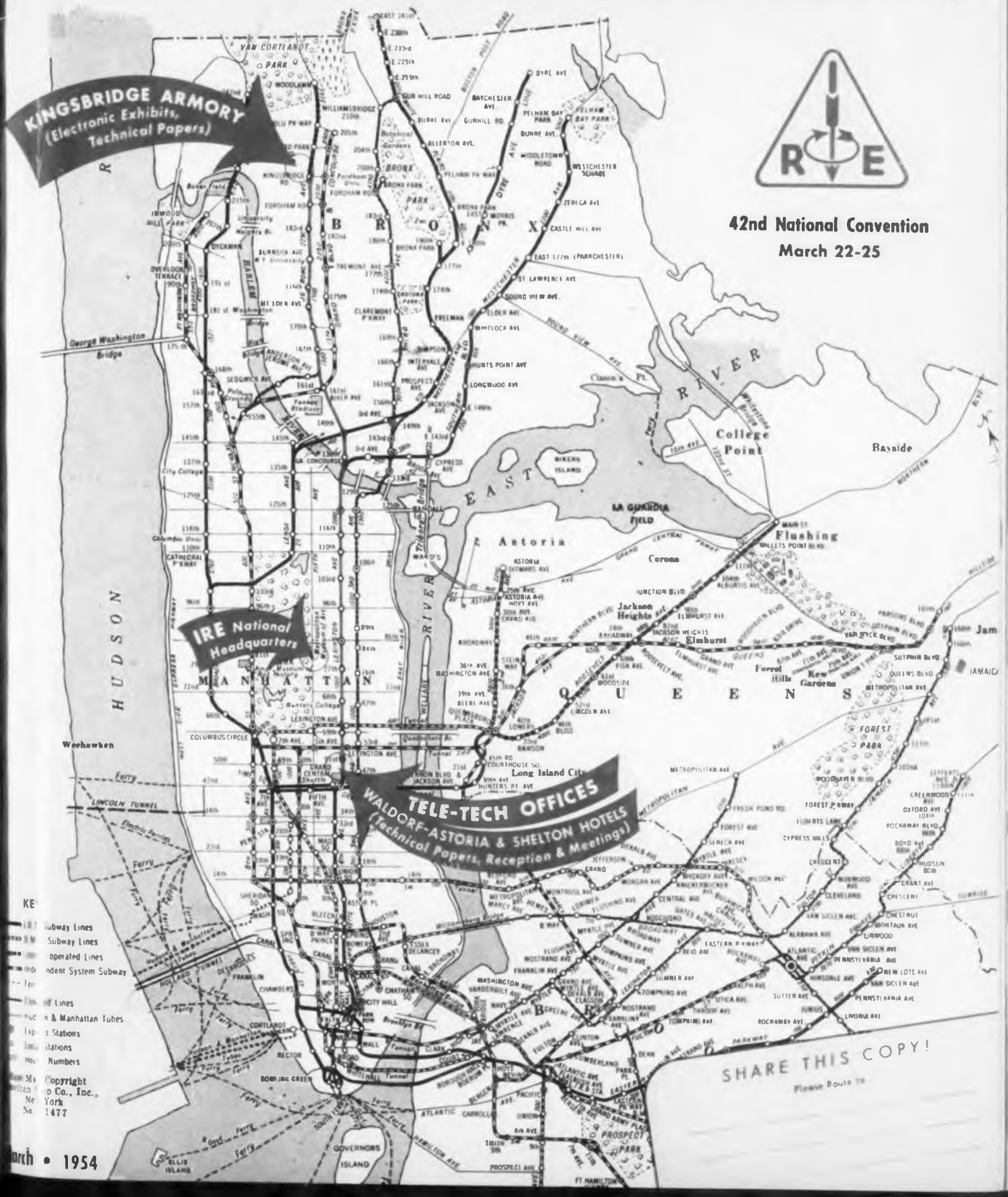
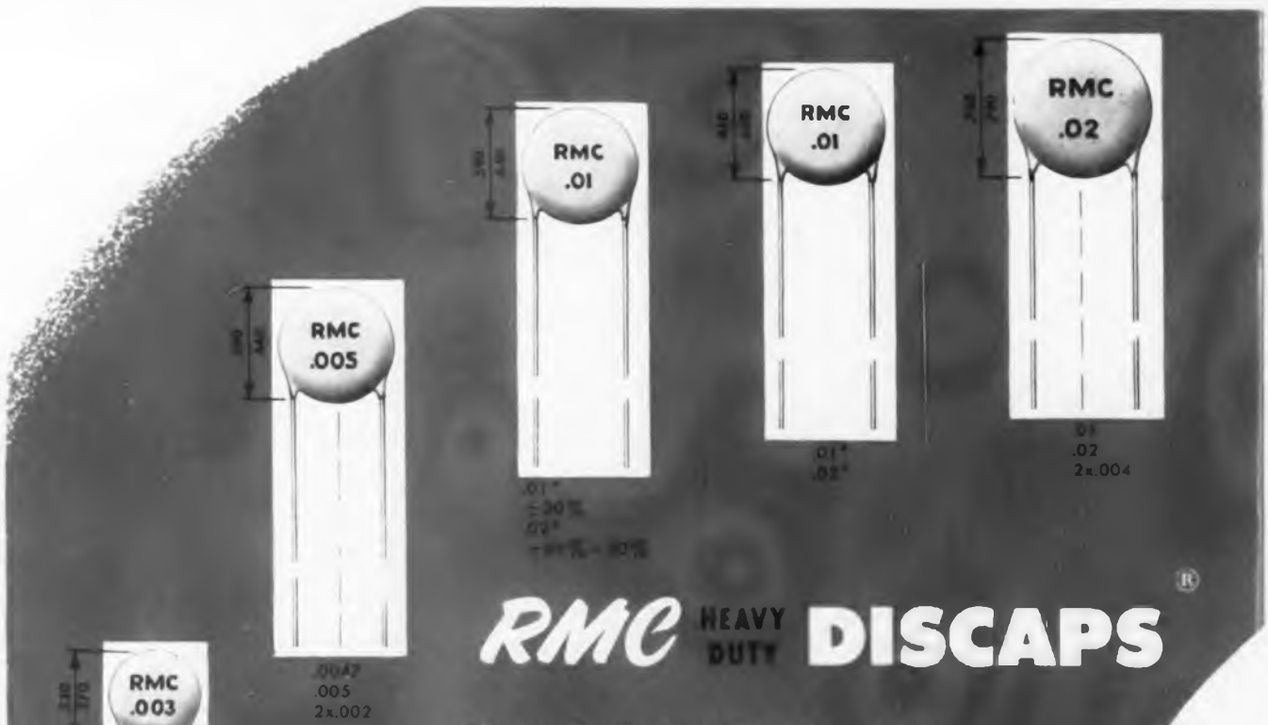
5-5

TELE-TECH

& Electronic Industries



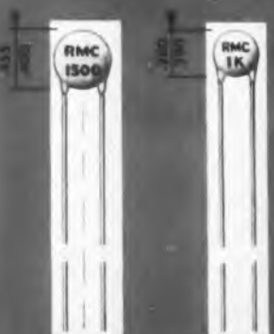


RMC HEAVY DUTY DISCAPS®

...the right way to say ceramic capacitors

TYPE B
1000 V.D.C.W. By-Pass Series
*Rated 600 V.D.C.W. Flash test 1200 V.D.C.

.003
.004*
.005*
2x.0015
2x.002*



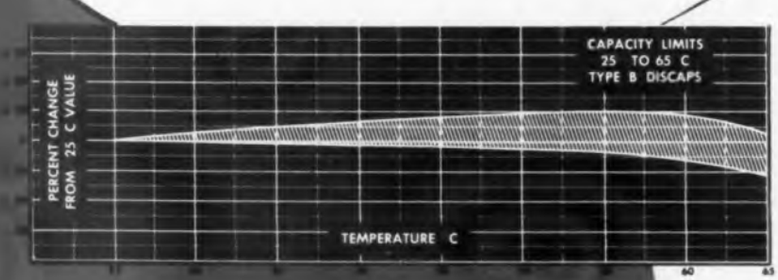
.0015
.002
2x.001

.00047
.00068
.0008
.001

SPECIFICATIONS

GUARANTEED MINIMUM VALUE

POWER FACTOR: 1.5% Max. @ 1 KC (initial)
POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)
INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms



BOOTH 518 Components Avenue, I. R. E. Show

SEND FOR SAMPLES AND TECHNICAL DATA

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.
DISTRIBUTORS: Contact Jobbers Sales Co., 146 Broadway, Paterson 1, N. J.

TELE-TECH
& Electronic Industries

MARCH, 1954

FRONT COVER: NATIONAL IRE CONVENTION—For the many thousands of engineers who will come to New York City for the annual IRE Convention, March 22-25, the map should be a helpful guide. The detailed subway stations are of particular interest this year because the exhibition is being held in the Kingsbridge Armory for the first time. For a preview of the convention, see page 72.

DEPARTMENTS

TELE-TECH*, Vol. 13, No. 3. Published monthly by Caldwell-Clements, Inc. M. Clements, President; M. H. Newton, Assistant to President; John J. Borghi, Vice President and Secretary; Marguerite B. Clements, 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. 75c 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.

Publication Office, Bristol, Conn.

Editorial/Business Offices 480 Lexington Ave., New York 17, N. Y., Tel. Plaza 9-7880

Publishers also of MART and TECHNICIAN

* Reg. U. S. Pat. Off.

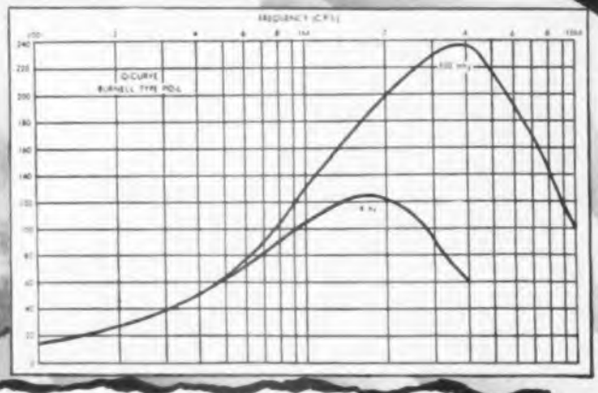
TELE-TECH'S CIRCULATION, 21,000

Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH's guaranteed circulation of 21,000.

*A New Level in Engineering is Achieved in the Functional Design of Toroidal Decades**

This unique development permitting precision toroids to be combined in decade steps of inductance will appeal to all engineers who are familiar with the disadvantages of the ordinary type of inductance decade box.

All the decade units in the plug-in decade series are higher Q toroids such as are employed in the Burnell attenuation filters. They are guaranteed to a tolerance of 1% of the marked inductance and have extremely good stability of inductance vs. voltage and temperature.



* Pat. Applied for

PLUG-IN DECADE COILS CAN ALSO BE DESIGNED WITH SPECIAL CHARACTERISTICS FOR SLIGHT EXTRA CHARGE. UNITS GENERALLY AVAILABLE FROM STOCK ARE AS FOLLOWS:

P.I.D. 1 (MHYS)*	
P.I.D. 2	"
P.I.D. 3	"
P.I.D. 4	"
P.I.D. 8	"
P.I.D. 10 (MHYS)*	
P.I.D. 20	"
P.I.D. 30	"
P.I.D. 40	"
P.I.D. 80	"
P.I.D. 100 MHYS	
P.I.D. 200	"
P.I.D. 300	"
P.I.D. 400	"
P.I.D. 800	"
P.I.D. 1000 MHYS	
P.I.D. 2000	"
P.I.D. 3000	"
P.I.D. 4000	"
P.I.D. 8000	"
P.I.D. 10000 MHYS	
P.I.D. 20000	"
P.I.D. 30000	"
P.I.D. 40000	"
P.I.D. 80000	"

*Also available in P.I.D.-H Type for higher frequency range.

OTHER RECENT *Burnell* ACHIEVEMENTS IN TOROIDS AND FILTER NETWORKS

SIDE BAND FILTERS

Our most recent engineering development in communications filters has already stirred the interest of the leading receiver manufacturers in the country.

The new side band filters which eliminate, for most applications, the necessity for expensive crystal filters are expected to accelerate the advancement of single side band communications.

MINIATURE TELEMETERING FILTERS

In recognizing the need for miniaturization of the presently bulky telemetering equipment, our engineering staff has succeeded in reducing the size of telemetering filters to as little as 25 to 50% of the original volume.

SUB MINIATURE TOROIDS

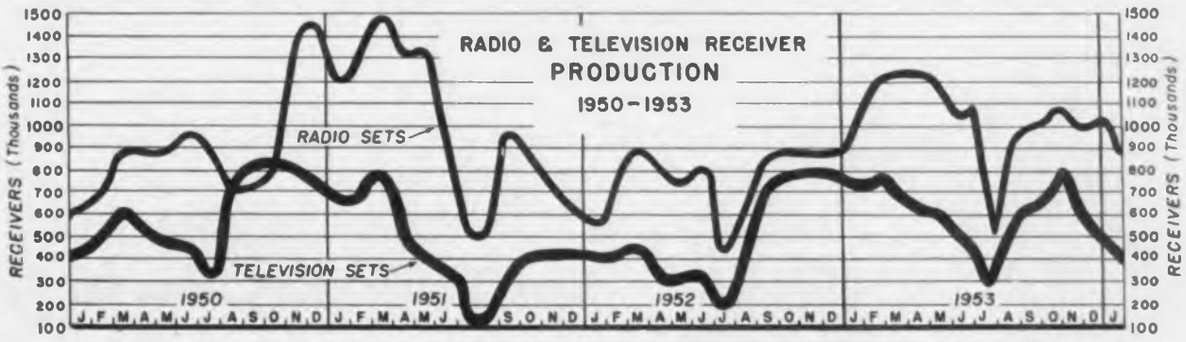
Toroids for intermediate frequencies of 100KC to 1 megacycle. A wide variety of coils ranging in size from $\frac{5}{8}$ inch provides high Q in the frequency range betweeen audio and RF.

The tiny toroid about the size of a dime has been welcomed by designers of sub miniature electronic equipment for the transistor, guided missile and printed circuit field.

Literature for all the above available on request

Write for new and enlarged 16 page catalog 102A
See us at the I R E show booth 678 Kingsbridge Armory, N. Y. City, March 22-23-24-25,
Exclusive Manufacturers of Communications Network Components

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS: BURNELL



Computer Components

T. R. Cott at Remington Rand Inc. has provided the following interesting summation of electronic components used in their "UNIVAC" digital computers. (See page 79 for similar details on the "REAC" analog computers)

(1) Relays—825
(2) Crystals—20,650
(3) Capacitors:

Ceramic	12,245
Mica	122
Electrolytic	641
Paper	7,396
Total	20,404

(4) Resistors:

Precision	5,862
Comp. Carbon	18,664
Wirewound	7,821
Total	32,347

(5) Tubes:

3C23	64
6AK5	412
6AL5	199
6AN5	136
6AU6	57
6SN7-GT	264
7AK7	363
25L6-GT	3947
28D7	274
807	27
829-B	47
2050	151
5687	14
5915	96
Misc.	52
Total	6103

TV Programming

From a recent NARTB report we obtained the figures that programmed television shows in 32 American cities consist of

Type Program	% Programmed Hours on Air
Educational & informational	22
Family entertainment	58
Kid shows	7
Live sports events	11
Misc.	2

Supply of Engineering Graduates (1954-1956)

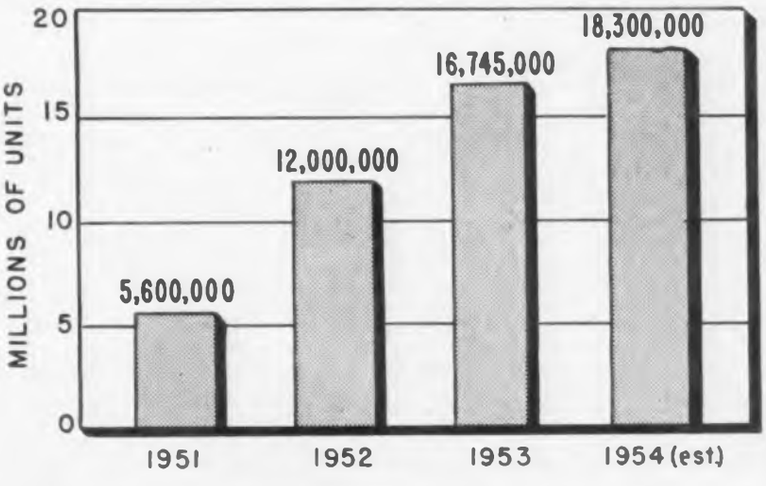
The following table estimates the probable distribution of engineering graduates 1954-56. The R.O.T.C. figures provided reflect the results of the latest adjustments by the Department of Defense

	1954	1955	1956
1. Graduates	17,000	20,000	26,000
2. Commissioned thru R.O.T.C.	5,500 (a)	8,100 (a)	8,800 (a)
3. Draft eligible and Other Reserves	7,100	9,900	14,100
4. Remainder (b) (Veterans and 4F)	4,400	2,000	3,100
5. Returnees—Recent Graduates (c)	12,000	11,700	12,600
6. Totals available for civilian employment	16,400	13,700	15,700

(a) Current Dept. of Defense objectives
(b) Line 1 minus 2 and 3
(c) Estimated on basis of R.O.T.C. graduates and Selective Service inductions. Many were employed before entry into service.

(From Engrg Manpower Commission, Engrs Joint Council)

ANNUAL SALES OF GERMANIUM DIODES



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in January 1954

Analyzers, linear	$ 41,950	Inverters	155,701	Sonobuoys	296,668
Antenna Group	31,216	Kits, antenna	36,119	Suppressors, electrical noise	26,595
Cable	1,369,564	capacitance simulator	193,573	Switchboards	138,635
Circuit Breakers	36,815	Motors	96,228	Switches, rotary	71,658
Compasses, magnetic	35,913	Oscillator Filter Elements	27,952	Test Stands	41,534
Controls, radio set	45,405	Power Units	240,090	Transformers	198,141
Crystal Units	295,882	Radar Beacons	66,610	Transmitters	474,219
Delay Lines	119,471	Receivers, radio	31,491	Tubes, electron	691,739
Generators	373,300	Receptacles and Plugs	31,589	Wire	35,280
Indicators	910,008	Recorders, pulsed photographic	88,029	X-Ray Machines	69,649

FILL ALL YOUR COLOR-TV TUBE NEEDS!

2V2
High-voltage rectifier

5AU4
High-output full-wave rectifier

6AR8
Sheet-beam synchronous detector

6BJ7
Triple diode for d-c restoration

6BU5
High-voltage pentode for shunt regulation.

OTHER NEW G-E TYPES
specially developed for color television will be ready shortly.

New G-E Receiving Tubes for Color!

Your first aim in designing your new color-TV chassis is quality reception. Your second aim is economy, so that the selling price may be—and remain—competitive.

General Electric helps you reach both objectives by bringing you five new receiving tubes specially designed for color. Each of them does a particular job in a color receiver *better* . . . or, it replaces two or more standard tubes, saving you money.

G-E tube engineers at the I.R.E. Show will be glad to explain fully the circuit functions of the five new tubes. Still other types are on their way. Keep constantly in touch with General Electric for new, advanced tubes for color TV!

G-E TUBE SERVICE includes (1) special design and application help with your tube problems, (2) coast-to-coast tube warehousing for fast deliveries to your plant, (3) same-day processing of your tube orders, (4) local-laboratory help in checking your circuit performance. Top service to manufacturer-users is an important chapter of the General Electric tube story!

SEE G.E.'s COMPLETE LINE AT THE SHOW!

Booths 186 to 190, Television Avenue

G-E Tri-color Picture Tubes!

In production at an expanding rate, G-E tri-color picture tubes are available now. See the 15" type on display, also the 19" tube that will be ready shortly. Both are aluminized, glass, using three electron guns, with a planar shadow mask for color selection.

Development is proceeding on larger tubes, on improved types. You may expect G-E tubes that will give steadily bigger—brighter—clearer pictures. You may expect an ever-truer palette of colors.

For your needs now . . . today . . . G. E. has picture tubes for color TV ready. For tomorrow's more advanced types, come to G.E also! *Tube Department, General Electric Co., Schenectady 5, N. Y.*

TYPE 15GP22

19-INCH TYPE

GENERAL ELECTRIC

FILL ALL YOUR COLOR-TV TUBE NEEDS!

2V2
High-voltage rectifier

5AU4
High-output full-wave rectifier

6AR8
Sheet-beam synchronous detector

6BJ7
Triple diode for d-c restoration

6BU5
High-voltage pentode for shunt regulation.

OTHER NEW G-E TYPES
specially developed for color television will be ready shortly

New G-E Receiving Tubes for Color!

Your first aim in designing your new color-TV chassis is quality reception. Your second aim is economy, so that the selling price may be—and remain—competitive.

General Electric helps you reach both objectives by bringing you five new receiving tubes specially designed for color. Each of them does a particular job in a color receiver *better* . . . or, it replaces two or more standard tubes, saving you money.

G-E tube engineers at the I.R.E. Show will be glad to explain fully the circuit functions of the five new tubes. Still other types are on their way. Keep constantly in touch with General Electric for new, advanced tubes for color TV!

G-E TUBE SERVICE includes (1) special design and application help with your tube problems, (2) coast-to-coast tube warehousing for fast deliveries to your plant, (3) same-day processing of your tube orders, (4) local-laboratory help in checking your circuit performance. Top service to manufacturer-users is an important chapter of the General Electric tube story!

SEE G.E.'s COMPLETE LINE AT THE SHOW!

Booths 186 to 190, Television Avenue

G-E Tri-color Picture Tubes!

In production at an expanding rate, G-E tri-color picture tubes are available now. See the 15" type on display, also the 19" tube that will be ready shortly. Both are aluminized, glass, using three electron guns, with a planar shadow mask for color selection.

Development is proceeding on larger tubes, on improved types. You may expect G-E tubes that will give steadily bigger—brighter—clearer pictures. You may expect an ever-truer palette of colors.

For your needs now . . . today . . . G. E. has picture tubes for color TV ready. For tomorrow's more advanced types, come to G.E also! *Tube Department, General Electric Co., Schenectady 5, N. Y.*

TYPE 15GP22

19-INCH TYPE

GENERAL ELECTRIC

TELE-TECH
& Electronic Industries

DR. O. H. CALDWELL, *Editorial Director* — M. CLEMENTS, *Publisher*
BERNARD F. OSBAHR, *Editor* — DR. A. F. MURRAY, *Consulting Editor*
ALBERT J. FORMAN, *Associate Editor* — HARRY D. WULFORST, *Associate Editor*
JOHN H. BATTISON, *Contributing Editor* — B. V. SPINETTA, *Directory Editor*
CARL THOMAS, *Assistant Editor*
R. C. DAVIES, *Washington News Editor*
CHARLES F. DREYER, *Art Director*
GAIL CARLSON, *Editorial Secretary*
Lt Col. STANLEY GERSTIN, *Consulting Editor* (Vice Pres. & Gen. Mgr., Caldwell-Clements Manuals Corp.)

BUSINESS DEPARTMENT

M. H. NEWTON, *Business Manager*
HOWARD A. REED, *General Sales Manager*
JOSEPH DRUCKER, *District Manager*
JAMES S. COLEMAN, *Asst. Sales Manager*
N. McALLISTER, *Asst. Business Manager*
CECILIA KAVANAUGH, *Advg. Records*
A. SHILLIN, *Production Manager*
480 Lexington Ave., New York 17, N.Y.
Telephone PLaza 9-7880

S. M. GASKINS, *Western Manager*
JOHN D. LUPTON, *District Manager*
201 N. Wells St., Chicago 6, Ill.
Telephone RAndolph 6-9225

CHRIS DUNKLE & ASSOCIATES
California Representatives
3257 W. 6th Street, Los Angeles 5, Calif.
Telephone DUnkirk 7-6149
1355 Market St., San Francisco 8, Calif.
Telephone KLondike 2-2311, Ext. 579

WARREN S. BROWN, *Circulation Manager*
M. GROENING, *Asst. Circulation Manager*
JOHN J. BORGHI, *Controller*

CIRCULATION 21,000

Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH's guaranteed circulation of 21,000.

TELE-TECH® & ELECTRONIC INDUSTRIES 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.

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.

THE ELECTRONIC INDUSTRIES DIRECTORY

Published annually as an integral section of TELE-TECH in June

picture of Perfection

Midland FREQUENCY CONTROL CRYSTALS for COLOR television

Color television brings a new set of critical demands for precision frequency control. Accuracy, stability and uniformity of crystals used in this application must be as nearly perfect as materials, methods, and quality controls can make them.

Midland meets this demand not only with a crystal of complete reliability in this new field, but also with a solid background of pioneering in the development of frequency control crystals and circuits for this and many other exacting applications.

Midland is prepared NOW to supply you in quantity with Color TV Crystals to meet your exact specifications, and to counsel on all matters concerned with this subject.

SEE OUR EXHIBIT in Booth No. 143
Radio Engineering Show, March 22-25.
Kingsbridge Armory, New York City.

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

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

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

ARNOLD MAGNETIC MATERIALS

TYPES "C" AND "E" CUT CORES

Arnold "C" and "E" Cores are made from precision rolled Silectron strip (highly oriented silicon steel) in 1, 2, 4 or 12-mil thicknesses and a wide variety of window sizes and core areas, for high and low-frequency applications. Sizes range up to 10 lbs. in 12-mil strip, and from fractions of an ounce to hundreds of pounds in the thinner gauges. Cores wound from ultra-thin strip (down to ¼ mil or less) can also be supplied.

Insulated strip of the proper width is wound on a mandrel, then heat treated, bonded and cut into halves. Careful control results in accurately dimensioned and matched core halves whose effective air gap at the butt joint is very small.

In 3-phase applications, the use of "E" Cores provides weight and size reduction, as well as higher efficiency and possible cost savings. Rigid standard tests are employed for both "C" and "E" types of cores, and special tests where required.

TAPE WOUND CORES

Depending upon the specific properties required, Arnold Tape Wound Cores are available made of Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750 Electrical Metal, or Silectron . . . in standard tape thicknesses of 1, 2, 4 or 12-mils, and in ultra-thin gauges of ½ and ¼-mil where required.

Practically any size core can be supplied, from a fraction of a gram to hundreds of pounds. Toroidal cores are made in 22 standard sizes with protective nylon cases. Special sizes of toroidal cores, and all square or rectangular Tape Wound Cores, are manufactured to meet individual requirements.

Used for magnetic amplifiers, pulse transformers, current transformers, wide-band transformers, non-linear retard coils, peaking strips, reactors, etc., this gapless type of core construction results in maximum effective working permeability with minimum flux leakage.

MOLY-PERMALLOY POWDER CORES

For use in loading coils, filters, broadband carrier systems and networks, for frequencies up to 200 kc, these Toroids provide high Q in a small volume, and are characterized by low eddy current and hysteresis losses.

Arnold Powder Cores are supplied in four standard permeabilities: 125, 60, 26 and 14 Mu. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc; the 60 Mu at 10 to 50 kc; the 26 Mu at 30 to 75 kc; and the 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability ($\pm 0.1\%$) over a specific temperature range.

These Moly Permalloy Powder Toroids are available in a wide range of sizes, to obtain nominal inductances as high as 281 mh/1000 turns. They are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

ALNICO MAGNETS

Arnold manufactures permanent magnets from all grades of Alnico, although Alnico V is usually the preferred type due to the high value of energy product of that alloy. Alnico Magnets are quite hard and somewhat brittle and may be machined only by grinding. Most sizes and shapes are manufactured as sand castings and are made to the customer's drawings and specifications. Some types and shapes of Alnico Magnets are carried as stock items.

Some small sizes of magnets may be furnished in sintered Alnico, but special shapes made in this way require rather expensive dies.

Stock sizes of all the products above are listed in Catalog GC-106. Write for your copy . . . but if you're attending the IRE show this year, see us at Booth 148.

WAD 4831

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois New York: Empire State Bldg. Boston: John Hancock Bldg. Los Angeles: 3450 Wilshire Blvd.

"Just click them in."

THE

AMPHENOL *Qwik*

MICROPHONE CONNECTORS

AMPHENOL proudly presents the new QWIK microphone connectors! Designed by one of America's leading industrial designers in cooperation with the skilled engineers of AMPHENOL, here at last are microphone connectors with the beauty and the efficiency to complement every microphone, in any setting!

In both mechanical and aesthetic considerations the new QWIKs are unique. They have an ingenious release device which is both extremely easy to operate and very efficient. Disconnection for either male or female connectors is made by simply sliding a button forward with a slight pressure of the thumb. For insertion, the QWIK is gently clicked in.

The finish of the new QWIKs is an attractive corrosion-resistant satin nickel—the body is a sturdy zinc alloy. They incorporate the famous 1-501 blue dielectric material, the same used on all AMPHENOL AN connectors. Contacts are gold-plated over a silver finished high conductivity bronze.

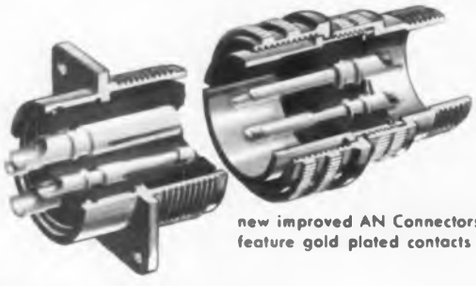
QWIKs are available, either male or female, with three or four contacts. The possibilities of their applications are such that you will want to see and study them as soon as possible.

For full information:
write to the Sales Engineering Department,
American Phenolic Corporation
1830 South 54th Avenue, Chicago 50, Illinois

small, compact Miniature Connectors for special electronic needs

hundreds of different miniature and industrial Tube Sockets

versatile Plugs—unique designs, sturdy construction



new improved AN Connectors now feature gold plated contacts

Cable quality guaranteed by strict controls, rigid inspection

fastest connect and disconnect with Blue Ribbon Connectors

PRECISION MADE COMPONENTS FOR THE ELECTRONICS INDUSTRY

AMPHENOL makes over 11,000 separate cataloged components that are used and relied upon by the electronics industry the free world over. These components include the famous AN connectors, RF connectors, cables and many special types of sockets, plugs and connectors. Their applications vary, but the distinguishing feature of all AMPHENOL components is present in each: *quality*.

The quality that is the mark of AMPHENOL components is the product of both precision engineering and precision manufacturing. Neither of these would result in quality alone. But the teamwork of the two produces the finest components available—the electronics industry has learned to rely upon AMPHENOL quality.

Not only the components on this page but thousands more are listed in the new AMPHENOL Catalog B-3. From the B-3 you will be able to fill the majority of your component needs. Where more specialized information is desired, the B-3 also lists the special AMPHENOL catalogs, A, C and D, as well as other product literature.

AN Electrical and RF Connectors
Microphone Connectors
Radio and Industrial Tube Sockets
RF Cable
TV, FM and Communication Antennas
Cable Assemblies
Radar and Radio Components

AMPHENOL

Rack and Panel connectors for many special applications

waterproof field serviceable Audio Connectors approved for Signal Corps

developed first for Signal Corps, waterproof Power Plugs

better design, better construction on all RF Connectors

a complete Cataloging service to the electronics industry

American Phenolic Corporation, Chicago 50, Illinois

Amform 2382—24400 Printed in U.S.A.

Mallory Capacitors for printed circuit applications

Mallory FP Electrolytic Capacitors are now available in a construction that is specifically designed for printed electronic circuits. Their mounting prongs and terminals have been adapted for quick, foolproof production line assembly.

1 *Prongs and terminals are smaller . . . take less space . . . hold securely with a small amount of solder. No need for large copper areas in the printed chassis.*

2 *Self-positioning. One mounting prong is wider. The capacitor can fit only in its correct position.*

3 *Shoulders on prongs hold capacitor clear of chassis, permitting use of printed circuitry on both sides.*

4 *Prongs can be automatically spread on insertion by simple jig, insuring strong mechanical mounting prior to soldering.*

5 *Positive soldering. Aluminum risers do not extend through chassis. No danger of contaminating solder.*

These refinements of design are one more step in the capacitor developments which Mallory has pioneered, and which have made Mallory FP Capacitors the leader in their field. Write or call us for detailed literature, or for engineering service on your capacitor problems by one of our field specialists.

Expect more . . . Get more from MALLORY

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

Serving Industry with These Products:

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

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

STACKPOLE Fixed RESISTORS

. . . dependable, easy-to-solder molded composition types

Stackpole 1/2-, 1- and 2-watt resistors not only meet exacting performance standards, but save assembly time thanks to their highly-tinned, easily-soldered leads.

JAN-R-11 TYPES—in styles RC10, RC20, RC21, RC30, RC31, RC41, and RC42 available. Write for JAN Resistor Bulletin J-2.

. . . A dependable source of reliable components for over 30 years

STACKPOLE Variable RESISTORS

with versatile switching

Single, ganged and concentric shaft dual types in smallest sizes consistent with real dependability offer long, and trouble-free performance for today's requirements. Gold plated "ring spring" contactors assure low noise level. A complete array of unique midget line switches offers practically any desired switching arrangement, with types for both civilian and military use.

STACKPOLE Composition CAPACITORS

Cost-saving, low-value, fixed types

Originated by Stackpole, these tiny units not only represent the simplest, most inexpensive capacitor design yet produced—but likewise have characteristics that make them more desirable than larger, more costly capacitors for many uses. 47 standard types, 0.1 to 10.0 mmf. Write for Stackpole GA Capacitor Bulletin.

New!

Cost-saver bushingless controls

Similar to standard Stackpole LR-2 controls except that a plate with sturdy mounting lugs replaces the conventional threaded brass bushing for easier assembly.

STACKPOLE Iron CORES

. . . to match any electrical or mechanical specification

Pioneers in modern iron core development, Stackpole offers practically any desired style and with assured uniformity of both electrical and mechanical characteristics.

Write for Iron Core Bulletin.

STACKPOLE

Ceramag® CORES

(Ferromagnetic)

for real uniformity! Wherever ferromagnetic cores are used, Stackpole Ceramag Cores have set the quality standards. But proved superiority in essential characteristics is only part of the story. Even more important is the fact that Stackpole Ceramag core characteristics are maintained with remarkable uniformity regardless of size, shape or production quantity. *The sample matches your specification "on the nose"—and each production unit is exactly like the sample!* Write for Ceramag Bulletin RC-9A including details on available grades and latest characteristic curves.

STACKPOLE

Molded COIL FORMS

Cut Assembly Costs!

You can reduce coil sizes and cut assembly costs with simplified point-to-point wiring and fewer soldered connections with these Stackpole molded coil forms. Types available with iron core sections. Axial or "hairpin" leads. Write for Catalog RC-9.

STACKPOLE

Slide SWITCHES

. . . the economy switches of 1001 uses!

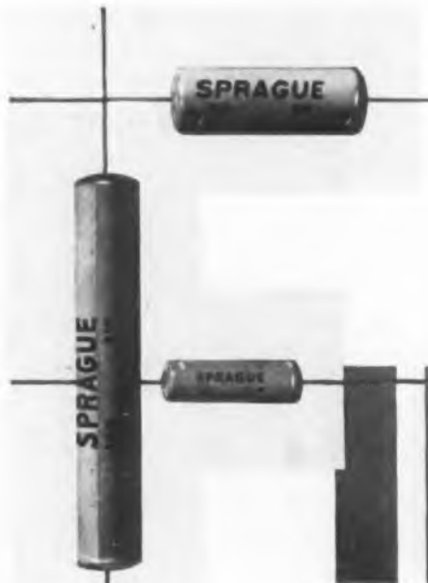
Over 20 types of these inexpensive little Stackpole slide switches cover just about every mechanical and electrical switching requirement for radio and television equipment, small motors, appliances, electrical toys, instruments, etc. For complete details, write for Stackpole Switch Bulletin RC-9B.

Engineering Samples are proof of the pudding!

Engineering samples of standard Stackpole components are available to quantity users. Send details of your requirement for recommendation by Stackpole engineers.

ELECTRONIC COMPONENTS DIVISION
STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE



MOLDED JACKET IS

MOISTURE-RESISTANT

VAPOR-RESISTANT

AND INERT TO FILM!

FILMITE® "B"

DEPENDABLE BORO-CARBON RESISTORS ...IN ½, 1, AND 2 WATT RATINGS

Now for the first time you can obtain a superior yet relatively low cost film-type resistor for military electronic gear—resistors that not only meet the severe performance requirements of Military Specification MIL-R-10509A, but are capable of full wattage dissipation at 70°C ambient!

Sprague Type 4E, 5E, and 6E Filmite B resistors are housed in a dense molded jacket which not only provides unexcelled physical protection for the film resistance element but serves as a barrier to moisture and vapor, the twin enemies of all film-type resistors.

Boro-carbon films are unusually sensitive to moisture. Protection against moisture in any form is a primary requirement for successful long term stability of resistance. The low-loss phenolic housings on molded Filmite resistors not only shed water but are vapor resistant and inert to the film material. There is minimum possibility of field failure through electrolytic action and penetration of moisture or vapor through the dense molded jacket.

Other features of molded Filmite B resistors are special low-contact-resistance, low noise end terminations held rigidly in place on special ceramic cores, extremely low temperature and voltage coefficients of resistance, and excellent load-life and high frequency characteristics.

For complete engineering data, write for Engineering Bulletin No. 130 to:

SPRAGUE ELECTRIC COMPANY

233 Marshall Street, North Adams, Mass.

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS (INCHES) L	D	RESISTANCE (OHMS) Min.	Max.	VOLTAGE (Max.)
4E	½	¾	¼	100	1 Meg.	350
5E	1	1 1/16	3/8	100	2 Meg.	500
6E	2	2 3/16	3/8	200	10 Meg.	750

Standard Resistance Tolerances: 1 2 and 5%

SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

• NORTH ADAMS, MASSACHUSETTS

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

As We Go To Press...

COLOR TV TEMPO on RISE

While TV receiver manufacturers were busily occupied getting their production lines into shape for moderate colors runs (early announced models were close to custom built), the spotlight turned on TV broadcasters and their equipment needs. So far, about 30 big city stations are equipped to rebroadcast color programs fed by the networks. RCA is continuing to push production of color cameras and monitoring equipment.

General Electric has signed a patent license agreement with CBS, granting GE the right to manufacture and sell color TV apparatus developed by CBS. GE is converting standard black-and-white cameras to field-sequential color for $6,000 each. The Chromacoder, which translates field-sequential to compatible NTSC signals, and can be used with any number of cameras, will sell for about $40,000. Such changes are reported to exact a saving over three-tube cameras. Total studio conversion necessary to permit rebroadcast of network color shows, and origination of local color slide and film shows, is expected to cost $82,000.

In addition to a CBS order for GE to deliver four cameras before March 1, CBS has also placed a million dollar order with RCA, and the first two of 12 cameras are to be delivered in February, with the remainder shipped by June. The same type of RCA cameras have been ordered by WKY, WPAP, WBEN, WTMJ, WCCO and KTLA. RCA also reports that substantial progress is being made in the development of a single pick-up tube to do the job of the three tubes used in present cameras.

Single-tube color TV camera (l) made by GE under CBS license. Three-tube camera at right

All-glass 15-in. color picture tubes undergo beam current checks in life test racks at GE

CBS-Hytron is starting to step up production of its three-color tube, and is converting Newburyport, Mass., plant to color. GE and RCA are moving along with 15-inch planar shadow mask types. From several quarters, the need for larger sizes has been voiced. Along these lines, RCA's announcement of a 19-inch tricolor tube was warmly received, but they will not be available until the latter half of 1954. Secret of the big tube lies in the gradation of hole size in the shadow mask toward the edge of the screen, as well as an improved electron gun assembly and deflection system. RCA is also pressing forward in research work for a brighter 21-inch tube using a focus mask, instead of a shadow mask.

Color "clinics" are springing up all over the country, most of them sponsored by large manufacturers or broadcasters.

Airtronic Research engineer has developed a rotating disc color converter, which he believes can be marketed for $50 to $100. At best, it is an interim device. One of its main drawbacks is high flicker.

Experimental Atomic Battery Revealed

An experimental model of a new type of battery which converts atomic energy directly into electrical energy has been revealed by RCA. In it, a radiactive source is coupled to a semiconducting crystal. Technical description is given on page 85.

FCC Rejects Petition for Manufacturers Radio

The FCC has denied the petition of the Committee on Manufacturers Radio Use for a separate radio service and allocation of 4 mc now occupied by the citizen's radio service.

In effect, the ruling rejects the establishment of point-to-point systems by manufacturers on the same basis as other industrial services, such as power and petroleum. The Commission noted that the broader problem of the extent to which private microwave systems will be permitted is now under study.

Japan Cuts Television Imports

Prohibition of TV receiver import, except for experimental use, is planned for Japan. The move to conserve foreign currency by the Ministry of International Trade and Industry is accompanied by plans to encourage, through tax exemption, mass production of a popular 10-in. set for 50,000 yen (about 360 yen per dollar), which is half of the current price. Domestic industry will also be assisted by loans of 330 million yen, and research subsidies of 43 million yen. To date, some 14,000 foreign made TV sets have been imported.

BELL REPEATERS TESTED

Specialists at Bell Labs test interstage network to go into repeaters of first transatlantic telephone cable. Overall cable diameter is 1.25 in., and repeaters 1.5 in. It will take three years to complete, cost $35,000,000

MORE NEWS on page 16

As We Go To Press . . . *(Continued)*

Forerunner of automatic assembly machine for electronic components, punch press controlled by digital computer is extremely versatile. Quick set-ups facilitate small lot production jobs

Computer Controls Punch Press

A punch press based on digital servo control has been developed by General Electric under a project sponsored by the Signal Corps. An opaque vinyl sheet acts as the memory card, and the photoelectric reader directs the computer, which in turn causes the press to position the work automatically. No template is needed, and 30 holes can be punched in one minute. The device is not primarily intended for large mass production runs. Rather, its high flexibility and rapid set-up allow design changes without the cost and excessive time of making a new template, thus making it ideal for small lot jobs.

This device is part of a program to develop an Automatic Component Assembly System (ACAS). The first phase of ACAS, to be completed by mid-1954, will provide for automatic component placement on terminal boards, printed circuits, etc. The second phase, which should be ready by mid-1955, will perform automatic component preparation, such as bending leads and testing parts. At the present, electronic production techniques depend on manual handling of components.

PRINTED CIRCUIT TV SET TO BE PRODUCED

TV receiver (l) with printed circuit chassis. Note concealment of high voltage circuit. Remote control unit turns set on, adjusts volume, and changes channels. Fred Miller (r), Kaye-Halbert Chief Engineer, points to circuit etched on copper-phenolic plate

A mass produced all printed circuit chasis for receivers will soon be manufactured by the Kaye-Halbert Corp. of Culver City, Calif. The chassis has been divided into nine major sections. Each of these major sections is separately silk screened and etched on copper phenolic plates. These plates are then punched and proper components and tubes are placed in them. The entire plate is then dip-soldered. When all nine printed circuit sections have been sub-assembled and dip-soldered they can be snapped into a large phenolic frame which acts as the chassis holder. The sections are then connected with each other through a few conventional wire attachments. Ease of servicing is said to be improved. The new chassis will contain 27 tubes instead of the 23 now operating in current chassis.

FCC Proposes Licensing Fees

The FCC has proposed a schedule of fees to cover the cost of licensing and similar activities. All fees collected would be turned over to the U.S. Treasury. Comments will be received on or before April 1, 1954. The contemplated fees include:

Major broadcast applications	$ 325
Minor broadcast applications	50
Safety and Special Radio Services applications	10
Except Amateur, Disaster and Radio Amateur Civil Emergency Services applications	3
Experimental services applications	20
Type acceptance of equipment applications	100
Type approval of equipment applications filed under Part 18 of the rules	600
Applications for type approval covered by Parts 3, 8 or 19 of the rules	1,500
Commercial operator license applications (all)	3
Restricted radiotelephone operator permit applications	3
Compulsory ship inspection applications	30
Applications for telephone acquisitions, consolidations, etc.	350
Applications for construction or extension of telephone lines	150
Applications by common carriers for exemptions from Commission jurisdiction under Title II	150
All other common carrier applications (except those covered in fees for the Safety and Special Radio Services)	30

Engineers Study Upper Atmosphere

There are no April showers and no snow falls but there are definite seasonal trends where unceasing winds of super-gale force sweep far above the surface of the earth. Wind velocities as high as 175 miles per hour and temperatures of 80° F below zero have been recorded in the upper atmosphere by Signal Corps meteorological engineers at Fort Monmouth, N. J.

Weather balloons carrying equipment which collects and transmits information back to earth climbed to an altitude of 27 miles while the research was carried on by scientists at Evans Signal Laboratory, near Belmar, N.J. The laboratory is a few miles from the Atlantic shore.

MORE NEWS on page 18

As We Go to Press . . . .

"Tinkertoy" TV Set

The modular design of electronic components, developed in "Project Tinkertoy" (Nov. 1953 TELE-TECH & ELECTRONIC INDUSTRIES, page 70), is being applied to semi-automatic production facilities for

Replacing "rat's nest" wiring with compact modular component sections gives TV new look

radio and TV, as well as military equipment. Sanders Associates of Nashua, N.H., has come up with a TV receiver using these modules under the trade name "Reliacubes."

CAA Approves Selective Calling Equipment

The CAA has approved a newly developed tone-coded selective signaling system developed by Motorola. It is reportedly the first of its type to receive such certification. The system, known as airborne "Quik-Call," relieves pilots and radio operators of the fatiguing task of listening to all ground-to-air

Selective calling equipment for aircraft is demonstrated by Motorola V-P Daniel E. Noble

radio transmissions. Instead, any selected craft equipped with a decoder for each channel to be monitored may be alerted that a call is intended by means of a light or bell actuated by the code.

COMING EVENTS

Mar. 15-19—NACE Tenth Annual Conference and Exhibition, Kansas City.

March 22-25—IRE National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

March 30-April 8—62nd Royal Netherlands International Industries Fair, Utrecht, Holland

April 2-3—Biennial Rice Exposition of Engineering Science and Arts, The Rice Institute, Houston, Texas.

April 5-8—A.M.A. 23rd National Packaging Exposition, Convention Hall, Atlantic City, N.J.

April 5-10—International Congress Soundtrack Recording, Paris, France.

April 15-16—RETMA Engineering Department Conference on Reliability of Electrical Connectors. Illinois Institute of Technology, Chicago, Ill.

April 19-20—Symposium on Automatic Production of Electronic Equipment, sponsored by Stanford Research Institute and U.S. Air Force, Fairmont Hotel, San Francisco, Calif.

April 22-23—AIEE Conference on Feedback Control, Claridge Hotel, Atlantic City, N.J.

April 22-23—Joint Meeting of Radio Technical Commission for Aeronautics, Franklin Inst. Labs., and IRE Professional Group on Aeronautical and Navigational Electronics. Franklin Institute, Philadelphia, Pa.

April 22-28—RTCM Spring Assembly Meeting, St. Francis Hotel, San Francisco., Calif.

April 26-29—1954 Metal Powder Show. Sponsored by Metal Powder Association, Drake Hotel, Chicago, Ill.

April 24—Eighth Annual TV Conference, IRE Cincinnati Section. Cincinnati, Ohio.

April 26-30—Tenth Biennial ASTE Industrial Exposition, Philadelphia Convention Center, Phila., Pa.

April 27-29—AIEE Electronic Components Conference, Washington, D.C.

May 3-6—URSI, U.S.A. National Committee and IRE Professional Group on Antennas and Propogation. Joint Spring Technical Meeting. National Bureau of Standards, Washington, D.C.

May 4-6—1954 Electronics Components Symposium, RETMA and others, U.S. Department of Interior Auditorium, Washington, D.C.

May 4-7—1954 AWS National Spring Technical Meeting, Hotel Statler, Buffalo, N.Y.

May 4-9—SMPTE 75th Annual Meeting, Statler Hotel, Washington, D.C.

May 5-7—Third International Aviation Trade Show, 71st Regiment Armory, New York, N.Y.

May 5-7—IRE Seventh Region Conference and Electronic Exhibit, Multnomah Hotel, Portland, Ore.

May 5-7—AIEE Northeastern District Meeting, Schenectady, N.Y.

May 5-8—1954 Welding and Allied Industry Exposition, Memorial Auditorium, Buffalo, N.Y.

May 7-8—IRE North Atlantic Region, New England Radio Engineering Meeting, Sheraton Plaza Hotel, Boston, Mass.

May 7-9—AFCA National Convention, Shoreham Hotel, Washington, D.C.

May 10-12—IRE National Conference on Airborne Electronics, Dayton Biltmore Hotel, Dayton, Ohio

May 17-20—Basic Materials Exposition, International Amphitheatre, Chicago.

May 17-20—1954 Electronic Parts Show Conrad Hilton Hotel, Chicago, Ill.

May 17-20—New York Import Show, 34th St. Armory, New York, N.Y.

May 24-26—IRE, AIEE, IAS, ISA 1954 National Telemetering Conference, Hotel Morrison, Chicago, Ill.

May 25-27—NARTB Convention Engineering Conference, Palmer House, Chicago, Ill.

June 13-18—ASTM Annual Meeting, 11th Exhibit of Testing and Scientific Apparatus and Laboratory Supplies and Ninth Technical Photographic Exhibit, Sherman and Morrison Hotels, Chicago, Ill.

June 15-17—RETMA Convention, Palmer House, Chicago, Ill.

June 16-18—High Vacuum Symposium, Berkely Carteret Hotel, Asbury Park, N.J.

June 21-25—AIEE Summer General and Pacific Meeting, Hotel Biltmore, Los Angeles, Calif.

July 6-9—International Conference on Electron Microscopy, Joint Commission on Electron Microscopy of International Council of Scientific Unions, London, England

July 8-12—Convention British Institution of Radio Engineers, Christ Church, Oxford, England.

July 13-15—Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 25-27—Western Electronic Show and Convention. Los Angeles and San Francisco IRE sections and WCEMA sponsored. (Show) Pan-Pacific Auditorium, Los Angeles. (Convention Hq.) Ambassador Hotel, Los Angeles, Calif.

September—First International Scientific Radio Union, Amsterdam, Holland.

Sept. 1-16—Golden Jubilee Meeting of the International Electrotechnical Commission, University of Pennsylvania, Philadelphia, Pa.

Sept. 15-21—ISA First International Instrument Exposition, Convention Hall, Philadelphia, Pa.

Sept. 30-Oct. 2—High Fidelity Show, International Sight and Sound Exposition, Inc., Palmer House, Chicago.

ACM: Assoc. for Computing Machines.
AFCA: Armed Forces Communications Assoc.
AIEE: American Institute of Electrical Engineers.
AMA: American Management Association.
ASTE: American Society of Tool Engineers.
ASTM: American Society for Testing Materials.
AWS: American Welding Society.
IAS: Institute of Aeronautical Science.
IRE: Institute of Radio Engineers.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
SMPTE Soc. of Motion Picture and TV Engineering.
URSI: International Scientific Radio Union.
WCEMA: West Coast Electronics Manufacturer's Association
WESCON: Western Electronics Show & Convention.

TELE-TIPS on page 38

BOLTING VOICES TOGETHER

Adjusting casing over splice in polyethylene cable. Edges and ends are sealed with a new Butyl rubber compound that won't harden, dry out or lose adhesion even in extreme heat or cold.

More than ever, light, flexible polyethylene sheathed cable developed by Bell Telephone Laboratories is providing speedy answers to the demand for more telephone service.

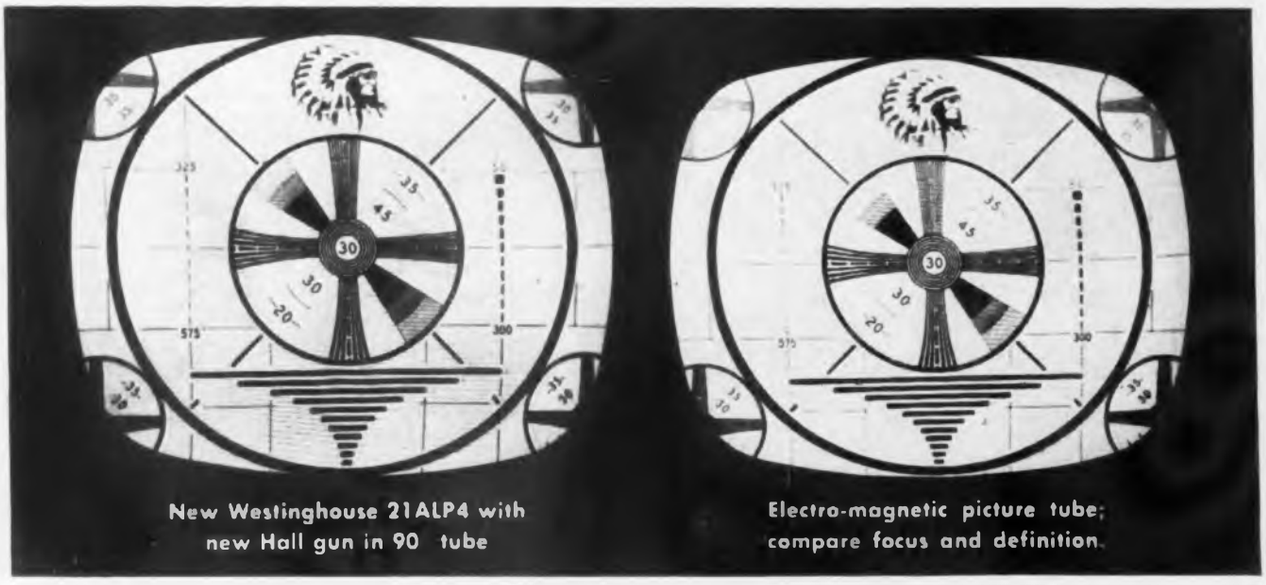
But at thousands of splices, the sheath must be thoroughly sealed against moisture. Laboratories engineers developed a protective casing which is quickly and simply bolted in place. The edges and ends of the casing are *permanently* sealed with a new compound developed by Laboratories rubber chemists.

Now, economical polyethylene cable can be installed much faster and at lower cost. Here is another example of how Bell Laboratories continually finds ways to keep telephone service high in quality, while the cost stays low.

CLOSED CASING IN PLACE

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE



New Westinghouse 21ALP4 with new Hall gun in 90° tube

Electro-magnetic picture tube; compare focus and definition.

BETTER FOCUS

than any other 21" picture tubes

Set manufacturers recognize the inherent advantages of electrostatic picture tubes since they offer lower weight, use fewer components, and sets have lower assembly costs; yet, until now, picture quality was not as good as when electro-magnetic picture tubes were used.

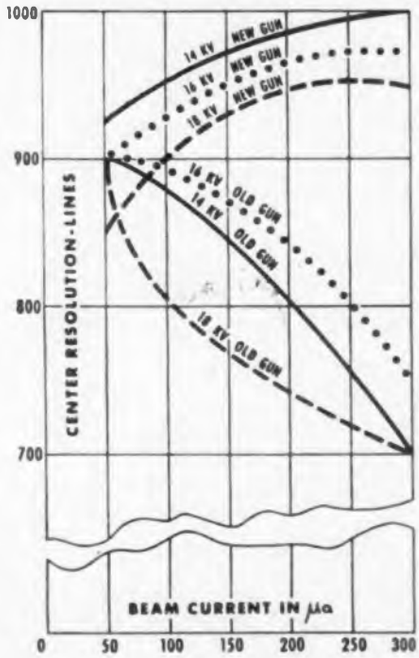
Now Westinghouse offers the 21ALP4 and the 21ALP4A; these 90° deflection electrostatic tubes offer pictures with better focus and higher definition than their electromagnetic counterparts. In the unretouched pictures above, notice the better corner resolution, higher definition, and better contrast in the electrostatic tube. Photographs were made under identical conditions with voltages as follows: $E_{B2} = 16$ kv; $E_{G2} = 300$ v; $E_F = 6.3$ v.

New Westinghouse 90° picture tubes have an added 13 square inches of picture area, a better aspect ratio, are 3" shorter which allows shorter cabinets or elimination of the hat.

These tubes offer good focus at voltages from 10 to 18 kv without distortion, less shift in focus voltage as beam current varies, and better fringe area reception. They are more stable under conditions where voltage variations are encountered due to home-current variations or to variations in components. These tubes are interchangeable in different receiver circuits due to their inherent stability.

Westinghouse invites your tests! Qualified set manufacturers are requested to write or call for sample tubes which may be tested in their own laboratories as desired. Call your nearest Westinghouse Electronic Tube Sales Office, or write to Dept. B-2034 at the address below.

These tubes offer set manufacturers clear, easily defined sales advantages. Check now for further information.



This chart illustrates the ability of the new Hall gun to maintain sharp definition despite changes in beam current — relating center resolution to beam current over a range of anode voltages.

ET-95052A

YOU CAN BE SURE... IF IT'S Westinghouse

RELIATRON® TUBES

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

KELLOGG SWITCHBOARD

Air Associates

Motorola

GENERAL ELECTRIC

WILCOX ELECTRIC COMPANY

HUGHES

UNION PACIFIC RAILROAD

Bendix AVIATION CORPORATION

SANGAMO ELECTRIC COMPANY

CROSLEY

Western Electric

Westinghouse

MELPAR, INC.

RADIO CORPORATION of AMERICA

...and many more!

C-A-C MOLDED TOROIDS

Stocked in Standard Inductances for immediate delivery...

With the new molded toroid simplifying mounting problems and with the resultant demand increasing daily, C-A-C now offers an added convenience to buyers by stocking standard types for immediate delivery.

Write for file of complete specifications and listing of stocked inductances. C-A-C molded toroids meet the performance requirements of Military specifications.

Why is it?...

From a modest beginning five years ago, Communication Accessories Company has grown to one of the largest exclusive toroid coil winding producers in the U. S. today. Why?

We like to think that this growth is due to the thorough, careful handling we apply to each coil . . . and because of the particular skill of our people. Whatever the reason, we'll continue — doing the best we know how — thankful for the trust that important companies have placed in us.

write for this catalog ⟶

COMMUNICATION ACCESSORIES Company

HICKMAN MILLS, MISSOURI

KWWL-TV

KFBB-TV

the Du Mont

WNAM-TV

KMMT-TV

WNOW-TV

KDSH-TV

WABD

WNEM-TV

WGEM-TV

Multiplier phototubes are employed as pick-ups. Tube designed by Du Mont, provides extreme stability, long life and high signal-to-noise ratio. Cost of tube $55. Tube has practically infinite life, barring breakage.

Signal amplifiers are flat within 8 mc, permitting full amplification of color signals. Circuitry as simple as that encountered in audio equipment. All plug-in units, completely accessible.

Light source is a special cathode-ray tube designed and built only by Du Mont. Face plate is optically corrected, of medium density and is non-browning. Tube is operated at 45,000 volts on accelerating ring.

KFBB-TV

...Surpassing all

for film pick-up

Finest reproduction of 16mm films—either new or old. Film moves through carrier silently, smoothly, minimizing chances of film breakage and wear.

opaque pick-up

Automatic carriers provide for 4" x 5" glossy or matte finish prints. Dual unit permits one carrier to be loaded while other is used in pickup.

2x2 glass slides

Automatic slide changer carries standard 2" x 2" glass slides. Dual pickup feature permits blending, or simultaneous pickup of two signals at once when operating from film, slides or opaques.

KWWL-TV

KOOL-TV

MULTI-SCANNER

The advanced method of film, opaque or slide pickup—**ready now!**—ready **for you** to use in your television broadcasting operations today!

The Du Mont Multi-Scanner offers a far more simple, more reliable and better method of electronic reproduction than ever available before. Film reproduction assumes studio pickup quality with all the original gray tones and elimination of edge flare inherent in other film pickup systems. The same true pickup is attained when the Multi-Scanner is used on slides or opaques.

Performance is only one of the many outstanding advantages of the Multi-Scanner. Simplicity of operation is such that the system is practically automatic. Thread the film in place, try it out if you wish, reverse the mechanism and you're ready to put the system in operation from a **remote** control panel.

Truly, the Du Mont Multi-Scanner has no equal —it is the modern pickup system — ready for you **today.**

The complete Multi-Scanner incorporating film, opaque and slide pickup equipment.

OPERATION: No shading adjustments necessary. Picture free from edge flare and shading. Completely automatic operation from a remote panel.

DEPENDABILITY: Simple mechanism carries film at continuous, smooth rate of travel. No tearing, wearing stop and go action.

PERFORMANCE: Gamma-corrected signals from Multi-Scanner brings out all gray tones of film, opaque or slides.

VERSATILITY: Reversing feature permits "dry runs" by operator immediately before going on air, without necessity of complete rewinding of film.

SHRINKAGE COMPENSATOR: Film shrinkage compensator permits complete control of allowances for shrinkage. Pictures frame right with the Multi-Scanner, whether new or old film.

COLOR: The Multi-Scanner is the only film system presently available that may be easily and quickly converted to color pickup.

Expectations!

Production of Multi-Scanner units is now going ahead at full speed to meet the ever-increasing orders for this system of tomorrow, today.

DU MONT®

ALLEN B. DU MONT LABORATORIES, INC. • TELEVISION TRANSMITTER DEPARTMENT • CLIFTON, N. J.

RPC Type J resistors where subminiature requirements specify full size reliability and performance

Precision Wire Wound

Type JA 1/4" diameter X 1/4" long. Maximum resistance 125,000 ohms. 0.10 watt.
Type JC 1/4" diameter X 3/8" long. Maximum resistance 250,000 ohms. 0.15 watt.
Tolerance 1% standard, tolerances to 0.05% available. All resistors furnished with low temperature coefficient alloys.
Special wire and impregnation available for greatly increased power rating.

rpc

RESISTANCE PRODUCTS CO.

714 Race Street · Harrisburg, Pa.

FOR BETTER PERFORMANCE SYLVANIA OFFERS NEW MICROWAVE MIXER CRYSTALS

Sylvania announces the addition of a series of new Microwave Mixer Crystals to the world's foremost line.

These new crystals bring simplicity and dependability to many specialized circuit designs. Matched pairs such as the 1N23B and the 1N155 are specially balanced for low-noise operation.

Sylvania also offers Silicon Video Detector Crystals for use as microwave detectors in receivers of the non-heterodyne type. Other quality Sylvania products, engineered for radar and SHF receivers, include Magnetrons, TR Tubes, ATR Tubes, Hydrogen Thyratrons, and Beacon Reference Cavities.

The unbeatable performance of all Sylvania Crystals, Tubes and other components is the direct result of Sylvania's longer experience and continuing advance in the field of electronic research . . . another reason why it pays to specify SYLVANIA!

SYLVANIA SILICON MIXER CRYSTALS		
Type	**Description**	**Approx. Freq.**
1N21B	S-Band Crystal	3,000 mc.
1N21C	S-Band Crystal	3,000 mc.
1N157	1N21B Reversed Polarity	3,000 mc.
1N23B	X-Band Crystal	10,000 mc.
1N23BM	1N23B Matched Pair	10,000 mc.
1N155	1N23B Reversed Polarity	10,000 mc.
1N156	1N23B matched with 1N155	10,000 mc.
1N23C	X-Band Crystal	10,000 mc.
1N155A	1N23C Reversed Polarity	10,000 mc.
1N23CMR	1N23C matched with 1N155A	10,000 mc.
1N25	L-Band Crystal	1,000 mc.
1N26	K-Band Crystal	24,000 mc.
1N78	K_u-Band Crystal	16,000 mc.
1N53	Classified. Information available upon proper clearance	
1N53M	Classified. Information available upon proper clearance	

Mail the coupon for this booklet describing the complete line of Sylvania Microwave Crystal Rectifiers.

SYLVANIA

Sylvania Electric Products Inc. 1740 Broadway, New York 19, N. Y.

in Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine St., Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

Sylvania Electric Products Inc.
Dept. 4E-4403, 1740 Broadway
New York 19, N. Y.

Please send me new illustrated booklet describing Sylvania's Microwave Crystal Rectifiers.

Name_____

Company_____

Street_____

City_____ Zone____ State____

Series SM-20.....Sub-Miniature Rectangular Connectors
Series 20.....Miniature Rectangular Connectors
Series H-20 .....Hermetical Seal Miniature Rectangular Connectors
Series C-20.....Miniature Hexagonal Connectors (Vibration Proof)
Series EZ-16.....Easy Release Power Connectors (Spring Loaded contacts)
Series 16.....Rectangular Power Connectors
Series 14.....Rectangular Power Connectors
Series PC.....Printed Circuit Connectors
Miniature Precision Stand-offs
SPECIAL DESIGNS – submit your connector problems to our engineering department.

Continental Connectors

ELECTRONIC SALES DIVISION DeJUR-AMSCO CORPORATION

Write Dept. TC-3, DeJur-Amsco Corporation
45-01 Northern Blvd., Long Island City 1, N. Y.

See the DeJUR line at Booth 200, "Production Road," Radio Engineering Show, Mar. 22-25

Here is amazing

MANEUVERABILITY

never before achieved!

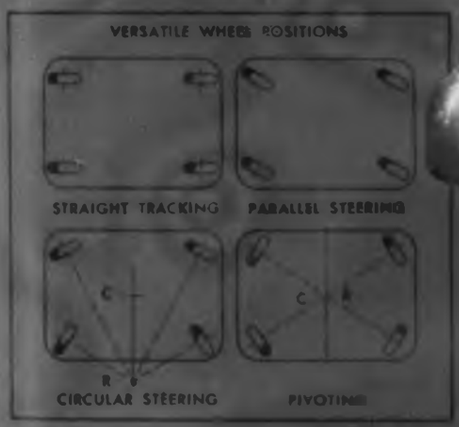
NEW!

for Film and TV Cameras

HOUSTON-FEARLESS CINEMOBILE

NEW! CIRCULAR STEERING

Entirely new steering mechanism makes possible easy, smooth, sharp turning on own axis or in any desired arc. Wheels can also be locked parallel for straight tracking in any direction.



NEW! HYDRAULIC BOOM LIFT

Camera boom is raised and lowered smoothly, quietly, effortlessly, automatically by hydraulic system. Extreme high and low lens heights are readily achieved even when dolly is in motion.

NEW! MANEUVERABILITY

The extreme flexibility of the steering mechanism makes possible fast positioning in small, crowded studios.

NEW! HANDLING EASE

Weighs only 500 pounds. Cameramen and grips appreciate easy dollying, turning, raising and lowering boom.

NEW! LOW SLUNG CHASSIS

Cinemobile is built low down for better balance, greater stability and smoother rolling.

NEW! VERSATILITY

Makes possible a wide range of camera effects formerly achieved only with larger, heavier equipment. Priced to fit the budget of smaller studios.

SEND FOR FULL INFORMATION NOW!

The **HOUSTON FEARLESS** *Corporation*

THE HOUSTON-FEARLESS CORPORATION
11805 W. Olympic Blvd. • Los Angeles 64, California

Send information on ☐ Cinemobile ☐ Film Processors ☐ All Metal Tripod
☐ Panoram Dolly ☐ Camera Crane ☐ TV Pedestal

Name _____

Firm _____

Address _____

City _____ Zone ____ State _____

"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE PROCESSING EQUIPMENT"

5 NEW

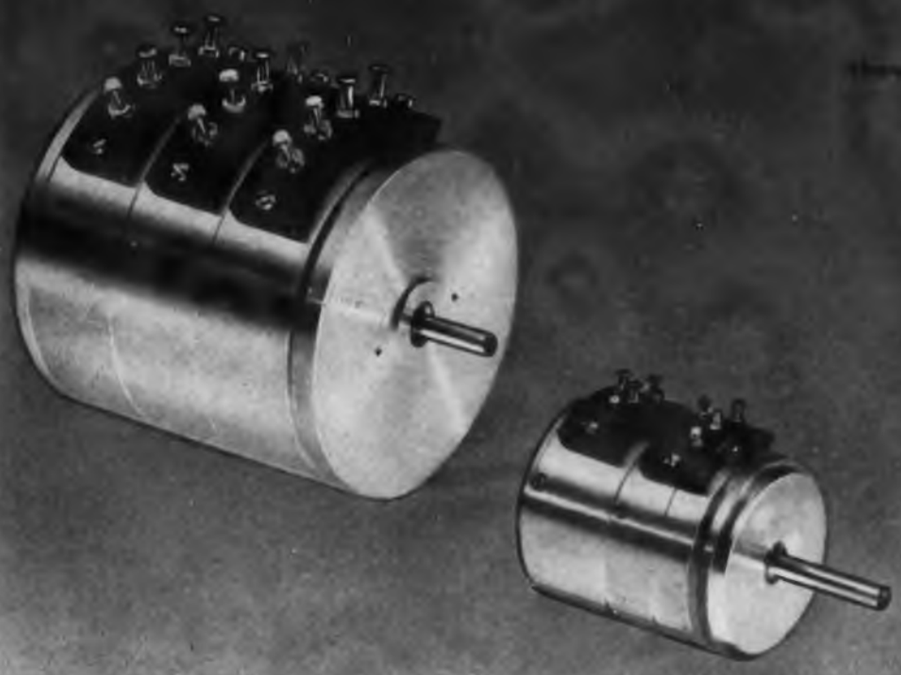
5 More reasons why FAIRCHILD can meet

TYPE 753 – Sine-cosine potentiometer – Full sine-cosine function without mechanical cams and linkages – can be ganged up to 6 cups. 20,000 ohms per quadrant; linearity, ±0.5% peak-to-peak; 3" diameter, 1¼" long from front of servo flange to rear of cup. Also available as straight sine function.

TYPE 745 – 10-turn helical potentiometer – Meets rigid government requirements for humidity, salt spray, altitude, temperature, vibration, shock, sand, dust and fungus resistance. High electrical accuracy (linearity ±0.025%); resistance range 100 to 300,000 ohms. 2" diameter, 2$\frac{3}{32}$" long from front of servo flange to end of case. Mechanical and electrical rotation, 3600° (+2° −0°).

See the complete Fairchild line of pots at the IRE Show, Booth 648, Radio Road and Circuits Avenue.

TYPE 771 – The FilmPot, metallic film potentiometer – Infinite resolution, high temperature operation (225°C). High wattage dissipation and exceedingly wide resistance range (100 to 200,000 ohms). Only ¾" in diameter and ½" long. Resistance element is precious metal deposited on an inorganic base. Available with servo flange or threaded bushing mounting.



POTENTIOMETERS

all your precision potentiometer needs

TYPE 754—2" linear potentiometer—Resistance range from 800 ohms to 100,000 ohms. High linearity (±0.15% standard). Internal clamp rings permit ganging up to 8 cups on single shaft without increasing over-all diameter. AIA standard 2" servo mount. Depth is 1" with .594" added for each cup section ganged. Gold-plated terminals are easier to solder and have better resistance to corrosion.

TYPE 741—1⅛" linear potentiometer—Internal clamp rings permit ganging up to 5 cups on a single shaft without increasing the over-all diameter. Resistance range 500 to 25,000 ohms; linearity ±0.5% standard. Electrical angle 350°. Only 1⅛" in diameter and ⅞" long; starting torque is 0.25 oz.-in. The simplified slip ring construction and a one-piece paliney wiper give longer life and lower noise.

● ***Available immediately in sample quantities.*** Look to Fairchild for assistance in solving all your precision potentiometer problems. Fairchild has, or can make, a potentiometer to fit any requirement. For information write: *Fairchild Camera & Instrument Corp., Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-45E.*

FAIRCHILD

PRECISION POTENTIOMETERS

The old Roman god Janus lives today in servo mechanisms, instruments, and controls which take past information and use it to guide the future —much as Janus faced backward and forward in time, to symbolize past and future.

time in your hands

Controlled, predictable flight depends upon data concerning the immediate past of a flight, as well as navigational information for the course ahead. Time is literally in your hands with Kollsman products.

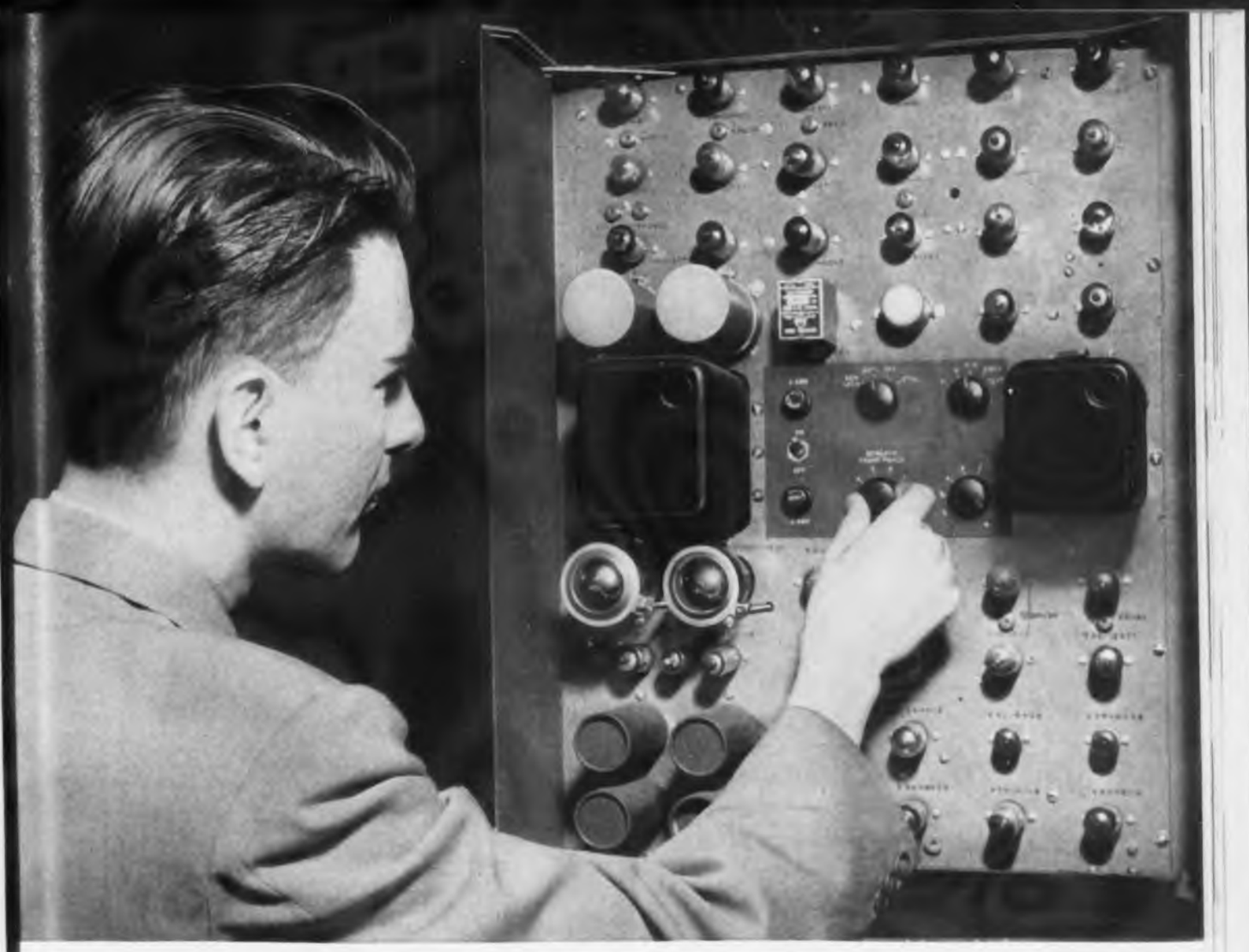
Today our activities encompass four fields:

AIRCRAFT INSTRUMENTS AND CONTROLS
OPTICAL PARTS AND DEVICES
MINIATURE AC MOTORS
RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT

Our manufacturing and research facilities . . . our skills and talents, are available to those seeking solutions to instrumentation and control problems.

kollsman INSTRUMENT CORP.

