ELECTRONIC INDUSTRIES

August • 1946

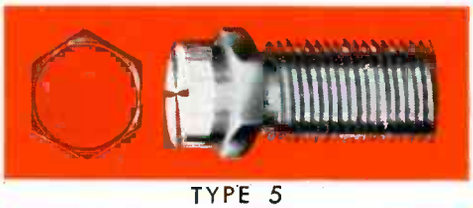
IN THIS ISSUE:

CALDWELL-CLEMENTS, INC.

TYPE 2 TYPE 1

TYPE 3 TYPE 8R

TYPE 4



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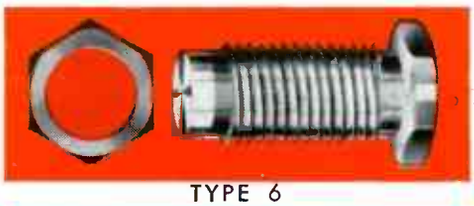

TYPE 6

TYPE 7

8 *Basic* MALLORY CONTACTS *Simplify* Product Designing

THE manufacture of electrical contacts, of course, can never be completely standardized. But contact selection can be greatly simplified for the vast majority of applications.

As the largest producer of electrical contacts in America, Mallory has created more than 5,000 contact designs in the last 25 years. From this experience, it has come to learn that the eight basic types, shown above, are the ones most commonly needed—the contacts that solve nine problems out of ten.

Mallory offers you a wide variety of these eight basic types. You can get them without delay—without the expense of *special tooling*. And you can order by catalog number.

How do you select the right Preferred Type Contact? Simply by consulting the Mallory Contact Catalog, copy of which is yours for the asking. For special problems requiring unusual mechanical and electrical characteristics, consult our engineers any time.

Send for your copy TODAY

In addition to the Mallory Contact Catalog (see right) Mallory also offers the Mallory Contact Data Book, a complete and authoritative text on contact fundamentals, designs, materials and applications. Sent free to engineers who write for it on company letterheads. $2.50, postage paid, to others.

P.R. MALLORY & CO. Inc.

MALLORY ELECTRICAL CONTACTS & CONTACT ASSEMBLIES

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

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

★ IN THIS ISSUE AUGUST, 1946 ★

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CALDWELL-CLEMENTS, INC. — TEL. PLAZA 3-1340 — 480 LEXINGTON AVENUE, NEW YORK 17, N. Y.

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....PUNCTURE-PROOF, FOR LONG, UNIFORM PERFORMANCE.

"Fail-proof" is a reasonable and honest description of the Lapp Gas-filled Condenser. It has no fixed or solid dielectric to deteriorate or puncture, and should out-last any electronic circuit of which it is a part. Also, it offers correspondingly lower loss and economy of power. Not needing to "warm up," it provides constant capacitance under temperature variation. Variable, adjustable, and fixed capacitance units are available. Fixed condensers have been made with capacitance up to 60,000 mmf., variable and adjustable units up to 16,000 mmf. Current ratings range up to 500 amperes R. M. S., and voltage ratings up to 60 Kv peak. *Above, Unit No. 25,934, rated at 200 amperes, 6500 volts, capacitance continuously variable from 4300 mmf. to 1100 mmf.* Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp INSULATOR CO., INC.
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many a tough spring engineering problem has been solved by Accurate engineers...

what's yours?

Manufacturers of hundreds of different things have brought their spring design problems to Accurate engineers. And, Accurate engineers have been able to design springs that were exactly right for the jobs. Often, their suggestions have improved product performance, reduced spring costs and even speeded up assembly time. Could you use practical help on your spring engineering problems? Would you benefit by the services of a specialized engineering department . . . one with millions of springs of experience? Ask an Accurate representative to call.

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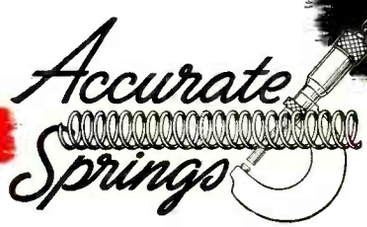
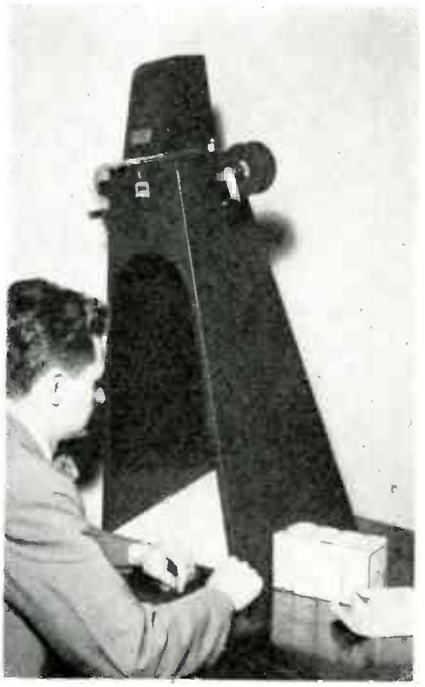


Springs *Wire Forms • Stampings*

"Electronic Industries" On Microfilm

The complete file of technical articles which appear in **Electronic Industries**, from the first issue (Vol. I, November, 1942) through Vol. IV, December, 1945, is now available on 35-mm. microfilm. This



Sixty pounds of back issues of Electronic Industries are now available on microfilm weighing less than a pound. Picture shows a microfilm "reader" instrument priced at $56.50

file of several hundred engineering articles from the thirty-eight issues is contained in two 100-foot rolls of the film which may be projected for reading with any standard microfilm "reader" such as the Eastman Recordak.

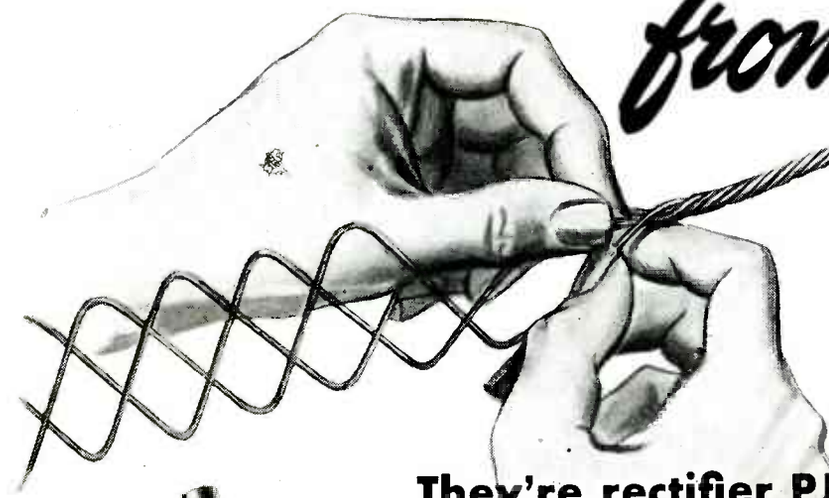
This microfilm file of **Electronic Industries** is among the first to be produced by the Electronics Research Publishing Company, 2 West 42nd Street, New York 19, N. Y., as part of a project to make the complete technical literature of electronic engineering available to laboratory libraries. To be known as the "Electronic Engineering Microfilm Library", this microfilm unit as planned will consist of some 8,000 articles from leading electronic periodicals as indexed in the same firm's recent publication "The Electronic Engineering Master Index".

The convenience and space-saving features of microfilm are of course well-known. In this connection, it is interesting to observe that the 38 issues of **Electronic Industries**, weighing 60 lb. and occupying more than three feet of shelf, is reduced in the two rolls of microfilm to less

(*Continued on page* 136)

HANDS THAT WEAVE D-C POWER

from A-C



They're rectifier PHANOTRONS—tubes your factory uses liberally. G. E. is your fastest, most dependable source of supply!

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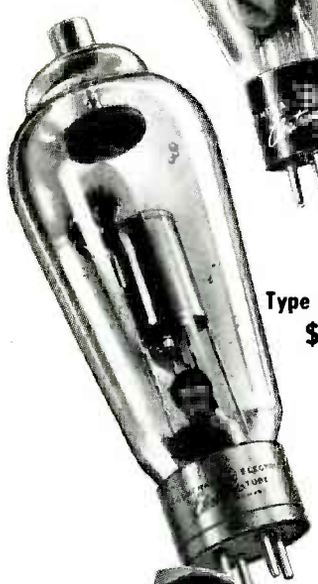
$11



Type FG-104
$30

RATINGS

CONSTANT-TORQUE, variable-speed motors driving your plant equipment need d-c power supply. Likewise your battery-chargers, capacitor-discharge welders, and much other electrical apparatus. Phanotron tubes take the a-c power from your feed-wires and convert it into d-c. They do this smoothly, quietly, without mechanical upkeep.

● When one or more of these rectifier tubes need replacement, you can't afford to wait! Delay means stalled machines, idle man-hours, COST! . . . Because a G-E distributor or dealer has them *right in your area,* General Electric gets phanotrons to you quickly. A phone-call will bring tubes by prompt local delivery.

● Once installed, G-E phanotrons perform better because they're better-built! They're more reliable, because tested at every stage! A sound investment, because they're designed for hard duty and lots of it! G.E.'s ironclad warranty is a further assurance you will get your money's worth in full-time, full-capacity service.

● Two popular G-E phanotrons with medium ratings are shown here. There are nine types in all, with peak voltages ranging from 175 to 22,000 v, and peak currents from 1 to 75 amp. Make your nearby G-E distributor or dealer your source for these service-proved tubes—and for any facts about them, or performance data, your maintenance staff may require! *Electronics Department, General Electric Company, Schenectady 5, New York.*

DISTRIBUTORS AND DEALERS EVERYWHERE, BACKED UP BY ADDITIONAL TUBE STOCKS IN CENTRALLY LOCATED CITIES FROM COAST TO COAST.

	CATHODE		ANODE		
Type	Volts	Amp	Peak volts	Peak amp	Avg amp
FG-32	5	4.5	1,000	15	2.5
FG-104	5	10	3,000	40	6.4

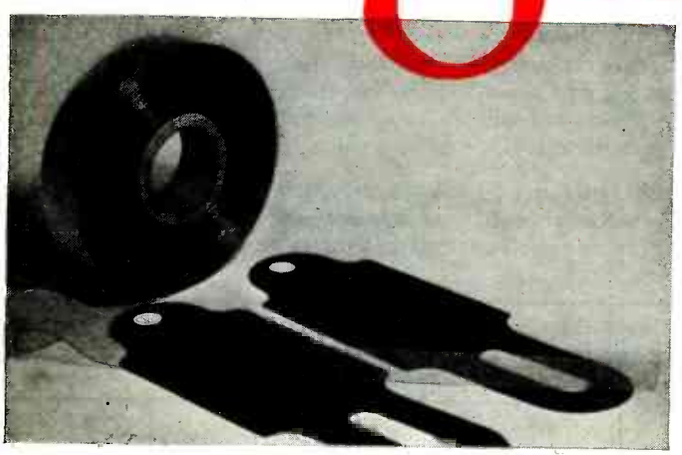
GENERAL ELECTRIC

162-E15-8850

FIRST AND GREATEST NAME IN ELECTRONICS

The New Way to *Insulate and Protect* harnesses and leads

WRAP WITH *Fibron* PLASTIC TAPE



Transparent Fibron Plastic Tape permits ready inspection.
Plastic gaskets also available.

IRVINGTON
Varnish and Insulator Company
Irvington 11, New Jersey, U.S.A.

Whenever equipment wiring must withstand severe operating conditions, attacks from moisture, oils, and chemical fumes as well as mechanical abuse, wrap harnesses and leads with protective Fibron Plastic Tape. This black or transparent tape is tough, remains flexible at low temperatures, and has good insulating properties.

Extremely elastic, Fibron Plastic Tape wraps smoothly and evenly over irregular surfaces and will not bulk in sharp corners.

Can be Fused into Homogeneous Structure

Ends can be instantly bonded by heat sealing, or the completely wrapped harnesses infra-red or oven baked to form a solid mass of insulation.

Note the outstanding characteristics of Fibron Plastic Tapes as listed below. Plan to test these products now. Generous samples will be gladly sent on request.

Outstanding Properties of Fibron Plastic Tapes

	#1 Black	#3 Transparent
Thicknesses	.008" .012" .020"	.020"
Widths	½" to 3"	½" to 3"
Dielectric Strength (.012" tape)	1000 VPM	750 VPM
Tensile Strength, lb. per sq. in. (dumbell specimen tested)	1600	1600
Elongation	250% to 400%	350%
Brittleness Temperature	−41 deg. C.	−38 deg. C.
Bonding Temperature (depending on method used)	130°-150°C.	135°-155°C.
Specific Gravity	1.25	1.22

The Rauland VISITRON R-6025

The Rauland Visitron R-6025 is a 10-inch, virtually flat face, direct-viewing Cathode Ray Tube especially suitable to television. The electromagnetically focusing and deflection method employed allows the screen to be excited by a relatively high beam current, insuring good contrast with excellent focus.

Virtually Flat Face

Direct-Viewing

Specifications of the Rauland Visitron R-6025	
Heater Voltage	6.3 A. C. or D. C.
Heater Current	0.6 amp.
Focusing Method	Electromagnetic
Deflection	Electromagnetic
Deflection Angle	50 degrees
Screen	Phosphor P4
Bulb Diameter (Max.)	10⅜" at screen end
Length (Max.)	17⅜" ± ⅜"
Base	Small Shell Duodecal 7 Pin
Anode Volts (Max.)	11,000
Anode Volts (Operating)	8,000

RADIO · RADAR · SOUND

Rauland

COMMUNICATIONS · TELEVISION

Electroneering is our business

THE RAULAND CORPORATION • CHICAGO 41, ILLINOIS

NEW!! WESTON Mutual Conductance Tubechecker and Circuit Analyzer

MODEL 798—TYPE 3

Outstanding Features

- ✓ Direct-reading mutual conductance tests, and "Good-Bad" indications.
- ✓ New patented high frequency tube testing circuit.
- ✓ AC-DC volt-ohm-milliampere ranges.
- ✓ Tests 4, 5, 6, 7 prong octal, loctal, miniature, and acorn tubes...spare octal and miniature sockets.
- ✓ Hot neon leakage test between any two tube elements . . . neon short check.
- ✓ Adjustable plate, screen, grid bias, and signal voltages.
- ✓ Flexibility in switching simplifies testing present and future tubes.
- ✓ Durable heavy-gauge, light-weight alumium case.

Model 798 combines broad utility, ruggedness, and dependable accuracy for maintenance of sound and electronic equipment. Detailed bulletin available. Weston Electrical Instrument Corporation, 666 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston Instruments

ALBANY • ATLANTA • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN • MINNEAPOLIS • NEWARK
NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST LOUIS • SYRACUSE • IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

THE LOGICAL CHOICE...

Eimac 4-250A Tetrode

ELECTRICAL CHARACTERISTICS—EIMAC 4-250A

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amps
Plate Dissipation (Maximum)	250 watts
Direct Interelectrode Capacitances: (Average)	
Grid-Plate (Without shielding, base grounded)	0.12 *uufd*
Input	12.7 *uufd*
Output	4.5 *uufd*

Proven performance is the reason why the EIMAC 4-250A tetrode is the logical choice when a dependable power-amplifier tube is needed. Below are listed characteristics and design features of the EIMAC 4-250A which explain why this tetrode is *picked for power.*

HIGH POWER—LOW DRIVE:

At frequencies up to 70 Mc. the EIMAC 4-250A develops a power output of 750 watts with a drive of less than 6 watts.

LOW PLATE—GRID CAPACITANCE:

Extremely low plate to grid capacitance, only 0.12 *uu*fd, permits operating without neutralization in many cases—simplifies neutralization in others.

OPERATIONAL STABILITY:

The unique arrangement of low inductance leads, plus especially treated grids insures exceptionally stable operation.

COMPACT—RUGGED:

Approximately 3½ x 6½ inches in size, the 4-250A has been constructed to withstand abnormal abuse —and give extra long life.

The 4-250A is just one of a host of EIMAC tubes designed for long-life and trouble-free operation. Investigate the possibilities of their use in your transmitters today. Contact your nearest EIMAC representative, or write direct for full technical information.

EITEL-McCULLOUGH, INC., 1265H San Mateo Ave., San Bruno, Calif.
Export Agents: Frazar and Hansen, 301 Clay St., San Francisco 11, Calif., U.S.A.

CALL IN AN EIMAC REPRESENTATIVE FOR INFORMATION

ROYAL J. HIGGINS (W9AIO), 600 So. Michigan Ave., Room 818, Chicago 5, Ill., Phone: Harrison 5948.

VERNER O. JENSEN, Verner O. Jensen Company, 2616 Second Ave., Seattle 1, Wash., Phone: Elliott 6871.

M. B. PATTERSON (W5CI), Patterson & Co., 1124 Irwin-Keasler Bldg., Dallas 1, Tex., Phone: Central 5764.

ADOLPH SCHWARTZ (W2CN), 220 Broadway, Room 2210, New York 7, N. Y., Phone: Cortland 7-0011.

HERB BECKER (W6QD), 1406 So. Grand Avenue, Los Angeles 15, California, Telephone: Richmond 6191.

TIM COAKLEY (W1KKP), 11 Beacon Street, Boston 8, Massachusetts, Telephone: Capitol 0050.

RONALD G. BOWEN, 1886 South Humboldt Street, Denver 10, Colorado, Telephone: Spruce 9368.

JAMES MILLAR ASSOCIATES, J. E. Joyner, Jr. (W4TO) 1000 Peachtree Street, N.E., Atlanta, Georgia.

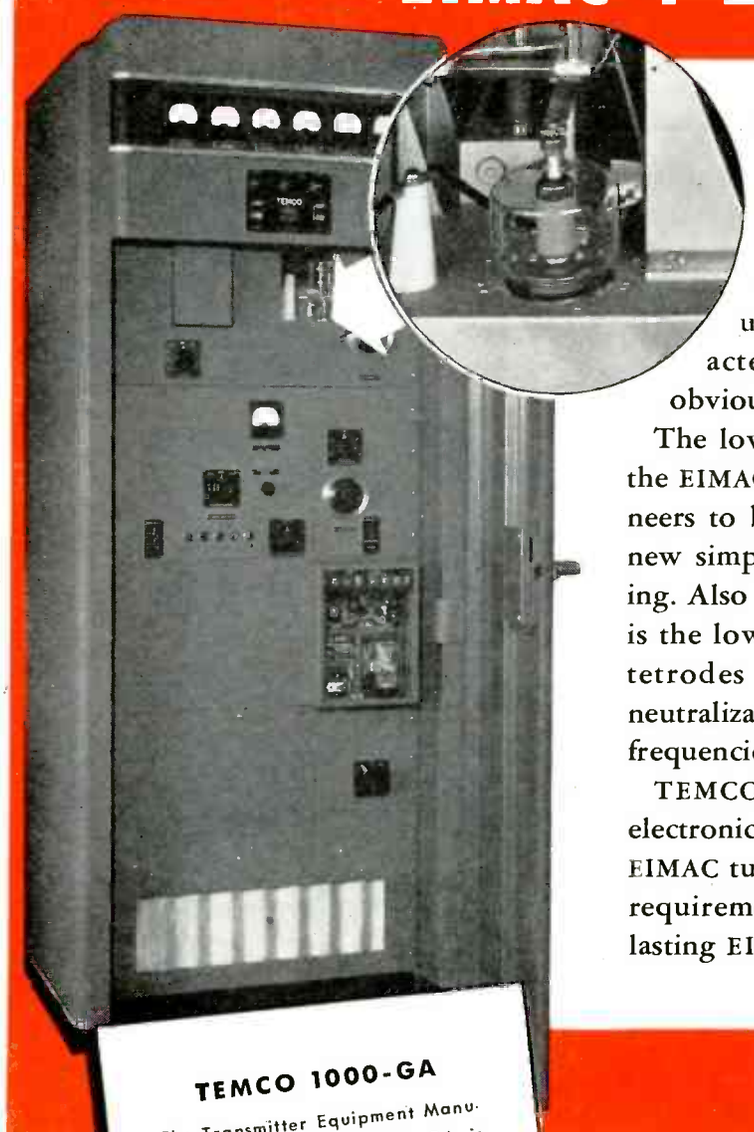
Follow the Leaders to

Eimac REG. U.S. PAT. OFF. TUBES

THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT

For Performance and Dependability

Another endorsement of
EIMAC 4-250A TETRODES



In the power amplifier of the 1000-GA transmitter, TEMCO employs two EIMAC 4-250A tetrodes to obtain a kilowatt input on CW and high level modulated radio telephone. The characteristics of this tube make it the obvious choice for this assignment.

The low driving power requirements of the EIMAC 4-250A permitted TEMCO engineers to build an exciter stage combining new simplicity with greater ease in servicing. Also contributing to circuit simplicity is the low plate-grid capacitance of these tetrodes (0.12 *uu*fd) which means that neutralization is ordinarily unnecessary at frequencies up to 40 Mc.

TEMCO is one of a number of large electronic equipment manufacturers using EIMAC tubes. No matter what your power requirement, there's a dependable, long-lasting EIMAC tube for the job.

TEMCO 1000-GA

The Transmitter Equipment Manufacturing Company's 1000-GA is a radio telephone and telegraph manually-controlled transmitter for operation on 5 frequency bands. It is rated at 1. KW input for phone and CW, on 5 crystal-controlled frequencies from 3.5 to 29.7 megacycles.

Follow the Leaders to

Eimac REG. U. S. PAT. OFF. TUBES

EITEL-McCULLOUGH, INC., 1265H San Mateo Ave., San Bruno, Calif.
Export Agents: Frazar and Hansen, 301 Clay St., San Francisco 11, Calif., U. S. A

Good News!...

INTER-OFFICE MEMO

To: Harry A. Ehle, Vice-pres., Sales

Date: 4/20/46

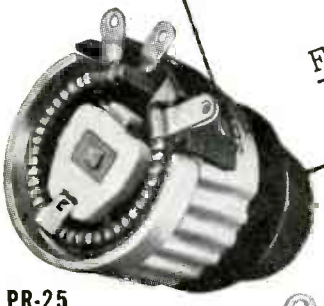
Production capacity on all types and ranges of All-Metal Rheostats has now been increased to provide additional production for scheduling during last week of May and following months, as per your request of 2/20/46.

From: O. J. Greenway, Works Manager

IRC

All Metal RHEOSTATS

. . . Increased Quantities Now Available on Short Delivery Cycle!



PR-25

PR-50

PRT (AN3155)

TYPE PR-25—25-watt rating. Temperature rise, 140°C. Standard resistance values, 1 ohm to 5,000 ohms. Diameter, 1 21/32". Depth behind panel, 3 1/32".

TYPE PR-50—50-watt rating. Temperature rise, 170°C. Standard resistance values, 0.5 ohm to 10,000 ohms. Diameter, 2 23/32". Depth behind panel, 1 3/8".

TYPE PRT-25—(AN3155-25). 25-watt rating. Fulfills AN3155 specifications. Totally enclosed. Heat-radiating black finish. Rear terminals. Standard values, 10 ohms to 200 ohms. To 5,000 ohms on special order. Temp. rise, 140°C.

TYPE PRT-50—(AN3155-50). 50-watt rating. Same construction as PRT-25, to AN3155 specifications. Standard values, 5 ohms to 200 ohms. To 10,000 ohms on special order. Temp. rise, 170°C.

All IRC Rheostats operate at about half the temperature rise of equivalent units and can be operated at full load on as little as 25% of the winding, with only a slight increase in temperature rise.

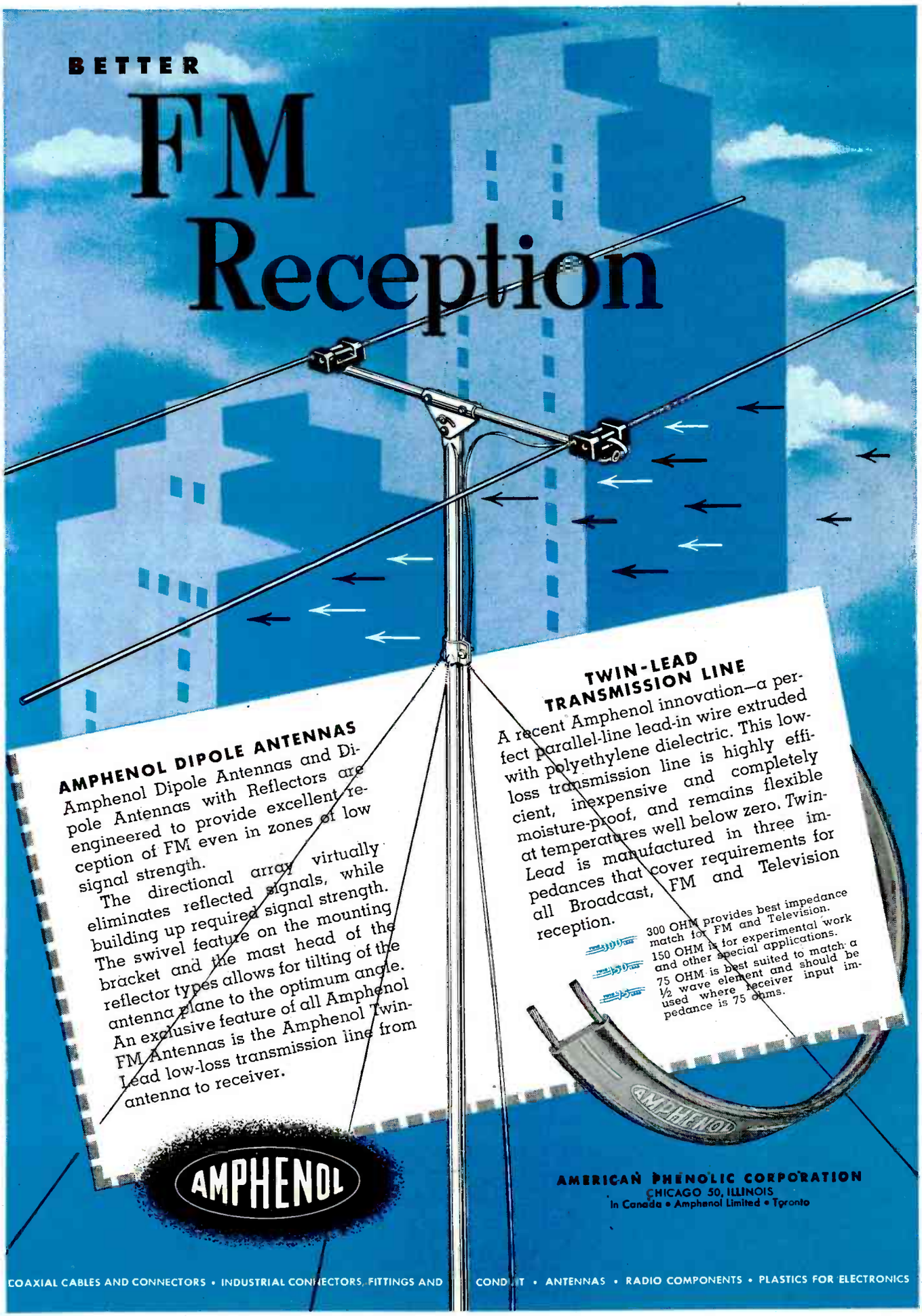
CONTACT YOUR IRC REPRESENTATIVE FOR COMPLETE DETAILS

PREFERRED FOR PERFORMANCE • IRC • FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

401 N. BROAD ST., PHILADELPHIA 8, PA.

Canadian Licensee: International Resistance Co., Ltd., Toronto


BETTER
FM
Reception
AMPHENOL DIPOLE ANTENNAS
Amphenol Dipole Antennas and Dipole Antennas with Reflectors are engineered to provide excellent reception of FM even in zones of low signal strength.
The directional array virtually eliminates reflected signals, while building up required signal strength. The swivel feature on the mounting bracket and the mast head of the reflector types allows for tilting of the antenna plane to the optimum angle. An exclusive feature of all Amphenol FM Antennas is the Amphenol Twin-Lead low-loss transmission line from antenna to receiver.
TWIN-LEAD TRANSMISSION LINE
A recent Amphenol innovation—a perfect parallel-line lead-in wire extruded with polyethylene dielectric. This low-loss transmission line is highly efficient, inexpensive and completely moisture-proof, and remains flexible at temperatures well below zero. Twin-Lead is manufactured in three impedances that cover requirements for all Broadcast, FM and Television reception.
300 OHM provides best impedance match for FM and Television.
150 OHM is for experimental work and other special applications.
75 OHM is best suited to match a ½ wave element and should be used where receiver input impedance is 75 ohms.
AMPHENOL
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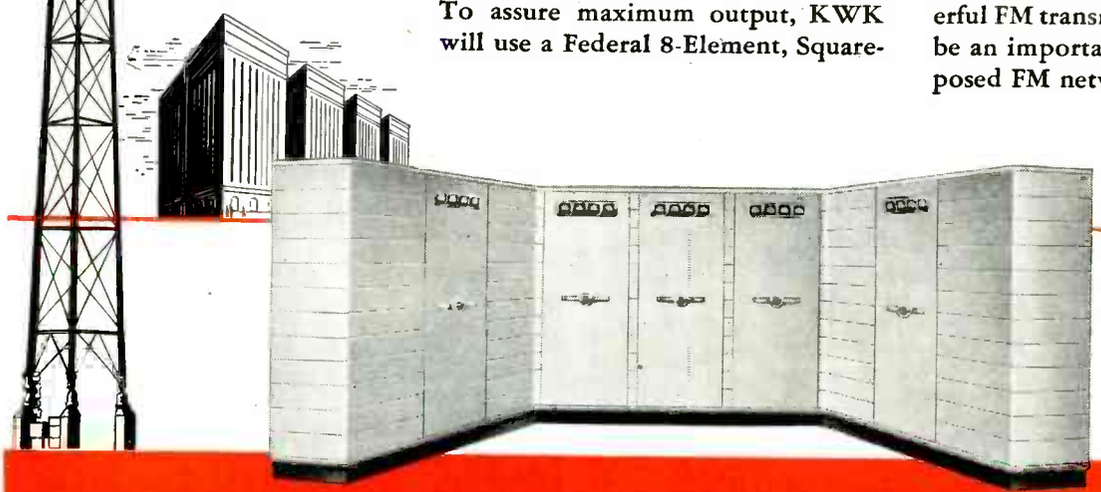
FIRST TWO FM STATIONS

Robert T. Convey, President of Station KWK, signing the contract for the 50-kw FM transmitter. L. to R.: Ray E. Dady, Station Director; V. E. Carmichael, Commercial Manager; Mr. Convey; Nick. J. Zehr, Chief Engineer; William Albright, Federal Representative.

50 KW KWK AND go on with FM by

RADIO LISTENERS in the St. Louis area will get a new thrill from finer, high-fidelity, interference-free broadcasting when Station KWK goes on the air this summer with FM—powered by Federal's new 50-kilowatt transmitter. To assure maximum output, KWK will use a Federal 8-Element, Square-Loop antenna with a power gain of 9, so that the 50-kw transmitter will actually deliver an effective radiated power of 450 kw.

As this station is a member of the Mutual Broadcasting System, its powerful FM transmitter will undoubtedly be an important link in Mutual's proposed FM network.



Both transmitters incorporate Federal's exclusive "Frequematic"* modulator, assuring outstanding fidelity and mean-carrier stability. As with all of its

8-Element Square-Loop Antenna will be able to deliver effective radiated power of approximately 450 kw.

Federal Telephone

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal
Export Distributor: International Standard Electric Corporation

IN THE ST. LOUIS AREA!

WEW 10 KW

the air FEDERAL

Nicholas Pagliara, General Manager of Station WEW, signs for Federal's complete 10-kw FM station. Left—W. E. Albright, Federal Representative. Right—N. E. Wunderlich, Executive Sales Director, Federal Telephone and Radio Corporation.

STATION WEW of the University of St. Louis—second oldest radio broadcasting station in the United States—has contracted with Federal for a 10-kilowatt FM transmitting station, completely Federal engineered and equipped from microphone to antenna. With the new 8-Element, Square-Loop antenna, WEW will actually have an effective radiated power of 90 kw.—providing more power and greater listening pleasure for the University's vitally important educational, religious and commercial programs. Space will be left above the FM antenna array for future 485-600 Mc color television antenna.

FM equipment, Federal is making available to KWK and WEW, the services of factory-trained engineers to supervise the installation, make the initial "tune-up," and see the stations successfully on the air. Write for general and technical data.

*TRADE MARK

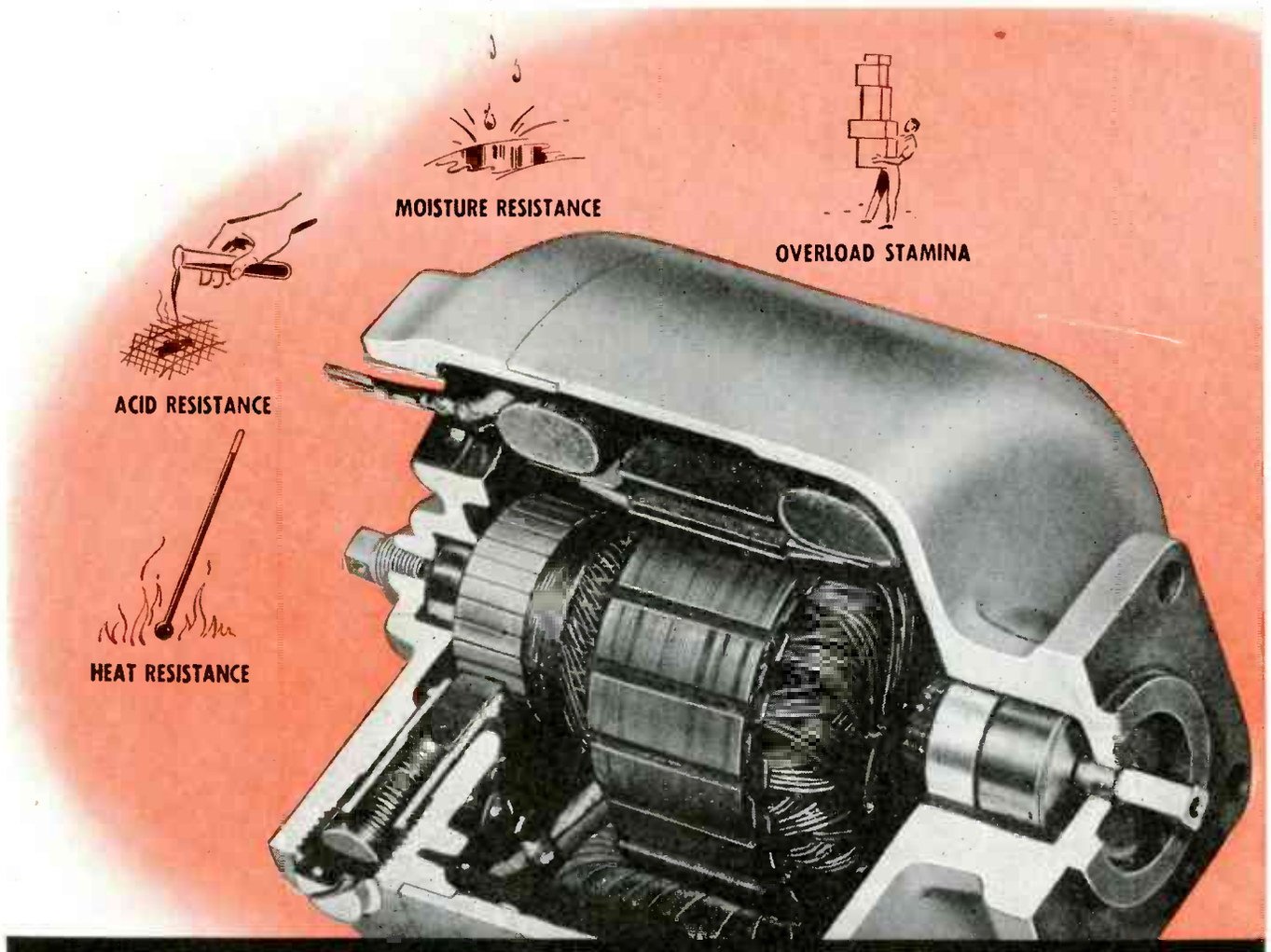
and Radio Corporation

Newark 1, New Jersey

AN IT&T ASSOCIATE

FEDERAL TELEPHONE & RADIO FTR

8-Element, Square-Loop Antenna will be able to deliver effective radiated power of approximately 90 kw.



How much is "*High-Safety-Factor*" insulation worth to you?

It's worth plenty, if efficient, dependable operation of electrical equipment is important to your business—if moisture, oil, heat, overload, corrosive acids and vapors and human carelessness or inexperience represent hazards that can throw expensive machinery out of service or cause costly delays.

Fortunately, the cost of added protection against the penalties frequently imposed by these conditions is slight—far less than the penalty imposed by failures that can be avoided. For the advantages of High-Safety-Factor Insulation can be added at only a small fraction of the cost of the equipment.

That's why the swing is to Fiberglas Electrical Insulation Materials —why so many engineers, production executives and maintenance men are insisting on Fiberglas Insulation for the equipment they buy and for their maintenance work.

Get complete information about this better electrical insulation material—write for your copy of the folder "Are your motors a good insurance risk?" The names of the Distributors serving your locality will also be furnished, if you desire. Owens-Corning Fiberglas Corporation, Department 867, Toledo 1, Ohio. Branches in principal cities.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario

OWENS-CORNING

FIBERGLAS

T.M. REG. U.S. PAT. OFF.

Fiberglas is the trade name for these electrical insulation materials and many other products made from fine, strong, pliable, moisture and heat-resistant, ageless glass fibers.

ELECTRONICS

Designers

NEW PYRANOL* CAPACITORS

new sizes, new quality

Strict quality control, new manufacturing techniques, and improved materials — the basis of the excellent war-time records of G-E d-c capacitors — are now incorporated in a new line of Pyranol capacitors designed to meet rigorous commercial requirements.

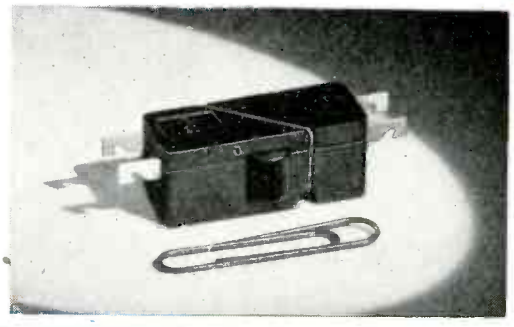
This new line makes possible a broad selection of sizes, ratings and mounting arrangements, with characteristics which permit operation over a wide temperature range (from 85C to —55C), at altitudes up to 7,500 feet. Sizes and shapes range from "bathtub" and small rectangular case styles to large, welded steel-case designs. Capacitance ratings are offered from .01 muf to 100 muf, and voltage ratings from 100 to 100,000 volts. Write *Transformer Division, General Electric Co., Pittsfield, Mass.*

MORE COMPACT COILS

wound faster

Formex* magnet wire, available in all standard wire sizes, puts more turns and more copper in a given coil cross-section area than fibrous-covered wire does, particularly if square or rectangular Formex wire is used. It's a natural where coil shapes require acute angle bends. Higher winding speeds are practical without increasing rejects; time-saving steps are possible that you wouldn't dare use with ordinary magnet wire. In most sizes, first cost of Formex is less than fibrous-covered wire, and only slightly greater than enameled. Check Bulletin GEA-3911.

*Reg. U.S. Pat. Off.



SWITCHETTES *do big jobs in cramped quarters*

G-E manually-operated Switchettes are outstanding for the long life and lightning-fast snap action packed into an unusually small, lightweight case. The Size 1 Switchette weighs only 9 grams, and is approximately 1¼ in. by ½ in. by ½ in. Size 1 Switchettes are available in ratings up to 10 amperes at 24 volts d-c, or 230 volts a-c, and in ten different contact arrangements. Size 2 Switchettes are rated 25 amperes at 24 volts d-c, (230 volts a-c), and are available in three contact arrangements: single circuit, normally open; single circuit, normally closed; and two circuit. Totally enclosed, with screw terminals, size 2 Switchettes measure about 2 by 1⅜ by 1 inch, and weigh approximately 2 ounces. Write for Bulletin GEA-3818C (Size 1) or GEA-4259 (Size 2).

A VERSATILE SWITCH

with 4,000 possibilities

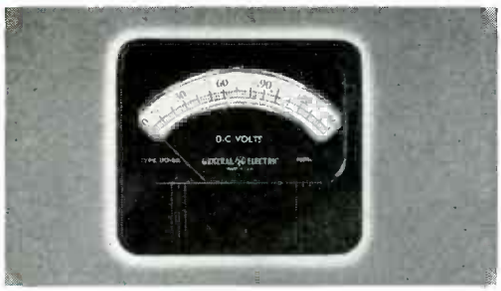
There's a *standard* SB-1 switch for most of the ordinary control and transfer jobs. Where the number or arrangement of circuits is unusual, special switches can be made from standard SB-1 cams, contacts, fingers, and other parts, giving great flexibility of application. Precision-built parts make even a 40-stage tandem switch easy to operate.

Already more than 4,000 different arrangements of circuits and sequences have been made by varying contacts and cam arrangements. Others can be made to meet your specifications. Write for Bulletin GEA-1631E.

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS



SMALL DC METERS

that are lighted two ways

General Electric Type DO-58 d-c meters are 4 by 4½ inches. Voltmeters are available registering from 0 to 1 volt, to 0 to 750 volts in self-contained models, and up to 30 kv with external resistors. Accuracy is to within 2 per cent of full scale value. The d-c ammeters, milliammeters and microammeters cover a range from 0 to 50 amperes, to 0 to 50 microamperes. Cased in black Textolite with a deep cover, these meters are offered in front-illuminated and rear-illuminated types, with lance-type, pointer-tip standard, and knife-edge and pear-shaped tips optional. These flush-mounted instruments are also available in alternating-current, a-c rectifier and r-f types. Write for Bulletin GEA-4272.

INDUSTRIAL RELAY *does a lot of jobs*

This sturdy, compact industrial voltage relay has a lot of uses, such as controlling pilot circuits in response to remote control switches or thermostats, or for direct control of small motors driving cooling blowers. It may be used as a fractional-horsepower motor starter, or in conjunction with magnetic switches controlling larger apparatus. Rated 10 amperes, continuous, with make-or-break rating of 45 amperes on normally open poles, 20 amperes on normally closed poles, at either 110 v or 220 v a-c. Three contact arrangements — double-pole, double-throw; double-pole, single-throw; and single-pole, single-throw — are available in either open or enclosed models. Write for Bulletin GEA-4668.

SPLIT-CYCLE CONTROL

of heavy currents

Thyratron Type FG-95 tubes are designed for rapid control applications where available grid power is very small, where it is necessary to actuate the grid from a high-impedance source, and where tube temperature can be maintained at a relatively constant level. This tube's negative grid characteristics mean lower overall power requirements for heavy-duty control work. Peak voltage, 1000 v, peak current 15 amp, average current 2.5 amp. Surge current (for design only) 200 amp for 0.1 second.

Among the applications of Thyratron tubes are resistance welding control, motor control, lighting control, rectification, and power supply for photoelectric relays. Write for Bulletin ETI-125. (For general data on Thyratrons, ask for ETI-116). *General Electric Co., Electronics Division, Syracuse, N.Y.*

DURABLE NAMEPLATES

with beauty built-in

General Electric laminated plastic nameplates are tough, durable, and resistant to impact. They are available stamped, engraved, or printed, in a variety of color combinations. Their appearance is exceptional — both satin and mirror finishes are offered with surfaces that need neither buffing nor polishing. The hard, smooth surfaces of G-E plastic nameplates are easily cleaned. They do an outstanding job for a wide range of diversified applications. For further information, write *General Electric Co., Plastics Division, Pittsfield, Mass.*

GENERAL ELECTRIC COMPANY, Sec. 642-12
Apparatus Department, Schenectady 5, N. Y.

Please send me

.....GEA-1631E (SB-1 Switches)	.....GEA-3818C (Switchettes—Size 1)
.....GEA-3911 (Formex)	.....GEA-4259 (Switchettes—Size 2)
.....GEA-4272 (Small D-C Meters)	.....GEA-4668 (Industrial Relay)

NOTE: More data available in Sweets' File for Product Designers

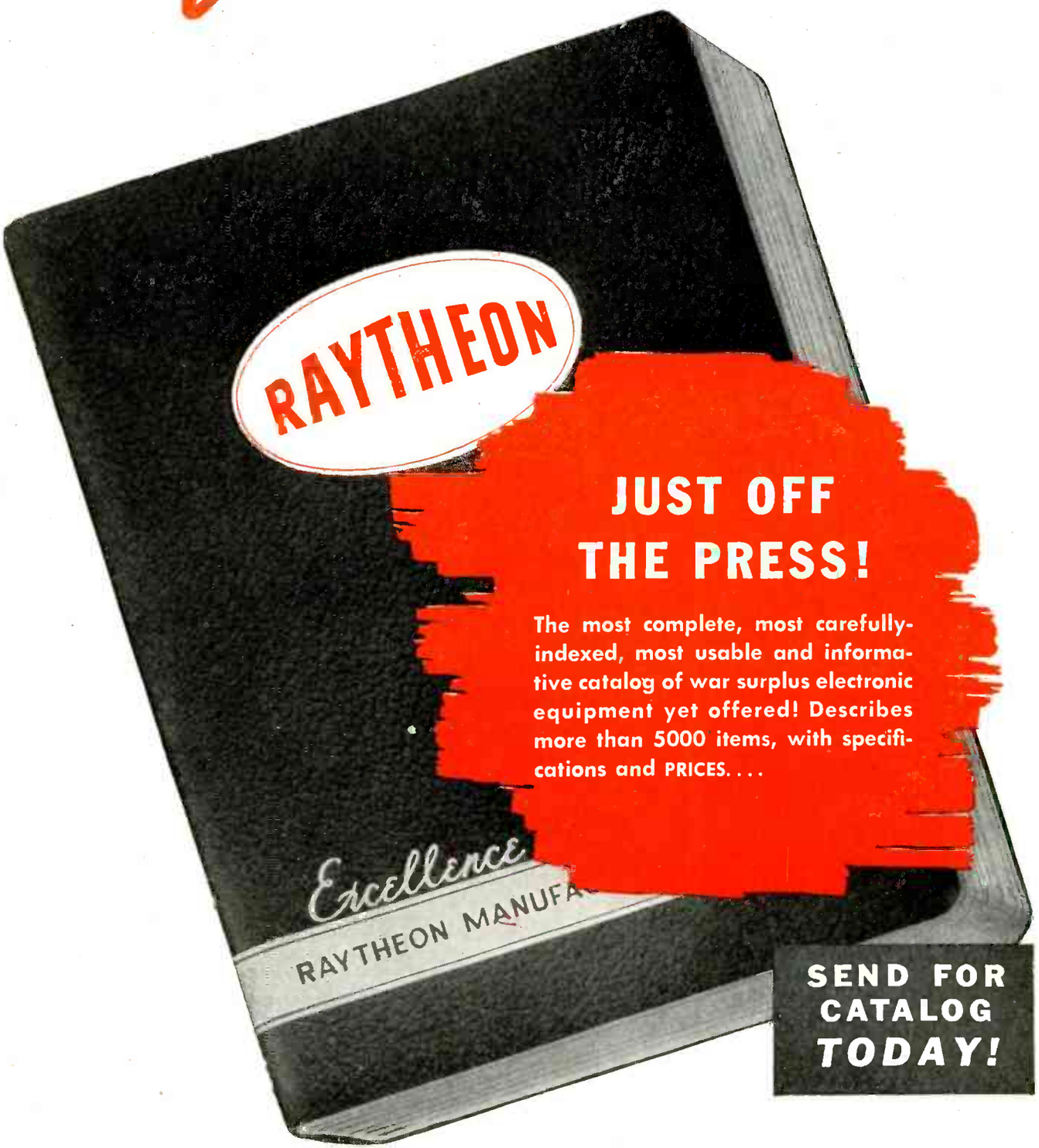
Name_____

Company_____

Address_____

City_____ State_____

Raytheon ANNOUNCES



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The most complete, most carefully-indexed, most usable and informative catalog of war surplus electronic equipment yet offered! Describes more than 5000 items, with specifications and PRICES. . . .

