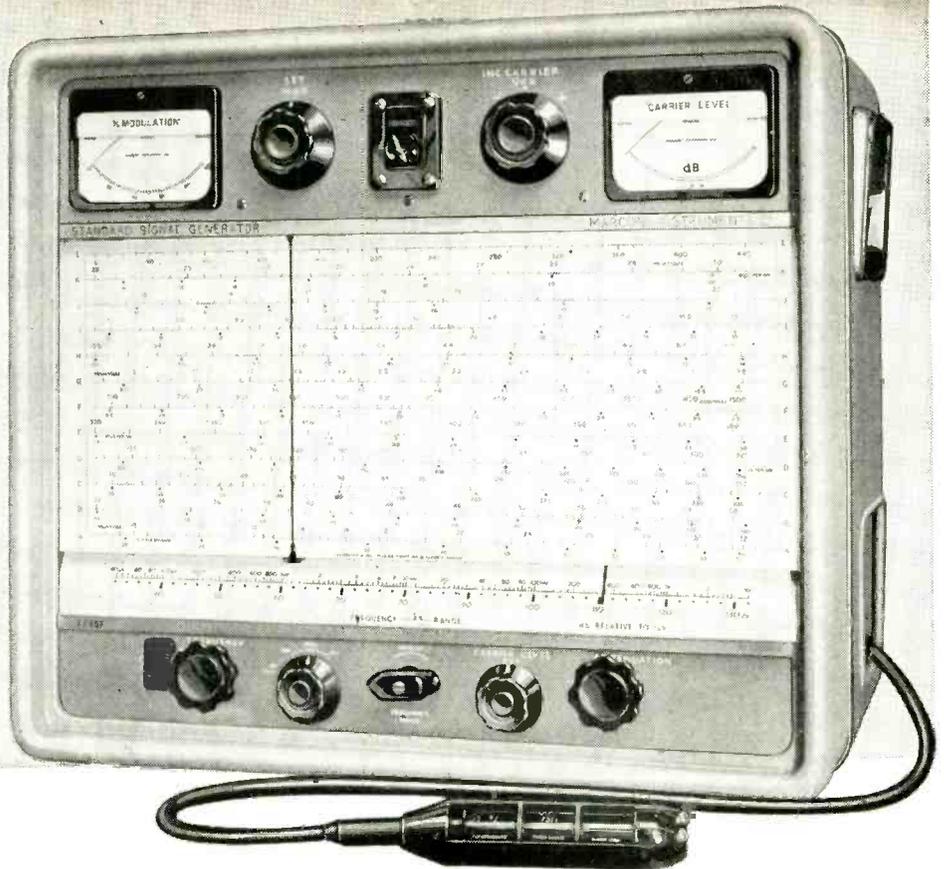
**WITHOUT**

**FM**

**WITH THE**

**STANDARD SIGNAL  
GENERATOR**

**TYPE TF867**



EXCELLENT amplitude modulation is an outstanding feature — a.m. accompanied by unmeasurable f.m. Other features include :

**Wide Range:** 15 kc to 30 mc on 15 ft. high-discrimination full-vision scale.

**Crystal Accuracy:** 0.01% with built-in 1 mc harmonic source.

**High Output:** 4 volts down to 0.4 microvolts.

**Flexible Modulation:** Internal 400 and 1,000 cps, external 50-10,000 cps within a db.

*Also incorporated:* Automatic level control, overall negative feed-back from r.f. output to modulation input, modulation monitoring by dual-rectification and variable impedance termination with animated diagram.

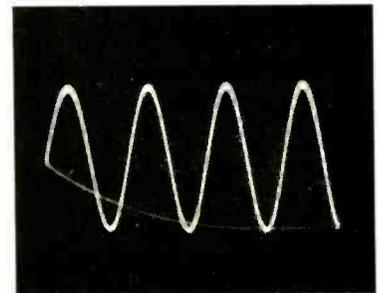
*A signal generator also ideal as a video oscillator for wide-band television systems.*

*Full data and prices of any of the items listed below will be mailed immediately on request.*

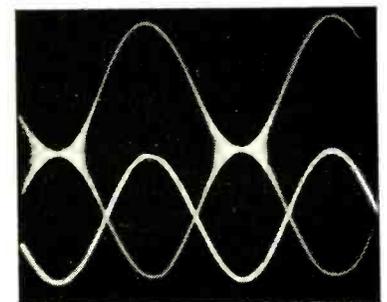
STANDARD SIGNAL GENERATOR TF 867 · FM/AM SIGNAL GENERATOR TF 995

UNIVERSAL BRIDGE TF 868 · FM DEVIATION METER TF 934

VACUUM TUBE VOLTMETERS · FREQUENCY STANDARDS · OUTPUT METERS  
WAVEMETERS · WAVE ANALYSERS · Q METERS · BEAT FREQUENCY OSCILLATORS



15 kc Unmodulated Carrier showing good waveform.



320 kc Carrier modulated at 400 cps — audio source on lower trace shows fidelity.

**TEST OSCILLOGRAMS**

**MARCONI INSTRUMENTS**

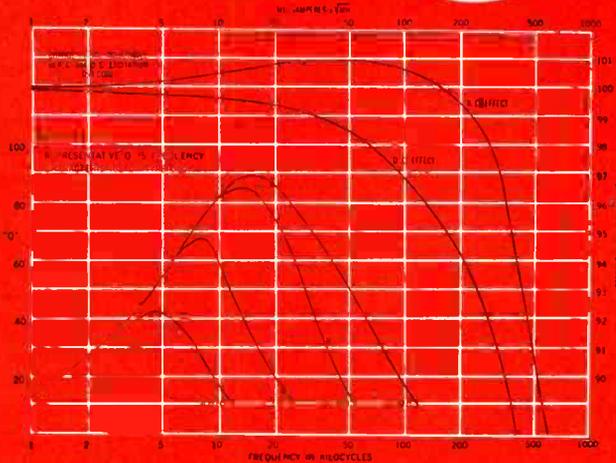
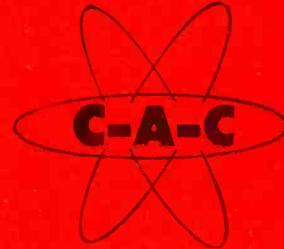
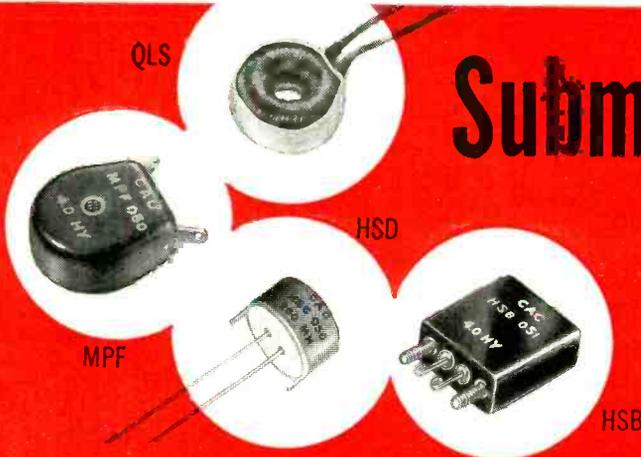
23-25 BEAVER STREET · NEW YORK 4

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL  
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE

Managing Agents in Export: MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

# Subminiature Toroids

**HIGH PRODUCTION  
PROTOTYPES  
ENGINEERING DEVELOPMENT  
RESEARCH**



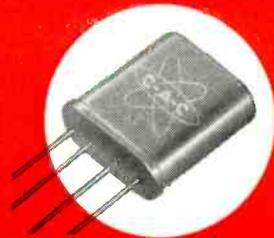
## TRANSISTOR TRANSFORMERS

Consistent with advanced engineering in subminiaturization, CAC offers transistor transformers in hermetically sealed cases, molded or cast type construction—designed to meet military requirements—temperatures (-) 55° C. to (+) 105° C. Enclosed magnetic field afforded by toroidal form. Frequencies and impedances to your specifications. Utilize our advanced engineering and modern high speed production facilities. See your CAC representative now.

### TYPICAL PULSE TRANSFORMER

IMPEDANCE RATIO	RISE TIME (MICRO SECS)	WIDTH (PERCENT)	DROOP (PERCENT)	—OVERSHOOT % OF + PEAK	INPUT PULSE TIME MICRO SECS	RING
200/800	1.0	10.0	10.4	0	8	3
700/2800*	1.0	10.0	10.4	4.1	8	2.5
5000/2000	1.3	8.0	10.0	20.0	8	0

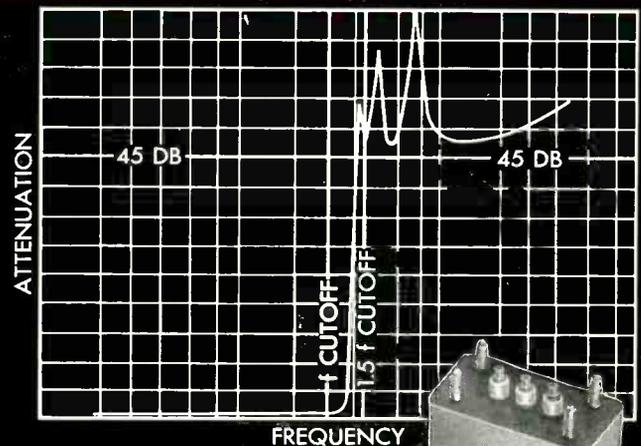
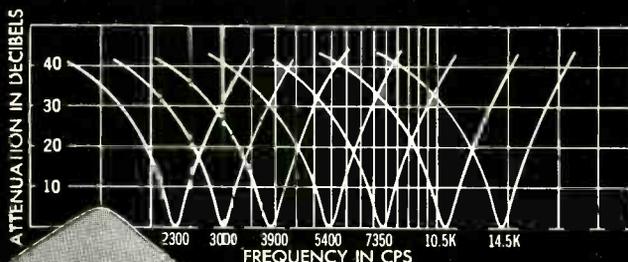
A TYPICAL PULSE TRANSFORMER—ONE OF MANY CUSTOM DESIGNS DEVELOPED BY CAC ENGINEERS — HIGHLY STABLE TOROIDAL UNITS — EXHIBIT EXCELLENT CHARACTERISTICS



KEEP YOUR DESIGNS AHEAD WITH CAC SUBMINIATURES  
APPLICATIONS: FILTERS, CHOKES, TRANSISTOR AND PULSE TRANSFORMERS, REACTORS AND INDUCTORS

# Subminiature Filters

FOR TELEMETERING AND AIRBORNE EQUIPMENT



.55 CUBIC INCHES AND LESS. EXCELLENT BAND PASS CHARACTERISTICS—DESIGNED TO MIL SPECIFICATIONS IDEAL MULTI CHANNEL OPERATION.



STANDARD LOW PASS SERIES — DESIGNED & PACKAGED TO MIL T27 SPECIFICATIONS — OFFERS OVER 45 db ABOVE  $f_c$  ( $f_c = 1.5 f_1$ ), HERMETIC SEALED — STUD MOUNTED — TEF-LON TYPE TERMINALS, CIGARETTE SIZE PACKAGE 3, 6, 10 & 15 KC STD. UNITS. ALSO AVAILABLE IN SUBMINIATURE VERSION.



FOR ADDITIONAL INFORMATION CONTACT  
**COMMUNICATION ACCESSORIES COMPANY**

HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 5528

# Memorandum

FROM: Engineering

TO: Purchasing

Here are typical parts  
Hamilton can make. Look at  
the range of sizes and types.  
And Hamilton works to any  
tolerance - in any quantity we  
need. Suggest sending print  
of part #420-A for quotation.

*X&C.*

ALL  
PARTS  
SHOWN  
ACTUAL  
SIZE

## Allied Products Division

### Hamilton Watch COMPANY

938 WHEATLAND AVE.,  
LANCASTER, PA.



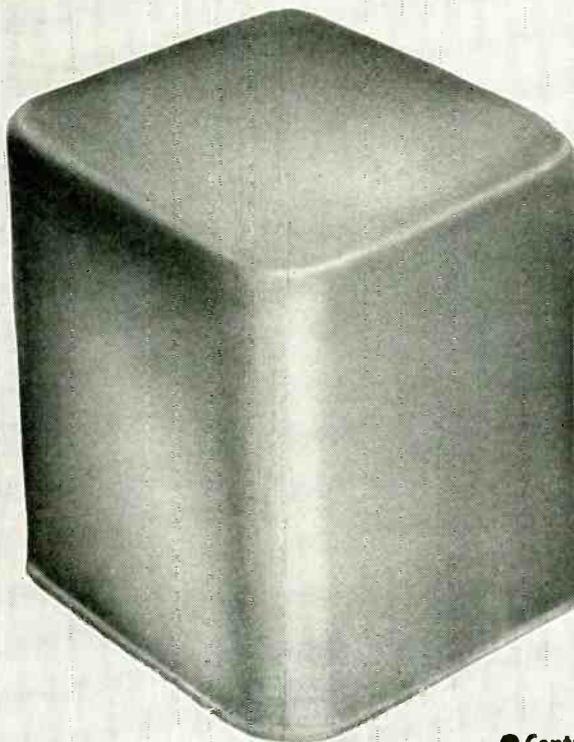
producers of  
precision parts  
and products

**NOW-**

**Heldor**

**QUALITY, SERVICE  
and ECONOMY in**

**DRAWN CANS**



Now you can forget about drawn can problems. HELDOR — the first name in fabricated cans — will produce drawn cans with inside fitting covers in *all* 22 sizes (AF through NB) to meet the latest MIL-T-27 specifications as well as to customers' requirements.

Tools are being rushed to completion. Presses are installed and waiting. Soon . . . consistent, TOP QUALITY drawn cans and covers will be made available to the electronic industry. On March 1, 1955 production on these cans will start to roll out of the HELDOR plant. Orders accepted now for custom-size drawn cans for earlier delivery.

We're all set NOW to save you money! Send us your specs or prints on your drawn can requirements today! **Write for complete information!**

Don't forget . . . you can effect major economies on any or all of Heldor's products and services listed below.

**Other *Heldor* Products:**

- Compression-type and new NON-TWIST, Hermetic Seal Lock-in Terminals
- Fabricated Cans & Covers and related precision metal products.
- Centrifugal Hot Tinning and other finishes.
- Metal Stampings.
- A Complete, hermetic seal Assembly Service!
- Complete Tooling.

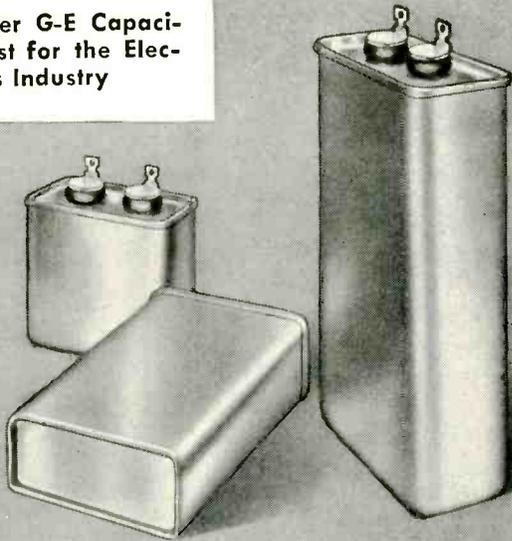
**HELDOR MANUFACTURING CORPORATION**

**HELDOR HERMETIC SEAL COMPANY, INC.**

**238 Lewis Street • Paterson, N. J.**



Another G-E Capacitor First for the Electronics Industry



DRAWN-RECTANGULAR CASE has no soldered seams, does not depend on solder for mechanical strength and effective sealing.

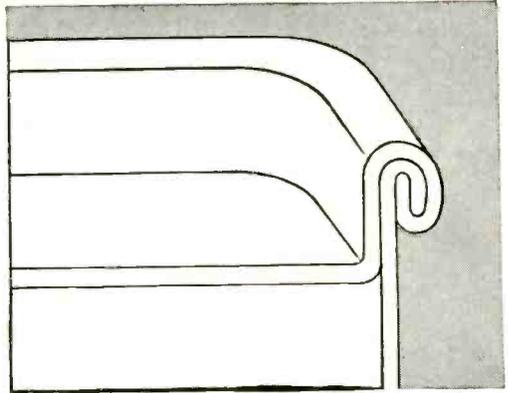
## new . . . G-E CAPACITORS IN DRAWN-RECTANGULAR CASES

- Solderless, double-rolled cover seam
- Seamless case with standard dimensions

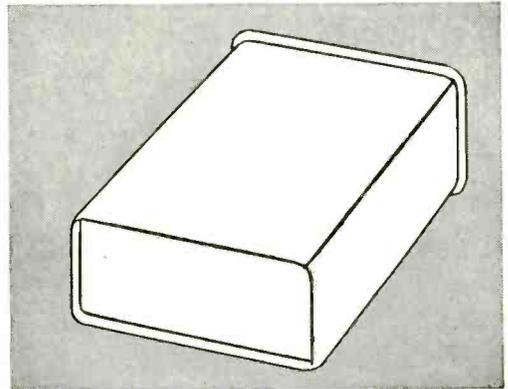
General Electric is now producing fixed paper-dielectric capacitors in seamless, solderless cases with standard dimensions that comply with or exceed MIL specifications. For complete information contact your G-E Apparatus Sales Office or write for Bulletin GEC-809A to Section 442-24, General Electric Co., Schenectady 5, N. Y.

*Progress Is Our Most Important Product*

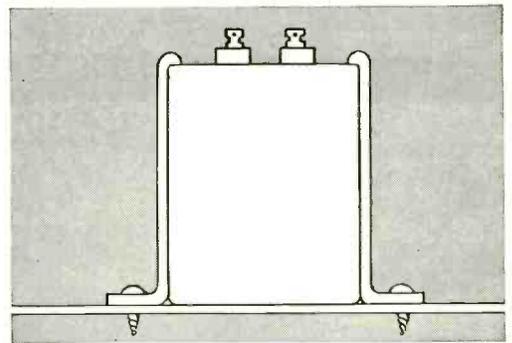
**GENERAL  ELECTRIC**



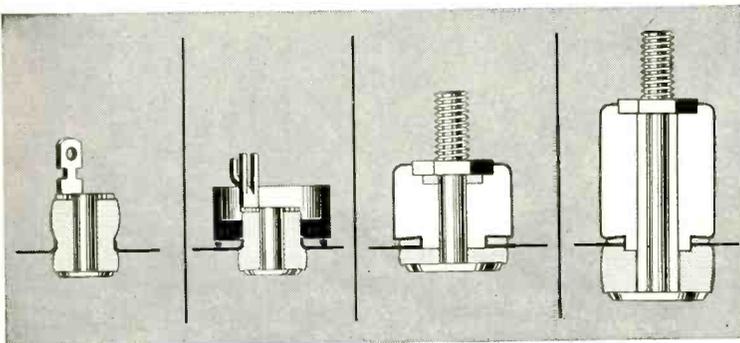
SOLDERLESS DOUBLE-ROLLED COVER SEAM makes a mechanically strong, hermetic seal.



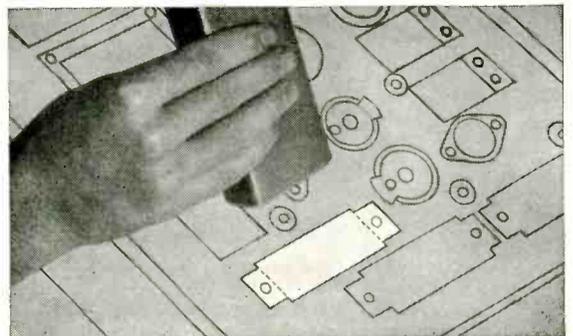
BOTTOM OF CASE IS INDENTED to permit mounting in inverted position.



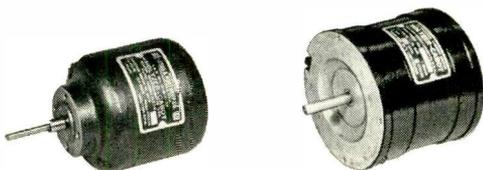
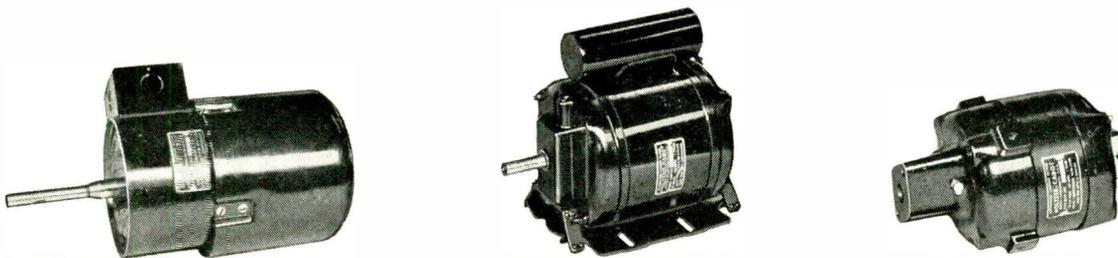
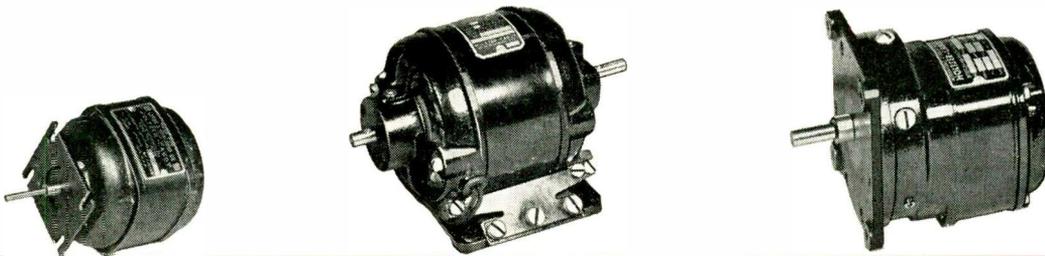
UPRIGHT OR INVERTED MOUNTING is possible using either spade lug, or footed brackets (above)



FOUR BUSHINGS STYLES are available for applications below 2000 volts d-c, special skirted bushings for higher voltages.



STANDARD CASE SIZES are interchangeable, making it unnecessary to change drawings or circuit layouts.



each of these HOLTZER-CABOT motors  
solved a **special** problem!

Holtzer-Cabot specializes in motor and generator design, and is tooled to produce both AC and DC motors and generators, in a wide range of frames, with unlimited varieties of mechanical and electrical features.

Quality motors correctly designed result in lowest ultimate cost.

Bring your small-motor application problem to Holtzer-Cabot. Our experience in developing custom-built motors assures you of a prompt and expert solution.

N.B. — The different mechanical designs shown were selected from one day's quantity production.

**NATIONAL PNEUMATIC CO., INC.** AND **HOLTZER-CABOT** DIVISIONS

125 Amory St., Boston 19, Mass.  
Sales Service Representatives  
in Principal Cities throughout the World



Designers and manufacturers of mechanical, pneumatic, hydraulic, electric and electronic equipment and systems

# Broadband RF Power Meters

THE CHOICE OF ALL ARMED SERVICES  
FOR MICROWAVE POWER MEASUREMENTS

**POWER:** PULSE and CW —  $5\mu\text{W}$  to 5W average

**FREQUENCY:** 20MC — 10,000MC

**ACCURACY:** 5% Absolute at all ranges,  
frequencies, temperatures

- ..... **INDICATIONS:** Direct Reading
- ..... **CALIBRATION:** Compensates for All Variables
- ..... **R-F COMPONENTS:** 3, 6, 10 and 20db Attenuators,  
Bolometer Mount and Elements, R-F Cable
- ..... **BOLOMETER:** Broadband, High Overload Capacity
- ..... **PLUMBING:**  $\frac{3}{8}$ " and  $\frac{7}{8}$ " 50-ohm Coaxial
- ..... **POWER SOURCE:** 115VAC  $\pm 15\%$ , 50-1000 cps
- ..... **CONSTRUCTION:** Rugged, meets all JAN, MIL requirements

## TYPICAL APPLICATIONS

Microwave Links . . . Television . . . Communications . . .  
Radar . . . Telemetry . . . Signal Generators . . .  
Laboratory Standards.

Write for descriptive literature to Department E-12

**Bruno - New York Industries Corporation**

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET

NEW YORK 1, N. Y.



## HIGH RESOLUTION LABORATORY STANDARD DC VOLTMETERS

For most applications these rugged portable, self-contained nulling voltmeters replace a potentiometer, voltbox, galvanometer and standard cell combination. They are suitable for laboratory use, production line testing and field service.

### Model LVM-5

Voltage Range: 0-100 Volts DC  
Resolution: At least 50 microvolts between 0 and 1 volt  
500 microvolts between 1 and 10 volts  
5 millivolts between 10 and 100 volts  
Absolute Accuracy:  $\pm 0.1\%$  of reading  
Input Impedance: Infinite at null

### Model PVM-4

Voltage Range: 0-600 Volts DC  
Resolution: At least 5 millivolts between 0 and 10 volts  
50 millivolts between 10 and 600 volts  
Absolute Accuracy:  $\pm 0.1\%$  of reading  
Input Impedance: Infinite at null

The Model LVM-5 may also be used as a deflection potentiometer, a sensitive null indicator and a precision millimicroammeter. Write for catalog PL which describes these instruments completely. Address Dept. E-12



Computer Company of America, Division of Bruno-New York Industries Corp. also manufactures the IDA analog computers and accessories. Their usefulness in the field of dynamics has been proven over the years.

A complete line of standard computers, instruments and regulated power supplies is supplemented by the ability to design and manufacture specialized equipment for your particular applications. Your inquiries are invited.

**Computer Company of America**  
DIVISION OF BRUNO-NEW YORK INDUSTRIES CORP.  
460 WEST 34TH STREET



# New variety of **CLARE** **Type J Relay** provides a power relay as sensitive and accurate as telephone-type relay

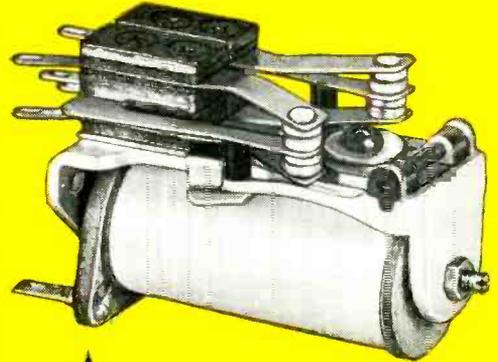
The new CLARE Type J Relay has all the advantages of the small size, light weight and sturdy construction which makes the standard Type J Relay so popular with designers of electrical and electronic equipment.

Increased current carrying capacity is provided by the use of Code 18 (Silver) heavy duty contacts which are riveted to the springs. A combination of the standard Type J twin contacts and the new heavy duty contacts is also available.

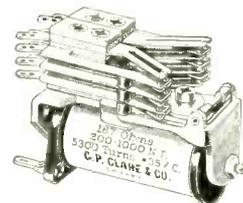
Nominal rating of this new Type J Relay is: 10 amperes, 115 volts a-c (resistive); 10 amperes, 27½ volts d-c. The relay is 2¼" long, 1⅛" wide and 1⅜" high with two Form C contacts.

Long life and increased adjustment stability is provided by a new hinge-type armature. The new heavy-duty yoke has a stainless steel pivot pin with a large bearing surface which turns in precisely reamed bearings of nonferrous material.

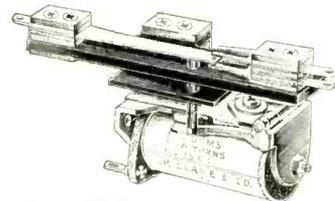
*For complete information write for CLARE Bulletin No. 119. For information on other variations of the Type J Relay send for our Engineering Data Book. Address: C. P. Clare & Co., 3101 West Pratt Blvd., Chicago 45, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.*



- 1** Handles inrush current of 50 amperes for 50,000 operations—rating of 10 amperes, 27½ volts d-c.
- 2** Has exceeded 500,000 operations on motor load of 6 amperes—inrush current of 15 amperes—at 70,000 feet altitude.



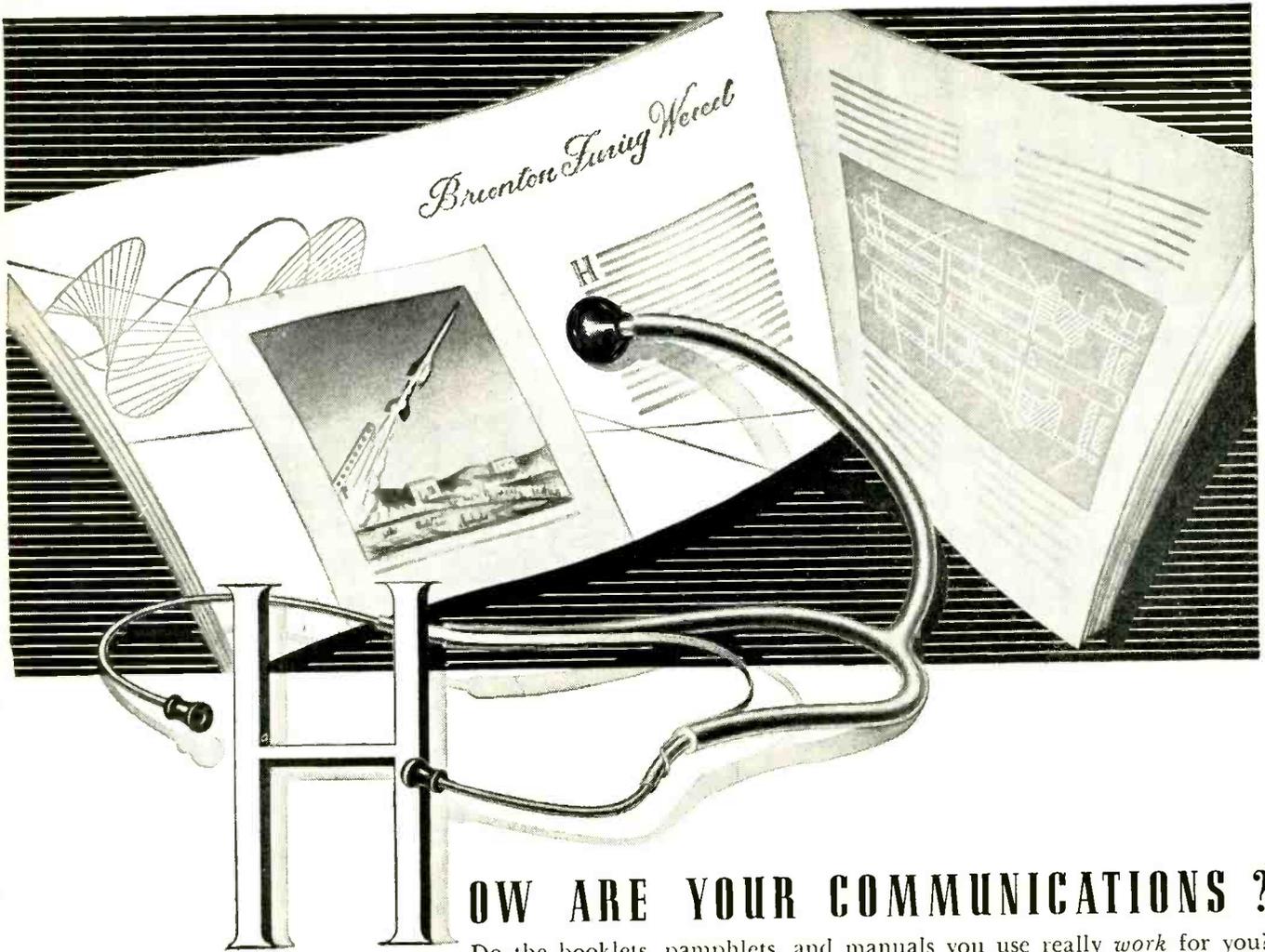
Standard Type J Relay with independent twin contacts



Type JV Video Relay for high frequency currents

# CLARE RELAYS

**FIRST**  
in the industrial field



## HOW ARE YOUR COMMUNICATIONS ?

Do the booklets, pamphlets, and manuals you use really *work* for you? Are these vital publications, that tell the story of your products and your company, as effective, readable, well designed and illustrated as they can be? Today more than ever, your entire operation is judged by each annual report, employee manual, and public relations piece that you produce. Have you examined your communications lately? If you have any doubt as to the impact of your instructional and promotional literature, remember . . .

## COMMUNICATION IS OUR BUSINESS

For a good many decades McGraw-Hill has stood for complete coverage in the business literature field. Now the McGraw-Hill TECHNICAL WRITING SERVICE offers a new approach to your publication problems — an *integrated* writing, editing, illustrating, and printing service for the *custom* production of: INSTRUCTION MANUALS, PRODUCT BULLETINS, TRAINING AIDS, INDUSTRIAL RELATIONS LITERATURE, ANNUAL REPORTS, COMPANY HISTORIES, PROCEDURAL GUIDES and other collateral literature. More than 150 editorial and graphic experts are at your disposal, ready to prepare high-quality material to your own or government specifications. Save time, save money . . . and make your communications work! Let *our* staff be your staff for technical and business publications.

## McGraw-Hill Book Co. TECHNICAL WRITING SERVICE

Write or phone Technical Writing Service, McGraw-Hill Book Co., Inc.  
330 West 42nd Street, New York 36, N. Y. • LOngacre 4-3000

*This service is available through ad agencies.*

# ELECTRO TEC SLIP RING ASSEMBLIES

\*PATENTS PENDING

## HIGH TEMP PLASTIC!

NEW ETC-7 (POLYESTER RESIN)  
USED ON ILLUSTRATED PART FOR  
HIGH TEMPERATURE OPERATION

**- for high temp applications!**

## HARD GOLD RINGS!

24 KT. SOLID GOLD RINGS —  
ENTIRE RING THICKNESS ELEC-  
TRODEPOSITED\* UNIFORM  
HARDNESS, 90 to 100 BRINNELL.

COURTESY LEAR, INC.

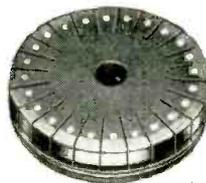
— these two features were incorporated in  
the assembly illustrated above, having 45  
rings, dia. .180", ring width .020", barrier  
width .010". Overall length, less leads 1.763".

Electro Tec Corp., in its constant endeavor to keep pace with the most exacting requirements, has developed these new processes and products. They provide flawless performance under conditions far exceeding the capabilities of other types of construction. Where high temperature is involved, the superiority of these assemblies is so marked, that acceptance has been industry-wide. At the same time, an increasing number of users are specifying these assemblies for the ultimate in dependability under normal operating conditions. Inquiries will receive prompt attention; no obligation.

← 72 rings on integral support — no accumulated tolerances — fulfills electrical, minimum weight and space requirements.



Dual purpose assembly combining "V" grooved signal circuits and wide power rings.



Miniature high speed sampling switch — 24 channels.



Combining low friction torque slip rings (.060 dia.) with reference switch segments.

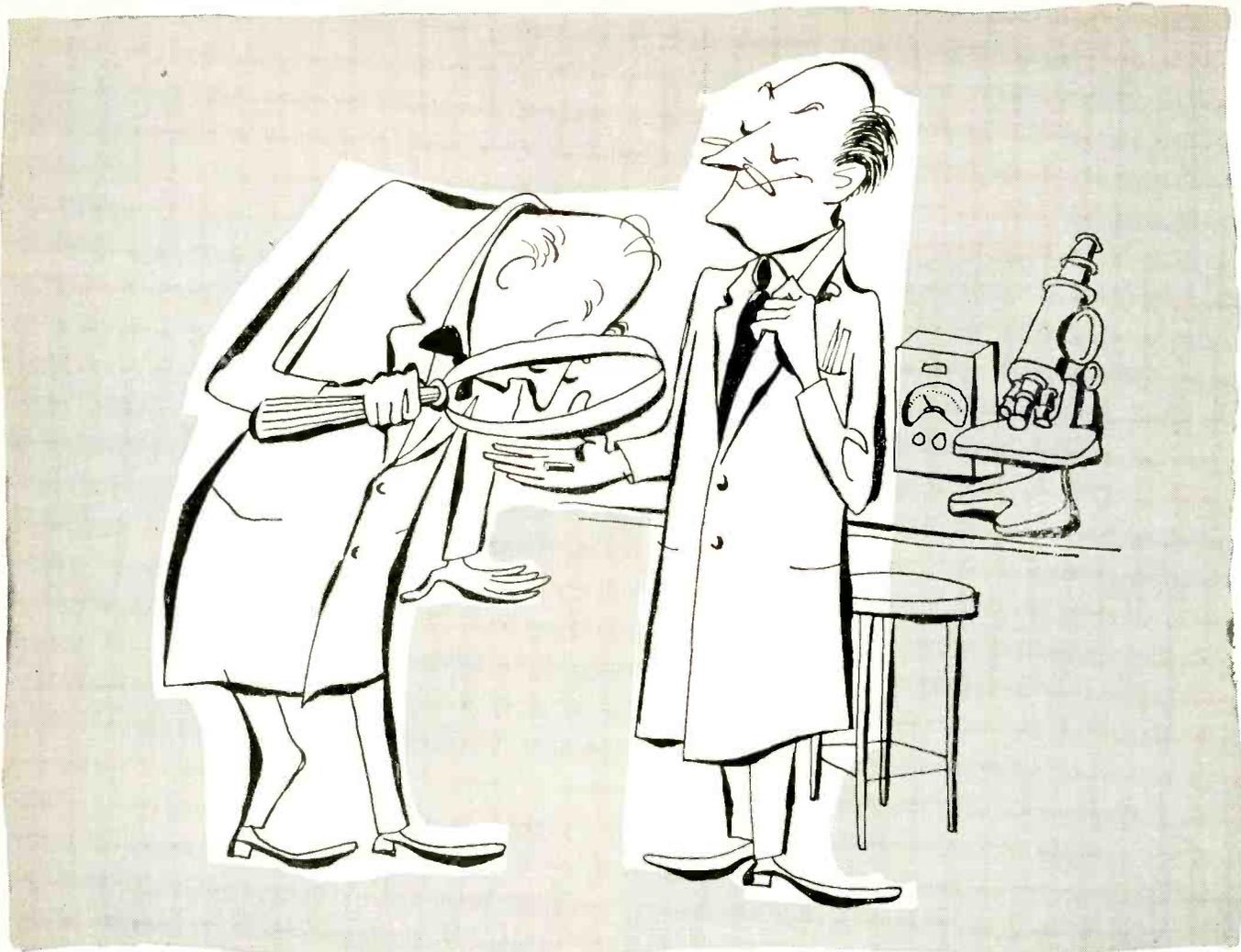
**NEW ETC-7 (POLYESTER RESIN) WITHSTANDS TEMPERATURE RANGE FROM  $-60^{\circ}$  to  $+500^{\circ}$ F.**

PRODUCTS OF PRECISION CRAFTSMANSHIP  
BY A NEW AND REVOLUTIONARY PROCESS

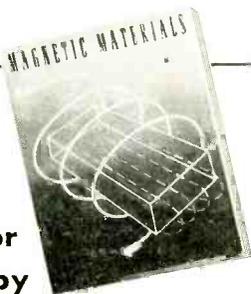


**ELECTRO TEC  
CORP.**

SOUTH HACKENSACK, NEW JERSEY



## How to make a Magnetic Core that's really small? Use PERMENDUR!



Write for  
your copy

### "MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. E-60

When the conditions of service make it imperative for you to hold the size and weight of magnetic cores at an absolute minimum, that's the place to use Permendur. With it you can push the flux density up to 20 kilogausses, and practically eliminate weight as a consideration.

Along with its suitability for cores wherever the premium is laid on compactness, Permendur is just the thing for sonar magnetostriction applications, too. We maintain proper annealing facilities for this

alloy. Write for technical data on it, and let our engineers help you to cash in on its possibilities.

In addition to Permendur, we offer a range of high-permeability alloys, oriented silicon steels and other electrical alloys that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment.

Let us supply your requirements.  
*Allegheny Ludlum Steel Corporation,  
Oliver Building, Pittsburgh 22, Pa.*

**STEELMAKERS** to the Electrical Industry

# Allegheny Ludlum

W&D 5443

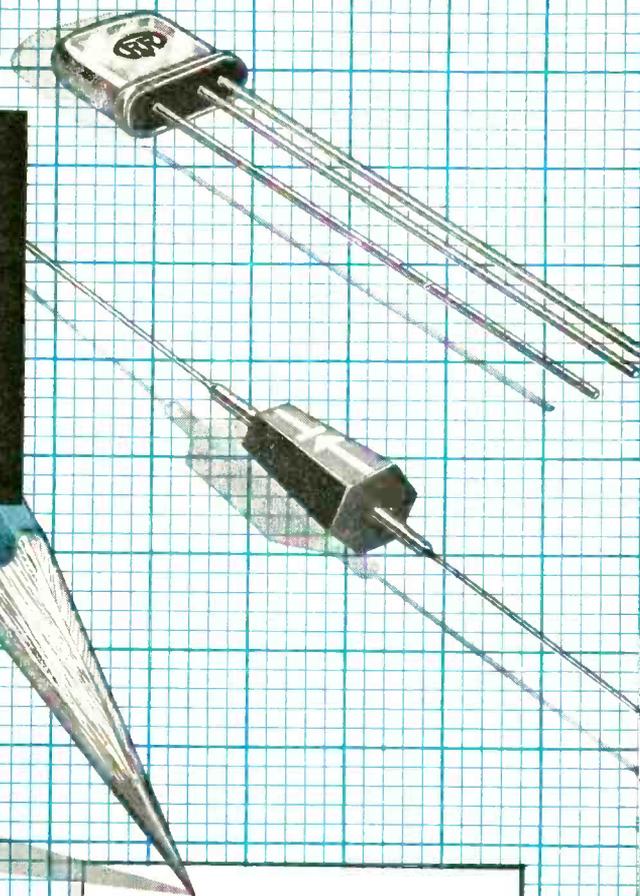
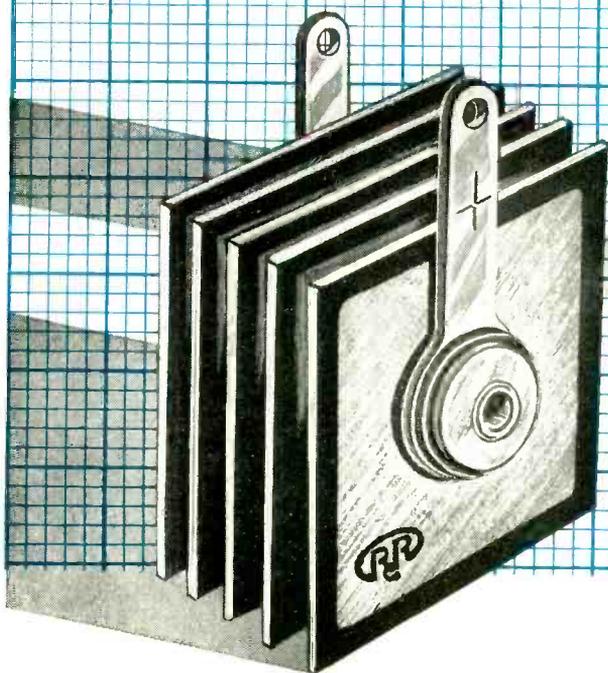


Really



Reliable

**SEMI-CONDUCTOR PRODUCTS**  
for all your rectifier,  
diode and transistor needs



- Outstanding performance
- Uniformly dependable
- Long life
- Rigid quality control
- Constantly improved

RADIO RECEPTOR Co. conducts continuing laboratory research to maintain highest standards for existing types of selenium rectifiers, silicon and germanium diodes and transistors—and to develop new units, including those to meet special needs where necessary.

As rapidly as possible we publish bulletins on our products and they are always available upon request. Sometimes, though, we find the printing presses simply cannot keep up with our progress . . . So, for the best and most up-to-date facts about RADIO RECEPTOR semi-conductor products *we suggest you submit your specifications*. Our engineers will gladly make recommendations incorporating the very latest information at their command. Just address Section E-4.



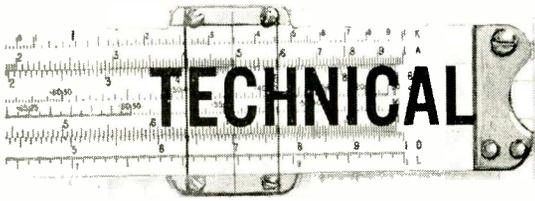
IN RADIO &  
ELECTRONICS  
SINCE 1922

*Semi-Conductor Division*

**RADIO RECEPTOR COMPANY, INC.**

SALES DEPARTMENT: 251 WEST 19TH STREET, NEW YORK 11, N. Y.  
Telephone: WAtkins 4-3633, *Factories in Brooklyn, N. Y.*

# RCA



## TECHNICAL NEWS FOR DESIGNERS

FROM THE RCA TUBE DIVISION

### **NEW!** RCA-6CG7 Miniature Version of 6SN7-GT

The new 9-pin 6CG7 is an RCA development. It's a general-purpose, medium- $\mu$  twin triode intended particularly for use as a vertical and horizontal deflection oscillator in TV receivers. Because of its compactness, the RCA-6CG7 is ideal for use in printed circuit sockets. It employs a structure which permits cool operation of the grids to minimize grid emission, and an internal shield to prevent coupling between the triode units. Designed with a 600-ma heater having a controlled warm-up time, the tube assures dependable performance in series-string TV circuits. The RCA-6CG7 can also be used as phase inverter, multivibrator, sync-separator and amplifier, and resistance-coupled amplifier.



### RCA "SPECIAL REDS" for special industrial applications The 10,000-Hour Plus Line



RCA "Special Reds" are receiving-type tubes designed specifically for unusually exacting requirements. These tubes offer extremely long life plus the special characteristics needed wherever uninterrupted operation of equipment is required. These tubes are engineered to minimize the effects of shock, vibration, and the continuous operation found in industrial service. Their high quality is "built in" rather than "tested in." So insist on RCA "Special Reds," the finest receiving-type tubes your money can buy for rigorous, industrial applications!

### RCA BATTERIES—Types for virtually every need!

More than 80 different types...ranging from the tiny penlite batteries to large types for industrial application...make up the RCA line. Special types are available for circuit designers and experimenters—such as the small, versatile "slice-away" batteries (VS087 and VS068) for use with subminiature tubes and transistors. RCA application engineers will gladly discuss your design problems with you. Write for battery catalog (BAT134B).



For technical data on any of the products shown,  
write to RCA Commercial Engineering Section, L-19-R Harrison, New Jersey

### TWIN BEAM POWER TUBE for 450-470 Mc Operation



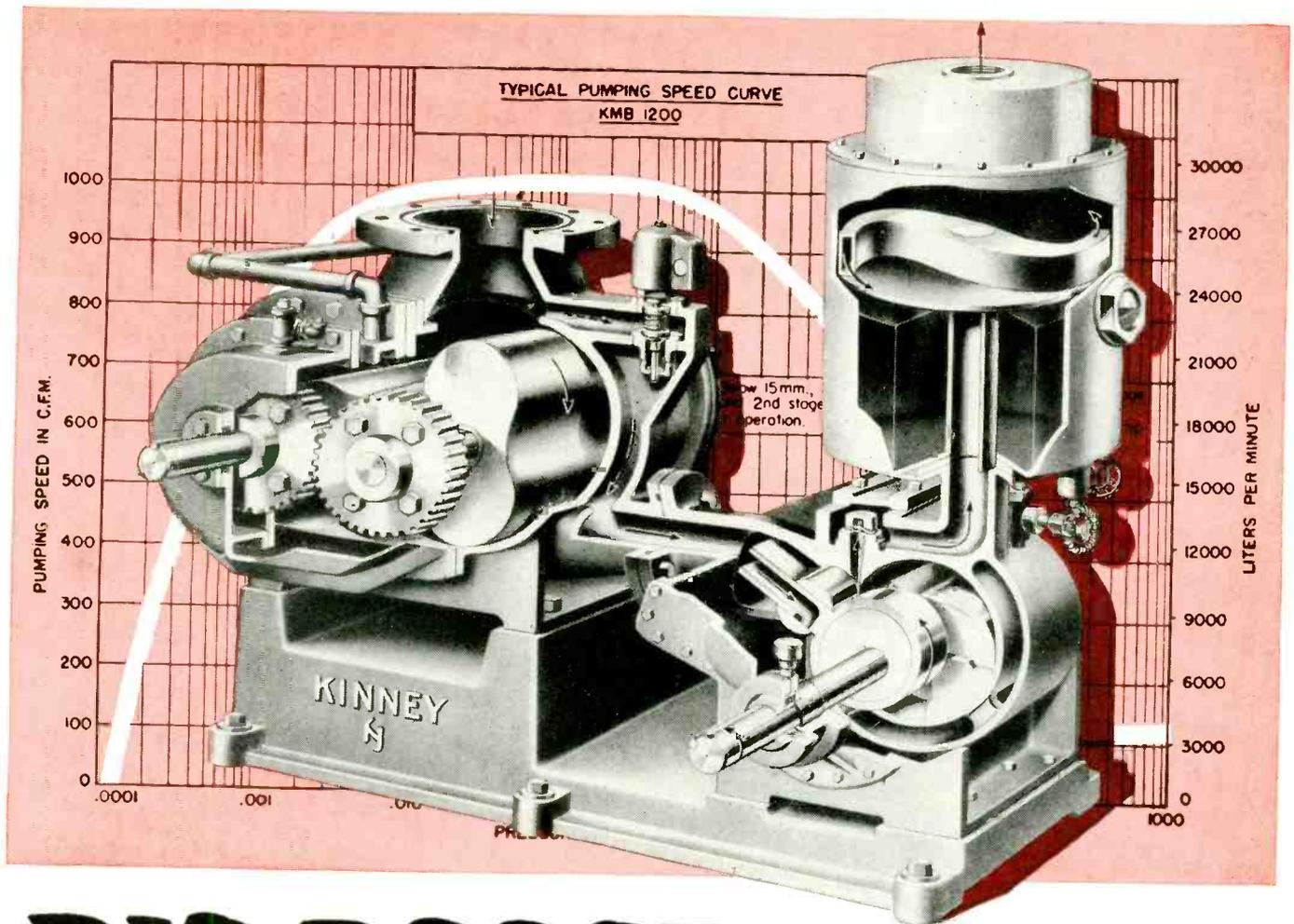
#### RCA-6524

is well-suited for fixed and mobile UHF design—as a balanced push-pull rf power amplifier or frequency tripler. Delivers 20 watts (approx.) under ICAS conditions in class C cw and fm services—at 462 Mc! Maximum plate dissipation is 25 watts (ICAS). Cathode inductance is reduced to a negligible value by a common cathode for the two units.

ELECTRON TUBES • SEMICONDUCTOR DEVICES • BATTERIES • TEST EQUIPMENT • ELECTRONIC COMPONENTS



**RADIO CORPORATION of AMERICA**  
TUBE DIVISION  
HARRISON, N. J.



# BIG BOOST IN FAST CLEAN VACUUM

This new pump has a pumping speed, in the micron pressure range, at least *eight times* greater per horsepower input than any previously developed mechanical vacuum pump. The new Kinney Model KMB 1200 Mechanical Booster Vacuum Pump is a positive displacement two-stage unit whose performance is revolutionary! It blanks off at one tenth micron (McLeod). There is no liquid sealant in the lobe rotor, first stage, to backstream into the vacuum system and contaminate the process. It will handle sudden outbursts of gas without interruption. For large central pumping systems and production processes, here is the ideal Vacuum Pump.

The Model KMB supplements the twelve other Kinney High Vacuum Pump Models — the big line of industry-proved Vacuum Pumps. Kinney district offices are staffed by competent vacuum engineers who will be pleased to help you select the right Kinney Pump for your needs. Send coupon for details.



## KINNEY MFG. DIVISION

THE NEW YORK AIR BRAKE COMPANY

3565 WASHINGTON STREET • BOSTON 30 • MASS.



Name.....

Company.....

Address.....

City..... State.....

Please send Bulletin V54 describing the complete line of Kinney Vacuum Pumps.

Our vacuum problem involves.....



At temperatures as high as +175°C and as low as -55°C, Mallory XT Tantalum Capacitors offer thoroughly dependable operation and stable electrical characteristics. Introduced by Mallory after more than ten years of development, these capacitors are the answer to the extreme temperature problems encountered in miniaturized electronic equipment.

Mallory Tantalum Capacitors give excellent life at high temperatures . . . hold stable capacitance and series resistance values. Rated for 175°C, they can also be supplied on special order for ambients up to 200°C. They perform equally well at the opposite end of the temperature band . . . maintaining high stability of capacitance and impedance down to -55°C.

In mechanical design, too, these capacitors meet every requirement of miniature equipment. All capacitance and voltage ratings are supplied in a standard compact case diameter of only 7/8". Your selection of mounting hardware is simplified, and the complete line of ratings fit into smaller space and weigh less than ever before.

Write today for our Technical Bulletin on XT Tantalum Capacitors. And have a Mallory capacitor engineer consult with you on your specific application. He can lend valuable assistance in selection of components, development of special types where needed, and simplification of circuits.

Parts distributors in all major cities stock Mallory standard components for your convenience

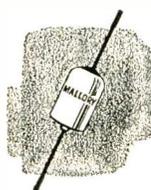
*Expect more . . . get more from* **MALLORY**

### Silverlytic\* Subminiature Capacitors

*For extreme temperatures*

Type TAP tantalum anode capacitors are available in ratings from 6 mfd. 100 volts to 30 mfd. 6 volts, for operation at -55°C to +85°C. Diameter 7/32"; length 3/8".

\*Trade Mark



CROSS  
TALK

► **MANAGEMENT TREND . . .**

We've been out in the field almost continuously for the past two months, talking to a wide variety of people at such places as the Instrument Show, the National Electronics Conference, AIEE's Fall Meeting and RETMA-IRE'S Radio Fall Meeting. Business is good, and most of the men to whom we have talked think it will be as good or better in 1955, but they also think there may be less spread between gross sales and net profit because of rising costs.

This conviction is causing management generally to take a close look at operating expenses, not with the idea of reducing expenditures considered necessary for the encouragement of additional volume but to weed out any nice but not strictly necessary expenses that may have crept in during the lush post-war period. Some long-range projects may suffer but, in the main, the objective is to effect economies by eliminating non-essential routine.

► **BUSINESS MACHINES . . .**

Data processing equipment is rapidly becoming one of the most important branches of the electronics industry. The promotional spotlight is currently playing brightly on the adaptation of such equipment to business offices. Over 100 big companies are known to be studying its possible use for the handling of such things as finan-

cial statistics, payrolls and stock records, and even to illuminate the road over which future sales efforts might go.

Certainly much of the technology by which data processing equipment can be adapted to general business use is known, so we are inclined to agree with those who think that this application of electronics may some day be as important as applications out in the manufacturing plant itself. But a word of caution seems advisable. Like industrial electronics, business electronics will take time to sell; it will be hard to devise universally useful packages, even for similar businesses, so pushbutton offices are not right around the corner.

► **TRANSISTOR AVAILABILITY**

. . . A major manufacturer has the circuit and pre-production model for a practical transistorized portable radio worked out. He thinks he could sell it, even at twice the price of conventional portables, because in addition to battery economy this particular design also offers superior sensitivity and other performance advantages.

So far, this manufacturer has not found it possible to buy the transistors he needs for even pilot-plant quantities, although they are going into military devices and hearing aids. He says he can buy good low-gain transistors suitable for general use in quantity and at

a reasonable price but has not so far found a source for types capable of delivering 30 db or more at the required radio frequencies. These, he says, seem to be available only in laboratory quantities, and at laboratory prices.

► **COLOR COMPLICATION . . .**

With just a few exceptions, manufacturers have not yet taken the color-television plunge, and it now seems unlikely that many will do so much before the end of next year at the earliest.

Designers are developing their own pet circuits to simplify sets that meet NTSC signal standards, and much has already been accomplished in the direction of cost-reducing simplification. But the cost of the picture tube remains very high, preventing the suggested list price of receivers from going down to about the \$500 mark, where many merchandisers think it must go before color can be widely sold to the mass market.

► **LAPEL RELIEF . . .**

In this, the heavy season for conventions and committee meetings, we note with interest the use of identification badges that stick to the lapel rather than being fastened to it with a marlinspike. The precise nature of the stickum is unknown to us but the stuff holds, yet you can remove a dogtag with a slight pull and none of the nap from your best suit comes with it.

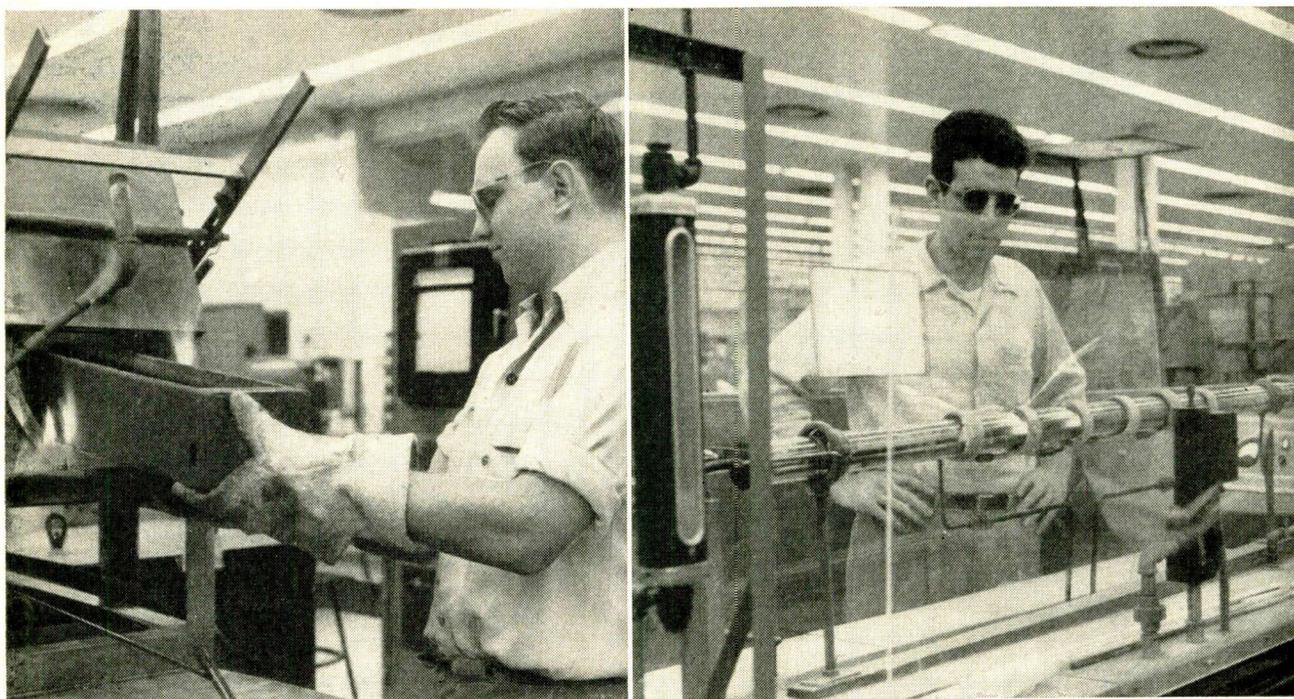


FIG. 1—Reduction of germanium dioxide is accomplished under hydrogen atmosphere in 600-C electric furnace (left). Temperature is then raised to 1,000 C to produce ingot. Zone melting (right) provides high-purity germanium. Six induction-heating coils melt germanium in long graphite boat

By **FRANK H. BOWER**

*Manufacturing Development Engineer  
Western Electric Co.  
Allentown, Pennsylvania*

# Manufacturing Grown

Step-by-step procedure for making grown junction germanium transistors is described. Details are given on critical processes such as growing and doping monocrystalline germanium, locating the junction and attaching the base lead

**G**ROWN JUNCTION *npn* transistor triodes, begin as germanium dioxide, an expensive white powder of high purity. The first operation, at left of Fig. 1, involves removal of the oxygen from the germanium dioxide at 600 C, accomplished in a hydrogen-filled furnace. The temperature is then raised to 1,000 C for several hours (936 C is the melting point of germanium) producing a metallic ingot. The impurity content of the germanium must now be reduced until less than one atom of impurity is present for every  $10^{10}$  germanium atoms.

The concentration of impurity in the reduced ingot is measured by the resistivity of the material and is usually found to be between 2 and 6 ohm-cm. For junction transistors, however, material of greater than 20 ohm-cm resistivity is required and 40 ohm-cm is preferred. At 27 C an intrinsic germanium bar would measure about 47 ohm-cm.<sup>1</sup>

### Zone Melting

The reduced ingot in a graphite boat is placed in a zone-melting furnace such as that shown at right

in Fig. 1. This furnace has a one-pound capacity; larger units are used for actual production runs. It is an inert-gas-filled quartz tube which has a pull mechanism to draw the boat slowly and smoothly from one end to the other. An associated r-f generator supplies power to six work coils located at intervals along the tube. As the boat traverses the tube, it is heated intensely within the field of each coil and a molten zone is produced. After several hours the boat reaches the end of the tube. Since the impurities tend to remain in

## STEPS IN MANUFACTURE

- Reduction of germanium dioxide and refining of the metal.
- Production of single-crystal germanium having minute amounts of doping alloys accurately distributed both in location and concentration within it.
- Shaping of a small bar of single-crystal germanium containing a back-to-back junction at its center.
- Performing cleaning, assembly and chemical operations necessary to attach the three electrodes to the bar; cleaning and protection of the bar's surface; and housing the assembled bar in a sealed structure with access leads for external circuits.
- Electrically testing for acceptance according to the unit's d-c and low-frequency a-c operating characteristics, frequency response, temperature characteristic, stability and characteristic input and output impedances

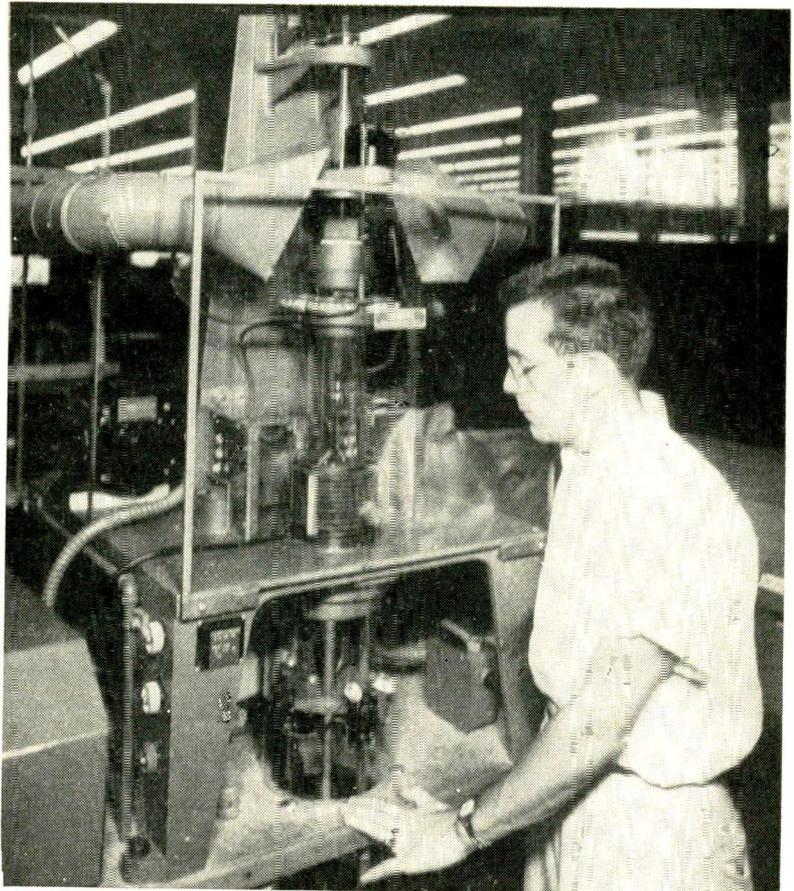


FIG. 2—Vertical crystal growing produces npn-type crystal. Grower has just completed its cycle and crystal is shown lifted from crucible to cool

# Junction Transistors

the liquid germanium, the six melting zones have literally swept impurities to the rear end of the ingot. This portion is the last to solidify and is below 20 ohm-cm in resistivity. It is cropped and along with other similarly cropped ends again refined by the same process.<sup>2,3</sup> The purified material measures between 20 ohm-cm and intrinsic and is suitable for the next operation.

### Crystal Growing Apparatus

The elimination of grain boundaries and the high degree of crystalline perfection of a germanium single crystal are highly favorable to the unimpeded flow of carrier holes and electrons in the solid. Therefore the growing of large single crystals is a requisite



FIG. 3—Checking grown crystal for width of p-layer and resistivity of n-regions. Operator is performing a four-probe resistivity measurement

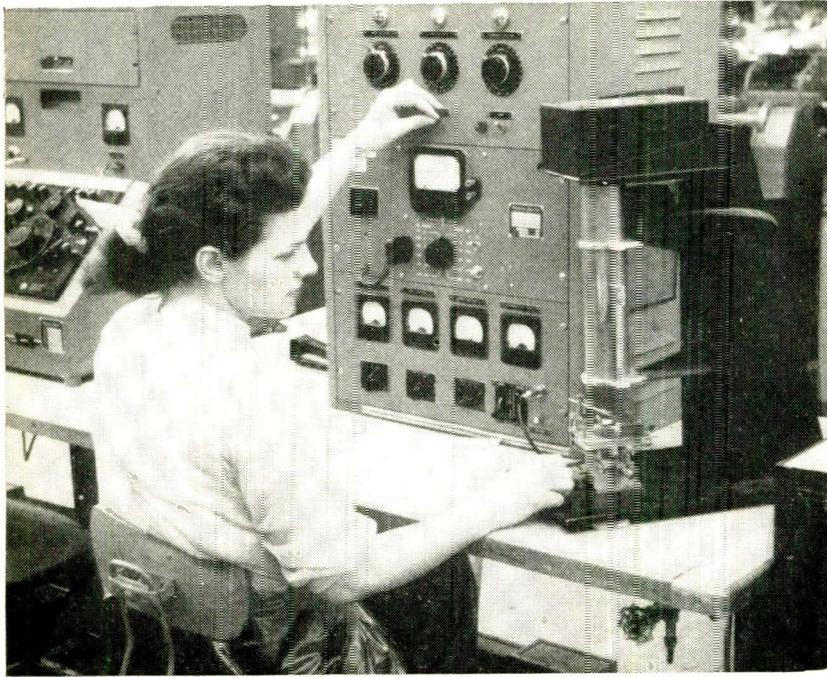


FIG. 4—Measuring minority carrier lifetime. Energy is applied to specimen in form of modulated light beam

for basic material for high quality transistors.<sup>4</sup>

By cooling very slowly the grains formed in the solid may be made larger than if the metal were rapidly solidified. If one of these larger grains is cut from the specimen and touched to a molten surface of the same metal, a single crystal can be grown as the temperature is slowly lowered and the crystal withdrawn. This growing process is referred to as vertical crystal growing.

Only the heart of the complete crystal grower is shown in Fig. 2; the complete unit includes temperature control equipment, an r-f

power generator, the growing chamber and associated mechanical and atmosphere control apparatus.

Heating is accomplished by an r-f induction coil surrounding and concentric with a germanium-charged crucible. Controlled variations in power input to the coil accurately set the temperature of the germanium with minimum thermal inertia. A graphite container is used so that inductive coupling may be obtained to heat the crucible and melt the germanium despite the fact that at low or room temperatures germanium is a poor conductor. A low-conductivity water-filled cooling chamber

surrounds the inside quartz tube and is formed by a second annular cylinder of Pyrex glass outside the r-f coil. This provides a heat sink for radiated heat and aids in reducing the thermal inertia of the temperature control system.

With germanium in the molten state, it is imperative that no unintended contaminants enter solution and that oxidation of both the melt and crucible be prevented. The inner quartz tube serves as an envelope for a controlled inert or reducing atmosphere such as helium or hydrogen.

### Crystal Growing

The growing of a single *n*-crystal is begun with a measured charge of zone-purified germanium which has been acid etched, rinsed and dried.<sup>5</sup> It is placed in the graphite crucible of the crystal grower and rapidly melted by heating a few hundred degrees above the melting point (936 C) for about 5 minutes. The temperature is then lowered to a few degrees above the melting point and a single crystal seed of germanium on a rotating vertical pulling shaft is slowly lowered until it dips into the molten charge. A short period of time is allotted for thermal equilibrium to be attained followed by a slow and steady withdrawal of the seed. As the seed is gradually pulled upward, temperature and pull rate are again adjusted so that germanium grows onto the seed to form a crystal of a desired cross sectional area.

When a definite cross sectional

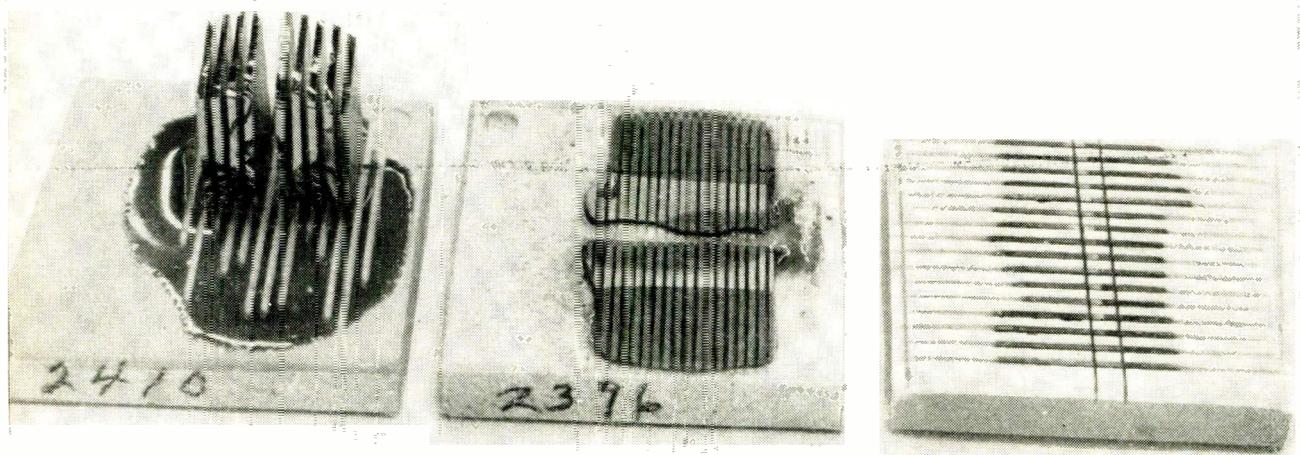


FIG. 5—Cutting operations produce transistor bars from single crystal. Slices are first made perpendicular to junction plane (left). These slices are gang sawed into bars (center). Electrolytic etching makes junction visible for centering between trimming saws (right)

size of the crystal is attained, the growing of the main body is begun. To accomplish this, temperature and pull rate are readjusted automatically causing the crystal to grow straight, vertical sides.

The seed is rotated to produce a symmetrical crystal. The rotation also produces a continuous agitation which distributes the calculated quantities of doping alloy more uniformly through the melt. If agitation and controlled growth rate were not employed, the crystal would solidify from a melt of rapidly increasing alloy concentration and exhibit an undesirable gradient throughout its length.<sup>9</sup> Frequently, a small amplitude vibration is also applied to the crystal during the growing process to achieve better distribution of the doping alloy.

### Doping

Growing single crystals with *p-n* junctions requires additional apparatus for controlled addition of minute amounts of doping materials such as gallium and arsenic. In producing *npn* junction transistors, the pulling of the crystal is the same as described, except that apparatus for dropping pellets of desired doping alloys is used. The pellets are barely visible to the naked eye and are dropped through tubes which may be seen in the photograph (Fig. 2).

The first *n*-type region is grown until it is the proper length. Then a charge of gallium-alloy pellets is dropped into the melt and diffuses

rapidly. It overcomes the weak concentration of *n*-dope (arsenic) already in the melt and the growing crystal picks up gallium atoms in its structure giving it *p*-type characteristics.

Within a specified period of time the doping apparatus releases a charge of concentrated arsenic *n*-dope and this overcomes the domination of the gallium concentration reverting the melt to strong *n*-type. The growth cycle is continued until this heavily doped second section of *n*-material has grown on the crystal. In this manner, a narrow *p*-layer sandwiched between two *n*-regions is produced.

### Crystal Inspection

The finished *npn* crystal is evaluated for width of the *p*-layer and resistivity of the *n*-regions by measurements of voltage profile and resistivity. The latter are made by a method illustrated in Fig. 3 using four probes.<sup>7</sup> The probes are placed on a flat surface of the crystal and a current is passed through the two outer electrodes and the floating potential is measured across the inner pair. This method is used to overcome the rectifying properties of metal-semiconductor contacts and the adverse influence of minority carrier injection at current-carrying contacts.

In addition, the lifetime of minority carriers<sup>8</sup> (holes) in the lightly doped *n*-region is measured, Fig. 4, and a visual inspection is made to assure that twinning and

lineage have not occurred to destroy the proper alignment of the atoms within the crystal.

### Sawing and Cleaning

After the single germanium junction crystal has been grown, the crystal is mounted on a ceramic plate and cut longitudinally into thin *npn* slabs (Fig. 5, left). A diamond saw cuts the hard and brittle germanium and the valuable germanium sawdust is recovered in special filters. The slabs are removed from the ceramic plates and a lapping machine such as that shown in Fig. 6 (left) finishes the cuts to close tolerances.

After a selective etching process that renders the junction visible, the slabs are mounted and cut as shown in Fig. 5 (center) in a second sawing operation. Figure 6 (right) illustrates the actual cutting operation. The bars produced are approximately 1/32 in. square in cross section each having a visible *npn* junction perpendicular to its length. The alignment of bars for trimming is illustrated in Fig. 5 (right) and the final trimming cut produces the basic *npn* bar about 1/4 in. long.

### Assembly

Assembly may be done under microscopes and in controlled low-humidity enclosures. All handling of the germanium is performed with great care so that the material is clean and uncontaminated. Oxide and films which can form on the surface of the material play significant roles in the ultimately

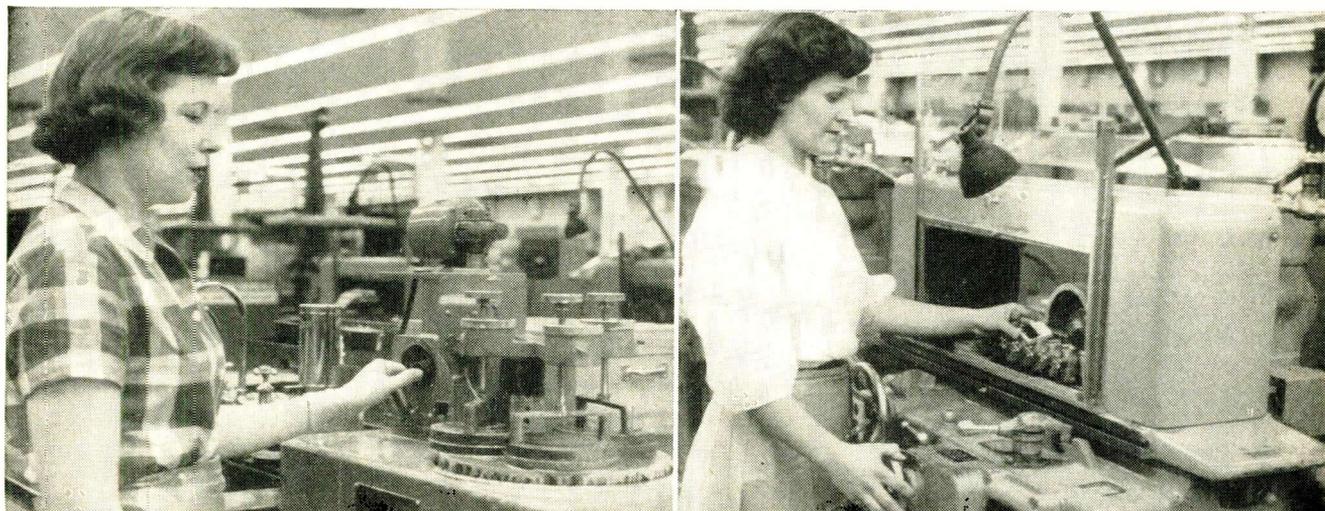


FIG. 6—After first cutting operation the slices are lapped to close tolerance (left). Semiautomatic saw trims bars (right). Machine incorporates provisions for recovering valuable germanium chips

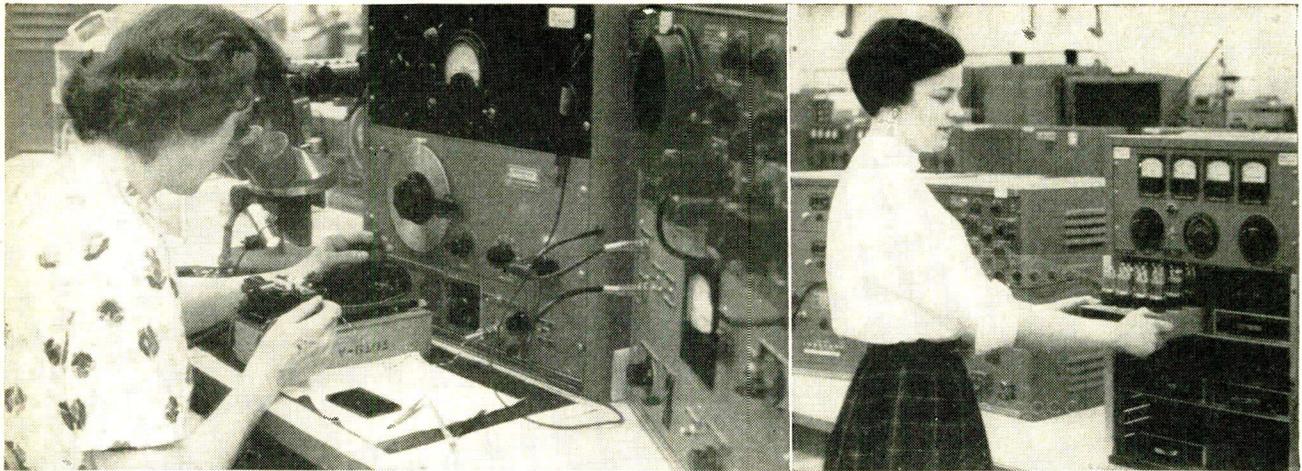


FIG. 7—Bonding base lead (left) involves welding fine gold wire to 0.002-in. *p*-region. Operator probes junction with micromanipulator while checking transistor characteristics on oscilloscope. Trays of completed transistors (right) are loaded into racks for 24-hour aging

attainable characteristics of the finished transistors.<sup>9</sup>

The inspected bar is mounted on a glass-and-metal header which makes ohmic contact to the ends of the bar giving rigid mounting and external electrical connection to the emitter and collector. After cleaning, an electrolytic etching operation is performed with a weak solution of potassium hydroxide in water as the electrolyte to remove the surface debris caused by the mechanical operations of sawing and lapping. In a period of one to two minutes, depending on the setting of current density, the bar surface is brought to a high polish without the need for masking and without the use of strong chemical etches. Then the current-voltage characteristics of the device are observed on an oscilloscope. From this point on, the device is protected from moisture by processing in a

controlled low-humidity atmosphere.

### Base Lead

A third lead must now be attached to the thin *p*-region of the bar. This operation is illustrated in Fig. 7 (left). The equipment for location of the base connection supplies operating biases and an input and output circuit to the transistor assembly so that when the base lead probe is bearing on the *p*-region, the transistor is operating as an amplifier. The circuit is arranged so that the small 10-kc input signal and the amplified output signal are presented on the oscilloscope in an envelope pattern characteristic of most of the electrical parameters of the assembly under test. When the maximum gain point has been located, the gallium-doped gold wire probe is bonded to the *p*-region by passing a welding current

through the contact. By observing the positioning through a 30-power microscope and watching the oscilloscope pattern, the bonding of a 0.002-in. diameter wire to an equally thin *p*-layer is readily accomplished. The gold wire is then attached to the third header lead and makes the base connection available for external contact.

A protective coating is applied to the internal bar assembly and it is hermetically sealed into a can in a dry atmosphere. The seal is made by soldering, using a few seconds application of r-f power to the header skirt which causes localized heating to soldering temperature.

After 24 hours of power aging (Fig. 7, right), the transistor is cycled twice from room temperature to 60 C to stabilize its characteristics. The final testing consists of measuring the 11 electrical parameters listed in Table I.

For assistance in preparing this material, acknowledgement is made to T. F. Briody and J. C. Yastrzab.

Table I—Key Electrical Parameters in Transistor Testing

- (1)  $I_{co1}$ , collector current at zero emitter current and collector voltage of +4.5 v with respect to the base ( $V_c = +4.5$  v)
- (2)  $I_{co2}$ , the same current measured at  $V_c = +10$  v
- (3)  $I_{co3}$ , the same current measured at  $V_c = +30$  v
- (4)  $1 + H_{21}$ , parameter  $H_{21}$  is equal to the absolute value of  $\alpha$ , the short-circuit current multiplication ratio
- (5)  $1 + H_{21}$ , same as in (4) but measured at 60 C
- (6)  $H_{12}$ , open-circuit feedback voltage ratio, approximately equal to base resistance  $r_b$  divided by collector resistance  $r_c$
- (7)  $H_{22}$ , admittance between collector and base, approximately equal to the reciprocal of the collector resistance  $r_c$
- (8)  $H_{11}$ , short-circuit input impedance, approximately equal to the emitter resistance  $r_e$
- (9)  $f_{co}$ , alpha cutoff frequency measured as the frequency at which alpha has dropped 3 db from its low-frequency value
- (10)  $C_c$ , collector to base capacitance in  $\mu\mu\text{f}$  measured at a collector voltage of +4.5 v and zero emitter current.
- (11)  $N_f$ , noise figure at 1,000 cps for 150-cps bandwidth

\* Tests conducted at room temperature unless otherwise noted.

### REFERENCES

- (1) F. J. Morin and J. P. Maita, Conductivity and Hall Effect in the Intrinsic Range of Germanium, *Phys Rev*, 94, p 15, June 1954.
- (2) W. G. Pfann, Principles of Zone-Melting, *Trans AIME*, 194, p 747, 1952.
- (3) E. E. Schumacher, Ultrapure Metals Produced by Zone-Melting Technique, *Jour of Metals*, Sec. 1, 5, p 1,423, Nov. 1953.
- (4) G. K. Teal, M. Sparks and E. Buehler, Single-Crystal Germanium, *Proc IRE*, 40, p 906, Nov. 1952.
- (5) J. N. Shive and W. Shockley, *Phys Rev*, 81, p 835, 1951.
- (6) G. L. Pearson, J. D. Struthers and H. C. Theurer, *Phys Rev*, 77, p 809, 1950.
- (7) L. B. Valdes, Resistivity Measurements on Germanium for Transistors, *Proc IRE*, 42, p 420, Feb. 1954.
- (8) L. B. Valdes, Measurement of Minority Carrier Lifetime in Germanium, *Proc IRE*, 40, p 1,420, Nov. 1952.
- (9) R. M. Ryder, and W. R. Sittner, Transistor Reliability Studies, *Proc IRE*, 42, p 414, Feb. 1954.



FIG. 3—Latest version uses miniature motor to scan area of interest. It hooks on belt and weighs only 1¾ pounds

quency of which is in the region 7 to 8 kc. Oscillograms of these clicks suggest that their waveforms are not unlike those produced in the projector just described, although intensity is many times greater.

This information reopened the question of whether or not sonar methods might be made to yield enough information for genuine obstacle avoidance. It was therefore decided to construct a projector utilizing automatic scanning. Two models have thus far been built. The latest, shown in Fig. 3, has a diameter of 3½ inches and a length of 8¼ inches. The transducers in each case are crystal sound-cells.

Paraboloidal horns are fastened to the top cap of the box and open vertically downward. The sound beam is reflected horizontally out through the opening in the side of the cylinder by the aluminum ellipse, which can be seen through this opening. The ellipse (oriented at 45 deg from the vertical) is mounted on a vertical shaft that is driven by a small motor in the lower section of the cylinder.

In the first model, the reflecting ellipse rotated at about 1 rps and thus the sound beam emerged from the projector only about half the time. Angular width of the opening in the side of the cylinder is 120 deg. In the latest model, the ellipse is made to execute an angu-

lar oscillation with an amplitude of 60 deg and a period of 0.7 sec by means of a mechanism comprising a Scotch crosshead and a rack and pinion assembly. Thus the beam continually emerges from the projector with a sinusoidal right-and-left scanning motion.

### Motor-Driven Scanner

In both models the motor is a permanent-magnet rotor type with make-and-break contacts actuated by the rotor shaft. The electrical pulses for exciting the transducer are supplied from the motor field coil at each break of the contacts. The transducer is tuned to resonance at approximately 10 kc by shunting it with a 50-mh choke.

This parallel-resonant circuit is coupled to the motor coil through a small capacitor to reduce the amount of low-frequency energy in the exciting pulses. Pulse amplitude from the second model is somewhat greater than that from the projector of Fig. 1. Recent developments have improved pulses.

Experience with this form of projector confirms the supposition that automatic scanning provides a gain in the information obtainable from the device. A scan rate of 0.7 to 1 sec is difficult to maintain manually and this rate has been estimated as about the optimum on the basis of a number of considerations. The later model is provided with a hook for attachment to belt

or clothing, so that both hands of the user can be free. Weight of this model is 1¾ lb. With this arrangement, it is conceivable that, at least in thinly settled areas, the blind might use a cane for the detection of step-downs or drops, while using the sound projector for obstacle avoidance.

Projectors of this kind are still inadequate for obstacle avoidance under many conditions, particularly in noisy and congested areas. If the intensity of the projected sound were increased to make it comparable with that of the oil birds' sounds, the noise would be so great that the user would become far too conspicuous.

However, it is probable that intensities of that order would be needed to assure the detection of all obstacles, because of the primarily specular character of sound reflections from most surfaces. Even then, high levels of ambient noise could seriously interfere with obstacle detection and avoidance.

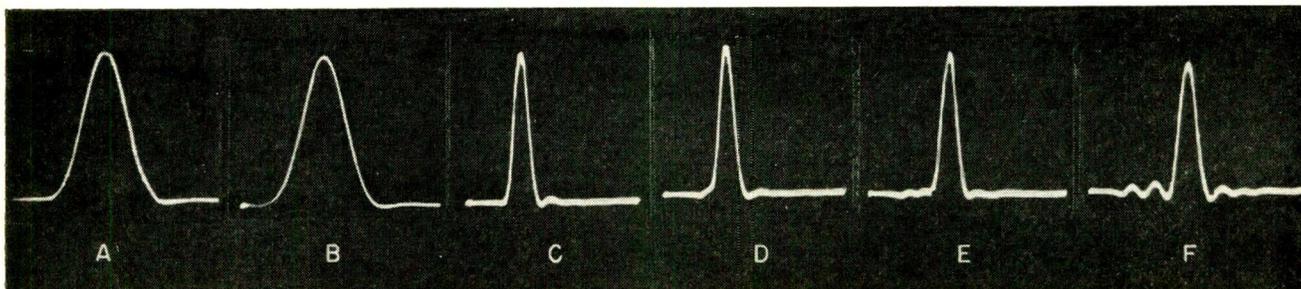
Since step-downs or drops can only be detected optically, or with a material probe such as a cane, it is highly probable that the eventual general-purpose travel aid for the blind will be entirely optical. However, the inherent simplicity, low cost and ruggedness of sound projectors still justify their consideration for use under very simple travel conditions, such as those encountered in rural areas.

## CHRONOLOGY OF SONIC BLIND AIDS

- 1941—D. R. Griffin<sup>1</sup> shows that bats make use of ultrasonic echo-location for obstacle avoidance in flight, and have nerve mechanism (like radar t-r switch) to "short-circuit" ear while high-intensity sound pulse is being emitted.
- 1944—K. M. Dallenbach and M. Supa<sup>2</sup> demonstrate that obstacle sense of the blind lies in ability to interpret sound echoes (above 8 kc) from large objects.
- 1944—Griffin's metallic snapper in paraboloid is used to train blinded veterans. W. Etkin, CCNY, and others at Haskins Laboratories, New York City, experiment with electrically driven sound sources.
- 1947—V. Twersky,<sup>3</sup> Witcher<sup>4</sup> and R. L. Beurle<sup>5</sup> use tones or pulses at 8 to 12 kc to projected by electromechanical transducer from paraboloid to minimize direct pickup and enhance reflections from obstacles.
- 1951—Griffin<sup>6</sup> shows that South American oil birds fly in absolute darkness of large caves by the aid of very intense, sharp, metallic-sounding clicks about 8 kc

### REFERENCES

- (1) D. R. Griffin and R. Galambos, *J Exptl Zool*, **86**, p 481, 1941.
- (2) M. Supa, M. Cotzin and K. M. Dallenbach, *Facial Vision: the Perception of Obstacles by the Blind*, *Amer J Psychol-ogy*, **57**, p 133, 1944.
- (3) V. Twersky, *Sound Flashlight for the Blind*, *ELECTRONICS*, **21**, p 156, 1948.
- (4) C. M. Witcher, *Pulsed Sonic Beam Obstacle Detector for the Blind*, *Radio News* (Radio-Electronic Engineering edition) **9**, p 8, 1947.
- (5) R. L. Beurle, *Electronic Guiding Aids for Blind People*, *Electronic Eng*, **23**, p 2, 1951.
- (6) D. R. Griffin, *Acoustic Orientation in the Oil Bird*, *Stearnornis*, *Proc Natl Ac Sci*, **39**, p 884, 1953.



# Sine-Squared Pulses

Flaws in television systems show up better when a sine-squared pulse is applied than when square waves are used for checking. Broadcast engineers will find the techniques described useful in lining up transmitters and studio gear for color

By **RALPH C. KENNEDY**

*Development Engineer  
National Broadcasting Company  
New York, New York*

**U**SE of a sine-squared test pulse subjects a television system to a more realistic test than does a square wave because the camera signal from a sharp vertical black-to-white transition follows a sine-squared curve.<sup>2</sup>

Furthermore, a sine-squared pulse provides a more rigorous test for ringing than a square wave. Overshoot, when a sine-squared pulse is passed through an ideal bandwidth-limited system, is 13 percent as against 8.9 percent for a square wave.

When ideally limited, the pulse appears as a  $(\sin x)/x$  function. The pulse spectrum is such that the component energies at the nominal high-frequency limit are down 6 db in power and have zero value at

twice the nominal high-frequency limit.<sup>3,4</sup> Since the pulse conforms to these values within about  $\pm 1$  percent, there is available in the sine-squared pulse a mathematical function readily reproducible and suitable for all types of analysis and synthesis.

## Test Interpretation

A system's response characteristic is appraised by the pulse duration and amplitude. The area under the pulse remains constant so that bandwidth limitation most frequently causes only a decrease in pulse height and an increase in pulse width. Furthermore, the phase characteristic is readily evaluated by the symmetry or lack of it about the pulse axis. A  $(\sin x)/x$

function is perfectly symmetrical about the pulse axis. Any departure from this ideal condition by the system phase characteristic most frequently causes only dissymmetry to occur. If time of transmission through a system is faster at high frequencies than at low frequencies, ripples appear prior to the pulse while the converse causes ripples following the pulse.

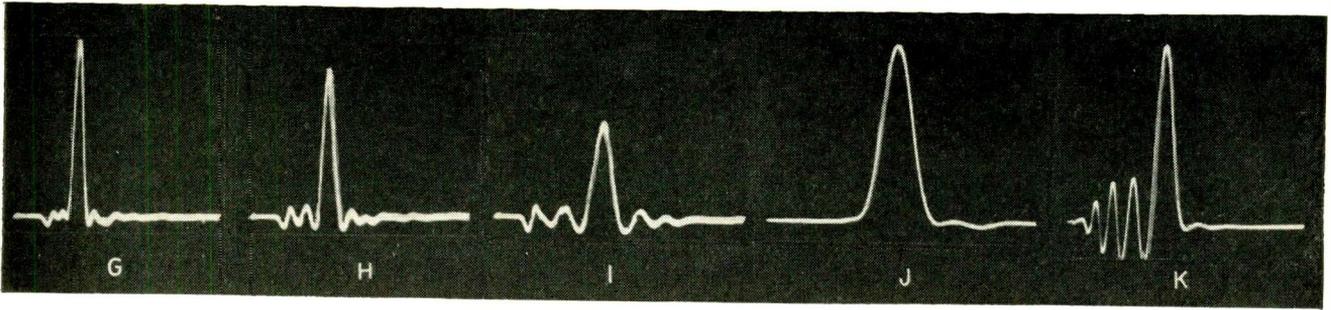
Since the pulse consists of frequency components up to twice the nominal high-frequency limit, the pulse appraises only a certain portion of the spectrum. This dictates the use of two pulses for testing 4-mc television circuits—one having 0.25- $\mu$ sec half-amplitude duration which contains energy 6 db down at 2 mc and no energy at 4 mc and a second of 0.125- $\mu$ sec half-amplitude duration which correspondingly is 6 db down at 4 mc and zero at 8 mc.

By combining a low-frequency square wave having sine-squared transitions with the above two pulses, a system can be thoroughly checked throughout the total pass band. The use of a calibrated oscilloscope scale based on a rating factor<sup>5</sup> enables the observer imme-

## SINE-SQUARED TEST PULSE

A pulse having the shape of the curve  $y = \sin^2 x$  has been used to check distortion in television links in England and on the continent for a number of years.<sup>1</sup> However, little use of this test pulse has been made in the U. S.

The CCIF (Comite Consultatif International Telephonique) in 1951 provisionally adopted the following specification for this test pulse: (1) the prf shall be at the line frequency and (2) the half-amplitude duration of the pulse shall equal half the period of the system's nominal bandwidth. Thus for a system 6 db down in power at 4.5 mc, the half-amplitude pulse duration is 0.111  $\mu$ sec



# Test Color-TV Systems

diately to determine the go or no-go characteristics of the system.

## Equipment

Figure 1 illustrates the equipment setup for generating test pulses. The input pulse amplifier is a twin triode. It accepts the horizontal-blanking signal and provides a sharply differentiated, large-amplitude negative pulse to drive the twin-triode cathode-coupled multivibrator that delays the sine-squared pulse 20 or 30  $\mu$ sec and delivers a large-amplitude negative pulse to the pulse shaper.

The pulse shaper is a pentode amplifier that increases pulse rise time and inverts the negative pulse. The trigger circuit is transformer coupled to a conventional blocking oscillator that creates large amplitude short-duration pulses, which are shaped in the filters.

Waveforms (A) to (B) show two

test pulses having half-amplitude durations of 0.34 and 0.11  $\mu$ sec respectively. These test pulses were put through a series of low-pass linear-phase-shift filters<sup>6,7</sup> and a lossless nonlinear-phase network.<sup>8</sup>

The low-pass filters have characteristics such that their response is down 3 db at 6.0, 4.0, 2.3 and 1.67 mc. Waveforms (C) to (F) show the effect the filters have on the 0.34- $\mu$ sec pulse. Decreasing pulse height and increasing width are evident in (E) and (F) while the symmetry in (F) occurs as the pulse begins to assume a  $(\sin x)/x$  form. Since the 0.34- $\mu$ sec pulse has essentially no energy above 3 mc, the 6 and 4-mc filters have no effect on pulse height or duration as is evident in (C) and (D).

## Filter Effects

Waveforms (G) through (I) show the effect of the 6, 4, and 2.3-

mc filters on the 0.11- $\mu$ sec pulse. The phase characteristic of both the 6 and 4-mc filters is not as good as it is in the 2.3-mc filter.

Waveforms (J) and (K) display the effect produced on the pulse by a lossless nonlinear-phase network. The network used was designed to produce the NTSC envelope-delay characteristics for color tv transmitters. The requirement is that the envelope delay remain constant from 50 kc to 3 mc and then decrease linearly to 4.18 mc so that it is 0.17  $\mu$ sec at a frequency of 3.579 mc.

## Distortion

Little effect should be produced on the 0.34- $\mu$ sec pulse as is evident in (J). However, the 0.11- $\mu$ sec pulse is distorted as seen in (K). Furthermore, the slight ripple in (J) follows the main pulse whereas it precedes the pulses in (K).

## REFERENCES

- (1) I. F. Macdairmid, A Testing Pulse for Television Links, *Proc IEE*, Part IIIA, 99, p 436, 1952.
- (2) V. J. Cooper, High Power Television Transmitter Technique with Particular Reference to the Transmitter at Holme Moss, *Proc IEE*, Part IIIA, 99, p 231, 1952.
- (3) W. E. Thompson, Networks with Maximally Flat Delay, *Wireless Eng*, 29, p 256, 1952.
- (4) W. E. Thompson, Delay Networks Having Maximally Flat Frequency Characteristics, *Proc IEE*, Part IIIA, 96, p 487, 1949.
- (5) N. W. Lewis, Waveform Response of Television Links, Part III, *Proc IEE*, 101, p 258, July 1954.
- (6) H. W. Bode and R. L. Dietzold, Ideal Wave Filters, *BSTJ*, 14, p 215, Apr. 1935.
- (7) G. L. Fredendall and R. C. Kennedy, Linear Phase Shift Filters, *RCA Rev*, 11, p 418, Oct. 1953.
- (8) G. L. Fredendall, Delay Equalization in Color Television, *Proc IRE*, 42, p 258, Jan. 1954.

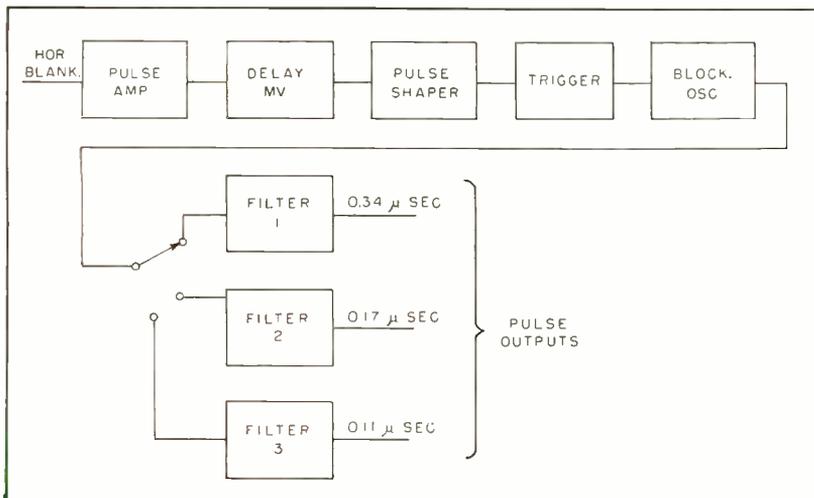


FIG. 1—Equipment setup for generating sine-squared pulses

# High-Frequency Coils

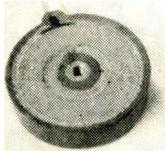


FIG. 1—Center-threaded brass insert of toroid allows coils to be stacked without applying mounting pressure to plastic case or coil assembly

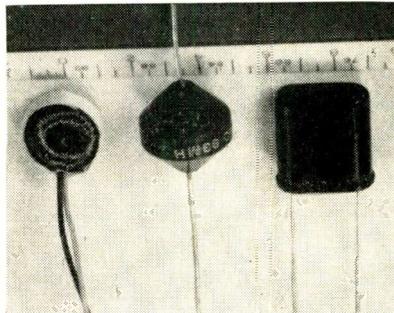


FIG. 2—Open toroid unit is recommended for high-temperature operation; pigtail unit has an inductance of 93 mh; hermetically sealed unit is small

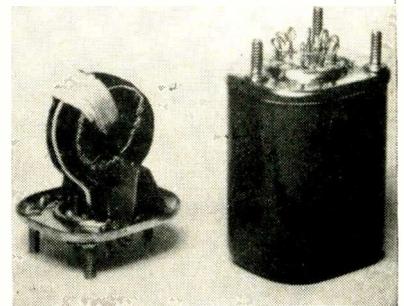


FIG. 3—High-frequency controllable inductor is wound on toroidal core and hermetically sealed in case that serves as magnetic shield

Ferrite and powdered-iron cores in varied shapes give new high-frequency inductors and transformers the versatility and compactness of low-frequency units. Toroidal construction finds greater use. Metallized glass inductors give stability and ruggedness

**T**WO of the more significant recent advances in high-frequency inductors are the extension of saturable reactor and magnetic amplifier techniques and the introduction of new materials for coil forms. The former advance includes ferrites, used as cores for inductors operating to about 100 mc; the latter includes glass and other low-loss materials, used as forms at higher frequencies.

High-frequency inductors are superficially simple, being wire wound on a form. Wire is available from innumerable producers and various materials are made as tubes suitable for coil forms. Winding is a relatively simple process. Thus many equipment manufacturers wind their own inductors and from such unsophisticated beginnings evolve special materials, techniques and designs. There seems to be more variety—and more manufacturers—of high-frequency inductors than of any other component. Units range from a few  $\mu$ h for use at hundreds of megacycles to a

By **FRANK ROCKETT**

*Research and Engineering Division  
Airborne Instruments Laboratory, Inc.  
Mineola, N. Y.*

hundred henrys or so for use at hundreds of cycles. This range necessitates variety.

### Toroids and Filters

From audio frequencies to a few megacycles, toroidal coils are often preferred for their self-shielding. For example, Burnell & Co. specializes in winding transformers, filters and mutual-inductance delay lines on molybdenum-Permalloy dust-core toroids. One more recent innovation is a set of plug-in decade precision toroids ranging in steps of 1, 2, 3, 4 and 8 in each decade from 1 mh to 180 h. Terminals are on the axis and serve to mount one unit on another to produce the desired inductance; this is especially useful during circuit development from 100 to 10,000 cps.

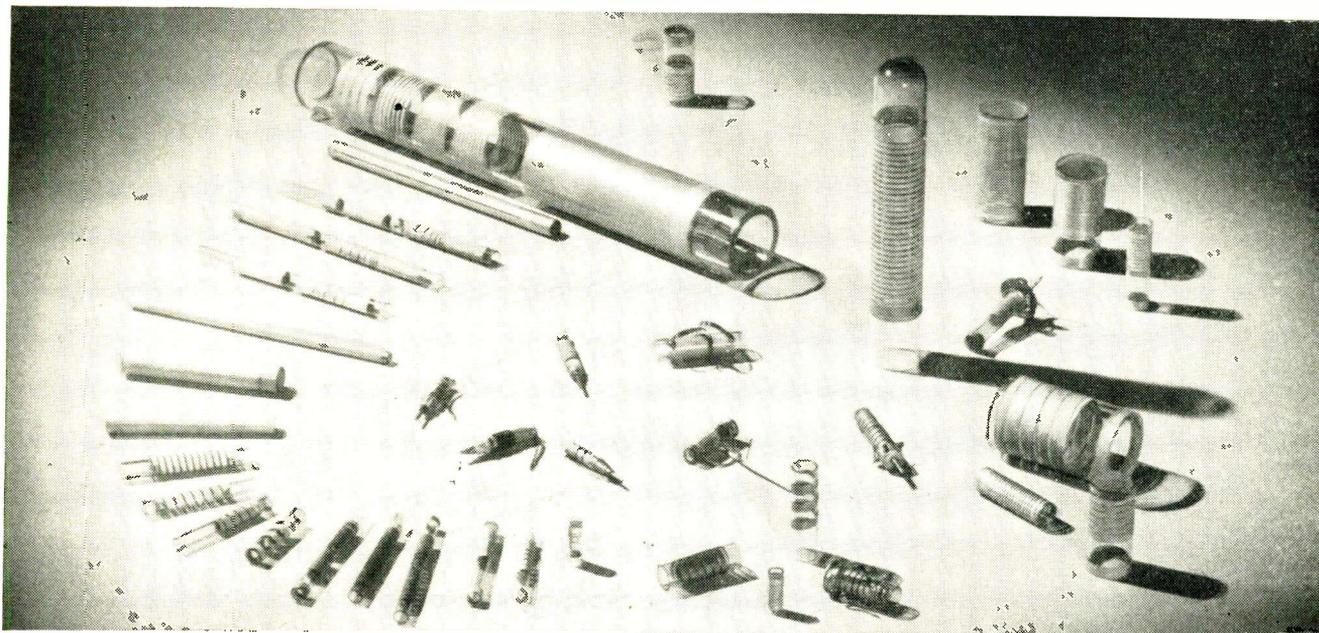
Many firms custom-engineer their inductors and transformers.

Raytheon Manufacturing Co. winds ultrasonic and other special units to order. On the other hand, companies such as Freed Transformer carry a wide range of inductors and filters as catalog items, including miniature transistor transformers.

High-temperature operation of core inductors is ultimately limited by Curie temperature (as low as about 100C for ferrites of high initial permeability, to about 800C for iron). At Tri-Dex Electronics, Teflon and ceramic insulation are used with metal bobbins where possible for high heat conductivity; such bobbins are attached directly to heat sinks for operation above 180C. The Arnold Engineering Co. furnishes powdered Permalloy toroids stabilized to provide a permeability constant within  $\pm 0.1$  percent over a specified temperature range.

These examples are by way of pointing out that a high-frequency inductor must be engineered for adaptability or tailored to its use. Refinements come from design,

# Use New Core Materials



Highly stable inductances are formed by metallizing windings on glass forms. Pitch of spiral can be varied to shape tuning curve of variable units with slug tuning. Transformers can be made by winding ordinary wire on metallized glass forms

choice of materials and techniques such as handling fine wire.

Advances in manufacturing techniques have lowered unit costs. Communication Accessories Co. uses toroidal winding machines with speeds of 2,500 to 3,000 turns per minute, compared with 500 tpm used formerly, to wind the coil on the powdered-iron core whose cross-section is shown in Fig. 1.

Polyester and alkyd compounds seal units and yet add little to their overall size. Such inductors operate over a temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ; in this range the frequency drift of a telemetering filter may be less than 0.5 percent, for example. In response to the demand for components compatible with transistors, manufacturers are developing such subminiature inductors as those in Fig. 2.

## Saturable Reactors

Automatic voltage-stabilizing inductors, variable and saturable regulators and magnetic amplifiers, which are common components at

power frequencies, are being extended in operation up to tens of megacycles. Controllable inductors are used in tunable filters, variable delay lines, switches and modulators. In the Increductor (trade name of CGS Laboratories) of Fig. 3, current through one or more control windings determines the magnetic state of the core to control the effective inductance of a signal winding. The windings and core are arranged to cancel inductive coupling.

At zero control current, the signal winding of a controllable inductor has its maximum inductance; this is about 66 microhenrys for the unit whose characteristics are plotted in Fig. 4. At full rated

control current of 100 ma the inductance of this unit is reduced to less than a microhenry. The relation between control current and inductance is given by the stationary scales at the top and bottom of Fig. 4. The scales are aligned for monotonically increasing control current. Because of hysteresis, the inductance is slightly different when reached by decreasing the current.

Loss relative to reactance varies with frequency and inductance as shown by the constant-Q contours of Fig. 4.

Most controllable reactors have larger temperature coefficients than linear components, although there is generally a control current at which temperature coefficient of in-

## Previous Articles in Series

- Part I: Fixed Capacitors Undergo Miniaturization, p 120, July 1954
- Part II: New Variable Capacitors Extend Tuning Range, p 130, Aug. 1954
- Part III: Fixed Resistors Show Stability Improvements, p 132, Sept. 1954
- Part IV: Precision Potentiometers Use New Materials, p 144, Oct. 1954
- Part V: Iron-Core Transformers Run Smaller and Hotter, p 136, Nov. 1954

## COMPONENT DESIGN TRENDS

- Self-shielding molybdenum-Permalloy dust-core toroids can be stacked for decade inductors
- Combining Teflon and ceramic insulation with heat-conducting metal bobbins permits operation above 180C
- New toroidal winding machines run at speeds up to 3,000 tpm
- Metallized glass construction permits economical production of variable-pitch units giving special tuning characteristics

ductance is zero from  $-50\text{C}$  to  $+80\text{C}$ . Typical values of temperature coefficient are 0.1 percent to 0.5 percent.

Up to 10 mc, ratios of maximum to minimum inductance in the hundreds are feasible; to 50 mc, ratios in the order of 30 to 100 are achieved; at higher frequencies the ratio of maximum to minimum inductance is less than 2. Up to 50 mc, the peak Q ranges from a few hundred down to 40; at 100 mc it is between 10 and 50. Control power is usually 0.1 to 100 milliwatts, and rarely over a watt, yet r-f outputs to 300 watts can be controlled between 20 and 40 mc. Special units can operate to 250 mc. Maximum inductance can exceed 100 henrys. Standard units respond to a 1,000-cps sawtooth control current; special units respond to control currents varying at megacycle rates. In a representative application, the frequency of an oscillator shifted 25 percent per ma of control current in the region of zero temperature coefficient.

To counteract the decrease in variation due to remanent magnetism, the Vari-L Co. shunts the toroid with a permanent magnet in addition to control windings. The permanent magnet provides a bias field with a stability that would be difficult to achieve by a bias current in a separate winding and without continuous expenditure of power. The magnet can be rotated with a screwdriver adjustment to trim the starting inductance or the shape of the characteristic curve.

### Ferrite Cores

Ferrites, which are crystals commonly formed from NiO, ZnO, and  $\text{Fe}_2\text{O}_3$  (but which may also contain copper, iron, lithium, magnesium, manganese or cadmium), are the core materials used in more re-

cently developed high-frequency inductors. At lower frequencies, grain-oriented tape-wound iron cores are used, but even in thin insulated laminations they introduce too much eddy current loss for general use above a few hundred kilocycles.

Ferrites are being applied to variable inductors, high-frequency saturable reactors, magnetic amplifiers, pulse transformers, resonant reactors, flyback inductances and, usually in toroids, to a wide variety of filters—lower sideband, band-pass, low-pass, high-pass, traps (band rejection), telemetering and interstage. They are well suited to antenna coil cores, television components and miniature transformers, especially for ultrasonics and for tv deflection and impedance matching.

Magnetostrictive effect is a function of composition. It can be made zero if undesired, or accentuated to provide electromechanical transducers. Composition also affects Q and Curie temperature.

### Antenna Transformer

By way of illustrating the performance of contemporary r-f transformers, the response of a Polycoupler (CGS Laboratories) antenna transformer is presented in Fig. 5. This unit, utilizing a core material adapted for the application, couples a balanced rhombic antenna with a mean impedance of 600 ohms to a 75-ohm feeder line; it can handle up to six receivers in parallel with negligible cross coupling. Although rated for operation from 2 to 20 mc, the curves are plotted over the full range of measurements as made by two independent users.

Different test equipment was used in the two measurements whose results are combined in Fig.

5; the methods were substantially the same, however. A signal generator fed the coupler through a simulated 600-ohm impedance. Three different loads were used one at a time in each case: 100, 75 and 50 ohms. Because of individual differences in the test setups, the data are presented as a scatter diagram. At the low-frequency end, response fell off as the load resistance increased; at the high-frequency end, response fell off abruptly as the load resistance decreased.

### Metallized Glass Inductors

Metallized glass inductors are filling various needs because of their drift stability, ruggedness and adaptability to production-line fabrication. Low coefficient of thermal expansion for the coil form coupled with low temperature coefficient of dielectric constant (substantially constant up to 100C) result in an extremely low tempera-

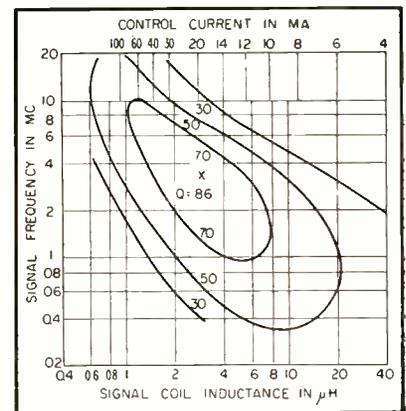


FIG. 4—Representative Q plot of controllable inductor shows Q as function of inductance (related to control current) and of frequency

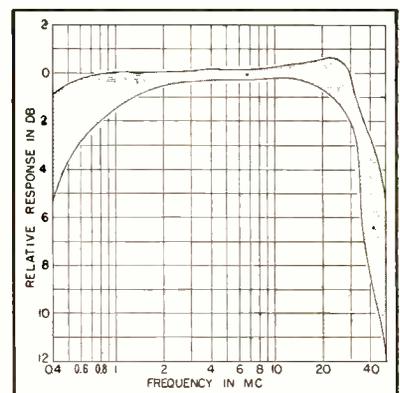


FIG. 5—Data from two independent tests of an antenna transformer are presented as a scatter diagram

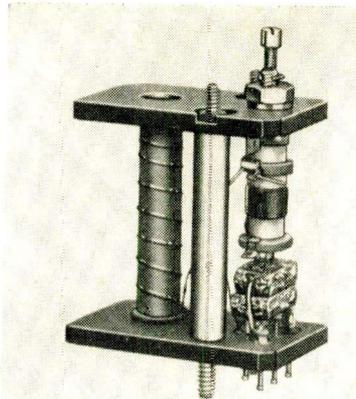


FIG. 6—For quality control, L, C and Q of this r-f assembly are measured

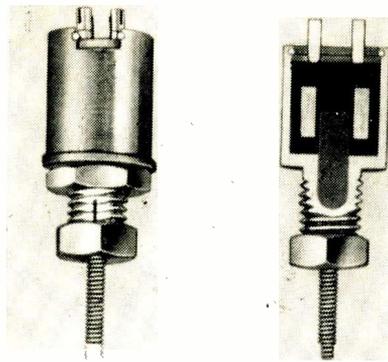
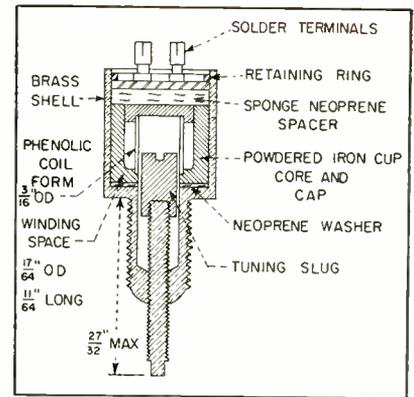


FIG. 7—Miniature slug-tuned and shielded r-f coil form is 7/16 inch in diameter and extends 3/8 inch below chassis when mounted with screw above chassis



ture coefficient of inductance, approximately  $7 \times 10^{-6}$  per degree C for Corning Glass units without cores. In these inductors, the conductors are fired on the coil forms, and consequently the units can be calibrated and accurately duplicated. Values of Q are in general lower than for comparable wire-wound units. At 20 tpi the average Q for a typical inductor is about 120. However, in designs where the unit behaves more as a distributed circuit element than a lumped constant, quality may be described better in terms of d-c resistance, which is usually low.

As illustrative values (for a variable inductor tuned by a slug over the f-m band from 87 to 109 mc), apparent inductance at 100 mc is 0.07  $\mu$ h, distributed capacitance without core is 0.6  $\mu$ mf, with core full in it is 1.1  $\mu$ mf, minimum Q at 108 mc without slug is 150 and temperature coefficient of inductance without core is  $+6 \times 10^{-6}$  per degree C at 100 mc, using the recommended low-loss ceramic core.

At Corning, such units are fabricated by firing silver onto the low-loss glass form; the silver is then copper-plated and, if desired, a coating of flash tinning is applied to protect the conductor from oxidation. Average total thickness of metal is 0.0010 to 0.0015 inch. Such metallized inductors are used from 30 to 1,000 mc; production units are used in low-frequency, f-m and uhf applications.

Bifilar inductances for transformers can be supplied with fixed pitches. Conductor width and gap width can be varied to meet particular requirements, although experience to date at Corning has

been that gap width can be fixed in any one design; minimum practical gap width is 0.020 inch, and gaps up to 0.125 inch have been produced. A maximum of 20 tpi seems practical.

Space limitations and required coupling coefficients may preclude metallized glass transformers. One alternative is a metallized inductor in the tuned circuit of an oscillator with a wire-wound tickler cemented onto the glass form.

A related component is the metallized coil form for delay lines. This form consists usually of from 12 to 30 metallized axial strips running the length of the form (1.5 to 6 inches) separated by an  $0.004 \pm 0.001$ -inch gap. A 1/8-inch ring at one end joins the strips. The form is about 1/4 inch in outside diameter. A distributed-constant delay line is formed by winding a wire coil on the form.

### R-F Coils and Transformers

Typical of r-f inductors is the tuner-buffer assembly of Fig. 6, produced by I-T-E Circuit Breaker Co. The wire coil is wound on a ceramic form, which may be treated with silicone. These forms are available in a wide variety of sizes with and without tuning slugs. To minimize the capacitance of terminals for such forms, Cambridge Thermionic Corp., for example, mounts them on silicone fiber-glass collars.

The unit of Fig. 7 illustrates, in unusually compact form, the principal features of r-f coil construction. The coil is wound on a phenolic form, providing a winding length of 11/64 inch, and is surrounded by a powdered-iron cup

core that shields the unit magnetically yet leaves the center available for a powdered-iron tuning slug that is driven by a threaded shaft. Composition of the cup core and slug depends on intended frequency; the recommended range is from 200 kc up. A brass shell provides electrical and mechanical shielding, and a compression locknut on a split mounting stud holds the slug in its set position. Inductance values to 1.5 mh with Q's below a hundred are obtained; maximum size of wire is No. 22. Because of the shielding and the compact, fairly shockproof construction, these coils can be mounted close together as in miniaturized i-f strips.

Where losses or high-voltage creepage are critical factors, air-wound inductors such as those built by Barker and Williamson are used. Applications range from miniature units for portable vhf transmitters to tank circuits for long-wave communication transmitters.

Until recently pulse transformers have been exclusively a customer-tailored component. For example, Engineering Research Associates developed a transformer for 0.1 to 0.5- $\mu$ sec pulses with three windings having turns ratios of 2:1:1 and a characteristic impedance referred to the high-turn winding of 1,300 ohms. Recently PCA Electronics announced a line of stock units. Standard units provide a pulse width from 0.1 to 16  $\mu$ sec and rise times from 0.01 to 1.2  $\mu$ sec with a drop of 10 to 15 percent in blocking oscillators. As with other high-frequency cores, ferrite cores have contributed significantly to recent advances.

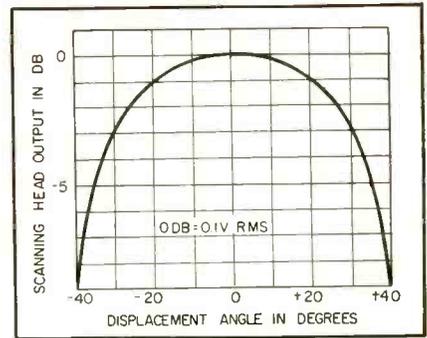
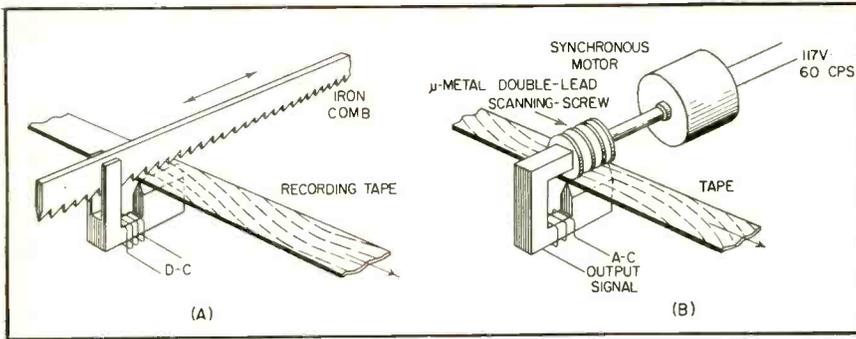
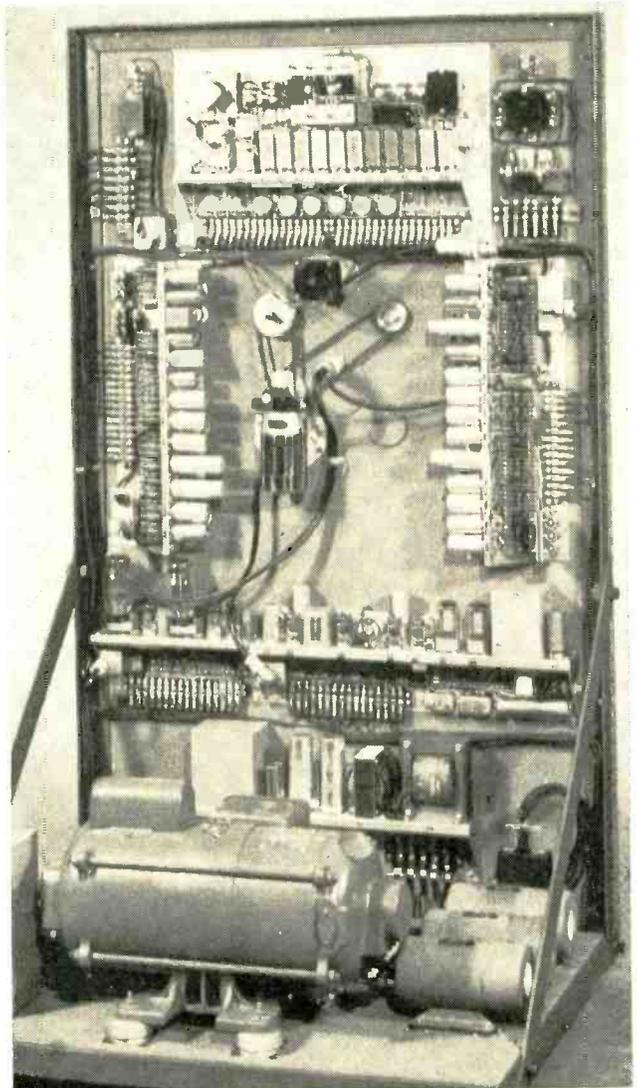
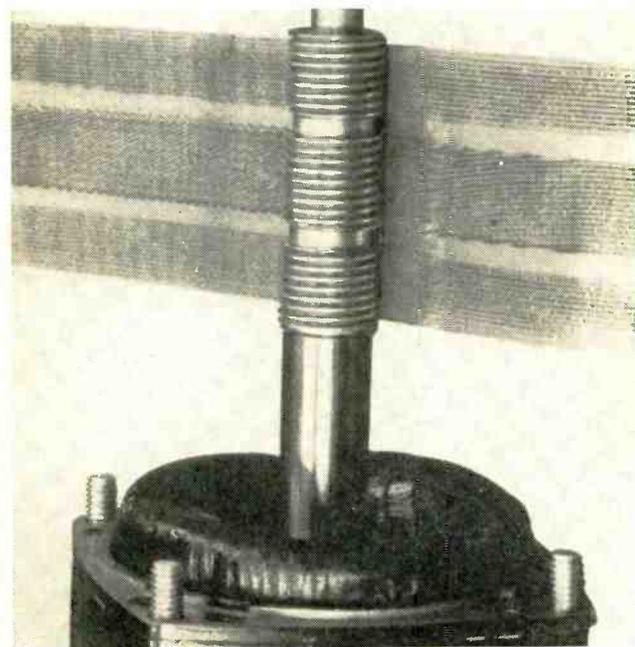
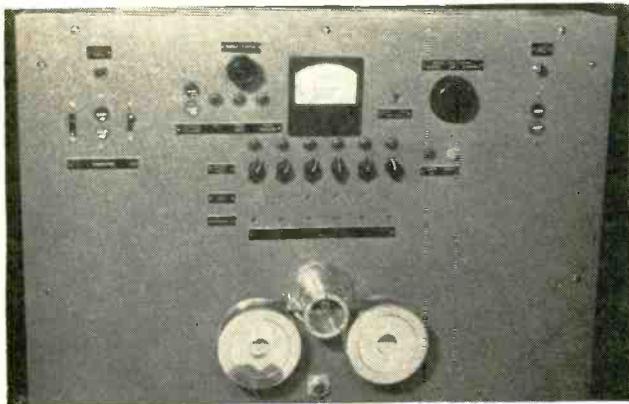


FIG. 1—Comb-shaped recording head coupled to cutting tool produces master tape for control (A); screw serves as playback head for producing control signal (B)

FIG. 2—Scanning-head response with zero tape velocity

# Magnetic Tape Controls



THE FRONT COVER—Control panel at upper left shows tape running through primary frequency generator. Mu-metal rotor, below, reads three-channel tape which has been immersed in a solution of finely powdered iron particles to show magnetization. Rear view of the complete electronic control is shown at right

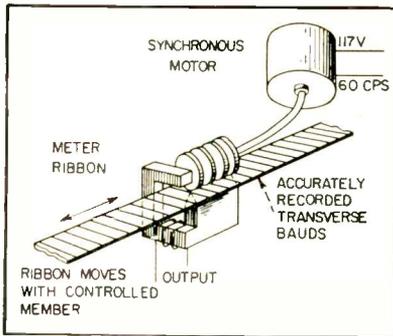


FIG. 3—Secondary signal generator detects position of controlled member

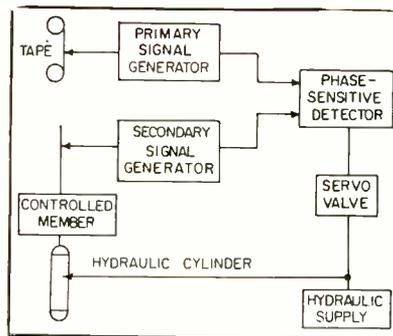
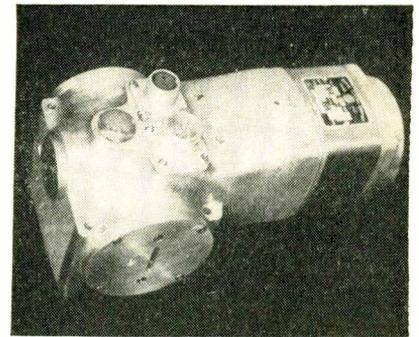


FIG. 4—Block diagram of single-dimension Factrol system



Secondary signal generator has slot on face for tape entry

# Machine Tools

By JOHN W. HOGAN

Technical Supervisor  
The Maico Company, Inc.  
Minneapolis, Minn.

Cutter displacements are accurately recorded as separate tracks on magnetic tape by moving comb linked to cutter by thyatron or other servo drive. Segments of rotating screw act as scanning devices to pick up multi-channel control information during playback

**A**UTOMATIC machine control incorporating a simple and accurate magnetic recording and playback technique is necessary to realize a unit that can be accepted by industry. In the Factrol system developed for large machine tools, programming information is recorded on a strip of tape. When completed, the tape contains all control signals necessary to start and stop spindle-drive motors, control spindle speeds if multiple tools are used, provide continuous speed control if maximum cutting rates are desired and provide precise displacement control of one or more cutting tools, grinders, drills or cutting torches. Tape signals to control automatic rewind of tape and other auxiliary functions are also recorded.

Basically, a phase-detection system of magnetic-tape playback is provided in conjunction with a conventional hydraulic, Amplidyne or thyatron servo drive. Plastic-backed oxide tape or steel ribbon provides an inexpensive, durable storage medium which is instantaneously ready for playback. It can be recorded, duplicated or erased for reuse by relatively inexperienced personnel. The single

tape provides multiple control tracks for several auxiliary functions as well as the actual tool-displacement control.

The displacement control signal is the part of the recorded information that forms the input to the servo unit and is the most important track or channel on the tape. It is effectively a cam signal because it acts as an integral part of a system that performs the same function as a mechanical cam-controlled machine tool.

## Record and Playback

The controlled displacement or cam motion to be reproduced is recorded on the medium by the mechanism shown in Fig. 1A. As the medium is drawn through the transverse magnetizing head, the desired displacement is recorded by moving a comb in the indicated direction. Total displacement is limited only by the physical length of the comb, since an equal number of recorded lines enter and leave the tape as the comb is moved. The polarity and direction of the magnetization are through the thickness of the tape.

Playback of the tape is accomplished by the scanning head shown

in Fig. 1B. The rotary pickup, a part of the magnetic circuit, has a pitch equal to the distance between adjacent teeth on the recording comb. As the rotary pickup revolves, it alternately provides a path of relatively high and low reluctance for the magnetizing pattern on the tape. The resultant generated sinusoidal emf provides the basic control signal for the system. In practice the scanning screw is double-lead and is driven by a miniature 3,600-rpm synchronous motor, resulting in a base frequency of 120 cycles per second. Since the head provides a signal without tape motion, the system does not require tape velocity to maintain locked-in control.

If the tape is moving and displacement velocity is present, the frequency output of the playback head will be increased or decreased, depending upon the relative direction between displacement and scanning-screw motion. In practice, the tape velocity and displacement angle are limited so that the constant-velocity frequencies lie between 60 and 180 cycles per second. The displacement-angle tangent is limited to one-half and tape velocity to six inches per second. This

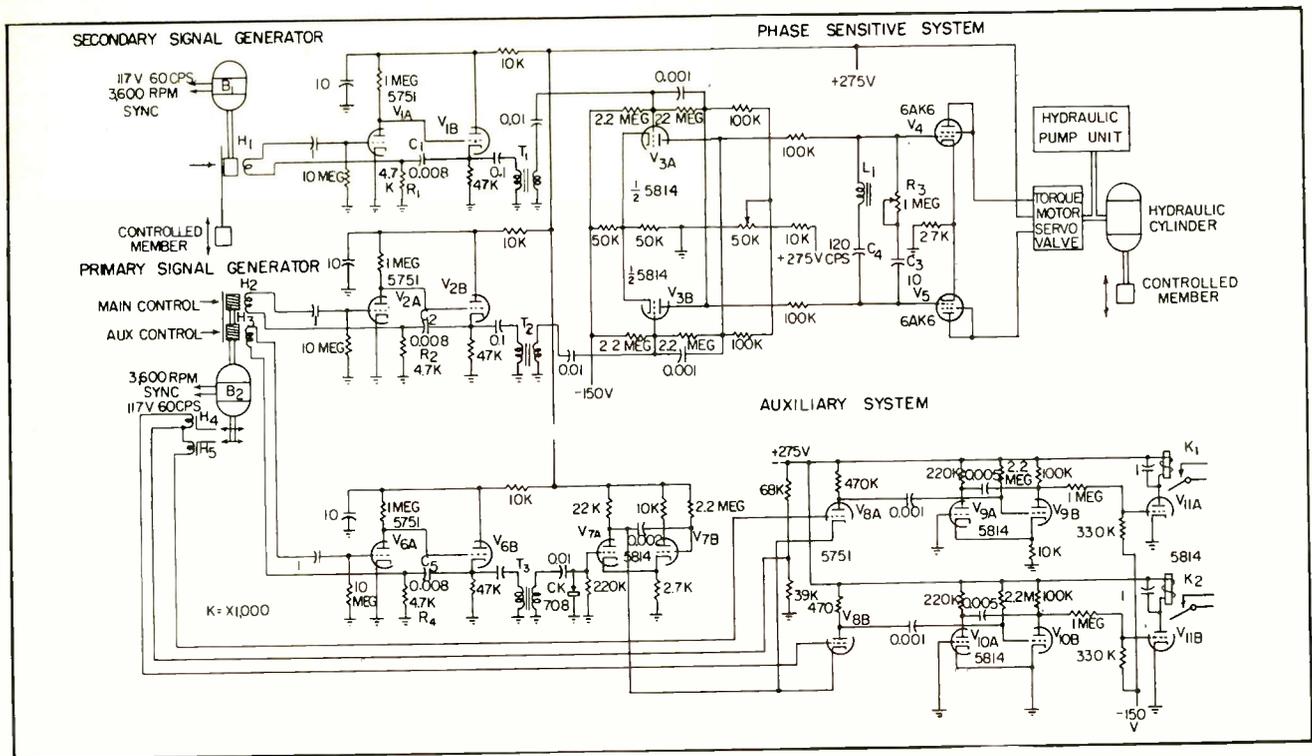


FIG. 5—Circuit diagram of single-dimension system showing sinusoidal inputs from the primary and secondary signal generators

results in a maximum displacement velocity of three inches per second.

### Equalization

An unusual equalization problem presents itself in amplifying the scanning-screw signal. The displacement angle produces an amplitude response versus angle as shown in Fig. 2. This is accompanied by negligible phase shift. A second source of amplitude deviation is due to the conventional 6 db per octave change when the tape velocity includes displacement velocity. In practice, conventional feedback equalization is used to correct the second source of deviation. This provides a minimum of phase shift error under all dynamic conditions.

The output of the pickup head is approximately 0.100 volt rms maximum and the dynamic range (above erased tape) is between 50 and 60 db. The signal contains less than 2-percent total harmonic distortion. One interesting feature of this head is the fact that the gap spacing between the rotating member and the pickup lip is not critical. Since the magnetic circuit is a simple series path, the vertical position of the tape in the gap will result in only second-order changes in output.

Two pickup-head assemblies are used in a single-dimension system. One, the primary signal generator, reads the recorded control signal from the tape, along with any auxiliary control signals. The second unit, the secondary signal generator, detects the position of the controlled member (lathe carriage or milling machine table) by reading the phase of equally spaced bauds recorded on a steel tape called a meter ribbon, shown in Fig. 3. Magnetically, it operates the same as the primary generator except that the axis of the scanning screw is parallel to the length of the meter ribbon. The meter ribbon, when put in place on the carriage, saddle or milling table, becomes a permanent installation. It functions as the accurate comparison link in the servo loop.

Much care is taken to magnetize this tape under uniform ambient temperature conditions, at a temperature that will be a mean value of that encountered in the ultimate location of the machine tool.

### Servo System

A single-dimension system is shown in block and schematic form in Fig. 4 and 5. The primary signal generator reads the control-

signal tape. The secondary signal generator gives a reading proportional to the actual position of the controlled member. The outputs of these two units are presented to a phase-sensitive detector and then to a torque motor which controls a hydraulic cylinder to complete the loop.

The sinusoidal signals from the primary and secondary signal generators are amplified by  $V_1$  and  $V_2$  and equalized by networks  $R_1, C_1$  and  $R_2, C_2$ . The signals are then shaped by saturating-core transformers  $T_1$  and  $T_2$  and used to trigger a dual-entry Eccles-Jordan circuit which serves as a phase comparator. The plates of  $V_3$  are adjusted so that the nonconducting and conducting plate voltages will be equally above and below ground potential.

When duty cycles are equal (resulting from 180-deg phase-displaced input pulses) the average d-c voltage at each plate will be zero. The circuit is direct-coupled push-pull into drivers  $V_4$  and  $V_5$  and into the differentially connected torque motor. Integrating network  $R_3, C_3$  permits more loop gain as the rate-of-error signal change decreases. The hydraulic servo valve used with the equipment has

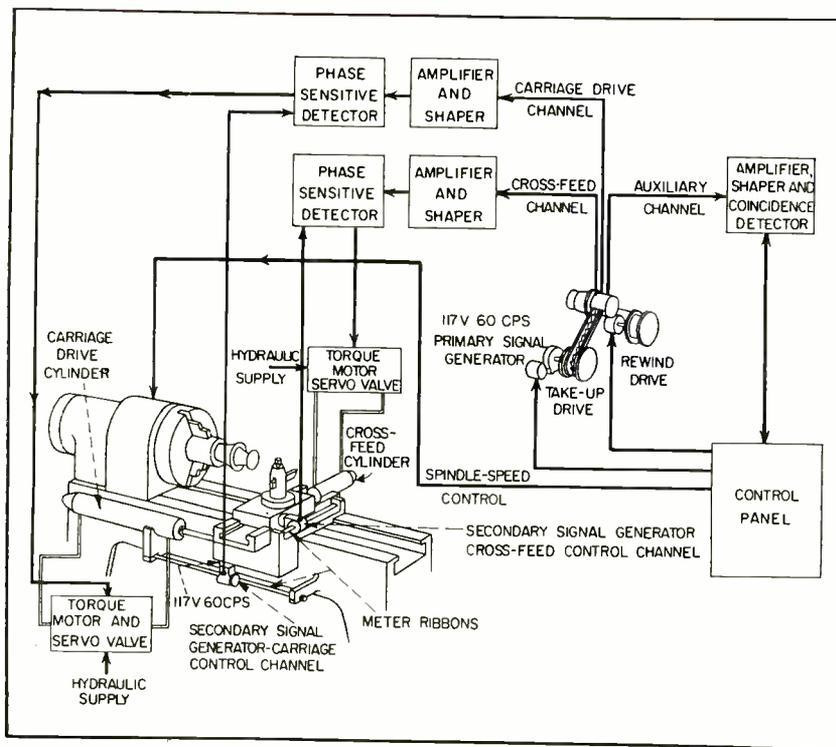


FIG. 6—Simplified diagram of two-dimensional control system applied to a lathe

response characteristics above 100 cycles per second, hence the  $L_1 C_1$  network is added for 120-cps fundamental suppression. An error signal of only three degrees provides full power to the torque motors.

Pulse techniques have been employed in the phase detector to avoid effects of tube aging and low-level transient noise conditions. As a secondary advantage, the output of this type of detector is linear from +180 electrical degrees to -180 electrical degrees.

### Auxiliary System

The auxiliary pickup head, an integral part of the primary signal generator, is identical with the main signal pickup. The auxiliary signals consist of the conventional parallel-line traces on the tape. However, they occupy only discrete phase-angle positions depending upon the desired number of auxiliary positions.

By a system of coincidence gates, operated by the auxiliary track in conjunction with a pulse-tooth pickup-head group, it is possible to include as many as six auxiliary controls with only one track channel. This operation can be understood by again referring to Fig. 5. When the magnetized insert falls beneath

$H_4$ , a positive pulse is injected into the grid of  $V_{8B}$ . At a time 180 mechanical degrees or 1/120th second later, a magnetized insert falls beneath  $H_5$  and a corresponding positive pulse is injected into the grid of  $V_{8A}$ .

The signal from auxiliary head  $H_5$  is amplified by  $V_9$  and equalized by network  $R_4 C_5$ . It is then shaped and made to trigger one-shot multivibrator  $V_7$ . The normally nonconducting plate of  $V_{1A}$  is direct-connected to the cathodes of gate  $V_8$ . When the auxiliary signal is in time coincidence with either  $H_4$  or  $H_5$ , the gate has an output which triggers the associated one-shot multivibrator  $V_9$  or  $V_{10}$ . This in turn operates an appropriate relay,  $K_1$  or  $K_2$ . Thus the relays individually stay closed as long as the auxiliary signal remains in phase coincidence with the appropriate pulse.

### Operation

The technique under discussion offers a simple means of dynamic control without need for data conversion to digital or other pulse techniques. The latter approach invariably requires continuous tape motion or start-stop circuitry to avoid displacement error in the record. The system described has

continuous closed-loop control, even when the tape is stopped. Thus, the tape can be stopped during certain operations, such as when a drill automatically positioned by the system is drilling through work and requires dwell time.

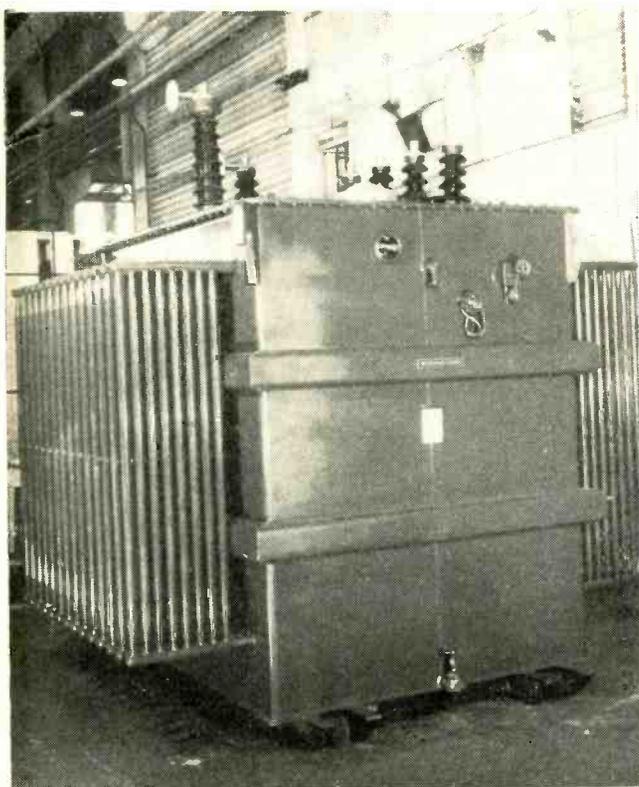
To conserve tape, the maximum displacement angle is usually used. The maximum angle tangent is 0.5; thus, 30 feet of tape gives a displacement total of 15 feet when meter ribbon pitch equals control-tape pitch.

Additional tape is required for acceleration. The recording process automatically provides constant acceleration (or uniformly increasing velocity) until the maximum displacement angle is reached.

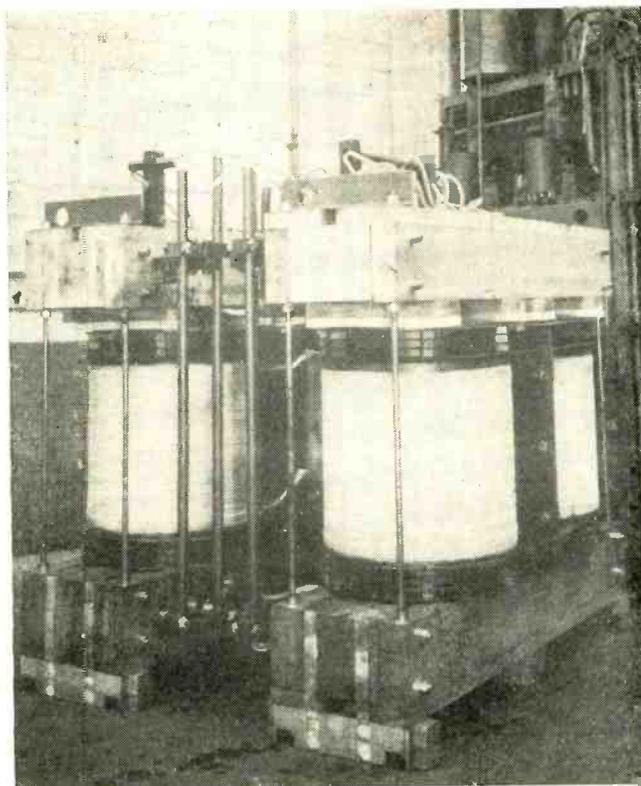
Occasionally the pitch of the recorded bauds on the meter ribbon is changed to a number greater or less than the pitch on the control tape. The resolutive accuracy of the system, as well as the ratio of tape length to controlled member displacement, is a function of this pitch ratio. With a pitch ratio of one to one, the overall accuracy from record to controlled member is better than  $\pm 0.001$  inch.

Controlled-member velocity is usually varied by changing the speed of the control tape. For multidimensional work and contour control it is often desirable to control member velocity by displacement-angle variation. Also, in multidimensional control, one primary signal generator with multiple pickup coils is used and all dimensional-control channels recorded on one control tape. The width of any control channel is six parallel traces of 0.050-inch pitch for a total of 0.3 inch. To reduce crosstalk, 0.10-inch separation is used between adjacent channels. An individual secondary signal generator is used for each independent dimension control.

The author acknowledges the invaluable assistance given by system inventor Eric Neergaard and his assistant H. Trechsel; J. F. Dundovic of Maico, who contributed heavily on development; the Maico engineering staff; S. Jatras and personnel of the Midwestern Geophysical Laboratories; and D. A. Gerard of DAG Tool and Engineering.



Single-phase saturable reactor rated at 7,500 kva



Core of saturable reactor used for vlf antenna tuning

# Keying VLF Transmitters

Rapid keying of high-power Navy transmitters operating on 15 to 35-kc carriers made possible with frequency modulation. High-Q antenna is kept resonant to driving frequency by means of a saturable reactor. Teleprinter signals transmitted at 19 kc with powers of 450 kw using 100-cycle shift are successfully received at 5,000 miles

COMMUNICATIONS with naval ships at sea and submarines running under the surface at distances up to several thousand miles must be maintained on a 24-hour-per-day basis. Such rigorous conditions can best be fulfilled with high-power, very low-frequency transmitters, operating from strategic positions around the world. These transmitters are capable of delivering from 250 to 1,000 kw of r-f power into antennas designed to radiate in the 15 to 35-kc radio frequency spectrum.

Practical antennas employed in this service are electrically short and therefore exhibit a very high Q. As a result, the speed of on-off keying is seriously restricted.

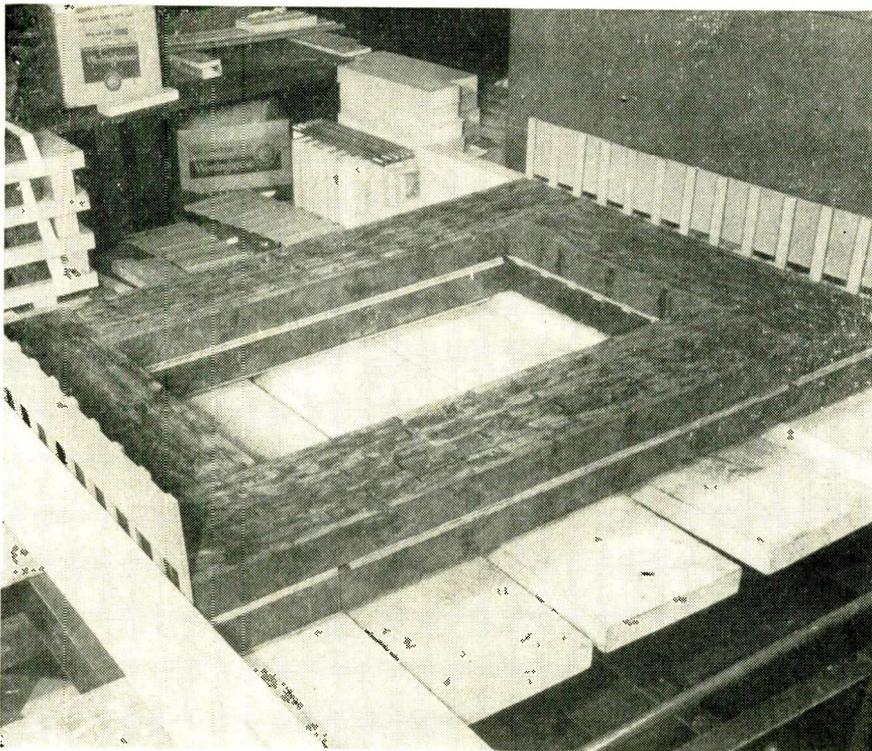
No attempts have been made in the past to frequency-shift key the transmitters because of the severe distortions produced by the limited bandwidth of the antenna resonant circuit.

## High-Q Antenna

The problem of adapting high-speed communication to vlf transmitters has been solved by employing a frequency-modulated transmitter followed by an antenna whose resonant frequency is kept tuned to the instantaneous driving frequency. As expected, varying the resonant frequency of a high-power, high-Q antenna in synchronism with the instantaneous driving frequency proved to be a major

task. It was accomplished, however, with a variable reactance in the form of a saturable reactor. With the reactance tapped across the tuned antenna circuit and the appropriate signals applied to its control windings, the desired antenna resonant frequency shift can be obtained.

The equivalent circuit for the antenna and associated tuning elements employed in vlf stations is shown in Fig. 1. In the frequency range of 15 to 35 kc, reactances in this type antenna frequently run as high as 450 ohms. On the other hand, resistance values are only 1 or 2 ohms. Thus, for developed powers in the order of 500 kw, voltages are obtained in hundreds of



Slabs of a special ferrite magnetic material are used to build up the core

# at High Speed

By **M. I. JACOB**

*Electronics Division  
Westinghouse Electric Corp.  
Baltimore, Md.*

and

**H. N. BRAUCH**

*Transformer Division  
Westinghouse Electric Corp.  
Sharon, Pa.*

kilovolts and currents are generated in hundreds of amperes.

## **Double-Ended Tuning**

Voltages applied to single ended antennas are limited to between 250 and 300 kv by the formation of corona discharges. For this reason the antenna circuit of Fig. 2 is often employed. This multiple tuning system increases the amount of antenna current flowing, for a given voltage, over a single-tuned system of the same size. The effect is accomplished by having two vertical downleads tuned by two separate inductances.

Thus, half of the antenna's total capacitance is tuned to resonance by one tuning coil having twice the

inductance of the tuning coil in the single-tuned system. The other half of the antenna is tuned by the other inductance and the two halves operate in parallel. It is only necessary to couple the transmitter to one of the inductances since the second section is excited because of its proximity to the first section.

Such an antenna has been installed at Naval Radio Station NSS at Annapolis, Maryland. It was on this antenna that all of the field tests of this communications system have been conducted. The characteristics of the antenna are shown in Fig. 3. Examination of these curves reveal that the Q of the antenna varies from 800 to 150 over the 15 to 35-kc frequency

range. The resulting bandwidth varies from 18 to 230 cycles. Thus, at the lower radio frequencies, the transient response time is such that serious distortion would occur at signaling speeds associated with machine keying.

No advantage is gained in this respect from frequency modulation when operated in the conventional manner. Even with low-frequency shifts, the signal would be subjected to serious amplitude distortions and phase shifts. To be compatible with high-speed operation, Q values have to be much lower, a condition that is incompatible with efficient operation at high power levels.

## **F-M and Variable Circuit**

The new system avoids the dilemma by utilizing frequency modulation and an antenna circuit having variable circuit elements. Since the objectionable distortion arises from temporary discrepancies between tuning frequency and instantaneous signal frequency, it is possible to avoid them simply by varying the resonant frequency of the tuned antenna circuit in synchronism with the instantaneous f-m driving signal.

At first the proposal seems to violate a principle that decrees the rate for transmitting information through a channel of given bandwidth is limited by that bandwidth. However, further investigation reveals that in this system, intelligence is transmitted only after advance information has been received at the control element. Thus, the signal can hardly be considered independent intelligence within the meaning of the theorem.

Having accepted and proved these concepts, the problem became one of supplying a device capable of tuning a high-voltage, high-power antenna in synchronism with a frequency-modulated signal. The device requires response times compatible with the frequency of the signaling equipments. It is desirable also that both the power necessary to control the device and the power dissipated in the device be held to conservative values.

## **Saturable Reactor**

A saturable reactor employed as shown in Fig. 4 meets the neces-

sary requirements. The reactor is tapped across a portion of the loading inductance normally used in the antenna circuit. Direct control current is supplied to the reactor in accordance with the keying signals supplied to the frequency-determining circuits of the transmitter. It is thus possible to vary the reactance of the antenna circuit with sufficient accuracy to transmit intelligence. Distortions are held within acceptable limits.

### Antenna Efficiency

The reactor used for this purpose has sufficient sensitivity and a low enough loss factor that it can be placed in the high-power antenna circuit without reducing the efficiency of the antenna beyond acceptable proportions. In fact, under the most unfavorable conditions possible in 500-kw operation, it is calculated that not more than 20 kw will be lost because of the addition of the reactor. This loss is encountered under conditions of the full 100-cycle shift employed by the system.

Success of this system depends to a large extent on the satisfactory performance of the saturable reactor. Careful consideration was therefore given to the design and construction of the 7,500-kva reactor employed.

Any iron-core device capable of handling 7,500 kva and dissipating over 20 kw without means of external cooling is necessarily large. This reactor is rated at 7,500 kva, single phase, 15,000 to 34,000 cycles, 75,000 volts. It is oil-insulated, self-cooled and suitable for outdoor operation. To facilitate moving, it is mounted on a structural steel base equipped with wheels having a standard railroad gage. The unit weighs 46,000 pounds and measures 10 by 12 by 12 feet.

### Construction

To obtain the desired electrical characteristics it was necessary to use two sets of cores and coils for each unit. The magnetic circuit is rectangular in shape, built up of slabs of a special ferrite magnetic material.

Each ferrite slab is separated from the adjacent one by press-board duct spacers to permit the

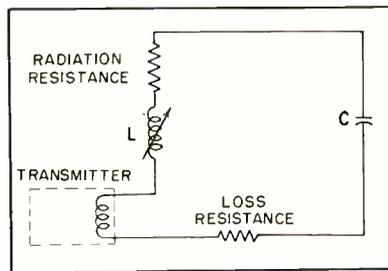


FIG. 1—Equivalent circuit of vlf antenna and tuning network with single-ended tuning

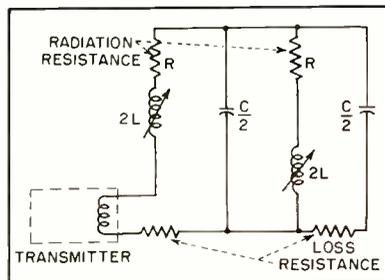


FIG. 2—Tuning network with double-ended tuning and equivalent circuit of vlf antenna

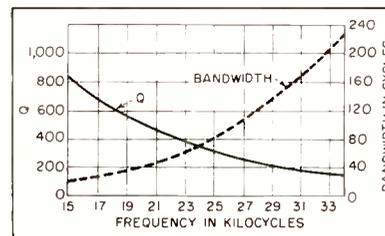


FIG. 3—Curves plotted for vlf antenna and tuning network with double-ended tuning

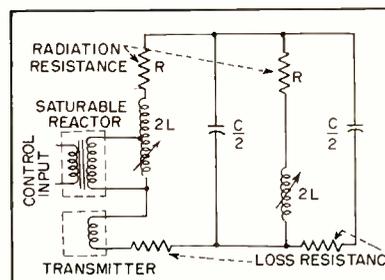


FIG. 4—Equivalent circuit of vlf antenna and tuning network with saturable-reactor tuning element attached

free circulation of oil through the core for cooling.

Each of these slabs is made up of Ferroxcube blocks approximately 2.8 by 1.1 by 6.9 inches, all laid and cemented together similar to a brick building. There are more than 2,000 bricks used in each core. Each brick has its surfaces carefully ground to reduce the effective gap length and keep reluctance to a minimum. Special jigs were re-

quired to construct the saturable reactor core.

### Coil Design

The high voltage and frequency at which this reactor must operate necessitated a special coil design. The coils are wound with a relatively few number of turns of a very low-loss Litz cable, consisting of 4,500 strands of 0.005-inch diameter copper wire, each insulated from the other and twisted into a transposed cable. The coils are cylindrical, with an inner and an outer coil on each leg of the core. Cooling ducts are dispersed through the coil to permit the free circulation of oil.

To keep stray eddy current losses to a minimum, no magnetic materials were used in the core and coil structure. The complete core assembly was given several dips in a thermosetting varnish and baked, bonding the complete structure into one solid mass.

### Cable Connections

Making electrical connections and splices in the Litz cable required a special technique. Conventional methods of brazing or soldering could not be used because of the small diameter of each strand of the cable and the fact that each strand is individually insulated with varnish. First, the number of connections necessary was kept to a minimum by continuing the cable in the coil directly to the final destination.

For the few connections that were necessary the following procedure was followed: each cable end was wrapped tightly with a fine bare copper wire and sweated together with solder; the cable was then cut off with a hack saw through the sweated end; the two ends to be joined were then telescoped into a copper ferrule with the two raw ends butted together; the joint was soldered by pouring molten metal through a hole at the center of the ferrule.

### Insulation and Shielding

A special low-capacitance design of high-voltage bushing was developed to insulate the high-voltage lead from the cover. At the voltage and frequency at which the reactor

operates, the dielectric loss in commonly used materials (such as wet process porcelain, micarta papers and some press boards) is so high that the internal heat developed would destroy them. Combinations of low power factor press board separated by oil ducts are assembled inside a porcelain weather housing. Shielding is placed at the high stress points to help distribute the dielectric stresses and remove the porcelain from the electrostatic field.

When operating under rated conditions of 75,000 volts at 100 amperes, at a frequency of 18 kc, the flux density in the core is approximately 800 gauss. The permeability of the unit measured on the assembled core with zero d-c control current approaches 1,200.

To obtain a 100-cycle variation in the antenna resonant frequency at 18 kc, a control current change of 100 amperes is required. This change is effected at an absolute current level of from 25 amperes to 125 amperes.

Special modulation equipment is required to produce control currents of the order required. Design of this equipment is determined to a large degree by two major factors. The first is the efficiency problem encountered when direct currents must be amplified to large values. For the second, fast changes in current must be produced in an inductance. This response time must be decreased to allow keying at reasonable speeds.

### Modulation Equipment

Both of these problems are overcome by the modulation equipment shown in Fig. 5. Efficient d-c amplification is made possible by a subcarrier amplifying chain followed by a rectifier in the power output stages. Response time is reduced to satisfactory levels by a pulse injection system that acts to increase the rise and decay time of the d-c control signals. Having produced current signals in the control winding of the reactor in accordance with the keying signals, it follows that an inductance change of the same form will occur at the output of the secondary windings of the reactor.

It can be shown that a shift of the same shape will result in the resonant frequency of the antenna circuit. Since the keying signal for the transmitter frequency-shift circuits is taken as a sample of the current in the control windings of the reactor, the shift of frequency of the transmitter will correspond in shape to the shift in antenna resonant frequency. By properly adjusting the amplitudes of the signals involved, both amplitude and shape of each frequency variation can be made to correspond.

### Subcarrier

Referring to the subcarrier signal chain shown in the top line in the block diagram of Fig. 5, operation can be described as follows:

The 1,800-cycle subcarrier signal is generated in the oscillator stage and then modulated approximately 70 percent by the keying impulses, usually teleprinter signals. This 1,800-cycle wave, now modulated in accordance with the keying signals, is amplified by the power amplifier, transformed to low impedance, rectified by dry-disk rectifiers and appears as a large d-c signal variable in amplitude. Except for rise and

decay times, the d-c signal is a reproduction of the original keying signal.

### Pulse Injection

Since the exception to the exact duplication of the keying signal (slower rise and decay time) is unacceptable for satisfactory operation of the system, the pulse chain shown in the lower half of the block diagram of Fig. 5 is employed. This portion of the modulation device provides pulses at the leading and trailing edges of the keying impulses or characters, which result in current signals of adequate rise and decay time to be supplied to the control circuit of the saturable reactor.

The type of circuit employed in the final stages of the modulation unit appears in simplified form in Fig. 6. The d-c control circuit of the saturable reactor is shown inserted in series with the secondary winding of a pulse transformer. Tubes  $V_1$  and  $V_2$  inject the pulse voltages necessary to effect the rapid current changes required to follow the beginning impulses accurately.

The addition of decay tubes  $V_3$  and  $V_4$  provides a low-resistance path for the circulating current in the primary of the transformer, which further serves to improve the control wave shape. By use of this system it is possible to effect the 100-ampere control current change with less than 10 kilowatts of power.

### Performance

Successful teleprinter transmissions were made at 19 kc using approximately 100-cycle shift and 450-kw maximum transmitter output. These signals were received and copied at various receiver stations varying in distance from the transmitter from 35 miles to over 5,000 miles.

The results of these tests demonstrated that this system of high-speed communication is basically sound. By applying such techniques to existing installations, the efficiency of vlf communications can be greatly increased at a cost far below the initial cost of the transmitting equipment now in service.

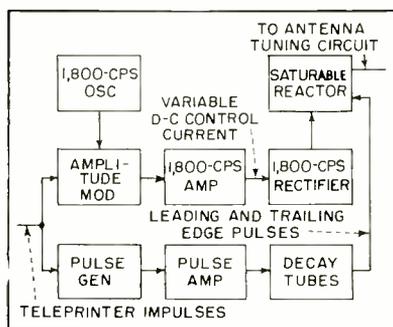


FIG. 5—Block diagram of the reactor modulator unit

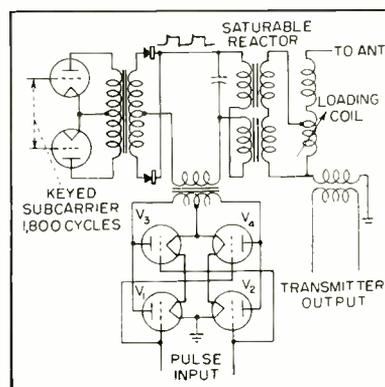
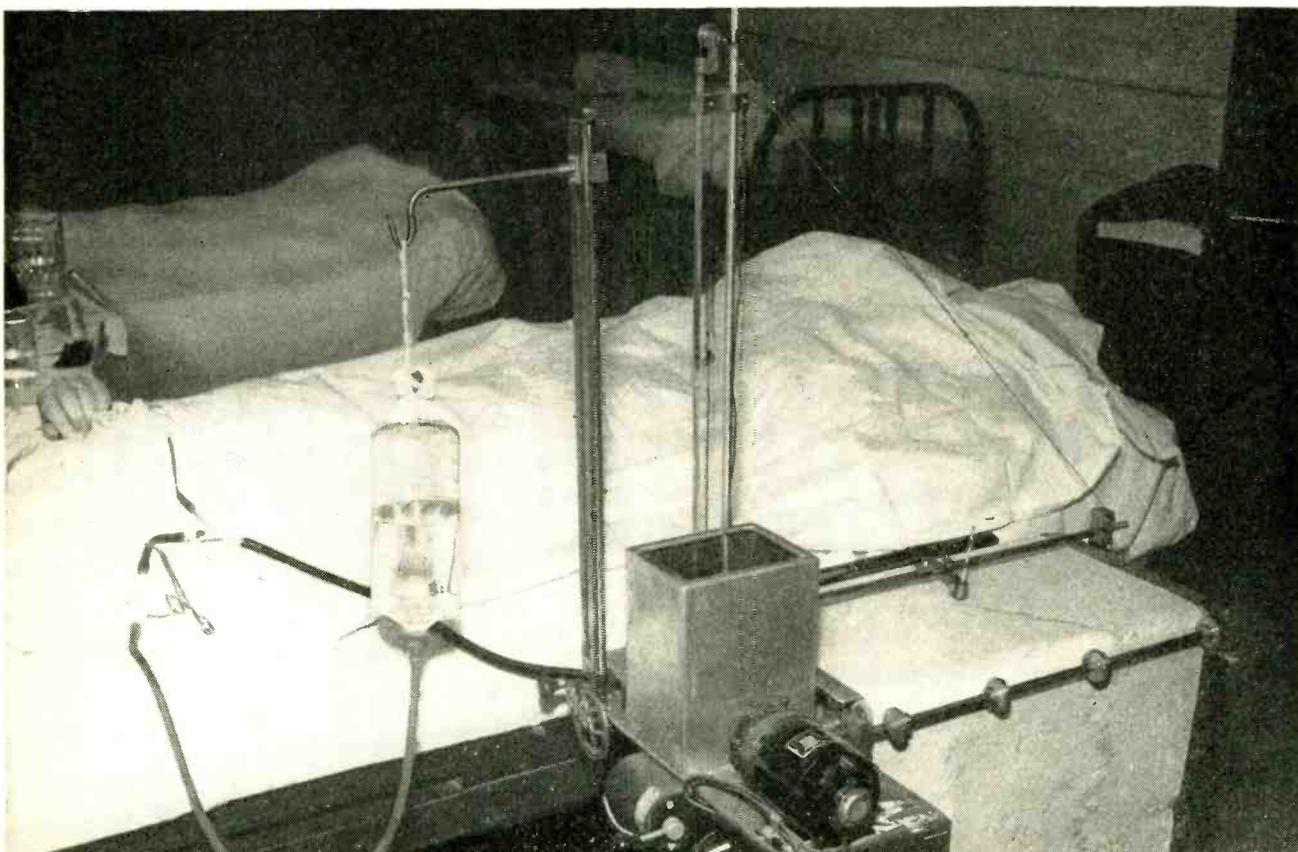


FIG. 6—Circuit for reactor modulator pulse injector with pulse decay tubes



Apparatus records changes in patient's biliary system pressure. Recordings are directly in centimeters of water

# Manometer Recorder for

Servomechanism helps medical researchers determine effects of various drugs on patients. Motor-driven ball-point pen records variations in manometer water level as pressure changes in bile-duct system. Recording technique is applicable to industrial uses

**P**AIN as a result of improper functioning of the gall bladder and associated ducts is not uncommon. The study of pressures existing in this system and their possible modification by drugs often used to treat this pain offer valuable information to the clinician.

Bile is formed in the liver, stored in the gall bladder and delivered to the small intestine through the common bile duct. The sphincter of Oddi located at the junction of the common bile duct and the small intestine acts as a valve to control the flow of bile. Its contraction is highly variable and its change in contraction as a result of drug action is of considerable interest.

Although the biliary system is ordinarily inaccessible, when a gall bladder is removed surgically and a T-tube introduced for drainage, it is possible to measure pressure changes in the system. It is also possible under these circumstances to increase the ductal pressure by the addition of physiological salt solution and thus to determine the amount of pressure necessary to overcome the contraction of the sphincter of Oddi. These pressure changes may be measured most easily with a water manometer, as shown in Fig. 1. The problem remains to record the level of the water manometer as a permanent record of pressure changes. This

could be done photographically by recording its lens-like action, but expensive paper and development of a large record are required. To eliminate the photographic process it was decided to use ordinary white paper in a roll 18-inches wide and a moving ball-point pen driven by a motor in a simple servomechanism.

## System Operation

As diagramed in Fig. 2 the motor is controlled by a follower device which consists of a lead weight suspended in the manometer tube with a contacting needle beneath it. The weight is suspended by a fine gold chain to provide sufficient flexibility. The chain passes over a pulley

By **W. E. GILSON**

Medical School  
University of Wisconsin  
Madison, Wisconsin

Typical recording shows effects of intravenous injections of morphine sulfate and etamon. The amyl nitrite is administered by inhalation. Effect of talking is reflected in increased intraductal pressure

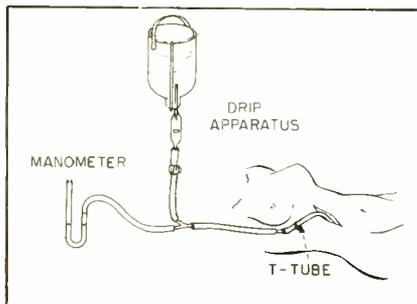
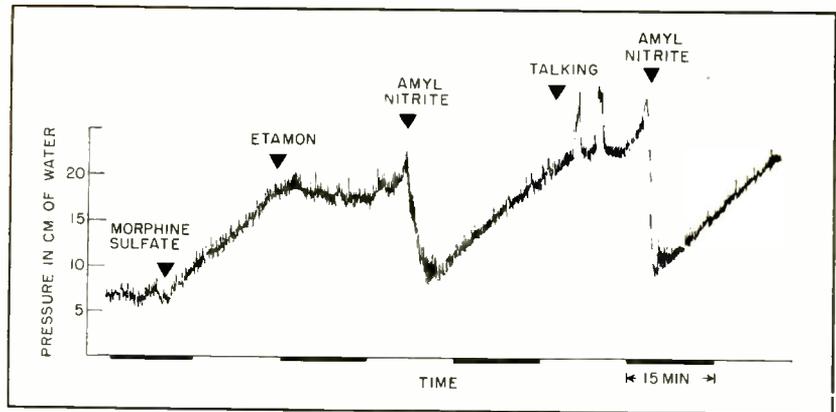


FIG. 1—Setup for measuring biliary pressure changes

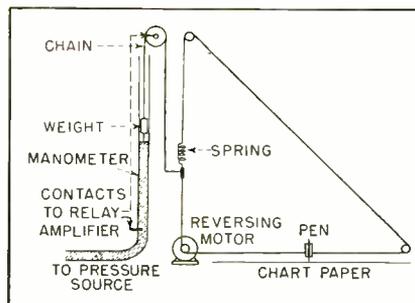


FIG. 2—Schematic representation of apparatus in photograph

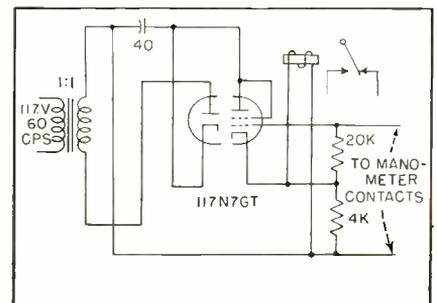


FIG. 3—One-tube amplifier controls motor-reversing relay

# Physiological Pressures

and is attached to a cord driven by a reversible motor, which controls the positions of both a pen passing horizontally over the recording paper and of the lead weight suspended in the manometer tube. The direction of motor rotation is changed by the relay in the cathode circuit of the amplifier in Fig. 3.

The relay is actuated by the presence or absence of a contact between the surface of the liquid in the manometer tube and the tip of the needle. If contact is made, the motor is energized to lift the weight and if broken, energized to lower the weight. This action provides a continuous small oscillation above and below the actual pressure.

The movements of the electrode are directly reflected, centimeter by centimeter, by the pen—giving a record of the height of the water column without further calibration.

There is no definite on and off electrical contact of the electrode and water column when the inside of the tube becomes wet, even if antiwetting agents are used on the glass. There is instead a small differential in resistance, that is not sufficient to operate an ordinary type of relay which when closed tends to remain closed. To operate with this small differential, a galvanometer of the type used in electroencephalographs was converted into a heavy meter-type contactor by the addition of tungsten contacts, which operate as a reversing switch.

To permit placing the apparatus at the proper level with respect to a patient lying in bed, the entire mechanism is mounted on a column, the height of which can be controlled by a threaded shaft obtained from an automobile jack. The lower end of this shaft has attached to it a worm gear which is

coupled to a worm on the shaft of a small reversible motor. The motor is controlled by a switch, raising or lowering the entire instrument to the desired position. A microswitch is so connected that the movement is stopped at a predetermined limit.

Although designed particularly for gall-bladder pressure recording, the instrument is also adaptable to recording venous or similar physiological pressures. It has the advantage of comparative simplicity, uses ordinary paper, produces a large record and insures complete stability of pressure recordings. The recordings are obtained directly in centimeters of water without need of calibration.

## BIBLIOGRAPHY

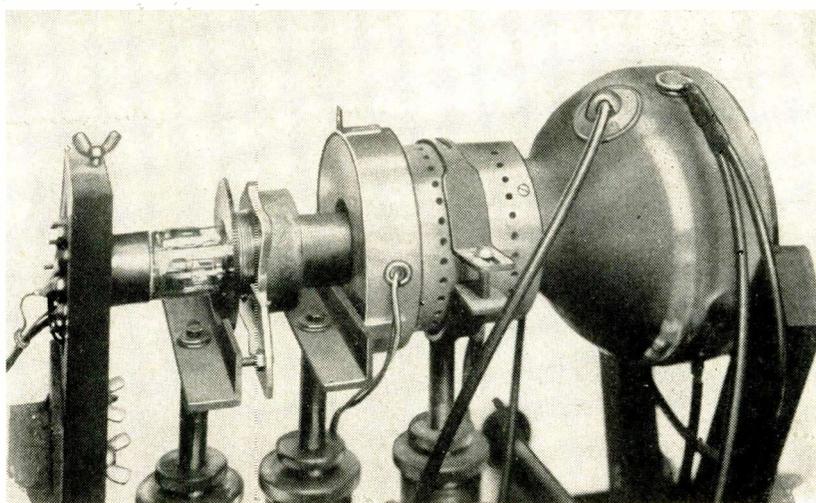
A. R. Curreri and J. W. Gale, Effect of Analgesics and Antispasmodics on Common Duct Pressures, *Annals of Surgery*, 132, p 348, Sept. 1950.

By SEYMOUR NOZICK,

NORMAN H. BURTON

and SAM NEWMAN

*Storage Tube Group  
U. S. Naval Material Laboratory  
Brooklyn, New York*



Tube assembly showing focus magnet and focus and deflection coils

# Dark-Trace Display Tube

Special electron optical design causes dark-trace crt to have writing speed better than three times previously available. Analysis of dark-trace tube writing-speed qualities presented as function of electron gun and screen characteristics, with experimental proof

**D**ARK-TRACE tubes have certain inherent advantages over bright display tubes which make their use desirable for information displays. These advantages are: the ability to integrate visually, to retain information for extended periods of time and to present optimum contrast with high ambient illumination. The daylight viewing characteristic of dark-trace tubes, in conjunction with the storage characteristic, explains the interest in these tubes.

One limit to the utilization of the dark-trace tube in the past has been the low information-display rate. A tube is described herein which greatly increases the display rate. It incorporates a special electron optical system, which reduces the deflection defocusing encountered when high beam currents are employed.

## Analysis

After basic analysis of the problem of the low information-display rate of dark-trace tubes, it was found that an appreciable improve-

ment was required. A study of the characteristics affecting the writing speed revealed that changes in the accelerating potential, the beam current or the screen sensitivity would influence the writing speed of the tube.

A possible solution to the problem was to increase the accelerating potential. However, limitations to this technique were immediately apparent. The magnitude of the possible increase in the writing speed due to increased potential would be limited. In addition, the insulation and corona problems associated with potentials higher than fifteen kilovolts limit any proposed tube's application.

Based on the relationship between contrast and the charge density deposited on the dark-trace tube screen, an analysis was prepared and experimental verification obtained of the relationship of writing speed, beam current and spot size.<sup>1,2,8</sup> The formulation arrived at was

$$W = KI/s \quad (1)$$

where  $W$  is writing speed,  $I$  is beam current incident on the screen,  $s$  is spot size and  $K$  is a constant determined by the screen sensitivity. This equation led to the information display rate, which is equal to the writing speed divided by the spot size

$$F = W/s = KI/s^2 \quad (2)$$

where  $F$  is the information display rate. This is a more accurate formulation for comparing different tubes since it is actually the maximum number of digits of information that can be displayed per unit time.

An increase in the writing speed could be attained by increasing the factor  $K$  in Eq. 1. This, however, would involve a modification in the basic screen material, entailing a long study of the crystal state of the screen material and the effect of the variations in the composition of the screen material on the formation of the  $F$  centers. Available information indicates that an increase in the sensitivity of pure potassium-chloride screens would

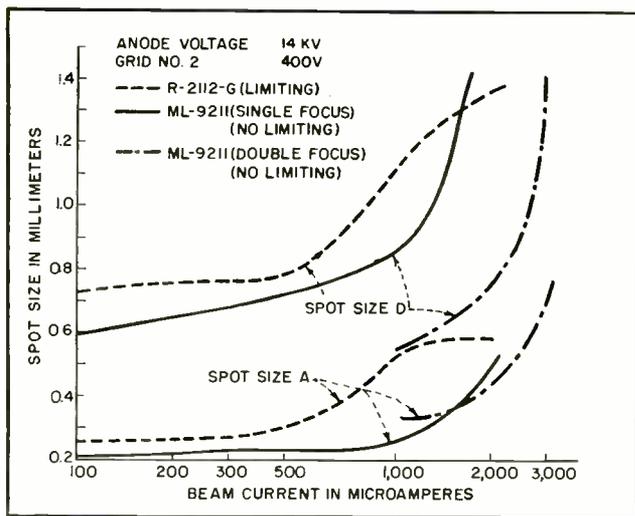


FIG. 1—Spot-size characteristics of R-2112-G and ML-9211

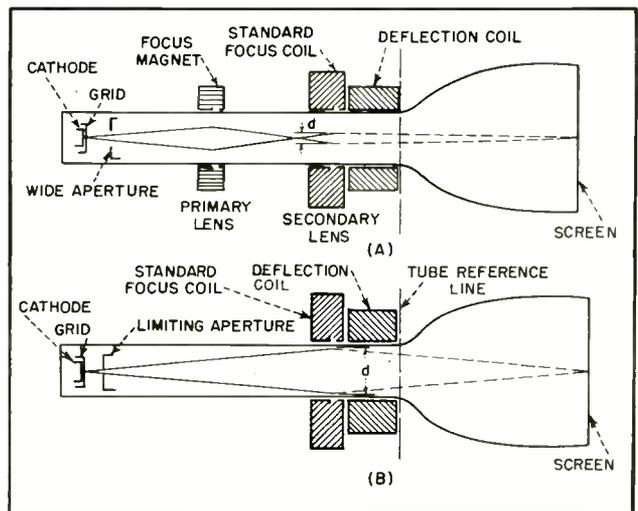


FIG. 2—Beam diameter in double (A) and single-focus (B) tubes

# Has High Writing Speed

be very difficult and here again, the possible increase would probably not be sufficient to warrant the effort.

The remaining factor in the writing-speed equation, the ratio of beam current to spot size, showed the most promise. Our objective, therefore, has been to increase the ratio of the screen current of a dark-trace tube to the spot size while maintaining satisfactory resolution.

## Tube Description

To attain the desired objective, a dark-trace tube (ML-9211) was constructed containing a wide-aperture tetrode gun and a low-heat-capacity mica-supported screen. The gun is capable of approximately ten-milliamperes emission through the wide aperture.

This tube was studied to determine if it satisfied the basic requirement of the problem, an improvement in the writing speed. The vertical-deflection waveform was a sawtooth and the horizontal waveform a sinusoid. The frequency of the sinusoid was increased until the trace just disappeared at the vertical centerline. The writing speed was then calculated by measuring the width of the raster, noting the frequency of the sinusoid and substituting these

values into the formula

$$W = 2 \pi f a \quad (3)$$

where  $W$  is writing speed in centimeters per second,  $f$  is frequency of the sinusoid in cycles per second and  $a$  is amplitude in centimeters. The small vertical velocity component can be neglected.

The results of this study were not completely satisfactory. The writing speed, at one-milliampere beam current, was 7.1 kilometers

per second as compared to a previously determined value of five kilometers per second for the standard R-2112-G tube, or an increase of about 40 percent.

An increase in the beam current beyond one milliampere was accompanied by increased deflection defocusing. To obtain a quantitative measure of this phenomenon the spot size was measured as the beam current was increased. It was found that a comparison of the standard spot size  $A^*$  of the shrinking raster method (the line width at the center of the raster), with spot size  $D$  produced a measure of the deflection defocusing. Spot size  $D$  is defined as the line width determined by shrinking a fifty-line raster until the top two lines merged. Results of these measurements, shown in Fig. 1, and spot size measurements of the R-2112-G confirmed the observation that the increasing spot size of the ML-9211 restricted it to operation with beam currents of one milliampere or less. The criterion for this limit was taken to be a spot size of one millimeter, which is comparable to that of the P-7 cascade screens currently in use.

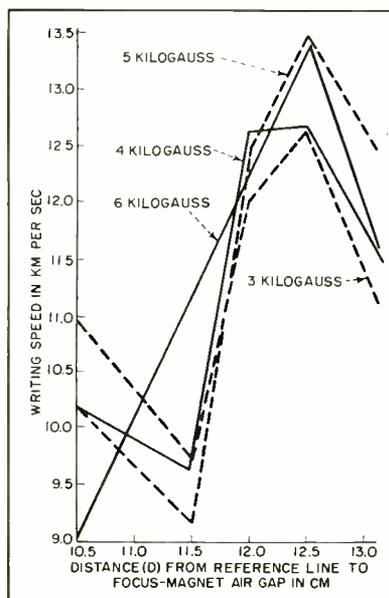


FIG. 3—Variation of writing speed with  $D$  at various values of flux density of the ML-9211 double-focus tube

## Electron Optics

It has been found that the basic cause of the deflection defocusing

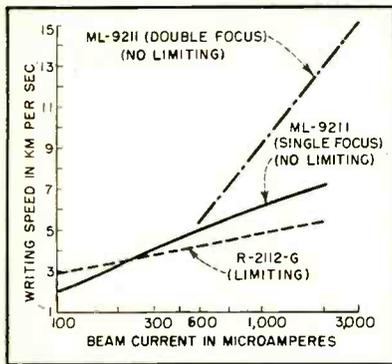


FIG. 4—Writing speed with 14-kv anode voltage and 400-v grid No. 2 voltage

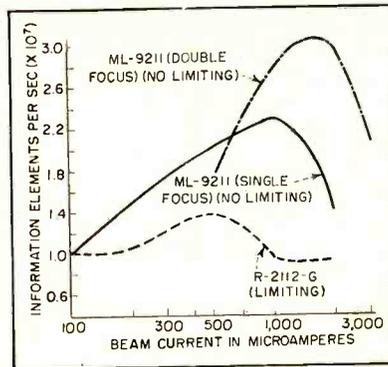


FIG. 5—Information display rate of various tubes

encountered is the large diameter of the electron beam in the field of the deflection coils.<sup>5</sup> With this as a guide, a lens system was designed to reduce the beam diameter entering the field of the deflection coils.

The lens system is shown in Fig. 2A. It is composed of a primary, short focal-length lens and a secondary, long focal-length lens. The primary lens, placed on the neck of the tube just forward of the gun structure, converges the beam at a point just before the field of the secondary lens. The secondary lens, in turn, refocuses the beam at the screen. Comparing this system to the conventional focus lens, shown in Fig. 2B, the diameter of the beam,  $d$ , has been reduced by producing an effective point electron source much closer to the focus coil.

The primary lens field, calculated from the geometric character of the tube employed, is approximately four kilogauss as measured in the air gap with a kilogauss meter. Since this field magnitude cannot be produced by a practical electromagnetic lens, an Alnico-V magnet was magnetized to a stable condition having a variation of from three to six kilogauss by mechanical variation of the air-gap dimension.

The secondary lens is a standard 2D2 electromagnetic focus coil.

Initial attempts to employ the system indicated a substantial reduction of the deflection defocusing found at two-milliamperes beam current. The position and field strength of the primary lens were then varied to determine the optimum operating conditions. The graph of the results, Fig. 3, indicates the position and field for min-

imum deflection defocusing to be at 12.5 centimeters from the tube reference line and a field strength of five kilogauss. These values were found to yield good results for all beam currents employed.

### Results

The results of the various spot-size determinations are summarized in graphical form in Fig. 1. It will be noted that, while the ML-9211 and the R-2112-G have equivalent spot sizes  $A$  and  $D$  for beam currents up to nine-hundred microamperes, the ML-9211 has much more severe deflection defocusing for higher beam currents. The aperture limiting of the R-2112-G is apparent when compared to the ML-9211 at these higher beam currents. The improvements obtained with the two-lens focusing system are verified by the displacement of the spot-size curves of the ML-9211 employing the system. The curves are displaced appreciably in the direction of higher beam current. The spot size  $A$  is maintained below 0.5 millimeter while the spot size  $D$  is practical for beam currents up to and including two and a half milliamperes.

The results of the writing-speed measurements are shown in Fig. 4. The R-2112-G is capable of a usable writing speed as fast as five kilometers per second. The ML-9211, employing the conventional focus system, attains a maximum of seven kilometers per second, while the two-lens focus system raises this value to fifteen kilometers per second. Thus the combination of the ML-9211 and the two-lens system provides a considerable improvement as compared with the R-2112-

G. The final figure attained is an improvement of more than three-hundred percent.

The information-display rate shown in Fig. 5, which provides a good figure of merit, varies from a maximum of  $1.37 \times 10^7$  elements per second at 500-microamperes beam current for the R-2112-G to  $2.30 \times 10^7$  elements per second at 1,000 microamperes for the ML-9211 and to approximately  $3.05 \times 10^7$  elements per second at 1,800 microamperes for the ML-9211 with the two-lens system. This is an improvement of 124 percent.

### Applications

In oscillography it will be possible to obtain recordings of faster nonperiodic phenomena than could previously be recorded. The two-lens system insures that the trace will be sharp and clear and enables display of more rapid phenomena.

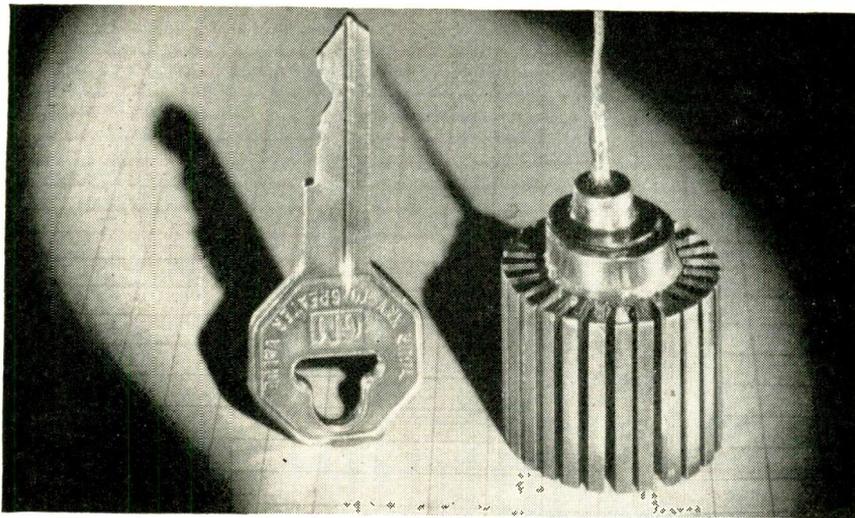
For radar applications the dark-trace tube now comes closer to having the high writing speed characteristics of bright-trace tubes, with the additional advantages of the scotophor. With its integration abilities and daylight viewing, it can prove most useful in the fields of signal-to-noise enhancement, where signal retention is required.

The two-lens focusing system itself is applicable to any cathode ray tube which is to be operated at high beam currents. It is useful where extremely small spot size is required and aperture limiting is not feasible. It may enable construction of shorter cathode ray tubes for television by reducing the deflection defocusing found when wide deflection angles are used.

The authors express their appreciation to F. Holborn for his kind cooperation and to D. H. Andrews and F. R. Darne without whose encouragement this work would not have been possible.

### REFERENCES

- (1) W. B. Nottingham, "Cathode Ray Displays", Vol. 22, MIT Rad Lab Series, Chap. 18, McGraw-Hill Book Co., Inc., New York, 1948.
- (2) R. B. Windsor, Production and Properties of Skiatron Dark-trace Cathode-ray Tube with Microcrystalline Alkali Halide Screens, Thesis, Rad Lab, MIT, 1944.
- (3) S. Noziel, *Bulletin of APS*, 29, p 41, Jan. 28, 1954.
- (4) R. D. Rawcliffe and T. Soller, "Cathode-Ray Displays", Vol. 22, MIT Rad Lab Series, Chap. 17, McGraw-Hill Book Co. Inc., New York, 1948.
- (5) K. Schlesinger, *ELECTRONICS*, 22, p 102, Oct. 1949.



