ELECTRONIC INDUSTRIES

TELE-TECH

A Caldwell-Clements Publication

APRIL, 1953

FRONT COVER: RUSSIAN EQUIPMENT CAPTURED IN KOREA—On a muddy hillside somewhere in Korea, Cpl. John Claypool of the 17th Infantry Regiment field tests a Russian-made telephone. This is one of the first group of photographs, just released by the Department of the Army, showing enemy communications equipment captured in Korea. Included in this group are a Russian-made switchboard, radio transmitter, field telephone, ohm meter, and TG key and tape printer; Chinese Communist field radio; and North Korean radio set. Photographs and additional details are shown on pages 62-64 in this issue.

DEPARTMENTS

TELE-TECH*, Vol. 12, No. 4. Published monthly by Caldwell-Clements, Inc. M. Clements, President; Oreste H. Caldwell, Treasurer. Acceptance under Section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., February 8, 1952 with additional entry at New York, N. Y. 75 cents a copy. Annual Subscription Rates: United States and Possessions: $7.00; Canada: $8.00; All Other Countries $10.00. Please give title, position and company connection when subscribing.

CALDWELL-CLEMENTS, Inc.

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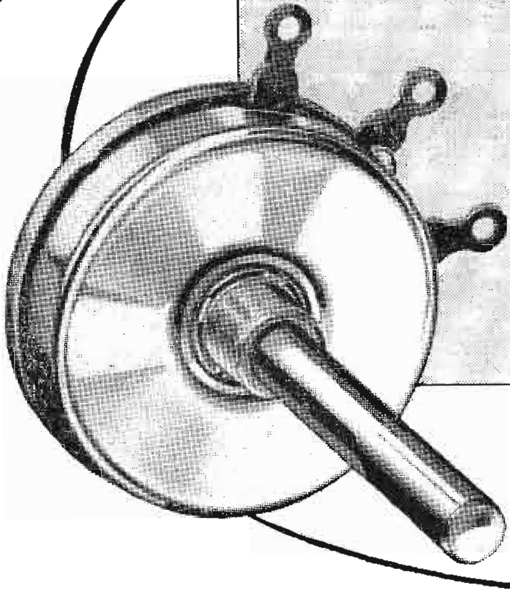
Publishers also of TELEVISION RETAILING

* Reg. U. S. Pat. Off.

TELE-TECH'S GUARANTEED CIRCULATION, 21,000

Because of the lag in auditing, never catching up with current circulation in an expanding industry, an audit for the calendar year 1953 will not be made until the summer of 1954. Meanwhile, sworn statements and post office receipts will be furnished covering the guaranteed 21,000 circulation.

Need a wire wound control with a million cycle life?



Probably not. But if you use wire wound controls you can learn something from an experience of one of our major airlines. They came to us with this problem . . .

When an aileron moves, resistance through a wire wound control changes . . . transmitting the aileron position to the automatic pilot which instantly and automatically corrects the aileron position. As a result, the aileron control is moving almost constantly within a very narrow range. It was the highly concentrated wear in this area that was causing the trouble.

The answer to the problem was a standard Mallory wire wound control except for special contact materials that provided the needed life. The result was a million cycles of dependable operation with substantial economies in maintenance schedules.

You may never need a control that will last for a million cycles, but you can bet that Mallory will have the answer to your control problems . . . standard or special. For complete information, write for your copy of our new Technical Information Bulletin 76-3 covering both military and commercial types.

Expect more . . .

***Get more from* MALLORY** (P.R. MALLORY & CO. Inc.)

Parts distributors in all major cities stock Mallory standard components for your convenience

P.R. MALLORY & CO. Inc.
MALLORY

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Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

Broadcast Stations in U. S.

	AM	FM	TV
Stations on Air	2350	613	131 VHF & 13 UHF
Under Construction (CPS)	142	56	87 VHF 175 UHF 12 Educational
Applications Pending	221	10	441 VHF & 250 UHF

Radio and TV Receiver Production

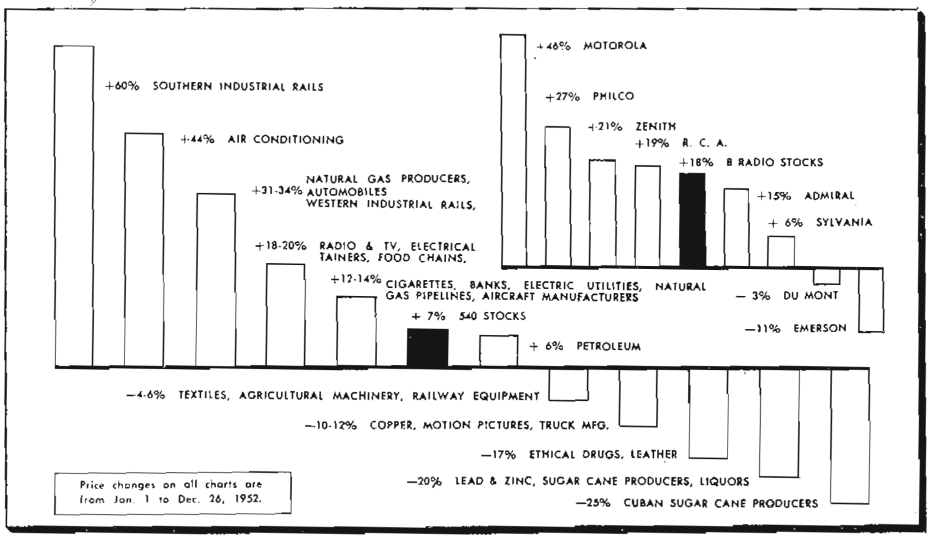
	TV		Radio
February 1953		Home	400,000
		Battery	75,000
		Auto	518,000
		Clock	209,000
Total	757,000		1,202,000
Two months (Jan.-Feb.) 1953		Home	752,000
		Battery	157,000
		Auto	935,000
		Clock	388,000
Total	1,438,000		2,224,000
January, '52	404,932		632,455
Jan.-Feb. '52	814,269		1,391,908

1952: 7.6 Million CR Tubes—368 Million Receiving Tubes Sold

Over 7.6 million cathode ray tubes and 368.5 million receiving-type tubes were sold by manufacturers in 1952, reports the Radio-Television Manufacturers Association. Cathode ray tube sales totaled 7,635,666 units valued at $170,652,078.72 while 368,519,243 receiving-type tubes valued at $259,116,089.21 were sold by manufacturers.

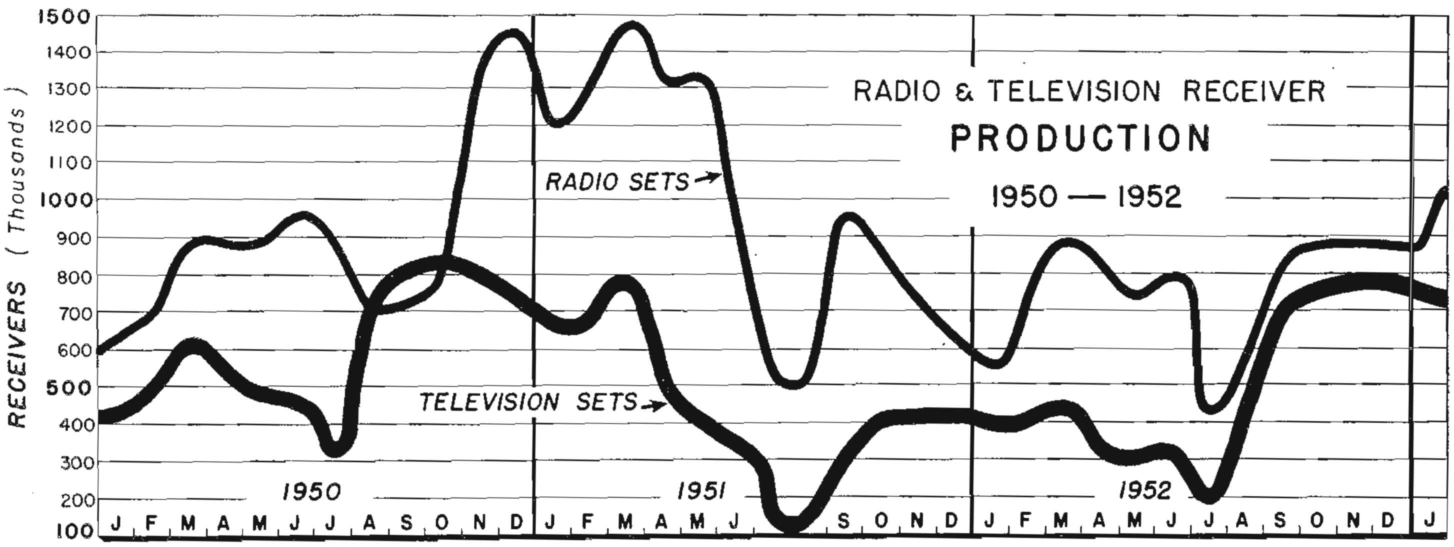
Cathode ray tube sales to manufacturers totaled 6,120,292 units during 1952. These were valued at $139,208,649.98. In December, '52 852,501 tubes with a value of $20,394,042.05 were sold to equipment manufacturers.

ELECTRONIC-TV VS. OTHER STOCK GROUPS

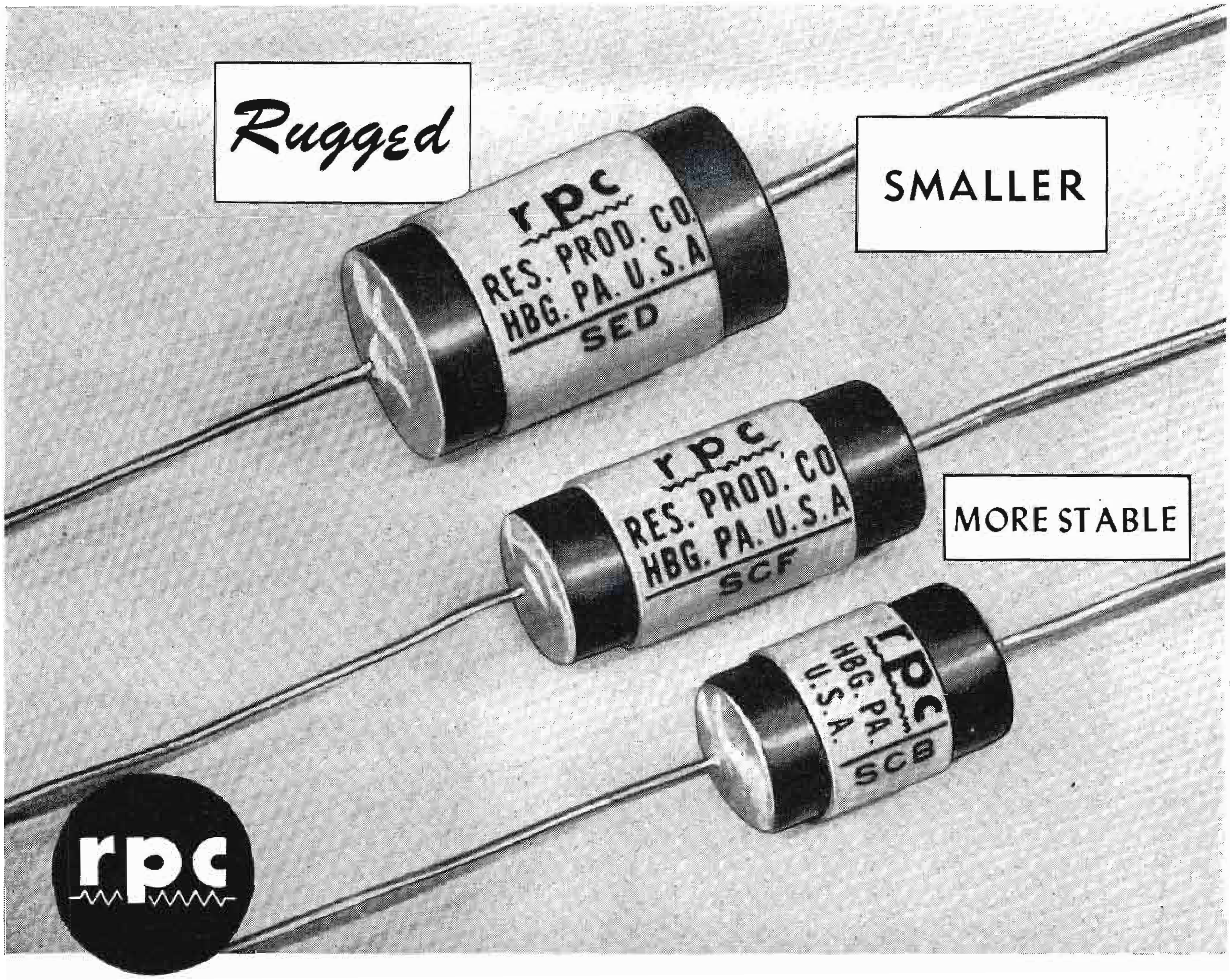


TELEVISION SETS IN USE, APRIL 1, 1953

Market Area	Stations No. TV	in Use TV Sets	Market Area	No. TV Stations	TV Sets in Use
Ames	1	146,000	Mobile	2	25,000
Atlanta	3	290,000	Nashville	1	107,000
Atlantic City	1	8,000	New Haven	1	351,000
Austin	1	30,000	New Orleans	1	164,000
Baltimore	3	480,000	New York	7	3,420,000
Binghamton	1	97,000	Norfolk	1	162,000
Birmingham	2	156,000	Oklahoma City	1	157,000
Boston	2	1,032,000	Omaha	2	185,000
Buffalo	1	356,000	Philadelphia	3	1,231,000
Charlotte	1	228,000	Phoenix	1	54,000
Chicago	4	1,430,000	Pittsburgh	1	600,000
Cincinnati	3	373,000	Portland	1	83,000
Cleveland	3	745,000	Providence	1	315,000
Columbus	3	273,000	Richmond	1	175,000
Dallas-Ft. Worth	3	267,000	Roanoke	1	50,000
Davenport-Rock Island-Moline	2	175,000	Rochester	1	180,000
Dayton	2	224,000	Salt Lake City	2	84,000
Denver	2	110,000	San Antonio	2	128,000
Detroit	3	820,000	San Diego	1	136,000
Erie	1	107,000	San Francisco	3	590,000
Grand Rapids-Kalamazoo	2	208,000	Schenectady	1	262,000
Greensboro	1	107,000	Seattle	1	248,000
Houston	1	239,000	South Bend	1	18,000
Huntington	1	150,000	St. Louis	1	520,000
Indianapolis-Bloomington	2	384,000	Syracuse	2	184,000
Jacksonville	1	107,000	Toledo	1	225,000
Johnstown	1	186,000	Tulsa	1	98,000
Kansas City	1	286,000	Utica	1	84,000
Lancaster	1	195,000	Washington	4	441,000
Lansing	1	110,000	Wilkes-Barre	1	17,000
Los Angeles	7	1,485,000	Wilmington	1	132,000
Louisville	2	196,000	Albuquerque	1	20,000
Memphis	1	194,000	Brownsville (Matamoros Mexico)	1	13,000
Miami	1	145,000	El Paso	2	13,000
Milwaukee	1	422,000	Spokane	1	20,000
Minn.-St. Paul	2	336,000	U. S. Total for All Stations		22,834,000



See also Caldwell-Clements Statistics in World Almanac, Encyclopaedia Britannica, National Conference Board Economic Almanac, and "Information Please" Almanac



HERMETICALLY SEALED miniature PRECISION WIRE WOUND RESISTORS

When the utmost in permanence and stability are required, these resistors have proven successful. Exposure to extremes in temperature cycling, aircraft altitudes and salt water immersion leaves these rugged resistors unaffected.

RESISTANCE PRODUCTS COMPANY has been able to achieve quality performance in mass production. RPC has the "know-how"—the special equipment and high degree of constant supervision that are needed.

RPC Type S Hermetically Sealed Resistors are wound on *highest grade steatite forms.* Winding forms are *solder sealed* into steatite jackets. Each resistor is *vacuum tested* to insure hermetic seal. *Long leakage path* between terminals provides top performance under most adverse climatic conditions.

Axial wire leads permit wiring directly into circuits—and the smaller size and lighter weight make these resistors self supporting. *Specially tested low coefficient alloys* are used. Standard resistance tolerance 1%. Tolerance of ½% and ¼% available.

Write for complete information and engineering data.

Type	Dimensions Len.	Diam.	Jan-R-93	Power Rating Jan.	Comml.	Resistance Min (ohm)	Max. (meg)
SCB	9/16	11/32	—	— watts	¼	2.0	0.15
SCF	13/16	11/32	RB51A	¼ watts	½	1.0	0.40
SED	13/16	15/32	RB51A	¼ watts	½	0.5	1.0

Specializing in manufacture of quality resistors in ANY amount

RESISTANCE PRODUCTS CO.

714 RACE ST. **HARRISBURG, PENNSYLVANIA**

High Megohm **High Voltage** **High Frequency** **Wire Wound Precision**

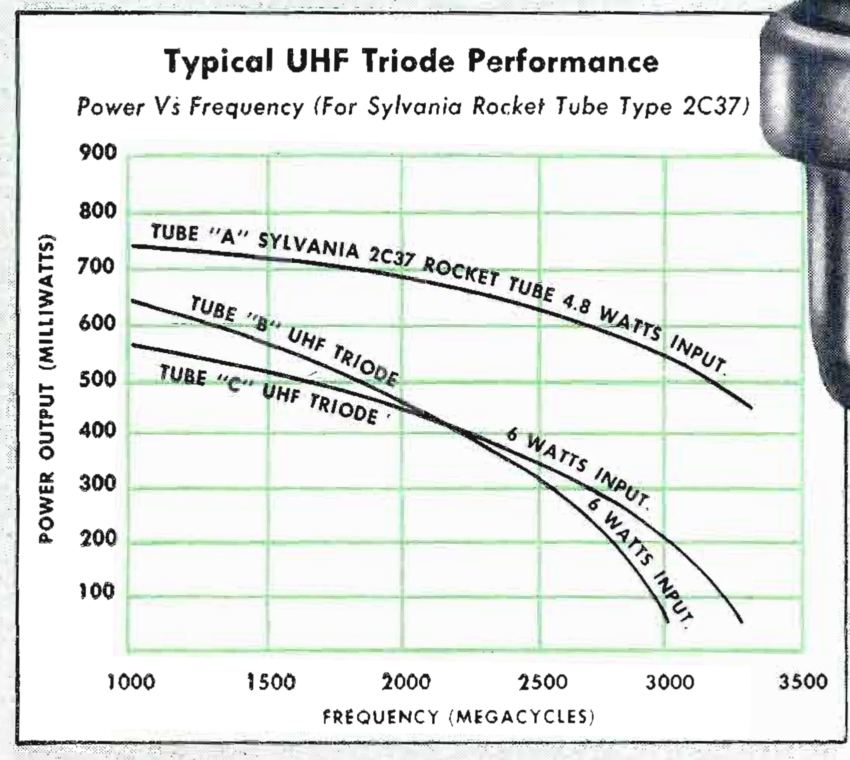
Here's how to get

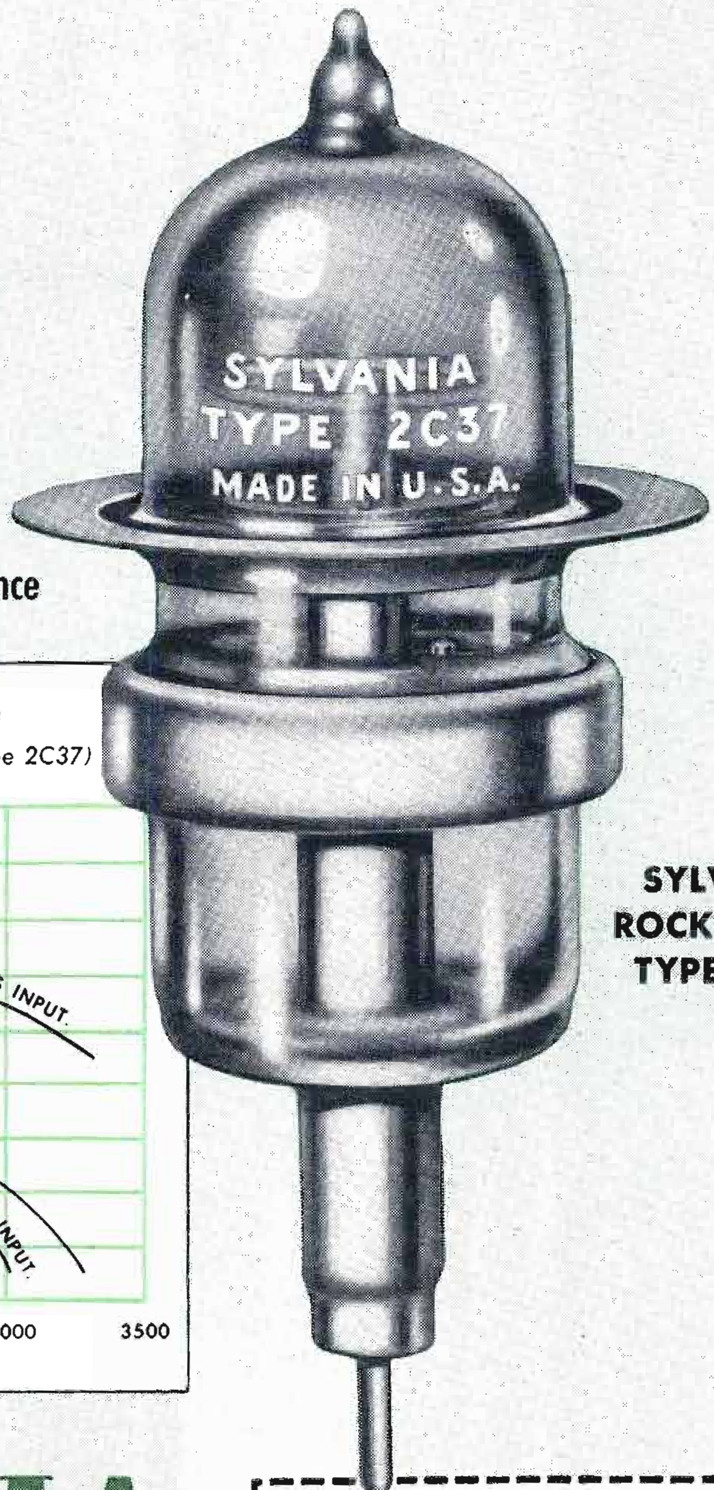
GOOD USABLE POWER AT UHF

Sylvania Rocket Tube Type 2C37 supplies 450 Mw at 3300 Mc.

Because of their high power throughout the UHF spectrum, Sylvania rocket tubes are especially recommended for service as pulsed oscillators, cw oscillators, rf amplifiers and frequency multipliers . . . this is one more reason why it will pay you to specify SYLVANIA.

Compare Sylvania Rocket Tube's Performance





SYLVANIA ROCKET TUBE TYPE 2C37

SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

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Please send me latest data sheets concerning Sylvania Rocket Tubes

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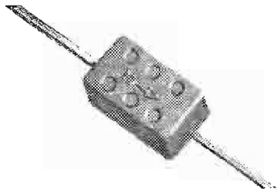
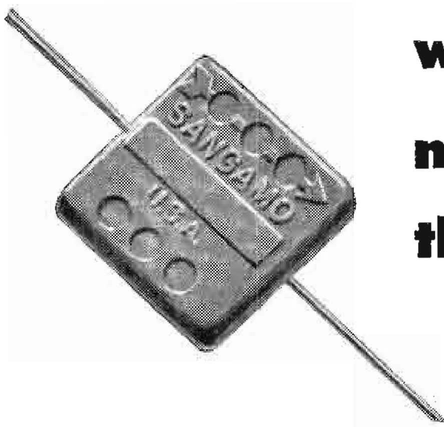
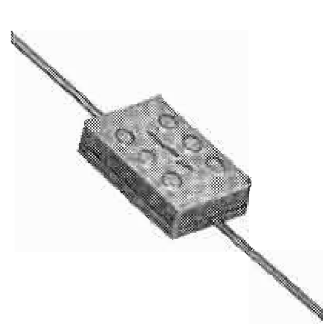
NOW..Wire Lead Micas with 500 times better moisture resistance than ever before!





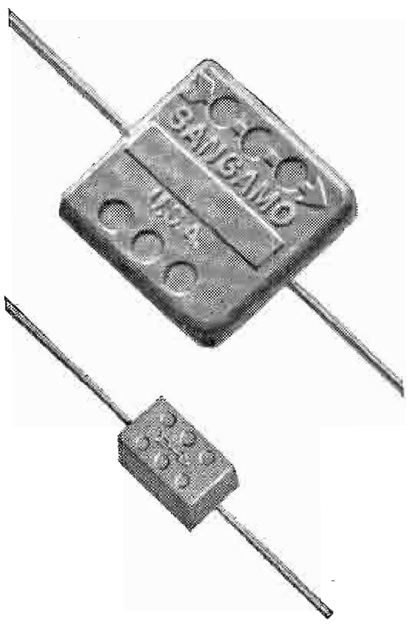
Sangamo HUMIDITITE* Mica Capacitors

When you use Sangamo HUMIDITITE molded Mica Capacitors, you gain all the advantages of an amazing moisture seal that offers previously unheard-of moisture resistance characteristics for compression molded plastic-encased mica capacitor components.



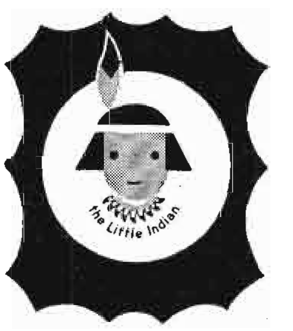
*what is HUMIDITITE?

Humiditite is a remarkable new plastic molding compound, developed by Sangamo, that gives Sangamo Mica Capacitors moisture resistance properties far superior to any others on the market.



HERE'S THE PROOF . . . The standard moisture resistance test described in MIL-C-5A (proposed) Specification requires mica capacitors to offer at least 100 megohms of insulation resistance after ten 24 hour cycles in a humidity chamber at 90% to 95% relative humidity. The best competitive micas barely meet this requirement . . . but Sangamo HUMIDITITE Micas, *under the same conditions*, all tested in excess of 50,000 megohms! Continued tests, over and above requirements, with the same HUMIDITITE Micas, proved them capable of withstanding from 21 to 52 cycles (from the smallest sizes to the largest) before failure.

Humiditite is just another example of the advanced engineering that enables Sangamo to meet the existing and future needs of the electronic industry. For additional information about HUMIDITITE, write for Engineering Bulletin No. TS-111.



Those who know... choose Sangamo

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

SC53-5

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TELE-TECH* is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive authoritative information and interpretation of the latest developments and new products, with emphasis on subjects of engineering import and timeliness. Special attention is given to:

MANUFACTURING

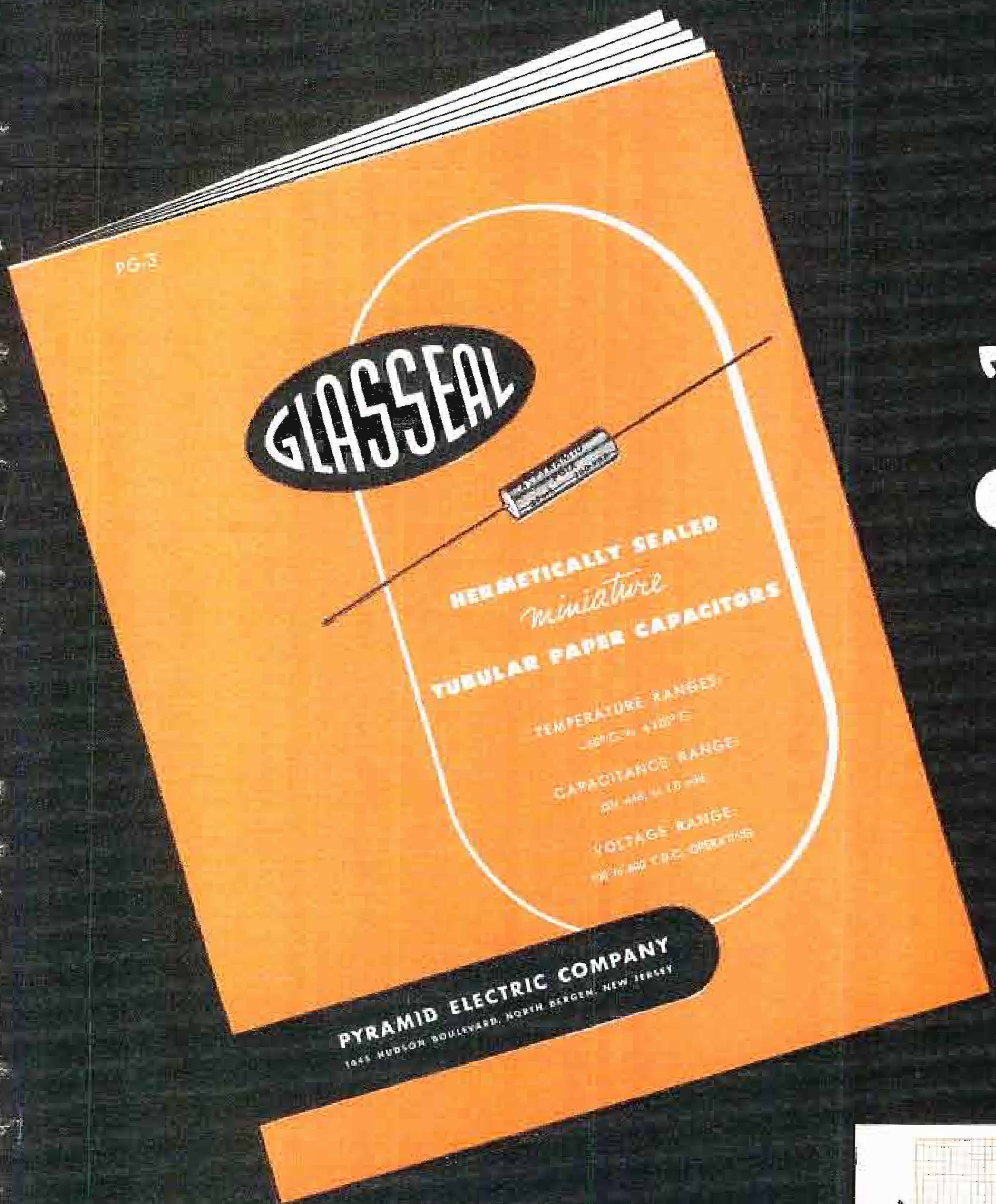
- **Electronic equipment, communications, broadcasting, microwave relay, instrumentation, telemetering, computing.**
- **Military equipment including radar, sonar, guided missiles, fire controls.**
- **TV-FM-AM receivers, phonographs, recorders, reproducers, amplifiers.**

OPERATION

- **Fixed, mobile and airborne communications in commercial, municipal, aviation and government services.**
- **Broadcasting, video and audio recording, records, audio and sound systems, motion picture production.**
- **Military, civilian and scientific electronic computing and control systems.**

* Reg. U. S. Pat. Off.

For Excellence in Performance . . .

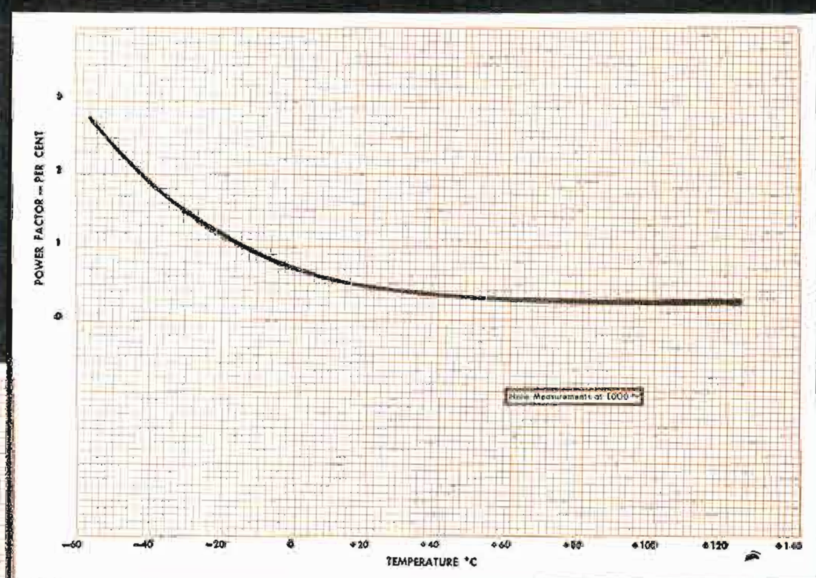


PYRAMID
subminiature
"GLASSEAL" CAPACITORS

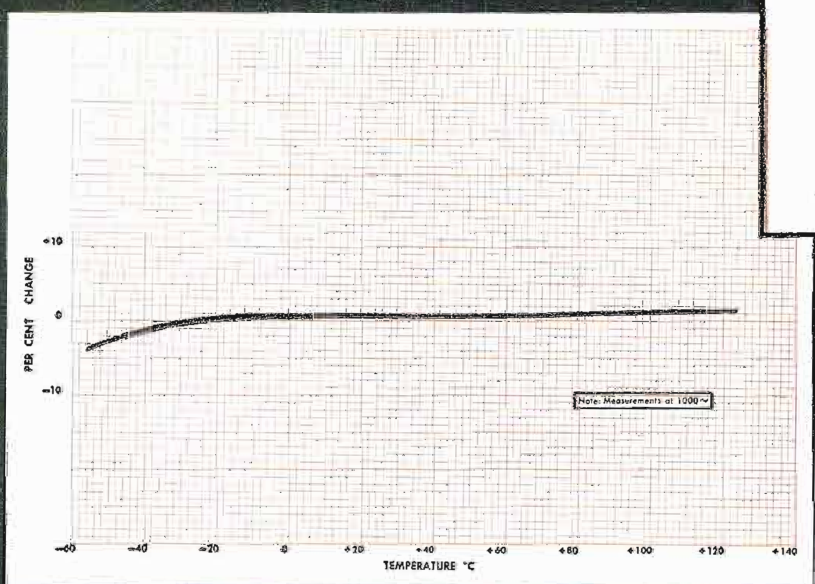
For the most demanding applications, where top-quality and minimum-size considerations are the most vital factors, Pyramid "Glasseal" capacitors are the popular choice.

This attractive new catalog PG-3, incorporating complete engineering data, styles, sizes, and capacitance and voltage ranges is now available.

Power Factor vs. Temperature Curve



% Capacitance Change vs. Temperature



These graphs show typical performance characteristics of the Pyramid "Glasseal X" type, which is designed for 125°C. operation. Full information on all "Glasseal" capacitors is provided in new catalog PG-3.

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PYRAMID ELECTRIC COMPANY

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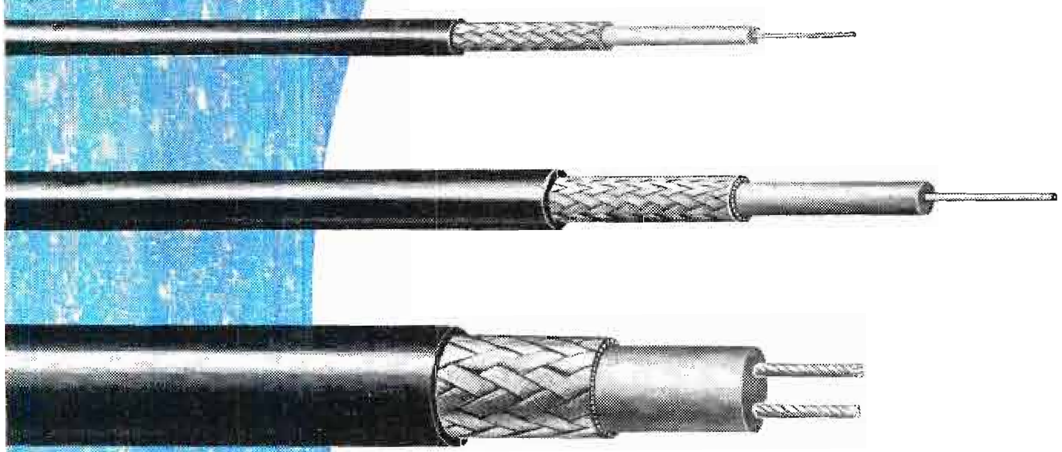
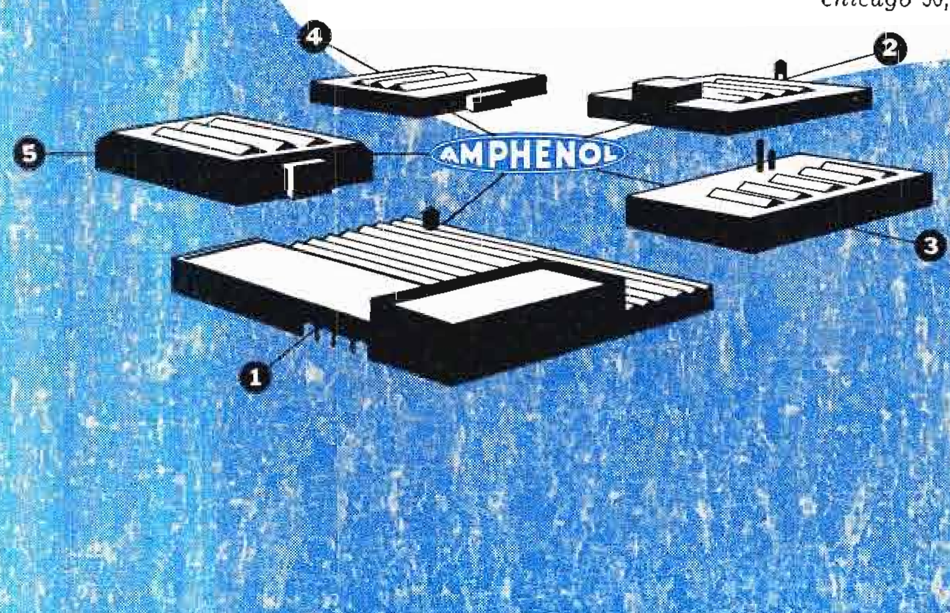




TELE-TIPS

EMPIRE STATE tower will shortly be carrying all seven of New York City's VHF TV transmitters. WOR-TV has received FCC permission to move to the 1460-ft. pinnacle, from its 750-ft. steel tower overlooking the Hudson. And WATV, long scheduled to move from its Newark location, has experienced delays in antenna delivery but expects to be operating from Empire State this month or next.

NO HANDICAP to industry are the workers in a small New York City defense plant. All of the employees are physically handicapped, but morale is high and efficiency is excellent. The plant is presently making motors for remote control units and automatic pilots under a subcontract from the Eclipse-Pioneer Div. of Bendix Aviation. This flourishing enterprise is part of a program instituted by the Federation of the Handicapped, 241 W. 23 St., New York 11, N. Y., to train handicapped pepole for skilled jobs in factories.

TAKE YOUR PICK—and that's just what engineering graduates are doing in selecting jobs. Most of them have their choice of any one of seven opportunities. According to Earl C. Kubicek, Placement Director of Illinois Institute of Technology, February graduates reported that type of work ranked first in determining employment offer. Next in importance was location. And salaries are up, too. The average electrical engineer started at the monthly rate of $361. The average for all engineers is $354, or $29 more than June 1952. Fifteen years ago his weekly salary would have been $23.08. Remember?

TIRED EYES are in store for engineers trying to keep up with all technical articles published in the scientific periodicals. It has been estimated that 1,000,000 technical articles are published annually in the world's literature. Of these, over 6000 deal with radio and electronic engineering. Assuming an average reading time of 20 minutes per article, it would take a zealous engineer in the electronic industries 5.5 hours of reading every night during the year to keep posted on all pertinent developments.

ATOMIC ENERGY is being used at U. of Chicago's medical research center to study the ability of radioactive isotopes to preserve food. A hollow cobalt tube, 14 in. long, 2.5 in. in diameter, and weighing 3 lbs., is irradiated in the Brookhaven reactor. This tube then produces a radiation of 50 roentgens per second (equivalent to 7 lbs. of radium) in the form of high-energy X-rays which strike the food at energies of 1,250,000 electron-volts. Should this study prove fruitful, not only will the food industry gain a money-saving tool, but the AEC will have a useful outlet for disposing of troublesome waste irradiated matter from atomic piles.

SELF-LABELING CRO which writes numerals and letters on the CRT screen to identify different traces has been developed by Bell Labs. under a Navy Bureau of Ordnance contract. Heart of the system is a symbol generator comprising a miniature transformer and passive network housed in a plug-in container. The generator forms each character by applying ac and dc voltages, of proper shape, amplitude and phase relation, to the horizontal and vertical deflection plates. A basic 10-KC sine wave signal source is employed as the symbol networks' input.

BOOSTERS—A new development in boosters was shown in London recently by the Belling-Lee Company. A double triode tube used as a push-pull amplifier with a grounded grid is employed and the whole unit is mounted at the antenna terminals. A coaxial cable is used to carry both the fifty cycle operating voltage (33 volts AC) and the amplified RF signals to the receiver. The tube is underrun to conserve tube life and replacements are expected to be comparatively infrequent. The use of antenna mounted boosters is not new, but however, the dual use of the coaxial cable is not yet practiced to any great extent in this country. It might be worth looking into!

GARAGE DOORS—Add to the ills of radio-controlled garage doors, that of random operation due to local television receivers. It seems that spurious radiations from television receivers are capable, on occasion, of operating radio controlled garage door openers. This seems to be hazard No. 2 to these devices; hazard No. 1 being AM interference from adjacent electrical equipment as previously reported in these columns.

(*Continued on page 34*)

50% more seamless nickel cathode capacity

Of this we are sure: you made us what we are today. You demanded so many of our seamless nickel cathodes that we had to add capacity. We did. We built another plant—this time at Wapakoneta, Ohio—increasing our seamless nickel cathode output by 50%.

Other familiar characteristics of Superior service remain—the desire to help you with your problems, the experience of skilled tube-fabricators, and quality-controlled manufacture.

Take advantage of Superior service and capacity now.

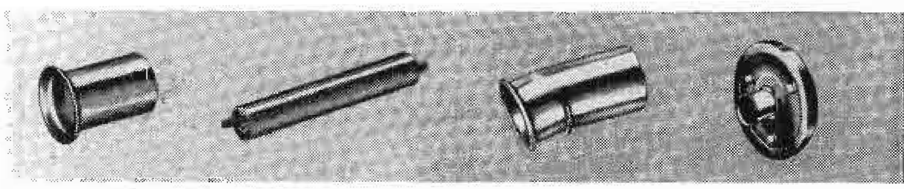
*Main Superior Tube plant at Norristown, Pa.
**NEW Superior Tube plant at Wapakoneta, Ohio

SEAMLESS NICKEL CATHODES

Representative size and shape specifications in current production

Type	Bead	O.D.	Wall Thickness	Length
ROUND	None	.015″	.002″	25.4 mm
ROUND	None	.121″	.0035″	8.0 mm
ROUND	Single	.045″	.002″	27 mm
ROUND	Double	.025″	.002″	28.5 mm
OVAL	Double	.025″x.048″	.003″	12 mm
OVAL	Single	.045″x.149″	.002″	31 mm
OVAL	Single	.025″x.048″	.003″	12 mm
ELLIPTICAL	Double	.025″x.048″	.003″	11 mm
RECTANGLE	Single	.030″x.0975″	.002″	11 mm
RECTANGLE	Double	.040″x.132″	.004″	33.4 mm

Many other types of nickel cathodes—made in Lockseam† from nickel strip, disc cathodes—and a wide variety of anodes, grid cups and other tubular fabricated parts are available from Superior. For information and Free Bulletin address Superior Tube Company, Electronics Division, 2508 Germantown Avenue, Norristown, Pa.



Superior
THE BIG NAME IN SMALL TUBING

All analyses .010″ to ⅝″ O.D.
Certain analyses (.035″ Max. wall) up to 1⅜″ O.D.

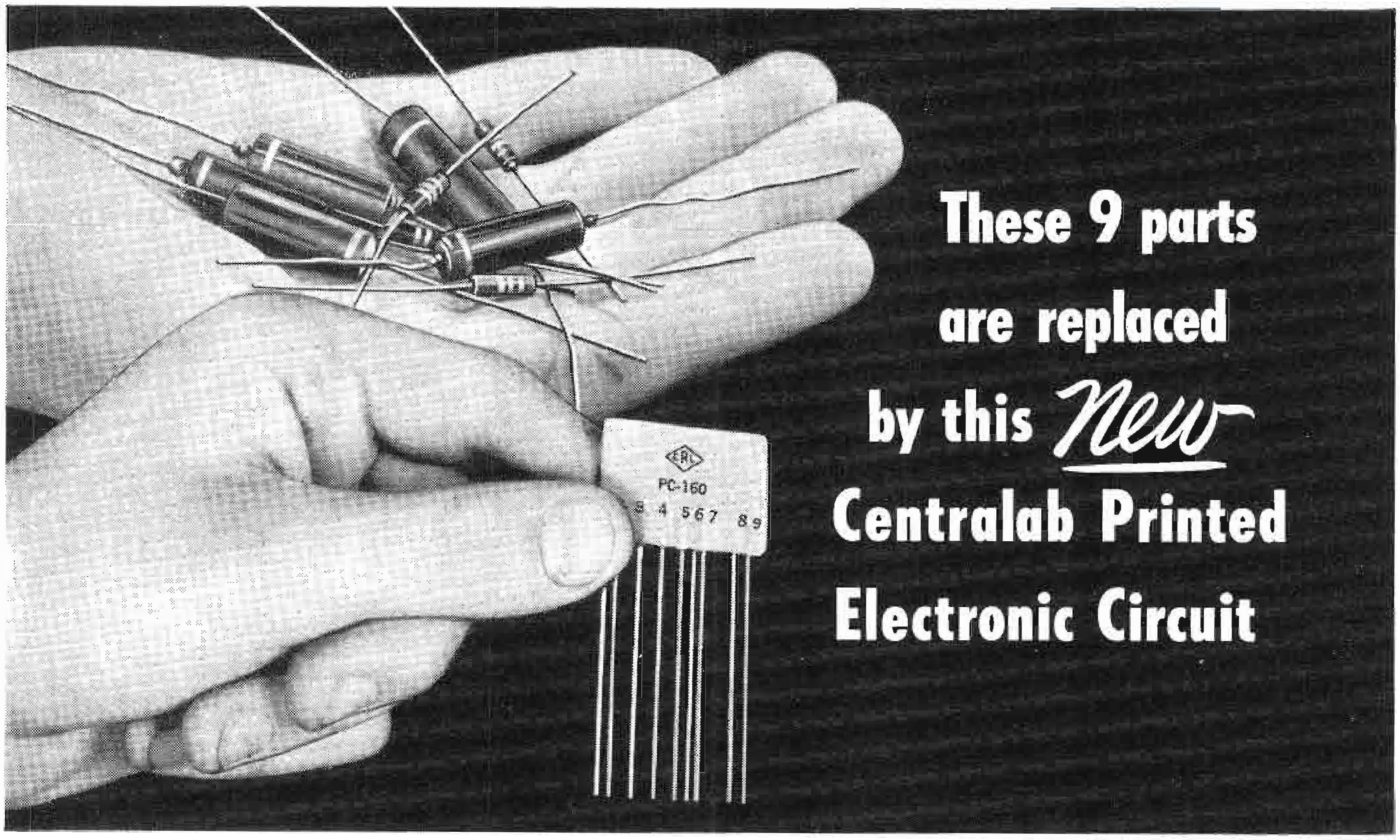
Seamless Nickel Cathode—Round, flanged one end. .115″ O.D. x .105″ I.D. .180″ long.

Lockseam† Nickel Cathode Plate, .170″ O.D. x .005″ wall. 1″ long.

Weldrawn‡ 305 Stainless Steel Anode Rolled and Bent 10°. .499″ I.D. x .010″ wall x 1.050″ long.

Disc Cathode .121″ O.D. .312″ long.

† Manufactured under U.S. Patents
‡ Trademark Reg. U.S. Pat. Off.



For scores of applications — Centralab Printed Electronic Circuits assure 6 tremendous SAVINGS in design, production and performance

1 25% to 80% fewer soldered connections

2 Fewer pieces to buy or inventory

3 Fewer connections minimize wiring errors

4 Lower installation cost — with fewer parts

5 Less weight, less space — "opens-up" chassis

6 Improved circuit stability from uniform PEC's

ANY way you look at them, Centralab Printed Electronic Circuits mean more money in your pocket. No other modern electronic development offers you *six* such tremendous time and cost-saving advantages for low-power applications.

Pioneered and completely developed by Centralab, these resistor-capacitor combinations in complete or partial circuits are extremely economical to use. Many times, the *first cost of PEC's* is less than the components they replace.

As for versatility — there are more than 30 standard circuits already tooled for you. There is a tremendously wide range of sizes and capacities available to you.

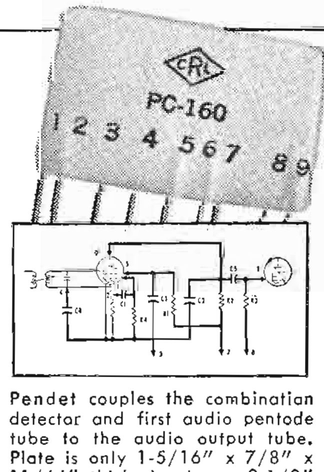
If you have a special circuit problem, we'll even design custom plates at nominal cost where volume warrants. *No wonder 25,000,000 PEC's are in use today!* No wonder scores of manufacturers say it's *good business* to specify and use Centralab Printed Electronic Circuits. Send coupon for full details.

Another Centralab first!
NEW PENDET

— a complete pentode detector and audio coupler circuit that replaces 9 parts . . . eliminates 9 soldered connections.

Talk about compactness—this new Pendet really has it! You get 4 resistors and 5 capacitors screened and fired to a *single* Ceramic-X plate. It replaces 9 conventional components. Only 9 connections are required instead of the usual 18.

Think what this terrific PEC "package" can do in simplifying installation and cutting manufacturing costs of ac, dc and portable receivers. Get complete information on this new PC-160 Pendet NOW. Check No. 42-149 in coupon.



Pendet couples the combination detector and first audio pentode tube to the audio output tube. Plate is only 1-5/16" x 7/8" x 11/64" thick. Leads are 2-1/2" long. Capacitors are 450 vdcw, 800 vdc test. Resistors are 1/5 watt.

Centralab

A Division of Globe-Union Inc.
Milwaukee 1, Wisconsin
In Canada, 635 Queen Street East, Toronto, Ontario

CENTRALAB. A Division of Globe-Union Inc.
938-D E. Keefe Ave., Milwaukee 1, Wisconsin

Please send the following bulletins: ☐ 42-149, ☐ PEC guide No. 2. I'd also like a copy of Centralab's new Electronic Components Catalog No. 28.

Name.................................Position.................................

Company.................................

Address.................................

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

TELE-TIPS

(*Continued from page 25*)

GERMANIUM AHEAD—Techniques for securing desirable properties from germanium are further advanced than those being developed for other semiconductor materials. This metal so far has proven itself easier to purify and control. Germanium has a simple, diamond-like, cubic structure. In other words, the structure of germanium crystals is the same in all directions. Additionally, the metal has a low enough melting point to resist contamination by reaction with the materials in which it is melted.

GERMANIUM COST in transistor production is a minor factor. Although the metal currently sells for $340 per pound, less than seven cents worth (.0002 lb.) is needed to make one transistor. The big job, of course, is to reduce processing and other production costs which, at the present time, set the selling price of a good transistor at $5 to $8, a considerable reduction from the earlier $30 price. Quantity production may pull future unit cost down to $1, though present sales are made at about three times equivalent tube prices. The main problem in price reduction is to find a wide range of transistor applications of varying requirements, so that the whole spectrum of present output can be utilized eliminating the current high rate of rejections.

WHAT PRICE RESEARCH? In 1952 the bill came to $3.5 billion, half of it coming from the government, according to a report prepared jointly by the Bureau of Labor Statistics and the Research and Development Board. The survey, covering companies accounting for $2 billion of research, notes that 27.3% or $500 million was in the radio-electronic field. Also, 23.2% of 94,000 research engineers were in the electronic industries. Copies of "Industrial Research and Development" may be obtained from the Research and Development Board, Dept. of Defense, Washington 25, D. C.

SOVIET TECHNICAL PERSONNEL is rapidly increasing, resulting in the forthcoming possibility of significant scientific advancements. That's the finding of D. Shimkin at Harvard's Russian Research Center. The reason is attributed to the growing number of enrollments in specialized schools during the past ten years.

(*Continued on page 38*)

TELE-TIPS

(*Continued from page 34*)

ELECTRONIC FLOWMETER, capable of measuring air currents in a still room or the rapid flow of fluids in pipes, has been developed at the National Bureau of Standards by Henry P. Kalmus. The device utilizes the change in velocity of sound waves as a measure of fluid flow. It has a very fast response and does not obstruct the fluid currents to make the measurement. In addition, the signal-to-noise ratio is sufficiently high to permit the measurement of extremely small velocities.

CENSORED—The recent passage of a bill by the Quebec Government which makes it illegal to transmit by television, whether by wire or wireless, any photographic film before submission of same for examination by the Board of Cinema Censors may establish hypothetical problems for telecasters in the United States whose signals reach Quebec Province. Will those telecasters be liable for extradition and the penalty of a $500 fine or a three months' prison sentence for showing uncensored films? And how about the law which provides for confiscation of the film and the equipment used in showing it? A similar question came up in the Great Lakes Region when Canadians started purchasing receivers to pick up U. S. transmissions from Buffalo and Niagara. Somehow we don't think that the International Courts will be unduly worried by this development.

BELOW 100 KC—A few queries have been received on the subject of the omission of three operating bands below 100 KC on the Spectrum Chart, supplement to January TELE-TECH. Examination of the chart will show that six columns have been used covering the range from 100 KC to 100,000 MC. If these three *comparatively* unimportant channels were included it would mean either adding a seventh column, and consequently compressing the information even more than has already been done, or losing the ten to one ratio which exists in each column. In view of these facts it was felt that the usefulness of the chart would suffer more by virtue of the inclusion of these channels than by their omission. However, in order to clarify the situation the following information is provided:

10 to 14 KC radio navigation
14 to 90 KC international fixed public
90 to 100 KC fixed Alaska, international fixed public, maritime and mobile telegraphy, radio navigation

TELE-TECH

& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

Engineers – and Executive Incomes!

In the radio, television and electronic industries the men who create the products,—and keep such products advancing abreast the roaring progress of the art,—are of course the engineers.

Yet it has always been distressing to us that, salarywise, engineers are invariably far down the list on most companies' executive payrolls.

These creative forces of the organization, the inventive and technical specialists on whom the very lift of the whole business depends, too often rank, in income, along with second-string officials who perform only routine functions.

Some recent studies of executive salaries in the manufacturing field show chief engineers' standings as follows, in terms of their company's annual business:

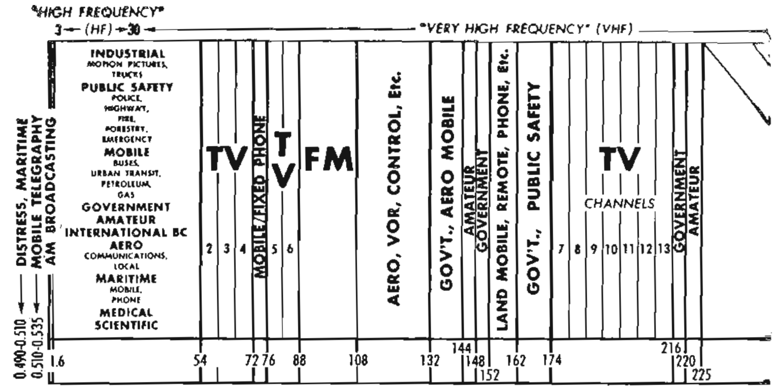
	Corporations Doing Annually	
	Around $10,000,000	Around $40,000,000
Presidents	$50,000	$80,000
Executive Vps.	35,000	50,000
Sales Mgrs.	28,000	40,000
Treasurers	25,000	38,000
Production Mgrs.	24,000	36,000
Legal Officers	17,000	23,000
Chief Engineers	15,000	22,000

Always, the engineer remains low man on the totem-pole. Yet certainly the engineer is the key executive of the whole outfit. It is the engineers who have created our six-billion-dollar radio-TV industry. And it is our engineers who are doing far more than all the politicians and diplomats to guarantee our American way of life.

We want to see engineers' salaries go to the top of corporate income schedules. This can come only as engineers are willing to take greater corporate responsibilities, think more broadly about management, and play the game of greater business risks.

Being men of precise technical training and careful conservative thinking, engineers are usually loath to stray into the lush fields of executive-guessing, politely known as "taking calculated risks,"—where success is measured on the liberal basis of "being right 51% of the time!"

Engineers have created our industry. But they must also learn general principles of business management, finance, corporation law, taxes, employee relations, and—yes—executive "front," if they are to be at the top and receive top rewards in the industries they have created.



RADARSCOPE

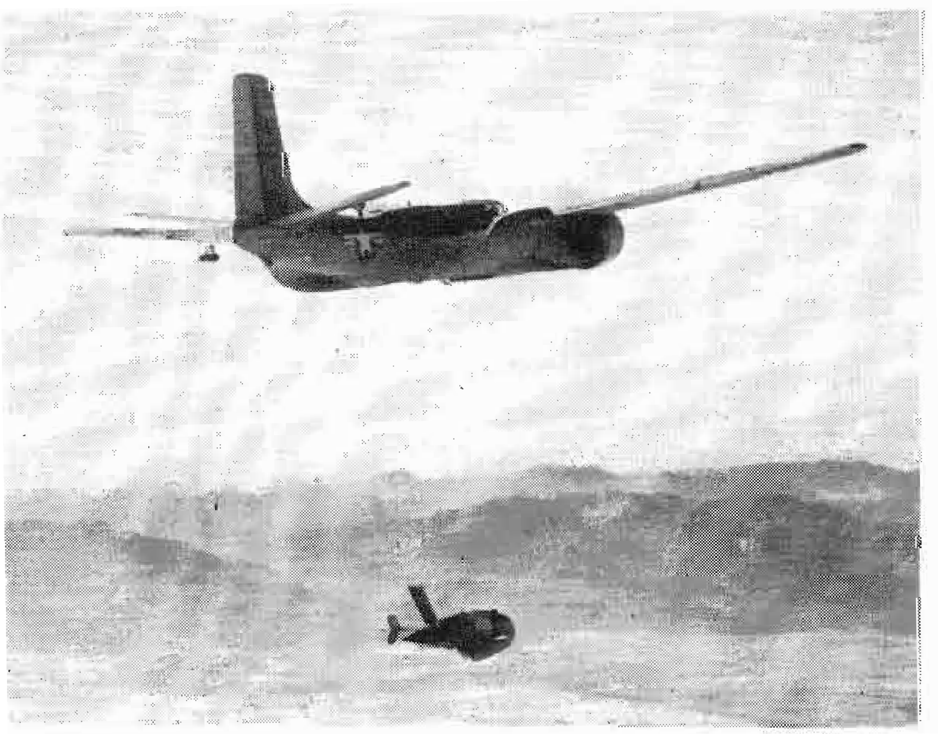
Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications

AVIATION

SINCE ADOPTION of the European Airways System utilizing very high frequencies for radiotelephone communication between aircraft and ground stations has proved inadequate, the International Civil Aviation Organization aims to add thirty-one reserve channels to the nineteen already in use, making a total of fifty VHF channels for European-Mediterranean aeronautical mobile service (VHF). The use of VHF and LF-MF facilities will be discussed in considerable detail at the seventh session of the Assembly of ICAO to be held in Brighton, England, on June 16. This is the first full scale assembly to be held since 1950 and will run from three to four weeks.

MOTION PICTURES

3-D—The recent activity in three-dimensional vision, popularly known as "3-D," is causing a revival of hope among the Hollywood film fraternity. Although not by any means new, the idea of three-dimensional pictures has caught on and the term is being applied wholesale to anything which is not standard projection. Real 3-D presentation involves the use of two separate images which are combined optically, by the use of either Polaroid filters or colored filters. A French system which is still in the experimental stage produces an image which is said to give stereoscopic or three-dimensional results, but it is subject to distortion and interference depending on the position of the viewer in the auditorium. Other attempts to introduce a three-dimensional aspect into the theatre screen involve the use of curved screens, such as Cinerama, Cinemascope, and "wide vision surrounds." In general, pseudo 3-D systems depend upon peripheral images and the effect of curvature of the screen to give the impression that the audience is actually part of the story unfolding on the screen. The advent of the three-dimensional interest in projection systems, together with feature films, will give a temporary boost to the motion-picture business but—it does not seem likely to affect television viewing to any extent.



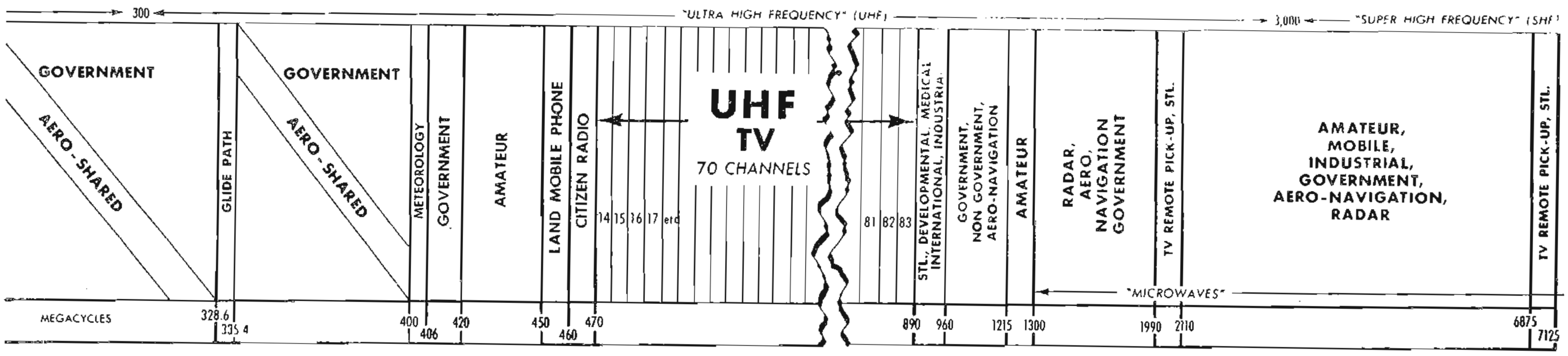
Near Alamogordo, N. M., the Ryan Q2 pilotless target-plane is launched from its "mother" B-26 and proceeds under radio remote control from the ground installations of the Holloman Air Development Center

THREE-DIMENSIONAL TV

MANY YEARS AGO Dumont demonstrated three-dimensional TV that was being developed for use in atomic laboratories handling "hot" materials to assist operators of mechanical hands in controlling their operations. There is no reason why three-dimensional television should not be presented to the home viewer in the near future, save that of channel availability. As previously demonstrated, three-D television was shown on closed circuits utilizing one distinct circuit or half the screen for each of the two pictures required. Again, Polaroid spectacles had to be worn. Conceivably some experimental stereoscopic television transmissions could be made by utilizing the facilities of two television stations in much the same manner as stereophonic transmissions are being made today using two AM, or FM, or a combination of AM and FM, stations. The same thing is possible for color television; it would merely be an added complication in a field which is already complicated. At any rate, both 3-D television and 3-D motion pictures offer a promising field for the promoter!

MANUFACTURING

LOUDSPEAKERS IN '53—NPA has received a report from the industry indicating that 1953 speaker production will total 22,500,000 units compared with 18,807,515 produced in 1952. The report submitted to NPA, also estimated that the average weight of an Alnico 5 magnet per speaker is 1½ oz. The estimated production of 22,500,000 speakers this year will require approximately 1,110,000 pounds of Alnico 5 material, consisting chiefly of cobalt and nickel. The estimate for 1953 production represents an increase over 1952 production because of increased markets due to opening of new television areas and a lack of finished-set inventory in the hands of manufacturers, distributors and dealers, which condition did not exist in the beginning of 1952.



PICTURE TUBES

BIGGER PICTURES desired by the public, are now evidenced by the fact that 80% of the picture tubes today being produced are 21 in. and larger. In fact, 21-in. tubes are by far the dominant size, representing 70% of the total output. An additional 8% of production is assigned to 24-in. tubes and about 2% to 27-in. tubes. To the surprise of the industry, the 17-in. size is still holding its own at 20% of the total unit output. Some industry leaders feel that this 17-in. percentage may even grow larger if the farm drop continues, and the buying public, watching its pennies, gets to counting the $20 to $70 saved by buying 17-in. as against 21-in. sets.

CIRCUITS

CIRCUITRY "PACKAGES"—The National Bureau of Standards has developed an improved system of standardized plug-in circuitry "packages" for use in the construction of electronic equipment. This NBS technique is an extension of similar improvements under development by industry. Each new circuit package has a large number of connections brought out to connector pins. A test jack at the top of each package helps locate defective units, making it easy to replace trouble-causing with trouble-free packages. A distinctive feature is the general similarity of most of the circuit stages. A single basic tube circuit is adapted to the great majority of requirements, and the same basic circuit serves as a low-impedance pulse driver, as a flip-flop, and for a number of gating functions. These rapidly replaceable units, if adopted by manufacturers, promise to combine reduced manufacture and repair costs with improved reliability.

WEATHER

STORM DETECTION—Capt. Howard T. Orville, technical consultant for Bendix Aviation, says that radar storm-detection units, placed at 35 points in the nation, could predict to the minute the arrival of a storm, its duration, and its intensity. Captain Orville, first in the Navy to advance the concept of radar tracking of hurricanes, which has cut deaths from these storms by 98%, said it would cost about $5 millon a year for 10 years to set up this nationwide electronic weather-warning system, but that the end result would be savings of billions in storm damage and thousands of lives. Equipment for each of the 35 stations would include: 1. Storm-detection radar to give an instantaneous "picture" of all rain, snow, sleet or hail over an area of several thousand square miles from the station. 2. Radar cloud-base and cloud-top recorders to provide continuous information on cloud layers passing over the station. 3. Upper-air weather recording equipment such as "Radiosonde" balloons which automatically radio back to earth data on temperature, pressure, humidity and other facts from altitudes up to 100,000 ft. 4. Radar and television units to relay "pictures" of weather conditions from one station to another. 5. Electronic computers to combine the data from the station with other facts gathered from Weather Bureau observation points throughout the Northern Hemisphere.

ELECTRONIC MARKET

U. S. POPULATION GROWTH IS the biggest single factor in the future of any business, according to the York Engineering & Construction Co., whose monthly report analyzes trends of population growth and points out ways they may used to evaluate future markets. For example:

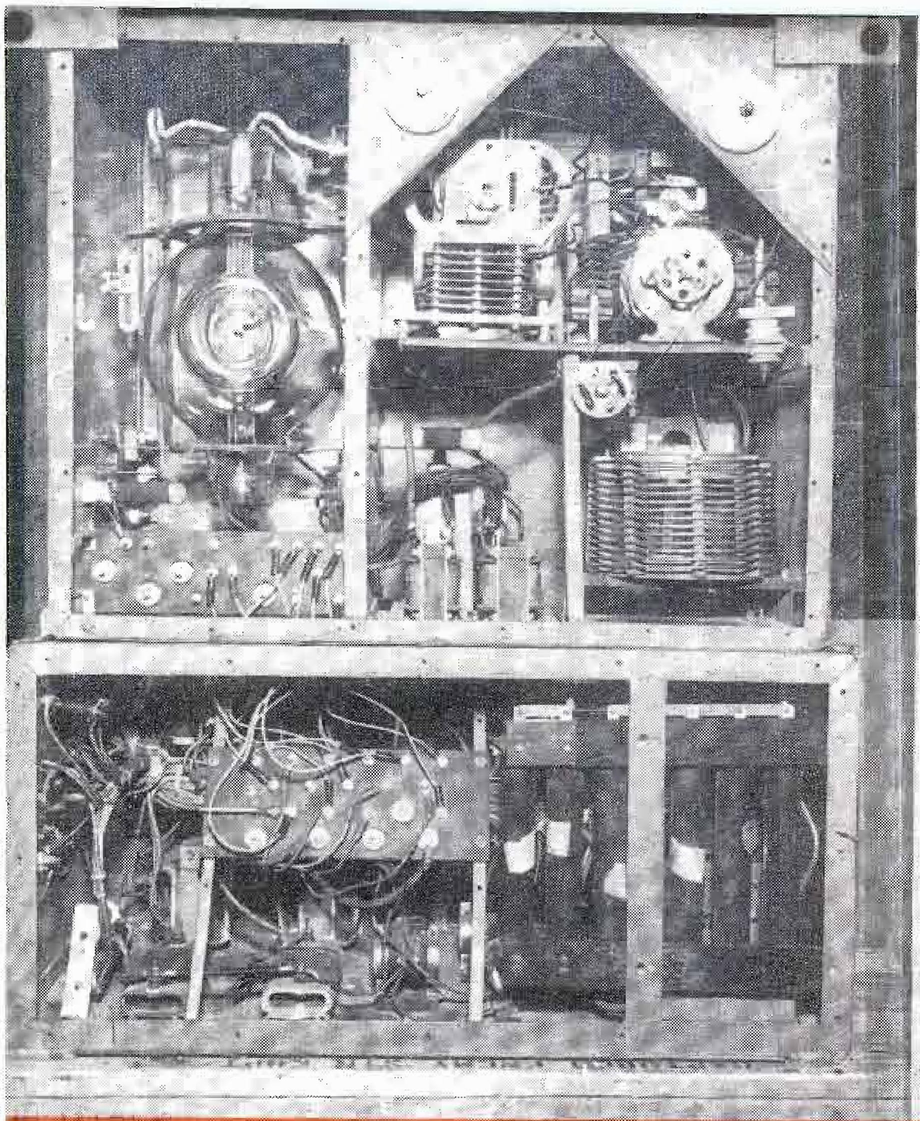
Abnormally low Depression birth-rates are beginning to have an effect; the marriage rate is now dropping and will continue to drop until 1960, when it will rise again.

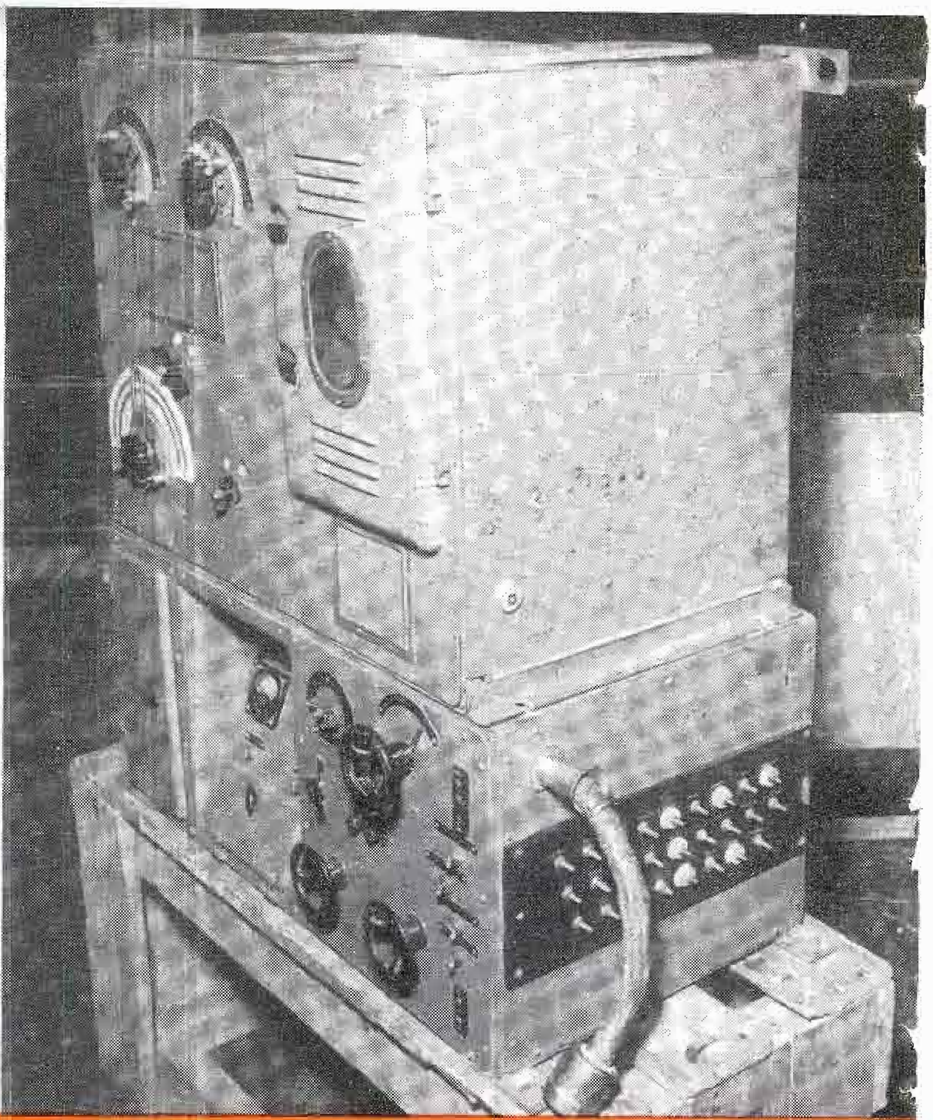
In 1950, there were 5 million men 20 to 24 years in the labor pool; in 1955 the number in that bracket will have dropped to 4.75 million.

U. S. population is increasing at a rate of 250,000 a month, and will rise to 193 million in 1975, by conservative estimate.

While the declining marriage rate now threatens the record rate of home building that has continued since the end of the war, it will pick up in the late sixties and may soar to an average of 1.3 million homes a year or more by 1975.