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Personalized Lighting . . . Instantly! DAZOR ALONE *Floats!*

CONCENTRATED light exactly *where* and *when* you want it! Light of the right *quality* and *quantity,* positioned so you can see the details of fine work quickly, with comfort and ease! Such are the advantages of Dazor, the *floating* lamp.

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Provide personalized Dazor lighting for every task in your plant or office which requires precise, accurate seeing. Increase the efficiency and productivity of your workers, reduce accidents and waste.

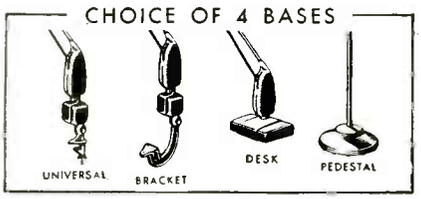
Phone YOUR DAZOR DISTRIBUTOR . . . let him demonstrate Dazor seeing benefits. For your distributor's name, if unknown to you, write to Dazor Manufacturing Corp., 4481-87 Duncan Ave., St. Louis 10, Mo. *In Canada* address inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ont.

No squinting or nervous muscular tension here—the work orea is brilliantly Dazor-lighted.

With "personally-fitted" Dazor lighting, this diamond setter adds the finishing touches to a ring mounting.

Instantly adaptable to the seeing conditions required, Dazor lighting permits speedier treatment of first aid cases.

CHOICE OF 4 BASES



DAZOR *Floating* LAMPS

FLUORESCENT *and* INCANDESCENT

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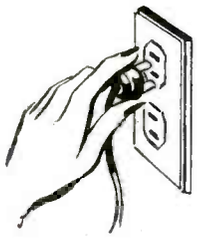
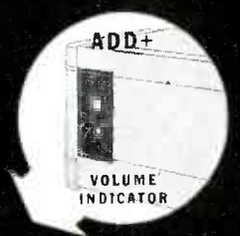
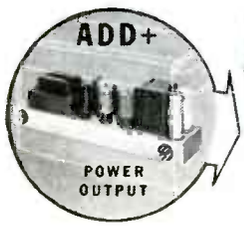


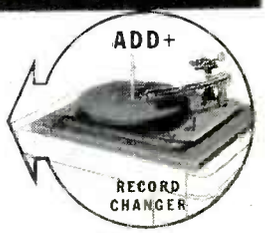
Exclusive! New Type CONCORD AMPLIFIERS

with amazing

ADD-A-UNIT features!







Add any or all of these units in a SINGLE cabinet!

Now available for **IMMEDIATE SHIPMENT,** the new, original and revolutionary Concord line of Multiamp Add-A-Unit Amplifiers and complete systems. Sets new high standards of flexibility, fidelity, performance, beauty and economy! 30 to 45 watt amplification increased, in a single cabinet, to 60, 75, or 90 watts *in minutes* with plug-in Add-A-Unit output stages—at minimum cost! Add two more input channels to total six channels if needed! Separate bass and treble tone-controls open a new world of tonal beauty and fidelity! Add a phono player, record changer, output indicator—any or all on the same Multiamp amplifier cabinet—eliminating extra space requirements and additional cabinet cost!

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Shhhh... they're designing a new ADLAKE RELAY

Although there's an Adlake Relay for 999 out of 1000 control jobs, occasionally our engineers—bless 'em—are asked to design one for new or unusual applications.

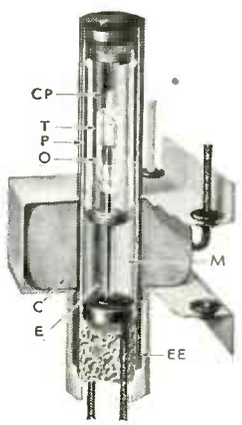
Helping you solve your out-of-the-ordinary problems is a specialty of ours. Just as giving dependable, trouble-free service is a specialty of Adlake Plunger-type Mercury Relays.

LOOK AT ALL THESE ADVANTAGES!

1. *Hermetically sealed* contact mechanism; impervious to dust, dirt, moisture.
2. Liquid mercury-to-mercury contact; no burning, pitting, sticking; positive in action, chatterless, silent.
3. Armored against outside vibration or impact; designed for either stationary or moving equipment.

Write today for free, illustrated Adlake Relay folder!

HOW ADLAKE RELAYS WORK



ENERGIZED—Coil C pulls plunger P down into mercury M. Mercury thus displaced enters thimble T through orifice O. Inert gas in thimble gradually escapes through ceramic plug CP.

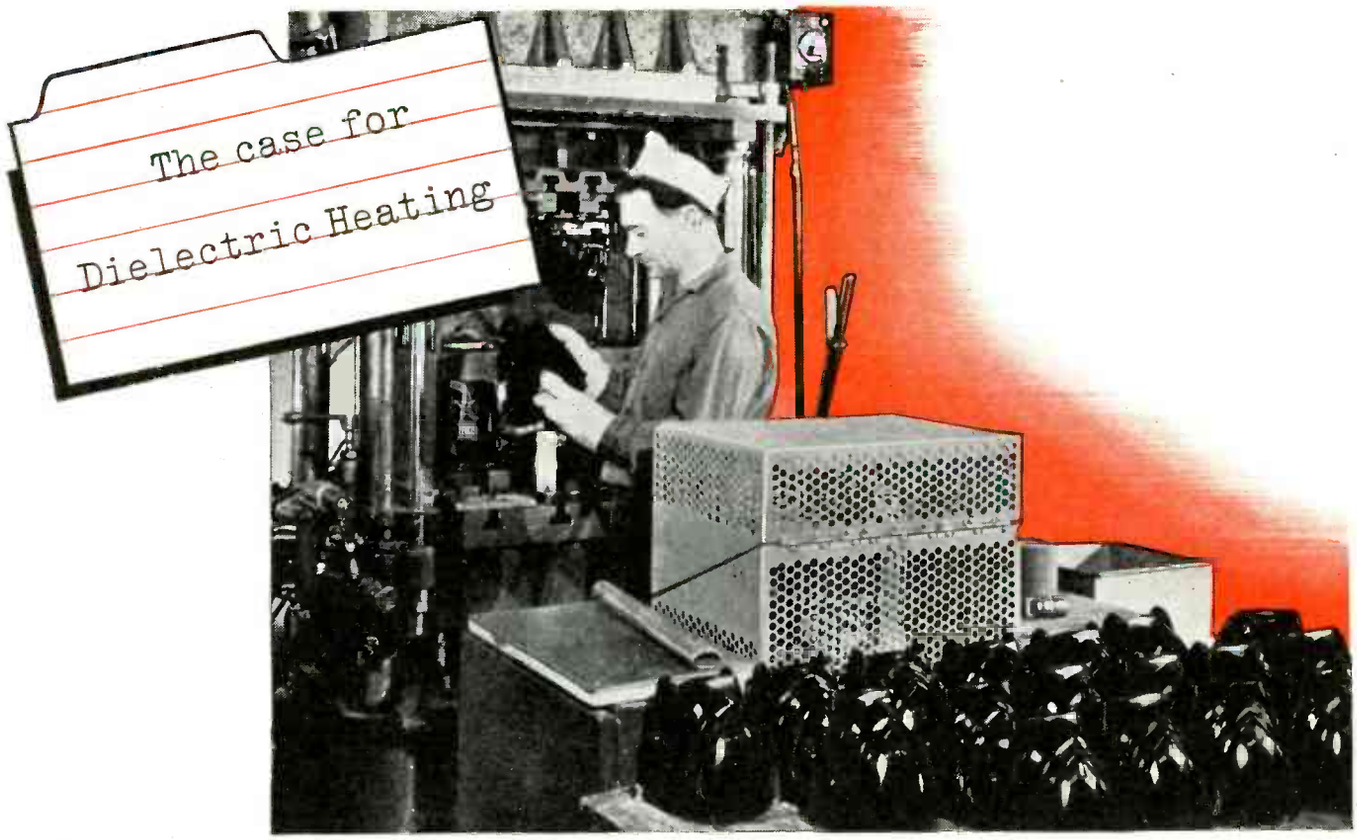
Mercury now fills thimble T, is completely leveled off and mercury-to-mercury contact established between electrodes E and EE. Degree of porosity of ceramic plug CP determines time delay.

Adlake TRADE MARK

THE ADAMS & WESTLAKE COMPANY

ESTABLISHED IN 1857 — ELKHART, INDIANA — NEW YORK : CHICAGO

MANUFACTURERS OF ADLAKE HERMETICALLY SEALED MERCURY RELAYS FOR TIMING, LOAD AND CONTROL CIRCUITS



Sure cure for housing problems:

. . . boost output 169%

High-powered cost cutting makes a strong case for any industrial process, and dielectric heating did just that when it sent production soaring 169% in this plastics operation.

The old way of producing heavy-sectioned motor housings involved molding powders in a two-cavity mold. But this required a 10-minute cure, limiting production to 130 pieces per day. Demand for a doubled output required another $12,000 mold (plus 14 weeks' waiting) and, in addition, the use of a second press.

The new way simply switched powders to preforms and preheated them with a standard Westinghouse 5-kw, r.f. generator. Results: curing time was slashed from 10 minutes to 3 minutes and production of the two-cavity mold rose from 130 units per day to 350 . . . a 169% boost!

Better yet, holes once drilled in the housing could now be molded since the new uniform plasticity reduced breaking strain on the mold pins.

This is just one example of the way dielectric heating does an effective, profitable job for the plastics industry. Ask your nearest Westinghouse office today for the full story. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-02074

HERE'S FREE HELPFUL INFORMATION

on both induction and dielectric heating . . . their principles and theories; where to use them; how to select them; actual case histories of their use. Write for your copy today, on your business letterhead, please. Ask for B-3620.

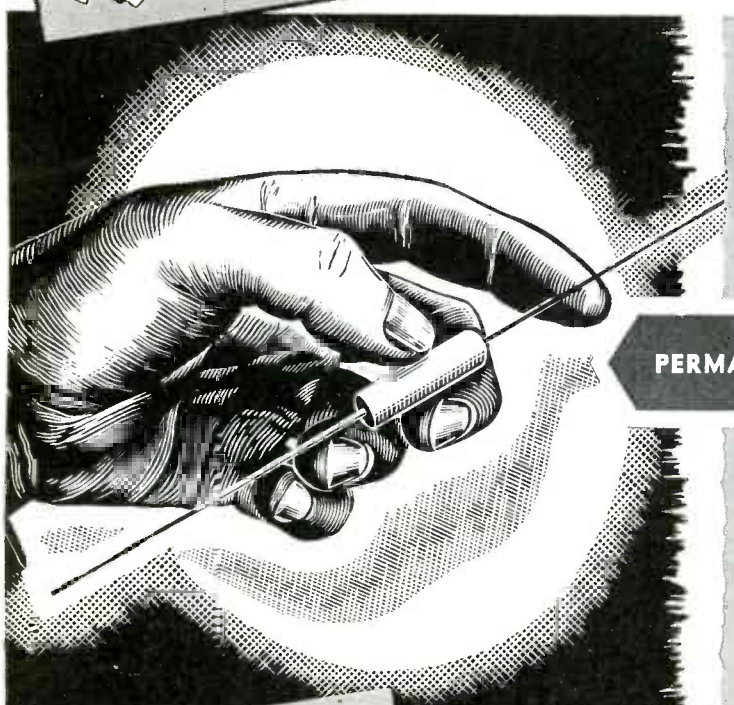
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

A NEW DEVELOPMENT IN SANGAMO CAPACITORS

Now PLASTIC MOLDED [LIKE MICAS] PAPER TUBULARS



IN Nineteen hundred and twenty-three, Sangamo made capacitor history by being first to develop successfully molded mica capacitors. History repeats itself today, as again Sangamo is first to offer, this time, paper tubulars—molded, like

PERMANENTLY SEALED AGAINST MOISTURE

micas in a thermo-setting plastic! The same advantages, derived in the past, from molding micas, are now inherent in the new plastic molded paper tubulars: capacity values are permanently sealed in—moisture is sealed out; the life of these tubulars is prolonged; they can be applied at higher temperatures; their finish is smooth, therefore less susceptible to catching dust. Priced only slightly higher than ordinary types, Sangamo Plastic Molded Paper Tubulars are readily applicable wherever ordinary types are used —but are much more economical and satisfactory in the long run.

WRITE FOR NEW CAPACITOR CATALOG

NEW ADVANTAGES OF MOLDED TUBULARS

- Moisture can't get in.
- Capacity values won't change.
- Applicable at higher temperatures.
- Longer Life. Low power factor.
- Molded, non dust-catching finish.

- MOLDED Paper Tubulars
- Metal-Encased Tubulars (Paper)
- Transmitting Oil-Filled
- Bathtub (Oil or Wax-Filled)
- Diaclor (A Paper Transmitting)

CHECK YOUR REQUIREMENTS AGAINST THE SANGAMO LINE...

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- Motor Starting, for A. C. and D. C.
- Tubular Transmitting (Oil-Filled Paper)
- Tubular Transmitting (Diaclor, Paper)
- Receiving Micas
- Transmitting Micas
- Silvered Micas
- Silvered Mica Buttons

SANGAMO ELECTRIC COMPANY
SPRINGFIELD • ILLINOIS

Helipot

Trademark of the **HELIcal POTentiometer!**

THE REVOLUTIONARY Potentiometer that Gives You 46½" of Slide Wire in a Panel Space 1½" in Diameter!

Throughout the electronic industry—wherever quality electronic instruments are designed, manufactured or used—the big news is HELIPOT, the helical potentiometer-rheostat that is making possible entirely new standards of accuracy, convenience and compactness in modern electronic equipment. Briefly, here's what makes the *Helipot* so unique ....

Instead of a single partial turn of slide wire as found in the conventional potentiometer, the Helipot has *many* full turns of slide wire coiled into a compact helix *requiring no more panel space than the ordinary potentiometer.* The sliding contact follows the long helical path of the slide wire from end to end when a *single* knob is rotated. Thus, the Helipot requires the same panel space—the same single control knob—as a conventional potentiometer...yet it provides the wide range control and accuracy of a slide wire approximately *twelve* times as long.*

In other words, whereas the conventional rheostat gives approximately 300° of rotation, the 10-turn Helipot gives 3600° of rotation in the *same* panel space.

Think what this important advancement can mean in simplifying the control, increasing the convenience and improving the accuracy of *your* electronic equipment. Helipots are already being used in a wide range of devices—depth sounding equipment, flight control instruments, electrical computors, strain-gage circuits, oscilloscopes and other indicating and measuring apparatus, and a great variety of other electronic applications. Let our engineering staff study *your* control problem and show you how Helipots can increase the accuracy, utility and simplicity of your equipment. There's no obligation, of course. **Send for the Helipot booklet.**

*For the standard 10 turn, 1½" unit. Other sizes proportional.

Some Important Helipot *Features*

HIGH LINEARITY—As a result of fulfilling wartime requirements for ultra-precision circuit controls, Helipots are mass-produced with linearity tolerances of *one tenth of one per cent*—and even less!

PRECISE SETTINGS—Because of the many-times longer slide wire, settings can be made with an accuracy impossible with single turn units.

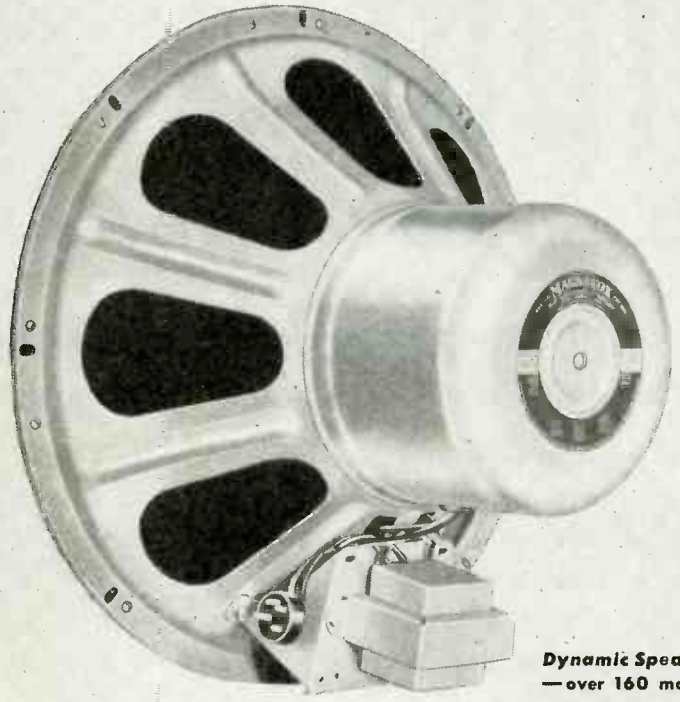
WIDE RANGE—By coiling a long potentiometer slide wire into a helix, the Helipot provides *many times* the range possible with a single turn unit of comparable diameter and panel space.

LOW TORQUE—Of special interest for servo applications—the Helipot has unusually low torque characteristics. The 1½" Helipot—for example—has a torque of *only one inch-ounce.*

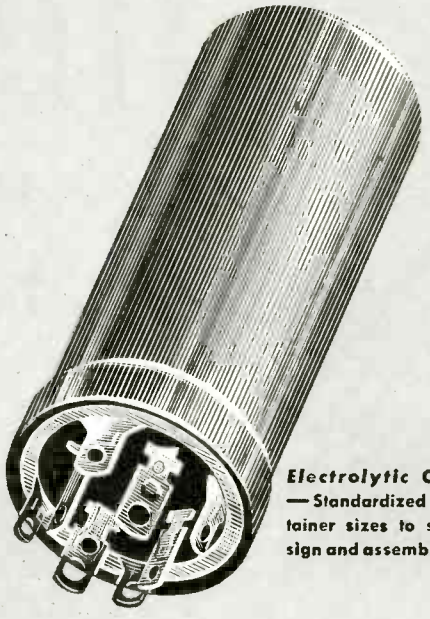
HELIPOTS are available with virtually any commercially-obtainable types of resistance wire, limited only by physical characteristics in certain resistance ranges. Three standard sizes are available; the Type A, ten turn and the Type C, three turn models, having 1½" diameter coils, and the Type B, fifteen turn model with 3" coils. The Type A can be wound with fewer than ten turns on special order, while the Type B can be made in sizes up to forty turns, if desired. The versatility of the design permits the addition of taps and extra sliding contacts. Write for full details.

We are also equipped to supply other types of potentiometer-rheostats. Send us your requirements.

● THE HELIPOT CORPORATION, 1011 MISSION STREET, SOUTH PASADENA, CALIFORNIA ●



Dynamic Speakers — over 160 models.



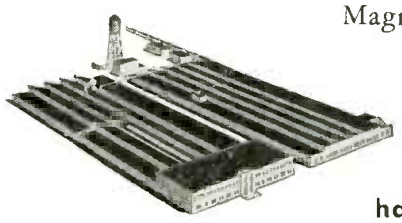
Electrolytic Capacitors — Standardized into 8 container sizes to simplify design and assembly problems.

Magnavox . . . specialists in quality components for quantity production

Dependability! Economy! Durability! Time-Tested Qualities of Magnavox Components.

FOR over thirty years Magnavox has set the pace in the manufacture of loud-speakers and component parts. The inventions and developments of Magnavox engineers and designers are established as standards of the radio industry.

Magnavox specializes in custom applications for quantity production. The oldest and largest manufacturer of loud-speakers, Magnavox is your guarantee of the finest speakers and electrolytic capacitors. There is no substitute for experience! The Magnavox Company, Components Division, Fort Wayne 4, Indiana.



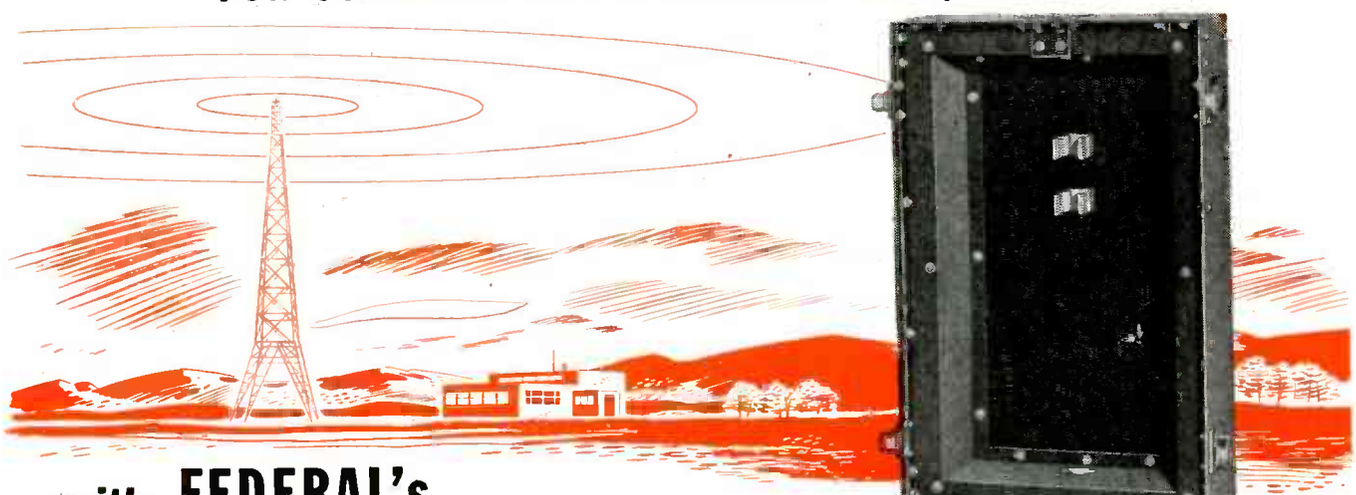
Magnavox

has served the radio industry for over 30 years

SPEAKERS • CAPACITORS • ELECTRONIC EQUIPMENT

FAST, ACCURATE, FIELD-STRENGTH MEASUREMENTS

FOR STANDARD AM BROADCAST FREQUENCIES



with FEDERAL's FIELD INTENSITY METER

For radio broadcast station engineering consultants, service or field men—

- *for measuring radiation patterns of directional antennas*
- *for checking power characteristics of transmitters by radiation measurement*
- *for locating the best area for installation of radio stations or antennas*

Federal's compact, light-weight, field intensity meter, Type FTR-101C, is a sturdy and highly accurate instrument—readily portable and quickly set up for operation. It permits precision measurements of field strengths from 20 microvolts to 10 volts per meter, over a frequency range of 200 to 400 and 530 to 7000 kc. Built-in coils, changed by a single control switch, cover the entire range—no plug-in coils are used. To assure more rapid and accurate indications, a vacuum-tube voltmeter is used instead of a thermocouple instrument.

The antenna loop for the broadcast band is built into the cover, and is electrostatically shielded to prevent interference from body capacity. A single control tunes the loop and two oscillators in one operation.

Measurements may be taken from an automobile while it is in motion, by connecting the set to a rod antenna by means of a transmission-line adapter, available on order.

Write Department B113 for complete descriptive and performance data.

Easy to Carry!

Complete set weighs only 29 pounds, including power pack or light weight batteries. Ready for carrying, set is only 15 inches long, 11 inches high and 9 inches deep.

Easy to Set Up!

Meter can be unpacked, set up, and in service in a matter of seconds. The case is light enough to be mounted on a tripod for easier field operation, and includes a tripod socket for this purpose. It also has rubber feet and can be set on any level surface.

Federal Telephone and Radio Corporation

Newark 1, New Jersey

An IT&T Associate

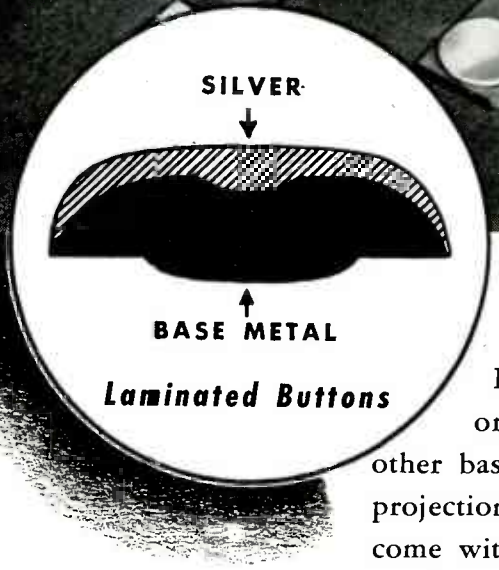
In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal
Export Distributor:—International Standard Electric Corporation

Solve Complicated Heavy-Duty Contact Problems with...

GENERAL PLATE

Laminated Contact Buttons

FOR WELDING OR SOLDERING



If you manufacture your own contact assemblies, investigate General Plate Laminated Contacts and Buttons. Made by permanently bonding silver, platinum or other precious metals to inexpensive steel, brass or other base metals, they can be easily applied to your parts by projection welding, electric brazing or soldering methods. They come with flat or dome tops . . . have projection backs for welding or solder flush backs for brazing. They'll speed production, save costs and give solid precious metal electrical performance at a fraction of the cost of solid precious metals.

If you have a contact problem, investigate General Plate Laminated metals. Our engineers are available for consultation. Write, specifying your particular requirements.

GENERAL PLATE DIVISION

OF METALS & CONTROLS CORPORATION

50 Church St., New York, N. Y.; 205 W. Wacker Drive, Chicago, Ill.; 2635 Page Drive, Altadena, California; Grant Bldg., Pittsburgh, Pa.

ATTLEBORO, MASSACHUSETTS

Only a drop...but look at the stir

EVEN THE TINIEST COMPONENT is important. Like capacitors. If they "sit in" and do exactly the job you've visualized for them, your final product performs as planned.

That doesn't mean—make a major issue of capacitor purchases! Buy the kind you *don't* have to worry about . . . the kind we make at Cornell-Dubilier. They're inconspicuous, because they're so dependable.

Others have tried to build capacitors like C-D's. They can imitate, but not duplicate. Because it's more than the paper and foil we use that makes C-D's different. It's the experience and engineering flexibility that comes of having made more capacitors of more different designs than anyone else. When you buy C-D, you buy a helpful amount of "freedom from worry".

If you have a special capacitor problem, our engineers can turn their thinking to it immediately. Consult us. Cornell-Dubilier Electric Corporation, South Plainfield . N. J. Other plants in New Bedford, Providence, Brookline and Worcester.

CORNELL-DUBILIER

world's largest manufacturer of

CAPACITORS

MICA • DYKANOL • PAPER • ELECTROLYTICS

G-E MYCALEX . . . FOR PRECISION-MOLDED INSULATION

●This contact yoke was designed to drive a vital moving part in a high-frequency application. A dimensionally stable part was required.

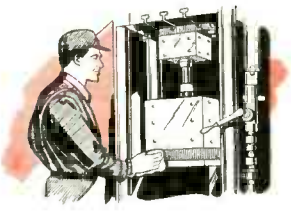
At No. 1 Plastics Avenue the problem was solved by specifying G-E mycalex—compound of glass and powdered mica with a unique combination of properties.

Molded in G-E mycalex by new techniques, this contact yoke has everything required of a high-frequency component—dielectric strength . . . low loss factor . . . stability . . . flatness . . . rigidity.

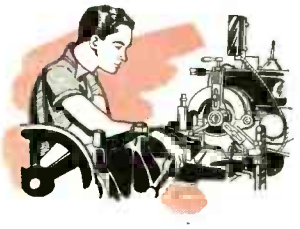
G-E mycalex is now available to all industry in standard rods and sheets, or molded to your own design. G-E designers and engineers will give you the benefit of their experience in molding hundreds of G-E mycalex parts. Write to Section T-12, Plastics Divisions, Chemical Department, General Electric Co., 1 Plastics Avenue, Pittsfield, Mass.

HOW THE G-E MYCALEX SERVICES CAN BENEFIT YOU NOW

You may order fabrication of sample G-E mycalex parts at surprisingly low cost. Test them yourself in your own equipment. Then, if you decide to specify G-E mycalex, your design can be converted to a molding process which permits speedy and economical production runs.



MOLDING SERVICE



FABRICATING SERVICE

Get This Unique Combination of Properties with G-E Mycalex

1. High dielectric strength
2. Low power factor
3. Prolonged resistance to electrical arcs
4. Chemical stability—no deterioration with age
5. Dimensional stability—freedom from warpage and shrinkage
6. Impervious to water, oil, and gas
7. Resistance to sudden temperature changes
8. Low coefficient of thermal expansion
9. High heat resistance

Samples Supplied on Request

MYCALEX

GENERAL ELECTRIC

CD46-M12

FOR FM RADIOS IT'S ERIE RESISTOR

Electronic Components and Products

Due to the high operating frequencies of FM, many electrical and mechanical characteristics not ordinarily considered in condensers, become of paramount importance. The most important of these is low inductance, both in leads and in the basic construction of the condensers themselves.

The condensers illustrated on this page fulfill this requirement through simplicity of design and low internal inductance. For by-pass applications, Erie Stand-Off Ceramicons and Erie Feed-Thru Ceramicons are most efficient for carrying off R.F. current to ground. Heavy terminals, with direct connection to ground, reduce external and internal inductance to a minimum. Available capacities, up to 1,000 MMF, are usually sufficient to efficiently by-pass frequencies of 80 MC or higher. Tubular Ceramicons, shown at the top right, have the same internal advantages as the Stand-Off and Feed-Thru type Ceramicons, because of their simplicity of construction, but are provided with regular pigtail leads necessary for many installations where some moderate lead inductance can be tolerated.

The Cinch-Erie Plexicon Tube Socket, shown in the center photogragh, with built-in by-pass Ceramicons, puts the condensers around the tube pins—where they belong. Leads are practically eliminated, and other components can be installed closer to the socket, further increasing efficiency. Any tube pin or groups of pins can be by-passed with condensers having up to 1,000 MMF capacity.

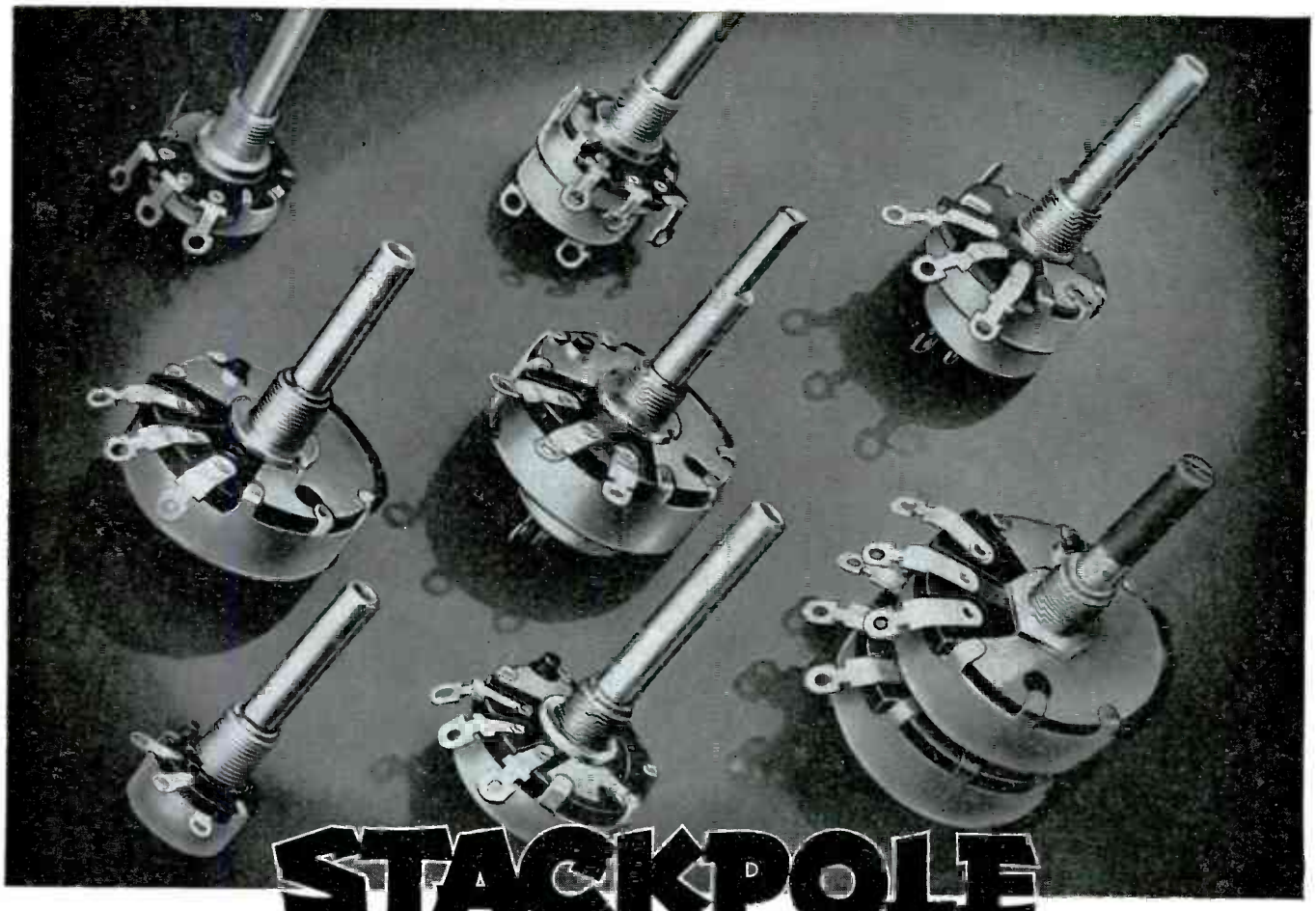
Erie Button Mica Condensers were designed specifically for high frequency work. Ribbon type leads, plus circular design, gives extremely short electrical path-to-ground through the entire area of the condenser. These compact units are available in a number of different mounting styles and in capacity ranges up to .006 mfd.

You can stake your reputation on these condensers for dependable use in tuned circuits, for by-pass applications, or as coupling condensers, in all FM applications. Write for complete details, giving desired operating characteristics.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND . . . TORONTO, CANADA



STACKPOLE

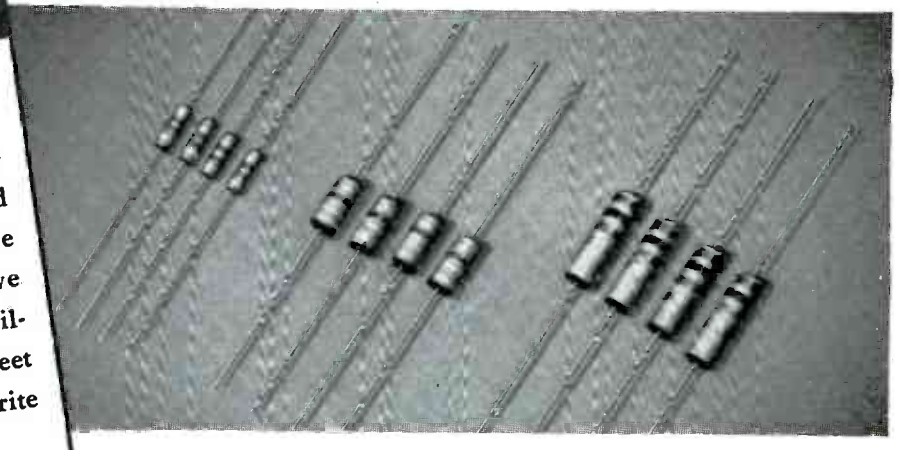
FIXED AND VARIABLE RESISTORS

One of the nation's largest producers, Stackpole offers a dependable source of supply for both fixed and variable resistors for a wide variety of applications. Fixed types include ½- and 1-watt insulated units in smallest sizes consistent with modern performance demands. Variables include standard-size units, midgets, sealed designs and numerous special types. Write today for Stackpole Electronic Components Catalog RC6.

DEPENDABLE LOW-COST SWITCHES

Line, Slide, Rotary Action Types

Ideal for radios, toys and all electrical equipment where high-grade but inexpensive switching is required. Available in standard types to meet almost any requirement. Write for Catalog RC6.



STACKPOLE CARBON COMPANY
(Electronic Components Division)
ST. MARY'S, PA.

Aircraft communication at its best

THE COLLINS 18S-1 transmitter-receiver is engineered for highest performance in aviation communications. It is specifically designed for commercial airlines and executive aircraft. Reflecting years of experience and proved dependability in the field of aircraft radio, the 18S-1 is new in every respect, and has performed superbly under flight tests.

Ten channels, with twenty crystal controlled frequencies are available for transmission between 2.5—10.0 mc. Power output from the transmitter is more than 100 watts. The receiver is controlled by a separate group of 20 crystals, and does not necessarily operate on the transmitting frequency. Quick, automatic frequency selection is provided, with all circuits tuned and ready to operate. Remote control encourages locating the unit with respect to proper weight distribution within the plane. The 18S-1 works into a 50 ohm transmission line.

A single 1½ ATR unit cabinet contains transmitter, receiver, and dynamotor power supply for the transmitter. The receiver operates directly from the 26.5 volt d-c source. The entire weight, including shock mount, is 60 lbs.

The first group of these equipments is scheduled for delivery to airlines in September of this year. Write today for further information.

THE 180K-1 antenna loading unit efficiently transfers the power output from the 18S-1 to any standard commercial fixed antenna. Remote controlled, pretuned operation for ten channels is provided. The nominal input impedance is 50 ohms. Weight, 10 lbs. Size, 7½" h, 10½" d, 12" l.

Collins Radio Company, Cedar Rapids, Iowa

11 West 42nd Street
New York 18, N.Y.

458 South Spring Street
Los Angeles 13, California

IN RADIO COMMUNICATIONS, IT'S...

COLLINS

WHEN WE SAY QUICK WE MEAN QUICK!

SHORT RUN FOR QUICK PIERCING OF SHEET METAL USE A WIEDEMANN

Here's a typical example of how piercing time was reduced 90% by using a Wiedemann Turret Punch Press.

THE JOB: An order of 10 pieces 12⅝ x 8½ x .078 mild steel (50 openings pierced requiring 7 different shapes and diameters)

TOTAL TIME FOR 10 PIECES:

OLD METHOD: 9 hours, 16 minutes

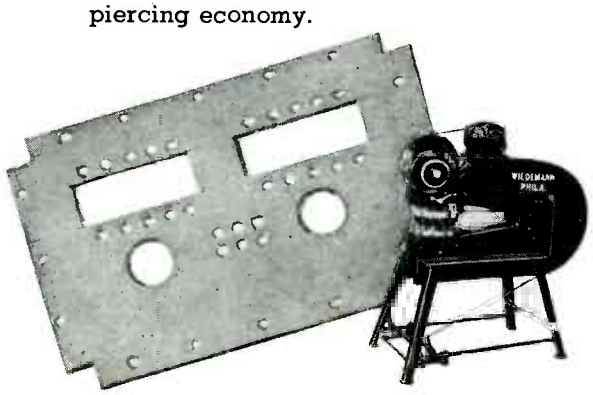
WIEDEMANN METHOD: 1 hour, 16 minutes (Time includes loading and unloading material in the machine)

TIME FOR 1st PIECE . . . 19 minutes, 18 seconds

TIME FOR EACH OF NEXT 9 PIECES . . 6 minutes, 39 seconds

The job was produced on a Wiedemann R-4P 11 Station Turret Punch Press with Drop-latch gauge. *Layout work was done directly in the machine and is included in the above time.*

You can see for yourself . . . when we say QUICK we mean QUICK. See a Wiedemann Turret Punch Press in operation. Write us for address of a shop in your vicinity that uses a Wiedemann for short run piercing at long run low cost . . . and send for Bulletin 92 for the complete story of short run piercing economy.



WIEDEMANN MACHINE COMPANY
1833 SEDGLEY AVENUE, PHILADELPHIA 32, PA.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES

Introducing... the new Aerovox Series 83

PLASTIC-CASE PAPER TUBULAR

that withstands HEAT and HUMIDITY

Combination of special plastic casing and special sealing compounds for ends, insures immunity to moisture.

Already rated for operation at maximum temperature of 95° C. (203° F.).

Will not deteriorate under normal storage conditions.

Overall dimensions identical with those of Aerovox paper tubulars of corresponding voltages and capacitance values.

Somewhat higher in cost than corresponding paper tubulars.

• Forget about that melting and dripping wax when it comes to tubular capacitors operating at elevated temperatures. Especially in auto radios. Also forget about humidity; capacitors sticking together and picking up dirt; premature breakdown.

The new Aerovox plastic-case bonded-seal tubulars (Series -83) now protect your good name with *performance insurance*. Slick as a seal, these clean, bright, handy tubulars are immune to temperatures ranging from sub-zero cold up to sizzling heat, and impervious to moisture penetration.

This latest Aerovox development (patents pending) overcomes usual objections to paper tubulars for the *more critical* applications. The rigid plastic case with bonded-seal ends, provides real protection for the capacitor section. Overall wax dip becomes a thing of the past, while rigid humidity tests are readily met.

Simply install them—forget them—and be insured!

• *Write for further details...*

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AEROVOX CORPORATION, NEW BEDFORD, MASS., U.S.A.

SALES OFFICES IN ALL PRINCIPAL CITIES • Export: 13 E. 40th St., New York 16, N. Y.

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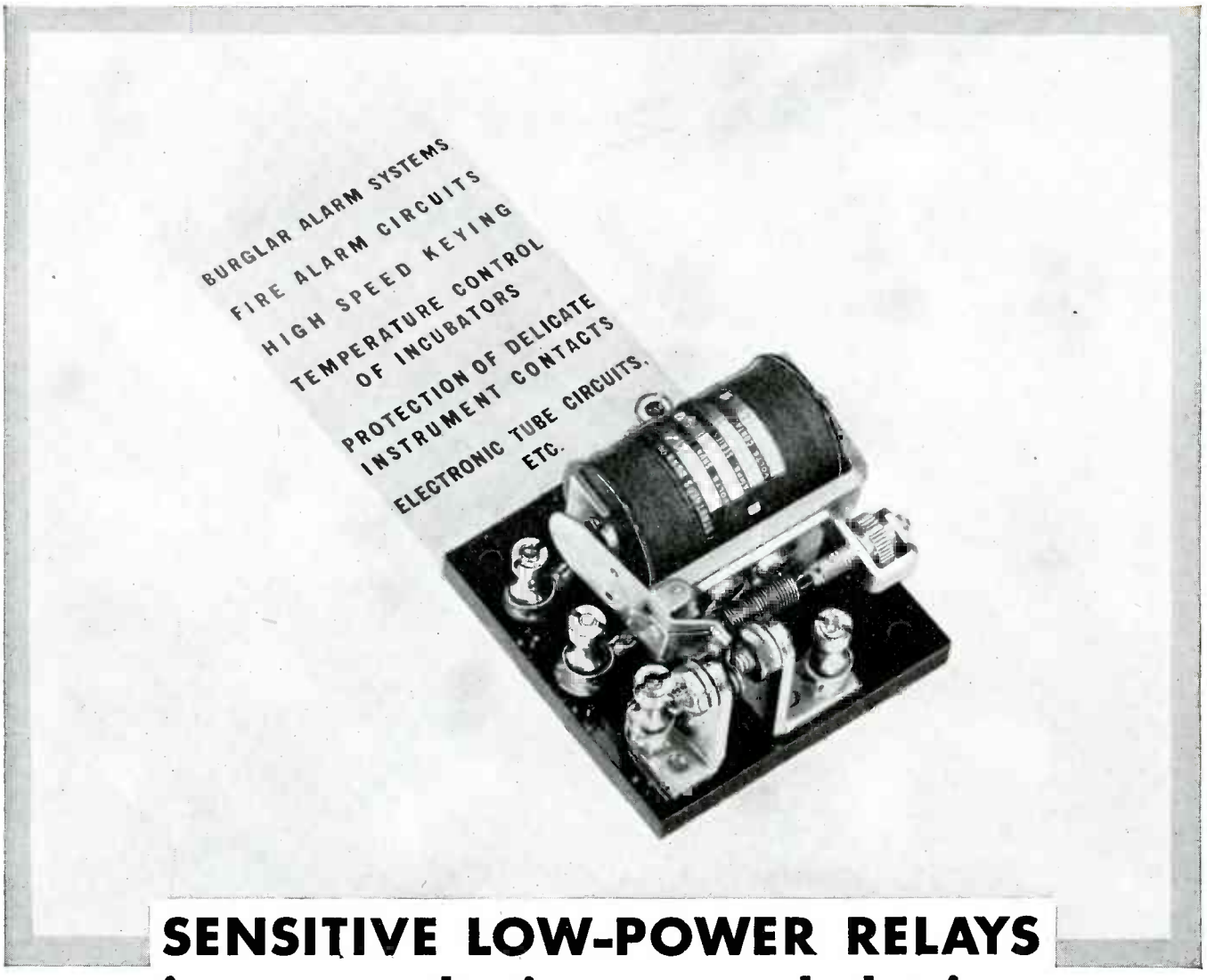

SENSITIVE LOW-POWER RELAYS in a newly improved design

FOR USE ON AC AND DC

Engineering superiority in every mechanical and electrical detail makes Struthers-Dunn Type 112 Relays far and away "tops" for sensitivity and durability for low-power operation on the order of a few milliwatts • A "fool-proof" micrometer adjustment assures exceptionally reliable setting of the contact spring • All parts are of low-inertia, quick-acting design • Contacts are easy to adjust and stay "put" once adjusted • Coils are well insulated and vacuum impregnated • These new relays are built throughout for easier installation, higher sensitivity, longer life • Available in single-pole double-throw and double-pole double-throw contact combinations.