New rectifier, shown approximately actual size, is 1 inch in diameter and about 1 inch high. Slots in copper mount aid cooling by natural convection or forced air

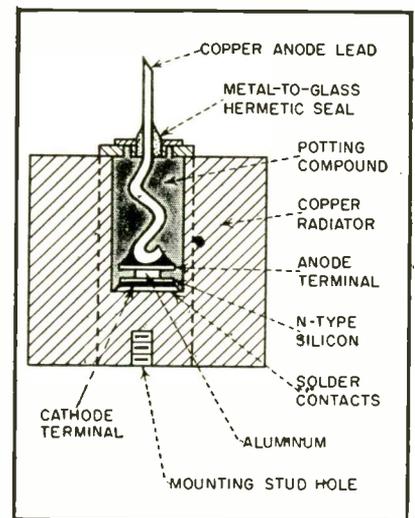


FIG. 1—Cross-section of rectifier. Junction area of silicon is 0.05 square inch

# Silicon Power Rectifier Handles 1,200 Watts

Larger junction area in new fused-junction silicon rectifier permits radical miniaturization of high-power rectifiers because efficiency approaches 98 percent and remaining heat loss is readily dissipated through copper mount. Air cooling doubles power rating

By E. F. LOSCO

Advisory Engineer, Semi-Conductor Development Section  
Materials Engineering Department  
Westinghouse Electric Corp., East Pittsburgh, Pa.

**N**EWLY DEVELOPED silicon power rectifiers have a junction area of 0.05 sq cm, as compared to 0.00005 to 0.0005 sq cm for older types of *p-n* junction silicon rectifiers. The new fused-junction units are prepared with *n*-type single-crystal silicon having an electrical resistivity in the order of 1 to 5 ohm-centimeters. Aluminum is used as the *p*-type impurity element which is fused to the silicon to produce the *p-n* rectifying junction. The units are assembled with suitable anode and cathode terminals and then encapsulated in heat exchangers, as illustrated in Fig. 1.

The heat exchanger consists of a finned copper radiator which serves as one electrode of the rectifying cell. The other electrode is a wire

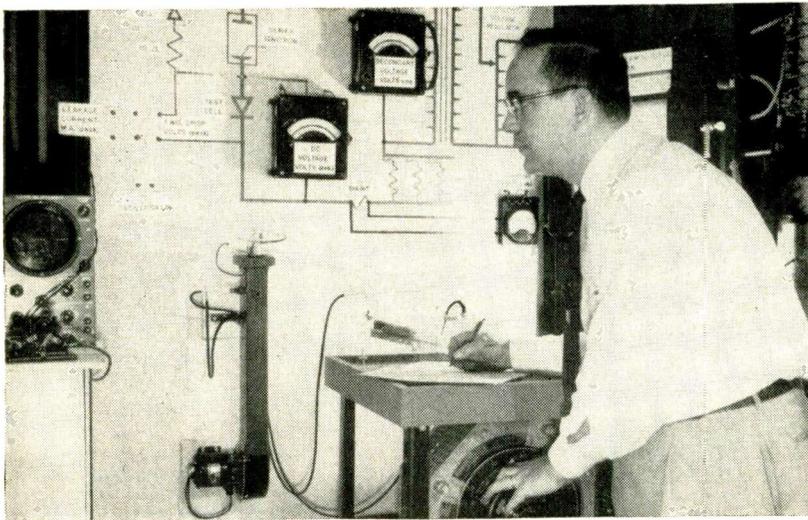
lead that emerges from the top of the radiator through a metal-to-glass bushing that hermetically seals the rectifier. A suitable potting agent fills the cavity between rectifier and top of the heat exchanger, and electrically insulates the rectifier terminals.

### D-C Characteristics

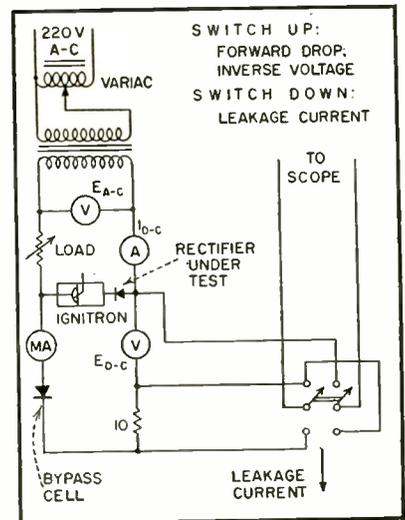
The curves in Fig. 2 present the d-c characteristics of a typical silicon power rectifier having a *p-n* junction area of 0.05 sq cm. Reverse and forward characteristics of an older silicon rectifier with an extremely small *p-n* junction area (0.00007 sq cm) have been added in Fig. 2A for comparison. The small-area junction rectifier has an extremely sharp reverse breakdown

voltage curve, whereas the power rectifier curve has a more gradual bend or soft knee. Also, the leakage current at relatively low values of voltage is high in comparison with small-area junctions. For example, at about 30 v the leakage current is 1 ma for the large junction, as compared to 0.05  $\mu$ a for the small junction.

Despite the inferior reverse characteristics, the larger-area junctions have leakage currents which are sufficiently low for the majority of power applications (about four times lower than those obtained on germanium rectifiers of comparable area when operated at the same inverse voltage). This is true despite at least a 100C increase in operating temperature for the silicon



Single-phase half-wave test setup for silicon power rectifier, using forced-air cooling. Rectifier is mounted on top of duct running up from blower on panel



Test circuit, showing use of series ignitron for limiting inverse voltage

power rectifiers during tests.

The forward d-c characteristics of the 0.05-sq-cm junctions are quite good. At 1 v, for example, the forward current is 10 amp, which corresponds to a current density of 200 amp per sq cm. For power applications, low values of forward drop are quite important since the bulk of the heat developed in the junction is produced by the forward rather than reverse characteristics.

Another important feature of a silicon power rectifier is the relatively high rectification ratio obtainable. For the unit of Fig. 2A the rectification ratio at 1 v is 5.9 million at room temperature, which is similar to the values obtained for small-area junctions. However, the high rectification ratio is obtained because the forward current density at 1 v is improved to a greater extent than the leakage current is adversely affected by increasing the

junction area.

Temperature affects leakage current of silicon power rectifiers appreciably, as shown in Fig. 2B. At low values of voltage, leakage current increases as test temperature increases. At high voltages, however, the curves for various test temperatures cross and leakage values become lower at higher test temperatures. Stated in another way, higher values of breakdown voltages are obtained as test temperatures are increased.

Figure 2B also illustrates that the forward voltage drop is lower at higher test temperatures. The effect of temperature on forward drop is apparently greater at low values of forward current. For a forward drop of 0.5 v, for example, the forward current changes from 0.045 ma at  $-50^{\circ}\text{C}$  to 0.2 amp at  $200^{\circ}\text{C}$ —a change of almost four orders of magnitude. At 1 v for-

ward drop, the corresponding change is from 1.5 to 3 amp or less than one order of magnitude.

The effect of temperature on rectification ratio for the application of 1 volt in both the forward and reverse directions is indicated in Fig. 2C for a typical 0.05-sq-cm silicon power rectifier. At room temperature, the forward-to-reverse current ratio is in the order of 0.5 million. This value decreases to 13,000 at  $150^{\circ}\text{C}$  and to 3,000 at  $200^{\circ}\text{C}$ . The increase in leakage current with temperature is primarily responsible for the drop in rectification ratio. Rectification ratios much higher than these, in the order of 6 million at room temperature, have been obtained as indicated in Fig. 2A.

### A-C Characteristics

The current-carrying ability of the encapsulated rectifiers was de-

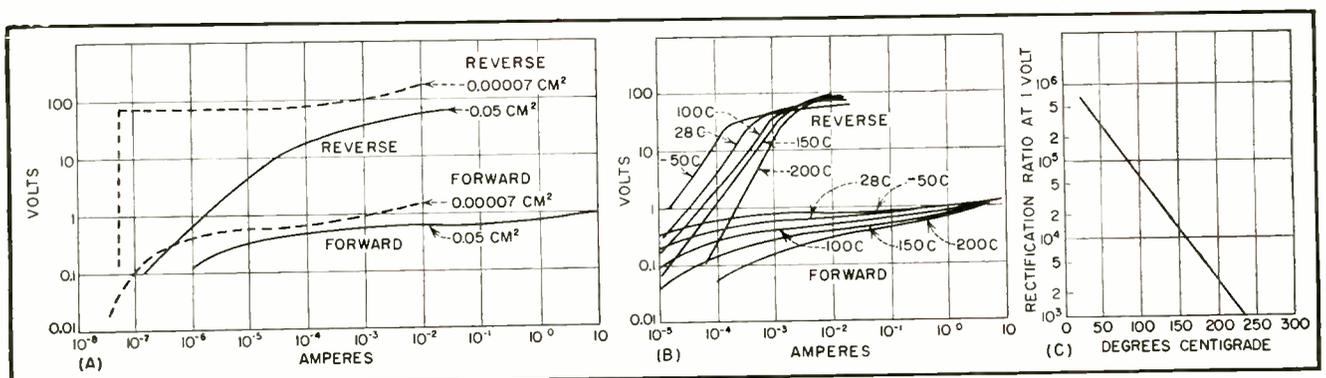


FIG. 2—Curves showing d-c forward and reverse characteristics of typical silicon power rectifier at room temperature, and effect of temperature on these characteristics and on rectification ratio. Dashed curves apply to older unit

terminated by noting how the peak values of forward voltage drop and leakage current varied as the load current was increased, both for natural and forced-air cooling.

Results obtained for a rectifier operated at a peak inverse voltage of 100 volts are shown in Fig. 3. For natural convection cooling, the forward drop and leakage curves vary almost linearly with load current until the latter exceeds about 6 amp average. At this point, the peak leakage current has reached 10 ma and is rising sharply, more so than the forward voltage drop. It appears that the heat-dissipating ability of the copper radiator is decreasing, so that higher load currents result in rapidly increasing leakage current. For natural convection cooling, therefore, the silicon power rectifier can safely handle a load current of 6.5 amp average at 100 v peak inverse. For single-phase half-wave circuits this corresponds to 10.2 amperes rms, which for the 0.05-sq-cm junction area indicates a current density of about 200 amp rms per sq cm. The rms power output of the rectifier under these conditions is  $10.2 \times 50 = 510$  watts.

For forced-air cooling, the slope of the forward drop curve is somewhat lower than before and remains essentially linear up to 15-amp load current. The peak leakage current is affected to a greater extent than forward drop by forced air cooling. Its initial value is appreciably reduced, and the curve has essentially a zero slope until quite high values of load current are reached. At a load current of 15.25 amp, corresponding to 20 ma peak leakage current, the upper limit of heat-dissipating ability of the

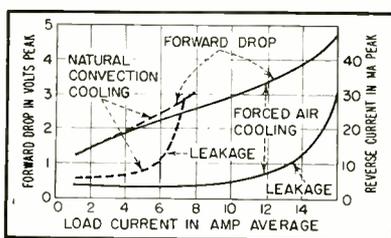


FIG. 3—Forward and reverse single-phase half-wave a-c characteristics with resistive load and peak inverse voltage of 100 volts

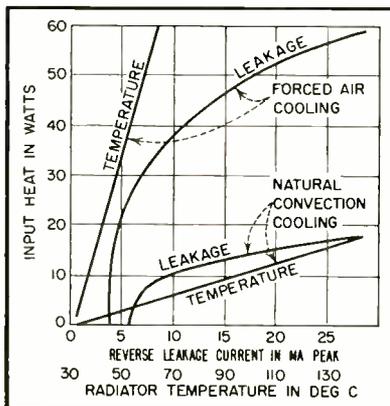


FIG. 4—Effect of external cooling on heat dissipation, cell temperature and leakage current

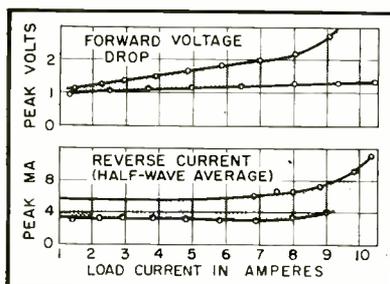


FIG. 5—Range of a-c characteristics of 0.05-sq-cm silicon power rectifiers when used with resistive load at 50 volts peak inverse in single-phase half-wave circuit for typical electronic application

## POTENTIAL APPLICATIONS

- In aircraft electronic power supplies, where ruggedness and ability to operate at temperatures up to 400F combine with greatly reduced space and weight as features
- In motors, generators and motor-generator sets, where compactness and ruggedness permit mounting directly on the rotor to replace the commutator for changing a-c to d-c
- In radio and television power supplies, where small size permits reducing chassis size
- In computers, to reduce space occupied by power supplies
- In all types of power supplies for transmitters, to replace rectifier tubes
- In all rectifier applications where efficiencies up to 98 percent—about 10 percent higher than the best motor-generator sets—are advantageous along with miniaturization

copper radiator is being approached for forced-air cooling.

If a load current of 15 amp average is taken as the safe upper limit for forced-air cooling, the encapsulated silicon power rectifier can safely handle 24 amp rms or about 480 amp rms per sq cm. The rms power output of the rectifier is then  $24 \times 50 = 1,200$  watts. Forced air cooling thus doubles the power-handling ability of the new silicon rectifiers.

The power-dissipating ability of the copper radiator may be seen more clearly in Fig. 4. Here the heat input to the copper radiator, as determined by the product of rms forward drop and load current, is plotted against leakage current and radiator temperature. For natural convection cooling, the heat input is about 10 watts when the leakage current begins to rise rapidly. The corresponding point for forced-air cooling is around 50 watts. The radiator temperatures for these particular heat inputs are only 70C and 60C respectively, and are rising linearly with heat input. Thus, for natural convection cooling the rectifier operates at a power efficiency of about 98 percent. For forced-air cooling the operating efficiency is 96 percent.

A different encapsulated rectifier was tested at 70 instead of 100 v peak inverse. At this lower voltage the rectifier could safely handle 470 watts with natural cooling and 1,540 watts with forced-air cooling.

Silicon rectifiers appear capable of handling quite high leakage currents before failing. In this respect, instead of failing suddenly as do germanium rectifiers, they give sufficient warning time which permits power reduction. Radiator temperatures as high as 230C have been reached.

Figure 5 shows the range for forward and reverse a-c characteristics obtained for a number of experimental silicon power rectifiers tested at 50 volts peak inverse using normal convection cooling. The peak leakage current remains fairly constant for individual rectifiers within the range of 3 to 7 ma for load currents up to about 9 amp average. For the same load current, the range of peak forward voltage drops is 1.3 to 2.7 v.

**M**EASURING hardness of small parts in large quantity production by the usual Brinell method requires grinding a flat area for the test and then measuring depth of penetration of a steel ball. On small parts it is often difficult to find sufficient area for Brinell testing without making the part unusable. To reduce time and material losses in measuring hardness of rocker arms for automobile engines an electronic hardness tester has been developed based on the magnetic retentivity of the Arma-Steel material used in the rocker arms.

In the early development of the tester, experimental work was done using permeability as a basis for measuring hardness but the results were inconsistent. Further work showed that magnetic retentivity was a function of hardness and could be used as a nondestructive means of hardness testing.

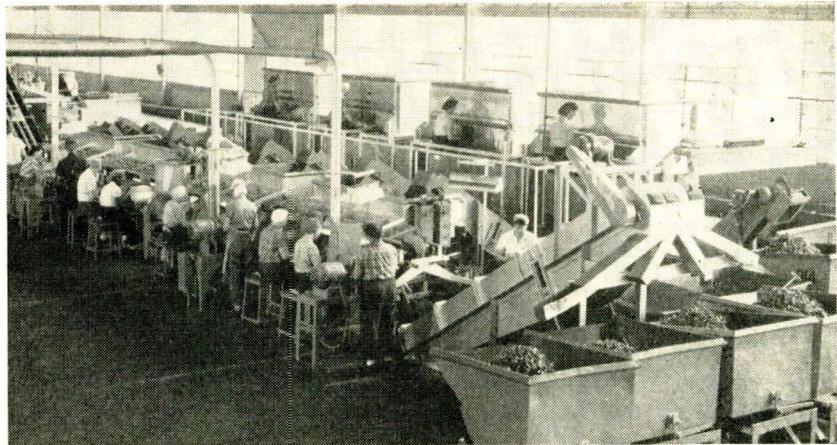
The tester, shown in block form in Fig. 1, tests hardness by measuring the field produced by a magnetized part as it drops through a set of coils.

The rocker arms drop through a plastic tube. Falling through the initiating coil, the part actuates a timer turning on the magnetizing coil. As the part reaches the magnetizing coil the field pulls it to the magnetic center and the arm is held there for a one-third second magnetizing period.

At the end of this time, the arm drops by free-fall through two pickup coils, each coil controlling the accept-reject switch through its own amplifier system. Sensitivity controls set the upper and lower values of retentivity that will trigger the amplifiers. Accepted rocker arms are demagnetized as they pass into the accept bin.

### Circuit Operation

The circuit of the complete tester is shown in Fig. 2. The signal produced by the part passing through the initiating coil sets the main timer for the magnetizing cycle. This timer closes relays 1 and 2, placing 110 volts on the grid of coil-control thyratrons  $V_1$  and  $V_2$ . The thyratrons, operating in a full-wave rectifier circuit, supply 125 v d-c to the coil for  $\frac{1}{3}$  sec.



Four hardness testers in background test entire output of production line. Acceptable rocker arms are dropped onto conveyor belt and distributed into hoppers

# Hardness Tester

By **MILTON J. DIAMOND**

*Research Engineer  
Central Foundry Division  
General Motors Corp.  
Saginaw, Mich.*

A relay connected to the output of the timer disables the initiating-switch circuit during this period to prevent repeating of the cycle. A time delay relay disconnects the plate supply to the accept-reject control thyratrons  $V_3$  and  $V_4$  during the magnetizing period to prevent the field of the magnetizing coil from producing a false triggering signal through the pickup coils.

At the end of the magnetizing cycle the part drops through two pickup coils generating a voltage in each coil that is a function of hardness or retentivity. The coil signals are amplified in the hard- and soft-side amplifiers.

Normal position for the accept-reject control is in the reject position. Bias on the hard-side amplifier is set so that thyatron  $V_3$  will fire only when the part is above the upper hardness limit. A rocker arm that is too hard will fire the hard-side thyatron first since the hard-side pick-up coil is placed above the soft-side pickup coil. Tube  $V_3$  operates a relay, opening the plate supply of the thyatron  $V_4$  making it impossible for the soft-side amplifier to trigger the

accept-reject control. The control remains in its normal position and the rocker arm goes to the reject side.

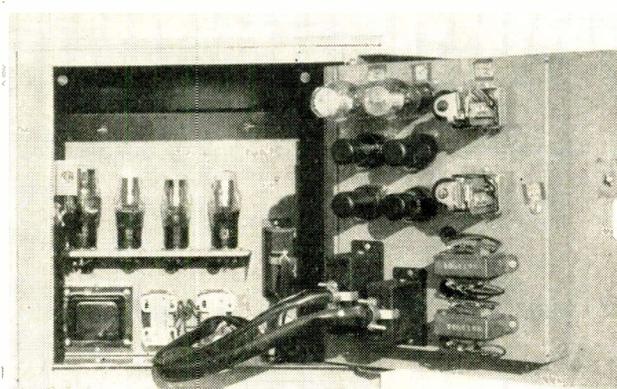
Bias of thyatron  $V_4$  on the soft-side amplifier is adjusted so that it will be triggered by a part having a hardness above the lower acceptable limit. When  $V_4$  fires, it operates relay 4 setting the accept-reject control to the accept position. A rocker arm that is too soft will not produce a signal large enough to fire the thyatron and the part will go to the reject side.

### Construction

Construction of the amplifiers is straightforward, using large-valued coupling capacitors to pass the low-frequency pulse, about 15 cps, produced by the parts falling through the coils.

Shielding of the amplifiers was necessary to eliminate the effect of stray magnetic fields. Power is obtained from a regulated source. A separate supply for the magnetizing coil has a time-delay relay to prevent application of B+ to the tubes until after warm-up.

Another time-delay unit discon-



Amplifiers and thyatron controls for hardness tester are mounted on door of cabinet. Power supply for entire unit is at rear of box

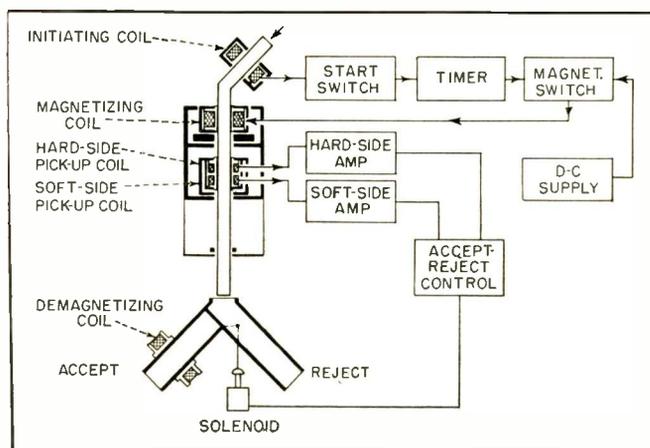


FIG 1—Magnetized parts falling through pickup coils triggers accept-reject control if part falls within preset hardness range

# Sorts Auto Engine Parts

Automatic sorter measures hardness of steel rocker arms for automobile engines at rate of 3,000 pieces per hour. Nondestructive test using magnetic retentivity provides 100-percent inspection, rejecting parts having hardness above or below preselected levels

nects the power to the accept-reject solenoid after a short period. This prevents coil burnout if the unit is left in the accept position.

## Setting Up

The hardness tester is set up by the use of rocker arms previously selected for hardness by the Brinell

method. A set of test rocker arms consists of a pair at the soft end of the range and a pair at the hard end of the range. One of each pair is 0.1-mm Brinell hardness within the allowable range and the other is 0.1 mm out of the range. The sensitivity controls of each amplifier are adjusted so that the two arms

within the range are passed and the two outside the range are rejected.

A set of test rocker arms is kept for each type of arm in production.

When changing from one type of rocker arm to another, only a few minutes are required to make the necessary adjustments.

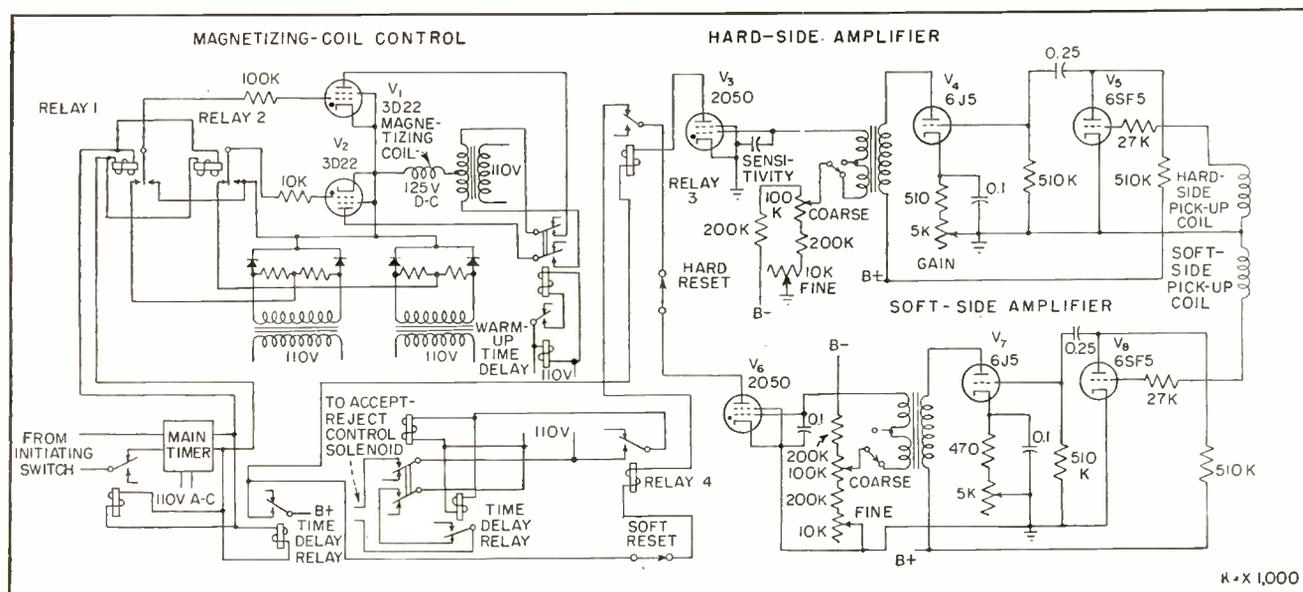


FIG. 2—Parts above lower hardness level will trigger soft-side amplifier to accept. Parts harder than upper level trigger hard-side amplifier which disables output thyatron of soft-side unit

# Direct VSWR Readings

Rapid check on operation of radio and radar transmission systems can be made using a simple instrument that presents the quotient of incident and reflected power on a meter reading directly in voltage standing-wave ratio. In laboratory service, the device complements slotted-line measurements

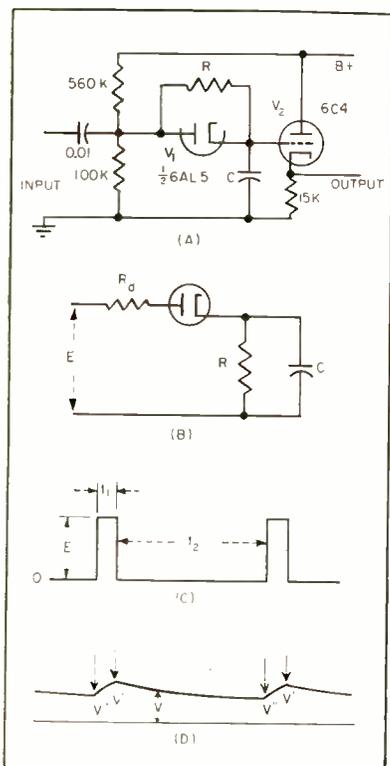


FIG. 1—Partial stretcher circuit (A) with cathode-follower output, basic stretching diode circuit (B) with applied pulse (C) and output waveforms (D)

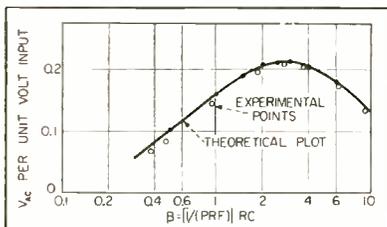


FIG. 2—Experimental verification of derived relation between a-c component and applied pulse for a partial stretcher circuit used in measurements

**D**IRECT INDICATION of voltage standing-wave ratio can be shown with the instrument to be described that samples incident and reflected signals simultaneously. Their quotient is read directly as vswr. Readings are independent of incident power variations. The only adjustments insure that internal amplifiers are not overloaded.

Besides the vswr indicator, a bidirectional coupler and r-f detectors are required. Little emphasis is placed here on directional couplers since they are adequately treated in the literature. The detectors used are of importance only in that they offer significant nonlinearity errors at small signal amplitudes.

Prior art has established techniques that are generally tedious but sufficiently accurate. The slotted line is a most accurate and versatile instrument. High precision slotted lines are expensive and require many accessories. Directional couplers and reflectometers<sup>1</sup> have been improved to the point where they compete with slotted lines in cost and accuracy. Great interest in impedance bridges<sup>2, 3</sup> has been augmented by the desire to circumvent the slotted line.

## Reflectometer Techniques

Two accepted reflectometer techniques are used for rapidly obtaining vswr readings. One method employs feedback that keeps the incident power on a transmission system constant and the reflected power is a measure of the reflection coefficient<sup>4</sup> or vswr.

Practically, the incident power level does not stay constant in an r-f transmitter. As an alternative, by setting the incident level reading to unity on a meter and then switching to the reflected signal, the vswr or reflection coefficient can be obtained directly.<sup>5, 6</sup>

An earlier paper<sup>7</sup> described an electronic ratio meter and its application to the measurement of reflection coefficients. An extension and improvement of the earlier techniques to pulse-modulated systems, such as radar, is considered below.

## Diode Nonlinearity

When the r-f signal is a typical radar output consisting of pulses of short duty cycle, the nonlinearity of the diode can be minimized only by working with large signals so the nonlinear region is a small percentage of the total swing. In addition, an averaging type of ratio meter cannot be used, since the large pulses (of small average value) cannot be accommodated in conventional amplifier circuits.

Techniques that stretch the pulse, to increase its average value, are required. Another serious consideration of pulse operation is that crystal diodes fail as detectors. The crystal diode is essentially a low-level device and most successfully used as a square-law detector. When large pulses are applied to crystals, they saturate and hence distort by virtually clipping the signal. Besides, they conduct significantly in the reverse direction.

There is, however, a small linear

# in Pulsed R-F Systems

By **L. A. ROSENTHAL**  
and **G. M. BADOYANNIS**

*Department of Electrical Engineering  
Rutgers University  
New Brunswick, N. J.*

region dangerously close to the burnout point that can be obtained in certain selected crystals. This region is completely impractical for present considerations but may be a necessity for high-frequency detector designs. Thermionic diodes were alone considered in the developed vswr indicator. They have all the desirable characteristics exclusive of frequency range. The type 6173 pulse diode was chosen because of its high peak current rating (1,000 ma) and high useful frequency, 3,300 mc. The tube is a pencil variety and can be conveniently mounted coaxially. With identical mounts, it is reasonable to assume that these diodes can be used up to their resonant frequencies in ratio measurements.

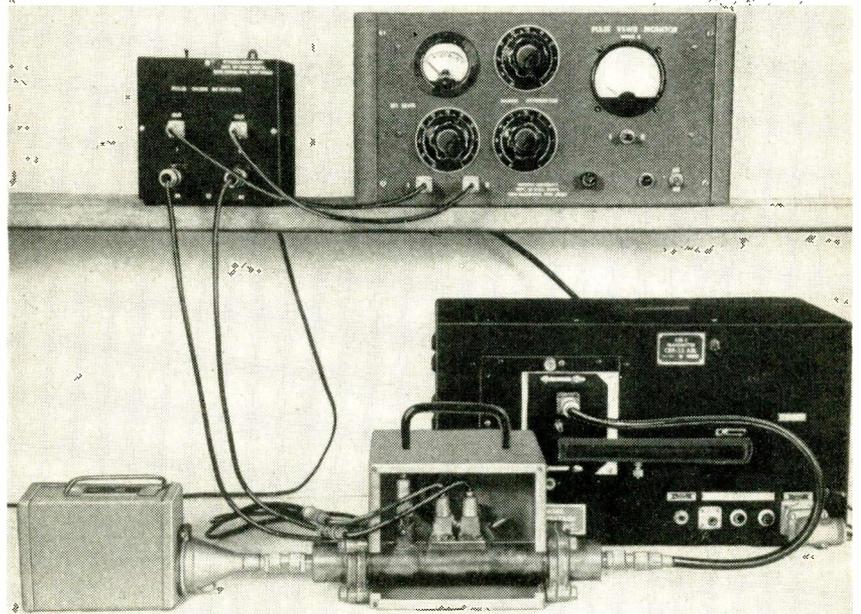
## Pulse Stretching

A technique was developed to measure pulse ratios by incompletely stretching the pulses and directly deriving an a-c exciting signal for the ratio meter. Equations of the diode charging circuit indicate the methods employed. A typical partial stretcher circuit is shown in Fig. 1A. The symbols and circuit used from which waveforms were derived are shown in Fig. 1. Voltage  $V'$  is the voltage after the pulse application and voltage  $V''$  is that after the time corresponding to a pulse-space period  $t_2$ . The important equations are

$$V' = E(1 - e^{-\alpha}) / [1 - e^{-(\alpha+\beta)}]$$

and

$$V'' = E(1 - e^{-\alpha}) / [e^{+\beta} - e^{-\alpha}]$$



Pulse monitor (upper right) is fed by diode detectors (left) from bidirectional coupler (below). Radar transmitter is in background and terminating load at lower left

where  $\alpha = t_1/RC$ , the charging parameter and  $\beta = t_2/RC$ , the discharging parameter. The capacitor can stay charged to the peak value  $V' = E$  only if  $\beta = 0$  (no discharge). For any value of  $\beta$  greater than zero there is some error. If the charging circuit has no resistance ( $\alpha = \text{infinity}$ ), then

$$V' = E$$

and

$$V'' = Ee^{-\beta}$$

Therefore, capacitor  $C$  charges up to voltage  $E$  and will discharge according to the equation

$$V = Ee^{-t/RC}$$

If it is assumed that the pulse width is negligible in the averaging process and that  $\alpha$  is extremely large, the average value of the voltage across the load is

$$V_{AV} = \frac{E}{t_2} \int_0^{t_2} e^{-t/RC} dt$$

where

$$t_2 = 1/PRF$$

which results in

$$V_{AV} = (E/\beta)(1 - e^{-\beta})$$

The average value can vary between the maximum limit  $E$  (when  $\beta = \text{zero}$ ) to zero ( $\beta = \text{infinity}$ ) and is lost in passing through an

$RC$  coupling network. The a-c value of the output signal, as would be read by an averaging instrument, is

$$V_{AC} = \frac{2E}{\beta} \left[ 1 - \frac{1 - e^{-\beta}}{\beta} + \frac{1 - e^{-\beta}}{\beta} \ln \left( \frac{1 - e^{-\beta}}{\beta} \right) \right] \quad (1)$$

This equation indicates that the ripple riding on top of the stretched pulse is proportional to the pulse amplitude and it can be used as a design equation. If, for example,  $\beta = 1$  then

$$V_{AC} = 0.168E$$

Decreasing  $\beta$  will decrease the available a-c component as the pulse stretches to pure d-c as shown in Fig. 2. Increasing  $\beta$  will increase the available a-c until some maximum value is reached after which the pulse becomes exceedingly narrow and the a-c component is again reduced. These a-c components can be applied directly to the ratio meter and although a certain amount of the pulse amplitude is lost, the proportionality is preserved so that ratio measurements are accurate.

## Complete VSWR Meter

As shown in Eq. 1, there is an a-c component associated with a



of ratio-meter current. The overload indicator is a 100- $\mu$ a meter connected as a voltmeter to monitor the current passing through a 30-ohm precision resistor. It is set by  $R_2$  so that 15 ma of ratio meter coil current corresponds to full-scale deflection. The average input signal for 15-ma output current is closely 450 mv. About 15 db feedback is included in each ratio-meter channel.

### Operating Procedure

In setting up the vswr meter, certain initial balancing adjustments must be made. The peak detector unit is connected to the incident and reflected channels but the input is derived from a single source, such as the incident signal of the directional coupler. With r-f on and with no attenuation in the range switch, both channels should be identical except for deviations in the detectors and stretchers.

These deviations can be compensated by balancing the ratio meter through potentiometer  $R_1$ . A center marker on the ratio meter scale indicates the equal-signal condition. This equalization procedure insures that each channel is identical from the r-f end to the direct current in the ratio-meter coils.

The r-f inputs can then be disconnected from the single r-f source and connected to the incident and reflected signals. If a bidirectional coupler of equal nominal coupling is used, this balancing procedure can be carried out with a good open circuit or short-circuit on the line. Similarly, if a coupler is provided with known incident and reflected coupling, the range attenuator can be set to equalize the coupling and allow balancing under an open-circuit or short-circuit condition.

The latter two methods assume that the load can be disconnected and that an appropriate open circuit or short-circuit is available. In general, it is necessary to inject equal signals into the ratio meter for the initial setup. It is also desirable that the diodes in the partial stretchers and in the r-f detector experience comparable r-f amplitudes.

Upon equalizing the ratio-meter channels, the monitor is ready for operation. The range switch setting

must be chosen based on the bidirectional coupler coefficients previously discussed. The only other control that must be set during operation is the level-setting ganged attenuator. By referring to the overload indicator and switching between incident and reflected, the level can be set for both readings on scale.

Since the ratio meter will never pass currents greater than the approximate ratio of 3.6-to-1, it is always possible to obtain  $I$  and  $R$  readings that are on scale. The level indicator region below 10 (corresponding to 1.5 ma) is a region of error since the ratio-meter coil currents are of insufficient strength completely to nullify the spring-restoring forces. This region should be avoided if sufficient signal strength is available.

### Calibrating Technique

To evaluate the vswr indicator, standard loads of known vswr were prepared. A simple mount that can be easily machined from 1  $\times$  1 in. brass stock was made. Two-watt Allen-Bradley composition resistors are mounted coaxially and terminate in a type N fitting. These loads were calibrated by the Rome Air Development RADC Standards Laboratory at low power levels and considered as standards.

Six more commercial loads with vswr values between 1.04 and 1.26 were obtained. This assortment of loads was used in the test evaluation of the instrument developed.

With these standard loads, a series of measurements was obtained. A modified ASB-5 radar unit having a pulse width of 0.7  $\mu$ sec at 500 mc was employed. The test set-up is shown in the photograph. The diode detectors exhibited a cross-coupling of approximately 0.3 percent and theoretically would limit the lowest measurable vswr to 1.006. However, this low vswr is not accommodated by the meter, which would under all circumstances be in gross error since the reflected diode's nonlinearity would be excessive.

### Measured Comparison

Values in Table I were obtained by setting up the ratio meter under open-circuit conditions. The slight

deviation in coupling (0.3 db) of the commercial bidirectional coupler is therefore equalized.

These results compare favorably with the RADC Standards Laboratory measurements. Some of the small discrepancies may result from aging of the resistors or peculiarities of pulse operation.

Larger errors were observed for the manufactured loads. The one-watt rating of these loads was insufficient, so that measurements had to be made immediately after

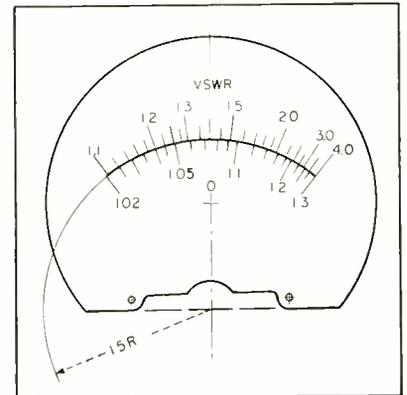


FIG. 4—Meter calibration shows two scales used. Zero centering is provided for initial adjustment

the application of r-f power. One typical 60-ohm load changed 3 ohms after 2 minutes of exposure to r-f power with average value approximately 2 watts. Repeated use of these loads may have permanently changed their characteristics. Also, reflected signals become small at small vswr values and introduce serious nonlinearity errors.

The authors thank the Rome Air Development Center, Griffiss Air Force Base, sponsors of this work under contract AF28(099)-33. The capable assistance of William C. Schaal, Research Assistant, is appreciated.

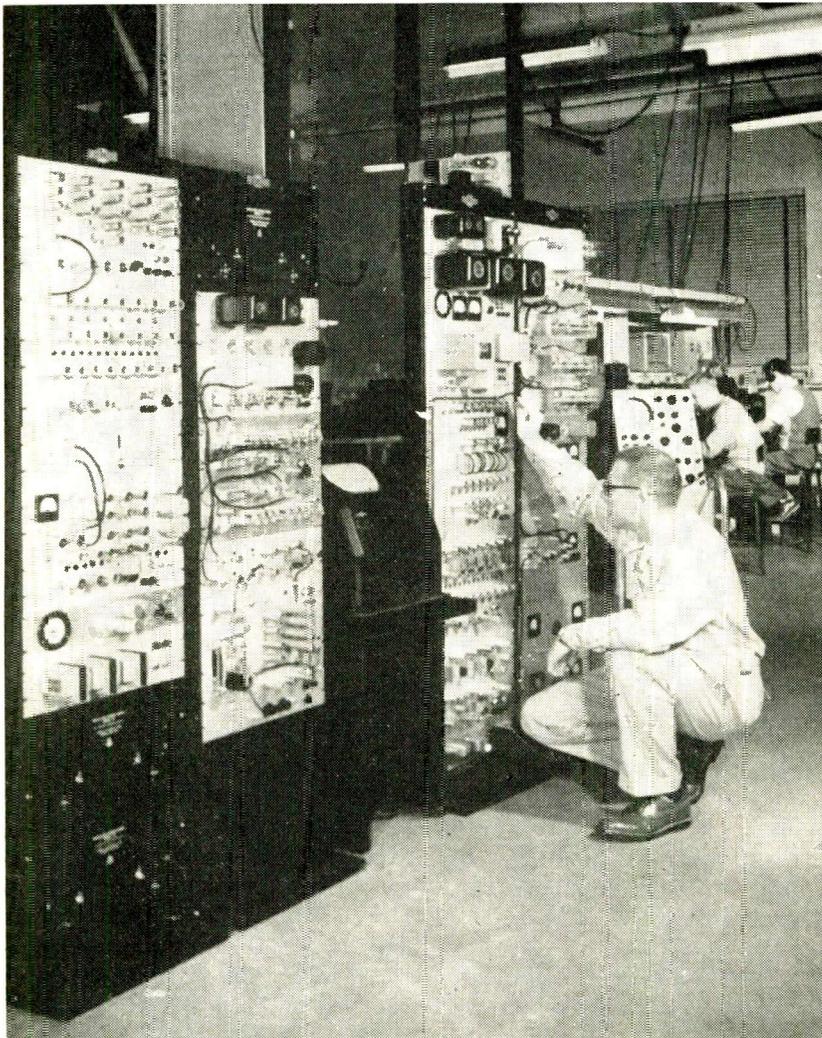
### REFERENCES

- (1) B. Parzen, Impedance Measurements with Directional Couplers and Supplementary Voltage Probe, *Electrical Communications*, p 338, Dec. 1949.
- (2) J. F. Bryne, A Null-Method for the Determination of Impedance in the 100-400 Mc Range, *Proc NEC*, 3, 1947.
- (3) O. M. Woodward, Comparator for Coaxial Line Adjustments, *ELECTRONICS*, p 116, Apr. 1947.
- (4) K. S. Packard, W. A. Falls and L. L. Mason, A Direct-Reading and Plotting Device for Measuring VSWR at UHF, Airborne Instrument Laboratory Report No. 163-1, June 1948.
- (5) G. E. Feiker, Standing Wave Indicator, *GE Rev*, p 43, Sept. 1946.
- (6) G. Glinski, Standing-Wave Ratio Meter for UHF, *Tele-Tech*, p 34, June 1947.
- (7) L. A. Rosenthal, J. L. Potter, and G. M. Badoyannis, Ratio Meter Measures Reflection Coefficient, *ELECTRONICS*, Nov. 1952.

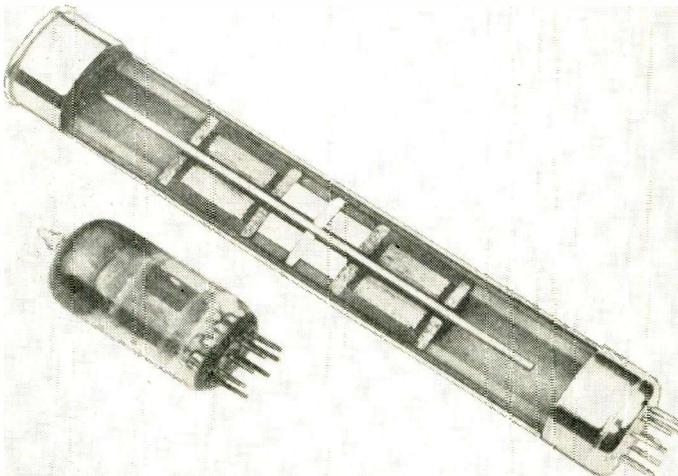
# Predicted-Wave

By M. L. DOELZ

*Collins Radio Co.  
Burbank, Calif.*



Laboratory prototype of 100-watt transmitter and complete receiver necessary to convert signals to teleprinter page copy



Cutaway view of the magnetostriuctive resonator compared to tube size

**C**URRENT PRACTICE in frequency-modulated radiotelegraphy requires use of frequency-measuring techniques for conversion of the received signal to a form suitable for operation of land-line telegraph equipment. Usual circuits include band-pass filtering (in the receiver i-f amplifier), a limiting amplifier and a discriminator. Refinement of these methods does not necessarily lead to the best use of received signal energy. The predicted-wave system to be described transmits a frequency-shifted signal similar in form to that currently used. However, the intelligence is obtained from this signal by methods leading to greater utilization of the received signal energy.

Predicted-wave detection circuits measure pulse amplitudes at the two alternate frequencies of the frequency-shifted wave by accumulating over each pulse period the signal and noise from each of the two frequency channels in a pair of high-Q resonators. If the largest amplitude is measured in the mark channel, a mark is transmitted to the page printer. When the largest amplitude is measured in a space channel, a space is transmitted. This circuitry performs the same function as the limiting amplifier, discriminator and keying relay chain used in fsk, but is less affected by noise and interference.

## **Sync Signal**

The radio-frequency wave emitted from a predicted-wave transmitter differs from the usual frequency-shifted telegraph signal in that a third frequency midway between the mark and space frequency is used to provide automatic synchronization. Time and frequency relations used in the pre-

# Radio Teleprinter

New radiotelegraph system, using diversity reception and magnetostrictive resonators for accumulating mark and space information, employs synchronizing pulse on center frequency. Characters are delivered in less time than start-stop type and have 8.5-db advantage at the 0.1-percent error-rate level

dicted-wave system are shown in Fig. 1. The synchronous signal includes a set of five pulses, each placed on either the mark or space frequency (each spaced 360 cycles from center), followed by a synchronizing pulse of equal duration occurring on center frequency at all times. The first pulse of the group of seven is used for the blank recognition function of the page-printer start pulse.

Minimum, maximum and normal timing for a conventional start-stop telegraph system are shown at the top of Fig. 1. The start-stop signal is characterized by a start pulse, which releases a timing sequence and places the following five signals in a mechanical storage that identifies one of 32 characters. The last information-carrying pulse is followed by a stop pulse approximately  $1\frac{1}{2}$  times as long as the first six pulses. The timing of the predicted-wave synchronous system has been chosen to deliver a character in slightly less time than the minimum required for the start-stop system. This means that a start-stop line feeding the synchronous system always lags and a storage of two-character capacity is all that is required to join the two systems.

## Transmitting Equipment

A block diagram of the transmitting equipment is shown in Fig. 2A. Start-stop signals from a non-synchronous line are fed to a two-character electronic storage code converter using hard vacuum tubes. Binary information, coded as shown in Fig 1, is read out of the code converter at a synchronous rate controlled by the time-base unit. The synchronous timing is so chosen that the read-out rate is

slightly faster than the fastest start-stop input signals. With an average keyboard or tape reader, the code converter will transmit about one blank in every 23 characters.

All timing signals are derived from a magnetostrictive oscillator operating at 23,040 cycles. Frequency-dividing circuits reduce this to 360 cycles for use in the frequency-shift circuits and to 45 cycles for pulse timing. The integral relation between the pulse timing rate and frequency shift results in minimum crosstalk between mark, space and synchronizing channels.

The frequency-shift generator accepts synchronous binary information from the code converter and delivers a frequency-shift-keyed output at 23,400 cycles for mark, 22,680 cycles for space and 23,040 cycles for synchronization (every seventh pulse). Both data and sync pulses are of  $1/45$ -second duration.

The mark and space signals are obtained by modulating the 23,040-cps signal from the same source in a doubly balanced modulator. Band-pass filters select the mark and space frequencies and three gates are synchronously keyed to

yield an output at the mark or space frequency for the data, or on center frequency every seventh pulse for synchronization.

The output of the frequency-shift generator is translated to a nominal 250 kc in the heterodyne unit and further heterodyned and amplified in the exciter unit to a 100-watt output level at operating frequency.

## Receiving Equipment

Receiving equipment is shown in block form in Fig. 2B. Signals from a pair of diversity antennas are heterodyned to a nominal 250 kc in a pair of crystal-controlled receivers operated from a common oscillator and using a common avc system. The chassis containing the automatic-frequency-control and oscillator circuits includes a crystal oscillator with suitable multipliers for excitation of the receiver mixers.

A pair of narrow-band discriminators at the mark and space frequencies of 23,400 cycles and 22,680 cycles are used to control the frequency of the heterodyne oscillator converting the 250-kc signal to the 23-kc range. This system forms an automatic frequency control capable of adjusting the received signal over a range of approximately 200 cycles. The avc and synchronizing chassis uses three band-pass filters, each approximately 200 cycles wide, to provide separate outputs for the mark, space and synchronizing channels. The mark and space outputs are added to provide a signal that drops to zero during the time of arrival of the synchronizing pulse. The synchronizing filter yields the inverse of this signal. The envelope of the added outputs from the mark and space filters

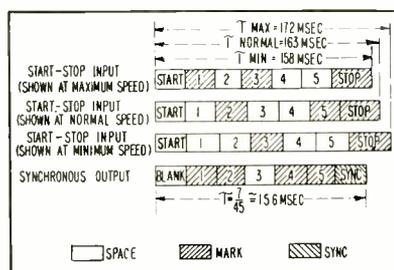


FIG. 1—Time and frequency relations for start-stop and synchronous teleprinter systems. Blank-recognition and center-frequency sync pulses characterize the newer system

is subtracted from the envelope of the synchronizing filter and the difference voltage is half-wave rectified and limited.

Multipath synchronizing signals smaller in amplitude than the desired synchronizing signal are discriminated against in this circuit.

### Magnetostriction Timer

An oscillator controlled by a magnetostrictive resonator like that in the photograph is used as a source of timing information in the receiver. The output frequency of this oscillator is divided to provide a signal at 45 cycles to be compared with the received synchronizing pulse in a product detector. The output of the product detector drives a servomotor that corrects the phase of the 45-cycle signal and the frequency of the magnetostrictive oscillator to synchronize the receiving time base with the incoming signal.

Automatic-gain-control information is obtained by adding the outputs of mark, space and synchronizing filters.

The intermediate-frequency outputs from the two diversity receivers are fed to the detector and diversity-selector unit. The output of each receiver is fed to a pair of magnetostrictive resonators, one at the mark frequency of 23,400 cycles and one at the space frequency of 22,680 cycles. Each resonator is damped to zero energy level at intervals of 1/45 second, corresponding to the transition times of the incoming signal. The damping is achieved by applying strong inverse feedback around the resonator for approximately one millisecond. Since the resonator is freed of stored energy and input-signal history by the damping pulse, it is possible to integrate the incoming signal over the necessary 1/45-second period preceding the following damping operation.

The resonator consists of a nickel-iron alloy rod a half wavelength long at operating frequency and supported at its center by staking into a brass disk. Ring-shaped biasing magnets are located on either side of the support disk and provide a permanent field through the rod. Multiturn driving and pick-off coils are located on either

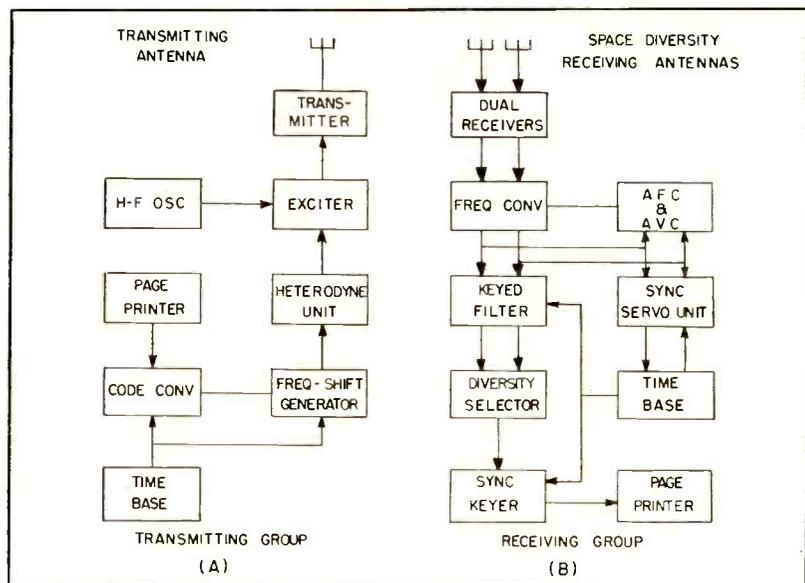


FIG. 2—Elements of the predicted-wave transmitter (A) and receiver (B) used to obtain more reliable communications

side of the magnets and are connected to the terminals of the 9-pin miniature plug. A resonator of this type operates in the vicinity of 20 kc with a Q of about 2,000 providing excellent frequency stability.

### Keyed Filters

A circuit diagram of one of the four identical keyed filters used in the detector and diversity-selector chassis is shown in Fig. 3. A timing impulse occurring at received-pulse transition times derived from the time base unit is stretched to approximately one millisecond and delivered to the grid of tube  $V_{1A}$  in the form of a positive pulse. Current flowing in the cathode circuit of  $V_{1A}$  causes the cathode of  $V_{1B}$  to become positive, cutting off the tube.

Conduction in  $V_{1A}$  also causes its plate voltage to drop, which in turn causes the grid of  $V_{2A}$  to go negative. This causes cutoff in tube  $V_{2A}$  and thence conduction in  $V_{2B}$ . Thus during the one-millisecond damping interval, tube  $V_{1B}$  is cut off and  $V_{2B}$  conducts, while during the remaining 21.2 milliseconds of the pulse period, tube  $V_{1B}$  conducts and  $V_{2B}$  is cut off. The 20-kc outputs of tubes  $V_{1B}$  and  $V_{2B}$  are added and amplified in  $V_{3A}$  to drive the magnetostrictive resonator.

Output of the resonator is amplified in  $V_{3B}$  and fed back through a 0.01- $\mu$ f capacitor and potentiometer to the grid of  $V_{2B}$ , thus es-

tablishing a high-gain feedback circuit during the one-millisecond damping period. This feedback is negative and rapidly quenches all vibrations in the resonator. Output of the resonator is also fed through a decoupling 33,000-ohm resistor to the grid of  $V_{1B}$  to provide a positive feedback of lower gain during the 21.2-millisecond period when the resonator is accumulating signals from the receiver output.

### Diversity Accumulation

Four of these keyed-filter circuits are used. They are actuated in synchronism by the common timing signal. One circuit using a resonator tuned to mark frequency and another for space frequency are driven from the output of one of the two diversity receivers. A parallel arrangement is used for the output of the other diversity receiver. Tube  $V_4$  operates as an amplifier to yield an output proportional to the output of the resonator. Diode diversity-selection circuits following the four outputs select the strongest of the four and produce a mark output if the strongest occurs in one of the two mark resonators or a space output if the strongest occurs in one of the two space resonators.

The keyed filter yields an output dependent upon the frequency of an input sine wave. Measurements of the output amplitude as a func-

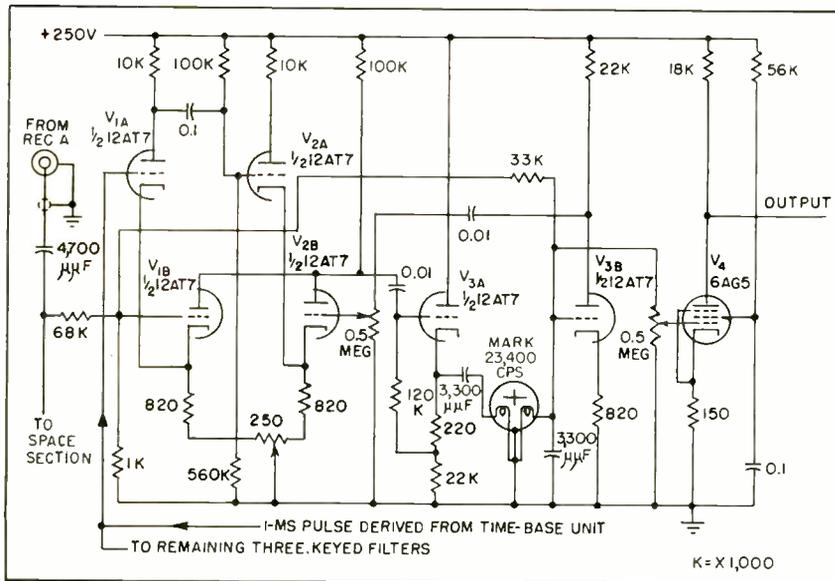


FIG. 3—Keyed-filter circuit employing magnetostrictive device is heart of new receiving technique

tion of frequency input are shown graphically in Fig. 4. The positive feedback existing during the 21.2-millisecond pulse period is adjusted to give an essentially infinite effective Q for the resonator.

Thus an incoming sine wave exactly at resonator frequency is accumulated there much as a direct current is accumulated in a perfect capacitor. Figure 5 illustrates this accumulation photographically. The waveform shown at the top is at the output of a keyed filter in which the resonator, on mark frequency, is driven from a signal of alternate marks (bottom) and spaces (middle). Linear buildup during the 21.2-millisecond driving period and the rapid damping are easily identified.

### Performance Characteristics

Error rate versus signal-to-noise ratio measurements for the predicted-wave system are shown in Fig. 6. The circles represent points obtained by counting the number of page-printer errors obtained in a period of approximately 20 minutes. The signal-to-noise ratio was obtained by measuring the noise and signal power in the 3,100-cycle i-f band of one receiver. Noise was supplied by a gas-tube noise generator and i-f power levels were measured with the aid of a bolometer.

An error rate of one-tenth of one percent was obtained with signals

6 db under the noise level in the i-f band. The solid line was computed from the formula

$$P_s = \frac{1}{\sqrt{2}} \epsilon \exp(-S^2 / 4a^2)$$

where  $S^2$  is the energy of the received signal pulse and  $a^2$  is the noise energy of  $\frac{1}{2}$ -cycle band integrated for one second.

For comparison purposes similar measurements were made on a start-stop frequency-shift-keyed system of conventional design. The converter used employed a pre-limiting bandpass filter 1,500-cycles wide followed by a limiting amplifier and a linear discriminator. Both the converter and the telegraph printer used for this test were adjusted for optimum performance immediately before the measurements were made. Three points were obtained, each having an operating period of approximately 20 minutes. A comparison of the two curves shows that at the one-tenth-percent error-rate level the predicted-wave system has an 8.5-db advantage over the frequency-shift system.

The ability of the predicted-wave system to utilize signals of lower quality makes it particularly valuable for use with scatter propagation.

The author acknowledges the aid of Earl Heald and George Grondin who assisted in the preparation of this article.

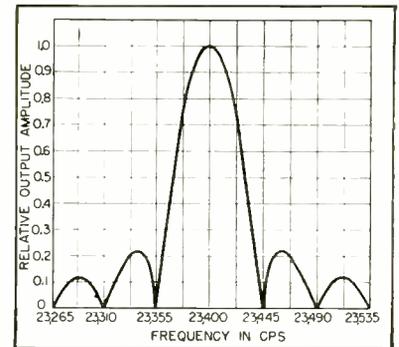


FIG. 4—Keyed-filter response shows high-amplitude response at resonance resulting from positive feedback

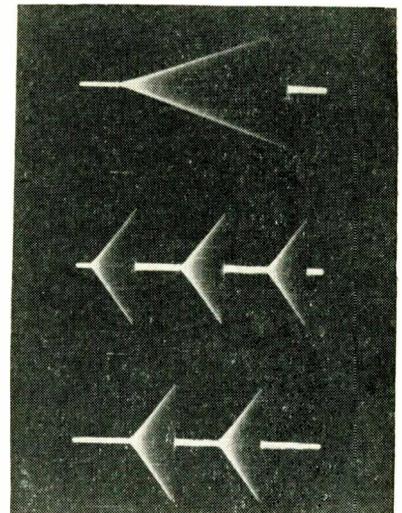


FIG. 5—Oscillograms of keyed-filter action, showing buildup (top) resulting from accumulation of pulses (bottom) and unaffected by undesired pulses (center). Rapid damping is indicated

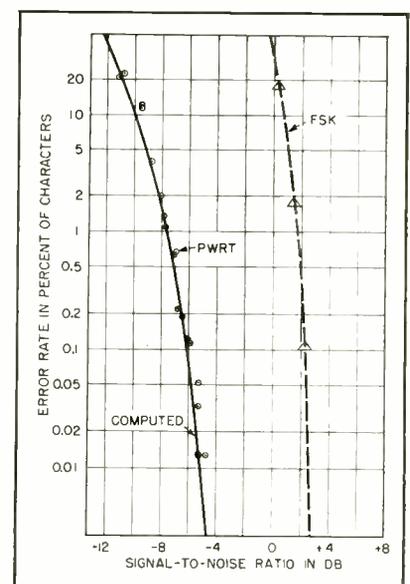


FIG. 6—Error-rate versus predetection signal-to-noise ratio. Experimental data obtained at 60-wpm for frequency-shift (right) and new system (left)

# Pulling-Figure Tester for

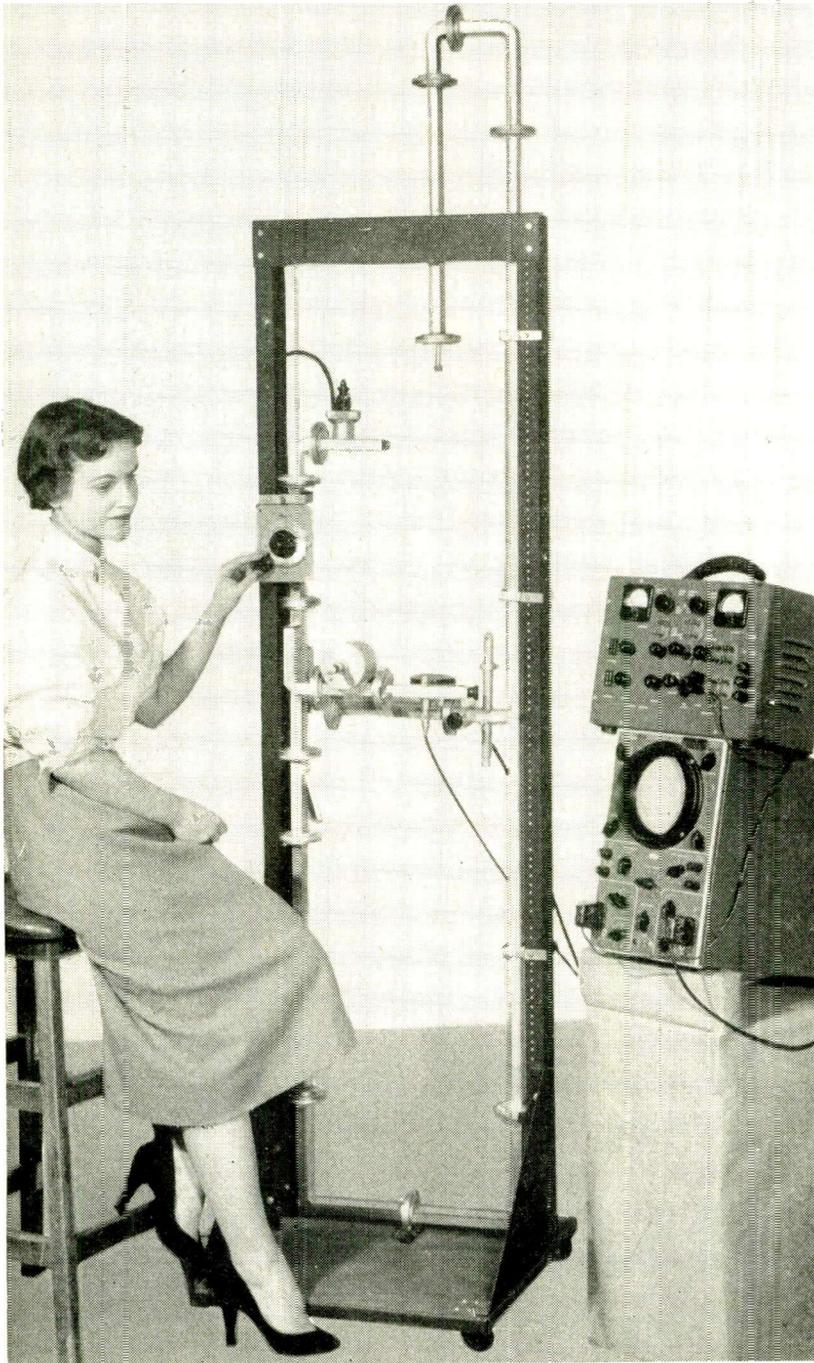
By **E. DYKE**

*Collins Radio Company  
Dallas, Texas*

and

**J. COHN**

*Microwave Research Department  
Motorola, Inc.  
Chicago, Illinois*



Complete pulling-figure tester in operation as used to measure the pulling-figure of reflex klystrons. Technique applicable to other oscillators

**M**ICROWAVE TRANSMITTERS frequently consist of an oscillator directly feeding an antenna with no buffer amplifier stages to provide isolation. This is due to the fact that suitable microwave amplifiers have only recently been developed and that microwave oscillators are capable of delivering sufficient power in many cases to eliminate the need for amplifiers.

This lack of oscillator isolation results in the antenna load affecting oscillator characteristics. The load may alter the frequency of oscillation, cause distortion in frequency-modulated oscillators and even make it impossible to tune the oscillator to certain frequencies.

A need existed for a means of measuring oscillator sensitivity to load effects and for a means of describing this sensitivity quantitatively. To accomplish this the pulling-figure characteristic was devised and may be defined as the difference between the highest and lowest frequencies which result when a specified load variation is presented to the oscillator. The dynamic method of pulling-figure measurement yields accurate results in a fraction of the time required for the conventional method.

## **Static P-F Measurement**

Figure 1 is the diagram of a typical test circuit for measuring static pulling figure. The power and frequency monitor are used to adjust the operating conditions of the oscillator. A fixed standing wave of 1.5 is obtained from a step reflector and terminating matched pad. The standing wave is passed through all possible phases by means of a matched phase shifter. An alternate method is to use a matched variable attenuator to limit the vswr fol-

# Microwave Oscillators

Production-line measurements of klystron and magnetron oscillator sensitivity are made quickly and accurately by unskilled operator with new dynamic tester that is independent of warmup for oscillator drift and requires no critical adjustments

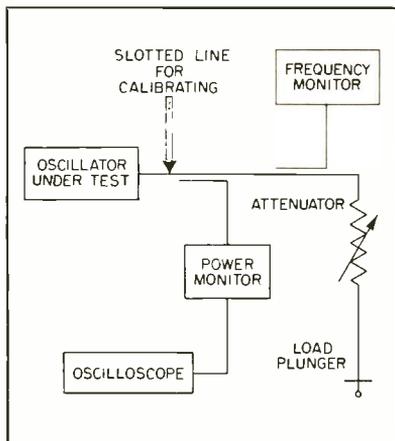


FIG. 1—Typical test circuit for measuring static pulling figure. Matched variable attenuator limits the vswr. Movable shorting plunger acts as a phase shifter

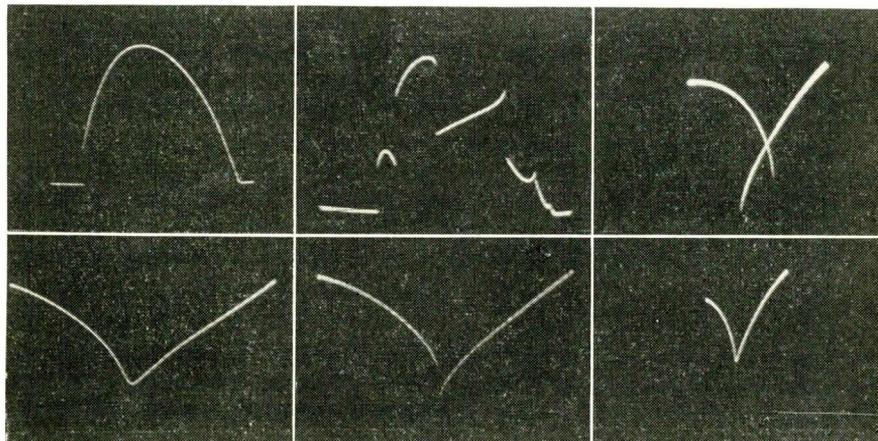


FIG. 2—Power output of reflex klystron, showing normal mode looking into a matched line at 7,500 mc, top left, same mode with several db padding, center. Center curve is magnified at right. In determining pulling figure, patterns show too little, bottom left, too much, center and proper amount, right, of attenuation added

lowed by a movable shorting plunger that acts as a phase shifter. The frequency may be observed as the phase shifter is moved and the two frequency extremes recorded.

There are several difficulties in using this sort of instrumentation. An inherent problem exists in that the change in frequency is ordinarily about one thousandth of the oscillator frequency, thus limiting measurement accuracy. A heterodyne circuit can compensate for this deficiency but does not solve the basic problem of drift in the oscillator being tested.

The power supplies must be highly stabilized and the temperature of the oscillator must be controlled. This demands a warmup time and some kind of controlled-temperature chamber if utmost accuracy is desired.<sup>1</sup>

## Analysis Of Dynamic Pulling Figure

Since the pulling figure states quantitatively the frequency sensitivity of an oscillator to reflections

from the load, effects of load on oscillator frequency should be considered. In its simplest form a microwave oscillator can be considered as an energized tuned circuit. Viewed from the oscillator, the load may have some reactance depending on the termination of the waveguide which the oscillator is feeding. This reactance appears in parallel with the oscillator tuned circuit and causes a shift in resonant frequency from that which occurs from a non-reactive load.

A discontinuity in the frequency and power characteristics may occur when the length of waveguide between the oscillator and the mismatched waveguide termination is larger than a few wavelengths. Cause of this discontinuity is the variation of the input impedance of the waveguide with frequency so as to permit the oscillator to have more than one stable frequency of operation. This phenomenon is known as the long-line effect.<sup>1-5</sup>

An equation has been derived for the minimum vswr in the wave-

guide load which will cause such a discontinuity to occur.<sup>2</sup> This equation is solved for the pulling figure of the oscillator

$$\text{pulling figure} = \frac{1}{1.19 KD(\text{vswr}^2 - 1)} \quad (1)$$

where  $\lambda_g$  = wavelength in guide,  $D$  = distance, source to sink, in same units as  $\lambda_g$ , and

$$K = \frac{2\pi}{\lambda_g^2} \frac{d\lambda_g}{df} \quad (2)$$

Figure 2 shows a series of oscillographs of a discontinuity in the power output characteristics of an overcoupled reflex klystron having a pulling figure of 15 mc at 7,500 mc. This includes an oscillograph in which the attenuator has been adjusted to reduce the vswr to the minimum value which could produce the discontinuity. When this condition is reached the attenuator dial is read and the pulling figure found from a calibration curve. A similar series is shown in Fig. 3 for a degree of coupling suitable for microwave transmitters. The pulling figure here is 6 mc at a

frequency of 6,800 megacycles.

A careful check was made to determine experimentally the difference between the dynamic pulling figure and its static value. Results were found to be the same for values of pulling figure below 10 mc at a frequency of 6,750 mc. However, for values of pulling figure above 10 mc the dynamic method gave values about 10 percent higher than the static method. The reason for this difference is that the static method depends on the tube characteristics over the entire frequency range through which it is pulled by the load, whereas the dynamic method depends only on the slope of the tube characteristic at the frequency of measurement as shown in Fig. 4.

To evaluate  $K$  accurately, Eq. 1 is rearranged. For the rectangular TE<sub>10</sub> mode and width  $a$

$$\lambda_o^2 = \frac{\lambda^2}{1 - (\lambda/2a)^2} \quad (3)$$

replacing  $\lambda$  with  $c/f$  and differentiating

$$\frac{d\lambda_o}{df} = - \frac{cf}{\left[ f^2 - \frac{c^2}{4a^2} \right]^{3/2}} \quad (4)$$

Substituting in Eq. 2, and also substituting  $2\pi f = \omega$ , yields

$$K = \frac{\omega}{c \left[ f^2 - \frac{c^2}{4a^2} \right]^{3/2}} \quad (5)$$

For example, at 6,300 mc,  $K = 2.868 \times 10^{-10}$  sec. per cm. This value substituted in Eq. 1 gives an accurate pulling-figure calibration.

### Dynamic Measurement

Basically, the same equipment shown in Fig. 1 will measure the dynamic pulling figure without tracking wavemeters and without attention to warmup or oscillator drift. The distance between source and sink is purposely made sizeable (10 or 20 feet for frequencies of several kmc) to increase the load effect on the oscillator.

The ordinarily smooth mode shown in Fig. 5 of a 2K25 reflex klystron as distorted by a reflection which, although only on the order of vswr of 1.2, is seen to result in serious pulling for the 130 feet of transmission line.

Measurement consists of adjusting the attenuator until a mode discontinuity appears on the oscillo-

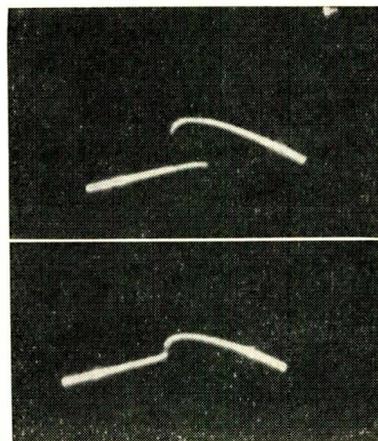


FIG. 3—Mode of 5976H klystron at 6,800 mc with attenuation set for excessive pulling (top) and (bottom) attenuation set for measuring pf

scope. The movable load-shorting plunger is moved to center this discontinuity in the region of interest, such as the center of klystron mode. The attenuator dial may be calibrated directly in dynamic pulling figure for any one carrier frequency or, its reading may be converted to dynamic pulling figure by means of a graph. In this apparatus the oscillator is frequency modulated from any convenient source such as a 60-cycle sine wave and is deviated a few megacycles in order to observe the top of the klystron mode on the oscilloscope. In all microwave oscillators with which this arrangement has been used the warmup time can be practically neglected, and frequency need be set only approximately. Remaining oscillator adjustments need be set only to the accuracy required for visual observation on the oscilloscope. This elimination of critical adjustments makes the procedure suitable for production quality control.

The pulling-figure tester is also useful in the design of oscillator-waveguide couplers or starting sections. It facilitates measurement of the effect of any pertinent parameters on the pulling figure of the combination. For example, the effect of varying the position of the shorting plunger in a Shepherd-type klystron coupler may be quickly determined by measurement of pulling-figure versus plunger position. Because the power output, f-m sensitivity and long-line distortion are related to the pulling figure, such a tester is

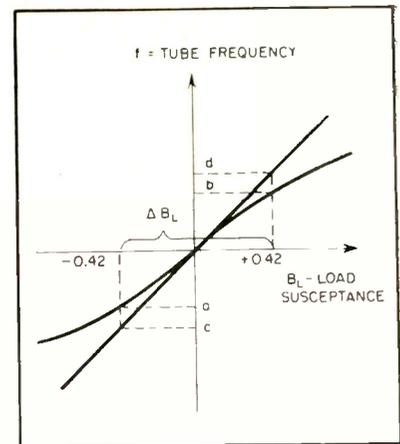


FIG. 4—Change in load susceptance due to a 1.5 vswr;  $\Delta f_{a-b}$  is pulling figure for static method;  $\Delta f_{c-d}$  is pulling figure for dynamic method

used extensively in microwave-transmitter design.

Quality control of klystrons ordinarily consists of applying standard voltages and then measuring the resulting currents and microwave properties at several frequencies across the intended frequency band. These properties are ordinarily pulling figure, power output, modulation sensitivity and distortion. For convenience, the pulling-figure tester includes adapters for the other tests.

Power is determined by the thermistor head plus an automatic power bridge. Wavemeters are used in the measurement of modulation sensitivity in cases where only a few measurements are to be made. For frequent measurement of modulation sensitivity, and also for measurement of distortion, a microwave superheterodyne receiver is used. For this purpose a directional coupler is connected in the equipment which in the photograph is capped with a pair of dust shields. For superheterodyne measurements, a local-oscillator assembly is connected to one flange of this directional coupler and a mixer assembly is connected to the other flange.

### Dynamic Tester Calibration

Measurements require temporarily installing a slotted line between any convenient oscillator and the attenuator, Fig. 1. For each frequency band, the attenuator is varied in steps of about one db and the standing-wave ratio is recorded versus the attenuator dial reading.

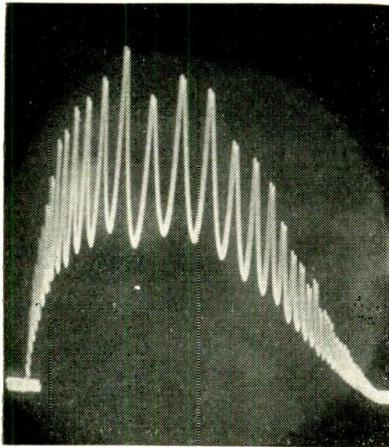


FIG. 5—Mode of klystron with mismatched load. Abscissa shows repeller voltage, and ordinate r-f power output

The attenuator should be fairly well matched so that any one position gives a constant standing-wave ratio regardless of variations in the position of the load plunger. A family of curves is then drawn for pulling-figure versus attenuator-setting for various carrier frequencies. These are computed from Eq. 1 with the aid of Eq. 5 in which  $K$  is a constant for a particular waveguide installation and frequency. If modulation is present each sideband will yield a particular phase of reflected wave which gives a modulation distortion.

### Other Oscillators

While the discussion on dynamic pulling figure measurement has been restricted to the reflex klystron oscillator, it should be equally applicable to other oscillators since the manner in which the load affects frequency is similar for many oscillators. For example, the equation showing how load susceptance alters oscillator frequency is the same for the klystron<sup>3</sup> and magnetron,<sup>4</sup> namely  $2C\Delta\omega + B_L = 0$  where  $B_L$  = load susceptance,  $\omega$  = angular velocity and  $C$  = equivalent capacitance of the frequency-determining circuit.

Dynamic pulling-figure measurements have been made on tubes that were designed to be operated c-w and f-m. Using a small amount of f-m is helpful in observing the critical discontinuity. To use the dynamic pulling-figure method with pulse modulation, the pulse duration would have to be long enough to allow the transients on the

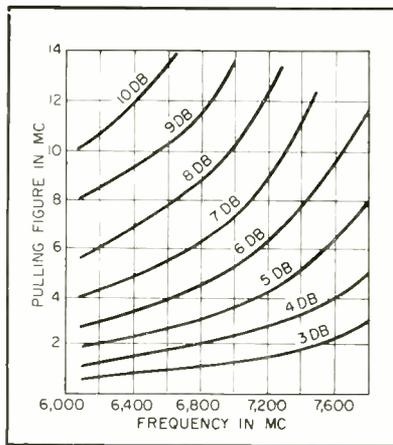


FIG. 6—Graphical calibration of dynamic pulling-figure tester for different attenuator settings

transmission line to die out, because the analysis used for this method is based on steady-state impedance concepts.

### Application

Several subsidiary definitions of pulling figure are useful in analysis or specifications. Some oscillators have a coupling adjustment such as the plunger used with a probe-coupled reflex klystron. In this case certain available degrees of coupling are of interest and may be specified by the pulling figure. Normal pulling figure is that obtained with the oscillator and its coupling adjustment tuned for maximum power output. This is the adjustment most ordinarily obtained in the field tuning of a finished design.

Maximum pulling figure is that obtained when the coupling adjustment is varied through a range to maximize the pulling figure regardless of its influence on other tube parameters. If overcoupling occurs, there will be proportionately-reduced power output. This figure is useful as an indication of how much pulling might be obtained in practice from maladjustment of the controls or it may be an indication of the maximum available modulation sensitivity.

Thus far pulling figure has been considered in units of reciprocal time (megacycles) for a microwave oscillator. For analytic work there is some value to the dimensionless relative pulling figure which is the ratio of dynamic pulling figure to carrier frequency. Present reflex

klystrons ordinarily have a relative normal pulling figure of about 0.0005 to 0.001 (0.1 percent, or perhaps 1.0 per 1,000). This may be a useful figure in distortion analysis because it accounts for the carrier frequency.

### The Tester

The tester shown in the photograph is used to measure the pulling figure of reflex klystrons operating across the frequency band of RG50/U waveguide supporting a  $TE_{10}$  mode of transmission. The length of waveguide is 15 feet from reference point (probe) of klystron to midpoint of load plunger travel. For purposes of standardization and interchange of oscillator tube samples this dimension has been adopted by several laboratories.

The calibration graph is shown in Fig. 6. Any other installation in this frequency band would have a calibration graph closely duplicating this one, provided the length of waveguide and the impedance match of the attenuator is the same. The attenuator shown has its dial calibrated directly in decibels. A more perfectly matched attenuator would be better for this purpose.

The range ordinarily found useful is from 3 to 10 db, this range being small enough that a reasonable broadband impedance match may be obtained. These values allow testing a range of pulling figure from 1 to 14 mc, using vswr's from 1.2 to 2.5. The vswr's in this range are easily measured and cause distinct discontinuities in the klystron characteristics. Values beyond 15 mc pulling figure are not calibrated in this usage and are recorded as 15 plus.

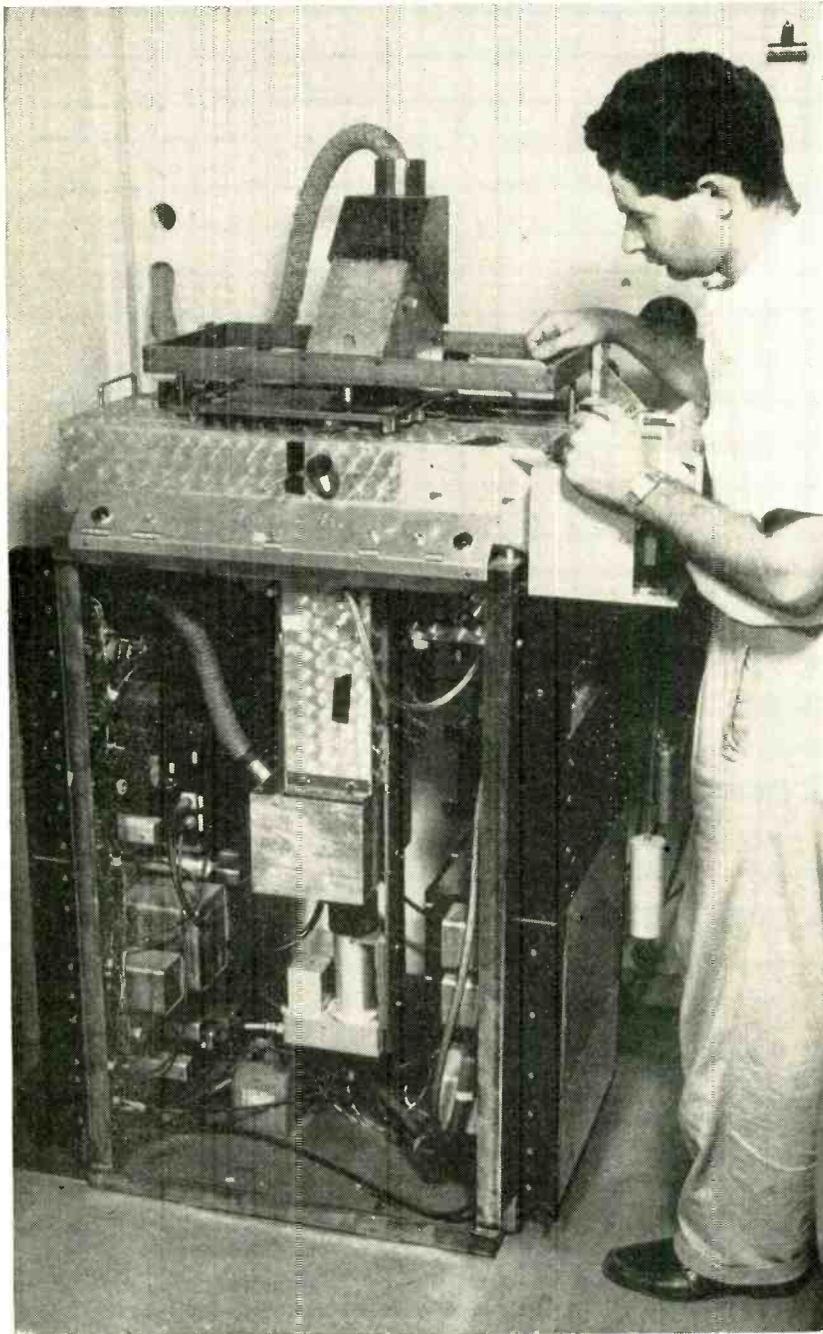
The authors wish to acknowledge and thank Richard E. Wells for his contributions to the development of this equipment.

### REFERENCES

- (1) G. B. Collins, "Microwave Magnetrons", MIT Rad. Lab. Series, Vol. 6, McGraw-Hill Book Co., N. Y., 1948.
- (2) J. Cohn, Operating Klystrons In Microwave Links, *ELECTRONICS*, June 1952.
- (3) J. Cohn, Long Line Effect On Klystron Oscillators, *Proc NEC*, 1951.
- (4) D. R. Hamilton, "Klystrons And Microwave Triodes", MIT Rad. Lab. Series, Vol. 7, p 415, McGraw-Hill Book Co., N. Y., 1948.
- (5) W. M. Hall, Long Line Effect With Pulsed and F-M Modulated Magnetrons, *Proc NEC*, 9, p 610, 1953.

# Microphotometer Scans

Intensity variations of light that produced spectrogram are automatically plotted in absolute values by comparing densities on spectrogram with those on a standard. Output may be recorded photographically or on an electronic pen recorder



Microphotometer undergoing adjustment. Light from lamphouse at top of unit is brought down through microscope objective onto subject spectrogram, which lies on horizontal carriage. Carriage housing contains rotating mirrors and optics

**A** RECENTLY CONSTRUCTED microphotometer scans the photograph of a line spectrum and records the intensity of the light that produced the spectrogram. It differs from typical microphotometers in that the latter record the photographic density on the spectrograms. Line profiles can be plotted from their readings only after a point-by-point comparison of microphotometer tracings with photographic characteristic curves for the spectrogram.

The microphotometer to be described automatically considers the characteristic curve at each wavelength by comparing the densities on the subject spectrogram with those on a standardizing spectrogram. In this regard it resembles the Williams-Hiltner microphotometer. It differs in a number of important features, however, which make it potentially a much faster instrument. These differences also eliminate the tendency of the Williams-Hiltner microphotometer to oscillate when hunting for a null position and the introduction of plateaus into line profiles owing to pinhole or dust streaks in the standardizing spectra.

## *Principles of Operation*

The high-speed comparison of the two spectrograms is effected by a rapidly rotating mirror, which sweeps the standardizing spectrum, and by a Kerr cell driven at a radio frequency, which permits light alternately from the standardizing spectrogram and from the subject spectrogram to strike a multiplier phototube.

Figure 1 shows a section of a typical spectrogram to be analyzed and its corresponding standardiz-

# Spectrum Photographs

By D. E. BILLINGS, R. H. COOPER, J. W. EVANS and R. H. LEE

Harvard University and University of Colorado  
High Altitude Observatory  
Boulder, Colorado

ing spectrogram. The two spectra have been photographed in the same spectrograph. The standardizing spectrum is that of an incandescent source, photographed when a wedge of continuously varying density was placed over the collimator slit.

The spectrograms are mounted side by side on the movable carriage of the microphotometer as shown in Fig. 2 so that corresponding wavelengths on the two spectrograms are illuminated by the microphotometer lamp.

As mirror *M* rotates, rectangle *R* in Fig. 1 sweeps across the film in direction *X*, as indicated in Fig. 2. The subsequent optical and electronic system responds at the instant when the light beams passing through *R* and rectangle *B* in Fig. 1 are of equal intensity and records the distance *X* of *R* from the edge of the film. As the carriage moves, carrying the two spectrograms in the direction of dispersion (*Y* of Fig. 2), the succession of values of *X* gives the locus of points on the standard spectrogram that have the same density as the points *B* of corresponding wavelength on the spectrogram being analyzed.

In Fig. 2, the various light beams are indicated by dotted lines, while the optics that direct these beams are for the most part omitted.

Beam *S<sub>1</sub>B* illuminates a narrow rectangular portion *B* of the unknown spectrogram. In normal operation the carriage moves, carrying the two films parallel to the dispersion of the spectrogram. Thus the intensity of beam *BC* is varied by the variations in density of the spectrogram with wavelength.

Beam *S<sub>2</sub>A* illuminates strip *A* of the standard spectrogram at the same wavelength as *B* on the un-

known spectrogram. The illuminated strip *A* extends the full width of the standard spectrogram, as shown in Fig. 1. The concave mirror *D* throws an image of *R*, a small portion of *A*, upon the slit *P*. The distance of *R* from the edge of the spectrogram is determined by the position of the rotating eight-sided mirror *M*. Thus as *M* rotates, the standard spectrogram is scanned normal to dispersion.

Beams *AC* and *BC* are united as they emerge from the calcite *C*. The former is the ordinary ray in the calcite and the latter the extraordinary ray so that the two will be plane-polarized at 90 degrees to each other.

Behind the calcite is a unit consisting of a quarter-wave plate, a solid Kerr cell to which an r-f voltage is applied and a Polaroid filter. The optical axes of the quarter-wave plate, Kerr cell and Polaroid are so oriented that the unit transmits the ordinary ray from the calcite when the voltage on the Kerr cell is of one polarity and the extraordinary ray when the voltage

polarity is reversed. Consequently the output of the multiplier phototube has an alternating component except when the density of the portion of *A* being scanned is equal to the density at *B*. This alternating component changes phase as the rotating mirror passes the portion of *A* of density equal to that at *B*.

The alternating component of the multiplier phototube output, after amplification, is transmitted to a phase-sensitive detector. The output voltage of the detector changes polarity abruptly as the input signal changes phase at the instant the densities at *R* and *A* are equal.

## Recording

An electronic pen recorder coupled directly to the phase-sensitive detector records intensity as a function of wavelength. The deflection of the recorder is essentially proportional to the time interval between the null instant and the passage of the mirror sweep off the standardizing film.

Because of the geometry of the rotating mirror system, this deflec-

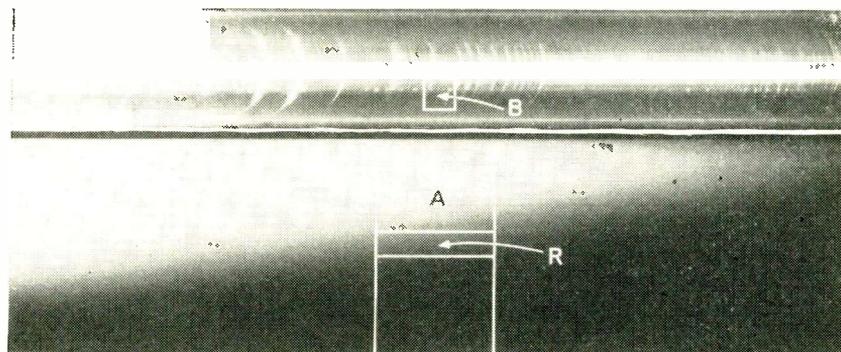


FIG. 1—Section of spectrogram under analysis (above) and its associated standardizing spectrogram. Small rectangle *B* is scanning slit and large rectangle *A* is portion of spectrogram being illuminated from microphotometer lamp. Rectangle *R* is portion of *A* that is being scanned at a particular instant by rotating mirror. The test section is from an ultraviolet flash spectrogram of the solar chromosphere taken during the total solar eclipse at Khartoum, Sudan on Feb. 25, 1952

tion is not strictly a linear function of  $X$ . Also, the deflection is somewhat dependent on the density of the film as well as the position of null on the standard film. These two difficulties are overcome by a calibration based on tracings along the direction of dispersion of a second standardizing film identical to the one in the standardizing spectrogram position.

Operation of the microphotometer with an electronic pen recorder has the advantage that the operator can observe line profiles as they are traced.

To utilize the intrinsic speed of microphotometer an alternative photographic recording system has been devised. This system has been operated for preliminary tests; a brighter source of light is needed, as described below, to make it fully successful. Operation of the photographic recording system is likewise shown in Fig. 2.

The phase-sensitive detector operates a pulse generator at the in-

stant the two densities are equal. The pulse generator applies a high voltage pulse to Kerr cell  $K$ , which, lying between two crossed Polaroids  $P_1$  and  $P_2$ , operates as an electro-optical shutter. Thus, at the moment the densities are equal, a light pulse passes from source  $S_2$  to the rotating mirror  $M'$ , which is on the same shaft as  $M$ . The position of  $M'$  determines the position of the pulse on the recording film. By making optical system  $M'D'P'$  a duplicate of  $MDP$ , nonlinearities between scan and record are eliminated.

Because the angular aperture of the recording optical system is limited by the Kerr cell and the size of a rotating mirror face and also because of the short time in which a recorded dot must register on the film, a bright light source,  $S_2$ , must be used. From preliminary tests of the photographic recording system, it was concluded that a source of approximately five times the brightness of a two-watt zir-

conium arc is necessary to attain the proper brightness.

### Circuits

The electronic system determines the instant at which two beams of light are equal and converts this information to a form suitable for operating either of the two forms of recorders. The two beams are sampled at a rate of 804 kc by the light-modulating action of the Kerr-cell electro-optical shutter. The Kerr cell is driven by the oscillator and power amplifier shown in Fig. 3. The circuit is conventional except for the 5687 clamp tube that provides a gradual increase in the voltage applied to the Kerr cell. The delay of several seconds between the switching on of the oscillator and the application of full voltage (2,200 volts rms) protects the cell from thermal shock.

The light modulated at the 804-kc rate falls on a 5819 multiplier phototube (Fig. 4), which is connected so the dynode voltage de-

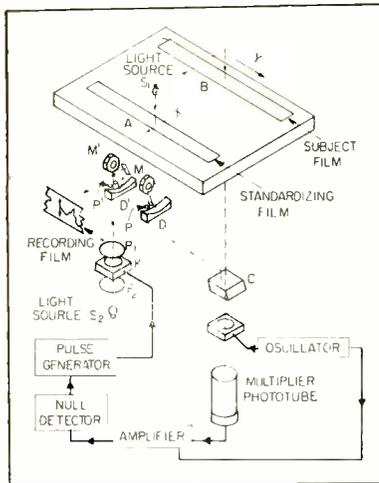


FIG. 2—Simplified circuit diagram of microphotometer

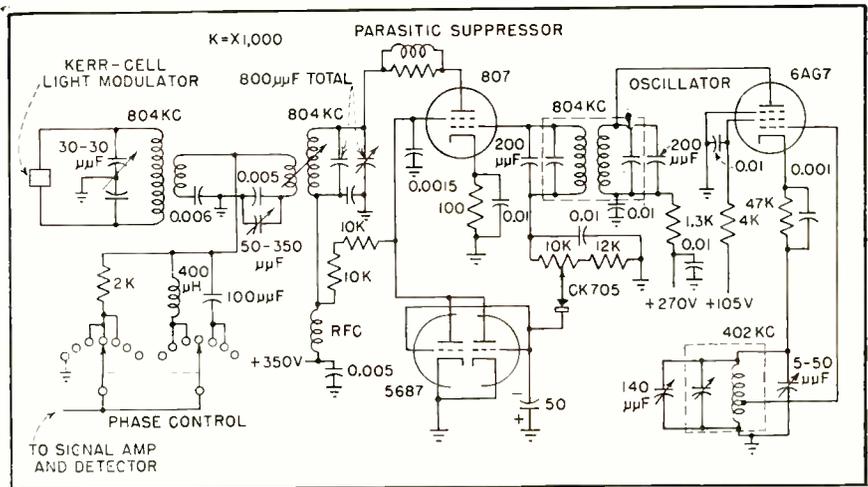


FIG. 3—Output of 6AG7 oscillator-doubler tube is transformer-coupled to 807 class-C amplifier that drives Kerr-cell light modulator

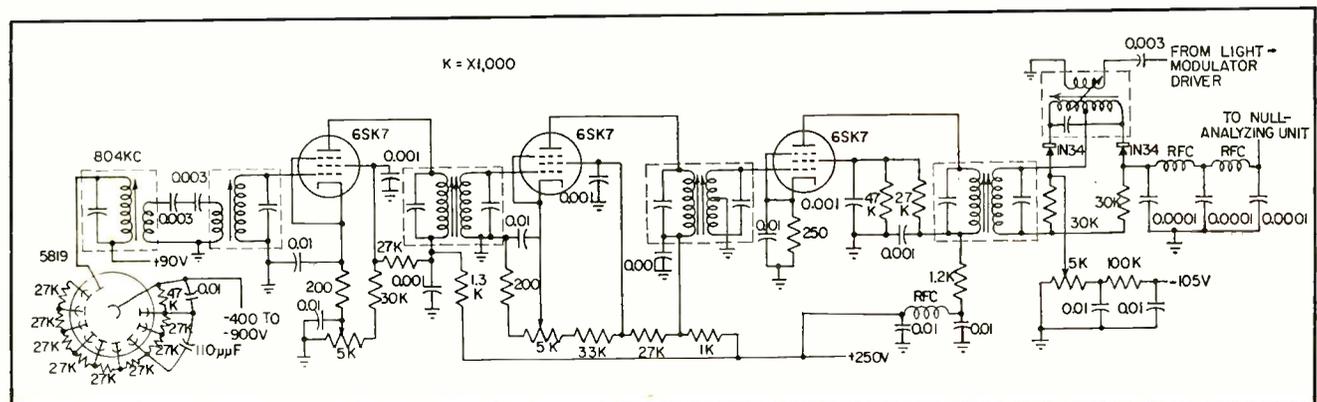


FIG. 4—Signal from multiplier phototube is amplified by 804-kc signal amplifier and fed to twin-1N34 phase detector

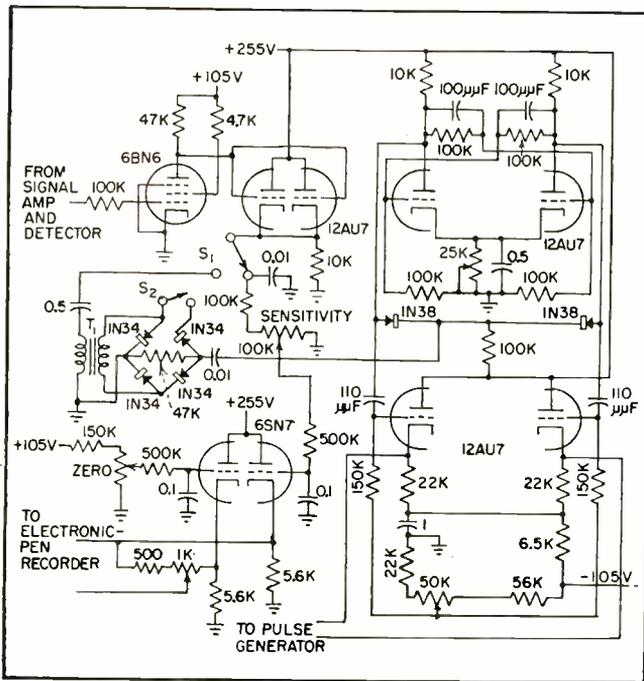


FIG. 5—Null-analyzing unit has clipper, flip-flop multivibrator and cathode follower circuits. Flip-flop stage routes pulses to alternate thyatron channels in pulse generator

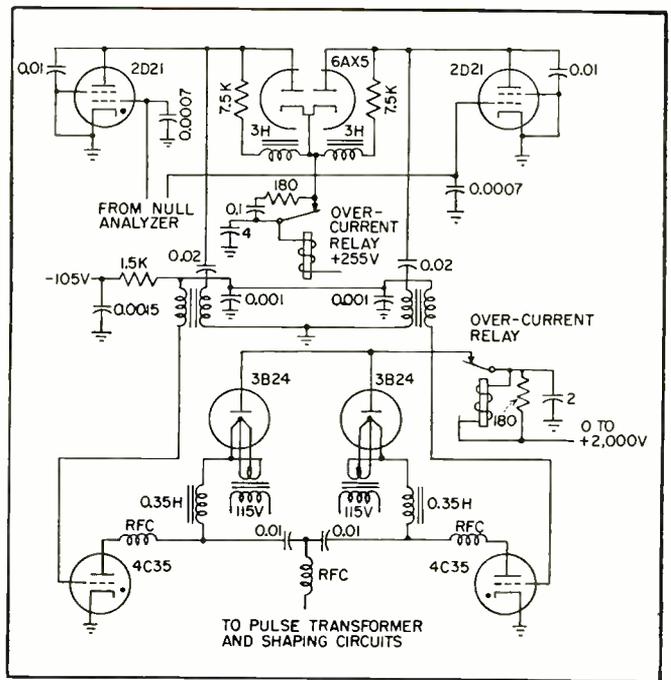


FIG. 6—Each of high-level pulse generators employs 2D21 thyatron to trigger 4C35 thyatrons. Both sides of system discharge through same transformer

creases with increasing light intensity, after a certain intensity is reached, thereby protecting the tube when no density is present in either of the optical systems.

The anode load for the 5819 is a resonant circuit with a low-impedance output for coupling through coaxial cable to the 804-kc signal amplifier. This amplifier is similar to a conventional three-stage i-f amplifier, except that its output is coupled to a phase-sensitive detector. The detector takes its reference voltage from the same source that drives the original light modulator, so the output of the detector is proportional to the light beam unbalance and the sign of the output indicates the direction of the error. This relation holds true only for a limited range on either side of the null, since the amplifier and detector saturate at large signal levels. The resulting difference in potential between the two rectifier cathodes, biased to a suitable value, is passed to the null analyzing circuit shown Fig. 5.

### Null Analyzer

The 6BN6 gated-beam tube in Fig. 5, changes abruptly from non-conducting to conducting when the voltage of the control grid passes through a critical value. By proper bias of the d-c signal from the

detector, the tube changes from nonconducting to conducting when the a-c component of the multiplier-phototube current changes phase. Hence, if the rotating mirror is sweeping the standard film from dark to transparent side, the tube becomes conducting at the moment the density of the swept portion of the standardizing film becomes equal to that of the subject film and remains conducting until the mirror sweeps off the standardizing film. The width of the resulting pulse is therefore a direct measurement of the intensity of the light causing the density on the subject film.

For electronic pen recording the d-c output of the 12AU7 cathode-follower is averaged by an R-C circuit, then supplied to the recorder by the 6SN7 differential cathode-follower.

Most of the circuits shown in Fig. 5 as well as the circuits of Fig. 6 and 7 are used in the high-speed photographic recording system.

When  $S_1$  is thrown in the left position, the square wave output of the 12AU7 cathode-follower is differentiated by the primary of  $T_1$  and its coupling capacitor so that positive pulses are generated in the primary winding corresponding to an increase in voltage at the

cathode-follower output and negative pulses, corresponding to a decrease.

### Densitometer Operation

For normal operation as a densitometer, switch  $S_2$  is left open and the 1N34 diodes are connected to  $T_1$  in such a manner that only the pulses corresponding to negative pulses in the primary appear at the output, where they are still negative. These nulls are recorded only when the density being scanned by the rotating mirror is changing in one sense. Accordingly, all true nulls, but only half of the false nulls (caused by noise) are recorded.

These negative pulses control the bistable 12AU7 multivibrator causing it to change its state each time a negative pulse is received. The multivibrator routes pulses alternately through the 4C35 thyatron channels in the pulse generator (Fig. 6), to get pulses closer together in time than would otherwise be possible. The deionization time of the thyatrons and the charging time of the pulse capacitors are the limiting factors.

The output of each side of the bistable multivibrator is differentiated and passed through the 12AU7 cathode-follower to the 2D21 thyatrons in Fig. 6. These thyatrons

act as pulse amplifiers to provide a pulse of sufficient amplitude to trigger the 4C35 thyatrons.

The over-current relays associated with the pulse capacitor-charging circuits are necessary because certain signal and noise combinations can cause any of the thyatrons to go into continuous conduction. If this happens, the average current through the relay increases and the B+ supply is opened momentarily, permitting the thyatron to deionize.

At the output of the 4C35 thyatrons, the alternate pulse channels are recombined by permitting both tubes to discharge their associated capacitors through the same pulse transformer.

### Gating Pulses

The secondary of the pulse transformer (Fig. 7) applies a 15-kilovolt pulse to a second Kerr-cell electro-optical shutter operating as a conventional shutter and admitting a pulse of light to the same rotating system that caused the null. The position at which the light falls upon the recording camera film is therefore determined by the angular position of the rotating mirror at the time the two light beams become equal.

The 300-kva pulse transformer used was more than adequate for this application since it has a short rise time and pulse duration. Therefore a 1-mh choke and a 500- $\mu$ f capacitor were added in series with the secondary winding of the transformer to increase the pulse duration and to remove the steep wave-front before it is applied to the electro-optical shutter. It was necessary to increase the pulse duration to admit enough light to the recording film and to reduce heating in the electro-optical shutter by reducing the peak current.

The 705A and 3B24 diodes remove the positive overshoot on the pulse, so that the pulse applied to the electro-optical shutter approximates a negative half-cycle of a sine wave with a duration of about 5 microseconds and a peak amplitude up to 15 kv. The capacitor voltage divider and test point provide a means of observing the pulse on an oscillograph.

When the instrument is to be

used as an isophotometer,  $S_2$  in Fig. 5 is closed, permitting a negative pulse to be sent to the bistable multivibrator in Fig. 6 each time the phase-sensitive detector passes through a null, regardless of direction.

Since the frequencies involved in this instrument are in a range where radio interference could result if r-f leakage were permitted, fairly elaborate filtering and shielding are necessary. Stray pickup within the instrument is greatly reduced by the same precaution.

### Isophotometer Use

The High Altitude Observatory microphotometer, is designed to have an alternative use as an isophotometer. When used as an isophotometer the photograph to be analyzed is scanned by the rotating mirror. Thus it is placed in the

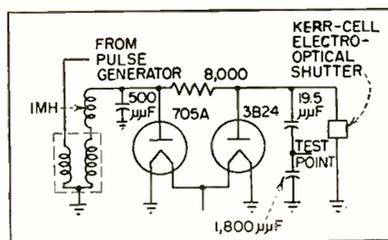


FIG. 7—Secondary of pulse transformer applies 15-kv pulse to Kerr-cell electro-optical shutter

position on the carriage that is occupied during microphotometry by the standardizing spectrum. A step on a comparison wedge (which does not move with the carriage) replaces the subject spectrum between the microscope objectives. Thus the phase-sensitive detector responds whenever the rotating mirror scan crosses the same density on the photograph as that between the microscope objectives.

If the photographic recording system is being used, a succession of exposed points on the recording film identify an isophotal contour. This method of tracing isophotes has two distinct advantages; the complete contour is traced in a single scan and if the contour runs off the film, the instrument automatically picks it up again at the appropriate point rather than hunting and perhaps finding a different contour. The pen recording system does not give an isophotal contour.

However, the area under the curve which it traces is proportional to the area within the contour.

### Application

The microphotometer, using Esterline Angus recording, has been in operation for about six months. Its most extensive use during that time has been in the analysis of the Balmer and Paschen lines and the Balmer continuum in the flash spectra of the solar chromosphere, taken at Khartoum during the solar eclipse of February 25, 1952. Since these lines occupy a rather limited portion of the spectrograms, the speed of the electrical recorder has been adequate for their analysis. It is anticipated, however, that if it is attempted to catalog the intensities, in energy units, of all the several thousand lines appearing on the eclipse plates, it will be necessary to bring the photographic recording into use.

The microphotometer is also being used for standardization of the line intensity readings of the coronal spectrograms which are taken daily at Climax, Colorado. During the several months of rather intensive use, the instrument has demonstrated a high degree of stability and has required negligible servicing by the operator.

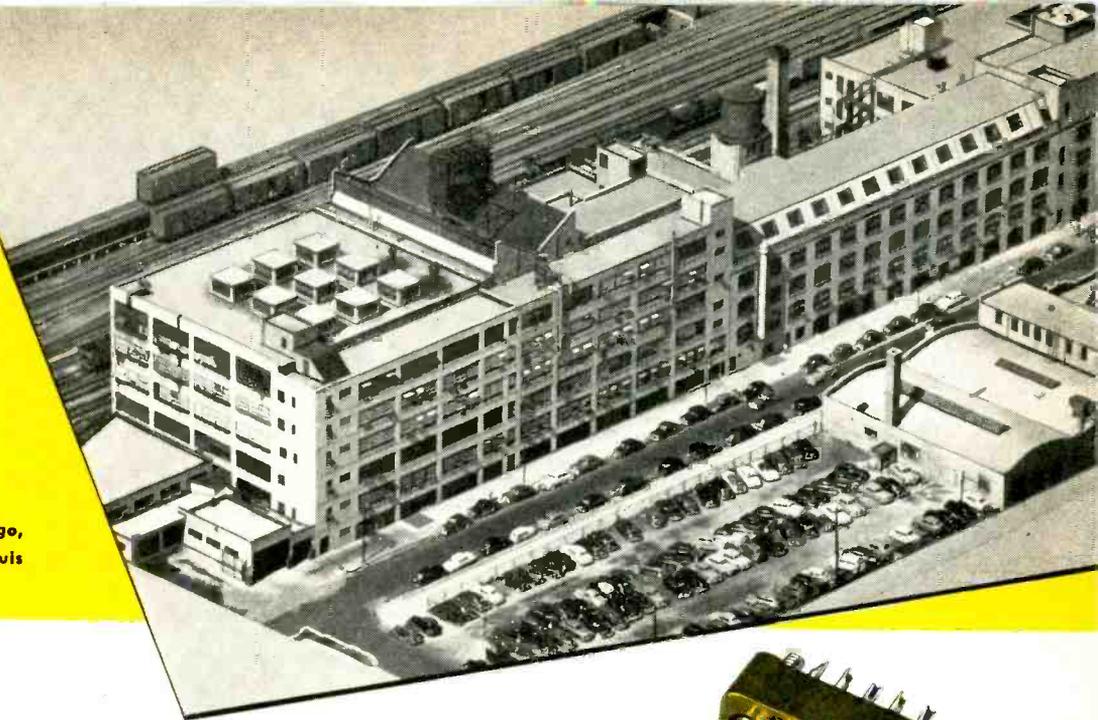
As the instrument now operates, the rotating mirror turns at 400 scans per second and the comparison Kerr cell is driven at 800 kc. The carriage speeds are 0.015, 0.068, 0.13 and 1 mm per sec. The three lower speeds are used with the electronic-pen recorder, the choice of speed depending on the gradient of the line profiles. The 1 mm per sec carriage speed is primarily for use with the photographic recorder.

The authors thank the Naval Research Laboratory and the Office of Naval Research for their support of the design and construction of this instrument. Thanks are also due to W. O. Roberts for assistance in the design of the microphotometer and to the Mount Sopris Instrument Co. for aid in many phases of its development.

### BIBLIOGRAPHY

R. C. Williams and W. O. Hiltner, Publications of the University of Michigan, 8, p 45, 1940.

Centrally located plants at Chicago,  
Shelbyville, Indiana and St. Louis



# CINCH PRODUCES LOW LOSS MICA COMPONENTS IN QUANTITY.. ...QUICKLY



Miniaturized  
Micro Connectors that save space, weigh  
less and are more efficient . . . 14,  
21, 34 and 50 contacts avail-  
able in low loss material  
for chassis mounting  
applications.

Cinch components available  
at leading electronic jobbers  
—everywhere

Adequate and unequalled  
facilities have advanced CINCH to  
the foremost producer of low loss  
Mica components in production  
quantity.



**Cinch**  
ELECTRONIC  
COMPONENTS

**CONSULT CINCH!**  
**CINCH MANUFACTURING CORPORATION**

1026 South Homan Ave., Chicago 24, Illinois

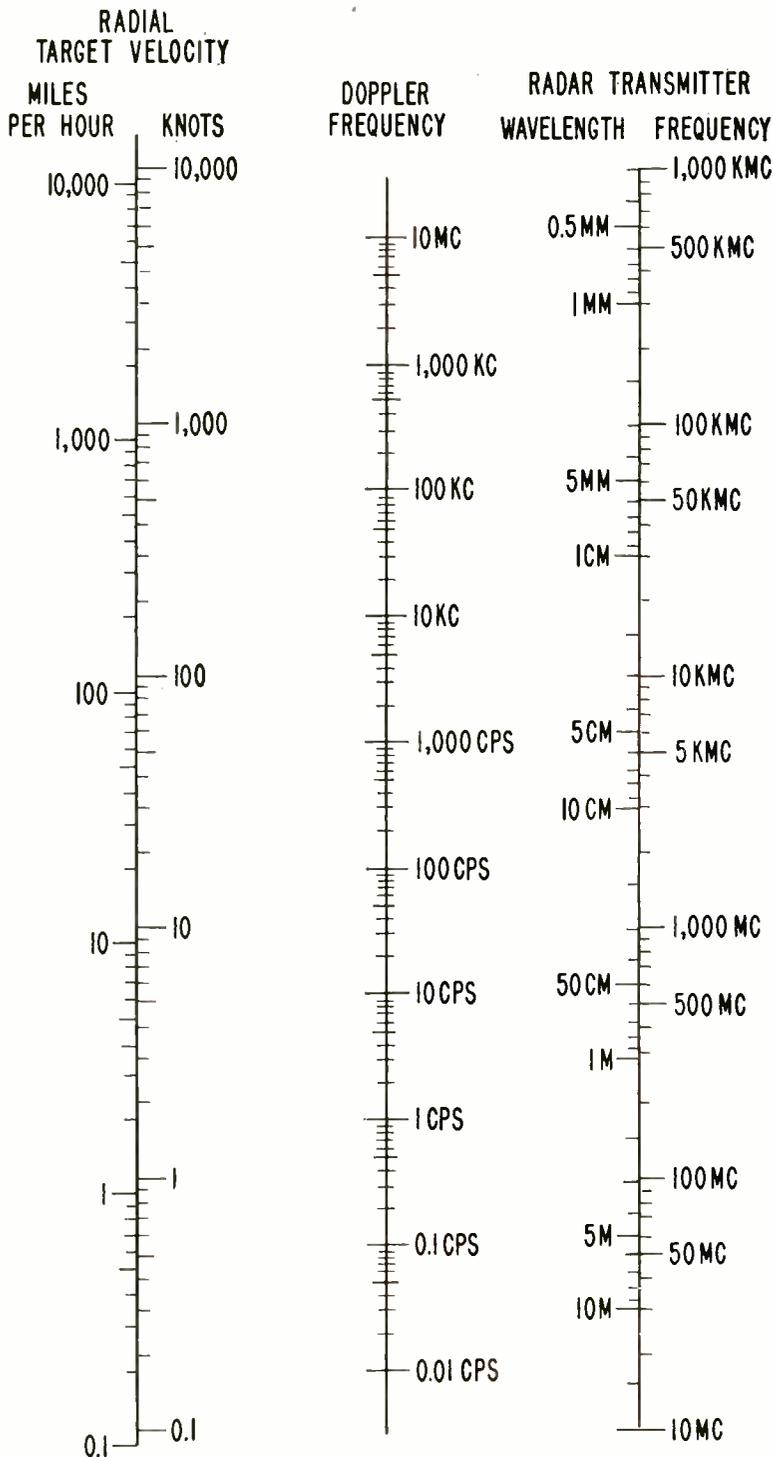
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass

# Radar Doppler Nomograph

Relates Doppler frequency, radar transmitter frequency or wavelength and radial velocity of target in miles per hour or knots, as aid in design of c-w or coherent pulsed radars capable of separating moving targets and suppressing clutter

By ALLEN H. SCHOOLEY

Naval Research Laboratory  
Washington, D. C.



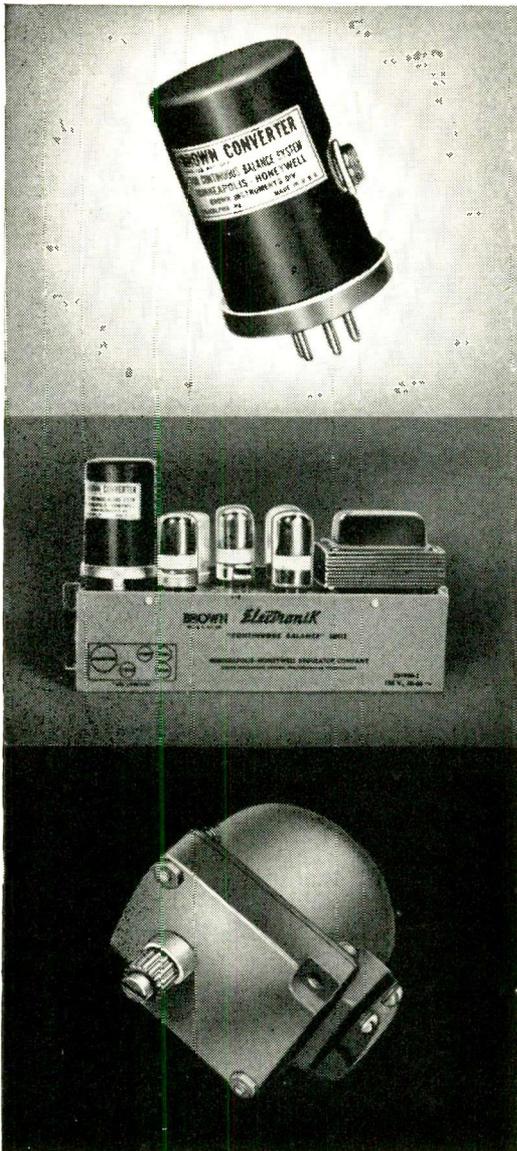
**R**ADAR targets having a radial velocity component, either toward or away from the radar, give a returned signal frequency that is higher or lower respectively than that of the transmitted signal. This difference or Doppler frequency is important to designers and users of radars.

To make practical use of Doppler information, it is convenient to refer to the adjacent nomograph which is based on the relationship  $f_d = 2|V|f_t/c$ , where  $f_d$  is the Doppler frequency in cps,  $|V|$  is the absolute value of the radial component of target velocity relative to the radar in miles per hour,  $f_t$  is the transmitted frequency in cps and  $c$  is equal to  $6.7 \times 10^8$  miles per hour, which is the speed of electromagnetic wave propagation.

A straightedge laid across the nomograph gives the Doppler frequency for any radar frequency from 10 mc to 1,000 kmc.

As an example, determine the Doppler frequency of a target traveling 100 knots directly towards (or away from) a 10-centimeter radar. Starting at the 100-knot point on the left scale of the nomograph, draw a straight line to the 10-centimeter point on the right scale. Read 1,000 cps at the point where the line crosses the center scale. Similarly, a 1,000-knot radial velocity target would produce a 10-kc Doppler signal.

# Build performance into servo systems — with Honeywell Components



## ● converters

Compact, durable; proved by years of service in *ElectroniK* recorders. Convert low power d-c signals to alternating voltages for nominal frequencies of 25, 40, 60 or 400 cycles, as specified. Useful for null detection or error voltage measurement. Refinements in design give low phase angle lag and extremely long life. Ask for Data Sheets 10.21-1 and 10.20-5.

## ● amplifiers

For use with converter and balancing motor, for null detection and error signal correction. See Data Sheets 10.20-3b and 10.20-4.

Amplifier No.	Input Impedance (ohms)	Sensitivity* (volts)	Overall Voltage Gain
357504-20	80,000	$3 \times 10^{-6}$	$1 \times 10^6$
357504-21	80,000	$1 \times 10^{-6}$	$3 \times 10^6$
357504-5	400	$4 \times 10^{-6}$	$1 \times 10^6$
356899	2,200	$.05 \times 10^{-6}$	$40 \times 10^6$

\*Approximate sensitivity, when used with motors listed below.

## ● balancing motors: 2-phase induction, reversing

Totally enclosed, self lubricated. High torque at low speeds. See Data Sheet No. 10.20-2c.

Ratings for 115 volt, 60 cycle operation†				
Shaft Speed, rpm	27	54	162	333
Maximum Torque, inch-ounces	85	43	19	11
Intermittent Rated Torque, inch-ounces	30	15	5	4
Maximum Power, inch-ounces per minute	5850 at 14-16 rpm	5800 at 30-32 rpm	7550 at 92 rpm	8750 at 190 rpm
Power Required, all speeds	Line Field, 11 watts Amplifier Field, 2.5 watts			

†Motors for 25 and 40 cycle service are also available. Above motors may be used on 50 cycles.

THESE precision-built components, used in *ElectroniK* recorders, are available as separate units or as complete systems for experimental servo circuits. Your inquiry is invited.

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.



MINNEAPOLIS  
**Honeywell**  
BROWN INSTRUMENTS

*First in Controls*

# ELECTRONS AT WORK

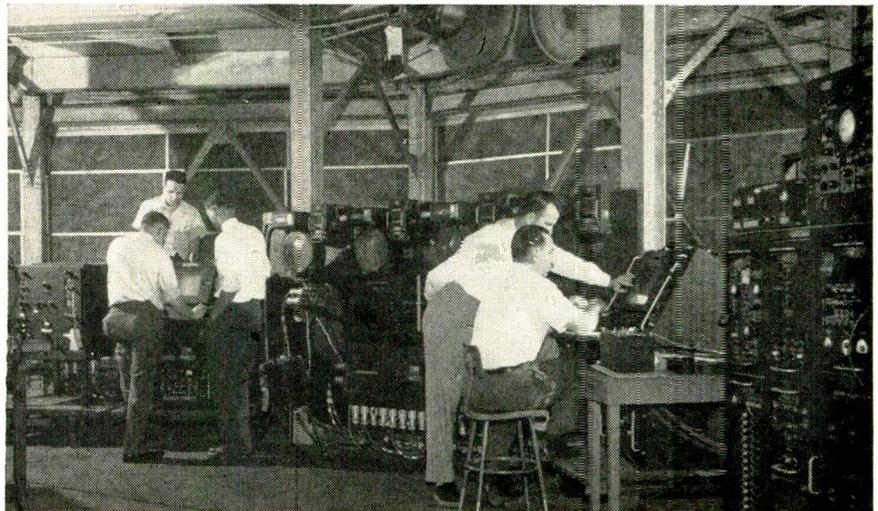
Edited by ALEXANDER A. McKENZIE

## OTHER DEPARTMENTS

featured in this issue:

	Page
Production Techniques	228
New Products	264
Plants and People	310
New Books	360
Backtalk	372

Radar Height Finder Fills Balloon.....	182	Low-Frequency Phase-Shift Modulator..	198
Transistor Audio Source.....	182	Continuous Phase Shifter.....	202
Solar Battery Improved.....	184	Mechanical Register Amplifier.....	206
Ionization Transducer Micrometer.....	184	Selective A-F Transistor Amplifier....	208
Inside Speech Clipper.....	186	Simple Remote Control.....	210
Transistors Use Emitter-Coupled Feed- back .....	188	Rocket Probe .....	212
Thyratron Peak Voltmeter.....	192	Pertinent Patents.....	212



## Radar Height Finder Fills Balloon

New Air Force height-finder built by GE has three times the range of previous equipments. It is adapted to Arctic climates by dome-shaped covering made of woven-glass fabric impregnated with a rubber compound. The balloon-like radome (left) is supported by about a half pound per square inch air pressure and can withstand winds up to 125 miles an hour. Entrance to the radome is through an air lock. Radar data from height and search radars is fed to control center (right) from whence it is relayed to fighter bases. Fluorescent tubes a hundred feet away can be lighted from the radio energy

## Transistor Audio Source

AUDIO OSCILLATOR producing 2 volts across 600 ohms at frequencies of either 400 or 1,000 cycles is said to be the first commercial test equipment to use a transistor. It is manufactured by General Radio Co.

Designed as a self-contained audio calibration device, the oscillator uses a *mpn* junction transistor in a Hartley circuit. The inductor is an iron-core coil with an air gap. The coil is divided to obtain proper d-c operating voltages for the transistor, but a large bypass capacitor connects the sections in series for audio currents. The tuning capaci-

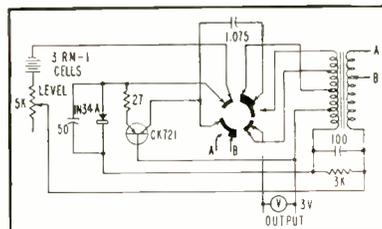
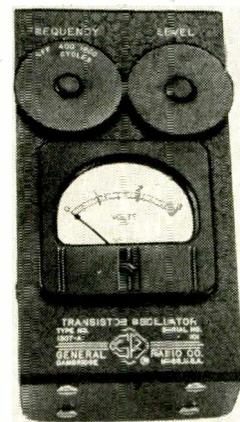


FIG. 1—Circuit diagram shows output winding coupled to inductor

tor is connected across the full coil for 400-cycle operation. It is switched across only a part for operation at 1,000 cycles.

In the circuit, the emitter of the transistor corresponds to the cathode of a vacuum tube; the base, to the grid; and the collector, to the



Commercial transistor oscillator produces two audio frequencies

EVERY ELECTRONICS ENGINEER HAS DESIGNED COILS TO UTILIZE  
**MOLDITE CORE "STANDARDS"**

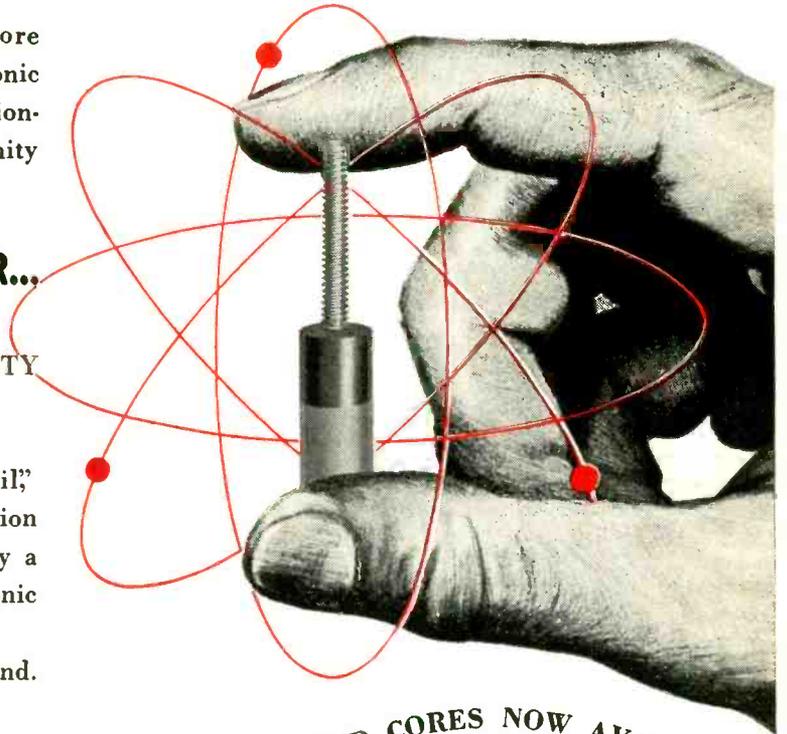
Consistently dependable, Moldite core "Standards" are in demand wherever electronic engineering requires the finest in precision-manufactured cores with absolute uniformity from first to last.

**MOLDITE CORE "STANDARDS" OFFER...**

- |              |                    |
|--------------|--------------------|
| ECONOMY      | HIGH QUALITY       |
| AVAILABILITY | INTERCHANGEABILITY |
| UNIFORMITY   | FLEXIBILITY        |

"The right Moldite core for the right coil;" is a byword at National Moldite whose precision production facilities have given the industry a superlative core or coil form for every electronic application.

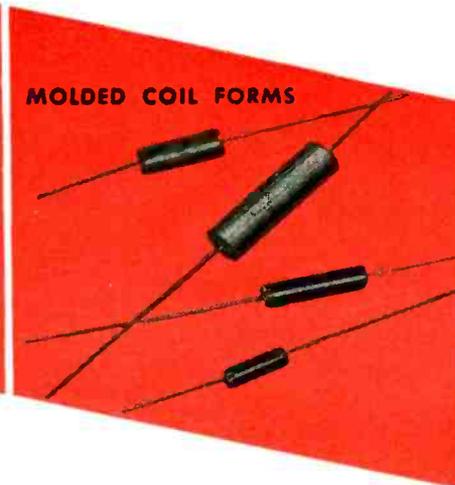
Design with Moldite Core Standards in Mind.



COMPLETE LINE OF MOLDITE ECONOMY-ENGINEERED CORES NOW AVAILABLE



**FERRICORES**



**MOLDED COIL FORMS**



**MAGNETIC IRON CORES**

- FERRITE CORES
- MOLDED COIL FORMS (iron and phenolic)
- MAGNETIC IRON CORES
- FILTER CORES
- THREADED CORES
- SLEEVE CORES
- CUP CORES



Send for our new Catalog #120

THE MOST COMPLETE LINE OF  
 CORES IN THE INDUSTRY!



**NATIONAL  
 MOLDITE  
 COMPANY**  
 1410 CHESTNUT AVE., HILLSIDE 5, N. J.

Robert T. Murray  
 614 Central Avenue  
 East Orange, N. J.

Jerry Golten Co.  
 2750 W. North Ave.  
 Chicago 22, Ill.

Arnold Andrews  
 521 Cumberland Ave.  
 Syracuse, N. Y.

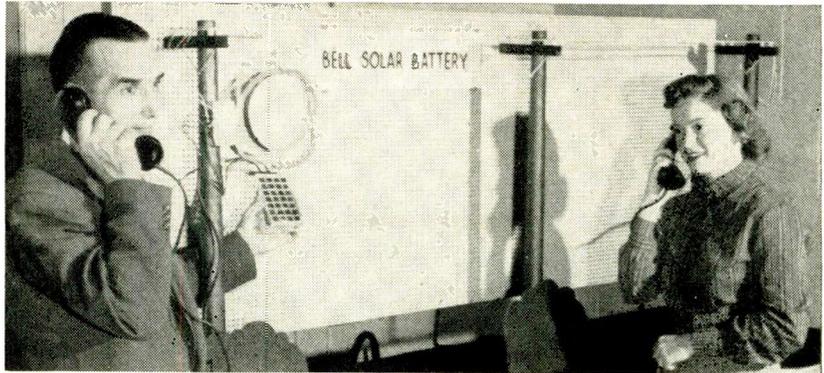
Perlmuth-Coleman & Assoc.  
 1335 South Flower  
 Los Angeles, Cal.

Jose Luis Ponte  
 Cardoba 1472  
 Buenos Aires

plate. The main tuned circuit for 400-cycle operation is connected between base and collector and the emitter is connected to the coil at a point between those two elements.

A germanium diode sets bias voltage for the base. Operating characteristics of the diode approximate those of the emitter-base junction of the transistor so oscillations will start for a wider range of temperature, battery voltage and transistors than would be possible with a linear resistor in the bias circuit.

The rectifier-type voltmeter is used to indicate output voltage.



Gerald L. Pearson, a coinventor of the Bell solar battery holds the new version of the silicon device with which eight percent efficiency has been obtained

## Solar Battery Improved

SOLAR BATTERIES operating at an efficiency of six percent were demonstrated at Bell Telephone Laboratories (ELECTRONICS, p 196, June 1954). More recently an increase in efficiency of a third was announced. Experimental cells now yield a record eight-percent efficiency, comparable to that of steam and gasoline engines.

While goals of 10 to 15 percent are yet to be attained, the value of eight percent is ten to fifteen times better than the efficiencies of the best photovoltaic devices available. Maximum theoretical efficiency is estimated at 22 percent.

Factors limiting the efficiency in-

clude losses of radiant energy by reflection from the silicon surface as well as those within the cell itself.

Technique for production of experimental silicon *p-n* junction devices is controlled introduction of a foreign element into a microscopic layer near the surface of a thin slice of arsenic-doped silicon.

Treatment under gas at high temperatures permits the introduction of minute traces of impurities into the atomic structure at the surface. Introduced at a precise rate and under carefully controlled conditions, the impurities reach a depth less than ten-thousandth inch.

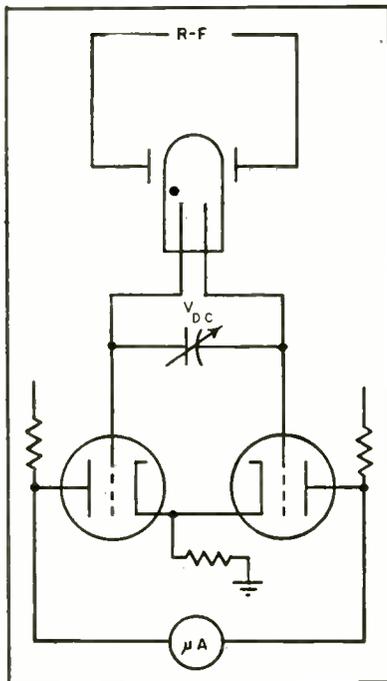
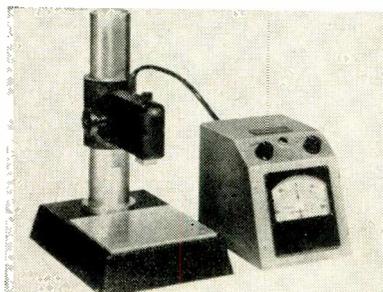


FIG. 1—Simplified circuit of the comparator micrometer using the gas-tube transducer

## Ionization Transducer Micrometer

DISPLACEMENT from 0.000001 to 0.0002 inch using a new capacitance principle can be measured in a newly developed comparator micrometer. Full-scale deflection of its indicating meter registers plus or minus 20 microinches.

Conversion of capacitance variation to electrical signal is accomplished through a new type of transducer element using the circuit shown in Fig. 1. The ionization



Commercial version of the micrometer giving measurements to a millionth of an inch without physical contact

transducer is a small glass capsule filled with noble gases under reduced pressure and excited by a regulated r-f source. The direct current developed by the transducer is applied to a differential circuit. The indicating microammeter gives 400 microamperes deflection for each volt of input signal.

Basic principle of the transducer element was discovered by Kurt S. Lion, now associate professor of Biophysics at Massachusetts Institute of Technology, Cambridge, Mass. He exposed a gas-discharge vessel containing two electrodes to a radio-frequency electric field existing between the plates of a capacitor. It was found that a relatively high direct voltage resulted between the two electrodes. Magnitude of the voltage varied between minus 60 and plus 60 volts as a function of the position of the vessel in the electric field. Symmetry in the vicinity of the electrodes leads to zero output voltage, while any slight asymmetry, owing to an unbalanced field or other cause, produces output voltage.

Systems have been built whereby



## how to stop an h-blast

**WANTED:** a camera to stop the action of a nuclear explosion at a pre-selected microsecond, with high quality image-definition . . . that was the problem handed by the AEC and its Los Alamos Scientific Laboratory to the Boston firm of Edgerton, Germeshausen & Grier, Inc. EG&G solved it by inventing the non-mechanical Rapatronic shutter . . . employing the Faraday Effect of magnetically rotating the plane of polarized light as it traverses an optical element . . . and relying on HELIPOT\* precision potentiometers and DUODIAL\* turns-counting dials for sensitivity setting and calibration.

A light-pulse from the blast falls on a photocell . . . generates a signal that passes through a variable time-delay to trigger a condenser-discharge circuit . . . releasing energy which surges through a coil wound around a lead-glass lens. The resulting magnetic field rotates polarized light from the blast as it passes through the lens . . . effecting a one-microsecond exposure.

Sensitivity of the photocell circuit is controlled by a standard-linearity Model A 10-turn HELIPOT, calibrated with a Model RB DUODIAL. Time-delay from photocell pick-up to shutter operation . . . continuously variable from 0 to 100 microseconds . . . is controlled by a Model A 10-turn HELIPOT of 0.1% linearity, calibrated with a Model W10 DUODIAL.

The coil of the HELIPOT is wound with more than 10,000 turns of resistance wire . . . the DUODIAL is settable to a

fraction of any of its thousand scale-divisions . . . and the Rapatronic shutter can be tripped at any preselected fraction of a microsecond.

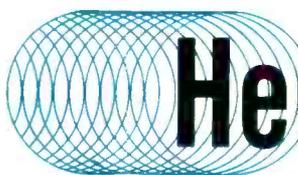
For complete details of this and other HELIPOT applications, write for Data File 1201



MODEL A HELIPOT



W10 DUODIAL



# Helipot

*first in precision potentiometers*

*Helipot Corporation/South Pasadena, California*  
*Engineering representatives in principal cities*  
 a division of BECKMAN INSTRUMENTS, INC.



\* 342  
T.M. REG.

a movement of the discharge tube in the high-frequency field of 1/1,000 mm produces an output voltage of greater than two volts.

## Inside Speech Clipper

By ED. C. MILLER

Inland Broadcast Co.  
Weiser, Idaho

CONVENTIONAL methods of speech clipping use biased diodes to clip off the positive and negative peaks that exceed the bias voltages. Such a circuit is shown in Fig. 1A. The output waveform is very nearly a square wave and as such contains a multitude of harmonics, besides the applied frequency.

A low-pass filter is inserted after the clipper to reduce the undesired high-frequency harmonics that would create unnecessary sidebands or splatter. In this outside type of clipper, the body or inside of the applied signal is passed and the peaks are removed.

Figure 1B illustrates a clipper circuit that takes out the inside of the signal and leaves the outside portions joined to form a con-

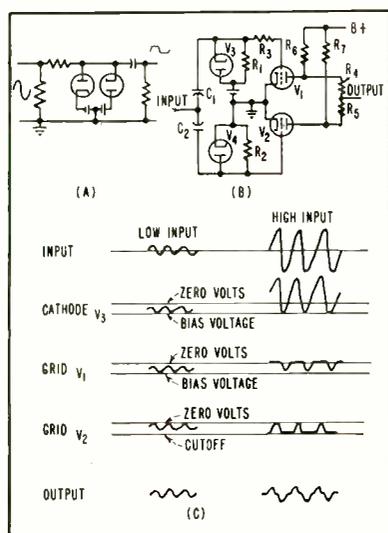


FIG. 1—Clipper circuit (A) removes waveform peaks. Circuit (B) passes positive and negative peaks of wave and rejoins them as shown in (C)

tinuous wave. The diodes are used as clamper tubes and clipping takes place in the triodes, by grid-current limiting in  $V_1$  and by cutoff of  $V_2$ . During the first positive half-cycle of signal,  $R_2$  is shorted to ground by  $V_1$ , causing  $C_2$  to become charged

to the extent of the positive signal voltage.

After the positive crest of the first half-cycle of input is reached and it begins to go in a negative direction,  $V_1$  will no longer conduct. Resistor  $R_2$  is sufficiently large so  $C_2$  will not discharge appreciably during the remainder of the cycle. Signal at the grid of  $V_2$  is the same as the input, except that its positive maximum is zero volts and it extends in a negative direction. If the input is great enough,  $V_2$  will be cut off during a certain portion of the cycle. The same action is accomplished with  $V_3$ , only it clamps the signal at its negative maximum to the bias voltage, with the audio-frequency voltage extending in a positive direction. When the bias voltage is exceeded, grid current will flow in  $V_1$  and clipping of a positive portion will occur. Combining the outputs of  $V_1$  and  $V_2$  results in an output wave that has the center portion removed.

Waveforms are shown in Fig. 1C that are present at various points in the circuit of Fig. 1B. At low signal inputs,  $V_1$  and  $V_2$  function as parallel Class-A amplifiers and as the input increases the mode of operation of these tubes changes. At extremely high inputs,  $V_1$  continues as a Class-A amplifier, but introduces grid-current limiting through  $R_2$ . Tube  $V_2$  operates Class-C, its grid being driven in excess of cutoff.

For easiest design,  $V_1$  and  $V_2$  should be the same type, and assuming such is the case, the clipping level of each tube should be made the same so the output waveform will be symmetrical. To do this, the grid bias of  $V_1$  must be just slightly less than cutoff.

If it were in excess of cutoff, both the positive and negative peaks would be clipped in  $V_1$ . From a practical standpoint, perfect symmetry cannot be attained in the grid circuits alone, but can be recovered in the plate circuit by making  $R_4$  and  $R_5$  of unequal values.

The complete inside clipper is shown in the photograph and in Fig. 2. A pentode amplifier precedes the clipper to allow the use of a high-impedance crystal or dynamic microphone and the output is attenuated to the output of a

microphone, so it can be inserted into any speech equipment with low-level high-impedance input.

In Fig. 2, no diode is used across the grid resistor of  $V_{3B}$ . Because current drain is negligible, the grid of  $V_{3B}$  performs the functions of the diode  $V_4$  in Fig. 2. The network

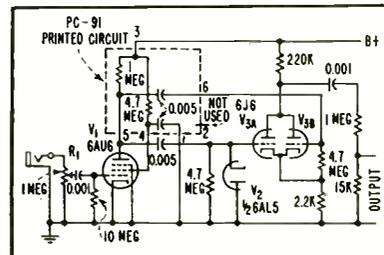
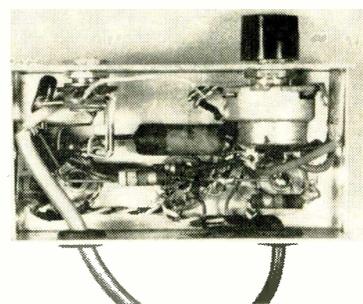


FIG. 2—Complete clipper circuit uses pentode preamplifier to provide high-impedance input

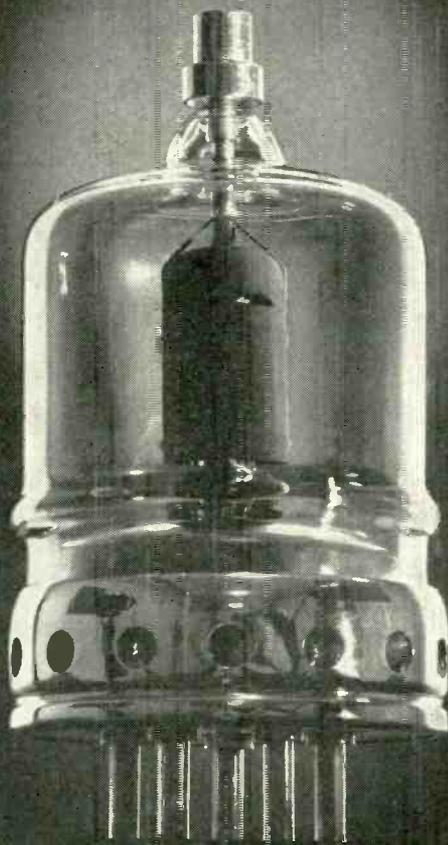
of mixing resistors shown in Fig. 2, is replaced by a single plate resistor. This can be done because at low inputs, both sections of  $V_3$  operate in parallel as previously described. Whenever one section is following the signal contour beyond the clipping point the other section is either saturated or beyond cutoff and will therefore not affect the total plate current of the two triodes.

For simplicity and to prevent the normal aging of the tube from adversely affecting the circuit operation, cathode bias is used on  $V_1$ , instead of the battery bias shown in Fig. 1B. Cathode bias does not permit the output to be held absolutely constant from the clip level on. But it does remain nearly constant, so this minor disadvantage is outweighed by its reduction of the sharpness of the cutoff or clipping. This reduces the harmonic content of the clipper output to basically third harmonics and minimizes the filtering re-



Clipper uses printed coupling circuit to reduce space requirements

# TIME-TRIED TETRODE



## LOS GATOS 4D21/4-125A

MODERN in every respect—  
with exclusive Sintercote black-  
body high-dissipation anode and  
emission-free grids—the Los  
Gatos 4D21/4-125A provides a  
new source of supply for a widely-  
applied tetrode type. Check  
Los Gatos for your requirements  
in other types with emphasis  
on long service life.

LEWIS and KAUFMAN, Ltd.

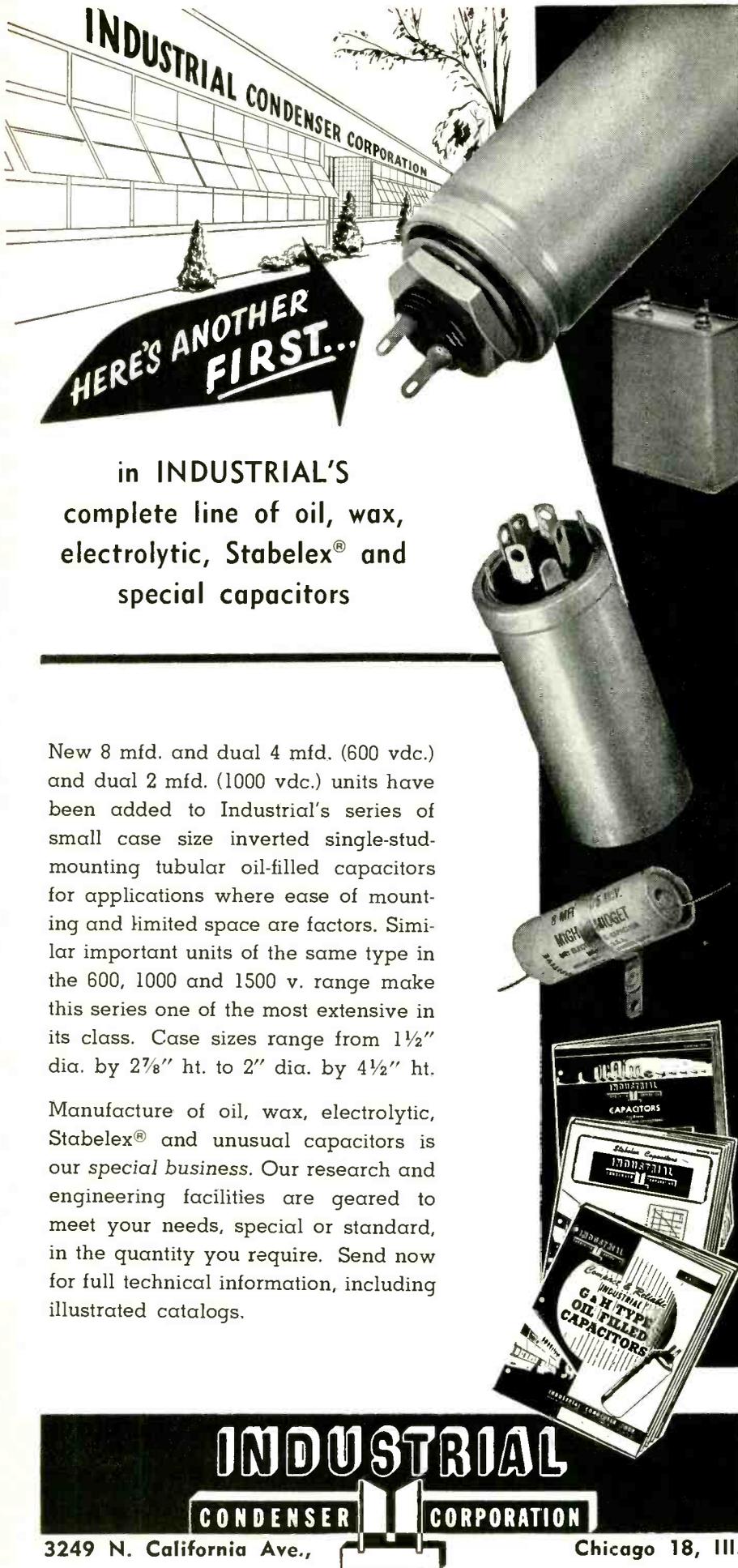
LOS GATOS 1

CALIFORNIA



Export Representatives:  
MINTHORNE INTERNATIONAL CO., INC.  
15 Mooee St., N.Y. 4, N.Y. Cable: Minthorne

In Canada:  
THE RADIO VALVE COMPANY OF CANADA, LIMITED  
189 Dufferin Street, Toronto 1, Ontario, Canada



in INDUSTRIAL'S  
complete line of oil, wax,  
electrolytic, Stabelex® and  
special capacitors

New 8 mfd. and dual 4 mfd. (600 vdc.) and dual 2 mfd. (1000 vdc.) units have been added to Industrial's series of small case size inverted single-stud-mounting tubular oil-filled capacitors for applications where ease of mounting and limited space are factors. Similar important units of the same type in the 600, 1000 and 1500 v. range make this series one of the most extensive in its class. Case sizes range from 1½" dia. by 2⅞" ht. to 2" dia. by 4½" ht.

Manufacture of oil, wax, electrolytic, Stabelex® and unusual capacitors is our special business. Our research and engineering facilities are geared to meet your needs, special or standard, in the quantity you require. Send now for full technical information, including illustrated catalogs.

**INDUSTRIAL**

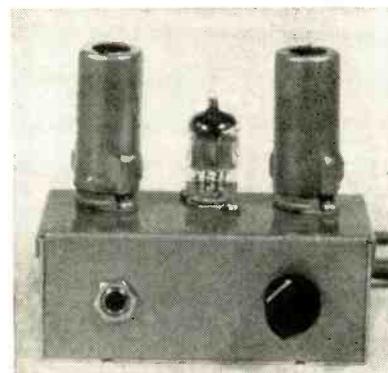
**CONDENSER CORPORATION**

3249 N. California Ave.,

Chicago 18, Ill.

quired. In most transmitters, no additional filter is needed except perhaps a capacitor across the modulation-transformer winding.

A printed circuit is used for coupling from the pentode stage to the clippers. The 6AL5 tube could be replaced with a germanium diode and the 12AU7 inserted after the preamplifier in an amplifier already in use, or the entire unit could be built on the same chassis with the rest of the speech amplifier. The



Potentiometer on clipper chassis controls clipping level

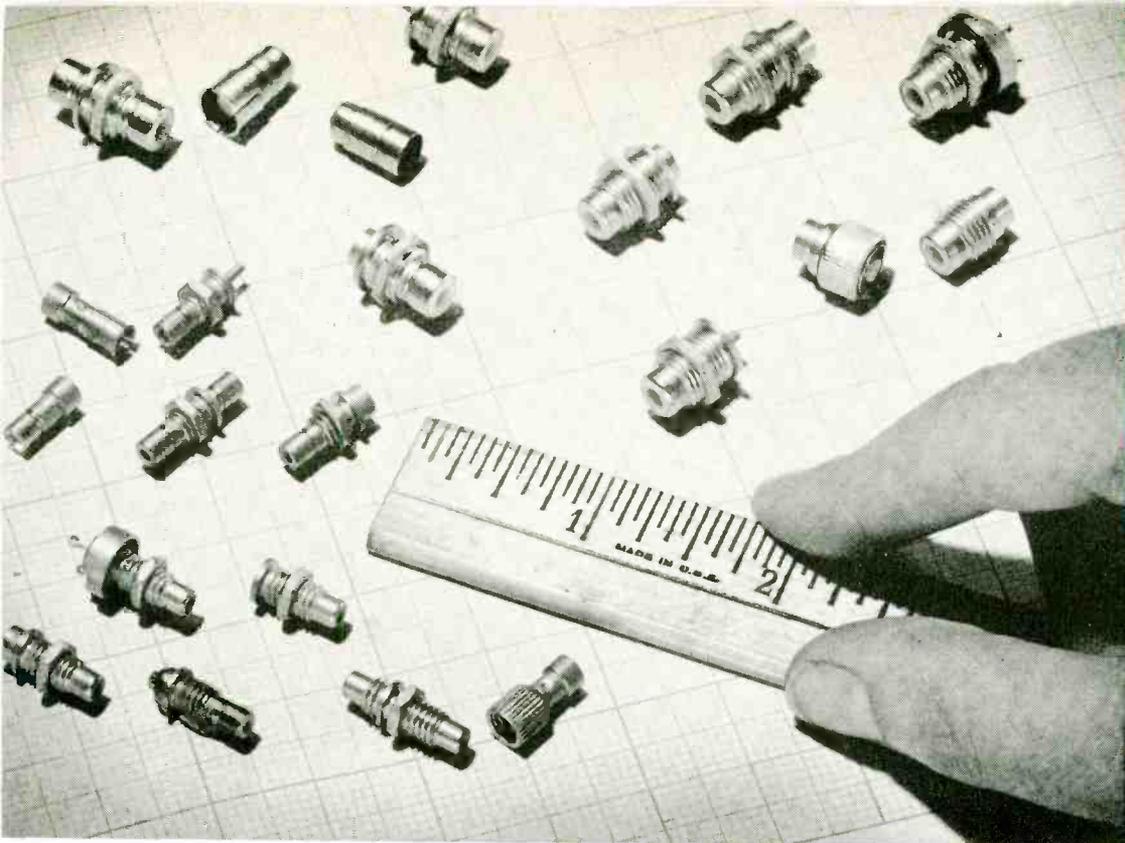
separate chassis was used in the present instance to allow its use with one of several transmitters.

Adjustment of the inside clipper is the same as any clipper circuit. The master gain control on the speech amplifier or modulator is adjusted to give the desired percentage of modulation with a high degree of clipping. Then  $R_1$ , the input potentiometer, is set such that clipping just begins at normal voice levels. If a sine-wave audio oscillator or generator is used to adjust the modulation percentage (and this is recommended,) 95 percent modulation at 20 db of clipping is suggested. Then with the audio oscillator disconnected and a microphone inserted in the clipper input,  $R_1$  is set such that a high level of peak modulation is obtained during all of the transmissions.

### Transistors Use Emitter-Coupled Feedback

By FRANK C. ALEXANDER, JR.  
Gulf Research and Development Co.  
Pittsburgh, Pa.

A LARGE FAMILY of cathode-coupled vacuum-tube circuits has grown up in the technology during the past fifteen years. This article describes



connectors are actual size

complete listing of  
SPACE-SAVING  
SUBMINAX  
RF CONNECTORS

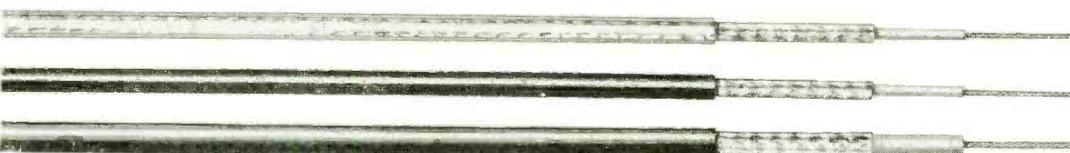
the ruler tells the story...

**AMPHENOL** SUBMINAX RF CONNECTORS

A complete line of 50 and 75 ohm RF connectors, so small that all of the twenty-two connectors in the series easily fit in the palm of your hand!—the ruler certainly tells the story of the amazing new AMPHENOL *subminax* RF connectors! A result of the continuing AMPHENOL development work in the field of miniaturization, the new *subminax* connectors have all the dependable features of their older, larger brothers compressed into a fraction of the space usually demanded in RF connectors!

The *subminax* line is exceptionally complete. Connectors are available in both screw-on and push-on types in either 50 or 75 ohms. In each design there is a plug, jack, receptacle, jack bulkhead and feed through. In addition, *hermetically sealed* receptacles are available in the 50 ohm and 75 ohm screw-on connectors. Construction? *Subminax* connectors have machined brass bodies with a tough and shining gold-plated finish.

Although *subminax* cable assemblies are available directly from AMPHENOL, assembly at your plant is both easy and practical. Inexpensive and easy-to-use *hand crimpers* are available along with the necessary lengths of AMPHENOL Miniature Coaxial Cable.



50 ohm Push-on

Part No.	Description
27-1	Plug
27-2	Jack
27-3	Receptacle
27-4	Jack Bulkhead
27-5	Feed Through

50 ohm Screw-on

Part No.	Description
27-5	Plug
27-8	Jack
27-9	Receptacle
27-10	Jack Bulkhead
27-11	Feed Through
27-12	Receptacle Hermetically Sealed

75 ohm Push-on

Part No.	Description
27-13	Plug
27-14	Jack
27-15	Receptacle
27-16	Jack Bulkhead
27-17	Feed Through

75 ohm Screw-on

Part No.	Description
27-19	Plug
27-20	Jack
27-21	Receptacle
27-22	Jack Bulkhead
27-23	Feed Through
27-24	Receptacle Hermetically Sealed

MINIATURE COAXIAL CABLE

Three types of miniature coaxial cable are available from AMPHENOL for making *subminax* assemblies. These are 50 ohm and 75 ohm polyethylene dielectric with black vinyl jacket cable and a 50 ohm Kel-F dielectric and Kel-F jacket cable.

Part No.	RG-/U No.	Impedance	Description
21-596	—	50 ohm	Kel-F
21-597	—	75 ohm	Poly.
21-598	174	50 ohm	Poly.

AMERICAN PHENOLIC CORPORATION

chicago 50, Illinois

In Canada: AMPHENOL CANADA LTD., Toronto

depend on



for progress!



# Dynacord<sup>®</sup>

the magnificent  
by Pentron

Now  
for the  
first time

... a professional tape recorder that offers both  
**MAXIMUM OPERATING CONVENIENCE**  
plus **UNMATCHED DEPENDABILITY**

Dynacord is engineered to exceed the rigid requirements of broadcast stations, sound studios, industry and government. Its wide dynamic range and many convenient operating features amaze engineers and audiophiles alike. Compare it in every way with any other professional tape recorder and see why Dynacord sets the new standard of professional recording.

Model DTM Tape Transport Mechanism, \$350 net.  
Model DP-100 Broadcast Amplifier, \$150 net.  
Model DS-10 Audiophile Amplifier, \$75 net.

Write for  
details and  
bulletin

Exclusive 2-speed, inside-out Hysteresis synchronous motor. Direct capstan drive.

Exclusive dynamic braking, fast, positive, fool-proof.  
Frequency Response: 50-15,000 CPS at 15 in./sec.  $\pm$  2DB  
Signal to Noise Ratio: better than 55 DB

**THE PENTRON CORPORATION**  
777 South Tripp Avenue, Chicago 24, Illinois, Dept. E-12  
Canada: Atlas Radio Corp., Ltd., Toronto  
Largest exclusive makers of tape recorders and accessories

SEND FOR FREE DETAILED BULLETIN TODAY!

**PENTRON**

Want more information? Use post card on last page.

some analogous transistor circuits that have been built and tested. They all use readily-available junction-transistor types.

Circuits have been built using both CK-722 *pnp* transistors and TI-201 *nnp* transistors. The *nnp* units are more expensive, but permit operation to higher frequencies.

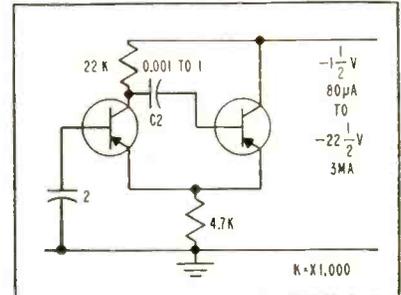


FIG. 1—Two-transistor free-running multivibrator uses a minimum of parts

Figure 1 shows a two-transistor free-running multivibrator using only two capacitors and two resistors. The prf was varied from 6 per sec to 6,000 per sec by varying  $C_2$  from 1  $\mu$ f to 0.001  $\mu$ f.

A monostable one-shot multivibrator with rise time of 2  $\mu$ sec, a minimum pulse width of 5  $\mu$ sec and a maximum pulse width of several seconds depending on  $C_2$  is shown in Fig. 2. A trigger of 0.03-volt amplitude and 1- $\mu$ sec duration is required.

Figure 3 shows a two-terminal oscillator. This has been operated

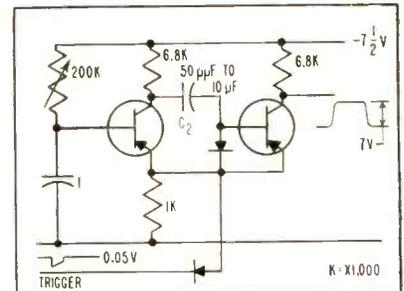


FIG. 2—One-shot multivibrator produces pulses with 2- $\mu$ sec rise time

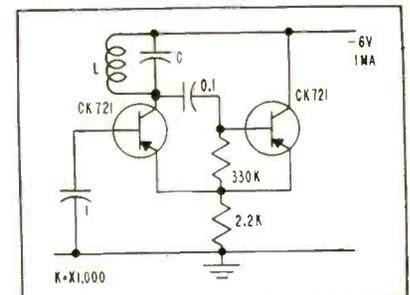


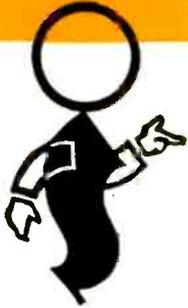
FIG. 3—Two-terminal oscillator circuit will operate to 500 kc

# STACKPOLE

## FIXED COMPOSITION RESISTORS



BLACK -0	BLACK -0	BLACK -	GOLD = ±5% TOL. SILVER = ±10% TOL. NO BAND = ±20% TOL.
BROWN -1	BROWN -1	BROWN -0	
RED -2	RED -2	RED -00	
ORANGE -3	ORANGE -3	ORANGE -000	
YELLOW -4	YELLOW -4	YELLOW -0000	
GREEN -5	GREEN -5	GREEN -00000	
BLUE -6	BLUE -6	BLUE -000000	
VIOLET -7	VIOLET -7	GOLD -MULT. BY .1	
GRAY -8	GRAY -8	SILVER -MULT. BY .01	
WHITE -9	WHITE -9		



These standard resistance ratings have been carefully selected to cover every circuit requirement while avoiding costly and unnecessary overlapping of values. All Stackpole 1/2-, 1-, and 2-watt resistors are reg-

ularly supplied in each of the ranges and tolerances indicated. Through this standardization you are assured of maximum quality and faster deliveries plus easier stocking of resistors for you.

Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pennsylvania

### These **269** RETMA Values Meet Every Modern Circuit Need!

±20%	±10%	±5%	±20%	±10%	±5%	±20%	±10%	±5%	±20%	±10%	±5%
10	10	10		390	390	15000	15000	15000		560000	560000
	12	11	470	470	430		18000	16000	680000	680000	620000
	15	13		560	470	22000	22000	20000	820000	820000	750000
	18	15	680	680	510		27000	24000	1.0 Meg	1.0 Meg	1.0 Meg
	22	16		820	560	33000	33000	22000	1.2 Meg	1.2 Meg	1.1 Meg
	27	18	1000	1000	620		39000	30000	1.5 Meg	1.5 Meg	1.2 Meg
	33	20		1200	680	47000	47000	33000	1.8 Meg	1.8 Meg	1.3 Meg
	39	22	1500	1500	750		56000	36000	2.2 Meg	2.2 Meg	1.6 Meg
	47	24		1800	820	68000	68000	43000	2.7 Meg	2.7 Meg	1.8 Meg
	56	27	2200	2200	910		82000	47000	3.3 Meg	3.3 Meg	2.0 Meg
	68	30		2700	1000	100000	100000	51000	4.7 Meg	4.7 Meg	2.2 Meg
	82	33	3300	3300	1100		120000	62000	5.6 Meg	5.6 Meg	2.4 Meg
	100	36		3900	1200	150000	150000	68000	6.8 Meg	6.8 Meg	2.7 Meg
	120	39	4700	4700	1300		180000	75000	8.2 Meg	8.2 Meg	3.0 Meg
	150	43		5600	1400	220000	220000	82000	10.0 Meg	10.0 Meg	3.3 Meg
	180	47	6800	6800	1600		270000	91000	12.0 Meg	12.0 Meg	3.6 Meg
	220	51		8200	1800	330000	330000	100000	15.0 Meg	15.0 Meg	3.9 Meg
	270	56	10000	10000	2000		390000	110000	18.0 Meg	18.0 Meg	4.3 Meg
	300	62		12000	2200	470000	470000	120000	20.0 Meg	20.0 Meg	4.7 Meg
	330	68		15000	2400			130000	22.0 Meg	22.0 Meg	5.1 Meg
		75		18000	2700			150000			5.6 Meg
		82		22000	3000			160000			6.2 Meg
		91		27000	3300			180000			6.8 Meg
		100		33000	3600			200000			7.5 Meg
		110		39000	3900			220000			8.2 Meg
		120		47000	4300			240000			9.1 Meg
		130		56000	4700			270000			10.0 Meg
		150		68000	5100			300000			11.0 Meg
		160		82000	5600			330000			12.0 Meg
		180		100000	6200			360000			13.0 Meg
		200		120000	6800			390000			15.0 Meg
		220		150000	7500			430000			16.0 Meg
		240		180000	8200			470000			18.0 Meg
		270		220000	9100			510000			20.0 Meg
		300		270000	10000						22.0 Meg
		330		330000	11000						
		360		390000	12000						
				470000	13000						

AVAILABLE THROUGH PARTS DISTRIBUTORS: For the name of nearest distributor stocking Stackpole resistors, switches and "EE" iron cores, write Distributors Division, Stackpole Carbon Company, 26 Rittenhouse Place, Ardmore, Pa.



New Edison Control Relay Amplifies Power 500,000 Times

Edison Control Relay Amplifies Power 500,000 Times

Control Relay Amplifies Power 500,000 Times

Relay Amplifies Power 500,000 Times

Amplifies Power 500,000 Times

Because there is an amplification factor of approximately 500,000 between the input power to the operating coils and the load capacity of its own contacts, Edison's Magnetic Control Relay actually eliminates the need for electronic boosting—operates *directly* from a thermocouple, photocell, or from vacuum tube currents. Yet this precision instrument stands up even under the shock and vibration of aircraft service.

Designed and developed in the world-famous Edison Laboratory, this small relay has features of particular interest to designers of electronic equipment.

**Low power operation**—Standard types operate at as low as 30 microamperes—do not drain

power from other circuit components, such as gyro motors.

**Versatility**—Coils can be supplied with resistances from 0.5 to 20,000 ohms. Differential operation is made possible by separate connections from each coil with polarized operation as an inherent characteristic.

**Stability**—Test relays have exceeded 8,000,000 cycles without calibration change.

**Rugged Movement**—Dissipates overloads up to 10,000 times normal operating input—withstands 50 g shock in all planes (unenergized).

**Contacts**—Platinum-iridium wire, either SPST or SPDT, with capacity of 1/2 ampere at 28 volts d.c. non-inductive.

*Write us—especially if you are now using a single-stage electronic amplifier—for more complete information.*

*Thomas A. Edison*

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

**Thomas A. Edison, Inc.**

INSTRUMENT DIVISION • 54 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

to 500 kc with *npn* transistors. The use of *npn* transistors permits operation to 1.5 megacycles.

A series-resonant crystal oscillator operating to 500 kc is shown in Fig. 4. This circuit is ideal for light crystal loading. It has been used with 98.324-kc. crystals as a

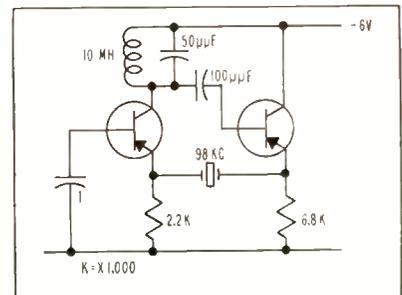


FIG. 4—Crystal oscillator circuit used in radiolocation work

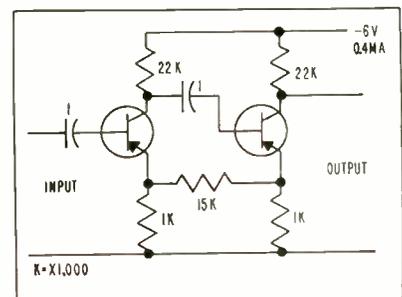


FIG. 5—Audio amplifier obtains current stabilization by series emitter resistors

5,000-ft range calibrator in radiolocation work.

The audio amplifier of Fig. 5 features transistor-current stabilization with series emitter resistors. Positive feedback is used to obviate the requirement for large bypass capacitors across the emitter resistors.

#### REFERENCES

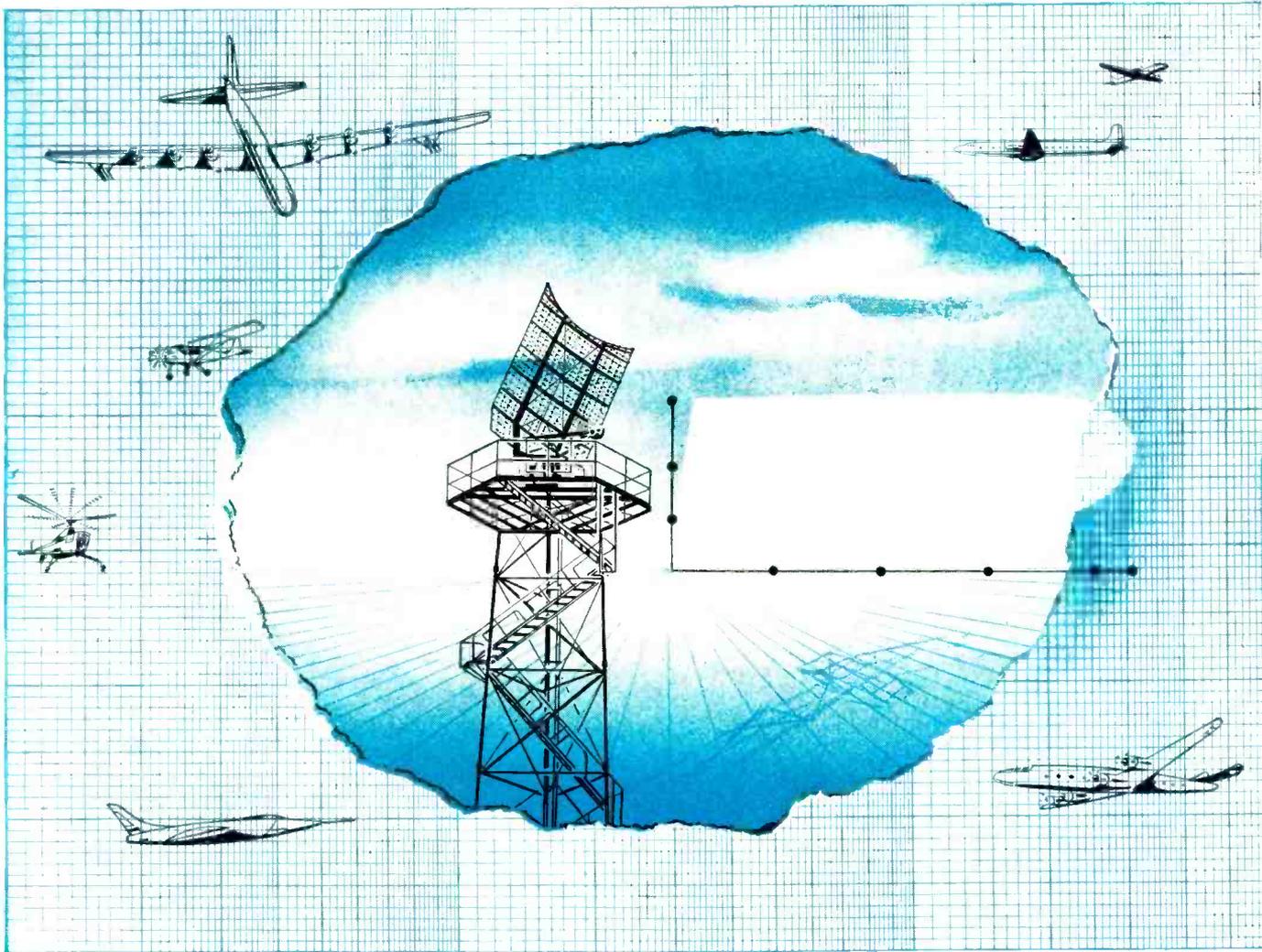
- (1) Peter G. Sulzer, Cathode-coupled Negative Resistance Circuit, *Proc IRE*, 36, p 1,034, Aug. 1948.
- (2) Frank C. Alexander, Jr., A Cathode-coupled Oscillator, *QST*, 30, No. 9, p 69, Sept. 1946.
- (3) F. Butler, Cathode Coupled Oscillators, *Wireless Engineer*, 21, No. 254, p 521, Nov. 1944.

## Thyratron Peak Voltmeter

By J. P. C. McMATH

Assoc. Prof. in EE  
University of Manitoba  
Winnipeg, Canada

MEASUREMENT of positive or negative peak values of steady-state alternating voltages, recurrent pulses or any transient voltage can be made with the simple instrument described below. It is not suitable



## Airport "Traffic Cop"

**RADAR ANTENNA SYSTEMS**  
design, development and fabrication

**JET ENGINES**  
manufacture of major hot-end  
components.

**TECHNOLOGY**  
**ABILITY**  
**FACILITIES**

General Electric developed this unique radar system to track, position and control plane traffic with maximum safety.

It provides many advantages over conventional systems. The special shape of the antenna radiates a beam 12,000 ft. vertically and from 30 to 60 miles horizontally, providing control of all planes in proximity to the airport. Within the pattern of this beam all aircraft are easily detected.

The Special Products Division of I-T-E was asked by General Electric to undertake the production design and fabrication of this antenna to rigid tolerances. Although 10 feet wide and 12 feet high, the finished product deflected only 1/4 inch in actual use when covered with ice and subjected to a 90 knot wind.

This is another of the many ways in which I-T-E technology and specialized fabricating background helps solve production problems for industry. Special Products has an experience in a wide variety of fields. Their engineers might have the solution to your problem.

*Why not send for Publication SP-100E-12 today.  
It shows what has been done to help others.*

### **SPECIAL PRODUCTS DIVISION**

**I-T-E CIRCUIT BREAKER COMPANY**

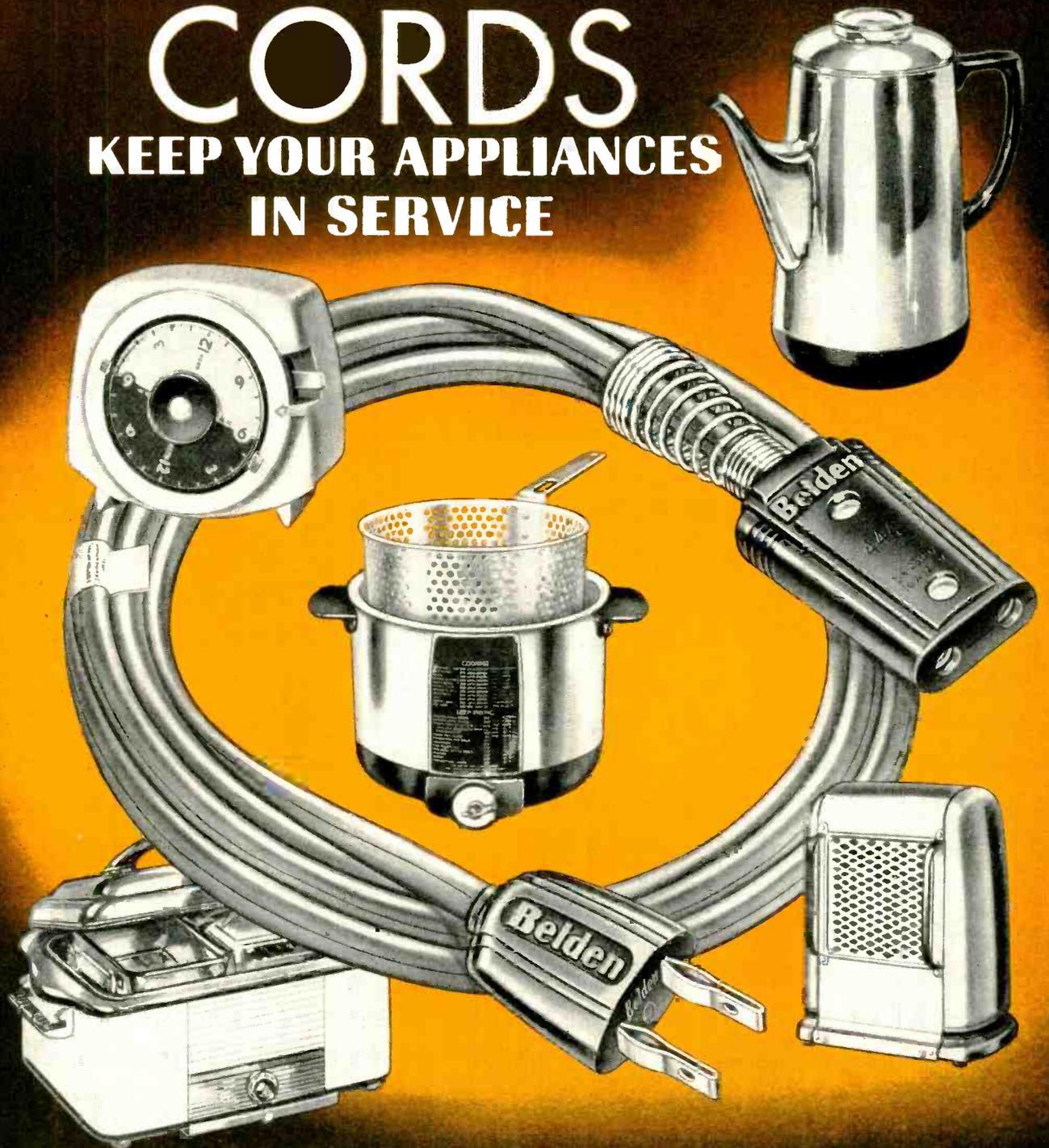
601 East Erie Avenue • Philadelphia 34, Pa.

*Progress through Problem Solutions*

SP 10.4



**ELECTRICAL  
CORDS  
KEEP YOUR APPLIANCES  
IN SERVICE**



**MANUFACTURERS AND SERVICE MEN WHO SERVE BEST**

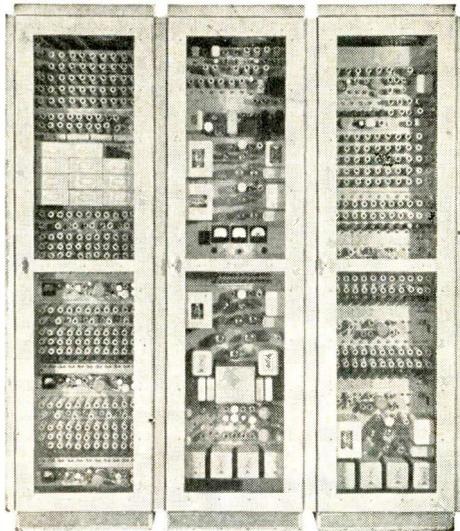
*Specify*

**Belden**

**WIREMAKER FOR INDUSTRY**

# DC TO DIGITAL TO DC CONVERSION

**± 0.035% ACCURACY**  
**OVER 2000 MILES**  
**OF TELEPHONE LINE**



- ...Converts 3 dc voltages to 11 digit binary code and back to dc.
- ...Samples each voltage 10 times per second.
- ...Insensitive to transmission system variations and noise.

## Data Transmission Equipment

EECO Data Transmission Equipment has operated successfully over 2064 miles of carrier telephone circuit passing through 60 filters and 32 sections of carrier terminal equipment -- all without loss of accuracy. By using only half of the equipment, DC data may be transmitted from a remote point for use in digital form, or digital data may be converted to analog form by using the receiving half of the equipment.

### PRINCIPLES OF OPERATION

The equipment accepts three separate dc data input voltages, encodes them into 11 digit binary codes, and decodes the received binary number to produce duplicate dc output voltages at the receiving end of the system.

In addition, six auxiliary on-off circuits are available. These auxiliary circuits may be used singly or as binary code groups. If used as six-digit binary code, 64 combinations are possible, one at a time.

#### TRANSMITTER

The three data and six auxiliary channels are each sampled 10 times per second.

#### ENCODING METHOD

A stable encoding method employs a modification of the self-balancing potentiometer principle. By means of a relay controlled summing network, 11 successive subtractions of 1/2, 1/4, 1/8 ... 1/2048 of full scale voltage are made from the input data.

#### OUTPUT SIGNAL

The binary codes from the input channels, the auxiliary codes, and the receiver synchronizing signals are multiplexed to permit transmission over a single communication circuit with a frequency band from 920 to 2920 cycles.

### MODIFICATIONS

Many different modifications can be economically worked out because the various circuit functions are generally self-contained on separate panels.

#### RECEIVER

Master or frame synchronizing signals together with channel synchronizing signals are used. The multiplexed serial codes are separated and stored in transfer registers. On completion of the sample, the code numbers in the registers are transferred in parallel form to decoders.

#### DECODING METHOD

Resistance summing networks are used for decoding. The output from control relays in the encoder are summed by means of a chopper stabilized direct coupled amplifier.

#### REFERENCE VOLTAGE

Either a self-contained standard cell or external voltage can be used as the dc reference.

at  $N$ , it will be opposite. Since the thyatron requires a positive voltage at its control grid for firing, when switch  $S_1$  is in position  $P$ , positive peaks will be measured and when in position  $N$ , negative peaks. The screen grid voltage of  $V_2$  is adjustable from zero to about minus 45 volts by means of  $P_1$  which should be wire-wound and preferably linear.

Its dial can be calibrated in terms of peak voltage input to  $V_1$ , the calibration being very nearly linear as shown by the dashed curve of input voltage against critical screen grid voltage in Fig. 2. In order that a

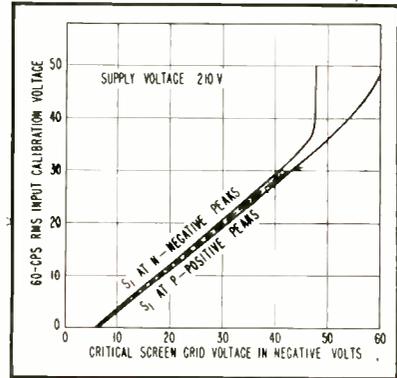


FIG. 2—Calibration curve differences due to imperfect matching of resistors

single calibration may apply for either positive or negative voltages, resistors  $R_2$  and  $R_3$  and also  $R_4$  and  $R_5$  must be closely matched pairs. The internal impedance of the power supply must be negligible or adequately bypassed, and  $C_3$  and  $C_1$  must have negligible leakage.

This last requirement is particularly important, owing to the considerable difference in d-c voltage between anode and cathode of  $V_1$ . Any leakage will cause considerable and probably erratic differences in the calibrations for positive or negative inputs. Only high grade mica capacitors of ample voltage rating should be used. Switch  $S_3$  interrupts the anode current and so resets the thyatron. Resistor  $R_6$  limits the anode current to a safe and convenient value.

For most purposes the tube glow is sufficient indication of firing; however, a pilot lamp, buzzer or relay could be inserted between  $S_3$  and  $R_6$ . Variation of the anode supply voltage from 200 to 220 volts has negligible effect on the calibration, except for very small input signals. The negative supply to the

DUNKIRK 2-7353



Electronic Engineering Company of California

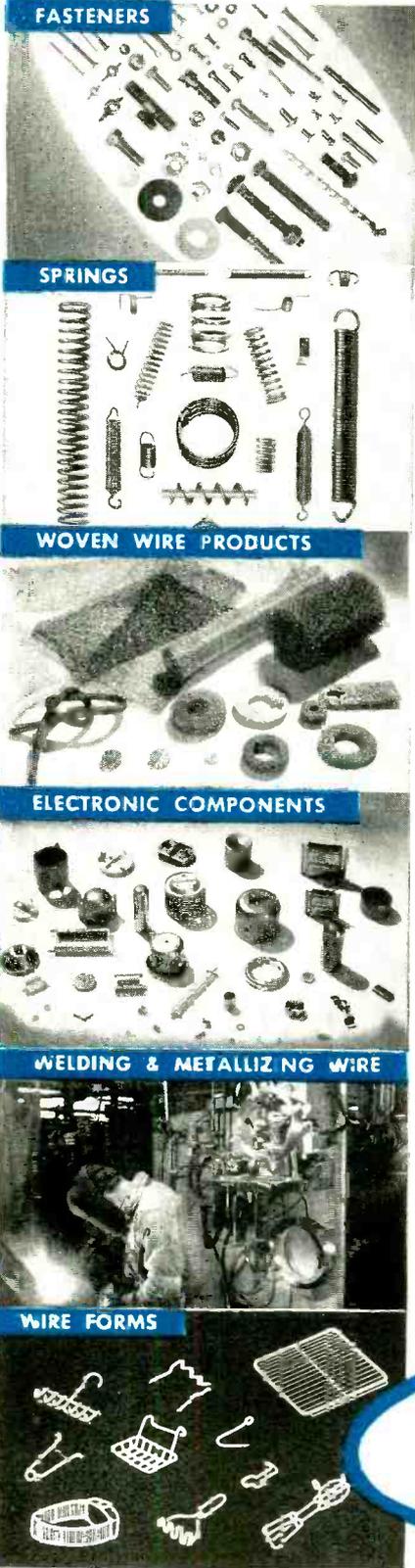
180 SOUTH ALVARADO STREET...LOS ANGELES 57, CALIFORNIA

For further information, please send attached coupon.  
 R. B. Bonney, Chief Engineer  
 Electronic Engineering Co. of Calif.  
 180 South Alvarado Street  
 Los Angeles 57, California

Data Sheet on Data Transmission Equipment ZA-11210, please.  
 Name \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 Title \_\_\_\_\_

# Basic Materials

**FOR A MILLION PRODUCTS**



## Alloy Wire, Rod and Strip . . .

Design Engineers are taking advantage of the outstanding mechanical and electrical properties and excellent formability of Alloy Wire, Rod and Strip. Results: Better products, smaller and lighter products, products that are more corrosion-resistant, more heat-resistant, more attractive—and more economical.

Alloy Metal Wire Division can supply you with high quality wire, rod and strip in Stainless Steels, Nickel Alloys and Electrical Resistance Alloys. Why not put these versatile materials to work for you?

**SEND  
FOR FREE  
HANDBOOKS  
TODAY**

## ALLOY METAL WIRE DIVISION

H. K. PORTER COMPANY, INC.

of Pittsburgh

PROSPECT PARK, PENNSYLVANIA

**FOR A BETTER DESIGN . . .**

*Use Wire, Rod, & Strip*

**FOR BETTER PRODUCT**

**PERFORMANCE . . . Use Alloys**

Among the alloys we fabricate, you will surely find one with just the right combination of properties for your specific application. And you can profit from the fabrication advantages and material cost and weight savings of wire, rod and strip parts and assemblies. Select the alloy you need from these three functional groups:

### STAINLESS STEELS—

Alloy Metal Wire Division can provide you with more than 20 different grades of stainless steels. These include the chromium-nickel Austenitic grades with their outstanding corrosion resistance and good mechanical properties; the high chromium Ferritic grades with their high heat resistance, corrosion resistance, and outstanding cold working properties; and the lower chromium Martensitic grades which can be heat treated to obtain exceptionally high strength and hardness in addition to good resistance to corrosion and high temperatures. Stainless steel Wire, Rod and Strip are used extensively for high strength and corrosion-resistant fasteners, springs and mechanical parts and for welding wire, woven and knitted wire parts, and many other applications.