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA • SUBSIDIARY OF *Standard* COIL PRODUCTS CO. INC.



New RCA single-unit Sync Generator takes less than one-third the rack space needed by other sync systems

Smallest, finest Studio Sync Generator ever built!

RCA *Type TG-2A*

COMPLETELY NEW THROUGHOUT—and incorporating a revolutionary new multivibrator circuit—Type TG-2A is, we believe, the *ultimate in synchronizing generators.* It combines all synchronizing functions into a single chassis (includes a Genlock, a Dot Generator, a grating generator, and a regulated power supply). It takes only 21 inches of rack space (one-third that required by other sync generators)—is so compact you can easily install two of these units (one a stand-by) and an RCA changeover Switch MI-26289 in a single rack. It uses fewer tubes than other sync generators (38 miniatures, 2 rectifiers). And, of course, the TG-2A can be operated in conjunction with a Color Frequency Standard.

RCA Type TG-2A's are now available for all TV stations—VHF and UHF. For technical details and delivery information, talk to your RCA Broadcast Sales Representative.

Only RCA's TG-2A has these features

- In a SINGLE standard chassis it includes: —a synchronizing generator, Genlock, dot generator, grating generator, regulated power supply
- Entire unit takes only 21 inches of rack space
- Only 4 operating controls
- Adjustable pulse output voltages
- Pulse outputs have sending end-terminations
- Adjustable "front porch" width
- Operates with Color Frequency Standard
- Can be remotely-switched to Genlock operation
- Provides Dot Convergence Pattern
- Fewest tubes of any sync generator (38 miniatures, 2 rectifiers)
- Test jacks for circuit checking
- Pulse widths and delays STABILIZED against tube aging
- Choice of 5 ways to control basic frequencies
- Characteristics more than meet FCC and RETMA standards

RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT CAMDEN, N.J.

1954

The Invention of Compression-Type Seals is about as Old as Grandma's Phonograph—

but Constantin's Production Facilities and Methods are as New as Tomorrow

UNITED STATES PATENT OFFICE.

COMPRESSION TYPE SEAL.

1,184,813. Patented May 30, 1916.

The invention of compression-type seals in general is quite old as evidenced by U. S. Letters Patent No. 1,184,813, issued to Wilfred T. Birdsall and assigned to the Westinghouse Electric and Manufacturing Co. on May 30, 1916, for the original compression-type seals, expired in 1933. It is now public domain.

Yes, the idea of high compression glass to metal seals is thirty-seven years old and public domain. The compression principle can be employed by anyone, but Constantin makes the *quality* seal.

The wise buyer now is concentrating on quality of manufacture and materials. For over eight years L. L. Constantin & Company has been operating the most modern machine shop facilities for die construction, stampings, and bending —a glass department capable of compounding, tableting and sintering—latest ovens for fusing—multi-slide machines for pin fabrication. In this way, our completely self-contained plant operating all under one roof, can produce true compression seals of highest quality, in addition to our regular line of hard glass to KOVAR and RODAR alloy seals.

We at Constantin realize that adding color to the already pure white glass does not add to the strength, and for identification purposes, whether you buy green, gray, blue, brown or other colors, you will find Constantin seals to be consistently uniform and superior in strength.

Constantin can proudly say that it is not selling an idea. Constantin is selling precision engineered high compression glass-to-metal vacuum seals. See them, test them, and compare.

Seals also available in KOVAR and RODAR alloys to hard glass types.

Also manufacturers of—
MULTI-PIN HEADERS
TERMINALS
TRANSISTOR MOUNTS
MULTI-PIN CON PLUGS
END SEALS
CRYSTAL HOLDERS
VACUUM COATING EQUIPMENT

L. L. Constantin & Co.

MANUFACTURING ENGINEERS

Rt. 46 and Franklin Ave., Lodi, N. J.

See us at the I.R.E. Show—Booths 672, 674, Circuits Avenue

designed for present requirement of 440′ and for extension—when needed—to 600′

When WICC-TV in Bridgeport, Connecticut, erected their tower, they went high enough to meet their present need—but also had an eye for the future.

So any time they need greater height for increased coverage, another 160 feet can be added to their present tower height of 440 feet. For the Blaw-Knox Type TG tower purchased by WICC was originally designed for extension to 600 feet—with a third set of guys to be installed at that time.

This is typical of how Blaw-Knox Towers are designed and constructed to meet specific customer requirements—based on some forty years experience in designing and building towers. Blaw-Knox Type TG towers, for example, are designed to support TV and FM antennas—available in standard heights up to 1000 feet and in special designs for higher structures. All have such features as

- pivoted or articulated base to avoid excessive bending stresses
- structural angle bracing (with no adjustable members) in a "tension and compression" system to provide extra strong rigid construction
- guys, with all connections permanently attached, factory pre-stressed and proof tested to load greater than ever required in service
- invar rule to insure accurate and simple tensioning of guys
- convenient support for transmission lines
- hot-dip galvanized to protect against all weather conditions

For more complete information on all types of Blaw-Knox Antenna Towers just write or phone to get your copy of Bulletin No. 2417. Or send us your inquiry for prompt service, specifying height of tower and type of antenna.

BLAW-KNOX COMPANY, PITTSBURGH 38, PENNSYLVANIA

BLAW-KNOX EQUIPMENT DIVISION • TOWER DEPARTMENT

BLAW-KNOX

ANTENNA TOWERS

Guyed and self-supporting types—for AM • FM • TV • microwave • communications • radar

Distributed by GraybaR

← INVAR RULE

Invar measuring rule is used to determine correct initial tension in the factory pre-stressed guys. Erectors use the rule when putting up the tower and can easily duplicate correct tension determined in the factory tests—thereby eliminating any guess work in the field erection.

GUY PIER →

glass-to-metal seals

A complete range of sizes and designs of terminals, lead-ins and stand-offs for hermetic sealing is offered by Stupakoff. Made with Kovar metal, the ideal alloy for sealing to hard glass, Stupakoff Seals are durable and dependable. These are not mechanical compression seals, but are permanently fused by chemical interaction. They may be installed by conventional assembly techniques.

Write for a copy of the new Stupakoff Catalog 453, giving details of over a thousand sizes and styles of Stupakoff Seals.

STUPAKOFF CERAMIC & MANUFACTURING COMPANY

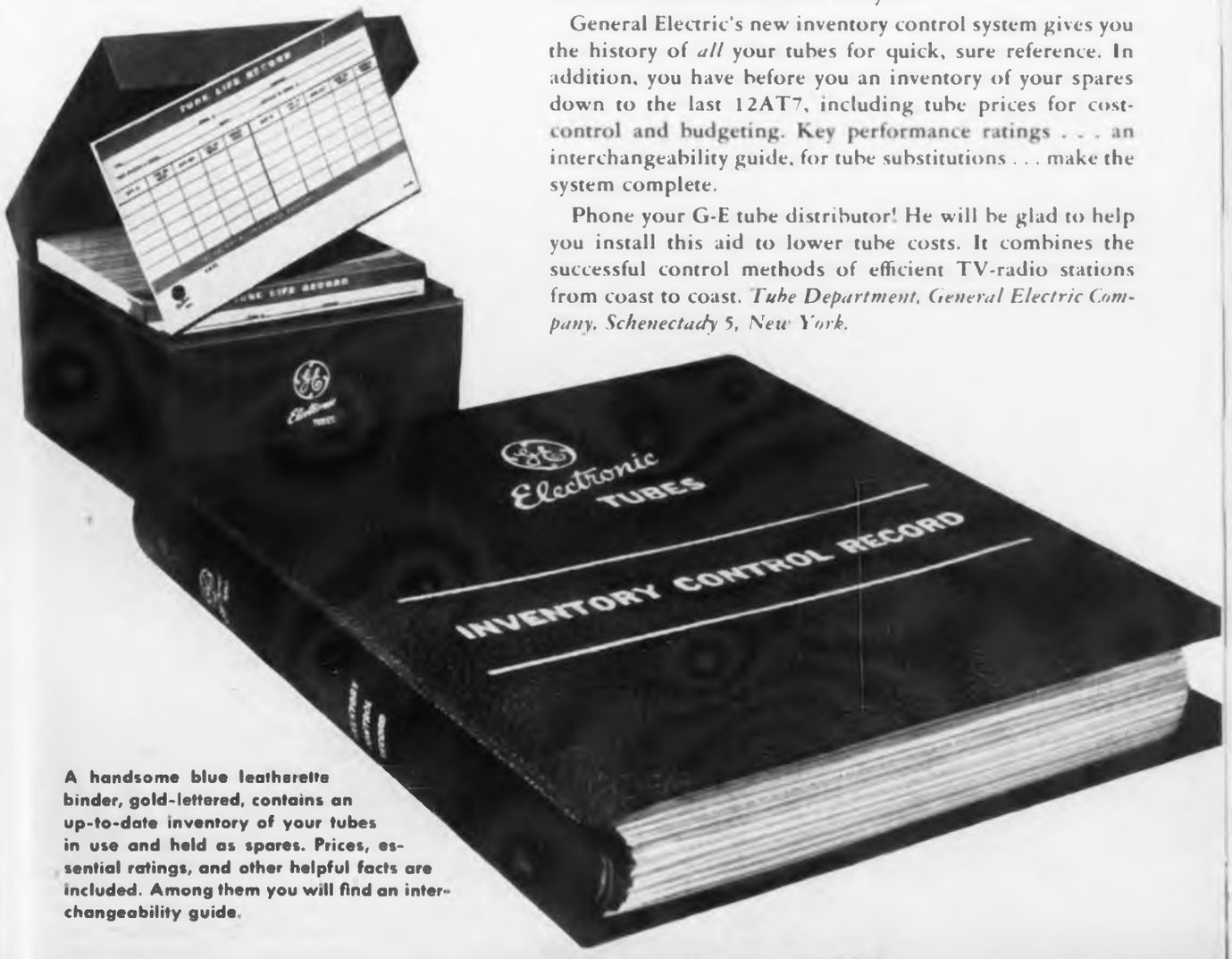
LATROBE, PENNSYLVANIA

TV-RADIO BROADCAST ENGINEERS!

Cut tube cost-per-hour with G.E.'s NEW complete . . .

TUBE INVENTORY CONTROL SYSTEM

A metal box holds your file of tube life cards. These show performance by type and location, from the time a tube is installed until replacement is made. You have an accurate check on operating life which helps you obtain more service hours per tube.



A handsome blue leatherette binder, gold-lettered, contains an up-to-date inventory of your tubes in use and held as spares. Prices, essential ratings, and other helpful facts are included. Among them you will find an interchangeability guide.

Ask your G-E tube distributor for details!

● In order to reduce tube replacement expense, you must have the full performance record of every tube in your equipment. A failure by any tube—power, rectifier, or other type—to meet life expectancy will then show up clearly. Conversely, those types which are giving better-than-average service will establish their value and economy.

General Electric's new inventory control system gives you the history of *all* your tubes for quick, sure reference. In addition, you have before you an inventory of your spares down to the last 12AT7, including tube prices for cost-control and budgeting. Key performance ratings . . . an interchangeability guide, for tube substitutions . . . make the system complete.

Phone your G-E tube distributor! He will be glad to help you install this aid to lower tube costs. It combines the successful control methods of efficient TV-radio stations from coast to coast. *Tube Department, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

TELE-TIPS

STEP DOWN! New York City Police Department is installing an industrial-type TV system to telecast the daily line-up of assorted criminals to various detective headquarters around the city. Previously, only a few representative detectives had the opportunity to witness the line-up, and become acquainted with local hoodlums. Through TV and microwaves, the criminal mugs will eventually be studied simultaneously in all city precincts.

SCIENTISTS PREFER BLONDES, report researchers at Minneapolis-Honeywell. At least they do when they are evaluating the best type of hair to be used as reacting element in humidity measuring devices. Swedish blonde hair comes out on top. Brunettes and redheads qualify no better than pig bristles or horse hair.

$90,000 FOR THE TAKING—The Educational TV Grant established by Emerson in June 1952, which offers $10,000 to each of the first ten non-commercial stations to start broadcasting with a permanent FCC license, has had only one taker so far—KUHT-TV, Univ. of Houston, Texas. KTHE-TV, Los Angeles, operating under special temporary authorization, also will soon be eligible. Since the grant was established, over 250 new commercial stations have gone on the air.

BY END OF 1954, there will be between 25 and 30 non-commercial TV stations programming regularly, according to estimates by the National Citizens Committee for Educational TV.

WATCH THOSE RATINGS! For the benefit of the uninitiated (and some who should know better), when you buy a piece of equipment, make sure all conditions are specified. As elementary as this may seem, a fellow engineer recently bought a 20-watt audio amplifier rated flat ±0.2 db from 20 to 20,000 cps. Manufacturer neglected to mention that response would be flat only if output were kept under 1 watt. Same applies for intermodulation distortion (power and frequencies should be specified) and other characteristics.

(*Continued on page* 46)

TUNG-SOL ALSO MAKES ALL-GLASS SEALED BEAM LAMPS, MINIATURE LAMPS AND SIGNAL FLASHERS.

TUNG-SOL 50 YEARS ACHIEVEMENT

TUNG-SOL®

TUNG-SOL ELECTRIC INC., Newark 4, New Jersey
Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle.

PROVEN PERFORMANCE with *Federal* TV at KSWS-TV...

A FEDERAL VHF INSTALLATION

KSWS-TV (Channel 8) Roswell, New Mexico . . . on the air since June, 1953 . . . in the rich and rugged Southwest area . . . has been achieving new, high standards of coverage and picture quality with its *all*-Federal VHF installation. Executives of KSWS-TV report "excellent reception from 100 to 186 air-line miles from the transmitter" . . . as well as "one of the best-transmitted pictures from film in the country."

This is the kind of *proof* that counts! And it's coming from areas throughout the U.S. . . . *proof* of the high-quality signals, wide coverage and dependable performance delivered by Federal VHF and UHF installations. Investigate Federal TV equipment for your requirements . . . whether for a small two-man operation or an elaborate multi-studio station. Federal has the equipment and the know-how to do the job.

The KSWS-TV control room features simplicity of layout . . . with maximum operating efficiency. Transmitter Console, Poly-Efex Scanner, Master Monitors and Camera Control units provide complete station control. Film, slides, studio and network program material are handled with a minimum of operating personnel.

J. A. Barnett, owner, and J. C. Porter, general manager of KSWS-TV, inspecting the FTL-19B 7.5 KW Federal VHF transmitter . . . outstanding for excellent picture quality and trouble-free operation since first going on the air.

KSWS-TV uses Federal's remarkably successful 16-bay High-Gain Triangular Loop Antenna . . . mounted atop this 710-foot tower. Exceptionally wide coverage is produced by its gain of 17.1.

Mr. Porter states: "Consistently good reception has been reported in the White Sands area about 150 miles from Roswell . . . despite a 9,000-foot mountain range half-way between the two points."

KSWS-TV

Distributed by GraybaR

Federal Telecommunication Laboratories

TELEVISION BRANCH ROUTE 17, LODI, N.J. Main Office: 500 Washington Avenue, Nutley, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P.Q.

NEW! FOR PRINTED
COMPLETE LINE

1 **FOR AUTOMATION: EXCLUSIVE NEW** Self-Supporting Snap-in Bracket Mounting. (See Type YGC-B45.)

2 **NEW** Twist-ear Mounting. (See Types XP45 and UPM45.)

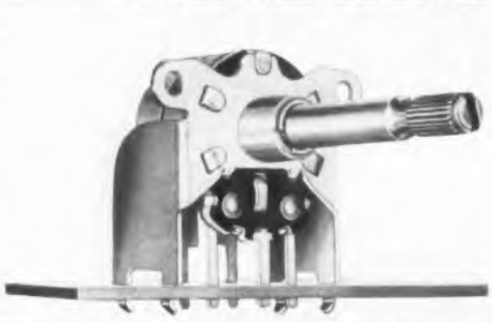
3 **PLUG-IN BLADE-TYPE TERMINALS** for vertical or horizontal mounting of control to printed circuit panel. (See all photos.)

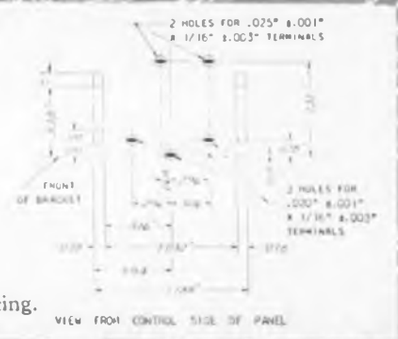
4 Threaded Bushing Mounting. (See Types XGC-45 GC-U45 and *miniaturized* U70.)

Consultation without obligation available on variable resistors for your printed circuit applications. Write today

VERTICALLY MOUNTED to Printed Circuit Panel. Shaft above panel. (Types YGC-B45, XP45 and XGC-45.)

- **NO** shaft protection needed during soldering.
- **PARALLEL** terminals permit *small* round connecting holes instead of *large* elongated slots necessary for fan shaped terminals.
- Terminals available in 7/8" or 1-1/32" lengths from control's center.

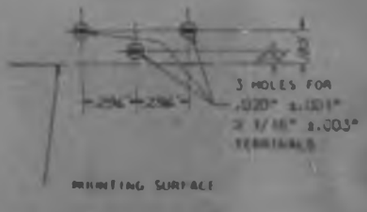




Suggested panel piercing.

Type YGC-B45 FOR AUTOMATION: *EXCLUSIVE NEW Self-Supporting Snap-in Bracket*

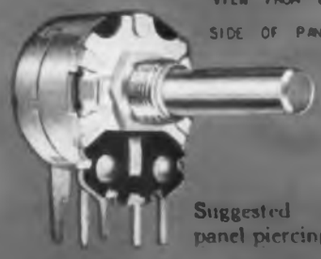
- Snaps instantly into place.
- Stays firmly put during soldering. Solder permanently anchors control to circuit panel.
- Terminal connections cannot loosen; bracket prevents mounting or operating strain on control or switch terminals.
- No mounting hardware, no separate supporting panel needed.
- No strain on printed circuit panel. Anchor tabs attach bracket to cabinet.
- Adequate clearance for circuit paths provided by ample spacing between terminals and by design of mounting lugs on bracket.



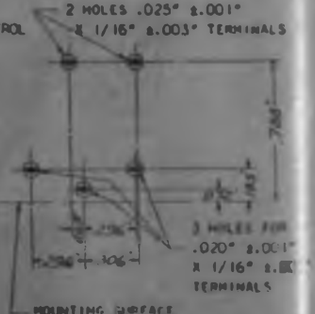
Suggested panel piercing.

Type XP45

For TV preset control applications using a mounting chassis to support printed circuit panel. Twisting 2 ears holds control rigidly to mounting chassis. Available in finger adjusted shaft lengths of 1/2", 5/8", 11/16", 7/8" and 1" from control's mounting surface. Also available with recessed screw driver slotted shaft (Type XPM45).



Suggested panel piercing.



Type XGC-45

For applications using a mounting chassis to support printed circuit panel. Threaded bushing mounting

All controls illustrated actual size.

CIRCUITS
OF VARIABLE RESISTORS

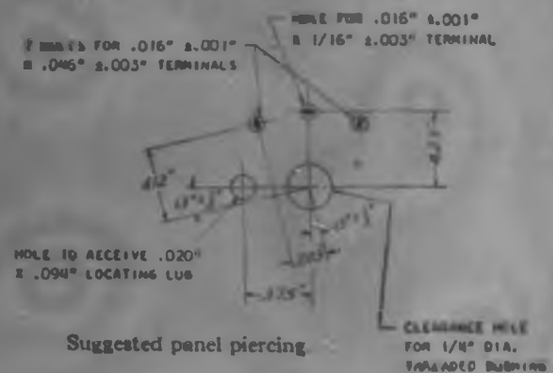
HORIZONTALLY MOUNTED

to Printed Circuit Panel. Shaft extends through panel. (Types U70, GC-U45 and UPM45.)

Type U70

(Miniaturized)

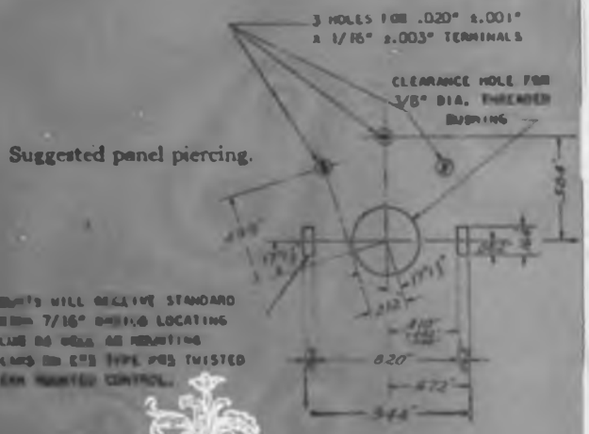
Threaded bushing mounting. Terminals extend perpendicularly 5/32" from control's mounting surface.



Suggested panel piercing.

Type UPM45

For TV preset control applications. Recessed screw-driver slotted shaft remains solder free during panel dipping. Control may be held rigidly to panel before soldering by twisting 2 ears. If ears are left straight, the solder will permanently anchor control to circuit panel. Terminals extend perpendicularly 7/32" from control's mounting surface.



Suggested panel piercing.

Type GC-U45

Threaded bushing mounting. Terminals extend perpendicularly 7/32" from control's mounting surface. Available with or without associated switches.

Specialists in Precision Mass Production of Variable Resistors. Founded 1896.

REPRESENTATIVES

Henry E. Sanders, McClatchy Bldg.,
69th & Market St.,
Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company,
1638 So. La Cienega Blvd.,
Los Angeles 35, California
Phone: Bradshaw 2-3321

John A. Green Company, 6815 Oriole Drive,
Dallas 9, Texas

CANADIAN MANUFACTURING AFFILIATE

C. C. Meredith & Co., Ltd.,
Streetsville, Ontario

SOUTH AMERICA

Jose Luis Pontet,
Buenos Aires, Argentina
Montevideo, Uruguay · Rio de Janeiro,
Brazil · Sao Paulo, Brazil

OTHER EXPORT

Sylvan Ginsbury,
8 West 40th Street,
New York 18, N. Y.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

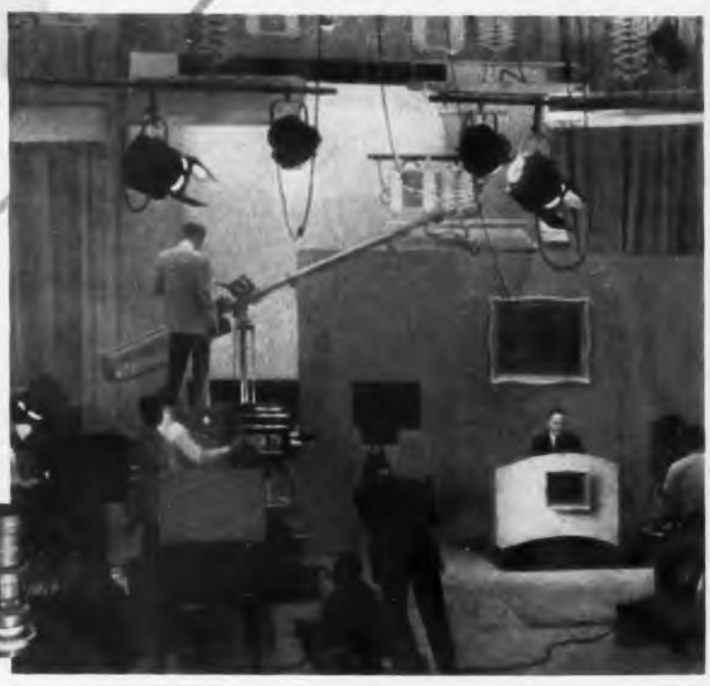
ELKHART · INDIANA

General tolerance all decimal dimensions ± .005".

Burton browne advertising

WHEN SHOOTING FILM

OR LIVE TELEVISION



THERE'S A **RAPTAR** LENS FOR EVERY REQUIREMENT

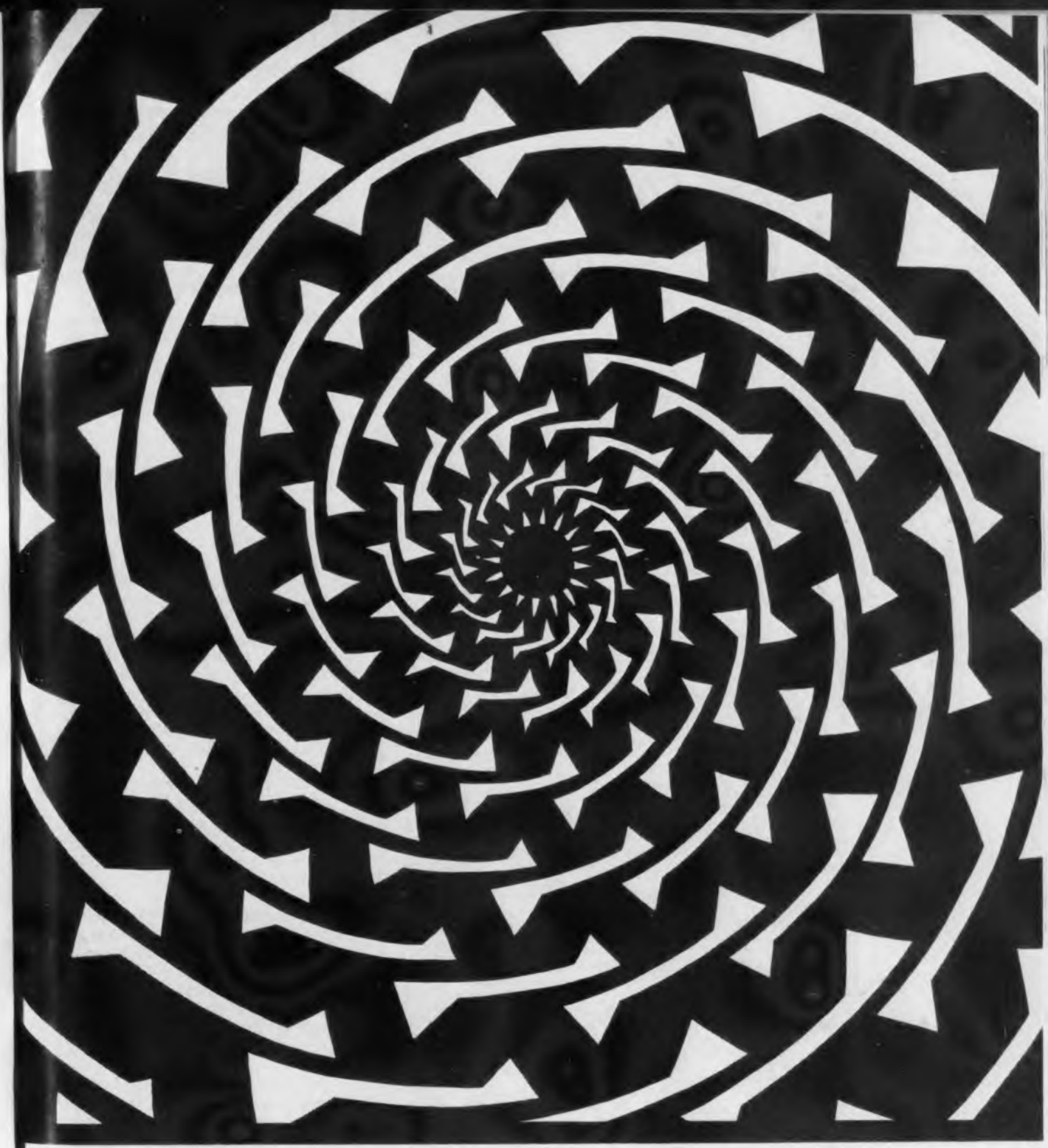
Wollensak TV Raptar Lenses are specially designed for the television industry . . . built for tomorrow's advancements as well as today's requirements. Robert Horn of Station KIMA-TV writes, "We have had extremely satisfactory results from the normal 25mm Wollensak Raptar on our Auricon camera. The extreme wide angle lens has more than paid its way in permitting good coverage in tight quarters."

When televising live you'll also get the finest results with TV Raptars . . . 14 lenses in focal lengths from 2" to 24". Write for literature. Wollensak Optical Co., 850 Hudson Avenue, Rochester 21, N. Y.

MASTERPIECES by **WOLLENSAK**

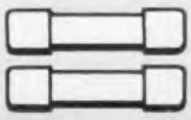
THE BETTER CAMERA HAS A WOLLENSAK LENS

Burton Browne advertising



THINGS ARE NOT AS THEY SEEM...

Things are not as they seem
These two fuses look alike . . .
Until you look inside.



LITTELFUSE

DES PLAINES, ILLINOIS

This is not a spiral. It is a series of concentric circles that do not join.

This fuse has a straight element—cannot be made more delicate than 1/16 amp. with normal blowing characteristics.

This fuse has a bridge construction (note short filament between electrodes). This type fuse may be rated as low as 1/500 amp. with precision blowing characteristics required for protection of extremely fine instruments. Without this construction pioneered by Littelfuse—the microscopically fine filament would break in shipment, in normal operating vibration or even from nearby footsteps.

Littelfuse leads all other fuse manufacturers in design patents on fuses.

Burton Browne advertising

TELE-TIPS

(*Continued from page* 38)

NATIONAL SAFETY COUNCIL is making available a new series of human relations training films for supervisors, featuring O'Grady, the safety skeptic. The Council is also publishing *Showmanship in Safety*, a book of attention-getting gimmicks. For prices, write to National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

FISH STORY—Business of "angling" for classified security information by unauthorized persons is being handled in novel fashion by Minneapolis-Honeywell. In series of card mailings, nine most flagrant security risks are satirically portrayed. For example, there is the three-martini worker (Fried Herring) who volunteers information after imbibing, and the loquacious employee (Large-Mouthed Bass) who discusses classified information over the telephone.

"RESEARCH is an organized method of finding out what you are going to do when you can't keep on doing what you are doing now."—Charles F. Kettering.

DOG DAZE—Do not force your dog to look at TV, advises the Gaines Dog Research Center. They believe that the canines are TV blind, and what to the human eye appears as a comprehensible picture may be a jumble of flashing lights to poor Fido.

PAYDAY, in the early days of the airlines was an uncertain time because of the precarious financial condition of many carriers, coupled with the problem of flying weather. When pay checks were actually in a company mail sack aboard a flight, the word would get to the radio operator, who would broadcast the message (in violation of unwritten regulations), "The eagle flies today." Hence the expression currently used on payday throughout American industry.

BOOK REVIEWS

BEGIN ON PAGE 52

New CBS-Colortron

NOW IN MASS PRODUCTION

Unique photographic process, like photoengraving, uses aperture masks as negatives to print consecutively the red, green, and blue phosphor dots (250,000 of each) on CBS-Colortron screens.

After tri-color screens are printed, aperture masks are temporarily removed and face plates move on to critical inspection for screen imperfections.

COLOR TV IS COMING . . . faster than you think. The revolutionary new CBS-Colortron . . . a practical color picture tube . . . hastens the day. Already it is in lower-cost, mass production . . . made possible by its simplified, advanced design.

As in black-and-white tubes, the CBS-Colortron's screen is deposited directly onto the inside of its face plate. A unique photographic technique makes this possible. Because each aperture mask serves as a negative to print its tri-color screen, perfect register of mask and screen is automatically achieved and maintained. The rugged, simple, light-weight mask sharply reduces assembly and exhaust problems. And the spherical design of mask and screen simplifies convergence circuitry and adjustment.

The CBS-Colortron is now a 15-inch, round tube. But, as soon as tooling is completed, it will be made in larger sizes. Watch for the new CBS-Colortrons. You'll see plenty of them soon. And you'll be sold on sight by their logical simplicity . . . their superior performance . . . their many advantages.

CBS-Colortron OFFERS MANY ADVANTAGES

Cross-section (face plate, aperture mask, funnel, tri-color electron gun) shows simplicity of CBS-Colortron and its adaptability to low-cost, mass production.

Spherical screen and aperture mask of CBS-Colortron simplify convergence and focus. Electron beams remain in focus over entire surface of screen.

Light-weight (6 oz.), rugged, simple aperture mask of CBS-Colortron minimizes problems of exhaust, handling, and assembly.

COMPLETE CBS-Colortron DATA *FREE!*

Take a look into the future. Write today for complete information on CBS-Colortron 15HP22. Construction . . . operation . . . application . . . installation and adjustment . . . electrical and mechanical data. Four packed pages . . . free!

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON, Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

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

RECEIVING • TRANSMITTING • SPECIAL-PURPOSE • TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

The Preferred Oscilloscope for **TELEVISION...**

Type 524-D

...for color development

...for station maintenance

Photo courtesy of KOIN-TV, Portland, Oregon

Condensed Specifications

Sync Separator
Permits triggering from composite signal.

Delayed Sweeps
Zero to 25 milliseconds from start of field—triggered at any selected line.

Field Selector
Instant shift to opposite field (easily identified by vertical block presentation).

Sweep Magnifier
3x or 10x magnification—expands sweep to left and right of center.

Sweep Range
0.1 μsec/cm to 0.01 sec/cm continuously variable, accurate within 5%.

4 kv Accelerating Potential
Flat-faced 5" cathode-ray tube.

60-Cycle Sine-Wave Sweep
Separate phase and amplitude controls.

Vertical Sensitivity
DC to 10 mc—0.15 v/cm to 50 v/cm.
2 cps to 10 mc—0.015 v/cm to 50 v/cm.

Transient Response
Risetime—0.04 μsec.

Signal Delay —0.25 μsec.

Undistorted Vertical Deflection
More than 6 cm.

Internal Time Mark Generator
Pips spaced 1 μsec, 0.1 μsec, 0.05 μsec, or 200 pips per television line.

Amplitude Calibrator
Square wave, zero to 50 v in 7 ranges... accurate within 3%...duty cycle variable from 1% to 99%.

Line-Indicating Video Output
Lines being observed on the Type 524-D are brightened on picture monitor.

DC-Coupled Unblanking

Electronically Regulated Power Supply

10x Attenuator Probe

Here's why:

Variable delayed sweeps at the frame rate let you examine any portion of the television picture—from complete frames to small portions of individual lines. Any one of the picture lines may be located and observed in minute detail. A touch on the Field Shift button provides a quick switch to the interlaced line or lines in the opposite field. Sweep magnifier expands the image 3x or 10x for detailed examination of sync and equalizing pulses. Internal markers are available for checking accuracy of sync timing. All other features meet Tektronix standards for laboratory-type oscilloscopes.

Type 524-D Cathode-Ray Oscilloscope—$1180

Type 500 Scope-Mobile—$97.50

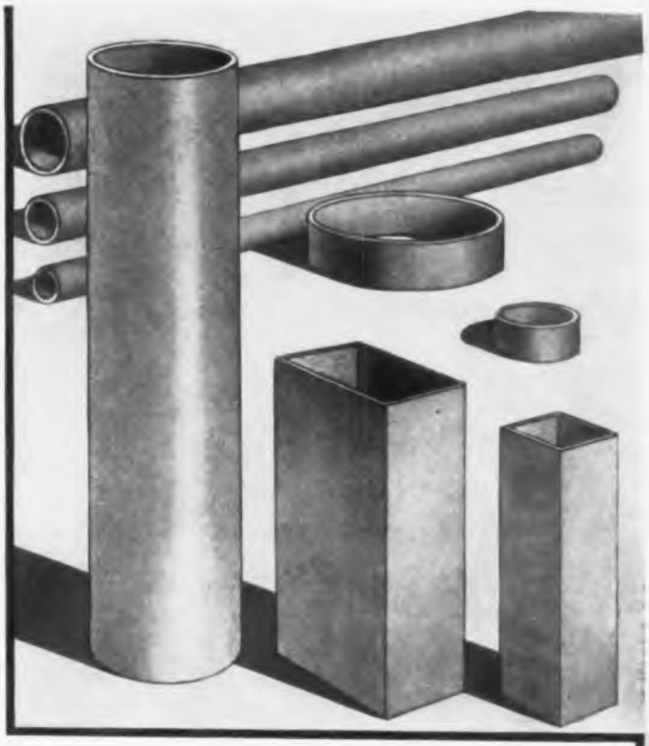
All prices f.o.b.
Portland (Beaverton), Oregon

For complete specifications call your Tektronix Field Engineer, or write to:

Tektronix, Inc.

P. O. BOX 831L • PORTLAND 7, OREGON • CABLE: TEKTRONIX

See the Type 524-D at Booths 129 and 131, Radio Engineering Show



PROVEN

IN HUNDREDS OF CRITICAL APPLICATIONS EVERY DAY

QUALITY

TO MEET UNLIMITED NEW APPLICATIONS

CLEVELITE*

LAMINATED PHENOLIC TUBING

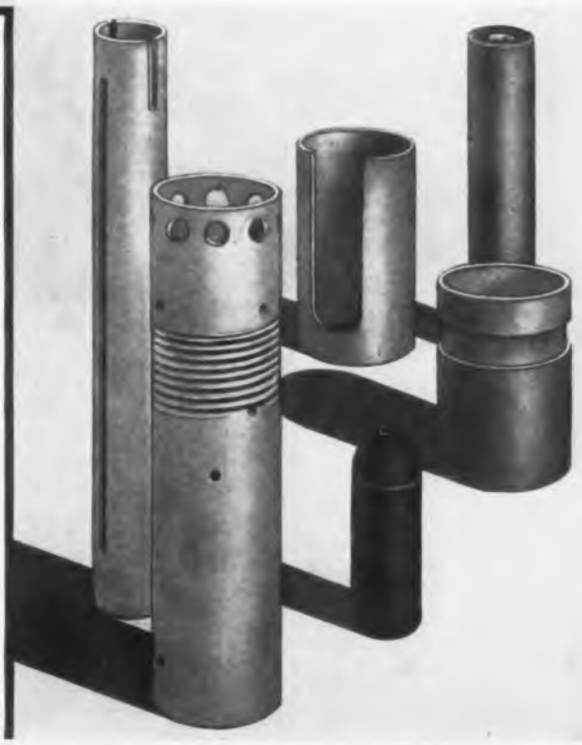
Moisture Resistant

Mechanically Strong

High Dielectric Strength

Dimensional Stability

Low Loss Factor



USE CLEVELITE

to make a good product better
. . . and at lower costs!

SERVICE

Our Design and Production Departments are geared to customers' needs in every way. Deliveries are prompt!

Your copy of our Clevelite Brochure available on request . . . of value to every Engineering Dept.

* Reg. U. S. Pat. Off.

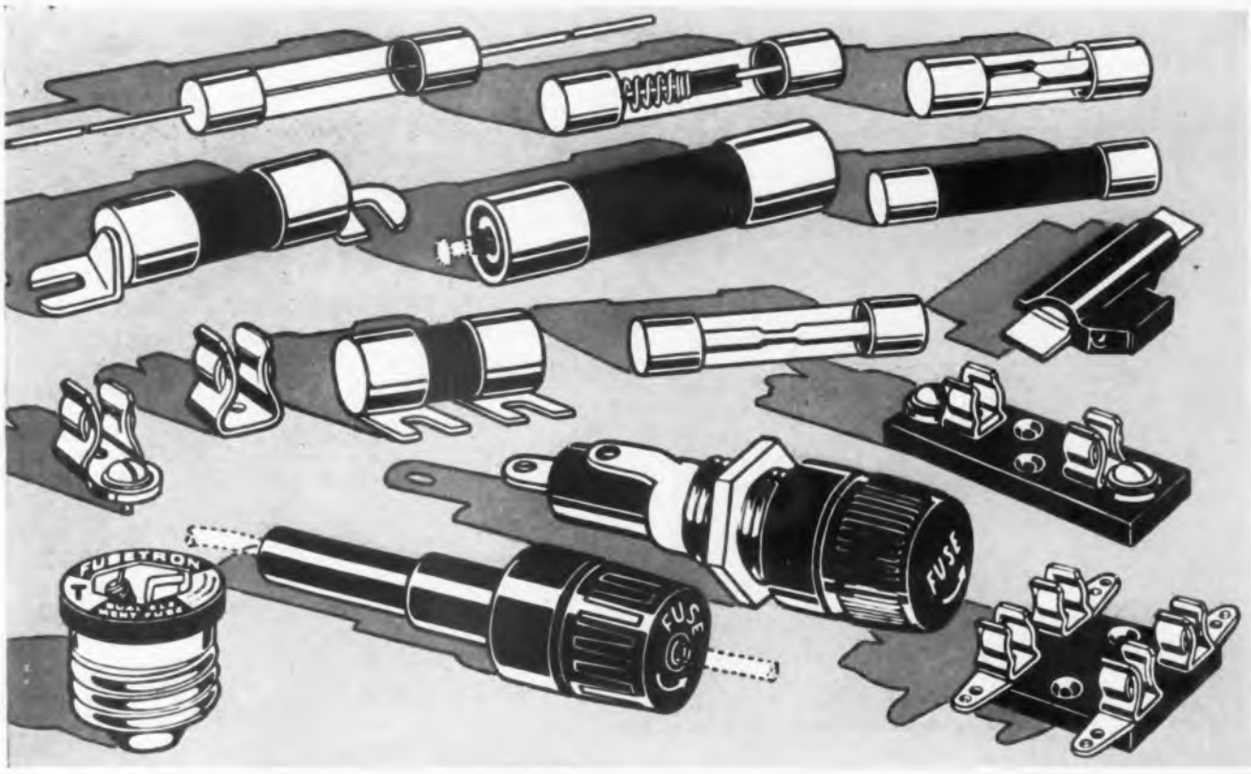
Visit our
Exhibit #519
at the
Radio Engineering Show
in New York City,
March 22-25.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES



WHY YOU WILL FIND IT PROFITABLE to STANDARDIZE on BUSS FUSES

BUSS OFFERS A COMPLETE LINE OF FUSES

It is easy and economical for you to choose the exact fuse for your requirements. Select from dual-element (slow blowing) renewable and one-time types . . . in sizes from 1/500 ampere up, plus a companion line of fuse clips, blocks and holders.

A fuse is a small but significant component part — for a faulty fuse that fails to protect — or a fuse that blows needlessly may reflect, in your customer's mind, on your product or service.

Dependable electrical protection is not an accident with BUSS fuses.

The makers of BUSS fuses maintain rigid quality control by testing every fuse in a sensitive electronic device that rejects any fuse not properly calibrated, properly constructed and right in all physical dimensions.

That is why you can be sure that a BUSS fuse will always operate as intended under all service conditions.

"Trouble-free" BUSS fuses can help protect your goodwill, reputation and profits.

Then be profit wise, change your buying and stock records today — to standardize on genuine BUSS fuses.

For more information mail this Coupon ▼

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

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

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ TT354

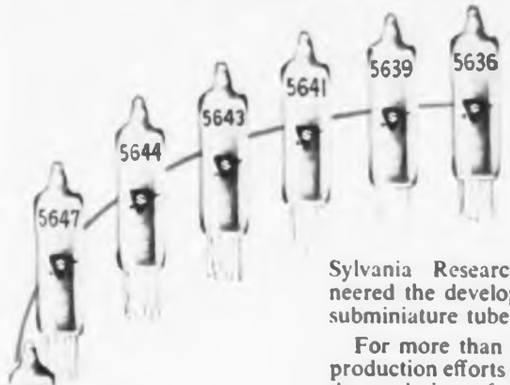
Let BUSS save you engineering time.

When selecting or designing a fuse or fuse mounting let BUSS, with the world's largest fuse research laboratory and its staff of engineers, be of service. At least be sure to get the latest BUSS fuse information before final design is crystallized. It's quite possible that the fuse to meet your exact requirements is already available in local wholesaler's stocks.

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

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FOR YOUR EQUIPMENT-



Specify Types from the Finest—most Complete Line of Premium Subminiature Tubes

Sylvania Research and Engineering pioneered the development of the cathode-type subminiature tube.

For more than a decade, engineering and production efforts have been directed towards the evolution of this premium line of high reliability types.

Many of the types listed were originally sponsored by the Armed Services. Others have been designed by Sylvania to furnish additional reliable types required for newer applications. Beyond this, there are other types not listed above which are presently undergoing active development.

Outstanding Design Features

- **Low inoperative failure rate**
- **Stable characteristics**
- **Long life**
- **Fatigue and impact resistant**
- **Vibration resistant**
- **High temperature operation**

all originated by Sylvania

5636 Pentode Mixer	†**5907** Semi-remote Cut-off Pentode
5639 Video Output Pentode	†**5908** Pentode Mixer
5641 Rectifier	*__5916__ Pentode Mixer
5643 Thyratron	**5977** Low Mu Triode
5644 Voltage Regulator	**5987** Power Control Triode
5647 T-1 Detector	**6021** Medium Mu Double Triode
5718 Medium Mu Triode	**6110** Double Diode Detector
5719 High Mu Triode	**6111** Low Mu Double Triode
5840 Sharp Cut-off Pentode	**6112** High Mu Double Triode
5896 Double Diode Detector	**6153** Sharp Cut-off Pentode Low Cgp (Separate suppressor)
5899 Semi-remote Cut-off Pentode	**6154** Remote Cut-off Pentode Low Cgp (Separate suppressor)
5902 Audio Power Pentode	**6205** Sharp Cut-off Pentode (Separate suppressor)
*__5903__ Double Diode Detector	**6206** Semi-remote Cut-off Pentode (Separate suppressor)
†**5904** Medium Mu Triode	
†**5905** Sharp Cut-off Pentode	
†**5906** Sharp Cut-off Pentode	

‡6308 Voltage Reference Tube.

*26-volt heater †26 volts all elements ‡Cold Cathode Type
All other types are 6.3 volt heaters.

For complete data sheets and specifications concerning any of the above tube types and for application information, see your Sylvania Sales Engineer or write to: Sylvania Electric Products Inc., Dept. 4R-4403, 1740 Broadway, New York 19, N. Y.

SYLVANIA

LIGHTING • RADIO ELECTRONICS TELEVISION

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

BOOKS

Soft Magnetic Materials for Telecommunications

Edited by C. E. Richards and A. C. Lynch. Published 1953 by Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y. 346 pages. Price $9.00.

With the use of magnetic material for communications systems continuing its growth, this book may be considered quite timely. Included are 35 collected papers of a symposium held in the British Post Office Engineering Research station in April 1952. It is unfortunate that this volume could not have been made available a year earlier; doubtlessly it would have been a considerable aid to researchers and designers. Nevertheless, it is most welcome at this time because it is highly informative and rather extensive in its coverage of the subject material. Some of the writing is of basic nature, but, for the most part, it comprises advanced laboratory developments.

To indicate its scope, the following partial list of subjects described in this data-packed book is presented:

Coercivities in dilute ferromagnetic alloys
Nonlinearity in core materials
Frequency dependence of magnetization process
Hysteresis modulation in directional filters
Ferromagnetic resonances in ferrites and metals
Inhomogeneity in high permeability alloys
Carbonyl iron and silicon iron
Tests of rectangular loop materials
Magnetostriction of ferrites

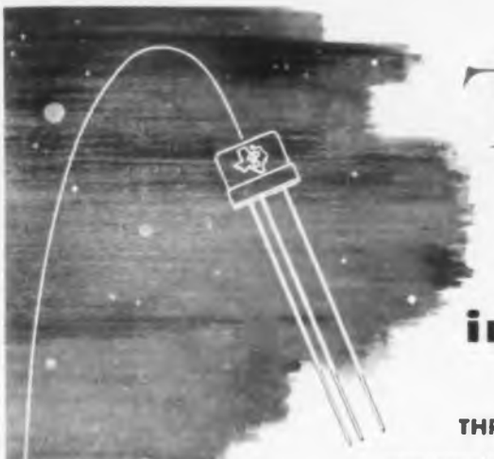
High Fidelity Techniques

By John H. Newitt. Published 1953 by Rinehart Books, Inc., 232 Madison Ave., New York 16, N. Y. 512 pages. Price $7.50.

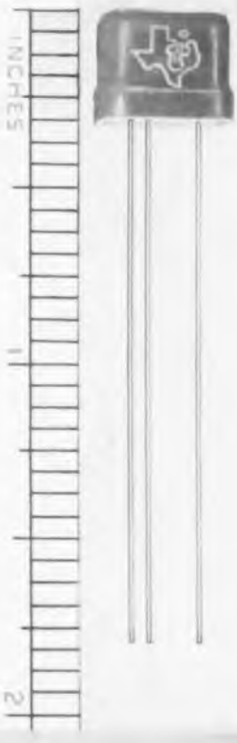
Much of the information primarily aimed at that anomolous creature, the "hi-fi bug," can be of considerable value to the professional broadcast or audio design engineer. For that reason, this volume crammed full of practical information is to be highly recommended to the engineer. It is clearly and simply written, and liberally illustrated with over 200 drawings and photographs. Although not every facet of audio is covered in extreme detail, the scope of the work is very thorough, and every important topic is quite adequately discussed.

Among the items described are design of various speaker enclosures, circuit features of a large number of commercially available amplifiers, speakers, tuners and pickups, and binaural systems. Other chapters are devoted to receivers, tape recorders, record players, equalizers

(*Continued on page* 60)



TI transistors will FIT in Your Future!



THREE MONTHS AGO we ran this "ad" announcing a major reduction in the physical size of TI hermetically sealed junction transistors. At the Radio Engineering Show in March, TI will show transistors only one-third the size of the one illustrated at the right.

This is typical of the rapid progress being made in semiconductor device design. For first-hand information on these and other new TI semiconductor products, visit Booth 776. A real southwestern welcome awaits you there.

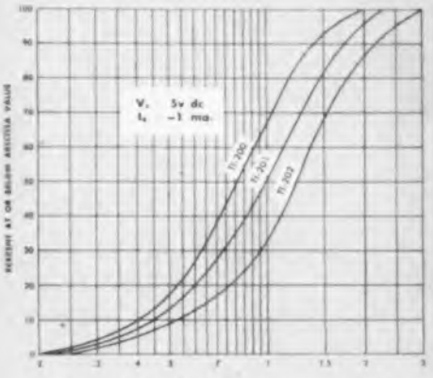
ELECTRICAL DATA: n-p-n junction transistors

	type 200	type 201	type 202	
RATINGS, RECOMMENDED MAXIMUM:				
Collector Voltage	30	30	30	volts
Collector Current	5	5	5	ma.
Collector Dissipation (at 25° C)	50	50	50	mw.
Ambient Temperature	50°C	50°C	50°C	
AVERAGE CHARACTERISTICS (AT 25° C.):				
Collector Voltage	5	5	5	volts
Emitter Current	−1	−1	−1	ma.
Collector Resistance (Minimum)	4	4	4	megohms
Base Resistance	150	170	200	ohms
Emitter Resistance	22	22	35	ohms
Current Amplification Factor* (Minimum)	9	19	49	
Collector Cutoff Current (Maximum)	10	10	10	μa.
Collector Capacitance	15	17	19	$\mu\mu$fd.
Noise Factor** (V_C = 2.5 V., I_E = −.5 ma)	26	23	20	db
Frequency Cutoff** (α_{co})	90	1.10	1.30	m.c.

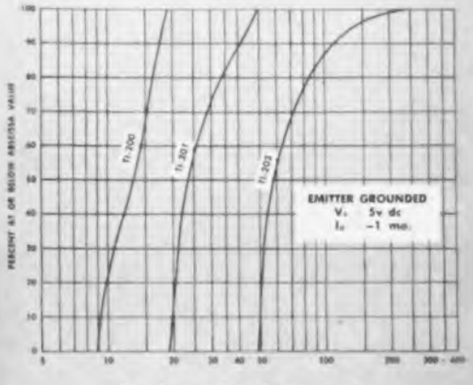
*Emitter Grounded

**Noise Factor and Frequency Cutoff are average and individual units may vary

STATISTICAL DISTRIBUTION CURVES
Based on 100 transistors of each type



α_{co} — Alpha Cutoff Frequency — megacycles



K — Current Amplification Factor

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

Choose Your Carbon Controls from this *Complete Mallory Line*

You can select Mallory Carbon Controls in any construction you may require. This complete line includes single, dual concentric and dual tandem types, with or without switch, in values from 200 ohms to 10 megohms.

Electrically, these controls assure you of the highest performance. They have a unique carbon element, with exceptionally high density and surface smoothness. It has set new standards of low noise level, minimum resistance drift and long life.

Mechanically, Mallory Controls are built to withstand vibration, and production line handling . . . through such features as welded construction, firmly clinched terminals, and sturdier fastenings. Switches have long-lasting silver contactors and heavy gauge terminals.

Mallory resistor engineers will welcome the opportunity of analyzing your specific circuits to see how engineered selection of resistors can help reduce your manufacturing costs. We will be glad to send you the complete new catalog on Mallory Fixed and Variable Resistors . . . including both carbon and wire-wound types.

FOR SPECIAL REQUIREMENTS

Get in touch with Mallory any time you need carbon controls with special tapers, non-standard resistance values, insulated shafts or bushingless mountings.

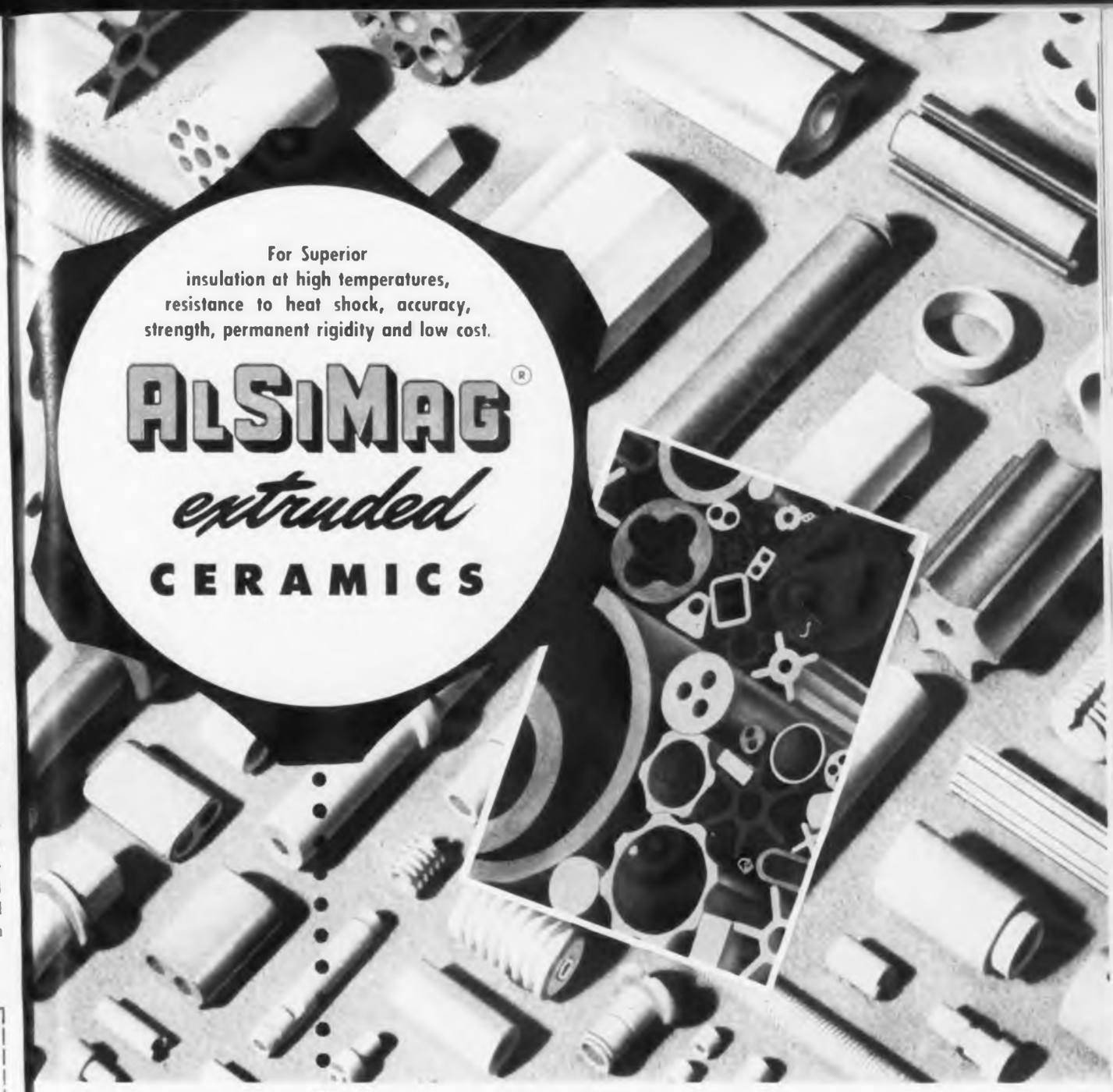
Our flexible manufacturing facilities enable us to produce, at economical cost, special controls which can solve your individual design or manufacturing problems.

Expect more...
Get more
from MALLORY

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

Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

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



For Superior
insulation at high temperatures,
resistance to heat shock, accuracy,
strength, permanent rigidity and low cost.

ALSiMAG® *extruded* CERAMICS

If you will give us details of your requirements our engineers will be glad to submit suggestions without cost or obligation. Try AlSiMag ceramics for best results at low cost.

AlSiMag ceramics can be extruded in uniform cross sections in almost any design. These extruded sections can then be sawed and economically machined before firing. This is the fastest and best way to produce many shapes which seem complex but which are actually quite practical and economical . . . AlSiMag ceramics are not affected by normal operating temperatures of electrical appliances and do not rust, corrode or carbonize. They are uniform physically and dimensionally, are totally and permanently rigid and do not deteriorate with time.

A SUBSIDIARY OF
MINNESOTA MINING AND
MANUFACTURING COMPANY

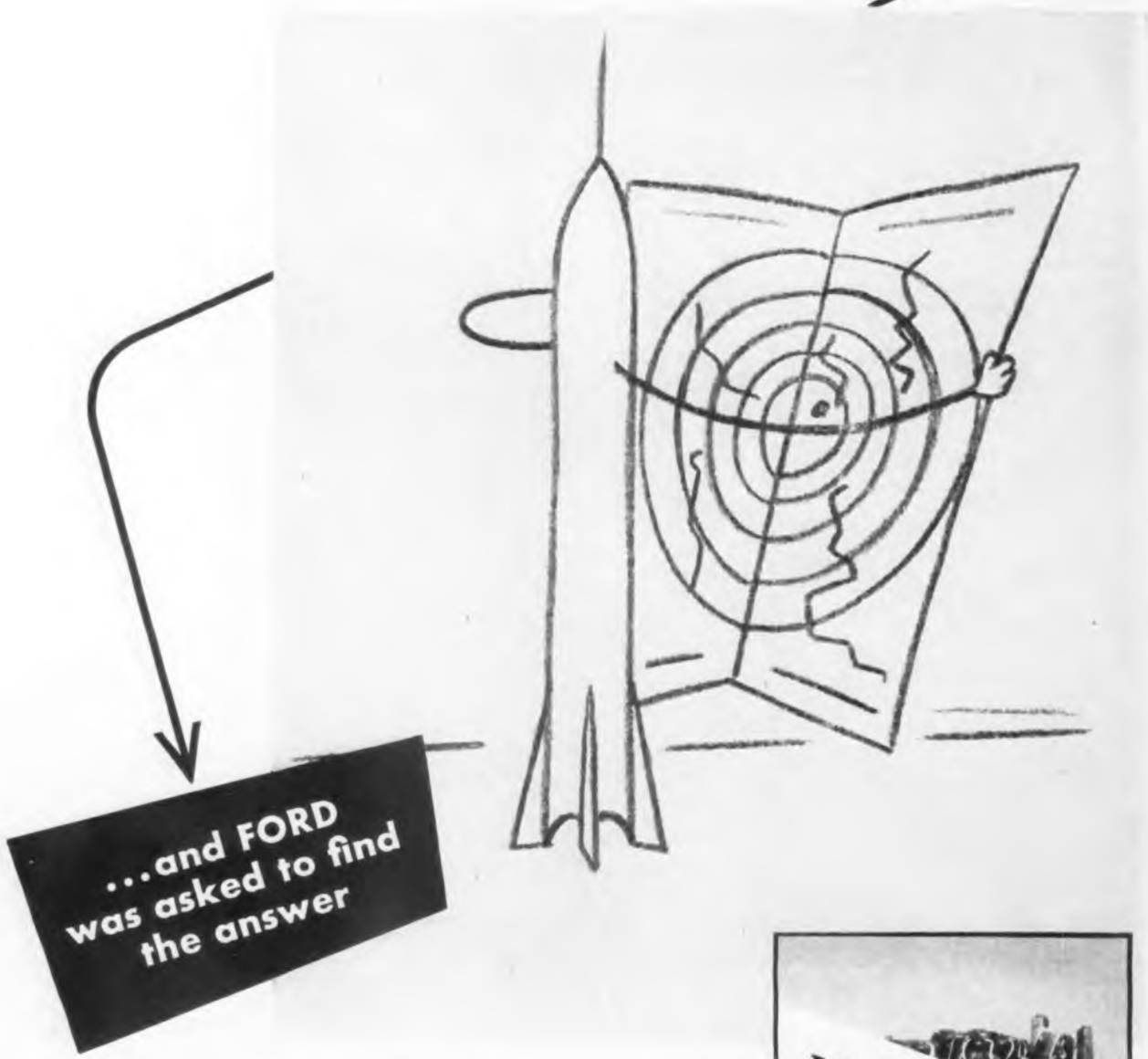
52ND YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • SYRACUSE, N. Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685
NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959
CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capital 1-9114

HOW TO TEACH A MISSILE
to read a map



Zwish! And off goes a missile. But where? And how to stay on the right track? And how to *find* the target? That's the problem Ford Instrument is helping to solve.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electromechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

VISIT OUR BOOTH 503-505 AT THE NEW YORK IRE CONVENTION

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

WAVELINE
precision instruments

measurement standard of industry

Man's progress has always depended upon the accuracy of scientific measurement.

Waveline, industry leader in production of precision microwave instruments and accessories ... parallels the needs of progress ... increases numbers of more exact measuring devices.

Improvements in engineering, laboratory and production facilities make possible even greater development, scheduling and delivery service for all clients.

In the field, Waveline's staff of trained engineers are ready to give immediate and personal attention to all technical problems.

SALES REPRESENTATIVES

BOSTON, MASS. AREA
Robert A. Waters, Inc.
4 Gordon Street
Waltham, Mass.

CHICAGO 45, ILLINOIS
Everette Associates, Inc.
6744 N. California Ave.

INDIANAPOLIS, INDIANA
Everette Associates, Inc.
Box 6236
Speedway City

KANSAS CITY 3, MO.
Everette Associates, Inc.
1629 East 31st

LOS ANGELES 6, CALIF.
John B. Tubergen Co.
2232 West 11th Street

NEWARK, N. J. AREA
Gawler-Knoop Co.
178 Eagle Rock Ave.
Roseland, New Jersey

NEW HAVEN 15, CONN.
Robert A. Waters, Inc.
1150 Whalley Avenue

NEW YORK CITY AREA
Gawler-Knoop Co.
178 Eagle Rock Ave.
Roseland, New Jersey

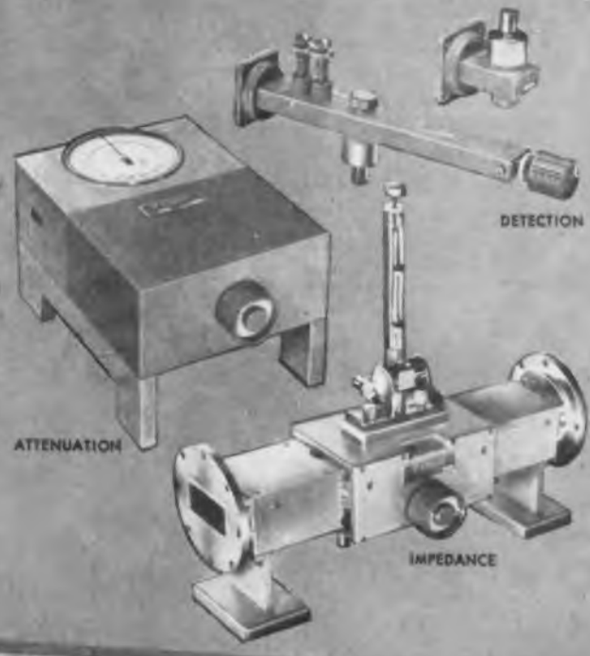
PHILADELPHIA, PA. AREA
Gawler-Knoop Co.
835 Glenside Avenue
Wyncote, Pa.

ROCHESTER 10, NEW YORK
Edward A. Ossmann & Associates, Inc.
3 Juniper Street

SYRACUSE, NEW YORK
Edward A. Ossmann & Associates, Inc.
308 Merritt Avenue

WASHINGTON, D. C. AREA
Gawler-Knoop Co.
901 Pershing Drive
Silver Spring, Maryland

TORONTO 12, CANADA
R.O.R Associates, Ltd.
290 Lawrence Ave., W.



Write today for Technical Data on microwave instruments

BE SURE TO SEE US AT BOOTH 376 IRE SHOW.

WAVELINE INC.
CALDWELL, NEW JERSEY

The *Pan Cinor* Zoom-type lens with a Bolex 16 mm camera ...what a terrific buy!

You can assure your viewers of a front row seat to every sports and news event in your TV area when you zoom in for a take with this precision equipment.

Think of it . . . this Pan Cinor-Bolex combination gives you a camera and zoom-type lens for less than one-half the price of other 16mm zoom-type lenses alone.

Here is a lens that can vary its focal length from wide angle (20mm) to telephoto (60mm), focusing from 5′ to infinity. It has its own parallax corrected variable field finder. Its maximum aperture is f/2.8. All lens elements are coated.

For TV filming, Bolex has proven itself a natural. Fast supplanting all other 16mm cameras used by TV stations today, its many exclusive features offer so much engineered value – unlimited forward and reverse hand winding . . . automatic film threading . . . time exposure and single frame setting.

Ask your Bolex Franchised Dealer for a demonstration, or write for literature. Pan Cinor lens and Bolex camera as shown in above photo . . . price $675.00.

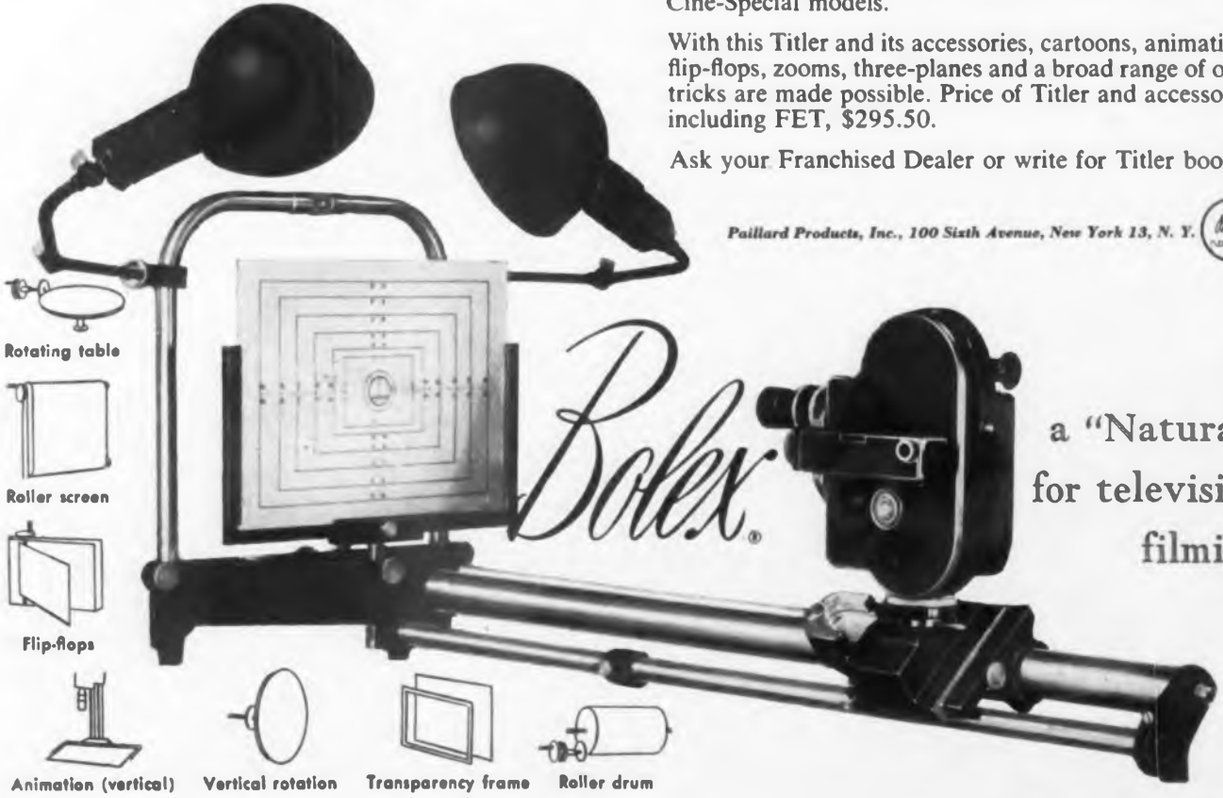
Take title to a *Titler*

Still in limited supply, we again offer the Bolex Titler for 16mm filming. No other equipment has the same ruggedness and versatility that is so essential to movie makers. Its rock-steady track and massive camera cradle (with rack-over for perfect focusing and centering even down to 4″ x 5″) accepts all Bolex, Bell & Howell, and Kodak Cine-Special models.

With this Titler and its accessories, cartoons, animations, flip-flops, zooms, three-planes and a broad range of other tricks are made possible. Price of Titler and accessories, including FET, $295.50.

Ask your Franchised Dealer or write for Titler booklet.

Paillard Products, Inc., 100 Sixth Avenue, New York 13, N. Y.



Bolex®

a "Natural" for television filming

BOOKS

(*Continued from page 52*)

tone controls, noise suppressors volume expanders, needles, turn tables—and just about any devic that can be connected to an audi system.

Elements of Electrical Engineering (6th Ed.)

By Arthur L. Cook and Clifford C. Carr. Published 1954 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 682 pages. Price $6.75.

Since the first edition was published some 30 years ago, this textbook has gained such widespread acceptance that it is practically a standard reference today. Interesting to note is the fact that the preface to the first edition made no mention of electronics, while the new volume emphasizes the role electronic circuits play in controlling electrical machinery. The thoroughly revised book is intended solely as a basic engineering textbook for a college course in electrical engineering, and it accomplishes its educational aim with extreme competence. From the fundamentals of electric and magnetic circuits, the authors go through the various types of ac and dc machinery. Their explanation of sinusoidal and vector relations in ac circuits is extremely well done. The last 10% of the text covers electron tubes and control systems.

Television Receiver Design—Monograph 2

By P. A. Neeteson. Published 1953 by Elsevier Press Inc., 402 Lovett Boulevard, Houston, Texas. 180 pages 137 illust.

Book VIIIB entitled Flywheel Synchronization of Saw Tooth Receivers provides an analysis of the flywheel action of resonant circuits, a study of automatic phase control and a discussion of partial circuits. As such, it is of particular interest to television receiver designers working with both black and white and with color sets. The book is another in the Phillips Technical Library Series. It will be followed by other volumes on such specialized topics as deflection circuits, front end problems and circuits in the audio part.