See following pages for photographs of captured radio equipment from Korea. Pictured above is a Russian field radio set.—U. S. Army photograph

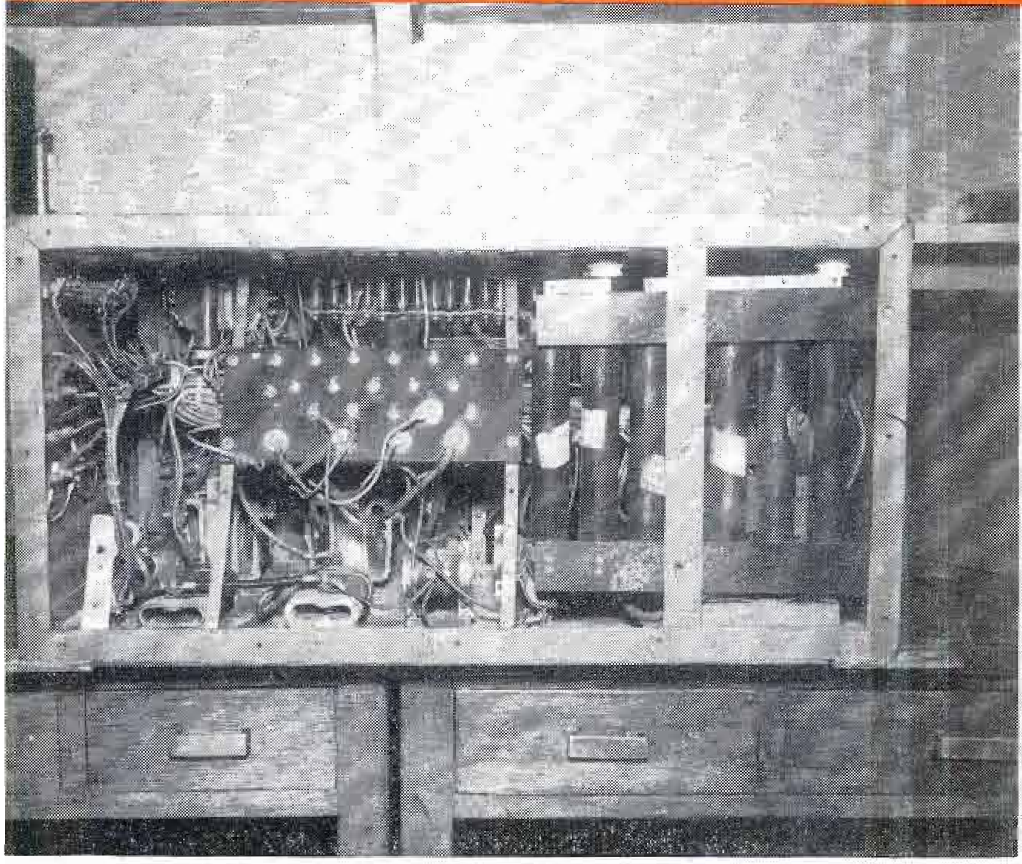


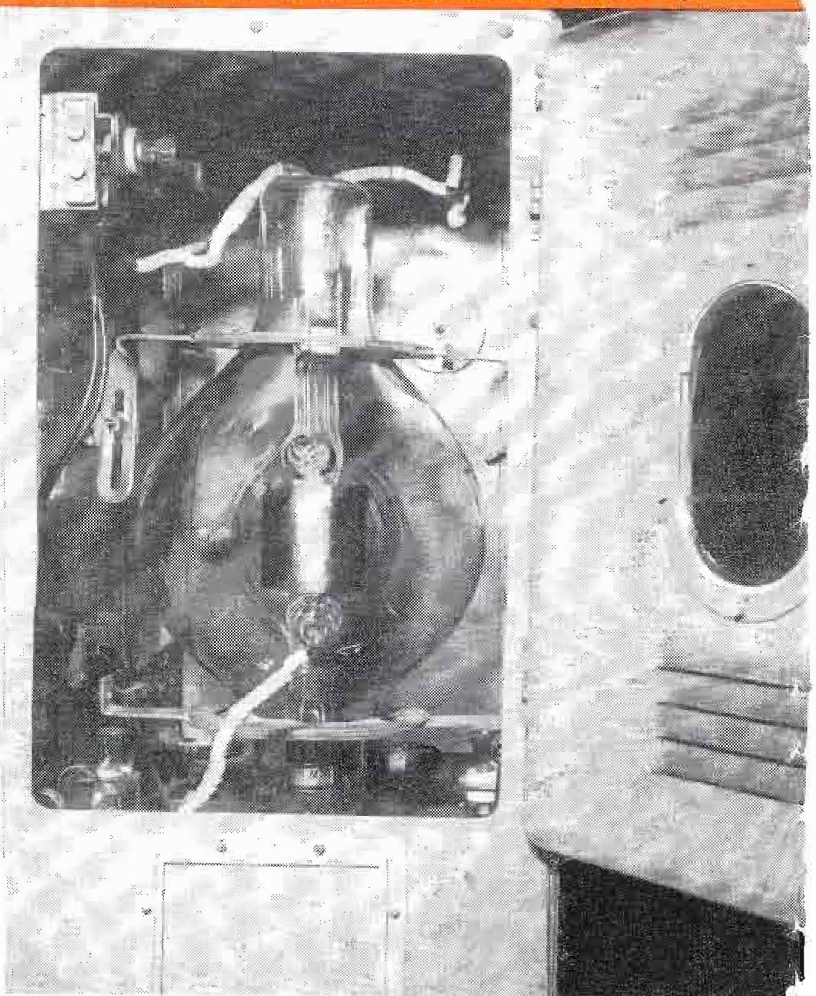


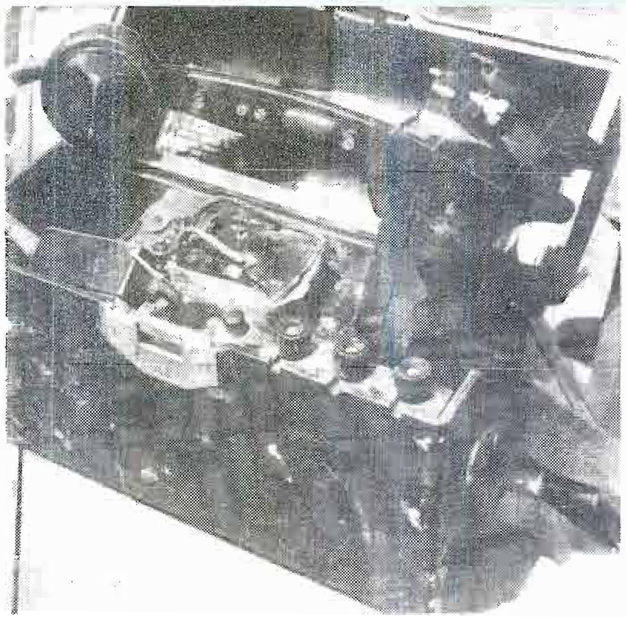
Rear view (l) and front angle view (r) of Russian radio transmitter Type K-500, normally used for communications in permanent and semi-permanent installations. Top part of cabinet, containing the r-f section, is detachable from the bottom power distribution and audio sections

KOREA— FIRST PHOTOS! Captured Communist

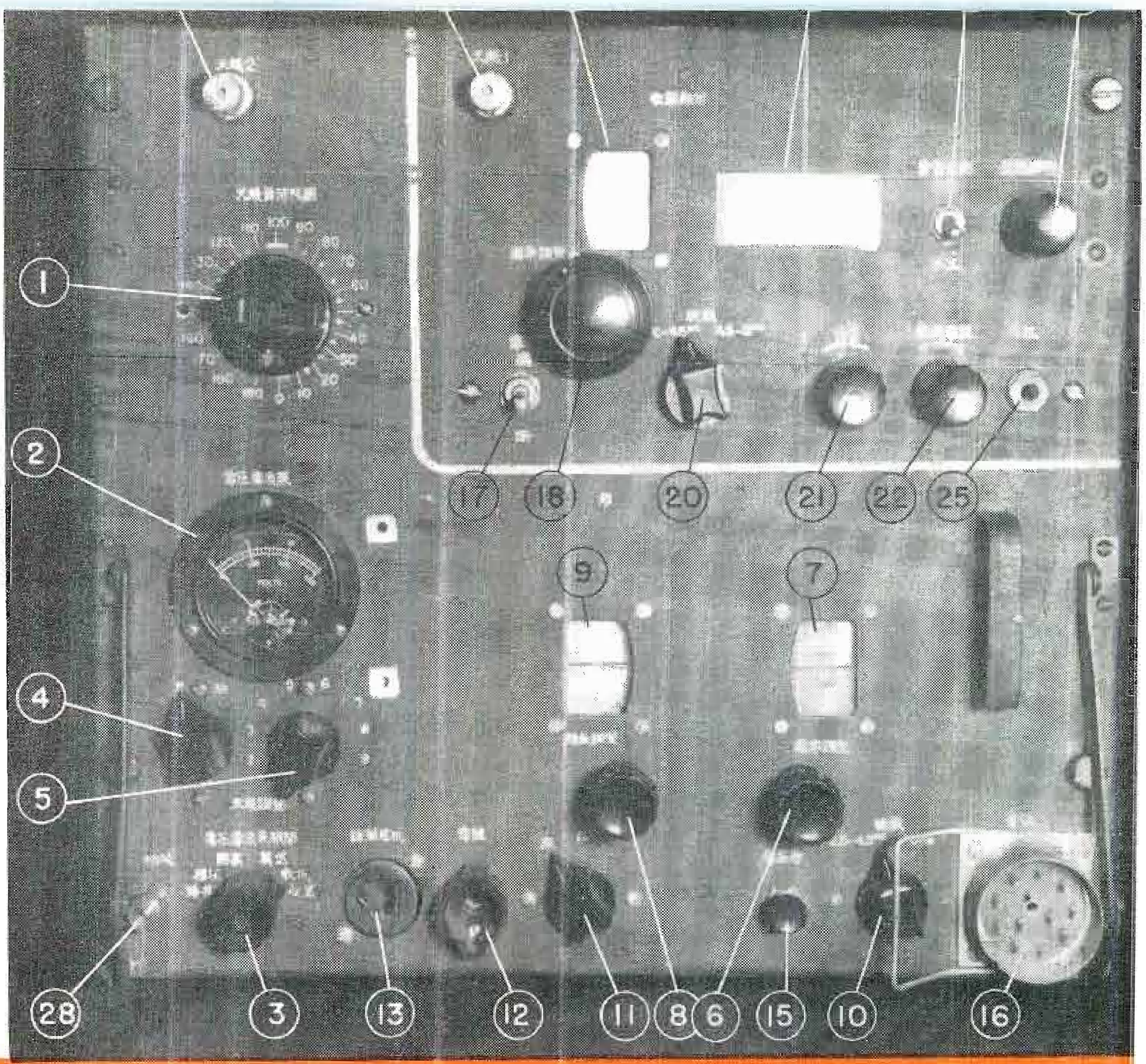
Close-ups of power distribution and audio sections (l) and Type GKZ-500 power amplifier tube (r) used in the K-500 transmitter indicate simple construction and somewhat crude wiring techniques. Note the absence of improved shock mountings for the power amplifier tube on the right







Field telephone captured from North Korean forces. Compare this with U. S. EE-8 phone

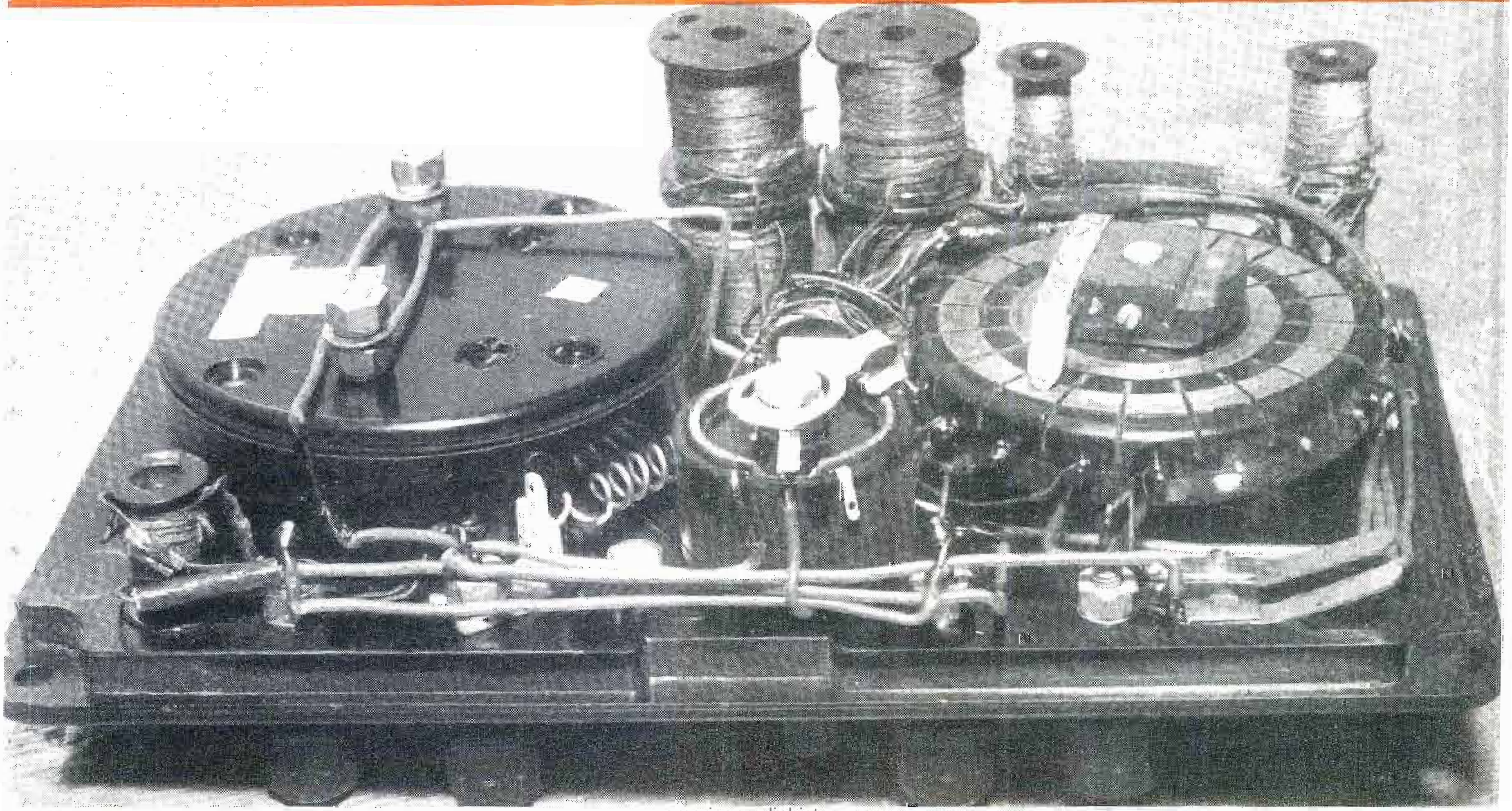


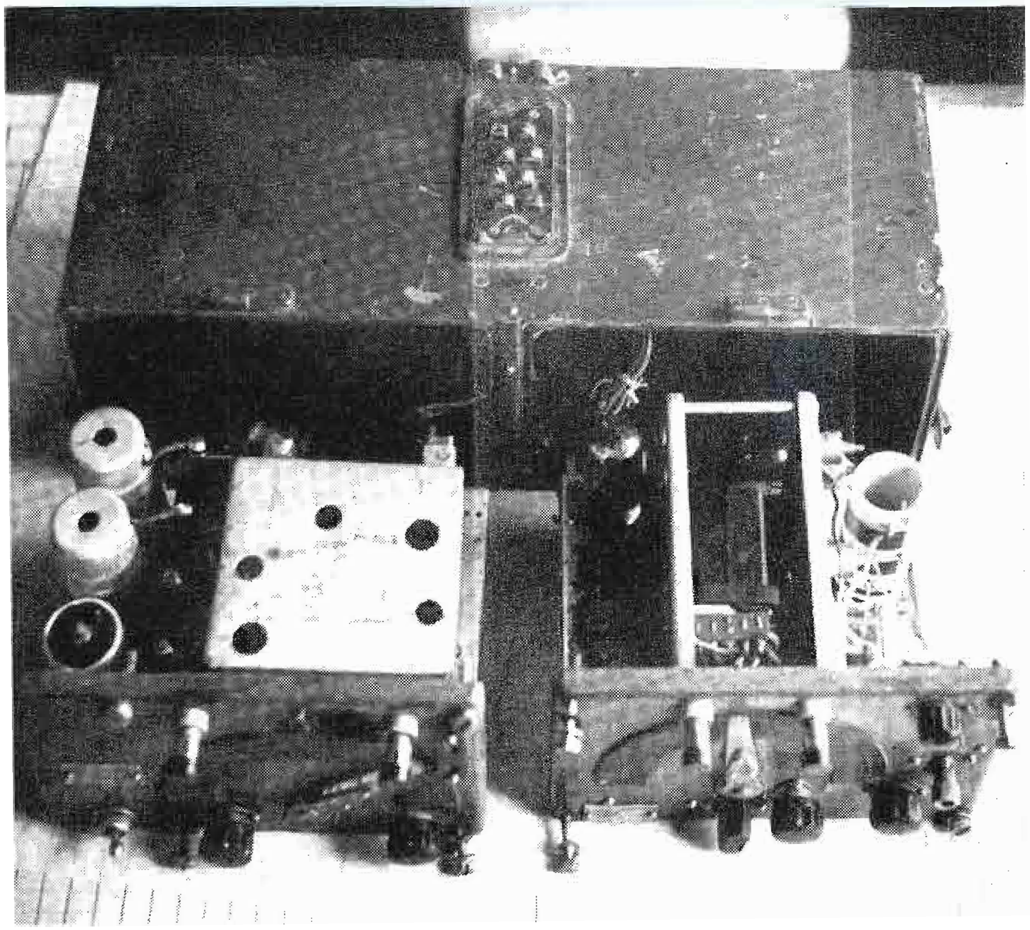
Controls on Chinese Communist field radio set Type E-27(r); 1) Trans. fine antenna loading; 2) Trans. voltmeter; 3) Trans. meter selector; 4) Trans. antenna selector; 5) Trans. coarse antenna loading; 6) Trans. oscillator; 7) Trans. oscillator dial; 8) Trans. power amplifier tuning; 9) Trans. power amplifier dial; 10) Trans. band selector; 11) Trans. voice-CW switch; 12) Trans. key jack; 13) Trans. mike connector; 14) Trans. antenna terminal; 15) Dial light switch; 16) Trans. & rec. power connector; 17) Rec. on-off; 18) Rec. tuning; 19) Rec. main dial; 20) Rec. band selector; 21) Rec. audio gain; 22) Rec. r-f gain; 23) Rec. BFO; 24) Rec. BFO pitch; 25) Rec. output jack; 26) Trans. or rec. short antenna terminal; 27) Nameplate; 28) Common ground

Communications Equipment

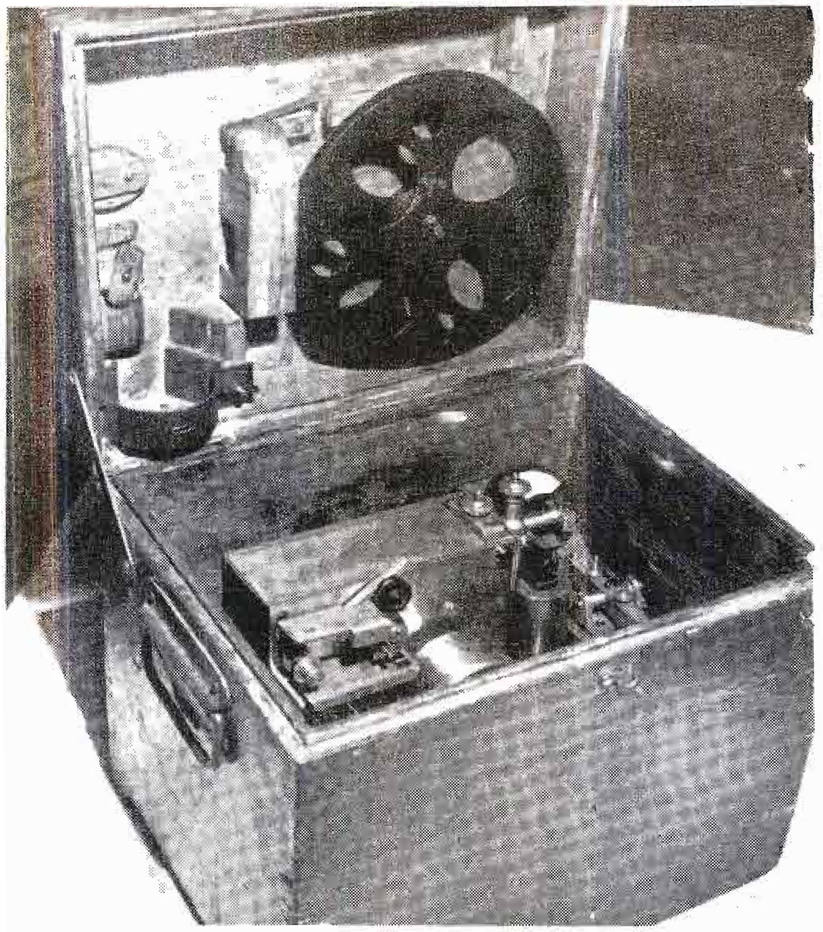
Russian transmitters, receivers and test instruments studied by Signal Corps. Design techniques appear to be similar in many ways to German units used in World War II

Russian-made ohm-meter Type M-493 appears similar to German and earlier American designs. TELE-TECH & ELECTRONIC INDUSTRIES will publish further information as it becomes available





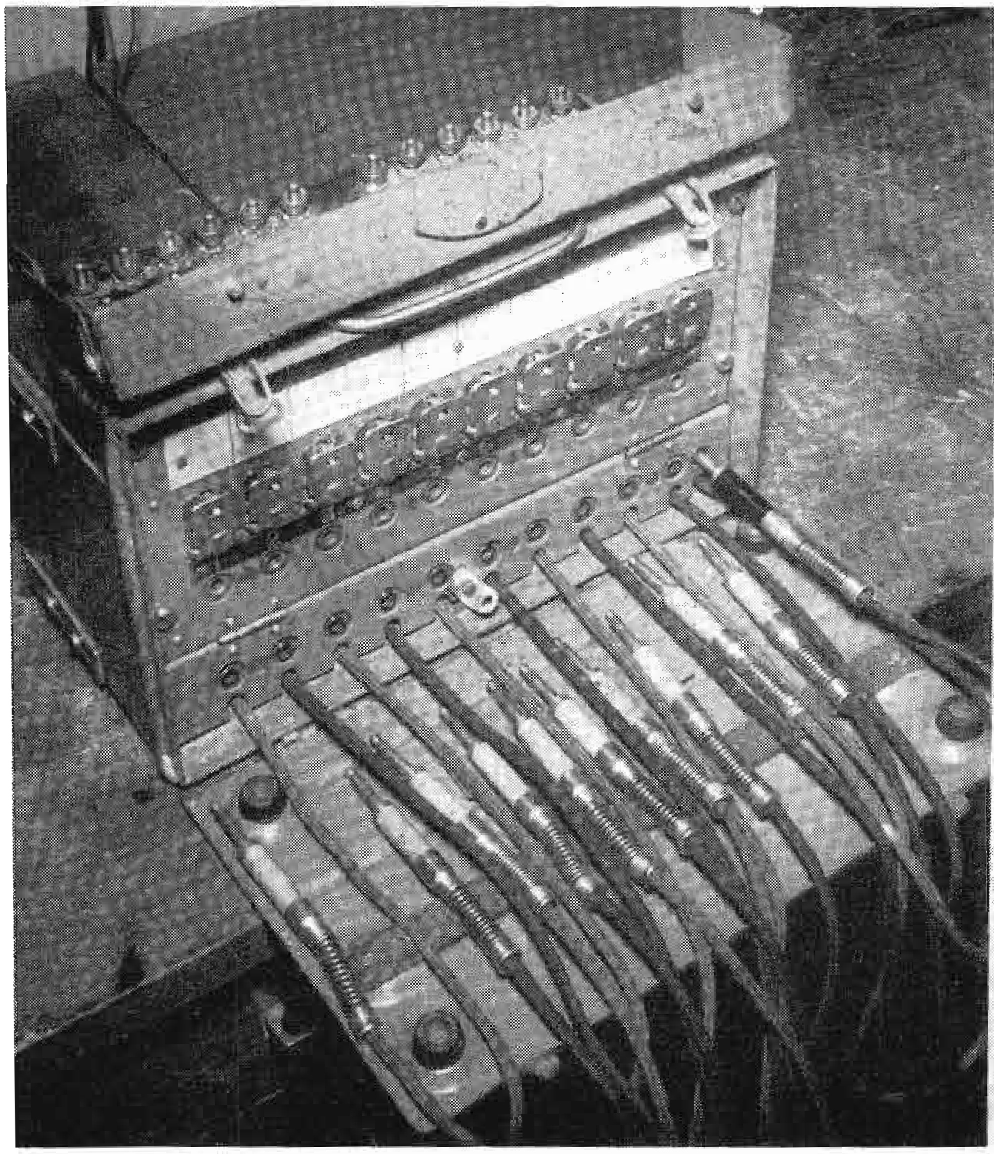
North Korean radio set about to be dismantled for study at a Signal Corps headquarters in Korea. Exposed terminals atop cabinet are "hot"



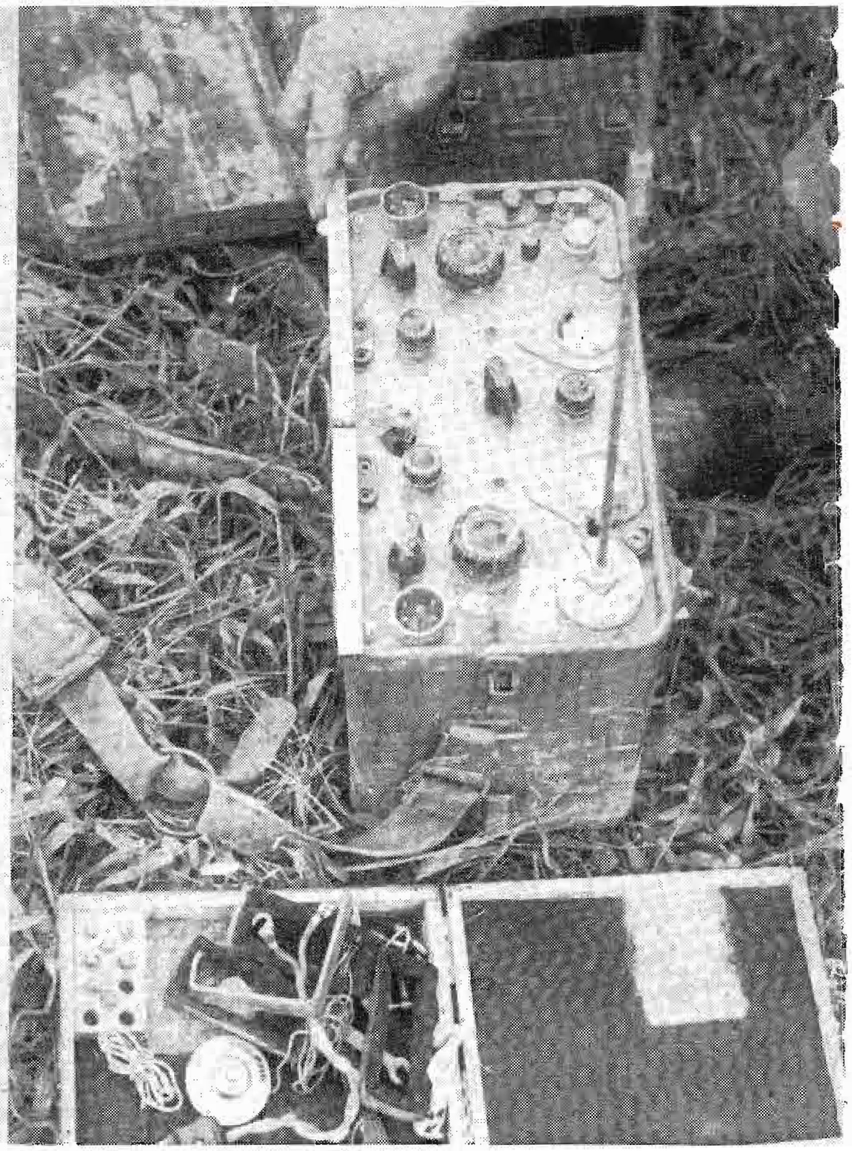
High angle view of a captured Communist telegraph key and tape printer. Reel hangs from cover of heavy wooden box

KOREA —*Radio, telephone and telegraph systems bear Soviet labels*

Russia's Model K-10 field switchboard is capable of handling ten telephone lines, uses drop-latch system. It resembles WW II U. S. units



"Made in U.S.S.R." is the label on this compact field radio with quick-mount antenna. Length of unit shown is 13 in.



Automatic Smith Chart Plotter

$$H=\sqrt{\left[Ae_D+e_r\cos\Theta(1+m\cos wt)\right]^2+e_r^2\sin^2\Theta(1+m\cos wt)^2}\quad;\quad V=\sqrt{e_r^2\cos^2\Theta(1+m\cos wt)^2+\left[Ae_D+e_r\sin\Theta(1+m\cos wt)\right]^2}$$

$$H=\sqrt{A^2e_D^2+2Ae_De_r\cos\Theta(1+m\cos wt)+e_r^2(1+m\cos wt)^2}\quad;\quad V=\sqrt{e_r^2(1+m\cos wt)^2+A^2e_D^2+2Ae_De_R\sin\Theta(1+m\cos wt)}$$

$$H\approx Ae_D\sqrt{1+\frac{2e_r}{Ae_D}\cos\Theta(1+m\cos wt)}\quad;\quad V\approx Ae_D\sqrt{1+\frac{2e_r}{Ae_D}\sin\Theta(1+m\cos wt)}$$

$$H\approx(Ae_D+e_r\cos\Theta)+me_r\cos\Theta\cos wt\quad;\quad V\approx(Ae_D+e_r\sin\Theta)+me_r\sin\Theta\cos wt$$

Fig. 1: Resolver audio terms are proportional to K cos and K sin, where K is reflection coefficient

New instrument speeds impedance meaurements in 100 to 400 MC range. Instantaneous plot on CRT aids study of transmission lines and VHF circuits

By KARLE S. PACKARD, *Airborne Instruments Lab., Inc., Mineola, N. Y.*

THE purpose of the Automatic Smith Chart Impedance Plotter is to measure the complex impedance of an unknown component over a relatively broad portion of the VHF range. This measurement is made rapidly and automatically, and the results are plotted on a Smith Impedance Chart. Although the equipment is not capable of high precision, its speed of measurement and the convenient form in which it presents the results represent distinct advantages over more precise methods in many cases. In particular, it is well suited for the preliminary stages of development work on a VHF component, where precise results are not usually required. It is equally suited for rough checking at the final stage of production.

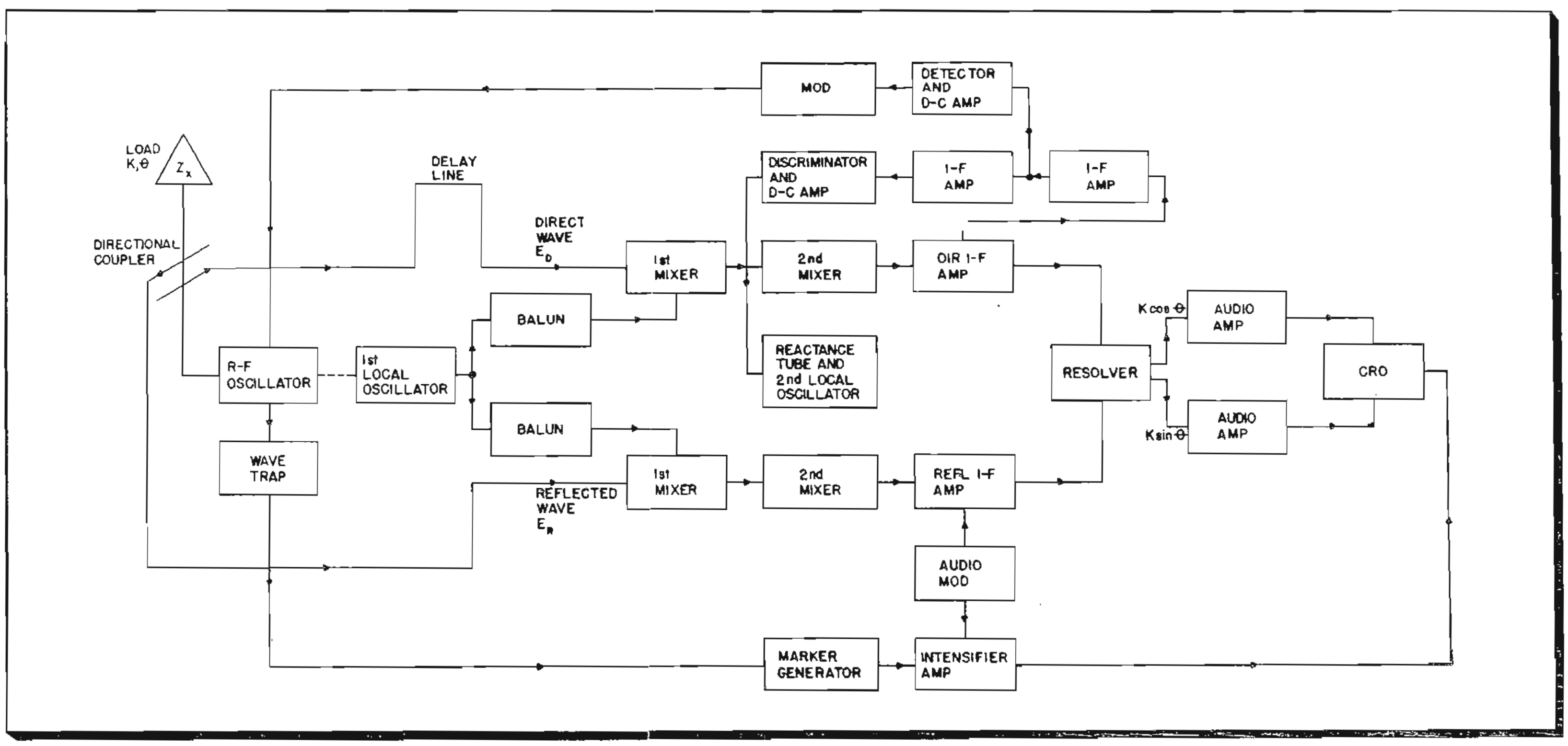
The total frequency range of the equipment is 100 to 400 MC. which is covered in two bands of one octave each. Either of these bands is swept at the rate of 2 CPS and the measured impedance vs frequency curve is plotted instantaneously on a cathode-ray tube (CRT) that has a Smith Chart overlay.

Measurement Limitations

In recent years, many standing-wave ratio and impedance plotters have been described in the literature. For the most part these devices have been limited (1) to measurements of magnitude only, (2) to measurements at narrow frequency ranges, or (3) to measurements at low frequencies. The present instrument is an outgrowth of some of these devices.

A few words should be said about the choice of presentation. The Smith Chart permits the plotting of any impedance within a given circle and gives an implicit plot of the reflection coefficient at the same time. In many cases the impedance, as such, is of secondary importance as compared with the reflection coefficient. The main advantage of the Smith Chart, however, is that the impedance at any point on the transmission line is easily found by rotating the readings by an angle that is a function of frequency. During development work, it is usually necessary to utilize this feature. The computations are elementary, but

Fig. 2: In Automatic Smith Chart Impedance Plotter, unknown component terminates directional coupler to obtain reflected- and direct wave voltages



they take time; this equipment automatically rotates the readings so that no calculations are required. By plotting the results on a CRT, they are available immediately, and the effect of adjustments is observed instantly.

Basically, the equipment utilizes a directional coupler to measure the reflection coefficient of the unknown component as the termination on a transmission line. Voltages proportional to the direct and reflected waves are obtained from the directional coupler. The relative phase and amplitudes of these voltages are measured to obtain the rectangular coordinates of the reflection coefficient. By applying voltages proportional to these coordinates to the horizontal and vertical deflection plates of a CRT, a Smith Chart can be obtained.

The measurement of the phase and amplitude of the reflection coefficient is accomplished as follows. The direct wave is maintained at constant amplitude by applying AVC to the r-f oscillator that supplies power to the load. A direct measurement of the reflected wave amplitude is then a measure of the amplitude of the reflection coefficient in terms of the direct wave. To measure the phase of the reflected wave, it is split into two channels and applied to two phase-sensitive detectors. The bias signals for these detectors are obtained from the direct wave and are in quadrature. Therefore, the detector outputs are proportional to the rectangular components of the reflection coefficient. The analysis of this resolver is shown in Fig. 1.

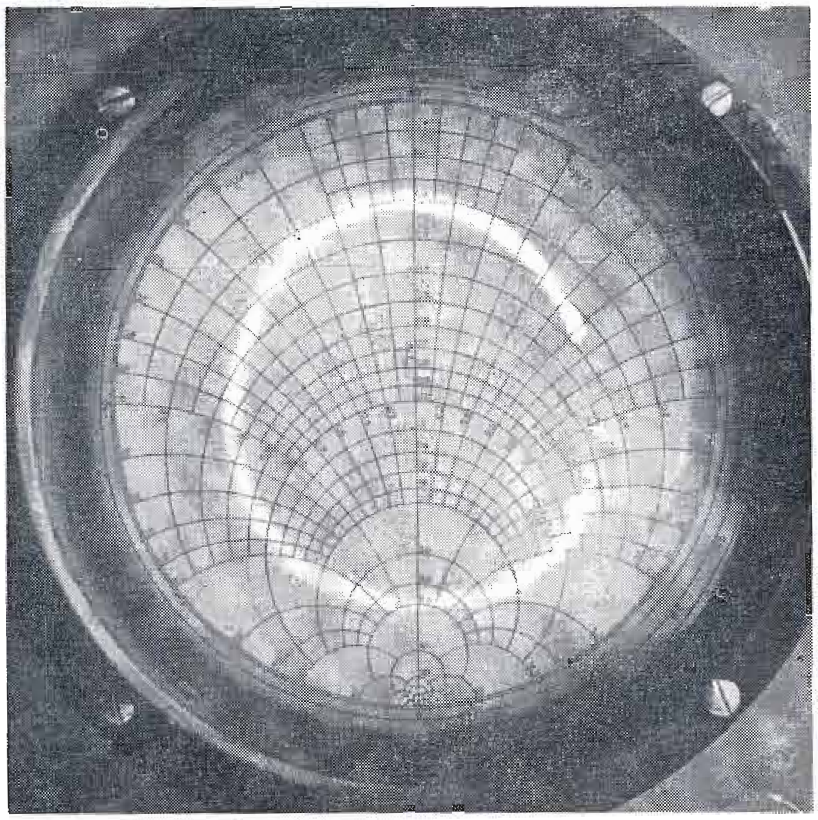


Fig. 3: (l) Impedance of 10-ohm resistive load terminating 50-ohm cable

Fig. 4: (c) Impedance of open line in parallel with length of mismatched line

Fig. 5: (r) Impedance of lossy resonance. All plots made in 100 to 200 MC range

Varying Frequency

The reflected- and direct-wave voltages obtained from the directional coupler are of varying frequency. These signals are transformed by superheterodyning into signals of constant frequency. Furthermore, in order to provide signals convenient to work with after detection, the reflected wave is modulated at an audio rate. This modulated reflected wave is added to the bias signal applied to the two phase-sensitive detectors. In one case, the bias signal is adjusted, by means of a phase-shifting network, to be in phase with the reflected wave for a pure real reflection coefficient. For the other detector, the bias signal is adjusted to be in phase with the reflected wave for a pure imaginary reflection coefficient. In both cases the bias signals have been amplified so that they are much greater than the amplitude of the reflected-wave voltage. It should be noted that the audio modulation frequency is much lower than the carrier frequency but is much higher than the rate of change of any of the terms. Therefore, we may consider the quasi-static case and the analysis shown in Fig. 1. The audio terms are proportional to K cos θ and K sin θ, where K is the amplitude of the reflection coefficient and θ is its phase angle. In Fig. 2 is a block diagram of the complete system.

Changing Line Length

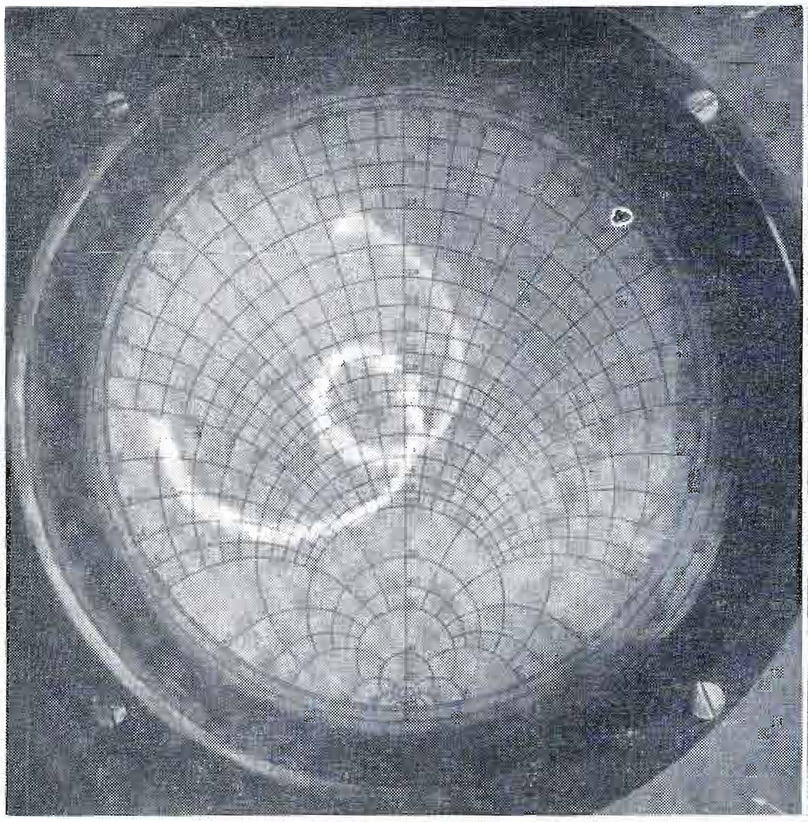
The unknown component terminates the directional coupler. Voltages proportional to the direct and reflected waves are obtained from the cross-arms of the coupler, which is a coaxial Bethe-hole coupler of 50 ohms characteristic impedance. The delay line in the direct-wave path compensates for the extra line length traveled by the reflected wave up to the load and back to the point of measurement. By changing the length of this line, the readings can be rotated to find the impedance at any point along the transmission line. These voltages are applied to two identical balanced mixers, the outputs of which are two fixed-frequency signals of 40 MC. The local oscillator for these mixers is swept in synchronism with the r-f oscillator and is coupled to the mixers through the baluns. The intermediate frequency will vary, however, because of tracking error and for this reason a double superheterodyne is used with AFC applied to the second local oscillator. The outputs of the second mixers are 5-MC signals, which are quite constant in frequency as the radio frequency is varied, and which are proportional in amplitude and equal in phase to the direct and reflected waves. These 5-MC signals are applied to two i-f amplifiers and thence to the resolver, which measures the rectangular coordinates of the reflection coefficient.

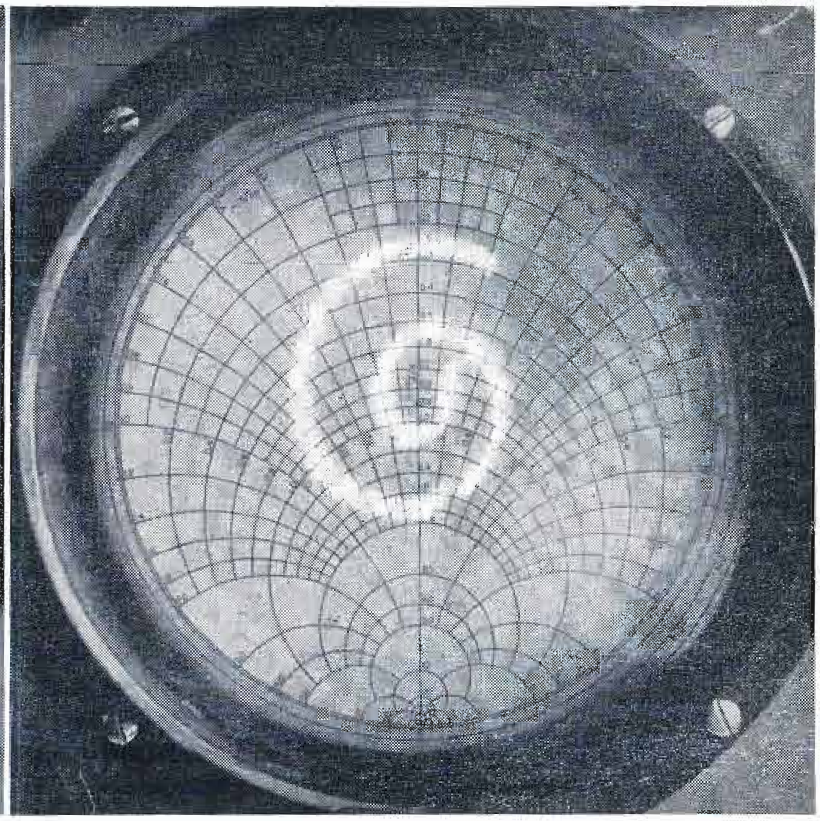
The direct wave is sampled from the i-f amplifier and detected; after dc amplification, it is used to control the power output of the r-f oscillator in AVC fashion to keep the direct wave constant. This 5-MC signal is also applied to a broad-band discriminator. The discriminator output is amplified by the dc amplifier and controls a two-stage reactance tube that in turn controls the frequency of the second local oscillator so as to maintain the final intermediate frequency at 5-MC.

Two Audio Voltages

The reflected-wave i-f amplifier is modulated at the first stage at an audio frequency in order to obtain audio signals from the resolver, as previously mentioned. These two audio voltages are amplified and applied to the horizontal and vertical deflection plates of a CRT.

Since the two audio voltages are in phase, a straight line of varying length and phase would be obtained on the scope face; this would give a 180° phase ambiguity. In order to eliminate this, the trace is normally held below cutoff and intensified only on, say, the positive peak of the signal. The peak of the modulating voltage is picked off and amplified.





This pulse is then sharpened to provide the intensifying pulse, which is applied to the Z-axis of the CRT.

If we use the positive peak of the modulation to indicate impedance, then the negative peak will indicate admittance. A polarity-reversing switch at the input to the intensifying circuit provides this feature.

Impedance Plot

In order to provide a frequency calibration of the impedance plot, a marker is generated that blanks out the trace, thus creating a "hole" in the plot. This marker is obtained from a tunable calibrated wave trap that is coupled to the r-f oscillator. Thus, as the r-f oscillator sweeps through the frequency to which the wave trap is tuned, a pulse is obtained from a detector placed across the wave trap. This pulse triggers a flip-flop circuit having a variable recovery time. The output of the flip-flop gates off the intensifying pulses to produce the hole in the trace. The variable-width gate is necessary because of the wide variation in writing rate that might be encountered; that is, although the frequency is varied at a relatively constant rate, the impedance might vary slowly in one part of the band and quite rapidly in another.

Before discussing some of the finer points of the system, let us look at some of the results. Fig. 3 shows the impedance of a 10-ohm resistive load terminating a length of 50-ohm cable. The cable is obviously three-quarters of a wavelength at one frequency and a full wavelength at another. Fig. 4 shows the impedance of a length of open line in parallel with a length of mismatched line. This is a case of stub matching, though the stub position was not varied to produce a good match. Fig. 5 shows the impedance of a lossy resonance. Such a plot would be obtained with a length of open-circuit lossy line. In this case, however, the effect was simulated because available lossy cable does not have sufficient loss to produce such an open pattern. These impedance plots cover measurements in the 100 to 200 MC range.

Component Parts

Now let us look at some of the component parts in more detail and see where design difficulties might arise. The first point to be considered is the variation of the direct-wave amplitude on the transmission line. This is due chiefly to variation of the power output of the r-f oscillator as the frequency is changed, the variation in coupling of the directional coupler, and the variable loading on the oscillator. The latter two variations are reduced considerably by using lossy line between the r-f oscillator and the directional coupler. However, in order to reduce the variations to a negligible value, AVC is necessary. The AVC loop gain of 40 db is just adequate. The frequency response of the AVC loop, from dc to 300 CPS, is made necessary by the 2-CPS sweep rate and the possible load variations. This is one of the points of compromise; it is desirable to have a high sweep rate to reduce flicker, but the high-frequency response of both the AVC and AFC loops would have to be increased in direct proportion. This would require a more elaborate feed-back loop to achieve stability.

Other sources of amplitude errors are (1) spurious heterodyne responses, (2) cross-coupling between channels, and (3) leakage of local-oscillator components into the i-f amplifiers. To eliminate the spurious responses, it was found necessary to insert a band-pass filter and buffer amplifier between the first and second mixers. This prevents beats between the first local oscillator and harmonics of the local oscillator.

Cross-coupling is kept to a low level by adequate shielding. Since the local oscillators are common to both signal channels, however, it is necessary to prevent coupling through these paths. This is one reason for using balanced mixers in which either the local-oscillator or the signal voltage is fed balanced, and the other is fed unbalanced. In this way, the cross-coupling is reduced by a factor equal to the produce of the percentage unbalance in each of the two balanced circuits.

Balanced Mixers

Another reason for the balanced mixers is to prevent second-local-oscillator voltage from passing through the i-f amplifiers. These 5-MC amplifiers are video amplifiers (for reasons to be given later) and the response at 45 MC is not negligible since the second-local-oscillator voltage is about 80 db above the smallest signal. By injecting the local-oscillator voltage unbalanced

(*Continued on page* 181)

Photograph of front of pulse timer

A Reliable Locked-

Highly stable frequency divider chain useful for r-f propagation measurement, phase comparison, time-division multiplexing, and TV waveform generator applications

By
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RADIO-propagation measurements using pulse techniques over long paths require the use of highly stable pulse-repetition-frequency sources. The problem is similar to that encountered with some radio navigation systems where pulse-delay measurements at a remote point require a stationary cathode-ray-tube display.

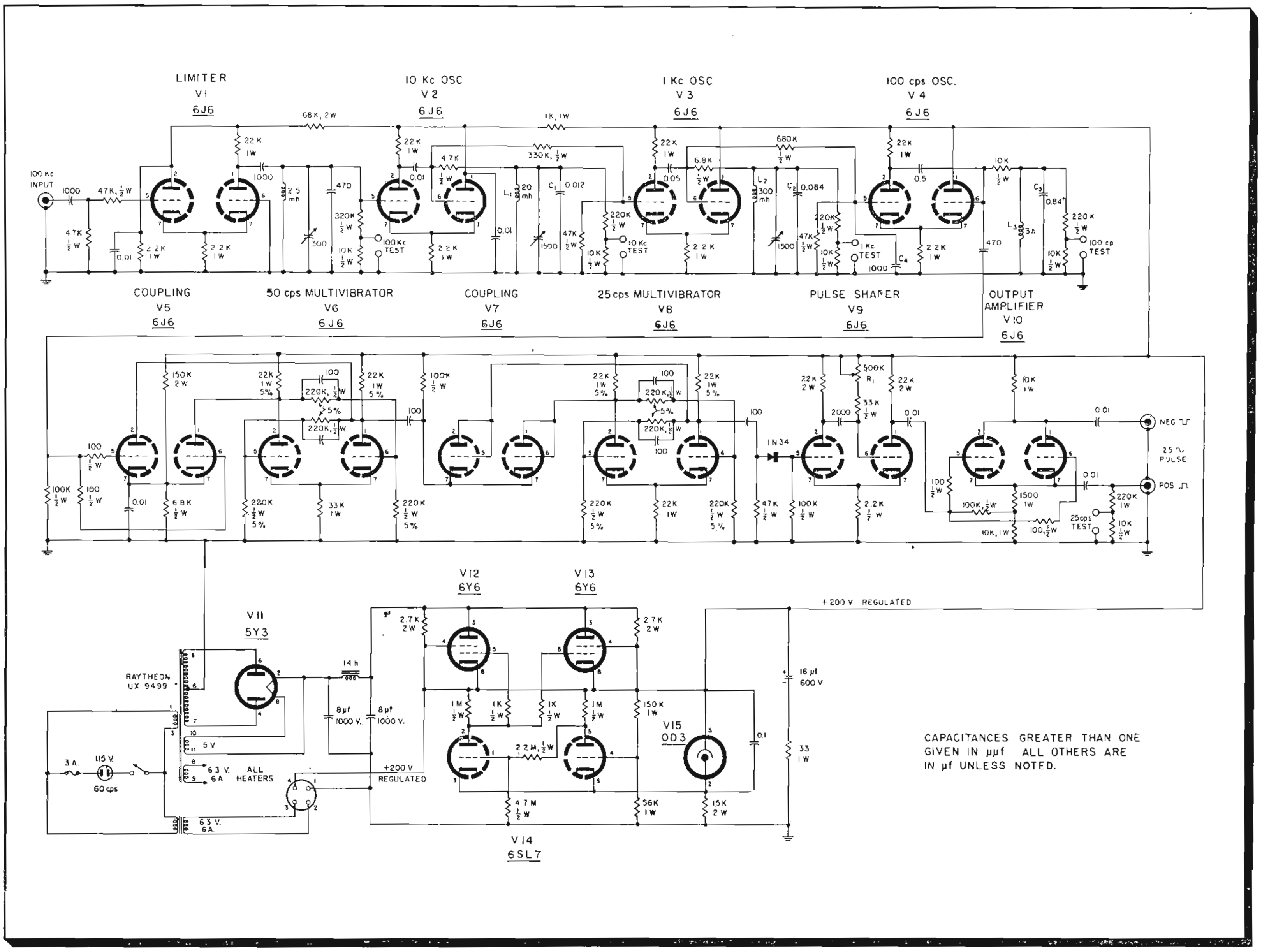
With the present state of oscillator development it seems that the highest frequency stability is obtained at frequencies of the order of 100 KC.

Since a pulse frequency as low as 25 cycles may be required, some form of frequency division is indicated. The subject of this paper is a highly reliable and stable frequency-divider chain supplying 25-cycle pulses from a 100-KC input. The equipment should also be useful in other applications such as those requiring precise, phase-stable frequencies for phase comparison or time-division multiplexing, while the individual divider circuits may be useful in television waveform generators.

Types of Dividers

In the past, several types of dividers have been employed including the locked regenerative oscillator[1], the oscillator with phase comparison and automatic frequency control[2], circuits employing regeneration and modulation[3], the astable

Fig. 1: Complete locked-oscillator pulse timer includes limiter, oscillators, pulse coupler, multivibrator, pulse shaper and output phase inverter



Oscillator Pulse Timer

multivibrator[4], the monostable multivibrator[5], and the counter chain. The first of these has seen a limited application, although the difficulty of obtaining reliable synchronization has restricted its use to frequency ratios of five or less. The second and third types are capable of very reliable operation in themselves; however, they may require a large number of tubes, rendering power consumption large and adjustment difficult. Astable multivibrators, including the dual-triode, pentode, and blocking-oscillator circuits, are particularly easy to synchronize, but are limited to applications requiring small frequency ratios because of their poor frequency stability. This also applies to the monostable multivibrator, although the phantastron circuit[6] appears to be an improvement in this respect. The counter chain can be operated as a frequency divider, although the number of tubes required may be large, particularly when dividing by a large prime number. Here the individual counters may be very reliable in themselves, but the large number of circuits will increase the chance of failure.

Improved Frequency Divider

Recently, however, an improved locked-oscillator frequency divider has been described[7]. The circuit combines the synchronizing ability of the free-running multivibrator with the frequency stability of the sinusoidal oscillator, permitting frequency division at large frequency ratios with excellent reliability and good phase stability. One form of the frequency divider, shown in the simplified circuit of Fig. 2, consists of a cathode-coupled oscillator with the addition of a resistance in series with the frequency determining circuit. The resistor may be considered as an all-pass network, permitting feedback at all frequencies. Consequently, there is a tendency toward a multivibrator type of operation, with the production of a large harmonic content in the voltage at the upper end of the resistor. With the circuit operating as a frequency divider, the harmonic voltages are capable of beating with the input frequency and producing a control voltage directly at the operating frequency of the oscillator, which greatly improves the locking properties of the oscillator. The presence of harmonic voltages also improves the phase lock obtained between the input and output frequencies.

Fig. 1 is a schematic diagram of the locked-oscillator pulse timer, which consists of a limiter, V_1, three locked oscillators, V_2, V_3, and V_4, operating at 10 KC, 1 KC, and 100 cycles, respectively, a pulse coupler, V_5, a 50-cycle multivibrator, V_6, a pulse coupler, V_7, a 25-cycle multivibrator, V_8, and a pulse shaper and output phase inverter, V_9 and V_{10}. The limiter, which is of the cathode-coupled type, was provided so that the equipment would operate over a wide range of inputs (1 to 100 volts) without requiring readjustment. The three locked oscillators, which perform the bulk of the frequency division in but three envelopes, require little comment, although it should be mentioned that highly stable components are required in the tuned circuits associated with L_1, L_2, and L_3. Excellent results have been obtained with molybdenum-permalloy-dust toroids and mica or polystyrene capacitors.

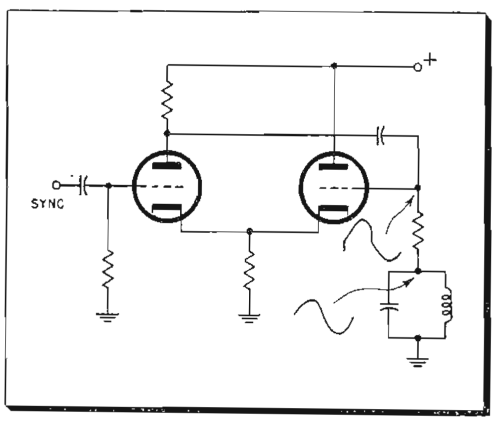
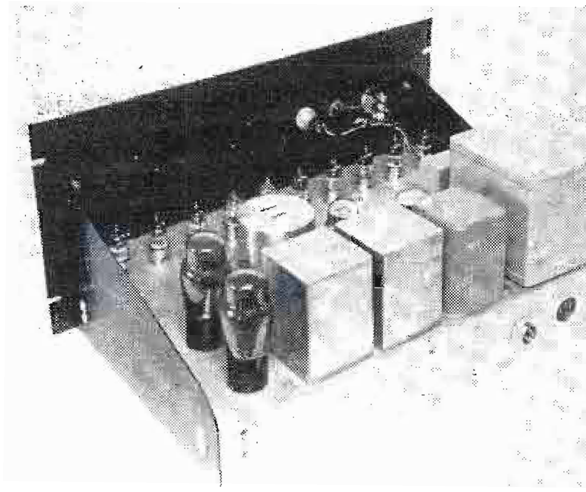


Fig. 2: Simplified schematic of a frequency divider with cathode-coupled oscillator

The plate-voltage waveform of the 100-cycle oscillator, V_4, which contains two sharp transitions, is rectified and the resulting pulses are used to drive V_5, which is normally operated at plate-current cut-off. The negative plate-voltage pulses then trigger V_6, a bistable multivibrator, at a frequency of 50 cycles. An additional bistable multivibrator, V_8, produces a square wave at 25 cycles, which, through differentiation and rectification, is used to drive a cathode-coupled trigger circuit, V_9. The output of V_9, a positive pulse whose duration is variable from 5 to 50 μsec. by means of R_4, is amplified by V_{10}, producing both positive and negative 50-volt pulses. The power supply contains an electronic voltage regulator circuit.


Photograph of rear of pulse timer

Tests of the completed unit have shown that stable operation can be obtained with a very long effective tube life, as the frequency dividers will function with type 6J6 tubes having transconductances as low as 100 μmhos, 1/50 the normal value. The overall phase stability of the unit is approximately 1/10 μsec. per volt of line-voltage change, which is sufficiently good for most applications. Front and rear views of the pulse timer are shown in the photographs.

Adjustment of Unit

Adjustment of the unit can be accomplished with the aid of a stable, 100-KC source, an audio oscillator, and an oscilloscope.

The 100-KC source, which should provide at least 1 volt, is connected to the input terminal, and the trimmer in the plate circuit of V_1 is adjusted for resonance, as indicated by a maximum in the magnitude of the voltage applied to pin 5 of V_2. It is desirable to couple the oscilloscope to this point through a very small capacitor to avoid detuning.

Subsequent steps require the use of the audio oscillator to provide the horizontal deflection of the cathode-ray spot. With the vertical input of the oscilloscope connected to the "100 KC Test" points, the audio oscillator should be adjusted to exactly 10 KC by means of a Lissajous figure. Connection of the oscilloscope to the "10 KC Test" points will then permit the adjustment of the 10-KC oscillator to the correct frequency, as indicated by a stable ellipse or circle. The 1500 μμf trimmer capacitor in the 10-KC tuned circuit should be set to the middle of the stable locking range. Similar adjustments are performed upon the 1-KC and 100-cycle oscillators by using the previous stage for purposes of com-

(*Continued on page* 173)

Improving

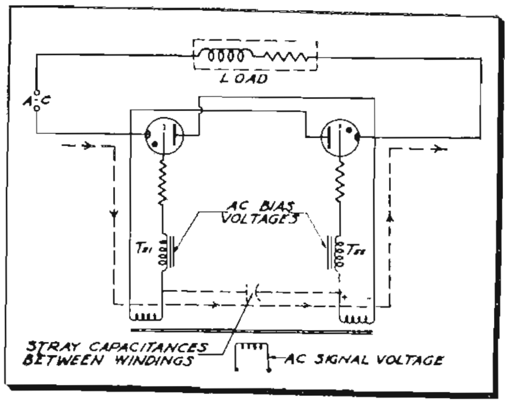


Fig. 1: Path of transient current through stray capacitances, thyratrons back-to-back

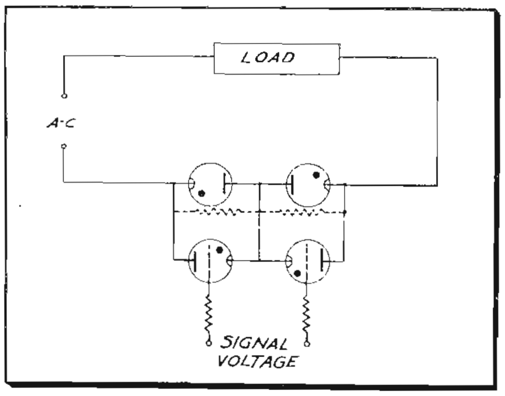


Fig. 2: Variable ac load with cathodes at common potential is convenient when signal is dc

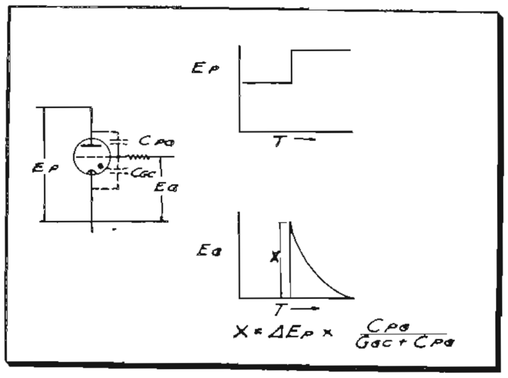


Fig. 3: Effect of thyratron interelectrode capacitances with sudden anode voltage change

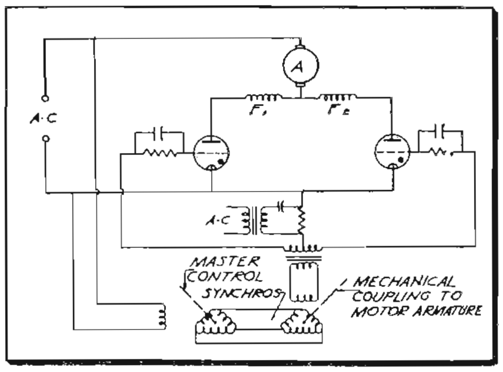


Fig. 4: Grid self-rectified bias improves operational stability in a positioning servo

By JAMES H. BURNETT,
Electrons, Inc., 127 Sussex Ave., Newark 4, N. J.

SUCCESSFUL designers of electronic equipment utilizing gas-filled thyratron tubes recognize there are important circuit factors to be considered which are often neglected without penalty when using high vacuum tubes. Many potentially sound thyratron applications have been avoided because of a feeling on the part of some equipment designers that such tubes are unpredictable in their performance. When tracked down, most of these reports have been found to stem from some unit design in which the importance of grid circuit reliability had been overlooked.

Modern thyratrons respond faithfully to the actual voltage of the grid with respect to cathode, whether it is a signal voltage, a false signal, or a noise voltage. Naturally, most noise voltages can be filtered by adding sufficient time constant at the grid to average out transient voltages to a negligible degree, but in applications where full advantage is to be taken of the fast response of gas thyratrons, such "brute force" filtering is not tolerable. Therefore, it is desirable to trace back to the source any such undesirable voltages and, having found the cause, apply a remedy which does not add excessive time constant.

A cathode-ray oscilloscope with a dc amplifier is indispensable in all phases of grid circuit development, and especially for the detection of noise. Since appreciable capacitance between the scope power supply and its signal ground terminal may distort the grid voltage if the tube cathodes are ungrounded, the use of an isolating transformer for the scope power supply may be helpful. The method previously described,[1] using the horizontal sweep setting with grid voltage connected to one set of plates and the anode voltage connected to the other set for viewing instantaneous grid and anode voltages is convenient, and indicates where misfiring by noise voltages is occurring, or where the margin of safety is low.

False Signal Voltages

In position follow-up systems, by opening the anode connections of one set of tubes, and analyzing the actual grid voltage supplied these tubes during the firing of the reversing tubes, with the oscilloscope brilliance control turned full on, transient noise or false signal voltages on the grid may be detected. These noise voltages may then be traced back to their sources, and necessary circuit modifications made. Possible sources of spurious or noise voltage in the grid circuit are numerous. Among these sources are circuit stray capacitance effects, line transients, interelectrode coupling, and the effects of grid current or float potential of other tubes in the equipment.

Stray Capacitance Effects

By far the most common source of noise voltage, and often the source overlooked is the transient charging or discharging of stray capacitance between grid transformer windings and between these windings and ground through relatively high grid circuit impedance, producing on the grid unwanted voltages of extremely large magnitude and short duration. A typical offender is the "back-to-back" connection where the cathodes are exposed to both line and load potential surges. Fig. 1 shows thyratrons so connected as they may be for either a reversing servo, or an X-ray contactor, or welding control, or for lighting dimmer control. This effect also may be found in servos where the forward and reverse circuits are linked only by stray capacitance between transformer windings, or when supplying separate reversing fields with common magnetic linkage. The effect also may occur when line switches are closed in such circuits with the resulting sudden charging up of grid circuit stray capacitances to ground.

In Fig. 1, consider conditions existing with a slightly inductive load at the end of conduction of one tube. Conduction continues past the end of the cycle for a few degrees due to load inductance. The cathode-to-anode voltage across this tube suddenly changes from tube voltage drop, of about 10 volts, to the instantaneous line voltage. A charging current then flows into the stray capacitances indicated, through part of the grid circuit impedance of the other tube, producing a voltage of short duration, but considerable magnitude. This has a polarity to raise the actual grid voltage above the critical grid voltage and misfire the tube.

Such effects may be minimized by including static shields around each grid transformer winding and connecting each shield to the respective thyratron cathode. Often, a small capacitor across the grid transformer secondary, or the use of lower impedance grid transformers, reduces such noise to a tolerable degree

Gas Tube Grid Circuit Reliability

Increased number of thyratron applications may be achieved by overcoming malfunctioning in grid circuit. Noise and false signals minimized to provide more stable servo control systems

without static shields. If it is desirable to hold the control tube cathodes at common potential for either ac load control, or dc half wave reversing control, without the cost of an anode transformer, two thyratrons and two diodes may be connected as in Fig. 2.

Line Transients

An obvious source of noise, although not the most common cause of trouble, is the instant collapse of ac grid voltage due to commutation of anode current from one tube to another in an adjacent electronic power unit on a common supply line with poor regulation. The inrush

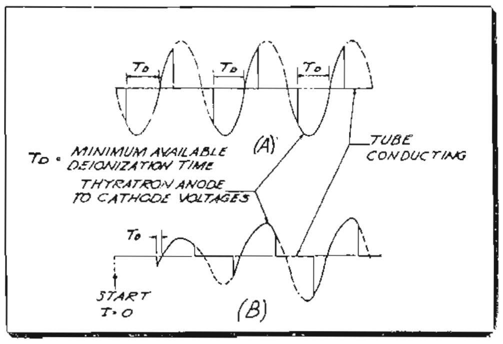


Fig. 5: Available deionization time for (A) full-wave rectifier with inductive load in a steady state, and (B) limiting transient starting conditions in a parallel inverter

magnetizing current when large transformers are switched on the supply line of the unit may also produce similar effects. Correction of such difficulties usually is accomplished by low pass filtering of the ac grid voltage. Often the connection of a relatively small capacitor across the grid transformer is adequate and has negligible effect on phase shift of the signal voltage.

Transient noise voltages are sometimes introduced on the grid through capacitive coupling of grid circuit wiring. Where it is unavoidable to employ extensive wiring between grid and cathode, shielded conductors may be justified. If this is done, the shields are preferably connected to the respective thyratron cathodes, not necessarily ground. Short grid leads are always advisable and it is especially desirable to connect the grid resistor as close as possible to the tube. It is usually worthwhile to check the effect on circuit noise of various possible cathode to ground voltages on an ungrounded chassis.

Transient grid voltages induced through interelectrode capacitances in the tube (Fig. 3) may be limited to a negligible value by connection of a small "padding" capacitor (usually 0.005 μf or less) directly from grid to cathode of each tube. The use of such a capacitor results in an effective capacitance ratio of anode to grid/grid to cathode of several hundred, and therefore limits maximum transient grid voltages so induced, to a small fraction of a volt. The time constant of padding capacitor and grid resistor must be limited to an insignificant fraction of a cycle to minimize carry over effects.

Critical Grid Characteristics

In most of the basic commonly used methods of control, the stability and uniformity of the thyratrons being used will usually determine the minimum practical signal voltages, and hence the sensitivity of the power amplifier unit.[2] Consideration of the maximum range of grid characteristics including the maximum range of critical grid voltage and starting voltage, of *all* tubes of a given type over their useful life and full ambient temperature range is the basic starting point in grid circuit design as it fixes the magnitude of signal voltage required, regardless of tube replacement.

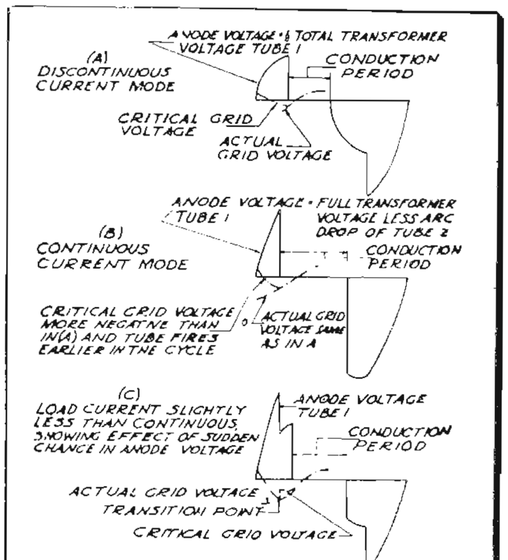
As the grid voltage is reduced to fire the tube, the greatest value of current which flows to the negative grid just prior to firing is defined as the maximum critical grid current. This current flows in a direction to make the grid less negative, or in a sense may be considered to make the apparent critical grid voltage correspondingly more negative than the true critical grid voltage. Since the critical grid current after cycles of heavy conduction may be greater than on the first cycle, the maximum value, not the "preconduction" grid current, is necessary for careful circuit design. Most modern tubes have so low a critical grid current at 60 cycles that circuit insulation leakage currents to be expected in usual industrial practice may be the limiting condition. However, since the critical grid current increases rapidly with frequency, this consideration becomes much more important above 60 cycles, and manufacturer's data should be studied. On the other hand, in modern tubes up to several thousand cycles the effect of frequency on critical grid voltage is minor.

Impedance Matching

Proper impedance matching is important as in any electrical circuit design. The impedance of the grid driving circuit is usually made relatively lower than the grid limiting resistance, to avoid distortion and phase shift of the signal voltage through regulation caused by loading, and to avoid carry over effects. The upper limit of grid resistance is usually set at a value which sufficiently minimizes voltage drop with a maximum critical grid current, or leakage current flowing through it.

During anode conduction, the grid under most conditions floats at a potential within a few volts of cathode potential. As a result, current may flow through the grid circuit during this period. This current may store energy in a grid circuit component. If the stored energy is dissipated too slowly after conduction ceases, it will

Fig. 6: Effects of full wave rectifier modes of operation on the anode and grid voltages



appear as a fictitious signal on the following cycle. This may appear as a tendency for the tubes to flicker instead of turning on sharply, to pass several cycles when the signal voltage calls for only one cycle, or irregularity in the control curve.

It is also desirable to recognize the effect on a tube about to fire, caused by flow of grid current to another conducting tube through a common grid circuit impedance. The actual grid voltage of the first may be materially affected by the float potential of the grid of the conducting tube. This can occur in a full wave or polyphase rectifier, as well as in a reversing circuit.

Self-Rectified Current

Self-rectified current in the grid circuit may provide a useful form of dc bias by the transient charging of a small bypass capacitor connected across the grid resistor. Fig. 4 shows a positioning servo combining a variable ac signal with fixed lagging ac grid bias and incorporating such a self bias scheme. With large error signal, the total ac grid voltage will be large in magnitude and nearly in phase with the anode voltage. By use of self bias, the first cycle of full conduction results in charging the bypass capacitor negatively. The firing angle on the succeeding cycles will be retarded more than the signal voltage indicates by an amount equal to the negative bias on the bypass capacitor. As this charge leaks off over several cycles, signal sensitivity is gradually regained. The effect is to desensitize the circuit when signals are large and thereby minimize hunting. This stabilizing effect may be desirable in some closed cycle systems where, for example, the overall time constant is in the order of several cycles, while the tubes respond almost instantaneously.

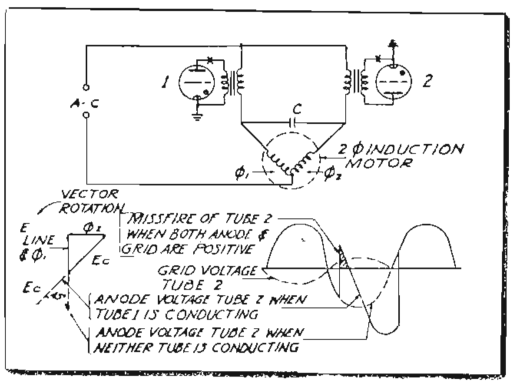


Fig. 7: Anode voltage phase shift in ac motor servo during conduction of revising tube

Most circuit designers are familiar with the usual observation of the time allowed for deionization of the tube. This is the time the anode is negative to cathode or less positive than the tube voltage drop as shown in Fig. 5a and is readily seen on the oscilloscope when connected from anode to cathode of the thyratron while the unit is in operation. However, in many circuits, such as inverters, the limiting available deionization time is that during the transient of unit starting or switching load (Fig. 5b). This can be measured by the use of a recording oscillograph. At best, it is exceedingly risky to try to determine the minimum available deionization time of the circuit by trial and error, using even a large selection of production tubes. Obviously, such procedure is also to be avoided in determining the tubes' required peak forward voltage and peak inverse voltage ratings.

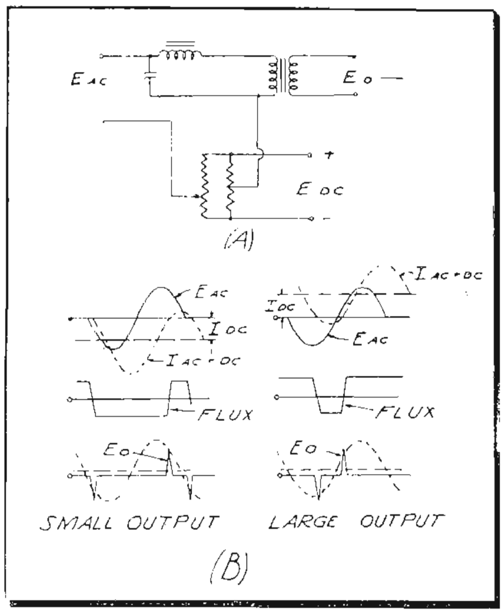


Fig. 8: (A) Typical circuit for peaking voltage source. (B) Waveforms of flux and voltages

The deionization time required by a thyratron is a function of anode voltage, grid voltage, and current magnitudes. Incipient failure to deionize shows up as an apparent increase in critical grid current. Grid circuit impedance and voltage are important factors, therefore, in determining the upper frequency limits of reliable operation. In fact, the tubes deionization time rating is often specified as measured under definite grid and anode circuit conditions.

Reference Voltage Distortion

In closed cycle control systems, the feedback voltage should be well filtered to avoid various types of tube unbalance and hunting. Distortion of either the reference voltage, or ac sinusoidal grid bias voltage may also be troublesome. For example, in a regulated dc supply consisting of a single phase full wave grid control rectifier, under some conditions of insufficient feedback filtering, if one tube conducts earlier and longer than is made the instantaneous increase of output voltage will tend to hold off the other tube more than the average output of the two tubes would indicate, and the unbalance between tubes increases still further. Under other conditions of improper filtering in such a circuit, the distortion of feedback voltage may cause first one tube, then the other, to "hog" the load or both tubes to come on together, and then shut off completely. Such effects are usually observed to be the result of inadequate attention to the feedback or reference voltages or their vacuum tube preamplifier circuits. The plate supplies of the latter may introduce undesirable results through the transient charging of unbalanced stray capacitances to ground.

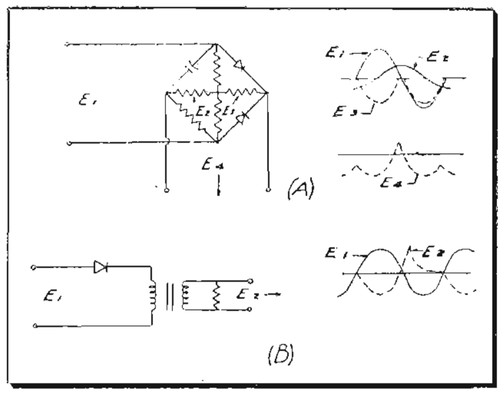


Fig. 9: Two simple means of obtaining a peaking voltage. (A) Addition of full wave rectified voltage and 90° phase shifted ac; (B) secondary voltage of standard transformer

If the feedback loop is opened, and a battery with potentiometer across it substituted for the feedback and reference voltages, and the preamplifier, adjustment of the control unit can be made to overcome other difficulties, and then the reference and feedback voltages added in separate steps until the cause of trouble is isolated.

Power Circuit Limitations

Certain inherent power circuit characteristics may cause undesirable effects which at first glance are sometimes erroneously attributed to grid circuit noise. There are a number of commonly encountered circuit conditions which may impose a sudden change in instantaneous anode voltage and corresponding critical grid voltage of a thyratron, with resultant undesirable change in firing angle. This may show up as "hunting," or rough spots in the con-

(*Continued on page 174*)

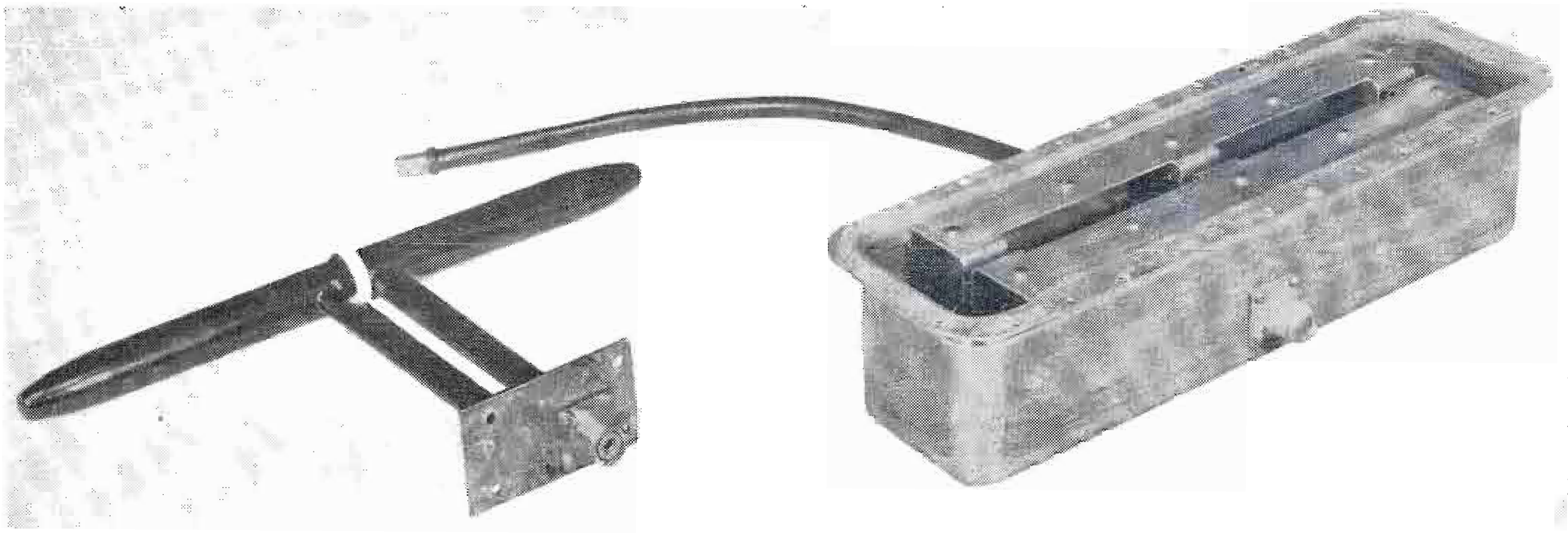


Fig. 1: Flush-mounted slot antenna shown at right may be used singly or in pairs to replace external dipole at left furnished with equipment

FM Altimeter Slot Radiators

Flush-mounted types developed in Navy program replace external dipoles. Radiation and feed-through tests guide design of slot arrays

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IN 1945 the Bureau of Aeronautics of the Navy Dept. accelerated an aircraft antenna development program whose ultimate goal was completely flush-mounted antenna systems where practicable for naval aircraft. One of the results of this flush antenna program was the development of a linear slot antenna system for the type AN/APN-1 FM absolute altimeter.[1] Used singly or in pairs as an array (double slots), these antennas can replace the standard external dipole furnished with the equipment. The dipole and the type of slot antennas discussed in this report are shown in Fig. 1.

Initial Flight Tests

When the development of the slot antennas was completed, pairs of the slots were installed on several service aircraft. The initial flight tests proved that the performance of these systems was poor at the high ends of the altitude ranges and failed to meet service specifications. The primary contributing factor to poor performance was excessive signal feed through from the transmitting slot to the receiving slot. The project for the investigation of the characteristics of the altimeter system using both dipole and slot antennas on typical service aircraft, with the emphasis on solving the feed-through problem, was then activated.

The FM altimeter measures absolute altitude by means of the frequency difference between the transmitted and the reflected signals. The indicator is calibrated to read directly in feet and has two ranges, 0 to 400 and 0 to 4,000 feet. The APN-1 system, using dipole antennas, was installed in attack and patrol type naval aircraft during the war for use in low altitude bombing, torpedo runs, carrier approach at night, etc. It should not be confused with the pulse type altimeter used by the Army Air Forces for high altitude bombing and pressure gradient navigation around storm areas. The pulse altimeter is not able to measure accurately altitudes much below 1,000 feet.

The various factors contributing to poor performance were isolated and evaluated. This was done by inverted mock-up, flight, and scale-model tests. Acceptable slot antenna systems have been developed for four common types of service aircraft. A few general rules were abstracted which are helpful in making the aircraft installation.

The AN/APN-1 FM altimeter[2] is a refined and improved version of the pre-war terrain clearance indicator.[3] The principles of operation of the system will be given in this section.

The basic system is shown in the block diagram, Fig. 2. The transmitter oscillator is frequency modulated by a vibrating-diaphragm capacitor. The transmitter frequency is varied sinusiodally over the band 420 to 460 MC for the 400 foot range, and 438 to 442 MC for the 4,000 foot range. The transmitter power is radiated by one antenna toward the ground. A small portion of the energy which is reflected, is picked up by the receiving antenna, and delivered to the receiver.

Receiver Components

The receiver consists of a balanced diode mixer, a high-gain amplifier, and an audio frequency meter. The received signal is mixed with a small fraction of the transmitter signal, producing an audio beat signal of a frequency equal to the difference between the transmitted and received signal frequencies. This difference is due to the frequency shift of the transmitter frequency during the fraction of a microsecond required for the transmitted signal to travel to the ground and back to the receiver.

The audio beat signal is fed into an audio amplifier with a frequency response such that the gain is proportional to frequency up to 10,000 cycles and then falls off rapidly above 10,000 cycles. The gain reaches approximately 100 decibels at the frequency of 10,000 cycles which corresponds to 125% of full-scale altitude. The amplified audio signal is fed through a limiter, and pulse-type frequency meter which is calibrated in feet.

As the aircraft flies higher above the ground, the strength of the ground-reflected signal decreases. At some critical altitude the ground signal is no longer the strongest signal at the counter input. At this altitude

FM SLOT RADIATORS (Continued)

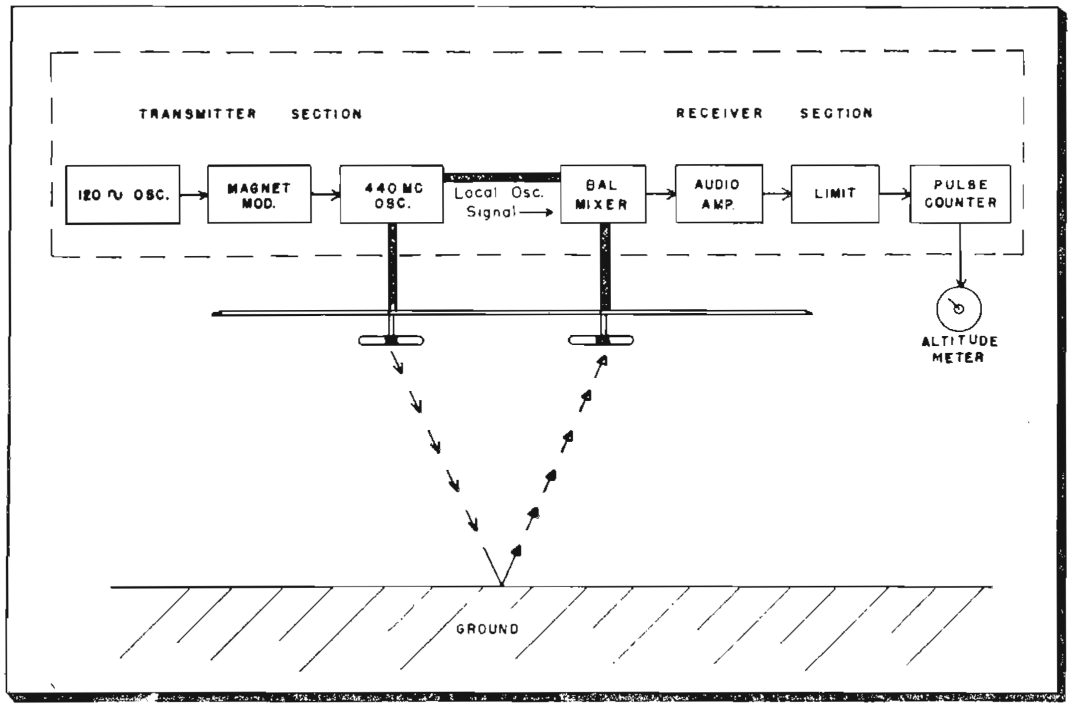


Fig. 2: Altimeter system determines altitude from FM transmitter frequency shift

we have meter "drop-out" and it erroneously indicates a low altitude or wavers erratically, depending upon the noise and internal signals. The Bureau of Aeronautics requires drop-out in level flight over sea water at not less than 1,000 feet on the low range and 8,000 feet on the high range.

High-range drop-out usually occurs when the ground-reflection signal is weaker than the thermal noise generated in the grid circuit of the first audio amplifier. Therefore, high-range drop-out depends upon antenna radiation patterns, cable attenuations, and antenna mismatch. Antenna feed-through and mismatch signals are not factors in this instance because the 4 MC FM deviation does not develop audio frequencies high enough to be effectively amplified.

Drop-Out Performance

The low altitude range drop-out performance is determined by three additional signals having short path-lengths and whose amplitudes are not affected by the altitude. The signal that is usually strongest is caused by feed-through current traveling from the transmitting antenna across the skin of the aircraft to the receiving antenna. The other two signals are caused by mismatch reflections at the cable junctions and antenna connectors.