### NICKEL ALLOYS—

A wide variety of Nickel alloys are also available for hundreds of electrical and mechanical applications. The excellent electrical characteristics of nickel are especially advantageous for electronic tube parts, such as grids, cathodes, support rods and pins. Monel, because of its excellent corrosion resistance and good mechanical properties, is also used for many mechanical parts, fasteners and springs.

Inconel provides the valuable combination of outstanding heat resistance, corrosion resistance and high strength required in many applications.

### RESISTANCE ALLOYS—

Five grades of electrical resistance alloys are now in production in wire, rod and strip form. These are: Alray A—20 Cr, 80Ni; Alray C—15 Cr, 62Ni, bal Fe; Alray D—18 Cr, 35Ni, bal Fe; Excelsior—45 Ni, 55 Cu; and Ni—Fe alloys.

These high quality alloys find extensive applications in the electrical and electronic fields.

### SPECIAL WIRE SHAPES—

You can cut costs and improve product performance with Alloy Metal's Special Shaped Wire. Almost any cross-sectional shape can be made on our wire drawing equipment. These shapes can save you tons of metal and many hours of machining time. Shaped wire can be held to close tolerances and has a smooth, tough, flaw-free surface.

# ELECTRICAL ENGINEERS

or

# PHYSICS GRADUATES

with experience in

## RADAR or ELECTRONICS

or those desiring to enter these areas...

*The time was never more opportune than now  
for becoming associated with the field of advanced electronics.*

*Because of military emphasis this is the most  
rapidly growing and promising sphere of endeavor for the young  
electrical engineer or physicist.*

Since 1948 Hughes Research and Development Laboratories have been engaged in an expanding program for design, development and manufacture of highly complex radar fire control systems for fighter and interceptor aircraft. This requires Hughes technical advisors in the field to serve companies and military agencies employing the equipment.

As one of these field engineers you will become familiar with the entire systems in-

olved, including the most advanced electronic computers. With this advantage you will be ideally situated to broaden your experience and learning more quickly for future application to advanced electronics activity in either the military or the commercial field.

Positions are available in the continental United States for married and single men under 35 years of age. Overseas assignments are open to single men only.

Scientific  
and  
Engineering  
Staff

## HUGHES

RESEARCH  
AND  
DEVELOPMENT  
LABORATORIES

Culver City,  
Los Angeles  
County,  
California



Hughes Field Engineer H. Heaton Barker (right) discusses operation of fire control system with Royal Canadian Air Force technicians. Avro Canada CF-100 shown at right.

Relocation of applicant must not cause disruption of an urgent military project.



shield grid should be regulated, as variations would directly affect the calibration. An OA3/VR75 tube was found adequate.

In use,  $S_2$  and  $P_1$  are adjusted until the input signal just triggers the thyatron. Its magnitude is then obtained from the dial calibration on  $P_1$  multiplied by the ratio setting of  $S_2$ .

The calibration curves of Fig. 2 were obtained using a 60-cycle sinusoidal input voltage. The small difference between the curves for positive and negative peaks is due to imperfect matching of resistors  $R_2$  and  $R_3$ , also  $R_4$  and  $R_5$  in the experimental model. Slight leakage in  $C_3$  and  $C_4$  may also have been a contributing factor to the curve differences.

When paper capacitors were used in these locations, a much greater difference between the curves was obtained. The upturn in the curve for negative peaks at large signal inputs results from plate current cutoff in the phase inverter section. For practical use the scale of ordinates would be converted to equivalent peak volts. It is suggested the input voltage at the grid of  $V_1$  be limited to approximately 40 volts peak.

In slightly more primitive form, this instrument has given excellent results in measuring the magnitude of troublesome switching transients that occurred on a 125-volt battery-fed power control system. These transients were much too fast to be seen with available oscilloscopes.

### REFERENCES

- (1) H. J. Reich, "Theory and Applications of Electron Tubes", p 611.
- (2) T. Offenbacher, Electronic Device Indicates Peak Transient Voltages, *Electrical World*, p 80, May 1945.
- (3) G. E. Jones, Jr., An Analysis of the Split Load Phase Inverter, *Audio Engineering*, p 16, Dec. 1951.

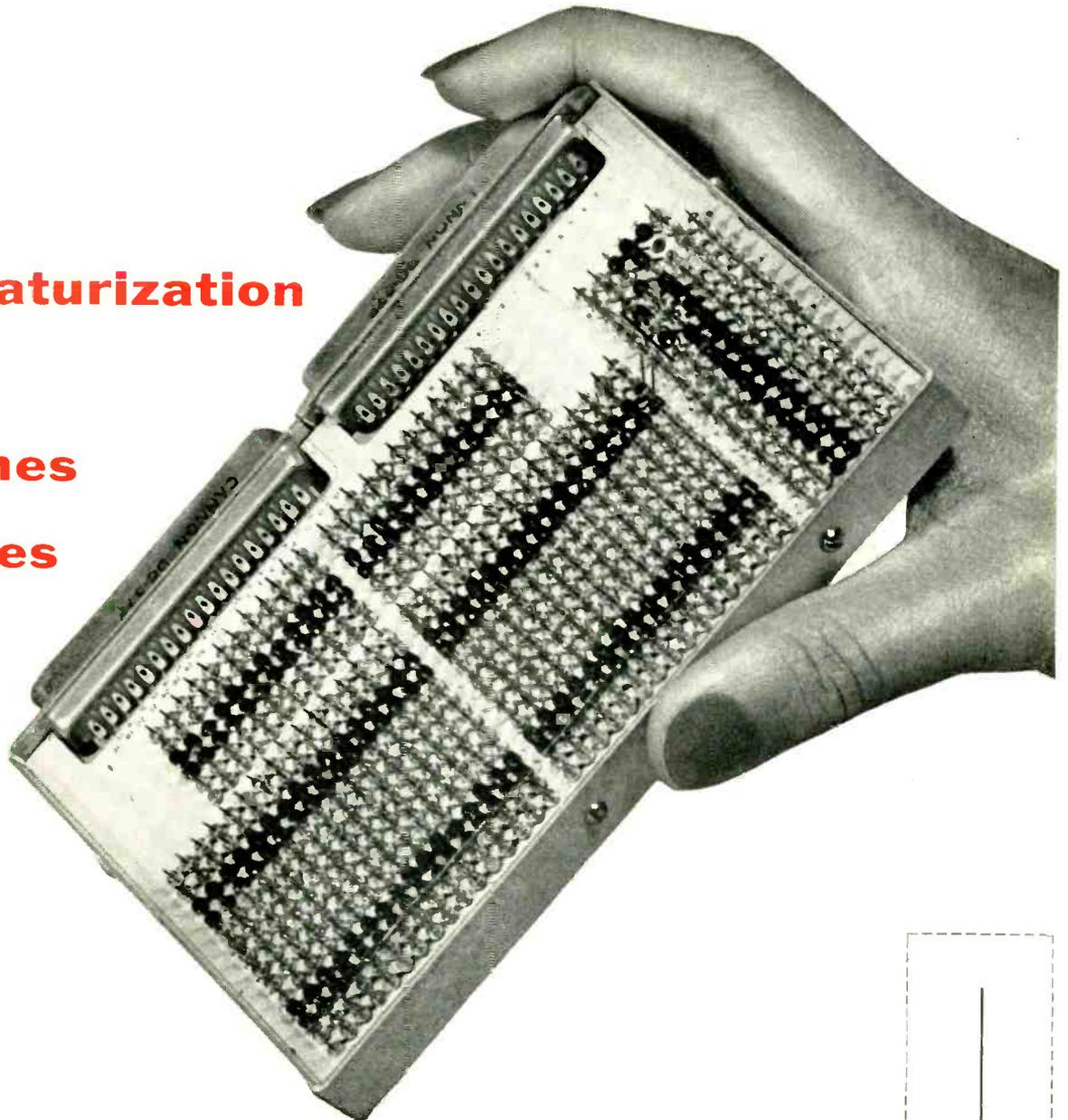
## Low-Frequency Phase-Shift Modulator

By W. F. COOMBS

Electrical Engineer  
University of Rochester  
Rochester, N. Y.

PRODUCING about 150 degrees of phase shift in a 60-cps waveform the phase modulator described in this article requires about 3 volts

# Miniaturization with Hughes Diodes



## *New computer matrix has high component density*

*This experimental reading gate matrix for airborne computers effectively utilizes the subminiature size of Hughes Point-Contact Germanium Diodes\*. Developed by the Miniaturization Group of Hughes Research and Development Laboratories, the unit measures 5¼ by 3⅞ by ½ inches (excluding plugs and frame). It contains 504 diodes, 209 resistors. Average component density: 94.5 per cubic inch!*

Frequently, space requirements of conventional wiring techniques will not permit electronic equipment to be miniaturized to the same extent as the components. However, spot-welded connections can effectively reduce wiring space . . . and it is easy to spot-weld the dumet leads of Hughes diodes. There is no adverse effect on diode characteristics, even when the connections are welded close to the diode body. With Hughes

diodes, designers can take full advantage of advanced packaging and wiring techniques.

Hughes diodes are easy to mount in conventional assemblies or in subminiature equipment. In service, these diodes have earned a reputation for reliable performance and stability under severe operating conditions. Make your selection from the many standard and special types available — all listed and described in our new Bulletin, SP-2A.



\*Actual size, diode body: 0.265 by 0.130 inches, maximum.

Reprints of a paper describing the packaging techniques of the subminiature matrix are available, too. Your copy will be sent promptly on request.

## Hughes

SEMICONDUCTOR SALES DEPARTMENT

*Aircraft Company, Culver City, Calif.*



*New York Chicago*

# SIE

## MODEL C-6

### RESISTANCE METER



for

- ★ RESEARCH
- ★ DESIGN
- ★ PRODUCTION
- ★ ACCEPTANCE TESTS

# 3

**UNIQUE FEATURES**  
**enable the C-6 to meet all**  
**requirements**

1. Three test voltages:  
 1½ volts — for low resistance ranges  
 50 volts — for low-voltage capacitor leakage measurements  
 500 volts — to meet MIL specs on insulation tests
2. Complete coverage, from zero ohms to 10,000,000 megohms, without auxiliary equipment.
3. Pre-settable "Charge Adjust" control and "Quick Charge" button for rapid Go, No-Go capacitor leakage tests.

### ACCURATE • VERSATILE • RELIABLE •

available from stock

# SIE

**\$200.** f.o.b. Houston

## SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.

P. O. Box 13058

2831 Post Oak Rd.

Houston, Texas

SEND FOR FREE LITERATURE.

REPRESENTATIVES THROUGHOUT THE WORLD.

54-2

d-c input control signal. The basic circuit is the phase-shift bridge shown in Fig. 1. Output voltage  $E_{cd}$  of such a bridge is equal in amplitude to the applied sinusoid  $E_{ab}$ , and lags it by a phase angle  $-2 \tan^{-1} \omega CR$ .

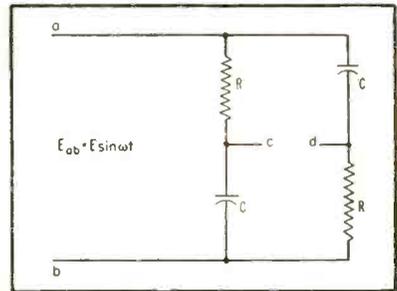


FIG. 1—Basic bridge circuit used in phase-shift modulator

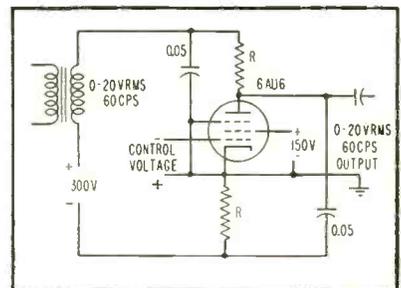
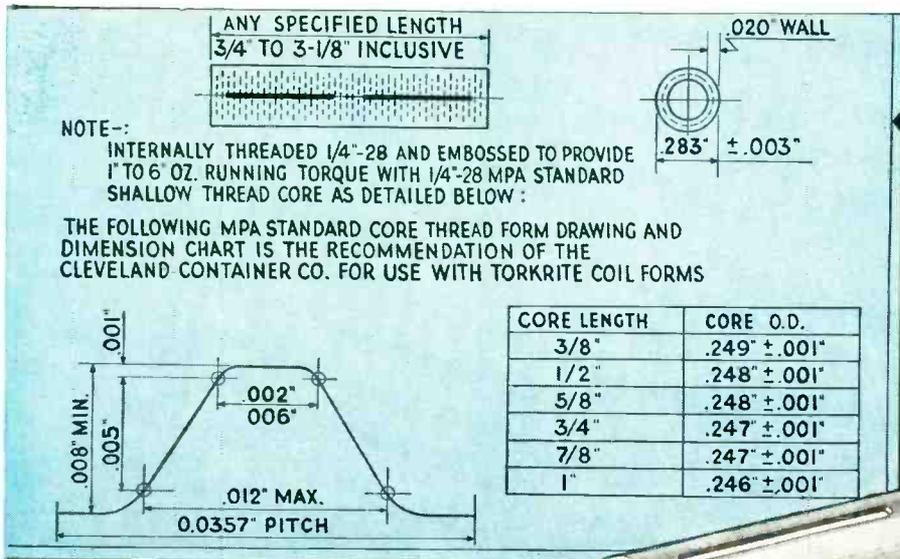


FIG. 2—Phase modulator provides up to 150-deg phase shift in 60-cps waveform

The circuit of Fig. 2 is the modified version of this bridge. The values of components are chosen for 60-cps operation. Resistors  $R$  are Carborundum type BNR. These resistors vary as a function of the voltage across them approximately as the voltage to the  $-3.5$  power.

A pentode was chosen to present a high-resistance load to the bridge and to provide a control element for the direct-current flowing in the resistors. The pentode is ideal for control in this circuit since the plate current is almost independent of plate voltage over the range of operation. Because of the nonlinear relation between resistance and voltage across the resistors it was expected that for small distortion the peak-to-peak a-c component across the resistor should not exceed approximately 20 percent of the d-c value. However, some correction is obtained because the distortion across each resistor partially cancels in the output.

In practice the 6AU6 tube was found to be a good choice for the load. The variation in resistance



DESIGN  
PRODUCT  
APPLICATION

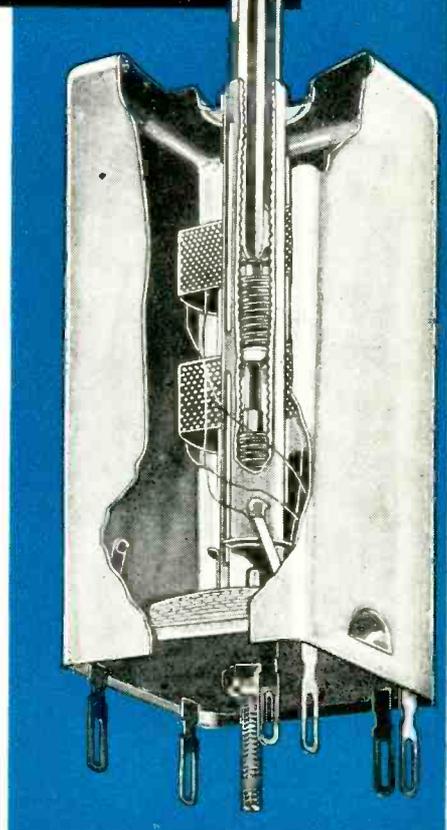


# TORKRITE

BY THE MAKERS OF CLEVELITE\* PHENOLIC TUBING

Torkrite coil forms eliminate torque and stripping problems and are rapidly replacing other coil forms because Torkrite:

- withstands more than required stripping pressure.
- requires no revision other than reduced winding arbor diameter.
- is round and concentric; winds coils at higher speed without wire breakage or fallen turns.
- permits use of lower torque since it is completely independent of stripping pressure.
- recycling ability is unmatched.
- is stronger mechanically because of heavier wall.
- provides 1-6" oz. running torque when used with MPA standard shallow thread core.
- has no holes or perforations thru tube wall which eliminates cement leakage locking cores.
- has smooth adjustment of core without lubricant.
- torque increases less after winding as heavier wall reduces any tendency to collapse and bind core.
- maximum stability results as core cannot move in relation to winding after peaking as it is engaged in internal threads.
- embossings are evenly spaced, with a lead at each end of the form to permit easy insertion of core.



INVESTIGATE this outstanding coil form.

Why pay more? For good Quality  
... Call CLEVELAND!

\*Reg. U. S. Pat. Off.

★ ★ ★  
Improved new Torkrite is now available in various diameter tubes. Lengths from 3/4" to 3-1/8" are made to fit 8-32, 10-32, 1/4-28 and 5/16-24 cores.

**The CLEVELAND CONTAINER Co.**  
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J.  
ABRASIVE DIVISION at Cleveland, Ohio  
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES  
NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.  
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.  
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO  
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

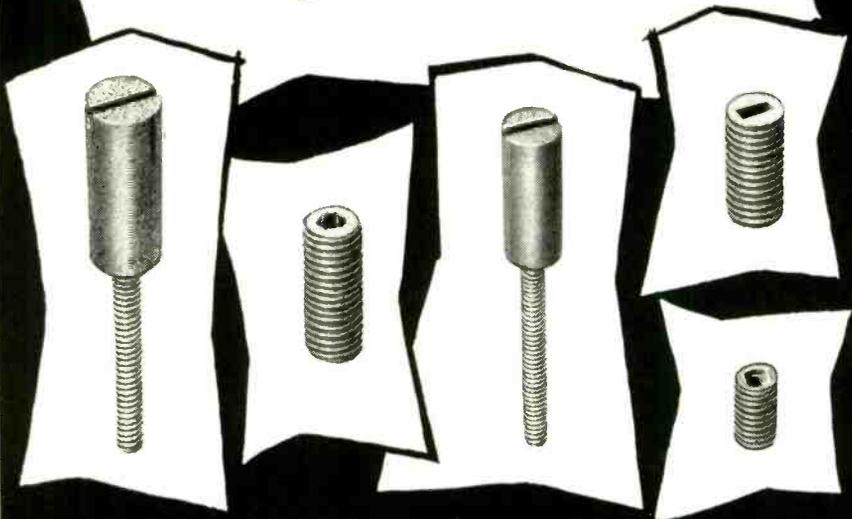


**We** 

*are the originators of*

**Engineered Economy**

**Iron Cores**



\* **Radio Cores, Inc.**, created and originated **ENGINEERED ECONOMY IRON CORES** . . . which are available at money saving prices and from stock.

Now . . . we have added six new Engineered Economy Iron Cores to expand our line to fourteen, covering most insert and threaded applications.

As the originators and creators of Engineered Economy Cores . . . leaders in engineering, quality, delivery and supply of samples, we are pleased that our tremendous volume enables us to lead in lower prices, too.

This has been achieved through our efficient production and your acceptance of "EE" cores.

We maintain an inventory of "EE" cores to eliminate your inventory problems and save you down time. Make certain that your "EE" cores come from the originator . . . **RADIO CORES, INC.**

We welcome your inquiries on "Custom Engineered Cores."

Write for our new "EE" specification data booklet



**Radio Cores, Inc.**

9540-50 Tully Avenue • Oak Lawn, Illinois



obtained was from about 50,000 ohms to 1 megohm for a current variation from 0.02 to 2.50 milliamperes through the tube. Actual phase-shift versus control-grid bias is plotted in Fig. 3. The input volt-

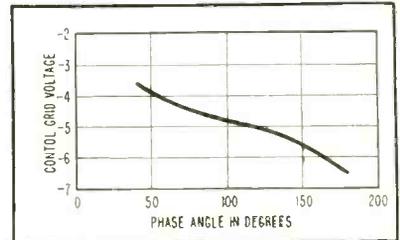


FIG. 3—Modulator phase shift versus control-grid voltage

age (equal to the output) can be as much as 20 volts rms before distortion is noticeable. If distortion can be tolerated, considerably higher outputs can be obtained. For outputs up to 20 volts rms the phase-shift versus control-voltage plot is independent of amplitude.

This particular circuit was designed for use in a grid-controlled thyatron power supply, but it should be useful in other systems. The equivalent shunt capacitance of the BNR resistors used is about 50  $\mu\text{f}$  which does limit their use in high-frequency applications. The bridge in practical use should be operated into a cathode follower or some equally high-impedance load.

The author wishes to thank the Carborundum Company, K. Enslin and L. W. Coulter for their assistance and helpful suggestions.

#### BIBLIOGRAPHY

"Characteristics and Methods of Calculating Applications of Type BNR Resistors", Carborundum Company, Global Division, Application Engineering Bulletin GR2.

## Continuous Phase Shifter

BY RANALD O. WHITAKER  
Silvis, Ill.

STUDY OF PHASE SHIFTS assumes importance in work with amplifiers for servo systems using 60-cycle two-phase motors. The study can be simplified by a phase-shifter giving a 60-cycle signal of constant amplitude but phased to the line

Now —

More Uses From ONE Instrument

# New L.f.E. Oscilloscope — Model 411



PLUS LFE's New PLUG-IN feature which greatly increases the number of applications which can be serviced by one instrument. More X-axis flexibility and unmatched versatility — at lower overall cost.

### Specifications

#### X-AXIS PLUG-IN ADAPTERS

Model(s) 1400, BASIC, with 500 to 5000 cps trigger generator.  
14C1, SWEEP DELAY, continuously variable from .5  $\mu$  sec. to .1 sec.  
14C2, SWEEP EXPANSION, 5 to 1 expansion  
14C3, GATED MARKER GENERATOR, .1  $\mu$  sec. to .1 sec.  
14C4, TV TRIGGER SHAPER, triggers on composite video signal.  
14C5, LONG SWEEPS, from .1  $\mu$  sec./cm. to 10 sec./cm.

#### BASIC SCOPE

##### Y-Axis Amplifier

Deflection Sensitivity — 15 mv./cm. p-p for both d-c and a-c (max.)  
Max. Signal Voltage — 500 volts, peak.  
Frequency Response — d-c to 10 mc/sec. (3 db point)  
Transient Response — Rise time (10%-90%) — 0.035  $\mu$  sec.  
Linearity of Deflection — Max. deflection, 5". At 2.5" unipolar deflection, maximum compression is 10%.  
Signal Delay — 0.25  $\mu$  sec.  
Input Termination — 53, 72, or 93 ohms.  
Input Impedance — 1 megohm, 30  $\mu\mu$ f.

##### X-Axis

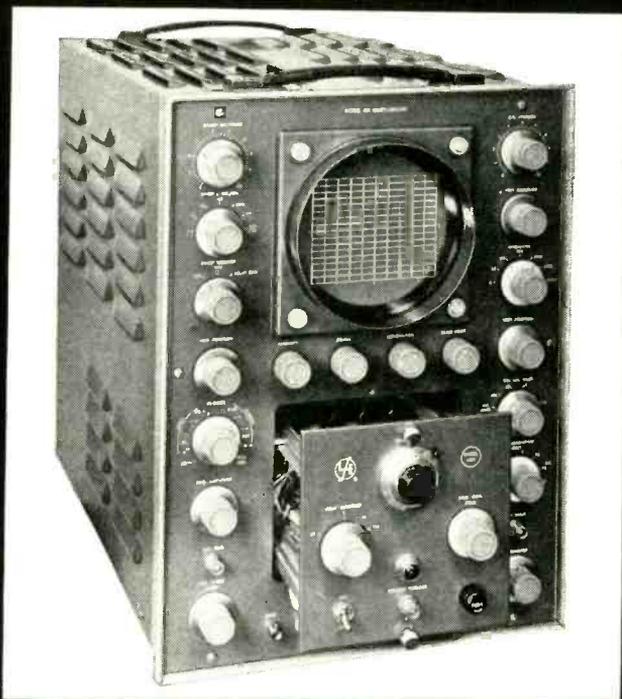
Sweep Time Range, calibrated — .1  $\mu$  sec./cm. to .1 sec./cm.  
External Sweep Sensitivity — 2 volts/cm., p-p.  
Frequency Response — DC to 1 Mc., (3 db. point)  
Triggers — Internal or External to 10 mc., 60 cps  
DC Blanking.

#### OTHER FEATURES

Flat-face CRT Type 5-ABP1 (P7 or P11 optional) — Accelerating Potential 3000 or 4000 volts.  
Deflection Plates Accessible.  
Power Requirements: 105-125 V., or 210-250 V., 50-60 cycles, 385 watts.  
Dimensions: 13" w, 17 $\frac{3}{4}$ " h, 21" d.

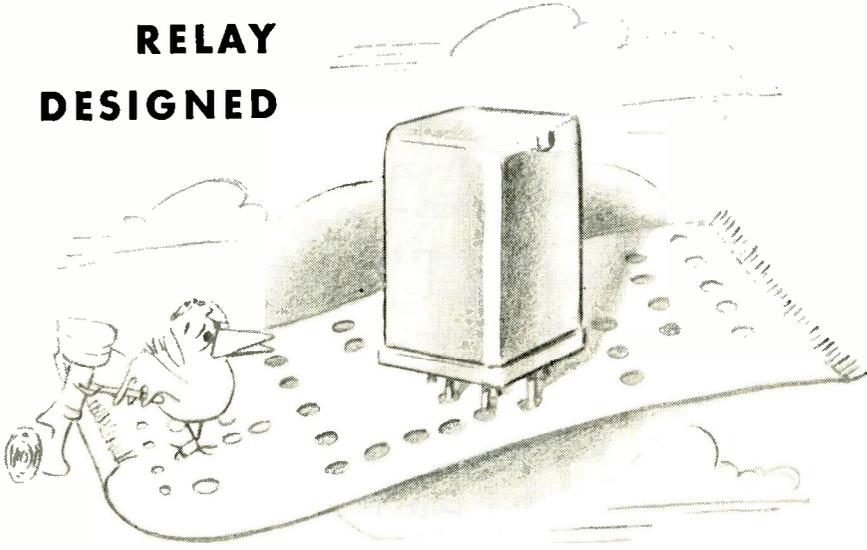


LABORATORY FOR ELECTRONICS, INC.  
75 Pitts Street Boston 14, Mass.



OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS  
SOLID DELAY LINES • SPAR • SPAR-S

# NEW RELAY DESIGNED



FOR

# AUTOMATION

Being totally unprepared the last time\* a vast new era suddenly dawned before us, this time we have taken steps: our new Series AM relays for AUTOMATION are now available in commercial quantities.

Although millenium system requirements are not yet fully charted, the new AM relays have built-in application selectors with automatic information read-out in six syllable superlatives, expressed in terms of a specific frontier. (Internal rectifier handles alternating decisions of management.) Resistance to practical limiting circuits is of a proportionately high order. Speed is variable, depending upon the relative setting of the hue and cry integrator and current fluctuations in the editorial line. Mechanical life is nominally rated at infinity.

Design refinements are already underway (work is now in progress on a space salesman-type choke version for high speed conversation switching applications), although present models are equipped with SPDT Bold-D contact arrangement for accepted utopian feedback circuits. Cylindrical ivory tower enclosure is mounted on a standard magnal base, with direct connection to maintenance department circuit provided by pins 2 and 7.

For complete technical data, write our New Era Division.  
Other conventional Sigma relays are also available, but their use is limited to the present industrial revolution only.

\*Advent of era of Electronics

# SIGMA

SIGMA INSTRUMENTS, INC.  
62 PEARL ST., SO. BRAINTREE, BOSTON 85, MASS.

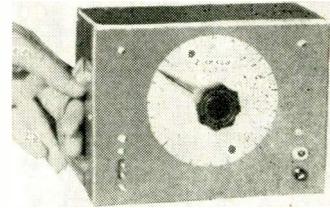
ELECTRONS AT WORK

(continued)

by an angle that may be varied from 0 to 360 degrees.

The circuit of a unit that is economical to build and will serve adequately is shown.

In this circuit  $E_1 = E_2 = E \sin \omega t$  and  $L$ ,  $R_1$  and  $C$  are chosen with respect to  $R_2$  and  $R_3$  so that  $V_{wx} = 2V_k \cos(\omega t + \alpha)$ , and  $V_{yz} = 2V_k \sin(\omega t + \alpha)$ . Potentiometers  $R_2$  and  $R_3$  consist of rectangular cards



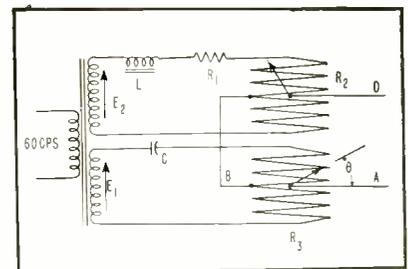
Lightweight, portable device for servo testing

on which resistance wire is uniformly wound top to bottom. Contact arms are pivoted at the centers of the cards and ganged to each other in positions 90 deg apart so that  $V_{AB} = V_k \cos(\omega t + \alpha) \sin \theta$ , and  $V_{BD} = V_k \sin(\omega t + \alpha) \sin(\theta + 90^\circ) = V_k \sin(\omega t + \alpha) \cos \theta$ .  $V_{AD} = V_{AB} + V_{BD} = V_k [\cos(\omega t + \alpha) \sin \theta + \sin(\omega t + \alpha) \cos \theta] = V_k \sin(\omega t + \alpha + \theta)$ .

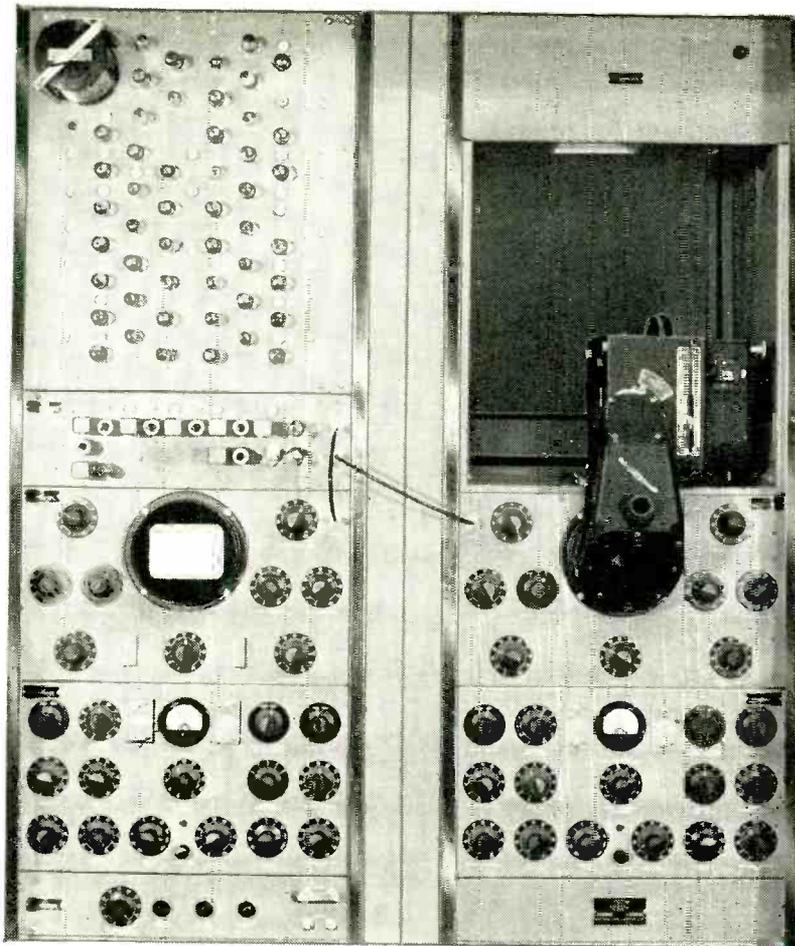
Hence, output is of constant amplitude and varies from phase of input in a linear manner with rotation of ganged arms.

Output impedance varies slightly over the range, but does not have the wide variation of the conventional R-C phase-shifter.

Harmonic content of the input signal causes the output waveform to be distorted—since the inductive half of the circuit tends to attenuate harmonics in the output,



Phase shifter uses two cards wound with resistance wire as  $R_2$  and  $R_3$ . Potentiometer arms, mounted in center of card, are ganged and displaced from each other by 90 deg



500 mc recording receiver, front section

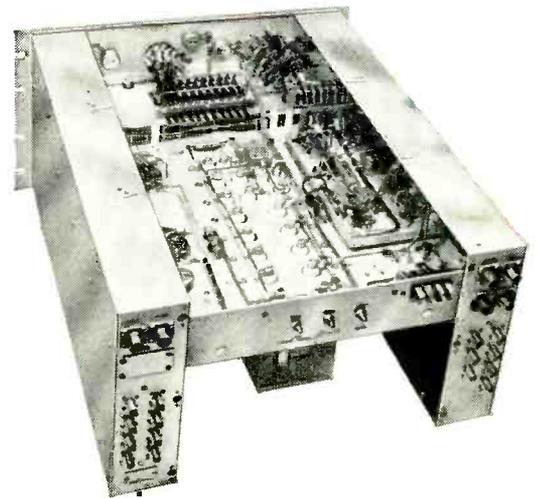
## Solutions Unlimited

**D**uring its thirty-two years, Radio Engineering Laboratories has received world-wide acclaim for superior designs and production of dependable radio equipment. REL gear is continuing to achieve outstanding performance in these and other current applications:

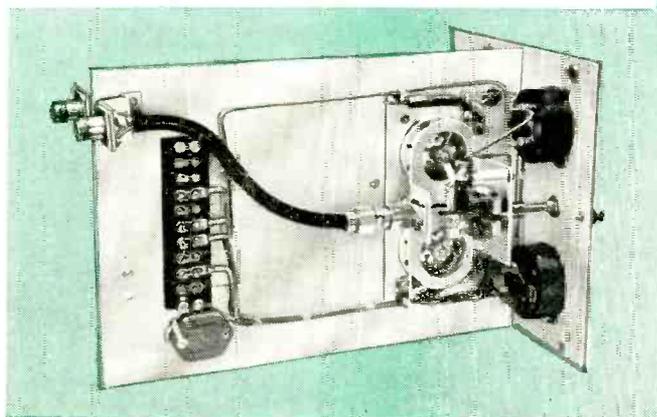
*Thin route telephone toll service  
Guided missile control  
Wave propagation research  
Point-to-point communications (long and short range)*

*Radio frequency bands: 50 to 1500 mc  
Output powers: 2 watts to 10 kw  
Modulation base bands: .20 kc to .5 mc  
Receiver noise factors: 3 to 7 db*

Your specialized radio problems are invited; REL has the experience and facilities to solve them.



Sweep generator, bottom view



150 mc output amplifier, bottom view



### RADIO ENGINEERING LABORATORIES · INC.

36-40 37th St · Long Island City 1, N. Y.  
STillwell 6-2100 · Teletype: NY 4-2816

Canadian representative:  
Ahearn & Soper Co., P. O. Box 715, Ottawa

International representative:  
Rocke International Corp., 13 E. 40, N. Y. C. 17





## **New Taylor laminates are premium in everything but price**

**Y**OU'LL LIKE everything about this new family of Taylor paper-base laminates—including their price. They're a new kind of hot-punch laminate, uniform all the way through, with no surface overlay of resin.

In insulation resistance, water absorption, power factor, flame retardance and dimensional stability, they'll meet or exceed your strictest specifications. And they punch and stake so well . . . with smooth surfaces and clean edges . . . that you can produce complex parts with maximum utilization of each sheet.

Four different grades are available in production quantities, in standard sheet size of approximately 49" by 49":

**XXXP-301** . . . *the top grade laminate* with unusually high insulation resistance, lowest water absorption . . . excellent punching and staking.

**XXP-351** . . . a high grade laminate with most of the properties of XXXP-301, at lower price.

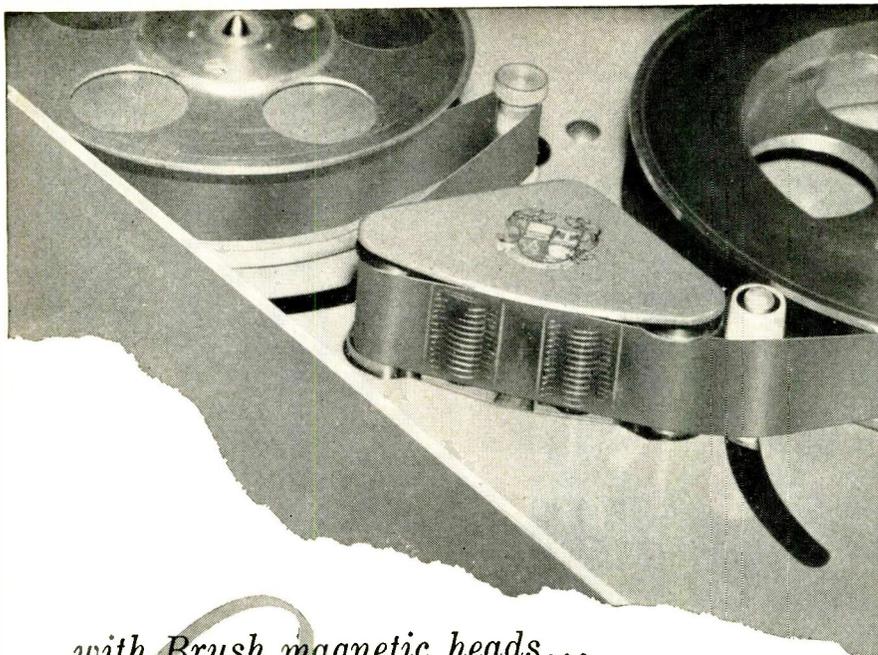
**Grade 353** . . . a quality grade laminate priced for economy, with outstanding electrical and physical properties.

**Grade 354** . . . an easily fabricated grade having low water absorption and good stability . . . priced for real savings.

Taylor Fibre Co. Plants in Norristown, Pa.; and La Verne, Calif. *Branch offices in Atlanta; Boston; Chicago; Cleveland; Dayton; Detroit; Indianapolis; Los Angeles; Milwaukee; New York City; Philadelphia; Rochester; San Francisco; St. Louis; and Tolland, Connecticut. Distributors in Grand Prairie and Houston, Texas; Jacksonville, Florida; New Orleans, Louisiana; and Toronto, Ontario.*

**WRITE TODAY FOR FULL SPECIFICATIONS, AND FOR ENGINEERING ASSISTANCE IN APPLICATION**

**TAYLOR**  
Laminated Plastics  
Vulcanized Fibre

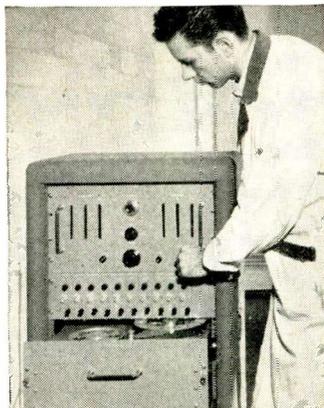


with Brush magnetic heads...

**25** data channels

**on a 1-inch tape!**

The Vic-Dar, produced by Victor Adding Machine Company, Chicago, Illinois, provides a new and faster method of data accumulation and storage with magnetic recording. For the first time, up to 25 channels of information can be stored on a tape only 1 inch wide.



*Vic-Dar System comprises a portable recording unit and a digital readout translator. The system can be used to accumulate and reduce data on speed, pressure, motion, temperature, etc.*

This is accomplished by using two Brush magnetic heads, one a 13-channel and the other a 12-channel model. These heads are positioned so that the channels interlace. The required high dimensional accuracy is achieved by Brush's advanced production techniques and workmanship. The precision gap alignment of the Brush heads also permits recording tapes on one unit and playing them back on another, with all signals in perfect relationship.

Can precision Brush heads help you open new frontiers in magnetic recording? For bulletin describing our complete line, write Brush Electronics Company, Dept. K-12, 3405 Perkins Avenue, Cleveland 14, Ohio.

## BRUSH ELECTRONICS

INDUSTRIAL AND RESEARCH INSTRUMENTS  
PIEZO-ELECTRIC MATERIALS • ACOUSTIC DEVICES  
MAGNETIC RECORDING EQUIPMENT  
ULTRASONIC EQUIPMENT



## COMPANY

formerly  
The Brush Development Co.  
Brush Electronics Company  
is an operating unit of  
Clevite Corporation.

the pulse duration and amplitude are similar. Resistance of the register is approximately 700 ohms. The circuit can be used with similar devices.

The type 6V6 cathode follower output tube puts out pulses in usable form that is independent of input voltage, provided input to the circuit is no less than 20 volts rms.

Information on this circuit has been made available through the courtesy of Tracerlab, Boston, Mass., distributors of the Swedish mechanical register described.

### Selective A-F Transistor Amplifier

BY D. BIER AND S. ROSEN

Tel-Aviv, Israel

GOOD STABILITY and selectivity are obtained with the amplifier circuit shown in Fig. 1, using a single junction transistor. Negative feedback for all frequencies is provided by a resistor in the emitter circuit. Positive feedback at one frequency is provided by a tuned transformer. Voltage gain is 76 and current drain is about 100 microamperes at 4.5 volts.

The tuned transformer has the following parameters:  $L_1 = 18$  mh,  $Q = 80$ , 460 turns,  $L_2 = 0.1$  mh, 25 turns, wound of 0.2-mm enamel-covered copper wire on an Arnold toroidal core having an outer diameter of 1.35 in., inner diameter 0.92 in. and a height 0.35 in.

The frequency of the circuit (10 kc) is determined mainly by  $L_1$  and  $C_2$  for the values given. Positive feedback is applied through  $L_2$  and is limited by  $R_3$  to avoid oscillations. Resistor  $R_2$  provides negative feedback and determines the selectivity of the circuit.

With the components shown the

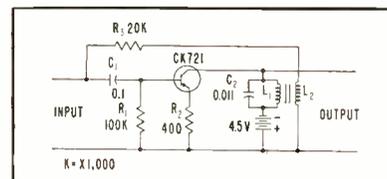


FIG. 1—Positive feedback is supplied by tuned circuit in collector of selective a-f amplifier

# color

# tv



**CHICAGO TELEPHONE SUPPLY**  
*Corporation*

ELKHART • INDIANA

*Specialists in Precision Mass Production  
of Variable Resistors • Founded 1896*

# controls

**THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS**

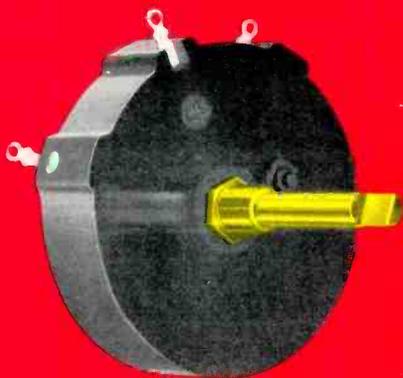
- 1. SIZES—"dime size" to 2 1/2" diameter.
- 2. WATTAGES—2/10 watt to 4 watt.
- 3. TYPES—carbon and wirewound with and without attached switch.
- 4. MOUNTINGS—conventional bushing, twist ear and snap-in bracket for printed circuits.

- 5. TERMINAL STYLES—for conventional soldering, printed circuits and wire wrap.
- 6. COMBINATIONS—an endless variety of tandems, both single and dual shaft.

**A CTS control can be tailored to your specific requirement.**

**FURTHER DETAILS ON OTHER SIDE**





High voltage control for focus applications. Rated up to 5,000 volts DC across end terminals and 2 1/2 watts depending on total resistance. Will operate up to 15,000 volts DC above ground when mounted on insulated panel. CTS type 85.



Miniature 3/4" "dime size" composition control. Conserves panel space at price comparable to larger size bushing mounted controls. CTS type 70.

1 1/8" diameter composition control for applications where ratings up to 3.4 watt required. CTS type 35.



Concentric shaft tandem control with conventional bushing mounting. Designed for front panel dual knob applications, such as contrast and volume. Available in various combinations of composition or wirewound front and rear sections with or without on-off switch attached to rear section. CTS type GC-C252-45 with wirewound front section, composition rear section and on-off switch illustrated.

Ear mounted composition control. Simply twist two ears for rigid mounting. Eliminates bushing and mounting hardware. Available with shafts for knob operation or for preset applications with insulated or metal shaft. CTS type P45 with metal shaft illustrated.



Ear mounted two watt wirewound available with or without center tap. CTS type P-254 with tap illustrated.



Four watt wirewound control available with or without center tap. CTS type 27 with tap illustrated.



**Higher Wattage Carbon Controls With Exceptional Stability Available**

- **ONE WATT:** Entire 45 series 15/16" diameter line available with 90 series special one watt military resistance elements.
- **TWO WATT:** Entire 35 series 1 1/8" diameter line available with 95 series special two watt military resistance elements.

Ear mounted tandem for preset applications. Combines panel space saving features of a concentric tandem with the economy of an ear mounted unit. Available in various combinations of composition or wirewound front and rear sections. CTS type P-C2-45 with composition front and rear sections illustrated.



## THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS

CTS also makes a complete line of controls for military, black and white TV, radio and other commercial applications. Consultation without obligation available for all your control applications. Write for complete catalog TODAY.



**CHICAGO TELEPHONE SUPPLY**  
*Corporation*

ELKHART • INDIANA

**EAST COAST OFFICE**  
Henry E. Sanders  
130 North Broadway  
Camden 2, New Jersey  
Phone: Woodlawn 6-1668  
TWX No. Camden NJ 380

**SOUTHWESTERN U.S.A.**  
John A. Green Company  
6815 Oriole Drive  
P. O. Box 7224  
Dallas 9, Texas  
Phone: Dixon 9918

**SOUTH AMERICA**  
Jose Luis Pontet  
Buenos Aires, Argentina  
Montevideo, Uruguay  
Rio de Janeiro, Brazil  
Sao Paulo, Brazil

**WEST COAST OFFICE**  
Robert A. Stackhouse  
928 S. Robertson Blvd.  
Los Angeles 35, California  
Phone: Crestview 4-5931  
TWX No. BEV H 7666

**CANADIAN DIVISION**  
C. C. Meredith & Co., Ltd.  
Streetsville, Ontario  
Phone: 310

**OTHER EXPORT**  
Sylvan Ginsbury  
8 West 40th Street  
New York 18, New York  
Phone: Pennsylvania 6-8239

*Specialists in Precision Mass Production of Variable Resistors • Founded 1896*

# Now! Meet **TOUGH** specifications with these **TOUGHER** ceramic-to-metal seals

## **ADVAC** **HERMETIC** **SEALS**

Proven reliable in both commercial and military applications including—

TRANSFORMER TERMINALS, JET ENGINE THERMOCOUPLES, NUCLEONICS, HEATING ELEMENTS, IGNITION INSULATORS, MAGNATRON OUTPUT WINDOWS, VACUUM TUBE CLOSURES, REFRIGERATION COMPRESSORS, SINGLE AND MULTIPLE CONDUCTOR CABLE END SEALS, CHEMICAL INSULATORS, EXPLOSION-PROOF ASSEMBLIES, CAPACITOR TERMINALS, CONNECTORS, RELAYS, FILTERS.

..for temperatures to 1400°F  
..pressures to 2000 psi

The ADVAC metalizing process makes it possible to produce hermetic seals capable of withstanding higher temperatures and severe thermal shock. These *super-rugged* seals are the result of the integration of the metal coating into the ceramic itself. "Wedding" the two materials furnishes a bond for the soldering or brazing of metal parts. A complete line of standard terminals is available. Custom seals are fabricated for special requirements.

### TYPES OF ADVAC SEALS AVAILABLE

New ADVAC seals can be inside or outside diameter and butt seals. Various metals are used to meet the conditions of different environments. Where corrosion is a factor, specify Grade A Nickel; Monel metal for applications requiring non-magnetic properties.

#### SOFT SOLDER TERMINALS

Metal bands fired to the metalized ceramic surface. Resist amalgamation, will not peel or lift, provide silver surface for soft-soldering.

#### CUSTOM BUILT SEALS

For extremely high pressures and temperatures to 1825°F and wide variations in ambient conditions. Rigid quality control assures vacuum tight seals.

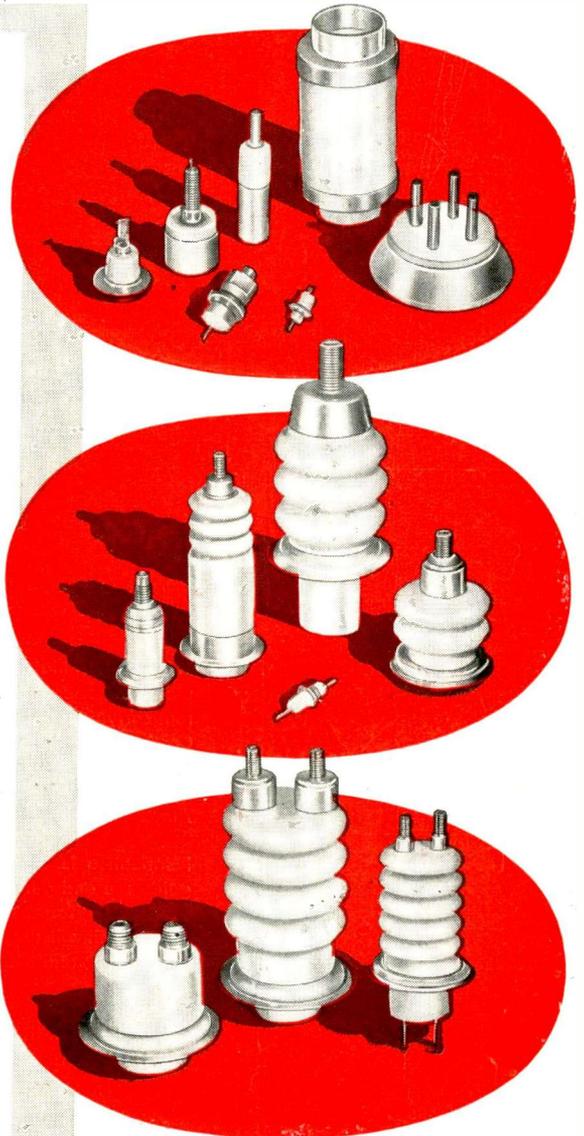
#### ASSEMBLED BRAZED TERMINALS

For service at elevated temperatures. Custom made for specific services. These ADVAC terminals withstand temperatures to 1400°F and higher.

#### COMPLETE ASSEMBLIES

Terminals can be supplied brazed to headers to your specifications. Quotations on complete assemblies, including cover plates, will be furnished on request.

CALL OR WRITE for literature or recommendations on your hermetic sealing problem. ADVAC engineers are specialists in high temperature, high pressure ceramic-to-metal seals. For competent assistance on your particular requirements, contact ADVAC, today!



**ADVANCED  
VACUUM  
PRODUCTS • INC**

18-22 LIBERTY STREET  
STAMFORD, CONNECTICUT

Telephone Stamford 3-8934

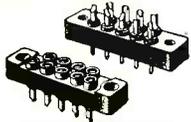
A DIVISION OF GENERAL CERAMICS CORPORATION



SERIES "EZ 16" EASY RELEASE



SERIES "16" POWER

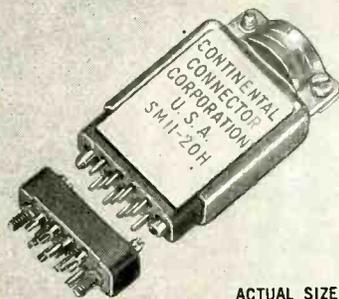


SERIES "14" POWER

# new... precision Continental Connectors

simplify your connector problems

11 CONTACT  
SERIES "SM-20"  
with top opening  
aluminum hood



ACTUAL SIZE



SERIES "20" MINIATURE



SERIES "SM-20" SUBMINIATURE



SERIES "P-C" PRINTED CIRCUIT



SERIES "H-20" HERMETIC SEAL



SERIES "C-20" HEXAGONAL

## Rectangular Series 'SM-20' SUBMINIATURE CONNECTORS

When your miniaturized equipment needs subminiature connectors with the same durability and current carrying capacity of larger connectors, specify Continental Series SM-20. This series is available in 7, 11, 14, 20, 26 and 34 contacts, in a choice of Mineral filled Melamine, Plaskon reinforced (glass) Alkyd 440A or Diallyl Phthalate.

Polarization is unusually positive with a reversed guide pin and guide socket. Engagement and disengagement forces have been reduced without sacrificing millivolt drop. Voltage breakdown is 2700 at sea level, and 800 volts at 60,000 feet.

For illustrated technical literature, write Dept. E, Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

Electronic  
Sales  
Division

# DeJUR

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.

selectivity obtained was  $\pm 150$  cps between the 3-db points 10 kc being the mid-frequency. Input level is 1 mv. Values of  $R_2$  and  $R_3$  are not critical and may be slightly reduced to increase the gain.

A 3-stage transistor selective a-f amplifier using this circuit is shown in Fig. 2. Coupling between the first and second transistor is achieved by a transformer with step-down im-

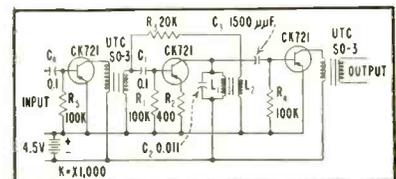


FIG. 2—Three-stage transistor amplifier provides a gain of 6,000 at 10 kc

pedance ratio of 10,000 to 200 ohms, which matches the collector impedance of the first CK 721 transistor to the base impedance of a few hundred ohms in the second transistor.

Coupling to the third stage by  $C_3$ , provides impedance transformation from the preceding collector. This transformation may be seen from the fact that the series circuit made up of coupling capacitor and base resistance may be considered as an equivalent parallel circuit having a much higher resistance. The equivalent parallel capacitance is included in the tuned circuit.

After introducing  $C_3$ ,  $C_2$  will require a slight readjustment to resonate at 10 kc. Overall voltage gain of circuit is 6,000. Input level is 0.5 mv.

## Simple Remote Control

REMOTE CONTROL by means of adjustable level d-c potential applied to a two-wire telephone line can be accomplished using a standard telephone dial to interrupt or pulse the steady state potential.

Experimental equipment developed at the Naval Research Laboratory at the request of the Bureau of Ships for airport traffic control uses two small adapter units and a reactance-tube assembly.

Amplifiers and metering circuits in the remote unit amplify and indicate the power level of audio signals returned over the same line from the local station. The local



# HUBBELL *Interlock*

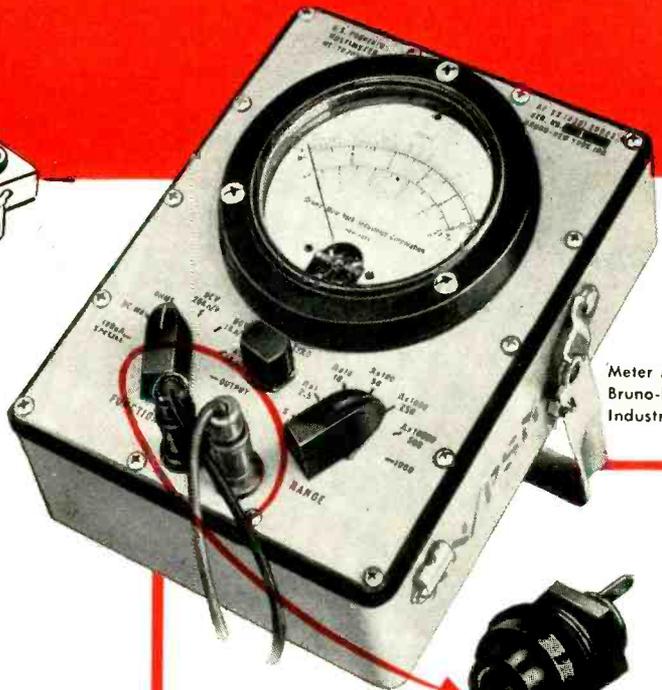
TRADE MARK

automatic locking — quick disconnect  
low contact resistance connection for  
**METERS**



**Meter leads cannot disconnect accidentally**

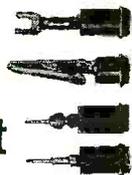
Bruno Multimeters take advantage of Hubbell Interlock's exclusive contact and locking features. Leads lock automatically when plugged into meter — disconnect only when intended. Contact resistance is extremely low, and stays constant because of unchanging coil spring pressure. Exclusive design and nylon insulation make Interlock jacks waterproof and weatherproof.



Meter Mfrd. by  
Bruno-New York  
Industries Corp.

## Another Hubbell Interlock Development!

**4 in 1**  
**Test Prod Kit**



This complete 10-piece kit, consisting of two prod couplers, one black and one red, and two each of four basic attachments, makes it possible to change from one tip to another without changing the entire test lead. Wired with Interlock Type S Plugs for a perfect, low contact resistance connection at the meter, Hubbell's versatile test kit gives an accurate reading every time. Basic attachments are: Phone Tip, Phono Needle, Alligator Clip and Spade Terminal. Extra attachments also available in black or red.



Hubbell Interlock connectors, shown, are nylon insulated . . . color-coded in black and red with a terminal wire connection.

The Type S connectors used in Bruno Multimeters accommodate wire sizes #14 to #18 with 15 amps. capacity.

Hubbell Interlock connectors may be put to a multiplicity of uses for both electrical and electronic devices. Our development laboratory will cooperate with your engineers to adapt Interlock for your specific applications.

For Further Information, Write Dept. AC



## HARVEY HUBBELL, Inc.

Interlock Electronic Connector Dept., Bridgeport 2, Conn.



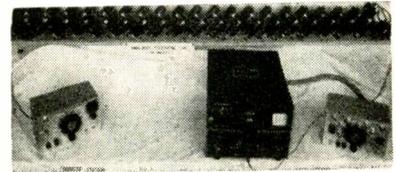
NEW **HIGH** ACCURACY  
**LOW WEIGHT**  
 SYNCHRO RECEIVERS

Weight of this receiver is less than 2 oz.—torque exceeds 2,300 mg mm/degree—accuracy 30 minutes, total error spread. Used in conjunction with a Clifton transmitter, overall system errors of less than 40 minutes spread— $\pm 30$  minutes approximately—are to be anticipated.

The same engineering team that developed the original 1.437" diameter high precision synchro has immediately available on a production basis these high torque high accuracy transmitter-indicator combinations at a saving of almost two-thirds the weight.

For full information on these and other units of this complete series of high accuracy Size #10, Size #11 and Size #15 units, write or telephone T.W. Shoop, Sales Manager, MAadison 6-2101. (Suburban Philadelphia)

**cppe**  
**CLIFTON PRECISION PRODUCTS COMPANY INC.**  
 CLIFTON HEIGHTS **PA** PENNSYLVANIA



Local station at right can be used to control simple functions of receiver (center) or control can be shifted to remote station (left). Lumped-constant simulated wire line is shown above

unit actuates a stepping switch in synchronism with d-c control pulses. Various preset receiver gain levels and several on-off functions can be remotely selected through the local stepping switch.

The reactance tube is connected across the first conversion oscillator tank circuit of the receiver and is controlled by the absolute level of steady-state d-c voltage impressed on the line by the remote unit. This feature makes it possible to effect fine tuning of the signal to which the local receiver is adjusted.

**PERTINENT PATENTS**

By NORMAN L. CHALFIN

*Hughes Aircraft Co.  
 Culver City, Calif.*

PATENT REVIEWS this month include an electron accelerator, miniaturized bandpass filter and an elec-

**Rocket Probe**



Electronic instrumentation used to obtain upper-atmosphere information is compactly assembled in cylindrical unit that forms rocket head. Instruments have been carried as high as 90 miles above Holloman Air Development Center using this technique

radio  
began  
here...

Here is the original miracle upon which all wireless telephony is founded... Lee de Forest's Audion tube.

Today of course it has been improved a thousand-fold... in sensitivity, in power, in range. But this one still stands as the granddaddy of them all.

*And what has this to do with Driver-Harris? Simply this:*

The improvements on the Audion have come about through the combined efforts of thousands of devoted physicists, metallurgists, and engineers, whose increasing skills have in turn been made possible by the production of ever more effective radio alloys. Since the very beginnings of radio, the Driver-Harris metallurgists have led the way in developing these special-purpose alloys conforming to rigid specifications, upon which the performance of electron tubes so largely depends.

*With the result that today Driver-Harris sells annually more tons of radio alloys to the makers of electron tubes than does any other supplier.*

Driver-Harris makes alloys for every electronic tube requirement: for grids, plates, side rods, glass seals, cathode sleeves and tabs, socket prongs, mica straps. We offer over 80 electrical heat- and corrosion-resistant alloys for various electrical and electronic applications.

If the alloy you need hasn't already been developed, send us your specifications. Our engineers with 48 years of experience are at your service.



*The Audion electron tube, invented by Lee de Forest in 1906*

Sole producers of world-famous Nichrome



**SOME PROMINENT DRIVER-HARRIS RADIO ALLOYS:** Nichrome\* • Gridnic\* • Nickel "A", "D", "E", "Z", 330, 499, 599 • Therlo\* • 152 Alloy • 142 Alloy • 146 Alloy

\*T. M. Reg. U. S. Pat. Off.

**Driver-Harris Company** HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Louisville, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario.

**MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD**

# VHF

... Very High Frequencies



**RADIO INTERFERENCE  
and FIELD INTENSITY \*  
measuring equipment**

**Stoddart NM-30A • 20mc to 400mc**

Commercial Equivalent of AN/URM-47

**PRINTED CIRCUITRY...** Modern printed circuits offer many advantages over conventional wiring, lighter weight, more compact units and freedom from many of the troubles normally encountered in conventionally-wired electronic equipment. Vibration becomes even less of a problem with printed circuits, adding to the many portable features already available with Stoddart equipment.

**ADVANCED DESIGN...** Specialized engineering and modern production techniques have produced one of the most advanced instruments for the accurate measurement, analysis and interpretation of radiated and conducted radio-frequency signals and interference ever manufactured. Designed to laboratory standards, rugged, and with matchless performance, the versatile NM-30A is an outstanding example of modern instrumentation. Its frequency range includes FM and TV bands.

**SMALLER SIZE...** A wider frequency range and higher standard of performance is incorporated into an equipment whose size is one-third that of any similar equipment ever manufactured.

**SENSITIVITY...** Sensitivity ranges from one to ten microvolts-per-meter, depending upon frequency and antenna in use.

**APPLICATIONS...** Field intensity surveys, antenna radiation pattern studies, interference location and measurement for checking radiation from virtually any mechanical or electrical device capable of generating or radiating radio-frequency signals or interference.

Stoddart RI-FI\* Meters cover the frequency range 14kc to 1000mc

#### VLF

NM-10A, 14kc to 250kc  
Commercial Equivalent of  
AN/URM-6B. Very low frequen-  
cies.

#### HF

NM-20B, 150kc to 25mc  
Commercial Equivalent of  
AN/PRM-1A. Self-contained  
batteries. A.C. supply optional.  
Includes standard broadcast  
band, radio range, WWV, and  
communications frequencies.  
Has BFO.

#### UHF

NM-50A, 375mc to 1000mc  
Commercial Equivalent of  
AN/URM-17. Frequency range  
includes Citizens band and  
UHF color TV-band.

**STODDART AIRCRAFT RADIO Co., Inc.**

6544-A Santa Monica Blvd., Hollywood 38, California • Hollywood 4-9294

tronic switching device.

#### Electron Accelerator

Novel electron sources have figured in recently issued patents. One in particular awarded to K. Gund, H. Berger, M. M. Scheer and R. Schittenhelm of Erlangen, Germany, is for an electron accelerator. The patent is No. 2,637,818.

The invention is shown in Fig. 1. Radiation output end of the device

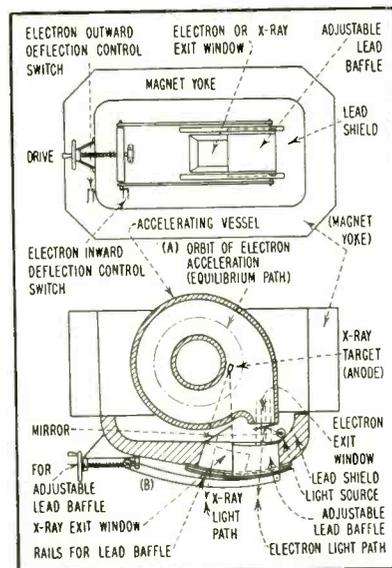


FIG. 1—Radiation output (A) and internal structure (B)

is shown at (A); Fig. 1B shows the internal structure.

Within the accelerator structure, the electrons are accelerated in an equilibrium orbit. Upon actuation of an appropriate switch the beam of electrons may be deflected inwardly or outwardly with respect to the orbit.

Inward deflection results in accelerated electrons striking the target anode to produce X rays. Outward deflection results in electron emission through an electron exit window. Either X ray or electron radiation may be selected by the switching devices. A lead baffle may be moved into place to cut off one or the other as needed.

The accelerator of this invention is used in medical therapeutic work where either X radiation or electron radiation is required.

A light source impinging upon mirrors whose surfaces are opaque and reflective to light but transparent to X rays or electron streams is used to show which of the radia-

## Got a problem?



This engineer just solved one in a matter of moments with his copy of Catalog No. 200, **Vac-Tite\* Compression Multi-Headers:**

**The Problem:**  
4-terminal headers

for a cover on a sensitive relay enclosure.



## The solution:



The exact part he needs is found on page 3. **Hermetic part number MSC 375R-400 EA4** meets the need perfectly with four terminals, hooked

outside, straight-cut inside; a flange reversed body, for inside mounting in a plate, pierced, .350 c.a. hole.



# FREE! Our New Addition to Your Encyclopedia Hermetica

**Now Available, Hermetic's Catalog No. 200, Offering Unparalleled Coverage of Vac-Tite\* Compression Multi-Headers.**

This handy desk-side reference on compression multi-headers is the latest volume of a series on hermetic seals for electronics "packaging". This series codifies and catalogs every significant innovation in hermetic seals. When complete, we believe you will find the "Encyclopedia Hermetica" the easiest, most helpful source of design and purchasing information on hermetic seals available in the industry.

**Hermetic's Catalog No. 200, Vac-Tite\* Compression Multi-Headers,** lists over 2,500 separate variations in body constructions, sizes and terminations. This wide selection is codified and arranged in an easy tabular form so that selection is almost automatic. When using this catalog, almost any conceivable preferred type of multi-header can be located and identified by its exact Hermetic number in a matter of seconds.

You will find a copy of this latest volume of the "Encyclopedia Hermetica" a most useful desk-side aid in selecting the exact multi-header you need—why not write today for your free copy?

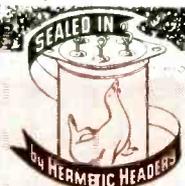
\***Vac-Tite**—a major improvement in mechanical strength and rigidity, achieved by **Hermetic's** exclusive glass-to-metal chemically bonded compression construction.



# Hermetic Seal Products Co.

31 South Sixth Street, Newark 7, New Jersey

F I R S T & F O R E M O S T I N M I N I A T U R I Z A T I O N



# FLORIDA'S

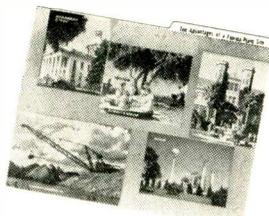
## Sunny Magic Extends to Business and Industry, Too!

It's great to be in Florida for vacation. But it's greater to LIVE and make your living in Florida. Florida's sunny tax climate and strategic geographic location in relation to expanding U. S. and Latin-American markets permit business and industry to grow and prosper.

Most types of industry and business can find a happy, sunny home in Florida with sun-blessed living for workers and executives. Florida has manpower—2,629 new residents moving here from other states every week. Florida has power. Florida has abundant water. Florida has a tax structure exceedingly favorable to business and industry. In short, Florida has what you need!

To find out how well qualified Florida is for the site of your new plant, branch plant, office or warehouse, write State of Florida, Industrial Development Divis., 3410C Caldwell Building, Tallahassee, Florida, for the NEW FREE FLORIDA INFORMATION KIT. It's file-size and contains separate folders, factually and accurately written, on the following aspects of Florida:

- MARKET • NATURAL RESOURCES
- EDUCATION & CULTURE • POWER
- RESEARCH • HEALTH & CLIMATE
- GOVERNMENT & TAXES • WATER
- LABOR • TRANSPORTATION



Plan national sales conventions, sales conferences and state and regional meetings for Florida. Exceptional facilities for any type of meeting. Get double value... successful meetings in delightful surroundings plus colorful recreational activities.

you'll always  
do better in



# Florida

Want more information? Use post card on last page.

tions is emanating at any time.

### Band-Pass Filter

A band-pass filter organization that can be incorporated into miniaturized assemblies is the subject of patent 2,668,882 awarded to M. Morrison of Upper Montclair, N. J. The title of the patent is simply "Amplifier".

The circuit of Morrison's assembly is shown in Fig. 2. Figure 3 shows the band-pass characteristics of the amplifier. Curve C represents the characteristic when the tank and both input and output are tuned to the center frequency. Curve D shows response when the tank is tuned to center frequency and the input and output are tuned to a lower frequency. It can be seen that there is greater symmetry in curve D. The inventor claims that the lower in frequency one tunes input and output away from center the more symmetrical are the skirts of the band-pass characteristic.

The filter proper shown at the left in Fig. 2 comprises a dust core toroidal high-Q tank coil, a tuning

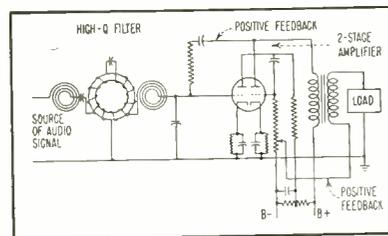


FIG. 2—Circuit of miniaturized band-pass filter

capacitor and input and output air-wound inductors. The inventor claims to obtain as much as 10 times the voltage across this circuit as in conventional circuits.

The two-stage amplifier at the right has a positive feedback path from output to input stages and another positive feedback path from the secondary of the output transformer to the grid of the output stage. Physically all of the resistor and capacitor components of the amplifier are located around the twin-triode amplifier tube.

The feedback of energy from amplifier to filter compensates for some of the normal filter dissipation losses. So long as the feedback does not equal the total filter dissipation losses, oscillations will not

# Another RMC First

"Wedg-loc" leads... they stay in place for easy soldering!

SEE DETAIL

$\frac{1}{4} \pm \frac{1}{32}$

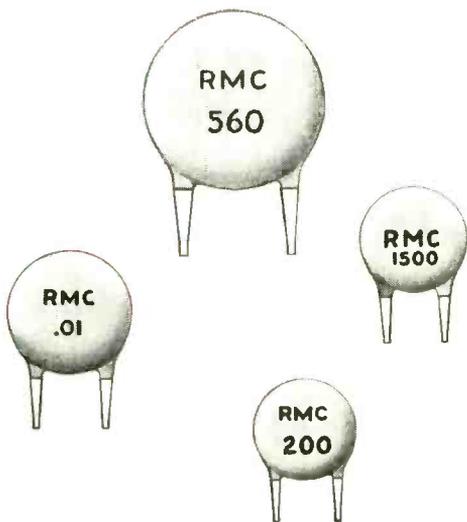
"D"

"E"

DIMENSION "E" VARIES WITH CAPACITY

BODY DIA "D"	.290 MAX.	.400 MAX.	.570 MAX.	.620 MAX.	.660 MAX.	.790 MAX.	.890 MAX.
SPACING "A"	.163	.163	.326	.326	.326	.326	.489

## Wedg-loc DISCAPS for printed wire circuits



The exclusive wedge design of the leads on these new DISCAPS lock them securely in place on printed circuit assemblies prior to the soldering operation. The "Wedg-loc" leads eliminate the possibility of the capacitors becoming loose or falling out. Application of "Wedg-loc" lead DISCAPS to your printed circuits will cut production time, reduce costs, and insure the uniformity of your soldered connection.

"Wedg-loc" DISCAPS are available in capacities between 2 MMF and 10,000 MMF in temperature compensating, by-pass, and stable capacity types with lead spacing as shown above. Electrical specifications and tolerances are the same as standard wire lead DISCAPS. Your inquiry is invited.

**ANOTHER NEW DEVELOPMENT FROM THE  
RMC TECHNICAL CERAMIC LABORATORY**

DISCAP  
CERAMIC  
CAPACITORS

# RMC

**RADIO MATERIALS CORPORATION**

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

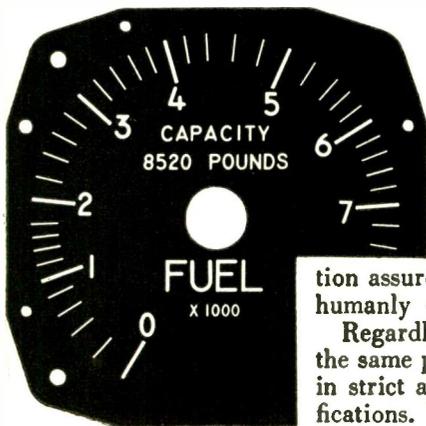
Two RMC Plants Devoted Exclusively to Ceramic Capacitors

Where the

INFINITESIMAL .001"

is **IMPORTANT**

AS IN INSTRUMENT DIALS



"MICROSCOPIC-PRECISION"

actually defines the minute accuracy of dials by U. S. Radium (instrument, clock, or watch), for "microscopic" checks and painstaking inspections in every step of production assure the *highest degree of perfection* humanly or mechanically possible.

Regardless of size of the order, we take the same pains to assure a finished product in strict accordance with prints and specifications. You are welcome to avail yourself of our engineering and designing experience toward the end that your product may be both *functionally satisfactory* and *less costly* in production.

where FUNCTIONAL DESIGN  
is IMPORTANT  
AS IN INSTRUMENT PANELS

Special equipment and specialized personnel, plus our rigid controls, constant checking and inspection guarantee the fine finished product your order merits. Whether flat or curved, we can produce your panels edge-lighted, and either luminous or non-luminous engraved, etched, screened or lithographed, with the *ultimate in uniformity and legibility*.

where APPEARANCE AND ECONOMY  
are IMPORTANT — AS IN NAMEPLATES

The same engineering skill and same plant facilities are yours for the production of nameplates. For years we have been the major source of supply for many industries and our reputation has been built on *attention to detail, prompt deliveries, and the economy* effected for our customers.

FOR COMPLETE INFORMATION on items of interest to you, address —  
United States Radium Corporation, 535 Pearl St., New York 7, N. Y.  
attention Dept. E-12



be sustained and so the system will be stable after removal of input energy from the source. The feedback path to the grid leak of the output stage is stabilized by the

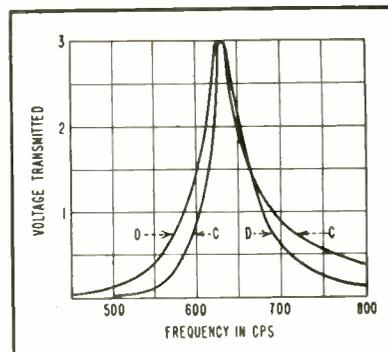


FIG. 3—Band-pass characteristics with tuning to center frequency C and input and output tuned to lower frequency D

grid conduction voltage, which limits the feedback current.

The inventor claims that he has developed herein a filter that attains results only obtainable with much larger and costlier filters in the prior art. The difficulty in the past, he points out has been due to much larger amount of stored energy present in multiple section filters. The single storage circuit of this invention lessens the difficulty.

The patent states that in a single-core storage unit, less core material is required for the same inductance, for two reasons; first, the same core is used for all the turns of the reactance and second, the inductance of a coil on a single core is proportional to the square of the number of total turns employed. That means, if four separate coils are used for a filter midsection, not only are four separate cores required, but also four times the total number of turns.

For example, if  $N$  turns are required on a certain size single core to obtain a given inductance, this inductance is proportional to  $N^2$ . If these  $N$  turns are equally distributed among four cores (as is common practice for a midsection) the inductance of each coil will be proportional to  $(N/4)^2$  and of the four coils will be  $4(N/4)^2$  which is equal to  $N^2/4$  or one fourth that of the single-core coil, which single coil results in a higher  $Q$  (more sharply defined cutoff characteristics) and less stored energy (faster modulation-frequency response

TO THE **MIGHTY**  
 ☆ **ARMED FORCES**  
*of the* **U. S. A.**



*Imprint of Integrity*

**HAS DEVOTED ITS FACILITIES**

- in the
- design
  - development
  - manufacture of
- ELECTRONIC and ELECTRO-MECHANICAL  
 MILITARY EQUIPMENT\***

**Having delivered annually many millions of dollars of equipment**

*.... on time!*

Including

- \* AIRBORNE NAVIGATIONAL EQUIPMENT
- \* COMMUNICATION SYSTEMS
- \* RADAR EQUIPMENT
- \* TEST EQUIPMENT

☆ **SERVING THE ARMED FORCES** is our most important business.

● Write for Facilities Brochure Dept. 12-E



*Imprint of Integrity*

**ELECTRONICS CORPORATION**

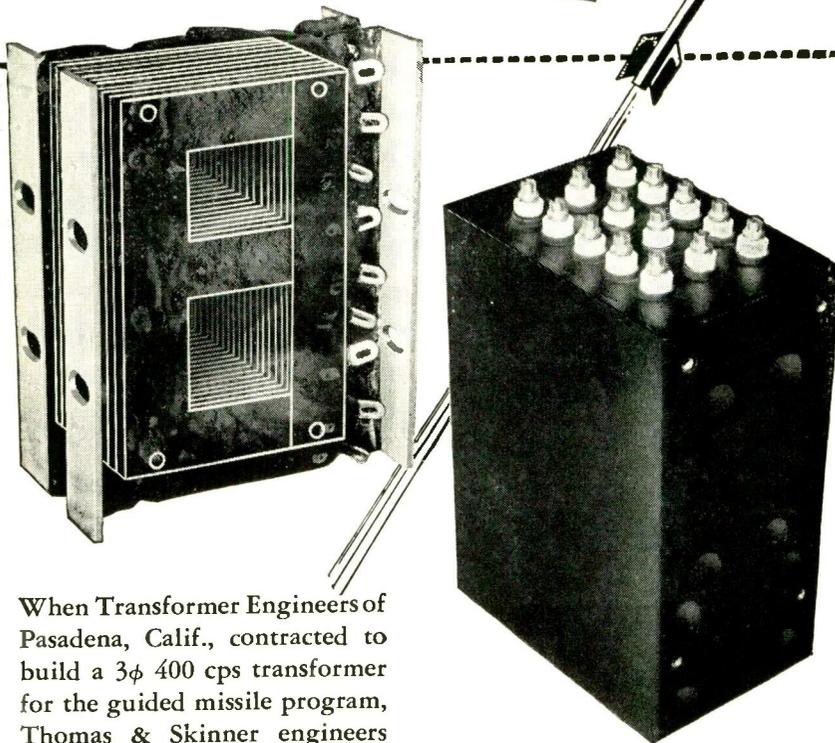
794 EAST 140th STREET

• NEW YORK 54, N. Y.

# ORTHO SIL

## 3-Phase Laminations

### Cut Costs, Weight, Space



When Transformer Engineers of Pasadena, Calif., contracted to build a 3 $\phi$  400 cps transformer for the guided missile program, Thomas & Skinner engineers were consulted for assistance. After thorough analysis, the new T & S EI 1/2"—3 $\phi$  OrthoSil 4 mil lamination was recommended. With this new, thin orthographic iron-silicon lamination, Transformer Engineers were able to cut both weight and size 25%, in addition to substantially reducing the unit cost.

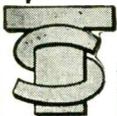
This success with 3 $\phi$  applications is typical of Thomas & Skinner's new OrthoSil lamina-

tions. The 3 $\phi$  series of OrthoSil laminations also include 3/8" and 5/8"—and will soon include the EI 7/8"—3 $\phi$ .

Transformers such as power and 3 $\phi$ , chokes, saturable reactors, and filters are but a few of the many electrical components for which OrthoSil oriented laminations are recommended.

Write today—ask for new T & S Electrical Laminations Bulletin No. L-752.

*Specialists in Magnetic Materials, Permanent Magnets, and Laminated Cores*



**THOMAS & SKINNER Steel Products Company, Inc.**

1122 E. 23rd Street, Indianapolis 7, Indiana

under transient working).

A further filter improvement can be made, if and when desired, under transient operation, by embodying the following discovery in filter terminal resistances, which may be included in the terminal reactors when indicated.

It is believed that this discovery can be taught by use of simpler filter circuits than that illustrated in Fig. 2 because the mathematical theory of such a circuit involves complex algebra and the disclosure desired to be made, can be taught easily by a simple procedure.

Referring to Fig. 4A, there is shown a conventional single-stage high-pass filter. Conventional filter theory assumes the flow energy in

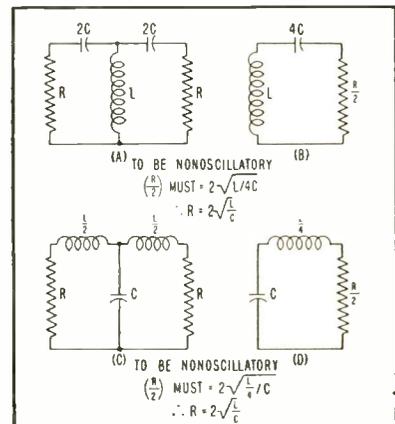


FIG. 4—Development of filter described in text

such a filter is always in one direction at a time, that is, it flows from left to right or from right to left. On this basis it is shown that if no reflections are to occur at the filter ends (which is merely another way of saying that the filter will not sustain oscillations of its own accord or that it is a nonoscillatory system), the terminal resistances must each equal the characteristic impedance of the system or  $R = (L/C)^{1/2}$ .

While most treatments of the subject do not point out that the result is arrived at on a basis of the steady-state analysis of the network, that is the case. It is known that this result has certain frequency limitations attached to it, but it is the basis of a good working rule for steady-state filter operation.

Referring again to Fig. 4A, if a rectangular pulse-modulated wave

# SOLVED! COLOR TV

TELECHROME  
SHOWS THE WAY

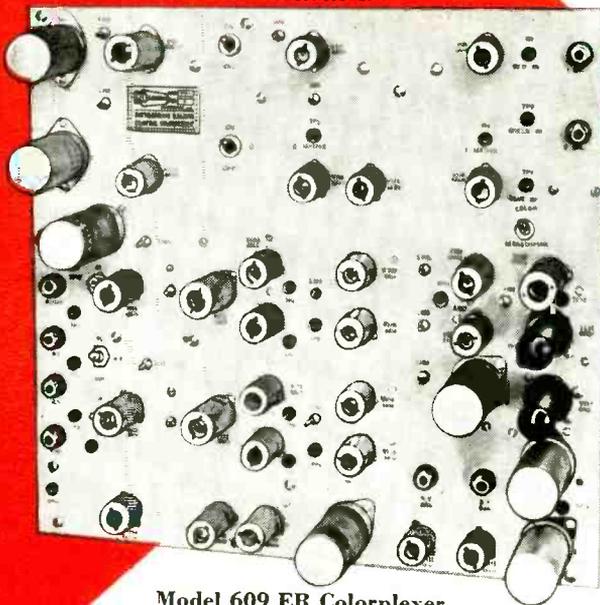
## DRIFT PROBLEMS IN COLORPLEXING EQUIPMENT



# AUTOMATIC BALANCE CONTROL



**Model 617 BR**  
Automatic Balance Control  
for ALL COLORPLEXERS  
REGARDLESS OF MANUFACTURE.



**Model 609 ER Colorplexer**  
with Built-in Balance Control

### ALL COLORPLEXERS DRIFT

One of the most difficult problems with which the color TV broadcaster is faced is that of drift in the modulator sections of the colorplexer. ALL COLORPLEXERS DRIFT, some more than others, but—

On the average, colorplexers require at least two hours of warm-up time and must be re-balanced a few times during a normal day's operation. Unbalance causes color receivers to "see" the wrong colors. TELECHROME'S new Model 617-BR Automatic Balance Control completely eliminates drift problems and works with ALL TYPES OF COLORPLEXERS REGARDLESS OF MANUFACTURE.

### ELIMINATES DRIFT PROBLEMS

An ingenious circuit locks the entire color encoding equipment in balance within 20 seconds after being turned on. Thereafter balance is held, even after weeks of operation.

The Automatic Balance Control holds balance even under conditions where ordinary colorplexers would go completely out of control—tubes may be replaced, room temperature conditions may be varied, line voltages may be changed, manual controls may be turned, tube types may be substituted—NONE of these conditions affects the colorplexer kept under control by the TELECHROME Model 617-BR Automatic Balance Control! WARM-UP TIME IS UNNECESSARY; this alone saves many engineering hours per week. And need for stand-by personnel to reset balance is eliminated.

A memory system is incorporated so that interruptions in signals or switching transients will not interfere with the operation of the correction circuits.

### NEW AUTOMATIC BALANCE CONTROL COLORPLEXER

The Model 609-ER Colorplexer is the ONLY unit engineered to incorporate Automatic Balance Control in order to eliminate chroma unbalance components in a color signal and to keep the colorplexer in balance at all times. This new Colorplexer design completely eliminates the necessity for manual adjustment of balance controls.

**DELIVERY 30 DAYS**



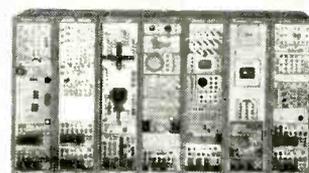
**Chromalyzer**  
Portable  
Color Bar  
Generator



**Chromoscope**  
Vector  
Display  
Signal  
Certification



**Phase Slope**  
(Envelope Delay)  
Curve Tracer



**Full facilities**  
Transmits,  
receives,  
monitors,  
analyzes  
composite  
color pictures

Literature on these and more than 100 additional instruments for color TV by TELECHROME are available on request.



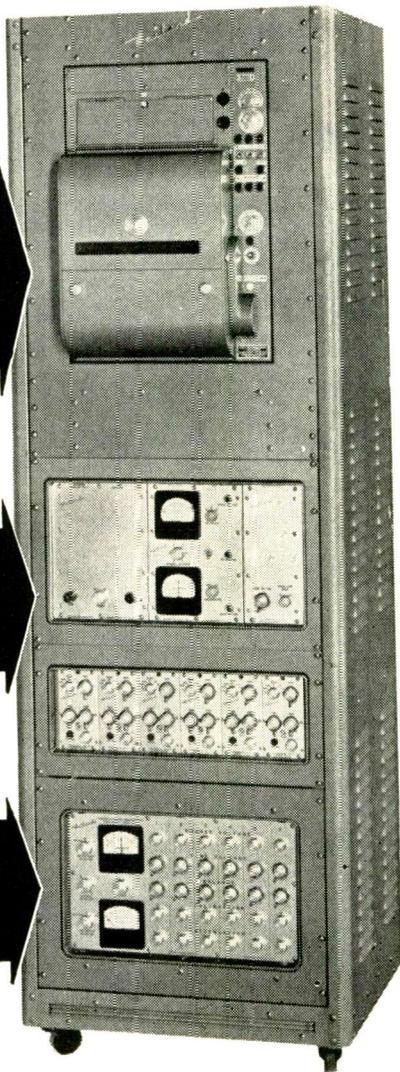
The Nation's Leading Supplier of Color TV Equipment  
88 Merrick Road Amityville, N. Y.  
AMITYVILLE 4-4446



**MULTI-(to 60) CHANNEL  
RECORDING  
OSCILLOGRAPHS**  
(Model 700)

**AMPLIFIER SYSTEMS**  
(Model 119)

**BRIDGE BALANCE UNITS**  
(Model 82-6)



*... designed* for fixed or mobile  
**relay rack mounting**

Write for complete details on the instruments shown above, as well as portable recording oscillographs and galvanometers.

**Heiland**  A DIVISION OF  
MINNEAPOLIS-HONEYWELL  
130 E. 5th Ave., Denver 3, Colorado

such as that in Fig. 5A is injected into one terminal resistance the *LC* of the circuit has to fill up before the steady-state transmission voltage value shows up at the other terminal resistance of the filter. This is illustrated by the form of the tracing of the envelope in (B) during the crescent interval. While

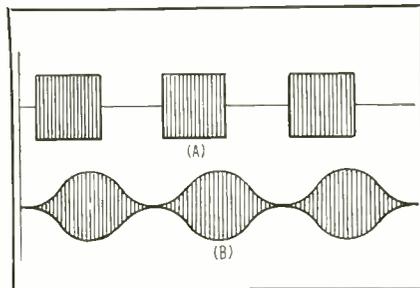


FIG. 5—Input waveforms (A) and output (B)

the curves in Fig. 5 are taken from the operation of the band-pass filter of Fig. 2, they can also be used as illustrating certain operations in filters having only high-pass or low-pass characteristics.

If the filter in Fig. 4A has its input energy interrupted when the *LC* of the circuit is full of stored energy, the flow of energy ceases to move in one direction. Because of the removal of opposing voltage at the input end, the stored energy moves toward that end as well as toward the output end. This means that when the input voltage is removed from the circuit, after steady-state operation is attained, circuit (A) operates exactly as circuit (B) of the same figure, which is its exact equivalent.

Circuit (B) is the familiar closed circuit system containing capacitance, inductance and resistance in series, represented by the differential equation

$$\frac{1}{c} \int idt + L \frac{di}{dt} + Ri = 0$$

It is well known that for a circuit represented by this equation to be nonoscillatory, *R* must have a value not less than that represented by the following relation:

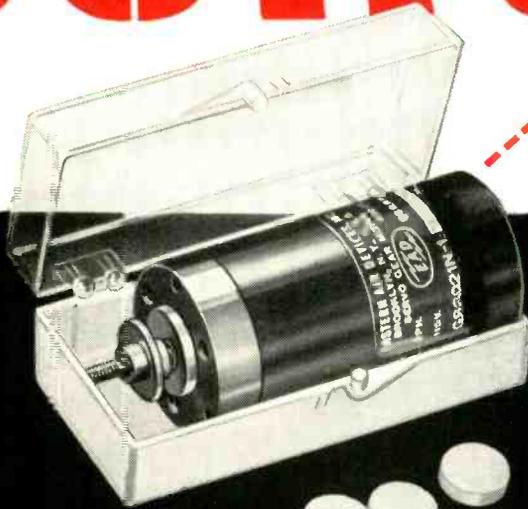
$$0 = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

or

$$R = 2\sqrt{L/C}$$

This double value of *R*, when the energy is flowing in two directions, provides the same resistance fac-

# POWER in a pillbox



## *EAD's* new *miniaturized* *1/8 inch* *servo-gear* *motor*

For high output torque in a miniature package EAD's tiny servo-gear motor has been designed for applications where size and weight are at a premium.

The various RPM and torque combinations are transmitted through precision cut gears mounted in miniature precision ball bearings.

For instant response and maximum torque in a tiny package this gear motor is well adapted for missiles, auto pilots, instrumentation and control devices.

Modifications are available in hysteresis-synchronous and induction designs.

EAD specializes in adapting its designs to meet unusual applications... Tell us your requirement.

Write for our new catalog today!

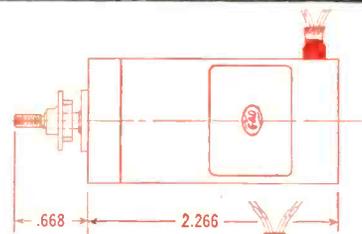


## **EASTERN AIR DEVICES, INC.**

SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD



387 CENTRAL AVENUE, DOVER, NEW HAMPSHIRE



MODEL NO.  
GS3021N-1



### CHARACTERISTICS

Input Voltage	115	Stall Torque	7 oz. in.
Phase	2	Rated Torque	3 oz. in.
Frequency	400 cycles	Size	1 1/8" dia.
No Load Speed	180 rpm		2 17/64" long
Full Load Speed	135 rpm	Gear Reduction	28.4
Rotor Inertia	1.25 gm. cm <sup>2</sup>	Weight	4 1/2 oz.
		Duty	Continuous

*a new achievement in  
fast-print oscilloscope  
recording...*

Simple to Operate. Uses standard Polaroid\* magazine and fast self-developing film. Delivers finished black field print in 60 seconds. Automatically Records 3 to 16 traces per print. Provides full size image on 3" scope, half-size image on 5" scope. No reversal of image.

### The Aremac Automatic

## RECORDOSCOPE 1185

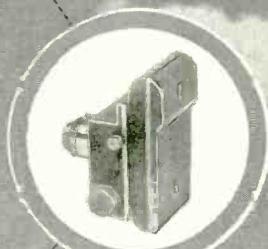
a fully automatic oscilloscope camera that reduces engineering time and costs ... improves results.

Sturdy Camera Mount with swing-a-way adapter hood. Camera easily swung aside when not in use. Provision for data card exposure. Versatile ... one camera can service several 3" and 5" scopes of different makes when provided with adapter mounts and hoods. Can be interchanged in seconds. Exposure plus automatic movement to next trace position can be accomplished in three ways: (1) manual shutter release, (2) cable release, (3) remote operating switch.

### Manual RECORDOSCOPE

The manually operated version of the RECORDOSCOPE 1185

offers many of the precision engineered advantages found in the companion automatic model. Though basically designed for manual release and advance of film, this camera can be factory modified for automatic operation.



\*POLAROID is the registered name of the Polaroid Corporation

### The Aremac RECORDOSCOPE 1073

*a 35 MM Synchronous Camera for Continuous Motion or Single Frame Oscilloscope Recording*

The Aremac 1073 Recordoscope is a compact self-contained unit mounting an f/2 six-element 50 mm lens and special 400 foot Aremac powered magazine. Shutter interlock system prevents film motion when shutter is closed. Synchronous film speeds range from 256"/sec. to 1/8"/sec. in 12 steps of 2:1 ratio. The camera can be stopped and restarted with practically instantaneous speed synchronization. Periscope mounts camera vertically. Provision for automatically illuminated data cards and strobe contacts.

Write for Complete Technical Data on AREMAC Cameras Today

# Aremac ASSOCIATES

MANUFACTURERS OF MECHANICAL & OPTICAL INSTRUMENTS  
329 WEST WASHINGTON STREET • PASADENA 3, CALIFORNIA

ing the double flow of the stored energy that the single  $R$  provides for the unidirectional flow of energy, because of the resistance being in parallel relation during double flow.

The same reasoning can be applied to a low-pass filter, as indicated in Fig. 4C, as well as to band-pass filters.

This means that if a filter functions under steady-state working in nonoscillatory operation with terminal resistances each equal to  $R$ ; for such a filter to function under transitory-state working in nonoscillatory operation, the terminal resistances must at least equal  $2R$ .

Referring again to Fig. 2 this means that, if and when desired, the nonoscillatory response of such a circuit can be materially improved by considerably increasing the resistance of the terminal half-sections, over and above that resistance that is equal to the characteristic impedance of the network.

### Photoelectric Switcher

J. A. Rajchman has been awarded patent 2,667,599 for an "Electronic Switching Device". The patent is assigned to RCA.

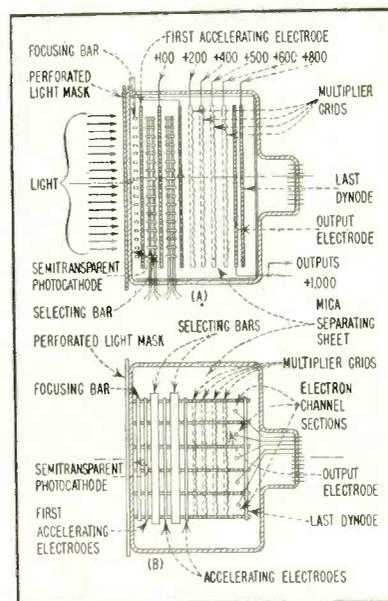
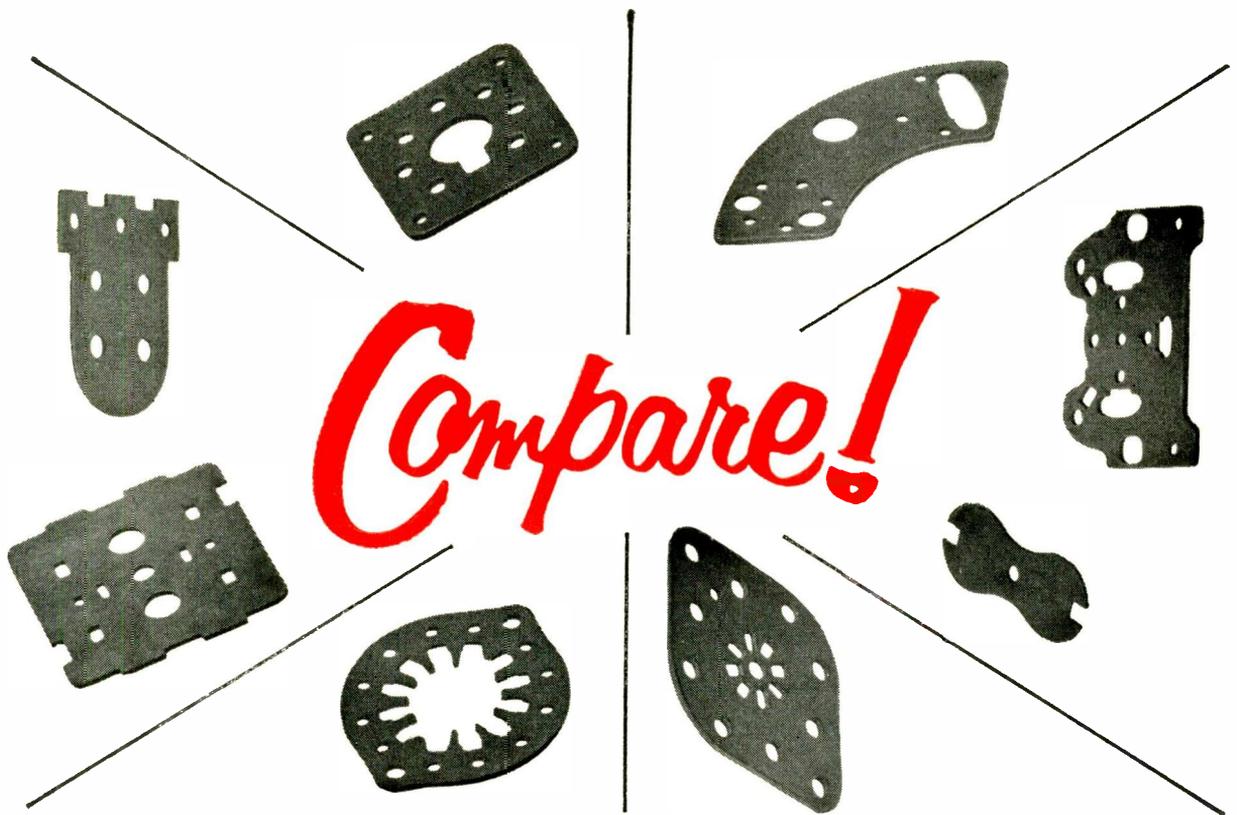


FIG. 6—Structure of the switching tube shows side (A) and top (B)

The structure of the switching tube is shown in Fig. 6. Figure 7 is a schematic of the device, which is a photoelectric type of electron multiplier.

Light entering the tube through



## New Mico XXP Laminate Gives You Much Higher Insulation Resistance

Here at last is a uniform, high-quality material with the higher insulation resistance you need for many applications in radar, television, radio, computers, electronic equipment of all kinds. It's MICO's Radar Grade LAMICOID #6229.

Compare for yourself! Test it together with other laminates under your own test methods for insulation resistance.

Write today for samples—or ask to have a MICO Sales Engineer call.

### Look at these other outstanding values!

#### WATER ABSORPTION, (%)

Precond. E-1/105	
Cond D1-24/23	
$\frac{1}{16}$ " thick	0.57
$\frac{1}{8}$ " thick	0.37

#### SPECIFIC GRAVITY

$\frac{1}{16}$ " thick	1.33
$\frac{1}{8}$ " thick	1.33

#### FLEXURAL STRENGTH, (psi)

Tested flatwise, Cond. A	
$\frac{1}{8}$ " thick	cut lengthwise 21,000
	cut crosswise 16,900

#### DISSIPATION FACTOR AT 1 MEGACYCLE

$\frac{1}{8}$ " thick	Cond. A	.0314
	Cond. D-24/23	.0316

#### DIELECTRIC CONSTANT AT 1 MEGACYCLE

$\frac{1}{8}$ " thick	Cond. A	4.42
	Cond. D-24/23	4.63

#### DIELECTRIC BREAKDOWN, (Kv.)

Parallel to lamination, S/S	
Cond. D-48/50	
$\frac{1}{16}$ " thick	68.8+
$\frac{1}{8}$ " thick	68.0+

#### PUNCHING QUALITY

$\frac{1}{16}$ " thick	Heated 1 min.	Good
	Heated 2 min.	Good
	Heated 3 min.	Good



**MICA** *Insulator* **COMPANY**

Schenectady 1, New York

Offices in Principal Cities

In Canada—Micanite Canada, Ltd., Granby, Quebec

LAMICOID® (Laminated Plastic) • MICANITE® (Built-up Mica) • EMPIRE® (Coated Fabrics and Papers) • FABRICATED MICA • ISOMICA®

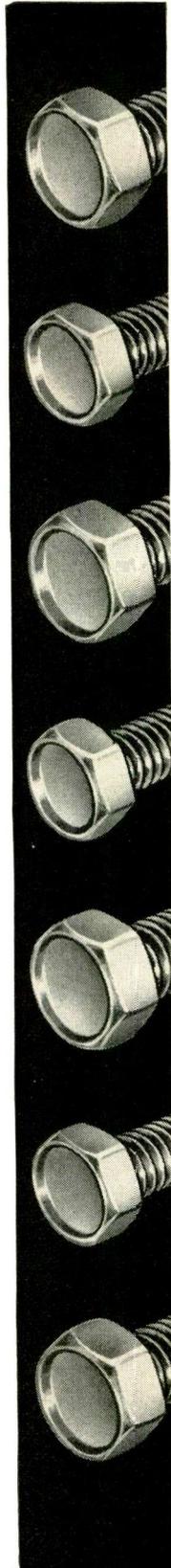
# SPECIALS may match the prices of STANDARDS

If ordered in fair quantities, recessed hex head screws cost no more than standard machine screws, and actually much less than trimmed hex head screws.

The saving results from elimination of one production operation, without loss of mechanical values. The difference is in appearance. And even that may be in favor of the recessed head.

To order only, made to standard dimensions in sizes to suit your needs or to your specifications.

*Get our prices and deliveries on your requirements. In fact write us about special upset, and rolled thread products of any kind. The cost may be lower than you think.*



MACHINE SCREWS AND SPECIAL FASTENERS ARE OUR BUSINESS



WRITE FOR  
OUR CATALOG

## THE PROGRESSIVE MANUFACTURING COMPANY

50 NORWOOD ST., TORRINGTON, CONN.

a perforated light mask impinges upon a photocathode. The perforations on the mask are prearranged according to some switching code. There is a plurality of columns and rows of electron multiplier channels each associated with one end of the

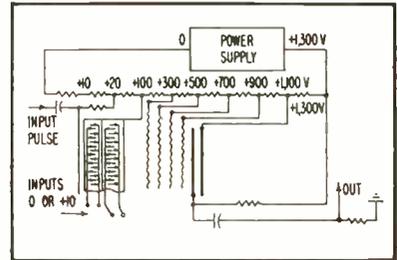


FIG. 7—Circuit of electron multiplier

mask, so that where there is a perforation in the mask, that area of the photocathode emits electrons into its associated electron-multiplier channel.

Selecting conductors are provided for each row of electron channels to select and maintain one row open to the passage of electrons. A separate target is provided for each column of electron channels. The position of perforations on the mask determine which of the electron channels in a row opened by the selector electrodes will have photoemitted electrons in it. There will be an output voltage at the target electrode connected with the selected column and row. The switching pattern may be changed by changing the pattern of the perforations.

A variation of the device not shown in the figures incorporates a horizontally and vertically selective grid structure instead of the light mask to actuate the electron channels and select those to be open or closed.

The device is used not only as a switching device but may be used as an encoder or decoder for computing machines. A given signal pattern may be applied to the selecting bars and be encoded in accordance with the mask pattern. Similarly a given signal code may be applied to the selecting bars to be decoded in accordance with the mask perforations. The switching tube may be used in this way to read perforated tapes or punched cards.

The number of the channels that may be included in one switching tube is not limited by anything but physical size requirements.

**HERE THEY COME...**

"Selenium Slims"

**New HI-VOLTAGE  
SELENIUM RECTIFIERS  
for the price of  
vacuum tube circuits!**

The long wait is over. Now you can design with reliable, trouble-free high-voltage selenium rectifiers at a price competitive with ordinary, power-hungry vacuum tube circuits.

The secret lies in a new production method worked out by Union Switch & Signal engineers, the original developers of copper-oxide rectifiers back in 1926. Cells can now be produced with greater precision and at a *lower cost* than ever before.

These are tubular rectifiers designed to fit standard fuse clips. Maximum RMS input voltage ratings vary from 13 to 3380 volts (with capacitive input filter.) Maximum DC current rating is 2.5 ma., though other current ratings can be supplied on special order. Stacks may be combined in series, as full-wave bridge circuits, or as voltage doublers.

These new rectifiers will reduce the cost, the weight and the power consumption of any high-voltage, low-current circuit. In addition, they give you the priceless advantage of rugged, trouble-free operation.

**CALL OR WRITE FOR MORE INFORMATION**

REPRESENTATIVES' TELEPHONE NUMBERS ARE LISTED BELOW

GENERAL APPARATUS SALES

**UNION SWITCH & SIGNAL**

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18  PENNSYLVANIA

NEW YORK  
IVanhoe 3-2424  
(Hempstead)

BOSTON  
JACKSON 9-3122  
(Wethersfield, Conn.)

BALTIMORE  
VALLEY 5-3431

CHICAGO  
HARRISON 7-0800

ST. LOUIS  
JEFFERSON 5-7300

LOS ANGELES  
CLINTON 6-2255

Copyright 1954 Westinghouse Air Brake Company

# Production Techniques

Edited by JOHN MARKUS

Sponge Rubber Pad Aids Pickup of Washers. ....	228	Checking Perpendicularity of C-R Traces .....	246
Taping Gun Speeds Wrapping of Harnesses .....	228	Winding Frame Grids for Ruggedized Tubes .....	248
Motor-Driven Roller Straightens Axial Leads of Resistors .....	230	Cataphoretic Coating for Heater Bends .....	256
Cathode Tabbing Machine .....	230	Furnace Sample Holder .....	257
Sluggish Solder .....	232	Spot Welder Makes Tap on Single Turn of Wire .....	258
Wafer Coil Technique Mechanizes Production of Transformers .....	234	Buffing Picture Tubes .....	259
Resistor Strip Fixture .....	240	Ceramic Twin-Triode Pumping Technique .....	259
Running-Count Tabulation of Picture-Tube Flaws .....	242	Induction Bonding Cuts Cost of Strip-ping Stranded Wire .....	261
Brazing Unit for Wire-Electroplating Machine .....	244		

## OTHER DEPARTMENTS

featured in this issue

	Page
Electrons At Work.....	182
New Products .....	264
Plants and People.....	310
New Books .....	360
Backtalk .....	372

## Sponge Rubber Pad Aids Pickup of Washers



Placing washers on bolts two at a time with aid of sponge rubber pad



Method of mounting pad in metal frame

ASSEMBLY of telephone relays at the Liverpool, England plant of the Automatic Telephone & Electric Company Limited has been facilitated by a simple device for pairing bolts and washers.

About a hundred washers are spread out in front of the assembler on a pad of  $\frac{1}{4}$ -inch-thick sponge rubber. She can then pick up the washers quickly and neatly by pressing the threaded end of each bolt through a washer into the rubber. This quickly gives a stock of bolts and washers to be used in the next assembly operation. The operation is more speedy and certain than the former method, in which a washer was picked up from a tray with one hand and a bolt with the other. Only one hand is required in the new method, or alternatively, twice the work can be done by using two hands simultaneously as shown in the illustrations.

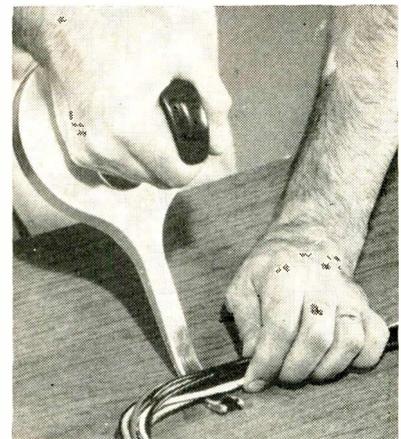
## Taping Gun Speeds Wrapping of Harnesses

ELECTRICAL harness wrapping can be speeded up from two to ten times by using plastic tape dispensed by a new taping gun marketed by Minnesota Mining and Manufacturing Co., St. Paul, Minn. for use with  $\frac{3}{8}$ -inch Scotch No. 33 plastic electrical tape. The lightweight gun makes it possible to bundle the wires and cut the tape in a single easy motion taking approximately one second.



As first step in using gun, end of tape protruding from curved tip is pressed over wiring

In use, the tape protruding from the end of the gun is stuck to the wires by the thumb, threaded around the bundle by the curved tip, and then cut with a touch of a thumb button. The end of the tape is pressed down to complete the



Second, tip of gun is pushed under cable to draw tape underneath

*S'matter, Swami,  
won't it work?*

Near-sighted or not, our snake charmer friend should know he can get more out of a wire if it has a well soldered connection. How do we know that? Well, making the right kind of flux core solder for every application has been Kester's sole business for more than 50 years. There's no mystery about Kester Solder, no secret ingredients either. With Kester, quality is the paramount feature . . . the same today as it's always been.

*TRIPLE-PLAY! Kester "44" Resin . . . "Resin-Five" . . . Plastic Rosin-Core Solder . . . your best bets . . . with exact core size or flux-content and alloy "tailored" to your requirements.*

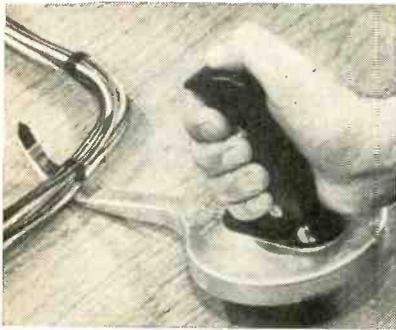


# KESTER

S O L D E R   C O M P A N Y

4204 WRIGHTWOOD AVENUE, CHICAGO 39, ILLINOIS  
NEWARK 5, NEW JERSEY • BRANTFORD, CANADA

WRITE TODAY for Kester's **NEW** 78-Page Informative Textbook, "SOLDER . . . its fundamentals and usage"



Third, operator presses button on grip to actuate spring steel cutting blade that cuts tape, then pulls gun out

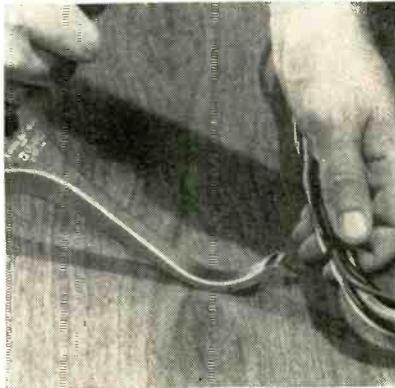
wrap for holding the wires together securely.

The slender 10½-inch curved tip serves as a convenient needle to thread the tape around wires on a cable layout board or in spots which would be difficult to reach.

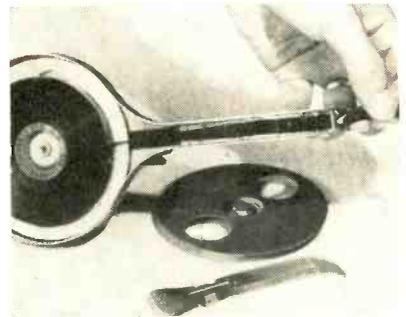
With the exception of the grip

and cutting button, which are molded from high-impact styrene plastic, the taping gun is of steel.

Advantages of plastic tape for electrical harness wrapping, as compared to previous methods using



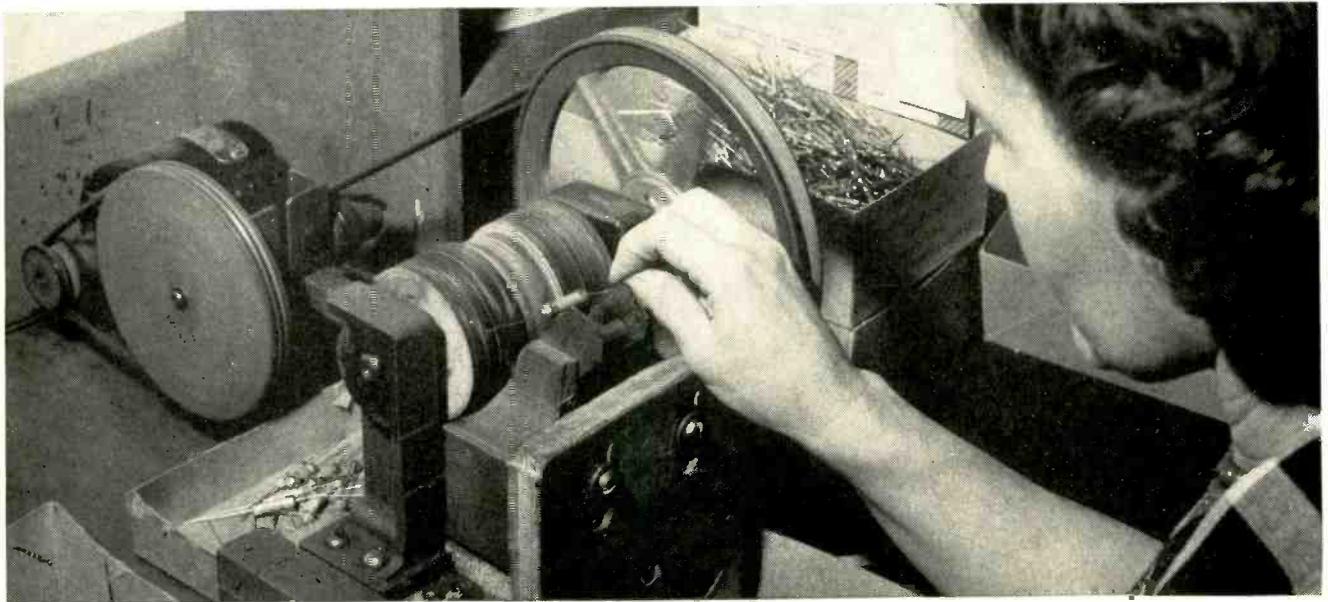
Final operation involves pressing down loose end of tape



Taping gun is loaded by removing revolving plate with coin or screwdriver and inserting 36-yard roll of tape, then threading tape down tip and under roller. Below is removable cover for bottom side of tip

twine, include drastically reduced time and cost, elimination of any danger of cutting the insulation and freedom from attack by fungus—especially important where warm, moist conditions prevail.

## Motor-Driven Roller Straightens Axial Leads of Resistors



Method of dropping resistors into lead-straightening fixture. Resistors pass under roller and drop into box at rear

A SIMPLE rubber-faced roller rotating in close proximity to a curved slide provides a quick and inexpensive means of straightening the axial leads of deposited carbon resistors after their manufacture in the Kansas City, Mo. plant of Electro Mfg. Co., Resistor Division.

The operator merely drops resistors one after another between the slide and the roller, with the body of the resistor positioned between two vertical metal plates so that it lines up with a recess in the

roller and does not get crushed. The leads are straightened as they are rotated against the wood slide by the rubber face of the rotating roller.

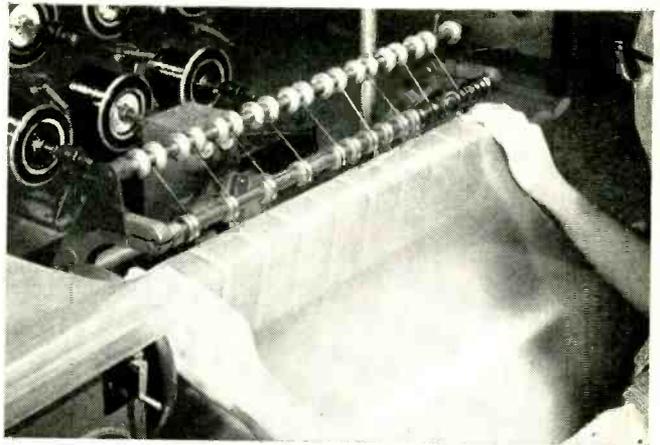
### Cathode Tapping Machine

THE OPERATION of welding a flat nickel ribbon to a tubular cathode sleeve for type 12AT7 tubes is performed automatically at high speed on a special welding machine in Tung-Sol's Bloomfield, N. J. plant.

The welded ribbon serves as a lead or tab for connecting the cathode to the wire lead coming through the tube stem.

The operator pushes the sleeves up to a stop near the rotary loading wheel. When they get close enough, a permanent magnet under the loading table pulls the sleeves into the wheel one at a time. Spring-loaded jaws in the wheel are opened by a cam at the loading position, and the sleeve is then transported to the welding position. Here an

**FREED  
CLASS H  
TRANSFORMERS**



Operator of a Universal winding machine using Natvar Silicone-Coated Fiberglas for interwinding and layer insulation of a Freed multiple wound class H transformer.

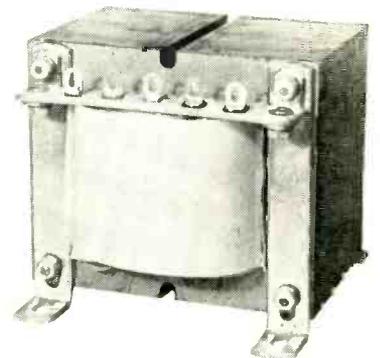
are insulated with  
**NATVAR** Silicone-Coated **FIBERGLAS**

**F**REED TRANSFORMER COMPANY, pioneer in the field of radio and electronics, designs and manufactures test instruments, transformers, reactors and filters of high reliability, including an extensive line of components built to meet MIL-T-27.

One of the significant developments in military apparatus is the saving of space and weight through use of new materials which permit operation at higher temperatures with no sacrifice of reliability. For these applications, Class H insulation must be used.

Freed uses Natvar Silicone-Coated Fiberglas to insulate Class H transformers because of its consistently good electrical and physical properties. All Natvar flexible insulations are dependably uniform, no matter when or where purchased. They are available either from your wholesaler's stock or direct from our own.

In spite of its weight, only 25 lbs., this class H unit delivers 2 kva. A unit of the same size with class A insulation would have an output of only 0.5 kva. Interwinding, interlayer and outside wrapper are of Natvar Silicone-Coated Fiberglas for maximum reliability.



**Natvar Products**

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Varnished-lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

**Ask for Catalog No. 22**

**NATVAR CORPORATION**

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE

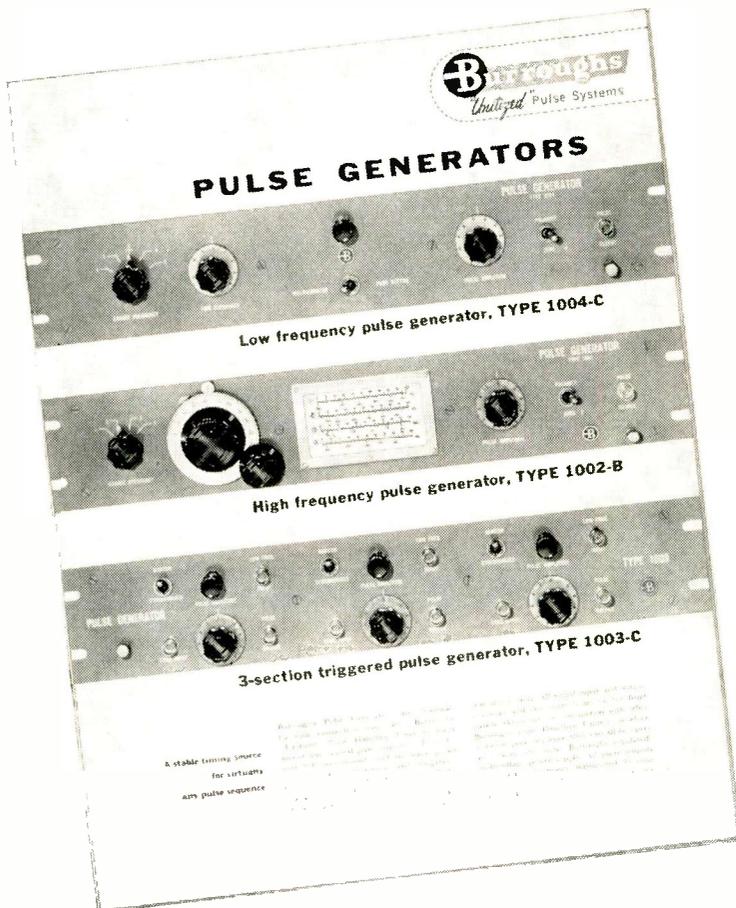
RAHWAY 7-8800

CABLE ADDRESS

NATVAR: RAHWAY, N. J.

201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

# IF YOU WORK WITH PULSES...



...read how Burroughs Pulse Units can save you weeks of engineering time

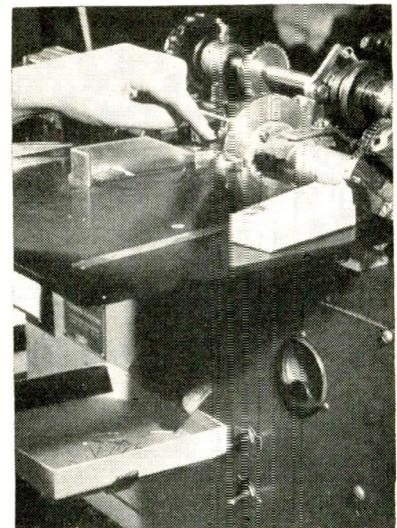
This new, free brochure shows by actual examples how you can assemble even complex pulse systems simply by connecting together matched Burroughs Pulse Units that perform basic functions.

You save weeks of breadboard engineering and can begin immediately on your primary engineering project. All your time can be spent designing commercial products—none lost designing test equipment. Because Burroughs Pulse Units are so easy to use, you can do many jobs you might otherwise never get time to do at all.

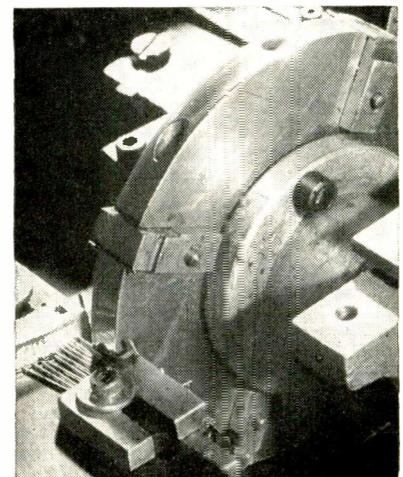
Prove to your management just how much engineering cost Burroughs Units can save for you. Without charge, we'll engineer a system to meet one of your current problems and let you compare the cost. Write for your free copy of the new brochure. Burroughs Corp., Electronic Instruments Div., Dept. 3M, 1209 Vine St., Phila. 7, Pa.

EASY AS THIS TO ASSEMBLE A PULSE SYSTEM WITH BURROUGHS PULSE UNITS

1. Prepare a time chart of the desired pulse sequence.
2. Draw a block diagram and determine which units you need.
3. Connect the units together with standard coaxial cables.



Automatic cathode tabbing machine. Operator has just pushed a sleeve up against a stop, from where it is pulled into the loading wheel by a magnet



Loading wheel of machine. Welding position is under wheel and hence not visible

anvil moves under the sleeve, the wire ribbon is fed over the top of the sleeve from its supply spool, and a welding electrode moves down over the ribbon to make the weld. The tabbed cathodes then drop down a chute to a box on a stand under the loading table. A Geneva cam mechanism provides the required dwell time at the welding and loading positions.

## Sluggish Solder

ONE problem in normal dip-pot soldering is metallic contamination of the solder due to solvent action of the molten solder on the metal being dipped. Solvent action is, of course, a normal and necessary reaction without which soldering could not take place. In the case of steel



ELECTRONIC INSTRUMENTS DIVISION

FIRST IN PULSE HANDLING EQUIPMENT

# PERFECTING HARDWICK, HINDLE RHEOSTATS



H-100  
100 Watt

H-150  
150 Watt

A-25  
25 Watt

H-50  
50 Watt

H-75  
75 Watt

- During the past two years we have re-designed and rebuilt into our rheostats tremendous improvements.

And we offer now *only one quality*—the best we can build. And that “best” is designed to comply with current standards of:

- |                                       |              |
|---------------------------------------|--------------|
| (a) Military Specifications JAN-R-22. | (c) R.T.M.A. |
| (b) Underwriters' Laboratories        | (d) N.E.M.A. |

Furthermore that “best” is offered to all industrial users as well.

Mechanically the improved features include:

- Unequaled perfection in our “buss-bar” type brush control, which automatically adjusts tension to complete, continuous contact with the entire winding surface.
- Positive, smoothly-controlled spring action which eliminates all strains tending to bind shaft in the bushing.
- Greater flexibility—no risk of backlash.

All models are of course completely bonded with our new high-temperature-enamel:—thermo-shock-proof; more resistant to heat; increased safety factor; higher terminal strength.

*Send today for our bulletin, containing additional information.*



**HARDWICK, HINDLE, INC.** Rheostats and Resistors

Subsidiary of **THE NATIONAL LOCK WASHER COMPANY**

ESTABLISHED 1886

NEWARK 5, N. J., U. S. A.

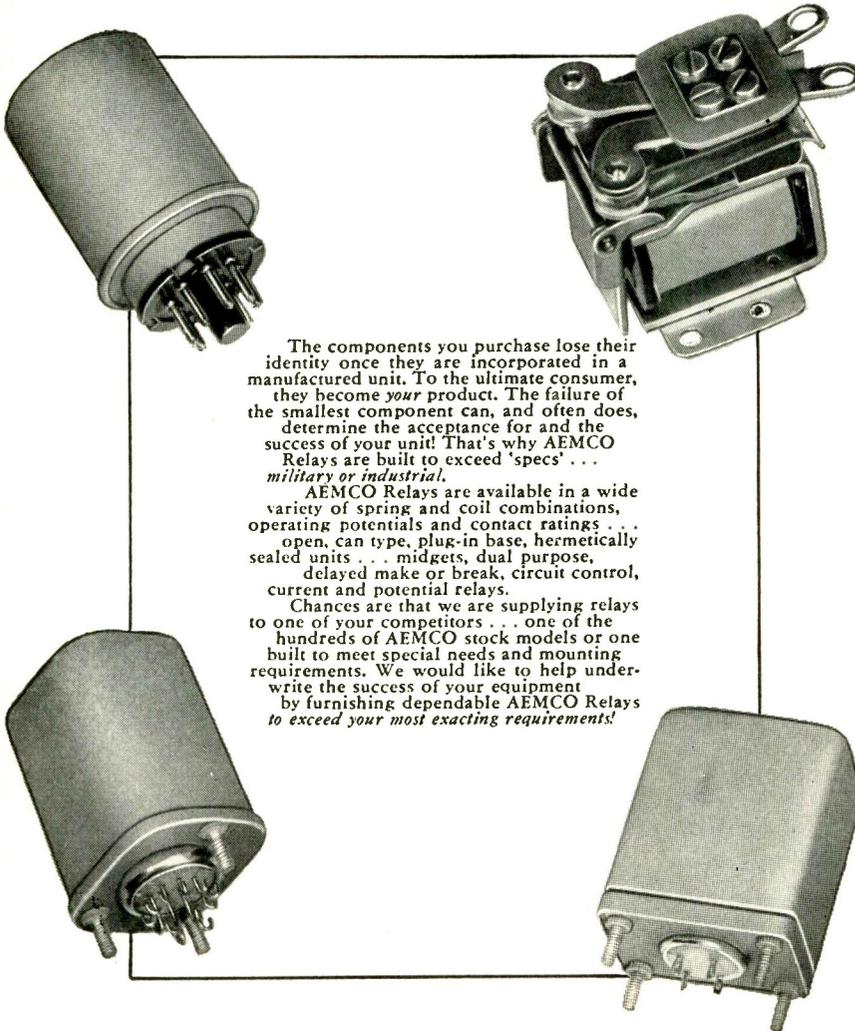
*The mark of quality for more than a quarter of a century*

# you can banish fear of component failure



## RELAYS

... BE ASSURED OF DEPENDABLE QUALITY!



The components you purchase lose their identity once they are incorporated in a manufactured unit. To the ultimate consumer, they become *your* product. The failure of the smallest component can, and often does, determine the acceptance for and the success of your unit! That's why AEMCO Relays are built to exceed 'specs' . . . *military or industrial.*

AEMCO Relays are available in a wide variety of spring and coil combinations, operating potentials and contact ratings . . . open, can type, plug-in base, hermetically sealed units . . . midgrets, dual purpose, delayed make or break, circuit control, current and potential relays.

Chances are that we are supplying relays to one of your competitors . . . one of the hundreds of AEMCO stock models or one built to meet special needs and mounting requirements. We would like to help underwrite the success of your equipment by furnishing dependable AEMCO Relays to exceed your most exacting requirements!

The Services of our Engineering Department are Available on Request. **WRITE TODAY!**



# Automatic Electric MFG. CO.

62 STATE STREET • MANKATO, MINN.

parts or assemblies, solder contamination due to solvent action is generally inconsequential because steel is relatively insoluble in solder. With such metals as brass and copper, however, there is rapid contamination of the solder bath due to the ready solubility of zinc and copper in liquid solder.

When molten solder finally becomes sluggish and unworkable due to metallic contamination, it should be replaced with fresh, pure solder, according to Kester Solder Co. It is fruitless and economically wasteful to add pure tin or pure solder to the bath in an attempt to compensate for metallic contamination.

## Wafer Coil Technique Mechanizes Production of Transformers

By ALBERT ZACK

*Project Engineer, Transformer Development  
Sylvania Electric Products Inc.  
Ipswich, Mass.*

DEVELOPMENT of automatic assembly methods for transformers was initiated as a development project by Wright Air Development Center to prevent a bottleneck in times of emergency, as well as to improve uniformity and reduce costs of these components. During the investigation, the idea was conceived that would laminated foil or rolled sheet material when sliced or cut into cross-sectional wafers would produce individual coils with close spacing and self-termination. The wafer slices have been constructed with spacings of 0.0002 inch and

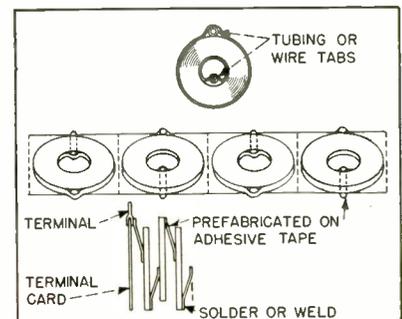


FIG. 1—Method of using adhesive tape for assembling individual wafer coils (top) to achieve insulation and interconnection of layers. Tape is cut at dotted lines and assembled, after which jumper leads are soldered to terminals of adjacent wafers and last wafer is soldered to terminal card having lead for external connection



It's always a good spring

**WHEN YOU USE BRIDGEPORT PHOSPHOR BRONZE** ♦

In any season, electrical parts made from Bridgeport Phosphor Bronze (Alloys 35 and 36) retain their resiliency and high flexural strength, year after year. They also resist corrosion and wear due to the inherent characteristics of these Bridgeport Alloys, and their excellent electrical properties help improve the operating efficiency of the parts.

To use the advantages of Bridgeport Phosphor Bronze for your parts, and for prompt service on your metal needs, call your nearest Bridgeport Sales Office.

♦ One of the many Bridgeport Metals with High I.Q. (Inner Quality) for economical fabrication and improved products.

**BRIDGEPORT BRASS**  
**COMPANY ♦ BRIDGEPORT, CONNECTICUT**



Serving Industry with a Nationwide Network of Conveniently Located Sales Offices and Warehouses  
 Mills in Bridgeport, Conn, Indianapolis, Ind., and Adrian, Mich.  
 In Canada: Noranda Copper and Brass Limited, Montreal

# 5 idea starters for product improvement in Metallized Glass

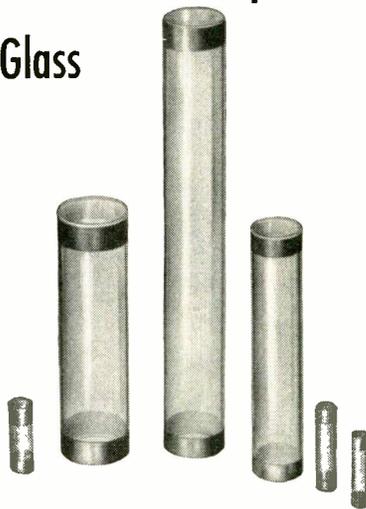
In each of the components shown here, the unique properties of metallized glass have helped solve a design problem and make a better product.

A basic idea starter is the Metallized Glass Enclosure Tube. You see six of the many available sizes at the right.

You can use these tubes to hermetically enclose many kinds of components. Such enclosure gives the components performance characteristics they otherwise do not have.

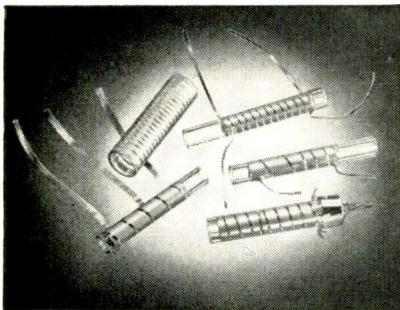
Corning's metallizing process makes possible a true hermetically sealed enclosure. Components encased in metallized glass enclosures are impervious to moisture, moulds, and atmospheric changes. Assemblies complete with end caps are capable of withstanding severe temperature changes. Glass has excellent electrical characteristics, and its transparency permits visual inspection. Bond strength for metallizing used on enclosure tubes has been measured at 1500 to 2000 pounds per square inch.

These characteristics can perhaps broaden your use of some product, ex-

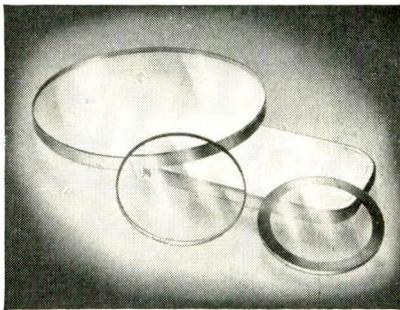


pand its performance limits, or reduce servicing and minimize breakdown possibilities.

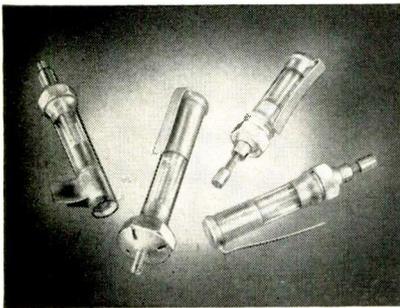
Illustrated below are other applications of Corning's metallizing process. If none of them exactly meets your needs—or, if metallized glass characteristics suggest solutions to other problems, write us your requirements. Chances are, we'll be able to help you. There is no obligation.



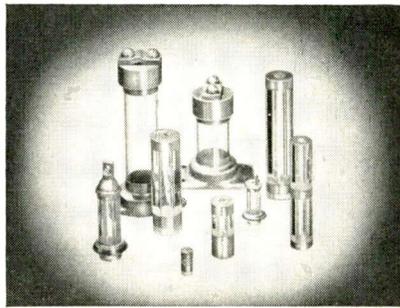
**CORNING METALLIZED GLASS INDUCTANCES** are made with a precision that guarantees duplication within close limits. When used in either FM or TV circuits, you can be sure that they will contribute negligible drift even under unusual temperature changes.



**METALLIZED GLASS INSTRUMENT WINDOWS** are made of both tempered and untempered glass with metallized bands on the edges. They can be easily soldered into a bezel to form a hermetic seal. Available in sizes and shapes to meet your needs.



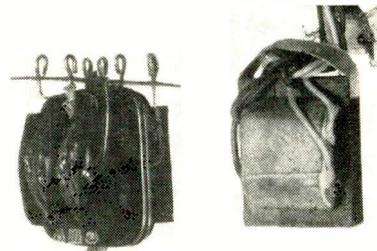
**MIDGET TRIMMER CAPACITORS** are available in standard types from 0.5 to 12.0 mmfds., or they can be designed to your requirements. Temperature coefficient for brass core units is approx. 200 ppm/deg. C.; for invar core units, approx. 50 ppm/deg. C.



**METALLIZED BUSHINGS AND STANDOFF INSULATORS** for high voltage applications. Bushings can provide hermetically sealed insulators for high voltage transformer and capacitor terminals. Standoff insulators are made of tempered low loss glass. Both can be furnished in special sizes.

conductor areas measuring  $0.0009 \times 0.00017$  inch (equivalent to No. 48 wire). Thus a great density of turns can be packed into a small area and a wide range of wire sizes can be obtained by simply varying the wafer thickness during slicing.

Audio transformers using aluminum-foil wafer coils have been constructed which are physically the same size as conventional units. Further reduction in size can probably be made by using copper foil which at present is not commercially available in 0.0002 inch thickness. Electrically, the frequency response and other characteristics of conventional and wafer-



Miniature output transformers as made with wafer coil technique (left) and conventional coils

type coils are essentially the same.

Wafer coil construction begins with winding wide metal foil into a roll. The foil is previously coated with an adhesive-type insulator or a spacer is used to separate the turns. Terminal tabs in the form of tubes or tinned copper foil are attached by soldering or folding at the beginning and finish of the winding, or the foil itself is folded into a terminal tab.

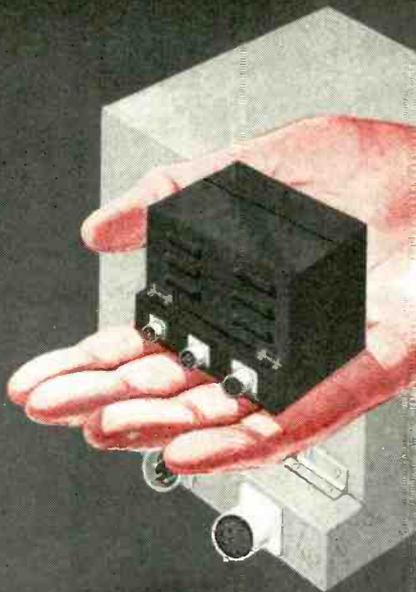
The wound roll is next sliced into wafers, the thickness depending upon the cross-section desired for the conductor. For instance, if a conductor equivalent to No. 44 wire is needed and 0.00017-inch foil is used, the wafer thickness needed is approximately 0.017 inch. Slicing is done on a lathe-type cutter, using either a straight blade or a rotating circular blade. If necessary, the wafers are given a quick etch to remove any burrs or sharp edges, then insulated by spraying and mounted on a tape for assembly.

One method of assembling the wafers is shown in Fig. 1. Each start tab is connected to a preformed terminal on a carrying tape. This brings the inside connection to the outside terminal tab of the



**CORNING GLASS WORKS, CORNING, N. Y.**  
New Products Division  
*Corning means research in Glass*

**CUT  
PRODUCT  
SIZE**



**WITH  
TEXAS  
INSTRUMENTS  
SUBMINIATURE  
TRANSFORMERS**

**T/I announces 32 new  
subminiature transformers...**

... for transistor and other miniaturization applications. Texas Instruments — also a leading transistor manufacturer — has applied its precise instrument standards in producing both transformers and transistors to bring you this first complete line of subminiature transformers. Behind every TI product are years of experience in meeting the exacting requirements of geophysical and military electronic equipment and components. This experience gives you added assurance of the reliable performance of these new transformers.

Input, interstage, choke, and output types are available in four size series ranging from less than  $\frac{3}{8}$  inch cubed (one milliwatt output) to slightly less than one inch cubed (over 100 milliwatts). Each series is manufactured in both open and cast construction, making a total of 16 basic types... 32 models. Designed for use in the audio and ultrasonic frequencies, these subminiatures will operate over a temperature range of  $-25^{\circ}$  C to  $100^{\circ}$  C, with the cast units being particularly resistant to moisture and other environmental contamination. For your special applications, our engineers will design models to your detailed specifications.

**Write for literature!** Let our sales and design engineers help you with your specific transformer, magnetic amplifier or pulse network problems.

**TEXAS INSTRUMENTS**  
INCORPORATED  
6000 LEMMON AVENUE DALLAS 9, TEXAS

All transformers shown ACTUAL SIZE

CAST TYPE

OPEN TYPE



100 SERIES



100 SERIES



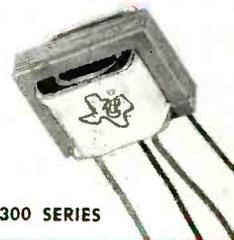
200 SERIES



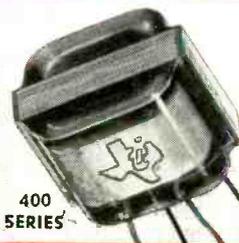
200 SERIES



300 SERIES



300 SERIES



400 SERIES



400 SERIES



More quality products  
from Texas Instruments'  
Components Division



Delay Lines



Pulse Transformers  
and Networks



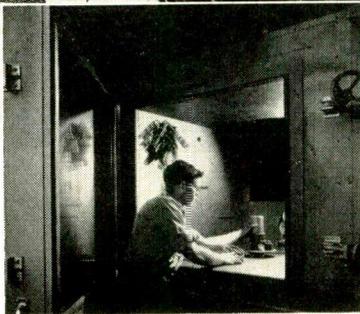
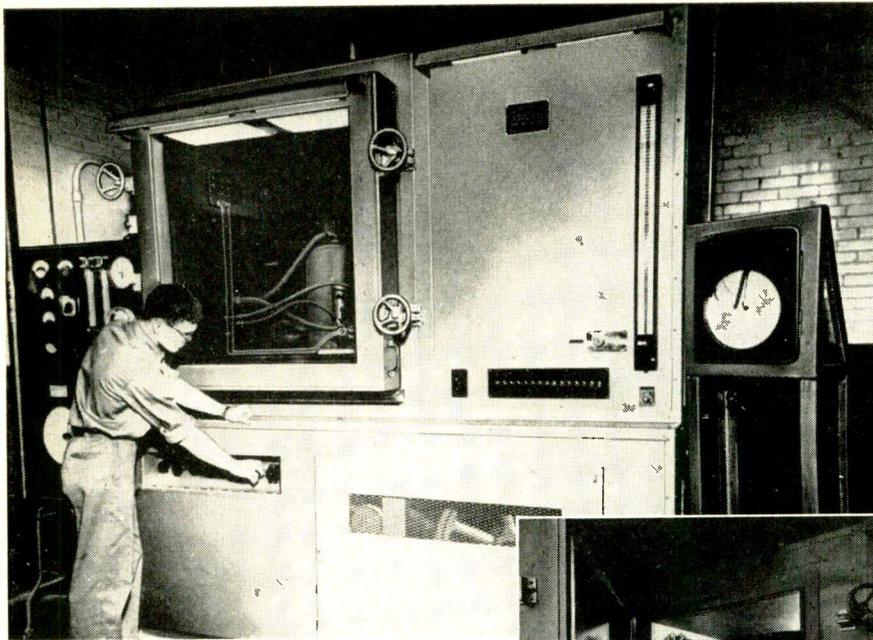
MIL-T27  
Transformers



Magnetic Amplifiers



Toroids



# BOWSER "L" CHAMBER DUPLICATES FLIGHT CONDITIONS AT LEAR-ROMECC

This Bowser Altitude Chamber provides on-the-ground answers to questions about in-flight performance. Here, fuel injection pumps and other aircraft accessories are subjected to extensive development and production testing under extreme conditions of altitude, temperature and humidity.

By use of this versatile, reliable Bowser unit, Lear-Romec engineers are able to determine how equipment will operate at altitudes from sea level to 80,000 feet . . . temperatures from  $-100^{\circ}$  F to  $+180^{\circ}$  F . . . relative humidity from 20% to 95%.

Whatever your environmental testing or production needs . . . low temperature, high altitude, humidity, sand and dust, explosion or fungus . . . be sure to check with Bowser, the pioneer. Or contact the Bowser sales engineer in your area.

*A free descriptive bulletin describing the complete line of Bowser high altitude chambers is available on request.*



**BOWSER TECHNICAL REFRIGERATION**

DIVISION OF BOWSER INC. • TERRYVILLE, CONNECTICUT

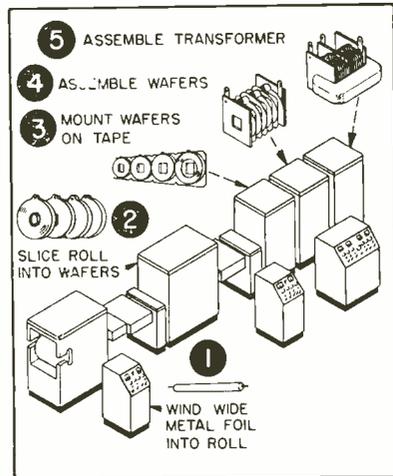
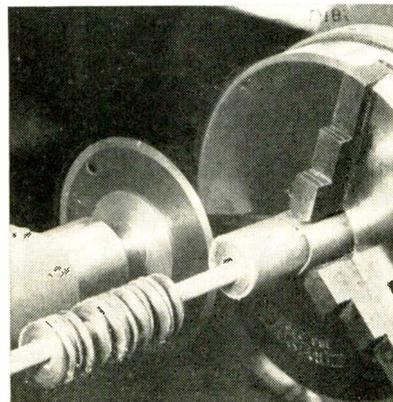


FIG. 2—Concept of complete mechanized setup for producing transformers using wafer coils

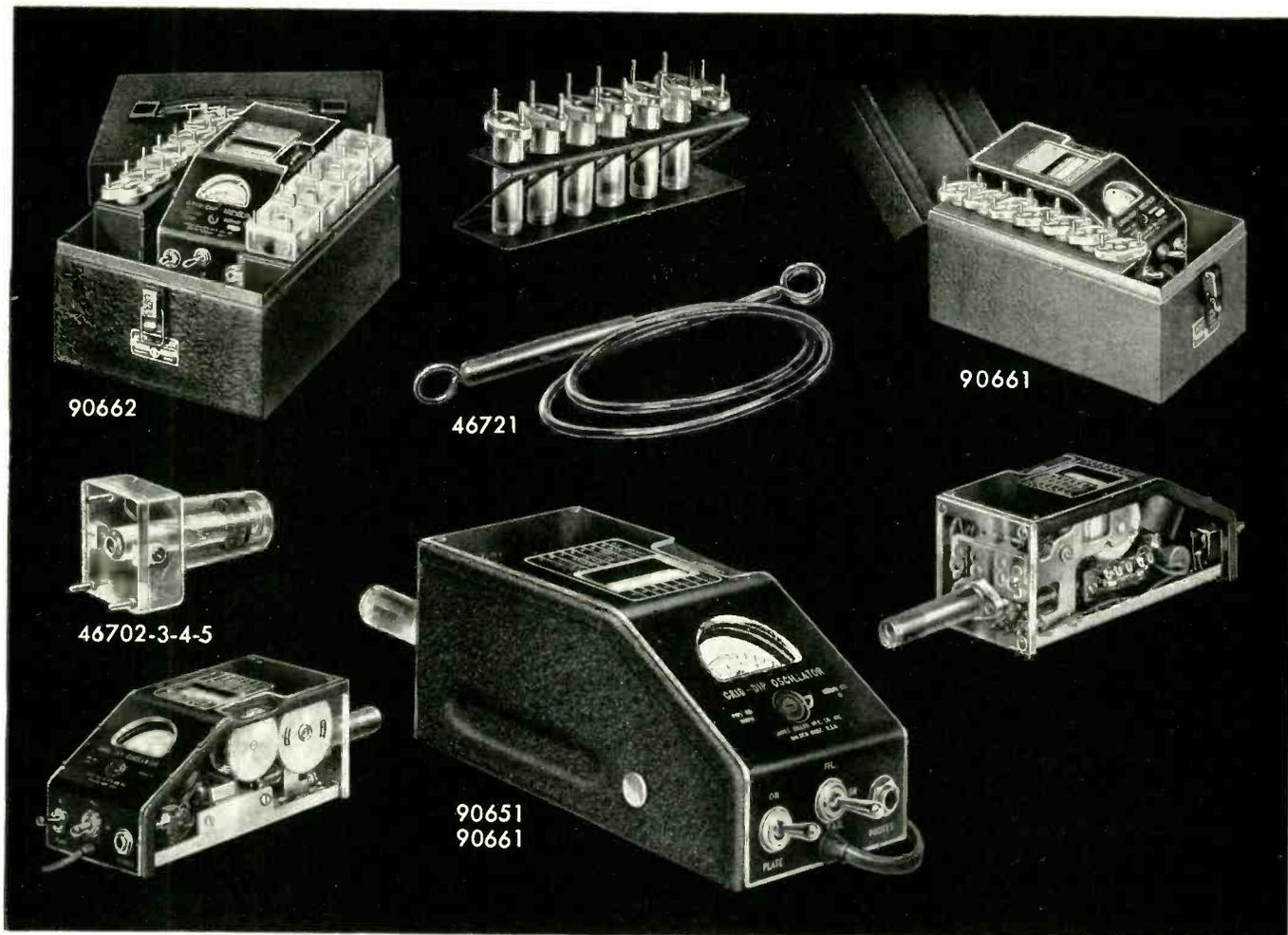
next following wafer, thus putting the coils electrically in series. As many wafers are used as are necessary to provide the proper number of turns. The first and last wafer are connected to preformed terminal cards which match the wafers and provide an outside connection to the coil. The assembled primary and secondary coils are then placed on a core and the unit is ready for final processing.

Essentials for an automatic assembly system are shown in Fig. 2. Construction of the wafers is separated into winding, slicing and prefabrication. Automatic winding can be accomplished on a bed-type winder similar to those common in the metal foil industry. This machine automatically coats and winds the foil and forms or fastens the terminal tabs at an estimated rate of twenty rolls per hour or the equivalent of 2,000 average units per hour.

The wound rolls are ejected into a magazine which feeds them into



Use of rotary blade for slicing wafers from foil roll in chuck



## Designed for Application

### Grid Dip Meters

Millen Grid Dip Meters are available to meet all various laboratory and servicing requirements.

The 90662 Industrial Grid Dip Meter completely calibrated for laboratory use with a range from 225 kc. to 300 mc. incorporates features desired for both industrial and laboratory application, including three wire grounding type power cord and suitable carrying case.

The 90661 Industrial Grid Dip Meter is similar to the 90662 except for a reduced range of 1.7 to 300 mc. It likewise incorporates the three wire grounding type cord and metal carrying case.

The 90651 Standard Grid Dip Meter is a somewhat less expensive version of the grid dip meter. The calibration while adequate for general usage is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case. The range is 1.7 to 300 mc. Extra inductors available extend range to 220 kc.

The Millen Grid Dip Meter is a calibrated stable RF oscillator unit with a meter to read grid current. The frequency determining coil is plugged into the unit so that it may be used as a probe.

These instruments are complete with a built-in transformer type A.C. power supply and internal terminal board to provide connections for battery operation where it is desirable to use the unit on antenna measurements and other usages where A.C. power is not available. Compactness

has been achieved without loss of performance or convenience of usage. The incorporation of the power supply, oscillator and probe into a single unit provides a convenient device for checking all types of circuits. The indicating instrument is a standard 2 inch General Electric instrument with an easy to read scale. The calibrated dial is a large 205° drum dial which provides seven direct reading scales, plus an additional universal scale, all with the same length and readability. Each range has its individual plug-in probe completely enclosed in a contour fitting polystyrene case for assurance of permanence of calibration as well as to prevent any possibility of mechanical damage or of unintentional contact with the components of the circuit being tested.

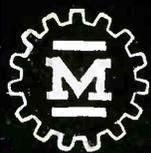
*The Grid Dip Meters may be used as:*

1. A grid Dip Oscillator
2. An Oscillating Detector
3. A Signal Generator
4. An Indicating Absorption Wavemeter

The most common usage of the Grid Dip Meter is as an oscillating frequency meter to determine the resonant frequencies of de-energized tuned circuits.

Size of Grid Dip Meter only (less probe): 7 in. x 3 $\frac{3}{16}$  in. x 3 $\frac{3}{8}$  in.

JAMES MILLEN



MFG. CO., INC.

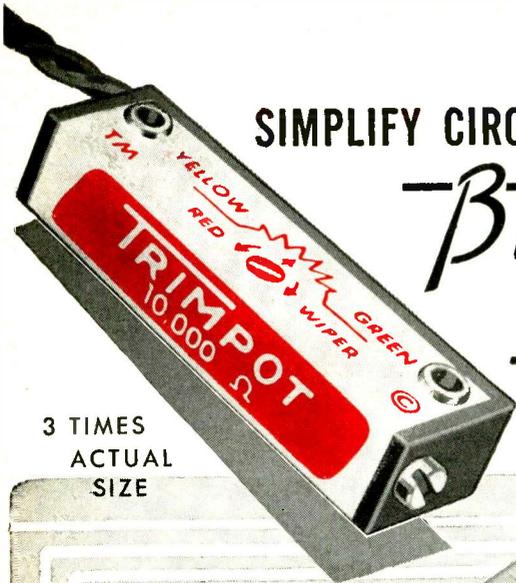
MAIN OFFICE

AND FACTORY

MALDEN, MASSACHUSETTS, U. S. A.

SIMPLIFY CIRCUIT TRIMMING *with*

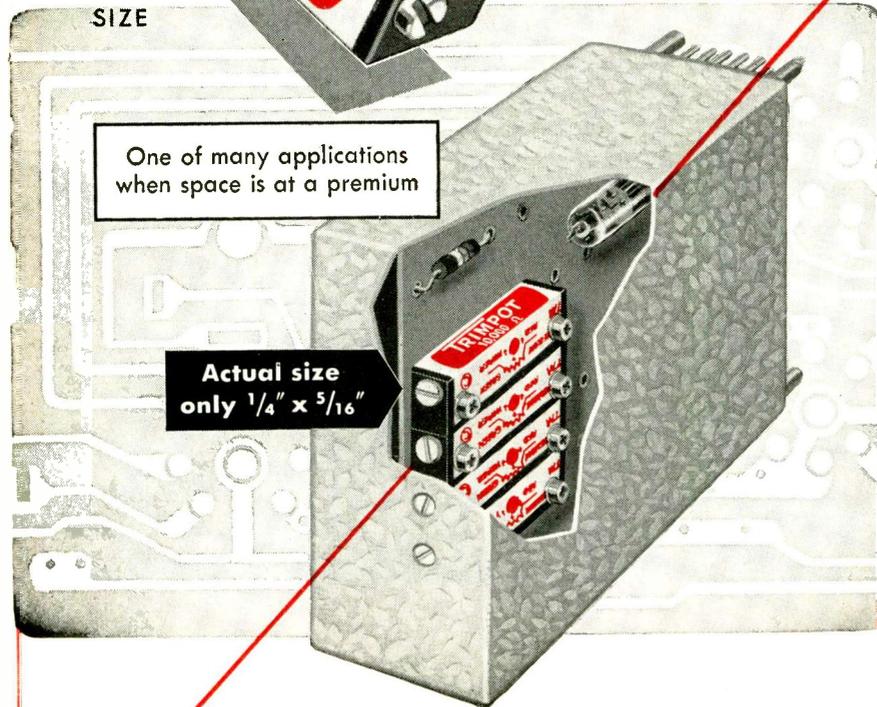
**B**OURNS  
sub-miniature  
**TRIMPOTS**  
TRADE MARK



3 TIMES  
ACTUAL  
SIZE

One of many applications  
when space is at a premium

Actual size  
only 1/4" x 5/16"



● **RESOLUTION: AS LOW AS 0.25%**

● **POWER RATING: 0.25 WATT AT 100° F.**

● **WEIGHT: ONLY 0.1 OZ.**

BOURNS **TRIMPOT** is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS **TRIMPOTS** may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS **TRIMPOTS** can also be furnished with various modifications including dual outputs, special resistances and extended shafts.

BOURNS also manufactures precision potentiometers  
to measure Linear Motion; Gage, Absolute, and  
Differential Pressure and Acceleration



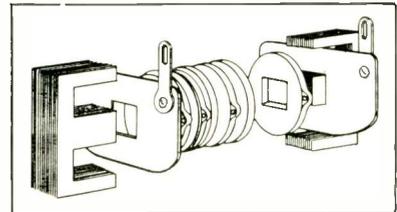
**B**OURNS LABORATORIES

6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA  
Technical Bulletin On Request, Dept. 12

© B. L. PATENTS PENDING

a slicing machine. The slicing machine automatically cuts each roll into wafers which are collected by a vacuum or pressure system. Controls on this machine will be used to vary the wafer thickness as needed.

The wafers next move through an etch spray and wash and then a spray for insulation. In one method, the wafers are placed on a pre-fabricated tape and connected to terminals on the tape by spot welding. The wafer tape is then fed



Wafer coil assembly fits conventional laminated iron-core structure

into an assembly point which places each wafer on an assembly arbor, starting and finishing with a rigid terminal card. From this point, the assembled coil is passed through a solder dip to connect the outside terminals and then is assembled to the core.

For r-f applications, larger spacings and low-loss dielectrics must be utilized to obtain high Q. Tuning can be accomplished by physical movement of the wafers to change mutual inductance, variation of capacitance between wafers, moving powdered-iron wafers or moving conventional powdered-iron slugs. Dip-coating the wafers in resins loaded with iron powder provides a complete coating of core material around the wafer. The wafers can be mounted on a printed-circuit chassis in much the same manner as flat disk capacitors.

### Resistor Strip Fixture

SMALL resistor subassemblies used in strip transmitters for Motorola 30-watt mobile communication equipment are assembled four at a time with the aid of a special fixture. The operator loads the insulating panels into recesses in the plate of the fixture, brings down a clamping bar to lock the panels in position and proceeds with assembly. A knurled nut on the right-hand pivot shaft holds the rotating

# DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company

DECEMBER 1954

## Insulator of KEL-F<sup>®</sup> Plastic Doubles as Vital Structural Part in Severe 250°F Water-Immersion Service

Perfect electrical insulation and maintenance of critical spacing of electrodes are provided by this spacer of KEL-F polymer plastic. Even under constant immersion in water at 250°F, insulation remains high, precision tolerances and dimensions of the spacer-insulator are maintained.

Excellent mechanical properties of this fluorocarbon plastic dielectric under extremes of temperature and stress permit the critical spacer to be used under heavy spring loading without deformation or failure. Accurately machined grooves in the plastic hold O rings to prevent liquid leakage.

McNab Incorporated, New York City, machines the spacers from rod extruded from unplasticized KEL-F polymer by the Resistoflex Corporation, Belleville, N. J. Spacers are used in special conductivity cell-valve units manufactured by the McNab company for use in marine and industrial installations producing potable water.

*For further information ask for Application Report E-131*



## Insulated Union of KEL-F<sup>®</sup> Plastic Carries 400 psi Gas Safely Through 10 Kv Potential in Atom Research

A hollow threaded stud of KEL-F plastic, one of the best "tough" dielectrics, maintains a gas-tight connection and effectively insulates the line in a high potential field. The plastic union is also required to hold a high vacuum when used in the nuclear research device.

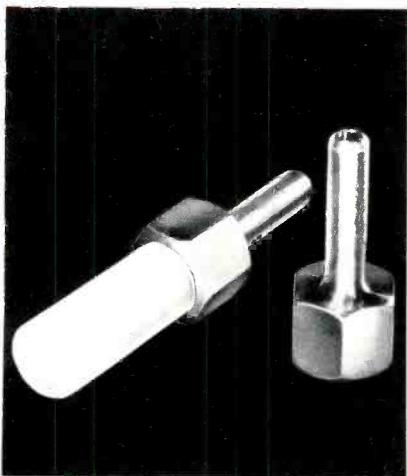
Used to carry a gas with an extremely high diffusion rate, the fluoro-

carbon plastic's non-porosity effectively blocks leakage.

The novel coupling was devised by the Brookhaven National Laboratory, Upton, N. Y. and machined from rod extruded from KEL-F polymer Grade 300 by the Plax Corporation, Hartford, Connecticut.

*For further information ask for Application Report E-132*

(SEE REVERSE SIDE)



KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

MOLDING  
POWDERS

KEL-F

FLUORO  
CHLORO  
CARBON  
PLASTIC

KEL-F

DISPERSION  
COATINGS

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

OILS  
WAXES  
GREASES

# Dome of KEL-F® Plastic Pressurizes Airborne Radar Antenna in Minus 85°F — Plus 160°F... Cuts Power Losses

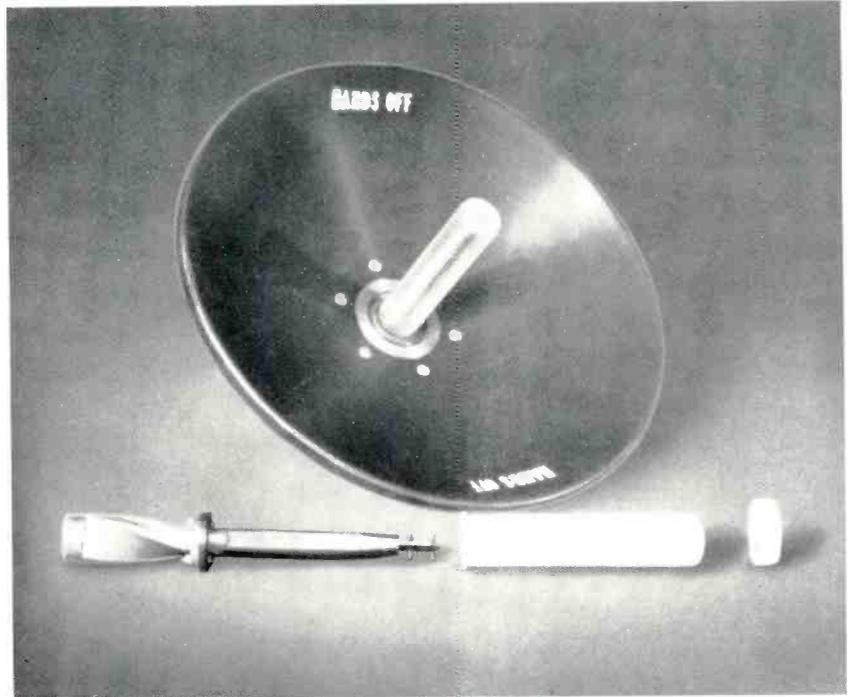
A "test tube" and machined lock nut—both made from KEL-F polymer—help maintain this radar "horn" under 15 psi positive pressure and prevent power breakdown even at high altitudes. Tough, but resilient, they are undamaged by accidental blows, vibration or exposure.

The fluorocarbon plastic remains transparent to high frequency pulses indefinitely. Zero water absorbing and non-wetting, interference from high humidity or fungus is cut.

Rigid but not brittle, the plastic tube and lock nut are readily installed and removed for servicing without danger of breakage or chipping.

Fluoro Plastics, Inc., custom molders of Philadelphia, Pa., compression-mold these new radar domes from unplasticized KEL-F polymer Grade 300. The molded tubes are ready for use without machining. The lock nut is machined from rod stock by the radar manufacturer.

*For further information ask for Application Report E-133*



## Recent Significant KEL-F Polymer Developments...

**Lip seals** for liquid oxygen and other liquefied gas equipment operating at low temperatures are molded now of KEL-F plastic. Resiliency at sub-zero temperatures, dimensional stability and chemical inertness overcome shortcomings of other gasket and sealing materials used.

**Liquid level gauges** now have their glasses protected by a thin sheet of KEL-F plastic. Remaining transparent indefinitely in spite of contact with highly corrosive chemicals such as HF, the plastic sheets act as their own gaskets.

**Miniature coil forms** are molded of KEL-F plastic for use in electronic devices operating at elevated temperatures. Types include special models with metal inserts.

**Quality test** for use by the manufacturer of trifluorochloroethylene polymer parts (the "Z.S.T." test) has been developed and field-tested by Kellogg. Test is simple, requires no special training. Equipment is automatic, eliminates the human error factor in test results.

**OFF THE PRESS...**  
*Revised "BUYERS GUIDE" listing KEL-F polymer products, molders and fabricators.*

*For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write*

**Technical Service**  
**CHEMICAL MANUFACTURING DIVISION**  
**THE M. W. KELLOGG COMPANY**

P. O. Box 469, Jersey City 3, N. J.  
or offices in Boston, Chicago, Dayton, Los Angeles and New York



## Molders & Fabricators of the Month

*Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F"... each month this column will spotlight several of these companies with their principal services and products.*

### Auburn Button Works, Inc.

Auburn, N. Y.  
Injection molding

### Bacon Industries, Inc.

Watertown, Mass.  
Compression & transfer molding  
Gaskets & O rings

### Elco Corporation

Philadelphia, Pa.  
Injection molding  
Electronic tube sockets

### Electronic Mechanics Inc.

Clifton, N. J.  
Extrusion, injection, compression & transfer molding  
Forming  
Rod, tube & sheet  
Coil forms & tube sockets  
Diaphragms & gaskets

### A. Gusmer, Inc.

Stalpic Division  
Woodbridge, N. J.  
Corrosion control  
Dispersion application

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

MOLDING  
POWDERS

KEL-F

FLUORO  
CHLORO  
CARBON  
PLASTIC

KEL-F

DISPERSION  
COATINGS

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

OILS  
WAXES  
GREASES

# "... cost of the projector will be returned within a three-month period"



Tool and Die Dept.

SUBJECT: Report of Savings through use of KODAK CONTOUR PROJECTOR in Tool Inspection

1-This report covers the period from June 1 through 30.

2-During this period, a Kodak Contour Projector was used to check circular form tools; flat drills, taps, and special cutters received from suppliers; and board samples.

3-The following table summarizes direct labor savings in man hours effected by replacing manual inspection with inspection on the Contour Projector. Time required for manual inspection is estimated on the basis of past experience with these parts.

<u>Parts Checked</u>	<u>Direct Labor, Manual Insp.</u>	<u>Direct Labor, Optical Insp.</u>	<u>Savings (In man hrs.)</u>
Circular form tools.....	350 hours.....	50 hours.....	300 hours
Flat drills, taps, special cutters.....	375 hours.....	65 hours.....	310 hours
Board samples.....	250 hours.....	90 hours.....	160 hours
Total man hours saved.....			770

4-Without savings cited here, three additional men would have been required for these inspections. In addition, use of the Contour Projector has reduced the possibility of error and resulted in more consistent checking.

5-RECOMMENDATION: Based on the knowledge that these savings can be duplicated each month with present tool room volume, purchase of a second Kodak Contour Projector is recommended. This opinion recognizes the fact we are now checking with one machine only about 40% of all work suitable for the projector. Assuming man hour savings equal to those already effected, cost of the projector will be returned in direct labor savings within a three-month period.

Such reports by users of the Kodak Contour Projector are typical. To find out more about how optical gaging speeds inspection, improves accuracy, write for a copy of the illustrated booklet "The Kodak Contour Projector."

EASTMAN KODAK COMPANY, Special Products Sales Division, Rochester 4, N. Y.

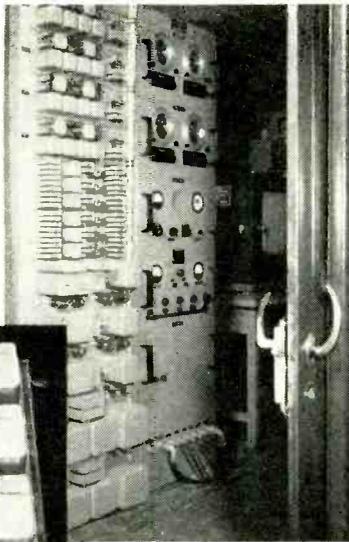
## the KODAK CONTOUR PROJECTOR



for absolute reliability in

# RAYDIST ultra-sensitive electronic tracking systems

THE  
LOGICAL  
CHOICE  
WAS



This power supply, shown with the Raydist mobile electronic tracking system, is typical of the use of CHICAGO transformers in Raydist equipment.

## CHICAGO the World's Toughest TRANSFORMERS

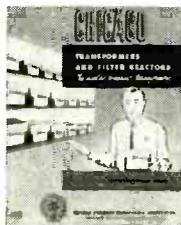
Raydist, designed and built by the Hastings Instrument Company, Inc., of Hampton, Virginia, is a remarkably precise and sensitive electronic radio location system. Raydist systems are used for air and marine navigation tracking, marine geophysical surveying, chartmaking, meteorological studies and a host of applications requiring infinitely accurate tracking and plotting.

Because Raydist precision performance is dependent upon the quality of the components used, Hastings specifies and uses CHICAGO MIL-T-27 hermetically sealed transformers.

Wherever absolute reliability and optimum precision are essential, you'll find CHICAGO, truly the world's toughest transformers.



CHICAGO MIL-T-27  
Sealed-in-Steel Transformer

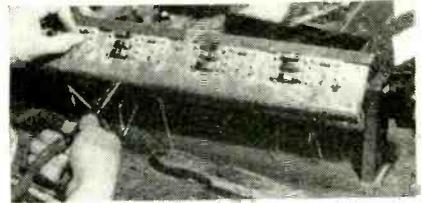


FREE: CHICAGO Catalog CT-554, listing over 500 Sealed-in-Steel transformers. Available from your parts distributor.



**CHICAGO STANDARD  
TRANSFORMER CORPORATION**  
Addison and Elston • Chicago 18, Illinois

EXPORT SALES:  
Roburn Agencies, Inc.  
431 Greenwich St.  
New York 13, N.Y.



Resistor subassembly fixture

fixture at the desired angle for optimum efficiency. After resistors have been mounted, wire leads are pushed through panel holes one by one from the top and their ends are twisted around the terminals.

### Running-Count Tabulation of Picture-Tube Flaws

AT THE screen inspection station on the conveyORIZED processing line for picture tubes in General Electric's tube plant at Electronics Park, Syracuse, N. Y., minor holes or other flaws in the fluorescent screen coating are cause for rejection. A high-intensity light source made up of banks of four-foot fluorescent lamps below the tubes makes screen defects readily noted. Bulbs re-



Overhead conveyor moves tubes slowly over fluorescent lamp bank at inspection position



Details of totalizing counters for types of flaws

The new **NORTHERN RADIO CATALOG** is

your **BUYER'S GUIDE** to

**FREQUENCY SHIFT  
COMMUNICATION EQUIPMENT**

**it's FREE!**

because it contains

*Complete Descriptions  
and Specifications -*

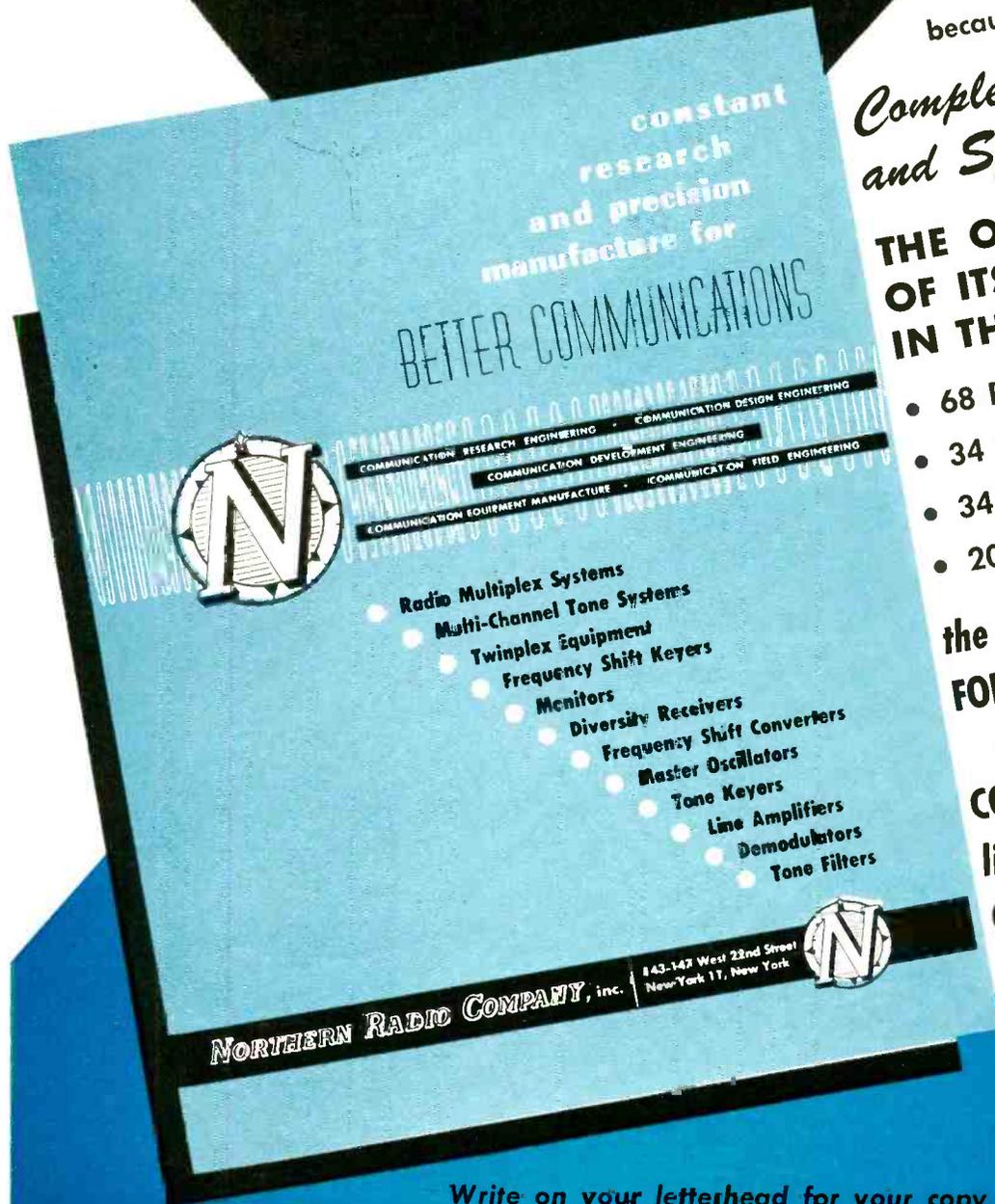
**THE ONLY BOOK  
OF ITS KIND  
IN THE FIELD!**

- 68 Pages
- 34 Items
- 34 Photographs
- 20 Block Diagrams

**the Industry's  
FOREMOST**

**and  
COMPLETE**

**line of Quality  
Communication  
Equipment!**



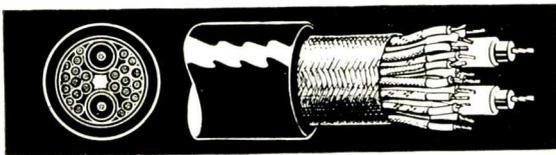
Write on your letterhead for your copy today.

***Pace-Setters in Quality Communication Equipment***

# PHALOCOM

Weather Resistant  
Communication Cables  
provide  
Year Round Dependability  
for...

## Motorola Microwave



This is the cable . . . Motorola and Phalo engineers collaborated on its design and manufacture.

The cable had to be tough . . . had to perform in tough weather and in rough terrain, 24 hours a day.

These Motorola Microwave Cables, (14 and 24 conductors) connect DC and AC voltages from remotely located control panels and power supplies to outdoor equipment in outdoor housing.

Here is a classic example of Phalo's ability to develop that special cable for that special communication application!

### PHALOCOM Cables!

Send for complete Phalo catalog

**PHALO PLASTICS CORPORATION**

Corner Commercial St., Worcester, Massachusetts  
Southern Plant: Monticello, Miss.

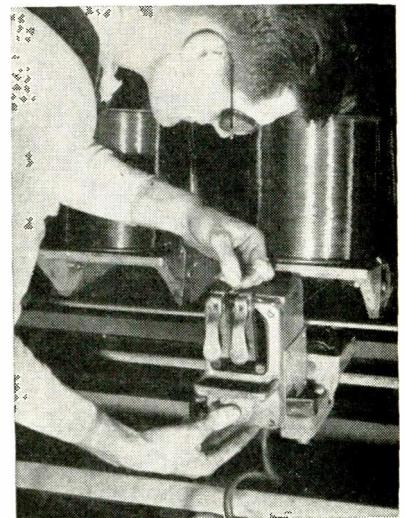
Insulated Wire and Cables — Cord Set Assemblies

jected at this station are returned to be washed out and rescreened.

A running record of rejects and reasons for rejection is kept on grouped banks of mechanical counters placed conveniently below the operator's hands. Coded identification symbols are written on strips of tape below the counters to identify the type of flaw represented by each counter. The counters are so designed that they advance one count when the top of the counter housing is pressed; the action resembles that of a pushbutton.

### Brazing Unit for Wire-Electroting Machine

SIMULTANEOUS electroting of 50 strands of copper wire at high speed is achieved with minimum stoppage in Western Electric's Tonawanda plant by employing a brazing unit to braze one end of the wire from a full spool to the inside end of a spool that is about to run out. The wire is then automatically transferred from the empty spool to the next full spool without stopping the machine.



Pressing button to initiate brazing with portable unit that slides on rail running the length of the spool-supporting rack for the electroting machine

The brazing unit slides on a rail and is connected to a power outlet through a coiled rubber-covered line cord which eliminates the need for trolley duct. Spring-mounted pulleys absorb the shock involved in starting the unwinding of a loaded spool during switchover.

Electrobrazing is achieved by placing one wire end under one

# ANNOUNCING ANOTHER NEW AMPEX

*but this time it's a superb amplifier-speaker*

It's a 25 pound portable amplifier-speaker that matches the Ampex 600 tape recorder in appearance **and in quality, too!** The new Ampex 620 has **FLAT ACOUSTIC RESPONSE** from 60 to 10,000 cycles. This would be a great achievement in a speaker of any size, but in a 25-pound portable it's truly exceptional — in the Ampex tradition.

A **quality demonstrator to sell broadcast time** Program samples or auditions can now be demonstrated with a new impact and clarity that will make prospective time buyers sit up and take notice. The Ampex 620 can be carried anywhere. It has ample power for

a group hearing in office, conference room or small auditorium.

**A speaker to monitor with greater sensitivity** The Ampex 620 is an extra sensitive monitoring unit usable anywhere inside the studio and outside with portable recorders as well. It will give operating personnel a much better indication of recording and broadcast quality than the usual monitor speaker. This can help forestall criticism from the growing percentage of your audience who listen through high quality amplifiers and speakers.

**AMPEX 620 PORTABLE AMPLIFIER-SPEAKER**  
Connects with your studio console — or reproduces directly from tape recorders, turntables or pre-amplified microphones. The Ampex 620 is a perfectly integrated design including a 10-watt amplifier, loudspeaker, reciprocal network, level control, equalization control and acoustically correct enclosure. By standard test procedures **in air** it has low distortion and an acoustic response curve that is essentially flat from 65 to 10,000 cycles.  
Price is \$149.50 complete.



**AMPEX 600 PORTABLE TAPE RECORDER**  
Like the great Ampex studio tape recorders the 600 is the best of its kind. It weighs only 28 pounds, yet the Ampex 600 can serve every broadcast station need. For auditions and demonstrations it is the perfect sound source for the Ampex 620 amplifier-speaker. Prices: \$498 unmounted, \$545 in portable case.

For full description and specifications write Dept. E-1977

*Signature of Perfection in Sound*

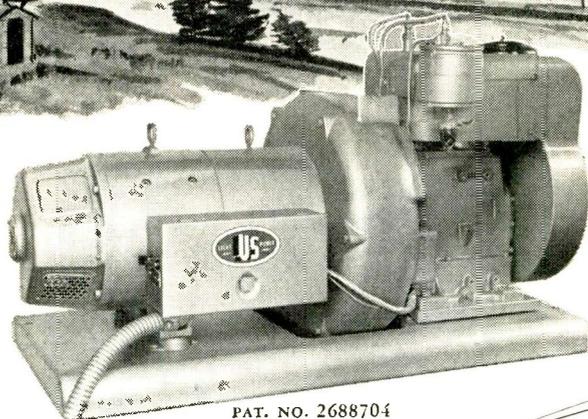
Distributors in principal cities (see classified section of your telephone directory under "Recording Equipment.")  
Distributed in Canada by Canadian General Electric Company.

**AMPEX**  
CORPORATION

934 CHARTER STREET  
REDWOOD CITY, CALIF.



# SPLIT-SECOND "emergency" power



PAT. NO. 2688704

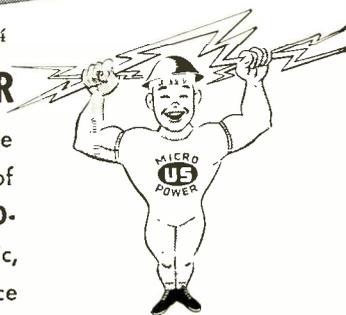
## ... With U.S. MICRO-POWER

BEFORE . . . voltage drops below a usable level . . . before there is any loss of power to essential equipment . . . MICRO-POWER IS IN ACTION. Completely automatic, Micro-Power operates with the main source of power. No time-consuming "load transfers", no power "outages" . . . EVEN FOR PRECIOUS SECONDS!

Micro-Power is a complete stand-by service that replaces several units of costly, more complicated equipment. Electric plant, rectifier, battery banks and motor-

Write U. S. Motors for complete information, specifications and power curve charts.

generator CAN ALL BE ELIMINATED . . . with the installation of a single MICRO-POWER UNIT. NEW INSTALLATIONS — SAVE UP TO \$300 PER MILE!



### UNITED STATES MOTORS CORPORATION

553 Nebraska Street  
OSHKOSH, WISCONSIN

spring clamp electrode and placing the other wire end in the other electrode clamp, in such a way that the wires butt together under slight pressure. The operator then presses a button to send current through the joint for the brazing operation.

## Checking Perpendicularity of C-R Traces

By IRWIN S. LANDOW

*Cathode Ray, Storage and Phototube Section  
U. S. Naval Material Laboratory*

CURRENT DEVELOPMENT of electrostatic cathode-ray tubes for military and commercial applications requires that the angle of intersection of the vertical and horizontal traces shall not differ from 90 deg by more than  $\pm 1$  deg. Previously a tube was acceptable if the deviation from normality of the traces was not greater than  $\pm 3$  deg. Quality control of these improved tubes requires that this characteristic be measured with a high order of precision.

This article describes an instrument which satisfies this specification and has the additional advantage that the measurement does not require the simultaneous display of the traces or the location of the point of intersection of the traces.

The instrument comprises a Plexiglas disk 7 inches in diameter and  $\frac{1}{4}$  inch thick with cross-hairs scribed at right angles on the front and back faces. The corresponding cross-hairs are aligned with mirror symmetry in order to eliminate



Operator measuring angle between traces

# 200 KW

FOR  
THE

## Shout Heard Round the World

### Federal's F-5918-A

Serves with distinction in the  
"VOICE OF AMERICA" transmitters  
of Crosley Broadcasting Corporation



#### Prime Features of the F-5918-A

**Heavy Wall Anode** provides improved heat dissipation . . . allows conservative plate dissipation ratings.

**Kovar Grid, Filament and Anode Seals** increase ruggedness . . . for industrial and other applications.

**Specially-treated Grid** permits high heat dissipation . . . has recuperating power, which prevents destruction by momentary overload.

**Low Grid-plate Interelectrode Capacity** allows easy neutralization at frequencies up to 22 mc.

**Thoriated Tungsten Filament** results in reduced operating temperature of all tube parts.

**Full Voltage** safely applied to cold filament . . . no step-starting or high reactance transformers needed.

*The power triode that's small in size  
but BIG in power and dependability*

DAY and night the "Voice of America" radios its messages of truth, hope and friendliness to millions of listeners. It is the *shout heard round the world!*

AT WLW, Cincinnati, two Federal F-5918-A power triodes are used in each of three "Voice of America" transmitters . . . to provide 200 KW for the steady stream of programs broadcast from this vital link in the vast "VOA" chain.

"We find these tubes very satisfactory for the international band," says Crosley Broadcasting Corporation. "They are stable in operation . . . easy to neutralize up to our highest frequency of 21.65 mc without using grounded grid operation."

Federal's F-5918-A is amazingly rugged . . . providing maximum dependability. Its thoriated tungsten filament results in longer life . . . lower costs. Each tube delivers *more* output (100 KW) with *less than half* the filament power required by pure tungsten types.

The F-5918-A also is particularly suitable for 100 KW induction or dielectric heaters. An air-cooled version of this rugged performer is available in Federal's F-5919.