Write for Data Bulletin 112.

S-D
5,327 RELAY TYPES

STRUTHERS-DUNN

STRUTHERS-DUNN, Inc., 1321 Arch St., Phila. 7, Pa.

ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS
DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL
NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

Precision Quality Control . . .

. . . A Year 'Round Feature of ALL

STUPAKOFF CERAMICS

Stupakoff precision quality control gives you uniform, dimensionally accurate ceramic parts. By standardizing on STUPAKOFF products, you minimize production losses . . . gain assurance of maximum mechanical strength and maximum electrical protection.

The advantages of Stupakoff ceramics have been developed through years of engineering experience and research. Carefully selected and laboratory controlled materials, modern manufacturing facilities and constant inspection insure highest quality of finished products at all times. Specify Stupakoff—and be sure of the finest. *Write for Bulletin 245.*

EXPORT DEPARTMENT
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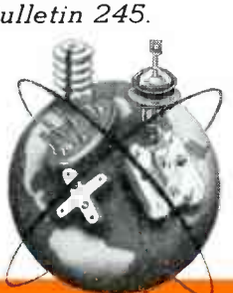
Cable Address ARLAB all codes



STUPAKOFF

CERAMIC AND MANUFACTURING CO. · LATROBE, PA.

★ What is *standard* and what can be made *special* by way of resistors, controls and resistance devices, is presented in these handy Clarostat Engineering Bulletins:

TYPE OF PRODUCT	BULLETIN NO.
Ballasts or Line Voltage Regulators	108
Composition-Element Controls	112
Constant-Impedance Output Attenuator	111
Constant-Impedance Controls (L-pads, etc.)	102
Flexible Resistors (Glasohms and Flexohms)	105
Fluorescent Lamp Conversion Resistors	125
General Information	101
General Utility Accessory Resistors	125
Hardware for Controls	120
Humdingers (Compact Potentiometers)	103
Metal-Clad Molded Resistors	109
Multiple-Unit Controls	142
Power Resistors (Greenohms)	113
Power Resistor Decade Box	114
Power Rheostats	115
Tube Type Plug-In Resistors	107
Wire-Wound Midget Controls	116
Wire-Wound Standard Controls	118

(Additional bulletins from time to time)

★ Write for those bulletins of interest to you, stating Bulletin Nos. ★ Also send us that resistance problem or requirement.

CLAROSTAT

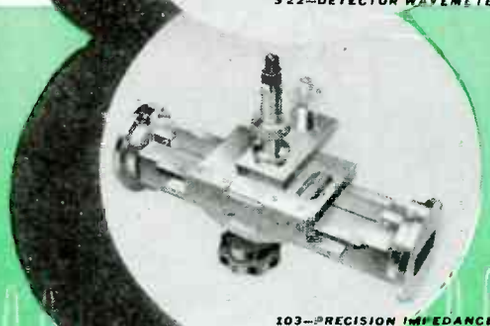
Controls and Resistors

CLAROSTAT MFG. CO., Inc., 285-7 N. 6th ST., BROOKLYN, N. Y.

Export Division: 25 WARREN STREET, NEW YORK 7, N. Y.

Cable Address: SIMONTRICE, NEW YORK

S 22—DETECTOR WAVEMETER

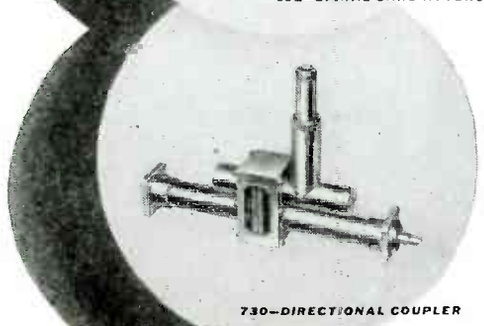


103—PRECISION IMPEDANCE METER

34 A—TRIPLE STUB TRANSFORMER

123—WATTMETER BRIDGE

102—SPIRAL CARD ATTENUATOR



730—DIRECTIONAL COUPLER

PRECISION MEASUREMENTS IN MICROWAVE FREQUENCY BANDS . . . PROVIDED BY THE NEW

Sperry *Microline**

Adequate microwave test and measurement equipment is of vital importance both in laboratory and field. Sperry provides it in its comprehensive MICROLINE. Virtually every type of instrument, essential to precision microwave measurements, is represented in this new Sperry line. The instruments shown in the illustrations but partly suggest the wide range of Sperry Microline instruments, among which are included many new designs and developments for obtaining quick, accurate measurements in the microwave frequency bands. For more complete information regarding these Sperry instruments, and their applications to your individual problems and requirements, write our Special Electronics Department.

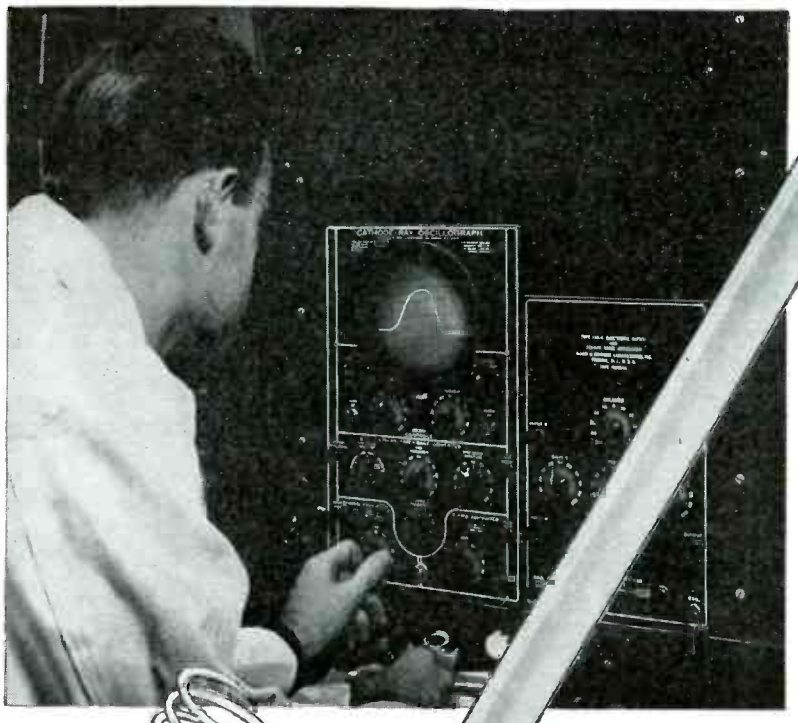
*Trade Mark

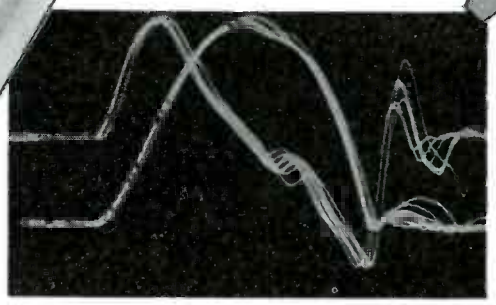
Sperry Gyroscope Company, Inc.

EXECUTIVE OFFICES: GREAT NECK, N.Y. • DIVISION OF THE SPERRY CORPORATION
LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS • CLEVELAND • HONOLULU
Aircraft: Gyropilots • Gyrosyn Compasses • Attitude Gyros • Directional Gyros • Gyro-Horizons • Detonation Indicators • Automatic Radio Direction Finders • Instrument Landing Systems • Traffic Control Systems • **Marine:** Gyro-Compasses • Gyro-Pilots • Gyro-Magnetic Compasses • Incandescent Searchlights Steering Systems • Radar • Loran • **Industrial:** Railroad Radio • Microwave Relays Microline-Test Equipment • Klystron Tubes • Strobodyne • Knockometer

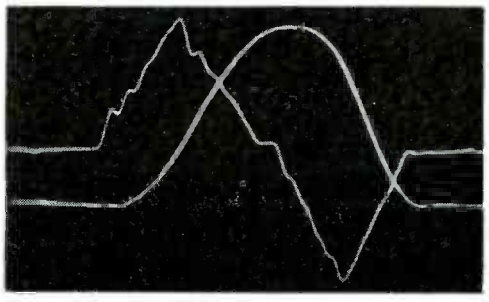
NEW FACTS about the mating of gears, the seating of valves, and the deflection of springs established by

EATON
MANUFACTURING COMPANY





The above oscillogram revealed a flexible cam shaft which was causing faulty engine performance.



Oscillogram from same engine after cam shaft had been stiffened, showing improved performance.

by means of . . .

DU MONT *Oscillography*

THE PRECISION METHOD OF SOLVING TIME-MOTION PROBLEMS

In their research laboratories at Detroit, the Eaton Manufacturing Company have found in *DuMont Oscillography* a precision method of studying hidden mechanisms operating at high speeds. Thus, the uncovering of new facts enables them to produce finer precision parts for the automotive and aircraft industries.

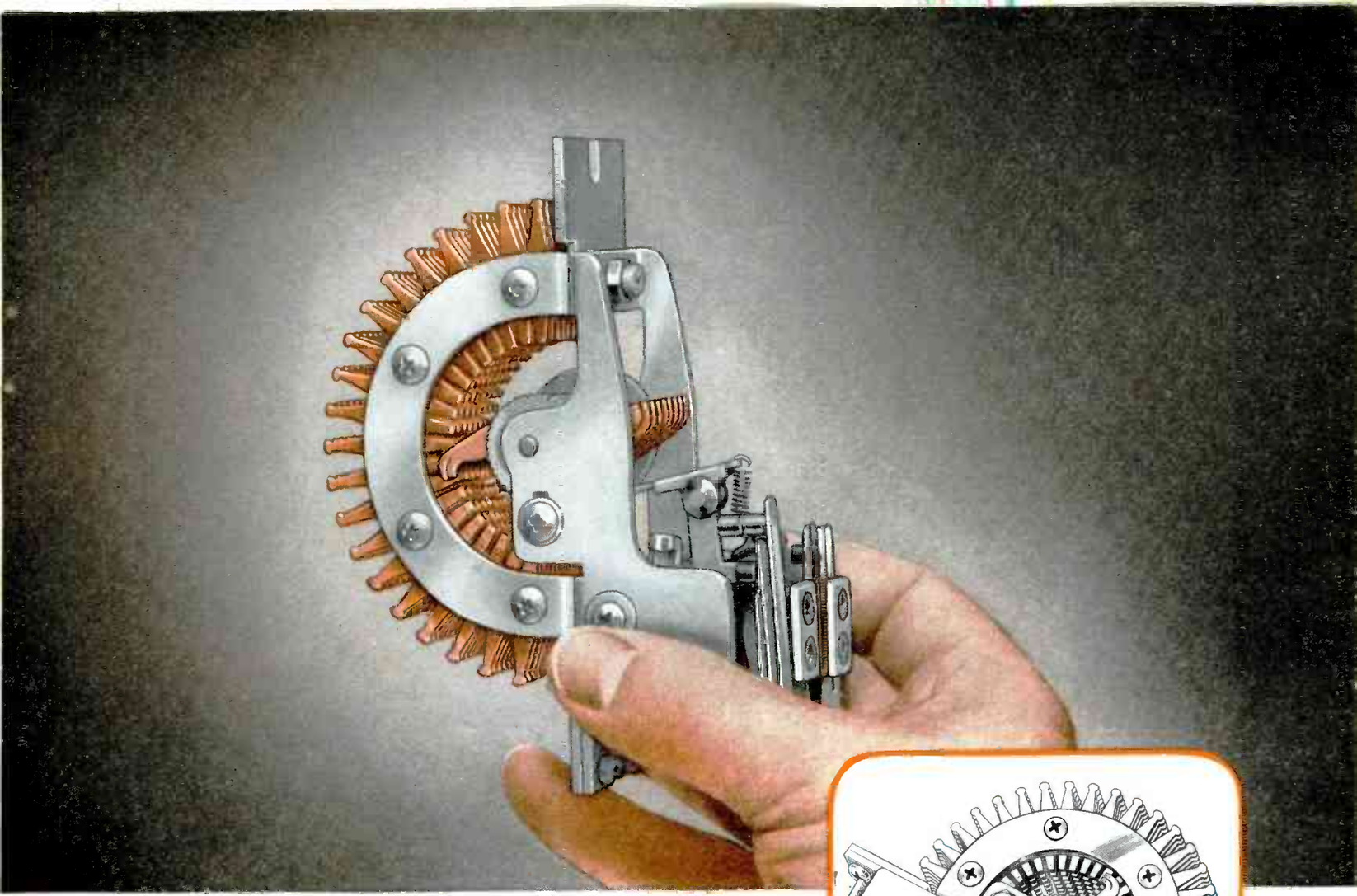
By translating motion into electrical impulses, visual curves of instantaneous mechanical actions are plotted against time and can be measured, compared, studied. They may also be permanently recorded on photographic film.

Yes, *DuMont Oscillography* can furnish you with invaluable information about YOUR specialized problems involving time and motion.

Submit your problem to our engineering staff!

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.



A New CLARE Stepping Switch for Your Most Exacting Control Demands

● Here's a new Clare Spring-Driven Stepping Switch that will select any channel or circuit path out of twenty . . . or forty. It will give automatic control of a series of operations . . . provide an accurate counter with initiation of impulses supplied by the objects to be counted. Combined with one or more switches as counters, it is a dependable totalizing switch.

Like all Clare Relays and electrical control apparatus, this Clare Spring-Driven Stepping Switch is built for the tough job . . . for applications that must have dependable, precise performance.

If your requirements are top notch . . . if just an ordinary relay or stepping switch won't do . . . Clare sales engineers are located in principal cities to show you how Clare products can provide just the performance you must have.

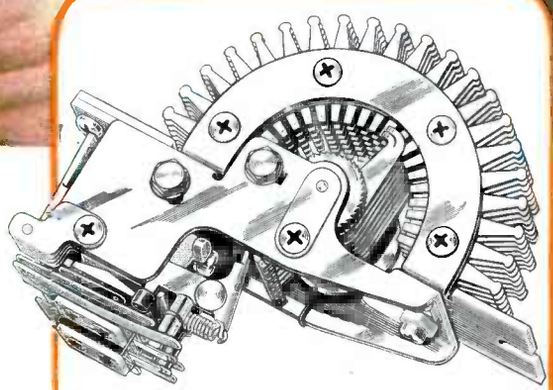
Ability of Clare products to meet your most exacting control demands stems from Clare's up-to-the-minute engineering, careful selection of highest quality materials and manufacture that adheres closely to precise standards.

That is why users of Clare "Custom-Built" Relays represent the top names in American industry . . . concerns who stake their good name on Clare performance.

Join the thousands of designers who have learned to count on Clare Relays and Clare "custom-building." Contact your nearest Clare sales engineer for information and advice. He is listed in your telephone book. Let us send you the new Clare Engineering Data Book, packed with information you can use. Address: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. Cable address: CLARELAY. *In Canada: Line Materials Ltd., Toronto 13.*

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use



SPECIFICATIONS

OPERATION
Automatic, or remote-controlled.

WIPERS
One to eight, traversing individual contact levels.

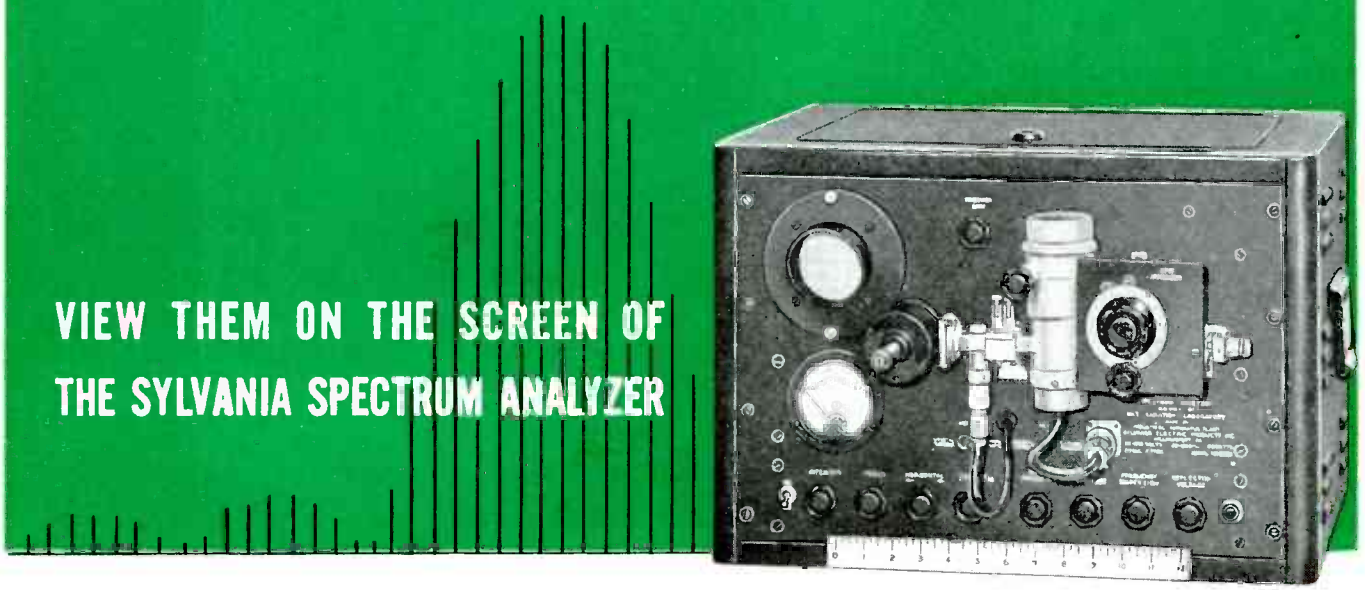
INTERRUPTER SPRINGS
Usually Form 1B, to open operating current at the end of each step. As many as eight contact springs may be provided. Contacts: single.

OPERATE SPEED
Remote-controlled operation—30 steps per second maximum; Self cycling operation—60 steps per second average.

FINISH
Framework and armature—cadmium; Bank contacts and wipers—phosphor bronze.

SIZE
Overall length — 5 5/16"; width — 2"; height—4 3/16".

Need to study the spectra of microwave oscillators?



VIEW THEM ON THE SCREEN OF THE SYLVANIA SPECTRUM ANALYZER

The Sylvania Spectrum Analyzer offers a convenient means of studying the energy spectrum of microwave generators operating as pulsed oscillators or modulated or unmodulated C. W. oscillators. The output of magnetron, klystron, rocket and similar UHF and SHF tubes can be conveniently investigated.

Basically, the Sylvania Spectrum Analyzer is a sharply tuned superheterodyne receiver with a cathode ray oscilloscope output indicator. Also included is a sawtooth generator performing the dual function of frequency-modulating the local oscillator and providing the horizontal sweep for the oscilloscope. Automatic synchronization is thus assured at all times.

An input probe is provided for easy insertion into cavities or wave-guides.

The energy at various frequencies emitted by the oscillator is displayed on the cathode ray tube as a pattern of vertical lines. The envelope of the pattern represents the spectral distribution.

The Spectrum Analyzer is available in two models — one for the 3,000 mc region; the other for the 9,000 mc region.

Share Wheat And Fats. Fight Famine!

TYPICAL APPLICATIONS:

Viewing the output of a radar system, to make certain that energy is not being distributed over too wide a frequency band.

Determination of the frequency of a pulsed oscillator.

Adjusting the local oscillator frequency of a radar receiver to space it properly with respect to transmitter frequency.

Checking of pulling or shifting in frequency of a pulsed oscillator of a radar transmitter, by observing the spectrum while the antenna is in motion.

Measurement of standing wave ratios by using the Spectrum Analyzer as a sensitive detector in conjunction with a slotted section.

THE SPECTRUM ANALYZER

is typical of many precision testing instruments, for laboratory and production purposes, manufactured by Sylvania Electric. Other Sylvania instruments include Synchroscopes, Thermistor Bridges, Capacity Bridges, Dilatometers and Oscilloscopes. Inquiries are invited.

SYLVANIA ELECTRIC

Electronics Division . . . 500 Fifth Avenue, New York 18, N. Y.

MAKERS OF ELECTRONIC DEVICES: RADIO TUBES; CATHODE RAY TUBES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

ELECTRONIC INDUSTRIES
Including INDUSTRIAL ELECTRONICS

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Police Radio for Police

Police organizations are well satisfied with their present radio communications systems. Such systems, currently available from a number of manufacturers, have been developed through close cooperation between engineers of the manufacturers and police experts and are doing a good job. But now with the advent of mobile radio equipment, developed by the telephone companies for private automobile owners and for private and public services, there has been some talk of the possibility of the telephone companies getting into the police communications field, perhaps taking over police systems by tying them in with these newly developed telephone facilities.

Emergency Needs

But the cops want no part of any such arrangement. They claim, and rightly too, that police facilities have been developed exclusively for police work as a direct result of police experience. They look upon reliability and speed of operation—the ability to reach a particular police car instantly—as of prime importance. They point out that the possibility of transmission delays, of public-utility strikes, or of natural disasters disrupting communications completely for a time, make any tie-in with the telephone services too hazardous to police work even to think about.

Theory vs. Handbook Teaching

Shall engineering schools teach handbook engineering, or the fundamentals of modern mathematical physics which underly all engineering?

This question has agitated the educational world for a long time and is now being discussed more than ever as a result of engineering experience in the war. In a recent address to a gathering of MIT alumni, General Groves, who was in charge of the atom-bomb project, ranged himself on the side of the existing methods of engineering education by stating it was the engineers who made the atom bomb possible. On the other hand, an electrical engineering professor at the same Institute, has complained of the limited usefulness of electrical engineers in carrying on Radiation Laboratory work, because of their weakness in theory.

The correct solution to this controversy is not easy. But thorough discussions, outside as well as inside educational circles, will help point the answer.

Radio in Expanding Air Travel

Looking ahead to the expansion of civil aviation, the Civil Aeronautics Administration announces that a new "approach control" system has been developed which permits landings every three minutes in instrument weather. Agreement with the airlines has also been developed on the installation of direction-finding equipment at key airports for bad-weather landings, pending completion of the VHF radio ranges and instrument (blind) landing systems and experimentation with radar for civil use.

CAA predicts that by 1955 there will be 20 million passengers carried by the airlines, compared with 7,700,00 in 1945. And 400,000 registered aircraft in '55 against 30,000 at present.

Honors for Radio Leaders

An appropriate means of perpetuating the memory of responsible radio engineers is presented in the call letters of transmitters. GE has its WRGB, Schenectady TV outlet memorializing Dr. W.G.R. Baker. The New York DuMont station WABD of course signalizes Dr. Allen B. DuMont. And the same organization's Washington television outlet is to be designated WTTG, in recognition of Dr. Thomas T. Goldsmith's engineering contributions. Just as informal portraits of the Old Masters' own faces are sometimes found tucked away in their paintings of great events, it would seem fitting in call letters, whenever possible, to honor the engineers who have made today's technical achievements possible.

RISING SUN PULSED

By H. G. SHEA
Associate Editor, Electronic Industries

Details of recent developments facilitating the physical production of resonators for waves as small as 6 millimeters or less

● Readers of the article on magnetrons in the January issue* will remember the problem of the elimination of the various possible modes of resonance of a magnetron cavity in favor of some desired mode (usually the pi mode where adjacent cavities are 180 deg. out of phase) to obtain frequency stability. It was noted in that article that a brilliant method of accomplishing this result was by introducing straps at each end of the anode in the form of copper rings connected to alternate vanes between the resonant cavities. This proved highly effective in separating the pi mode from other modes of resonance by increasing the wavelength change between the pi and the adjacent mode. It may be recalled that a formula was given showing the increase in resonant wavelength due to strapping. This means that a strapped anode for a given wavelength is considerably smaller than an unstrapped one.

Further research into the microwave region particularly at 1.25 cm showed the tremendous physical difficulty of making tubes. Not only are the cavities extremely small, but the mounting of the straps therein calls for jewelers' technics. In addition, the small size sharply restricts the heat dissipation and the power obtained.

Casting about for a new means of mode separation, physicists at the Columbia Radiation Laboratory at first attempted to make a tube to operate in a mode other than the pi mode by making cuts in the rear of alternate cavities, with the object of splitting the modes into two groups which would show good separation and then using as the operating mode the one giving the shortest wavelength out of the long wavelength group.

Results were quite disappointing, a maximum of 2 kw peak pulse power being attained at an efficiency not over 2%.

It was not until three months after these attempts that the possibility of operating a tube with unequal cavities in the pi mode was discerned. It was then found that by increasing substantially the ratio of the size of the large to the adjacent small cavities, the modes actually were split into three groups: an upper group, the solitary pi mode in the middle and a lower group. (See Fig. 1.) Resonant anode cavities made in this manner were named "Rising Sun" anodes on account of their appearance. (See Fig. 2.)

A physical picture of the reasons for this mode separation can be obtained readily by ordinary circuit theory. Each cavity may be represented by an LC circuit, the capacity across the mouth being C and the path around the cavity L, and the capacity from anode to cathode can be called C^1. (See Fig. 3.)

It is quite plain that there are three possible states of resonance for this circuit (Fig 4): a state where the wavelength is such as to make L_2C resonant so that its terminal reactance is infinite, another wavelength such as to make L_1C resonant and a third such that the series sum of the large and small cavity reactances is zero. This latter corresponds to the pi mode operation.

It was shown in a previous article that the current and voltage in any mesh (Fig. 3) could be related to those in another mesh in terms of a phase change (Γ). In the present case it is important to find the phase change across a pair consisting of a large and a small cavity. If the phase change across the large cavity is Γ_1, and across the

*Theory of Magnetron Tubes and Their Uses —by H. Gregory Shea, ELECTRONIC INDUSTRIES, Jan. 1946, pp. 66.

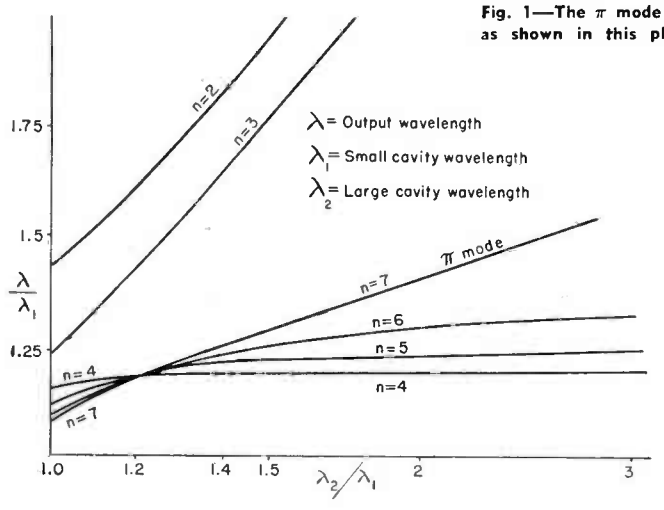
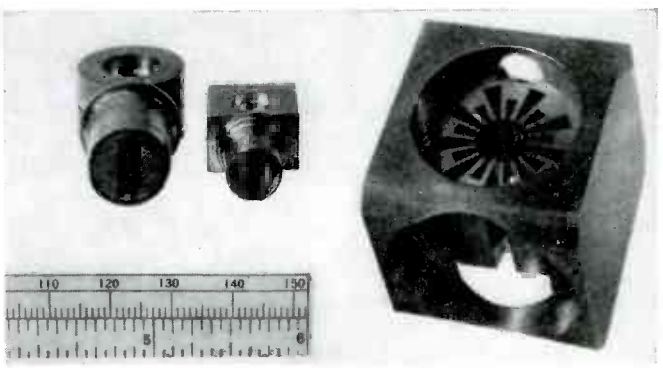


Fig. 1—The π mode separates out for large ratios of λ_2/λ_1 as shown in this plot for a 14 cavity rising sun anode

Fig. 2—Left, 1.25 cm strapped anode showing size of output wave-guide. Middle, 6 mm, and right, 3 cm rising sun anode showing alternate size cavities



AND CW MAGNETRONS

small Γ_2 and $\frac{jwc^1}{2} = Y$, the current and voltage after passing cavity 1 can be related to these quantities before the cavity by the equations:

$$I_1 = \cos(\Gamma_1) I_0 - \sin(\Gamma_1) Y \cot\left(\frac{\Gamma_1}{2}\right) V_0 \quad (1)$$

$$V_1 = \sin(\Gamma_1) \frac{1}{Y \cot\left(\frac{\Gamma_1}{2}\right)} I_0 + \cos(\Gamma_1) V_0 \quad (2)$$

A similar pair of equations with changed subscripts can be written for cavity 2, and with the two pairs of equations, the current and voltage between the cavities can be eliminated.

The resulting equations can be solved and reduced to

$$\cos \Gamma_{1+2} = 2 \cos \Gamma_1 \cos \Gamma_2 - 1 \quad (3)$$

This equation expresses the phase change per pair of unequal cavities in terms of the change in each cavity. Since the phase change must return to its starting point in going

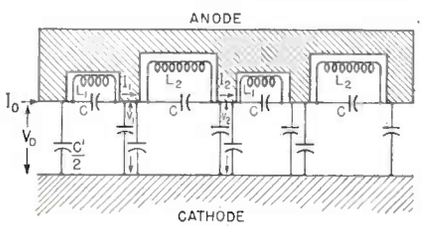


Fig. 3—Simulated circuit diagram for rising sun magnetron (cavity sizes highly exaggerated)

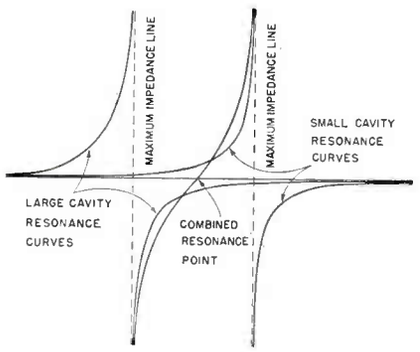


Fig. 4—Resonance curves for small, large, and combined cavities of a rising sun magnetron

around a circle of cavities, the phase change per pair can be related to the number of cavities by the expression

$$\frac{N}{2} \Gamma_{1+2} = 2\pi m, \text{ or } \Gamma_{1+2} = \frac{4\pi m}{N} \quad (4)$$

The quantity "m" can be any integer from 0 to N/4 (or to N/4—½ if N is twice an odd integer).

In order to find the phase changes Γ_1, and Γ_2 for the individual resonators we make use of the previously derived* relation

$$\frac{\lambda}{\lambda_0} = \sqrt{1 + \frac{C^1/2C}{1 - \cos\frac{2\pi n}{N}}} = \sqrt{1 + \frac{C^1/2C}{1 - \cos\Gamma}} \quad (5)$$

Solving this relation for cos Γ and applying it first to the small resonator and then to the large resonator we find

$$\cos\Gamma_1 = 1 - \frac{C^1/2C}{\left(\frac{\lambda}{\lambda_1}\right)^2 - 1} \quad (6)$$

$$\cos\Gamma_2 = 1 - \frac{C^1/2C}{\left(\frac{\lambda_1}{\lambda_2}\right)^2 \left(\frac{\lambda}{\lambda_1}\right)^2 - 1} \quad (7)$$

A plot can be made of cos Γ_{1+2} versus the ratio $\frac{\lambda}{\lambda_1}$. This is given in Fig. 5.

From this plot it may be seen that for each value of cos Γ_{1+2} there are two possible values of $\frac{\lambda}{\lambda_1}$ except when cos $\Gamma_{1+2} = 1$, when there is only one finite value. These two values occur when the phase difference between adjacent cavities is nearly π degrees and when it is nearly zero degrees.

It may be seen from Fig. 5 that the curve of the left branch for large ratios of $\frac{\lambda_2}{\lambda_1}$ changes direction sharply as the pi mode is approached. It is this which indicates the considerable wavelength separation available for operation in this mode.

A plot of wavelength vs. mode number is shown in Fig. 6 which shows the splitting of the spectrum into three parts.

The technic of manufacturing small anode cavities is of great interest and consists briefly of making a negative model of a desired cavity out of hardened steel. This can be done with relative ease by milling a round steel bar with radial slots and then hardening, or by grinding slots with a fine wheel into a previously hardened piece.

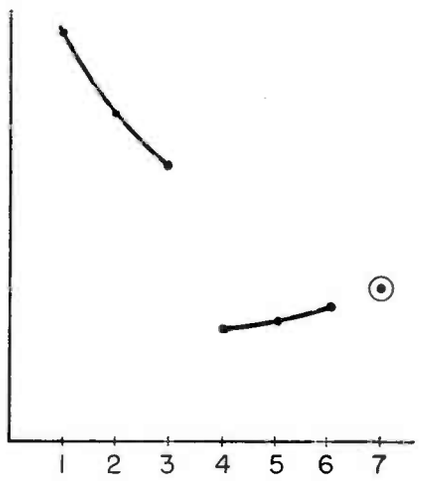


Fig. 6—Wavelength versus mode number for 14 cavity rising sun magnetron. Note the splitting of the spectrum due to alternate small and large cavities

The end of the bar is shaped into a blunt cone.

This tool, called a hob (Figs. 7 and 8), is mounted in a hydraulic press and a solid copper cylinder is placed in a steel block underneath it. The tool is then forced into the copper, the latter being caused to flow up and around the hob and down through a small hole in the backing anvil.

With pressures varying from less than 1 to more than 60 tons depending on size, a perfect replica of the hob is produced in the copper. All flash is trimmed off in a lathe.

The advantages of the rising sun magnetron design are considerable and include:

1. A larger and simpler structure for a given small wavelength.

2. Mode separation independent of anode height, up to a height of about one wavelength. This permits making anodes about ¾ wavelength high instead of only about 1/3 for a strapped tube strapped only at its ends.

3. Mode separation persists for

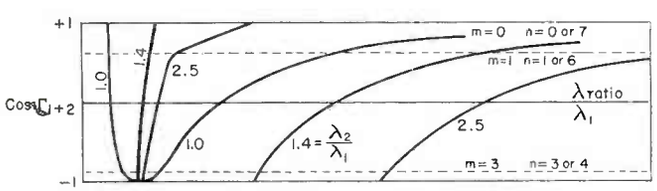


Fig. 5 — Cosine of phase angle per pair of cavities versus output to small cavity wavelength ratios

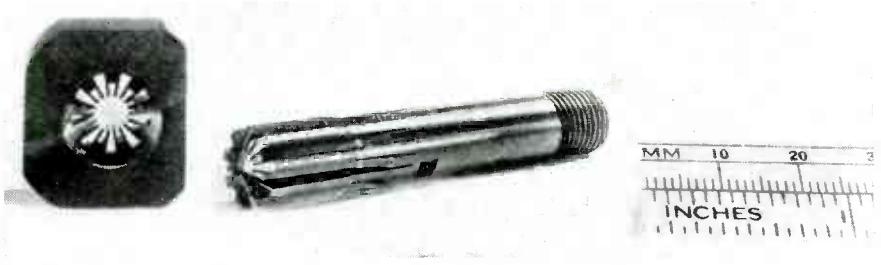


Fig. 7—1.25 cm anode with hob used to produce it. The hob is pressed into a copper blank

larger numbers of cavities. Tubes with as many as 38 cavities have operated satisfactorily.

4. Copper losses are less than in a strapped anode. Thus, for example, at 1.25 cm 35% of the rf power is lost in the copper surfaces of the anode resonators of a rising sun tube, whereas 45% is lost in a strapped tube. The savings in copper losses increase with decreasing wavelength.

There is one important disadvantage. This is, that a zero mode contamination of the π mode pattern causes inefficient operation at magnetic fields near $B = \frac{12{,}000}{\lambda}$ gauss. This is explained below.

Advantage number 2 above is due to the fact that ordinarily straps are placed only at the ends of the anode. Therefore the ends of the anode are loaded with extra capacity while the center is unloaded.

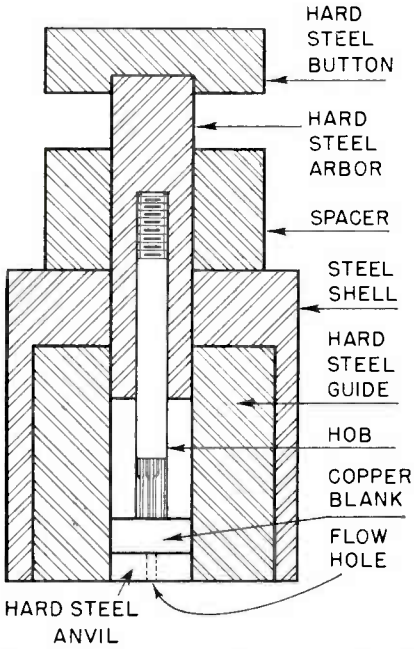
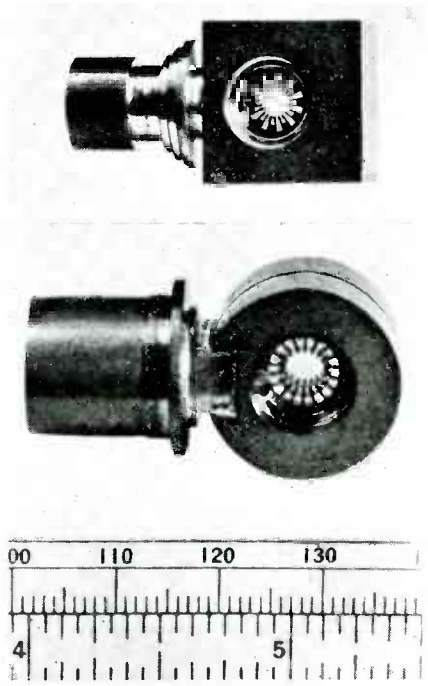


Fig. 8—Method used to hob out cavities in copper blank. All flow flash is trimmed off in a lathe

If the ends are too far apart, it is possible for them to operate nearly independently. This manifests itself in a competing mode of oscillation which has a nodal plane through the center of the anode parallel to the ends.

The use of longer anodes is important in that it permits longer cathode design and more room for power dissipation.

As for the zero mode contamination mentioned above, it has been shown by a theoretical analysis of the field distribution inside the cavities that the nodal current point between adjacent small and large cavities is not opposite the separating web, but some way inside the large cavity. In fact, this is almost obvious upon examination.



Figs. 9 & 10—6 mm rising sun anode compared in size to 1.25 cm strapped anode

The large cavity is larger than a quarter wavelength and the smaller one, smaller. Therefore, the voltage across the large cavity mouth is greater than across the small cavity mouth (Fig. 11). Hence, the currents in the ends of all the fins are at any instant in the same direction. This is equivalent to saying that the π mode is not a pure $n = \frac{N}{2}$ mode but has some admixture of an $n = o$ component.

When electrons are emitted from the cathode they tend to move in circular paths such that their centrifugal force $\frac{mv^2}{r}$ equals the magnetic force on them $\frac{Bev}{c}$. The frequency of this motion in terms of

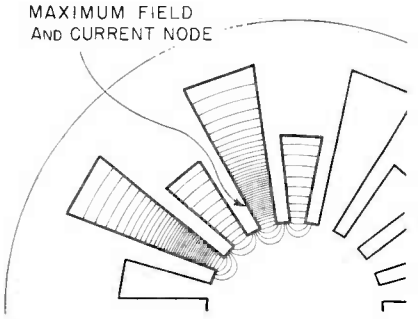


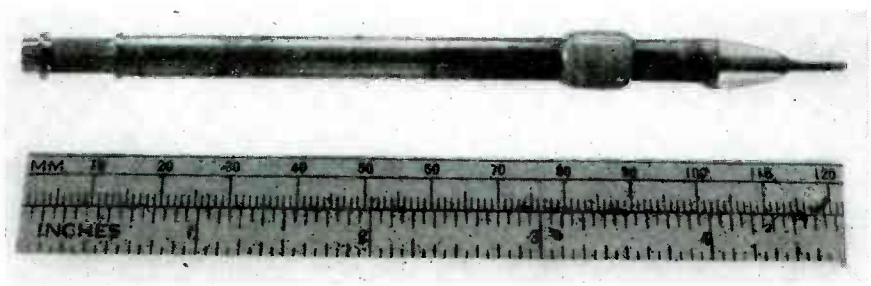
Fig. 11—Distribution of electric fields in rising sun cavities. Point of greatest field is not at mouth but inside large cavity

radians is Be/mc and is ordinarily called the cyclotron frequency.

Due to the difference in field strength at the mouth of the small and large cavities, there is an unbalanced component of the radio frequency electric field circulating around the cathode. If this is in synchronism with the cyclotron frequency of the electrons coming from the cathode, their normal paths are distorted either inward or outward. Interfering with the normal production of rf oscillations.

The condition for synchronism is that the rf frequency equals the cyclotron frequency. If expressions for these frequencies are equated,

Fig. 12—A coaxial magnetron cathode inserted through a hole in one magnet pole piece. The emissive surface may be seen at left between the hats, and is imbedded in a fine mesh screen



it is found that synchronism occurs for values of wavelength times field strength λB around 12,000 gauss centimeters. At this magnetic field the influence of the zero mode contamination is a maximum and creates a region of low efficiency in the performance characteristic of a tube (Fig. 14).

It is therefore necessary to operate the magnetron at field strengths either above or below this value. For wavelengths around 3 cm it is possible to operate above it at fields of 5000 or 6000 gauss, but at 1.25 cm and below it is almost necessary to operate below this region even though efficiency tends to be reduced as it occurs around 10,000 or more gauss, an unreasonably high field.

In connection with the invention of rising sun magnetrons much experimental work has been done on other features and it is interesting here to note some of the results.

Most magnetrons constructed to date have been used in pulse operation with a small duty cycle. A need exists for continuous wave power at frequencies around 2,000 to 100,000 mc. To provide this, some tubes were built for this service by making cathodes of pure tantalum and tungsten. The most successful tube had a tungsten coil cathode in a coaxial mount. With

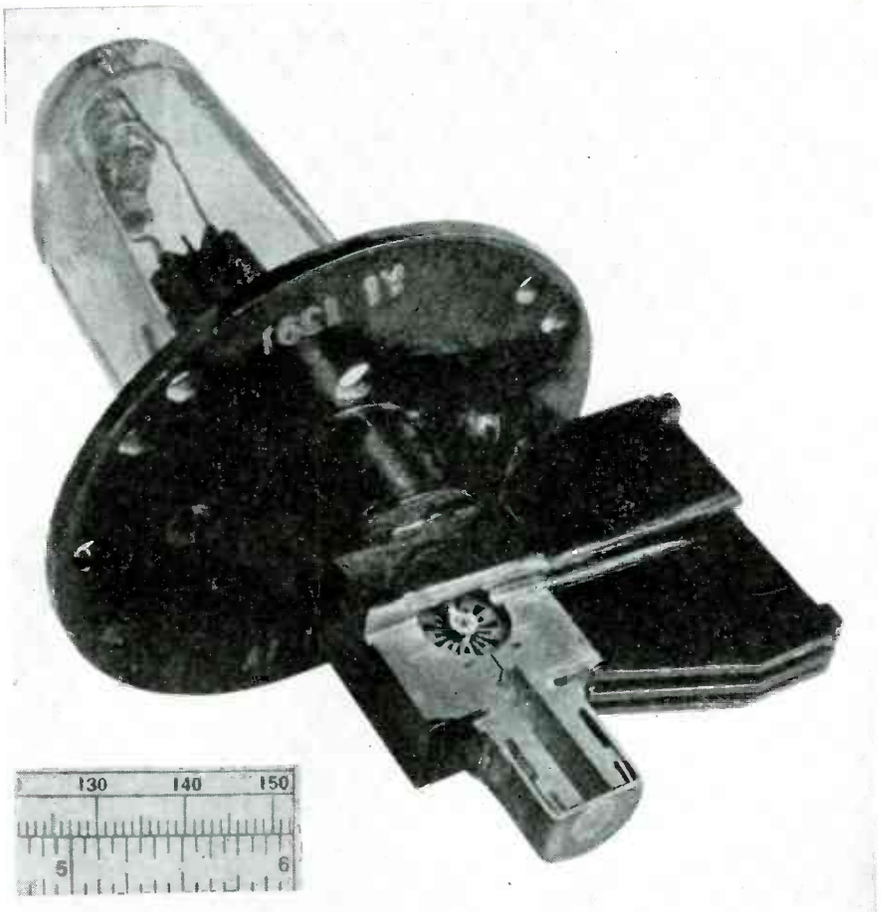


Fig. 13—A 1.25 cm magnetron with sides cut away. Note the glass window construction at end of wave-guide, the quarter wave choke grooves. Type of glass and matching are important to prevent melting

Fig. 14—Performance chart for 3 cm magnetron. Irregularity in efficiency curves around 3500 gauss is due to zero mode contamination

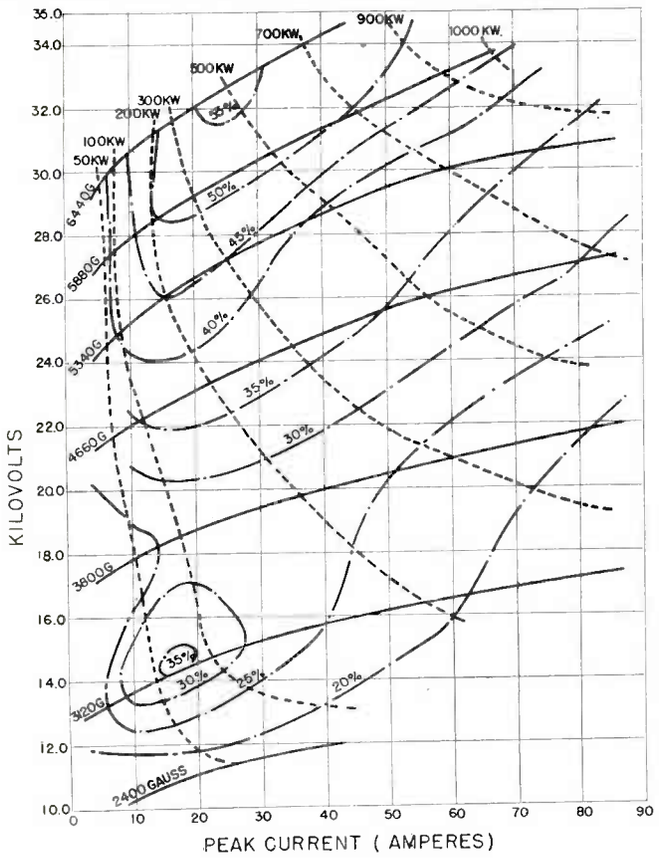


Fig. 15—Performance chart of a cw magnetron operating at 2.6 cm

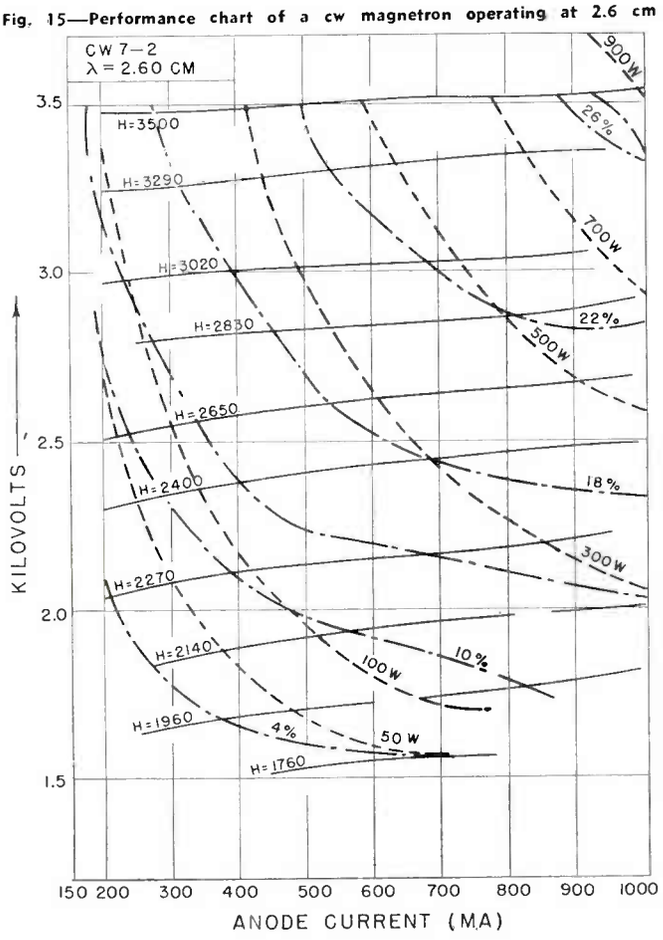


Fig. 16—(Right) Performance chart of a 1.21 cm magnetron
Fig. 17—(Above) View of CW magnetron showing output guide (lower left), quarter wave transformer section, housing, anode, one anode cover plate, magnet pole piece with hole for coaxial cathode

this structure the hats (enlarged washer shaped ends of cathode) could be kept fairly cool, which appeared to improve the operation considerably. It was possible to obtain 900 watts at 26% efficiency with a dc supply of 3500 volts at one ampere and with a field of 3500 gauss. This was at 2.60 centimeters (Fig. 15). The tube had 34 vanes which were closed at the ends to decrease competition from longer wavelength modes.