BOOKS RECEIVED

Microwave Lenses

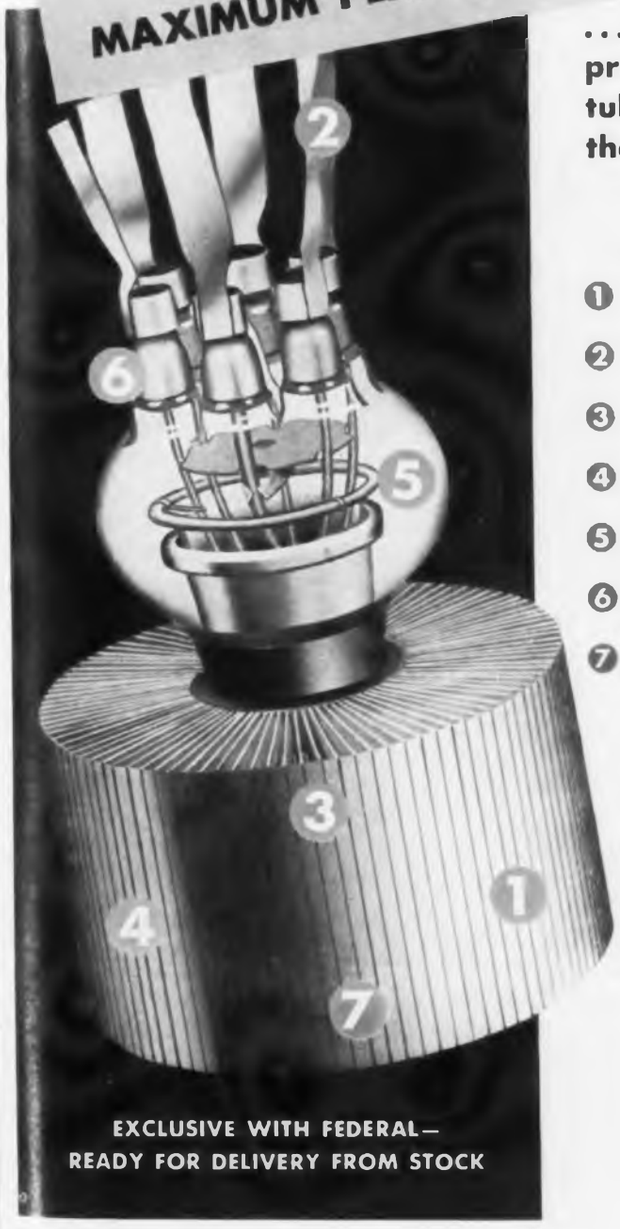
By J. Brown. Published in Great Britain in 1953. Available through John Wiley & Sons, Inc., 440 Fourth Ave. New York 16, N. Y. 125 pages. Price $2.00. An interesting monograph on the use of artificial dielectrics in microwave lenses.

DESIGNERS—Cut New-Equipment Costs

F-6366 7 KW | F-6367 12 KW
MAXIMUM PLATE INPUT

with *Federal's*

2 NEW TRIODES



EXCLUSIVE WITH FEDERAL—
READY FOR DELIVERY FROM STOCK

. . . incorporating built-in savings and proved design features that increase tube dependability and life and multiply the performance quality of new units

For Electronic Heating, Broadcast and Communications Service

1. **High-Efficiency Radiator** requires reduced pressure drop . . . cuts blower cost for new equipment.
2. **Grid and Filament Leads Attached** for convenience of designers . . . for extra savings.
3. **Double Helical Filament** of thoriated tungsten . . . for high peak emission . . . lower temperature.
4. **No Internal Insulators** to expose tubes to danger of arc-over and gassiness.
5. **Internal Corona Ring** eliminates trouble with hot-spots and glass cracks.
6. **Kovar Terminal Cups** used throughout for ruggedness required in industrial service.
7. **Full Voltage** can be safely applied to the cold filament . . . no step starting or high reactance transformers necessary.

Federal's F-6366 and F-6367 are the power triodes that new equipment designers have been waiting for . . . to boost the efficiency of induction and dielectric heating units, broadcast and communications equipments . . . to bring important savings to production lines!

Both tubes not only provide *more* ruggedness, *longer* service life and *higher-quality* performance, but they actually cut costs for manufacturers . . . saving as much as 80% on blower costs, while factory-attached grid and filament leads eliminate this expense.

Federal's new triodes feature simplified construction . . . with fewer potential trouble spots. Wide element spacing gives better protection against filament-grid shorts. Rated filament voltage may be applied to cold filament, eliminating need for step starting or high reactance filament transformers. Both tubes are operable up to 30 Mc/SEC at full ratings . . . anode up or anode down.

Equipment manufacturers now using the F-6366 and F-6367 in new designs report they are "extremely well pleased" with their stamina and performance. For prices and technical data, write to Federal, Dept. K-466.

Visit Federal's Exhibit—IRE Show
885-893 Audio Ave. at Broadcast Way

Federal's 72-page booklet gives complete data on efficient operation of tubes in service. Mail your request to the department listed above.

FEDERAL TELEPHONE & RADIO — FTR — DIVISION OF IT&T

Federal Telephone and Radio Company

VACUUM TUBE DEPARTMENT 100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

HIGH VOLTAGE REGULATION AT...

Lower Cost

. . . Superb regulation at lower cost for color T.V. receivers is assured if you plan now to use Victoreen's type 6353 Corona Regulator Tube in your Models. Designed to be used with high-voltage power supplies in color T.V. sets, the 6353 stabilizes the second anode potential at 20,000 volts regardless of line voltage and intensity setting.

The 6353 positively protects the picture tube against excessive voltage surges. Any failure in the circuit or components results in a drop in the second anode voltage. Safeguarding of the Kinescope from damage due to voltage fluctuation is positive. There's complete *safety* in failure with a 6353.

No grid voltage or filament power is used. Ultra simple mounting, extremely long life and rugged construction are a few of the many features of this tube.

The RX-Series resistors are an hermetically sealed 10 KV, deposited carbon type which provide maximum stability and uniformity in operation. Specifically designed for color T.V. convergence and focus voltage-divider strings, these extremely stable resistors are available in 20, 25, 50, 55, 80 and 100 megohms. Tolerances are plus or minus 5, 10, 15 or 20 percent. These 10 KV resistors were designed for long operation under extreme conditions of temperature and humidity.

Write to our Components Division for detailed specifications.

The Victoreen Instrument Co.

3800 PERKINS AVE. • CLEVELAND 14, OHIO

Permeability plus Stability

DEPENDABLE EQUIPMENT

High-Precision Tuner

Remarkable stability of performance

QUALITY THROUGHOUT

Second to None for Power and Sensitivity

THE MOST DEPENDABLE IN RADIONIC HISTORY

Automatically Right!

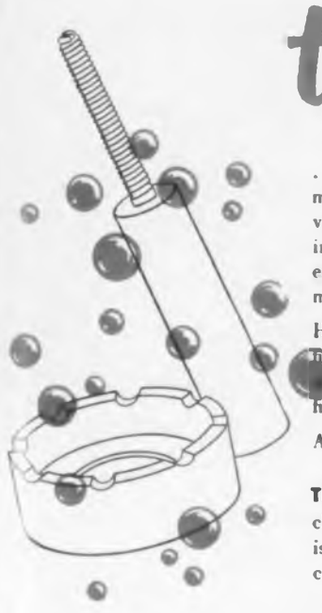
TOP QUANTITY PRODUCTION OF TOP QUALITY ITEMS

...most accurate magnetic tester

WHEN LEADING FIRMS WITH LONG EXPERIENCE MAKE SUPERLATIVE CLAIMS SUCH AS THESE...

ULTRA-STABLE COILS

there's a reason!



...when America's best known manufacturers make such claims as these—for their radio, television, radar and similar equipment—they're basing their statements largely upon the cores in their equipment. And they know that these cores are made of G A & F Carbonyl Iron Powders.

Heat, cold, humidity, atmospheric influences, stray fields and similar conditions—any of these can have no adverse effect on the core materials and on the final performance of the equipment.

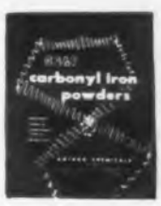
An iron core made with G A & F Carbonyl Iron Powders has a high degree of stability—and is thereby protected against these many influences.

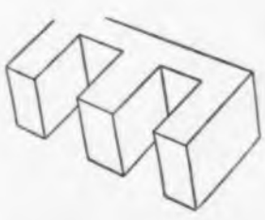
We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment or product you make, while reducing both the cost and the weight.

We also invite inquiries for powders whose performance characteristics are different from those exhibited by any of our existing types.

• • •

This 32-page book offers you the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy—without obligation—kindly address Department 65.





GA&F® CARBONYL IRON POWDERS

ANTARA

gaf

ANTARA CHEMICALS

A SALES DIVISION OF GENERAL ANILINE & FILM CORPORATION

435 HUDSON STREET • NEW YORK 14, N. Y.

MEMBER mpa METAL POWDER ASSOCIATION

Styroflex COAXIAL CABLE

NOW IN UHF-TV SERVICE!

WJMR • 990 KILOCYCLES TV CHANNEL 61

CHESTER F. OWENS, PRES.

Supreme Broadcasting Company, Inc. • JUNG HOTEL
1500 CANAL STREET • NEW ORLEANS, LA. • PHONE CANAL 0356

January 14, 1954

PHELPS DODGE COPPER PRODUCTS CORPORATION
1009 Carondelet Building
New Orleans, Louisiana

ATTENTION: Mr. F. W. Lemly

Gentlemen:

I would like to bring to your attention the fact that WJMR TV is now employing your "Styroflex" transmission line, with excellent results. As you know, WJMR TV employs the unique installation consisting of two entirely separate antennae --- ans for picture and one for sound--- thus eliminating the complex diplexer unit with its consequent transmission losses.

The "Styroflex" line has proved very satisfactory. Besides being easy to install, we have found it to possess very low signal attenuation. We are indeed pleased with the use of this product and are looking forward to further installation of this line in our now-being-constructed transmission tower.

Sincerely yours,

George A. Mayoral

George A. Mayoral
Executive Vice-President

GAM:cl

• 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.

PHELPS DODGE COPPER PRODUCTS CORPORATION
REG U S PAT OFF

One Source of Supply by E-I

—for every hermetically sealed termination

Specify— E-I sealed leads and multiple headers

HUNDREDS OF STANDARD TYPES AT MASS PRODUCTION PRICES TO MEET EVERY REQUIREMENT

—at your fingertips!

Development, production and design engineers will find the complete E-I Data File a helpful addition to company files. The new brochure includes standardized terminations that economically solve all but the most unusual terminal problems. If custom types are required, E-I can supply these quickly, to exact specifications at quantity production prices.

CALL OR WRITE FOR THE NEW E-I DATA FILE NOW!

ELECTRICAL INDUSTRIES
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

DIVISION OF AMPEREX ELECTRONIC CORP.

SEE US AT THE SHOW!
BOOTHS 650-652
CIRCUITS AVENUE

1. BULLETIN 949-A

On hermetically sealed terminals. Discusses cushioned glass construction, thermal shock resistance, preferred types and special terminals. Explains code systems and methods of installation.

2. BULLETIN 950-A

On hermetically sealed multiple headers. Explains vacuum tight feature, cushioned glass construction, strain-free qualities. Tin dipped for easy soldering and silicone treated for highest electrical resistance.

3. BULLETIN 951

With complete information on octal type plug-in and multiple headers. Feature a new principle of hermetic sealing. Solid metal blanks insure maximum mechanical strength and rigidity.

4. BULLETIN 952

Complete information on E-I end seals for hermetic sealing condensers, resistors and other tubular electronic and electrical components. Provide a permanent hermetic seal. Completely strain-free.

5. BULLETIN 953

Individual, color-coded hermetically sealed terminals. Available with glass inserts colored in standard, easily identified RMA color codes. Coloring is in the glass —no lacquers or enamels are used.

6. BULLETIN 960

Compression type multiple headers. Super rugged, absolutely rigid and practically indestructible. An exclusive E-I achievement offers vastly greater resistance to shock and vibration. Guaranteed vacuum-tight.

EXPORT AGENTS:
PHILIPS EXPORT CORP., 100 EAST 42nd STREET, NEW YORK 17, N. Y.

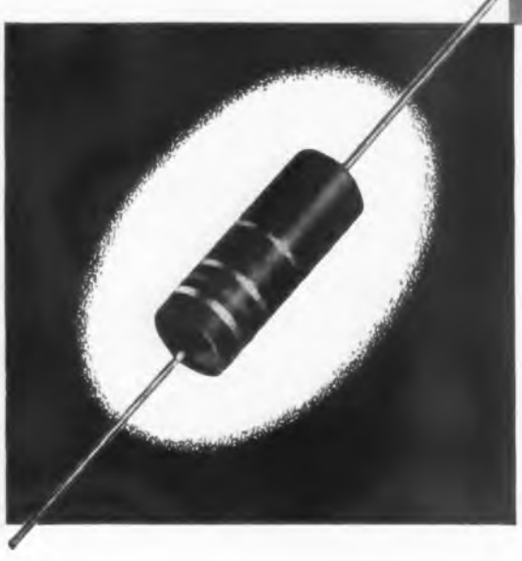
*PATENT PENDING

BLACK BEAUTY®

dry-assembly phenolic-molded

TV TUBULARS

The Standard By Which Others Are Judged



LOOK at the critical points in any TV set. That's where you'll find Sprague "Black Beauty" Molded Tubular Capacitors. Over 250 million have been made since 1947 and demands are still increasing . . . thanks to their unprecedented failure-free record.

Sprague's unique patented design and "dry assembly" processing make these the first tubulars made just like more expensive metal-encased oil capacitors. Every "Black Beauty" from 200 to 12,500 volts is molded *dry* in non-flammable phenolic. After molding it is impregnated thru an eyelet under high vacuum; the lead is then inserted and the capacitor solder sealed.

Every major TV manufacturer uses "Black Beauties" in critical circuits. He can depend on *extra high insulation resistance; minimum capacitance change with temperature variations; and absence of drift with repeated heating and cooling.*

A letterhead request will bring you sizes, ratings, and performance data. Write for Engineering Bulletins 210C and 214A to the Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

"Visit our Booths at the I. R. E. Show — 247-249 Instruments Avenue"

TELE-TECH
& Electronic Industries

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

Let's Solve Our Own Problems!

Last month the editors of TELE-TECH & ELECTRONIC INDUSTRIES proudly saluted the achievements of NTSC in developing an industry-wide compatible color television system. It was noted too that Dr. W. R. G. Baker, who headed this splendid group of engineers, announced the dissolution of the National Television Systems Committee, since its work has apparently been completed. The fine performance of this committee suggests the desirability of another all-industry committee for the purpose of resolving other pressing industry-wide problems.

All-Industry Committee Needed

The need for such a committee is quite evident. We have at the present time two very active organizations in the form of the Institute of Radio Engineers and the Radio Electronic Television Manufacturers Association, who develop engineering standards for the benefit of the industry. Essentially the standards developed by the IRE define theoretical test and measurement standards while those of the RETMA establish practical specifications for the construction of components and equipment. There are, however, the more general industry problems that arise from time to time which are not in the scope of either of the aforementioned organizations, and for which no steering or handling committee exists today.

Usually these industry problems start out as small ones. But they keep growing constantly and ultimately assume monumental proportions. As a problem grows, confusion starts within the industry. Both individuals and organizations concerned join cliques or groups to press more effectively for their own individual points of view. And as the problem grows larger, parts of the industry upheaval spill over into the minds of the public or into the hands of the legislators. The result in either of the latter cases serves only to harm the industry! A confused public will reflect its displeasure with less buying dollars, and legislation all too frequently enhances rather than reduces the immediate problem.

Types of Problems

High Fidelity

What types of problems are there? Well a good one to start off on might be the current High Fidelity (Hi-Fi) fiasco. For many years the industry has been saddled with this general term, and many groups have wrestled with this problem in vain. The difficulties of arriving at a definition are of course apparent. The desirable frequency responses of either the individual or overall input, amplifying, and reproducing elements; the intermodulation distortion; the directivity of microphones and speakers etc., are in effect system engineering probems. An all-industry committee could, by mutual agreement, settle the issue with dispatch because it is of mutual advantage to do so.

Printed Circuits

Printed circuits represent another area of rapidly growing dispute within the industry. In the booklet "Printed Circuit Techniques" published through the government printing office in Washington, there is the statement that circuits are defined as printed when they are produced on an insulated surface by any means. Painting, spraying, chemical deposition, vacuum processes, die stamping, and dusting are listed as the methods now in use. In discussing the subject with many of the manufacturers, however, it becomes quite apparent that each considers his product to be the only "true" printed circuit! And so again there is needless confusion and upset in our industry which works only to the disadvantage of all concerned.

Antennas

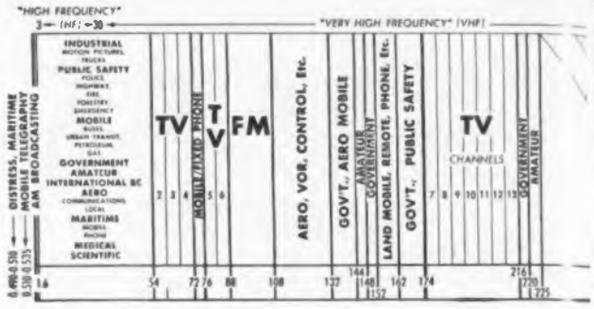
The advertised technical specifications of television receiving antennas, especially the performance curves, in many instances look more like the advertising manager's dream than they do engineering actuality. Apparently, in our industry, antennas are somewhat like cigarettes. Each brand is better and all perform to a degree. With cigarettes, the tobacco at least is the common denominator. Certainly there should be some common denominator for all the claims and counterclaims that tell what antenna to use and what the array will do electrically.

Permanent Policing

Policing the industry to establish a code of ethics that will prevent direct or indirect consumer purchases of substandard products through fraudulent advertising is best done by the industry itself. Note too that the self-policing in our industry before (1938—when Caldwell-Clements exposed the counterfeit radio sets faked with dummy tubes) has not been permanent. We definitely need a permanent, all-industry, engineering committee to spell out the technical framework so as to avoid government intervention and undesirable trade barriers.

RADARSCOPE

Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation



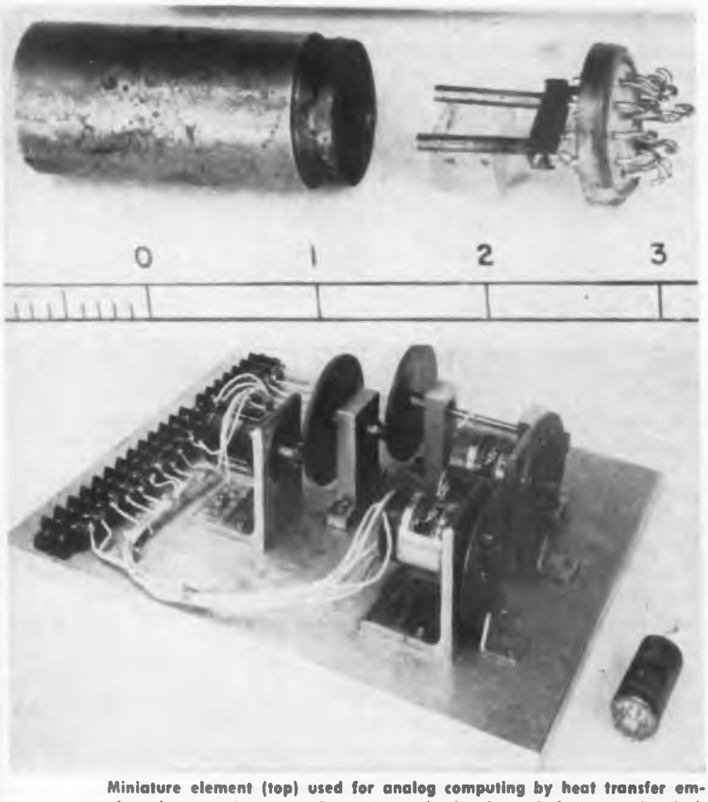
TRAVELING-WAVE TUBES will be taken out of the laboratory and introduced in commercial microwave relay systems during the fall of this year. Such systems have favorably withstood the test of time in European installations.

COLOR TV BROADCAST equipment has been installed in over 30 big-city stations, now geared to rebroadcast network color programs.

MAGNETIC TAPE BOOKS are in the wind again. Idea of having library on reels was discussed in 1930's, and may burst into fruition within a year or two. Low-cost recorder, comparable to ac-dc radio, is needed for mass acceptance.

SILICON TRANSISTORS have been announced by Philco and Raytheon. Units can operate up to 350°F, and possibly several hundred degrees higher, according to reports. They are not yet available for production.

HEAT TRANSFER COMPUTER



Miniature element (top) used for analog computing by heat transfer employs heater wires wound on two rods. In thermal, but not electrical, contact with heater, are sensing wires. Input signals are converted into heat, and differences between sensor resistance changes perform integration and other analog functions. Unit developed by Arma Corp. can replace much larger geared assembly (bottom) in servo system. Among many potential uses are controls and instrumentation. For complete technical details, see page 101 in Feb. 1954 TELE-TECH & ELECTRONIC INDUSTRIES

INTERESTING LEGAL-TECHNICAL question being asked behind closed doors is: "Do transistors made by surface-barrier method come under scope of Bell patent claims?"

AUTOMATIC CHROMA CONTROLS will be incorporated in color TV sets coming off production line within one year, according to Dr. George Brown of RCA.

INGENIOUS TEST TAPE for magnetic recorders is scheduled for introduction in month or so. It will include methods for checking frequency response, tape speed, wow and flutter, signal-to-noise ratio, and new way of measuring head azimuth alignment.

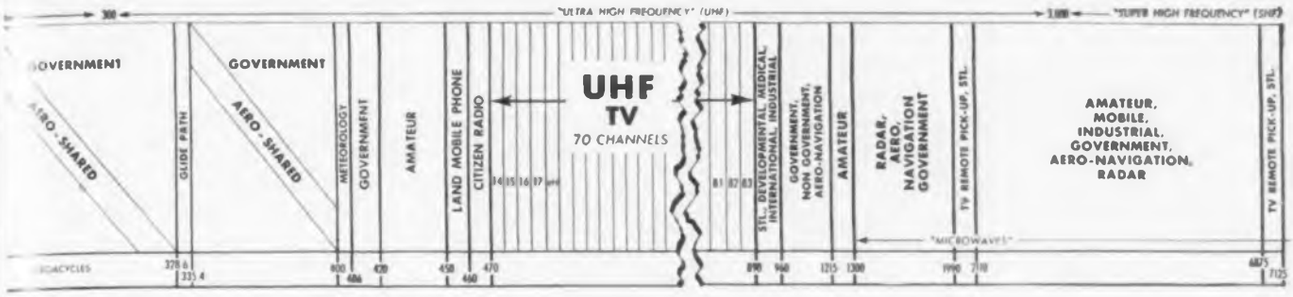
ENGINEERING GRADUATES will decline in number this year. Some 17,000 will receive baccalaureates in June 1954, a drop of about 4500 from previous year. Heartening sign is expected rise of master and Ph. D. degrees over 1953's 4200.

AIRCRAFT CONTROL system which automatically lands planes on rolling and pitching decks of aircraft carriers has been developed by Minneapolis-Honeywell in cooperation with Bureau of Ships.

STRICTER FCC MONITORING of frequencies is likely for 1954-1955. Eisenhower's budget request for fiscal 1955 asked for almost $1 million for frequency surveillance in the 10 to 27,500 KC range. It will aid more efficient spectrum allocation and bolster national security.

MILITARY

RADAR can be a decisive element in winning—or even preventing—wars. As has been done since science began, as offensive tactics were evolved, defensive ones have been developed to cope with them. Nowhere is this more manifest than in the closely guarded radar race. First countermeasures are developed, then counter-counter measures, then counter-counter-countermeasures, and so on. This is typified in the war on submarines, where search radar is made increasingly sensitive, and snorkels are made decreasingly reflective. The latest thing in the works is a system which may become a keystone in our continental defense. It can jam enemy airborne radar on any frequency, up to several hundred miles away. And the race goes on, at each step pointing up the need for a large pool of highly trained electronic engineers.



BROADCASTING

COMPUTATION OF DEPRECIATION for tax purposes appears to rest on an optimistic long life expectation, according to the existing Bureau of Internal Revenue schedule. A recent DuMont proposal filed with the Bureau presents a more realistic depreciation rate for TV equipment. It can affect station income for many years to come. Excluding building and towers, DuMont proposes that the overall life of TV station equipment be set at six years for VHF and five years for UHF, instead of the present interim rate of 15 years for audio and 10 years for video equipment. Suggested life span for specific equipment involved follows similar pattern.

EMPLOYMENT

ENGINEERING PERSONNEL REQUIREMENTS for 1954 are about on par with the previous year. According to the Engineering Manpower Commission, out of 106 companies seeking technical college graduates in 1954, 52 have same requirements as a year ago, 30 want more, and 24 want fewer. In 1953, 56 wanted the same, 33 wanted more, and 10 wanted less than the year before.

COMMUNICATIONS

EXTREMELY LONG DISTANCES are being covered by transmissions from VHF and UHF communication and TV transmitters. Multi-channel telephone carriers are spanning the Mediterranean with 300-mile jumps. Experiments at 400 mc indicate reliable operation with medium power over 100 to 200 mile links. Several TV stations in Texas and Mexico report clear reception from 250 to 330 miles away. With the development of high-power transmitters and very-high-gain antennas especially designed for point-to-point communications at frequencies below 1000 mc, we can look forward to greater utilization of the spectrum for long distance communications, both within countries and between continents.

INTERNATIONAL

A NEW LANGUAGE for scientists and engineers, Interlingua, is very slowly but surely starting to gain acceptance. It is based on the fact that the languages of the West fall into one pattern, called Standard Average European. Since science is a kind of supranational language, scientists understanding Interlingua would be able to follow developments in other countries without spending much time learning several other languages. Interlingua, which is not intended to be a single world language for all people, was started in 1923 by a group of technical men. Now, a 27,000-word Interlingua-English dictionary, including 17,000 technical terms, is in preparation. The new medium can often be read with little reference to the dictionary. For example, "Energia es necessari pro toto que ocurre in le mundo," means "Energy is necessary for all that occurs in the world."

COLOR TV PICTURE TUBES

One of the big limitations on the growth of color TV has been the small size of most of the picture tubes available. This obstacle is starting to disappear, and one of the most welcome indications is the announcement of a 19-inch tricolor tube, which RCA plans to make available in limited quantities during the latter half of 1954. Dr. D. Joseph Donahue is shown comparing the 15-inch shadow mask tube with the new model. RCA reports that it is also working on a focus-mask type rectangular tube, 21 inches and very bright, for production next year

1954 IRE National Convention

Kingsbridge Armory will house 3 meeting halls and 600 manufacturers' exhibits

MARCH 22nd will mark the beginning of another record-breaking four-day IRE National Convention. New York City's Waldorf-Astoria and Shelton Hotels will provide four session halls this year for the presentation of the majority of the 243 scheduled technical papers. Additional facilities for the presentation of three simultaneous technical sessions will be provided at the Kingsbridge Armory in the Bronx. A total of 51 sessions, topping last year's figure of 43, will be held in the seven meeting halls between March 22 and 25.

Exhibits of the Radio Engineering Show, formerly located at Grand Central Palace, will also be housed at the armory. Attendance is expected to surpass 1953's record of 35,642 and it is reported that 600 exhibits, better than a 40% increase over last year, will be erected on the four-acre floor of the armory.

The convention's social program will be initiated by a "get-together" cocktail party on March 22 in the Grand Ballroom of the Waldorf-Astoria. Two evenings later, the Grand Ballroom will be the scene of the Annual Banquet, at which Dr. Alfred N. Goldsmith, Editor Emeritus and co-founder of the IRE will deliver the major address on the topic: "IRE —Past and Future." (Dr. John R. Pierce, of the Bell Telephone Laboratories has been named Editor of the Proceedings of IRE for 1954.)

William R. Hewlett will formally assume the presidency of the Institute at the Convention's opening meeting on March 22nd at 10:30 A.M., also to be held in the Waldorf's Grand Ballroom. Professor John D. Ryder will be the principal speaker at this meeting.

The technical program includes the following papers:

Monday, March 22

SYMPOSIUM: ADVANCES IN MOBILE COMMUNICATIONS

"Transient Response of Selective Networks and Impulse Noise in Narrow Band FM Receivers," by S. P. Lapin and J. J. Suran
"Advances in Petroleum Mobile Communications," by L. A. M. Barnette
"A New Approach to 450-470 Mc Communications Equipment," by R. W. Tuttle
"Operation and Planning on a Utility System," by A. B. Buchanan

INFORMATION THEORY I—APPLICATION OF INFORMATION THEORY TO COMMUNICATION SYSTEMS

"Information Theory—Past, Present, and Future," by R. M. Fano
"Optical Filters—Their Equivalence To and Difference From Electrical Networks," by T. P. Cheatham, Jr.
"Theoretical Improvement in Signal to Noise of Television Signals by Equivalent Comb Filter Technique," by M. B. Ritterman and M. J. Stateman
"Information Losses in Regenerative Pulse Code Systems," by W. D. White
"A Gaussian Noise Generator for Frequencies Down to 0.001 Cycles Per Second," by D. F. Winter

AERONAUTICAL AND NAVIGATIONAL ELECTRONICS I

"An Impulse Generator for Receiver Performance Measurement," by J. H. Vogelman
"Aerial Methods in Microwave Survey," by M. Sheldon and L. Dickerson
"The Development of a Production Radome Tester," by R. P. Walcutt
"A Correlation Direction Finder for Guided Missile Range Instrumentation," by M. S. Friedland and N. Marchand
"Present Status of Microwave Radiometric Receiver Development," by R. M. Ringoen

QUALITY CONTROL AND RELIABILITY

"Improving Reliability of Electronic Equipment by Effective Analysis of Field Performance," by R. R. Landers
"A Survey of Electronic Failure Prediction Techniques," by J. H. Muncy
"A New Approach to the Attainment of Reliability in the Production of Airborne Electronic Systems," by A. Warsher and F. Hanusek
"A Method of Testing and Evaluation of Complex Missile Systems," by E. J. Althaus, S. C. Morrison, and W. R. Tate

RADIO TELEMETRY AND REMOTE CONTROL I—SYSTEMS AND ELEMENTS

"Guided Missile Range Instrumentation—A New Electronic Art," by M. S. Friedland
"Interpretation of Sequential Samples from Commutated Data," by L. L. Rauch
"Comparison of Required Radio Frequency Power in Different Methods of Multiplexing and Modulation," by M. H. Nichols
"Flight Testing of an Airborne Digital Computer," by E. M. Grabbe and D. W. Burbeck
"Evaluation of Magnetic Tape Equipments for Telemetering Instrumentation," by R. E. Rawlins

ELECTRONIC COMPONENTS I—TECHNIQUES

"The Effect of Maintenance on Reliability of Complex Military Electronic Equipment" by J. B. Arnold

William R. Hewlett
President of the IRE for 1954

"Miniaturized Computer Applications of the Hughes Diode," by S. G. Lutz
"Subminiaturization Techniques for UHF Communication Equipment," by G. Shapiro
"Synthetic Quartz Crystals for the Electronic Industry," by D. R. Hale and W. H. Chambonnet
"Application of Precise Components in Permeability Tuned Oscillators," by D. M. Hodgin

RADIO COMMUNICATIONS I—SYMPOSIUM: FACSIMILE

"Facsimile Systems," by A. S. Hill
"Operation of International Commercial Radiophoto Circuits," by M. P. Rehm
"Applications of Facsimile in the USAF," by H. R. Johnson
"Application of Cathode-Ray Tubes in Facsimile Systems," by W. H. Bliss

Preview

atest electronic engineering developments o be covered by 243 technical papers in 51 essions. Kingsbridge Armory houses 600 manufacturers' exhibits on single floor

Inside armory exhibitors will occupy 4½ acres of floor space

uesday, March 23

AERONAUTICAL AND NAVIGATIONAL ELECTRONICS II

"he **Digitac Airborne Digital Computer,"** by E. Bolles
"New Fixed-Beam Instrument Approach ystem for Aircraft," by R. A. Hampshire
"he Role of Flight Directors in Present-Day ircraft," by N. L. Graham
"he Navaglobe Long Distance Navigation ystem," by C. T. Clark, R. I. Colin, M. ishal, I. Gordy, and M. Rogoff
"The N-I Compass," by R. C. Rosaler

ENGINEERING MANAGEMENT I

"The Engineer and Return on Investment," by S. C. Peek
"Technical Information: Communication for Research," by C. De Vore
"A Working Philosophy for Engineering Management," by T. G. Slattery
"Organization for Operations Research," by F. Weldon
"Training for Operations Research Groups," by T. Page

RADIO TELEMETRY AND REMOTE CONTROL II—TELEMETRY

"A 227 Mc Pulse Position Modulation Telemetering System," by D. G. Mazur
"Crystal Control Low Distortion FM Telemetering Transmitter," by R. E. Rawlins
"A Crystal Controlled FM Telemetry Transmitter," by F. N. Reynolds
"A New Subcarrier Oscillator," by J. W. Wynn

AUDIO I—HIGH FIDELITY

"Large Area Microphones for Distant Pickup Use," by T. Aamodt and F. K. Harvey
"The Enhancement of Music by Reverberation," by D. W. Martin

(*Continued on page 134*)

TECHNICAL PAPERS TOPICS, SYMPOSIA, and their LOCATIONS for 1954 IRE CONVENTION

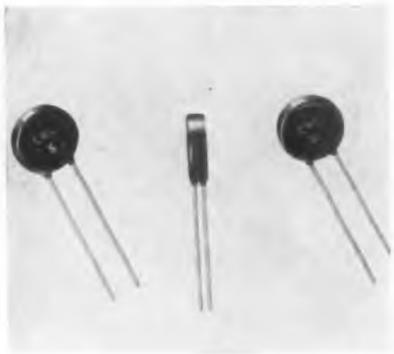
	SHELTON HOTEL	WALDORF-ASTORIA HOTEL			KINGSBRIDGE ARMORY		
	Ballroom	Grand Ballroom	Astor Gallery	Jade Room	Marconi Hall	Faraday Hall	Morse Hall
Mon. 2:30 P.M.	Session 1 Vehicular Communications Symposium: Advances in Mobile Communications	Session 2 Information Theory I Application of Information Theory to Communication Systems	Session 3 Aeronautical and Navigational Electronics - I	Session 4 Quality Control and reliability	Session 5 Radio Telemetry and Remote Control - I Systems and Elements	Session 6 Electronic Components - I Techniques	Session 7 Radio Communications - I Symposium: Facsimile
Tues. 10:00 A.M.	Session 8 Aeronautical and Navigational Electronics - II	Session 9 Engineering Management - I	Session 10 Radio Telemetry and Remote Control - II Telemetry	Session 11 Audio - I High Fidelity	Session 12 Information Theory - II Coding and Noise	Session 13 Broadcast and TV Receivers - I General	Session 14 Electronic Components - II Application
Tues. 2:30 P.M.	Session 15 Aeronautical and Navigational Electronics - III	Session 16 Engineering Management - II Symposium: Personnel Training and Selection for Engineering Management	Session 17 Medical Electronics	Session 18 Audio - II General	Session 19 Information Theory - III Speed and Computation	Session 20 Broadcast and TV Receivers - II Color Television	Session 21 Radio Communications - II General
Tues. 8:00 P.M.		Session 22 Medical Electronics Symposium: Engineering Based on Biological Design			Session 23 Audio - Seminar High Fidelity in Audio Engineering		
Wed. 10:00 A.M.	Session 24 Nuclear Science - I Symposium: Progress Report	Session 25 Electron Devices - I Electron Tubes	Session 26 Broadcast Transmission Systems - I Symposium: TV Broadcasting	Session 27 Electronic Computers - I Computer Design and Techniques	Session 28 Circuit Theory - I Symposium: Network Equalization	Session 29 Instrumentation - I	Session 30 Antennas and Propagation - I General
Wed. 2:30 P.M.	Session 31 Nuclear Science - II Symposium: Reactor Electronics	Session 32 Electron Devices - II Transistors	Session 33 Broadcast Transmission Systems - II Symposium: Color TV Broadcasting	Session 34 Electronic Computers - II Computer Components	Session 35 Circuit Theory - II Circuit Theory	Session 36 Instrumentation - II Symposium: High Frequency Measurement and Control	Session 37 Antennas and Propagation - II Microwave Antennas
Thurs. 10:00 A.M.	Session 38 Industrial Electronics	Session 39 Circuit Theory - III Network Synthesis	Session 40 Electron Devices - III Storage Tubes	Session 41 Ultrasonics - I	Session 42 Antennas and Propagation - III	Session 43 Microwave Electronics - I Ferrites and Strip Lines	Session 44 Instrumentation - III
Thurs. 2:30 P.M.	Session 45 Radio Telemetry and Remote Control - III Remote Control	Session 46 Circuit Theory - IV Transistor Circuits	Session 47 Electron Devices - IV Microwave Tubes	Session 48 Ultrasonics - II	Session 49 Antennas and Propagation - IV Symposium: UHF Television - Boom or Bust	Session 50 Microwave Electronics - II Components	Session 51 Electronic Computers - III Discussion

New Products at

Previews of new equipment and wha

Booth 7 — Capacitors

"Centrathene" insulated molded disc ceramics are said to have high breakdown to ground, lead strength, and resistance to mechanical damage. The units can be placed directly against a chassis or adjacent to high voltage



leads without danger of flashover or breakdown. Voltage ratings are 1,000 VDCW to 4,000 μμf, 600 VDCW to over 4,000 μμf. Tolerance is ±10% 5 μμf through 680 μμf., ±20% 750 μμf through 3,300 μμf. Guaranteed minimum value, 4,000 μμf through 10,000 μμf. **Centralab, Div. Union-Globe Inc., 900 East Keefe Ave., Milwaukee 1, Wis.**

Booth 123 — Capacitor

The piston type variable trimmer capacitor shown in the illustration is a

new development with a dust-proof metal cap with an extruded lead-in rather than the old wire wound pigtail lead-in. Another new feature soon to go into production, is a piston capacitor with an invar band and an invar sheet lead-in without soldering or other metals which will eliminate loss due to metals and add stability to capacitance. **JFD Manufacturing Co., 6101 Sixteenth Ave., Brooklyn 4, N.Y.**

Booth 129 — L,C Meter

Designed for the development engineer, type 130 L,C meter enables quick readings of inductance and capacitance values while circuit changes are being made. It is also suitable for testing sorting, and color code checking on a pro-

duction basis. The unit has coarse and fine zero adjustment controls and an illuminated 4-inch meter. Five ranges, 0-3, 0-10, 0-30, 0-100, and 0-300 μh or μμf are accurate within 5% full scale. Weight, 9 lbs. **Tektronix, Inc., P.O. Box 831, Portland 7, Ore.**

Booth 261 — TV Camera System

The "Kay-Lab" TV Camera System comprises three basic units: camera; camera control; and synchronizer monitor. The system enables the installation of additional cameras and controls without equipment duplication. Use of an accessory modulator unit enables

distribution of the composite TV signal at video level or at the frequency of any of the standard commercial broadcast channels. Scanning lines, 525; Interlace, 2 to 1; Field repetition rate, 60/sec.; Frame repetition rate 30/sec.; line repetition rate 15,750/sec.; Synchronization, AFC power line frequency; Camera band width, 8 MC.; Video line amplifier band width, 8 MC. **Kalbfell Laboratories, Inc., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.**

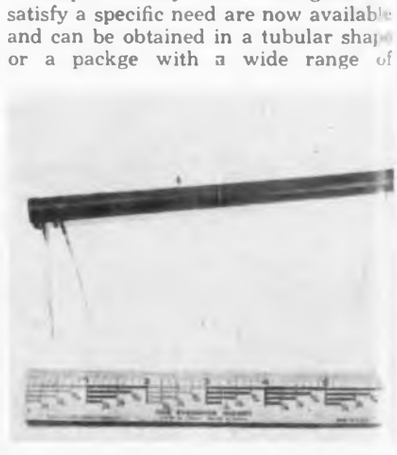
Booth 281 — Power Supplie

The series "RP" 41, 42, 43, and 4 regulated dc power supplies are dynamically compensated to provide ze or slightly negative internal impedan to compensate line voltage between th power supply and the consumer. Sup-

plies are rated nominally as follows: RP-41, 250 v. 0-50 ma.; RP-42, 250 v. 0-100 ma.; RP-43, 400 v. 0-50 ma.; RP-44, 400 v. 0-100 ma. All regulators have a stability of 0.5% at rated voltage over the full load range with line voltage variations between 10% above and 10% below rated value of 117 v., 60 cps. **Millivac Instrument Corp., P.O. Box 997, Schenectady, N.Y.**

Booth 330 — Delay Lines

Compact delay lines designed to satisfy a specific need are now available and can be obtained in a tubular shape or a packge with a wide range of



mountings. The delay line for color T shown has the following specification Delay, 1 μsec, nominal; Impedan 1,000 ohms ±10%; Voltage rating, 500 Frequency response, phase, line within 1% over 6 MC's; amplitude, f within 0.5 db to 3.5 MC., down 1.5 at 5 MC., down 3 db at 8 MC., down db at 10 MC. Leads 2 in., No. 20 tinn copper. **Technitrol Engineering C 2751 North 4th St., Philadelphia 33, P**

The IRE Show

Exhibits will display at the convention

Booth 386 — Measuring Set

The "Universal" measuring test set for direct current consists of three identical instruments having a full scale sensitivity of 5 ma and 100 mv, and one galvanometer. Each instrument will measure ma., amps., mv., and

v. As they are interchangeable, the user can combine those he needs to perform desired measurements. The galvanometer has a basic sensitivity of 50-0-50 μa with multiplying factors of 1 3/10/30/100. Accuracy —0.5 of 1%. Ranges, 1 μa to 60 amps. Voltage, 1 mv. to over 750 v. Scale length 4 in., each instrument. **Sensitive Research Instrument Corp., 9-11 Elm Ave., Mount Vernon, N. Y.**

Booth 711 — Reflection Coefficient Meter

Model 136A, a reflection coefficient meter, is designed for the rapid measurement of reflection coefficient or VSWR. The unit includes a local oscil-

lator that is continuously tunable from 92 to 355 MC and an i-f amplifier centered at 60 ±2 MC. The oscillator produces a harmonic in the range 184 to 710 MC, and a third at 276 to 1,065 MC. Any harmonic can be used to mix with the incoming signal to produce the 60 MC i-f signal. **Sierra Electronic Corp., San Carlos 2, Calif.**

Booth 786 — Oscillator-Wavemeter

Model U-4, a new type grid-dip oscillator-wavemeter, is designed specifically for UHF-TV band use. It covers the 450 to 900 MC range in excess of the allocation for UHF video transmission. Tuning element uses low-loss cav-

ity resonated to desired frequency by a split-stator type capacitor. The resonant cavity is coupled by a small external loop that is not part of the tuned circuit. The unit is designed to enable ready access to other cavities, transmission lines, or virtually any type of UHF tuned circuit. **Linear Equipment Laboratories, Brightwater Place, Massapequa, L. I., N. Y.**

Booth 533 — Tubechecker

Model 981 type 2, proportional mutual conductance tubechecker, consists of a vacuum tube and voltage regulator tester mounted in one assembly. Protection against obsolescence is obtained by use of nine single-circuit,

twelve-position, selector switches which make possible more combinations of tube connections. Three toggle switches enable checking and comparing the sections of twin section tubes at one selector switch setting. Sockets are provided for conventional type tube bases as well as for acorn, and 7 and 8 pin subminiatures. **Weston Electrical Instrument Corp., Newark 5, N. J.**

Booth 776 — Milliammeter

A new design ink-writing, dual-recording milliammeter uses standard curvilinear chart paper and features two independent channels and four selective chart speeds. The speeds range from 12 in./hr. to 12 in./min. allowing

continuous recording up to 100 hrs. Frequency response ranges through 15 cps with an accuracy of ±5% from dc through 6 cps. Sensitivity is 0.45 in./100 μamps. with a linear recording range to 500 μamps. Unidirectional recording is possible to 1 ma.—**Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas.**

Booth 810 — Code Sender

Smaller and lighter than a typewriter, the Model EBC2, is a new, simplified device for automatically sending Morse code. Leads are clipped across a hand key or to a transmitter and a touch of the letter buttons of the unit

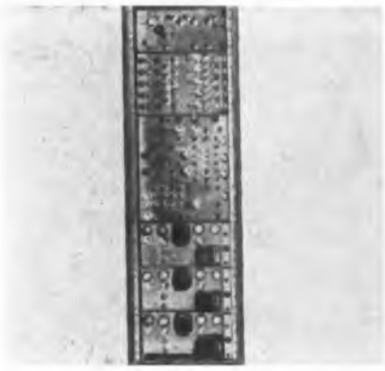
forms the code message electronically at any speed from 10 to 75 wpm. Designed for ac or dc operation, the unit contains only 12 miniature tubes, and has a continuously variable speed control. It also incorporates encapsulated unit cells, a self-contained monitor, a keying relay output, and an internal power supply. **Codetyper Laboratories, 530 Fifth Ave., New York 19, N. Y.**

IRE Show Exhibits

Previews of the latest electronic equipment that

Booth 823 — Color TV Conversion

A new color conversion package converts any monochrome synchronizing generator for color, generates standard color bars, and encodes output of color bar generator, color camera chain, or



color slide scanner to produce composite color video signal. The equipment consists of model ISG-1 interlace signal generator, model CBG-1 color bar generator, model CC-1 color coder, and power supplies. Interlace signal generator produces 3.579545 MC reference signal. Oscillator output is available at 75-ohm termination, and at output of three isolation and distribution amplifiers. **Wickes Engineering and Construction Co., 12 St. and Ferry Ave., Camden 4, N. J.**

Booth 520 — Electronic Counter

Pulse or sync wave signals of 10 mv or greater at frequencies up to 1000 cps are counted by model 21 electronic totalizer. Two decade counting tubes are used with a six-digit mechanical register. Decade-counting tubes are rated at 10,000 hours and the 5000 hour

industrial type electronic tubes are operated at a fraction of their normal load for comparable long life. A remote start-stop connection is provided in addition to the manual switch to facilitate counting over controlled time intervals. **Potter Aeronautical Co., Route 22, Union, N. J.**

Booth 409 — Power Supply

The 6/12 v. Duovolt Genemotor incorporates two 6 v. input windings, each having its own field, for the operation of mobile radio equipment requiring a dual-voltage power supply. Duovolt powered radio equipment may be transferred from one car to another,

regardless of battery voltage, without impairment of transmitting or receiving quality, without replacement of the Genomotor, and without modification of the wiring hookup. The Duovolt is the same size as standard Carter Genomotors except for ⅞ in long length. End brackets with removable cover plates permit easy commutator inspection. **Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.**

Booth 390 — Connectors

Series SM and MX subminiature and miniature connectors, produced in England, are highly specialized. The Type MX, are small, lightweight, non-military plugs and sockets with a matched impedance of 63 ohms. Teflon insulated, the units have spring loaded quick con-

nect-disconnect action. The type SM are fractional size and weight constant-impedance connectors. Frequency limit is 2,000 MC/S. Maximum voltage 500 v. peak; 50 to 70 ohms. Units are heavily silver plated. **Transradio Ltd., 138A Cromwell Road, London, S.W.7, England.**

Booth 715 — Capacitors

A representative line of polystyrene capacitors, in standard and extended temperature stabilized ranges in values from 0.01 to 10 rf at tolerances from 0.1 to 1.0%, features a 1 mfd. ultra precision capacitor that enables setting to 1 part in 10,000 with long time stability in

the order of 0.03%. These units also exhibit temperature coefficients of 100 P.P. M./°C. to 140° F. Conservatively rated at 200 v. dc, the units show no trace of voltage coefficient. Inherent noise is not measureable. The capacitor is hermetically sealed, and has all the advantages of high insulation resistance, low power factor and soakage. **Southern Electronics Co., 239 W. Orange Grove Ave., Burbank, Calif.**

Booth 387 — Amplifier

The FXR Type B810A standing wave amplifier is designed to provide full utilization of the latest precision slotted sections and probes when measuring the impedance or VSWR in a coaxial or wave guide transmission line. VSWR range is to 100. Noise level is less than

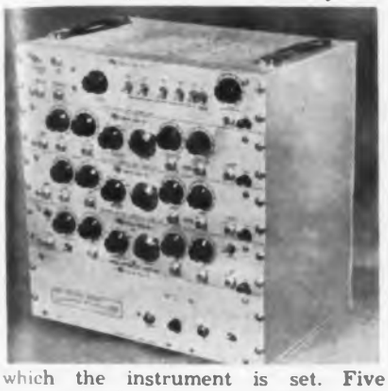
0.03 μv. Variable 3.5 to 9 ma. constant current-metered bolometer bias. Automatic bolometer protective circuit. Narrow and wide band operation. **F-[illegible] Machine Works, Inc., 44-14 Astoria Blvd., Long Island City 3, N.Y.**—TELE-TECH & ELECTRONIC INLUSTRIES

and New Products

will be on display during forthcoming convention.

Booth 817 Time Delay Generator

Model 221A time delay and gate generator gives a high-resolution, accurate time delay from an external trigger source. It also generates both positive and negative gate pulses whose width corresponds to the delay for



which the instrument is set. Five ranges of pulse delay are available with upper limits as follows: 1.0, 10, 100, 1,000, and 10,000 μsecs. Positive and negative delayed outputs from a blocking oscillator through a cathode follower and from the plate, respectively, are available. **Electro-Pulse, Inc., 11811 Major St., Culver City, Calif.**

Booth 869 Surface Indicator

The Model BL-110 is designed accurately to measure surface finish roughness ranging from 1 to 1,000 microinches. It can be calibrated to read directly in arithmetric average or RMS microinch diviation from the mean surface. A variable cut-off switch permits the separation of waviness and roughness characteristics of surfaces by filtering out wavelengths exceeding

0.003, 0.010, or 0.030 inch. The instrument case contains the indicating meter, amplifier, power supply, controls. The hinged cover houses the pick-up and precision reference specimens which comply with the American Standards Association, Standard B 46.2 and the Society of Automotive Engineers' requirements. **Brush Electronics Co., 3405 Perkin Ave., Cleveland 14, Ohio.**

IRE Exhibit Summaries

Booth 106-108 Inverters

Several models of inverters, emphasizing new type of control and shock mount. Demonstration of vibration isolating mechanism. **Leland Electric Co.**

Booth 141 Packaging

New approach to packaging electron tubes and delicate instruments. Methods of reducing shipping costs. **Cargo Packers, Inc.**

Booth 155 Broadcast Equipment

New 1-kw UHF-TV transmitter, system for AM remote control, and portable remote equipment for AM and TV. Also, consoles, plug-in amplifiers and standby transmitter. **Gates Radio Co.**

Booth 214 Control Panels

Illuminated control panels, dials, knobs, and switch assemblies. Test equipment for organic coatings. **Universal Aviation Equipment, Inc.**

Booth 350 Metal Strip

Very close tolerance strip metals, tin gages, foils and clad metals. Coil metals, silver brazing material, and thermostatic bimetals. **American Silver Co.**

Booth 424 Signal Generators

New time-delay generators, pulse generator, pulse train calibrator, range sweep generator, and other test instruments. **Rutherford Electronics Co.**

Booth 465 Wire & Cable

Fine wire, ground rods and clamps, guy strand, antenna wire, grounding wire, hook-up wire, twin-lead, and coaxial cables. **Copperweld Steel Co.**

Booth 488 Fuses

Small dimension fuses of various types. Dual-element, slow-blowing fuses, and fast acting fuses for circuit protection. Fuse blocks, clips and holders. **Bussmann Mfg. Co.**

Booth 490 Capacitors

Mica capacitors, paper capacitors, and electrolytic capacitors. Engineering consultation. **Sangamo Electric Co.**

Booth 489, 493, 496 Color TV Equipment

Color film and slide equipment, color TV test devices for manufacturers and broadcasters, color TV microwave. New surface-barrier transistor. **Philco Corp.**

Booth 501 Solder

New line of solders and fluxes for printed circuits, and low melting alloys for use with diodes and transistors. General purpose rosin-filled solder. **Alpha Metals, Inc.**

Booth 511-513 Phototransistors

Compact transistorized automatic headlight dimmer for cars features phototransistors and junction transistors. Also, hermetically sealed power diodes. **Radio Receptor Co.**

Booth 523 Magnets

New type of permanent magnet, TV focusing units, polarized relays, high frequency mechanical oscillators, and loudspeaker magnets. **Indiana Steel Products Co.**

Booth 692 Engineering Study

Home study engineering courses in radio broadcasting, TV, communications and servicing. **Capitol Radio Engineering Institute.**

Booth 705, 802 Winding Machines

Automatic and semi-automatic toroidal coil winders, new winder for subminiature coils, new tape winding machine ,and new shuttle head assembly for winding stacked coils. **Boesch Mfg. Co.**

Booth 725, 727 Resistors

Standard and special power resistors, miniature resistors, resistor decade box, and screw-base resistors. **Clarostat Mfg. Co.**

Booth 744 Rectifiers

Rectifier used in magnetic amplifier circuit, and selenium rectifiers. **Kotron Rectifier Corp.**

Booth 756, 758 Potentiometers

Precision potentiometers employing spot-welded taps. **Helipot Corp.**

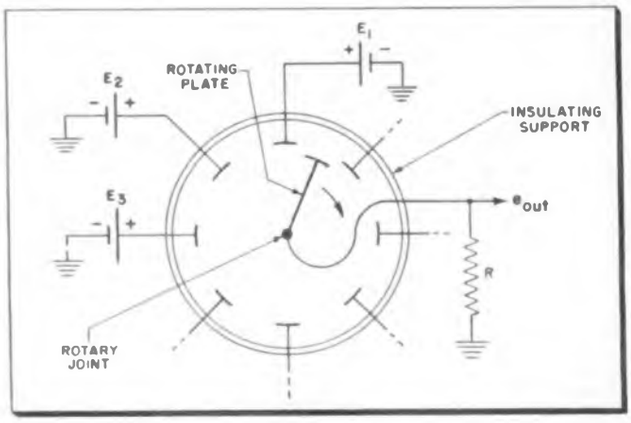
Booth 814 Microwave Lens

New reflectionless lens for microwave relays, design of free space antenna test rooms and radomes. Low-loss dielectrics and gas tubes. **McMillan Laboratory.**

Booth 835, 837 Printed Circuits

Various new grades of materials for printed circuitry. **Formica Co.**

Capacity Commutator Eliminates



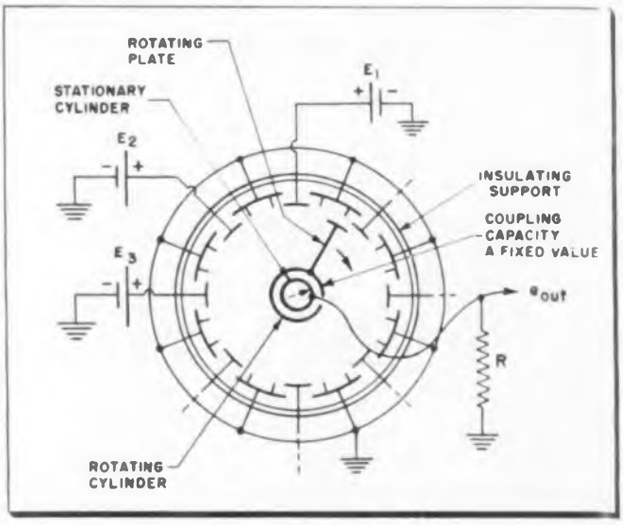


Fig. 1: (l) Crude capacity commutator would induce spurious voltages, crosstalk and be subject to friction. Fig. 2: (r) Improved design eliminates rotary joint by using coaxial cylinders. Ground plates between input plates provide shielding of static charge and decoupling

By DR. ANGELO MONTANI
Fairchild Guided Missiles Div.
Wyandanch, N.Y.

THE drawbacks of mechanical commutators are too well known for a detailed description. These drawbacks originate from the inherent destructive frictional effect between the sliding contacts. After a few hours of operation, chatter increases beyond tolerance and the imbedding of metal particles between the adjacent contacts introduces objectionable interchannel crosstalk. As a result, the life of any conventional type commutator is always too short, even when the operating speeds are limited to only a few revolutions per second.

Mechanical commutators have already taxed the ingenuity of designers for quite a long time, and it is best to consider whether sequential electrical contacts could be practically established by avoiding at the same time any mechanical contact. Hence, if a solution exists, it will be found by exploiting a phenomenon entering the "action at a distance."

Sequential Coupling

Eliminating, because of practical considerations, the effect of magnetic induction, the only remaining alternative is the investigation of the forces between electrical charges. That is, a variable-capacity type of sequential coupling.

The expression for the current across a variable capacitor is first determined. The electrical charge on a capacitor is

$$q = CE \qquad (1)$$

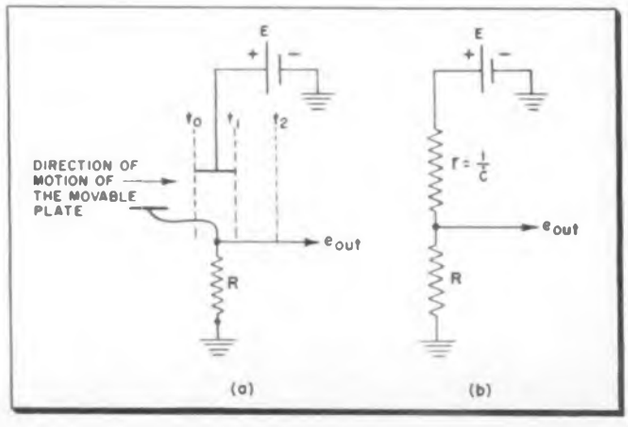
where: q = charge
C = capacity
E = volts

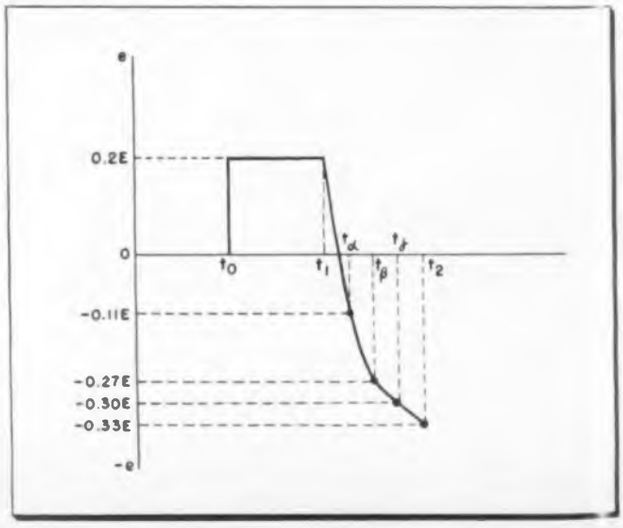
Assuming that the capacity increases linearly with time, as in the case of a rectangular parallel plate capacitor gradually meshing along one of the sides,

$$i = \dot{E}C \qquad (2)$$

In the above equation C has the dimensions of a conductance. That it is an actual conductance can be verified by differentiating with respect to time the dimensional formula for capacitance. This conductance may then be employed for sequentially connecting several inputs to a common output on a time sharing basis. A first mechanical

Fig. 3: (l) Circuit configuration of commutator element. For simplification, fringing effect is ignored by assuming zero capacitance before t_0. Fig. 4: (r) Output voltage curve for complete cycle from t_0 to t_2





Frictional Contacts

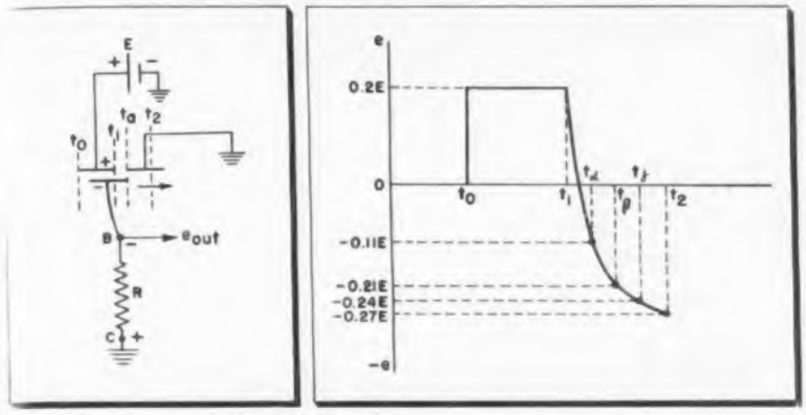


Fig. 5: (l) Circuit for analyzing unmeshing using ground plate. Fig. 6: (r) Output curve

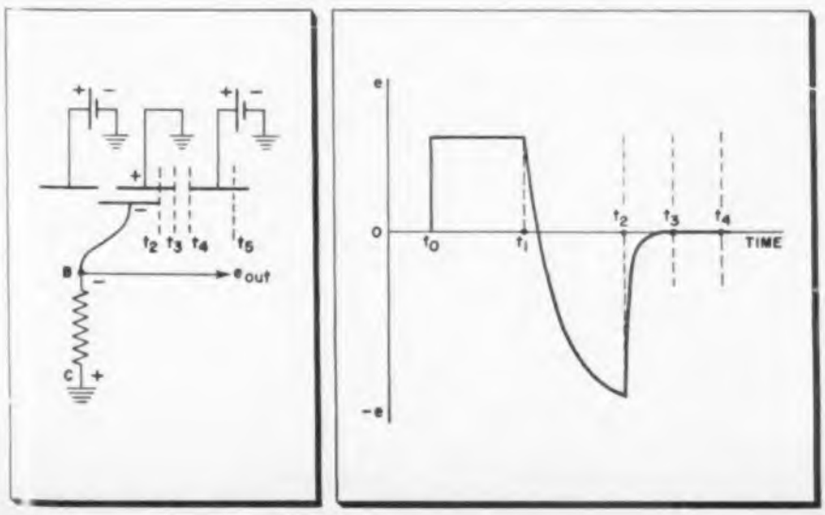
Inherent drawbacks of conventional rotary contact commutators are overcome with new design. Outputs of several circuits are sampled on a time-sharing basis

interpretation of this conclusion is sketched in Fig. 1.

The crude capacity commutator of Fig. 1 would give very poor results. As a matter of fact it would not work at all and it is here mentioned only because it directly points out the need for an improved design. Referring again to Fig. 1, it is easily seen how any static charge on the inner surface of the insulating support would induce spurious voltages in the output circuit. Furthermore, the stray capacity between the adjacent output plates would introduce intolerable crosstalk between the sampled channels. Last, but not least, the rotary joint between the rotating plate and the stationary output lead is still subject to the effect of mechanical friction.

In Fig. 2, the above shortcomings have been eliminated. First of all, there is no longer a rotary joint but a coupling capacitor of fixed capacity which is realized by means of two coaxial cylinders, insulated from each other. The inner cylinder being stationary and electrically connected to the output, while the outer one, carrying the sampling plate, is supplied with the motor torque. Interlaced with the input plates are located additional ground plates, which because of their sectional appearance may be referred to as π plates. They have a twofold purpose: Shielding the view of any eventual static charge on the insulating support from the rotating plate, and affording the static decoupling between sequential input plates, thus eliminating crosstalk. Their surfaces are kept as far as possible from the surface of the rotating plate because the capacity between the π plates and the rotating plate appears periodically in parallel to the resistance R thus shunting the output voltage. Constant angular velocity rather than constant torque is postulated in the present investigation. In practice, a constant velocity system is always encountered because of "flywheel effect."

Fig. 7: (l) Circuit for analyzing output after time t_2. Fig. 8: (r) Voltage output curve



Circuit Configurations

A sequence of circuit configurations is here analyzed, each following configuration representing a closer approximation to any one of the individual channels of the commutator.

Referring to Fig. 3a the simplifying assumption is made that zero capacitance is experienced before t_0 and after t_2 (the fringing effect is ignored). The represented times refer to the instantaneous positions of the leading edge of the sampling or movable plate, which has the same relative dimensions as any one of the stationary plates.

After t_0 the current equation is

$$i = (E - Ri)\dot{C} \qquad (3)$$

Because of (2) which conveys knowledge of the variation of i with C when the restriction

$\dot{C} = 0$ is also introduced,

the output voltage across R can be written down immediately.

$$e_{out} = ER\dot{C}/(1 + R\dot{C}) \qquad (4)$$

Between t_0 and t_1, the circuit of Fig. 3b is equivalent to that of Fig. 3a. Hence e_{out} is a step at t_0.

Another way of getting to the result would have been to solve for the equation

$$Rq + [q/(C + at)] \qquad (5)$$

where: $C + at = C(t)$

for $t_0 \leqslant t \leqslant t_1$.

Then letting C tend to zero and entering the initial condition of zero charge

$$e_{out} = ERa/(1 + Ra) \qquad (6)$$

which is the same as (4) because

$$\dot{C} = a \text{ if } \ddot{C} = 0$$

Also, for the unmeshing portion of the cycle, (5) becomes

(*Continued on page* 181)

Ultrasonic Metal Delay Lines

NBS investigation discloses materials which yield thermally stable delay lines. Finding should lead to improved computer and radar devices

THE National Bureau of Standards recently completed an investigation of metal ultrasonic delay lines for application in electronic computers, radar and ordnance devices. The study disclosed that use of isoelastic alloys containing combinations of iron, nickel, chromium, and other minor elements may solve one of the primary problems in this field—finding materials that yield a thermally stable delay line with respect to time delay. The investigation was conducted by R. W. Mebs, J. H. Darr, and J. D. Grimsley of the NBS thermal metallurgy laboratory.

A delay line is a device for slowing down or storing a signal in an electric circuit. At radio frequencies this can be done by transforming the electric signal into a much slower sound signal and propagating it through an appropriate medium. After a given length of time the sound signal is converted to an electric signal again.

The use of isoelastic alloys for delay lines is apparently new, although such materials have been known and used in other applications for over 50 years. Isoelastic alloys are ones which have a constant modulus of elasticity with respect to temperature changes. Their primary use to date has been in watch springs and similar applications. Since one of the requirements for ordnance delay lines is ability to give constant signal delay regardless of temperature changes, only the isoelastic alloys and relatively few other materials can be considered for such a use.

Use of Quartz and Mercury

Up to the present time quartz, mercury, water, and certain magnesium alloys have exhibited some of the qualities needed for use in ultrasonic delay lines. Quartz and mercury have been used fairly extensively in certain applications, but both have drawbacks. Quartz is expensive and hard to shape or machine while mercury is thermally unstable and is susceptible to mechanical shock, leakage, aging, and contamination. Mercury has been used, however, in the long delay lines of the NBS Eastern Automatic Computer (SEAC). In some devices

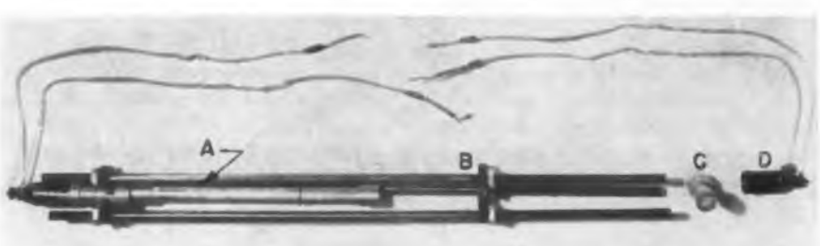
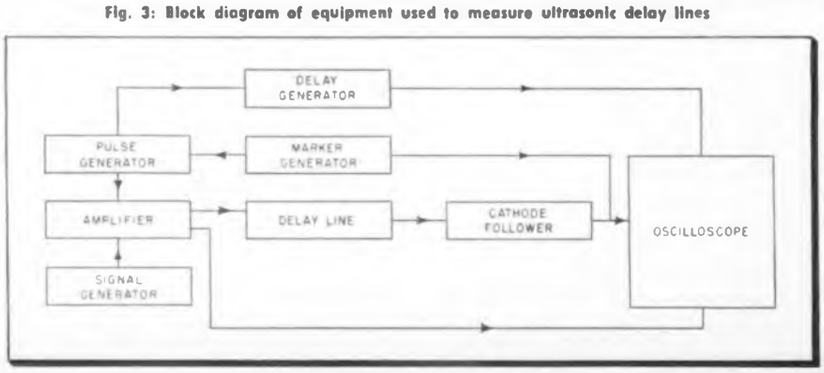


Fig. 1: Buffer technique for tests in which crystals were cemented to short lengths of magnesium alloy rods. (A) Specimen; (B) clamp holder; (C) magnesium alloy buffer with cement-attached crystal; (D) Electrical connector. Special clamp holds buffers against delay lines under test

Fig. 3: Block diagram of equipment used to measure ultrasonic delay lines



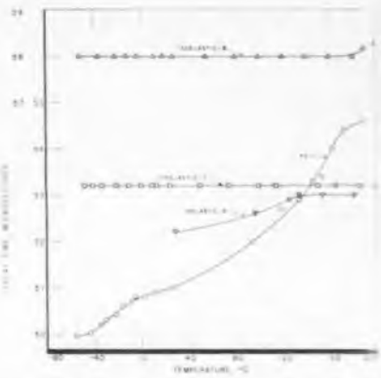


Fig. 2: Thermal stability of metal materials studied by NBS. FS-1 is for magnesium alloy

it is desirable to use a material that will transmit 10-MC pulses, without appreciable attenuation or distortion of the signal, and give a 50 μsec time delay. At the same time the material must be thermally stable and be easily shaped into specific dimensions. No delay lines developed so far have all these qualities.

Before the delay lines could be investigated, certain problems relating to the transducers used to transform the signal had to be solved. Quartz-crystal transducers were found to be the most efficient elements. The crystals were cut so that they transmitted only shear waves. Careful acoustical matching between delay line and crystal was required. The Bureau adopted a buffer technique (Fig. 1) for preliminary tests in which crystals were cemented to short lengths of magnesium alloy rods. A special clamp was devised to hold the unmounted ends of these buffers against the delay lines under test. In the second method for attaching crystals to delay lines, the one which was used in the final investigations, crystals were cemented directly to the delay lines as they would have to be in potential service use. Best signal characteristics were obtained using epoxy type cement and overcuring it.

Various Lengths Studied

Although the principal objective was to obtain a line of a length which would produce a delay of 2[illegible] μsec, specimens of various lengths were studied. This was done to determine the attenuation per unit length and the transducer or buffer loss associated with the various materials. Delay line length varied

(*Continued on page* 178)

Fig. 1: Computing equipment in Project Cyclone Simulation Lab. Power supplies and voltage regulators are located in room behind laboratory

"REAC" Computer Reliability

Data gained from experience of large analog installation in Project Cyclone Simulation Lab points up design features and operating procedures for enhancing reliability

By BERNARD LOVEMAN
Reeves Instrument Corp.
215 E. 91 St., New York 28, N.Y.

PROJECT Cyclone at the Reeves Instrument Corp. is under the cognizance of the Bureau of Aeronautics of the Dept. of the Navy. The primary function of Project Cyclone is the development and operation of a Guided Missile Simulator and the establishment and operation of a Simulation Lab. Problems in aeroelasticity, engine control, aircraft stability, dynamics, and navigation have also been studied with the aid of these computing facilities.

Early in Oct. 1952, a new large simulation laboratory was put into operation and subsequently subjected to exhaustive acceptance tests. Fig. 1 shows an overall picture of the computing equipment of this laboratory. The power supplies and voltage regulators are located in a room behind the computer laboratory. The essential elements of this analog installation are the Reeves Electronic Analog Computer (REAC®) and the Reeves Computing Servomechanism.[1]

In June 1953, Project Cyclone acquired a medium-sized, medium speed digital computer with magnetic drum storage, the Elecom 100. This computer is being used primarily to obtain checks on the analog computer solutions.

The problem of maintenance and reliability becomes more and more serious as the complexity and size of a computing facility increases. The size of an analog computing installation may be evaluated in a variety of ways. Criteria useful in this evaluation are

a) the number of computing amplifiers,

b) the number of vacuum tubes and crystals, and

c) the power consumed.

The new REAC Simulation Lab. contains 404 dc. amplifiers, 2950 vacuum tubes, 392 crystals and consumes about 35 kw. A detailed breakdown of the components in the laboratory is given in Table 1.

From the users' point of view, the most significant criterion of size is expressed in terms of the problems that can be solved. At Project Cyclone problems involving the equivalent of as many as 91 first order ordinary differential equations, linear or nonlinear, can be solved.

Comparison of Computers

At this point a comparison of analog and digital computers is in order. The reliability demanded of parts in digital computers will be appreciably greater than that of corresponding components in their analog cousins. This can be shown

TABLE 1—COMPONENTS IN SIMULATION LABORATORY

Tubes		Components		Number
Type	Number			
6SJ7	1222	Crystals (IN38)		392
6L6	536	Neon Bulbs (NE51)		376
6SL7	451	Synchronous Converters (Vibrators)		483
12AU7	200	Scale Factor Potentiometers (0.1% Linearity)		446
5691	91	Servo Potentiometers (0.025% Linearity)		222
6SN7	78			
6AS7	66	Precision Wire Wound Resistors (.05%)	1 Megohm	1,423
6B4	60		500 Kilohms	15
6SK7	52		250 Kilohms	430
6AL5	52		100 Kilohms	603
12AT7	44	Polystyrene Computing Condensers		115
12AX7	39	Film Resistors (1%)		1,948
6AU6	23	Wire Wound Resistors (1%)		734
5R4	18	Carbon Resistors (5%)		11,865
6H6	12	Condensers		5,270
Misc.	8	Relays		544
Total	2,952			

"REAC" COMPUTER (Continued)

by tracing the steps involved in obtaining the solution to a complex problem. For analog computers the first step is to decide on the simulation technique and code the problem accordingly. A similar procedure is followed for digital machines where a numerical method is selected and the problem coded. The second step is to insert the code into the computer. On analog computers, this is accomplished by interconnecting the appropriate components with patch cords; on digital computers, an input device is provided. The third step for both analog and digital computers is trouble-shooting the setup or code checking.

Here the similarity ends; for in a dc analog computer the time for one solution is usually 60 to 90 seconds. On the other hand, for most digital computers, especially where a large number of variables must be printed out, a single solution may take from one to several hundred hours. A component failure results in a significant difference because of this time factor. In the analog computer, a failure invalidates only one minute of computing time. In the digital computer, only error-free, permanently stored results can be salvaged.

A second important difference arises from the manner of detecting intermittent failures. It is well known that because such failures are more difficult to locate, they are far more serious than sudden total failures. In the REAC most voltages are "smooth" functions of time which are plotted on recorders or ploting boards. The presence of intermittent failures will be evidenced by irregularities in these functions and thus can be observed easily. In addition, the true overload system detects all sudden surges or pulses. On the other hand, the computing voltages in a digital computer are pulses and the machine output consists of tabulated values. An intermittent failure may be interpreted by the computer as a signal and cause a circuit to function improperly. All subsequent calculations are invalidated. The overflow circuits may detect this failure. However, as a general rule analysis is required in order to insure that results are free of error caused by such spurious signals.