On the low altitude range, drop-out occurs when the altitude is so high that the ground-reflected signal no longer over-rides the feed-through and mismatch signals. Therefore, low-range drop-out depends upon the antenna radiation patterns, antenna feed-through, and antenna mismatch.

Installation Rules

The following general rules indicate the optimum locations and types of slot antenna systems to be used for conventional aircraft installations.

Single slots are less expensive, easier to install, and have broader radiation patterns, minimizing the danger of drop-out during unusual maneuvers. A double slot fed in phase gives 3 db gain and the improved performance obtained from double slots often justifies their installation. The two recommended configurations are:

(1) The elements located with the long axes in line with the array center line (end-to-end).

(2) The elements located with the long axes parallel (side-by-side).

When the choice of single or double shots has been made, five general rules apply for minimum feed-through:

(1) Single slots must be mounted with their long axes in line (end-to-end orientation).

(2) Single slots must have some barrier such as a nacelle, fuselage section, or tail section between them.

(3) Double slots should have a barrier between the two arrays.

(4) Double slots will offer a reduction in feed-through as much as 6 db, as compared to single slots, if the long axes of the four slot elements are in line.

(5) The two antenna cables should be short as possible.

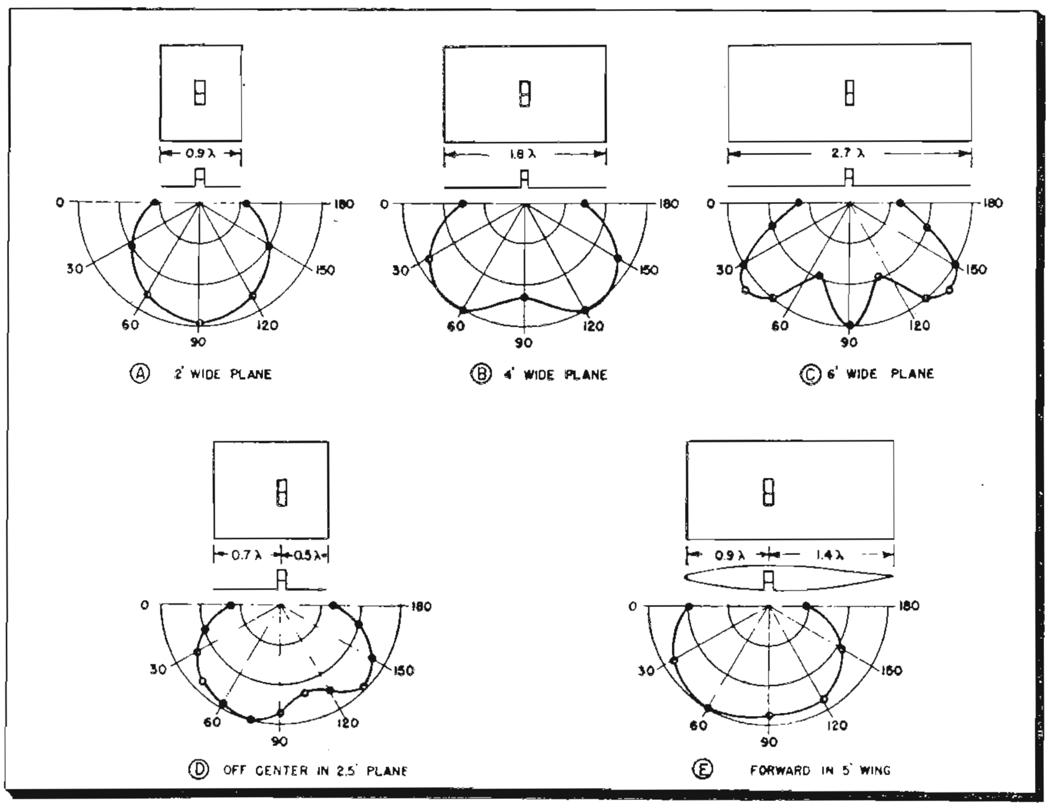
Three general rules may be laid down concerning radiation patterns:

(1) The radiation patterns of single slots are such that the drop-out performance of the system will barely meet service specifications, if feed-through is at a minimum. However, if the ground plane is small the trends shown in Fig. 3 must be considered.

(2) Assuming an adequate aircraft ground plane that is horizontal during level flight, the use of double slots will result in 6 db greater ground reflection signal than for single slots.

(3) The radiation pattern of double slots is rather narrow in one plane. The patterns of the various

Fig. 3: Variation of slot patterns in θ plane relative to ground plane size



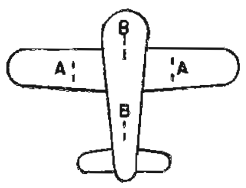
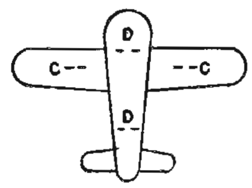
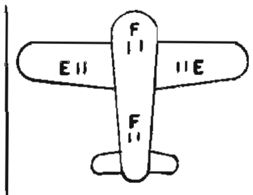
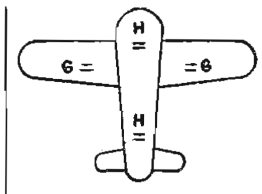
	END TO END ARRAYS			SIDE BY SIDE ARRAYS	
					
Long Axis of Slots on Aircraft	Parallel to Aircraft Axis A-A or B-B	Crosswise to Aircraft Axis C-C or D-D	Long Axis of Slots on Aircraft	Parallel to Aircraft Axis E-E or F-F	Crosswise to Aircraft Axis G-G or H-H
Pitch for ground reflection signal equal to that of level single slots	±25°	±70°	Pitch for ground reflection signal equal to that of level single slots	±40°	±30°
Roll for signal equal to level single slots	±70°	±25°	Roll for signal equal to level single slots	±30°	±40°

Fig. 4: Double slot configurations and aircraft pitch and roll angles which reduce ground reflection signal 6 db down from level flight

configurations must be considered to see which configuration will best satisfy the requirements of maneuverability. Fig. 4 shows the common configurations of double slots and the angles of aircraft pitch and roll which reduce the ground reflection signal 6 db down from level flight.

Feed-Through Measurements

Accurate feed-through measurements can be made by flight tests at a relatively high altitude. For the modified altimeter measuring system to be described in this section, an altitude of 5,000 feet is adequate for low-range feed-through.

If the aircraft is not available for flight tests, it is necessary to construct an inverted sectional mock-up of the aircraft as shown in Fig. 5 so that the antennas face upward and away from the earth. Comparisons made between mock-up data and flight test data indicate that the mock-up path need be no more than twice as wide as the distance between the antennas.

These relative feed-through measurements are most useful since they account for the special way the signals are amplified in the receiver proportional to their path-lengths. Feed-through values at 6 KMC using an inverted 1/13th scale precision model aircraft with both model single and double slots have been measured.

The measuring system which has been developed incorporates a modified altimeter set, a group of attenuator pads, and two ten-foot coax cables. See Fig. 6. The coaxial pads are made from modified type N fittings and small metallized resistors, and have attenuations of 6 db, 12 db, 20 db, and 60 db. The pads have an accuracy of ±1 db, are small, cause no mismatch and have convenient fittings to facilitate quick changing. The two standard ten-foot lengths of RG-8/U cable give 15 feet of equivalent altitude for calibration at a standard level with the 60 db pad.

The relative fee-through signal in the absence of any appreciable ground-reflection signal is measured by the following procedure: switch the modified altimeter set to the 400 foot range. Connect the two standard cables to the transmitter and receiver jacks, plug the other ends into the 60-db pad to form a series path, and read "E_c" on the voltmeter. Disconnect the standard cables from the 60-db pad and connect them to the respective transmitting and receiving cables. Insert between the transmitter jack and the transmitter cable resistor pads, "A_p" so that the voltmeter reading is within the 6 to 18 volt range. This reading is the voltage "E_{f+r}", feed-through plus some antenna reflection. If this latter signal is negligible the feed-through path attenuation, "A_{ft}", is

$$A_{ft} = 60 - A_p + 20 \log_{10} (E_c/E_{f+r}) \text{ db} \quad (1)$$

Pattern Measurements

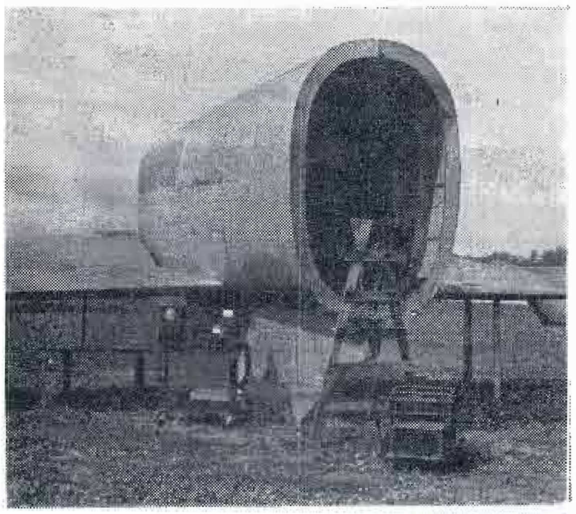
The patterns of dipole and slot antennas on various ground-planes and fuselage mock-ups were measured. Spherical coordinates will be used to specify the antenna patterns; θ will indicate direction in the electric plane of both the slot and dipole, and φ will indicate direction in the magnetic plane.

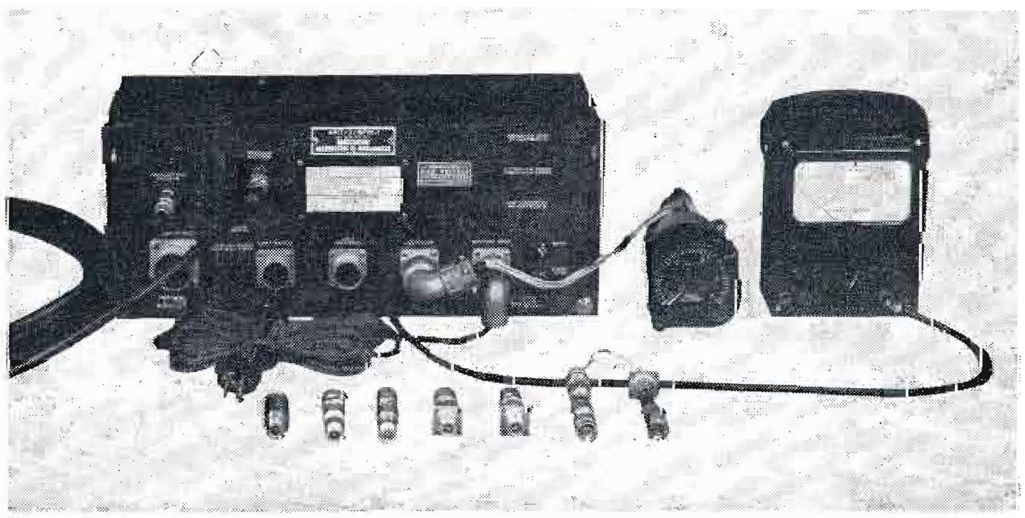
The radiating element of the AT-4 dipole is a half-wave long at the center of the band, and is supported a quarter-wave length off the ground plane by parallel lines that also provide balanced feed to the radiators. The AS-333/AP slot is a form of linear slot that is capacity-loaded at the aperture. The double slots consist of two single slot antennas fed in phase by lines a half-wave long from a junction tee.

The three-dimensional pattern of the dipole has a single lobe whose axis is perpendicular to the ground plane and approximately 90° wide to the 3 db point in both principal

(*Continued on page* 178)

Fig. 5: (l) Antennas face skyward on mock-up for feed-through measurements. Fig. 6: (r) Measuring system includes altimeter, attenuators and cables





Designing Trouble-Free Series Tube

Economy of transformerless TV receivers indicates desirability of using series heater arrangement. Promising method shows how to eliminate voltage unbalance during warm-up

By
M. B. KNIGHT
RCA Tube Dept.
Radio Corp. of America
Harrison, N.J.

THE potential low cost of transformerless TV receivers, together with the possible savings in weight and critical materials, make such receivers particularly attractive to designers. In these receivers, however, the operation of tube heaters in series presents several engineering problems, which may be classified under the headings of (1) steady-state heater voltage; (2) voltage unbalance during receiver warm-up; (3) heater-cathode voltage; and (4) multiple tube failures.

Perhaps the least troublesome problem in the design of a transformerless TV receiver is the arrangement of the tube heaters so that each has the proper voltage under steady-state conditions. Although many arrangements can be devised, other design considerations in a particular receiver, some of which will be discussed in this article, usually narrow the choice to a very few. The usual tube requirements of TV receivers suggest that, in general, the most promising arrangement consists of two 300-ma strings joined to form a small common 600-ma section, as shown in Fig. 1. The 600-ma section is needed to accommodate the kinescope, the damper tube, and any 450-ma tubes (with a shunt resistor). When this general arrangement is used, little, if any, series resistance is required to establish the proper steady-state heater voltages.

The resistance-temperature characteristic of the heater material has some effect on the steady-state operation of the heaters in a series string. The resistivity of tungsten, for example, increases by a factor of more than seven between room temperature and 1500° K, which is the approximate operating temperature of most tube heaters. Because some tolerance must be allowed in the manufacture of heaters, the wire diameter in different heaters is certain to vary slightly, causing the resistance and operating temperature to vary. This variation is aggravated in a series string. A heater in which the wire diameter is larger than normal, for example, has lower resistance and assumes less than its normal voltage; as a result, such a heater operates at lower temperature, and its resistance becomes still lower with respect to that of heaters having normal or smaller-than,normal wire diameter. The extremes in cathode temperature, therefore, are increased beyond the extremes resulting from the normal 10% variation in supply voltage, and a slight reduction in average tube life may result.

Voltage Unbalance

Although the heater voltages in a series string may be properly balanced under steady-state conditions, severe unbalance may occur during receiver warm-up. Normal considerations in tube design require that heaters of different material, size, mechanical arrangement, and thickness of insulating coating be used in various tube types. Such differences in construction cause differences in the rate at which the heaters warm up. One heater may reach its normal operating temperature and resistance while other heaters are still relatively cool and have relatively low resistance. The fast-heating tube, therefore, is subjected to a heater voltage and temperature considerably higher than the normal value until the entire string reaches stable condition. It is important, of course, to avoid the placement of a fast-heating tube in series with several slow-heating tubes. The heating time referred to, however, is primarily a characteristic of the heater and its insulation and may bear no relation to the time required for the start of cathode emission. The maximum heater voltage occurs before the cathode is heated much, usually within the first five seconds of warm-up.

A test on a very simple heater string, shown in Fig. 3, illustrates typical differences in heating characteristics of three tube types. A voltage of 18.9 v. was applied to three 6.3-volt tubes in series. Two of the tubes were 6CB6's; the third tube in one test was a 6AL5 and in the other test was a 12AU7 with heaters connected in parallel. The heater-voltage variation with time after the switch was closed is shown in Fig. 3 for each tube type. It is significant to note that, although the heater-cathode structures of the 6AL5 and the 12AU7 are quite similar, the results for these two tubes are quite different.

Some general rules may be used

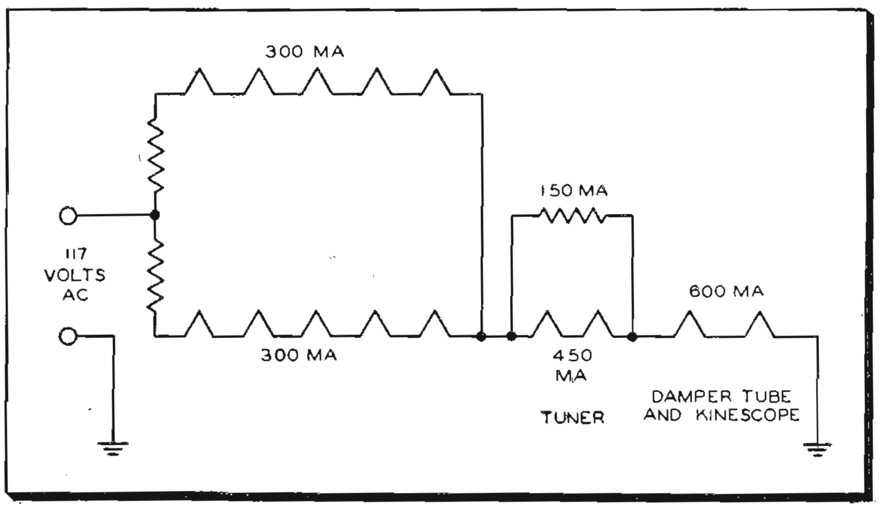
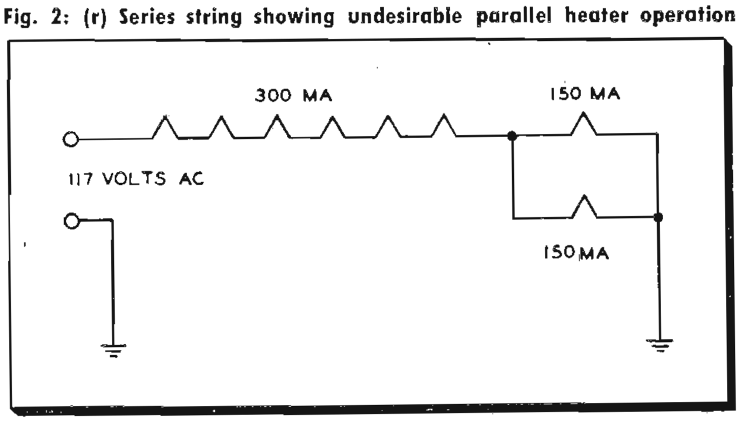


Fig. 1: (l) Typical series heater arrangement for television receivers
Fig. 2: (r) Series string showing undesirable parallel heater operation



Heater Strings

for guidance in devising series strings to minimize the voltage unbalance during warm-up. First, tubes with large heater power usually warm up more slowly than tubes with less heater power. This fact suggests that in receivers having two nearly independent strings, as shown in Fig. 1, tubes with large heater power can be placed in one string and tubes with smaller heater power in the other. There may not be enough tubes with large heater power to fill one string, however; it is then usually preferable to divide the slower-heating tubes evenly between the two strings.

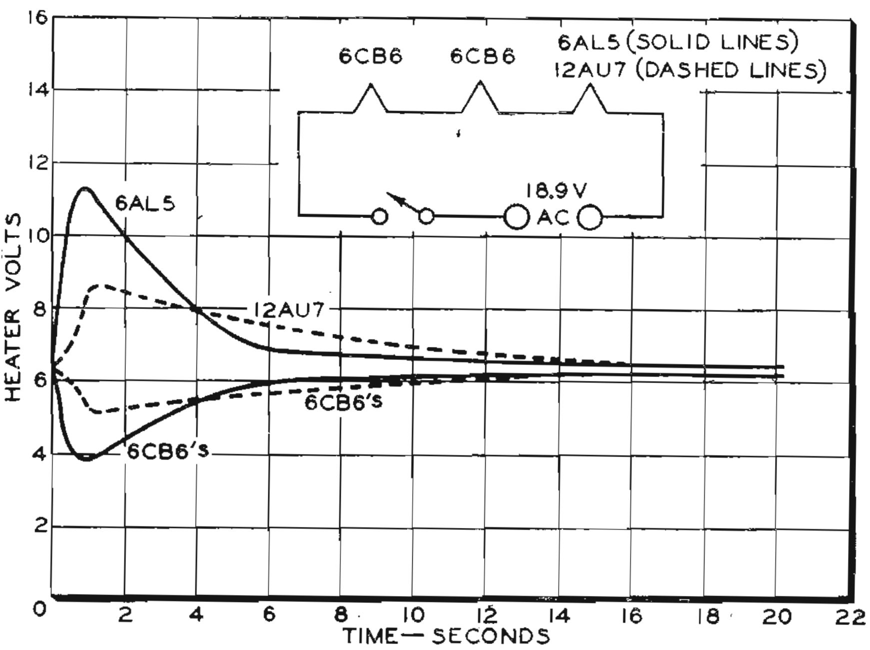


Fig. 3: Variation in heater voltages during warm-up of two simple series heater strings

Fixed Series Resistance

A second general rule is that the use of fixed resistance in series with a string is one of the most effective ways to reduce the voltage unbalance. The use of fixed series resistance increases the warm-up time of the receiver, however, and this method has practical limitations.

A third general rule, the converse of the second, is that the use of fixed resistance in parallel with a tube heater aggravates voltage unbalance during warm-up. It would be unwise, for example, to place a 150-ma heater with parallel resistor in a 300-ma string. The use of a 450-ma tube and parallel resistor in a 600-ma string, as shown in Fig. 1, is also undesirable, but may be required when existing tube types are fitted to television circuit requirements.

Probably the most important thing to remember about these general rules, however, is that their usefulness is limited to guidance. Extensive voltage measurements are required for proper evaluation of a string arrangement. Even with TV receiver string arrangements adhering to the recommended general principles, warm-up voltages on some types have averaged more than twice their rated heater voltages. In fact, the far simpler strings used in ac-dc radio receivers have proven so complex in warm-up behavior that the tube industry has been forced to rely on voltage measurements rather than analytical methods, despite years of experience. Furthermore, variations between individual tubes require that some quantity of tubes be used in the evaluation of a string arrangement, and that tubes from various manufacturers be included. The tubes should be allowed to cool for a minimum of 10 minutes between tests.

Meters used in warm-up voltage measurements must respond quickly. Although most precision instruments are too sluggish for the job, they can be used to check the calibration of faster-acting meters such as some ac vacuum tube voltmeters. A calibrated oscilloscope is also a suitable measuring instrument.

Heater-Cathode Voltages

In the design of the series-string arrangement, it is important to consider the maximum heater-cathode voltage ratings of the tubes. Heater-cathode voltage ratings are usually given in terms of peak voltage, and the pertinent voltage, therefore, consists of the dc voltage plus the peak ac voltage, including any signal voltages.

The damper tube often presents the most serious problem, and it should usually be placed near the ground end of the string. The ratings of tubes intended for damper service acknowledge the capability of the heater-cathode insulation for withstanding voltage pulses better than dc voltages. The heater-cathode voltage rating, therefore, includes a maximum peak pulse-voltage value, with the duration and repetition rate of the pulse defined, and a maximum dc voltage value. Any 60-cycle sine-wave component added by the series string arrangement is almost as dangerous to the insulation as dc voltage, and the sum of the dc voltage and the peak 60-cycle sine-wave voltage should not exceed the dc heater-cathode voltage rating.

Because the kinescope also has considerable dc heater-cathode voltage, its heater, too, should be placed near the ground end of the string. Attention to a design for conservative kinescope operation is warranted because of the relatively high replacement cost.

Large ac heater-cathode voltages are also conducive to heater-cathode hum in some circuits. It is advisable to place tubes used in circuits susceptible to heater-cathode hum near the ground end of the string.

One unfortunate result of high heater-cathode voltages is the fact that the incidence of breakdown of the heater-cathode insulation is certain to increase. Although we can state that the life of a tube used within its ratings will be satisfactory, the term "satisfactory" is a relative one. Tube operation will be more reliable if the heater-cathode voltage is minimized. A high heater voltage during warm-up is also conducive to heater-cathode failures because of the mechanical motion and stresses resulting from the large temperature variation in the heater.

Multiple Failures

In a series-string TV receiver there are a number of ways in which one tube failure may bring about the failure of another tube. Such possibilities should be considered in the design of the string arrangement.

As an example of one type of multiple failure, heater-cathode shorts in certain tubes in the string could bypass portions of the string and place excessive heater voltage on other tubes. No practical solution to this problem is apparent, although the use of fuses is a rather costly possibility.

Multiple failures may also result from an open heater. In complex ar-

(*Continued on page 176*)

Bell System Plans for Broadband

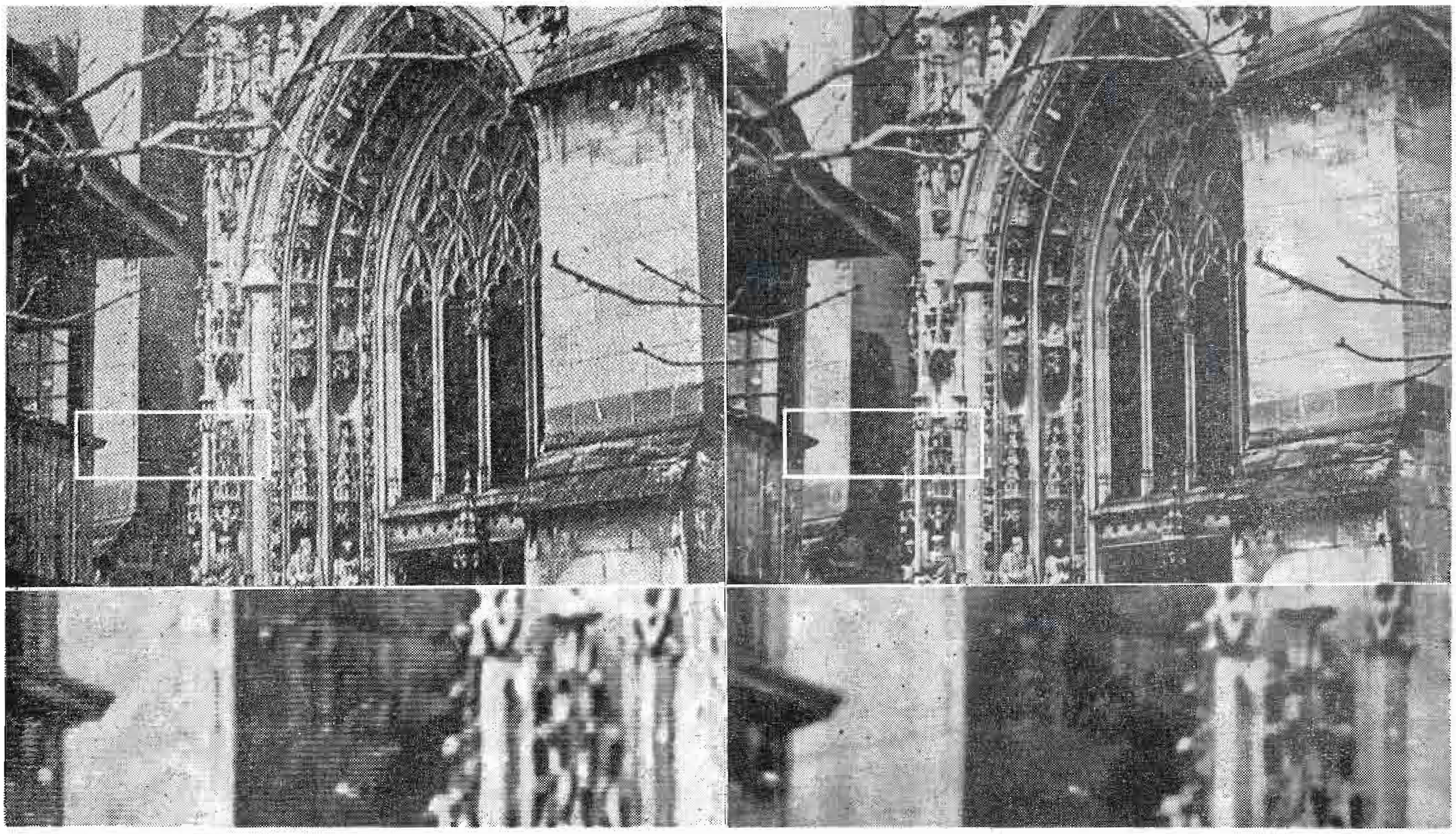


Fig. 1: (l) TV picture, using 625-line scan in 8-MC band, is comparable to original photograph, Fig. 2 (r). Fine detail of rectangular section is shown in blow-up beneath photo. Note that pictures printed on this page are of lower quality than originals due to photographic and engraving processes

By FRANKLIN LOOMIS

THE engineering testimony of the American Telegraph and Telephone Co. before the Federal Communications Commission in the hearing on the petition of the Motion Picture Industry for frequencies for theatre TV contains many points of interest for the communications engineer.

In general, the purpose of the testimony was to show that the A T & T, as a common carrier, could make available the wideband facilities which the petitioners said would be needed when and if theatre TV became widespread. The men testifying for A T & T were their engineers, F. A. Cowan and F. M. Ryan, and also W. H. Doherty of BTL.

Present Status

How wide should a broadband TV System be? This is our logical starting point. The MPAA witness, A. F. Inglis, after considerable theoretical calculation arrived at the conclusion that, for theatre TV, 735 scanning lines and a video bandwidth of 10 MC was required. The basis for this was that the TV picture would approach as closely as possible in quality the picture projected from 35 mm film. The RCA witness, G. L. Beers, using this same basis and partly the same approach (the Schade number and the sine-wave response characteristic for both electrically and photographically reproduced pictures), found theoretically and experimentally, that a 625-line TV picture with an 8 MC bandwidth gave an acceptable picture in the theatre. Figs. 1 and 2, taken from his exhibit are reproduced here so the reader can compare the transmitted 625-line image, Fig. 1, with the original, Fig. 2.

The A T & T engineers made no statement as to bandwidth needed since their position was that they would endeavor to furnish facilities capable of transmitting bands as wide as their customer demanded. However, on an experimental basis they had set up circuits in New York which would pass frequencies up to 20 MC for the transmission of TV signals to an Eidophor TV theatre projector. As this extremely wide band was reduced in steps, degradation of the picture was not noted until the band was cut to more than half its original width, the exact width needed not being stated.

Bell System Facilities

From a start in 1946 the number of channel miles has grown rapidly until 63,000 miles of coax and 65,000 miles of radio relay will be in use by the end of 1953. If long-distance telephone facilities are added to today's TV facilities, the total is 11 million miles. The cost of the present system is $100,000,000. During the last three years the growth of radio relay has been more rapid than that of the coax. Has the latter been abandoned? No, five coax hookups have been installed within the last year. The choice depends on relative costs and terrain. Coax is indicated where line-of-sight is difficult to obtain and where there is radio congestion, as found today around city terminals. For intra-city use, radio relay and wire circuits are superior to coax because of low-frequency noise difficulties if transmission is at video frequency. For such use polyethylene cables are preferred to the usual coax for theatre TV connections within a city.

The band transmitted over the

Network Facilities

Engineering testimony before FCC shows how 8-10 MC bandwidths will be transmitted for theatre TV. Recent developments include Clogston concentric-conductor cable, and no transmission for same-shade adjacent picture elements

coax, previously about 3 MC, has been extended to 4 MC and can be widened to 8.5 MC. In fact, a bandwidth of 10 MC can be obtained if balanced "poly" pairs are employed with amplifiers located every two miles, instead of every four miles. A polyethylene cable, 5,000 ft. long, was used, with laboratory-type amplifiers placed every 3,000 ft., for the 20 MC wide transmissions in New York for the Eidophor demonstration.

L-3 System

The L-1 system is giving away to the L-3 system. These amplifiers are spaced along the coax at intervals of eight miles for the L-1 equipment and four miles for the L-3 equipment.

The TD-2 repeater station used in the transcontinental link employs a delay-type lens antenna having a bandwidth of 500 MC at the operating frequency of about 4,000 MC. Repeater spacing averages 30 miles. Performance of the TD-2 system when modified for broadband transmission can be judged from the curve in Fig. 3, which is for 440 miles. Broadband operation over considerably longer distances runs into the difficulty of excessive phase shift because of the numerous cutoff effects of many relays in tandem. This can be corrected when the passband is 8 MC, but not when it is 10 MC.

Unsatisfactory Bandwidth

The klystrons used in the TD-2 system are being replaced by Type 416A & B triodes, which have a grid-to-cathode spacing of less than 0.001 in. because the klystrons had unsatisfactory bandwidth and were difficult to adjust. The triode tubes give an output of 0.5 watt in an FM system at 4,000 MC that is flat over 10 MC.

Bell System intracity video cable layouts: There are extensive cable layouts for TV installed in the following cities: Baltimore, Boston, Chicago, Cleveland, Detroit, Los Angeles, Milwaukee, Philadelphia, Pittsburgh, St. Louis, San Francisco, Washington, and, of course the most extensive one is in New York City. This is shown in Fig. 4. Within cities there are often demands for TV relays between points that are not line-of-sight and where no video cable is available. A mobile radio relay unit is then brought into use.

The A T & T engineers pointed out that, although the MPAA plan had no provision for spare circuits for use when regular circuits were out of service, in the Bell System "protection" circuits were found most necessary. They were used a dozen times a day with the new automatic switching which requires only milliseconds for the switch. They come into use in times of severe fading or equipment failure so quickly that TV observers in their homes are unaware that circuits have been switched.

Cost of a Washington-New York theatre TV network: This subject has no connection with what has gone before, but it may interest readers to know the A T & T estimates: the book-cost of the proposed network is $4,485,000 and the annual operating expense $1,040,000.

Broadband TV Relays

To take the place of the TD-2 radio relay system, the TH system is being developed. This will operate at 6,000-7,000 MC with a bandwidth of 10 MC, over distances of up to 4,000 miles. The same repeater spacing will be used but a new type of antenna will supplant the TD-2 type, and the traveling wave tube will furnish the transmitter power.

In the *Bell System Technical Journal* for April 1948 (also as Monograph B-1565), there is available a very complete paper "Microwave Repeater Research" by H. T. Friis.

Mr. Doherty, director of Research in Electrical Communications, BTL, testified regarding some of the developments that will affect the future of relaying:

1. *More efficient use of the TV channel:* The BTL approach to this old and intriguing problem is to find what portion of the transmission band is not in continual use—it is the high-frequency end of the band —and in this space transmit other

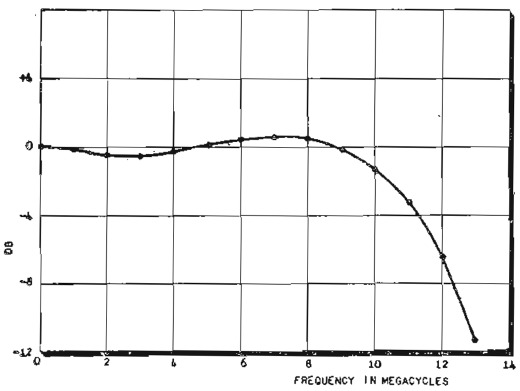


Fig. 3: Performance of TD-2 repeater, used in transcontinental link, over a 440-mile stretch

picture information. A system was devised in which *no transmission* takes place when an adjacent picture element is the same shade as the element which preceded it. This results in an average power reduction over the link connecting the receiver and transmitter of about 22 db. Experimental results of this first step are shown by the lower photo of Fig. 5. It will be seen that there are fairly long periods when no signal is transmitted, and it is at these times that it is proposed to send the fine detail in the picture. Just how this was done was not disclosed.

2. *Color TV research:* It has been found that equal detail in the three colors used for TV is not needed. The bandwidth for some of the colors therefore can be reduced; for instance, the red detail can be reduced to ⅗ of the green detail, and the blue reduced to ⅕ of the green detail. BTL equipment, to be com-

FCC HEARING on THEATRE TV

In the FCC hearing on Theatre TV, the first portion of which was reported in TELE-TECH & ELECTRONIC INDUSTRIES for Dec. 1952, page 42, all the engineering testimony now has been completed. Besides the Motion Picture petitioners, MPAA and NETTC, the following have testified: AT & T, RCA, Western Union and Am. Petroleum Inst. At this time the hearing is indefinitely recessed while the FCC studies the answers the petitioners have made to certain FCC questions in order to determine if it is desirable to continue the hearing.

pleted this year, will have three channels, each 15 MC wide.

3. *Traveling-wave tubes:* Compared with klystrons and triodes this tube holds the most promise for microwave links because of its wideband operation made possible by the absence of sharply-tuned cavities and because of the ease of replacement due to no frequency-fixing adjustments. The problem is to match the impedance of the input and output waveguides to the internal "helix" of the tube. See Fig. 6. Electrons travel along the helix at 1/15 the speed of light. The amplification factor is 20 to 40 db; operation within the 4,000-11,000 MC band is satisfactory. At the lower frequency a bandwidth of 500 MC can be secured. Fig. 7 shows various types of traveling-wave tubes. The 1779 tube is said to suffer from high noise factor. BTL has on hand 70 type 1552 tubes, 200 type 1717 tubes, with production of the latter being four per week.

4. *Transistors:* A fourth electrode now has been added which permits higher frequency operation, up to 200 MC for oscillators (see Nov. 1952 TELE-TECH & ELECTRONIC INDUSTRIES, p. 38). Intensive transistor development has led to an experimental miniature coax repeater which is probably the world's smallest (see March 1953 TELE-TECH & ELECTRONIC INDUSTRIES, p. 104). This was exhibited to the Commissioners by Mr. Doherty, who showed how the input and output 100 mil coax could be plugged into the two ends of the tiny amplifier which is completely contained in a metal tube about 1/8-in. diam. and 1.5 in. long. It is hard to believe that this metal capsule contained: a tetrode transistor, input and output transformers, diodes for voltage regulation, capacitors, resistors, two terminal boards and even a negative-feedback connection.

This low-distortion amplifier has a gain of about 20 db over the band 0.4 to 11 MC. In the side of the repeater case is a small hole for the battery supply wire, the other side of the battery being grounded on the sheath of the coax. The battery supplies 22½ v. at 5 ma. These miniature repeaters are spaced in the cable at 1/3-mile intervals.

5. *Clogston laminated cable:* This experimental cable, in the center of which is placed a series of concentric conductors, spaced by dielectric as shown in Fig. 8, has a lower attenuation than the usual coax over a portion of the frequency band. According to theory these concentric conductors should have infinitely thin walls, something that is obviously impossible in production.

6. *Waveguides and millimeter waves:* Communications between cities may in the future be carried mostly by empty, metallic pipes. In a pipe waveguide, where the *circular electric mode* is chosen for millimeter wave propagation, transmission losses *decrease* with increasing

(*Continued on page* 184)

Fig. 4: Bell System video cable layout in New York City

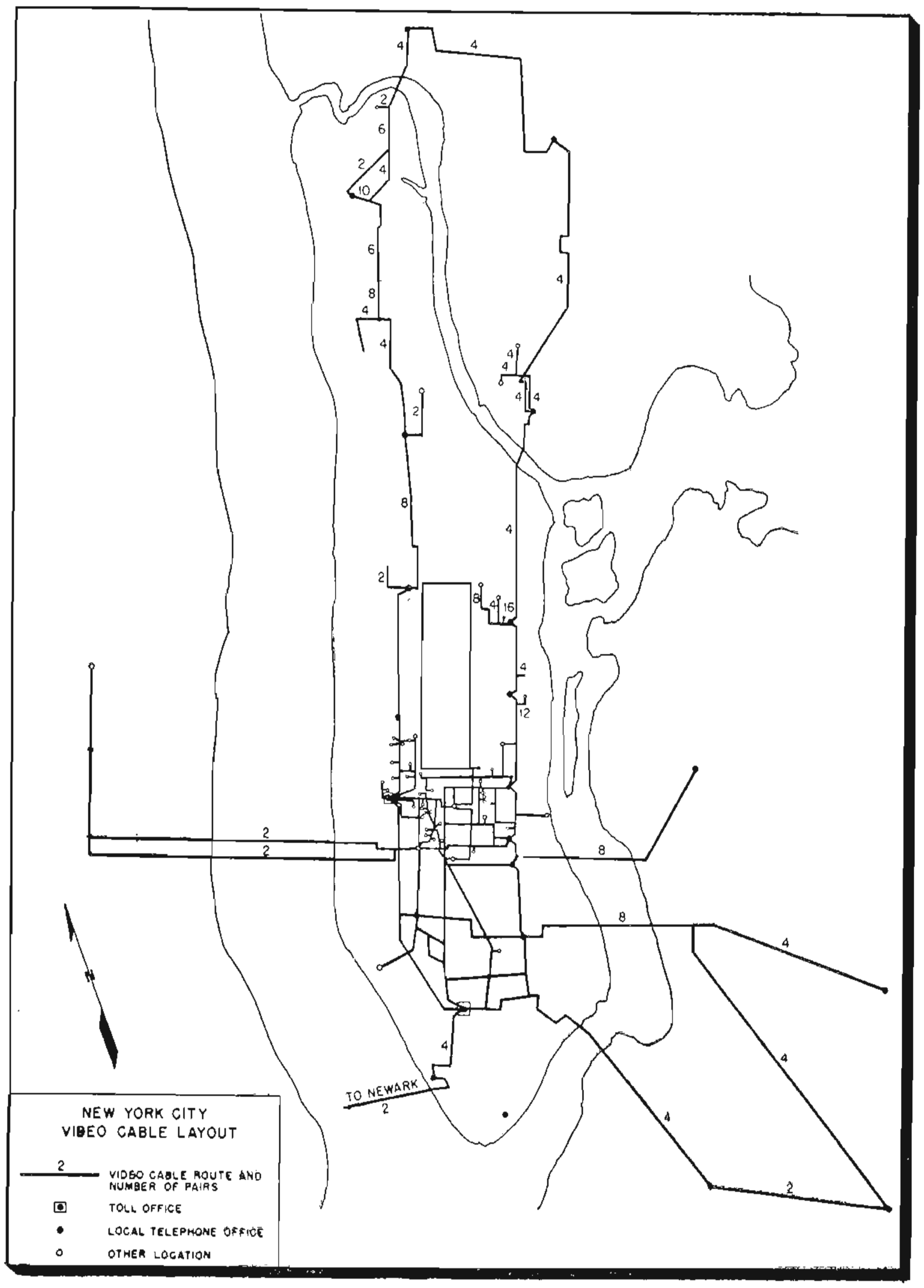


Fig. 5: New spectrum-saving method of sending original picture (top) is to make no transmission when adjacent picture element is same as preceding one (bottom)

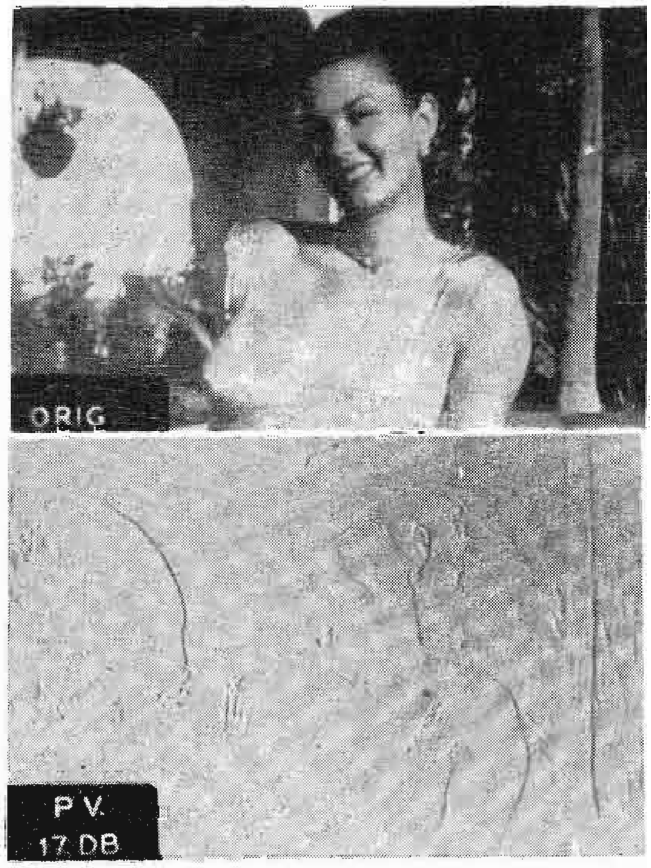
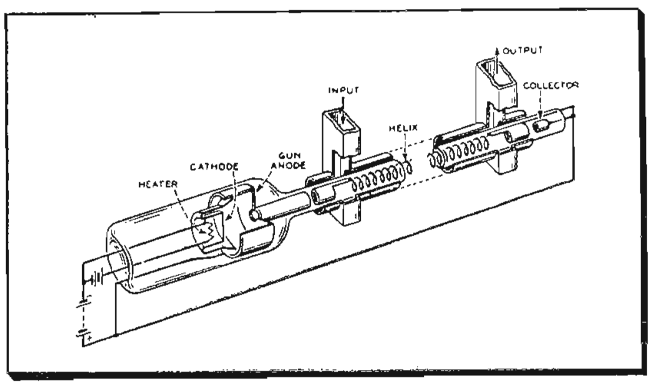


Fig. 6: Traveling-wave tube holds promise for microwaves



Page from an Engineer's Notebook

No. 19 — Parallel-Paired Resistance Values

By CHARLES F. WHITE, Electronic Scientist, Naval Research Laboratory, Washington 25, D. C.

Several excellent nomographs exist for the determination of the value of paralleled resistances but for everyday convenience a simple tabulation proves most satisfactory.

The table gives the nominal resistance for the paralleled combination of two standard ±5% (gold band) RMA value resistors. This series includes the values in the ±10% and ±20% series.

The values for two resistors in the same decade for two resistors in adjacent decades are given. Because of the tolerance on the values of the resistors being paired, the actual value obtained physically may deviate by the same tolerance from the tabulated values.

→ R2 → ↓ R1 ↓	100	110	120	130	150	160	180	200	220	240	270	300	330	360	390	430	470	510	560	620	680	750	820	910	1000	← R2 ← ↓ R1 ↓
100	50	52	55	57	60	62	64	67	69	71	73	75	77	78	80	81	82	84	85	86	87	88	89	90	91	100
110	52	55	57	60	63	65	68	71	73	75	78	80	83	84	86	88	89	90	92	93	95	96	97	98	99	110
120	55	57	60	62	67	69	72	75	78	80	83	86	88	90	92	94	96	97	99	101	102	103	105	106	107	120
130	57	60	62	65	70	72	75	79	82	84	88	91	93	96	98	100	102	104	106	107	109	111	112	114	115	130
150	60	63	67	70	75	77	82	86	89	92	96	100	103	106	108	111	114	116	118	121	123	125	127	129	130	150
160	62	65	69	72	77	80	85	89	93	96	100	104	108	111	113	117	119	122	124	127	130	132	134	136	138	160
180	64	68	72	75	82	85	90	95	99	103	108	113	116	120	123	127	130	133	136	140	142	145	148	150	153	180
200	67	71	75	79	86	89	95	100	105	109	115	120	125	129	132	137	140	144	147	151	156	158	161	164	167	200
220	69	73	78	82	89	93	99	105	110	115	121	127	132	137	141	146	150	154	158	162	166	170	173	177	180	220
240	71	75	80	84	92	96	103	109	115	120	127	133	139	144	149	154	159	163	168	173	177	182	186	190	194	240
270	73	78	83	88	96	100	108	115	121	127	135	142	149	154	160	166	171	177	182	188	193	199	203	208	213	270
300	75	80	86	91	100	104	113	120	127	133	142	150	157	164	170	177	183	189	195	202	208	214	220	226	231	300
330	77	83	88	93	103	108	116	125	132	139	149	157	165	172	179	187	194	200	208	215	222	229	235	242	248	330
360	78	84	90	96	106	111	120	129	137	144	154	164	172	180	187	196	204	211	219	228	235	243	250	258	265	360
390	80	86	92	98	108	113	123	132	141	149	160	170	179	187	195	205	213	221	230	239	248	257	264	273	281	390
430	81	88	94	100	111	117	127	137	146	154	166	177	187	196	205	215	225	233	243	254	263	273	282	292	301	430
470	82	89	96	102	114	119	130	140	150	159	171	183	194	204	213	225	235	245	256	267	278	289	299	310	320	470
510	84	90	97	104	116	122	133	144	154	163	177	189	200	211	221	233	245	255	267	279	291	304	314	327	338	510
560	85	92	99	106	118	124	136	147	158	168	182	195	208	219	230	243	256	267	280	294	307	321	333	347	359	560
620	86	93	101	107	121	127	140	151	162	173	188	202	215	228	239	254	267	279	294	310	324	339	353	369	383	620
680	87	95	102	109	123	130	142	156	166	177	193	208	222	235	248	263	278	291	307	324	340	357	372	389	405	680
750	88	96	103	111	125	132	145	158	170	182	199	214	229	243	257	273	289	304	321	339	357	375	392	411	429	750
820	89	97	105	112	127	134	148	161	173	186	203	220	235	250	264	282	299	314	333	353	372	392	410	431	451	820
910	90	98	106	114	129	136	150	164	177	190	208	226	242	258	273	292	310	327	347	369	389	411	431	455	476	910
1000	91	99	107	115	130	138	153	167	180	194	213	231	248	265	281	301	320	338	359	383	405	429	451	476	500	1000
1100	92	100	108	116	132	140	155	169	183	197	217	236	254	271	288	309	329	348	371	397	420	446	470	498	524	1100
1200	92	101	109	117	133	141	157	171	186	200	220	240	259	277	294	317	338	358	382	409	434	462	487	518	545	1200
1300	93	101	110	118	134	142	158	173	188	203	224	244	263	282	300	323	345	366	391	420	446	476	503	535	565	1300
1500	94	102	111	120	136	145	161	176	192	207	229	250	270	290	310	334	358	381	408	439	468	500	530	566	600	1500
1600	94	103	112	120	137	145	162	178	193	209	231	253	274	294	314	339	363	387	415	447	477	511	542	580	615	1600
1800	95	104	112	121	138	147	164	180	196	212	235	257	279	300	321	347	373	397	427	461	494	529	563	604	643	1800
2000	95	104	113	122	140	148	165	182	198	214	238	261	283	305	326	354	381	406	438	473	507	545	582	625	667	2000
2200	96	105	114	123	140	149	166	183	200	216	240	264	287	309	331	360	387	414	446	484	519	559	597	644	688	2200
2400	96	105	114	123	141	150	167	185	202	218	243	267	290	313	335	365	393	421	454	493	530	571	611	660	706	2400
2700	96	106	115	124	142	151	169	186	203	220	245	270	294	318	341	371	400	429	464	504	543	587	629	681	730	2700
3000	97	106	115	125	143	152	170	188	205	222	248	273	297	321	345	476	406	436	472	514	554	600	644	698	850	3000
3300	97	106	116	125	143	153	171	189	206	224	250	275	300	325	349	380	411	442	479	522	564	611	657	713	767	3300
3600	97	107	116	125	144	153	171	189	207	225	251	277	302	327	352	384	416	447	485	529	572	621	668	726	783	3600
3900	98	107	116	126	144	153	172	190	208	226	253	279	304	330	355	387	419	451	490	535	579	629	678	738	796	3900
4300	98	107	117	126	145	154	173	191	209	227	254	280	306	332	358	391	424	456	495	542	587	639	689	751	811	4300
4700	98	107	117	127	145	155	173	192	210	228	255	282	308	334	360	394	427	460	500	548	594	647	698	762	825	4700
5100	98	108	117	127	146	155	174	192	211	229	256	283	310	336	362	397	430	464	505	553	600	654	706	772	836	5100
5600	98	108	117	127	146	156	174	193	212	230	258	285	312	338	365	399	434	467	509	558	606	661	715	783	848	5600
6200	98	108	118	127	146	156	175	194	212	231	259	286	313	340	367	402	437	471	514	564	613	669	724	794	861	6200
6800	99	108	118	128	147	156	175	194	213	232	260	287	315	342	369	404	440	474	517	568	618	675	732	803	872	6800
7500	99	108	118	128	147	157	176	194	214	233	261	288	316	344	371	407	442	478	521	573	623	682	739	811	882	7500
8200	99	109	118	128	147	157	176	195	214	233	261	289	317	345	372	409	445	480	524	576	628	687	745	819	891	8200
9100	99	109	118	128	148	157	177	196	215	234	262	290	318	346	374	411	447	483	528	580	633	693	752	827	901	9100
10,000	99	109	119	128	148	157	177	196	215	234	263	291	319	347	375	412	449	485	530	584	637	698	758	834	909	10,000
↑ R1 ↑	100	110	120	130	150	160	180	200	220	240	270	300	330	360	390	430	470	510	560	620	680	750	820	910	1000	↑ R1 ↑

Pressure Sensing Calculations

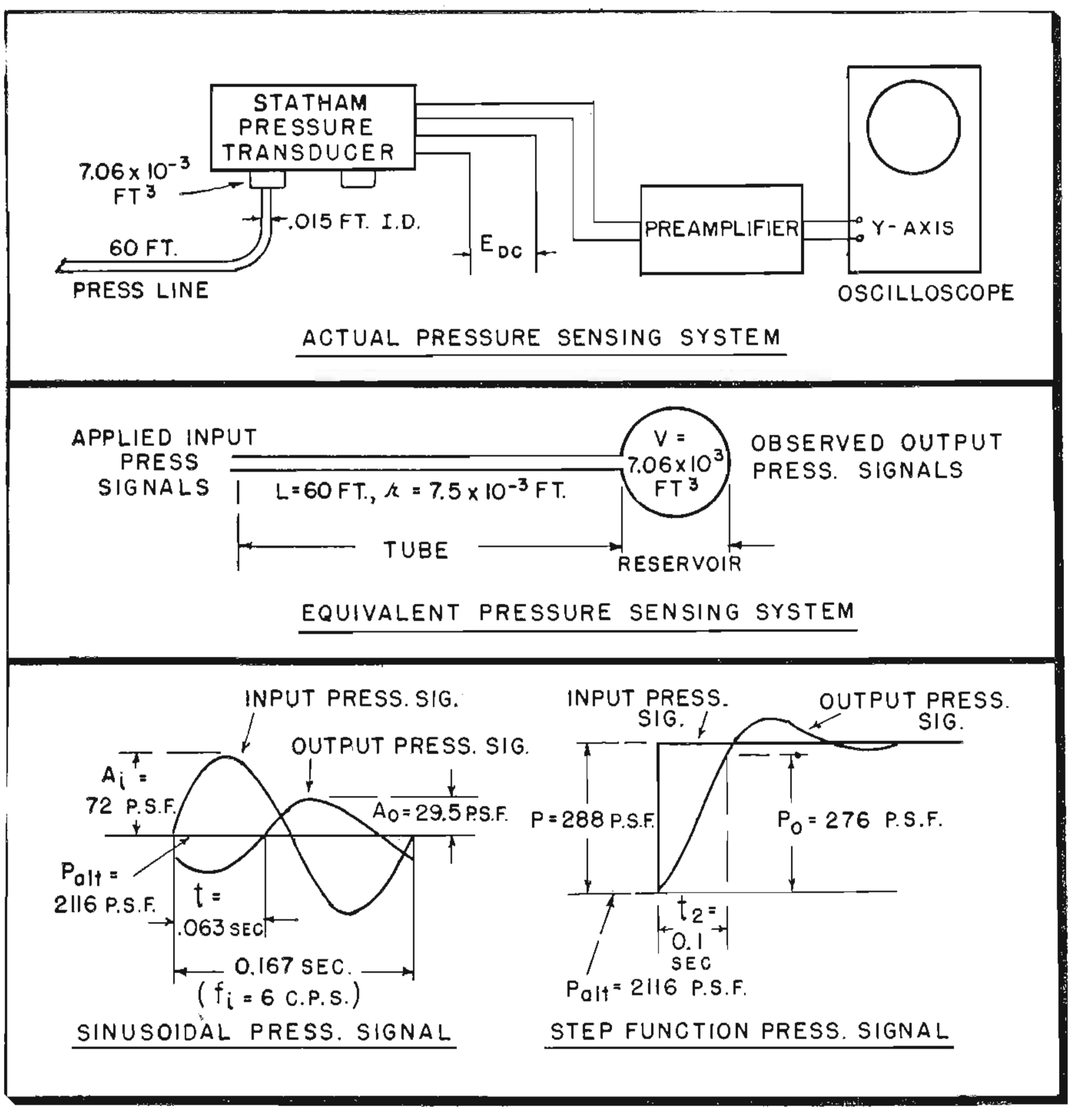
Easily workable analytical method employs equivalent system approach to provide design information for data measuring equipment. Transducer characteristics described

By
J. D. Humphreys
Northrop Aircraft, Inc., Hawthorne, Calif.

A METHOD for calculating the characteristics of a pressure sensing system provides the design criteria for predicting the difference between signals transmitted by the sensing capsule and the signals applied to a pressure sensing system. The procedure here is designed for the analysis of air pressure sensing systems, since air is the most commonlv used fluid in aircraft and missile data measuring of servo control systems.

A pressure sensing system usually incorporates a tube and reservoir at the end, or, several reservoirs connected to the tube along its length near the end. To apply the following method effectively, it is necessary to reduce the pressure system under consideration to an equivalent tube and single reservoir at the end. Reducing most pressure sensing systems to this simple configuration for calculation can be done without introducing excessive errors, provided the meters and/or transducers are not connected large distances apart compared to the pressure line length. It is assumed that the acoustic lag (time of sound transmission in the system) is negligible compared to the time of response of the system under consideration. Also, the applied pressure signals are assumed small enough to have negligible effect upon the viscosity, density, and average pressure level of the system fluid.

Fig. 1: Block diagram of a typical pressure sensing system, its equivalent and characteristics



The typical pressure sensing system to be analyzed for sea level operation is shown in Fig. 1 and a photograph of the Statham Labs. Model P-96 Differential Pressure Transducer (−1 to +10 psid) as the sensing element is presented in Fig. 2. The volume of the transducer pressure port reservoir is 7.06×10^{-3} cu. ft. Of particular interest is how the application of various pressure signals at the open end of the tube will affect the pressure sensing system and the characteristics of the resultant signals transmitted to the oscilloscope, for example:

a. What is the natural frequency of the pressure sensing system? The expression for the natural frequency of the pressure system is:

$$\omega_n = \sqrt{\frac{\pi \gamma r^2 P_{alt}}{V L \rho}}$$

where:

ω_n = Natural frequency, radians/sec.
r = Inside radius of tube, ft.
γ = Ratio of specific heats (1.40 for air).
P_{alt} = Absolute pressure at altitude under consideration, lb/ft²
ρ = Density of fluid in tube, slugs/ft³
V = Volume of reservoir, ft³
L = Length of tube, ft.

Hence:

$$\omega_n = \sqrt{\frac{3.14 \times 1.40 \times (7.5 \times 10^{-3})^2 \times 2116}{7.06 \times 10^{-3} \times 60 \times 2.38 \times 10^{-3}}} = 22.8 \text{ radians/sec}$$

b. What is the damping ratio of the system?

The expression for the damping ratio of the pressure system is:

$$\xi = \frac{4\mu}{P_{alt}\, r^3} \sqrt{\frac{V L P_{alt}}{\pi \gamma \rho}}$$

where:

μ = Absolute viscosity, lb sec/ft² (estimate average temperature level in pressure system and use Fig. 3 to determine value of μ).

Hence:

$$\xi = \frac{4 \times 3.72 \times 10^{-7}}{2116 \times (7.5 \times 10^{-3})^3} \sqrt{\frac{7.06 \times 10^{-3} \times 60 \times 2116}{3.14 \times 1.40 \times 2.38 \times 10^{-3}}} = .488$$

c. What is the amplitude of the sinusoidal pressure frequencies ob-

for Aircraft and Guided Missiles

served on the oscilloscope when various sinusoidal pressure frequencies are applied at the tube open end? Such a condition may exist in the flight of an aircraft with the tube open exposed to the buffeting oscillations of an airstream. If the frequency approaches the resonant frequency of a system with low damping ratio (less then 0.4) resonant instability could be encountered.

See Fig. 4:

A_i = Max. sinusoidal pressure amplitude applied, lb/ft^2

A_o = Max. sinusoidal pressure amplitude experienced by transducer, lb/ft^2

α_r = Amplitude ratio $= A_o/A_i$

$\omega_i = 2\pi f_i$ = Applied sinusoidal frequency, rad/sec.

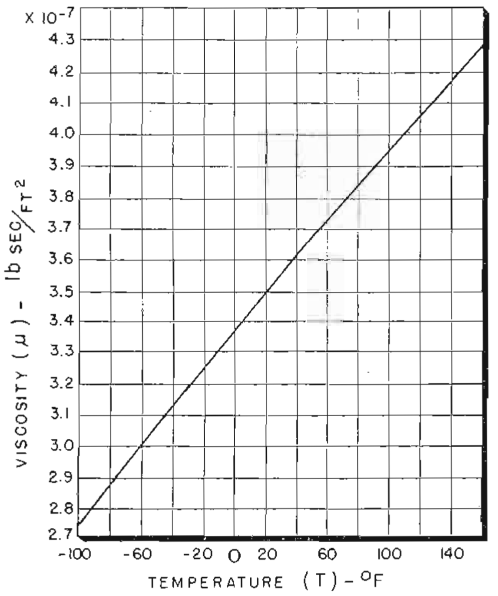


Fig. 3: Temperature-viscosity curve for air

f_i = Applied sinusoidal frequency, cycles/sec.

β = Frequency ratio $= \omega_i/\omega_n$

Calculate frequency ratio (β) at applied frequency (ω_i) under consideration using value of natural frequency (ω_n) calculated in Section a. Using Fig. 4, obtain amplitude ratio (α_r) for this value of (β) with system damping ratio (ξ) calculated in Section b.

f_i = 6 CPS (assumed)

$\omega_i = 2\times3.14\times6 = 37.7$ rad/sec.

A_i = 72 psf (assumed)

Note: These assumed values of f_i and A_i are order of magnitude of possible buffeting frequencies and amplitudes. They are assumed to demonstrate the application of the analysis only.

Hence:

$\beta = 37.7/22.8 = 1.65$

Fig. 2: Differential pressure transducer used as the sensing element

From Fig. 4 for $\beta = 1.65$ and $\xi = 0.488$

$\alpha_r = 0.41$; therefore the amplitude of the signal at the transducer and observed on the oscilloscope is attenuated and its value is $A_o = .41\times72 = 29.5$ psf.

d. What is the time lag between the input and output signal of Section c? See Fig. 5:

ϕ = Phase angle lag between transducer signal applied (A_i) and transducer signal (A_o) degrees.

Using Fig. 5, obtain phase angle lag (ϕ) at frequency ratio (β) calculated in Section c with system damping ratio (ξ) calculated in Section b. The time lag in seconds can be obtained from the expression

$t_1 = \phi/57.3\omega_i$

From Fig. 5 for $\beta = 1.65$, and $\xi = 0.488$

$\phi = 136°$, therefore the time lag of the signal at the transducer and observed on the oscilloscope is

$t_1 = 136/57.3\times37.7 = 0.063$ seconds.

e. What is the amplitude value of the pressure signal observed on the oscilloscope at any desired time lapse after the application of a step function pressure change at the tube open end? See Fig. 6:

P_o = Aplitude value of the pres-

(*Continued on page* 163)

Fig. 4: Variation of amplitude ratio with frequency ratio for various damping ratios

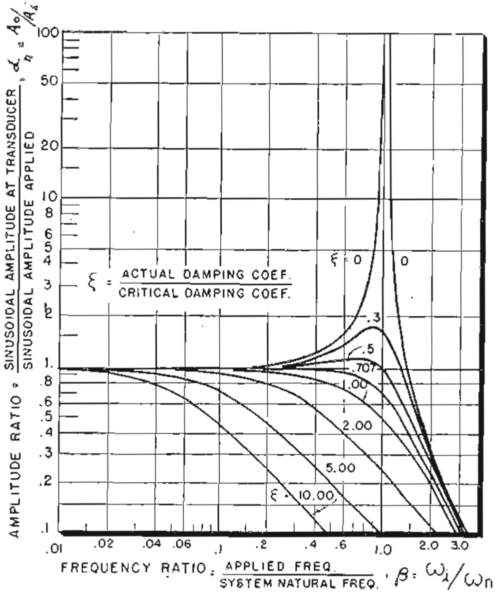
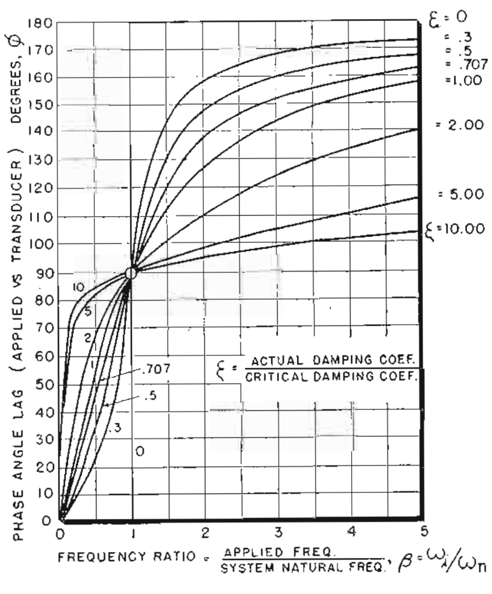


Fig. 5: Variation of phase angle lag with frequency ratio for various damping ratios



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Accurate Tuning of Isolation Networks

G. W. LEE, 46 Roxborough St., Toronto, Ont., Canada

IN directional antenna arrays employing half wave towers, the usual method of obtaining samples of tower currents is to mount a loop on insulators at the point of maximum current on the tower. A flexible coaxial cable is then connected to the loop run down the tower leg into an isolation network to the equipment using the sample currents. This Cue out lines a quick and accurate field method of tuning isolation networks.

The isolation network is a high impedance circuit containing inductance and capacitance which when tuned to resonance, effectively isolates the tower from the terminating equipment (usually a phase monitor). The loop mounted on the tower becomes part of the tower self impedance. The tower self impedance will be altered and the array detuned if there is not an extremely high impedance between the loop and ground. The isolation network provides this high impedance.

Also, high impedance is offered to the sampling loop current. Hence, only a small part of this current is used for sampling purposes. If all the current induced in the loop were used, the tower output would be altered.

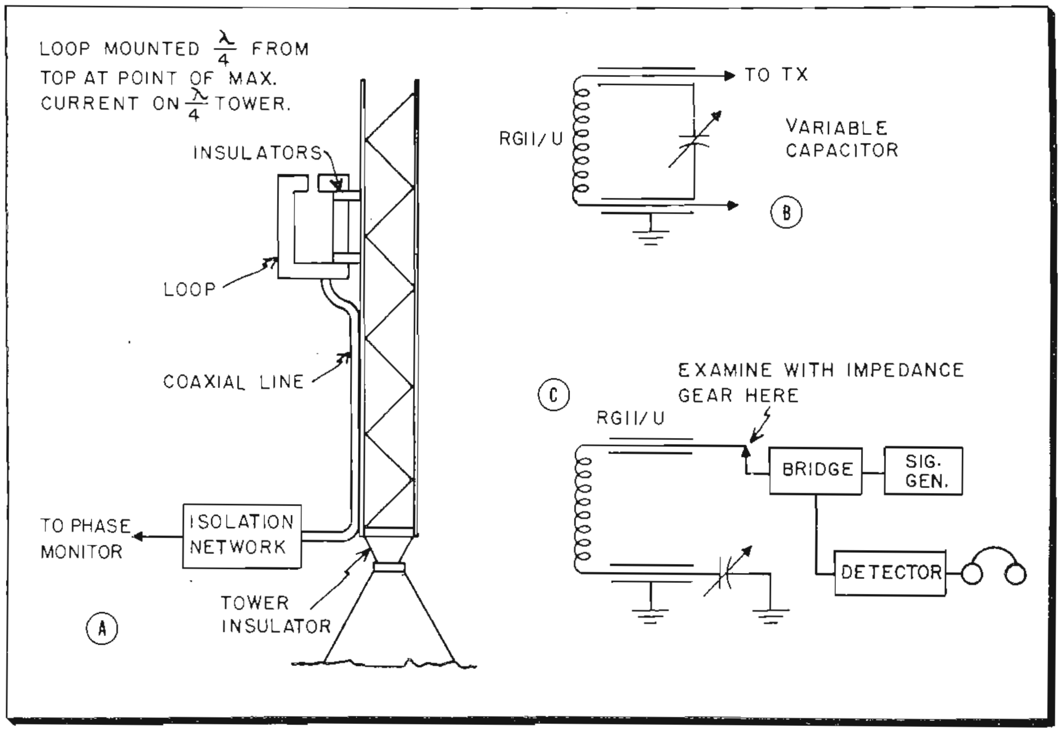
$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is requested. Our usual rates will be paid for material used.

The author has found isolation networks very difficult to tune using standard methods. One method: Connect r-f signal at the station frequency into the network while measuring the voltage across the network with VTVM, and tune for minimum voltage. The following method was found to be more accurate and quicker: (1) Rearrange the network so that L and C are connected in series. Refer to C. (2) "Look into" circuit with standard impedance measuring equipment. Signal Generator should be set at station's operating frequency. (3) Vary capacitance until zero reactance can be measured in the r-f bridge. (4) Connect network in parallel, as in B. (5) Check tuning by "looking into" network. A high impedance should be found. (6) A further check of the tuning may be made by measuring the self-impedance of the tower with the isolation networks connected to the sampling loop as in A and the isolation networks not in the circuit and the sampling loops floating.

The impedances measured will be exactly the same if the isolation networks are accurately tuned. For series resonance: (Xc) Capacitive reactance = (Xc) Inductive reactance. For parallel resonance: (Xc) Capacitive reactance = (Xc) Inductive reactance. Therefore, the same value of Xc and Xc are used for series and parallel resonance. "It will be noted that the only difference between the series and parallel circuit is in the manner of connection."*

Tuning isolation networks for AM towers: (a) general method of mounting sampling loops, (b) standard isolation network schematic, (c) look into network with impedance bridge.



Pushbutton Remote Control of Studio Turntables

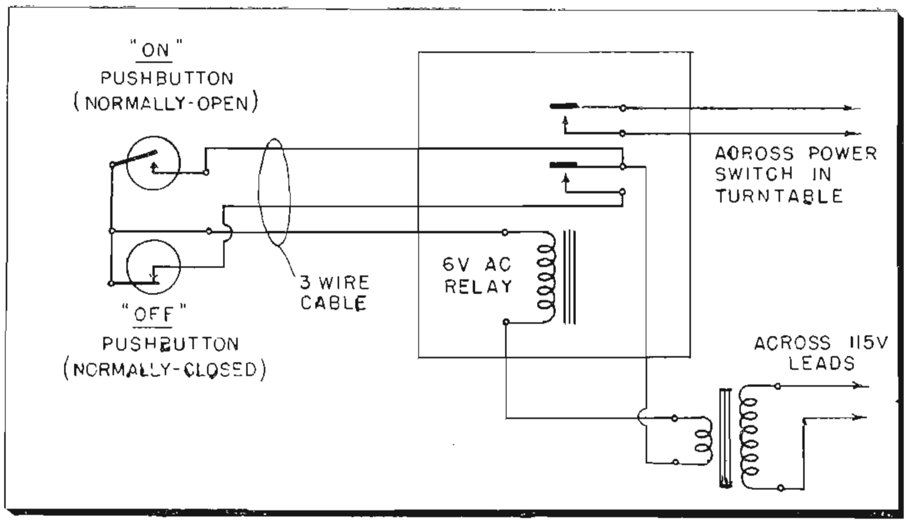
PHIL WHITNEY, Chief Engineer, WINC, WRFL and WHYL, Winchester, Va.

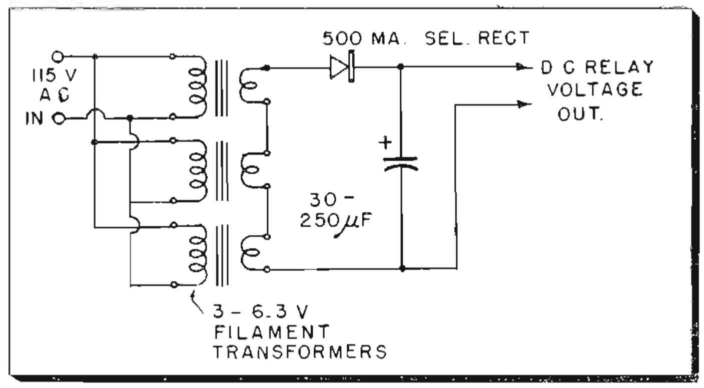
HERE is a little kink that facilitates operation of a small station where the operator is also the announcer and generally has his hands full. The device may also be adapted to stations where the announcer in another studio must start the turntables in the control room. Relay start and stop for turntables can be as inexpensive as mercury switch control, and low voltage control leads can be used in place of more expensive conduit or BX lines.

Pushbutton operation has been found preferable to switch action, resulting in surer, quicker operation. A set of pushbuttons for each turntable is mounted in front of the console at the operator's position, with a recessed guard around them to prevent accidental operation, and a set of the buttons is also installed at each mike position in the studios. A Jones plug is used to connect the button control box in the studios, so that it can be disconnected when not required. The relay is mounted inside the turntable on a piece of Celotex, so that no thump or click can be heard.

The relay power supply is also mounted inside the table in such a manner that any field generated by the supply does not interfere with pickup or preamplifier operation. If a 6 v. ac relay is used, all that is necessary is a small filament transformer. If a 12 v. dc relay is used,

*Terman's Radio Engineers Handbook, Page 141.





Pushbutton turntable control for the small station. Main and relay wiring and low voltage DC supply (above) for relays.

a power supply could be constructed from three 6.3 v. filament transformers, a 500 mil selenium rectifier and a condenser. It may be necessary to apply a .1 μf condenser across the 115 v. contacts of the relay if the arc gets into the audio equipment.

Sound Effects

W. CARROLL BLEWSTER, Chief Engineer, WBBZ, Ponca City, Okla.

DURING the recent Christmas holidays the engineering department was faced with the problem of obtaining a microphone which would distort the announcer's voice so that he would sound like Santa Claus. We soon discovered the particular sound was difficult to obtain even though we have little trouble getting unwanted noise distortion out of a microphone!

It was decided to try an ordinary telephone handset connected as a carbon microphone complete with battery, microphone transformer, and ON-OFF switch. Needless to say this gives a perfect telephone speech effect. But the sound is not "long distance" enough to make a suspecting 6-year-old believe that he is listening to Santa Claus and not the announcer he has heard all year.

Finally we found a microphone that will do the North Pole Telephone Company justice. It is an ordinary "Military type," Western Electric Receiver, ANB-H-1 headphone, measuring 200-300 ohms dc resistance. We mounted our headphone on top of discarded metal table lamp, less shade and the top of the light socket. The mike cord was fed down the stem and out the base in place of the ac cord. This places the headphone in a vertical position.

Signal Lamp Circuit for Tape Cueing

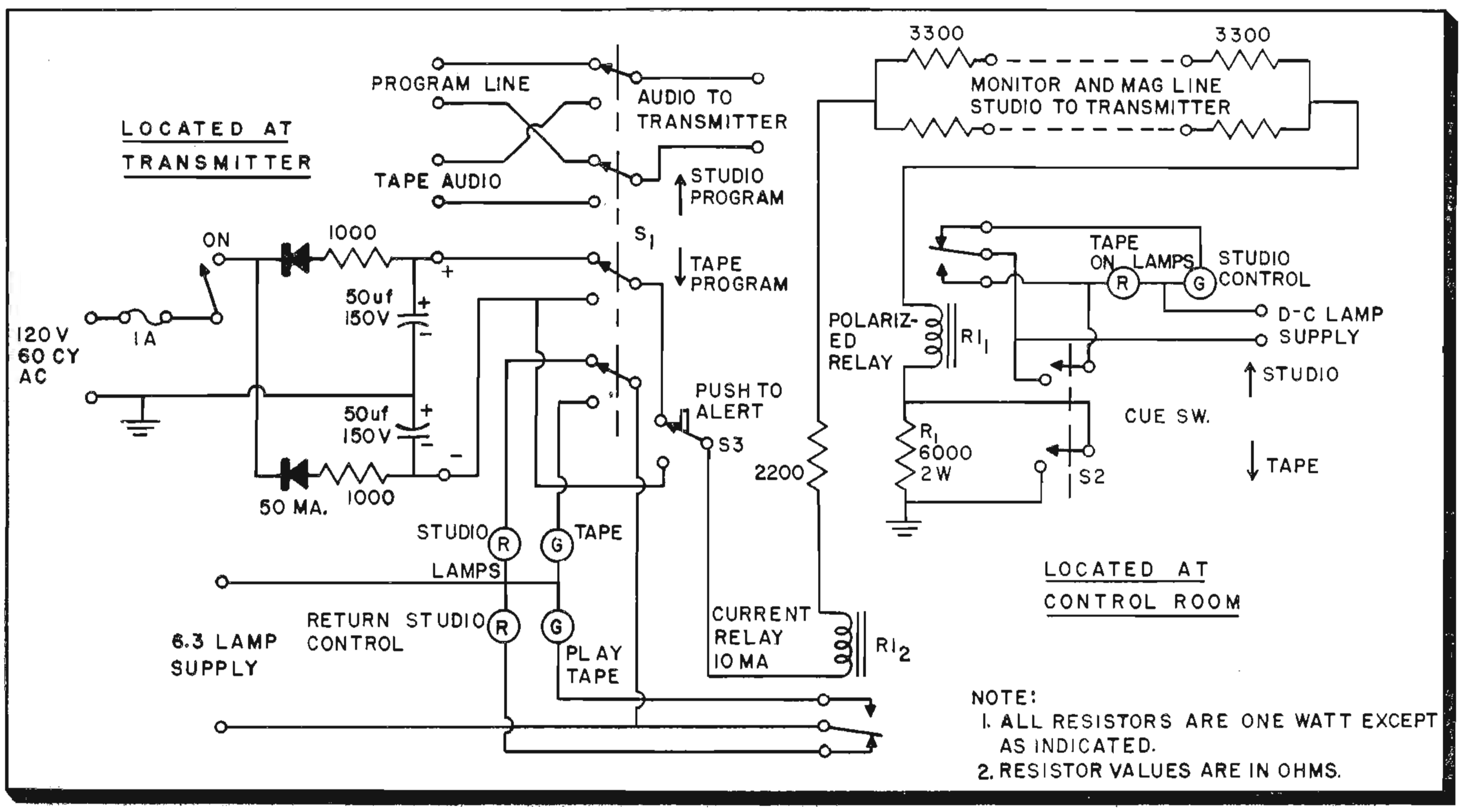
PAUL HERTEL, Jr., KVET, Austin, Tex.

THE signal lamp circuit shown below is used at KVET to aid cueing of tape programs which are recorded and played from the transmitter location. However, it is adaptable to many other uses where remote control or indication is desired. The circuit provides two operationally independent indicator circuits on one line which is also used for communication between studio and transmitter, and for feeding monitor audio to the studio when a tape program is being played.

A dc phantom circuit is provided by the line and ground. Current flows in the circuit at all times but its direction is changed by the polarity reversing switch S_1 which also switches the transmitter input from program line to tape recorder out-

(*Continued on page* 110)

Remote cue lamp circuit for cueing programs with phantom circuit and polarised relays reduces errors



MTI in Pulse Radar

Moving target indication
Lucid explanation clears

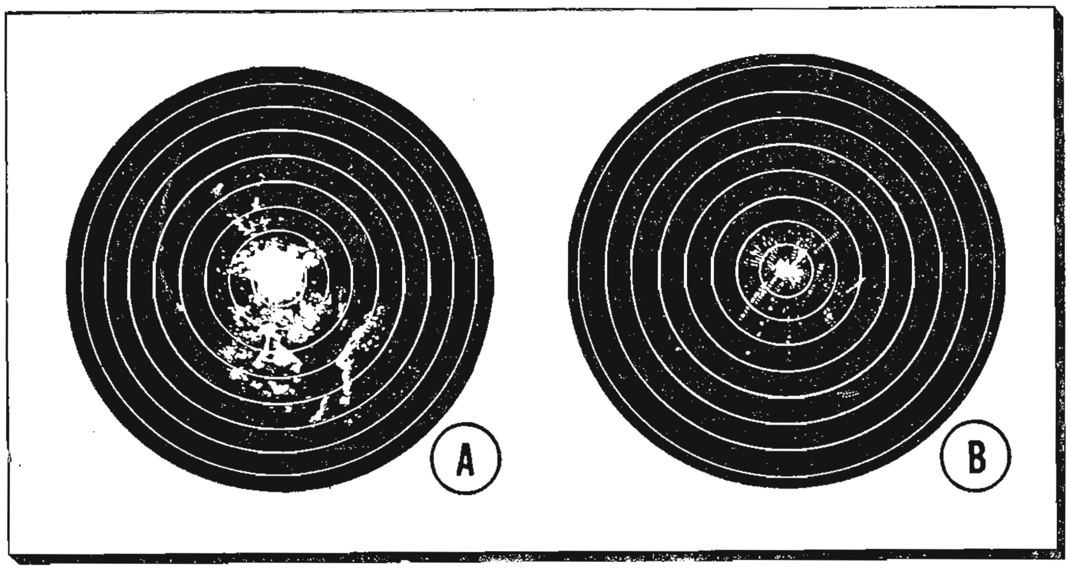


Fig. 1: (a) Normal radar PPI display shows extensive ground clutter. (b) In MTI receiver PPI display for same radar set, clutter disappears, showing moving targets which were previously masked

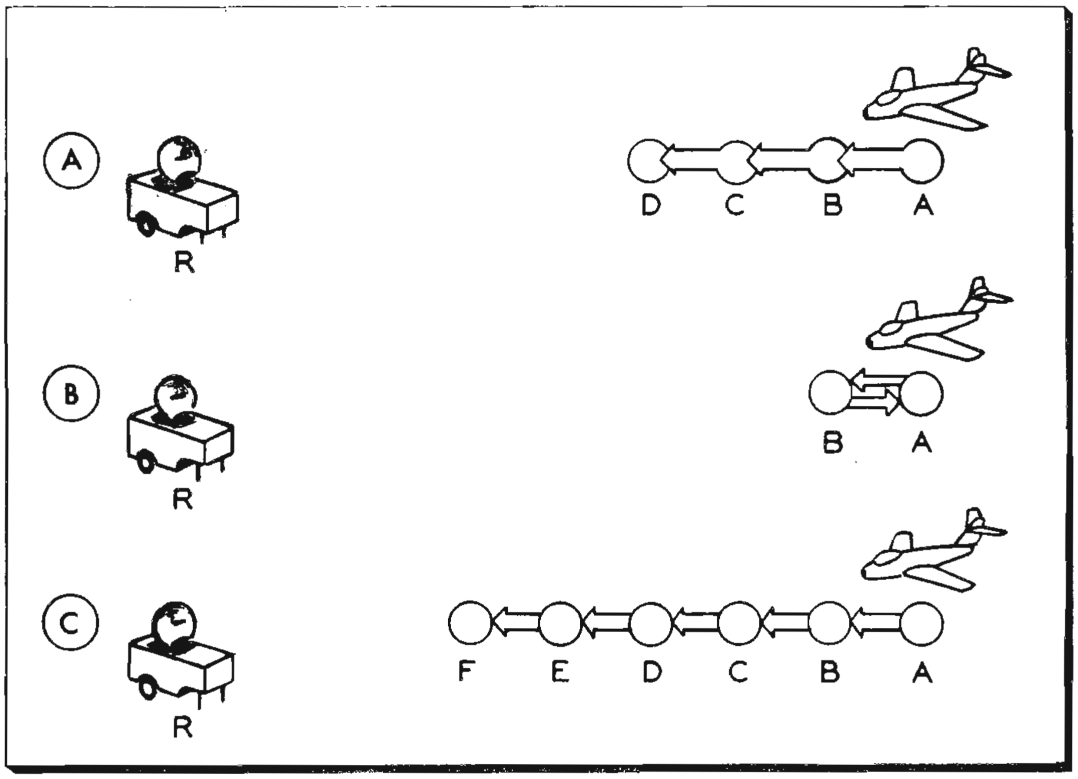


Fig. 2: (a) Conventional case of uniformly moving target causes time and frequency change in echo return. (b) Back-and-forth target causes only Doppler frequency shift. (c) Go-stop motion may change only return time of the reflected signal without affecting frequency

By JOHN F. BACHMAN, ***Project Engineer***
Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md.