*"Federal always has made better tubes"*

## Federal Telephone and Radio Company

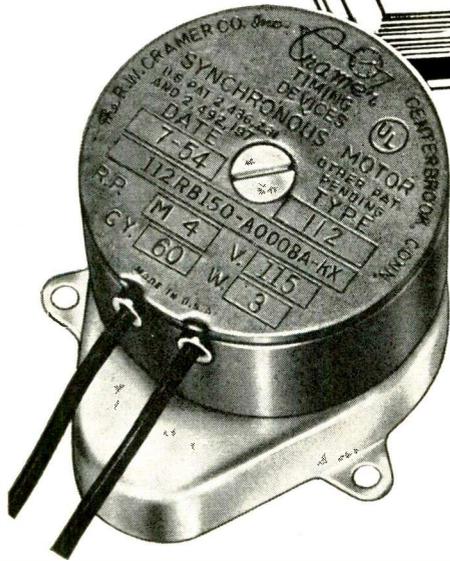
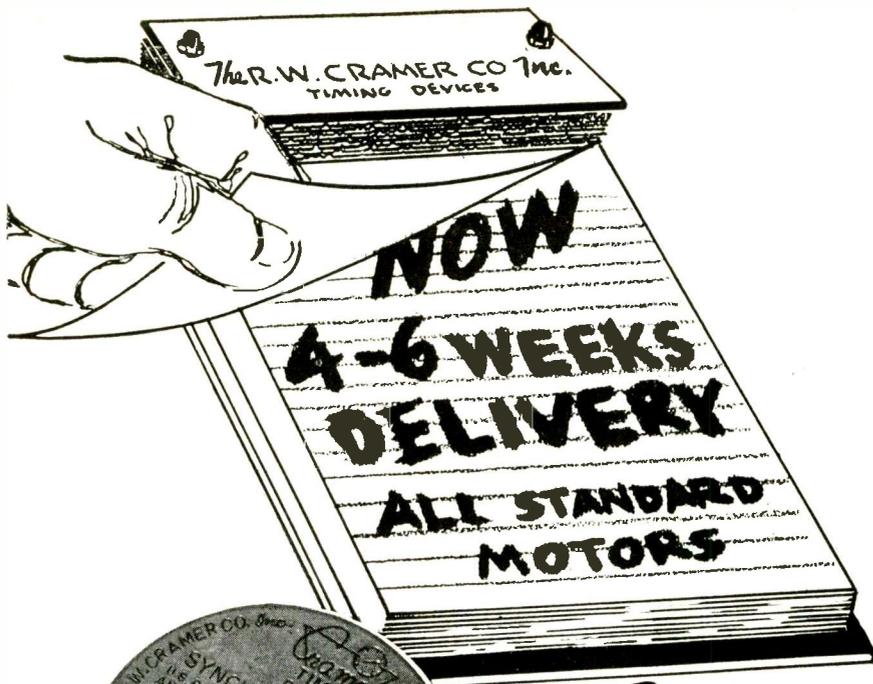
A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

COMPONENTS DIVISION 100 KINGSLAND ROAD CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.  
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

For Complete  
Technical Data  
on Federal's  
F-5918-A  
write today to  
Dept. K-613





# Cramer

## SYNCHRONOUS MOTORS

For instrument and control applications, in timing devices, power drives and signal systems which require constant speed.

The Type 112 Synchronous Motor recently announced by The R. W. Cramer Company is now in full production. Expanded facilities for standard motors now make possible prompt deliveries of small or large volume orders.

Write for new Bulletin PB-110.



### OUTSTANDING FEATURES

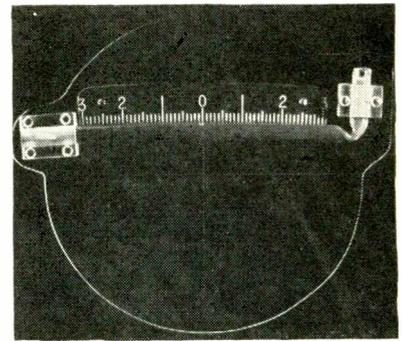
- Extra reserve strength (30 in. oz. torque at 1 r.p.m.)
- Instant start-stop.
- Runs in any position. Highly versatile
- Truly synchronous speed. NO SLIP.
- Temperature rise only 43° C.



SPECIALISTS IN TIME CONTROL

*The R. W. CRAMER CO., Inc.*

BOX 3, CENTERBROOK, CONNECTICUT



Instrument for measuring angle between traces on cathode-ray tube screen

parallax. A clinometer is mounted on the Plexiglas disk for measuring angles of inclination. It consists of a spirit level and a circular scale graduated in tenths of a degree within the interval of  $\pm 3$  deg. By means of a reservoir of air at one end of the glass tube, the size of the air bubble may be adjusted. For this application the radius of curvature of the glass bulb is approximately 10 feet. The large radius of curvature of the glass bulb permits the required instrumental precision.

In order to measure the angle between the traces, the cathode-ray tube is initially operated with one focused line trace almost horizontal. The horizontal cross-hair on the Plexiglas disk is aligned with the trace and the clinometer reading recorded. The deflection voltage is now applied to the second pair of plates of the cathode-ray tube and the clinometer reading is recorded when the vertical cross-hair is aligned with this trace. The algebraic difference between the two clinometer readings is the deviation from 90 deg of the angle between the traces.

### Winding Frame Grids for Ruggedized Tubes

By ROBERT E. BOOTH and

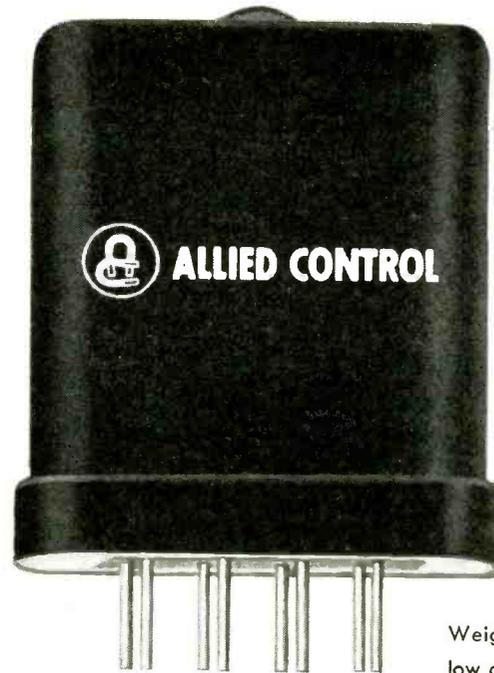
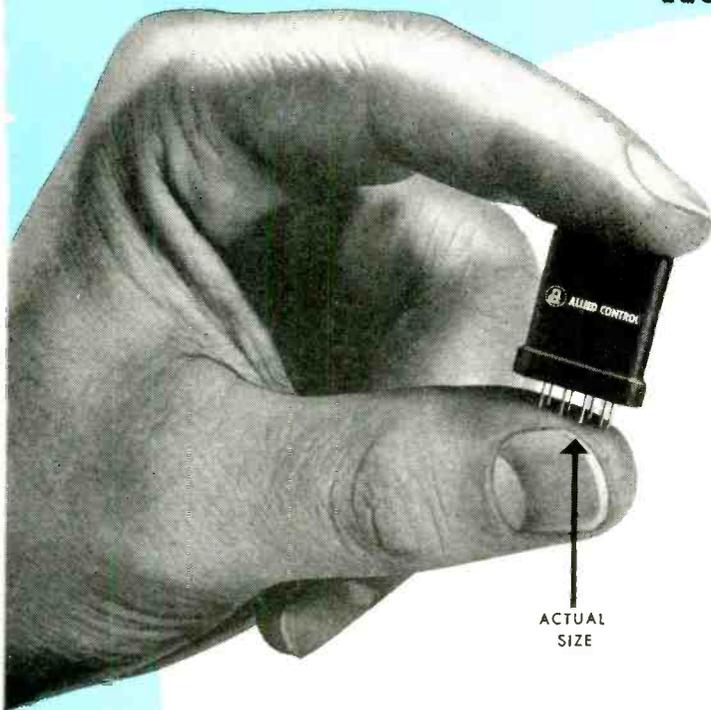
RICHARD C. WHITE

*Sylvania Electric Products Inc.*

CONVENTIONAL siderod grids are inadequate for many high-performance tubes because comparatively heavy lateral wires must be used to achieve needed strength. As the wire approaches 0.0005 inch in diameter, siderod grids not only suffer seriously from lack of strength, but also are difficult to manufac-

# New Sub-Miniature Relay

Now Double Pole Double Throw  
with Increased Ratings



## TYPE KH-6D

### ELECTRICAL SPECIFICATIONS

**CONTACTS:** Double pole double throw rated at 0.5 amperes at 26.5 volts DC or 115 volts AC resistive

**COIL:** Sensitivity—nominal 1.0 watts, maximum 0.3 watts  
Resistance—up to 1500 ohms standard

**TEMPERATURE:** Minus 60° C to plus 125° C

**VIBRATION:** 10 G up to 500 cycles

**SHOCK:** 100 G plus (operating)

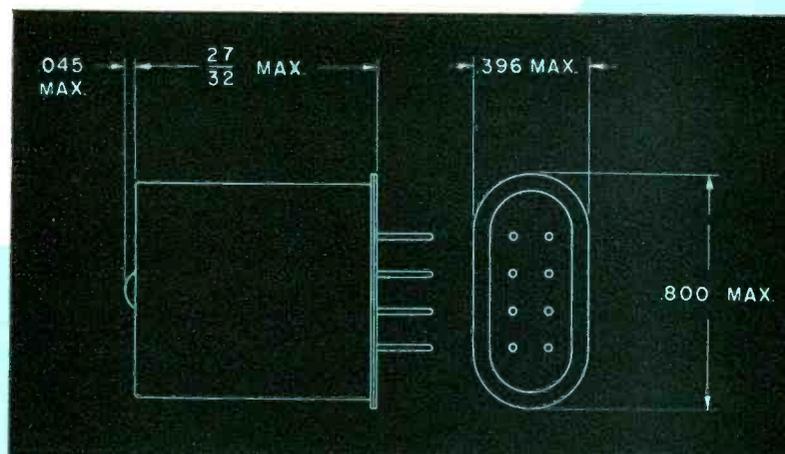
**SPEED OF OPERATION:** 2 milliseconds at nominal voltage direct from battery supply and 1 millisecond with series resistance

**ALTITUDE:** 350 volts rms at 80,000 feet

**TERMINAL TYPES:** Printed circuit, solder terminals and plug-in

**CAPACITY:** N. O. contact to case 0.6 mmf.

Weights 0.33 oz.—has low capacity for RF switching. Applicable to printed circuits.



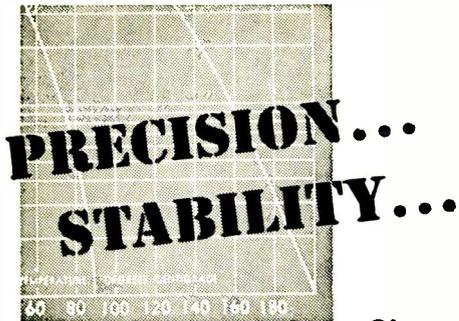
Write for catalog sheet giving complete information



# ALLIED CONTROL



ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.



**Signposts of Quality that make F. C. I. Capacitors ideal for exacting applications.**



**POLYSTYRENE CAPACITORS**

For applications where low power factor, low soakage, high insulation resistance and high capacitance stability are of vital importance. Voltage ranges from 100 volts up; temperature to 85° C. Types satisfying MIL-C-25A specifications available.



**TEFLON CAPACITORS**

Electrical characteristics equal to those of polystyrene at operating temperatures up to 200° C. Highest possible I.R. at any temperature. Ideal for applications where high electrical qualities are required at ambient temperatures above 125° C.



**HIGH VOLTAGE CAPACITORS**

Employ a "high-breakdown" plastic film producing capacitors remarkably smaller and lighter than previously available. Operation at temperatures to 125° C, with voltages from 2 to 60 KV. Hermetic glass or plastic tube housings with wire leads or threaded stud mountings.



**MINIATURE CERAMIC CAPACITORS**

Mylar\* dielectric capacitors housed in ceramic jackets with thermosetting plastic end fill. Specially impregnated to minimize temperature coefficient. Insulation resistance is maintained under the most severe conditions of temperature and humidity. \*Du Pont trademark

**ELECTRICAL CHARACTERISTICS**

	POLYSTYRENE	TEFLON	H.V.	MINIATURE MYLAR
Operating Temp. Range	-55°C to +85°C	-55°C to +200°C	-55°C to +125°C	-55°C to +125°C
Voltage Range, D.C.	100 to 30,000	100 to 30,000	2 KV to 60 KV	100-600V
Capacitance Range	.001 to 20 MF	.001 to 20 MF	.0001 to 0.1 MF	.0001 to 1.0 MF
Power Factor	.02% @ 1 KC	.02% @ 1 KC	0.3% @ 1 KC	0.3% @ 1 KC
Dielectric Absorption	.01%	.01%	0.1%	0.1%
Voltage Derating at 85°C	none	none	30%	none
Voltage Derating at 125°C	not operable	none	66%	30%
Voltage Derating at 150°C	not operable	none	not operable	60%
Voltage Derating at 200°C	not operable	33%	not operable	not operable
Temperature Coefficient	-100 PPM/°C	-100 PPM/°C	+500 PPM/°C	+60 PPM/°C up to 70°C
I.R. at Room Temperature	10 <sup>6</sup> megohms/MF	10 <sup>6</sup> megohms/MF	10 <sup>6</sup> megohms/MF	10 <sup>6</sup> megohms/MF
Capacitance Stability	0.1%	0.1%	0.5%	0.2%

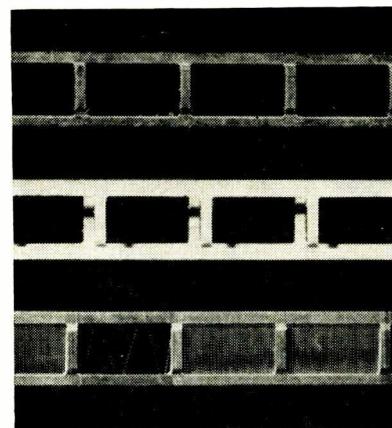
When your industrial capacitors specs. call for precision and stability, specify FCI.

Excellent delivery on standard or special types—Capacitors made to your specifications.

For more complete technical data, write for catalog.

**film capacitors, inc.**

3400 Park Ave., New York, N.Y.  
Telephone CYpress 2-5180



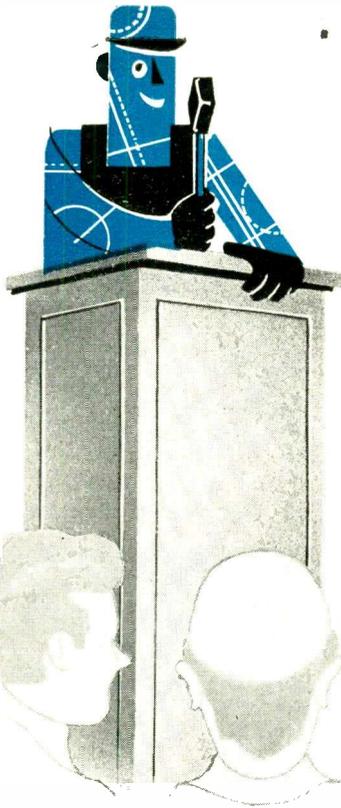
Steps in production of frame grids. The frame is first stamped, then two frames are assembled back to back so laterals may be wound and brazed into place

ture. Normal methods of lateral wire placement, by nicking and swaging the siderod material, are difficult to employ without breaking the lateral wire or producing an erratic pitch. Lack of adequate control of lateral-wire springback when the grids are released from the mandrel also contributes to non-uniformity.

The frame grid, developed as part of a U.S. Navy contract, provides a satisfactory answer to these problems. It is readily adaptable to automatic production techniques and can be fabricated at a rate approaching that of conventional siderod grids, at only slightly higher cost. It relies on a rigid frame for its strength and stiffness, and therefore extremely small-diameter lateral wires wound with a small, accurately controlled pitch can be used to provide the current control necessary for better tube performance.

The lateral wires are brazed to a rigid frame, the thickness of which determines the minor dimension of the grid. Thus frame grids can be made more nearly identical, and the spacing between grid and emitter can be controlled with greater ease. As a result, tube shrinkage can be greatly reduced for given testing limits, or the testing limits can be tightened appreciably to give the necessary improvements in reliability and uniformity.

The frame grid has rugged features that are especially desirable when tubes must be capable of giving good performance under conditions of severe shock and vibration. This is particularly true in the case



... "and always remember that  
**KARP IS CONSERVATIVE IN PRICE**  
**LIBERAL IN SERVICE**  
**THOROUGH IN QUALITY"**

**30 YEARS** of practical experience in designing, engineering and manufacturing sheet metal fabrications is yours for the asking at Karp.

Each order, whether large or small, receives the expert-care and attention of Karp Craftsmen from quotation to completion.

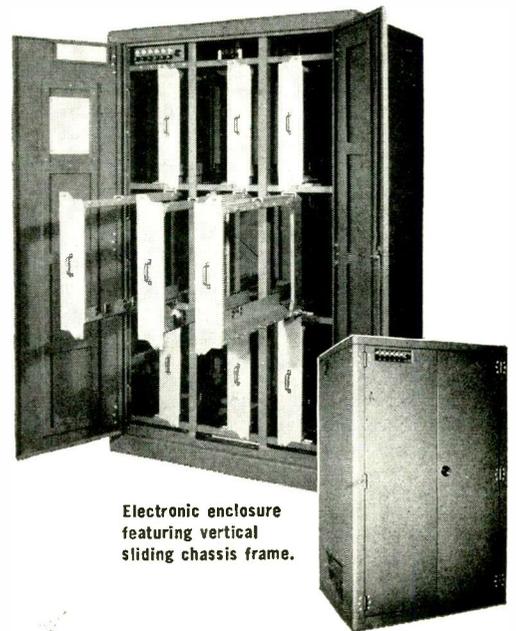
You can rely upon Karp \*"one-stop-service" to cut your cabinet, enclosure, chassis and housing costs and at the same time produce your requirements rapidly — under constant quality-control.

It will be a privilege to prove our claims. Just send us your blueprints, samples or sketches for quotations. There is no obligation, of course!

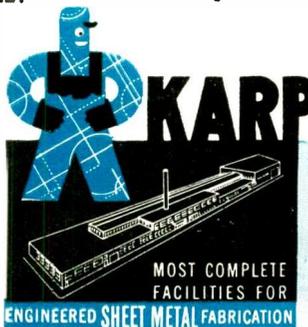
**KARP METAL PRODUCTS CO.**  
 Division of H & B American Machine Company, Inc.

211 63rd STREET

BROOKLYN 20, N. Y.



Electronic enclosure featuring vertical sliding chassis frame.



*\*enclosures reflect the skills within*

FACILITIES FOR ENGINEERED SHEET METAL FABRICATIONS: in aluminum or steel • long run or short • spot, arc, gas or heliarc welding • any type finish

- Modern plant—3 city blocks long
- Thousands of dies available
- Most modern of sheet metal fabricating equipment
- U. S. Air Force Certified Welding Facilities
- Air-conditioned spray room...complete baking facilities
- Complete sub-assembly facilities

# SAR PULSESCOPE

by

# Waterman

MODEL S-4-C

**DIRECT-READING  
DELAYED SWEEP  
ACCURATE TO  
0.1%**



Size:  
9 1/8" x 11 1/4" x 17 1/4"  
31.5 Pounds

## ANOTHER EXAMPLE OF *Waterman* PIONEERING...

The SAR PULSESCOPE, model S-4-C, is JANized (Gov't Model No. OS-4), the culmination of compactness, portability, and precision in a pulse measuring instrument for radar, TV and all electronic work. An optional delay of 0.55 microseconds assures entire observation of pulses. A pulse rise time of 0.035 microseconds is provided thru the video amplifier whose sensitivity is 0.5V p to p/inch. The response extends beyond 11 mc. A and S sweeps cover a continuous range from 1.2 to 12,000 microseconds. A directly calibrated dial permits R sweep delay readings of 3 to 10,000 microseconds in three ranges. In addition, R sweeps are continuously variable from 2.4 to 24 microseconds; further expanding the oscilloscope's usefulness. Built-in crystal markers of 10 or 50 microseconds make its time measuring capabilities complete. The SAR PULSESCOPE can be supplied directly calibrated in yards for radar type measurements. Operation from 50 to 400 cps at 115 volts widens the field application of the unit. Countless other outstanding features of the SAR PULSESCOPE round out its distinguished performance.

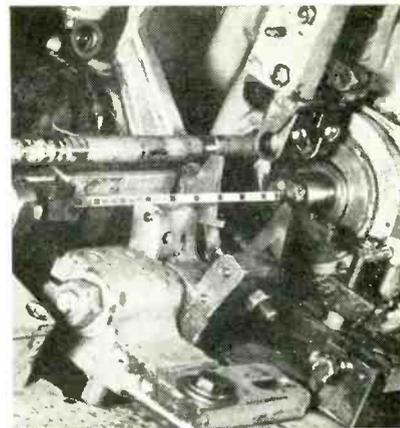
## WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.  
CABLE ADDRESS: POKETSCOPE

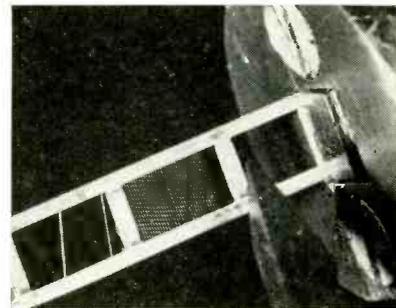
### WATERMAN PRODUCTS INCLUDE

- S-4-C SAR PULSESCOPE®
- S-5-A LAB PULSESCOPE
- S-6-A BROADBAND PULSESCOPE
- S-11-A INDUSTRIAL POKETSCOPE®
- S-12-B JANized RAKSCOPE®
- S-14-A HIGH GAIN POKETSCOPE
- S-14-B WIDE BAND POKETSCOPE
- S-15-A TWIN TUBE POKETSCOPE
- RAYONIC® Cathode Ray Tubes  
and Other Associated Equipment

MEMO...  
Write for details today!



Frame grid strip being wound on slightly modified standard grid lathe



Strip emerging from pressure mandrel, showing the skip-wound portion between grids. Wire here is 0.0005-inch tungsten, wound at 210 turns per inch

of subminiature tubes. Ruggedness is also desirable in the process of tube assembly since, in being welded, grids may be subjected to possible twisting, a major cause of lateral distortion and siderod bowing that frequently leads to short-circuits or cutoff difficulties in finished tubes.

### Fabrication of Frame Grids

Molybdenum was selected as the frame material because of its high modulus of elasticity and high-temperature strength. Also, its thermal expansion coefficient, which is important in brazing, is comparable with that of the tungsten laterals.

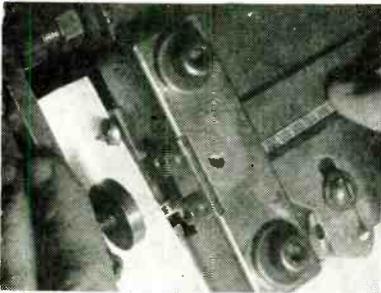
The first operation in preparing the frame grid is to punch and form the material into strips of frames. These are then cleaned and gold-plated. Two strips are placed back to back with the cross bars lined up and are drawn through a pressure mandrel on the grid machine by the lead screw.

The lateral wire is wound on the frame at the desired pitch as the frame emerges from the mandrel. No nicking or swaging is necessary

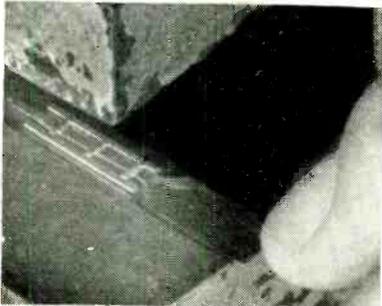
because the tension on the laterals is sufficient to hold the frame strips together and the laterals temporarily in place. By means of a cam, sections of the frame are skipped in the winding to provide free, unwound legs for mounting the grid into the mica support.

The wound strips are placed in a wide V-shaped slotted rack and fired in a hydrogen furnace to braze the laterals to the frame. The gold plating on the frame serves as the brazing material. It was found possible to straighten the strips by cold stretching them after brazing.

Brazed strips are cut into individual grids and the loose turns



Cutting operation, showing positioning of brazed strip in cutter



Lateral tensioning operation. Pressure is applied to the crossbars, which are offset for that purpose as well as for filament clearance

occurring in the skip-wound portion are peeled off the frame. If the laterals still exhibit loose tension after stretching and brazing, they can be tightened by exerting pressure on the crossbars of the frame, which have been offset for that purpose as well as for providing clearance for the filament assembly.

Since tensioning can be accomplished after winding and brazing, it is not necessary to control the winding and brazing to a fine degree. This, of course, is a saving in setup time on the grid machine and is an important factor governing production costs.

The completed grids are next in-

**Where dependability,  
long life and uniform  
performance are  
all-important . . . select**

**Bendix**  
Red Bank

## HARD GLASS Miniature Beam Power Amplifier



Here's another advance in the Bendix Red Bank "Reliable" Vacuum Tube program. Featuring a hard glass bulb and stem with gold-plated pins . . . plus a conservative design center of cathode temperature . . . the Bendix Red Bank RETMA 6094 can operate at temperatures up to 300° C. compared to an average of only 175° C. for soft glass bulbs. Thus, this new tube ideally meets aircraft, military and industrial applications where freedom from early failure, long service life, and uniform performance are essential.

The Bendix 6094 uses pressed ceramic spacers, instead of mica, for element separation. In other tubes, deterioration of mica in contact with the hot cathode causes loss of emission which is greatly accelerated under shock and vibration. Ceramic eliminates this problem and greatly reduces damage caused by fatigue failure of parts.

For complete details on our special-purpose tubes, write today.

### ELECTRICAL RATINGS\*

Heater voltage (AC or DC)**	6.3 volts
Heater current	0.6 amps.
Plate voltage (maximum DC)	275 volts
Screen voltage (maximum DC)	275 volts
Peak plate voltage (max. instantaneous)	550 volts
Plate dissipation (absolute max.)	12.5 watts
Screen dissipation (absolute max.)	2.0 watts
Cathode current (max. instantaneous peak value)	100.0 ma
Heater-cathode voltage (max.)	±450 volts
Grid resistance (max.)	0.1 megohm
Grid voltage (max.)	+5.0 volts
(min.)	-200.0 volts
Cathode warm-up time	45 seconds
(Plate and heater voltage may be applied simultaneously.)	

\*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

\*\*Voltage should not fluctuate more than ±5%.

### MECHANICAL DATA

Base	9 pin miniature hard glass—gold plated tungsten pins
Bulb	Hard glass—T6½
Max. over-all length	2¾"
Max. seated height	2¾"
Max. diameter	¾"
Mounting position	any
Max. altitude	80,000 feet
Max. bulb temperature	300°C.
Max. impact shock	500g
Max. vibrational acceleration	50g
(100-hour shock excited fatigue test, sample basis.)	

**Bendix**  
Red Bank

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, Voltage Regulators, Fractional D.C. Motors and A.C. and D.C. Generators.

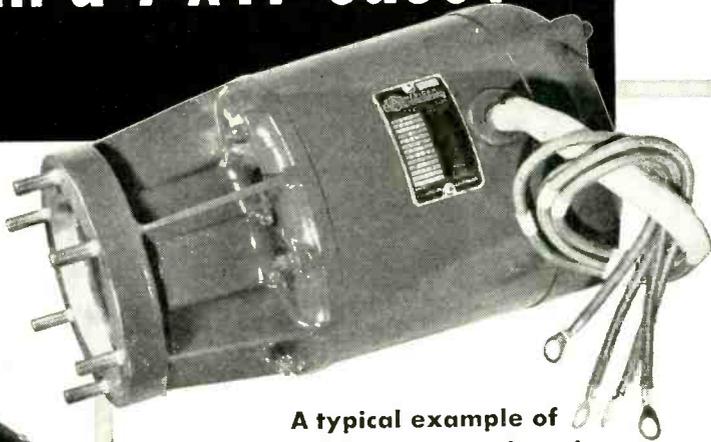


EATONTOWN, N. J.

DIVISION OF

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif.  
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.  
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.

# 15 Horsepower in a 7"x11" case!



## A typical example of American Electric engineering

This 400 cycle 3 phase motor for driving a hydraulic pump is a special aircraft design, custom-developed by American Electric Motors Inc. Rated at 15 h.p. continuous duty at 11,500 r.p.m., it actually produces 19 h.p. on intermittent duty, yet occupies less than  $\frac{1}{4}$  cubic foot. A special case made of magnesium holds weight down to a mere 32 lbs. or approximately  $\frac{1}{2}$  h.p. per pound. This motor is fungus-proof, corrosion resistant, meets AND 20002 type XIIB mounting specifications and is sealed against hydraulic oil. It operates within a temperature range of  $-67^{\circ}$  to  $+131^{\circ}$  F. Overall length of the motor unit is 7" with a 4" coupling extension.

## MINIATURE MOTORS for all PURPOSES

In addition to engineering such "specials" described above, American Electric makes an almost unlimited range of miniatures for 60 and 400 cycle, and variable frequency operation. These feature low weight and compact size, meeting high temperature requirements. With our wide variety of completed tooling, laminations are available for almost any miniature motor requirement without design compromise or delay.

**INDUCTION OR SYNCHRONOUS TYPES**—Both reluctance and hysteresis motors are available in the synchronous type.

**APPLICATIONS**—American Electric Miniatures are available for all *drive requirements*, for *propeller fans* and *centrifugal blowers*. Let us quote on your requirements. Wire, write or phone today!

Variable frequency motors in these blowers and fans operate at minimum watts loss over the full range of frequencies encountered with aircraft power supplies—from 320 to 1000 c.p.s. CFM output of blowers is substantially uniform over full frequency range at atmospheric pressure. RPM rises at high altitude, increasing velocity and cooling ability.

Also Manufacturers of High Cycle Motor-Alternators and A.C. Industrial Motors.

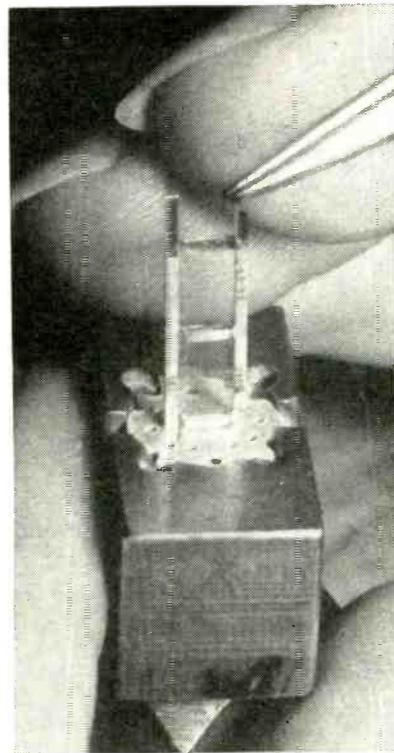


4811 Telegraph Road,  
Los Angeles 22,  
California

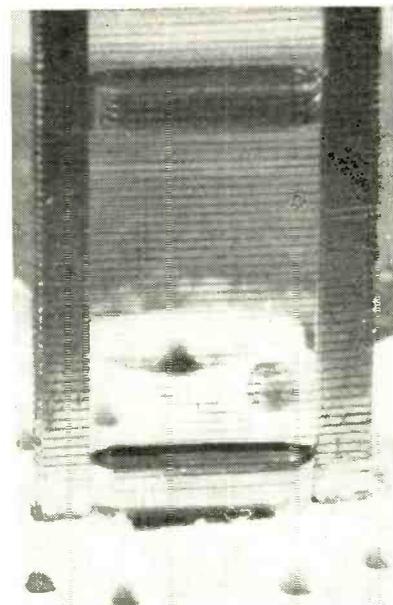
DIVISION OF AMERICAN ELECTRONICS, INC.  
FIELD ENGINEERING REPRESENTATIVES: Silver Spring (Md.) • Boston • Buffalo • New York City • Chicago  
Dallas • Kansas City • Wright Field • Minneapolis • Seattle • Montreal • Toronto  
JOE DAVIDSON & ASSOCIATES, Los Angeles

spected and trayed. Finally, the trayed grids are sealed in plastic bags to prevent the accumulation of small dust particles on the lateral wires.

The resultant frame grid has perfectly plane surfaces and a very uniform pitch. Controlling the thickness of the frame material to insure accurate, close tolerances of the grid minor dimension is much simpler than determining the uncontrolled, allowable lateral-wire



Frame grid being mounted in a mica support

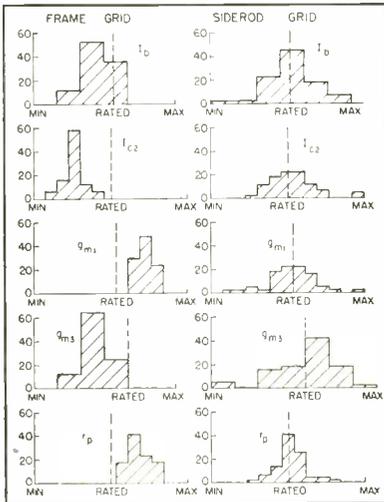


Crossbars prevent end lateral jamming during assembly

springback of conventional grids.

Frame grids will withstand almost any rough handling short of jabbing an object through the laterals. Even then, the laterals are not appreciably dislocated unless they are broken. The crossbars prevent jamming of the end laterals during assembly, virtually eliminating potential shorts and cutoff shrinkage.

Grids have been wound successfully with 0.00034-inch tungsten lateral wire at 472 turns per inch

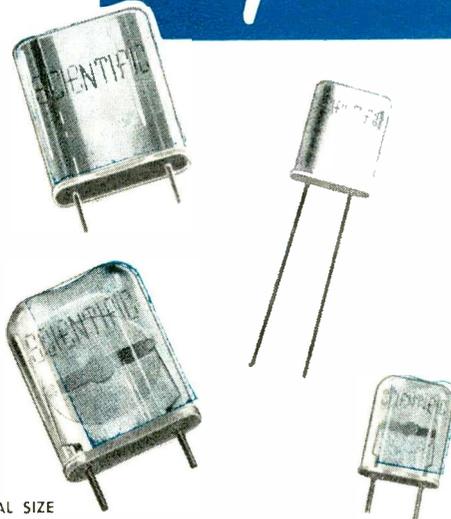


Spread in characteristics of tubes having frame and siderod grids. Frequency of occurrence in percent of total tubes is plotted against five different tube characteristics

on standard grid lathes with excellent results. It is believed that 0.0002-inch wire could be wound safely, although no attempt has been made to do so.

*Conclusion*

The advantages of a frame grid that can be adapted to automatic mass-production techniques are numerous. Its contribution to the manufacture of higher-performance tubes with more-uniform electrical characteristics is clearly shown by the narrower range of characteristics exhibited by the tubes incorporating it. It provides the most reliable method, to date, for the fabrication of grids with closely-spaced, extremely small lateral wires. Its strength and rigidity alleviate handling problems in tube assembly and are beneficial in the construction of ruggedized tubes, particularly those required by the Armed Services. Finally, although the manufacturing cost of frame



ACTUAL SIZE

- AIRCRAFT
- AIR FORCE
- AMATEUR
- ARMY-SIGNAL CORPS
- BROADCAST
- CAA CERTIFICATION
- CIVILIAN BANDS
- HOBBY MODELS
- INDUSTRIAL
- LAW ENFORCEMENT
- MARINE
- MOBILE TWO-WAY
- NAVY
- PIPELINE
- RAILROAD
- RAM JET CONTROLS
- TAXI
- TELEVISION

ENGINEERING COUNSEL

In the rapidly expanding electronics field, many engineers are designing equipment using frequency control devices.

Are you using the circuit which will get the most stability and drive out of your crystals? Scientific has a staff of engineers available for consultation and a complete experimental and development laboratory is maintained to assist you. Prototype engineering crystals will be developed in our laboratory in accordance with your specifications.

Our engineers may be able to assist you. Their services are available at no charge.



SCIENTIFIC

CRYSTALS OF THE HIGHEST QUALITY

SCIENTIFIC RADIO PRODUCTS, INC.

ONE OF THE OLDEST MANUFACTURERS OF CRYSTALS IN THE UNITED STATES.

215 SOUTH 11TH ST.

ATLANTIC 9787

OMAHA, NEBRASKA, U. S. A.

*Be Specific-Say Scientific*



USE **New**  
**DIEHL**

**INSTRUMENT SERVO MOTORS**

Designed for use on recording instruments where rapid acceleration and deceleration are of primary importance.

DIEHL Instrument Servo Motors feature a novel construction with an integrally molded stator and housing. Liberal design characteristics are built-in so that long life can be expected even under severe ambient temperature conditions.

While intended primarily for commercial use, these Servo motors meet pertinent JAN specifications for resistance to humidity, salt spray, fungus, shock and vibration.

SPECIFICATIONS	DIEHL NUMBER	
	FPE21L-27-1	FPE25L-92-1
Output (Watts)	1	5
Frequency (Cycles)	60	60
Poles	2	2
Reference Phase (Volts)	115	115
Control Phase (Volts)	50	115
Reference Phase (Watts)	10	17
Control Phase (Watts)	3.5	17
Control Phase Impedance (Ohms)	555	575
Locked Torque (Oz.-In.)	1.5	5.5
Theoretical Acceleration (Rad/sec. <sup>2</sup> )	9650	19000

Our engineering staff will gladly help you select the motors best suited to your specific requirements. A request on your letterhead will bring you a copy of Technical Manual No. EL-1254 describing Diehl Servo Motors and related equipment.

*Other Available Components:*

**D.C. SERVO SETS • RESOLVERS  
MINIATURE PERMANENT MAGNET D.C. MOTORS**

**DIEHL MANUFACTURING COMPANY**

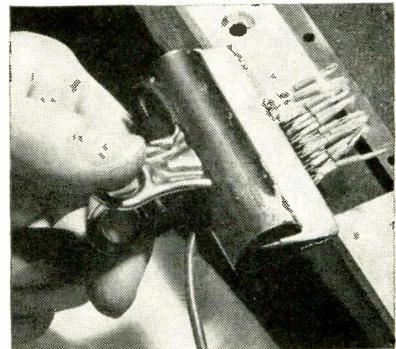
Electrical Division of THE SINGER MANUFACTURING CO.  
Finderne Plant, SOMERVILLE, N. J.



grids is at present higher than that of conventional siderod grids, the number of tubes rejected for mechanical and electrical defects should be considerably lower.

**Cataphoretic Coating for Heater Bends**

To COAT the exposed peaks or bends in heaters for vacuum tubes after they have been folded, the heaters are picked up in batches of a dozen or more with a large spring-type paper clip and treated in a cataphoresis process developed in the Bloomfield, N. J. plant of Tung-Sol



Method of picking up heaters with clamp-type electrode after aligning them with the aid of bars arranged on bench



Holding batch of heaters in cataphoretic coating solution

Electric Inc. The paper clip is connected to the negative terminal of a Variac-controlled d-c power supply delivering 10 volts at about 100 ma. The clip is held for 2½ seconds over an aluminum container serving as the positive electrode and containing a special electrolyte obtained from Electron Tube Coil Co. Only the ends of the heater are immersed; these pick up solids of aluminum hydroxide and aluminum oxide from the solution.

The solution is stirred continuously by a paddle-shaped Alnico magnet inside, driven magnetically by another magnet on the shaft of a small a-c motor in the stand under the container. Speed of stirring is

controlled by a rheostat in the motor circuit. This magnetic stirrer is available from Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

A signaling timer connected into the plating circuit cuts off plating current in 2½ seconds. A lamp in series with the timer and bath indicates to the operator that the coating process on a batch has been completed.

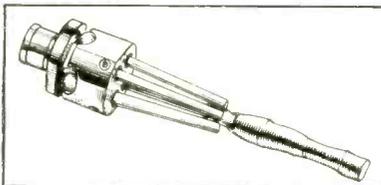
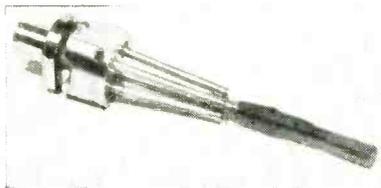
### Furnace Sample Holder

By J. SOLED and A. MACDONALD  
Signal Corps Engineering Laboratories  
Fort Monmouth, New Jersey

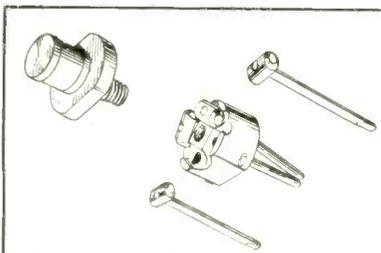
IN THE DEVELOPMENT of the floating zone technique for the recrystallization of silicon, a need arose for a small metal sample holder. Tungsten was selected as the material for the supporting fingers because they often approach close to the induction coil. In preliminary resistance heating, the fingers also act as conductors for the current.

In the design evolved for the purpose, set screws pressing against each of the four tungsten fingers lock the irregularly shaped sample in place. The radial movement of each tungsten finger is obtained by a T-bar pivot construction.

Stainless steel was used for all parts except the fingers, which are of 0.90-inch-diameter ground tung-



Sample holder with silicon in tungsten fingers



Parts of holder, showing T bar sockets

# SENSITIVITY—ACCURACY—STABILITY

# make BALLANTINE

## The World's Leading Electronic Voltmeters

### AUDIO TO 150 KC

### Model 300

- 1 mv—100 v ..... Voltage Range
- 10 cps—150 kc ..... Frequency Range
- 2% ENTIRE RANGE ..... Accuracy
- ½ meg. shunted by 30 µpf ..... Input Impedance



### SUB-AUDIO TO 150 KC [Battery Operated] Model 302B

- 100 µv—100 v ..... Voltage Range
- 2 cps—150 kc ..... Frequency Range
- 3% 5 cps—100 kc  
5% 2 cps—5 cps  
100 kc—150 kc ..... Accuracy
- 2 meg. shunted by 15 µpf\* ..... Input Impedance



### AUDIO TO 2 MC

### Model 310A

- 100 µv—100 v ..... Voltage Range
- 10 cps—2 mc ..... Frequency Range
- 3% to 1 mc  
5% 1 mc—2 mc ..... Accuracy
- 2 meg. shunted by 15 µpf\* ..... Input Impedance



### AUDIO TO 6 MC

### Model 314

- 1 mv—1000 v ..... Voltage Range  
(100 uv—1 mv without probe)
- 15 cps—6 mc ..... Frequency Range
- 3% to 3 mc  
5% 3 mc—6 mc ..... Accuracy
- 11 meg. shunted by 7.5 µpf ..... Input Impedance  
(1 meg. shunted by 25 µpf without probe)



### PEAK-TO-PEAK

### Model 305

- 1 mv—1000 v pk-to-pk ..... Voltage Range
- 10 cps—100 kc (Sine Wave) ..... Frequency Range
- 3 µsec—250 µsec ..... Pulse Width
- 20 pulses per sec. .... Min. Rep. Rate
- 5% for pulses ..... Accuracy
- 2 meg. shunted by 15 µpf\* ..... Input Impedance



\*Shunt capacitance is 8 µpf on all ranges except two most sensitive ranges.

Write for complete catalog of all Ballantine Electronic Instruments



# BALLANTINE LABORATORIES, INC.

100 FANNY ROAD, BOONTON, NEW JERSEY



## KEARFOTT ANNOUNCES

a new product line from the West

## CUSTOM AND STANDARD MICROWAVE EQUIPMENT

**STANDARD** microwave equipment by Kearfott for laboratory or production includes attenuators, directional couplers, crystal-mixers, wavemeters and all universally-used microwave components. Units have been developed for the S, C, X<sub>u</sub>, X, and K<sub>u</sub> microwave bands. Components to applicable AN specifications are available in brass or aluminum—other materials to order.

**CUSTOM-DESIGNED** microwave equipment is a specialty of Kearfott. Manufacturing facilities, engineering-design personnel, a complete test laboratory and wide experience can be brought to bear on your problem. Kearfott can supply specialized components such as rotary joints, RF sources, matched assemblies and test equipment such as:

### X-BAND TEST SET MODEL W-109

A four-in one instrument that saves time and money. Precision Wavemeter, Signal Generator, Spectrum Analyzer and Power Monitor in a single instrument for rapid field or assembly line testing. Designed by Kearfott engineers, utilizing Kearfott specialized microwave components.



Write for brochures

- X Band Test Set.
- Microwave Components.

**Kearfott** COMPANY, INC.  
LITTLE FALLS, NEW JERSEY

WESTERN MANUFACTURING DIVISION  
14844 OXNARD ST. • VAN NUYS, CALIF.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

#### SALES OFFICES

EASTERN OFFICE:  
1378 Main Ave.  
Clifton, N. J.

MIDWEST OFFICE:  
188 W. Randolph St.  
Chicago, Ill.

SOUTH CENTRAL OFFICE:  
6115 Denton Drive  
Dallas, Texas

WESTERN AREA OFFICE:  
253 Vinado Ave.  
Pasadena, Calif.

sten rod  $1\frac{1}{2}$  inches long. The body of the holder is  $\frac{3}{4}$  inch in diameter and the pivots are made of  $\frac{3}{16}$ -inch-diameter rod.

Some of the characteristics of this design are open construction which is desirable for high-vacuum applications, ease of assembly which facilitates cleaning of parts and metal-to-metal contact of the components which improves cooling of the tungsten fingers.

The feature of grasping an irregular sample by adjustable fingers could be used in other applications such as surface analysis. The fingers may be of varying lengths and may alternatively be constructed of nonmetallic materials, such as quartz.

## Spot Welder Makes Tap on Single Turn of Wire

IN SPOT-WELDING tap connections at Helipot Corp., South Pasadena, California, skilled workers use binocular microscopes in conjunction with a new technique in spot welding the very fine electrical connections. This technique assures that tap connections are attached to a single turn only of the resistance wire, rather than to several adjacent turns as is often the case with conventional methods. Thus the high resolution, important



Setup for welding wire lead for tap to single turn of resistance wire inside housing, by working through drilled hole in housing while observing operation through microscope. Lead is held in tweezer-type welding electrode

to the proper functioning of a precision potentiometer, is not reduced. None of the wire turns adjacent to the one tapped are shorted out.

### Buffing Picture Tubes

SCRATCH marks on the faces of television picture tubes are removed economically, quickly and with no operator fatigue by using a Stow B50 flexible shaft machine in the plant of CBS-Hytron. This transmits one horsepower to the buffing pad while the motor rests on a



Buffing face of picture tube to remove scratches

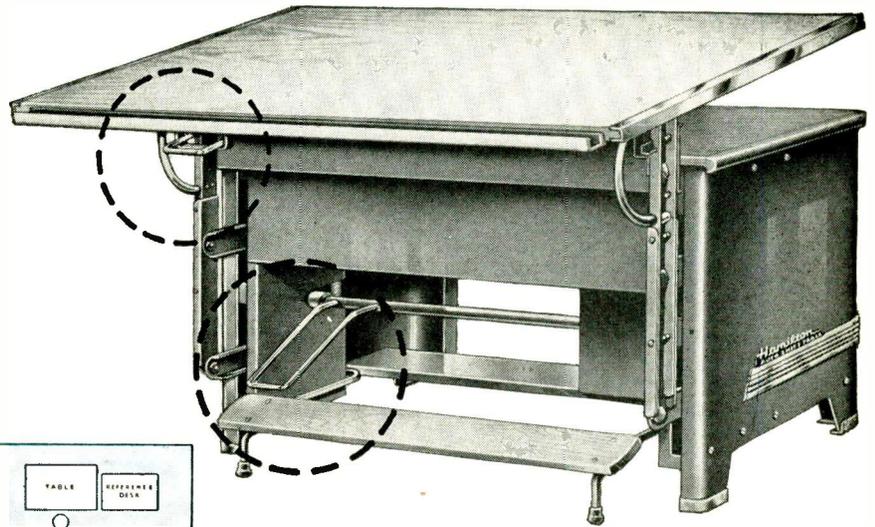
bracket up out of the way. A half-inch flexible shaft six feet long, with a five-to-one reduction angle head gives a buffing speed of 690 rpm. The machine is made by Stow Manufacturing Co., Binghamton, New York.

### Ceramic Twin-Triode Pumping Technique

NEW high-reliability developmental ceramic tubes comparable to the 6SN7 are sealed without using exhaust tubulations, in a Government-sponsored Eimac program concentrating on smaller tubes. An end disk of the tube is automatically brazed to the ceramic envelope inside the vacuum chamber after

# Auto-Shift

## tables help get the work done



with 30 - 50% more space efficiency

About 250 square feet accommodate two more Auto-Shifts than separate boards and desks. Auto-Shift puts a large reference surface and drawer directly behind each draftsman for maximum space and operating efficiency—especially effective in row installations.



with much less draftsman fatigue

Auto-Shift has greater flexibility. Note the foot and hand releases (circled above) to adjust board height and slope instantly. Fully counterbalanced top moves effortlessly. Draftsman can change working position often—fatigue is sharply reduced—and the work gets done with Auto-Shift.

For the whole important Auto-Shift story, mail the coupon below today.

DRAFTING EQUIPMENT DIVISION

# Hamilton

MANUFACTURING COMPANY

Two Rivers, Wisconsin

This Auto-Shift booklet is yours, free. Contains all the Auto-Shift facts, new ranges of sizes, data on new models for front and rear of row installations. Fill out and mail this coupon now!



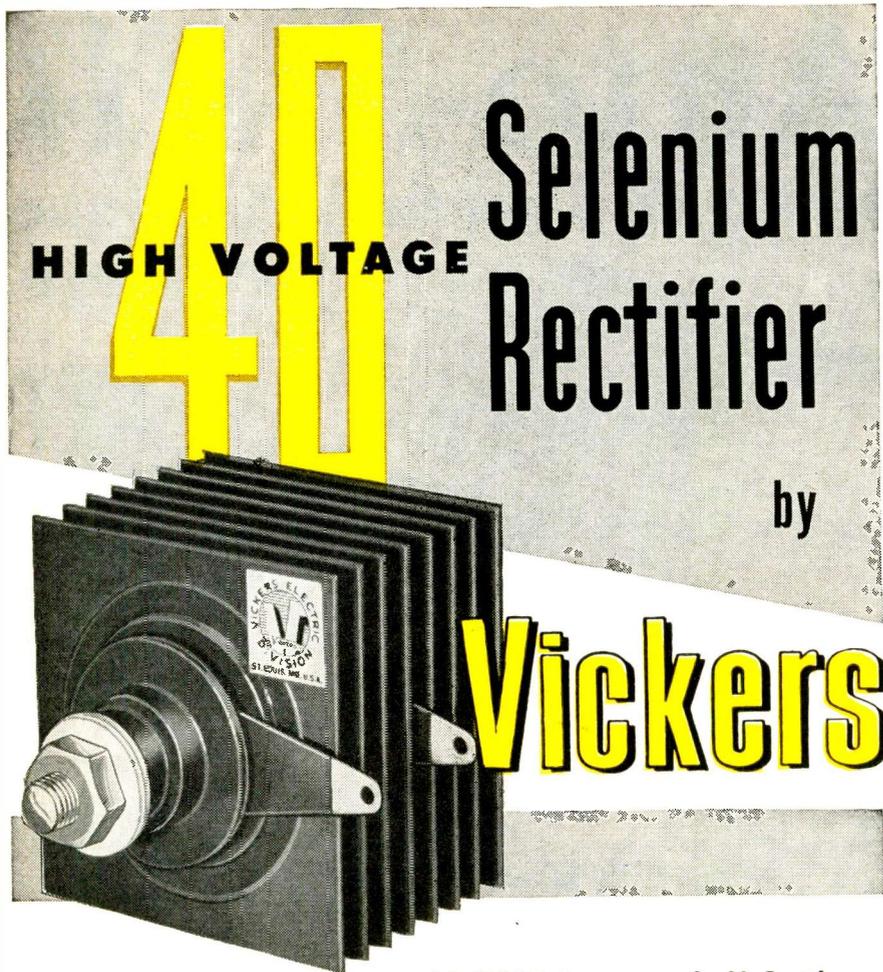
Hamilton Manufacturing Company, Two Rivers 7, Wisconsin  
Please send me the new Auto-Shift booklet (ADR-97)

Name \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_



a combination of  
outstanding features  
that results in  
**MORE WATTS  
PER DOLLAR  
INITIAL COST**  
**LOWER  
ANNUAL COST**  
**WRITE TODAY**  
for complete  
information

**40-VOLT Inverse Cell Rating  
Combined with:**

- LOW LEAKAGE...**  
only 2 milliamperes per square inch average  
... one-half that of conventional rectifiers.
- LOW INVERSE LOSS...**  
heating as a result of low inverse loss at  
high voltage averages less than 5°C—one-  
half that of conventional rectifiers.
- HIGH DIELECTRIC QUALITY...**  
withstand surges up to twice rated voltage.

**PLUS the advantages of  
HIGH AMBIENT**

Operate in ambient temperatures up to 125°C.  
No derating for 50°C.  
Operate at temperatures that would destroy ordinary  
rectifiers—withstand accidental temperature  
excesses due to overload or cooling malfunction.

**LONG LIFE**

Newly developed inorganic barrier is inherently  
stable. Inverse characteristics actually improve with  
use. Life test now past 25,000-hour mark.

**Vickers Builds Better Rectifiers**



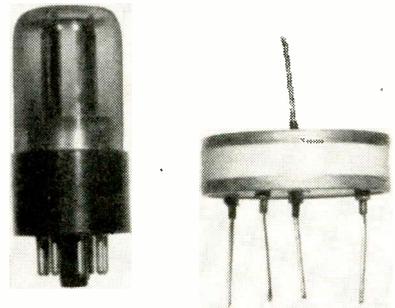
**VICKERS ELECTRIC DIVISION**

**VICKERS Inc.**

A UNIT OF THE SPERRY CORPORATION

1801 LOCUST STREET • SAINT LOUIS 3, MISSOURI

pumpdown with heavy-duty pumps. From appearance, it is difficult to recognize the resulting design as a vacuum tube. The flat cylindrical shape resembles more that of a pill box. Flexible leads are provided because the inherent reliability is expected to permit soldering the tube permanently into a circuit. The tube is at present still in a pioneering stage at the San Bruno, Calif. plant of Eitel-McCullough, but the



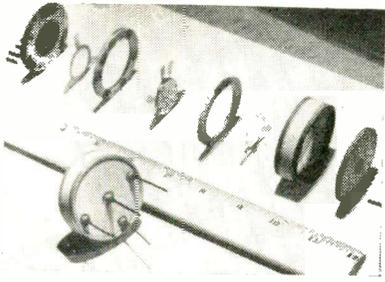
Comparison of conventional 6SN7 twin-triode with ceramic equivalent

ideas embodied in its design are believed to be fundamentally sound.

In the new ceramic twin-triode, ceramic end disks comprise the anodes. Grids and cathode are separated by ceramic spacer rings, all assembled in stacked relationship in a confining ceramic envelope cylinder. The grids are made by a photographic electroforming process for accurate high-speed production. The cathode button contains a packaged heater which is a structurally integral part of the unit. Since the heater is integrally formed, it cannot move or vibrate. All of the parts, including the electrode supports, are brazed solidly in position. Spot welds have been eliminated.

The stacked construction was selected because it permits assembly without requiring skilled operators. It is also ideal for automatic machine assembly operations, that also being one of the objectives of our program.

The stacked construction illustrated is a basic design, adaptable for a variety of tube types. Eliminating the grids gives a twin-diode. Inserting more grids gives a twin-tetrode. While a twin structure has been illustrated, this stacked structure is adaptable for the commoner single-unit tubes such as diodes and triodes. In some



Exploded view of ceramic twin-triode. From left to right, parts are anode disk, frame grid, ceramic spacer, cathode, ceramic spacer, frame grid, ceramic envelope and other anode disk. Base of complete tube shows in foreground

designs the disk at one end of the tube supports the cathode and the disk at the other end forms the anode, thus providing a simple diode. This basic diode may then be expanded into a triode, tetrode or pentode simply by stacking in the requisite number of grids. Certain tube parts, not unlike building blocks, are therefore common to a variety of tube types.

The proposed method of pumping these tubes is of interest. There is no exhaust tubulation on the tube. All parts are assembled and brazed together except one of the end wall disks. The exhaust then takes place in a vacuum chamber, while the end disk is held separated from the main body of the tube, providing a wide opening for withdrawal of gas. Exhaust problems associated with restricted pumping tubulations are thus avoided. As a final step, the end disk is lowered and brazed in place while the tube is still in the vacuum chamber. Many tubes can be exhausted simultaneously in this manner.

Bakeout and exhaust at 650 C is permitted because of the absence of glass and other low melting point materials. Flash getters are eliminated.

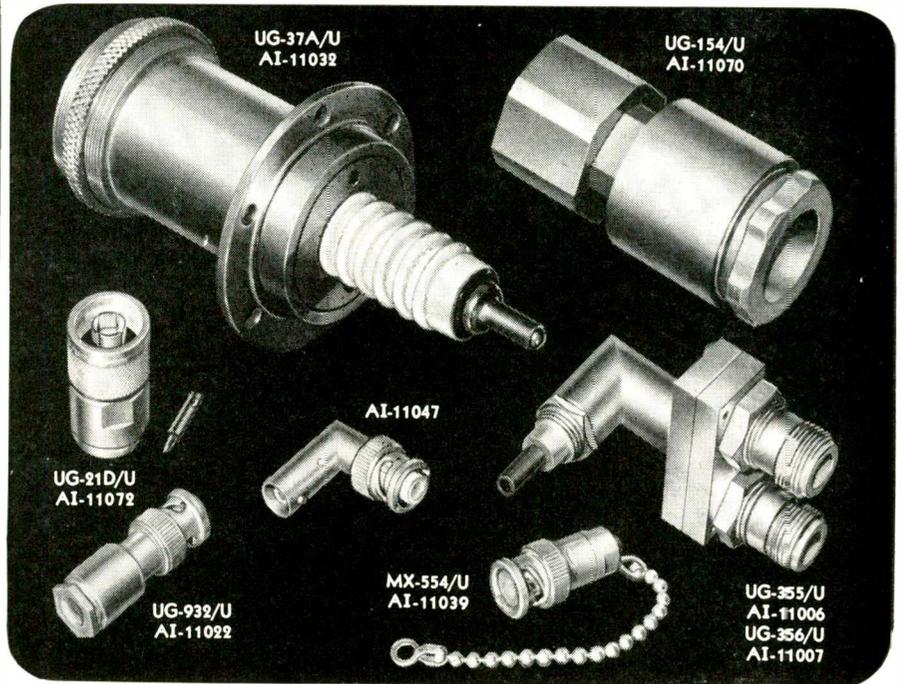
### Induction Bonding Cuts Cost of Stripping Stranded Wire

NEWLY developed induction heating units for bonding stranded wire during the cutting and stripping operation have been studied by engineers of The William Brand & Co., Willimantic, Conn.

After induction heating and prior to the cut and strip operation, it is

# Allied Industries

## A PROVEN SOURCE FOR QUALITY U.G. CONNECTORS



Allied's reputation for precision made connectors is growing throughout the Electronic Industries.

Our entire plant has earned approved Air Force quality control—and the U. G. connectors meet all government specifications. Sensitive testing devices make it possible to maintain tolerances to new minimums and assure the highest standards of uniformity and dependability.

Care of manufacture is reflected in all details, as weight and texture of silver plating and other items often overlooked or neglected.

### We keep delivery promises

Adequate plant facilities enable us to gear our delivery schedules to meet your production needs.

Here's another reason why our customers know we won't let them down. On 95% of our connectors, we carry a large, complete inventory of parts. Overnight we can assemble and ship enough connectors to avoid production tie-ups. The remainder of the order promptly follows.

### Complete line of R.F. connectors

Allied offers a complete line of R. F. connectors to meet your exact needs. In addition, we make specials to anyone's design. We have the engineers, tooling and experience to do the job.

For quotations and fast action on quality connectors at the right price—phone, wire or write;

# Allied Industries inc.

25th at Woodland Ave.  
Louisville 10, Ky.

N-610B



# BOLOMETERS

## NARDA

Highest Specification/Cost Ratio!

N-821B



**The new Narda Bolometers offer optimum characteristics and specifications combined with long life and low cost.**

N-610B is designed for use in any crystal or Bolometer mount for measuring power, attenuation, antenna patterns, and in impedance meters for measurement of high VSWR's. Correct bias current is obtained from all VSWR amplifiers and from all microwave wattmeter bridges.

N-610B is interchangeable with 1N21 and 1N23 crystals in all waveguide and coaxial crystal holders.

**order your  
supply now!**

**\$9.50 each**

N-821B may be used in any standard Bolometer or "barretter" mount. It is electrically identical to the N-610B, but is designed for holders of the 821 type Bolometer.

Like the N-610B, N-821B is hermetically sealed, moisture-proof and tropicalized. Meets all shock and vibration requirements.

NARDA MANUFACTURES A COMPLETE LINE OF MICROWAVE TEST EQUIPMENT, THERMISTORS AND BOLOMETERS. WRITE OR CALL FOR TECHNICAL LITERATURE . . . and use the Narda advisory services without obligation.

# NARDA

THE NARDA CORPORATION  
66 MAIN STREET • MINEOLA, NEW YORK  
Pioneer 6-4650

important to quench the plastic with a wet sponge or some similar cooling method to obtain a clean strip. It is also important to use die type cutting blades and not V type since the latter has a tendency to destroy the bond by untwisting action.

Consistent bonding can be obtained, but the tin coating flows into the interstices of the stranded wire (which is necessary to obtain the bond). Even with double-dipped tinned wires, in general it is necessary to dip-solder the cut and stripped wires to obtain a good soldered termination because there is insufficient tin remaining. Despite this, the machine is a significant cost reducer in eliminating twisting before soldering and in easing the problem of handling cut and stripped wires without danger of flaring the conductor.

In those operations where it has been found that induction heating bonded well and yet retained sufficient tin without the need to solder-dip, it was noted that:

(1) The dial setting should be advanced only to the point where the tin coating is grayish or similar to a tarnished silver appearance. The dial should not be advanced to the point where the tin coating becomes dark.

(2) The termination operation should be done within 6 to 8 hours after the cut and strip operation.

(3) The traditional aspiration to have a bright tinned appearance of the stripped wire prior to termination will have to be discarded. It has been noted that with the grayish or tarnished silver-like finish it is still possible to get a good termination without solder dip.

(4) Though double tinning is not an industry standard and might present procurement problems, it does seem to indicate some slight advantage over the single or standard tin coating. Double tinning also presents the disadvantage of higher cost than standard coating.

(5) Double or heavy tinned stranded wire shows more consistently favorable performance.

Close control of the extrusion process in insulating the wire is an extremely important factor contributing to successful use of this induction bonding technique.

# MINIATURE

Magnetic Servo Amplifier

Size: 1 Cu. Inch — Weight: 50 Gr.

Here's the perfect miniature magnetic amplifier, designed by Atlas engineers to match the Oster Company, 18V, 400 cycle, 2 phase servo motor type 2 ET-123 Model 2. The SA-427 occupies only 1 cubic inch of space; weighs but 50 grams. It is available with either a high impedance control winding to work with a vacuum tube pre-amplifier, or a low impedance control winding to operate with a transistor pre-amplifier. The Atlas SA-427 has a gain of 1,000 and a response time of less than one-and-one-half cycles of supply frequency. **FREE FOLDER . . . contains complete electrical and mechanical specifications. Write today for Booklet SA-427.**

# ATLAS

ATLAS ENGINEERING CO., Inc.

3 EDGEWOOD ST., ROXBURY, MASS.

In Canada

CANADIAN ATLAS TRANSFORMER CO. LTD., 17 CARLAW STREET, TORONTO, CANADA

# 60-DAY FREE TRIAL

of America's most popular  
bench assembly stool



A tired worker costs **MUCH**  
more than a good chair

- 4-way adjustable backrest
- Scroll shaped posture seat
- Tamper-proof tubular all-welded construction
- Adjustable height ranges from 17" to 25" or 24" to 32"

Now test Royal's famous No. 515 stool in your own plant without cost or obligation. See why the country's top firms choose it for superior versatility and durability. Write for free trial stool today!

metal furniture since '97



**Royal Metal Manufacturing Co.**

175 North Michigan Avenue, Dept 2112 Chicago 1

Factories: Los Angeles • Michigan City, Indiana  
Warren, Pa. • Walden, N. Y. • Galt, Ontario  
Showrooms: Chicago • Los Angeles • San Francisco  
New York City • Authorized Dealers Everywhere

**MAIL TODAY**

Royal Metal Mfg. Co., 175 N. Michigan Ave.,  
Dept. 2112 Chicago 1, Ill.

- We want to test your No. 515 stool for 60 days without obligation. Send short \_\_\_\_\_ tall \_\_\_\_\_ model.
- Please send your new catalog of industrial seating.

Name \_\_\_\_\_

Firm Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## Heathkit TEST EQUIPMENT

BUILD YOUR OWN — INCREASE KNOWLEDGE — SAVE MONEY — BUY DIRECT FROM MANUFACTURER . . . Top quality instruments in kit form featuring latest design and circuit developments. Completely detailed step-by-step construction manual — clear pictorials — complete schematics. All sheet metal work punched, formed and finished. Low kit prices include tubes, chassis, cabinet and all necessary constructional components.

Kits for the school — service shop — industrial laboratory — hobbyist, etc.

Write for free catalog for further information.

**HEATH COMPANY**  
BENTON HARBOR 14,  
MICHIGAN

NEW MULTIMETER KIT \$26.50

SIGNAL TRACER KIT \$23.50

NEW SCOPE KIT \$59.50

CONDENSER CHECKER KIT \$19.50

VACUUM TUBE VOLTMETER KIT \$24.50

TUBE CHECKER KIT \$29.50

SIGNAL GEN. KIT \$19.50

GRID DIP METER KIT \$19.50

# NEW PRODUCTS

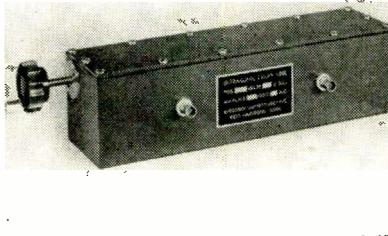
Edited by WILLIAM P. O'BRIEN

67 New Products and 25 Manufacturers' Bulletins Are Reviewed . . . Control, Testing and Measuring Equipment Described and Illustrated . . . Recent Tubes and Components Are Covered

## DELAY LINE

has wide variation range

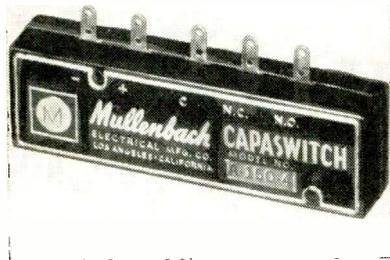
ANDERSEN LABORATORIES, INC., 39 Talcott Rd., West Hartford, Conn. In the delay line illustrated continuous variation of delay time is effected by rotary motion of a shaft. Variation can be as wide as 4 to 1 (as for instance, from 10 to 40  $\mu$ sec) with practical extremes being 2.5 to 5  $\mu$ sec and 20 to 75  $\mu$ sec. Special features include wide



range, high stability (short-time jitter nonexistent) smooth, positive action, ruggedness and dependability. Carrier frequency is 15 mc; bandwidth, 3 mc; attenuation, 48 db; and dynamic range, 25 db. Complete details are given in bulletin 227.

## NONMAGNETIC RELAY

has many applications



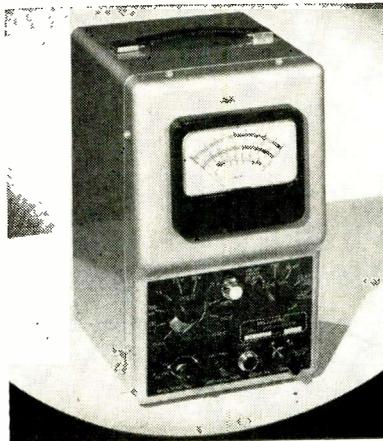
MULLENBACH ELECTRICAL MFG. CO., 2300 E. 27th St., Los Angeles 58, Calif. The Capaswitch is a sensitive, nonmagnetic relay utilizing an entirely new actuating principle. In place of the electromagnetic coil of ordinary relays, it uses an electrostrictive capacitive unit to cause transfer of the contacts. The Capaswitch invites a multitude of applications, some of which may re-

quire unusual circuitry. Consultation with the company's application engineers is welcomed. Nominal working voltage is 150 v d-c; maximum operating voltage, 175 v d-c, and Capaswitch test voltage, 500 v d-c. Contacts are spdt, 1 ampere at 125 v a-c (resistive load). Life expectancy is 300,000 operations minimum at rated contact load. A 4-page folder gives chief features, complete specifications, a dimensional drawing, 9 of its applications and a special circuit.

## MILLIVOLT METERS

for aviation research

MILLIVAC INSTRUMENT CORP., 444 Second St., Schenectady 6, N. Y., has developed a new series of d-c millivolt meters covering a voltage range of 100  $\mu$ v to 1 kv, at 6 megohms input impedance on the low ranges and 60 megohms on all ranges above 1 v full scale. They contain an accurately-tuned 120-cps d-c modulator which is driven from its own highly stable 60-cps R-C tuned oscillator. The MV-17CP unit illustrated is designed for 400-cycle operation. The meters are available as portable models



and in rack-mounted form, also with or without facilities for operation as highly stable d-c amplifiers. In the latter case they have a gain of 1,500 and a d-c drift of less than 50  $\mu$ v referred to the input circuit over long periods of time. They may be used over a wide power supply frequency range extending from 40 to 500 cps.

## C-BAND WAVEMETER

covers 3,500-6,500 mc range

AMERAC, INC., 116 Topsfield Rd., Wenham, Mass. Model 230° C-band wavemeter is a coaxial-line type

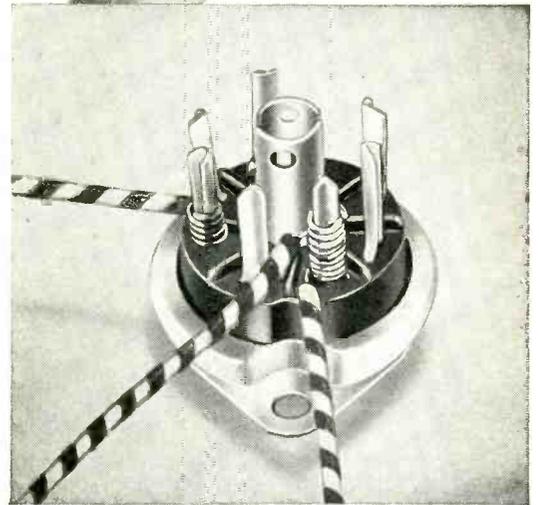
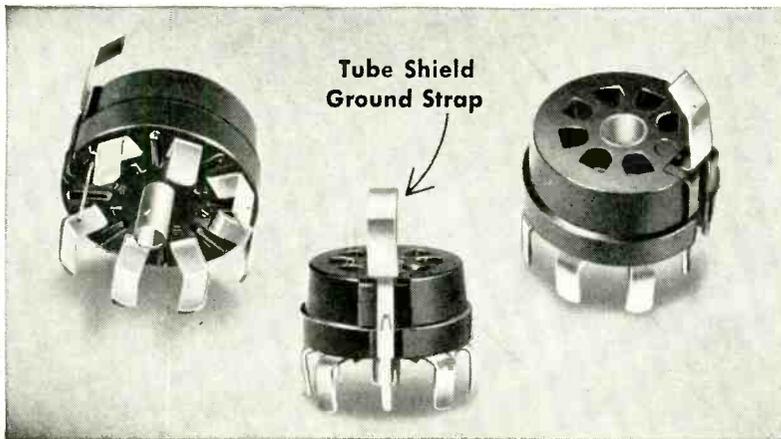
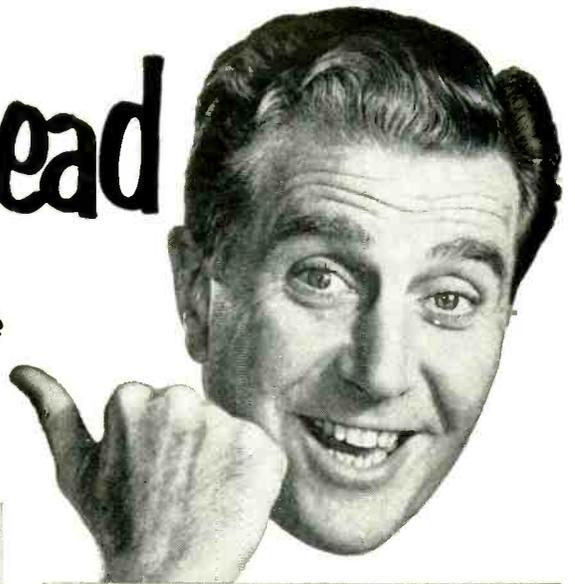
## OTHER DEPARTMENTS

featured in this issue:

	Page
Electrons At Work.....	182
Production Techniques ..	228
Plants and People.....	310
New Books .....	360
Backtalk .....	372

# Big Savings Ahead

**2 New SYLVANIA SOCKETS save  
Assembly Time... Cut Costs  
... Improve Performance!**



**1.** New Sylvania 7-pin Miniature Printed-circuit Sockets. Contacts and center shield are shaped so that sockets can be stacked one upon another for automatic feeding and assembly. Small slots are used on the circuit board to receive the contacts, resulting in stronger chassis construction. Only one socket assembly need be stocked since terminals can be interconnected by printing the circuit on the chassis board rather than using a metallic connector on the socket itself.

Insulator is molded of general-purpose or low-loss phenolic. Contacts are brass or phosphor bronze, plated to suit your specification. Supplied with or without center shield. Now available in 7-pin construction with 9-pin miniature and other types to follow. Tube Shield Ground Strap can also be furnished.

**2.** New Sylvania Solderless-type Sockets for wire-wrapped connections are now being made in all 7 and 9-pin miniature sizes. Contacts are shaped to provide reliable connections with the use of present wire-wrapping tools.



See the full story of Sylvania's Fabricating Services in Sweet's Catalog — Product Design File. Look for **1b** **Sy**

*For full information concerning these or other Sylvania parts, or special quality components engineered to your own specifications, write to Dept. 4A-1612, Sylvania today.*



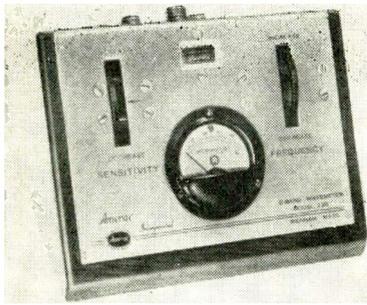
# SYLVANIA



Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

**LIGHTING • RADIO • ELECTRONICS • TELEVISION**



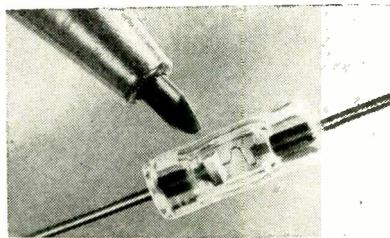
instrument covering the frequency range from 3,500 to 6,500 mc, by either the transmission or absorption method. Among its features are: (1) a precision-ground lead screw, which helps give a high accuracy of measurement; (2) a cavity body made from a solid block, precision-machined to close tolerances, giving extreme mechanical stability; (3) the use of Invar in

the line displacement portion, affording a high frequency stability throughout the temperature range of 10 C to 40 C; and (4) tri-plating of all r-f surfaces. Power-handling capability by absorption method is from 0.5 mw to 1 w maximum; by transmission method, from 1 mw to 25 w (peak power). Approximate loaded Q is 2,500. Net weight of the unit is 4½ lb.

## GERMANIUM DIODES

with tiny gold junction

HUGHES AIRCRAFT Co., Florence Ave. at Teale St., Culver City, Calif., has available a new line of subminiature germanium diodes employing a miniature gold junction. Their high forward conductance with high back resistance properties make them particularly



suitable for such applications as magnetic amplifier circuits, clamps, d-c restorers and logical gates. They are manufactured with a fusion-sealed, one-piece glass body, impervious to external contaminating agents. Actual size of the diode body is 0.265 in. long × 0.130 in. wide, maximum. Dumet leads are tinned, easy to solder or spot-weld.

## TINY ELECTROLYTICS

use tantalum as anode



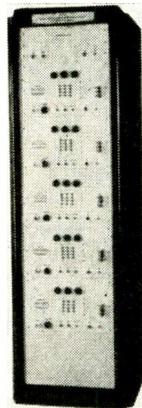
SPRAGUE ELECTRIC Co., 35 Marshall St., North Adams, Mass. The Tantalex capacitors are ideal for low voltage applications where they provide relatively large values of capacitance in a minimum of space. Use of tantalum as the anode gives

them unusual stability of performance. Only ½ in. in diameter × ⅝ in. long, they are ideal for bypass, coupling and filter applications in low voltage transistor circuits. Other uses include transistor hearing aids and military amplifiers. Operating temperature range is -20 to +65 C, with outstanding resistance to severe humidity.

## INTERVAL GENERATOR

for research and testing

POTTER INSTRUMENT Co., INC., 115 Cutter Mill Rd., Great Neck, N. Y. Model 3157 multiple-sequence megacycle preset interval generator provides a convenient means of generating a series of preset time delays adjustable in increments of 1 μsec. Typical applications include multiple-sequence control of high-speed camera systems and radiographic units for use in firing ranges and destructive testing facilities. The system includes a 1-mc crystal-controlled master oscillator that feeds one or more preset counters capable of producing an output pulse any desired number of



counts (microseconds) after application of a start pulse. Each counter is set to the desired num-

ber of microseconds (up to 999) by means of front panel selector switches. For sequential intervals or extended delays, the output of one counter may be used to start another. Provisions are made for using the equipment as a multiple-channel interval timer. The model illustrated has five separate timing channels.

## TRANSDUCERS

for sensing linear motion

MINATRON CORP., 14 Cliveden Place, Belle Mead, N. J. A new line of linear motion displacement transducers, featuring minimum size and high sensitivity, is now available in

Let **E-I** eliminate your

# HERMETIC SEALING PROBLEMS



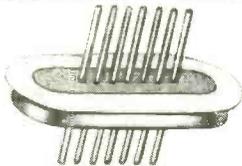
1. Transistor and diode assemblies available with cans



2. Strain-free end seals for condensers, resistors, tubular assemblies



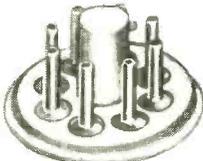
3. Single wire compression type miniature sealed terminals



4. Miniature sealed header with cushioned glass construction



5. Lug type, lead thru insulators for voltages from 2,000 to 4,000 (rms.)



6. Octal headers with solid metal blanks for high mechanical strength



7. Super durable compression headers offer maximum shock resistance

**E-I Standardization  
Rigidly Controls  
Quality...Lowers  
Costs...Speeds  
Deliveries**

Precision quality hermetically sealed terminals and miniature closures are mass produced by EI in hundreds of standardized designs. Economical standard catalog items are available in a wide range of types offering electrical and mechanical characteristics that solve all but the most unusual circuit requirements. Where applications require modifications or completely new custom components, these can be supplied quickly and economically in reasonable quantities.

✓	MINIATURIZATION
✓	CUSHIONED GLASS CONSTRUCTION
✓	MAXIMUM RIGIDITY
✓	VACUUM TIGHT SEALING
✓	HIGH DIELECTRIC STRENGTH
✓	VIBRATION RESISTANT
✓	SUPER DURABILITY
✓	DESIGN STANDARDIZATION
✓	FAST DELIVERY IN QUANTITY

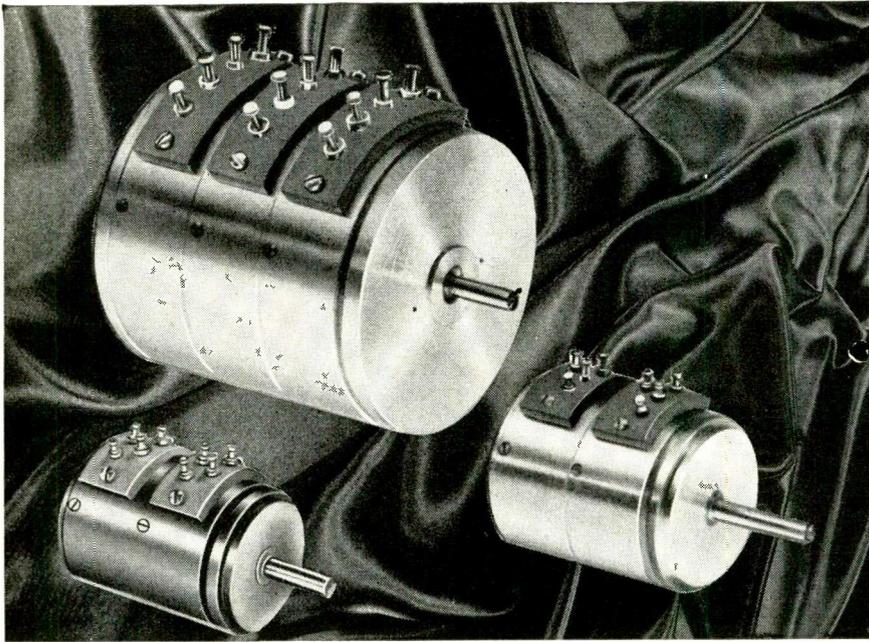
\*PATENT PENDING  
ALL RIGHTS RESERVED



**ELECTRICAL INDUSTRIES**

DIVISION OF AMPEREX ELECTRONIC CORP.

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY



## Three NEW Fairchild Precision Potentiometers

**TYPE 751 7/8"**

**TYPE 741 1 1/8"**

**TYPE 754 2"**

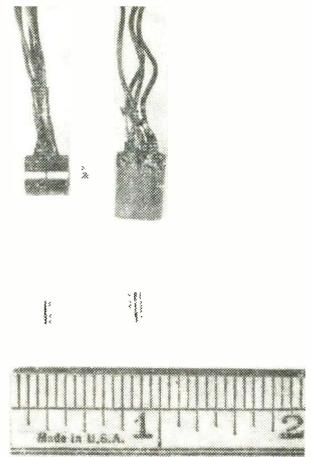
LINEAR

Type 751, resistance range 400 to 20,000 ohms, linearity  $\pm 0.5\%$  or better; Type 741, resistance range 500 to 25,000 ohms, linearity  $\pm 0.5\%$  or better; Type 754, resistance range 800 to 100,000 ohms, linearity  $\pm 0.15\%$  or better. All are extremely compact and are available with servo mounts. Internal clamp rings permit ganging without increasing overall diameter. All have gold-plated terminals for reduced contact resistance and easier soldering. Standard resistance values Types 741 and 751—500, 1000, 5000, 10,000, 20,000 ohms; Type 754—1000, 5000, 10,000, 20,000, 50,000 ohms.

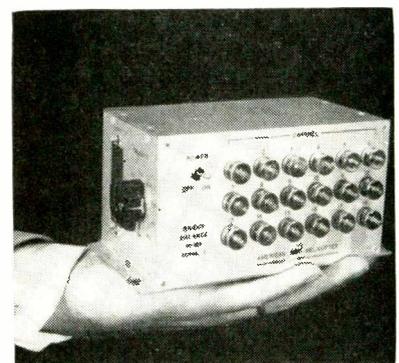
## Three more reasons why Fairchild can supply ALL your precision potentiometer needs

Fairchild makes a complete line of precision potentiometers to fill all your needs—linear and nonlinear potentiometers, single or in ganged combinations . . . single-turn, helical and linear motion . . . with servo or threaded bushing mounts . . . and with resistance elements to meet your requirements.

Fairchild guarantees accuracy of  $\pm 1\%$  in nonlinear types and  $\pm 0.5\%$  in linear types. Highly accurate production methods and close mechanical tolerances, plus thorough type-testing and quality control, assure high resolution, long life, low torque and low electrical noise level in every Fairchild potentiometer. For more information, or for help in meeting your potentiometer problems, call on Fairchild Camera & Instrument Corp., Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-53A 3.



32 models with linear displacement ranges from 0.003 in. to 2 in. Lyn-A-Syn transducers are highly accurate and sensitive inductive components for precise sensing of rectilinear motion. Operation of the units is based on the linear change in flux linkage between the primary coil and secondary coils with displacement of the high-permeability metal core. The large range of available models allows the systems engineer to select units designed for power frequency or medium audio-frequency operation, and at input voltages of 0.5 to 10 v. Physical size of the Lyn-A-Syn models ranges from 15/64 in. o.d.  $\times$  15/64 in. long for the 0.003-in. linear displacement unit to 3/4 in. o.d.  $\times$  9 1/2 in. long for the 2-in. linear displacement unit. The photograph shows a 0.005-in. magnetically shielded unit, and a 0.010 standard miniature model.



## BRIDGE BALANCE has 18 channels

AMERICAN HELICOPTER, Div. of Fairchild Engine and Airplane Corp., 1800 Rosecrans Ave., Manhattan Beach, Calif. Model BP-18A is an 18-channel bridge balance

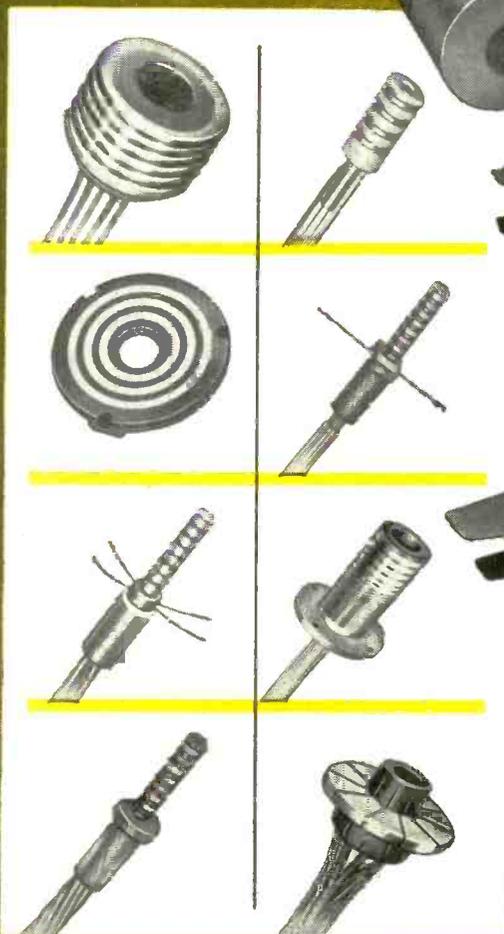
**INSTRUMENT CORPORATION  
OF AMERICA**

# slip ring & commutator assemblies

**One-piece construction\*  
assures high accuracy and  
super-dependability to the  
most rigid specifications.**

*Proven for  
performance in  
precision instruments  
and equipment including  
SYNCHROS, GYROs, RADAR,  
FIRE CONTROL, TEST TABLES  
and other CRITICAL APPLICATIONS*

Specify Instrument Corporation of America Slip Ring and Commutator Assemblies for closer tolerances, absolute uniformity and the ultimate in miniaturization. Wherever extreme dimensional precision, accurate concentricity and high dielectric qualities, are required, Instrument Corporation of America assemblies are specified with confidence. One-piece, unitized construction eliminates dimensional variation due to accumulated errors, provides jewel-like finish, uniform ring hardness and reduced weight. Engineering "know-how" resulting from years of specialization and continuous collaboration with leading manufacturers all over the world is at your immediate service.



**TYPICAL  
SPECIFICATIONS**

- SIZES: .035" to 24" Diameter, Cylindrical or Flat
- CROSS-SECTIONS: Ring Thickness .005" to .060" or More
- FINISH: 4 Micro-Inches or Better
- BREAKDOWN: 1000 V or More Hi-Pot Inter-Circuit
- RING HARDNESS: 75 to 90 Brinell
- SURFACE PROTECTION: Paladium and Rhodium, or Gold Prevent Tarnish, Minimize Wear & Noise

**INSTRUMENT CORPORATION OF AMERICA  
BLACKSBURG · VIRGINIA**

ELECTRO DEPOSITION PROCESS AVAILABLE UNDER EXCLUSIVE LICENSE AGREEMENT WITH ELECTRO TEC CORP.

# THE NORDEN Synchro Alignment Set

NEW PRODUCTS

(continued)

with provisions for controlling the electrical balance, sensitivity and calibration of resistance bridge sensing devices, such as strain gages, accelerometers and pressure pickups. It weighs only 2.4 lb. and its overall dimensions are 7½ in. × 3½ in. × 3½ in. Ten-turn potentiometers with shaft locks are employed for circuit balancing. Calibration resistors are accurate to within ±0.1 percent, operating over a -40 F to 200 F temperature range with a temperature coefficient of 0.00002 per deg C. Model BP-18A is ideally suited for use in aircraft and guided missiles flight instrumentation as well as a laboratory instrument.



Today, when scientific research is continuously pushing yesterday's findings into obsolescence, the precision of many new developments should be ascertained by an extra sensitive testing device that can provide very fine electrical zero settings — the Norden Synchro Alignment Set.

## PORTABLE, SELF-CONTAINED

Used in laboratory or production testing to check electrical zero alignment of 400 cycle per sec. synchros and resolvers, this set operates from a power source of 115V rms. ±10%, 400 cycles per sec. ±5%. It provides switching for proper connections to any of four types of synchros as well as excitation voltages with properly related phase to the phase sensitive voltmeter measuring the synchro alignment.

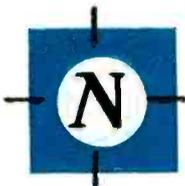
## MAXIMUM ACCURACY

The accuracy of synchros in various computing or measuring systems is generally dependent upon the zeroing of elements in addition to the basic precision of the synchro itself. The NORDEN Synchro Alignment Set, which eliminates both harmonic and quadrature voltages, permits very precise readings of the true, fundamental electrical zero.

## NUMEROUS USES

The NORDEN Synchro Alignment Set is most valuable in routine checking, trouble shooting, and electrical alignments of new components. It will align 400 cycle transmitters, differential transformers, control transformers, and resolvers with excitation currents of 0.15 amps. or less. It may also be used to check the positioning of a synchro or resolver by direct measurement without disturbing the existing position.

NORDEN standards, recognized the world over, are equally exacting for small units like the Synchro Alignment Set as for expansive Navigational, Fire Control, or Bomb Director Systems. Please write for descriptive folders.



### NORDEN TEMPERATURE PROBES



designed for all-weather operation in the sub-sonic and super-sonic range.

### NORDEN PRECISION REDUCTION GEAR BOXES



designed for maximum performance with minimum weight and ultra-precision.

### NORDEN DIGITAL CONVERTERS



designed to transpose mechanical information accurately into comprehensive digital notation.

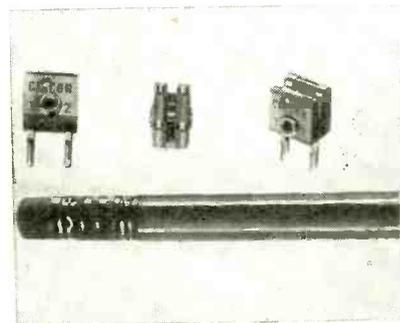
### NORDEN COMPUTER TEST SETS



are designed and manufactured to meet exacting requirements.

## VOLTAGE REGULATOR for aircraft systems

RHEEM MFG. Co., 9236 East Hall Rd., Downey, Calif. The REL-11 subminiature voltage regulator is designed for missile or aircraft instrumentation systems. It regulates within 0.1 percent for load variations of ± 25 percent and input variations of ± 20 percent. The output is 100 to 150 v d-c at 100 ma. Dimensions are 4.7 in. × 2.8 in. × 1.3 in., and it weighs 7 oz. The voltage regulator functions to specifications and is completely reliable while subjected to severe environmental conditions.



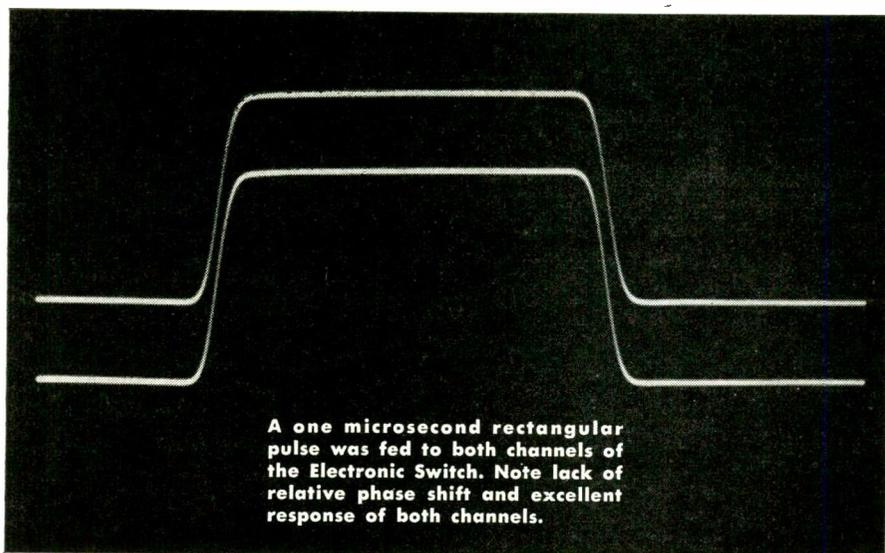
## TINY CONNECTOR for printed circuit use

CIRCON COMPONENT Co., 17544 Rayer St., Northridge, Calif. The SM4F116 subminiature multiple circuit connector weighs less than 0.8 gram (about ¼ oz) and is less than 0.03 cu in. in volume. It is usable in both printed circuit and

THE NORDEN

LABORATORIES  
CORPORATION  
Milford, Connecticut

Convert to  
Dual Channel  
Operation in  
the Range of  
DC to 15 MC



...using any Single-Channel Oscilloscope  
with the

# NEW DU MONT TYPE 330 ELECTRONIC SWITCH

The new Du Mont Type 330 Electronic Switch is a self-contained accessory for oscillography that permits . . .

1. Converting *any* single-beam oscillograph into a dual-channel instrument.
2. Adding a channel to any multi-channel instrument.
3. As a chopper, converting an a-c oscillograph for d-c measurement.

Within the range of DC to 15 MC, the Type 330 is limited only by the characteristics of the cathode-ray oscillograph being used.

This is the answer to those studies requiring comparison between two or more functions. Maximum time shift between the channels of the Type 330 is within one millimicrosecond. Both channels may be adjusted for unity gain making it a simple matter to superimpose two phenomena for very precise time, phase or amplitude comparison.

Three free-running switching rates, 1KC, 10KC and 100KC, or triggered operation allow selection for best presentation on the cathode-ray oscillograph. The Type 330 can be connected into a test setup or disconnected as the need arises.



## MAJOR SPECIFICATIONS

- SIGNAL CHANNELS**
- I. Sinusoidal Frequency Response: with an output load of 60 uuf, either channel, flat to d.c. and down not more than 3 db at 15 mc.
  - II. Amplifier Rise Time: with external load of 60 uuf, no greater than 0.022 usec.
  - III. Variable Attenuator: Each channel has two series stepped attenuators with attenuation ratios of 1, 2, 4, 10, 20, 40, 100, 200, and 400; accuracy of attenuators  $\pm 2\%$ .
  - IV. Output: Level is zero volts d.c. with no signal or positioning voltage; positioning controls provide  $\pm 1$  volt of d.c. positioning voltage.
- SWITCHING**
- I. Recurrent: Free-running, fixed frequencies of approximately 1 KC, 10 KC and 100 KC; Triggered, rate may be triggered at 0 to 100 KC rates.

# DU MONT

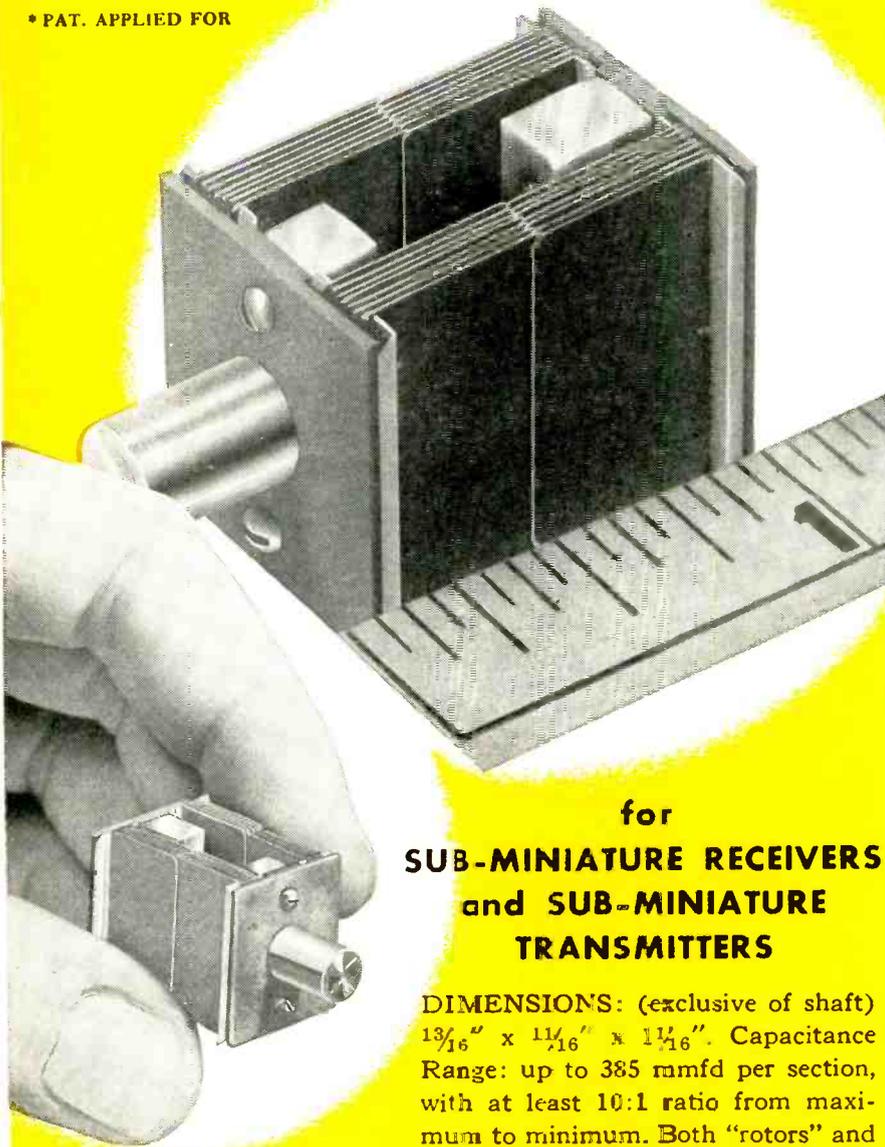
PRICE \$295  
WRITE FOR COMPLETE INFORMATION  
ALLEN B. DU MONT LABORATORIES, INC.  
INSTRUMENT DIVISION  
760 BLOOMFIELD AVENUE • CLIFTON, N. J.

# McCoy

## MINI-DUAL

### Variable Capacitor\*

\* PAT. APPLIED FOR



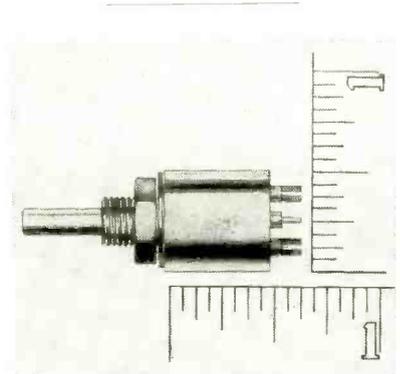
Prototype models available only. For further details, price information and delivery dates, write, wire or phone.

#### for SUB-MINIATURE RECEIVERS and SUB-MINIATURE TRANSMITTERS

**DIMENSIONS:** (exclusive of shaft)  $1\frac{3}{16}$ " x  $1\frac{1}{16}$ " x  $1\frac{1}{16}$ ". Capacitance Range: up to 385 mmfd per section, with at least 10:1 ratio from maximum to minimum. Both "rotors" and both "stators" are isolated for flexibility of circuitry. Specially cut plates are possible but not recommended. Shaft diameter:  $\frac{3}{16}$ " or  $\frac{1}{4}$ ". Standard Shaft length:  $\frac{3}{8}$ ". Other lengths to order. Weight  $\frac{1}{2}$  oz. Patent Applied For.

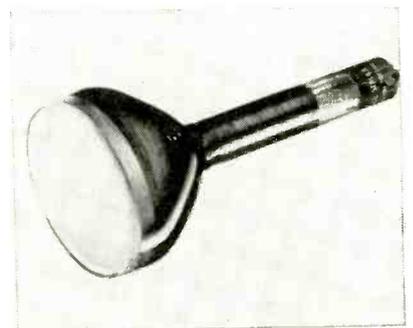
QUARTZ CRYSTALS and ELECTRONIC DEVICES by  
**McCoy** ELECTRONICS COMPANY  
MT. HOLLY SPRINGS, PA.  
PHONE 376

conventional cabling applications. This 4-contact connector permits side-by-side and end-to-end mounting of any desired combination with a rated maximum load of one ampere per contact. The open-end feature allows accommodation of straight edges of any size printed circuit without special shapes or fabrication. It will connect independently to both sides of a circuit and is particularly adaptable to transistor circuits.



#### TINY PRECISION POTS are wire-wound units

ACE ELECTRONICS ASSOCIATES, 125 Rogers Ave., Somerville 44, Mass. Model No. 500 Acepot is a new standard in subminiature wire-wound precision potentiometers. The unit illustrated features  $\frac{1}{2}$ -in. diameter, special precision winding equipment and assembly process, use of new materials and techniques for the lowest dielectric constant and power factor; extremely low torque; and availability in threaded bushing, servo or tapped hole mountings.



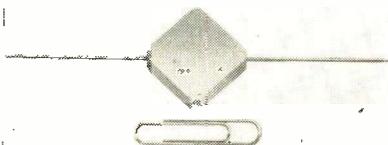
#### FIVE-INCH CRT for radar applications

GENERAL ELECTRIC Co., Syracuse, N. Y., has announced a new 5-in. cathode-ray tube for radar applica-

tions. It has a high-resolution electron gun providing an exceptionally narrow trace on the screen. The tube, type GL-5FP14-A, has a maximum line width limit specification of 0.25 mm. The decrease in line width, or spot size, means that target identification will be aided considerably. The tube is all-glass, employs magnetic focus and deflection, has a 53-deg deflection angle, and has a medium-long persistence phosphor. Typical operating conditions are: anode voltage, 5,000 v d-c; grid No. 2 voltage, 250 v d-c; grid No. 1 voltage (for visual extinction of focused undeflected spot), -25 to -70 v d-c; spot position, 9 mm; typical line width A, 0.009 in.

### R-F POWER AMPLIFIER for missiles and aircraft

RHEEM MFG. CO., 9236 East Hall Rd., Downey, Calif. The miniature r-f power amplifier, REL-09, is currently being used in missile and aircraft instrumentation systems. The unit utilizes an Amperex 6360 tube, tunes from 215 to 235 mc, provides 10-w output and weighs only 12 oz. Operating voltages are: B + 250 v d-c; filaments, 6.3 or 12.6 v, and bias -45 v d-c. The unit will function properly and be completely reliable when subjected to severe environmental conditions.



### TOROID COIL encased in epoxy plastic

HYCOR Co., INC., 11423 Vanowen St., North Hollywood, Calif., is producing a new postage-stamp toroid coil consisting of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as  $\frac{1}{16}$  in. Windings are impregnated with a special compound and the finished coil is encased in a tough epoxy

# Maxson WIDE BAND

## Power Oscillator

200 to 2500 mc/sec

50 watts to 400 mc

25 watts to 1000 mc

10 watts to 2500 mc

### 1141A Cavity Oscillator

A NEW INSTRUMENT of unusual capabilities, the Maxson Model M1141 UHF Wideband Power Oscillator, provides exceptionally broad frequency coverage and substantial power output in a single source. A simple changeover of feedback assemblies provides overlapping coverage of the full range in two bands. For easier portability, the instrument is divided into two units. Provision is made for internal and external amplitude modulation and for CW operation. With its smooth tuning and precise resettability, the Model M1141 is an excellent general-purpose signal source.



### 1141B Power Supply and Modulator

#### Frequency Ranges

200 to 1050 mc — 1000 to 2500 mc

#### Calibration Accuracy

±1% or ±5 mc whichever is greater

Resettability.....better than 0.1%

#### Modulation

- Internal square-wave 400 cps
- Internal square-wave 1000 cps
- Internal sine-wave 400 cps
- Internal sine-wave 1000 cps
- External

Output impedance .....50 ohms (nominal)

Price, including both units—\$1990 net F.O.B. Long Island City, N. Y.

Write for free bulletin E1254.



MAXSON develops and manufactures systems, subsystems, and components in armament, navigation, electronics, and special devices.

Ask for facilities report.



THE W. L. **MAXSON** CORP.

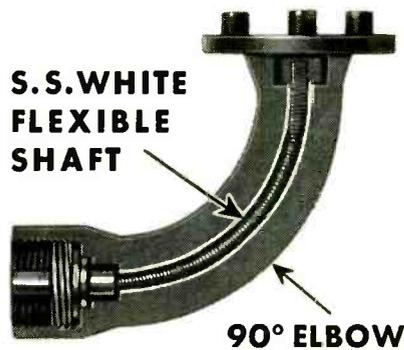
460 WEST 34th STREET, NEW YORK 1, N. Y.  
Plants at Old Forge, Penn. and Long Island City and New York, N. Y.

**COST-SAVING IDEAS**  **FOR DESIGN ENGINEERS**

**EVEN A SMALL  
S.S. WHITE FLEXIBLE SHAFT  
CAN RESULT IN BIG SAVINGS**

Illustrated is a cutaway of a truck recorder drive, in which a 3" S.S. White power drive flexible shaft replaced gearing as a means of transmitting power around a 90° turn. The shaft not only saved parts, but it eliminated troublesome breakage caused by excessive friction of the gear train in cold weather.

**S.S. WHITE  
FLEXIBLE  
SHAFT**



**ECONOMIZE  
WITH FLEXIBLE SHAFTS**

If the products you manufacture include power drives or mechanical control systems, you will find ample cost-saving opportunities in the use of S.S. White flexible shafts for these purposes. S.S. White engineers stand ready to assist you in working out any application you may have.



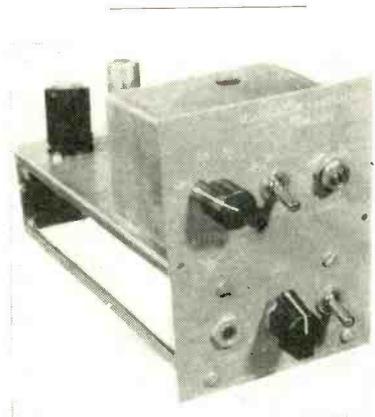
**BULLETIN 5306** gives details on how to select and apply flexible shafts. Send for your copy. Address Dept. E

P-5

**THE S.S. White INDUSTRIAL DIVISION**  
**DENTAL MFG. CO.**  **10 East 40th Street**  
**NEW YORK 16, N. Y.**

Western District Office • Times Building, Long Beach, California

plastic. Tinned No. 20 Awg wire leads are provided and the coil may be handled and mounted in the manner of its counterpart, the postage-stamp mica capacitor. Dimensions are  $\frac{1}{8}$  in.  $\times$   $\frac{1}{8}$  in.  $\times$   $\frac{3}{8}$  in. thick. It is available in any inductance up to 1 henry. Useful frequency range covers 1,500 cps to 150 kc, dependent upon the inductance value. The unit can withstand temperatures from  $-55$  C to  $+125$  C, plus extreme environmental conditions. These coils are also available in the unencapsulated form with the winding ends exposed for making direct connections. Unencapsulated dimensions are only  $\frac{5}{8}$  in. o.d.  $\times$   $\frac{3}{8}$  in. thick.



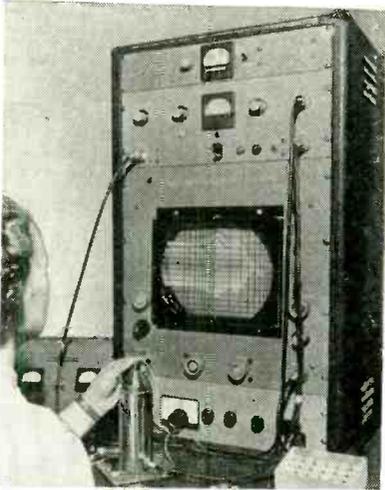
**AMPLITUDE MODULATOR**  
for use with magnetic tape

ALLEGANY INSTRUMENT Co., 1000 Oldtown Road, Cumberland, Md., announces a new amplitude modulator for use with magnetic tape in the frequency range of d-c to 5 kc which is amplitude modulated by 50 kc. This signal in turn modulates the tape and has the advantage of greatly reduced cost over f-m systems. Input sensitivity is 1 mv.

**MODULATOR**  
for microwave spectroscopy

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N. Y. The Stark modulator provides a referenced high voltage, and a variable frequency square wave to be applied to the waveguide electrode containing gas under test. The square-wave modulation facilitates the viewing of the Stark effect in microwave spectroscopy by

supplying a high voltage waveshape capable of working into a capacitive load which is presented by the Stark cell. The output level is continuously variable from 10 v to 1,000 v peak to ground over the frequency range of 50 to 30,000 cps and is monitored by a 2-percent-accuracy direct-reading voltmeter. Either sine-wave or pulse input may be utilized in driving the modulator.



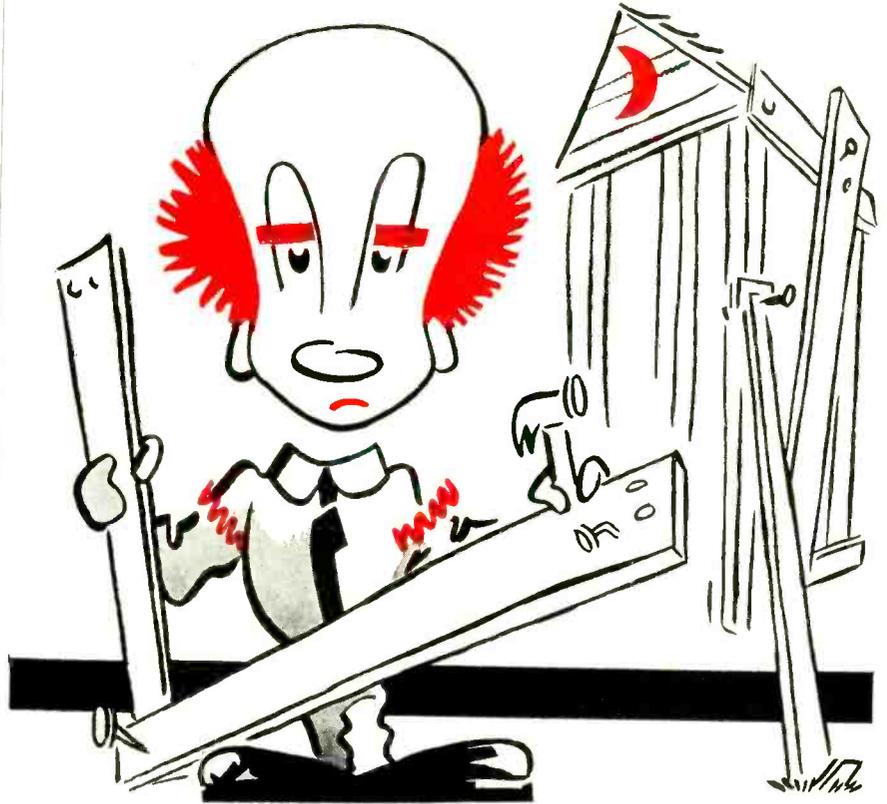
### A-F CURVE TRACER features 12-in. crt

MAICO Co., Minneapolis, Minn., has introduced a new audio-frequency curve tracer that can cut testing time in half. It features a giant 12-in. c-r tube instead of the 5-in. tube in common use. The device is used for research, quality control and production line testing of receiver, loudspeakers, microphones, filters, transformers and other partial or completed audio assemblies. Chief advantage of the curve tracer is the extra ease of visibility, enabling the operator to get a fast, accurate picture of the frequency response of the unit under test.

### PICTURE TUBE with 17-in., 90-deg deflection

WESTINGHOUSE ELECTRONIC TUBE Div., Box 284, Elmira, N. Y., has available a new 17-in. tv picture tube. An improved bulb design permits 90-deg deflection and a weight reduction of 5½ lb with a resulting overall length reduction of approximately 3 in., compared to previous

# Where there's a need



**IF YOUR NEED IS TO GET ELECTRIC  
CURRENT FROM A STATIONARY WIRE  
TO A ROTATING OBJECT, THERE'S NO  
ONE WHO CAN DO IT BETTER THAN  
P M I**

From miniature one circuit slip ring assemblies to giant 8-foot complete installations, P M I can produce electro-mechanical devices to meet your most exact requirements.



**PROJECT 13E270**

S.R.A. for ground-to-air radar. Customer: Goodyear Aircraft Corp. Rings carry 208 volts RMS 60 cycle. Circuits withstand 2,500 volts RMS 60 cycle. Adjacent ring cross talk at 30 mc is 60 DB. 80 Circuits.



**P M INDUSTRIES, INC.**  
270 FAIRFIELD AVENUE  
STAMFORD, CONNECTICUT

# LOOK to INTERNATIONAL RECTIFIER



## Cartridges



### HIGH VOLTAGE TYPES

DC output voltage from 20 volts to 20,000 volts and up. DC output current, half wave from .2 MA to 195 MA. Cell diameter: 1/16" to 1". Length: from 1/2" to 12"

Write for Bulletin H-2

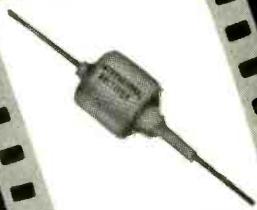
## Selenium Rectifiers



### DC POWER TYPES

Ratings to 250 Kw, 50 MA to 2,300 amperes and up. 6 volts to 30,000 volts and up. Efficiency to 97%. Power factor to 95%. Ambient temperature range to 125°C with proper derating.

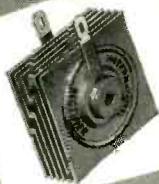
Write for Bulletin C 349



### HERMETICALLY SEALED TYPES

Recommended for airborne equipment. Available in all types and sizes from .2 MA to 155 MA, DC current output, half wave.

Write for Bulletin H-2



### TV & RADIO TYPES

Input ratings from 25 to 195 volts AC and up. DC output current from 10 to 1,000 MA. Available in half wave and voltage multiplier units. Bridge units available to 1200 MA.

Write for Bulletin ER-178A

Widest  
Range  
in the  
Industry

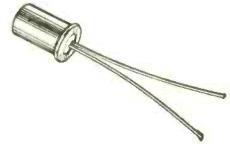
# INTERNATIONAL RECTIFIER CORPORATION

EL SEGUNDO, CALIFORNIA • OREGON 8-628T

World's Largest Supplier of Quality Industrial Rectifiers

NEW YORK  
CHICAGO

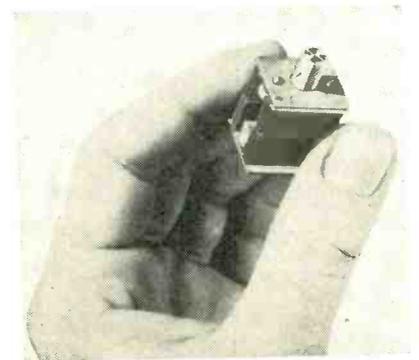
17-in. models. Two new tube types (17ATP4 and 17ATP4-A), are available. Both are electrostatic focus, directly viewed picture tubes of rectangular glass construction. Both tubes have external conductive coatings. The 17ATP4-A has an aluminized screen for increased picture brightness.



## SILICON DIODES

use *p-n* junction structure

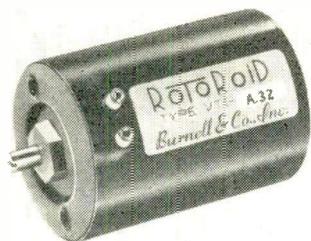
NATIONAL SEMI-CONDUCTOR PRODUCTS, Evanston, Ill., has available a line of silicon diodes employing a *p-n* junction structure. They are characterized by excellent stability, extremely low reverse current, moderate to heavy forward conductance and a sharply defined low impedance breakdown region in the reverse direction which occurs at a particular applied voltage termed the Zener voltage. Internal contacting is a shock tested alloyed junction that will withstand military as well as commercial usage.



## VARIABLE CAPACITOR for tiny receivers

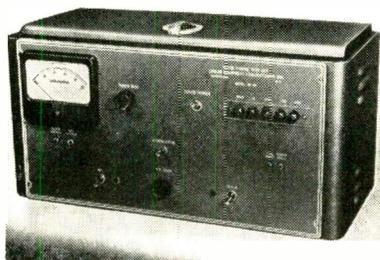
MCCOY ELECTRONICS Co., Mt. Holly Springs, Pa., has developed a Mini-Dual variable capacitor for subminiature receivers and subminiature transmitters. Dimensions, exclusive of shaft, are 1 3/8 in. × 1 1/8 in. × 1 1/8 in. Capacitance range is up to 385 μmf per section, with at least 10 to 1 ratio from maximum

to minimum. Both rotors and both stators are isolated for flexibility of circuitry. Other specifications include: shaft diameter,  $\frac{1}{8}$  in. or  $\frac{1}{4}$  in.; standard shaft length,  $\frac{3}{4}$  in.; weight, only  $\frac{1}{2}$  oz.



**TOROIDAL INDUCTOR is continuously variable**

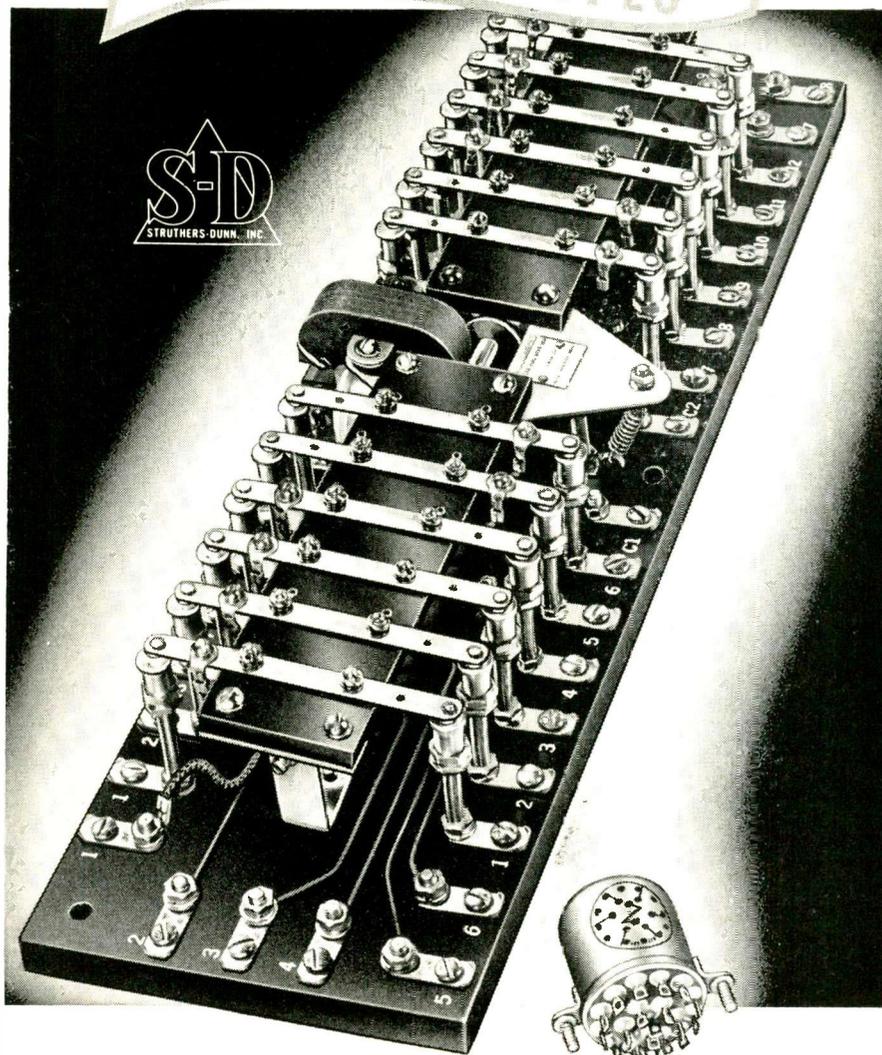
BURNELL & Co., INC., 45 Warburton Ave., Yonkers 2, N. Y. The RotoRoid continuously variable toroidal inductor is stepless and employs no mechanical resistance contacts and is therefore free of noise and wear. It provides a 3 to 1 range of maximum-to-minimum inductance in 180-deg rotation of a shaft, and at maximum inductance provides the full Q of the toroid it contains. RotoRoids are hermetically sealed and are virtually vibration and shock proof. They can be chassis or panel mounted. Uses include tunable audio oscillators, variable impedance devices, adjustable selective networks, variable phase shift networks, variable filters, servo systems and telemetering.



**TEST SET for noise figure measuring**

LINEAR EQUIPMENT LABORATORIES, INC., Brightwater Place, Massapequa, L. I., N. Y. Model HF-20 noise figure test set comprises a wide-band amplifier, built-in 3-db attenuation network, detector and output

# STRUTHERS-DUNN



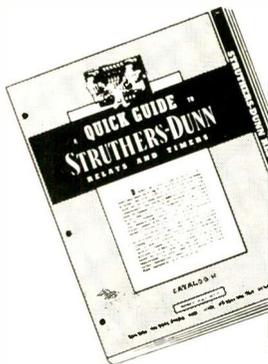
... from the smallest to the largest  
... and everything in between!

Industrial

Electronic

Military

**QUICK GUIDE** . . . to the most popular of the S-D 5,348 relay types.



STRUTHERS-DUNN, Inc.,  
Pitman, N. J.

Without obligation send the 20-page "Quick Guide" to S-D relays and timers.

Name .....

Position .....

Company .....

Address .....

SALES ENGINEERING OFFICES IN: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO CINCINNATI • CLEVELAND • DALLAS • DETROIT • KANSAS CITY • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW ORLEANS • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

## What are YOUR paper tube requirements?

- Special size or shape
- Critical tolerances
- High dielectric strength
- High tensile strength
- Dimensional stability
- Low unit cost
- Prompt delivery in any quantity

# PRECISION can

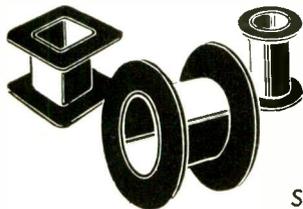
## meet your exact specifications

You can order from Precision in an infinite variety of sizes, shapes, I.D.'s or O.D.'s and be sure of the finest quality and construction, plus uniformity throughout. You can specify kraft, fish paper, acetate, combinations, phenol impregnation, etc., whichever material is best suited to your particular application.

Precision's modern high production facilities and rigid manufacturing control bring you all these advantages at lowest possible cost!

*Request samples and Arbor List of over 2000 sizes.*

### PRECISION BOBBINS CUT COIL COSTS



Eliminate rejects, waste, loss of time. Order in any size or shape, plain or fitted with leads, slots or holes. Flanges cut to your specification. Ask for samples and bulletin.

#### Sales Representatives in:

**New England:**  
Framingham, Massachusetts, Framingham 7091

**Metropolitan New York, New Jersey:**  
Jersey City, New Jersey, Journal Square 4-3574

**Upstate New York:**  
Syracuse, New York, Syracuse 76-8056

**Northern Ohio, Western Pennsylvania:**  
Cleveland, Ohio, Atlantic 1-1060

**Indiana, Southern Ohio:**  
Logansport, Indiana, Logansport 2555

**Missouri, Southern Illinois, Iowa:**  
St. Louis, Missouri, Sterling 2318

**Maryland:**  
Baltimore, Maryland, Plaza 2-3211

**Philadelphia, Camden:**  
Philadelphia, Pa., Chestnut Hill 8-0282

**California:**  
Pasadena, California, Sycamore 8-3919

**Canada:**  
Montreal, Quebec, Canada, Walnut 2715



## PRECISION PAPER TUBE CO.

2041 W. CHARLESTON ST.

CHICAGO 47, ILL.

Plant No. 2: 79 Chapel St., Hartford, Conn.

indicator, and necessary electronically regulated power for both amplifier and most tuners. Introduction of attenuation does not affect selectivity. It permits uniform, consistent measurements of noise factor, and observation of tuner r-f selectivity.

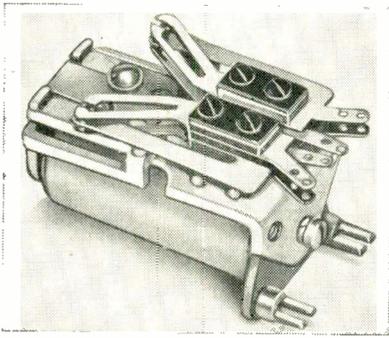


### PRESSURE TRANSDUCER has 50- $\mu$ sec rise time

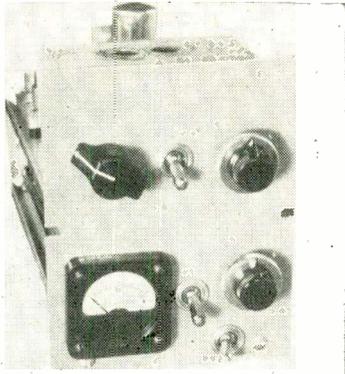
ULTRADYNE ENGINEERING LABS., INC., P. O. Box 8007, Albuquerque, New Mexico. Model S-3 pressure transducer operates on the variable reluctance principle and is suitable for use with a wide variety of recording and telemetering systems. It is especially suited for transient and h-f pressure measurements. The gage has such features as 50- $\mu$ sec rise time, 1-percent or less non-linearity, 0.1 to 0.4-percent hysteresis, 0.03-percent-per-g acceleration sensitivity and 0.01-percent-per-deg F zero shift with temperature. It weighs 2 oz and is  $\frac{3}{4}$  in.  $\times$   $\frac{3}{4}$  in.  $\times$   $1\frac{1}{16}$  in. in size.

### TINY RELAY with bifurcated contacts

MAGNECRAFT ELECTRIC Co., 1448 W. Van Buren St., Chicago 7, Ill., announces development of miniature relays with bifurcated (twin) contacts for reliable switching of extremely low voltage and low current. Flexibility of the long bifurcated contact springs enables the twin points to make contact inde-



pendently, thus permitting one point to make contact, even when the other is blocked by dust or grit. Bifurcated contacts are available with series 22 relays, for a-c or d-c, in open types, as well as with a wide selection of hermetically sealed and dust-tight enclosures. Literature is available on request.



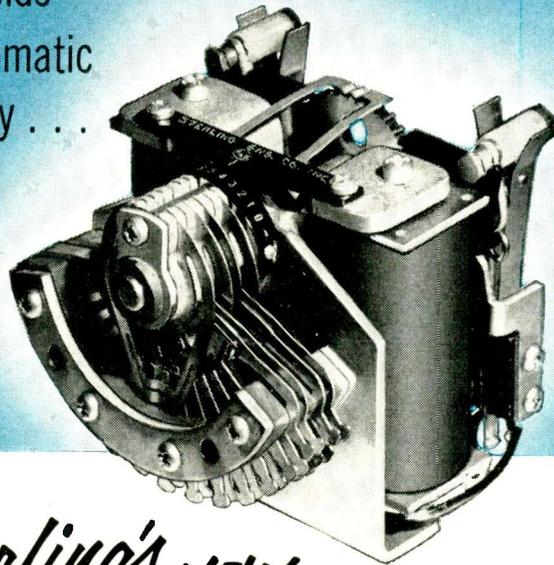
### D-C AMPLIFIER used with oscillographs

ALLEGANY INSTRUMENT CO., 1000 Oldtown Road, Cumberland, Md. Model 306 d-c amplifier is designed for use with galvanometer oscillographs. These amplifiers employ electronic inversion of d-c and subsequent amplification on a-c amplifiers. They may be employed either for strain gage or thermocouple work. Packaging is for 19-in. rack. Power unit may be supplied for either 24 v d-c or 110 v, 50 cycle.

### SSB FILTER is fixed tuned and compact

BURNELL & Co., INC., Yonkers 2, N. Y. The S-16000 single sideband filter is designed for use in applications where upper sideband

Opening vast  
new fields  
in automatic  
circuitry . . .



*Sterling's* **NEW**

## BI-DIRECTIONAL STEPPING SWITCH

GOING FAR BEYOND the limitations of stepping switches that operate in only one direction, STERLING'S new Type SS Stepping Switch operates in *both* directions!

This *bi-directional* stepping switch, having *two* driving magnets, is normally equipped with a 4-level, 12-position bank and wipers. The wiper shaft is rotated—either clockwise or counterclockwise, in 10° increments—by an intermittent ratchet-and-pawl action, depending on which of the electro-magnets is energized. Interrupter contacts act as an interlock to protect against partial steps and to permit self-stepping. Limit switches stop rotation at the end of the bank travel. Coils are available for DC currents up to 120 volts.

The range of possibilities of Model SS as a stepping switch alone is extremely wide . . . differential counting, remote selection of circuits under control of impulses, as a digit-storage register in automatic computers, etc.

Without wipers, the impulse-operated "motor" may be adapted to position servo-motors or potentiometers. Designers of automatic machinery will undoubtedly find many more uses for this versatile, new STERLING product.

For further details, write STERLING ENGINEERING COMPANY, INC., 54 Mill Street, Laconia, N. H. (Subsidiary of American Machine & Foundry Company).



## SOMETHING NEW FOR THE ELECTRICAL AND ELECTRONIC INDUSTRIES



# SILVER POWDERS AND FLAKES

Here is another group of silver products produced and supplied by Handy & Harman to help solve conductivity problems.

Silver particles with their excellent corrosion resistance and exceptional conductivity, whether in the form of crystalline powder or wafer-like flake, make possible conductive coatings and even resistive coatings as well.

Are you a user or interested in the use of silver powders or flakes? If you are, do you have conductivity or density problems? Are you looking for better covering power, better flow char-

acteristics or a particular particle size? If so, get in touch with us. We'll be glad to cooperate and help solve problems involving materials of this kind.

### TYPICAL USES OF SILVER POWDERS AND FLAKES

- Sintered Metals
- Silver Paints
- Silver Cements
- Silver Inks
- Printed Circuitry
- Conductive Coatings
- Resistive Coatings

operation is preferred. It may be installed in any existing amateur receiver or in a new design. It also can be used for reception not only of ssb but of regular a-m signals. The new filter uses toroidal coils of high Q instead of costly crystal elements, to provide a narrow-band sharp cutoff response which insures maximum intelligibility and maximum signal strength. It is fixed tuned, requires no adjustment, and is compact, hermetically sealed, rugged and trouble-free. Price is \$40. These filters are designed to be used in a 50-kc second i-f amplifier. With normal tuning, sidebands as much as 3,000 cps above the carrier are passed with not more than 3-db attenuation, the carrier is attenuated 15 db, and the sidebands 200 cps or more below the carrier are attenuated at least 30 db.



### POTENTIOMETER and millivolt source

ALLEGANY INSTRUMENT Co., 1000 Oldtown Road, Cumberland, Md. Model P-55 is a miniaturized potentiometer and millivolt source. Small size and light weight make it truly a portable instrument. The input is dual, with an internal switch. The overall range is 0 to 50 mv and the smallest reading is 0.01 mv. Battery life is guaranteed to be two years.

### THYRATRON has high control ratio

AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, L. I., N. Y.,



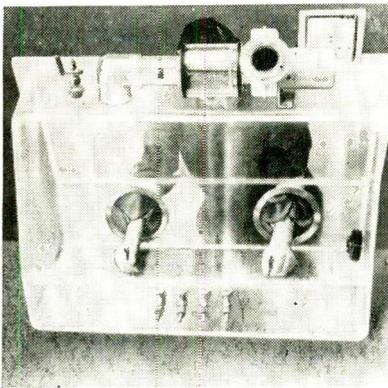
## HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

OFFICES and PLANTS  
BRIDGEPORT, CONN.  
PROVIDENCE, R. I.  
CHICAGO, ILL.  
CLEVELAND, OHIO  
DETROIT, MICH.  
LOS ANGELES, CALIF.  
TORONTO, CANADA  
MONTREAL, CANADA



has broadened its line of thyratron tubes with the addition of type AX5727, a ruggedized version of the standard type 2D21. The AX-5727 is designed for relay and servo-control applications where reliability of operation and mechanical ruggedness are important. It is an inert gas filled thyratron with negative control characteristics. It has a high control ratio, which is stable over a wide temperature range, and features low grid-anode capacitance and low grid current. The heater-cathode construction is made to withstand the rigorous requirements of intermittent operation.



**DRY BOX**  
for lab and industry

P. M. LENNARD Co., Inc., 671 Bergen St., Brooklyn 38, N. Y. Illustrated is a rear view of the new low cost 15-lb portable controlled-atmosphere dry box showing the new sealproof hand entry diaphragms. The box can be hermetically sealed in 30 seconds. A relative humidity electronic circuit controls r-h to a constant 1.0 percent. It is made of heat, chemical

**New KU slotted section and probe**  
Easy, accurate operation . . . rugged construction . . . simple convenient drive adjustments . . . highly efficient probe and crystal tuning for exceptional sensitivity

**New KU slide and variable screw tuners**  
Stable adjustments . . . easy, precise settings . . . no backlash . . . no R. F. leakage

**New KU precision attenuator**  
Attenuation to 40 DB . . . accurate to  $\pm 0.3$  DB . . . no backlash . . . smooth precision control

**New KU fixed and tunable crystal mounts**  
Highest sensitivity . . . optimum impedance matching . . . very efficient, convenient tuning adjustments

*Ku frequency range 12,400 to 18,000 Mcs.*

**FOR ACCURATE MEASUREMENT**  
*over the entire microwave spectrum*  
**RELY ON WAVELINE**

. . . for highly engineered multi-function instruments (newest in the Ku band are pictured at the right) . . . to carefully craft these instruments to the highest degree of precision . . . for the most dependable operation yet achieved.

Rely on Waveline as many, many engineers working on exacting projects in Ku, Ka and all other microwave bands have for years . . . for a complete line of advanced instruments including VSWR amplifiers, noise generators, power, measurement and related equipment—the basic tools of more efficient microwave research and communication.

Rely on Waveline for fast, economical deliveries on every project large and small . . . new expanded plant facilities enable Waveline to better execute all orders including large quantity deliveries of brass or aluminum waveguides for radar, communications or other industrial or government applications.

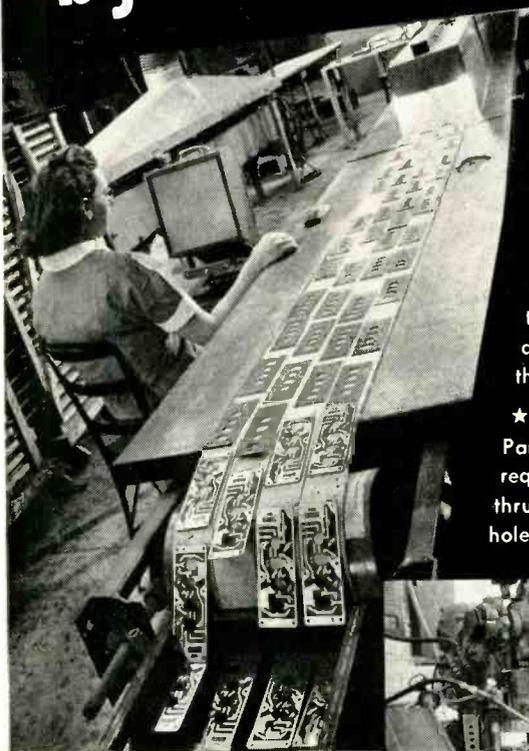
Rely on Waveline's field sales engineers to give immediate professional attention to all your microwave problems . . . cutting your costs while saving valuable engineering time.

*For microwave reference catalogs containing technical information and the name of the nearest Waveline sales engineer—WRITE TODAY!*

**WAVELINE** INC.

CALDWELL, NEW JERSEY

# For PRINTED CIRCUITS by the THOUSANDS



Select **METHODE** for Quality in Quantity on these circuit types:

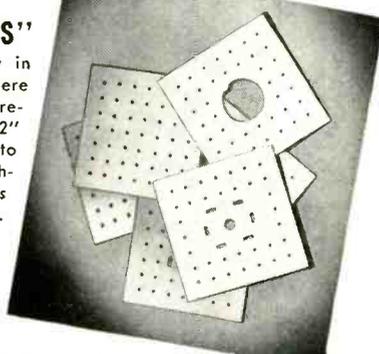
- ★ Single Side Conductor Panels — for Economy and Simplicity in Auto-assembly and dip soldering . . .
- ★ Two Sided Conductor Panels — For Compactness in applications requiring miniaturization and involving relatively few feed thru connections.
- ★ "Plated Through" Conductor Panels — For the complex circuit requiring a large number of feed thru connections with conductive holes to permit circuit cross-overs.

Well integrated facilities and a department specialized and experienced on custom tooled volume applications assures performance and satisfaction consistent with Methode's record in serving high production users.



## Or by the Hundreds with "QUAD-KARDS"

Where the designer wishes uniformity and simplicity in assemblies which will be used in small quantities where custom printed circuit tooling would be uneconomical, pre-tooled QUAD-KARDS can be furnished in standard 2" square segments with (or without) conductors printed to specifications. Quad-Kards have standard hole punchings for tube sockets, transformers and condensers plus a grid pattern of .050" diameter holes on 1/4" centers. Undesired holes are omitted and the conductor pattern printed to the customer's layout. "Quad-Kards" may be abutted, angled or stacked during incorporation into finished assemblies. Details on request.



**METHODE Manufacturing Corp.**

2021 West Churchill Street • Chicago 47, Illinois

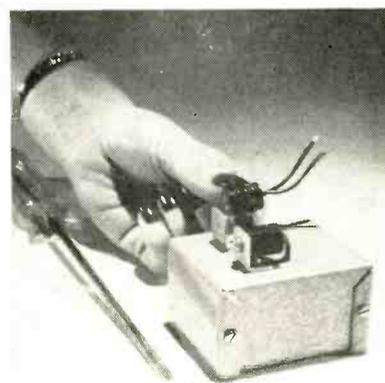
Geared to produce Plastic and Metal Electronic Components  
Want more information? Use post card on last page.

resistant transparent plastic, and mass produced with standard air-lock, filter system to control dust to 1 micron, glove assembly, and the like.



## DRUM CAMERA with 2,400-ips film speed

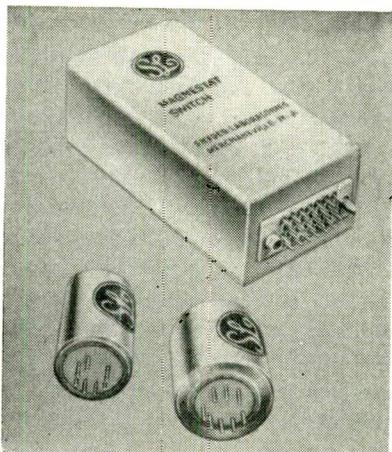
ALLEGANY INSTRUMENT CO., 1000 Oldtown Rd., Cumberland, Md., announces a new series of rotating drum cameras having 6-in. and 12-in. diameter drums. A film speed of 2,400 ips is available in the model 912. This instrument may be used for multichannel recording at cro's, the movement of a spot of light reflected from the mirror of a string galvanometer or a Bourdon tube. The movement of objects in motion may also be recorded.



## POWER TRANSISTOR for any I-f circuit

WESTINGHOUSE ELECTRIC CORP., 401 Liberty Ave., Pittsburgh 30, Pa. A combination of mounting and physical design has made possible the 1-w rating of this new ger-

manium power transistor. The black, ribbed surface provides cooling capacity for the 1-w collector dissipation rating. Additional cooling is accomplished by fastening the unit in thermal contact with the chassis as shown. The new pnp-type transistor (2N71) will be applicable to any low-frequency circuit, such as class A amplifiers, where output power is desired.



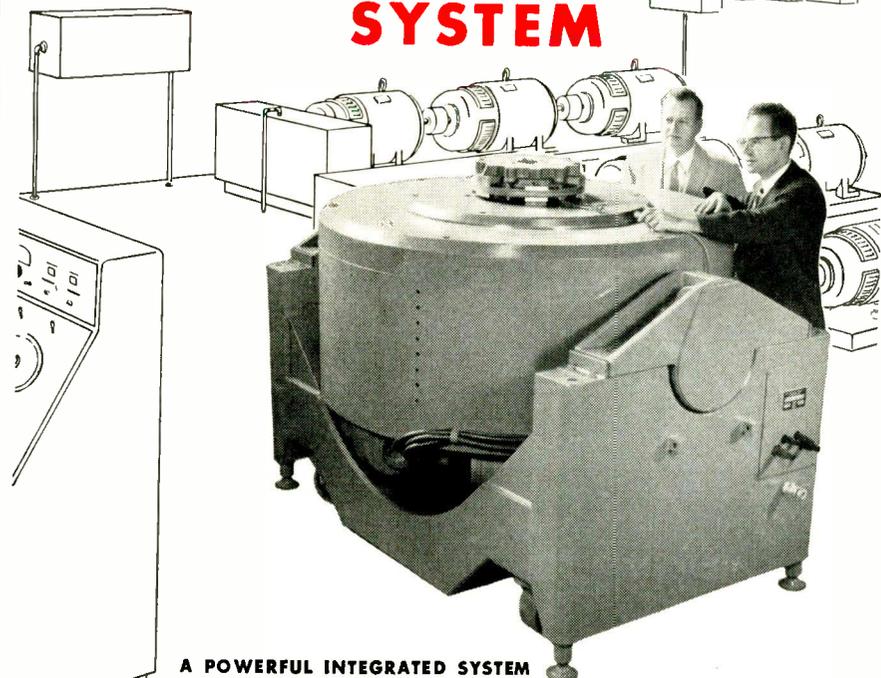
### SATURABLE REACTORS for use in computers

SNYDER LABORATORIES, 601 Chapel Ave., Merchantville 10, N. J., announce a series of Magnestats, small saturable reactors to control pulse or sine wave power ranging from microwatts to deciwatts at frequencies from 100 kc to 20 mc. They are as stable as transformers, do not depend on resonance, and the control and the controlled circuits are electrically independent. Magnestats are made for use in computers and similar complex systems as amplifiers, gates, flip-flops, switches and arithmetic elements. For example, type AH25 is an amplifier which operates on 15-mc power. It will drive two other similar amplifiers with a signal rise time of less than 0.5  $\mu$ sec.

### AUTOTRANSFORMERS for 350 to 1,200-cps use

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Higher power frequencies, used in aeronautical and marine equipment, call for voltage controls designed specifically for the requirements of

# CALIDYNE'S new 12,500 pound force INTEGRATED SHAKER SYSTEM



#### A POWERFUL INTEGRATED SYSTEM

Calidyne's new 12,500 pound force shaker system is an achievement in magnitude of force-output and over-all system performance, available in no other vibration testing system. With it you can now meet vibration test specifications with loads far heavier than ever before. It also opens new research and product-testing possibilities to commercial manufacturers.

#### FULL PERFORMANCE OPERATION OVER A WIDE RANGE

Uninterrupted, full rated performance over the 5 to 500 cps range without alternator switching or power factor correction results from a new rotary power supply design, which incorporates two identical alternators series-connected with provision for shifting phase between the two outputs. A new ring-type shaker armature suspension assures pure *linear, sinusoidal* motion of the armature system, rather than motion along an arc found in conventional shakers. Useful load is also greater, due to the high force output and light weight armature: 10g with 1000 lb. load, 20g with 375 lb. load.

#### EXCEPTIONAL STABILITY AND SIMPLIFIED CONTROL

Calidyne servo controls hold a set frequency of 500 cps to  $\pm 1$  cps, and displacement or acceleration level to  $\pm 3\%$ . The automatic cycling system further provides automatic changeover from constant displacement to constant acceleration at any preselected point, such as required for conformance to MIL-E-5272A. The new power supply design also permits direct connection of alternators to shaker armature. This eliminates control and switch gear, attendant maintenance and inconvenience.

Complete specifications and details on the Model 82 Shaker and Associated System available on request



## THE CALIDYNE COMPANY

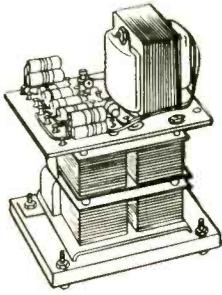
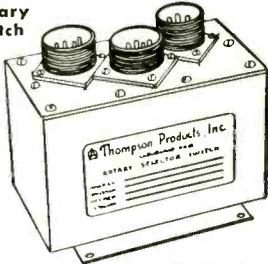
120 CROSS STREET, WINCHESTER, MASSACHUSETTS

SALES REPRESENTATIVES:  
WALTHAM, MASS.  
Robert A. Waters, Inc.  
Waltham 5-6900  
NEW HAVEN, CONN.  
Robert A. Waters, Inc.  
Fulton 7-6750  
NEW YORK CITY AREA  
G. C. Engel & Associates  
Rector 2-0991  
RIDGEMOOD, NEW JERSEY  
G. C. Engel & Associates  
Gilbert 4-0878  
PHILADELPHIA, PA.  
G. C. Engel & Associates  
Chestnut Hill 8-0892

NORTHERN NEW YORK  
Technical Services Co., Boston  
Capital 7-9797  
CLEVELAND, OHIO  
M. F. Odell Co.  
Prospect 1-6171  
DAYTON, OHIO  
M. F. Odell Co.  
Oregon 4441  
WASHINGTON, D. C.  
F. R. Jodan, Inc.  
Woodley 6-2615  
SOUTHEAST  
W. A. Brown & Assoc.  
Alexandria, Va.  
Overlook 3-6100

CHICAGO, ILLINOIS  
Hugh Marland & Co.  
Ambassador 2-1555  
INDIANAPOLIS, INDIANA  
Hugh Marland & Co.  
Clendale 3803  
MINNEAPOLIS, MINN.  
Hugh Marland & Co.  
Collfax 7949  
DALLAS, TEXAS  
John A. Green Co.  
Dixon 9918  
HOLLYWOOD, CALIFORNIA  
G. B. Miller Co.  
Hollywood 9-6305

SAN FRANCISCO, CALIF.  
G. B. Miller  
Lyell 3-3438  
ALBUQUERQUE, NEW MEXICO  
G. B. Miller Co.  
Albuquerque 5-8606  
SEATTLE, WASH.  
G. B. Miller Co.  
Lander 3320  
CANADA  
Measurement Engineering Ltd.  
Aurora, Ont. Phone 400  
EXPORT  
Rocke International Corp.  
13 East 40th St., N. Y. 16, N. Y.  
Murray Hill 9-0200

Thompson's  
Magnetic  
AmplifierThompson's  
Airborne Rotary  
Selector Switch**ideas...****facilities...****experience****Thompson has all three**

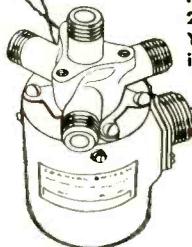
It's no accident that more and more manufacturers are turning to Thompson to solve tough electronics problems.

**Thompson has ideas!** Thompson engineers will not admit "it can't be done" for they are continually finding the answers to tough research, development and production problems.

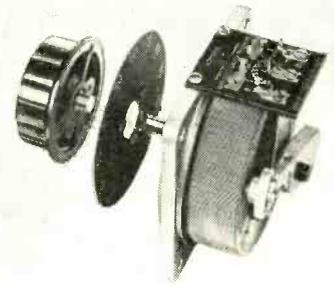
**Thompson has facilities!** Complete development and testing laboratories, and modern production equipment are available to the skilled electronics engineers who make up the highly successful Thompson team!

**Thompson has experience!** For 52 years, Thompson has been blazing trails and making vital contributions to the automotive, aircraft and general industries of the nation. The highly valuable skills and experience of the entire Thompson organization are at your service for research, development and production of all things electronic.

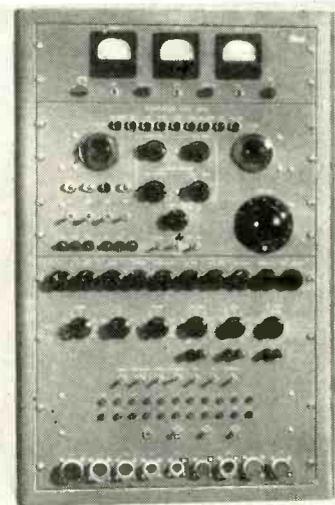
**FOR COMPLETE INFORMATION on how Thompson's Electronics Division can work for you, write to Thompson Products, Inc., Electronics Division, 2196 Clarkwood Road, Cleveland 3, Ohio. You will receive details of Thompson ideas... facilities... experience.**

One of the  
many  
Thompson  
Coaxial  
Switches*Electronics Division***Thompson Products, Inc.**

2196 CLARKWOOD RD., CLEVELAND 3, OHIO



these services. The types M-2 and M-5 Variac autotransformers are rated at 2 and 5 amperes respectively for 115-v, 350 to 1,200-cycle input. Output range is 0 to 115 or 0 to 135 v depending on connections. For 0 to 115-v connection maximum output currents are 3 and 7.5 amperes. Two-gang and three-gang assemblies for multiple-circuit as well as 3-phase controls are available in addition to single units, and special requirements can also be considered where standard models are unsuitable.

**COMPUTER TEST UNIT  
for flight data**

CAL-TRONICS CORP., 11307 Hindry Ave., Los Angeles 45, Calif., has designed and manufactured the flight data computer test unit illustrated. It gives a detailed test of every individual circuit and provides means for a complete alignment simulating all other units of a radar fire control system. The unit is used for production, hangar

and flight-line tests of a complex airborne analog ballistics computer. Full information may be found in bulletin CT-54.



### R-F FILTER for screen rooms

MICAMOLD RADIO CORP., 1087 Flushing Ave., Brooklyn 37, N. Y., is manufacturing a radio interference filter for use in the power feed lines entering shielded enclosures or screened rooms. This r-f filter is rated at 100 amperes up to 600 v d-c or 250 v a-c at frequencies from 0 to 400 cycles. Maximum attenuation is provided from 10 kc through 1,000 mc and beyond. From less than 100 kc up to 1,000 mc the attenuation exceeds 100 db; at 14 kc it is about 40 db.



### TEST SET measures voltage coefficient

BRUNSWICK INSTRUMENTS, P. O. Box 813, New Brunswick, N. J., has available a test set that provides a rapid and reliable measurement of the voltage coefficient for composition resistors and will find application in the study of resistor materials and geometry, contact behavior and semiconductor phenomena. The unit can be used for inspection and quality control of resistors and similar components. The instrument operates on the principle that the nonohmic nature of a material or resistor (that is,

From the exceptional resources of Raytheon...



## MINIATURE PULSE TRANSFORMERS



Raytheon, giant in the electronics industry and long-time leader in transformer design, offers miniature pulse transformers — the last word in modern design — thoroughly proved under exacting performance requirements in such world-famous equipment as Raytheon Radar.

Take advantage of Raytheon's exceptional resources to solve your transformer problems. Send in your requirements or write for complete information.

### MINIATURE PULSE TRANSFORMERS

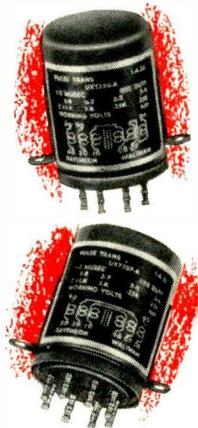
for blocking oscillator use

#### AVAILABLE FROM STOCK

These hermetically sealed, military approved pulse transformers are designed for universal blocking oscillator use at repetition rates from 50 to 5000 pps.

UX-7307A and UX-7350A are identical in electrical characteristics, having two windings for 1000 ohms impedance and two windings to match 250 ohms. To cover a wider variety of applications, the windings are arranged differently in the two transformers.

These units are also available in octal type tube bases as UX-7307 and UX-7350. Bulletin DL-K-320 gives complete information including typical circuits. Write for it.



## RAYTHEON

MANUFACTURING COMPANY  
EQUIPMENT SALES DIVISION

DEPT. 6120-A WALTHAM 54, MASSACHUSETTS  
DISTRICT OFFICES: BOSTON, NEW YORK, CLEVELAND, CHICAGO, NEW  
ORLEANS, LOS ANGELES (WILMINGTON), SAN FRANCISCO, SEATTLE  
INTERNATIONAL OPERATIONS: 589 FIFTH AVENUE, NEW YORK CITY

#### TYPICAL RAYTHEON TRANSFORMERS:

Plate, Filament, Pulse, Audio and R.F. Transformers; Toroids;  
Filters; Chokes; Reactors; Voltage Stabilizers; Magnetic  
Amplifiers; Delay Lines; TV Deflection and Focus Coils.

BUILD



*Excellence in Electronics*

**DEPENDABILITY  
INTO YOUR  
PRODUCTS**

# KEEP UP TO DATE WITH THIS FREE IDEA SERVICE....



## KOILED KORDS\* APPLICATION REPORTS GIVE CASE HISTORIES OF SUCCESSFUL USES OF RETRACTILE CORDS.

Let us send you a file-full of ideas at no cost to you, and we will see that you get future Application Reports as issued. Write today.

KOILED KORDS are used on Electronic Instruments, Cameras, Dictating Machines, Air Conditioners, Industrial Balancers, Automotive Checking Devices, Portable Tools, Hydraulic Lift Jacks, Hoists, Telephones, An Infinite Number of Machine Tools, Trouble Lamps, Railway Sewing Machines . . . . .

**IN FACT KOILED KORDS, RETRACTILE CORDS, HAVE THOUSANDS OF USES IN COMMUNICATIONS — ON ELECTRICAL MACHINES THAT MOVE — IN THE HOME**

See for yourself through KOILED KORDS Application Reports how versatile KOILED KORDS can be. You, too, may find them the answer to a problem.

© 1954



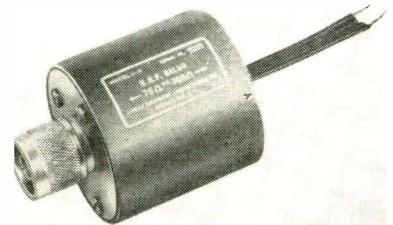
**Box K, New Haven 14, Conn.**  
**IN CANADA: R. D. FLECK & CO., LTD., OSHAWA, ONT.**

\*KOILED KORDS is the trademark of Koiled Kords, Inc.

NEW PRODUCTS

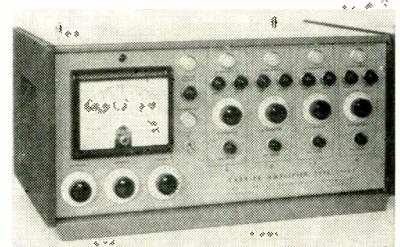
(continued)

voltage coefficient), will result in the generation of current harmonics when an alternating voltage is applied. The apparatus applies an adjustable voltage to both a specimen under test and a standard variable linear resistor. The measured harmonics can be directly correlated to voltage coefficient.



## UHF-VHF BALUNS in four new types

LINEAR EQUIPMENT LABORATORIES, INC., Brightwater Place, Massapequa, L. I., N. Y. New additions to the company's line of baluns now extend the range covered. Model V-6A is designed to match an unbalanced 50-ohm source to a balanced 300-ohm load with negligible loss and good balance efficiency over the frequency range from 50 to 220 mc. The V-6B is similar, but designed for a source impedance of 75 ohms. Model U-2A matches a 50-ohm unbalanced source to a balanced 300-ohm load over a frequency range from 450 to 900 mc. The U-2 is similar, but designed for a source impedance of 75 ohms.



## CARRIER AMPLIFIER is ± 1 percent accurate

CONSOLIDATED ENGINEERING CORP., 300 N. Sierra Madre Villa, Pasadena 8, Calif., has introduced a 4-channel carrier amplifier which has a flat frequency response from 0 to

3,000 cycles. The type 1-127 amplifier is particularly useful in the aircraft and guided missile fields for reproducing outputs of resistance or reluctance type transducers in the frequency range of 0 to 3,000 cycles. The instrument contains a regulated power supply, a 20-ke oscillator, 4-carrier amplifiers with associated bridge balancing and demodulator circuits, control and metering system and a calibrating system. For nominal amplifier sensitivity, a 1-mv modulation signal causes full-scale output of  $\pm 50$  ma. The amplifier is provided with a gain control to adjust for full scale when an input of 1 mv is applied with any source impedance from 60 to 1,000 ohms. Amplified accuracy is  $\pm 1$  percent for modulating frequencies from 0 to 3,000 cycles.

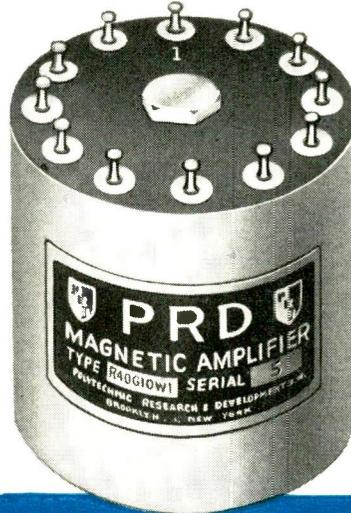


**POWER SUPPLY**  
has outstanding stability

KEITHLEY INSTRUMENTS, 3868 Carnegie Ave., Cleveland, Ohio. Model 2204A regulated voltage supply offers outstanding stability, compact size and a wide range of test potentials. Line regulation of the new supply is within 0.01 percent; output, zero to 1 ma. Six taps of 500, 250, 100, 50, 25 and 10 v are furnished, accurate within 2 percent. In addition, the potential can be continuously varied from 5 to 500 v. A polarity switch is provided, so that the test voltage can be either positive or negative. Also included is a zero-output switch, permitting connections to be made while the instrument is on, and facilitating the timing of measurements. The new supply is used in measuring

# A HIGH PERFORMANCE MAGNETIC SERVO AMPLIFIER

**- expressly designed for high temperature Mark 7 and 8 Servo Motor applications**



Features of the PRD Type R40G10W1 Magnetic Amplifier:

- Response time of one cycle
- Temperature range  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  with normal servo duty cycles
- Hermetically sealed reactor unit only  $2\frac{1}{2}$ " high and  $2\frac{1}{4}$ " diam., weighs less than 12 oz.
- Power supply 115V  $\pm 10\%$ , 400 cps  $\pm 10\%$ , single phase
- Rugged design meets MIL-5272 Procedure I Vibration Spec.

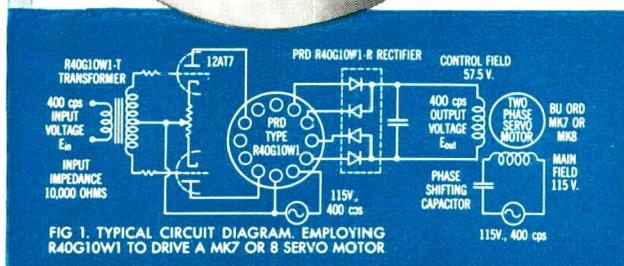
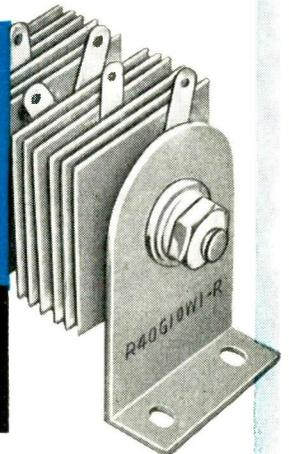
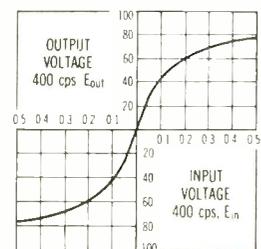


FIG 1. TYPICAL CIRCUIT DIAGRAM, EMPLOYING R40G10W1 TO DRIVE A MK7 OR 8 SERVO MOTOR

**Specify this improved Magnetic Amplifier for Miniaturization plus!**



The R40G10W1 can be supplied as illustrated or with built-in magnetic, transistor, or vacuum tube pre-amplifier. In all cases, no additional power supply is required. The moisture and fungus proofed rectifier is supplied for external mounting. Containing a minimum number of components, the R40G10W1 assures the utmost in ruggedness and long, trouble-free life at minimum cost. It is ideal for use in servo systems requiring up to 10 watts amplifier output such as the control phase of Mark 7 and Mark 8 servo motors. Write for information on the R40G10W1 or send your specifications for applications of magnetic servo amplifiers, low level amplifiers, or regulators of voltage, frequency, speed, and torque.

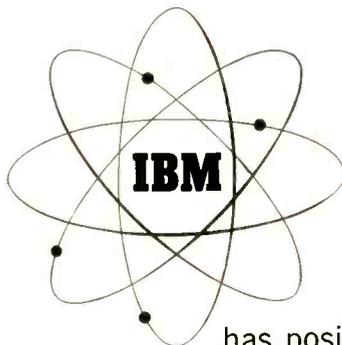


TRANSFER CHARACTERISTIC FOR FIG. 1 CIRCUIT, MK7 MOTOR

**Polytechnic** RESEARCH & DEVELOPMENT CO. Inc

Telephone: ULster 2-6800

202 TILLARY STREET, BROOKLYN 1, N. Y.



WORLD'S LEADING PRODUCER  
OF ELECTRONIC ACCOUNTING  
AND COMPUTING MACHINES

has positions open in  
Development and Manufacturing  
for  
Electronic and Electro-mechanical  
**ENGINEERS**

FOR WORK IN THE DIGITAL COMPUTER FIELD

FUNCTIONAL TESTING AND ANALYSIS  
PROGRAM DEVELOPMENT  
SYSTEMS PLANNING

BS, MS, or PhD degree and experi-  
ence in the fields of computers or  
weapons systems are required.

ELECTRONIC & ELECTRICAL CIRCUIT DESIGN  
TEST EQUIPMENT DESIGN  
PRODUCTION TESTING

BS degree or equivalent experience is  
required. Experience in the following  
fields is desirable. Radar—Servo-  
mechanisms—TV—Analog Comput-  
ers—Audio Systems—Instrumenta-  
tion—Data Handling Systems.

Replies will be held in strict confidence.  
Write giving full details of education  
and experience to:

Mr. W. M. Hoyt, Dept. 686 (A)

INTERNATIONAL BUSINESS MACHINES  
590 Madison Ave., New York 22, N. Y.

**What an Engineer  
—and his family—  
should know about IBM**

\* You'll be working with  
the great teams of engineers  
that created and developed  
the world's most advanced  
digital computers—IBM's  
701 and 702 data process-  
ing machines.

\* Your future will be as  
big as you make it, with  
your advancement depend-  
ing on your own merits.

\* You'll be joining a com-  
pany with a 40-year record  
of growth and stable em-  
ployment and with one of  
the very lowest employee  
turnover records in the en-  
tire country.

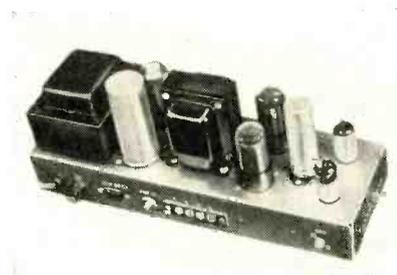
\* Your salary will be excel-  
lent, and IBM's exceptional  
employee benefits will be a  
life-long advantage for you  
and your family.

\* You can continue your  
engineering education  
through IBM's education  
program.

\* Family recreational facil-  
ities including golf courses,  
swimming pools and super-  
vised children's activities  
are of the finest at IBM's  
Country Clubs.

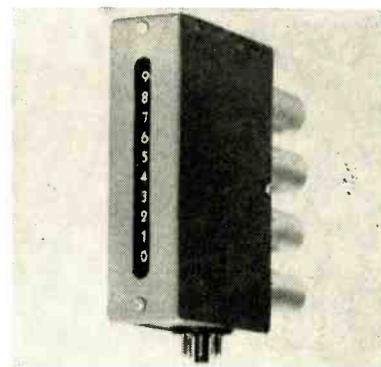
Your moving expenses will  
be paid to Poughkeepsie or  
Endicott, N. Y., where  
IBM's plants and labora-  
tories are located and living  
conditions are excellent.

ultrahigh resistances, furnishing  
excitation voltage to photocells and  
ion chambers, and supplying a buck-  
out potential for precise voltage  
measurements by the null method.  
It is also useful separately as a  
stable test potential in checking d-c  
amplifier gains and in calibrating  
meters.



**TEN-WATT AMPLIFIER**  
for high fidelity

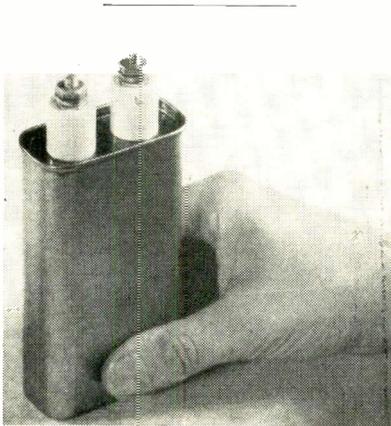
FREED-EISEMANN, 200 Hudson St.,  
New York 13, N. Y., has produced  
a new 10-w amplifier for high-  
fidelity reproduction. Model 910  
Williamson type linear amplifier  
features a frequency response of  
20 to 30,000 cycles at  $\pm 1$  db. The  
total harmonic distortion is less  
than 0.5 percent at full rated out-  
put. Hum and noise level is 80  
db below the rated output. Specially  
designed output transformers are  
constructed with grain oriented  
steel laminations and interleaved  
windings. The model 910 chassis  
measures only 13 in.  $\times$  4 $\frac{1}{4}$  in.  $\times$   
5 $\frac{1}{8}$  in.



**DECIMAL COUNTERS**  
available in two types

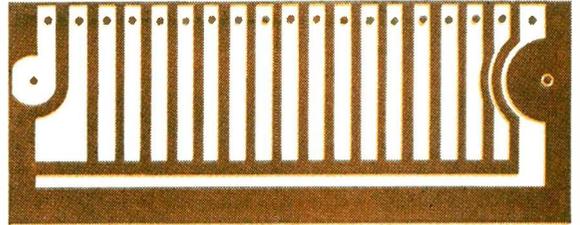
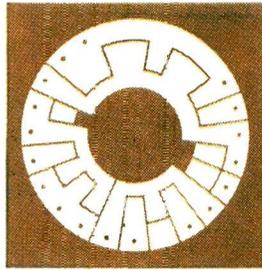
ADVANCE ELECTRONICS Co., INC.,  
451 Highland Ave., Passaic, N. J.,  
has available types 100A and 100B  
decimal counting units. They are

direct-reading plug-in electronic counters. Each unit counts the number of input pulses from 0 to 9; the 10th pulse resets the counter to 0 and at the same time produces an output pulse. The number of pulses applied to the input is indicated by the illumination of one of the ten neon bulbs installed behind a numbered plastic front panel. To increase counting capacity a number of these decimal counters may be connected in cascade with the output of one unit fed to the input of the next unit. Type 100A is used for counting from 40 kc to 0 cps. The 100B is used for counting from 100 kc to 0 cps. Both have identical power requirements, 6.3 v at 1.2 amperes and 300 v at 15 ma. Input signal for both must be at least 100 v; rise time, 1  $\mu$ sec or shorter; and duration, 2  $\mu$ sec or longer. Resolution time is 5  $\mu$ sec for both types. Arrangement is provided for zero reset. Output pulses of either type are adequate to trigger another type 100A.



### CAPACITORS in drawn rectangular cases

GENERAL ELECTRIC Co., Hudson Falls, N. Y., has announced new fixed paper-dielectric capacitors in drawn rectangular cases, which are designed to give greater protection against leakage than fabricated cases. Elimination of soldered seams in the drawn can provides the added protection. These capacitors for motor, industrial control, filter, luminous-tube transformer, and other a-c or d-c applications were previously available in drawn cases, but only in oval styles. Features of the new capacitors include welded bushing studs, welded taps, high-



## Better... and Cheaper *Sliding Contact Devices* because of

# AEROVOX PRINTED WIRING

An entirely new approach to dependable, long-life, economical sliding contact devices. Made possible only by the unique Aerovox Printed Wiring technic.

Switches, commutators and other electro-mechanical assemblies can now be made with that ruggedness and high performance which only solid silver contacts can provide. Herewith are typical examples of such sliding contact segments or stators. Life of several million cycles under various conditions.

Aerovox Printed Wiring for circuits, even including capacitance, inductance, shielding, and associated resistance elements, means metallic silver conductor mechanically formed and partially imbedded in phenolic base. No adhesive. No etching with resultant danger of acid or chemical deterioration. No oxidation or tarnishing. No surface plating. Identically reproducible due to precision printing process. Yes, obviously different!

*Printed Wiring Primer:* Yours for the asking.

Also representative samples if you write on business stationery and indicate particular interest in switching, commutating or wiring applications. Let us quote on any requirements.



## AEROVOX CORPORATION

SPECIAL PRODUCTS DIVISION

NEW BEDFORD, MASS.

**Hi-Q**  
DIVISION  
OLEAN, N. Y.

**ACME**  
ELECTRONICS INC.  
MONROVIA, CALIF.

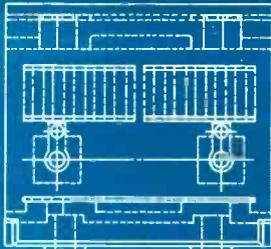
**CINEMA**  
ENGINEERING CO.  
BURBANK, CALIF.

In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

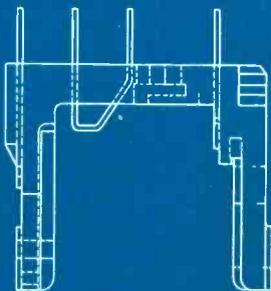


"Your Blueprint In Plastics"

ALL MATERIALS • ALL PROCESSES



Custom  
Molding



**CONSOLIDATED**  
MOLDED PRODUCTS CORPORATION

SCRANTON 2, PENNA.

purity aluminum foil, low-loss Kraft paper, and Pyranol dielectric. The new units are available in capacitance ratings of 0.05  $\mu$ f to 16  $\mu$ f and voltage ratings of 400 v to 12,500 v d-c and 236 to 660 v a-c.



**PRECISION RESISTOR**  
for automation purposes

CINEMA ENGINEERING CO., Division Aerovox, Burbank, Calif. The series PW precision wire-wound resistors are designed especially for printed wiring assembly technique and automation. Entirely encapsulated in an epoxy resin, they meet requirements of humidity protection and aging presently met only by resistors under MIL-R-93A. Simplification in design is featured in both subminiature and larger models. One feature is a key moulded along the length of the resistor to allow for the necessary indexing and registration on the printed wiring. Other outstanding technical points include the latest in low temperature wire and very light weight, with the smallest resistor having a weight of but 1 gram, capable of dissipating 0.1 w. Other units vary in weight to 1 oz., capable of dissipating 1 w.

**NOW...SOLVE YOUR  
HIGH VOLTAGE PROBLEMS**  
with  
**BETTER EQUIPMENT**



Our years of experience gives you MAGNATRAN Heavy Duty High Voltage products . . . built for longer life and rugged performance

← **NEW UNITIZED RECTIFIERS**

For high voltage D.C. sources . . . lower initial cost . . . minimum upkeep . . . convenient — ready to connect to AC. line and D.C. load . . . compact — requires minimum floor space.

**AIR . . . OIL . . . ASKAREL**

Plate Transformers . Filament Transformers . Filter Reactors . Modulation Transformers . Distribution Transformers . Pulse Transformers . Testing Transformers . Precipitation Transformers . General Purpose Transformers . Hi-Voltage Transformers.

34 KW 17,000 V.D.C.



Askarel Immersed  
Filter Reactor  
50,000 Volt Test

WRITE FOR DETAILED INFORMATION

MEETS STANDARDS OF AIEE-NEMA

A NAME SYNONYMOUS WITH EXPERIENCE

**MAGNATRAN INCORPORATED**

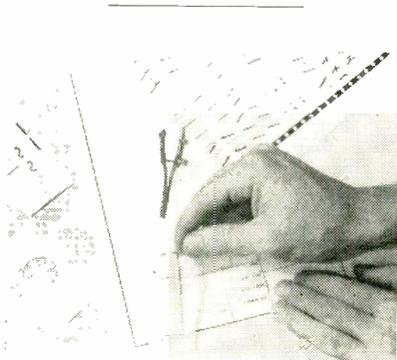
TRANSFORMERS AND ELECTRICAL EQUIPMENT  
WALTER GARLICK, JR., PRESIDENT  
246 SCHUYLER AVE., KEARNY, NEW JERSEY



**CAPACITORS**  
are h-v glass-cased type

GUDEMAN Co., 340 W. Huron St., Chicago 10, Ill., offers a new hermetically-sealed h-v d-c glass cased

GC type line of paper dielectric capacitors. The GC line has improved electrical characteristics, is smaller in size and lighter in weight than present conventional types. Reduction in size and weight is primarily a function of the high dielectric strength characteristic of impregnant No. 258 and the high creepage path preferred by thermal glass tubing. Operating temperature range of GC 45 series and GC 46 series is from  $-55\text{ C}$  to  $+105\text{ C}$ . No voltage derating is necessary up to  $85\text{ C}$ . At  $105\text{ C}$ , the maximum applied voltage recommended for continuous operation is 75 percent of the rated voltage. Insulation resistance at  $25\text{ C}$  is 10,000 megohm- $\mu\text{f}$  minimum but need not exceed 20,000 megohms. At  $85\text{ C}$ , insulation resistance is 100 megohm- $\mu\text{f}$  minimum but need not exceed 1,000 megohms. At  $105\text{ C}$ , insulation resistance is 30 megohm- $\mu\text{f}$  minimum but need not exceed 300 megohms.



### DRAFTING AIDS save time and effort

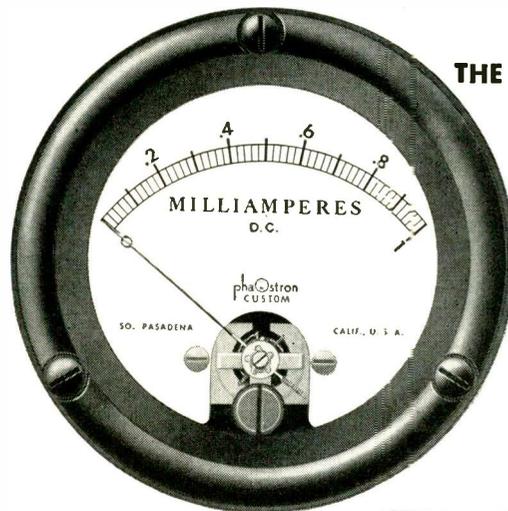
JOHNSON RESEARCH CORP., Bethpage, L. I., N. Y., has developed improved title blocks, technical symbols, etc., for use by engineers and draftsmen on drawings and tracings. They are known to industry as Transeals, a thin transparent printed plastic sheet with a pressure-sensitive adhesive coating that is protected by a removable waxed paper sheet. Transeals eliminate rubber stamps and the time-consuming hand lettering, symbol drawing and ruling usually required for engineering drawings on paper, vellum or cloth. Furnished for application to either the reverse side or the face of drawings, Transeals are easily applied by slight hand pressure without the use of



**2 1/2" and 3 1/2"**  
**round or square**

## CUSTOM PANEL INSTRUMENTS

**METAL-CASED TO INSURE THEIR CONTINUED INTEGRITY**



**THE RELIABILITY OF A METER**

**AS AN INSTRUMENT**

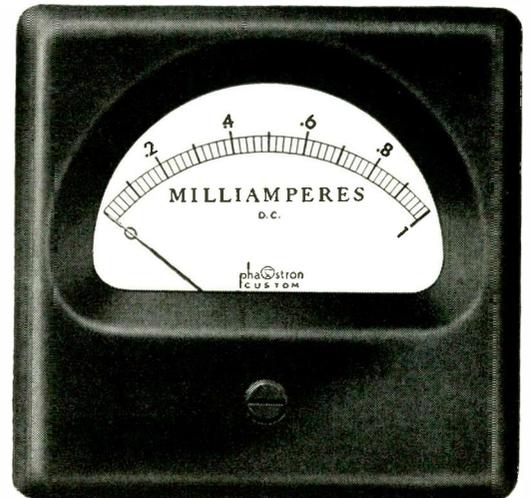
**DEPENDS**

**ON ITS**

**PERMANENT ACCURACY**

### PERMANENT ACCURACY

is assured by the  
**DRAWN STEEL CASE**  
which shields the  
permanent magnetic assembly  
of the instrument  
against  
external magnetic fields.



**phaOstron TIME PROVEN MOVEMENTS**

**phaOstron ANTI-MAGNETIC SHIELDING**

**phaOstron 2% ACCURACY**

**phaOstron INSULATED  
ZERO ADJUSTMENTS**

**Phaostron CUSTOM Panel Instruments offer highest quality at new low cost**

**phaOstron PRICE — YOU CANNOT BUY BETTER**

Inquiries are invited and catalog sheets are available on this  
**NEW CUSTOM LINE** which also includes 6" MIRROR SCALE INSTRUMENTS.

**PHAOSTRON CO. • 151 PASADENA AVE. • SO. PASADENA, CALIF.**

# When you measure TIME look to HAYDON\*



**TIME DELAY RELAYS**  
5900 Series: For time delay or interval timing in ranges from 0 to 10 minutes.



**INTERVAL TIMERS**  
8006 Series: Times intervals from 60 seconds to two weeks with exactness.



**ELAPSED TIME INDICATORS**  
5700 Series: Registers passage of time in minutes and tenths of minutes and hours with mathematical regularity.



**TIMING MOTORS**  
Compact HAYDON Timing Motors that can be operated continuously in any position drive all HAYDON Timing Devices. HAYDON specializes in timing; engineers and builds only timing components; has the "know how" to put time to work for you.

TAKE TIME NOW to write for the name of your HAYDON Timing Specialist, and for HAYDON Catalog.

A SUBSIDIARY OF GENERAL TIME CORP.



## AMPLIFIER PENTODES for high-fidelity audio

AMPEREX ELECTRONIC CORP., 230 Duffy Ave., Hicksville, L. I., N. Y., has announced two new amplifier pentodes designed especially for high-fidelity audio sound systems. Type 6CA7 (25-w plate dissipation) and type EL84 (12-w plate dissipation) are designed to deliver high power without drawing control grid current.



## D-C SUPPLY is a tubeless unit

SORENSEN & Co., INC., 375 Fairfield Ave., Stamford, Conn. Model MA65 magnetic amplifier d-c supply is compact, inexpensive, tubeless, designed particularly for telephone and telegraph systems, radio and tv applications. Input is 105 to 125 v a-c, single phase, 60 cycle. Out-

**HAYDON**  
AT TORRINGTON

HEADQUARTERS FOR  
**TIMING**

**HAYDON Manufacturing Company, Inc.**

2436 ELM STREET, TORRINGTON, CONN.

- Send me "Electric Timing Devices" catalog.
- Send me name of HAYDON Timing Specialist.

NAME \_\_\_\_\_

TITLE \_\_\_\_\_

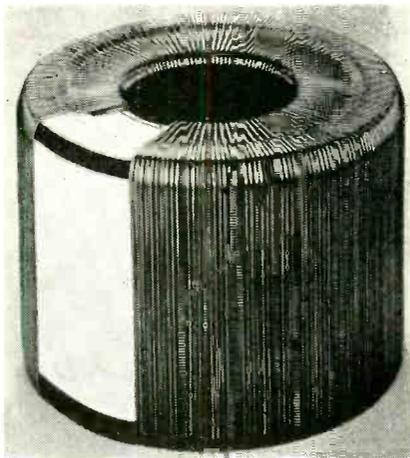
COMPANY \_\_\_\_\_

CO. ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

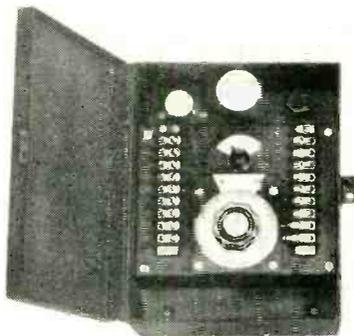
\*Trademark Reg. U.S. Patent Office

put is 6 v d-c, adjustable  $\pm 10$  percent. Load range is 0 to 5 amperes. Ripple is 1 percent maximum.



**BANKED WINDING**  
for variable transformers

REX RHEOSTAT CO., 3 Foxhurst Rd., Baldwin, L. I., N. Y. An attachment for automatic toroidal winding machines is now available to wind variable transformer cores with banked winding without using knurled guiding plates.



**ELECTRONIC TIMER**  
with 1-percent accuracy

FERRARA, INC., 8106 W. Nine Mile Road, Oak Park 37, Mich., announces a new precision general purpose electronic timer with 1-percent accuracy for interval timing, timed delay, repeat cycling, programming or pulsing. Because of unique circuit design the T2 timer is designed for use on process timing, sequence control of automated equipment, induction heating equipment, conveyors, machine tools, injection molding machines,

**NEW CONCEPTS**

**NEW POTENTIALS**

**HAYDON\***

*Because manufacturers must have better products, they rely on you — the designers and engineers who have the ability to apply skill and experience with IMAGINATION — to develop new and better products and methods! Ready to work with you are industrials with the same vision and creative talents. In the field of timing motors, HAYDON is such a company.*

**because new IDEAS take TIME and TIMING!**

4400 Series Timing Motor

If 60 cycle, 400 cycle, or d-c timing motors are to be used in your product or process, call in the nearby factory-trained HAYDON Field Engineer. He can help you find the right motors for precisely, dependably using time . . . controlling time . . . metering time — for bettering performance and opening new horizons to product and process use. Clip and mail the coupon for his name . . . and for an informative catalog — today!

**HAYDON**  
AT TORRINGTON

HEADQUARTERS FOR  
**TIMING**

A SUBSIDIARY OF GENERAL TIME CORP

**HAYDON Manufacturing Company, Inc.**  
2436 ELM STREET, TORRINGTON, CONN.

Send me the name of the nearby HAYDON Field Engineer  
 Send me catalog, "Electric Timing Motors"

NAME \_\_\_\_\_  
POSITION \_\_\_\_\_  
COMPANY \_\_\_\_\_  
CO. ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

\*Trade Mark Reg. U. S. Patent Office

# LOWER YOUR SET COSTS

## WITH THIS LOWER-PRICED DEPENDABLE SPEAKER

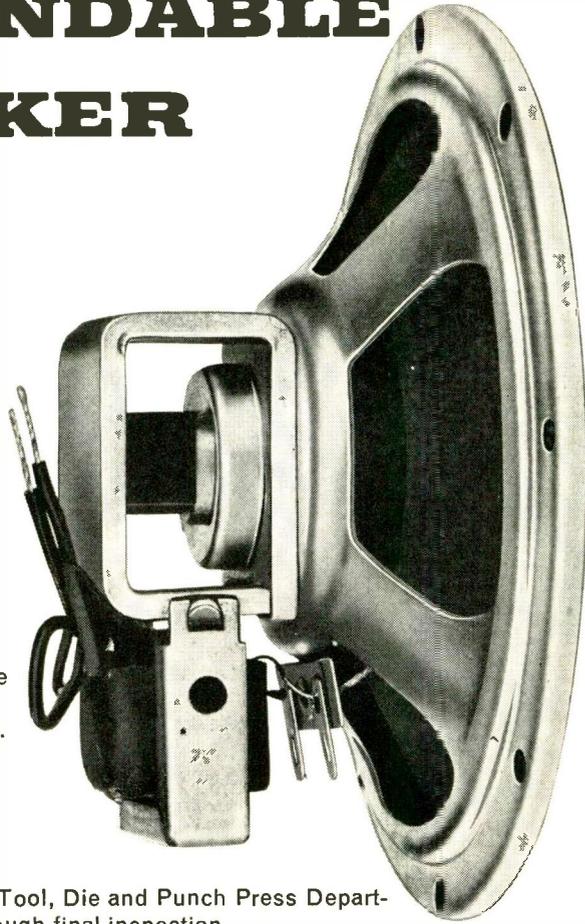
A line of 4" and 5" speakers designed for peak performance. Break off or cast magnet may be used.

Low priced only because of unusually efficient manufacturing techniques.

Produced under rigid quality control. Metal stampings completely manufactured in our own Tool, Die and Punch Press Departments. Exceptionally thorough final inspection.

Plugs, transformers and/or brackets to your specifications.

Lower your set costs with this dependable speaker. Write for further information TODAY.



**OTHER HEPPNER PRODUCTS:**  
Ion Traps, Centering Devices, Fly-Back Transformers and Focomags.

# HEPPNER

MANUFACTURING COMPANY  
ROUND LAKE, ILLINOIS  
(50 Miles Northwest of Chicago)  
Phone: 6-2161  
Specialists in Electro-Magnetic Devices

#### Representatives:

JAMES C. MUGGLEWORTH, 324 Haddon Avenue, Collingswood 7, New Jersey • RALPH HAFNEY, R.R. 1, U.S. 27, Coldwater Rd., Ft. Wayne 8, Indiana • IRV. M. COCHRANE CO., 408 So. Alvarado St., Los Angeles, Calif. • JOHN J. KOPPLE, 60 E. 42nd St., New York 17, N. Y.

NEW PRODUCTS

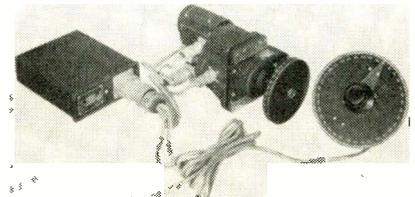
(continued)

and packaging and filling machinery. Features include: 3 time ranges of 0.1 to 1 sec, 1 to 10 sec, and 10 to 100 sec; a direct-reading time dial; and 2 spdt load contacts with 8-ampere rating. A 4-page technical brochure is available.



### MOTOR-ALTERNATOR is highly portable

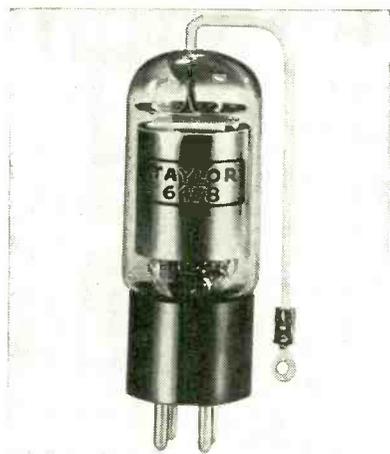
ELECTRIC MOTORS AND SPECIALTIES, INC., King and Hamsher Sts., Garrett, Ind. Model SA-40 is a 420-cps synchronous motor-alternator. It features two-bearing construction and 60-lb weight for high portability. Applications include lab test equipment, servos, electronic controls, indicating systems, photographic devices, recorders, actuators and computers.