Operating Differences

Two additional differences in operating procedure should be mentioned. The profusion of results from an analog computer facility requires that one or more operators be in attendance to monitor and process the solutions. For example, in one large problem the solution rate reached 200 runs per day. On the other hand, a digital computer may run unattended for many hours. Finally, an important feature of some analog installations, including Project Cyclone, is the flexibility of interconnection. This enables the operator to select the most suitable simulation setup and also the optimum number of components. From the standpoint of reliability, flexibility assures that no extraneous components will be used in the problem. This is in contrast to the digital computer or the prewired analog computer where all elements of the system must be operating to obtain solutions. Furthermore, the Project Cyclone Simulator may be divided into several parts in order to solve smaller problems. As many as four different problems have been on this computer at one time.

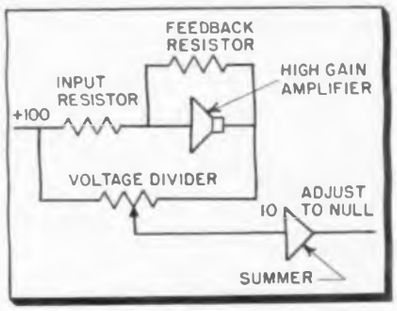


Fig. 2: Bridge circuit employed to measure the input gains of every computing amplifier

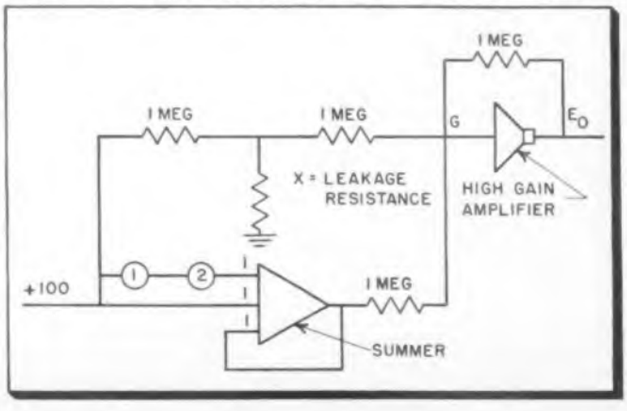
The acceptance test for the new Project Cyclone installation was divided into two phases. The first consisted of equipment checks. Every computing element in the system was performance tested and checked for accuracy. A few of the more interesting tests are described below.

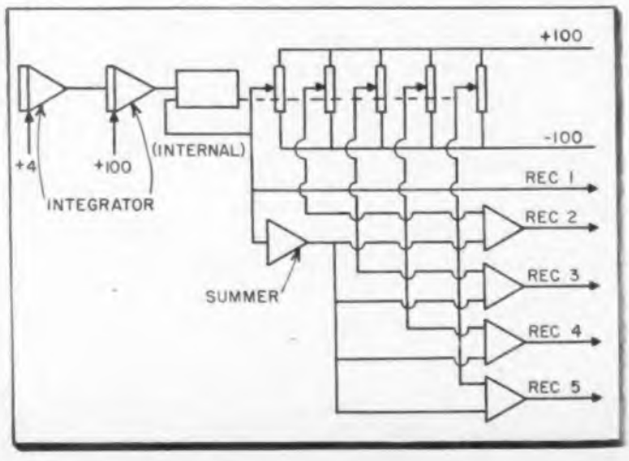
Fig. 2 is a schematic of the bridge circuit used to measure the input gains of every computing amplifier. A Leeds & Northrup 0.001% voltage divider was used as the standard. The maximum permissible error in gain was 0.05%. 94% of the gains were within 0.025% of their nominal value; 70% were within 0.012% of their nominal value. The mean of the absolute values of the errors in gain was 0.01%.

The followup potentiometer of each servo was checked with a similar bridge. The setup used to check the multiplying potentiometers with the followup potentiometer taken as a standard is shown schematically in Fig. 3. The error voltages were plotted on a Brush recorder for the complete excursion of the potentiometer wiper. The maximum acceptable deviation was 0.05%.

The circuit used for measuring the leakage resistance to ground of interconsole leads is shown in Fig.

Fig. 3: (l) Checking servo multiplying pots with follow-up pot as standard. Fig. 4: (r) Measuring interconsole leakage resistance





Potentiometers 1 and 2 are used o null the setup before the inter-onsole resistance is plugged in. The leakage resistance is calculated rom the formula,

$$X\ (\text{MEG}) \approx 25/E_o.$$

The equation is valid for

$$X > 100\ \text{MEG or } E_o < 0.25\ \text{volt.}$$

The minimum acceptable leakage esistance was 1,000 megohms.

The second phase of the accept-nce test consisted of a computing heck. A highly complex nonlinear imulation problem, for which a umerical solution was available, vas solved. An indication of the omplexity of this problem is given y the fact that a single check so-ution took 75 hours of computing ime on the IBM CPC. The problem equired 304 computing amplifiers, 0 multiplying servos, 11 resolvers, 4 diode function generators, and ssociated equipment.

The REAC plots for 26 variables were checked against corresponding numerical solutions with excellent results. Figs. 5 and 6 show a comparison between the REAC and the numerical solutions for two of the variables.

Reliability

In an analog computer two classes of maintenance service are required, namely, adjustments and repairs.

Adjustments are provided in order to optimize the performance of the equipment as the components change characteristics. Some examples of adjustments are zeroing computing amplifiers, setting gain and damping controls of computing servomechanisms, and balancing limiting amplifiers. These adjustments are made as required, once a week or less frequently.

Repairs are required whenever a failure occurs. Failures arise from three causes,

a) defective parts,
b) operator abuse, and
c) component deterioration.

In general, the number of failures may be reduced by adequate inspection and testing to eliminate defective components wherever possible before installation in the system. The procedure at Project Cyclone is to inspect and measure all components when they are received and then check them operationally after installation. Occasionally manufacturing defects appear after appreciable operating experience. One example is a potentiometer card that contained a scribe indexing mark under the winding which produced a week spot. After 1500 hours of operation, the winding broke. A change of manufacturing procedure has eliminated this type of failure.

TABLE 2—SELECTED FAILURE RATES FOR FIRST 12 MONTHS (2527 HOURS) OF OPERATION

Component	Number	% Failure Per 100 Hours
6SJ7	1,222	0.38
6L6	536	0.19
6SL7	451	0.29
12AU7	200	0.30
5691	91	0.22
Vacuum Tubes of all Types	2,952	0.38
Vibrators	483	0.057
Deposited Film Resistors	1,948	0.026
Servo Motors	40	1.08

Skilled operators are required in order to minimize failures and downtime. Operators may cause failures by carelessly overloading components. The following examples illustrate this point. If the reference computing voltage (± 100 v. in the REAC) is applied to the arm of a potentiometer which is at a low setting, excessive current will flow

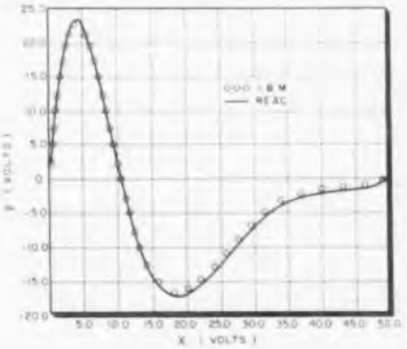


Fig. 5: Results of computer acceptance test

through the turns and the winding will open. The operator may also damage the mechanical parts of a computing servomechanism. The servo motor is coupled to the potentiometers through a dry disc clutch with mechanical stops provided to prevent damage to them. If the voltage input to the servo is excessive, it will hit the stops; and if this voltage is maintained, the clutch will slip and be impaired. Finally, the operator must be able to distinguish between malfunction of the equipment and problem errors.

Failures due to deterioration will be reduced by conservative design and operating policy. Operating procedures which contribute to extending the life of computer components are time delay between the application of filament and plate voltage and adequate cooling.

Two complementary concepts are used to evaluate the reliability of this analog installation. The first is based on the service-free hours and the second on the number of failures. These ideas are embodied in two coefficients defined below.

The first of these is the *reliability coefficient*,

$$R = 100\ [\ 1 - (S/T)\ ]$$

in per cent, where S is the service time and T is the total scheduled operating time.

Service time is the repair time spent on failures arising from both component deterioration and operator abuse. It includes, in addition to equipment downtime, repairs performed in non-operating time. Under non-operating time are subsumed checkout periods, Saturday, and time spent on chassis replaced by spares. Service time does not include operator time spent in locating trouble; nor is the time spent in making adjustments included.

Because this is a flexible simulator, the failure of a component in many cases signifies that only a part of the system is inoperative; other problems will continue uninterrupted. This is not reflected in the factor, T.

The second coefficient is the *failure rate*, defined as the percentage of failures of a specified type per hundred operating hours. The coefficients are evaluated monthly.

Reliability Data

Project Cyclone's weekly operating schedule has been set at 50 hours by the Bureau of Aeronautics. This is achieved in a ten-hour day, five-day week. During its first year, the installation has been in operation 2,527 hours. The data presented in this report have been accumulated during this period.

When the new Simulation Lab. was installed, it was decided that, with the exception of operator checks, only breakdown maintenance would be provided as long as problems were plugged in; upon completion

(*Continued on page* 146)

How to Test NTSC Color with

By W.B. WHALLEY
Polytechnic Institute of Brooklyn
Brooklyn 1, N. Y.

THE black-and-white test charts which have been developed by the RETMA Engineering Department over the period 1945-1951 are almost invaluable for the overall and sectional checks of an NTSC color TV system. They were initially developed to test as many as possible of the characteristics of a black-and-white TV system. The fact that the most critical requirement of a color system is that it reproduce black-and-white pictures accurately, makes these charts extremely important.

Checking Resolution

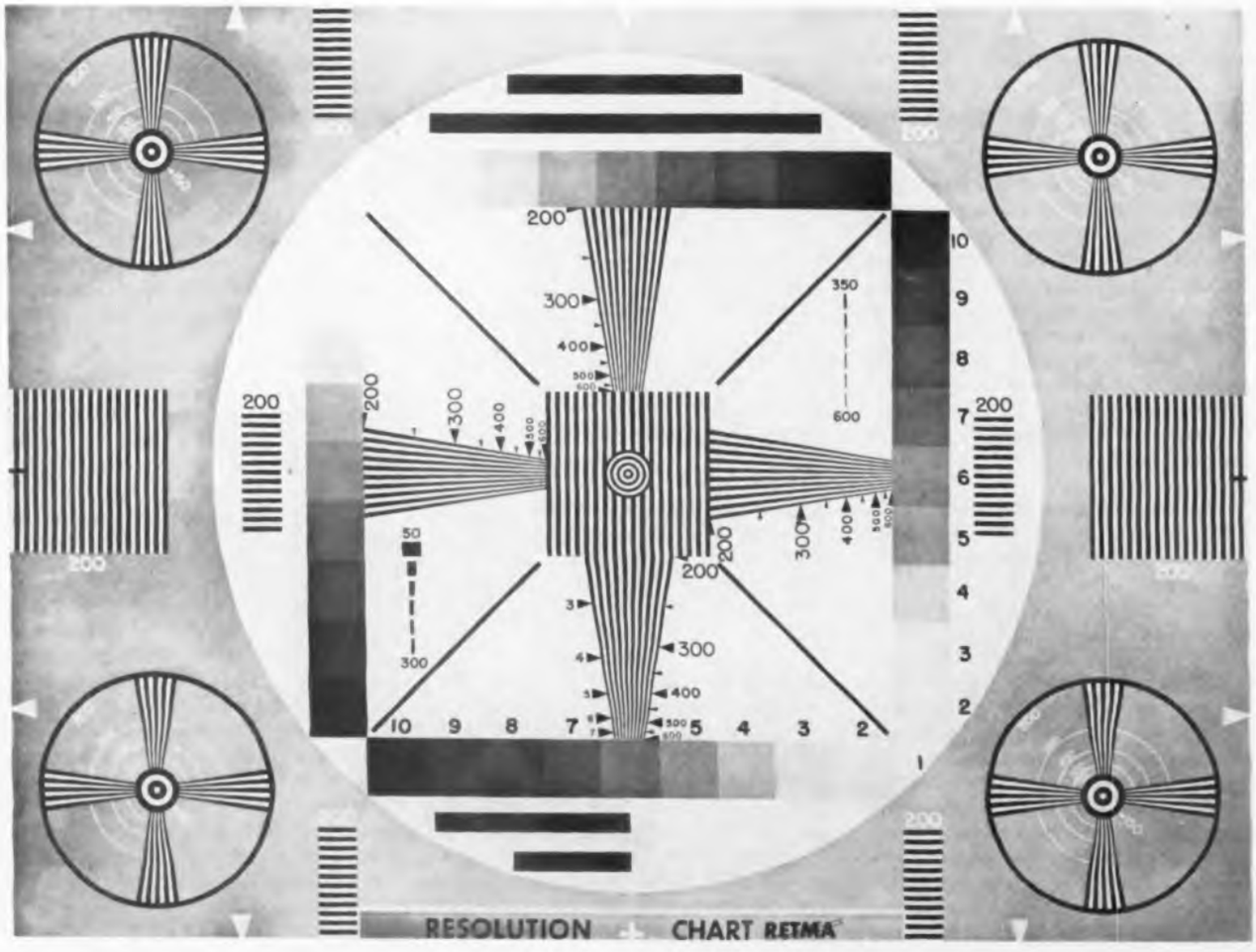
The first chart, known as the RMA Resolution Chart (of 1946), will be referred to as Chart A, and is shown in Fig. 1. It is designed to check horizontal and vertical resolution, both toward the center and the corners of the picture; some of the phase characteristics, at the higher frequencies by the shape of the reproduced fine structure of the vertical wedges, and at low frequencies by noting the trailing edge of the heavy "bars" at the top and bottom of the pattern; contrast and gamma by checking the output signal produced by the vertical and horizontal gray scales; the uniformity of background level of the camera and the system by observation of the intervening areas of the whole pattern; and fairly accurate checks of the vertical and horizontal linearities and the aspect ratio.

The second chart, known as the RTMA Linearity Chart (of 1951), will be referred to as Chart B, and is shown in Fig. 2. It was specifically designed for accurate checks of aspect ratio, horizontal and vertical linearity, at the same time checking the horizontal and vertical blanking times.

Both Charts A and B are available as large opacities. Chart A is also available as a 2 x 2 slide transparency for use in flying spot scanners. Chart B could be used as a large transparency for placement over a monitor kinescope for alignment purposes.

In testing an NTSC color system, all of the tests listed above can be made, and, in addition, tests of registration of the camera or the color monitor and similarity of gradation in each of the primary colors can be checked.

Fig. 1: RMA Resolution Chart checks horizontal and vertical resolution, phase, contrast, gamma, background, linearity and aspect ratio



Black-and-White RETMA Charts

Widely used resolution and linearity charts may also be applied to testing registration of color camera or monitor, and similarity of each primary color gradation

In addition to the usual meters available in a studio it is essential that there be a good monitor oscilloscope, a good color picture monitor, and a good black-and-white picture monitor. The oscilloscope should fulfill the specifications of the IRE Television Studio Standards, and should be calibrated in percentage of maximum white and maximum sync amplitude. Associated with the master synchronizing and blanking generator, there should be 315 kc and 900 cycle sources to provide a bar pattern for linearity testing. In addition, it is valuable to have a vectorimeter to check the limits of the primary colors of the system.

After the usual warming-up period, the black-and-white monitor should be adjusted for reasonable linearity, both vertical and horizontal, and for the correct aspect ratio, using the bar pattern generator and the transparent form of Chart B. As the linearity adjustments are made, the thin grating on the face of the monitor should closely line up with the centres of the circles of the Chart.

Chrominance Subcarrier

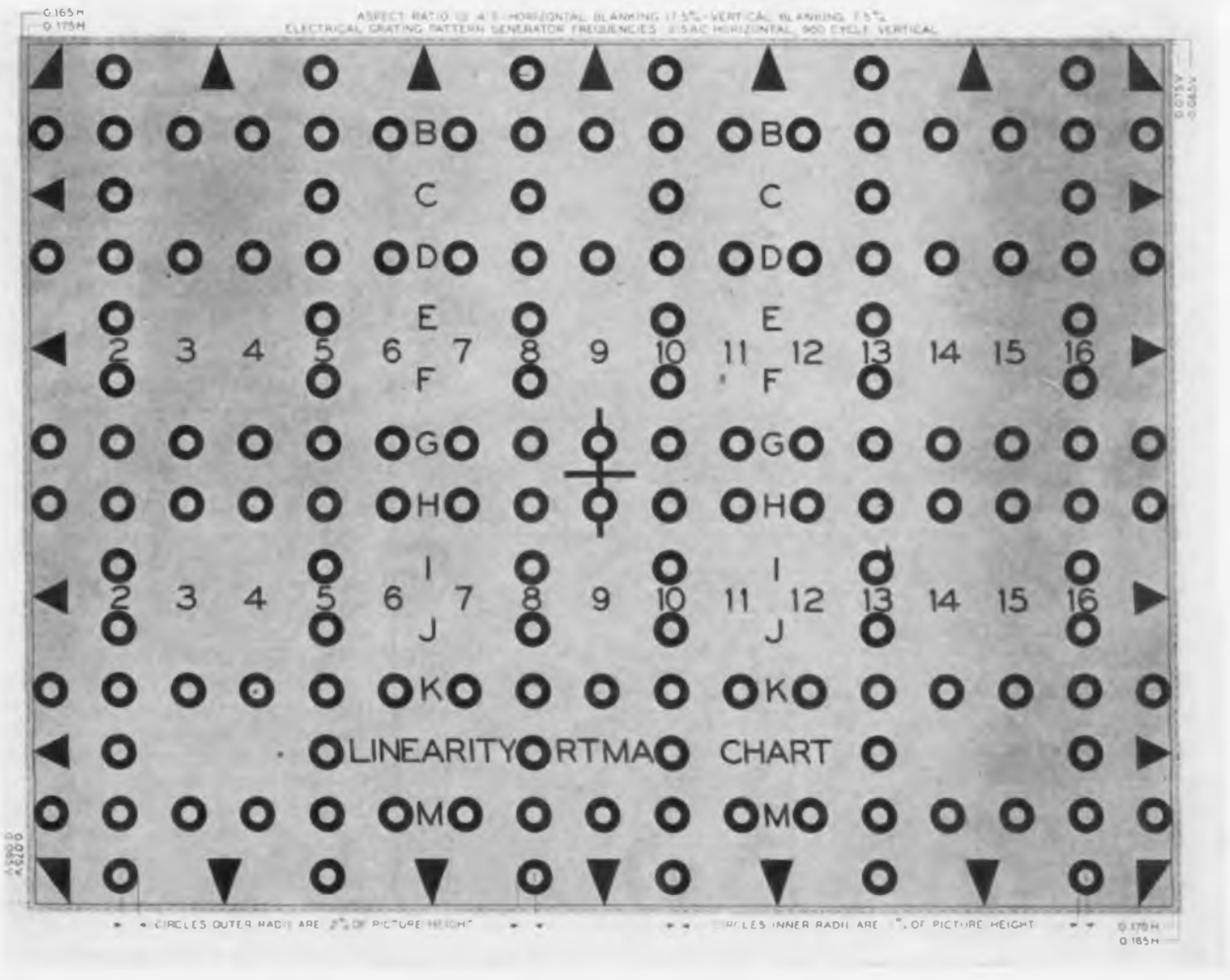
In Fig. 3 is shown a simplified block diagram of a typical NTSC studio, which should be referred to during the following discussion. Before proceeding further, the frequency of the chrominance subcarrier crystal oscillator should be measured by using the beat with the auxiliary high stability temperature controlled master crystal generator, which is periodically checked against WWV.

Then the amplitude, symmetry, and the number of cycles of the burst signal should be checked on the oscilloscope. See Fig. 4.

By both dc and oscilloscope measurement (using test dc and ac voltages inserted at the points marked R_1, then G_1, then B_1), check the resistance ratios of the various sections of the matrices. Set the gains of all of the combining and inversion video amplifiers at their specified values, using test video frequency signals, the monitor oscilloscope and a VTVM.

Now place the opaque Chart B in front of the camera and accurately

Fig. 2: RTMA Linearity Chart is designed to check aspect ratio, horizontal and vertical linearity, and horizontal and vertical blanking times



TESTING NTSC COLOR (Continued)

position the latter so that the Chart image will completely fill the useful area of the pickup tube mosaic. It will be assumed that the dichroic mirror and lens assembly has already been tested and adjusted on an optical bench. Observing the *black-and-white picture monitor,* the camera line amplifiers should be switched to the various color channels (red, green and blue) to see if each centering control, for both vertical and horizontal, has some latitude for bringing the center of the picture to the same point on the monitor face for each pickup tube.

With the red and blue amplifiers disconnected, the green channel pickup tube should be adjusted for best operation. This includes adjusting the horizontal and vertical linearity so that Chart B appears on the black and white monitor to be superimposed upon the electrical bar pattern.

Replacing Chart B with Chart A, the green channel pickup tube is carefully adjusted for best focus, and, at the same time, the overall background level, high and low frequency phase characteristics are checked. On the monitor oscilloscope, connected through a line selector, the gradation scale of this green channel may be observed. The gamma amplifier should be adjusted until the steps on the oscilloscope are reasonably uniform.

Next, the red channel should also be switched on so that the black-and-white monitor is receiving signals from both tubes. The vertical and horizontal linearity and centering adjustments must now be made for the red pickup tube, using Chart B in front of the camera. As the adjustments continue, each of the various circles on the Chart will change from a double image to more and more closely approximate a single image, indicating that the two pickup tubes are approaching registration.

Switching off the red channel, the blue channel should be connected and adjustments made in the same way as for the red channel. Throughout, the electron beams of the three tubes should be kept at best focus.

Replacing Chart B with Chart A, the resolution values for each of the

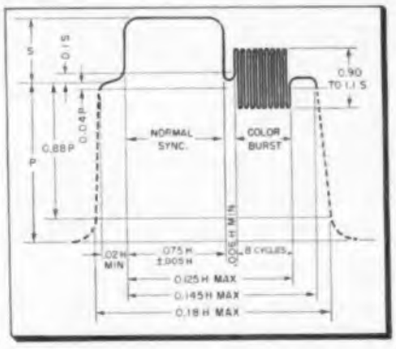


Fig. 4: NTSC waveform, showing color burst

channels. and for the combined three pickup tubes should be noted on the test wedges, and where necessary further trimming of the linearity and centering adjustments be made.

With the line selector connected to the monitor oscilloscope, the horizontal gradation scale of Chart A should be observed for each of the channels and for the three channels combined. Errors can be noted by the width of the horizontal portions of the step on the oscilloscope, and can be corrected by adjustment of the gamma controls on the red and blue channels to agree with the previously set green channel.

With a suitable *tricolor monitor,* the gradation wedge should appear of the same color throughout. Small differences in gamma adjustment of one channel with respect to another will show as a change in tint of the wedge at one place or another.

Transient Response

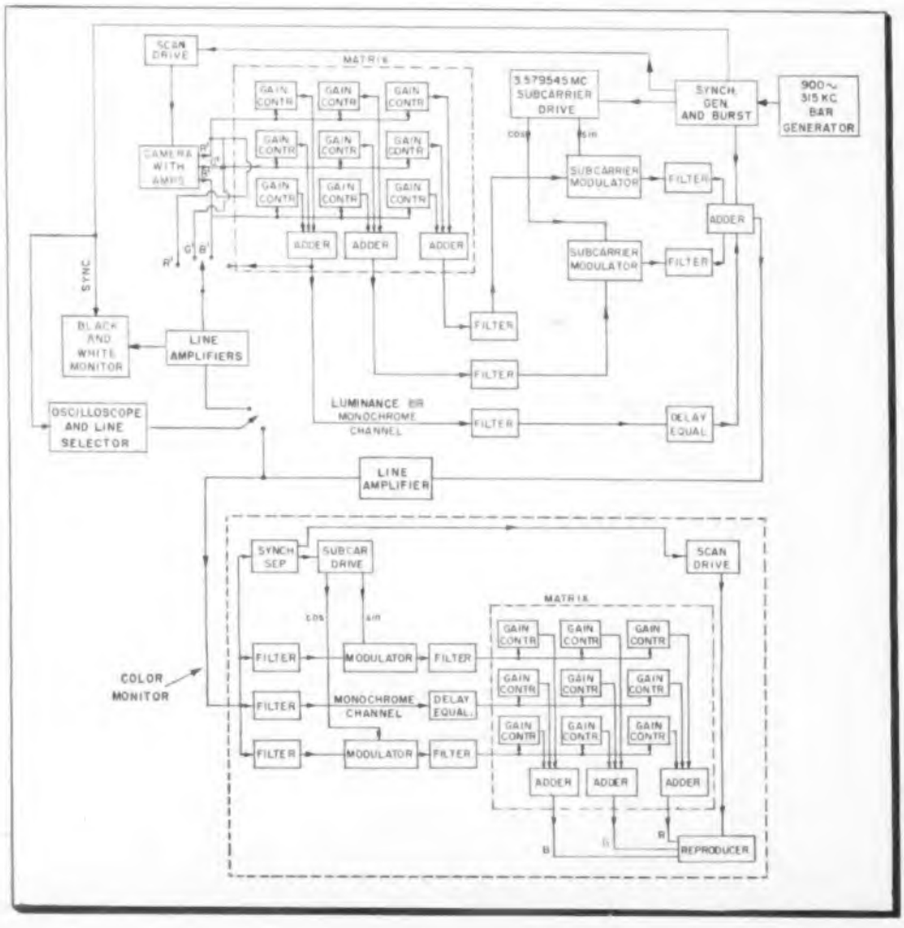
With the tricolor camera still viewing Chart A, any differences in transient response of the three color channels will show as changes in hue from the neutral gray, after the trailing edge of each of the heavy bars at the top and bottom of the pattern.

For adjusting a color flying spot scanner, the 2 x 2 slide of Chart A is most valuable. After adjusting linearity, centering and aspect ratio, each channel can be adjusted for maximum resolution as viewed on the black-and-white picture monitor. A check on equivalent time delay through each of the color channels from the photo tube to the matrix amplifier can be made by viewing on the same black-and-white monitor at the output of the matrices the resolution wedges with two channels connected at a time, and finally with all three channels.

As with the live pickup camera, the adjustment of the separate gamma amplifiers is made by observing the steps on the monitor oscillo-

(*Continued on page* 180)

Fig. 3: Simplified block diagram of a typical installation providing for NTSC color



The Atomic Battery

Beta emitter, strontium-90, working into silicon p-n junction generates sufficient power to operate transistor audio oscillator

LAST month at his offices in Radio City, Brig. General David Sarnoff, Chairman of the Board of RCA, demonstrated a thimble-sized atomic battery which for the first time converts atomic energy directly into small but useable quantities of electricity. The battery output was used to operate a transistor oscillator operating at an audio frequency. General Sarnoff interrupted the oscillator with a telegraph key to send the following two messages, "Atoms for peace," and "Man is still the greatest miracle and the greatest problem on this earth."

Present Output Small

The atomic battery was developed at the RCA Princeton Laboratories through the efforts of Dr. Irving Wolff, Dr. Ernest G. Linder, Paul Rappaport and other staff members. In its present form the electrical output is extremely small (1 microwatt—5 μa @ 0.2v) and not yet such as to be applied with any great practicality. General Sarnoff pointed out, however, that three months ago the output was a billionth of a watt and that this thousandfold increase indicated that the research scientists were on the right track for significant practical developments in the near future. Another important characteristic of the atomic battery is that its half-life is twenty years. This of course would mean that batteries would last as long as the associated electronic equipment, and that as a completely reliable source of power, they would find extensive applications in military communications equipment, aeronautical communications and navigation equipment, etc.

Fig. 1 shows a simplified sketch of the atomic battery. A radioactive source (in this case strontium-90 and yttrium-90—a waste nuclear by-product) as a β or electron emitter emits high velocity electrons (appr. 1 mev). Each of these electrons on striking the silicon produces an effect similar to secondary emission in the ratio of about 200,000 to 1. At the junction of the antimony and silicon an effect similar to the "contact potential" encountered in radio circuits occurs, and by connecting a load across the silicon and antimony the battery circuit is complete.

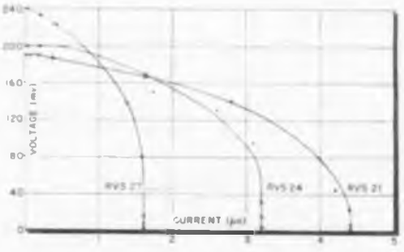


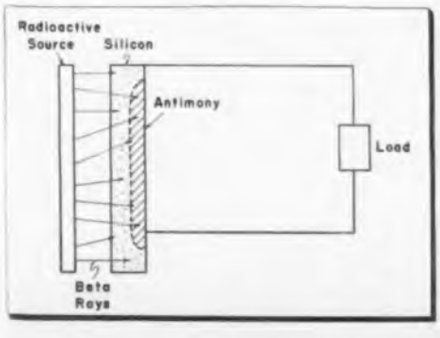
Fig. 3: Curves showing current vs voltage of various silicon atomic battery units

Fig. 2 shows the potential distribution curve within a silicon p-n junction unit. Fig. 3 shows current vs voltage curves for various silicon units tested at the Laboratories. When used as a power generator, a large single silicon junction exhibits the following characteristics: From the 50-millicurie radioactive source, which has available about 200 microwatts of radioactive power, 0.8 microwatt of electrical power is delivered to a matched load of about 10,000 ohms. This represents a conversion efficiency of about 0.4%. Calculations indicate that a similar wafer of optimum thickness would give an efficiency of 2%.

Referring to Fig. 3, a maximum open circuit voltage of 250 mv. and a short circuit current of 10^{-5} amp have been observed in silicon. From the short circuit current, the multiplication of the beta current (which is 3.2×10^{-10} amp) can be computed. A multiplication of 1.5×10^{5} is obtained for silicon if corrections for wafer thickness compared to beta depth of penetration and surface recombination are taken into consideration. For germanium, using the same radioactive source, a maximum voltage of 30 mv. and a short circuit current of 2×10^{-3} amp have been observed, giving a corrected multiplication of 1.9×10^{5}. Assuming the average energy of a beta particle from the Sr^{90}—Y^{90} source as 0.7 mev, the cost in energy per charge carrier would be 3.7 e.v. for germanium and 4.7 e.v. for silicon.

Closeup showing two basic elements of atomic battery. Strontium-90 is at right

Fig. 1: (Left) Simplified sketch of the atomic battery. Fig. 2: (Right) Potential distribution curve within silicon p-n junction unit



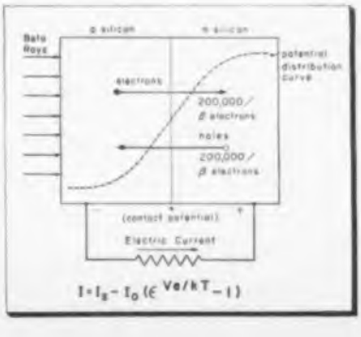
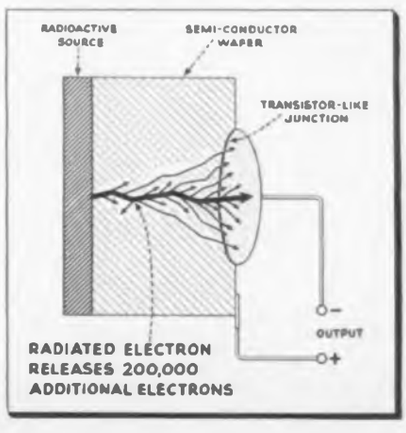


Fig. 4: Another sketch of the atomic battery showing electron multiplication effect



"Vagabond" Wireless

Subminiature transmitter and self-contained antenna induction system does not require FCC approval. Design

By THOMAS W. PHINNEY
Shure Brothers, Inc.
225 W. Huron St., Chicago 10, Ill.

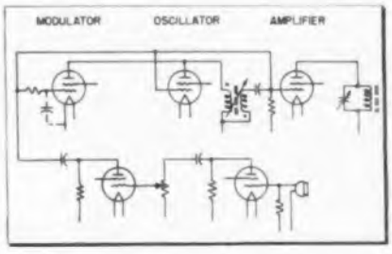


Fig. 1: Basic circuit of two-tube audio and three-tube r-f sections of mike's transmitter

"Vagabond" microphone contains transmitter, antenna and batteries, employs induction system for public address and entertainment work

SINCE the first use of electrically amplified sound, audio engineers have been faced with the problem of minimizing the pickup of extraneous sound by the microphone. The usual approach to the problem is to keep the microphone and the sound source in close proximity. This may be comparatively simple if the sound source to be amplified has a fixed location. If, however, the source is mobile, as is frequently the case, the problem of maintaining this proximity can be a very difficult one. In the case of an individual performer, several approaches to the problem are possible.

A microphone on a fixed stand can be used. In many situations, the enforced immobility of the performer greatly reduces the utility of the system.

Alternatively, a microphone can be mounted on a boom and a trained technician so manipulate the microphone as to follow closely the sound source. This approach is satisfactory for motion picture and television work, but completely unsuitable for general public performance from the standpoint of expense as well as for obvious aesthetic reasons.

A method, frequently used in public address and entertainment work, is to attach the microphone to the user or to have him carry it. The most serious defect in this technique is the encumbrance caused by the microphone cable. The user must move about, dragging the cable after him and avoiding entanglements.

A solution to the problem which eliminates these difficulties is the use of a miniature radio transmitter which can be carried or worn by the performer. It was for this purpose that the Shure "Vagabond" system was designed.

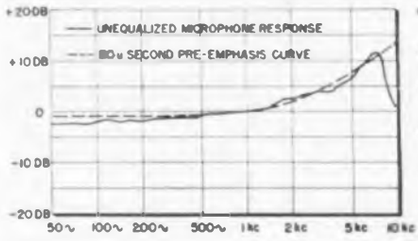
When we set out to design a wireless microphone system, two basic avenues of approach lay before us. The first was to design a high frequency system with a large operating range which would adequately cover Madison Square Garden, or Soldiers Field. Such a system must necessarily be relatively high powered and hence have short battery life. It would definitely require a Federal license which would greatly restrict or even prohibit its use in the very applications which we wished to reach, namely, general public address work, and theater and night club entertainment. Furthermore, those frequency assignments which might be obtained are available on a non-exclusive basis and will be subject to greater and greater interference as time goes on. A final disadvantage of the licensed system was the strict technical requirements imposed by law. These requirements would make the design of a miniature transmitter more difficult and would certainly increase its cost.

Induction System

The second approach which we saw was to design an induction system which would have a relatively restricted operating range but would require no Federal licensing, and hence be available to any and all potential users. If such a system could be developed to give adequate performance, it would offer excellent operating economy through prolonged battery life and it would have to meet only those technical requirements dictated by satisfactory operation. Since it was felt that a practical induction system could be de-

Microphone System

allow operation in areas up to 5000 sq. ft. Roving mike features include printed circuits and resin casting



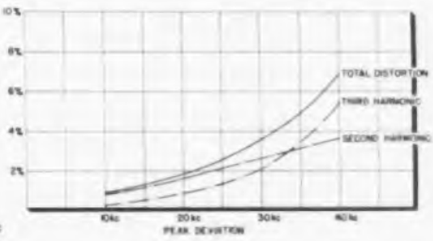


Fig. 2: (l) Pre-emphasis curve of omnidirectional ceramic microphone cartridge. Fig. 3: (r) Performance curves of reactance modulator used in microphone transmitter

veloped, that approach was chosen for the "Vagabond" system.

Having decided upon a non-licensed or induction system, other fundamental design decisions had to be made. These were the choice of the physical form of the transmitter, the modulation system to be employed, and the operating frequency of the system.

Principally, two physical forms were considered for the transmitting unit. One form consisted of a pocket-size case, containing the transmitter and batteries, which could be worn concealed about the person of the user, and a separate lapel type microphone attached to the transmitter with a cable.

The second form considered was that of a stick type case which would contain the microphone, antenna, transmitter, and batteries.

Stick Form Adopted

The stick form was adopted, as it offered several advantages. Being completely self-contained, the stick mike could readily be handed from one person to another, or it could be placed in a microphone stand and used conventionally. The performer would not have to "dress" himself in the microphone. Having no interconnecting cables, the self-contained unit would not be subject to wear and tear and would require less maintenance. It was also felt that the stick form, being quite similar to several conventional microphones in appearance and use, would place performers at ease and hence would be more readily accepted. The only manifest disadvantage of the stick form was its inability to be concealed easily on the person. This was felt to be a minor consideration, while the ability of one microphone to be used by several performers in immediate succession represented an economic advantage as it would replace several wearable units.

FM Selected

Two primary considerations led to the choice of frequency modulation for the "Vagabond" system. Since the coupling between the transmitting and receiving antennas in a wireless microphone system will vary greatly, some means of assuring constant overall audio gain is imperative. A FM system was chosen as the simplest means of achieving this goal.

Secondly, the desire to obtain the best possible signal-to-noise performance, with a transmitter of limited power, again indicated the use of FM. A modulation index of at least five was set as a goal.

The carrier frequency chosen for the "Vagabond" system was a compromise of opposing factors. To obtain reasonable performance from a miniature transmitting antenna and to accommodate the bandwidth required by the FM system, it was desirable to use the highest possible carrier frequency. Furthermore, a study of the literature on the occurrence of noise throughout the radio spectrum indicated that less interference could be expected at the higher frequencies.

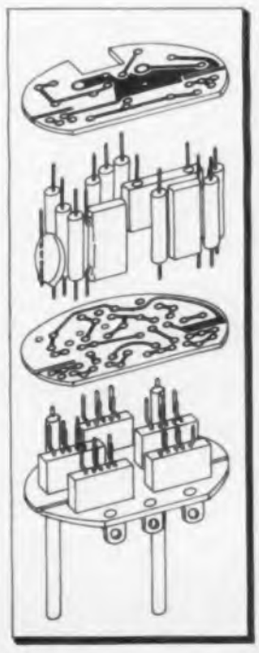
On the other hand, the FCC regulation governing unlicensed transmitters limits the radiated field strength in inverse proportion to the carrier frequency, thus dictating the use of the lowest possible frequency.

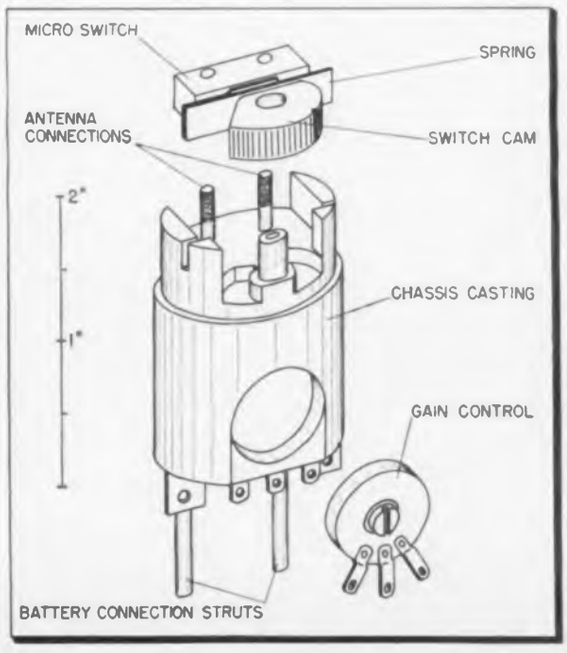
A final consideration was the minimization of interference from other transmitters operating on the same frequency. This obviated the use of the Broadcast, Amateur, Police, and Loran bands which lie between 0.5 and 2.0 MC. In view of all these factors, a carrier frequency of approximately 2.1 MC was chosen.

Design of Transmitter

Since the feasibility of the entire stick design depended on the development of a satisfactory miniature antenna, the development of such an antenna was undertaken. Calculation and experiment indicated that within practical limits the size

Fig. 4: (l) Chassis assembly includes printed circuit plates which are soldered to component leads and tube socket pins. Fig. 5: (r) After chassis assembly is cast in resin, switch, gain control and battery contact assembly are attached





WIRELESS MIKE (Continued)

of the transmitting antenna would not affect the performance of an induction system. Since any antenna could be reduced to an equivalent magnetic dipole, the only effect of size variation was to change the power required to produce the desired field strength. A satisfactory ferrite core transmitting inductor was developed which was 3 in. long and weighed 2 oz.

Having achieved a practical ferrite antenna, a transmitter circuit was developed to operate from a 30-volt hearing aid battery and a 1.3-volt mercury cell. Five subminiature tubes were used (Fig. 1). The transmitter circuit is divided into two sections: a two tube audio section and a three tube radio frequency section.

Eliminating Motorboating

Two tetrode voltage amplifiers are cascaded in the audio section to obtain a gain of 55 db at 1000 cycles. A miniature volume control between the two stages allows the gain to be adjusted for the desired degree of modulation. While the two-stage audio amplifier alone showed no tendency toward regeneration without any decoupling networks, motorboating at low frequencies occurred when it was connected to the reactance modulator, due to modulation of the plate supply voltage. To eliminate this motorboating, it was necessary to add a decoupling filter in the first audio stage and to restrict the low frequency response of the audio amplifier as well.

In order to obtain the best possible signal-to-noise ratio in the over-all system, an 80 μsec pre-emphasis was used in the transmitter and a corresponding de-emphasis in the receiver. The problem of obtaining sufficient audio gain together with the necessary pre-emphasis was solved by providing a microphone cartridge of special design, with a response which very closely approximated the desired pre-emphasis curve (Fig. 2). An omnidirectional ceramic microphone cartridge was used. The choice of such a unit was in conformity with present day trends in stick microphone design.

The r-f section of the transmitter consists of a self-controlled oscillator, a reactance modulator, and a r-f amplifier (Fig. 1).

After trying many circuit arrangements utilizing only two tubes, the r-f power amplifier stage was added. When only the two tubes were used, the oscillator necessarily had to operate at a higher power level, as its plate load was the high Q antenna circuit This arrangement had a serious weakness. It required excessive modulator plate current to produce the 2% frequency deviation required.

Reactive Current

In order for a reactance modulator to cause a frequency shift of 1%, it must produce a reactive current which is approximately 2% of the magnitude of the circulating current in the oscillator tank circuit. If the oscillator tank circuit has a Q of 50, a typical value in this application, the reactance modulator must draw an average ac current equal to that of the oscillator and must be capable of 100% modulation of that current without distortion. This means that the modulator must draw three or four times as much plate current as the oscillator. This was obviously impractical, and the use of a low power oscillator followed by a power amplifier was necessary. A further advantage of such an arrangement was the elimination of carrier frequency shift because of antenna detuning caused by hand capacity.

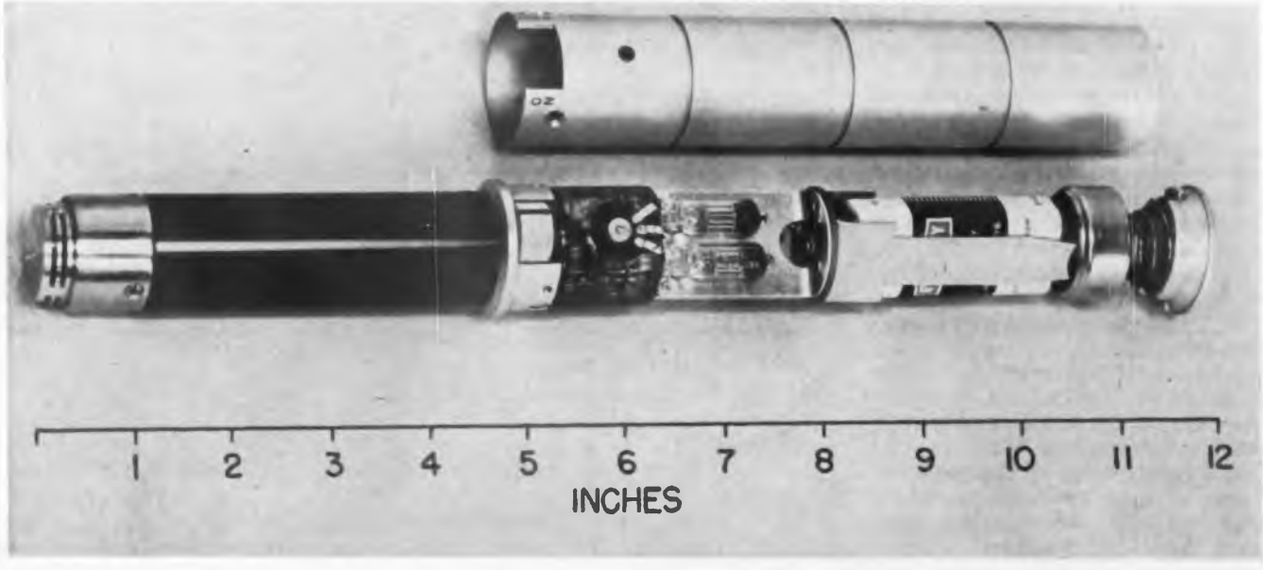
A second circuit feature worthy of attention is the method of feeding signal and bias to the reactance modulator grid. Two operational difficulties are substantially reduced by this circuit arrangement. They are, first, the amplitude modulation of the oscillator due to variable loading by the reactance modulator, which produces distortion, and second, the carrier frequency shift which occurs as the batteries run down.

Single RC Phase Shift

By obtaining the ac grid voltage for the reactance modulator from the secondary of the oscillator plate transformer, which is connected out of phase with the primary, it is possible to use a single RC phase shifting network and obtain a phase difference between the modulator grid and plate voltages which exceeds 90°. The use of a modulator grid voltage which is more than 90° out of phase with the plate voltage causes the reactance modulator to appear as a reactance in parallel with a negative resistance. This negative resistance will vary as the voltage on the modulator grid varies, and, with proper circuit adjustment, can be made to compensate for the variable loading of the oscillator by

(*Continued on page* 152)

Fig. 6: Elements of "roving mike" include microphone cartridge, antenna, transmitter and batteries. Tubular case slips over part held in hand



Page from an Engineer's Notebook

No. 25 — Reactance Nomograph

Easily used graphical structure eliminates maze of crossing scales for solving reactance formulas. Expanded split-scale technique allows high accuracy in frequency range of 0.01 cps to 1000 megamegacycles. Extremely wide limits of L and C provided

By JOSEPH F. SODARO, Registered Engineer, 2924 Selby Ave., Los Angeles 64, Calif.

GRAPHICAL calculators and sliderules which solve the reactance formulas are generally limited in range or are an overly complex maze of crossing scales. In some cases folded scales or multiple charts are used to obtain extended scale limits. As a result these charts have scale discontinuities which are inconvenient to the user. Such shortcomings are overcome in the reactance nomograph described in this article by the expanded scale technique which provides the coverage of extreme scale limits without the loss of significant figures.

The nomograph is shown in Fig. 1. All scales increase in value in the upward direction with the exception of X_c. The scale stems are split to facilitate reading. On the left-side stems are the overall ranges for each scale which are useful for rough calculations and for the determination of magnitude or decimal point location. The right-side scale stems are expanded cycles which give a detailed answer and thus yield the significant figures. On these scales the inductance (L) limits are from 0.1 μμh to 10.000 henrys, capacitance (C) from 0.1 μμf to 10,000 μf and frequency (f) from 0.01 CPS to 1000 MMC.

Frequency Scale

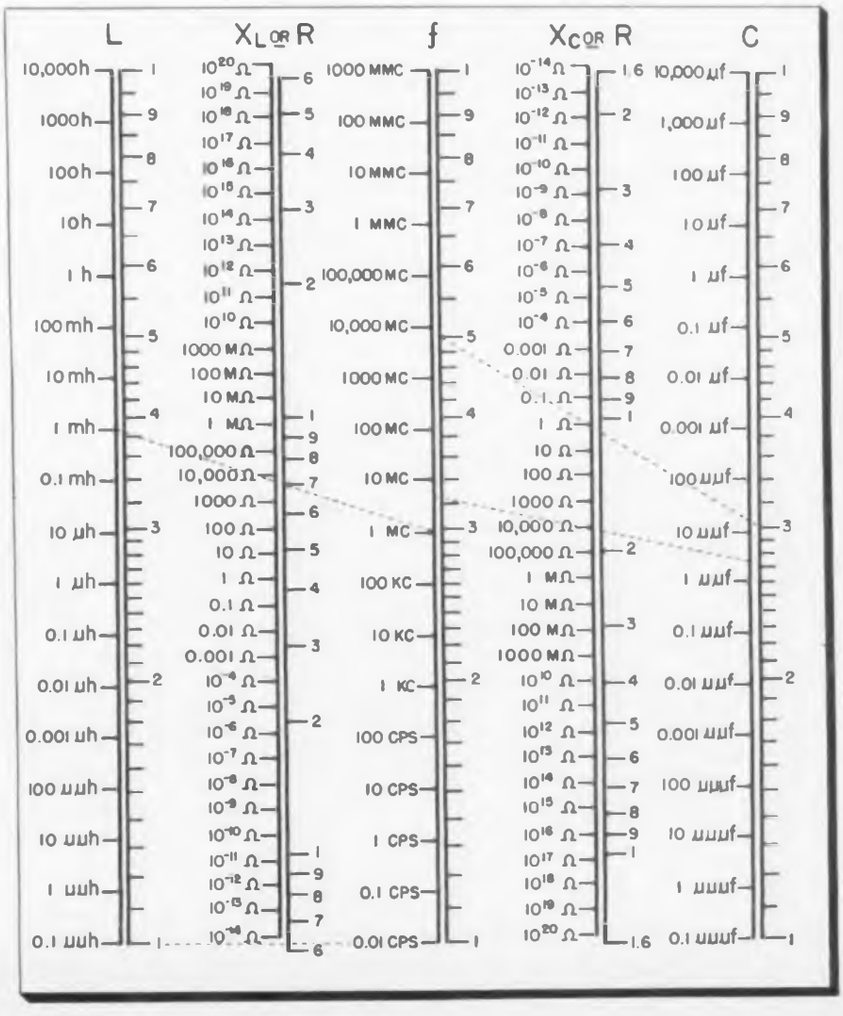
The frequency scale is common to the L and C scales. Thus, the left side of the chart is for inductive reactance calculations and the right side is for capacitive reactance calculations. Since many different problems can be solved on this nomograph, the problem is designated, formulas set forth, and graphical construction briefly outlined in Table I. The graphical construction is shown by the indicator line with circles and squares at the scale intersections. These symbols indicate the entry scales by the intersections enclosed in circles and the answer scale by the intersection enclosed in a square. While these are the usual procedures, entry can be on any two of the three designated scales and the answer read on the third.

Single Setting

Of course, only magnitude (left-side) or expanded (right-side) scales may be used for one indicator setting. Thus, although the graphical construction in Table I does not show the split scale stems, it implies that similar constructions are required for magnitude and significant figure determinations. The following examples are given to better understand these procedures:

Inductive Reactance: Approximate the value of inductance on the left-side of the L scale and the value of frequency on the left-side of the f scale. Construct a straight line between these points and read approximate inductive reactance on the left-

Fig. 1: Left stems of nomograph's split scales are overall ranges; right stems for exact figures



REACTANCE NOMOGRAPH (Continued)

side of the X_L scale. Repeat on the right-side scale stems to obtain additional significant figures, if required. For example, determine the inductive reactance for a 1 mh coil at 1 MC. On left-side scale stems locate 1 mh on L and 1 MC on f. Join these points with a straight line and estimate 6000 ohms at the intersection of this line with X_L. (Remember that these are logarithmic scales. Thus, three is slightly below the midpoint between

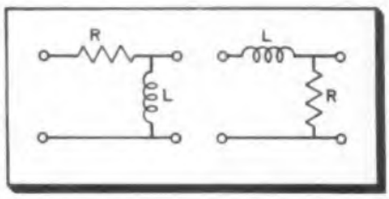


Fig. 2: Simple RL filter networks provide 3 db attenuation at determined cut-off frequency

division lines.) On right-side scale stems locate one on L, one on f and join these points with a straight line. Read 6.3 at the intersection with the X_L scale. Thus, the answer is 6300 ohms. By comparing the second answer with the first and finding that these are similar, we can be assured that the correct construction was made on the right-side scale stems.

Capacitive Reactance: First, on left-side scale stems, locate the value of capacitance on C and frequency on f. Join these points with a straight line and read capacitive reactance at the intersection of this line with X_C. Repeat using right-side scale stems if a more accurate answer is needed. As an example determine the capacitive reactance of a 3 μμf capacitor at 5 MC. Estimate 3 μμf on C and 5 MC on f and connect these points with a straight line. At the intersection of this line with the X_C scale estimate slightly more than 10,000 ohms. Repeat this procedure on right-side scales and read 1.06. Thus, the reactance is 10,600 ohms.

Inductance-Resistance Filter Cut-off: The simple filter networks shown in Fig. 2 present a voltage attenuation of 3 db (0.707) at the cut-off frequency. To determine this frequency locate the value of resistance on the R (or X_L) scale and inductance on the L scale. Extend the straight line drawn through these points until it intersects f. Read the 3 db attenuation frequency at this intersection.

Capacitance-Resistance Filter Cut-off: The 3 db attenuation frequency for the networks shown in Fig. 3 can be determined in a similar manner. Locate the capacitance value on C and the resistance value on R (or X_C) and extend a straight line through these points to f. Read the 3 db attenuation frequency at this intersection.

Resonance: If the resonance frequency and either inductive or

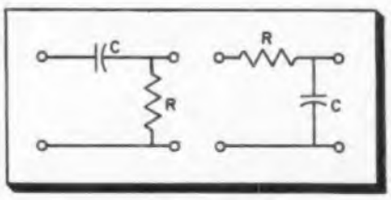


Fig. 3: Simple RC filter networks provide 3 db attenuation at determined cut-off frequency

capacitive reactance (which are considered to be equal at resonance) are given, inductance and capacitance can be determined. On the other hand, if Fig. 1 is entered with resonance frequency reactance and either inductance or capacitance, the resonance frequency can be determined. These procedures will be briefly described.

Resonant Inductance and Frequency: To determine the inductance required to resonant a tuned circuit, locate the resonant frequency value on the f scale and the inductive reactance or capacitive reactance at resonance on X_L. Connect these points and extend the joining straight line until it intersects L. Read the required inductance at this intersection. To determine the resonance frequency enter on L with inductance and on X_L with resonant reactance. Read resonance frequency at the intersection of the indicator line with f.

Resonant Capacitance and Frequency: Use the same procedures as the case above. Enter on X_C and f scales. Read on the C scale. Enter on X_C and C and read on the f scale.

Many other problems can be solved on this chart. Those who are interested can superimpose time constant scales which are simply reciprocal frequency scales. Thus, 1 MC becomes 1 μsec, etc. Also, the reciprocal of the reactance scales are susceptance scales and reciprocal of resistance are conductance scales.

Among the other problems which can be solved are equivalent shunt and series resistance determination of tuned circuits, tuned circuit bandpass analysis, high and low-pass filter design, bandpass filter design, transmission line characteristic impedance and time delay calculations.

Table 1: Equations and graphical construction performed on Fig. 1 for various problems

PROBLEM	EQUATION	GRAPHICAL CONSTRUCTION
INDUCTIVE REACTANCE	$X_L = 2\pi fL$	L X_L f X_C C
CAPACITIVE REACTANCE	$X_C = \frac{1}{2\pi fC}$	f X_C C
INDUCTANCE RESISTANCE FILTER CUT-OFF	$R = 2\pi fL$	L R f
CAPACITANCE RESISTANCE FILTER CUT-OFF	$R = \frac{1}{2\pi fC}$	f R C
RESONANT INDUCTANCE AND FREQUENCY	$L = \frac{X_L}{2\pi f}$	L X_L f
	$f = \frac{X_L}{2\pi L}$	L X_L f
RESONANT CAPACITANCE AND FREQUENCY	$C = \frac{1}{2\pi f X_C}$	f X_C C
	$f = \frac{1}{2\pi C X_C}$	f X_C C

○=INDICATES ENTRY SCALE
□=INDICATES ANSWER SCALE

Wheeler, Harold A., "Reactance Chart," *Proc. IRE*, Dec. 1950.

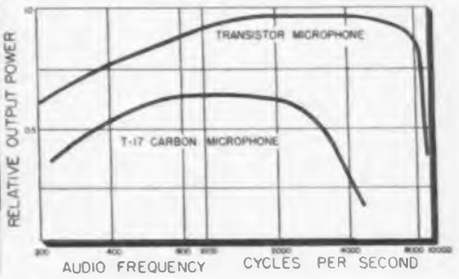
Transistorized Magnetic Microphone

BY using transistors to make a diminutive pre-amplifier coupled with a high quality magnetic microphone, Remler Co. Ltd., San Francisco, has developed a new combination unit yielding improved speech intelligibility and reduced noise in radio and aircraft public address applications through eliminating the hazard of misunderstood orders in air-to-ground communications.

The transistors are built into the microphone unit in both straight microphone and handset applications. Units plug directly into existing equipment previously using carbon button microphones. The reliability of the transistor amplifier, plastic seal-coated, has been proved by thousands of hours of life tests, humidity, hot and cold, and high altitude tests. It has also been flight-tested by a major airline. The microphone itself is the Remler ruggedized unit formerly supplied only to the U. S. Navy and merchant marine service. This new microphone is now in production at Remler's San Francisco plant.

Designed to combine the advantages of the magnetic and carbon microphones, the transistor-magnetic microphone overcomes the disadvantages of both. The noise-free fidelity of the rugged magnetic type variable-reluctance microphone combined with an efficient high gain transistor preamplifier permits direct interchangeability in carbon microphone circuits.

Transistor amplifier being held in hand fits into mouthpiece of a handset or a microphone



Performance of the transistor microphone compared with performance of carbon button type

Specifications: Output*—0.778 vrms at 100 dynes/sq.cm.; Matched Impedance—150 ohms, ±1 db 50 to 500 ohms; DC Supply Load—1000 ohms between 5 & 35 volts dc; Frequency Response—±6 db 500 to 6000 cps, 6 db per octave fall off from 500 cps.

Tests: A life test, continuous operation at room environment, has been in progress for sixteen weeks with no depreciation in performance. Performance of a test unit was not affected after exposure to the following environment: −60° F for 5 hrs; +160° F for 3 hrs; +125° F for 3 hrs; simulated altitude of 50,000 ft. and relative humidity of 95-100% at +122° F for 96 hrs. In addition, approximately 1,000 hrs. on regular service with a major airline.

* At nominal supply voltage of 27.5 vdc. Output down 2db at 15 volts, 4db at 10 volts, 11db at 5 volts.

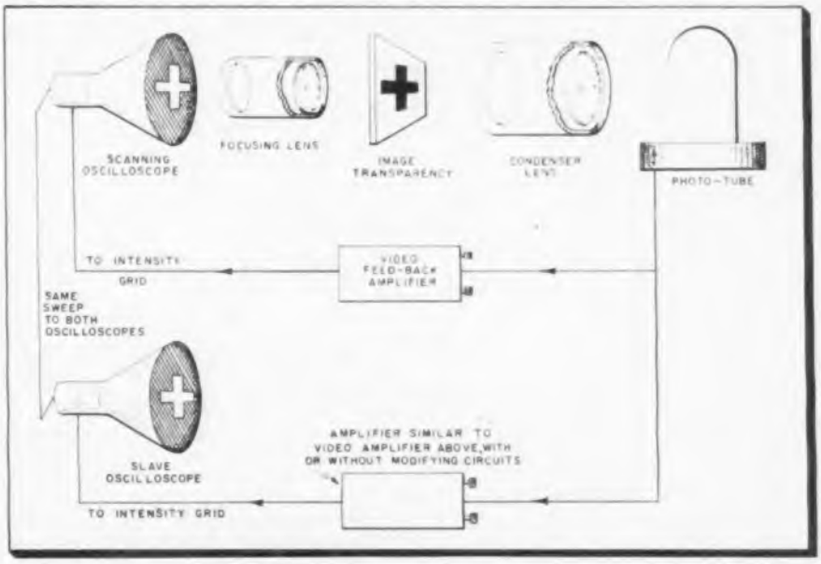
Electro-Optical Image Processing System

THE National Bureau of Standards has recently constructed an experimental optico-electronic system that will facilitate the study of visual perception and recognition of patterns and also promises to have a number of useful engineering applications, including TV, radar and computers. The device was developed by H. M. Joseph of the Bureau's electronic instrumentation laboratory in consultation with Dr. L. S. G. Kovasznay, Johns Hopkins Univ. This device can clarify blurred images or produce outline pictures and line drawings from half tone photographs.

Negative Picture

In operation (Fig. 1), moving spot on the cathode-ray tube scanner is focussed on the transparency. The light through the transparency impinges on the phototube which converts the changes in light intensity into electrical signals. These video signals are amplified and applied to the scanning tube intensity grid, thus reducing the light intensity of the spot and producing a negative picture on the scanning tube screen.

The negative feedback obtained in this way improves the tonal rendition of the picture. The same signals are also applied to another amplifier and the resulting signal is used to control a monitor cathode-ray tube which reproduces the same picture. Altering the monitor for the image processing is accomplished by introducing modifying circuits between the phototube and the monitor. This freedom to modify the picture on the monitor is the essence of the system.



Light from scanner spot passes through transparency and impinges on phototube. Resulting video signals are amplified and applied to scanning grid to produce negative picture on screen

Any scanning pattern may be used, but it greatly simplifies the

(*Continued on page* 187)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

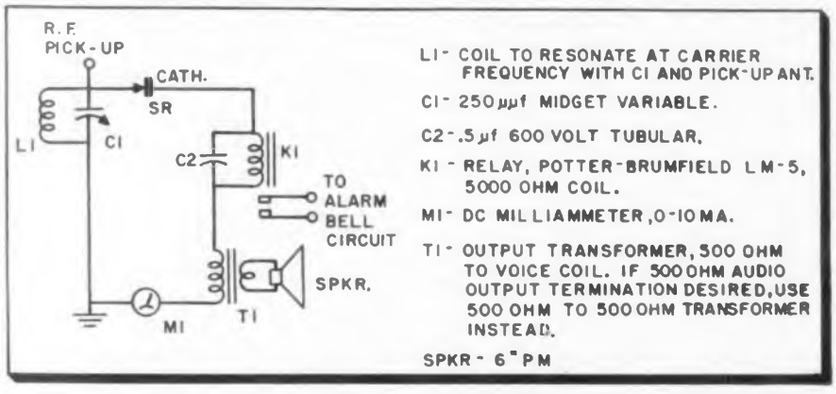
Transmitter Failure Alarm and Monitor

CHARLES M. SPARKS, Chief Engineer, WCRS, Greenwood, S.C.

AN easily-built and fool-proof unit for sounding an alarm when the transmitter carrier fails for any reason, also drives a speaker for monitoring purposes in the transmitter room or shop, and although its volume is limited, it is entirely adequate for the average room. By using a suitable matching transformer at T1 this unit will supply a 500-ohm audio output which is of proper level to feed into a telephone line and thus back to the studio, where it may be fed into the studio monitor amplifiers. Thus a transmitter failure will instantly kill the studio monitor speakers, a very desirable feature especially if remote control operation is used.

L1, C1, and the pick-up antenna resonate at the carrier frequency, the r-f is detected by the 1N34, and the resulting voltage operates the plate relay K1 and flows through the primary of the output transformer T1, driving a 6-in. PM speaker. If a 500-ohm audio output is desired instead of a speaker, a 500-ohm to 500-ohm matching transformer should be used at T1. An output level of approximately plus ten VU will be available, which if desired may be fed through a ten db pad before connecting to a telephone line. The relay used is a Potter Brumfield LM-5, 5000-ohm coil with SPDT contacts, which are connected to operate as a normally closed relay. Thus the rectified carrier voltage holds the contacts open until the carrier fails, then the contacts close, sounding an alarm bell or buzzer.

The pick-up antenna requirements will depend on the strength of the r-f field. All that is needed is enough r-f to register about 5 ma. on the meter, M1 when the tuned circuit is resonated. The entire unit is so small that it could be mounted inside the transmitter or antenna tuning unit, in which case no pick-up antenna should be required. A more sensitive relay could be used, which would of course reduce the amount of r-f required, but the speaker volume would also be reduced. C2 increases speaker volume and improves relay operation.



Simple and foolproof monitor and transmitter failure alarm also kills studio speakers

The primary impedance of T1 is 500 ohms, the secondary being 4-ohm for the speaker voice coil or 500 ohms for other purposes. The meter M1 is a dc milliammeter having a scale of 0-10. In locations where the transmitter and studios are combined in one building, this meter may be mounted in the control room in order to give the operator additional visual indication of the presence of the transmitter carrier. It will also indicate if the operating power is approximately correct.

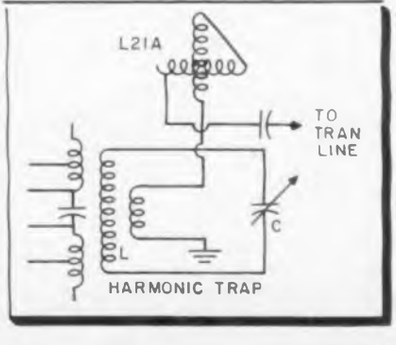
Harmonic Suppression

EDWARD J. WHITE, 136 Woodlawn St., Chicopee Falls, Mass.

AFTER many years of proper operation, the Western Electric 310B transmitter at Radio Station WMAS developed strong second harmonic radiation, and was promptly reported by an FCC monitoring station. Several tests and inspections confirmed the fact that no component transmitter part was defective and the transmission line/antenna circuit was operating properly. The 310B transmitter had a harmonic suppression filter. (Variocoupler L21A) Additional filters installed in the final plate leads suppressed the harmonic but the normal plate circuit loading was affected. After several trap insertions it was finally decided that an absorption wave trap coupled tightly to the final tank was effective. Size and adjustment of the coil are critical. No difference was noted in performance when the trap was grounded. An absorption wave meter was used to determine the effectiveness of experimental trap placements. Use of this meter was misleading, since it indicated harmonic suppression when used in the transmitter room but an additional check with a selective receiver at a point three miles distant proved the wave meter to be incorrect.

Before correction, the second harmonic signal strength at the three mile check point was 30db over S9 in the early morning (6 AM), dropping into the noise level of approximately S3, by 9 AM on an SX24 receiver. The trap condenser is a Barker and Williamson JCX100E, the inductance wound with 12 turns #14 wire.

12 turns of No. 14 wire around final tank and tuned provide efficient 2nd, harmonic trap



Heat Pays Off

ERNEST G. UNDERWOOD, Chief Engineer, KFRC, San Francisco 9, Calif.

DURING the war, when vacuum tubes were hard to procure, high voltage mercury vapor rectifier tubes posed a problem. KFRC accumulated many 12 KV mercury vapor rectifier tubes that were removed from service due to repeated arc-backs.

The problem was, what to do with many apparently usable rectifier tubes? Apparently the problem was tied to the fact that when the station was shut down at midnight, the transmitting equipment cooled down to such an extent, that by 5:30 a.m., when the transmitter was started for warm-up, they were uncomfortably cold. This condition had caused no difficulty with pre-war mercury vapor tubes, but was presumed to be causing the difficulties with tubes of war time and post-war manufacture.

A 1500 watt electric heater was installed in the transmitting, rectifier and generator rooms. These heaters were turned on at midnight when the station was shut down. Use of these heaters resulted in the temperature of the three rooms staying between 68 and 72° F. throughout the night.

Since the installation of the heaters the accumulated stock of wartime 12 KV mercury vapor rectifiers has been exhausted. Normal life was obtained from tubes considered "questionable." Arc-backs in the 12 KV rectifier are now exceedingly rare. The smaller mercury vapor rectifiers give more staisfactory service as well.

Component failure in the transmitter is practically non-existent. The constant temperature maintained during "off the air" hours prevents the equipment from cooling down completely.

Clock Synchronization

FRANCIS J. BOCK, Chief Engineer, WJVA, South Bend, Ind.

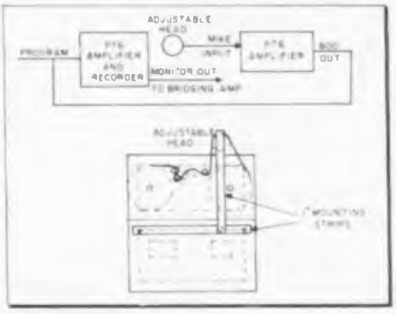
BECAUSE our clocks did not maintain accurate time, we decided to install five IBM clocks, operating from 110 v. ac with an automatic reset arrangement built into them. This means that if clocks are fast or slow, they can be adjusted to correct time by using a reset switch. Then we incorporated a short wave receiver into the system with the proper antenna to tune in WWV on 2.5, 5, and 10 MC. Now we can set all our clocks the moment we receive the WWV time signal.

Multiple Echo Effects

BOB CROSSTHWAITE, Chief Engineer, KWYO, Sheridan, Wyo.

SOME interesting multiple echo effects can be produced by using a tape recorder with an added, adjustable playback head and an amplifier.

The amplified, delayed output of the adjustable pickup head is fed back in parallel with the input to the tape recorder amplifier to produce the echo. Various results can



Delayed output from tape recorder produces variable echo effect by use of extra head

be obtained by changing the spacing of the adjustable head and the gain of its amplifier. It was found necessary to operate a Magnecorder PT6-AH recorder at a speed of 15 in./sec. because of the mechanical difficulty of obtaining the close spacing required at a speed of 7½ in./sec. A Brush Soundmirror record-reproduce head was used as the adjustable pickup. Its flat base is easy to clamp to a supporting metal strip.

When a Magnecorder PT6 recorder-amplifier combination is used simultaneous use of the echo effect can be obtained by feeding the output of the monitoring jack into a bridging amplifier. Since the delayed output is in parallel with the recorder input, the program source has to be isolated to prevent continuous echoes.

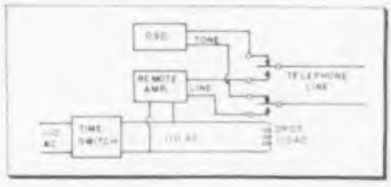
In the case of a rack-mounted PT6 unit, the adjustable head may be mounted rather easily by using two 1" metal strips. The horizontal strip is fastened with screws and suitable spacers into the holes normally occupied by the two top thumb-screws. The vertical support is bolted to this strip and the head clamped in place.

Automatic Remote Amplifier Setup

HENRY C. LOVELL, Chief Engineer, WHIR, Danville, Ky.

MANY stations carry Sunday church broadcasts. The setup described below eliminates the Sunday trip to turn the amplifier on and off. Equipment can be installed on Saturdays. One mike is placed in the church, and the task of riding gain is left to the studio operator.

Time switches costing less than ten dollars, will turn equipment on and off once in 24 hours—or many times with addition of trippers. Certain models will skip any days desired. If a check on the line is not

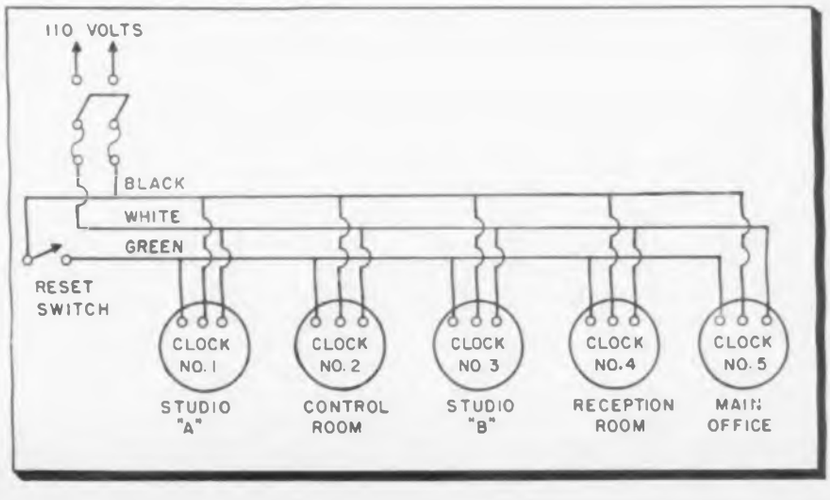


Time switch controls remote amplifier a and provides tone source as "OK" signal

desired, the time switch used with the amplifier will suffice. For a constant check on the line, an easily built tone oscillator such as described in TELE-TECH (Mar. '53, p. 87) or (Jan. '51, p. 38) and a DPDT

(*Continued on page 114*)

IBM clock corrector circuit manually controlled by WWV signals provides accuracy



Design Criteria for Transistor

Development of general theory overcomes shortcomings of elementary design principles. Differences between vacuum tubes and junction transistors clarified

By Dr. S. K. GHANDHI, Electronics Laboratory, General Electric Co., Syracuse, N.Y.

THE transistor art has now reached a stage where it is possible to secure any practical value of amplification. It is at this stage that properties such as stability and freedom from nonlinearities begin to assume increasing importance. The use of feedback methods, specifically degenerative feedback methods where amplifier gain is traded for one or more of the other desirable properties, thus becomes a very attractive proposition.

Perhaps the most important difference between transistors and vacuum tubes is that, whereas the maximum available power gain of a transistor is about 40 db, that of a vacuum tube operating over the same frequency range is considerably higher. A consequence of this is that the design of a tube amplifier may be taken up as the design of a voltage amplifier, with all the networks designed on a voltage transfer basis, and the entire burden of power amplification left to the output stage which is designed to transfer power into the load efficiently. With a transistor amplifier, each stage must be designed for power transfer.

Feedback Loops

A second difference is that, whereas a vacuum tube is a voltage actuated element, a transistor is a power actuated device. Thus voltage must be fed back in tube circuits, and power in transistor circuits. This affects the impedance level of the feedback loops. In vacuum tube amplifiers it is usually possible to design a feedback loop at such an impedance level that it neither loads the output circuit appreciably, nor has an appreciable transmission in the forward direction. This is usually not true for transistor amplifiers. Furthermore, the application of feedback around a transistor output stage will reduce the power available to the load; this is usually not the case in vacuum tube amplifiers employing feedback.

In developing an elementary theory of feedback, it is necessary to make use of the fact that a transistor may be approximately represented as a current actuated device. The simple feedback configuration then takes the form of an amplifier with a current ratio A°, between the input and output terminals of which is connected a four terminal network, as in Fig. 1.

Let γ = percentage of output current fed back to the network.

β = percentage of output current fed back to the input of the amplifier.