The problem of cathode design for high powers in this frequency range is difficult as it is necessary to prevent not only undue heating from back bombardment but also arcing to the anode.

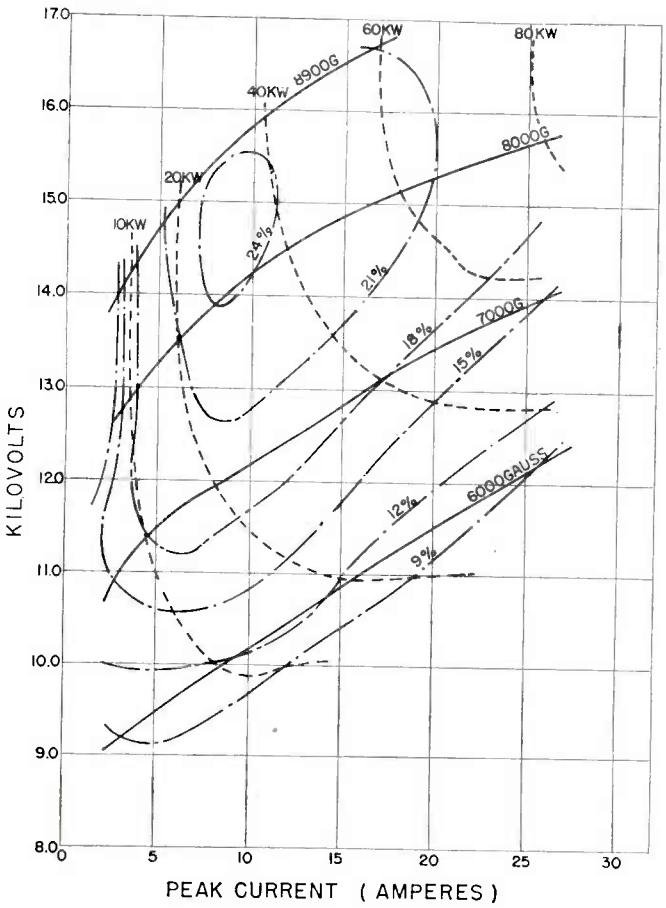
In connection with the use of waveguide outputs instead of coaxial outputs, a considerable amount of work was also done on the proper matching of the waveguide output of low wavelength magnetrons with the resonant cavity. Since the impedance of the cavity is of the order of one hundredth that of the guide, a transformer must be introduced between the two whose impedance is the geometric mean between the cavity and guide impedance and whose length is one quarter wavelength.

In terms of the dimensions of a rectangular waveguide whose large and small internal dimensions are respectively a and b and of the corresponding dimensions a^1, b^1 of the transformer section, this could be expressed by the relation

$$Z = \frac{a(b^1)^2}{(a^1)^2 b}\sqrt{\frac{1-(\lambda/2a)^2}{1-(\lambda/2a^1)^2}\frac{\mu_o}{e_o}}$$

If three of the dimensions a, b and a^1 are kept fixed, the impedance is proportional to the square of the small dimension b^1. It was found necessary to reduce slightly the length of the transformer to compensate for the abrupt change at the transformer faces.

The glass window in the output line was also studied extensively and the design adopted may be seen in Fig. 13. Altogether it may be said that magnetrons will probably find considerably increased peacetime uses due to some of the recent developments in their design.

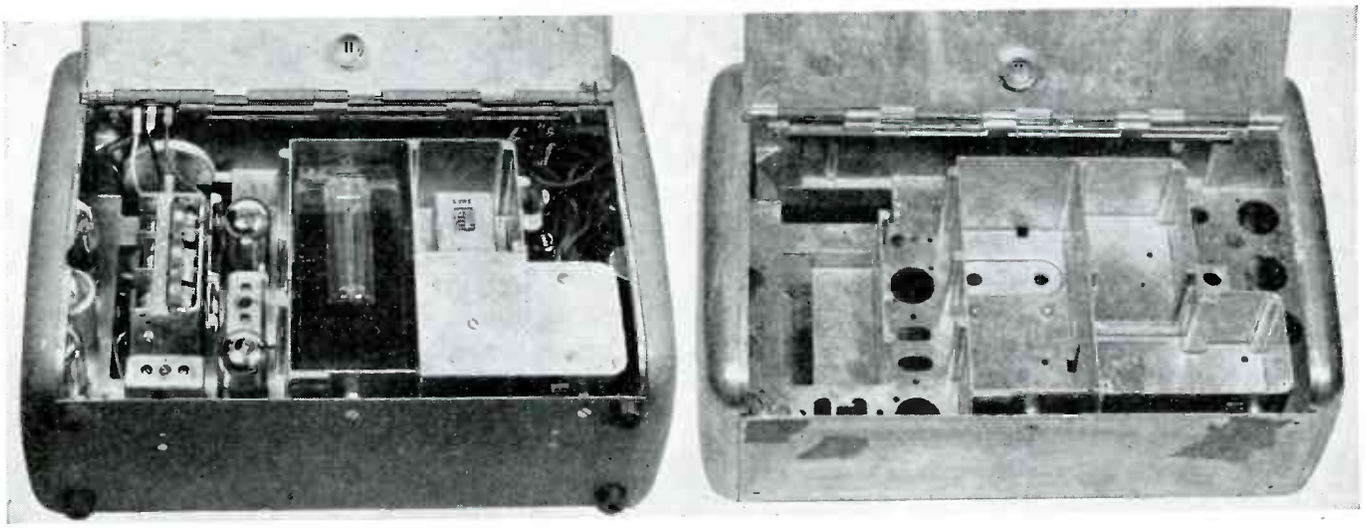


New Permanent-Magnet Materials

Five new permanent-magnet materials, known as cunico, cunife, vectolite, alnico 12 and silmanal, have been developed by the General Electric Co. Cunico is an alloy of copper, nickel and cobalt, made from rod, strip or wire; magnets are furnished only in their final shapes because they are age-hardened in the manufacturing process. Cunico is malleable, ductile and machinable.

Cunife is a copper-nickel-iron alloy which has all the physical properties of cunico, differing in that it has directional properties and must be magnetized only along the direction in which the material has been cold-worked, to obtain highest magnetic quality. Cunife magnets are made from wire stock in round, square or rectangular form.

Vectolite is the first non-metallic, non-conducting magnet material ever made. It is a hardened, sintered combination of iron rust and cobalt oxide mixed when still in powder form. Vectolite magnets are extremely light, being non-metallic, and their non-conductive properties prevent electrical losses caused by conduction of current. In addition, they have a high coercive force, or resistance to demagnetizing forces. Alnico 12 is made up of aluminum, nickel, cobalt, iron and titanium. Alnico 12 magnets are cast, and must be ground to shape. Silmanal has a high intrinsic coercive force, which makes magnets made from this material useful in instruments where service in strong electrical fields is required. Silmanal is ductile and malleable and can be punched, machined, rolled, or ground.



Left is a view of the new General Electric storage battery-operated portable receiver with the back cover open showing disposition of the battery, power supply and other principle components. Right is a view of the elaborate die cast foundation unit

DIE CAST CHASSIS

Outstanding example of aluminum casting technic in two new battery operated portable broadcast receivers

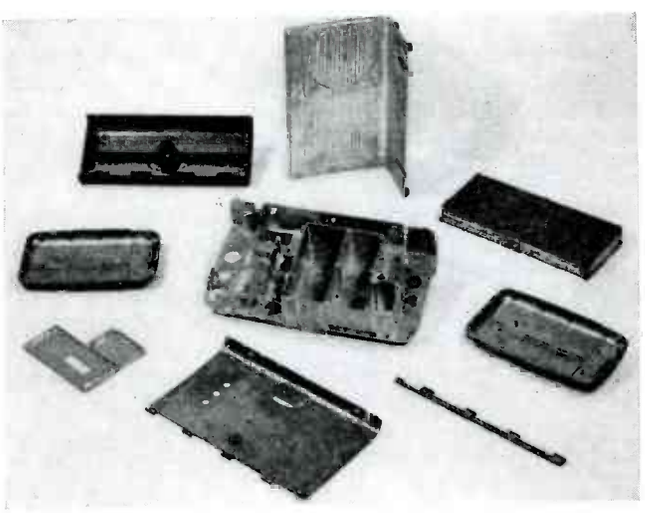
● The new portable broadcast receivers developed by General Electric represent an outstanding example of die casting engineering. There are two models, one for standard broadcast with dial tuning and five tubes, the other for standard broadcast and five short wave bands with push button tuning and six tubes. Both have the same die cast chassis, airplane type rechargeable storage battery and vibrator. Both are entirely battery operated but may be operated from ac with the battery floating.

The chassis is the foundation of these receivers (Models 250 and 260). It is a fairly large casting and one of the most intricate aluminum die castings ever made. Some of the wall thicknesses are unusual inasmuch as they taper from .093 to .050 in. The casting has mounting ears so that the end covers may be attached with Tinnerman nuts.

The filter cover, also an aluminum die casting, is designed to permit the mounting of all component parts, including the vibrator, to make a complete power supply, less the storage battery. This casting is assembled in its compartment on the chassis by means of a force fit and three flat head screws. The battery box cover, an aluminum die casting, is assembled on the chassis by means of a force fit and two Tinnerman spring latches.

The end covers also are aluminum die castings and are assembled to the chassis by means of three Tinnerman speed nuts. The rear brace, an aluminum die casting, is the rigid member of the hinge and is attached to the chassis by means of two screws, nuts, and lockwashers. The front grille and cover, an aluminum die casting, provides the mounting lugs and the grille opening for the loudspeaker. This part is assembled to the chassis with screws. The back cover is also an alminum die casting.

The receiver loop, located in the cabinet cover assembly, is a molded phenolic-pulp product. Model 260 has in addition a small plug-in loop for short waves.



Left—Cover raised on the broadcast model showing controls. Right are shown the die cast foundation unit used in both receivers together with several of the other die cast parts which are used in the chassis design. Entire design is credited to engineer F. D. Schnoor, of receiver division

MICROWAVE APPROACH

By W. T. SPICER
Bendix Radio Division of Bendix Aviation Corp.
Baltimore, Md.

Using a distant radar beam and two close-in beams for precision the GCA eliminates special airplane installations

● Airfields closed in by fog, rain, or other adverse weather have always constituted one of the major hazards in aircraft operations.

In 1940, operation of the Air Forces of the United Nations from fog-bound and blacked-out airfields all over the face of the earth provided the impetus for development of an instrument approach system capable of supplying accurate let-down information for all aircraft under conditions of zero visibility.

Basically, the equipment consists of two microwave radar sets which are placed adjacent to the runway in use. One set locates all aircraft in the vicinity of the airport, and the other provides continuous information regarding the position of incoming aircraft with respect to the runway (see Fig. 1). The first, a conventional two-dimensional radar system, known as the Search System, provides a polar radar map of the area within a 30-mile radius of the airport.

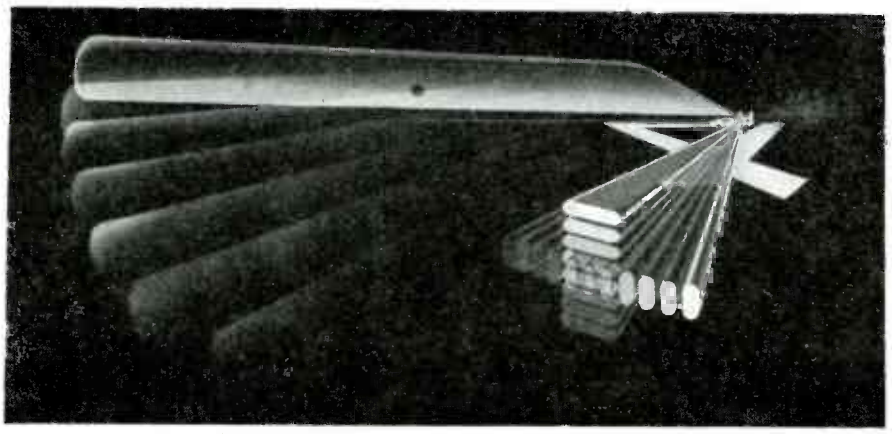


Fig. 1—Artists drawing of search and precision system radar beams

Fig. 2—Search system PPI indicator

Precision system

The second radar system, known as the Precision System, covers only the sector in space through which a plane must fly in order to make a proper approach to the runway. This system is subdivided into two portions, the first supplying continuous information regarding the range and azimuth of an incoming plane, and the second supplying range and elevation information on the plane. The combined information from these two subdivisions, therefore, locates the incoming plane in three dimensions (range, azimuth, and elevation).

All equipment is installed in a single truck and trailer, placed adjacent to the runway. Five operating positions are included, two for the Search System and three for the Precision System. Each of the two Search System operators has a cathode-ray tube radar indicator presenting a polar radar map of the area surrounding the airport (see Fig. 2). Communications equipment covering all required ranges in the hf and vhf frequency bands is available to each of these operators for establishing two-way contact with aircraft in the area. One operator directs traffic by sending the pilots of the various planes the vector heading and elevation which each should fly while awaiting landing instructions. Since only one plane can land at a time, it is the responsibility of the second operator to select each plane in the order of landing, and to vector it to a point within the sector covered by the Precision System.

In the Precision System there are two sets of indicators. One set, the Azimuth Indictaor, is operated by the Azimuth Tracker, and presents azimuth versus range data. The resulting picture is, as shown in Fig. 3, plan view of the airport, runway, and incoming plane. A movable hairline mounted over the face of the indicator is electrically connected with an azimuth error meter, and is actuated manually by the Azimuth Tracker so that the hairline remains over the signal echo of the incoming plane.

The equipment is so adjusted that as long as the incoming plane is on-course, the echo signal and the hairline follower are coincident with the selected approach path, and the error meter reads zero. However, if the plane flies off the selected approach path, the Azimuth Tracker follows the deviation with the follower, and a resultant error is indicated on the azimuth error meter. This meter is calibrated to read, directly in feet, the amount of deviation from the selected approach path (see Fig. 4).

The second set of indicators showing elevation is operated by the Elevation Tracker and presents elevation versus range data. The resulting picture is, as shown in

AND LANDING SYSTEM

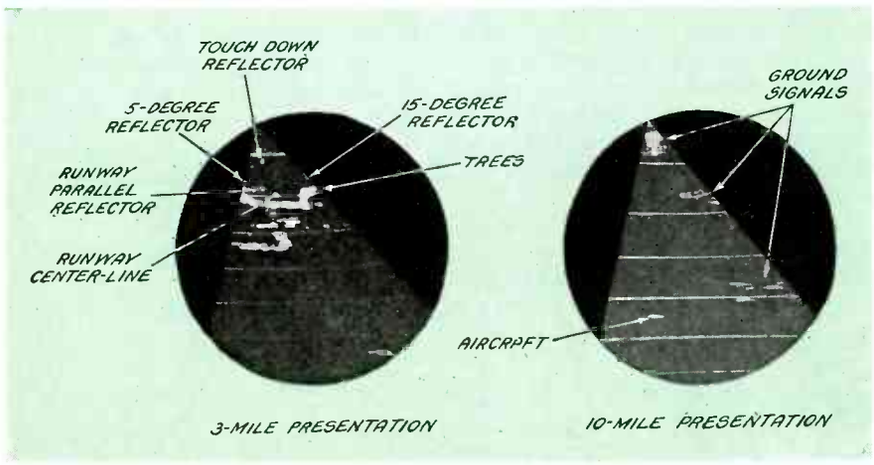


Fig. 3—Precision system azimuth indicator presentation

of the incoming aircraft in the form of verbal instructions as to the direction in which he is to fly to make the proper approach to the landing strip.

Inasmuch as all instructions for controlling both the traffic flow and the landing procedure are issued by the crew of ground operators, the equipment is called the GCA (Ground Controlled Approach). No equipment is needed in the plane other than the communications equipment normally carried. Hence the only requirement for use of GCA by any aircraft, whether a small personal plane or a Moscow-to-New York air transport, is that the pilots have facilities for

Fig. 5, an elevation view of the airport, runway, and incoming plane. Just as on the Azimuth Indicator, facilities are provided for establishing on the presentation a glide path along which the plane should fly to make the let-down to the runway. Angular elevation of the glide path can be adjusted easily and quickly for any type of plane being landed. Tracking facilities identical with those on the Azimuth Indicator are electrically connected to an Elevation Error meter which indicates, directly in feet, the deviation above or below the selected glide path. Zero error indicates that the incoming plane is on the approach path (see Fig. 6).

The two error meters (Azimuth and Elevation), shown in Fig. 7, are placed directly in front of the third Precision System operator, who is known as the Approach Controller. Like the Search System operator, he is equipped with all necessary communication facilities for establishing two-way contact with the incoming aircraft.

The Approach Controller, by watching the Azimuth and Elevation Error Meters, is able to tell at all times the position of the incoming aircraft with respect to the selected glide path, since one meter (the Azimuth Error meter) indicates right and left deviations (from the approach path), while the other (Elevation Error meter) indicates deviations above or below the selected glide path. By means of the communication equipment, the Approach Controller conveys the deviation data to the pilot

Fig. 4—Method of using azimuth error meter to advise pilot

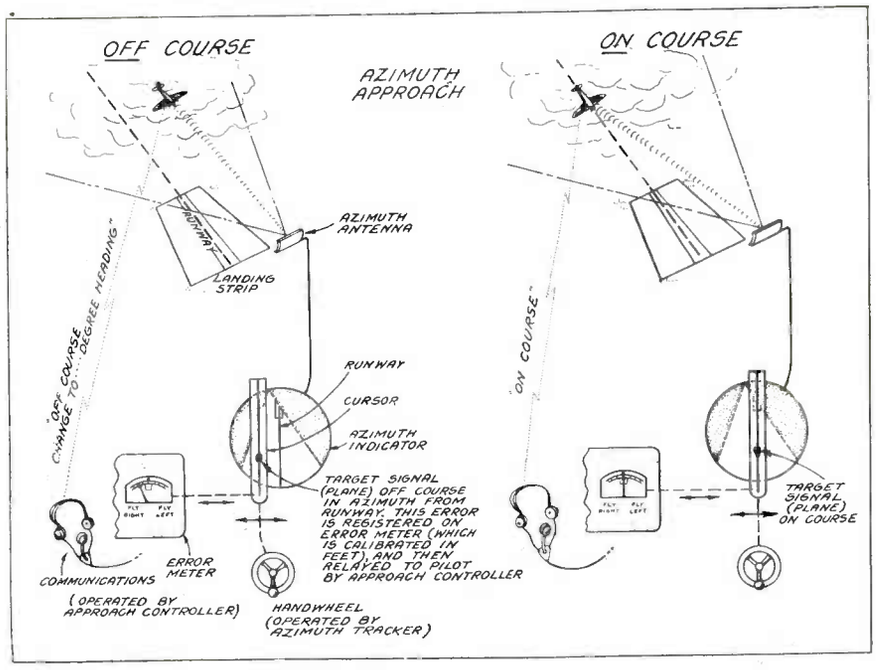
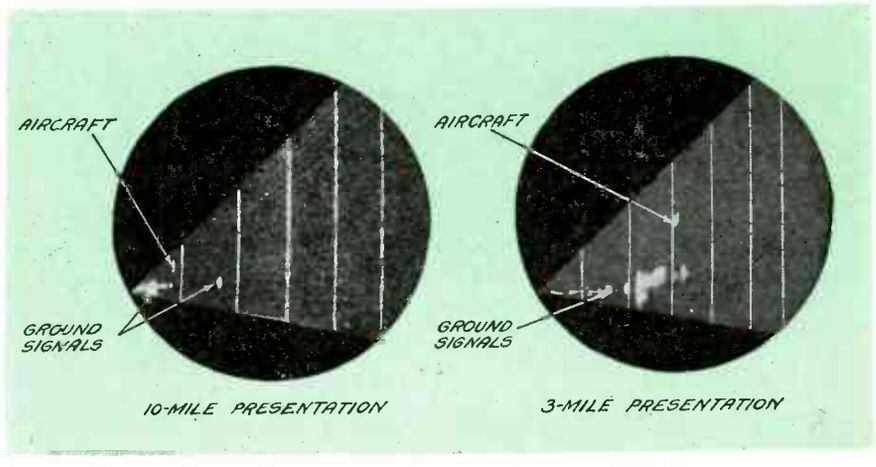


Fig. 5—Scope face presentation of elevation indications



establishing radio communication with the operating crew.

Increased aircraft pay load and greater utility result from the adoption of GCA. Moreover, experience in combat theatres proved conclusively that GCA requires less pilot training than other types of landing systems, and that it could be used effectively by inexperienced pilots or by battle weary veterans returning from all-night bombing missions.

GCA, constructed as a mobile system, can be shifted from one runway to another and be placed in operation in less than 30 minutes. This extreme mobility obviates dual installations for cross-runways.

The Search System, a microwave radar operating at a frequency of approximately 3000 mc, has a maximum range of 30 miles. The information obtained from this system is presented on Plan Position Indicators (PPI) in the form of a polar-coordinate map with the mobile station as the center, and with all detected targets located in coordinates of range and azimuth. Coverage of 360° in azimuth is obtained by using an antenna which rotates at a speed of 30 rpm. Fig. 9, an elevation view of the antenna beam coverage, shows the complete coverage obtained up to approximately 5000 ft. altitude by use of the odd-shape antenna pattern.

To obtain the peculiarly shaped antenna beam, an array of 33 probe-fed, half-wave dipoles, mounted in a section of waveguide, is used. At the extremely high frequencies used the halfwave antennas are approximately 5 centimeters over-all, and hence the array is only about 7.5 ft. long. By placing this array along the focal line of a semi-cylindrical aluminum reflector of parabolic cross section, an azimuth antenna pattern having a beam width of less than 7° between half power points is obtained.

The transmitting, receiving, and indication portions of the Search System, much like a standard radar system, utilizes a magetron transmitter tube, a Klystron local oscillator tube, an automatic frequency control circuit, and a high-gain radar receiver. The receiver IF strip is stagger-tuned to provide a bandpass of approximately 3 mc between points 3 db down about a center frequency of 30 mc. The transmitter is pulsed at a repetition rate of 2000 per second, each pulse having a duration of 0.5 microsecond. A peak power of approximately 75 kw is obtained in each pulse.

Received echo pulses, which appear in the receiver output, are further amplified and then applied

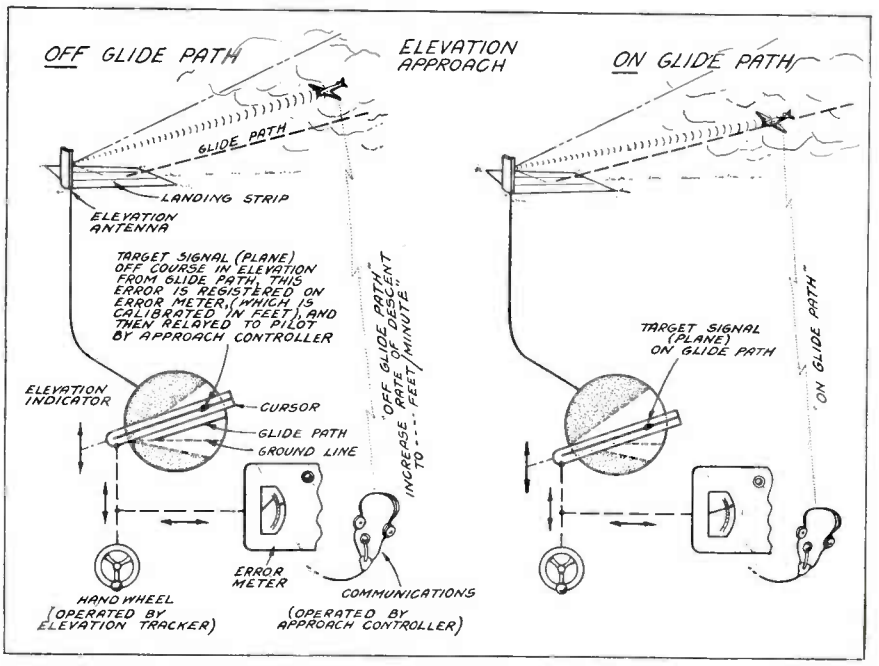


Fig. 6—Error meter indication of elevation

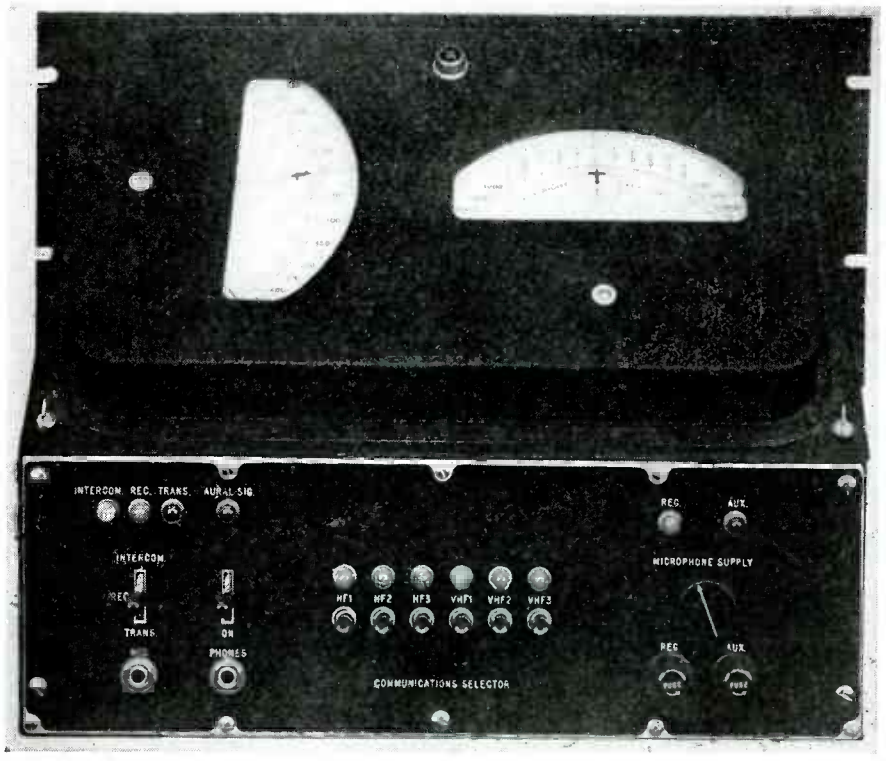


Fig. 7—Operating error meter used on ground

to the control grid of a 7-in. magnetically deflected cathode ray tube to intensity-modulate the sweep on the tube screen, and thus produce the desired radar picture. A transparent rotatable navigating head having an etched compass rose is placed over the face of the indicator tube, and when properly oriented with the installation, provides the operator with the necessary information for vectoring planes into the traffic pattern.

In the Precision System, the transmitting magetron operates at a frequency of approximately 10,000 mc, and is pulsed at a rate of 2000 per second in synchronism with the Search System transmitter. The peak power delivered is approximately 20 kw, and the system has a maximum range of 10 miles. A Klystron local oscillator is also utilized in this circuit to produce a 30-

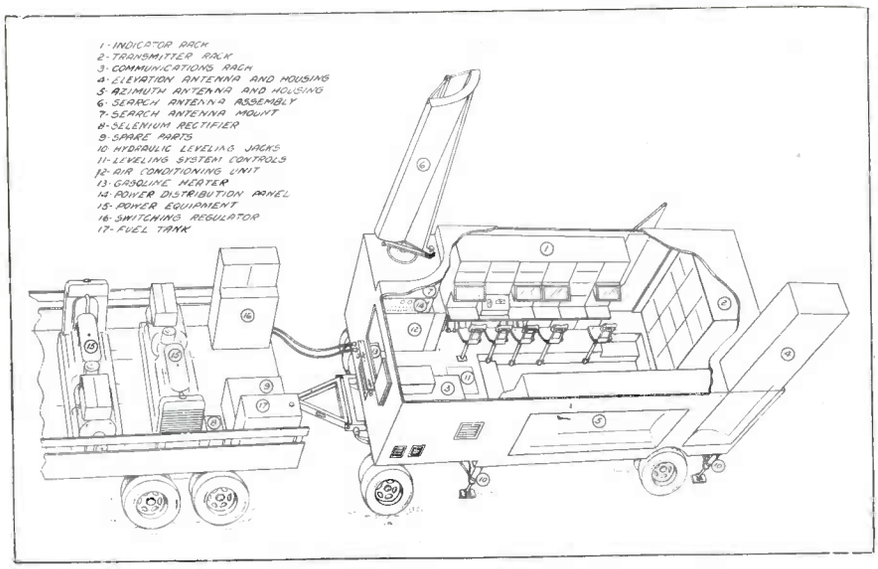


Fig. 8—Phantom view of equipment trailers showing 3 antennas

mc IF. Video output of a receiver identical to that in the Search System intensity-modulates the Precision Indicators. The system is much like a conventional radar, except for its indicator and antenna portions. Because the latter two components are the very heart of GCA a more detailed discussion of them follows.

As previously stated, the Precision System is subdivided into two portions, one concerned with azimuth and range data and the other with elevation and range data. To obtain this three-dimensional information, two antennas are necessary, one whose beam scans through a horizontal plane to provide azimuth and range data and the other whose beam scans through a vertical plane to provide elevation and range data.

It was pointed out that in the Search System 360° beam coverage is obtained by actually rotating the entire antenna and reflector assembly through 360°. In the Precision System it is desirable to cover a sector 20° wide in azimuth and 7° high in elevation. Since the elevation angle must be scanned by one antenna beam (the elevation antenna) and the azimuth angle must be scanned by the other antenna beam (the azimuth antenna), the problems involved in actually moving the two antennas through these angles at the desired scan rate became almost insurmountable, and another scan method was devised.

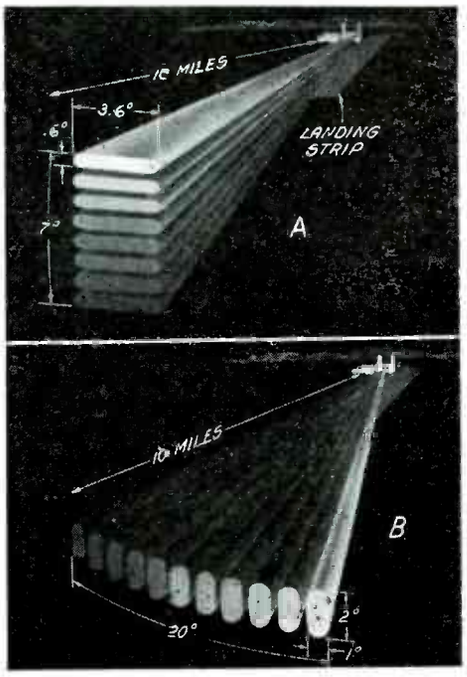


Fig. 10—Elevation and azimuth beams

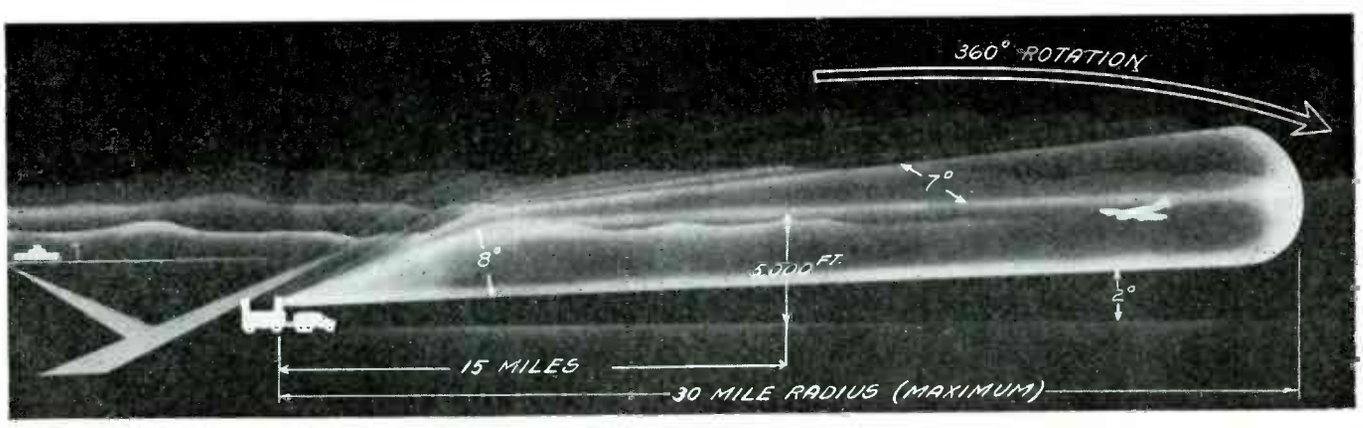
The azimuth antenna beam (scanning in a horizontal plane) must be extremely narrow in azimuth to obtain maximum definition and target resolution, and must be wide in elevation to avoid scanning either above or below the incoming plane and missing the target completely.

Dimensions in the elevation antenna are reversed, since, here, the beam must be narrow in elevation (for definition and resolution) and wider in azimuth (to avoid scanning on either side of the target).

Extremely narrow beams can be obtained only by using an array of many antennas and, in the azimuth and elevation systems, each antenna consists of a multiple dipole array mounted in a waveguide section and placed along the focal line of a cylindrical reflector of semi-parabolic cross-section.

The elevation antenna has its main axis in a vertical plane and, with its 14-ft. array of 165 half-wave dipoles, produces a highly directive beam which is less than 0.6° thick in elevation between half power points. The reflector reduces the beam to less than 3.6° in azimuth. The main axis of the azimuth antenna is horizontal, and its 8.5-ft. array of 115 half-wave dipoles produces a beam which is less than 1° wide in azimuth between half power points. The reflector reduces the beam to less than 2° thickness in elevation. The large number of half-wave dipoles in each array is physically possible only because of the extremely short wavelengths used (approximately 3 centimeters).

Fig. 9—Important dimensions and range of search beam for early location



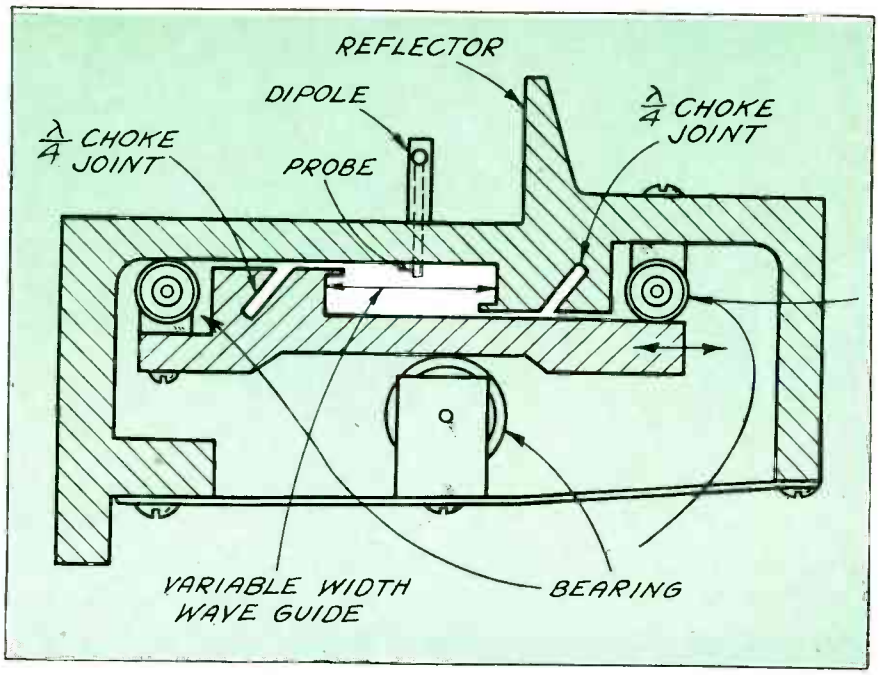


Fig. 11—Variable wave guide causes beam swings

As already noted, electrical scanning was adopted. Since the dipoles of the antennas are mounted in and fed from a waveguide section, the relative phase at which the individual dipoles receive energy from the guide can be changed by alternating the wavelength of the energy in the guide.

However, if the phase of dipole feed is shifted by altering the wavelength of energy in the guide, the antenna beam will be shifted to one side or the other of the normal of the antenna, depending upon whether the wavelength is increased or decreased.

This alteration is accomplished by changing the wide dimension of the waveguide. The antenna waveguide section consists of two extruded aluminum sections mounted together as shown in Fig. 11, a cross-sectional view of the antenna. The two L-shaped pieces fit together, as shown, to form a rectangular waveguide section in the center through which rf energy is directed to the dipoles. The movable wall is given a reciprocating motion by means of a driving tie-rod and a series of toggle joints, as shown in Fig. 12.

The resulting variable waveguide width causes a smooth variation in the wavelength of energy in the guide. If the waveguide width is such that the dipoles are all fed exactly in phase, the radiated beam will be normal to the antenna array. However, under this condition, the reflections in the waveguide from each dipole probe would all be in phase, a large standing

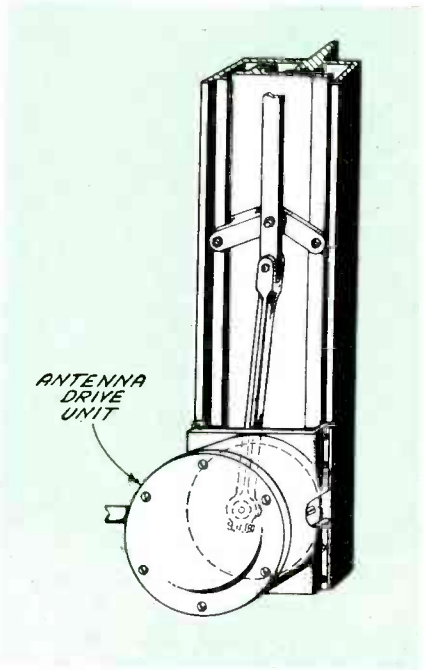


Fig. 12—Toggle wave guide mechanism

wave ratio would be set up, and tranmitter tube loading and a large frequency shift would result. To avoid this condition, the waveguide width is never allowed to reach this critical point during the scan period, the antenna beam only being allowed to scan within 1° of the antenna normal. At this point, the dipoles are fed slightly out of phase, resulting in good standing wave ratio due to cancellation of the probe reflections.

It would seem at first glance that, since two antennas are used, each supplying different information, two transmitters also would be necessary. However, by use of a special switch section inserted in the waveguide leading from the transmitter to the two antennas, they are fed alternately by a single transmitter. One is energized for ⅛ second, and then the other is energized for ⅛ second.

The Azimuth Indicators, like the Elevation Indicators, includes two cathode ray tube presentations. One CRT presentation has a 10-mile range, while the other has a 3-mile range. The 10-mile tube information is used during the initial stages of the approach, when the incoming plane is being lined up with the approach path, and the 3-mile tube information is utilized during the later stages when extreme accuracy is required. All sweep deflections in the indicator tubes are obtained by means of magnetic deflection coils mounted around the neck of the cathode ray tubes and driven by sweep amplifier circuits.

Coupling units

Coupling units consisting of 1-megacycle oscillator circuits, a capacity-divider network, and a rectifier circuit, are connected to the variable waveguide mechanisms and supply the sweep amplifier circuits with voltages whose amplitude varies linearly with the antenna beam scanning motions.

In order to present azimuth (or elevation) information in addition to range, the indicator sweeps must scan in synchronism with the antenna beam scan and it is the coupling unit voltage which provides the required synchronism. Since the azimuth and elevation antenna beams scan through 20° and 7° angles, respectively, it is necessary to expand the angular scan of the indicator sweeps to permit more accurate observation.

The azimuth indicator sweep, which ordinarily would scan through 20°, is expanded three times, and the elevation indicator sweep, which would scan through only 7°, is expanded 10 times. This expansion is not direct angular expansion (where the 20° azimuth beam scan would be represented by a 60° indicator scan and the 7° elevation beam scan by a 70° indicator scan). On the contrary, only the vertical deflection component is expanded until it is either three or ten times as great as that required to produce a 20° or 7° scan, respectively. The other deflection component is held constant.

The presentation is known as expanded partial PPI or EPI. In ad-

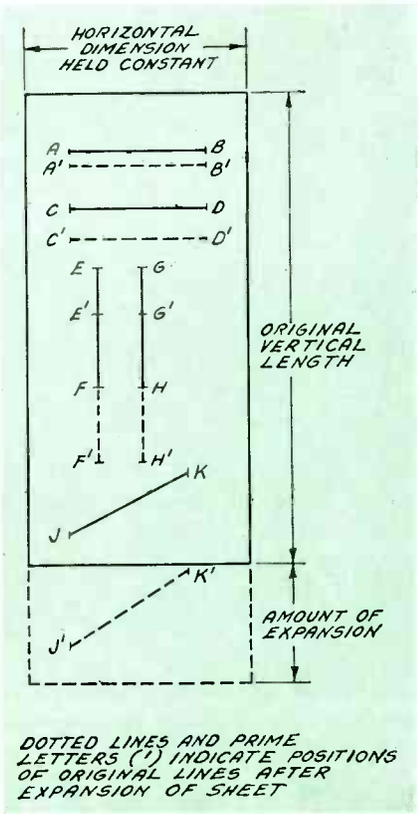


Fig. 13—Effect of sweep expansion

dition to the expansion provided, the origin of the presentation is moved to the edge of the CRT by dc centering currents in the deflection coils, thus providing maximum utilization of the screen area. Since the azimuth presentation is a plan view of the scan area and the elevation presentation is an elevation view of the scan area, the tubes are rotated 90° from each other to give the operators the proper view of the presentations.

The presentations, as developed thus far, would be as shown in Fig. 14. In this illustration, the deflection coils to which the constant amplitude deflection pulse is applied are called the time-base sweep coils, while the variable pulse coils are called the expansion sweep coils. Because the azimuth antenna scans from 5° on one side of the approach path to 15° on the other and the elevation antenna scans from 1° below ground to 6° above, the approach path on the azimuth tube and the ground line on the elevation tube are not perpendicular to the electronic range marks in the tube presentations. This is inconvenient, since it is desirable to have the range marks perpendicular to these two reference lines in order to obtain greatest tracking accuracy when following echo signals with the tracking cursors.

To provide this 90° relationship, a portion of the expansion sweep voltage is inverted and applied to the time-base sweep voltage with the result that the time-base sweep component decreases slightly as the expansion sweep increases from zero to maximum value. The focus of the ends of the sweeps therefore is tilted inward and the presentation shown in Fig. 15 is obtained.

Range marks

Electronic range marks which appear as straight lines are supplied to both sets of indicator tubes, 2500-ft. range marks appearing on the 3-mile tubes and 10,000-ft. marks appearing on the 10-mile tubes.

In setting up the GCA trailer for operation, the equipment is placed at the windward end of the runway in use in order to allow incoming planes to head into the wind when approaching the landing strip. By placing the centerline of the trailer at an 84° angle with respect to the major axis of the runway, as shown in Fig. 16, an azimuth scan coverage of 5 degrees to starboard and 15 degrees to port of the landing strip is secured. The equipment is located from 200 to 300 ft. from the runway centerline for safe operation. The apparently excessive angular displacement of 1° between the trailer and runway is required because the antenna beam scans only to within 1° of the antenna normal.

The Ground Control Approach system which permits blind landing of any airplane carrying only voice communication equipment was originally conceived by Luis Alvarez at the M.I.T. Radiation Laboratory as a result of his experience with gun laying devices. The commercial development was carried on by the Watson Laboratories of the Army Air Forces, the Bureau of Ships of the Navy and several contractors.