### REMOTE POSITIONER extends servo usefulness

LEAR, INC., Grand Rapids 2, Mich. The Electrolink remote positioning system extends the useful power range of electric servomechanisms in both the aviation and industrial fields. Because of relative control inefficiency and high weight per-unit-power, electric servos have hitherto been limited to low-power applications whenever h-f response

was required. For remote control systems requiring higher torque output, it had been necessary to rely on hydraulic servomechanisms. The Electrolink brings the advantages of electric servo operation to many remote positioning applications previously considered beyond the scope of such systems. The three components of the remote positioner are an electric amplifier, a transmitter autosyn and a magnetic-powder-clutch servo-drive with integral receiver autosyn. Power required is 115 v, single-phase, 400-cycle; and 28 v d-c. All components meet applicable USAF and Navy specifications for airborne use. Accuracy is within 0.25 deg for most loads, with h-f response retained over the entire output range. The system of contrarotating magnetic powder clutches is the key to the high positioning speed and accuracy of the Electrolink.



### XENON THYRATRON for airborne operation

TAYLOR TUBES, INC., 2312 Wabansia Ave., Chicago 47, Ill. The 6478 xenon thyatron meets the exacting electrical and mechanical requirements for reliable airborne operation at high altitudes. Its small size and flexible anode lead make it ideal for applications where space is limited. The tube has a maximum operating voltage of 1,500 v a-c. Continuous anode current is 1.5 amperes and the continuously recurring peak anode current is 20 amperes. Filament current is 7 amperes at 2.5 v. The type 6478 features a maximum deionization

# PRECISION AND SKILL



IN  
RESEARCH  
DEVELOPMENT  
PRODUCTION

# DAYSTROM

I  
N  
S  
T  
R  
U  
M  
E  
N  
T

Division of  
Daystrom, Inc.

ARCHBALD,  
PENNSYLVANIA

Write  
For  
Facilities  
Report



Daystrom Instrument will take on the complete project . . . from design to the delivery of systems on a volume production basis. At Daystrom the development of a new product, or the improvement of an existing product can be undertaken. Experienced production engineers convert the design into modern shop practices which result in efficient production and assembly of a quality product. This ability to assume the complete job for research, design and production under one roof means worthwhile savings in time and money.

*The Army, Navy and Air Force as well as the aircraft industry have experienced Daystrom's ability to get the job done.*

Radar  
Fire Control  
Navigation

Systems  
Computers  
Communications

Miniaturization  
Instrumentation

**New!****"P" TYPE  
ENCAPSULATED  
RESISTORS****Stable... Small...  
Light-weight...**

Shallcross "P" Type Encapsulated Resistors are ideal for installation where stability, dependability, and minimum size and weight are a must. These radically new resistors offer the performance advantages of hermetically-sealed seatite resistors at less cost.

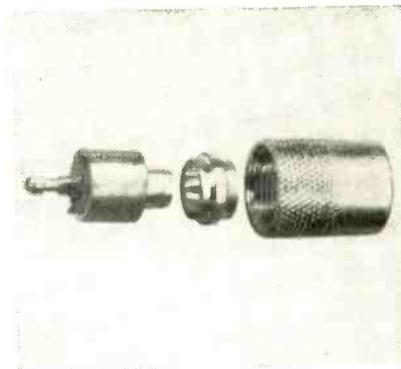
Because of the unique Shallcross method of encapsulating windings, "P" type resistors have greater maximum resistances, longer leakage paths, and higher wattage ratings.

Shallcross "P" type resistors are available in six MIL-R-93A lug-type styles and five axial lead styles with wattage ratings ranging from .500 to 3.5 watts. All styles meet and exceed JAN-R-93A, Characteristic A.

Complete information on sizes, ratings, and test results of Shallcross "P" type precision wirewound resistors is available in Engineering Bulletin L-30. Write for your copy today.

SHALLCROSS MANUFACTURING CO.  
522 Pusey Avenue, Collingdale, Pa.

time of 80  $\mu$ sec. Ambient temperature limits are  $-75^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Maximum cathode warmup time is 15 sec. Hard glass construction makes the tube applicable in high shock installations. Maximum physical dimensions are  $4\frac{1}{8}$  in. long,  $1\frac{1}{8}$  in. in diameter. The anode lead has a maximum length of  $4\frac{1}{2}$  in. with a closed No. 6 lug.

**COAX CONNECTOR  
is completely solderless**

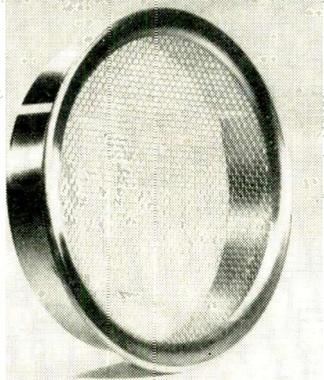
ENTRON, INC., 4902 Lawrence St., Biadensburg, Md. A new coaxial cable connector offers several features that recommend its incorporation in communications and tv equipment. Of interest to designers particularly is its electrical reliability, high mechanical strength and effective shielding, the latter obtained by a radial grounding contact. Quickly and easily installed, completely solderless, it offers as a principal feature time-saving efficiency.

**MARINE RECEIVER  
has improved selectivity**

MARINE DIVISION OF MACKAY RADIO AND TELEGRAPH CO., INC., an associate of American Cable & Radio Corp., 67 Broad St., New York 4, N. Y., has available a general-purpose, 5-band superheterodyne communication receiver covering the frequency ranges from 35 to 500 kc and 1.9 to 24 mc. Its ultra-sharp selectivity enhances reception of c-w signals in the presence of intense static and interfering transmissions. Type 3007-A marine receiver is entirely self-contained with panel-mounted loudspeaker.

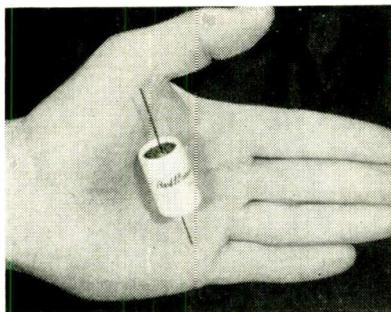
Our  
25th Year 1929  
1954  
**Shallcross**

It is designed to operate from 115 v, either a-c or d-c. The double-conversion oscillators are thoroughly shielded to reduce radiation of energy from the receiver antenna well below the permissible maximum specified by the FCC.



**COPPER LOUVERS**  
available in many designs

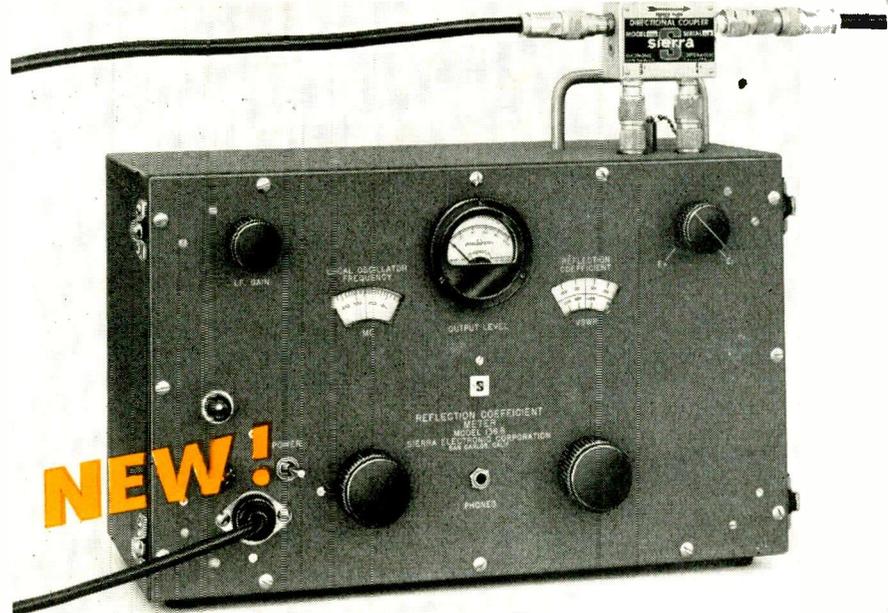
MIDGET LOUVER CO., Norwalk, Conn., has introduced a new line of copper louvers as an addition to its line of push-in type, circular aluminum louvers. They are available in 1, 1½, 2, 2½, 3, 4 and 6-in. sizes. They should interest manufacturers of electronic equipment where midget louvers provide ventilation and moisture-vapor control for instrument and other type casings. Installed on radio transmission sets they prevent picture interference on adjacent tv receivers.



**THERMAL TIME DELAY**  
is tiny and inexpensive

BELLTRON MFG. Co. INC., 6th and Fulton St., Elizabeth, N. J. The miniature thermal time delay illustrated is meant to fill the gap where a very low-cost time-delay unit is

# Match Lines Fast!



## Sierra 136B Reflection Coefficient Meter

This compact, moderately-priced instrument gives you materially greater speed and convenience for measuring coaxial transmission line reflection coefficient, VSWR, or for matching loads to line. The instrument has high accuracy; sensitivity permits operation with any standard CW signal generator. (See Figure 1) It provides continuous monitoring of the reflected signal, is simple to operate, and sturdily built for laboratory, production line or field use. Frequency coverage is continuous from 32 to 1125 mc.

The new 136B employs the unique Sierra Wideband Directional Couplers (Model 138 for 51.5 ohms and Model 138A for 50.0 ohms) to sample incident and reflected voltage in a transmission line. A built-in superheterodyne VTVM may be switched to indicate either reflected or incident voltage directly. In the incident position, a precision attenuator calibrated directly in reflection coefficient and VSWR is inserted in the IF amplifier circuit.

WRITE DIRECT FOR BULLETIN

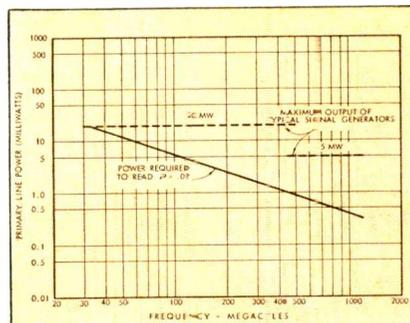


Figure 1. Sensitivity, Sierra 136B. Primary line CW power required to read reflection coefficient 0.02 as a function of frequency. Values are for Sierra 138 and 138A Directional Couplers.

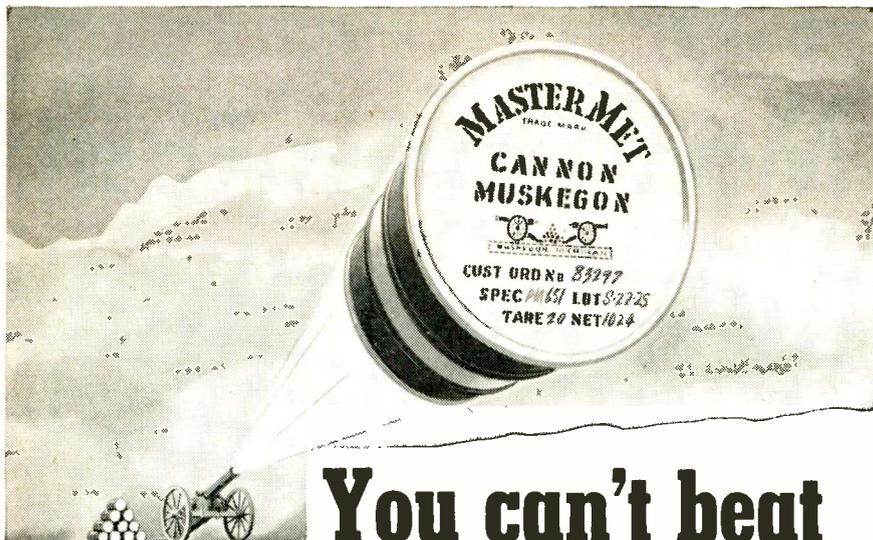
Data subject to change without notice



**Sierra Electronic Corporation**  
San Carlos 2, California, U. S. A.

Sales representatives in major cities  
Manufacturers of Carrier Frequency Voltmeters, Wave Analyzers, Line Fault Analyzers, Directional Couplers, Wideband RF Transformers, Custom Radio Transmitters, VHF UHF Detectors, Variable Impedance Wattmeters, Reflection Coefficient Meters.

3232



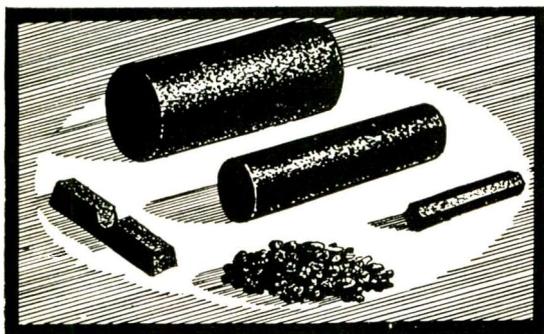
# You can't beat Cannon-Muskegon MASTERMET alloy service

... for fast delivery of standard or custom certified\* alloys for remelt or reprocessing!

CANNON-MUSKEGON regularly produces a wide range of certified alloys to maintain one of the electronic industry's finest stocking programs. Immediately available are stainless steels in the 300 and 400 series plus certain carbon steels.

### Service on "special" alloys is remarkable too!

Preparation is begun immediately after your specifications are received. You get *exactly predictable* electrical, physical and chemical properties to your specific requirements. And, depending upon the form you order, alloys can be cast, forged, extruded and machined. Furnished regularly are alloy tool steels, ferritic and austenitic stainless, alloys of cobalt and nickel-base, plus aeronautical-types for extreme high temperature use, industrial and military applications.



MasterMet alloys are available in ingot, shot, billet or short (6" dia.) cast bar forms and are normally shipped in drums. Specifications, weight, lot and customer's order number are clearly imprinted on container, making selection and storage a simple matter.

\*Cannon-Muskegon furnishes notarized certificates of analysis to meet prescribed metal specifications. For more information about this, and complete technical service, write for New MasterMet Bulletin.



## Cannon-Muskegon CORPORATION

2885 Lincoln Street  
MUSKEGON, MICHIGAN

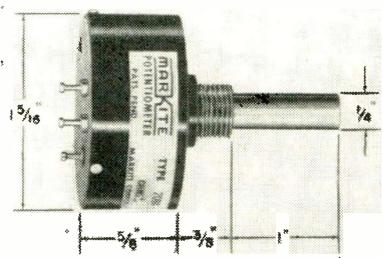


METALLURGICAL SPECIALISTS

desired and where ambient thermal and humidity conditions are not beyond average. It is designed around a radically new and different heater element permitting an overall body size  $\frac{3}{8}$  in. diameter  $\times$  1  $\frac{1}{4}$  in. long. Its appearance is similar to that of a paper-wound capacitor. Cost is no more than for a standard capacitor of similar size. Factory-set time delays, from 2 to 60 sec, can be supplied with operating voltages of 6.3 v to 110 v a-c or d-c. Standard contacts are rated at 2 to 5 amperes with higher ratings available on special order. It has spst circuits only—normally closed or normally open. The heater element can be had in parallel with contacts, as illustrated, or a 3-wire model can be supplied for separate heater connection.

### TV PICTURE TUBE for compact receiver design

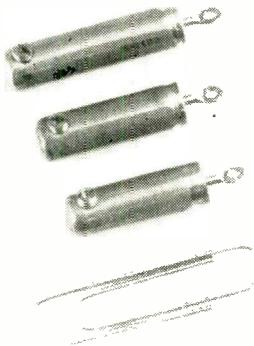
SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y., has announced a new, 90-deg magnetic deflection, 17-in., glass tv picture tube, with an overall length of only 15  $\frac{3}{8}$  in. The 17AVP4 is an all-glass, rectangular type with a grey spherical face. It is not aluminized. The tube is electrostatically focused and requires a single field ion trap magnet. It is supplied with external conductive coating. Its length, 3  $\frac{3}{4}$  in. shorter than previous 17-in. types, makes the tube well suited to compact receiver designs.



### POTENTIOMETER features high resolution

THE MARKITE CORP., 155 Waverly Place, New York, N. Y. Type 2094 rotational potentiometer is designed for applications where long life, substantially infinite resolution and

low noise under extreme vibration and acceleration are essential. It carries a life guarantee of 5 million revolutions at 600 rpm or less. The active element is a solid resistance track of conductive plastic which is integrally co-molded to terminals, taps and a rigid supporting phenolic insulator plastic. Standard resistance values of 2,000 to 100,000 ohms with linearity of  $\pm 1.0$  percent or  $\pm 0.5$  percent are available.



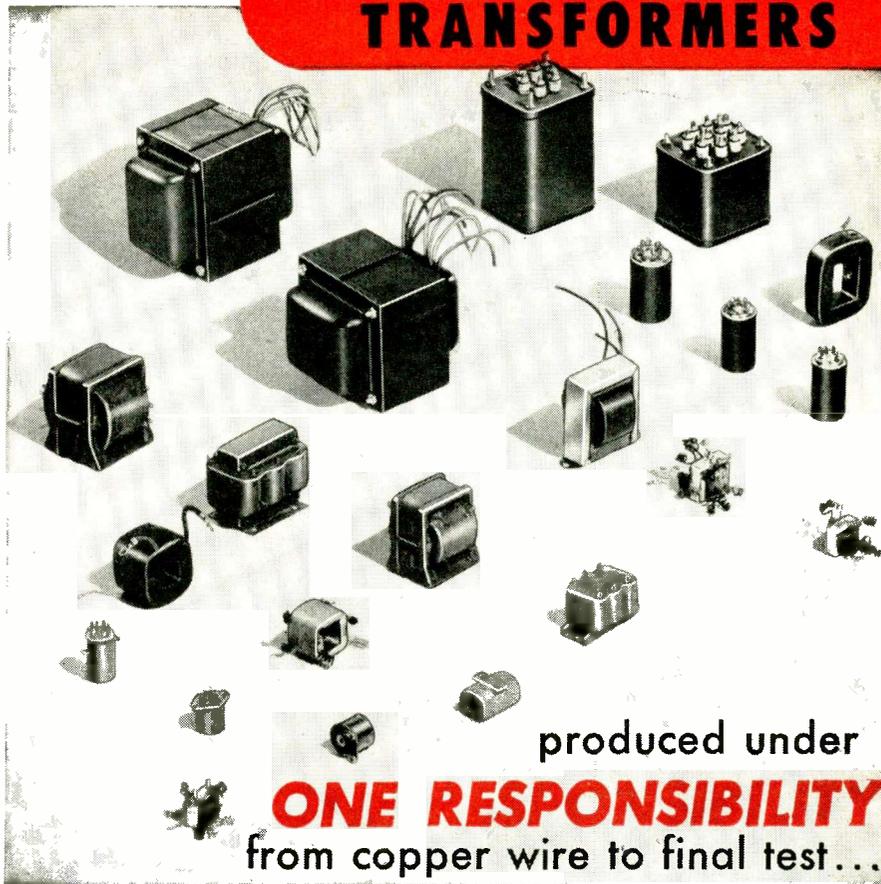
### SEALED THERMOSTAT has fast response time

CHATHAM CONTROLS CORP., 110 Summit Ave., Chatham, N. J., announces an adjustable hermetically-sealed thermostat that is rugged, exceptionally small in size and has extremely fast response time. Sealed in a brass tube with a glass-to-metal base, this thermostat can be used as a nonhermetic unit and still be completely resistant to corrosion, fumes and dirt. Three models are available, all  $\frac{1}{4}$  in. in diameter, featuring different lengths, depending on internal construction. These lengths vary from  $\frac{3}{8}$  in. to  $\frac{1}{2}$  in. exclusive of terminal. Temperature ranges from  $-65$  C to  $+150$  C and have 0.5 deg or less temperature differential at the thermostat. Non-inductive load up to 5 amperes at 27.5 d-c may be handled. Its 110-v rating is 0.5 ampere.

### TIME CALIBRATOR is compact and portable

ALLEN B. DUMONT LABORATORIES, INC., 760 Bloomfield Ave., Clifton, N. J. Type 300 compact, portable, crystal-controlled time calibrator is designed to check a great variety of instruments that employ time bases,

## CUSTOM-ENGINEERED TRANSFORMERS



produced under  
**ONE RESPONSIBILITY**  
from copper wire to final test...

- Wheeler transformers are custom-engineered to meet your specific requirements. Your needs come first with us.
- Wheeler makes its own magnet wire . . . from the copper rod to the finished, insulated and tested product . . . with quality under our control every step of the way.
- Wheeler uses the most modern winding techniques and equipment.
- Wheeler's facilities for the production of intricate coils and assemblies are unexcelled.
- Wheeler affords fullest protection to its transformers with latest techniques in wax and varnish impregnation and FOSTERITE® encapsulation.
- Wheeler transformers are subject to specially devised engineering and test procedures throughout manufacture, and must individually undergo a final comprehensive test before shipment.

To learn what these advantages can mean to you, write:

### THE WHEELER INSULATED WIRE COMPANY, INC.

Division of The Sperry Corp.  
1101 East Aurora St., Waterbury 20, Conn.



## WHEELER

MAGNET WIRE

COILS

COMMUNICATIONS EQUIPMENT

TRANSFORMERS

WHEELER MAKES THESE PRODUCTS A *Specialty*

®The WESTINGHOUSE encapsulating material that gives a high degree of protection to small transformers. Applied by Wheeler under license.

EW114

we put  
everything  
we have  
behind  
our wishes  
for a...



from....

**SIGNAL  
ENGINEERING & MFG. CO.**  
manufacturers of:

RELAYS  
BELLS  
TELEPHONE  
RINGING  
RELAY SETS



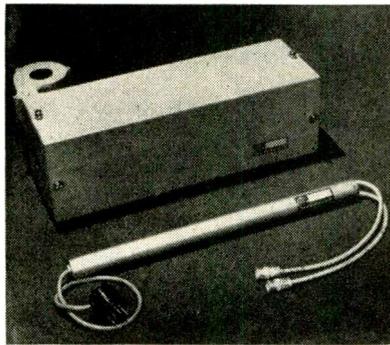
CHIMES  
HORNS  
FIRE ALARMS  
CODE CALL  
SYSTEMS



NEW PRODUCTS

(continued)

or incorporate timing functions. A 10-mc sine wave, and five sharply peaked pulse outputs having repetition rates variable in decade steps from 1  $\mu$ sec to 10 millisecc are provided by the instrument. The accuracy at any repetition rate selected is within 0.1 percent. Either 3-v positive or 30-v negative pulse outputs may be selected. Synchronizing signals of 100 cps, and 1, 10, and 100 kc rates are also available at front-panel jacks enabling accurate triggering of oscillographs or other devices at desired rates regardless of timing pulse-rate selected. In addition, the type 300 serves as a shaper for external signals, transforming signals of any wave shape, fed to the unit, into sharp pulses at the same frequency. Calibration pulses may be thus obtained from external frequency standards in the range of 100 cps to 1 mc.



**T-W AMPLIFIER TUBE**  
for S-band medium power use

HUGGINS LABORATORIES, INC., 711 Hamilton Ave., Menlo Park, Calif., has announced a new broadband S-band medium power amplifier developed to deliver 1-w output with 1-mw input from 2 to 4 kmc without resorting to any electrical or mechanical tuning procedures. The tube finds its greatest application where wide bandwidth and medium power output are required. These applications include use as a power amplifier to raise the output of milliwatt signal generators in microwave measurement techniques and as a driver amplifier in system applications. With the addition of a grid it becomes useful as a medium power modulator. Approximate operating characteris-

**OPTICAL SYSTEMS**

**INDUSTRIAL  
PERISCOPES**



**DESIGN  
DEVELOPMENT  
MANUFACTURE**

For nearly half a century Kollmorgen has designed, developed and manufactured precision optics and optical systems for industry and the military.

We have the engineering "know-how", the design personnel and the manufacturing capacity to help you solve your optical problem.



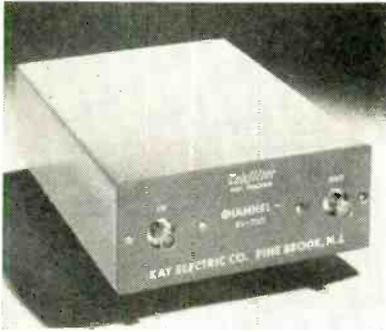
Plant: 347 King Street • Northampton, Mass.  
New York Office  
30 Church Street  
New York 7, N. Y.

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS

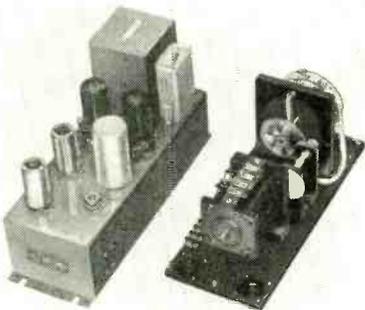
Want more information? Use post card on last page.

tics over this band are 30-db gain, 1-w output, and 25-db noise figure. It requires a 600-gauss field and a 1,200-v regulated power supply.



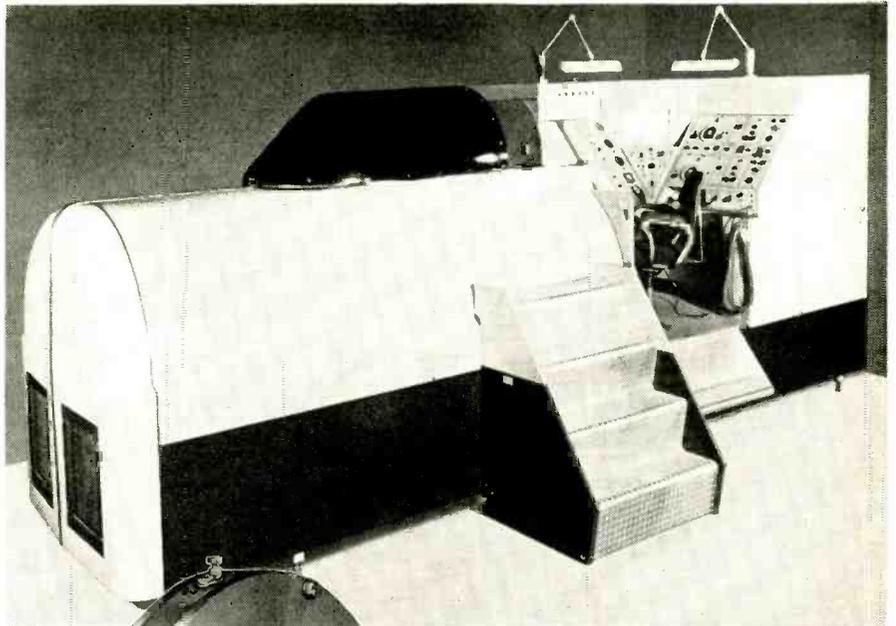
**SSB FILTER**  
priced at \$195

KAY ELECTRIC Co., Pine Brook, N. J. For generation of ssb tv signals the company offers a vestigial sideband filter, which, used in conjunction with their Mega-Pix or with any other tv r-f carrier generator, passes upper and rejects lower sideband of any one vhf tv channel. It is known as the Telefilter and has the following features: flatness—better than  $\pm 7$  percent over the 4.5-mc band; lower sideband discrimination—adjacent sound, 20 db down; adjacent picture, 35 db down; insertion loss—less than 10 db; characteristic impedance—nominal 75 ohms. It is available for any single channel from 2 to 13, inclusive. Price is \$195.

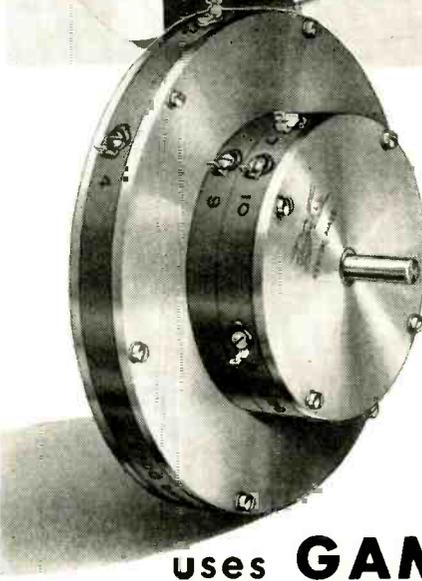


**SERVO MULTIPLIER**  
driven by d-c data

INDUSTRIAL CONTROL Co., Wyandanch, L. I., N. Y. The SL-1053 is a high-precision servo multiplier operating from the 60-cps line. Its basic action is to convert a d-c input variable into a shaft rotation. A precision potentiometer, driven by



LINK C-118 Jet Flight Trainer is the standard basic jet trainer for all branches of the military. In the rear is control station for setting up all flight and navigation problems.



Another famous name in aviation



uses **GAMEWELL**  
**Precision Potentiometers**

To insure precise control and accurate operation of trainers, LINK AVIATION, INC. utilizes Gamewell Precision Potentiometers for several of its models.

When your problem could be solved with a truly precision potentiometer, it is time to consult Gamewell. Our technical men will be glad to work with your staff, to solve your project problems in the shortest possible time.

Mail Coupon for Your Copy of This Booklet . . .



THE GAMEWELL COMPANY  
Newton Upper Falls 64, Mass.



PRECISION POTENTIOMETERS

THE GAMEWELL COMPANY  
Newton Upper Falls 64, Mass.

At no obligation to me, please send a copy of the booklet describing Gamewell Precision Potentiometers.

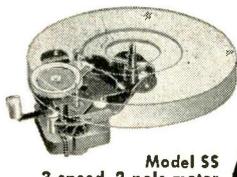
Name ..... Title .....

(Please Print)

Company .....

Address .....

City ..... Zone ..... State .....



Model SS  
3-speed, 2-pole motor



Model DSS  
3-speed, 4-pole motor

## The ONE Source for EVERY Phonomotor Need!

*First choice of America's  
Leading Manufacturers*

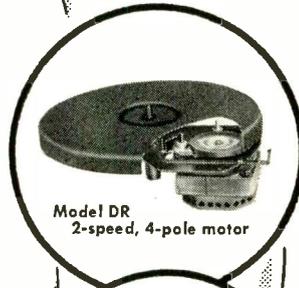
Any speed, any type — no matter what your phonomotor requirements may be, you'll always be right if you follow the lead of America's foremost manufacturers and choose from the GI "Smooth Power" line.

Specified as original equipment for many years on the finest recording and play-back devices, GI motors have built up an unmatched record of trouble-free performance and dependability.

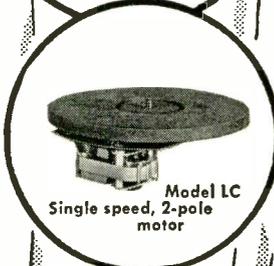
When *you* need phonomotors . . . *any* speed, *any* type . . . remember that the greatest names in the industry rest their reputations on "Smooth Power" quality . . . remember to "*Specify GI*".

Write today for quantity-price quotations and specifications.

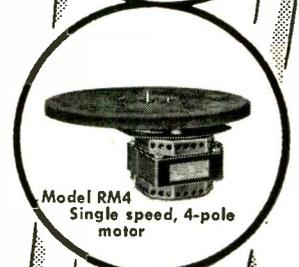
GI Phonomotors for: *Portable Phonos • Hi-Fi Units • Combinations • Record Changers • Tape Recorders • Replacement*



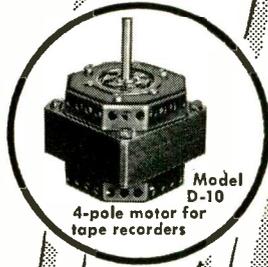
Model DR  
2-speed, 4-pole motor



Model LC  
Single speed, 2-pole motor



Model RM4  
Single speed, 4-pole motor



Model D-10  
4-pole motor for  
tape recorders

this shaft, performs the computation. Three 2-megohm summing inputs are provided to accommodate 1, 2 or 3 input variables. Overall accuracy is 0.3 percent; full-scale travel under 0.5 sec; response extends to 10 cps; and input zero drift is negligible. The SL-1053 finds wide application in research and development laboratories. It has been especially designed as a building block for the control equipment in automatic factories, in process control installation, nuclear energy reactor control and monitoring, and other industrial control applications.

### T-W TUBES for microwave radio use

RADIO CORP. OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y., has developed two new types of low-noise traveling-wave tubes which promise greater efficiency, range and sensitivity in microwave radio applications. The t-w tubes are an S-band type, for use in the input stage of microwave receivers and amplifiers operating over a frequency range from 2,700 to 3,500 mc, and a C-band type, for use in microwave relay applications covering the frequency range from 5,900 to 6,900 mc. Their low noise advantages result from utilization of a novel three-region velocity-jump electron gun which de-amplifies shot noises in the tubes. The S-band tube will operate in a solenoid with a noise figure less than 10 db for a gain of 20 db; the C-band type, which utilizes a waveguide feeds, has a noise figure of only 12 db, with a 20-db gain.

### THYRATRON TUBE for industrial control

NATIONAL ELECTRONICS, INC., Geneva, Ill., has announced a new single-end thyatron. This tube, designated as the NL-716, is rated at 1 ampere d-c and 8 amperes peak current. It is designed especially for motor speed control and low current regulated voltage supplies. The NL-716 is gas and mercury filled for quick-starting and long

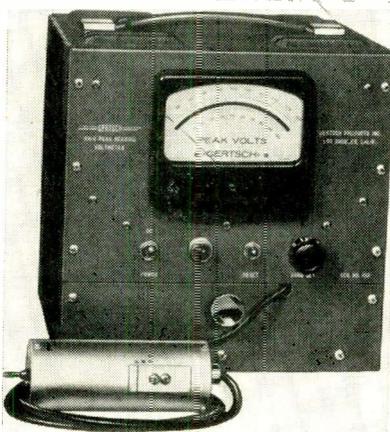


THE GENERAL INDUSTRIES CO.

DEPARTMENT MA • ELYRIA, OHIO



life. Its constant characteristics through wide temperature ranges and long life make it particularly valuable for industrial control applications. Other ratings are: filament voltage, 2.5 v; filament current, 6.3 amperes; peak forward and peak inverse voltage, 1,250 v.



### VTVM for short duty cycle pulses

GERTSCH PRODUCTS, INC., 11846 Mississippi Ave., Los Angeles 25, Calif. A portable, true-peak reading vtvm is capable of measuring pulses with very short duty cycles. Designed to operate over a wide bandwidth—50 cps to over 100 mc—the model VM-1 may be used to measure positive peak, negative peak, or the peak-to-peak voltage of a waveform. Voltage range of the VM-1 is 100 v full scale, with multipliers available to 30 kv, designed to permit rapid selection of voltage ranges. Actual measuring elements are housed in a probe. The circuitry in the VM-1 consists of a pair of diodes, housed in the probe, arranged so they give a positive d-c output voltage equal to the peak



## A New Baby in the Stone Tube Family!

Stone is happy to be the first in the industry to announce the addition of "Mylar"\* Polyester Film—The Du Pont Company's latest contribution to effective electrical insulation—to its already wide range of materials.

Many months of laboratory research by Stone have made this announcement possible.

Stone spiral wound small diameter tubes of "Mylar" with a neutral, heat resistant adhesive can be furnished in a thin wall, all "Mylar" construction and in combination with asbestos, high dielectric kraft, and fish paper.

Stone precision manufactured tubes using "Mylar" have low moisture absorption and high mechanical strength qualities. Good dielectric properties over a wide temperature range, excellent fungus resistance, and splendid corrosion resistance to copper are other principal features of this new marvel from the Du Pont laboratories.

A conveniently located representative will be glad to show you how Stone tubes made of "Mylar" may solve some of your insulation problems. Write us today.

\*Du Pont trade-mark

# Stone

PAPER TUBE CO.

AFFILIATED WITH

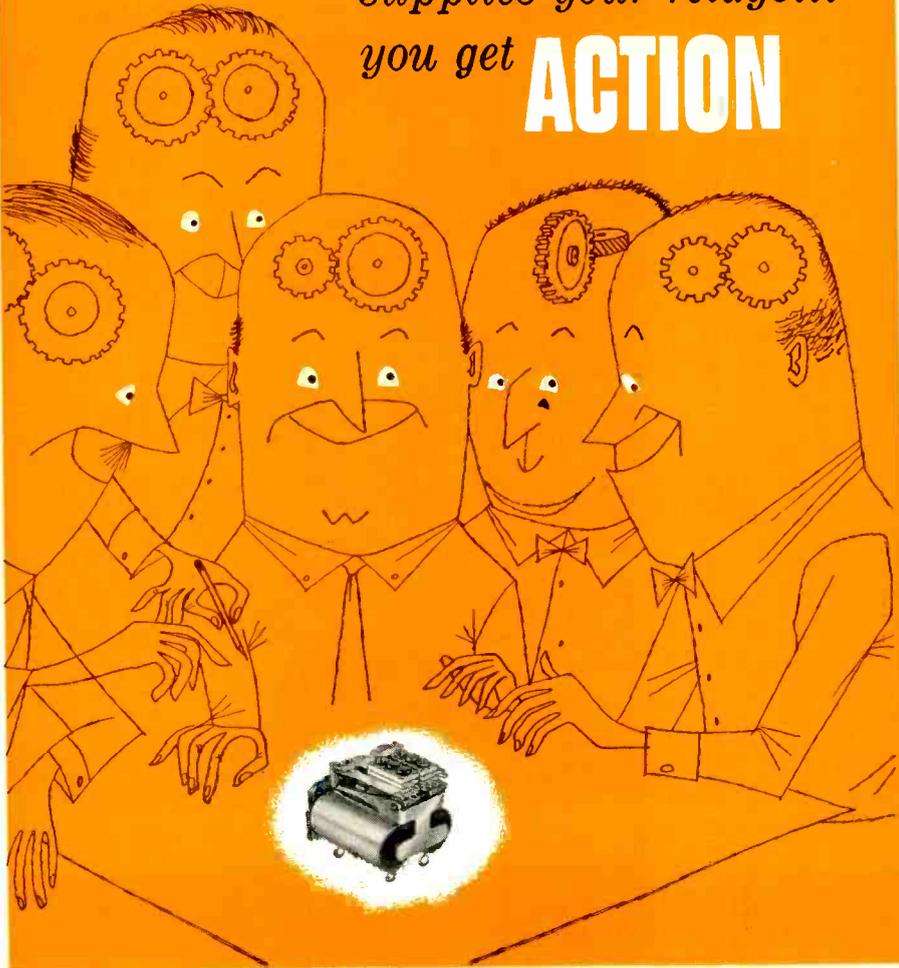
## STONIZED PRODUCTS CO. INC.

900-922 Franklin Street, N.E., Washington 17, D. C.

when **ADVANCE**

supplies your relays...

you get **ACTION**



**Action on Standard Items.** Choose from a wide variety of in-stock relays, available for immediate shipment from Burbank or Chicago. Light-weight, small and precision-built, ADVANCE relays stand up under rugged service. They're specified by major manufacturers the country over.

**Action on "Specials."** When you need a specially designed relay, ADVANCE will work closely with your engineers to determine accurately what's needed... develop it in minimum time. You'll find us ready to cooperate with you on any relay problem.

**Action on Producing Relays.** There's manpower here to build your relays right... on time... and at the lowest prices consistent with top quality. It's our aim to help keep your production rolling... your products operating dependably. Whatever your relay problems—call ADVANCE for action.



**ADVANCE ELECTRIC AND RELAY COMPANY**

2435 NORTH NAOMI STREET, BURBANK, CALIFORNIA

Sales Representatives in Principal Cities of U. S. and Canada

positive, peak negative, or peak-to-peak voltage being measured. This voltage is fed to a stabilized feedback amplifier utilizing an electrometer tube which drives the indicating meter. All critical voltages are regulated.

## Literature

**Large Screen Oscilloscopes.** Electromec, Inc., 3200 North San Fernando Blvd., Burbank, Calif. A 4-page folder covers the company's large-screen oscilloscopes. Included are illustrations and descriptions of the 21-in. and 17-in. types. Important features and specifications are given.

**Tube Clamping Shields.** International Research Corp., 177 W. Magnolia Blvd., Burbank, Calif., has available a complete 2-color catalog on miniature and subminiature electron tube clamping shields. A wide range of tube shield types and sizes are illustrated and keyed to appropriate dimensional engineering drawings. The catalog gives information on pure silver, Beryllium copper, aluminum alloy and special-purpose tube shields. Contents also include complete facts on the company's new low-cost series 100 and 200 tube clamp shields designed for use under average to high tube operating temperatures in most commercial applications.

**Phase Meter.** Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y. A single-sheet bulletin illustrates and describes the model 200A Phazor phase meter, an instrument that is useful wherever precision phase measurements are necessary. The brochure lists applications, principle of operation, features and specifications.

**Tubular Capacitors.** Corson Electric Mfg. Corp., 540-39th St., Union City, N. J. The complete line of type G-6 tubular, glass-cased, plastic dielectric capacitors is described in the new catalog sheet just issued. Ratings listed range from 0.01  $\mu$ f at 600 v through 0.0015  $\mu$ f at 60,000 v. The units described are partic-

ularly useful where space is at a premium and for handling high voltages at high temperatures in d-c and low-frequency a-c circuits.

**Compass System.** Collins Radio Co., Cedar Rapids, Iowa. An 8-page folder covers the MC-101 compass system. Included are modern aircraft data requirements. Power requirements, installation information, dimensional diagrams, specifications and a block diagram are available.

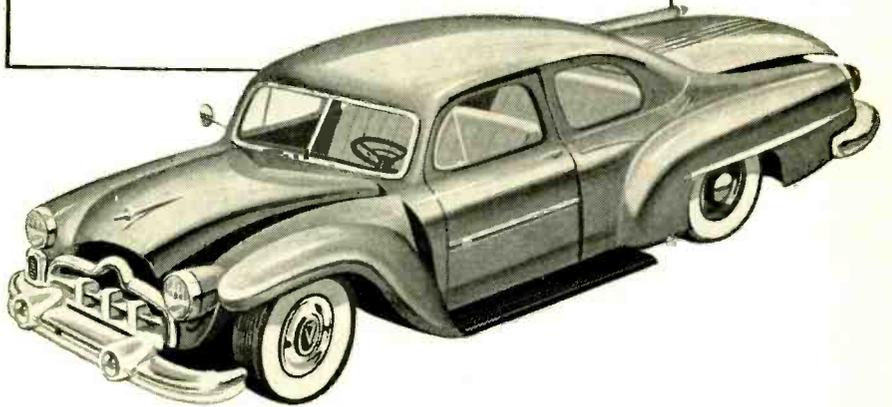
**Uranium Prospecting Instruments.** El-Tronics Inc., Fifth and Noble Sts., Philadelphia 23, Pa. A 4-page folder covers a new line of Geiger counters designed primarily for prospecting applications. Illustrated descriptions and prices are given for 9 different instruments.

**Components Catalog.** Herman H. Smith Inc., 2326 Nostrand Ave., Bklyn 10, N. Y., has issued 24-page reference book listing a complete line of plugs, jacks, connectors, switches, terminals, and hundreds of vitally needed electronic components and accessories. Exhaustive schematic dimensional diagrams throughout the book make this an important guide for the engineer as well as the purchasing agent. Catalog 55 lists some 50 new items including linen and nylon cable, nylon plastic cable clamps and Vibrex panel fasteners.

**Facilities Folder.** The Johns-Hartford Tool Co., Inc., 390 Capitol Ave., Hartford, Conn., announce publication of a facilities folder and equipment lists covering their extensive precision contract manufacturing facilities. The company specializes in experimental and short run production work of extremely close tolerances and in the manufacture of precision components or subassemblies for instruments, turbo-jet engines, automotive, aircraft, electronic and other mechanisms.

**Circuit Assembler.** U.M.&F. Mfg. Corp., 10929 Van Owen St., North Hollywood, Calif. A single-sheet bulletin illustrates the See Zak circuit assembler for simplifying breadboard problems. All parts of

Does your servo system  
end up like this?



Of course, you've never bought an automobile in pieces, picking up a bumper here, a carburetor there, a clutch somewhere else. Even if you *could* arrive at the appearance and performance of a finished car, chances are it would require countless hours of work and a factory-full of fabricating equipment to integrate the odd sized parts.

Surprising, then, how many companies build servo systems just this way. Buying parts from different manufacturers . . . putting them together and hoping for an ideal system. Either the final result is far below potential efficiency, or the time, labor, machinery, and materials wasted in trying to "fit" the components together boosts the cost astronomically.

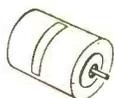
Experience proves that complete assemblies of Transicoil components not only assure improved system performance but actually cost less than the total purchase price of the individual components acquired from several sources.

If you are now purchasing servo components from several manufacturers, a serious talk with Transicoil will pay you dividends in lower costs and a better system. But if you require only one component, you can be sure of optimum performance from the Transicoil units you specify.

# TRANSICOIL

## CORPORATION

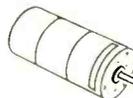
107 GRAND STREET  
NEW YORK 13, N. Y.



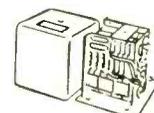
Miniature  
Control Motors



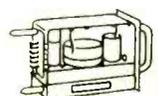
Motor and Gear  
Train Assemblies



Motor, Generator, and  
Gear Train  
Combinations



Servo  
Amplifiers



Plug-In  
Assemblies

**NO EXTERNAL CHANNELLING EQUIPMENT !**

**Standard**  
*8*  
**channel**

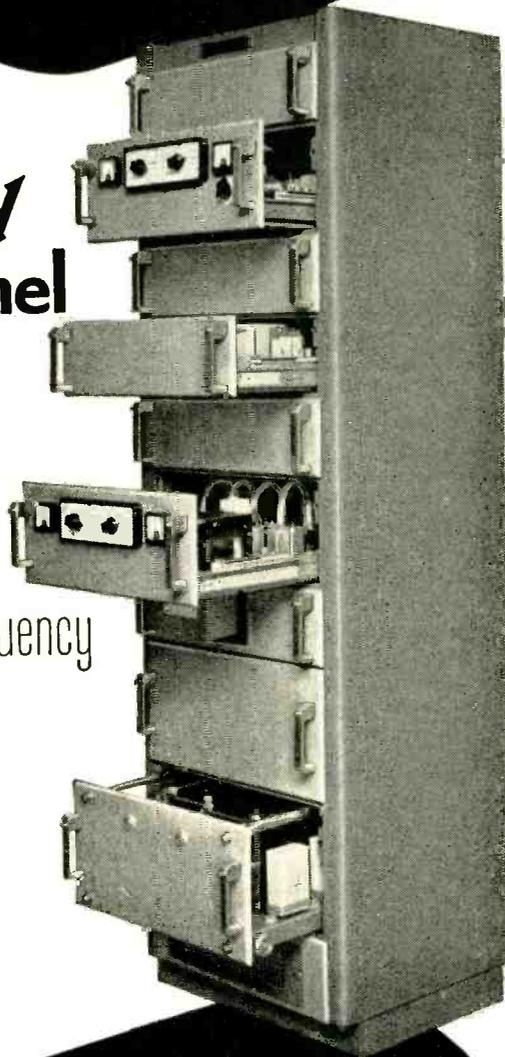
**V**ery **H**igh **F**requency

radio link

type

**FP11**

**complete in one cabinet**



Six Telephone or Teleprinter Channels, plus Independent Order Wire Circuit. Full Supervisory and Control Facilities. Alternative Radio Frequency Bands.

Write for leaflet No. 198/33

**available for early delivery**



**Standard Telephones and Cables Limited**

Registered Office: Connaught House, Aldwych, London, W.C.2

**RADIO DIVISION • New Southgate • London • N.11 • England**



an introductory kit selling for \$12 are pictured and numbered. Some of the advantages of the circuit assembler are listed.

**Block Unitized Pulse Instruments.** Electro-Pulse, Inc., 11811 Major St., Culver City, Calif., has available a general catalog on block unitized pulse instruments, and brochures on the model 2120A pulse generator, and model 2140A double pulse generator. Illustration descriptions, chief features and applications are included.

**H-V Glass-Cased Capacitors.** The Gudeman Co., 340 W. Huron St., Chicago 10, Ill. A new 4-page catalog describes hermetically sealed h-v glass cased GC type paper dielectric d-c capacitors. Operating temperature of the units covered in bulletin GC-1 ranges from -55 C to +105 C. Data include explanation of catalog numbers, high altitude application, lead specifications, ripple voltage and complete engineering specifications. Illustrations consists of GC-45 series, GC46 series, dimensional drawings, and typical performance curves for power vs temperature, insulation resistance vs temperature and change of capacitance vs temperature.

**H-F Generators.** Electronic Processes Corp., 1078 San Antonio Road, Los Altos, Calif. Details on a new convertible Electrotherm high-frequency generator primarily designed for plastic welding and packaging machinery are given in a new leaflet, form G-554. The convertible feature of the generator described permits rapid conversion between two input power ratings of 2,000 and 4,000 d-c watts. Besides illustrating the unit, the leaflet includes application notes concerning the various welding length limitations related to power ratings; shows construction details of the sliding-drawer arrangement for subassemblies which permits convertibility and also facilitates service and maintenance. Specifications are tabulated to cover operating frequency, line power requirements, weights and dimensions.

**Germanium p-n Junction Photo Diode.** Transistor Products, Inc., 241 Crescent St., Waltham 54,

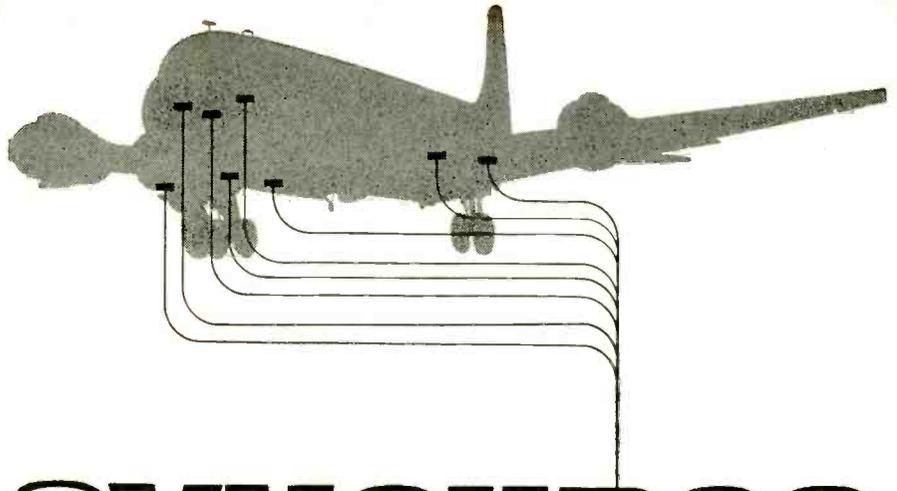
Mass. Form No. DS-54-1B covers the type 1N188 germanium  $p-n$  junction photo diode. The device described and illustrated is designed for use as a light detector in devices requiring high sensitivity particularly in the near infrared region. Mechanical specifications, electrical data and a typical characteristics chart are included.

**Electronic Filters.** Communication Accessories Co., Hickman Mills, Missouri, has available new technical data on its electronic filters. The information is largely on additions to the company's standard line of electronic filters. The literature illustrates the new units and describes the electrical characteristics, complete with response curves, physical sizes and mounting dimensions.

**System Analysis with the Complex Plane Analyzer.** Technology Instrument Corp., 531 Main St., Acton, Mass. Laboratory Report No. 11 discusses a simple network example and is the first in a series of 3 articles on system analysis with the complex plane analyzer. Articles two and three in this series discuss the complex plane analyzer and its methods of use and closed-loop systems, root locus and their relation to the complex plane analyzer. These will be available in the near future. They may be had for the writing.

**Instrument Calibration Standard.** Radio Frequency Laboratories, Inc., Boonton, N. J., has published a folder illustrating and describing the model 829 instrument calibration standard. Included is information on accuracy, reliability, operating procedure, accessory equipment and net price. Some typical instruments that can be calibrated with this equipment are listed.

**Kits and Wired Instruments.** Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., has published its 1955 catalog describing and illustrating 38 kits and 42 factory-wired instruments. To enable the reader more readily and fully to understand the function and application of each instrument, the descriptions for each model are carefully analyzed into features,



# SYNCHROS

## Nerve ends for sky giants!

Rotors of these super-sensitive synchro torque transmitters duplicate or interpret the rotation or position of other rotors in remotely placed counterparts. In this way they give accurate, visual information on the action or angle of control surfaces, gear, fuel flow, auxiliaries, etc.

They are widely used in closed loop control systems where they demonstrate the precision quality of Oster Avionic Products.

They conform to military specifications for altitude, high and low temperature, life, shock, vibration, humidity and fungicidal treatment.

You can depend on Oster quality in rotating components for automatic control.

Insure dependability... specify **Oster**

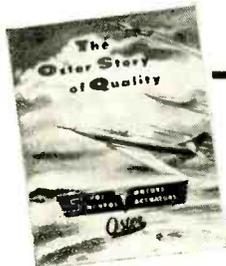
**John Oster**

MANUFACTURING CO.

AVIONIC DIVISION

RACINE, WISCONSIN

Mail this coupon for your copy of our illustrated pamphlet No. 974 on Oster Avionic Products.



**JOHN OSTER MANUFACTURING CO. AVIONIC DIVISION**  
Dept. 4312, Racine, Wisconsin, U.S.A.

Please send, postpaid, your catalog of OSTER Avionic Products.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

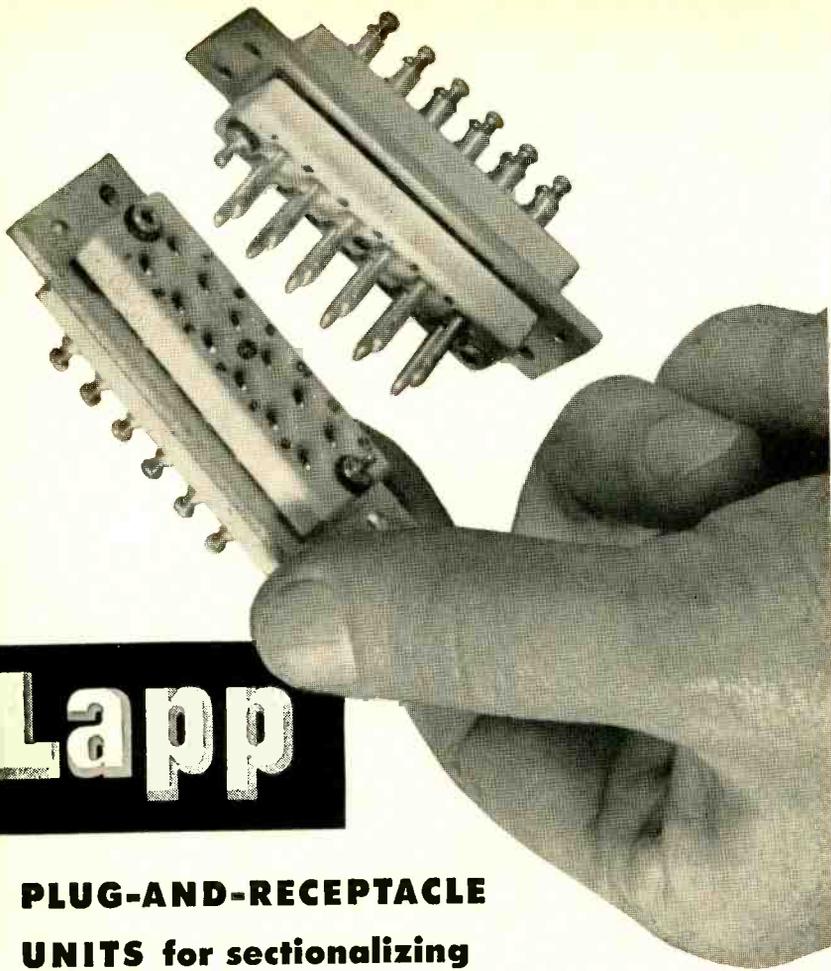
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



OSTER lightweight Synchro Transmitters, type 2G Accurate to .25° or less, in angular definition. Has many applications in the avionics industry, where angular or linear position indications must be accurately interpreted.

Other OSTER Avionic Products include:

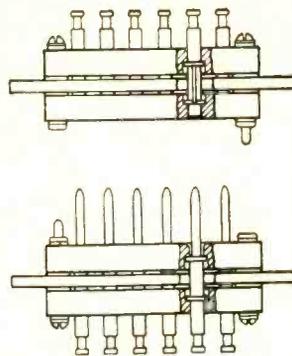
- Special motors: Servos, Drive Motors, Blowers and Fans for use with D-C and A-C supply voltages in common usage on aircraft and ground equipment.
- Synchro Generators, Control Transformers, Transmitters, Differentials, Receivers, Resolvers and Two-Speed Synchros.
- Tachometer Generators and Reference Generators.
- Aircraft Actuators, both linear and rotary.



# Lapp

## PLUG-AND-RECEPTACLE UNITS for sectionalizing circuits

● Simultaneous contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is steatite, the low-loss ceramic—non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown here provides twelve contacts, rated for operation at 2.5kv peak terminal-to-terminal, 1.5kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product. Write Lapp Insulator Co., Inc., Radio Specialties Division, 232 Sumner St., Le Roy, N. Y.



- STEATITE INSULATION
- FULL-FLOATING CONTACTS

# Lapp

specifications and applications. The catalog also describes the company's engineering laboratories, quality control department and other important facilities.

**Systems Engineering.** Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Custom Engineering of electronic instrumentation tailored to specific industrial, scientific and military needs is the subject of a recently announced 16-page brochure. Case histories of typical instrumentation systems, applications, biophiles on key personnel, description of service facilities and methods of planning used to solve customer problems are features highlighted in the new publication. Write for bulletin CEC-1304.

**Test Equipment.** Radio City Products Co., Inc., Easton, Pa., announces a new multicolor brochure describing and illustrating the company's complete line of test equipment. It includes testers for color tv as well as black-and-white, together with many instruments for tube testing and servicing all radio and tv receivers. It also covers instruments for industrial applications in the electronic and related industries.

**Vertical Subminiature Tube Holders.** Atlas E-E Corp., Bedford Airport, Bedford, Mass., has available a bulletin describing a new line of precisely engineered vertical subminiature tube holders especially designed for application in printed circuitry and similar limited-space conditions, where it is necessary to hold tubes and components securely against shock and vibration. The tube holders discussed will hold up under 5-g vibration at 500 cycles.

**Thermosetting Laminated Plastics.** Synthane Corp., Oaks, Pa., has compiled a tabulation of the latest military and government specifications for NEMA grades of thermosetting laminated plastics has been compiled in chart form. The chart also describes the composition of the 24 grades of tubing, rods and sheet stock covered. The information contained in the government specification chart has proved particularly helpful to manufacturers of government-purchased equip-

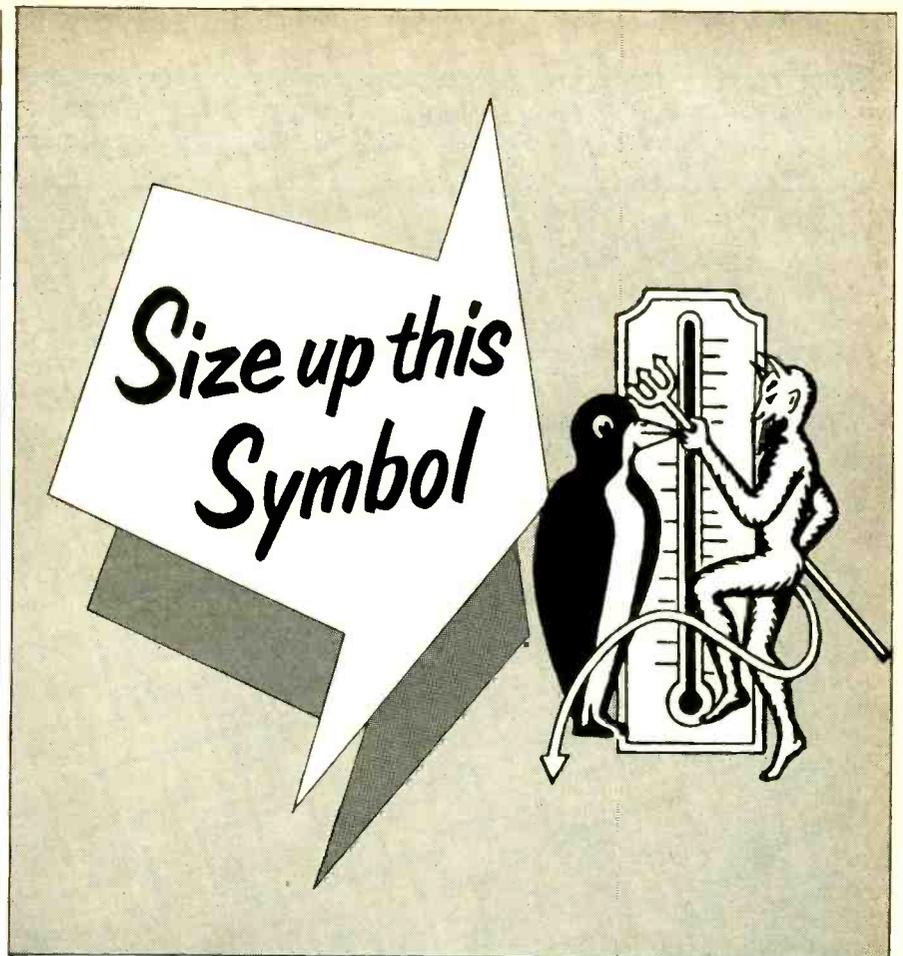
ment, designers, engineers and purchasing men.

**Voltage Regulator.** Leach Corp., 4441 Santa Fe Ave., Los Angeles 58, Calif. A 4-page, 2-color bulletin No. T-8400 fully describes and illustrates a new type all static voltage regulator for 400-cycle a-c machines, named the INETRX400. The unit described is constructed of long-life magnetic amplifiers, rectifiers and resistors. The bulletin presents detailed specifications on construction, installation and operating characteristics. Included are photographs of oscillograms showing voltage recovery and stability, and output voltage waveform.

**Sealed Panel Meter.** DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. A 2-color, 2-page engineering data sheet on round model 150 panel meter gives detailed specifications, actual size illustrations, outline drawings and ordering information.

**Printed Circuit Data.** Photocircuits Corp., Glen Cove, N. Y., has available eight technical bulletins, P-1 through P-8, dealing with various aspects of printed circuitry. Topics covered are: printed circuit design for ease in fabrication; base materials for printed circuitry; plating and plated holes; etched or plated conductor characteristics; printed components for etched circuits; printed circuit switch plates and commutator disks printed circuitry assembly and dip soldering; and printed wiring layout and design. Also available is an 8-page brochure covering printed circuits and allied electronic subassemblies. This lists special applications, tips for the designer, and outlines the company's facilities for technical services.

**Bobbinless Precision Resistors.** Monson Mfg. Corp., 6059 W. Belmont Ave., Chicago 34, Ill., has released a catalog page picturing and describing its new line of lower cost, smaller size bobbinless non-inductive precision wire type resistors. Complete data include tolerances, sealing of ceramic tubes, resistance wire, terminals, and a table listing typical sizes and resistances available.



## IT MARKS A COMPLETELY **NEW** INDUSTRIAL HEAT TREATING SERVICE

With 15 years of experience in the manufacture of the finest heat treating equipment, the Sargeant & Wilbur Heat Treating Corporation brings to the metal working industry the most complete and modern heat treating service found anywhere.

Ultra-modern facilities have been completed, an extensive line of the very latest certified equipment\* installed and geared for volume production . . . meeting any requirement. To slash production time and increase profits it will pay you to investigate these services.

- Bright Annealing, Brazing, Hardening of Stainless Steel
- Cycle Annealing of Laminations — Silicons, Irons, Steels
- Unmatched Quality In Any Quantity
- All Specifications Rigidly Enforced

Phone, Write, or Wire For Complete Information  
Sample Processing Without Obligation



**SARGEANT & Wilbur**  
HEAT TREATING CORP.

170 YORK AVENUE PAWTUCKET, RHODE ISLAND

\*Certified by the United States Army

# PLANTS AND PEOPLE

Edited by WILLIAM G. ARNOLD

Engineers receive awards from technical societies . . . Electronic manufacturers promote engineers and management executives . . . New plant expansions are announced . . .

## OTHER DEPARTMENTS

featured in this issue:

	Page
Electrons At Work . . . . .	182
Production Techniques . . . . .	228
New Products . . . . .	264
New Books . . . . .	360
Backtalk . . . . .	372

## IRE Names Annual Award Winners For 1955



Harald T. Friis



Arthur V. Loughren



Bernard Salzberg



Harold B. Law

HARALD T. FRIIS, director of radio research of Bell Telephone Laboratories, will receive the IRE Medal of Honor, the highest technical award in the radio engineering profession at the Institute's national convention next March in New York City. The award will be given "For his outstanding technical contributions in the expansion of the useful spectrum of radio frequencies, and for the inspiration and leadership he has given to young engineers."

The Morris Liebmann Memorial Prize, awarded annually to an IRE member who has made a recent important contribution to the radio engineering art, will be given to Arthur V. Loughren, director of research of Hazeltine Corp., "For his leadership and technical contributions in the formulation of the signal specification for compatible color television."

Bernard Salzberg of the Naval

Research Laboratory will receive the Harry Diamond Memorial Award, which is given to persons in government service for outstanding work in radio and electronics. The award will be presented "For his contributions in the fields of

electron tubes, circuits, and military electronics."

The Vladimir K. Zworykin Television Prize Award goes to Harold B. Law of RCA Laboratories Division for his contributions to the shadow-mask tri-color tv picture tube.

## MIT Plans Karl Compton Laboratories

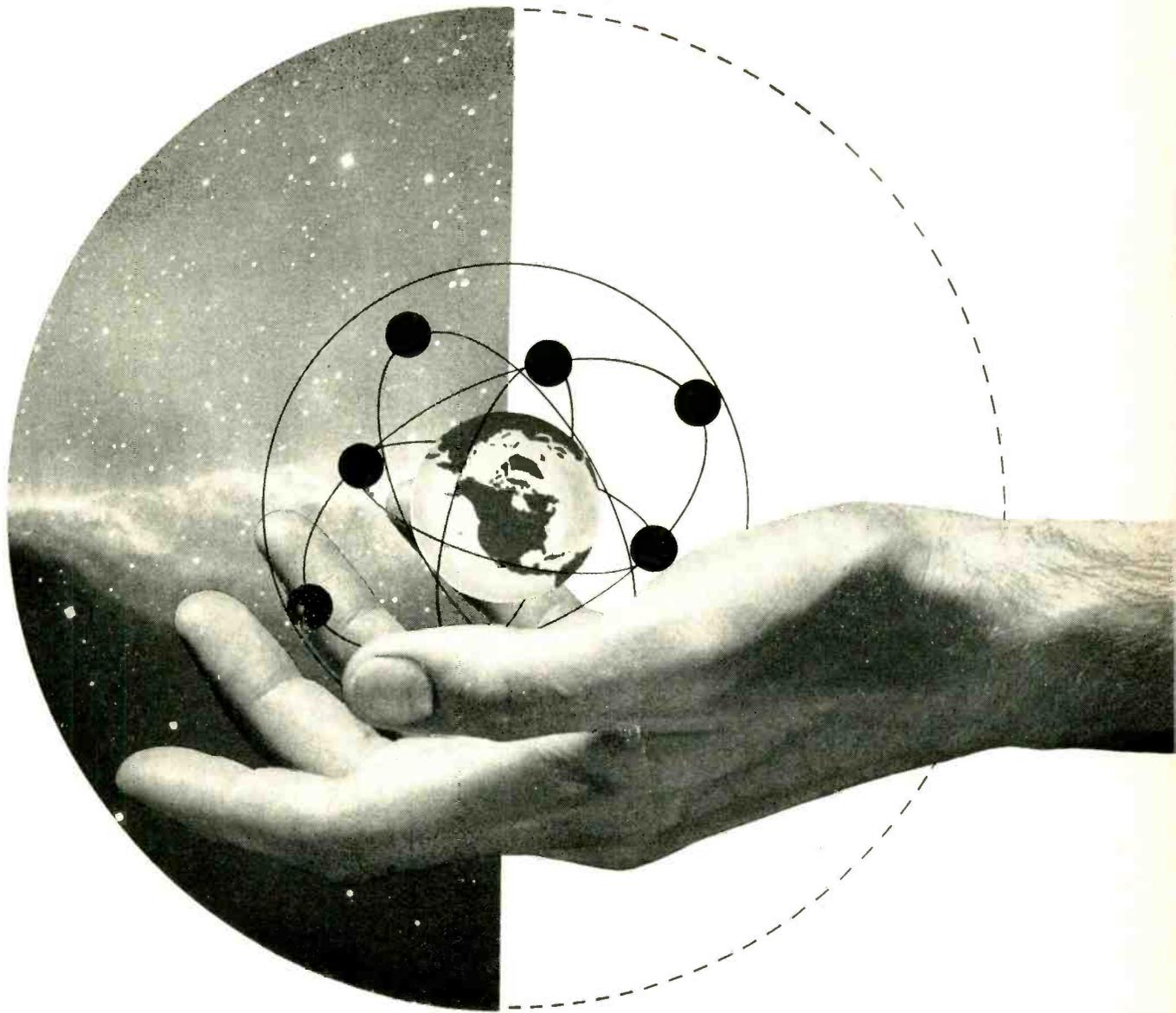
THE KARL TAYLOR COMPTON LABORATORIES for Nuclear Science and Electronics will be built at MIT as a memorial to the Institute's late chairman, Dr. Karl Taylor Compton.

Plans for a \$3 million building are being made and a fund of \$3,000,000 will be provided for unrestricted support of the Institute's work in these fields.

The proposed laboratory building will comprise about 125,000 sq ft of floor area, designed especially for M.I.T.'s work in nuclear science,

nuclear engineering, electronics and related activities under the departments of physics, electrical engineering and chemical engineering.

James R. Killian, president of MIT, said in announcing the Institute's plans . . . "Developments in electronics over the last twenty-five years have amply demonstrated the far-reaching impact of physical science on our economy, our health and our security. In large measure, continued Dr. Killian, electronics is still in its infancy in terms of its potential



## **brand new world**

As a major development in its program of advanced design, Martin has expanded its operations into the field of atomic power.

This means that a top team of scientists, physicists and engineers is now ready at Martin to carry on a strategic long-range program in the application of nuclear energy to weapons systems development.

Yesterday, Martin took the lead in recognizing the importance of electronics, integrating this new science into its operations with engineering and development facilities second to none in the industry.

Today, the horizonless science of nuclear power has been added—again ahead of the calendar.

And tomorrow you can expect Martin to develop techniques for harnessing the potential of each new science to come.

*You will hear more about Martin!*

**MARTIN**  
BALTIMORE · MARYLAND



value to the United States and to the whole world."

The Research Laboratory of Electronics, which will share the new facilities of the Karl Taylor Compton Laboratories, was founded

at M.I.T. just after World War II. It now has 245 staff members—including faculty and graduate students—and a total research and teaching budget of about \$1,500,000 yearly.

## Audio Society Honors Engineers

AT THE AUDIO ENGINEERING SOCIETY annual banquet in New York City the Society's John H. Potts Award for outstanding achievement in audio engineering was bestowed upon Joseph P. Maxfield of Espanola, New Mexico. Maxfield was honored for his contributions in the field of audio engineering, including the development of electrical recording and reproducing systems for phonograph transcription and sound picture applications. His pioneering work led to important improvement in the fields of studio, theatre, industrial and military acoustics. Maxfield was associated with the Bell System throughout most of his career.

The Award for service to the Society was given to John D. Colvin, director of engineering of Gates

Radio Co., who was previously chief audio engineer with the American Broadcasting Company.

Frederick V. Hunt, Rumford professor of physics and Gordon McKay professor of applied physics at Harvard University, received the Society's Emile Berliner Award. The latter is bestowed annually for outstanding developmental work in audio engineering. Dr. Hunt was given the award in recognition of his analysis of tracing distortion in disc reproduction, his work on underwater sound systems and his studies in acoustical measurement techniques.

The Society gave an honorary membership to Harold S. Black of Bell Telephone Laboratories for his work in development of stabilized feedback amplifiers.

## Elgin Watch Company Enters Electronics

ELGIN NATIONAL WATCH Co., of Elgin, Ill. has purchased Neomatic of Los Angeles, Calif. as part of its diversification program in the fields of electronic components and automatic production instruments.

Founder and former president of Neomatic, T. Ross Welch, will direct research and engineering and William M. Brandes, vice president of Elgin in charge of manufacturing, will become president. Welch was instrumental in his company's development of sub-miniature relay switches and holds many patents in the field.

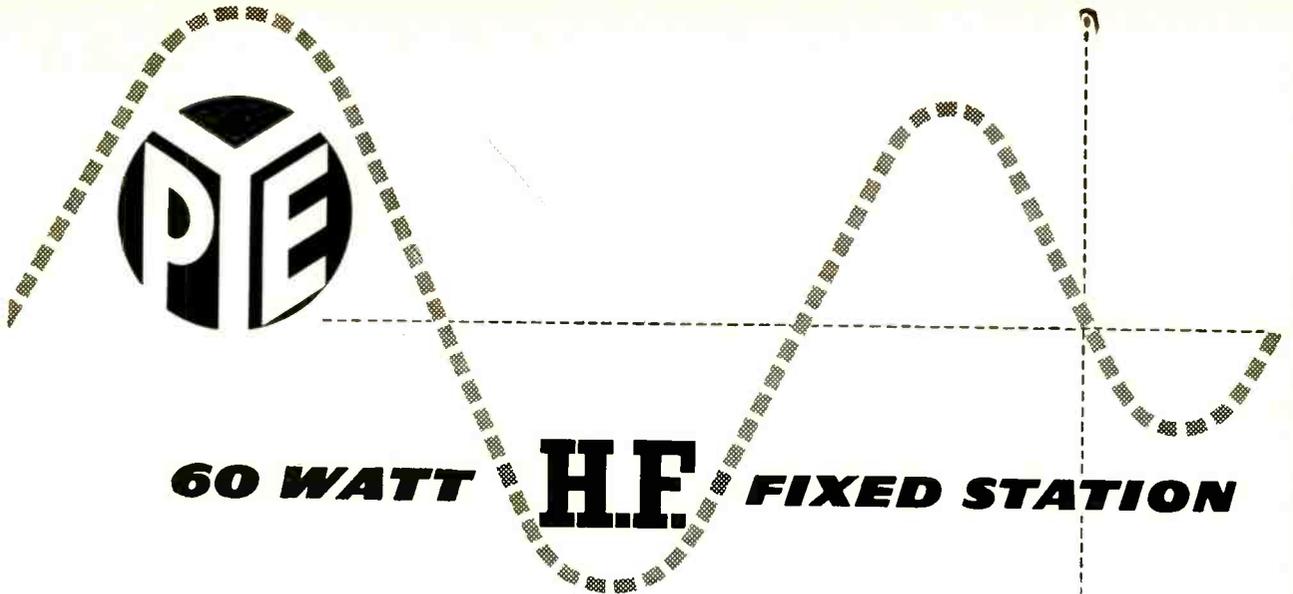
Neomatic grossed \$500,000 in sales last year and employs approximately 100 people.

## Magnecord Buys Davies Laboratories

MAGNECORD purchased all of the outstanding stock of Davies Laboratories of Riverdale, Md. Gomer L. Davies, president and founder of the firm bearing his name, was elected to the Magnecord seven man

## RETMA Board Of Directors And Officers For 1954-55

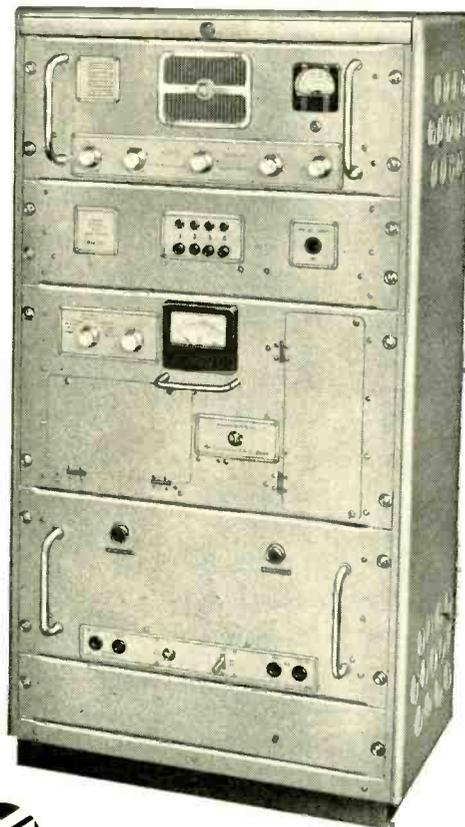




This completely new Pye equipment has been specifically designed for point-to-point communication and will fulfil equally well a ground-to-air role in air traffic control systems.

Push button control brings any one of four preselected channels into immediate operation; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with 'break-in' facilities on telegraphy.

The equipment is suitable for unattended operation in the tropics.



## Telecommunications

CAMBRIDGE ENGLAND



Pye (New Zealand), Ltd.,  
Auckland C.I., New Zealand.

Pye Canada, Ltd.,  
Ajax, Canada.

Pye-Electronic Pty., Ltd.,  
Melbourne, Australia.

Pye Ireland, Ltd.,  
Dublin, Eire.

Pye Radio & Television (Pty.) Ltd.,  
Johannesburg,  
South Africa.

Pye Limited,  
Plaza de Necaxa 7,  
Mexico 5.

Pye Limited,  
Tucuman 829,  
Buenos Aires.

Pye Limited,  
5th Avenue, Bdg.,  
200 5th Avenue, New York.

**PYE LIMITED • CAMBRIDGE • ENGLAND**

# LONG BEACH

*in Southern California*

# OFFERS INDUSTRY

# LOW COST

# TRANSPORTATION

### Looking for a new plant site?

Then these low-cost rates will interest you!

Three transcontinental railways and an inter-city electric railway serve the Long Beach industrial area...connecting Long Beach with the East and all parts of the Western states. Rates from distant points are the same to Long Beach as to other near-by cities.

The modern Long Beach Airport, municipally owned, is one of the four major air terminals in Southern California. Transcontinental air service is provided for all types of commercial air cargo.

Over 180 common carrier truck lines serve this area, with all major transcontinental lines operating direct service to and from Long Beach.

And the Long Beach Harbor is truly America's most modern port.

Write today for complete information—yours for the asking. Confidential, of course.

**CHAMBER OF COMMERCE • DEPARTMENT OF INDUSTRY**

**200 East Ocean Boulevard, Long Beach 2, California**



Gomer L. Davies

board of directors.

The firm will continue as a wholly-owned Magnecord subsidiary under the direction of Davies and no immediate change in management personnel is contemplated. Both companies will retain their corporate entities.

Davies Laboratories had 63,000 shares outstanding which were exchanged for a total of 10,512 shares of Magnecord stock. At the time of the purchase Magnecord had 26,732 shares of stock outstanding against an authorized issuance of 200,000 shares.

In addition to the exchange of stock, purchase terms included a five year contract for Davies, at an undisclosed figure, and his election to the company's board of directors. The Magnecord charter authorizes a maximum board of eleven directors.

The engineering and research staffs of the subsidiary will be increased by at least 50 percent as soon as additional production space is acquired.

### Willys Motors Plans Laboratory

WILLYS MOTORS, wholly-owned subsidiary of Kaiser Motors Co., is planning a new research and development laboratory devoted to electronics at Stanford University.

It will be a 12,000 sq ft building on 3½ acres of land in the Stanford industrial tract adjacent to the GE microwave laboratory now under construction.

The laboratory will be devoted to development of new types of radar,

# HEYCO NYLON STRAIN RELIEF BUSHINGS

anchor power cords to the housing & eliminate strain on terminals



CHASSIS

1. Slip over wire
2. Snap into hole



**CUT PRODUCTION COSTS  
IMPROVE PRODUCT QUALITY**

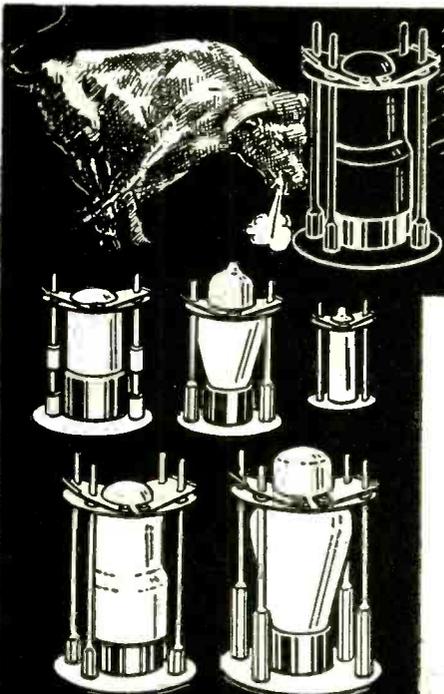


● Heycos absorb all cord pull, push and torque and insulate wire from housing. Product life is increased and product appearance is improved. Samples available on receipt of wire sizes.

**HEYMAN MANUFACTURING COMPANY**  
KENILWORTH 2, NEW JERSEY

THE HEYMAN ORGANIZATION WITH 25 YEARS STAMPING EXPERIENCE HAS MODERN PRESS CAPACITY FOR OVER 2,000,000 FINISHED STAMPINGS PER DAY.

ASK FOR BULLETIN 33



# SHOCK PROOF

## VACUUM TUBE RETAINERS

These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

Available for envelope types T7, T8, MT8, T9, T12, ST12, 7122DL, ST14, S14, ST16, T5 1/2, T6 1/2, MT-1C, ST19, T14, ST128CT-9.

Manufacturers of Electronic Components

**JAMES IPPOLITO & CO., INC.**  
401 CONCORD AVENUE, BRONX 54, N. Y.

536K Multimeter Kit \$12.90  
Wired \$14.90  
1000 ohms/volt



425K 5" Scope Kit \$44.95  
Wired \$79.95



470K 7" Push-Pull Scope KIT \$79.95. WIRED \$129.50.

## YOU BUILD

# EICO

## KITS IN ONE EVENING-

but they last a lifetime... and you save 50%

38 Kits and 42 Instruments — the Industry's most complete line of MATCHED TEST INSTRUMENTS

1/4 - million EICO Instruments are now in use the world over! That's the proof of EICO's leadership in Value.

For latest precision engineering, finest components, smart professional appearance, lifetime performance and rock-bottom economy — see and compare the EICO line at your Jobber before you buy any higher-priced equipment! You'll agree with over 100,000 others that only EICO Kits and Instruments give you the industry's greatest values at lowest cost.



221K VTVM Kit \$25.95  
Wired \$39.95



565K Multimeter Kit \$24.95  
Wired \$29.95  
20,000 ohms/volt



377K Sine & Square Wave Audio Gen. Kit \$31.95. Wired \$49.95



360K Sweep Gen. Kit \$34.95. Wired \$49.95



1050K Battery Elim. Kit \$29.95. Wired \$38.95



625K Tube Tester Kit \$34.95  
Wired \$49.95

Write NOW for FREE latest Catalog E-12

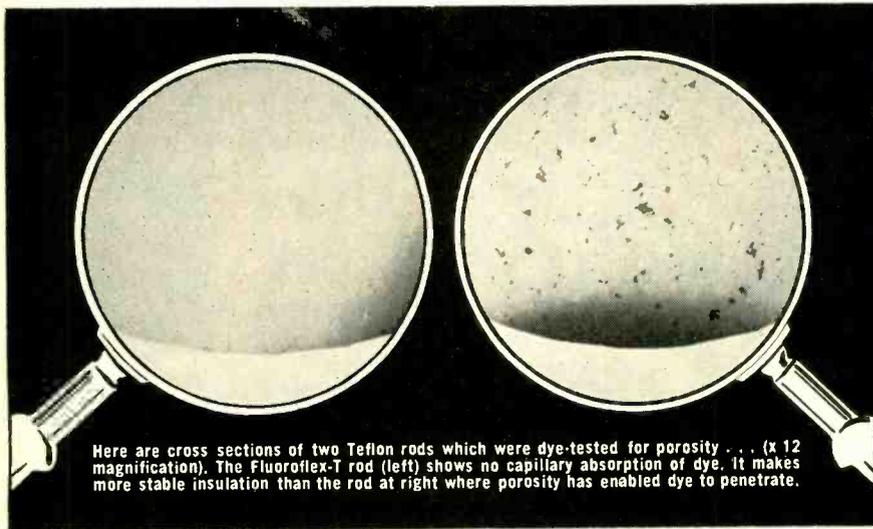
# EICO

Laboratory Precision at lowest cost

©1954

ELECTRONIC INSTRUMENT CO., Inc.  
84 Withers Street, Brooklyn 11, N. Y.

# Are you getting **TEFLON\*** with no porosity



*Non-porous FLUOROFLEX®-T rod, tube, sheet  
assure optimum electrical stability in parts*

At its optimum electrical values, Teflon is virtually the perfect dielectric material for UHF use. If, during extrusion or molding, however, a high degree of porosity results, dielectric strength, power factor and dielectric constant are bound to be affected. That's because *porous* insulation means *absorbent* insulators.

As the above photographs show, Fluoroflex-T is *non-porous*. This is achieved in two ways. (1) By processing on equipment especially designed to compact Teflon powder to the critical density. (2) By not bleaching out Teflon's natural spotting at the expense of optimum density.

Fluoroflex-T products are also stress relieved. Result: Non-porous rods, tubes, and sheets that not only give greater electrical stability but also *dimensional* stability and fewer rejects in machining. Write for Bulletin FT-1.

\*DuPont trade mark for its tetrafluoroethylene resin.  
© Resistoflex trade mark for products from fluorocarbon resins.

## **RESISTOFLEX** *corporation*

Belleville 9, N. J.

**SPECIALY ENGINEERED FLEXIBLE RESISTANT PRODUCTS FOR INDUSTRY**

television, and other electronic equipment.

Cost of the building and land is expected to be \$250,000. Plans are to lease the property from the university.

Mort Frank, an executive of the Kaiser organization, will be manager of the laboratory. Director of research will be Ross Aiken, previously with the University of California radiation laboratory.

### **RETMA Honors Loughren for Color TV Work**

ARTHUR V. LOUGHREN, vice-president in charge of research of the Hazeltine Corp., was cited by the engineering department of RETMA for outstanding service to the television industry.

Loughren, who also is executive vice-president of Hazeltine Research of Chicago, was presented a plaque at the annual Radio Fall Meetings.

The award, made for Loughren's contributions to color television circuitry, was presented by W. R. G. Baker, vice-president of GE and general manager of the Electronics Division, who received the association's first award in 1941 for his work in the development of black-and-white television standards.

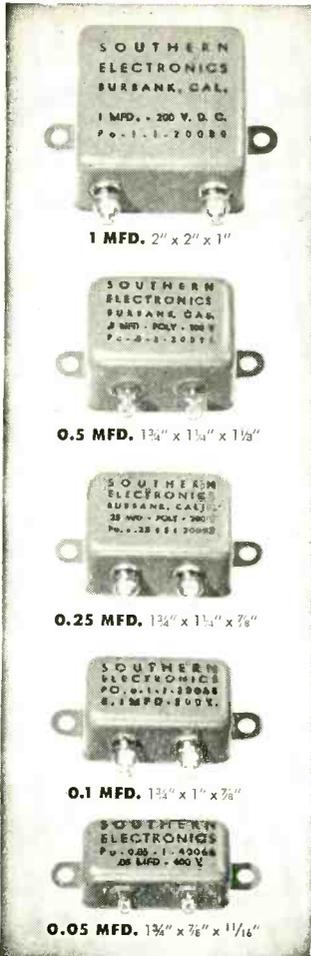
Loughren became an associate member of the IRE in 1924, a member in 1929, a senior member in 1943 and a fellow since 1944. He was elected a director in 1952.

Through the years, he has been active on a number of IRE and RETMA committees. He is presently chairman of the Joint Technical Advisory Committee of IRE and RETMA and chairman of the RETMA Television Systems Committee.

### **Signal Corps Names Research Chief**

EDWARD L. NELSON, technical director of the Signal Corps engineering laboratories at Fort Monmouth, N. J., has been appointed scientific chief of research and development for the Army Signal Corps.

Nelson will be responsible for the technical direction of research and



# ULTRA-HIGH PRECISION POLYSTYRENE CAPACITORS

as low as 0.1%  
tolerance in most values

CAPACITANCE AVAILABLE—0.05 to 10.0 MFD.  
VOLTAGE AVAILABLE—100 to 400 VDC  
INSULATION RESISTANCE— $10^8$  MEG./MFD.  
TEMP. COEFF.—100 P.P.M. per °C (—20°  
to 140°F)  
DIELECTRIC ABSORB.—.015%  
DISSIPATION—.0002

Special Values to  
Close Tolerances—Our Specialty

Write for new, complete catalog to Dept. IA

**SOUTHERN ELECTRONICS CORP.**

239 W. Orange Grove Avenue, Burbank, Calif.

## PERKIN TUBELESS • MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLIES

**NOW IMMEDIATE  
DELIVERY!**

WIDE VOLTAGE RANGE  
5-32 volts @ 15 amps. (cont.)

REGULATION:  $\pm 1\%$  (a) from  
5-32 V. D.C. (b) from 1.5 to 15  
amps. (c) from 105-125 V. A.C.  
(Single phase, 60 cps.)

RIPPLE: 1% rms @ 32 V. and full  
load, increases to max. of 2%  
rms @ 5 V. and full load.

RESPONSE: 0.2 Seconds

MOUNTING: Cabinet or 19"  
Rack Panel WEIGHT: 150 lbs.

METERS: 4 1/2" AM and VM

FINISH: Baked Grey Wrinkle

DIMENSIONS: 22"x17"x14 1/2"

Price: \$524 w/o cabinet, \$549 w/cabinet

All prices F.O.B., El Segundo, Terms: 1% -10 days, net 30  
Phone collect for quantity discounts.



MODEL  
MR532-15

Write for Bulletin MA 154 . . . also write (on company  
letterhead) for free subscription to technical periodical  
PERKIN POWER SUPPLY BULLETIN.

**PERKIN ENGINEERING CORP.**  
345 KANSAS ST. EL SEGUNDO, CALIF. • ORegon 8-7215



Duplexer

## CUSTOM MADE PRECISION

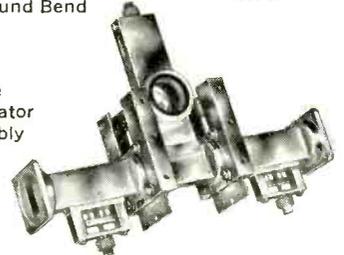


Flexible Tee

## TECHNICRAFT MICROWAVE ASSEMBLIES



Compound Bend



Double  
Attenuator  
Assembly

We are staffed to design to your specifications or manufacture to your drawings. Supporting this engineering and manufacturing capacity is a completely equipped Electrical Testing Laboratory utilizing the finest in Testing Techniques. Technicraft also has a complete line of flexible waveguides and test components.

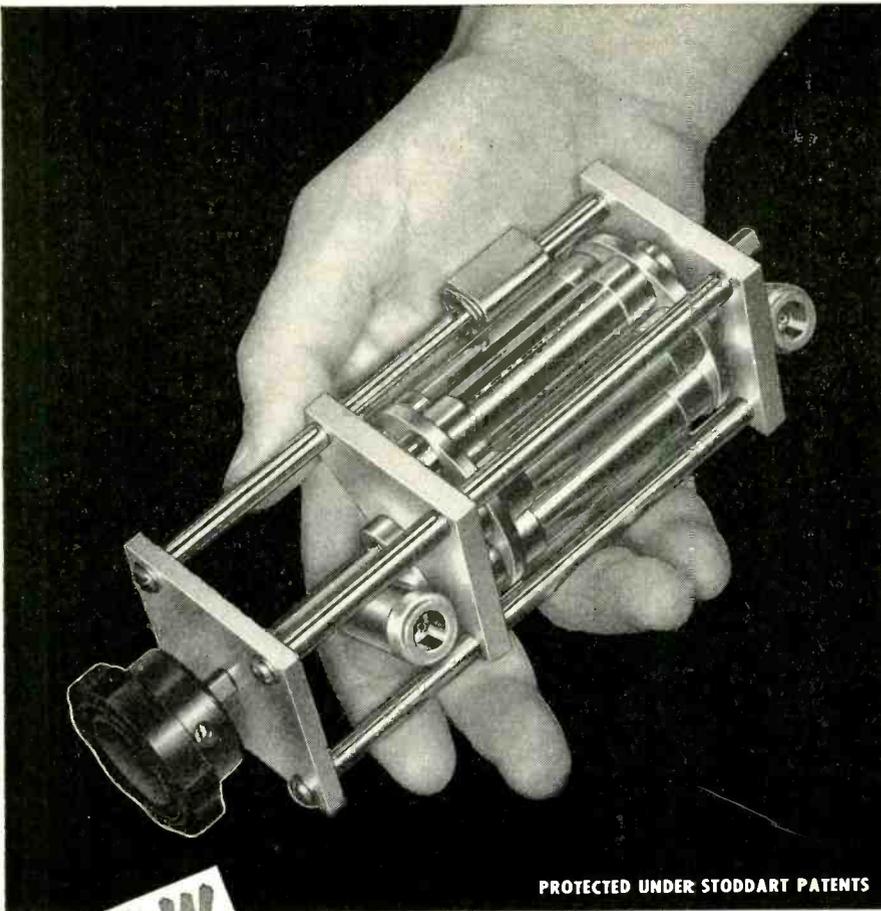
Write for literature.



**TECHNICRAFT LABORATORIES**  
INCORPORATED

1550 Thomaston Road  
THOMASTON, CONNECTICUT

West Coast Office | Westron, 7407 Melrose Ave.,  
Los Angeles 46, California



PROTECTED UNDER STODDART PATENTS

NOW

## Precision Attenuation to 3000 mc!

TURRET ATTENUATOR featuring "PULL-TURN-PUSH" action

SINGLE "IN-THE-LINE"  
ATTENUATOR PADS  
and  
50 ohm COAXIAL  
TERMINATION



**FREQUENCY RANGE:**  
dc to 3000 mc.

**CHARACTERISTIC IMPEDANCE:**  
50 ohms

**CONNECTORS:**  
Type "N" Coaxial female fittings each end

**AVAILABLE ATTENUATION:**  
Any value from .1 db to 60 db

**VSWR:**  
< 1.2, dc to 3000 mc., for all values from 10 to 60 db  
< 1.5, dc to 3000 mc., for values from .1 to 9 db

**ACCURACY:**  
±0.5 db

**POWER RATING:**  
One watt sine wave power dissipation

*Send for free bulletin entitled  
"Measurement of RF Attenuation"*

*Inquiries invited concerning pads or  
turrets with different connector styles*

### STODDART AIRCRAFT RADIO Co., Inc.

6644-A Santa Monica Blvd., Hollywood 38, California • Hollywood 4-9294

development for the Corps.

Prior to his appointment at Fort Monmouth, he was with Bell Telephone Laboratories in New York City engaged in the development and design of military weapons systems and equipment under Army and Navy contracts.

### Hoffman Plans TV Plant Expansion

HOFFMAN RADIO plans to begin construction on a \$1.5 million television manufacturing plant shortly after the first of the year in El Monte, Calif. The 200,000 sq ft facility will have 170,000 sq ft of production space and the remainder for offices, cafeteria, and building services. When the plant is completed, around May 1, 1955, Hoffman expects to combine production from two plants at the new location.

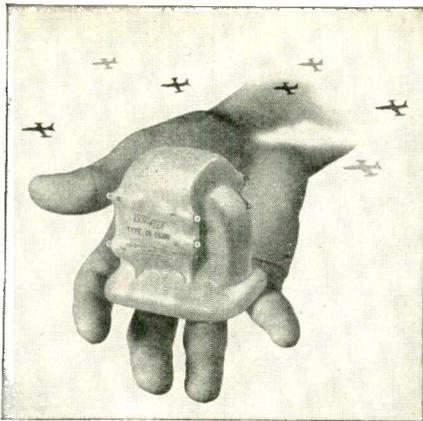
### Engineers Receive 1954 SMPTE Awards

THE SOCIETY of Motion Picture and Television Engineers awarded the 1954 David Sarnoff Gold Medal Award to Ray D. Kell for his pioneering achievements in the development of all-electronic television and important contributions to color television, including its adaptation to the limits of a 6-mega-cycle channel. Lorin D. Grignon received the 1954 Samuel L. Warner Memorial Gold Medal Award.

Kell is a member of the television research staff of RCA Laboratories. He has been a leading participant in television develop-



Ray D. Kell



**HERE IT IS!**

*Hermetically Sealed*

**CLASS H**

**Open Type Transformer**

POSSIBLE ONLY WITH

**FORM FLEX**

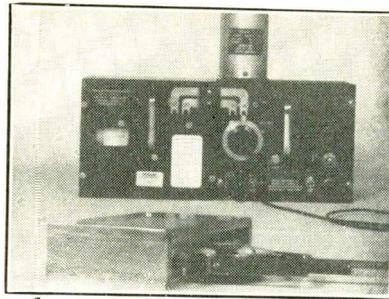
Designed for long life at "Hot Spot" temperatures of 200°C, permitting weight and size reductions over class A designs. Hermetically sealed (MIL-T-27) Grade 1, using exclusive FormFlex process.

**AIRCRAFT TRANSFORMER CORPORATION**

Manufacturers of Inductive Equipment

2 West Avenue

Long Branch, N. J.



## MICROWAVE DEVELOPMENTS

Wheeler Laboratories is an engineering organization offering consulting, research and development services in the fields of communications and radar.

The electromagnetic height gauge shown above in a test cavity enables convenient and sensitive exploration of the spacing between parallel metal plates, as in the pillbox of an X-band antenna. The small changes in inductance caused by spacing variations of the order of .001" are detected by the WL Inductance Meter, shown in the background. Contact with only one of the metal surfaces is required.

At present, Wheeler Laboratories comprises a staff of twenty engineers under the personal direction of Harold A. Wheeler, with supporting facilities including a group of designers and a model shop.

A brief summary of our work will be sent on request, and comprehensive engineering reports on some of our developments are available. Inquiries are welcomed regarding your particular problems in microwave design and development.

**Wheeler Laboratories, Inc.**

122 Cutter Mill Road, Great Neck, N. Y.  
HUnter 2-7876

## ELECTRONIC ENGINEERS

North American's Aviation Missile and Control Equipment Department offers unusual opportunities for engineers in the following fields:

**FIRE CONTROL SYSTEMS**

**RADAR**

**ANALOG AND DIGITAL COMPUTERS**

**INSTRUMENTATION**

**TRANSISTOR CIRCUITRY**

**SERVOMECHANISMS**

**SYSTEM TESTING**

Openings exist at both senior and junior levels. BS, MS or PhD in Mathematics, Physics or EE required. Junior engineers with this educational background, without experience, will be accepted for training in the above openings.

For additional information please forward resume to:

Missile & Control Equipment Dept.,  
Engineering Personnel  
**NORTH AMERICAN AVIATION, INC.**  
DOWNEY, CALIFORNIA

In the N. Y. area, pls. contact our representative, Mr. G. W. Benedict; 19 Rector St. & m. 1609, N. Y. 6, N. Y.

**IN-RES-CO  
TYPES CX & BX  
WIRE WOUND  
RESISTORS**

**FEATHERWEIGHT!**  
-another IN-RES-CO solution  
for CIRCUIT DESIGNERS

**SEALED IN MOLDED BAKELITE  
PLUS LIGHTWEIGHT**

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-sturdy, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.



**IN-RES-CO  
TYPE CX  
NON-INDUCTIVE  
RESISTOR**



**IN-RES-CO  
TYPE BX  
NON-INDUCTIVE  
RESISTOR**



ASK FOR THE NEW  
RESISTOR HANDBOOK -  
Contains complete data on  
resistors for every purpose  
and their recommended  
applications. Please  
make request on com-  
pany letterhead

**INSTRUMENT  
RESISTORS CO.**

COMMERCE  
AVENUE

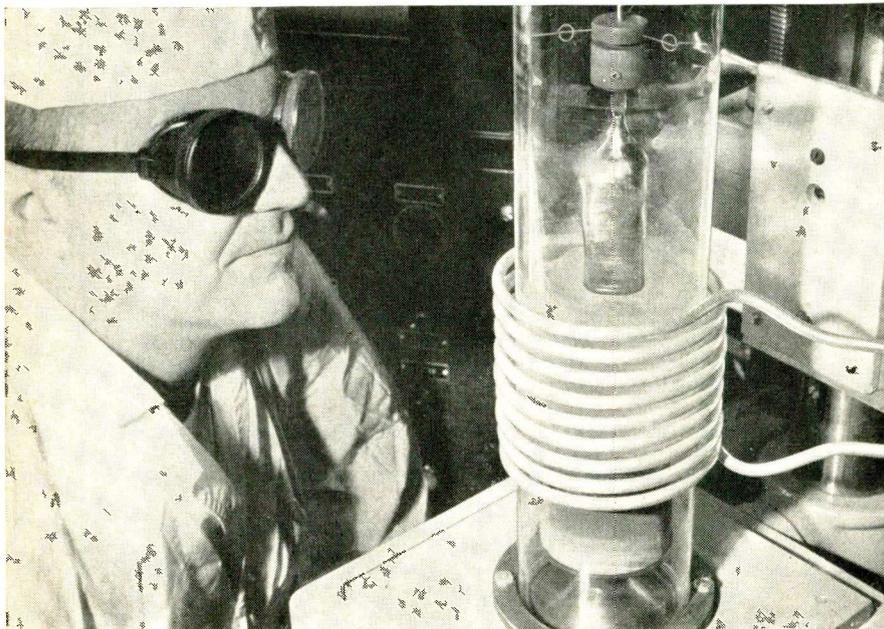


UNION  
NEW JERSEY

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

Announcing the Honeywell H-2 . . .

## NEW, IMPROVED POWER TRANSISTOR!



"Growing" germanium in an induction furnace for use in the new Honeywell H-2 Power Transistor

The new Honeywell H-2 Transistor has remarkable power and gain characteristics. Operating from a standard 28-volt DC supply on a class B push-pull circuit, the H-2 will deliver 10 watts to a load with a gain of 30 db.

Having moved from the pilot line stage to production, the improved H-2 is available in quantities at the same low price as former models.

Like the Honeywell 2N57, the H-2 is ideal for driving servos and tripping relays—yet it requires less input.

It's available now as a solution to your weight, space, reliability and vibration problems.

Write for full information on your business letterhead to Honeywell, Transistor Division, Dept. EL-12-226, Minneapolis 8, Minn.

### REAL POWER AND GAIN — H-2 POWER TRANSISTOR

Collector current 800 ma max.

Collector voltage 60 volts max.

Collector dissipation—20 watts max. at 70° F. mounted on adequate heat sink.

Frequency range—Audio

Sinusoidal power outputs 5 watts max.

Push-pull output 10 watts (2 units) max.

DC switching 40 watts max.

Power gains for ordinary applications  
20-30 db.

Maximum temperature—will operate at conservative output levels up to 165° F.

Vibrations resistance 30G up to 1000 cycles/sec.

Hermetically sealed.

MINNEAPOLIS  
**Honeywell**  
Transistor Division

112 OFFICES ACROSS THE NATION



ment during the past 27 years and has to his credit more than 36 inventions in the field of television and communication. He joined RCA in 1930. The Sarnoff Award was established to give recognition to technical contributions to the art of television and is awarded primarily for achievements within the last five years. In 1953 it was presented to A. V. Loughren of the Hazeltine Corp.

Grignon received the Warner Award for work over a ten-year period in the development of systems and techniques for the application of stereophonic sound to motion pictures. He is a development engineer in the research department of Twentieth Century Fox. The 1954 Warner Medal recognizes Grignon's specific contributions to Cinemascope, particularly, "the application of stereophonic sound, standardization of the release film, application of magnetic sound recording for release prints; supervision of magnetic striping and printing equipment, and preparation of engineering data for release throughout the world".



### Garstang Joins Allen-Bradley Radio

WILLIAM W. GARSTANG has been appointed chief engineer of the radio division of Allen-Bradley Co., manufacturers of radio, television, and electronic components.

Prior to joining Allen-Bradley Company, he was vice-president in charge of manufacturing at the Chicago plants of Raytheon. Previous to that he was president of

# DANO COILS

## Serve Modern Industry

Behind the scenes come Dano Coils—made to exact customer specifications to perform an exact electrical function . . .

- Molded Coils
- Form Wound
- Paper Section
- Acetate Bobbin
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Application

Also, Transformers  
Made to Order

The **DANO** Electric Co.  
MAIN ST., WINSTED, CONN.

DESIGNED AND DEVELOPED  
BY SPECIALISTS FOR  
PRINTED CIRCUIT  
SOLDER OPERATIONS

### VULCAN "EVEN-DIP" SOLDER POTS

- 16 Crucible sizes
- High Fidelity thermostat control — adjustable to 150-600° F.
- Surface Temperatures do not vary beyond  $\pm 2^\circ$  F. Localized Hot Spots completely eliminated.
- Replaceable heavy-duty heating elements.



Send for free detailed specifications.

VULCAN ELECTRIC CO.  
DANVERS 10, MASS.

TAKE NO CHANCES WITH  
VITAL EQUIPMENT... *Specify*

SERIES 6918 or 6924

# RACKS by PAR-METAL

18½" or 24" DEEP, for 19" WIDE PANELS

- Panel Spaces: 61¼", 70", or 77" high.
- Finished in Prime Coat, Black Wrinkle, Grey Lacquer, Grey Wrinkle.
- Series 6918 or 6924 Racks may be used in "rows" or "gangs," as corner trims are removable from front of cabinet.
- Standard shelves and roller trucks are manufactured by us for use with these Racks.

THESE RACKS ARE MODERATELY PRICED  
and AVAILABLE FOR SHIPMENT FROM STOCK

Planning an electronic product? Consult Par-Metal for

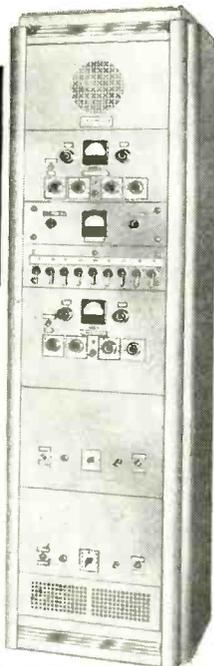
RACKS • CABINETS  
CHASSIS • PANELS

Remember, Par-Metal equipment is made by electronic specialists, not just a sheet metal shop.

Made by  
Electronic  
Specialists!



Our P-6924 Rack as used by  
Gai-Tronics, Inc., Reading, Pa.



**PAR-METAL**  
PRODUCTS CORPORATION  
32-62 — 49th ST., LONG ISLAND CITY 3, N. Y.  
Tel.: ASTORIA 8-8905  
Export Dept.: Rocke International Corp.  
13 East 40 Street, New York 16, N. Y.

WRITE FOR CATALOG!

CONTINUOUS, DIRECT-READING

## X-BAND VSWR MEASUREMENT



better than  
**2% overall accuracy!**

For speedy and accurate VSWR measurements in laboratory or production use, the CTI Model 110B Measuring System reads directly, is continuously tunable from 8,500 to 9,600 mc.

#### SPECIFICATIONS

Two VSWR Ranges: 1.02 to 1.2; 1.2 to 2.5  
Attenuation Scale: 0 to  $\infty$ ; 1.5 db midscale  
Waveguide Fitting UG-39/U  
Directional Couplers, directivity. over 40 db

COLOR TELEVISION INCORPORATED

SAN CARLOS 1, CALIFORNIA



# SENSITIVE

## D' Arsonvai METER-RELAY

Jeweled Moving Coil Armature

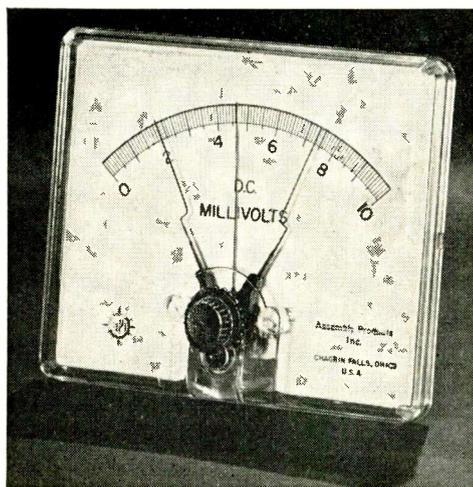
**0.2 Microamperes**  
(0/20 scale range)

**0.05 Millivolts**  
(0/5 scale range)

**A.C. D.C.**  
(voltage - current)

**Thermocouples**  
(R.F. or temperature)

**Adjustable**  
(90° scale arc)

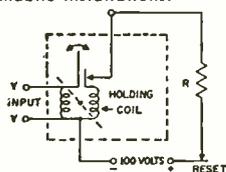


Model 451-C, (4½ inch) double contact, 0/10 DC Millivolts, as used in Vacuum Gauge made by Hastings Instrument Co., Inc., Hampton, Va., used to maintain pressure in a vacuum system.

The contact meter-relay as made by Assembly Products is an indicating meter with built-in micro-contacts which can be set to operate at any point of indication on the scale.



Model 266, plug-in, (non-indicating) hermetically sealed, with shack mounted movement. Suited to marine or aircraft or other mobile installations.



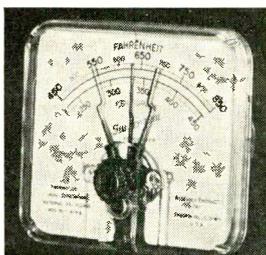
Single contact meter-relay schematic.

Model 263, (2½ inch), double contact, (non-indicating) used in Model 653 SILVERCEL<sup>®</sup> BATTERY CHARGER CONTROL manufactured for the Navy by Franklin Transfarmer Mfg. Co., Minneapolis, Minn.



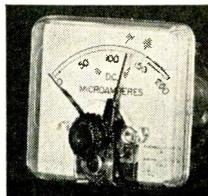
Made like a conventional panel meter, it can be substituted for an existing meter in most circuits and will add relay action for over or under limit or automatic control.

A locking coil gives high contact pressure. Spring action in the contacts gives forceful separation. Contacts are released by breaking the circuit to the locking coil, either manually or by an automatic interrupter switch.



Model 351-C, (3¾ inch), double contact, suppressed zero millivoltmeter, with bimetal compensation for thermocouple reference junction. Dial calibrated 450-850° Fahrenheit (also Centigrade), for Iron-Constantan thermocouple. Used in control of temperature of THERMO DIMPLER made by Zephyr Mfg. Co., Inc., 201 Hindry, Inglewood, Calif.

Model 261-C, (2½ inch), single contact, high limit, 0/200 DC Microamperes as used in Consolidated Engineering Corp., Pasadena, California Model 21-220 Mass Spectrometer.



**ASSEMBLY PRODUCTS, INC.**  
CHESTERLAND 4, OHIO  
Phone: Cleveland, Ohio  
HA milton 3-4436

\*Yardney Silvercel—Reg. Trademark of Yardney Electric Corp.

PLANTS AND PEOPLE (continued)

Electronic Laboratories Inc. of Indianapolis. Several patents have been issued to him covering the design and manufacture of vibrator-type rectifiers for radio apparatus.

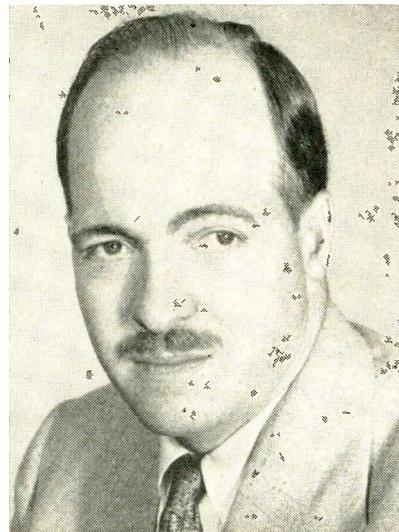
## Admiral Expands TV Set Plant

CONSTRUCTION has started on the fourth addition, since 1946, to Admiral's television plant in Harvard, Illinois. The 65,000 sq ft addition will increase the total plant area to over 187,000 sq ft.

Of the 65,000 sq ft to be added, approximately 45,000 sq ft will consist of a warehouse addition. The remaining 20,000 sq ft will be devoted to an extension of production facilities.

## GE Microwave Lab Appoints Personnel

JAMES W. NELSON, JR. has been named as manager for advanced tube development at the GE Microwave Lab in Palo Alto, Calif. George C. Trotter was appointed manager of auxiliary operations.



James W. Nelson

The new GE laboratory will concentrate on developing and exploring the application of new types of microwave electron tubes which the company believes will revolutionize the broadcast, communications and radar industries over the next ten years.

Operations will soon be housed in an ultramodern building under construction in the industrial and



**VITRAMON®**

# CAPACITORS

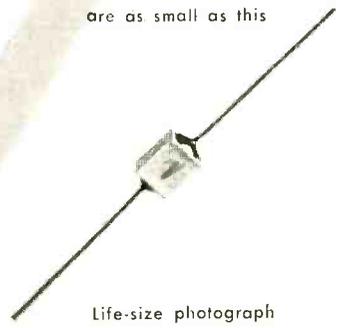
will help you build

## MINIATURE

circuit systems

### VITRAMON CAPACITORS

are as small as this



Life-size photograph



Two materials — a monolithic block of porcelain enamel and fine-silver electrodes — fused into one strong, stable, efficient and effectively homogenous unit.

Sheer bigness may be a great thing in Texas. But it has no place in an electronic circuit. Vitramon Capacitors will save you space AND deliver critical electrical performance at the same time.

**MINIATURE? YES! PLUS...**

- LOW LOSS**
- LOW NOISE**
- WIDE TEMPERATURE RANGE**
- RUGGED**
- STABLE**
- VAPORPROOF**

The biggest names in electronics use Vitramon Capacitors in guided missiles, beat-frequency oscillators, jet ignition, interceptor guidance, radar and servo systems, carrier telephone and telemetering systems, proximity fuses, etc.

**IF YOUR CAPACITOR PROBLEM IS CRITICAL  
WRITE TODAY FOR COMPLETE DATA...**

**VITRAMON**  
INCORPORATED  
BOX 544 E • BRIDGEPORT 1 • CONN.

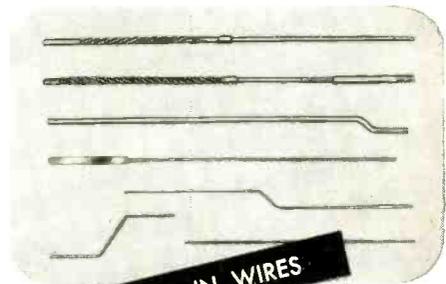
*Specify*



*for -*

## PRECISION QUALITY components

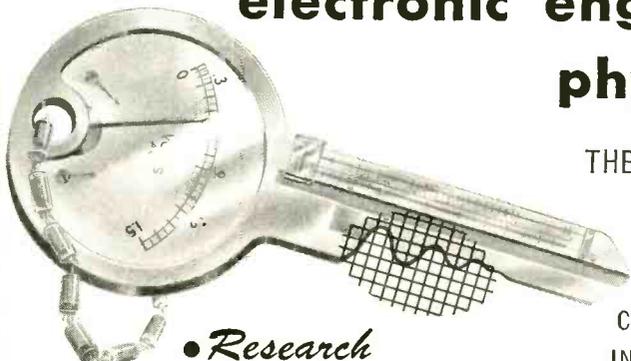
**OF TUNGSTEN,  
MOLY, NICKEL CLAD WIRE,  
ALLOYS, KOVAR**



**• DKE LEAD IN WIRES**

Quality controlled throughout production with Tungsten leads produced under General Electric Timing Control. Each tungsten lead is microscopically inspected for flaws. DKE offers highest quality and **LOW PRICES** now. Send drawings for quotations and let us prove the economy of our prices.

## electronic engineers physicists



THE KEY TO YOUR

*future* IN  
AUTOMATIC  
DATA HANDLING  
COMMUNICATIONS  
INSTRUMENTATION

- *Research*
- *Development*
- *Field Engineering* • *Technical Writing*

Our electronic computer program is providing unequalled opportunities for qualified individuals to participate in the dynamic field of computer technology. Write now for additional information.

INTERVIEWS ARRANGED AT OUR EXPENSE      HOUSEHOLD GOODS, MOVING EXPENSES PAID

LIBERAL EMPLOYEE BENEFITS

*You Will Enjoy Living in Minnesota*  
**Remington Rand**

**ENGINEERING RESEARCH ASSOCIATES** DIVISION

1902 West Minnehaha      St. Paul W 4, Minnesota



**• DKE TUBE BASES**

The Engineering Company can give you immediate delivery on following bases: 50 Watt, 3303B, 412 Industrial Base, Giant 7 Pin Bayonet, 4310 Four Pin Jumbo, Tetrode, Hydrogen Thyratron Bases in both Aluminum and Copper up to 6.50 dia etc. All bases to JAN-1A/MIL-E-1B and subjected to weights and strength tests.

### DKE HYDROGEN THYRATRON TUBE BASES



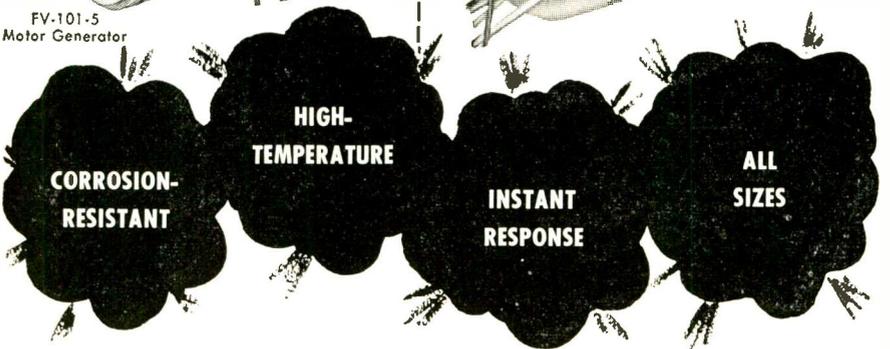
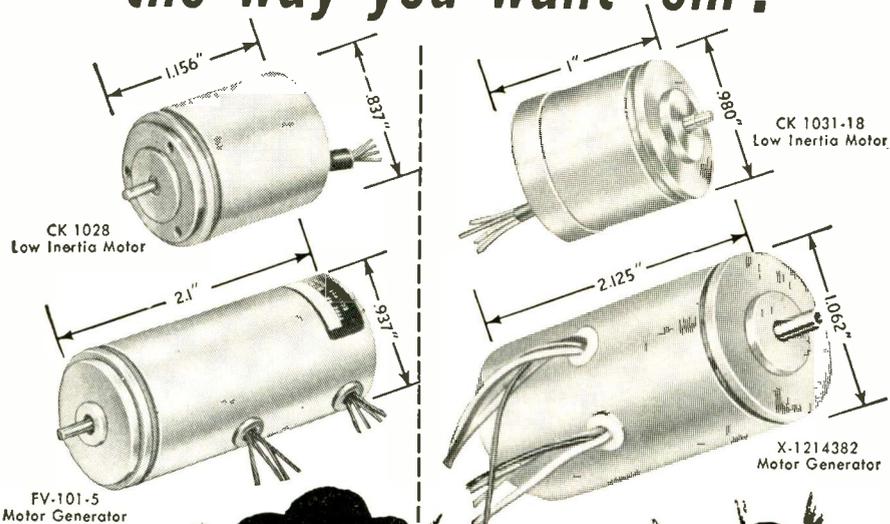
CALL OR WRITE FOR QUOTATIONS  
ON YOUR SPECIFIC REQUIREMENTS

**THE engineering co.**

27 WRIGHT ST., NEWARK 5, N.J.

# servo motors

*the way you want 'em!*



As one of the world's oldest and largest producers of servo components, we are ideally qualified to provide you with the right answer to your motor and motor generator needs. Why not take advantage of our long, practical experience? Call on us for recommendations based on your individual problem.

**TYPICAL CHARACTERISTICS**

Type Number	Rated Voltage		Max. Power Input Total (Watts)	No Load Speed (RPM)	Stall Torque (oz. inches)	Torque to Inertia Ratio (Radians per Sec. <sup>2</sup> )	Weight (oz.)
	Phase 1	Phase 2					
<b>LOW INERTIA MOTORS</b>							
CK-1018-7	18	18	5	10,000	0.13	13,000	1.6
CK-1022-13	115	115/57.5	12	4,800	1.45	33,800	8.0
CK-1027-14	115	115/57.5	7	6,200	0.63	41,500	4.5
CK-1028-16	26	26	6	10,000	0.28	13,000	1.6
CK-1031-18	26	55	9	6,400	0.35	10,000	2.2
CK-2006-1	64	64	30	7,200	2.6	70,000	10.0
CK-3000-1	110	220	80	3,700	14.0	3,750	30.0
<b>MOTOR GENERATORS</b>							
FV-101-5	26	26	9.5	10,000	0.28	10,000	2.9
FV-2001-2	115	115	30	6,600	3.0	70,000	12.6
FV-3000-1	110	220	80	3,700	14.0	3,750	30.0
X-1214382	26	26	9.7	6,000	2.6	21,000	5.5

WRITE DEPARTMENT C

## ECLIPSE-PIONEER

Division of

**TETERBORO, NEW JERSEY**

Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.

West Coast Office: 117 E. Providencia Ave., Burbank, Calif.

technical center being developed by Stanford University in Palo Alto. Nelson has been associated with GE since 1946 when he became a radar development engineer for the Company at Syracuse, N. Y.

In 1951, Nelson was appointed manager of application engineering for military electronics equipment, a position he held until early this year when he was named a joint project leader on color television receiver development.

Trotter, who joined GE in 1948, was sales manager for U.S. Air Force equipment made by the GE Heavy Military Electronic Equipment Department at Syracuse, N. Y., prior to his new appointment.

### Guided Missile Scientists Join Ramo-Wooldridge



Left to right: J. C. Fletcher, M. U. Clauser, L. G. Dunn

TWO MORE missile scientists have joined the newly formed guided missile research division of Ramo-Wooldridge, Los Angeles affiliate of Thompson Products.

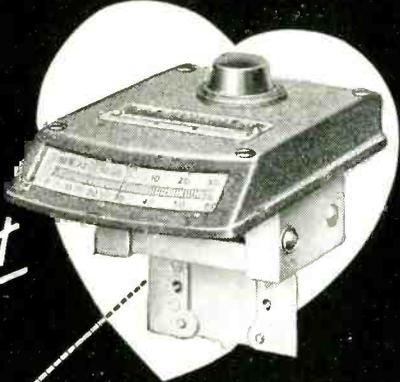
In addition to Louis G. Dunn, who is now associate director of the new division, Milton U. Clauser has been appointed director of the aeronautics and structures staff of the division. He was formerly head of the School of Aeronautics of Purdue University. Prior to 1950 he was with Douglas Aircraft Co.

James C. Fletcher has been appointed director of the guidance and control staff of the division. He was formerly with Hughes Aircraft where he headed theory and analysis for the Falcon, the Air

Make a **GM** PORTABLE D'ARSONVAL

# GALVANOMETER

*the Heart  
of Your  
Instrument*



FOR MEASURING HEMOGLOBIN content of blood samples, the Fisher Scientific Co. of Pittsburgh uses a Model 100 G-M Galvanometer in its popular Electro-Hemometer (at left). Whatever your own particular instrument field, you can achieve this same self-contained portability, ruggedness and high sensitivity with G-M Galvanometers. Complete catalog on request.



**GM** LABORATORIES · INC.

In Canada: Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S. 4336 NORTH KNOX AVE., CHICAGO 47

highly efficient source of  
**BLACK LIGHT**  
for fluorescence tests and  
analyses



**HANOVIA**  
INSPECTOLITE

A lamp of high intensity capable of illuminating large areas, the Hanovia Inspectolite is proving invaluable equipment for many industrial and laboratory uses. May be employed for the differentiation and classification of numerous materials, including chemicals, oils, drugs, food products and textiles. Oil filled transformers and capacitors may be effectively tested for leakage by the fluorescence of seepage.

Identification and analysis by fluorescence is rapidly becoming a valuable technique in industrial and engineering practice. Quickest and easiest method of examination is by observation and fluorescence comparison. For closer study or permanent recording, the Hanovia Inspectolite provides excellent light source for ultraviolet photography.

Of sturdy, practical construction, the Hanovia Inspectolite is flexible in usage with supporting upright that permits vertical adjustment of direction of light radiations over an arc of 180°

**Yours on Request:** Complete application data and details on Hanovia Inspectolite #16106.



DEPT. E-12, Newark 5, New Jersey

# Beat THE Heat (AN OLD CORNISH CUSTOM)

with **"TEF-COR"**  
HOOK-UP WIRE



scores another triumph with this tough, super-flexible product that has proven itself under fire.

## Heat-resistant to 500° F.

This new super-heat wire, insulated with "TEFLON," is ideal for guided missile, jet and low-tension aircraft applications, transformer and coil leads. Sizes from AWG10 through 28. Also supplied with silver coated copper shields, and to individual customer requirements. Write for further information.

- ◆ Cold-resistant to -67° F
- ◆ High dielectric properties
- ◆ Does not support combustion
- ◆ Impervious to known solvents
- ◆ Perfect concentricity
- ◆ Tough, homogeneous, uniform

Companion to the famous "NOFLAME-COR"

"MADE BY ENGINEERS FOR ENGINEERS"

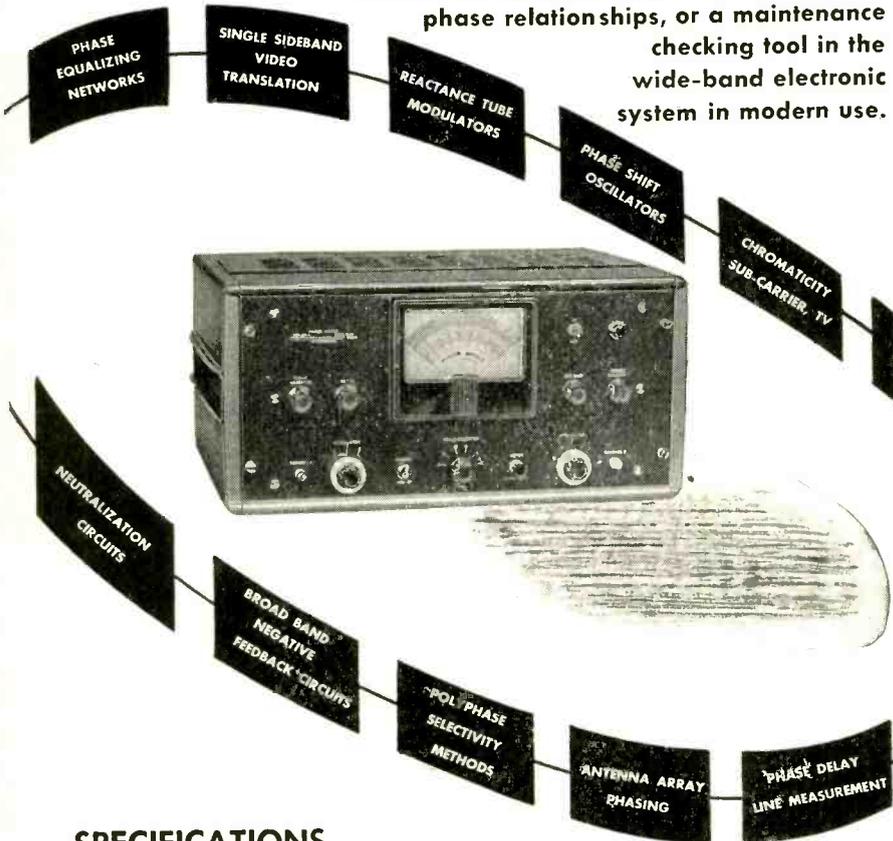
# CORNISH WIRE CO., INC.

50 Church St., New York 7, N. Y.

# TECHNOLOGY INSTRUMENT CORP.

## TYPE 324-A VIDEO PHASE METER

This instrument of laboratory precision makes possible the rapid and accurate measurement of phase angle THROUGH THE VIDEO RANGE. It provides verification of design calculations, a criterion for optimum adjustment of delicate phase relationships, or a maintenance checking tool in the wide-band electronic system in modern use.



### SPECIFICATIONS

- METER RANGES:** Phase angles from 0° to 360° full scale; and 90° quadrants full scale; no ambiguity.
- FREQUENCY RANGE:** 20 Kc. to 4.5 Mc. — Range down to 20 cycles may be supplied on special order.
- WAVEFORMS ACCEPTED:** Sine waves and any complex waves having not more than one positive-going zero axis crossing per cycle. Phase angle measurement is defined as phase difference between corresponding positive going zero axis crossings of the periodic signals being compared.
- AMPLITUDE RANGE:** 2 volts to 300 volts peak.
- ACCURACY:** ± 4° on quadrant scales. Incremental change of 0.25° is easily read.
- INPUT IMPEDANCE:** 10 megohms shunted by 14 mmf.
- FULL DETAILS UPON REQUEST**

# TECHNOLOGY INSTRUMENT CORP.

533 MAIN ST., ACTON, MASS., Colonial 3-7711  
 West Coast Mail Address P. O. Box 3941 North Hollywood, Calif., POplar 5-8626

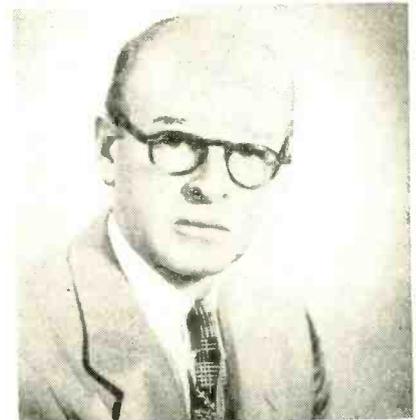
Want more information? Use post card on last page.

Force air-to-air guided missile.

During the coming year, according to D. E. Wooldridge, president, the company's guided missile research and development commitments call for an expenditure of nine million dollars. A building program will provide the new division with laboratory and office facilities of approximately 100,000 sq ft by mid 1955.

The new facilities will have an electronic computing center equipped with \$1.5 million of digital and analogue computers to facilitate theoretical work.

Simon Ramo, executive vice-president of the company, will also serve as director of the new Guided Missile Research Division. He will be assisted in over-all technical direction by R. P. Johnson, vice-president for research and development. He was formerly director of research and development at Hughes Aircraft and before that, deputy director of the research division of the Atomic Energy Commission.



### American Bosch Arma Promotes Foss

CLIFTON T. FOSS has been appointed assistant general manager of Arma Division of American Bosch Arma Corp. Foss continues as vice-president of engineering of the division. He joined Arma 21 years ago as a development engineer.

### Litton Buys West Coast Companies

LITTON INDUSTRIES has purchased controlling interest in West Coast Electronics Co. of Los Angeles, manufacturer of electronic mobile communication equipment and com-

# MICO

Precision Apparatus



**PORTABLE  
PANTOGRAPH  
ENGRAVER**

with  
**SUPERIOR  
FEATURES**

**TOROID COIL WINDERS  
UHF COAXIAL WAVEMETERS**

Send for Illustrated Catalogs

**MICO INSTRUMENT CO.**

76-E Trowbridge St. Cambridge 38, Mass.

# ZOPHAR

WAXES

COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc.

Cold flows from 100°F. to 285°F.

Special waxes non-cracking at -76°F.

Compounds meeting Government specifications plain or fungus resistant.

Let us help you with your engineering problems.



**ZOPHAR MILLS, INC.**  
112-130 26th Street,  
Brooklyn 32, N. Y.

*Versatility*

with a  
**GREEN  
ENGRAVER**

ENGRAVES

PANELS

DIALS

PLATES

Widely used in electronic and plastic fields, in machine tool shops and wherever permanent marking is needed. The GREEN ENGRAVER engraves equally well on metals, plastic wood, hard rubber and glass. ✓ Fact-filled folder on request showing how economies in costs, labor and time are achieved with the GREEN ENGRAVER.

Mark your own symbols, numbers, lettering, on our small parts, tools, identification and name plates easily, simply, quickly tracing from a master with the GREEN ENGRAVER.

✓ Routes ✓ Models  
✓ Profiles ✓ Engraves  
Etching attachment and other special equipment for industrial uses are available.



# GREEN

INSTRUMENT COMPANY  
363 PUTNAM AVE., CAMBRIDGE, MASS.

*Measure* FREQUENCY AND FM DEVIATION *To 500 MC!*

For development . . . production . . . and communication testing!



**LAMPKIN 105-B  
MICROMETER FREQUENCY METER**

Heterodyne-type, uses one crystal to measure all transmitters from 0.1 to 175 mc., and crystal-controlled transmitters to 500 mc. Accuracy better than 0.005%. Readings in absolute frequency, or percentage of error from desired frequency. Useful as precision, low-level, CW signal generator, 20 mc. up. Price \$220.00.

MEET FCC SPECS—for mobile-radio maintenance. SMALL SIZE—less than 13" wide, less than 14 lbs., apiece.

For technical data, mail coupon today!



**LAMPKIN 205-A  
FM MODULATION METER**

Direct indication of peak deviation on voice modulation, 0-25 kc. positive or negative. Tunable 25 to 500 mc. in one band. Doubles as relative field-strength meter. Built-in speaker. Jack for oscilloscope. Price \$240.00.

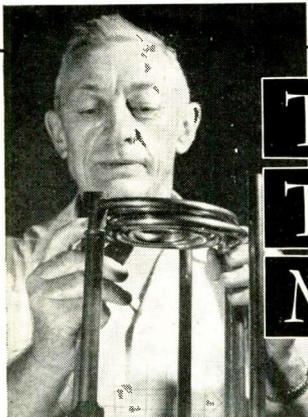
LAMPKIN LABORATORIES, INC.  
INSTRUMENTS DIVISION  
BRADENTON, FLORIDA

Without obligation, please send me data on Lampkin meters.

Name \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

**LAMPKIN LABORATORIES, INC.**  
Bradenton, Florida

*Nature Made  
Their Properties...  
Fansteel Made  
Them Practical!*



**TUNGSTEN  
TANTALUM  
MOLYBDENUM**

The valuable properties of tungsten, tantalum and molybdenum usually make it self-evident whenever one of these metals is the best possible material for a given application. However, the most practical and economical method of fabricating parts is a never-ending problem.

Here, at Fansteel, we *make* refractory metals; from raw ore to finished ingot, bar, rod or sheet. In working with hundreds of other engineers on their fabrication problems, we have learned a lot about forming these metals—about stamping, bending, deep drawing, machining, forging, brazing or welding them.

If you use Tungsten, Molybdenum or Tantalum components, we can probably fabricate them for less money than you can—with less rejects, less scrap loss, and with a *fixed* price per unit. We'd like to discuss it with you.

We have some very interesting and informative booklets on Tungsten, Tantalum and Molybdenum. Write for your free copies today.

*Let FANSTEEL insure your cost control of  
refractory metal components*

**Fansteel Metallurgical Corporation**

**NORTH CHICAGO, ILLINOIS, U.S.A.**

42501C



ponents. It also acquired Digital Control Systems of La Jolla, Calif. West Coast will continue to operate under its own name with a new president, Bruce A. Worcester, formerly a management executive of Litton Industries.

Howard P. Gates, Jr., was appointed vice-president of engineering and Howard G. Grove, vice-president in charge of military liaison and field service of West Coast.

Gates was formerly head of the communications and navigation section of Hughes Aircraft Co. Prior to his appointment, he served as head of communications and navigation section at Litton Industries.

Grove, a founder of West Coast eight years ago, had been active in Southern California radio, serving as Dean of the Radio Institute of California from 1935 to 1937. Later he was associated with Cound Products Corp. and Pacific Aviation as plant manager.

### **IRC Acquires Van Dyke Instruments**

VAN DYKE INSTRUMENTS has been purchased by International Resistance for an undisclosed sum.

Van Dyke Instruments produces precision potentiometers required for guided missiles, electronic equipment vital to automation and atomic installations and other related devices.

Van Dyke Instruments will be operated by its present management as an IRC wholly-owned subsidiary.

### **RCA Names Engstrom, Hillier, Color Staff**

ELMER W. ENGSTROM has been elected as a member of the board of directors of RCA. His election fills a vacancy caused by the retirement from the Board of Walter A. Buck.

Dr. Engstrom, who became executive vice president, research and engineering, on June 4, 1954, has broad responsibility for all research and engineering activities of RCA. In addition, he is head of RCA Laboratories and a member of the board of directors of RCA Victor of Canada.

He joined RCA in 1930. First

SINCE 1920  
**WENCO**  
**SPADE BOLTS**

Specialists in designing and manufacturing All-Purpose Fasteners and Mounting Lugs. Tooled to produce over 1,000 sizes and styles of Spade Bolts in any finish, material or quantity.

OTHER PRODUCTS

**Simplex**  
 WIRE STRIPPERS & CUTTERS

- TOOLS AND DIES
- METAL STAMPINGS
- WIRE SPECIALTIES
- REPLACEMENT TIPS for Electric Soldering Irons

Send samples or specifications for quotations. Descriptive bulletin on request.

**WENCO MANUFACTURING CO.**  
 1133 W. Hubbard St., Chicago 22, Ill., U.S.A.

**EPCO**

**TRANSFORMERS**  
 " Fill Your Need to a "

For INDUSTRIAL and ELECTRONIC EQUIPMENT

SAMPLE SHORT and LONG RUNS

Let us quote on your Specifications, no obligation

Delivery as Promised!

DESIGNED TO COMMERCIAL AND MILITARY SPECIFICATIONS (MIL-T-27 and AN-E-19)

**EPCO Products Inc.**  
 2500 Atlantic Ave.  
 Brooklyn 7, New York

**NEW** **TRANSCONDUCTANCE ANALYZER & CIRCUIT SIMULATOR**



**MODEL 901**

**SPECIFICATIONS**  
 Transconductance Range: 0-100, 0-500, 0-1000, 0-5000, 0-10,000 and 0-50,000 micromhos. Range of Current Measurements: Plate & Screen: 0-100  $\mu$ a, 0-10 ma, 0-100 ma, 0-200 ma; Grid & Suppressor: 100-0-100  $\mu$ a, 1-0-1 ma, 10-0-10 ma. Available D. C. Voltages: Plate & Screen: 0 to 300 V; Grid & Suppressor: 0 to 3 V, 0 to 15 V, or 0 to 150 V pos. or neg.

This direct-reading vacuum tube transconductance meter measures transconductance under all operating conditions and reproduces all kinds of static or dynamic tube characteristics. It has means for connecting components to simulate the circuitry in which the tube will operate. Push button switching applies voltages to each tube element.



**SQUARE WAVE GENERATOR**

*Combined Voltage Calibrator and Source of Square Waves*

**MODEL 183**

This precision instrument provides square waves suitable for testing the transient and frequency response of wide band amplifiers, and for accurately measuring their amplitude. A wide range of output levels is available. Attenuator settings do not affect the output wave shape.

**SPECIFICATIONS** — Frequency Range: 10 cps to 1 mc continuously variable over decade steps; Rise time: 0.02  $\mu$ sec for 100 ohms output, 0.05  $\mu$ sec for 1200 ohms output; Max. output: 10 volts p-p across 100 ohms, 100 volts p-p across 1200 ohms.

*Write for specifications and catalog on our complete line of measuring equipment.*

**NEW LONDON INSTRUMENT Company**  
 P. O. BOX 189 E  
 NEW LONDON, CONN.

**ANALOG-DIGITAL CONVERTER**

**NO AMBIGUITY**  
**FAST RESPONSE**

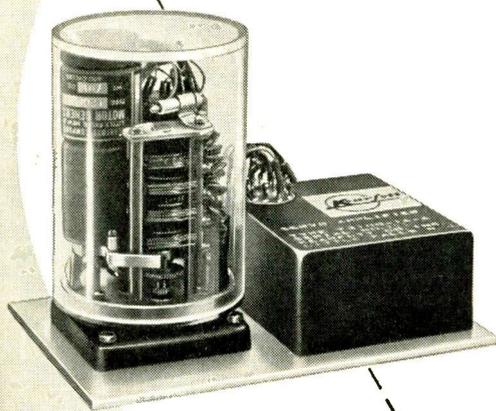
A shaft position to digital conversion component for data handling systems and digital computers. Multi-brush pick-offs eliminate ambiguity. Adapted to be used in digital to analog conversion systems and closed loop systems. Standard unit handles 13 digits; 7, 17, and 19 digit models also available. Multi-channel converters designed to be time-shared with one scan network. Custom models may be ordered to your specifications.

**SPECIFICATIONS:**  
 Dia. 2 in. Wt. 8 oz.  
 Length: 2-3/4 to 5", according to model  
 Torque: Under 0.2 oz. in.  
 Meets applicable military specifications

Write for catalog information.

Computers and Controls  
**LIBRASCOPE**  
 A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION  
 808 WESTERN AVE. • GLENDALE • CALIF.

# KEARFOTT ADAC



ADAC shown in plastic case is normally hermetically sealed in metal cover.

servo

Analog

Digital

Analog

Converter

This servo driven Converter is designed to be read-out either "on the run" or "on demand". For read-out, the digital computer sends an interrogating pulse to all the drums (and their segments) in common. The pulse can only return to the computer via the brushes contacting the tracks. If a brush is on a conducting segment, the pulse returns to the computer; if the brush is on an insulated segment, the pulse is blocked. All 12 tracks are simultaneously read and the return pulses are thus coded to represent discrete steps of the transducer feeding ADAC.

By using precision servo components, the accuracy of ADAC has been reduced to

**ADAC is a device for the precise electro-mechanical conversion of analog information to digital form. ADAC works from a synchro voltage input and produces a 12-binary-digit informational output.**

one part in 4096 (.02%), or approximately 5 minutes of transmitter rotation. It weighs only 2½ pounds and measures three inches in diameter and four inches in length. The device is hermetically sealed and is highly shock resistant. The T3100 Servo Amplifier provides the necessary excitation for the servo elements of the Converter. A direct drive ADAC providing the segmented drums and necessary gear trains, and an inverse ADAC for digital-analog conversion is available.

Let us send you complete data sheets. Write today.

## KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Send for bulletin giving data of components of interest to you.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

## KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.  
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas  
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

as an engineer and then as a research administrator, he has had a pioneering role in the development of radio, sound motion picture apparatus, the general science of electronics, and both black-and-white and color television.

James Hillier, pioneer in the development and use of the electron microscope, has joined the research and engineering staff of the Corporation as an administrative engineer.



James Hillier

Dr. Hillier, who has been director of the research department of Melpar, a subsidiary of Westinghouse Air Brake, was associated with RCA Laboratories from 1940 to 1953, first as a research physicist and later as supervisor of fundamental electron microscope research.

In the RCA Tube Division a separate operations staff was appointed for administration of all activities connected with the engineering and manufacturing of color television picture tubes at its Lancaster, Pa., plant.

The staff will function under the supervision of Harry R. Seelen who recently was appointed manager of a newly created color kinescope operations department. The new department divides Lancaster activities into two separate plant operations: one devoted exclusively to color kinescopes; the other to black-and-white kinescopes and other types of cathode-ray and power tubes.

Appointed to the color staff are: Donald O. Corvey, manager, purchasing; S. M. Hartman, manager, equipment development; Homer L. May, manager, planning and controls; C. Price Smith, manager, engineering and Rex E. McNickle,



**WHEREVER DESIGNERS SPECIFY  
ELECTRONIC PRODUCTS  
THERE YOU'LL FIND THE "GUIDE"**

When designer-specifiers need reliable product information,  
what do they do?

Do they fumble through the files looking  
for individual company catalogues?

Do they waste valuable time waiting  
for product information to arrive by mail?

No, they do not!\*

Designer-specifiers, needing immediate electronic product data,  
specifications, manufacturers' names, etc.,

look for it in the easy-to-read  
**ELECTRONICS BUYERS' GUIDE,**

the only publication

where this information is readily accessible  
for the entire industry.

You, too, can profit when you  
get in the habit of looking it up in the . . .

## **electronics BUYERS' GUIDE**

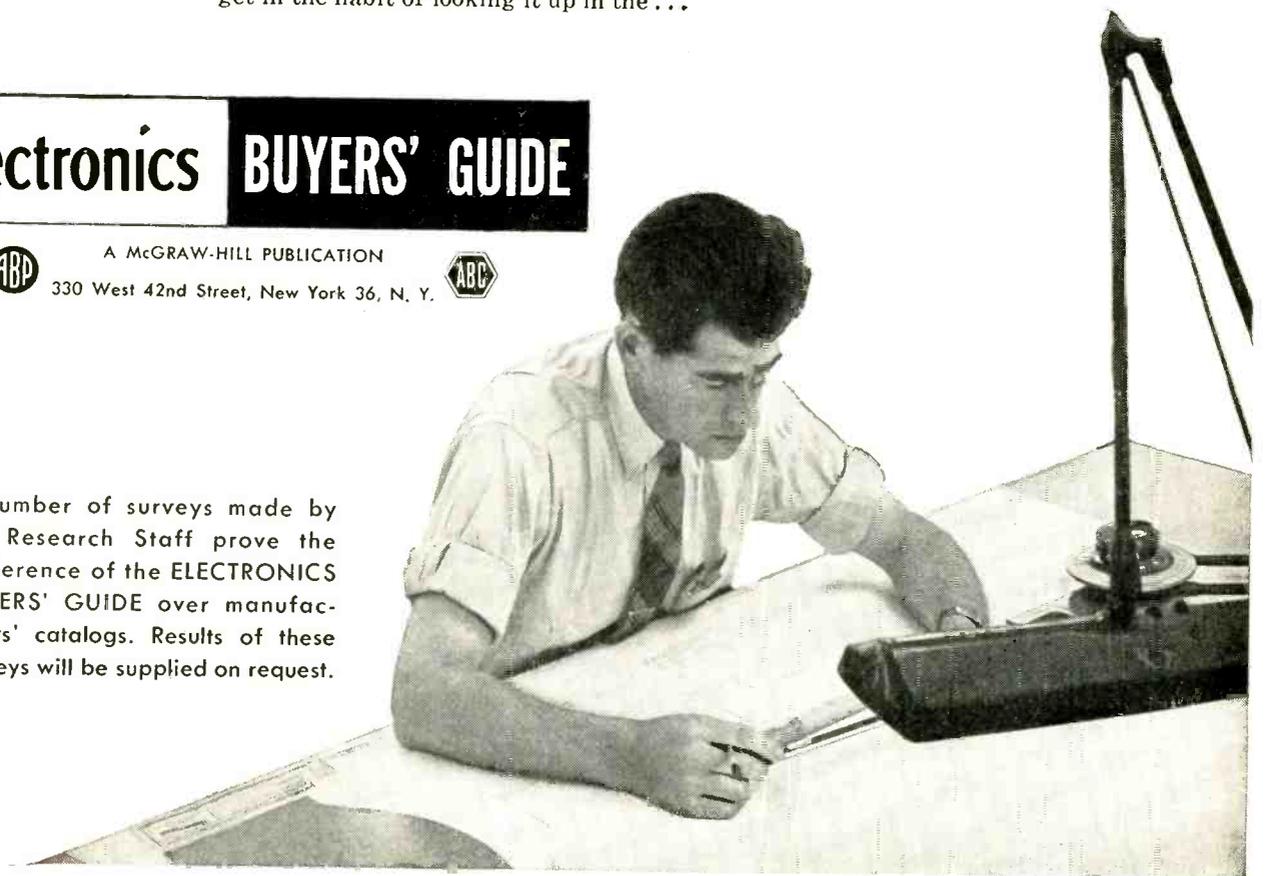


A MCGRAW-HILL PUBLICATION

330 West 42nd Street, New York 36, N. Y.

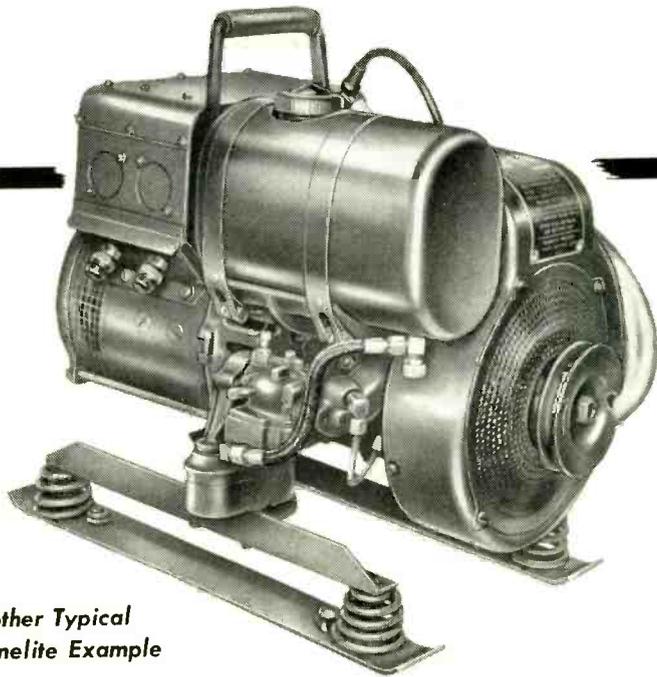


\*A number of surveys made by  
the Research Staff prove the  
preference of the **ELECTRONICS  
BUYERS' GUIDE** over manufac-  
turers' catalogs. Results of these  
surveys will be supplied on request.



# HOMELITE

will meet your specs for  
**LIGHTWEIGHT GENERATORS**



*Another Typical  
Homelite Example*

To meet the requirements for lighter, smaller and more powerful auxiliary gasoline-engine-driven generators for both rotary and fixed wing aircraft, Homelite has designed and built several special units.

Typical of these new Homelite generators is the Model 34D28 shown above.

Weighing only 67 pounds . . . almost half the weight of previous auxiliaries with comparable power . . . this Homelite develops 70 amperes at 28.5 volts DC and is capable of starting 700 h.p. aircraft engines either directly or with a small battery floated on the line.

Requiring less than 3 cubic feet of storage space, this unit is equipped for push button or manual starting and starts without preheating in temperatures as low as minus 40 degrees Fahrenheit.

Meeting specifications for lightweight, powerful generators . . . for both military and commercial applications . . . is the specialty of the house with Homelite. We've been doing it for close to half a century.

No matter how new, how different or how tough your requirements . . .

turn them over to Homelite. The chances are you'll get the most satisfactory answer . . . faster.

Write and our engineers will get in touch with you.

Homelite builds generators in sizes from .15KW up to 5KW in all voltages and frequencies . . . with either gasoline engine or electric motor drive.

Manufacturers of Homelite  
Carryable Pumps  
Generators • Blowers  
Chain Saws

PERFORMANCE • DEPENDABILITY  
**HOMELITE**  
CORPORATION  
SERVICE

6812 RIVERDALE AVENUE • PORT CHESTER, N. Y.

Canadian Distributors: Terry Machinery Co., Ltd., Toronto, Montreal, Vancouver, Ottawa

administrator, quality control.

Kenneth M. McLaughlin, formerly manager of transistor manufacturing at the Harrison, N. J., plant, has been appointed manager of the Lancaster color kinescope plant. Earl M. Wood continues as manager of the Lancaster cathode-ray and power tube plant.



## Librascope Opens New Plant

LIBRASCOPE, a subsidiary of General Precision Equipment Corp., has dedicated a new \$500,000 plant addition at its Glendale, Calif. facility.

The new 55,000 sq ft building brings Librascope's total floor space to 160,000. It will house administrative offices, engineering and an electronics laboratory.

The firm manufactures electronic computers and controls for both military and commercial applications.

## Farnsworth Electronics Promotes Engineers

WALTER G. HAWKINS of Farnsworth Electronics has been appointed manager of missile and radar development and Vinton D. Carver was named manager of product engineering.

Hawkins has been associated with the company for three and a half years in charge of guided missile development.

Before joining the firm, he was active in development of radar and missile equipment at Hughes Aircraft; Hazeltine Electronics and Sperry Gyroscope.

Carver started with the company

he's working for you



THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

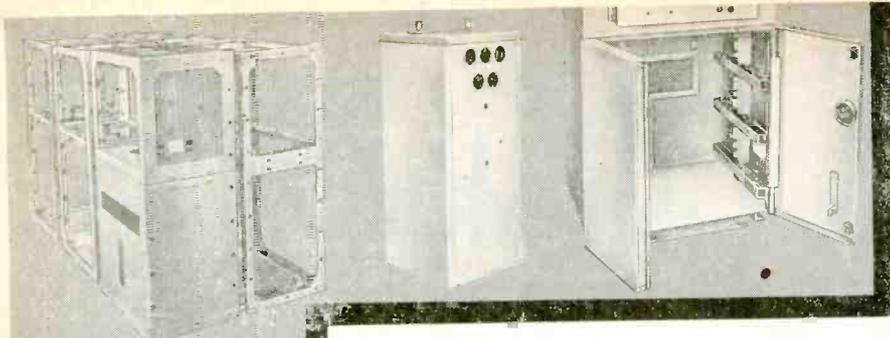
THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it"—"they" being all the industry's front line of innovators and improvers — and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

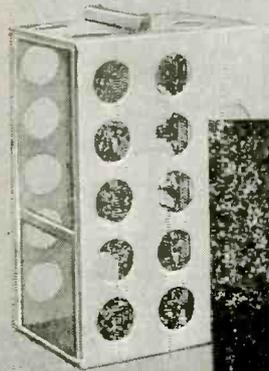
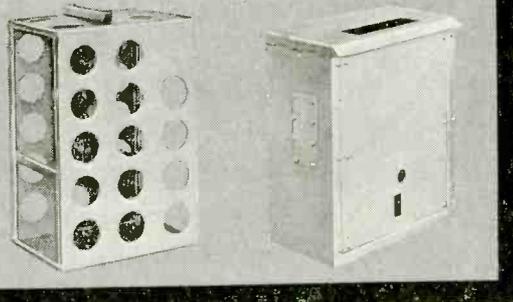
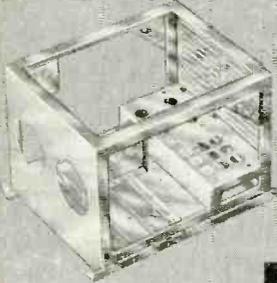
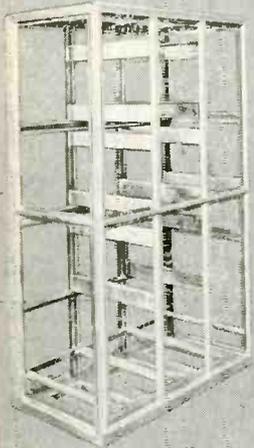


McGRAW-HILL PUBLICATIONS



## FALSTROM SHEET METAL FABRICATORS

chassis, cabinets  
 housings,  
 enclosures, etc.



Falstrom has the quick, accurate, low cost answer to your instrument mounting needs, regardless of shape, size, metal (aluminum, steel, stainless steel, etc.) or finish . . . regardless of whether you need one unit or thousands!

**Design to assembly**—Falstrom handles the complete job under one roof. Falstrom engineers are highly experienced; Falstrom facilities are modern. And—wherever possible—Falstrom makes use of standard production techniques, stock tools and dies—to eliminate unnecessary costs!

Ask for quotes on your blueprints, samples or sketches—no obligation. Contact Falstrom now—write, wire or phone for your illustrated Falstrom catalog #142-B.

**FALSTROM MEANS IT'S  
THAT MUCH BETTER!**

# FALSTROM

FALSTROM COMPANY, 93 Falstrom Court, Passaic, N. J.  
PRescott 7-0013 Since 1870



W. G. Hawkins

in March, 1953 as chief mechanical engineer in the technical products division. He was subsequently named chief mechanical engineer of research and development and held that position until this appointment. Prior to his association with Capehart he was with the Argonne National Laboratory and Tennessee Eastman.



V. D. Carver

In addition to these appointments, Donald R. Rasley continues as chief engineer of the radar department and William W. Harger was appointed chief engineer of the missile department.

Rasley has been with the company for thirteen years having started as a junior engineer in 1941. Since that time, he has been associated with the company in radar development and has been chief engineer of that activity since 1953.

Harger started with the company in March, 1946 as a junior engineer. He has been active in the company's missile development and prior to his present appointment, he was



# it takes two

## DISPLAY ADVERTISING

- AROUSES INTEREST
- CREATES PREFERENCE

## DIRECT MAIL

- GETS PERSONAL ATTENTION
- TRIGGERS ACTION.

After your prospect has been convinced by DISPLAY ADVERTISING, he still must take one giant step. *He must act.* A personalized mailing piece direct to his desk, in conjunction with a display campaign, is a powerful action getter.

McGraw-Hill has a Direct Mail Division ready to serve you with over 150 specialized lists in the Industrial Field.

To get your copy of our free INDUSTRIAL DIRECT MAIL CATALOGUE (1954) containing complete, detailed information about our services, fill in the coupon below and mail it to McGraw-Hill.

Do it now! The best advertising programs are planned well in advance.

for Results



USE

**Mc GRAW-HILL**  
**DIRECT MAIL LIST SERVICE**

Direct Mail Division,  
McGraw-Hill Publishing Co., Inc.  
330 West 42nd St., N. Y. 36, N. Y.

Please forward my free copy of the McGraw-Hill  
"Industrial Direct Mail Catalogue."

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

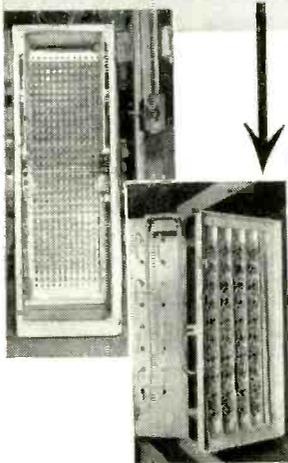
# SAVE TIME and MONEY

Buy a  
Complete  
"PACKAGE"  
Assembly  
from

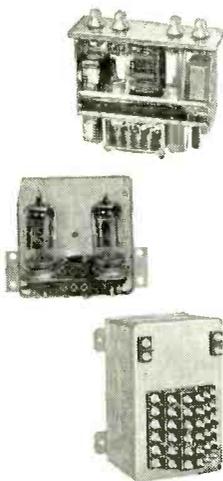
- Parts manufactured
- Tool and die work provided
- Components procured
- Wiring & Assembly completed
- Internally and externally finished
- Tested and inspected
- Delivered to directed locations

## ELECTRO-SEAL

• Electro-Seal service includes engineering and design when desired. Our customers include many outstanding leaders in the electrical and electronic field. Bring your special assembly or wiring problem to Electro-Seal. We may have already solved it—for somebody else. Save time—call or write TODAY.



Typical  
"PACKAGE"  
Assemblies  
by  
Electro-Seal



- Counting chains (fixed or sequential)
- Test and inspection sets
- Remote telemetering controls
- Carrier equipment
- Private telephone switchboards
- Control cabinets
- Electro-mechanical controls
- Special enclosures
- Hermetic Sealing



**Electro-Seal Corporation**

946 North Avenue • Des Plaines, Illinois

section head, missile guidance and assistant chief engineer of the guided missiles department.

### Sylvania Appoints New Radio-TV Head



Howard E. Riordon

HOWARD E. RIORDON has been appointed general manager of the Radio and Television Division of Sylvania Electric.

Riordon, who has held executive posts with Sylvania and subsidiary and predecessor companies for the past 23 years, succeeds John K. McDonough, who recently resigned from the company.

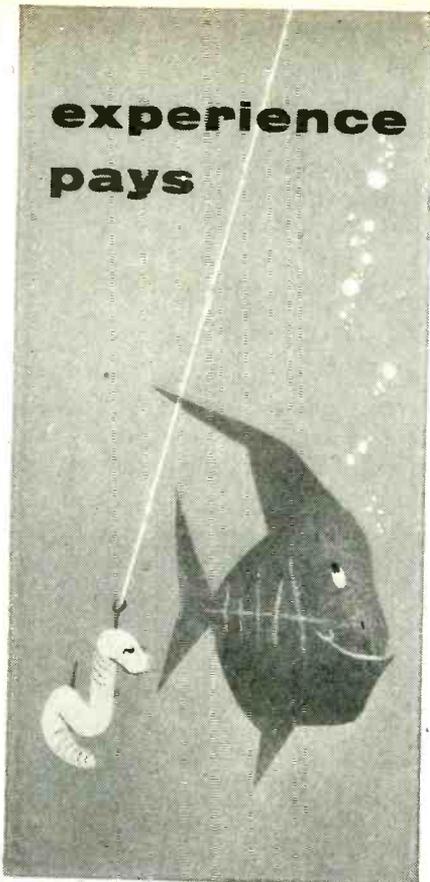
Elected president of Sylvania Electric of Puerto Rico, a subsidiary manufacturing company, in August, 1953, Riordon served in Puerto Rico until his new appointment.

### Leverenz To Receive Brown Medal

A FRANK P. BROWN MEDAL will be awarded to Humboldt W. Leverenz, director of the physical and chemical research laboratory of RCA Laboratories, by Franklin Institute for his contributions to the development of the fluorescent lamp, principally by the invention of reliable, efficient and versatile phosphors.

Ultraviolet radiation produced by electric energy of the fluorescent lamp cannot pass through ordinary glass, but must be converted to visible light by a phosphor coating on the inside of the tube. Mr. Leverenz' research on luminescent materials was of considerable import to the evolution of fluorescent light-

**experience  
pays**



Yes, experience does pay in many ways. Our clients know from experience they have a dependable, responsible source for preparation of better industrial and business literature.

Why not do the job right? It saves time, money and produces results. Let us give you a proposal on your next publication.

We'll do the whole job—from planning to printing—or just those parts that you need.

product literature

military manuals

company publications

training material

Call or write for more information.

**TECHNICAL WRITING SERVICE**  
McGraw-Hill Book Co., Inc. • 330  
West 42nd Street • N. Y. 36, N. Y.

**NEW!**

**PRINTED  
CIRCUIT  
LOWERS  
COST on...**

*Detectron*



**DECIMAL DECADE TOTALIZER**

Incorporating printed circuitry into the TU-100P makes it possible to reduce the selling price by producing more uniform units, faster and more efficiently. Greater operating stability through better heat dissipation made possible by improved physical layout. Standard octal plugs assure adaptability to most existing high speed counting equipment.

**Direct illuminated read-out;**  
pulse pair resolution —  
5 microseconds; maximum  
counting rate —  
100,000 per sec.



A Complete  
Line of:  
**FREQUENCY COUNTERS  
RADIATION SCALERS  
DECADE TOTALIZERS • ACCESSORIES**

COMPUTER-MEASUREMENTS

Division of *Detectron* CORP.

5420 Vineland, Dept. 78-8 North Hollywood, Calif.

**Simplicity  
of Design**

Requires less than  
one-half the space  
usually needed for  
a lever switch.



**SWITCHCRAFT**

**"LEV-R-SWITCHES"**

**Plus  
Serviceability**

Made in two and three position types; momentary and locking actions. Single hole mounting. Attractive hardware. Long springs without any "forms" at point of flexing insure long spring life. Springs insulated from each other by phenolic spacers with hard rubber tubing press fit through the stock—insures correct alignment of the contacts and provides high insulation resistance. "Soft" easy action actuator; real detent action on locking types.

Full details in Catalog S-52—fourth printing—  
send for your copy.

Fine silver contacts, rated at 3 amperes, 120 volts, A.C. non-inductive load—standard. Also available on special order with larger silver contacts for higher currents and Palladium contacts for low current—low voltage circuits.

**TELEVER SWITCH**

For more rugged applications. Features unusual "T-Beam" frame construction—light design with ruggedness of a structural "T-Beam".

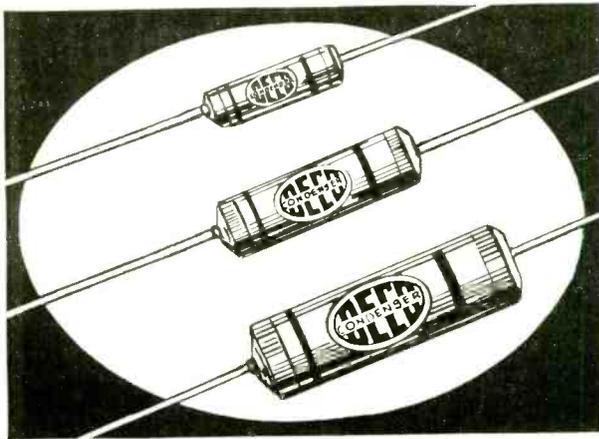


**SWITCHCRAFT**  
INC.

1336 N. Halsted Street, Chicago 22, Ill.

Canadian Representative: Atlas Radio Corp. Ltd., 560 King St. W., Toronto 2B, Canada. Phone Waverly 4761

**AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS •**

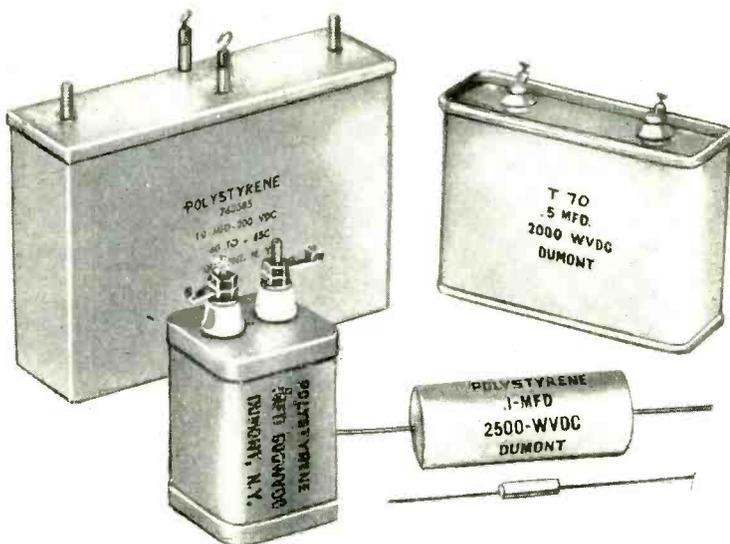


## DUMONT *Miniature* CAPACITORS

HIGHLY STABILIZED . . . .  
MOLDED IN CERAMIC TUBES

*Ideal For . . .*

- ★ COMPUTERS
- ★ RADIOSONDES
- ★ NUCLEAR INSTRUMENTS
- ★ HIGH FREQUENCY AMPLIFIERS
- ★ TIME DEVICES



### PLASTIC FILM CAPACITORS

1. POLYSTYRENE . . . HIGHLY STABLE
2. THERMOFILM (MYLAR) 150° C  
HIGH TEMPERATURE OPERATION

*Descriptive literature available . . . write to-day.*

**DUMONT-AIRPLANE & MARINE INSTRUMENTS, Inc.**  
OFFICE  
15 William Street  
New York 5, N. Y.

FACTORY  
Clearfield  
Pennsylvania

ing techniques.

Joining RCA in 1931 as a chemico-physicist, he was in charge of research on electronically active solids from 1942 until being named to his present post this year.

### IBM Promotes Top Engineers

RALPH L. PALMER was appointed director of engineering of IBM. He formerly was manager of the company's engineering laboratory at Poughkeepsie, N. Y.



Ralph L. Palmer

Other appointments include those of John C. Abrams as director of laboratory operations, Jerrier A. Haddad as director of advanced machine development and James J. Troy as director of product design. Horace S. Beattie has been named manager of the company's Poughkeepsie laboratory and Francis E. Hamilton has been made manager of the Endicott, N. Y. laboratory.

Abrams was previously assistant to the IBM director of engineering,



John C. Abrams



## you could make your own suit...

But it's better business to have an experienced tailor do it — right!

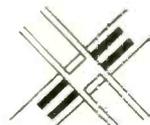
Coils are the same way. Maybe you make your own — but usually we at Coto-Coil can make them for you faster, better and at lower cost. It's our business to know the best types of materials for each type of coil. We have time-saving automatic equipment, the most modern testing devices. And we bring to your job nearly 40 years of coil design and manufacturing experience.

Find out how this combination can save costs for *you*.

Coto-Coil Company, 65 Pavilion Avenue, Providence 5, R. I. New York Office: 10 East 43rd Street, New York 17, N. Y.

**Coto**  **Coils**

**Cunningham**  
ESTABLISHED 1930



**CROSSBAR**

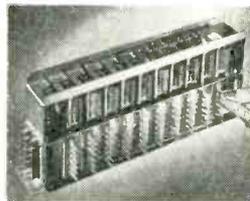
A truly superior switch for MASTER CONTROL AND MONITOR SWITCHING OF AUDIO & VIDEO CIRCUITS

Also

COMPUTERS • TELEMETERING  
TELEPHONE • DELAY LINES  
ETC.

### Advantages

Extreme flexibility  
Fast quiet switching  
Crosstalk down 60 Db at 19 MC  
Any group of setups may be held intact while setting up others  
Provision for spot or remote control  
Strapwiring eliminated  
Excellent HF characteristics  
Palladium contacts  
Reduced cost  
Compact design, small size  
Low operating power—2.5 watts  
Simple "package" installation



- Individual magnets at each cross-over.
- Maximum, six conductors per circuit.
- Life-tested to 100 million operations.

**JAMES CUNNINGHAM, SON & CO., INC.**

33 Litchfield St., Rochester, N. Y. Tel: Baker 7240

HIGHEST STANDARDS  
TOP QUALITY!

**COSMIC**

"CONDENSER SPECIALISTS SINCE 1923"

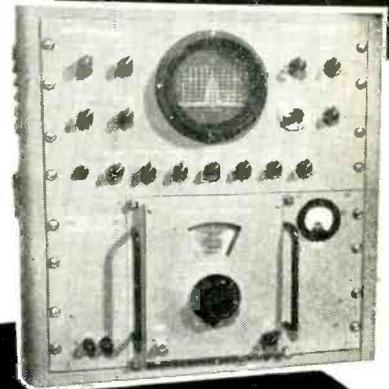
ELECTROLYTIC  
AND PAPER TUBULAR  
**CONDENSERS**

For A.C., D.C. Sets-Phonographs  
etc.

**COSMIC CONDENSER CO.** 853 Whittier St., Bronx, N. Y. -Phone LU 9-3360

**NEW**

**PANORAMIC  
SPECTRUM  
ANALYZER SPA-1**



**now 50 mc  
to 4000 mc**

### WITH TWO TUNING HEADS

Check these outstanding features:

- Low noise input, less than 0.5 microvolts across 50 ohms, for high usable sensitivity
- 10 MC maximum sweepwidth, continuously reducible to 0 MC
- Continuously variable differential markers,  $\pm 50$  kc to  $\pm 5$  mc
- Continuously variable resolution (I.F. bandwidth) 9 kc to 100 kc
- 1 cps to 60 cps sweep rate, continuously variable with single control.
- DC coupled video amplifier for analysis of CW signals.
- Three selectable amplitude scales, 40 db log, 20 db linear and square law.
- Low frequency swept oscillator provides high inherent stability.
- Excellent construction and design make the equipment unparalleled for minimum down time.
- Optional bezels and CRTs for visual examination or camera use.
- Low cost.

### Tuning Heads

RF-2 50 mc - 250 mc  
RF-3 220 mc - 4000 mc in five ranges

Inquiries invited on Panoramc Spectrum Analyzers for special problems. Write today for descriptive literature.



- Makers of
- Panadapter
  - Panalyzer
  - Panoramc Sonic Analyzer
  - Panoramc Ultrasonic Analyzer

10 South Second Avenue, Mount Vernon, N. Y.  
MOUNT VERNON 4-3970

READ *Torque*  
LIKE YOU READ THE *Time*

A COMPLETE

**NEW**

SET OF

*Torque*  
*Watch*  
GAUGE



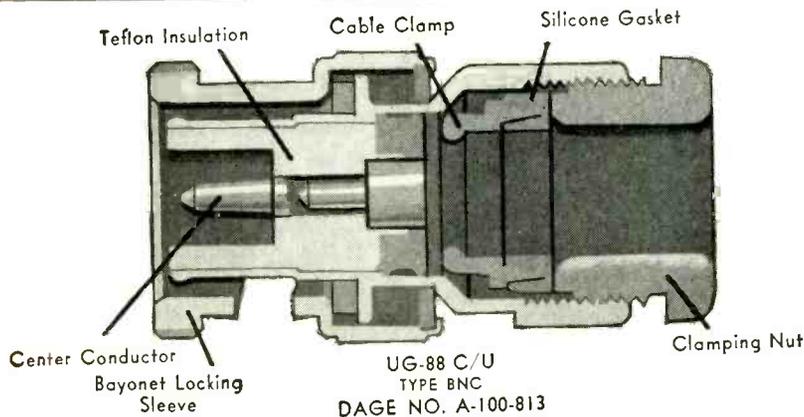
A NEW set of "TORQUE-WATCH" gauges  
for measuring LOW TORQUE

- Four Models:
- |        |  |
|--------|--|
| 6000-1 | 0.010 to 1.2 inch-ounces, clockwise.         |
| 6000-2 | 1.0 to 20 inch-ounces, clockwise.            |
| 6000-3 | 0.010 to 1.2 inch-ounces, counter-clockwise. |
| 6000-4 | 1.0 to 20 inch-ounces, counter-clockwise.    |
- **Accurate** — Repeatable accuracy of plus or minus 5% on the 300° watch-face.
  - **Easy to Read** — Linear scale on a one-inch dial.
  - **Compact** — 1½ inch diameter and ¾ inches long, including the Jacobs chuck for shafts to ¼ inch diameter.
  - **Two Gauges of rugged construction** in a plush-lined instrument case: Price per set \$99.50 Also available singly, price each \$54.95
- A complete set of gauges for measuring low torque on servo-mechanisms, variable condensers, potentiometers, and small rotating machinery. Write for detailed information.

**WATERS MANUFACTURING, inc.**

Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES



# Design with Dage!

Dage engineers are interested in *your* design problems . . . even before you have them! Call on Dage at the very beginning of your next project—see for yourself how skillfully Dage can help you coordinate details and overcome design "bugs."

Your RF connector order placed with Dage receives the careful attention it de-

serves. Dage expertly designs, carefully makes all types of RF connectors including Type N, C, BNC, improved BNC's and SM's. Dage designers are *specialists* in producing your *special* connectors.

Remember, on *your* next project—"Design with Dage"; call Dage . . . even before you start!



UG-88 C/U  
TYPE BNC  
DAGE NO. A-100-813

**DAGE**



Write Dage today for your copy of Catalog 201. Write, phone or wire your RF connector order to Dage today!

DAGE ELECTRIC COMPANY, INC., 67 NORTH SECOND STREET, BEECH GROVE, IND.

## Seneca Falls Machine Goes Electronic

SENECA FALLS MACHINE COMPANY, machine tool manufacturing concern, has formed an electronics division. The company has for some time been experimenting with electronics and has made considerable progress, according to Edwin R. Smith, president. He said that it would seem the time has now arrived, "when any machine tool builder who intends to be in a competitive position in the future should devote some of his time, energy and money to the development and application of electronics."

Robert H. Eisengrein, who is credited with four electronics patents, has been appointed director of the new division. He comes to Seneca Falls from Sundstrand Aviation where he was chief research engineer responsible for



Robert H. Eisengrein

analysis, development and design of automatic control systems and components. Prior to joining Sundstrand he was a research assistant at the Servomechanisms Laboratory of M.I.T. and before that was with GE as a development engineer.

Smith said that with the tremendous development that has been made in electronics, particularly with servo mechanisms, we probably will see in the next few years new and better machine tools which will not only do the work required but also the thinking. . . . It is difficult to tell at the present time just how far this trend is going, but it would seem that if we can produce at reasonable cost machines which further reduce physical and mental effort they will be in demand. Rapid advances have been made already not only in the application of servo mechanisms, but also in new circuits in the servo mechanisms themselves.

Although the company was originally interested in electronics solely in connection with machine tools, he said that it already appears that some of the devices with which Seneca Falls has been experimenting will probably be applicable to other fields.

## Magnavox Expands, Appoints Carlton

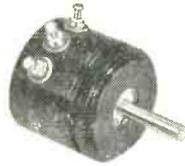
MAGNAVOX expanded its operations into the field of fundamental electronic research by forming a new division of the company to be known as Magnavox Research Laboratory located in Los Angeles, California.

Ragnar Thorensen has been named director of research to head

# Aerohm Precision Potentiometers

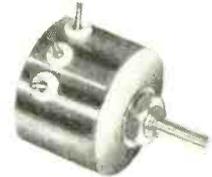
A Complete Line of  
Micro-miniature  
and Miniature Wire-wound

## "LO-TORK" POT



Designed for minimum-torque uses. Minimum torque is 0.01 inch-ounce. Dissipates one watt at 80° C. Resistances — 100 to 100,000 ohms. Weight is only 1/2 ounce. Ganging to 6 decks, internal clamps hold 7/8 in. diameter.

## "HOT-POT"



Designed for high-temperature use. Dissipates one watt at 200° C. Dissipates five watts at 80° C. Resistances 1,000 to 25,000 ohms. Stainless steel case, one inch dia. by 11/16 in. depth behind panel. Teflon-insulated terminals.

These potentiometers have standard linearity of .5%, special order .25%; precision toroidal winding allows winding angles to 360°, standard 354°.

## Micro-miniature Series AP 1/2



Two watts continuous at 80° C. Resistances from 10 to 20,000 ohms; 5% tolerance standard. Diameter is 1/2 in., depth is 1/2 in. Weight is only 1/4 ounce. Sealed well enough for potting.

## Miniature Series RT/RTS 7/8



Precision wire-wound construction. Three watts continuous at 80° C. Resistances 10 to 50,000 ohms. Diameter 7/8 in., depth is 3/8 in. Weight is only 1/2 ounce. Independent linearity 3% standard.

## Ganged Units



The Series AP 1/2, AP 1-1/8 and the RT 7/8 are easily ganged together with potentiometers of the same series to permit control of the unit by a single shaft.

## Miniature Series AP 1 1/8



Four watts continuous at 80° C. Resistances 10 to 100,000 ohms. Diameter 1-1/8 in., depth 1/2 in. Weight is less than 3/4 ounce.

These potentiometers are precision machined, with bodies of anodized aluminum, line-reamed phosphor bronze bushings, centerless-ground stainless steel shafts, and gold-plated fork-type terminals. Units are fully sealed, and treated with Service-approved moisture-proofing and fungicidal materials. On special order these potentiometers can be processed for operation up to 125° C.

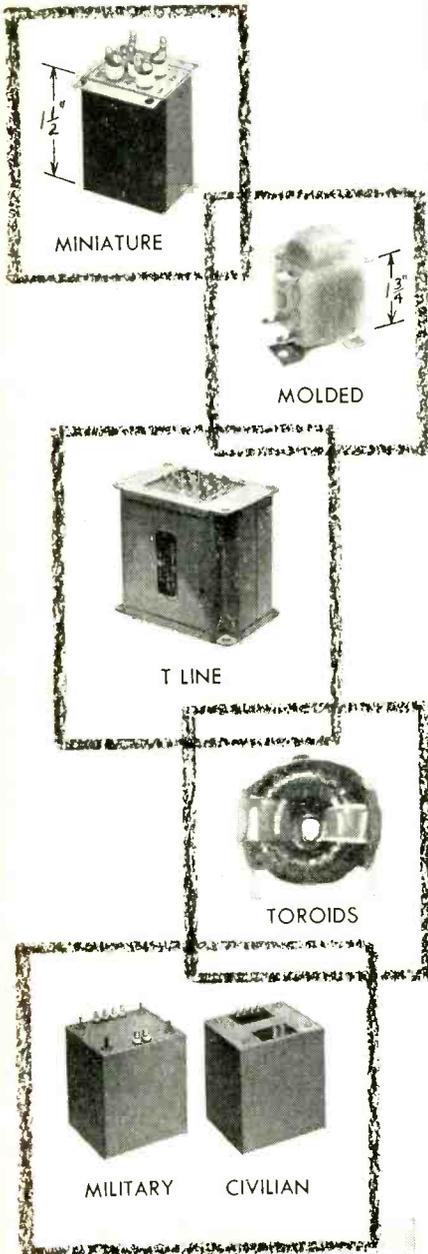
AEROHM potentiometers are individually checked in a quality-control system that guarantees full performance from every unit. Write for information and prices.



**WATERS MANUFACTURING, inc.**

Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES



## KENYON TRANSFORMERS

Meet All Government and Commercial Requirements  
Inquiries Invited



**KENYON TRANSFORMER CO., INC.**

840 Barry St., New York 59

Want more information? Use post card on last page.



Ragnar Thorensen

the laboratory. He formerly headed the computer section of the NBS Institute for Numerical Analysis.

David M. Goodman has been appointed administrative head of the laboratory and west coast regional director of the industrial and defense products division. He was formerly head of management engineering at Hughes Aircraft.

Emphasis will be placed on research and development in high-speed digital computers, military control systems, and data processing equipment at the lab. Research and development is being carried out on magnetic gates and core memories, magnetic drums and other computer components. Long-range plans call for the development of a general research and development center for the firm.

In another move, Magnavox named M. Barry Carlton as general manager of the company's defense products division.

For the past six years, he served as executive director and coordinator of reliability in the office of the Secretary of Defense. In this



M. Barry Carlton

Let Williams help you apply

**FERRIC OXIDES**

to the manufacture of your

**FERRITES**

You'll be well repaid by getting the facts on a special group of Pure Ferric Oxides, developed by Williams especially for use in the manufacture of ferrites.

Williams Ferric Oxides analyze better than 99% Fe<sub>2</sub>O<sub>3</sub>. They contain a minimum of impurities. They are available in a broad range of particle sizes and shapes. Among them, we're certain you'll find one that's "just right" for your requirements. The proper application of Ferric Oxides to the manufacture of Ferrites is our specialty.

Tell us your requirements . . . we'll gladly send samples for test. Chances are good that our Ferric Oxide "Know How" can save you considerable time and money. Address Dept. 25, C. K. Williams & Co., Easton, Pa.

**WILLIAMS**  
COLORS & PIGMENTS

C. K. WILLIAMS & CO.

Easton, Pa. • East St. Louis, Ill.  
Emeryville, Cal.

**P.S.** We also produce IRN Magnetic Iron powders for the Electronic Core Industry, the Magnetic Tape Recording Industry and others. Write for complete technical information.

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS

**JUST OUT!**  
OUR BRAND NEW  
**1954-55**

INDUSTRIAL  
PARTS & EQUIPMENT

**"MASTER  
CATALOG"**

**SPECIAL  
ALMO OFFER**  
A REG. \$6.50 VALUE

YOURS FOR ONLY **1.95**

WHICH WILL BE  
**REFUNDED**  
ON PURCHASES OF  
\$25.00 OR MORE

- \*1,440 pages
- \*Over 85,000 items
- \*Over 8,500 illustrations
- \*Fully indexed
- \*Weights 6 lbs.

COME IN OR WRITE TO

**Almo RADIO CO.**  
509 ARCH STREET

PHILA., PA. PHONE WA 2-5153

Branch Stores: Wilmington, Del., Atlantic City,  
Camden, N. J., Salisbury, Md., Norristown, Pa.

Radio's MASTER - 1954-55

*Radio's*  
MASTER



for  
**BUYING**  
wisely  
for  
**SPECIFYING**  
intelligently  
for  
**SELLING**  
rapidly

# TWIN Power Supply

*Electronically  
Regulated for  
Precise  
Measurements*



Two independent sources of continuously variable D.C. are combined in this one convenient unit. Its double utility makes it a most useful instrument for laboratory and test station work. Three power ranges are instantly selected with a rotary switch:

- 175-350 V. at 0-60 Ma., terminated and controlled independently, may be used to supply 2 separate requirements.
- 0-175 V. at 0-60 Ma. for single supply.
- 175-350 V. at 0-120 Ma. for single supply.

In addition, a convenient 6.3 V.A.C. filament source is provided. The normally floating system is properly terminated for external grounding when desired. Adequately protected against overloads.

Dimensions: 16" x 8" x 8"

Twin Power Supply Model 210

Complete \$140.00

Shipping Wt. 35 lbs.

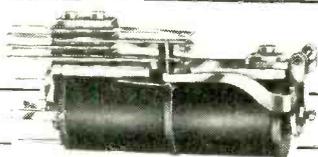
*Inquiries Invited on our line of Regulated Power Supplies*



**FURST**

**ELECTRONICS, INC.**

3324 W. Lawrence Ave., Chicago 25, Illinois



Joe:

Order **KURMAN TELEPHONE RELAYS** for our latest jobs. They've got a tremendous variety for all types of applications. Parts are interchangeable with all standard telephone relays! Prices are competitive — and they're meeting their schedules. Send for complete catalog L.

O.K. *J.S.*

**KURMAN ELECTRIC CO., INC.**  
Quality Relays Since 1928  
35-18 37th St., Long Island City 1, N. Y.

## New Catalog answers O-ring questions

You'll find complete installation data — and the answers to most O-ring questions — in the new O-ring catalog 9-B given free by Minnesota Rubber. No matter how tough your O-ring problem, rest assured that Minnesota Rubber will find the best answer at the lowest possible cost.

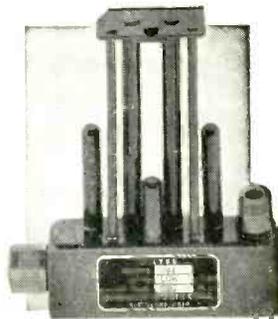
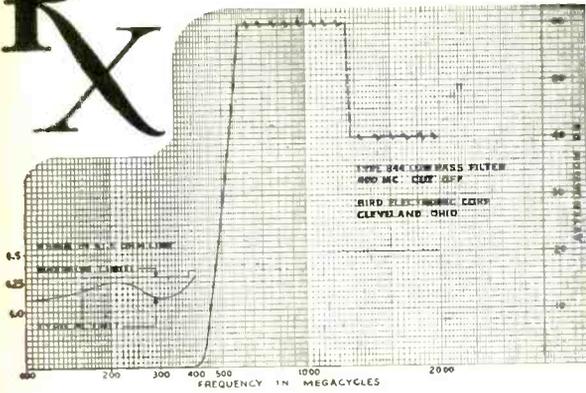
Minnesota Rubber is the world's largest manufacturer of O-rings. Many are used today in the finest electrical systems. Write today for complete details. Don't forget to request your free catalog 9-B, "O-rings."