Then,

$$i_o = A^\circ i\,(1-\gamma)$$
$$i = i_i + A^\circ \beta i$$

Whence,

$$\frac{i_o}{i_i} = A_i = \frac{A^\circ(1-\gamma)}{1-A^\circ\beta} \qquad (1)$$

In commonly encountered circuits

$$|\gamma/\beta| \geq 1;$$

since the effect of γ is to reduce the gain, it is usual to assume a two terminal network for the feedback.

With such a network, $\beta = \gamma$, and

$$A_i = \frac{A^\circ(1-\beta)}{1 - A^\circ\beta} \qquad (2)$$

By direct comparison with the well known equation for a vacuum tube feedback amplifier, we note the inclusion of the multiplying factor $(1-\beta)$. This is due to the loading effect of the β loop on the amplifier..

For amplifiers with large amounts of feedback,

$$|A^\circ\beta| \gg 1,$$

whence

$$A_i = -\frac{1-\beta}{\beta} \qquad (3)$$

Thus the current ratio of such an amplifier is determined by the transmission through the β loop.

The effect of feedback on the parameter stability is obtained as follows:

$$\frac{i_o}{i_i} = \frac{A^\circ(1-\beta)}{1 - A^\circ\beta}$$

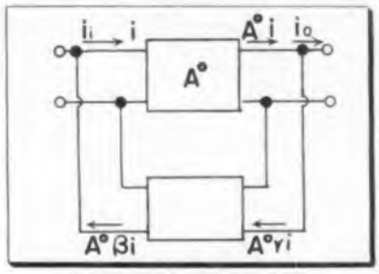


Fig. 1: Simple feedback circuit

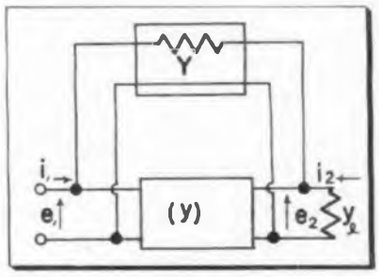


Fig. 4: Analysis of feedback amplifier

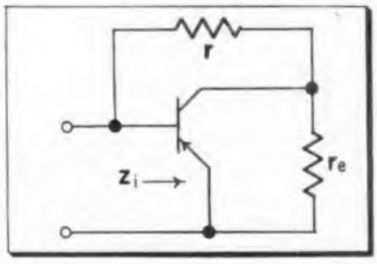


Fig. 7a: Grounded emitter with feedback

whence

$$\frac{di_o}{i_o} = \left[\frac{1}{1 - A^\circ\beta}\right]\frac{dA^\circ}{A^\circ} \qquad (4)$$

dA°/A° is the relative change in the current ratio without feedback due to a change in the transistor parameters, and di_o/i_o is the relative change with feedback. Thus the application of feedback modifies the variation of the current ratio by the factor $1/(1 - A^\circ\beta)$.

A simplified stability criterion follows, by direct analogy with the Nyquist criterion: If a plot of $-A^\circ\beta$ is made in the complex $-A^\circ\beta$ plane, the system is unstable if the plot encloses the critical point

$$-1 \pm j0.$$

In order to plot the $-A^\circ\beta$ locus, it is necessary to know the behavior of the transistor at frequencies inside as well as outside the range of

Feedback Amplifiers

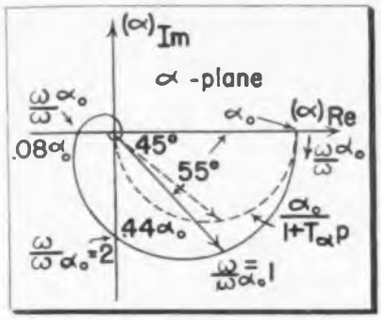


Fig. 2: Plot of alpha in alpha plane

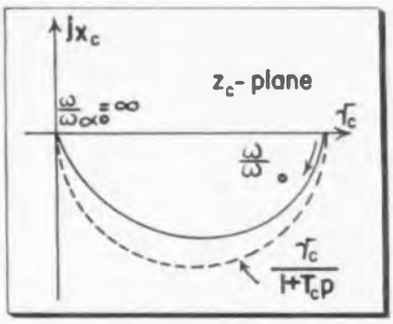


Fig. 3: High frequency behavior of Z_c

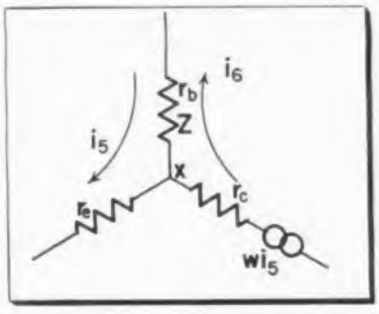


Fig. 5: Transistor equivalent circuit

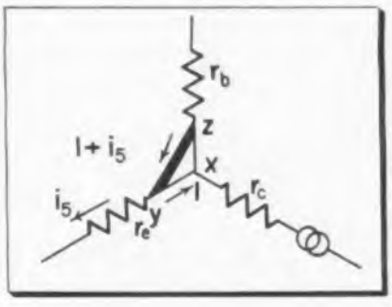


Fig. 6: Transistor short circuit bypass

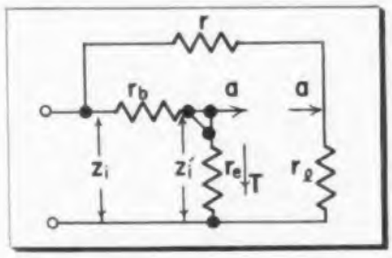


Fig. 7b: Redrawn equivalent circuit

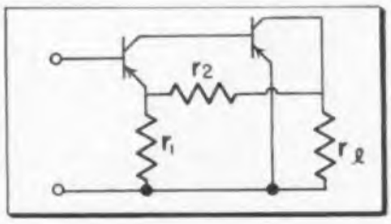


Fig. 8: Cascaded grounded emitter stages

peration of the amplifier. At frequencies where transit time effects become apparent, it becomes exceedingly difficult to define the transistor behavior by simple mathematical expressions. In most cases, it is sufficient to make a stability analysis using approximate formulae for the high frequency effects, and then to make qualitative adjustments to the analysis.

Fig. 2 shows a plot of α in the -plane. A plot of

$$\alpha_o/(1 + T_\alpha p)$$

s also shown (dashed line) for comparison.

$\omega_{\alpha o}$

s the angular frequency at which α s 3 db down from its low frequency alue of

α_o, and T_α is given by $1/\omega_{\alpha o}$.

Both the collector capacitance and the collector resistance fall off with frequency. Fig. 3 shows the high frequency behavior of z_c. An approximate representation, $r_c/(1+T_cp)$ is given by dashed line, and is that formed by a parallel R-C network with time constant T_c.

Theory Assumptions

It is interesting to investigate the assumptions made in the elementary theory.

(a) Loading effect of the feedback loop on A° is neglected. As mentioned earlier, the impedance level at which the feedback loop of vacuum tube amplifiers is designed is often such that this loading effect is negligible.

(b) The input impedance of the amplifier is neglected in computing the value of β. Since β is a function of both the load impedance and the impedance of the β network seen from the load end, and since this latter is in itself a function of β, an accurate computation of this quantity leads to considerable complication. An approximate value for β may be obtained if the input impedance of the amplifier is neglected in the computation.

(c) Direct transmission through the feedback loop is neglected. If the input impedance of the amplifier without feedback is neglected, this direct transmission is not present. An estimate of the effect of this direct transmission may be made if the input impedance is neglected in the computation of β alone. The loading effect of the feedback loop on A° can be taken into consideration by redefining A° as the current ratio of the amplifier without feedback, when terminated in a parallel combination of the load and the short circuit impedance of the feedback loop.

(Continued on page 158)

Analysis Procedure

The analysis is made as follows. Fig. 4 shows a feedback amplifier. Let the y matrix for the amplifier be

$$\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \quad (5)$$

and let Δ' be the determinant of the array.

For the feedback loop, we have the matrix

$$\begin{bmatrix} Y & -Y \\ -Y & Y \end{bmatrix} \quad (6)$$

$$\begin{bmatrix} y_{11} + Y, & y_{12} - Y \\ y_{21} - Y, & y_{22} + Y \end{bmatrix} \quad (7)$$

and let Δ be the determinant of the array. Then the current ratio of the combination is given by

$$A_i = -\frac{i_2}{i_1} = -\frac{(y_{21}-Y)\,y_l}{(y_{11}+Y)\,y_l} \quad (8)$$

Current ratio for the amplifier without feedback, but with a load of $y_l + Y$ is given by

$$A^\circ = -\frac{y_{21}\,(Y+y_l)}{\Delta' + y_{11}\,(Y+y_l)} \quad (9)$$

The feedback factor is given approximately by

$$\beta \cong \frac{Y}{Y + y_l} \quad (10)$$

Whence

$$A_i \cong A^\circ \frac{1 - \beta\left(1 + \frac{y_l}{y_{21}}\right)}{1 - A^\circ \beta\left(1 + \frac{y_l}{y_{21}} + \frac{y_{12}+y_{22}}{y_{21}}\right)} \quad (11)$$

Magnetron

THE magnetron, used in military, industrial and scientific applications, requires special attention in its manufacturing and testing. Among these important requirements are the factors affecting magnetron's stability, which may be tested by means of the Magnetron Stability Tester.

The exterior view of a magnetron stability tester is shown in Fig. 1 and the essential parts are given in Fig. 2. The tester will be used with the same power supply and modulator that is used in the radar set so as to approach as close as possible the actual operational condition of the magnetron. Special attention must be paid to the interconnections between the radar pulser—modulator—amplifier and magnetron stability tester. This requires the practical and constructive investigation of the short interconnections between radar set and magnetron stability tester, investigation of special cable for the high voltage, etc.

The left hand side of the apparatus is occupied by a section with safety interlock for the testing of different kinds of magnetrons and different bands of frequencies. This section of the magnetron stability tester should be located as close as possible to the radar set. It has the necessary measuring apparatus to measure variable dc and pulsed currents of anodes and filaments of a magnetron and a fluxmeter to measure the magnetic field of the magnetron.

H. S. Bennett

A. A. Kiriloff

By DR. H. S. BENNETT & A. A. KIRILOFF
Dynamic Electronics
73-39 Woodhaven Blvd.
Forest Hills, L.I., N.Y.

The central and right-hand side of the apparatus is occupied by a slotted line and dummy terminal load with the associated measuring apparatus: standing wave detector, thermistor bridge, frequency meter, spectrum analyzer and output power meter.

The magnetron stability tester, especially this section of the apparatus, permits the different factors, or special criteria, of a magnetron's stability itself and the influence of input and output circuits on this stability, to be determined.

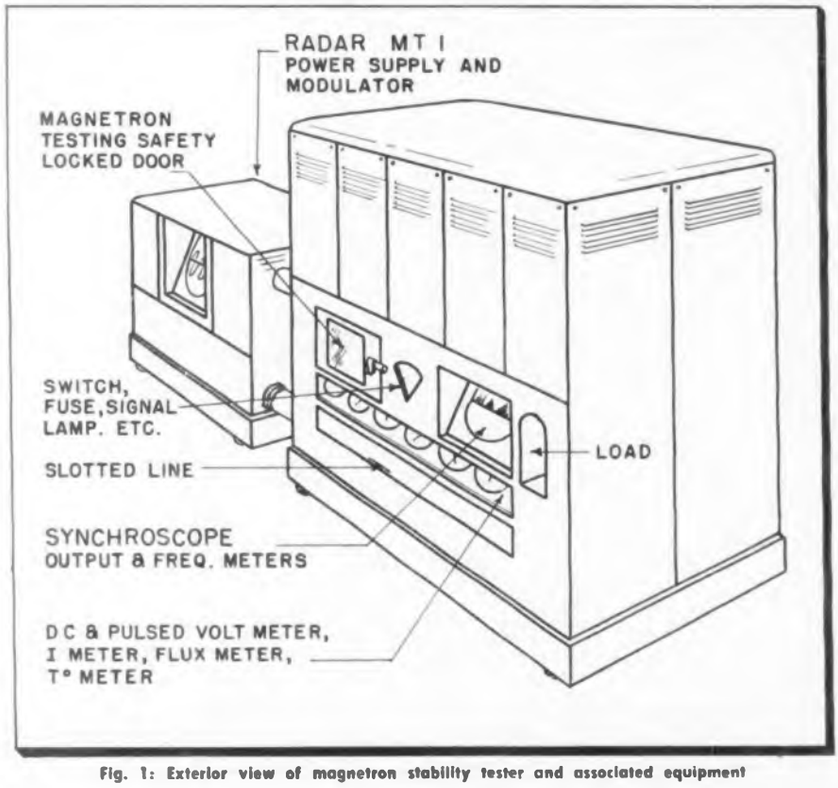


Fig. 1: Exterior view of magnetron stability tester and associated equipment

Magnetron Stability Factors

The stability of a magnetron is determined as a change in magnetron operating characteristics against changes in input and output conditions. It is desirable to attain both high efficiency (or output power) and high frequency stability against changes in load and changes in input conditions.

Frequency Stability

For any given frequency the magnetron's impedance or ratio $\sqrt{L/C}$ determines the efficiency and frequency stability. The efficiency with which a magnetron converts the input power into r-f power at the output is given by

$$\eta = \frac{\text{power input} - \text{losses}}{\text{power input}},$$

where η is the product of $\eta_c \times \eta_e$

η_c – circuit efficiency

η_e – electronic efficiency

The losses arise from the bombardment of the anode of magnetron by the electrons and from the circulating r-f currents producing r-f losses in the copper and other materials of the magnetron.

The efficiency, especially circuit efficiency η_c, is affected by the impedance of the magnetron. It is highest in a high impedance magnetron, but the electronic efficiency depends on the r-f voltage across the magnetron gap; the maximum η_e occurs at a lowest r-f voltage for a given power output. This reduction of the r-f voltage can be produced by decreasing the magnetron impedance

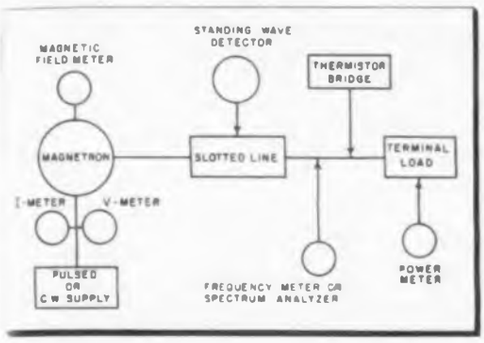
$$\sqrt{L/C}$$

or by coupling the magnetron tightly to the load. Heavy loading, ie., closer coupling between the load and magnetron, increases the efficiency but reduces the frequency stability. The high impedance magnetron acts in the same way and has less stability against load changes than a low impedance magnetron.

Overall Efficiencies

These general conditions of stability of a magnetron must apply for a large number of magnetrons, ranging in frequencies from 30 to 30,000 mc and in power output from 30 to 1000 watts CW operation, or from 1 to 3000 kw pulsed power. The working voltage range extends from about 500 to 50,000 v. The overall efficiencies of most existing magnetrons are in the range of 30 to 60% and must

Stability Tester



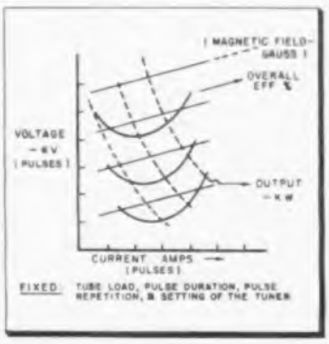
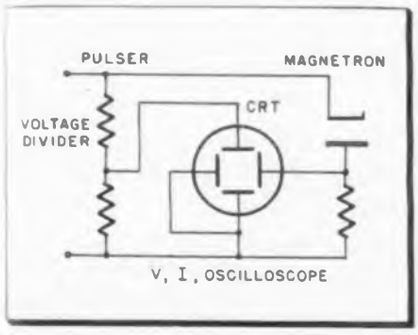


Fig. 2: (l) Equipment set-up for studying operating conditions of a magnetron. Fig. 3: (r) Magnetron performance chart at constant load, pulse duration and pulse repetition



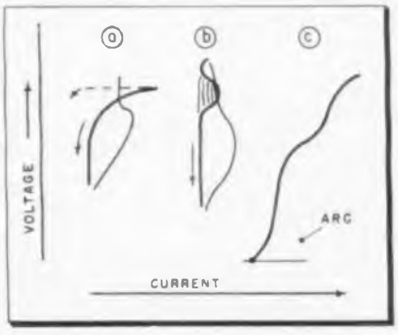


Fig. 4: (l) Circuit to determine starting. Fig. 5: (r) (a) Normal, (b) misfire, and (c) arc at start

System employs same power supply and modulator as that used in radar set. Tests show how to avoid mode jump, misfiring and sparking

operate for the pulse duration from 0.1 to 10 μs under a variety of duty ratios.

With the magnetron stability tester may be measured the following stability factors of a magnetron:

The Performance Chart: The relationship among H.V.I.P. and λ (or f_o) for constant load determines the performance chart of a magnetron (see Fig. 3).

The performance chart is the most useful presentation of the operating characteristics of a magnetron and any change in the chart indicates the instability of a magnetron. The study of this chart is especially very useful to determine the causitive factor of misfiring. The rate of buildup of oscillations in the magnetron depends not only upon the circuit characteristics, but also upon the electronic behavior with increasing dc and r-f voltage.

An increase in the load results in an increase of circuit conductance (Z_o) and in a decrease of oscillations buildup, which are inversely proportional to Q and λ.

The correct starting of a magnetron, for example, in the π—mode is possible only for a limited range of voltage near that which provides synchronism between the electron motion and the rotating field pattern of a magnetron. This can be determined from the performance chart using an oscilloscope, whose vertical deflection is proportional to dc voltage and whose horizontal deflection is proportional to dc current. The special device for this observation may be installed also in the magnetron stability tester, as shown in Fig. 4.

Intensity Modulation

The CRT tube plots voltage against current automatically. To make arrangement practical, the CRT tube must be intensity modulated, somewhat as in the synchroscope.

In Fig. 5 are shown:

(a) the normal starting of a magnetron in the π-mode.

(b) the "misfiring" of a magnetron.

The "misfiring" also is generally attributable to failure to start in the lower voltage mode and in many cases can be eliminated by sufficiently reducing the rate at which voltage is applied to the magnetron.

The misfiring and instability can be produced also by sparking (c), which is an internal discharge in the magnetron which arises as a consequence of the generation of bursts of gas within the tube. To avoid this, the magnetron must be operated under conditions that do not exceed specifications. Special attention must be paid to avoid overworking of the cathode, operating instructions for reduction of the heater voltage during oscillation should be exactly followed.

The mode shift in a pulsed magnetron or "mode jump," i.e., sudden change from one mode to another, is shown in Fig. 6, and is generally influenced by instability of the power supply. A small increase in supply voltage may cause the shift to lower current oscillation. Very small changes in anode potential produce large changes in anode current. For example, a 4J31 magnetron at H equal 2300 gauss changes its anode voltage from 20 kv to 22.5 kv which causes a change in current from 20 to 50 amps.

The proportion of the number of pulses in the respective modes of oscillation changes with power supply voltage and indicated in Fig. 7 for the "mode skip."

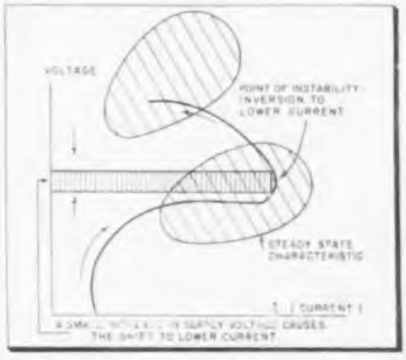


Fig. 6: Mode shift in pulsed magnetron may be caused by a small increase in supply voltage

To avoid all these phenomena, the control of a power supply must be such that no change occurs in its output. According to all these considerations it should be possible to reduce the tendency toward misfiring by:

(1) increasing the amplitude of the

(*Continued on page* 164)

Passive Broadband

By DR. H. M. SCHLICKE
Consultant Engineer, Allen-Bradley Co.
136 W. Greenfield. Ave.
Milwaukee 4. Wis.

THE reduction of the multitude of special methods used for reactive, passive broadband technique to a few basic relations, provides a powerful tool for treating broadband problems systematically.

Fig. 1 signifies the need for wideband matching by representing the power transfer efficiency as function of the transmission line attenuation and with the load VSWR as parameter. The diagram is premised on input matching equal to Z_0 of the line.[2]

The bandwidth over which the minimizing of the VSWR can be accomplished, is limited by a certain, yet inevitable property of electrical networks. This intrinsic property can be expressed in several ways that are consubstantial and wholly equivalent:

For two poles:

(a) Any non-dissipative, passive reactance X has the fundamental behavior $dX/df > 0$ (except of poles). This is Foster's reactance theorem.

(b) Another expression for this behavior is that no negative L or C exists as a physical entity.

(c) In the complex impedance plane, physically realizable two poles describe curvatures that are clockwise progressing for increasing frequency.

For four poles:

(a) Foster's reactance theorem was extended to n-pair terminals by Cauer.[4] The special case of four poles is treated by Guillemin.[5] This extension states that the elements of the impedance matrix are principally similar reactance functions as found for two poles.

(b) The input impedances of arbitrarily terminated four poles show the same well-known tendency of clockwise progression with increasing frequency as do two poles.

The significance of this restriction will become particularly clear in the section on anomalous dispersion. Altogether, it will soon become obvious that broadbanding is an "unnatural" correction of a natural behavior; that is, this correction will only be possible within certain limits.

Desirable Load Characteristics

The first prerequisite and the condition for all further procedures of broadband technique is to have a load as "flat" as possible. A load having a low Q will ab initio introduce a low VSWR. In the particular case of antennas, the attenuation exerted by the radiation must be high. High radiation attenuation, e.g., for dipoles is reached by choosing a low characteristic impedance of the antenna. That means that one must use thick dipoles as illustrated in Fig 2.

Nils E. Lindenblad[6] went even further in his tendency by a judicious choice of the shape of the antenna. In the equivalent circuit of the dipole he makes the attenuation $R/2Z = 0.5$ for the inductive branch and 0.5 for the capacitive branch thus providing theoretically a frequency independent dipole impedance (application of Boucherot circuit). Of special importance is the configuration of the antenna in the neighborhood of the feeding point. For

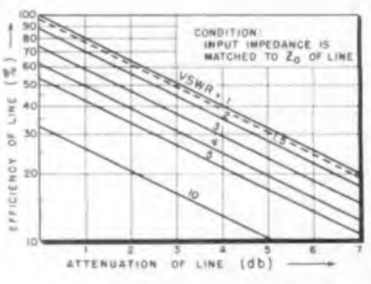


Fig. 1: Power transfer efficiency of lines

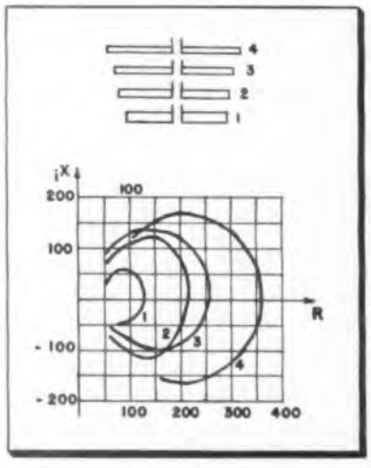
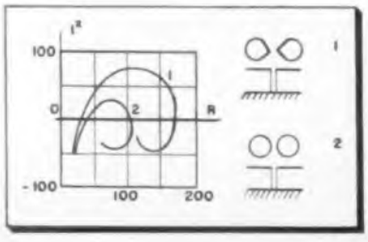


Fig. 2: Input impedance of round dipoles of different thickness, equal electrical length

Fig. 3: Influence of configuration in neighborhood of feeding point on input impedance



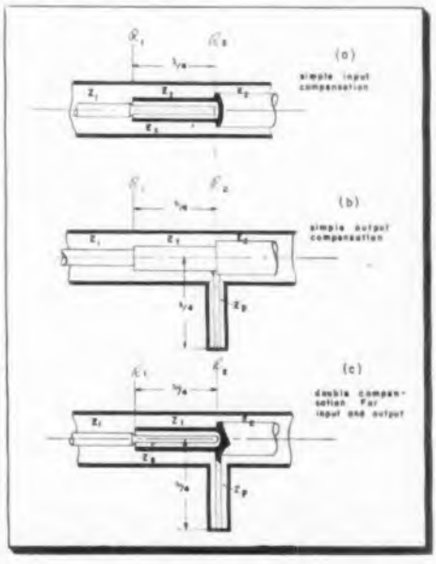
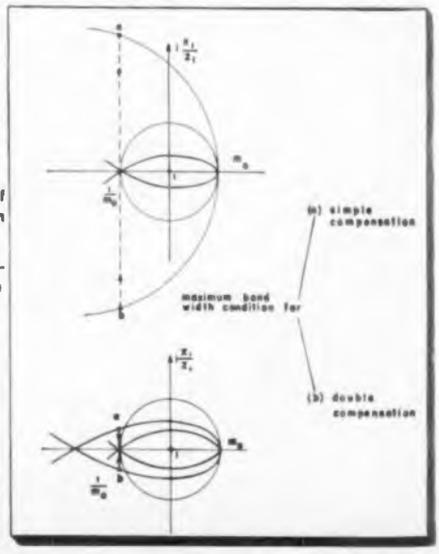


Fig. 4: Compensated λ/4 transformers

Fig. 5: Compensation for maximum bandwidth



Design Techniques

Broadband circuit design is facilitated by classification of many methods in use. Reactive and linear elements, and bidirectional fourpoles are analyzed

instance, changing the leaflike antenna 1 to a circular antenna 2 effects an essential shrinking of the impedance curve (Fig. 3).

The anomalous behavior of radiation coupling can be used to contract the input impedance curve of antennas with reflectors to a considerable degree, when the distance of the reflector is properly chosen. A simple rule of thumb, applying to dipoles or dipole pairs in front of plane reflectors, is to make the reflector distance $\frac{1}{8}$ instead of $\frac{1}{4}$ of the mean wavelength in order to get the best broadbanding effect.

Broadbanding Procedures

Compensation: Series- and antiresonance circuits have opposite phase characteristics. Hence, in the neighborhood of a series resonance point ($\lambda/4$ antenna) the reactance can be compensated by parallel connection of an antiresonance circuit of a certain

$$\sqrt{L/C}$$

In the region of an antiresonance point ($\lambda/2$ antenna) compensation is possible by series connection of a series resonance circuit of a certain

$$\sqrt{L/C}$$

The limit of compensation is given by Foster's reactance theorem. With the assumption that the resistive component is constant, the limits of compensation are given by

$$(f_2 - f_1)/f_1 f_2 \leq 2/\pi Q,$$

where Q is the figure of merit of the equivalent circuit of the antenna.

Reactance compensation of $\lambda/2$ dipoles: If X_r is the maximum reactance to be compensated and Z_e the

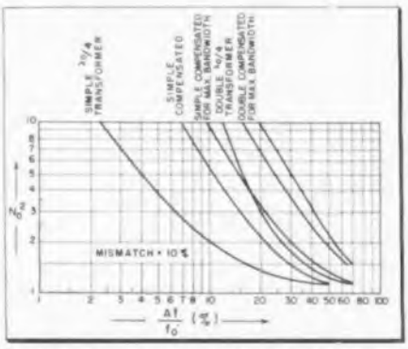


Fig. 6: Maximum transformer ratio vs. frequency range for transformers, allowing 10% mismatch

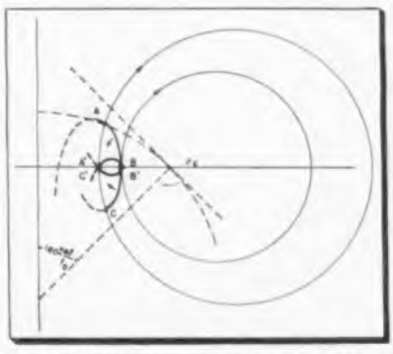


Fig. 7: Curve contraction by a line which is $\lambda/2$ long, and has characteristic impedance Z_0

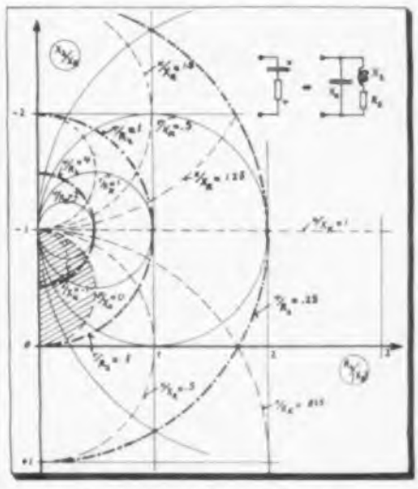


Fig. 8: Effect of parallel reactance

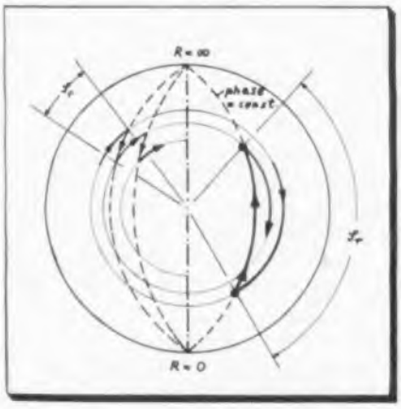


Fig. 9: Process of phase regression

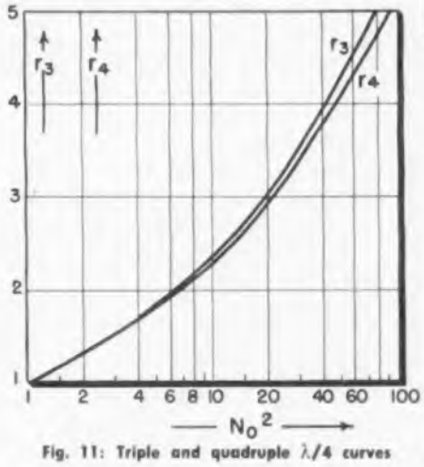


Fig. 11: Triple and quadruple $\lambda/4$ curves

Fig. 12: Mechanism of line transformer

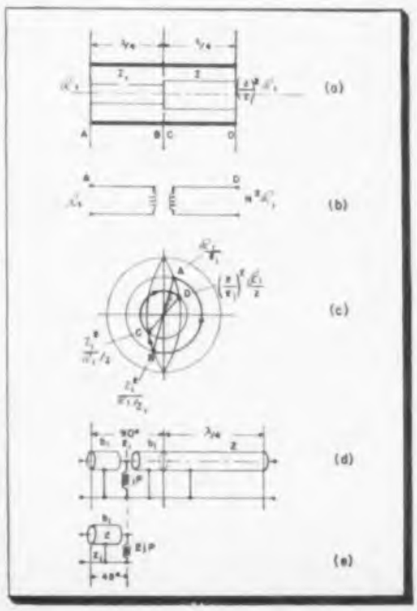


Fig. 10: Construction of simple and double quarter-wave transformers

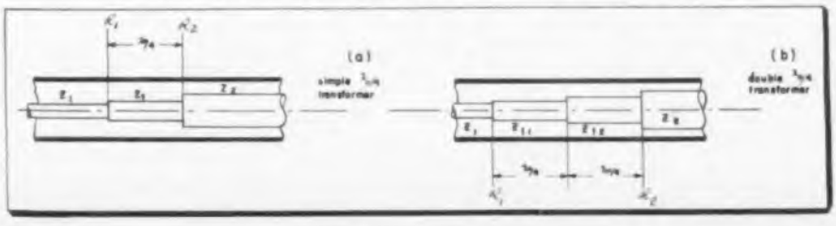


TABLE 1: COMPENSATION OF SIMPLE $\lambda/4$ TRANSFORMERS

		(a) No mismatch at the band mean		(b) Compensation for maximum bandwidth	
		$Z_1 > Z_2$	$Z_1 < Z_2$	$Z_1 > Z_2$	$Z_1 < Z_2$
a	simple compensation at input	$Z_1 = \sqrt{Z_1 Z_2} = Z_2 N_0$	$Z_1 = \sqrt{Z_1 Z_2} = Z_2 N_0$		
		$Z_\kappa = Z_1(N_0^2 - 1)$	$Z_\kappa = Z_1 (N_0^2 - 1)$		
	simple compensation at output	$Z_1 = \sqrt{Z_1 Z_2} = Z_1 N_0$	$Z_1 = \sqrt{Z_1 Z_2} = Z_2 / N_0$		
		$Z_\kappa = Z_1 (N_0^2 - 1)$	$Z_\kappa = Z_1 (N_0^2 - 1)$		
	double compensation	$Z_1 = Z_1 N_0$	$Z_1 = Z_2 / N_0$		
		$Z_\kappa = Z_1 (N_0^2 - 1) / 2$			
		$Z_p = Z_1 2 (N_0^2 - 1)$			
		$Z_1 = \sqrt{Z_1 Z_2} = \sqrt{Z_\kappa Z_p}$			
b	simple compensation	$Z_1 = Z_1 N_0 \sqrt{m_0}$	$Z_1 = Z_2 N_0 \sqrt{m_0}$		
		$Z_\kappa = Z_1 N_0^2 (m_0 - 1)$	$Z_p = Z_1 (m_0 - 1) / N_0^2$		
		m_0 can be calculated from: $q^2 = \tan^2 [(\pi/2)(\Delta f / f_0)] = (m_0 - 1 / m_0)(N_0^2 - m_0)$			
	double compensation	$Z_\kappa = Z_1 k (N_0^2 m_0 - 1) / 2$ input	$Z_p = Z_1 2 / k (N_0^2 m_0 - 1)$		
		$Z_p = 2 Z_1 / (N_0^2 m_0 - 1)$ output	$Z_\kappa = Z_1 (N_0^2 m_0 - 1) / 2$		
		auxiliary equations: $k = [q(N_0^2 m_0 - 1) / 2] [1 + q^2 + q^4 (N_0^2 m_0 - 1)^2 / 4]$			
		$q^2 = 2 [(m_0^2 - 1)(N_0^2 m_0 - 1)^2] [1 + \sqrt{1 + (N_0^2 m_0 - 1)^2 (m_0^2 - 1)}]$			

characteristic impedance of the compensating line, the following relations hold:

$X_c = Z_c (\pi/2) \Delta f / f_0$ For an open $\lambda_0/4$ line

$X_c = Z_c \pi \cdot \Delta f / f_0$ For a shorted $\lambda_0/2$ line

These equations hold for small detuning Δf; for large one's tan functions have to be used.

Susceptance compensation of $\lambda/4$ dipoles: Here the compensation has to be done by parallel connection of a shorted $\lambda_0/4$ or open $\lambda_0/2$ line of the characteristic impedance Z_c. The susceptance to be compensated is

$Y_c = (1/Z_c)(\pi/2) \Delta f / f_0$ For a shorted $\lambda_0/4$ line

$Y_c = (1/Z_c)(\pi) \Delta f / f_0$ For an open $\lambda_0/2$ line

Compensation of simple $\lambda/4$ transformers: The well-known $\lambda/4$ transformers hold only for one frequency. Broadbanding can easily be achieved by compensation. Two assumptions are made:

(1) The load Z_2 is a pure resistance R_2 (at least at the mean frequency).

(2) The transformed ratio N_0 (index "o" means mean frequency) is in terms of the voltage. Hence the resistances are transformed by N_0^2 or $1/N_0^2$ respectively. N_0 is always chosen in such a way that $N_0^2 > 1$.

The following nomenclature is used:

Z_1 = characteristic impedance of the transforming $\lambda/4$ line.

Z_κ = characteristic impedance of the open compensating $\lambda/4$ line at the end of the higher resistance load of the transformer.

Z_p = characteristic impedance of the shorted $\lambda/4$ line that compensates in parallel connection at the low impedance end of the transformer.

m_0 = VSWR for the band mean when maximum bandwidth is tried for.

Z_1 = input impedance.

Z_2 = output impedance.

Fig. 4 explains the arrangement of the compensating elements. For the simple $\lambda/4$ transformer the following equations are applicable:

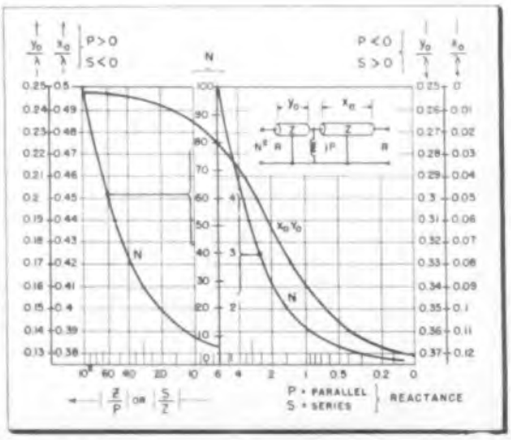
$$Z_1 > Z_2 : Z_\kappa = \sqrt{Z_1 Z_2} = Z_2 N_0$$

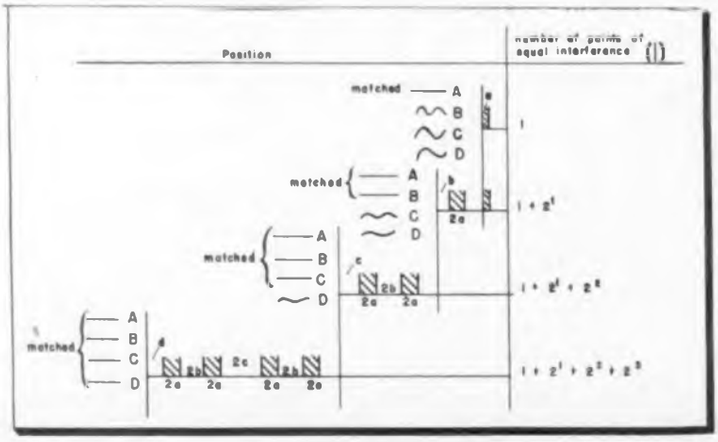
$$Z_1 < Z_2 : Z_\kappa = \sqrt{Z_1 Z_2} = Z_2 / N_0$$

The possibilities and relations of compensating simple $\lambda/4$ transformers are marshalled in table 1. The upper part of the table refers to cases where no mismatch is introduced at the mean frequency. The lower part of Table I treats the compensation for maximum bandwidth. Fig. 5 explains how this is achieved by allowing the same mismatch m_0 for the mean frequency and for the limiting frequencies.

(*Continued on page* 116)

Fig. 13: (l) Diagram for simple line transformer. Fig. 14: (r) Schedule for point-by-point matching of line transformers





UHF-VHF Printed Circuit Diplexer

Circuit design problems are overcome to provide almost flat response over complete range of TV frequencies. Installation of antenna-receiver combinations facilitated

By ANSEL GERE
Gabriel Laboratories
135 Crescent Rd.
Needham Heights 94, Mass.

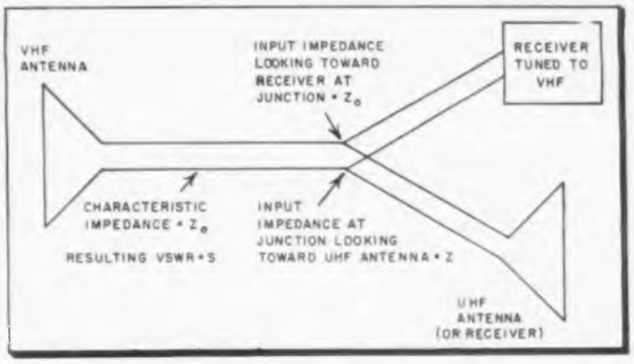


Fig. 1: Shunting unused UHF component across the transmission line causes signal loss due to VSWR from mismatch, and power absorption which would otherwise go to the VHF receiver

IN areas where both UHF and VHF TV reception exist, three distinct antenna-receiver combinations will be used. Namely:

1. The use of separate antennas and separate receivers for UHF and VHF.

2. The use of a single antenna for both UHF and VHF, but separate receivers, e.g., a VHF receiver and a UHF converter.

3. The use of separate antennas, but a single receiver.

With both separate antennas and separate receivers, the use of separate transmission lines produces two distinct systems, and no problems arise. However, when either an antenna or a receiver serves for both UHF and VHF, the question arises what is the best method to interconnect the three components used.

A diplexer is defined as any device intended to connect to a single transmission line two like devices (antennas, receivers or transmitters) operating in different frequency bands. Investigations have demonstrated the need for a diplexer in UHF-VHF TV reception.

Fig. 2: Power loss at matched receiver due to shunting impedance Z across its input

Fig. 1 shows the situation where one receives VHF, with the UHF antenna (or receiver, as the case may be) unused, but still connected. The discussion which follows is perfectly general, and the alternative situation of receiving UHF results from reading UHF for VHF everywhere, and vice versa.

In the absence of the unused component the VHF receiver presents a matched load to the transmission line, and absorbs all the power delivered to this line by the antenna (line losses being neglected). The introduction of the unused component into the system results in two types of losses. First, it mismatches the line, introducing a VSWR greater than 1. The resulting loss (in db) is given by

$$L_1 = 10 \log [(S+1)^2/4S]$$

where s is the resulting VSWR on the transmission line to the VHF antenna. Second, the unused component absorbs power which otherwise would go to the VHF receiver. This loss is

$$L_2 = 10 \log (1 + R_e/Z)$$

where Z is the normalized input impedance at the junction looking toward the VHF antenna.

"S" will be recognized to be a function only of Z, so that the combined loss $L_1 + L_2$ is a function only of Z. All possible values of Z are conveniently shown on a Smith Chart, and if those resulting in identical losses are joined, the result is a set of constant loss contours. These are shown in Fig. 2. One enters Fig. 2 with the complex impedance looking into the unused transmission line, and reads the loss in db associated with shunting that impedance across a matched transmission line.

Since the unused component is unspecified, one might assume that the reflection coefficient at the junction looking toward the unused component is randomly distributed in both magnitude and phase, or, knowing that the unused component is more likely to be mismatched than not, that the probability of finding a reflection coefficient smaller than a given value is proportional to the square of that value. The last assumption is equivalent to assuming that the fractional number of installations in which the loss exceeds a given level is proportional to the area to the left of that contour in Fig. 2. The arrangement of Fig. 1 is seen to be unsatisfactory a vast majority of the time.

The function of a diplexer may be viewed as transforming in a given band of frequencies any arbitrary impedance Z to an impedance which falls inside the permissible loss contour, while leaving the impedance unchanged at frequencies within the other band.

Simple Diplexer

The circuit of Fig. 3a is the simplest which might reasonably be expected to act as a diplexer in a balanced system. Fig. 3c is the simplified equivalent representation of this circuit when receiving VHF. L is chosen so that it introduces a VSWR of less than 2:1 in an otherwise matched line at 216 MC, and C so that it introduces a VSWR of less than 2:1 at 470 MC.

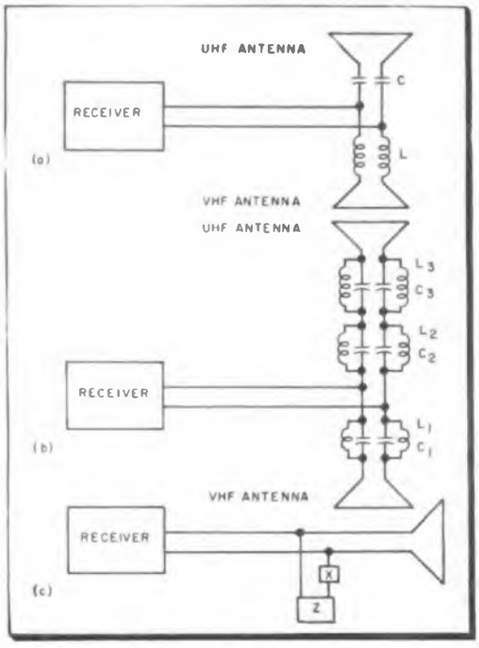
That is:

X_L at 216 MC = X_C at 470 MC $= 0.73Z_0$

X_L at 470 MC = X_C at 216 MC $= 1.59Z_0$

Fig. 4 shows the approximate loss

PRINTED CIRCUIT DIPLEXER (Continued)



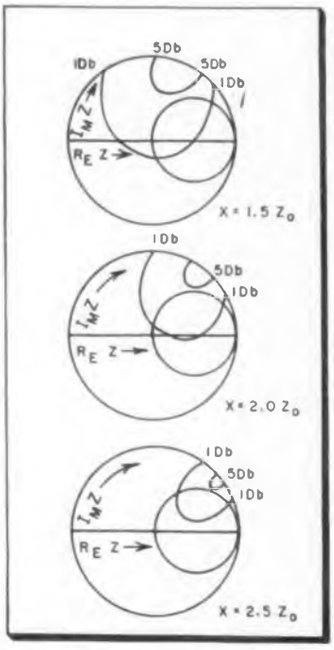


Fig. 3: (l) Simple diplexer (a), and a refinement (b). Simplified equivalent representation (c). Fig. 4: (r) Signal loss at receiver due to shunting impedance of Fig. 3c

associated with various values of X in Fig. 3c. It is shown for X negative (or for VHF operation). For X positive the contours should be reflected in the real axis. Exact values can be obtained from Figure 2. Since $X = 1.59Z_o$ at the edge of the bands, this diplexer is somewhat better than no diplexer at all.

Improved Diplexer

The circuit of Fig. 3b has been suggested as a diplexer. The impedance of the parallel circuits is given by

$$X = \frac{X_L}{1-\left(\frac{\omega}{\omega r}\right)^2} = \frac{X_C}{1-\left(\frac{\omega r}{\omega}\right)^2}$$

where $X_L = \omega L$, $X_C = -1/\omega c$, $\omega_r = 1/\sqrt{LC}$

The impedance of the parallel combination of an inductance and capacitance is greater than that of the inductance alone below resonance and greater than that of the capacitance alone above resonance, and significantly so for a narrow band of frequencies surrounding ω_r. The diplexer of Fig. 3b is therefore a variation of that of Fig. 3a, with increased action over certain frequency bands.

It may be inferred from Figs. 2 and 4 that if the series impedance is greater than $3Z_o$ at all frequencies in a band, the diplexer will work "almost all of the time." This requires that the impedance of the parallel combination be twice that of the single component, or that ω differ from ω_r by less than 30%. This is consistent with the variation of frequencies over the widest TV band.

However, for use with $Z_o = 300$ ohms, the inductances in the resonant circuits are impractically large. This is discussed later. A commercial diplexer utilizing this design must necessarily perform poorly.

Filter theory has been developed to the extent that Tee filters can be designed by straightforward means to approximate any desired stop and passband characteristics. The combination of a high and a low pass filter, both with cut-off in the neighborhood of 350 MC, might be expected to serve as a diplexer for UHF and VHF frequencies. Such a diplexer utilizing so called constant K filter sections is shown in Fig. 5.

Both the high and low pass filters have the property that sufficiently far from cut-off frequency in the stop band they behave like open circuits regardless of their termination, and sufficiently far from cut-off in their pass band they behave like a terminated transmission line with Z_o determined by the L and C used, and that in the neighborhood of cut-off they behave like reactive elements for most values of termination.

The first two properties are those required for a diplexer, with the last property serving to determine the extent of the useless frequency band between the two bands in which the diplexer must operate.

A distributed constant diplexer (made with sections of transmission lines) was built using the design equations given by Cohn[1] and ignoring the shunting effect of a filter in its stop bands. Its response curve is shown in Fig. 9a. This curve, and all others in this report, are the measured insertion losses of the diplexer with the unused terminal terminated in 300 ohms. Curves were also measured for short circuit and open circuit terminations, but except for frequencies from 216 to 470 MC were equivalent to those for 300 ohms termination.

The shunting effect of the high pass filter can be seen in the losses of the low pass filter beginning at 210 MC. This effect can be minimized by including the shunting effect of one filter in the design of the other. The procedure is easily done by trial and error and the effect was compensated on subsequent diplexers.

This distributed constant diplexer turns out to be difficult to fabricate, large, and sensitive to its environment. The last property explains the measured results in the UHF band.

In order to eliminate the last two objections it was decided to employ

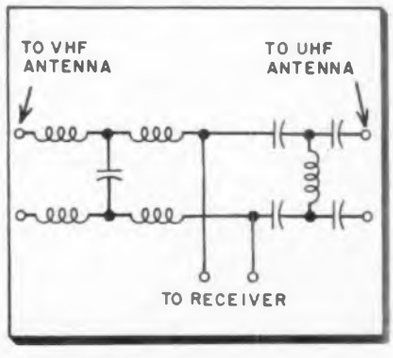
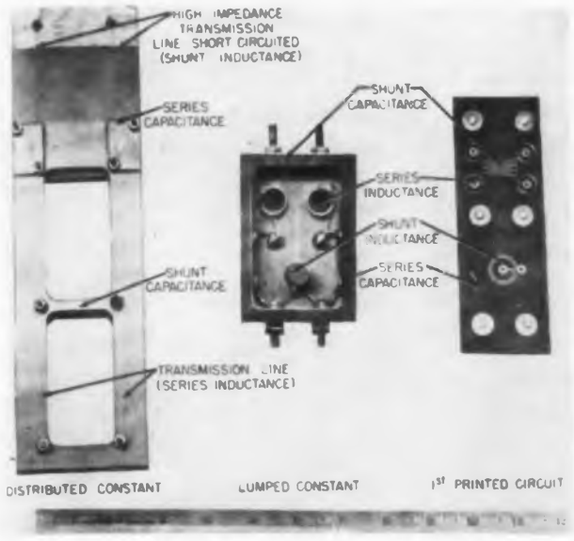


Fig. 5: Diplexer using two constant K section

a lumped constant diplexer. A conventional lumped constant diplexer roughly equivalent to the distributed constant diplexer, was built. It was difficult to fabricate, and therefore was not investigated further. These two diplexers are shown in Fig. 6

Printed Circuits

It became evident that the only economical way to construct a diplexer was through the use of printed circuit techniques. Fig. 6 shows the first printed diplexer built. Fig. 7 shows the other side of this filter as well as the drawing from which the filter was fabricated by



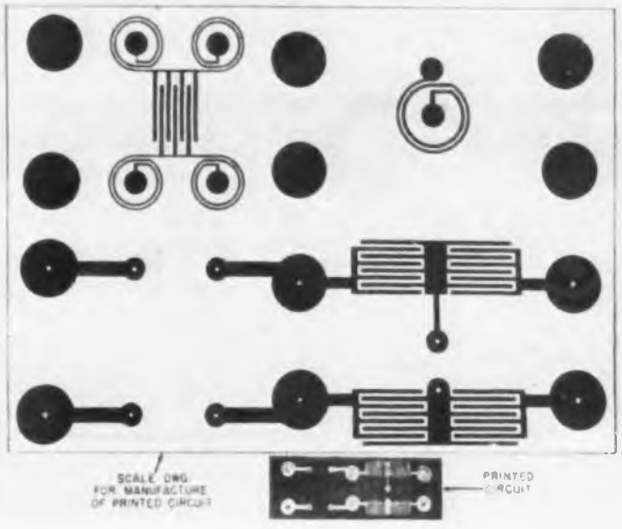


Fig. 6: (l) First experimental diplexers using printed circuits. Fig. 7: (r) Reverse side of filter and drawing from which filter was made

the photo etch technique.[2] Schematically, this filter was equivalent to the distributed constant diplexer, except for the small correction to improve response at the upper end of the VHF band.

The diplexer did not perform satisfactorily at UHF and the cause was traced to resonances in the coils. An investigation of spiral coils was conducted and it was found that the reactance of a coil is closely approximated by

$$X = 4f_1L_0 \tan(\pi f/2f_1)$$

where L_0 is the low frequency inductance of the coil, and f_1 is the first natural resonant frequency of the coil. "f_1" was found to be a function of the length of the conductor in the coil, the spacing between turns, and the material on which the coil was formed. For coils of the geometry used, formed on XXXP phenolic, it was found that f_1 is the frequency for which the length of the wire is 1/5 of a free-space wavelength. Calculations from these formulas show that any inductance greater than a few tenths of a microhenry will have resonances below 890 MC unless constructed with microscopic conductor widths and spacings. This completely rules out practical construction of the filters of Fig. 3b because of the requirement that either L_2 or L_3 be many fold larger than this in a 300 ohm system.

The required inductances in Tee filters with cut-off frequencies in the neighborhood of 350 MC are not large, however, and by making the coils small enough the proper value of inductance can be secured from a coil which has no resonances within the television bands.

Dimensions of such coils were computed, and a new diplexer fabricated. This diplexer is shown in Fig. 8. Response curves are shown in Fig. 9b. Abnormal response in the vicinity of 750 MC can be attributed to an increase in the apparent inductance of the shunt coil due to stray shunt capacities in the circuit. An increase in the output condenser is sufficient to transfer this abnormal response to the edge of the band.

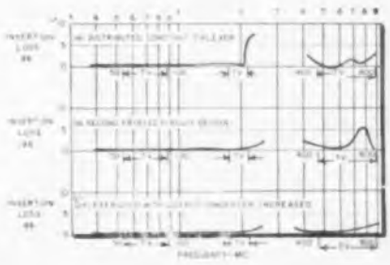
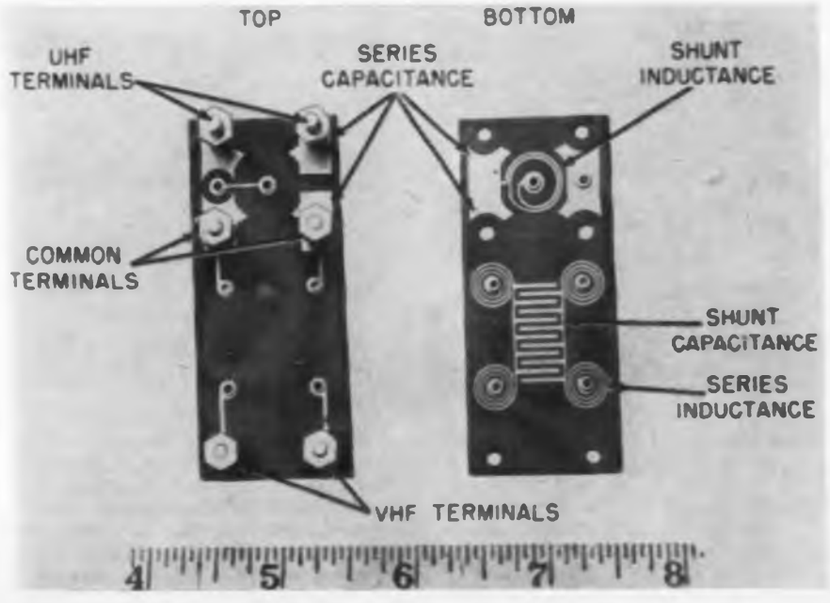


Fig. 9: Insertion loss of UHF-VHF diplexers with 300 ohms connected to unused terminals

Fig. 8: Second printed circuit diplexer



The response of this diplexer with the capacitor increase is shown in Fig. 9c. This design is satisfactory for home TV reception in all respects and is taken as the final electrical prototype.

The commercial version of this filter will differ only with respect to arrangement of the terminals, and the inclusion of a weatherproof plastic case.

1. Radio Research Lab. Staff, Harvard U., *VHF Techniques*, McGraw-Hill Book Co., N.Y.
2. R. L. Swigett, MODERN PLASTICS, August 1951.

New Test and

SWEEP OSCILLATOR

The Model Video TTV "Marka-Sweep," is a wide-band sweeping oscillator that covers the 50 KC to 8 MC range in a single sweep. The unit is equipped to provide frequency identification markers throughout the sweep

trace. These can be continuously variable, 50 KC to 8 MC, from the unit's calibrated CW oscillator, or crystal-positioned at 0.2, 0.75, 1.25. 4.0, or 6.0 MC. Other frequencies are available. **Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.**—TELE-TECH & ELECTRONIC INDUTRIES.

WOBULATOR

Intended primarily to align the UHF tuning heads of TV receivers, the Type 1211 UHF wobulator can also be used to determine impedance characteristics of antenna systems, and for proper termination of coaxial cables in the UHF

TV spectrum. The instrument covers the entire spectrum of 450-900 MC on oscillator fundamental frequency. Output is flat within ±10% over the entire spectrum for 50 MC band-width with the exception of a spurious absorption at 650 MC. **Tel-Instrument Co., Inc., 728 Garden St., Carlstadt, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DISTORTION ANALYZER

Model TDA-1 telegraph distortion analyzer rapidly and accurately measures the bias and distortion of "Teletypewriter" signals, circuits, and equipment. Percent of distortion is read on a scale in front of a cathode ray tube

No test signals are required. Measurements are made on regular teleprinter traffic. As the self-contained portable instrument measures 7-½ x 8 x 12 in. and weighs only 15 lbs., it can be carried to repeater or terminal points in field working circuits. No special skill or technical knowledge is required to operate the unit. **Stelma, Inc., 389 Ludlow St., Stamford, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FM SIGNAL GENERATOR

The Type ASG-1, FM signal generator comprises a highly stable oscillator coupled inductively to a piston-type attenuator. Frequency range, 20-100 MC in five bands. Calibrated output; 0.05 μv to 100,000 μv in 50 ohms external impedance calibrated to 2 db accuracy. Internal instrument impedance is 50 ohms. Three other test equipment

units announced by the manufacturer are the Model AR-1 FM demodulator and deviation meter, the Type AAM-1 dual channel audio amplifier, and the Model AFR-1 crystal calibrator. **A.R.F Products, Inc., 7627 Lake St., River Forest, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

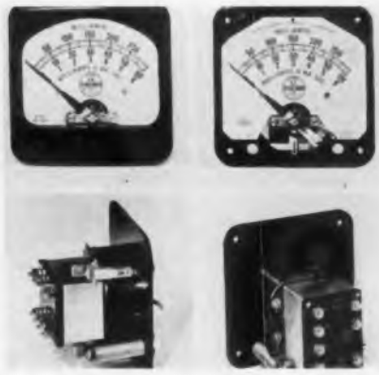
POLAR RECORDER

The Model PR polar recorder is designed for recording patterns of antennas and other directional devices. Its chart table is driven by a Selsyn motor that is provided with a gear reduction of 36:1 or 100:1 ratio, or to the customer's order. The chart diameter is 8¼ in. Actual recording width is 4⅛ in. which can be covered from O-20

db up to 0-80 db. Interchangeable linear, square root, and squaring scales are available. Frequency response is from 20 to 200 k cps. and over. The electronic circuit can be supplied for ac. or ac.-dc. recording. **Sound Apparatus Co., Stirling, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

BALLISTIC METER

The Model S43X dc and ac (rectifier) milliampere and milliampere second meter is one of a group of special 5-inch ballistic meters. Large movement which it has is necessary to achieve the sluggish action required in ballistic-type meters. The most sensitive prac-



tical range is 0-200 μamps. which, due to the long wire-length per ampere turn, has a resistance of 2,500 ohms. A milliammeter of 0-1 has the normal resistance of 2,500 ohms. **The Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Measuring Equipment

VSWR INSTRUMENTATION

Model 620 is a compact, commercial version of the AN/UPM-12 automatic VSWR instrumentation system. The computer-display unit provides automatic VSWR determinations over two ranges covering ratios of 1.02 to 1.2.

and 1.2 to infinity, at any preset power level from five w. to one megawatt and repetition rates from 400 to 4,000 pps. After installation of the matched directional coupler in the waveguide run, VSWR is computed and displayed by the computer display unit. **Cubic Corporation, 2841 Canon St., San Diego 6, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FLUTTER METER

The Gaumont-Kalee flutter meter is designed to measure small frequency variations of a given carrier frequency. The unit consists of a narrow band amplifier, a limiter, a discriminator and detector, and a metering system. The whole is self-contained and has its own power supplies. The input amplifier is

tuned to 3,000 cps. and has a 1,000 cps. bandwidth. For correct operation, an input control adjustment for signal level must not be less than 100 mv. **S.O.S. Cinema Supply Corp., 602 West 52nd St., New York 19, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TIME DELAY GENERATOR

The model A-5 time delay generator has the following delay ranges: 1-10 μsecs, 2.5 to 100 μsecs, 5-1,000 μsecs. Incremental delay is limited by the resolution of the helical potentiometer control to 1/9.800 of full scale. Accu-

racy after calibration and long term is ±1%. Output pulses, blocking oscillator, width 0.5 μsec wide between 10% points. Rise time, 0.1 μsec between 10% and 90% points. Output impedance, 100 ohms 0.01 μf blocking condenser. Amplitude 50 v. **Rutherford Electronics Co., 3707 Robertson Blvd., Culver City, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

COUNTER

The Model 21 electronic totalizer counts pulse or sine wave signals of 10 mv or greater at frequencies up to 1,000 cps./secs. Two decade counting tubes are used with a six-digit mechanical register to give a counting capacity of 99,999,999. Decade-counting tubes are rated at 10,000 hrs. The 5,000 hr. industrial type electronic tubes are operated at a fraction of their normal load for comparable long life. The unit uses only 5 thermionic tubes and draws 22 w. of 95-135 v. 50-60 cps. ac. Each decade-counting tube with one associated electronic tube takes the place of 10 neon bulbs and four electronic tubes employed in conventional counting circuits. Three inches high and six inches deep, the unit mounts in a standard relay rack. Weight is approximately four lbs. **Potter Aeronautical Co., Route No. 22, Union, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

NEW TECHNICAL PRODUCTS
for the
Electronic Industries
on pages 130-131
Other NEW PRODUCTS Reviews appear on following pages:
72, 73, 74, 75, 106, 107, 108, 112, 122, 124, 126

PASSIVE NETWORK

Type 2011 passive network consists of a continuously variable delay line, an input cathode follower, a voltage amplifier, and two output followers. The step variable delay line has a time delay of 10.5 μsecs. in step of

0.5 μsec. The continuously variable delay line has a total time delay of 0 to 0.5 μsec. with resolution time less than 5 x 10^{-3} secs. from 0 to 11 μsecs. **Advance Electronics Co., Inc., P. O. Box 394, Passaic, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SIGNAL GENERATOR

Type 190 constant-amplitude signal generator generates sine waves in the frequency range of 350 kc to 50 MC. Output amplitude varies less than 2% from 350 kc to 30 MC; less than 4% from 30 MC to 50 MC. Frequency is continuously variable in six ranges. Frequency indication is accurate within 2%. Output amplitude is continuously variable from 4 mv. to 10 v. peak-to-peak in 10 ranges with amplitude in-

dications accurate within 10%. Output impedance is 52 ohms. Weight 24 lbs. **Tektronix, Inc., P. O. Box 831, Portland 7, Ore.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Audio Accessories

RECORDING TAPE

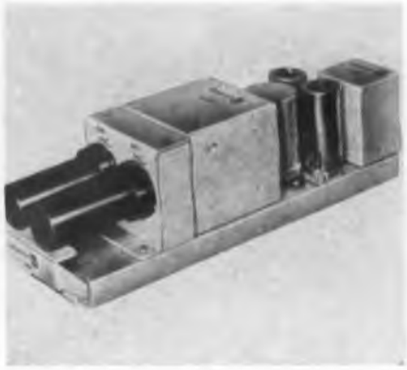
The newly-developed "Lifetime" magnetic recording tape is unconditionally guaranteed never to break or curl under normal recording and playback conditions; nor will recording machines or ordinary handling break it. Furthermore, neither humidity nor temperature will affect it. The permanent qualities of the new tape are the result of a newly-developed magnetic oxide applied to DuPont "Mylar" polyester film—neither of which contains a plasticizer. **Reeves Soundcraft Corp., 10 East 52nd St., New York 22, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

REEL

A new 7-inch plastic reel with a 2¼-inch hub provides essentially the same accuracy of timing and tension and stress freedom as the previous 2¾-inch hub, but its additional storage space eliminates outer tape turns slipping off. Holds 1200 ft. of tape with additional capacity for long end leaders and leaders between selections. Flanges provide more space for labels and give greater protection for the rolled tape. Raised edges around the rim and flange openings are said to provide increased strength and rigidity with minimum weight, and also serve to keep the clear plastic flange surfaces from becoming scratched or marred. **Audio Devices, 444 Madison Ave., New York 22, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PLUG-IN AMPLIFIER

Type 5117 miniature plug-in audio amplifier is a two-stage, push-pull, fixed gain unit that is conservatively rated at 8 watts. Gain, 55 db. Input source impedance, 30/150/250/600 ohms —150 and 600 ohms center-tapped. Output load impedance, 150/600 ohms—600 ohms center tapped. Output power as a program amplifier, +26 dbm (0.40 watts) with less than 0.5% rms total harmonic distortion over the range 50 to 15,000 cps. Output noise, unweighted, cps. As a monitor amplifier +39 dbm (8 watts) with less than 1% rms total harmonic distortion over the range 50 to 15,000 cps. Output noise, unweighted, equivalent to an input signal of-110 dbm or less, ±0.5 db, 30 to 1,500 cps., depending on tubes. **Langevin Manufacturing Corp., 37 West 65th St., New York 23, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



TAPE REEL

An 8/in. reel that can be used on any machine which takes the standard NARTB hub to eliminate tape-stretch, breakage and pitch changes has been announced. The new unit avoids use of a 10½ in. reel, which causes tension near the end of a small reel, and tension introduced by the smaller hubs of the standard 7 in. plastic reels. **Ampex Corp., 934 Charter St., Redwood, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SPLICER

A splicing device, said to be the first for magnetic tape as employed on tape recorders has been announced. The plastic back, of the splicer is provided with an adhesive mounting material for firmly attaching it to the tape recorder or work table. The splice is made by pressing the tape ends into a groove—overlapping about one-half inch. Held in place by edge friction, the ends are then trimmed by a blade run through a guide slot and a pre-cut tab of splicing tape is then pressed over the joint. **Cousino, Inc., 2326 Madison Ave., Toledo 2, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SPEAKER SYSTEM

The IT-1 speaker system is individually tuned. Each enclosure is tuned to its own speaker to secure the optimum 1-f performance from the system. The result is extended bass response without booming effect. The enclosure consists of a critically damped resistance-controled venting system. All tuning is performed by engineering personnel using laboratory measuring equipment. Cabinets are available in blond birch, walnut and dark mahogany. All finishes are hand crafted and hand rubbed. Front dimensions are 25 x 30 in. Speaker impedance is 8 ohms. **Laboratory of Electronic Engineering, Inc., 413 L Street, N.W., Washington 1, D.C.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Electronic Tubes

AMPLIFIER TUBE

The HA-2/4-50/20-1 broadband S-band voltage amplifier was developed to provide voltage amplification from 2 to 4 kmc which does not have to be tracked by tuning voltage or mechanism. The unit finds use in applications

where wideband and high gain are required at a low level, as preamplifiers, untuned r-f receivers, and in microwave measurement techniques. Operating characteristics over this band are 40 db gain, 20 mw. output, and 20 db noise figure. The unit requires a 300 gauss field and a 500 v. regulated power supply. **Huggins Laboratories, 700 Hamilton Ave., Menlo Park, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SHUTTER TUBE

The BL-58 TR shutter tube is said to be the only TR tube with continuous crystal protection—in one complete package. When equipment is not in use, or is in standby condition with the TR keep-alive voltage off, an automatic fail-safe shutter provides a minimum of 40 db insertion loss ahead of crystal. When equipment is in operation with voltage applied, the shutter

action is automatically removed and the TR tube functions normally. **Bomac Laboratories, Inc., Salem Road, Beverly, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MAGNETRON

The 4-J52 magnetron, used in radar equipment, has been redesigned to replace the oxide-coated cathode with the new Phillips dispenser-type cathode that is fabricated from tungsten impregnated with barium aluminate

enabling the tube to operate over a wider temperature range, and making it practically indestructible, it is said. A bifiler winding heater is used to reduce tube noise. Glass in the tube has been replaced by ceramic, allowing baking at considerably higher temperatures. **Microwave Associates, 22 Cummington St., Boston 15, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER TRIODES

F-6366 and F-6367 are 3 and 6 kw. output power triodes that are improved versions of Federal types F-7C25, F-5680, and F-5996. Although electrically similar, the new tubes differ from current models in characteristics, design, and performance. The F-6366 is a three-electrode industrial oscilaltor with a 3 kw output and filament characteristics of 11 v., 29 amps. The F-6367 is a three-electrode 6 kw tube designed for use as a modulator, amplifier, or oscil-

lator It has a filament voltage of 13 v. and a filament current of 36 amps. **Federal Telephone and Radio Co., 100 Kingsland Road, Clifton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

AMPLIFIER TUBE

A new beam power amplifier tube, 5992, is designed to replace the 6V6 and other such tube types. The units have a cathode type structure with an extruded ceramic heater insulator and a coil type heater instead of a filament

structure. This construction, it is said, along with the ruggedized mount structure, virtually eliminates heater failures, shorts, and other adverse effects of shock and vibration. An arc-resistant, compound-filled melamine base with inter-pin barriers enables operation at altitudes up to 80,000 ft. **Bendix Aviation Corp., Red Bank Div., Eatontown, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MULTIPLIER PHOTOTUBE

RCA-6328 9-stage type short multiplier phototube has instantaneous response to meet the critical timing requirements of headlight-control service. Its high luminous sensitivity allows use of an amplifier with relatively low-impedance input and fewer stages than required by a less sensitive tube. The low electrode dark current of the 6328 makes feasible the use of high-resistance voltage-divider networks to mini-

mize power requirements and to improve operating stability and life. **Radio Corporation of America, Tube Dept., Harrison, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Lab and Plant Equipment

CYCLOGRAPH

Model C-1 Cyclograph can be used to sort raw stock, semi-finished, or finished ferrous or non-ferrous parts by metallurgical characteristics such as analysis, hardness, structure, case depth, etc. Comparison with an acceptable known part as a "standard" en-

ables the quick separation of unwanted parts. Used as a "hand" sorter, the operator watches the screen and throws out off-standard parts manually. Used with a type 407 automatic relay unit, operator discrimination is eliminated which makes it possible to sort thousands of parts more per day. The relay unit sends out a reject signal whenever an off-standard part passes the test coil. This signal can be used to operate a solenoid operated reject gate, paint spray marking device, or other reject means. **J. W. Dice Co., 1 Engle St., Englewood, N.J.** — TELE-TECH & ELECTRONIC INDUSTRIES.

WIRE TWISTER

The Model G-6 wire twister is designed for a specific kind of wire, gauge of wire, and length of twist, and has no

treadle-operated jaws. A funnel-type opening guides the loose strands into a special head which holds the strands so that its rotation imparts the proper twist. Each twister is produced to order. **The Eraser Co., Inc., Rush Wire Stripper Div., 1068 S. Clinton St., Syracuse, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

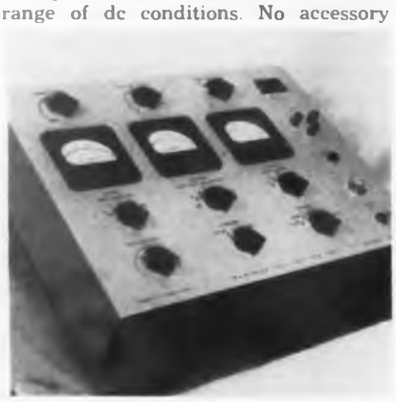
HARDNESS TESTER

The Model 317 sheet metal hardness tester tests all types of ferrous and non-ferrous sheet metal. Its calibrated microscope and reticle facilitate readings within two points in the Brinnel scale. The microscope has a self-contained battery-type illuminator. Sheet

stock from 0.01 in. to 0.250 in. can be measured. A precision ground spring, which loads a $\frac{1}{8}$ in. ball with 150 KG load, remains in constant calibration. Sheet pressure is applied by parallel jaw pliers, and indentations are measured with the microscope. A limiting pad assures that all indentations are formed with the same load. **Pacific Transducer Corp., 11921 West Pico Blvd., Los Angeles 64, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TEST SET

Type 210 transistor test set is intended for use in the circuit laboratory, inspection department, and on the production line. It measures the equivalent circuit parameters of both junction and point-contact units over a wide range of dc conditions. No accessory



equipment is necessary. The internal generator operates at 1.5 KC, and the ac voltmeter has a sensitivity of 1 mv full scale. The unit gives directly the value of input resistance, output resistance, voltage feed-back ratio, and current amplification factor. **Owen Laboratories, 412 Woodward Blvd., Pasadena 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PLATING BARREL

The Gill-Singleton plating barrel has a patented dual V-belt suspension drive that eliminates transmission gears and cylinder bearings. The cylinder is suspended in the tank from the superstructure by two belts that drive shaft pulleys to the grooved circumferences

at the ends of the cylinder. The belts support the cylinder weight while transmitting rotation power. The belts are acid, alkali, and stretch-resistant composition with guaranteed 2,000 lb. capacity, and heat-resistant to well over 200° F. Cathode contact is made by a self-cleaning, 12-in. inverted V-block on each end of the superstructure. **The G. S. Equipment Co., 5317 St. Clair Ave., Cleveland, Ohio**—TELE-TECH & ELECTRONIC INDUSTRIES.

PARTS WASHER

The triple automatic parts washer was developed for cleaning metal parts, paint-stripping, rinsing and similar cleaning and dipping operations. Each compartment is a complete tank with separate controls. Each is equipped with a spare parts rack. Pushing a

switch lowers the rack to the tank bottom and automatically agitates the parts in the solution. A second switch stops agitation and raises it flush with the tank top for unloading and reloading. All electrical switches and connections are explosion proof. The racks are raised and lowered by air under pressure. **D. C. Cooper Co., 1467 South Michigan Ave., Chicago 5, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Special "miniaturized" strips available, actual size shown.