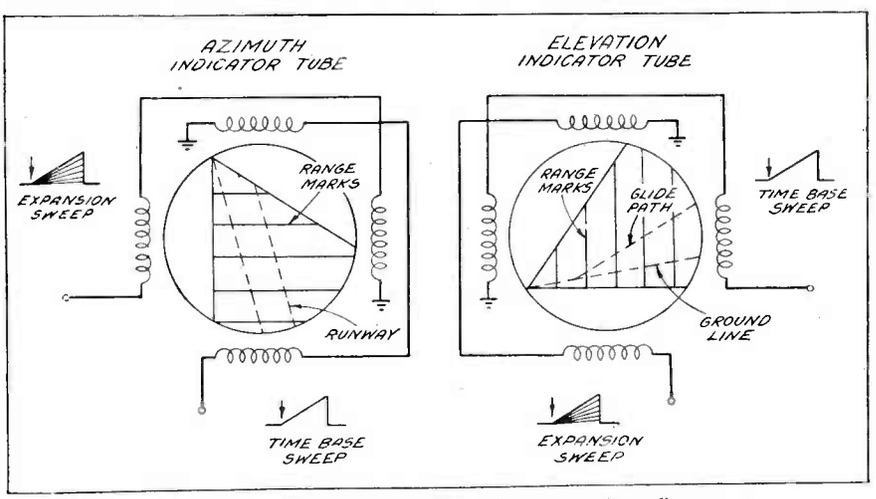
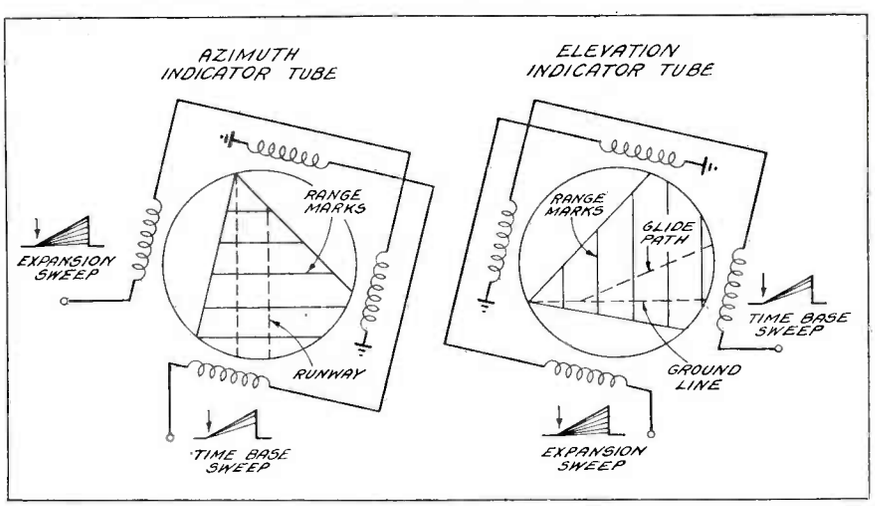
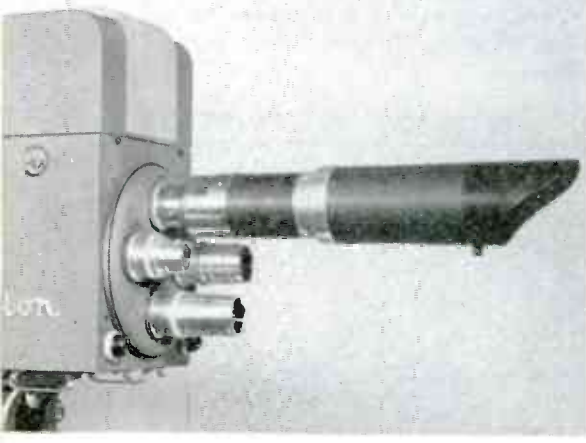


Fig. 14—Range marks are not perpendicular to runway with ordinary sweep

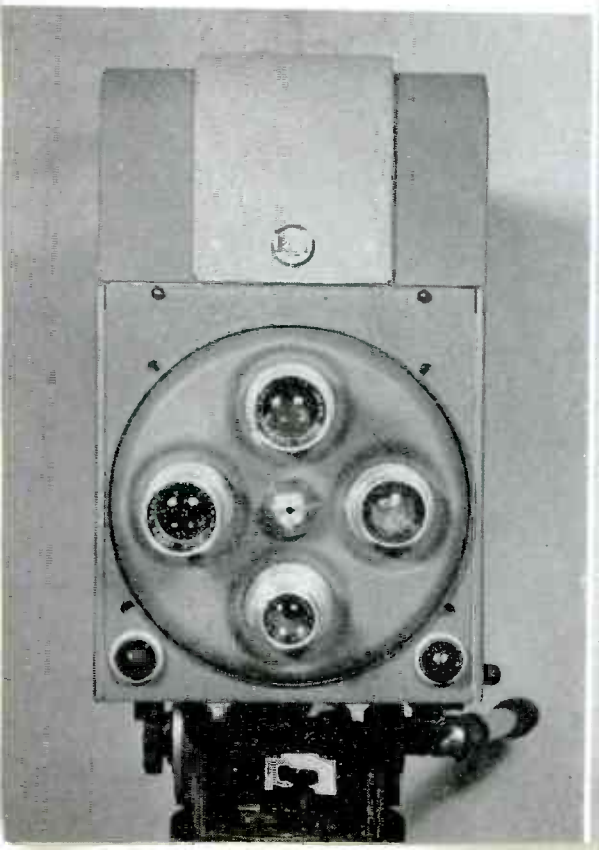
Fig. 15—By using feed back on sweep range marks are corrected



Close-up of the new RCA model TK-30A Image Orthicon camera which carries four lenses in a turret. Below, addition of telephoto



Head-on view showing arrangement of the turret lens mounting, individual lenses being positioned by rotating the turret



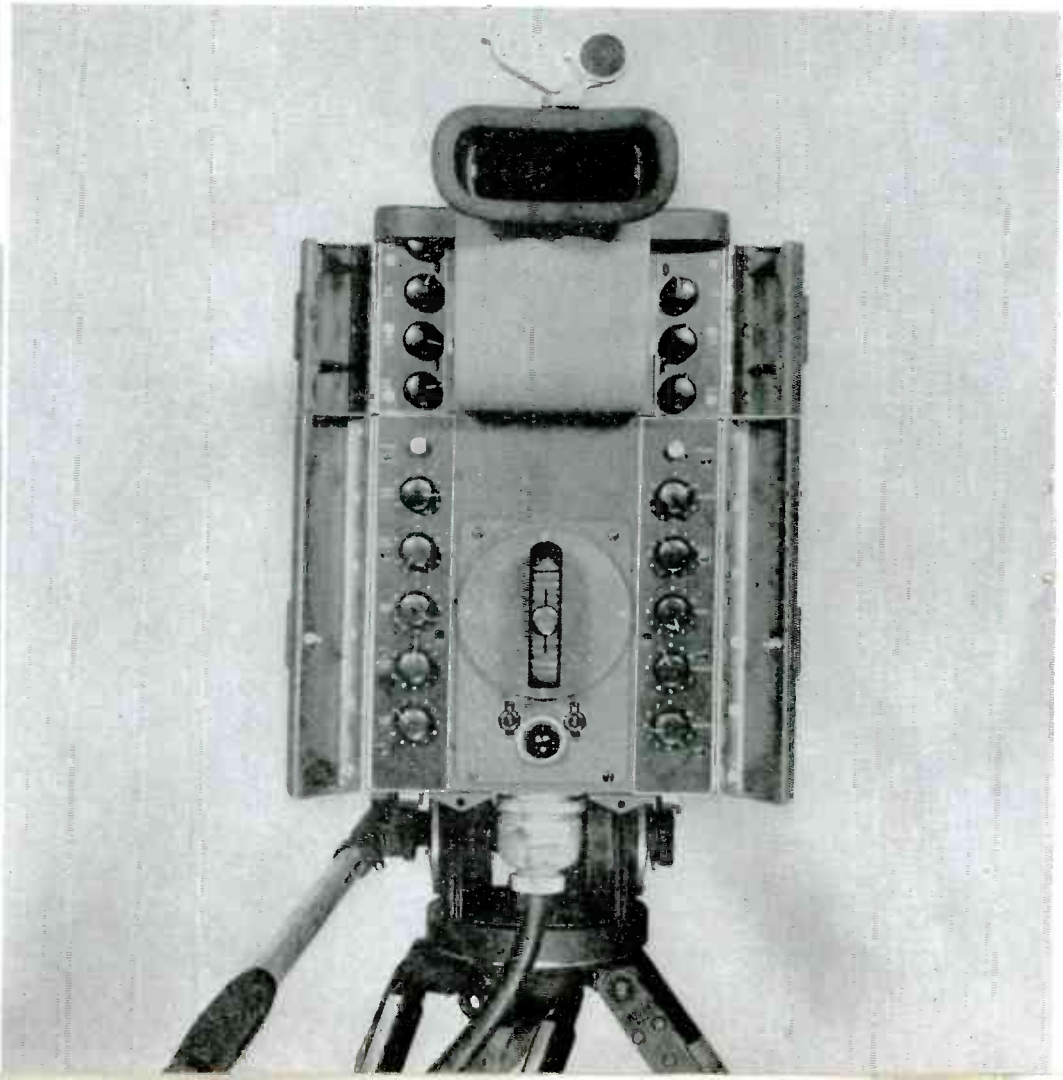
General view of the NBC television setup for the Louis-Conn fight, equipment being located in the lower section of the stand, putting the cameras 235 ft. from the center of action

MODERN TELE

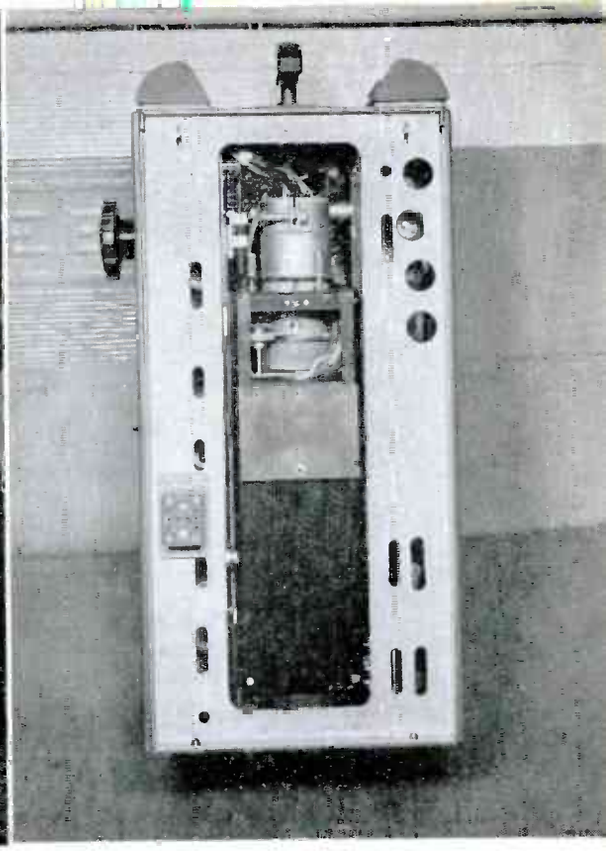
Recently developed RCA equipment as used

See Article, Page 86,

Top view of the camera with the view finder section removed. View finder section, fitting on top, is removable by releasing mechanical catches; there are no leads to disconnect



Close-up of the NBC booth, showing two of the new Image Orthicon cameras in position, alongside an experimental camera used together with two more pre-war Orthicons, five altogether



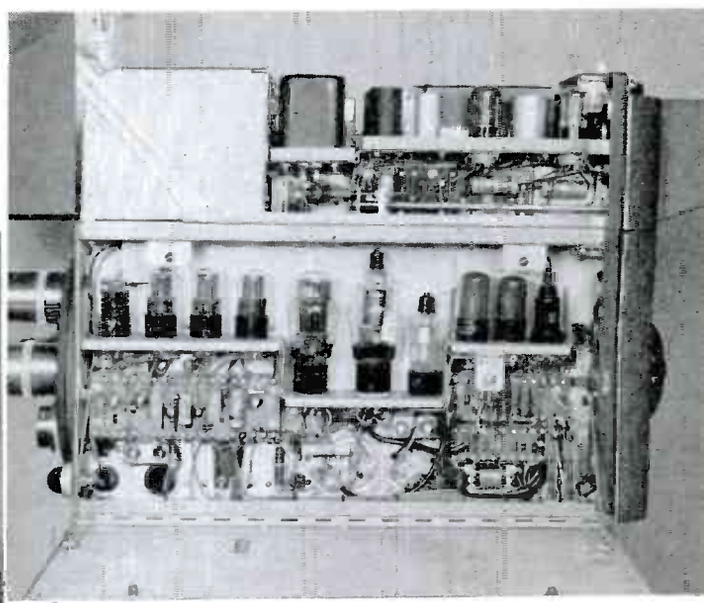
Top view of camera case with view finder section removed. All parts are accessible

CAMERA UNIT

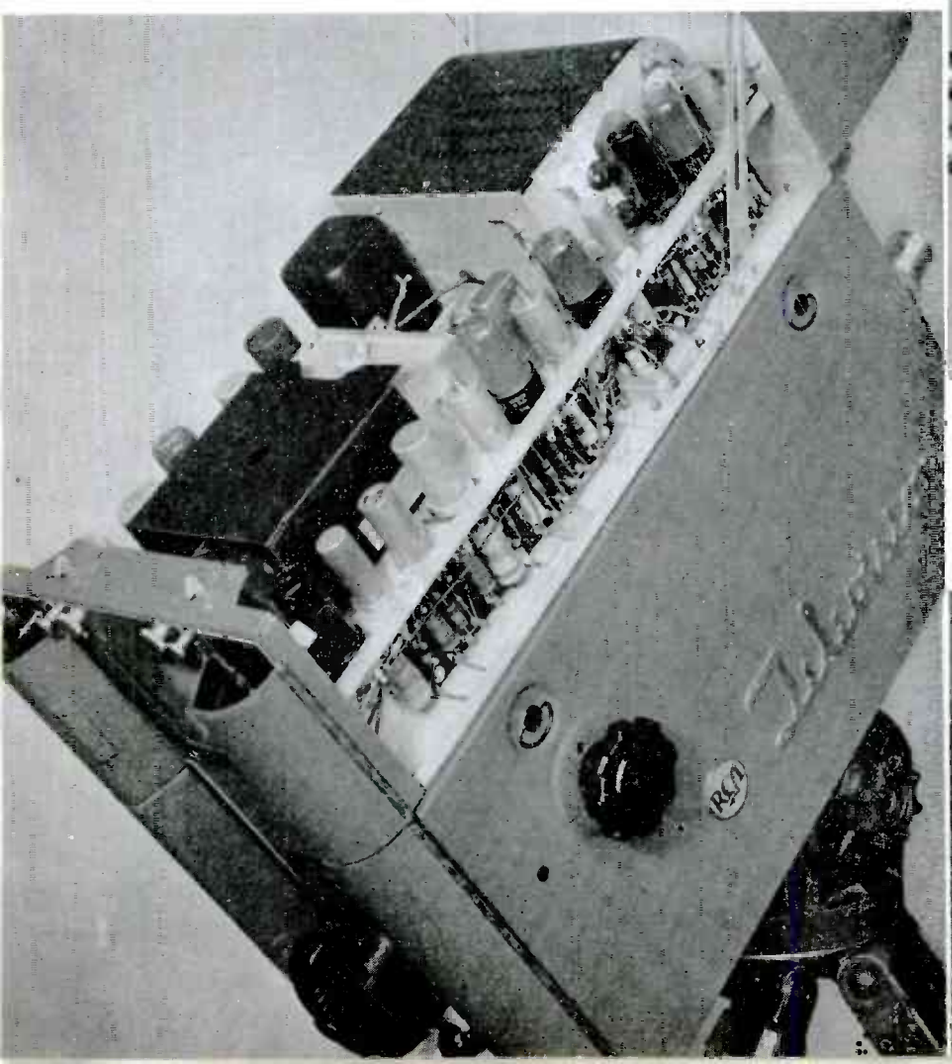
at the Louis-Conn video broadcast by NBC

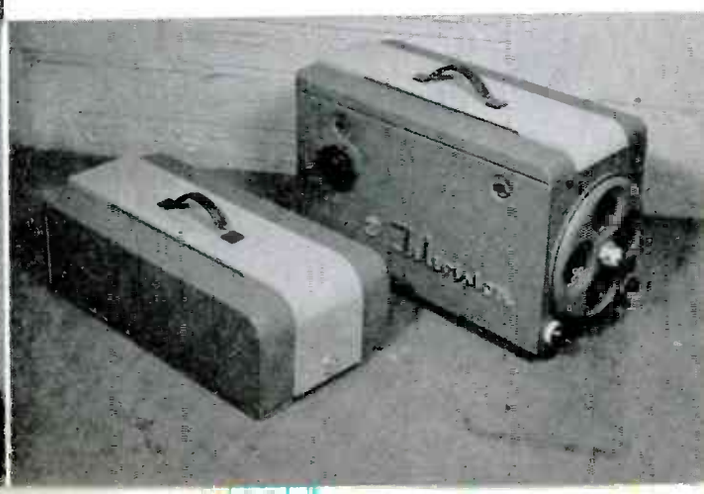
in This Issue)

Top of camera, case raised to reveal interior of electronic view finder section. View finder has a 5-in. kinescope, produces good picture under normal conditions for monitoring



Side view of camera opened to show accessibility provided for all tubes, components and wiring. View finder cover is raised. Below are shown the separable camera and view finder sections, each an integral unit itself, removable for maintenance operations





RESONANT CAVITIES

By L. J. GIACOLETTO
Eatontown, N. J.

Parameters associated with the dimensions of a resonant cylinder having particular design features are theoretically considered

● A lossless cylindrical cavity exhibits multiple resonances determined by the relationship

$$\left(\frac{n\lambda}{2L}\right)^2 + \left(\frac{r_{lm}\lambda}{2\pi b}\right)^2 = 1 \qquad (1)$$

where

b = radius of cavity
L = length of cavity
λ = free space wavelength = velocity of light / frequency

all measured in the same units, and l, m, and n are integers ranging from 0, 1, 2, —— upward except for m = 0 which is excluded and r_{lm} are roots of certain characteristic equations.[1] In the case of transverse magnetic oscillations (TM_{lmn} modes of oscillation) r_{lm} is the mth root of the lth order Bessel function, i.e.

$$J_l(r_{lm}) = 0 \qquad (2)$$

which are in part[2] $r_{01} = 2.405$, $r_{02} = 5.520$, ——, $r_{11} = 3.832$, $r_{12} = 7.016$ ——. The position magnitudes of the electric and magnetic fields are

$$E_z = A\frac{r_{lm}^2}{b^2} J_l\left(r_{lm}\frac{\rho}{b}\right)\cos l\theta \cos n\pi\frac{z}{L} \qquad (3)$$

$$E_\rho = -A\frac{n\pi r_{lm}}{L\rho} J_l'\left(r_{lm}\frac{\rho}{b}\right)\cos l\theta \sin n\pi\frac{z}{L}$$

$$E_\theta = A\frac{ln\pi}{L\rho} J_l\left(r_{lm}\frac{\rho}{b}\right)\sin l\theta \sin n\pi\frac{z}{L}$$

$$H_z = 0$$

$$H_\rho = -A\frac{l\sqrt{\left(\frac{r_{lm}}{b}\right)^2 + \left(\frac{n\pi}{L}\right)^2}}{\rho} X \left[J_l\left(r_{lm}\frac{\rho}{b}\right)\sin l\theta \cos n\pi\frac{z}{L}\right]$$

$$H_\theta = -A\frac{r_{lm}\sqrt{\left(\frac{r_{lm}}{b}\right)^2 + \left(\frac{n\pi}{L}\right)^2}}{b} \left[J_l'\left(r_{lm}\frac{\rho}{b}\right)\cos l\theta \cos n\pi\frac{z}{L}\right]$$

where A is an arbitrary constant determined by the magnitude of the field excitation and $J'_l(x)$ is the derivative of $J_l(x)$ with respect to the entire argument x.

For the transverse electric oscillations (TE_{lmn} modes of oscillations) r'_{lm} is the mth root of the first derivative of the lth order Bessel function, i.e.

$$\frac{dJ_l(r'_{lm})}{dx} = 0 \qquad (4)$$

which are in part[2] $r'_{01} = 3.832$, $r'_{02} = 7.016$, ——, $r'_{11} = 1.841$, $r'_{12} = 5.331$, ——. The position magnitudes of the electric and magnetic fields in this case are

$$E_z = 0 \qquad (5)$$

$$E_\rho = -A\frac{l\sqrt{\left(\frac{r'_{lm}}{b}\right)^2 + \left(\frac{n\pi}{L}\right)^2}}{\rho} X \left[J_l\left(r'_{lm}\frac{\rho}{b}\right)\sin l\theta \sin n\pi\frac{z}{L}\right]$$

$$E_\theta = -A\frac{r'_{lm}\sqrt{\left(\frac{r'_{lm}}{b}\right)^2 + \left(\frac{n\pi}{L}\right)^2}}{b} X \left[J_l'\left(r'_{lm}\frac{\rho}{b}\right)\cos l\theta \sin n\pi\frac{z}{L}\right]$$

$$H_z = A\frac{\left(r'_{lm}\right)^2}{b^2} J_l\left(r'_{lm}\frac{\rho}{b}\right)\cos l\theta \sin n\pi\frac{z}{L}$$

$$H_\rho = A\frac{n\pi r'_{lm}}{L b} J_l'\left(r'_{lm}\frac{\rho}{b}\right)\cos l\theta \sin n\pi\frac{z}{L}$$

$$H_\theta = -A\frac{ln\pi}{L\rho} J_l\left(r'_{lm}\frac{\rho}{b}\right)\sin l\theta \cos n\pi\frac{z}{L}$$

The design of resonant cylindrical cavities is simplified by the introduction of the sine and cosine, respectively, for the first and second terms in eq. (1) so that

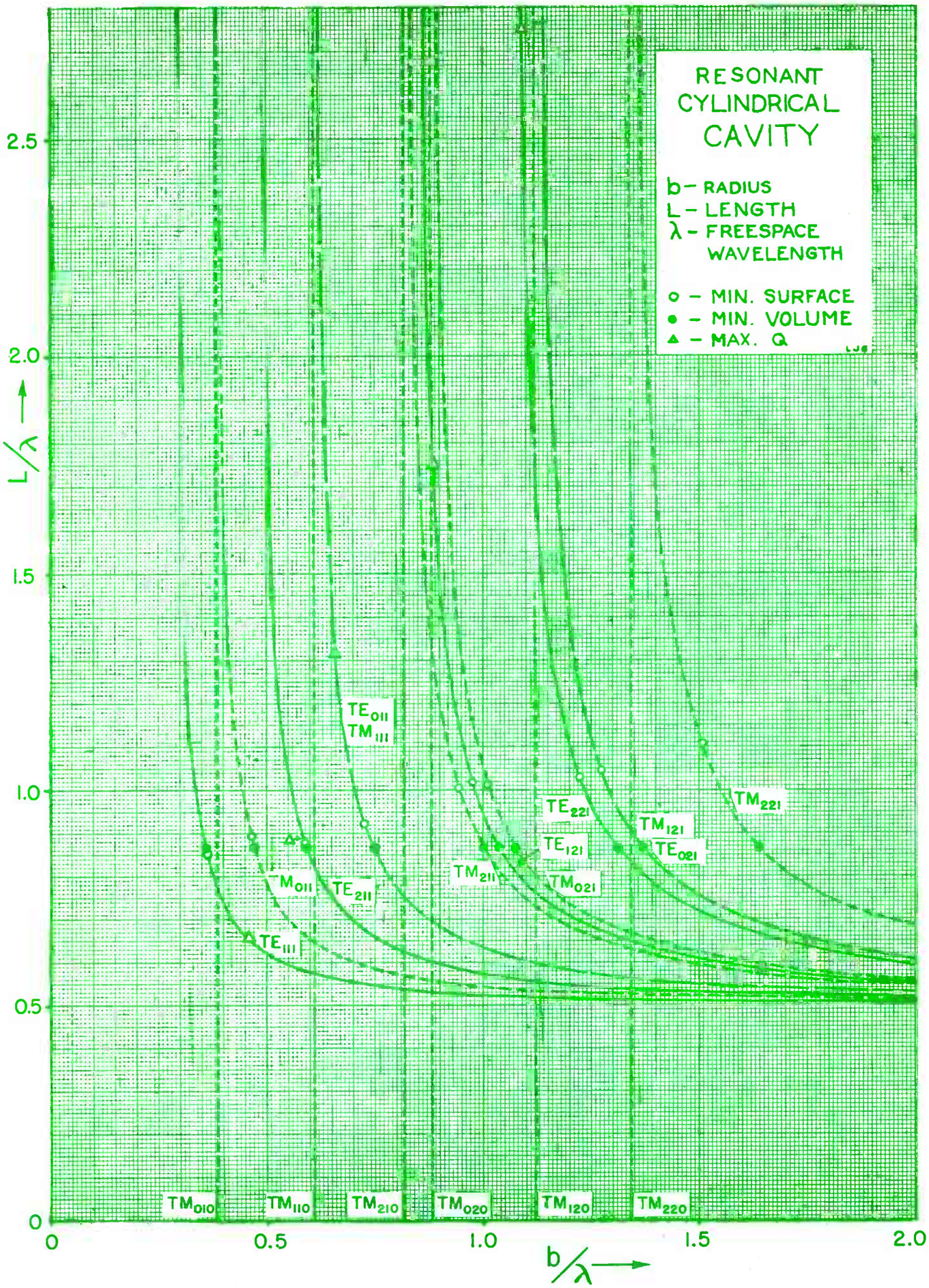
$$\frac{L}{\lambda} = \frac{n}{2\cos\alpha} \qquad (6)$$

$$\frac{b}{\lambda} = \frac{r_{lm}}{2\pi\sin\alpha}$$

The range of α is from 0° to 90°, although in practice the value of α would usually be in the range of from 15° to 75°. Equation 6 has been used to compute the curves shown in the chart. These curves give the length and radius of a resonant cavity in relation to the free space wave length of the oscillating field. The TM_{1mn} modes are shown in dotted lines and the TE_{1mn} modes are solid lines. The TE_{0mn} and the TM_{1mn} curves are identical and a broken line has been used. All the permissible lower order modes for which n = 1, m = 1, 2, and 1 = 0, 1, 2 have been shown. The curves for other values of n are easily obtained by multiplying L/λ by n. Thus for n = 2 another set of curves are obtained similar to those shown but asymptotic to the line L/λ = 1. This fact should be kept in mind particularly when designing cavities to be free from spurious oscillations. The curves in the chart can be used in designing wave guides by noting the asymptotic value of b/λ approached as L/λ gets larger.

Since the dimensions of a cavity resonant for a particular mode are not uniquely determined, it is advantageous to consider the dimensions required to give certain optimum conditions. Thus a cylindrical

1. Care should be exercised in comparing works of different authors as different systems of designating the various modes have been used. The main discrepancy arises in the designation of the lowest root of the characteristic equations as the zeroth root or the first root. The latter designation is used in this paper and follows the Institute of Radio Engineers' Standards on Radio Wave Propagation, Definition of Terms Relating to Guided Waves (1945).
2. For additional roots see D. B. Smith, L. M. Rodgers, and E. H. Traub, Journal of the Franklin Institute, April, 1944, or Electronics, July, 1944; p. 240.



Design curves for cavities having either minimum surface or volume, or maximum Q

cavity will have minimum volume when

(7)

$$\left.\frac{L}{\lambda}\right|_{MIN.VOL.} = \frac{\sqrt{3}}{2}n = 0.866\,n$$

These points are indicated by solid dots on the chart. The condition for minimum surface area is satisfied when

(8)

$$\frac{b}{\lambda} = \sqrt{\frac{r_{\ell_m}^2}{4\pi^2} + \frac{n^2}{4\beta} + \frac{n}{12\pi}\left[6r_{\ell_m}^2 - \left(\frac{n\pi}{2}\right)^2\right]^{\frac{1}{2}} \sinh\frac{\theta}{3}}$$

$$\sinh\theta = \frac{\left(\frac{n\pi}{2}\right)^3 - 9\left(\frac{n\pi}{2}\right)r_{\ell_m}^2 + 27\frac{r_{\ell_m}^4}{n\pi}}{\sqrt{\left[6r_{\ell_m}^2 - \left(\frac{n\pi}{2}\right)^2\right]^3}}$$

The points for minimum surface are indicated by the open dots on the chart. Values of minimum volume and surface area in relation to the freespace wavelength are tabulated in Table I.

Another optimum condition that is of considerable interest is that for maximum Q. According to Schelkunoff,[3] the Q of a cylindrical cavity when only boundary surface losses are considered is given by

(a) For TM_{1mn} oscillations

(9)

$$Q = 34.4\sqrt{g\mu_r\lambda}\,\frac{b/\lambda}{1 + b/L} \quad \text{if } n = 0$$

$$Q = 34.4\sqrt{g\mu_r\lambda}\,\frac{b/\lambda}{1 + 2\,b/L} \quad \text{if } n \neq 0$$

3. Schelkunoff, "Electromagnetic Waves," D. Van Nostrand Comp., Inc., p. 440. Note that in the two equations quoted here as Equat. 9 there is a typographical error in Schelkunoff's book wherein h should be replaced by l, the length of the cavity in his notation. Also in both (9) and (10) the notation differs from that used by Schelkunoff and substitution has been made for the intrinsic resistance of the boundary material so that

$$\frac{\omega\mu}{2R} = 34.4\sqrt{\frac{g\mu_r}{\lambda}}$$

(b) For TE_{1mn} oscillations

(10)

$$Q = \frac{34.4\sqrt{g\mu_r\lambda}\left(r_{\ell_m}^2 - \ell^2\right)\left(r_{\ell_m}^2 L^2 + n^2\pi^2b^2\right)b/\lambda}{\left[\ell^2n^2\pi^2b^2 + r_{\ell_m}^4L^2 + 2n^2\pi^2\left(r_{\ell_m}^2 - \ell^2\right)b^3L^{-1}\right]}$$

where

g = conductivity of boundary material $= 5.8 \times 10^7 \frac{\text{mho}_s}{\text{meter}}$ for copper

μ_r = relative permeability $\doteq 1.0$ for nonmagnetic conductors

and λ, b, and L are measured in meters. If it is assumed that the losses in the cavity are small enough that (1) still holds, then Q will be minimum or maximum as indicated when

(a) For TM_{1mn} oscillations

(11)

$$\left.\frac{b}{\lambda}\right|_{MIN.Q.} = \left(\frac{r_{\ell_m}}{\pi}\right)^2\sqrt{\left(\frac{1}{n}\right)^2 + \left(\frac{\pi}{2r_{\ell_m}}\right)^2} \qquad n \neq 0$$

(b) For TE_{1mn} oscillations

(12)

$$\left.\frac{b}{\lambda}\right|_{MAX.Q.} = \frac{1}{4}\sqrt{n + 4\left(\frac{r_{\ell_m}}{\pi}\right)^2} \qquad \ell = 0$$

$$\left.\frac{b}{\lambda}\right|_{MAX.Q.} = \sqrt{\frac{G - \sqrt{G^2 - 4H}}{2}} \doteq \sqrt{\frac{H}{G}} \qquad \ell \neq 0$$

where

(13)

$$G = \frac{3}{2}\left(\frac{r_{\ell_m}}{\ell\pi}\right)^2\left(r_{\ell_m}^2 - \ell^2\right)\left[\frac{6}{n^2}\left(\frac{r_{\ell_m}}{\ell\pi}\right)^2\left(r_{\ell_m}^2 - \ell^2\right) - 1\right]$$

$$H = \left(\frac{3}{4}\right)^2\left(\frac{r_{\ell_m}}{\ell\pi}\right)^4\left(r_{\ell_m}^2 - \ell^2\right)\left[1 + \frac{4}{n^2}\left(\frac{r_{\ell_m}}{\pi}\right)^2\right]$$

The points for maximum Q are shown as triangular dots on the chart. Data for both minimum and maximum Q together with other information are tabulated in Table I.

OPTIMUM CONDITIONS FOR RESONANT CYLINDRICAL CAVITY—TABLE I

		Minimum Surface			Minimum Volume			Minimum or Maximum Q			
Mode	r_{ℓ_m}	b/λ	L/λ	S/λ^2	b/λ	L/λ	V/λ^3	Max. or Min.	b/λ	L/λ	$Q/34.4\sqrt{g\mu_r\lambda}$
TE_{111}	1.841	0.362	0.850	2.755	0.360	0.866	0.357	Max.	0.459	0.653	0.279
TM_{011}	2.405	0.466	0.892	3.975	0.471	"	0.606	Min.	0.705	0.600	0.210
TE_{211}	3.054	0.590	0.878	5.445	0.592	"	0.955	Max.	0.591	0.877	0.318
TE_{011}	3.832	0.724	0.923	7.470	0.750	"	1.532	Max.	0.659	1.330	0.661
TE_{111}	3.832	0.724	0.923	7.470	0.750	"	1.532	Min.	1.600	0.541	0.231
TM_{211}	5.136	0.945	1.003	11.55	1.000	"	2.722	Min.	2.780	0.523	0.239
TE_{121}	5.331	0.977	1.019	12.25	1.038	"	2.940	Max.	0.885	1.770	0.858
TM_{021}	5.520	1.011	1.012	12.88	1.075	"	3.150	Min.	3.200	0.520	0.241
TE_{221}	6.706	1.221	1.028	17.27	1.313	"	4.705	Max.	1.098	2.250	1.001
TE_{021}	7.016	1.274	1.045	18.53	1.370	"	5.107	Max.	1.142	2.295	1.140
TM_{121}	7.016	1.274	1.045	18.53	1.370	"	5.107	Min.	5.105	0.512	0.244
TM_{221}	8.417	1.508	1.105	24.75	1.638	"	7.300	Min.	7.270	0.509	0.246

List of optimum values giving desired features under typical operating modes

"Travelling Wave" Amplifier Tube

A new type of "travelling wave" amplifier tube, was revealed for the first time at the I.R.E. microwave conference at Yale University by Dr. J. R. Pierce (Bell Telephone Laboratories) who developed it. The principle of the tube's operation is different from previous type amplifiers. It consists of a bulb, containing an electron gun, which terminates into a narrow glass stem about a foot long. A long coil of small wire, or helix, running from one end of the stem to the other, carries the wave which is to be amplified. The signal is fed to the coil through waveguides.

Dr. Pierce and "travelling wave" tube

Because of the turns of the wire, the wave travels along the length of the tube at about one-thirteenth of the speed of light. The beam of electrons from the electron gun passes down the center coil in the same direction and at approximately the same speed that the wave is moving but with the electrons going a little faster than the wave. Because of the retarding effect of the fields from the travel-

(*Continued on page 97*)

DUPLEX CRYSTALS

By bonding crystal plates with unlike faces together low frequency vibrations are obtained

● One of the principal limitations on the use of crystals in oscillating and filter circuits has been their restricted range. The lower limit of their usefulness has been approximately 50 kc and the upper limit about 20 mc. These points have been exceeded but not for very general use. Hence, for all applications requiring low frequencies more complex devices such as precise tuning forks have been used.

In a recent important development of the Bell Telephone Laboratories* described by C. E. Lane, crystals of the order of 1 kc have been obtained with a length less than 3 in. This is done by mounting two crystal plates together.

Low-resonance frequency, which characterizes the duplex plate, results from using the lowest natural flexure frequency of a free bar which might be designated as edge flexure. Such a vibration of the type indicated, greatly exaggerated, is shown in Fig. 1, where the nodal lines are at a distance of 0.224 times the length of the bar from the two ends. If a +5-degree X-cut quartz plate 50 mm long, 10 mm wide and 0.5 mm thick were suspended from its nodes by fine wire, a vibration of this type could be induced by tapping the plate at the center of one of its major faces. For such a plate, the resonance frequency of this type of vibration would be about 1,300 cycles.

There is no way of producing a flexural vibration of the type of Fig. 1 in a single plate. Suppose, however, that two plates of the length and breadth of the one considered above but of only half the thickness be bonded together face to face with a very thin metallic layer, and that a voltage is applied across the outer faces of the bonded pair. It will be assumed first that the crystals are bonded with like faces together (Fig. 2). Then the voltage applied across the plate will make one plate expand and the other contract. This will result in a bending as indicated by the dash lines of Fig. 1. When an alternating voltage is applied across the plate, the crystal will vibrate in flexure at a resonance frequency of about 1,300 cps.

Duplex crystal mounted in vacuum

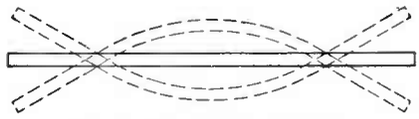


Fig. 1—Edge flexure vibrations

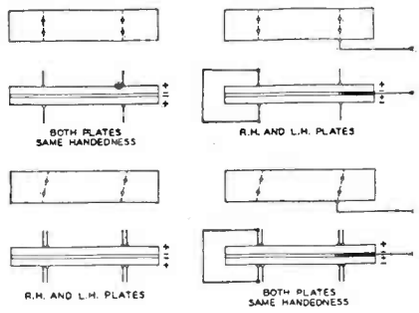


Fig. 2—Methods of mounting duplex crystals

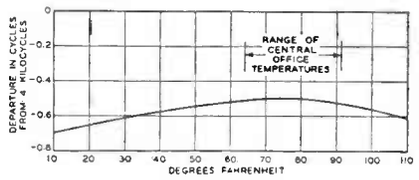


Fig. 3—Effects of temperature on frequency

This type of vibration may also be obtained by bonding the plates with unlike faces together, that is, a positive to a negative face. When this is done, one terminal of the supply voltage is connected to the bonding layer, and the other to both of the outer surfaces of the plates.

Although duplex plates may be made from any type of cut that will vibrate longitudinally, the best results have been obtained with +5-degree X-cut plates having a small width-to-length ratio. Such plates vibrating longitudinally have a low frequency-temperature coefficient, and duplex plates that have been made from them have a similar and lower characteristics.

Two quartz plates that are to form a duplex crystal are first sprayed with a silver paste on the sides that will be bonded, and then baked at a high temperature to fix the paste firmly to the quartz. After this, the silver is burnished and then tinned. The two tinned surfaces are then pressed together with sufficient pressure to force out all excess solder. The resulting film holding the plates together is only about 0.02 mil thick.

This thin layer of solder has negligible effect on the performance of the plate since it is located at the neutral plane where there is zero compression and elongation. The outer surfaces are coated with evaporated silver as with other types of crystals. Duplex crystals are supported by fine wires attached to the face along the nodes. When a connection is to be made to the bonding layer, a narrow strip of silver coating is extended from one of the supporting wires over the edge of the plate to the bonding layer. This connection is then isolated electrically from the rest of the plating on the surface by fine dividing lines.

To realize a good "Q" for the duplex crystal, it is essential that it be mounted in a vacuum. When this is done, "Q's" as high as 25,000

(*Continued on page 97*)

*Record, April, 1945, page 140.

GRAPHICAL SOLUTION

By G. GLINSKI
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High frequency impedance matching network problems are simplified by a method based on circle diagrams

● The problem of matching a load impedance to a source of power is common in high frequency technic. The matching of an antenna to a transmission line is a typical example. The L-section shown in Fig. 1 is extensively used for such a purpose.

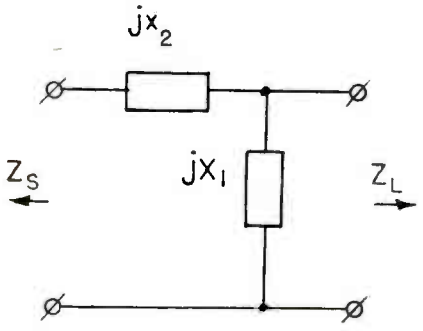


Fig. 1. Simple L-section network

There can be found in the technical literature formulas and graphs facilitating the determination of the elements of an L-network when the load and source impedances are known. The formulas, however, require rather lengthy calculations whereas the graphs refer to some particular combination of the elements in the L-network (such as shunt L and series C, etc.).

The simple graphical method of design for matching L networks here presented uses the same circle diagram for any combination of elements, requires a minimum of computations and gives a clear physical picture of the process of matching.

The method is based on the use of the complex impedance plane with rectangular coordinates on which are mapped the circles of the constant conductance and susceptance (Fig. 2). The units marked on the coordinate axis and the circles give the "normalized" impedance, that is the ratio of the actual load impedance to the source impedance (assumed to be a pure resistance). The fact that the rectangular coordinates of the complex admittance plane map into the circles in the complex impedance plane follows from the general theorem on so called "bilinear transformation".*

The circles of constant conductance and susceptance can be easily determined. The centers of the circles of constant conductance lie on the axis of resistance. The diameter of the circle of constant conductance g is determined by the fact that it must go through the origin of the coordinates and the point $(\frac{1}{g}, 0)$. Therefore its center lies at the point $(\frac{1}{2g}, 0)$ and its radius is $\frac{1}{2g}$ (Fig. 3). The centers of the circles of constant susceptance lie on the axis of reactances. The diameter of the circle of constant susceptance b is determined by the fact that it must again go through the origin of the coordinates, and the point $(0, \frac{1}{b})$ or $(0, -\frac{1}{b})$ depending upon the sign of susceptance. Therefore, its center lies either at the point $(0, \frac{1}{2b})$ or $(0, -\frac{1}{2b})$ and its radius is $\frac{1}{2b}$, (Fig. 4).

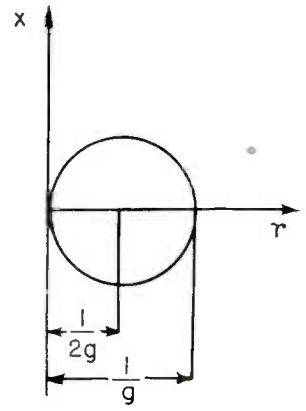


Fig. 3. Construction of conductance circle

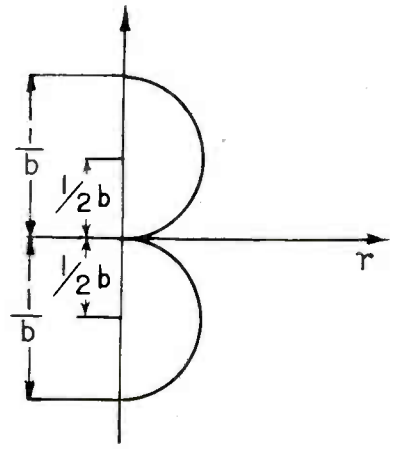
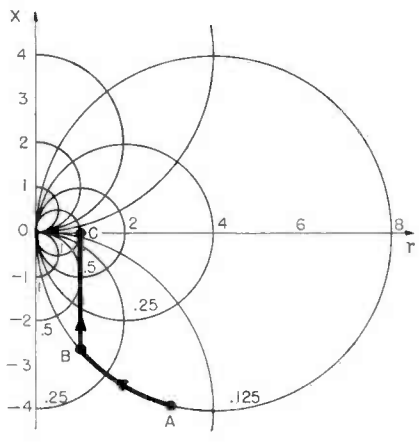


Fig. 4. Construction of susceptance circle

The use of the diagram can be illustrated by the following example. The antenna impedance $Z_L = 186 - j248$ ohms has to be matched to a transmission line of the impedance $Z_s = 62$ ohms. The normalized load impedance is therefore $\frac{Z_L}{Z_s} = 3 - j4$ (the point A on Fig. 5),

Fig. 5. Matching antenna to transmission line



*H. W. Bode—Network Analysis and Feedback Amplifier Design. D. Van Nostrand Co., New York, 1945 p. 223.

# of MATCHING PROBLEMS

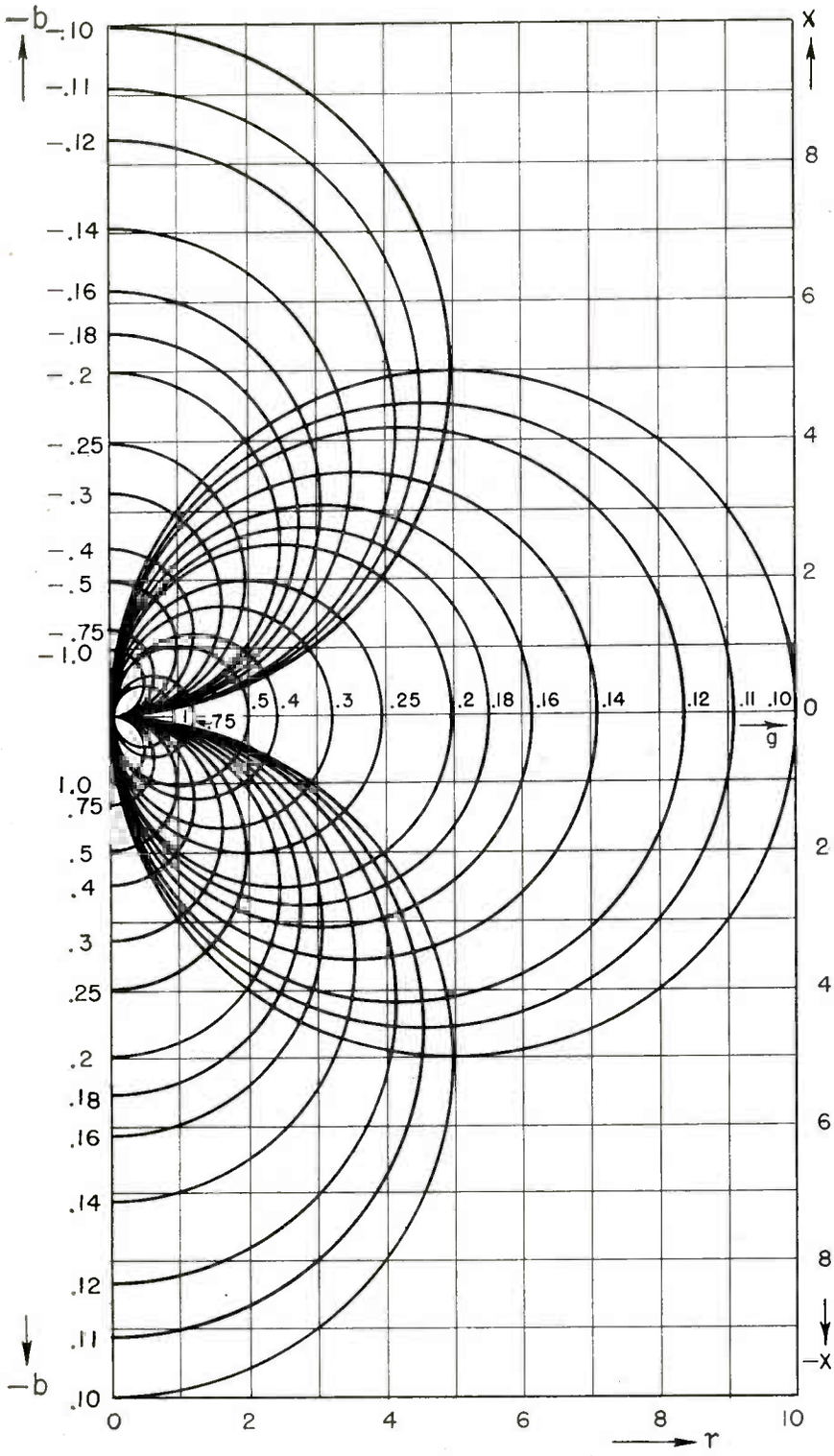


Fig. 2. Impedance-admittance chart; when r and x scales are divided by 10, the g and b scales should be multiplied by 10

whereas the normalized load admittance is $\frac{Y_L}{Y_a} = .12 + j.16$ (as can be directly read from Fig. 2).