### Minnesota Rubber and Gasket Company

3630 Wooddale Avenue, Minneapolis 16, Minnesota,  
Dept. 311, Phone Mohawk 9-6781



# Rx for HARMONIC TROUBLES



**Model 844  
Low Pass Filter**

• Suppression of low-order harmonics in transmitters operating below 400 mc is the prime function of Model 844 Low Pass Filter. 40 db or more attenuation of 2nd to 5th harmonics of transmitters operating between 225-400 mc is afforded. Insertion loss and VSWR are very low thruout the pass band. Teflon insulation and rugged construction thruout assures reliability.

**FREQUENCY RANGE** — pass band 0-400 mc. Stop band 500-2000 mc.  
**POWER RANGE** — 150 watts maximum.  
**IMPEDANCE** — 50 ohms. VSWR better than 1.35 thru pass band.

**CONNECTORS** — Type N. One male and one female. Filter is reversible with equal results.  
**ATTENUATION** — pass band -3db or less below 400 mc. Stop band -40db or more 500 to 2000 mc.

**PHYSICAL DIMENSIONS** — 5½" H x 5" W x 1". Weight — 12 oz.



**BIRD ELECTRONIC CORP.**  
1800 EAST 38<sup>TH</sup> ST., CLEVELAND 14, OHIO  
TERMALINE Coaxial Line Instruments

**NEELY ENTERPRISES**  
Hollywood • San Francisco  
Albuquerque  
**EARL LIPSCOMB ASSOCIATES**  
Dallas • Houston

position he guided the government's program for improving the performance of military electronic equipment and helped to establish a single, sound, integrated military electronics program.

Prior to joining the department of defense staff, Carlton was technical administrator of the radio countermeasures division at the Naval Research laboratory. He also served for more than two years as a member of the radiation laboratory at MIT where he participated in the initial development of radar and radar beacons.

He will be retained as an expert consultant, without compensation, in the office of the assistant secretary of defense for applications engineering to continue his contribution to the reliability program and defense effort.

## Lion Appoints New Color TV Engineer

BUFORD COX has been appointed assistant chief color engineer of the television and radio division of the Lion Manufacturing Corp. in Chicago.

Cox was formerly associated with the Hallcrafters Co. in Chicago.



## Gyromechanisms Names Benson Vice-President

ROBERT M. BENSON has been appointed vice-president of Gyromechanisms in charge of the west coast division.

He will coordinate sales and engineering activities for Gyromechanisms' Western customers.

Benson was formerly chief en-

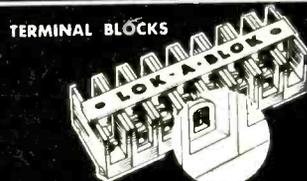
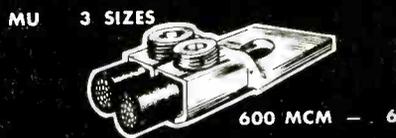
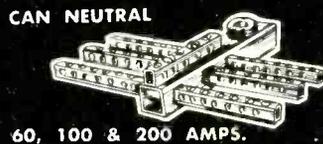
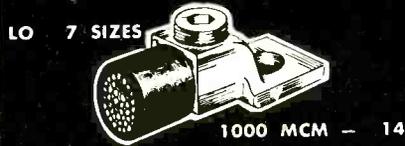
*hot off the griddle!*  
**ILSCO'S**  
*New*  
**CATALOG**



*for solving connector problems*

WRITE TODAY for your personal 80-page colorfully illustrated copy.

ILSCO 5753 MARIEMONT AVE., CINCINNATI 27, OHIO



gineer of American Gyro Corp. Previously he had been supervisor of a gyro design and development unit at the aerophysics laboratory of North American Aviation and a project engineer with Sperry Gyroscope.



### Assembly Products Moves Into New Plant

ASSEMBLY PRODUCTS is moving into a modern 'all on one floor' building in Chesterland, Ohio with nearly double the usable floor space that was previously occupied.

Sales of the firm's instruments and controls for automation are running about 25 percent ahead of last year—the best previous year, according to Bradley Thompson, president.

### Varian Associates Elects Vice-Presidents

VARIAN ASSOCIATES appointed Emmet G. Cameron as vice-president for production and Merle R. Zinser as financial vice-president.

Cameron, works manager of the Varian manufacturing plant in San Carlos, joined the company in April 1953 and was elected to the board of directors in 1954. He has previously served as works manager with Sarkes Tarzian, as chief engineer at Federal Telephone and Radio and as production manager of Heintz and Kaufman, vacuum tube manufacturers.

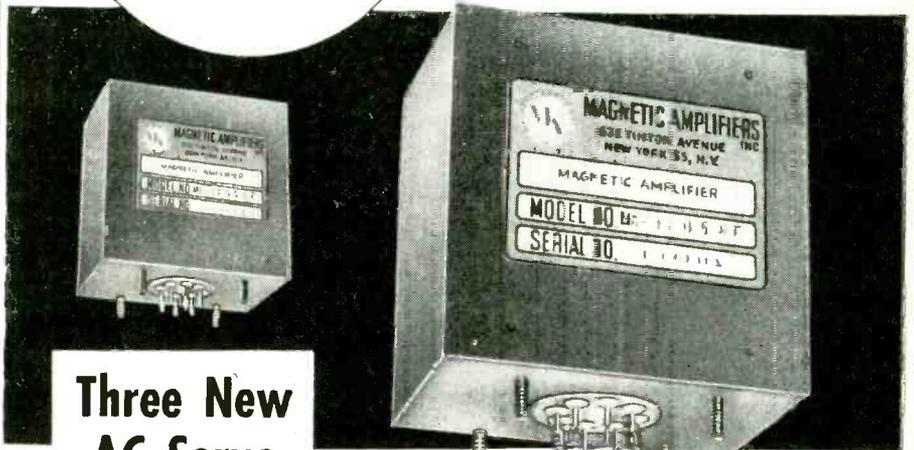
Zinser, controller and business manager, has been with Varian Associates since 1951. Prior to joining Varian, he was assistant to

# NEW!

## MINIATURE

## SERVO

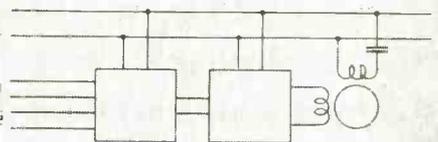
# Magnetic Amplifiers



### Three New AC Servo Types Available..

115 VOLTS  
60 or 400 cps.

INPUT NO. 1  
INPUT NO. 2



#### STANDARDIZED SERVO SYSTEMS AND OTHER STANDARD TYPES FOR AUTOMATIC CONTROL —

In addition to new lines illustrated, many standard and higher power magnetic amplifiers are available for applications involving automatic control.

#### CUSTOM DESIGNS FOR SPECIAL REQUIREMENTS

— we design  
and engineer  
complete servo  
or automatic  
control systems

AFFILIATE OF  
THE GENERAL  
CERAMICS  
CORPORATION



#### ● MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS

Supply: 115 volt 400 cps.  
Power output: 3.5, 5, 10, 18 watts  
Sensitivity: 1 volt AC  
Response Time: .03 sec.  
Lowest Cost — Smallest Size  
For further information request Form S493

#### ● MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIER

Supply: 115 volt 400 cps.  
Power output: 5, 10, 15, 20 watts  
Sensitivity: .1 volt AC  
Response Time: .008 to .1 sec.  
Highest performance — All magnetic  
For further information request Form S496

#### ● TRANSI-MAG\*: TRANSISTOR + HIGH GAIN MAGNETIC AMPLIFIER

Supply: 115 volt 400 or 60 cps.  
Power output: 2, 5, 10, 15, 20 watts  
Sensitivity: .08 volt AC into 10,000 ohms  
Response Time: .01 sec.  
Fast response at high gain  
For further information request Form S499  
(400 cps.); Form S497 (60 cps.)

\*TRADE NAME

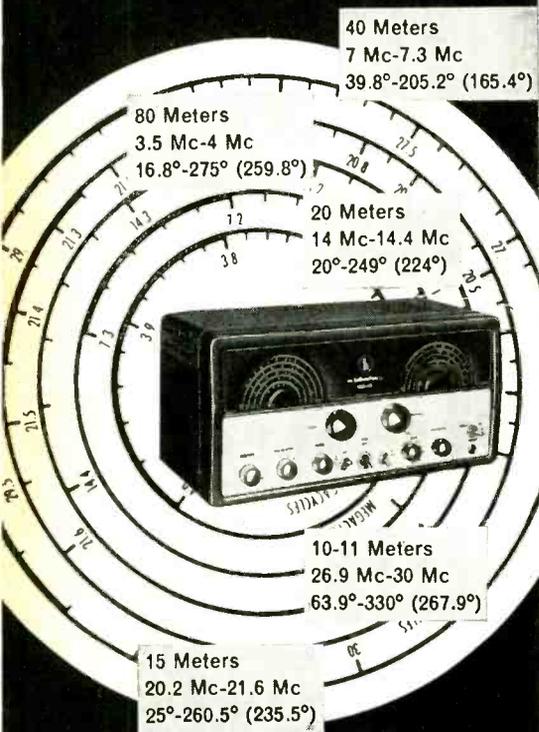
## MAGNETIC AMPLIFIERS • INC

Telephone: Cypres 2-6610  
632 TINTON AVE., NEW YORK 55, N. Y.

Leading a brand new line...

**1000°**

**OF CALIBRATED BANDSPREAD!**



**MODEL S85**

S-85 Receiver (AC)  
S-86 Receiver (AC-DC)  
105/125 V. 50/60 cycle  
Either \$119.95

We here at Hallicrafters are proud of our new communications line, especially the new S-85 receiver with over 1000° of calibrated bandspread. Broadcast band 540-1680 Kc and three short-wave bands 1680 Kc-34 Mc on large easy to read dial. Separate bandspread tuning condenser and built-in speaker. Seven tubes plus rectifier. Coupon below brings complete specifications.

*Used by 33 governments,  
Sold in 89 countries.*

**hallicrafters**  
Chicago 24, Illinois



**MAIL THIS COUPON**

FREE  World-wide time converter  
Specification sheet  S-85(S-86)  
 S-95(S-94)  S-38D

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_  
 Ham (call letters \_\_\_\_\_)  Listener  
Occupation \_\_\_\_\_



Emmet G. Cameron

the president of Marchant Calculating Machine Co.

The other officers of the firm are Russel H. Varian, president; H. Myrl Stearns, executive vice-president and general manager; Sigurd F. Varian, vice-president for engineering; Richard M. Leonard, secretary and Charles J. Marsh, treasurer.



**Della-Corte Joins Anton Labs**

JOSEPH P. DELLA-CORTE has been appointed director of engineering of Anton Electronic Laboratories.

Della-Corte will head up the staff of physicists, electrical engineers, mechanical engineers, radiochemists and technicians currently engaged at AEL in the design, development and production of nuclear and electronic equipment.

Prior to his appointment, Della-Corte served for eighteen years with the Fairchild Camera and Instrument Co. During this time he held positions of chief engineer, director of engineering and prior to his resignation, assistant to the president. He holds several patents

Plan Now  
for the **4** biggest days  
in radio-electronics!

**I R E** National Convention  
and  
**RADIO ENGINEERING SHOW**

**March 21-24**  
**New York City**

Once again, you'll soon have the opportunity of appraising all of the important new developments of the past year in radio and electronics. In 4 days, from March 21 through 24, the I R E National Convention and Radio Engineering Show will give you the complete picture of significant developments in the industry achieved during the past year.

**You'll hear** the presentation of scientific and engineering papers of vital interest to you, carefully arranged into related groups of technical sessions.

**You'll see** more than 700 exhibits in a 4-acre panorama of all that's new in the radio and electronics field, at Kingsbridge Armory and at Kingsbridge Palace.



The Institute  
of Radio Engineers  
1 East 79th Street,  
New York City

Want more information? Use post card on last page.

**BUILD Professional Finished CABINETS  
IN YOUR OWN SHOP  
WITH**

**Widney DORLEC  
CABINET  
COMPONENTS**



The Widney Dorlec Cabinet System, consisting of a series of pre-fabricated, dural die-cast corners, extruded dural sections and other special components, now makes it possible to build modern, full-radius cabinets to any set of dimensions without special tools!

For Free Catalog & Price List, write Dept. E-12  
**BRITISH INDUSTRIES CORPORATION**  
164 Duane Street New York 13, N. Y.

**You Name It EISLER Makes it...**  
GLASS TO METAL

**ELECTRONIC GLASS WORKING EQUIPMENT for  
RADIO, TELEVISION TUBES, INCANDESCENT LAMPS, GLASS  
LATHES for TELEVISION TUBES**

We make Transformers, Spot and Wire Butt Welders, Wire Cutting Machines and 500 other items, indispensable in your production. Eisler Engineers are constantly developing New Equipment. If you prefer your own designs, let us build them for you. Write to Charles Eisler who has served The Industry over 34 years.

**IF YOU NEED ANY SPECIAL CAMS  
WE MAKE THEM**



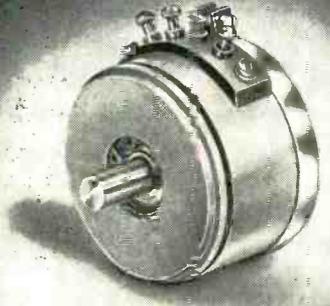
MISC. CAMS M.S.

World Famous for Over 33 Years  
*Charles Eisler* M.E.

DR. CHAS. EISLER M.E. PRES.  
**EISLER ENGINEERING CO., INC.**  
751 So. 13th St., NEWARK 3, N. J.



**PRECISION**



**POTENTIOMETERS  
LINEAR - NON-LINEAR**

Ratray precision potentiometers have a wide scope and cover many types and sizes, in the field of wire-wound units of high accuracy, long life and stability.

If you have a requirement involving procurement of precision potentiometers, in small or large quantities — see us first for the best in standard and special designs.

Model 162-C shown here is typical of our compact design, with mechanical and electrical capabilities of highest quality, as shown by comparative tests.

Technical Bulletin 3-54 Now Available

**GEORGE RATRAY & CO., Inc.**  
116-08 MYRTLE AVENUE  
RICHMOND HILL 18, N. Y.

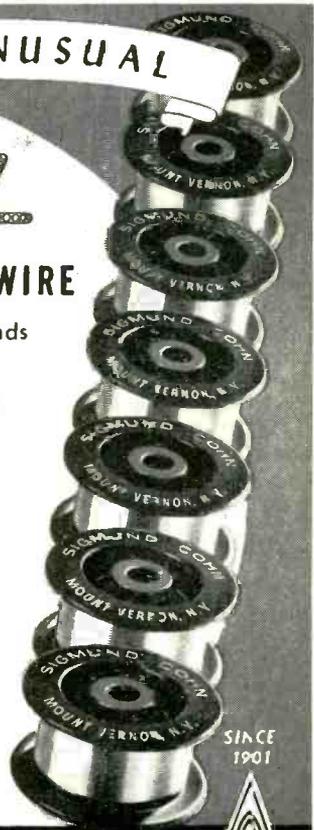
**SPECIALISTS in the UNUSUAL**

**NEW Braided**

**No. 479<sup>®</sup> PLATINUM ALLOY WIRE**  
.0008" Wire Diameter—16 Strands

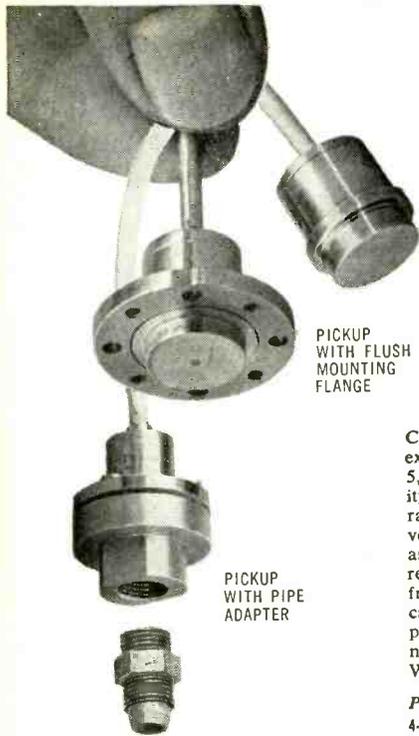
- Over 90% Platinum for maximum corrosion resistance . . .
- Extra-long flex-life . . .
- High tensile strength . . .
- Easily welded or soldered . . .
- Valuable as a flexible lead . . .
- Practical for many applications where usual products fail . . .

We invite inquiries from research or idea men. Write for list of products



**SIGMUND COHN CORP.** Metallurgists and Producers of Small Wire  
121 South Columbus Avenue • Mount Vernon, N. Y.





These CEC miniature precision instrument-type

**pressure pickups**

cover a wide performance range

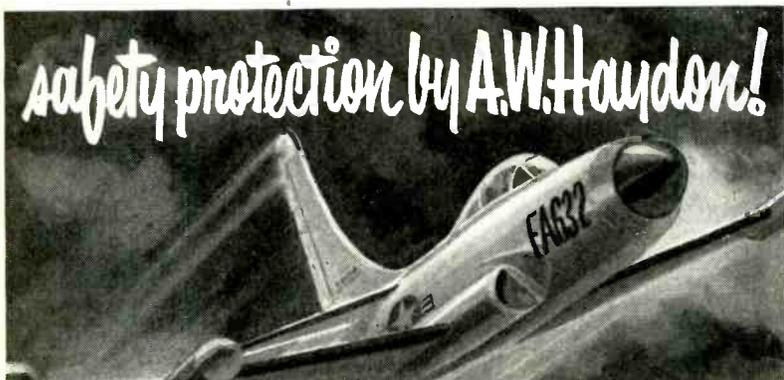
Consolidated pressure pickups feature a-c or d-c excitation—full-scale pressure ranges from 5 to 5,000 PSI—linearity within 1%—negligible sensitivity to acceleration and vibration—wide temperature range from -65°F to +250°F—output 20 millivolts with 5-volt excitation—flush-type diaphragm as standard construction—stainless steel, corrosion-resistant construction—overload protection—high frequency response—variable-resistance types—calibration certificate with each pickup. Electrical principle is unbonded strain-gage windings connected in a four-arm bridge as the active element. Write for Bulletin CEC 1552-X2 and price list.

Pickup Type	Range	Dimensions
4-310 gage pressure pickup	5 to 250 PSI	0.5" diam. x 0.7"
4-311 gage pressure pickup	5 to 5,000 PSI	0.625" diam x 0.875"
4-312 absolute, differential, or gage pressure pickup	5 to 250 PSI	0.5" diam x 0.7"



**Consolidated Engineering CORPORATION**

300 North Sierra Madre Villa, Pasadena 15, California

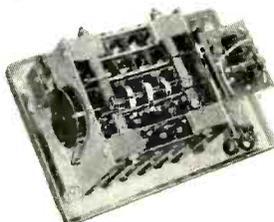


Lockheed F-94C Starfire

"icing conditions heavy—de-icers working fine—bandits on screen..."



7800 Series  
**A. W. HAYDON**  
Repeat Cycle  
Timer  
Lockheed Wing De-Icer



Custom Designed By THE A. W. HAYDON COMPANY To Control the Power for 10 De-icing Circuits carrying 35 amperes 3 phase 220 Volt 400 Cps. A.C. to the de-icing heaters in 10 wing sections. Each heater is energized for a 10 second interval in an accurately controlled sequence.

WHEN TIMING POSES A PROBLEM — CONSULT

The **A.W. HAYDON COMPANY**  
235 NORTH ELM STREET  
WATERBURY 20, CONNECTICUT  
Design and Manufacture of Electrical Timing Devices

general catalogs sent on request

for radio navigational devices and was a pioneer in the radio navigation field.

**Graflex Purchases Strobe Research**

STROBO RESEARCH, a 15-year-old Milwaukee concern which has developed electronic flash units for photography and electronic devices for the armed forces, has been purchased by Graflex of Rochester, N. Y.

In the purchase, Graflex acquires the capital stock of Strobe Research, which becomes a wholly-owned subsidiary of the Rochester firm.

All Strobe Research manufacturing, sales and service activities will



E. R. Farber, left, and G. C. Whitaker

continue in Milwaukee for the time being, according to G. C. Whitaker, Graflex president.

Edward Farber, president of Strobe Research, will continue in that capacity.

**Electronics Corp. Adds Two Vice-Presidents**

COLONEL JOHN C. HARVELL, U.S.-A. F., was appointed vice-president of the military and marine divisions of the Electronics Corp. of America.

Colonel Harvell joined Photoswitch earlier this year as assistant general manager following his resignation as Deputy Commanding General of Air Force Procurement District, a post to which he had been named in 1950. His new appointment reflects the consolidation of Photoswitch, Combustion Control Corp., Fireye Corp. and

Photoswitch Marine Division into the newly-organized Electronics Corporation of America.

Wayne B. Nottingham, has been appointed vice-president for research of the company. Raymond H. McFee was named director of research.

Dr. Nottingham continues as a full professor of physical electronics at MIT. For some years he had been associated with Photoswitch as director of research.

Dr. McFee formerly was project director for Photoswitch. He was a research physicist at MIT and worked in the fields of crystals, optics, infra-red and micro-wave. Burton E. Shaw has been named vice-president for operations and vice-president of the Photoswitch division.

Shaw has been vice-president of Photoswitch since shortly after he became associated with the company in 1946.

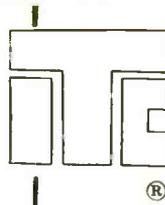


### New York University Appoints Philpott

LAVERNE R. PHILPOTT has been appointed a coordinator in the research division of New York University's College of Engineering.

Dr. Philpott will direct and participate in basic research problems including studies fundamental to air navigation and scientific photography.

He received a Presidential citation in 1946 for his work with R. M. Page and others of the Naval Research Laboratory who helped to make radar a practical weapon in



## METLFILM TRIMMER POTS

featuring

**MINIATURE SIZE**  
**INFINITE RESOLUTION plus "ZERO PHASE-SHIFT"**

### DIMINUTIVE SIZE

... (approximately  $\frac{3}{8}$ " square end surface), permits stacking seven units in a square inch of panel area. Ideal for trimming adjustments in computers, analyzers, telemeter and airborne electronic equipment.

Rugged construction insures dependability despite wide changes in ambient temperature and extreme conditions of salt spray, humidity and vibration.

### INFINITE RESOLUTION

... of the unique deposited metal resistance element embodied in Type RFT Metfilm Trimmer Potentiometer is available over a wide resistance range. 9000° of adjustment, the equivalent of 25 turns of the adjustment screw on which sliding contact rides, permits voltage settings to be set and maintained with extreme precision.

### SPECIFICATIONS

#### ELECTRICAL

RESISTANCE RANGE: 50-25,000 ohms

TOTAL RESISTANCE TOLERANCE:  $\pm 10\%$

INDEPENDENT LINEARITY:  $\pm 5\%$  of total resistance

RESOLUTION: Infinite

POWER RATING:  $\frac{1}{2}$  watt at 40°C.,  $\frac{1}{4}$  watt at 125°C. per JAN-R-19 test specification.

AMBIENT TEMPERATURE RANGE: -65°C to +125°C.

TEMPERATURE COEFFICIENT OF RESISTANCE ELEMENT:

.000250/°C (nominal)

DIELECTRIC TEST: 500 volts DC between all leads, shaft and mounting eyelets for 5 seconds without flashover or breakdown.

#### MECHANICAL

RESISTANCE ELEMENT: Metal film deposited on inert base.

MECHANICAL ROTATION: 26 complete turns (nominal).

USABLE MECHANICAL ROTATION: 90% minimum of slider travel is on resistance element.

END STOPS: Will withstand 1 inch pound maximum applied torque.

VIBRATION: Exceeds exacting requirements of MIL-E-5272a.

For further details write:

## TECHNOLOGY INSTRUMENT CORP.

533 Main St., Acton, Mass. Colonial 3-7711  
West Coast Engr'g. Facility P.O. Box 3941 North Hollywood, Calif. POplar 5-8620  
Plant, 11020 Sherman Way, Sun Valley, California

World War II and a peacetime aid to flight, navigation, and meteorology.

For his contribution to the development of an American system of radio recognition, Dr. Philpott also received in 1947 the Navy's highest award for distinguished civilian service.

He has designed radio countermeasures "jamming" equipment, naval fire control radar, and industrial electronic control equipment. In recent years, he invented and patented a system of dry-color facsimile, permitting radio transmission of pictures directly in color, without chemical processing.

Before coming to NYU, he was chief scientist for Balco Research Laboratory in Newark, N. J. He also has been employed by Finch Telecommunications and various government agencies. At the Naval Research Laboratory he was a physicist and consultant from 1934 to 1947.

### Eitel-McCullough Names Ceramic Chief

PAUL D. WILLIAMS has recently been appointed chief of ceramic development for Eitel-McCullough, manufacturer of Eimac electron power tubes.

Williams will supervise the work being done at Eimac with ceramic materials to replace glass in electron-power tube construction. The use of ceramics will make possible the production of smaller, more rugged tubes with greater resistance to both thermal and physical shock without sacrificing power,

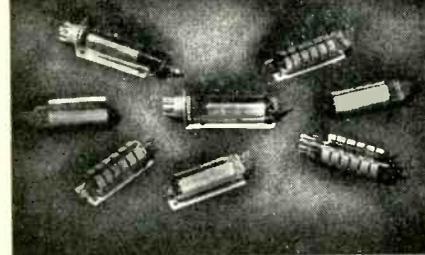


Paul Williams

COOL



## BIRTCHEK KOOL KLAMPS



KOOL KLAMPS are made of a specially developed, heat treatable alloy 99½% pure silver. Under certain conditions, KOOL KLAMPS reduce subminiature tube temperatures as much as 40° C.

In addition, KOOL KLAMPS hold tubes firm and secure, regardless of how they are shaken or vibrated.

Where heat conditions are less critical, beryllium copper KOOL KLAMPS are available.

### The BIRTCHEK CORPORATION

4371 Valley Blvd.  
Los Angeles 32, California

Dept. E-72-4

Please send Bulletin which describes and illustrates Kool Klamps in detail.

Company .....  
Attention of .....  
City ..... State .....

Want more information? Use post card on last page.

# convert

SELF-BALANCING  
POTENTIOMETERS TO

# digital read-out

PRINTED TAPE • PUNCHED CARD  
PUNCHED TAPE

Complete... Easy to Install... Reads from 0-1000; Accuracy ± 0.1%. A complete system kit for obtaining digital information from standard self-balancing potentiometers. Easy to install, complete with all necessary hardware, this conversion does not affect the accuracy of the recording instrument, and no modification of the potentiometer is required. Readings can be taken while the recording pen is moving.

Non-linear calibrations available for use with thermocouple applications.



GIANNINI  
ENCODER  
KIT



CODED  
COMMUTATOR:

Digitizes shaft position. Binary or Decimal Codes.

## Giannini

SALES ENGINEERING OFFICES:  
NEW YORK, N. Y.—580 FIFTH AVE.—JUDSON 6-7500  
LOS ANGELES, CALIFORNIA—RYAN 1-7152

Laboratory Apparatus Division

G. M. GIANNINI & CO., INC.  
PASADENA 1, CALIF.

Want more information? Use post card on last page.

**UNIVERSAL**  
meets exacting  
**DESIGN**  
**REQUIREMENTS**

*in*

**TOROIDAL COILS**

Our specially designed machines now wind Toroidal Coils quicker and with more accuracy than other standard methods. Universal Toroidal Coils in any size wire to your specifications—are economical in materials and possess the smallest external leakage field of all other shapes.

Universal Toroids wound to Mil-T-27 specs.

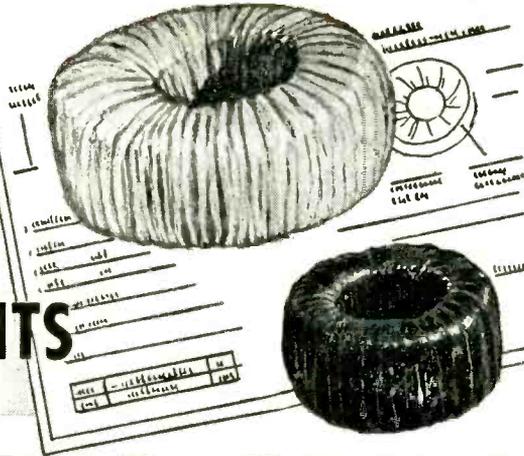
Wire sizes #42 (.00249 mils) to #10 (.1019 mils).

Excellent Delivery in small or large quantity.

Engineering Service Available.

"ACCURACY IS A UNIVERSAL WORD"

**UNIVERSAL**  **MANUFACTURING COMPANY, INC.**  
410 Hillside Ave., Hillside, N. J.



**NOW** the smallest  
gyro in the field...  
**74.6%** smaller  
**61.2%** lighter



**Pacific**

**FREE GYRO**

Smaller...lighter...yet this new Pacific Free Gyro conforms to all military environmental specifications and will outperform similar gyros of much larger size and weight.

Particular attention has been given to the design of a unique, simplified caging system. Only one moving part on the gimbal suspension permits instant, positive caging without damage to the Gyro...and instantaneous uncaging with 28 volts DC. Tested and proven, this simple and reliable caging system insures trouble-free operation.

Extremely rugged, the new Pacific Free Gyro operates on 115 volts, 400 cycles, single or three phase. Precision potentiometer on outer gimbal with resistance from 500 to 20,000 ohms. Write for complete detailed specifications.

**PACIFIC SCIENTIFIC —**  
PIONEERING IN THE  
FIELD OF AIRCRAFT  
INSTRUMENTATION  
SINCE 1919

**Pacific** **SCIENTIFIC CO.**

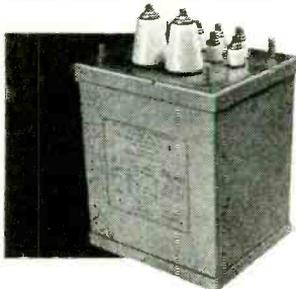
LOS ANGELES, CALIF., 1430 Grande Vista Ave.  
SAN FRANCISCO, CALIF., 25 Stillman Street  
SEATTLE, WASHINGTON, 421 Michigan Street  
ARLINGTON, TEXAS, 111 East Main Street  
Eastern Representative: Aero Engineering Inc.

Have you seen

**CORNING'S NEW PRICES**

on Fixed Glass Capacitors?

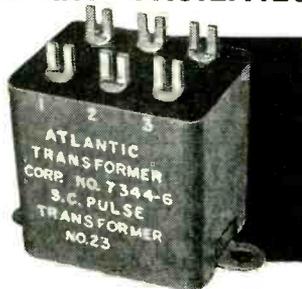
**TESTED PER MIL-T-27 IN OUR "IN-PLANT" FACILITIES**



**HIGH VOLTAGE PLATE TRANSFORMER**

We are now producing government and commercial transformers in quantity. Our top flight engineering staff and complete electrical test facilities can help solve your toughest transformer problems.

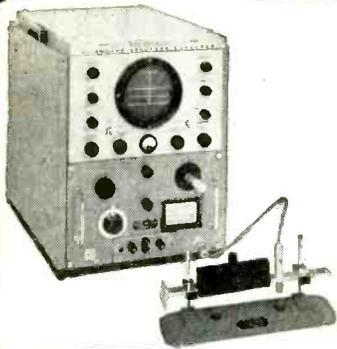
"In-plant" testing means a minimum of waiting before passing Government tests. Write or phone for detailed information.



**MOLDED MINIATURE BLOCKING OSCILLATOR TRANSFORMER**

**ATLANTIC TRANSFORMER CORP.** 30 Hynes Ave., Groton, Conn.

**NOW...K-BAND  
COVERAGE  
TO 40,000 MC/S**



**with VECTRON'S SA25  
Microwave Spectrum Analyzer**

**THE VECTRON 25 SERIES K-BAND MICRO-WAVE SPECTRUM ANALYZERS** are complete, including a display unit, an R. F. assembly and a K-band mixer to cover the desired portions of the "K-band" region of the microwave spectrum.

Due to the relatively recent development of equipment for use in K-band and the band's extremely broad range, it has been necessary to develop several assemblies to cover economically the most active portions of the spectrum.

- SA25K1 — 15.3 kmc/s to 17.7 kmc/s
- SA25K2 — 22.8 kmc/s to 26.4 kmc/s
- SA25KQ1 — 34.0 kmc/s to 38.6 kmc/s

**SPECIAL K-BAND MIXER-R. F. ASSEMBLY COMBINATIONS** provide coverage of other ranges from 12.4 to 40.0 kmc/s.

**INDIVIDUAL K-BAND R. F. HEADS** may be purchased separately, or with the new Vectron SA25 Microwave Spectrum Analyzer.

**THE SA25 SPECTRUM ANALYZER** includes these features:

- 5" medium persistence CRT display.
- Choice of I. F. Amplifier — 20 kc bandwidth, 22½ mc input; or 50 kc bandwidth, 50 mc input.
- Dual range sweep—2 to 20 or 6 to 60 CPS in two overlapping ranges.
- Standard CRT bezel for camera or hood.
- Improved frequency spread control.
- New wavemeter marked gain control.

These and the many other features of the Vectron SA25 Microwave Spectrum Analyzer can be utilized at lower microwave frequencies with your choice of Vectron's interchangeable R. F. Heads . . . providing specific tuning ranges on fundamentals from 800 to 10,250 mc/s.



**SEE ADVERTISEMENT  
AT RIGHT** →

**SEND FOR  
BULLETIN "K-BAND"**

**VECTRON, inc.**

*Electronic and Electro-Mechanical Equipment*  
404 MAIN STREET, WALTHAM 54, MASS.

**VECTRON FOR DESIGN AND MANUFACTURE OF:**  
Gyros and Gyro Systems    Precision Mechanical Devices  
Gyro Stabilized Platforms    Computers and Calculators  
Servo and Gyromechanisms    Special Gears and Assemblies  
Aircraft Instruments        Synchros and Control Motors

Want more information? Use post card on last page.

352

PLANTS AND PEOPLE

(continued)

according to the company.

Williams joined the Eimac staff in 1942 as a research chemist and later became chief research chemist. He was responsible for the development of Eimac Y-3 Grid Wire, the Eimac Pyrovac plate and the Eimac moulded glass header.

## National Electrical Elects New President

A. S. CLARKE has been elected president of National Electrical Machine Shops to succeed the late E. M. Nevils, Jr. The company manufactures communications equipment and electronic instruments. It employs 400 people in its Silver Spring, Maryland plant.

Clarke was formerly vice-president in charge of engineering of the company. During World War



A. S. Clarke

II he was senior technical aide to the chief of division 4 of the National Defense Research Committee. He was responsible for setting up production facilities for classified ordnance developments, and for his war work received the Presidential Certificate of Merit and the Naval Ordnance Development award.

## New Transistor Firm Is Formed

A NEW COMPANY, the General Transistor Corp. has been formed to engineer and manufacture high quality transistors and related semi-conductor products.

President of the firm is Eugene Kral, formerly with Eugene Kral &

**VECTRON'S NEW SA 25  
Microwave Spectrum Analyzer**



**covers the Microwave Spectrum  
800 mc/s to 10,250 mc/s  
ON FUNDAMENTALS**

**ACCURATE** — Calibrated micrometer wavemeters . . . lifetime accuracy to .05% with incremental accuracy to better than .005% independent of Klystron changes. Transmission wavemeters for maximum indication without "pulling".

**RELIABLE** — Double conversion for stability with minimum drift . . . standard replaceable klystrons . . . no complex harmonic interference. Highly efficient circuits with minimum power consumption, designed for cool, continuous operation.

**ECONOMICAL** — 99.8% of all microwave research, development, production, test, installation and maintenance requires precise work in a specific portion of the microwave spectrum, usually only a few hundred megacycles wide. Compromise coverage of large areas costs more and delivers less.

**VECTRON'S** new SA 25 Microwave Spectrum Analyzer provides adequate tuning range for the 99.8% of spectrum analyzer requirements through the use of interchangeable R.F. Heads.

25L1 800-2400mc/s	25X2a 5700-7425mc/s
20S1 2400-3650mc/s	25X2 6250-7425mc/s
20S1a 2400-4040mc/s	20X1b 9500-10,250mc/s
25C1b 4240-4910mc/s	20X1a 8500-10,250mc/s
25C1a 4240-5900mc/s	20X1 8500-9660mc/s
25C1 5100-5900mc/s	25K1 15,300-17,700mc/s
25X2b 5700-6600mc/s	25K2 22,800-26,400mc/s
	25KQ1 34,000-38,500mc/s



**WRITE FOR  
BULLETIN SA25**  
and bulletins on  
R. F. Heads  
in the frequency  
range you use.

**NEW K-BAND R. F. ASSEMBLIES  
SEE ADVERTISEMENT AT LEFT**

**VECTRON, inc.**

*Electronic and Electro-Mechanical Equipment*  
404 MAIN STREET, WALTHAM 54, MASS.

**VECTRON FOR DESIGN AND MANUFACTURE OF:**  
Precision Electronic Components    Microwave Test Equipment  
Electronic Networks and Filters    Radar Units and Systems  
Complete Electronic Systems    Special Test Instruments  
Variable Frequency Power Supplies    Electronic Control Units

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS

Co., manufacturers of quartz crystals. His experience with quartz, the processing of which is similar to that of germanium in some respects, has enabled the firm to develop wafer surfacing techniques for transistors with low noise characteristics. The application of x-ray diffraction techniques to properly orient the germanium wafers, prior to alloying, has improved the yield of highest quality transistors, according to the company.

Vice-president of the firm is Herman Fialkov, formerly chief engineer of the germanium division of Radio Receptor Co. Fialkov has also served in engineering capacities with Emerson Radio, the Mutual Broadcasting System and Tele-Tone. He has engineered a modern plant and established a process for the manufacture of p-n-p alloy transistors.

### Raytheon Appoints Black And Nichols

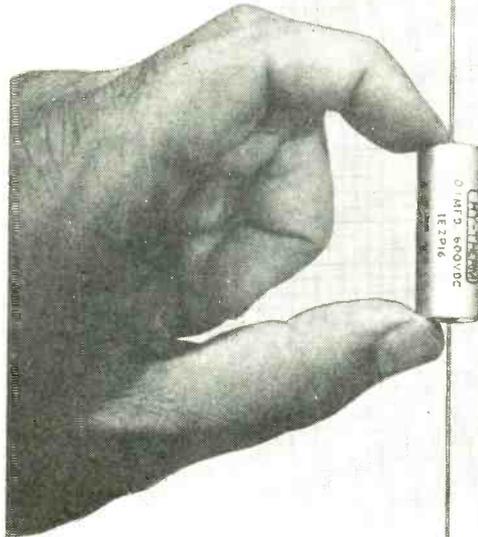
NATHANIEL B. NICHOLS, manager of the Raytheon research division, has been appointed an assistant vice-president. K. C. Black was named head of the communications engineering department.

Nichols joined the firm in 1951. He helped develop several of Raytheon's unusual products, leading his scientific group through the investigative phases of work that eventually made possible the mass production of transistors. He helped to develop the "Micronaire" room air cleaner, the "Ultrasonic



Nathaniel B. Nichols

for all applications  
requiring exceptionally  
high insulation  
resistance and unusual  
stability at high  
temperature



2082 Lincoln Ave.,  
Altadena, Calif.  
Sycamore 8-1185  
Offices in  
WASHINGTON, D. C.  
and DETROIT

## HOPKINS "HY-THERM"

New sub-miniature  
high temperature

# CAPACITOR

Hermetically sealed and metal encased, new HY-THERM capacitors have been designed to meet or exceed military requirements (Mil-C-25A). **Example:** At 125°C the minimum insulation resistance is 20 megohm-microfarads and maximum insulation resistance is 500 megohms. Available in all standard values and tolerances. Variety of mounting and circuit combinations. Special units designed to meet individual requirements.



Have a special problem? Write, wire or phone for details, TODAY! Catalog available.

## MANSOL makes Glass Multiform Pellets for GLASS-TO-METAL SEALS

WE CAN FULFILL G-12  
MULTIFORM REQUIREMENTS



### FORMULA 800 MULTIFORMS

Extracted from epoxy resins. "800" can be used in multiforms and for conductive or non-conductive small parts welding at 400° F. It possesses extremely high bonding strength, with no shrinkage, on metals to metals and metals to non-metals.

### MULTIFORMS OF STEATITE

We specialize in small die-pressed ceramic parts held to closest tolerances. All tools and dies are made in our shop to assure quick delivery.

**GLASS MULTIFORMS** — The ideal multiforms for Iron Sealing and Kovar Sealing, matching the expansion of these metals over their entire working range. They resist mercury attack, have ample mechanical strength, and seal readily. Our laboratory is prepared to assist you in selecting the proper glass for any metal.

- If you are still making your own multiforms, Mansol would like to show you how to save money and eliminate rejects.

- Write to Dept. N for the complete story about multiforms, Formula 800 and our production facilities. No obligation of course.



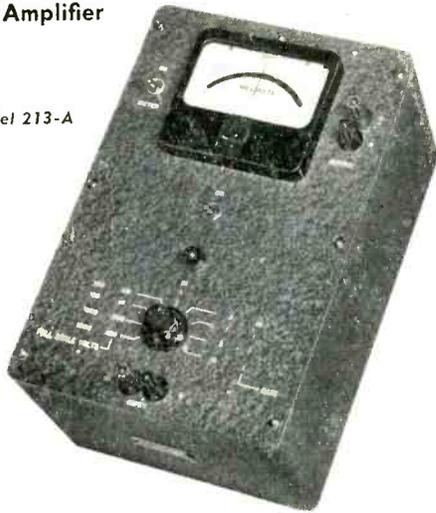
CABLE ADDRESS: MANSOL

# DC MEASUREMENTS

## 5 MICROVOLTS TO 10 VOLTS

The most sensitive and stable DC Millivoltmeter and Amplifier available today.

Model 213-A



- No Zero drift, no zero control.
- Internal noise, 5 microvolts DC.
- Input impedance, meter & amplifier, 2 megohms.
- Zero center meter, direct polarity indication.
- Meter full scale ranges, 1 mv, 3 mv, 10 mv . . . to 10 volts.
- Maximum DC amplifier gain - 1000
- Stabilized amplifier gain and meter indication.

Applications:—Semiconductor diode and transistor studies, preamplifier for CRO and recorders, null measurements, transducer calibration, general circuit design.

PHONE: MIDLAND 3-7548



K. C. Black

Machine Tool" and the single-motion duplicator, an electronic brain for machine tools.

During World War II, he was associated with the Radiation Laboratory of MIT where he headed the servo group of the fire control division. Subsequently, he became research director of Taylor Instrument leaving in 1950 to accept a professorship at the University of Minnesota.

Dr. Black comes to the company from his position as business manager of the Polytechnic Research and Development Co. of Brooklyn, N. Y. He has done engineering and research work for AT&T, Radio Frequency Laboratory of Boonton, N. J., Boonton Research Corp., Bell Telephone Laboratories, Aircraft Radio Corp. of Boonton and Air Associates of Teterboro, N. J.

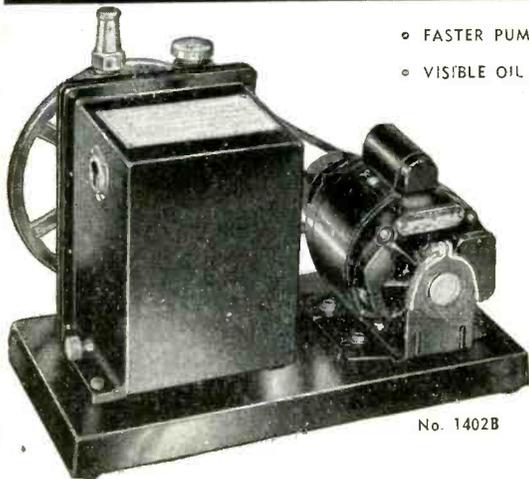
From 1949 to 1952 he was chief scientist at the Naval Air Development Center in Johnsville, Pa., where he was concerned with programs in communications, sonar, radar, counter measures, armament development and missile guidance.

Dr. Black's new position makes him responsible for the design and development of new communications products to fill out Raytheon's line of electronic equipment.

### Electronics Conference Makes First Award

E. D. MCARTHUR, manager of the electron tube section at the GE Research Laboratory and E. F. Peterson, manager of marketing for the company's radio and television department, were recipients of the

## LARGE-CAPACITY HIGH-VACUUM DUO-SEAL PUMP GUARANTEED VACUUM 0.0001 mm Hg. or 0.1 Micron FREE AIR CAPACITY 140 Liters Per Min.



- FASTER PUMPING
- QUIET OPERATION
- VISIBLE OIL LEVEL
- COMPACT DESIGN

Overall dimensions for pump and motor 15½" high and 11" wide x 19½" long.

**1402B. DUO-SEAL PUMP, MOTOR-DRIVEN.** A No. 1402 Pump mounted on a base with a ½ H.P. 115-volt A.C. motor. Complete with pulleys, belt, and cord. **Each \$295.00**

**1405G. BELT GUARD** for 1402B Duo-Seal Pump. **Each \$15.00**

**1402. DUO-SEAL TWO STAGE VACUUM PUMP.** Pump unit only, not mounted on a base, but with a 10 inch grooved pulley, a supply of oil, and directions for use. **Each \$225.00**

No. 1402B

18-Page Booklet on Welch Duo-Seal Pumps has just been issued. A complete description, including performance curves of the Duo-Seal Pumps ranging from 21 liters per minute to 375 liters per minute, is given, as well as a greatly enlarged listing of Diffusion Pumps, Vacuum Gauges and accessories.

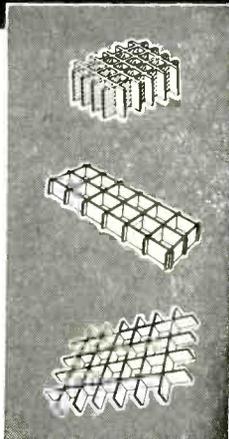
**NEW!**

Manufacturers of Scientific Instruments and Laboratory Apparatus

**W. M. WELCH SCIENTIFIC COMPANY**  
DIVISION OF W. M. WELCH MANUFACTURING COMPANY  
ESTABLISHED 1880  
1515 Sedgwick St., Dept. H, Chicago 10, Illinois, U.S.A.

Pre-assembled partitions...made to exact specifications...for manufacturers of **Radio, Electrical and Electronic components and allied products.**

**P**artitions for  
**P**rotective  
**P**ackaging



WRITE, PHONE or WIRE for QUOTATIONS on YOUR REQUIREMENTS

**peter partition corp.**  
Manufacturers of Cardboard Partitions

19-21 HEYWARD ST. BROOKLYN 11, N. Y.  
Telephone: TRiangle 5-4033

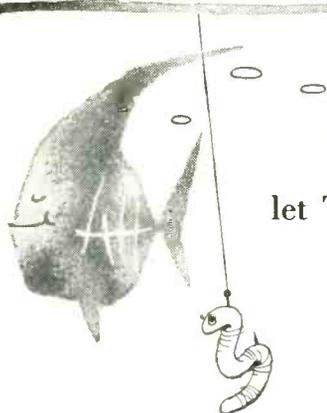
for YOUR MICA REQUIREMENTS

NEW ENGLAND MICA COMPANY

Incorporated  
30 WOERD AVE., WALTHAM, MASSACHUSETTS

MANUFACTURERS OF  
ELECTRICAL MICA INSULATION  
ALL TYPES — FORMS — CLASSES  
FABRICATED FORMS & STAMPINGS TO  
SPECIFIED DIMENSIONS & TOLERANCES

Send for Catalogue

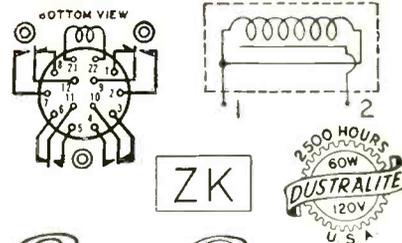


**experience pays**

let TWS\* prepare your industrial literature

\*TECHNICAL WRITING SERVICE  
McGraw-Hill Book Co.  
330 W. 42nd St., N.Y.C.

send for information



*Super Samitas*  
FABRIC WALL COVERING

+MALLORY  
5 MF10VDC  
5-53



**Are better than rubber  
3 ways**

ENGRAVED Vinylite IS ACID-PROOF

Acid etching inks, used for permanent stamping on metal and all non-porous surfaces will eat away at rubber. Vinylite resists this action . . . gives longer life by far.

ENGRAVED Vinylite STAMP DIES GIVE RAZOR-SHARP IMPRESSIONS EVERY TIME

Opaque inks will clog shallow rubber stamp faces rapidly. Our deep-molded engraved VINYLITE stamp faces have more than three times the depth of ordinary rubber stamps. Markings always remain super sharp . . . the clearly identifying mark that distinguishes and labels your product of quality.

ENGRAVED Vinylite STAMP DIES HAVE CUSHION-LIKE RESILIENCE

Our VINYLITE molding process includes a timed curing that imparts to this versatile plastic all the elasticity of rubber. Resilient VINYLITE STAMP DIES resist abrasive action, conform to irregular surfaces . . . and last much longer!

Engraved Vinylite Stamp Dies are adaptable to any automatic or hand marking device. They can be used to stamp on every surface, metal, wood, fabric, paper, plastic, etc.

KRENGEL MANUFACTURING CO., INC.  
Dept. 1F 227 Fulton St., New York 7, N.Y. Tel. CO 7-5714

Please check the following:

Free Vinylite Sample and Price List  Please have salesman call for appointment

NAME .....

COMPANY .....

STREET .....

CITY..... ZONE..... STATE.....

first National Electronics Conference Award.

According to R. M. Soria, 1954 NEC president, the new award may be presented annually to "the author or authors of a paper presented at a previous conference which introduced developments of a new and revolutionary character capable of significantly influencing an electronic field or of opening an avenue to a major field of electronic science or application."

McArthur and Peterson were co-authors of a paper entitled "The Lighthouse Tube; A Pioneer Ultra-High-Frequency Development" presented at the first NEC conference in 1944. It described the then-new development of disk-seal tubes which played an important part in World War II radar defense and earned for McArthur the U.S. Navy's Certificate of Commendation.



### Hallcrafters Appoints General Willis

BRIGADIER GENERAL JAMES S. WILLIS, U. S. Army, retired, has joined Hallcrafters as coordinator of research and development.

General Willis was commanding general of the Signal Corps supply agency at Philadelphia. Earlier assignments included the post of chief of the engineering and technical division in the office of the chief signal officer in Washington, from 1946 to 1948. From 1945 to 1946, Willis was a deputy theater signal officer in the European theater of operations, with headquarters in Frankfurt, Germany. Prior to that,



## Resinite VINYL TUBING

Resinite Vinyl Tubing not only meets, but consistently surpasses specifications for control of fungus and corrosion, flame resistance, dielectric strength and for performance at low and high temperatures. Extreme operating conditions prove the superiority of Resinite Specification Vinyl Tubing.

This superior quality of Resinite Tubing has been achieved through many years of specializing in vinyl tubing. It is maintained through constant research, accurate compounding, skillful workmanship, rigid quality control and thorough inspection. That's why more Resinite Specification Vinyl Tubing than any other is used by the aircraft and electronics industries.

Write today for samples and performance data.

**Resinite**  
RESIN INDUSTRIES, INC.  
315 Olive St. • Box 1589 • Santa Barbara, Calif.  
SPECIALISTS IN VINYL SLEEVING AND TUBING FOR THE AIRCRAFT ELECTRONICS AND PHARMACEUTICAL FIELDS

Want more information? Use post card on last page.



## STOP RF LEAKAGE ON THE DRAWING BOARD

... WHEN YOU DESIGN METEX ELECTRONIC WEATHERSTRIPPING INTO YOUR EQUIPMENT YOU GET ITS POSITIVE SHIELDING EFFECTIVENESS — AT MAXIMUM OVERALL ECONOMY

Plan now to take full advantage of *Metex Electronic Weatherstripping's* unusual effectiveness in shielding all types of electronic equipment. Because it is made of knitted wire mesh, *Metex Electronic Weatherstripping* is both conductive and resilient. It assures positive metal-to-metal contact between all mating surfaces. And being resilient it accommodates itself positively to surface inequalities.

In reality, *Metex Electronic Weatherstripping* can do more for you than just shield RF leakage. It can cut the cost of machining mating surfaces to close tolerances. It can eliminate the need for extra fasteners and many other costly means of making joints RF tight.

Applications in which *Metex Electronic Weatherstripping* has already proved its effectiveness include pulse modulator shields, wave-guide choke-flange gaskets, local oscillators on TV sets, dielectric heaters, etc.



For detailed information on METEX ELECTRONIC PRODUCTS, write for FREE copy of "Metex Electronic Weatherstrips" or outline your SPECIFIC shielding problem — it will receive our immediate attention.

**METAL TEXTILE CORPORATION**



ROSELLE NEW JERSEY

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS

during combat operations from 1944 to 1945, he was chief of plans and operations for the signal division of Supreme Headquarters, Allied Expeditionary Forces in Europe.

### Stanford Organizes New Electronics Lab

THE APPLIED ELECTRONICS LABORATORY, a newly organized engineering research facility, has been formed at Stanford University.

Scientists in the laboratory will be engaged in industrial and government research work. Their efforts are to be directed at the development and exploitation of new discoveries in electronics.

Stanford's electronics research laboratory will now be devoted entirely to fundamental research and teaching, according to Dean F. E. Terman, director of both laboratories.



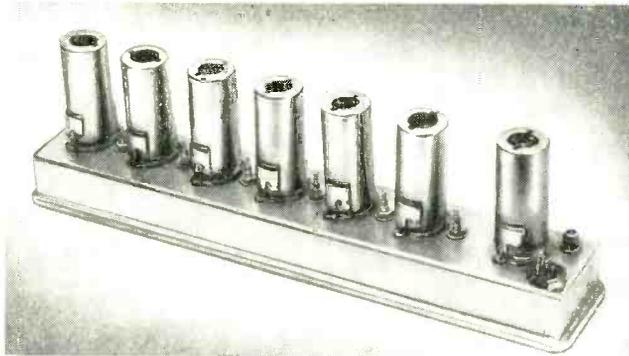
### Bendix-Pacific Names Perrine

C. D. PERRINE JR., was appointed director of engineering of the Pacific division of Bendix Aviation.

Perrine formerly was assistant manager and chief engineer of a Consolidated-Vultee division. For the past two years he specialized in major guided missile development and production for the Navy's Bureau of Ordnance and the Applied Physics Laboratory of Johns Hopkins University. Previously he was for two years assistant chief engineer for missiles and electronics at Convair's San Diego division.

Before joining Convair, the new Bendix executive was for five years

# RADAR i.f. amplifiers



## SAVE ENGINEERING TIME AND EXPENSE!

LINEAR EQUIPMENT LABORATORIES will design and build to your electrical and mechanical specifications I.F. strips of ANY type. We are currently producing our standard wide-band postamplifier strips incorporating built-in attenuator networks.

Our staff has designed and built minimal noise I.F. strips using stagger-tuned, M derived, double-tuned, bridged T, and feedback types of coupling. We are also experienced in the construction of rugged, reliable, subminiature amplifiers. Inquiries invited on our standard or your custom I.F. amplifiers, in any quantity. Write to:

**LINEAR EQUIPMENT LABORATORIES, INC.**

BRIGHTWATER PLACE • MASSAPEQUA, N. Y.

## Designer and Manufacturer of . . .

- UHF TRANSFORMERS
- UHF BALUNS
- UHF WAVEMETERS
- UHF GRID-DIP OSC.
- UHF REFLECTION BOX
- UHF BALUNS
- UHF REFLECTION BOX
- TERMINATIONS
- LO-C OSCILLOSCOPE
- SQUAREWAVE GENERATOR
- NOISE FIGURE TEST SET
- VIDEO LINE AMPLIFIER

WRITE FOR CATALOG

For **HEAVY DUTY** WORK! Severest Electrical Services!



P-506-CE Plug with Cap



S-506-DB Socket with deep Bracket

**JONES PLUGS & SOCKETS**  
500 SERIES  
Proven Quality

For 5,000 Volts, 25 Amperes per Contact Alterable by circuit Characteristics.

Socket contacts phosphor bronze, knife-switch type, cadmium plated. Plug contacts hard brass, cadmium plated. 2, 4, 6, 8, 10, and 12 contacts. Plugs and sockets polarized. Long leakage path from terminal, and terminal to ground. Caps and brackets, steel parkerized (rust-proofed). Plug and socket blocks interchangeable in caps and brackets. Terminal connections most accessible. Cap insulated with canvas bakelite.

Write for Jones BULLETIN 20 for full details on line.



**HOWARD B. JONES DIVISION**  
CINCH MANUFACTURING CORPORATION  
CHICAGO 24, ILLINOIS  
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

## VHF-UHF REFLECTION BOX



Specifically designed to facilitate the measurement of reflection coefficient of VHF and UHF tuners and converters. Enables simple visual observation of the ability of a tuner to provide a proper match to a 300 ohm transmission line over the VHF and UHF TV bands

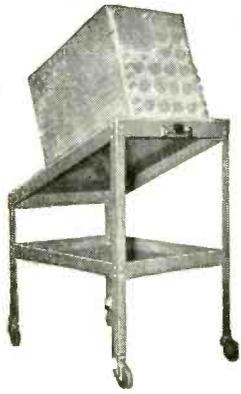
### FEATURES:

- Aids in design of tuner input and coupling networks
- Eliminates cumbersome, unsightly transmission line installations in lab or factory.
- Increases sensitivity in measurements of impedance
- Permits accurate measurement of attenuation
- Models available 50 or 75 ohm source; VHF-50-220 mc or UHF-470-890 mc

WRITE FOR CATALOG E-12

**LINEAR EQUIPMENT LABORATORIES, INC.**  
MASSAPEQUA, L. I., N. Y.

## ALUMINUM DOLLIES



### SCOPE DOLLY MODEL 1

- Convenient Height and Viewing Angle
- Adjustable to Hold Portable Scopes
- Ball Bearing Swivel Rubber Tired Casters
- Lightweight Aluminum Construction
- Recommended by Laboratories Wherever Used

**\$38.50**

FOB Louisville, Ky.



MODEL A

- 31½" high, 18¾" wide, 27" long.

## LAB DOLLY

- 8 Power Outlets with 10 ft. heavy duty extension cord 1500 watts—110 volt A. C.
- Ball Bearing Swivel Rubber Tired Casters
- 2 Shelves for Equipment
- Pan for Test Leads, Notebooks, etc.

Price **\$49.50**

FOB Louisville, Ky.

## TECHNICAL SERVICE CORP.

1404 W. Market St.

Louisville 3, Kentucky

manager of the electronics department of Fairchild's guided missiles division in Farmingdale, L. I. Under his direction and with the aid of the U.S. Naval Research Laboratory, Fairchild developed and tested one of the first radar homing devices for the Navy's "Lark" ground-to-air test missile.

From 1937 to 1945 Perrine was associated with Howard Hughes, advancing to manager of Hughes' radio division.

## Toy Manufacturer Builds Electronics Plant

MATTEL, musical toy manufacturer has formed a subsidiary, Mattel Engineering Co., to make aircraft electronic components. A 30,000 sq ft plant has been constructed next to the firm's 65,000 sq ft main plant in Los Angeles.

## Eisler Receives Marconi Award

THE BRITISH IRE presented its Marconi Award to Paul Eisler, physicist and inventor of the Technograph process of printing electrical circuits. He is a director and head of the research laboratories of Technograph Printed Circuits in London.

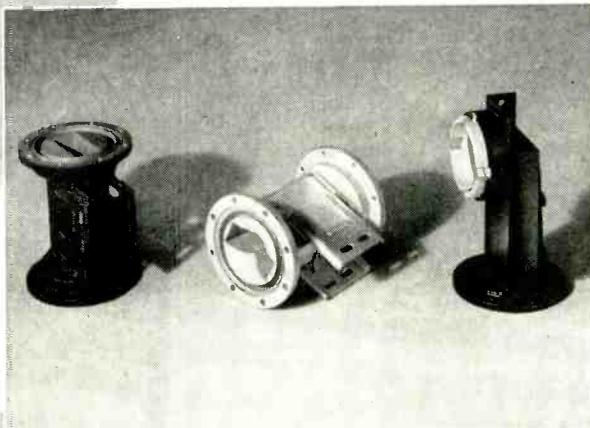
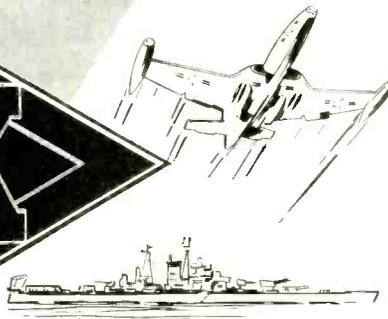
The presentation came in recognition of Dr. Eisler's war-time development and later perfection of a means whereby electrical circuits could be produced by the process of printing rather than by mechanical methods.

## Gudeman Buys California Firm

THE GUDEMAN CO., electronic components manufacturer, has purchased Dilectron of Monrovia, California, manufacturer of ceramic capacitors. The 12,000 sq ft Dilectron plant becomes Gudeman's fifth plant and will be known as the Dilectron Division of The Gudeman Company. There will be no personnel changes in Dilectron. F. T. Reischel is vice-president and general manager, George Wiesinger, sales manager and purchasing agent and Steve Taylor is chief engineer.



Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured and designed to your specifications.



### N.R.K. MFG. & ENGINEERING CO.

4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPing 7-2970

West Coast Representatives TUBERGEN ASSOCIATES 2232 W. 11th St., Los Angeles 6, Calif.

## CROSS FIRES OXYGEN-GAS by AGF



for  
more  
HEAT  
INTENSITY

### and CONCENTRATION

Oxygen-Gas Burner Equipment is used where the temperature, heat intensity or flame concentration obtainable with ordinary Air-Gas Equipment is insufficient to produce satisfactory results.

AGF Oxygen-Gas Burner Equipment has been approved by the New York City Board of Standards and Appeals Cat. No. 391-435A.

WRITE FOR COMPLETE  
BURNER CATALOG



AMERICAN GAS FURNACE CO.  
130 SPRING STREET, ELIZABETH 4, N. J.

## 16/1 SIGNAL-TO-NOISE AT 1 MICROVOLT



MODEL 110  
•  
WWV  
RECEIVER

- Sensitivity: 2/1 signal-to-noise at 1/2 microvolts without audio filter. 16/1 for single tone modulated signal at 1 microvolt with filter.
- Selectivity: Less than 2-kc at 65 db down.
- Image Rejection: More than 60 db at highest operating frequency.
- Frequency: Choice of any three frequencies, crystal controlled on 2.5, 5, 10, 15, 20, and 25 mc in stock. Any frequencies between 2 and 25 mc at slight additional cost.

- Beat frequency oscillator and series noise limiter.

- Dual Audio Output: Speaker on panel and 600 ohm line terminated at rear.

- Audio Filter: Electronic rejection or selection of any frequency in audio range with adjustable selectivity.

- Size: Standard panel mounting, 5-1/4 x 19 x 8-1/2 inches behind panel.

30-day delivery

Literature Available



Continental Communications, Inc.

452 WEST CHICAGO AVENUE, CHICAGO 10, ILLINOIS

# Quality Ribbons STRIPS

for the ELECTRONIC  
INDUSTRIES

MOLYBDENUM  
TUNGSTEN  
TANTALUM  
FORMED PIECES

Your Special  
Metals Rolled  
to Thin Sizes &  
Close Tolerances

YOUR INQUIRIES WILL  
RECEIVE PROMPT ATTENTION

H. CROSS CO.

15 BEEKMAN ST., N. Y. 38, N. Y.  
Worth 2-2044 and Cortlandt 7-0470

the COMPLETELY NEW



**HYCOR**

## VARIABLE ATTENUATOR

... a revolutionary design in attenuators!

- PROOF against SHOCK — MOISTURE — TEMPERATURE
  - Withstands ambient temperatures of  $-40^{\circ}\text{C}.$  to  $+70^{\circ}\text{C}.$ ; 95% humidity.
  - Resistive elements are accurate, noninductive, wire-wound and hermetically sealed in a special tough plastic compound.
  - Greater power dissipation.
  - Switch surface flat and smooth . . . easy to clean, BRUSHES CANNOT TRIP, exceptionally long life.
  - QUIET . . . extremely low switch noise level . . . ideal audio mixer controls.
  - "Lubricated for life" bearings.
  - Stock types available with "LADDER," "T," "H," "L" and potentiometer configurations up to 32 steps.
- Send for Bulletin A-2 for specifications and prices.

#### DISTRIBUTOR

Hycor Sales of California  
11423 Vanowen St., No. Hollywood, Calif.

#### REPRESENTATIVES

Beebe Associates  
1155 Waukegan Road, Glenview, Illinois  
Burlingame Associates  
103 Lafayette Street, New York City  
Harrison J. Blind, 1616 Cord St.  
Indianapolis 24, Indiana  
G. M. Howard & Associates  
734 Bryant St., San Francisco 7, Calif.

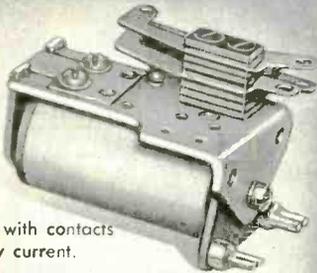
#### EXPORT DIVISION

Morhan Exporting Corporation  
458 Broadway, New York  
13, N. Y., U.S.A.  
Cable: "MORHANEX"

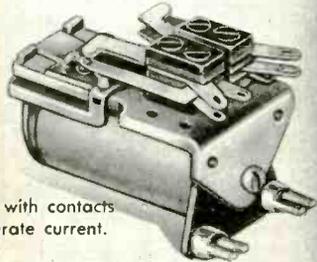
**HYCOR**  
Company, Inc.

# RELAYS

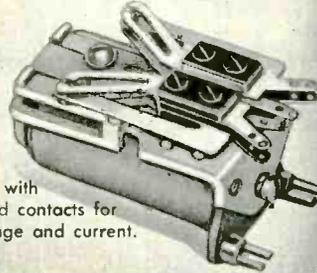
## for EXACTING REQUIREMENTS



Class 22 with contacts for heavy current.



Class 22 with contacts for moderate current.



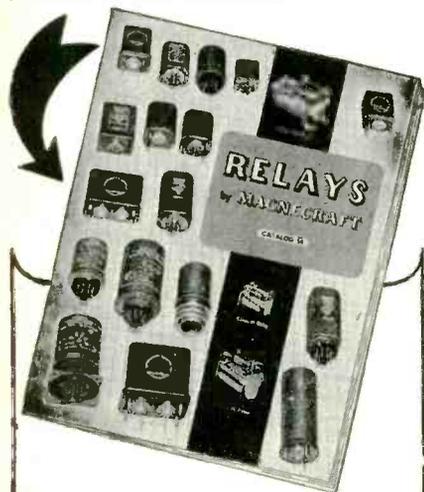
Class 22 with bifurcated contacts for low voltage and current.

A.C. or D.C., open, plug-in, dustproof, hermetically sealed and many special models.

Available with resistance to shock, vibration, and temperature change to meet military specifications.

Special variations engineered to exacting application requirements.

Whatever your service, just tell us what you need or send for catalog.



**MAGNECRAFT ELECTRIC CO.**

1448 W. VanBuren St., Chicago 7, Ill.

Want more information? Use post card on last page.

## NEW BOOKS

### Information Theory

By STANFORD GOLDMAN, *Syracuse University*. Prentice-Hall, Inc., 1953, 385 p., \$9.00.

AS THE FIRST published text in this field, Dr. Goldman's work attempts to satisfy a very important need both for the classroom and the worker in the field. The material is quite properly intended for use by graduate students in electrical engineering, although the attraction of this subject matter for many phases of applied science has been clearly demonstrated in other publications.

#### Background

The treatment is based upon the classical work of Shannon (published in 1948), with considerable amplification of the concepts and theoretical development and with much added mathematical and statistical theory. The use of examples is liberally made to aid in the presentation, and many problems are included. Although for the advanced engineer or scientist no article or other publication is better suited than the well written and masterly presentation of Shannon's own work, yet for the student or beginning investigator it would appear that the present volume under review is better suited for an exposition of the field and a guide to its many applications.

#### Contents

Chapter I, entitled "Information Theory of Discrete Systems", together with mathematical developments in the appendices covers the basic definitions and theorems for communication systems employing a finite set of symbols. The concept of information is discussed and quantitatively defined. Probability theory is introduced as required. For the complete communication channel, the text discusses language as a statistical construction, then coding into symbols which can be handled by the channel, the capacity of the channel, and the relation between the rate of transmission of information and the channel capacity. Entropy and re-

# DC-AC CHOPPERS

0-500 cycles  
DEPENDABLE



All military specifications met. Liberal factors of safety to meet emergency conditions.

1. Production sampled daily and life tested to check 1,000 hour rating.
2. Every Chopper given not only one but two tests over the full range of military temperatures before shipment.
3. Only gold contacts used for superior operation in the vital 0-1½ volt d-c range.
4. Liberal safety factors to meet emergency conditions.
  - a. 0-500 cps.
  - b. Input voltage  $\pm 30\%$ .

WRITE FOR THESE CATALOGS:  
No. 371, 0-500 CPS.  
No. 370, 60 CPS.

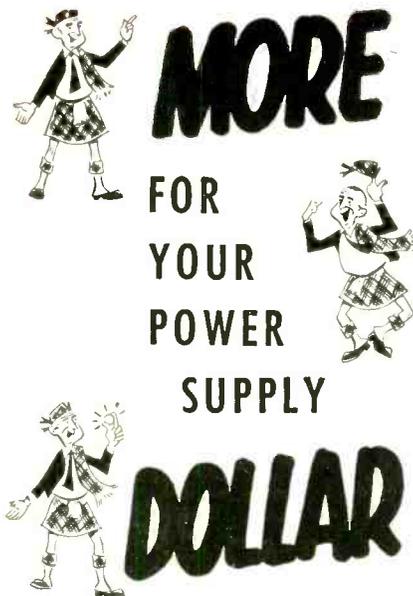
**STEVENS  
ARNOLD  
INCORPORATED**

22 ELKINS STREET  
SOUTH BOSTON 27, MASS.

S/A-11

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS



## N. J. ELECTRONICS CORP. REGULATED POWER SUPPLIES



— meet every need  
— fit every budget

### STANDARD GRADE

Simple, conservative designs, constructed of high-quality standard components for general shop, bench, experimental use. No frills, no unwanted extras. Eighteen models start at \$48.50!!\*

\*Model 100R: 200-325 V, 100 ma, reg. 1% 6.3 V, 3 A unreg. Rack mfg.

### LABORATORY GRADE

Entirely new standards of performance and service life. All components derated at least 30%. All units blower-cooled. No electrolytics! No carbon resistors! No carbon potentiometers! 10,000 hour tubes! Unusually high stability, close regulation, low ripple. Built to last a lifetime, intended for research labs, permanent equipment. The ultimate in convenience and flexibility, yet prices start under \$100.00!

Write for our complete catalog No. 1-5455



**N. J. ELECTRONICS CORP.**

345 CARNEGIE AVENUE KENILWORTH, N. J.

Chestnut 5-8038

Want more information? Use post card on last page.  
ELECTRONICS — December, 1954

dundancy are defined and discussed. Finally, the relations concerning the transmission of information over a noisy channel are developed.

In chapter II, the informational equivalence of a continuous band-limited signal to a finite sequence of samples either in time or frequency is demonstrated. Chapter II on "Ergodic Ensembles and Random Noise", chapter IV on "The Entropy of Continuous Distributions" and chapter V on the Transmission of Information in Band-Limited Systems extend the theory to deal with continuous types of signals in band-limited noisy channels. This subject is somewhat more abstract and mathematical than the material of chapter I. Major topics covered include certain statistical properties of noise relations between the temporal and frequency distributions, and the transmission capacity of the channel with either average power or peak power limitations. Chapter VI on the "Use of Signal Space" presents an alternative derivation of the relation for the maximum rate of transmission based upon a geometrical argument wherein finite band limited signals are represented by points in a multi-dimensional space.

The material in chapters I through VI represent the basic theory. Chapters VII through IX present detailed applicational studies with emphasis upon communications, optimum filters and improvement in systems employing periodic signals, such as radar and navigation.

Chapter VII discusses first the information transmission rates for the usual modulation systems, and then the noise reduction possibilities for these systems by the use of extra bandwidth, threshold performance and human observer noise reduction.

Chapter VIII, entitled "Linear Correlation, Filtering, and Prediction", presents an interesting and readable exposition of Wiener's work on linear, least square smoothing and prediction. Preliminary material is given on physically realizable filters and the correlation functions. Finally, the application of correlation methods to improvement of signal-to-noise ratio in periodic signal systems is briefly

## THE Number One Name

In Socket Screws & Keys

# ALLEN



Don't take it for granted that any hex socket screw is an Allen. Your Allen Distributor *alone* can offer you

- 1. ALLENPOINT SET SCREWS** with the new smaller point — proved by impartial laboratory tests to have greater locking power and vibration resistance, plus uniformly high shaft holding power, compared with conventional cup point screws and those with serrated or angled points.
- 2. LEADER POINT CAP SCREWS**, for substantially reduced chance of thread injury or damage to threaded holes.
- 3. ALLENOY STEEL** — with the strength and temper to permit the use of smaller sizes, and make button head and flat head screws practical despite necessarily shallower sockets.
- 4. ALLEN PROGRESSIVE PRESSUR-FORMING**, producing contoured uncut fiber flow, from head to point. A process originated and perfected by Allen.

Be sure to get Allens in the black and silver striped box, sold only through leading Industrial Distributors. Write us for technical information.



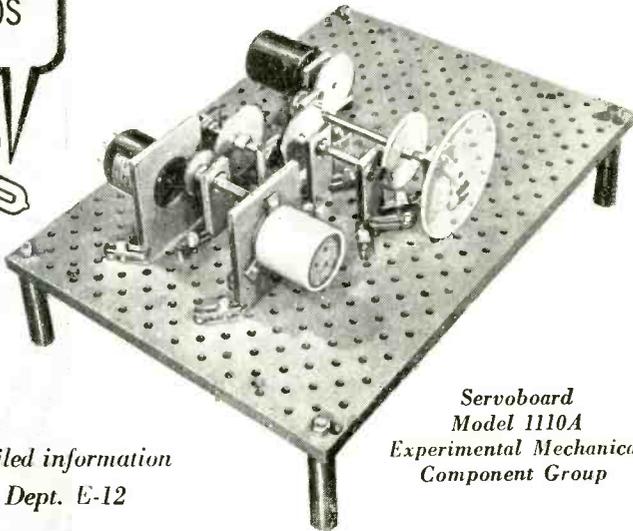
Want more information? Use post card on last page.

Hook Up  
With  
Servoboard  
and Speed Up  
Your Set-Ups



SERVOBIRD

Whatever you're assembling—servo system, computer or regulator—the Servoboard speeds up the job by providing means for quickly synthesizing the electro-mechanical parts of the control system. Complete set includes gears, shafts, bearings, hangers and mounting plates, all precision made for rapid coupling with necessary motors, tachometers, synchros, potentiometers and amplifiers.



Servoboard  
Model 1110A  
Experimental Mechanical  
Component Group

For detailed information  
Write Dept. E-12



**SERVO**

**CORPORATION OF AMERICA**

New Hyde Park, New York

SC 121



**CONVENIENCE**

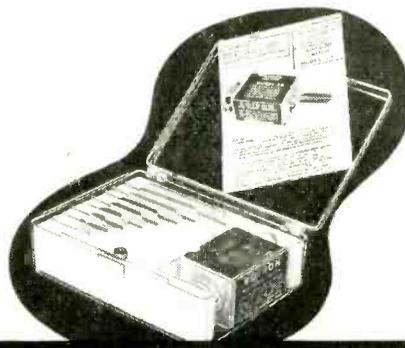
With **8** Velocity Ratings

Rotron "Determinator Kit" allows quick experimental determination of air velocity and of air turbulence at any point in an air circuit. The "Kit" consists of a Rotron Model 2A Electrical Air-Interlock switch together with 8 clip-on sensing vanes of different rating ranging from 1000 to 4000 Ft./Min.

A handy kit for every radio design engineer to keep in his desk—nothing like it for prototype work.

Immediate delivery • \$14.50 Each—Quantity Discounts • Incl. Application notes

- Works in both up and down stream
- Interchangeable actuating vanes
- Mounts on round and flat ducts through simple round hole
- SPDT contacts—5 AMP 250 VAC—Differential better than 25%
- Two metal-to-metal bearings



DETERMINATOR  
KIT



**ROTRON MFG. CO.**

Schoonmaker Lane Woodstock, N. Y.

NEW BOOKS

(continued)

covered. This material is of special interest since it is in this field that these methods have had considerable early success.

Chapter IX opens with an extended and very useful review of the concepts and general results of the theory. The remainder of the chapter indicates how information theory may be applied to an analysis of thinking, knowledge and scientific procedures.

*Conclusions*

In summary, the author has done a very fine job of collecting and organizing the material needed for an adequate presentation of the development of the subject of communication theory. As a somewhat personal note, the treatment is not aided by a tendency to coin new words.—M. LEIFER, *Engineering Manager, Electronic Defense Laboratory, Mountain View, Calif.*

**Elements of Mathematics for Radio, Television and Electronics**

BY BERNHARD FISCHER AND HERBERT JACOBS. *Macmillan Co., New York, 569 p, 1954, \$7.20.*

A LARGE and practical book aimed at teaching the reader "to use mathematics fluently, easily, accurately on radio and television problems." The endpapers display the color codes for resistors and capacitors, actual sizes of machine screws and the appendices give data on screw threads, copper wire tables, log tables etc. There are hundreds of problems dealing with all manner of electronic circuits including square waves, time constants, tube current, impedance matching, tv test patterns as well as many problems dealing with the formal mathematical processes.—K.H.

**Transients, Inverse Feedback and Stability (Einschwingvorgänge, Gegenkopplung, Stabilität)**

BY JOHANNES PETERS. *Springer-Verlag, Berlin, Germany, 181 p, 1954, 27DM.*

A BOOK in the field of circuit theory serves two distinct classes of readers. To some, the study of networks is a full-time job; mathe-

# Investment Problems and Opportunities in Atomic Energy

by  
ARMAND G. ERPF, Partner

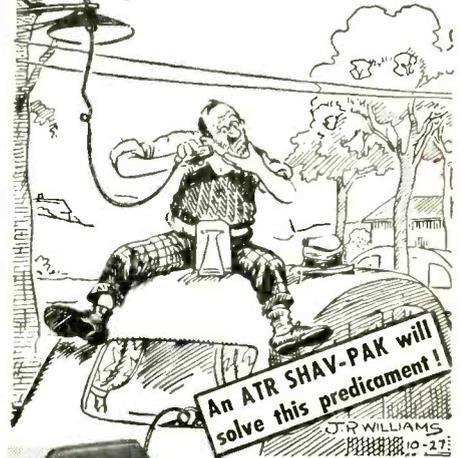
Address at a meeting of the  
ATOMIC INDUSTRIAL FORUM, INC.  
New York

For copy, address Dept. E

## Carl M. Loeb, Rhoades & Co.

Members New York Stock Exchange and other  
Leading Stock and Commodity Exchanges  
42 WALL STREET NEW YORK 5, N. Y.  
Private Wire System to Branch Offices, Correspondents  
and their connections in 90 Cities throughout the U. S.

# ATR SHAV-PAK NEW, LOW PRICE!



SHAVE IN THE COMFORT  
OF YOUR CAR,  
Boat or Plane!

Plugs into  
Cigarette Lighter  
Receptacle on Dash

\$ **9.95**  
LIST PRICE

Specially Designed for  
Operating Standard A.C.  
Electric Shavers in  
Automobiles, Buses,  
Trucks, Boats, and  
Planes.

TYPE	INPUT D.C. VOLTS	A.C. OUTPUT 60 CYCLES	OUTPUT WATTAGE	LIST PRICE
6-SPB	6	115 volts	15	9.95
12-SPB	12	115	15	9.95

# Have you seen CORNING'S NEW PRICES on Film-Type Resistors?

WE CARRY  
IN STOCK...

ALL SIZES  
ALL SHAPES

ALL ALNICO  
GRADES

ALNICO  
PERMANENT MAGNETS  
Cast and Sintered CARBOLOY Permanent Magnets

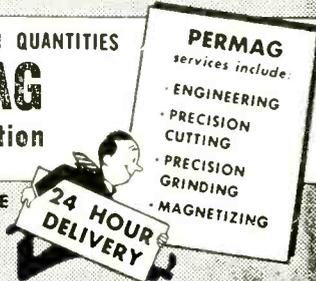
EXPERIMENTAL OR PRODUCTION QUANTITIES

Call **PERMAG**  
for Prompt Attention

Catalog upon request

AUTHORIZED SALES AND SERVICE  
CARBOLOY DEPARTMENT  
OF GENERAL ELECTRIC CO.

PERMAG CORP., 210 TAAFFE PL., BROOKLYN 5, N. Y. - Phone: MAin 2-0114



**PERMAG**  
services include:  
- ENGINEERING  
- PRECISION  
CUTTING  
- PRECISION  
GRINDING  
- MAGNETIZING

# Introducing ATR MIGHTY MIDGET portable INVERTER WITH GREATER OUTPUT

Dictate reports accurately-promptly!

make your car, boat or plane  
a "rolling office"



Plugs into  
Cigarette Lighter  
Receptacle on Dash

with ATR INVERTERS  
for changing your  
storage battery  
current to A. C.  
Household  
ELECTRICITY

Anywhere  
in your own car!

\$ **19.95**  
AND UP  
LIST PRICE



ATR INVERTERS...  
especially designed for operating  
standard 110 volt A. C.

- Dictating Machines
- Tape Recorder
- Electric Razors
- Wire Recorders

TYPE	INPUT D.C. VOLTS	A.C. OUTPUT 60 CYCLES	OUTPUT WATTAGE	LIST PRICE
6-DME	6	115 volts	30-40	19.95
6H-DME	6	115 volts	60-75	29.95

Above Inverters also available for 12-volt operation.

See your jobber or write factory today  
for complete information

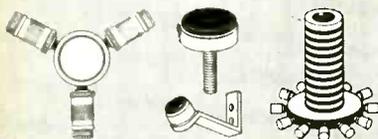
**ATR** AMERICAN TELEVISION & RADIO CO.  
Quality Products Since 1931  
SAINT PAUL 1, MINNESOTA - U.S.A.



# BRUSHES CONTACTS

## SLIP RINGS

...AND SLIP RING ASSEMBLIES



BRUSHES — CONTACTS — ASSEMBLIES

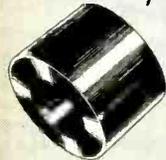
... Use **SILVER GRAPHALLOY** for applications requiring low electrical noise; low and constant contact drop; high current density and minimum wear.

EXTENSIVELY USED IN:

**SELSYNS • GUN FIRE CONTROLS  
ROTATING THERMOCOUPLE and  
STRAIN GAGE CIRCUITS  
ROTATING JOINTS • DYNAMOTORS**

Wide range of grades available for standard and special applications.

### Other Graphalloy Products



Oil-free, self-lubricating Bushings and Bearings (applicable  $-100^{\circ}$  to  $+300^{\circ}$  F.; with expansion coefficient half that of steel will not seize shaft at low temperature); oil-free Piston Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.

#### GRAPHITE METALLIZING CORPORATION

1053 NEPPERHAN AVE. • Yonkers, New York

- Please send data on Graphalloy BRUSHES and CONTACTS.  
 Send data on BUSHINGS.

NAME & TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_

ZONE \_\_\_\_\_

STATE \_\_\_\_\_

Want more information? Use post card on last page.

matics, far from being an obstacle, is the habitual and preferred way of thinking. Practical applications seem nice but hardly fascinating.

On the other side of the fence are people whose specialty may range from tape recorders to gas turbines. When they open a book on circuit theory, they do not hope to become expert in the field; they hope to find a little insight, a few bits of additional understanding to add to their bag of tools. They are knowingly trespassing into a highly specialized domain, foreign territory in which they hardly expect to feel like natives. Nevertheless this group probably outnumbers the full-time group by a wide margin. If this is more so in circuit theory than in other theoretical subjects, it is probably because few have an opportunity to design tape recorders or gas turbines on a part-time basis; but almost anyone builds amplifiers.

In the preface, the author says that an approximate treatment will not do for the feedback amplifier, because of the stability problem. Stability criteria, he continues, are not useful unless they contain design information. To attempt to meet a stability criterion by trial and error is no better than to stabilize the completed feedback amplifier by the same method. He hopes to show how one arrives at a stable amplifier of predictable performance.

The first chapter contains an introduction into the methods and mathematics of circuit theory. Starting with fundamentals such as the physical meaning of the complex notation, it progresses smoothly and rapidly to the theorems which govern amplitude and phase response, to Fourier and Laplace transformations, and the like. The second chapter, on transfer functions of passive and active systems, deals with the task of translating a given network into a system of equations by means of admittance matrices. The third chapter treats the problem of stability. With the exception of its last section, this chapter and the preceding two are highly mathematical.

#### Feedback Design

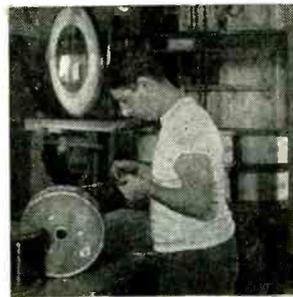
The last section of the third

# ACME MAGNET WIRE

made by

SPECIALISTS  
for  
FIFTY YEARS

The Acme Wire Company's balanced pioneering experience of a half-century has made this company the leader in the field for the best in magnet wire. Highly trained personnel inspect Acme magnet wire at all stages of manufacture to make sure that this important product is of top quality.



An Acme Wire inspection station

The Acme Wire Company have been specialists for fifty years in the field of dependable electrical insulations.

#### Do You Know These Other ACME Products?

- ✓ Varnished Electrical Insulations
- ✓ Coil Windings
- ✓ Electrical Insulating Varnishes and Compounds

**ACME WIRE CO.**  
NEW HAVEN, CONN.



MAGNET WIRE • COILS  
VARNISHED INSULATIONS  
INSULATING VARNISHES

Want more information? Use post card on last page.

December, 1954 — ELECTRONICS

chapter, as well as the entire fourth, deal with feedback amplifier design. These parts of the book are likely to be the most valuable to many readers. Generally, they can be understood without a detailed study of the mathematical portions of the book and they contain a great deal of useful information.

Because feedback amplifier theory also applies to purely mechanical and electromechanical systems, there is a brief final chapter on mechanical circuits, electromechanical analogies and transducers. Here the author seems to do a little trespassing of his own, away from his home grounds; this comes to light when he labels a capacitive transducer without restoring force "impossible", not merely unstable.

He might have pointed out that negative compliance, very much unlike negative capacity, is rather common in nature—which no one will deny who has ever tipped over backwards on a reclining chair.

To summarize, this is a well-organized and thorough treatise on circuit theory which uses mathematics abundantly but always tries to explain the result in physical terms. In many respects it reflects the work of H. W. BODE (Network Analysis and Feedback Amplifier Design, 4th ed., Van Nostrand, 1947) to whom the author gives a large measure of credit. The book should be of value to many readers. A nonmathematical book on the same subject is not likely to be written for some time.—ROBERT ADLER, *Zenith Radio Corp., Chicago, Ill.*

### The Amplification and Distribution of Sound

By A. E. GREENLEES. *Chapman and Hall, London, third edition, revised, 300 p, 35 shillings.*

This book applies the typical English virtues of clarity and conciseness to the explanation of the basic principles of public address systems and practices. It is an excellent introduction to basic principles, but the treatment of specific components and operating practices will seem definitely old-fashioned and incomplete to American practitioners of public address who keep up with equipment developments and follow the periodical



# Sub-Miniature PILOT LIGHTS



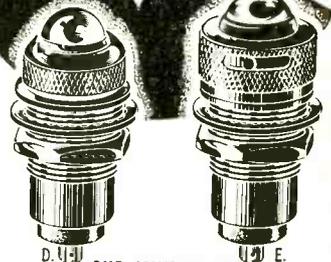
**A. PLASTIC PLATE LIGHT ASSEMBLIES**



**B. LIGHT SHIELD ASSEMBLY**



**C. LIGHT SHIELD ASSEMBLY**



**D. SUB-MINIATURE INDICATOR LIGHTS**

**A great aid to miniaturization**

Require a single 15/32" hole

All lens colors

All units applicable to Mil Specifications

*when you're CRAMPED for SPACE*

(All illustrations are approx. actual size.)

Foremost Manufacturer of Pilot Lights

## DIALIGHT CORPORATION

60 STEWART AVE. • BROOKLYN 37, N. Y.  
HYACINTH 7-7600

Any assembly available complete with lamp.

**SAMPLES ON REQUEST — NO CHARGE**

Write for Catalogue L-153

# NOW!

accurately controlled electric heat

for

HEATING LIQUIDS

MELTING SOLIDS

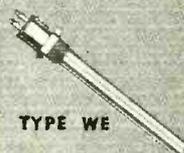
in Tanks and Vessels

with

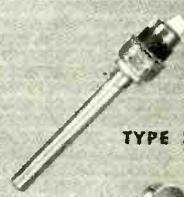
# WATLOW

## IMMERSION HEATERS

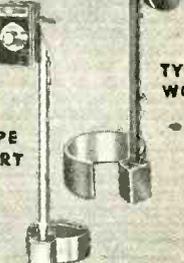
The most efficient method of heating fluids in tanks, kettles, steam tables, boilers, etc. Watlow Units are designed for low internal operating temperatures—which results in maximum life. Available in brass, steel or nickel alloy, also stainless steel sheaths, for maximum corrosion resistance. Standard sizes: 3/4" to 2" dia., 3 1/2" to 60" lengths; 10W-35W densities. Special sizes and shapes built to your specifications.



TYPE WE



TYPE PO



TYPE WGR

Send for your free copy of  
Watlow Electric Heating Units Catalog.

# WATLOW

SINCE 1922—DESIGNERS AND MANUFACTURERS OF ELECTRIC HEATING UNITS

**ELECTRIC MFG. CO.**

1390 FERGUSON AVE.

SAINT LOUIS 14, MO.

literature in their field.

*Deficiencies of Treatment*

In his preface the author declares his intention to discuss principles mainly, and does not promise the reader a complete manual of public address operation. However, the reader must take this disclaimer with more force than the author probably intended. A kind of nonsense, stick-to-old-established-ways approach leads to many errors of detail, such as the discussion of the control of volume from phonograph records on page 146. This would lead the unwary reader to assume that modern practice invariably puts the volume control directly across the pickup terminals, and obvious holdover based on the high-output pickups of the thirties and forties, and not relevant to today's very-low-level records and pickups.

The whole discussion of records as a program source suffers from the same standpatism. Motors, pickups, records, scratch filters are all presented in terms definitely out of date. The author does give an admirable account of fundamentals in each case, but he does not give the reader an accurate notion of what is going on today. In one short paragraph stuck at the end of the chapter like an afterthought, he mentions the fact that there are such things as records made to revolve at 45 and 33½ times per minute. To borrow a phrase from the theatre, this is throwing away the long-playing revolution with a vengeance.

*Amplifiers and Speakers*

Things come out better on amplifiers, because the author does stick to discussing basic types, which haven't changed much in a couple of decades. On loudspeakers, the author is again excellent on fundamentals but very restricted, and sometimes at odds with current practice on practical details.

The treatment of the fundamentals of distribution lines and load matching is excellent, showing at its very best the author's real ability to put technical material into simple, concise, unambiguous, utterly lucid language. The same applies to the sections on micro-



**CO-AX**  
**4 mmf/ft**

**★ ULTRA LOW capacitance & attenuation**

TYPE	μμf/ft	IMPED.Ω	O.D.
C1	7.3	150	.36
C11	6.3	173	.36
C2	6.3	171	.44
C22	5.5	184	.44
C3	5.4	197	.64
C33	4.8	220	.64
C4	4.6	229	1.03
C44	4.1	252	1.03

WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS  
SPOT DELIVERIES FOR U.S. BILLED IN DOLLARS—SETTLEMENT BY YOUR CHECK  
CABLE OR AIRMAIL TODAY

**TRANS RADIO**

**NEW 'MX and SM' SUBMINIATURE CONNECTORS**  
Constant 50Ω-63Ω-70Ω impedances

TRANSRADIO LTD. 138A Cromwell Rd. London SW7 ENGLAND CABLES: TRANSRAD, LONDON

send for the most widely used Electronic Supply Guide

**free**

**ALLIED'S COMPLETE 308-PAGE 1955 CATALOG**



**your guide to the world's largest stocks of ELECTRONIC SUPPLIES FOR INDUSTRY**

We specialize in Electronic Equipment for Research, Development, Maintenance and Production Operations

Simplify and speed the purchasing of all your electronic supplies and equipment. Send your orders to us at ALLIED—the reliable one-supply-source for all your electronic needs. Depend on us for fast shipment from the world's largest stocks of electron tubes (all types), test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.) and accessories—everything for industrial and communications application. Let our expert Industrial supply service save you time, effort and money. Send today for your FREE copy of the 1955 ALLIED Catalog—the complete up-to-date guide to the world's largest stocks of quality Electronic Supplies for Industrial and Broadcast use.

**ALLIED RADIO**  
100 N. Western Ave., Dept. 11-M-4  
Chicago 80, Illinois

**SEND FOR FREE CATALOG**

One complete dependable source for everything in electronics



For consistently high purity...

**"LINDE" M.S.C. RARE GASES**  
Trade-Mark  
(Mass Spectrometer Controlled)

- Helium
- Argon
- Neon
- Krypton
- Xenon

In radar electronic equipment, nuclear radiation counters, cosmic ray cloud chambers, and thyratrons, where the purest rare gases are demanded, LINDE M.S.C. Grade gases meet the specifications. They are produced under continuous mass spectrometer control to assure you of gases of *known* purity and consistently high quality. LINDE, the world's largest producer of gases from the atmosphere, can meet your individual needs of volume, mixture, and container.

For information on the physical, chemical, and electrical properties of these gases, send for the booklet, "LINDE Rare Gases."



**LINDE AIR PRODUCTS COMPANY**

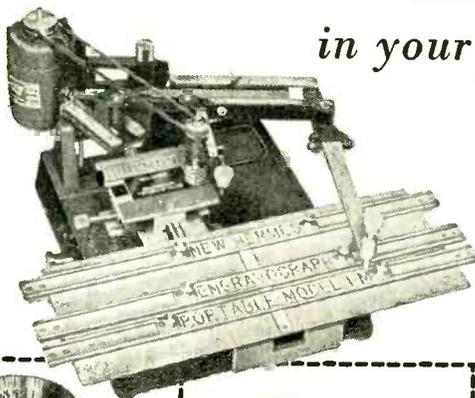
A Division of  
Union Carbide and Carbon Corporation  
30 E. 42nd Street **UCC** New York 17, N.Y.

In Canada:  
Domintion Oxygen Company, Division  
of Union Carbide Canada Limited, Toronto  
The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation.

# ENGRAVE

NAME PLATES • PANELS • DIALS

*in your own shop*



*Lowest set-up time  
for unskilled labor*



CALIBRATIONS



PROFILES



CURVED SURFACES

**10,000 IN USE** Accepted by all leading manufacturers as the speediest, most versatile portable engraver. Only the NEW HERMES has these patented features:

- Adjustable for 15 ratios.
- Self-centering holding vise.
- Automatic depth regulator.
- Adjustable copy holders.

SEND FOR BOOKLET 1M - 79

**NEW HERMES ENGRAVING MACHINE CORP.**

13-19 University Pl.

New York 3, New York

when there's a soldering job to be done...



On industrial assembly lines  
... in home workshops ...  
in electronic labs ... for  
production, repair,  
maintenance ... the  
world's most versatile  
family of pencil soldering  
irons is on the job,  
doing a better job! No  
wonder they're called  
"Ungar's Little Angels"!

- Interchangeable tips for every soldering need from repair to high-speed production soldering.

• Feather-light, designed for hard-to-reach jobs.

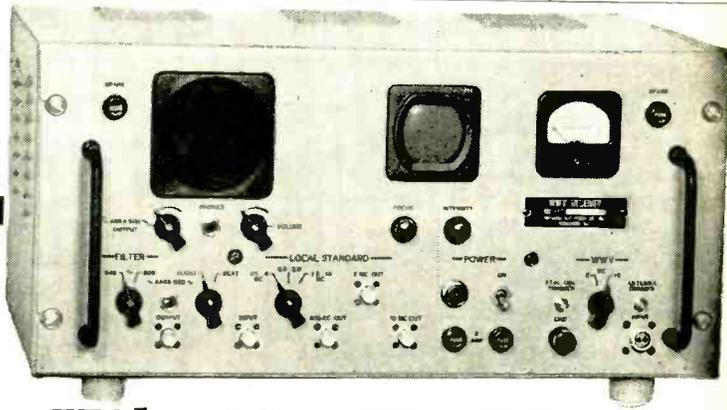


Write for Catalog U-16

**UNGAR ELECTRIC TOOLS, INC.**  
P. O. Box 312, Venice, California

**WWV  
IS**

**FREE — Why Not Use It?**



The WWV frequency standard, as transmitted by the U. S. Bureau of Standards, is the most accurate frequency standard of any in the world.

By using the new Matawan WWV receiver, this frequency standard, with all its information (standard audio frequencies, time signals, propagation notices) is now available to your laboratory. The WWV carrier, after elimination of its modulation, by means of a narrow band pass crystal filter, monitors your local HF standard. The rotative pattern on the screen of the cathode ray tube gives sense and amount of the frequency deviation.

Either the 5MC WWV or the 15MC WWV may be received. The receiver will accommodate any local frequency in the range from 50kC to 10MC equal to a subharmonic of 10MC, 2 MC or 400 kC. A second channel receives the audio modulation and time signals of the WWV-Standard.  
Four Models Available.

Fully descriptive, illustrated spec. brochure available on request.

**PHILLIP H. HARRISON & CO.**  
Route 34, Matawan, N. J.  
Matawan 1-3113

	WWV Input	
	5.0 MC	5 and 15.0 MC
Audio Modulation on Speaker Phone Jacks	Model ME-117A \$865	Model ME-117C \$910
Additional Filter for 440/600 CPS	Model ME-117B \$940	Model ME-117D \$985

phone and loudspeaker placement, which are, of course, the essence of public address as distinguished from other branches of the art of reproducing sound. The reader will learn what to do with his speakers at a typical stadium, skating rink, large hall, small hall, cinema, bandstand, etc. However, because of the space limitations the author has imposed on himself, he is not able to do more in each case than suggest one typical solution, in very brief style. Thus the book comes out more like a course in types of handling than like a practical manual of public address work.

#### Comments on High-Fidelity

The plan of the book is exceptionally thorough, including chapters on the fundamentals of sound engineering, on all the components of public address systems including radio receivers, on planning large permanent installations for hospitals and such, on maintenance, testing, drawing up specifications, etc. And, although the author (gratefully to this reviewer) does not mention the words high fidelity, he does range himself on the side of the hi-fi angels when he deplores that fact that a public address system "... is often expected to make its presence felt, otherwise it is not considered satisfactory. It is to be hoped that this state of things will pass ... so that the benefits of the system may be unconsciously enjoyed without its users being reminded of its existence."—R. S. LANIER, *New York, N. Y.*

#### Engineering Analysis

By D. W. VER PLANCK AND B. R. TEARE, JR., *Carnegie Institute of Technology. John Wiley & Sons, Inc., New York, 1954, 344 p., \$6.00.*

THE PROFESSIONAL method in this case is how to solve problems by using one's head plus whatever mathematical tools may be required. But the big idea is to use your head.

The young engineer, once free from school, finds that problems with which he has to cope are not stated in very "clearly worded statements." As the authors say, "you will be confronted with situations out of which you yourself must formulate specific problems to be solved. Until you analyze the



## NEW Phase Angle Measuring Set by

# INFRA

Provides a simple and accurate method of measuring relative phase angles in the audio frequency range. In addition, at the output terminals, an accurately phase shifted voltage is available for external use.

Eliminates the inaccuracies normally involved in Lissajous figure calculations and the necessity for special phase shifting circuits in your experimental work. Use it as a precision measuring instrument or as a means of finding the optimum value.

Frequency range: 50 cps to 10 KC.

Input level: 100 mv. minimum.

Accuracy:  $\pm 1$  degree.

Power: 115 volts, 60 cps, 18 watts.

WRITE NOW FOR DETAILED  
SPECIFICATION SHEETS.

INFRA ELECTRONIC CORP.

555 Eagle Rock Ave.

Roseland, N. J.

Gentlemen:

Please send specification sheets on Phase Angle Measuring Set.

Name & Title

Company

Address

Want more information? Use post card on last page.

## VACUUM DEVICES

Our modern well equipped plant with 60 employees is currently manufacturing medium power transmitting tubes for the Armed Services and industrial use. We also custom manufacture a diversified line of laboratory and production, high vacuum equipment incorporating complex electronic circuitry.

Our Engineering Department consists of five men, each with a minimum of 15 years experience in this field.

Your inquiries are invited for design, development or production of high vacuum equipment, vacuum seals, high and low vacuum measuring equipment, medium and high power vacuum tubes and special purpose tubes.

**CENTRAL SALES & MFG. CORP.**

Denville, New Jersey

*new*  
**laboratory kit**  
*saves design-in time*

ACTUAL SIZE!

**MICRODOT®**

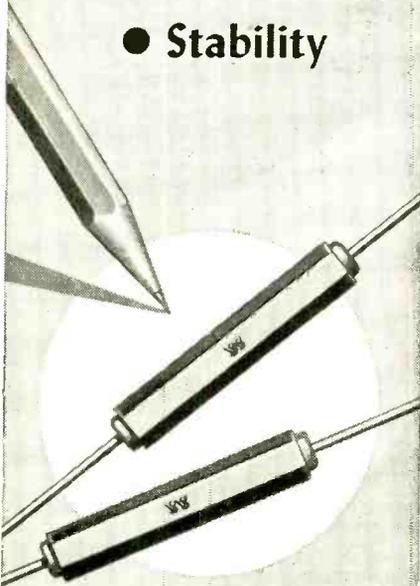
*World's smallest COAX connectors, cables and assemblies*

Specify world's most flexible line... Microdot Connectors and Mininoise® cable. 7 Kits now equipped with Microdot's unique 20x. hand tool... makes possible thousands of new coax combinations... including missile harnesses requiring minimum size and weight. Write for data.

**MICRODOT**  
1826 FREMONT ST.  
SO. PASADENA, CALIF.

Want more information? Use post card on last page.

- Low noise level
- Precision
- Stability



**S. White 65X  
MOLDED RESISTORS**

**RATING**—1 watt.

**TEMPERATURE COEFFICIENT**—From approx.  $+0.1\%/^{\circ}\text{F}$  for 5000 ohm values to approx.  $-0.2\%/^{\circ}\text{F}$  for 10 megohm values.

**VOLTAGE COEFFICIENT**—Rated at less than  $0.02\%/ \text{Volt}$ .

**UPPER TEMP. LIMIT**— $170^{\circ}\text{F}$  for continuous operation.

**NOISE LEVEL**—Low noise level inherent, but at extra cost we can test and guarantee standard range resistors with "less noise than corresponds to a resistance change of 1 part in 1,000,000 for the complete audio frequency range."

**VALUES**

Standard Range—1000 ohms to 9 megohms.

Extra High Value Range—Up to 10,000,000 megohms.

**BULLETIN 5409**

has full details. Send for a copy. Attention Dept. R



THE **S. White** INDUSTRIAL DIVISION  
DENTAL MFG. CO.



10 EAST 40TH ST.  
NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, Calif.

situation it may not be clear what the problem really is, nor is it likely that the important factors will be apparent at first. Often, in practice, it is harder to define a problem than to solve it."

This book, then, seeks to teach young (and old) engineers how to analyze engineering problems that are not stated as clearly as "how many inches are there in five feet"—problems that cannot be handled by jamming some figures into a formula. Creative thinking is the key to practical problems and the whole of this interesting and, at times, exciting, text is to teach the methods of creative thinking as applied to industrial engineering situations.

*The Method*

The case method is the one used here to a great extent, although some formal gyrations with differential equations are included. The situations employed vary from an accelerometer in the form of a U-shaped glass tube filled with colored liquid, to the magnetic force on an iron core, to a nonfogging mirror, to the life of a roller bearing, and many others. All are analysed, some in several ways, and all are solved.

Since an engineer is not only supposed to figure out how things work but to make things work at practical cost, and not only in his own field, basic principles that apply to all of nature are the starting point—conservation of matter and energy, Newton's laws of motion, electric circuit principles, or the phenomena of heat flow—and the mathematics involved is purely incidental, as a tool should be.

*The Contents*

The seven chapters are as follows: The Professional Method of Dealing with Engineering Problems, Application of Professional Method, Understanding the Principles Fundamental to Engineering, Translation into Mathematics, Solutions of Some Ordinary Differential Equations, Checking, and Interpretation of Mathematics.

It is a strong hunch that many an engineer, doddering around with formulas, could learn much from this important book, even if he has been away from his formal mathe-

IF  
**hot spots**

ARE  
**trouble spots**

LOOK TO -

**ENGINEERED CERAMICS**

If you're having difficulty with material failures at high temperatures, put the job up to Frenchtown high alumina ceramics. Here you'll find the low thermal expansion which is the mark of efficiency for thermal endurance.

Take advantage of the unusual combination of properties of Frenchtown ceramics. Tell us your problem. We'll be glad to share our ceramic engineering know-how with you.

*Frenchtown*

**PORCELAIN COMPANY**  
86 Muirhead Ave. . . . Trenton 9, N. J.

Want more information? Use post card on last page.  
ELECTRONICS — December, 1954

Want more information? Use post card on last page.

# NOTHING



# ON THE SHELF!

We purposely keep our cupboard as bare as Mother Hubbard's. We have no stock items to sell—

Our business is designing, engineering and manufacturing of nothing but

*Special Purpose Devices* in the electrical, electro-mechanical and electronic fields.

When you need a component or device that isn't made or stocked—

## THINK of



Send your specifications or requirements to us for prompt quotations.

Ask for Brochure J54

# RAM METER, INC.

Founded 1936

1102 Hilton Road, Ferndale  
DETROIT 20, MICHIGAN  
Telephone Lincoln 4-7220

Want more information? Use post card on last page.

NEW BOOKS

(continued)

matics for many a year. The processes by which the examples are solved are clear, interesting and surely instructive.—K.H.

## THUMBNAIL REVIEWS

**Electronics for Everyone.** By Monroe Upton. Devin-Adair Co., New York, N. Y., 1954, 370 pages, \$6.00. A popular attempt to explain electronics and what tubes do, starting with Alexander Volta and ending up with color television, radar and some industrial applications.

**Transient Analysis of Alternating Current Machinery.** By Waldo V. Lyon. John Wiley & Sons Inc., New York, N. Y. 309 pages, 1954, \$7.00. First systematic application of Fortesque's method of symmetrical components to the solution of transient conditions. Chapters on Static circuits, Symmetrical components of instantaneous potentials and currents, differential equations for the ideal cylindrical-rotor machine, Transient conditions in the induction machine with stationary rotor and with constant speed, Uniform-air-gap machine with rotor excitation and with speed constant, Synchronous machine with salient poles, Induction and synchronous machines with speed variable, Appendices, Problems and Bibliography.

**Rotating Electrical Machinery.** Universal Scientific Co., Vincennes, Ind., 1954, 256 pages, \$3.50. Manual for civilian and service schools; large type, large illustrations, large format, easy to read and use.

**Insulation of Electrical Equipment.** Edited by Willis Jackson. John Wiley & Sons Inc., New York, N. Y., 1954, 340 pages, \$7.75. Eleven papers by eleven authors representing lectures given at Imperial College, London, for engineers from the electrical industry. Although most of the contents relates to insulators of primary use in the power field, a chapter covers communication components which includes data on particular materials for particular uses.

**Fundamentals of Transistors.** By Leonard Krugman. John F. Rider, New York, N. Y., 1954, 140 pages, \$2.70. A straight-forward text in paper covers and handy format dealing with transistor characteristics, circuit design, and operation. A practical book for the engineer.

**RC/RL Time Constant.** By Alexander Shure. Rider Publication, New York, 48 pages, 1954, 90¢. First of a series of specialized texts for students of electronics, covering time constants and applications.



## VERSATILE SIGNAL SOURCE speeds

electro-acoustical measurements

### Beat Frequency Oscillator, Model BL-1012

This Beat Frequency Oscillator is designed to incorporate the many features required in a complete and flexible signal source such as — continuously tuned frequency range, metered output, frequency modulating circuit, variable compression and noiseless oscillator stop switch.

When coupled with the Bruel & Kjaer Level Recorder, the Oscillator automatically sweeps through the audio frequency range. This permits fast, accurate recording of frequency response, sound insulation properties, reverberation times, energy decay, etc. The Oscillator has a high frequency accuracy;  $1\% \pm$  one cycle per second. An incremental tuning adjustment and scale permit very accurate frequency setting. An automatic gain control circuit is utilized to maintain the desired output voltage for constant current, voltage, or sound pressure.

For complete specifications on this and other Bruel & Kjaer instruments, write Brush Electronics Company, Dpt. K-12A, 3405 Perkins Avenue, Cleveland 14, Ohio.

### ACOUSTIC AND TEST INSTRUMENTS

*Bruel & Kjaer instruments, world famous for their precision and workmanship, are distributed exclusively in the United States and Canada by Brush Electronics Company.*

- BL-1012 Beat Frequency Oscillator
- BL-1502 Deviation Test Bridge
- BL-1604 Integration Network for Vibration Pickup, BL-4304
- BL-4304 Vibration Pickup
- BL-2002 Heterodyne Voltmeter
- BL-2105 Frequency Analyzer
- BL-2109 Audio Frequency Spectrometer
- BL-2304 Level Recorder
- BL-2423 Megohmmeter and D. C. Voltmeter
- BL-3423 Megohmmeter High Tension Accessory
- BL-4002 Standing Wave Apparatus
- BL-4111 Condenser Microphone
- BL-4120 Microphone Calibration Apparatus and Accessory
- BL-4708 Automatic Frequency Response Tracer

## BRUSH ELECTRONICS COMPANY

formerly  
The Brush Development Company.  
Brush Electronics Company  
is an operating unit of  
Clevite Corporation.



Want more information? Use post card on last page.

**FIRST CHOICE**  
For Every Industrial Use

## LIVERMONT TORQUE WRENCHES

Rugged, streamlined, accurate wrenches for every torquing problem! Based on patented non-friction principle, so will give years-longer, dependable service. Used in major auto, aircraft plants.

(A) New Livermont "ROTO-TORQ" screwdriver. For low torque electronic—or similar—precision assembly work. Fits 50 standard bits.

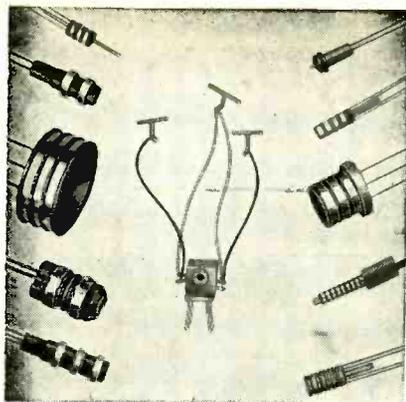
(B) Only "MODEL F" has adjustable and reversible ratchet head! 16 models, 10 to 500 foot pounds. Also plain square drive.



Write Dept. E.  
for complete price  
catalog.  
Opportunities for Distribution B



**RICHMONT INC.** "THE HOME OF TORQUE"  
922 SO. MYRTLE AVE., MONROVIA, CALIF.



## Miniature and Sub-Miniature SLIP RING ASSEMBLIES BRUSH BLOCK ASSEMBLIES COMMUTATORS

and other  
Electro-Mechanical Components

**PRECISION MADE  
TO YOUR OWN SPECIFICATIONS**

Precision molded products with exacting tolerances in precious and non-precious solid metals of all alloys. All types of Thermo-Plastic and Thermo-Setting materials.

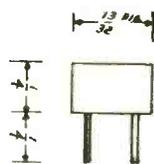
Slip Ring Assemblies fabricated or one-piece precision molded to your specifications in Nylon, Kel-F, Mineral filled Mellamine, Phenolic, and other materials. Rings and leads spot welded or brazed together for positive electrical circuit

**Our Swiss methods and techniques are geared to meet exacting requirements. We invite your inquiries.**

## COLLECTRON CORPORATION

MUrray Hill 2-8473 • 216 East 45th Street • New York 17, N. Y.

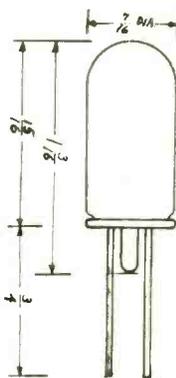
## CADMIUM PHOTOCELLS



Type PC-1

Spectral response in the visible range and X-ray wave lengths, with remarkable response time. Sensitivity comparable with photo-multipliers per unit area. Resistance change is proportional to the light received. Ideal for applications of activating, counting, measuring, etc. End on activation.

for applications of activating, counting, measuring, etc. End on activation.



6—Type PC-2

Spectral response in visible and infra-red range. Cell resistances covering a wide range can be supplied. For example, dark resistances of 5 to 8000 megohms down to as low as a few hundred thousand ohms. Different sensitivities can also be supplied over a long range from 10 microamps per lumen to as high as amperes per lumen. Ideal for auto dimmers and the like. Activation from all directions. Both of these types are extremely sensitive to very low levels of illumination.

**PHOTOCRYSTALS, INC.**

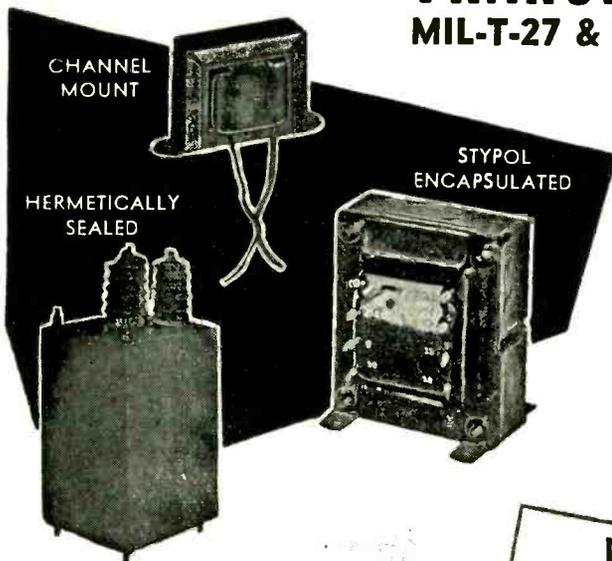
15 S. First St.

Geneva, Ill.

## STERLING

A DEPENDABLE SOURCE  
FOR

## TRANSFORMERS MIL-T-27 & COMMERCIAL



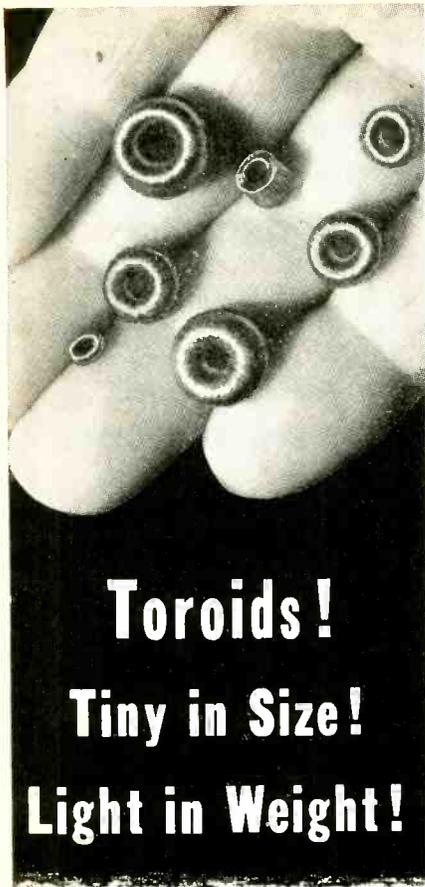
- Pulse
- Audio
- Power
- Filter Choke
- Filament
- RF Coils

Custom Built to  
your Specifications



297 North 7th St., Brooklyn 11, N. Y.

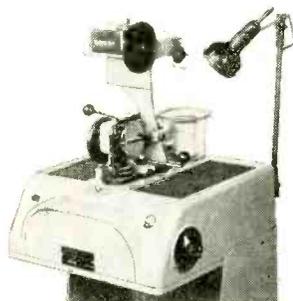
**WE SOLICIT  
SAMPLES AND SHORT  
RUN PRODUCTION**



**Toroids!**  
**Tiny in Size!**  
**Light in Weight!**

Envision the potentialities of these bantam coils in solving space and weight problems! Sub-miniature toroids from the BOESCH Model SM reveal a new horizon in equipment design.

Write for detailed information on the NEW Model SM Sub-miniature Toroidal Coil Winding Machine.



Model SM

Makers of the world's most versatile winding machines.



Want more information? Use post card on last page.

## BACKTALK

### Name Sake

DEAR SIRs:

THANK you for publishing my Transistor Nomograph, p 178, August, 1954 . . . however, the last name is "Bolie" instead of "Bolis" as printed . . .

Since publication of the article I have received requests for about a dozen reprints . . . all addressed with the misspelled name. In fact, I was even invited to join the IRE, an organization with which I was already associated.

VICTOR W. BOLIE  
*Scientific Staff  
 Collins Radio Company  
 Cedar Rapids, Iowa*

Editors' Note: We regret the inconvenience caused Mr. Bolie. Printer please note.

### Tape Curves

DEAR SIRs:

TWO ERRORS which appeared in the final printing of the article "Magnetic Tape Pickup Has D-C Response" in the September 1954 issue of ELECTRONICS, page 156, should be called to the attention of your readers.

Labels referring to the two curves of Fig. 4, p 158, are reversed. The solid-line curve showing the better high-frequency response should have been labeled "tape coating against pole"; data for the dashed-line curve were obtained with the "tape coating centered."

The second integral in the equation near the center of page 158 should have limits of 8 to 20 rather than  $e$  to 20 as shown.

J. W. GRATIAN  
*Research & Development Dept.  
 Stromberg-Carlson Company  
 Rochester, N. Y.*

### More Amplifier Design

DEAR SIRs:

IN HIS LETTER in June, 1954 *Backtalk* (p 378), Mr. Diamond has inferred that my comments on his article are incorrect. . . .

Mr. Diamond quotes the "Radio-tron Designers Handbook" to the effect that pentode output tubes produce more high order distortion than triodes; however, we are dis-

## MISSILE SYSTEMS

*Research  
 and  
 Development*

PHYSICISTS  
 AND ENGINEERS

Inquiries are invited from those who can make significant contributions to, as well as benefit from, a new group effort of utmost importance.

*Lockheed*

MISSILE SYSTEMS DIVISION

*research  
 and  
 engineering  
 staff*

LOCKHEED AIRCRAFT CORPORATION

VAN NUYS • CALIFORNIA

Want more information? Use post card on last page.

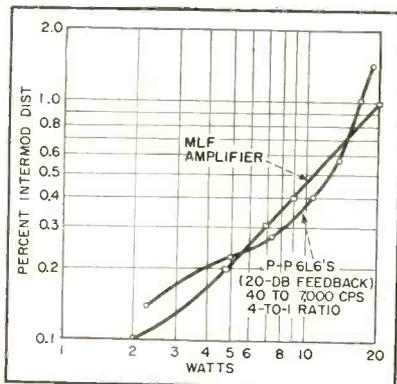
cussing beam tetrode output tubes which comprise still another class of tube. Further down the page the handbook states that beam tetrodes are different from pentodes in that they have more second harmonic and less third and higher harmonic distortion. The Handbook states that push-pull class-A 6L6's will give 18.5 watts output with two-percent harmonic distortion. There are no receiving-type triodes which will match this performance.

I have run intermodulation tests on many amplifiers, including Williamson's, with the output tubes connected as triodes, as tetrodes, and as tetrodes with inverse feedback to the screens (So-called "Ultra Linear"). These curves show no significant difference resulting from the different connections except that with triode connection the power output is greatly reduced.

I think it can safely be stated that with the excellent output transformers now available, which allow 20 db of overall feedback with good stability, there is no longer any reason to use triodes in amplifiers up to 100 watts.

My statement concerning the plate-to-grid feedback was that I doubted that it was effective in reducing the total distortion in the amplifier. I will remain of this opinion until I see some facts and figures to prove the opinion wrong.

To show that 36 db of feedback is superfluous I have enclosed a graph comparing one of my 6L6 amplifiers with data on the ampli-



fier published by Mr. Knapp in *Radio and Television News* for May, 1954. Since my amplifier is running with a 300-volt supply it overloads at 18 watts. For anyone who must have over 20 watts, four

# Square Wave Generator



## MODEL 71

### SPECIFICATIONS

- FREQUENCY RANGE:** 5 to 100,000 cycles.
- WAVE SHAPE:** Rise time less than 0.2 microseconds with negligible overshoot.
- OUTPUT VOLTAGE:** Step attenuator giving 75, 50, 25, 15, 10, 5 peak volts fixed and 0 to 2.5 volts continuously variable.
- SYNCHRONIZING OUTPUT:** 25 volts peak.
- R. F. MODULATOR:** 5 volts maximum carrier input. Trans-lation gain is approximately unity—Output impedance is 600 ohms.
- POWER SUPPLY:** 117 volts, 50-60 cycles.
- DIMENSIONS:** 7" high x 15" wide x 7½" deep overall.

MANUFACTURERS OF  
Standard Signal Generators  
Pulse Generators  
FM Signal Generators  
Square Wave Generators  
Vacuum Tube Voltmeters  
UHF Radio Noise & Field  
Strength Meters  
L-C-R Bridges  
Megohm Meters  
Megacycle Meters  
Intermodulation Meters  
TV & FM Test Equipment

**MEASUREMENTS CORPORATION**  
BOONTON  NEW JERSEY

# Specification Coils



—for every requirement—radio, FM, TV and Government Applications!

Including Universal, Bank Wound, Universal Progressive and Solenoid. All are precision-built to highest engineering standards and conform exactly to specifications. For uniform high quality, prompt delivery and economical unit costs, specify coils by Fugle-Miller. Radio, TV and JAN specifications are a specialty. Phone, wire or write for quotations.

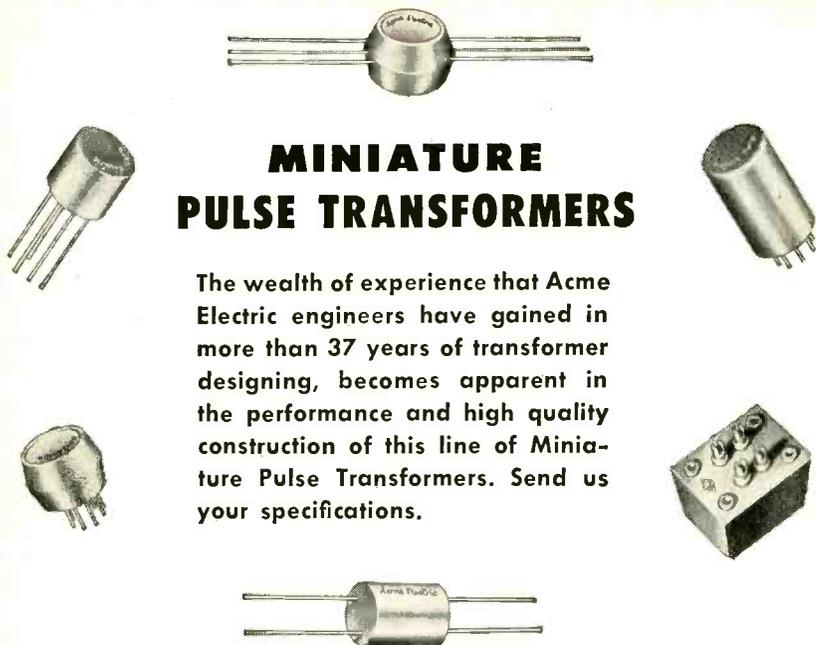
ADDRESS INQUIRIES TO DEPT. E



**FUGLE-MILLER LABORATORIES**  
MAIN STREET, METUCHEN, NEW JERSEY  
Telephone: Metuchen 6-2245

## MINIATURE PULSE TRANSFORMERS

The wealth of experience that Acme Electric engineers have gained in more than 37 years of transformer designing, becomes apparent in the performance and high quality construction of this line of Miniature Pulse Transformers. Send us your specifications.

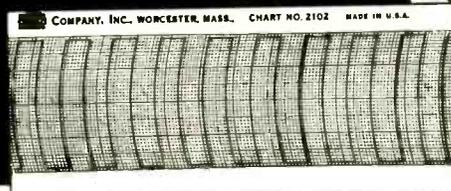


**ACME ELECTRIC CORPORATION**  
1375 WEST JEFFERSON BLVD. • LOS ANGELES, CALIF.

WRITE FOR  
CATALOG  
PT-301

**Acme Electric**  
TRANSFORMERS

## Turn Over Your Square Wave Recording Problems to EDIN



Square wave pulses are recorded square—without overshoots caused by resonance—on Edin scientific recording equipment.

For assistance in the selection of equipment for any graphic recording task, there is an Edin representative nearby, anxious to serve you. Tell us you would like to see him.

THE EDIN COMPANY  
207 Main St., Worcester 8, Mass., Dept. B  
Gentlemen:

Have your representative call with complete information on recording instruments.

Name.....  
No..... Street.....  
City..... State.....  
Position.....



**COMPANY, INC.**  
207 Main Street • Worcester, Mass.

6V6's may be substituted for the two 6L6's. The higher distortion shown at the low end of the curve may to some degree be attributed to the fact that the i-d test setup gave a reading of 0.11 percent with no amplifier included.

This amplifier is stable with 0.02  $\mu$ f across the 16-ohm load. It is also stable with the output terminals open-circuited and either output tube removed. Under this condition the remaining output tube may be driven to clipping level without high-frequency blips or motorboating appearing.

The statement that doubling the gain of one 6L6 will cut the inter-stage impedance in two, thus halving the gain of the associated 6AU6, is not true in a push-pull circuit with coupling between halves of the primary. If the coupling between halves of the primary is near 100 percent the impedances offered to the plates of both of the 6AU6's will be lowered about 30 percent. Neither of the balanced feedback loops has any tendency to restore any push-pull unbalance resulting from a change in tube characteristics. . . .

I am still of the opinion that 15,000 ohms is a very low load for a 6AU6. Plotting a load line and a transfer characteristic will show that there is considerable second-harmonic distortion. Although this distortion may be balanced out to a considerable degree, it seems much more desirable not to generate it in the first place where it can be avoided.

Mr. Diamond mentions substitution of different type tubes with negligible effects. It would be interesting to see some figures on just how negligible this effect is. Listening is not a very accurate test for power output or distortion. It is reiterated that the two balanced feedback loops do not stabilize the gains of the individual halves of the push-pull circuit and therefore have no tendency to correct for push-pull unbalance. . . .

If the two 6L6's are considered as generators in parallel feeding one load, it must be appreciated that the impedance of these generators is not constant but varies with a variation of the balance of the excitation of the two grids. If

# PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

## ANNIS ELECTRIC RESEARCH LABORATORY, INC.

CONSULTING — RESEARCH — DEVELOPMENT  
AND DESIGN OF RADIO AND ELECTRONIC  
EQUIPMENT

Antennas, Wave Propagation, Information Storage,  
Computers, Impedance Matching and Variable  
Speed A-C Motors.  
P. O. Box 581 140 1/2 S. Nell St.  
Champaign, Ill. Tel. 6-1780

## Professional Assistance

*in solving your most difficult  
problems in the specialized  
field of electronic devices is  
offered by consultants whose  
cards appear on this page.*

## NIAGARA ELECTRON LABORATORIES

CONSULTATION - DESIGN - CONSTRUCTION  
MFG. THE THERMOCAP RELAY

Specializing in solution of problems of electronic  
and electro-physical instrumentation for the re-  
search or analytical laboratory. Industrial plant  
problems also invited.

Andover, New York Cable Address: NIATRONLAB

## CROSBY LABORATORIES, INC.

*Murray G. Crosby & Staff*

Radio - Electronic  
Research Development & Manufacturing  
Communication, FM & TV

Robbins Lane, Hicksville, N. Y.  
Hicksville 3-3191

## PICKARD & BURNS, INC.

*Consulting Electronic Engineers*

Analysis and Evaluation  
of Radio Systems

Research, Development and Production  
of Special Electronic Equipment

240 Highland Ave. Needham 94, Mass.

## EDGERTON, GERMESHAUSEN & GRIER, INC.

*Consulting Engineers*

Stroboscopy — Transient Oscillography  
Photoelectricity — Pulse Techniques — Timing  
High-Speed and Electric Flash Photography  
Telemetering — Industrial Television Applications  
160 Brookline Avenue Boston 15, Mass.

## INTERFERENCE MEASUREMENT LABORATORY

Interference Study per Government Specifications  
Shielded Space for Interference Investigation  
Field Surveys for F.C.C. Certification of Induction  
and Dielectric Heating Equipment

907 East 51st Street • Brooklyn 3, New York  
Ingersoll 9-1765

## ALBERT PREISMAN

*Consulting Engineer*

Television, Pulse Techniques, Video  
Amplifiers, Phasing Networks,  
Industrial Appliances

Affiliated with  
MANAGEMENT-TRAINING ASSOCIATES

3224-16th St., N. W. Washington 10, D. C.

## Eldico of New York, Inc.

Pioneers of Television Interference Elimination from  
Transmitters, Induction Heaters, Diathermy and etc.

Donald J. S. Merten & Engineering Staff

70 E. Second St. Mineola, L. I., N. Y.  
Garden City 7-0383

## THE KULJIAN CORPORATION

*Consultants • Engineers • Constructors*

Electronic Control  
Specialists

Utility • Industrial • Chemical

1200 N. Broad St. Phila 21, Pa.

## JOSEPH RACKER CO., INC.

HOW GOOD IS YOUR NEW PRODUCT?

NEW PRODUCT CONSULTANTS

A complete service for your new product  
Evaluation . . . Market Research . . . Sales Building  
Commercialization . . . Financing . . . Promotion  
. . . Production

140 Nassau St., New York 38, N. Y. Worth 4-1463

## ELECTRONIC RESEARCH ASSOCIATES, INC.

"TRANSISTORIZE" YOUR PRODUCT!

Complete Service in consulting, research, develop-  
ment, and production on Transistor circuitry, prod-  
ucts and instrumentation.

715 Main Street North Caldwell, N. J.  
Caldwell 6-6729

## G. LEWIN

*Consulting Physicist*

ELECTRON TUBES

development, design and manufacture

21 Yale Terrace West Orange, N. J.

Orange 4-6994

## THE TECHNICAL MATERIAL CORPORATION

*Communications Consultants*

Systems Engineering  
General Offices and Laboratory

700 Fenimore Rd., Mamaroneck, N. Y.

## ERCO RADIO LABORATORIES, INC.

*Radio Communications Equipment*

Engineering - Design - Development - Production  
Our 25th Year in Air to Ground  
Communications and Radio Beacons  
Garden City • Long Island • New York

## ROBERT McCABE

Radio Noise Measurement and Elimination  
Field Intensity Surveys

1781 Bide-a-Wee Park Columbus 5, Ohio

## TELECHROME, INC.

*Electronic Design Specialists*

COLOR TELEVISION EQUIPMENT

Flying Spot Scanners, Color Synthesizers, Keyers,  
Monitors, Oscilloscopes and Related Apparatus  
J. R. Popkin-Churman, Pres. & Ch. Mgr.

88 Merrick Rd. Amityville, L. I., N. Y.

## HANSON-GORRILL-BRIAN INC.

*Product & Mfg. Development*

ELECTRICAL - ELECTRONIC  
HYDRAULIC - MECHANICAL

One Continental Hill Glen Cove, N. Y.  
Glen Cove 4-7300

## Measurements Corporation

*Research & Manufacturing Engineers*

HARRY W. HOUK MARTIAL A. HONNELL  
JOHN M. VAN BREUEN

Specialists in the Design and  
Development of Electronic Test Instruments  
Boonton, New Jersey

## WHEELER LABORATORIES, INC.

Radio and Electronics

Consulting — Research — Development  
R-F Circuits — Lines — Antennas

Microwave Components — Test Equipment  
Harold A. Wheeler and Engineering Staff

Great Neck, N. Y. HUster 2-7876

## R. W. HODGSON CO.

*Technical Sales Representation &  
Research & Development Engineering*

Specializing in Electronics, Nucleonics,  
Instrumentation, Servomechanisms &  
Cybernetics. Let Us Handle Your New  
Product or Invention.

3406 W. Washington Blvd. Los Angeles 18, Calif.  
REpublic 3-0322

## NEW ROCHELLE TOOL CORP.

FOR CERTIFICATION OF INDUCTION  
AND DIELECTRIC HEATING EQUIPMENT  
IN ACCORDANCE WITH F.C.C. RULINGS

Mobile Test Unit Available Entire U. S.

320 Main St. New Rochelle, New York  
Phone NE 2-5555

## YARDNEY LABORATORIES, INC.

*Research - Design - Development*

Electro-Chemical Generators of Energy

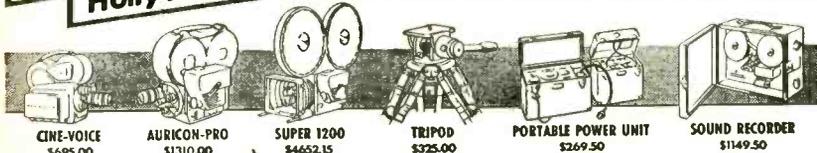
40-46 Leonard Street Worth 6-3100  
New York 13, N. Y.

# CONTACTS

FOR THE FIELD OF ELECTRONICS

**Auricon Hollywood**

16mm SOUND-ON-FILM EQUIPMENT FOR TELEVISION NEWSREELS, TV FILM INSERTS AND KINESCOPE RECORDINGS... SOLD WITH A 30-DAY MONEY-BACK GUARANTEE. YOU MUST BE SATISFIED!

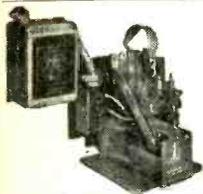


CINE-VOICE \$695.00    AURICON-PRO \$1310.00    SUPER 1200 \$4452.15    TRIPOD \$325.00    PORTABLE POWER UNIT \$269.50    SOUND RECORDER \$1149.50

WRITE FOR FREE ILLUSTRATED INFORMATION

**BERNDT-BACH, Inc.**  
6924 Romaine St., Hollywood 28, Calif.

MANUFACTURERS OF SOUND-ON-FILM RECORDING EQUIPMENT SINCE 1931



EISLER MANUFACTURES COMPLETE EQUIPMENT  
WELDERS FOR SPOT & WIRE BUTT  
RADIO, TV TUBE EQUIPMENT & REPAIR UNITS  
INCANDESCENT, FLUORESCENT MFG. EQUIPMENT  
NEON SIGN MAKERS EQUIPMENT, GLASS LATHES  
ELECTRONIC EQUIPMENT, VACUUM PUMPS, Etc.  
Wet Glass SLICING & CUTTING MACHINES for Lab Use  
TRANSFORMERS, SPECIAL & STANDARD TYPES

EISLER ENGINEERING CO., INC.  
751 So. 13th St.    Newark 3, N. J.



## CINEMA'S TAPE AND FILM

# Degausser

CLEAN ERASURE OF MAGNETIC TAPE & FILM



TYPE 9205 DEGAUSSER

Noise & program erasure. Use the best. Cinema's Bulk-Tank Type Degausser 9205. Economically priced. Buy yours today

**CINEMA ENGINEERING CO.**  
DIVISION AEROVOX CORPORATION  
1100 CHESTNUT STREET • BURBANK, CALIF.

FLUXES  
SODERING  
BRAZING & WELDING  
L. B. ALLEN CO. INC. Chicago 31, Ill.  
6751 BRYN MAWR AVE.

## COILS

2uH—2MH in Stock for Immediate Delivery  
SPECIAL COILS DESIGNED AND WOUND  
**NORTH HILLS ELECTRIC CO., Inc.**  
203-18E 35th Ave., Bayside 61, L. I., N. Y.

World's Only Recorder of its Kind  
**WALKIE-RECORDALL**  
8-LB SELF-POWERED BATTERY RECORDER

- AUTOMATIC UNDETECTED RECORDING up to 4 hrs. Records noiselessly in or out of closed briefcase, containing hidden mike while walking, riding, flying. Conferences, lectures, dictation, 2-way phone. Permanent, unalterable, indexed recording at only 3¢ per hr.
- PICKS UP WITHIN 60 FT. RADIUS.
- VOICE ACTIVATED "SELF-START-STOP"
- NO WIRES OR PLUGS.

MILES REPRODUCER CO., INC.  
812 Broadway, N. Y. 3, N. Y. Dept. E

### Precision BLACK ANODIZING

Specializing in black anodizing, both sulphuric and chromic, on all alloys and castings.

All other colors as well.

GOVERNMENT CERTIFIED  
Contact us for special service.

**HENRY and MILLER INDUSTRIES, INC.**  
675 Garfield Ave., Jersey City, N. J.  
Henderson 4-4200

### LEGAL NOTICE

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION

Of Electronics published monthly at Albany, New York for October 1, 1954.

- The name and address of the publisher, editor, managing editor, and manager is Publisher McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y.; Editor, W. W. MacDonald, 330 West 42nd Street, New York 36, N. Y.; Managing editor, Vir. Zelut, 330 West 42nd Street, New York 36, N. Y.; Manager, Wallace B. Blood, 330 West 42nd Street, New York 36, N. Y.
- The owner is: McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y.; Stockholders holding 1% or more of stock: Donald C. McGraw and Willard T. Chevalier, Trustees for Harold W. McGraw, Donald C. McGraw and Elizabeth M. Stolzfus, all of 330 West 42nd Street, New York 36, N. Y.; Donald C. McGraw and Harold W. McGraw, Trustees for Catherine M. Rock, 330 West 42nd Street, New York 36, N. Y.; Donald C. McGraw, Executor of the Estate of Curtis W. McGraw, 330 West 42nd Street, New York 36, N. Y.; Donald C. McGraw, 330 West 42nd Street, New York 36, N. Y.; Mildred W. McGraw, Madison, New Jersey; Grace W. Mehren, 536 Arenas Street, LaJolla, California; Touchstone & Company, c/o Wellington Fund, Inc., Claymont, Del.
- The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.
- Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

McGRAW-HILL PUBLISHING COMPANY, INC.  
By J. A. GERARDI, Vice Pres. & Treas.  
Sworn to and subscribed before me this 14th day of September, 1954.  
[SEAL] ELVA G. MASLIN.  
(My Commission expires March 30, 1956)

by some chance the excitation to one tube is reduced in relation to the excitation of the other its internal impedance is raised.

If there is no grid voltage on one 6L6 it will appear as just a 30,000-ohm load across the other. If one 6AU6 deteriorates below the point of offering no signal to its 6L6, the feedback circuit tends to excite the 6L6 180 degrees out of phase with the desired signal, thus tending to reduce the voltage across the output transformer to zero.

The feedback from the output plates to the output grids has a tendency to multiply any unbalance which takes place between the transconductances of the 6AU6's due to age or changing line voltage. It probably results in little or no reduction in distortion, and it is not necessary for the reduction of output impedance. It therefore has more disadvantages than advantages and should be eliminated. The feedback from the output plates to the driver cathodes is useful to reduce distortion; it does not affect the balance or unbalance of the circuit but it does mitigate against the use of self-balancing provisions in the driver stages. It would be improved by increasing the current feedback in the driver circuits, thus making the gains of the two halves more independent of the driver tube characteristics.

The overall feedback loop does the most desirable work and therefore should be increased to the maximum that stability will allow. To permit the greatest amount of overall feedback it is desirable to keep to the minimum the number of stages included within the loop. I consider that the type of amplifier suggested in my previous letter is the easiest way to get adequate power with low distortion and I think that the test information I have collected verifies this.

I would like to see some curves showing the intermodulation distortion versus output power for Mr. Diamond's amplifier when a 6CB6 tube has been substituted for a 6AU6 with the signal balance control set at the optimum position for a 6AU6, and the curve for the amplifier without the plate-to-grid feedback loops connected.

W. B. BERNARD  
San Diego, California

REPLIES (Box No.): Address to office nearest you  
 NEW YORK: 330 W. 42nd St. (36)  
 CHICAGO: 520 N. Michigan Ave. (11)  
 SAN FRANCISCO: 68 Post St. (4)

### POSITIONS VACANT

**DEVELOPMENT ENGINEERS** needed by small, growing engineering and manufacturing company to do circuit design in following systems: Radar, Computers, Simulators, Cathode Ray Displays, Industrial Automatic Control. Minimum of 2 years experience essential. Located in Allentown-Reading area. Send resume to Penn-East Engineering Corp., Box 240, Kutztown, Pa.

**LICENSED TECHNICIAN** — steady work — good pay incentive bonus — established firm in ideal climate — must have 2nd phone or better and know marine RT servicing. Apply with full particulars to P-4475, Electronics.

**ASSISTANT OR Associate Professor** needed by September, 1955, at an expanding midwestern technical college for instruction in electronics, communications and servomechanisms. M.S. E.E. degree and teaching or research experience are minimum requirements. Salary open. Send resume to Fournier Institute of Technology, Lemont, Illinois.

**ELECTRONIC DEVELOPMENT Engineer** needed by Ohio manufacturer to assume responsibility for the design and development of electronic equipment associated with high speed printing systems for special applications. Must have had at least 5 years design and development experience on equipment involving pulse techniques and synchronization problems. Starting salary \$7500 per year. Allowance for moving expense. Replies held in confidence. Submit resume to P-4545, Electronics.

**RADAR ENGINEERS**—Interesting and challenging project positions are open in the field of radar systems design for guided missile research. Level of work requires advanced degree and a minimum of five years of experience. P-4609, Electronics.

### SELLING OPPORTUNITY OFFERED

**MANUFACTURER'S REPRESENTATIVE** wanted to sell Diecut Pressure Sensitive tapes. Substantial commissions; constant re-ordering potential. Every aircraft and electronics manufacturer is your prospect. Write Printed Cellophane Tape Company, 521 No. La Brea Avenue, Los Angeles 36, Calif. for information.

### POSITION WANTED

**ELECTRONICS ENGINEER—BSEE**—4 years development engineering in Electronics components—supervisory experience—desires position as development engineer. PW-4421, Electronics.

### SELLING OPPORTUNITIES WANTED

**SUCCESSFUL SOUTHERN California** manufacturers' representatives expanding organization established among aircraft and electronic manufacturers and wholesalers. Offers experienced, aggressive representation to companies with good growth potential. Warehouse and offices in Los Angeles, RA-4448, Electronics, 1111 Wilshire Blvd., Los Angeles 17, Calif.

**MANUFACTURERS OPPORTUNITY** salient, experienced, responsible, powerful, successful manufacturers representatives for Conn., New York, New Jersey, & Penna. Large following with wholesalers, chains, premium outlets, mail-order firms & exporters. Seeks an aggressive manufacturer, you or we can carry the account but billing by you. RA-4590, Electronics.

**SALES ENGINEERING Organization** (manufacturers representatives) Available for New York, New Jersey, Eastern Penn. Equipment Specialists with exceptional technical backgrounds and sales records in industrial, research and nuclear equipment instruments and specialized components. RA-4599, Electronics.

### WANTED

ANYTHING within reason that is wanted in the field served by Electronics can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

### MFGRS. REP. AVAILABLE

Experienced sales engineer desires top electronic lines to represent in Texas, Oklahoma and New Mexico. Highest quality representation guaranteed.

RA-1645, Electronics  
 330 W. 42 St., New York 36, N. Y.

# SEARCHLIGHT SECTION

(Classified Advertising)

**EMPLOYMENT: BUSINESS: OPPORTUNITIES: EQUIPMENT USED OR RESALE**

## UNDISPLAYED — RATES — DISPLAYED

\$1.80 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line.

*Position Wanted* undisplayed advertising rate is one-half of above rate, payable in advance.

*Box Numbers*—offices count as one line.

*Discount* of 10% if full payment is made in advance for 4 consecutive insertions.

The publisher cannot accept advertising in the Searchlight Section which lists the names of the manufacturers of resistors, capacitors, rheostats, and potentiometers or other names designed to describe such products.

*Equipment Wanted or For Sale Advertisements* acceptable only in Displayed Style. *Individual Spaces* with border rules for prominent display of advertisements.

The advertising rate is \$16.10 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured 7/8" vertically on one column. 3 columns—30 inches—to a page.

## FIELD ENGINEERS AND TECHNICIANS

Radio Communications  
 Microwave  
 Terminal Equipment  
 Teletype  
 Radar

Responsible positions with a well established progressive organization. Applicants must have diversified training and experience. All positions are subject to travel. Personal interviews will be arranged for applicants meeting employment requirements. Reply by letter giving age, education, experience and other qualifications to:

Duane C. Enochs  
 NATIONAL SCIENTIFIC LABS. Inc.  
 2010 Mass. Ave., N. W.  
 Washington 6, D. C.

## ADMINISTRATIVE CAREERS FOR TECHNICAL MEN

We have a number of excellent positions for graduate or experienced Electrical Engineers who prefer a position combining technical knowledge and general management administration. Starting salaries are higher than for straight technical work and potential is much greater. COMPLETELY CONFIDENTIAL, NATIONWIDE.

Drake Engineering  
 Personnel Service  
 7 W. Madison St. Chicago 2, Ill.  
 Financial 6-2100

### Manufacturer's Representative Southern California

Experienced sales rep. with good technical background (MS, Physics) now calling on S. Calif. Electronics industry wishes to contact manufacturers in need of intensive technical sales representation in Calif. Test equipment, components, computing devices and computer components, etc.

RA-4467, Electronics  
 1111 Wilshire Blvd., Los Angeles 17, Calif.

### SALES REPRESENTATIVE

Electronics and TV industry seeks additional lines complementing special coils and metal stampings. Metropolitan NY, Connecticut, New Jersey.

RA-4501, Electronics  
 330 W. 42 St., New York 36, N. Y.

### MANUFACTURERS REPRESENTATIVE

Sales Manager of electro-mechanical product leaving firm shortly to set up mfg. rep. agency. Available for New Jersey, New York and eastern Penna. areas. Enjoy entree to purchasing and engineering groups now. Interested in progressive principals with specialized components, test equipment, hardware, wire, etc.

RA-3961, Electronics  
 330 W. 42 St., New York 36, N. Y.

## SENIOR ELECTRONICS ENGINEERS

EE degree or equivalent experience. Background in communications and navigation desirable. Permanent positions in design and development. Citizenship required. Position at Rochester, New York. Excellent living and recreational conditions in this area.

### ADDRESS:

Chief Electronics Engineer  
 STROMBERG-CARLSON COMPANY  
 ROCHESTER 3, NEW YORK

## COMMUNICATIONS ENGINEERS and TECHNICIANS

EXCELLENT SALARIES  
 MINIMUM PREREQUISITES

**ENGINEER** EE Graduate with 3 years experience  
**TECHNICIAN** 2 years technical school in communications and 3 years experience.

Require installation adjustment and maintenance experience with communication receivers and associated terminal equipment. Also, men with similar experience with high-powered transmitters, antennas, transmission lines.

Must be willing to travel in United States and Overseas.

Page Communications Engineers, Inc.  
 710 Fourteenth St., N.W., Washington 5, D.C.

### HAVE YOU A BETTER MOUSETRAP?

Let us introduce it at GRIFFISS AFB, center for all AF ground electronic equipment and see that you no longer miss any AF business.

WRIGHT ASSOCIATES  
 Manufacturer's Representatives  
 P. O. Box 623 Rome, New York

### WANTED

## INVENTIONS—IDEAS

East Coast electronic manufacturer interested in obtaining rights under patents or patent applications for new devices useful in fields of electronics, atomic energy, automation or television; arrangement will be made to protect rights and interests of owner of acceptable items; write, giving technical background and general description of item.

BO-4396, Electronics  
 330 W. 42 St., New York 36, N. Y.

advanced electronics developments  
create new opportunities for engineers  
at General Electric

▶ **ENGINEERS  
PHYSICISTS**

New revolutionary developments are under way at General Electric. Behind each advance are the General Electric engineers . . . working with the finest facilities . . . exploring the most challenging aspects of their field . . . knowing the sense of stability and progress their work provides.

And, with each new advance, broadening the scope of electronics . . . new challenges, new opportunities constantly arise.

The opportunity is ever-growing at General Electric. And, an excellent salary and liberal benefits are other advantages worth knowing about.

Experience required in the following fields:

*Advanced Development, Design, Field Service  
and Technical Writing in connection with:*

**MILITARY RADIO & RADAR      MULTIPLEX MICROWAVE  
MOBILE COMMUNICATION      COMMUNICATIONS  
ELECTRONIC COMPONENTS  
TELEVISION, TUBES & ANTENNAS**

Bachelor's or advanced degrees in Electrical or Mechanical Engineering, Physics, and/or experience in electronics industry necessary.

Please send resume to: Dept. 12-4-E, Technical Personnel

**GENERAL  ELECTRIC**

ELECTRONICS PARK, SYRACUSE, N. Y.

## PROGRESSIVE ENGINEERS LOOK WEST

Qualified Electronic and Electro-Mechanical engineers find happy association with a Western electronics pioneer and leader.

*design  
development  
production*

Commercial and military projects. Radar, DME, Communications, Noise, Test Equipment including color T.V. — Many others with real interest & challenge. Relocation expenses — excellent working conditions — Central location. Scheduled reviews & advances. Fine Insurance plan. Move should not disturb urgent military projects.

Send complete resume, income history & requirements to engineering employment mgr.

**Hoffman** LABORATORIES, INC.

(A SUBSIDIARY OF HOFFMAN RADIO CORP.)

3761 SO. HILL ST.

LOS ANGELES 7, CALIF.

## DESIGN ENGINEERS

The Pacific Division, Bendix Aviation Corporation has openings for design engineers in development of radar, sonar and telemetering offering excellent opportunities for growth with the corporation and the opportunity to live in Southern California. Positions are open at several levels.

Please Address Inquiries to

**W. C. WALKER**

ENGINEERING EMPLOYMENT MANAGER

11600 Sherman Way

North Hollywood, California

- RADAR DESIGN AND APPLICATIONS ●
- COMPUTER DESIGN ●
- MISSILE GUIDANCE ●
- COMMUNICATIONS ●

Positions are available in the Assistant, Associate, and Principal Engineering categories for

**ELECTRONIC ENGINEERS  
AND  
PHYSICISTS**

BS degree and experience is required, advanced degree with experience to back it up is even better

**CORNELL AERONAUTICAL  
LABORATORY, INC.**

Buffalo 21, N. Y.

# RCA NEEDS ENGINEERS

## who won't be held back!

RCA, world leader in electronics, has career opportunities for qualified **ELECTRICAL** and **MECHANICAL ENGINEERS** . . . **PHYSICISTS** . . . **METALLURGISTS** . . . **PHYSICAL CHEMISTS** . . . **CERAMISTS** . . . and **GLASS TECHNOLOGISTS** for long range work in military or commercial fields.

**SYSTEMS—ANALYSIS—DEVELOPMENT  
—DESIGN—APPLICATION ENGINEERING**

*in the following fields:*

**AVIATION ELECTRONICS (FIRE CONTROL, PRECISION NAVIGATION, COMMUNICATIONS)**—Radar—Analog Computers—Digital Computers—Servo-Mechanisms—Shock & Vibration—Circuitry—Heat Transfer—Remote Controls—Sub-Minaturization—Automatic Flight—Transistorization—Automation

**RADAR**—Circuitry—Antenna Design—Servo Systems—Information Display Systems—Gear Trains—Stable Elements—Intricate Mechanisms

**COMPUTERS**—Digital and Analog—Systems Planning—Storage Technique—Circuitry—Servo-Mechanisms—Assembly Design—High Speed Intricate Mechanisms

**COMMUNICATIONS**—Microwave—Aviation—Mobile—Specialized Military Systems

**MISSILE GUIDANCE**—Systems Planning and Design—Radar and Fire Control—Servo-Mechanisms—Vibration and Shock Problems—Telemetry

**COMPONENT PARTS (COLOR & MONOCHROMETV)**—HV Transformers—Coils—Deflection Yokes

**SEMI-CONDUCTORS**—Transistors—Diodes

**ELECTRON TUBE DEVELOPMENT**—Receiving—Transmitting—Cathode-Ray—Phototubes and Magnetrons—Power Tubes—Camera Tubes

**ELECTRONIC EQUIPMENT FIELD ENGINEERS**—Specialists for domestic and overseas assignment on military electronic Communications, Navigational Aids, and Guided Missiles.

At RCA you'll work in an atmosphere conducive to creative work—laboratory facilities unsurpassed in the electronics industry . . . constant association with leading scientists and engineers.

Positions now open in Systems, Analysis, Development, Design and Application Engineering. Your choice of long range work in commercial or military fields.

Delightful suburban living easily available. Modern retirement program . . . liberal tuition refund plan for advanced study at recognized universities . . . modern company paid benefits for you and your family.

Individual accomplishments readily recognized. Ample opportunities for increased income and professional advancement.

Join the team at RCA and grow with the world leader in electronics.

*Personal interviews arranged in your city.*

Please send complete resume of your education, experience, and specialized field preference to:

**MR. JOHN R. WELD**  
Employment Manager  
Dept. 300L

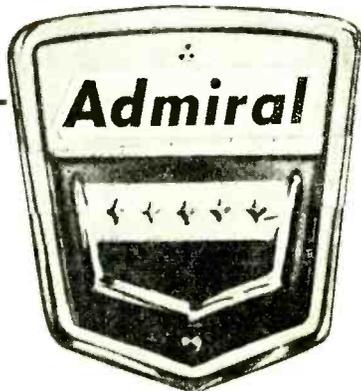
Radio Corporation of America  
30 Rockefeller Plaza, New York 20, N.Y.



**RADIO CORPORATION of AMERICA**

# CAREERS WITH A FUTURE

## ENGINEERING



• Positions are available in our organization at all levels for qualified personnel in the following fields:

- TELEVISION
  - Commercial
  - Military
  - Monochrome
  - Color
- MILITARY COMMUNICATIONS
- COMMERCIAL RADIO
- RADAR

Our rapidly expanding interests in these and other fields open many opportunities for experienced electrical engineers as well as recent graduates.

Chicago location offers excellent facilities for further study and graduate work in the electronics field.

*Personal interviews will be arranged at the convenience of qualified applicants.*

We suggest you write Mr. Walter Wecker, Personnel Department to get more information on career opportunities, advanced educational plans, and other advantages.

## Admiral Corporation

3800 W. Cortland St.  
Chicago 47, Illinois

## DEVELOPMENT ENGINEERS

FOR: Design Engineering, Practical Research, Investigations of Theories, Functional Analysis

An interesting challenge for senior design engineers to work directly with top project supervisors helping through the prototype stage new developments in:

- Automatic Control Instruments
- Electronic Navigational Aids
- Magnetic Amplifiers
- Airborne Armament Systems
- Guided Missile Controls
- Computing Equipment

For these jobs we are interested in men with two or more years experience in electro-mechanical work related to the above fields or in men with superior scholastic records in physics; electrical, electronic or mechanical engineering.

### YOU'LL LIKE WORKING AT FORD INSTRUMENT

- Not too large, not too small
- Stable but progressive company
- N. Y. C. location with all its additional varied opportunities
- Above-average fringe benefits
- Pension Plan
- Nine Paid Holidays
- Two Weeks vacation with pay
- Tuition assistance for further related studies

Our policy of permanency of positions and continuity of service does not allow us to employ engineers unless there is a *clear and definite need for them projected years into the future*. And we promote from within. If you can qualify, we urge you to contact by mail, or if in N. Y. C. phone:

Mr. P. F. McCaffrey, Stillwell 4-9000, Extension 416

## FORD INSTRUMENT COMPANY

Division of the Sperry Corporation

31-10 Thomson Ave., Long Island City, N. Y. (20 minutes from the heart of New York City)

## DEVELOPMENT & FIELD SYSTEMS ENGINEERS

- ANTENNA
- RADIO COMMUNICATIONS
- RADAR
- MICROWAVE
- NAVIGATIONAL AIDS
- TERMINAL EQUIPMENT
- TELETYPE

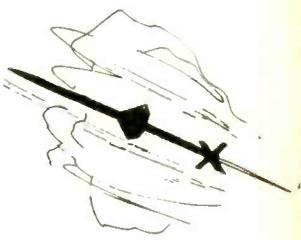
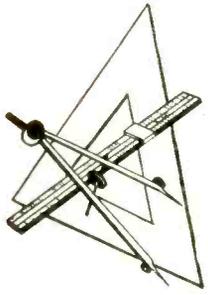
With a progressive, expanding, well established corporation. Interviews will be arranged for qualified applicants. Send complete biographical resume, experience and education to

Mr. J. E. Richardson  
Personnel Director

MARYLAND ELECTRONIC MFG. CORP.  
5009 Calvert Road  
College Park 9, Maryland



# Help Build Tomorrow's World TODAY!

**GOODYEAR AIRCRAFT CORPORATION**, pioneer and leader in lighter-than-air craft, offers you a new employment opportunity with a well-established and fast-growing company where "careers are planned."

**DESIGN AND DEVELOPMENT** engineering opportunities are available for capable and imaginative men and women in the field of airships, aircraft and aircraft components.

**RESEARCH AND DEVELOPMENT** projects — missiles, electric and electronics systems, servomechanisms, new special devices, fiber resin laminates — all present an urgent need for engineers with fresh talent, aptitude and ambition.

**POSITIONS ARE OPEN** at several levels in various fields with salaries based on education, ability and experience.

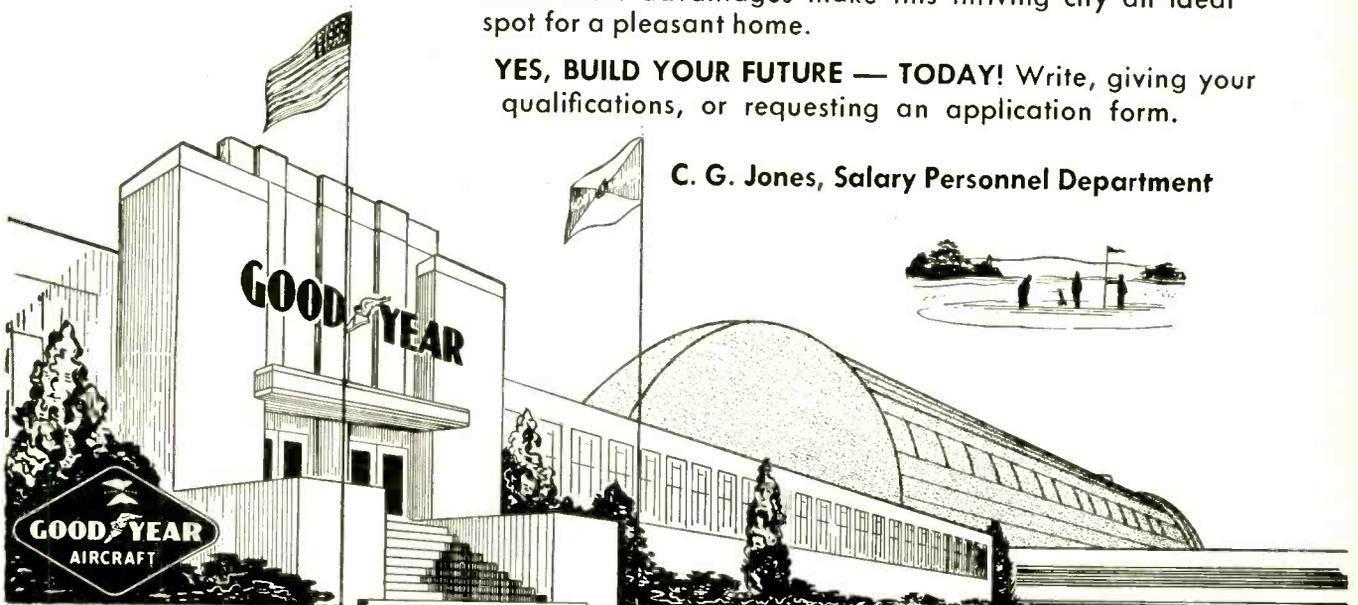
Physicists	Civil engineers
Mechanical engineers	Electrical engineers
Aeronautical engineers	Technical editors
Welding engineers	Technical illustrators



**AKRON, THE HOME OF GOODYEAR AIRCRAFT**, is located in the lake region of northeastern Ohio. Cosmopolitan living, year-round sports and recreation, cultural and educational advantages make this thriving city an ideal spot for a pleasant home.

**YES, BUILD YOUR FUTURE — TODAY!** Write, giving your qualifications, or requesting an application form.

C. G. Jones, Salary Personnel Department

**GOODYEAR AIRCRAFT CORPORATION, 1210 MASSILLON RD., AKRON 15, OHIO**

# M. I. T.

## LINCOLN LABORATORY

Staff research positions available for exceptional **electrical engineers** with advanced training or experience in **electronics** as applied to . . . Radar,  
Communications  
and  
High Speed  
Digital Computers.

Please reply to:  
**Personnel Department, P. O. Box 73,**  
Lexington 73, Mass.

### ENGINEERS

#### PRODUCT DEVELOPMENT

E.E. Degree plus demonstrated ability in design of electronic equipment. Three to Five years' experience in Industrial Instruments involving A.C. and D.C. Amplifiers, Meters, Signal Generators, Oscilloscopes.

Practical production background also desirable. Positions offer secure future with aggressive and expanding organization. Excellent working conditions and associations. Starting salaries commensurate with training and experience.

Send your complete resume in confidence to . . .

**BRUSH DEVELOPMENT CO.**  
3631 Perkins Ave., Cleveland 14, Ohio  
(Division of Clevite Corp.)

### Teaching Opportunity Electronics and Physics

Three positions in electronics engineering as well as advanced physics are open at a rapidly expanding Eastern technological university. Excellent opportunities for the right men. Write, giving experience and qualifications, to

P-4538, Electronics  
330 W. 42 St., New York 36, N. Y.

## CAREER BUILDING THROUGH RESEARCH

The Cook Research Laboratories, one of the Nation's most progressive research and development laboratories, has openings for qualified engineers and physicists at both Senior and Junior levels.

**A Growing Company**  
**Outstanding Personnel**  
**High Starting Salaries**  
**Excellent Working Conditions**

There are immediate openings in the following fields:

**Radar**  
**Microwave Techniques**  
**Antenna Design**  
**Field Theory**  
**(Electro-Magnetic)**  
**Servomechanisms**

**Aircraft**  
**Instrumentation**  
**Circuit Theory & Design**  
**Marine Design (M.E.)**  
**Operations Research**  
**Mechanical Design**

Contact

MR. D. M. HALLIDAY

## COOK RESEARCH LABORATORIES

8100 Monticello Avenue Skokie, Illinois  
KE 9-2060

A Division of  
Cook Electric Company  
Chicago

Electrical and Mechanical Engineering and Manufacturing  
Since 1897

### ELECTRICAL—ELECTRONICS DESIGN ENGINEERS

**Long Range Program—Aircraft Trainers**  
Challenging, creative assignments in an expanding and progressive organization. BSEE plus experience in electro-mechanical devices, servo-mechanisms or analogue computers desirable. Send complete resume to:

**STANLEY AVIATION CORPORATION**  
Buffalo Municipal Airport  
Buffalo 25, New York

### REPRESENTATIVES WANTED

Manufacturer of electronic test equipment for military and commercial applications needs technically qualified representatives. Write giving qualifications, lines handled, territory covered.

RW-2178, Electronics  
1111 Wilshire Blvd., Los Angeles 17, Calif.



WESTINGHOUSE CALLING . . .

# ELECTRONIC ENGINEERS WITH A DESIRE TO CREATE!

The chief requirement of advanced development work such as that now being conducted at the Westinghouse Electronics Division is a staff of experienced engineers with a keen desire to create!

Top-level positions in our expanding Electronics Division provide a challenge and opportunity for creative engineers.

Begin now to satisfy your desires . . . at Westinghouse. Current openings offer excellent income and employe benefits, as well as ideal working conditions. You will have no difficulty finding comfortable suburban living accommodations.

## CURRENT OPENINGS INCLUDE:

### ELECTRONIC CIRCUIT ENGINEERS (MILITARY)

Applied research, development and design of electronic apparatus for communications, radar and missile guidance systems.

### VHF COMMUNICATIONS ENGINEERS

Applied research, development and design of military VHF communications apparatus at all power levels for both transmitters and receivers.

### ANTENNA AND WAVEGUIDE ENGINEERS

Applied research, development and design of antennas and waveguide systems for military communications and radar equipment.

### RADAR INDICATOR SYSTEMS ENGINEERS

planning, studying, proposing, and applied research, development, design to include search, fire-control and missile guidance systems.

**For Confidential  
Interviews . . .**

Send a letter outlining your education and experience to:  
R. M. Swisher, Jr., Employment Supervisor, Dept. 29  
Westinghouse Electric Corp.  
2519 Wilkens Avenue, Baltimore 3, Maryland  
Illustrated brochure will be promptly forwarded  
to all qualified applicants

YOU CAN BE SURE . . . IF IT'S **Westinghouse**



# Electronic Engineers *Your Move*

The men we seek are experts in their specialized fields; capable of filling responsible engineering positions with MELPAR, a leader in research and development. Perhaps one of these men may be you. We invite you to learn about our long-range military and industrial programs.

If you are experienced in one or more of the fields listed, write us about yourself, and let us tell you during a personal interview about our past record of success and how you can successfully fit into our future plans.



- Network Theory
- Microwave Techniques
- UHF, VHF or SHF Receivers
- Digital Computers
- Magnetic Tape Handling Equipment
- Radar and Countermeasures
- Microwave Filters
- Flight Simulators
- Subminiaturization Techniques
- Electro-Mechanical Design
- Photographic Eqm't. Design
- Packaging Electronic Equipment
- Pulse Circuitry

Technical Personnel Representative



**melpar, inc.**

A Subsidiary of the Westinghouse Air Brake Co.  
452 Swann Ave., Dept. E-12, Alexandria, Virginia  
or 11 Galen St., Watertown, Mass.

## WHITE-RODGERS ELECTRIC CO. NEEDS MICRO-WAVE and SERVO ENGINEERS TO JOIN AN OUTSTANDING RESEARCH and DEVELOPMENT GROUP NOW

Developments of Inertial Guidance and Control Systems  
and Automatic Flight Formation Systems  
Accomplished By White-Rodgers Armament Engineering Divisions  
Are Commanding Wide-Spread Attention and Interest  
In The Guided Missile and Drone Aircraft Fields

*Long Term Expansion of this  
Permanent and Well-established Organization offers  
UNLIMITED OPPORTUNITY for  
Qualified Technical Personnel*

All Offices and Laboratories Completely Air Conditioned  
All Laboratories Fully Equipped

**POSITIONS ALSO AVAILABLE  
FOR ENGINEERS EXPERIENCED IN**

**Systems Analysis  
Mechanical Design  
Test Instrumentation  
Electronics Packaging  
Circuit Design**

SEND RESUME TO EMPLOYMENT MANAGER, 1201 CASS AVENUE, ST. LOUIS 6, MO.

## ENGINEERS ELECTRONIC

WORK FOR THE LEADER  
IN THE INDUSTRY

E. E. Degree required. Experience helpful in any of the following:

**MILITARY ELECTRONICS  
TWO WAY RADIO  
ADVANCE CIRCUIT DESIGN  
MICROWAVE  
FIELD ENGINEERING**

High starting salary plus many company benefits including profit sharing

WRITE, GIVING COMPLETE RESUME  
OR APPLY IN PERSON 8 TO 5 DAILY.

## MOTOROLA

4545 W. Augusta  
Chicago 51, Illinois

*Electrical Engineers  
and Physicists*

- Radar Simulation
- Advanced Circuitry
- Analog Computers
- Ballistics
- Mapping
- Telemetering

*Senior and Junior Engineers*

## *Monotony Unknown . . .*

Here is your opportunity to join with an organization where your skill will be utilized in association with an entire project, not just a segment of a job. We are small but growing . . . we offer you the opportunity to grow and advance with us. Gain individual recognition by working closely with technical management. Associate with other top-notch engineers . . . live and work in suburban surroundings, just 8 miles from metropolitan Baltimore. If you are interested in an organization where monotony is unknown . . . write:

**Industrial Research Laboratories**  
Dept. A-12, Hilltop & Frederick Rds.  
Baltimore 28, Maryland



## SENIOR ELECTRICAL ENGINEER

Five to ten years' experience in the electrical engineering field required. Experience to have been gained in the area of controls, servo-mechanisms, magnetic amplifiers or electronics. A degree in electrical engineering necessary.

The activity will consist in leading a group of junior and intermediate engineers in the design and development of controls involving magnetic amplifiers, transistors and other electro-mechanical devices; design, testing and fabricating into systems for turbo-jet, ram-jet engine controls and other developmental propulsion systems. To propose and develop new control systems.

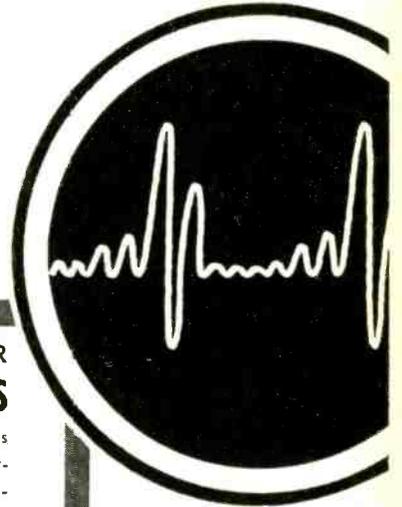
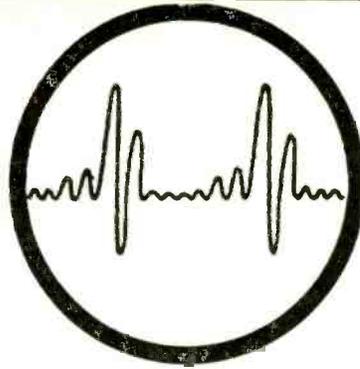
## COMPUTER ENGINEER

Requiring an engineering degree plus a minimum of three years of computer activity.

Must be capable of handling programming in the simulation and study of jet and reciprocating engine fuel systems, and aircraft shock strut and brake systems. Problems involved would be linear and non-linear in nature and applied to product design as well as research into basic phenomena. No maintenance ability necessary.

The salary of both positions will be commensurate with ability and experience.

Send resume to  
Technical Employment Department  
**BENDIX PRODUCTS DIVISION OF  
BENDIX AVIATION CORPORATION**  
401 Bendix Drive  
South Bend 20, Indiana



## SPECIAL OPPORTUNITIES FOR ELECTRONIC ENGINEERS

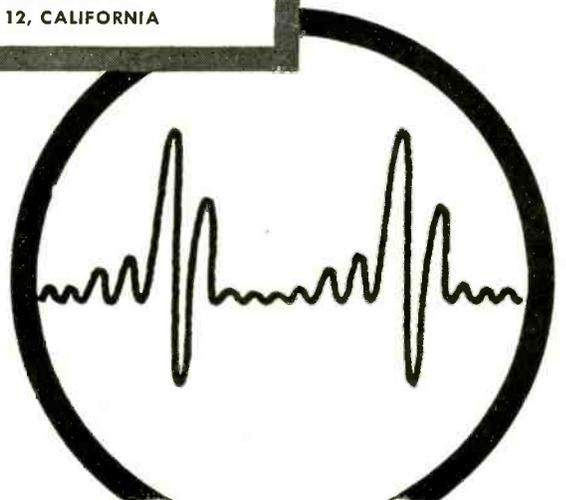
Convair in beautiful, sunny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in missiles, engineering research and electronics development. Positions open in these specialized fields:

Microwave Antennae	Dynamics Testing
Microwave Components	Telemetry
Electronic Packaging	Servomechanisms
Mathematical Physics	Electron Tubes
Electronic Components	Radome Design
Electronic Systems	Digital Computers
Applied Mathematics	Test Equipment
Transmitters & Receivers	Miniature Circuits

Generous travel allowances to those accepted. For free brochure, write Mr. H. T. Brooks, Engineering Dept. 900

## CONVAIR IN BEAUTIFUL SAN DIEGO

Division of General Dynamics  
3302 PACIFIC HIWAY  
SAN DIEGO 12, CALIFORNIA





## YOUR CALLING CARD FOR A BRILLIANT FUTURE...

Bendix Missile Section is a major contractor in the U. S. Navy's guided missile program -- a part of the "new look" in our defense plan. Our expanding program has many opportunities for senior engineering personnel: Electronics Engineers, Dynamicists, Servo-Analysts, Stress Analysts, Project Coordinators, and Designers. Take time now to look into the opportunities which Bendix can offer you. Write Employment Dept. M, 401 Bendix Drive, South Bend, Indiana.

## SENIOR ENGINEER

*To Initiate & Direct Long-Range Research Programs*

Requires a wide background and extensive experience (8 years' minimum) in operational and systems analysis, and in development of airborne fire control systems of advanced design.

Will be expected to think in terms of long-range, imaginative research ideas, to initiate them and direct their follow-through; must be able to visualize new markets and applications.

This position is both highly creative and administrative, demanding technical competence and flexibility, an effective sales personality, and proven record of administrative ability.

**If you have these qualifications, please send complete resume to:**

Technical Personnel Department.

### ARMA DIVISION

American Bosch Arma Corporation

Roosevelt Field  
Garden City,  
Long Island

## COLOR TV ENGINEERS

**RCA**—foremost color TV component producer—offers immediate opportunities to graduate engineers experienced in the design and development of Color TV deflection circuits and components.

Openings available at our Camden Development Laboratories for engineers with Black and White or Color deflection background. Allied experience acceptable.

Investigate this opportunity to enter a new field and grow with the world leader in electronics.



*Please send resume to:*

Mr. John R. Weld  
Employment Manager, Dept. B-454L  
Radio Corporation of America  
Camden 2, New Jersey

**RADIO CORPORATION OF AMERICA**  
ENGINEERING PRODUCTS DIVISION, CAMDEN 2, N. J.

## JUNIOR

## PROJECT

## ENGINEERS



Excellent opportunity for advancement with leading manufacturer of coils and filters in N. Y. City area. Familiarity with coils and filtered networks desired. College education.



### BURNELL & CO., INC.

45 Warburton Avenue  
Yonkers 2, New York  
FIRST IN TOROIDS AND RELATED NETWORKS

# Engineers TUNED TO TOMORROW

If you are an engineer who thinks in terms of tomorrow... who has the ability and drive to move ahead professionally but finds advancement slow-going in a large, impersonal organization... then it's time you knew about us and the opportunities we offer. National Company, Inc. is a quality pioneer in the electronics industry with steady and sound growth over the past forty years.

Our eyes are on the future. If you are interested in growing along with us, you are invited to apply for any of the following positions:

## MECHANICAL

**Design Engineers** — B.S.M.E. Projects related to analog and digital computers, radar and electronic counter devices.

**Designer** — For electronic equipment, such as transmitters, receivers, radar, computers, etc.

## ELECTRONIC & ELECTRICAL

**Project Engineers** — B.S.E.E. Electronic circuit development and design for communication frequencies and above.

**Product Designers** — B.S.E.E. Receiver engineering, binary counter knowledge or transmitter exciter experience.

**Development Engineer** — B. S. E. E. and/or Physics. UHF transmitter and/or receiver development. Knowledge pulse circuitry and transistor circuitry.

**Electronic Engineers** — B.S.E.E. Designing and following units through production and formulating procedures.

**Electrical Engineer** — Minimum B.S.E.E.; M.S.E.E. preferred. UHF and/or microwave circuit design and feedback technique.

## PHYSICIST

**Experimental Physicist** — M.S. or equivalent. Minimum 1 year solid state gas discharge and some vacuum systems experience.

*You will have the opportunity to qualify for excellent salaries commensurate with your ability and experience, plus National's liberal fringe benefits.*

Please forward complete resume to:  
**Mr. James R. Keskula**  
Employment Manager

# National



**NATIONAL COMPANY, INC.**  
61 Sherman St. Malden, Mass.

A  
**BRIGHT FUTURE**

IN  
**ORIGINAL RESEARCH**

FOR  
**ELECTRONIC ENGINEERS**  
**PHYSICISTS** *and*  
**MECHANICAL ENGINEERS**  
WITH  
**SYLVANIA**

It is not surprising that many contributions and advances in the field of electronics have been made by Sylvania engineers. Our company has always placed heavy emphasis on original research, development and product design, offering engineers wide latitude for exploration and creative expression.

As a result, growth opportunities for engineers are virtually unlimited, as Sylvania aggressively advances in its growth tradition.

To aid our engineers in their progress, Sylvania also provides financial support for advanced education, as well as liberal insurance, pension and medical programs.

The following **PERMANENT POSITIONS** are now open at:  
**BOSTON & BUFFALO ENGINEERING LABORATORIES**

Section Heads, Engineers-in-Charge, Senior Engineers, Engineering Specialists and Junior Engineers for Research, Design, Development and Product Design on complex subminiaturized airborne electronic equipment and computers, experienced in:

Pulse Techniques  
Electro-Mechanisms  
Microwave Techniques  
Microwave Applications  
Circuit Design  
Equipment Specifications  
F. M. Techniques  
Miniaturization  
Servo Mechanisms  
Transistors  
Heat Transfer  
Shock & Vibration  
Technical Writing

Analytical Problems  
Antenna Design  
Applied Physics  
Systems Development  
& Testing  
Component Selection  
Component Analysis  
& Testing  
Component Specifications  
Digital Computer Circuits  
& Systems  
Mechanical Design

Please forward complete resume to:  
**COL. CHARLES KEPPLER**

**SYLVANIA**   
**ELECTRIC PRODUCTS INC.**

175 Great Arrow Avenue, Buffalo, New York

# ELECTRONIC ENGINEERS & PHYSICISTS

OUR STEADILY EXPANDING LABORATORY OPERATIONS  
ASSURE PERMANENT POSITIONS AND UNEXCELLED  
OPPORTUNITY FOR PROFESSIONAL GROWTH IN

## RESEARCH-DEVELOPMENT-DESIGN

ELECTRONIC COUNTERMEASURES

RADAR SYSTEMS

MICROWAVE COMPONENTS

AIRBORNE ANTENNAS

MISSILE GUIDANCE CONTROL SYSTEMS

SOLID STATE PHYSICS

TELEVISION

ADDRESS

INQUIRIES TO **FARNSWORTH ELECTRONICS CO.**  
FORT WAYNE, IND.

THE EMPLOYMENT DEPT.

## UNIVERSITY of MICHIGAN ENGINEERS and SCIENTISTS

Unusual opportunities for outstanding and experienced men are available at the University of Michigan's Willow Run Research Center. Research Engineers and Physicists with advanced degrees and/or experience in the fields of:

DIGITAL COMPUTER LOGICAL DESIGN • INFRARED ACOUSTICS • DIGITAL COMPUTER PROGRAMMING ELECTROMAGNETIC THEORY • COMMUNICATIONS CIRCUIT DESIGN • COMPONENT DEVELOPMENT RADAR • OPTICS ENGINEERING • SYSTEMS DESIGN

Salary commensurate with training and experience. Excellent working conditions. Liberal vacation policy along with other fringe benefits. Unusual opportunity to carry on University graduate studies while working full time. Moving expenses paid. U. S. Citizenship required.

*Write, giving details of education and experience, to*

**W. N. MacDonald, Personnel Office**  
University of Michigan  
Willow Run Research Center,  
Ypsilanti, Michigan

# ENGINEERS

Electronics • Systems  
Electromechanical  
Analogue Computer • Field  
Senior Microwave Research

To those engineers who prefer a variety of assignments on interesting, long-range projects, General Precision Laboratory offers an exceptional opportunity.

This growing research laboratory combines the challenge of exploring new fields with the stability afforded by a large and diversified parent organization—General Precision Equipment Corporation.

The location in New York's well-known Westchester County provides an ideal living and working environment—beautiful surroundings, high standard of living, and just one hour from New York City with its many cultural and educational facilities.

Men with interests in the above and related fields should submit resumes to Mr. Hollis F. Ware. Expenses will be paid for qualified applicants who come for interviews. We regret we can consider only U. S. citizens.

## GENERAL PRECISION LABORATORY INCORPORATED

A Subsidiary of General Precision Equipment Corporation

63 Bedford Road

Pleasantville, New York

# ENGINEERS

The APPLIED PHYSICS LABORATORY OF THE JOHNS HOPKINS UNIVERSITY offers an exceptional opportunity for professional advancement in a well-established laboratory with a reputation for the encouragement of individual responsibility and self-direction. Our program of

GUIDED MISSILE  
DEVELOPMENT

provides such an opportunity for men  
qualified in:

ELECTRONIC CIRCUIT DESIGN AND ANALYSIS  
DEVELOPMENT AND APPLICATION OF TRANSISTOR CIRCUITRY  
SERVOMECHANISMS AND CONTROL SYSTEM ANALYSIS  
ELECTRONIC EQUIPMENT PACKAGING INSTRUMENT DESIGN  
MISSILE SYSTEMS DEVELOPMENT  
FLIGHT TESTING

Please send your resume to

Glover B. Mayfield  
APPLIED PHYSICS LABORATORY  
THE JOHNS HOPKINS UNIVERSITY  
8621 Georgia Avenue  
Silver Spring, Maryland

## ELECTRONIC AND MECHANICAL ENGINEERS!

Motorola Research Laboratories, located in the healthful climate of Arizona's Valley of the Sun, has several openings for experienced engineers in the following fields:

Electronic research and development for missile guidance, radar and VHF communications.

Mechanical design of missile-borne and vehicular electronics equipment.

Analysis and laboratory work involving development of new types of airborne and ground radiators and waveguide components.

VHF and microwave antenna waveguide circuitry.

Transistor development.

Desire men with B.S. degree or above. Salary commensurate with education and experience. Free health, accident and life insurance. Free hospitalization. Profit Sharing. Paid holidays. Sick leave. Vacations. Ideal working conditions. Plenty of housing, reasonably priced. Excellent schools. Exceptionally mild and dry winter climate.

WRITE: J. A. Chambers, *Manager*  
Motorola Research Laboratory  
3102 North 56th Street  
Phoenix, Arizona

### *Bendix Aviation Corporation*

#### ● YORK Division . . .

This NEW division of our nationally-famous corporation has openings for . . . .

## ENGINEERS PHYSICISTS

Top-flight men in advanced fields of electronic research, development and product engineering are needed for challenging work under ideal conditions in our new, modern plant.

You benefit at Bendix York from our location in the heart of a beautiful suburban area, from high wages, paid vacations and holidays . . . and excellent opportunities for advancement.

Openings at all levels.

Write, Wire or Phone  
Department Y-1



AVIATION CORPORATION ●  
YORK DIVISION

Phone: York 5521

York, Penna.

## Micro-Wave Specialists

The growing importance of micro-wave applications to aircraft has created a staff opening for a Micro-Wave Specialist at Lockheed Aircraft Corporation.

The position requires a specialist who couples at least three years' practical experience in airborne radar applications with a strong theoretical background. An advanced degree in Physics is preferred.

Duties will involve keeping abreast of latest developments in the field of micro-waves, redesigning micro-wave systems for application on Lockheed Aircraft, and acting in a staff advisory capacity on micro-wave subjects.

Lockheed offers you a high salary commensurate with the importance of the position; generous travel and moving allowances; an opportunity to enjoy Southern California life; and an extremely wide range of employee benefits which add approximately 14% to each engineer's salary in the form of insurance, retirement pension, sick leave with pay, etc.

Address inquiries to E. W. Des Lauriers,  
Dept. E-M-12.

## Lockheed

*Aircraft Corporation*

Burbank, California

# ENGINEERS

- ADMINISTRATIVE
- INTERMEDIATE
- SENIOR
- PROJECT
- JUNIOR

LONG RANGE PROGRAMS IN . . .

## ◀ RESEARCH

## ◀ DEVELOPMENT

## ◀ DESIGN

- Fire Control Systems
- Communications
- Guided Missles
- Radar Systems
- Navigation
- Telemetrying
- Transitors

DIRECT INQUIRIES TO—

Director of Engineering  
Government Products  
**CROSLY DIVISION**  
AVCO Manufacturing Corporation  
Cincinnati 15, Ohio

# ENGINEERS

ELECTRONICS BACKGROUND

A few responsible positions available for systems work associated with navigational computers.

Also a few openings for electronic engineers for antenna and microwave component development.

The modern facilities and congenial atmosphere at Kollsman, designers of America's finest aircraft instruments, provide an environment conducive to truly creative work.

Please submit resumes to Employment Manager.



**KOLLSMAN Instrument Corp.**

80-08 45th Ave.

Elmhurst, L. I., New York



## OFFERS OUTSTANDING OPPORTUNITIES IN FIELD ENGINEERING

E E graduates or equivalent with field experience in radar will find unequalled opportunities for professional advancement with Raytheon—a world leader in electronics. Foreign and domestic assignments. Excellent salaries. Liberal allowances.

Write

**RAYTHEON**

GOVERNMENT FIELD ENGINEERING  
WALTHAM 54, MASS.

## RECEIVER ENGINEERS With Experience in VHF and UHF Frequencies

Career Opportunities  
With Old Established  
Central Connecticut Firm  
Interesting Projects  
Top Salaries  
Suburban Living

Replies Held in Strict Confidence  
Wire or Phone Collect  
Personnel Mgr. SHerwood 7-2741

**THE ALLEN D. CARDWELL  
ELECTRONICS PRODUCTIONS  
CORPORATION**

Plainville, Connecticut

## AUDIO ENGINEERS

Electro-Voice, Inc. has positions open for engineers with degrees in Electrical Engineering or Physics for work in the field of Audio. Openings in both production and engineering departments.