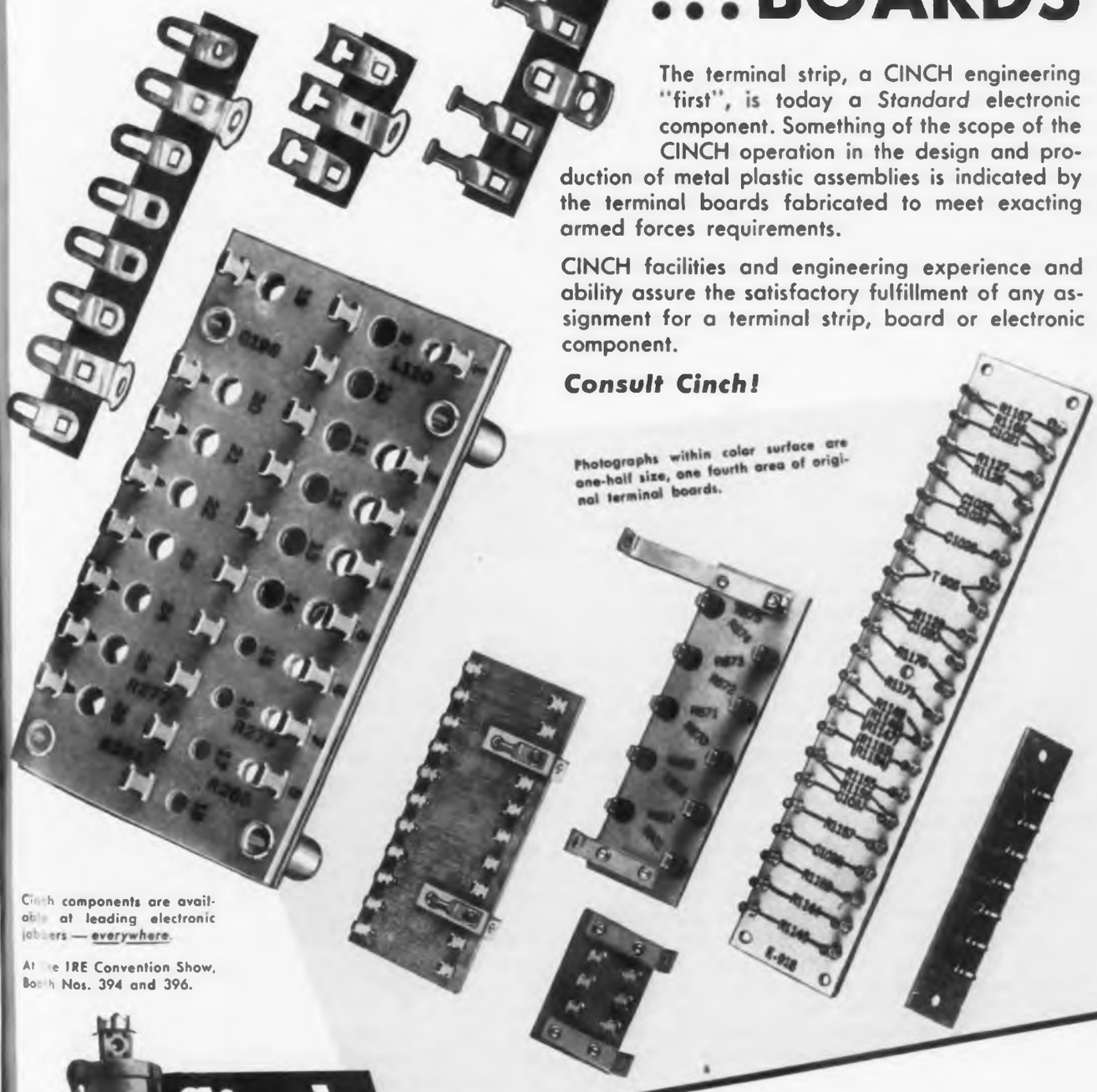
TERMINAL STRIPS ...BOARDS

The terminal strip, a CINCH engineering "first", is today a *Standard* electronic component. Something of the scope of the CINCH operation in the design and production of metal plastic assemblies is indicated by the terminal boards fabricated to meet exacting armed forces requirements.

CINCH facilities and engineering experience and ability assure the satisfactory fulfillment of any assignment for a terminal strip, board or electronic component.

Consult Cinch!

Photographs within color surface are one-half size, one fourth area of original terminal boards.



Cinch components are available at leading electronic jobbers — everywhere.

At the IRE Convention Show, Booth Nos. 394 and 396.

Cinch
ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass

WASHINGTON
News Letter

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

PRESIDENT'S RECOGNITION—The outstanding achievements in research in the electronics field as bulwarks for the growth of the nation's economy received full recognition from President Eisenhower in his administration's first Economic Report to Congress. With outlays having doubled in recent years for research, the President stated that "a fundamental condition of economic progress is a growing fund of scientific and technological knowledge" from which "come opportunities for investment and new industries, based upon the development of new materials and products, more efficient processes, and the improvement of old products." The President cited electronics, together with atomic energy, jet engines, helicopters, titanium and heat resistant materials, plastics, synthetic fibers, soil conditioners and hybrid seeds, as notable examples of new industries created by research. He specified as last year's research achievements of new industries, electronic computers and electronic process controls as well as communication equipment.

FCC FEES—What has been in the making for the past few years came to a head recently in the proposed schedule of fees to be charged by the FCC for the filing of applications and licenses for stations and there is no question but that the radio-electronics industry's various segments, even though granting the justification for the Commission's recovery of part of its expenditures in serving the industry, will seek in the filing of comments with the Commission clarification of some of the charges, especially the largest proposed fee of type approval of equipment. The latter is a proposed charge of $1,500 for type approval of equipment for broadcasting, marine, mobile and citizens radio services. The FCC under its fee program would recoup approximately 45 per cent or $2.8 million of its current 1953 fiscal year budget of $6.4 million. Comments are to be filed by April 1.

RANGE OF CHARGES—The first agency to make public its program of charges for its services, the FCC schedule of fees is likely to receive revision in its final form after analysis of the impact of the costs upon the mobile and amateur radio services and upon smaller radio-electronic manufacturers, particularly, because of the potential threat of retarding progress in the art. Clarification of the FCC plan is to be sought by the various elements in the industry through the comments and probably oral arguments before the Commission. The schedule of fees was as follows: $325 for major broadcasting-television applications such as sale of stations and competitive station proceedings; $50 for minor broadcast-TV applications; $10 for processing of all types of applications for the safety and special radio services, including modifications of licenses; $20 for experimental services applications; $3 for amateur, disaster and RACES (radio amateur civil emergency service) which is a charge likely to be hotly debated by many "hams"; $60 for type approval of equipment applications for industrial, scientific and medical services; $100 for type acceptance of equipment applications; and $30 for compulsory ship radio-electronic equipment inspections by the FCC field staff. The charges of equipment approvals ranging from $100 to $1500 have aroused the principal controversy, it is understood.

VIEWS ON UHF-TV—FCC Commissioner George E. Sterling, one of the two "engineer" members of the Commission, gave some significant technical views on how the FCC could help the progress of UHF television. He declared the FCC should look favorably on granting extensions of time for completion of UHF stations which are seeking transmitters of power greater than 1 kw, but he cautioned that possibly stations should not seek such high power. He also felt the FCC could relax or lift the limitations on antenna directionalizing to aid UHF stations in better coverage. The Commissioner who presented his views before the Boston section of the IRE likewise expressed the viewpoint that licensing of satellites and booster stations would help UHF television progress.

MICROWAVE LANDMARK CASE—Proposal of California to establish a state-operated microwave radio system which is before the FCC promises not only a long dispute between the telephone and telegraph systems on the one hand and several state governments and police, fire and forestry conservation departments on the other side but is slated to a landmark case in the development of FCC microwave policy. A virtual flood of comments by supporters and opponents of the California application has been transmitted to the Commission. California has asked to establish its statewide system for its public safety (police, forestry, conservation, etc., services), and to handle traffic for its state agricultural market news service as well as state government administrative traffic in off-peak hours. The telephone and telegraph companies stressed to the FCC that their facilities, already available are entirely adequate and the California move if adopted by other states would provide government competition with private enterprise as well as being a rather costly venture on the part of the state governments. The California plan undoubtedly was a subject of discussion at the Feb. 24 meeting of the central microwave coordinating council in Chicago.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

first ...choice----→ GPL again!

J. Patrick Beacom, president of Beacom Broadcasting Enterprises, specified GPL equipment at WJPB-TV for "top quality plus economy"

Century-old mansion was restored by radio-television firm, now houses both WJPB and WVVW studios and offices.

Robert M. Drummond, vice president and general manager of WJPB-TV, directs station operations in Monongahela Valley area.

$117,565 Completely Equips WJPB-TV... LOWEST COST EVER FOR CAMERA CHAIN STATION

● Fairmont, West Virginia, is America's smallest market with a camera chain station for live shows . . . 319,000 persons and 32,101 UHF sets in range of WJPB-TV, Channel 35.

"Keeping costs down," says station president J. Patrick Beacom, "was the only way this community could have a live station." He equipped it for $117,565, on a GPL plan for a basic package of camera chain and film chain, projector, transmitter, antenna and accessory units.

"We analyzed *all* equipment," adds Mr. Beacom. "We visited numerous other stations. Then we picked the GPL package plan as best for both our company and our community. Community TV just wasn't possible with other equipment, yet we have top engineering and best picture quality with GPL, plus the economy."

In any market today, costs are important. If your CP is in a highly competitive and densely populated area, you need GPL for quality to get and hold an audience, at a profitable operating rate. If it's in a sparse market, where TV is new, you need it for utmost economy. In short, in any market, big or small, network or independent station, it combines the best quality with operating economy.

Ask for proof! You'll discover how GPL can save you money . . . with the best.

Write, wire or call for complete information.

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

GPL

Cable address: Prelab

Export Department:
13 East 40th St., New York City
Cable address: Arlab

Subsidiary of General Precision Equipment Corporation

Camera Chains • Film Chains • GPL-Watson Varifocal Lenses • Theatre TV Equipment • GPL-Continental Transmitters

WINDING MACHINE

The Type DB automatic core winding machine, produced by Froitzheim & Rudert, Berlin-Reinickendorf-West Germany, is designed to wind toroidal cores, transformers and power rheostats. Uniformly even and firm windings are obtained by means of an infinitely variable wire-feeding arrangement which can be adjusted during operation, and by an automatic brake on the winding magazine. The ring to be wound is inserted in the open winding magazine. Then, the magazine is closed and filled with the required winding material. The ring is wound by the movement of a rotary winding table on which it is mounted, or by the segment table to which it is mounted. Exclusive distributor for U.S.A. and Canada, **Rex Rheostat Co., 3 Foxhurst Road, Baldwin, L.I., N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

REPEATING FUSE

The Sightmaster patented indicator repeating fuse for home and industrial use has gone into production. When the fuse ceases to function a neon indicator lights which is a signal to switch to the next fuse position. Since there are six positions, the fuse can be used repeatedly by twists of the switch. The fuse will be produced in 15, 20, 25, and 30 amp. ratings. **Sightmaster Corp., 111 Cedar St., New Rochelle, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ELECTROMAGNET

The 6-in. model V-4007 multi-purpose laboratory electromagnet features changeable pole caps for uniform or high field work, an adjustable gap that provides a gap range from ½ in. to 6 in., and a dolly mount that gives complete mobility without loss of rigidity. The changeable yoke angle enables use of a variety of positions to provide working access. **Varian Associates, 611 Hansen Way, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New! A low-cost

MARKER GENERATOR

for PRD's VHF-UHF Sweep Frequency Generator

The Type 909 Marker Generator – precision engineered by PRD – provides frequency markers of crystal accuracy, which are added electronically to the response pattern. This is accomplished by connecting the Marker Generator to a special marker injection circuit in PRD's Type 907 Sweep Frequency Oscillator.

UHF Frequency Meter Type 587 provides a method of accurate absolute frequency measurement in the UHF range.

TYPE 909 CRYSTAL MARKER GENERATOR

GENERATOR: Crystal Oscillator, Harmonic Amplifiers
OUTPUT: 2, 10 or 50 mc/s (±.01%) markers up to 2000 mc/s
OUTPUT CONTROL: Marker amplitude continuously adjustable
OUTPUT IMPEDANCE: Both high and low
RADIATION: Low

TYPE 907 SWEEP FREQUENCY GENERATOR

WIDE RANGE: 40 to 900 mc/s
WIDE SWEEP: At least 40 mc/s for UHF
HIGH OUTPUT: At least 0.3 volts over entire range
OUTPUT IMPEDANCE: 50 or 75 ohms
LOW RADIATION: 10 μv or less

TYPE 587 FREQUENCY METER

CAVITY TYPE METER: May be connected as Reaction or Transmission Type
FREQUENCY RANGE: 400-1000 mc/s
ACCURACY: ±0.2%
Q FACTOR: Approx. 1000 (not less than 600)
READING: Direct

Complete data and specifications will be forwarded promptly upon request to Department T-3.

See the Complete Line at the I.R.E. Show
BOOTHS 293-295
INSTRUMENTS AVE.

Polytechnic PRD

RESEARCH & DEVELOPMENT COMPANY • Inc

202 TILLARY STREET, BROOKLYN 1, NEW YORK

MIDWEST SALES OFFICE: 1 SO. NORTHWEST HWY., PARK RIDGE, ILL.
WESTERN SALES OFFICE: 741½ NO. SEWARD ST., HOLLYWOOD 38, CAL.

CUES for BROADCASTERS

(*Continued from page 93*)

relay will round out the setup. Those unwilling to depend upon a normal type relay, can use a locking model, however the tone would not return to the line after the broadcast. With a normal type relay, this setup is convenient for any fixed daily, or weekly broadcast, and gives a constant line check.

Single Channel Transistor Remote Amplifier

ROBERT FLORY, Chief Engineer, WVBR, Ithaca, N. Y.

THERE are many remote broadcast applications for a compact single channel remote amplifier. Battery operation is often desirable Fig. 2 shows the circuit diagram of such an amplifier, employing two RCA type 2N34 junction transistors. The

Fig. 1: Rear view of Transistor amplifier chassis

operating condition of transistors are fixed, and any transistor of the 2N34 type can be plugged into either socket. Constructional details are shown in Fig. 1.

The first stage is designed for lowest noise level. This has been found for this type of transistor to be at a collector current of 1 ma or 2 ma and a collector-emitter voltage of 1 v. or 2 v.

The circuit constants for the first stage in Fig. 2 have been chosen to produce these operating conditions. The input impedance of a base input amplifier is about 1000 ohms. A Stancor UM-111 transformer matches a 50 ohm microphone to the base of the transistor. Resistance-capacitance coupling is used between the two stages. If more gain is desired, impedance matching can be used. A Stancor UM-110 transformer would be suitable. Shunt feed should be used to maintain the proper operating conditions on the first transistor. The gain control is of the degenerative type in the output stage. Maximum gain is obtained when the capacitor is connected to the emitter.

The output circuit will depend on the output power required. Output is limited by a 50 mw dissipation limit on the transistor. The amplifier as constructed was designed for 1 mw undistorted output. Collector load impedance for maximum power output is closely approximated by dividing the collector-emitter voltage by the collector current. Hence the load impedance for the output stage is 8000 ohms. The impedance match to the 600 ohm telephone line is accomplished by a UTC A-26 transformer.

Frequency response is limited by the transformers rather than the transistors. Noise level is about 30 to 40 db below average signal level, using a Shure 55S microphone with the announcer about 1 ft. from the microphone. This noise level is low enough that it is almost always obscured by the background noise in a remote location.

Power Requirements

The amplifier requires 4 ma at 20 v. which is obtained from a Burgess XX15 battery, and battery life is about 50 hours with one hour daily operation. To avoid accidental battery drain, the amplifier operates only when it is connected to the telephone line with the proper connector which has a jumper to connect the battery to the amplifier. The entire amplifier, including battery, is contained in an aluminum box measuring 3 x 4 x 5 in.

The operation of the amplifier is extremely simple, the power switch being the only control. The gain control was made a service, or set-up adjustment for simplicity. It is so adjusted that the output never ex-

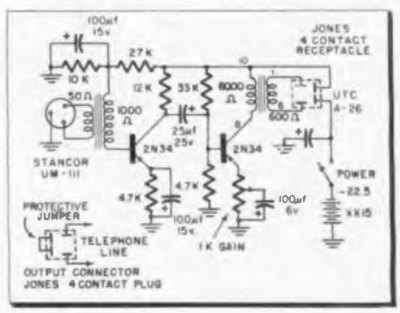
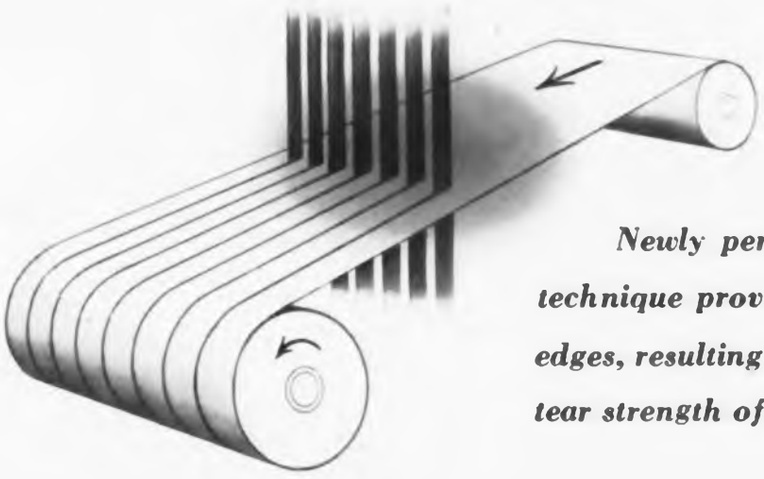


Fig. 2: Circuit details of remote amplifier unit

ceeds 1 mw with the microphone used. The noise level of telephone lines used is low enough that the average signal level can be 10 to 20 db below 1 mw, without line noise becoming important.

NEW HOT-SLITTING PROCESS

GIVES audiotape EXTRA STRENGTH



Newly perfected thermal-slitting technique provides smoother, cleaner edges, resulting in increased break and tear strength of plastic base Audiotape

IN THE manufacture of Audiotape, particular care has always been given to the slitting operation, in which the processed tape is cut into reel-size widths. Precision straight-line slitting has been one of the reasons why Audiotape tracks and winds perfectly flat and has no fuzzy edges to impair frequency response.

Now, however, even this superior slitting operation has been still further improved by precisely controlled heat application. The result, though not visible to the naked eye, is a significant increase in tape *strength*. For thermal slitting avoids the formation of the microscopic cracks and irregularities which result, in varying degrees, from any cold slitting process. Each such defect is a source of weakness and a potential tape break.

The thermal treatment in no way alters Audiotape's *balanced performance*. Hence Audiotape not only offers you the most faithful reproduction of the original sound, but also assures the highest mechanical strength obtainable with cellulose acetate base material—all at *no extra cost*.

Audiotape is now available on this NEW 7" PLASTIC REEL

• 2¼ inch hub • more area for labeling • less chance of tape spillage • greater protection to tape • rugged, non-warping construction • distinctive, modern design

. . . and in colors, too!

Audiotape 7" reels can now be obtained, for special applications, in red, blue, green, yellow or clear plastic. And Audiotape is also being offered on either blue or green colored plastic base, in addition to standard red. These distinctively colored tapes offer interesting possibilities for specialized recording and filing applications. Write for further details.

AUDIO DEVICES, INC.

444 Madison Avenue, New York 22, N. Y.

Export Dept., 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

audiodiscs • audiotape • audiofilm • audiopoints

BROADBAND DESIGN TECHNIQUES

(*Continued from page* 100)

In Fig. 6 the square of the transformer ratio is plotted over $\Delta f/f_0$ for the various compensations. It should be mentioned that the length of the transformers is a bit shorter than $\lambda/4$ to account for capacitive effects of the edges.

The opposite phase relation between series and parallel resonance can also be extended to fourpoles. Fig. 7 exemplifies this point. A load operating in the neighborhood of the $\lambda/2$ is compensated by a cascaded $\lambda/2$ line having an essentially larger characteristic impedance than the load, thus shifting the load in the series resonance range of the impedance diagram.

In this connection reference is made that M. P. Mason and R. A. Sykes[7] developed unsymmetrical line arrangements working as wideband transformers for large transformer ratios.

Curve Contraction

Several detailed examples[7] are given for empirically derived curve contraction within certain transformation circles. Though no illustration need to be given here, it seems

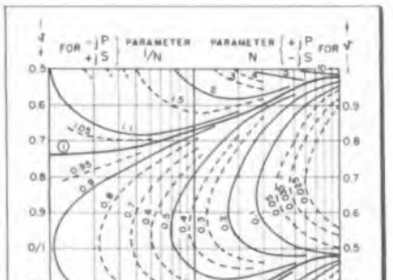


Fig. 15: Composed line transformer, ratio

worthwhile to extract the intrinsic property that allows this contraction. Fig. 8 helps for a pictorial understanding. By parallel connection of jX_k, an impedance $R_2 + jX_2$ is converted into $r + jx$.

The normalized r and x are families of orthogonal circles, representing virtually the input impedance of a parallel circuit with damping in one branch only. Of relevant interest are the heavy semicircles constituting loci for constant r/R_2. The semicircle through $(1, -1)$ designates $r/R_2 = 1$ and separates the two domains of upward and downward transformation. The inside (where R_2 is small) holds for upward transformation of R_2 and the outside of the circle (where R_2 is predominantly large) for downward transformation.

Thus, by proper selection of the operating range, large R_2 can be converted into small r and vice versa. The optimum center of transformation is the point $(1, -1)$, to which the center of the curve to be contracted has to be shifted by series reactances or sections of transmission lines.

Phase Regression Occurring with Z-Variation

The clockwise phase shifting of transmission lines can partly be compensated by the use of Z-variation. A glance at the simplified Smith diagram, Fig. 9, reveals that a counterclockwise phase regression can be established, if the characteristic impedance of the line is changed at the proper point. At the point of change the phase angle of the input-impedance will not change. The impedance will therefore move along the semicircles of constant phase (Fig. 9). The limits of the methods based upon this principle depend on the particular arrangement used; they can, however, not exceed 90° per discontinuity. The broadband short circuit[8] can easily be shown to be a consequence of phase regression.

The principle of phase regression opens new aspects for the understanding of the internal mechanisms of exponential lines. If Z is imagined to vary in little steps, even the need to put a series capacitance at the high impedance end and a shunt inductance at the low impedance end of the exponential line[9] can be visualized with the help of Fig. 9. Exponential lines[10] are broadband transformers, but they are hard to build. A very useful rule, however, is inferred from the theory of exponential lines. If a change of any kind of transmission quality (e.g., characteristic impedance, or mode transition) has to be made for a broad band, a change of 5% of the property in question for a length of $\lambda/20$ of the wavelength (lowest) is permissible, to secure good broadband characteristics.

It is generally simpler to work with discontinuously instead of continuously non-uniform lines. They may consist of a sequence of $\lambda/4$

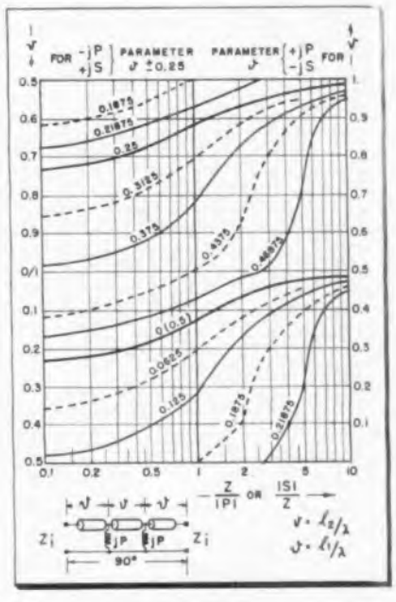


Fig. 16: Composed line transformer, length

lines with characteristic impedances staggered according to certain patterns to be described. The phase regression is the more complete, the more line sections are used, more being necessary for larger transformer ratios. This procedure is only suitable within the range of $\lambda/8$ to $3\lambda/8$ for the line section length in terms of the wavelength.

The equations for the double λ-quarter transformer shown in Fig. 10 are:

$$Z_1 > Z_2 : Z_1/Z_{i1} = Z_{i2}/Z_2 = \sqrt{N_0}$$

$$Z_1 < Z_2 : Z_2/Z_{i2} = Z_{i1}/Z_1 = \sqrt{N_0}$$

In following up the clear-cut advantage of two $\lambda/4$ transformers in cascade as compared with one (Fig. 6), Daellenbach[12] investigated analytically the possibilities for n $\lambda/4$ transformers in tandem. The input impedance in terms of the output impedance is then:

$$Z_1/Z_2 = N^2_0 [1 - j^n (N_0 - (1/N_0))]^p$$

with

$$p = \tan [(\pi/2)(\Delta f/f_0)/(1 + \Delta f/f_0)].$$

For $p<1$ the broadbanding effect increases rapidly with increasing n.

For a triple set of $\lambda/4$ transformers the characteristic impedances are to be:

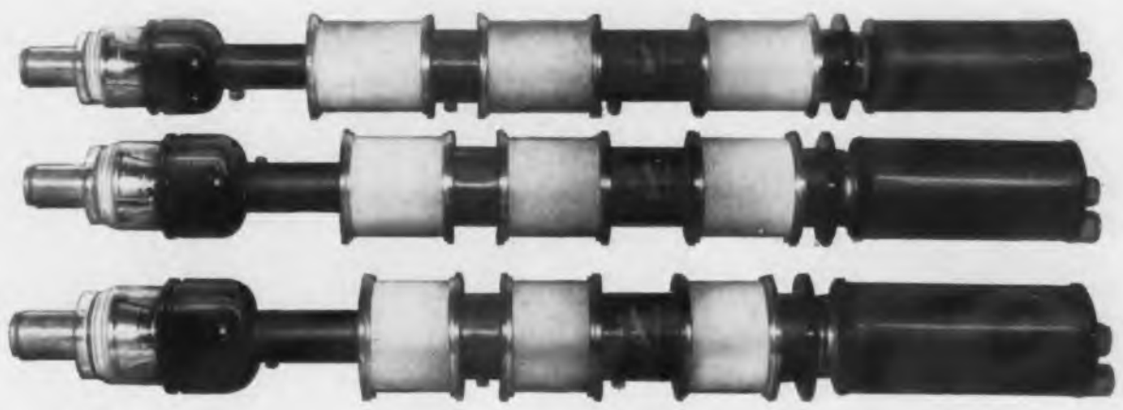
$$Z_{i1} = \sqrt{Z_1 Z_2 r_3}\,; Z_{i2} = \sqrt{Z_1 Z_2}\,;$$

$$Z_{i3} = \sqrt{Z_1 Z_2 \cdot r_3}.$$

r_3 can be calculated from the following equation or taken directly from Fig. 11.

$$r^3_3 (2 + r_3)/(1 + 2r_3) = N^2_0.$$

For a quadruple set of $\lambda/4$ transformers there is no longer a simple



all this and color too!
...with EIMAC UHF TV Klystrons

HIGH GAIN — SIMPLE TRANSMITTER. Eimac klystrons are inherently ideal for the final linear amplifier in UHF color TV transmitters. There is no need for by-pass condensers, rf chokes or feedback loops, and through low driving power and high power gain, the preceding circuits are simplified, and the smallest number of rf stages is required.

LOW NOISE LEVEL. Eimac klystrons operate below the noise level specified by the NTSC color television standards. The low noise level of these klystrons is amply demonstrated in UHF television transmitters now in daily operation.

NO TRANSIT TIME PHASE SHIFT EFFECTS. Regardless of amplitude level, the transit time of electrons in klystrons is substantially constant, and, having excellent linearity, a klystron will provide the amplitude and phase responses necessary for faithful transmission of color values.

WIDE BANDWIDTH. The rf resonant cavities are completed external to the tube, permitting the optimum arrangement of the rf circuits for bandwidths greater than six mc — more than enough for color TV.

RELIABLE — ECONOMICAL. Because of the sheer simplicity of these klystrons, they are light weight, readily mass produced, and give long, reliable life.

Eimac Klystrons for UHF-TV

TYPE	CHANNELS	SATURATION POWER
3K20,000LA	14-32	6 kw
3K20,000LF	33-55	6 kw
3K20,000LK	56-83	6 kw
3K50,000LA	14-32	15 kw
3K50,000LF	33-55	15 kw
3K50,000LK	56-83	15 kw

For further information contact our Application Engineering Department

Eimac TUBES

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazer & Hansen, 301 Clay St., San Francisco, California

geometric progression of the Z_i's, but rather:

$$Z_{t1} = \sqrt{Z_1 Z_2} / \sqrt{N_0}\ \sqrt{r_4};$$

$$Z_{t2} = \sqrt{Z_1 Z_2} / \sqrt{r_4};$$

$$Z_{t3} = \sqrt{Z_1 Z_2} \cdot \sqrt{r_4};$$

$$Z_{t4} = \sqrt{Z_1 Z_2} \cdot \sqrt{N_0}\ \sqrt{r_4},$$

wherein r_4, determinable from the

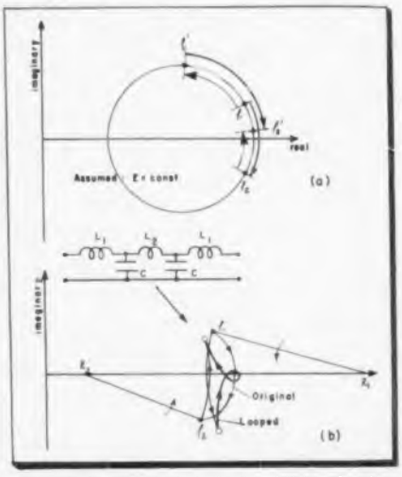


Fig. 17: Symmetrical clockwise shifting 4-poles

following equation, is given by Fig. 11.

$$r_4 = \sqrt{N_0}\ [\sqrt{2(1-N_0)} - (1-\sqrt{N_0})] / (1+\sqrt{N_0}).$$

A method in point was developed by W. W. Hansen and communicated by Slater.[11]

Line Transformer Pairs

If a $\lambda/4$ line of characteristic impedance Z_1 and a $\lambda/4$ line of characteristic impedance Z are cascaded, as shown in Fig. 12a, they form effectively an ideal, real transformer for the frequency for which the $\lambda/4$ relation holds (Fig. 12b). The actual, ideal transformer action is sketched with Smith's diagram in Fig. 12c.

Instead, now, of using a $\lambda/4$ line of characteristic impedance Z_1, a section of the original Z line can be converted into an equivalent $\lambda/4$ Z_1-line by inserting a parallel reactance P (as shown in Fig. 12d) or a series reactance S. for the latter the underlying relations are:

$$N_0 = \text{cotan } b_1;$$
$$2 \text{ cotan } 2b_1 = S/Z.$$

For practical needs Fig. 13 has been prepared allowing the direct reading of the required complementary lengths and of S or P for the transformer ratio N desired.

This simple line transformer alone has no broadband behavior. However, by putting two equal line

transformers in opposition, the resulting transformer ratio is one. Hence, the pair of opposing transformers may be moved to any place along the transmission line without creating any mismatch for the frequency for which they are designed. This simple fact is utilized to form for other frequencies more complex transformers that will not unmatch previous matchings.

Referring to Fig. 14, it is assumed that a simple transformer is used to match the load for frequency A (straight line stands for VSWR = 1), whereas for frequencies B, C, and D wavy lines symbolize standing waves (top part of Fig. 14). Now two opposing line transformers are used (second step in Fig. 14); they transformer matching the load for leave A matched and form a new a certain frequency B (becomes now straight line). The spacing between the the two points of inserting P (or S) is 2a, determined by the complementary length a of the original transformer for A. Two pairs of P's, each spaced 2a in itself and spaced 2b from pair to pair will match for frequency C, but will not unmatch A and B. In order to match also for frequency D four more pairs have to be added as indicated in the bottom row of Fig. 14. In order to match exactly at n frequencies

$$\sum_{0}^{n-1} 2^{n-1} \text{ discontinuities P (or S)}$$

have to be inserted into the feeding line. Though these insertions may be simple polysterene discs in coaxial lines or simple irises in wave guides (or any other series or parallel reactance in the line), the matching at four or five frequencies is usually the practical limit. The experimental adjustment is relatively easy and quick, if the schedule of Fig. 14 is kept in mind and if the matching is done at R_{min} or R_{max}.

Fig. 15 provides the transformer ratio and Fig. 16 the required complementary lengths for pairs of line transformers considered as one. All pertinent information is indicated in the diagrams. The diagrams are based on the following equations:

For brevity the contents of the brackets is not repeated.

It should be borne in mind that Fig. 15 and Fig. 16 refer to a simple "pair" of line transformers, not to paired pairs as needed for matching more than two frequencies.

Anomalous Dispersion

For all transmission lines and waveguides being of uniform or simple periodic structure, two correlated features are evident:
(a) Wavelength decreases with increasing frequency.
(b) Phase shift is clockwise.
Both relations combined determine the clockwise bending of the input impedance with increasing frequency.

Broadbanding could easily be accomplished, if *one* of the above properties could be reversed, thus

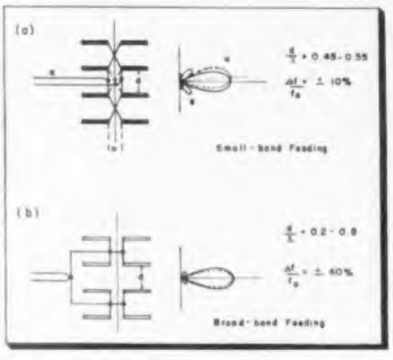


Fig. 18: Smallband and broadband feeding

providing a counterclockwise bending of the input impedance.

Called superlattice structures by Brioullin[13] certain biperiodic bandpass structures (as one shown in Fig. 17) can be realized, for which the wavelength increases with frequency (anomalous dispersion) in one or several passing bands. Unfortunately this behavior is by necessity coupled with a counterclockwise phase shifting, since the propagation time or delay $t_u = db/df$ must be positive in any real network (b being the phase constant).

Fig. 17 illustrates this situation. f_1, moving to f'_1 by insertion of the anomalous section, is the lower frequency. f_2 and f'_2 refer to the positions at the higher frequency. Though the phase shift is counterclockwise, the phase shift for the lower frequency is larger than for the higher frequency. Hence, again, the progression from f'_1 to f'_2 is clockwise as was the original progression f_1 to f_2. No counterclockwise curving of the input impedance is possible.

Broadbanding Conditions

The prospects for broadbanding, however, are not completely negative. If the characteristic impedance of the anomalous section decreases rapidly with frequency, as it does, e.g., for the structure shown in Fig. 17, a looping as represented by Fig. 17b will occur, thus providing a result similar to the effect of a half wavelength section.

Since $b = \cos^{-1} A_{11}$ (f), (where the cascade matrix element A_{11} according to the theory of symmetric fourpoles is the reciprocal of the open-circuit transformer ratio of the inserted section) anomalous dispersion will occur in passing bands wherein

(1) $dA_{11}/df > 0$ (anomaly).

(2) $-1 < A_{11} < +1$ (passing band)

The author did not succeed so far in getting theoretically any band width larger than

$$\sqrt{2};$$

1 at most.

Symmetric Pairing: The need for paired feeding of arrays of broadband antennas is self-explanatory by inspection of Fig. 18, since otherwise lobe shifting would take place.

$$N = \frac{\left[-\frac{1-(1/2)\,(Z/P)^2-(Z/P)\cot 2v}{(Z/P)+\cot 2v} \right] \pm \sqrt{1+|z|^2} + \frac{\tan v}{1+(Z/P)\tan v}}{|[z] \pm \sqrt{1+|z|^2}|\,\frac{\tan v}{1+(Z/P)\tan v} - 1}$$

$$\tan b_i = |z| \pm \sqrt{1+|z|^2}$$

REFERENCES

1. "A General Theory of Wideband Matching," R. La Rosa and H. J. Carlin, Convention record of IRE, 1953 Ntl. Conv., Pt. 5, pp. 17, 18.
2. "Efficiency of Mismatched Lines," H. M. Schlicke, *Electronics*, June 1950.
3. "A Reactance Theorem," R. M. Foster, *BSTJ*, April 1924.
4. "Ein Reaktanz Theorem," W. Cauer, Sitz.-Ber. d. Preuss. Akad. d. Wiss., Phys.-Math. Kl., Vol. XXX 1931.
5. *Communication Networks*, vol. II, E. A. Guillemin, J. Wiley & Sons, 1935.
6. US Patent R 105264, May 18, 1938, Nils E. Lindenblad.
7. "The Use of Coaxial and Balanced Transmission Lines in Filters and Wideband Transformers," W. P. Mason and R. A. Sykes, *BSTJ*, 1938.
8. *Very High Frequency Techniques*, p. 53 ect. Radio Res. Lab., Harvard Univ., McGraw-Hill, 1947.
9. "The Exponential Transmission Line," C. S. Burrows, BSTJ 1938, pp. 555.
10. "Transmission Lines with Exponential Taper," H. A. Wheeler, *Proc. IRE*, Jan. 1939.
11. *Microwave Transmission*, J. C. Slater, McGraw-Hill, 1942.
12. "Transformationsstuecke mit von der Wellenlaenge unabhaengigem Uebersetzungsverhaeltnis," W. Daellenbach, *Z. f. Hochfr. Techn.* 62 (1943) pp. 33-38.
13. *Wave Propagation in Periodic Structures*, L. Brillouin, McGraw-Hill, 1946.

Frequency 10 cps to 200 mc
Interval 1 μsec to 100 days
Period 0 cps to 10 kc

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

-*hp*- 525A
Frequency Converter

-*hp*- 525B
Frequency Converter

-*hp*- 526A
Video Amplifier

-*hp*- 526B
Time Interval Unit

-*hp*- 524B ELECTRONIC COUNTER

Why buy more instrumentation than you need? The new all-purpose -*hp*- 524B Electronic Counter with Plug-In Units gives you *precisely* the frequency, time interval or period measuring coverage you want now. Later, you can add other inexpensive plug-in units to double or triple the usefulness of the Counter.

Model 524B offers direct, instantaneous, automatic readings requiring no calculation, interpolation or complex instrument set-up. It has high sensitivity, high impedance, and its operation is so simple and dependable it can be used readily by non-technical personnel. Resolution is 0.1 μsec, and accuracy is 1/1,000,000 ± 1 count. Construction throughout is of highest quality components in a compact militarized design.

The new Counter with Plug-In Units gives you more range, more convenience, smaller size and lower cost than any commercial instrument combination ever offered. With this one compact equipment, you readily measure transmitter and crystal oscillator frequencies, time intervals, pulse lengths, repetition rates, frequency drift; make high accuracy ballistics time measurements or high resolution tachometry measurements, or use as a precision frequency standard giving convenience and flexibility not provided in the usual primary standard.

Data subject to change without notice. Prices f.o.b. factory

BASIC COUNTER

The basic -*hp*- 524B Counter unit measures frequency from 10 cps to 10 mc with accuracy of ± 1 count ± stability, reading direct in kc; or measures period from 0 cps to 10 kc with accuracy of ± 0.3% reading direct in seconds, milliseconds or microseconds. Eight-place registration, short term stability 1/1,000,000, display time variable 0.1 to 10 seconds. $1,890.00

COUNTER WITH PLUG-IN UNITS

-*hp*- 525A Frequency Converter extends Counter's range to 100 mc, maintains accuracy, and increases Counter's video sensitivity to 0.1 volts through basic 10 cps to 10 mc range. $225.00

-*hp*- 525B Frequency Converter like 525A but extends Counter's range to 200 mc at 0.25 volts sensitivity. $225.00

-*hp*- 526A Video Amplifier increases Counter sensitivity between 10 cps and 10 mc to 10 millivolts for low level frequency measurement. $125.00

-*hp*- 526B Time Interval Unit measures interval 1.0 μsec to 100 days with accuracy of 0.1 μsec ± 0.001%, reading direct in seconds, milliseconds or microseconds. Start, stop triggering in common or separate channels, through positive or negative going waves. $150.00 (Plug-in units supplied in aluminum storage case).

Request complete details today from your -hp- Field Representative, or write direct

HEWLETT-PACKARD COMPANY
2998T Page Mill Road • Palo Alto, California, U.S.A.

hp at I.R.E. Corner INSTRUMENTS AVENUE and RADIO ROAD

ADHESIVE NAMEPLATES

Permanent metal nameplates called "Speedy-Cals" are applied to equipment without use of rivets or screws. They consist of 0.003 in. abrasive resistant metal foil, laminated with bonding material, and may be embossed with cir-

cuit diagrams, trademarks, specification data, and similar patterns. To apply to flat or curved surfaces, they are immersed in water for one minute, blotted, and protective cellophane film removed. These nameplates are then rolled on any clean, smooth surface, such as metal, glass, bakelite and paint. Maximum bond is achieved in 24 hours; considerably less if heat is applied. Available in all shapes and sizes, almost all standard colors, shiny or matte finish. **North Shore Nameplate Co., Bank of Manhattan Bldg., Bayside, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POTENTIOMETER

Type 771 "FilmPot" is a metallic film potentiometer that is only ¾ in. in diameter and ½ in. long. It is available with either a servo-flange or threaded

bushing mountings. The unit has a resistance element of precious metal deposited on an inorganic substrate that is electrically stable up to temperatures of 225° C. that assures a low temperature coefficient of resistance over a range of 100 to 200,000 ohms in the ½ in. case size. The Type 771, said to be the first of its kind to be offered to the commercial market, meets JAN-R-9 specifications for salt spray, vibration, temperature cycling, and low temperature. **Fairchild Camera and Instrument Corp., Potentiometer Div., 225 Park Ave., Hicksville, L.I., N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Now...at no increase in price...

HERMETICALLY SEALED Germanium Diodes

JAN TYPES

A. Ceramic Case
B. Solder
C. Germanium Pellet
D. Weld
E. Platinum-Rhuthenium Whisker
F. Weld
G. Solder
H. Nickel Pin
I. Weld
J. Leaded Copper Clad Wire

COMPLETE METAL TO CERAMIC SEAL. Gas-tight ceramic cases with metalized ends permit solder seal to nickel pins.

MOISTURE PROOF. These new diodes exceed the requirements of JAN humidity specifications.

REQUIRED ELECTRICAL PROPERTIES. More than two years of development were necessary to perfect this combination of hermetic seal and superior performance.

MECHANICAL STABILITY. Platinum-rhuthenium whisker is welded to the germanium pellet.

LONG-LIFE. The elimination of moisture effects adds years to the life of your equipment!

MAXIMUM RATINGS (At 25°C)

Hermetically Sealed DIODES	1N69	1N70	1N81*
Peak Inverse Voltage	75	125	50
Continuous Operating Inverse Voltage	60	100	40
Min. Forward Current (MA) at + 1V	5.0	3.0	3.0
Max. Inv. Current (μa) At — 50V	850	300	—
At — 10V	50	25	10
AV Rectified Current (MA)	40	30	30
Peak Rectified Current (MA)	125	90	90
Surge Current (MA)	400	350	350

*JAN approval applied for

Production quantities of hermetically sealed types 1N69, 1N70, and 1N81 are now available. Hermetically sealed commercial types are expected to be ready in a few months. Be sure to include them in your design planning now! For complete information write: *General Electric Company, Section X4834, Electronics Park, Syracuse, New York.*

DON'T MISS THE G-E EXHIBIT!
See Germanium Products In Action
I. R. E. Show . . . Booths 192-194

GENERAL ELECTRIC

NEWS FROM OUR ADVANCED DEVELOPMENT LABORATORIES

● A four-terminal junction transistor has been developed having a region of negative output impedance. This switching device is unique in that two coincident trigger signals are required to turn it on. Thus two gating functions may be accomplished by a single transistor.

CONNECTOR RECEPTACLE

A new printed circuit connector receptacle consists of solid one-piece contacts mounted in Alkyd or Melamine. Sockets maintain positive wiping contact on 0.061 boards after 1,000 insertions of 0.071 in. boards. Permanent set

and contact fatigue, even under vibration, have been eliminated by the design and the production processes used. Ample allowance for misalignment of mating boards has been made. The printed circuit connector is presently available in 18 and 22 contact configurations. Dimensional drawings and complete test data are also available. **Richardson Co., 5860 Spring Oak Drive, Hollywood 28, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

COMMUNICATIONS INDICATOR

Radar device developed in cooperation with U.S. Air Force tells whether a radio broadcast is getting through to the listeners. "COZI" (Communications

Zone Indicator) indicates approximately how strong the broadcast signals are at their destination, and whether the enemy is jamming that frequency. In operation, COZI sends out a radar beam which follows the same path as the radio waves, and then returns to show whether a given frequency is being reflected at the proper skip distance. **Raytheon Mfg. Co., Waltham 54, Mass.**—TELE-TECH & ELECTRONICS INDUSTRIES.

every TV station needs

LOW COST COMMERCIALS

that local sponsors can afford

Here's how the GRAY Telop screens out high production costs

Install a Gray Telop as part of your basic TV broadcast equipment for commercials . . . "screen" out high production costs! Use with any television film camera, including the new Vidicon camera. Projects opaque cards, photographs, artwork, 3¼" x 4" transparent glass slides, strip material, **even** small objects . . . pens, watches, cigarette lighters, pipes, etc., or small models of large products.

A Gray Telop . . . at low initial cost . . . projects these economical materials and small objects with all the professional versatility of major "network" effects . . . **without** using costly film strips or live talent. Sponsors' copy can be prepared quickly, easily, for a variety of effects that is virtually unlimited. Gray's Telop will help you to sell more revenue producing commercials . . . Increase Your Profits!

GRAY TELOP I

Seeing is Believing

- Gray Telop projection of commercials must be seen to be appreciated . . .
- You get dual projection, superposition, lap dissolve, fade-out . . . with a single lens system.
- You can project 'cinematic', exciting visual effects for greater audience interest . . .
- Your Gray Telop will pack punch and profit into every minute of your TV commercials . . . at a price that local sponsors can afford!

GRAY TELOP II

GRAY RESEARCH

AND DEVELOPMENT CO. Inc., Hilliard St., Manchester, Conn.
Division of the GRAY MANUFACTURING COMPANY
Originators of the Gray Telephone Pay Station and the Gray Audograph and PhonAudograph.

WRITE FOR:
Visual proof of the profit making potential of Gray Telops. Request "TV Anytown," the completely illustrated, detailed description of Gray Telops.

MINIATURE RELAYS

A new series of telephone type relays, adaptable to low wattage sensitive applications, have been designated as class 22 and are supplied in hermetically-

sealed, dust tight enclosed and open types. They are especially useful in applications where one relay must perform a large number of switching functions with minimum input power. Coil and contact spring terminals at mounting end of relay facilitates concealed wiring of either individually or strip mounted relays. They are available for 60 cps ac, any voltage to 440; and for dc any voltage to 230. They are supplied with a variety of contact combinations; single or twin contacts; snap action contacts; coil resistance from 0.12 to 21,000 ohms; time delay, slow release to 125 millisec. **Magnecraft Electric Co., 1442-E West Van Buren St., Chicago 7, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

R-F AMPLIFIER

Utilizing a traveling-wave tube, the model 24 broad band amplifier provides high gain over the 2,000 to 4,000 MC frequency range. The small-signal gain

averages 35 db, and the saturation output power is 30 mw. Maximum noise figure is 20 db or less. Primary supply requirements are 108 to 122 v. at 1 amp., 50-800 cps. The unit is completely self contained in a case with JAN dimensions —4⅞ x 7⅝ x 19 9/16 in. **Westlabs, Inc., P.O. Box 1111, Palo, Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FLUTED SET SCREWS

Setko set screws, now available in a complete range, stay more positively on the wrench or key while being started or inserted in a tapped hole, hence save production time. Further, the fluted type is tamper resistant because their application requires a special key or wrench. The strength of the screw is dependent upon its special design rather than its material, therefore, it can be tightened or loosened repeatedly without distortion nor will it split or round out. Because of its extra strength, the fluted socket screw small-sizes are particularly suitable for small, precision type products. **Set Screw & Mfg. Co., 42 Main St., Bartlett, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MOTOR

The type PM-47 miniature permanent-magnet motor, rated at 1/400 h.p. with operating speed of 10,500 rpm, is suggested for application to small fans,

blowers, and other light-weight loads. Designed for continuous duty, the unit draws 0.18 amp. at 27 v. dc. and has a total weight of 5 oz. Dimensions: 1 13/16 in. long by 1⅛ in. diameter. The ⅛ in. diameter shaft has an extension length of 1 1/16 in. Other lengths, and special arrangements, such as splines, keyways, gears, etc., can be provided. A number of electrical-connection arrangements can be provided to suit application requirements. **Dalmotor Co., 1375 Clay St., Santa Clara, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ELECTRIC FURNACE

A new electric, box-type re-circulating furnace for temperatures up to 1,250° F. is built in 9 different sizes and 2 heat ranges, 0-800° F. and 0-1,250° F.

Sizes are 18 x 12 x 18 in. to 24 x 24 36 in. The furnace has a new skirt-typ cabinet and is furnished with an inf trol, electronic indicating temperatu controller, contactor, and switch bo Exterior is baked-on "Hammerloid **K. H. Huppert Co., 6830-32 Cottag Grove Ave., Chicago 37, Ill.**—TELE TECH & ELECTRONIC INDUSTRIES

HICKOK PERFECTED 250° ARC-ANGLE METER

Doubles Possibilities in Design Field

3½" Round Case

3½" Square Case

- Provides more practical space usefulness than any other electrical indicating instrument.
- New, 2½ times longer scale specifically designed for maximum space economy.
- The result of 8 years of continuously improved HICKOK development.

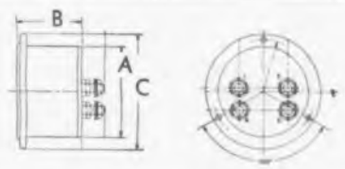
The pioneering development of this 250 Degree Arc-Angle instrument class has made possible numerous new applications in all fields of electrical-electronic indication. Engineers can now utilize the long-scale readability advantages of a meter with uniform and evenly spaced scale divisions. A full 250° arc on the dial now replaces the conventional 100° arc of other electrical instruments . . . (2½ times longer scale). A 3½" HICKOK 250° meter has a scale length equal to the standard 6" switchboard meter. A 2½" HICKOK 250° meter equals scale length of a conventional 4" meter.

In considering the development of this new line, it was decided to do more than just offer a class of miniature panel meters with accuracies already commercially available . . . but to produce a new instrument equivalent in sturdiness, accuracy and scale length to the larger rectangular switchboard models.

These 250° instruments meet performance requirements of military specifications. Components are exactingly machined to provide the highest possible torque to weight ratio. The exacting design of the magnetic circuitry, the high standard of meticulous manufacture and the elaborate laboratory and field testing of this revolutionary achievement has resulted in a new class of 1% panel instruments. Available in 1½ through 5½-inch sizes, round, square, or AN cases, sealed or unsealed, and in all D.C. ranges and A.C. rectifier types.

Your inquiry is invited. Kindly list specification details of your requirements.

See these new meters at the I. R. E. Show, Booth 458-460 Electronics Ave.



MODEL	A	B	C
2½" R56	2.187"	1.375"	2.687"
3½" R46	2.750"	1.969"	3.500"
4½" R48	3.500"	1.875"	4.500"
5½" R44	4.625"	2.250"	5.500"

Diagram showing physical dimensions

Conventional 100 Degree Arc-Angle instrument showing 0—200 microampere range.

The HICKOK moving coil assembly consists of precision machined components. Carefully designed to insure mechanical stability and dependable electrical accuracy.

HICKOK 250 Degree Arc-Angle instrument showing same range on a scale approximately 2½ times as long in the same size instrument.

Write today for your copy of the new HICKOK Instrument Catalog No. 28.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10606 Dupont Avenue • Cleveland 8, Ohio

New Technical Products for the Electronic

SUPER-REGULATOR

The "Kay-Lab" super-regulator converts ordinary power supplies to provide extremely low output impedance and ripple. Stable high gain amplifiers

and pentode series passing tubes make the unit immune to preceding power supply variations. Constant plate current versus plate voltage characteristics of the pentode tube series is maintained by an internal screen voltage source. Amplifier gain of 105 db maintains both the dc and ac output impedance extremely low. There are no electrolytic condensers in the operating circuitry, and the regulator can be used for either positive or negative output voltage. Voltage range, 200-350 v. Current range, 0-450 mas. Load regulation for full load current change 0.01%. Line regulation for 10% line voltage change 0.03%. Voltage stability 0.2%. Provided terminals enable connecting a Model 122 chopper stabilizer affording absolute long time stability to the output voltage. **Kalbfell Laboratories, Inc., P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

REMOTE TV CONTROL

The "Controla-Tone," an inexpensive patented TV and radio set remote volume control now being manufactured and distributed will be available soon in dealers' store. The unit is installed by first disconnecting the set from its electrical outlet. Then, if the set has two voice coil leads, one is cut and the insulation is stripped from the resulting ends. These are then secured to the ends of two "Controla-Tone" wires by furnished wire nuts. To eliminate stress and prevent short circuits, the lead of the device is then attached by an insulated staple to the receiver interior or base board. Thus installed the device can vary volume from a whisper to a shout by a flick of the thumb. **Controla-Tone Co., 111 North Tacoma Ave., Tacoma 2, Wash.**—TELE-TECH & ELECTRONIC INDUSTRIES.

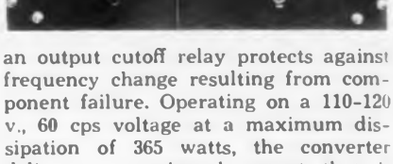
FREQUENCY CONVERTER

The Model 2500 frequency converte delivers 60 va., 2,500 cps power. It frequency-regulated output is accur ately controlled by a tuning fork, an

an output cutoff relay protects against frequency change resulting from component failure. Operating on a 110-120 v., 60 cps voltage at a maximum dissipation of 365 watts, the converter delivers a monitored output that is adjustable between 90 and 115 v., 2,500 cps, at 60 va. maximum. Within the specified input voltage limits, voltage regulation, frequency regulation, and harmonic distortion are independent of the power factor between 0.5 lagging and 0.5 leading. **Avion Instrument Corp., Div. of American Car Foundry Co., 299-30 State Highway No. 17, Paramus, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

HEADSET

The "Earset" is a single-cord, single-phone headset that is held to the ear by a flat, plastic, comma-shaped frame. The center of the "comma" is a sensitive hearing aid type receiver that is held in place by a "tail" which fits over the ear. The other ear is left free to listen to the telephone or conversa-



tion. Frequency response runs from 50 to 4,000 cps. and provides comfortable hearing at 0.3 mw. input. **Telex Inc., Telex Park, St. Paul, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Industries

COLOR TV COILS KIT

A new color TV coils kit contains 32 items for use with shadow mask tubes. Included are a distributed constant delay line, a horizontal output transformer, a horizontal dynamic convergence and focusing transformer, horizontal dynamic-convergence phase control, and a complete set of i-f., video, and color information circuit coils. The kit is available for immediate delivery in small quantities. **Electrometric, Inc., Olson St., Woodstock, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

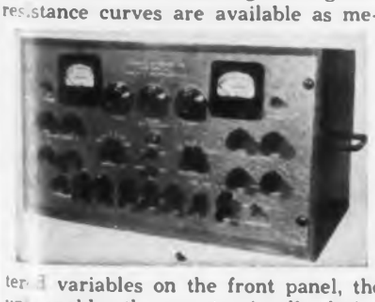
POTENTIOMETER

The Model D miniaturized millitorque, single-turn, wire-wound potentiometer, produced by Telepot Instruments, Neuchatel, Switzerland, has the following performance characteristics: linearity, 0.1%; starting torque, 0.003

oz. in.; running torque, 0.0015 oz. in.; resistance range, 100-100,000 ohms; resistance tolerance, 0.2%-3.0%; mechanical rotation, 360°, electrical rotation, 355° +5°, power rating, 0.5 watt; temperature, —65° to +85° C.; maximum operating speed, 1,200 rpm; acceleration parallel to shaft, 50 G.; acceleration at right angles to shaft, 15 G. Diameter, 0.87 in., height, 1.05 in., diameter of shaft 0.078 in. **F. H. Paul & Stein Bros., Inc., 100 Gold St., New York 38, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TRANSISTOR ANALYZER

All negative resistance curves of N-type and P-type point contact transistors can be traced with the model TA-2 transistor analyzer. Inasmuch as all circuit parameters controlling the negative resistance curves are available as me-

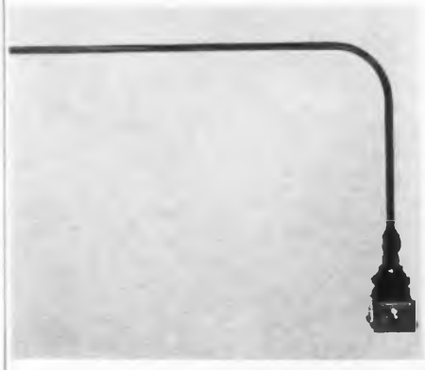


tered variables on the front panel, the unit enables the user to visually design any negative resistance circuit in a matter of minutes. **Polyphase Instrument Co., 705 Haverford Rd., Bryn Mawr, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products for the Electronic

VHF ANTENNA

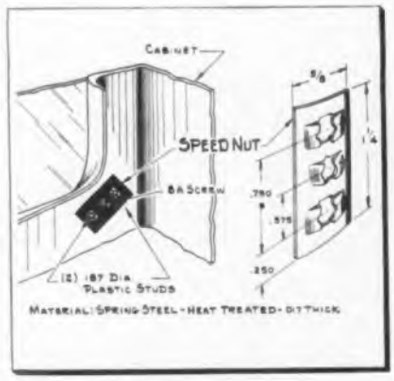
The A-15 is an inverted "L" antenna that is broad-banded to cover 118-148 MC. Its vertical section is 8 in.; its horizontal section is 13 in. The unit can be single-hole mounted on the belly of the smallest 2-place helicopter, with



sufficient clearance for operation, where it has the best radiation field pattern. Designed to withstand mild icing, the unit can be used on aircraft speeds of 250 mph. VSWR is under 2 from 118-144 MC and rises 2.7 at 148 MC. **Aircraft Radio Corp., Boonton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

COMBINATION FASTENER

The flat-type combination "Speed Nut" is flanked on both sides with push-on fasteners that bite into integral studs and similar parts. Pressing the one-piece spring-tension fastener by hand over two plastic studs on the rear



face of a TV cabinet, secures the "Speed Nut" in position to receive the screw that holds the glass viewing-window in place. Four of the combination nuts securely attach the window to the cabinet without threading. Their use enables the easy removal of the window for cleaning or replacement. **Tinnerman Products, Inc., P. O. Box 6688, Cleveland, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ATTENUATORS

A line of coaxial and turret attenuators with available attenuation steps from 0.1 to 60 db and a frequency range dc to 3,000 MC has been announced. The units may be obtained singly (90500) or in a turret selector

(90506) containing any six values of attenuation which features a "pull-turn-push" selection sequence. The type of resistive elements used is such that with a 1,000 pps at four μsecs duration, the maximum accommodated peak voltage applied to the input connector is about 100 v. **Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RACK ASSEMBLY

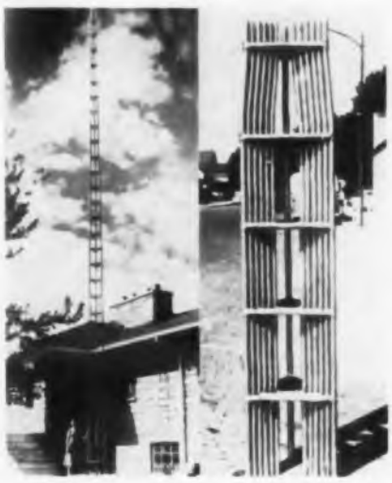
The HQ-140-X communication receiver is now available for standard rack mounting. The rack mounting assembly is a #16 gauge steel frame designed for placement around an HQ-

140-X chassis to make rigid mounting possible in a 19 in. rack. The assembly can be added to an HQ-140-X receiver chassis, or it can be supplied ready-mounted in a new HQ-140-X chassis. Included is a grey panel border trim to cover the standard cabinet mounting holes and rack mounting screws. **Hammarlund Manufacturing Co., 460 West 34th St., New York 1, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Industries

TOWER

A new radio and TV tower design enables six sections to nest so compactly that a 100 foot tower occupies vareroom space of less than 2½ sq. ft. The structure and all accessories make a package that is only 90 x 20 x 20 in.



in size. It is made entirely of heavily-coated steel. All bracing is riveted, and there are no welds to rust. No wrenches are necessary to assemble the tower, and rotators can be installed within it without additional accessories. It is said that the package reduces freight charges by 50%. **Spaulding Products Co., Tipton, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TV LENS

The 35 mm Angenieux Retrofocus lens features a 64° angle of view. The short focal length, quality lens is supplied in a focusing mount with an iris diaphragm that has f2.5 effective aperture. Complete information is available from the manufacturer. **Ponder & Best, Telens Div., 814 North Cole Ave., Hollywood 38, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

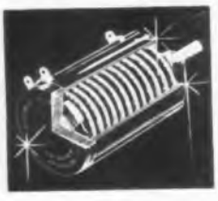
POWER RECTIFIER

The "Center-Sealed" power rectifier consists of an outside collector, an inside collector, phenolic washer, counter electrode, selenium disc, and base plate. The "outside" collector seals the "inside" or center collector against paint and moisture penetration. This assures a clean contact between the inside collector and plate surface which, it is said, provides a near zero resistance after years of operation. **Sarkes Tarzian, Rectifier Div., 415 N. College Ave., Bloomington, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES.

How to Wind Up with a Better Coil!

A precision potentiometer is used as a voltage divider...to translate mechanical motion into voltage change. Essentially, it consists of a resistance element with terminal connections, and a sliding contact. A current is impressed on the element ...when the sliding contact is moved, a change in output voltage results. For compactness, the element is usually bent into a circle, and the slider arranged to traverse it when a shaft is turned.

The resistance element may be of composition, deposited film, or wire-wound type. Each has its advantages ...the wire-wound element used in the Helipot* precision potentiometer provides the most satisfactory combination of accuracy, high resolution, and economy.



Resistance wire may be wound on a toroid...or on a card or mandrel which is then bent to shape...and Helipot makes appropriate use of all these cores in various models. In the great majority of Helipots, the resistance wire is wound on a copper mandrel...which has most advantageous heat-dissipating properties...and can be coiled into the space-conserving helical shape which was a Helipot innovation.

The linear potentiometer is designed to change output voltage in direct proportion to change in shaft position. For accurate performance, any given amount of slider travel must effect a precisely corresponding voltage change...no matter which portion of the coil is traversed.

To achieve this, a potentiometer manufacturer must select resistance wire of uniform thickness...and space it as accurately as possible when winding it. Good resistance wire is available from several sources...the critical phase is the series of operations involved in coil-winding. Sectional dimensions and straightness of the copper mandrel...tensioning of the almost invisible filament of resistance wire...spacing between turns ...all must be practically unvarying. The coil must then be preheated...coated with just the right amount of insulating varnish... dried...and formed to required shape.

Traditionally, these delicate operations require a variety of equipment and the work of many specialists...to produce a single coil. Helipot Corporation engineers have developed a machine unique in the industry...which performs all these coil-making operations automatically...in continuous sequence and at high speed.

At Helipot's Pasadena plant, a battery of these coil-winding machines permits full-scale production of high-quality coils...the heart of the Helipot precision potentiometer.

* * * *

WRITE FOR YOURS TODAY! Your Helipot Pocket Slide Rule is waiting for you. Only 6 inches long, this valuable pocket rule contains A, B, C, CI & D scales, plus Ohms Law Formulae. Handy temperature-conversion chart makes it doubly valuable. Write for yours today on your company letterhead, ask for S.R. No. 303.

* * * *

Write to Helipot Corporation... a division of Beckman Instruments, Inc., South Pasadena, California.

*T. M. Reg. U. S. Pat. Off. • 248

New Research Firm

Dr. Edward Bentley, former vice president and director of research a Instrument Development Laboratories, 163 Highland St., Needhan Heights 94, Mass., has founded a new industrial and research firm whicl has been named PhoToCorp, Inc The new group is located at 751 Main St., Waltham, Mass., and is staffed by former associates of Dr. Bentley Purpose of the organization is to apply extensive engineering knowledge and advanced management principles to problems in instrumentation and subminiaturization.

Index Lists H-P Journal Issues

A four-page index listing all issues of the *Hewlett-Packard Journal* from September, 1949, through August, 1953 is available by writing Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, California.

The Index contains a cross-reference listing of all issues of the technical publication by title of article, by subject, and by model number or type of Hewlett-Packard electronic test instruments mentioned. The Index, as well as previous issues of the Journal, is offered free upon written request giving name, business connection and title.

Friction-Free Tape for Magazine Operation

A magnetic tape that is reported to be almost friction-free and will give over 200 hours of excellent performance in loops over 200 ft., has been announced by Cousino, Inc., 2325 Madison Ave., Toledo 2, Ohio The low friction is achieved by a special coating on the back of mylar base tape. The tape loop is used with the company's "Audio Vendor" continuous play magazine, which may be attached to standard recorders.

American Mica Moves to New Quarters

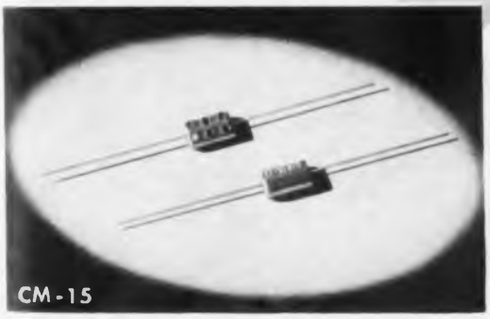
American Mica Insulation Co. is now established at new and larger facilities at Manasquan, N. J. The company manufactures and fabricates precision insulating materials

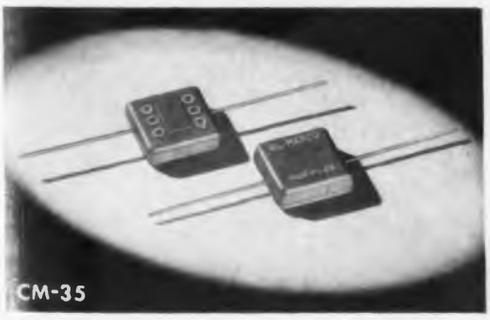
Philadelphia Electronics Buys Atlas Resistor

The Atlas Resistor Co., formerly located at 423 Broome St., New York 13, N. Y., has been bought by the Philadelphia Electronics Corp of 24 East Coulter St., Philadelphia Pa. It is planned to continue Atlas operations as a wholly owned subsidiary under the direction of Edward Herman.

ONLY ONE—out of many—IS FIRST

They all started equal...
but ONLY ONE WON!





A spanking breeze across the bay . . . the echoing boom of the race steward's deck cannon . . . ropes and sails straining for advantage of position. Each boat, sleek and ship-shape, is out to win — but only *one* will come in first.

. . . most capacitors start even, too

. . . but EL MENCO Capacitors always win first place in specification requirements because their superiority and dependability have been *proven*. They're factory-tested at more than double their working voltage . . . they're guaranteed stable under the most adverse conditions of application.

No matter what your requirements — from the mighty high-capacity CM-35 (5-10,000 mmf) to the midget low-capacity CM-15 (2-525 mmf) — EL MENCO gives you superior job-rated, job-tested performance. They're built to win!

Electro Motive is now supplying special silvered mica films for the electronic and communication industries in any quantity — just send us your specifications.

Jobbers and Distributors are requested to write for information to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y. — large stocks on hand — spot shipments for immediate delivery. Sole Agent for Jobbers and Distributors in U. S. and Canada.

WRITE FOR FREE SAMPLES AND CATALOG ON YOUR FIRM'S LETTERHEAD

El-Menco

MOLDED MICA CAPACITORS **MICA TRIMMER**

Foreign Electronic Manufacturers Get Information Direct from our Export Dept. at Willimantic, Conn.

THE ELECTRO MOTIVE MFG. CO., INC. WILLIMANTIC, CONNECTICUT

IRE Program

(*Continued from page 71*)

"Some New Developments in High Fidelity Loudspeakers," by H. F. Olson and J. Preston
"High Fidelity and the Hearing Process," by W. E. Kock
"Some Aspects of Stereophonic Sound in Motion Picture Theaters," by R. H. Ranger

INFORMATION THEORY II—CODING AND NOISE

"Matched Filters for Detecting Pulsed Signals in Noise," by J. S. Rochefort
"An Experimental Study of the Bandwidth of a Digital Computer," by N. R. Scott
"Time-Varying Quasi-Linear Method of Speech Noise Suppression," by M. J. DiToro
"Discriminatory Analysis Applied to Speech Sound Recognition," by H. L. Stubbs
"A Discussion of Auto-Correlated Error Terms in Time Series Analysis," by R. K. Weller

BROADCAST AND TV RECEIVERS I—GENERAL

"Ferrite Cored Antennae," by C. A. Grimmett
"Transistor AM Broadcast Receivers," by A. P. Stern and J. A. A. Raper
"Wide-Band Amplification with Surface-Barrier Transistors," by J. B. Angell
"Automatic Damping in Vertical Deflection Circuits," by H. E. Thomas, S. DeMars, and M. Jones
"Wide-Range Tuning System," by H. T. Lyman, F. G. Mason, and H. Ross

ELECTRONIC COMPONENTS II—APPLICATION

"Magnetic-Core Delay Cables," by D. R. Stein
"Improvements in the Field of Electrolytic Capacitors," by D. Altenpohl
"An Investigation of Lowest Resonant Frequency in Commercially Available Bypass Capacitors," by D. T. Geiser
"Resolution in Precision Potentiometers," by R. J. Sullivan
"Evaluation of Core Materials for Magnetic Amplifier Applications," by R. D. Teasdale and H. R. Browneil

AERONAUTICAL AND NAVIGATIONAL ELECTRONICS III

"Operational Analysis of Track-While-Scan Radars," by S. J. O'Neil
"A Study of the UHF Omnidirectional Aircraft Antenna Problem and Proposed Methods of Solution," by W. Spanos and J. J. Nail
"A Modulator Technique for Producing Short Pulses in High Powered Magnetrons," by T. J. Parker
"The Role of Stereo in '3-D' Radar Indicating Systems," by W. R. Tower
"An Automatic Antenna Matching Unit," by E. W. Schwittek

ENGINEERING MANAGEMENT II—SYMPOSIUM: PERSONNEL TRAINING AND SELECTION FOR ENGINEERING MANAGEMENT

"For the Universities," by S. C. Hollister
"For Industry," by W. R. G. Baker
"For the Government," by J. M. Mitchell

MEDICAL ELECTRONICS

"Visualization of the Distribution of Gamma Emitters in-vivo By Means of the Gamma Ray Pinhole Camera and Image Amplifier," by R. K. Mortimer, H. O. Anger, and C. A. Tobias
"Expansion Chamber for Measurement of Red Cell Permeation by Water," by A. K. Solomon and C. V. Paganelli
"Color and Enhanced Contrast X-Ray Images," by R. S. MacKay
"Measurement of Slow Neutron Depth Doses" by E. Stickley
"Use of Charged Particles to Measure Skin Thickness and Other Surface Properties," by F. Hutchinson

AUDIO II—GENERAL

"Some Aspects of Clipped Speech," by R. L. Saxe and R. E. Lacy
"A Miniature Unidirectional Microphone," by B. B. Bauer and J. W. Medill
"A High Efficiency-High Quality Audio Power Amplifier," by A. B. Bereskin
"System Design Factors for Audio Amplifiers," by M. V. Kiebert, Jr.
"Driver System for Single Ended Push-Pull Amplifiers," by C. T. Hall

INFORMATION THEORY III—SPEECH AND COMPUTATION

"Optimize Data Encoding for Digital Computers," by W. H. Kautz

How THE NATION'S LEADING PIPELINES USE

PHILCO *MICROWAVE*

hilco Microwave is being used daily by the Nation's leading pipeline ompanies. These pipeline companies have selected microwave ecause: (1) it is an economical, reliable and expandable communica- ons system eliminating costly and vulnerable wire lines, and (2) it rovides them with private, dependable communications over long istances, cutting maintenance costs to a minimum.

ipelines stretching over hundreds of miles can be operated and ontrolled from a single point by microwave. Pressure, rate of flow nd tank level readings can be recorded automatically and relayed headquarters or various points along the route. Philco Microwave arries telephone, teletype, control and telemetering channels . . . *nd offers complete tie-in with VHF two-way radio systems and existing ire line facilities.*

hown here are two of the many Philco Microwave systems that rovide the nation's leading pipelines with modern and efficient ommunications.

OTHER INDUSTRIES USING PHILCO MICROWAVE

Communication companies use Philco Microwave for telephone, telegraph and television transmission. Reliability, economy and quality of transmission make Philco Microwave ideal for their use.

Philco Microwave is being used by leading railroads for telephone, telegraph and train dispatching. Microwave is a private system, saves costly wire installations and simplifies right-of-way problems.

Utilities rely on Philco Microwave for the control of power stations, dispatching of repair trucks and communication. Dependable channels, unaffected by adverse weather, are a necessity for utility use.

For complete details, write to Dept. Y today!

From this central console headquarters at Kansas City, Missouri, the entire Platte pipeline and communication system can be controlled and monitored.

Platte Pipe Line Company's microwave system is over 1000 miles long . . . to provide every communication and control facility: voice channels, remote supervisory control, continuous or selective telemetering, teletype, alarm signaling and VHF radio. This entire microwave system was surveyed, designed and installed by Philco.

Typical Philco Pipeline Installations

El Paso Natural Gas Company has 500 miles of Philco Microwave with an average distance of 50 miles between stations. This New Mexico to Arizona system consists of repeater and terminal stations, multiplexing equipment for system party line and VHF radio channels.

The longest microwave hop in the nation is this 81-mile El Paso hop from Mount Elden to Dilkon, Arizona . . . typical of the utilization of terrain advantage by Philco.

PHILCO *Tradition of* QUALITY

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION PHILADELPHIA 44, PA.

IRE PROGRAM (Cont.)