Since the resistive component of the antenna impedance is larger than the source resistance, the L-network should have its shunt element next to the antenna impedance. Let us call this shunt element jb_1. The addition of this element will move point A to B along the segment of the circle of constant conductance .12 (since element jb_1 is assumed to be purely reactive). The point B is determined as the intersection of the circle .12 of constant conductance and the vertical line through the point (1, 0). It lies on the circle of constant susceptance .32. Therefore, $b_1 = .32 - .16 = .16$ or $x_1 = -6.26$. The addition of the remaining series element jx_2 of the L-section moves the point B to C along the vertical line of constant resistance 1. Therefore $x_2 = 2.65$.

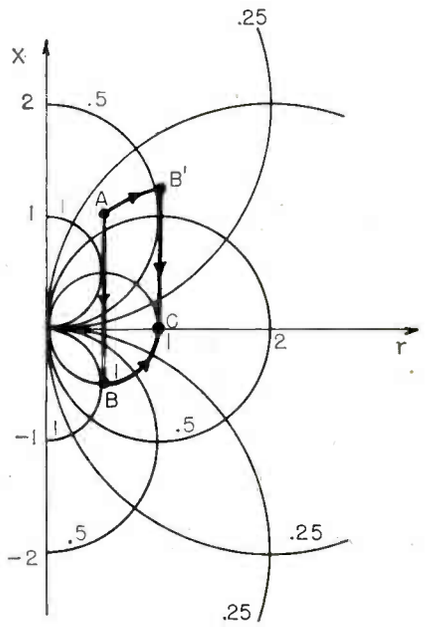


Fig. 6. Choice of L-network components

By consulting the diagram one can immediately answer many questions pertaining to the type of the configuration and type of elements in the L-section. Suppose for instance that the antenna impedance is $\frac{Z_L}{Z_a} = .5 + j1$ (Point A on Fig. 6). To match this impedance, we could either add first the series capacitive element AB and then the shunt inductive element BC or first add the shunt capacitive element AB′ and then the series capacitive element B′C.

Of course, the use of the same diagram can be extended to more complicated problems involving complex source impedance and τ or π matching networks.

FLIGHT RESEARCH ON

By CAPTAIN E. L. CLEVELAND
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Methods used to eliminate hazards to communication and navigational aids represented by voltages that accumulate on aircraft

• Among problems which must be dealt with before the dream of all-weather flying can become a reality are such matters as take-off and landing under zero-zero ceiling and visibility conditions; anti-icing and de-icing of various members of the aircraft, as carburetors, propellers, wings, etc.; alleviation of hazard of turbulence encountered around thunderstorms; and the matter of loss of radio facilities under certain types of adverse weather conditions.

Radio communciation and navigation aids are so essential to the successful operation of aircraft today that anything which interferes with radio reception or renders it unreliable is a serious problem. It now may be told that, during the war and before suitable anti-static devices were developed, several Army Air Force airplanes and aircrews were lost as a result of failure of these radio facilities due to precipitation static.

The term "precipitation static" was first applied to a particular type of radio interference encountered by aircraft flying through snow, ice crystals, dust, or rain; however, this type of interference is also sometimes experienced in clear air and adjacent to precipitation areas. In a communication or range receiver, precipitation static usually produces one or a combination of characteristic noises which include: frying sounds, intermittent or regular crackling sounds, more or less musical "crying" sounds of variable pitch (from moans to shrieks, as the crackle repetition rate varies through the audio frequency range), and an overwhelming background of noise like that produced by a large volume of coal sliding down a tin coal chute. For the radio compass receiver, precipitation static usually produces erratic and unreliable operation. Precipitation static is all the more treacherous in that almost always it occurs only in bad weather when visibility is poor and radio aids are most needed.

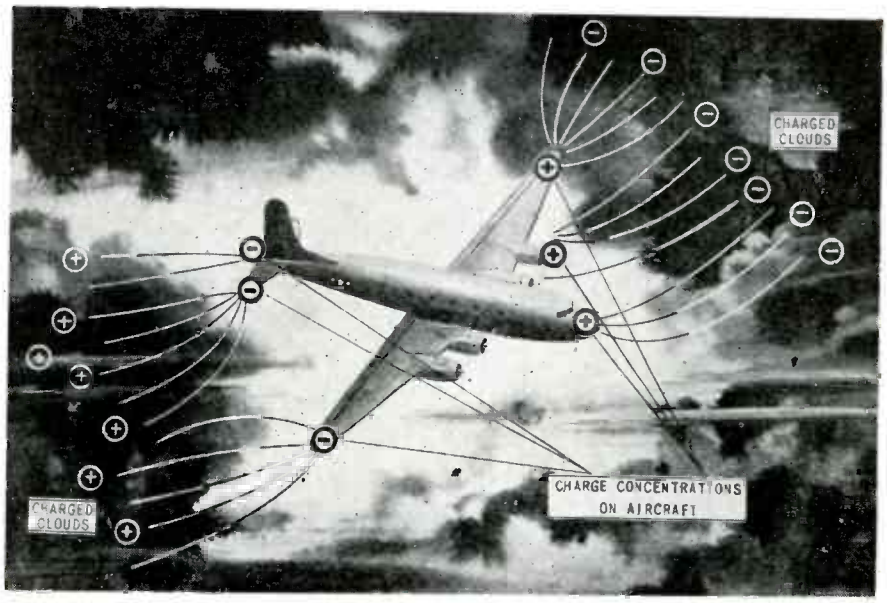


Fig. 1—Charge concentrations build up on opposite extremities when aircraft nears charged cloud

Cause of accidents

Historically, precipitation static was first encountered in ground radio receivers about forty years ago. However, since the phenomenon did not occur frequently and since its effects were not serious, little work was done on it until about 1930 when it became a problem of importance to the air-transport industry. It was at that time that all transport aircraft were being equipped with radio, and pilots were beginning to depend on radio as a navigational aid. The occasional complete loss of reception due to precipitation static seriously impaired the reliability of radio navigation; and, when this interference became recognized as a contributing cause in several aircraft accidents, the importance of work on the reduction of precipitation static was established.

On Great Lakes boats metallically-covered loop direction finders had been found to give reception in snowstorms when open-wire antennas were useless; in 1935 this fact was correlated with the then accepted theory that precipitation static was caused by charged particles striking the antenna. Shortly thereafter models of metallically-shielded loops suitable for use on aircraft were constructed and flight tested with results that indicated considerable improvement over open-wire antennas. Later, it was suggested that precipitation static might be caused primarily by corona discharge of accumulated static charges from the aircraft extremities, and not by charged particles striking the antennas.

This naturally resulted in work on various kinds of static dischargers to drain off the excess static electricity without radio noise. It may be said, however, that previous to 1942 no satisfactory static discharger had been produced and use of the electrostatic-

PRECIPITATION STATIC

ally-shielded loop antenna constituted the only important development in the reduction of precipitation static. Also, snow static was the only type of precipitation static then considered to be of any importance. A report by Mr. Hucke* constitutes a good summary of work done on this problem prior to 1942.

In 1942 the precipitation static problem was still in the realm of mystery and magic. Although the corona discharge theory had been proposed, it had not been established as the basic precipitation static mechanism and very little reliable quantitative information was available for testing this or any other theory. The problem was then one of getting the numbers, i.e., fixing the problem quantitatively in terms of fundamental electrical quantities, such as electric field intensities existing at various points on the surface of the aircraft and corona discharge currents from the various extremities of the aircraft.

At first this appears to be a relatively simple problem in physics of the air; but it becomes difficult and complicated when it is realized that not only must these data be obtained in flight but under the worst of weather conditions (snowstorms, thunderstorms, etc.) and at high as well as low altitudes.

Such flight research data have clearly demonstrated that, basically, precipitation static results when electrical discharge takes place from the various extremities of an aircraft to the surrounding atmosphere. This electrical discharge which is attendant to precipitation static may or may not be visible to the aircraft pilot or the crew members, depending upon the ambient conditions of light intensity.

*H. M. Hucke, "Precipitation Static Interference on Aircraft and at Ground Stations", Proc. IRE Vol. 27, pp. 301-316, May 1939.

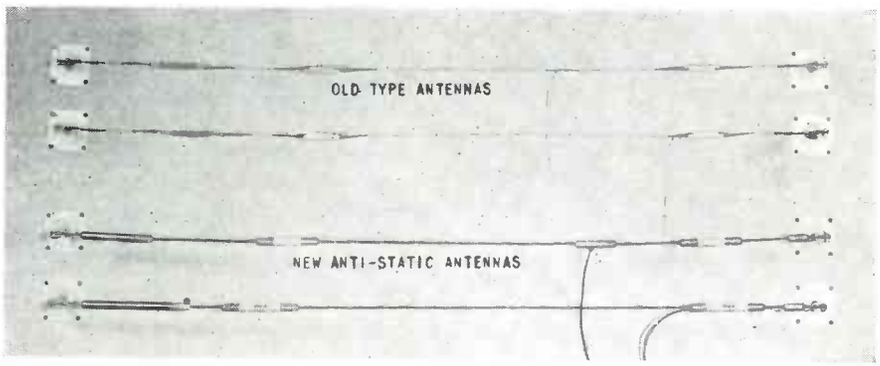


Fig. 3—At the top are shown old style open-wire antennas and below them the newer types of dielectric covered antennas equipped with anti-static hardware to eliminate noisy corona discharge

St. Elmo's fire

On dark nights bluish discharge, known as corona discharge (sometimes referred to as St. Elmo's fire), may be observed to take place from the fixed-wire antennas, from the extremities of mast and whip antennas, from the propeller tips (producing a halo effect), and in the form of streamers across windshields and sighting blisters.

Sparks as long as 5 to 6 in. have been reported both inside and outside aircraft, between electrically isolated metal objects in a windshield and grounded metal structures. As would be expected, of all the visual manifestations, it is corona discharge from the fixed-wire antennas themselves that produces the most severe precipitation static.

However, corona discharge from the antennas is seldom listed in pilot reports, whereas corona from propeller tips and streamering across windshields are frequently reported. The reason for this is that observation at close range of windshields and propellers by aircraft observers is always possible, while observation of fixed-wire antennas at close range usually is not possible.

There are two main types of precipitation static, depending upon which of two processes is involved in producing charge concentrations on aircraft extremities sufficient to cause corona discharge.

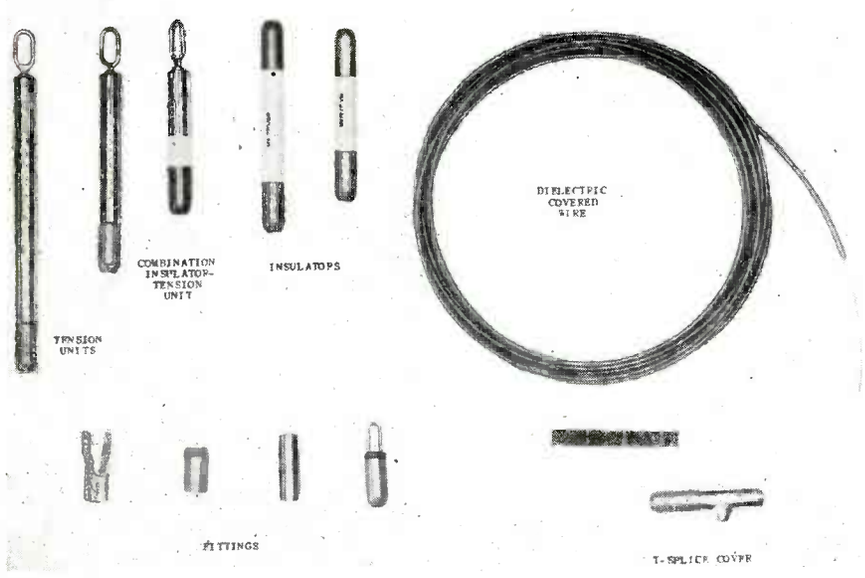
a. Charging Static:

In flight through an atmosphere containing foreign particles, particularly snow and ice crystals, an aircraft becomes charged by a process involving impact and friction between the airplane skin and neutral precipitation particles.

b. External Field Static:

In flight through electrostatic fields, such as are usually associated with thunderstorms, charge separation occurs in the conducting aircraft skin and large charge con-

Fig. 2—Dielectric covered wire and anti-corona hardware suppress noisy corona discharge from fixed wire antennas. These are various forms of lately developed anti-static equipment



centrations of opposite sign are built up on opposite extremities.

In the usual charging static case the aircraft becomes charged negatively with respect to the surrounding atmosphere. In this case the aircraft as a whole becomes charged and the charge concentrations on all the various extremities are of like sign.

The charging of the aircraft results from the impact of precipitation particles with the aircraft skin and the rubbing of these particles over the aircraft skin. The process is similar to that by means of which a rubber rod becomes charged by being rubbed with cat's fur or by which a man becomes charged by walking across a dry rug. The charging rate depends primarily on the size and speed of the aircraft and on the character of the particles and of the surface on which the particles impinge. The rate increases with approximately the cube of the velocity and with the first power of the projected area of the aircraft normal to the line of flight. It varies greatly with the type of aircraft surface covering (camouflage paint normally charges at about five times the bare-metal rate). Less important factors include temperature, pressure, relative humidity, etc.

Charging process

As the aircraft enters the precipitation region and the charging process begins, the absolute potential of the aircraft (the potential difference between the airplane and a point at a great distance from the airplane) begins to rise. It is perhaps more convenient to think in terms of the difference in potential between the airplane and a point in space a thousand feet away, since in the diverging electric field which exists around the airplane, most of the voltage difference is accounted for in the first few airplane diameters.

In elementary electrostatic concepts the electric field around the airplane is visualized as made up of lines of intensity which begin on positive charges and end on negative charges. In this case, the positive charges are located partly at a great distance from the airplane (at infinity) and partly in the space charge immediately following the airplane; the negative charges are located on the skin of the airplane itself.

The electric field intensity is of course greatest in the atmosphere immediately adjacent to those aircraft extremities which are most exposed electrically (both physically exposed and having relatively sharp edges). However, no corona discharge, and therefore no precipitation static, occurs until the charge concentration on one of these extremities reaches a critical value such that the adjacent potential gradient exceeds the breakdown strength of the ambient atmosphere. This breakdown strength varies greatly with pressure, from about 30,000 volts/cm at sea level to about 6,000 volts/cm at an altitude of 55,000 feet.

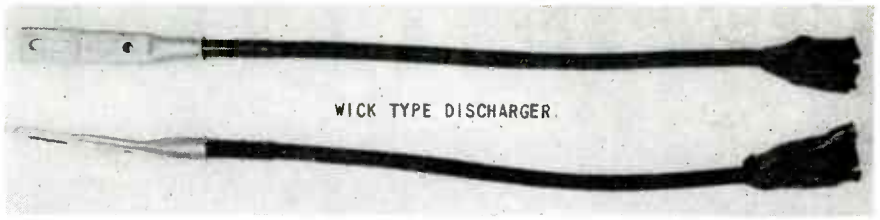


Fig. 4—Wick type static dischargers mounted on aircraft extremities bleed off accumulated static electricity without producing the type of radio interference called precipitation static

Measuring interference

The severity of any given static condition may be measured and expressed in any one of several ways: electrical field intensity or voltage gradient produced at some reference point on the skin as a result of the charge on the aircraft, in volts/cm; or, discharge current from any chosen discharge point or points, in microamperes; or, quantity of charge delivered to the airplane per second per unit of area normal to the line of flight, in microamperes/cm^2. Although the last mentioned has been used, the first two have been found to be most convenient and useful, generally.

As a result of ionization by cosmic rays, etc., charges of both signs are present in normal neutral atmosphere. The charged airplane attracts those charges which are of sign opposite to its own. The neutralizing of those charges which come into electrical contact with it constitutes a small discharge current from the airplane and a few microamperes are thus bled off by conduction to the atmosphere without the production of radio interference.

If the charging current exceeds a few microamperes the charge on the airplane builds up rapidly until corona discharge begins to take place from one or more of the aircraft extremities. For a typical airplane, the corona discharge from a normal bare wire antenna usually begins when the electric field at a central point on the belly of the plane reaches an intensity of about 250 volts/cm. Hangar charging experiments indicate that this corresponds to a potential on the airplane of about 100,000 volts.

A corona discharge current of 5 microamperes from a wire antenna is usually sufficient to cause loss of reception in the radio receiver which that antenna serves. Total antenna discharge currents frequently run as high as 200 microamperes. Occasionally, total currents from wire antennas of as high as 500 microamperes are experienced; this means belly electric fields of about 800 volts/cm and potentials of about 400,000 volts on the airplane.

Process of induction

Often severe electrostatic fields are produced by free charges in the atmosphere (such as charged clouds) together with the bound charges induced in the surface of the earth by the free charges above. When an airplane enters such an electrostatic field, large charge concentrations of opposite sign are built up on opposite extremities by the process of induction. This process is illustrated in Fig. 1, which shows how the electric field becomes concentrated at opposite aircraft extremities. No corona discharge, and therefore no precipitation static, occurs until the charge concentration at some extremity reaches a critical value such that the resultant potential gradient at that extremity exceeds the breakdown strength of the surrounding atmosphere.

Obviously the external electric field required to produce a critical charge concentration at a given aircraft extremity depends on the orientation of that field with respect to the airplane (the relative magnitudes of the vertical, lateral, and longitudinal components of the field) and on the physical configuration of the particular airplane in question (the relative disposition of propellers, wire antennas, mast antennas, etc.).

In the case of a severe external field the steady state condition is reached only when a current actually flows through the airplane, supported by positive corona discharge at one extremity and negative corona discharge at the other. Often one or both of these discharging extremities is a radio antenna and, as in the charging case, severe precipitation static results when antenna corona discharge currents exceed about 5 microamperes. In very severe external field conditions corona discharge currents as high as 2,000 microamperes have been recorded.

Corresponding to this, electric field meter readings on the belly of the aircraft would read approximately 1,500 volts/cm for a vertical external field. Obviously, if a field located on the belly gave a negative field indication, a similar meter located on the top of the aircraft would give a positive indication. In this external field case, of course, the potential of the airplane is not appreciably different from what the mean potential of the region occupied by the airplane was before the arrival of the plane.

In the above discussion, charging static and external field static have been treated separately. However, both produce corona discharge from fixed-wire antennas, and since the crackling, crying, frying sounds produced in radio receivers are identical, they cannot be separated aurally. In flight both charging static and external field static are frequently encountered simultaneously.

Static research

On precipitation static research aircraft, simple dc microammeters are used to measure the corona currents from various discharge points or from special static dischargers. This is accomplished by insulating the discharge device in question from the aircraft skin and connecting it to aircraft ground through a microammeter. For measuring antenna corona discharge currents, a dc path from the antenna to the airplane is provided through a suitable rf choke and a microammeter, while the rf itself is passed to the receiver through a condenser input.

The electric field-indicating meter is mounted on the outside of the airplane at points at which the electric field intensities are desired. Electrostatic induction is the fundamental principle underlying the operation of this device. By means of a wind-driven or motor-driven vane, an insulated electrode is alternately exposed to and shielded from the electric field external to the airplane.

This insulated electrode is connected to the airplane through a suitable network, and across this network the induced charges flowing to and from the electrode develop an alternating voltage signal.

Fig. 5—Sparks between ungrounded metal objects and adjacent grounded objects produce radio interference and constitute a fire hazard

This signal is directly related in magnitude to the electric field intensity to which the electrode is exposed, and when amplified and rectified, it is fed to a dc milliammeter which is normally calibrated to read directly in volts/cm.

For efficiently gathering data in flight, it is convenient to assemble numerous indicating meters into a photo-observer unit so that simultaneous readings can be obtained of various discharge currents, various electric field intensities, outside air temperature, indicated air speed, altitude, noise meter readings, and such other relevant information as can be reduced to the reading of a small meter. Operation of the photo-observer camera may be either semi-automatic (using a push button) or automatic (using an intervalometer). Also a voice recorder has been found to be a very valuable companion to the photo-observer as it permits relatively easy recording of supplementary data even under such adverse flight conditions as turbulence and high altitude, when recording by writing is very unsatisfactory.

The devices and technics now being used to reduce precipitation static may be considered as applications of a few basic principles as follows:

a. The use of dielectric covered antenna wire and associated anti-corona antenna hardware to prevent corona discharge from occurring from the fixed-wire antennas.

b. The use of special static dischargers to drain off accumulated static charges without appreciable interference.

c. The grounding of all insulated metal objects which protrude outside the aircraft, to eliminate the sparking which would otherwise result.

The dielectric covered wire and some of the associated antenna hardware components are illustrated in Fig. 2. The wire is 50 mil copperweld covered to an outer diameter of approximately 185 mils with polyethylene dielectric. Corona discharge from the ends of the wire, where the polyethylene is broken is suppressed by the large diameter and smooth contour of the metal caps on the insulators and tension units.

Note the contrast between the new anti-static antenna and the old type of antenna, as in Fig. 3. Following satisfactory service experience with this equipment on a few hundred Army Aircraft, the Air Technical Service Command, Wright Field, is now engaged in an extensive program involving the installation of this anti-static antenna equipment on all new aircraft and in retroactive installations of it on certain aircraft in service.

Wick dischargers

The dry wick type of static discharger now in use is shown in Fig. 4. Ten to twelve of these dischargers are required on each airplane, mounted to trail from wing tips and extremities of empennage. The discharge consists essentially of cotton wicking metallized to make it slightly conducting. The current passed by a given wick is the sum of a large number of small currents passed by individual fibers; the energy associated with these individual discharge pulses is very small, and because of their random phase relation the resultant discharge current is not particularly impulsive.

(*Continued on page* 94)

ELECTRONIC SURPLUS

By H. G. SHEA
Associate Editor, Electronic Industries

There's lots of it, but as a continuing source of supply surplus agencies cannot compete with established parts suppliers

● Stepping into the display room of one of the central agents appointed by the Reconstruction Finance Corporation to dispose of some of the parts and equipment declared surplus by the various owning agencies, the prospective purchaser finds a vast range of types of parts and equipment on display. Walls and standing six foot sections of wallboard are covered with small parts suspended from hooks; long tables are loaded with almost every imaginable type of electronic equipment ranging from large transmitting station racks to tiny receivers housed in plastic cases. Each part and each piece of apparatus has attached to it a tag indicating the physical characteristics of the part or equipment, the quantity available and in many cases the price that the United States paid for the item as well as the surplus offering price.

Offerings fall into three categories, namely standard items that can be found in current manufacturers catalogues, items that closely resemble standard items but have some degree of variation, and special items not ordinarily offered to the trade or the public. Many capacitors are available in all sizes and voltages from small silver mica to larger ceramic transmitting types. The buyer for a radio set manufacturer, however, would find that instead of being the paper cased, wax insulated type that he uses in his sets, the by-pass capacitors are mostly the more expensive tin cased oil filled type. These do not fit at all into his manufacturing program. On the other hand, the manufacturer of a more expensive type of equipment might to able to pick up a buy in this line or break a bottleneck in his plant. As a continuing source of supply however the surplus agency cannot compete with established parts suppliers.

Pricing Policy

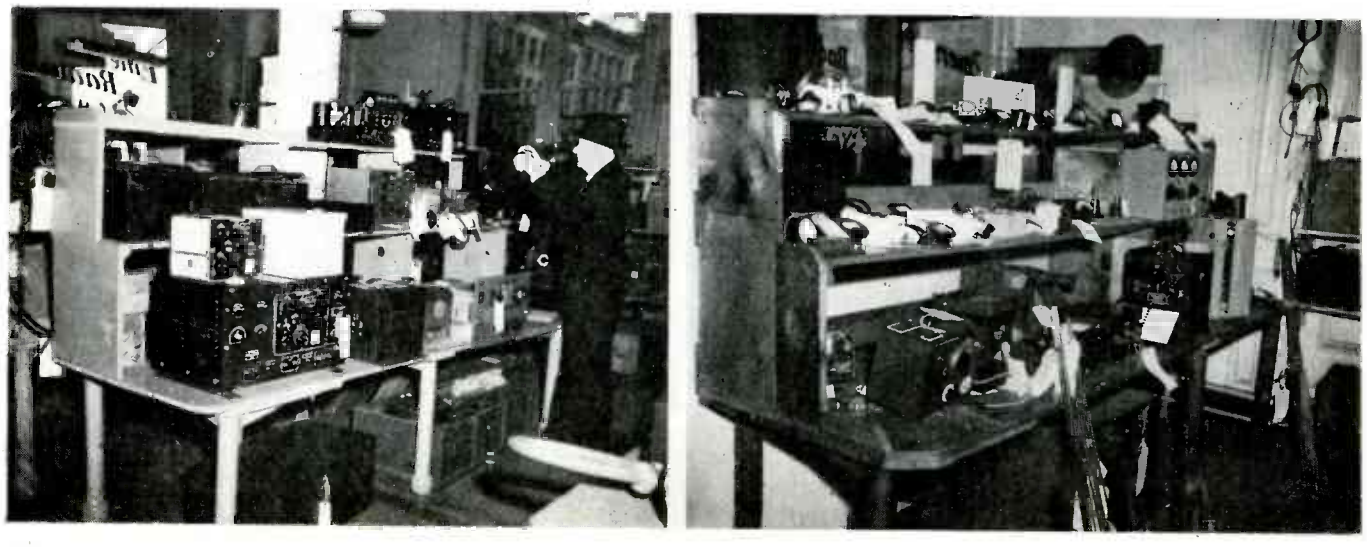
Endless styles and sizes of transformers are available but with these certainly more than with capacitors, the designs are apt to run to special windings, heavier cores, hermetic sealing, higher insulation than usual in peacetime practise.

In pricing standard items of parts one of the agencies has a definite policy of finding the manufacturer's list price in his current catalogue and then deducting 70% and 10% to obtain the selling price. This works out to a selling price of 27% of list. In many cases the result is not very different from the manufacturer's current offering price.

If the part is not quite, but nearly standard, this agency finds the nearest standard item list price and applies its formula thereto while in the case of special items, the agency recommends a selling price which then has to receive the approval of the War Assets Administration. In many cases the agency finds it necessary to go ahead and make sales on its suggested price before approval is forthcoming in order not to tie up warehouse space endlessly. These price formulas apply to parts only, equipment being handled on a different basis as explained below.

It is in the field of equipment, that the greatest variety of original

The author, left, looks at equipment displayed in a central agent's showroom. In the foreground a wide band set with plug-in units may be seen. Specialized test equipment and panel meters are shown at right



At left, multimeters and tube testers held for veterans. Lightweight aircraft sets in right foreground, with parts display panel at rear.

and specialized designs is found. For example, a test set recently offered for sale known as the LU-3 radar test set consisted of a transmitter-receiver which could be tuned within plus or minus 5 mc from two points near 490 and 470 mc, these being known as the L and H bands. The sole military purpose of the set was to tune particular models of radars designed to transmit pulses at these frequencies. Some of these sets were purchased by a retail dealer and offered to the public with a kit of spare parts for $60. Probably the main value was in the spare parts as the work of modifying this sort of equipment is claimed by some engineers who have tried it to exceed by far the work of building new equipment.

"Lot" Sales

Some of the problems faced by the disposal agencies in connection with this specialized equipment are really of a formidable nature. In one warehouse there was a lot of 1100 aircraft receiving and transmitting sets beautifully made and housed in lightweight aluminum cases on shock mountings. These are tunable over a range from 187 to 13,950 kc and have a dynamotor power supply to run off airplane battery systems. The agency is asking somewhere in the neighborhood of $50,000 for the lot. The difficulty is that these sets are complete in some cases while in others they are not. The degree of incompleteness and its exact nature is unknown. The set that had been unpacked for display purposes lacked a power supply. While the agency probably could sell the complete sets it is afraid to do so for fear of being left with incomplete sets. Hence it refuses to break the lot.

In another case some walkie talkies obtained by a contract cancellation were found to lack antennas, but in other respects to be the latest up to date FM type of walkie talkie. To make these sets salable the agency purchased antennas for them in the open market and is now offering them complete for a price in the neighborhood of $50. The cost of the antennas is said to have been charged to the agency's operating expenses. Of course the sets are not very useful in the United States as they cover a frequency range from 38 to 50 mc which cuts right across television channel number one. It is hoped to export them.

Other items seen include battleship voice channel control switches housed in heavy solid steel boxes about ⅜ in. thick, radar echo boxes, tape code recorders for use in tanks, recorder scanners (minus the amplifier), direction finding equipment, 250 watt public address systems (used in beach invasions), sound detectors (used by the office of strategic services in its spy work), magnetic wire voice recorders (incomplete) and so on ad infinitum.

As to test equipment, as indicated before very little is of general usefulness. Here one may see a signal generator, but it covers a pair of special ranges from 1-10 and from 38-50 mc and is priced around $300. Another covers from 300 to 1,000 mc and is priced around $600. A frequency meter covers 375 to 725 mc. Twelve of these are available at about $75. apiece. One may obtain a used 160 to 220 mc wavemeter for $20.

Elsewhere a large quantity of wavemeters is available covering a range from about 120 kc to 20 mc. Some engineers in the know, however, say that while the ones that were not fungus proofed are excellent, most of them were sprayed inside with anti-fungus liquid and not only was their calibration ruined thereby but they tend to drift badly.

No Bargain

An extremely attractive looking item is a portable oscilloscope made by Western Electric Co. It is built around a 2 in. tube, and has a magnifying glass in front which is observed through a rubber hood and which makes the face of the 2 in. tube look like that of a 5 in. tube. It is linear to 1 mc, has not only a saw-tooth, but also a slave sweep, will exhibit ¼ microsecond pulses, is 23 x 11 x 12 in. and weighs 40 lbs. This is priced at $175. wholesale, to be sold at $275. retail. Engineers who have used it, however, say they do not like the magnifying glass, and since it is necessary to put one's head close to the hood it is not nearly as desirable for laboratory work as a 'scope with a directly viewed face. At $275. these engineers say, it is no bargain. In fact some engineers who have looked over the field claim that prices in general are on the high side. The equipment looks fine they say but when analyzed turns out to be unsuitable for one reason or another. The instance of the Russian tank sets sold by a large department store for $78.50 is an excellent illustration of this. Instead of WAA giving them away says one engineer, it is the buyer who got stuck with a beautiful pile of junk.

Many test engineers who hoped to obtain bargains in test equip-

ment have been disappointed. This is not surprising, since according to one agency, the pricing policy on standard equipment is to sell it at the same prices as new equipment at the various levels of trade channels. If a specially large quantity is available, however, or some other special condition exists, the price may be modified accordingly. If the equipment is of special design, a price is recommended to the WAA and approval secured. Sometimes the price is reduced to sell slow items. The agents sell wholesale only and may or may not break lots. That is a matter of judgment in individual cases.

Originally it was the plan of the RFC to use each manufacturer of parts or equipment as an agent for his own products. Therefore, a contract was offered whereby a manufacturer could take back his goods on a consignment basis, the War Assets Administration paying all operating costs and warehousing expenses and allowing the manufacturer-agent a profit on his sales varying up to 10%. However, a number of companies did not care to become such agents for their own products. As a consequence central agents' contracts were offered to some concerns whereby they could handle not only their own manufactures, but those of others. (A list of these central agents is printed at the end of this article.) Some of these have since dropped out or become inactive.

Surplus Procedure

The sequence of events whereby material becomes surplus is about as follows: The owning agency, which means the Army, Navy, OWI, OSRD, etc., determines on the basis of its own present and projected needs what equipment it wishes to dispose of and notifies the War Assets Administration. The latter has a technical section whose members examine the technical features of the material in question to determine whether there is any use trying to sell it, as if not, there is no point in spending money to ship it and handle it. If it has some possible use, it goes to a storage section whence it is allocated to the appropriate manufacturer or central agent. This is done on the basis of nearness and also type of equipment as some agents are better in one field than in another due to the nature of their ordinary business.

The agent is notified of what he is going to receive so that he may make advance preparations and also possibly do some early selling. The material is then shipped.

Meanwhile, the WAA makes an effort to match up any priority request it may have with the material going out and if such requests can be filled, it notifies the selling agent, freezing the material for the benefit of the priority claimant. For obvious reasons this system does not work perfectly. Many priority claimants don't know exactly what they want or they may be late with their requests.

A major part of the selling of one agency is done by means of personal contacts. Also files of requests from various manufacturers and dealers are built up and consulted. Selling is also done by mail by means of catalogues and lists, although desirable items generally move so fast that they do not appear in such lists.

There is intense competition by the various central agencies not only to make sales, but also to obtain desirable merchandise for sale. The agency showrooms are also frequented by dealers and distributors who maintain public salesrooms in New York, Chicago and other centers for direct sales to the public. These men try to be Johnny on the spot when "good" items arrive. These dealers and retailers advertise in the trade press, and it is only from them that the experimenter or individual buyer can obtain surplus. The greatest dollar volume of business of the central agencies is probably done with large concerns, although one of the largest of these agents reports most of its sales are made right off the sales floor. Schools are also good customers. They receive a 40% discount from lowest selling price. The types of electronic and equipment consigned to such central agents and their names are given below.

Where Surplus Electronic Equipment Is Sold

TYPE OF EQUIPMENT	EAST	CENTRAL	WEST
Two way communication equipment			
1. Fixed Ground			
a. Low powered (to 100W)	CML ECA Ry SM	B Ha	Hf PB Rm
b. Medium powered (100W-1KW)	Ry SM	B Ha	Hf PB Rm
c. High powered (over 1KW)	Ry SM	B Ha	Hf PB Rm
2. Mobile (Tactical type) (Police & Command Set)	CML ECA Em Ry	B Ha M	Hf No PB Rm
3. Inter-communication (incl. Walkie-talkies, Etc.)	ECA Em Ry	Ha M	Hf No PB Rm
4. Marine	ECA Ry SM	B Ha	No PB Rm
5. Airborne	ECA Em Ry	B Ha	Hf PB
6. Other & Unidentified	ECA Em Ry	B Ha	Hf PB Rm
Radio Receivers (not part of 2-way equipment)	CML ECA Em	B	Hf PB
Radio Direction Finders & Compasses	CML Em Ry	AC B	No PB Rm
Test Equipment	CML ECA Em	B Ha	Hf No PB Rm
Public Address Equipment	CML Em	M	Hf No PB Rm
Sound Recording & Reproduc. Equipt.	ECA Em	Ha	Rm
Interphone Equipment	CML Em	M	Rm
Telephone & Telegraph Equipment			
1. Telephone	FT Ry	KS	CT
2. Telegraph & Teletype Equipment	Ry SM	B	PB Rm
3. Facsimile Equipment	CML Em Ry	B	Hf PB
Code Practice Equipment	Em	Ha	Hf No PB
Radiosonde Equipment	Em	B	PB
Sonar Equipment	Ry SM	B	Hf
Mine Detectors	CML Ry SM	B	Rm
Radar Equipment	CML Ry SM	B Ha	Hf PB Rm
Antenna Towers	CML Ry	B	Rm
Unidentified Sub-assemblies	CML ECA Em	B	Hf No PB Rm

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AC—Air Communications, Inc.
2233 Grand Ave., Kansas City 10, Mo.
B—Belmont Radio Corp.
3633 S. Racine Ave., Chicago 9, Ill.
CML—Communications Measurements Labs.
350 W. 40 St., N. Y., N. Y.
CT—Calif. Telephone & Elec. Co.
6075 W. Pico Blvd., Los Angeles 35, Cal.
ECA—Electronic Corp. of America
353 W. 48 St., N. Y. 19, N. Y.
Em—Emerson Radio & Phono. Corp.
123 Duane St., N. Y. 7, N. Y.
FT—Federal Tel. & Radio Corp.
15 Alling St., Newark, N. J.
Ha—The Hallicrafters Co.
5025 W. 65th St., Chicago, Ill.
Hf—Hoffman Radio Corp.
3761 So. Hill St., Los Angeles 7, Cal.
KS—Kellogg Switchboard & Supply Co.
3243 So. Kedzie Ave., Chicago 23, Ill.
M—Majestic Radio & Telev. Corp.
125 West Ohio St., Chicago 10, Ill.
No—Northern Radio Co.
2208 4th Ave., Seattle 1, Wash.
PB—Packard-Bell Co.
3443 Wilshire Blvd., Los Angeles 5, Cal.
Rm—Remler Co. Ltd.
2101 Bryant St., San Francisco 10, Cal.
Ry—Raytheon Mfg. Co.
255 18th St., Brooklyn 15, N. Y.
SM—Smith-Meeker Eng. Co.
125 Barclay St., N. Y. 7, N. Y.

TELE INTERFERENCE

By DR. T. T. GOLDSMITH
Director of Research, Allen B. DuMont Laboratories, Passaic, N. J.

Part II—Specific recommendations for engineering changes that will help in alleviating picture and sound interference

A survey of forms of interference that may have an effect on television reception was made in Part I, which included an two-color chart that permitted a detailed study of these problems. This chart is frequently referred to in Part II.

It is not possible, however, for every receiver to be affected by all of these troubles, and in many locations none may ever be in evidence. Although the circuit arrangements in postwar designs will alleviate these effects to a marked degree, a more detailed analysis of the problems as they affect converted prewar designs is taken up so that the design experience need not be gained twice. Remedies that have been found effective are also mentioned.

● A general analysis of the chart accompanying Part I relating to the interference between television channels and other services shows that the following effects may be present:

1. Radiation from nearby local oscillators,
2. Presence of other services, assigned on the same channel with television,
3. Beats between two services of high signal strength causing generation of signals at the intermediate frequency of television receiver,
4. Strong signals from other services on the intermediate frequency of the television receiver,
5. Harmonics of other services falling in the television channel,
6. Reception of signals on the image frequency of the television receiver.

The local oscillator reradiation problem is important only in locations where receiving antennas are congested. The effect of signals from other television receivers was discussed in Part I. However, other types of receivers may be encountered at times whose reradiated signals fall at a critical point.

The presence of other services assigned to television channels (item 2) cannot at this time present difficulties, since only the higher television channels between 174 and 216 mc have been assigned on a shared basis with other services, lines 4, 5, 7 and 9 of the chart. The conditions of this sharing are stipulated to be on a mutual noninterfering basis, and it is the intention of the F.C.C. to make these assignments in general only to low powered services in areas distant from the particular television stations operating on these same frequencies.

An interference condition (item 3), although rarely observed, may occur when two strong signals arrive separated from one another by the intermediate frequency, so they can ride through the RF stage and combine in the mixer tube to produce a difference frequency in one of the IF passbands. This interference sometimes persists independent of the tuning of the local oscillator. In fact, if the local oscillator tube is pulled out of its socket, the signal continues to pass through the receiver and produce an interference pattern on the cathode-ray tube or in the sound channel. Here one arriving signal serves as a local oscillator for the other producing the combined modulations in the video or audio circuits.

FM interference

For example, line 25 of the chart indicates that television channel 5 (with sound carrier frequency of 81.75 mc) might pick up strong signals from an FM station in New York City operating on 92.1 mc. Now, if the latter has a very high field strength at the receiver, its signals may pass through the TRF stage of the receiver and arrive in the mixer tube with appreciable strength. The difference frequency between 92.1 mc and 81.75 mc is 10.35 mc, which is definitely within the passband of the video IF amplifier. As a result, the interfering and varying beat pattern between the channel 5 sound carrier and the FM station will be superimposed upon the picture signal produced in its normal manner by the action of the channel 5 local oscillator and the incoming picture carrier signal. In practice, the prevalence of this interference condition is not very serious.

One form of interference sometimes observed on television receivers is characteristic of the television standards themselves (item 4). This interference may occur as a 4.5 mc beat frequency between the picture carrier and the sound carrier, which causes a very fine grained structure of the order of picture element size to appear on the screen. A properly designed and adjusted television receiver is free of such interference. Trap circuits at the sound IF minimize the presence of the sound carrier in the picture IF channel.

Fortunately, however, these circuits are in tune with the sound channel IF stages and therefore the receiver owner automatically adjusts his receiver for the least fine grained interference when he tunes in his sound channel for best performance.

A frequently noted source of interference comes from the second and even higher harmonics of radio services authorized to operate on the lower frequencies (item 5). In the chart on line 8 are indicated the two channels assigned to Scientific, Industrial and Medical services. Also, there are inserted two additional reference points entitled "2f", indicating second harmonics

of these assigned channels. Industrial heating equipment and medical apparatus frequently employ very high powers and may radiate considerable harmonic signal energy.

These second harmonics, particularly the one near 82 mc, may cause appreciable trouble to television services. If the industrial and medical equipment is unable to maintain the frequency tolerances provided by the allocations, much wider interference ranges may be introduced. Other radio services of high power may also generate harmonics of sufficient energy to cause interference.

Many older diathermy machines are still in use, designed for the 6 meter band, employing frequencies near 50 mc, outside the newly authorized FCC medical bands. Their characteristic 60 cycle or 120 cycle power line modulation produces one or two horizontal regions of interference on the television pictures.

The difficulties associated with receiving signals associated with the image frequencies (item 6) may best be explained by reference to examples that have been reported in the New York area.

A certain prewar receiver tuned to Channel 2 WCBW, had the channel 5 WABD, signal appearing faintly in the background. That is, the Du Mont test pattern or picture appears to wander slowly and faintly back and forth across the Columbia pictures. The signals arrived through the image frequency acceptance of the channel 2 receiver, as illustrated on line 22 of the chart. Actually this condition is not serious and can be observed only in certain locations where the WABD signal is quite strong with respect to the WCBW signal. From the same causes a receiver tuned to WNBT, Channel 4, may receive a heterodyne interference from the Armstrong FM station on 92.1 mc in areas where the WNBT signal is weak with respect to the (W2XMN) signal, either due to relative antenna exposure to the two stations or due to the receiver location being close to Alpine, N. J., and relatively distant from the Empire State Building.

A television receiver tuned to WABD, Channel 5, may receive heterodyne interference from a strong local oscillator radiation from an old type receiver operating on Channel 4 as illustrated on lines 24 and 25 of the chart. It is not easy to design a television receiver for wideband acceptance through its RF circuits, and at the same time secure a low order of reradiation from the local oscillator which is a relatively few megacycles removed from this RF acceptance band.

Signals may enter the receiver through the IF channel, since the RF stages have insufficient selectivity to prevent the very high signal strength energy from riding through the receiver. For example, a receiver with prewar IF standards may pick up the international broadcast stations at Wayne, N. J., operating near 9.5 and 11.5 mc.

Also, a new television receiver employing a 21.9 mc sound IF tuned to WCBW, Channel 2, may be subject to image frequency acceptance of the Raytheon experimental FM transmitter at 106 mc. Since new receivers have far greater sensitivity in the desired channel than in the image channel (as shown on line 36 of the chart) they will minimize interference from the FM stations. The employment of a sound channel IF of 21.9 mc and the picture channel IF carrier of 26.4 mc in place of the lower IF channels in the old receivers is mainly responsible for this improvement. The latter has been chosen just above the international broadcast channels and extending almost to the scientific, industrial and medical allocation above 27 mc. The assignments to fixed services in this band are not likely to be of high power.

A further and possibly more important advantage of the choice of a higher intermediate frequency lies in the greater separation of the image frequency from the carrier frequency of the desired station. The commercial television assignments are in two groups, one running from 44 to 88 mc and the other running from 174 to 216 mc. In other words, twice the IF of the receiver is a frequency spread in excess of the entire spread of the lower television band. Furthermore, in the upper television band for channels 7 through 13, the separation between the image frequency and the desired frequency is a greater frequency spread than the width of the upper television band, making it possible to obtain far greater image rejection in the tuned radio frequency circuits of the receiver. Even when television services may be assigned around 120 mc or higher, the image rejection characteristics of the receivers will allow good performance for television.

In these new receivers the local oscillators are more widely separated from the desired carriers than in the old sets so that better rejection is inherent in the receivers. Also the circuits of the receivers are so designed that a much lower signal strength is radiated from the antenna by the local oscillator.

Measurements made on the inductive tuner mechanism, Fig. 1, which is capable of covering the entire 13 channels for television and the intervening assignments to

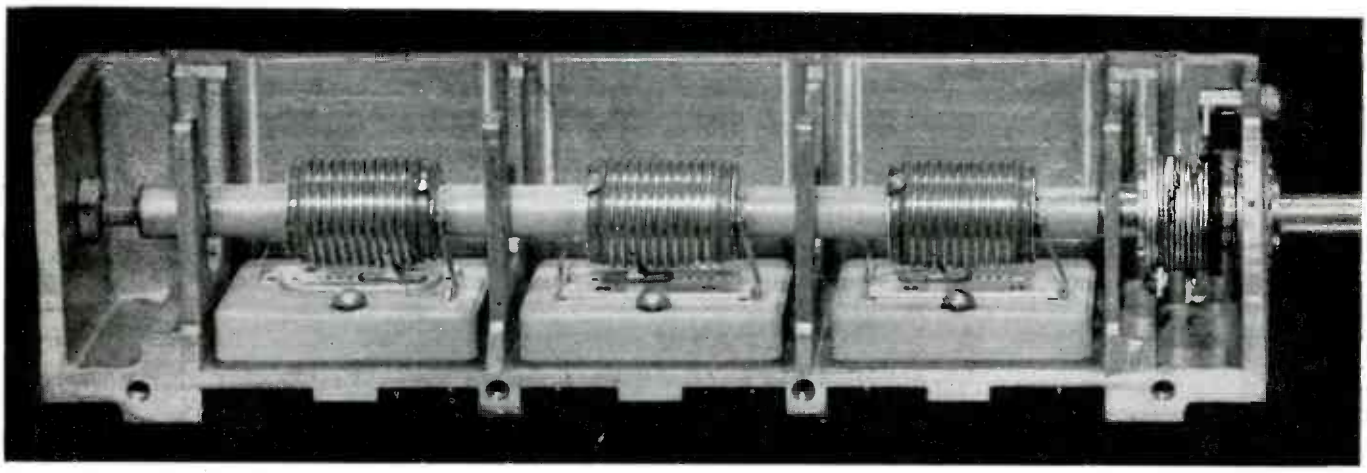


Fig. 1—Mallory-Ware inductive tuning unit which is capable of tuning the entire 13 television channels and intervening assignments to FM and other services, and which makes possible 100 to 1 amplitude discrimination against image frequency in the middle of the band

FM and other services indicate that it is capable of producing a 100 to 1 amplitude discrimination against the image frequency in the middle of the band.