Excellent opportunity for men with experience in loudspeaker manufacturing.

Write:

Vice President, Engineering  
**ELECTRO-VOICE, INC.**  
BUCHANAN MICHIGAN

## NEW HORIZONS

Today's horizons in electronic engineering are limited only by the vision of the individual himself. To those qualified men who desire to stand on the constantly changing frontiers of electronic development, we offer a chance to pioneer and grow with a soundly-established, yet young and progressive company.

### • Electronics Field Engineers

Local & Field Assignments Available

At least 5 years' experience in any one of these fields: Servo Mechanisms; Special Weapons; Microwaves; Antennas; Circuit Design; Flight Simulators; Radio Propagation; Electronic Computers and Communications.

Qualified to instruct in the operation and supervise installation, maintenance and repair of Radar, Sonar, Flight Simulators and allied electronic equipment in the field.

Salary and advancement commensurate with ability; liberal vacation, sick leave, 9 paid holidays, group life, sickness and accident insurance plans, and a worthwhile pension system.

### STAVID ENGINEERING, INC.

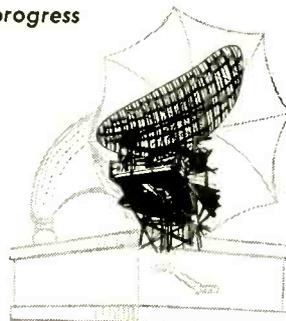
Personnel Office, 312 Park Avenue  
Plainfield, N. J.—Plainfield 6-4806

## ENGINEERS

with **EXPERIENCE**

in electronic development

with experience comes progress



are you **EXPERIENCED** in  
RADAR - MISSILE CONTROL  
AIRBORNE COMMUNICATIONS  
MOBILE COMMUNICATIONS  
AUTO RADIO

... does an analysis of your background show that—at present—you are employed at THE HIGHEST LEVEL OF YOUR SKILL?

... Send us a resume of your background. We may have a higher level position open for you!

Send resume to Mr. L. H. Noggle, Dept. J

## BENDIX RADIO

Division of Bendix Aviation Corp.

Baltimore 4, Md.

## Exceptional OPPORTUNITY for Engineer

Long established manufacturer of temperature, humidity and pressure control instruments requires engineer with sound electronics education and background to work on design projects. Midwest location. Excellent prospects for the future. Age, preferably between 28 and 35. Apply by letter giving age, education, experience and salary requirements. All letters will be answered, and all held confidential.

P-4202, Electronics  
520 N. Michigan Ave., Chicago 11, Ill.

### ELECTRONIC ENGINEERS

Unique opportunity to set in on ground floor of young successful company applying atomic energy to industrial uses (non-government).

Graduate engineers are needed in two major functions: sales and applications engineering, and development and design engineering. Rapid expansion of company offers promotion opportunities found in few organizations. Only men with top academic and work records who desire and are capable of hard work and rapid promotion will be considered.

INDUSTRIAL NUCLEONICS CORP.  
1205 Chesapeake Ave., Columbus 12, Ohio

A leader in Nuclear Instrumentation and Automation Equipment.



### Electronic Engineering Company of California

The Electronic Engineering Company of California is an independent firm engaged in the design, development and fabrication of electronic equipment for private industry and the Armed Forces. Founded and managed by electronic engineers, the Electronic Engineering Company offers a broad background of experience, highly trained personnel, excellent facilities plus a well integrated, expanding organization.

The Electronic Engineering Company has openings for engineers with experience and background in industrial and military electronics.

Please send resume of experience and education with salary requirements to:

Electronic Engineering Company of California  
180 SOUTH ALVARADO STREET  
LOS ANGELES 57 - CALIFORNIA

### AUTOMATIC TEST EQUIPMENT ENGINEERS

Graduate electronic engineers with two to four years experience to supervise design of electronic test equipment for TV receivers and government electronic equipment. Emphasis on automatic testing techniques. Openings at Stromberg-Carlson provide solid growth opportunities for capable engineers interested in this expanding field. Substantial employee benefits. Community noted for fine schools, cultural and recreational facilities.

Send resumes to: H. P. Field  
Manager of Test Equipment Engineering Department  
Radio-Television Division  
Stromberg-Carlson Company  
Rochester 3, New York

**Terrific Transmitter-Receiver Buy!**

**FAMOUS BC-645  
450 Mc.—15 Tubes**



Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over \$1000—You get it all, in original factory carton, BRAND NEW, complete with 17 tubes—less power supply. \$29.50  
SHP. wt. 25 lbs.

- BRAND NEW!**
- PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation instructions included)..... only **\$4.85**
- UHF ANTENNA ASSEMBLY, for BC-645..... **\$2.45**
- CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **\$2.50**

**DC AMMETER  
0-15 Amps**

A terrific buy! 3 1/4" easy reading scale. 75 divisions. Black plastic case 4 1/2"x5 1/4"x2 1/4". Rubber covered test clip leads plus black metal carrying case with hinger cover. Brand new. Wonderful for automotive, battery charging, general test work. Value \$25. All yours for only **\$3.99**

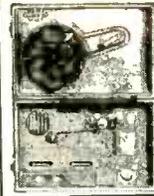


**FAMOUS SCR-522  
VHF  
RECVR-XMITTER**

Terrific Buy! 100 to 156 Mc VHF Transmitter-Receiver. 4 channels. Crystal-controlled. Amplitude modulated voice. Complete with tubes. Excellent condition only **\$79.50**



**CODE KEYS  
TG-34A**



Self-contained automatic unit, records on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 8 to 25 WPM. BRAND NEW, in or. \$18.95 original carton..... **\$12.95**

TG-10 CODE KEYS, complete with 7 tubes and electric eye. 65 lbs. BRAND NEW **\$17.50**

- JK-26 and PL-354 JACK & PLUG combination, for headset extension, etc. **29¢**
- PL-55—Standard 2-circ. phone plug, fits all phone jacks. **22¢**
- PL-68—Standard 3-circ. mike plug, fits all 3-way mike jacks. **68¢**

**CATHODE RAY TUBES**



Type	Lots of 2 Each	Type	Lots of 3 Each
1CP1	1.95	5BP1	2.65
1FP1	1.95	5BP1	2.75
1CP1	1.48	7BP1	1.95
1CP1	2.95	5LP1	2.24

**TELEGRAPH KEYS**



All Brand New Special Low Prices!  
J-37 Navy Type..... 85¢  
J-38 Sig. Corps Type..... 74¢

**LORAN APN-4**  
FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, export packed.

**R-65/APN-9 LORAN Receiver-Indicator**

Furnishes position data at greater distances from transmitting stations than is possible by any other methods. Accurate to within 1% of distance from ground transmitters. Operates entirely by radio. Complete in one case. BRAND NEW export packed. **\$295.00**

**COMPLETE \$129.50**

**MAGNETRON TUBES**

All brand new and perfect SPECIAL LOW PRICE!

Type	Each
2J21	\$2.25
2J22	2.25
2J39	4.95
826	.33
954	.10
9004	.08

**BC-221 FREQ. METER**

Limited quantity, first come first served! Range 125 to 20,000 Kc with crystal check points in all ranges. Complete with tubes, crystal, calibration charts. Excellent condition. **\$129.00**

**DYNAMOTORS**  
Compare Murry's Low Prices!

Type	Input	Excellent Output	Used	BRAND NEW
DM-40	14V 3.4A	172V .138A	\$1.95	\$3.95
DN-42A	14V 46A	515 1030 2/8	12.95	16.95
		MA 215/260		
DM-42A	28V 23A	515 1030 2/8	29.50	
		MA 215/260		
DM-32A	28V 1.1A	250V .05A	2.95	7.50
DM-34D	12V 2.8A	220V .080A	11.95	
DM-35D	12.5V 18.7A	625V .225A	9.95	
DM-36	28V 1.4A	220V .080A	9.95	
DM-37	25.5V 9.2A	625V .225A	12.95	
DM-28	28V	224V .07A	1.95	
DM-53A	28V 1.4A	220V .080A	2.95	6.95
DM-33A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
PE-73C	28V 20A	1000V .350A	9.50	12.50
PE-101C	13V 12.6A	400V .135A		
	26V 6.3A	9VAC 1.12A	3.75	4.85
PE-94A	28V 10A	300V .200A		
		150V .101A	3.95	7.50
PE-94C	26V 10A	300V .200A		
		150V .101A	7.95	12.75
PE-103	6V	500V .160A		
	12V	500V .160A	24.50	39.50
PE-98	14V 21A	300V .200A		
		150V .101A	22.50	32.50
PE-36	28V 1.25A	250V .060A	2.95	5.24
PE-135AX with filter	24V 12A	100V .200A		
BD-77	12V	500V .350A	16.50	22.50

**INVERTERS**

- PE-206 Inverter. Leland. Input: 28V DC @ 38A. Output: 500V 800cyc. 80VA, 1ph BRAND NEW **\$11.50**
- PE-204A Sig. Corp Power Supply. Made by Radiart. BRAND NEW **\$3.24**
- PE-218 Inverter. Leland-Wincharger-DE. Input: 28V DC @ 92A. Output: 115V 380/500 cycles 1500VA, 1 ph. BRAND NEW **21.50**
- Used. Excellent Condition **12.95**

**FAMOUS B-29 BOMB SIGHT**  
ASSEMBLED BY SPERRY GYROSCOPE CO.

Comes in three units—the main body and two attachable periscopes, 22 and 68 inches high, alternate parts of an intricate optical system made by Eastman-Kodak Co. Main body is 35x26x14 inches. Contains at least 8 27 VDC motors, electric heater and temp. control, precision sextant, dozens of switches and controls, hundreds of fine gears and driving rods all types. Shipping wt. 250 lbs.

Cost to U.S. Govt. \$21,800  
Your Cost **\$129.50**

**BC-375 TRANSMITTER**

A famous transmitter, originally cost \$1800. Yours, for a small fractional Ship wt 276 lbs. Complete with tubes, Brand New... **\$49.50**

Used, Excell. **\$29.50**

Cond. ....

**TUNING UNITS FOR BC-375**

Type	Excellent BRAND NEW	Type	Excellent BRAND NEW
TU-10-a	\$2.25	TU-7	2.25
TU-9	2.25	TU-6	2.95
TU-8	2.25	TU-5	3.95

**HEADPHONES**  
Smashing price reductions!

Model	Description	Used	Excellent BRAND NEW
HS-23	high impedance	\$2.25	\$4.35
HS-33	low impedance	1.75	4.65
HS-38	low imp. (leatherw.)	1.45	1.85
H-16V	high imp. (2 ph.)	2.75	7.95
CD-307A	corda, with PL55 plug and JK26 Jack		.88

**MICROPHONES**

Model	Description	Used	Excellent BRAND NEW
T-17	Carbon hand mike	\$5.45	\$7.95
T-18	Carbon Throat Mike	.33	4.69
T-45	Navy Lip Mike		1.28
RS-38	Navy Type	1.95	5.95
T-24	Carbon mike		3.95

**FULL WAVE SELENIUM RECTIFIER**  
110 V at 150 mil's **59¢**

**BEACON RECEIVER BC-1206-C**

Complete with 8 tubes. Tunes 195 KC to 420 KC. IF Frequency—123 KC. Receiver Sensitivity—3 Microvolts for 10 Milliwatts output. Output Impedance—300 Ohms and 400 Ohms. Volume Control—RF Gain Control. Power Supply—24-28 Volt Aeroplane Battery, Current—7.8 Amperes. **\$11.95**

**HANDSET**

Cradle-type handset with butterfly switch, unbreakable black plastic. 4-ft 3 wire cable, individually packed, each **\$2.95**

**EE-8 FIELD PHONES**

Talk as far as 17 miles. Dependable 2-way communication at low cost. Ideal for home, farm, field. Up to six phones can be used on one line. Each phone complete with ringer. Originally cost govt. \$65.00 each. Excellent Condition **\$17.95**

**New Complete I.F.F. Equipment RC-188-A**

Originally cost about \$20,000

... new buy is for a tiny fraction of cost! Easily converted for television. Complete assembly consists of Control unit with 5 C.R. Tube, transmitter and receiver assembly (187 to 185 Mc), Indicator unit, and Power Supply (450 watts), operating on 110 volts, 60 cycles AC. All assembled, ready to operate. 88 Tubes included: 8-6V6GT, 9-6B1VGT, 14-6SN7GT, 1-5CP1, 2-8006, 1-6Y6G, 2-6ES, 1-100T8, 2-6J5, 2-2C26, 1-3E29, 1-4E8, 7-8AG5, 3-4K5, 6C4, 3-2X2, 1-4X5GT, 3-4U4GT. Overall size 8 1/2" high 28" wide, 20 1/2" deep. Ship. weight 85 lbs. Your cost, complete, BRAND NEW in original packing. **\$149.50**

**GOULD 6-VOLT STORAGE BATTERY**

15 Amp. Hour Rating Navy Standard Black Rubber Case, BRAND NEW **\$5.95**

**WILLARD 6-VOLT Midget Storage Battery**  
3 Amp. Hour. BRAND NEW. 3 1/2" x 1-15/16" x 2 3/4". Uses Standard Electrolyte only **\$1.85**

**WILLARD 2-VOLT STORAGE BATTERY**  
20 Amp. Hour. BRAND NEW. Transparent plastic case **\$1.95**

**1-QUART ELECTROLYTE** **\$1.45**

enough for two cells. Bottle..... **\$1.45**

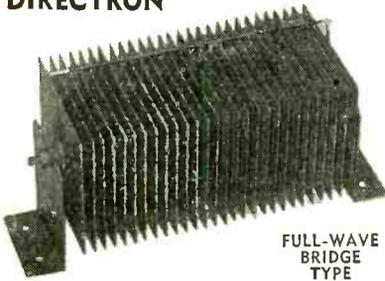
Please include 25% Deposit with C.O.D. Order. MINIMUM ORDER \$5.00. All Shipments F.O.B. our Warehouse, N. Y. C.

**MURRY'S RADIO**  
"Serving the Electronics Industry Since 1920"

Dept. E-12  
51 VESEY ST., N. Y. 7, N. Y.  
CORTLANDT 7-4605

Immediate Shipment from one of the Most Complete Inventories of

DIRECTRON



FULL-WAVE BRIDGE TYPE

SELENIUM RECTIFIERS

Max. Amps	18/14 Volts	36/28 Volts	54/42 Volts	72/56 Volts	130/100 Volts
1	1.40	2.40	3.80	4.60	8.50
2	2.10	3.00	5.40	6.00	10.50
2½	3.00	4.20	6.00	8.00	13.00
4	3.75	7.50	11.50	14.50	25.25
6	4.50	9.00	13.00	17.50	33.00
10	6.60	12.75	20.00	25.00	42.50
12	8.20	16.25	22.50	30.00	46.00
20	13.25	25.50	38.00	45.00	75.50
24	16.25	32.50	45.00	58.00	86.50
30	20.00	38.00	57.50	72.00	.....
36	25.00	48.50	66.00	88.00	.....
50	32.00	62.50	.....	.....	.....
100	60.00	120.00	.....	.....	.....

We Build other Selenium Rectifiers, Transformers and Chokes to your specifications. Buy from the Direct Source for Quick Delivery.

NEW RECTIFIER TRANSFORMERS

Pri: 115 V., 60 cycles in. 4 Amps.....\$8.75  
 SEC: 9, 12, 18, 24, and 36 12 Amps.....16.75  
 24 Amps.....35.75  
 Continuous Ratings 30 Amps.....45.00  
 50 Amps.....59.75  
 New—1 & 2 amp. Write for Prices, Specs.

NEW RECTIFIER CHOKES

1 Amp .1 Hy .15 ohm \$3.95  
 2 Amps .04 Hy .9 ohm 4.15  
 2½ Amps .01 Hy .1 ohm 4.95  
 4 Amps .07 Hy 6 ohm 7.95  
 12 Amps .01 Hy .1 ohm 14.95  
 24 Amps .004 Hy .025 ohm 29.95

FILTER CAPACITORS

Capacity	W. Voltage	Each
500 MFD	200 V.	\$1.95
500 MFD	50 V.	.85
1000 MFD	15 V.	.35
2000 MFD	50 V.	2.25
6000 MFD	15 V.	1.50

3,000 VOLT MULTITESTER

AC: 0-15, 150, 750, 3000 volts.  
 DC: 0-15, 75, 300, 750, 3000 volts.  
 DC MA: 0-15, 150, 750 ma.  
 Resistance: 0-10,000, 100,000 ohms.  
 Complete with battery, test leads. Only 3½"  
 Wx 4½"Hx1½" deep. Brand new Only \$9.95

TUBE CARTONS

Two-Colored Cartons With New Safety Partitions—Super-Glass Red and Black Carton is the Most Distinctive Box Available Today.

SIZE	EACH	SIZE	EACH
Miniature	5 .01	LARGE GT	.015
6AU6, 6AL5, etc.		1B3, 6BQ6GT, etc.	
GT	.0125	LARGE G	.02
6SN7, 6W4, etc.		5U4G, 68G6G, etc.	

\*Quantity Users—Buy These Cartons by the Case. Write for Quantity Discounts.

Terms: F O B—N Y C—25% Deposit with order—send full remittance to save C O D charges—D & B Rated Firms (F2½ or Better) Net 10 Days. CABLE BARRYLECT, N. Y. TELEGRAPH BARRY ELECTRONICS, FAX, N. Y.

SPECIAL PURPOSE, TRANSMITTING, RADIO AND TV RECEIVING TUBES

Hermetically Sealed Chicago Transformer Co. Components

Class 1A (The Very Best) All in Telephone Black Finish

- Power Transformer Cat. No. PHC-200 Primary: 117 v 50-60 cycles. Delivers 390 volts DC (after choke) @ 200 MA. Also delivers 6.3 VCT @ 4.5 amps, 6.3 volts @ 1 amp and 5.0 volts @ 3 amps. Test Volts: 2000.....\$6.95
- Choke to match above Cat. No. HM-12200 9.6 Henries at 200 MA.....each \$4.75
- Filament Transformer Cat. No. FH-610 Primary: 115 v or 230 volt—50-60 cycles. Secondary: 6.3 VCT at 10 amps. Test Volts: 2500.....\$4.95
- Power Transformer Cat. No. PHC-70 Primary: 117 v 50-60 cycles. Delivers 320 volts DC (after choke) @ 70 MA. Also delivers 6.3 VCT @ 3 amps and 5.0 volts @ 2 amps. Test Volts: 1750.....\$3.95
- Choke to match above Cat. No. PH1585 12 Hy @ 85 MA.....\$2.75
- G E Transformer Cat. No. 2PB2C1 Primary: 115 v, 60 c—Secondary 15 v, 12 amp.....\$6.95

1A7GT	\$ .30
1C6GT	.11
1H4G	.11
1N91	.30
1N38A	.65
1P30	3.00
2E25	2.50
2K55	29.50
3BP1	2.95
3BP11	2.95
3DP1	1.95
5B1	1.95
6F4	2.75
FC17	3.90
7C25	120.00
FG32	3.90
RK62	1.75
215A	3.00
251A	3.00
359A	2.00
403B/5591	3.00
404A/5847	9.90
407A	2.50
408A	2.50
416A	45.00
416B	55.00
417A/5842	12.00
434A	8.50
471A	1.25
503AX	1.25
WL530	16.00
702B	1.95
705A	WRITE
713A	.75
722A	3.00
725A	4.75
731A	5.00
803 Original Box	1.90
838 Original Box	1.90
852	10.00
878A	1.25
954	.20
2050	1.00
2051	.85
5670	2.25
5814	1.75
6080WA	3.25

SUPER SPECIAL! 3000 Volts DC—330 Ma. BASIC COMPONENT POWER SUPPLY KIT

- Contains: ● 3500 V. AC XFMR @ 400 MA. Primary—115 V., 60 c.
  - 400 MA. Matched Smoothing Choke.
  - 115 Volts Primary Bridge Filament for Four 866-A's.
- Complete Only \$39.95

Also These Individual Components for Sale—Write

RADIOSONDE 500 Pieces Meteorological Transmitter

Type T-49C. Uses RCA 3A5. Complete with tube, antenna, battery harness. Brand New Only \$1.75

Miniature High-Voltage Converter For Geiger Counter

- Operate your geiger counter from standard 1½ volt flashlight cells.
- This compact powerful unit converts regular battery voltage to 900 volts for direct operation of geiger counter tubes. Actual range of output is 0 to 7,000 Volts AC (easily rectified and regulated with circuits supplied) so that any type of geiger counter or photo multiplier tube can be operated from unit. Weighs only 4 ounces and small enough to fit in the palm of your hand.

\$10.00 each with instructions

WE ARE WORKING ON A COMPLETE KIT USING THIS CONVERTOR PLUS OTHER PARTS TO BUILD A SENSITIVE, HIGH QUALITY GEIGER COUNTER.

100 Amp (Fan Cooled) SELENIUM RECTIFIER STACK

Input: Up to 10—0—10 V.A.C. Output: ½ V.D.C.

This rectifier will handle 50 amps, convection cooled, or up to 150 amps, fan cooled, depending on air flow. \$11 each in lots of 3 or more. \$11.98

FAST CHARGER STACKS MADE TO ORDER — 48 HOUR SERVICE

Victoreen Voltage Regulator VXR-130, subminiature. Brand New. Users net cost \$5. Quantity in stock.....only 75c

Western Electric Steel Blank Panels, 10½" high, 19" wide, ¾" thick. Brand new, individually boxed. W.E. No. 296 A & B, in commercial grey or telephone black. Special.....each 85c

Johnson No. 122-101, 829B, 3E29 Ceramic Sockets, 69c NEW 6MFD 600 VDC Oil Capacitors 85c

BC-160 Filter Choke, 20 Hys.—300 MA—125 ohms resis, insulated for 15 kv.....9.95

Jefferson Filament Transformer, 115 v, 60 cycle input secondary, 20 v at 10 amps. Brand new, boxed.....8.95

4X500F Orig. Box Surplus \$65.00

304TH Surplus, New Lab. Test @ 3000 V \$6.75  
 304TL Guaranteed

872A \$1.75 • 872A-GE \$2.50

TO SERVE YOU EVEN BETTER

AFTER DEC. 15TH

we will be located at

512 BROADWAY

NY 12, NY—Bet. Broome & Spring

Over 10,000 Sq. Feet to Give You Even Better Barry Service

6AK5W Original Box Tungsol—RCA—Raytheon \$1.15

6AK5 Original Box Sylvania—Hytron 50¢

750TL Surplus JAN, Eimac \$49.00

6J4 RCA Commercial \$4.25 RCA JAN \$4.50

Many Other Types in Stock. Phone wire or write for quotations.

BARRY ELECTRONICS CORP.

Authorized Distributors for Eimac, Westinghouse (WL) CBS-Hytron (CBS), Cetron, Lewis & Kaufman and Penta Tubes.

136-C Liberty St., New York 6, N. Y. PHONE: RECTOR 2-2562

# SPECIAL PURPOSE TUBES

OA2 .75	3B24W 5.75	9MP7 7.50	271A 5.00	715C 12.50	959 1.25
OA3/VR75 .75	3B25 2.50	10Y .25	272A 5.00	717A .75	991/NE-16 .35
OA5 3.25	3B26 3.25	12A6 .25	274A 4.75	719A 10.00	CK-1005 .25
OB2 .75	3B28 3.00	12GP7 15.00	274B 1.50	721A 1.50	CK-1006 1.00
OB3/VR90 .75	3C23 4.00	12J5WGT 2.50	275A 5.00	722A 1.50	R-1100 5.00
OC3/VR105 .75	3C24 24G 1.50	12L8GT .50	276A 3.75	723A/B 12.00	R1130B/
OD3/VR150 .50	3C45 6.00	15E 1.50	282A 5.00	724B .75	1B59 10.00
C1B 2.00	3D21A 6.00	15R .25	283A 3.50	725A 7.50	1500T 75.00
1B22 1.00	3D22 9.75	FG-17/5557 3.00	286A 6.00	726A 10.00	1603 4.00
1B23 3.75	3DP1A 7.50	RK-19 1.50	304TH 6.00	726B 30.00	1611 2.50
1B24 3.50	3E29 9.00	RK-20A 12.50	304TL 5.00	726C 30.00	1612 1.50
1B27 8.75	3EP1 1.50	RK-21 1.25	305A 3.50	728AY-GY 10.00	1613 .75
1B32 1.00	3FP7A 5.00	RX-21 5.75	307A/	730A 15.00	1614 1.25
1B35 4.75	3GP1 2.50	PJ-22 1.75	RK-75 1.00	801A .25	1616 .50
1B42 6.00	3HP7 3.00	RK-23 3.00	310A 2.75	802 3.00	1619 .25
1C21 1.50	3KP1 7.25	FG-27A 4.50	311A 5.00	803 2.00	1622 1.50
1P23 1.50	4-65A 12.50	28D7 .75	313C 2.00	804 12.50	1624 1.00
1P24 1.50	4AP10 3.75	28D7W 2.00	316A .50	805 2.75	1625 .25
1P36 2.50	4B22 6.50	TWIN 30 10.00	323A 10.00	807 1.00	1626 .25
1V5 1.50	4B26 3.50	FG-32/5558 7.25	323B 5.00	808 1.00	1629 .25
1Z2 2.00	4B27 3.50	FG-33/	327A 3.50	809 2.75	1630 .50
VG-2 10.00	4B31 25.00	5720 11.50	328A 3.75	810 10.00	1635 1.50
2AP1 5.00	4C22/	GL-34 2.00	329A 7.50	811 2.50	1851 2.50
2C21/1642 .50	HF-100 7.50	35TG 5.75	348A 4.50	811A 3.50	1852 .75
2C22/7193 .25	4C27/CV-92 5.00	VC-50 5.00	349A 7.50	812 2.50	1853 .75
2C26A .50	4C35 15.00	FP-54/	350A 3.00	813 10.00	1960 .50
2C33/	4E27 12.00	5740 44.00	350B 4.50	814 3.50	2050 1.00
RX-233A 1.25	4J34 25.00	HK-54 3.50	352A 15.00	815 1.00	2051 .75
2C34/RK-34 .25	4J35 75.00	RK-60/1641 1.75	353A 5.00	822 15.00	ZB-3200 100.00
2C39A 10.00	4J42 35.00	RK-62 1.75	354A 15.00	826 .50	R-4330 10.00
2C40 5.00	5BP1 2.00	RK-65/	355A 15.00	828 9.75	GL-5545 25.00
2C43 10.00	5BP2A 5.00	5D23 10.00	368AS 4.00	829B 9.00	5551/652 40.00
2C44 .50	5BP4 2.00	FG-67/	371A .75	830B 1.00	5556/PJ-8 6.75
2D21 .75	5C30/C5B 1.75	5728 13.00	F-375A 15.00	832 4.00	5610 1.25
2E22 1.50	5CP1 3.75	RK-73 .75	388A 1.00	832A 6.00	5645 6.50
2E24 2.25	5GP1 5.00	75T 5.00	393A 5.00	833A 29.50	5656 10.25
2E26 3.25	5D21 7.50	75TL 6.00	394A 2.00	834 7.50	5670 2.50
2J21A 3.50	5FP7 1.00	FG-81A 9.00	WL-417A 6.50	835 15.00	5696 1.25
2J22 3.00	5FP14 5.00	FG-95/	GL-434A 5.00	836 2.50	5725 2.75
2J26 4.75	5J23 25.00	5560 14.00	446A .75	837 .75	5801/
2J27 6.00	5J29 7.50	C-100D 2.00	446B 3.25	838 2.00	VX-33A 4.75
2J29 25.00	5J30 15.00	100TH 5.75	450TL 45.00	843 .25	5820 (See 2P21)
2J30 50.00	5J32 25.00	FG-105 17.50	WL-460 10.00	845 7.50	5827X 4.75
2J31 20.00	5JP1 12.50	RX-120 15.00	464A 3.00	845W 10.00	CK-5829 2.00
2J32 15.00	5JP2 7.50	VT-127A 2.50	WL-468 15.00	846 125.00	5933 8.00
2J33 15.00	5JP4 7.50	F-128A 50.00	SS-501 7.25	849 10.00	5963 1.00
2J34 15.00	5JP5A 7.50	HK-154 3.00	CK-510AX 1.25	850 10.00	5981/5650 50.00
2J36 60.00	5LP1 9.75	VT-158 15.00	527 15.00	851 25.00	R-7301 10.00
2J37 9.00	5R4GY 1.00	FG-172 20.00	WL-530 10.00	860 2.50	8002R 25.00
2J38 8.00	C6A 10.00	FG-190 3.50	WL-531 4.50	861 10.00	8005 4.00
2J39 6.00	C6F 10.00	HF-200 9.50	559 .75	866A 1.00	8011 .50
2J40 25.00	C6J 5.00	C-202 10.00	575A 15.00	868/PJ-23 2.00	8012 1.75
2J50 35.00	C6L/5528 7.50	203Z 5.00	WL-579B 12.50	869B 25.00	8012A 2.50
2J55 50.00	6ACTW 2.50	204A 5.00	KU-610 10.00	872A 1.00	8013 2.50
2J56 75.00	6AJ5 1.00	205B .50	HY-615 .50	874 .75	8013A 3.50
2J61 20.00	6AJ6 2.50	207 40.00	WL-632A 15.00	876 1.00	8014 50.00
2J62 10.00	6AN5 2.50	211 .75	WL-670A 8.75	878 .75	8016 2.00
2J-B51 2.00	6AR6 3.00	212E 25.00	WL681/	884 1.00	8020 1.25
2K25 15.00	6BM6 45.00	217A 2.00	686 25.00	885 1.35	8025 2.00
2K33A 60.00	6C21 12.50	WL-218 25.00	701A 2.75	902P1 6.00	8025A 3.50
2K41 75.00	6G4/	220C 182.50	702A-B 1.00	917 2.25	PD8365 50.00
2K54 25.00	X-102B 2.50	221A .75	703A 1.75	918 1.75	9001 1.00
2K55 15.00	6J4 4.00	235R 50.00	704A .75	920 2.50	9002 1.00
2P21 (Image Orthicon) 250.00	6L6GAY 1.50	249B 4.00	705A .75	922 1.00	9003 1.00
2X2/879 .25	6Q5G 3.25	250R 5.00	706AY-GY 20.00	923 1.00	9004 .25
2X2A 1.25	6SB7Y 1.00	250TH 17.50	707A 3.50	925 1.75	9005 1.50
3A4 .50	6SC7GT 2.00	250TL 15.00	707B 7.50	927 1.50	9006 .25
3A5 .50	6SK7Y .50	251A 35.00	708A 1.00	931A 3.00	9906R 1000.00
3AP1 5.00	7BP7 1.50	252A 15.00	709A 1.50	954 .25	
3B22 1.50	7C29 65.00	253A 3.50	713A .50	955 .35	
3BP1 2.00	7CP1 15.00	257A 2.00	714AY 17.50	956 .35	
3B24 2.75	9GP7 3.75	264C 3.00	715A 2.00	957 .35	
	9LP7 1.75	267B 6.00	715B 3.00	958A .50	

**western engineers**

\*Prices do not include transportation

ELK GROVE, CALIFORNIA

\*Fully guaranteed

GEORGE WHITING, OWNER

# COMMUNICATIONS EQUIPMENT CO.

## MICROWAVE COMPONENTS

### 10 CM.—RG 48/U Waveguide

**10 CM ECHO BOX:** Tunable from 3200-3333 Mc. For checking out radar transmitters, for spectrum analysis, etc. Complete with pickup antenna and coupling devices. \$27.50

**10 CM ANTENNA ASSEMBLY:** 3000-3300 Mc. Parabolic Dish, 29 inch Diam. Fed from dipole. Rotation: 380 Deg. Azimuth at speeds of 20 and 10 RPM. Tilt: 20 deg. above and below horizontal. Motor-Driven by 2-28V motors. 4.5 A Total Drain. Azimuth info. is fed to selsyn mechanism, and elevation data is obtained from Azimuth potentiometer. Net weight 65 lbs. \$78.50

**POWER SPLITTER** for use with type 726 or any 10 CM Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" output connectors. \$22.50 EACH

**LHTR, LIGHTHOUSE ASSEMBLY.** Parts of RT39 APG 5 & APG 15, Receiver and Trans. Cavities w/ assoc. Tr. Cavity and Type N CPLG. To Recv. Uses 2C40, 2C43, 1B27, Tunable approx. 2400-2700 MCS. Silver Plated. \$22.50

**BEACON LIGHTHOUSE** cavity p/o UPN-2 Beacon 10 cm. Mfg. Bernard Hite, each. \$27.50

**MAGNETRON TO WAVEGUIDE** Coupler with 721-A Duplex Cavity, gold plated. \$45.00

**721A TR BOX** complete with tube and tuning plungers. \$12.50

**MENALLY KLYSTRON CAVITIES** for 701B or 2K28 2700-2900 Mc. \$20.00

**WAVEGUIDE** to 7/8" Rigid Coax "Doorknob" Adapter Choke Flange Silver Plated Broad Band. \$32.50

**AS14A AP-10 CM Pick Up Dipole** with "N" Cables. \$4.50

**HOLMDELL-TO-TYPE "N" Male Adapters,** V17.5, #D167284. \$2.75

**I.F. AMP. STRIP:** 30 MC, 30 db gain, 4 MC Bandwidth, uses 6AC7's—less tubes. \$24.00

**BEACON ANTENNA,** AS31/APN-7 in Lucite Ball. Type "N" feed. \$22.50

**ANTENNA, AT94/APR:** Broadband Conical, 800-3300 MC Type "N" Feed. \$12.50

**"E" PLANE BENDS,** 90 deg. less flanges. \$7.50

### 3 CM.—RG 52/U Waveguide

**FLEX. WAVEGUIDE SECTION,** 1 ft. long. With UG-40/UG-39 flanges. Attenuation is less than 0.1 db at 9375 mc, and VSWR is less than 1.02. \$7.50

**3 CM ANTENNA ASSEMBLY:** Uses 17" paraboloid dish, operating from 24 vdc motor. Beam pattern: 5 deg. in both Azimuth and elevation. Sector Scan: over 160 deg. at 35 scans per minute. Elevation Scan: over 2 deg. tilt: over 24 deg. \$85.00

**Cross-Guide Directional Coupler,** UG-40 output flange. Main Guide is 6" Long, with 90 Deg. "E" Plane bend at one end, and is fitted with Std. UG 39/UG 40 flanges. Coupling figure: 20 db Nominal. \$22.50

**RG52/U Waveguide** in 5' lengths, fitted with UG 39 flanges to UG40. Silver plated. per length \$8.00

**Rotating Joints** supplied either with or without deck mountings. With UG40 flanges. each, \$17.50

**Bulkhead Feed-thru Assembly.** \$15.00

**Pressure Gauge Section** with 15 lb. gauge. \$10.00

**Directional Coupler, UG-40/U** Take off 20db. \$17.50

**MAGNET AND STABILIZER CAVITY** For 2J41 Magnetron. \$24.50

**Rotary joint** choice to choke with deck mounting. \$17.50

**90 degree elbows,** "E" plane 2 1/2" radius. \$12.50

**ADAPTER, waveguide** to type "N". UG 81-U, p/o TS 12, TN-13, Etc. \$14.50

**ADAPTER, UG-163/U** round cover to special btl. Flange for TS-45, etc. \$2.50 ea.

### ECHO BOX RF 3/AP

Cavity has a "Q" of 30,000 and is tuned by means of an internal 24 vdc motor. Unit is tunable over a range of 80 mc. When motor is left on, the tuning plunger goes thru the tuning range three times per minute. During the tuning motion, an eccentric cam on the mechanism causes an additional flutter action of the tuning disk at approximately 200 cycles per minute. This flutter range curves about 15 mc. This eliminates need of stopping the motor at the peak of the signal, and also gives a characteristic pattern to the echo signal. Input is to type "N" input jack. \$125.

### JAN WAVEGUIDE FLANGES

UG 39/U	\$1.10	UG 51/U	\$1.85
UG 40/U	1.25	UG 52/U	3.40
UG 40A/U	1.85	UG 52A/U	3.40

### THERMISTORS

D-164699 Bead Type DCR: 1525-2550 Ohms @ 75 Deg. F. Coefficient: 2% Per. Deg. Fahr. Max. Current 25 MA AC/DC	\$2.50
D-167332 Bead Type. DCR is 1525-2550 Ohms. Rated 25 MA at 325-175 VDC	\$1.35
D-167613 Disk Type. DCR: 355 Ohms @ 75 Deg. F. P.M. 2.5%, 1 Watt.	\$1.35
D-166228 Disk Type 7120 Ohms @ 60° F. 4220 Ohms @ 80°F. 2500 Ohms @ 100°F., 1640 Ohms @ 120°F.	\$1.35

### VARISTORS

D-167208	\$1.35	D-171812	\$1.63
D-171858	1.42	D-172155	1.50
D-168687	1.35	D-167176	1.25

## DYNAMOTORS

TYPE	INPUT VOLTS	INPUT AMPS	OUTPUT VOLTS	OUTPUT AMPS	Price
35X.059	19	3.8	405	.095	\$4.35
POSX-15	14	2.8	220	.08	8.95
DA-7A	28	27	1100	.400	15.00
DM33A	28	7	540	.250	3.95
23350	27	1.75	285	.075	3.95
B-19	12	9.4	275	.110	6.95
DA-3A*	28	10	300	.260	6.95
			150	.010	
			14.5	5.	
PE 73 CM	28	19	1000	.350	22.50
BD 69†	14	2.8	220	.08	8.95
DM-33A	18	3.2	450	.06	4.49
DM 25†	12	2.3	250	.05	6.95

† Less Filter.  
‡ Used, Excellent.  
\* Replacement for PE 94.

PE 94-C, Brand New \$6.95

## INVERTERS

800-1B Input 24 vdc, 62 A. Output: 115 V, 800 cy, 7A, 1 phase. Used, excellent.	\$18.75
PE-218H: Input: 25/28 vdc, 92 amp. Output: 115V, 350/500 cy 1500 Volt-ampere. NEW	\$77.50
PE206: Input: 28 vdc, 26 ampere. Output: 80 V, 500 volt-amps. Dim. 13 x 5 1/2 x 10 1/2	\$22.50

## 400 CYCLE TRANSFORMERS

Stock	Rating	Price
KS9608	1233VCT/35MA, 1140VCT/.07A	\$5.79
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/1.0MA, 2.5V/75A, 6.4V/3.9A, 5V/2A, 6.5V/3A, P/O ID-39/APG-13	4.95
352-7039	60V/6A @ 380MA, 6.3V/.9A, 6.3V6A	5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
K59607	734VCT/177A, 1710VCT/177A	6.79
352-7273	700VCT/350MA, 6.3V 0.9A, 6.3V 25.4 6.3V/.08A, 5V/CA	6.95
352-7070	2x2.5V/2.5A 2KV TEST 6.3V/2.25A, 1200/100/750V @ .005A	7.45
352-7196	1140/1.25MA, 2.5V/1.75A, 2.5V/1.75A—5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2x6.3VCT/6A	4.79
RA6400-1	13V 9A	2.39
901692	2.77V @ 4.25A—10KV Test	2.49
901699-501	900V75MA, 100V/.04A	3.45
901698-501	900VCT/067A, 5V/3A	3.79
UX8855C	900VCT/65MA, 5VCT/3A	3.69
RA6405-1	6.3V/9.1A, 6.3VCT/2A, 6V/1.75A	4.25
T-48852	2500V/6MA, 300, CT 135MA	5.95
352-7098	1100V/50MA TAPPED 625V 2.5V/5A	3.95
KS 9336	6.3V/2.7A, 6.3V/66A, 6.3VCT/21A	4.25
M-7474319	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
KS8984	650VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
52C080	400VCT/35MA, 6.4V/2.5A, 6.4V/1.5A	3.85
32332	115V-0-1150V 2MA	2.75
68G631	6VCT/.0006 KVA	1.75
80C198	6.3V/9.1A, 6.3VCT/2A, 2.5V/3.5A, 2.5/3.5A	4.85
302433A	5APTRV/118MA, 6.3V/8.1A, 5V/2A, 6.4/7.5A, 6.4V/3.8A, 6.4/2.5A	5.39
KS 9445	600VCT/36MA	4.79
KS 9685	2100V/.027A	2.65
70G30GI	2.2-5.5V Wdgs at 2.5A, Each Lo-Cap., 22kV Test	4.95
M-7474318	2.5V/1.79A, 5V13A, 6.5V/6A, 6.5V/1.2A, D/O BC800	5.95
352-7096	360VCT/20MA, 1500V/1MA, 2.5V/1.75A, 6.3V/2.5A, 6.3V/6A, P/O BC729	4.95
352-7099	5200V-002A, 2.5V/5A	6.45
D163253	2.5V/20A, 12KV Test	4.85
M-7471957	250V/100MA, 6.5V/12ACT 5V/2A	3.45
352-7179		

## MAGNETRONS

Type	Freq. Range (MC)	Peak Power (KW)	Duty Ratio	Price
2J21A	3345-9405	50		\$8.75
2J22	3267-3333	265		7.50
2J26	2992-3019	275	.002	7.49
2J27	2965-2992	275	.002	13.50
2J29	2914-2939	275	.002	44.95
2J31	2820-2860	285	.002	21.50
2J32	2780-2820	285	.002	24.50
2J38*	3249-3263	5		8.50
2J39*	3267-3333	8.7		8.50
2J48	9310-9320	50	.001	24.50
2J49	9000-9160	50	.001	54.50
2J56*	9215-9275	35	.001	132.50
2J62†	2914-3010	35	.002	32.50
3J31	24-27KMC	50	.001	85.00
4J34	2740-2780	900	.001	87.50
4J38	3550-3600	750	.001	125.00
4J42†	670-730	30	.003	169.50
5J23	1044-1056	475	.001	42.50
700B	690-700	40	.002	22.50
700D	710-720	40	.002	39.75
706EY	3838-3069	200	.001	32.50
706CY	2976-3007	200	.001	32.50
KQ259†	2700-2900	800	.001	249.50
KQ60†	2840-3005	100	CW	65.00
KQ61†	2975-3170	100	CW	65.00
KQ62†	3135-3350	100	CW	65.00

\* Packaged with magnet.  
† Tunable over indicated range.

## MICROWAVE ANTENNAS

AT49/APR—Broadband Conical, 300-3300 MC, Type N Feed	\$8.95
Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4 1/2" x 3". New	\$100.00
Discone Antenna, AS 125 AP1R, 1000-3200 mc. Stub supported with type "N" connector.	\$14.50
AS14A/40 CM pick up dipole assy. complete w/ length of coax and "N" connectors	\$4.50
AS16A/APG-4 Yagi Antenna, 5 element array.	\$22.50
30" Parabolic Reflector Spun Aluminum dish.	\$4.85
APS-34 Pillbox Antenna, waveguide input; 24,000-27,000 MC	\$22.50
TPS-3, 10 Ft. Dish, "Chicken Wire" Parabola. Extremely lightweight, portable	\$125.00
AN-154 3 vertical dipoles working against a rectangular mesh approx. 3/4". Freq. 140-200 mc with lobing switch (115V, 60 cy) and portable slatted crate. Extremely rugged	\$27.95
LP-24 Alford loop, for use with glide-path transmitters (MRN-1, etc.) 100-108 mc.	\$32.50

## PULSE NETWORKS

15A—1,400-50; 15 KV, "A" CKT, 1 microsec. 400 PPS, 50 ohms imp.	\$22.50
G.E. #3E (3-84-810) (8-24-405) 50P4T; 3 KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp; Unit 2, 2.4 sections, 2.24 microsec. 405 PPS 50 ohms imp.	\$6.50
7-5E3-1-200-67P, 7.5 KV, "E" Circuit, 1 microsec. 200 PPS, 67 ohms impedance 3 sections.	\$7.50
7-5E4-16-60-67P, 7.5 KV, "E" Circuit, 4 sections, 16 microsec. 60 PPS, 67 ohms impedance.	\$15.00
7-5E3-3-200-67P, 7.5 KV, "E" Circuit, 3 microsec. 200 PPS, ohms imp. 3 sections.	\$12.00
H-616 10KV, 2.2 usec., 375 PPS, 50 ohms imp.	\$27.50
H-615 10KV, 0.85 usec., 500 PPS, 50 ohms imp.	\$27.50
KS865 CHARGING CHOKE: 115-150 H @ 0.2A, 92 40H @ .08A, 21 KV Test.	\$37.50
G.E. 25E5-1-350-50 P2T, "E" CKT, 1 Microsec. Pulse @ 350 PPS, 50 OHMS Impedance.	\$69.50
KS9623 CHARGING CHOKE: 10H @ 75 MA, 380 Ohms DCR, 9000 Volt Test.	\$14.95
G.E. 6E3-5-2000 50 P2T; 6 KV, "E" Circuit 0.5 usec./2000 PPS/50 ohms/2 sections	\$7.50

## PULSE TRANSFORMERS

K35J45—Pulse Inversion; PRI: 5 KV PK, Pulse Negative. Sec. Pos. Pulse, 4 KV; 1 usec and .001 DUTY RATIO	\$6.50
54J318-1 3 wdgs. Ratio: 1:1:1, 1.10 uh/wdg. 2.5 ohms DCR	\$3.50
Westinghouse 4P37: Primary: 50 ohms imp. 750 v. Sec. 15 kv. 100 ohms imp. Bilal filament trans. built-in delivers 12.6 c at 2.5 amp (pri. 115v. 400 cy) \$37.50	\$37.50
RAYTHEON WX 4298E: Primary 4KV, 1.0 USEC. SEC: 16KV-16 AMP DUTY RATIO: .001 400 CYCLE FIL. TRANS. "BUILT-IN"	\$42.50
WECO: KS 9948: Primary 700 ohms; Sec. 50 ohms. Plate Voltage: 18KV, Part of ATQ-13	\$12.50



### GE #K-2449A

Primary: 9.33 KV, 50 ohms Imp.  
Secondary: 24 KV, 450 ohms Imp.  
Pulse length: 1.05 usec @ 635/190 PPS, PK Power Out: 1.740 KV Bilal; 1.5 amps. (as shown). \$62.50

GE #K2748-A, 0.5 usec @ 2000 Pps. PK. Pwr. out is 32 KV. Impedance 40/100 ohms. Pri volts 2.3 KV PK. Sec. volts 11.5 KV PK. Bilal rated at 1.3 AMP. Fitted with magnetron well.	\$39.50
K-2745 Primary: 3.1/2.8 KV, 50 ohms Z. Secondary: 14/12.8 KV @ 0.25 PPS. Z. Pulse Length: 0.25/1.0 usec @ 600/600 PPS. PK Power 200/150 KW. Bilal: 1.3 AMP. Has "built-in" magnetron well.	\$42.50
K-2461-A, Primary: 3.1 2.6 KV—50 ohms (line). Secondary 14/11.5 KV—1000 ohms Z. Pulse Length: 1 usec @ 600 PPS. PK Power Out: 200/130 KV Bilal: 1.3 Amp. Fitted with magnetron well.	\$39.75
UTAH X-151T-1: Dual Transformer, 2 Wdgs. per section. 1:1 Ratio per sec 13 MH inductance 30 ohms DCR	\$5.00
UTAH X-150T-1: Two sections, 3 Wdgs. per section. 1:1:1 Ratio. 3 MH, 6 ohms DCR per Wdg. per section.	\$5.00
68G711: Ratio: 4:1 Pri; 200V. Sec. 53V, 1.0 usec Pulse @ 2000 PPS, 0.016 KVA	\$4.50
TR1049 Ratio 2:1 Pri. 220 MH, 50 Ohms, sec. 0.75 H. Freq. 100 Ohms.	\$6.75
K-904695-501: Ratio 1:1, Pri Imp. 40 Ohms. Sec. Imp. 40 Ohms. Passes pulse 0.6 usec with 005 usec rise	\$8.95
RAY UX 7896—Pulse Output Pri. 5v sec 41v. 1.5 sec	\$7.50
RAY UX 8442—Pulse Inversion 40v + 40v	\$7.50
PHI CO 352-7250, 352-7251, 596-7307	\$5 ea.
W.E.: D-166310, D-166638, KS9800, D-163247	\$5.00
UTAH #9262, with Cracked Beads, but will operate at full rated capacity.	\$5.00
UX 8693 (SCS #279627-54): 3 Wdgs. 32 turns @ 18 wire. DCR is 302/372/4 ohms.	\$5.00
D-166173: Input: 50 ohms Z, Output: 900 ohms 3 Wdgs. Freq. range 10 kc-2mc. P/O AN/ATQ* 13	\$12.50
K-2450 Pulse-inversion auto-transformer; primary 12 kv, 4 usec. Output: 14 kv @ 100 kw peak	\$34.50

# FAY-BILL DISTRIBUTING CO.

PARTIAL LISTING ONLY

## LARGEST SURPLUS TUBE DEALER IN THE COUNTRY STANDARD BRANDS — TRANSMITTING & RECEIVING

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AB-150	\$2.95	2C43	14.77	4C35	18.99	253A	7.99	721A	1.95	957	.26	6A57G	3.69	12AU7	.79
CEP-220	.94	2C44	.85	4D22	19.95	258B	4.49	721B	9.95	958	.26	6AX4	.79	12AT7	.99
CEP-120 ZB	.94	2C46	9.99	4D32	19.89	259A	6.99	722	1.99	959	1.99	6B4G	.79	12AV7	.94
CK-507AX	.99	2C51	3.59	4E27	17.50	264C	4.19	723A/B	15.99	991	.44	6BA7	.89	12AX4	.83
CK-521AX	.99	2D21	.94	4J22	79.60	271A	12.99	724A/B	1.99	1500T	84.50	6B5	.89	12AX7	.79
CRP-72	.79	2E22	2.49	4J23	79.60	274B	3.35	725A	7.50	CK1005	.49	6B8	.69	12AY7	1.31
DG-1290	3.99	2E24	3.29	4J26	79.50	282A/B	8.49	726C	39.50	CK1006	3.19	6BG6G	1.99	12BA6	.64
EF-50	.39	2E26	1.89	4J28	79.50	286A	7.49	800	.98	1608	.99	6BH6	.79	12BA7	.64
E-1148	.39	2G-22	1.19	4J31	99.50	287A	6.15	801A	.29	1613	1.70	6BE6	.69	12C8	.69
EC1	.39	2J-21	1.50	5AP1	4.99	304TH	7.75	802	3.59	1614	1.99	6BJ6	.69	12C7	.89
F123A	5.99	2J-22	1.50	5BP1	2.99	304TL	8.75	803	2.85	1616	1.55	6BK7A	1.21	12SQ7	.59
F127A	3.99	2J-26	2.50	5BP4	2.99	307A/RK75	1.99	805	2.99	1622	1.64	6BL7	1.10	12SR7	.59
F128A	29.50	2J-27	3.00	5CP1	4.49	310A	3.69	807	1.29	1624	1.64	6BN6	1.24	12SF7	.82
HF-100	6.99	2J-31	17.50	5CP1A	10.50	316A	.99	808	2.45	1625	.19	6BQ6	1.19	12SG7	.85
HF-200	10.99	2J-32	15.99	5CP7	10.50	327A	3.69	809	3.49	1626	.11	6BQ7A	1.19	12SH6	.65
HF-150	15.99	2J-33	17.50	5CP11A	15.50	329A	4.69	812	2.95	1629	.11	6BX7	1.24	12SH7	.69
HF-300	19.99	2J-34	17.50	5C21/C6J	8.49	336A	4.99	813	9.95	1630	.69	6CD6	1.78	12SJ7	.69
HK-24	3.99	2J-38	29.50	5C22	31.75					1632	.89	6CB6	.69	12K8	.69
HK-54	4.59	2J-40	29.50	5D21	13.65					1639	.89	6C4	.49	12K7	.69
HY-114B	.19	2J-42	69.95	5FP7	1.99					1641	.19	6C5	.49	12K7	.79
HY-615	.19	2J-49	49.50	5HP4	3.99					1642	.29	6C6	.49	12L7	.49
KU-610	12.99	2J-61	21.50	5HP1	3.99					1806P1	3.99	6C8G	.99	12Z3	.79
		2J-62	17.50	5JP1	14.50					1851	1.39	6D4	2.75	14A7	.69
QK-61	63.50	2K-22	16.99	5JP5	16.50					1960	.99	6E5	.79	14B6	.69
QK-62	69.00	2K-23	17.95	5RP2	16.50					2050	1.19	6F5	.49	14B8	.79
RK-34	.29	2K25	19.95	5J29	9.20					2050W	2.20	6F6G	.69	14N7	.99
RK-38	1.89	2K28	28.99	5J30	16.65					2051	.81	6J4	4.89	14R7	.99
RK-59	1.89	2K-		5J33	5.90					1A3	.69	6J6	.78	19T8	.69
RK-60	2.49	33A	59.50	5LP1	15.95					1B3	.69	6J7	.94	25L6	.64
RK-65	16.99	2K41	109.50	5NP1	11.95					16&GX	.69	6K4	2.69	25Z6	.61
RX-21A	8.99	2K45	69.50	5R4GY	2.05	347A	3.99	814	4.49	16&GX	.69	6K4	2.69	26D7	1.21
UV-217C	3.50	2K54	29.00	5R4GY	1.49	350B	4.99	815	2.49	16&GX	.69	6K4	2.69	26D6	1.75
UH-50	1.99	2K55	29.50	6-4	.19	371B	.89	816	1.39	16&GX	.69	6K4	2.69	35L6	.69
10S/VT-25A	.89	2X2	879.26	6C21	16.99	388A	.99	827R	79.50	16&GX	.69	6K4	2.69	35Z3	.69
VR-78	.89	2V3	.86	7C22	69.00	393A	4.99	828	9.75	16&GX	.69	6K4	2.69	35Z5	.51
VR-90	.89	3A5	.69	7C25	89.50	394A	5.99	828B	9.50	16&GX	.69	6K4	2.69	35Y4	.69
VR-105	.89	3BP1	2.99	7BP1	6.99	417A	9.49	830B	1.99	16&GX	.69	6K4	2.69	50A5	.69
VR-150	.80	3B22	1.93	7BP7	6.99	434A	9.95	832A	7.49	16&GX	.69	6K4	2.69	50B5	.69
VT-52	.19	3B23	3.99	7LP7	5.50	446A	1.49	833A	37.49	16&GX	.69	6K4	2.69	50C5	.69
30S/VT-67	.19	3B24	3.99	10Y	.21	446B	3.99	836	3.20	16&GX	.69	6K4	2.69	50L6	.69
VT-127A	2.89	3B25	3.39	12X3	1.66	446B	3.99	837	1.22	16&GX	.69	6K4	2.69	77	.49
VT-158	15.99	3B27	11.69	15E	1.09	446B	3.99	838	2.90	16&GX	.69	6K4	2.69	78	.59
VU-111	.19	3B28	3.69	15R	.19	446B	3.99	841	.19	16&GX	.69	6K4	2.69	80	.80
OA2	.84	3C21	.94	18C	.19	446B	3.99	843	.19	16&GX	.69	6K4	2.69	83V	.99
OB2	.84	3C22	69.69	24R	1.99	446B	3.99	845	11.99	16&GX	.69	6K4	2.69	5516	6.99
1B22	1.19	3C23	7.45	25TG	4.44	446B	3.99	849	49.69	16&GX	.69	6K4	2.69	5559	18.99
1B24	4.65	3C24	.99	53A	1.99	446B	3.99	851	24.99	16&GX	.69	6K4	2.69	5560	24.40
1B36	1.46	3C29	1.49	89Y	.10	446B	3.99	860	3.99	16&GX	.69	6K4	2.69	5633	10.95
1B37	10.45	3C30	1.49	100TH	6.99	446B	3.99	861	16.99	16&GX	.69	6K4	2.69	5634	4.99
1B39	2.59	3C31	1.49	100TL	8.99	446B	3.99	864	.19	16&GX	.69	6K4	2.69	5638	8.70
1B32/532A	1.19	3C32	1.49	203	3.99	446B	3.99	866A	.99	16&GX	.69	6K4	2.69	5651	2.15
1N21	.69	3C33	1.49	204A	9.49	446B	3.99	865	1.89	16&GX	.69	6K4	2.69	5654	2.20
1N23	2.10	3C34	1.49	205B	.89	446B	3.99	866A	.99	16&GX	.69	6K4	2.69	5670	3.49
1N27	7.99	3C35	1.49	207	42.50	446B	3.99	869B	39.95	16&GX	.69	6K4	2.69	5687	4.25
1P28	15.70	3C36	1.49	211	.89	446B	3.99	872A	1.99	16&GX	.69	6K4	2.69	5718	5.69
1P30	3.99	3C37	1.49	215A	3.49	446B	3.99	874	.86	16&GX	.69	6K4	2.69	5763	1.59
2AP1	6.99	3C38	1.49	217A	2.49	446B	3.99	876	.96	16&GX	.69	6K4	2.69	5796	7.99
2B22	1.49	3C39	1.49	217C	6.99	446B	3.99	878	1.29	16&GX	.69	6K4	2.69	5814	2.69
2BP11	7.99	3C40	1.49	218A	2.49	446B	3.99	884	1.19	16&GX	.69	6K4	2.69	5964	1.15
2C22	.99	3C41	1.49	219A	2.49	446B	3.99	885	1.49	16&GX	.69	6K4	2.69	7193	.09
2C26	.11	3C42	1.49	219B	2.49	446B	3.99	891R	199.50	16&GX	.69	6K4	2.69	8002R	24.95
2C30	4.95	3C43	1.49	219C	2.49	446B	3.99	892	199.50	16&GX	.69	6K4	2.69	8005	4.99
2C33/RX233	1.69	3C44	1.49	219D	2.49	446B	3.99	902	6.99	16&GX	.69	6K4	2.69	8012	1.94
2C39A	12.99	3C45	1.49	219E	2.49	446B	3.99	918	2.10	16&GX	.69	6K4	2.69	8013A	4.69
2C40	7.29	3C46	1.49	219F	2.49	446B	3.99	927	1.95	16&GX	.69	6K4	2.69	8020	2.59
		3C47	1.49	219G	2.49	446B	3.99	931A	5.99	16&GX	.69	6K4	2.69	8025	2.95
		3C48	1.49	219H	2.49	446B	3.99	934	.19	16&GX	.69	6K4	2.69	8602	.69
		3C49	1.49	219I	2.49	446B	3.99	954	.19	16&GX	.69	6K4	2.69	9001	.99
		3C50	1.49	219J	2.49	446B	3.99	955	.24	16&GX	.69	6K4	2.69	9002	.69
		3C51	1.49	219K	2.49	446B	3.99	956	.26	16&GX	.69	6K4	2.69	9003	1.29
		3C52	1.49	219L	2.49	446B	3.99			16&GX	.69	6K4	2.69	9004	.19
		3C53	1.49	219M	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C54	1.49	219N	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C55	1.49	219O	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C56	1.49	219P	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C57	1.49	219Q	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C58	1.49	219R	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C59	1.49	219S	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C60	1.49	219T	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C61	1.49	219U	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C62	1.49	219V	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C63	1.49	219W	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C64	1.49	219X	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C65	1.49	219Y	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C66	1.49	219Z	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C67	1.49	219AA	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C68	1.49	219AB	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C69	1.49	219AC	2.49	446B	3.99			16&GX	.69	6K4	2.69		
		3C70	1.49	219AD	2.49	446B	3.99			16&GX	.69	6K4	2.69		
	</														

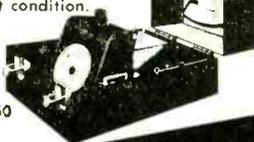


TS 45/APM...\$99.50

Stock No. 01

TEST EQUIPMENT

Fine laboratory test equipment, used but in excellent condition.



TS 76/APM...\$49.50

Stock No. 02

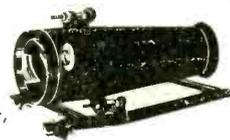
PIONEER TORQUE UNITS



TYPE 12602-1-A. Includes CK-5 Servo Motor coupled to output shaft thru 125:1 gear reduction train. Output shaft coupled to autosen follow-up (AY-43). Ratio of output shaft to follow-up autosen is 30:1. Includes base mounting type cover for motor and gear train.....\$34.95 ea.

Stock No. 03

LINK COLLIMATOR



An instrument used for projecting infinite light in the Link Navigational Trainer. Consists of a 5" acromat, 2-piece cemented lens with approximate 25" focal length. Includes a first surface mirror reflector. Used commercially for projecting infinite light in the alignment of precision optical instruments. May also be used as a telescope. Size: 14 1/2" L. x 7 3/8" W. Used, excellent condition. Original cost over \$200.00 \$25.00 F. O. B. Pasadena

Stock No. 04

TREMENDOUS SAVINGS IN ELECTRONIC

WAR TERMINATION INVENTORIES

SAVE UP TO 85% • IMMEDIATE DELIVERY • EQUIPMENT FULLY GUARANTEED



INVERTERS

PIONEER 12126-2-A Output: 26 volts; 3 phase; 400 cycle; 10 VA; 6 PF Input: 27.5 volts DC; 1.25 amps \$24.50 DMF 2506M

CONTINENTAL ELECTRIC 24-30 volts input; 5.5-4.5 amps; cont. duty. Output: 115 volts; 44 amps; 400 cyc; 1 phase; PF 1.0; 50 watts \$39.50

10563 LELAND ELECTRIC Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. Input: 28.5 VDC; 12 amps \$39.50

PIONEER 12117 Output: 26 volts; 400 cycles; 6 volt amperes; 1-phase. Input: 24 VDC; 1 amp \$19.95

ALTERNATOR, CARTER Mfd. Carter Motor Co.; Output: 7 VAC; 9.7 amp; 650 cycles; and 295 VDC; 200 amps. Input: 26.5 VDC; 10.5 amps; 6500 rpm \$29.50

PE 218 LELAND ELECTRIC Output: 115 VAC; Single phase PF 90; 380/500 cycle; 1500 VA. Input: 25-28 VDC; 92 amps; 8000 rpm; Exc. Volts 27.5 BRAND NEW \$39.95

PE 109 LELAND ELECTRIC Output: 115 VAC; 400 cyc; single phase; 1.53 amp; 8000 rpm. Input: 13.5 VDC; 29 amp \$65.00

MG153 HOLTZER-CABOT Input: 24 VDC; 52 amps. Output: 115 volts -400 cycles; 3-phase; 750 VA and 26 volt -400 cycle; 250 VA. Voltage and frequency regulated \$95.00

PIONEER 12130-3B Output: 125.5 VAC; 1.5 amp; 400 cycles single phase, 141 VA. Input: 20-30 VDC; 18-12 amps. Voltage and frequency regulated \$69.50

12116-2-A PIONEER Output: 115 VAC; 400 cyc; single phase; 45 amp. Input: 24 VDC; 5 amp \$39.95

10285 LELAND ELECTRIC Output: 115 volts AC; 750 VA; 3 phase; 400 cycle; .90 PF and 26 volts; 50 VA; single phase; 400 cycle; .40 PF Input: 27.5 VDC; 60 amps; cont. duty; 6000 rpm. Voltage and frequency regulated \$59.50

10486 LELAND ELECTRIC Output: 115 VAC; 400 cycles; 3-phase; 175 VA; 80 PF. Input: 27.5 DC; 12.5 amps; cont. duty \$90.00

PIONEER 10042-1-A DC input 14 volts; output: 115 volts; 400 cycle; 1-phase; 50 watt \$39.50

10339 LELAND ELECTRIC Output: 115 volts; 190 VA; single phase; 400 cycle; .90 PF and 26 volts; 60 VA; 400 cycle; .40 PF. Input: 27.5 volts DC 18 amps cont. duty; voltage and freq. regulated \$49.50

PIONEER 12147-1 Output: 115 VAC; 400 cycles; single phase. Input: 24-30 VDC; 8 amps \$49.50

MG 149F HOLTZER CABOT Output: 26 VAC @ 250 VA; 115V @ 500 VA; single phase; 400 cycle. Input: 24 VDC @ 36 amps \$49.50

EICOR CLASS "A" No. 1-3012/08-7 Output: 125 VAC; 400 cycles; single phase; 100 VA. Input: 24-30 VDC; 11 amps; Duty int. Voltage and Frequency Regulator \$49.50

PIONEER 12123-1-A Output: 115V; 3-phase; 400 cycle; Amps .5. Input: VDC; 12 amp \$69.50

PRECISION GEAR ASSORTMENT

Select assortment of precise gears made by leading gear mfrs., e. g.; Boston, Western, etc. Includes brass, steel, aluminum and other materials in worm, spur, bevel, miter and wide selection of other types. Ranges from 16 to 64 pitch. Origin from Gov't termination contracts... mostly 1/4" shafts. A \$35.00 value.



50 gear asst. \$ 5.00 ppd.  
150 gear asst. \$12.50 ppd.

Stock No. 05



GEAR REDUCTION UNIT

TYPE B181091 U.S. Ordnance, 22:1 ratio. Die cast aluminum case; precision steel to fiber to steel gears, minimum backlash. Ball bearing mounted shafts. Output (slow speed) is a 2" dia. metal coupling... Input shaft is a 1" dia. brass collar, interchangeable to 1/2" dia. x 5/8" L shaft. Input and output direction of shaft is the same.

Size: 7" L. x 5 1/4" W. x 7 1/2" H. Wt. approx. 9 lbs. \$8.50

Stock No. 07

SYNCHRONOUS SELSYNS



110 volt, 60 cycle, brass cased, approximately 4" dia. x 6" long. Mfd. by Diehl and Bendix QUANTITIES AVAILABLE

REPEATERS \$20.00 ea.  
TRANSMITTERS \$20.00 ea.

SYNCHROS

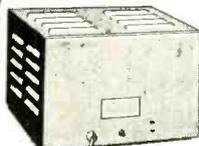
- GENERAL ELECTRIC MOD. 2J15M1; 115-57.5 volts; 400 cycle \$22.50
- KOLLSMAN AUTOSYN MTR. TYPE-403; 32 VAC; 60 cycle; single phase \$9.95
- BENDIX AUTOSYN MTR. TYPE-851; 32 VAC; 60 cycle, single phase \$9.95
- MICROSYN UNIT TYPE 1C-006A \$15.00
- IF SPECIAL REPEATER; 115 volt-400 cycle \$15.00
- 2J1F3 GENERATOR; 115 volt-400 cycle \$10.00
- 5CT CONTROL TRANSFORMER; 90-50 volt; 60 cycle \$45.00
- 5F MOTOR; 115-90 volt; 60 cycle \$45.00
- 55DG DIFFERENTIAL GENERATOR; 90-94 volts; 400 cycle \$30.00
- BENDIX TRANSMITTER TYPE C-78248; 115 volt; 60 cycle \$22.50
- DIFFERENTIAL TYPE C-78249; 115 volt; 60 cycle \$5.00
- BENDIX REPEATER TYPE C-78410; 115 volt; 60 cycle \$37.50
- REPEATER, AC SYNCHRONOUS; 115 volt; 60 cycle \$9.95
- DIEHL REPEATER TYPE FJE 22-2; 115 volt; 400 cycle; secondary 90 volt \$27.50
- 5G GENERATOR; 115/90 volt; 60 cycle \$45.00
- 7G SYNCHRO GENERATOR; 115/90 volt; 60 cycle \$75.00
- 6G SYNCHRO GENERATOR; 115/90 volt; 60 cycle \$60.00
- 6BG SYNCHRO DIFFERENTIAL GENERATOR; 90/90 volt; 60 cycle \$50.00
- 2J5F1 SELSYN CONTROL TRANSFORMER; 105/55 volts; 60 cycle \$22.50
- 2JD5HAT SELSYN GENERATOR; 115/105 volts; 60 cycle \$50.00
- 2J1F1 GENERATOR; 115/57.5 volts; 400 cycle \$12.50
- 2J1H1 DIFFERENTIAL GENERATOR; 57.5/57.5 volt; 400 cycle \$12.50
- 2J1G1 CONTROL TRANSFORMER; 57.5/57.5 volts; 400 cycle \$7.50
- 2J5H1 SELSYN GENERATOR; Mfr. G.E.; 115/105 volts, 60 cycle \$27.50



Stock No. 06

MAGNETIC AMPLIFIER UNIT

Mfr. Pioneer Instrument. TYPE 12071-1-A. 110 volts-400 cycle; 26 volts-400 cycles; 4-tubes (12AH7-GT); take-off for four autosyns. 29.95 ea.



Stock No. 08

TELEGON OSCILLATOR

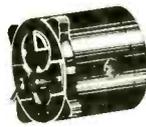
INPUT: 115 volts-60 cycle. OUTPUT: 26.5 volts, 400 cycle, 3-watts @ 250 ohm load. Ideal for laboratory use. Approximately 10" x 7" x 8", weight 16 lbs. 29.95 ea.



Stock No. 09

115 VOLT GENERATORS

Brand new Eclipse generators; 115 VAC; 9.4 amp.; 1000 watts; single phase; 800 cycles; 2400-4200 rpm. DC output is 30 volts at 25 amps. Unit has spline drive shaft and is self excited \$29.95



Stock No. 10

BC-608-A INTERVALOMETER with E-231 Contactor Unit

Mfr. Sangamo Electric. Hand wound clock which controls contacts. Timer hand rotates at one rpm. Makes excellent timing device for laboratory and photographic applications. NEW... in original cartons. \$2.95

ALTIMETERS, SENSITIVE



Stock No. 12

Pioneer sensitive altimeters... range 0-35,000 feet. Calibrated in 20 ft. increments. Includes barometric pressure setting adjustment. No hook-up required, ready to install in laboratory, auto or aircraft \$12.95

WRITE OR WIRE FOR INFORMATION ON OUR COMPLETE LINE OF SURPLUS ELECTRONIC COMPONENTS ALL PRICES NET F O B PASADENA, CALIF

C & H SALES CO

2176 East Colorado Street Pasadena 8, California • RYan 1-7393

**WANTED**

**BC-788, T-47A/ART-13,  
BC-348R, R-5/ARN-7,  
R-89-B/ARN-5, BC-653**

**RADALAB**

87-17 124th STREET  
Richmond Hill 18, New York  
Phone Virginia 9-8181-2-3

**Prices FOB NYC. Rated firms open  
account. Prices subject to change  
without notice.**

**CABLE: Radalab, NY  
TELETYPE: NY-4-4361**

**AN/ARC-2**  
2-9.5 mc autotune transmitter-receiver. This equipment will provide 8 channel autotune operation on voice or C.W. power output is app. 30 watts. This set is similar to ART-13 but incorporates a receiver which is automatically tuned to the trans. freq. as channels are changed, providing a very compact communication pkge. for air or ground use. Power input is 28v DC. POR.

**AN/CPN-6, 17 RADAR BEACONS**  
3 cm & 10 cm. High Pwr. Airport Radar Beacon. Output approx. 40 kw. Complete installation available. POR.

**AN/TXC-1, RC-120 FACSIMILE SETS**  
Page sending and receiving equipment. These sets will transmit and receive a 12 by 18 inch or a 7 by 8 inch page of written or picture material over a telephone line or a radio circuit in 20 minutes. The copy may be sent on or received on either photographic printing paper or on direct recording paper. Power input is 110v 60 cyc. POR.

**AN/ASQ-1 and 1A MAGNETOMETERS**  
This is an airborne magnetometer used to measure the magnetic flux of the earth and to locate submarines and other metallic objects by their distortion of the magnetic field. Complete sets available. P.O.R.

**SCR-506A**  
2-6mc mobile or field radio transmitting and receiving equipment. This equipment is a currently used mobile communication set by many govts. The power output is 90 watts CW and 25 watts phone. The trans. may be set to 4 pre-selected channels or tuned manually. Power input is either 12 of 24v DC. POR.

**SCR-694**  
3-6mc. portable field radio. This equipment provides reliable communications in the field or vehicle. Provisions are made for 2 preset channels, or the set may be tuned manually. Power output is 5 watts phone and 20 CW. This set can be supplied with either a vibrator pack for 6 or 12 volt operation in a vehicle; or a hand generator for field use. POR.

**AN/TRC-1**  
70-100 mc point to point VHF radiotelephone equip. This is a frequency modulated 50 watts point to point radio trans. and receiver set to be used as a communication channel in mountain country where a land wire is impractical, or where temporary operation is desired such as a construction project. The range is approx. 60 miles line of sight. The set is completely portable and operates from 110v 60 cyc. POR.

**AN/TRC-7**  
100-156 mc. portable crystal controlled 2 channel walkie-talkie battery operated. POR.

**AN/APN-3 SHORAN EQUIPMENT**  
This equip. is used for navigation and surveying. Operates in conjunction with AN/CPN-2 ground beacons. Operating freq. is 290mc. Accuracy is plus or minus 10 feet up to its range of 300 miles. Spares available. AN/CPN-2 ground beacons available. POR.

**AN/GSQ1-A SPEECH SCRAMBLERS**  
Speech scrambler for use on any comm. channel to insure privacy. We can supply complete installations of this equipment 28v DC input. Also 110v, 60 cyc.

**SCR-508-528-608**  
10 channel freq.-modulated mobile military radio set. 20-27.9mc. Output 25 watt transmitter is crystal controlled. Receiver is tuneable. Input 12 or 24v DC.

**SCR-291A**  
Automatic ground direction finder covering 1.5mc-30mc. Provides instant bearings on a C.R. indicator of any signal in its range. This equipment is transportable and can be set up quickly. 110v 60 cyc. POR.

**AN/ARC-1**  
100-156 mc. VHF transmitter-receiver. This equip. provides phone operation in 10 crystal controlled automatically selected channels from 100-156 mc. with one guard channel. We can also modify these sets for 20 and 50 channel operation and can supply complete sets for ground operation from 110v 60 cyc supply. Normal input 28v DC. POR.

**SCR-682 A RADAR**  
10CM high power long range harbor surveillance and early warning RADAR. This equipment is a 3000 mc mobile search radar that can be transported in a truck. The equipment incorporates a 7" PPI for operation up to 240,000 yards. Azimuth accuracy is ± 1%. Range accuracy is 100 yards at 10,000 yard range and 5000 yards at 240,000 yard range. Trans. output is approx. 225KW, pulse width is one microsecond. Antenna beam width is 6". Input is 110v 60 cyc. Can be supplied with or without operating shelter or antenna tower. POR.

**AN/APQ-15**  
Multiple echo equipment. This set will pick up signals from a ground search radar and re-transmit them making the plane carrying it look like an entire fleet of planes on the ground radar .....POR

**— TELEMARINE —**

**The Best in Electronic Surplus!**

**BARGAINS FOR HAMS,  
EXPERIMENTERS, INDUSTRIALS,  
AND EXPORTERS!**

**FINEST STOCK OF X'MTTRS &  
RADIOTELEPHONES FOR FIXED  
STATION INSTALLATION,  
50 WATTS TO 20 KW.**

**HEADQUARTERS FOR TCS EQUIP-  
MENT AND SPARE PARTS: WALKY-  
TALKIES (SCR-300 or BC-1000), HANDY-  
TALKIES (SCR-536 or BC-611), COM-  
PLETE AND SPARE PARTS AVAIL-  
ABLE.**

**SPECIAL!! UHF RADIO BEACON EQPT.**  
Model YL. Freq. range 241-251 mc. 25  
Watts output CW, MCW, Voice. Operates  
from 110 V. 50/60 cycles AC. Complete  
with lobe-switching unit, Antenna, and  
spare units. Used — very good condition.

**— TELEMARINE —**

**COMMUNICATIONS CO.**

3040 W. 21st Street, Brooklyn 24, N. Y.  
Phone: ES 2-4300  
CABLE ADDRESS: TELEMARINE, N. Y.

**ELECTRONICA ESOTERICA**

*We specialize in premium grade components high accuracy, high performance, high stability, high reliability. Most items listed below not available elsewhere at surplus bargain prices.*

**\* WESTERN ELECTRIC COMPONENTS:**  
Varistors: 6-terminal CMO ring mod. ass'y's.  
D-164537, D-162482 . . . Either type . . . \$2;  
6/\$10.  
Thermistors: Type 1A . . . \$1.50; D-160956  
\$2; 6/\$10.  
Resistance Lamp: D-167882 . . . \$1.80; 4/\$6.  
Many other WE items. Write.

**\* TELEMETERING FILTERS:** B.P., L.P., and Dis-  
crite. Filters for sid telemet. frequencies. Freed.  
Burnell. Most use toroids. Write for list.

**\* PRECISION RESISTORS:**  
Type DCC and BCC. "Precision" deposited carbon  
and BOROCARBON 1/2 watt miniature 1%  
units; write for list and amazingly low prices.  
Wirewound types: all wound with EVANOHM low  
temp. coeff. wire; type WM-3; 150 K. 200 K.  
40c; BX-198E. 1.8 Meg . . . \$1.80.  
10/\$15

**\* POTENTIOMETERS:** Types JU and JLU.  
SPECIAL: locking, ss. 500 ohm . . . 75c, 10/7.  
Special computer pot. RL-204 (see MIT Rad Lab  
Ser. V. 17 p. 284) . . . \$18 ea. 2/\$35.

**Telephone Quality Capacitors:**

D-162400 1 mf/1 kv. 85°C . . . \$1.50  
D-162003 4 mf/600 V., 85°C . . . \$1.  
D-164977 2 mf/200 V. . . \$0.85  
D-162246 3 mf/250 V. . . \$1.25  
Type 402-D Silver mica; many values.  
SPECIAL: 0.01 mf 50v \$0.85, 10/\$8.

**THIS AD WILL NOT RUN AGAIN. WRITE FOR  
OUR LISTS, WHICH GIVE DETAILED INFOR-  
MATION ON THIS AND OTHER INTERESTING  
MATERIAL. TERMS NET F.O.B.; POSTAGE  
PREPAID IN U.S.A. IF CHECK ACCOMPANIES  
ORDER.**

**G. GREENE**

166-04 - 67th Avenue Flushing 65, N. Y.

**OFFERING**

7,000 new relays 24 V. 25c ea for lot.  
1,000 new relays 600 V. max. 40c ea for lot.  
5,000 ea BC-631 Junction Boxes new for SCR-522.  
.15c ea for lot.  
3,000 new BD-93 dynamotors \$1.50 ea.  
150 ea new BD-57 switchboards \$12.00 ea 20 circuit.  
1,000 amplifiers with tubes for the A-5 auto Pilot  
.75c ea. minimum order 100.  
200 new GN-45 hand generators \$3.75 ea, order of  
25.  
1,000 new PP-112 Power supplies \$2.50 ea, order of  
100.  
3,500 new BC-348 transformers \$1.00 ea lots of 100  
or more .75c.  
Aircraft Generator test sets up to 9KW Bench type,  
write for full description.  
2,000 carbon pile voltage regulator .25c ea for lot.  
2 Hundred thousand ft. of plastic tubing blanc &  
Clear \$500.00 for the lot.  
200 New PE-219 Battery Chargers, \$5.00 ea, in lots  
of 10 or more.

All types of Dynamotors, Inverters

**VETS** Dist. Co. 3613 N. Western Pky.  
Louisville 12 Ky, CY-8904

**MULTIPLE RANGE  
CONTINUOUS INDICATING  
PORTABLE TACHOMETER**

Three Ranges in R.P.M. and in F.P.M.

LOW RANGE . . . . . 300- 1500  
MEDIUM RANGE . . . . . 1000- 5000  
HIGH RANGE . . . . . 3000-15000  
LARGE OPEN DIAL 4" DIAMETER . . \$37.50

**MARITIME SWITCHBOARD**

336-340 Canal St., New York 13, N. Y.  
Worth 4-8216 (7)

OVER 1 MILLION RECEIVING INDUSTRIAL  
AND NEW TYPE TUBES AT LOWEST PRICES  
—AVAILABLE ANYWHERE—ALL GUARAN-  
TEED, ALL SPECIALLY PRICED—AVAILABLE  
FROM STOCK FOR IMMEDIATE DELIVERY—  
WRITE, CALL OR WIRE FOR QUOTATIONS;  
THYRATRONS, KLYSTRONS, CATHODE RAY,  
VOLTAGE REGULATORS, MAGNETRONS,  
LIGHTHOUSE

➔ SUPER SPECIAL FOR THIS MONTH ONLY ➔

W. E. 725A In Original Packing \$475  
Fully Guaranteed

**ALLIED ELECTRONIC SALES**

74 Cortlandt St. N.Y.C., N. Y.  
Phone BArlay 7-5839, 5840

**Selsyn Motors**

Type C-78248 Bendix and Diehl similar to U. S. N. type Mark III Transmitter. May be paired and used as a selsyn system. Excellent for experimental uses. 60 cy. 115 v.

**PRICE . . . . . \$7.95 each**

**DELAWARE EQUIPMENT CO.**

124 N. 3rd St. Phila. 6, Pa.  
Lombard 3-4930



# COMPASS ELECTRONICS SUPPLY

A Division of Compass Communications Corporation

WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY TO TEST AND GUARANTEE ANYTHING WE SELL

### TEST SETS

- TS-3A/AP
- TS-10A and B
- TS-12/AP
- TS-13/AP
- TS-16/AP
- TS-36/AP
- TS-62/AP
- TS-74/UPM
- TS-89/AP
- TS-101/AP
- TS-125/AP
- TS-173/UR
- TS-278
- TS-323
- OAA
- OAP
- OBU
- LAE
- LM
- LU
- IE-19
- 1-46
- 1-56
- 1-208
- 1-222
- SCR-211

### AND OTHERS

### MARINE TRANSMITTERS

- TAJ
- TAQ
- TBL
- TBK
- TBM
- TBN
- TCE
- TCF
- TDE
- TDQ
- TDO

### AND SPARE PARTS

### SPECIAL RADAR AND MICROWAVE ACCESSORIES

#### RADAR BEACONS

YJ and YG ..... for shipboard use AN/CPN-8 ..... 10 cm.  
 AN/CPN-6 ..... 3 cm. AN/APS-2, APS-3, APS-4, APS-6, APS-15  
 Also SA, SF, SG, SD, SJ, SK, SN, SQ—both equipment and spare parts

### SA-2 RADAR

Used for air traffic control, tracking and search, both land-based and shipborne. 5 microsec. pulse., PPI indication, operates at 200 mcs, peak power of 150 KW. Input 110/120 volts a.c. 4 complete installations in stock.— Write for price.

SN—RADAR—10 cm—Compact, light and portable, ranges of 5 and 20 miles. Uses 5CPI scope. Operation is from 115 volts, 60 cycle, but we can supply converter for dc operation. .... \$750.00 ea

ANTENNA ASSEMBLY—10 cm RADAR—Reflector is a lightweight parabolic cylinder, Ass'y has both manual and motor drive. Ideal unit for labs, classroom demonstration, small craft, etc. \$99.50 ea

MAG—10 cm. remarkable link radar, portable, operated from 6 volt battery, uses folding antenna and tripod. A pair at..... \$1,750.00

APS-3—3 cm—Airborne radar for search and homing, 5-in scope, 10 brand new sets at... \$700.00 ea

APQ-13—Very late model airborne radar set, complete and new. One only at..... \$2,950.00

SCR-545—Complete radar set, less vehicle, antenna and power plant, pretty fair condition, sold as-is at ..... \$1,375.00

### TEST SETS

TS-35A/AP—(Late Model) X-Band Signal Generator and Power Meter—Input 115/1/50-1200 CPS. Generates and measures RF power. Produces (CW or pulsed, int. or ext. synchronized) signal of known frequency and power. Generates FM signal for trouble shooting radar. NEW..... \$375.00

TS-69/AP Frequency Meter, Range 340-1,000 mcs. Uses 0-200 microammeter; Excellent..... \$75.00

TS-100/AP Test Scope with type A, R, J and X Indications. Gated and ungated sweeps, int. or ext. triggering ..... \$125.00

393 Greenwich St., New York 13, N. Y.  
 BEEKMAN 3-6510 Cable: COMPRADIO, N. Y.

Write for More Details on Any Particular Item in Which You are Interested

Wholesale, Industrial and Institutional Sales Only

These are partial listings only of our stock. Please write for other types.

### RECEIVERS

- ARB
- ARC-1
- ARC-3
- ARC-4
- ARC-5
- AR-88
- CR-91
- SLR
- RAK
- RAL
- RAO
- RBB
- RBO
- RBG
- RBL
- RBA
- RBM
- RCH
- BC-224
- BC-312
- BC-314
- BC-344
- BC-348

### AND SPARE PARTS

### FIELD EQUIPMENT

- SCR-274
- 300
- 399
- 536
- 808
- 828
- BC-191
- 654
- 603
- 604
- 610E
- 683
- 684
- 923
- 924
- 1000
- 1306

### AND SPARE PARTS

## NEED METERS?

STANDARD or SPECIALS

ANY QUANTITY — NEW — SURPLUS

FOR ELECTRONIC — MILITARY  
 AIRCRAFT — HAMS

ALL MAKES — MODELS  
 RANGES — SIZES

METERS REPAIRED  
 RESCALED  
 RECALIBRATED

WRITE - PHONE - WIRE

## INSTRUMENT SERVICE

455 B. 67th St.  
 Arverne, New York

CAA No. 4264 Ltd.

NE 4-8594

## NEW TUBES

Standard brands. First grade only. No pull outs. No rejects. No rebrands. At lowest prices. Wholesale and export only. Minimum order, per type, 100.

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
1A7GT	.42	6AC7	.68	6D6	.45
1H5GT	.38	6AK5	.63	6F5	.28
1G6GT	.45	6B7	.69	6F8G	.38
1D8GT	.55	6B8G	.29	6G6G	.45
1LA6	.55	6C6	.38	6H6	.38
1LD5	.50	6C8G	.38	6J5GT	.35
1S4	.38				

This is just a sample. We have thousands of other types of Receiving, Transmitting, Magnetrons, Klystrons and Rectifiers. Come to us for any kind, whether standard or special, made by Western Electric, RCA, Sylvania, General Electric, Hytron, Raytheon, and others. We also carry Micro Wave Test Equipment for S, X, and K bands.

THIS MONTH'S SPECIAL:  
 500V. POWER SUPPLY FOR  
 1P25 INFRA RED IMAGE  
 CONVERTER, \$9.90  
 each.



Phone: WOrth 4-8262

**LIBERTY ELECTRONICS, INC.**

135 LIBERTY STREET,  
 NEW YORK 6, N. Y.

Minimum Order \$25.00 Cables: TELSERUP

# S & R... WHEREVER YOU ARE!

From Timbuctu to Tallahassee, Le Havre and Los Angeles—when they want the best by far—there's S&R! The letters of satisfaction we're gazing fondly at would gladden the heart of a Republican in Mississippi—and the wire on our desk is from Biloxi!

OA-3	\$ .90	5B21	13.25	88D7	.90	722A	.99	5670	2.50
OB2	.80	5J30	45.00	8807W	3.00	805	3.00	5676	.85
OD3	.85	5R4GY	1.45	53A	3.95	806	14.50	5686	1.75
1A7GT	.55	5R4WGY	2.55	85A1	3.50	807	1.35	5687	4.00
1N23B	1.40	6AC7	.68	OK95	12.00	811	2.95	5691	4.25
1Z2	1.95	6AK5	.55	100TL	6.00	811A	3.10	5749	1.90
2C39A	9.95	6AK5W	1.15	114B	.75	813	7.75	5814	1.50
2D21	.75	6F4	1.90	VT127	2.45	832A	8.00	5851	4.90
2D21W	2.00	6J6	4.10	VT127A	3.95	842	3.00	5933 807W	7.00
2E24	1.60	6J6W	1.35	VXR130	4.15	872A	2.60	5963	1.25
2E26	3.00	6J6WA	2.25	203A	7.00	959	2.25	5993	5.00
2J21A	3.25	6SK7Y	.70	249T	4.00	CK1022	12.50	6021	2.80
2J22	4.00	6X4W	1.10	250R	4.25	1603	3.50	6080	2.95
2K33A	65.00	7CP1	20.00	250TL	11.25	1616	2.00	6080WA	4.00
3B21	8.50	9CP7	10.00	371B	1.00	2050	1.10	6082	2.95
3B22	1.50	9JP1	30.00	GL471A	1.85	2051	.75	6088	1.95
3B23	6.00	12C8	.45	CK501LX	15.00	5636	5.48	6095	1.45
3C24	1.25	FG17	3.00	RH507	39.00	5641	4.85	6099	2.95
4-65A	12.50	KK19	2.25	707A	6.95	5644	6.95	8013A	3.75
4C27	4.50	RK20A	25.00	707B	5.95	5647	5.75		
4C28	10.00	25T	2.85	717A	.50	5651	1.30		
4C35	16.00	26Z5W	3.00			5654	1.69		

## RECEIVING TUBE SPECIALS

5Z4	.75	6L7	.60
6AF4	.85	6N7	.65
6B8	.70	6U8	.79
6BZ7	.89	12AT7	.79
6F6	.44	12AU7	.75
6K7	.50		

We are the originators of the two colored tube cartons with new safety partition, prevents tube breakage.

SIZE

Miniature	(6AU6, etc.)	.009
GT	(6SN7, GT, etc.)	.01
Large GT	(1B3GT, etc.)	.0125
Large G	(5U4G, etc.)	.015

Minimum Order 100 of any Size

WIRE . . . WRITE . . . PHONE . . . . . HUNDREDS OF OTHER TYPES IN STOCK; SEND US YOUR NEEDS; ALL PRICES FOB-NYC—TERMS: RATED FIRMS (D&B) NET 10 DAYS, OTHER 25% WITH ORDER; ADVANCE REMITTANCE IN FULL SAVES YOU PP CHARGES YOU CAN PUT YOUR CONFIDENCE IN S&R. . . . . BEST BY FAR!

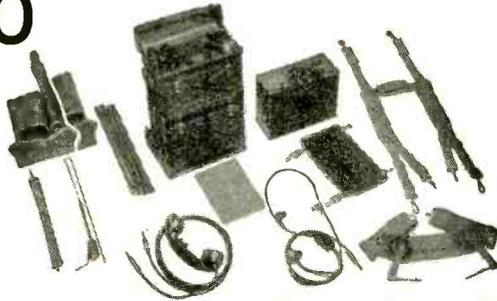
# S & R ELECTRONICS, Inc.

TELEPHONE CORTLANDT 7-4710-1-2

136 LIBERTY STREET • NEW YORK 6, N. Y.

## SCR-300

World Renowned  
PORTABLE  
WALKIE-TALKIE



- 18 Miniature Tubes
- Frequency 40.0 to 48.0 Mcgs.
- F.M. Reception & Transmission
- Rugged & Compact Construction
- Dependable Two-Way communications
- Range—5-miles or better depending upon terrain
- Minimum Maintenance—spares readily available
- Guaranteed and Checked for operation prior to each shipment.

The SCR-300 as pictured here is supplied complete and ready to operate. It is generally considered to be the best portable set of its kind to come out of World II, and is still in general use. As specialists in the SCR-300, we have sold thousands throughout the world to completely satisfied users.

This equipment can be also employed in vehicles or in fixed locations with separately mounted tree-top ground plane antenna with coaxial feed to the unit on the ground.

All equipment is checked minutely for peak performance prior to shipment and guaranteed. Accessories, test equipment and a large stock of spare parts from antennas to the smallest component, available from stock.

- COLLINS TCS. Complete equipment for all voltages. Large quantity of spare parts.
- Transmitting, Receiving, Communication Equipment for all modes, in all power ranges.
- We specialize in Point-to-Point Communications.
- Large stocks on hand.
- Brochures and data sheets on request.

## COMMUNICATION DEVICES CO.

Cable—Commudev, N. Y. 2331 Twelfth Avenue, New York 27, N. Y.  
Tel. ADironclack 4-6174 TWX—NY1—223

## OIL CONDENSERS

8-8 Filtermite	\$2.00
8-8-8-600 V	6.00
8-660AC	4.25
2-2-2-4000V	3.10
.01-600V mica	.45
.01-2500V mica	1.10
.002-300V 6 amp.	
.002-12000V 9 amp.	
.0001-20.000V Type G	\$30.00

\$50 order 10% off.  
\$200—15% off.  
\$500—20% off

## RELAYS

Large stock, some types never before available on surplus market. Priced far below wholesale. Leach, Advance, Clane, G.E., Kerman, Espey, Potter Blumfield, Cramer or Price time delays. Monarch overload. 110V AC or 6V DC. Write for list and prices.

## ONAN 213G 800 CYCLE MOTOR GENERATOR SETS

Generator output 1500W 110V-800 cycles 1φ plus 500W-28V DC. Belted to enclosed G.E. 5 HP 220-440 60 cycles AC-3φ motor with Allen Bradley remote controlled starting switch. \$245. Same with 5 HP 230V DC motor and starter \$200.

All items brand new — condensers and relays almost all export packed. FOB San Diego.

## NORTH ELECTRONIC SUPPLY

3704 Bandini Street  
San Diego, Calif.

SAVE ON TUBES BRAND NEW TUBES GUARANTEED TUBES

OA2	.75	2D21	.95
OA3/VR75	1.00	2D21W	2.49
OA5	3.00	2J31	15.00
OB2	.75	2J32	15.00
OC3/VR105	.90	2J33	15.00
OD3/VR150	.80	2J34	15.00
1B23	4.00	2J36	55.00
1B24	5.00	2J42	99.50
1B26	1.75	2J49	59.50
1B27	12.50	<b>2J51</b>	<b>150.00</b>
1B35	5.00	2J55	50.00
1B49	8.25	2J56	75.00
1B51	7.50	2J61	24.50
1B63A	25.00	2K22	17.50
1D21/SN4	3.50	2K25	15.00
1N21B	2.00	2K26	45.00
1N23B	2.00	2K28	25.00
<b>1N26</b>	<b>4.95</b>	2K33A	65.00
1N34A	.79	2K33B	100.00

3K30	199.50	6AL5W	1.60
4C27/CV92	7.50	6AN5	2.50
4C35	15.00	6BM6	45.00
4J26	79.50	6C31	24.50
4J28	79.50	6F4	3.00
4J29	79.50	<b>6J4</b>	<b>3.25</b>
4J30	99.50	7C22	99.50
4J31	79.50	7C25	135.00
4J34	25.00		

254A	7.50	706AY/GY	20.00
274B	1.00	707B	7.00
282A	4.00	708A	1.95
282B	4.00	713A	.95
304TH	6.95	715B	6.00
304TL	6.95	715C	14.00
307A/RK75	1.95	717A	.90
312A	2.95	719A	10.00
316A	1.25	720AY	49.50

884	1.00	5672	1.29
GL889	75.00	CK5678	1.00
GL889A	89.50	5686	2.25
889RA	150.00	5687	3.50
902A	6.50	5696	1.10
913	14.00	5702	2.95
922	1.25	5703	1.15
923	1.30	5704	2.20
931A	3.75	<b>5718</b>	<b>3.00</b>
935	5.00	5719	6.95
SN949C	4.50	5725	2.25
SN953D	4.50	5727	1.75
957	.49	5744	1.30
958A	.49	5750	3.10
959	1.10	5780	199.50
SN980	4.50	5781	4.95
CK1006	1.25	CK5787	4.95
1616	.75	<b>5814</b>	<b>1.30</b>
1620	2.95	5837	67.50
1623	1.10	5844	4.50

NOW-NEW LOW PRICES

4J36	79.50	12GP7	17.50	323B	6.50	720CY	25.00
4J42	79.50	15E	1.75	327A	3.50	720EY	25.00
4J50	79.50	RK21	1.00	328A	3.23	721A	1.00
4J51	149.50	35TG	5.95	336A	write	721B	12.50
4J52	160.00	D42	write	338A	6.00	722A	1.95
4J57	149.00	OK60	35.00	349A	8.50	723A	7.95
4-125A	19.00	RK60 1641	1.95	350A	3.50	723A/B	9.00
4X150A	27.50	RK65	10.00	350B	3.50	724B	1.00

**SPECIAL!**

Vacuum Capacitors

6 mmfd. 30 KV	10.00
50 mmfd. 20 KV	10.00
50 mmfd. 32 KV	12.00
50 mmfd. 40 KV	14.50
100 mmfd. 10 KV	12.00
150 mmfd. 20 KV	14.00

YOUR SURPLUS WANTED  
We Pay Highest Prices!

**SPECIAL!**

5" DUAL GUN TUBE

Long persistence tube. Valued at \$200.00. This tube has been rejected for military use.

Tested Before Shipped & Fully Guaranteed. Only **\$17.95**

1N44	.99	2K34	139.50
1N47	4.50	2K39	110.00
1N55	2.75	2K41	125.00
1N63/K63	1.95	2K45	75.00
<b>1N69</b>	<b>4.49</b>	2K54	25.00
1P28	9.00	2X2A	1.25
1P29	2.00	3AP1	6.00
1P36	2.75	3B22	1.95
1P39	1.20	<b>3B24</b>	<b>2.75</b>
1Z2	2.00	3B26	3.50
VS-2	7.50	3B29	6.95
2C21/1642	.69	<b>3C22</b>	<b>65.00</b>
2C36	25.00	3C23	6.50
2C39	12.50	3C24/24G	1.00
<b>2C39A</b>	<b>10.00</b>	3C33	9.95
2C40	7.25	3C45	9.50
2C43	14.95	3E29	9.00
2C44	.89	3JP1	12.50
2C46	10.00	3J30	99.50
2C51	3.50	3K23	149.50
2C52	3.00	3K27	149.50

4-400A	39.50	FG67/5828	12.50	368AS	4.00	726A	8.00
4X500A	75.00	RK72	.75	383A	write	726B	29.50
5AP1	2.95	RK73	.75	394A	3.50	730A	12.50
5BP2A	2.95	75T	6.95	412A	write	750TL	32.50
5BP4	2.00	75TL	7.95	417A	3.00	803	1.50
5CP1A	14.50	FG95/5560	19.50	418A	15.00	805	2.95
5CP2A	3.50	FG104	29.50	434A	9.95	807	1.00
<b>5C22</b>	<b>29.50</b>	FG105	15.00	438A	50.00	813	9.95
5CP7A	14.50	HF120	9.95	446A	1.19	815	2.00
5D21	9.50	VT-127A	2.75	446B	3.50	829	6.00
5FP14	5.00	VT158	12.00	WL456	59.50	829B	9.50
5HP1	3.95	QK159	149.60	464A	2.50	830B	.95
5HP4	3.95	WL200	write	CK512AX	1.30	<b>832A</b>	<b>6.00</b>
5JP1	17.50	207	40.00	527	12.50	836	2.95
5JP2	17.50	211/VT4C	.80	WL530	16.95	837	1.00
5JP4	17.50	WL218	16.00	GL605	write	838	1.95
5JP5	17.50	Z91A	.98	WL616	99.50	846	write
5J23	29.50	FG-235A	35.00	KU627	14.50	851	20.00
5J26	85.00	QK221/6002		KU628	14.50	<b>852</b>	<b>7.50</b>
5J29	10.00	QK235	125.00	WL-651	39.50	860	3.50
5J30	10.00	QK249	200.00	WL652	25.00	861	8.00
5J33	7.50	QK253	149.50	F660	150.00	865	.50
5LP1	9.95	249B	3.00	700/B/C/D	16.50	866A	1.00
5MP1	3.95	249C	6.00	701A	2.00	869B	20.00
<b>5R4GY</b>	<b>1.00</b>	250R	6.95	702A	1.95	872A	1.00
5R4WGY	1.60	250TL	10.00	703A	1.75	874	.60
6CJ	6.50	251A	33.00	705A	1.60	878	.60

6AL5W	1.60	6AN5	2.50	6BM6	45.00	6C31	24.50	6F4	3.00	6J4	3.25	7C22	99.50	7C25	135.00
-------	------	------	------	------	-------	------	-------	-----	------	-----	------	------	-------	------	--------

All Prices F.O.B. Los Angeles, subject to change without notice. Minimum order \$5.00. Check with us for items not listed.

WRITE FOR FREE CATALOGUE!

**Jsh**  
SALES CO.

ELECTRONICS  
Dept. EK  
7552 Melrose Ave  
Los Angeles 46,  
California

Thousands of other types in stock. Send us your requirements. RECEIVING TUBES! We carry a complete line in stock. Standard brands only.

**CONDENSERS**

**SPECIALS**

Oil  
Mica 4 Mfd—600V. .... \$99  
Tubular 5 Mfd—400V. S.T.Bath .38  
Silver Mica  
Bathtub 24 Mfd. 500V. 4 terms  
Channel 3 sects 8-8-8 Mfd. \$1.95  
Ceramicons 7 Mfg—600V. .... \$1.25  
1 Mfd—6KV ..... \$6.25  
\* Large quantity always in stock  
2 Mfd—7500V ..... \$23.95  
Pryanol #F135--Orig. Car.

For a more comprehensive listing see our ads in October and November 1954 Electronics

Write: ART HANKINS, Owner

**MONMOUTH RADIO LABORATORIES**  
Box 159  
Long Branch 6-5192 OAKHURST, N. J.

*Wishing you . . .*

a very

**Merry Xmas**

and a

happy, prosperous

**New Year**

**A. MOGULL CO.**  
17 Warren St., N. Y. 7, N. Y.  
Phone: WORTH 4-0865

**Build TV-FM-AM Sweep Generator**

You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units ..... \$5.95

**AN/APR5A** Airborne superhet radar search rec. Freq. range 1000 to 3000MC. Rec. has a 10MC IF band width operating from 80/115VAC, single phase 60 to 2600 cps and one amp. at 26VDC ..... complete with tubes ..... like new ..... \$250.00

**AN/APT5 TRANSMITTER** ..... operates over a freq. of 300 to 1400 MC; output 30 watts. The carrier freq. is noise-modulated with effective random noise freq. up to 2MC. Complete with tubes ..... like new ..... \$99.50

**I-122 SIGNAL GENERATOR** RF signal 15 to 25 MC and 90 to 125 MC; modulated at 400 cps. or 625 cps. Power Supply 100 to 135 VAC, 25 to 60 cps. like new ..... \$39.50  
Spare parts kit for above ..... \$5.95 (new)

**AN/APN 9 Loran** long range navigation system as used in ships and aircraft. Brand new—original cartons Ea. \$295.00  
complete ..... \$129.50 per set

**I.D. 6A/APN-4 Loran** Indicator, BRAND NEW. complete with 5CP1 tube and 100 KC crystal at ..... \$29.50

**R-9A/APN4-4**—160 meter Loran Receiver, less tubes, Brand New. Complete with conversion diagrams ..... \$14.50  
Both I.D. 6A and R-9A—\$41.50

Write for prices and bulletin

25% Deposit on orders. Shipments F.O.B. Chicago

**RW Electronics**  
Dept. EL  
2430 S. Michigan Ave. Chicago 16, Ill.  
Phone: CALumet 5-1281

**APR-4** with TN-17 TN-18 **\$675.00**

T47A/ART-13, Dy-17, Dy-12, ATC  
Be-312, BC-342, BC-348, SCR-694-C  
ARC-1, 1.208, Dumont #241

ALLTRONICS, Box 19, Boston 1, Mass.  
Telephone S. Richmond 2-0048, 2-0916

**INDUSTRIAL X-RAY INSPECTION EQUIPMENT**

General Electric OX-200, XRD Diffraction, Picker, Standard, Westinghouse and Kelet units from 100 KV up. Special inspection booths made to order.

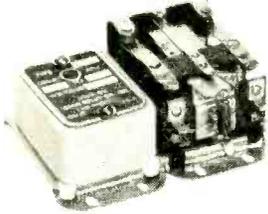
**MEDICAL SALVAGE CO., INC.**  
217 E. 23rd St. N. Y. 10, N. Y.



world's largest stock

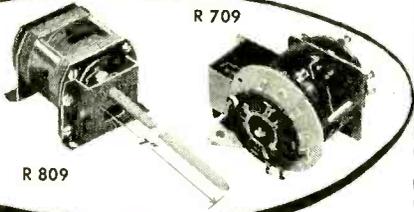
# RELAYS

immediate delivery!



### ADJUSTABLE THERMAL TYPE TIME DELAY RELAY

Operates on 115 V.A.C. Continuously adjustable delay from 5 to 20 seconds. 1/4 Inch D.P.D.T. 12 1/2 amp. contacts. Primarily designed for use with radio transmitters but has wide variety of other applications. Catalog No. R 686 Price \$6.10 each



### STEPPING UNIT

Operates on 22 to 30 V.D.C. 12 Position driving mechanism operates through 360° in progressive steps. Indexes one position for each momentary current impulse. Attached wafer switch may be used for self interruption. 7 inch flatted shaft will drive pulley, gear or one or more wafer switches. Catalog No. R 809 Price \$2.45 each

### SOLENOID OPERATED RATCHET STEPPER

Operates on 6 V.D.C. Operates three 12 position wafer switches. Most standard wafers are interchangeable with those supplied. Rotates 30° with each impulse. Catalog No. R 709 Price \$3.90 each

### HUNDREDS OF RELAY TYPES IN STOCK

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| Standard Telephone Relays        | Differential and Polarized Relays |
| Short Telephone Relays           | Special Relays BK-Series          |
| Midget Relays                    | Antenna and Ceramic Relays        |
| Timers                           | Motor and Control Relays          |
| Aircraft Contactors              | Relay Assemblies                  |
| Rotary Relays                    | Latching and Interlocking Relays  |
| Western Electric Type "E" Relays | Mechanical Action Relays          |
| Keying Relays                    | Ratchet and Stepping Relays       |
| Hermetically Sealed Relays       |                                   |
| Voltage Regulators and Cutouts   |                                   |

All relays are new, individually inspected and unconditionally guaranteed. They are first line products of leading manufacturers. Special attention given to orders of one or more relays. 24 Hour delivery. Write for new catalog. Phone, write or wire your requirements.



AUstin 7-0709  
4717 W. Madison St.  
Chicago 44, Ill.

# Calvert Electronics

INCORPORATED

59 Fourth Avenue New York 3, N. Y.  
OR egon 4-3027  
Cable Address "CALVERTRON"

### RECEIVING TUBES

01A . . . . . \$ .29	6AG7 . . . . . \$ .77	6N7GT . . . . . \$ .44	12SQ7GT . . . . . \$ .55
1F7G . . . . . .50	6AK5 . . . . . .55	6R7 . . . . . .50	12SR7 . . . . . .40
1H6G . . . . . .50	6AL5 . . . . . .42	6SA7GT . . . . . .45	14A4 . . . . . .75
1LA4 . . . . . .50	6AQ5 . . . . . .45	6SF5 . . . . . .45	14C7 . . . . . .64
1LA5 . . . . . .64	6AS7G . . . . . 3.35	6SL7GT . . . . . .53	19 . . . . . .65
1L25 . . . . . .54	6AT6 . . . . . .34	6SN7GT . . . . . .55	25L6GT . . . . . .44
1LG5 . . . . . .79	6B1 . . . . . .55	6SK7GT . . . . . .44	26 . . . . . .40
1LH4 . . . . . .65	6BF5 . . . . . .30	6SQ7GT . . . . . .42	28D7 . . . . . .75
1P5GT . . . . . .34	6BG . . . . . .33	6T8 . . . . . .50	30 . . . . . .77
1Q5GT . . . . . .40	6BF8 . . . . . .33	6V6GT . . . . . .50	35Z5GT . . . . . .40
2A3 . . . . . .89	6EG6 . . . . . .22	7A6 . . . . . .60	7A6 . . . . . .12
2A5 . . . . . .49	6H6 . . . . . .22	7CA/1203A . . . . . .12	38 . . . . . .12
2X2/879 . . . . . .40	7J6 . . . . . .22	7E6 . . . . . .40	39 . . . . . .12
3B7 . . . . . .35	6J7 . . . . . .65	12A8GT . . . . . .39	46 . . . . . .55
5RAWGY . . . . . 1.25	6K7 . . . . . .44	12B8GT . . . . . .29	57 . . . . . .50
5X4 . . . . . .50	6K8 . . . . . .44	12K8 . . . . . .44	70L7GT . . . . . .85
5Y4G . . . . . .55	6L5G . . . . . .59	12S7 . . . . . .65	71A . . . . . .35
6 7 BALLAST . . . . . .29	6L6M . . . . . 1.25	12SK7M . . . . . .45	76 . . . . . .45
6AC7 . . . . . .66	6GAY . . . . . .42	12SK7GT . . . . . .42	77 . . . . . .45
6AG5 . . . . . .53	6L7G . . . . . .39	12SL7GT . . . . . .55	89Y . . . . . .30

### SPECIAL PURPOSE

KC4 . . . . . \$19.00	5HP1 . . . . . 3.75	311B W.E. . . . . 53.75	1616 . . . . . .49
KCA-3 . . . . . 19.00	5RAWGY . . . . . 1.25	312A . . . . . 2.95	1619 . . . . . .22
1AB5 . . . . . .39	6 7 BALLAST . . . . . .29	313CA . . . . . 1.75	1625 . . . . . .19
1B2 . . . . . .44	7B7 . . . . . \$2.77	313CA . . . . . 9.45	1626 . . . . . .19
1B35 . . . . . 3.25	7C4/1203A . . . . . .12	371B . . . . . .75	1629 . . . . . .10
1B56 . . . . . 14.00	9GP7 . . . . . 3.75	373A W.E. . . . . 1.75	1630 . . . . . .55
1P23 . . . . . .44	10 . . . . . .19	374A W.E. . . . . 1.75	1632 . . . . . .22
2C33/RX233A . . . . . .88	10 Special . . . . . .19	388A W.E. . . . . 1.75	1680 . . . . . 1.00
2C43 . . . . . 12.75	10Y . . . . . .19	404A W.E. . . . . 12.50	5691 . . . . . 5.00
2C53/396A . . . . . 3.75	12AP7 . . . . . 9.45	407A W.E. . . . . 2.95	CK-5702 . . . . . 1.45
2E24 . . . . . 1.75	12AT6 . . . . . 2.9	408A W.E. . . . . 2.95	CK-5703 . . . . . 1.00
2J21 . . . . . 1.95	12CP7 . . . . . 9.45	416 W.E. . . . . 13.75	CK-5744 . . . . . .77
2J21A . . . . . 1.95	15R . . . . . 2.00	417A W.E. . . . . 2.45	CK-5784 . . . . . 2.25
2J22 . . . . . 1.75	T20 . . . . . 2.00	421A W.E. . . . . 2.45	5800 Victoreen . . . . . 3.50
2J26 . . . . . 4.75	T21 . . . . . 2.00	422A W.E. . . . . 3.75	5803 Victoreen . . . . . 1.75
2J32 . . . . . 9.95	T21 . . . . . 2.00	46A . . . . . 4.64	5825 . . . . . 5.50
2K28 . . . . . 20.00	23D4 . . . . . .44	CK507AX . . . . . .44	5933 . . . . . 7.50
2K31 . . . . . 77.00	30 Special . . . . . .22	575A . . . . . 19.45	5964 . . . . . .77
2K45 . . . . . 57.00	FG32 . . . . . 1.00	705A . . . . . 1.50	6035 . . . . . 10.00
2K56 . . . . . 55.00	RK34 . . . . . .29	713A . . . . . .41	6038 . . . . . 1.00
2X2/879 . . . . . .22	35Tion Gauge . . . . . 1.75	715B . . . . . 5.50	6045 . . . . . .77
3B7 . . . . . .35	39/44 . . . . . .22	717A . . . . . 5.50	6099 . . . . . .55
3BP1 . . . . . 2.75	T40 . . . . . 2.00	721A . . . . . 1.00	7133 . . . . . .77
3B24W . . . . . 9.45	HY40Z . . . . . 2.00	722A . . . . . .77	8002R . . . . . 25.00
3B29 . . . . . 7.75	RK49 . . . . . 3.95	730A . . . . . 12.50	8011 . . . . . .44
3B29 . . . . . 9.45	RK62 . . . . . 2.00	812A . . . . . 4.75	8012 . . . . . 1.95
4B28 . . . . . 3.75	VRE5 . . . . . .39	826 . . . . . .55	8025A . . . . . 3.45
4J25 . . . . . 99.50	RK72 . . . . . .77	826 . . . . . .55	8025A . . . . . 3.45
4X100A . . . . . 22.00	RK73 . . . . . .77	832 . . . . . 6.50	8025A . . . . . 3.45
5AP1 . . . . . 2.15	101 W.E. . . . . 4.95	832A . . . . . 7.75	9022 . . . . . .65
5B11 . . . . . 1.75	VU-1115 . . . . . .99	841 . . . . . 19.00	9003 . . . . . .99
5BP1 . . . . . 1.75	F-127A . . . . . 17.75	866A . . . . . 1.19	9006 . . . . . .24
5BP4 . . . . . 3.95	FG-172 . . . . . 17.50	880 . . . . . 233.00	3811A (Low capacitance 211 for crystal application) .55
5CP1 . . . . . 7.98	205B . . . . . .66	889R . . . . . 99.00	
5D21 . . . . . 207	211 . . . . . .49	891 . . . . . 99.50	
5FP7 . . . . . 1.75	212A . . . . . .45	921 . . . . . .39	
	215A W.E. . . . . 2.00	931A . . . . . .35	
	249B . . . . . 3.75	954 . . . . . .14	
	249C . . . . . 3.75	955 . . . . . \$ .24	
	250R . . . . . 4.75	CK-1006 . . . . . 1.25	
	311A W.E. . . . . 2.75	CK-1089 . . . . . .84	

## SELLING

## WILL BUY ALL

New or Used

- Receivers
- Transmitters
- Radar
- Special Purpose Tubes
- Relays
- Meters
- Switches
- Connectors
- Rectifiers
- Transformers
- Motors & Generators
- Wiring Cable
- Instruments and
- All Electronic Components

- Leach Relay #5059-R
- #5058
- #5055
- #5053-SM
- #5053

- Price Bros. Relay #10
- Relay #5586
- #5587

- Antenna Switching Relay
- Box # CBY 23049
- # BG-AN-198
- # BC -408

- Tubes #53A
- VT-127A
- 35T
- WL-530

Highest prices paid for most all types of aircraft sparkplugs any condition

Wholesale Only

**RADIO & ELECTRONIC SURPLUS**  
13933-9 BRUSH STREET  
Detroit 3, Mich. TO 9-3403

Wholesale Only

## RECONDITIONED SURPLUS

25-SCR-284 Field Transmitter-receivers  
25-BD-72 Field Telephone Switchboards  
Export packed with testing certificate

**RAYA TRADING COMPANY**  
33 West 42nd Street New York 36, N. Y.

## New Sola Const. Volt. Transformers

Input 95-125VAC. Output 118VAC 60 cycle 165VA. \$24.95, 225VA \$32.95, 310VA \$42.50, 500VA (115V out) \$47.50, Raytheon 120VA (115V out) \$19.95

## LAPIROW BROS.

1649 Hoffner St. Kirby 1285 Cincinnati 23, Ohio

# SPECIALISTS JAN, RUGGEDIZED TUBES SPECIAL PURPOSE

1B24	6.75	5J29	9.25	434A	9.00	5643	8.00	5840	5.50	1N34	.90
1B26	1.50	5J33	10.00	464A	6.00	5644	11.50	5851	6.00	1N34A	2.10
1B35	7.50	5R4WGY	3.75	471A	2.00	5645	7.00	5879	1.40	1N35	2.10
1B35A	7.50	CSB	4.25	532	3.25	5646	7.00	5881	2.95	1N38	1.75
1B42	7.00	6A3	.75	700A/B/C/D	7.50	5647	7.00	5902	8.00	1N3A	4.95
1B63A	35.00	6AQ5W	2.00	701A	2.00	5652	6.50	5910	.75	1N44	1.10

**SPECIAL**  
2K25 ..... 13.75

1P28	7.50	6ALS	1.10	713A	7.75	5656	11.00	5932	8.50	1N45	1.20
1P41	2.50	6A5E	1.75	CK716	17.50	5657	7.50	5937	33.50	1N48	.65
1Z2	2.75	6A5W	2.35	CK721	7.50	5658	1.00	5963	1.20	1N51	.50
2C33	1.95	6ASTG	3.25	CK722	4.40	5702	3.50	5964	1.35	1N52	1.30
2C39A	17.00	6D4	2.15	727A	1.25	5702WA	5.00	5987	4.00	1N54	.75
2C40	9.50	6F4	3.25	800	3.00	5703	5.00	5995	6.00	1N54A	1.45
2C43	15.00	6H4	4.00	832A	7.50	5703WA	5.25	6005	2.50	1N55	2.90
2C46	7.50	6L6WGA	8.50	837	90	5718	3.55	6021	5.00	1N55A	4.30
2C51	3.95	6Q24	400.00	865	.75	5719	3.55	6074	3.75	1N58	1.45
2C52	13.25	6LPT	3.50	H9053D	75.00	5720	3.50	6074	3.25	1N58A	1.80
2D23	.85	15R	.25	CK1090	6.00	5726	1.10	6080WA	5.00	1N60	.75
2D23W	2.00	24G	6.50	1620	4.20	5744	1.00	6082	3.25	1N63	1.80
2E30	17.30	25T	6.50	1636	2.50	5744WA	5.00	6095	1.25	1N64	.65
2J21	3.50	26A7GT	3.95	1654	4.00	5749	1.60	6095	1.50	1N65	.70
2J21A	3.50	FG27A	11.00	2050	1.00	5750	1.75	6098	1.90	1N69	2.40
2J22	3.75	28D7	4.50	5627	27.00	5751	2.00	6098	1.90	1N72	.85
2J26	5.75	FG32	8.50	5628	26.00	5763	1.10	6111	1.50	1N72	.85
2J37	11.00	35T	8.00	5629	21.00	5784	5.00	6110	11.00	1N75	2.50
2J40	25.00	35TG	4.50	5635	9.00	5784WA	7.50	6112	7.50	1N81	1.95
2J51	250.00	100R	15.00	5636	5.50	5787	5.00	6111	1.25	1N92	2.50
2J62	15.00	1F23A	6.25	5638	12.00	5814	1.75	6136	2.00	1N92	2.50
2K23	17.30	25T	6.50	5639	9.00	5814A	1.75	6146	4.65	1N110	1.05
2K28	25.00	215A	2.25	5641	7.50	5829	2.20	6201	3.75	1N111	2.40
2K33A	47.50	249C	7.00					6216	3.25	1N112	1.90
3B28	17.30	25T	6.50					1N21	1.50	1N113	2.30
3CP1(51)	2.00	305A	4.25					1N21A	1.80	1N114	1.80
3C24	.95	316A	.55					1N21B	1.90	1N115	1.55
3HP14	6.00	TR517	4.00					1N21C	1.90	1N115	1.55
4D22	20.50	412A	5.00					1N23B	1.75	2N34	10.00
4E27	13.00	416A	75.00								
5BP1	2.25	416B	75.00								

**SPECIAL**  
2K33A ..... 47.50

**SPECIAL**  
5651WA ..... 2.50

5932	8.50	1N45	1.20
5937	33.50	1N48	.65
5963	1.20	1N51	.50
5964	1.35	1N52	1.30
5987	4.00	1N54	.75
5995	6.00	1N54A	1.45
6005	2.50	1N55	2.90
6021	5.00	1N55A	4.30
6074	1.65	1N56A	1.10
6074	3.75	1N58	1.45
6080WA	5.00	1N58A	1.80
6082	3.25	1N63	1.80
6095	1.25	1N64	.65
6095	1.50	1N65	.70
6098	1.90	1N69	2.40
6098	1.90	1N72	.85
6111	1.50	1N72	.85
6110	11.00	1N75	2.50
6111	7.50	1N81	1.95
6112	7.50	1N91	1.50
6113	1.25	1N92	2.50
6136	2.00	1N92	2.50
6146	4.65	1N110	1.05
6201	3.75	1N111	2.40
6216	3.25	1N112	1.90
1N21	1.50	1N113	2.30
1N21A	1.80	1N114	1.80
1N21B	1.90	1N115	1.55
1N21C	1.90	1N115	1.55
1N23B	1.75	2N34	10.00

### JAN CAPACITORS

CV11A070 variable ceramic 1.5-7	.25	CP70E1EF605V 6MFD 600	1.00
CV11A120 variable ceramic 3.5-12	.25	CP70E1EF805V 8MFD 600	1.10
CV11A250 variable ceramic 4.5-25	.25	WVDC	
CV11B130 variable ceramic 3-13	.25	CP70E1EF105V 10MFD 600	1.25
CV11B200 variable ceramic 5-20	.25	WVDC	
CV11D060 variable ceramic 6-20	.25	CP70E1EG105V 1MFD 1000	1.10
CV11D300 variable ceramic 4-30	.25	WVDC	
CV11D450 variable ceramic 7-45	.25	CP70E1EG405V 4MFD 1000	1.25
CP5B1E1B405V .4MFD 100 WVDC	.30	WVDC	
CP5B1E1B405V .25MFD .25MFD	.40	CP70E1EG605V 6MFD 1000	1.50
600 WVDC		WVDC	
CP5E1EF105V 1MFD-600	.30	CP70E1EF205V 2MFD 600V	.50
WVDC		CP70E1E1104V 1MFD 1000	1.00
CP5B5F5F504V 5.5-.5MFD 600	.30	WVDC	
WVDC		CP70E1E1504V .5MFD-2000	1.10
CP5781EG503V .05MFD 1000	.35	WVDC	
WVDC		CP70E1E1105J 1MFD 2000	1.25
CP6B85F503V .05MFD .05MFD	.35	WVDC	
600 WVDC		CM70B222J 2200MFD 5000	.30
CP26A1EF504M .5MFD 600	.20	WVDC	
WVDC		CM70B472J 4700MFD 3000	.30
CP26A1EG104M 1MFD 1000	.20	WVDC	
WVDC		CM20A202M 2000MFD 200	.15
CP26A1EG254M .25MFD 1000	.20	WVDC	
WVDC		CM20A602M 6000MFD 200	.15
CP26A1EH104M 1MFD-1500	.20	WVDC	
WVDC		CM20E101M 10,000MFD 120	
CP6781EG203V .02-1000 WVDC	.20		

WVDC		CM3E302M 3000MFD 800	.15
WVDC		WVDC	
CM20B390J 39MFD 500 WVDC	.07	WVDC	
CM42E503M 50,000MFD 400	.20	100,000 Ohms 1% 1/4W Precision	.19
WVDC		Resistors	
12,500 Ohms 1% 1/4W Precision	.19	Resistors	

### FACTORY STOCK— BRAND NEW ELECTROLYTIC CONDENSERS—

8MFD 450VWVDC	.27
16MFD 450VWVDC	.38
20-20MFD 150VWVDC	.25
30-20MFD 150VWVDC	.38
40-40MFD 150VWVDC	.38
50-30MFD 150VWVDC	.38
50-50MFD 150VWVDC	.38
40-40-20MFD 150VWVDC	.48
50-30-20MFD 150VWVDC	.48
40-40-20MFD 150, 150, 25VWVDC	.53
50-50-20MFD 150, 150, 25VWVDC	.58

INQUIRIES INVITED FROM EXPORTERS AND FOREIGN AGENCIES. SPECIAL QUANTITY PRICES. WE ARE INTERESTED IN BUYING YOUR SURPLUS.

## HANOVER ELECTRONICS

125 CEDAR ST. NEW YORK 6, N. Y.  
RECTOR 2-1296

### GLASS TUBING

PYREX - NONEX - URANIUM  
BULB & CYLINDERS  
WRITE FOR FREE MONTHLY LIST  
HOUE SUPPLY COMPANY  
PHONE KEYPORT 7-1286  
M. R. #1 Box 86X Keyport, N. J.

### FOR SALE INDUSTRIAL TELEVISION CAMERA

DAGE MODEL 100-B  
DEMONSTRATOR—WITH ACCESSORIES  
New Condition—Reasonably Priced  
WILLE ELECTRONICS CO.  
3435 N. 47 St. Milwaukee 16, Wisc.

# K-RK-ARC-UG-PL-AN

## CONNECTORS

In Stock for Immediate Delivery

### Connector Corporation

OF AMERICA

137 Hamilton St., New Haven 11, Conn. Phone: Spruce 7-2513  
New York Phone: LExington 2-6254

### FOR SALE Slightly Used Recording Equipment 25% off

Fairchild, Collins, McIntosh, Wurlitzer. Racks, mikes, Speakers, Amplifiers, mike booms, stands, folding chairs, electric organ, furniture, cords, patch panels, disc recorders, Tape recorder, 1/2 off. Test equipment. List on request.

FS-4472, Electronics  
68 Post St., San Francisco 4, Calif.

## WANTED

### WILL BUY ALL

Art-13 T-47A Transmitters BC-348 Rec'r modified \$200.00  
Art-13 T-47 Transmitters BC-348 Rec'r unmodified \$150.00  
BC-788C Altimeters \$100. ARC-1 Radio complete \$150.00  
R5/ARN7 Radio Compass \$125. BC-312 Receiver \$40.00  
ARC-3 Complete \$185.00 BC-342 Receiver \$50.00  
Ship via Express C.O.D.. Subject to Inspection to:  
H. FINNEGAN  
49 Washington Ave. Little Ferry, N. J.

### WANTED VIBRATION MACHINE

Late model L.A.B. Type. RVH 30-300 or equal.  
Box E 1147  
221 W 41 St., New York 36, N. Y.

### WANTED

Type R19/TRC-1 Receivers.  
W-3652, Electronics  
330 W. 42 St., New York 36, N. Y.

### WANTED ENVIRONMENTAL TEST CHAMBER

late model, capable of testing electronic components in accordance with Mil-T Specifications. Box E 1148, 221 W. 41 St., N. Y. 36, N. Y.

### SURPLUS TUBES WANTED

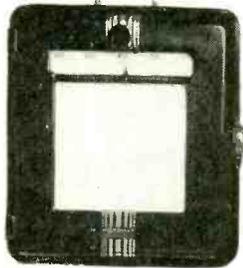
New or used types 862-898-893-892 must be tested prior sale. Prices and quantity to  
XEN P. O. Box 25979 Mexico City 12

### "SEARCHLIGHT" IS Opportunity Advertising

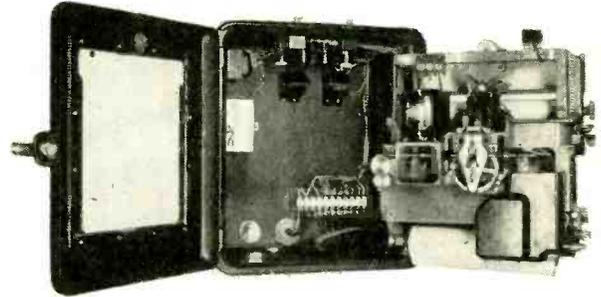
—to help you get what you want.  
—to help you sell what you no longer need.

Take Advantage Of It  
For Every Business Want  
"Think SEARCHLIGHT FIRST"

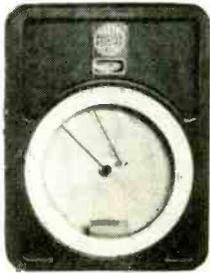
# SURPLUS—SAVE! SAVE! MICROMAX RECORDERS



For fast and sensitive recording or controlling one or more points throughout a wide variety of processes. Used originally for temp. ranges of 350-550 Degrees cent. but may be changed for other applications by suitable control units. Control units not incl. with instrument. Used but guaranteed to satisfy or money back.



Price - - \$89.50



**BAILEY METER RECORDER**, as pictured, used and guaranteed . . . . . **\$65.00**

All mdse. guaranteed to satisfy or money back if returned prepaid.

## ESSE RADIO COMPANY

42 W. South Street

Indianapolis 25, Ind.

### WESTERN ELECTRIC STEPPER

44 Step, 2 Levels, Bridging Wipers, Gold Plated Contacts, Oper. Voltage 5.5 to 12 V.D.C. 4.4 Ohms. Inter. Contact 1 Break-Make. Price One to 10 Pieces \$12.00 Each. Brand New. Quan. Discounts.

**X  
B  
A  
N  
D**

**MITRED BAND.** Vy Short Radius. E plane. \$10.00  
**TRANSITION.** 1"x1/2" to 1 1/4"x5/8" Luth 3/4". \$6.50.  
**WAVE GUIDE.** R652V, 1"x1 1/2". Per Ft. Length. \$10.00.  
**BEND 90 DEGREE.** E or H plane. Std. radius. UG39evr to UG40 chk. \$10.50.  
**TWIST 90 DEGREE.** UG39 to UG40. Silver plated. \$6.50.

type Xtal. 1" x 3/4" guide std coax output. UG40 fig. input. \$15.00.

**DIRECTIONAL COUPLER.** Uni. or Bi directional types 20db. coax "N" output. UG39 fig. to UG40 chk. \$24.50.

**FLEX SECT. #7.** UG39 figs. \$10.00. 12" at \$17.50.

**TR-ATR SECTION.** Duplexer assy w/UG-39 to UG40 run, iris cpig. cpig. to 1B24 type TR tube. ATR cavity 724 type compl. w/tuning slugs. \$8.50.

**ROTARY JOINT.** 3 types available, miniature 180 deg. input output, miniature 90 deg. input output, large 90 deg. input output 360 deg. rotary coupling for lab or high speed scanner VSWR 1.2 or better, \$15.00.

**LINE STRETCHER.** VSWR matching device for XMSN Lines. \$34.50.

**S  
B  
A  
N  
D**

**GUIDED MISSILE F-28/APN-19 FILTER CAVITY.** 2700-2900mc. Max. 1.5-db loss at cir. freq. over band, 3db at 15 mc band ends. JAN spec. Ideal as standard reference cavity. Brand new. Guaranteed. \$25.00.

**COAXIAL CRYSTAL MOUNT.** Type N fittings, tuneable silver plated. Holds any IN21 type Xtal. \$9.50.

**LIGHTHOUSE CAVITY.** For 2C40 tube. Tuneable 2700-2900mc w/suitable grid cys. Can be freq. modulated. \$22.50.

**FEEDBACK DIPOLE.** 7/8" coax. 1 1/4" o.a. \$14.50.  
**ECHO BOX.** TS-207/U17, 2700-2900mc. \$64.50.

**K  
B  
A  
N  
D**

**MAGIC TEE,** precision milled. . . \$45.00

**DIRECTIONAL COUPLER** bi-dir. UG-113 U flanges, \$45.00

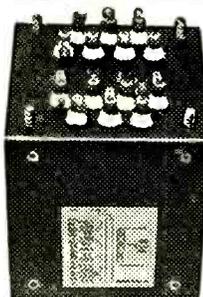
**KLYSTRON OUTPUT COUPLING** for 2K50, RG 66/U guide, \$12.50.  
**H BEND** 90 deg. CG346/U.

**E BEND** 90 deg. CG345/U. Cpig. UG-117 to UG-116. RG66 guide. \$25.00 each.  
**ADAPTERS** 1 1/2" lk UG116 to UG116. UG117 to UG117 ea. . . . . \$10.00

**RADIO-RESEARCH INSTRUMENT Co.**  
550 - 5 Ave., N. Y. 36, N. Y. Tel: JU 6-4691  
PAUL J. PLYSHNER

## HERSHEL RADIO CO. BIGGEST BUYS!

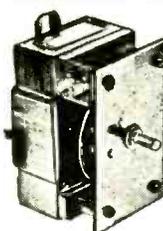
### ALL PURPOSE FILAMENT TRANSFORMER



\$4.95

Pri. 117 VAC  
60 cy. Sec.  
#1 6.4V 12  
Amp. #2 6.4  
V 10 Amp.  
#3 5.0V 5  
Amp. #4 5.0  
V 3 Amp. #5  
6.25V 1.75  
Amp. Size e  
5 - 9 / 1 6"x  
5 - 1 / 1 6" x  
5 1/4" H.

### VARIABLE TRANSFORMER



\$4.95

Pri. 115VAC.  
4 Amp. 50-60  
cy. Sec. 30  
to 135V. 25  
Amp. Used  
with Dicta-  
phone Re-  
producer  
MFD. U.T.C.

- A—TELEPHONE SW. BOARD LITE TYPE 55C. 55V. G.E. . . . . 15c
- B—ARGON GLOW-LAMP 2 1/2 WATT 105-125V. MED. BASE. . . . . 35c
- C—CE. PHOTO ELECTRIC CELL USED IN AMPRO PROJ. . . . . \$1.29
- D—BC614E SPEECH-AMP. . . . . \$49.50

**HERSHEL RADIO CO.**  
5245 Grand River Ave.  
DETROIT 8, MICHIGAN

### RCA OUTPUT TRANS.



\$1.95

PP6LG's  
25 Watt  
#1 1.5,000  
Ohm Sec.  
#1 500  
Ohm #2  
600 Ohm  
Side tone  
15 to 15.  
0 0 0 cy  
Flat.

### PLATE TRANS.



Only \$9.95

Pri. 90 VAC 60 cy 3  
Amp. Sec. 640 V. 1  
Amp 6 1/2 x 5 1/2 x 6 1/4  
H.

### VACUUM SWITCH



Magnetic Type \$1.95

15000 V Con-  
tacts 30 Amp  
Operates with  
DC Coil Spdt

### WILLARD BATTERY



\$265  
2 Volt Wet  
20 AMH

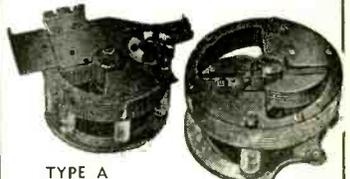
### POWERSTAT



15 AMP  
\$29.95

Pri. 115 V  
90 cy Sec. 0-  
125 V-2KVVA  
15 A m p.  
Brand New.

### BUTTERFLY COND.



TYPE A  
106 to 330  
MC Can  
Use 9 5 5  
Type Tube

TYPE B  
135 to 485  
MC Silver  
Plated



TYPE C  
300 to 1000  
MC can use  
368AS tube.  
Silver Plated

YOUR CHOICE

\$4.95



TYPE D  
300 to 1000  
MC has a  
clip for  
Xtal De-  
tector

# TIME ELECTRONIC SALES IS THE MOST COMPLETE SOURCE OF CONNECTORS IN THE COUNTRY

The Following UG Connectors are in STOCK—by the Country's Leading Manufacturers at These LOW, LOW Prices!

UG 7/AP.....\$5.95	UG 83/U.....\$1.35	UG 201A/U.....\$1.95	UG 291B/U.....\$1.25	MX 564A/U.....\$0.95
UG 8/A.....2.10	UG 84/U.....1.25	UG 202/U.....2.95	UG 294/U.....1.50	UG 564/U.....1.75
UG 9/U.....1.05	UG 85/U.....1.85	UG 203/U......75	UG 299/U.....5.25	UG 565/U.....2.20
UG 10/U.....1.70	UG 87/U.....1.15	UG 204A/U.....2.40	UG 306/U.....1.75	UG 566/U.....4.75
UG 11/U.....2.05	UG 88/U.....1.40	UG 205/U.....1.75	UG 310/U.....2.75	UG 567/U.....3.60
UG 12/U.....1.10	UG 88B/U......90	UG 207/U.....19.50	UG 318/U.....2.75	UG 568/U.....1.60
UG 13/U.....2.05	UG 88C/U.....1.00	UG 208/U.....19.50	UG 323/U.....3.95	UG 569/U.....3.60
UG 14/U.....1.50	UG 89/U.....1.90	UG 212A/U.....2.35	UG 323A/U.....3.50	UG 570/U.....1.75
UG 15/U......75	UG 89A/U.....1.25	UG 212B/U.....3.75	UG 334/U.....7.50	UG 571/U.....1.75
UG 16/U.....2.10	UG 90/U.....1.10	UG 213A/U.....3.25	UG 334A/U.....7.00	UG 572/U.....2.00
UG 17/U.....1.50	UG 91/U.....1.40	UG 215/U.....3.85	UG 335/U.....2.70	UG 573/U.....2.20
UG 18A/U.....1.60	UG 91A/U.....1.10	UG 216/U.....9.50	UG 347/U.....1.95	UG 574/U.....2.50
UG 18B/U.....1.00	UG 92/U.....1.30	UG 217/U.....4.75	UG 348/U.....1.75	UG 575/U.....2.00
UG 19A/U.....1.40	UG 92A/U.....1.55	UG 218/U.....5.50	UG 349A/U.....2.25	UG 580/U.....4.60
UG 19B/U.....1.50	UG 93/U.....1.40	UG 219/U.....4.95	UG 350/U.....21.00	UG 593/U.....1.65
UG 20A/U.....1.85	UG 93A/U.....1.20	UG 220/U.....25.00	UG 352A/U.....4.50	UG 603/U.....2.00
UG 20B/U.....1.00	UG 94/U.....1.40	UG 222/U.....2.35	UG 352A/U.....4.50	UG 603/U.....2.00
UG 21A/U.....1.20	UG 95/U.....1.20	UG 224/U.....1.20	UG 381/U.....1.65	UG 604/U.....1.00
UG 21B/U......85	UG 95A/U.....1.00	UG 231/U.....2.15	UG 387/U.....2.25	UG 625A/U......90
UG 21C/U.....1.00	UG 96/U.....1.75	UG 232/U.....14.50	UG 400/U.....21.00	UG 625A/U......90
UG 22A/U.....1.35	UG 96A/U.....1.10	UG 233A/U.....26.50	UG 402/U.....21.00	UG 625U.....2.95
UG 22B/U.....1.20	UG 97/U.....2.25	UG 234/U.....14.50	MT 412.....26.00	UG 627/U.....3.50
UG 22C/U.....1.00	UG 98/U.....1.00	UG 235/U.....28.00	UG 413/U.....26.00	UG 628/U.....2.60
UG 23A/U.....1.10	UG 100/U.....1.25	UG 237/U.....17.00	UG 414/U.....1.30	UG 629/U.....2.60
UG 23B/U.....1.40	UG 100A/U.....2.85	UG 240/U.....10.50	UG 419/U.....1.30	UG 631/U.....3.50
UG 23C/U.....1.00	UG 100B/U.....2.50	UG 241/U.....9.00	UG 421/U.....2.25	UG 632/U.....3.55
UG 23D/U.....1.00	UG 101A/U.....3.50	UG 242/U.....2.85	UG 422/U.....2.65	UG 633/U.....2.70
UG 23E/U.....1.10	UG 107A/U.....2.95	UG 243/U.....3.25	UG 423/U.....5.00	UG 634/U.....3.65
UG 23F/U.....1.40	UG 107B/U.....2.50	UG 244/U.....2.95	UG 424/U.....2.25	UG 635/U.....3.65
UG 23G/U.....1.00	UG 108A/U.....2.50	UG 245/U.....2.50	UG 446/U......75	UG 638/U.....3.75
UG 23H/U.....1.10	UG 108A/U.....2.00	UG 246/U.....2.25	UG 447/U......85	UG 637/U.....4.85
UG 23I/U.....1.00	UG 109/U.....10.25	UG 247/U.....1.80	UG 448A/U.....26.00	UG 637/U.....3.95
UG 23J/U.....1.00	UG 114/U.....1.65	UG 250/U.....14.50	UG 482/U.....26.00	UG 642/U.....3.95
UG 23K/U.....1.75	UG 115/U.....6.55	UG 251/U.....14.50	UG 483/U.....2.40	UG 646/U......33
UG 23L/U.....2.10	UG 117/U.....1.80	UG 252/U.....4.95	UG 484A/U.....4.75	UG 657/U......95
UG 23M/U.....2.10	CW 123A/U......30	UG 253A/U.....5.20	UG 486/U.....1.80	UG 692/U......75
UG 23N/U.....2.10	UG 131/U.....3.95	UG 254A/U.....2.10	UG 487/U.....1.80	UG 693/U......75
UG 23O/U.....2.40	UG 146/U.....6.55	UG 255/U.....1.80	UG 488A/U.....4.75	UG 702/U......75
UG 23P/U.....1.10	UG 148A/U.....5.50	UG 256/U.....12.25	UG 491/U.....2.10	UG 698/U......75
UG 23Q/U.....1.10	UG 149A/U.....3.95	UG 257/U.....12.25	UG 492/U.....2.50	UG 699/U......90
UG 23R/U.....1.30	UG 150/U.....4.95	UG 259A/U.....4.75	UG 493A/U.....2.50	UG 704/U.....9.50
UG 23S/U.....1.80	CW 155A/U......40	UG 260A/U......95	UG 494/U.....3.35	UG 702/U.....5.75
UG 23T/U.....2.50	UG 155/U.....5.75	UG 260B/U.....1.00	UG 495/U.....5.75	UG 703/U.....5.75
UG 23U/U.....18.00	UG 156/U.....4.85	UG 261A/U......85	UG 496/U.....1.30	UG 704/U.....4.95
UG 23V/U.....20.00	UG 157/U.....4.65	UG 261B/U.....1.25	UG 497/U.....13.00	UG 706/U.....3.10
UG 23W/U.....9.50	UG 158/U.....39.00	UG 262A/U......90	UG 498/U.....1.85	UG 707/U.....4.95
UG 23X/U.....16.00	UG 159A/U.....1.70	UG 262B/U.....1.95	MX 504......50	UG 708/U.....6.95
UG 23Y/U.....36.00	UG 160A/U.....1.25	UG 263/U.....10.00	UG 504/U.....26.00	UG 709/U.....2.95
UG 23Z/U.....13.00	UG 160B/U.....1.25	UG 264/U.....10.00	UG 505/U.....26.00	UG 711/U.....7.50
UG 24A/U.....1.50	UG 166/U.....39.00	UG 266/U.....1.00	UG 506/U.....28.00	UG 909/U.....1.60
UG 24B/U.....2.10	UG 167/U.....3.00	UG 268/U.....5.00	UG 507/U.....26.00	UG 910/U.....1.50
UG 24C/U.....1.50	UG 168A/U.....1.30	UG 269/U.....16.00	UG 516A/U.....21.00	MX 913/U.....2.95
UG 24D/U.....1.50	UG 168B/U.....1.30	UG 270/U.....7.10	UG 519/U.....21.00	UG 913/U.....2.95
UG 24E/U.....1.50	UG 173/U.....2.25	UG 271/U.....7.10	UG 528/U.....2.85	UG 914/U.....1.25
UG 24F/U.....1.50	UG 174/U.....14.00	UG 272/U.....16.00	UG 530/U.....3.35	UG 923/U.....2.30
UG 24G/U......65	UG 175/U......10	UG 273/U.....1.10	UG 531/U.....3.95	UG 928/U.....1.95
UG 24H/U......70	UG 176/U......10	UG 274/U.....2.25	UG 532/U.....4.90	UG 931/U.....2.40
UG 24I/U.....1.60	UG 180A/U.....5.25	UG 275A/U.....4.65	MX 539/U.....3.95	UG 932/U.....2.40
UG 24J/U.....1.70	UG 181A/U.....5.25	UG 275/U.....4.95	UG 535/U.....1.75	UG 935A/U.....1.75
UG 24K/U.....2.30	UG 182A/U.....5.65	UG 276/U.....4.95	UG 536/U.....1.45	UG 940A/U.....2.10
UG 24L/U.....1.75	UG 183/U......75	UG 277A/U.....4.65	MX 543/U......60	UG 941/U.....2.35
UG 24M/U.....1.50	UG 184/U.....1.05	UG 278/U.....3.60	UG 541/U.....3.75	UG 941A/U.....1.85
UG 24N/U.....2.75	UG 185/U.....16.00	UG 287/U.....5.75	MX 543/U......60	UG 982/U.....3.50
UG 24O/U.....1.75	MX 195/U.....52.00	UG 290/U.....7.00	MX 584/U......60	UG 983A/U.....6.00
UG 24P/U.....2.00	UG 197/U.....3.70	UG 291/U.....1.00	UG 557/U.....3.95	
UG 24Q/U.....2.50	UG 201/U.....1.50	UG 291B/U.....1.25	UG 560/U.....2.45	
UG 24R/U.....22.00	UG 201U.....1.50	UG 291A/U.....1.85	MX 564/U......50	

AN CONNECTORS 50 TO 80% OFF LIST. INQUIRIES INVITED

## Time Electronic Sales

368 BROADWAY NEW YORK 13, NEW YORK BArlay 7-3922

## We Have A Large Stock Of Electronic Parts

Such as tubes, relays, resistors, meters, condensers, switches, transformers, chokes, hardware, plugs, pots, large & small motors, dynamometers, micas, headphones and other units.

### WE BUY AND TRADE SURPLUS

Write, Phone or Wire—Send us your bids

## DOW RADIO

2011 - Lincoln Avenue - Pasadena - 3 - Calif.

Sycamore 4-1186

Los Angeles Phone RYan 1-7282

## AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications radar, and laboratory electronics of all kinds. Kelaket alpha scalars and chambers, dosimeters and other nucleonics now in stock. Quality standards maintained.

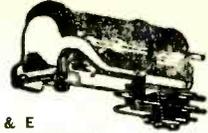
NEW TS-13/AP X-BAND SIGNAL GENERATORS with manual \$575.00; TS-175/U Frequency Meter 85-1,000 Mc. \$485.00; H-P, Boonton, G-R, Measurements, many others in stock.

## ENGINEERING ASSOCIATES

434 PATTERSON ROAD

DAYTON 9, OHIO

## TELEPHONE RELAYS



Large Stock of CLARE, TYPES C D & E COOKE, AUTOMATIC—ELECTRIC

ALL TYPES OF COILS and PILE-UPS Send Us Your Specs. for Our Quote

### CLARE TYPE C HALF SIZE SENSITIVE TELEPHONE RELAYS

Coil	Contacts	Operates at	Price
1) 6500 ohms	2A	5 MA	\$2.50 ea.
2) 5800 ohms	3A	4 MA	2.50 ea.
3) 5800 ohms	2B-1C	5 MA	2.50 ea.
4) 4850 ohms	1C	4 MA	2.50 ea.
4) 3600 ohms	1C	6 MA	2.00 ea.
5) 4850 ohms	1A	5 MA	2.00 ea.
6) 3300 ohms	(None)	ACTUATOR	1.50 ea.
7) 3300 ohms	1A	Micro-Switch	2.50 ea.

All above Relays may be used for continuous duty operation on 110V. D.C.

### OTHER TYPE G TELEPHONE RELAYS

1) 1300 ohms	1A-1C	24 or 48V	\$2.50 ea.
2) 400 ohms	1A	24V	1.65 ea.
3) 500 ohms	1D	24V	1.50 ea.
4) 200 ohms	1A	24V	1.50 ea.

### CLARE TYPE C STANDARD SIZE D.C. TELEPHONE RELAYS

Coil	Contacts	Operates at	Price
1) 1300 ohm	1B	24 to 85V	\$2.25 ea.
2) 1300 ohm	2A-1B	24 to 85V	2.75 ea.
3) 1300 ohm	2C-1A	24 to 85V	4.00 ea.
4) 1300 ohm	4C-2A	30 to 85V	3.00 ea.
5) 1300 ohm	2A-1B-1C-1D	30 to 85V	3.00 ea.
6) 1300 ohm	6C	30 to 85V	4.50 ea.
7) 2500 ohm	1A	24 to 110V	2.25 ea.
8) 2000 ohm	2C-1A	24 to 110V	3.00 ea.
9) 2000 ohm	4C-2A	30 to 110V	4.50 ea.
10) 2000 ohm	6C	36 to 110V	3.50 ea.
11) 2000 ohm	8A	24 to 150V	4.95 ea.
12) 3000 ohm	3A	24 to 150V	2.75 ea.
13) 3600 ohm	2C-1A	24 to 150V	3.00 ea.
14) 110V. AC	2C-1A	110V. AC 60cy	3.50 ea.

### CONTACT SYMBOLS

A=Norm. Open B=Norm. Closed C=S.P.D.T. D=Make Before Break

Allied Type LKX-58 Tel. Relay. Coil-5,000 ohm contacts—3A Operates at 6 MA. Price—\$2.50 ea.

Signal Wheelock Relays #KS9665 Coil—2,000 ohms Contacts-1A, 1B, 1C Oper. at 3 MA. Price—\$2.75  
GM #13017 Relays, 24 volts 150 ohm, Contacts-3PDT 10 AMP. Price—\$2.00 ea.  
MINIATURE TEL. RELAY, 300 ohm, 24 volt SPDT #13017 Relays, 24 volts 150 ohm, Contacts-3PDT 10 AMP. Price—\$2.00 ea.  
FIVE Prong CR-2791 G.E. Plug In Relays, 1) C-103C25 2200 ohms SPDT 4.5 MA. Price—\$4.00 ea.  
2) C-104B28 700 ohms SPDT 6 MA. Price—\$3.00 ea.

Bulletin #700 Allen Bradley Contacts 110V AC 60 cy. D.P.S.T. N.O. 25 Amps. Price—\$7.50 ea.

### ALLIED BJD36 MINIATURE RELAYS

1) 24V.	250 ohms	DPDT	\$1.25 ea.
2) 24V.	100 ohms	DPST NO	1.00 ea.

Clare SK-5032 (Herm. Sealed) Plug-In Relays, Coil—30 ohms 6 volts Contacts—DPDT. Price \$4.00 ea.

SIGMA TYPE 5F SENSITIVE RELAYS. Has two 70 ohm coils. Contacts—SPDT. Price—\$3.00 ea.

Leach Relays Type 1025-SN-BF. Coil—24V. 425 ohms. Contacts—D.P.S.T. Norm. closed. Rated at 10 Amps. Price—\$1.25 ea.

STROM. CARL. TEL. RELAY Coil—100 ohm 6 Volts. Contacts—1A. Price—\$1.35 ea.

## Chase

Electronic Supply Co. 105-07 225 St. Queens Village, N. Y. HOLLIS 4-5033

### FOR SALE

HEADSETS, IIS-30/U  
REMOTE CONTROL UNITS, RM-29  
ANTENNA EQUIPMENT, RC-173  
DYNAMOTORS, DY-12  
DYNAMOTORS, DM-32A  
DYNAMOTORS, DM-36  
DYNAMOTORS, PE-86

VICTOR-BERNARD INDUSTRIES, INC.

1511 N. 26th St., Phila. 21, Pa.

## TIME DELAY

Haydon relay 115v 60 cy adjustable in 5 sec. steps to .40 seconds max. 3/2x3/2x2 1/2 \$4.50

## 4PDT RELAY

Midget 12 vdc 700. \$1.65. 425Ω 24vdc \$2.50  
PRC 5724-1 HSK-Herm. Seal. \$3.95  
SPDT 6 vdc 35Ω cer. insul. Dunco 181xAx100 1.25  
115 vac 60 cy SPDT P. & B. #MR5A 1.95  
ERIE #557 silver trimmer 3-12 NPO \$150./K

Transistor or 5 pin submini socket \$75./K  
All material is from excess inventories & is new and guaranteed. Write for Bulletin

## EMPIRE ELECTRONICS CO.

409T Ave. L Brooklyn 30, N. Y. CL 2-4000

**SPECIAL**  
723A/B... 11.00  
BRAND NEW!

# EMELTONE ELECTRONICS CO.

71 W. Broadway - N. Y. 7, N. Y. Phone REctor 2-1696

**SPECIAL**  
726A... 9.50  
each

## Crystal Diodes

### Standard Brands Only

1N21	\$.65	5BP1	2.75
1N21B	1.80	5CP1	5.50
1N21C	14.20	5FP7	1.75
1N22	.99	5LP1	20.00
1N23	1.10	5MP1	8.95
1N23A	1.75	7BP7	3.95
1N23B	1.85		
1N25	5.25	OA2	1.00
1N26	8.50	OA3	1.10
1N27	1.50	OB2	.80
1N28	5.00	OB3	.80
1N34	1.75	OC/VR-150	.80
1N34A	.75		
1N35	2.10	1B21A	2.50
1N38	1.25	1B22	1.15
1N38A	.95	1B23	3.95
1N40	12.25	1B24	6.75
1N41	12.25	1B26	3.50
1N42	21.00	1B27	13.00
1N43	1.80	1B35	6.50
1N44	1.20	1B36	7.95
1N46	1.00	1B42	9.00
1N51	.55	1B63A	30.00
1N52	1.45	C1B	3.00
1N54	.95	1P21	35.00
1N55	2.75	1P28	10.00
1N56	1.00	1Z2	2.25
1N57	.20	2C26A	.60
1N58	1.35	2C32A	14.50
1N58A	1.70	2C40	8.50
		2C43	16.00
		2C46	30.00
		2C51	4.50
		2D21	1.05
		2E24	2.50
		2J21A	10.00
		2J22	10.00
2AP1	8.00		
3AP1	8.00		
3BP1	3.00		
3CP1-S1	2.00		
3DP1-S2	5.95		
3GP1	1.99		

## SPECIAL PURPOSE TUBES

2J26	12.00	4E27	13.00
2J27	20.00	4J42	65.00
2J31	30.00	5C22	34.50
2J32	26.00	5D21	14.00
2J33	35.00	5J26	125.00
3J34	35.00	5R4GY	1.50
2J36	70.00	6A35	1.50
2J37	15.00	6AK5W	1.70
2J38	24.00	6AK5	.55
2J39	12.00	6AR6	2.00
2J40	38.00	6AS6	1.95
2J48	45.00	6AS7G	3.50
2J49	68.00	6C61	6.50
2J55	45.00	6C21	18.00
2K22	15.00	10Y	.80
2K23	10.00	12A6	.49
2K25	19.95	12AY7	1.25
2K28	34.00	15E	1.50
2K33A	48.00	15R	.95
2K41	110.00	15S	2.25
2K54	35.00	15T	2.25
2K55	35.00	15U	2.25
2X2	.35	15V	2.25
3B22	3.50	15W	2.25
3B24	5.00	15X	2.25
3B25	5.50	15Y	2.25
3B26	6.60	15Z	2.25
3B28	4.50	249B	8.75
3C24	1.35	249C	6.00
3C45	12.00	OK250	110.00
3E29	12.00	250R	8.00
4B24	5.00	250T1	15.00
4B25	8.00	252A	18.00
4B25	10.00	304TH	7.50
4B28	6.00	304TL	7.50
4C27	38.00	307A	1.50
4C35	19.00	316A	1.50

## Receiving Tubes

### Klystrons, Magnetrons

800	8.00	814	3.25	5517	.90
801	8.00	815	3.95	5636	5.00
806	6.00	816	1.25	5651	2.50
807	6.50	826	.99	5654	1.75
808	.85	828	12.00	5670	3.50
809	.85	829B	11.00	5687	3.99
810	3.00	830B	2.75	5703	1.90
811	8.50	832	6.00	5879	1.85
812	4.00	832A	8.50	5881	3.00
813	12.00	834	13.00	5898	9.00
814	9.00	836	2.95	5901	8.00
815	1.25	837	1.45	5904	7.00
816	18.00	838	3.95	5905	13.50
817	3.00	845	10.00	6095	3.95
818	1.00	851	45.00	6098	5.50
819	14.00	852	19.00	6099	2.00
820	35.00	860	2.95	6101	2.00
821	5.00	869B	35.00	8013A	4.00
822	7.50	872A	2.25	8020	2.00
823	25.00	884	1.00	8025	3.95
824	.99	885	1.75	9001	1.20
825	28.00	931A	6.00	9002	.65
826	3.25	954	.45	9003	1.30
827	14.00	955	.65	9004	.80
828	1.50	956	.55	9005	1.90
829	1.25	957	.40	9006	.40
830	7.50	958A	.75		
831	9.50	1616	1.10		
832	3.25	1619	.40		
833	3.50	1624	1.75		
834	1.65	1625	.29		
835	1.25	1626	.25		
836	3.50	1641	2.25		
837	11.50	1655	1.25		
838	2.99	1665	1.25		
839	3.50	2050	1.25		
840	11.00	2051	.90		

Prices Subject To Change All Items Subject To Prior Sale Write, Wire Or Phone Cash Paid For Your Surplus Tubes—Send List And Prices

Above listing is only partial. Inquire if your items are not listed.  
**ATT. EXPORTERS & FOREIGN AGENCIES**  
Special prices for quantities. We ship all over the world.

**Harjo** Brings you What you need at **LOWEST PRICES!**

**COLLINS AUTOTUNE ASSEMBLY**  
with 110V., 60 cy. AC motor. Tunes automatically to any of 10 preset positions. For tuning xmters., instrument devices, etc. Orig. govt. cost \$300. Brand new. Shipping wt. approx. 5-lbs. **\$39.50**

**TEST EQUIPMENT**

TS-11	\$45.00	1E-19	\$200.00
TS-13	650.00	1-222	89.50
TS-34	250.00	1-139A	12.50
TS-47/APR	200.00	1-183A Freq.	
TS-89	32.50	Meter	22.50
TS-100	85.00	1-185A Oscilla-	
TS-101	7.50	for Sig. Gen.	24.50
TS-126	75.00	LZ	7.50
TS-131	14.95	(S-band)	15.00
TS-184	45.00	LM	85.00
TS-268	37.50	BC-221 Meter	89.50

**RCA Surplus TV CAMERA**  
Only **\$225**

Comes with 1846 Iconoscope and 6-stage video amplifier and clipper. Only a few left—so hurry, FB for movie pickup chains, training and experimental work. Send for complete information on this wonderful bargain buy!

**OIL CAPACITOR**  
Model No. 1313852  
120 MFD @ 3000 V. Made for DC welding service and many other uses. Contains 1.7 gallons of non-flammable liquid. Brand new. \$175 value! **\$69.50**

TS-45... a real bargain!... \$125  
PANORAMIC ADAPTER... \$9.50

**Top \$\$ paid for your equipment!**  
We'll pay top dollar for electronic equipment and component parts. Send complete list condition and asking price. Prompt replies!

ORDER BY MAIL—Minimum order \$3.00. No COD's please. Please send check with order (credit to rated firms only). All shipments FOB warehouse.

**Harjo Sales Co.**  
Dept. EL  
4109 BURBANK BLVD., BURBANK, CALIF.  
Phone: Victoria 9-2411 Cable Address: HARJO  
Visit Our Retail Showrooms

**"CERTIFIED"**  
**ELECTRONIC TUBES**  
**SELL BETTER!**

**RESEARCH ASSOCIATES INC.**  
1121 FLUSHING AVENUE  
BROOKLYN 37, N. Y.  
TUBE TEST REPORT

Tube Type No. Magnatron, Klystron, Transmitter, Special Purpose, Receiving, etc. Quality 1 to 100,000

DESCRIPTION OF TEST	STATUS
Heater	To 11 V To 400A
Grid No. 1	To 500,000 V From 0001 uA
Grid No. 2	To 50,000 V To 400A
Signal Frequency	DC to R Band to 50 KC
Pulse Duration	25 uSec to CW
Power Output	Microwatts to Megawatts

All tests performed under qualified engineering supervision. Write or phone for price and delivery information. HYacinth 7-2142

**"CERTIFY" YOUR TUBES**  
**WITH THIS**  
**RESEARCH ASSOCIATES**  
**REPORT**

This report certifies that your electronic tubes have been tested under Qualified Engineering Supervision to  
JAN 1A, M.I. E 1B  
Commercial or Special Specifications, magnetrons klystrons, special purpose, transmitting, receiving, subminiature, etc.

Prompt service on small runs and production quantities. Write or phone for price and delivery information.

**RESEARCH ASSOCIATES INC**  
1121 Flushing Ave., Brooklyn 37, N.Y.  
Tel. Hyacinth 7-2142

**LAVOIE TYPE 105**  
**FREQUENCY METER**

VHF. 2 tubes. Battery operated portable frequency meter designed to measure frequencies for 300-600 MC. This unit is used for a variety of measurements on the VHF circuit. Complete unit with 0-200 micro amp meter, time switch, instruction book, all in metal carrying case. New condition **\$29.50**

**SCR-503**  
Complete Radio Direction Finder. Freq. range: 100-300 KC. Receiver detects AM and CW signals. NEW with all cables and power supply. Operates from 12 V. battery. Write for descriptive data. P.U.R.

**HANDSET & MIKE SPECIALS**

- MI-2040 RCA sound powered. With mounting rack. New. Ea. \$14.95
- TS-9 Handset with switch and cord. New. Ea. 8.50
- TS-10 Sound powered handset. Used. Ea. \$5.50. 2 for... \$10.00
- TS-12 Handset. Complete with cord and mounting hook. New. Ea. 8.50
- TS-14 Handset. With cord and mounting hook. New. Ea. 9.95
- PL-204 Plug. New. Ea. 9.95
- TS-17D Mike. Military approved. cord and plug. New. Ea. 8.25

**MOTOROLA FSTR-250**  
250 W. Crystal Controlled FM Transmitter. With one receiver for communication. Freq. range: 30-40 MC. Complete with 120 VAC power supply. Like new. P.U.R.

**SIGNAL GENERATOR 1-208**  
Complete, crystal controlled, for testing FM receivers. Freq. range: 1.9-4.5 MC. 19-45 MC. Operates from 12 VDC or 120 V 60 cps P.U.R.

**UHF FM TRANSCEIVER APG-17**  
2 watt FM transmitter-receiver radar set, frequency range 1475-1525 MC. The antenna system consists of 2 double-bay cylindrical parabolas to operate in the above frequency. Electronic computer unit has air cooled power supply for the transmitter. Complete installation. Brand new. P.U.R.

**NEW CATALOGUE NO. 114**  
**LISTS LATEST INVENTORY OF AIRCRAFT, INDUSTRIAL AND MILITARY ELECTRONICS EQUIPMENT. SEND FOR YOUR COPY TODAY!**

**ARROW SALES INC.**  
Address: P. O. BOX 3878-E, N. HOLLYWOOD CALIF.  
Dist. Warehouse: 7460 VARNA AVENUE, N. HOLLYWOOD CALIF.  
Phone: 3-1810 • Stanley 7-6005 • Cable Address: ARROW/SALES

**HIGH POT TRANSFORMER**

WESTINGHOUSE. Pri: 115, 60 cy. Sec: 15,000V C.T. @ .060A. C.T. ungrounded. Excitant for high-potting resist. Size 10 1/2" x 8 1/2" W x 9 1/4" D. Weight 67 lbs. Fully enclosed steel case Price.....\$29.50

**PULSE TRANSFORMERS**

KS-9563 Supplies 3500V peak from 807 tube \$3.95 High Reactance Trans. G. E. Type Y3502A—60 cy. Voltage 11,200-135. Ind. H.V. winding 135 hv. Output: Peak 22.8KV. Cat. 8318065-G1.....\$79.50

**60 CYCLE TRANSFORMERS**

G. E. Step-Down 6.0 KVA. Pri: 230/460. Sec: 115/125, 60 cy. Size: 20" x 11" x 9 1/4". Weight 225 lbs. Navy grey finish, integral junction box and mounting brackets \$59.50 Plate Trans. Raytheon U. 1215. Pri: 440/220, 60 cy 3 phase. Sec: each phase 1310V @ 0.67A test 6000V.....\$59.50 Plate Trans. Pri: 115V, 60 cy, 1 Ph. Sec: 1470V. C.T. @ 1.2A tested at 5500V. RMS. Raytheon. Size 12 1/4" x 15 1/2" x 10 1/2" in. Shipped wt: 150 lbs. New. Price.....\$19.50

**400 CYCLE TRANSFORMERS**

Auto. KVA .946S—520P Volts 460/345/230/115 New. G.E. Cat. 80G184. Weight 22 lbs. \$1.50 Fil. Int. 0.75/80/85/105/125. Out: 5V3A/5V3A/5V6A/6.3V/5A No. 7249010.....\$2.95 Plate. KS9560 800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A Eleestat shld. Wt. 2.3 lbs.....\$2.95 Plate & Fil. KS9555. Pri: 115V. Sec: 930-0-930 and three 24V windings.....\$3.95 Fil. KS9553 Pri: 115V. Sec: 8.2V 1.25A/6.35V1.5A Eleestat Shld. Wt. 0.5 lbs.....\$2.95 Plate & Fil. Pri: 0/80/115V. Sec: =1200V DC @ 1.5MA. Sec: =2-400V DC @ 130MA. Fil. Secs: 6.4V4.8A/6.35V. 8A (115. 1500V) 5V2A/5V2A.....\$4.95 Plate. Thordarson T46889 500 cy. Pri: 105/120. Sec: 2800-0-2800. RKV lbs. 1.5KV. A.....\$29.50 Misc. types G.E. #68G665X, #68G666X, #68G667, #68G688X, #80G200, #80G199 each.....\$2.00

**FILTER CHOKES**

KS9589 Retard. 411Y @ 100 MA V. 60 Cy. Makes two breaks one. New.....\$1.95 Multi-Choke 3 hv @ .275A 70 ohms, 17 hv. @ .125A 200 ohms, 17 hv. @ .125A 200 ohms 7 1/2" x 6 1/2" x 3 1/2".....\$2.95

**PLUG IN RELAYS**

Clare octal base 70 ohm coil 115 V. 60 Cy. Makes two breaks one. New.....\$1.95 Western Electric D163781 Octal Base 2400 Ohm coil 10 MA operating. Makes one. Normally open. New.....\$4.95

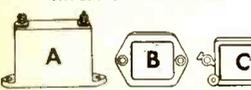
**30-10,000 CYCLE MODULATION TRANSF.**

For RCA. Type 250-K Broadcast Transmitter (M1-7242) I to P Primary Imp. 15,000 ohms. Secondary Load 5,030 ohms. Size 1 1/4" x 9 1/2" x 13". Wt. 143 lbs. New.....\$19.50

**ALTITUDE INDICATOR**

Type 1D-11A/APN-1. Brand New in original cartons. Special.....\$2.95

**MICA CAPACITORS**



High voltage Transmitting types, thousands in stock. Wide selection of sizes, types & ratings. All new and made by top manufacturers. Write for complete listings.

**PARABOLOIDS**

1 1/2" diameter, spun magnesium dishes, 4 inches deep. Reinforced perimeter. Two sets of mounting brackets on rear. Opening at apex for waveguide dipole assembly 1 1/2" x 1 1/2". New.....Per Pair \$12.50 2 1/2" diameter dishes 5 1/4" deep with 10 CM dipole waveguide, etc. New.....Price Each \$24.50

**RADAR ANTENNAS**

SO-1 (10CM) assembly with reflector, waveguide nozzle and drive motor. New.....\$279.50 SO-3 (3CM) Surface Search type with reflector and drive motor, but less plumbing. New in original cases.....\$149.50 SO-13 (10CM) Complete assembly with 24" dish, dipole, drive motor and gearing. New.....\$89.50

**RADAR SETS**

MODEL SQ. Portable radar set. 10CM. Operates on 90-130 volt, 60 cy, 1 Ph. "A", "B", and "PP" presentation. Complete with technical manual and full set of operating spare parts. Used but in good condition.....\$495.00

**SCR-545A RADAR**

Removed from trailer. Includes: Azimuth and Elevation Control Units; 214A and 151A Indicators; Input and Output Servo Amplifiers; Three BC-1035A Scopes; Power Panel and RA-65A Power Supply; Range Cont. Unit; Range Converter; Search Rec. and Control Unit; Search Trans; Track Rec. and Control Unit; Track Trans; Range Unit; Auto. Controller; no Antenna included. In good condition. A terrific value at \$975.00 Only one set available.

**G. E. SERVO AMPLIFIERS**

Used in B29 planes for Central Station Fire Control Systems B2, B3 and B4. Used to drive Amplidyne 5AM31N9A and Control Motor 5BA501J2A listed in 1st column. New less tubes.....\$29.50

**RA38 RECTIFIER**

Variable output 0-15000 V DC @ 500 MA. Input 115V 60 cy. 1 ph. Size 63 x 53 x 56 in. Write for detailed information.

**Radar Repeater Adapters NAVY TYPE CBM-50AFO**

A repeater unit for video signals and trigger pulses designed to work in conjunction with standard Navy radar equipments wherein provision is made for operation of remote P.P.I. sets. This adapter provides four video and trigger pulse lines for operating one or more remote P.P.I. control installations. 115 Volts, 60 cycles A.C. Dimensions are 3 1/2" x 2 1/2" x 1 1/2" in. New \$67.50

**NEW SCR-522A EQUIPMENT**

Complete BC-624C receivers and BC-625AM Transmitters including mounting racks, plugs, connectors, dynamotor. Brand new equipment with instruction manuals. Write for full details.

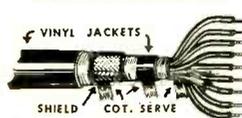
**REPAIR PARTS FOR BC-348**

(Models H, K, L, R.) Also BC 224 Models F, K. Coils for ant., I.F., det., osc., I.F., c.w. osc. xtal filters, 4 gang cond. front panels, dial assemblies, vol. conts. etc. Write for complete list and free diagram.

**FLUXMETER**

Used to calibrate field strength of magnets from 500 to 4000 gauss and indicate polarity. Probe has gap of 1/4". Beautifully built in hardwood case with hinged cover. Instructions for operation on underside of cover. Size 12 1/2" x 9 x 6 in. Ideal for lab and school use. New. An exceptional value at \$24.50

**9 CONDUCTOR CABLE**



Army spec. CO-215 Weatherproof 9 Cond. No. 20 AWG stranded tinned copper, plastic ins., color coded, double vinyl jackets with tinned copper braid between. Dia. 9/16" made by G.E. Available 1000, 1500, 2000 ft. reels Price \$12 ft. Sample 100 ft. Coil.....\$15.00

**TERMS: Rated Concerns Net 30.**

FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change.

**INVERTERS**

Onan MG-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2KW and 26 V DC @ 4 amps. New.....\$295.00 Onan MG-0-75. Navy type PU/11 Input 115/230, 60 cy. 1 Ph., 5.3 amps. and 26 VDC @ 3.8 Amps. New.....\$225.00 Leland Elec. Co. PE206A. Input: 28DC @ 38 Amps. Output 80V, 800 cy., 1 Ph., 485W. New \$16.50 PE218H. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. New.....\$32.50 G.E. 5AS131J11A. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5 KVA. Regulated. New.....\$89.50 Eleor. 32VDC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New.....\$29.50 Type PU-7/AP 2500 VA Input 160 Amps. @ 28 V. Output 115 V. 400 Cy. 1 Ph. (1.00 PF) 2500 W. Continuous. Both voltage and freq. regulated. New. Price.....\$98.50

**DYNAMOTORS**

Navy type CA10-21144. Input: 105 to 130 VDC. Output: either 26VDC at 20 amps, or 13VDC at 40 amp. Radio filtered and complete with line switch. New \$89.50 Type PE94CM. For SCR-522. Brand new in overseas cases. Has wide band input and output filters.....\$16

**AMPLIDYNES**

5AM21J17. Input 27 VDC @ 15 A. Output 60 VDC @ 2.5A 4600 RPM. New.....\$31.40 5AM31N9A. Input 27 VDC @ 44 A. Output 60 VDC @ 8.8 A. 7500 RPM. New.....\$23.50 5AM31N18A. Input 27 VDC @ 34 A. Output 60 VDC @ 8.8 A. 8300 RPM. New.....\$12.50

**HIGH VOLTAGE OIL CAPACITORS**

Mfd.	Volts	Price
.001	50 KV	\$22.29
.01	5	2.65
.02	20	26.75
.025	50	26.50
.05-.05	30	34.50
.1	1	3.50
.1-1	1	3.50
.135	7.5	6.95
.2	50	39.50
.2	15	15.50
.25	20	17.50
.25	50	44.50
.25	7.5	19.50
1	15	39.75
1	5	3.50
2	5	12.50



SPECIAL \$6.95

**OIL FILLED CAPACITOR**



.02 mfd 20 KV. Size OA-10 1/2" L x 2 1/2" Dia. Special \$9.95

**SMALL DC MOTORS**

G.E. 5BA50L2A. Armature 60 VDC at 8.3 Amps. Field 27.5VDC at 2.3A RPM 4000. H.P. 1.5. New.....\$27.50 G.E. 5BA50L22. Armature 60 VDC at 8.3 Amps. Field 27.5 at 2.9 Amps. RPM 4000. H.P. 0.5 Gear Box No. T8254261-G1. Has two 160 RPM and one 120 RPM take-off. Gov't. Cost \$207.00. Our price.....\$29.50 Oster E-7-5. 27.5DC. 1/20 HP. 3600 RPM Shunt Wound. New.....\$9.50 Dumore Co. type ELBG. 24 VDC. 40-1 gear ratio. For type B-2 intervalometer. New.....\$2.75

**400 CY. BLOWERS**

Westinghouse Type FL. 115V. 400 cy., 6.700 RPM. Airflow 17CFM. New.....\$3.95

**SYNCHROS**

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 58FDG. 60/80V. 400 cy. Ord. Dr. 173029. New.....\$4.50 Armor. Synchro Differential Generator. Type 6DGT. New.....\$29.50 Hobart Mfg. Co. Synchro Dif. Generator Type XIX 115V. 60 Cy. New.....\$4.95 5F. 5G. 5CT Also in Stock

**MOTOR GENERATORS**

2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph., Except Crates \$25.00 MOTOR GENERATOR. TYPE CGU-2 Unit of U. S. Navy TCK 7 Transmitted Motor: 2 H.P. 230V. D.C. 10 amps. Generator: 1800 V. D.C. 0.4 A. 500V. D.C. 0.35A. 115V. D.C. 1.5A. 12 V. D.C. 2A. 580 RPM. Self excited. Brand new including spare armature.....\$269.50 ALLIS-CHALMERS 230DC to 115 AC. 60 cy., 1 Ph., 1.25 KVA.....\$149.50

INDEX TO THE SEARCHLIGHT ADVERTISERS

DECEMBER, 1954

This index is published as a convenience to the readers. Care is taken to make it accurate but ELECTRONICS assumes no responsibility for errors or omissions.

SEARCHLIGHT SECTION (Classified Advertising) H. E. Hilly, Mgr.

**EMPLOYMENT**

Positions Vacant.....	377-391
Selling Opportunities Offered.....	377, 382
Positions Wanted.....	377
Selling Opportunities Wanted.....	377
Employment Services.....	377
SPECIAL SERVICES.....	377

**BUSINESS OPPORTUNITIES..... 377**

**NOTICES Legal..... 376**

**EQUIPMENT (Used or Surplus New) For Sale.....392-410**

**WANTED Equipment..... 404**

ADVERTISERS INDEX

Admiral Corporation.....	380
Allied Electronic Sales.....	398
Alltronics.....	401
Arma Div. of American Bosch Arma Corp.....	386
Arrow Sales Inc.....	407
Barry Electronics Corp.....	393
Bendix Aviation Corp., Missile Section Products Div.....	386
Bendix Aviation Corp., Pacific Div.....	378
Bendix Aviation Corp., York Div.....	389
Bendix Products Div. of Bendix Aviation Corp.....	385
Bendix Radio Division of Bendix Aviation Corp.....	391
Blau.....	402
Brush Development Co.....	382
Burnell & Co., Inc.....	386
Calvert Electronics.....	403
Cardwell Electronics Prod. Corp. Allen D.....	390
Chase Electronic Supply Co.....	406
C & H Sales Co.....	397
Communications Devices Co.....	400
Communications Equipment Co.....	395
Compass Electronics Supply.....	399
Connector Corp. of America.....	404
Cook Research Laboratories.....	382
Convair.....	385
Cornell Aeronautical Laboratory Inc.....	378
Crosley, Div. of Avco Manufacturing Corp.....	390
Delaware Eq. Co.....	398
Dow Radio.....	406
Drake Engineering Personnel Service.....	377
Electronic Engineering Co. of Calif.....	391
Electroncraft.....	408
Empire Electronics Co.....	406
Engineering Associates.....	406
Electro-Voice Inc.....	390
Emeltone Electronics.....	407
Empire Electronics Co.....	406
Engineering Associates.....	406
Esse Radio Co.....	405
Fair Radio Sales.....	402

(Continued on opposite page)

# INDEX TO THE SEARCHLIGHT ADVERTISERS

DECEMBER, 1954

This index is published as a convenience to the readers. Care is taken to make it accurate but ELECTRONICS assumes no responsibility for errors or omissions.

(Continued from opposite page)

Farnsworth Electronics	388
Fry-Bill Distributing Co.	396
Finnegan, H.	404
Ford Instrument Co.	380
General Electric Co., Syracuse Div.	378
General Precision Laboratory Inc.	388
Goodyear Aircraft Corp.	381
Greene, G.	398
Harjo Sales Co.	407
Hanover Electronics	404
Hershel Radio Co.	405
Hoffman Laboratories Inc.	378
Houde Supply Co.	404
Industrial Nucleonics Corp.	391
Industrial Research Laboratories	384
Instrument Service	399
Johns Hopkins University, The	388
JSH Sales Co.	401
Kollsman Instrument Corp.	390
Laprow Bros.	403
Liberty Electronics	399
Lockheed Aircraft Corp.	389
Maritime Switchboard	398
Maryland Electronic Mfg. Corp.	380
Massachusetts Institute of Technology	382
Medical Salvage Co., Inc.	401
Melpar, Inc.	384
Mogull, Alexander	401
Monmouth Radio Labs.	401
Motorola	384
Motorola Research Laboratory	389
Murry's Radio	392
National Co., Inc.	387
National Scientific Laboratories Inc.	377
North Electronic Supply	400
Page Communications Engineers Inc.	377
Radalab	398
Radio Corp of America Eng Product Div.	386
Radio Corp of America	379
Radio & Electronic Surplus	403
Radio Research Instrument	405
Railway Communication Inc.	396
Raya Trading Co.	403
Raytheon Mfg. Co.	390
Relay Sales Inc.	403
Research Associates Inc.	407
RW Electronics	401
Safut Trading Co.	402
S & R Electronics Inc.	400
Stanley Aviation Corp.	382
Stavid Engineering Inc.	391
Stromberg Carlson Co.	377, 391
Sylvania Electric Products Inc.	387
"TAB"	410
Telemarine Communications Co.	398
Time Electronic Sales	406
Tractor & Equipment Co.	56
Universal General Corp.	409
University of Michigan	388
Vets Distributing Co.	398
Victor-Bernard Industries Inc.	406
Western Engineers	394
Westinghouse Electric Co.	383
White-Rodgers Electric Co.	384
Wilgreen Industries	396
Wille Electronics Co.	404
Wright Associates	377
XEN	404

## 2 MILLION DOLLAR INVENTORY OF SENSITROLS AND STEPPERS!



### WESTON TYPE 705 SENSITROL

Operation is as follows: The stationary contact is a small powerful permanent magnet and movable contact is iron "rider" mounted on pointer which travels over relay scale. Operating torque moves pointer into magnetic field of stationary contact. This contact then draws movable contact and holds it firmly. Perfect contact is assured and chattering is eliminated. Contacts remain closed until reset. Accuracy in general may be considered as within 5% of the range. Operates directly from a photocell or a group of thermocouples. Net weight 14 oz.

draws movable contact and holds it firmly. Perfect contact is assured and chattering is eliminated. Contacts remain closed until reset. Accuracy in general may be considered as within 5% of the range. Operates directly from a photocell or a group of thermocouples. Net weight 14 oz.

#### Weston Model 705 Type 6

Double contact with Solenoid Reset  
Sensitivity 7.5 Microamps  
Reset coil 6-24 DC or 24 VAC  
Makes contact on increasing or decreasing values.  
Contacts: "Twintacts", Capacity 100 ma at 110 volts  
Nickel plated, Brass cover; #R560...\$18.75  
10 for \$170.00

#### Weston Model 705 Type 6

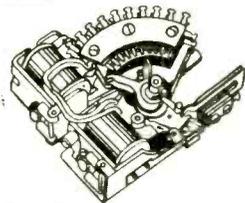
Same as #R560 but with glass face;  
#R561 10 for \$180.00

#### Weston Model 705 Type 4

Single contact (Normally Open), Solenoid Reset  
Sensitivity: 10 Microamperes  
Reset coil 6-24 V DC or 24 V AC  
Contact: "Twintact", capacity 100 ma at 110 volts  
Glass Face: #R523...\$17.75  
10 for \$160.00

Production Quantities Available.  
Call Us for Prices.

### STEPPING SWITCHES



#### STEPPING SWITCH SS5:

Mfg by Western Electric, Automatic Electric Sales

Minor Switch  
10 steps and off  
Single Level;  
Contacts: Gold plated brass;  
Bridging Wiper;

Operating Voltage 6.0 to 12.0 V. DC  
Resistance:  
Oper. Coil 6 ohm  
Reset Coil 9 ohm  
Net Weight: 1 lb. 2 oz. #R960...\$11.95  
10 for \$100.00

#### STEPPING SWITCH SS6:

Mfg by Western Electric Co., Automatic Electric Sales  
22 step; 5 levels; Bridging Wipers;  
Contacts: Gold plated brass  
Operating Voltage: 5.5 to 12 V. DC;  
Coil Resistance: 4.0 ohm  
Interrupter Switch: 1 Break-Make  
Net Weight: 2 lb. 2 oz. #R926...\$14.75  
10 for \$120.00

#### STEPPING SWITCH SS7:

Mfg by Western Electric Co., Automatic Electric Sales  
44 step; 2 levels; Bridging Wipers;  
Contacts: Gold plated brass;  
Operating Voltage: 5.5 to 12 V. DC;  
Coil Resistance: 4.4 ohm  
Interrupter Switch: 1 Break-Make  
Net Weight: 1 lb. 14 oz. #R927...\$14.75  
10 for \$120.00

### GUARDIAN TYPE 110 AC RELAYS



Volts A. C.	Contacts*	Amps	Stock No.	Ea.
6	1A	8	R726	1.50
6	1A, 1B	8	R727	1.75
6	1A, 1C	8	R728	2.00
6	1B, 1C	8	R729	2.00
6	2C	8	R730	2.25
6	1A, 2C	8	R731	2.50
6	2A, 2C	8	R732	2.75
12	1A	8	R735	1.25
12	1B	8	R736	1.25
12	1A, 1B	8	R737	1.50
12	2A	8	R738	1.50
12	1A, 1C	8	R739	1.75
12	1B, 1C	8	R740	1.75
12	2C	8	R741	2.00
24	1A	8	R743	1.25
24	1A, 1B	8	R744	1.50
24	1A, 1C	8	R745	1.75
24	1B, 1C	8	R746	1.75
24	2C	8	R747	1.95
115	1A	8	R562	1.75
115	1B	8	R563	1.75
115	1C	8	R564	2.00
115	3A, 1C	3	R565	2.75
115	1A, 2C	3	R566	2.75
115	2A, 2C	3	R583	3.00
115	2A	3	R567	2.00
115	3A	3	R568	2.50
115	4A	3	R569	2.75
220	1A	8	R574	1.50
220	1B	8	R575	1.50
220	1A, 1C	8	R576	2.00
220	1B, 1C	8	R577	2.00
220	1A	8	R578	2.25
220	1A, 2C	8	R579	2.50
220	2A, 2C	8	R580	2.75

### OTHER GUARDIAN AC RELAYS

Type	Volts AC	Contacts*	Amps	Stock No.	Ea.
40	6	1C	12.5	R733	5.00
120	24	1A	8	R742	1.00
200	24	2A, 2B	8	R808	1.50
200	24	3A, 1C	8	R807	1.50
200	48	1A	8	R687	1.25
200	48	1B	8	R688	1.25
200	48	1C	10	R690	1.50
200	48	2C	10	R691	2.00
200	48	2A, 2B	8	R693	2.50
200	48	3A, 1C	8	R694	2.50
200	115	3C	8	R724	3.00

### OTHER AC RELAYS

Mfg & No.	Volts A. C.	Contacts*	Amps	Stock No.	Ea.
RBM98736	6	2C	12	R725	2.00
Advance 9104	12	2C	10	R734	3.00
Clare B19553	24	1A, 2C	1	R582	2.75
Allied B06D55	55	2C	10	R211	2.50
Sigma 41FZS7	115	1C	3	R909	2.00
Price 1300	115	2C	5	R457P	2.75
Sigma 5RJ	115	1B	3	R145	4.50
Ward Leonard 105	115	1A	20	R748	2.50
Allied BN18A115	115	6C	10	R749	8.95
Allied B06A115	115	2C	10	R692	3.00
Allied P010A115	115	4A	10	R936	3.95
Allied B06A115	115	2C	5	R866	2.00
Price 1300	115	2C	10	R686	2.50
RBM 42600	115	2A	15	R723	3.00
Automatic Type RA	115	1C	1	R570	3.00
Potter Brumfield SU14A	115	3PDT	3	R938	3.00
Advance 964B	115	2C	10	R571	4.25
Advance 604B	115	2C	10	R572	7.00
Wheelock B1-X44	115	2A	5	R573	3.50
Advance K1504	220	2C	3	R531	2.00

\* A = SPST, normally open; B = SPST, normally closed; C = SPDT.

TERMS:—All Prices F.O.B. Our Plant. Rated Firms Net 10 Days; All Others Remittance with Order.

Orders Under \$10 Remittance With Order. Plus Approximate Shipping Charges (coverage will be returned.)