THE development of pulse radar was a great step forward in the detection and tracking of aircraft. Not only did it increase the distance at which planes can be "seen," it also allowed tracking at night and through fog and rain when visibility for human observers was zero. The main difficulty with early radar sets was their inability to track planes to within 20 to 35 miles of the radar site. This is due to the fact that at these distances ground clutter and fixed target returns start blanking out the plan position indicator (PPI) and individual target identity is lost. The receivers used in these early sets are known as normal receivers and the PPI display is known as a normal display.

Practically every pulse radar system built today has not only a normal receiver system but also a moving target indication receiver system. This moving target indication receiver system, commonly known as an MTI system, eliminates all fixed targets, and displays on the PPI scope only those targets that are moving. This type of display is known as an MTI display. The advantages of an MTI receiver over a normal receiver, in regions of ground clutter, are shown in Fig. 1.

Fig. 1a is a normal receiver PPI display. Fig. 1b is the MTI receiver PPI display on the same radar set in the same location. Note how the ground clutter has disappeared and many moving targets, which were masked in the normal receiver PPI display, appear clearly in the PPI display of the MTI receiver.

Actually there is nothing extremely complicated about an MTI receiver, but although MTI has become almost standard equipment on all new radar sets and is supplied as a kit for many already existing installations, the operating principles are rather hazy to many radar engineers. One of the more common errors is the belief that successful MTI operation depends in some way, on the utilization of the Doppler effect.

Basic Principles

In the following explanation, the basic principles on which MTI operates will be set forth in the simplest manner possible, and the results will show that the Doppler effect is not a contributing factor. No attempt will be made to describe any particular system, but the same general approach may be used to analyze a specific system. The article is divided into three parts.

The first part points out the differences which exist between echo returns from fixed targets and echo returns from moving targets, and explains briefly which of these echo differences an MTI receiver utilizes.

The second part shows graphically the basic principles on which MTI operates. Since basic principles only are to be considered, this analysis does not include a stalo (stable local oscillator), coho (cohorent oscillator), or low frequency i-f channels. These parts are included in all practical MTI systems but are for convenience only and do not change the basic operation of the receiver.

The third part is a simplified mathematical analysis of a more conven-

Systems and the Doppler Myth

system for aircraft-tracking radar eliminates ground clutter on PPI displays. away confusion between frequency shift and time delay of target echo returns

tional MTI receiver in that it contains a stalo, coho, and low frequency i-f channels. No attempt has been made in this analysis to follow any particular type of receiver such as a lin-log or limiting, but rather to trace an echo through a receiver and present the video output in such a manner that it is possible to see why fixed target echoes can be cancelled while moving target echoes cannot.

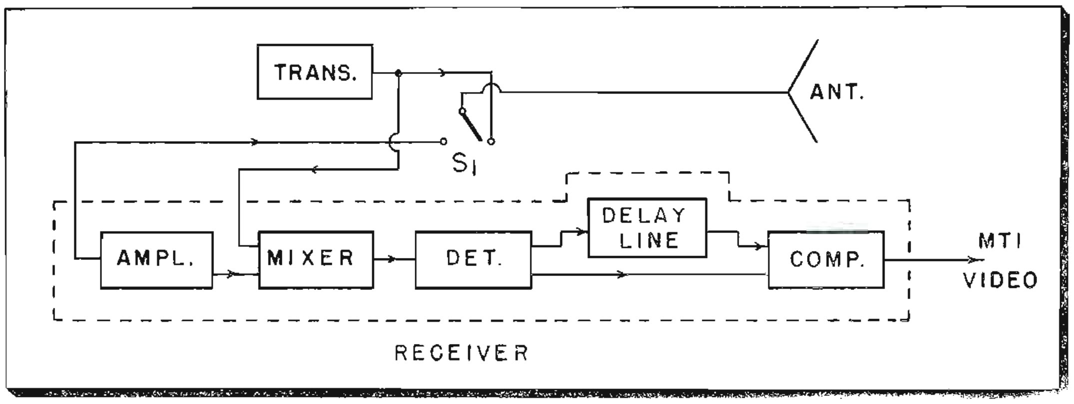


Fig. 3: Simple pulse radar and MTI receiving system feeds part of transmitter CW to mixer

MTI Receiver Echoes

Echo returns from moving targets differ from echo returns from fixed targets. Radar receivers capable of distinguishing between these echoes are known as MTI receivers. There are two differences in these echo returns. They are:

1. Echo return time: The elapsed time between the transmission of a pulse and the return of an echo is the same, pulse to pulse, for a fixed target; and it changes, pulse to pulse, for a moving target.

2. Frequency difference: The echo returns from fixed targets are of the same frequency as the transmitted r-f frequency; while the r-f frequency of the echo returns from moving targets differ from the transmitted frequency by the Doppler frequency.

MTI receivers do not use frequency comparison and, therefore, cannot use the frequency difference due to the Doppler effect, to ascertain which is a moving target. Instead an MTI receiver compares the length of time that it takes the echo from a target due to one pulse to return with the length of time that it takes the echo from the same target due to the next pulse to return. These times change, pulse to pulse only when a target is moving, and, while this same target movement is also responsible for the Doppler change in the echo frequency, this frequency change is not a necessary condition for successful MTI operation. The dependence of MTI on time change rather than frequency change (Doppler effect) will be explained later.

The Doppler change in the frequency of the reflected pulse and the pulse to pulse change in echo return time, are separate and distinct results of target movement. Normally both conditions are present. It is possible, but not probable however, for a target to move in such a manner as to produce either the frequency change or the time change only.

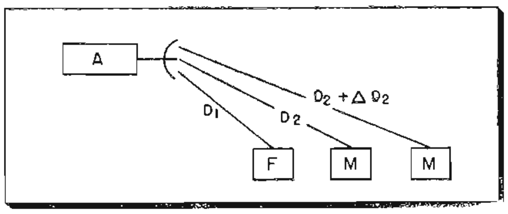


Fig. 4: Radar pulses strike (F) fixed and (M) moving targets, traveling distances shown

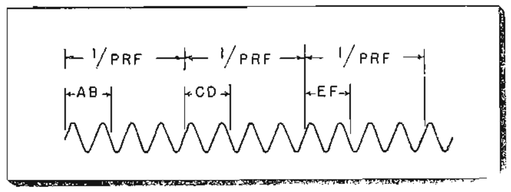


Fig. 5: CW transmitter wave. AB, CD and EF are times antenna is connected to transmitter

Fig. 2a illustrates the conventional case. The radar set is at R and the target is moving uniformly from A toward F. While reflecting the first pulse the target is moving from A to B, therefore, the reflected signal is changed due to the Doppler effect. During the time interval between the first and second pulse, the target moves from B to C. The second pulse is reflected while the target is moving from C to D and again there is a Doppler frequency change in the reflected signal. Target movement from D to E occurs during the time between the second and third pulse. Target movement of this nature, therefore, results in a Doppler frequency change because the target is moving while reflecting the signal, and a change in echo return time because the distance between the target and the radar set is different for every pulse. It will be shown that this time change is the important factor.

Fig. 2b illustrates how a target could move and cause only a Doppler frequency shift. Here the target will move from A to B while reflecting a radar pulse and return from B to A in the time interval between pulses. Since the target is in motion while reflecting the signal, there is a Doppler frequency change. However, since the distance between the radar and the target does not change, pulse to pulse, there is no change in echo return time. An MTI receiver will not "see" this target.

Fig. 2c shows a target moving in such a manner that there is no Doppler frequency change. The target will remain stationary at A while reflecting the first pulse. In the time interval between the first and second pulse, the target will move from A to B. While reflecting the second pulse the target will remain stationary at B. Since the target is stationary while reflecting a signal there can be no Doppler frequency change. There will be a pulse to pulse change in echo return time, however, because the distance between the radar and target has changed. An MTI receiver will "see" this target.

Time Differences

The time differences that an MTI receiver measures can be very minute, in some cases as small as 100 μμ sec. These minute time differences are measured by comparing the relative phases, pulse to pulse, of the echo signal and a CW reference signal which is generated in the receiver and synchronized with the magnetron at every magnetron pulse. These relative phase changes are due to the fact if the echo return time changes, the CW phase advances or retrogresses, pulse to pulse depending on whether the target is receding from or approaching the receiver.

Simple MTI System

The minute time differences can be measured by the simple pulse radar and MTI receiving system of Fig. 3. Since the exact circuitry by which the above measurements will be made is unimportant in this discussion, the radar set is shown in simple block form.

The transmitter is a CW transmitter with part of its output fed into the mixer of the MTI receiver. In order to satisfy pulse requirements, switch S_1 is inserted. This switch is instantaneous in action and connects the antenna to the transmitter for whatever time is selected as the pulse length and at whatever rate is selected as the PRF (pulse rate frequency). During the balance of the time the antenna, is connected to the mixer via an amplifier which amplifies the weak echo signals.

The mixer output will depend on the relative phase and amplitude of the CW and echo signals. The detector output is proportional to the r-f input. The delay line inverts and delays part of the detector output by 1/PRF seconds, and the comparator compares the delayed echo return from one pulse with the direct echo return from the next pulse.

Now suppose the equipment is set up under the conditions of Fig. 4. The transmitter at A will radiate a series of pulses via the antenna. Some of the energy from each pulse will travel a distance D_1, be reflected by the fixed target at F and returned a distance of D_1 to the antenna, a total distance of $2D_1$ for each and every pulse. Energy from the first pulse will also travel a total distance of $2D_2$ to the moving target at M and return, the second pulse will travel a total distance of $2D_2 + 2 \Delta D_2$, the third pulse a total distance of $2D_2 + 4 \Delta D_2$, etc., where ΔD_2 is the distance through which the target moves between pulses.

Therefore the elapsed time, T_f, between the transmission of the pulse and the return of the echo from a fixed target will be the same for each pulse while the time, T_m, for moving targets echo returns will change by ΔT_m for every pulse.

Returning to the transmitter, let Fig. 5 represent the transmitter generated CW. AB, CD, EF, etc. will represent the time during which the antenna is connected to the transmitter, and the time interval between pulses is equal to 1/PRF seconds.

Figs. 6 to 9 show what is happening in the receiver during successive interpulse intervals. In all of the figures:

Part A Indicates the CW generated by the transmitter and fed to the mixer with the various parts AB, CD, etc. indicating that portion of the signal radiated by the antenna.

Part B indicates the echo signals amplified, with T_f the fixed target echo return time and T_m the moving target echo return time.

Part C shows the mixer output, that is Part A plus Part B.

Part D shows the detector output.

Part E shows the delay line output and it is always due to the signal from the previous pulse.

Part F shows the comparator output, the sum of Parts D and E.

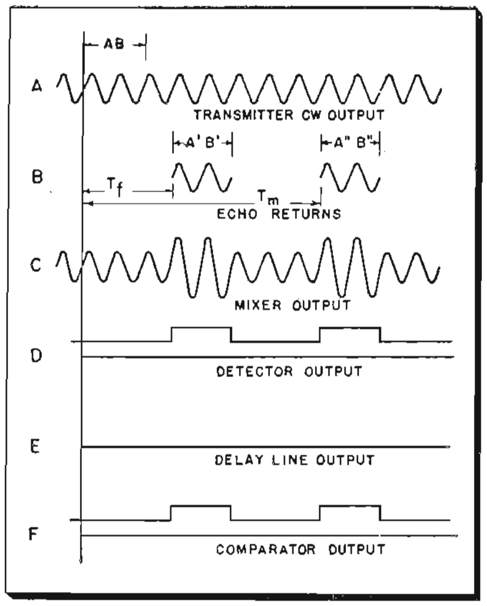


Fig. 6: Receiver pulses after first pulse

Figs. 6 to 9 show what is happening in the system after the first pulse. Notice that there is no output from the delay line as this is the first pulse. Since there is no delayed output from a previous pulse the comparator output is the same as the detector output.

Echo Time Increased

In Fig. 7 notice that the moving target echo time has been increased by ΔT_m. This changes parts C and D because the relative phase between the CW and moving target echo has changed. The delay line E now has an output. This output is equal to but opposite to Fig. 6D. The comparator output at F is now zero for the fixed target due to cancellation, but shows an output due to the moving target.

In Fig. 8 the only change is that the moving target echo return time has increased an additional ΔT_m and the end result is again a cancellation of the fixed target echo but not the moving target echo.

Notice that in the illustrations time, T_m, the moving target echo return time, differs from $T_m + \Delta T_m$, and $T_m + \Delta T_m$ from $T_m + 2 \Delta T_m$ by an interval long enough to allow the relative phases of the echo and CW to change by 180° between pulses, and that the relative phase between CW and echo is alternately 0° and 180°. This phase change of 180°, as well as the fact that the relative phases are alternately 0° and 180°, results in a maximum pulse to pulse variation in detector output. This condition of 180° pulse to pulse relative phase change occurs at what is known as an optimum target speed and the alternately 0° and 180° relative phase is known as optimum phase. (Optimum speed is actually any speed allowing a $[2n + 1] \times 180°$ relative phase change between

(*Continued on page* 165)

Fig. 7: Receiver pulses after target echo

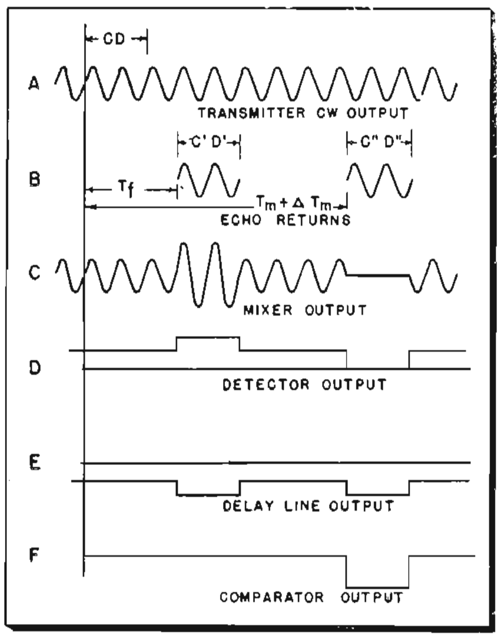
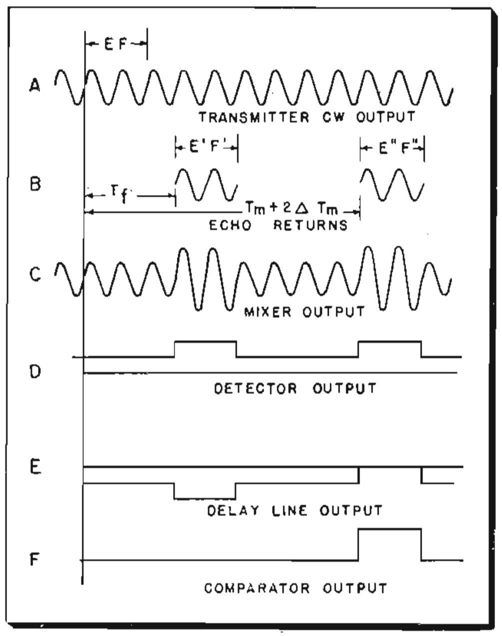


Fig. 8: Receiver pulses after target moves



Propagation Above 100 MC

Factors governing losses in beyond-line-of-sight communications systems described. Shadow effect critical for higher frequencies

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IN any communications circuit the total circuit loss must be computed in order to establish the input power, given a necessary output minimum. Just as the telephone engineer determines the number of repeaters, size of wire and input level, the radio engineer determines the length of a suitable space path, transmitter power, antenna gain and operating frequency. The *main loss* in any radio path is the loss due to the *radio space path*. Those losses due to the r-f transmission line and antenna efficiency are negligible in comparison.

At frequencies above 100 MC it is not necessary to perform the laborious calculations of field strengths, antenna currents, microvolt sensitivities and ground losses associated with lower-frequency propagation.

The common approach to the high-frequency propagation problem is to assume that both the transmitter and receiver are located in a free homogeneous space, and then compute the effects of diffraction and refraction.

Isotropic Radiator

Assume that the transmitter is located at the center of a sphere of radius R, and that the power is radiated by an isotropic radiator, (that is, power is distributed uniformly in all directions similar to a point source in optics). Let us denote the transmitter power as P_T, in watts. When the sphere has a radius of one unit (one cm, foot, meter, mile) the sphere has an area of 4π square units, and the power incident on one square unit is $P_T/4\pi$ watts. Similarly, for any general value of R in meters, the power per square meter is $P_T/4\pi R^2$ watts/sq.m.

Suppose the transmitting antenna has a gain denoted as G_T, and for our purpose gain is defined as the ratio of the power received at a distant point to the power received at the same point if an isotropic radiator were used and the ratio expressed as a dimensionless numerical value.

The power density of that given point is $P_TG_T/4\pi R^2$ in watts/sq.m. Now that the power density is known at a given point on the surface of the sphere, it is necessary to consider the meaning of this in relation to the received power. In order to accomplish this it is necessary to understand the concept of effective area. An antenna can be considered as a funnel which intercepts a certain amount of power. The amount that the antenna intercepts is called the effective area. The effective area of an isotropic antenna is $\lambda^2/4\pi$. Thus, for a wavelength of one meter the effective area is $1/4\pi$ sq.m.

Antenna Gain

If the antenna has an area greater than $\lambda^2/4\pi$ it becomes directional and has gain. The gain of any receiving antenna is equal to $4\pi A_R$ where A_R represents the area in square wavelengths and is in the same units as R. $P_TG_T/4\pi R^2 \times A_R$ is power intercepted by the receiving antenna. However, from the preceding definition of gain, $G_R = 4\pi A_R/\lambda^2$. Substituting in the previous equation we have

$$P_r = \frac{(P_TG_TG_R\lambda^2)/(16\pi^2R^2)}{16\pi^2R^2}$$

Suppose we see what happens when we have a transmitter power of one watt, and a range of 10 mi. and a 1 x 1 ft. antenna.

R = 52,800 ft. or 10 mi.
area of sphere = 35×10^9 sq. ft.
Power/sq. ft. = 0.285×10^{-10} watts/sq. ft., but since the total power is 0.285×10^{-10} watts/sq. ft. $\times 3.5 \times 10^{-10}$ sq. ft. we have accounted for the full watt.

Now we can "juggle a few numbers" and see what happens when we alter the variables.

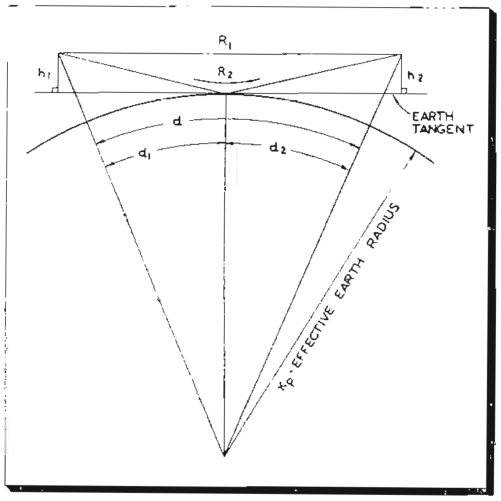

Fig. 1: Radio path over a spherical earth

(a) If we vary R or range, the received power varies as the inverse square, so that by doubling the range we reduce the received power to one-quarter.
(b) As we decrease wavelength we decrease the received power by the square so that by reducing the wavelength to one-half we reduce the received power to one-quarter.
(c) If the frequency is doubled (λ halved) and the antenna aperture size remains constant, the power received is increased four times, since the gain is increased four times.

For the sake of argument let us set up the hypothetical conditions where communication is required over a path of 10 mi. and this path is in free space.

If the antenna at the terminals is non-directional, the loss due to the space path alone is as follows:

	ATTENUATION	
Frequency MC	10 Miles db Loss	20 Miles db Loss
100	97	103
200	103	109
1,000	117	123
5,000	131	137
10,000	137	143

When it is not necessary to use an omnidirectional antenna the story is slightly different. Suppose we restrict the antenna at each terminal to a four-foot-diameter parabola or similar aperture.

		ATTENUATION	
Frequency MC	G_T Ant Gain	10 Miles db Loss	Plus G_T
100	2.3	97	92.4
200	8.3	103	86.4
1,000	21.0	117	75.0
5,000	33.5	131	64.0
10,000	41.0	137	55.0

The first modification of the free-space concept is that of destructive interference between the direct wave and the reflected wave. The first-order reduction of the expression for this "looping," as it is commonly called, is

$E/\bar{E} = 1 + D\,e^{-s}$

E = actual field strength

$\bar{E}$ = free space field strength

where D = divergence factor

$D = [1 + (2d_1{}^2 d_2/h_1 d)]^{-1/2}$

(See Fig. 1.)

ρ = reflection coefficient

and s = a quantity as shown in the expression below

$s = j4\pi K h_1 h_2/\lambda\, d$ radians.

Theoretically, E can vary from $\bar{E} + 6$ db to zero. However, this is not true in practice; for instance, ρ at 4,000 MC is equal to 0.1 for most land so that the maximum variation is then ± 2 db. This phenomenon is more troublesome at lower frequencies (nearer 100 MC) and when the reflecting object is a building, etc., in which case it can vary the full $\bar{E} + 6$ db to zero range. This is one of the basic reasons for unreliable communications at these frequencies. There is a two-fold reason for the trouble being accentuated at the lower line-of-sight frequencies.

(a) ρ is a fraction in all cases and as the frequency is lowered it approaches unity.

(b) The first Fresnel diffraction zone is a function of wavelength.

First Fresnel Zone

The first Frenel zone is an ellipse as shown in Fig. 2, and is described by a reflection path R + △R when △R = λ/2. It is evident that a reflection at point C would cause a 180° phase difference in the signal arriving over the path R + △R from that arriving over path R. This causes a cancellation of signals at B. Since point C is not a reflector but a separate and inefficient source, the signal does not go to zero.

As long as no obstacle is contained within this ellipse of revolution the effect of diffraction is limited to values that are insignificant in comparison to the total loss. This clearance is a function of wavelength and the zone at 100 MC is much larger than the required zone for 1000 MC. It is also a function of distance.

Distance Miles	Frequency MC	Required Clearance for First Fresnel Feet
1	100	170
1	500	70
1	1,000	50
1	5,000	20
1	10,000	17

Frequency MC	dx Feet	Clearance Feet
4,000	100	3½
4,000	200	4.8
4,000	528	7.5
4,000	½ Mi.	16.5
4,000	1 Mi.	23
4,000	2 Mi.	32
4,000	4 Mi.	45
4,000	8 Mi.	62
4,000	16 Mi.	88

The effect of a single object blocking the path will be considered next. If we have a radio path which may be simulated as shown in Fig. 3, it is interesting to see what will happen if we alter one variable at a time keeping all others constant.

In the first instance we will vary h, keeping frequency and d_1 constant. Assuming d_1 to be equal to one mile; positive h corresponds to interference by the obstacle and negative h indicates the amount of clearance above the object. A typical plot of this is shown in Fig. 4 for 4,000 MC.

Additional Loss Over Free Space	H In feet	Additional Loss Over Free Space	H In feet
20	45	1.2	−25
10	8	0	−32
6	0	1	−40
3	− 6	0	−50
0	−16	0.8	−60

To obtain an estimate of the effect caused by frequency, h will remain constant at 200 ft.—about the height of a tall building or a hill. If d_1 is one mile and frequency is varied, we obtain the following losses over and above the free-space loss.

Frequency MC	Loss in db One Mi.	0.1 Mi.	100 Ft.
100	16	27	34
500	24	34	41
1,000	27	37	44
5,000	32	43	50
10,000	37	48	35

From this tabulation it is evident that mobile reception in a metropolitan area would be very spotty even if this was the only source of signal attenuation. If it is added to the effect of reflections from other objects which are either in phase or out of phase, mobile communication is not as reliable as we would like it or as reliable as some people would have us believe.

If we are interested in line-of-sight, point-to-point operation and rely upon antenna gain to overcome the increased propagation loss, the higher the frequency the more reliable the communications except for atmospheric attenuation and anomalies of propagation.

Before we proceed to atmospheric attenuation and anomalies of propagation, the effect of operation beyond line of sight will be considered briefly. The only safe line of sight to use for UHF calculations is the one allowing for no diffraction around the horizon (K = 1).

The following is the tabulation for the line-of-sight distance over a spherical earth such as over water.

Height Feet	Distance to Horizon Miles
5	2.9
10	4.0
20	5.8
40	8.0
80	11.6
160	16
320	22
640	31

If height at a = 80 ft., (Fig. 5)
and b = 80 ft.,
$d_1 = d_2 = 11.6$ mi.
If total path = 30 mi.
$d_1 + d_2 + d_3 = 30$ mi.
$d_3 = 6.8$ mi.

Additional losses over and above free space at various frequencies for the above conditions are shown below.

Frequency MC	Loss d_1 db	Loss d_2 db	Loss d_3 db	Total Loss db
100	20	9	4	33
500	18.5	4.8	6.7	30
1,000	18.5	4.0	8.5	31
5,000	18.9	2.3	16.0	37.2
10,000	19.5	1.5	21.0	42.0

It is evident that the losses associated with d_1 and d_2 add to a

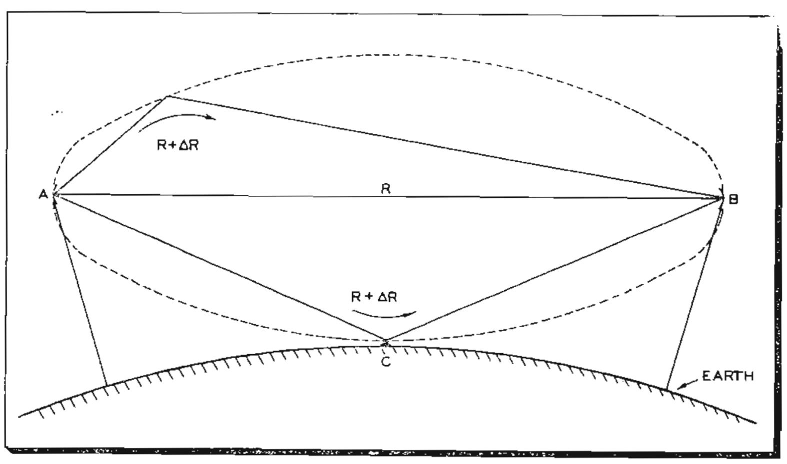

Fig. 2: (l) First Fresnel clearance

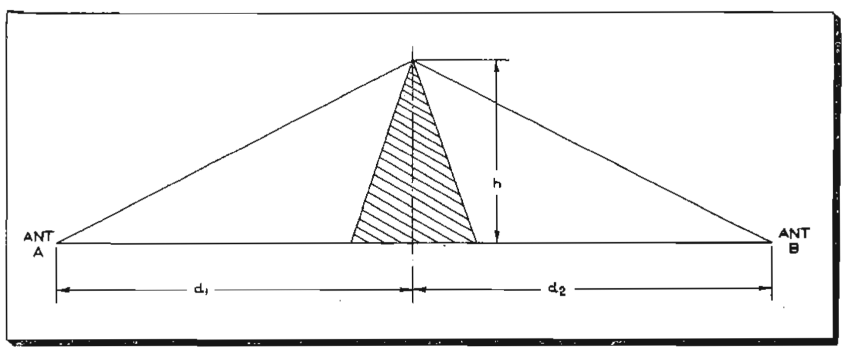

Fig. 3: (r) Shadow loss in radio path

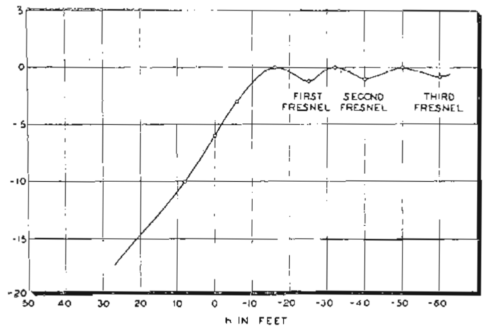

Fig. 4: Shadow loss relative to free space

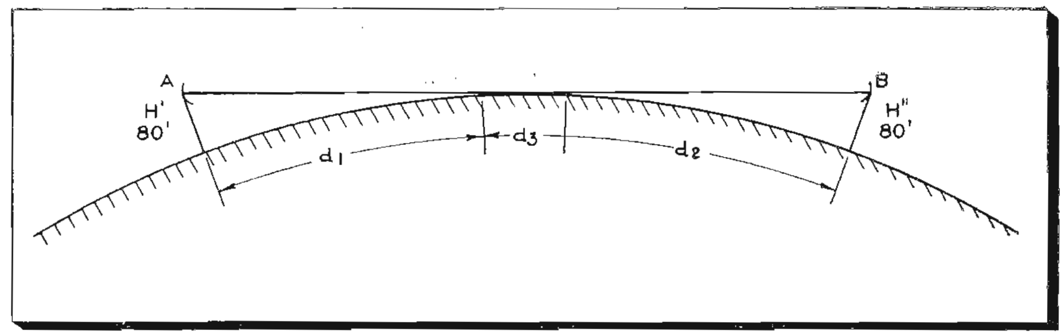

Fig. 5: Propagation beyond line of sight shows loss at d_3 increases with frequency

relatively constant figure, whereas the loss associated with d_3 increases with frequency. The farther one tries to operate beyond true line of sight the more important it is to operate at as low a frequency as possible.

Now that we have covered the problems that are capable of being calculated without too much difficulty, let us consider other factors which will attenuate the radiated power. One of these is absorption by the atmosphere. Water vapor is the element in the atmosphere that begins at the lowest frequency to absorb power, and this is not a serious consideration unless we operate above 5,000 MC. Curves of attenuation versus frequency for the atmospheric absorption are available and if operation above 5,000 MC is contemplated these should be consulted. It may be well to mention that Army radar equipment which operated at 29,000 - 30,000 MC was almost useless during a heavy rain because of a peak in the absorption curve at this frequency.

Over-Water Path

The last item that enters into the path attenuation is refraction because of the atmosphere not being of uniform density. This is called an anomaly of propagation. When the radio path is over sea water and is short, say 10 miles and well within optical line of sight, variations are only 2 or 3 db. However, if the same length path is used but not line of sight, variations of 10 to 15 db take place.

On longer paths, say 60 mi., within optical line of sight, fades of 20 db are average, while at 100 mi., 30-db fades are common.

On these long paths beyond 60 mi., fades occur which make any communication system unreliable if line-of-sight conditions are not maintained.

In order to evaluate propagation conditions over land we must compute the free-space propagation loss, the loss due to the path not being optical line of sight, if such is the case, and then make allowances for anomalies of propagation.

In order to show what is involved we can review the experimental results obtained over a 38-mi. path at a frequency of 3,200 MC. The path is described as line-of-sight when plotted from profile maps, but not true optical because of local houses and trees in the last mile of the path. If these were capable of being represented as a knife edge or a bare ridge, the diffraction loss would be either 25 or 27 db respectively. The average of the daily mean signal over a year's time was 30 db below free space, which checks the theory within three db. However, the daily mean signal varied from 10 db to 45 db below free space.

Conclusions

The conclusions drawn from the operation of this link are:

(a) Summer normal signal level 25 db below free space.
(b) Winter daily average 36 db below free space.
(c) Signal seldom greater than 20 db below free space.
(d) Signal faded to noise level 52 db below free space less than 0.1% of the time.

Remember this was not true line of sight. On a similar path, but having true line of sight and 70-ft. minimum terrain clearance somewhat different results are experienced:

Path Length — 42-½ mi.
Frequency — 2800 MC.
Type of Path — Free space plus 70-ft. clearance.

The following conclusion can be drawn from the graphical data:

(a) Normal summer level 0.8 db above calculated.
(b) Normal winter level 3.3 db below calculated.
(c) The winter signal was never more than 8 db below normal.
(d) The summer level faded to at least 25 db below the calculated value at times and this 25 db was equipment threshold.

Over a 10.6-mi. path with good line-of-sight conditions and a frequency of 1200 MC, the maximum variation was = 6 db.

On other paths that were optical line of sight, variations of +6 db to 50 db from the normal signal were encountered.

Why do we have this fading? It is due to the air not being homogeneous. If you pass from a medium of one density to a medium of a different density the radiation does not follow a straight line but is "bent." The air density is a function of the temperature and with rapidly varying temperatures accompanied by little air movement a marked stacking into layers takes place. This bending may cause the radio paths to follow the earth curvature or to be bent toward the upper atmosphere. Instead of considering the radius of curvature of the path followed by the radio waves it is possible to establish an effective radius of curvature for the earth which would exist for the same propagation conditions and if the radio path was a straight line. This effective earth's radius is called $K\rho$ where ρ is the true earth radius and K is a factor varying from -1 to infinity. K equal to infinity would then be a flat earth whereas a K equal to -1 would be a saucer effect (Fig. 6).

This sounds as if operation above 100 MC is a futile business. It is if one rushes into it without very careful consideration. This is also true at the broadcast frequencies. However, when a few rules are observed and a certain amount of common

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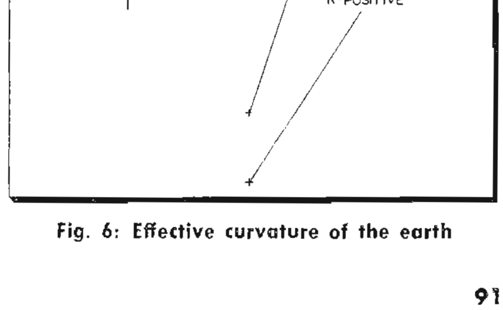


Fig. 6: Effective curvature of the earth

A New Multiplex System for

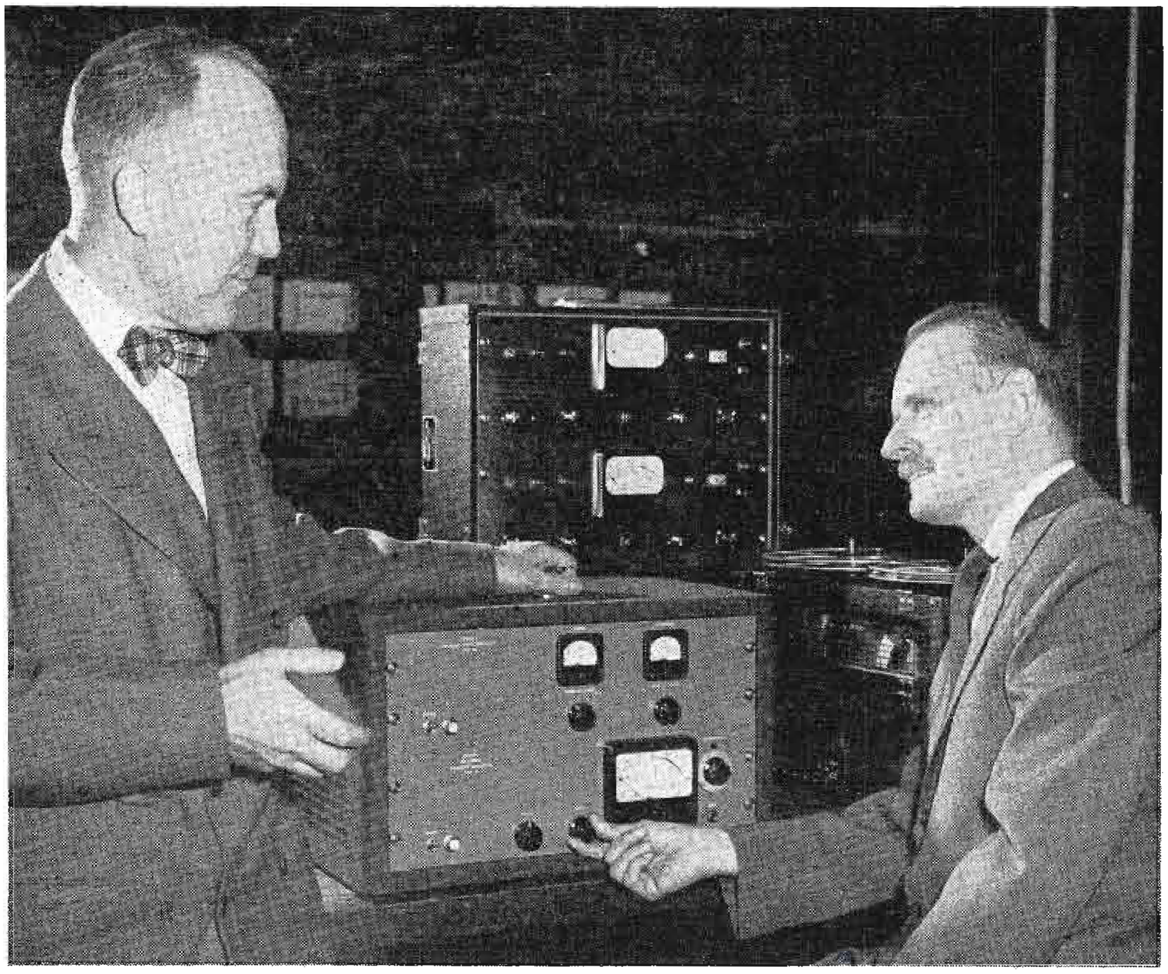


Fig. 1: Murray Crosby (l) and William Halstead examine multiplex FM transmitting equipment

By ALBERT J. FORMAN, *Assistant Editor*
TELE-TECH & ELECTRONIC INDUSTRIES

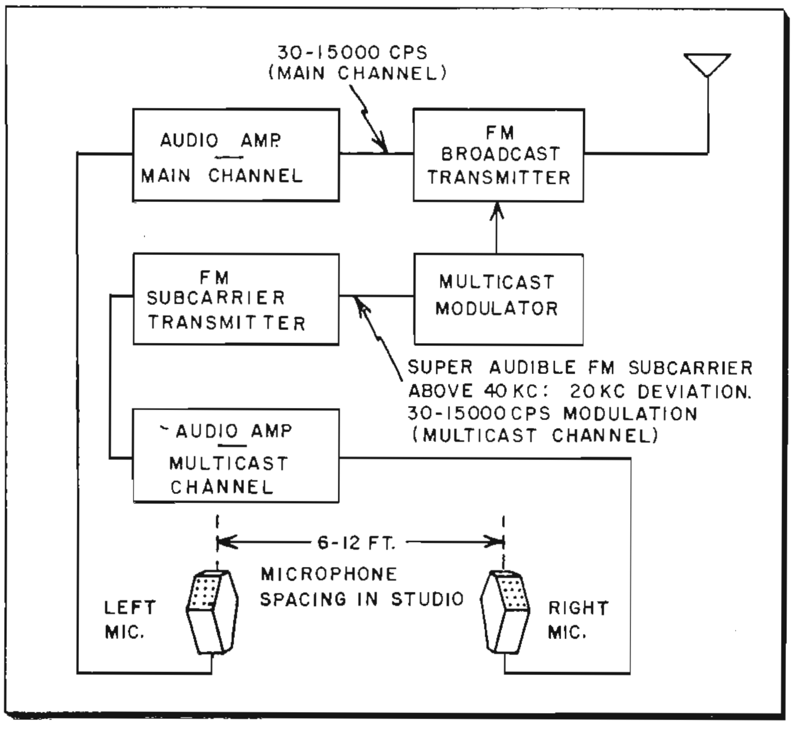
A NEW development in multiplexing as applied to FM broadcasting will permit the reception of high-fidelity stereophonic, or "three-dimensional" sound in the home, while employing a single FM transmitter and the bandwidth of *only one FM channel.* Normal reception on standard FM receivers is not disturbed as the system is fully compatible with existing FCC engineering standards relating to FM broadcast stations. Standard commercial FM broadcast transmitters may be utilized without alteration of existing modulator or power amplifier circuits. Its introduction this year will not only mean a boost to FM broadcasting, but will prove a significant shot-in-the-arm to manufacturers producing FM receivers and sound equipment. In addition, potential application to TV may logically be expected.

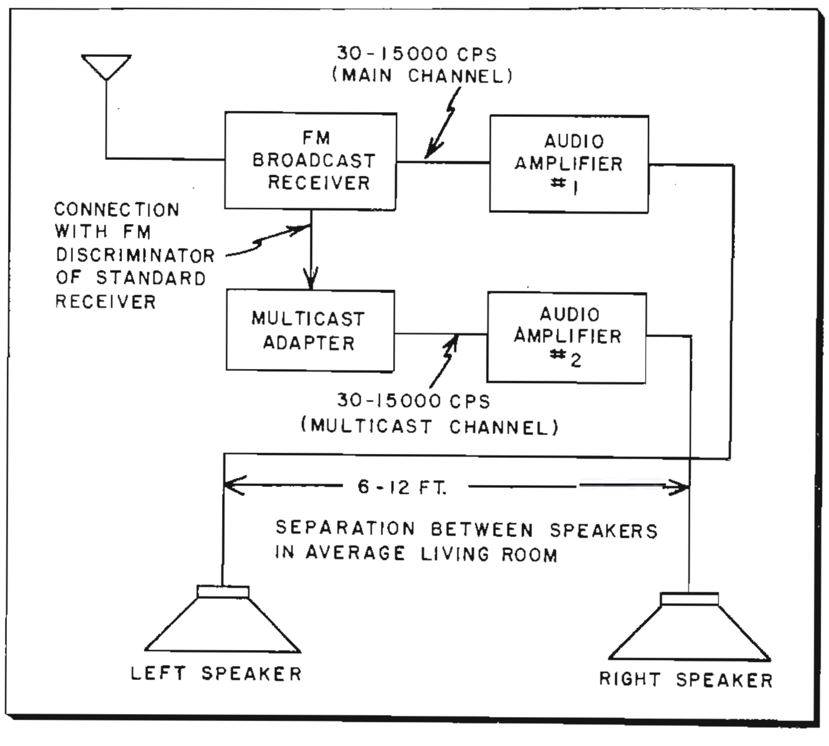
Development Background

This "3-D" broadcast system is the outgrowth of five years of development, starting in 1948 as a method for carrying facsimile information on regular FM broadcasts of the New York State Rural Radio Network without interfering with the main programs. Credited with its development are William S. Halstead, President of Multiplex Development Corp., and Murray G. Crosby, President of Crosby Laboratories, Inc.

A block diagram of the transmitting-receiving system and photographs are shown in Figs, 1, 2 and 3. At the transmitter, one microphone (left) feeds the regular modulator, while the second microphone (right) is connected to the FM subcarrier transmitter and multiplex modulator, which in turn adds a

Fig. 2: Stereosonic transmitting system (l) and receiving system (r) provide two sound channels within bandwidth of one standard FM channel. At the transmitter, one microphone feeds the regular modulator, while other feeds subcarrier unit. Reverse process at receiver poduces three-dimensional sound





Three-Dimensional Sound

"Stereosonic" system heralds big boom in audio and FM. Recent techniques provide two high-fidelity channels in bandwidth of one standard FM channel

second 15-KC high-fidelity program channel to the main FM varrier. At the receiver, the reverse process, utilizing the main channel and multiplex channel, reproduces in two speakers, suitably spaced with respect to each other, the sounds picked up originally by the two microphones.

Initial field tests were conducted in 1950 by Multiplex Development Corp., employing the standard commercial FM transmitting equipment formerly used by Station WGYN, New York City. Under the call letters KE2XKH, the station made multiple-program and stereophonic transmissions at 97.9 MC at an ERP of 4 kw. At that time, the main channel was modulated to 90% of full frequency modulation. The modulation of the main carrier by the 35-KC subcarrier was 10%, and the subcarrier deviation was 5 KC. In these pioneering tests, *before recent improvements were made*, the frequency response of the subcarrier channel was 8 KC, and the signal-to-noise ratio (50 db when a 1 millivolt signal was applied to the antenna input circuit of an FM broadcast receiver) of this channel was about equal to that which would be obtained if the main-carrier power of the FM transmitter were used in an AM system. No appreciable difference was noted by ear in performance of the main and multiplex channels when commercial transcriptions were employed.

Field Tests

In Sept. 1950, special field tests, including the first stereophonic broadcasts over a single FM station, were conducted with multiplex receiving equipment located at Reeves Sound Studios in New York City. In Dec. 1950, fringe-area listening tests of two multiplex program channels in addition to the main FM channel were made 45 miles from the station. These tests proved that the two multiplex programs, each consisting of different musical selections, could be received selectively without mutal interference or multipath effects and that the main channel performance continued to meet all FCC requirements. Conventional FM broadcast receivers without multiplex adapters simply receive the main FM channel only, with no trace of the multicast programs.

The solid lines of Fig. 4 indicate the frequency response and distortion of the subcarrier channel under the conditions employed in 1950. The dashed lines show the approximate characteristics employing the improved techniques which will be described. It can be seen that the subcarrier frequency response has been extended to 15 KC, thus producing two high-fidelity channels where one existed before. The distortion in the subcarrier channel at maximum frequency deviation has been lowered to about 1.5% and is approximately the same as that of the main channel of the FM receiver.

The curves of Fig. 5 show measurements made in 1950 on the signal-to-noise ratio obtained on both channels. They were made using a Boonton 202B signal generator and a REL Model 746B FM broadcast receiver. The subcarrier receiver was connected to the FM detector of the REL receiver through a cathode follower. The noise comprised

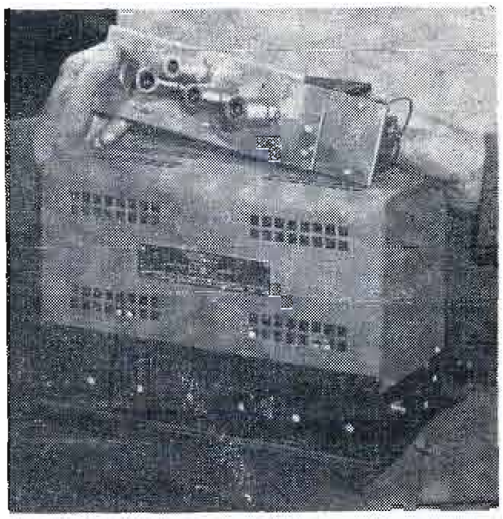


Fig. 3: New version of multiplex subcarrier adapter (top) and original receiver (bottom)

random noise at the input terminals of the main channel receiver. Note that when a millivolt FM carrier was applied to the antenna terminals of the receiver, the signal-to-noise ratio of the subcarrier channel was about 30 db below that obtained on the main channel. However, more recent improved techniques have increased the signal-to-noise ratio on the subcarrier channel so that it is approximately 20 db below that on the main channel. These improved techniques include the use of pre-emphasis and de-emphasis on the subcarrier channel, increased percentage of modulation of the main carrier by the subcarrier channel, and increased subcarrier deviation. With these improved techniques, the signal-to-noise ratio on the subcarrier

(*Continued on page* 188)

Fig. 4: Subcarrier frequency response and distortion. Recent performance shown by dashes indicate improvement over 1950 solid curves

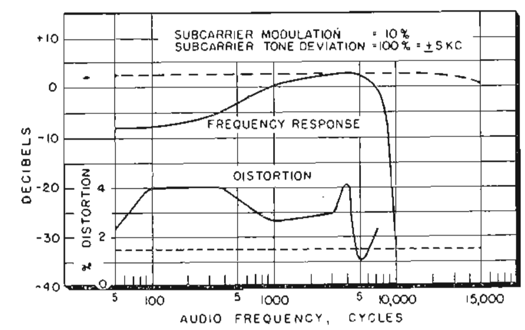


Fig. 5: Signal-to-noise for main and subcarrier channels (1950 data). New techniques bring subcarrier S/N up to 60 db at 1000 µv contour

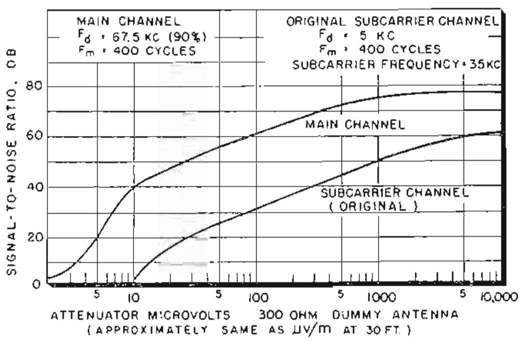
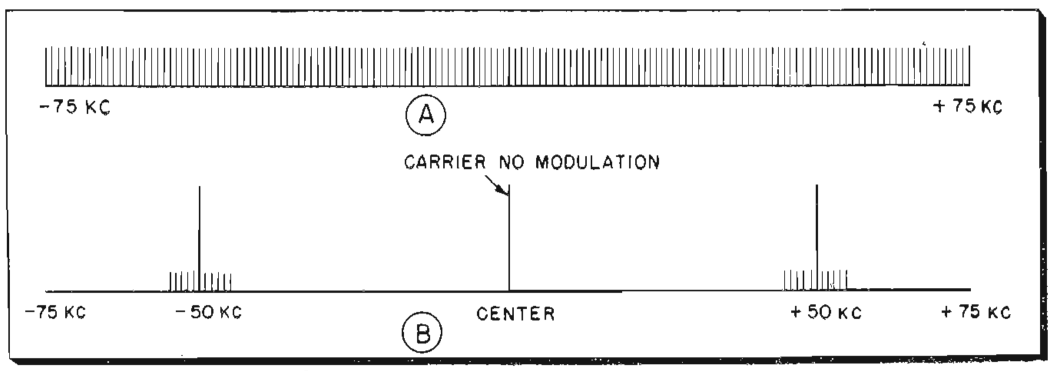


Fig. 6: (A) Main FM channel with 1-KC modulation, but no multiplexing. (B) Subcarrier with 1-KC modulation, no main channel modulation. Combination of two produces complex waveshape

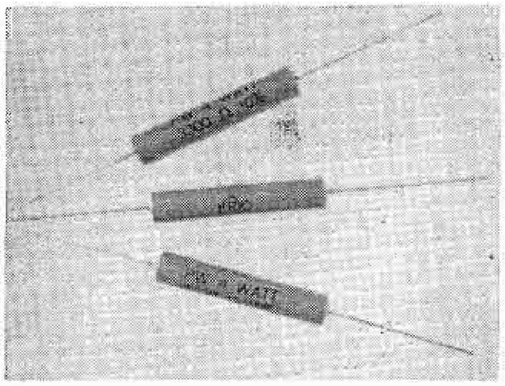


What's New at the

Technical Descriptions and illustrations of many products displayed by more than

Resistor *(1-110)*

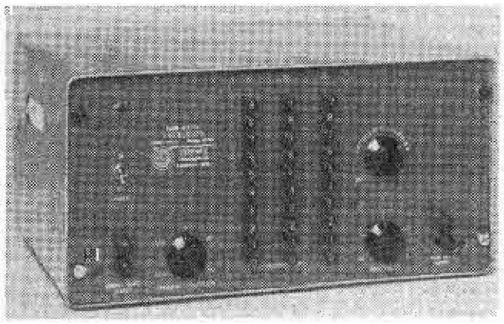
Completely insulated with an inorganic core material molded in a high temperature plastic, type PW4 power resistor unit will



not support combustion and is rated at 4 watts. Wire element is uniformly and tightly wound on glass fibre core with axial leads 1½ in. long; 0.36 in. diameter. Body dimensions are 1¾ in. long by 21/64 in. diameter. Type PW4 is available from 1 ohm to 8200 ohms in ±5% and ±10% tolerance.—**International Resistance Co., 401 North Broad St., Philadelphia 8, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

Push-Button Oscillator *(4-301)*

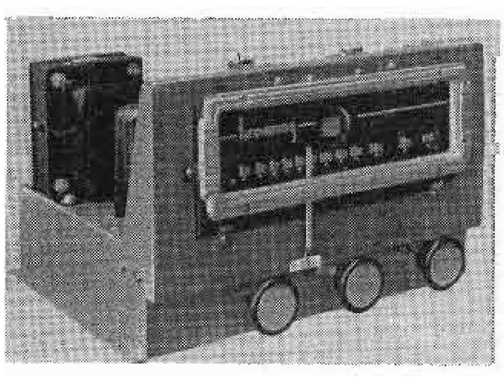
Three banks of 10 push-button switches are provided on model 440-A push-button oscillator. It provides both sine waves and



square waves at any frequency between 0.01 CPS and 100 KC. Vernier control varies the frequency continuously by an amount equal to the increment between adjacent buttons of the third switch bank. Hum and distortion are attenuated when the setting of the calibrated logarithmic output level control is reduced and are thus maintained at a constant low percentage of the desired output signal.—**Krohn-Hite Instrument Co., 580 Massachusetts Ave., Dept. E, Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

FM Tuner *(2-106)*

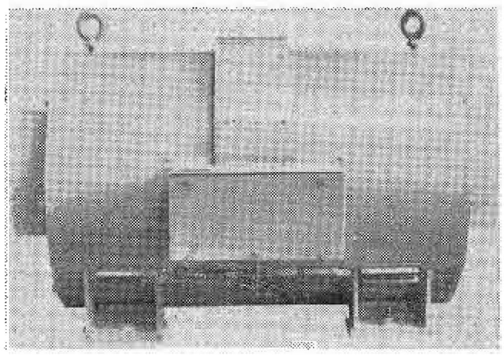
Model RV-31 FM tuner is a superheterodyne employing the Armstrong system of FM reception and using one 12AT7 as a cascade, all triode r-f amplifier. One half of a 12AT7 is used as the mixer, the second half as a local oscillator. One 6J6 serves as the automatic frequency control reactance tube. The intermediate frequency amplifier operates



at 10.7 MC and employs two 6AU6 tubes in transformer coupled stages. Two 6AU6 tubes are used as dual cascade limiters feeding a 6AL5 discriminator. The output from the discriminator is fed to a 6AU6 triode connected as a cathode follower audio output stage. A 6AL7 tuning indicator shows precisely correct tuning for any channel. Three panel controls are used; a tuning control, and a selector switch. The selector switch is so connected that any of three signal inputs at the rear of chassis may be selected as well as FM. The volume control will control the volume of any of these external signals or of the FM output.—**Browning Laboratories, Inc., 750 Main St., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

Motor Generator Set *(4-205)*

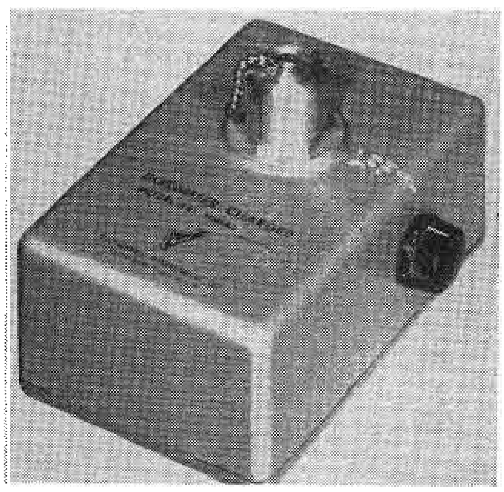
A new 400-cycle motor generator set consists of a two bearing machine made up of a synchronous motor and a sine-wave high



frequency alternator. Designed specifically for use in laboratories and factories for testing electronic equipment, this generator features sine-wave output with total harmonic content less than 2%. Voltage regulation of ±1% no load to full load with frequency remaining at exactly 400 cycles no load to full load is provided.—**Bogue Electric Manufacturing Co., 52 Iowa Ave., Paterson 3, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Dosimeter Charger *(4-103)*

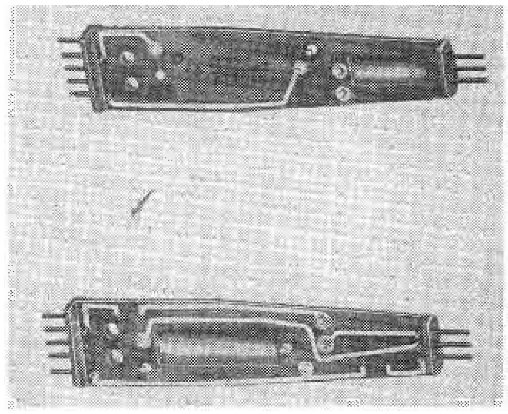
Model 561 dosimeter charger is designed to charge all makes of direct-reading pocket dosimeters to any value from 100 to 225 v.



The internally-lighted charging socket extends ½ in. above the case top to receive dosimeters of larger outside diameters than the standard Victoreen model 541/A, 547A, 548 and 534 dosimeters. The charger features a single off-on-charge knob and a spring loaded charger socket to prevent damage to the dosimeter due to excessive pressure by the operator. This waterproof unit is 4 x 5 x 6 in. and weighs 3 lbs.—**The Victoreen Instrument Co., 3800 Perkins Ave., Cleveland 14, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES

Printed Circuit Component *(1-130)*

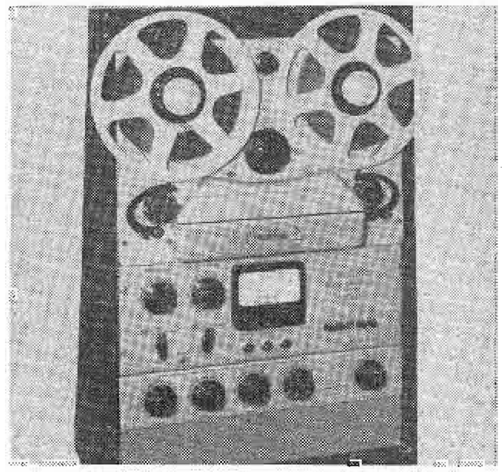
A printed circuit made of Mycalex 410 glass-boned mica features a coefficient of thermal expansion close enough to those of



most inserts, including silver, to hold the insert tight over operating temperature ranges. It also offers permanent dimensional stability and the ability to be molded to close tolerances and continuous temperature endurance to 650°F. Electrically, Mycalex 410 is the injection-molded counterpart of Mycalex 400, a machinable insulator featuring much the same properties.—**Mycalex Corp. of America, Clifton Blvd., Clifton, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Tape Recorder *(3-304A)*

Drive mechanism and erase-bias oscillator on network recorder NWR-1 is mounted on a rigid cast aluminum panel. In threading



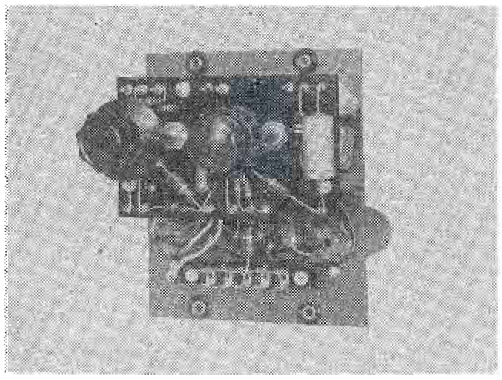
and fast traverse, tape is held in a straight path away from heads, thus minimizing wear. In run position, tape is automatically wrapped around heads for intimate contact without pressure pads. Continuous-duty, cool-running, balanced-torque take-up and supply motors provide smooth winding of tape under all operating conditions. Reverse power facilitates rapid start in fast traverse even when using large and small reels simultaneously. Bayonet hub locks center and fasten either 10½ in. NAB or 7 in. RMA reels without need of adapters. Electrical switch controls selection of tape speeds (7.5 ips and 15 ips) and automatically changes equalization to maintain flat response. Self-threading tape tensioning arms are counter-balanced and controlled by individual constant pressure springing. Editing control knob may be set for running tape in contact with heads during fast traverse in either direction, or for manual handling to bring tape into exact position for cutting. Heads may be varied in height, longitudinal angle and lateral angle. Adjustment for azimuth may be made with recorder in operation. Space is provided for up to 5 heads, permitting use of the recorder for special purposes.—**Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

1953 IRE Show

400 exhibitors at New York City's Grand Central Palace, March 23-26

Amplifier (3-317)

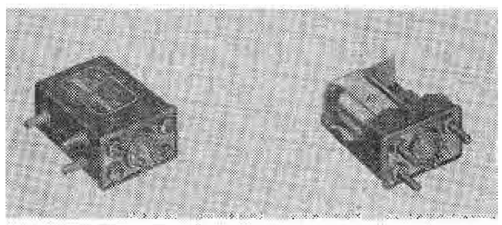
The 1411A amplifier is a dual purpose unit providing equalization for use with variable reluctance type phonograph reproducers and bass and treble controls for all elements comprising a 1400 series amplifier system. Electrically, the 1411A is comprised of two sections. The first section provides fixed equalization for the use of variable reluctance type reproducers. The second section provides variable bass and treble tone controls, which may or may not be used for equalization of the entire sound system. Insertion gain of the variable equalization portion is zero db with the tone controls in the flat position, and 1410A preamplifiers when used, may be mixed at the input to the second section of the 1411A or at the output, as desired. When the mixing is done at the input of the second section of the 1411A, the variable tone controls are effective for all channels. When the mixing takes place at the output of the 1411A, the tone controls are effective only in the phonograph chan-



nel. Fixed treble de-emphasis for LP records, when desired, is attained by proper loading of the pickup cartridge. Two resistors are supplied for this purpose with recommendations for use with the various makes of record reproducers.—**Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Relay (2-203)

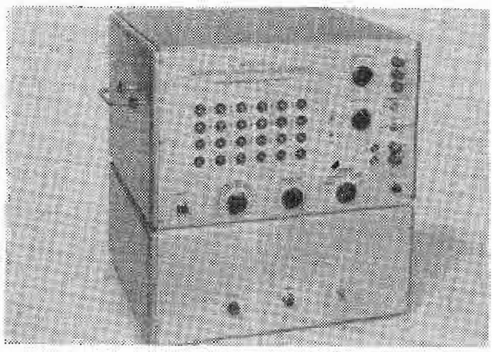
Bantam-sized class "S" relay is hermetically-sealed in enclosures measuring 2 1/12 x 31/32 x 1 1/2 in. and weighing 1 7/8 oz.



Mounting studs may be arranged on the base or narrow side of housing. It is tamper-proof and atmosphere-protected and meets or betters all provisions of MIL-R 6106.—**Automatic Electric Sales Corp., 1033 West Van Buren St., Chicago 7, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Frequency-Time Counter (1-113)

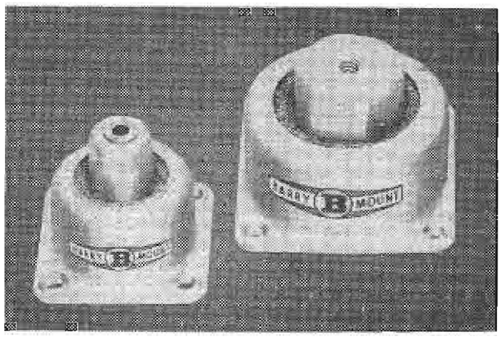
A universal counting and timing instrument contains all of the input, gating, switching, counting and crystal-controlled time base circuitry necessary to perform any counting, timing or frequency measurement function. Direct frequency measurement is provided from 0 to 1 MC. Period measurement can be timed for 1 to 10 cycles of frequency. Time interval measurement ranges from 10μ sec. to 1,000,000 seconds. Frequency ratio measurements are ratios of two external frequencies. Secondary frequency standard can be 100 kc, 10 kc, 100 cps, 10 cps, and 1 cps. In direct frequency measurements, the cycles of the unknown



frequency are permitted to pass through a gate into a six-decade electronic counter for a precise crystal-controlled period of time. The count accumulated is then displayed for an adjustable readout period, after which the counter automatically resets and repeats the measurement.—**Potter Instrument Co., Inc., 115 Cutter Mill Road, Great Neck, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Vibration Isolator (2-312)

Type 7630 and type 7640 vibration isolators are said to eliminate loss of efficiency due to damper packing. These units are respec-



tively JAN cup-type size 1 and JAN cup-type size 2. Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack down and become stiffer after repeated shock and vibration. These units are so designed that the load-baring spring returns the damper to its normal position on every cycle, thus preventing packing. Additional features of the new units are light weight, a new hex top to simplify installation, high isolation efficiency, ruggedized construction, and wide temperature tolerance.—**The Barry Corp., 700 Pleasant St., Watertown 72, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

Miniature Power Supply (4-212)

Model A-1220 is the first of a series of miniaturized dc to dc power supplies. Total weight is 1 lb., 14 oz. Vibrator and power supply are hermetically sealed. Output of 150 v., 100 ma is filtered to 1% peak ripple. Three standard units of 6, 12 and 16.5 v. dc input are offered. On special order, output power up to 20 watts, output voltages up to 300 v., and input voltage between 4 and 100 v. dc can be provided. Unit is designed to meet severe military standards of vibration, shock, temperature range, humidity and altitude.—**The Airpax Products Co., Middle River, Baltimore 20, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES

BOOTH NUMBERS

at which equipment described will be on display in Grand Central Palace are indicated by numbers in parentheses

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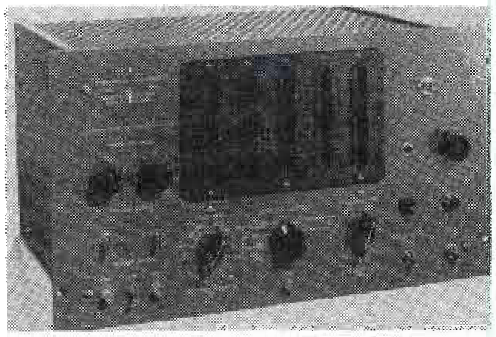
Electronic Counters (1-509)

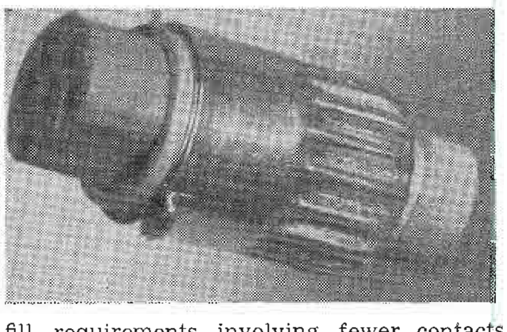
Model 522A electronic counter will respond to continuous waves from 1 cps to 100 KC, or to random impulses occurring at peak rates up to 100,000 per sec. The instrument is arranged to measure frequency or period (1/f). This allows maximum accuracy in the determination of both high and low frequencies. Model 522B (illustrated) is more elaborate, since it handles the basic functions of the —hp— 522-A with more flexibility and in addition will measure time intervals. This instrument has selectable gate times for frequency measurement; selectable count frequencies for period and time interval measurement; automatic decimal point registration so that readings are made directly in cycles, kilocycles, seconds or milliseconds; and independent start and stop channels for time interval measurements, with selectable triggering level and triggering slope. For frequency measurement, the unknown waves or impulses are applied to an electronic gate. When the gate is open,



these are passed to the counter circuits. When the gate is closed, the counters display the counted value. The gate is opened for an accurate time interval based on an internal temperature-controlled quartz crystal frequency standard. For period or time interval measurement, the counters count the output of the internal frequency standard during one or more cycles of the unknown frequency, or between two impulses, the interval between which is to be measured. The instruments are arranged so that the counted value can be displayed for a preselected period of time, adjustable up to ten seconds, or indefinitely by manual control.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Subminiature Connectors (2-512)

Type U series is a companion to the type D series of Cannon rectangular subminiature connectors. The U line was developed to ful-

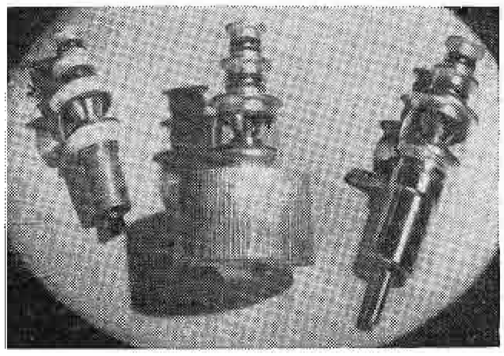


fill requirements involving fewer contacts than are contained in the smallest of the D line. Primarily intended to afford a quick, compact electrical connect and disconnect, it consists of a series of subminiature connectors in the more conventional round shape with the positive polarization flat. It is available in 3, 6, and 12 contact sizes. As in the Cannon UA line, the cable entries of the cord connectors are protected with Silcan #62 resilient sleeves. Latching is accomplished by means of bayonets and J slots, which require less than ⅛ turn of the coupling member to latch or unlatch. U contacts are rated at 5 amps, 1700 dc flashover. —**Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

New Products Revealed to 30,000

Coaxial Terminal Triodes (1-116)

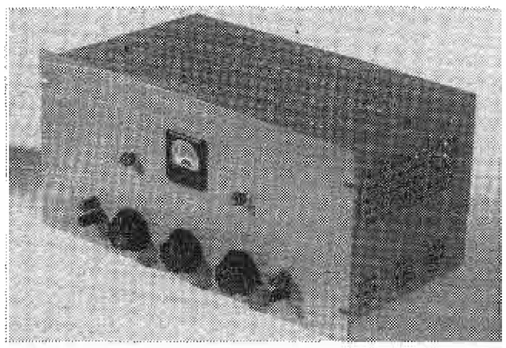
ML-6256, ML-6257 and ML-6258, coaxial terminal triodes incorporate respectively, water cooled anode (using water jacket), in-



tegral-jacket water cooled anode, and radiator type forced air cooled anode. Designed for r-f heating in the 2-3 kw range, these coaxial terminal triodes are well adapted for AM, FM and TV. Maximum ratings apply to 110 MC. Stress-free thoriated tungsten filaments operate at 12.6 v., 27 amps.—**Machlett Laboratories, Inc., Springdale, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES

Super Regulator (2-206)

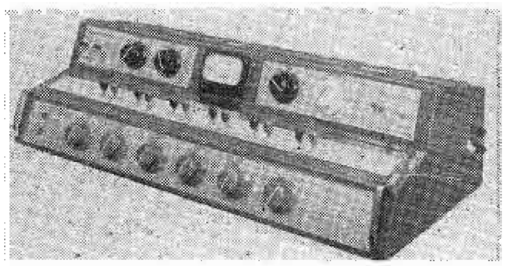
Model 121 super-regulator works equally well from regulated or unregulated power supplies and if preceded by an unregulated supply, LC filtering is unnecessary if a



large input capacitor is employed. Pentode series tubes are utilized so that the ripple and impedance variations of the unregulated supply will be isolated from the regulated output to the highest degree. A separate power supply within the super-regulator supplies screen voltage for the series tubes. The input amplifier stage is a differential amplifier in an optimum configuration to afford minimum susceptibilty to filament voltage changes. A new high performance, long stability, voltage reference tube is used, giving low output drift. The amplifier gain at mid-frequencies is in excess of 105 db.—**Kalbfell Labs., P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Console (3-317)

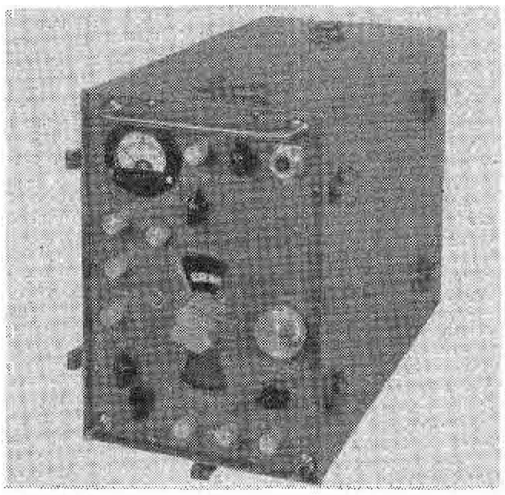
Eight low level microphone or turntable inputs (mix four simultaneously) are provided on the 230B console. There are four remote line inputs (mix two simultaneously). There is a built-in cueing circuit on line mixer controls. Frequency response ranges from ±1 db 20-20,000 cycles. Noise level is 74 db below +24 dbm from microphone input to program line with 70 db net gain. Source



impedances for microphones are 50, 150, 300 or 600 ohms. Output impedance for program line is 500/600 ohms balanced.—**Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Noise Meter (2-147)

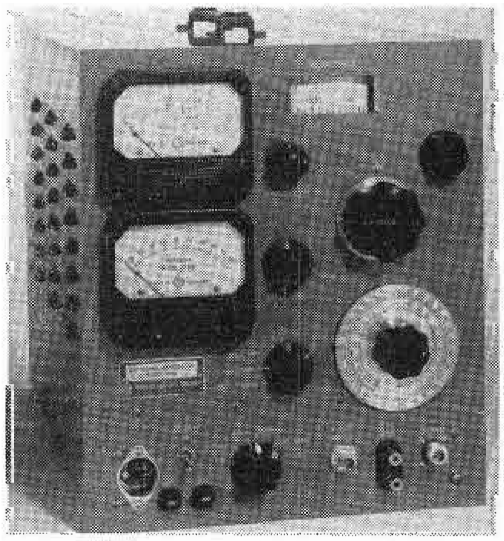
A frequency range of 0.15 to 80 MC in 8 bands is provided by NF-114 noise meter. Frequency ranges are switched with a turret. Two tuned r-f amplifier stages are used throughout for high sensitivity and optimum rejection of spurious responses. Three i-f frequencies are used: 0.125 MC; 0.455 MC; and 6 MC. A built-in impulse generator produces flat output to 100 MC. Vacuum tube voltmeter indicates carrier or true peak voltage. As an alternate means of measure-



ment, aural-slide-back operation is provided. It will operate on dry batteries or ac (regulated A and B).—**Empire Devices Inc., 38-25 Bell Blvd., Bayside 61, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

UHF Signal Generator (1-509)

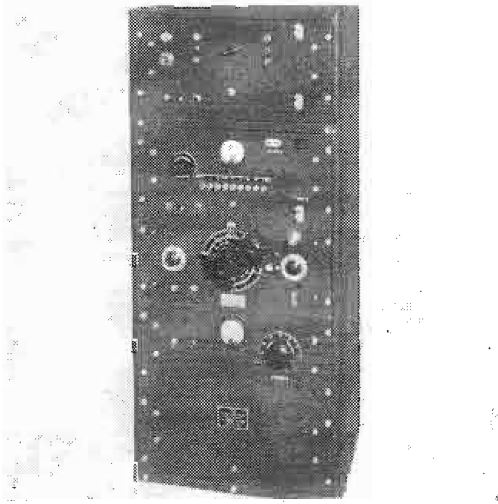
The 450-1200 mc band is covered by model 612A UHF signal generator. Its master oscillator-power amplifier circuit provides high output power, low incidental FM and good



modulation capabilities up to 5 MC. Both frequency and output are directly set on large, precisely calibrated dials. No charts or interpolation are required. It has a maximum output of 0.5 v. into 50 ohms over its entire frequency range. It may be modulated internally or externally, amplitude modulated, or pulse modulated (good r-f pulse 0.2μ sec. or longer). Pulse modulation may be applied to the amplifier; or direct to the oscillator when high on-off signal ratios are required. A dc restorer circuit allows modulation up or down from set level to simulate TV modulation characteristics. Percent modulation meter responds to peak value, indicating degree of pulse modulation.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Automatic Cycling System (2-110)

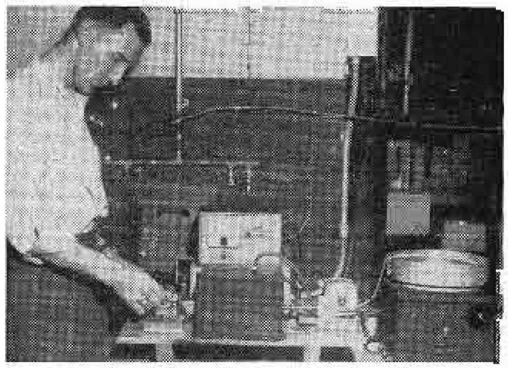
MB model ACS-11 automatic cycling system was designed to provide automatic control of frequency and amplitude of accelera-



tion of an exciter table. It provides automatic cycling from 10-55-10 CPS in one minute intervals; 10-500-10 in 15 minute intervals, and other ranges are available. It is said to be the first unit in the field for completely automatic control of cycling, as well as amplitude and acceleration for lower range vibration exciters to meet government specifications.—**The MB Mfg. Co., Inc., 1060 State St., New Haven 11, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES

Deposited Carbon Furnace (4-129)

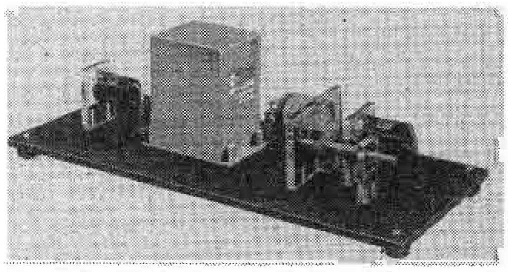
A compact continuous automatic deposited carbon furnace has been developed for the manufacture of deposited carbon resistors.