There are a number of methods of improving the performance of television receivers when interference conditions become serious. It is desirable first to try to identify the frequency and type of modulation of the interfering signal, by the typical patterns which are produced upon the television picture, especially when a cathode-ray oscillograph is used to observe the video waveform, and get a quantitative measure of the degree of interference. In some cases the interference may be so severe as to destroy synchronization of the picture, and analysis on the picture tube itself becomes difficult.

Some signals change in appearance as the local oscillator is tuned and othere remain fixed, independent of the tuning. A signal generator capable of producing a reasonable field strength near the receiver in the frequency range of the IF and RF channels is helpful in comparing forms of interference. The signal generator may then be utilized to cause a controllable interference. Once identified, it is then possible to take steps for attenuating the undesired signal.

Preventive methods

If the interfering signal is found to lie within the normal acceptance band of the desired television channel, it is not practical to attempt to remedy the conditions in the receiver itself. If the source can be found preventive measures at such source might be applied. For example, if a local oscillator of some nearby radio or television receiving system is providing the interference, that receiver requires additional shielding or an RF stage to prevent such radiation. If a diathermy machine or other service is operating in a television channel, the FCC may be notified so that control measures may be taken.

Where international broadcast stations arrive in the IF channel, it is possible to provide IF rejection circuits in the transmission line from the antenna. A low impedance resonant circuit consisting of a few turns of wire in shunt with a variable condenser, say 10 to 100 $\mu\mu$f may be employed. This parallel resonant circuit is connected in series with the hot lead of the transmission lines. With a balanced transmission line two such resonant circuits, one in each side of the line, may be used, tuned to resonate in the IF band around 10 or 11 mc so as to reduce the interfering international broadcast station signals. If interference still persists, a series resonant circuit across the receiver terminals, resonated to this IF forms substantially a short circuit for these signals and yet allows nearly full passage for the desired television signals. In some cases if the signal is very strong, it becomes necessary to provide additional shielding in the early IF stages, since even the small exposed lengths of wiring serve as pickup loops for strong signals.

Image interference

Where the interference occurs on image frequency, it is possible to minimize such interference by the use of parallel tuned circuits resonant for the interfering frequency. These are inserted in series with the "hot" lead of the transmission line. For example, a receiver may be tuned to Channel 2, WCBW, and have a faint picture of Channel 5, WABD, in the background. A tuned circuit consisting of inductance and a variable capacitor in parallel, inserted in the transmission line and resonated for WABD's frequency, will reduce or eliminate such interference. A sharper tuned coil with variable capacitor in parallel, inserted in the transmission line and resonated for 92.1 mc, will reduce interference on channel 4 caused by the Armstrong FM station at 92.1 mc.

These rejection circuits can be wired permanently into the gang switch in some receiver designs so that they operate on the specified channel only. In other cases, it may prove more convenient to arrange easily connected rejection circuits which may be inserted in the transmission line as given channels are selected for reception.

One form of interference frequency trap which has proved quite useful is a short stub of transmission line connected directly to the receiver terminals along with the regular transmission line. Such a stub forms a resonant quarter-wave section of line for the frequency of the interfering signal and thus reflects a substantial short-circuit at the receiver terminals for this frequency. It will not materially reduce the signal strength for the desired channel if it is properly tuned. This section of transmission line is left open at its free end. A section of coaxial cable or a section of polyethelene bonded wire pair is satisfactory. The effective capacitance at the receiver terminals varies from set to set and thus experimentation is the best method of determining the most effective length of line. For example, for the above 92.1 mc FM station, a length of transmission line of about 28 inches is connected across the receiver terminals. Observation of the decrease in heterodyne interference on the picture pattern as the section of transmission line is snipped shorter and shorter by quarter inch steps will determine the optimum length.

In many cases an improvement in antenna directivity reduces interference greatly. The mere rotation of a simple dipole to a new position may cut down markedly the signal strength from the interfering FM station or nearby local oscillator while it still allows sufficient signal strength to arrive from the desired television station.

In extreme cases where the image frequency problem does not submit to simple solution as outlined above by further rejection circuits, it may be worthwhile to actually change the intermediate frequency of the receiver.

Added pre-selection

In certain cases additional RF pre-selection may be warranted. Tuned circuits with channel switching may be used between the antenna terminals and the existing input circuit of the receiver. Where high signal level is already available it may not be necessary to use an amplifying tube in these circuits. If the antenna coil is resonated and a second tuned coupling coil is employed, thence feeding a third resonant circuit connected to the grid of the input tube, such added selectivity will greatly reduce interference.

A small RF-IF chassis may readily be constructed which utilizes new intermediate frequencies for both the picture and the sound channels. Such an input tuner can then deliver the improved video and sound signals to the conventional circuits beyond the detectors in the regular television receiver.

For apartment house installations where the local oscillator problem is likely to become very serious and where the number of antennas is strictly limited to practical quantities, it will be very desirable to install a number of master receivers. These receivers could even employ

(*Continued on page* 94)

TUBES ON THE JOB

Evacuation Leakage Check

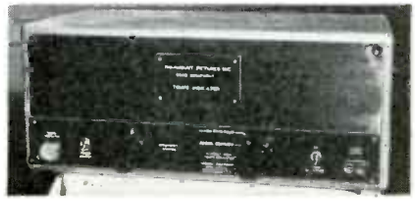
In connection with the production of uranium, thorough checking of a number of high vacuum systems was accomplished by use of helium gas as a testing substance and a Westinghouse mass spectrometer as detector. In operation, the latter is attached to the vacuum system and the pumping is initiated. Then a blanket of helium gas is applied to all suspected locations of leaks. Molecules passing into the system are given an electrical charge which controls their movement in the electromagnetic field of the spectrometer according to their mass. Molecules of the particular mass of helium pass to an exit slit at the end of the tube and are then detected and recorded. Helium gas is used because it does not react harmfully with other gases and is inherently stable. If the detector shows a reading while testing at some particular point in the system with the helium nozzle, helium is entering through some opening at that particular location. The speed of the method makes feasible thorough advance checking of extensive high vacuum installations.

Electronic Metal Detector

Damage to machines due to minute metal particles hiding out in non-metallic industrial materials and loss in production time resulting from it may be prevented by use of an automatic electronic metal detector recently developed by the RCA Victor Div. of the Radio Corporation of America, Camden, N. J. Unlike magnetic metal detectors the device is capable of spotting any kind of metal or alloy including iron, copper, brass, lead, aluminum, stainless steel etc. Its sensitivity to very small or larger pieces of metal may be adjusted to fit conditions in each installation. Detection is independent of the depth of the particle in the product under inspection. In operation a high-frequency electro-magnetic field is generated by coils at the top and bottom of the inspection aperture. A self-contained electronic oscillator feeds rf power to the coils. The reaction caused by a metal object passing under the aperture is detected and amplified by an electron tube amplifier, which in turn triggers either a signaling device or an automatic marking or ejection mechanism or any desired combination of these. The objects and materials to be screened are passed through the inspection aperture either on an endless conveyor belt, which may have speeds up to 600 ft. per minute or by means of a chute. A ⅛ in. cold-rolled steel frame shields the inspection aperture making it insensitive to nearby metal objects and electrical apparatus. The detector is sealed against dirt, lint and dust, and is splashproof. Normal humidity and temperature variations do not affect the unit, which is provided with an automatic voltage regulator against line voltage variations.

Electronic Cueing Device

First use was made of an electronic visual dance cueing device recently developed at Paramount, the initial application being for square dance sequences of "Welcome Stranger," starring Bing Crosby. The device was created by Loren L. Ryder and the Paramount



The electronic visual metronome insures synchronization of music and dancers

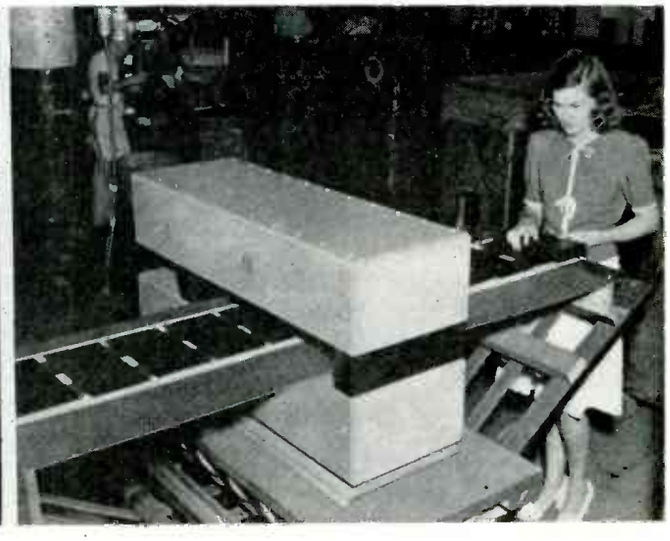
sound department, because during the filming of most dance numbers in order to playback the recorded musical accompaniment it is necessary to cut off or reduce the volume so low that the dancers have difficulty maintaining a rhythmic beat.

The "visual metronome" operates from a previously prepared click sound track, disc or film loop. The record is reproduced on standard equipment into a special amplifier system with electronic control for flashing any desired number of incandescent lights around the set.

These lights, which are activated by an electrical impulse caused by the "low cycle" sound are placed where they are always visible to the dancers but far enough out of camera angles so as not to interfere with the photography.

Use of a mass spectrometer for determining leaks in uranium production

Equipment for location of metallic particles in industrial materials



CR Tube Facsimile

A new telecommunication system that differs fundamentally from conventional systems of facsimile transmission and reproduction has been developed by A. C. Cossor, Ltd., Highbury Grove, London N. 5, England. The unit comprises a system which enables graphic intelligence, i.e., handwriting, sketching, etc., to be reproduced electrically at a distant location, the transcription being simultaneous with the inscription at the transmitter instrument.

The two terminal points contain both a transmitter and receiving unit, thus enabling two-way communication of written matter via a common line. An anti-side-tone circuit is incorporated in each end, which prevents the sender's script being reproduced on its own oscillograph unless required for setting-up purposes.

The transmitter instrument contains a metal plate on which the subject matter is inscribed by hand, with the aid of a stylus or pencil, this being wired back to the chassis via a flexible lead. The act of inscribing on the plate results in the production of signal components which are communicated to the remote receiver via a cable link.

The receiving instrument contains a cathode ray tube, signal amplifier and associated power supplies. The signal amplifier converts the received signals into a pair of dc components which are applied to the "X" and "Y" plates of the CRT. The resultant deflection of the beam causes the luminous spot on the screen to assume a definite position within the area of the tube face, this being related to the position of the stylus point when in contact with the plate at the transmitter. Subsequent movement of the stylus in the act of writing produces a corresponding movement of the CRT beam. The tube screen material has a long afterglow period, which enables the luminous track inscribed by the spot to be viewed. A considerable reduction of signal band width required to transmit certain forms of facsimile is achieved.

Spectrum Analyzer

At the May 1 meeting of the New York section of the IRE a description of a wide-range double heterodyne spectrum analyzer was presented by L. Apker, J. Kahnke, E. Taft, R. Watters of the G. E. Research Labs., covering the frequency

Wide range double heterodyne spectrum analyzer covering 10 to 3000 megacycles

range from 10 to 3000 mc. In this instrument the incoming signals were applied directly to a first crystal mixer driven by a special reflex beating oscillator tunable thermally[1] over the range from 24,600 to 21,600 mc. A band-pass filter network incorporating two high-Q resonant cavities rejected unwanted components in the output of the first mixer and delivered the desired 24,600 mc power to a second crystal mixer.

A simple automatic frequency control circuit of a standard type held the second beating oscillator at an average frequency of 24,715 mc. A very small amount of frequency modulation was produced on the output of the oscillator by a 60-cycle sine-wave voltage applied to the repeller. A fraction of the oscillator output was delivered to a resonant-cavity transmission filter with a very narrow pass band. The amplitude modulated output of the filter was then applied to the input of a phase discriminator and the direct-current output of the latter was returned to the repeller of the second beating oscillator. The frequency of the oscillator was thus held at the center of the filter pass band.

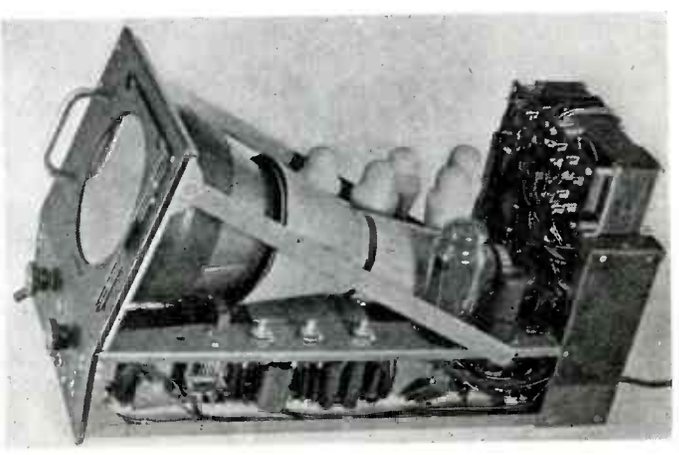
The output of the second mixer was delivered to a 115 mc amplifier which featured high-Q coaxial resonant elements. A bandwidth of 200 kc at 115 mc determined the resolving power of the analyzer. The video stage had a logarithmic response and heights of the oscilloscope "pips" were thus linear in decibels.

The frequency of the first beating oscillator was swept in synchronism with an oscilloscope trace by a sawtooth voltage applied to the repeller of the oscillator in the usual manner. The 60 cycle sweep had a variable bandwith from 10 to 100 mc. Provision is made for single-dial tuning of the analyzer over its entire range. The instrument (as shown) included an absorption-type frequency meter range of the first beating oscillator provided calibration over the entire range of the instrument. This work was done under O.S.R.D. Contract OEMsr-931 with the General Electric Co.

[1]The authors acknowledged indebtedness to J. O. McNally, P. Kusch and J. M. Lafferty of the Bell Telephone Laboratories for the special beating oscillators used.

External appearance of the cathode ray tube facsimile equipment

Internal view of the CR tube unit showing disposition of amplifiers



SURVEY of WIDE READING

Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

Surface Defect Detector

G. R. Polgreen and G. M. Tomlin (Electronic Engineering, London, April, 1946)

In a lecture on "non-destructive testing of materials," the radio frequency surface tester was described. This device was developed specifically for the detection and measurement of longitudinal cracks, laps or seams in uniform cross section conductors.

The conductor to be tested is placed in the field of an inductance carrying high frequency current. If the coupling between the sample and the inductance is fairly close, the eddy currents affect the current flowing in the inductance. Since, due to the skin effect, the eddy currents flow in the surface of the sample, a longitudinal crack will reduce the currents in the sample, and, if deep enough, will completely interrupt it.

The effect on the inductance in which the sample is placed thus varies with the presence of a crack, and is also proportional to the depth of the crack if an appropriate frequency is chosen. In the detector, the inductance forms part of an oscillating circuit and the change in frequency resulting from a change in coil inductance caused by a crack is indicated by a beat frequency method.

Geiger Counter Spectrometer in Powder Metallurgy

E. S. Kopecki (Iron Age, February 28, 1946)

The Geiger-counter spectrometer permits rapid measurement of X-ray intensities as a function of the diffraction angle. This method is superior to photometric recording of X-ray intensities, using film and densitometer, as well as to the ionization chamber determination of X-ray intensities.

Relative amount of crystalline compounds in a mixture determine the relative intensities of the X-ray diffraction lines. Qualitative and quantitative analysis of metal powders may therefore be based on X-ray intensity measurements. Crystalline mixtures can be recognized and the relative amounts of the component compounds established within a few minutes and with great accuracy by means of the Geiger-counter spectrometer.

Ionization Gage Indicator

W. M. Brubaker and V. Wouk (Review of Scientific Instruments, March, 1946)

An FM oscillator has been designed for indications in connection with an ionization gage used for leak hunting in vacuum systems. Pressure inside the vacuum system is converted into a dc voltage which is amplified (see figure) and employed to control the frequency of a relaxation oscillator. The resulting variable-pitch audio signal is amplified and applied to the input of a loudspeaker.

With the circuit constants as listed, the frequency varies between 15 and 3000 cycles per second as the grid voltage is varied from -6 volt to 0 volt. The voltage sensitivity is increased more than tenfold by the addition of the direct coupled triode amplifier. An input signal of 15 millivolts will cause blocking reliably.

Airplane Noise Interferes with Seismic Prospecting

J. M. Kendall (Geophysics, January, 1946)

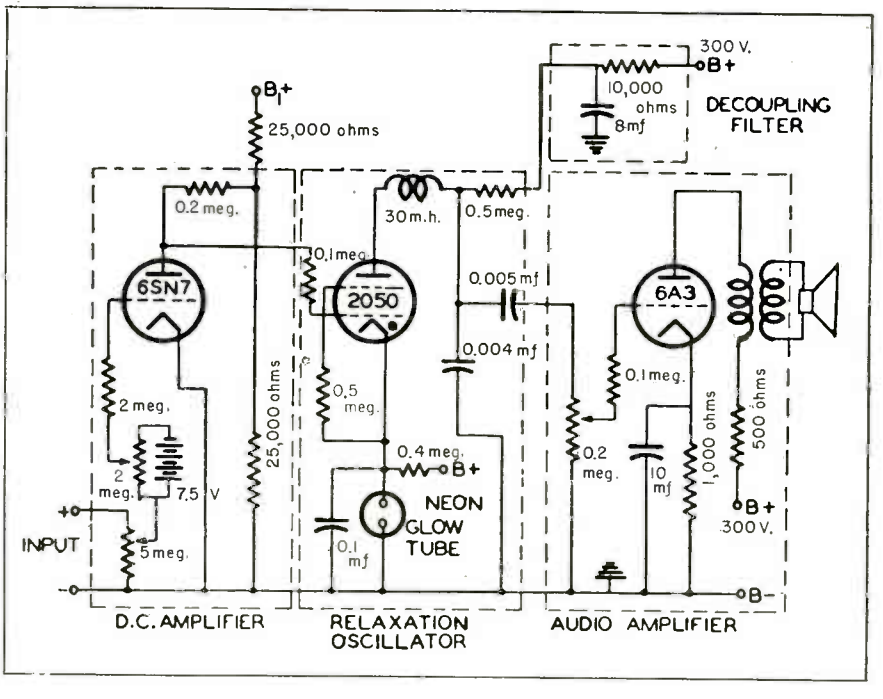
The interference produced by airplane low-frequency noise on geophones is studied and data on a cargo plane are presented. Approximate computations indicate that one airplane can blanket an area of several hundred square miles. The interference may be reduced by frequency discrimination, by the addition of a microphone responsive to the airplane sound and compensation, or by soundproofing. However, none of the suggested remedies is a satisfactory solution to the problem.

Sintered Glass

E. G. Dorgelo (Philips Technical Review, Eindhoven, Netherlands, January, 1946)

In the manufacture of certain articles in which many metal parts (e.g., lead-in wires) must be fused into glass close to each other, it is sometimes impossible, due to the too low fluidity of the molten glass, to force the drop of glass between

DC voltage indicative of pressure in vacuum system controls frequency of relaxation oscillator



the metal parts. This difficulty can be overcome if powdered glass is introduced directly into the space between the metal parts.

Powdered glass is obtained by grinding up pieces of glass. This powder is cast in a mold in which the metal parts to be fused are already present. After covering the mold the whole is heated to a temperature at which the glass is very fluid so that only slight pressure is enough to fill even the smallest cavities.

The glass obtained after fusing is called sintered glass. It contains numerous very small gas or air bubbles which make it appear somewhat turbid and also change the mechanical and electrical properties of the glass to a small extent. The specific weight of sintered glass is reduced by the presence of the air bubbles by about 5 to 10% as compared to clear glass. If the air bubbles take up 10% of the total volume, the thermal and electric conductivity will be reduced by approximately 15% and the dielectric constant by 12%; the tangent of the loss angle will be 2% less than that for clear glass. Less strain at surfaces fused to other materials were observed in sintered glass as compared to clear glass.

Sintered glass offers advantages in the manufacture of experimental tubes and lamps because of the rapid and simple manner in which almost any desired base can be made. Simultaneously with the fusing-in of leads, the glass envelope can be welded on. Sintered glass is particularly useful in the manufacture of tubes with complicated or crowded electrode structure.

It is possible to fill the mold with layers of powdered glass having different properties, and then to fuse the whole. By choosing powdered glasses of gradually increasing coefficients of expansion, graded seals can be made. For instance, tubular parts which at one end can be fused to a glass with a high coefficient of expansion and at the other to a glass with a low coefficient of expansion may be obtained.

Radio-Sonde Recording of Potential Gradients

K. Kreielsheimer and R. Belin, Auckland University College, New Zealand (Nature, London, February 23, 1946)

The potential gradient in air as a function of height is recorded by the signals generated by a transmitter during its ascent. Frequency modulation is obtained by the grid potential of the modulator in dependence of the passing current due to point discharge in an electrostatic field through a resistor in the grid circuit of the modulator tube. A recording illustrating the rapid change of potential gradient within a cumulo-nimbus cloud is presented.

On Radar

J. H. De Witt, Jr. (Journal of the Franklin Institute, February, 1946)

A comprehensive survey article on the technical and tactical features of radar is presented. A description of the component parts of radar is followed by an explanation of how the various indications possible with a radar system are obtained. Several design considerations for specific applications are included.

X-Ray Inspection of Castings

G. Mullowney (Aluminum and Magnesium, February, 1946)

The defects detected by X-rays in magnesium castings are correlated with fault in foundry technic. A table is presented listing the most common defects (shrinkage, cold shut, cracks, porosity and inclusions), the cause of their presence in the finished product, and a description of their X-ray appearance. Production of X-rays and operational and equipment cost are discussed.

Inspecting Steel with Million-Volt X-ray Unit

(Steel, March 25, 1946)

The 1,000,000-volt X-ray equipment installed at the steel foundry of the Bethlehem plant of the Bethlehem Steel Co. for the inspection of heavy steel sections is described.

Outdoor Sound Propagation

F. L. Hopper and R. C. Moody (Journal of the Society of Motion Picture Engineers, February, 1946)

The article reports observations made with an outdoor loudspeaker system on the effect of the temperature, wind, humidity, nature of terrain, etc., on the propagation of sound. Data on measured and computed sound pressure distributions of loudspeaker arrays are given; particularly, the frequency dependence is considered. The experiments were carried out in the Mojave desert.

Re-Radiation Affects Video Contrast

E. W. Herold (RCA Review, Vol. VII, No. 1)

Among the effects introduced into television pictures by local-oscillator radiation from nearby receivers is the superposition of vertical streaks on the pictures. The number and intensity of these black and white bands depends upon where the l.o. frequency falls within the RF pass band of the receiver. As the frequency of the interfering signal increases (upward) with respect to the carrier, the number of bands increases and when the separation reaches 3-4 mc they are no longer distinguishable as such. It has been shown by E. W. Herold that at this point the contrast is reduced and in certain cases a reversal of blacks and whites results.

When the interfering wave approximately equals the picture carrier amplitude for black, Fig. 1c, the combined waves will vary in amplitude from twice the black level to zero. Thus a black area will appear a medium gray; and during transmission of a white area the interfering signal of black level amplitude will in itself make the picture appear black, giving a complete reversal of contrast or a negative picture, Fig. 1b or 1c from the Herold paper.

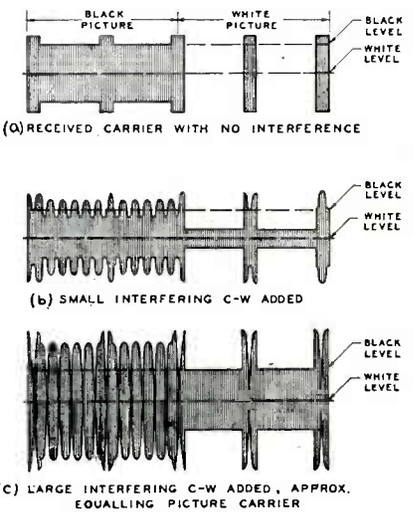


Fig. 1—Effect of interfering continuous-wave signal spaced 3 to 4 mc from picture carrier

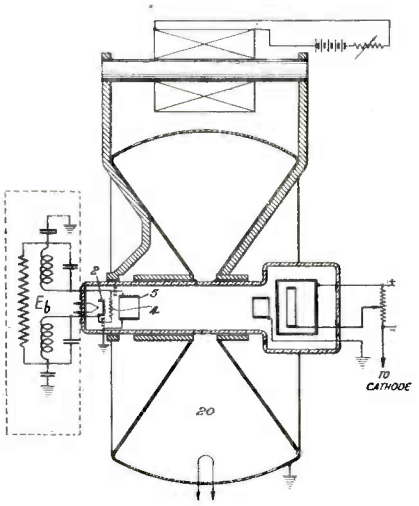
The quantitative values depend somewhat on the levels reached by the dc restoration circuit. If the latter operates at peak values no picture reversal results, but the black areas have increased brightness. The analysis also shows that

(*Continued on page 94*)

NEW PATENTS ISSUED

UHF Oscillator

The oscillator designed for 300 megacycles per second or more incorporates a cathode 2, grid 4 and accelerating electrode 5 coupled as a grounded-plate oscillator and a resonator tank 20. Operation of the



circuit will be clear from an inspection of the drawing.

O. E. Dow, RCA, (F) April 24, 1941, (I) March 26, 1946, No. 2,397,411.

Flight Path Controller

An accessory circuit to a localizer receiver in an aircraft permits a predetermined deviation of the path taken by the aircraft from the equisignal path provided by the localizer transmitter. For this purpose an additional signal generated in the receiver is superposed on the localizer signal. The additional signal is identical but opposite in sign to the signal provided by the localizer if the aircraft would fly the desired path. It may be obtained from a record made during a previous landing in favorable weather which is synchronized with the instantenous position of the aircraft by an avc control.

T. M. Ferrill, Sperry Gyroscope, (F) November 8, 1943, (I) March 5, 1946, No. 2,395,854.

Discriminator

The proposed system permits demodulation of more elaborate phase-modulated waves than conventional systems. A wave of the form

$$E = E_o \sin (\omega_o t + \Phi_s)$$

may be demodulated, where the phase variation, Φ_s, is an arbitrary function of the signal, s, and ω_o is the angular frequency of the carrier. In the conventional frequency-modulated carrier, $\Phi_s = (k e \sin \omega_1 t)/\omega_1$, where $\sin \omega_1 t$ is the signal to be transmitted; or the signal is proportional to the differential of the phase variation, Φ_s with respect to time.

According to the invention and as illustrated in the drawing, the phase of the incoming wave,

$$E_o \sin (\omega_o t + \Phi_s),$$

is shifted by an amount $\Phi = a\Phi_s$, which is proportional to Φ_s, so that a wave $E_1 \sin (\omega_o t + \Phi_d)$ is obtained, where $\Phi_d = \Phi_s - \Phi$. If a is chosen to be a constant close to unity, Φ_d will be much smaller than the original phase deviation, Φ_s, and proportional to it. A considerably smaller frequency band will be covered by this new frequency-modulated wave so that the amplifier stages in the receiver do not require to pass a wide frequency band. A bandwidth equal to that provided in amplitude-modulation receivers is considered adequate.

The wave is now heterodyned in the conventional way to change the angular carrier frequency ω_o to an angular intermediate carrier frequency, ω_1, corresponding to a frequency of 450 kc. The intermediate frequency wave, $E_2 \sin (\omega_1 t + \Phi_d)$ is amplified. The next step involves the beating of the frequency-modulated intermediate frequency wave with a locally generated wave,

$$E_3 \sin \omega_1 t,$$

of constant intermediate angular frequency, ω_1, and the derivation of the difference wave, $E_4 \sin \Phi_d$, from the output of the mixer tube. This voltage is amplified in a tube AT.

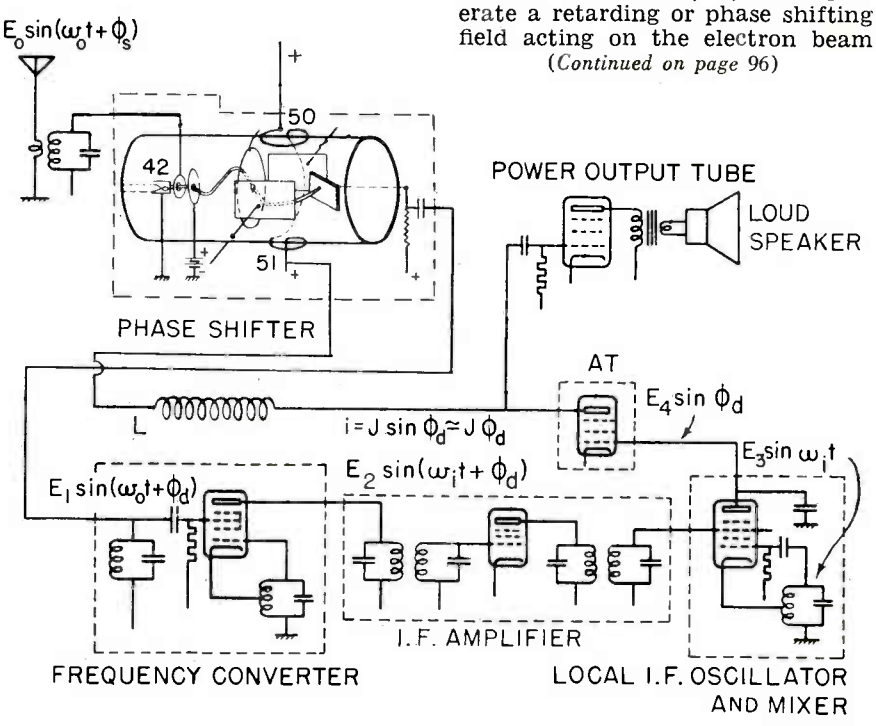
It is proposed, in an example, that an original phase variation, $\Phi_s = 2000$ radians, be transformed into $\Phi_d = .25$ radian, reducing the phase variations of the original signal by a factor of 8000.

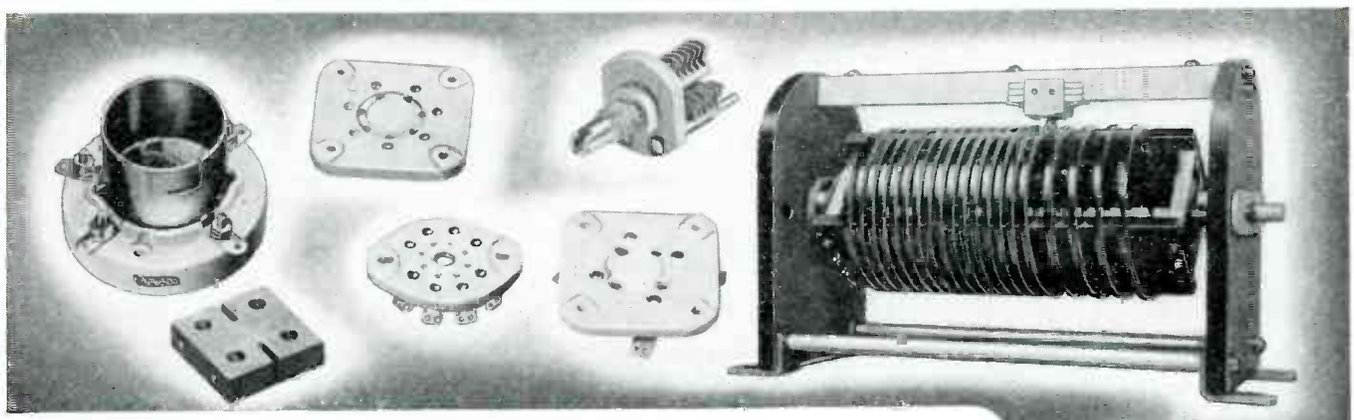
As Φ_d is a small angle, its sine is approximately equal to the argument so that the plate current, J sin Φ_d, may be considered approximately equal to $J\Phi_d$, or proportional to the difference angle, Φ_d, and consequently proportional to the original phase shift, Φ_s.

The plate current, $J\Phi_d$, passes through a coil, L, across which a voltage proportional to the differential of the current is developed. In a conventional frequency-modulated wave, where the signal is the differential of the phase variations, this voltage will be proportional to the original signal. It may be amplified in a power output tube and applied to a loudspeaker. If the original phase shift, Φ_s, is another function of the signal, coil L must be replaced by a suitable demodulator.

The current, $J\Phi_d$, is also passed through two coils 50, 51, which generate a retarding or phase shifting field acting on the electron beam

(*Continued on page 96*)





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Latest Electronic News Developments Summarized
by *Electronic Industries'* Washington Bureau

REAL RECONVERSION AHEAD—With the clouds of confusion over the price situation and OPA's powers blown away, the radio manufacturing industry is poised for a sprint finish in production during the remainder of the summer and early fall which will mean at least 13-million broadcast home set output, equal to the prewar peak. For the next twelve months the industry's leadership visualizes a great year of production, provided no further hazards of materials shortages and governmental controls appear.

SEE PRODUCTION RECORDS—Parts and components manufacturers are geared to conquer their postwar problems with full output; tube manufacturers estimate production of receiver tubes during next year will exceed the 1945 peak of 139 million; and transmitters of all types, broadcast, communications and specialized, will fill a much larger part of the electronic market than in the pre-war years.

INDUSTRY CRITICS MAY BLUSH—On two counts the accusers of the radio-electronics industry should be blushing. The Senate Small Business Committee issued a New Deal perennial blast against "big companies" having "hogged" war production and named not just the so-called "giant" concerns in the radio field but a number of substantial smaller companies which were notable war producers. These critics forget that large "prime" war contractors had hundreds of small companies as subcontractors and suppliers. The payoff came in the disclosures before the Senate War Investigating Committee on the huge ordnance orders of the Midwest "paper" company through political influence, moves no substantial concern would attempt.

FM SETS REACH MARKET—On the second score, blushes are in order about the labor union charges of FM production being held up by leading manufacturers, which occasioned advocacy by New Dealer Senator Taylor of Idaho for an anti-trust probe. Two major manufacturers, RCA and General Electric, pointed out that their entire lines of FM sets are ready for sale in August, while Zenith has already placed on the market a plastic combination AM-FM (two-band FM) receiver.

FM BROADCASTERS OPPOSE FCC MOVE—Commission's proposal to reserve every fifth FM channel in various areas for future assignment, probably to labor unions, civic organizations, etc., was vigorously opposed at July 12 oral agreement by National Association of Broadcasters FM Department. Interjection of a demand for more FM space by a certain group of broadcasters in that field through taking away television channel No. 6 on the basis that FM manufacturers can more adequately produce FM-lower band TV receivers has also precipitated possibilities of a split in the broadcasting industry. Some leading FM broadcasters are threatening to withdraw FMBI from NAB and put it back on its independent status unless NAB makes a determined fight before FCC on FM rights.

EDUCATIONAL RADIO MOVES AHEAD—Fertile market for FM radio equipment among schools and colleges is being spaded up by the government authorities interested in promoting this service. U. S. Office of Education is completing revision of its comprehensive handbook, "FM in Education" and plans early this month to circulate about 55,000 copies to educational institutions. Planning for the use of FM is going ahead in 41 of the 48 states and to date there are 81 stations either on the air or ready to commence operation.

TELEVISION IMPRESSES LEGISLATORS — Despite the poor subject-matter—the Louis-Conn fight—television passed a most important milestone in public acceptance in its "showings" in the National Capital. The fact that around 800 members of Congress and leading officials in Washington spent the evening at the video demonstrations and came away with the clear impression that television is "ready" will implement governmental action in aiding the progress of the "visual" broadcasting art. Certainly, the members of Congress as the "representatives of the American people" appeared to be sold on television.

ELECTRONICS APPLICATIONS IN MAPPING AND SURVEYING—Exemplifying importance of new developments in electronics, the annual American Congress on Surveying and Mapping in its recent Washington meeting devoted one-quarter of its sessions to a discussion of this field. Detailed application and usage of loran, shoran and decca (the British system of using continuous waves in phase modulation rather than the pulsed method), together with "raydist" for short distance measurements, were pictured by over a half-dozen Army, Coast and Geodetic Survey and university experts.

MISCELLANY—Industry and U. S. government radio allocation experts have commenced preparations for first postwar World Telecommunications Conference even though date may be long way off. . . . Motor bus industry slated to win FCC sanction to create its own mobile radiocommunications agency.

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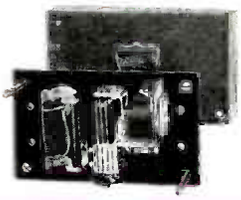
Each unit offers an unlimited number of variations . . . often making a *standard* Guardian Relay a "special," effecting big savings in time and money. Highly efficient, compact, low-priced, long life, you can depend on it—they'll increase the dependability and quality of your product.

Series 40 A. C. Laminated Relay

This laminated relay is designed to produce maximum output with minimum current input. Typical uses include control of call system bells; auxiliary for automatic radio tuning; remote control of fractional motors; safety devices; instruments; sound movie auxiliaries.

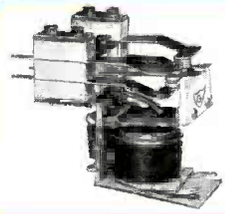
Series 1-A Solenoid

The series 1-A Solenoid by Guardian is one of numerous types for intermittent and continuous duty. Applications include valve control and operation; electrical locking; clutch and brake operation; material ejector; spray gun operation among others.



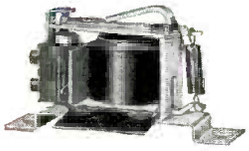
Series T-110 Time Delay Relay

This relay employs a resistance wound bimetal strip to achieve a delayed operation from 10 to 60 seconds. Current flows through the windings generating heat, causing the bimetal strip to bend, closing a contact after the required time delay.



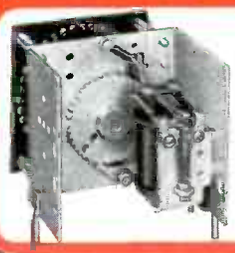
Series A-100 High Frequency

This A-Si-Mag insulated relay is compact, convenient, low in cost. In radio applications it is used for antenna changeover, break-in, high voltage keying, grid controlled rectifier keying, remote control of receives and transmitter, and other high frequency applications.



Series 120

The Series 120 is a small, compact relay. It is an economical unit designed for control needs which do not exceed single pole, double throw combination. Economy and simplicity of construction make it possible to offer the Series 120 at a low price compared with its high quality performance.



Series R Stepper

This Relay is built in three basic types for A.C. and D.C. operation: (1) Continuous rotation, (2) Electrical reset (3) Add and subtract. Its principle application is automatic circuit selection including automatic sequence, automatic wave changing on short wave transmitters, automatic business machines, totalizing units, conveyer control.

GUARDIAN ELECTRIC

1622-J W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

NEWS OF THE INDUSTRY

RMA Drafts Cosgrove

Radio Manufacturers Association at its annual meeting in Chicago re-elected president R. C. Cosgrove (Crosley) and four of its officers, added 15 new members to its roster bringing membership to a new high of 337 companies. Re-elected in addition to Cosgrove were: vice president and chairman of the tube division M. F. Balcom, Emporium, Pa.; executive vice president, general manager and secretary Bond Geddes; general counsel John W. Van Allen; treasurer Leslie F. Muter. New officers are vice presidents Henry C. Bonfig, Chicago (chairman set division); Fred R. Lack, New York; J. J. Kahn, Chicago (chairman of parts division); Allen Shoup, Chicago. New directors in addition to Bonfig and Shoup are: W. J. Barkley, Cedar Rapids; Lloyd H. Coffin, Salem, Mass.; George R. Haase, St. Charles, Ill.; Lloyd A. Hammerlund, New York; Larry F. Hardy, Philadelphia; W. P. Hilliard, Baltimore; Harold C. Mattes, Chicago; A. D. Plamondon, Jr., Chicago; Ross D. Siragusa, Chicago; C. M. Srebroff, Long Island City, N. Y.; J. Hall Stackpole, St. Marys, Pa. It was RMA's 22nd annual convention and membership meeting.

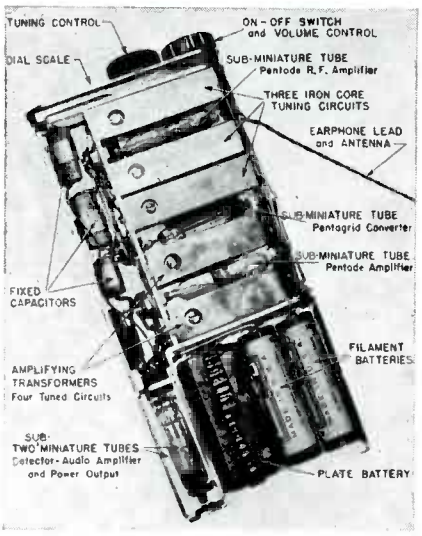
Philco Licenses RCA

Philco Corp., Philadelphia, has entered into a license agreement with Radio Corp. of America under which some 600 Philco patents relating to radio, television and electrical phonographs, will be available for use by RCA. The agreement includes use of the recently perfected Philco advanced FM system.

Housley Heads AIEE

American Institute of Electrical Engineers has elected J. Elmer Housley its new president. He is district power manager for the Aluminum Company of America, Alcoa, Tenn. Other officers elected were: Vice Presidents E. W. Davis, Cambridge, Mass.; O. E. Buckley, New York; T. G. LeClair, Chicago; R. F. Danner, Oklahoma City; C. F. Terrell, Seattle; Directors J. F. Fairman, New York; R. T. Henry, Buffalo; E. P. Yerkes, Philadelphia; Treasurer W. I. Slichter, Schenectady (re-elected). Total membership of the organization has reached 25,090.

POCKET RADIO



Internal arrangement of Belmont pocket radio which measures 3 x ¾ x 6¼ in., weighs 10 oz. with batteries. It is a 5-tube superhet, tunes broadcast band

Radiation Lab Quits

The Radiation Laboratory, established during the war and operated under the supervision of the National Defense Research Committee at the Massachusetts Institute of Technology in Cambridge, has ceased to exist. Shortly after the end of the war a start was made at winding up the affairs of the laboratory and the winding up process was completed on July 1st.

IRE Nominates Baker

Dr. W. R. G. Baker, vice president of General Electric Co., has been nominated for president of the Institute of Radio Engineers, the nomination being tantamount to election. Other nominees whose names will be submitted to membership for vote are: Vice president, Noel Ashbridge, deputy director-general of British Broadcasting Corp. Directors, 1947-1949, M. G. Crosby, consulting engineer, Paul Godley Co., Upper Montclair, N. J.; Raymond F. Guy, radio facilities engineer, National Broadcasting Co.; R. A. Heising, patent engineer, Bell Telephone Lab.; G. T. Royden, senior engineer, Federal Telephone & Radio Corp., Newark, N. J.; J. E. Shepherd, research engineer, Sperry Gyroscope Co., Long Island City; D. B. Smith, director of research, Philco Corp., Philadelphia.

Wheeler Leaves FFC

Dr. L. P. Wheeler, chief of the technical information division of the engineering department of FCC, has retired. He has been intimately connected with FCC since July, 1936. Other FCC changes involve retirement of V. Ford Greaves, who has been supervisor of the western area of the Radio Intelligence Div. of the engineering department in San Francisco; the appointment of James E. Barr as chief of the stand-

(*Continued on page 96*)

Conventions and Meetings Ahead

American Institute of Electrical Engineers—Pacific Coast Convention, Aug. 27 to 30. Seattle; Great Lakes District Meeting, September 26-27, Fort Wayne, Ind. (H. H. Henline, 29 W. 39th St., New York)

American Chemical Society—Chicago, Ill., Sept. 9 to 13. (Alden H. Emery, 1155 Sixteenth Street, N.W., Washington, D. C.).

Instrument Society of America—1946 Exhibit and Conference, Pittsburgh, Pa., Sept. 16 to 20. (Chairman of the Exhibit Committee, Paul Exline, P. O. Box 2038, Pittsburgh 30, Pa.)

American Physical Society—New York, N. Y., Sept. 19 to 21. (Karl K. Darrow, Secretary, Columbia University, New York)

American Society of Mechanical Engineers—Boston, Mass. Sept. 30 to Oct. 3. (Ernest Hartford, 29 W. 39th Street, New York, N. Y. PE 6-9220.)

National Electronics Conference—Edgewater Beach Hotel (October 3, 4 and 5, 1946).

Television Broadcasters Association Conference—Waldorf-Astoria Hotel, New York, N. Y. October 10 to 11. (Will Baltin, Secretary, Room 1038, 500 Fifth Ave., New York 18.)

Electrochemical Society—Toronto, Oct. 16-19. (Colin G. Fink, Columbia University, 3000 Broadway, New York, N. Y. UN 4-3200.)

American Welding Society—Annual Meeting, New York, N. Y., October 24. Atlantic City, November 17 to 22. (Miss M. M. Kelly, 29 West 39th St., New York, N. Y.)

Electronic, Radio and Television Exposition—Grand Central Palace, New York, Oct. 14 to 19. (Electronic Exhibitors. Harry G. Cisin, Executive Director, 50 Broad St., New York.)

Electrical Engineering Exposition—71st Regiment Armory, New York, January 27 to 31, 1947.

Institute of Radio Engineers—Annual Meeting (Commodore Hotel) and Show, (17th Regiment Armory) New York, March 3-7, 1947.

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Ceramic Plate Capacitors Bulletin 630

Selector Switches Bulletin 722

★ TELEVISION TODAY* ★

New Developments in the Video Field

9,603,000 Considering Television Purchase

A potential market for home television receivers which may reach nearly 10 million sets during the next five or six years providing telecast facilities are made available in all urban areas is predicted by Frank Mansfield, director of sales research for Sylvania Electric Products Inc. He bases his figure on answers given by home radio listeners, 28% of which are now located within range of existing television transmitters.

26% of the urban families interviewed said they definitely planned to buy a television receiver and 18.5% were considering television but had not definitely made up their minds. In other words, 45.1% or possibly 9,603,000 families are considering the purchase of a home television set.