"Symbolic Methods in the Design of Delay and Cycle-Free Logical Nets," by G. W. Patterson
"Threshold Detection," by B. L. Basore
"The Nature of the Uncorrelated Component of Induced Grid Noise," by T. E. Talpey and A. B. Macnee
"Effect of Limiting on the Information Content of Noisy Signals," by G. O. Young and B. Gold

BROADCAST AND TV RECEIVERS II—COLOR TELEVISION

"Self-Balancing Phase Detector for Color Receiver Reference Oscillators," by E. J. Clark
"Color Fidelity in TV Receiver Having Non-standard Primaries," by F. J. Bingley
"Color Distortion in Sequential Displays," by D. C. Livingston
"Single-Gun Picture Tubes in NTSC Color Television," by S. K. Altes and A. P. Stern
"Significance of Some Receiver Errors on Flesh Color Reproduction," by H. Weiss

RADIO COMMUNICATIONS II—GENERAL

"System Aspects and Trends of Modern Communication," by I. S. Coggeshall
"Predicted Wave Radio Teletype," by M. L. Doelz and E. T. Heald
"Design Consideration for FSK Circuits," by W. Lyons
"Predicting Interference Levels in Communication Systems," by P. G. Wulfsberg
"UHF Diversity System for Long-Range Ship-to-Air Communication," by F. J. Altman and J. J. Nail

MEDICAL ELECTRONICS SYMPOSIUM: ENGINEERING BASED ON BIOLOGICAL DESIGN

"Human Engineering," by L. C. Mead
"Information Theory," by N. Wiener
"Biological Transducers," by S. S. Stevens
"Biological Servomechanisms and Control Circuitry," by O. H. Schmitt

AUDIO SEMINAR: HIGH FIDELITY IN AUDIO ENGINEERING

"Microphones," by J. K. Hilliard
"Loudspeakers," by H. F. Olson
"Room Accoustics," by R. L. Hanson
"Broadcasting Systems," by J. V. L. Hogan
"Stereophonic System," by J. E. Volkman

Wednesday, March 24

NUCLEAR SCIENCE I—SYMPOSIUM: PROGRESS REPORT

"Secrecy and the Electronics Engineer," by J. G. Beckerley
"Non-Reactor Electronics at Oak Ridge," by P. R. Bell
"Brookhaven Electronics Work," by W. A. Higinbotham
"Non-Reactor Electronics Work at Argonne," by T. Brill
"Non-Reactor Electronics at Los Alamos," by R. J. Watts

ELECTRON DEVICES I—ELECTRON TUBES

"The Hollow Cathode in Cylindrical Geometry," by B. D. Kumpfer and H. Brett
"The Machining of Tungsten and Its Appli-

NEW HONOR SOCIETY MEMBERS

Dr. Reinhold Rudenberg (left), Gordon McKay professor of electrical engineering at Harvard University; Dr. W. R. G. Baker (center), General Electric vice president and general manager of the company's Electronics Division; and Dr. Marvin J. Kelly, president of Bell Telephone Laboratories were initiated recently into the Eminent Membership of Eta Kappa Nu Assoc., honor society for the electrical engineering profession

a Two-Signal
Audio Generator

for Complete Audio-Frequency Testing

. . . . . *Harmonic Distortion Determinations*
. . . . . *Gain Measurements*
. . . . . *Intermodulation Tests*

The Type 1303-A Two-Signal Audio Generator has three separate oscillators and three mixers for simultaneously supplying two signals, each separately adjustable in magnitude. These signals enable the complete and reliable testing of recording and reproducing systems, hearing aids, filter networks, noise suppressors, loud-speakers, high-efficiency speech-reproducing systems, recording and other devices.

The Following Signal Combinations Are Available

★ A single low-distortion signal whose frequency is adjustable from 20 to 40,000 cycles and to a maximum power of 1 watt.

★ One frequency adjustable to any value from 20 to 20,000 cycles, and a second frequency, higher than the first by a fixed amount which may be any value from 0 to 10 kc — one knob varies both frequencies simultaneously, keeping the difference frequency constant.

★ Two sinusoidal voltages at the same output terminals, each separately adjustable, one frequency to 20 kc and the other to 10 kc.

Additional features include: As much as 50-volts output, indicated by a panel meter — 120-db attenuation in seven steps — frequency standardization to within 1 cycle at any time; calibration of main 20 to 20,000 cycle frequency dial can then be relied upon to ±(1% + 0.5 cycle) — excellent frequency stability; drift is less than 7 cycles in first hour and essentially complete within two hours.

Type 1303-A Two-Signal Audio Generator $1450

The Most Accurate, Convenient and Reliable System for Complete Audio-Frequency Testing

the G-R Type 736-A Wave Analyzer in conjunction with the Two-Signal Audio Generator

The Wave Analyzer is tuned to the constant-difference frequency of the generator. The main generator-frequency-control is then slowly turned through its range and a running record of intermodulation distortion is directly indicated on the panel meter, over the complete audio-frequency range.

SINCE 1915 — MANUFACTURERS OF ELECTRONIC APPARATUS FOR SCIENCE AND INDUSTRY

GENERAL RADIO Company

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

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

Admittance Meters ☆ Amplifiers ☆ Coaxial Elements ☆ Distortion Meters ☆ Frequency Measuring Apparatus ☆ Frequency Standards ☆ Impedance Bridges ☆ Light Meters ☆ Megohmmeters ☆ Modulation Meters ☆ Polariscopes ☆ Precision Capacitors ☆ Oscillators ☆ U-H-F Measuring Equipment ☆ Parts & Accessories ☆ Signal Generators ☆ Wave Analyzers ☆ Varicas ☆ TV & Broadcast Monitors ☆ Pulse Generators ☆ R-L-C Decades ☆ R-L-C Standards ☆ Unit Instruments ☆ Sound & Vibration Meters ☆ Stroboscopes ☆ Null Detectors ☆ Motor Controls ☆ Wave Filters ☆ V-T Voltmeters

IRE PROGRAM (Cont.)

cation in the Fabrication of Philips Dispenser Cathodes," by R. Levi
"The GE Post Acceleration Color Tube," by C. G. Lob
"Amperex Type EIT Decade Counter Tube," by I. Rudich
"A Developmental Thyratron Capable of Current Interruption by Grid Action," by E. O. Johnson, W. M. Webster, and J. A. Olmstead

BROADCAST TRANSMISSION SYSTEMS I—SYMPOSIUM: TV BROADCASTING

"Antenna System for Station WOR-TV (Channel 9) Installed on Empire State Building," by G. J. Adams, A. Alford, H. H. Leach, R. Rubin, and F. Abel
"A Pulse Distribution System for a TV Network Originating Center," by J. S. Auld and A. Gallonio
"Improved TV Clamp Circuit Employing a Feedback," by K. R. Wendt and W. K. Squires
"High Level Plate Injection Mixer for Use at UHF," by R. E. Western
"Coaxial Line Transfer Switch for Television Transmitters," by C. F. Schunemann and J. B. Epperson

ELECTRONIC COMPUTERS I—COMPUTER DESIGN AND TECHNIQUES

"The Role of General Purpose Digital Computers in Automatic Control and Information Systems," by A. A. Cohen
"Design Features of Current Digital Differential Analyzers," by E. L. Braun
"Design Features of the JAINCOMP-C and JAINCOMP-D Electronic Digital Computers," by D. H. Jacobs
"A Germanium Tape Reader," by R. A. Langevin
"Electrostatic Reading of Perforated Media," by S. Lubkin

CIRCUIT THEORY I—SYMPOSIUM: NETWORK EQUALIZATION

"Limitations on Amplitude Equalizers," by H. J. Carlin
"Synthesis of Restively-Terminated RLC Ladder Networks," by Er-Chun Ho and D. L. Trautman
"Equalization of Video Cables," by P. W. Rounds
"Application of a Minimum Phase Matrix to Adjustable Equalizer Design," by W. R. Lundry
"Equalization in the Time Domain," by M. S. Corrington, R. W. Sonnenfeldt, and T. Murakami

INSTRUMENTATION I

"Phase Measurements in the Video Frequency Range," by W. W. Graustein and R. W. Houghton
"An X-Band Rapid-Sweep Oscillator," by H. H. Rickert and D. Dettinger
"A Shielded Two-Wire Hybrid Junction and Its Use as a UHF Impedance Bridge," by E. W. Matthews, Jr.
"High-Speed High-Resolution Spectrum Analyzer," by N. L. Duncan
"Rapid, Precision Impedance Measurements in the 400-1600 Megacycle Frequency Range," by D. M. Goodman

ANTENNAS AND PROPAGATION I—GENERAL

"Empirical Approximations to the Current Values for Large Dolph-Tchebyscheff Arrays," by L. L. Bailin, R. S. Wehner, and I. P. Kaminow
"Gain Pattern of a Terminated-Waveguide Slot Antenna by an Equivalent Circuit Method," by L. B. Felsen
"A Four Slot Cylindrical Antenna for VOR Service," by R. M. Sprague and A. Alford
"Trapped Wave Antennas," by H. Ehrenspeck, W. Gerbes, and F. J. Zucker
"Scattering of Electromagnetic Waves by Wires and Plates," by J. Weber

NUCLEAR SCIENCE II—SYMPOSIUM: REACTOR ELECTRONICS

"Simulators," by K. H. Fischbeck
"Safety Aspects of Control Circuitry," by T. Cole
"Instruments Used with Experimental Reactors," by E. J. Wade
"Synthesis of Nuclear Control Systems," by N. Grace

ELECTRON DEVICES II—TRANSISTORS

"Transistors for High Power Application," by J. S. Saby
"A New Type High Temperature Silicon Diode," by L. D. Hanley and C. G. Thornton
"Small-Signal Parameters of Grown-Junc-

MICROWAVE SIGNAL GENERATORS

Complete coverage of the range 950-10,800 mcs /sec.

with Polarad single dial operation

Four new Microwave Signal Generators covering the range 950-10,800 mcs/sec. All with famous **Polarad single dial operation.** Each provides the maximum working range possible in one compact signal generator. And, additional Polarad Signal Generators are available to cover 12.8 to 39.7 kmc.

These features on all MSG units assure fast and simple operation: direct reading, single dial frequency control that tracks reflector voltages automatically . . . direct reading attenuator dial . . . conveniently placed controls, in logical sequence . . . high visibility on the face of each instrument.

Polarad Signal Generators are built to the same high standards required for military equipment. They are practical for the factory assembly line—engineered ventilation assures continuous and stable operation of all instrument functions. Components are readily accessible for easy maintenance. And laboratory accuracy is guaranteed under the most rigorous operating conditions.

Write directly to Polarad or your nearest Polarad representative for details.

Visit our Booth 277-279 at the I R E Show March 22-25.

	MSG-1	MSG-2	MSG-3	MSG-4*
Frequency Range	950-2400 MCS/sec.	2150-4600 MCS/sec.	4450-8000 MCS/sec.	6950-10,800 MCS/sec.
	(Frequency set by means of a single directly calibrated control)			
Frequency Accuracy	±1%	±1%	±1%	±1%
Power Output	1 MW	1 MW	.2 MW	.2 MW
Attenuator Range	120 db	120 db	120 db	120 db
Attenuator Accuracy	±2 db	±2 db	±2 db	±2 db
Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms
Input Power	115V±10% 60 cps	115V±10% 60 cps	115V±10% 50-1000 cps	115V±10% 50-1000 cps
Internal Pulse Modulation:				
Pulse Width	0.5 to 10 microseconds			
Delay	3 to 300 microseconds			
Rate	40 to 4000 pulses per second			
Synchronization	Internal or external, sine wave or pulse			
Internal FM:				
Type	Linear sawtooth			
Rate	40 to 4000 cps			
Synchronization	Internal or external, sine wave or pulse			
Frequency Deviation	±2.5 MCS	±2.5 MCS	±6 MCS	±6 MCS
External Pulse Modulation:				
Polarity	Positive or Negative			
Rate	40 to 4000 pulses per second			
Pulse width	0.5 to 2500 microseconds			
Pulse separation	(For multiple pulses) 1 to 2500 microseconds			
Output Synchronizing Pulses:				
Polarity	Positive, delayed & undelayed			
Rate	40 to 4000 pps			
Voltage	Greater than 25 volts			
Rise time	Less than 1 microsecond			
Size | Approx. weight	17" long x 13¼" high x 15½" deep | 60 lbs.		17" long x 15" high x 19½" deep | 100 lbs.	

*Also available—MSG 4A: 6,950—11,500 MCS/sec.

"THE FINEST SIGNAL GENERATORS OF THEIR KIND"

Polarad ELECTRONICS CORPORATION 100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

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

IRE PROGRAM (Cont.)

tion Transistors at High Frequencies," by R. L. Pritchard and W. N. Coffey
"The Study and Design of Alloyed Junction Transistors," by L. J. Giacoletto
"An Analytic Study of z, y, and h Parameter Accuracies in Transistor Sweep Measurement," by H. G. Follingstad

BROADCAST TRANSMISSION SYSTEMS II—SYMPOSIUM: COLOR TV BROADCASTING

"Color Film Scanner Circuits," by J. F. Fisher
"Color Characteristics of a TV Film Scanner," by J. H. Haines
"Factors in the Design of Keyed Clamping Circuits," by R. N. Rhodes
"Photographic Simulation of Proposed Brightness Modifications for Televising Color Film," by J. H. Ladd and W. L. Brewer
"Feasibility and Technique of Storing Color Video Information on Black and White Film," by W. L. Hughes
"A System For Recording and Reproducing Television Signals By Means of Magnetic Tape," by H. F. Olson, W. D. Houghton, A. R. Morgan, J. Zenel, M. Artzt, J. G. Woodward, and J. T. Fischer

ELECTRONIC COMPUTERS II—COMPUTER COMPONENTS

"Considerations for the Selection of Magnetic Core Materials for Digital Computer Elements," by O. J. Van Sant
"Magnetic Core Selection Systems," by S. Guterman and R. D. Kodis
"Circuits to Perform Logical and Control Functions with Magnetic Cores," by S. Guterman, R. D. Kodis, and S. Ruhman
"Packaged Logical Circuitry for a 4 MC Computer," by N. Zimbel
"Transistor Shift Registers," by C. Huang, E. Slobodzinski, and B. White

CIRCUIT THEORY II

"The Group-Theoretical Aspect of Linear Four-Pole Theory," by W. W. Gaertner
"A Mathematical Technique for the Analysis of Linear Systems," by J. R. Ragazzini and A. R. Bergen
"Weighting Functions for Time-Varying Feedback Systems," by J. A. Aseltine and R. R. Favreau
"Interconnection of Linear Transducers," by H. Kurss
"Dynamic Characteristics of Four-Terminal Networks," by W. W. Happ

INSTRUMENTATION II—SYMPOSIUM: HIGH FREQUENCY MEASUREMENT AND CONTROL

"An Approach to a Company Owned Frequency Standard," by J. W. Smith
"Frequency Standard Controlled Wide-Range Oscillator," by E. Felch, J. O. Israel, O. Kummer
"Performance of the Bell System Standard of Frequency," by G. N. Packard
"A Computer-Type Decade Frequency Synthesizer," by R. W. Frank
"A High-Speed Digital Frequency Divider of Arbitrary Scale," by R. W. Stuart

NEW TV TRANSMITTER

WOR-TV's new 50 KW transmitter located on the 83rd floor of New York City's Empire State Building, is inspected by representatives from Standard Electronics Corp., a subsidiary of Claude Neon, Inc., manufacturers of the entire transmitter installation. From left to right are Roy Kelley, secretary and treasurer, Harry Smith, Mgr. TV Engineering, and David T. Bonner, president of Standard Electronics.

"Maverick" usually spells trouble, on the production line as well as out on the range. Being an unknown quantity or a "Johnny-come-lately," it leaves room for genuine doubt both as to performance and quality. And that's the reason so many experienced buyers—production experts to supervisors—insist on Kester . . . the one "brand" that is synonymous with the best solder and solder products.

Next time, choose one of these famous solder products: "44" Resin, "Resin-Five" and Plastic Rosin—all made only by KESTER . . . Key Name in Flux-Core Solder for More Than 50 Years.

KESTER

SOLDER COMPANY

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

IRE PROGRAM (Cont.)

ANTENNAS AND PROPAGATION II—MICROWAVE ANTENNAS

"Reflections in Microwave Antennas and Their Harmful Effects," by P. W. Hanna
"Surface Matching of Dielectric Lenses," by E. M. T. Jones and S. B. Cohn
"Double Parabolic Cylinder Pencil Beam Antenna," by R. C. Spencer, F. S. Holt, H. Beauchemin, and J. Samson
"Diffuse Radiation in Pencil Beam Antennas," by D. Carter
"Theoretical Gain in Flat Microwave Reflectors," by D. R. Crosby

Thursday, March 25

INDUSTRIAL ELECTRONICS

"The Design of Automatic Factories," by G. Post
"Industrial Punch Card Automatic Control," by W. L. Atwood
"Electronic Automation of a Turret Punch Press," by F. M. Rives
"Electronic Flow Measurement and Control," by E. Mittelmann
"Photosensitive Germanium Devices and Some Device Applications," by R. G. Seed

CIRCUIT THEORY III—NETWORK SYNTHESIS

"Some Techniques for Network Synthesis," by G. L. Matthaei
"An Iterative Method for RC Ladder Network Synthesis," by R. E. Scott and N. DeClaris
"Networks Terminated in Resistance at Both Input and Output," by L. Weinberg
"Approximating Band-Pass Attenuation and Phase Functions," by V. H. Grinich
"An Application of Modern Network Synthesis to the Design of Constant-Time-Delay Networks with Low-Q Elements," by L. Storch

ELECTRON DEVICES III—STORAGE TUBES

"The Metrechon—A New Halftone Picture Storage Tube," by L. Pensak
"Characteristics of Viewing Storage Tubes with Halftone Display," by M. Knoll, H. O. Hook, and R. P. Stone
"A High Writing Speed Dark Trace Tube," by S. Nozick, N. H. Burton, and S. Newman
"A Large Capacity Storage Tube for Digital Computer Application," by R. B. DeLano, Jr.
"Noise Limitations on Storage Tube Operation," by S. Winkler and S. Nozick

ULTRASONICS I

"The Ultrasonic Burglar Alarm System," by S. Bagno, J. B. Cooper, and E. A. Levi
"A Complex Impedance Recorder," by H. Sharaf
"Ultrasonic Delay Lines," by D. L. Arenberg
"Wide-Band Large-Dynamic-Range Fused-Quartz Delay Lines for Increased-Capacity High-Speed Computer Memories," by D. A. Spaeth, T. F. Rogers, and S. J. Johnson
"Contour Modes of Plates Excited Piezoelectrically and Determination of Elastic and Piezoelectric Constants," by R. Bechmann

ANTENNAS AND PROPAGATION III

"Isotropic Variable Index Media," by W. O. Puro and K. S. Kelleher
"The Characteristics of a Vertical Antenna with a Radial Conductor Ground System," by J. R. Wait and W. A. Pope
"Toward an Information Theory of Propagation Through Time Varying Media," by J. Feinstein
"Comparative 100 MC Measurements at Distances Far Beyond the Radio Horizon," by A. P. Barsis
"The Measurement of the Polarization of Radio Waves Reflected from the Ionosphere at Non-Vertical Incidence," by G. T. Inouye

MICROWAVE ELECTRONICS I—FERRITES AND STRIP LINES

"Non-Reciprocal Microwave Components," by H. N. Chait
"Ferrite Quarter-Wave and Half-Wave Plate at X Band," by N. G. Sakiotis
"The Radiation Conductance of a Series Slot in a Strip Transmission Line," by A. A. Oliner
"New Techniques for High-Q Strip Microwave Components," by E. Fubini, W. Fromm, and H. Keen
"Microwave Applications of High-Q Strip Components," by E. Fubini, W. Fromm and H. Keen

Really Reliable

Audio Transistors

Read the Reasons

- Stable-surface processed.
- Hermetically sealed.
- Every transistor periodically observed for two weeks on all parameters: alpha, I_{co}, R11, R22, power gain and noise figure.
- Low noise units observed for an hour of operation for any noise drift.
- Only transistors stable within error of measurement are accepted.
- Samples of each lot subjected to JAN 193 humidity and temperature cycling.

RESULT?

- Of thousands of RR_{co} transistors in use in the field for about a year, *over 99%* are giving continuing service.

If you have an application where audio transistors will fit, we'll be glad to discuss it without obligation.

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

In Radio and Electronics Since 1922

SALES DEPT.: 251 WEST 19TH STREET, NEW YORK 11, TEL.: WATKINS 4-3633

Factories in Brooklyn, N. Y.

Make Sure To See Our Exhibit At The I.R.E. Show, March 22-25, Kingsbridge Armory, Booth 511-513—Components Avenue

IRE PROGRAM (Cont.)

INSTRUMENTATION III

"A Novel Approach to Transistor Testing," by N. J. Gottfried
"Transistor Frequency Scanner," by G. Kummer
"A Simple Transistor Noise and Gain Test Set," by R. W. Carlisle and H. A. Pearson
"Wide-Band Amplitude Distribution Analysis of Voltage Sources," by L. W. Orr
"A Generator of Uniformly Distributed Random Noise," by R. Bernstein, H. Bicker and E. Brookner

RADIO TELEMETRY AND REMOTE CONTROL III—REMOTE CONTROL

"A Proportional Data Transmission System," by W. C. Petrie
"A Digital Autopilot Coupler," by W. L. Exner and A. D. Scarbrough
"System Compensation with a Digital Computer," by J. M. Salzer
"Binary Control System for Digital-to-Shaft Position Mechanisms," by A. H. Wulfsberg
"Optimization of Servosystems (for Time-Varying Spectra)," by R. C. Lyman and W. P. Caywood, Jr.

CIRCUIT THEORY IV—TRANSISTOR CIRCUITS

"A Transistor Analog," by R. D. Lohman
"Junction-Transistor Multivibrators and Flip-Flops," by E. Sard
"A Synthesis Procedure for Linear Transistor Circuits," by J. R. Burnett
"Network Partitioning Techniques Applied to the Synthesis of Transistor Amplifiers," by H. Markarian
"A New Equivalent Circuit for Junction Transistors," by G. Y. Chu

ELECTRON DEVICES IV—MICROWAVE TUBES

"A Voltage-Turnable Magnetron for Operation in the Frequency Range 1500 to 3000 Megacycles," by J. A. Boyd
"Control of Electron-Beam Spread by Positive Ion Traps," by E. L. Ginzton and B. Wadia
"The Multipactor Effect in Klystrons," by K. Bol
"Backward-Wave Oscillator Characteristics," by H. R. Johnson
"The Propagation Properties of Cross-Wound Twin Helices Suitable for Traveling Wave Tubes," by M. Chodorow, E. L. Chu, and J. R. Nevins, Jr.

ULTRASONICS II

"Applications of Ultrasonic Energy to Industrial Use," by A. Bayles
"The Effects of Ultrasonic Waves on Electrolytes and Electrode Processes," by S. Barnartt
"Studies of the Effects of High Frequency Sound on the Brain," by P. A. Lindstrom
"Selective Action of Ultrasound on Nerve Tissue," by W. J. Fry
"Effects of Ultrasound on Living Cell Structure," by E. E. Newcomer

ANTENNAS AND PROPAGATION IV—SYMPOSIUM: UHF TELEVISION—BOOM OR BUST

"FCC Rules and Propagation Data," by E. W. Allen
"Propagation in the UHF TV Band," by J. W. Herbstreit
"Overcoming the Line of Sight Shibboleth with the Air and High Power," by T. J. Carroll
"A Comparison of the Antenna Problems in UHF and VHF TV," by L. Krause

MICROWAVE ELECTRONICS II—COMPONENTS

"Design of Stable Tunable Microwave Oscillators," by J. G. Stephenson
"Microwave Measurements with a Lossy Variable Short Circuit," by H. M. Altschuler and A. A. Oliner
"Survey of Design Techniques and Operating Characteristics of Directional Couplers," by P. J. Sferrazza
"Diplexing Filters," by M. E. Breese
"A High Precision Compensated Reference Cavity for C Band," by J. Hall and F. McCarthy

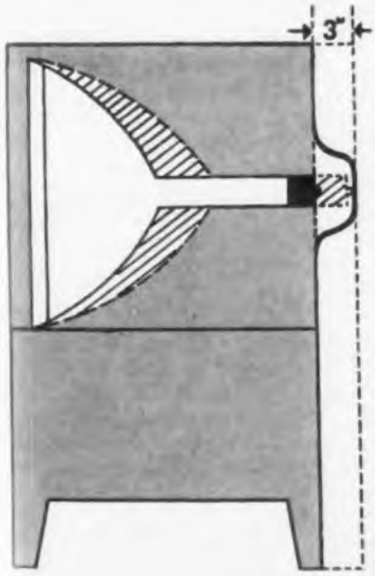
ELECTRONIC COMPUTERS III—DISCUSSION

"Can computers be made more autonomous?"
"Can computers be made to repair themselves?"
DISCUSSION LEADERS: N. Rochester, J. Von Neumann, W. B. Huskey, J. W. Mauchly, L. N. Ridenour, C. Shannon, E. F. Moore, A. L. Samuel, and J. B. Wiesner

THIS IS 13 SQUARE INCHES

13 SQ. IN. BIGGER PICTURE
3 IN. SHORTER CABINET

WITH NEW WESTINGHOUSE 90°, 21-INCH TUBE



The new Westinghouse 90° deflection picture tubes give you a 5 percent larger picture than any other 21-inch tube — 13 square inches more actual picture area than that of the largest 70° tubes.

What's more, the overall length of the tube has been cut at least three inches. Here's the way to reduce TV cabinet depth — or to eliminate the "hat" from the back of the set.

But still more, the new Westinghouse 90° tubes will actually produce a sharper picture than old 70° types. Electrostatic types are equipped with the new Westinghouse electrostatic focus gun which produces sharp, clearly defined pictures because of its smaller spot size. Magnetic focus tubes contain the simply constructed magnetic focus gun which gives crisp pictures in all areas.

ET-95044

New Westinghouse aluminized screens are available, too.

Investigate these Westinghouse 90° deflection 21-inch tubes today. They will make your black-and-white sets sell faster in the months ahead. Call your Westinghouse sales representatives for complete data and sample tubes or write, wire or phone Dept. B2034 at the address below.

21-INCH WESTINGHOUSE 90° DEFLECTION TUBES ARE AVAILABLE WITH:

- **Electrostatic Focus**
- **Electromagnetic Focus**
- **Aluminized Screens**
- **Non-Aluminized Screens**

YOU CAN BE SURE... IF IT'S Westinghouse

RELIATRON® TUBES

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

"REAC" Computer

(*Continued from page 81*)

and unpatching of a problem, time would be allocated to check components and repair all defective parts. This course of action was adopted because the extent of a preventive maintenance program for a large analog simulator had not been established.

During the first 12 months, there have been six partial system checkouts. The time between checkouts of any cabinet varied from two months to a year. Operator checking is performed daily. It consists of examining all amplifier outputs with the computer in Balance Check, i.e., with the inputs to the amplifiers disconnected. Typical of amplifier failure is a noisy output or inability to zero the amplifier. Defective amplifiers are repaired immediately or replaced with spares.

The monthly reliability coefficients are plotted in Fig. 7. The average reliability coefficient for the first year exceeded 90%. The total service time was 234 hours. Approximately 75% of this was expended in repairing failures caused by component deterioration; the remainder was due to defective parts or operator abuse.

The failure rates for certain selected components are given in Table 2. The criterion for this selection was a sufficient number of failures from which a significant estimate of the failure rate could be made. It is interesting to note that vacuum tubes constituted 63% of all failures.

The REAC components listed in Table 2 are largely in the 404 computing amplifiers, namely, 69.6% of the vacuum tubes, 81.3% of the vibrators, and 89.7% of the deposited film resistors. Therefore, a careful scrutiny of the failures in these amplifiers is desirable. Three hundred and nine amplifiers (76.6%) have not had a single failure during the first 12 months of operation of the Simulator Laboratory. Conversely, 95 have had one or more failures. These 95 amplifiers had a total of 207 failures of which 164 were vacuum tube failures. The average repair time for a failure was slightly less than 20 minutes.

At least one tube failed in 85 amplifiers. The distribution of vacuum tube failures in these amplifiers was as follows:

a) 45 had one tube failure;
b) 23 had two;
c) nine had three; and
d) eight had four to seven.

Not one vibrator in a computing amplifier failed during the 2,527

I·R·E NATIONAL CONVENTION and RADIO ENGINEERING SHOW

New York City
March
22-23-24-25

See latest developments in Fusion Sealed semiconductor devices at the

Hughes Exhibit

Booths
753-755-757
Kingsbridge Armory

Inspect the new Hughes Silicon Junction Diode shown for the first time. Standard Hughes point-contact germanium diodes in RETMA and special types will also be on display.

HUGHES DIODES

A New Standard of Reliability

Reliability in semiconductor devices is determined principally by permanent freedom from the two major causes of failure—moisture penetration of the envelope, and electrical instability under extreme operating conditions.

HUGHES SEMICONDUCTOR DEVICES are designed to prevent such failures through two exclusive features:

1. **Fusion Sealing**—The glass-to-metal seal, proved in billions of vacuum tubes, is incorporated to full advantage in semiconductor devices by the Hughes-developed process of fusion sealing at high temperature. The result is a rigid *one-piece* glass envelope impervious to moisture.

2. **100% Testing**—Hughes 100% testing procedures *invite* instabilities to occur prior to shipment, assuring rejection of defective units. *Each* standard **HUGHES DIODE** is temperature-cycled in saturated water vapor, JAN shock-tested, and electrically tested under vibration. This testing procedure insures operation of **HUGHES DIODES** under adverse conditions of moisture, temperature, vibration and severe shock.

Reliability of **HUGHES DIODES** has been proved in advanced airborne military radar and fire control systems, and for guided missiles. All Hughes semiconductor devices are designed to the same high standards of reliability.

hours covered by this report. However, seven vibrators located elsewhere failed in this period; five of these were in meter amplifiers and two in servo amplifiers. Five of the vibrator failures occurred within the first three hundred hours of operation.

The deposited film resistors which failed have been traced to a defective lot. The quarterly failure rates for deposited film resistors were 0.15%, 0.046%, 0.033%, and 0.033%. The defective resistors are reflected in the higher failure rate earlier in the year.

The first year of operation re-

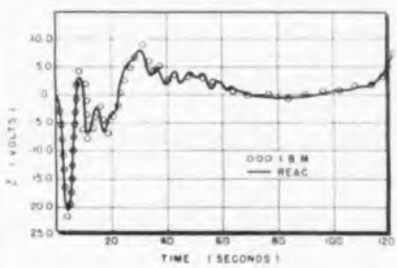


Fig. 6: Results of REAC acceptance test

vealed one design weakness. Certain two-phase, 60-cycle servo motors are operated at twice rated voltage in order to drive a greater load with improved dynamic performance. The resulting stress causes a gradual deterioration of the insulation between windings which finally leads to a short circuit between stator field coils. The cure for this is either improved insulation or a larger motor operating at rated voltage.

The effect of component deterioration is mitigated if a wide variation in characteristics can be tolerated. In a dc analog computer this is accomplished by using large amounts of feedback. The dc amplifier, for example, has 90 db feedback with a gain of one.

A second feature that contributes to reliable operation is the introduction of a true overload indicator system, rather than one that indicates overloads at some arbitrary value. Both visual and audible indication of overload is provided. This enables the operator to take remedial action immediately to relieve the arcing across the vibrator contacts and thus extend the life of the chopper. This conclusion is substantiated by the fact that no vibrators in computing amplifiers have failed.

The tubes in a dc analog computer operate in Class A as in normal communication applications.

The eye-opening event of the radio-electronic new year!

Waldorf-Astoria Hotel

Kingsbridge Armory

For the past 12 months the vast, fast-growing radio-electronic industry has been preparing for 4 great days — March 22-25. This is when the IRE National Convention and Radio Engineering Show — the biggest and best ever — will take place in New York City. Be sure to join the other radio-electronic men — nearly 40,000 are expected — who will come, see and appraise the show at which all that is new will be unveiled.

A practical summary of radio-electronic progress will be unfolded at 54 technical sessions during the four-day period. 243 scientific and engineering papers, grouped by related interests, will be presented during these sessions, more than half of which are organized by IRE professional groups. Actually, you will be attending 21 conventions fused into one. New York's finest meeting facilities are provided — the Waldorf-Astoria Hotel plus 3 huge halls in Kingsbridge Armory. Transportation between the two locations is quick, easy — by subway and bus service.

At the show you will find over 600 firms **"spotlighting the new"** in their high-interest product exhibits. These will extend over a mile and a half along avenues appropriately named for radio elements: "Instruments," "Components," "Airborne," "Radar," "Transistor," "Audio," "Microwave," etc. These exhibits, an education and revelation in themselves, fill the four-acre space of the great Kingsbridge Armory . . . and can be viewed throughout any one or all of the four days.

Admission is by registration only, and serves for the four-day period. For IRE members the cost is only $1.00. For non-members it is a low $3.00, covering sessions and exhibits. Social events have been carefully planned. These are priced separately.

March 22-25, 1954

is the date! New York is the city where the radio-electronic event of the year will take place. Come! See! Enjoy!

THE 1954
IRE NATIONAL CONVENTION
AND
RADIO ENGINEERING SHOW
THE INSTITUTE
OF RADIO ENGINEERS
1 EAST 79th STREET, NEW YORK CITY

"REAC" COMPUTER (Cont.)

The life expectancy should equal or exceed that achieved in these applications, because the tube operating conditions are conservative, e.g., the quiescent plate dissipation of the 6L6 output stage of the computing amplifier is only three watts.

The use of plug-in interchangeable computing amplifiers reduces both service and downtime. The number of spare amplifiers necessary to maintain this installation is less than 3% of the total.

The first year of operation has demonstrated that the simulator has a very high reliability. Therefore, only a limited preventive maintenance program is required. The cost of this program will be carefully evaluated relative to the improvement in system performance.

The present system of patching precludes the possibility of checking permanently wired components when a problem is wired in. This difficulty can be overcome by installing a suitable prepatch system. At the time (1951) the present Project Cyclone Laboratory was designed, no large prepatch facilities were in operation. Since experience with this idea was very limited, the proven telephone jackbay was selected. With a prepatch setup the problem can be removed readily if a failure is suspected, and a test circuit substituted for it. If the necessary repairs take too much time, the problem board can be plugged into a spare computer. Thus, prepatch adds to installation flexibility and downtime is reduced.

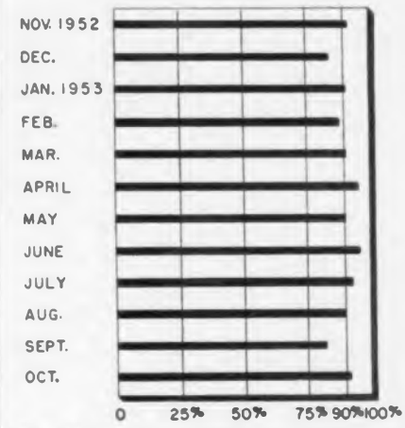


Fig. 7: Monthly reliability coefficients for Project Cyclone Simulation Laboratory. The average for the first year is close to 90.6%

1. Bauer, L., *New Laboratory for Three-Dimensional Guided Missile Simulation*, Proceedings of the Western Computer Conference, 1953, pp. 187--195.

The author wishes to acknowledge the assistance rendered by his associates in writing this paper.
This paper was presented at the Eastern Joint Computer Conference, held Dec. 1953 at Washington, D. C.

Wireless Microphone

(*Continued from page 88*)

the modulator grid circuit. This minimizes the amplitude modulation of the oscillator and reduces the overall distortion. Using the reactance modulator circuit shown, it has been possible to obtain excellent modulator performance together with adequate r-f amplifier grid driving voltage at a reasonable total plate current (Fig. 3).

Since the use of any sort of automatic frequency control in the transmitter was out of the question volved and the minute space available, it was necessary to design an oscillator-modulator circuit which would have sufficient frequency stability to meet the requirements of the system. This stability was achieved by means of the modulator grid bias circuit shown. The bias is derived from the self-rectified voltage developed by the oscillator and amplifier grids. As the plate and filament batteries run down in use, the transconductance of the reactance modulator will tend to be reduced and cause the carrier frequency of the transmitter to shift. However, the circuit arrangement used causes the dc grid bias of the modulator to be changed in such a fashion that its transconductance variation is greatly reduced.

Printed Circuit Chassis

The entire transmitter circuitry, excluding the antenna and tubes, occupies a volume of about 1 cu. in. The chassis casting, which contains eight capacitors, eleven resistors, a volume control, five subminiature tube sockets, and a powdered iron core oscillator coil, is a cylinder 1 in. in diameter and 1.3 in. long. To obtain such extreme miniaturization, it was necessary to use rather unorthodox construction.

Two printed circuit plates form the fundamental structure of the transmitter chassis. They are made by a technique which produces a conductive pattern on both sides of a phenolic plate, and on the inside surface of the holes through the plate. It is thus possible to produce cross connections between the two sides of the phenolic plate, automatically, and without the aid of eyelets. Since one printed circuit plate, with an area of less than 1 sq. in., contains 54 holes for tube socket pins and component leads, the use of eyelets for making cross connections would be impossible. This is further emphasized by the fact that the center-to-center spacing of the tube socket pins is only 0.100 in. A very important

NOW Soundcraft brings you tape perfection!

the revolutionary new

LIFETIME® magnetic recording tape

Here is news of monumental importance to every recording perfectionist. It is the all new Soundcraft LIFETIME Tape. We've called this amazing high-fidelity tape "LIFETIME" because . . .

*It will last, to the best of engineering knowledge, forever!**

Your recording machine will never break it. Neither will careless handling. Because LIFETIME Tape is fully a third as strong as machine steel. It ends tape shrinkage and stretch when your home or studio air is dry or humid. It will never cup or curl. You can forget about storage problems.

All this means that for the first time you can preserve your important recordings, capture and keep those precious moments of music and the spoken word, for generations to come—in all their original fidelity!

LIFETIME Tape owes these new and permanent qualities to its new magnetic oxide coating, and to its base of DuPont "Mylar" polyester film. For both are free of plasticizers whose gradual loss from ordinary tapes limits their useful life.

LIFETIME Tape is indeed the biggest development in tape since the tape recorder itself. Your serious recordings deserve it. Order LIFETIME Tape today.

Like all Soundcraft magnetic products, LIFETIME Tape is Micro-Polished®, assuring maximum high-frequency response. It provides uniformity of ±¼ db. within a reel, and ±½ db. reel-to-reel. It is splice-free in 600-, 1200- and 2400-foot reels.

REEVES

SOUNDCRAFT

CORP. **Dept. N-3**

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

***LIFETIME GUARANTEE.** Soundcraft unconditionally guarantees that Soundcraft LIFETIME Recording Tape will never break or curl, and that the magnetic oxide will never flake or crack, when the tape is used under normal conditions of recording and playback.

WIRELESS MICROPHONE (Cont.)

advantage of printed circuits of this type is the fact that it is possible to do all soldering on the upper side of the plate and still make connections to the pattern printed on the under side. In this assembly, the soldering of the 25 tube socket connections could be done in no other way.

Assembly of the chassis is begun by mounting the tube sockets in a phenolic plate which serves to position them and which carries three terminals for connection to the gain control (Fig. 4). The lower printed circuit plate is then placed over the tube socket pins and soldered to them from the top side. Next, the various resistors and condensers are soldered to the top side of the lower plate. Finally, the upper printed circuit plate is fitted over the leads from the components, and the leads are cut off and soldered to the printed circuit. Again, connections are made to the printed pattern on the under side of the top plate by soldering on the upper side.

Setting in Mold

After the printed circuits and components are assembled and inspected, the entire unit is placed in a mold and filled with a casting resin. Upon setting, this resin forms a rigid, moisture-proof mechanical assembly which cannot be damaged by vibration or shock and which is readily attached to the other portions of the transmitter. An additional advantage of such an embedded circuit is the mechanical immobilization of all leads and components which eliminates any possibility of detuning due to mechanical motion.

After the chassis assembly is cast

TUBE TEST SET

A semi-automatic test set, capable of handling up to 1,000 radio and receiving tubes per hour, has recently been designed and developed by Sylvania Electric Products Inc., Emporium, P.

SAVE $300 PER MILE!
on each Micro Wave installation

with MICRO POWER

And it's easy to figure too—because "Micro-Power" *replaces several units of costly, more complicated equipment.* Electric plant—rectifier—battery banks and motor-generator . . . *CAN ALL BE ELIMINATED—by the installation* of a *single* "Micro-Power" Unit. Study the following information . . . and see how you can save up to $300 per mile on your next Micro-Wave installation.

a micro-power stand-by unit can save up to

MICRO-POWER . . .

	APPROXIMATE SAVINGS
ELIMINATES A STAND-BY ELECTRIC PLANT — "Micro-Power" performs the functions of a stand-by electric plant during power interruption and power droop. "Micro-Power" is designed for use with equipment that *cannot tolerate any interruption of electric power*	$800 to $1,000
ELIMINATES BATTERIES "Micro-Power" can eliminate the need for costly battery banks, for *"Micro-Power" assures constant power to essential equipment at all times.*	$2,000 to $6,000
ELIMINATES RECTIFIERS "Micro-Power" is a motor and/or engine driven electric generator interposed between the source of electric power and essential equipment. *"Micro-Power" makes current and voltage conversions.*	$500 to $1,000
ELIMINATES MOTOR-GENERATOR SETS "Micro-Power" is a motor generator set with an internal combustion engine stand-by. In operation "Micro-Power" will serve as a voltage regulator	$900 to $1,000

$4,200 to $9,000
PER INSTALLATION

The above figures are typical of dozens of complete Micro-Wave installation costs as submitted to United States Motors Corporation for comparison purposes. In many studied cases "Micro-Power" can effect savings in excess of $7,500 per installation. ($300 per mile.)

If you are planning a Micro-Wave installation, now or in the future . . . write U. S. Motors Corporation for complete details on "Micro-Power" *"Micro-Power" reduces original cost. "Micro-Power" provides continuous, UN-INTERRUPTED SERVICE.*

UNITED STATES MOTORS CORPORATION
LIGHT US POWER
OSHKOSH • WISCONSIN

U. S. MOTORS CORPORATION
OSHKOSH, WISCONSIN

WIRELESS MICROPHONE (Cont.)

advantage of printed circuits of this type is the fact that it is possible to do all soldering on the upper side of the plate and still make connections to the pattern printed on the under side. In this assembly, the soldering of the 25 tube socket connections could be done in no other way.

Assembly of the chassis is begun by mounting the tube sockets in a phenolic plate which serves to position them and which carries three terminals for connection to the gain control (Fig. 4). The lower printed circuit plate is then placed over the tube socket pins and soldered to them from the top side. Next, the various resistors and condensers are soldered to the top side of the lower plate. Finally, the upper printed circuit plate is fitted over the leads from the components, and the leads are cut off and soldered to the printed circuit. Again, connections are made to the printed pattern on the under side of the top plate by soldering on the upper side.

Setting in Mold

After the printed circuits and components are assembled and inspected, the entire unit is placed in a mold and filled with a casting resin. Upon setting, this resin forms a rigid, moisture-proof mechanical assembly which cannot be damaged by vibration or shock and which is readily attached to the other portions of the transmitter. An additional advantage of such an embedded circuit is the mechanical immobilization of all leads and components which eliminates any possibility of detuning due to mechanical motion.

After the chassis assembly is cast

TUBE TEST SET

A semi-automatic test set, capable of handling up to 1,000 radio and receiving tubes per hour, has recently been designed and developed by Sylvania Electric Products Inc., Emporium, Pa.

SAVE $300 PER MILE!
on each Micro Wave installation

with MICRO POWER

And it's easy to figure too—because "Micro-Power" *replaces several units of costly, more complicated equipment.* Electric plant—rectifier—battery banks and motor-generator . . . *CAN ALL BE ELIMINATED—by the installation* of a *single* "Micro-Power" Unit. Study the following information . . . and see how you can save up to $300 per mile on your next Micro-Wave installation.

a micro-power stand-by unit can save up to

MICRO-POWER . . .	APPROXIMATE SAVINGS
ELIMINATES A STAND-BY ELECTRIC PLANT — "Micro-Power" performs the functions of a stand-by electric plant during power interruption and power droop. "Micro-Power" is designed for use with equipment that *cannot tolerate any interruption of electric power*	$800 to $1,000
ELIMINATES BATTERIES "Micro-Power" can eliminate the need for costly battery banks, for *"Micro-Power" assures constant power to essential equipment at all times.*	$2,000 to $6,000
ELIMINATES RECTIFIERS "Micro-Power" is a motor and/or engine driven electric generator interposed between the source of electric power and essential equipment. *"Micro-Power" makes current and voltage conversions.*	$500 to $1,000
ELIMINATES MOTOR-GENERATOR SETS "Micro-Power" is a motor generator set with an internal combustion engine stand-by. In operation "Micro-Power" will serve as a voltage regulator	$900 to $1,000

$4,200 to $9,000
PER INSTALLATION

The above figures are typical of dozens of complete Micro-Wave installation costs as submitted to United States Motors Corporation for comparison purposes. In many studied cases "Micro-Power" can effect savings in excess of $7,500 per installation. ($300 per mile.)

If you are planning a Micro-Wave installation, now or in the future . . . write U. S. Motors Corporation for complete details on "Micro-Power" *"Micro-Power" reduces original cost. "Micro-Power" provides continuous, UN-INTERRUPTED SERVICE.*

UNITED STATES MOTORS CORPORATION
LIGHT US POWER
OSHKOSH • WISCONSIN

U. S. MOTORS CORPORATION
OSHKOSH, WISCONSIN

in resin, the gain control, filament circuit microswitch, and battery contact assembly are attached (Fig. 5). The addition of the antenna and microphone completes the transmitter chassis assembly (Fig. 6). A tubular case is attached to the transmitter chassis with three screws after the tubes are installed. The batteries are inserted in the bottom of the case and the battery cap is snapped into place. Connection to the junction between the filament and plate batteries is made automatically by the battery contact assembly.

Casting an entire circuit in plastic is certainly a case of "burning your bridges behind you," as it is virtually impossible to repair such a unit. However, any properly designed assembly which was good before casting, should be good after casting, and should remain good indefinitely. Component failure is very unlikely since the casting resin provides protection from corrosion and mechanical damage which are the chief causes of failure in very low power circuits.

It should be added, however, that a circuit which is to be cast must be designed to make allowance for the increased distributed capacitance caused by the dielectric properties of the casting resin. To simulate this dielectric effect during development work, sample assemblies were immersed in cottonseed oil, which closely duplicated the dielectric constant of the casting resin used. This proved to be an extremely useful experimental technique.

Vagabond Receiver

The high performance superheterodyne receiver designed for the Vagabond system, has a pentode tuned r-f amplifier with a bandwidth of 150 kc. A pentode mixer with a separate triode oscillator is used and automatic frequency control is provided by a pentode reactance modulator. The wideband i-f amplifier employs two pentode amplifier stages, two cascaded triode limiters and a Foster-Seeley discriminator. The output of the discriminator is fed through a gated, cathode follower triode to the audio output terminals of the receiver. A triode d-c amplifier is provided in the carrier operated squelch circuit.

To aid in tuning the Vagabond transmitter, the receiver incorporates a double target tuning eye controlled by the outputs of the discriminator and the first limiter. By means of this tuning eye, it is possible to tune both the oscillator and

antenna circuits of the transmitter. A three-position switch on the receiver shifts the frequency of the receiver oscillator in 50 kc steps to provide three operating channels. These may be used when more than one Vagabond system is to be operated simultaneously in the same vicinity or when strong interference is experienced on any one channel. Since the radio frequency amplifier has a 150-kc bandwidth, no retuning of the receiver is required.

Evaluation of Performance

The Vagabond system has been installed in a number of locations and some evaluation of the induction system can be made. It has provided ample quality for general public address and entertainment work with operating areas of 500 to 5000 sq. ft. depending upon local interference conditions and the nature of the particular application. The audio response and signal-to-noise ratio have proved sufficient for radio broadcasting purposes in some studio installations.

The objective of developing a transmitting unit comparable in size and weight to current stick type microphones has been met. The transmitting unit weighs less than 1 lb. and is 1¼ in. in diameter and 12 in. long. The life of a set of batteries is 40 operating hours. The battery cost is about five cents an hour.

The author wishes to express his gratitude to his fellow employees for their generous assistance, especially to Mr. John Knox, Assistant Project Engineer, Mr. J. S. Knechtsberger, Project Mechanical Engineer, and Mr. J. W. Medill, who developed the special microphone cartridge. Deep appreciation is also extended to Mr. B. B. Bauer, Vice-President—Engineering, and to Mr. E. V. Carlson, Development Engineer, for their many contributions to the project.

This paper was presented at the National Electronics Conference held in Chicago, Sept. 28-30, 1953.

NEW BROWNING PRESIDENT

Dr. Glenn H. Browning (right), Chairman of the Board of Browning Laboratories, Inc., 750 Main St., Winchester, Mass., congratulates Gardiner G. Greene, new president and principal stockholder of the company as he takes over active management. Mr. Greene will head a new expansion program and Dr. Browning will continue with the company in an advisory capacity

Transistor Feedback

(Continued from page 95)

For the grounded base and grounded emitter stages,

$$\frac{y_{12} + y_{22}}{y_{21}} \ll 1 \qquad (12)$$

and may therefore be neglected if the analysis is confined to circuits where the last stage around which feedback is taken is one of the above types.

$$\frac{y_l}{y_{21}} = \frac{y_{11}}{y_{21}} \cdot \frac{y_l}{y_{11}} = \frac{z^0_{i\,(sc)}}{A^0_{sc}\, z_l} \qquad (13)$$

where

$z^0_{i\,(sc)}$ is the short circuit input impedance without feedback, and A^0_{sc} is the short circuit current gain without feedback.

Thus, if

$$\frac{z^0_{i\,(sc)}}{A^0_{sc}\, z_l} \ll 1 \qquad (14)$$

Eq. (11) degenerates to (2). We can say then, that the term $z^0_{i\,(sc)}/A^0_{sc}\, z_l$ is a measure of the forward transmission through the β loop.

(d) It is assumed that the amplifier has a clearly defined feedback loop. The theory is quite inadequate for the handling of cases where the feedback is not of this form. Thus even the simple case of a grounded emitter stage with an impedance in the emitter circuit defies analysis by the method.

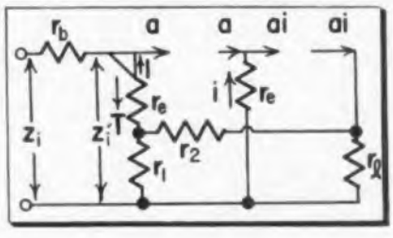


Fig. 9: Redrawn cascaded equivalent circuit

The above assumptions serve to show some of the weaknesses in the elementary theory. It is clear then, that a more general approach to the problem is desirable.

At present there is in existence a general feedback theory for vacuum tube amplifier circuits. It will be shown that, after making certain redefinitions of some of the basic terms, this theory can be applied to transistor circuits.

Fig. 5 shows the equivalent circuit of any one transistor in a generalized network.

The behavior of this transistor may now be expressed by considering the junction as something remote from the three resistances associated with it. Thus, any current (from Y→X) results in a propor-

We assure you of prompt delivery and courteous service of TRU-OHM WIRE WOUND RESISTORS . . . the finest available . . . from stock or to your specifications.

- **Fixed vitreous enameled RESISTORS**
- **Adjustable vitreous enameled RESISTORS**
- **"Econohm" RESISTORS**
- **"Tru-Rib" RESISTORS**
- **Special size RESISTORS**

Our engineering department is at your service to assist in the selection or design of a resistor to fit any and all applications.

Write for our latest catalog today on TRU-OHM RESISTORS and POWER RHEOSTATS.

TRU-OHM PRODUCTS Division of Model Engineering & Mfg., Inc.

General Sales Office: 2800 N. Milwaukee Avenue, Chicago 18, Ill.

Factory: Huntington, Indiana

MANUFACTURERS: Power Rheostats, Fixed Resistors, Adjustable Resistors, "Econohm" Resistors, "Tru-rib" Resistors

ionate voltage in the collector cir-uit. The proportionality factor, W, as the dimensions of impedance.

With the loop currents marked as hown, the impedance matrix for the ystem may now be set up. Then,

$$\Delta = \Delta^0 + W\Delta_{65} \qquad (15)$$

where Δ = determinant of the array
Δ^0 = determinant of the array with $W = 0$
Δ_{65} = Cofactor for row 6, column 5

The transistor may be replaced by a T-network of three resistances, with the generator replaced by e_6. Since there are no external generators, and since $W = 0$, we have

$$i_5 = e_6\Delta_{55}/\Delta^0$$

Thus the current in the junction is Δ_{55}/Δ^0 times the voltage appearing in the collector circuit due to it.

This will also hold for an operative transistor, whose junction is by-

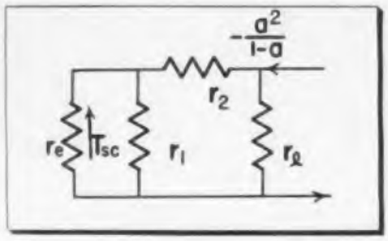


Fig. 10: Circuit for obtaining T_{sc}

passed by a short circuit, as in Fig. 6. (Mathematically, we consider that X—Y has a resistance of $\epsilon \to 0$.) If unit current is forced into Y→X, a voltage W appears in the collector side, and i_5 is given by

$$i_5 = W\Delta_{65}/\Delta^0$$

The current in the short circuit,

$$1 + i_5 = 1 + W\Delta_{65}/\Delta^0 = \Delta/\Delta^0$$

In order to maintain uniformity with Bode's terminology, the current i_5 is called the return ratio T, and the current in the short circuit is called the return difference F.

Using the new definitions for F and T it is now possible to apply all the theorems already developed for vacuum tube amplifiers. Care must be exercised in their application, however, since an inactive transistor does not provide the complete isolation between stages that an inactive tube does. As an example of the application of Bode's theorems to transistor circuits, the impedance of active networks will be taken up in some detail.

Bode's theorem on active networks may be interpreted as

$$z_n = z_n^0 (F_{sc}/F_{oc}) \text{ where}$$

z_n = impedance of the network as

seen by an external source across points x,x

z_n° = impedance of the network when a certain transistor in it is rendered inoperative.

F_{sc} = return difference for this transistor when x,x are short circuited.

F_{oc} = return difference for this transistor when the external source is replaced by an open circuit.

Example 1

Find the input impedance of a grounded emitter transistor with shunt feedback.

Fig. 7a shows the equivalent circuit. Assuming that r_c is larger than

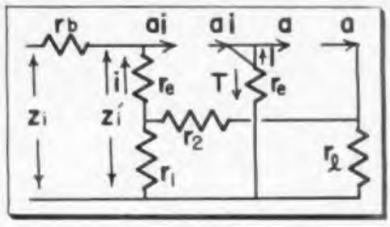


Fig. 11: Two-transistor equivalent circuit

all the other resistances in the network, the circuit may be redrawn as in Fig. 7b.

$$z^\circ_i = \frac{(r_e+r_b)\,(r+r_l)}{r_e + r_b + r + r_l}$$

$$T_{sc} \cong -\frac{ar_b}{r_e + r_b}$$

$$F_{sc} = 1 + T_{sc} \cong \frac{r_e + r_b\,(1-a)}{r_e + r_b}$$

$$T_{oc} \cong -\frac{a\,(r_b + r)}{r_e + r_b + r + r_l}$$

$$F_{oc} = 1 + T_{oc} \cong \frac{r_e + r_l + (r_b+r)\,(1-a)}{r_e + r_b + r + r_l}$$

Whence,

$$z_i \cong \frac{(r+r_l)\,[r_e + r_b\,(1-a)]}{r_e + r_l + (r_b+r)\,(1-a)}$$

Example 2

Find the input impedance of two cascaded grounded emitter stages with feedback, as shown in Fig. 8.

Making the approximation that r_c is larger than all other elements of the network, and shorting the junction of the first transistor, we have the equivalent circuit of Fig. 9.

Here,

$$z_i = z'_i + r_b$$

Let,

$$U = [(r_e + r_1)\,(r_2 + r_l) + r_e\,r_1]$$

HIGH RESOLUTION LOW DISTORTION...

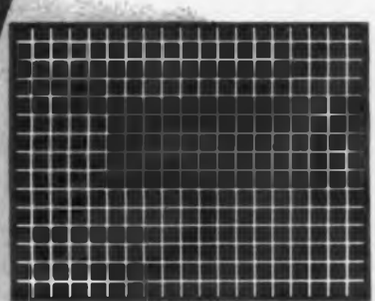
TYPE 5AMP—
Cathode-ray Tube
Low-capacitance deflection plate connections for high-frequency applications. Limited vertical scan.

NEW MONO-ACCELERATOR Cathode-Ray Tubes by DU MONT

In the new mono-accelerator Types 5AMP– and 5AQP– cathode-ray tubes, Du Mont has utilized modern principles of cathode-ray tube design combined with the Du Mont Tight-tolerance construction, automatic-focus lens and new high-resolution electron gun to provide a cathode-ray tube with the greatest freedom from distortion and best resolution and linearity yet achieved. Primary advantages of mono-accelerator cathode-ray tubes include virtual freedom from field and spot distortions; high deflection uniformity over the entire tube face; uniform resolution from edge to edge; and practically automatic focus. Both tubes have flat face-plates. The Type 5AQP– is intended for low and medium frequency applications, the Type 5AMP– for high-frequency applications.

SPECIFICATIONS (Typical Operating Conditions)

Type	Accelerator Voltage	Deflection Factors D1D2	D3D4	Useful Vertical Scan	Deflection Factor Uniformity
5AMP–	2500	40-50v/in	22.5-27.5v/in	2½"	1% max.
5AQP–	2500	40-50v/in	31.5-38.5v/in	4"	1% max.



An actual, unretouched linearity bar pattern of the Type 5AMP–. Not an engraved calibrated scale.

DU MONT

For complete specifications write to:
Technical Sales Department, ALLEN B. DU MONT LABORATORIES, INC., 760 Bloomfield Ave., Clifton, N. J.

TRANSISTOR FEEDBACK

(*Continued from page 162*)

$$z'_1{}^0 = r_e + \frac{r_1 (r_2 + r_l)}{r_1 + r_2 + r_l} = \frac{U}{r_1 + r_2 + r_l}$$

$$1 + a = ai$$

$$i = \frac{a}{1-a}$$

T_{ee} is obtained from the circuit of Fig. 10

$$T_{ee} \cong \frac{a^2 r_l r_1}{U (1-a)}$$

$$F_{ee} = \frac{a^2 r_l r_1 + (1-a) U}{(1-a) U}$$

$$T_{oe} \cong -a$$

$$F_{oe} \cong 1 - a$$

Whence

$$z'_1 = \frac{a^2 r_l r_1 + (1-a) U}{(r_1 + r_2 + r_l)(1-a)^2}$$

And

$$z_1 = r_b + \frac{a^2 r_l r_1 + (1-a) U}{(r_1 + r_2 + r_l)(1-a)^2}$$

It is interesting to see how the problem may be handled with reference to the second transistor. Fig. 11 shows the equivalent circuit. In this case knowledge of the input impedance of a single stage grounded emitter amplifier is used to compute $z'_1{}^0$.

$$\text{Thus } z'_1{}^0 = \left[r_e + \frac{r_1 (r_2 + r_l)}{r_1 + r_2 + r_l} \right] \frac{1}{U} \frac{}{(1-a)} = \frac{U}{(r_1 + r_2 + r_l)(1-a)}$$

Let T'_{ee} be due to the first transistor
T''_{ee} be due to the second transistor
Then $T'_{ee} \cong ai$

$$\text{But} \qquad i = \frac{a r_1 r_l}{U}$$

Therefore

$$T'_{ee} \cong \frac{a^2 r_1 r_l}{U}$$

$$T''_{ee} \cong -a$$

Whence

$$F_{ee} = 1 + T'_{ee} + T''_{ee} \cong \frac{a^2 r_1 r_l + (1-a) U}{U}$$

Also

$$T_{oe} \cong -a$$
$$F_{oe} \cong 1 - a$$

Whence

$$z_1 = r_b + \frac{a^2 r_1 r_l + (1-a) U}{(r_1 + r_2 + r_l)(1-a)^2}$$

as before.

The elementary theory of feedback is a useful tool in the analysis of circuits having clearly defined feedback loops with negligible forward transmission. In either case where the feedback loops are hidden or where appreciable forward transmission occurs through the loop, the general theory finds its use. The general theory is capable of providing an accurate solution, and is especially valuable when an approximate solution is required, since approximations may be made from the beginning. Direct methods of approach, such as Kirchoff's equations always end in the evaluation of high order determinants which must be done accurately, the approximations being made at the very end.

This work has been supported by the U. S. A. F. Air Research and Development Command, U. S. A. F. Air Materiel Command, Army Signal Corps and Navy Bureau of Ships under Contract AF 33 (600)-17793.

Bibliography

1. H. W. Bode, *Network Analysis and Feedback Amplifier Design*, D. Van Nostrand Co., Inc., New York, N. Y., 1945.
2. R. F. Shea, *Principles of Transistor Circuits*, John Wiley and Sons, Inc., New York, N. Y., 1953.

This paper was presented at the 1953 National Electronics Conference.

MAGNETRON STABILITY TESTER

(*Continued from page 97*)

noise (within compromise)
(2) increasing the rate of buildup of oscillation of magnetron
(3) increasing the time interval during which the applied voltage remains within the starting range.

One notes that heavy loads result in a reduction of the current at which misfiring takes place. At the same time the speed of buildup is inversely proportional to the capacitance C of the resonant circuit and changes the amplitude of the noise voltage (inversely proportional to C).

Tendency to Misfire

It is interesting to make C small and adjust the loading for high efficiency, but attention must be paid to the stabilization of frequency and some compromise has to be made. It has also been observed that increasing the diameter of the cathode of the megnetron reduces the tendency toward misfiring, but at the same time reduces the efficiency of a magnetron, so that the magnetron must be based on a compromise. Some experiments indicate that the structure at the end of the cathode has an influence on the tendency to misfire. With some magnetrons the tendency to misfire is correlated with low primary emission of electrons from the cathode. Magnetrons that do not ordinarily skip modes seem generally to function satisfactorily, even when the primary emission of the cathode is very low. Non-uniform and non-axial magnetic field also have an effect on the tendency to misfire.

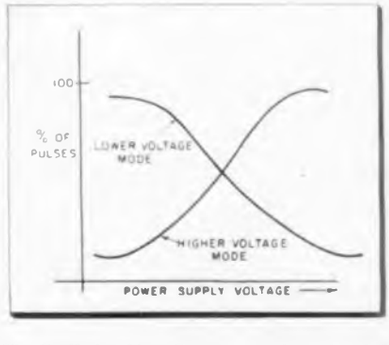


Fig. 7: Mode skip effect on number of pulses

Between all these factors of misfiring, the important are the following:

(1) The open circuit voltage of the pulses must be in the starting range, i.e., the quantitative statement of the requirement is to reduce the rate at which voltage is applied to magnetron.
(2) The magnetron must be operated at a relatively low current.
(3) The pulses must have a relatively low impedance.
(4) The starting time of a magnetron must bear a close relation to the maximum rate at which the input voltage can be applied without causing the magnetron to misfire and it is determined by two factors namely, the noise-level from which the buildup of oscillations starts, and the rate of buildup.

Pulling Figure (PF): The Rieke

iagram is plotted on polar coor-inates, the radial coordinate being he reflection coefficient measured the line joining the magnetron to e load and the angular coordinate eing the angular distance of the oltage standing wave minimum rom a suitable reference plane on he output terminal (see Fig. 8). lagnetic field, anode, current, pulse uration, repetition frequency and tting of tuner are fixed.

The maximum excursion of frequency (or "pulling figure") which occurs when the load is varied in such a way as to maintain a VSWR of 1.5 while varying the phase over a range of 360°. Rieke diagram is taken by varying the load while keeping the magnetic field and input current constant. The power output, VSWR in the line and the position

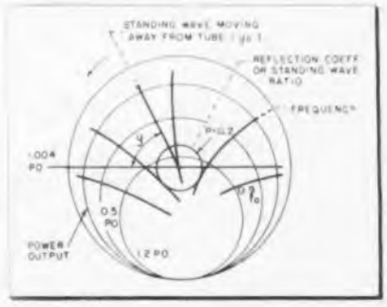


Fig. 8: Pulling figure shown on Rieke diagram

of a minimum of the standing wave as referred to the output coupling are measured. The value of the phase and amplitude of the standing wave represent the load. VSWR is defined as the ratio of the maximum voltage to the minimum voltage along the line.

Standing wave equipment of a magnetron stability tester, as is indicated in Fig. 2, may consist of a slotted section with a sliding probe moving over a distance of greater than $\frac{1}{2}\lambda$ together with a suitable detector and measuring instruments.

Power Output: The practice is to measure the output power of a magnetron in terms of average power. The pulsed peak power equals of magnetron

$$P_{peak} = \frac{P_{average}}{f \times \tau}$$

Duty cycle $= f \times \tau$

f = frequency of repetition of pulse.

τ = the duration of pulse.

The average power of magnetron = The pulsed peak power X duty cycle of pulse of magnetron.

A number of devices have been used for measuring average power in the microwave range, such as thermistors or bolometers, platinum wires or thermocouples. In each case

MAGNETRON STABILITY TESTER

(*Continued from page* 165)

the r-f power to be measured is absorbed in the measuring element and consists of observing the resistance change. The change in the thermistor or bolometer resistance due to r-f heating current is determined by placing the thermistor in one arm of bridge and by observing a direct power by means of calibrated resistance or other device reading in a balanced bridge. Appropriated attenuator may be used before the thermistor in a slotted line.

Measuring High Level Power

For measuring high level microwave power in more recent practice (the old method, which consisted of terminating the r-f transmission line in a water load is abandoned), is to terminate the r-f slotted line in a solid load, such as polyiron, and to couple a thermistor, bolometer or other devices to the line by means of a directional coupler of known

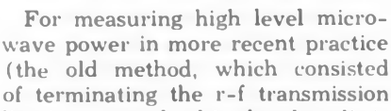


Fig. 9: Magnetron frequency spectrum

loss. Various power output meters are designed for various band in the frequency range from 500 to 30,000 MC.

It is possible also to measure the power in a waveguide practically without absorbing, by using a Johnson meter which consists of a short section of waveguide of thin constantan. The temperature rise in the constantan is measured by means of a resistance thermometer, and is proportional to the power transmitted through the waveguide. This constantan section of Johnson meter can be installed as a permanent part of the line, and no special matching of this section is necessary.

Frequency: The frequency of a magnetron, as is shown in Fig. 9, may be measured by a frequency meter or spectrum analyzer. The stability of frequency of a magnetron may be increased:

1. by decreasing the load conductance, i.e., by reduction of the coupling between magnetron and load.
2. by increasing the circuit characteristic admittance, i.e., by coupling to magnetron a tuned cavity of high non-loaded Q, called "stabilizing cavity," independent of F as possible. However, the first condition entitles a reduction of output power.

Since in the matched condition, the slotted line is deemed to be terminated in a load match to Z_0 (characteristic impedance), any change in the impedance of the load must cause a change in the reflected energy, and appears as a change in the magnitude and phase of the SWR, which may be measured by means of standing wave detector of the magnetron stability tester. As a result, this changes the Rieke diagram and pulls the frequency f_0 of the magnetron. The input condition, especially the variable impedance of a pulsed modulator of radar also produce a change in frequency f_0.

Frequency Stability

The best method to increase the stability of frequency is based on the principle of automatic frequency control system. In this system, a frequency discriminator generates an error signal whenever the frequency departs from its proper value. The error signal is amplified and then used to actuate a tuning mechanism of the magnetron. This system may be combined with a stabilizing cavity of a magnetron.

The measurements of frequency stability can be realized by the sensitive and stable receiver of special design with a recording system or a signal relay to determine time shift of frequency, or by a stable and accurate wavemeter with cavity of high "Q," conventionally coupled with the output circuit of magnetron to the recording system or the signal relay. Ordinarily, high absolute accuracy is not required of a frequency meter used in a radar test set. Specifications

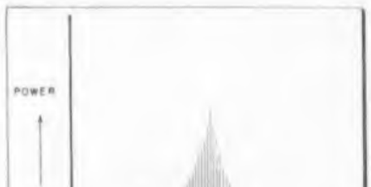


Fig. 10: Theoretical frequency spectrum

may call for an accuracy of 1 MC at a frequency for beacon operation and an accuracy of 3 MC at about 9000 MC (t° and humidity constant).

Frequency Spectrum: (Fourier analysis of the pulses) The frequency spectrum is displayed on a spectrum analyzer or a synchroscope analyzer. The theoretical form of this spectrum is shown in Fig. 10. It is very important to know the different deviations from this theoretical form to determine different factors of instability of spectrum.

Observe the following deviations from this theoretical form:

(a) The voltage pulse with rounded top will produce a *FM* that may broaden the spectrum and marked difference in the heights of the secondary maximum on one side of the spectrum.

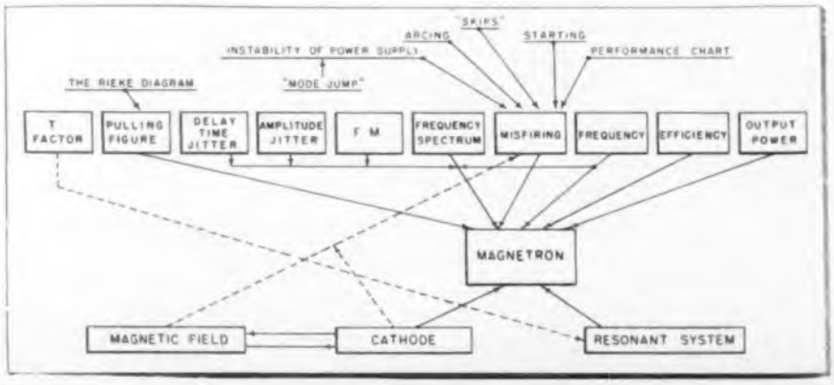
(b) The intermittent disappearance of several vertical lines indicated that the magnetron is *misfiring*, has "shifted modes" or was arcing.

(c) For heavily loaded magnetrons (closely coupled) and for a very low magnetron current the spectrum is changed into a *noise distribution*.

(d) *The frequency shift* and frequency stability may be observed on the spectrum analyzer and may be useful for observing the frequency stability of a magnetron.

(e) *Amplitude jitter and pulse delay jitter.*

Fig. 11: Relationship of various factors governing stability of a magnetron



The ideal spectrum form from a rectangular pulse is given by the curve of Fig. 9, where F_0 is the carrier frequency and all frequencies are present in amplitude as shown by the envelope. When a stable carrier frequency is pulsed at uniform intervals and in precise phase relation, only harmonics of the repetition frequency are present under the envelope, but in radar practice this condition is not sufficiently stable and produce amplitude jitters and pulse delay jitters.

The limits of these jitters on spectrum display must be determined and evaluated for every kind of magnetron and type of radar.

Temperature Factor (t^o): The magnetron operating frequency f_0 can produce shifts by temperature variations of the resonance block of a magnetron, especially when the duty cycle of pulses changes. Since the resonator system is generally constructed of copper, it expands or contracts uniformly with t°. The shift of frequency is roughly proportional to the change in t°, in a 3 CM magnetron. For example, a change of 50°C in the temperature of the copper results in a frequency shift of about 9 MC. Consequently, to increase the stability of frequency of a magnetron, it is necessary to install around the magnetron a special thermostating room (of non-magnetic material) and to measure the temperature instability factor by conventional thermal measuring apparatus. Control of temperature within 5°C is normally adequate.

Stability Factors and Recording Systems

All these factors of magnetron's stability, which have been measured by means of a magnetron stability tester, may be summarized in one general diagram, as shown in Fig. 11, which gives a full picture of investigation of magnetron stability.

These factors may be tested by the different methods of recording systems, such as photographic or writing recording, which permits comparing of these constants simultaneously or periodically all together or separately by recording diagram or curves.

The magnetron may be tested in three phases:

1. Stability magnetron for input and output constant conditions.
2. Stability magnetron for input constant condition, and output variable conditions.
3. Stability magnetron for variable input conditions (tests of different radar sets) and output constant conditions.

Transistor Guide Available

The 1954 "Guide to Transistor Literature" has been published by the Presentations Section, Engineering Div., Glenn L. Martin Co., Baltimore 3, Md. A limited supply is available for free distribution to interested engineers. This excellent bibliography covers well over 400 papers. The compilation includes 747 published references, broken down into theory, characteristics, circuits, types, applications, production & testing, and general information.

Powerful Search Radar Being Built

General Electric is producing a powerful airborne search radar, developed under a multi-million dollar contract with the Navy's Bureau of Aeronautics. According to GE, it is twice as powerful as any previous

Bubble-like radomes atop and below aircraft fuselage house antennas of powerful radar

airborne search unit. The radar is being installed in a number of Navy and Air Force aircraft, including new flying radar stations built by Lockheed to carry six tons of electronic equipment. The GE radar and indicator system, which uses printed circuits, weighs about two tons.

Color Transcriptions Report Issued

A technical report on "Color Transcriptions" for TV has been made available by NTSC Panel 11-A, under the chairmanship of Dr. Alfred N. Goldsmith. It points out that color film records of live programs and color release prints for TV can be produced and satisfactorily transmitted by available materials. Copies may be obtained from NTSC Chairman W. R. G. Baker, General Electric Co., Electronics Park, Syracuse 1, N.Y.

Connector Clinic

In conjunction with its participation in the IRE Show, Elco Corp. will hold daily Connector Clinics at New York's Lexington Hotel, March 22-25, from 2 to 5 P.M., for the benefit of visiting engineers.

TV Set Survey

One of the most extensive nationwide county-by-county surveys of TV set ownership has been conducted by A. C. Nielsen Co. under commission of the CBS-TV network. Among the many interesting statistical results of the CBS survey is the fact that 1,774,690 of the 27,506,500 families owning TV sets are equipped to receive UHF, as of Nov. 1, 1953.

Semi-Portable Television Set

Crosley is concentrating its production effort on a new TV receiver design which utilizes a vertically mounted chassis through which the

New compact TV receiver employs vertically mounted chassis through which tube projects

picture tube neck passes. The compact set, priced at $139.95, includes a 17-in. picture tube, 13 tubes and one rectifier. Control knobs are on the side. Weight is only 53 lbs., and the overall size is 14-½x19x21-5/16 in.

$1 UHF Station Closes Down

Station KCTY, Kansas City, Mo., which was purchased by DuMont from the Empire Coil Co. at the end of 1953 for $1, has closed down. The channel 25 station was obtained by DuMont to study the feasibility of broadcasting UHF in that city, already dominated by three VHF stations.