Dimensions are 2 x 2 x 4 ft. Shown in the photo is Joe Matejka, the designer of the furnace, who will be in attendance at the booth to explain his operation and methods used in making deposited carbon resistors. Samples of coated resistor blanks will be available to visitors.—**Dale Products, Inc., Columbus Nebraska.**—TELE-TECH & ELECTRONIC INDUSTRIES

Servo Amplifiers (4-206)

A new line of adjustable magnetic servo amplifiers will stabilize a servo loop with easily made adjustments over wide ranges

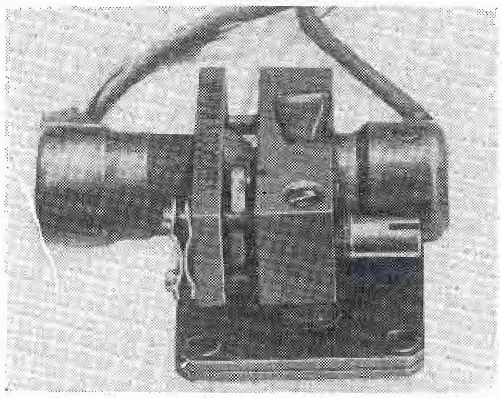


of performance requirements, load conditions, and gear ratios. Other exhibits include the company's standard line of high gain push-pull magnetic amplifiers, saturable transformers, and 400 or 60 cps servo systems.—**Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.**

Engineers at IRE meeting

Klystrons (1-617)

Four x-band reflex klystrons, designed for radar applications, feature very low microphonics, extreme ruggedness against mechanical shock and vibration, and complete frequency stability regardless of ambient pressure changes. The last characteristic will be demonstrated by actual operation of one of the tubes under atmospheric pressures



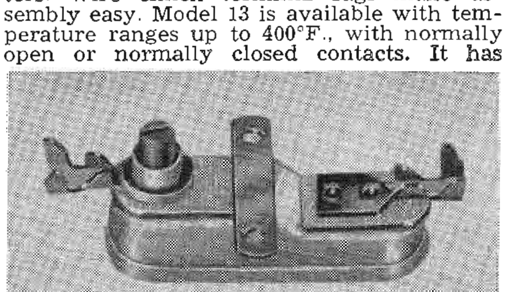
ranging from sea level to 80,000 ft. altitude. The V-260 is a rugged local oscillator for mobile radar. It is highly non-microphonic, and the shaft tuner, free form chatter and systems. The V-280 is designed for radar, backlash, is well adapted to motor tuned beacon or low-power transmitter operation under severe mechanical punishment. The lock-nut tuner holds the tube on frequency under shocks of several hundred g. The V-270 and V-290, electrically identical with V-260 and V-280, are fitted with silicon-rubber-potted base and reflector connections, replacing conventional base and reflector cap, for high-altitude or high humidity service. All four of the tubes have a frequency range of 8500 to 10,000 MC.—**Varian Associates, 990 Varian St., San Carlos, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Vibration Mounting (2-124)

New vibration mountings known as Temproof (temperature proof) because of their ability to function efficiently throughout the entire range of operational temperatures from -80°F to 250°F are designed for use with JAN-C-172A equipment. According to the manufacturer, Temproof mountings not only pass but exceed the requirements of specification AN-E-16 which requires that mountings withstand a 30G drop test. Friction dampers are designed into Temproof mountings to prevent excessive equipment motion at resonant frequencies. Mounting drift has been reduced to a negligible amount, which eliminates the tendency of equipment to sag or droop after long periods of service. Temproof mountings function efficiently over a wide range of loadings, which makes it practical for manufacturers to standardize upon one mounting for several types of equipment.—**Lord Manufacturing Co., 1635 13 St., Erie, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

Miniature Thermostat (4-131)

Model 13 miniature thermostat measures 1 x $\frac{5}{16}$ x $\frac{1}{4}$ in. It is totally enclosed and special tri-element strain relief construction permits its use under extreme temperatures without straining of the bi-metal. Precision calibration is controlled by turning a special finely threaded self-locking adjustment screw. Units are mounted to heated surfaces through two 0.067 diameter holes at $\frac{17}{32}$ centers. Wire clinch terminal lugs make assembly easy. Model 13 is available with temperature ranges up to 400°F., with normally open or normally closed contacts. It has



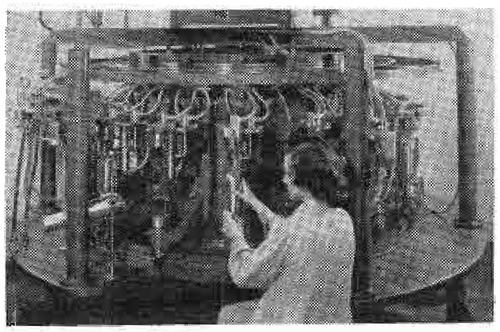
been used for applications up to 140 watts, 115-230 v. ac.—**George Ulanet Co., 413 Market St., Newark 5, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

UHF Oscillator Triode (2-316)

The new "Hytron" type 6AF4 oscillator triode has a T5½ bulb, and small-button 7-pin (E7-1) base. Direct interelectrodes grid-to-plate input, and output capacitances are respectively, 1.9 $\mu\mu f$, 2.2 $\mu\mu f$, and 0.45 $\mu\mu f$. As a Class A amplifier, its performance data and characteristics are as follows: heater voltage 6.3 v; heater current, 0.225 amps; dc plate voltage 100 v.; cathode bias resistor 150 ohms; transconductance 75 μmhos; plate current 20 ma; amplification factor 16. As an oscillator at 950 MC, plate voltage is 100 dc v.; grid #1 voltage -4 dc v. from grid resistor of 10,000 ohms; plate current 22 dc ma; approx. grid current 400 dc ua; useful power output 160 mw.—**Hytron Radio & Electronics Co., Div. of CBS, Inc., Danvers, Mass.** —TELE-TECH & ELECTRONIC INDUSTRIES

Rotary Exhaust & Sealing Machine (2-408)

There are no sliding valves at the center of a new high vacuum, high speed, rotary exhaust and sealing machine for miniature and subminiature electron tubes. Pumping is accomplished by an easily removable packaged system, composed of a mechanical pump, a high speed oil diffusion pump, a mechanically operated valve and a compression port. The unit will produce a pressure of less than 0.1 micron at the port in the positions immediately ahead of the tip-off. The machine is non-indexing; that is there are no starting and stopping motions. Once



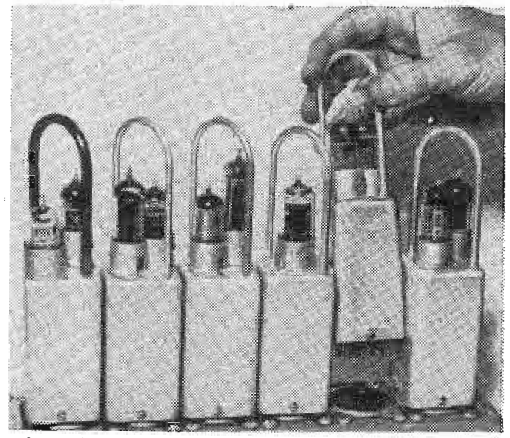
in motion the turret turns continuously sealing in the envelopes to the base, transferring to the pumping position, and finally tipping-off the tubulation. The continuous motion of the turret is said to permit production rates 25% to 30% greater than the conventional machines. The machine is normally supplied with 16 pumping and sealing heads, however, this can be increased to 32 if large production rates are required. — **Consolidated Vacuum Corp., 735 Ridge Rd. West, Rochester 3, N. Y.** — TELE-TECH & ELECTRONIC INDUSTRIES.

Autotransformer (4-113)

Model PT-1 Decatran is a precision autotransformer capable of high accuracy and extreme resolution in the measurement of ac voltage ratios. Among its many uses are the exact measurement of turns ratio in precision transformers, checking the accuracy of ac resolvers, calibration of ac meters, as a precision ac potentiometer, as a ratio arm in an ac bridge and as an impedance transformer. Accuracy of indicated ratio is ±0.005% from 50 to 3000 CPS. Accuracy decreases above 3000 CPS to about ±0.05% at 10 KC. Resolution is better than 1 part in 10^6. Source impedance at ratio arm is 7.5 ohms maximum. Open circuit input impedance is approximately 150 henrys. Temperature has no effect on accuracy. The ratio between the ratio arm and the full winding is read directly by means of 3 decade push button switches and a ten turn precision potentiometer. Unusually low source impedance enables this unit to be used in applications where a resistance type device would be useless.—**Gertsch Products, Inc., P. O. Box 13856, W. Los Angeles 25, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Plug-in Packages (2-143)

Alden "20" plug-in packages are bail color-coded to socket for quick locating, but non-interchangeable so spare cannot be plugged into wrong socket. This is accomplished by arranging circuitry in logical



sub-units and mounting vertically; providing straight through connections and central coded point of check for incoming and outgoing leads by Alden slide-in back connectors; housing circuitry and electronic gear in Alden plug-in packages and Alden slide-in basic chassis; monitoring by Alden sensing units that are tell-tales to instantly signal and locate trouble; interconnecting by coded Alden unit cables which permit units to be connected in the field as fast as unloaded without need for trained personnel. — **Alden Products Co., 117 N. Main St., Brockton 64, Mass.** — TELE-TECH & ELECTRONIC INDUSTRIES.

Plug (3-114)

A new 3-conductor type "Littel-Plug" with 0.2065 in. diameter sleeve is announced which mates with the JAN type JJ-033 jack. Furnished with 3 tinned terminals fastened by screws, the JAN designation (PJ-068) is hot stamped on shell and filled with white. Design and material are in accordance with specification JAN-P-642. —**Switchcraft, Inc., 1328 N. Halsted St., Chicago 22, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Aircraft Receiver (1-413)

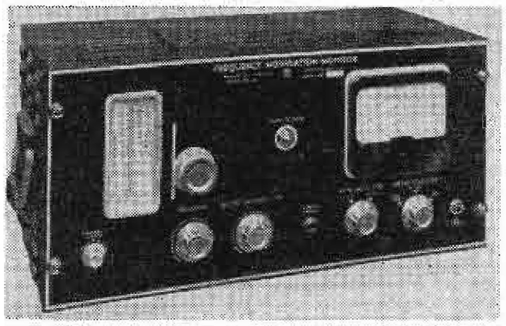
Crystal controlled reception on 360 channels spaced 50 KC apart in the 118.0 to 135.9 MC band is provided by the RA-188 VHF aircraft receiver. Selection of the de-

sired frequency is accomplished by means of a simple "finger-tip" control panel calibrated directly in frequency and located in the cockpit of the aircraft. Operation is from either a 27.5 v. dc or 115 v. ac (300 to 1000 CPS) primary power source. The unit, including power supply, is mounted in a standard JAN-A1-D (½ ATR) form factor housing and is fitted with removable side covers. A shock-mounted mounting base is provided with rear plug connector and special extractor mechanism. Sensitivity is better than 2.5μv. on all channels. Spurious and image rejection is at least 75 db. Squelch is adjustable to open from receiver noise threshold up to 25μv. Output is held within 3 db from 5 to 100,000 μv. by automatic gain control.—**Bendix Radio, Div. of Bendix Aviation Corp., Baltimore 4, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES

$10 Million of Military and

FM Monitor (2-106)

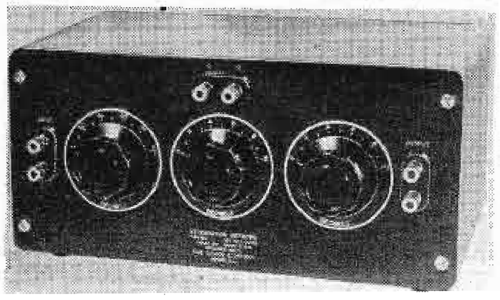
Model MD-33 FM monitor is designed to supply the need for a single instrument capable of checking the modulation of FM transmitters operating from 25 to 174 MC. It



covers this range on two bands, 25 to 70 MC and 70 to 174 MC. A 4-in. panel meter, used to indicate modulation swing, has a linear scale with 20 KC maximum indication. A peak flasher circuit is included which is extremely fast in its reaction and indicates when peaks exceed a certain preset limit. A two position switch adjusts the flasher circuit for indication of either of two values of swing. Normally the unit is set to indicate at 7.5 and 15 KC. Sensitivity is better than 1 mv. to 140 MC and better than 2 mv. from 140 to 174 MC. Automatic frequency control is applied to local oscillator to facilitate tuning and to permit continuous monitoring of station transmitters. Audio output is approximately 5 v. RMS at rear terminals is adjustable from front panel. Frequency response of this output voltage is flat between 100 CPS and 15 KC.—**Browning Laboratories, Inc., 750 Main St., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

Attenuation Network Series (4-118)

A new type direct-reading, precision, non-inductively wound, attenuation network has been designed for gain and loss measurements of filters, transformers, amplifiers and associated transmission equipment for both the audio and video range. The operation range 0 to 1 MC can be extended to 10 MC



if precaution is taken in shielding the external leads. The new type 790 is series-mounted on an alumilited panel and housed in an attractive metal cabinet. Each decade dial provides 11 positions or 10 steps of attenuation; each decade is shielded in a brass case and all are grounded to the panel. The unit provides accuracy over a range extending into the low radio frequency spectrum; a wide range of attenuation in small decibel steps; and the stops and detents on the individual decade positively prevent over-travel. Both balanced "H" and "T" networks are available. Low stray capacity and low-loss silver alloy switch blades and contacts insure continued accuracy; and non-inductive precision resistors and a specially designed circuit reduce frequency discrimination to a minimum. Networks are made for various impedance requirements.—**The Daven Company, Dept. AT, 191 Central Ave., Newark 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

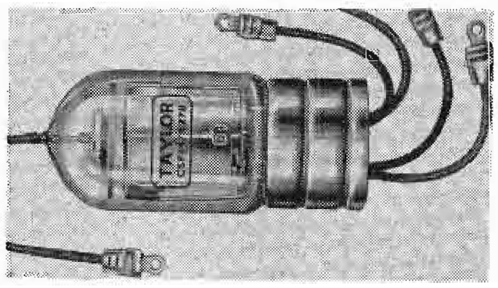
Rectifier Tubes (4-622)

Two new Xenon Thyratron rectifier tubes, types C5F14/6278 and C3R14, have metalized carbon anodes that give more efficient plate dissipation and can absorb tremendous overloads. Rugged construction makes them especially applicable for high shock installations up to 200 g. In addition to use as conventional Thyratrons, they are adaptable to motor control and inverter circuits and to various tuning and controlling functions.

BOOTH NUMBERS

at which equipment described will be on on display in Grand Central Palace are indicated by numbers in parenthesis

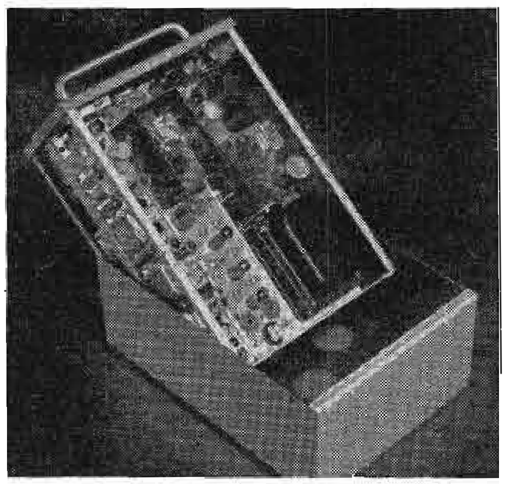
Precious metal grid structures provide control through all ranges of tube operation, requiring less grid current, loss of control due to stand-by service is eliminated. Improved cathode processing results in low arc drop, long life and substantial overload reserve. Both tubes have 14 v., 2.5 amp. heaters with indirectly heated cathodes. Average arc drop is 10 v. or less. Their ambient temperature range is -55°C to -75°C. The tubes have identical physical dimensions (diameter 2 in., length 5 in.). Base connections are made from flexible leads having closed #6 lugs. The type C5F14/6287 has flexible anode connection. Average anode current is 5 amps. Peak anode current is 60 amps. Peak anode voltage is 750 v. De-



ionization time is less than 200 μ secs. The type C3R14 extended anode connection is made through a medium cap without flexible lead. Average anode current is 3 amps with a peak anode current of 30 amps. Peak anode voltage is 1000 v. The C3R14 also features an extremely low deionization time of under 175 μ secs.—**Taylor Tubes, Inc., 2312 W. Wabansia Ave., Chicago 47, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Mobile Communications Equipment (1-413)

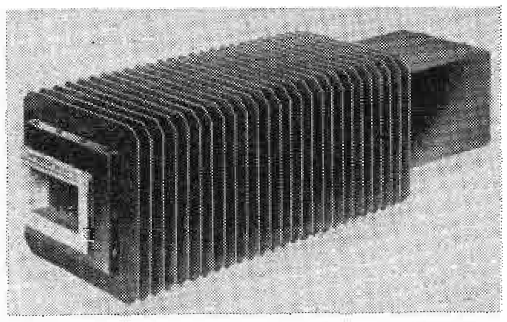
Separate transmitter, receiver and power supply chassis packaged in a single compact case for 152-174 MC band provide sin-



gle or dual channel operation. Known as the Traffic-master, this unit is said to meet or exceed all present proposed specifications as set forth by the FCC, RTMA, IRE and AAR for general VHF mobile operation. Frequency stability of transmitter is ±.0006% with oven type crystal. ±.0025% without oven. Temperature range is from —40°C to +70°C. The receiver is a crystal-controlled, 15-tube double conversion type superheterodyne and incorporates an extremely sensitive and effective squelch. The audio output is located on the power supply chassis. Selectivity of receiver is —100 db or more at ±30 KC. No i-f tuning adjustment required; —6 db or less at ±15 KC.—**Bendix Radio, Baltimore 4, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES

High Power Load (4-126)

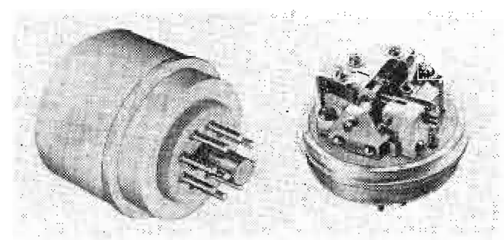
Type 311 high power load consists of a stainless steel jacket containing a lossy material which is compound tapered to maintain uniform power dissipation as well as to achieve a low VSWR. The lossy material is



impregnated to prevent varying ambient humidity from adversely affecting load performance. Absorbed power is dissipated by heat-radiating fins surrounding the jacket and forced air cooling of the load is not required up to full rated power. Frequency range is 1.15-1.25 kmc/s. Maximum average power is 1000 watts. Maximum VSWR is 1.08 and maximum peak power 1.0 megawatts—**Bogart Mfg. Corp., 315 Seigel St., Brooklyn, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

HF Impulse Relay (2-306)

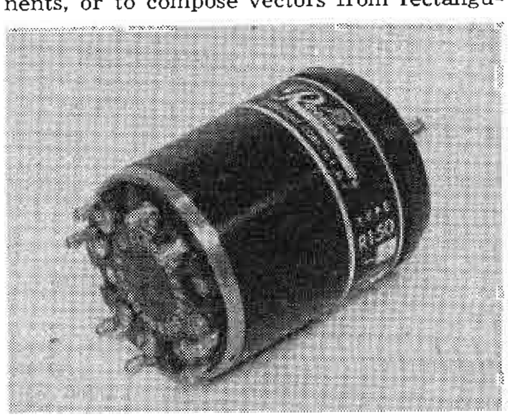
The Type T, high-frequency impulse relay, has been developed by C. P. Clare & Co. for applications which require a highly sensitive relay free from contact bounce and capable of a number of operations at extremely high speed. The unit has a pull-in time of 120 μ secs. and a drop-out time of 100 μ secs.



which enable it to follow 2,500 CPS, aperiodic to 1,000 CPS. Following a run-in period of 1 x 10^6 operations in a typical application it has a life expectancy of 5 x 10^9 operations with a 0.75 ma contact load over a 6-month period without readjustment.—**C. P. Clare & Co., 4719 W. Sunnyside Ave., Chicago 30, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Miniature Resolver

While employed primarily for computer applications, the new REAC miniature resolver can be used wherever it is desired to resolve vectors into the rectangular components, or to compose vectors from rectangu-

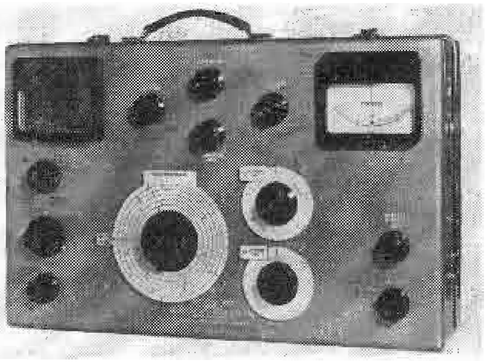


lar components. Accuracy is ±1% or better from —55°C (—67°F) to +85°C (185°F) Navord 15 case is approximately 1⅞ in. long, excluding shaft and terminals. The unit weighs only 6 oz. and has spring loaded precision bearings. 0.185 diameter shaft can withstand better than 50 G shock or vibration.—**Reeves Instrument Corp., 215 E. 91 St., New York 28, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Commercial Equipment on Display

Radar Test Set (1-520)

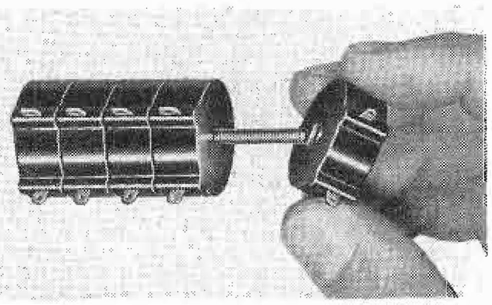
Type TF.890/2 S-Band radar test set (portable) supersedes and replaces both the TS.147 and TS.148 since it contains several units in one case, (i.e.) signal generator, wavemeter, spectrum analyzer, power meter, and directional coupler. Covering the band



from 8500-9600 MC, it is designed to make comprehensive tests on a complete radar system. Tests and measurements possible are: transmitter, receiver, and local oscillator frequencies; transmitter power; antenna reflections and determination of SWR; transmitter pulse spectrum; TR cell receiver time; tr cell reception lose; receiver noise power level; IF response curve display; AFC discriminator response. Because of its compact size and convenient shape, it is especially suitable for pre-flight work on airborne X-band radar.—**Marconi Instruments Ltd., Dept. TT, 23-25 Beaver St., New York, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

(3-309) *Encapsulated Toroid Coil*

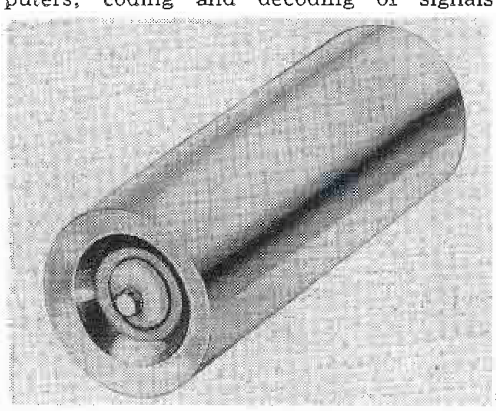
The new Hycor Type P toroid coil, hermetically encapsulated in a special tough plastic compound withstands an ambient



temperature range of —55°C to 130°C; 95% humidity; boiling salt water, and an exceptional degree of mechanical shock. Small physical size makes them ideal for use in miniature assemblies; and they can be mounted compactly on a single screw. Electrical characteristics of the new Type P are the same as the manufacturer's old type cased toroids.—**Hycor Co., Inc., 11423 Vanowen St., North Hollywood, California.**—TELE-TECH & ELECTRONIC INDUSTRIES

Ultrasonic Delay Lines (2-510)

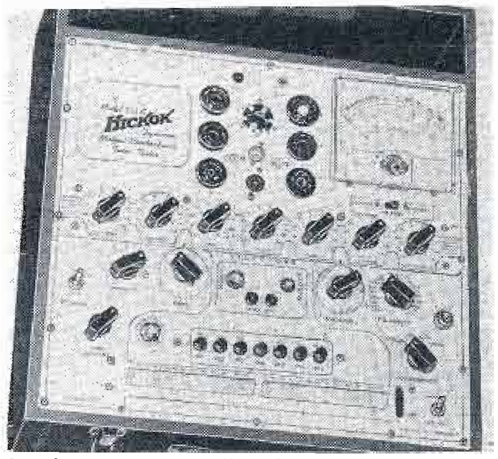
A new electronic tool, "Fused Quartz Ultrasonic Delay Lines," is announced for distance measuring equipment; geophysical explorations; moving target indicators; communication systems; loran radar system computers; coding and decoding of signals;



automatic machinery; and television. In "Fused Quartz Delay Lines" electrical energy is converted into sound energy, passed through the fused quartz, and reconverted into electrical energy by means of Piezo-electric quartz transducers which are bonded to either or both ends of the line. Delay time or transit time in the fused quartz can be held to close tolerance by the utilization of proper techniques. Manufacturer states the present frequency range of the new product is from 5-100 MC, with delay time values from 5 to 1500 μsecs (depending upon related end use requirements). Stability is ±2% between —35° and +85°C. "Fused Quartz Ultrasonic Delay Lines" designed and custom built to individual specifications.—**Bliley Electric Co., Union Station Bldg., Erie, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

Tube Tester (2-118)

Designated as the Model 533AP, a professional type tube tester is now available as a radio-TV and communication technician's portable for on-location or shop bench servicing. This instrument provides many new features to increase the accuracy and completeness of test on all tubes normally encountered in electronic equipment maintenance. It is built with patented dynamic mutual conductance circuits to permit tube tests under simulated operating condition and contains micromho ranges of 0-3000, 6000, 15,000. It includes new built-in bias fuse to prevent accidental damage to bias potentiometer; a 5 in. static-free meter with large easy-to-read scales. The unit contains calibrated GM circuit; incorporates the Hickok gas test, noise test, and a new test feature that forecasts future life of a tube. It accurately tests the latest tubes, including miniature and subminiature types. Model 533 AP has sturdy portable case with detachable cover and is attractively covered with durable black leatherette. 16¾ in. wide, 18⅜ in. long, 7½ in. deep. 110-130 VAC, 40 watts. 24 lbs. net weight. Model 533 AC is housed in an attractive hammertex blue steel case with polished aluminum panel for laboratory table or tube dealer's counter use. 17½ in. wide, 18½ in. long, 6 in. high. 24 lbs. net weight. Also available as Model 533AD, is the Hickok steel display case designed to stand upright on the technician's bench and match the set of other Hickok signal generators and test instruments. 17 in. wide, 18¼ in. high, 11 in. deep. Either of



the 3 cases are optional at no increase in cost.—**Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES

Decade Counter Switch

A new decade switch has been designed particularly for work which requires indication of shaft position at a remote point. Contact panels are modified so that the rotor arm makes electrical contact every tenth revolution of the input shaft. The switch operates somewhat like a visual counter indicator in that an electrical contact is substituted for each digit seen on the wheel scale. Designed for applications that require switching one circuit after complete rotation, or switch-cycling another circuit after complete rotation, or switch-cycling another circuit, the first section makes 10 revolutions for 1 rev. of the second section, and in turn requires 10 rev. to 1 of the third section, etc. Five contact panel decades are arranged through a series of intermittent gear reduction mechanisms providing a total of 99,999 switch positions. The number of decade panels can be varied to suit individual requirements. Offered for application in computers, recorders, remote indicators and other electro-mechanical devices, the unit enables high speed operation up to 500 RPM: 1000 VDC insulation. Silver alloy contacts and rotors assure a minimum of two to three million operations.—**The Daven Co., 191 Central Avenue, Newark 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Other Products Being Shown

In addition to the many products described elsewhere in this issue, the following exhibits to be presented at the IRE Show, March 23-26, should prove of interest to engineers. Booth numbers are shown in parentheses.

Amperex Electronic Corp. (1-310)—High-power air-cooled tube, UHF tubes, magnetrons, transistors, thyratrons, klystrons, beam deflection tube.

Andrew Corp. (2-120)—UHF transmission line and waveguide, UHF antennas, coaxial fittings.

Avery Adhesive Label Corp. (4-817)—Pressure-sensitive labels and dispensers.

Boesch Mfg. Co. (3-211)—Toroidal coil winding machines, tape winders.

Bomac Labs., Inc. (4-907)—Gas switching tubes, thyratrons, semiconductors, TR systems, pressurizing windows.

Brush Electronics Co. (1-809)—Welding analyzer, magnetic recording components, surface finish indicator.

Bussman Mfg. Co. (3-120)—Dual-element and fast acting fuses; fuse blocks, clips and holders.

Centralab (2-403)—Printed circuits, variable resistors, switches, electronic organ banks, ceramic capacitors and insulators.

Engineering Research Assoc. (4-913)—Computers, storage drums, analog-to-digital converters, conveyor line sorting system, delay lines.

Hytron Radio & Electronics (2-316)—Filter-reactor tube, germanium diodes, tubes, transistors.

Kester Solder Co. (2-411)—Latest applications of pre-formed solder.

National Research Corp. (1-705)—Refined metals, diffusion pump, vacuum gauge.

Product Development Co. (3-115)—UHF-TV waveguide and transmission lines, fittings, reflectors, connectors, antenna assemblies.

Shallcross Mfg. Co. (2-210)—Hermetically-sealed wirewound resistors.

Victory Engineering Corp. (3-403)—Subminiature thermistors.

Waldes-Kohinor, Inc. (2-127)—Internal grooving tools, E-rings and dispenser

Exhibitors at IRE Convention

IRE Show Management's List features over 400 companies displaying $10 million of latest equipment at Grand Central Palace in New York
Asterisks indicate exhibitor is also occupying adjacent booths

Ace Eng. & Mach., Pa. 3-204*
Aerovox Corp., Mass. 1-602*
Aircraft-Marine, Pa. 4-502
Aircraft Transfmr., N.J. 4-213
Air-Marine Motors, N.Y. 4-315
Airpax Products, Md. 4-212
Airtron, N.J. 3-102
Alden Electr., Mass. 2-144
Alden Products, Mass. 2-143
Alfax Paper, Mass. 2-145
Allegh. Ludlum, Pa. 1-406*
Allied Control, N.Y. 2-209
Alpha Metals, N.J. 3-512
Alpha Wire, N.Y. 4-604
Altec Lansing, N.Y. 3-317
Amer. Elec. Mot., Calif. 4-717
American Lava, Tenn. 1-606
Amer. Phenolic, Ill. 1-101*
Amer. Radio Hdwr., N.Y. 4-701
Amer. Tel. & Rad., Minn. 2-304
Amperex Electr., N.Y. 1-310*
Ampex Elec., Calif. 4-405*
Amplifier Corp., N.Y. 3-314
Andrew Corp., Ill. 2-120
Anton Electr. Labs., N.Y. 4-108
Applied Science, N.J. 4-806
Arco Electr., N.Y. 4-308
Arnold Eng. Co., Ill. 1-406*
Astron Corp., N.J. 4-707
Atomic Instr. Co., Mass. 4-109*
Audio Devices, N.Y. 3-305
Audiocom, Inc., Mass. 3-310
Automatic Elec. Sales, Ill. 2-203
Avery Adh. Label, Calif. 4-817*
Avion Instr. Corp., N.J. 3-408
Ballantine Labs., N.J. 1-112
Barker & Williamson, Pa. 2-128
Barry Corp., Mass. 2-312*
Bart Labs., N.J. 3-525
Beam Instruments, N.Y. 2-117
Bendix Aviation, Md. 1-413*
Berkeley Scientific, Calif. 4-302*
Berlant Assoc., Calif. 3-304A
Beta Electric Corp., N.Y. 2-138
Bird Electr. Corp., Ohio 2-410
Bliley Electric Co., Pa. 2-510
Bodnar Industries, N.Y. 4-708
Boesch Mfg. Co., Conn. 3-211
Bogart Mfg. Corp., N.Y. 4-126
Bogue Electric Mfg., N.J. 4-205
Bomac Labs., Mass. 4-907
Bond Electr. Corp., N.J. 4-614
Boonton Radio, N.J. 2-521*
Borg Corp., Geo. W., Wis. 2-517
Brady Co., W. H., Wis. 2-503
Brand & Co., Wm. H., Conn. 4-519
Brentano's, N.Y. 2-501*
British Industries, N.Y. 2-515
Brooks & Perkins, Mich. 1-706
Brown Electro-Meas., Ore. 4-917
Browning Labs., Mass. 2-106*
Brush Electr., Ohio 1-809*
Buggie & Co., H.H., Ohio 4-520
Burlingame Assoc., N.Y. 2-135*
Burlington Instr., Iowa 2-323
Burroughs Add. Mach., Pa. 4-921
Bussmann Mfg., Mo. 3-120
C.G.S. Labs., Conn. 2-125*
C & H Supply Co., Wash. 3-526
Caldwell-Clements, N.Y. 2-215
Calidyne Co., Mass. 2-518
Cambridge Therm., Mass. 2-218
Cannon Electric, Calif. 2-512
Capitol Radio Eng., D.C. 3-106
Carboloy Dept., GE, Mich. 1-601
Cargo Packers, N.Y. 4-802
Centralab, Wis. 2-403*
Century Geophys., Texas 3-203
Chase Resistor, N.J. 4-712
Chatham Electr., N.J. 4-512
Chester Cable, N.Y. 4-704
Chicago Tel. Supply, Ind. 4-608
Clare & Co., C. P., Ill. 2-306
Clarostat Mfg. Co., N.H. 2-507*
Cleveland Contnr., Ohio 2-309
Ciba Co., N.Y. 4-909

Cohn, Sigmund, N.Y. 2-214
Coil Winding Equip., N.Y. 3-521
Collins Radio Co., Iowa 1-801*
Commun. Measure., N.J. 4-418
Condenser Prods., Ill. 2-112
Consolidated Eng., Calif. 4-413*
Consol. Vacuum, N.Y. 2-408*
Constantin & Co., L.I., N.J. 4-422
Continental Carbon, Ohio 2-133
Cont.-Diamond Fibre, Del. 4-603
Copperweld Steel Co., Pa. 4-911
Cornell-Dubilier, N.J. 1-807*
Corning Glass Works, N.Y. 1-416*
Cramer Co., R. W., Conn. 3-504*
Crest Labs., N.Y. 4-128
Crosby Labs., N.Y. 4-808
Crucible Steel Co., N.Y. 4-203*
Curtis Dev. & Mfg., Wis. 3-514
DX Radio Prods., Ill. 3-502
Dale Products, Nebr. 4-129
Daven Co., N. J. 1-118*
Davis Pub., Bryan, N.Y. 2-201
Decade Instr., N. J. 4-905
DeJur-Amsco, N.Y. 4-125
Deutschmann, Tobe, Mass. 3-520
Dialight Corp., N.Y. 1-504
Diamond Mfg., Mass. 4-309
Diamond Micro., Mass. 4-309
Driver, Wilbur B., N.J. 2-103*
DuMont Labs., CRT, N.J. 1-212*
DuMont, Tel. Trans., N.J. 1-208*
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Eitel-McCullough, Calif. 1-519
Elas. Stop Nut, N.J. 4-209*
Elco Corp., Pa. 4-313
Electra Mfg. Co., Mo. 4-217
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Electcl. Indus., N.J. 2-314
Electro Precision, N.Y. 3-410
Electro Tec Corp., N.J. 4-215
Electr. Assoc., N.J. 1-114*
Electr. Computer, N.Y. 4-425*
Electr. Devices, N.Y. 4-219
Electr. Instr. Co., N.Y. 4-401
Electr. Mechanics, N.J. 4-610
Electr. Parts Mfg., N.J. 3-508
Electr. Tube Corp., Pa. 2-519
Empire Devices, N.Y. 2-147
Eng. Resch. Assoc., Minn. 4-913*
Equipto Div., Aurora, Ill. 4-805
Erie Resistor, Pa. 1-123
Fairchild Camera, N.Y. 2-405*
Fairchild Recordg., N.Y. 3-400
Falstrom Co., N.J. 4-507
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Fed. Tel. & Radio, N.J. Fed. Hall
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Federated Metals, N.Y. 4-511*
Ferris Instr. Co., N.J. 1-301*
Filtron Co., N.Y. 1-502
Finn & Co., T. R., N.Y. 4-611
Fisher Radio Corp., N.Y. 3-304A
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Freed Transfmr., N.Y. 1-109
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General Ceramics, N.J. 1-506
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General Electric, N.Y. 4-120
General Instr., N.J. 4-518
Gen. Precision Lab., N.Y. 1-407*
General Radio, Mass. 1-121*
Gen. Transformer, Ill. 4-310
Germanium Prods., N.J. 4-605
Gertsch Prods., Calif. 4-113
Giannini, G. M., Calif. 4-706
Gomhos Co., John, N.J. 2-516
Grant Pulley, N.Y. 4-306
Gray Mfg. Co., N.Y. 1-402*
Grayhill, Ill. 4-612

Green Instr. Co., Mass. 3-118
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Hastings Instr. Co., Va. 4-420
Haydon Co., A.W., Conn. 1-619
Heiland Research, Colo. 3-212
Heinemann Elec., N.J. 4-620
Heldor Bushing, N.J. 2-111
Helipot Corp., Calif. 1-120
Heminway & Bartlett, N.Y. 3-513
Heppner Mfg. Co., Ill. 3-312
Hermetic Seal Prods., N.J. 1-701
Hewlett-Packard, Calif. 1-509*
Hickok Elec., Ohio 2-118
Hi-Q Div., Aerovox, N.Y. 1-602*
Hubbell, Harvey, Conn. 4-515
Hudson Tool & Die, N.J. 3-208
Hughes Aircraft Co., Calif. 4-814
Hughes Co., Kenneth, N.Y. 4-617
Hycor Co., Calif. 3-309
Hytron Radio, Mass. 2-316*
Illinois Condenser, Ill. 4-222
Indiana Steel Prods., Ind. 2-208
Indus. Hardware, N.Y. 2-101
Indus. Prods., Conn. 2-320*
Indus. Tape Corp., N.J. 4-607
Instr. Specialties, N.J. 3-110
Instr. Publishing, Pa. 2-108
Insuline Corp., N.Y. 2-202
International Nickel, N.Y. 1-521
Internatl. Resistance, Pa. 1-110
J-B-T Instruments, Conn. 2-130
JFD Mfg. Co., N.Y. 2-134
Jeffers Electronics, Pa. 4-127
Jennings Radio, Calif. 4-211
Jensen Mfg. Co., Ill. 3-506*
Jones Div., Cinch, Ill. 2-505*
Kalbfell Labs., Calif. 2-206*
Karp Metal Prods., N.Y. 1-510*
Kay Electric Co., N.J. 1-401
Kenyon Trans., N.Y. 1-615
Kepco Labs., N.Y. 4-406*
Kester Solder., Ill. 2-411
Ketay Mfg. Corp., N.Y. 4-711
Keystone Products, N.J. 4-609
Kimble Glass Co., Ohio 1-124*
Kings Electronics, N.Y. 2-204
Knights Co., James, Ill. 2-109
Krohn-Hite Instr., Mass. 4-301
Kulka Electric, N.Y. 2-139
Kupfrian Mfg. Co., N.Y. 3-101
Lab. for Electr., Mass. 4-105*
Lambda Electr., N.Y. 3-501
LaPointe Electr., Conn. 4-503
Lavoie Labs., N.J. 1-126*
Leland, G. H., Ohio 4-820
Littelfuse, Inc., Ill. 1-702
Lord Mfg. Co., Pa. 2-124
M B Mfg. Co., Conn. 2-110
Machlett Labs., Conn. 1-116*
Maclen Corp., D. C. 4-810*
MacLeod & Hanopol, Mass. 4-919
Magnecord, Ill. 3-301*
Magnetic Amplifiers, N.Y. 4-206
Magnetics, Inc., Pa. 4-616
Makepeace, D. E., Mass. 3-401
Mallory, P.R., Ind. 1-515*
Marconi Instr., N.Y. 1-520
Marion Elect., N.H. 2-303
McGraw-Hill Pub., N.Y. 2-301*
Measurements Corp., N.J. 2-327*
Melpar, Inc., Va. 4-816
Mepco, Inc., N.J. 2-121
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Metal Powder, N.Y. 4-719
Metal Textile, N.J. 4-223
Mica Fabricators, N.Y. 3-517
Micro Switch, Ill. 2-122
Microtran Co., N.Y. 4-128
Microwave Assoc., Mass. 4-218
Microwave Dev., Mass. 4-601
Midland Mfg. Co., Kans. 4-613
Midwestern Geoph., Okla. 4-403
Millen Mfg., James, Mass. 1-507
Millivac Instr., N.Y. 4-112

Milwaukee Trans., Wis. 4-807
Model Eng. & Mfg., Ill. 4-119
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Multi-Metal Wire Cl., N.Y. 4-314*
Muter Co., Ill. 3-506*
Mycalex Corp., N. J. 1-130*
NRK Mfg. & Eng., Ill. 2-212
National Carbon Co., N.Y. 1-514*
National Co., Inc., Mass. 2-105
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New Hermes Engrav., N.Y. 2-131*
Ney Co., J. M., Conn. 4-101
North Elec. Mfg., Ohio 4-517
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Oak Mfg. Co., Ill. 4-606
Ohmite Mfg. Co., Ill. 2-213
Optical Film Eng., Pa. 4-216
PSC Appl. Resch., Can. 4-122
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Panoramic Radio, N.Y. 2-123
Paramount Paper, Ind. 4-705
Par-Metal Prods., N.Y. 2-119
Penta Labs., Calif. 4-710
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Philco Corp., Pa. 1-501*
Phillips Control, Ill. 4-702
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Pioneer Elec., Ill. 3-519
Plastoid Corp., N.Y. 4-305
Polarad Electr., N.Y. 2-511
Polymer Corp., Pa. 3-503
Polytechnic Res., N.Y. 2-513*
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Potter Instr. Co., N.Y. 1-113
Precise Dev. Corp., N.Y. 4-426*
Precision Appar., N.Y. 2-307
Premier Met. Etch., N.Y. 4-710
Premier Met. Prod., N.Y. 4-509
Presto Recording, N.J. 3-306
Price Elec. Corp., Md. 4-501
Product Dev. Co., N.J. 3-115
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Pyramid Elec. Co., N.J. 2-310
REF Mfg. Corp., N.Y. 3-202
Racon Electric, N.Y. 3-315
Radell Corp., Puerto Rico 4-121
Radio Corp. of Amer., N.J. 1-304*
Radio-Electronics, N.Y. 2-141
Radio Magazines, N.Y. 3-316
Radio Materials, Ill. 2-509
Radio Receptor Co., N.Y. 2-113
Radio & Tel. News, N.Y. 3-402
Radioactive Prods., Mich. 4-115
Rawson Elec., Mass. 2-412
Raymond Eng., Conn. 4-903
Raytheon Mfg., Mass. 1-422*
Reeves Instr., N.Y. 1-423
Rex Corp., Mass. 3-119
Rhode I. Ins. Wire., R.I. 4-703
Rider, John F., N.Y. 3-523
Riester & Thesmacher, O. 4-130
Robinson Aviation, N.J. 2-216*
Rola Co., Ohio 3-506*
Roller-Smith Corp., Pa. 4-521
Rotron Mfg. Co., N.Y. 3-201
Rutherford Electr., Calif. 3-111
Sanborn Co., Mass. 2-116
Sangamo Electric, Ill. 3-510
Scheidl Mfg. Co., N. Y. 4-416
Schutter, Carl W., N.Y. 2-205
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Scientific Specits., Mass. 4-822
Secon Metals Corp., N.Y. 4-506
Servo Corp., N.Y. 3-524
Servomechanisms, N.Y. 4-207*
Sessions Clock, Conn. 3-107*
Shallcross Mfg. Co., Pa. 2-210*
Sheldon Electric, N.J. 3-206*
Sigma Instr., Mass. 2-311
Simpson Electric, Ill. 1-128
Smith, Herman H., N.Y. 3-511
Sola Electric Co., Ill. 1-405
Sorensen & Co., Conn. 2-318*
Southwstn. Indus., Texas 4-116*
Speer Resistor, Pa. 4-127

Spencer-Kennedy, Mass. 2-142
Sperry Gyroscope, N.Y. 1-607*
Sprague Electric, Mass. 1-410*
Square Root Mfg., N.Y. 2-520
Stand. Elec. Time, Mass. 4-417
Standard Piezo, Pa. 2-305
Standard Transfmr., Ill. 4-801
Stevens, George, Ill. 4-516
Stevens Mfg. Co., Ohio 2-140
Stupakoff Ceramic, Pa. 3-105
Superior Electric, Conn. 1-103*
Surprenant Mfg., Mass. 4-201*
Swank, Wally B., N.Y. 4-612
Switchcraft, Inc., Ill. 3-114
Sylvania Electric, N.Y. 2-102
Sylvania Electric, N.Y. 1-106*
Synthane Corp., Pa. 2-129
Taylor Tubes, Ill. 4-622
Tech Labs., N.J. 2-146
Tech-Master Prods., N.Y. 3-112
Technical Materiel, N.Y. 1-703*
Technitrol Eng., Pa. 4-107
Technology Inst., Mass. 1-111
Tektronix, Inc., Ore. 2-401*
Telechrome, N.Y. 3-407
Telechron Dept., GE, Mass. 1-129
Teletronics Lab., N.Y. 4-901
Television Equip., N.Y. 3-406
Tel-Instrument, N.J. 2-114*
Tensolite Ins. Wire, N.Y. 4-124
Thomas Electr., N.J. 4-220*
Thompson Prods., Ohio 3-209
Thor Ceramics, N.J. 3-409
Tinnerman Prods., Ohio 3-404*
Titeflex, Inc., N.J. 2-308
Trad Television, N.J. 4-419
Triad Trans., Calif. 4-602
Triplett Elec. Inst., Ohio 2-504
Truscon Steel Co., Ohio 2-322
Tung-Sol Elec., N.J. 4-715
Ulanet, George, N.J. 4-131
Ungar Elec. Tools, Calif. 4-303
United Catalog Pub., N.Y. 3-518
U. S. Gasket Co., N.J. 3-103
United Transfmr., N.Y. 1-132
Universal Avia., N.Y. 4-416
Univ. Loudspeakers, N.Y. 3-311
Vacuum-Electr., N.Y. 4-404
Vacuum Metals, Mass. 1-705
Varian Assoc., Calif. 1-617
Vector Electr., Calif. 3-515
Vectron, Inc., Mass. 3-411
Victoreen Instr. Co., Ohio 4-103*
Victory Eng. Corp., N.J. 3-403
Vitramon, Inc., Conn. 3-516
Waldes Kohinoor, N.Y. 2-127
Wang Labs., Mass. 4-803
Ward Leonard Elec., N.Y. 3-113
Waveforms, Inc., N.Y. 3-313
Waterman Prods., Pa. 1-414
Welch Sci., W.M., Ill. 2-137
Western Litho. Co., Calif. 1-105
Westinghouse Elec., Pa. 1-610*
Weston Elec. Inst., N.J. 4-409*
White Industries, N.Y. 3-304B
Whitso, Inc., Ill. 4-721
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Workshop Assoc., Mass. 1-513

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Braun Tool & Instrument, N.J. 4-424
Canadian Radium & Uranium Corp., N.Y. 4-522
Cinch Mfg. Co., Ill. 2-505
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Digital Instrument Co., Fla. 4-111
Etched Products Corp., N.Y. 4-617
Industrial Television Inc., N.J. 3-509
Inet, Inc., Calif. 4-423
Jerrold Electronics Corp., Pa. 4-618
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Photo Chemical Products Inc., N.Y. 3-308
Popper & Sons Inc., N.Y. 4-818
Radio City Products Inc., N.Y. 3-307B
Reiner Electronics Co. Inc., N.Y. 3-307B
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New TV Station Timetable

Geographical listing of new outlets for which "post-freeze" FCC grants and construction permits have been issued through March 2, 1953

State and City	Call Letters	Channel No.	Date On Air
ALABAMA			
Birmingham	WJLN	48	10/53
Birmingham	WSGN-TV	42	*
Gadsden	WTVS	21	4/53
Montgomery	WCOV-TV	20	3/53
ARIZONA			
Mesa	KTYL-TV	12	4/53
Tucson	KVOA-TV	4	3/53
Tucson	KCNA-TV	9	*
ARKANSAS			
Ft. Smith	KFSA-TV	22	5/53
Little Rock	KRTV	17	4/53
Little Rock	KETV	23	*
CALIFORNIA			
Bakersfield	KAFY-TV	29	4/53
Fresno	KMJ-TV	24	5/53
Los Angeles	KPIK	22	9/53
Los Angeles (NCE)	KUSC-TV	28	*
Salinas	KICU	28	9/53
San Bernardino	KITO-TV	18	10/53
Santa Barbara	KEYT	3	5/53
Stockton	KTVU (TV)	36	9/53
COLORADO			
Colorado Springs	KRDO-TV	13	4/53
Denver	KDEN	26	Spring
Denver	KIRV	20	*
Pueblo	KCSJ-TV	5	3/53
Pueblo	KDZA-TV	3	3/53
CONNECTICUT			
Bridgeport	WICC-TV	43	2/53
Bridgeport	WSJL	49	2/53
Bridgeport (NCE)	*	71	*
Hartford (NCE)	*		*
New Britain	WKNB-TV	30	*
New London	WNLC-TV	26	8/53
Norwich (NCE)	*	*	*
Waterbury	WATR-TV	53	3/53
FLORIDA			
Ft. Lauderdale	WITV	17	*
Ft. Lauderdale	WFTL-TV	23	4/53
Lakeland	WONN-TV	16	*
Pensacola	WPFA	15	6/53
St. Petersburg	WSUN-TV	38	5/53
West Palm Beach	WIRK-TV	21	6/53
IDAHO			
Boise	KIDO-TV	7	6/53
Boise	KGEM-TV	9	Fall
ILLINOIS			
Belleville	WTVI	54	5/53
Chicago	WHFC-TV	26	*
Danville	WDAN-TV	24	12/53
Decatur	WTVP	17	7/53
Peoria	WTVH-TV	19	*
Rockford	WTVO	39	4/53
INDIANA			
Lafayette	WFAM-TV	59	5/53
Muncie	WLBC-TV	49	3/53
IOWA			
Fort Dodge	KQTV	21	10/53
Sioux City	KWTV	36	*
Sioux City	KVTV	9	4/53
KANSAS			
Hutchinson	*	12	*
Manhattan (NCE)	KSAC-TV	8	*
KENTUCKY			
Ashland	WPTV	59	7/53
Henderson	WSON-TV	50	5/53
Louisville	WKLO-TV	21	6/53
Louisville	WLOU-TV	41	*
LOUISIANA			
Baton Rouge	KHTV	40	*
Lake Charles	WTAG (TV)	25	6/53
Monroe	KNOE-TV	8	4/53
Monroe	KFAZ-TV	43	5/53
MARYLAND			
Baltimore	WITH-TV	60	*
Frederick	WFMD-TV	62	*
MASSACHUSETTS			
Fall River	WSEE-TV	46	5/53
New Bedford	WNBH-TV	28	3/53
Northampton	WACE-TV	36	*
Springfield	WACE-TV	36	12/53
Springfield-Holyoke	WWLP	61	3/53
Springfield-Holyoke	WHYN-TV	55	3/53
MICHIGAN			
Ann Arbor	WPAG-TV	20	3/53
Battle Creek	WBKZ-TV	64	5/53
Battle Creek	WBCK-TV	58	8/53
East Lansing	WKAR-TV	60	8/53
Flint	WCTV	28	Spring
Flint	WTAC-TV	16	*
Jackson	WBIM-TV	48	*
Kalamazoo	WKMI-TV	36	*
Lansing	WILS-TV	54	9/53
Muskegon	WTVM	35	11/53
Saginaw	WKNX-TV	57	3/53
MINNESOTA			
Duluth	KFTV	38	3/53
Rochester	KROC-TV	10	5/53
St. Cloud	WJON-TV	7	*
MISSISSIPPI			
Meridian	WCOC-TV	30	*
MISSOURI			
Columbia (NCE)		8	*
Festus	KACY-TV	14	6/53
Kansas City	KCTY	25	7/53
St. Joseph	KFEQ-TV	2	4/53
St. Louis	KSTL-TV	36	*
Springfield	KTTS-TV	10	4/53
Springfield	*	3	7/53
MONTANA			
Billings	*	8	*
Butte	KOPR-TV	4	9/53
Great Falls	KFBB-TV	5	*
NEBRASKA			
Lincoln	KOLN-TV	12	3/53
Lincoln	KFOR-TV	10	4/53
NEVADA			
Reno	KZTV	8	3/53
NEW JERSEY			
Asbury Park	WCEE-TV	58	Late '53
Atlantic City	*	52	*
New Brunswick (NCE)	WTLV	19	*
NEW MEXICO			
Roswell	*	8	*
Santa Fe	*	2	*
NEW YORK			
Albany (NCE)	WRTV	17	*
Binghamton (NCE)	WQTV	46	*
Buffalo (NCE)	WTVF	23	*
Buffalo	WBUF	17	4/53
Buffalo	WBES-TV	59	9/53
Elmira	WTVE	24	4/53
Ithaca (NCE)	*	14	*
Ithaca	WHCU-TV	20	11/53
Jamestown	WJTN-TV	58	*
Kingston	WKNY-TV	66	*
N. Y. City (NCE)	WGTV	25	*
Poughkeepsie	WEOK-TV	21	10/53
Rochester (NCE)	WROH	21	*
Syracuse (NCE)	WHTV	43	*
Watertown	WWNY-TV	48	*
NORTH CAROLINA			
Asheville	WISE-TV	62	4/53
Greensboro	WCOG-TV	57	*
Raleigh	WETV	28	4/53
Winston-Salem	WTOB-TV	26	8/53
NORTH DAKOTA			
Fargo	WDAY-TV	6	*
OHIO			
Akron	WAKR-TV	49	Winter
Dayton	WIFE	22	7/53
Lima	WLOK-TV	73	3/53
Lima	WIMA	35	Summer
Massillon	WMAC-TV	23	3/53
Sandusky	WLEC-TV	42	12/53
Warren	WHHH	67	*
Youngstown	WUTV	21	7/53
Zanesville	WHIZ-TV	50	4/53
OKLAHOMA			
Lawton	KSWO-TV	7	3/53
OREGON			
Salem	*	24	*
PENNSYLVANIA			
Bethlehem	WLEV-TV	51	*
Easton	WEEX-TV	57	Spring
Harrisburg	WHP-TV	55	4/53
Harrisburg	WTPA (TV)	71	*
Hazelton	WAZL-TV	63	*
Johnstown	WARD-TV	56	*
New Castle	WKST-TV	45	3/53
Philadelphia	WIP-TV	29	*
Pittsburgh	WENS	16	9/53
Pittsburgh	WTVQ	47	8/53
Pittsburgh	WKJF-TV	53	5/53
Reading	WEEU-TV	33	7/53
Scranton	WTVU	73	3/53
Scranton	WGBI-TV	22	4/53
Wilkes-Barre	WILK-TV	34	*
Williamsport	WRAK-TV	36	*
York	WNOW-TV	49	4/53
SOUTH CAROLINA			
Charleston	WCSC-TV	5	4/53
Columbia	WNOK-TV	49	4/53
Columbia	WCOS-TV	25	Spring
Greenville	*	23	*
SOUTH DAKOTA			
Sioux Falls	KELO-TV	11	3/53
TENNESSEE			
Chattanooga	WTVT	43	3/53
Chattanooga	WOUC	49	*
Johnson City	*	11	*
Memphis	*	13	*
TEXAS			
Amarillo	KGNC-TV	4	3/53
Amarillo	KFDA-TV	10	3/53
Austin	KCTV	18	*
Austin	KTVA	24	*
Beaumont	KBMT	31	5/53
Dallas	*	23	*
El Paso	KEPO-TV	13	4/53
Galveston	KGUL	11	3/53
Galveston	KTVR	41	*
Houston (NCE)	KUHT	8	5/53
Houston	*	23	*
Houston	KNUZ-TV	39	7/53
Lubbock	KCBD-TV	11	4/53
San Angelo	KTXL-TV	8	*
San Angelo	KGKL-TV	3	*
Temple	*	6	*
Tyler	*	19	*
Waco	KANG-TV	34	6/53
Wichita Falls	KTVW	22	4/53
Wichita Falls	KFDX-TV	3	3/53
Wichita Falls	KWFT-TV	6	3/53
VIRGINIA			
Charlottesville	*	64	*
Danville	WBTM-TV	24	*
Lynchburg	WWOD-TV	16	*
WASHINGTON			
Bellingham	KVOS-TV	12	5/53
Tacoma	KMO-TV	13	5/53
Yakima	KIMA-TV	29	3/53
Yakima	KIT-TV	23	7/53
WISCONSIN			
Appleton	WNAM-TV	42	9/53
Green Bay	WBAY-TV	2	*
Madison	WKOW-TV	27	6/53
Madison	*	33	6/53
Neenah	WNAM-TV	42	Fall
Oshkosh	WOSH-TV	48	4/53
WYOMING			
Cheyenne	KFBC-TV	5	*
HAWAII			
Honolulu	KAMI	11	Early '53
PUERTO RICO			
San Juan	WKAQ-TV	2	Late '53

* Information not available at press time.
(NCE) Noncommercial educational station

NEW TV STATIONS on the AIR

State and City	Call Letters	Channel No.	Date On Air
ALABAMA			
Mobile	WKAB-TV	48	12/52
Mobile	WALA-TV	10	1/53
ARIZONA			
Tucson	KOPO-TV	13	2/53
COLORADO			
Colorado Springs	KKTV	11	12/52
Denver	KBTV	9	10/52
Denver	KFEL-TV	2	7/52
ILLINOIS			
Peoria	WEEK-TV	43	1/53
INDIANA			
South Bend	WSBT-TV	34	12/52
LOUISIANA			
Baton Rouge	WAFB-TV	28	1/53
MAINE			
Bangor	WABI-TV	5	2/53
MISSISSIPPI			
Jackson	WTVJ	25	2/53
NEW JERSEY			
Atlantic City	WFPG-TV	46	12/52
OHIO			
Youngstown	WKBN-TV	27	1/53
Youngstown	WFMJ-TV	73	2/53
OREGON			
Portland	KPTV	27	9/52
PENNSYLVANIA			
Altoona	WFBG-TV	10	2/53
Reading	WHUM-TV	61	2/53
Wilkes-Barre	WBRE-TV	28	1/53
York	WSBA-TV	43	12/52
TEXAS			
Austin	KTBC-TV	7	11/52
El Paso	KROD-TV	4	12/52
El Paso	KTSM-TV	9	1/53
Lubbock	KDUB-TV	13	11/52
VIRGINIA			
Lynchburg	WLVA-TV	13	2/53
Roanoke	WSLS-TV	10	12/52
Roanoke	WROV-TV	27	2/53
WASHINGTON			
Spokane	KXLY-TV	4	2/53
Spokane	KHQ-TV	6	12/52
Tacoma	KTNT-TV	11	3/53
HAWAII			
Honolulu	KGMB-TV	9	12/52
Honolulu	KONA	11	11/52
MEXICO			
Tijuana	XETV	6	2/53

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

TV HEARING LOAD—The FCC leadership has quickly recognized that its task of processing the tremendous number of applications for television stations which require hearings, is extremely difficult and that some solution for speedier authorizations must be found. Retiring FCC Chairman Paul A. Walker told the House Interstate and Foreign Commerce Committee that with the limited numbers of examiners and regular engineering and legal staff of the Commission available for the hearings the FCC has in prospect a hearing load that may last for years. It is recognized by the FCC Commissioners, particularly Vice Chairman Rosel H. Hyde, that a revision of the hearings and processing procedures to expedite the Commission approvals of new television stations so as to serve the American public is imperative.

EXCELLENT PROPOSAL—What appeared to be an excellent plan for accelerating the expansion of TV service throughout the nation was presented to the FCC by the head of a Fresno, Cal., station, (KFRE) Paul R. Bartlett, who proposed that the Commission approve an interim station with a "trustee corporation," composed of directors from the two or more competing TV applicants and one or more "public members." The latter would be community-minded citizens with voting power to resolve any disputes among the applicants who would jointly finance the interim operation of the television station. Columbia Broadcasting System President Frank Stanton endorsed the plan to the FCC as a "significant and constructive suggestion."

MANY VACANT TV AREAS— Not only does the FCC have a backlog of more than 900 television station applications, many of which are competing organizations requiring lengthy hearings, but there are many cities and large towns in the country without a single video station or with only one station in operation. It is disclosed that there are 69 areas with 25,000 or more population without any television service whatsoever and with competing applications which may prevent the building of new TV stations for several years. There are also 51 communities with only one station and in this group there are three and a half million families with video receivers confined to one program service.

TELE-TECH'S FREQUENCY CHART—The House Appropriations Independent Offices Subcommittee which handles the FCC funds learned about the frequency allocation problem during the recent hearings on the next fiscal year's appropriations for the FCC through the TELE-TECH Frequency Chart. Copies of the chart were distributed by FCC Commissioner E. M. Webster to the members of the House Subcommittee as the best medium for exposition of the spectrum and the Commission's responsibilities in the allocations of frequencies to the myriad of radio services.

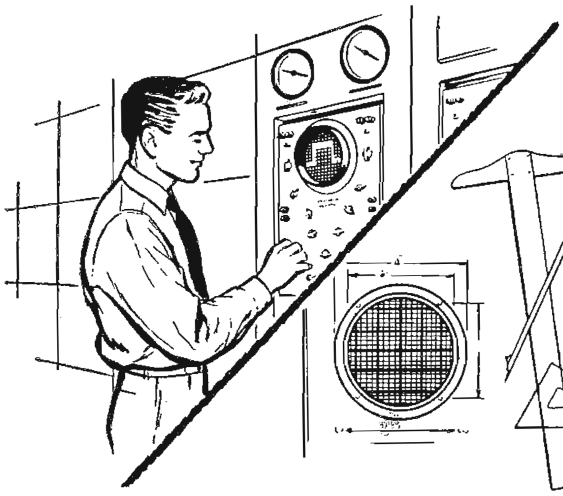
THEATRE TELEVISION PLAN—The FCC has a difficult decision to make in the theater television service situation and wrestled all March with the latest proposal of the motion picture industry that there would be no objection on the part of the motion picture producers and the film theaters if theater TV limited common carriers, eligible for use of existing common carrier fixed frequencies, are authorized under certain conditions. These conditions are that the FCC will expect all common carriers to cooperate in the resolution of conflicts pertaining to the use of the latter's fixed frequencies through advance consultations, that the Commission will expect interconnection of common carriers' facilities where frequency usage conflicts, and that in such cases general common carriers will be expected to provide facilities technically equivalent to those of the theater television carrier with which interconnection is desirable. In event of FCC approval of this plan the motion picture industry stated it would not interpose objection to a dismissal of its request for exclusive frequencies for theater television.

MISCELLANY—FCC is prepared to review color television situation, particularly to sanction an all-electronic compatible system, this summer through procedures already established. . . . Television organizations and engineering experts feel FCC must give better protection against TV interference in its plan for assignment of the 72-76 megacycle band to operational safety fixed stations and fixed stations in the domestic public service. . . . Regional frequency coordinating committees in seven areas of the country are to be established by the newly formed Special Industrial Radio Service Association as result of St. Louis meeting.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

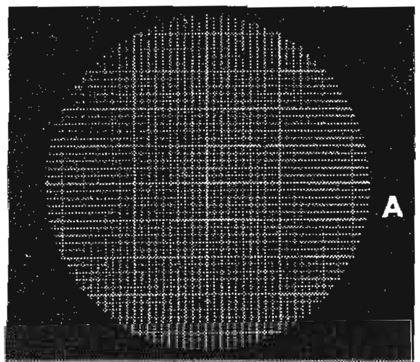
DU MONT STANDARD ACCESSORIES FOR CATHODE-RAY OSCILLOGRAPHS

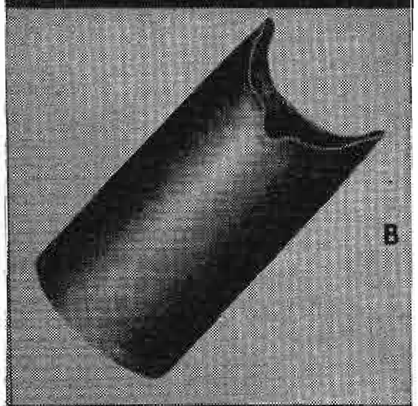


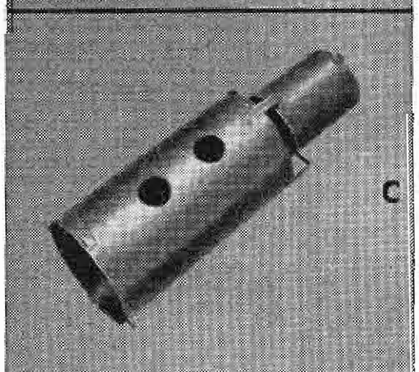
Whether you own a cathode-ray oscillograph or are designing cathode-ray oscillographs for production—Du Mont standard accessories increase the usefulness of your oscillograph to *you*—increase the usefulness of your oscillograph to your *customer*. Standard Du Mont oscillographic accessories enable photographic recording from the cathode-ray tube screen—ease viewing of the screen—aid in making measurements from the cathode-ray tube—reduce the effects of external magnetic fields—and many others.

For information on these and other accessories to complete your cathode-ray oscillograph, write to:

Technical Sales Department
INSTRUMENT DIVISION, ALLEN B. DU MONT LABORATORIES, INC.
1500 Main Avenue, Clifton, New Jersey







When writing for prices include quantity and end use intended.

A—Illuminated Scale Kit—Type 2562 – Includes scale, dimmer control, four connected illuminating lights, Type 2501-A Bezel, and color Filter. Excellent for time and amplitude calibration for visual and photographic measurements. Scale intensity variable from dark to more than sufficient for viewing or photography. $15.50

B—Viewing Hood—Type 276-A – Black rubber hood for any five-inch cathode-ray oscillograph. Produces darkened room conditions even in a brightly lighted room. $5.25

C—Magnetic Shields—Types 2502, 2503, 2521-A – Made of carefully annealed mu-metal for best shielding. These standard shields fit most commonly used types of cathode-ray tubes. Specially fabricated shields available to your designs. $22.75 to $29.95

D—Bezel—Type 2501-A – Circular metal flange for five-inch cathode-ray oscillographs. Adapts oscillographs for mounting standard color filters, oscillograph-record cameras, viewing hoods, calibrated scales, projection lenses, etc. $2.50

E—Terminal Adapters—Type 2592–52, 75 or 93 ohm terminated adapters for UHF or BNC connectors or 52 and 75 ohm adapters for Type N connector. Adapts standard 3/4'' center terminals to signals carried on coaxial lines. $5.00

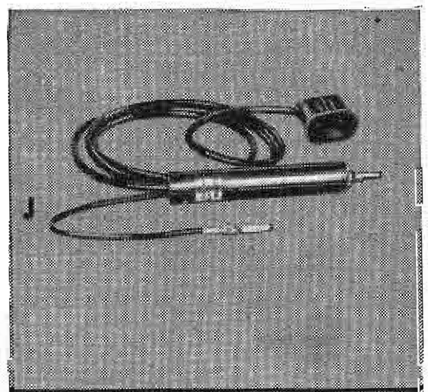
F—High-voltage Connectors and Cables—Types 2546, 2547–Low corona loss cables designed to carry up to 25 kilovolts d.c. at low current values. $14.60 to $48.00

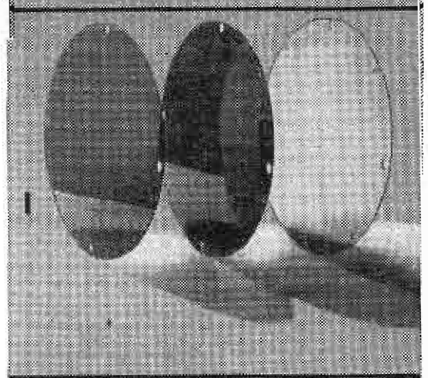
G—Movable Table—Type 2602–Sturdy metal table with adjustable top, lower shelf, storage drawer and four heavy-duty casters. Extremely mobile and adaptable to carrying a large variety of instruments. $95.00

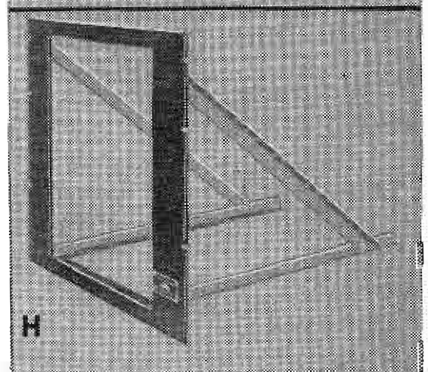
H—Rack-mounting Adapter—Type 2598–Standard 19'' relay rack. Adapts Du Mont Types 303, 303-A, 303-AH or 322 for rack mounting. $35.00

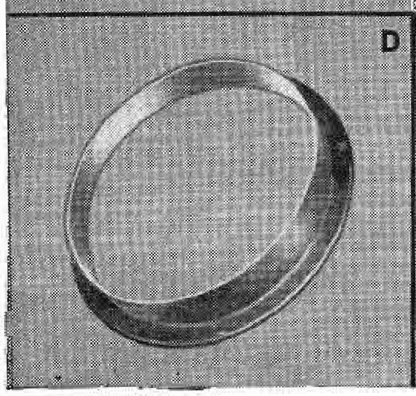
I—Color Filters—Types 2560-D, 260-E, 2560-F–Heavy plastic. Improves contrast especially with a high level of ambient light on the screen. Color of filter matches screen type. $2.75

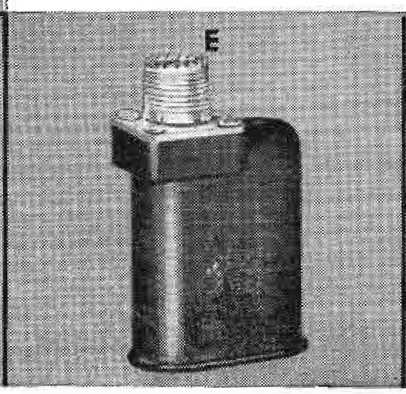
J—Test Probes—Type 2507, 316, 316-A–A-C and D-C Probes. Offer high impedance to signal at low capacitance. $25.30 to $27.00

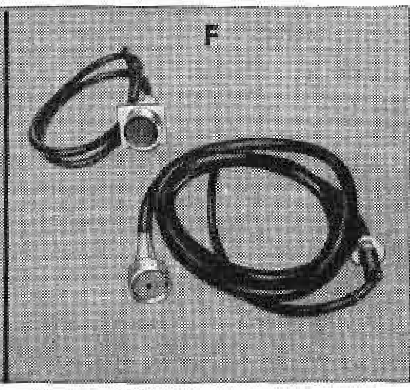


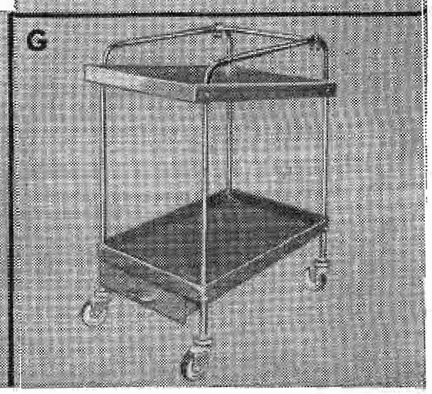








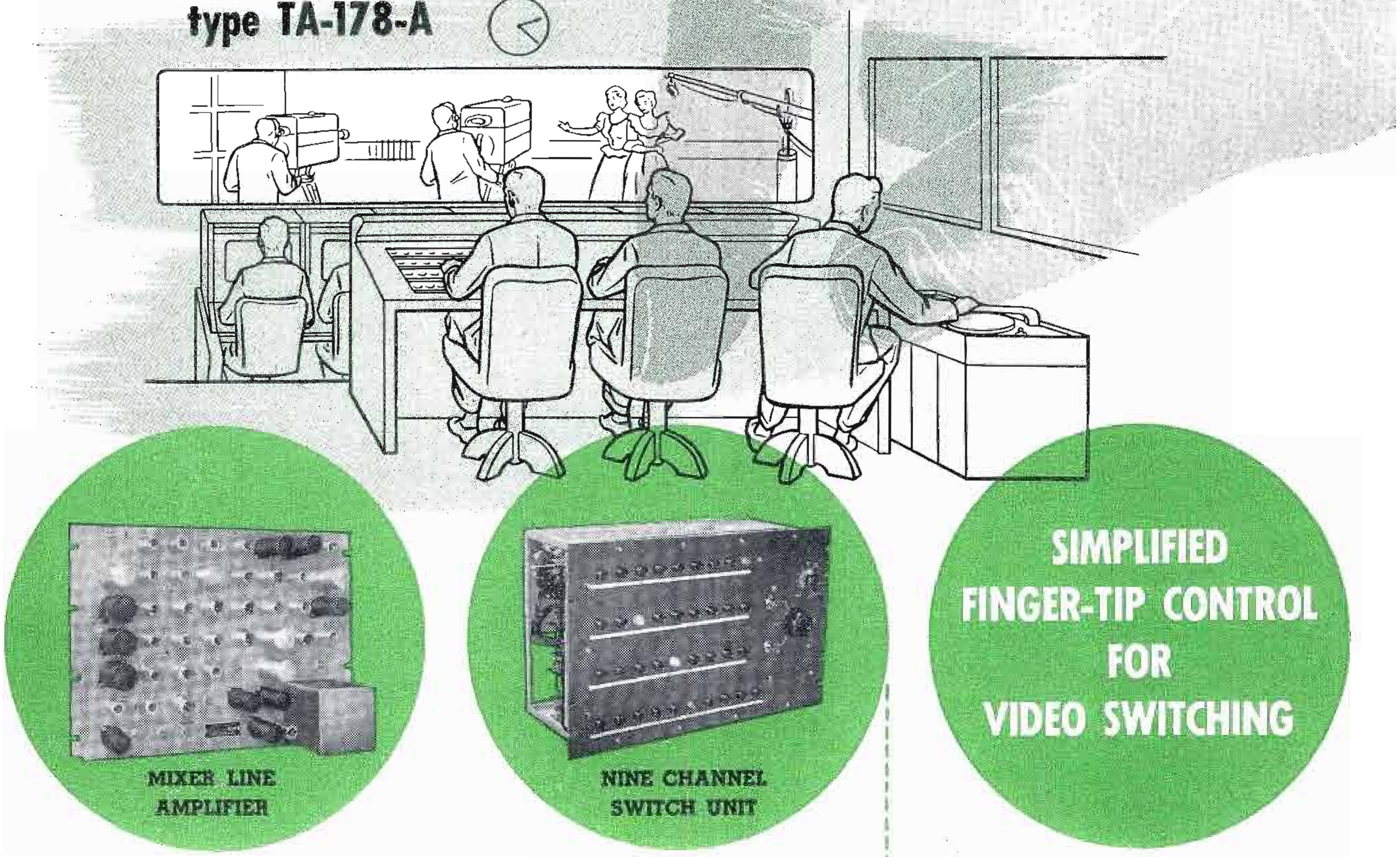




DuMont

VIDEO SWITCHING — MIXING EQUIPMENT

type TA-178-A



Comprising the Nine-Channel Switch Unit (5262-A), Mixer Line Amplifier (5263-A) and Low Voltage supply (5019-A).

Variety of special effects, achieved quite simply with the provisions in the Mixer Amplifier, can be previewed before being put on the air. Single Mixer Control at Switching unit permits smooth transition from one channel to another. Again, another control at Switch Unit determines bus cutoff voltage cross-over point, so that any degree of fading, lapping or superimposing of two signals an be accomplished. Provision is made available in the Mixer Amplifier for insertion of special blanking to create special effects such as wipes, montages, etc.

While main line is feeding transmitter, the mixer amplifier output can be used to feed, simultaneously, a different mixed studio show to an audition circuit. The Mixer Amplifier has three identical program outputs which may be fed to transmitter, network cable and master line monitor.

First with the Finest in Television

TELEVISION TRANSMITTER DIVISION

ALLEN B. DU MONT LABORATORIES, INC.

1500 Main Avenue, Clifton, N. J.

FEATURES

Switch Unit available for mounting in standard 19" relay rack or in console. Mixer Line Amplifier and its power supply are rack-mounted.

All channels take either local or remote signals.

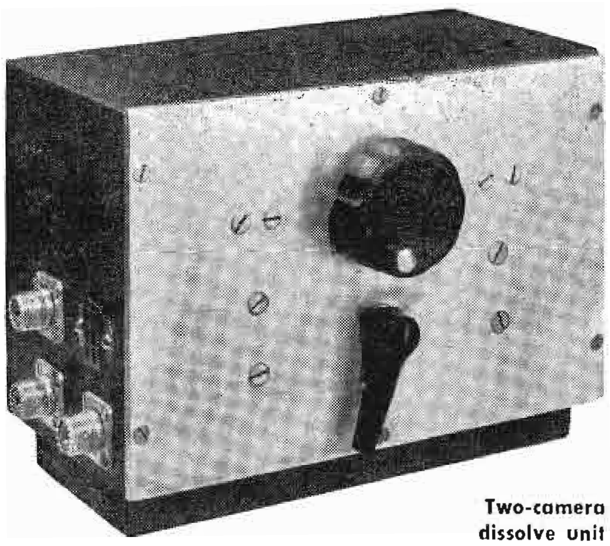
Lap, fade or super are achieved with single control. Facilities for inserting special blanking (horizontal wipes, montages, etc.). Preview for special effects.

Sync insertion on local signals, controlled by pushbuttons. No switching transients on main-line switching. Automatic pedestal setup incorporated in mixer amplifier.

Frequency response of preview monitor No. 1 amplifier, mixer amplifier and main-line amplifier flat within 0.5 db to 8 MC: less than 6 db down at 10 MC. Preview Monitor No. 2 amplifier flat with in 0.5 db to 6 MC: less than 6 db down at 8 MC.

Lucite, pushbuttons lighted internally when button is pressed.

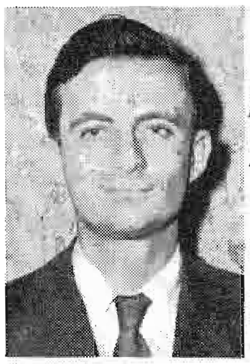
FURTHER DETAILS and QUOTATIONS ON REQUEST



Two-camera dissolve unit

Simple TV Camera Dissolve Unit

Easily constructed two-camera control maintains constant mixed output level. Stable on-off tally light switching coupled to potentiometer shaft



By
R. M. Crotinger
Remote Engineering Supervisor
WHOI-TV
45 S. Ludlow St.
Dayton, Ohio

THE effective operation of a TV station requires that superimposition of camera chains be utilized to break the monotony of continual switches and to provide the artistic affects of good programming. Equipment required for this is always basic in its design although there are several methods of accomplishing the same result. In the case of the unit described here, it was desired to provide for switching or dissolving two camera outputs. The cameras could, of course, be either two studio or field cameras, two film cameras, or one film and one studio camera. In the description that follows, several features will be shown which can be incorporated in similar equipment which might be constructed to accommodate more cameras.

Since the output of a camera control is usually cathode-coupled from the output stage into a 72-ohm termination at the receiving end, the mixing of two camera outputs should be done in such a manner as not to decrease the load seen by the cathode output of either camera. In standard pushbutton switches, sometimes an attempt at superimposition is made by pushing in two buttons at the same time. This method is always obvious on the air as the two cameras are now paralleled into a load of half that of one camera used alone. The result is that the level drops to one-half amplitude and should the camera control operator readjust the camera outputs to compensate for this, the switch back to one camera causes the level to be considerably too high. The switch-dissolve unit must therefore provide a mixed level which will remain constant throughout the dissolve.

In the unit shown, resistance is merely added in series with the output of the camera control being dissolved out until the level is such a small percentage of the total output that it can be opened completely. This is shown in Fig. 1, where it will be seen that if R_1 and R_2 are turned through their range together and one increases while the other decreases, the output level will remain the same. Of course, the two potentiometers must have a linear taper and their maximum value must be just enough to drop the camera output to a negligible level at the mixed output. The lead used to carry the mixed output to the equipment being fed should be as short as possible since the impedance of the unit goes over a thousand ohms during the mid-range of the pots. Under these conditions the shunt capacity from the output lead to ground could become effective. If the unit is used with a standard pushbutton switcher, it can be located close to it and fed into one of the auxiliary inputs. The termination resistor must of course be taken off the input it is fed into as the unit itself has a termination for each of the two inputs. In any case, even if the connecting coax lead is comparatively long, the shunt capacity will only become effective when a camera is being dissolved out.

The value of 5,000 ohms for the potentiometers will permit only the brightest highlights to show up in the output when a camera is dissolved out. To positively eliminate this, the pots are made to open completely at maximum "dissolved out" position by carefully cutting a small slot in the carbon element so that the arm will just pass over this point at maximum rotation. The cut in the carbon need not be wide, a razor's edge width is sufficient.

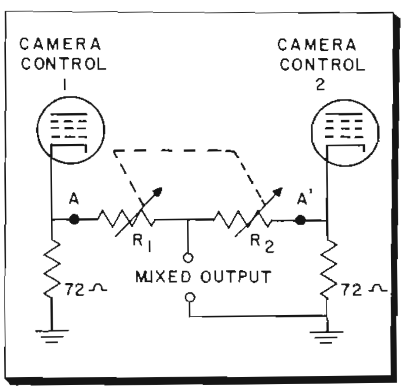
So far, we have provided a very simple solution to the problem of dissolving, but we must also be able to switch. This is accomplished quite easily by utilizing a reversing switch to transpose points A and A′ in Fig. 1. A look at the schematic diagram (Fig. 2) will disclose this.

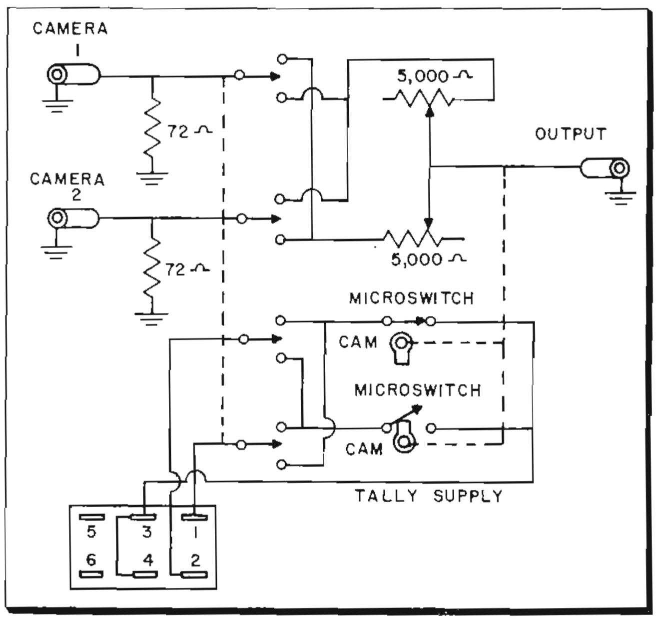
The tally lights on the camera

(*Continued on page* 146)

Fig. 1: (below) Basic mixing circuit. R_1 is maximum when R_2 is minimum

Fig. 2: (r) Two-camera dissolve unit with tally light controls





CUES for BROADCASTERS

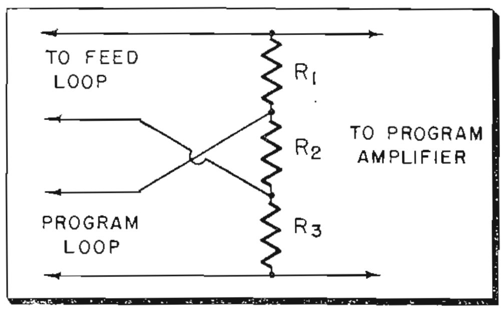
(*Continued from page 85*)

• Relay $R1_1$ is of the polarized telephone type and operates only when the transmitter program switch S_1 is in the "Tape" position. Its operation is independent of the position of switch S_2 which changes the magnitude of the current in the circuit. Relay $R1_2$ is adjusted so that it actuates only when the cue switch S_2 increases the current by shorting R_1 when in the "Tape" position. The push switch S_3 is used to blink the lamp at the studio for alerting the operator when he is on mike. One set of contacts on S_2 parallels the relay contacts on $R1_1$ and holds the red lamp on to warn the operator to return the cue switch to the "Studio" position when he gets a green light. Switch S_1 also operates a set of indicator lamps at the transmitter which serve as a rapid check of proper switch position since the lamps at the transmitter should be paired two red or two green.

Economical Audio Bridge

HENRY N. FONER, Chief Engineer, WDIA, Bluff City, Tenn.

OCCASIONALLY it is necessary for small stations to feed a program being broadcast to another outlet, but not frequently enough to warrant the purchase of an expensive bridging amplifier.