324 CANAL ST., N.Y.C., 13, N.Y. Walker 5-9642

# Universal general corp.

**OIL CONDENSER SPECIAL**  
 10 MFD 600 VDC **\$1.75 ea.**  
 Lots of 3  
 Case Dimensions, Not Including Insulators, 4 1/2" x 3 1/2" x 1 1/2"  
 1 MFD 600V 49c; 10 for \$3.50

**SELSYNS—SYNCHROS**  
 AY1/Autosyn/26V/400Cyc. \$3.98 2 for \$7  
 CK-2/Low Inertia Motor/E.P. 20.00  
 AY20/Autosyn/26V/400Cyc/E.P. 4.98 2 for \$9  
 CS677/Type 11-5 Syn R/R/115V/60Cyc. \$21  
 CS406/L Type 11-2 Syn R/R/115V/60Cyc. \$21  
 C78248/Syn Xmt/115V/60Cyc. \$12; 2 for \$20  
 C78249/Syn DHI/115V/60Cyc. \$7; 2 for \$12  
 J11F3/Synchr Gen/115V/57.5/57.5/400Cyc. \$9.00  
 J21G1/Syn Tran/57.5/57.5/400Cyc. \$9.00

OTHER TYPES IN STOCK  
 GET OUR QTY PRICES

**FILAMENT TRANS.**  
 INPUT 115/60 cy  
 2.5V CT/10A 5KV5 \$3.59; 3/4:10  
 7.5V CT/10A 5KV5 \$3.95; 2/17:50  
**AUTOTRANSFORMERS** 230 TO 115V  
 For 220-240V/50-60 cy Input. To 110-120V or Step-up with Cord Plug & Receptacle  
 TPA 050/50W. \$2.55 TPA 075/75W. \$3.65  
 TPA 100/100W. \$3.00 TPA 200/200W. \$7.75  
 TPA 250/250W. \$6.75 TPA 300/300W. \$7.25  
 TPA 750/750W. \$11.75 TPA 1000/1000W. \$16.95  
 GET OUR QTY PRICES

**TRANSFORMER SPECIAL!!**  
 6.3 Volt 3 1/2 Amp. CONTINUOUS DTY  
 SIZE 2 1/2" x 1 1/2" x 1 1/2"  
 HVV DTY CHANNEL MTG. 8 INCH WIRE LEADS  
 LOSS OF 12% @ 89c  
 QUANTITY OF 25 EA. 85c  
 SOLD SINGLY SPEC. 98c

**METER BARGAINS**  
 0-1MADC/3 1/4 Rnd/JAN \$3.95 @ 2 for \$7  
 0-5MADC/3 1/4 Rnd/JAN \$3.50 @ 2 for \$6  
 0-10MADC/3 1/4 Rnd/JAN \$3.50 @ 2 for \$6  
 8000/DC/3 1/4 Rnd/Weaton. \$7.00 @ 2 for \$12  
 1500VDC/3 1/4 Rnd \$1.45  
 150VAC/2 1/4 Rnd. \$1.45  
 150VAC/3 1/4 Rnd. \$1.45  
 3 & 15 Amp/DC/Weaton/Portable \$5.95, Sp1 3 for \$15  
 15 Amp/DC/LAB Sid Mirror. \$5.95, Sp1 3 for \$15  
 SMA/DC/Tuning Meter/A. \$11.99; 2 for \$24.00  
 Weston 120 M.A./R/F/Rnd/30. \$10.95; 2 for \$20  
 Weston 50 Microamps/DC/3 Sq/301 \$7.00  
 Weston VU-20 to +3 1/3 Sq/301 \$15.38; 2 for \$25

**NEW RELAY LIST**  
 Tremendous Bargain Prices  
 R1ST1 24Vdc Steno Arnold Resonant Relay \$189 Freq 240v. \$3.98; 3 for \$10  
 RAKU1 SPST/Mini/115VAC/4A CTS \$1.39  
 R5K2U SPDT/Mini/115VAC/4A CTS \$1.39  
 R7CL1 Clare SK5010 VAC SLD/DPDT/178-28 VDC/3A CTS Oetal Base \$2.98; 2 for \$5.00  
 R191R1 SPDT/Mini/115VAC/30A CTS \$2.99  
 R12AC Allied-H/D/DPDT/115VDC/5A CTS \$1.39  
 R11AC Allied-H/D/DPDT/6VDC/5A CTS \$1.49  
 R14A1 SPDT/Mini/115VDC/30A CTS \$1.49  
 R17GM1 GM/SPST/24VDC/20A CTS \$1.49  
 R18E2 Lench/D/DPDT/115VDC/10A CTS \$1.49  
 R22AD1 Advance-4000-1/B/DPDT & SPNO/115 VDC/RF-Ceramic Insulation. \$7.10; 2 for \$13.  
 Sellum Rectifier/115VDC/40A CTS \$1.99  
**WRITE FOR QUANTITY PRICE & LISTING**

**GLOLITE**  
 Combo TV Light & Electric Clock (60/120 TV numerals) Provides proper background light for TV viewing. Accurate. TV numerals. Luminous window. Walnut case, U.L. Size \$1.59; \$7.95  
**"TAB" Special.**

**866A KIT and XFORMER**  
 (2) 866A Tubes & Sockets. Transformer Rated. P.R.I. 115V/60cy. Hi-Volt Insulation. \$4.98

**"TAB" THAT'S A BUY**

**NEW POCKET AC-DC VOM Model 12C**  
 Lots of 3  
**\$9.35 ea.**  
 SOLD SINGLY \$9.89 (plus 40c ship in U.S.A.)  
 Hi-accuracy precision pocket imported VOM 1000 ohm per 1% Read AC & DC volts 0, 5, 25, 50, 100V DCMA. 0, 1, 10, 100MA. ohm 0, 10R, 100K Size 1 1/4" x 4 1/4" L. 3 1/2" W. Test leads.  
 Model T-5-52 Smallest precision built VOM. 1000 ohm per 1% Read. AC & DC volts 0, 10, 250, 500V. DCMA. 0, 1, 250MA. Ohms, 0-100K. Measures only 1 1/4" x 4 1/4" L. 3 1/2" W. Test leads. \$6.89

**PRECISION RESISTORS FOUR MILLION IN STOCK**  
 Western Elec.-IRC-Wilkor-Mepco  
 All 1% Accuracy Gtd.  
 ORDER ANY VALUE. HAVE IT. 100 CENTS SOLD. 100 CENTS UP.  
**"TAB" SPECIAL 35c EACH; 25¢ Ea.**  
 10 OF ONE VALUE. \$20.00  
 100 OF 10 VALUES. \$20.00  
 10 ASSORTED VALUES (U-SELECT). \$3.00  
 INDICATE SECOND RANGE. 50% GR5 CHOICE. WE SHIP TYPES IN STOCK

**INFRARED SNOOPSCOPES**  
 See in Dark Tube Hi-Sensitivity simplified design 2" dia. Willemite anode—Resolution up to 360 lin/in. Tube & Data.  
**"TAB" Special. \$10.20 for \$18**  
 Snoopscope Pwr Supply. 1000 Ohm/100mA. U.S. Distrib. Crk. Transformer, Rectifiers, Sockets, Resistors Capacitors and Diagram 115V/60cy Oper. \$6.98

**106 WATT PHOTO-FLASH KIT—AC**  
 Includes transf. condensers two/525XFD/450V Total 103WV. \$6 @ 2/516  
 100 Ohm/100mA. U.S. Distrib. Crk. Transformer, Rectifiers, Sockets, Resistors Capacitors and Diagram 115V/60cy Oper. \$6.98

**BATTERY 106 WATT/SCDS KIT**  
 Same specs only batteries. \$32.98  
 525 MFD/450V/75 Vdc cond's new low loss. \$6 @ 2/516  
 100 Ohm/100mA. U.S. Distrib. Crk. Transformer, Rectifiers, Sockets, Resistors Capacitors and Diagram 115V/60cy Oper. \$6.98

**"TAB" PHOTOFLASH LAMPS**  
 W-sec  
 "No." Replaces Max Each  
 TWL FA 100/FF118 100 10.98  
 THL AMGL0 5804X 100 10.98  
 238T GE RT 210 100 9.98  
 TLVA SVW 4430 100 9.98  
 VAX 4X400 100 10.98  
 TLX DX & FA100 150 9.00  
 TDX DXO/260-350 150 9.00  
 350TQ T1 508 2000 49.98  
 FT 106 GE FT106 1000 49.98  
 TRIGGER COIL for Lo & Hi Volt Flash. \$1.42  
**Write for "TAB" Flash Tube Data 50c**

**TEST EQUIPMENT**  
 EMC Model 205P Tube Tester LN. \$21.95  
 EMC Model 110K VTY VOM Demo. \$21.95  
 EMC Model 1104 Multimeter (20,000 ohm PV) \$22.95  
 Demo Model 1107 VTYM Demo. \$22.95  
 Electronic Flash Handbook ok data. \$2.98  
 (LN) Like New (Demo) Demonstrator GTD

**SMALL PARTS CABINETS**  
 49-115 Four Drawers, 3 Divisio<sup>n</sup> Per Draw 9 1/4" H/10 1/4" W/6 1/4" D. \$3.99; 4 for \$14  
 4602 Four Drawer Plain 6 1/2" Div Each. One Drawer Plain 6 1/2" Div 6W/9D. \$1.58; 4 for \$7  
 EMC Model 1107 VTYM Demo. \$22.95  
 File, A-Z Index. \$2.98  
 Tool Box 3 1/2" H/10 1/4" W/6 1/4" D. \$1.69; 4 for \$7

**NEW "TABTRON" SELENIUM RECTIFIERS**

**"TAB" ENGINEERED FOR INDUSTRIAL USE**  
 "TAB" manufactures power rectifiers to your specifications. From one amp up to and above 1000 amps, conventional or fan-cooled, single or 3 phase, also magamps. Write for rectifier catalog.

Amps	18VAC	36VAC	72VAC	130VAC	144VAC	216VAC	Ctr Tap AC/DC	3 Phase - Bridge
1	\$1.35	\$2.35	\$4.60	\$7.50	\$12.75	\$22.25	\$2.10	15.90 28.95
2	2.95	2.75	6.00	9.25	15.75	28.85	4.20	15.90 30.90
3	2.95	4.15	14.90	12.90	26.75	38.85	2.95	18.90 36.95
4	4.10	8.00	17.50	29.95	34.75	54.85	3.25	20.90 39.95
10	5.95	11.50	25.00	41.50	44.75	84.85	4.75	36.90 72.95
15	8.50	14.50	30.00	44.50	54.75	99.85	5.75	41.90 81.95
20	12.00	23.00	45.00	72.00	82.75	160.85	7.95	50.90 97.95
30	14.50	29.00	58.00	113.00	94.75	190.85	9.95	89.90 159.95
40	18.00	34.50	72.00	131.00	128.75	235.85	11.95	225.90 389.95
50	22.50	42.50	88.00	135.00	165.75	295.85	14.95	134.90 269.95
60	29.75	54.50	117.00	175.00	195.75	405.85	23.95	179.90 359.95

**New Rectifier & Transformer Combo**  
 Sel/Bridge 115 Volt 60 cyc Input up to 14VDC at 12 amps Cont. Duty. \$19.98  
 up to 28VDC at 4 amps Cont. Duty. 14.98  
 Full Wave Selenium Rectifier. 14.50  
 up to 28VDC at 12 amps Cont. Duty. \$9.98  
 up to 28VDC at 50 amps Cont. Duty. 117.98  
 up to 28VDC at 100 amps Cont. Duty. 139.00  
 \*Transformer has dual primary 115 & 230 v

**NEW HIGH CURRENT POWER SUPPLIES GTD**  
 Variable 0-28VDC Completely Built, Ready to Go. Full Wave Selenium Rectifier. Transformer, Variac Volt & Amp Meter, Switch, Terminal & Fuse. In Heavy Duty Steel Cabinet Standard 115V/60cy Input 220V & Other to Order. One Year. Stock

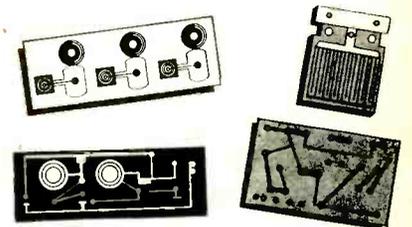
Rating	Continuous	With Meters
0-28VDC at 5 Amp	\$45.00	\$50.00
0-28VDC at 12 Amp	\$9.00	\$15.00
0-28VDC at 12 Amp (1% Ripple)	\$125.00	\$135.00
0-28VDC at 24 Amp (1% Ripple)	\$175.00	\$185.00
0-28VDC at 50 Amp	\$235.00	\$245.00
0-28VDC at 100 Amp	\$300.00	\$310.00
0-28VDC at 100 Amp (1% Ripple)	\$650.00	\$660.00
0-10 or 10VDC at 10 Amp	\$50.00	\$55.00
0 or 13VDC Filtered, Continuous Duty. \$34.00		
T2V2 BATT 2 VOLT CHARGER	\$3.98	

**NEW RECTIFIERS XFMR'S**  
 RIMARY 115V 60cy SPEC 18-15-9-0-9-15-18 Volts  
 12 amp. \$16.85; 2 for \$29.95  
 24 amp. \$35.75; 2 for \$69.95  
 50 amp. \$69.75; 2 for \$139.50  
 100 amp. \$139.50; 2 for \$279.00  
 250 amp. \$343.75; 2 for \$687.50  
 500 amp. \$687.50; 2 for \$1375.00  
 1000 amp. \$1375.00; 2 for \$2750.00  
 2000 amp. \$2750.00; 2 for \$5500.00  
 4000 amp. \$5500.00; 2 for \$11000.00  
 8000 amp. \$11000.00; 2 for \$22000.00  
 16000 amp. \$22000.00; 2 for \$44000.00  
 32000 amp. \$44000.00; 2 for \$88000.00  
 64000 amp. \$88000.00; 2 for \$176000.00  
 128000 amp. \$176000.00; 2 for \$352000.00  
 256000 amp. \$352000.00; 2 for \$704000.00  
 512000 amp. \$704000.00; 2 for \$1408000.00  
 1024000 amp. \$1408000.00; 2 for \$2816000.00  
 2048000 amp. \$2816000.00; 2 for \$5632000.00  
 4096000 amp. \$5632000.00; 2 for \$11264000.00  
 8192000 amp. \$11264000.00; 2 for \$22528000.00  
 16384000 amp. \$22528000.00; 2 for \$45056000.00  
 32768000 amp. \$45056000.00; 2 for \$90112000.00  
 65536000 amp. \$90112000.00; 2 for \$180224000.00  
 131072000 amp. \$180224000.00; 2 for \$360448000.00  
 262144000 amp. \$360448000.00; 2 for \$720896000.00  
 524288000 amp. \$720896000.00; 2 for \$1441792000.00  
 1048576000 amp. \$1441792000.00; 2 for \$2883584000.00  
 2097152000 amp. \$2883584000.00; 2 for \$5767168000.00  
 4194304000 amp. \$5767168000.00; 2 for \$11534336000.00  
 8388608000 amp. \$11534336000.00; 2 for \$23068672000.00  
 16777216000 amp. \$23068672000.00; 2 for \$46137344000.00  
 33554432000 amp. \$46137344000.00; 2 for \$92274688000.00  
 67108864000 amp. \$92274688000.00; 2 for \$184549360000.00  
 134217728000 amp. \$184549360000.00; 2 for \$369098720000.00  
 268435456000 amp. \$369098720000.00; 2 for \$738197440000.00  
 536870912000 amp. \$738197440000.00; 2 for \$1476394800000.00  
 1073741824000 amp. \$1476394800000.00; 2 for \$2952789600000.00  
 2147483648000 amp. \$2952789600000.00; 2 for \$5905579200000.00  
 4294967296000 amp. \$5905579200000.00; 2 for \$11811158400000.00  
 8589934592000 amp. \$11811158400000.00; 2 for \$23622316800000.00  
 17179869184000 amp. \$23622316800000.00; 2 for \$47244633600000.00  
 34359738368000 amp. \$47244633600000.00; 2 for \$94489267200000.00  
 68719476736000 amp. \$94489267200000.00; 2 for \$188978534400000.00  
 137438953472000 amp. \$188978534400000.00; 2 for \$377957068800000.00  
 274877906944000 amp. \$377957068800000.00; 2 for \$755914137600000.00  
 549755813888000 amp. \$755914137600000.00; 2 for \$1511828275200000.00  
 1099511627776000 amp. \$1511828275200000.00; 2 for \$3023656550400000.00  
 2199023255552000 amp. \$3023656550400000.00; 2 for \$6047313100800000.00  
 4398046511104000 amp. \$6047313100800000.00; 2 for \$12094626201600000.00  
 8796093022208000 amp. \$12094626201600000.00; 2 for \$24189252403200000.00  
 17592186044416000 amp. \$24189252403200000.00; 2 for \$48378504806400000.00  
 35184372088832000 amp. \$48378504806400000.00; 2 for \$96757009612800000.00  
 70368744177664000 amp. \$96757009612800000.00; 2 for \$193514019225600000.00  
 140737488355328000 amp. \$193514019225600000.00; 2 for \$387028038451200000.00  
 281474976710656000 amp. \$387028038451200000.00; 2 for \$774056076902400000.00  
 562949953421312000 amp. \$774056076902400000.00; 2 for \$1548112153804800000.00  
 1125899906842624000 amp. \$1548112153804800000.00; 2 for \$3096224307609600000.00  
 2251799813685248000 amp. \$3096224307609600000.00; 2 for \$6192448615219200000.00  
 4503599627370496000 amp. \$6192448615219200000.00; 2 for \$12384897230438400000.00  
 9007199254740992000 amp. \$12384897230438400000.00; 2 for \$24769794460876800000.00  
 18014398509481984000 amp. \$24769794460876800000.00; 2 for \$49539588921753600000.00  
 36028797018963968000 amp. \$49539588921753600000.00; 2 for \$99079177843507200000.00  
 72057594037927936000 amp. \$99079177843507200000.00; 2 for \$198158355687014400000.00  
 144115188075855872000 amp. \$198158355687014400000.00; 2 for \$396316711374028800000.00  
 288230376151711744000 amp. \$396316711374028800000.00; 2 for \$792633422748057600000.00  
 576460752303423488000 amp. \$792633422748057600000.00; 2 for \$1585266845496115200000.00  
 1152921504606846976000 amp. \$1585266845496115200000.00; 2 for \$3170533690992230400000.00  
 2305843009213693952000 amp. \$3170533690992230400000.00; 2 for \$6341067381984460800000.00  
 4611686018427387904000 amp. \$6341067381984460800000.00; 2 for \$12682134763969221600000.00  
 9223372036854775808000 amp. \$12682134763969221600000.00; 2 for \$25364269527938443200000.00  
 18446740673709556032000 amp. \$25364269527938443200000.00; 2 for \$50728539055876886400000.00  
 36893481347419112064000 amp. \$50728539055876886400000.00; 2 for \$101457078117753772800000.00  
 73786962694838224128000 amp. \$101457078117753772800000.00; 2 for \$202914156235507545600000.00  
 1475739253967644824576000 amp. \$202914156235507545600000.00; 2 for \$405828312471015091200000.00  
 2951478507935289649152000 amp. \$405828312471015091200000.00; 2 for \$811656624942030182400000.00  
 5902957015870579298304000 amp. \$811656624942030182400000.00; 2 for \$1623313249884060364800000.00  
 1180591403174115859608000 amp. \$1623313249884060364800000.00; 2 for \$3246626499768120729600000.00  
 23611828063482317193216000 amp. \$3246626499768120729600000.00; 2 for \$6493252999536241459200000.00  
 47223656126964634386432000 amp. \$6493252999536241459200000.00; 2 for \$12986505999072483118400000.00  
 94447312253929268772864000 amp. \$12986505999072483118400000.00; 2 for \$25973011998144966236800000.00  
 188894624577857537545728000 amp. \$25973011998144966236800000.00; 2 for \$51946023996289932473600000.00  
 377789249155715075091456000 amp. \$51946023996289932473600000.00; 2 for \$103892047992578864947200000.00  
 755578498311430150182912000 amp. \$103892047992578864947200000.00; 2 for \$2077840959851577299894400000.00  
 1511156996222860300365824000 amp. \$2077840959851577299894400000.00; 2 for \$4155681919703154599788800000.00  
 3022313992455720600731648000 amp. \$4155681919703154599788800000.00; 2 for \$8311363839406309199577760000.00  
 6044627984911441201463296000 amp. \$8311363839406309199577760000.00; 2 for \$16622727678812618399155520000.00  
 12089255969822882882926592000 amp. \$16622727678812618399155520000.00; 2 for \$332454553576252367983110040000.00  
 24178511939645765765853184000 amp. \$332454553576252367983110040000.00; 2 for \$66490910715250473596622080000.00  
 4835702387929153153170736000 amp. \$66490910715250473596622080000.00; 2 for \$132981821425509471193244160000.00  
 9671404775858306306341472000 amp. \$132981821425509471193244160000.00; 2 for \$26596364285101894236488320000.00  
 193428095571666126126882944000 amp. \$265963642851

# INDEX TO ADVERTISERS

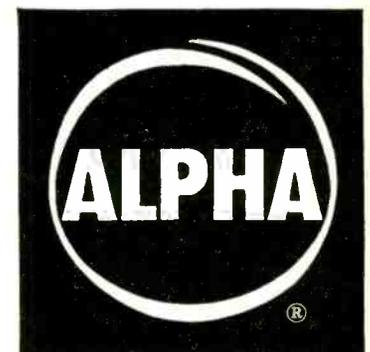
Acme Electric Corp.....	374	Burnell & Co., Inc.....	32A, 32B
Acme Wire Co.....	364	Burroughs Corp. Electronic Instruments Div.....	232
Adams & Westlake Company.....	47	Bussmann Mfg. Co.....	65
Advance Electric & Relay Co.....	304		
Advanced Vacuum Products, Inc.....	209		
Aeronautical Communications Equipment, Inc.....	76	CBS Hytron, A Div. of Columbia Broad- casting, Inc.....	58
Aerovox Corporation.....	289	Calidyne Company.....	283
Aircraft Transformer Corp.....	319	Cambridge Thermionic Corp.....	52
Airpax Products Co.....	26, 27	Cannon Electric Company.....	61
Allen-Bradley Co.....	48	Cannon Muskegon Corp.....	298
Allen Co., Inc., L. B.....	376	Carboloy Dept. of General Electric Co....	73
Allen Manufacturing Co.....	361	Carborundum Company.....	108
Allegheny Ludlum Steel Corp.....	124	Central Sales & Mfg. Corp.....	368
Allied Control Company, Inc.....	249	Chatham Electronics Corp.....	53
Allied Industries, Inc.....	261	Chicago Standard Transformer Corp.....	242
Allied Radio.....	366	Chicago Telephone Supply Corp.....	208A, 208B
Alloy Metal Wire Division, H. K. Porter Company, Inc.....	197	Cinch Mfg. Corp.....	179
Almo Radio Co.....	343	Cinema Engineering Co.....	376
Alpha Metals, Inc.....	411	City of Long Beach, Chamber of Com- merce.....	314
American Airlines, Inc.....	74	Clare & Co. C. P.....	121
American Electric Motors.....	254	Cleveland Container Co.....	201
American Gas Furnace Co.....	359	Clifton Precision Products Co., Inc.....	212
American Lava Corporation.....	57	Cohn Corp., Sigmund.....	347
American Phenolic Corp.....	189	Collectron Corporation.....	371
American Television & Radio Co.....	363	Collins Radio Co.....	45
American Time Products, Inc.....	88	Color Television, Inc.....	321
Ampex Corporation.....	245	Communication Accessories Co.....	115
Andrew Corporation.....	34	Computer Company of America.....	120
Aremac Associates.....	224	Computer-Measurements, Div. of the De- tectron Corp.....	337
Arnold Engineering Co.....	11	Consolidated Engineering Corp.....	348
Assembly Products, Inc.....	322	Consolidated Molded Products Corp.....	290
Atlantic Transformer Corp.....	351	Continental Communications, Inc.....	359
Atlas Engineering Co., Inc.....	263	Continental-Diamond Fibre Co.....	35
Automatic Electric Mfg. Co.....	234	Cornell-Dublier Electric Corp.....	101
		Corning Glass Works.....	236, 351, 363
		Cornish Wire Co., Inc.....	325
Ballantine Laboratories, Inc.....	257	Cosmic Condenser Co.....	339
Barker & Williamson, Inc.....	194	Coto-Coll Co.....	339
Barry Corp.....	15	Cramer Co., Inc., R. W.....	248
Belden Manufacturing Co.....	195	Cross Co., H.....	359
Bell Telephone Laboratories.....	54	Crucible Steel Co. of America.....	92
Bendix Aviation Corporation Eclipse-Pioneer Div.....	324	Cunningham, Son & Co., Inc. James.....	339
Red Bank Div.....	253		
Berndt-Bach, Inc.....	376	Dage Electric Company, Inc.....	340
Bird Electronics Corp.....	344	Dano Electric Co.....	321
Bircher Corporation.....	350	Daven Company.....	23
Boesch Mfg. Co., Inc.....	372	Daven Electronic Sales Corp.....	3rd Cover
Bourns Laboratories.....	240	Daystrom Instrument, Div. of Daystrom, Inc.....	295
Bowser, Inc.....	238	DeJur-Amsco Corporation.....	210
Bridgeport Brass Co.....	235	Dewey & Almy Chemical Company, Div. of W. R. Grace & Co.....	109
British Industries Corp.....	347		
Bruno-New York Industries Corp.....	49, 120		
Brush Electronics Co.....	208, 370		

## HAVING PRINTED CIRCUIT



## SOLDERING OR FLUX PROBLEMS?

*write or call*



A TRUSTED NAME  
in the  
ELECTRONIC INDUSTRY

The facilities of a modern, well equipped metallurgical laboratory, competent research staff and trained field engineers are available to help you solve printed circuitry problems.

**ALPHA METALS, INC.**

59 Water St., Jersey City 4, N. J.

**HEnderson 4-6778**

Specialists in

SOLDER, FLUXES for over 50 years  
Want more information? Use post card on last page.

# Let's face it!

## HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

### **BOMBS...OR FIRE...OR FLOOD...OR TORNADO ... you can handle them if you act now.**

Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

- Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.
- Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your

CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

- Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.
- Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

*Act now . . . check off these four simple points . . . before it's too late.*



Dialight Corporation	365
Diehl Manufacturing Company	256
Driver-Harris Co.	213
Dumont Airplane & Marine Instruments Inc.	338
Dumont Laboratories, Inc. Allen B.	271
DuPont de Nemours & Co., (Inc.) E. I. Polychemicals Dept.	48A, 48B

Eastern Air Devices, Inc.	223
Eastman Kodak Company	211
Edin Company Inc.	374
Edison Inc., Thomas A.	192
Edo Corporation	102
Eisler Engineering Co., Inc.	347, 376
Eitel-McCullough, Inc.	69
Electric Regulator Corp.	206
Electrical Industries, Div. of Ampere Electronic Corp.	267
Electronic Engineering Co. of California	196
Electronic Instrument Co. Inc. (EICO)	315
Electro-Seal Corp.	336
Electro Tec Corporation	123
Engineering Co., The	323
Engineering Research Associates, Div. of Remington Rand	323
Epco Products, Inc.	329
Erie Resistor Corp.	25

Fairchild Camera & Instrument Corp.	268
Fulstrom Company	331
Fansteel Metallurgical Corp.	328
Federal Telephone & Radio Company	81, 247
Film Capacitors, Inc.	250
Frenchtown Porcelain Company	369
Fugle-Miller Laboratories	373
Furst Electronics, Inc.	343

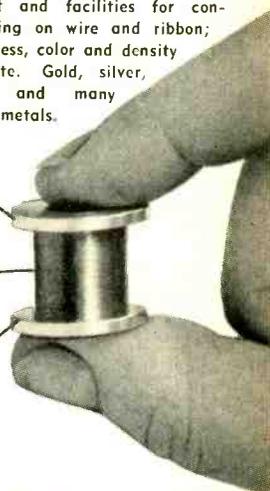
G M Laboratories, Inc.	325
Gamewell Company	301
General Electric Company Apparatus Dept.	50, 71, 118
Tube Dept.	64A, 64B
General Industries Co.	302
General Magnetics, Inc.	28
General Precision Equipment Corp.	104, 105
General Radio Company	17
Giannini & Co. Inc. G. M.	350
Good-all Electric Mfg. Co.	99
Goodmans Industries Limited	78
Graphite Metallizing Corp.	361
Green Instrument Co.	327
Gries Reproducer Corporation	416
Guardian Electric Mfg. Co.	84

Hallcrafters	346
Hamilton Manufacturing Co.	259

# SECON

## ELECTROPLATED WIRE & RIBBON

Both the equipment and facilities for continuous electroplating on wire and ribbon; uniform in thickness, color and density of electroplate. Gold, silver, rhodium and many other metals.



round •  
- oval  
flat —  
- grooved  
ribbon —

**precision small wire**

bare •  
insulated  
plated •

**for highly engineered applications**

all metals  
all alloys

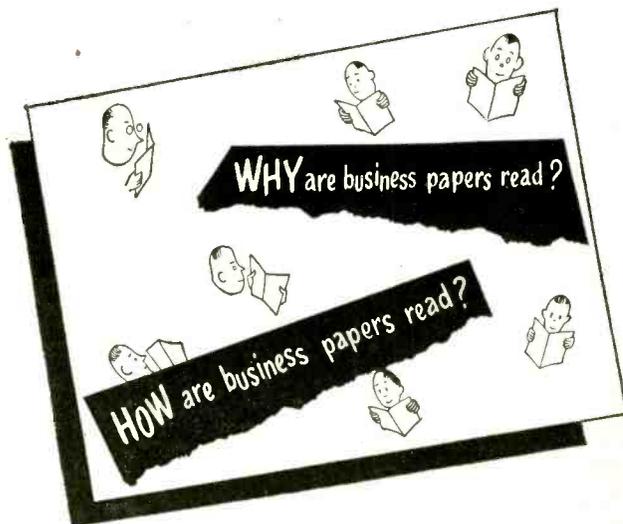
Precision potentiometer wire, components for electronic tubes, transistors, and crystal diodes, instrumentation wire, precision small wire & thin ribbon.



## development and production metallurgists SECON METALS CORPORATION

7 Intervale Street, White Plains, New York  
WHite Plains 9-4757

Write for Pamphlet E.



A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet."

McGraw-Hill Publishing Company, Room 2710, 330 West 42nd St., New York 36, N. Y.

Hamilton Watch Company, Allied Products Div. ....	116
Hammarlund Manufacturing Co. Inc. ....	21
Handy & Harmon .....	280
Hanovia Chemical & Mfg. Co. ....	325
Hardwick, Hindle, Inc. ....	233
Harrison & Co., Phillip H. ....	367
Harvey Hubbell, Inc. ....	211
Haydon Company, A. W. ....	348
Haydon Manufacturing Company, Inc. ....	292, 293
Heath Company .....	263
Helland, a Div. of Minneapolis-Honeywell .....	222
Hellpot Corporation, a Div. of Beckman Instruments, Inc. ....	185
Heinemann Electric Co. ....	43
Heldor Manufacturing Corp. ....	117
Henry & Miller Industries, Inc. ....	376
Heppner Manufacturing Co. ....	294
Hermetic Seal Products Co. ....	215
Hewlett-Packard Company .....	75
Heyman Manufacturing Co. ....	315
Homelite Corporation .....	332
Hopkins Engineering Co. ....	353
Hughes Aircraft Company. ....	199
Hughes Research & Development Labs. ....	198
Hycor Company, Inc. ....	359

ITE Circuit Breaker Company, Products Div. ....	193
Ilseco Copper Tube & Products Inc. ....	344
Indiana Steel Products Company. ....	64
Industrial Condenser Corp. ....	188
Industrial Control Company. ....	354
Industrial Development Div. State of Florida .....	216
Industrial Timer Corp. ....	96
Infra Electronic Corp. ....	368
Institute of Radio Engineers. ....	316
Instrument Corporation of America. ....	269
Instrument Resistors Co. ....	319
International Business Machines. ....	288
International Rectifier Corp. ....	276
International Resistance Company. ....	30, 31
Ippolito & Co., Inc. James. ....	315
Iron Fireman, Electronics Div. ....	94
Irvington Varnish & Insulator Div. of Minnesota Mining & Mfg. Co. ....	113

Jones Div., Howard B. Cinch Mfg. Corp. . 357

Kahle Engineering Co. ....	13
Karp Metal Products Co., Div. of H & B American Machine Co. ....	251
Kearfott Co., Inc. ....	258, 330
Kellogg Company, M. W. ....	240A, 240B
Kenyon Transformer Co., Inc. ....	342
Kepco Laboratories .....	32

## flower of the Engineered Plastics

### TEFLON and KEL-F

**Electrically**—The finest insulating materials known for VHF, UHF and microwave circuits operating in wide range of ambient temperatures and pressure altitudes to 80,000 feet.

**Chemically**—The only materials that are inert to all chemicals except molten alkali metals, fluorine under pressure and chlorine trifluoride.

**Physically**—The most anti-heave material known, as well as tough, resilient, wear resistant.

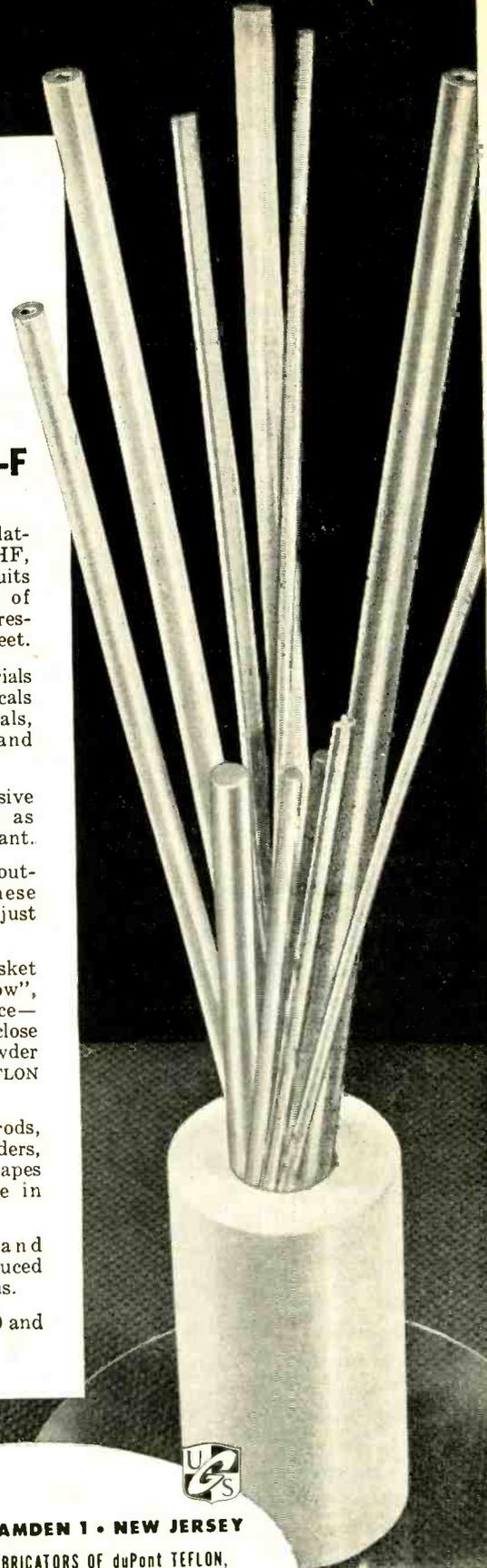
But to gain all their outstanding advantages, these materials must be handled "just right" in their fabrication.

The United States Gasket Company offers "Knowhow", based on long experience—specialized facilities—and close Quality Control "from powder to part" to assure you TEFLON and KEL-F at their best.

Stock includes sheets, rods, tubing, tape, bars, cylinders, beading, and extruded shapes (the most complete line in the country).

Precision molded and machined parts are produced to customers' specifications.

Ask for Bulletins No. 300 and No. 500.



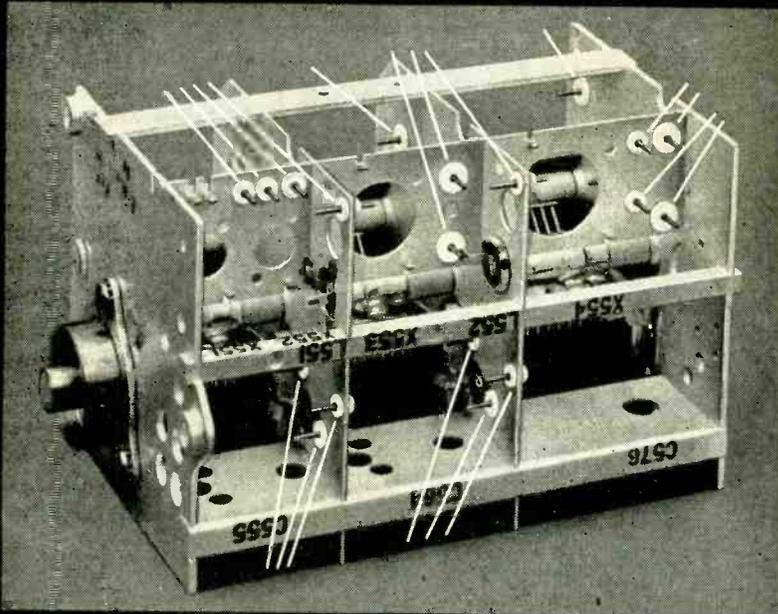
**UNITED  
STATES  
GASKET  
COMPANY**

**CAMDEN 1 • NEW JERSEY**  
FABRICATORS OF duPont TEFLON,  
Kellogg KEL-F AND OTHER PLASTICS

Representatives in Principal  
Cities Throughout the World



# replacing GLASS with TEFLON



## Chemelec Stand-Off and Feed-Through Insulators

● Tough, resilient TEFLON made these miniatures possible—and **BETTER**—than glass-insulated components.

**COMPRESSION MOUNTING**, without breakage.

**WITHSTAND SHOCK** and vibration in service.

**NO ADDITIONAL HARDWARE NEEDED.**

**ASSEMBLY COSTS GREATLY REDUCED.**

**THE PLASTIC'S "MEMORY"** securely locks insulators permanently in place. Minimum pull test 10 lbs., insulator to deck, hardware to insulator.

**MINIATURIZATION** is easily accomplished.

**INVESTIGATE** Chemelec Stand-Off and Feed-Through Insulators for superior service and lower assembly costs.

**SEVEN STOCK SIZES**, including sub-miniatures. Other dimensions feasible.

**WRITE** for Chemelec Bulletin EC-1153.

● TEFLON's superior insulating characteristics made these miniatures possible—and **BETTER**—especially for high frequency, high voltage or current, high temperature service.

**HIGHER** surface and volume resistivity.

**LOWER** loss factor and dielectric constant.

**HIGHER** dielectric strength.

**WIDER** service temperature range ( $-110^{\circ}\text{F}$  to  $+500^{\circ}\text{F}$ ).

**ZERO** water absorption (A.S.T.M. Test).

**WON'T CARBONIZE** under arcing or DC-plate.

**UNITED STATES GASKET COMPANY**

**FLUOROCARBON PRODUCTS, INC., DIVISION CAMDEN 1 • NEW JERSEY**

Representatives in Principal Cities Throughout the World

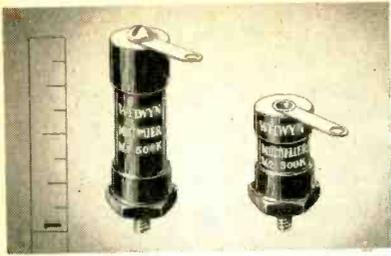


Kester Solder Co. ....	229
Ketay Instrument Corp. ....	90, 91
Keystone Products Company ....	107
Kinney Mfg., Division, New York Air Brake Company ....	127
Koiled Kords Inc. ....	286
Kollmorgen Optical Corp. ....	300
Krengel Manufacturing Co., Inc. ....	355
Kurman Electric Co., Inc. ....	313

Laboratory for Electronics ....	203
Lampkin Laboratories, Inc. ....	327
Lapp Insulator Co., Inc. ....	308
Lear Incorporated ....	55
Lewis & Kaufman Ltd. ....	187
Librascope, Inc. ....	329
Linde Air Products Company, Div. of Union Carbide & Carbon Corp. ....	367
Linear Equipment Laboratories, Inc. ....	357
Lockheed Missile Systems Div. ....	372
Loeb, Rhoades & Co. Carl M. ....	363
Loral Electronics Corp. ....	219
Lord Manufacturing Company. ....	29

M B Manufacturing Company, Inc. ....	42
Magnecraft Electric Co. ....	360
Magnetic Amplifiers, Inc. ....	345
Magnetics, Inc. ....	38
Magnatran, Inc. ....	290
Mallory and Co., Inc. P. R. ....	128
Mansol Ceramics Co. ....	353
Marconi Instruments, Ltd. ....	114
Marion Electrical Instrument Co. ....	68
Martin Company, Glenn L. ....	311
Maxson Corp., W. L. ....	273
McCoy Electronics Co. ....	272
Measurements Corporation ....	373
Metal Textile Corporation. ....	356
Metals & Controls Corp., General Plate Div. ....	46
Methode Manufacturing Corp. ....	282
Mica Insulator Co. ....	225
Mico Instrument Co. ....	327
Micro Switch, A Div. of Minneapolis-Honeywell Regulator Co. ....	106
Microdot Div. of Felts Corp. ....	368
Midland Mfg. Co., Inc. ....	63
Miles Reproducer Co., Inc. ....	376
Millen Mfg. Co., Inc., James. ....	239
Minneapolis-Honeywell Regulator Co. Industrial Div. ....	181
Transistor Div. ....	320
Minnesota Rubber & Gasket Co. ....	343
Monsanto Chemical Company ....	83
Muirhead & Co., Ltd. ....	3

N. J. Electronics Corp. ....	361
N. R. K. Mfg. & Engineering Co. ....	358
Narda Corporation, The. ....	262



## METER MULTIPLIER DEPOSITED CARBON RESISTORS

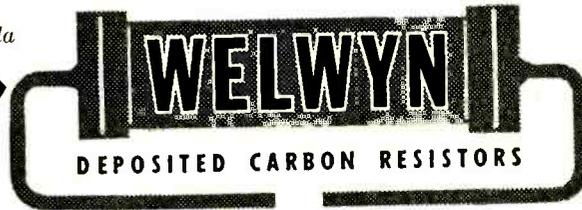
Designed specifically for panel instrument circuits, Welwyn Meter Multipliers offer definite advantages in both size and economy over previously employed, bulkier and costlier, wire wound units.

Welwyn Meter Multipliers find their greatest application where circuit performance permits stability limits in the order of .25% to .5%. Physically, these resistors are ideally suited for mounting in restricted space, yet they provide ample, convenient tie-in points for connecting other circuit components.

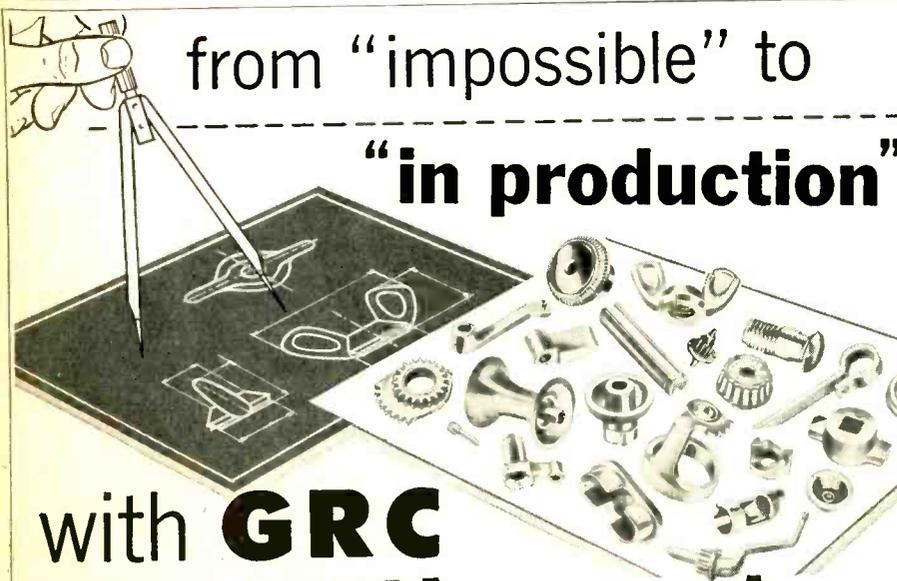
Welwyn Meter Multiplier values range from 20 ohms to 1 megohm.

*Manufactured in  
England and Canada*

For complete data  
and specifications  
write to Dept. LM-7



ROCKBAR CORPORATION 215 East 37th Street, New York 16, N. Y.



## from "impossible" to "in production" with **GRC** die cast **tiny parts**

The unusual flexibility of the Gries die casting technique may be the answer to your small parts problems. Thanks to the ingenuity of Gries' methods, you gain almost unlimited design latitude; your requirements—from the simplest to the most complex designs—are cast exactly to your specifications, swiftly, accurately, and economically. GRC zinc alloy parts are produced in one labor-saving, automatic operation. They require no trimming, and, in most cases, require no secondary operations. Gries' engineers have solved thousands of "impossible" problems for cost-minded industry.

Send prints for quotation; write today for bulletin and samples

**GRIES REPRODUCER CORP.**

151 Beechwood Avenue, New Rochelle, N. Y. • Phone NEw Rochelle 3-8600

Quick delivery on quantities  
of 100,000 to many millions.

**NO MINIMUM SIZE:**

Maximum Weight 1/2 oz.

Maximum Length: 1 3/4"

**GRIES** World's Foremost  
Producer of Small  
Die Castings

National Moldite Co.	183
National Pneumatic Co., Inc. & Holtzer-Cabot Divisions	119
National Vulcanized Fibre Co.	87
Natvar Corporation	231
New England Mica Company	355
New Hermes Engraving Machine Co.	367
New London Instrument Co.	329
Nopco Chemical Co.	100
Norden Laboratories Inc.	270
North American Aviation Inc.	319
North Hills Electric Co., Inc.	376
Northern Radio Company, Inc.	243
Nothelfer Winding Labs.	44
Oster Mfg. Co., John	307
P. M. Industries, Inc.	275
Pacific Scientific Co.	351
Panoramic Radio Products, Inc.	339
Par-Metal Products Corp.	321
Pentron Corporation, The	190
Perkin Engineering Corp.	317
Pernag Corp.	363
Peter Partition Corp.	355
Phalo Plastics Corp.	244
Phelps-Dodge Copper Products Corp., Inca Mfg. Div.	40, 41
Phaotron Co.	291
Philamon Laboratories, Inc.	85
Phillips Control Corp.	36, 37
Photocrystals, Inc.	371
Polarad Electronics Corporation	39
Polytechnic Research & Development Co., Inc.	287
Potter & Brumfield	80A, 80B
Precision Apparatus Co., Inc.	417
Precision Paper Tube Co.	278
Presto Recording Corp.	67
Progressive Manufacturing Co.	226
Pye, Ltd.	313
Radio Cores, Inc.	202
Radio Corporation of America	126, 4th Cover
Radio Engineering Laboratories, Inc.	205
Radio Materials Corp.	217
Radio Receptor Co., Inc.	125
Ram Meter, Inc.	370
Rattray & Co., Inc., George	347
Raytheon Mfg. Company	19, 95, 285
Resin Industries, Inc.	356
Resistoflex Corp.	316
Richardson Company, The	66
Richmont Inc.	371
Rockbar Corp.	416
Rotron Mfg. Co., Inc.	362
Royal Metal Manufacturing Co.	263

Sargeant & Wilbur Heat Treating Corp.	309	Vectron, Inc.	352
Scientific Radio Products, Inc.	255	Veeder-Root, Inc.	80
Secon Metals Corp.	413	Vickers Electric Div. Vickers Inc.	260
Servo Corporation of America	362	Vitramon Incorporated	323
Shalleross Mfg. Co.	296	Vulean Electric Co.	321
Sierra Electronic Corp.	297		
Sigma Instruments, Inc.	204		
Signal Engineering & Mfg. Co.	300		
Simmons Fastener Corp.	60	Waldes Kohinoor, Inc.	51
Sola Electric Co.	98	Ward Leonard Electric Company	96A, 96B
Sorensen & Co., Inc.	2	Waterman Products Co., Inc.	252
Southern Electronics Co.	317	Waters Manufacturing Inc.	310, 311
Southwestern Industrial Electronics Co.	200	Watlow Electric Mfg. Co.	365
Sprague Electric Co.	9, 79	Waveline, Inc.	281
Stackpole Carbon Co.	191	Welch Scientific Co., W. M.	354
Standard Telephones & Cables, Ltd.	306	Wenco Mfg. Co.	329
Sterling Engineering Company, Inc.	279	Weston Electrical Instruments Corp.	86
Sterling Transformer Corp.	371	Wheeler Insulated Wire Co., Inc.	299
Stevens Arnold Inc.	360	Wheeler Laboratories, Inc.	319
Stoddart Aircraft Radio Co., Inc.	211, 318	White Dental Mfg. Co., S.S.	271, 369
Stokes Machine Company, F. J.	62	Williams & Co., C. K.	342
Stone Paper Tube Co.	303	Wincharger Corp.	97
Struthers-Dunn, Inc.	277		
Superior Electric Co.	93		
Superior Tube Co.	56		
Switchcraft, Inc.	337		
Sylvania Electric Products, Inc.	7, 265		
		Zophar Mills, Inc.	327

Taylor Fibre Co.	207	PROFESSIONAL SERVICES	375
Technical Service Corp.	338		
Technicraft Laboratories, Inc.	317		
Technology Instrument Corp.	326, 349		
Tektronix, Inc.	82		
Telechrome Incorporated	221		
Texas Instruments Incorporated	72, 237		
Thomas & Skinner Steel Products Co., Inc.	220		
Thompson-Bremer & Co.	103		
Thompson Products, Inc.	284		
Transcoil Corp.	305		
Transitron Electronic Corp.	89		
Transradio Ltd.	366		
Tung-Sol Electric Inc.	77		

Ungar Electric Tools Inc.	367		
Union Carbide & Carbon Corp., Linde Air Products Div.	367		
Union Switch & Signal, Div. of Westinghouse Air Brake Co.	227		
United States Gasket Co.	414, 415		
United States Motors Corporation	246		
United States Radium Corp.	218		
United Transformer Co.	2nd Cover		
Universal Manufacturing Co., Inc.	351		
Universal Winding Company	33		
Variflex Corporation	59		
Varian Associates	112		

SEARCHLIGHT SECTION

(Classified Advertising)

H. E. HILTY, Mgr.

SEARCHLIGHT ADVERTISING INDEX

408, 409

This index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

# PRECISION

ANNOUNCES THE

## Model E-300

### SINE-SQUARE WAVE SIGNAL GENERATOR

(AUDIO-VIDEO RANGE)



The Series E-300 provides sine and square wave signals of high accuracy and stability for direct-performance testing of:

- ▶ High Fidelity Audio Amplifiers
- ▶ TV Video Amplifiers
- ▶ Carrier Current Systems, etc.

**GENERAL SPECIFICATIONS**

- ★ Variable-Frequency Sine Wave Ranges: 20 Cps. to 200 KC. in Four Bands.
  - ★ Variable Frequency Square Wave Ranges: 20 Cps. thru 20,000 Cps. In Three Bands.
  - ★ Four Fixed, High-Frequency Square Waves: for analysis of wide-band amplifiers up to 20 MC band width: 50 KC.—100 KC.—250 KC.—500 KC. steps.
  - ★ Output Characteristics:
    - Variable Frequency Ranges: 0-2000 ohms, 0-10 volts RMS, ± 1 db.
    - Accuracy: ± 2% from 50 cycles to 200 KC.
    - ± 1 cycle from 20 cycles to 50 cycles.
    - Distortion: Less than 1% from 20 cycles through 200 KC.
    - 20 KC Square Wave Rise Time: .5 microseconds.
    - Fixed High Frequency Square Waves: 0-250 ohms, 0-5 volts P-P
    - Rise Time: .05 microsecond
    - Overshoot: Negligible
  - ★ Tube Complement: 1-5879, 1-6CL6, 1-6J6, 2-6AU6, 1-6BL7, 1-6AH6, 1-6X4.
  - ★ Separate Output Circuits: for the variable and fixed frequency ranges.
  - ★ Terminated, Low-Loss, High Frequency Coaxial Output Cable
  - ★ External 'Sync' Terminal Post: for synchronizing scope to H.F. square wave.
  - ★ Etched-Anodized Tuning Dial and Panel
- MODEL E-300: in black, ripple finished, portable steel case — 10½ x 12 x 6". Complete with tubes, coaxial, output cable and operating manual. Net Price \$175.00

**PRECISION APPARATUS CO., INC.**

70-31 84th Street, Glendale 27, L. I., N. Y.

Export: 458 Broadway, New York 13, U. S. A.  
Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 28

Want more information? Use post card on last page.

# Index to

# electronics

VOLUME XXVII

1954

January to December Issue Inclusive

McGraw-Hill Publishing Company 330 West 42nd St New York 36

## A

A-C matching of resistors.....200D Apr  
 Accelerator fights cancer.....220D May  
 Accelerator for cancer research.....200D Apr  
 Accelerator for food industry.....180D Sept  
 Accelerator, power supply for 3-bev. 160 Feb  
 Accelerometer, shake table for testing.....178 June  
 Accounting machine, decade counter tube for.....151 Nov  
 Accurate beat-frequency measurements, Schlicke.....196D Nov  
 Adding uhf-tv coverage.....226D Oct  
 Adjustment procedures for color tv production, McClane.....140 Aug  
 AFC using inductor control.....244D Feb  
 AGC for transistor amplifiers.....224D Jan  
 AGC, sequentially gated.....186 June  
 Air control improves relays.....294D Oct  
 Aircraft antennas, servocoupler matches.....188 Oct  
 Aircraft, computer controls.....218D June  
 Aircraft, designing flush antennas. 136 Mar  
 Aircraft, designing supersonic radomes.....130 Jan  
 Aircraft fuel gage, temperature-compensated.....160 Sept  
 Aircraft, infrared detector.....180D Aug  
 Aircraft, radar solution to mid-air collisions.....146 Nov  
 Aircraft, radio control rescue boat. 130 Mar  
 Aircraft radio, tones provide private lines.....196D May  
 Aircraft receiver for VOR-ILS-communications, Gray.....180 June  
 Aircraft, recorder monitors test flight.....192D Sept  
 Air-sea rescue system.....204D Apr  
 Alignment of color tv receivers.....140 Aug  
 Altitude corrector for tracking radars, McQuistan.....157 June  
 Amplifier, audio, general purpose.....203D Jan  
 Amplifier, cascode audio.....156 Mar  
 Amplifier, d-c. for computer.....188 Apr  
 Amplifier, design chart for video.....190 Jan  
 Amplifier, design of transistor power.....146 Mar  
 Amplifier, dielectric, building and using.....150 Feb  
 Amplifier, fast-response logarithmic.....190 Mar  
 Amplifier, fifty-watt audio.....160 Oct  
 Amplifier, gain-stabilized transistor. 183 Feb  
 Amplifier, high-frequency transistor.....142 Apr  
 Amplifier, high-power visual.....220D May  
 Amplifier, high sensitivity d-c.....206D Jan  
 Amplifier, magnetic, for synchronous motors.....133 Mar  
 Amplifier, magnetic, negative inductance cuts lag.....162 Jan  
 Amplifier, magnetic using conventional inductors.....181 Jan  
 Amplifier, mechanical register.....206D Dec

Items for which the page reference is marked "D" are editorial material published monthly in *Electronics at Work and Production Techniques*.

Amplifier, phototube chopper for d-c.....226D Mar  
 Amplifiers, power transistors for.....144 Jan  
 Amplifier, push-pull transistor, in bioelectric integrator.....176 May  
 Amplifier, sensitive, for medical research.....164 Apr  
 Amplifier, square wave.....214D Feb  
 Amplifier, thyatron protects.....208D Oct  
 Amplifier, time-shared computer.....188 Apr  
 Amplifier, transformerless audio.....176 Feb  
 Amplifier, transistor a-f.....208D Dec  
 Amplifier, transistor, cascading.....158 Jan  
 Amplifier, transistor, feedback in.....129 Nov  
 Amplifier, temperature-stabilized transistor, two-stage transistor.....144 June  
 Amplifier, two-stage transistor.....169 Apr  
 Amplifiers, age for transistor.....224D Jan  
 A-M system measures microwave attenuation.....175 Jan  
 Analog computer, see computer  
 Antenna, aircraft, servocoupler matches.....188 Oct  
 Antenna, automatic deicing.....152 Jan  
 Antenna, cosecant for uhf-tv.....138 June  
 Antenna, delay-line dummy load.....167 June  
 Antenna, designing, for aircraft.....136 Mar  
 Antenna, measuring microwave, pattern.....184D Nov  
 Antenna pattern, predicted by ship model.....162 Apr  
 Antenna, switching system.....192 Mar  
 Arc-lamp tachistoscope improves reading speed, Spaven.....174 May  
 Array, see also antenna  
 Assembly techniques, Schick..(insert) M-45 Oct  
 Astronomy, measurement of star position.....158 June  
 Astronomy, radar antenna follows stars.....180D Sept  
 Atmospheric research, balloon-borne radiation telemetering.....138 May  
 Atmospheric research, rawinsonde. 196D Apr  
 Atmospheric research, rocket-borne photometer.....151 Sept  
 Atomic battery.....212D July  
 Atom smasher to fight cancer.....200D Apr  
 Attenuation, see also attenuators  
 Attenuation, a-m system for microwave measurements.....175 Jan  
 Attenuation, delay line, reduced by transistor amplifier.....181 May  
 Attenuator, low distortion electronic.....220D Oct  
 Attenuator, rotary, for microwave.....184 Jan  
 Audio amplifier, cascode.....156 Mar  
 Audio amplifier, fifty-watt.....160 Oct  
 Audio amplifier, gain-stabilized transistor.....183 Feb

Audio amplifier, general purpose.....203D Jan  
 Audio amplifier matches voice-coil impedance, Onder.....176 Feb  
 Audio equipment for binaural broadcasts, Kleinklaus.....134 Feb  
 Audio filter, tunable.....173 Nov  
 Audio oscillator uses new R-C design, Owens.....176 Mar  
 Audio, power transistors.....144 Jan  
 Audio, signal-operated tone control. 141 Mar  
 Audio source, transistor.....182D Dec  
 Audio, standby console.....141 Mar  
 Audio, transistor volume compressors and expanders.....224D Jan  
 Automatically deiced X-band beacon antenna.....152 Jan  
 Automatically plotting electrostatic field lines, Andrews.....182 Oct  
 Automatic assembly, ceramic tube mount.....162 Aug  
 Automatic circuit tester speeds production, Stahl & West.....136 Oct  
 Automatic control for crucible heat. 149 Feb  
 Automatic control, for shaft position.....134 Aug  
 Automatic control, machine tool.....124 Nov  
 Automatic control, marker pulse shows shaft position.....146 May  
 Automatic control, sorting crayons. 150 July  
 Automatic equipment turns over tv consoles in cartons.....264D Mar  
 Automatic frequency control, see AFC  
 Automatic gonophotometer measures gloss.....196D Apr  
 Automatic inspection, void detector for tape.....136 Jan  
 Automatic measurement of star positions, Lentz & Bennett.....158 June  
 Automation, see automatic control  
 Automobiles, hardness tester for parts.....160 Dec  
 Automobiles, tape recording in research.....154 Feb  
 Automobiles, wheel balancing by vibration pickup.....236D Mar  
 Axle tester, tape recorder controlled.....130 July

## B

Baffles reduce punch-press noise.....253D July  
 Balancer for automobile wheel.....236D Mar  
 Balloon-borne radiation telemetering system, Burgwald & Reiffel.....138 May  
 Banana-plug switch, high voltage.....256 Mar  
 Battery-powered a-c voltmeter, Fleming.....216D Jan  
 Battery, solar.....196D June  
 Battery, solar, improved.....184D Dec  
 Battery, switch for conservation. 250D Mar  
 Battery, tritium.....212D July  
 Beam-deflection tube simplifies color decoders, Adler & Heuer.....148 May

Beat-frequency, cros measurement of 24D Apr  
 Beat frequency measurement 196D Nov  
 Bending tool for springs 234D Aug  
 Bias control for i-f limiters, Bishop 200D June  
 Bias supplies for direct-coupled circuits, Reaves 172 Aug  
 Binary reader, magnetic matrix 157 May  
 Binaural broadcast, audio equipment for 134 Feb  
 Binaural broadcasts use multiplexed f-m 194D Feb  
 Bioelectric integrator uses two transistors, Ford 176 May  
 Bioelectric potentials, amplifier for 164 Apr  
 Biophysics, see medical electronics  
 Birds, tape recording scares 212D May  
 Blind, cane guides sightless 186D Nov  
 Blind, echo location for 136 Dec  
 Blind, pointer and line locator 194D Feb  
 Boat, radio controlled rescue 130 Mar  
 Body characteristics in heat diathermy 172 Mar  
 Breadboard, for training 184D Aug  
 British electronic developments 228D Jan  
 Britain uses industrial controls, Jupe 216D May  
 Broadband rotary waveguide attenuator, Hand 184 Jan  
 Broadcast receiver, design of f-m mobile 130 May  
 Broadcast transmitter switching system, Knaack 192 Mar  
 Broadcasting, see also binaural, f-m, television  
 Broadcasting, audio equipment for binaural 134 Feb  
 Broadcasting, binaural, using multiplexed f-m 194D Feb  
 Broadcasting, color filter for monochrome tv 216D Oct  
 Broadcasting, color test techniques 120 Nov  
 Broadcasting, color video tester checks distortion 128 Sept  
 Broadcasting, conelrad receiver 156 Jan  
 Broadcasting, cosecant antenna 138 June  
 Broadcasting, film scanner for monochrome or color 152 Aug  
 Broadcasting, frequency control for multiple transmitter 142 Sept  
 Broadcasting, measuring tv sound modulation 212D June  
 Broadcasting, portable sync generator 138 Apr  
 Broadcasting, pulse distribution in tv network origination 166 Aug  
 Broadcasting, standby audio console 141 Mar  
 Broadcasting, transistor gun for tv 137 May  
 Broadcasting, tv flying-spot slide scanner 134 July  
 Broadcasting, tv station monitor 153 July  
 Broadcasting, visual amplifier 220D May  
 Broadcasting, wireless mobile camera 210D July  
 Building and using dielectric amplifiers 150 Feb

**C**

Cabinet design (insert) M-57 Oct  
 Cable, capacitance gage checks 134 Apr  
 Calculator, see computer  
 Camera adapter for tv receivers, Flory, Pike, & Gray 141 Jan  
 Camera, wireless mobile tv 210D July  
 Cameras, multixposure flash for high-speed 180 Feb  
 Cancer research, accelerator for 200D Apr  
 Cane guides sightless 186D Nov  
 Capacitance, see also capacitor  
 Capacitance gage checks cable sheath thickness, Wojciechowski 134 Apr  
 Capacitor, fixed, trends in 120 July  
 Capacitor Production Techniques  
 Air cylinders speed terminal spinning 27D Feb  
 Punched mounting for metal-can 266D June  
 Capacitor, variable, trends in 130 Aug  
 Capacitor voltage multiplier 182D July  
 Captive screwdriver for self-tapping screws 270D Mar  
 Card reader, phototransistor 216D July  
 Carrier, color, stabilizing reinsertion 142 July  
 Carrier radio, frequency control 142 Sept  
 Carrier system, transistors simplify 192D May  
 Cascading transistor amplifier stages, Coblenz & Owens 158 Jan  
 Cascode audio amplifier has low noise level, Price 156 Mar  
 Cathode emission studies, high-power pulser for 178 Mar  
 Cathode-ray tube, dark trace, has high writing speed 154 Dec  
 Cathode-ray tube display for spectrophotometer 196D July  
 Cathode-ray tube storage devices 184 Oct  
 Cavity-resonator design charts, Spencer 186 May  
 Centrifuge, magnetic suspension 152 Mar  
 Ceramic tube mount for automatic assembly, Palmer 162 Aug  
 Characteristics of ring recording heads, Gratian 184D Sept  
 Chart, cavity resonator design 186 May  
 Chart, circular waveguide 194 Oct  
 Chart, radar doppler 180 Dec

Chart, radio spectrum . . . Insert and 210D Mar  
 Chart, thermistor characteristic 178 Aug  
 Chart, video amplifier design 190 Jan  
 Chassis design (insert) M-5 Oct  
 Chopper, photoelectric d-c 162 Nov  
 Chopper, phototube 226D Mar  
 Circuit analysis, frequency response in four-terminal network 220D Feb  
 Circuit analysis, transistor equations using h-parameters 191 Apr  
 Circuit, d-c, bias supply for 172 Aug  
 Circuit, feedback in junction transistor 174 July  
 Circuit tester, automatic 136 Oct  
 Circuit, transistor amplifier 158 Jan  
 Circuit, tuning, designing wide-range 174 Aug  
 Circuit, unilateral four-terminal 136 Feb  
 Circular-waveguide chart, Hudson 194 Oct  
 Circular radar cuts rain clutter, White 158 Mar  
 Circuits, crystal oscillator 200D May  
 Citizen's radio, portable transceiver circuit 204D May, 218D July  
 Civil defense, conelrad random sequence switching 165 Feb  
 Civil defense, conelrad receiver 156 Jan  
 Cleaner for drill press 254D Oct  
 Cleaning and oiling components 260D Oct  
 Clean-up in thyatron circuits 198D Mar  
 Closed circuit tv, camera adapter 141 Jan  
 Clutter, antenna cuts 158 Mar  
 Coil, see also inductor  
 Coil design, wide-range tuning 174 Aug  
 Coil, high-frequency use new materials 140 Dec  
 Coil Production Techniques  
 Air-driven winder 244D Apr  
 Applying dolflex coating 278D June  
 Crimping and stitching leads 246D Aug  
 Forms for threaded cores, Blair 300D Oct  
 Winding vhf coils 302D Mar  
 Color bar generator produces I-Q signals, Bosca 143 June  
 Color carrier, stabilizing reinsertion 142 July  
 Color demodulators for television receivers, Clark & Phillips 164 June  
 Color filter for monochrome broadcasts 216D Oct  
 Color signal, for single-gun tube 168 Sept  
 Color television, see also television  
 Color television, adjustment 140 Aug  
 Color television, beam-deflection tube decoder 148 May  
 Color television, conversion of monochrome i-f strip for 170 July  
 Color television, demodulator 164 June  
 Color television, film scanner 152 Aug  
 Color television, I-Q bar generator 143 June  
 Color television, pulsed-envelope detector 142 Mar  
 Color television receiver design 136 Feb  
 Color television, sine-square pulses tests 138 Dec  
 Color television, stabilizing carrier reinsertion 142 July  
 Color test techniques for tv broadcasters, Wentworth 120 Nov  
 Color video tester checks distortion, Kelly 128 Sept  
 Communications, aircraft receiver for VOR-ILS and 180 June  
 Communications, diffraction-gain transmission 196D May  
 Communications, high speed keying for 148 Dec  
 Communications, infrared modulator 155 Oct  
 Communications, inside speech clipper 186 Dec  
 Communications, microwave market 152 Oct  
 Communications, multichannel f-m 126 July  
 Communications, portable transceiver circuit 204D May, 218D July  
 Communications, predicted-wave teleprinter 166 Dec  
 Commutation factor in thyatron circuit design, Marshall & Shackelford 198D Mar  
 Compensation, temperature, for aircraft fuel gages 160 Sept  
 Component design trends, fixed capacitors 120 July  
 Component design trends, fixed resistors 132 Sept  
 Component design trends, high-frequency coils 140 Dec  
 Component design trends, iron core transformers 136 Nov  
 Component design trends, precision potentiometers 144 Oct  
 Component design trends, variable capacitors 130 Aug  
 Computer, aircraft control 218D June  
 Computer, analog, balanced d-c for 212D Jan  
 Computer, analog, for radar altitude corrector 157 June  
 Computer, analog, multiplier for 144 Sept  
 Computer, binary output reader 157 May  
 Computer, digital, memory for Whirlwind 226D Aug  
 Computer, digital, shaft position control 134 Aug  
 Computer for pulse-width ratio 164 Jan  
 Computer, FOSDIC input system 236D Feb  
 Computer, instantaneous multiplier for 144 Feb  
 Computer, saturable transformer used as gate transformer 174 Sept  
 Computer, tape recorder storage 166 July

Computer, time-shared amplifier 188 Apr  
 Computer, tube failure in SEAC 212D Mar  
 Computer, welded diode reduce bulk 154 Nov  
 Condenser, see Capacitor  
 Conelrad, random sequence switching 165 Feb  
 Conelrad receiver with built-in alarm, Quenstedt 156 Jan  
 Consistency recorder 210D Apr  
 Console, standby audio 141 Mar  
 Continuous film scanner for monochrome and color, Traub & Fisher 152 Aug  
 Continuous phase shifter, Whitaker 202 Dec  
 Control, see also automatic control  
 Control, air-sea rescue boat 130 Mar  
 Control, frequency, for multiple transmitters 142 Sept  
 Control, for crucible heat 149 Feb  
 Control, ground, for helicopter 196D Mar  
 Control, magnetic amplifier for synchronous motor 133 Mar  
 Control, photoelectric, for gas concentration 196D Feb  
 Control room, mobile tv 182D July  
 Control, simple remote 210 Dec  
 Control, tape recorder for truck axle tester 130 July  
 Conversion of monochrome i-f strips 170 July  
 Converted limousine aids tv pickup, Weiland 196D Jan  
 Converter, digital-to-analog 134 Aug  
 Converter, transistor 212D Sept  
 Converter, transistor, sine wave to pulse 160 May  
 Converter Belt Production Techniques  
 Belt for brazing 248D June  
 Green belt reduces eye fatigue 292D Feb  
 Instrument railway aids calibration 242D Apr  
 Motorized benchtop and turntables 262D Mar  
 Pallets on rails 234D Sept  
 Core materials for high-frequency coils 140 Dec  
 Corrector, altitude, for tracking radar 157 June  
 Correlation computer, instantaneous multiplier 144 Feb  
 Cosecant antenna aids uhf-tv coverage, Martin & Ruzic 138 June  
 Cosmotron, power supply for 160 Feb  
 Counter, digital, frequency meter 189 June  
 Counter, hard tube operates magnetic pulse 186D Sept  
 Counter, lightning stroke 158 Oct  
 Counter, single-tube decade 174 Oct  
 Counter, staircase generator pulse 187 Mar  
 Counter tube, decade, for accounting machine 151 Nov  
 Counter, using ferroresonant flip-flop 152 May  
 Crayons, photoelectric gage for sorting 150 July  
 CRO measurement of beat frequencies, Frell 224D Apr  
 Crucible heat control, Siau 149 Feb  
 Crystal, grinding vhf 161 Mar  
 Crystal growing, vacuum furnace for 214D Mar  
 Crystal oscillator circuits 200D May  
 Crystal-controlled oscillator, transistor 171 Sept  
 Crystals reduce mobile interference, Manke & Myers 154 Sept  
 Current-limited variable power supply, Deming 206D Oct  
 Current-step waveform generator, Babits, Spengler & Morris 164 Mar  
 Curve tracer, pulsed, for semiconductors 172 Sept

**D**

Dark-trace display tube has high writing speed, Nozick, Burton & Newman 154 Dec  
 Data translating, digital-to-analog 134 Aug  
 D-C amplifier, high sensitivity 206D Jan  
 D-C power supply 165 Oct  
 D-C recording, magnetic pickup head for 156 Sept  
 Decade counter, single tube 174 Oct  
 Decade counter tube for accounting machines, Koehler & Richards 151 Nov  
 Decibel, power level chart 194 June  
 Decision elements, chart testing magnetic 200D Jan  
 Decoder, beam-deflection tube for color tv 148 May  
 Deicing of radar antennas 152 Jan  
 Delay-line dummy load has high power rating, Brueckmann 167 June  
 Delay line using transistor amplifiers 181 May  
 Delay time, extending multivibrator 232D Feb  
 Demodulation, see also modulation  
 Demodulator, color, for tv receivers 164 June  
 Demodulator, color, I-Q generator for 143 June  
 Demodulator, for color tv 148 May  
 Demodulator, radar pulse 170 June  
 Demonstrating efficiency of sampling techniques 294D Feb  
 Density measurement, sensitive microphotometer 196D Mar  
 Design chart, for cavity resonators 186 May  
 Design chart, video amplifier 190 Jan

Design, eliminating ringing in tv circuit ..... 162 May  
 Design, ferroresonant flip-flop ..... 152 May  
 Design, mobile f-m receiver ..... 130 May  
 Design of military equipment ..... 230D Aug  
 Design of R-C audio oscillator ..... 176 Mar  
 Design of transistor power amplifiers.  
 Ghandhi ..... 146 Mar  
 Design techniques for color television receivers, Kronenberg & White ..... 136 Feb  
 Designing flush antennas for high speed aircraft, Granger ..... 180D Aug  
 Designing radomes for supersonic speeds, Olesky ..... 130 Jan  
 Designing surface-wave transmission lines, Gorbau ..... 180 Apr  
 Designing the cabinet, Muller, (insert) M-57 Oct  
 Designing the chassis, Lesser, (insert) M-5 Oct  
 Designing wide-range tuning circuits, Johnson ..... 174 Aug  
 Detecting voids in insulating tape, Anderson ..... 136 Jan  
 Detector, for high noise levels ..... 210D June  
 Detector, infrared for aircraft ..... 180D Aug  
 Detector, moving target ..... 169 Aug  
 Detector, moving target ..... 138 Sept  
 Detector, phase-selective ..... 188 Feb  
 Detector, pulsed-envelope ..... 142 Mar  
 Dielectric amplifiers, building and using ..... 150 Feb  
 Diffraction-gain transmission ..... 196D May  
**Digital computer, see computer**  
 Digital servomechanism controls shaft position, Thomasson ..... 134 Aug  
 Diode, germanium, voltmeter ..... 212D Feb  
 Diode, welded joints ..... 154 Nov  
 Direct-coupled circuits, bias supply for ..... 172 Aug  
 Direct-reading Grenz-ray dosimeter, Weisbecker & Steinitz ..... 168 Oct  
 Direct vswr readings in pulsed r-f systems, Rosenthal & Badoyannis ..... 162 Dec

**Directional antenna, see antenna**  
 Distributed amplifier for nuclear research, Enslin ..... 138 July  
 Distributed transducer for ultrasonic power, Rabinow and Apstein ..... 160 July  
 Distribution, pulse, in tv network origination ..... 166 Aug  
 Diversity reception, single-channel ..... 158 Aug  
 Doppler, pulsed, in moving target detector ..... 138 Sept  
 Doppler radar, nomograph ..... 180 Dec  
 Dosimeter, direct-reading ..... 168 Oct  
 Drafting, electronic tools and techniques ..... 120 Aug  
 Drilling, transducer for ultrasonic, 214D Apr  
 Dual-mode horn feed for microwave multiplexing, LeVine & Sichak ..... 162 Sept  
 Dummy load, delay-line ..... 167 June  
 Duplexer, using dual t-r tube ..... 149 Aug

**E**

Echo-location for the blind, Witcher & Washington, Jr. .... 136 Dec  
 Electric and ultrasonic deep-heating diathermy, Schwan, Carstensen & Li ..... 172 Mar  
**Electrocardiograph, see medical electronics**  
 Electron-beam pickup head has d-c response ..... 158 Sept  
 Electronic air-war game simulates missile strikes, Davis ..... 146 Apr  
 Electronic drafting tools and techniques ..... 120 Aug  
 Electronic filter for central power supplies, Riggs & Cronin ..... 174 Feb  
 Electronic juggler, Whaley and Godet ..... 204D July  
 Electronic shake table, Honnell ..... 178 June  
 Electronic store dick ..... 198D June  
 Electronics in the oil industry, Carroll ..... 120 Sept  
 Electronically tuned wide-range oscillator, King & Konigsberg ..... 184 Mar  
 Electron microscope, water flow safety interlock ..... 194D May  
**Electron Tube, see also Tube**  
 Electron tubes, military reliability ..... 130 Apr  
 Electrostatic generator, printed ..... 222D Apr  
 Electrostatic speaker accents high frequencies, Hobbs ..... 143 Nov  
 Emission plotter, high-power pulser ..... 178 Mar  
 Equipment design, military ..... 230D Aug  
 Equipment, reliability check list ..... 176 Nov  
 Extending multivibrator delay time, Kaufer ..... 232D Feb

**F**

Failure of military tubes ..... 130 Apr  
 Faraday shutter freezes transient ..... 198D Feb  
 Fastening techniques, (insert) M-45 Oct  
 Fast-response magnetic servo amplifier, Hill & Fingerett ..... 170 Oct

Feedback in junction transistor circuits, Gade ..... 174 July  
 Feedback simplifies transistor amplifier, Schenkerman ..... 129 Nov  
 Ferrite-core transformer used as gate ..... 174 Sept  
 Feedback, transistors use emitter-coupled ..... 188 Dec  
 Ferroresonant flip-flop design, Rutishauser ..... 152 May  
 Field, electrostatic, plotting automatically ..... 182 Oct  
 Field pulses produce nuclear spin echoes, Malling ..... 134 June  
**Field strength, see propagation**  
 Fifty-watt amplifier for high-quality audio, Bereskin ..... 160 Oct  
 Film marker, high speed ..... 202D Nov  
 Filter, color, for monochrome broadcast ..... 216D Oct  
 Filter, crystals reduce mobile interference ..... 154 Sept  
 Filter, electronic, for power supplies ..... 174 Feb  
 Filter, tunable audio ..... 173 Nov  
 Fixed capacitors undergo miniaturization, Rockett ..... 120 July  
 Fixed resistors show stability improvements, Rockett ..... 132 Sept  
 Flash for high-speed cameras ..... 180 Feb  
 Flaw detection, in tape ..... 136 Jan  
 Flip-flop, design of ferroresonant ..... 152 May  
 Flip-flop, transistor, using two frequencies ..... 175 June  
 Flush antennas for aircraft ..... 186 Mar  
 Fluxmeter, recording ..... 147 July  
 Flying infrared detector spots aircraft ..... 180D Aug  
 Flying-spot scanner, for monochrome or color ..... 152 Aug  
 Flying-spot slide scanner ..... 134 July  
 F-M, binocular using multiplexed ..... 194D Feb  
 F-M receiver design, mobile ..... 130 May  
 F-M tape recording, for vehicular research ..... 154 Feb  
 F-M tape recording, truck axle tester ..... 130 July  
 Foil, used as shielding ..... 180D July  
 FOSDIC feeds figures ..... 236D Feb  
 Four-channel FSK adds radio circuits, Buff ..... 156 July  
 Four-megawatt klystron ..... 200D Nov  
 Four-terminal network, frequency response ..... 220D Feb  
 Four-terminal network, transistor equations using h-parameters ..... 191 Apr  
 Four-terminal network, unilateral, 186 Feb  
 Frequency code telemetering system, Schultheis ..... 172 Apr  
 Frequency control for multiple transmitters, Flory ..... 142 Sept  
 Frequency, cro measurement of beat ..... 224D Apr  
 Frequency deviation indicator, Harned & Shorkey ..... 214D Aug  
 Frequency diversity reception, single-channel ..... 158 Aug  
 Frequency meter uses digital counters, Boff ..... 189 June  
 Frequency-modulated uhf transmitter, Gates ..... 238D Feb  
**Frequency Modulation, see also broadcasting, communication, f-m, etc**  
 Frequency-modulation, multichannel marine ..... 126 July  
 Frequency response in four-terminal networks, Konigsberg ..... 220D Feb  
 Frequency synthesizer ..... 230D Feb  
 FSK, four-channel ..... 156 July  
 Fuel gage, aircraft, temperature-compensated ..... 160 Sept  
 Fungi attack army equipment ..... 190 June  
 Furnace, for crystal growing ..... 214D Mar  
 Furnace sample holder, Soled & MacDonald ..... 257D Dec

**G**

Gage, aircraft fuel, temperature-compensated ..... 160 Sept  
 Gage, capacitance, for sheath thickness ..... 134 Apr  
 Gage, for shell inspection ..... 196D Jan  
 Gage, microwave, for surface irregularities ..... 210D Aug  
 Gage, noncontacting microdisplayment ..... 172 June  
 Gage, photoelectric, for sorting crayons ..... 150 July  
 Gage, runoff determined by radioactive snow ..... 220D Mar  
 Gage, time interval go-no go ..... 208D Aug  
 Gage, ultrasonic, for liquid levels ..... 156 Apr  
 Gain control, automatic, sequentially gated ..... 186 June  
 Gain-stabilized transistor amplifier, Krause ..... 183 Feb  
 Game, electronic air-war ..... 146 Apr  
 Gas concentration, photoelectric control for ..... 196D Feb  
 Gas discharge, microwave applications ..... 168 Nov  
**Gas discharge tube, see tubes**  
 Gate, saturable transformer used as ..... 174 Sept  
 Gated marker generator, Jensen ..... 177 Apr  
 Gated time markers for cro display ..... 150 Mar

Geiger counter, transistor power supply for ..... 144 Aug  
 Generating r-f power for 3-bev accelerator, Rogers & Plotkin ..... 170 Feb  
 Generator, current-step waveform ..... 164 Mar  
 Generator, gated marker ..... 177 Apr  
 Generator, gunshot ..... 137 May  
 Generator, I-Q color bar ..... 143 June  
 Generator, locator guides helicopter ..... 196D Mar  
 Generator, microsecond spike ..... 182D Sept  
 Generator, multipulse ..... 173 May  
 Generator, noise, for air-weapons ..... 163 July  
 Generator, portable sync ..... 138 Apr  
 Generator, printed electrostatic ..... 222D Apr  
 Generator, pulse, transistor ..... 188D July  
 Generator, pulse, transistor ..... 165 Sept  
 Generator, r-f, for synchrocyclotron ..... 142 May

**Generator, signal, see also oscillator**  
 Generator, square-wave, radar pulse demodulator ..... 170 June  
 Generator, square-wave, single tube ..... 206D June  
 Generator, staircase, for pulse counting ..... 187 Mar  
 Generator, step-function, for transient recording, transistor pulse ..... 160 May  
 Generator, waveform, for shake table ..... 178 June  
 Geophysics, electronics in oil industry ..... 120 Sept

**Germanium, see also transistors**  
 Germanium crystal growing, vacuum furnace for ..... 214D Mar  
 Germanium-diode push-pull voltmeter, Davis ..... 212D Feb  
**Germanium Diode Techniques**  
 Soldering ..... 246D June  
 Two-contact test prod. .... 215D June  
 Zone-melting setup ..... 271D June  
 Germanium modulator for infrared communication, Gibson ..... 155 Oct  
 Goniophotometer, measures gloss ..... 196D Apr  
 Go-no go gage, time interval ..... 208D Aug  
 Graphical solution of power transfer problems, Macpherson ..... 208D July  
 Grinding vhf crystals ..... 161 Mar  
 Grooving recorder heads with abrasive wire ..... 272D May  
 Guided missile, photoelectric chopper ..... 162 Nov  
 Guided missile, sequentially gated age ..... 186 June  
 Guided missile, tape recording data ..... 194D May  
 Guided missiles, transistor f-m telemetering ..... 178 Jan  
 Gun, transistor for tv ..... 137 May

**H**

h-parameter, transistor equations using ..... 191 Apr  
 Hard tube operates magnetic counters, Fleming ..... 186D Sept  
 Hardness tester sorts auto engine parts, Diamond ..... 160 Dec  
 Hat radio, for police ..... 242D May  
 Hay, removing iron from ..... 134 May  
 Heat control, crucible ..... 149 Feb  
 Heating, electric and ultrasonic ..... 172 Mar  
 Heating time for tv tubes ..... 126 Aug  
 Height finder fills balloon, radar ..... 182 Dec  
 Helically coupled traveling-wave tube, Lacy ..... 132 Nov  
 Helicopter, ground control for ..... 196D Mar  
 High-frequency coils use new core materials, Rockett ..... 140 Dec  
 High-frequency transistor amplifiers, Chow ..... 142 Apr  
 High-power pulser aids cathode studies, Marzetta ..... 178 Mar  
 High-power visual amplifier for tv, Ruston ..... 220D May  
 High sensitivity d-c breaker amplifier, Liston ..... 206D Jan  
 High-speed counting with one-tube decades, Nather ..... 174 Oct  
 High-speed film marker, Strabala ..... 202D Nov  
 High-voltage, from battery ..... 182D July  
 High-voltage supply, transistor ..... 144 Aug  
 High-voltage switch from banana plugs, Newman & Burton ..... 256D Mar  
 Horn, dual mode, for microwave multiplexing ..... 182 Sept  
 How long-line effect impairs tunable radar, Hull, Novick & Cordray ..... 168 Feb  
 How to handle ringing in television design, Heiser ..... 162 May  
 Hysteresis, recording fluxmeter ..... 147 July

I-F limiter, bias control for ..... 200D June  
 I-F strip, monochrome, conversion for color ..... 170 July

Illegal radio shocks betters.....196D Oct  
 Illumination, tv lighting calculator  
     192 June  
 ILS, aircraft receiver for VOR.....180 June  
 Image dissector, mechanical.....169 Aug  
 Importance of mechanical design, Car-  
 roll.....(insert) M-2 Oct  
 Improved demodulator for radar rang-  
 ing, Goodell.....170 June  
 Improved recording heads.....210D Nov  
 Impulse voltmeter.....180D July  
 Increasing validity of shock tests.  
 Crede.....236D June  
 Indicator, frequency deviation.....214D Aug  
 Indicator, rpm, expanded scale.....146 Aug  
 Indicator, ultrasonic liquid level.....156 Apr  
 Inductor control gives a/c.....244D Feb  
 Inductor, magnetic amplifiers using  
     181 Jan  
 Industrial control in Britain.....216D May  
 Infrared detector for aircraft.....180D Aug  
 Infrared modulator, germanium.....155 Oct  
 In-phase indicator, Porter.....202D Oct  
 Inside speech clipper, Miller.....186 Dec  
 Inspection, for tape.....136 Jan  
 Installing thread inserts in housings  
     270D Jan  
 Instantaneous multiplier for com-  
 puters, Mehron & Otto.....144 Feb  
 Instrument for phototube testing.....228D Feb  
 Instrument, pulling figure tester.....170 Dec  
 Instrument, recording fluxmeter.....147 July  
 Instrument, salinity measurement.....172 Jan  
 Instrument, spectrograph for rocket  
     149 Jan  
 Insulating tape, detecting voids in.....136 Jan  
 Integrator, bioelectric, using transis-  
 tors.....176 May  
 Intensity-modulated cro time markers  
     150 Mar  
 Interference, crystals reduce mobile  
     154 Sept  
 Interlock, water flow safety.....194D May  
 Intermodulation distortion, crystals re-  
 duce mobile.....154 Sept  
 Low-frequency phase-shift modulator.  
 Coombs.....198 Dec  
 Ionization transducer micrometer.....184 Dec  
**Ionosphere, see propagation**  
 Iron-core transformers run smaller  
 and hotter, Rockett.....136 Nov  
 Iron, removing from hay.....134 May  
 Isoecho spots storm intensities.....200D Oct

**J**

Japan, microwave relay.....152 June  
**Jig Techniques**  
 Nine assembly.....268D Sept  
 Pipe nipple.....268D May  
 Three-size turret.....277D Apr  
 Totem-pole cut wiring costs, Wise-  
 leder.....276D Oct  
 Tube Socket Holder.....264D Apr  
 Turret socket fixture.....266D Oct  
 Juggler, electronic.....204D July  
**Junction transistor, see also transistor**  
 Junction transistor pulse forming cir-  
 cuits, Oakes.....165 Sept

**K**

Keying, frequency shift, multichannel  
     156 July  
 Keying, self, transistor oscillator.....214D July  
 Keying transmitters at high speed,  
 Jacob & Brauch.....148 Dec  
**Klystron, see also tube**  
 Klystron, four megawatt.....200D Nov  
 Klystron, stable power supply for.....168 Jan  
 Knob setscrew inserter.....232D Aug

**L**

**Labeling Techniques**  
 Metal embossing machine.....251D July  
 Self-adhesive labels.....262D Mar  
 Laboratory power supply, Fleming  
     224D Aug  
 Lamps call supervisor.....255D May  
 Level-gate, ultrasonic.....156 Apr  
 Lever-operated press installs G-  
 washers.....248D June  
 Lift tables for tv consoles.....232D Aug  
 Light-beam telemetering, Strickland  
     135 Dec  
 Lighting calculator for tv.....192 June  
 Lightning, receiver counts strokes.....168 Oct  
**Limit, see also f-m**  
 Limiter, bias control for i-f.....200D June  
 Line drawing made from photographs  
     228D May  
 Linear accelerator for cancer research  
     200D Apr

Linear low-level rectifier, Scharfman  
     228D Mar  
 Liquid level gage, ultrasonic.....156 Apr  
 Locator, echo, for blind.....136 Dec  
 Logarithmic amplifier with fast re-  
 sponse, DeShong, Jr.....190 Mar  
 Long-line effects, radar.....168 Feb  
 Long-period timer, Rozenstein & Gross  
     185 June  
 Loran, sequentially gated a/c for.....186 June  
 Low-capacitance transformer, for bias  
 supply.....172 Aug  
 Low-cost breadboards for electronic  
 training, McGrane & Martin.....184D Aug  
 Low-distortion electronic attenuators,  
 Swain.....220D Oct  
 Low-frequency switch for recording  
 transients, Cordes.....168 May  
 Low-frequency phase-shift modulator,  
 Coombs.....198 Dec  
 Low-frequency tape recording, mod-  
 ulator for.....220D Aug  
 Low-frequency transmitter, tankless  
     164 May  
 Low-noise audio amplifier.....156 Mar  
 Luminescence, photocell records ma-  
 rine.....182D Nov

**M**

Machine methods make strip transmis-  
 sion line, Packard.....148 Sept  
 Machining contact fingers for uhf qus-  
 cavities.....239D July  
 Magnetic amplifier, fast response.....170 Oct  
 Magnetic amplifier, negative induct-  
 ance.....162 Jan  
 Magnetic amplifier uses conventional  
 inductors, Bennett, Jr.....181 Jan  
 Magnetic amplifiers for synchronous  
 motors, Zucchini.....133 Mar  
 Magnetic decision elements, testing  
     200D Jan  
 Magnetic gate, saturable transformer  
     174 Sept  
 Magnetic-matrix switch reads binary  
 output, Brean.....157 May  
 Magnetic recorder arrests transients,  
 Hoberman.....178 Oct  
 Magnetic recording, characteristics of  
 ring recording heads.....184D Sept  
 Magnetic recording for vehicular re-  
 search, Guttwein & Leslie, Jr.....154 Feb  
 Magnetic recording of pwm signals,  
 Van Doren.....232D May  
 Magnetic servo, transistor preamplifier  
 drives.....168 Mar  
 Magnetic-suspension ultracentrifuge cir-  
 cuits.....152 Mar  
**Magnetic tape, see also recorder, tape  
 recording**  
 Magnetic tape controls machine tools,  
 Hogan.....144 Dec  
 Magnetic-tape pickup has d-c response,  
 Gratian.....156 Sept  
 Magnetic tape recorder for axle tester  
     130 July  
 Magnetics, recording fluxmeter.....147 July  
 Magnetostrictive transducer for ultra-  
 sonics.....160 July  
**Magnetron, see also tube**  
 Magnetron, long-line effects on.....168 Feb  
 Magnetron, output windows for.....170 May  
**Magnetron Production Techniques**  
 Air-operated vise seals.....274D Oct  
 Coining anodes, Caprarola.....284D May  
 Induction sealing of pulse plug.....269D June  
 Leak detector.....264D May  
 Metal-to-ceramic seals, Prysak.....282D Jan  
 Microprojector checks alignment  
     292D Mar  
 Paper clip aids assembly.....296D Mar  
 Resistance brazing of cavities.....260D Aug  
 Maintenance tool dolly.....277D June  
 Making small parts, Clarke & Courage  
     (insert) M-15 Oct  
 Manometer recorder for physiological  
 pressures, Gilson.....152 Dec  
 Manufacturing grown junction tran-  
 sistors, Bower.....130 Dec  
 Marine communications, multichannel  
 f-m.....126 July  
 Marker, gated time, for cro display  
     150 Mar  
 Marker generator, gated.....177 Apr  
 Marker pulse shows shaft position,  
 Woesteneryer.....146 May  
 Masking tape for plating.....238D Nov  
 Matching resistors at a-c, Josias.....200D Apr  
 Matrix, magnetic, for binary output  
     157 May  
 Measurement, capacitance gage for  
 cable sheath thickness.....134 Apr  
 Measurement of beat frequencies.....196D Nov  
 Measurement, surface irregularities  
     210D Aug  
 Measuring microwave antenna pat-  
 terns, Small & Hatcher.....184D Nov  
 Measuring noise in resistors, Koch, Jr.  
     181 Mar  
 Measuring transistor temperature rise,  
 Tellerman.....185 Apr  
 Measuring tv sound modulation, Wolf  
 skill.....226D June  
 Mechanical design, importance of  
 (insert) M-2 Oct  
 Mechanical design, moving parts  
 (insert) M-29 Oct  
 Mechanical design of electronic equip-  
 ment.....(insert) 192-193 Oct

Mechanical register amplifier.....206 Dec  
 Medical electronics, accelerator fights  
 cancer.....220D May  
 Medical electronics, accelerator for  
 cancer research.....200D Apr  
 Medical electronics, arc-lamp tachisto-  
 scope.....174 May  
 Medical electronics, bioelectric in-  
 tegrator.....176 May  
 Medical electronics, electric and ultra-  
 sonic deep heating.....172 Mar  
 Medical electronics, sensitive amplifier  
     164 Apr  
 Memory, crt storage.....184 Oct  
 Memory for Whirlwind computer.....226D Aug  
 Memory, tape, for computer.....166 July  
 Memory, testing magnetic decision ele-  
 ments.....200D Jan  
 Metal detector, for iron in hay.....134 May  
 Metal foil used to shield laboratory  
 equipment.....180D July  
 Meter, battery powered a-c voltmeter  
     216D Jan  
 Meter, digital-counter frequency.....189 June  
 Meter, salinity, for sonar.....172 Jan  
 Meter, uhf power.....159 Nov  
 Microdisplacement gage, noncontact  
 ing.....172 June  
 Micrometer, ionization transducer.....184 Dec  
 Microphone, phantom.....254D Mar  
 Microphotometer scans spectrum pho-  
 tographs, Billins, Cooper & Lee  
 Evans.....174 Dec  
 Microphotometer, sensitive.....196D Mar  
 Microsecond-spike generator, Greif  
     182D Sept  
 Microwave, a-m system measures at-  
 tenuation.....175 Jan  
 Microwave applications of gas dis-  
 charge, Arams.....168 Nov  
 Microwave, cavity resonator design  
 chart.....186 May  
 Microwave, designing surface-wave  
 transmission lines.....180 Apr  
 Microwave, dual-mode horn for mul-  
 tiplexing.....162 Sept  
 Microwave, long line effects in radar  
     168 Feb  
 Microwave, machine methods make  
 strip transmission line.....148 Sept  
 Microwave market picture, Carroll  
     153 Oct  
 Microwave, measuring antenna pattern  
     184D Nov  
 Microwave oscillator, voltage-tuned  
     242D Mar  
 Microwave, power supply for.....168 Jan  
 Microwave, pulling figure tester for  
 oscillators.....170 Dec  
 Microwave relay for Japanese televi-  
 sion, Nomura, Surzki, Mita &  
 Sawazaki.....152 June  
 Microwave, rotary waveguide attenu-  
 ator.....184 Jan  
 Microwave tv crosses Alps.....180D Nov  
 Microwave, window for magnetrons  
     170 May  
 Microwaves gage surface irregularities  
     210D Aug  
 Military carrier telegraph equipment,  
 Boughtwood & Cramer.....196D Oct  
 Military equipment design.....230D Oct  
 Military reliability of electron tubes,  
 Jervis and Swauger.....130 Apr  
 Miniaturization of fixed capacitors.....120 July  
 Miniaturization, welded diodes.....154 Nov  
 Mismatch, in tunable radar.....168 Feb  
 Mixture consistency recorder.....210D Apr  
 Mobile, crystals reduce, interference  
     154 Sept  
 Mobile f-m broadcast receiver design,  
 Onder.....130 May  
 Mobile receiver speeds police.....242D May  
 Mobile tv control room.....182D July  
 Model, ship, predicts antenna pattern  
     162 Apr  
 Modified color signal for single-gun  
 tubes, Altes & Stern.....168 Sept  
**Modulation, see also type a-m; f-m;  
 pcm; pfm; etc.**  
 Modulation, frequency-code.....172 Apr  
 Modulation, magnetic recording of  
 pulse-width.....282D May  
 Modulator for low-frequency tape  
 recording, Kolb.....220D Aug  
 Modulator, germanium infrared.....155 Oct  
 Modulator, phase shift.....198 Dec  
 Monitor for tv station.....153 July  
 Monitor measures intensity of radio-  
 active concrete.....198D Apr  
 Monochrome i-f strip conversion for  
 color, Steinberg.....170 July  
 Motor control, magnetic amplifier.....133 Mar  
 Motors, power devices.....(insert) M-37 Oct  
 Moving parts, Guttman.....(insert) M-29 Oct  
 Moving target detection by pulse Dop-  
 pler radar, Sargent.....138 Sept  
 Moving-target detector, McLucas &  
 Laughlin.....169 Aug  
 Multichannel f-m aids marine com-  
 munications, Ornstein and Cahn.....126 July  
 Multiexposure flash for high-speed  
 cameras, Findley, Kennedy & Van  
 Horn.....180 Feb  
 Multipath transmission, single-channel  
 frequency diversity.....158 Aug  
 Multiplexed f-m, for binocular broad-  
 cast.....194D Feb  
 Multiplexing, dual-mode for microwave  
     162 Sept  
 Multiplier for analog computers,  
 Savant, Jr. & Howard.....144 Sept  
**Multipler phototube, see phototube**

Multipulse generator has variable delay, Strassman ..... 178 May  
 Multivibrator, extending delay time ..... 232D Feb  
 Multivibrator, square-wave generator ..... 206D June  
 Music, electronic aid for ..... 200D Aug

**N**

Negative inductance cuts magnetic-amplifier lag, Ettinger ..... 162 Jan  
 Neoprene gasket cutter ..... 255D May  
 Network, frequency response in four-terminal ..... 250D Feb  
 New compounds for transistor research ..... 238D Mar  
 New electronic drafting tools and techniques, McDermott ..... 120 Aug  
 New variable capacitors extend tuning range, Rockett ..... 130 Aug  
 Noise detector for high ..... 210D June  
 Noise generator, stabilized for air-weapon design ..... 163 July  
 Noise measurement in resistors ..... 181 Mar  
 Noncontacting gage for microdisplacements, Sharaf ..... 172 June  
 Nonlinear capacitors for dielectric amplifier ..... 150 Feb  
 Nomograph for shunt-series peaking circuits ..... 194 Mar  
 Nomograph, power level ..... 130 Dec  
 Nomograph, radar doppler ..... 190 May  
 Nomograph, shielding ..... 190 May  
 Nomograph, thermistor characteristics ..... 178 Aug  
 Normalized general purpose audio amplifier, ..... 203D Jan  
 Nuclear research, accelerator fights cancer ..... 220D May  
 Nuclear research, accelerator for food industry ..... 180D Sept  
 Nuclear research, direct-reading dosimeter ..... 168 Oct  
 Nuclear research, distributed amplifier ..... 138 July  
 Nuclear research, fast-response logarithmic amplifier ..... 190 Mar  
 Nuclear research, power supply for 3-bev accelerator ..... 160 Feb  
 Nuclear research, r-f generator for ..... 142 May  
 Nuclear resonance spectrometer ..... 134 June

**O**

Ocean currents detected by radar ..... 254D Mar  
 Oil industry, electronics in ..... 120 Sept  
 Oil research, robot speeds ..... 208D Nov  
 Omnirange, aircraft receiver for ..... 180 June  
 Operation of crt storage devices, Winkler & Nozick ..... 184 Oct  
 Optical measurement controls gas concentration ..... 196D Feb  
 Oscillator, crystal ..... 200D May  
 Oscillator, electronically tuned ..... 184 Mar  
 Oscillator, inductor control for afc ..... 244D Feb  
 Oscillator, pulling figure tester for microwave ..... 170 Dec  
 Oscillator, R-C audio ..... 176 Mar  
 Oscillator, single transistor f-m ..... 130 Feb  
 Oscillator, transistor converter ..... 212D Sept  
 Oscillator, transistor flip-flop ..... 175 June  
 Oscillator, transistor f-m ..... 178 Jan  
 Oscillator, transistor, self-keying ..... 214D July  
 Oscillator, vhf transistor ..... 220D June  
 Oscillator, video test ..... 206D Mar  
 Oscillator, voltage-tuned microwave ..... 242D Mar  
 Oscilloscope display for spectrophotometer ..... 196D July  
 Oscilloscope, gated time markers for ..... 150 Mar  
 Oscilloscope shows denture strain ..... 182D July  
 Output system, tape, for computer ..... 166 July  
 Output windows for tunable magnets, Chen ..... 170 May  
 Overload relay for tv receiver ..... 153 Apr

**P**

**Packaging Techniques**

Corrugated cardboard protects relays ..... 228D Nov  
 Crate protects amplifier ..... 370D Nov  
 Elasticized-edge plastic for tote boxes ..... 230D July  
 Plastic containers ..... 250D May  
 Plug-in detector checks desiccant ..... 280D May  
 Rubberized hair for camera tube ..... 318D Mar  
 Transparent containers for camera tubes ..... 259D Aug  
**Pads, see attenuators**  
 Parachute-borne telemetering system, Greenough & Gordon ..... 148 June

Particle accelerator fights cancer ..... 220D May  
 Particle accelerator for food industry ..... 180D Sept  
 Particle accelerator, power supply ..... 160 Feb  
 Particle accelerator, r-f generator ..... 142 May  
 Parts, making small ..... (insert) M-15 Oct  
 Patents, pertinent ..... 236D Jan, 246D Feb  
 258D Mar, 228D Apr, 242D May, 220D July, 214D Aug, 214D Sept, 230D Oct, 212D Nov, 212D Dec  
 Peaking circuit, shunt-series ..... 194 Mar  
 Pedestal-removing slicer circuit, Sokal & Nonnemaker ..... 220D Mar  
 Pencils, gage for sorting ..... 150 July  
**Pertinent patents, see patents**  
 Phantastron computes pulse-width ratios, Findley ..... 164 Jan  
 Phantom microphone ..... 254D Mar  
 Phasemeter, in-phase indicator ..... 202D Oct  
 Phase-selective detectors, Schafer ..... 188 Feb  
 Phase-sensitive detector, for color carrier reinsertion ..... 142 July  
 Phase-sensitive detector, for color television ..... 142 Mar  
 Phase shifter, continuous ..... 202 Dec  
 Phase transducer, uses high-speed relay, Isle ..... 234D Jan  
 Photo-cell records marine luminescence ..... 182D Nov  
 Photoelectric d-c chopper for guided missiles, Schwartz & Solomonoff ..... 162 Nov  
 Photoelectric gage sorts pencil crayons, Vossberg ..... 150 July  
 Photoelectric heat control ..... 149 Feb  
 Photographs changed to line drawings ..... 228D May  
 Photographs, microphotometer scans spectrum ..... 174 Dec  
 Photography, Paraday shutter for transients ..... 198D Feb  
 Photography, high-speed film marker ..... 202D Nov  
 Photography, multiexposure flash for high-speed ..... 180 Feb  
 Photography, video recorder uses shutterless camera ..... 214D May  
 Photometer, micro, scans spectrum photographs ..... 174 Dec  
 Photometer, rocket-borne ..... 151 Sept  
 Photometer, sensitive ..... 196D Mar  
 Phototransistor card reader ..... 216D July  
 Phototube chopper ..... 242D Mar  
 Phototube tester checks anode current, Adelman, Burke & Leibowitz ..... 228D Feb  
 Piano roll programs driving conditions ..... 180D Aug  
 Pickup, magnetic tape, has d-c response ..... 156 Sept  
 Picture tube, single-gun, color signal for ..... 168 Sept  
**Picture Tube Techniques**  
 Aluminizing ..... 260D June  
 Automatic metalizer ..... 286 Oct  
 Blast cleaning salvages walls ..... 248 Aug  
 Buffing ..... 269D Dec  
 Cementing metal screens, Holmes ..... 300D Feb  
 Checking perpendicularity of c-r traces, Landow ..... 246D Dec  
 Clam shell housing speeds cooling ..... 298D May  
 Color tube alignment ..... 248D May  
 Inline system for aluminizing ..... 286D Apr  
 Lifting aids ..... 270D Apr  
 Motorized neck sparker ..... 248D June  
 Moving dies with fork lift truck ..... 262D Apr  
 Number wheel shows sequence ..... 260D May  
 Oven heat recorder ..... 258D Oct  
 Painting with knuckle-joint brushes ..... 254D June  
 Pilot production line for color ..... 260D Jan  
 Quality control test set ..... 268D Nov  
 Running-count tabulation of flaws ..... 242D Dec  
 Screen-bake oven ..... 286D Apr  
 Screen-settling conveyor ..... 256D Sept  
 Testing on conveyor line ..... 258D Sept  
 Tube-cooling tunnel ..... 272D Nov  
 Ultraviolet inspection ..... 248D Nov  
 Washing machine cleans inside of bulbs ..... 282D Nov  
 Plastic curtains for tools ..... 284D Mar  
 Plastic research aid ..... 198D Sept  
 Plastic-top assembly bench ..... 281D June  
 Plotting electrostatic fields ..... 182 Oct  
 Plug-in units, multipulse generator ..... 178 May  
 Pneumatic lift serves as worktable, Goldrath ..... 268D Oct  
 Pointer and line locator aids blind ..... 194D Feb  
 Portable sync generator for tv broadcasting, Ennes ..... 138 Apr  
 Portable transceiver, Knaack ..... 204D May  
 circuit ..... 218D July  
 Position control, servomechanism for ..... 134 Aug  
 Position measurement of stars ..... 158 June  
 Potentiometers, trends in precision ..... 144 Oct  
 Potting and shielding ..... (insert) M-23 Oct  
 Potting-wax centrifuge ..... 260D Apr  
 Power amplifier, transistor ..... 146 Mar  
 Power amplifier, transistors for ..... 144 Jan  
 Power devices, Sabath, Sporn & Kaplan ..... (insert) M-37 Oct  
 Power-level nomograph, Halabi ..... 194 June  
 Power meter, uhf ..... 159 Nov  
 Power meter, uhf, r-f ..... 188D Nov  
 Power rectifier silicon ..... 157 Dec  
 Power supply, current limited ..... 206D Oct  
 Power supply, electronic filter for ..... 174 Feb  
 Power supply for microwave standards ..... 168 Jan

Power supply for precipitator ..... 218D Apr  
 Power supply for submerged repeaters ..... 186 Jan  
 Power supply for three-bev accelerator ..... 160 Feb  
 Power supply, high-efficiency d-c ..... 165 Oct  
 Power supply, laboratory ..... 224D Aug  
 Power supply, transistor ..... 144 Aug  
 Power transfer, graphical solution for ..... 205D July  
 Power transistors for audio output circuits, Giacoletto ..... 144 Jan  
 Practical two-stage transistor amplifiers, Riddle ..... 169 Apr  
**Preamplifier, see also amplifier**  
 Preamplifier-mixer for binaural broadcast ..... 134 Feb  
 Preamplifier, transistor, drives magnetic servo ..... 168 Mar  
 Precipitator, pulsed power supply for ..... 218D Apr  
 Precision potentiometers use new materials, Rockett ..... 144 Oct  
 Precision resistors, trends in ..... 132 Sept  
 Predicted-wave radio teleprinter, Doelz ..... 166 Dec  
 Pressure recorder, for physiological measurements ..... 152 Dec  
 Printed-circuit electrostatic generator ..... 222D Apr  
**Printed Circuit Techniques**  
 Adhesive-clad copper cuts costs ..... 308D Mar  
 Alignment checks quality ..... 265D Aug  
 Automatic assembly line ..... 240D Nov  
 Continuity tester ..... 300D Mar  
 Cutting and forming pigtail leads, Strauss ..... 230D Nov  
 Dip-soldering i-f amplifier ..... 274D May  
 Driving trimmer screws in i-f transformers ..... 246D July  
 Drying copper-clad sheets ..... 236D Sept  
 Flux reduces leakage ..... 256D June  
 Lead-staking machine ..... 258D June  
 Machining inserts components ..... 232D Sept  
 Machine racks support ..... 261D Aug  
 Phonograph spreads photo resist ..... 294D May  
 Polishing copper laminates ..... 254D Apr  
 Shorted-turns tester ..... 234D Aug  
 Staples serve as conductors ..... 279D Apr  
 Vibrator shakes leads into holes, Huggins, Jr. ..... 256D Nov  
 Printed electrostatic generator ..... 222D Apr  
**Process Control, see also automatic control**  
 Production, automatic circuit tester ..... 136 Oct  
 Production, ceramic tube mount for automatic ..... 162 Aug  
 Production, color television adjustment ..... 140 Aug  
**Production control, see also automatic control**  
 Production control in Britain ..... 216D May  
 Production of small parts, (insert) M-15 Oct  
**Production Techniques, see type: capacitor; coil; magnetron; printed circuit; etc.**  
 Programming, punch tape for driving conditions ..... 180D Aug  
 Propagation, diffraction-gain transmission ..... 196D May  
 Propagation forecasts for Pacific ..... 224D Mar  
 Propagation pattern predicted by ship model ..... 162 Apr  
 Probe, rocket ..... 212 Dec  
 Publications present problems ..... 198D Oct  
 Pulling-figure tester for microwave oscillators, Dyke & Cohn ..... 170 Dec  
 Pulse amplifier, distributed ..... 138 July  
 Pulse amplifier, for computer ..... 188 Apr  
 Pulse counter, staircase generator ..... 187 Mar  
 Pulse demodulator for radar ranging ..... 170 June  
 Pulse distribution in tv network origination, Auld & Gallonio ..... 166 Aug  
 Pulse-forming circuit, junction transistor ..... 165 Sept  
 Pulse generator for testing color television ..... 138 Dec  
 Pulse generator, high-power ..... 178 Mar  
 Pulse generator, microsecond ..... 182D Sept  
 Pulse generator, multi ..... 178 May  
 Pulse generator, transistor ..... 160 May  
 Pulse generator, transistor ..... 188D July  
 Pulse modulation, magnetic recording ..... 232D May  
 Pulse power supply for precipitators ..... 218D Apr  
 Pulse transmitter for rocket research, Mazur ..... 164 Nov  
 Pulse-width ratio, phantastron computes ..... 164 Jan  
 Pulsed curve tracer for semiconductor testing, Pankove ..... 172 Sept  
 Pulsed-envelope detector for color television ..... 142 Mar  
 Pulsed r-f system, direct vswr reading ..... 162 Dec  
 PWM, magnetic recording of signals ..... 232D May  
 Pyrometer, heat control ..... 149 Feb

**Q**

Quality control sets factory traffic lights ..... 262D Oct  
 Quantity reproduction of photo-oscillograms, Naidamast ..... 264D Sept  
 Quartz crystals, grinding for vhf ..... 161 Mar

## R

Radar, altitude corrector.....157 June  
 Radar antenna follows stars, Stine  
 180D Sept  
 Radar, C-band weather.....200D Oct  
 Radar, circular polarized antenna.....158 Mar  
 Radar cop smoothes traffic flow.....182D Aug  
 Radar, deicing X-band antennas.....152 Jan  
 Radar detects ocean currents.....254D Mar  
 Radar Doppler nomograph, Schooley  
 180 Dec  
 Radar duplexer uses dual t-r tubes,  
 Heins.....149 Aug  
 Radar height finder fills balloon.....182 Dec  
 Strip fixture.....240D Dec  
 Radar, isoecho spots storm.....200D Oct  
 Radar, moving target detector.....169 Aug  
 Radar, noise generator.....163 July  
 Radar offers solution to mid-air plane  
 collision, Brantley.....146 Nov  
**Radar Production Techniques**  
 Fabricating tubular frames for  
 screens.....258D Feb  
 Reaming fixtures for antenna units  
 267D June  
 Radar, pulse demodulator for.....170 June  
 Radar, pulse-width ratio computer.....164 Jan  
 Radar, pulsed Doppler moving target  
 detection.....138 Sept  
 Radar, radome design for supersonic  
 speeds.....130 Jan  
**Radiation, see also propagation**  
 Radiation detector, balloon-borne.....138 May  
 Radiation detector, infrared.....180D Aug  
 Radiation, direct-reading dosimeter  
 168 Oct  
**Radio, see also communications, broad-  
 casting**  
 Radioactive snow gages determine  
 runoff.....200D Mar  
 Radioactivity measurement, monitor  
 198D Apr  
 Radio astronomy, radar follows stars  
 180D Sept  
 Radio control directs air-sea rescue  
 boat, Schug & Hall.....130 Mar  
 Radio controls traffic signals.....200D June  
 Radio disturbance warnings.....224D Mar  
 Radio receiver counts lightning  
 strokes, Sullivan, Wells & Dinger.....158 Oct  
 Radio spectrum chart, insert & 210D Mar  
 Radiotelegraph, multichannel fsk.....156 July  
 Random sequence switching, Ettlinger  
 165 Feb  
 Radomes, automatic deicing.....152 Jan  
 Radomes, designing.....130 Jan  
 Rawinsonde probes troposphere.....196D Apr  
**Reactors, see also inductor; choke;  
 coil; etc.**  
 Reader, for binary output.....157 May  
 Reading, tachistoscope for increasing  
 speed of.....174 May  
 Receiver, adjustment of color tv.....140 Aug  
 Receiver, aircraft for VOR-ILS and  
 communications.....180 June  
 Receiver, camera adapter for tv.....141 Jan  
 Receiver, color television, demodu-  
 lator for.....164 June  
 Receiver, color television, design tech-  
 niques.....136 Feb  
 Receiver, color television, pulsed en-  
 velope detector.....142 Mar  
 Receiver, conelrad.....156 Jan  
 Receiver counts lightning strokes.....158 Oct  
 Receiver, design of mobile f-m.....130 May  
 Receiver, mobile, for police.....242D May  
 Receiver, ringing in tv.....162 May  
 Receiver, signal overload for tv.....153 Apr  
 Receiver, television, beam-deflection  
 tube for color decoders.....148 May  
 Receiver, tv, four system.....140 Oct  
**Receivers, see also f-m, television**  
 Reception, single-channel frequency  
 diversity.....158 Aug  
 Recorder-controlled automatic machine  
 tools, Leaver & Mounce.....124 Nov  
 Recorder monitors test flight.....192D Sept  
 Recorder, for physiological pressure  
 152 Dec  
 Recorder, tape, cycles truck axle tester  
 130 July  
 Recording, characteristics of ring  
 heads.....184D Sept  
 Recording fluxmeter, Berge and Guder-  
 jahn.....147 July  
 Recording heads, improved.....210D Nov  
 Recording, magnetic, of transients.....178 Oct  
 Recording tape, for computer storage  
 166 July  
 Recording, tape, for machine control  
 144 Dec  
 Recording, tape, for missile data.....194D May  
 Recording, tape, in vehicular research  
 154 Feb  
 Recording, tape, modulator for low-  
 frequency.....220D Aug  
 Recording, tape, of pwm signals.....232D May  
 Recording, tape, pickup head has d-c  
 response.....156 Sept  
 Recording transients, low-frequency  
 switch for.....168 May  
 Recording, video, using shutterless  
 camera.....214D May  
 Rectifier, linear low-level.....228D Mar  
 Rectifier, selenium, testing.....200D Sept  
 Rectifier, silicon power.....157 Dec  
 Reference voltage, test.....198D Apr  
 Regulated d-c supply has high  
 efficiency, Bakeman & Richardson.....165 Oct  
 Relay, microwave, for Japanese tele-  
 vision.....152 June

Relay-operated phase transducer.....234D Jan  
 Relay, overload for tv receiver.....153 Apr  
 Relay, simple time-delay.....178 Apr  
 Reliability check list for electronic  
 equipment.....176 Nov  
 Reliability, tube failure in SEAC.....212D Mar  
 Reliability, tube, military.....130 Apr  
**Remote control, see telemetering**  
 Removing tramp iron from chopped  
 hay, Dobie & Jacob.....134 May  
 Repeaters, power supply for submerged  
 186 Jan  
 Rescue system, air-sea.....204D Apr  
 Research, sensitive amplifier for med-  
 ical.....154 Apr  
 Resistor, fixed, survey.....132 Sept  
 Resistor, matching at a-c.....200D Apr  
 Resistor, noise measurement.....181 Mar  
**Resistor Production Techniques**  
 Abrading machine.....290D Mar  
 Automatic fabrication of terminal  
 cards.....228D July  
 Automatic spiralling.....284D Mar  
 Canvas-covered rubbing block.....256D Feb  
 Drilling holes for taps.....254D July  
 Drilling jig for rotors.....246D Sept  
 Linearity tester.....280D Sept  
 Roller straightens leads.....230D Dec  
 Snap-in mounts as terminals.....278D Apr  
 Strip fixture.....240D Dec  
 Resonator, cavity, design charts.....186 May  
 R-F generator for nuclear energy  
 studies, Kornblith, Jr.....142 May  
 R-F generator, for nuclear resonance  
 spectrometer.....134 June  
 R-F generator for three-bev accel-  
 erator.....160 Feb  
 R-F power meter, uhf.....188D Nov  
 Ringing, in television circuits.....162 May  
 Robot controls aircraft.....218D June  
 Robot speeds oil research.....208D Nov  
 Rocket-borne photometer measures  
 sky light, Corman & Bedinger.....151 Sept  
 Rocket-borne servo tracks the sun,  
 Stacy, Stith, Nidey & Plettenpol.....149 Jan  
 Rocket probe.....212 Dec  
 Rocket, pulse transmitter for.....164 Nov  
 Rocket, servo tracks sun.....149 Jan  
 Rocket, transistor f-m telemetering.....178 Jan  
 RPM indicator provides expanded  
 scale, Strassman.....146 Aug

## S

Safety interlock, water flow.....194D May  
 Salinity meter for sonar measurements,  
 Harwell & Hood.....172 Jan  
 Saturable reactor for a-f.....244D Feb  
**Saturable reactors, see also reactors;  
 magnetic amplifiers; etc.**  
 Saturable transformers as gates, Moffat  
 174 Sept  
**Scaler, see counter**  
 Scanner, film, for monochrome or color  
 52 Aug  
 Scoreboard for production line.....238D Sept  
 Scribing dial windows.....252D Oct  
 SEAC tube failures in.....212D Mar  
 Selective a-f transistor amplifier, Bier  
 and Rosen.....208 Dec  
 Selenium rectifier testing techniques,  
 Pagano.....200D Sept  
 Self-keyed transistor oscillator, Alex-  
 ander.....214D July  
**Semiconductor, see also transistor**  
 Semiconductor, new compounds.....238D Mar  
 Semiconductor, pulsed curve tracer  
 172 Sept  
 Sensitive amplifier for medical re-  
 search, Beckwith.....164 Apr  
 Sensitive microphotometer, Clink.....196D Mar  
 Sequentially gated automatic gain  
 control, Eliason.....186 June  
 Series capacitors multiply battery volt-  
 age, Reed.....182D July  
 Series heater strings for tv receivers,  
 Roberts.....126 Aug  
 Servo amplifier, magnetic.....170 Oct  
 Servocoupler matches aircraft an-  
 tennas, Schwitek.....188 Oct  
 Servo, for shaft position control.....134 Aug  
 Servo, magnetic, transistor preampli-  
 fier drives, Zuchino.....168 Mar  
 Servo, multiplier for analog computers  
 144 Sept  
 Servo, rocket-borne spectrophotograph.....149 Jan  
 Servo system, cutting magnetic ampli-  
 fier lag.....162 Jan  
 Servo system, electronic juggler.....204D July  
 Servo system, magnetic amplifier  
 using conventional inductors.....181 Jan  
 Servo system, transistor amplifier for  
 168 Mar  
 Selective a-f transistor amplifier, Bier  
 and Rosen.....208 Dec  
 Setscrew fittings for pipes speed plant  
 alterations.....232D Apr  
 Shaft position control, servo.....174 Aug  
 Shaft positioned indicator.....146 May  
 Shake table, electronic.....178 June  
 Shell gage draws graph of fault.....196D Jan  
 Shielding and Potting, Burruano,  
 Bailey & Cramer.....(insert) M-23 Oct  
 Shielding, metal foil.....180D July  
 Shielding nomographs, Sodaro.....190 May  
 Ship models predict antenna patterns,  
 Smith and Hatcher.....162 Apr  
 Ship, multichannel f-m for.....126 July  
 Shock measurement in parachute test-  
 ing.....148 June

**Shock Mounting Techniques**.....274D June  
 Installing.....274D June  
 Loudspeaker cabinet support.....298D Mar  
 Quick-leveling, for production ma-  
 chines.....246D Apr  
 Shock test, increasing validity of.....236D June  
 Shunt-series peaking, Sodaro.....194 Mar  
 Shutter, Faraday, for transient photo-  
 graphs.....198D Feb  
 Shutterless camera for video recording  
 214D May  
 Signal detector for high noise levels,  
 Shive.....210D June  
 Signal equipment, testing.....228D Oct  
 Signal generator, see also oscillator  
 Signal-operated tone compensation,  
 Miller.....184 May  
 Signal overload relay for television  
 receivers, Masucci, Peltz and Whal-  
 ley.....153 Apr  
 Silicon power rectifier handles 1,200  
 watts, Losco.....157 Dec  
 Silicon surface-barrier transistors.....194D May  
**Silicon transistor, see also transistors**  
 Simple circuit stabilizes transistor,  
 Barron.....182D Nov  
 Simple remote control.....210 Dec  
 Simple time-delay relay, Morgan.....178 Apr  
 Sine-squared pulses test color tv sys-  
 tems, Kennedy.....138 Dec  
 Single-channel system of frequency  
 diversity, Howard.....158 Aug  
 Single-transistor f-m transmitter,  
 Thomas.....130 Feb  
 Single tube square-wave generator,  
 Bernstein & Spaven.....206D June  
 Sky light, photometer for.....151 Sept  
 Slicer circuit, pedestal-removing.....220D Mar  
 Slide scanner, flying-spot.....134 July  
 Smith chart, modified for power trans-  
 fer.....208D July  
 Solar battery.....196D June  
 Solar battery improved.....184 Dec  
 Soldering and wiring.....(insert) M-49 Oct  
**Soldering Techniques**  
 Automatic.....252D July  
 Inspection of connections.....250D Sept  
 Sluggish solder.....232D Dec  
 Soldering stand with automatic feed  
 284D Oct  
 Three-position turntable.....250D May  
**Solid state, see transistors, semi-  
 conductors**  
 Sonar, distributed transducer.....160 July  
 Sonar, salinity meter for.....172 Jan  
 Sorting pencil crayons.....150 July  
**Sound, see also audio**  
 Sound effects, transistor gun for tv.....137 May  
 Sound modulation, measuring tv.....226D June  
 Sound, signal-operated tone control.....184 May  
 Speaker, electrostatic.....143 Nov  
 Spectrophotometer for rocket control.....149 Jan  
 Spectrometer, nuclear resonance.....134 June  
 Spectrophotometer shows crt displays,  
 196D July  
 Spectrum chart.....insert and 210D Mar  
 Spectrum photographs, microphoto-  
 meter scans.....174 Dec  
 Speed, expanded scale tachometer.....146 Aug  
 Spin echo, nuclear resonance spectro-  
 meter.....134 June  
 Sponge rubber pad speeds pickup of  
 washers.....223D Dec  
 Square-wave amplifier.....214D Feb  
 Square-wave generator, single tube  
 206D June  
 Stabilization, temperature, of trans-  
 istor amplifier.....144 June  
 Stabilization, time-shared amplifier for  
 computer.....138 Apr  
 Stabilized noise source for air-weapons  
 design, Beecher, Bennett and Low  
 163 July  
 Stabilizing circuit for X-ray gages,  
 Ettlinger.....210D Oct  
 Stabilizing color carrier reinsertion  
 oscillator, Clark.....142 July  
 Stable power supplies for micro-  
 wave standards, Ernst.....168 Jan  
 Stain counter totals droplets, Clin-  
 ton.....202D Feb  
 Staircase generator counts pulses,  
 Sokal & Resnick.....187 Mar  
 Stamps, for drafting.....120 Aug  
 Standby audio console, full.....141 Mar  
 Star position, automatic measure-  
 ment of.....158 June  
 Starlings scare starlings.....212D May  
 Step-function generator for transient  
 recording.....168 May  
 Storage racks protect turret assemblies  
 248D May  
 Stringing tv receiver tubes.....126 Aug  
 Submerged repeaters use stabilized  
 power, Atherton.....186 Jan  
 Sun powers telephone.....196D June  
**Supersonic, see also nitramonic**  
 Supersonic speed, radomes for.....130 Jan  
 Surface-barrier transistor, silicon.....194D May  
 Surface measurement, microwave  
 gage for.....210D Aug  
 Surface-wave transmission line.....180 Apr  
 Switch for battery conservation.....250D Mar  
 Switch, high-voltage banana plug.....256D Mar  
 Switch, low-frequency, for recording  
 transients.....168 May  
 Switching, ferresonant flip-flop design  
 152 May  
 Switching production heads gives  
 savings, Bordiga.....274D Apr  
 Switching, random, for conelrad.....165 Feb  
 Switching system for transmitters.....192 Mar  
 Sync generator, portable.....138 Apr  
 Synchrocyclotron r-f generator.....142 May

**T**

Tachistoscope, arc-lamp	174	May	Checking 4,000-mc radio relay tubes	252D	Nov	Transmission lines, surface-wave	180	Apr
Tachometer, expanded scale	146	Aug	Noise-generating cart.	270D	Feb	Transmitter, delay-line dummy load		167
Tankless low-frequency transmitter			Power transformer tester	296D	Oct	Transmitter, f-m uhf.	238D	Feb
Gomard	154	May	Running in oscillators	262D	May	Transmitter, frequency control for	142	Sept
Tape, insulating, detecting voids in	136	Jan	Self-balancing bridge checks parts.			Transmitter, keying at high speed	148	Dec
Tape recording controls machine tools			Isle	275D	June	Transmitter, pulse, for rocket research		164
Tape recorder cycles truck axle tester,	144	Dec	Testing magnetic decision elements,			Transmitter, radiotelegraph fsk.	156	Nov
Washburn and Stavely	130	July	Goodell	200D	Jan	Transmitter, single-transistor f-m.	130	Feb
Tape recorder for missile data	194D	May	Testing signal equipment	228D	Oct	Transmitter, switching system	192	Mar
Tape recorder stores computer output,			Thermistor nomograph, Bolie	178	Aug	Transmitter, tankless low-frequency		154
Fritze	166	July	Thickness, capacitance gage checks	134	Apr	Transmitter, wide-range tuning circuit		174
Tape recording, characteristics of ring			Threshing machine for missile data	194D	May	for		174
heads	184D	Sept	<b>Thyratron, see also tube</b>			Traveling-wave tube, helically coupled		132
Tape recording for vehicular research	154	Feb	Thyratron, commutation factor	198D	Mar	<b>Trays, for production use</b>		
Tape recording, modulator for low-			Thyratron peak voltmeter, McMath	192	Dec	Plastic, modernize assembly benches		
frequency	220D	Aug	Thyratron time-delay relay	178	Apr	Self-stacking plastic	240D	Sept
Tape recording, pickup head with d-c			Thyratron-type transistor circuit,			Tritium battery	212D	July
response	156	Sept	Prugh & Keller	190D	Aug	T-R tube, dual, for radar	149	Aug
Tape recording, to scare birds	212D	May	Thyratrons protect unloaded amplifier,			<b>Tubes, see also type, magnetron;</b>		
Telegraph equipment, military	196D	Oct	Woods	208D	Oct	thyatron; etc		
Telemetering, balloon-borne radiation			Time-delay relay	178	Apr	Tube failures in SEAC	212D	
Telemetering, balloon-borne radiation			Time interval go-no go gage, Porter	208D	Aug	Tube, heating time in tv receivers	126	Aug
Telemetering, frequency-code modu-	138	May	Time marker, gated for cro.	150	Mar	Tube, magnetron output window	170	May
lation	172	Apr	Time-shared amplifier stabilizes com-			Tube mount, for automatic assembly		162
Telemetering, light beam	135	Dec	puters, Slaughter	188	Apr	<b>Tube Production Techniques</b>		
Telemetering, parachute-borne system			Time track for magnetic memory			Automatic tip-off machine	252D	Apr
Telemetering, recorder for test flights	148	June	Timer for reading test	174	May	Base alignment gage	256D	Oct
Telemetering, recorder for test flights			Timer, long period	185	June	Broken-back preheater for sealers		237D
Telemetering, recorder for test flights			Timer saves monitor batteries, Zelinger			Cathaphoretic coating for heater		
Telemetering, recorder for test flights			drum	260D	Jan	bends	256D	Dec
Telemetering, sequentially gated age			Transducer, distributed ultrasonic	160	July	Cathode tabbing machine	230D	Dec
for	186	June	Transducer, high-speed relay phase			Cement adhesion tester	282D	Apr
Telemetering, tape recording missile			Transducer, microdisplacement gage			Ceramic twin-triode pumping tech-		
data	194D	May	for testing	172	June	nique	259D	Dec
Teletypewriter, predicted wave	166	Dec	Transducers for ultrasonic drilling			Cutting and bending stem wires		
Telemetering, transistor f-m oscillator			Transformer, iron core, trends in	136	Nov	Envelope-cutting gage	270D	May
Telephone, transistor simplify, plant	178	Jan	Transformer, low-capacitance bias	214D	Apr	Felt-padded boxes hold X-ray tubes	315D	Mar
Television, adding uhf coverage	192D	May	Transformer, saturable, gates	172	Aug	Filament bending jig	230D	July
Television aids turbine control	200D	Apr	Transformerless audio amplifier	176	Feb	Gage for glass bases	258D	Feb
Television, beam-deflection tube for			Transient, in tube heaters	126	Aug	Graphite-spraying for anodes	252D	June
color decoder	148	May	Transient, vtm for	180D	July	Grid stretcher	248D	Apr
Television, camera adapter for receiv-			Transients, low-frequency switch for			Inserting terminals, drill press	274D	Mar
ers	141	Jan	recording	168	May	Inspecting micas with optical compar-		
Television, color demodulator	164	June	Transients, magnetic recording of	178	Oct	ator	263D	Feb
Television, color, I-Q bar generator			Transistor, age for, amplifiers	234D	Jan	Inspection program, Kleinhofer	248D	July
Television, color, I-Q bar generator			Transistor amplifier, feedback simpli-			Impact tester	296D	May
Television, color, monochrome i-f strip	143	June	files	129	Nov	Lamp and switch system for cathode		
conversion	170	July	Transistor amplifier, gain-stabilized	183	Feb	spraying	252D	Jan
Television, color, pulsed-envelope de-			Transistor amplifiers reduce delay line			Metal jig speeds insertion of tube		
telector	142	Mar	attenuation, Schooley	181	May	leads	250D	Jan
Television, color receiver design	136	Feb	Transistor amplifier, selective a-f.	208	Dec	Molding stems with powdered glass		
Television, color signal for single-gun			Transistor amplifiers used in delay line			Socket holders for aging conveyor		
tube	168	Sept	Transistor audio source	181	May	Stretching device for hand-wound		
Television, color test techniques	120	Nov	Transistor, cascading amplifier stages	182	Dec	grids	253D	Aug
Television, color video tester checks			Transistor, circuit stabilizes	158	Jan	Socket holders for aging conveyor		
distortion	128	Sept	Transistor converter, Hruska	212D	Sept	Welding gold-plated grid wire	250	Aug
Television, converted limousine for re-			Transistor equations using h-para-			Winding frame grids, Booth & White	248D	Dec
mete pickup, Weiland	196D	Jan	meters, Cheng	191	Apr	Winding grids for reliable tubes		
Television, eliminating ringing	162	May	Transistor, feedback in circuits	174	July	314D	Mar	
Television, film scanner for mono-			Transistor flip-flop uses two frequen-			Tube, reliability of military	130	Apr
chrome or color	152	Aug	cies, Broch	175	June	Tube, single-gun, color signal for	168	Sept
Television flying-spot slide scanner,			Transistor f-m transmitter	130	Feb	Tube, thyatron commutation factor		198D
Barckett	134	July	Transistor gun for tv, Lafferty	137	May	Tube, traveling-wave helically coupled		132
Television, four system receiver	140	Oct	Transistor, high-frequency amplifier	142	Apr	Tunable audio filters, Zelinger	133	Nov
Television, high-power visual amplifier			Transistor, in bioelectric integrator	176	May	Tunable oscillator, microwave	242D	Mar
Television, lighting calculator	192	June	Transistor, manufacturing grown junc-			Tuning capacitor, trends in	130	Aug
Television, measuring sound modula-			tion	130	Dec	Tuning circuit, wide-range	174	Aug
tion	226D	June	Transistor, measuring temperature rise			Turbine control, television aids	200D	Apr
Television, microwave crosses Alps	180D	Nov	Transistor, oscillation	185	Apr	Turntable speeds plastic seating	266D	Feb
Television, microwave relay for Japan			Transistor oscillator, vhf	220D	June	Turret press for short chassis runs		236D
Television, mobile control room	182D	July	Transistor oscillator, self-keying	214D	July	<b>TV, see also television</b>		
Television, portable sync generator			Transistor power amplifiers	146	Mar	TV avalanches	188D	July
Television, portable sync generator			Transistor, power, for audio	144	Jan	TV color detectors use pulsed-envelope		
Television, pulse distribution in net-	318	Apr	Transistor, power supply for geiger			method, Schlesinger	142	Mar
work origination	166	Aug	counters, Pearlman	144	Aug	TV distributor's pickup uses wire horn		198D
Television receiver, signal overload			Transistor preamplifier drives magnetic			TV lighting calculator, Sodaro	192	June
relay	153	Apr	servo, Zucchini	163	Mar	TV receiver operates on four system		140
Television, sine-square pulses test color			Transistor pulse-forming circuits	165	Sept	standards, Werner	140	Oct
Television, sine-square pulses test color			Transistor pulse supply, Prugh and			TV station monitor, Thomas and Stein		153
Television, stabilizing color carrier re-	138	Dec	Keller	188D	July	Tweeter, electrostatic speaker	143	Nov
insertion	142	July	Transistor, pulsed curve tracer for			Two-frequency transistor flip-flop	175	June
Television station monitor	153	July	testing	172	Sept	Two-stage transistor amplifiers	169	Apr
Television, uhf cosecant antenna	138	June	Transistor research, new compounds					
Television, underwater, searches for			Transistor selection, tester for	240D	June			
Comet	198D	Mar	Transistor, silicon surface-barrier	194D	May			
Television, wireless mobile camera			Transistor, temperature-stabilized am-					
Television, wireless mobile camera			plifier	144	June			
Temperature-compensated aircraft fuel			Transistor, thyatron-type circuit	190D	Aug			
gage, Levine	160	Sept	Transistor, two-stage amplifier	169	Apr			
Temperature measurement, transistor			Transistorized oscillator, Madsen	171	Sept			
Temperature measurement, transistor			Transistors convert sine waves to					
Temperature-sensitive resistor, see			pulses, McMahon, Lebon & Baker	160	May			
thermistor	185	Apr	Transistors in telemetry, Riddle	178	Jan			
Temperature-stabilized transistor am-			Transistors select routes	204D	Oct			
plifiers, Tate	144	June	Transistors simplify telephone plant,					
Tenth-of-hour clocks	266D	May	192D	May				
<b>Terminals, production techniques</b>			Transistor use emitter-coupled feed-					
Cotter pin insulator	256D	Apr	back, Alexander, Jr.	188	Dec			
Deburring feed-through	258D	Aug	Transmission, diffraction-gain	196D	May			
Induction fusing for ceramic	280D	Mar	Transmission line, machine methods					
Inserting T-shaped lugs	260D	Sept	make strip	148	Sept			
Test voltage reference	198D	Apr						
Tester for transistor selection, Kramer								
Tester, hardness, for auto engine parts	240D	June						
Tester, tape recorder cycles truck axle	160	Dec						
Testing, see also measurement, ultra-	130	July						
sonics								
Testing selenium rectifiers	200D	Sept						
<b>Testing Techniques</b>								
Automatic cycling machine	242D	Apr						
Calibrating frequency meters	276D	Mar						
Calibrating meters	298D	Oct						

**U**

UHF meter measures low power levels,			Ultrasonic, distributed transducer	160	July
Bailey & Quirk	159	Nov	Ultrasonic, drill transducer	214D	Apr
UHF r-f power meter, Reed	188D	Nov	Ultrasonic heating in diathermy	172	Mar
UHF transmitter, f-m	238D	Feb	Ultrasonic liquid level indicator sys-		
UHF-TV, cosecant antenna for	138	June	tems, Rod	156	Apr
Ultracentrifuge, magnetic suspension					
Ultrasensitive amplifier	164	Apr			

Ultrasonic, microdisplacement gage for transducer testing .....172 June  
 Ultrasonic tone for transmitter synchronization .....142 Sept  
 Underwater tv searches for Comet 198D Mar  
 Unilateral four-terminal circuits, Foley 186 Feb

**V**

Vacuum bag supports irregularly shaped parts .....246D Nov  
 Vacuum cup positions domes on speaker .....233D July  
 Vacuum furnace for crystal growing 214D Mar

**Vacuum tube, see tubes**  
 Vacuum-tube voltmeter for impulse measurements, Blake .....180D July  
 Variable balanced d-c with low output impedance, Hellerman .....212D Jan  
 Variable capacitor survey .....130 Aug  
 Variable delay pulse generator....178 May  
 Vernier time marker for cro.....150 Mar  
 VHF communications, multichannel marine f-m .....126 July  
 VHF crystal grinding, Gerber.....161 Mar  
 VHF transistor oscillators, Hollmann 220D June  
 Vibration and heat test for two-way radio .....308D Oct  
 Vibration, increasing validity of shock tests .....236D June  
 Vibration pickup for wheel balancing 236D Mar  
 Vibration study, electronic shake table 178 June

**Video, see also television**  
 Video amplifier design charts, Squires & Newman .....190 Jan  
 Video amplifier, transistor .....142 Apr  
 Video recorder uses shutterless camera 214D May  
 Video test oscillator, Fleming....206D Mar  
 Video tester checks distortion....128 Sept  
 Visual aid for music training, Nelson 200D Aug

Voltage multiplier, series capacitor 182D July  
 Voltmeter, battery powered a-c....216D Jan  
 Voltmeter, germanium-diode push-pull 212D Feb  
 Voltmeter, thyatron peak.....192 Dec  
 Voltmeter, vacuum-tube, for measuring transients .....180D July  
 Voltage reference, test.....198D Apr  
 Voltage-tuned microwave oscillator 212D Mar  
 VOR-ILS, aircraft receiver for....180 June  
 VTVM, battery powered .....216D Jan  
 VSWR, direct readings in pulsed r-f systems .....162 Dec

**W**

Wafer coil technique mechanizes production of transformers, Zack....234D Dec  
 Wallman circuit, audio amplifier using 156 Mar  
 War game, electronic air.....146 Apr  
 Warm-up of tubes in tv receivers....126 Aug  
 Water flow safety interlock, Woods 194D May  
 Waveform generator, current-step..164 Mar  
**Waveguide, see also microwave**  
 Waveguide, circular, chart.....194 Oct  
 Waveguide, dual-mode horn for multiplexing .....162 Sept  
 Waveguide, machine methods make strip transmission line.....148 Sept  
**Waveguide Production Techniques**  
 Dip brazing, Randolph.....274D Feb  
 Flocking stands .....268D Apr  
 Mass-producing lapping.....267D Mar  
 Notched waveguides speed assembly 278D Mar  
 Waveguide, rotary attenuator.....184 Jan  
 Weather radar operates in C band 200D Oct  
 Welded joints on diodes reduce computer bulk, Lutz .....154 Nov  
 Welding slider contacts.....257D Aug  
 Wheel balancing by vibration pickup 236D Mar  
 Whirlwind Memory .....226D Aug

Wide-band distributed amplifier...138 July  
 Wide-range oscillator, electronically tuned .....134 Mar  
 Wide-range tuning circuits.....174 Aug  
 Window, for tunable magnetron...170 May

**Wire Production Techniques**  
 Air-operated guillotine cuts sleeving 256 May  
 Brazing unit for electroplating machine .....244D Dec  
 Coding methods .....287D Jan  
 Conductor-banding machine .....272D Oct  
 Display board teaches safety....238D July  
 Drilling soft insulation.....242D Aug  
 Frames for cable-lacing boards....252D Oct  
 Induction bonding cuts cost of stripping .....261D Dec  
 Induction heater bonds strands 246D June  
 Lead-coiling tool, Boire.....266D Jan  
 Plastic sleeving dispensers, Ives....290D Feb  
 Plastic windows improve strippers 248D Sept  
 Pliers minimize assembly rejects 250D Jan  
 Preparing teflon cable.....272D Jan  
 Probe light aids inspection....266D Nov  
 Quality control of stripping, Richards .....234D Aug  
 Spool rack .....230D July  
 Spot welder makes tap on single turn 258D Dec  
 Stripping coax .....236D Nov  
 Taping gun speeds wrapping of harnesses .....228D Dec  
 Teflon extruder .....278D Sept  
 Vinyl lacing cord reduces harness rejects .....265D Mar  
 Writing serial numbers with vibrating tool .....278D May  
 Wireless tv camera .....210D July  
 Wiring and soldering, Seelig & Schultz (insert) M-49 Oct  
 Wiring tester, automatic.....136 Oct

**X**

X-ray gage, stabilizing.....210D Oct

# AUTHOR INDEX

Items in the author index for which page references are preceded by (letter) are comments from readers, published monthly in the Backtalk department

**A**

Adelman, M., Burke & Leibowitz, Phototube tester checks anode current .....228D Feb  
 Adler, Robert and Heuer, Beam-deflection tube simplifies color decoders .....148 May  
 Alexander, F. C., Jr., Self-keyed transistor oscillator .....214D July  
 Alexander, F. C., Jr., Transistors use emitter-coupled feedback .....188 Dec

Altes, S. K. & Stern, Modified color signal for single-gun tubes.....168 Sept  
 Anderson, R. E., Detecting voids in insulating tape .....136 Jan  
 Andrews, D. H., Automatically plotting electrostatic field lines.....182 Oct  
 Apstein, M. and Rabinow, Distributed transducer for ultrasonic power...160 July  
 Arams, F. R., Microwave applications of gas discharges .....168 Nov  
 Ashford, D. A., Engineer imports (letter) 404D Apr  
 Atherton A., Submerged repeaters use stabilized power .....186 Jan  
 Auld, J. S. & Gallonio, Pulse distribution in tv network origination...166 Aug

**B**

Babits, V. A., Spengler & Morris, Current-step waveform generator....164 Mar  
 Badoyannis, G. M. & Rosenthal, Direct vswr readings in pulsed r-f systems .....162 Dec  
 Bailey, E. F., Cramer & Burruano, Shielding and potting...(insert) M-23 Oct  
 Bailey, R. L. & Quirk, UHF meter measures low power levels.....159 Nov  
 Bakeman, D. C. & Richardson, Regulated d-c supply has high efficiency 165 Oct

Baker, R. H., Lebon and McMahon, Transistors convert sine waves to pulses ..... 160 May  
 Baracket, A. J., Television flying-spot slide scanner ..... 134 July  
 Barron, F. E., Simple circuit stabilizes transistor ..... 182D Nov  
 Bataimis, D. J., Ionic or iontic (letter) light ..... 454D Oct  
 Beams, J. W., Magnetic-suspension ultracentrifuge circuits ..... 152 Mar  
 Beckwith, John R., Sensitive amplifier for medical research ..... 164 Apr  
 Bedinger, J. F. & Corman, Rocket-borne photometer measures sky light ..... 151 Sept  
 Beecher, D. E., Bennett and Low, Stabilized noise source for air-weapons design ..... 163 July  
 Beiser, Leo, How to handle ringing in television design ..... 162 May  
 Bennett, A. I., Jr., Magnetic amplifier uses conventional inductors ..... 181 Jan  
 Bennett, R. & Lentz, Automatic measurement of star positions ..... 158 June  
 Bennett, R. R., Low and Beecher, Stabilized noise source for air-weapons design ..... 163 July  
 Bereskin, A. B., Fifty-watt amplifier for high-quality audio ..... 160 Oct  
 Berge, R. I. and Guderjahn, Recording fluxmeter ..... 147 July  
 Bernard, W. B., Mixed feedback (letter) 401D Jan  
 Bernard, W. B., More Amplifier Design (letter) 372 Dec  
 Bernstein S., Spaven, Single tube square-wave generator ..... 206D June  
 Bler, D. & Rosen, Selective a-f transistor amplifier ..... 208 Dec  
 Billins, D. E., Cooper, Evans & Lee, Microphotometer scans spectrum photographs ..... 174 Dec  
 Bishop, N., Bias control for i-f limiters ..... 200D June  
 Blair, H. T., Selecting coil forms for threaded cores ..... 300D Oct  
 Blake, R. F., Vacuum-tube voltmeter for impulse measurements ..... 180D July  
 Blumberg, W. E., Source impedance (letter) 384D June  
 Boff, A. F., Frequency meter uses digital counters ..... 189 June  
 Boire, P. C., Lead-coiling tool ..... 266D Jan  
 Bolie, V. W., Thermistor nomograph ..... 178 Aug  
 Bolie, V. W., Name Sake ..... (letter) 372 Dec  
 Booth, R. E. & White, Winding frame grids for ruggedized tubes ..... 248D Dec  
 Bordiga, B., Switching production heads gives plant savings ..... 275D Apr  
 Boscia, A. F., Color bar generator produces I-Q signals ..... 143 June  
 Boughtwood, J. E. & Cramer, Military carrier telegraph equipment ..... 196D Oct  
 Bower, F. H., Manufacturing grown junction transistors ..... 130 Dec  
 Bradley, W. E., Transistor mechanics (letter) 420D May  
 Brantley, J. Q., Radar offers solution to midair plane collisions ..... 146 Nov  
 Brauch, H. N. & Jacob, Keying transmitters at high speed ..... 148 Dec  
 Brean, John W., Magnetic-matrix switch reads binary output ..... 157 May  
 Brock, R. L., Transistor flip-flop uses two frequencies ..... 175 June  
 Brueckmann, H., Delay-line dummy load has high power rating ..... 167 June  
 Buff, C., Four-channel fsk adds radio circuits ..... 156 July  
 Burgwald, G. M., and Reiffel, Balloon-born radiation telemetering system ..... 138 May  
 Burke, R. W., Leibowitz & Adelman, Phototube tester checks anode current ..... 288D Feb  
 Burruano, S. J., Bailey & Cramer, Shielding and potting ..... (insert) M-23 Oct  
 Burton, N. H. & Newman, High-voltage switch from banana plugs ..... 256D Mar  
 Burton, N. H., Newman & Nozick, Dark-trace display tube has high writing speed ..... 154 Dec

**C**

Cahn, P. and Ornstein, Multichannel f-m aids marine communications ..... 126 July  
 Caprarola, L. J., Coining cuts costs of magnetron anodes ..... 284D May  
 Carroll, J. M., Electronics in the oil industry ..... 120 Sept  
 Carroll, J. M., The importance of mechanical design ..... (insert) M-2 Oct  
 Carroll, J. M., The microwave market picture ..... 152 Oct  
 Carstensen, E. L., Li & Schwan, Electric and ultrasonic deep-heating diathermy ..... 172 Mar  
 Chalfin, N. L., Pertinent patents 236D Jan, 246D Feb, 258D Mar, 226D Apr, 242D May, 220D July, 214D Aug, 214D Sept, 230D Oct, 212D Nov, 212D Dec  
 Chen, T. S., Output windows for tunable magnetrons ..... 170 May  
 Cheng, C. C., Transistor equations using h-parameters ..... 191 Apr

Childs, U. J., Tone compensation (letter) 364D Aug  
 Chow, W. F., High-frequency transistor amplifiers ..... 142 Apr  
 Clark, E. G., Stabilizing color carrier reinsertion oscillator ..... 142 July  
 Clark, E. G. & Phillips, Color demodulators for television receivers ..... 164 June  
 Clarke, K. B. & Courage, Making small parts ..... (insert) M-15 Oct  
 Clink, W. L., Sensitive microphotometer ..... 196D Mar  
 Clink, W. L., Stain counter totals droplets ..... 202D Feb  
 Coblenz, A., & Owens, Cascading transistor amplifier stages ..... 158 Jan  
 Coblenz, A. & Owens, Acknowledgment (letter) 404D Apr  
 Cohn, J., & Dyke, Pulling-figure tester for microwave oscillators ..... 170 Dec  
 Cooper, R. H., Evans, Lee, & Billins, Microphotometer scans spectrum photographs ..... 174 Dec  
 Cordes, Harry B., Low-frequency switch for recording transients ..... 168 May  
 Cordray, R., Hull & Novick, How long-line effect impairs tunable radar ..... 168 Feb  
 Corman, A. & Bedinger, Rocket-borne photometer measures sky light ..... 151 Sept  
 Cramer, S., Bailey & Burruano, Shielding and potting ..... (insert) M-23 Oct  
 Crede, C. E., Increasing validity of shock tests ..... 236D June  
 Cronin, J. D. & Riggs, Electronic filter for central power supplies ..... 174 Feb  
 Csabai, P., Correspondent ..... (letter) 418D Feb

**D**

Davis, D. D., Germanium-diode push-pull voltmeter ..... 212D Feb  
 Davis, F. E., Stereovectorcardiograms (letter) 502D Mar  
 Davis, L. I., Electronic air-war game simulates missile strikes ..... 146 Apr  
 Deming, C. R., Current-limited variable power supply ..... 206D Oct  
 DeShong, J. A., Jr., Logarithmic amplifier with fast response ..... 190 Mar  
 Diamond, J., Audio feedback ..... (letter) 378D June  
 Diamond, M. J., Hardness tester sorts auto engine parts ..... 160 Dec  
 Dinger, H. E., Sullivan & Wells, Radio receiver counts lightning strokes ..... 158 Oct  
 Doelz, Predicted-wave radio teleprinter ..... 166 Dec  
 Dobie, J. B., and Jacob, Removing tramp iron from chopped hay ..... 134 May  
 Dyke, E. & Cohn, Pulling-figure tester for microwave oscillators ..... 170 Dec

**E**

Eliason, M. C., Sequentially gated automatic gain control ..... 186 June  
 Ennes, Harold E., Portable sync generator for tv broadcasting ..... 138 Apr  
 Enslein, K., Distributed amplifier for nuclear research ..... 138 July  
 Ernst, W. P., Stable power supplies for microwave standards ..... 168 Jan  
 Ettinger, G. M., Negative inductance cuts magnetic-amplifier lag ..... 162 Jan  
 Ettinger, G. M., Stabilizing circuit for X-ray gages ..... 210D Oct  
 Ettinger, A. B., Random sequence switching ..... 165 Feb  
 Evans, J. W., Lee, Cooper & Billins, Microphotometer scans spectrum photographs ..... 174 Dec

**F**

Findley, L. D., Phantastron computes pulse-width ratios ..... 164 Jan  
 Findley, L. D., Kennedy & Van Horn, Multi-exposure flash for high-speed cameras ..... 180 Feb  
 Fingerett, J. A., & Hill, Fast-response magnetic servo amplifier ..... 170 Oct  
 Fisher, J. F., & Traub, Continuous film scanner for monochrome and color ..... 152 Aug  
 Fleming, L., A video test oscillator ..... 206D Mar

Fleming, L., Laboratory power supply ..... 224D Aug  
 Fleming, L., Hard tube operates magnetic counters ..... 186D Sept  
 Fleming, L., Teacher ..... (letter) 503D Mar  
 Flory, L. E., Pike & Gray, Camera adapter for tv receivers ..... 141 Jan  
 Flory, R., Frequency control for multiple transmitters ..... 142 Sept  
 Foley, J. S., Unilateral four-terminal circuits ..... 186 Feb  
 Ford, A., Bioelectric integrator uses two transistors ..... 176 May  
 Fritze, C. W., Tape recorder stores computer output ..... 166 July  
 Full, E., Standby audio console ..... 141 Mar

**G**

Gade, D. W., Feedback in junction transistor circuits ..... 174 July  
 Gallonio, A., & Auld, Pulse distribution in tv network origination ..... 166 Aug  
 Gates, H. W., Frequency-modulated uhf transmitter ..... 238D Feb  
 Gerber, E. A., VHF crystal grinding ..... 161 Mar  
 Ghandhi, S. K., Design of transistor power amplifiers ..... 146 Mar  
 Giacchetto, L. J., Power transistors for audio output circuits ..... 144 Jan  
 Gibson, A. F., Germanium modulator for infrared communication ..... 155 Oct  
 Gilson, W. E., Manometer recorder for physiological pressures ..... 152 Dec  
 Godet, S., and Whaley, Electronic juggler ..... 204D July  
 Goldrath, B., Pneumatic lift serves as assembly work table ..... 268D Oct  
 Gomard, Preben, Tankless low-frequency transmitter ..... 154 May  
 Goodell, C. E., Improved demodulator for radar ranging ..... 170 June  
 Gordon, C. C. & Greenough, Parachute-borne telemetering system ..... 148 June  
 Goubau, Georg, Designing surface-wave transmission lines ..... 180 Apr  
 Granger, J. V. N., Designing flush antennas for high-speed aircraft ..... 136 Mar  
 Gratian, J. W., Characteristics of ring recording heads ..... 184D Sept  
 Gratian, J. W., Magnetic-tape pickup has d-c response ..... 156 Sept  
 Gratian, J. W., Tape Curves ..... (letter) 372 Dec  
 Gray, G. W., Aircraft receiver for vor-its-communications ..... 180 June  
 Gray, G. W., Flory & Pike, Camera adapter for tv receivers ..... 141 Jan  
 Greenough, M. L. & Gordon, Parachute-borne telemetering system ..... 148 June  
 Greif, K., Microsecond-spike generator ..... 182D Sept  
 Gross, E., & Rozenstein, Long-period timer ..... 185 June  
 Guderjahn, C. A., and Berge, Recording fluxmeter ..... 147 July  
 Guttman, E., Moving parts ..... (insert) M-29 Oct  
 Guttwein, G. K. & Leslie, Jr., Magnetic recording for vehicular research ..... 154 Feb

**H**

Halabi, T., Power-level nomograph ..... 194 June  
 Hall, S. B. & Schug, Radio control directs air-sea rescue boat ..... 130 Mar  
 Hand, B. P., Broadband rotary waveguide attenuator ..... 184 Jan  
 Hangstefer, J. B., Silicon diodes (letter) 364D Aug  
 Harned, J. L., & Shorkey, Frequency deviation indicator ..... 214D Aug  
 Harwell, K. E. & Hood, Salinity meter for sonar measurements ..... 172 Jan  
 Hatcher, C. M. & Smith, Measuring microwave antenna patterns ..... 184D Nov  
 Hatcher, C. M. & Smith, Ship models predict antenna patterns ..... 162 Apr  
 Heins, H., Radar duplexer uses dual-tr tube ..... 149 Aug  
 Hampson, J. G. G., Low-frequency resonators ..... (letter) 417D Feb  
 Heuer, C. & Adler, Beam-deflection tube simplifies color decoders ..... 148 May  
 Hill, F. & Fingerett, Fast-response magnetic servo amplifier ..... 170 Oct  
 Hobbs, M., Electrostatic speaker accents high frequencies ..... 143 Nov  
 Hoberman, M., Magnetic recorder arrests transients ..... 178 Oct  
 Hogan, J. W., Magnetic tape controls machine tools ..... 144 Dec  
 Hollmann, H. E., VHF transistor oscillators ..... 220D June

Honnell, P. M., Electronic shake table 178 June  
 Hood, D. W., Salinity meter for sonar measurements 172 Jan  
 Howard, D. D., Single-channel system of frequency diversity 158 Aug  
 Howard, E. C. & Savant, Multiplier for analog computers 144 Sept  
 Hruska, L. J., Transistor converter 212D Sept  
 Hudson, A. C., Circular waveguide chart 194 Oct  
 Huggins, J. E., Jr., Vibrator shakes leads into printed-circuit holes 256D Nov  
 Hull, J. F., Novick & Cordray, How long-line effect impairs tunable radar 168 Feb

Isle, D. E. S., Self-balancing bridge checks parts automatically 275D June

Jacob, F. C. and Dobie, Removing tramp iron from chopped hay 134 May  
 Jacob, M. I. & Brauch, Keying transmitters at high speed 148 Dec  
 Jensen, G. D., Gated marker generator 177 Apr  
 Jervis, E. R., Tube reliability (letter) 362D Aug  
 Jervis, E. R. and Swauger, Military reliability of electron tubes 130 Apr  
 Johnson, R. W., Designing wide-range tuning circuits 174 Aug  
 Josias, C., Matching resistors at a-c 200D Apr  
 Jupe, J. H., Britain uses industrial controls 216D May

Kaplan, J. Y., Sabath & Sporn, Power devices (insert) M-37 Oct  
 Kaufer, G. E., Extending multivibrator delay time 232D Feb  
 Keller, J. W. and Prugh, Transistor pulse supply 186D July  
 Keller, J. W. & Prugh, Thyatron-type transistor circuit 190D Aug  
 Kelly, H. P., Color video tester checks distortion 128 Sept  
 Kennedy, E. S., Van Horn & Findley, Multi-exposure flash for high-speed cameras 180 Feb  
 Kennedy, R. C., Sine-squared pulses test color tv systems 138 Dec  
 King, D. D. & Konigsberg, Electronically tuned wide-range oscillator 184 Mar  
 Kleinhof, B. A., Tube inspection program for airborne equipment 248D July  
 Kleinklaus, L. J., Audio equipment for binaural broadcasts 134 Feb  
 Knaack, F., Broadcast transmitter switching system 192 Mar  
 Knaack, H. S., Portable transceiver 204D May  
 Koch, M. E., Jr., Measuring noise in resistors 181 Mar  
 Koehel, W. P., Cement adhesion tester for receiving tubes 282D Apr  
 Koehler, R. B. & Richards, Decade counter tube for accounting machines 151 Nov  
 Kolb, E. R., Modulator for low-frequency tape recording 220D Aug  
 Konigsberg, R. L., Frequency response in four-terminal networks 220D Feb  
 Konigsberg, R. C. & King, Electronically tuned wide-range oscillator 184 Mar  
 Korewick, J., A-M system measures microwave attenuation 175 Jan  
 Kornblith, Jr., Lester, An r-f generator for nuclear energy studies 142 May  
 Kramer, N. H., Tester for transistor selection 240D June  
 Krause, C. A., Gain-stabilized transistor amplifier 183 Feb  
 Kronenberg, M. H. & White, Design techniques for color television receivers 136 Feb

Lacy, P. D., Helix-Coupled traveling-wave tube 132 Nov  
 Lafferty, R. E., Transistor gun for tv 137 May  
 Landow, I. S., Checking perpendicularity of c-r traces 246D Dec  
 Laughlin, R. D. & McLucas, Moving-target detector 169 Aug  
 Lax, L., Transistor amplifier (letter) 346D July  
 Leaver, E. W. & Mounce, Recorder-controlled automatic machine tools 124 Nov  
 Lebon, I. L., McMahon and Baker, Transistors convert sine waves to pulses 160 May  
 Lee, R. H., Billins, Cooper & Evans, Microphotometer scans spectrum photographs 174 Dec  
 Leibowitz, R. T., Adelman & Burke, Phototube tester checks anode current 228D Feb  
 Lentz, J. & Bennett, Automatic measurement of star positions 158 June  
 Leslie, J. M., Jr. & Guttwein, Magnetic recording for vehicular research 154 Feb  
 Lesser, J., Designing the chassis (insert) M-5 Oct  
 LeVine, D. J. & Sichak, Dual-mode horn feed for microwave multiplexing 162 Sept  
 Levine, R. J., Temperature-compensated aircraft fuel gage 160 Sept  
 Levy, L., More on teachers' problems (letter) 397 Nov  
 Li, K., Schwan & Carstensen, Electric and ultrasonic deep-heating diathermy 172 Mar  
 Losco, E. F., Silicon power rectifier handles 1,200 watts 157 Dec  
 Low, H., Beecher and Bennett, Stabilized noise source for air-weapon design 163 July  
 Lutz, S. G., Welded joints on diodes reduce computer bulk 154 Nov

MacDonald, A. & Soled, Furnace sample holder 257D Dec  
 Macpherson, A. C., Graphical solution of power transfer problems 208D July  
 Madsen, J. F., Transistorized oscillator 171 Sept  
 Malling, L., Field pulses produce nuclear spin echoes 134 June  
 Manke, A. G. & Myers, Crystals reduce mobile interference 154 Sept  
 Mamott, H., Foreign transistors (letter) 504D Mar  
 Marshall, D. E. & Shackelford, Commutation factor in thyatron circuit design 198D Mar  
 Martel, C. W., Early silicon diode (letter) 400 Nov  
 Martin, J. E. & Ruze, Coscant antenna aids uhf-tv coverage 138 June  
 Marzetta, L. A., High-power pulser aids cathode studies 178 Mar  
 Masucci, C., Peltz and Whalley, Signal overload relay for television receivers 153 Apr  
 Mazur, D. G., Pulse transmitter for rocket research 164 Nov  
 McClane, C. T., Adjustment procedures for color tv production 140 Aug  
 McDermott, J. R., New electronic drafting tools and techniques 120 Aug  
 McGrane, E. J. & Martin, Low-cost breadboards for electronic training 184D Aug  
 McLucas, J. L. & Laughlin, Moving-target detector 169 Aug  
 McMahon, R. E., Lebon and Baker, Transistors convert sine waves to pulses 160 May  
 McMath, J. P. C., Thyatron peak voltmeter 192 Dec  
 McMurtrey, A. W., Jr., Teacher vs engineer (letter) 418D May  
 McMurtrey, A. W., teachers' problems (letter) 400 Nov  
 McQuistan, W. R., Altitude corrector for tracking radars 157 June  
 Mehron M. & Otto, Instantaneous multiplier for computers 144 Feb  
 Miller, E. C., Inside speech clipper 182 Dec  
 Miller, E. C., Signal-operated tone compensation 184 May  
 Mita S., Sawazaki, Nomura & Suzuki, Microwave relay for Japanese television 152 June  
 Moffat, B., Saturable transformers as gates 174 Sept  
 Morgan, Edgar D., Simple time-delay relay 178 Apr  
 Morris, R. V., Babits & Spengler, Current-step waveform generator 164 Mar  
 Mounce, G. R. & Leaver, Recorder-controlled automatic machine tools 124 Nov

Muller, J. T., Designing the cabinet (insert) M-57 Oct  
 Murphy, W. R., Fitting title (letter) 404D Jan  
 Myers, R. T. & Manke, Crystals reduce mobile interference 154 Sept

Naidamast, D., Quantity reproduction photo-oscillograms 264D Sept  
 Nather, R. E., High-speed counting with one-tube decades 174 Oct  
 Nelson, L., Space charge (letter) 504D Mar  
 Nelson, V. R., Visual aid for music training 200D Aug  
 Newman, H. L., & Squires, Video amplifier design charts 190 Jan  
 Newman, S. & Burton, High-voltage switch from banana plugs 256D Mar  
 Newman, S., Nozick & Burton, Dark-trace display tube has high writing speed 154 Dec  
 Nidey, R. A., Pietenpol, Stacy & Stith, Rocket-borne servo tracks the sun 149 Jan  
 Nomura, T., Suzuki, Mita & Sawazaki, Microwave relay for Japanese television 152 June  
 Novick, G., Cordray & Hull, How long-line effects impairs tunable radar 168 Feb  
 Nozick, S., Burton & Newman, Dark-trace display tube has high writing speed 154 Dec  
 Nozick, S. & Winkler, Operation of crt storage devices 184 Oct

Oakes, J. B., Junction transistor pulse forming circuits 165 Sept  
 Oleesky, S. S., Designing radomes for supersonic speeds 130 Jan  
 Onder, K., Audio amplifier matches voice-coil impedance 176 Feb  
 Onder, K., Mobile f-m broadcast receiver design 130 May  
 Onder, K., Source impedance (letter) 384D June  
 Oppenheim, B. J., Range control (letter) 346D July  
 Ornstein, W., and Cahn, Multichannel f-m aids marine communications 126 July  
 Otto W. & Mehron, Instantaneous multiplier for computers 144 Feb  
 Owens, H. L., & Coblenz, Acknowledgment (letter) 404D Apr  
 Owens, H. L., & Coblenz, Cascading transistor amplifier stages 158 Jan  
 Owens, J. H., Audio oscillator uses new R-C design 176 Mar

Packard, K. S., Machine methods make strip transmission line 148 Sept  
 Pagano, E. L., Selenium rectifier testing techniques 200D Sept  
 Palmer, R. N., Ceramic tube mount for automatic assembly 162 Aug  
 Pankove, J. I., Pulsed curve tracer for semiconductor testing 172 Sept  
 Pearlman, A. R., Transistor power supply for Geiger counters 144 Aug  
 Pelfrey, L. S., Silicon vs germanium (letter) 345D July  
 Peltz, J. R., Whalley and Masucci, Signal overload relay for television receivers 153 Apr  
 Phillips, C. H. & Clark, Color demodulators for television receivers 164 June  
 Pietenpol, W. B., Stacey, Stith & Nidey, Rocket-borne servo tracks the sun 149 Jan  
 Pike, W. S., Gray & Flory, Camera adapter for tv receivers 141 Jan  
 Plotkin, M., & Rogers, Generating r-f power for 3-bev accelerator 160 Feb  
 Porter, J. H., In-phase indicator 202D Oct  
 Porter, J. H., Time interval go-no go gage 208D Aug  
 Prell, G., CRO measurement of beat frequencies 224D Apr  
 Price, R. L., Cascade audio amplifier has low noise level 156 Mar  
 Prugh, T. A. and Keller, Transistor pulse supply 188D July  
 Prugh, T. A. & Keller, Thyatron-type transistor circuit 190D Aug  
 Pryslak, N. E., Metal-to-ceramic seals for magnetron waveguides 282D Jan

**Q**

Quenstedt, R. E., Conelrad receiver with built-in alarm ..... 156 Jan  
 Quirk, J. B., & Bailey, UHF meter measures low power levels ..... 159 Nov

**R**

Rabinow, J., and Apstein, Distributed transducer for ultrasonic power ..... 160 July  
 Radius, C., Teacher speaks. (letter) ..... 345D July  
 Ray, H. A., Jr., Engineer adjudication (letter) 502D Mar  
 Reaves, J. H., Bias supplies for direct-coupled circuits ..... 172 Aug  
 Reed, H., UHF r-f power meter ..... 183D Nov  
 Reed, J. M., Series capacitors multiply battery voltage ..... 182D July  
 Reiffel, L., and Burgwald, Balloon-borne radiation telemetering system ..... 138 May  
 Resnick, I. L., & Sokal, Staircase generator counts pulses ..... 137 Mar  
 Richards, R. K., & Koehler, Decade counter tube for accounting machines ..... 151 Nov  
 Richards, W. O., Quality control of wire stripping ..... 234D Aug  
 Richardson, J. E., & Bakeman, Regulated d-c supply has high efficiency ..... 165 Oct  
 Riddle, F. M., Transistors in telemetry ..... 178 Jan  
 Riddle, R. L., Polarity. (letter) 364D Aug  
 Riddle, R. L., Practical two-stage transistor amplifiers ..... 169 Apr  
 Riggs, R. N., & Cronin, Electronic filter for central power supplies ..... 174 Feb  
 Rivera, J. J., Engineers and executives (letter) 406D Sept  
 Roberts, F., Series heater strings for tv receivers ..... 126 Aug  
 Rockett, F., Fixed capacitors undergo miniaturization ..... 120 July  
 Rockett, F., Fixed resistors show stability improvements ..... 132 Sept  
 Rockett, F., High-frequency coils use new core materials ..... 140 Dec  
 Rockett, F., Iron-core transformers run smaller and hotter ..... 136 Nov  
 Rockett, F., New variable capacitors extend tuning range ..... 130 Aug  
 Rockett, F., Precision potentiometers use new materials ..... 144 Oct  
 Rod, R. L., Ultrasonic liquid level indicator systems ..... 156 Apr  
 Rogers, E. J., & Plotkin, Generating r-f power for 3-bev accelerator ..... 160 Feb  
 Rosen, S., & Bier, Selective a-f transistor amplifier ..... 208 Dec  
 Rosenthal, L. A., & Badoyannis, Direct vswr readings in pulsed r-f systems ..... 162 Dec  
 Rozenstein, S., & Gross, Long-period timer ..... 185 June  
 Ruston, J., High-power visual amplifier for tv ..... 220D May  
 Rutishauser, R., Ferroresonant flip-flop design ..... 152 May  
 Ruze, J., Cosecant antenna aids uhf-tv coverage ..... 138 June

**S**

Sabath H., Sporn & Kaplan, Power devices ..... (insert) M-37 Oct  
 Sachs, D., Untried ideas. (letter) 399D Jan  
 Sargent, R. S., Moving target detection by pulse doppler radar ..... 138 Sept  
 Savant, C. J., Jr., & Howard, Multiplier for analog computers ..... 144 Sept  
 Schafer, C. R., Phase-selective detectors ..... 138 Feb  
 Scharfman, H., Linear low-level rectifier ..... 228D Mar  
 Schenkerman, S., Feedback simplifies transistor amplifiers ..... 129 Nov  
 Schick, P. T., Assembly techniques (insert) M-45 Oct  
 Schlesinger, K., TV color detectors use pulsed-envelope method ..... 142 Mar  
 Schlicke, H. M., Accurate beat-frequency measurements ..... 196D Nov  
 Schooley, A. H., Transistor amplifiers reduce delay line attenuation ..... 181 May  
 Schooley, A. H., Radar Doppler nomograph ..... 180 Dec

Schug, G. V., & Hall, Radio control directs air-sea rescue boat ..... 130 Mar  
 Schulthess, Jr., H. B., Frequency-code modulation system ..... 172 Apr  
 Schultz, C. F., Wiring and soldering (insert) M-49 Oct  
 Schwan, H. P., Carstensen & Li, Electric and ultrasonic deep-heating diathermy ..... 172 Mar  
 Schwartz, J., & Solomonoff, Photoelectric d-c chopper for guided missiles ..... 162 Nov  
 Schwittek, E. W., Servocoupler matches aircraft antennas ..... 188 Oct  
 Seelig, C., & Schultz, Wiring and soldering (insert) M-49 Oct  
 Shackelford, C. L., & Marshall, Commutation factor in thyatron circuit design ..... 198D Mar  
 Sharaf, H. M., Noncontacting gage for microdisplacements ..... 172 June  
 Shive, S. L., Signal detector for high noise levels ..... 210D June  
 Shorkey, J. J., & Harned, Frequency deviation indicator ..... 214D Aug  
 Siau, J. H., Crucible heat control ..... 149 Feb  
 Sichak, W., & LeVine, Dual-mode horn feed for microwave multiplexing ..... 162 Sept  
 Silverstein, A., Building and using dielectric amplifiers ..... 150 Feb  
 Slaughter, D. W., Time-shared amplifier stabilizes computers ..... 188 Apr  
 Small, B. I., & Hatcher, Measuring microwave antenna patterns ..... 184D Nov  
 Smith, V., & Hatcher, Ship models predict antenna patterns ..... 162 Apr  
 Sodaro, J. F., Shielding nomographs ..... 190 May  
 Sodaro, J. F., Shunt-series peaking ..... 194 Mar  
 Sodaro, J. F., TV lighting calculator ..... 192 June  
 Sokal, N., Staircase generator. (letter) ..... 421D May  
 Sokal, N. O., Pedestal-removing slicer circuit ..... 220D Mar  
 Sokal, N. O., & Resnick, Staircase generator counts pulses ..... 187 Mar  
 Soled, J., & MacDonald, Furnace sample holder ..... 257D Dec  
 Solomonoff, R., & Schwartz, Photoelectric d-c chopper for guided missiles ..... 162 Nov  
 Spaven, W. J., Arc-lamp tachistoscope improves reading speed ..... 174 May  
 Spaven, W. J., & Bernstein, Single tube square-wave generator ..... 206D June  
 Spencer, N. A., Cavity-resonator design charts ..... 186 May  
 Spencer, R. E., Engineering personalities (letter) 404D Sept  
 Spengler, S. R., Morris & Babits, Current-step waveform generator ..... 164 Mar  
 Sporn, S. R., Kaplan & Sabath, Power devices ..... (insert) M-37 Oct  
 Squires, W. K., & Newman, Video amplifier design charts ..... 190 Jan  
 Stacey, D. S., Smith, Nidey & Pietsenpol, Rocket-borne servo tracks the sun ..... 149 Jan  
 Stahl, R. J., & West, Automatic circuit tester speeds production ..... 136 Oct  
 Stavely, E. B., and Washburn, Tape recorder cycles truck axle tester ..... 130 July  
 Stein, E., and Thomas, TV station monitor ..... 153 July  
 Steinberg, P., Gated time markers for cro display ..... 150 Mar  
 Steinberg, P. S., Monochrome i-f strip conversion for color ..... 170 July  
 Steinitz, H., & Weisbecker, Direct-reading Grenz-ray dosimeter ..... 168 Oct  
 Stern, A. P., & Altes, Modified color signal for single-gun tubes ..... 168 Sept  
 Stine, W. V., Radar antenna follows stars ..... 180D Sept  
 Stith, G. A., Nidey, Pietsenpol, & Stacey, Rocket-borne servo tracks the sun ..... 149 June  
 Strabala, F. I., High-speed film marker ..... 202D Nov  
 Strassman, A. J., Multiple generator has variable delay ..... 178 May  
 Strassman, A. J., RPM indicator provides expanded scale ..... 146 Aug  
 Strauss, I., Cutting and forming digital leads for printed circuits ..... 230D Nov  
 Strickland, H. J., Light-beam telemetering ..... 135 Dec  
 Sullivan, A. W., Wells & Dinger, Radio receiver counts lightning strokes ..... 158 Oct  
 Suzuki, K., Mita, Sawazaki & Nomura, Microwave relay for Japanese television ..... 152 June  
 Swain, W. H., Low-distortion electronic attenuators ..... 220D Oct  
 Swauger, J., & Jervis, Military reliability of electron tubes ..... 130 Apr

**T**

Tate, H. J., Temperature-stabilized transistor amplifiers ..... 144 June  
 Teitelman, J., Measuring transistor temperature rise ..... 185 Apr

Thomas, D. E., Single-transistor f-m transmitter ..... 130 Feb  
 Thomas, E. C., Jr., Automatically de-iced X-band beacon antenna ..... 152 Jan  
 Thomas, H. E., and Stein, TV station monitor ..... 153 July  
 Thomasson, L. T., Digital servomechanism controls shaft position ..... 134 Aug  
 Traub, E. H., & Fisher, Continuous film scanner for monochrome and color ..... 152 Aug

**V**

Van Doren, M. L., Magnetic recording of pwm signals ..... 232D May  
 Van Horn, J. H., Pindley & Kennedy, Multiexposure flash for high-speed cameras ..... 180 Feb  
 Vossberg, C. A., Photoelectric gage sorts pencil crayons ..... 150 July

**W**

Washburn, R. P., and Stavely, Tape recorder cycles truck axle tester ..... 130 July  
 Washington, L. Jr., & Witcher, Echo-location for the blind ..... 136 Dec  
 Weisbecker, H. B., & Steinitz, Direct-reading Grenz-ray dosimeter ..... 168 Oct  
 Wells, J. D., Dinger & Sullivan, Radio receiver counts lightning strokes ..... 158 Oct  
 Wentworth, J. W., Color test techniques for tv broadcasters ..... 120 Nov  
 Werner, W., TV receiver operates on four system standards ..... 140 Oct  
 West, G. R., & Stahl, Automatic circuit tester speeds production ..... 136 Oct  
 Whaley, C., and Godet, Electronic juggler ..... 204D July  
 Whalley, W. B., Masucci and Peltz, Signal overload relay for television receivers ..... 153 Apr  
 Whitaker, R. O., Continuous phase shifter ..... 202 Dec  
 White, E. S., & Kronenberg, Design techniques for color television receivers ..... 136 Feb  
 White, F. B., Feedback. (letter) 456D Oct  
 White, F. B., Zero output impedance (letter) 362D Aug  
 White, F. D., Heat rise. (letter) 417D Feb  
 White, F. D., Interference. (letter) ..... 418D Feb  
 White, R. C., & Booth, Winding frame grids for ruggedized tubes ..... 245D Dec  
 White, W. D., Circular radar cuts rain clutter ..... 158 Mar  
 Wiebach, W. F., Optical methods speed tube components inspection ..... 301D May  
 Winkler, S., & Nozick, Operation of crt storage devices ..... 184 Oct  
 Wiselender, D. E., Totem-pole jigs cut wiring costs ..... 276D Oct  
 Witcher, C. M., & Washington, Echo-location for the blind ..... 136 Dec  
 Woestemeyer, F. B., Marker pulse shows shaft position ..... 146 May  
 Wojciechowski, B. M., Capacitance gage checks cable sheath thickness ..... 134 Apr  
 Wolfskill, R. F., Measuring tv sound modulation ..... 226D June  
 Woods, R. W., Thyratrons protect unloaded amplifiers ..... 208D Oct  
 Woods, R. W., Water flow safety interlock ..... 194D May

**Z**

Zack, A., Wafer coil technique mechanizes production of transformers ..... 234D Dec  
 Zelinger, G., Timer saves monitor batteries ..... 250D Nov  
 Zelinger, G., Tunable audio filters ..... 173 Nov  
 Zucchini, M. B., Magnetic amplifiers for synchronous motors ..... 133 Mar  
 Zucchini, M. B., Transistor preamplifier drives magnetic servo ..... 168 Mar

# electronics

## READER SERVICE SECTION

A method that provides readers with a . . . .

### "DIRECT-TO-THE-MANUFACTURER"

method of obtaining additional information on products advertised in this issue. No time lost in remailing your request from publication to manufacturer.

THESE POST CARDS ARE FOR YOUR USE 

and

HERE IS WHAT YOU DO:

1. Fill in with ink or typewrite your name, company, address and title.
2. Then fill in the name of the specific product or service and the page number on which it appears.
3. Place a check mark in the box or boxes applicable to your needs.
4. Tear out the postcard on the perforated lines and address it to the manufacturer(s) whose products you are interested in. Place a stamp in the box indicated and drop into the mail.

THE MANUFACTURER WILL PROMPTLY SEE THAT YOU RECEIVE THE NECESSARY PRODUCT DATA OR THAT HIS REPRESENTATIVE CALLS UPON YOU, WHICHEVER YOU DESIRE.

If there is insufficient space on the postcard for describing your problem specifically, we suggest you write to the manufacturer, spelling out your requirements in detail. Be sure your filled-in postcard accompanies your letter.

Name .....  
Company .....  
Address ..... City & State .....  
Title .....  
Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files  
 I wish to see your representative  
 Please contact me by phone no. \_\_\_\_\_

Name .....  
Company .....  
Address ..... City & State .....  
Title .....  
Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files  
 I wish to see your representative  
 Please contact me by phone no. \_\_\_\_\_

Name .....  
Company .....  
Address ..... City & State .....  
Title .....  
Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files  
 I wish to see your representative  
 Please contact me by phone no. \_\_\_\_\_

Name .....  
Company .....  
Address ..... City & State .....  
Title .....  
Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files  
 I wish to see your representative  
 Please contact me by phone no. \_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# To the Readers

of

# electronics

**A New Reader Service designed to provide prompt response**

You, as a reader, may never have thought specifically of the viewpoint of the advertisers whose informative and up-to-date product news reaches you through the advertising pages of **ELECTRONICS**.

They are **VITALLY** interested in you and your needs. You and thousands like you constitute the market and without you they cannot continue to present their product story; indeed, they cannot remain in business.

These manufacturers whose products and services are shown in this issue welcome your inquiries and your desire for more information.

If your requirements are complicated and you require more space, we suggest that you write directly to the manufacturer, stating your problem in detail and asking for specific information or assistance. Be sure to include the postcard with your detailed request in order that your inquiry be given prompt and expeditious attention. Make certain that you specify which **PRODUCT** you are interested in if more than one appears in the advertisement.

# electronics

## READER SERVICE SECTION

A method that provides readers with a . . . .

### "DIRECT-TO-THE-MANUFACTURER"

method of obtaining additional information on products advertised in this issue. No time lost in remailing your request from publication to manufacturer.

THESE POST CARDS ARE FOR YOUR USE

and

HERE IS WHAT YOU DO:

1. Fill in with ink or typewrite your name, company, address and title.
2. Then fill in the name of the specific product or service and the page number on which it appears.
3. Place a check mark in the box or boxes applicable to your needs.
4. Tear out the postcard on the perforated lines and address it to the manufacturer(s) whose products you are interested in. Place a stamp in the box indicated and drop into the mail.

THE MANUFACTURER WILL PROMPTLY SEE THAT YOU RECEIVE THE NECESSARY PRODUCT DATA OR THAT HIS REPRESENTATIVE CALLS UPON YOU, WHICHEVER YOU DESIRE.

If there is insufficient space on the postcard for describing your problem specifically, we suggest you write to the manufacturer, spelling out your requirements in detail. Be sure your filled-in postcard accompanies your letter.

Name .....

Company .....

Address ..... City & State .....

Title .....

Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files
- I wish to see your representative
- Please contact me by phone no. \_\_\_\_\_

Name .....

Company .....

Address ..... City & State .....

Title .....

Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files
- I wish to see your representative
- Please contact me by phone no. \_\_\_\_\_

Name .....

Company .....

Address ..... City & State .....

Title .....

Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files
- I wish to see your representative
- Please contact me by phone no. \_\_\_\_\_

Name .....

Company .....

Address ..... City & State .....

Title .....

Please send me further information on  
(Product or Service).....

As described on page \_\_\_\_\_ of December 1954

**electronics**

- I want this information for my files
- I wish to see your representative
- Please contact me by phone no. \_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ELECTRONICS**  
December 1954

Place  
Stamp  
Here

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**For PRODUCTS  
and SERVICES**

not specifically advertised  
or described in this issue

of

**Electronics**

Consult your

**1954-1955**

**ELECTRONICS**

**BUYERS' GUIDE**

or

Write to:

**Reader Service Department**

**Electronics**

**330 West 42nd Street**

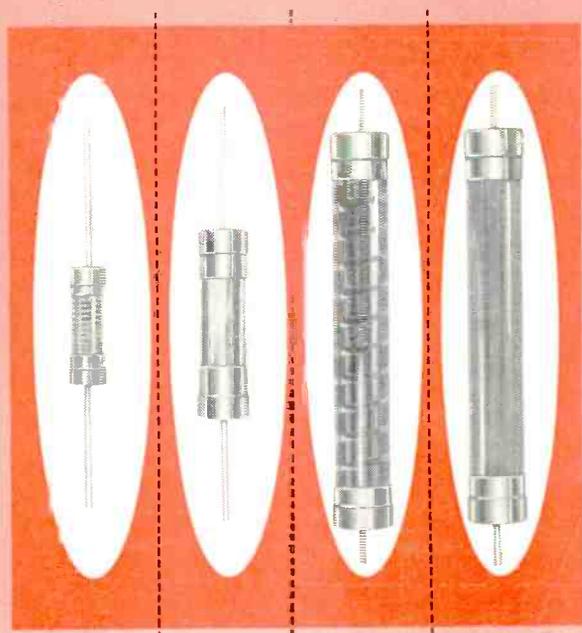
**New York 36, N. Y.**

**THE HERMETICALLY SEALED DAVOHM SERIES 850 IS THE PERFECT COMPROMISE BETWEEN PRECISION WIRE WOUND AND COMPOSITION TYPE RESISTORS**

Rugged simplicity keynotes the design of the new Davohm Series 850 resistor. Basically, it is a heat resistant glass tube, with the noble-metal resistive element deposited on the inside surface. Hermetically sealed, the resistive elements need no "protective" coatings, and are deposited with such extreme accuracy that even microscopic examination will show no flaws or raggedness which might otherwise result in noise, erratic readings, hot spots and opens. The temperature coefficient is always positive, always constant, and does not vary with resistance value. High frequency performance is excellent due to low reactive component of impedance.

The unique performance characteristics of the Davohm Series 850 compares with MIL-R-10509A as follows:

	MIL-R-10509A ALLOWABLE CHANGE	Series 850 TYPICAL CHANGE
Temperature Cycling	1.0%	0.02%
Low Temperature Exposure	3.0%	0.04%
Short Time Overload	0.5%	0.02%
Effect of Soldering	0.5%	0.02%
Moisture Resistance	5.0%	0.08%
Voltage Coefficient	0.002%	0.00%
Load-Life (per 1000 hours)	1.0%	0.20%
Temperature Coefficient (PPM/°C)	±500	+370 ±20



Available immediately in 1/2, 1 and 2 watt sizes and in ±1%, ±0.5%, and ±0.25% tolerances in any desired value.

Write for full technical data or see your local Daven Sales Representative.

# New and Revolutionary Davohm

*metal film*

outdates all previous film types in performance

# Series 850

*resistors ...*

characteristics.

DAVEN ELECTRONIC SALES CORP., associated with

THE **DAVEN** CO.

191 Central Avenue, Newark 4, New Jersey



World's largest manufacturer of attenuators



# COLOR TV COMES OF AGE

**The RCA 21-INCH COLOR PICTURE TUBE,**  
*the tube in your future, is here!* Intensive RCA research brings you full-sized pictures of excellent clarity and brightness . . . makes production-line color TV a reality. Outstanding features of the new RCA-21AXP22 are:

21" round tube with aluminized phosphor dot screen gives largest picture in color TV, a full 250 square inches of brilliant color.

Metal shell means lighter weight and greater mechanical strength.

Thermally-compensated, spherical shadow mask permits uniform expansion of mask for improved color registration and brighter pictures.

70° deflection angle—combined with a short electron gun having improved resolution—provides a short tube which permits reduced cabinet depth.

## RCA-21AXP22

- 21-inch metal envelope
- electrostatic focus
- magnetic deflection
- magnetic convergence

### Three New RCA-Developed Receiving Tubes for Color TV



**RCA-6BL4—**  
Half-Wave Rectifier Tube (Damping Diode)



**RCA-6BK4—**  
Sharp-Cutoff Beam Triode (Shunt Voltage Regulator)



**RCA-6CB5—**  
Beam Power Tube (Horizontal-Deflection Amplifier)

RCA pioneered and developed compatible color television



**RADIO CORPORATION of AMERICA**  
ELECTRON TUBES

HARRISON, N.J.