Because of conditions existing in that particular area, including viewers' reluctance to use outdoor antennas, it was concluded that operation is not economically feasible.

Versatile Computer Announced by Bendix

A high-speed, moderately priced digital differential analyzer has been announced by the Bendix Computer Div. of Bendix Aviation Corp., 5630 Arbor Vitae St., Los Angeles 45, Calif.

The computer, characterized by simplicity of operation and mathematical versatility, utlizies the decimal numbering system in programming and calculating. It has the capacity of 60 integrators.

ACF Establishes Electronic Division

Charles J. Hardy, Jr., president of American Car and Foundry Company, has announced the establishment of a new company division to be known as ACF Electronics Co. The new division will specialize in engineering development and manufacturing in the field of electronics. J. Gilman Reid, Jr., recently resigned director of the Electronics Div. of the National Bureau of Standards, heads the new company which has established quarters in Alexandria, Va.

Cable Power Rating Increased by 80%

The power handling capacity of Styroflex coaxial cable has been raised 80% by filling the helix space with helium, which has several times the conductivity of air, as well as greater mobility. It is being offered to the Canadian market by the manufacturers, Felten & Guilleaume.

Human Engineering Course Offered

A five-day course dealing with the design of equipment, products, and work stations with emphasis on human limitations and capacities is again being offered by Dunlap and Associates during the week of May 10, 1954, in Stamford, Conn. This year's new institute incorporates not only the suggestions of last year's participants, but also the most recent experience of our human engineering specialists. Specific subject matter includes:

Allocation of jobs to men and equipment

Control of lighting, air noise, vibration

Design of instruments, warning devices, handles, pedals, etc.

Seating, panel design, other workplace aspects

Enrollment will be limited. Lecture-discussions will be conducted for approximately 16 people and laboratory sections for approximately four. Enrollment deadline is April 15, 1954. Tuition of $30.00 covers texts, materials and two evening activities. For further information contact: Dr. Bernard J. Covner, Director, Human Engineering Institute, 429 Atlantic St., Stamford, Conn. Phone: Stamford 48-9271.

Recording Standard Approved by RIAA

A standard recording and reproducing characteristic has been recommended by the Engineering Committee of the Record Industry Association of America (RIAA). The record equalization curve is identical to that recently adopted by NARTB.

Do you want *more* information about PRODUCTS advertised in TELE·TECH & ELECTRONIC INDUSTRIES

LEADING MANUFACTURERS

are using space in this issue to acquaint you with their products. Perhaps you want more information on some of them—on one or two, or possibly a score. You can cover all of your needs with the cards below. They are convenient and postfree.

Use the convenient postage-free card below to get information quickly about products listed here—all advertised in this issue

801 Abrasive production units—S. S. White Dental Mfg. Co.
802 Alarms, carrier interruption—Rust Industrial Co., Inc.
803 Amplifiers, remote—General Electric Co.
804 Audio generators, two-signal—General Radio Co.
804A Automation aids: cylinders; comparators—Clippard Instrument Lab., Inc.
805 Cable clips, nylon—Weckesser Co.
805A Cable, coaxial, for UHF-TV—Phelps Dodge Copper Products Corp.
806 Cable for telephones—Bell Telephone Laboratories
807 Capacitors, ceramic disc—Radio Materials Corp.
807A Capacitors, metallized-paper—Aerovox Corp.
808 Capacitors, mica molded—Arco Electronics Inc.
809 Capacitors, mica molded & trimmer—Electro Motive Mfg. Co., Inc.
810 Capacitors, molded tubular—Sprague Electric Co.
811 Capacitors, piston-type variable—JFD Manufacturing Co., Inc.
812 Capacitors for printed circuits—P. R. Mallory & Co., Inc.
813 Capacitors, steatite-cased tubular—Cornell-Dubilier Electric Corp.
814 Capacitors, variable vacuum—Eitel-McCullough, Inc.
814A Catalog, electronic equipment—United Catalog Pub., Inc.
815 Ceramics, extruded—American Lava Corp.
816 Coaxial transmission lines—Prodelin Inc.
817 Coils, deflection, for color TV—Rayper Inc.
818 Coils & transformers, i-f & r-f—I-T-E Circuit Breaker Co.
819 Coils & yokes for color TV—Videocraft Mfg. Co.
820 Communications equipment—Collins Radio Co.
821 Connectors, miniature—Elco Corp.
821A Connectors; plug-in units; terminals—Alden Products Co.
821B Connectors for printed circuits—Harvey Hubbell, Inc.
821C Connectors, printed circuit & miniature—DeJur-Amsco Corp.
822 Contact, assemblies, screw machine—U. S. Components, Inc.
823 Controls, aircraft navigation equipment—Kollsman Instr. Corp.
824 Controls, automatic—Ford Instrument Co.
825 Control systems, remote—Paul Schafer Custom Engineering
826 Cores, iron; resistors; capacitors; switches—Stackpole Carbon Co.
826A Counters, electronic—Hewlett-Packard Co.
827 Crystals for color TV—Midland Manufacturing Co.
827A Crystals, frequency control—James Knights Co.
828 Deflection yokes—Tel-Rad Mfg. Co., Inc.
829 Degausser for tape & film—Cinema Engineering Co.
830 Digital volt-ohm-milliamp meter—Telecomputing Corp.
830A Diodes crystal—National Union Radio Corp.
831 Diodes, fusion sealed—Hughes Aircraft Co.
832 Diodes, sealed germanium—General Electric Co.
833 Dollies, all-directional TV—Ceco Distributing Corp.
834 Dynamometers, precision—George Scherr Co., Inc.
835 Engineering personnel—Federal Telecommunication Labs.
836 Engineering personnel—Hughes Res. & Development Labs.
837 Engineering personnel—Lockheed Aircraft Corp.
838 Engineering personnel—Melpar Inc.
839 Ferric oxides; iron powders—C. K. Williams & Co.
841 Film cameras & sound equipment—Berndt-Bach, Inc.
842 Filters, radio noise—Potter Co.
843 Filters, rejection network—White Instrument Labs.
844 Focus unit, ferrite magnet—Heppner Mfg. Co.
845 Fuses—Littelfuse, Inc.
846 Fuses; fuse holders—Bussmann Mfg. Co.
847 Generator, square wave—Measurements Corp.
848 Generator, studio TV sync—Radio Corp. of America.
849 Generators, UHF-TV sweep, FM—New London Instrument Co.
850 Glass tubing and cane—Demuth Glass Works, Inc.
851 Hardware; accessories—Federal Screw Products Inc.
852 Indexing turntables—Elsler Engineering Co., Inc.
853 Insulators for color TV tubes—Anchor Industrial Co., Inc.
854 Interpolators, frequency standard—Gertsch Products, Inc.
855 Iron powders, carbonyl—Antara Chemicals Div., General Aniline & Film Corp.
856 Klystron tubes, reflex—Bendix Aviation Corp., Red Bank Div.
857 Lacing tape, nylon—Gudebrod Bros. Silk Co., Inc.
858 Lamps, glow; pilot lights—General Electric Co.
859 Lead and multiple headers, sealed—Electrical Industries
860 Lenses, TV and film—Wollensak Optical Co.
861 Lenses, zoom-type camera; titlers—Paillard Products, Inc.
862 Magnetic materials; cores—Arnold Engineering Co.
862A Meters, 250 arc—Hiekok Electrical Instrument Co.
863 Microphones—American Microphone Co.
864 Microphones, dynamic—Turner Co.
865 Microphone stands—Atlas Sound Corp.
866 Microwave assemblies; radar—N.R.K. Mfg. & Engineering Co.
867 Microwave precision instruments—Waveline Inc.
867A Microwave relays—Philco Corp.
868 Microwave signal generators—Polarad Electronics Corp.
868A Modular electronic systems—Audio Products Corp.
869 Nameplates, metal adhesive—North Shore Nameplate Co.

Listings continued on next page ▶▶|

Use these postage-free cards to get further information

INQUIRY CARD Not good after May 1, 1954

Write in boxes the code numbers of products for which you want information. See list above and on next page.

Your company .....

Address .....

.....

Your name .....

Your title .....

TELE-TECH—MARCH 1954

CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

INQUIRY CARD Not good after May 1, 1954

Write in boxes the code numbers of products for which you want information. See list above and on next page.

Your company .....

Address .....

.....

Your name .....

Your title .....

TELE-TECH—MARCH 1954

CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

PRODUCT INFORMATION?

If that is what you need, use the cards below to get it quickly, through . . . .

TELE·TECH
A ELECTRONIC INDUSTRIES

Listings continued from preceding page

870 Oscilloscopes for TV—Tektronix, Inc.
870A Packaging, shock-proof—Cargo Packers Inc.
871 Phasemeters, 0 to 360 degrees—Technology Instrument Corp.
872 Photo equipment; lenses—Burke & James, Inc.
873 Plastic sheets, rods & tubes—Synthane Corp.
874 Pliers for wire & printed circuits—Mathias Klein & Sons
875 Plugs & sockets, shielded—Howard B. Jones Div. Cinch Mfg. Corp.
876 Potentiometers precision—Helipot Corp.
877 Potentiometers, precision—Vectron, Inc.
878 Potentiometers, precision—Fairchild Camera & Instrument Corp.
879 Power plants, motor-generator—U. S. Motors Corp.
880 Power plants, standby electric—D. W. Onan & Sons Inc.
880A Printed circuits—Electralab Inc.
881 Printed circuits—Insulated Circuits Inc.
882 Printed circuits, volume controls for—Chicago Tel. Supply Corp.
883 Radio engineering show—Institute of Radio Engineers
884 Rectifiers, selenium—International Rectifier Corp.
885 Rectifiers, selenium—Sarkes Tarzian Inc.
886 Regulators, color TV voltage; resistors—Victoreen Instrument Co.
887 Relay manual service—Sigma Instruments, Inc.
888 Relays for remote controls—Sigma Instruments, Inc.
889 Relays, thermo delay; ballast regulators—Amperite Co. Inc.
890 Relays, time delay—Thomas A. Edison Inc.
891 Relays, vibration resistant—Hart Mfg. Co.
892 Resistors, boro-carbon—Sprague Electric Co.
893 Resistors, encapsulated wirewound—Daven Co.
894 Resistors, high-temperature film—Corning Glass Works
895 Resistors, miniature power—Dale Products, Inc.
896 Resistors, molded—S. S. White Dental Mfg. Co.
896A Resistors, subminiature—Resistance Products Co.
897 Resistors, variable carbon & wire—P. R. Mallory & Co., Inc.
898 Resistors, wirewound; rheostats—Tru-Ohm Products Div., Model Engrg. & Mfg. Co.
899 Scanners, TV film and slide—Allen B. DuMont Labs., Inc.
900 Screen rooms, prefabricated—Erik A. Lindgren & Assoc.
901 Sealed terminals & Lead-ins—Stupakoff Ceramic & Mfg. Co.
902 Seals, compression type—L. L. Constantin & Co.
902A Seals, vacuum compression—Hermetic Seal Products Co.
903 Shafts, remote control flexible—S. S. White Dental Mfg. Co.
903A Slides, electronic equipment—Grant Pulley & Hardware Corp.
903B Sockets, miniature tube—Methode Mfg. Corp.
903C Sockets, UHF & printed circuit; plug-ins—Hugh H. Eby Inc.
904 Sockets, vacuum tube—E. F. Johnson Co.
905 Solder, flux core—Kester Solder Co.
906 Solder, rosin-filled, preforms—Alpha Metals, Inc.
907 Spectrum analyzers—G & M Equipment Co., Inc.
908 Stamps, vinylite inspection—Krengel Mfg. Co., Inc.
909 Switches, crossbar—James Cunningham, Son & Co., Inc.
910 Switches, rotary—Shallcross Mfg. Co.
910A Tape, magnetic recording; reels—Audio Devices, Inc.
911 Tape, mylar magnetic recording—Reeves Soundcraft Corp.
912 Telephone handsets—Shure Brothers, Inc.
913 Terminal blocks—Ilsco Copper Tube & Products, Inc.
914 Terminal strips & board—Cinch Mfg. Corp.
915 Test instruments; transformers—Freed Transformer Co., Inc.
915A Testers, high potential—Peschel Electronics, Inc.
916 Toroidal decades; filters—Burnell & Co.
917 Toroids, molded—Communication Accessories Co.
918 Towers, antenna—Blaw-Knox Co.
919 Transformers—Triad Transformer Corp.
920 Transformers; chokes; reactors—Thermador Electrical Mfg. Co.
921 Transformers, custom built—Airdesign, Inc.
921A Transformers; reactors—Langevin Mfg. Corp.
921B Transistors, audio, sealed—Radio Receptor Co., Inc.
922 Transistors, junction power—Transistor Products, Inc.
923 Transformers, toroids—Kenyon Transformer Co., Inc.
924 Transistors, sealed junction—Texas Instruments Inc.
925 Transmission lead, 300-ohm tubular—Phalo Plastics Corp.
925A Transmitter, 250-watt paging—Gates Radio Co.
926 Tube inventory control—General Electric Co.
927 Tubes, color TV picture—CBS-Hytron
928 Tubes, color TV receiving—General Electric Co.
929 Tubes, electron—Allied Radio Corp.
930 Tubes, electrostatic TV picture—Westinghouse Electric Corp.
931 Tubes, paper & impregnated—Precision Paper Tube Co.
932 Tubes, paper & impregnated—Stone Paper Tube Co.
933 Tubes, picture & receiving—Tung-Sol Electric Inc.
934 Tubes, power triode—Federal Telephone & Radio Co.
935 Tubes, premium subminiature—Sylvania Electric Products Inc.
936 Tubes, 90° TV picture—Westinghouse Electric Corp.
937 Tubes, UHF-TV klystron—Eitel-McCullough, Inc.
938 Tubing, laminated phenolic—Cleveland Container Co.
939 TV camera chains & transmitters—General Precision Lab. Inc.
940 TV camera cranes, mobile—Houston Fearless Corp.
941 TV, color tubes & components—Radio Corp. of America
941B TV, color instrumentation—Telechrome Inc.
941C TV, color test & broadcast equipment—Tel-Instrument Co. Inc.
942 TV projection equipment—Gray Research & Dev. Co., Inc.
943 TV transmitters—Federal Telecommunication Labs.
943A Vacuum equipment for color TV—Optical Film Engrg. Co.
944 Waveguide; microwave components—Premier Instrument Corp.
945 Winding machines, toroidal—Rex Rheostat Co.
946 Wire & Cable, teflon insulated—Tensolite Insulated Wire Co., Inc.
947 Wire; coils; sound powered phones—Wheeler Insulated Wire Co.
948 Wire stripping machines—Artos Engineering Co.

MAIL CARD TODAY

NOT GOOD AFTER MAY 1, 1954

TELE-TECH & ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE • NEW YORK 17, N. Y.

FIRST CLASS
PERMIT No. 22273
(Sec. 34.9, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

TELE-TECH
A ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE
NEW YORK 17, N. Y.

Caldwell-Clements, Inc.

FIRST CLASS
PERMIT No. 22273
(Sec. 34.9, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

TELE-TECH
A ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE
NEW YORK 17, N. Y.

Caldwell-Clements, Inc.

PERSONAL

Richard D. Schotter was recently made vice-president of Phen-O-Tron, Inc. New Rochelle, N. Y. **Jack Bayha**, priorily associated with Emerson Radio Phonograph Corp. in the capacity of senior engineer, was named chief engineer of the company's new printed circuit plant.

Harold J. Adler has become vice-president in charge of engineering of the Edwin I. Guthman & Co., Inc., of Chicago, Ill. Mr. Adler will coordinate

Harold J. Adler

the diverse engineering activities of the company For the past four years, Mr. Adler has been director of engineering for Hallicrafters Co., Chicago, Ill.

Harold Higinbotham has retired from active service as technical director of Acheson Colloids Ltd., London, Eng., unit of Acheson Industries, Inc., New York. He will remain on the board of directors, however. He became technical director of E. G. Acheson Ltd., as the company was then called, in 1935.

Lawrence R. Thielen has become a member of the New York district office staff of Ampex Corp., Redwood City, Calif. The New York City office of Ampex in the Chrysler Bldg. serves New England, New York, New Jersey, and Pennsylvania.

Franklin L. Eger has been made senior field investigator of the technical survey staff of Designers for Industry, Inc., Cleveland, Ohio. **Dante J. Domizi** joined the company as senior project engineer, electronics engineering. **Philip N. Bredesen** was promoted to assistant project manager, electronics; **Guilbert M. Hunt** to industrial designer, mechanical; **Alfred L. Lea** to project engineer, mechanical; **Roger L. Chaloupka** and **James V. Westberg** to project designers, mechanical; and **Hiram G. Gilbert, Edward Holasek, Edward F. Mazur,** and **George J. Prusha** to project designers, electronics. **Andrew M. Filak**, has transferred to the sales department, and will cover Ohio, Michigan, Indiana, and Kentucky.

PERSONAL

(Continued from page 173)

William C. Jenner has joined the engineering staff of Reliance Electric and Engineering Co., Cleveland, Ohio, and will be responsible for the development and application of electrical insulating materials. March 1943 to January 1946, he was a lieutenant commander, USNR.

Bron Kutny has joined Channel Master Corp., Ellenville, N.Y. as field engineer. Mr. Kutny was formerly educational director of Emerson Radio and Phonograph Co.

Martin V. Kiebert, Jr., formerly director of the special products research department of Bendix Aviation, has been appointed chief engineer of

Martin V. Kiebert, Jr.

the tuner division of P. R. Mallory & Co., Inc., Indianapolis, Ind. Mr. Kiebert will be in charge of all research, development, and design for the division.

Harris O. Wood, who has been in charge of Philco Corp., Philadelphia, Pa. TV receiver design, was recently made chief engineer of the television division. **Wilson P. Boothroyd**, who has been in charge of Philco's engineering development laboratory for the past four years, was appointed chief engineer of the advance development laboratory.

Albert Lederman was recently made engineering specialist in a new mechanized circuits department of the parts division of Sylvania Electric Products Inc., New York, N.Y. As section head of the new department, Mr. Lederman will make his headquarters at 43-20 34th St., Long Island City, N.Y. With Sylvania since 1946, Mr. Lederman was a technical representative in Washington, D.C. prior to his present assignment.

Charles W. Baechler, Jr., until recently chief engineer of Lucian Laboratories and formerly chief engineer of Raymond Rosen Engineering Products, Inc., has joined the engineering staff of the Applied Science Corporation of Princeton, Princeton, N.J.

J. P. Smith, Jr., formerly chief engineer of the Daven Co., Newark, N.J. has been promoted to director of engineering. **Walter Voelker**, who was ap-

J. P. Smith, Jr.

pointed chief engineer of the company, was formerly with Day & Zimmerman, Inc., Leeds & Northrup, and Bell Telephone Laboratories.

I. F. Matthysse, formerly chief design engineer for Burndy Engineering Co., Inc., Norwalk, Conn., was recently promoted to assistant chief engineer, and **Dr. W. F. Bonwitt**, formerly chief planning engineer was made chief administrative engineer. Mr. Matthysse has been a member of the Burndy engineering department for 25 years. Dr. Bonwitt, who has been largely concerned with the firm's testing, research, and quality control programs, joined Burndy in 1938.

Reeves Develops Lifetime Magnetic Tape

Reeves Soundcraft Corp. has developed a magnetic recording tape which it "unconditionally guarantees will never break or curl when used under normal conditions of recording and playback." It will be marketed under the trademark name, "Lifetime" Tape.

"Neither recording machines nor ordinary handling will ever break it," said Frank B. Rogers, Jr., Reeves vice-president and general manager. The new tape owes its permanent qualities, Mr. Rogers said, to Soundcraft's newly developed magnetic oxide coating and to its base of DuPont "Mylar" polyester film, neither of which contains a plasticizer. He said it is a third as strong as machine steel, and offered the following comparison with standard cellulose acetate base tape: Its break strength is two-and-a-half times greater; Its break elongation is four times greater; Its impact strength is twenty times as great; Its tear strength is five times as great; Its flex life at 75 degrees Fahrenheit is 500 times as great.

Youth Connects

New horizons are ever present. Leo Kagan of Elco Corp. received a letter from 12-year old John Little, which reads: "I use them (varicon connectors) on my electric train. I also plan to spread them around (sic) the house for speaker extentions (sic), and I plan to make a rack of female sockets (sic) and male plugs to make different things work."

Microwave Impedance Tester Developed

A microwave impedance measuring instrument covering the frequency range 400 to 1600 MC has been developed by the Engineering Research Div. of New York Univ. The new device eliminates certain elaborate slotted-line set-ups, and permits rapid measurements of variable SWR and impedance. Accuracy of the reflection coefficient is better than 5%. High sensitivity of new impedance bridge permits measurement of impedance in such elements as bolometers and crystal mounts.

Tube Application Data Released

Important tube application information on the type 6x4 has been released by the Panel on Electron Tubes of the Research and Development Board. It includes charts which help the user to avoid many tedious calculations, particularly for military equipment. CBS-Hytron is distributing copies to its customers.

High Altitude TV Freeze

Community TV antennas atop 13,770-foot Mt. McNamee recently bore the brunt of storms which cut off reception in Climax, Colo. Antennas were completely blown off the supporting masts. Temporary erection of a Davis antenna is intended to provide reception from Denver, pending construction of permanent Yagi antennas with internal electric heating elements.

POLICE TV

RCA industrial TV system is tried out in New York City police lineup. Daily display of criminals will eventually go to all precincts

Training Programs in Modular Design

Sanders Associates, Inc., Nashua, N. H., has initiated complete training programs designed to give an immediate working knowledge of modulator design techniques for electronics. The courses are based upon the vast background of experience gained through their major design-engineering participation in "Project Tinkertoy" and their further extensive explorations into application of the modular design system to all types of commercial equipment.

Two complete courses in modular electronics are available. The first, Introduction to Modular Design Principles, is primarily for key engineering personnel, and is designed to acquaint them with the field of modular electronics. Six lectures, covering basic principles and reduction of circuits for modular electronics; design and manufacture; mechanical and circuit layout, plus demonstrations, laboratory tours and discussion periods, will permit the engineer to gain an appraisal of modular techniques and principles. The course, furthermore, will allow the engineer ample opportunity to ascertain pertinent facts relative to his particular circuitry and enable him to intelligently discuss with his top management the feasibility of modulizing the company's equipments.

The Advanced Course

The second course is the Advanced Course in Modular Design. This course has been designed for engineering, production and technician personnel. It consists of three weeks of lectures, demonstrations, discussion groups, tours and laboratory periods. Subject matter will cover basic principles and reduction of circuits to modular electronics; design and manufacture of components, circuit and mechanical layouts, test and assembly; and, plant layout for modular production. In the laboratory training, special emphasis will be placed upon that phase of modular electronic production with which a specific category of personnel is principally concerned. Engineering personnel will undertake the modular design of a specific circuit and supervise its construction and testing. Production personnel will schedule and supervise the operation of the semi-mechanized module facility of the school. Technician personnel will be instructed in the operation and use of the special jigs and fixtures peculiar to modular assembly.

Delay Lines

(*Continued from page 78*)

from ¼ in. to over 6 in. The NBS study revealed that there was little effect on the transmission of ultrasound attributable to specimen cross-section so long as it was not less than transducer cross-section.

NBS investigated 14 materials in the course of the work. A number of characteristics such as attenuation, distortion, and temperature response were studied for each material. The total attenuation of a high-frequency signal is the result of several factors. Besides losses in the delay line itself, there are losses due to the crystal transducer and due to the bond between the crystal and delay line. The attenuation losses of the line have been attributed to elastic hysteresis, sound scattering, and a sound diffusion process. Distortion also has several sources. It can be caused by the crystal transducer or by the matching between crystal and delay line. Internally, the principal sources of distortion are scattered signals which have been reflected or refracted back into the main beam. To investigate these effects, the laboratory made studies of the relationships between the transmission of ultrasound and such factors as chemical composition, cold deformation, annealing treatment, specimen length, and sound path cross section.

The third, and most important quality, sought in the NBS investigation was temperature stability of time delay over the range from −50° to +200°C. See Fig. 2. The delay time of a delay line is affected by the length and the shear modulus of the material. For most metals, the temperature coefficient of the modulus is negative and of much greater magnitude than the positive expansion coefficient. Actually, the expansion coefficient is relatively small especially for certain alloys of iron and nickel. Consequently a thermally stable delay line material must have a very small negative temperature coefficient of shear modulus.

Materials chosen for study included two magnesium alloys, a high purity and a commercial nickel, Invar, a 32% nickel-iron, and 18:8 Cr-Ni steel, a 1% carbon tool steel, an aluminum single crystal, and five isoelastic alloys. Of the isoelastic alloys three were of commercial origin, one was an experimental alloy, and one was a special alloy prepared in the Bureau's experimental foundry and treated in the NBS thermal metallurgy laboratory.

The electronic apparatus consisted of an r-f signal generator and amplifier; pulse, marker, and delay generators; an output cathode follower; and an oscilloscope. See Fig. 3. For attenuation studies, a pulse modulated signal was fed into both the ultrasonic delay line and directly into the oscilloscope. The outputs were applied to the vertical input of the oscilloscope. As the oscilloscope deflection sensitivity and circuit constants were known, the attenuation of the delay line could be determined. For delay time studies, the marker generator provided marker pulses for the vertical input of the oscilloscope and synchronized the pulse generator output which was being applied to the delay line. The delay generator was synchronized by the pulse generator and provided in its output a delay pulse which was used to trigger the oscilloscope sweep. The sweep delay was variable over a wide range. By this method, the expanded sweep could be observed over a wide range, facilitating accurate determination of the delay time of the delay line.

For tests at elevated temperatures, a nichrome-wound alundum tube furnace was used having a uniform temperature zone over the specimen length. Thermocouples were attached to the center and both ends of the delay line. In order to obtain subzero temperatures, a very simple but effective low-temperature test chamber was constructed. It consisted of an open-top wooden box with holes drilled in its opposite ends. A thick-walled copper tube ran through the holes. The delay lines were inserted in the tube. By gradually filling the box with dry ice, the specimen was cooled slowly. The copper tube maintained effectively uniform temperatures over the specimen length.

Of the 14 metals and alloys investigated, only two of the isoelastic alloys possessed satisfactory temperature stability over the range from −50° to +200°C. These materials were alloys of iron, both containing approximately 36% nickel and 7 to 8% chromium plus other minor constituents. While mercury and the magnesium alloy have temperature coefficient of delay time of about 300ppm/°C and 400ppm/°C, respectively, one of the isoelastic materials tested had a temperature coefficient of only 8ppm/°C. The second isoelastic alloy was nearly as good; it exhibited a constant delay time over the range from −50° to +170°C, with a slight increase in delay time at temperatures above 170°C.

scope with the line selector on one of the horizontal gray scales of the Chart pattern. The adjustments can then be checked on the tricolor monitor for uniformity of hue (gray) along the gradation wedge.

In the previous description, the color picture monitor is used chiefly for checking the similarity of the gradation scales in the primary colors, and for noting errors in the transient response of the individual color channels.

Chart B is also useful in adjusting the tricolor picture tube. Using the bar pattern generator and a transparent form of Chart B, the horizontal and vertical linearity and aspect ratio are adjusted. With the three gun type of color tube, the purity coil current, the convergence voltage and the small convergence magnets must be carefully adjusted for the most accurate registration of the three electron beams and the mask.

During this procedure the electron beams must be kept in good focus, and the grid bias controls adjusted for a uniform white shade. When correctly adjusted, the picture should consist of uniform white lines or dots against a black background.

It should be noted that these two charts, A and B, the only ones presently available, are almost indispensable for testing color TV systems. Additional charts specifically designed for color TV are in the planning stage, but these charts probably will be in black-and-white, and not in color. Hence, charts A and B will continue to be of great value.

"SECRET WEAPON"

Ralph Marduena, welder at Dalma Victor, proudly displays gag antenna, "the ideo-radiator," a universal cold war antenna primarily used as a counter flying saucer measure. It is maintenance-free, and temporarily unclassified at present

Capacity Commutator

(Continued from page 77)

$$Rq + \frac{q}{C + a(2t_1 - t)} = E \qquad (7)$$

where: $C + a(2t_1 - t) = C(t)$

$$t_1 \leq t \leq 2t_1$$

($2t_1 = t_2$ in the notation used in Fig. 3a)

Thus, the condition for continuity of the charge on the variable condenser at t_1 would be entered in a more elegant way. On the other hand, in order to emphasize the physical aspect of the circuit behavior, two different equations are here written respectively for the meshing and for the unmeshing phase of the complete cycle. This because both phases may be physically made quite independent of each other.

Between t_0 and t_1 there is only one active element in the circuit: The battery E and two ohmic resistors

$$R \text{ and } 1/C$$

Between t_1 and t_2 there are two active elements: The battery E and the resistance

$$-1/C \text{ (a negative resistance)},$$

R remaining necessarily the same.

While during the interval

$$\overline{t_0 t_1}$$

the electrical charges from E flow naturally into the increasing capacity without any expenditure of mechanical torque; during

$$\overline{t_1 t_2}$$

some mechanical torque is instead expended to force these same charges back into E. Therefore during the unmeshing time there is a voltage q/C across the condenser which opposes the voltage E and it must be taken into account in the representative equation. This is

$$Rq + [q/(C - Ct)] = E. \qquad (8)$$

The solution of (8) is

$$q = \frac{E(C - Ct)}{1 - RC} + K\left(1 - \frac{t}{C}\right)^{\frac{1}{RC}} \qquad (9)$$

The initial conditions for the second part of the cycle are

$$q = q_1$$
$$C = C_1$$
$$t = t_1 = 0$$

Hence $$K = q_1 - \frac{EC_1}{1 - RC} \qquad (10)$$

Entering (10) in (9)

$$q = \frac{E(C_1 - Ct)}{1 - RC} + \left(q_1 - \frac{EC_1}{1 - RC}\right)\left(1 - \frac{t}{C}\right)^{\frac{1}{RC}} \qquad (11)$$

CAPACITY COMMUTATOR (Cont.)

Eq. (11) gives the charge on the variable capacitor at any time between t_1 and t_2. By differentiating (11) the current is found

$$i = \frac{-E\dot{C}}{1-R\dot{C}} + \frac{2E\dot{C}}{1-R^2\dot{C}^2}\left(1-\frac{\dot{C}}{C_1}t\right)^{\frac{1}{R\dot{C}}-1} \quad (12)$$

The output voltage is

$$e_{out} = -\frac{ER\dot{C}}{1-R\dot{C}} + \frac{2ER\dot{C}}{1-R^2\dot{C}^2}\left(1-\frac{\dot{C}}{C_1}t\right)^{\frac{1}{R\dot{C}}-1} \quad (13)$$

For $t = t_1 = 0$, Eq. (13) reduces to Eq. (4). Hence they both apply at t_1.

The discussion of Eq. (13) is presently delayed because it will acquire more significance if this is done at the very end.

Actual values are instead immediately given to the parameters. The following orders of magnitude are considered within the realm of engineering feasibility.

$C_1 = 10^{-11}$ farads = Value of the fully meshed capacity where $C_1 = Ct_1$

$t = |t_a - t_1|$ or $|t_1 - t_2| = (2)(10^{-4})$ sec. = Meshing or unmeshing time

$$\dot{C} = \frac{C_1}{t} = 0.5 \times 10^{-7} \text{ mhos}$$

$R = 5 \times 10^6$ ohms

Entering the above values in (4) and (13) and respectively calling e_1 and e_2 the output voltages during the meshing and unmeshing periods.

$$e_{1_{out}} = 0.2E$$

$$e_{2_{out}} = -0.33E + 0.53E\,(1-5000t)^{\frac{1}{5000}-1}$$

When $t = t_2 = (2)(10^{-4})$ sec. or $1/5000$ sec.

$$e_{2_{out}} = -0.33E.$$

As soon as the transient dies out, the circuit suddenly opens and the current drops to zero.

For the purpose of illustrating the behavior of the curve between t_1 and t_2 the following values of t following t_1 are chosen.

$t_\alpha = 0.5 \times 10^{-4}$ sec.; $t_\beta = 10^{-4}$ sec.; $t_\gamma = 1.5 \times 10^{-4}$ sec.

The respective values of $e_{2_{out}}$ are

$$-0.11E\,; \quad -0.27E\,; \quad -0.30E$$

and the entire output voltage curve for the complete cycle appears as shown in Fig. 4.

The unmeshing part of the cycle is again analyzed for the circuit of Fig. 5 where a ground plate is introduced following the input plate. Edge fringing is again ignored. After

t_{1}, as before, the first capacitor starts decreasing. At time t_a, before it has completely unmeshed, the second capacitor (to ground) starts meshing and increasing. The voltage source for this second condenser is the voltage across points BC with the indicated polarity. Because the initial charge on the second capacitor is zero, it behaves like a conductance. Hence an equivalent resistance

$$1/\dot{C}_g$$

suddenly appears in parallel to R at $t = t_a$, where t_a is a time between t_1 and t_2 which depends upon the physical spacing between

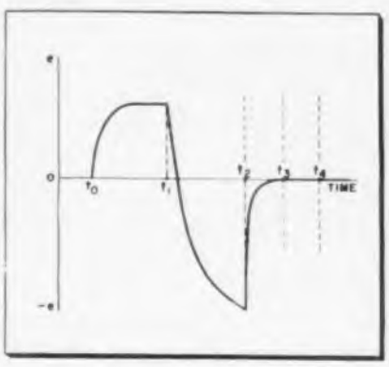


Fig. 9: Typical output waveform for any input plate preceded and followed by ground plates

the first (input) plate and the second (ground) plate. After t_a the load resistor is no longer R but

$$R_t = 1/[(1/R) + C_g]$$

where C_g = Fully meshed capacity of capacitor to ground

For convenience assume that

$t_a = t_\alpha$ of the preceding case where Fig. 4 applies

$\dot{C}_g = \dot{C}$

Then $R_t = 4 \times 10^6$ ohms and after t_α

$$e_{2_{out}} = -0.27E + 0.42E\,(1 - 5000t)^3$$

$$t_2 \geqslant t \geqslant t_\alpha > t_1$$

The output voltage curve is modified as in Fig. 6. The presence of the ground plate is seen to lower the absolute values of the negative voltage output.

Fig. 7 applies to the analysis for

$$t \geqslant t_2.$$

At t_2 the first input capacitor suddenly disappears, but a certain voltage ($-27E$ for the above numeric case) still exists on the second ground capacitor and is applied across R. It would appear that to treat the problem rigorously an equation valid between t_2 and t_3 should be written and solved. Thereafter, an equation valid between t_3 and t_1 should also be solved. There is no need for it. The

final aim is to find out whether or not the second ground capacitor is completely discharged before the leading edge of the moving plate meshes with the third plate or the second input plate at t_4. Any residual charge would be detrimental to the device, because it would carry over from the first input plate to the second input plate. Such a "voltage memory" cannot be tolerated because it would otherwise introduce a "dynamic crosstalk" between the sampled circuits. Said dynamic crosstalk is surely avoided if the time constant of the fully meshed ground capacitor C_g times R is smaller than ¼ the time interval between t_2 and t_4. The validity of this criterion is self-evident. The full discharge time for the variable C_g capacitor can never be greater than 4 RC_g. This criterion is easily satisfied because in practice it is always possible to make C_g from 50 to 100 times less than C. By reducing the capacity between ground plates and movable plate while still retaining their static decoupling function the π section was evolved as it was first represented in Fig. 2. Also, by lowering the C_g capacity, the negative voltage swing of Fig. 4 will not be any more reduced as it was shown in Fig. 6. Qualitatively the output voltage between t_0 and t_1 will appear as in Fig. 8.

Unmeshing Capacitance Effect

Finally, the effect of the unmeshing capacitance C_g upon the initial output voltage due to the meshing of the third capacitor after t_4 must be analyzed.

At $t = t_4 - \varepsilon$, a portion of the unmeshing C_g is still in parallel with R but by now completely discharged. At t_4 the third capacitor starts meshing, hence a step voltage is applied to R and to the remaining unmeshing section of C_g which is in parallel with R. After t_4; the unmeshing section of C_g must accept charges at a rate falling faster than the exponential dieaway rate which would be experienced should the unmeshed section of C_g remain constant. Consequently, the voltage across R increases at a rate greater than the exponential one because of the diminishing shunting effect due to C_g. At t_5, capacitor C_g disappears altogether and the voltage across R then reaches the steady state given by Eq. (4). The typical output waveform for any input plate preceded and followed by ground plates is shown in Fig. 9, which is similar to Fig. 8, but for the rounded, initial step.

As mentioned at the beginning, the

introduction of a stationary coupling capacity, as represented by the two coaxial cylinders shown in Fig. 2, is necessary for the elimination of sliding contacts. In practice this coupling capacity C_c can be easily made several hundred times greater than C and because RC_c is relatively very large no practical deformation of the output waveform is introduced by it.

In addition to fringing, the unavoidable practical stray capacitances have been disregarded in the present investigation. Their pres-

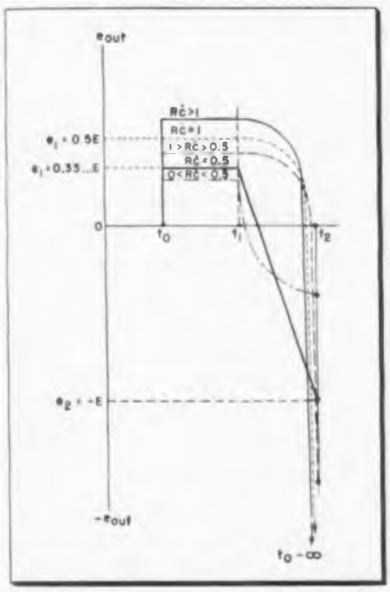


Fig. 10: Qualitative picture of output voltages for various values of RC, fringing ignored

ence and magnitudes will shift the boundary conditions of the equations when applied to fit a particular design of the commutator.

The discussion of Eq. (13) is now entered,

$$e_{out} = -\frac{ERC}{1-RC} + \frac{2ERC}{1-R^2C^2}\left(1-\frac{C}{C_1}t\right)^{\frac{1}{RC}-1} \quad (13)$$

For $RC = 0.5$ the exponent in Eq. (13) becomes unity and the curve representing the output voltage between t_1 and t_2 transforms into a straight line. Making $RC = 0.5$ in Eq. (4) and (13) the output voltage is 0.333...E for the meshing phase and reaches the peak of $-E$ during the unmeshing phase as shown in Fig. 10. Eq. (13) must be analyzed for $RC = 1$. Eq. (13) can be written as

$$e_{out} = -\frac{ERC}{1-RC} \times \quad (14)$$

$$\left[1 - \frac{2}{1+RC}\left(1-\frac{C}{C_1}t\right)^{\frac{1}{RC}-1}\right]$$

Making $RC = A$ (15)

CAPACITY COMMUTATOR (Cont.)

$$e_{out} = -EA\,\frac{1-\frac{2}{1+A}\left(1-\frac{\dot{C}}{C}t\right)^{\frac{1}{A}-1}}{1-A}$$

Differentiating numerator and denominator with respect to A

$$e_{out} = EA\left[\frac{2}{1+A}\left(1-\frac{\dot{C}}{C}t\right)^{\frac{1}{A}-1}(16)\times\right.$$

$$\left.\ln\left(1-\frac{\dot{C}}{C}t\right)\frac{1}{A^2}+\left(1-\frac{\dot{C}}{C}t\right)^{\frac{1}{A}-1}\frac{2}{(1+A)^2}\right]$$

For A = 1; the above equation reduces to

$$e_{out} = E\left[\ln\left(1-\frac{\dot{C}}{C_1}t\right)+\frac{1}{2}\right] \quad (17)$$

At $t = t_2$; $\dot{C}t = C_1$

$$e_{out} = E\left(\ln 0+\frac{1}{2}\right) \quad (18)$$

A spike of infinite voltage occurs at t_2.

In this case, for an idealized capacitor where fringing effects have been arbitrarily removed, a step function would be obtained at t_1, at an impulse function at t_2.

Fig. 10 presents a qualitative picture of the output voltages for various values of

$$R\dot{C}$$

While these curves would only apply to the ideal case represented in Fig. 3a when the fringing effect is ignored, nevertheless they convey quite clearly the trend shown by the output voltage versus the range of values assumed by

$$R\dot{C}$$

The capacity commutator is a high impedance device and it requires double-wall electrostatic shielding. A few laboratory models of the device were built while the writer was Director of Research with Communication Measurements Lab., Inc., Plainfield, N. J. The experimental work done at the above Laboratories also extended to the investigation of the commutator as a dc chopper and voltage amplifier. Furthermore, a more complex commutator was designed with the π plates "enclosing" the input plates. The decoupling between the adjacent π plates being obtained by means of grounded vanes. Also by means of individual cathode followers the capacity between any input plate and associate π plate was furthermore reduced. More recently, while the writer was Electronic

Consultant with the Electronic Dept. of the Glenn L. Martin Co., Baltimore, Md., a 16 channel experimental capacity commutator was built there. This last model incorporates bearings which could stand up to 65,000 rpm. From the experimental evidence available at this time it appears that the rms noise voltage output can be kept at least 6 db below 1 mv for a well machined sample. At such a high level the noise is purely of microphonic origin. Hence it is quite premature, for all practical purposes, to start worrying about the ultimate theoretical sensitivity of the device.

Electro-Optical Image

(*Continued from page 91*)

electronic circuits if the scanning velocity is the same in two orthogonal directions. The NBS system achieves this type of scan by applying triangular waves to the horizontal deflection of the scanner and a slightly different frequency wave of the same type to the vertical deflection. The result is a Lissajous figure of rectangular shape that changes its proportions with the instantaneous phase between the two waves. The same waves are applied to the monitor for identical scanning.

Video picture (l) of photo is changed to outline form (r) by differentiating and rectifying signals, and then clipping to constant level

This image processing system has so far been employed in the study of the enhancement of contours in photographs and to the production of outline pictures from half tone photographs. The process of contour enhancement is essentially that of increasing the abruptness of tone transition at contour lines. A similar phenomenon occurs in the "brightness contrast" in human vision. If a dark area is adjacent to a light area, the dark appears darker and the light appears lighter close to the boundary.

The sharpening of tone transitions for contour enhancement is accomplished by modifying the waveform of the signal applied to the monitor oscilloscope. This is done by elec-

trically adding an enhancing signal (the negative of the second derivative) derived from the original signal. Mathematical analysis of the process indicates that a first approximation to a correctly focussed picture is obtained when this process is applied to an incorrectly focussed picture. Used in this way, the system is a two-dimensional (visual) analog of a high frequency compensated audio system.

The formation of outline pictures from photographic negatives is accomplished by using different modifying signals. If the signals from a differentiating network are rectified, a positive pulse is obtained as the light spot passes over a region of sharp tone gradient. The application of such signals to the intensity control of the monitor results in pictures that show only the contour lines, like line drawings.

Use of Process

This outlining process may be used for automatic production of sketch maps from terrain photographs or the display of contours on X-ray pictures or coronagraphs. In picture transmission where line drawings are acceptable, economies in bandwidth are possible through reduction in the information that must be transmitted (Fig. 2). Also, contrast enhancement may be used in TV to reduce the effects of low transmission bandwidth. The suggestion has been made that the system would be useful in the field of analog computers as an aid to the solution of some types of differential equations.

Dalmo Victor Stock to Textron, Inc.

Sale of the entire stock of Dalmo Victor Co., 1414 El Cannino Real, San Carlos, Calif., to Textron, Inc., leading textile manufacturer in Providence, R.I., has been announced by Tomlinson I. Moseley, president of the San Carlos electronics firm. Under the terms of the transaction completed, Dalmo Victor becomes a wholly owned subsidiary of Textron and maintains intact its present operation and management.

Dalmo Victor is a leading producer of airborne radar antennas with five plants and more than 1400 employees in San Carlos and Belmont. Its entire output is under defense contracts and sales volume exceeded $24,000,000 during the fiscal year ending September 30, 1953.

BULLETINS

Tape Recorder

Bulletin No. AB 3-1-2 presents the general performance characteristics and specifications covering the model 350 tape recorder made by Ampex Corp., 934 Charter St., Redwood City, Calif.

Telephone System

Telecom Inc., 1019 Admiral Blvd., Kansas City, Mo. has released Bulletin Tel 101 which describes the model 4A23 dial telephone system.

Tubes

Two catalog sheets were recently released with a price list by Lewis and Kaufman, Ltd., Los Gatos, Calif. The sheets provide engineering data and general characteristics covering the "Los Gatos" high-vacuum rectifier, 3B24W and the medium mu triode, 3C-24/24G.

Rectifiers

"Selenium Rectifiers for Color Television," a new folder published by Federal Telephone & Radio Co., 100 Kingsland Road, Clifton, N.J., provides information about the design of color TV power supplies, and lists a special group of selenium rectifiers adaptable to this application. Folders are available on request.

Switch

Thompson Products, Inc., announces the availability of a bulletin that describes the Model DOY3AA coaxial switch for 3⅛ in. coaxial cable. The switch is distributed through the Andrew Corporation of Chicago.

Measurement Techniques

Hewlett-Packard Co., 395 Mill Page Road, Palo Alto, Calif., has issued Vol. 5, No. 1-2 of the -hp- Journal which discusses techniques for measuring operating time of high speed clutches, rpm on very high speed shafts, stability of rotation, electrical relay operating times, and phase delay in 1-f devices such as servo mechanisms. May be obtained at no charge by writing Dept. P.

Seals

The Hermaseal Co., Elkhart, Ind., has published a 20-page color booklet which explains "Why glass-to-metal sealing" and presents drawings and characteristics and performance data covering electrodes, tubular button-seals, headers, octal plugs, etc.

Potentiometers

A new 19-page catalog (form No. 79-7) is devoted exclusively to carbon and wire-wound potentiometers and associated hardware. Designed for equipment-design engineers, it contains electrical and mechanical characteristics, descriptions, drawings, dimensions, etc. Write to P. R. Mallory & Co., Inc., Resistor Div., Frankfort, Ind.

Guide Pins & Sockets

DeJur-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N.Y. have released an engineering data sheet covering their Continental" Series 20 miniature precision connectors that are now available with polarizing "screwlock" guide pins and guide sockets.

Wire Forms

A new educational brochure describes wire forms and shows how they can do the job of more complicated parts. It includes a chart on coil spring manufacturing variations, and simplifies technical data to enable easier ordering. Write Dudek & Bock Spring Mfg. Co., 2100 W. Fulton, Chicago 12, Ill.

Capacitors

Dumont-Airplane & Marine Instruments, Inc., 15 William St., New York 5, N.Y., have released catalogue 53, a 19-page booklet that describes and presents detailed descriptions, drawings, and ratings covering "Milcaps" glass-to-metal hermetically sealed subminiature capacitors designed to meet military specifications MIL-C-25A.

BULLETINS

(*Continued from page* 189)

Accelerometers

Bulletin A104 describes, illustrates, and presents engineering data covering "Glennite" accelerometers, models A104 and A1[illegible]2, manufactured by Gulton Mfg. Corp., Metuchen, N.J.

Papers

A brochure recently published by Potter & Brumfield, 233 N. Main St., Princeton, Ind., contains papers selected from those delivered during the Symposium on Electro-Magnetic Relays at Oklahoma A&M. It is available without charge.

Precistors

Bulletin B-8, catalog section B, presents important information for engineering and purchasing departments covering molded boron-carbon ½W precistors made by International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Library Edition

A library edition of the complete catalog of the Amperex Electronic Corp., 230 Duffey Ave., Hicksville, N.Y. incorporates general and operating data covering every electronic tube and accessory made by the company. The plasticized "Fabrihide"-covered, 578-page, loose-leaf, ring-binder-bound manual, priced to sell at $2.00, will be made available to qualified engineers.

Speed Tally

Details of the "Speed Tally" and how it functions is described in a new four-page folder, EL148, that is available on request to Remington Rand Inc., 315 Fourth Ave., New York 10, N.Y.

Greater Efficiency

The booklet, "More Dollars from Less Space," released by Alden Systems Co., Alden Research Center, Westboro, Mass., tells how to improve the efficiency of job, department, and factory.

Scientific Equipment

The Edin Company, Inc., 207 Main St., Worcester 8, Mass., has released a four-page condensed catalog describing their recording equipment, accessories and supplies.

Pulse Instruments

Bulletin 1-53, published by Electro-Pulse, Inc., 11811 Major St., Culver, Calif., is a four-page brochure which describes and gives performance data covering block unitized multi-purpose pulse instruments.

Plastic

The Richardson Co. 2735 Lake St., Melrose Park, Ill., has released Cat. No. 20.000.1 "Index of Grades by Outstanding Properties," which lists various grades of "Insurok" laminated plastic by their outstanding characteristics.

Filter Aid

Johns-Manville, 22 East 40th St., New York 16, N.Y. has issued an illustrated 8-page brochure on the use of "Sorbo-Cel," a specially treated "Celite" diatomite filter aid for removing emulsified oil from condensate or process water. Available to power engineers and others on written request.

Plastics Catalog

A new general plastics catalog and handbook featuring polystyrene rod, tubing and sheets, plastic covered steel, plastic splicers and channels, etc. has been released by Julius Blum & Co., Inc., Carlstadt, N.J.

Transducer

Gulten Mfg. Corp., Metuchen, N.J. has released bulletin P-401 covering the characteristics of the "Glennite" blast gauge wide range pressure transducer.

BULLETINS

(*Continued from page* 190)

Delay Lines

Electrometric, Inc., Woodstock, Ill., has released a catalog page on distributed constant delay lines for I.F.F., color TV and other military and commercial applications.

Twin Tetrode

"Data and Application Notes" is a 26-page booklet which presents the performance curves and special features of the type 5894/AX-9903 twin tetrode produced by Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.

Clocks

Sessions Clock Co., Forestville, Conn. has distributed an up-to-date product manual that includes complete service data on all electric clocks, movements, and clock-radio timers made by the company.

"Flexineering"

"Flexineering," the scientific application of flexible tubing for air, oil, steam, gases, and volatiles, is explained in an 8-page illustrated data book published by Pennsylvania Flexible Metallic Tubing Co. Write to Penflex, 72nd Street & Powers Lane, Philadelphia 42, Pa.

Magnetic Receiver

Telex, Inc., Telex Park, St. Paul, Minn., has released a two-color catalog sheet which lists the specifications and advantages of the "Twinset" twin magnetic receiver and its professional, business, and technical uses.

Color Generator

Wickes Engineering and Construction Company, 12th St., and Ferry Ave., Camden 4, N. J., have released two illustrated data sheets. One describes and presents characteristics and performance data covering the model ISG-2 interlace signal generator, the model CBG-1 color bar generator, the model CC-1 color coder, and the model PS-1 D-E-F power supply, units which comprise a color conversion package. The second sheet describes and presents data covering the models VDE-2 and VDE-3 vector display equipment.

Insulation

The Rex Corp., West Acton, Mass., have prepared an announcement which explains the advantages of "Rex-KF" wire and Kel-F insulation with striped color coding which makes available over 2,000 combinations.

Broken-Back Tube Preheater

Broken-back preheater for tempering glass of receiving tubes in production is Sylvania development which replaces slower circular preheater. Automatic conveyor belt feed tube mounts to operator at bulb sealing machine

News of MANUFACTURERS' REPS

Jack Carter and Robert L. Bray, sales engineers on the staff of **John B. Turbergen Co.,** 2232 West 11th St., Los Angeles, Calif., have become associates in the firm of manufacturers' representatives. Allen B. DuMont Laboratories, Inc., Clifton N.J., has announced that the John B. Tubergen Co., will handle company replacement sales on tubes and tube parts to jobbers in the Southern California and Arizona areas.

George Davis Sales Co., 5259 E. Beverly Blvd., Los Angeles, Calif., electronic representatives have been appointed to cover the Southern California and Arizona areas and Las Vegas, Nev., for Vaco Products Co., Chicago, Ill. producers of electronic tool items.

G. S. Marshall Co., Pasadena, Calif., electronic manufacturers' representatives, have been named to cover California, Arizona, and New Mexico for San Fernando Electric Mfg., Co., San Fernando, Calif., producers of hermetically sealed paper capacitors. Tom Williams and Frank Stevens, formerly with the Brown Instrument Div. of Minneapolis-Honeywell Co., recently joined the staff of G. S. Marshall Co. as field engineers.

Kerrigan Sales Co., Room 310, 1313 West Randolph St., Chicago, Ill. has been appointed exclusive representative for Ilsco Copper Tube and Products, Inc., Cincinnati, Ohio, manufacturers of electrical connectors, lugs, neutral bars, etc.

Weller-Rahe Co., Worthington, Ohio, will represent Brook Electronics, Inc., Elizabeth, N.J., manufacturers of audio amplifiers, in western Pennsylvania and Ohio.

E. V. Roberts and Assoc., 5068 W. Washington, Los Angeles, Calif. have been made representatives for Houghton Laboratories, Inc., Olean, N.Y., in California, Arizona, Nevada, and New Mexico.

J. O. Malvin, associated with the Idaho Power Co., for 34 years, has been appointed sales representative for the Idaho area by Burndy Engineering Co. Inc., Norwalk, Conn. Mr. Malvin will handle the entire Burndy electrical connector line and will operate from offices located at North 36th St., Boise, Idaho.

Charles E. Ruckstuhl has been made electronic sales engineering representative for the Pacific Division of Bendix Aviation Corp. He will handle the company's telemetering beacon, sonar, and other electronic products on the east coast, and make his headquarters at the division's New York office, 475 Fifth Ave.

Jack Grand recently retired from Burlingame Associates, 103 Lafayette St., New York, N.Y. after having been with the company for 12 years. However, he continues to serve the company in the capacity of consultant.

Wright Engineering, 4241 Melbourne Place, Indianapolis, Ind., has been appointed representative for Indiana and Kentucky by Pyramid Electric Co., North Bergen, N.J. manufacturers of electrolytic capacitors.

Vern Carson, formerly associated with Radio Specialties Co., Los Angeles, Calif., has joined Hycor Sales Co., 11423 Vanowen St., North Hollywood, Calif., to cover the Southern California audio field.

G. L. Electronics, 905 South Vermont Ave., Los Angeles, Calif., has been appointed authorized dealer in Greater Los Angeles for Kaar Engineering Corp., Palo Alto, Calif. manufacturers of mobile and marine radiotelephones. **Dane Communications Service,** 255 Betty Lane, has been appointed in Concord, Calif.; **Harold Friedman,** 1301 N.E. Miami Court, in Miami, Fla.; **W. W. Sanford Sound Engineering Co.,** 64 East Central Ave., in Orlando, Fla.; **Mobile Radio Service Co.,** 2821 North 48th St. Terrace, in Kansas City, Kan.; **Television Service Co.,** 249 North 48th St., in Lincoln, Nebr.; **Van Sickle Radio Co.,** 1113 Pine St., in St. Louis, Mo.

Televising Microscope Images

A lens attachment developed by George I. Schwartz, New York Univ. biologist, and Victor Grenier, technical director of WPIX, enables a

Lens attachment for TV camera uses periscope type prism to televise microscope images

TV camera to project directly from a microscope. The new device, a light-tight metal tube, attaches to the microscope and camera lens turret. A right-angle reflecting prism in the tube picks up the image of the sample and reflects it into the camera.

For IRE Exhibitors

Exhibitors at the forthcoming IRE Show, March 22-25, may borrow a "variac," the continuously adjustable autotransformer, for use in their exhibits to control illumination or adjust voltages for working displays. The units are being made available through the courtesy of the General Radio Co., Cambridge 39, Mass.

Major Armstrong Dies

Major Edwin H. Armstrong, famed radio pioneer, fell to his death on Feb. 1, 1954. He is generally credited with being one of the most important inventors in the field. Among his inventions are four basic discoveries that revolutionized radio, and made possible the present state of the art. These include: the regenerative circuit, which took radio out of the crystal detector stage; the superheterodyne circuit, the basic circuit of today's standard radio; the superregenerative circuit, used in military and UHF communications; and the FM communication systems which achieve static-free high-fidelity reception. Major Armstrong was born on Dec. 18, 1890, attended Columbia University, and became Professor of Electrical Engineering at the school. Among the many honors bestowed on Major Armstrong are the Medal for Merit and the IRE Medal of Honor.

The following statements, by two of the electronic industry's leading figures, are representative of the widespread recognition and deep appreciation of the man and his great inventions.

"The name of Major Edwin H. Armstrong will go down in the history of science as one of the great contributors to the growth of modern communications. I feel a personal loss in his passing, as must every engineer who knew him, as well as a recognition of deep loss to the electronics industry and the scientific fraternity. He was a kindly man, and in many respects, shy, but through this shyness always could be felt a sincerity of purpose and a professional integrity.

"The many contributions he made in the field of radio will live for uncounted years and his name must be linked with the other pioneers upon whose discoveries the great radio and television industries have been built. They exist today as monument to such scientific giants as Major Armstrong.

"Major Armstrong was one of the few great individualists in science. It is to his credit that working alone he made his major discoveries. He well deserved the many professional honors bestowed upon him."—Dr. W. R. G. Baker, Vice President, Electronics Div., General Electric Co.

Major Edwin H. Armstrong

"In the death of Major Edwin Howard Armstrong the world of science has suffered an irreplaceable loss, for the Major was one of the world's great engineers and unquestionably one of the greatest inventive geniuses in human history.

"In my opinion he contributed more to the development of radio and television than did any other person, but my sense of personal loss goes far beyond regret for the passing of a great scientist.

"I knew Howard Armstrong for thirty years, the last twenty as his friend and confidant. I knew him as a man of highest personal integrity who stubbornly refused to sacrifice his principles for any consideration: I saw him refuse a million dollars in cash rather than make such a sacrifice.

"I knew him as a patriot, who was the first to grant the United States government free wartime use of all his radio patents, even though some others charged the government royalties while also profiting from manufacture for the government. This was done at great personal loss since Armstrong's major source of income was invention, not manufacturing.

"No man can say what was in Howard's heart during his last hours but this I do know: Armstrong, the man, had stature equal to that of Armstrong, the scientist. I have lost a great friend." —E. F. McDonald, Jr., President, Zenith Radio Corp.

FM Net Formed

An FM radio network, the Good Music Network, has been set up to continue a broadcasting service which had been privately financed by Major Armstrong's Continental Network as a public service. Musical programs will be relayed from Washington to New York, and eventually Boston.

Colored Tape

Rapid identification of magnetic recording tape is facilitated by the development of colored tape. Audio Devices is now making plastic base types in blue and green, as well as standard clear. Plastic reels come in a choice of five different colors, further facilitating selection of stored reels.

Symposium Planned on Information Networks

"Information Networks" is the subject of the third in a series of annual international symposia which will be held April 12-14, 1954 at the Engineering Societies Bldg., 33 West 39th St., New York, N. Y.

The symposium will deal with network theory, particularly network synthesis as it is influenced by the newer concepts developed in information and general communication theory. In particular, the first part will concentrate upon the performance of networks and their design for specific types of information such as pulses, pulse modulation, statistical inputs, etc. The second part will concentrate upon the generalized network concepts and their application to computer and switching systems, neuron networks and optical systems. American and European authorities will participate.

The cooperation of the IRE Professional Group On Circuit Theory and the cosponsorship of the Office of Naval Research, the Air Force Office of Scientific Research and the Signal Corps permits this symposium to be held without charge.

"Proceedings Of The Symposium On Information Networks" will be published by October 1954, at a cost of Four Dollars ($4.00) per copy. A cloth bound edition will also be available at additional cost. Members of the IRE Professional Group On Circuit Theory may obtain a copy at a saving of One Dollar ($1.00). Orders for the "Proceedings," accompanied by check or money order, made out to Treasurer, Network Symposium, will be accepted in advance.

Copies of the detailed program, hotel accommodation information and registration forms are available on request. All correspondence should be addressed to: Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

Helipot Offers Pocket Slide Rule

A handy pocket-size slide rule is available for the asking from Helipot Corp., 916 Meridian Ave., South Pasadena, Calif. Made of heavy-gauge plastic, with a transparent runner, it carries the most-used A, B, C, D and C1 scales. The slider is also useful as a ruler; one edge is calibrated in sixteenths, the other in millimeters. The reverse of the slide bears Ohm's Law formulae and a Fahrenhite-Centigrade conversion scale.

INDUSTRY NEWS

Jan King joined the West Coast sales organization of Gates Radio Co., Quincy, Ill. He will work the northwestern area of the U.S. and maintain headquarters in San Francisco.

Joseph H. Quick has been elected president of National Co., Inc., Malden and Melrose, Mass. Mr. Quick who

Joseph H. Quick

came to National from the presidency of Harrington & Richardson Arms Co. had been a director and member of the National Company, Inc. executive committee.

W. Walter Jablon has been named sales manager of the home instruments division of the Freed Electronics & Controls Corp., 200 Hudson St., New York 13, N.Y. He will devote his efforts to the promotion and distribution of the company's products.

Larry F. Hardy has been appointed vice-president in charge of product development and **John M. Otter** has been made vice-president in charge of consumer products divisions for Philco Corp., Philadelphia, Pa. Mr. Hardy has been president of the TV and radio division of Philco since 1949. In his new position he will be responsible for the development of all Philco product lines. Mr. Otter has been vice president and general manager of the refrigeration division since early in 1952. He will coordinate the activities of all consumer product divisions including sales, merchandising, and distribution of TV, radio, and major appliances.

Michael F. Callahan, recently named vice-president in charge of all CBS-Hytron plants, headed a list of seven men who were promoted to new positions in the firm. **Edgar K. Wimpy** was made director of engineering, a newly-created post. **Dr. Russell R. Law**, was made director of research and development. **Clifford Hughes** was made plant manager of the Newburyport receiving tube plant. **Elwood W. Schafer** was made manager of color planning. **J. Farley** was made director of quality control. And, **David A. Sokolov** was made supervisor of development of receiving tubes.

INDUSTRY NEWS

(*Continued from page* 199)

Robert A. Seidel was recently appointed vice-president of the sales and service subsidiaries division of Radio Corporation of America. With headquarters in RCA executive offices, Radio City, New York, N.Y., Mr. Siedel is now responsible for RCA Institutes, Inc., RCA Service Co., Inc., and RCA Victor Distributing Corp.

Leslie B. Tollaksen has been appointed manager of technical products by Remler Company Ltd., San Francisco electronics manufacturer. Three years previously, he was with the government and industrial division of the Philco Corp. in Washington, D. C.

Leslie B. Tollaksen

Rudolf Feldt has been made manager of the new instrument division of Federal Telecommunication Laboratories, Nutley, N.J., research unit of International Telephone and Telegraph Corp. The new division will study the commercial possibilities of measuring instruments and testing equipment. Prior to joining the Federal Laboratories, Mr. Feldt served as research engineer at the Allen B. DuMont Laboratories, Clifton, N.J. Since 1947, as manager of their instrument division plant, he was responsible for the development, manufacture, and sale of cathode ray instruments.

David C. McNeely, former sales manager of the Philadelphia Gear Works, Philadelphia, Pa., has been appointed national sales manager of Helipot Corp., Div. of Beckman Instruments, Inc., So. Pasadena, Calif.

E. B. Conley has been appointed vice-president and general manager of the Allied Engineering Div., of Allied International Inc., South Norwalk, Conn. Mr. Conley will be in charge of all manufacturing operations in the plant. Before joining Allied, Mr. Conley was associated for thirty years with Electric Specialty Co., Stamford, Conn.

INDUSTRY NEWS

(*Continued from page* 200)

James B. Tharpe heads the TV transmitter department of the Allen B. DuMont Laboratories, Inc., Clifton, N.J. An operating arm of the new Communication Products Div., the department will be headed by Mr. Tharpe as national sales manager. Assisting him in the new setup will be **Charles E. Spicer**, sales operations manager; **Lewis C. Radford**, Eastern district manager; **Herb Bloomberg**, Central district manager; **Robert J. Myers**, Western district manager, and **Thomas B. Moseley**, Southern district manager. **Fred M. Link**, former president of Link Radio

Fred M. Link

Corp., was recently appointed director of operations of the company's newly-formed Mobile Communications Products Div. and will supervise system design and distribution of Du Mont's two-way mobile radio communications systems.

Charles F. Stromeyer, former executive vice-president of CBS-Hytron Columbia Broadcasting System, Inc., tube manufacturing division, Danvers, Mass., has been named president to succeed **Bruce A. Coffin** who has retired as president but will retain his membership on the CBS, Inc. board, as will **Lloyd H. Coffin** whose retirement as treasurer of CBS-Hytron was announced simultaneously. **Dr. Peter C. Goldmark**, who joined CBC in 1936, has been made president of CBS Laboratories, Engineering Research and Development division of CBS, Inc. He has been vice-president of the division since 1950.

Robert G. Bach, formerly in charge of TV sale and advertising for Federal Telecommunication Laboratories, has been appointed assistant sales and advertising manager of Fairchild Recording Equipment Co., Whitestone, Long Island, N.Y. He served as administrative assistant to the director of the Columbia Radiation Laboratory from 1946 to 1950.

TELE-TECH ADVERTISERS — MARCH, 1954

INDUSTRY NEWS

(*Continued from page 202*)

John Jipp, former West Coast parts and service depot manager and Southwestern regional sales manager for Motorola, Inc., has joined Ampex Corp., Redwood City, Calif., as manager for instrumentation recorder sales.

D. W. Gunn has been appointed general sales manager of electronic products, Sylvania Electric Products Inc., New York, N. Y. He will be responsible for the sales of the products of the radio tube, TV picture tube, and electronics division. Mr. Gunn has been a member of the Sylvania organization since 1931.

Willis Linn has been appointed to the newly created position of West Coast electronics sales engineer for the Electrical Products Div. of Corning Glass

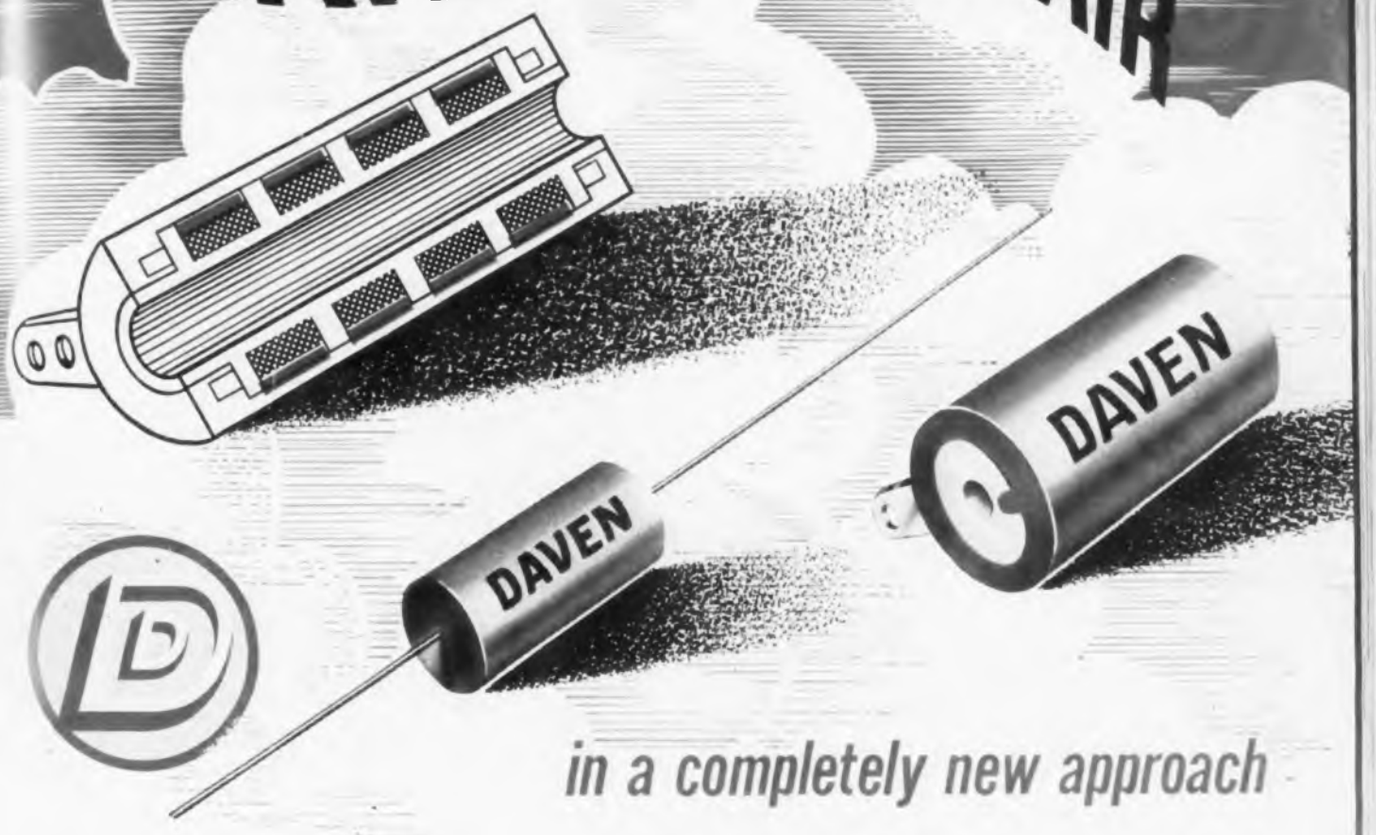
Willis Linn

Works. In his new position, Mr. Linn will maintain headquarters in Corning, N. Y., but will cover 11 states along the West Coast and in the Rocky Mountain area.

Jay M. Allen, works manager of the Sunbury, Pa., TV-Radio plant, has been appointed assistant manager of operations for the Westinghouse TV-Radio Division headquarters at Metuchen, N.J. Mr. Allen will supervise manufacturing operations at the Sunbury and the local Headquarters plants.

Lynn Eaton has been made vice-president of National Company, Inc., Malden and Melrose, Mass. He will supervise both foreign and domestic sales activities, advertising, promotion, and market surveys. **C. G. Barker,** one of the founders of Magnecord, Inc., and former vice-president in charge of sales and president of Magnecord International, Ltd. and Magnecord Western Hemisphere, has been named distribution manager of National Company Inc. where he will direct the company's representatives and establish basic distribution policies.

DAVEN TURNS TO AIR



in a completely new approach

to the production of Encapsulated Seald-Ohm Wire Wound Resistors

Only DAVEN **turns to air to keep the molding material absolutely separated from the resistance wire in its new line of Super Davohm Encapsulated Seald-Ohm Resistors. The wire is maintained in a slot filled with dry air . . . no external pressures are applied to it. These air pockets, between the wire and the plastic coating, guarantee absolute stability . . . eliminate shorted turns.**

Only DAVEN **matches the temperature coefficient of expansion of the molding compound with the ceramic bobbin, the resistance wire and the metal terminals. This removes the possibility of cracks or strains on the wire during cycling.**

Because of the special construction used, Daven can furnish Encapsulated Wire Wound Resistors with temperature coefficients below ±20 P.PM/°C. when required, and with accuracies to ±.05%.

These exclusive Daven precision, wire wound resistors are completely hermetically sealed . . . yet are no larger than standard lug-type resistors.

In addition, these units are made in accordance with MIL-R-93A specifications, and are substantially more rugged than conventional resistors. They will withstand the JAN-R-93, characteristic A, salt-water immersion test, and, in addition, temperature cycling from −65°C. to +125°C. The strong molding material will resist pressures equivalent to 75,000 ft. altitude, and will not cold flow at temperatures up to 150°C.

Write for latest Resistor Brochure

THE DAVEN CO. 179 Central Ave. Newark 4, N. J.

Visit us at the I.R.E. Show—Booths 543 & 545

WORLD'S LARGEST MANUFACTURERS OF ATTENUATORS

READY ... for COLOR TV!

RCA technical leadership in compatible electronic color television is the product of a decade of intensive research, and unequalled engineering and manufacturing experience. Today, RCA's mass-production facilities are turning out tricolor picture tubes, receiving tubes, and deflection components to meet the growing needs of industry.

Now, RCA-15GP22 tricolor kinescopes are coming off the production lines . . .

Now, to supplement its other receiving tubes applicable to color television, RCA has developed three brand-new types *specifically for color circuits*: RCA-6AN8, RCA-3A3, and RCA-6BD4. With these additions, RCA offers a complete tube complement for color TV . . .

Now, RCA is producing the basic components for the high-voltage supply and deflection circuits of the RCA tricolor tube. Each is specially designed to provide optimum performance.

If you are getting into color circuitry, take advantage of RCA's integrated line of units—engineered specifically for color television. For information, write RCA, Commercial Engineering, Section C50Q, or contact your nearest RCA Field Office.

(EAST) HUmboldt 5-3900
415 South Fifth St.,
Harrison, N. J.

(CENTRAL) WHitehall 4-2900
589 E. Illinois St.
Chicago 11, Ill.

(WEST) MAdison 9-3671
420 S. San Pedro St.,
Los Angeles 13, Cal.

IRE SHOW
Be sure to see RCA's newest contributions to color TV at the IRE Show in New York City
VISIT BOOTHS 151-153.

RCA-15GP22 Tricolor Kinescope
Heart of Compatible Color TV

NEW TUBES FOR COLOR TV

RCA-6BD4 Sharp-Cutoff Beam Triode

RCA-6AN8
Medium-Mu Triode
Sharp-Cutoff Pentode

RCA-6AU4-GT
Damper Diode

RCA-3A3 Half-Wave
Vacuum Rectifier

RCA-6BY6
Pentagrid Amplifier

NEW COMPONENTS FOR COLOR TV

RCA-241T1 Vertical
Dynamic-Converging
and Dynamic
Focusing Transformer

RCA-240T1
Horizontal-Output
and High Voltage
Transformer

RCA-224D1
Purifying Coil

RCA-223D1
Deflecting Yoke

RCA-219R1 Vertical
Isolation Inductor

RCA-242T1 Horizontal
Dynamic-Converging
and Dynamic
Focusing Transformer

RCA-243T1
Vertical-Deflection
Output Transform

RADIO CORPORATION of AMERICA
TUBE DEPARTMENT **HARRISON, N. J.**