Cheap bridging circuit uses standard resistors and provides adequate isolation

With this simple circuit it is possible to bridge in using three 500 ohm resistors yet it affords complete line insulation if the precaution is taken to use resistors of equal value. Use of this necessitates increasing the output level of the amplifier since the output divides across the network. Inasmuch as most program or line amplifiers are operated at low levels, no difficulty should be experienced.

Tape Conversion

T. J. McDERMOTT, WABY, Albany, N. Y.

HAVE you ever received a tape program recorded at 3.75 in. speed only to find that your tape equipment is not able to play back at that speed? That was the case at WABY when I received a political talk on tape recorded at the slower speed. Being unable to get a playback machine for 3.75 in. speed on short notice I devised the following:

The tape was played on a mechanical unit at 7.5 in. speed and recorded it on a second unit at 15 in. speed. Played back on the air at 7.5 in. speed, it sounded O.K.

Of course to do this, one has to have two machines or other equipment which will play back and record simultaneously. We used two Presto mechanical units and one amplifier, which are equipped with a switch for duplex operation as described on pages 46 and 48, Sept., 1951, TELE-TECH.

Cue Outlet

RAY BOHNERT, Chief Engineer, WIGM, Medford, Wisc.

AN improvement to permit using the Magnecord PT6-JA amplifier as a remote amplifier is the addition of headphone jack for receiving cue from the station. The regular monitor jack will not provide cue to the remote engineer since it is connected to a separate winding of the output transformer. A convenient way is to mount a standard phone jack on a small bracket, and attach in the space in the back of the case beside the amplifier chassis with a couple of screws so it does not touch the chassis, and does not interfere with the rear cover.

The jack may also be mounted directly on the chassis provided that insulating washers are used. If it is not mounted on the chassis, it can be wired to the 600 ohm terminals on the rear of the chassis with soldering lugs so the amplifier can be removed from the case without dismantling the phone jack. Isolate the phones from the line with a series resistor of about 5000 ohms. Usually while recording with this amplifier, the speaker volume is too loud, but it is undesirable to cut the speaker with the switch provided, or to use headphones. The speaker on-off switch can be discarded, and a variable 4 ohm T pad such as a Mallory type T4 connected in the wiring to the speaker. This pad can be mounted either in a position where the power on-off switch is, or where the monitor jack is—either the power switch or the monitor jack is moved to the position vacated by the speaker switch. The T pad is too large to be installed in the place vacated by the original speaker switch.

here are the

30 BEST SELLING RECORDS OF 1952*

29 of them used audiodiscs® for the master recording

Record, Artist & Label	Made from Audiodisc Master
BLUE TANGO *(Leroy Anderson—Decca)*	✓
WHEEL OF FORTUNE *(Kay Starr—Capitol)*	✓
CRY *(Johnnie Ray—Okeh)*	✓
YOU BELONG TO ME *(Jo Stafford—Columbia)*	✓
AUF WIEDERSEH'N, SWEETHEART *(Vera Lynn—London)*	
I WENT TO YOUR WEDDING *(Patti Page—Mercury)*	✓
HALF AS MUCH *(Rosemary Clooney—Columbia)*	✓
WISH YOU WERE HERE *(Eddie Fisher—Hugo Winterhalter—Victor)*	✓
HERE IN MY HEART *(Al Martino—BBS)*	✓
DELICADO *(Percy Faith—Columbia)*	✓
KISS OF FIRE *(Georgia Gibbs—Mercury)*	✓
ANY TIME *(Eddie Fisher—Hugo Winterhalter—Victor)*	✓
TELL ME WHY *(Four Aces—Decca)*	✓
BLACKSMITH BLUES *(Ella Mae Morse—Capitol)*	✓
JAMBALAYA *(Jo Stafford—Columbia)*	✓
BOTCH-A-ME *(Rosemary Clooney—Columbia)*	✓
GUY IS A GUY *(Doris Day—Columbia)*	✓
LITTLE WHITE CLOUD THAT CRIED *(Johnnie Ray—Okeh)*	✓
HIGH NOON *(Frankie Laine—Columbia)*	✓
I'M YOURS *(Eddie Fisher—Hugo Winterhalter—Victor)*	✓
GLOW WORM *(Mills Brothers—Decca)*	✓
IT'S IN THE BOOK *(Johnny Standley—Capitol)*	✓
SLOW POKE *(Pee Wee King—Victor)*	✓
WALKIN' MY BABY BACK HOME *(Johnnie Ray—Columbia)*	✓
MEET MR. CALLAGHAN *(Les Paul—Capitol)*	✓
I'M YOURS *(Don Cornell—Coral)*	✓
I'LL WALK ALONE *(Don Cornell—Coral)*	✓
TELL ME WHY *(Eddie Fisher—Hugo Winterhalter—Victor)*	✓
TRYING *(Hilltoppers—Dot)*	✓
PLEASE, MR. SUN *(Johnnie Ray—Columbia)*	✓

**According to Retail Sales, as listed in THE BILLBOARD.*

. . . and over 43% used **audiotape**† *for the original sound!*

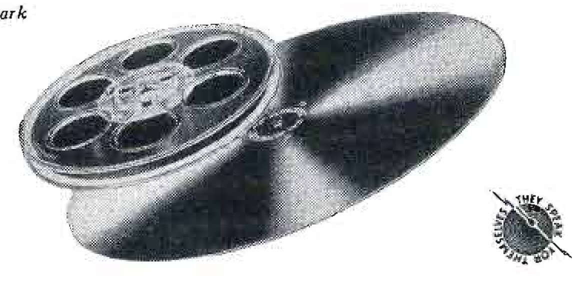
Like Audiodiscs and Audiotape, this record speaks for itself.

Of the thirty top hit records of the year, all but one were made from Audiodisc masters! And that *one* — a London Record — was made abroad.

It is significant, too, that the original recordings for over 43 per cent of these records were first made on Audiotape, then transferred to the master discs. This marks a growing trend toward the use of Audiotape for the original sound in the manufacture of fine phonograph records.

Yes — Audiodiscs and Audiotape are truly a record-making combination—in a field where there can be no compromise with Quality!

†Trade Mark



AUDIO DEVICES, INC.

444 MADISON AVE., NEW YORK 22, N. Y.
Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

Audio discs are manufactured in the U.S.A. under exclusive license from PYRAL, S.A.R.L., Paris

audiodiscs • audiotape • audiofilm • audiopoints

Quality Control in Component Manufacturing

ALTHOUGH quality control has now been in service in many electronic manufacturing plants for ten years or more, it is surprising how few contracts between customers and vendors specify what quality is expected. According to Malcolm Young, Director of Quality Control Dept., Erie Resistor Corp., only a few customers are fully aware of the quality control and sampling plans used in controlling quality for them.

Two subcommittees of the Electronics Technical Committee of the American Society For Quality Control have been set up to suggest ways to improve the ability of the consumer to evaluate the material coming from the vendor. Mr. M. E. King of the Navy Bureau of Ordnance, and a member of the committee, has suggested that the following points be covered in the vendor's Lot Quality Reports:

1. Sampling table used
2. Quality level used
3. Classification of defects as to seriousness
4. Process average before final inspection
5. Frequency distributions of certain important characteristics

It is not the intention that such information or levels should be industry-wide, but that they should be a basis for negotiations between the vendor and his customer. Erie Resistor is operating under terms of MIL-Q-5923 and has found it useful in advancing its own quality control program.

Listed below are the principal problems that might come up for discussion between the vendor and customer:

Laboratory Tests and Inspection: Type tests are performed in the quality control laboratory. The laboratory also makes electrical receiving inspection of a great many materials. The third function of the laboratory is to run special tests on samples of lots during production. This is done in order to learn more about processes and means of improvement of quality. Statistical control charts are far more sensitive to changes than reports based only on specification limits, showing trends as well as danger points. To pass type test data onto the customer is quite a problem. The tests are not performed on every lot, but are performed periodically or on samples taken from a number of lots. Erie's present method of recording this data is by means of average and range charts, new points being plotted as tests are run.

Process Inspection: The most important part of quality control work is done in process inspection. During the past year, process level for capacitance and power factor at one location improved from a 7% defective to a 2% defective level. This was done by means of $\overline{x}$ and R (average and range) charts and the excellent co-operation of production personnel whenever the charts showed out of control points.. By means of these process charts alone, one can determine whether the material must be sorted or is good enough to be further processed. Because of the process improvement, very much less 100% sorting is necessary.

Sampling Levels: When Erie certifies a certain quality level to a customer, they tell by what means Final Quality Control Inspection accepted the material for shipment. They specify what type Sampling Plan was used (MIL STD 105A, Dodge & Romig, Army Ordnance, Columbia U., etc.) and also state the quality level of the lots shipped. When the type table and the level are specified, the customer is able to tell just what his chances are of getting poorer material or better material than the average. This may be done by means of operating characteristic curves which accompany the sampling tables.

Rating the importance of different defects is also important. They must be classified as critical, major or minor.

Frequency Distributions or "Lot" Plot Plans: Dorian Shanin's Lot Plot simple frequency distributions are extremely useful at inspection points when standard sampling methods are not required. For variable sampling it is very useful to determine by frequency distribution whether lots are to be accepted at final inspection. This allows sampling of fewer pieces. It also allows differentiation between borderline and scrap.

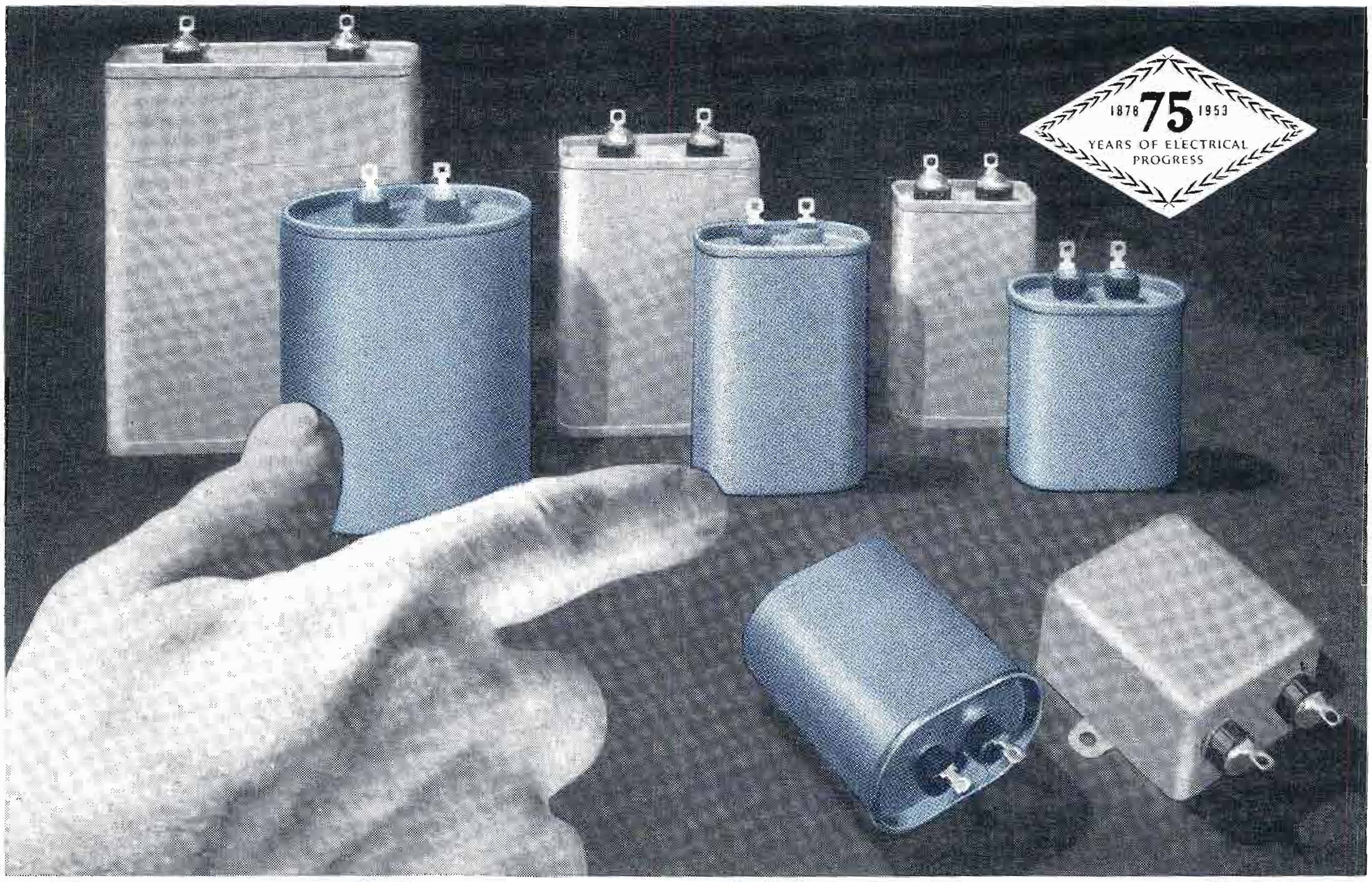
Final Inspection: Sampling Plans used at final inspection depend upon how good or how bad the process level is. At Erie, final inspection is on the following basis:

1. Process average very poor electrically (2% defective or worse)—100% inspection followed by normal sampling.

(*Continued on page* 147)

NEW MICROWAVE RELAY SYSTEM

Preview of transmitter end of Raytheon's new 7000 MC television broadcasting microwave relay equipment. Range is up to 25 miles and reflector dishes from 2 to 4 ft. may be employed. Entire equipment will be on display at forthcoming NARTB conference on West Coast. See Tele-Tech & Electronic Industries for additional technical details next month.



Photographic comparison of the new G-E Drawn-oval capacitors (in color) and the conventional units they replace, showing savings in size.

New General Electric Capacitor is Smaller, 10 to 20% Lower in Price

These fixed paper-dielectric hermetically-sealed capacitors offer:

- **Reduced costs—10 to 20%**
- **Savings in size and weight**
- **Double-rolled seams**
- **Drawn-steel cases**
- **Savings in critical materials**

If you're using fixed paper-dielectric capacitors with case styles CP53 and CP70 in ratings from 1 to 10 muf, 600 to 1500 volts d-c or 330 to 660 volts a-c—these Drawn-oval units offer you improved reliability in addition to an opportunity for reducing the size, weight and *cost* of the electrical equipment you manufacture.

In the new Drawn-oval capacitors, we get minimum seam length by using drawn-steel cases, attaching the capacitor covers with a double-rolled seam of proven reliability. This construction results in a lighter, yet stronger capacitor. Actual savings in size and weight vary with case style and rating but they can amount to as much as 30%.

This new construction has enabled us to increase output while eliminating some critical materials. The resulting savings are passed on to you in the form of shorter shipments and lower prices. Prices average 10 to 20% lower than standard capacitors, again depending upon case style and, of course, quantity ordered.

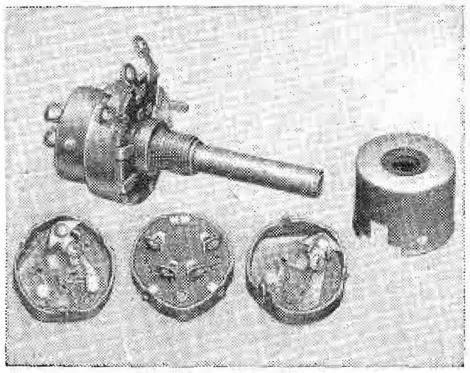
For more information on the new G-E Drawn-oval capacitors, their ratings, dimensions and prices, see your local G-E apparatus sales representative or write for Bulletin GEA-5777. Address Section 407-311, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

NEW EQUIPMENT for Designers and Engineers

Miniature Switches

Several new miniature switches for attachment to types LP and LR or other standard variable composition resistors are 7/8 in. at widest diameter and 3/32 in. deep exclusive



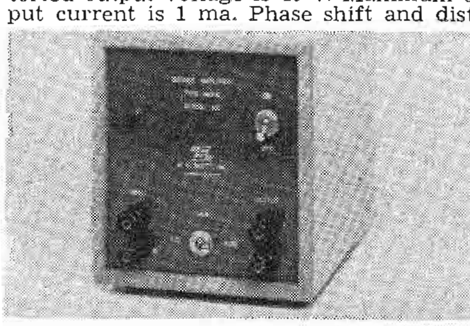
of terminals. All are Underwriters approved. The Stackpole A-10 a DPST switch rated 3 amps. at 125 v. or 1 amp. at 250 v. ac-dc, is suited for small battery-operated radio receivers. Type A-15, rated 1 amp. at 125 v. ac-dc, is similar except for its lower rating and low torque feature which enables it to operate readily with light turning pressure from a small knob. A feature of both switches is the fact that sturdy hot tin dipped terminals are doubly locked in position by both ears and rivets. Another new switch, the A-11 is SPST rated 3 amps. at 125 v. dc or 5 amps. at 125 v. ac. It is available either with or without a dummy terminal and is designed or large radio-phonograph combinations, television receivers and instruments where heavier currents are involved.—**Stackpole Carbon Co., St. Marys, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Potentiometer Element

Type 2028 potentiometer element is a rectilinear model of 20,000 ohms resistance having an active length of 10 in. and a linearity of ± 1%. It is useful for applications where the advantages of extreme wear resistance and substantially infinite solution are important. Major savings of man and machine time have been effected by its use in conjunction with input-output tables of analog computers such as the 10-101A input-output table of the REAC computer. A variety of rotational as well as rectilinear type elements and potentiometers have been developed to customer specifications. Functional and linear designs are available offering combinations of wear resistance, precision, extremely high resolution and adaptability to miniaturization over a wide impedance range. In all units the active electrical contact volume is precision molded of Markite conductive plastic.—**The Markite Corp., 155 Waverly Place, New York 14, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Decade Amplifier

Type 140-A decade amplifier is a miniaturized laboratory voltage amplifier with 1 MC frequency response and stabilized voltage gains of 10 and 100. A low-flux-density transformer permits the amplifier to be used without effect on nearby equipment operating at low signal levels. It is entirely resistance coupled, and no peaking coils or compensating networks are used which might cause undesirable transient effects. Frequency response is flat from 2 cps to 1 MC, ±0.1 db. Equivalent input noise is less than 8 μv. in the x100 position. Maximum undistorted output voltage is 40 v. Maximum output current is 1 ma. Phase shift and distor-



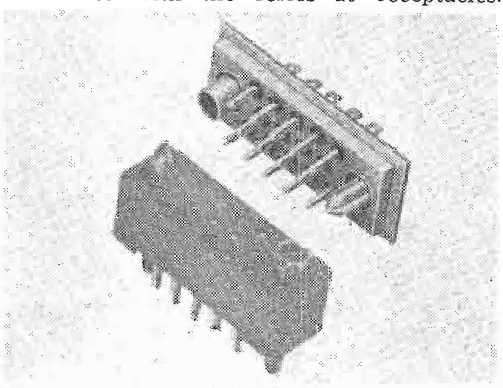
tion are entirely negligible. Line voltage variations between 70 and 130 v. cause less than 0.1 db changes in output. Input impedance is 1 megohm shunted by 10 μμf. An accessory high-impedance vacuum-tube probe is available for use where even slight loading of sensitive circuits is to be avoided.—**Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Motor Generator

Miniaturization of control motor-generator and motor generator gear train combinations for servo-mechanisms have resulted in a new 400-cycle unit which weighs four oz. and measures 0.9 in. in diameter. Phase voltage of the motor is 26 v. with a maximum stall power of 2.6 watts per phase and a minimum stall torque of 0.3 in.-oz. Output of the generator is 0.34 v./1000 rpm with an excitation power of 2.0 watts maximum. Generator characteristics further include a 5° phase shift working into a 100,000 load, and a 20 mil maximum null with a 10 mil maximum swing.—**Transicoil Corp., 107 Grand St., New York 13, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Hermetically-Sealed Plug

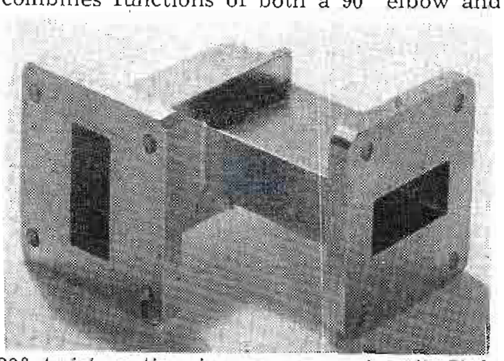
Available in 14 and 20 contacts for #20 AWG wire, new hermetically-sealed plugs will mate with the series 20 receptacles.



When engaged with mating receptacle, they have a voltage breakdown of 750 v. dc 60,000 ft. altitude and 3000 v. dc at sea level normal conditions. The body plate has a flange for placement in a rectangular opening and the contacts are silver plated with a gold finish for ease of soldering and non-corrosion. Each contact is fused to the metal body, forming a glass-to-metal seal.—**DeJur-Amsco Corp., for Continental Connector Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Improved "Twist & Turn" Elbow

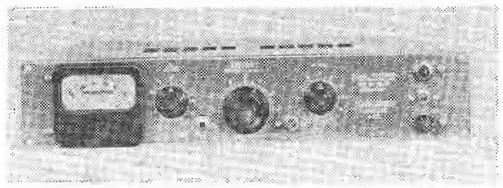
Recent engineering modification has increased the power handling capacity and the width of this "X" band component which combines functions of both a 90° elbow and



90° twist section in one compact unit. It is available in RG 51/U, RG 68/U, RG 52/U, and R/G 67U waveguide. Arm lengths and terminations are made to customers' specifications. Representative electrical data for RG-52/U and RG-67/U are as follows: VSWR (Design Center, 1.03; VSWR (maximum) with 400 MC bandwidth, 1.10; over 10% bandwidth, 1.40; Power handling capacity, 100 kw, peak. Representative electrical data for RG-51/U and RG-68/U are as follows: VSWR (design center), 1.03; VSWR (maximum) with 400 MC bandwidth, 1.10; over 10% bandwidth, 1.30; Power handling capacity, 500 kw, peak.—**General Precision Lab., Inc., 63 Bedford Road, Pleasantville, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Selectivity Converter

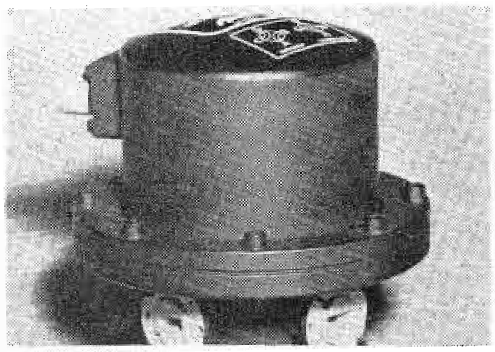
Type MCL-50 signal splitter is said to provide exact jam-free-bandwidths for every CW/Speech receiving conditions. Its continuously variable filters provide bandwidths



from 0.4 KC to 6.0 KC with 60 db cutoffs from 500 to 600 cps. It can be used with any standard AM receiver and requires a rack-panel space of only 3½ in. It has self-contained power-supply and audio amplifier with an output of 18 dbm/600 ohms.—**J. L. A. McLaughlin, P. O. Box 529, La Jolla, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Waveguide Switch

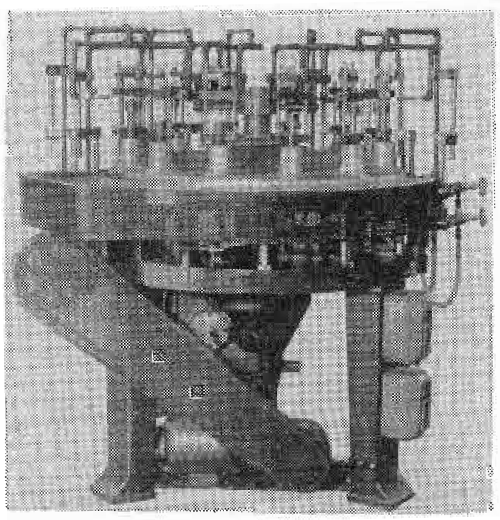
A new aluminum "K" band reversing switch may be used between two antennas to reverse the direction of transmission. The switch has been designed for remote control operation and is extremely useful in providing a connection between either of two radars to a single antenna. The unused



or standby radar may be automatically connected to a dummy load so it can be repaired and readjusted without interruption of service. A VSWR of 1.10 maximum over the entire waveguide frequency range of 18 to 26.5 kilomegacycles is maintained, while the cross talk isolation over the frequency range is 50 db minimum.—**Airtron, Inc., 20 E. Elizabeth Ave., Linden, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Lead Wire Welding Machine

The automatic lead wire welding machine (Model 2148) designed and built recently to make 12,000 3-piece leads per hour for miniature receiving tubes, is the basis for a



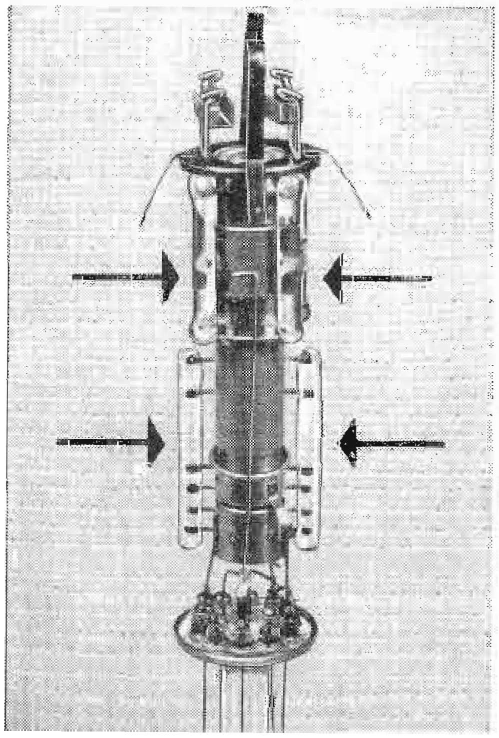
machine to manufacture leads for the transistor. Another Kahle unit adaptable to transistor production is the fully automatic filament making and tabbing machine, Model 2036, that turns out from 1,000 to 3,000 fine wire assemblies per hour.—**Kahle Engineering Co., 1312 Seventh St., North Bergen, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Two 21-inch Metal Cone Picture Tubes Announced by Westinghouse

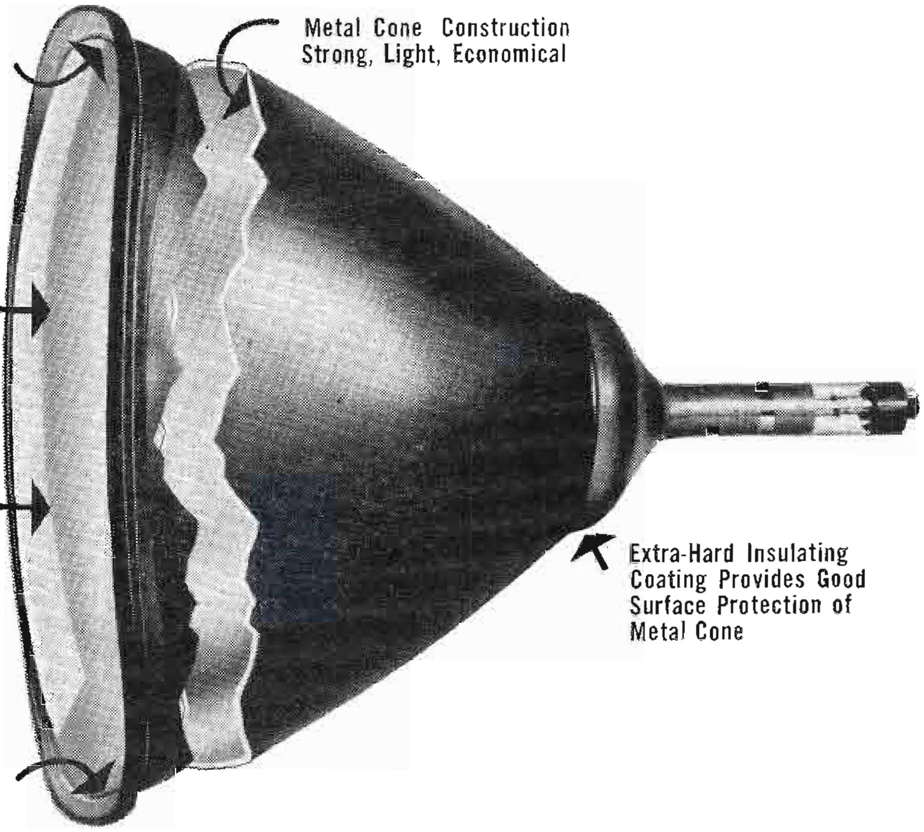
21AP4 and 21MP4 now available for immediate delivery

Manufacturers faced with problems of handling, cost and uniformity in large picture tubes now may order Westinghouse 21-Inch RELIATRON™ Metal Cone Picture Tubes for immediate delivery. The new tubes—almost 33⅓% lighter in weight—are manufactured under the most rigid quality control system in the country.

Superior face plate quality assures greater freedom from blemishes and glass imperfections. Uniform face plate thickness greatly reduces optical distortion over the viewing area. The etched glass of the face plate eliminates glare from external light sources.



Improved Gun Employs Glass Beads. **Westinghouse makes the new metal cone electrostatic focus tube with glass-beaded assembly. This assures accurate element spacing within close tolerances to improve spot size and picture uniformity.**



The 21-Inch RELIATRON Picture Tubes feature still another important improvement. The face plate is sealed to the metal cone using an intermediate glass-enamel frit.

PRODUCTION SAVINGS

The 21-Inch RELIATRON Picture Tubes introduce new economies throughout TV set production. Their lighter weight cuts shipping costs. The 21MP4 tube is electrostatically focused, requiring no focusing coil or focusing magnet. The 21AP4 is designed for magnetically focused operation.

Metal cone tubes give increased mechanical strength, and because of their light weight are easier to handle and assemble in TV receivers.

BETTER PICTURES

Metal cone picture tubes permit the use of spherical face plates of uniform thickness that allow receiver manufacturers to use standard available deflection components that produce pictures of consistently high quality.

Employment of the Westinghouse 21-Inch RELIATRON Metal Cone Picture Tubes enables you to meet the growing demand for larger screen TV receivers, to deliver a better picture, and at the same time, to realize important savings in your production operations.

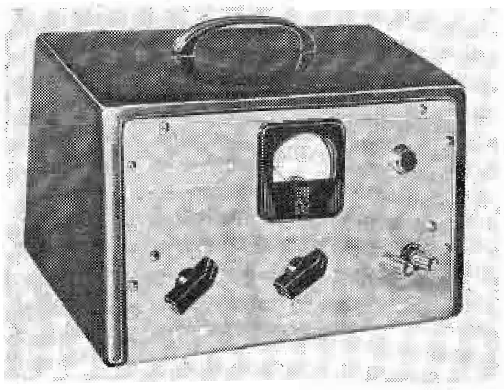
The new RELIATRON metal cone tubes now are available in quantities which permit immediate delivery of production-size orders. For complete details, write Dept. B-204.

YOU CAN BE SURE...IF IT'S **Westinghouse** **RELIATRON TUBES** TM

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Step Frequency Oscillator

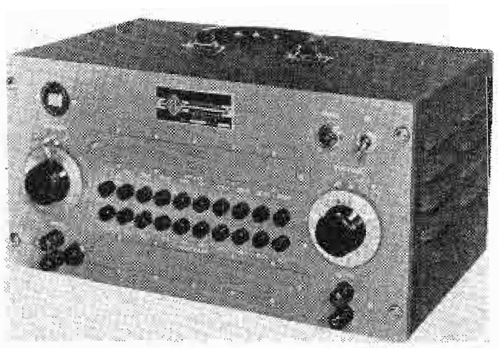
In a new step oscillator, 17-fixed frequencies are provided at the turn of a single knob. Weighing 7-pounds, the instrument is



designed for use in the laboratory; for production line testing of amplifiers, filters, recorders; and in telemetering applications. A unique gain stabilizing circuit holds amplitude variation over the entire frequency range to less than ±0.2db. Use of Toroid coils is an important factor in assuring an overall frequency stability of better than ±1%, including replacement of tubes. The more 60 db signal-to-hum ratio is maintained at all output levels, and known resistive output impedance is provided through the use of a "T" pad attenuator. The frequencies supplied on the standard model cover the audio range. Other frequencies are available and any 17 will be provided on request. Distortion is less than 0.7% throughout the range.—**Pulse Techniques, Inc., 1411 Palisade Ave., W. Englewood, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Audio Oscillator

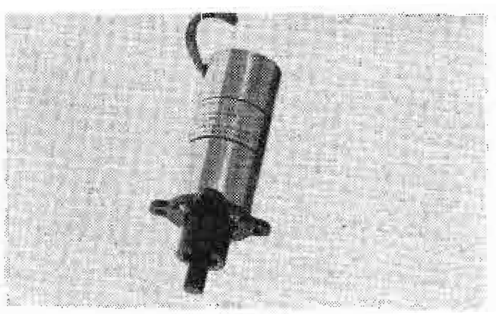
Model TO-100 has twenty fixed center-frequencies and is especially useful for checking sub-carrier equipment. The stand-



ard model is furnished with FM/FM telemetering frequencies from 400 to 70,000 CPS. Other frequencies between 200 and 100,000 CPS are available on special order. Selected by a push-button control, each frequency can be varied plus or minus 10% by a calibrated control. Each frequency is accurate to plus or minus 1% and an independent sub-panel control is available for each frequency for more accurate setting if necessary. Output is adjusted by a continuously variable calibrated level control from either low impedance output terminals or a 600 ohm connector. Waveform distortion is kept to a minimum. Maximum total distortion at full output is less than 1%. Calibration of an unknown external signal is provided by a zero beat indicator.—**Teletronics Lab., Inc., 54 Kinkel St., Westbury, L. I., N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Planetary Gearing

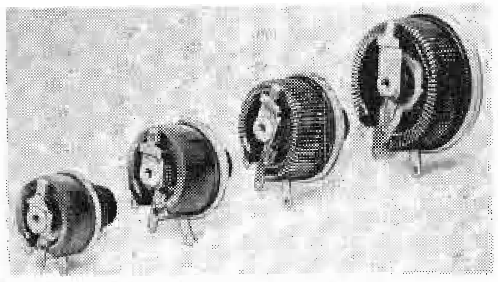
Designed to mount directly on a 1/100 HP or a 1/50 HP "Moto-Mite" permanent magnet, the planetary is available in eighteen



different ratios between 17.8 to 1 and 21,808 to 1. The torque varies with the reduction up to a maximum continuous torque of 1000 oz./in. for the higher ratios. Back lash is held to close limits. The standard unit has four-hole flange mounting and a 5/16 in. diameter shaft extention, ½ in. long. Gear train and motor are completely enclosed in one integral cover. The output shaft and last stage carrier are made in one integral piece. All assemblies are heat treated. All gears are precision cut. Units can be supplied for most standard dc voltages.—**Globe Industries, Inc., 125 Sunrise Place, Dayton 7, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES

Rheostats

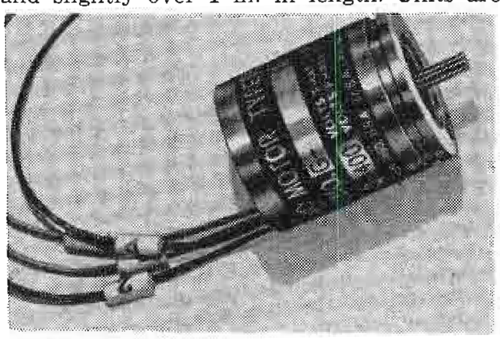
Three new power rheostats incorporate an extra deep ceramic core on which the resistance wire is toroidally wound and



bonded with vitreous enamel. The result is better heat dissipation and a more conservative power rating. An exclusive torsion spring assembly provides positive and constant brush pressure. Other features contribute long rotational life, minimum back lash, low contact resistance, and smooth, practically stepless resistance control. Units in 50, 75, 100, and 150 watt sizes are available in a range of resistance values. Special types with tapered windings, mounting and shaft assemblies for non-standard panels, auxiliary switching attachments, off positions, tandem units, enclosures, etc., are also produced by this concern.—**Tru-Ohm Products, 2800 Milwaukee Ave., Chicago 18, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Miniature Servo Motors

A new miniature precision servo motor measures approximately 1 in. in diameter and slightly over 1 in. in length. Units are



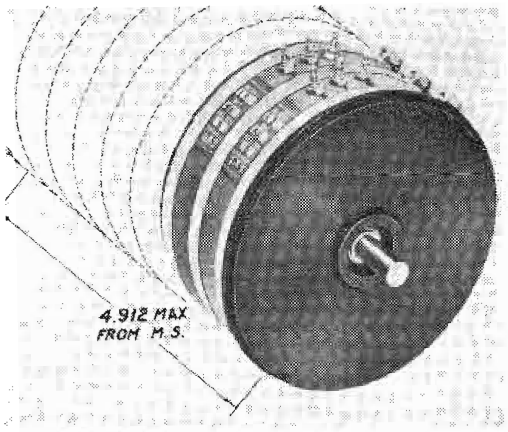
available for frequencies varying from 60 to 400 CPS, and in 2, 4, or 8 pole construction. Stall torque ranges from 0.25 to 0.35 oz/in. Output shaft can be supplied to suit, with or without integral pinion.—**G-M Labs., Inc., 4300 N. Knox Ave., Chicago 41, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES

Subminiature Connectors

The new subminiature rectangular series SM-20 connectors are available in 11, 14, 20 and 34 contacts for #20 AWG wire. Physical size is reduced 30% without sacrificing contact pin diameters. The husky 0.040 diameter pins are standard with series SM-20. Contacts are precision machined phosphor bronze assembled in a unique floating, non-rotating arrangement to insure self-alignment of each individual contact. Positive polarization is also featured to guarantee contact engagement only in the proper position. Voltage breakdown at sea level under normal conditions is 1400VRMS. Current rating is 5 amps. Maximum wire size is #20 AWG. Contact engagement length is 9/64 in. Weight of plug and receptacle is .25 oz.—**DeJur-Amsco Corp., for Continental Connector, 45-01 Northern Blvd., Long Island City, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Potentiometers

A new series of 360°, continuous rotation, 3 in. o.d., high-precision potentiometers includes Model L with bushing mounting and sleeve bearings; Model LS with servo lid mounting and Oilite bearings; and, Model LSP with servo lid mounting and ball bear-



ings. Models L and LS have standard linearities of ±0.5% in resistance ranges from 10 K to 100 K ohms. Other versions, manufactured to order, have linearities as high as ±0.1% (5K ohms and above). All Model L units are equipped with foolproof phasing ring clamps; hence, phasing is easily accomplished in the field, and, each section of ganged assemblies can be phased independently. Extra taps can be spotwelded at the factory with a tolerance of ±1°. Thirty-three taps can be made in a single section; and up to eight sections of the Model L can be factory-ganged on a common shaft. Double shaft extensions are optional. All electrical connections are spotwelded. The Model L series supersedes the Model F, but generally is physically and electrically interchangeable with Model F series units designed into or installed in existing equipment though the o.d. of the Model L is only 3 in. compared with 3 5/16 in. for the Model F.—**Helipot Corp., South Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Regulated Power Supply

Model two adds inherent reliability to ripple combined with noise and jitter 1/3 mv or less; impedance level of 1/20 ohms down to zero frequency throughout load range. A 15 μf oil condenser is incorporated directly across the output terminals. Conservatively load is rated at —1000 ma. Hermetically sealed transformers and chokes have grain-oriented cores. Extra heavy filtering affords maximum front end efficiency before regulator. Amplifier has high gain, high stability, and balanced input. Input 50/60 CPS, 115 v. For bench or rack mount.—**Eastgap Co., 285 Columbus Ave., Boston 16, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

Dot Generator

The Model 102, pin point pattern Cathode Ray dot Generator of ultra-short pulses, provides means for critical checking, comparison and measurement of TV picture tubes, screen phosphors, deflection yokes, ion traps, electrostatic and electromagnetic focus guns, focus coils, and spot size and shape. The unit is equipped with 2 coaxial output cables.—**Research Electronics Labs., Roslyn, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

X Band Test Set

Model 108 X Band Test Set is capable of meeting all engineering requirements for a complete radar test; and also is able to perform a variety of test functions on other equipment operating in a frequency range from 8,500 to 10,000 megacycles. The instrument combines the function signal generator, spectrum analyzer, power monitor and wavemeter in a single package; and is small and light enough to be used as a field test or laboratory instrument. —**Century Metalcraft Corp. (Electronics Div.), 14806 Oxnard St., Van Nuys, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Navy Contract Awarded

The National Company, Inc., Malden and Melrose, Mass., manufacturers of electronic equipment, has been awarded a contract from the Bureau of Ships, U. S. Navy Dept. The contract is for the manufacture of communication radio receivers and it is estimated that it will exceed $1,250,000.

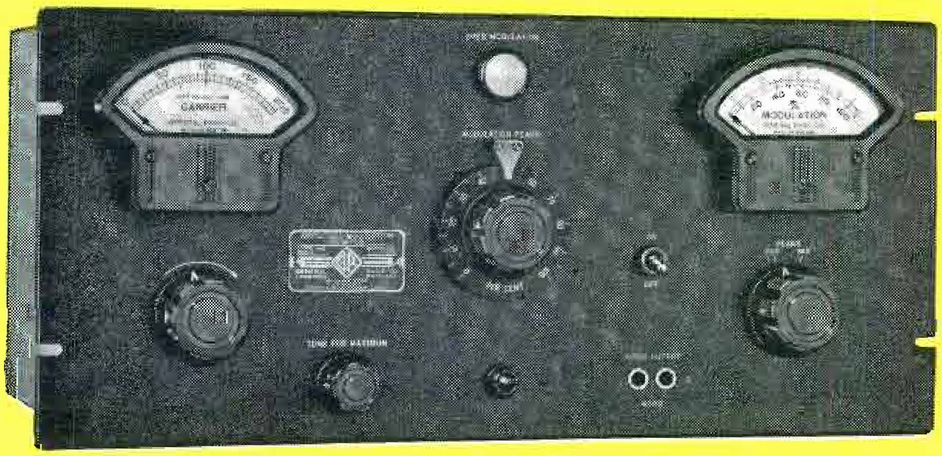
For Accurate — Reliable — and FCC Approved —

Measurements of MODULATION, DISTORTION and NOISE

in the Broadcast Station

The G-R Type 1931-A Modulation Monitor and Type 1932-A Distortion and Noise Meter are highly accurate instruments widely used in broadcast stations for monitoring modulation and measuring distortion and noise in audio frequency circuits. Transmitter operators find these instruments convenient and extremely reliable in operation. They meet all FCC specifications.

The Distortion and Noise Meter is a most versatile laboratory tool. It permits complete and accurate wave analysis of fundamentals from 50 to 15,000 cycles and harmonics to 45,000 cycles, when used with an oscilloscope. Its ability to rapidly and accurately measure frequency, audio voltage, AVC characteristics and hum level, has adapted it to a wide variety of measurements in the communications laboratory. This Meter is also used for the production checking of radio receivers, attenuators, audio amplifiers and oscillators, and electronic instruments and components.



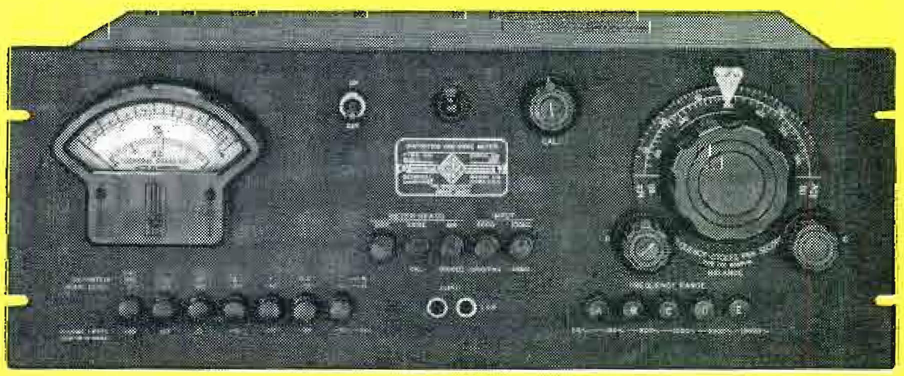
Type 1931-A *Modulation Monitor ..0.5 to 8 Mc. or 3 to 60 Mc.* ... **$440.00**

Type 1931-P5 ... *0.5 to 8 Mc. Extra Tuning Coil* **16.50**

Type 1931-P6 ... *3 to 60 Mc. Extra Tuning Coil* **16.50**

The G-R Type 1931-A Modulation Monitor

- ★ *Operates over a wide carrier-frequency range — 0.5 to 8 Mc. or 3 to 6 Mc. depending upon tuning coils used; either set supplied with instrument.*
- ★ *Continuously indicates percentage modulation of either positive or negative peaks, as selected by a panel switch — meter range is 0 to 110% on positive peaks, 0 to 100% on negative peaks.*
- ★ *Provides a very useful overmodulation alarm whose flashing rate increases markedly when modulation peaks are in excess of a predetermined level set by a panel dial.*
- ★ *Requires about 0.5 watt input R-F power.*
- ★ *Measures the relative magnitude of any carrier shift occurring during modulation.*
- ★ *Has two low-distortion audio-output circuits operating from separate diode rectifiers:*
  One is matched to a 600-ohm line for audible monitoring. Other output supplies a faithful reproduction of the carrier envelope for measurement of transmitter distortion and noise with the aid of a distortion and noise meter — output amplifier is flat to within 1.0 db. from 30 to 30,000 cycles.



Type 1932-A *Distortion and Noise Meter* .... **$595.**

The G-R Type 1932-A Distortion and Noise Meter

- ★ *Features rapid and continuous frequency adjustment over the entire audio frequency range — one main tuning control and push buttons are used.*
- ★ *Includes a high gain amplifier which balances to a null at frequency set by the main tuning dial, and thus passes to the meter circuit only the distortion components present.*
- ★ *Measures distortion values as low as .05%; 0.10% above 7,500 cycles.*
- ★ *Detects noise levels down to 200 μv — instrument noise is considerably less than 80 db.*
- ★ *Accuracy is essentially ±5% of full scale for distortion, noise and dbm measurements.*

GENERAL RADIO Company

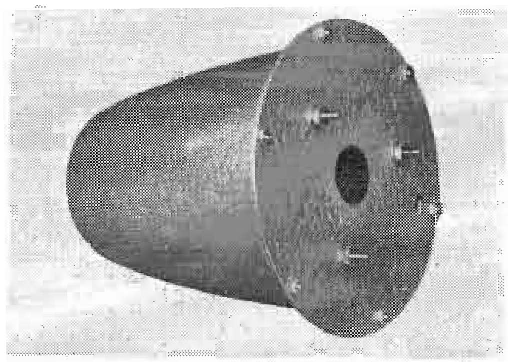
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

90 West St. NEW YORK 6 920 S. Michigan Ave. CHICAGO 5 1000 N. Seward St. LOS ANGELES 38

Admittance Meters ☆ Coaxial Elements ☆ Decade Capacitors Decade Inductors ☆ Decade Resistors ☆ Distortion Meters Frequency Meters ☆ Frequency Standards ☆ Geiger Counters Impedance Bridges ☆ Modulation Meters ☆ Oscillators Variacs ☆ Light Meters ☆ Megohmmeters ☆ Motor Controls Noise Meters ☆ Null Detectors ☆ Precision Capacitors Pulse Generators ☆ Signal Generators ☆ Vibration Meters ☆ Stroboscopes ☆ Wave Filters U-H-F Measuring Equipment ☆ V-T Voltmeters ☆ Wave Analyzers ☆ Polariscopes

Loudspeaker Driver

Type 730A heavy duty permanent magnet driver unit is adaptable for use with 30A and 40A re-entrant hours. A new acoustic chamber enables the 730A to handle peak inputs of 80 w. with a continuous power rating of 40 w. The average sound level produced by the 30A horn is 104 db with a warble frequency source of 200 to 5000 cps at level about 10^{-16} w. per sq. com at 30 ft. on axis at rated power of 40 w. With the 40A horn the sound level produced under the same conditions is 107 db. Frequency response is 200-7000 cy; voice coil impedance is 8 ohms. The use of an extra large "Alnico 5" magnet with a low leakage field and a phenolic diaphragm with exceptional mechanical strength make this unit extremely efficient and rugged. The complete coil and diaphragm assembly is easily replaced in the field. The unit is equipped with a removable weather-



proof housing and the case is drilled and tapped to mount a 70V line matching transformer internally. Transformer 15037X, comes equipped with a mounting bracket and screws and must be ordered as a separate item when required. Overall dimensions: base, 5⅞ in. diameter; height, 7 in. Finish is hammertone gray.—**Altex Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

New Generator

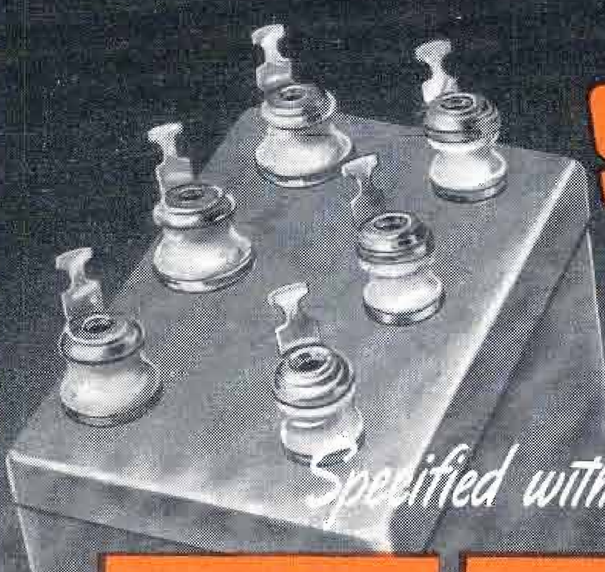
A new signal generator covers the VHF and UHF frequency range from 54 MC to 330 MC in the first band, and from 300 MC to 950 MC in the second band. The instrument has a calibrated frequency dial, a power output meter, calibrated output attenuator (wave guide beyond cut-off) and a regulated power supply. The approximate front panel dimensions are 9½ x 11 x 14 in. The two rf ranges are calibrated in megacycles with an accuracy of $\pm 2\%$. The band of 54 MC to 330 MC is covered in approximately 28 turns of the tuning control. There are graduations every 3 MC on the range. The 300 to 950 MC band is covered in approximately 11 turns of the tuning control and the dial is graduated every 10 MC. The rf output voltage is continuously variable over the range of 10 to 100,000 μv from 54 to 950 MC. Output is available at the type N connector on the front panel. The output is constant to ± 3 db of the graduated reading when the meter is adjusted to the proper scale reading. Provisions for external audio modulation have been included. The regulated self-contained power supply is 110-130 v. 60 cycle ac.—**Conn. Telephone & Electric Corp., Meriden, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES

Rectifier Kit

"Build-your-own" selenium rectifier kit enables the assembly of a wide range of selenium rectifier stacks at substantially reduced costs. Included in the compact, self-contained unit are all the necessary components for assembling any one of four different types of selenium rectifiers: half-wave rectifier, full-wave center-tap rectifier, full-wave bridge type and full-wave battery charger. The rectifiers can be assembled for approximately half the cost of conventional, ready-made types and in only a matter of minutes. Moreover, they can be easily disassembled and the parts used to produce other rectifier types. Sufficient components are available to build any one of 12 rectifier stacks for use in a wide range of ac to dc applications. Applications include dc office machine conversion, and power supplies for dc motor speed controls, relays, electromagnets, solenoids, brakes, chucks, clutches, separators, and similar components. The kit is also ideal for building prototypes in the laboratory.—**Federal Telephone & Radio Corp., Clifton, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

General Ceramics' *hermetically-sealed*

SOLDER-SEAL TERMINALS



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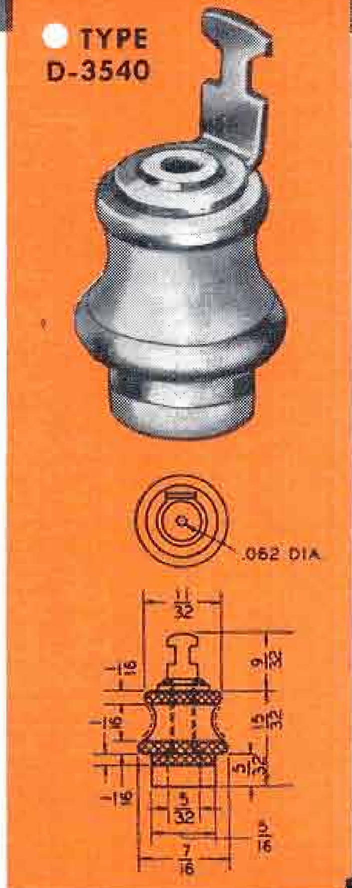

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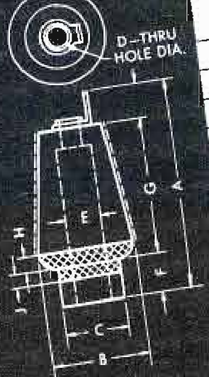
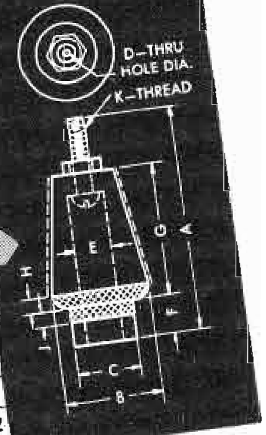
Solder-seal Terminals by General Ceramics — engineered for severe service and extra dependability — effect a permanent, positive hermetic seal practically immune to mechanical and thermal shock. There are no plastic or rubber gaskets to age or deteriorate in these reliable terminals. Soft-soldering to closures is accomplished easily and quickly. General Ceramics Solder-Seal Terminals are available in a wide range of sizes and shapes to meet almost every requirement.



STANDARD SOLDER LUG TYPES

PART NO.	A	B	C	D	E	F	G	H	J
D-3342	1 1/32	.490	3/8	.095	3/16	3/16	1/2	1/16	3/32
D-3346	1 19/32	5/8	.490	.095	1/4	3/8	7/8	3/32	1/8
D-3350	2 9/32	15/16	11/16	.130	3/8	3/8	1 15/32	1/8	1/8
D-3349	3 3/16	3/4	9/16	.130	1/4	5/16	2 7/16	1/8	1/8



STANDARD THREADED STUD TYPES

PART NO.	A	B	C	D	E	F	G	H	J	K
D-3856	1 7/32	.490	3/8	1/16	1/4	3/16	1/2	1/16	3/32	6/32
D-3857	1 51/64	5/8	.490	1/16	1/4	3/8	7/8	3/32	1/8	6/32
D-3962	2 15/32	15/16	11/16	.055	3/8	3/8	1 15/32	1/8	1/8	8/32
D-3638	2 15/32	15/16	11/16	1/16	3/8	3/8	1 15/32	1/8	1/8	10/32

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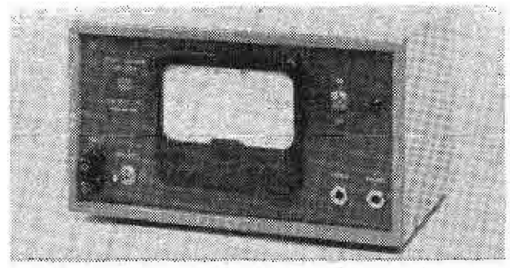
Bridge Indicator

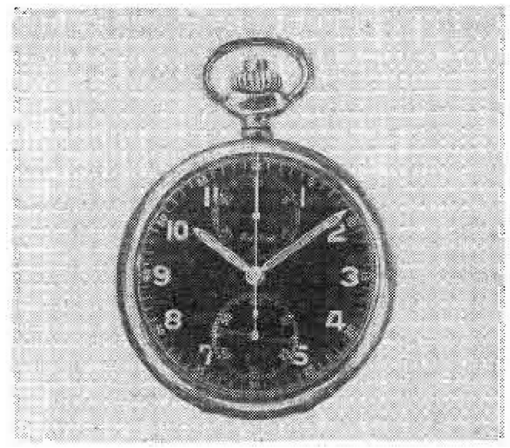
An approximately logarithmic response provided by type 615-A bridge indicator allows balancing from coarse to extremely



sensitive fine without the frequent range changes normally required with bridges. A large indicating meter permits precise visual null-detection. An output jack for earphones is also provided. Since the output is virtually logarithmic with respect to input over a range of 10,000 to 1 (80 db), precise aural null-detection is possible without extreme concentration or strain on the part of the operator, even in noisy surroundings. Frequency response is flat from 60 cps to 20 KC. Input voltage ranges of 0.1 v. and 0-100 v. are provided. Maximum output is 1 v.—**Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Timers

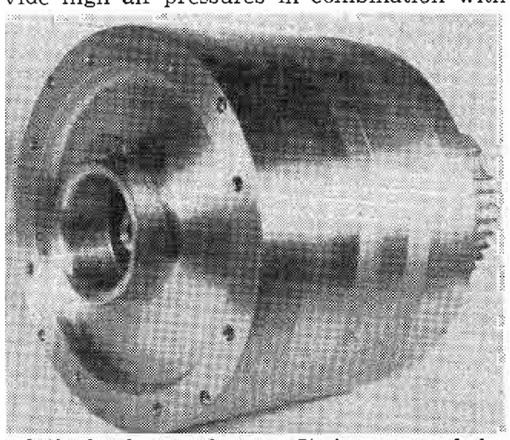
Standard and special purpose timers are being produced for military and commercial applications. Among these are navigational



stop watches produced in accordance with Air Force specs MIL-W-5605 (shown in photo) and MIL-W-6510. Other types are manufactured for inclusion in radar equipment. Custom designed timers are available for production, testing, research and broadcasting. Engineering consultation service furnished for special purpose units.—**Wakmann Watch Co., 15 W. 47th St, New York 36, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Air Blower

A small, lightweight, direct-driven, brushless, axial-flow blower (turbine) will provide high air pressures in combination with



relatively low volumes. It is powered by totally enclosed induction motors (no brushes, sliprings, centrifugal switches or belts) built on a single shaft. Units are available for 1, 2 and 3-phase operation, 50-60-400 CPS and variable frequency. Overall diameter is 7¼ in. and length varies with number of stages (static pressure) and type of power supply. Pressures range from 5 to 28 in. W.C.—**Rotron Mfg. Co., Inc., Schoonmaker Lane, Woodstock, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

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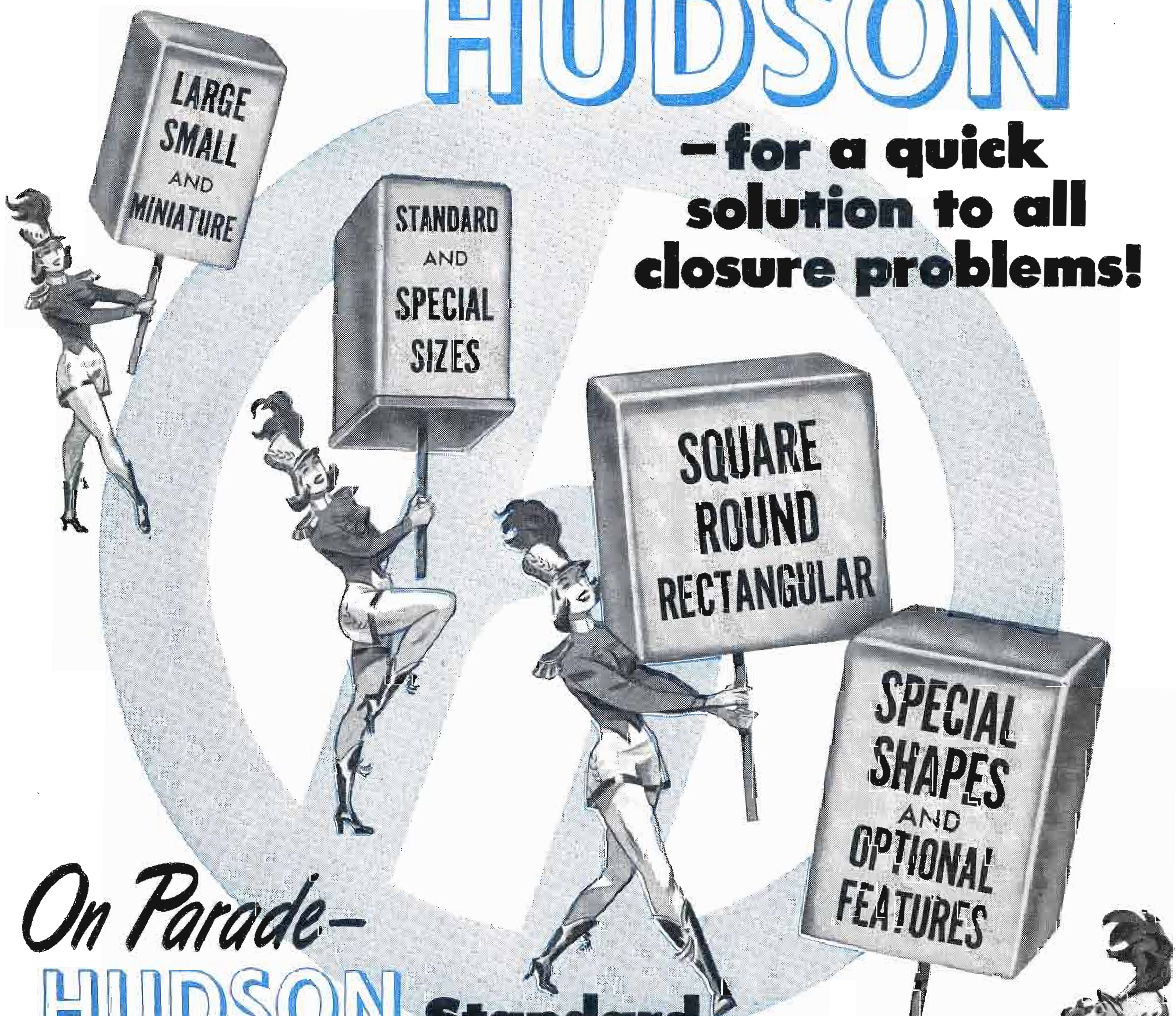

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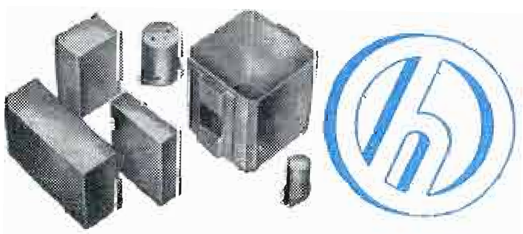
Visit Booth 3-208 I.R.E. Electronics Show! See the standard cases and covers that solve special closure requirements, economically. Hudson stocks hundreds of types, sizes, shapes with dozens of optional features available. Precision drawn and thoroughly inspected to simplify the work of engineers, designers and purchasing officials. Ask for a copy of the Hudson Engineers Catalog File. It's yours without obligation!



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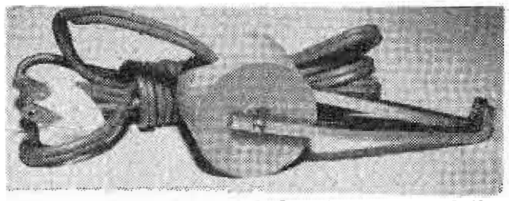
Demagnetizer

An ac magnet assembly permits the removal of residual permanent magnetism from the sound recording heads of magnetic



tape recorders. Extended pole pieces of the Demagnetizer fit the contours of all standard recording heads. It is furnished complete with cord and plug for connection to 110-115 volt ac outlet. Demagnetization with this device is simple and can be done in a few seconds. When the output of the tape recorder has become noisy due to the accumulation of permanent magnetism in the recording heads, demagnetization can effect a significant improvement in machine performance. List price $12.00.—**Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES

Shielding Enclosure

According to tests made by the Hopkins Engineering Co. testing laboratory, the suppression of radio interference and the attenuation characteristics of a new type of prefabricated enclosure with a single sheet copper shielding layer, are as good as the conventional cell-type room made of copper screening. The portable RFI solid enclosure consists essentially of heavy copper sheet panels bolted to rigid copper-plated channels. RF leakage is minimized at the seams by tensioners. Inexperienced personnel can assemble or disassemble a room indoors or out, in a few hours with standard tools. Available 8 feet high in eight floor sizes range from 6 x 8 feet to 15 x 10 feet. Each unit has as optional equipment air conditioning and provisions to accommodate mechanical or electrical power, water, gas, and air services.—**RFI Shielded Enclosures, Inc., 3634 N. Lawrence St., Philadelphia 40, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

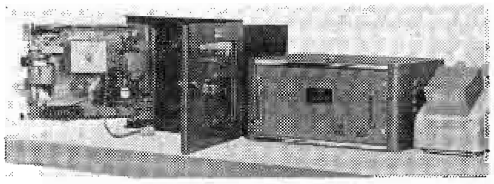
Transistors

Point contact transistors will be in full production and available for industry in June of this year. New production machinery facilitates the production of this unit

in very large quantities. This new Electronics Division is also working on new transistor applications for aircraft industry. —**Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

Position Encoder

An Angular Position Encoder is available which can be used for indicating instantaneously angular shaft positions of 360° or less with 0.1% accuracy without the use of gearing. A maximum shaft speed of 100 rpm is presently possible. The unit can be connected directly to electro-mechanical print-



ers or card punch equipment to provide decimal digital data. The heart of the equipment is a new coded multi-segment commutator which transmits signals to a relay rack and provides data that can be recorded in decimal digital form either on a printed tape or a punched card. The system includes three major components—the commutator which mounts on the rotating shaft, a relay panel and a thyratron holding circuit.—**G. M. Giannini & Co., Inc., 117 E. Colorado St., P. O. Box N, Pasadena 1, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES

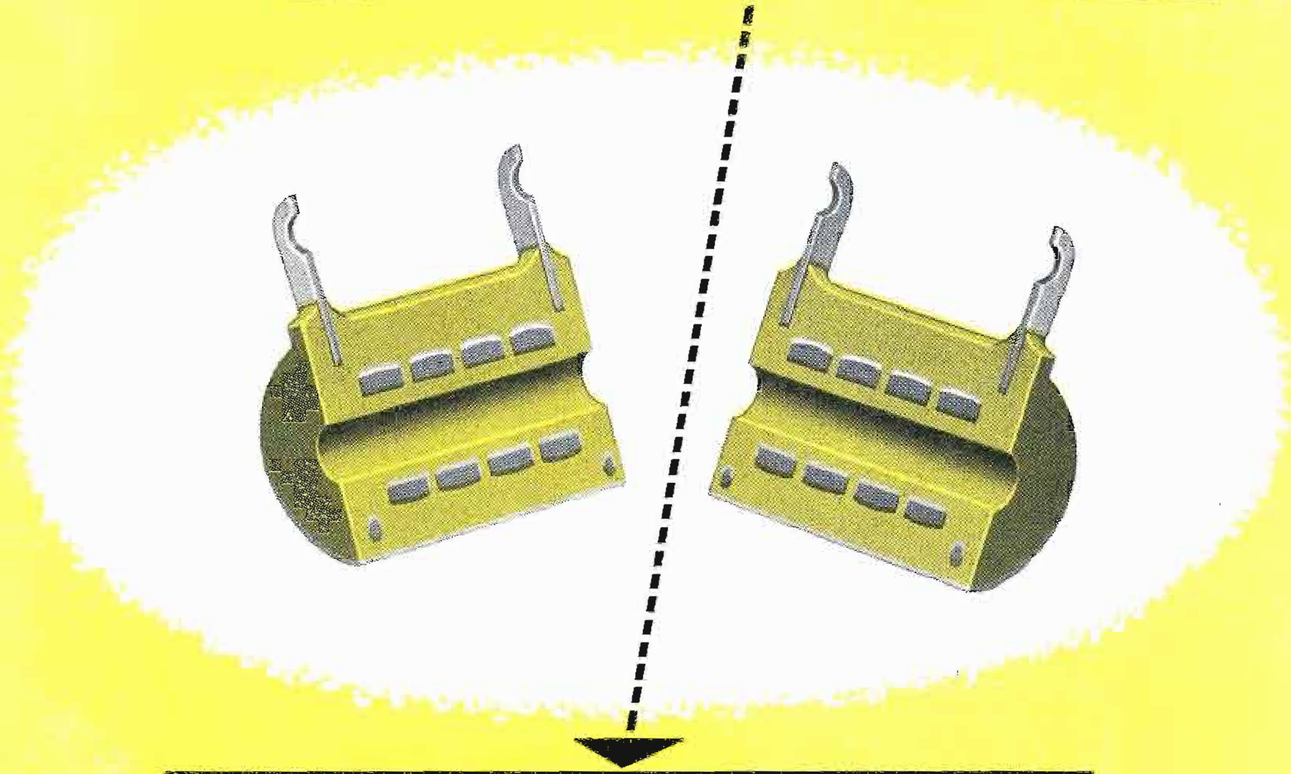
Connector Kit

The Varicon kit contains all parts needed in assembling Elco's miniature connector Varicons. Variations in arrangement of contacts at time of assembly make possible construction of connectors with the same number of contacts, but with different polarity, adding greatly to versatility of connector systems. Some of its unusual features include identical male and female components; only four basic parts; high current and voltage rating; low resistance and low capacitance. Available in general purpose, black phenolic; low-loss mica phenolic; natural; alkyd, natural; or general purpose phenolic in colors.—**Elco Corp., 190 W. Glenwood Ave., Philadelphia 40, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

Tubular Trimmer

New Tubular Trimmer combines the desirable features of extremely small size, easy mounting, stable performance and economical price. Known as Chemelec Style 535 Tubular Trimmer, its small size and ribbon type leads offer very low inductance and uniform, straight-line noiseless adjustment. Capacity range is from 0.7 to 3.0μf and working voltage is 500 v. Mounting is through chassis punch-out identical to that required for tubular ceramic trimmers. Operator works from only one side of chassis as trimmer is locked in hole by turning adjusting screw through top terminal. No additional hardware is required. Body is high temperature polystyrene. When mounted, it extends only 17/32 in. from the underside of the chassis, and is only 7/32 in. in diameter. —**United States Gasket Co., Camden 1, N. J.** —TELE-TECH & ELECTRONIC INDUSTRIES

The Inside Story



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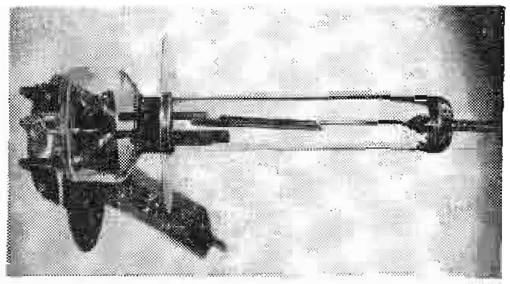
High-Vacuum Relay

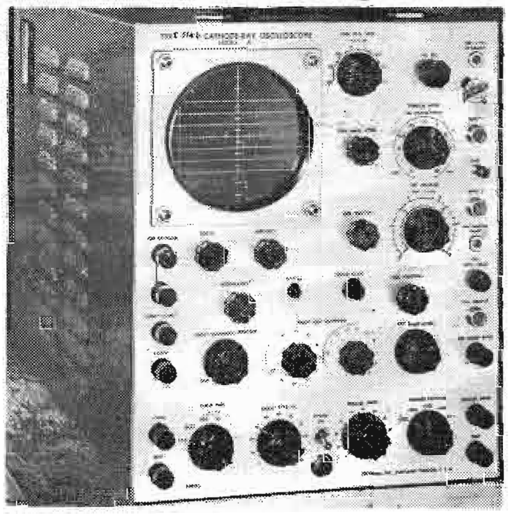
High voltage, high vacuum relay (PS-32) with an externally operated dc solenoid is 4¼ in. high with a 300 amp. peak pulse cur-



rent rating, a pulse duration of 3 μsec and a vibration characteristic of 15g's acceleration. The unit has been designed primarily for partial oil immersion applications for switching pulse forming networks in radar installations. The lower portion of the switch can be hermetically sealed directly into the pulse forming network case, transformer or other oil filled device.—**Pioneer Electronics Corp., 2232 Broadway, Santa Monica, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES

CR Oscilloscope

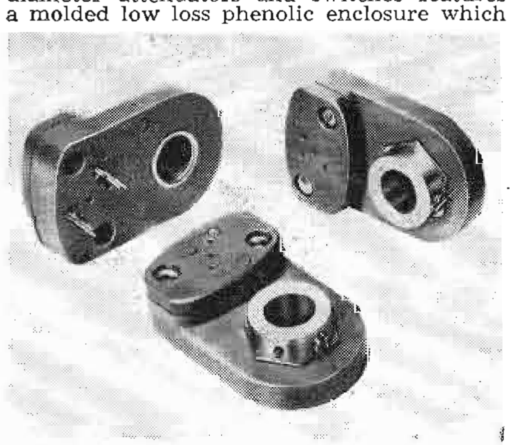
Type 514-AD is a portable laboratory type oscilloscope with 6 cm undistorted vertical deflection with new direct-coupled vertical



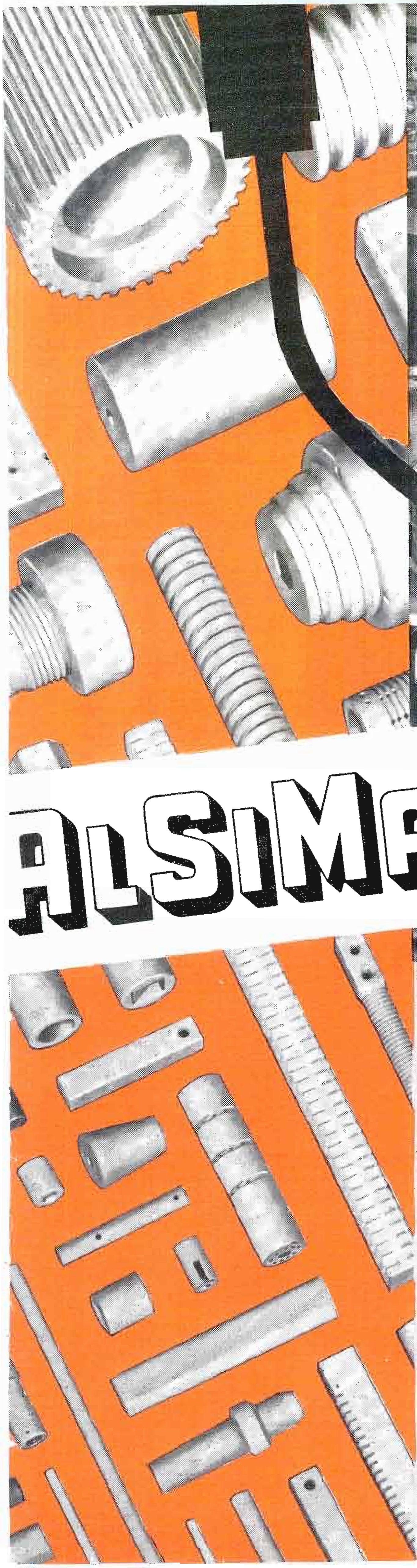
amplifier, flat-faced cathode-ray tube, variable duty cycle calibrator, direct-coupled unblanking. Vertical amplifier bandwidth dc to 10 mc at 0.3 v/cm to 100 v/cm sensitivity, 2 cycles to 10 mc at 0.03 v/cm to 100 v/cm sensitivity, rise-time 0.04μsec, 0.25μsec signal delay. Time base range 0.1μsec/cm to 0.01 sec/cm accurate within 5% of full scale, improved 5x sweep magnifier. Square wave calibrator variable from 0 to 50 volts, accurate within 3% of full scale, duty cycle variable from 2% to 98%.—**Tektronix, Inc., P. O. Box 831, Portland 7, Ore.**—TELE-TECH & ELECTRONIC INDUSTRIES

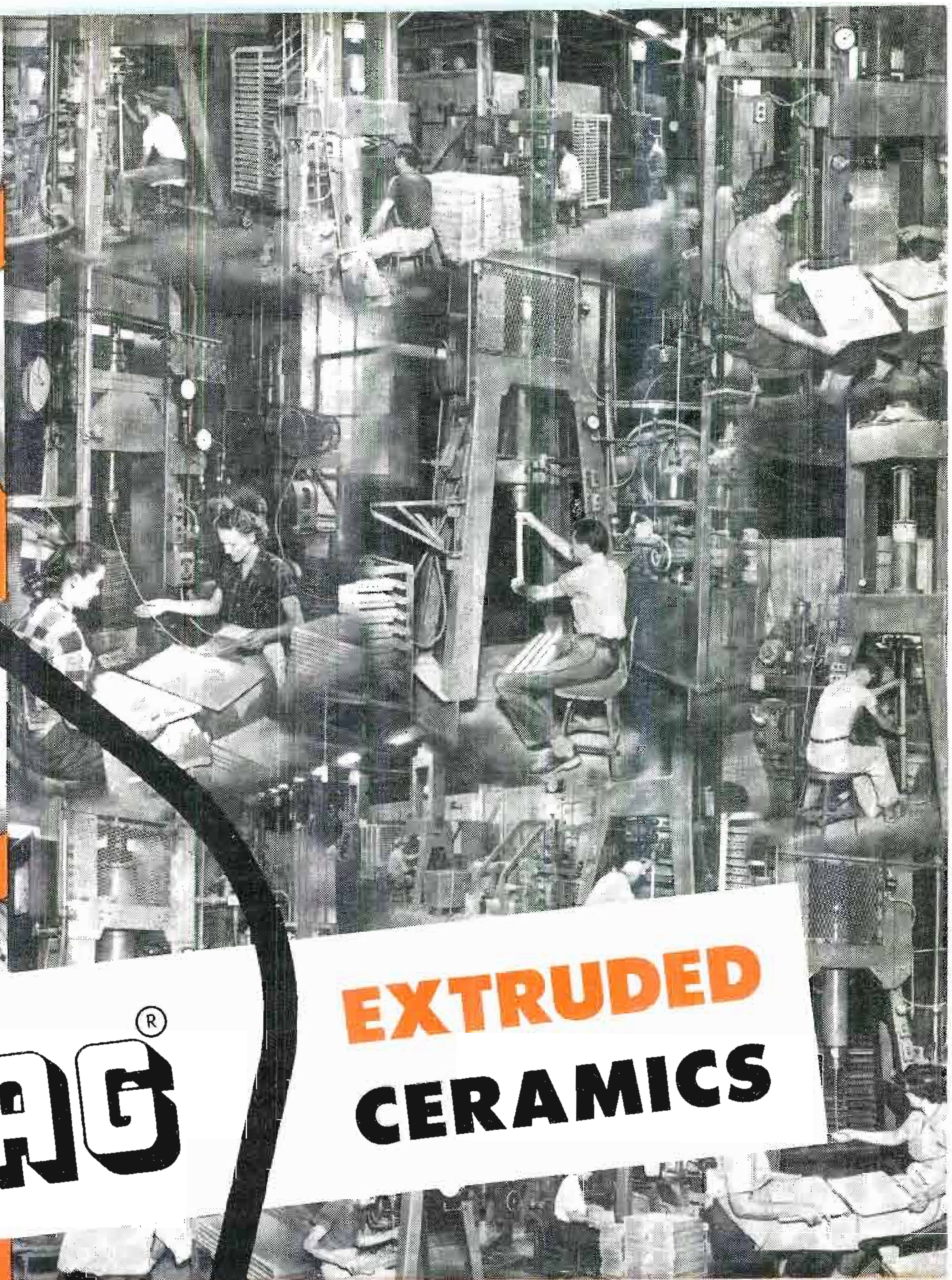
Molded Rotor

"Knee-Action" Rotor for use on 1¾ in. diameter attenuators and switches features a molded low loss phenolic enclosure which



protects its operating mechanism. The unit cannot be tampered with in field use because of this enclosure, and this design provides greater insulation between contacts and ground, and effectively protects the switch interior. Silver alloy contact springs operate independently of each other and supply uniform pressure against the contact surfaces. The molded insulating material is of extremely low loss phenolic and meets all applicable JAN and MIL specifications.—**The Daven Co., Dept. MH, 191 Central Ave., Newark 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES





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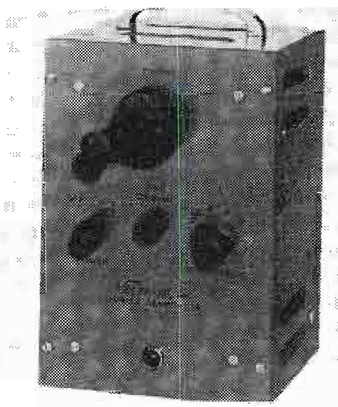
Marker Generator

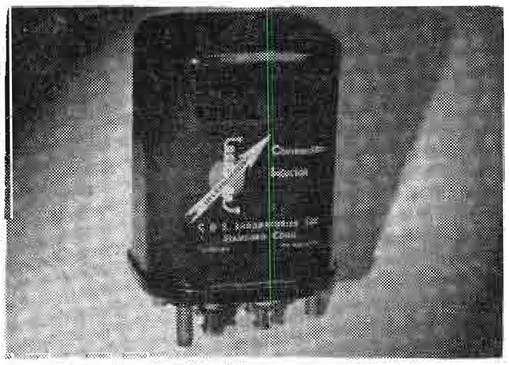
The addition of precise markers to the CRT display of a spectrum analyzer permits quick visual interpolation and differential estimates without reference to calibration charts or hard-to-read dials. MG10S micro-



wave marker generator permits the addition of 4, 2, or 0.5 MC markers to the display of any S-band spectrum analyzer. This self-contained unit (9 x 6 x 5¼ in., weighing less than 10 lbs.) uses standard receiver-type tubes and the special harmonic circuit permits continuous coverage of the entire S-band, 1550 to 5122 MC, and through C-band at least 6200 MC. Standard units provide a choice of 0.5, 2 and 4 MC multiple sideband markers, factory adjusted to an accuracy of ±1% of the marker frequency. The four-foot output cable, fitted with a special "Type N" connector, is permanently attached to the unit. Internal regulated supply operates directly from the 115 volt ac.—**Vectron, Inc., 400 Main St., Waltham, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES

Controllable R-F Inductor

The 65BA1 current controllable inductor provides wide range frequency shift or inductance variation between 1 MC or lower, and about 215 MC, or higher, at zero control current. At least a 7 to 1 variation of fre-



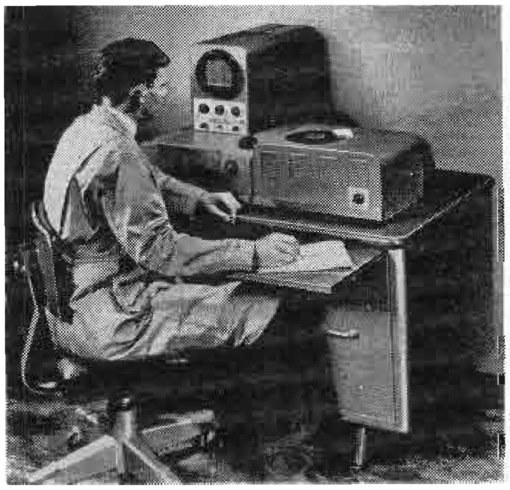
quency is obtainable. The upper frequency limit with maximum control current is approx. 30 MC. The unit has a maximum inductance of 30 μh at zero control current which can be reduced to 1/50th of this value by the application of 40 ma control current. Its Q characteristic versus frequency obtained in tuned circuits tends to reduce bandwidth variations. The inductor has one control winding and one signal winding so arranged that there is negligible electromagnetic and electrostatic coupling between them.—**C.G.S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES

Wheatstone Bridge

Compact fault location Wheatstone Bridge for general laboratory use or field servicing, Model 6100, measures resistance between 1 and 1,011,000 ohms to an accuracy of ±0.1% ±0.01 ohm. Housed in an aluminum case, the 6100 Bridge weighs only 8 lbs. and measures 8⅞ x 7⅜ x 5¾ in. including removable lid. In addition to measuring resistance, it locates grounds, crosses, opens, and shorts by the Murray, Varley, Hilborn, or Fisher Loop and Capacitance tests. Dial settings can quickly be converted to show the exact distance to the fault. The instrument includes a built-in battery operated power supply and a new type of galvanometer designed for troublefree performance under rough handling.—**Shallcross Mfg. Co., Collingdale, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES

New Device Combines CRO and Spectrophotometer

The American Optical Co. and the Allen B. Du Mont Labs., have developed a rapid-scanning spectrophotometer. This unique combination of optical spectrophotometer and cathode-ray oscillograph produces spectrophotometric curves instantaneously on the cathode-ray screen. The rapid operation of this spectrophotometer is accomplished by the use of an oscillating mirror which scans the image of the spectrum across a slit placed in front of a photocell. The result is a curve on the cathode-ray screen in which the amplitude of the trace at any instant is proportional to the intensity of a particular wavelength of light. Both coordinates of the curve are linear and either or both may be expanded.



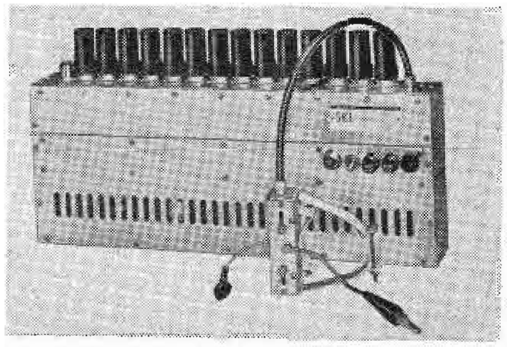
The spectrophotometer will handle transparent, solid, or liquid samples up to 100 mm thick. By means of a separate reflection attachment, the instrument will produce data from opaque solids or powders. The portion of the spectrum covered by the instrument ranges from 400 to 700 millimicrons. This range is scanned at an interval of 1/180 of a second, at a repetition rate of 60 times per second. Because of this high scanning rate, the rapid-scanning spectrophotometer is particularly adaptable to the investigation of rapidly changing spectra, problems which require telemetering or simultaneous transmission of spectrophotometric data to several points, or to production control where continuous monitoring is desired.

TV Changes at Corning Glass

Campbell Rutledge, Jr. has been appointed to the newly created position of assistant general manager of the Electrical Products Division of Corning Glass Works, Corning, N. Y. and Forrest E. Behm, Jr. is the new manager of the division's Pressware Plant which produces television bulbs. Mr. Rutledge had held a similar post in the company's Technical Products Division. Mr. Behm succeeds Paul T. Clark, former Pressware Plant manager, who has just been appointed manufacturing manager of Technical Products.

Chain Pulse Amplifier

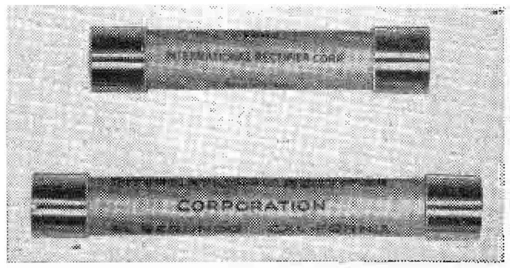
Greater bandwidth, fast rise time without overshoot, and high output voltage are said to be provided by the new SKL model 214B



chain pulse amplifier. Fourteen 6AH6 vacuum tubes are used to obtain the maximum output voltage of 125 v. over a bandwidth of 200 cps to 90 MC. It has a pulse gain of 30 db and a rise time of better than 0.006 μsec. Frequency response is flat within 1½ db from 500 cps to 80 MC. Phase response is substantially linear within the pass band. Power supply is stabilized to prevent fluctuations of gain due to variations in the signal duty factor. Output connection of the model 214B is at the end of 15 in. of coaxial cable and is designed to fit the neck of a CR tube or be connected to other equipment without alteration or special connectors. Two output impedances are provided: 500 ohms and 5000 ohms.—**Spencer-Kennedy Labs., Inc., Dept. TT, 186 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Selenium Rectifiers

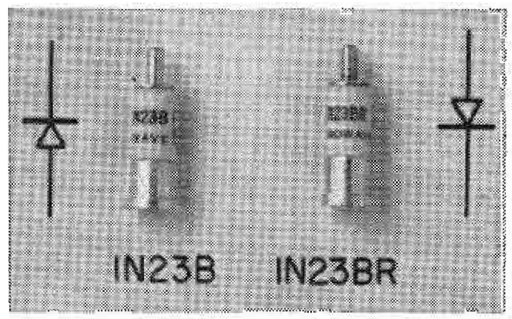
Type V-75HF high-voltage selenium rectifiers are designed with ferrule terminals for insertion into standard 30-amp fuse clips.



The diameter of the units is 9/16 in. Type V75HF is 3¼ in. long and the type V100HF is 4 5/32 in. long. Both units are designed to deliver 5 ma into a capacitive load at a dc output voltage of 1500 and 2000 v. respectively. These cartridge rectifiers are designed to meet JAN humidity, altitude, vibration and shock specifications. Both units have been incorporated into the horizontal oscillator circuit of video cameras.—**International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

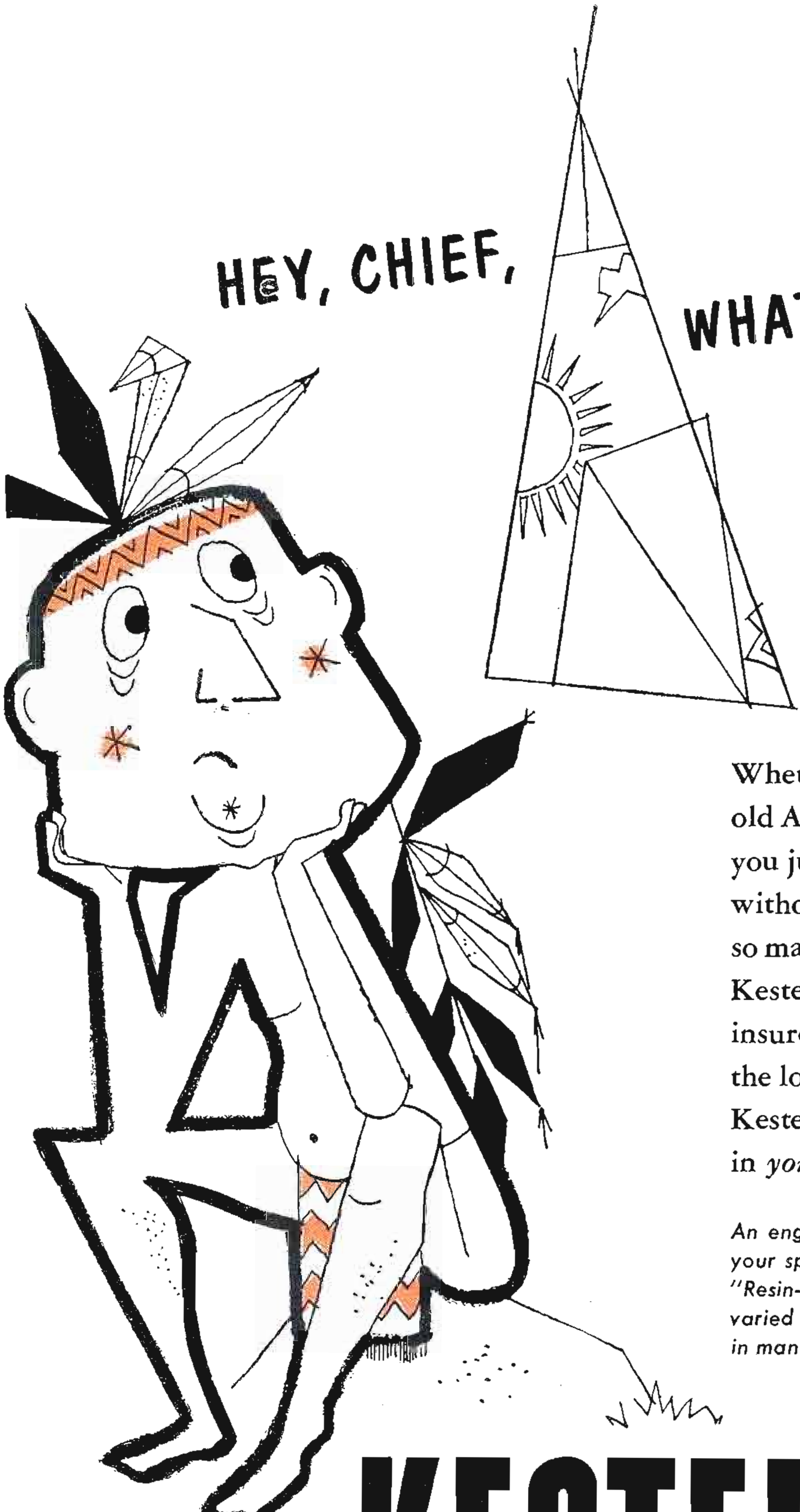
Matched Diodes

Matched pairs of silicon diodes are available with one unit of reversed polarity. The 1N23BMR has been developed to meet



the need for low noise circuitry. General use of matched crystals of the same polarity in a balanced mixer reduces the noise contribution of the local oscillator. Use of matched pair with one unit or reversed polarity simplifies both the mechanical and electrical design requirements of the mixer and i-f input circuit. Both the standard 1N23B pairs, the 1N23BM, and the new 1N23BMR with one 1N23B paired with a selected 1N23BR are now available. Both types are matched within narrow limits for conversion loss, r-f and i-f impedance. Pairs for other bands can also be supplied on special request.—**Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

HEY, CHIEF, WHAT'S A WIGWAM WITHOUT WAMPUM?



Whether it's shells or beads — or good old American dollars, for that matter — you just can't operate successfully without showing a profit. That's why so many progressive companies depend on Kester quality and performance to insure maximum results in production at the lowest possible cost. And we'll bet Kester Solder can mean more "wampum" in *your* "wigwam," too!

An engineered adaptation can be made to your specific requirements with Kester "44" Resin, "Resin-Five" or Plastic Rosin-Core Solder . . . varied core sizes or flux-contents are available in many different diameters.

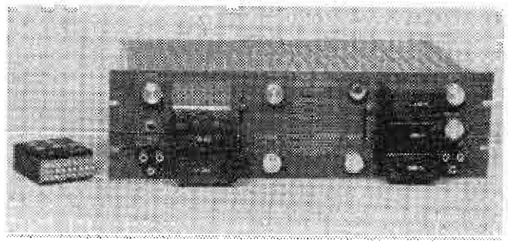
KESTER

SOLDER COMPANY

4210 WRIGHTWOOD AVENUE, CHICAGO 39, ILLINOIS
NEWARK 5, NEW JERSEY • BRANTFORD, CANADA

WWV Receiver

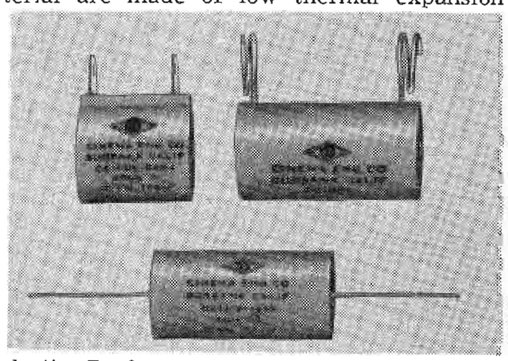
Model WWVR facilitates the checking of instruments with standard WWV transmissions at any time without special setup.



Three plug-in front ends permit instantaneous switching to optimum frequency for reception of standard radio frequency transmissions. A highly selective audio system can be switched in for noise-free presentation of standard audio frequencies. There are three individual inputs for tuned antennas, one common input for broad-band antenna use (either balanced 300 ohm or unbalanced 72 ohm input may be used) and four tuned circuits at signal frequency. Sensitivity is better than 1 μv. on all frequencies.—**Specific Products, 5864 Hollywood Blvd., Hollywood 28, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Resistors

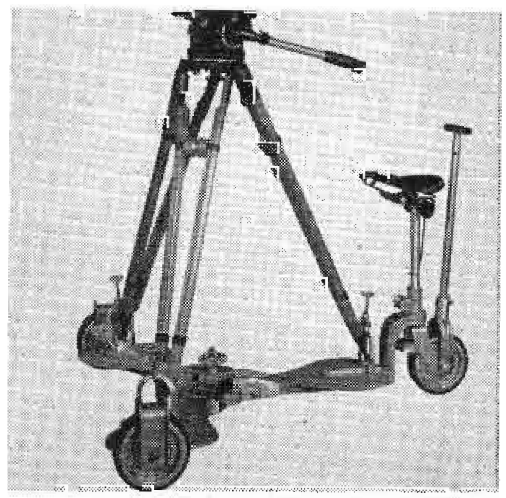
The CE resistor series is encapsulated in cast epoxy. Bobbins and encapsulated material are made of low thermal expansion



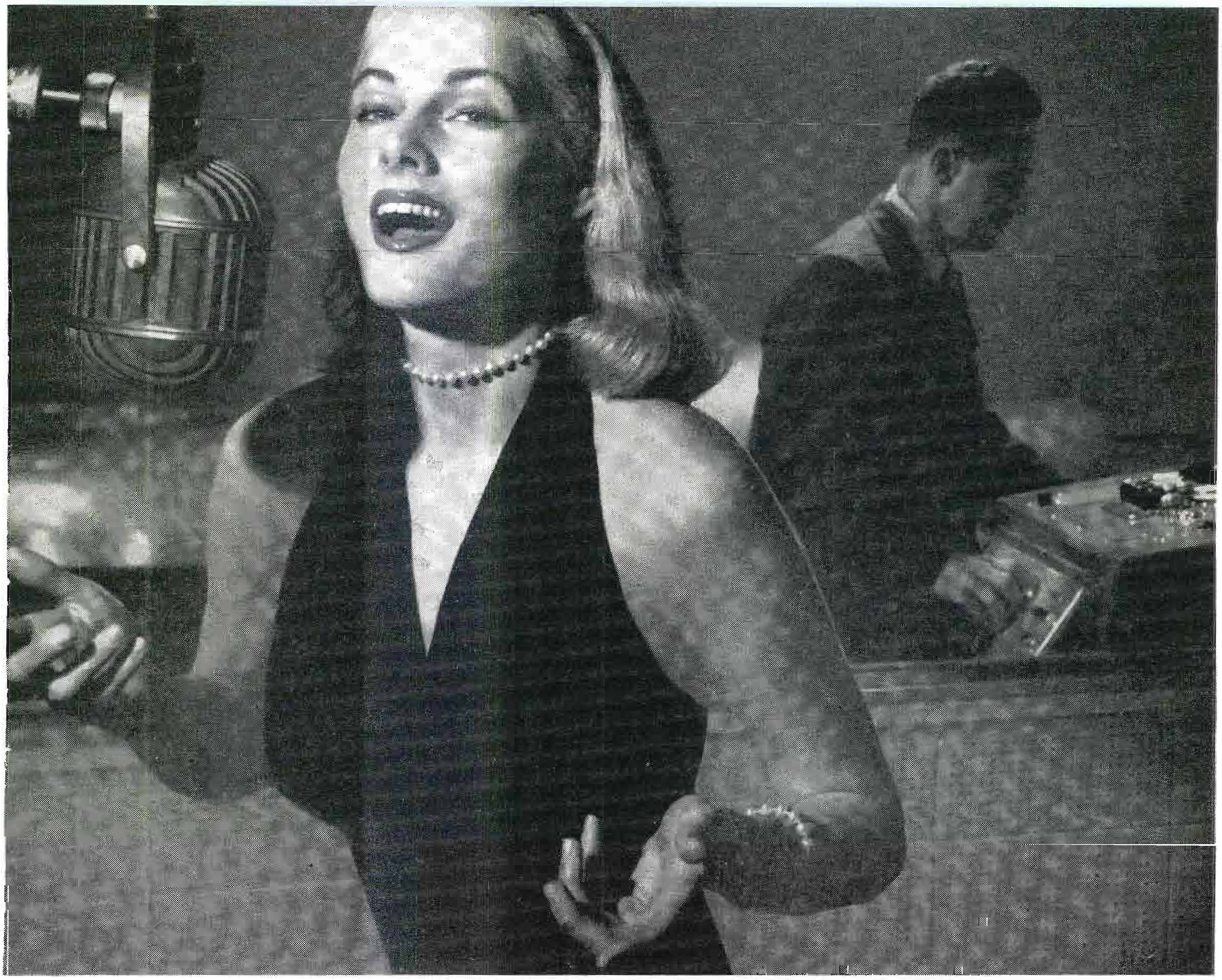
plastic. Performance characteristics are said to exceed Mil-R-93 specifications. The series will be produced in three general types, using radial terminal lugs, radial pigtail leads and axial pigtail leads. There are 45 types available from ¼ to 2 watts.—**Cinema Engineering Co., 1410 W. Verdugo Ave., Burbank, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Collapsible Dolly

A three-wheel dolly, made of sturdy cast aluminum, folds into one compact lightweight unit secured by screws into center mount casting. This mount also provides a hook for optional use of the tie down chains when using standard or baby tripods. Additional baby tripod point holders are



provided to control the spread of the baby tripod legs. Foot tread plates are part of casting for camera operators use. Dolly can be used with any professional or semiprofessional tripod. Extra wide rubber wheels are used to prevent side sway. Bronze tie down clamps, for all types of standard and television tripod legs, are used to hold the tripod absolutely rigid. An adjustable spring mounted seat for the operator is provided. Floor hand jack screws are used for leveling or stationary position.—**National Cine Equipment, Inc., 209 West 48th St., New York 36, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



Of course he's using Soundcraft Recording Tape ...it's micro-polished*

Perfect reproduction — that's the reason why more and more engineers today demand Soundcraft Professional Recording Tape.

Soundcraft is the only professional tape that is Micro-Polished. The only tape that is polished, buffed and re-polished by a special process to produce a surface that is mirror-smooth, completely free of even the most minute irregularity. The results of Micro-Polishing are apparent to any sound engineer:

Lower distortion
Uniformity of output
Improved high frequency response
Better head contact
Less friction, longer head life

Soundcraft Professional Recording Tape incorporates all the features developed by Soundcraft research engineers during the last two years: **pre-coating** to insure better adhesion, prevent curling and cupping — **dry lubrication** to eliminate squeals. The 7″ reel has the 2¾″ hub, eliminating torque problems and resulting in better timing. All this, plus a splice-free guarantee on all 1200′ and 2500′ reels.

Why settle for less than the best? Next time, insist on Soundcraft Professional Recording Tape. It's Micro-Polished!

REEVES **SOUNDCRAFT** CORP.

*PATENT APPLIED FOR

WRITE FOR FREE INFORMATION DEPT. P.

10 East 52nd Street, N. Y. 22, N. Y.

BOOKS

Vacuum Tube Oscillators

By William A. Edson, Published 1953 by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, N.Y. 476 pages. Price $7.50.

This book is an effort on the part of the author to present a systematic and reasonably complete treatment of the many factors affecting the behavior of vacuum-tube oscillators. While relatively little of the work here presented is original, and virtually all has been published previously, material on this subject has here-to-fore been too scattered to be effectively available. Also, the viewpoints and notations employed in discussing vacuum tube oscillators have been so divergent as to greatly impede the understanding of the work accomplished. By use of a uniform notation and several coordinated viewpoints developed in logical sequence, the treatment in this book overcomes most of these difficulties. The book is intended as a text for senior or graduate electrical engineering courses as well as for guidance of practicing engineers. Mathematics has been employed freely where it is helpful. The volume also includes a rather extensive bibliography to aid those readers wishing more detailed treatment of subjects contained in the eighteen chapters.

Data & Circuits of Receiver & Amplifier Valves

Book IIIA, 2nd supplement. Published 1952 by Elsevier Press Inc., 402 Lovett Blvd., Houston 6, Texas. 500 pages, size 6 x 9 in., 505 figures. Price $6.25.

This volume contains the data of Philips newly developed valves: Rimlock—Noval—and Miniature Valves together with a great many application diagrams and circuit discriptions. It is part of the series of books on Electronic Valves edited by Philips' Technical Library. Those published to date include: Book I, Fundamentals of Radio Valve Technique; Book II, Data and Circuits of Modern Receiving and Amplifying Valves (Dutch edition sold out), available in English, French and German editions; Book III, 1st Supplement; Book IIIA, Ditto, 2nd Supplement; Book IIIB, Ditto, 3rd Supplement. In Preparation; Book IIIC, Data and Circuits of Television Valves. In preparation; Book IV, Applications of Electronic Valves in Receivers; Book V, Ditto, Part 2; Book VII, Transmitting valves. Book VI, "Applications of Electronic Valves in Receivers and Amplifiers, Part 3," is to be published later this year.

Principles of Radar

Third Edition by J. Francis Reintjes & Godfrey T. Coate. Published 1952 by McGraw-Hill Book Co., Inc., London. 985 pages, 9 x 6 in. Price $7.75.

Prepared originally by the Massachusetts Institute of Technology School Staff for use in their war training courses, this new third edition has been

(Continued on page 139)

thoroughly revised and expanded. As in the two preceding editions, this book deals with the fundamental concepts and techniques of pulse radar, differing in order of presentation however, in that it has been almost completely rewritten in order to achieve better continuity of articles and chapters. The engineering principles of the pulse circuits and high frequency devices used in the text, are those common to almost all radar systems. Following a description of the general features of radar systems and system components, there are detailed discussions of pulse circuits and their application to radar modulators, indicators, and receivers.

The latter part of the book is devoted to the radio-frequency aspects of radar, covering basic concepts pertaining to transmission lines, waveguides, cavity resonators, antennas, and the techniques of their use in radar systems. A new chapter has been included on propagation at radar frequencies in this section, also one entitled Radio-Frequency Transmitting and Receiving Systems.

BOOKS RECEIVED

Motion Picture and Television Almanac

Edited by Charles S. Aaronson. Published 1952 by Quigley Publishing Co., 1270 Sixth Ave., New York 20, N.Y. 1010 pages. Price $5.00. Book contains Who's Who, list of companies, codes, trade organizations, TV stations, service firms and world markets.

Linear Scale Non-Logarithmic Slide Rules

By Morris L. Groder. Published 1952 by G & G Corp., 2003 E. 12 St., Brooklyn 29, N.Y. 64 pages. Price $2.98. Instructions show how to construct and use a non-logarithmic slide rule made with straight edge, pencil and paper. Finished unit performs same functions as standard slide rule. Advantages claimed include rapid construction, easy use, no compression at high end of scale, and low cost.

Philco's WPTZ Sold to Westinghouse

E. V. Huggins, president, Westinghouse Radio Stations, Inc., and James H. Carmine, executive vice-president, Philco Corp., have announced that Westinghouse had arranged to purchase TV station WPTZ, Philadelphia, from Philco. It was stated that approval of the FCC would be sought immediately. Acquisition of the station will involve approximately $8,500,000. WPTZ started operations on an experimental basis in 1932. It is an affiliate of the NBC network.

Telecasting on Channel 3, WPTZ is one of three TV stations serving the Philadelphia area. It received the nation's second commercial TV license in 1941. After approval of the purchase by the FCC, it will become the second TV station to be operated by Westinghouse. The first is WBZ-TV, Boston.

25th Anniversary of Police Mobile Radio

The 19th Annual National Conference of the Associated Police Communications Officers will be held in Detroit's Sheraton-Cadillac Hotel, Aug. 25-28, 1953.

Raydist Helps Helicopter to "Land on a Dime"

The Raydist blind landing system which recently brought a helicopter down within two inches of a predetermined touchdown point at Patrick Henry Airport in Warwick, Va., is a continuous wave, radio location system. For this demonstration, the Raydist system employed two cw transmitters which emitted r-f signals differing in frequency by approximately 400 CPS.

As reported by Hastings Instrument Co., one of these transmitters was located in the Coast Guard helicopter (see photo) which was talked down. This was the only Raydist equipment required in the craft. The second transmitter, known as a reference transmitter, was placed at a known location on the airfield. This transmitter was used to set up a heterodyne beat (400 CPS) with the signal being emitted from the transmitter in the helicopter.

At fixed relay stations Raydist receivers were tuned to the frequency of the cw transmitters. Equipment for relaying the heterodyne beat to the phase measuring units was also located at the relay stations. The phasemeters were located in the Raydist master station, set up in a mobile unit.

Raydist system installed in Coast Guard helicopter permits craft to be "talked down" by ground operator. Installation requires only one transmitter

The ability of the Raydist blind landing system to indicate the exact position of the helicopter is derived from the change of relative phase of the heterodyne cw signals as they are received at the relay stations.

The heterodyne waves, or beat notes, at the receivers beam a fixed phase relationship to one another. When these two tones are compared in a phasemeter, an indication of their phase difference is obtained. Each time that the helicopter, containing the mobile transmitter, moved one-half wavelength closer to one relay station than the other, the phase at one relay advanced 180°. Naturally, the phase of the tone at the other relay station was retarded by 180°. The phasemeter, therefore, detected 360° relative phase change.

It was known, therefore, that a family of hyperboloids existed in space with the receivers as foci. The helicopter could move along any of these curves without changing the distance difference. These hyperbolic loci make up the loci of constant relative phase indication.

A given phase indication, therefore, defined the position of the helicopter as being on one particular hyperboloid. By setting up two baselines and by obtaining the hyperbolic location on each baseline, the location of the mobile transmitter (in the craft) was defined as the intersection of the hyperbolic loci indicated.

One of the phasemeters was used to indicate the lateral deviations of the helicopter from the touchdown point. The centerline was indicated as "zero" on the dial. As the helicopter moved to the left or right of this centerline, the dial pointer moved to the left or right. The second large dial indicated the distance the helicopter was from the exact point of landing. The pointer of this indicator made a complete revolution for each 53.7 feet the helicopter moved along the approach path.

A lone Raydist operator watched the two dials, talked the helicopter to a point directly over the touchdown point. Then, the operator instructed the pilot to lower the craft. After correcting the pilot's descent, the operator talked the helicopter down onto the predetermined spot.

Guided Missile Operation Initiated

Two new operations have been established within the General Electric Company's Aeronautic & Ordnance Systems Div., it was announced by Walter C. Heckman, general manager. They are the Guided Missiles Dept. and the Aircraft Products Dept. Dr. Richard W. Porter was named general manager of the Guided Missiles Dept., with headquarters in the Schenectady plant. Fred B. Law has been appointed general manager of Aircraft Products Dept., which will be located at G.E.'s Johnson City, N. Y., plant.

New Tube Plant to Be Erected

The radio Tube Division of Sylvania Electric Products Inc. has announced plans to construct a 120,000-sq. ft. facility in Williamsport, Pa., to house a group of divisional engineering laboratories.

Consolidated Vacuum Elects Nunan

Election of Kneeland Nunan as Executive Vice-President and member of the Board of Directors of Consolidated Vacuum Corp. of Rochester, New York, newly acquired subsidiary of Consolidated Engineering Corp. of Pasadena, Calif., was announced today by Philip S. Fogg, President of both corporations.

News of MANUFACTURERS' REPS

Frederick I. Kantor has opened sales offices at 4010 Saxon Ave., New York 63, N.Y., to represent manufacturers in the electronic industries. The new organization will cover the territories of New York City, Long Island, Westchester County, and Northern New Jersey, and handle electronic parts and equipment, audio devices, and sound reproduction systems.

Gertsch Products, Inc., Los Angeles electronic manufacturing firm, has appointed Atlas Radio Corp., Ltd., 56 King St. West in Toronto 2-B, Ont., Canada, as its Dominion representative.

Staver Co. Inc., Bay Shore, Long Island, N.Y., makers of tube shields, minisprings and other stampings for manufacturers, has appointed the Frank A. Emmet Co., Los Angeles, to represent it in all Pacific Coast States, Arizona and New Mexico.

Walter E. Bornemann, manufacturers' representative residing at 4719 Cartier Ave., New Orleans, La., has been appointed Mississippi-Louisiana representative for H. H. Buggie & Company, Toledo, Ohio, manufacturer of connectors, cable assemblies and component parts for the communications and electronics industries.

Neely Enterprises, Hollywood electronic engineering representatives, appointed rep in California, Arizona, Nevada and New Mexico by Reeves Soundcraft Corp., N.Y., makers of magnetic recording tape and recording discs.

The Burlington Instrument Co., Burlington, Iowa, announce that the Robert E. Brown Company, 311 Ross Street, Pittsburgh 19, Pennsylvania, Phone Atlantic 1-2142, will represent them in the Western half of Pennsylvania west of and including the counties of Potter, Clinton, Centre, Huntingdon, and Franklin, and the entire state of West Virginia.

Audio Products, Inc., Los Angeles, has appointed E. V. Roberts & Associates, in the same city, to represent it in a 4-state area. The coast firm manufactures a unit called the Modular and subminiature amplifiers (Pak-AP).

Yale L. Saffro will represent Coil Winders, Inc., Westbury, N. Y., in the Chicago area. Mr. Saffro maintains an office at 800 North Clark St.

Bittan-Shafer Sales Co., manufacturers' representatives of electronic parts, television and radio, has been formed by Harry Bittan and Peter Shafer with offices and showroom at 120 Liberty St., New York City. Their sales activities will cover the metropolitan New York and northern New Jersey area.

The Kittleson Co., Los Angeles electronic representatives, has been appointed representative in four western states for Reon Resistor Co., Yonkers, N.Y., makers of wire wound resistors.

Styroflex COAXIAL CABLE

PROVED IN SERVICE!

TELEPHONE
PROSPECT 6-5100

KPIX
INC

TELEVISION
CHANNEL 5

VAN NESS AVENUE AT GREENWICH STREET
SAN FRANCISCO 9, CALIFORNIA

March 4, 1953

Phelps-Dodge Copper Products Company
40 Wall Street
New York, New York

Gentlemen:

The Styroflex co-axial cable installation at KPIX has proven its worth to us. As you know, where even short outages occur, both maintenance headaches and loss in station revenue are the results.

We at Television Station KPIX are certain your cable will be as free from leaks or junction difficulties in the future as it is today.

Engineers should be especially interested to know that an over-all standing wave ratio of 1.02 was obtained on Channel 5. Only five pounds of dry air pressure was used.

It is my belief that Styroflex cable will find many applications because of its ease of rapid installation. It seems within the realm of actuality to use this cable for powers of several hundred kilowatts, replacing certain open wire transmission lines.

I am personally convinced that Styroflex co-ax has a real and important future.

Very sincerely,

A. E. Towne

A. E. Towne
Director of Engineering
KPIX, KSFO, KWID

AET/bh

AFFILIATED WITH CBS TELEVISION NETWORK

• The properties of this cable can help reduce your operating costs. Our engineering, production and application experiences are at your service.

PHELPS DODGE COPPER PRODUCTS
CORPORATION
40 WALL STREET, NEW YORK 5, N.Y.

AFCA Convention Date Set

Dates and events for the 1953 Annual Convention of the Armed Forces Communications Assoc. in Dayton, Ohio, have been set. Registration will be at 9 AM on May 14 and 15. A demonstration will be held at Wright-Patterson Air Force Base at 3:15 PM on May 15.

GE's Pix Tubes to Have Internal Magnetic Focus

At this year's IRE convention the General Electric Co. will introduce the first television picture tubes to have internal magnetic focus. Late fall is indicated as the time for quantity availability. R. B. Gethman and L. E. Huyler, of Electronics Park in Syracuse will deliver a paper on this subject on Wednesday, March 25 entitled "The Internal Magnetic Focus Tube, Its Theory, Performance and Application."

Thermistors

Victory Engineering Corp., Union, N.J., has made available a thermistor data book covering the historical background, operating characteristics, typical applications, and engineering data on thermistors.

British Industries Fair

The 1953 British Industries Fair, to be held in London and Birmingham, April 27 to May 8, will feature developments which should be of interest to American visitors. Included will be: a radar trainer which simulates aircraft blips; polyethylene film; wire recorder for test pilots, which will withstand crash damage; and a new facsimile transmission system.

Test Equipment Firm Formed

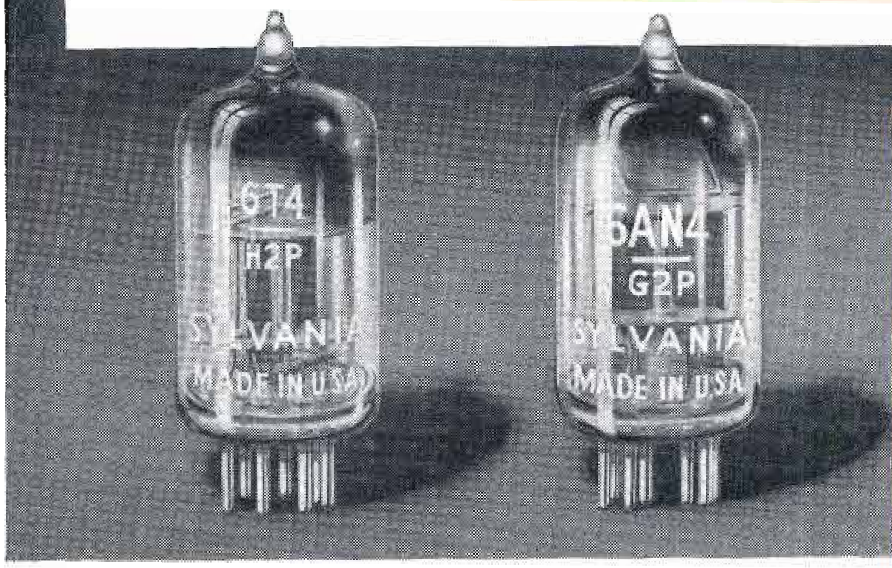
Pulse Techniques, Inc., 1411 Palisade Ave., West Englewood, N.J., has been formed for the design, development and manufacture of electronic test equipment, it is announced by W. Oliver Summerlin and Eugene R. Shenk. Mr. Summerlin was formerly Vice-president for Engineering with Audio and Video Products Corp., and Mr. Shenk was Assistant Section Head at the Terminal Facilities Laboratory of RCA.

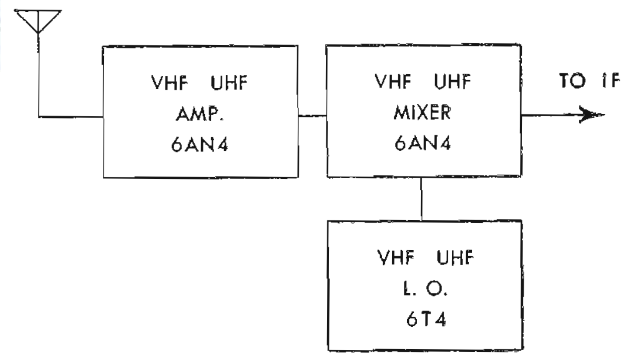
Handicapped Produce for Defense

Crutches are no handicap to the production of stators at the Federation of the Handicapped plant in New York City. The plant, which subcontracts from Bendix Aviation employs only physically disabled, boasts high efficiency

Make your UHF circuits as simple as VHF designs...

Use these two New Sylvania Tubes in tuners and converters





Representative block diagram of combination VHF-UHF tuner using the new Sylvania 6AN4 as rf amplifier and mixer, and the 6T4 as local oscillator.

Equipment Manufacturers! Simplify design of combination VHF-UHF tuners, UHF converters for TV! Two new Sylvania-developed tubes permit adaptation of conventional amplifier-mixer-local oscillator circuit to the new frequency bands—completely eliminate complicated switching arrangements or stage duplication. Leading Tuner Manufacturers have adopted these types for current tuner production.

- Short Bulb T-5½ 7-pin miniature construction
- Requires no special socketry
- Designed for use at frequencies up to 1000 mc
- Double plate and grid leads
- Uniformity at high frequency means lower cost and better availability

THE SYLVANIA 6T4 is designed for use as a local oscillator at frequencies up to 1000 mc. Used as the companion tube to the 6AN4, it makes possible the design of extremely simple combination tuners and UHF converters.

THE SYLVANIA 6AN4 can be used both as an rf amplifier and as a mixer. Its performance in the VHF band is equal to or better than previously existing types of tubes, and in UHF tuners it gives comparable performance to VHF tuners.

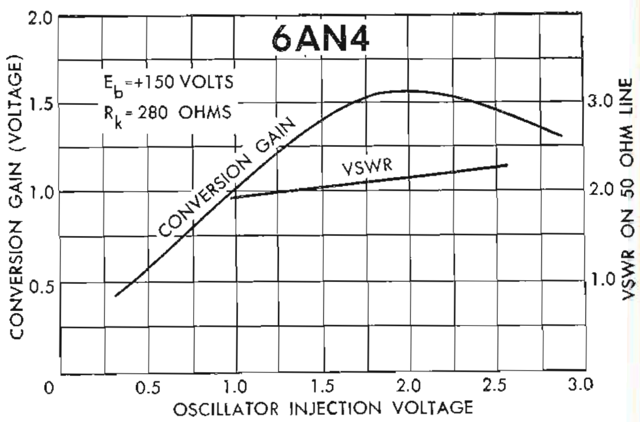
The 6AN4 is designed for both high g_m and high mu. Under representative operating conditions as a Class A amplifier, the transconductance is 10,000 micromhos and the amplification factor is 70.

When used as a mixer, the 6AN4 offers the advantages of a conversion gain and of relatively low oscillator drive requirements.

Complete technical information on operating characteristics, including performance curves, is included in the manual, "Sylvania's UHF Story." A copy is yours for the asking. Write to: Sylvania Electric Products Inc., Dept. 3R-3004, 1740 Broadway, New York 19, N. Y.

COMPARATIVE PERFORMANCE OF THE 6AN4 AT VHF AND UHF

CONDITIONS		INSERTION GAIN (db)	AMPLIFIER NOISE FIGURE (db)	BANDWIDTH (Megacycles)
Single Tube in Channel 13 booster	VHF	14	9	10
Two tubes in cascode in Channel 13 booster	VHF	22	8	7.5
Single tube in open half-wave tuned amplifier at 450 mc.	UHF	12	12	10
Single tube in open half-wave tuned amplifier at 900 mc.	UHF	10	15	10



Curves show conversion voltage gain using 50 ohm input and output, and input VSWR of the type 6AN4 when used as a mixer.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT LAMPS, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

TV Camera Dissolve

(*Continued from page* 108)

must also be switched along with the camera output and this is quite simply accomplished by another set of contacts on the reversing switch. The entire reversing switch consists of a simple wafer switch of good quality.

Switching the tally lights is quite simple, but the problem of turning them on when the camera begins to dissolve in, having them both on during the dissolve, and then turning out the one dissolved out, is slightly more involved. This was accomplished quite positively by the use of a small gear-drive, manufactured by Millen Co., which is readily available. This drives both R_1 and R_2 from a single shaft, the pots each coming

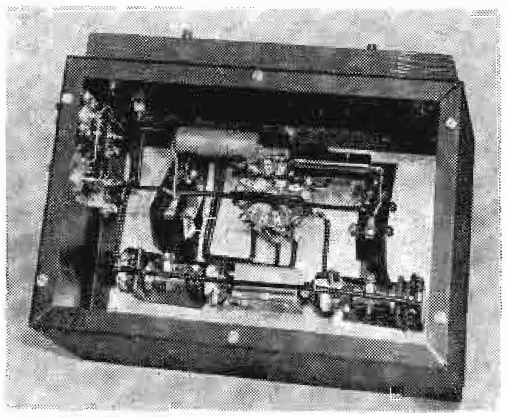


Fig. 3: Underside of dissolve unit shows the pots and tally cams mounted on shaft at bottom

off opposite sides of the gear drive (Fig. 3). It will be noticed that the pots are the last thing on the shaft. Halfway between each pot and the gear box is a brass shaft coupler in which a slot has been cut and a metal finger (⅛-in. brass) inserted. This finger is positioned on the shaft so that when its pot is almost dissolved out, the curved edge encounters a microswitch, and by cam action pushes its reed up, thus *opening* the circuit to the tally light for the camera being used on that pot. It was decided to open the tally to the camera being dissolved out rather than close the one being dissolved in because the switch spark would be associated with the camera whose picture was not being fed into the system. If desired, 0.1 μf capacitors can be connected across the microswitch contacts to further decrease the arc, although it is not objectionable without them.

This system provides a latitude of adjustment, since the coupler with the finger can be rotated on the shaft or moved sideways during the the initial positioning and the time at which the microswitch opens can be easily adjusted. The mechanical stability of the arrangement is very good, the unit shown having been in operation over a year with no attention required.

It will be seen that the microswitches are mounted on triangular metal flanges as shown in Fig. 3 Rigid flanges can be cut from the opposite ends of a steel chassis angle bracket. The flanges are then bolted to the front panel with the boltheads countersunk.

Adaptation of this unit for more cameras can easily be accomplished by using a switching system ahead of the Camera #1 and Camera #2 inputs (Fig. 2), and calling these inputs A and B. Then an A and B button can be provided for each camera input to be used and any camera set up on the input not being used on the air.

Quality Control

(*Continued from page* 116)

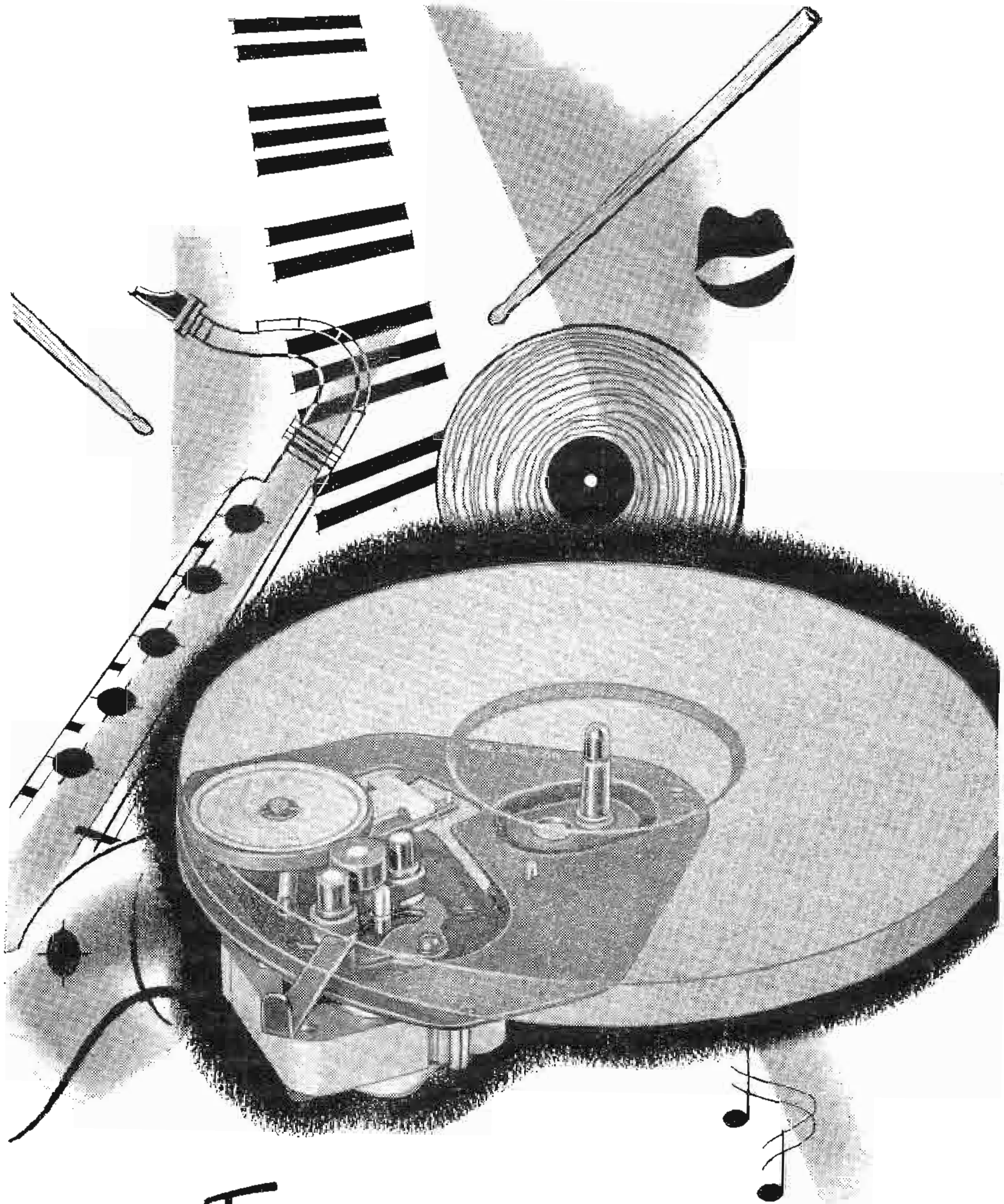
2. Inferior process average (above certain statistical levels)—tightened sampling.
3. Normal process levels (within certain statistical levels)—normal sampling.
4. Process very good (below certain statistical levels)—reduced sampling.
5. Where process is very good and defects are only minor in nature, process inspection only is performed by means of sampling tables or control charts.

Any lot, no matter in which of the five categories named above, that fails the sampling or process inspection, must be 100% inspected and then resampled. Final electrical inspection is done with 0.4% A.Q.L. sampling tables or by means of frequency distribution. As most mechanical attributes do not affect performance, a 1.5% A.Q.L. sampling table for final mechanical inspection is employed. A few very important mechanical defects are, however, tested with the 0.65% A.Q.L. table.

100% Inspection: It used to be considered that 100% inspection gave assurance of perfect quality. This is not necessarily true, for example:

It is not enough to state that all capacitors are 100% inspected for breakdown or flash test. What was the voltage of that test; what type equipment was used; will the equipment drift during lengthy tests? Were the components that were 100% tested given any further inspection? 100% testing large lots by hand produces some strange results due to causes such as operator fa-

(*Continued on page* 148)



tigue, faulty setups of instruments, inattention of the operator, and drift of test equipment.

Customer Complaints: It is also Quality Control's job to handle customer complaints and secure the cooperation of other departments in correcting the cause of the complaint. One of the most difficult problems in this category is evaluating a complaint. In order to handle complaints, we need to know four things.

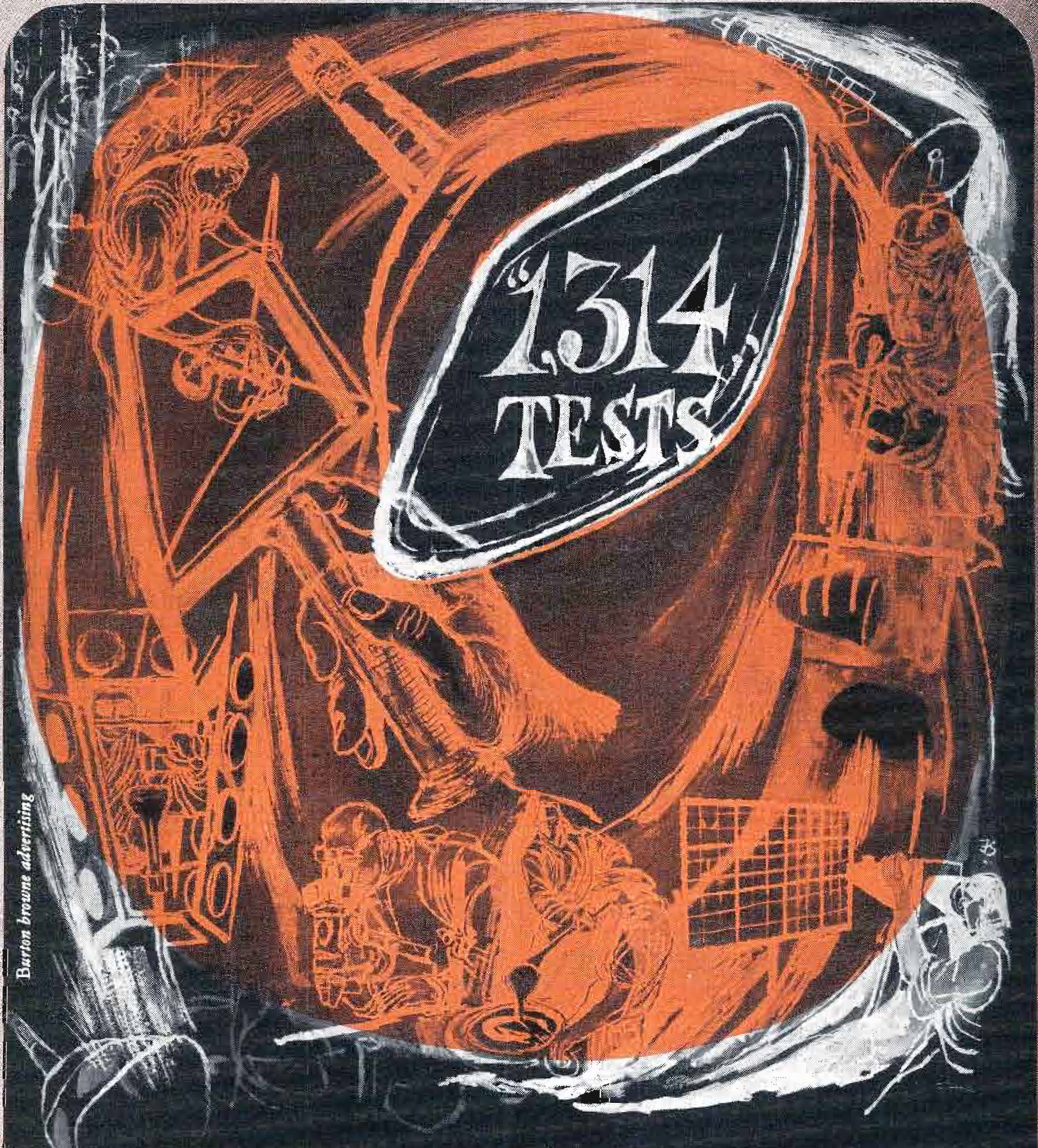
1. What is the defect?
2. How is the part used?
3. What percentage of the pieces have the defect?
4. Samples of the defect.

Returned Orders: An important function of the Quality Control Dept. is to examine all material returned by customers as defective. Returns fall in the following principal categories:

1. Quality of product unsatisfactory for following reasons:
   a) Engineering difficulties unforeseen in original specifications or unsolved.
   b) Mistake at final inspection.
   c) Probabilities of sampling (95% to 99% of pieces are salvageable).
   d) Small quantities are defective.
2. Sales policy or sales department error:
   a) Misinterpretation of order.
   b) Shipped ahead of schedule.
3. Customer:
   a) Customer returned good material in error.
   b) Material misused by customer.
   c) Customer stocked the lot before his inspection and held it an excessive length of time.
   d) Customer unable to use material because of his engineering error or engineering change.
4. Shipping:
   a) Material damaged in transit Such claims should be made upon the delivering carrier.
   b) Error in shipping department.
   c) Faulty packaging.

The Quality Control Department has three principal functions:

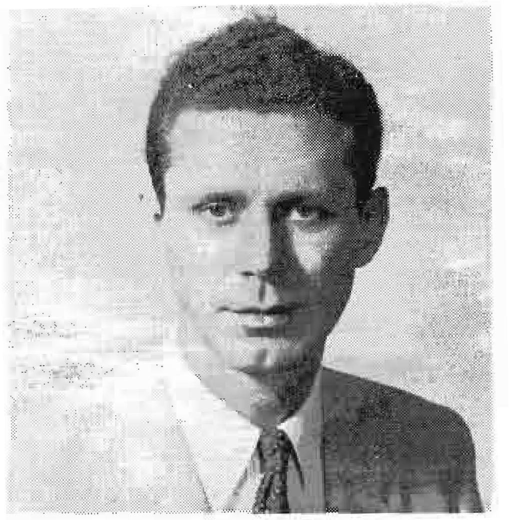
1. To aid Production and Engineering so that process improvement is made where it is most needed. This results in better yields and a better process *before* it has final inspection.
2. To represent the customer at the factory, and to suggest changes or improved quality when needed.
3. To pass on materials that are to be shipped out the door. In order to serve the customer better, Erie now includes a lot quality certificate with each shipment of standard products. The advantages for the customer are: less receiving inspection, better understanding of material being received, and better quality.


"1,314" TESTS
Burton browne advertising

PERSONAL

Robert W. Sanders has been elevated to the post of chief television engineer of the Magnavox Company, Fort Wayne, Ind. Mr. Sanders was formerly general manager of the television division of the D. J. Roesch Co., manufacturer of Douglas remote-control television. Prior to that, he was chief television engineer of the Hoffman Radio Corp. Frank R. Norton, formerly chief engineer of radar and television for Magnavox, is now chief radar engineer.

Robert T. Cavanagh has been named Assistant Director of Research of Du Mont's Research Laboratories. This promotion follows a leave of absence of 18 months from the Research Division during which time he served as chief engineer of the Receiver Division. He joined Allen B. Du Mont Laboratories as a Research Engineer in November, 1947, having previously been engaged in joint research activities with Du Mont from his former home in Toronto, Ontario, Canada.



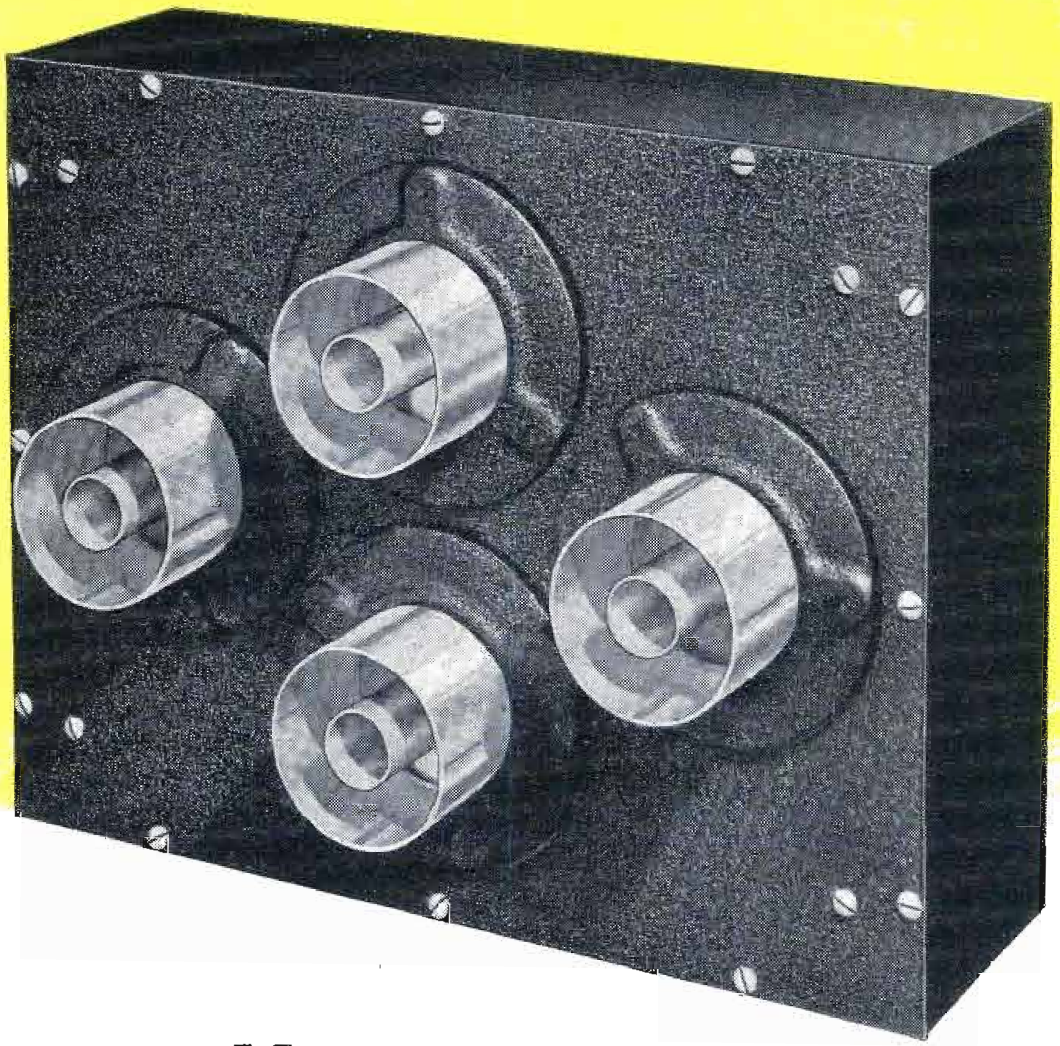
Robert T. Cavanagh

James L. Lahey has been named general plant manager of Dage Electronics Corp., Beech Grove, Ind. For the past four years he has been plant superintendent and assistant general manager of Television Associates, Inc., Michigan City, Ind. During that time, he engineered aerial surveys for proposed microwave relay systems and assisted establishment of WSAZ-TV relay from Huntington, W. Va., to Cincinnati, Ohio.

Peter J. Totino has been appointed chief process planner in the manufacturing division of the Consolidated Engineering Corp., Pasadena, Calif.

Alden R. Joy and **Roland J.Melanson** have been appointed senior engineers with Clarostat Manufacturing Co., Inc., Dover, N. H. Mr. Joy has assumed responsibility for the design and development of new carbon-element products and the engineering supervision of the company's Carbon Controls Section.

YOU CAN ALWAYS COUNT ON Thompson



Here's another new Thompson Coaxial Switch

THIS MODEL NO. DOY3AX, 1P3T, 3⅛ inch size coaxial switch is the newest member of the Thompson family of coaxial switches. It is for manually switching VHF television transmitters to stand-by or test positions. It operates on a new switching principle and can be supplied with two, three, or four outlet positions or with remote actuator.

Let us work with you in the solution of your microwave component and accessory problems. The Electronics Division's staff of competent engineers, electronic and environmental test equipment, model shop and production facilities are at your service. We invite your problems.

* *WRITE for further technical information; your inquiry will bring a prompt reply.*

VISIT US
March 23-24-25-26, 1953 Booth 3-209 I. R. E. Exhibit, Grand Central Palace, New York, N. Y

Thompson Products

ELECTRONICS DIVISION
2196 Clarkwood Rd., Cleveland 3, Ohio

John W. Thayer, member of the WEWS engineering staff since 1950, has been named chief transmitter engineer of the Cleveland video outlet of Scripps-Howard Radio, Inc. Cleveland, Ohio. In commercial radio since 1939, Mr. Thayer served as assistant to the manager, Cleveland Municipal Airport before joining WEWS.

Alfred Y. Bentley has been named chief engineer of the receiver division, Allen B. Du Mont Laboratories, Inc. He had been chief engineer of the Du Mont cathode-ray tube division since 1947. Prior to that time, he was assistant head of the cathode-ray tube engineering department, the position to which he was assigned when he joined the Du Mont organization in December, 1945.

Alfred Y. Bentley

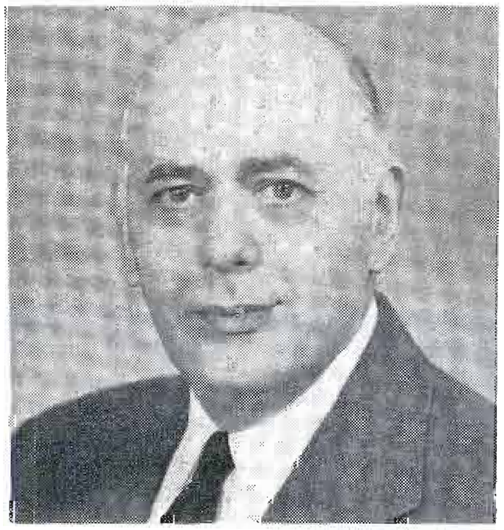
Angus A. MacDonald has been appointed assistant chief engineer in charge of two-way radio development of Motorola, Inc. Prior to his assignment to Motorola's development activity, he was a section manager with the Westinghouse Electric Corporation. His experience includes work on the SCR-584 gun laying radar equipment and experiments in television broadcasting from aircraft. More recently, he was responsible for the design and development of VHF mobile equipment, medium and high frequency point-to-point transmitters, and broadcast equipment.

Angus A. MacDonald

Paul F. Evans has joined Heppner Manufacturing Co., Round Lake, Ill., as a design engineer specializing in Heppner's new line of deflection yokes and horizontal output transformers. Previously, Mr. Evans was project engineer with Sylvania Electric and on the engineering staff of Westinghouse radio-TV division.

William P. Maginnis has been elected vice president and chief engineer of Federal Telephone and Radio Corp., Clifton, N. J., associate of International Telephone and Telegraph Corp. He was with the Radio Corporation of America for 21 years and headed components engineering at the RCA Camden plant prior to joining Federal. Previous to his Camden assignment, Mr. Maginnis was chief engineer at the RCA manufacturing plant in Bloomington, Ind.

Leon Golder has been named general sales manager of Carbonneau Industries, Inc. He has had a long previous association with the Rola Co. and with the Magnavox Co. For the past two years, Mr. Golder has been chief of the Radio and Television Section, Electronics Division of National Production.



Leon Golder

Dwight W. Bloser, formerly chief engineer of the Transicoll Corp., New York City, has been named vice-president of that company. His new position involves supervision of the design, engineering, and production of control motors, gear trains, induction generators, servo amplifiers, and synchros.

George F. Schroeder has been named acting assistant chief engineer for Airborne equipment of the Ford Instrument Co., Long Island City, N. Y.

Robert C. Foote has been appointed general plant manager of Dage Electric Co., Beech Grove, Ind. He will supervise production of r-f connectors.

George Krygier has been elevated to the post of administrative engineer for CBS-Columbia, Inc. Formerly the company's liaison engineer with Underwriter's Laboratories, he will now handle engineering administrative functions and coordinate activities between the engineering department and other divisions of CBS-Columbia.

Electronic Components Symposium Program

A wide range of technical subjects in both the production and developmental fields are scheduled to be covered during the 1953 Electronic Components Symposium to be held April 29-May 1 at the Shakespeare Club, Pasadena, Calif. Sponsored by the IRE, AIEE, RTMA and WCEMA, the three-day meeting is under the general chairmanship of Dr. A. M. Zarem, Stanford Research Institute. Early reports indicate that more than 1,500 scientists, engineers and executives will attend. Registration may be obtained through Symposium headquarters of Stanford Research Institute, 621 S. Hope, Los Angeles 17, Calif.

Following is the tentative program:

Session 1—General

Chairman: Simon Ramo, Vice President in Charge of Operations, Hughes Aircraft Co.

"The Development of Industry Standards by the RTMA," Ralph R. Batcher, Chief Engineer, RTMA

"Inferences from Tests of Electronic Ordnance," B. P. Ramsay, Chief, U. S. Naval Ordnance Lab.

"A Critical Compilation of Electronic Information," Richard Larson, Vitro Corp. of America

"The Component Problem in Industrial Electronics," Ellsworth D. Cook, General Electric Co.

Session 2—Environment & Packaging

Chairman: A. W. Rogers, Chief, Components Branch, Signal Corps Electronics Lab.

"Protective Coatings for Etched Circuit Wiring," Morris Weinberg and Lester J. Martin, Hughes Aircraft Co.

"Review of Component Progress for Auto-Sembled Electronic Equipments," V. J. Kublin and R. A. Gerhold, Signal Corps Engineering Lab.

"Components for Mechanized Production of Electronic Equipment," L. K. Lee and F. M. Hom, Stanford Research Institute

"Recommended Temperature Measuring Techniques and Ratings for Electronic Parts," James P. Walsh, Cornell Aeronautical Lab.

"The Behavior of Component Parts in High-Intensity Short-Duration Environments," C. R. Gates and Floyd A. Paul, California Institute of Technology

"Temperature-Pressure Derating of Electron Tubes," Bernard Smith, Wright Air Development Center

Session 3—Tubes & Tube Reliability

Chairman: To be announced

"Electron Device Reliability vs Post-War Equipment Complexity," John E. Gorham, Chief, Signal Corps Engineering Lab.

"Statistical Control of Electron Tube Reliability," A. J. Heitner, Sylvania Electric Products

"Performance of Vacuum Tubes in Military Applications," E. R. Jervis and R. Madison, Aeronautical Radio

"Reliability—Tubes vs Transistors," C. W. Martel, Raytheon Manufacturing Co.

"Improving Equipment Reliability by Tube Aging and Inspection," Roy E. Colander, Bendix Aviation Corp.

Session 4—Reliability

Chairman: M. Barry Carlton, Research and Development Board

"The Case of Reliability vs Defective Components et al," Ralph M. C. Greenidge, Bell Telephone Labs.

"The Necessity of Statistical Experimental Design in Testing for Component Reliability," John L. Balir, Consolidated Vultee Aircraft Corp.

"Rudiments of Good Circuit Design," Norman H. Taylor, Mass. Institute of Technology

"Reliability of Transistors," R. M. Ryder and W. R. Sittner, Bell Telephone Labs.

Session 5—Resistors, Capacitors & Dielectrics

Chairman: Louis Kahn, Aerovox Corp.

"Characteristics and Applications of Voltage Sensitive Dielectrics," George S. Shaw and James L. Jenkins, Radiation, Inc.

"Some Characteristics and Limitations of Capacitor and Resistor Components," Julian K. Sprague and Leon Podolsky, Sprague Electric Co.

"New Developments in General Purpose Ceramic Dielectric Capacitors," A. K. Das Gupta, and William G. Delp, Solar Manufacturing Corp.

"Recent Developments in Dielectric Materials Related to Component Development," G. T. Kohman, Bell Telephone Labs.

"Quality Components and Improved Dielectrics," A. J. Warner, Federal Telecommunication Labs.

Session 6—Devices & Materials

Chairman: Reuben Lee, Westinghouse Electric Corp.

"New Ferritic Materials," Ephraim Gelbard, Gen-

eral Ceramics and Steatite Corp.
"Ferro-Resonant Devices," Hugo Woerdemann, Magnetic Research, Inc.
"Transformer Design Limitations," Robert Hanson, Transonic, Inc.
"Selenium Rectifier Characteristics and Limitations," G. B. Farnsworth, General Electric Co.
"Contact Phenomena as Related to Miniaturization," Frank Spayth, Head, P. R. Mallory & Co.

Air Force's Newest Pilotless Aircraft

Details of one of the nation's newest pilotless target drone aircraft, the Ryan Q-2 "Firebee", were released by the U.S. Air Force's Air Research and Development Command as the first announced development of its kind to emerge from the nation's huge guided missiles program. The drone is somewhat less than half the size of present-day jet fighters and has performance characteristics that simulate jet aircraft now in combat in Korea.

In the high-speed class, the Firebee, which can operate at high altitudes, is powered by a Fairchild J-44 turbo-jet engine of about 950 lbs. thrust. The engine is approximately 6 ft. long, 22 in. in diameter. The mid-wing all-metal robot has sharply swept back wings and tail surfaces. It has an approximate 12-ft. span and 18-ft. length. It weighs about 1800 pounds.

The principle mission of the Firebee which has been revealed is its use as a drone target for modern defense weapons. It is designed to offer a high-speed target capable of simulating piloted jet plane maneuvers for the training of anti-aircraft crews. It is equally adaptable for ground-to-air tracking and firing and for air-to-air interception problems.

In order to achieve the most economical employment of the Q-2 through its repeated use as a drone, Ryan Aeronautical Co. and Air Force technicians from the Wright Air Development Center developed a two-stage parachute system to decelerate the drone from its near-sonic operating speed and lower it safely to the ground without damage to the aircraft structure or the delicate electronic controls.

In the test program at the Holloman Air Development Center, the Firebee has been launched on numerous flights both from the belly and wings of twin-engine "mother" aircraft. It has also been successfully launched from the ground.

Sales Office Opens

Audio & Video Products Corp., 730 Fifth Ave., New York, has opened a new branch sales and engineering office in the Bankers Security Building at Juniper and Walnut Streets, Philadelphia, Pa. it is announced by Kenneth B. Boothe, Vice President.

The office under the direction of A. F. Schoenfeld, Jr. will handle sales, service and engineering on Ampex Data Recorders and also standard Ampex equipment, as well as the products of Altec-Lansing, Minnesota Mining & Manufacturing and The Atomic Instruments Co., plus a complete line of audio accessories.

Coming Events

April 21—RDB Panel on Electron Tubes, Symposium of Ceramic-to-Metal Seals, Rutgers Univ. School of Ceramics, New Brunswick, N. J.

April 12-16—Electrochemical Society, International Meeting, New York, N. Y.

April 18—Cincinnati Section, IRE, Seventh Annual Spring Technical Conference, Cincinnati, Ohio.

April 20-22—MPA, 9th Annual Meeting, Cleveland, Ohio.

April 23-24—IRE Prof. Group on Circuit Theory, International Symposium on Nonlinear Circuit Analysis, Engineering Societies Bldg., New York, N. Y.

April 26-30—SMPTE 73rd Convention, Hotel Statler, Los Angeles, Calif.

April 28-May 1—7th Annual NARTB Broadcast Engineering Conference, Burdette Hall, Philharmonic Auditorium, Los Angeles, Calif.

April 29-May 1—Electronic Components Symposium, Shakespeare Club, Pasadena, Calif.

May 11-13—IRE, National Conference on Airborne Electronics, Dayton Biltmore Hotel, Dayton, Ohio.

May 14-16—AFCA, 7th Annual Convention, Dayton, Ohio.

May 18-21—Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

May 24-28—SAMA, Annual Meeting, The Greenbriar, White Sulphur Springs, W. Va.

June 9-11—2nd International Aviation Trade Show, Hotel Statler, New York, N. Y.

June 15-19—Exposition of Basic Materials for Industry, Grand Central Palace, New York, N. Y.

June 16-24—International Electro-Acoustics Congress, The Netherlands.

June 20-Oct. 11—German Communication and Transport Exhibition, Munich, Germany.

Aug. 19-21—Western Electronic Show and Convention, San Francisco Municipal Auditorium, San Francisco, Calif.

Aug. 25-28—APCO, 19th Annual Conference, Sheraton-Cadillac, Detroit, Mich.

Aug. 29-Sept. 6—West German Radio and TV Exhibition, Duesseldorf, Germany.

Sept. 1-3—International Sight and Sound Exposition, Palmer House, Chicago, Ill.

Sept. 9-12—NEMA, Haddon Hall Hotel, Atlantic City, N. J.

Sept. 21-25—ISA 8th National Instrument Exhibit, Sherman Hotel, Chicago, Ill.

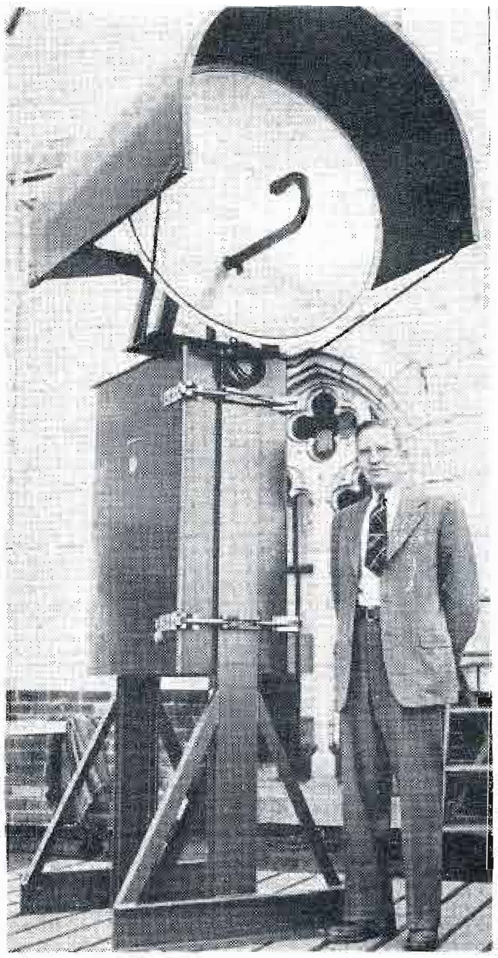
AFCA: Armed Forces Communications Assoc.
APCO: Associated Police Communication Officers
AIEE: American Institute of Electrical Engineers
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
MPA: Metal Power Assoc.
NARTB: National Association Radio and Television Broadcasters
NEMA: National Electrical Manufacturers Assoc.
RDB: Research and Development Board
SAMA: Scientific Apparatus Makers Assoc.
SMPTE: Soc. of Motion Picture and TV Engineers

New Microwave Relay

The availability of a new microwave relay designed for the transmission of TV signals to remote points has been announced by Motorola, Inc. of Chicago. These systems can be used either for stub relay of network broadcasts to remote localities or as "STL" interconnects between centrally located studios and remotely located TV broadcast transmitters. The system features a single microwave r-f channel carrying the broadcast quality video signal, the high fidelity audio program channel plus a two-way voice order wire or cue channel.

Common carrier frequencies of 6415 MC and 6340 MC are used in the system. The first is for video-audio-service transmission and the second for service or cue channel transmission in the return direction. The equipment is also available for operation in the 6875-7125 MC STL range.

The first of these new microwave TV relay installations was recently completed by the Mountain States Telephone and Telegraph Co. in Denver, Col. The installation provides an interconnecting circuit between the radio relay terminated in the telephone company office in Denver and a TV broadcast transmitter on top of Lookout Mountain 14 miles away and some 3000 ft. above the "mile high city". Service provided by the relay is made available to station KBTV.



Hubert Sharp, radio engineer for the Mountain States Tel. & Tel. Co. stands before Motorola microwave TV relay at company's Denver office

LETTERS...

Q-Meter Correction Chart

Editors, TELE-TECH

In reply to Mr. Gegenheimer's comments (TELE-TECH, February 1953), on my Q-Meter correction chart for the effect of distributed capacitance on both Q and inductance, I would first like to say I agree with him. Secondly, the chart was originally drawn for Q corrections, but because the correction factor applies for inductance as well as Q, both parameters were included on the ordinate. Nevertheless, if the Q capacitor dial incorporates an inductance scale, the true inductance can be obtained more conveniently from this scale than with the chart.

Mr. Gegenheimer's letter was principally directed to engineers who may not have been aware of this particular short cut. In that same spirit, may I use this opportunity to describe another Q-Meter measurement which may interest some engineers. The measurement is apparently little known, judging from the frequent complaints that the minimum value of Q capacitance (27 $\mu\mu f$) is often embarrassingly large. While a lower value would unquestionably be helpful in many instances, the construction of such a variable capacitor (say, from 5 $\mu\mu f$ to 450 $\mu\mu f$) will probably never be realized. Fortunately, a simple method exists to determine the external capacitance required to resonate coils, even when this capacitance approaches zero.

Perhaps the procedure is best described by considering an actual problem. Assume an inductor is required to resonate at 26.5 megacycles in the input circuit of an rf amplifier. The input capacitance measures 6.0 $\mu\mu f$. The coil can be properly adjusted on a Q-Meter as follows:

1. Set the Q-Meter oscillator to the desired frequency (26.5 MC).
2. Connect an auxiliary coil to the inductor posts of the Q circuit and tune and Q capacitor for resonance. The coil should preferably be shielded, have a reasonably good Q, and resonate at the desired frequency with a small amount of Q capacitance (say, between 30 and 75 $\mu\mu f$). Call this capacitance C_1.
3. De-tune the Q circuit by increasing the Q capacitance an amount equal to the external capacitance with which the coil must resonate (6.0 $\mu\mu f$ in this example). Call this new capacitance C_2.
4. Connect the test coil to the Q capacitor posts and adjust its inductance until resonance is restored to the Q circuit. The coil will now tune to 26.5 MC with an external capacitance of 6.0 $\mu\mu f$.

The validity of this measurement can be shown by first considering the Q circuit with the auxiliary coil alone. We may then write

(*Continued on page* 160)

$$L_{aux} = 1/(\omega^2 C_1) \qquad (1)$$

When the Q capacitor has been increased to a value, C_2, and the test coil connected in parallel with this capacitor and adjusted for resonance, we have for the combination

$$L_{aux} = \frac{L}{\omega(\omega^2 LC_2 - 1)}$$

$$L = \frac{L_{aux}}{\omega^2 L_{aux} C_2 - 1} \qquad (2)$$

$$L = \frac{1}{\omega^2 (C_2 - C_1)}$$

which says, in effect, the inductance tunes with the difference of Q capacitor settings. If the vernier capacitor on the Q-Meter is used to establish C_2, very small changes can be employed.

If the Q of the test coil is desired, it may be calculated from

$$Q = \frac{Q_1 Q_2 (C_2 - C_1)}{C_1 (Q_1 - Q_2)}$$

This method is particularly useful for the adjustment of video peaking coils where interstage capacitance is usually in the order of 15 to 25 μμf.

National Broadcasting Co.,
New York 20, N.Y.

RAYMOND E. LAFFERTY,
Development Engineer

New England IRE Meets

The 1953 New England Radio Engineering Meeting (NEREM), sponsored by the North Atlantic Region of the IRE, will be held at the U. of Connecticut, Storrs, Conn., on Saturday, April 11, 1953. All reservations should be addressed to Prof. Edward J. Robb, Box U-37, U. of Connecticut, Storrs, Conn. A nominal registration fee of $1.00 will be made.

The following technical papers will be presented: "Some Ancient Propagation—Their Lessons," Major E. H. Armstrong; "New Cosmotron Instrumentation," Frederick Cowan, Brookhaven Labs.; "Field Tests of Compatible Color Television," Donald Fink, Philco; "TD2 Microwave Systems," R. C. Glancy, A.T. & T.; "Acoustical Design Including Strategic Locations of Loud Speakers," Robert Newmant, M.I.T.; "Servo-Mechanisms," P. M. Schultheiss and C. A. Worgrin, Yale Univ.

WCBS-TV Increases ERP 2½ Times

WCBS-TV, CBS-owned station in New York City, became the first TV station in the Metropolitan area to broadcast its signal with the full power permitted by the FCC. The Channel 2 station increased its effective radiated power by more than two-and-one-half times bringing the visual ERP from the top of the Empire State Building up to 43 kw.

Rolling Studio for KHQ-TV

KHQ-TV's Herman Body houses monitor for two cameras, switching units for the cameras, an on-the-air monitor and a director's booth. Projected plans call for a more elaborate installation but the pressure of getting the nation's first 100-kw station on the air has held back this part of the program.

The mobile TV body for the "Rolling Studio" was built by The Herman Body Co. of St. Louis, Mo., the nation's largest builder of special truck bodies. It is equipped with a specially reinforced roof to support the weight of cameras and operators. The roof has built-in rings for anchoring the on-roof equipment and a guard rail which goes completely around the top of the body. A built-in ladder on the rear of the unit gives quick access to the roof.

"Rolling TV Studio" recently put into operation by KHQ-TV, Spokane, Wash. Chief engineer Al G. Sparling checks camera view finder as KHQ-TV president R. O. Dunning looks on

Load Space

Inside height of the Herman Body is 78 in., which enables occupants to walk around comfortably inside the body. Load space is 12 ft. long by 78 in. wide. The body is designed to give maximum load space and carrying capacity on the shortest wheelbase possible, thus increasing the maneuverability of the unit.

CBS-Hytron Plans New Plant

Plans for the construction of an ultra-modern TV picture tube plant and warehouse in Kalamazoo, Mich., were announced by Bruce A. Coffin, President of Hytron Radio & Electronics Co.

The new plant is scheduled for occupancy in June, 1954, when production wil start. It is expected that the full operating rate of production will be reached by the fall of 1954. The 235,000 sq. ft. plant has been designed for production of the new large-screen TV picture tubes under the direction of Charles F. Stromeyer, CBS-Hytron's Vice President in Charge of Engineering and Manufacturing.

NARTB Conference Agenda Completed

The seventh annual NARTB Broadcast Engineering Conference, scheduled to run concurrently with the National Association of Radio and Television Broadcasters' 31st annual convention in Los Angeles, April 28-May 1, 1953, is expected to be the largest in the history of the undertaking. The agenda tailored to fit the needs of AM, FM, and TV engineers, was developed from an offering of enough technical papers to complete a full week of programming.

According to Raymond Guy, NBC, New York, chairman of the General Guidance Committee, the committee was able to include only an approximate 40% of the material submitted in the conference program which runs from April 29 through May 1. All technical sessions will be staged in Burdette Hall, located diagonally across from convention headquarters at the Biltmore Hotel which will also house thousands of dollars worth of the most modern broadcast equipment available.

On opening day Commissioner George E. Sterling, of the FCC, will divulge the latest information on the CONELRAD Project, designed to permit AM stations to remain on the air during any possible enemy air attack. Following his address, Robert Linx, Western Zone supervisor of the CONELRAD Project, and Stephen J. McCormick, Director, Audio-Visual Division, Federal Civil Defense Administration, will be available for consultation with broadcasters seeking information on the project.

On Thursday afternoon, following the management conference on "Small Market Television," an engineering symposium on "Low Budget TV Operation" will be featured with James L. Middlebrooks, KING-TV, Seattle, Wash., serving as moderator of a four-man panel.

Some of the papers scheduled to be presented are:

"Automatic Station Operation"—by Ross Snyder, Ampex Electric Co.

"Waveguides for UHF Television"—by J. S. Brown, Andrew Corp.

"Contouring of TV Antenna Patterns"—by L. O. Krause, General Electric Co.

"Methods of Controlling the Vertical Pattern on UHF and VHF Antennas"—by L. J. Wolf, RCA

"The Proper Care of a Tower and Installation From A Tower Designer's Viewpoint"—by Roger Hayden, IDECO Division, Dresser Stacy Co.

"Approved Wiring and Control Methods for TV Studio Lighting"—by Herbert A. Kliegl, Kliegl Bros.

"Remote Control of FM 10 KW Transmitter"—by Ben Akerman, WGST, Atlanta, Ga.

"Operation and Installation Problems of Remote Control Equipment"—by William F. Rust, Jr., Rust Industrial Co.

"Proof of Performance Measurements for TV"—by R. D. Chipp, DuMont Television Network

"Experimental Booster Station for WSM-TV"—by John H. DeWitt, WSM, Nashville, Tenn.

"High Efficiency AM Radiation from High TV Towers"—by Glenn Gillett, Gillett & Bergquist

"TV Systems Measurements"—by Roy Monfort, National Broadcasting Co.

"New Developments in Television"—by Neal McNaughten, NARTB

"Video Tape Recording"—by John Mullin, Bing Crosby Enterprises

"Requirements for High Quality TV Film Projectors"—by W. E. Stewart, RCA

"Development of the Station Camera"—by L. L. Pourciau, General Precision Laboratory

Pressure Sensing

(*Continued from page 83*)

sure signal "seen" by the transducer, lb/ft²

P_i = Amplitude value of the step function pressure change applied at the tube open end, lb/ft²

δ_r = Amplitude response index $= P_o/P_i$

t_2 = Time lapse after application of step function pressure, sec.

Select desired time lapse (t_2) and amplitude of step function pressure change applied (P_i). Multiply natural frequency (ω_n) calculated in Section c by time lapse (t_2) and using

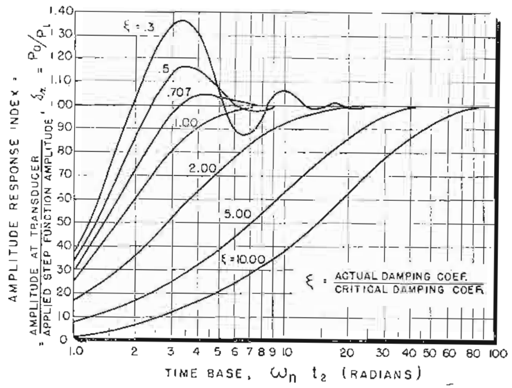


Fig. 6: Variation of amplitude response index with time base for various damping ratios

Fig. 6 determined amplitude response index (δ_r) for system damping ratio (ξ) calculated in section b. Let $t_2 = 0.1$ sec the time lapse and $P_i = 288$ psf the applied step function for which system is to be examined. From Fig. 6 for $\omega_n t_2 = 22.8 \times 0.1 = 2.28$ radians and $\xi = 0.488$. $\delta_r = 0.96$, therefore the amplitude value of the pressure signal "seen" by the transducer is,

$P_o = 0.96 \times 288 = 276$ psf. at 0.1 second after application of step function pressure change P_i.

The parameters discussed in sections c, d, and e may be seen perhaps more clearly from the input-output sketches of Fig. 1.

Conclusion

In conclusion it is advisable to examine pro and con the characteristics of the system analyzed here. Referring to Fig. 1, it can be seen that the system will exhibit excellent response to step function pressure changes, however, some amount of overshoot (about 15% max.) beyond the value of the input signal P_i is evident. This may be undesirable and could be reduced to about 5% max. by increasing the value of the system damping ratio to 0.707, but at the expense of poorer response. Since the damping ratio varies inversely as the cube of the tube

(*Continued on page 164*)

inside radius it could be most effectively increased by a suitable reduction of the tube radius. The performance of the system with sinusoidal input signals (buffeting) could be excellent for a servo control loop because of the large attenuated output which means only a small signal would be sensed and could have neglible effect. For data measuring work such a characteristic is not desirable since the true signal value would not be recorded. To obtain a more efficient transfer of the signal it would be necessary to increase the natural frequency which could be done most effectively by increasing the tube radius since the natural frequency of the system varies directly with the radius. It is obvious from the above discussion that it may be necessary to run through the calculations several times with different system dimensions until the desired characteristics are obtained.

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Mexico Purchases Philco Microwave System

Philco Corp. has been selected by the Secretary of Communications and Public Works of Mexico to provide a microwave radio relay communications system between the Government overseas radio receiving station at Escalera and the communications control center on Calle de Tacuba, Mexico City, D. F.

The system, which is scheduled for installation during 1953, will provide 35 simplex and 4 duplex voice channels, 12 simplex teletype channels and 4 wideband channels capable of receiving and transmitting facsimile or radio programs. These services will be made possible through the installation of two parallel r-f paths utilizing Philco Model CLR-6 microwave relay equipment, diplexed over a single antenna assembly, plus Philco Model CMT-4 Time Division Multiplex equipment and telegraph subcarriers.

New Britain Added to Bell TV Network

The Bell Telephone System's nationwide TV network facilities have been extended to station WKNB-TV, New Britain, Conn., which recently began commercial operation. Network programs are being fed to WKNB from the New York-Boston radio-relay system. With this new addition, programs are now available to 120 TV stations in 76 cities in the U. S.

Pulse Radar

(*Continued from page* 88)

pulses.) It should be apparent that target speeds resulting in other values of pulse to pulse relative phase change will give smaller outputs from the comparator.

From Figs. 6 to 8 it should be apparent that target echoes will be cancelled if successive echoes add to the CW in such a manner as to result in the same amplitude, pulse to pulse. Fixed targets always return echoes that result in this condition. There are also two pulse to pulse phase shift conditions when even a moving target can add to the CW and result in the same amplitude, pulse to pulse. The MTI receiver will be "blind" to these signals.

One of these phase shift conditions occurs at what is known as a "blind speed," the target speed which causes the relative phase between echo and CW to change (n x 360°) from pulse to pulse, n being any whole number. Fig. 6 will again be used for the first echo condition.

Fig. 9 will now be used for the second pulse, CD condition. Here, again, the fixed target echo C′D′ returns after T_f. However, the moving target echo C″D″ now takes $T_m + 2\Delta T_m$ seconds to return, with $2\Delta T_m$ seconds being a time long enough for the CW to advance 360° further than in Fig. 6. Steps C and D are obtained as previously. Step E, the delayed output from the previous pulse (Fig. 6D) is now equal to and opposite in polarity to the direct output, and as a result the moving target signal is cancelled in the same manner as our fixed target signal.

The second phase condition which can cause cancellation of moving target returns can occur at "optimum" speeds. Figs. 6 to 8 showed optimum speed (180° relative phase change pulse to pulse) and optimum phase (alternately 0° and 180° relative phase between echo and CW) to give maximum indication for moving targets. If now the relative phase advance remains at 180° but the rela-

(*Continued on page* 166)

TABLE I

TARGET SPEED	γ TARGET MOVING NEARER	γ TARGET MOVING AWAY
3600 mph	1.0000106	.999998
1800 mph	1.0000053	.999994
900 mph	1.0000026	.9999973
450 mph	1.0000013	.9999986
0 mph	1.0000000	1.0000000

$$\gamma = \frac{2V}{V - v}$$ for target moving nearer

$$\gamma = \frac{2V}{V + v}$$ for target moving nearer

V = speed of light
v = target speed

tive phase is alternately 90° and 270° instead of 0° and 180°, there will be a "blind" condition because the sum of two sine waves differing by 90° and the sum of two sine waves differing by 270° will add up to the same maximum value and, therefore, result in equal amplitude signals out of the detector.

However, this phase condition, which results in the MTI receiver being "blind" at "optimum" speeds, is of academic interest only, as the possibility of a target continuing to move in such a manner as to satisfy this condition, is very remote.

In all of the illustrations it was assumed, for simplicity, that the echoes were of the same frequency as the CW. This is not actually true because of the Doppler effect. It was previously stated that the Doppler effect, while present, cannot contribute to the ability to distinguish between fixed and moving targets because of

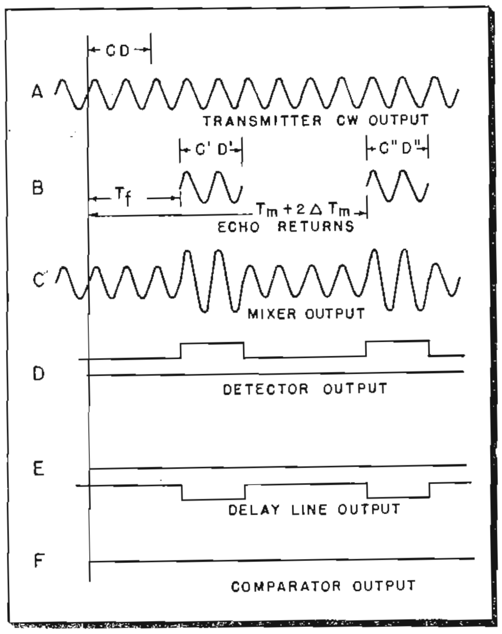

Fig. 9: Receiver pulses after second pulse

the method on which MTI operates. Justification for using an echo signal of the same frequency as the transmitted pulse is outlined below.

With a transmitted frequency of 3000 MC and a target speed of 600 mph, the Doppler formula ($f_d = 89v/\lambda$) indicates that $f_d = 5340$ cycles.

If it is assumed that the target is moving toward the receiver, the transmitted frequency of 3000 MC will return as a frequency of 3000.00534 MC. However, the signals are pulses and not CW. If the pulses are 0.5 μsec long, the transmitted pulse will contain 1500 cycles. The echo can contain only 1500 cycles, but due to the Doppler effect they will occupy a shorter time. This shorter time is equal to: (the number of cycles in the pulse)/(cycles per second). In this case, 1500/3,000,005,340, which is equaly to slightly more than 0.499999 μsec. If cycle by cycle, the original

0.5 μsec pulse and the 0.499999 μsec pulse are compared, the relative phase from start to finish will change less than 2°. A phase shift of this magnitude changes the maximum amplitude of the added CW and echo signals by such a small amount that the use of the original pulse frequency results in an error of less than 1%.

It has been shown that if the relative CW and echo phase changes by 180°, pulse to pulse, there is an optimum condition which results in

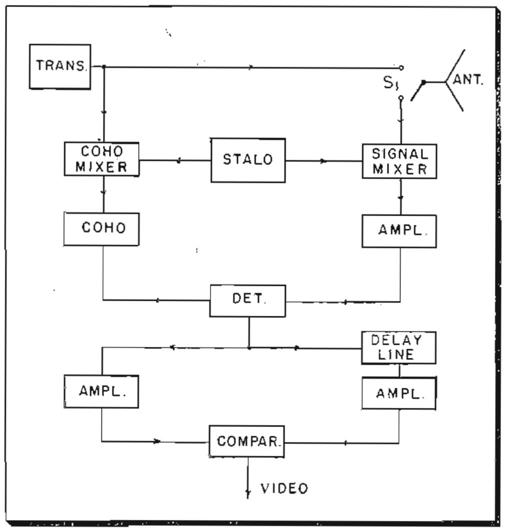

Fig. 10: Conventional MTI radar system

maximum indication. It has also been shown that if the relative CW and echo phases change by 360° pulse to pulse, there is a "blind" speed. Relative phase changes between CW and echo of 180° occur when a target moves $(2n + 1) \times 90°$ between pulses, and relative phase changes of 360° occur when a target moves $(n \times 180°)$ between pulses. It will now be shown that the Doppler frequency formula can be used to predict "blind" and "optimum" speeds.

The number of electrical degrees traversed by a target between pulses is given by the equation

Electrical degrees $= (v \times 1.609 \times 10^4)/\mathrm{PRF} \times \lambda$

where v = target speed, statute miles /hour

PRF = pulse rate frequency

λ = radar wavelength in cm

Solving this equation for v/λ

$v/\lambda =$ (electrical degrees) PRF/ 1.609×10^4

Substituting in turn $(2n+1) \times 90°$ and $n \times 180°$ for (electrical degrees)

$v/\lambda = [(2n + 1) \times 90 \times \mathrm{PRF}]/1.609 \times 10^4$

$v/\lambda = [n \times 180 \times \mathrm{PRF}]/1.609 \times 10^4$

Substituting these values in turn in the Doppler frequency formula, $f_d = 89v/\lambda$, the result is:

Optimum speed condition when $f_d = [(2n + 1)\ \mathrm{PRF}]\ /2$

Blind speed condition when

(Continued on page 168)

$$f_d = n \times \text{PRF}$$

From this, it can be seen that although the Doppler effect does not affect MTI operation, the Doppler formula $f_d = 89v/\lambda$ can tell when to expect "optimum" and "blind" speeds.

While the simple radar set of Fig. 3 serves to illustrate MTI principles, such a set has never been built. First of all a CW transmitter, operating at radar frequencies, of sufficient power to furnish peak powers of 0.5 megawatt and more for the pulses could not be built today. Even if it were, it would waste most of the power because the transmission intervals are almost always less than one per cent of the total operating time. Secondly, an amplifier, operating at transmitter frequency, of sufficient gain to raise echo levels high enough for sufficient video output from the mixer, cannot be practically built today.

Mathematical Presentation

For the mathematical presentation, a more conventional MTI system will be used. Such a system is shown in block form in Fig. 10.

In this set, the transmitter generates high power pulses of r-f instead of CW. The antenna, as previously, is connected to the transmitter during the pulse and to the receiver at all other times.

The stalo is a stable CW oscillator differing from the transmitter frequency by the system i-f. The stalo signal is mixed with a small amount of the transmitter pulse energy in the coho mixer and the resulting i-f pulses are used to synchronize the coherent oscillator (coho) with every transmitter pulse, the coho being a CW oscillator operating at the system i-f frequency.

The stalo signal and echo signals are also mixed in a signal mixer to produce i-f echo pulses. These echo i-f pulses, after amplification, are combined with the coho voltage, in the detector, to produce a video signal. This video output is then fed through delayed and undelayed channels and compared in the same manner as indicated in the simple radar set shown in Fig. 3.

The analysis used will be simplified in that no transients or sidebands ordinarily accompanying pulse operation will be considered. It will be complete enough, however, to show that the resulting video pulses change, pulse to pulse, for moving target echoes; and do not change, pulse to pulse, for fixed target echoes; and, lastly, that the Doppler effect has no bearing on MTI operation.

Since the time factor, t, is extremely important in MTI operation, the following explanation of how t can vary in the following equations is necessary. In equations denoting pulses, t is always zero at the start of a pulse, whether the pulse be the magnetron pulse or an echo pulse, and the maximum value that it can attain under these conditions is equal to the pulse length. In equations denoting CW, t is always zero at the time of the start of the magnetron pulse and can have a maximum value of 1/PRF seconds.

Referring now to Fig. 10, let the magnetron pulse voltage be

$$E_m \sin(\rho t + \phi) \qquad (1)$$

where ϕ = magnetron phase when $t = 0$

Let the stalo voltage be

$$E_m \sin(\omega t + \theta) \qquad (2)$$

As indicated previously, these two voltages are combined in the coho mixer. The resulting i-f pulse produced can be written as[1]

$$CE_s E_m \cos(\omega t + \theta - \rho t - \phi) \qquad (3)$$

If this pulse is used to synchronize the CW coho oscillator, the CW signal may be said to be

$$E_c \cos(\omega t + \theta - \rho t - \phi) \qquad (4)$$

and at time t_2 will be

$$E_c \cos(\omega t_2 + \theta - \rho t_2 - \phi) \qquad (5)$$

Return now to (1) of the magnetron voltage. This r-f is not only mixed with the stalo but is also radiated by the antenna. After some time t_2 it will return if it has been reflected by a target.

This reflected signal, even though the time is now t_2, can be expressed mathematically, except for amplitude, by (1). It is important to have a full understanding of this fact if one is to see mathematically, how MTI works. Perhaps Fig. 11 will help to clarify the above statement concerning the echo equation.

Station observers at Points A and B and let a pulse composed of a number of r-f cycles travel in the direction of the arrow. If the observers have no means of determining time

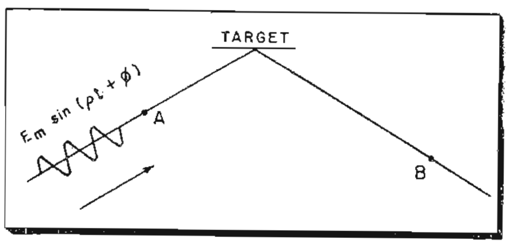

Fig. 11: Relations of observer, target pulse.

except by the start of the pulse, then when the wave train passes observer A, he will say that the equation of the wave is

$$E_m \sin(\rho t + \phi)$$

with time $t = 0$ at the start of the

(*Continued on page* 170)

pulse and θ the starting phase at time $t = 0$.

As the wave continues and eventually passes observer B, he will also say that the equation is

$$E_m \sin (\rho t + \phi)$$

with time $t = 0$ at the start of the pulse and ϕ the starting phase at time $t = 0$.

The statement of observer B is based on the assumption that the reflecting target is stationary and also that the target does not alter the starting phase of the reflected signal. If the target is moving, however, the observer at B will say that the equation of the reflected wave is

$$E_m \sin (\rho t \gamma + \phi)$$

with γ being a factor which changes the frequency. See Table 1—Doppler Effect.

If the reflecting surface of the target also changes the phase of the reflected signal the observer at B will say that the equation of the wave is

$$E_m \sin (\rho t \gamma + \phi + \beta) \quad (6)$$

with β representing the phase shift due to reflection. Eq. (6) therefore, represents the echo signal and takes into account any phase shift due to the reflection coefficient of the target as well as any frequency change due to the Doppler effect.

Reflected Wave

As stated previously, it is important to understand that the phase of the reflected wave is the same as that of the transmitted wave except for those changes introduced by the reflecting object or its motion, and that no phase change takes place due to the elapsed time between observation at points A and B.

Points A and B may very well be the same point in space and, in fact, this is the case of a radar set where the magnetron is observer A and the receiving antenna is observer B.

Fig. 10 indicates that the echo signal, Eq. (6), and the stalo signal, Eq. (2), are combined in the signal mixer. If the echo signal returns and mixes with the stalo voltage at time t_2, the echo i-f will be

$$E_s E_c \cos (\omega t_2 + \theta - \rho t \gamma - \phi - \beta) \quad (7)$$

There are now two i-f signals, the CW coho, Eq. (5), and the echo Eq. (7). These two signals are combined in the detector at time t_2 to give a detector output of

$$E_c{}^2 E_s \cos (90 - \omega t_2 - \theta + \rho t_2 + \phi$$
$$-90 + \omega t_2 + \theta - \rho t \gamma - \phi - \beta)$$

Combining terms and simplifying the above equation results in

$$E_v \cos [\rho (t_2 - t \gamma) - \beta] \quad (8)$$

This video output is sent through the delayed and undelayed channels for pulse to pulse comparison in the comparator. This video equation shows that the stalo term ω and stalo starting phase θ as well as the starting phase ϕ of the magnetron have no bearing on the output. The only factors left are the magnetron term ρ, time t_2 and t, the Doppler factor γ and the reflection factor β.

Factors to be Considered

Careful examination of these remaining factors reveals the following:

1. ρ is constant in any particular radar set.
2. β is constant for any particular target.
3. γ is constant for any particular target speed for any one target.
4. t is a constant in that it always varies the same way in any particular set, that is 0 at the start of the pulse and say M at the end of the pulse if the pulse length is M.
5. t_2, the echo return time, is constant for a fixed target but varies with a moving target.

Since t_2 is the only possible variable and since it changes, pulse to pulse, only with moving targets, it has to be the one factor which enables the MTI receiver to distinguish between fixed and moving targets by comparing pulse to pulse returns.

At first glance Eq. (8) seems to indicate that the video output is an r-f voltage of magnetron frequency because it contains factor ρ. However, closer examination will reveal that it is a video pulse whose amplitude and polarity depend on t_2.

Doppler Factor Utility

Assuming that the Doppler factor is unity ($\gamma = 1$), the variable in Eq. (8) is $(t_2 - t)$.

During an echo pulse the factors t_2 and t vary in the following manner:

t_2 is the time of return of the start of the pulse and if the pulse length is M the time of return of the end of the pluse is $t_2 + M$.

$t = 0$ at the start of the pulse and $t = M$ at the end of the pulse.

Using these values the variable at the start of the pulse is

$$t_2 - 0 = t_2$$

and the variable at the end of the pulse is

$$t_2 + M - M = t_2$$

Since the variable factor remains constant during a pulse, Eq. (8) actually defines the amplitude and polarity of a video pulse of length M, M being the length of the radar pulse.

Of course the Doppler factor γ cannot be unity if t_2 varies, but in

(*Continued on page* 172)

any event it will be so close to unity that it cannot measureably affect the video output. See Table I.

Video Eq. (8) also proves statements made earlier, that is: A target moving as in Fig. 2c will show as a moving target even though there is no Doppler effect; and the target moving as in Fig. 2b will not be seen by the MTI receiver notwithstanding our Doppler effect, because t_2 does not vary.

Magnetron Instability

In the discussion just concluded, perfect cancellation of fixed targets can theoretically be obtained because it was assumed that the stalo and coho oscillators as well as the magnetron were absolutely frequency stable. Practically however it is impossible to attain this sort of stability, and, as a result, even fixed targets do not cancel completely. Magnetron instability results in fixed target residue of uniform amplitude for all targets, whether they are close in or far out, while stalo and coho instability cause increasing fixed target residue with range. In any event the practical stability of the above mentioned components can be made good enough so that the fixed target residue and system noise, which in itself is of such a random nature that it cannot be eliminated, may be set for equal amplitude.

Instability Factor

The amount of instability that can be tolerated can be determined for any of the components by writing the equation of the component with an instability factor, and noting its end result as indicated in the video equation.

1. W. L. Everitt, *Communication Engineering*, McGraw-Hill Pub. Co. 2nd Ed., p. 378.

RCA to Develop Radar Weather Unit

Development of a new type of airborne weather-detection radar unit will soon be undertaken by the RCA Victor Division, Radio Corporation of America, in cooperation with United Air Lines, Inc.

This is the first program RCA has undertaken with the goal of providing commercial air lines with a radar system designed exclusively for weather-mapping use, an RCA Victor spokesman stated.

This radar unit will operate at new frequencies to "map" weather obstacles on a wide front. It is expected to provide pictures that will give a pilot information on the depth as well as the breadth and height of storm fronts.

Pulse Timer

(*Continued from page 69*)

parison, with R_1 and R_2 as frequency controls. If desired, the audio oscillator can be omitted, and 10 : 1 frequency comparisons can be made directly between the proper test points. Some confusion may result, however, if the phases are such that parts of the patterns overlap.

After the alignment of the locked oscillators, the cathode bias of V_5, the pulse selector and coupler, is adjusted by means of R_3 to obtain a 50-cycle square wave from V_6.

The final step requires the adjustment of R_4, which is associated with V_9, for the required pulse duration.

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Industry to Cooperate on CD Receiver

Complete cooperation with a plan of the Federal Civil Defense Administration to develop a small, low cost, mass produced AM radio set was offered the Government by manufacturers of radio and TV sets at an industry-Government meeting called by RTMA Executive Vice President James D. Secrest at the suggestion of FCDA officials. Under the FCDA plan to maintain some radio stations in operation during attacks, the two frequencies of 640 KC and 1240 KC would be utilized exclusively throughout the nation for civil defense and other emergency information. Other AM, FM and TV stations would go off the air during an attack. This plan is called CONELRAD. For details, see March 1953 TELE-TECH & ELECTRONIC INDUSTRIES, page 85.

Government officials specifically asked assistance in two instances:

1. In the development and manufacture of a low cost "family protection" receiver which would enable the public to receive vital information despite power failures and other handicaps.

2. To assist FCDA officials in acquainting the public with the two frequencies which will be utilized during attacks and other details of the plan.

Manufacturers were asked to indicate by some suitable marking on their AM radio dials that these two frequencies will be used by civil defense in a national emergency.

Gas Tube Reliability

(Continued from page 72)

trol, or other poor performance, unless understood and anticipated by the circuit designer.

Such a condition is found in a full-wave, or polyphase, rectifier circuit where the load is at least partially inductive, and unit operation covers the range where current in the load may change from discontinuous to continuous current. At this point (Fig. 6) the peak forward voltage applied to the tubes suddenly doubles in magnitude, with the resultant sudden change in critical grid voltage. In a closed cycle control system this will result in inherent "hunting" at such an operating point, unless the designer has provided a grid circuit voltage which minimizes the effect.

Another circuit condition which produces a sudden change in critical grid voltage is the double three-phase rectifier circuit with interphase reactor, operating at light load. As the output current is reduced to a low value, the voltage generated in the interphase reactor no longer is great enough to sustain current conduction through each tube for as long as 120° and the mode of operation suddenly changes from double three-phase (120° tube conduction) to six-phase star (60° tube conduction) with a resultant sudden change in peak forward voltage and the corresponding critical grid voltage on all tubes at a given firing angle.

Anode Voltage

In position follow up servos, employing either dc armature or field voltage reversing, the instantaneous anode voltage on the "off" tube or tubes is the sum of the anode transformer voltage and the voltage appearing across the load due to motor rotation, or because of conduction of the "on" tubes. It will include any "hash" from the commutator. In some ac motor reversing circuits, the actual anode voltage of the "off" tube may be the voltage across the phase splitting capacitor hence of different phase angle from the line voltage (Fig. 7). In these cases the actual anode voltage may be positive during a large part of the cycle when the anode voltage would normally be negative if the servo signal voltage is zero. Negative dc bias plus pulse firing is one solution in such cases to avoid misfiring. Numerous peaking voltage sources are available if required for any of these applications.

A few simple schemes for obtaining useful peaking voltages which may be phase shifted are shown in Figs. 8 and 9. Fig. 8 illustrates the use of a standard transformer operated from an ac voltage higher than its normal rating through a series impedance with phase shift obtained by varying the magnitude and polarity of a dc control voltage in series with the ac supply. Fig. 9 shows two schemes for producing a peaking voltage where the slope need not be very steep but where a single voltage peak per cycle is desired. Phase shift of the ac input voltage to either of these networks may be accomplished by combining a variable magnitude and direction ac signal voltage with a fixed magnitude ac voltage which lags the signal voltage in the order of 150°.

Peaking Voltage

Other methods of obtaining peaking voltages which have been described previously include a variable phase input to a vacuum tube multivibrator; a variable phase input to an overdriven amplifier combining saturation limiting and cutoff limiting, and the resulting square wave output differentiated[3]; a variable dc magnitude and polarity input to a self blocking vacuum tube oscillator having a small magnitude ac bias lagging the thyratron anode voltage approximately 90°[4,5]; a phaseable pulse as a result of suddenly reducing the current in a linear inductance to zero by cutting off a vacuum tube in series with the inductance, directly or by means of associated capacitances and non-linear inductance[6]; applying interrupted dc to the primary of certain grid transformers to produce a peaked secondary voltage.

Many successful equipment designers report encountering some, or all, of the above considerations. Therefore, in unit design a careful engineering analysis of the circuit along these lines is advisable to assure reliability of operation over a long life, and full realization of the fast response, and compact amplification unaffected by temperature, which gas thyratrons offer the equipment designer.

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This paper was presented at the National Electronics Conference held in Chicago, Sept. 29—Oct. 1, 1952.

Heater Strings

(*Continued from page 77*)

rangements in which two strings are brought together in a common section, as shown in Fig .1, a heater failure in one string causes increased voltage on the heaters in the other string. As an extreme example of this effect, a string arrangement is shown in Fig. 2 in which two parallel 150-ma heaters complete a string of 300-ma heaters. If one of the 150-ma heaters failed, the total current in the string would change only slightly, but the other 150-ma heater would dissipate more than four times normal power. Even if this tube did not fail immediately, it would almost surely fail when the receiver was allowed to cool off and then switched on again. It follows logically that operation of tubes in parallel within a series string is undesirable, and that tubes should be arranged in separate strings to the greatest extent possible. The use of a common 600-ma section in the series string TV receiver seems to be necessary at present, but the voltage across the common section should be made as small as possible.

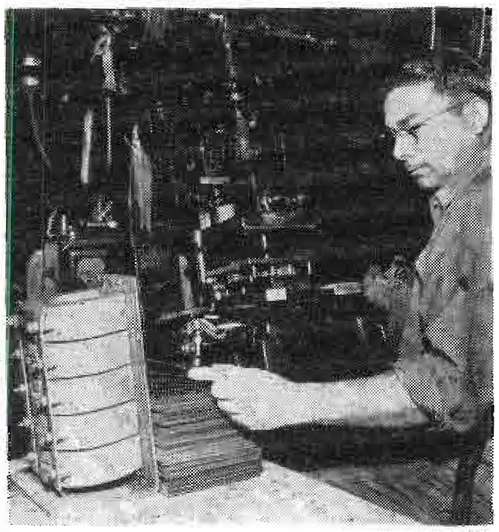
A similar problem arises when a resistance is placed in parallel with 450-ma heaters so that they may be fitted into the 600-ma section of the string. Failure of one of the 450-ma heaters sends almost 600 ma through the shunt resistor which normally carries only 150 ma, an increase in power approaching a factor of 16. In addition to the normal consequences of resistor overload, there is an insidious effect if the resistor opens. Replacement of the defective tube would restore the receiver to operation, and the open resistor might escape notice, causing greatly reduced life of the 450-ma tubes.

Multiple failures can also be caused by a heater failure damaging another tube through excessive current or dissipation in some electrode. Such a situation commonly arises in horizontal deflection circuits. Failure of the circuit which supplies the grid driving signal to the horizontal output tube, or failure of any tube heater in series with the tube used in generating the grid signal, may cause several times the normal plate dissipation in the horizontal output tube. Failure of the heater circuit of the damper tube, on the other hand, removes the plate voltage from the horizontal output tube, causing excessive screen-grid dissipation. At first glance, it seems desirable to arrange the horizontal oscillator tube, the horizontal output tube, and the damper tube in the same string. Frequently, however, such an arrangement is made impractical by other design considerations, and other protective techniques need to be devised. Fusing the circuit is one possibility. When the grid drive to the horizontal output tube is removed, however, the plate current usually increases very little, seldom more than 50%. A fuse in the plate or cathode circuits, therefore, is not a practical protective device. If the horizontal oscillator and damper tubes can be placed in the same string (but a different string than the horizontal output tube), however, a heater failure in that string will cause a large increase in screen-grid current in the horizontal output tube and a fuse in the screen circuit would protect the horizontal output tube.

Commercial Considerations

In the design of TV receivers for series heater operation, it is difficult to weigh the engineering considerations against the more commercial considerations. It is clear, however, that the average life of tubes in series heater operation cannot be as great as would be obtained with the conventional parallel heater connection. In series strings, the variations from the normal heater power is increased, the incidence of open heaters and heater-cathode shorts is increased, and the chance of one tube failure causing damage to other tubes is increased. If commercial considerations dictate the use of series strings, however, the careful application of good design practices will greatly enhance the chance of obtaining satisfactory tube life and receiver performance.

TV PRODUCTION TIP



Five permanent horseshoe magnets at left solved CBS-Columbia's problem on rapid punching of steel braces for TV picture tube supports. Magnets keep top sheet of unpunched sheets one finger thickness above others so they can be lifted easily off top of pile by operator

FM Altimeter

(Continued from page 75)

planes. This broad pattern allows for any normal maneuver of the aircraft.

A single AS-333/AP slot develops a pattern similar to any compact slot element. On a large ground plane of good conductivity, it has a broad major lobe that is over 150° wide in the θ (electric) plane of the exciting stub, and about 90° wide in the φ (magnetic) plane. A null is formed along the ground plane off the ends of the slot; and the pattern in the φ plane is not affected by the size of the ground plane. For this reason, antennas are mounted end-to-end to obtain the least amount of feed-through.

The double slots tested had the elements mounted both end-to-end and side-by-side with the centers spaced a half-wave length apart. The side-by-side configuration, with half-wave spacing narrows the pattern in the very broad θ plane. Although this may be desirable, the end-to-end mounting has the added advantage that it provides a reduction in feed-through if both pairs of slot antennas are mounted with their axes in line. Flight tests have shown that this type of installation has an adequate pattern width in the φ plane, especially when the slots are mounted in line along the centerline of the aircraft.

Fig. 3 shows how the slot pattern in the θ plane varies relative to the ground plane size. The slot-mounting off-center is often required for slots mounted in the wings because of the presence of structural members. A theory has been proposed by Lazarus and Dorne[4] that explains patterns 3a, 3b, and 3c. This theory considers the slot and ground plane as a radiating line element plus image line elements at the edges of the plane.

Fig. 7 compares the φ pattern of a single and an end-to-end double slot.

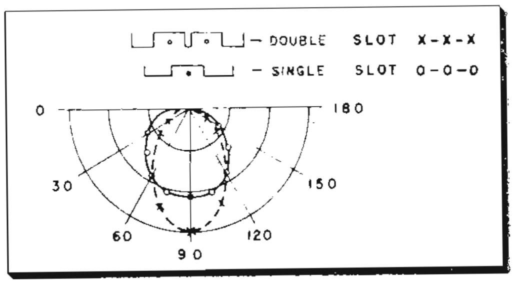


Fig. 7: End-to-end double slot shows sharper pattern and 3 db more gain than single slot

The double slot antenna has a sharper pattern, and a gain of about 3 db compared to that of the single slot. It will give more ground-reflection signal than the single slot for φ angles within 25° of φ = 90°. The θ pattern is the same as the θ pattern of the single slot in Fig. 3.

The patterns of the double slots can be calculated very easily from equations which specify the directivity of arrays of thin dipoles. The radiation pattern of a narrow slot is the same, except for its crossed polarization, as the pattern of a dipole with the same outline as the slot.[5] In addition, the same principles of directivity apply for slot arrays as for dipole arrays.[6]

The ϕ pattern of the end-to-end

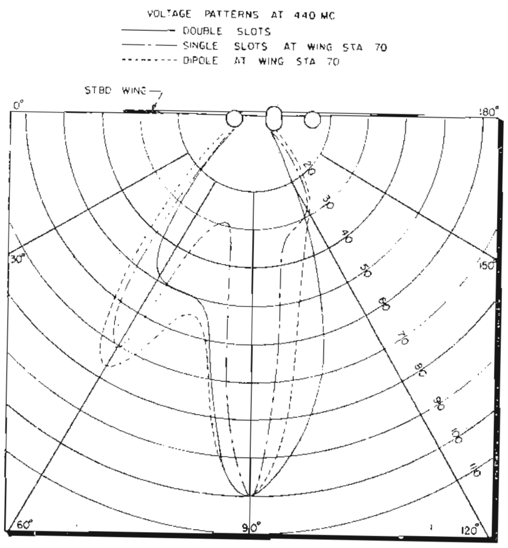


Fig. 8: Antenna patterns at 440 MC. Elements are end-to-end and ground plane is 4 x 4 ft.

double slot with half-wave spacing between centers is, then

$$F\phi = F_a\, F_d = \sqrt{2}\cos\left(\frac{\pi}{2}\cos\phi\right)\frac{\cos\,(\pi/2\cos\phi)}{\pi\,\phi} \quad (2)$$

and the θ pattern of the side-by-side array is

$$F\theta = \sqrt{2}\cos\left(\frac{\pi}{2}\cos\theta\right) \quad (3)$$

In the practical case of a twin-engine high-wing bomber, the slots had to be mounted in the wings because no other area was available on the under side of the aircraft. Fig. 8 shows the measured radiation patterns of dipole, single slot, and double slot antennas. The patterns are narrowed as a result of reflections from the nacelles and fuselage. The main lobe of the double slot is wider than that of the single slot since the double slot does not "illuminate" as strongly the sides of the nacelle and fuselage where the reflection occurs. For this reason, the double slot will allow a greater angle of roll.

Conclusions

The general rules listed previously serve as a guide for the design of slot antenna systems on conventional

(*Continued on page* 180)

aircraft types. As new types of aircraft are developed, additional data on patterns and feed-through may be obtained by measurements on mock-ups and scale models. If several locations are available on the underside of even the most unconventional types of aircraft, there is a good chance that, by the use of these techniques and the proper configuration of double slots, acceptable drop-out performance can be obtained.

If necessary, it is possible to analyze mock-up feed-through, and radiation pattern data for a given antenna installation, and make a reasonably accurate prediction of drop-out altitudes on both ranges. The predictions will usually be within 15% of the drop-outs measured by subsequent flight tests, but is not described because it is of secondary accuracy, and also it is seldom necessary to predict drop-out altitudes prior to flight tests.

Installation Problems

The APN-1 altimeter system poses problems in some installations due to feed-through, propeller modulation, line noise, cable leakage, etc. If the transmitter-receiver unit were modified so that the "local-oscillator" signal from the oscillator to the balanced mixer passes through a cable whose length equals the feed-through path length, several benefits result. In this case the beat due to feed-through has a low frequency which is not amplified as much. In general, however, it seems apparent the future of the FM altimeter system is best enhanced by changing to a higher frequency of operation. Such a system has already been developed and described.[7]

The author wishes to acknowledge the assistance of R. R. Silliman formerly of the Antenna Section of the Naval Bureau of Aeronautics, and also the helpful suggestions given by J. B. Caraway, Jr., and E. H. Barnard, and the assistance of L. J. Lorenz, of Electronics Research, Inc.

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Smith Chart

(*Continued from page* 67)

and taking the output balanced, a rejection of better than 30 db can be obtained. This is sufficient with the amplifiers used.

Needless to say, the amplitude vs frequency characteristic of the two channels must be identical over the range of frequency variation. Although the variation of the final intermediate frequency is quite small, because of the AFC, the first intermediate frequency may vary by several megacycles from the 40-MC nominal frequency.

Differential phase variations between the two channels are a serious source of error. An angle of 6° might correspond to as much as a 5% change in the reflection coefficient. If the intermediate frequency were constant, then any phase difference could be balanced out. However, because the first local oscillator does not track the r-f oscillator perfectly, there will be frequency variations.

Swept Oscillators

It might be well at this point to say a word about these swept oscillators. They are lumped-constant circuits using a 5718 subminiature triode and split-stator capacitors that have straight-line capacitance variation. The full frequency range is covered in the first 180° of rotation, and in reverse order in the second 180°. The angular correction required to make the local oscillator track the r-f oscillator during the second half of one full rotation is of the opposite sign from that required for the first half. If the oscillators are padded so that they track perfectly at the end points of the frequency range, it will be found that a sinusoidal correction will be quite satisfactory. Therefore, rather than use a cam for angular correction, the capacitor shafts can be offset and driven from a common shaft by means of crank arms. This correction is simple and permits continuous adjustment after assembly. With this arrangement, the tracking error can be kept within 2 MC over the whole range.

This frequency variation is still much too large. Because the gain of the direct-wave i-f amplifier is much greater than that of the reflected-wave amplifier, as required by the resolver, the phase shift will be quite different in the two amplifiers. Therefore, a phase-correcting network is required to bring them in phase at the resolver. Furthermore,

(*Continued on page* 182)

in order to obtain the quadrature component, it is necesasry to shift the phase of one channel output by 90° with respect to the other. These phase-shifting networks are, of course, frequency sensitive; at 5 MC a variation of 2 MC will produce a large phase shift. For this reason AFC is necessary, and a loop gain of 26 db has been found adequate. The response extends from dc to about 150 CPS, which is more than adequate.

Wide Band Pass

Because the direct-wave i-f amplifier is included in the AFC loop, its pass band must be wide enough to pass the uncorrected frequency errors encountered. It is for this reason that video amplifiers are used in the i-f channels. The frequency response extends from about 2 MC to 8 MC, the low-frequency cutoff being determined by the coupling capacitors. Since the reflected-wave i-f amplifier must have the same phase characteristic as the direct wave amplifier, it is also a broadband amplifier.

One of the more fundamental sources of error arises from the approximations used in the analysis of the resolver. The error caused is equal to one-half the ratio of the signal to the bias signal. In order to reduce this error to a practical value, the bias signal must be at least ten times the signal voltage. This fact limits the detected signal to something less than half a volt if ordinary receiving tubes are used; it also makes the system very sensitive to noise in the bias signal. Because of this latter effect, two stages of amplitude limiting are used in the direct-wave amplifier.

System Accuracy

Aside from the errors arising in the vacuum-tube circuits, the system accuracy is limited by the errors introduced by the directional coupler and its associated fittings. The coupler actually consists of two couplers in series, with the direct wave being sampled from one and the reflected wave from the other. This provides isolation between the two channels. The unused arms of each coupler are terminated in matched loads, and the reflection coefficient of these loads limits the accuracy of measurement. The couplers are made from ⅞-in. bead-supported line, and an adapter is used at the output to enable type C fittings to be used for the unknown impedance. The reflection coefficient of this adapter is also a source of error. Adapters must also be used at the direct-and reflected-wave outputs; although these do not have to be well matched, they must be identical for the two channels. These sources of error correspond to a total error in the reflection coefficient of about 0.03.

At this point it is well to indicate how the system accuracy may be specified. Although impedance is being measured, the percentage error in impedance measurement would vary greatly with the impedance measured. This would also hold true for the percentage error in the reflection coefficient. The only practical way of specifying the accuracy is to say that the measured reflection coefficient is within a certain small circle about the true reflection coefficient. The desired accuracy in the present system is 0.07. Although this has not yet been carefully checked, it is believed that it will be achieved.

Because the various sources of error would become more serious at higher frequencies, the extension of the system would present serious problems. The present frequency range represents the practical limit of lumped-constant oscillators and vacuum-tube mixers for broad band applications. However, the system from the second mixer on is useful for any frequency range. At higher frequencies the tracking problem and the matching of the two first mixers would present the real difficulties. It is probable that some other schemes, such as synchronous switching of a single mixer and beating of one fixed and one variable r-f oscillator to obtain a constant intermediate frequency, would have to be resorted to.

Basic Materials Conference to be Held June 16-18

Twenty leading industrial research engineers and government scientists will comprise the advisory committee to formulate a program for the first Basic Materials Conference which will be held June 16-18 at the Hotel Roosevelt, New York City.

The conference will be aimed at introducing the new industrial concept that a knowledge of all materials is essential before a single material can be used for a product. In addition to the advisory committee for the conference, heads of 21 major companies have formed a board of sponsors for the first Exposition of Basic Materials for Industry, which will be held at Grand Central Palace, N.Y., June 15-19. Don G. Mitchell, president, Sylvania Electric Products, Inc., N.Y., is chairman of this board.

Broadband Facilities

(Continued from page 80)

frequency. In a single pipe, at 50,000 MC it is possible to transmit a band 2,000 MC wide. To show that dents or irregularities in the pipe wall cause

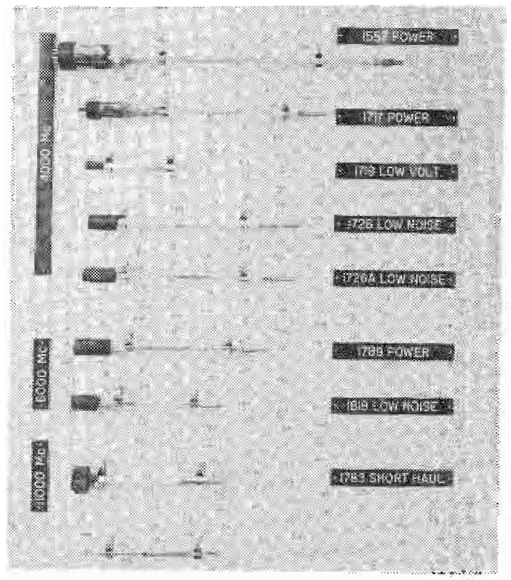
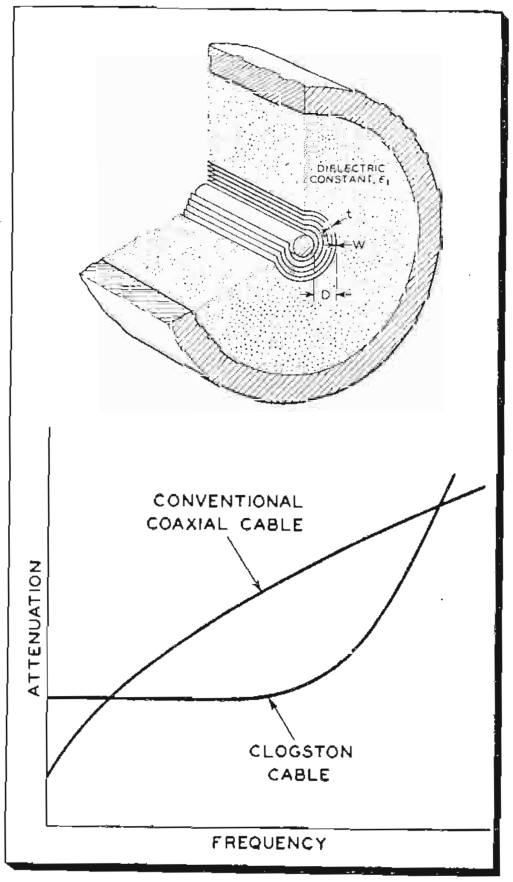


Fig. 7: Various Bell Tel. Labs. traveling-wave tubes for operation in the 4000-11,000 MC band

no difficulties, BTL set up 40 miles of 4¾ in. pipe. Oscillograms of pulses transmitted over this system at 50,000 MC showed satisfactory operation. Repeaters would be used at 20-mile intervals on such waveguide circuits. Photos of traveling wave tubes for generating power at 50,000 MC, giving gains of over 20 db with bandwidths of 1,000 MC, were shown by BTL.

Fig. 8: Clogston cable with concentric conductors has low attenuation over most of band



Compare the performance of a 2-in. diam. waveguide, carrying a band of frequencies as wide as 2,000 MC, with the usual coax, which in a 2-in. diam. has 8 cables, each having a bandwidth up to 8 MC, thus affording a total communication bandwidth of 64 MC.

Editor's Note: Both RCA and A T & T exhibits mentioned above contained lists of published technical papers, books, etc. relating to the subject matter of that particular exhibit or portion of testimony. These references, about 105 in number, will be made available through TELE-TECH & ELECTRONIC INDUSTRIES if your editor receives a sufficient number of requests.

WESCON Issues Call For Technical Papers

Authors are invited to submit prospective papers for the technical sessions of WESCON (Western Electronic Show and Convention) which will be held in San Francisco August 19 to 21. WESCON is jointly sponsored by the 7th Region IRE and by WCEMA (West Coast Electronic Manufacturers' Association).

According to the announcement by B. M. Oliver papers chairman and research director of Hewlett-Packard Company, Palo Alto, papers in the fields of antennas, circuits, communication theory, computers control and instrumentation, electron devices, audio, uhf and microwave techniques, nuclear electronics, transistors and non-vacuum tube electronics are of particular interest. However, no paper should be withheld merely because it does not fall into one of these categories.

Authors desiring to make presentation at WESCON are asked to send the following information to Mr. Oliver at Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, California: (1) Name, address and affiliation of author, (2) title and 100-word (maximum) abstract for publication in the program, and (3) a 500-word summary which will be used to evaluate the paper and should present clearly the essential new material of the paper. The program will be closed on May 1st, but earlier entries will, because of time considerations, receive fuller consideration.

New RTMA Standards

Two new RTMA recommended standards have been released. The first is REC-121-B—Variable Control Resistors (this Standard supersedes REC-121-A and includes material from Standards Proposals Nos. 221, 222, 223, and 343), and the second is TR-133—Wire-Wound Power-Type Rheostats (this Standard, from Standards Proposal No. 363, is new material). It was also announced that the Joint RTMA-NEMA Standard for Dimensional Characteristics of Gaskets for Water-Cooled Transmitting Tubes, ET-104-A has been rescinded.

Motorola Delivers Radio System to New York

A new two-way FM communications system—reportedly the world's largest and most complete—has been delivered to the New York City Fire Dept. It replaces an obsolete AM system placed in operation in 1937. Under the $586,000 contract awarded to Motorola, Inc., the company supplied the major portion of the equipment, including over 521 mobile two-way units. In addition, the system includes 75 station receivers, eight base stations, and six control consoles. Eleven of the mobile units are installed on fireboats.

The communications system is separated into four radio networks, one city-wide and three for the city's boroughs, each network using two channels in the 154 MC band. In addition, Chief Officers are equipped with walkie-talkie units operating at 33.42 MC.

Control Consoles

The control consoles switch frequencies, turn transmitters on and off, and switch base station transmitters from one antenna to another. These functions are performed remotely by the transmission of audio tones over a pair of wires. The tone generators, called Vibrasenders, are stable oscillators whose frequency is determined by a driven tuning fork. Control tones are received by companion Vibrasponders, which are essentially resonant reed relays, to actuate the remote switching relays.

Not only does the new communications system mean more efficient Fire Department operations, but it will also save the city a considerable amount of money. Apparatus en route to a fire may be given supplementary information, re-routed, and efficiently coordinated. One large metropolitan Fire Department recently reported a mileage savings of 20% as a result of their two way radio system. And in case of bombing or similar disasters destroying land lines, radio would carry the communications ordinarily handled by telephone.

NARTB Registration Data for Los Angeles Meet

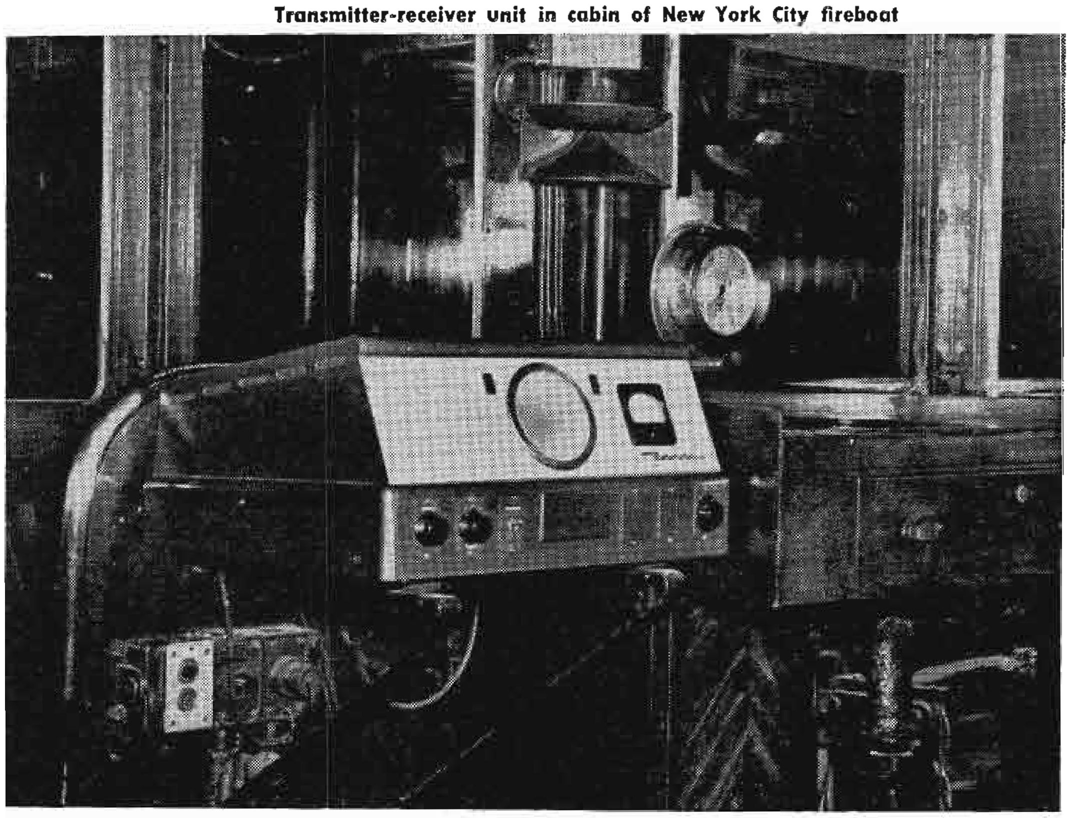
Pre-registration fees for the 1953 "Gold Rush" convention of the National Association of Radio and Television Broadcasters at Los Angeles, April 28-May 1, have been set at $35 for the Management Conference and $25 for the Engineering Conference.

Active and associate members of NARTB have been mailed a large folder containing application forms for both conferences, hotel room reservations, and the new $15 ladies registration (for wives) which includes a banquet coupon and admission to a Hollywood style show. Pre-registration savings amount to $2.50 each and deadline for receipt of applications has been set for April 15. Convention registration will be limited to stations, or allied industry firms which are active or associate members of NARTB; representatives of organizations such as advertising agencies, lawyers, etc., which are not eligible for either active or associate membership.

Information included in NARTB's pre-registration folder is the procedure for handling requests for tickets to the annual banquet at Hollywood's Palladium, hotel room rates, and transportation facilities to Los Angeles. The Management Conference will be staged at the Biltmore Hotel with Engineering Conference sessions in Burdette Hall across the street.

Inquiries regarding the convention should be directed to C. E. Arney, Jr., NARTB secretary-treasurer, at 1771 N Street, N.W., Washington 6, D.C. Arthur Stringer is in charge of exhibit space, and J. H. Smith, Jr., is handling pre-convention promotion.

Transmitter-receiver unit in cabin of New York City fireboat



Propagation

(*Continued from page 91*)

sense employed, these higher frequencies have a definite place in radio communication.

The rules are:

(a) Use line of sight paths (optical),

(b) Allow sufficient height to maintain first Fresnel clearance,

(c) Maintain a "power-antenna-gain" safety factor of at least 40 db.

If these rules are observed meticulously, little trouble will be experienced. However, it will be very difficult to follow any of these rules if mobile communications are necessary above 100 MC. If omnidirectional operation is necessary allow at least a 50 db signal above the calculated value and expect signal drop-outs in certain locations, especially in shadow regions and metropolitan areas.

Acknowledgement: The author wishes to acknowledge the assistance and cooperation of Stromberg-Carlson under whose auspices the theoretical and experimental work covered in the article was done.

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New Cable by AT&T

A new coaxial cable system, which is capable of providing three times as many telephone circuits as the system now in use, has been opened for service on the New York-Philadelphia route by the Long Lines Department of the American Telephone and Telegraph Co. Eleven new repeater stations were built midway between existing stations so that repeaters are now located at approximately 4-mile intervals.

Three-Dimensional Sound

(*Continued from page 93*)

channel at the 1,000 μv contour is approximately 60 db.

The wave shape of the subcarrier plus the main carrier is extremely complex. This is particularly true since the two produce beat sidebands. However, Fig. 6 should be an aid toward visualizing what happens in two simple examples. Fig. 6 is a representation of the main FM program channel with a 1-KC tone modulation, but no multiplexing. Fig. 6 shows the subcarrier with a 1-KC modulation, but no modulation on the main channel.

Spectrum Width

An important point to note from the viewpoint of economy of radio spectrum utilization is the fact that the application of subcarrier actually *reduces* the spectrum width of the transmitted wave. Fig. 7 shows the spectrum distribution of transmissions for KE2XKH, with and without multiplexing. Modulating the subcarrier increases the bandwidth somewhat with respect to an unmodulated subcarrier, but either one results in a bandwidth less than that obtained with full modulation

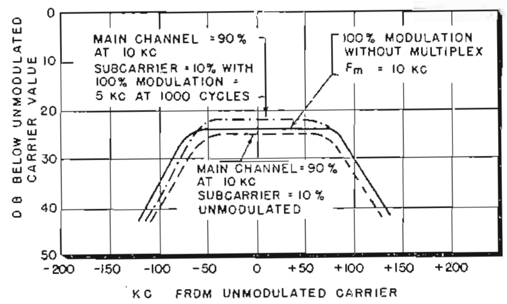

Fig. 7: KE2XKH spectrum with and without multiplex. Note that multiplex reduces bandwidth

on the main channel. The reduction to 90% modulation of the main channel appears to have a greater effect on spectrum reduction than the subcarrier modulation.

If additional subcarrier channels are applied, the signal-to-noise ratio goes down in inverse proportion to the number of channels; also this ratio on any given channel is inversely proportional to the subcarrier frequency. For example, the addition of a 55-KC subcarrier over and above a 35-KC subcarrier would reduce the signal-to-noise ratio on the 35-KC channel by 6 db, if each were applied with a 5% modulation of the main carrier. Also, the 55-KC channel would have a signal-to-noise ratio 4 db less than the 35-KC subcarrier by the proportion 35 to 55.

The system described here has been given the name "Stereosonic" (stereophonic using an ultrasonic subcarrier). As compared to "flat" sound, it presents a feeling of realism, providing tonal perspective, movement and quality of reproduction that rival actual presence at the sound source. Already one firm in Houston, Texas, is planning to use such a system to provide three-dimensional music to restaurants, stores and similar commercial purchasers of specialized musical programs.

Muzak, the large wired music firm, plans to use this multiplex system for improved distribution purposes. By this method they expect to open 200 FM markets in "in-store" broadcasting.

The following companies are reported among those presently producing and using stereophonic recordings on discs:

Cook Laboratories,
Stamford, Conn.

House of Music
48 Pine Dale
Houston 6, Texas

Also, the following companies are planning to make stereophonic recordings on tape:

Magnecord, Inc.
225 W. Ohio St.
Chicago 10, Ill.

Audio-Video Recording Co.
730 Fifth Ave.
New York, N. Y.

Audio-Master Corp.
341 Madison Ave.
New York, N. Y.

Already Magnecord and Ampex Electric Corp., 934 Charter St., Redwood City, Calif., have announced stereophonic tape recorders. And Livingston Electric Corp., Livingston, N.J., is producing binaural disc recording arms.

Stereophonic Recordings

Home music enthusiasts will not only be able to receive the two Stereosonic FM broadcast channels, but will be able to play stereophonic recordings through two-channel amplifying and reproducing systems. Crosby Laboratories, Inc., Robbins Lane, Hicksville, N.Y., is planning to make available to them the needed multiplex subcarrier receiver, which is attached as an adapter to a standard FM broadcast receiver, for under $100.

Broadcasters who are now considering the addition of an FM subcarrier channel will be able to equip their transmitters with the necessary multicast and monitor facilities for about $2000.

It is expected that the motion pictures' rush into stereoscopic films will be accompanied by increased use of stereophonic sound. Just as

(*Continued on page* 190)

the movies have been the source of much recorded music, three-dimensional sound tracks should provide a considerable number of popular releases in the years to come.

The R. T. Bozak Co., 114 Manhattan St., Stamford Conn., has developed a new speaker which will be incorporated in their stereophonic speaker-enclosure system soon to be made available.

Standard TV should prove a natural for the Stereosonic system, both for home and theatre use. The sounds would be able to follow the action to heighten realism, and quality of reproduction will be improved to a substantial degree. A speculative glimpse into the future indicates that three-dimensional TV, now used in industry and medicine, stands a good chance of eventually becoming available to the public. Should this come about, the Stereosonic system would be the logical choice for producing realistic sound.

Denmark Honors Peter Jensen

Peter L. Jensen, president of Jensen Industries, Chicago, and a pioneer in sound reproduction, has been honored by a rare award from his native country, Denmark. Commemorating his outstanding contribution to science and industry as a father of "sound," a bronze plaque has been placed on the house in which he was born on the island of Falster.

Mr. Jensen's achievements span nearly a half century, beginning in 1907 when he originated radio broadcasting in Denmark. A few years later, after coming to the United States, he collaborated with Edwin S. Pridham in the invention of the dynamic speaker. Later they developed the lip-neutralizer microphone.

Instrument Park Planned by Consolidated Engineering

Plans for the development of "Instrument Park," a landscaped and architecturally-controlled industrial community in Pasadena, Calif., have been revealed by Philip S. Fogg, president of Consolidated Engineering Corp. The company has filed an application with the Pasadena Planning Commission requesting a zone change to permit light manufacturing use of a 20-acre site north of the firm's existing plant in the Hastings Ranch area.

A "Master Plan" to govern the development of the project will be prepared by landscaping and architectural experts. The plan will incorporate requirements for off-street parking and loading facilities, internal roadways designed to keep traffic off of neighboring residential streets, landscaped planting and recreation areas, flowered walkways, and low (36 foot limit) modern buildings of attractive design.

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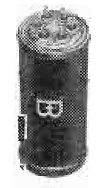
Bradley copper oxide modulator for this very low voltage threshhold application features low noise level, good temperature characteristics, and long-term stability. No moving parts to get out of order as in mechanical modulator; much longer life than vacuum tube.



selenium rectifiers, copper oxide rectifiers, and self-generating photocells

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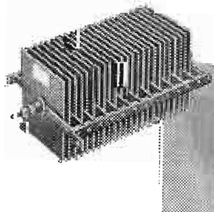

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The complete selenium rectifier line . . . from microamperes to thousands of amperes.

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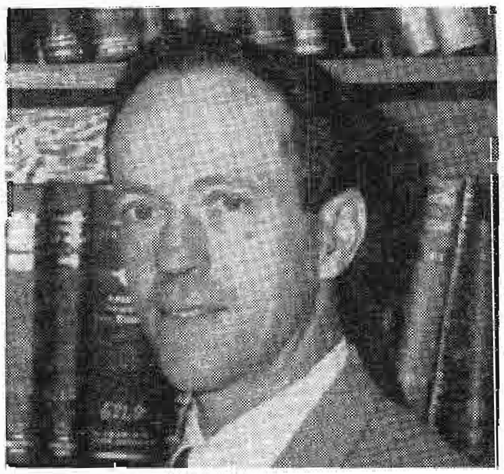
WESCON Completes Committee Appointments

Appointment of four additional committee chairmen by the board of directors completes the roster of officers for the 1953 Western Electronic Show and Convention (See TELE-TECH, March, '53, page 108) This event has been scheduled for August 19 through 21 and will be held in the San FranciscoMunicipal Auditorium New chairmen are: Beardsley Graham, publicity; Winfield G. Wagener, social events; Robert A. Helliwell, technical session registration; and Elvin Feige, Elmar Electronics, Oakland, exhibits registration.

Beardsley Graham

Beardsley Graham, publicity chairman, is assistant director of Stanford Research Institute. Formerly associated with RCA Manufacturing Co., in San Francisco, he has also been a senior project engineer at the Lewyt Corporation; chief engineer and head of the special products development department, chief engineer of the research laboratory, and technical consultant to the vice president in charge of research at Bendix Aviation Corp.



Winfield G. Wagener

Winfield G. Wagener, social events chairman, is in charge of the technical division of the field engineering department of Eitel-McCullough, Inc. For more than 20 years he has been identified with the vacuum tube engineering field, having been successively a transmitting tube engineer with the Federal Telegraph Co.; a transmitting tube engineer with RCA at Harrison, N.J.; chief engineer of Heintz and Kaufman, Ltd., and chief engineer of the tube section of Litton Industries.

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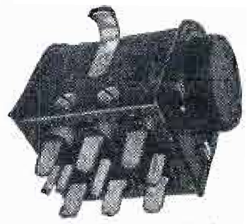
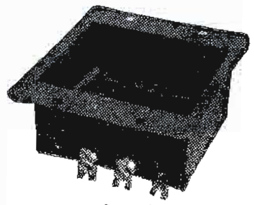


P-506-CE—Plug with Cap



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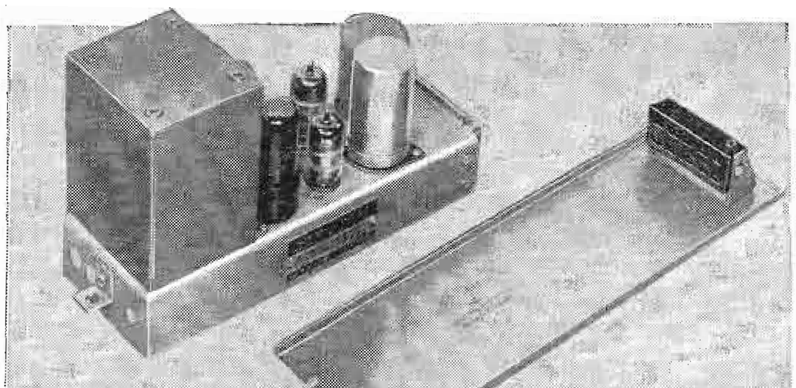
Plug-in Broadcast PROGRAM/MONITOR AMPLIFIER



Type BA-12-C

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For information write: General Electric Company,

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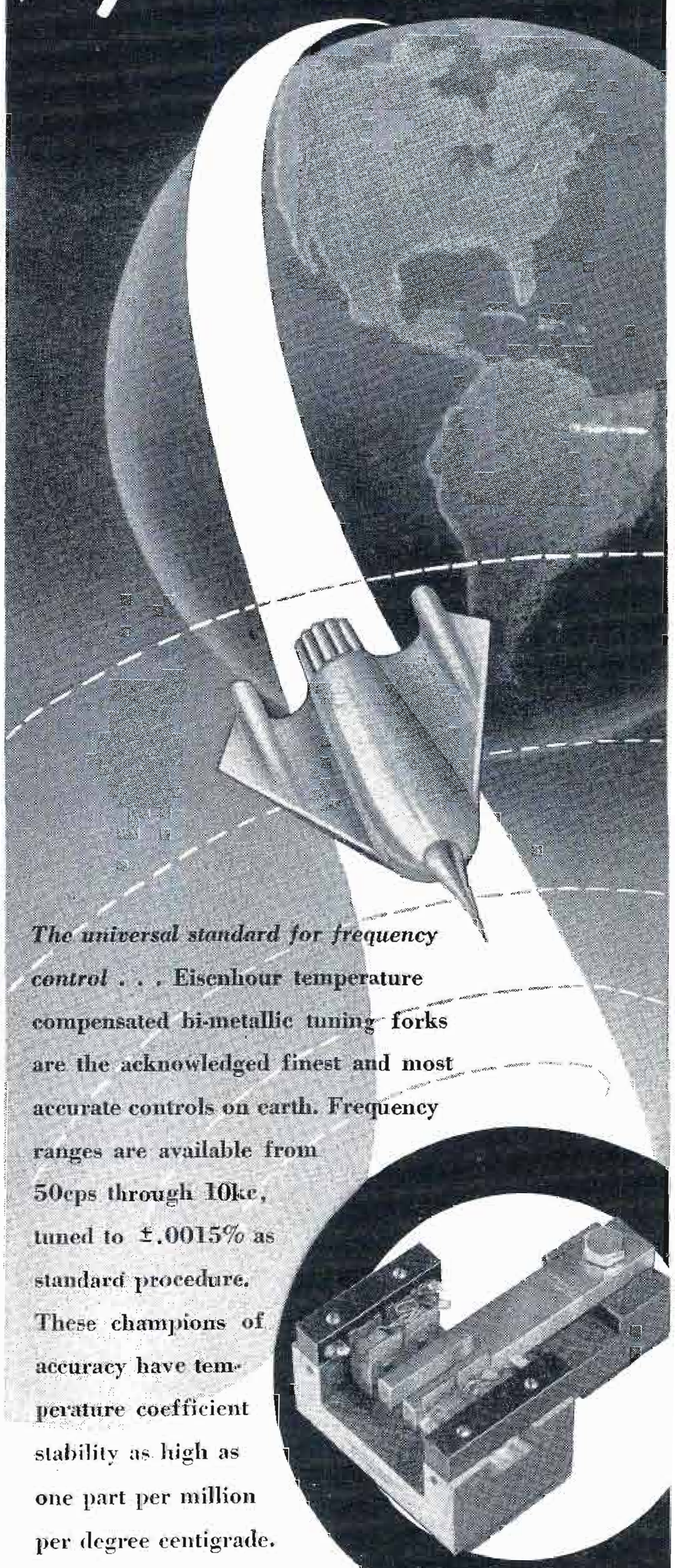

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PATENT NEWS

The patents described in the following list are some of the many patents, presently available for licensing or sale, which may be of interest to TELE-TECH & ELECTRONIC INDUSTRIES readers. Register numbers are those given in the Official Gazette of the Patent Office. Inquiries should be addressed to the owner of the patent rights or other party specified. Complete copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., for $.25 each.

Pat. 2,580,803. **Phase Measuring Device,** patented Jan. 1, 1952. System measures phase difference of two signals of like frequency by connecting sources to high impedance potentiometer. One signal source may be fed simultaneously through the two paths leading to a phase indicator. By shifting potentiometer, signals may be fed through separate path to indicator. Difference in readings indicate phase. (Owner) Northern Electric Co., Ltd., P.O. Box 6124, Montreal, Quebec, Canada. Reg. No. 50,181

Pat. 2,589,664. **Antenna System,** patented March 18, 1952. Flush-mounted antenna for aircraft operates over wide frequency range. Series of slots in vertical stabilizer with outer conductive skin are connected through a T-shaped cavity by coax line. (Owner) Airborne Instruments Lab., 160 Old Country Rd., Mineola, N.Y. Reg. No. 49,713

The following four patents, owned by the U. S. Atomic Energy Commission, are available on a non-exclusive, royalty-free basis. Apply to Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D.C.

Pat. 2,605,332. **Electronic Analyzer,** patented July 29, 1952. Classification and accounting of the magnitude distribution of a series of events is accomplished by converting the events into proportional voltages, applying these pulses to a CRT, and recording beam positions. Reg. No. 49,534.

Pat. 2,605,429. **Portable Radiation Survey Instrument,** patented July 29, 1952. Improved circuitry reduces response time by positive feedback developed in input circuit of amplifier, but exterior to ionization chamber circuit. Reg. No. 49,536.

Pat. 2,605,449. **Pulse Generator,** patented July 29, 1952. Pulses of variable duration generated, controllable by single element over large range. Two gaseous discharge tubes are controlled to discharge a section of artificial transmission line, and provide variable pulse in response to input pulse.

Pat. 2,605,633. **Insulator Testing Apparatus,** patented Aug. 5, 1952. Solder joint between a porcelain bushing and metal end plate of an insulator tested. Trace of resonant curve is obtained from the frequency-modulated output of audio and sawtooth oscillators. Reg. No. 49,538.

(*Continued on page* 197)

The following 10 patents, owned by General Electric, are available to domestic manufacturers for non-exclusive licensing on reasonable terms. Write to Manager, Patent Services Dept., General Electric Co., 1 River Rd., Schenectady, N. Y.

Pat. 2,581,199. **Sawtooth Wave Generator**, patented Jan. 1, 1952. Reg. No. 49,615.

Pat. 2,583,773. **Diplex Antenna Feed System**, patented Jan. 29, 1952. Reg. No. 49,624.

Pat. 2,587,282. **Step Gauge for Measuring Thickness of Thin Films**, patented Feb. 26, 1952. Reg. No. 49,633.

Pat. 2,587,304. **Crystal Pressure Gauge**, patented Feb. 26, 1952. Reg. No. 49,635.

Pat. 2,587,414. **Ultrasonic Materials Testing**, patented Feb. 26, 1952. Reg. No. 49,639.

Pat. 2,588,181. **High-Frequency Phase Angle Responsive Circuit**, patented Mar. 4, 1952. Reg. No. 49,644.

Pat. 2,598,478. **Degenerative Feedback Radio Amplifying System**, patented May 27, 1952. Reg. No. 50,201.

Pat. 2,599,266. **Electronic Switching Circuit**, patented June 3, 1952. Reg. No. 50,202.

Pat. 2,602,140. **Coincidence Timing System**, patented July 1, 1952. Reg. No. 50,203.

Pat. 2,602,922. **Sensitivity Time Control**, patented July 8, 1952. Reg. No. 50,205.

The following 15 patents, owned by AT & T, are available for licensing on reasonable terms. Write to Patent Licensing Div., Western Electric Co., 195 Broadway, New York 7, N. Y.

Pat. 2,580,685. **Color Television with Reduced Band Width**, patented Jan. 1, 1952.

Pat. 2,582,218. **Electronic Start-Stop to Multiplex Extensor**, patented Jan. 15, 1952.

Pat. 2,582,690. **Backlash Eliminating Device**, patented Jan. 15, 1952.

Pat. 2,583,029. **Method of Preparing Glow Discharge Devices**, patented Jan. 22, 1952.

Pat. 2,583,542. **Vibratory Reed-Controlled Oscillator**, patented Jan. 29, 1952.

Pat. 2,584,297. **Apparatus for Guiding Lead Wires to Be Soldered to Crystals**, patented Feb. 5, 1952.

Pat. 2,584,990. **Transistor Counting System**, patented Feb. 12, 1952.

Pat. 2,585,077. **Control of Impedance of Semiconductor Amplifier Circuits**, patented Feb. 12, 1952.

Pat. 2,585,890. **Delay-Action Filter Circuit**, patented Feb. 12, 1952.

Pat. 2,586,080. **Semiconductive Signal Translating Device**, patented Feb. 19, 1952.

Pat. 2,587,055. **Electrical Cavity Resonator for Microwaves**, patented Feb. 26, 1952.

Pat. 2,588,103. **Wave Guide Coupling between Coaxial Lines**, patented Mar. 26, 1952.

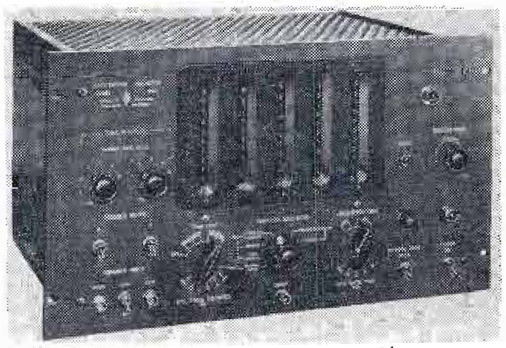
Pat. 2,589,169. **Method of Insulating Conductors**, patented Mar. 11, 1952.

Pat. 2,589,711. **Off-Channel Squelch Circuit for Radio Receivers**, patented Mar. 18, 1952.

Pat. 2,590,584. **Sea-Water Battery**, patented Mar. 25, 1952.

Electronic Counter

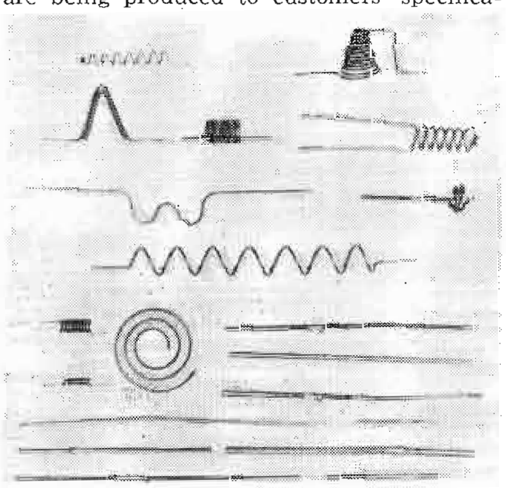
Precision counter providing frequency, period and time interval measurements over a broad range is designated Model 522B. It measures rate of occurrences from 0.00001 to 100,000 per second. It measures time from 10 μsec. to 27.8 hours. Counting is available over periods of 1/1,000, 1/100, 1/10, 1 and 10



seconds or multiples. Time of display can be varied to any duration, counts are automatically reset, and action is repetitive. Results are shown in cycles per second, kilocycles, seconds or milliseconds. Model 522B is completely contained in a small, bench size unit. Results are displayed instantly and automatically in direct-reading form, complete even to automatic illuminated decimal point. Unskilled personnel can use the equipment immediately. The new instrument consists of five decade counters, a wide range time base, and gating and auxiliary circuits applying counters and time base to a broad variety of measurements. The unknown is applied to the counters through a gate circuit. This circuit remains open for a precise interval controlled by an over-housed quartz crystal. Crystal stability is at least 5 ppm per week, and may be standardized against Station WWV. Price is $900.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES

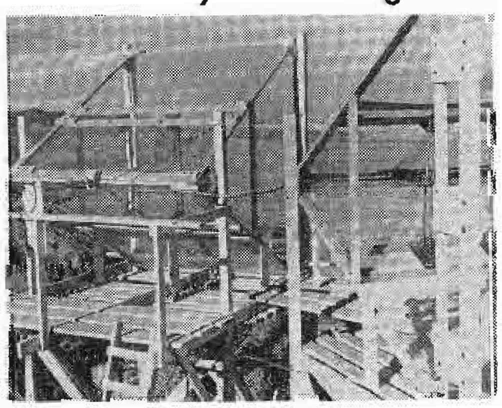
Coils and Leads

Tungsten and Molybdenum hand-woven coils for use as emitters, filaments, coiled coils and leads, with and without beadings, are being produced to customers' specifica-



tion.—**Electronic Parts Mfg. Co., Inc., Union City, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES

Twin City TV Coverage



View of present transmitting antennas of KKTV, Colorado Springs, which are fed from DuMont 5 KW transmitter. One antenna is beamed to Colorado Springs while the other is beamed at Pueblo. Antenna is approximately 4500 ft. high atop Cheyenne Mountain. Micro wave relay system is used to provide studio signals to the transmitting location.

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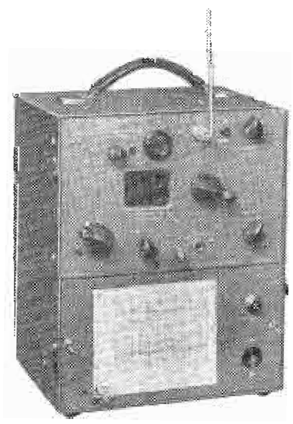

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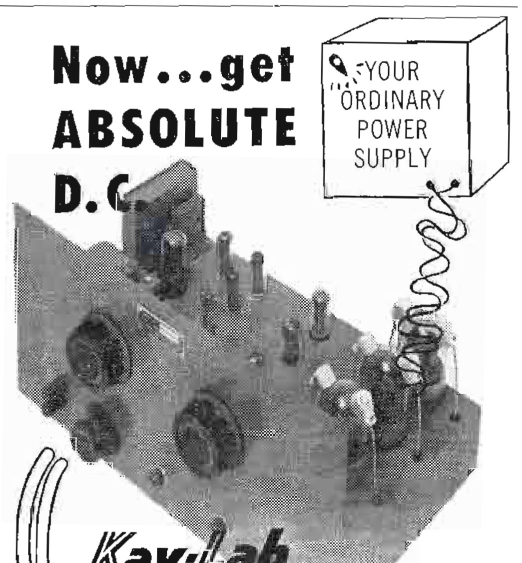

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BULLETINS

Telemetering

Timely information and engineering data are contained in Bulletin M1710 on telemetering just published by the Bristol Manufacturing Co., Waterbury, Conn. The manufacturer's instruments for remote recording, indicating, and totalizing electric variables are described and typical Metameter installations in generating stations and on tie lines and dispatching boards are presented.

Thermal Relays

Hermetically sealed miniature and octal size time delay relays are described in Publication No. 30, a new 4-page, two-color, released by G-V Controls, Inc., 28 Hollywood Plaza, East Orange, N. J. The bulletin includes cut-away views of the mechanism and shell, operating characteristic curves and specifications of six time ranges having delay intervals from 3 to 5 secs.

Mass Spectrometer

Bulletin CEC-1824, a two-color, 4-page release, describes the new model 21-610 mass spectrometer, designed primarily to monitor and control chemical continuous processes, manufactured by Consolidated Engineering Corporation, 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Photoelectric Recorder

A new, fully illustrated, 12-page, two-color bulletin, GEA-5536 describing recorder application to seismology, psychology, textiles, metals, fatigue and research testing, light-intensity study, and paper-machine-speed measuring has been announced by General Electric Company, Schenectady 5, New York.

Equipment and Accessories

Audio & Video Products Corporation, 730 Fifth Ave., New York, has released a 4-page catalogue of specifications and prices on Ampex recording equipment and audio; and the new Ampex playback.

Sealing

A new brochure describing their products and services for sealing bolts, studs, rivets, AN fittings, access doors, hatch covers, flanges, electric terminals, etc., has been completed for distribution by The Franklin C. Wolfe Company, Inc., 3644 Eastham Drive, Culver City, Calif.

Lehman Celebrates 25th Anniversary

This year Hart Lehman, whose agency bears his own name, is celebrating his 25th year serving accounts in radio-TV and electronic industries. He was elected to 4-A membership in 1949. Among the accounts now served are: Audak Co., Cornish Wire Co., Apex Coated Fabrics Corp. and Airtron Inc.