When asked how much they thought they would pay for a television receiver, Mansfield stated that 58.9% said they would pay from $100 to $249 and 31.0% said they would pay from $250 to $500. Only 3.4% said they would pay less than $100 while 5.9% appeared to be willing to pay more than $500. The average price for all families interested in a television set was in the $250-$500 range.

CBS Licenses Bendix

Columbia Broadcasting System has licensed its third manufacturer for the production of color television receivers under the CBS patents. Newest addition to the CBS fold is Bendix Radio Div. of the Bendix Aviation Corp., Baltimore. Bendix plans immediate establishment of an experimental color television transmitter at its research and engineering laboratories.

DuMont's Capitol Tele

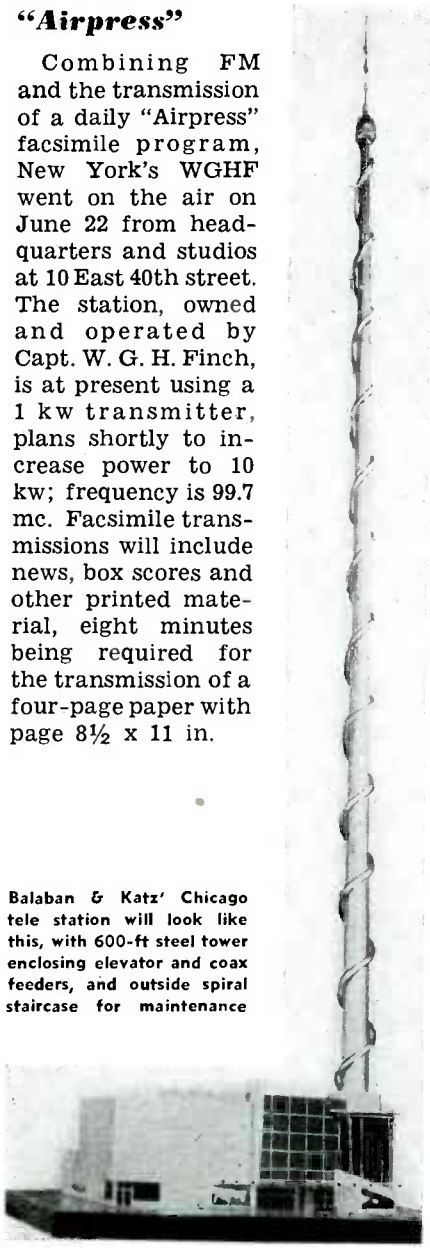
Allen B. DuMont Laboratories, Inc., has been granted a construction permit for the erection of a 5 kw television transmitter in Washington, D. C. Construction was started in June and will be completed within six months. The station will be assigned the call letters WTTG, the final three letters coinciding with the initials of Dr. Thomas T. Goldsmith, Jr., director of research and engineering.

Shupert Heads ATS

George T. Shupert was elected president of the American Television Society at the annual meeting of that organization during which awards in 13 categories were presented for achievements in the television field. Other officers elected were: Ralph Rockafellow, vice president; Dian Dincin, secretary and Archibald U. Braunfield, treasurer.

"Airpress"

Combining FM and the transmission of a daily "Airpress" facsimile program, New York's WGHF went on the air on June 22 from headquarters and studios at 10 East 40th street. The station, owned and operated by Capt. W. G. H. Finch, is at present using a 1 kw transmitter, plans shortly to increase power to 10 kw; frequency is 99.7 mc. Facsimile transmissions will include news, box scores and other printed material, eight minutes being required for the transmission of a four-page paper with page 8½ x 11 in.



Balaban & Katz' Chicago tele station will look like this, with 600-ft steel tower enclosing elevator and coax feeders, and outside spiral staircase for maintenance

How NBC Televised Louis-Conn Fight

(*See Pictures, Pages* 58-59)

The television cameras used in the Louis-Conn fight at Madison Square Garden in June are of an advanced design that permits them to be used almost as easily as a movie camera. One of their most interesting features is a built-in receiving set or monitor by which the focusing is accomplished and which shows the operator the picture as seen by the television audience.

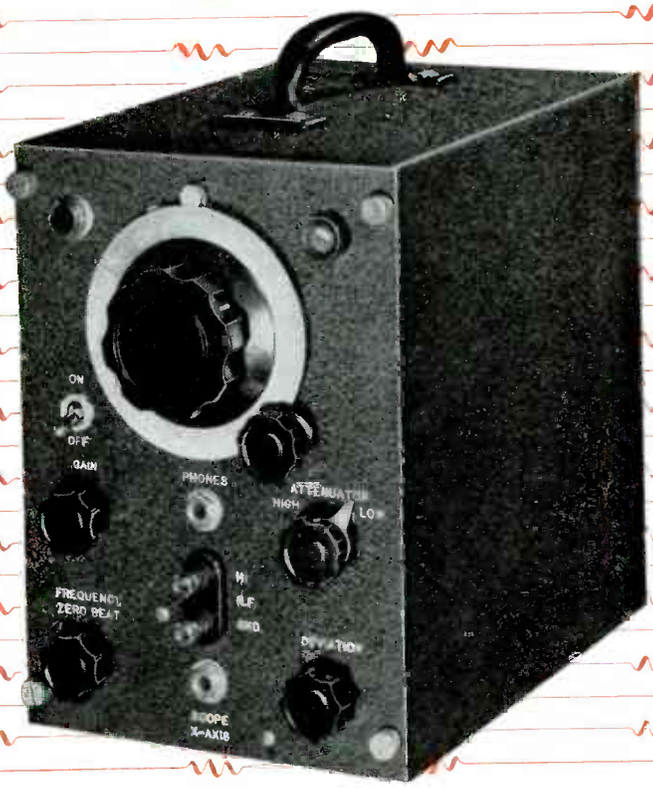
At first an optical finder was tried but was unsuccessful as the scene viewed with the naked eye is too dim for proper focusing! Incidentally, the focusing is done by racking the Image Orthicon tube back and forth behind the lens instead of moving the lens as in an ordinary camera.

The cameras are equipped with four-lens turrets permitting a wide choice of objectives. Furthermore, due to the small sensitive screen size of the Image Orthicon, the lenses used can be the ordinary photographic type instead of the large long focus lenses used previously.

Controls of the cameras are accessible and the entire operation has been made remarkably simple. Connection is by means of a cable under 1 in. diameter containing the required coaxial lines and wires.

For studio use "on air" and "ready" lights have been mounted just below the lens turret. An "on air" light is also located at the rear. There is provision for using one of the lens positions for a small projector carrying "commercials". Rotation of the turret is accomplished by a knob at the rear and permits one and one half second changeover. Accessibility is featured with hinged sides and portability by plug in connection between the separate top and the main body of the camera.

Three Image Orthicon and two pre-war cameras were used for the Louis-Conn fight and demonstrated the tremendous field of television in public events of this nature. Reception throughout was satisfactory as attested by many visitors to the viewing facilities provided by several organizations. (*To page* 96)



The New 205 TS
HAR-CAM *Visual Alignment* SIGNAL GENERATOR

Essential for development, experimental and servicing work in connection with FM applications, IF amplifier alignment and in other uses where a sweep deviation is needed in the frequency range of 100kc to 20mc. Harmonic output useful for many applications up to 120mc.

SPECIFICATIONS

1. Linear frequency sweep deviation adjustable from zero to 900kc peak to peak.
2. Vernier frequency control of 100kc allows zero beat calibration of main tuning dial or for vernier frequency deviations about main dial frequency setting.
3. Stable r-f gain control independent of frequency.
4. Five-step attenuator of r-f output giving over-all voltage range of 1 microvolt to .1 volt when used in conjunction with the gain control.
5. Output impedance, 1 ohm to 2500 ohms.
6. Phone jack for aural monitoring of zero beat calibration of main tuning dial.
7. Panel jack to feed linear sweep voltage X-axis amplifier of oscilloscope, thus synchronizing the frequency linear sweep of the generator with the sopt trace on the scope screen.
8. Voltage regulated supply for internal oscillators. Careful oscillator design to minimize drift.
9. Size, 7" wide, 9½" high, 10½" deep. Weight, 18 pounds.

HARVEY RADIO LABORATORIES, INC.

441 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS



HAR-CAM
HARVEY OF CAMBRIDGE

Typical HARVEY products: *Above left:* The HARVEY Marine Radio Telephone Model M-25; *center:* The HARVEY Regulated Power Supply 106 PA; *right:* The HAR-CAM Model MFT-25 FM Transmitter. Write for Bulletins.

WHAT'S NEW

Devices, products and materials the manufacturers offer

Vacuum-Tube Voltmeter

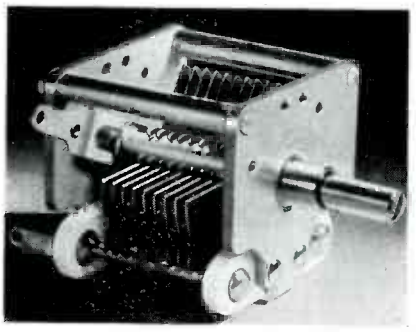
The Meter and Instrument Dept. of the General Electric Co. offers an ac vacuum-tube voltmeter, type AA-1, having full scale ranges from 10 millivolts to 300 volts, rms. The meter and ten position push button switch are also calibrated in terms of decibels, referred to 6 mw into 500 ohms. This instrument is accurate within 3% from 15 c/s to 500 kc and within 5% to 1 mc. Its input resistance is 2 megohms.—Electronic Industries

Photo-Flash Equipment

Portable electronic photo-flash equipment is in production at Raytheon Mfg. Co., Waltham, Mass. The equipment uses two cold cathode rectifiers (CK 1013), a small battery and converter and a flasher bulb filled with Xenon gas and fired by capacitor discharge. The tube has a life up to 10,000 exposures. A larger model operates from 110 v. ac line.—Electronic Industries

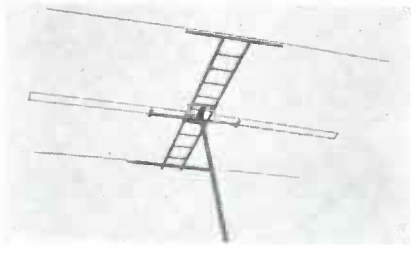
Regulated Power Supply

A regulated power supply which provides two dc high voltage outputs having regulation within 1% from no load to full load and for line voltage variations from 105 to 125 volts is in production at Electronic Measurements Co., Red Bank, N.J. Both 100-325 volts dc at 150 ma, and 0-150 volts dc at 5 ma are available as well as 6.3 volts ac, unregulated at 6 amps. DC voltages are continuously variable. The unit consumes 250 watts at full load.—Electronic Industries



Midget Variables

A new line of midget variable capacitors, designated model RMC and varying in capacity from 50 to 327 mmfd., max. has been added by Hammarlund Mfg. Co., 460 West 34th Street, New York. They are rated at 1000 v. Frames have 3/32d in. end plates rigidly reinforced with three horizontal bars. Stators are supported in two silicone treated ceramic insulators. Bearings are hand fitted in front and single ball thrust in rear. Rotor contact is through a silver-plated beryllium forked spring bearing. Brackets are supplied for mounting either side down or to the panel; there are threaded mounting holes for panel mounting.—Electronic Industries

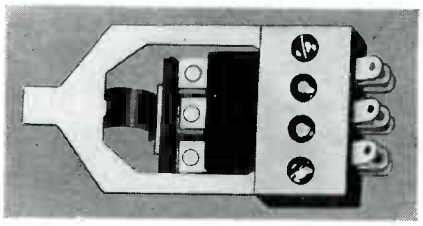


Fabricated Antennas

An assortment of fabricated antennas for FM, television and amateur uses is being made by Electronic Indicator Corp., 35-44 61st Street, Woodside, N. Y. All are made of aluminum tubing, furnished knocked down complete with all supports and hardware. Included are plain dipoles, dipoles with director and/or reflector and folded dipoles in the form of rotatable beams (illustrated). —Electronic Industries

Sensitive Analyzer

An extremely compact and sensitive analyzer provided with complete range coverage has been brought out by Weston Electrical Instrument Corp., Newark, N. J. Model 779 has five overlapping ac and dc voltage ranges, four dc resistance ranges and five decibel ranges. All dc ranges are available either at 1000 or 20,000 ohms per volt sensitivity.—Electronic Industries



Three Pole Switch

A new three-pole open blade snap switch has been developed by Aero Electric Co., 1308 Superior Avenue, Cleveland, O. Measuring 3 x 13/8 x ½ in. it is rated at 10 amps, 125 v ac or 5 amps 250 v. Operating pressure is 12 to 18 oz. for return type and 4 to 8 oz. for set type. May be either open or closed, normally, single or double throw and features beryllium rolling spring construction.—Electronic Industries

Plate Cap

A snap-lock plate cap providing tighter than normal grip for mobile and industrial applications is being marketed by James Millen Mfg. Co., 150 Exchange St., Malden, Mass. Contact is self-locking when cap is pressed into position. A snap button at the top releases the contact grip for easy removal.—Electronic Industries

For the first time . . .

A BASIC VACUUM COATING UNIT FOR YOUR LABORATORY AT $975

D. P. I. now offers the LABORATORY VACUUM COATING UNIT—a small unit ideal for a myriad of experimental purposes, yet inexpensive enough to meet the requirements of modest budgets.

Like the larger units—the Single and Double Vacuum Coaters—this complete unit will deposit metals or metallic salts on glass, other metals, and plastics. It is equipped with a simple indicator to denote pressures in the bell jar. Additional gauges can be used if desired by means of outlets already installed. Within the production limitations of its size, it is capable of any of the jobs performed by the larger units—such as experiments in electronics, surface replicas, dehydration, and other subjects, as your interests may dictate.

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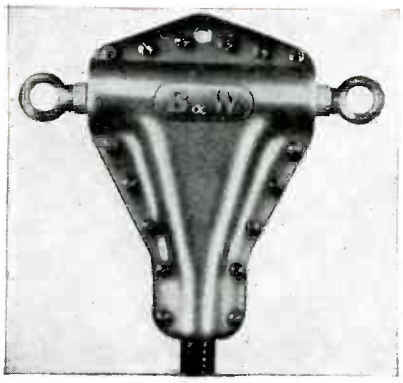
Vacuum Equipment Division

DISTILLATION PRODUCTS, INC.

Rochester 13, New York

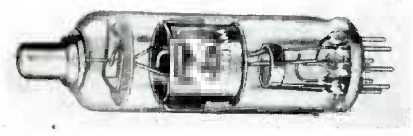


Coaxial Cable Connector

A new coaxial cable connector, "CC-50", introduced by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa., provides a means of making efficient, water-tight coaxial cable connections for antennas. It also serves as center insulator for a half wave doublet. It is aluminum with steatite insulation and two forged steel eyebolts equipped with soldering connections. A bottle of weatherproof cement and a piece of ⅝ in. outside diameter rubber tubing, plus the necessary assembly screws, are supplied. The connector weighs 12 oz.—Electronic Industries

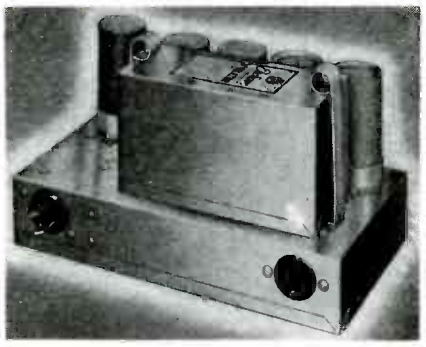
Thickness Measurements

The Filmeter, a device for measuring rapidly and non-destructively the thickness of non-conducting coatings deposited on non-magnetic base metals such as aluminum and its common alloys has been developed by American Instrument Co., Silver Spring, Md. The coatings may be paint, varnish, sheliac, lacquer, enamel, plastics, etc. Thicknesses from zero to 5 mils may be measured with an accuracy of 3% of full scale. The Filmeter consists of a battery operated electronic beat frequency oscillator.—Electronic Industries



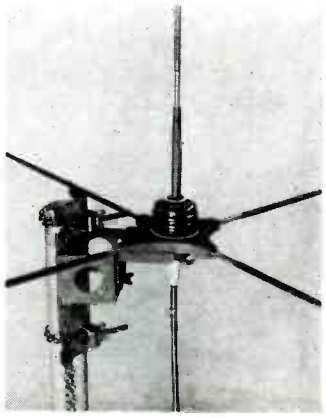
Television Rectifier

A miniature high voltage vacuum rectifier of low current capacity suitable for use in rectifiers operating from an rf supply is being made by Chatham Electronics, 475 Washington St., Newark 2, N. J. Two type 1Z2 tubes in a voltage doubler circuit will supply 20,000 volts at 2 ma dc. Filament voltage of the 1Z2 is 1.5, current 29 amps. —Electronic Industries



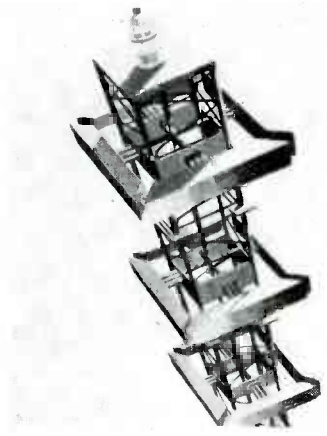
Inverter

A vibrator inverter permitting operation of ac refrigerators on 115 volt dc supply is in production at Electronic Laboratories. Inc., Indianapolis. Model 2113A is designed to operate a ⅛ horsepower motor at an efficiency of 90% with an output of 200 watts. The unit is provided with radio interference filters.—Electronic Industries



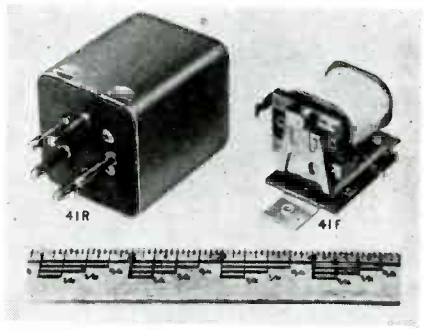
Ground Plane Antenna

A quarter wave Ground Plane Antenna for use on frequencies 28 to 152 mc complete with 50 ft. of weather-proof solid dielectric cable has been brought out by Andrew Co., 363 E. 75 St., Chicago 19, Ill. The antenna is provided with a universal mounting bracket and is designed for use with 50 ohm feeder.—Electronic Industries



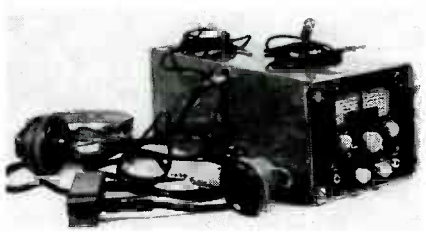
FM Antenna

An 8 bay square loop fm antenna, which provides a power gain of nine, has been brought out by Federal Telephone and Radio Corp., Newark, N. J. The same structure can be used over the entire FM band with only slight reduction in efficiency at extreme frequencies. The antenna is horizontally polarized and may be fed with standard 51.5 ohm coaxial lines.—Electronic Industries



Plug-In Relay

The series 41 Relay, a sensitive ac or dc, large load capacity relay in the low price class, is in production at Sigma Instruments, Boston, Mass. The unit is constructed with a beryllium-copper armature and contact springs, spring-reed type armature hinge and high permeability iron parts. SPDT contacts are rated up to 15 amp. on low voltage dc and 1 kw non-inductive load at 115 volts ac.—Electronic Industries



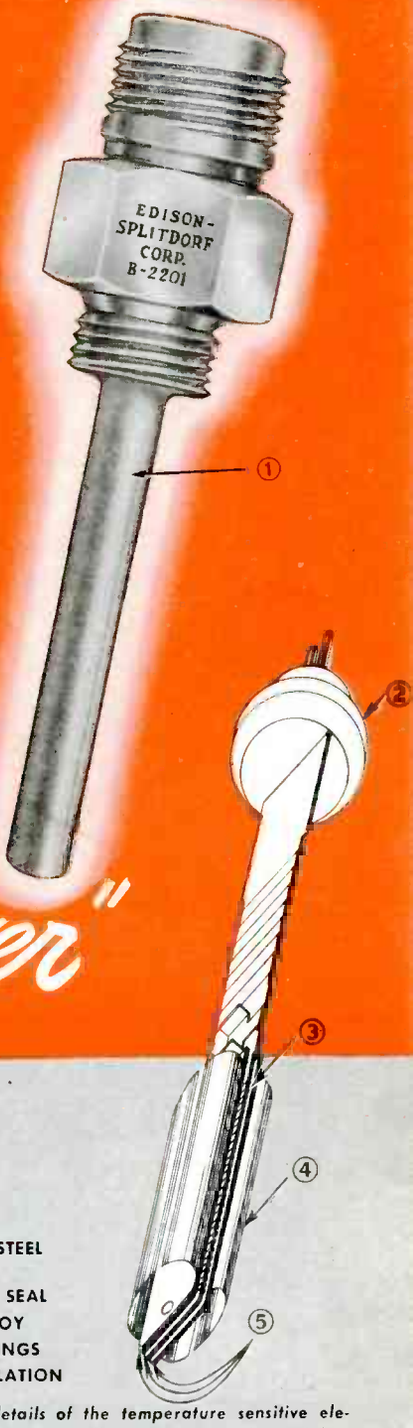
Radiophone

A two-way plane radio incorporating facilities for low frequency and vhf has been developed by the Belmont Radio Corp., Div. of Raytheon Mfg. Co., 60 E. 42nd St., New York. Weighing only 14 lbs. the transmitter and receiver combination gives continuous coverage from 195 to 410 kc. and from 540 to 1600 kc. It also includes the fixed-tuned 75 mc. vhf channel. Power output on 3105 kc. is 14 watts. A DF loop may be attached for radio navigation.—Electronic Industries

Video Amplifier

To extend the range of cathode-ray oscilloscopes, Model V101 video amplifier, developed by Polarad Electronics Co., 135 Liberty St., New York 6, provides a gain of 120 (41.5 db), uniform within 1.5 db from 100 cps to 20 mc. The push-pull output stage is designed for direct connection to deflection plates and is capable of 56 peak-to-peak volts output. A maximum of 50 db attenuation of the input signal is provided by a frequency compensated, five step attenuator, supplemented by a vernier attenuator for the intermediate 10 db. steps. Input probe impedance is equivalent to 12 mmf across 4.7 megohms.—Electronic Industries

World-Wide Photo



Sure Cure for Hay "Fever"

With This New Electrical Resistance Thermometer

WATCH that hay! When it runs a temperature it may ignite and burn down the barn. That's spontaneous combustion and to prevent it an extremely sensitive Electrical Resistance Thermometer Bulb, developed by Edison-Splitdorf Corporation, is used to detect temperature changes.

Not only does this wonder bulb detect overheating in hay mows; it also determines ground and air temperatures in greenhouses — reports temperature changes in the bearings of power station generators, railroad cars, vital spots of airplanes, chemical reactions, hospital rooms and even in patients undergoing operations. Its uses are unlimited and it will measure temperatures ranging from −200° F to 600° F in solids, liquids and gases. Time constant is less than 2 seconds.

The heart of this bulb is a resistance element wound with a wire having a Temperature Coefficient of Resistance of .00636 per degree C. A change of 1° C produces a .39 ohms change in the unit which in turn produces a corresponding change in the current flowing through the recording meter.

Although this type thermometer has been used in industry for many years it was never successfully developed for volume production because of a lack of an adequate supply of a resistance wire with a stable T. C.

Spurred by the urgency of the war, Driver-Harris Metallurgists working with Edison Engineers speedily developed D-H 99 Alloy to meet this need. It is a resistance wire having a stable T. C. of .00636 per degree C when drawn to .002" diameter and available in large quantities with dependably uniform properties from spool to spool.

Today Driver-Harris manufactures over 80 electrical *heat and corrosion-resistant* alloys. If, like Edison-Splitdorf, the alloy wire you need has not been developed, tell us about it. We've solved many difficult metallurgical problems in 47 years.

1. STAINLESS STEEL BULB
2. PORCELAIN SEAL
3. D-H 99 ALLOY
4. SILVER SPRINGS
5. MICA INSULATION

Construction details of the temperature sensitive element which is hermetically sealed into the stainless steel bulb of the Edison-Splitdorf Electrical Resistance Thermometer. Made for the Foxboro Company and other instrument manufacturers.

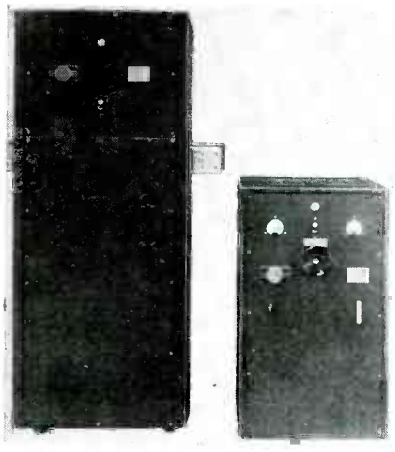
D H
SPECIAL PURPOSE ALLOYS SINCE 1890

Driver-Harris
COMPANY
Exclusive Manufacturers of Nichrome
HARRISON, N. J.

BRANCHES: Chicago • Detroit • Cleveland
Los Angeles • San Francisco • Seattle
The B. GREENING WIRE COMPANY, LTD.
Hamilton, Ontario, Canada

WWV Frequency Calibrator

As a convenient primary standard of frequency, Browning Laboratories, Inc., Winchester, Mass., has designed a special receiver, Model RH-10, pre-tuned to the 5 and 10 mc transmissions of the Bureau of Standards station WWV. Comparison of local audio or radio frequency signals with the WWV carriers or with their 440 and 4000 cycle modulation is facilitated by a special mixing circuit having selective filters for eliminating the undesired frequency components. A built-in speaker and a cathode-ray "tuning eye" are provided as calibration indicators, but audio output terminals are also available for use with external indicators. Sensitivity is said to be better than ½ microvolt and image rejection ratio greater than 50 db.—Electronic Industries

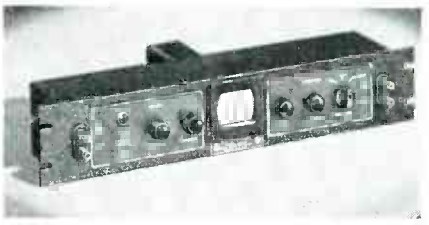


Variable Platers

Richardson-Allen Corp., 15 W. 20 St., New York has developed a series of nine variable rectifiers for electroplating available either as basic units with separate remote control or as self-contained units with meters and stepless variable auto-transformers. Ratings range from 6 V, 500 amps. to 12 V., 1000 amps. either for 220 volts or 440 volts, 3 phase 60 cycle ac. Long life selenium rectifiers are used. Units may be combined in series or parallel.—Electronic Industries

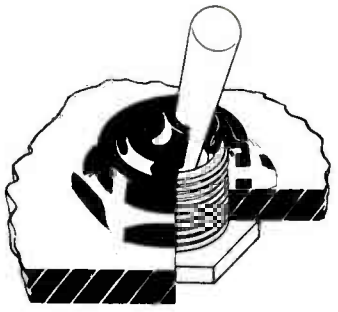
Transmitting Tube

The 7C29, a three-electrode transmitting tube has been brought out by the Tube Div. General Electric, Schenectady, N. Y. Designed for application as Class C rf amplifier, the tube uses forced air-cooling and has a plate dissipation of 500 watts at 110 mc. Typical power output for a dc plate voltage of 2800 volts in an open line circuit is 600 watts.—Electronic Industries



Special Purpose 'Scope

For use with external amplifiers, sweep circuits, etc., James Millen Mfg. Co., 150 Exchange St., Malden, Mass., can supply their Model 90902 cathode-ray oscilloscope. The unit provides a 2 in. screen in a standard rack mounted panel for use in transmitter monitoring, laboratory or industrial applications and provides the usual controls for centering, focus and intensity.—Electronic Industries



Moisture Seal

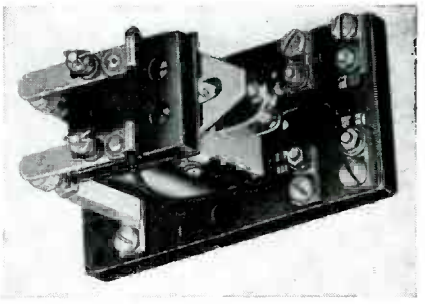
Sealnut, a rubber-metal device for providing toggle switches, control shafts and similar components with an effective seal against moisture, dust particles, gases, etc., has been brought out by Radio Frequency Laboratories, Boonton, N. J. By means of the sealed nut, which is designed to replace the standard mounting nut on moisture-proof components, equipment usually requiring a complete sealed enclosure may be constructed with exposed operating controls.—Electronic Industries

New Pentode

The new Type 1LG5 tube developed by the Radio Tube Division of Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18, is a semi-remote cut-off pentode of the "Loktal" base type and may be used as an ave controlled rf amplifier in battery operated receivers. A transconductance of 800 micrombos when using an anode supply of only 45 volts is claimed.—Electronic Industries

Servo-Motor

A compact low inertia motor for remote control applications designed for operation on 60 cycle, 2 phase is being made by Transicoil Corp., 114 Worth St., New York. The model 2A Servo-Motor is available for operation from 10 to 80 volts and has nearly constant impedance from full speed to stall.—Electronic Industries



Heavy Duty Relays

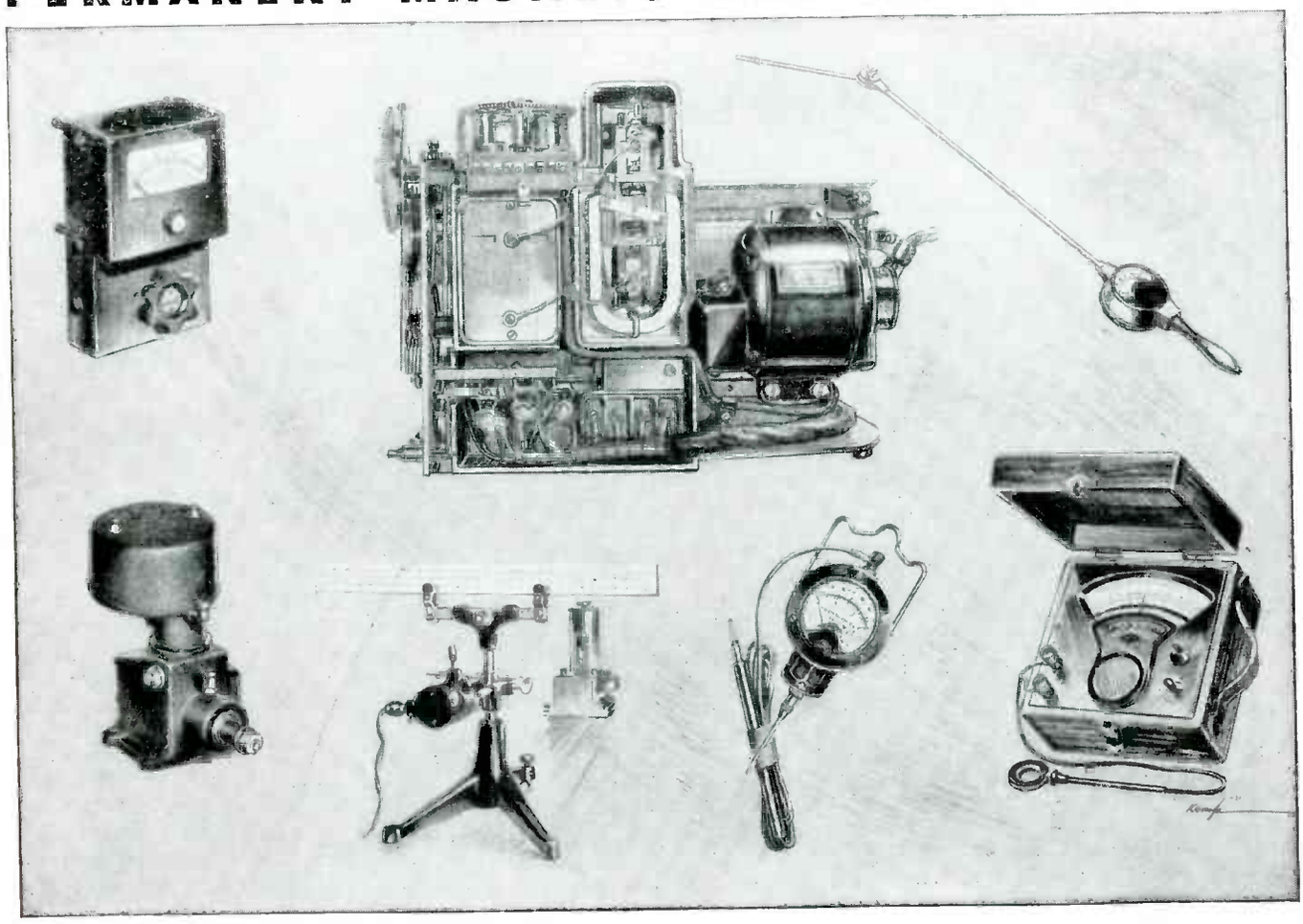
Type 130 relays designed for heavy duty industrial and electronic applications have been brought out by Ward Leonard Electric Co., Mt. Vernon, N. Y. Contact arrangements from one to four poles, normally open or normally closed, single or double throw are provided. Contacts are silver to silver and operating voltages range from 6 to 230 volts dc, and from 6 to 440 volts ac.—Electronic Industries

Filter Capacitor

Cornell-Dubilier Electric Corp., South Plainfield, N. J., is manufacturing the type MC vehicular filter capacitor series for heavy duty service in spark suppression, noise elimination, arc quenching and similar applications. The capacitors are hermetically sealed, oil impregnated and oil filled. They are rugged mechanically and designed to withstand excessive temperatures.—Electronic Industries

(*Continued on page 126*)

PERMANENT MAGNETS MAY DO IT BETTER



Permanent Magnets Help Guide Science and Industry

Permanent magnets play a vital role in modern manufacturing methods, scientific research, testing and measurements, industrial and domestic controls, signals and alarms.

Ammeters, Wattmeters, Voltmeters, Magnetic Gauges, Thermostats, Pressure Controls, Polarized Relays and Fluxmeters—these are but a few of the many—all of which rely upon the "Packaged Energy" of the magnet in their function.

Permanent Magnets aid physicists, chemists and engineers in the laboratory, plant and field. They aid the *Pyrometer* in measuring extreme temperatures of molten metal; in recording the intense heat in ovens, linotypes, die castings; and in the exacting heat controls in electrical, rubber, paper and plastic manufacturing. The *Galvanometer* using permanent magnets is a basic tool in the measurement of electricity. It is used in connection with other devices such as the *Potentiometer.*

Permanent Magnets also serve in measuring mechanical conditions such as the measurement of speed in *Tachometers* and *Speedometers,* and to indicate relative positions, as in *Gauges.*

Permanent Magnets help guide men, methods and machines employed by modern science and industry, with split-second charting, controlling, and recording of speed, accuracy, precision and efficiency.

Actually millions of magnets serve you daily, each doing some job or process better. They range in size from the tiny, feather-weight magnet in the hearing aid to the powerful, heavy radar magnet. Perhaps permanent magnets can do some job or process better for you in your industry. You are invited to consult our engineers on any problem of magnet application.

This Alnico Magnet is the generator rotor which supplies the operating power for the proximity fuse.

The Indiana Steel Products Company has made magnets for more than 24,000 applications. It is the world's largest sole producer of "Packaged Energy". For complete information, please write for free "Permanent Magnet Manual".

Producers of "PACKAGED ENERGY"

★ ★ ★ **THE INDIANA STEEL PRODUCTS COMPANY** ★ ★ ★

6 NORTH MICHIGAN AVENUE, CHICAGO 2, ILLINOIS

SPECIALISTS IN PERMANENT MAGNETS SINCE 1910

PRECIPITATION STATIC

(*Continued from page 69*)

The damping effect of the approximately one megohm of resistance in the wick between the mounting end and the fuzzy business end tends to further smooth out the discharge. In addition, the dischargers are located at positions remote from antennas. The result of all this is that relatively large currents can be carried by the static dischargers without producing precipitation static interference in nearby receivers (i.e., without shock-exciting their input circuits). These dischargers are on practically all Army aircraft today.

Underground Surfaces

The matter of ungrounded metal surfaces exposed to the windstream is illustrated in Fig. 5 which shows a metal frame in the plexiglas nose of a B-17. Other items in this category which must be grounded include metal thermometers, rear-view mirrors, insulated antenna guy wire sections, etc. In addition to producing radio interference, sparks from such ungrounded objects constitute a fire hazard, especially for aircraft which have sections where gas fumes sometimes collect.

Applications of the above principles has been found very effective in the reduction of precipitation static. Use of these devices and technics in their present stage of development constitute a satisfactory solution to the charging static problem and gives considerable relief from external field static. Work is now in progress on the development of a completely dielectric-enclosed antenna system. It is believed that, when this improvement is completed, at least a 90% cure to the precipitation static problem will have been effected.

During the past three years the main research effort on the problem of reduction of precipitation static has been centered in a joint Army - Navy Precipitation Static Project located at Wold-Chamberlain Field, Minnesota. There, under the direction of Dr. Ross Gunn, Naval Research Laboratory, a research team of Army and Navy personnel have carried out an extensive laboratory and flight research program.

Perhaps the most significant piece of special equipment assembled in this laboratory is a high voltage generator by means of which an airplane suspended in the hangar can be artificially charged to potentials of a million volts or more to stimulate conditions encountered in flight and to permit detailed study of the effect of the resulting corona discharge from antennas, etc. This high voltage equipment has been provided and maintained by the University of Minnesota. Two Army aircraft, a B-17 and a B-25, have been converted into flying laboratories and used in the flight research work. These have been operated and maintained by Northwest Airlines.

Also, significant contributions to the problem of reduction of precipitation static have resulted from flight research work done by Transcontinental and Western Air, Inc., for the Air Technical Service Command under the direction of TWA's chief radio engineer, R. C. Ayres, using a specially equipped B-17. Recently that airplane has been flown in the worst weather conditions obtainable, under the direction of an Army enginer, P. W. Couch, to obtain in a few weeks service test data for various antistatic devices, which would have required many months to accomplish with normal service test aircraft.

WIDE READING

(*Continued from page 79*)

less reduction in contrast is found with high gamma receiving tubes, suggesting gamma compression at the transmitter and expansion at the receiver.

Experimental and analytical studies of the maximum allowable local oscillator interference (at a frequency of 3.7 megacycles above the video carrier) indicate that a minimum difference of at least a 20db between l.o. interference intensity and the carrier is desirable. In other words, to protect a 500-microvolt/meter area, the radiating receiver should radiate less than 0.01

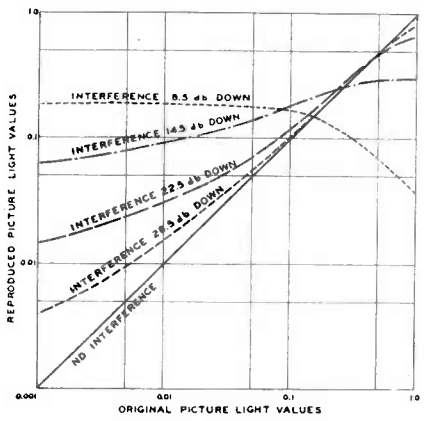


Fig. 2—Contrast reduction relations when dc restorer follows average of sync. pulse levels

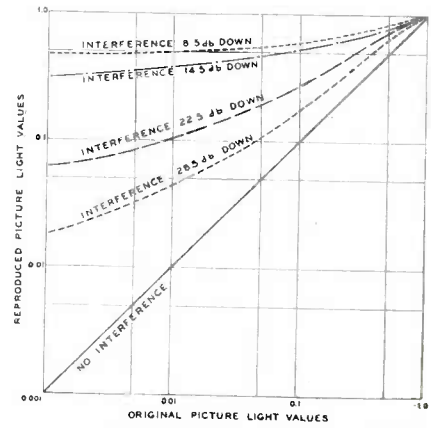


Fig. 3—Contrast reduction when dc restorer follows peak levels of sync. pulse levels

microwatts if receivers are to be as close as 50 feet.

A carefully designed pentode radio frequency stage between the antenna and a pentode mixer, together with a reasonably high intermediate frequency (so as to tune the local oscillator far away from the band-pass of the radio-frequency amplifier), can be expected to provide enough attenuation. Other alternatives lie in the use of balanced or radiation neutralized mixers, or additional selectivity with an oscillator rejection circuit between antenna and mixer. A grounded-grid triode radio frequency stage may give a reduction of about 30 decibels or more.

TELE INTERFERENCE

(*Continued from page 75*)

TRF frequency circuits without any superheterodyne principles, one for each channel, each with its properly chosen antenna system for best performance. The signals from these receivers would be distributed by video frequency amplifiers over coaxial cables to the individual apartments, where "jeep" receivers designed for operation from a video line and a sound line and requiring no RF and IF sections would prove adequate.

In this paper have been treated primarily those types of interference generated by radio frequency carrier signals from radio apparatus. There are obviously many other forms of interference which have been treated extensively in the literature. To mention some of these briefly we have ghost patterns caused by multipath conditions. We have atmospheric static (which for-

UNRIVALED MECHANICAL CHARACTERISTICS

LOW LOSS COAXIAL LINE SPACERS CUSTOM MADE OF ALSIMAG 243

The mechanical properties of AlSiMag 243, coupled with excellent dielectric characteristics, make this material highly desirable for vhf, uhf and shf coaxial line insulators. This permanently rigid, mechanically strong material does not leave conducting paths after flashover. It does not warp or distort with age.

Coaxial line spacers of AlSiMag 243 are custom made to your design and to the tolerances you specify. Extremely close tolerances involve commensurate cost. The material is non-hygroscopic. Glazed finish available if desired.

A coaxial line is expensive. Electric power at high frequencies is expensive. Repairs to a coaxial line are expensive. Thus it is economy to use permanently stable, mechanically strong, low loss insulation . . . AlSiMag 243.

ABBREVIATED PROPERTY CHART
ALSIMAG 243

(Complete chart on request)

Softening Temperature		2624° F
Resistance to Heat (Safe limit for constant temperature)		1832° F
Tensile Strength—lbs. per sq. in.		10,000
Compressive Strength—lbs. per sq. in.		85,000
Flexural Strength—lbs. per sq. in.		20,000
Dielectric Constant	1 MC.	6.2
	10 MC.	6.2
	100 MC.	6.1
Power Factor	1 MC.	.0004
	10 MC.	.0003
	100 MC.	.0003
Loss Factor	1 MC.	.0025
	10 MC.	.0019
	100 MC.	.0018

ALSIMAG
TRADE MARK REGISTERED U.S. PATENT OFFICE

ARMY ★★ E ★★ NAVY

Original Award July 27, 1942
Second Award February 13, 1943
Third Award September 25, 1943
Fourth Award May 27, 1944
Fifth Award December 2, 1944

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

43RD YEAR OF CERAMIC LEADERSHIP

ENGINEERING SERVICE OFFICES:

ST. LOUIS, Mo., 1123 Washington Ave., Tel: Garfield 4959 • NEWARK, N. J., 671 Broad Street, Tel: Mitchell 2-8159
CAMBRIDGE, Mass., 38-B Brattle St., Tel: Kirkland 4498 • CHICAGO, 9 S. Clinton St., Tel: Central 1721
SAN FRANCISCO, 163 Second St., Tel: Douglas 2464 • LOS ANGELES, 324 N. San Pedro St., Tel: Mutual 9076

tunately produces little interfering energy within the channels assigned to television). Magnetic fields from electric railways and the earth's magnetic field may cause momentary or steady displacement of the pattern on the cathode-ray tube. In regions of weak signal strength, the ultimate tube and component noises within the receiver circuits become predominant and give a snowy background to the pictures.

Many sources of man-made static which heretofore have been relatively unimportant, will require far more careful control as television receivers go into wider use. Examples of such man-made static are the sparking of elevator contactors, trolley lines and electric motors. Small electric motors used in household appliances become worn with consequent commutator or slip ring sparking. Ignition systems of automobiles radiate considerable energy. Neon signs produce serious radiation in a localized area.

If the source of interference can be located and shielding or filtering or repairs effected, this is the ideal solution. Lacking this possibility, the next best alternative is to locate the receiving antenna well away from streets and business or industrial establishments so as to attain as high a signal to noise condition as possible.

Where the signals from the desired television station are strong with respect to either radio carrier type interference or man-made signal interference, good television reception is achieved.

Fortunately, television receivers of good design are capable of excellent performance in the majority of locations since they can discriminate against the sources of interference by proper tuned circuit selection.

PATENTS

(*Continued from page* 80)

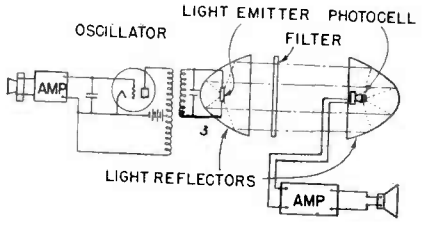
moving in a helical path. Consequently the current through these coils determines the phase shift imparted on the intensity-modulated electron beam; the intensity-modulation is controlled by electrode 42, which is connected to the antenna. It is stated that the output signal is independent of fading, variations of the local oscillator voltages, etc., due to insensitivity with regard to amplitude variations.

M. Ziegler, Hartford National Bank and Trust Co., (F) July 16, 1941, (I) March 12, 1946, No. 2,396,360.

Light Signaling Apparatus

The inventors have discovered that a conductor of the second class such as the glower used in a Nernst lamp, or a steatite refractory unit, for example "Insulcon", responds readily to current changes and that the emitted light intensity will closely follow current changes of voice frequency. These conductors comprise a refractory composition which, when cold, are poor conductors but which, upon being heated, become increasingly conductive. It is proposed to use this type of light source for transmitting signals over visible distances. Conductors of the second class emit a very substantial amount of infra-red light, and it is contemplated for secrecy reasons to filter out the visible light and convey the intelligence by means of the infra-red light. Ship-to-ship or ship-to-shore messages may be transmitted by this system.

In the drawing the voice-current modulated oscillations are impressed on the resonant circuit 3 which is connected in parallel with the light emitting unit. Operation of the system will be readily understood from the diagram. Large vari-



ations of a high-intensity light beam is achieved. The system is applicable to the transmission of television signals. An additional direct voltage source may be connected across the light emitting element to increase the light intensity.

R. E. Stark et al, Stupakoff Ceramic & Manufacturing Co., (F) June 15, 1942, (I) November 27, 1945, No. 2,389,649.

TELEVISION TODAY

(*Continued from page* 86)

About 500 persons were at the NBC studio in Radio City, New York and an equal number at the Statler in Washington, the Washington-New York coaxial cable being used for transmission. Other stations carrying the program were WPTZ in Philadelphia (Philco), WRGB in Schenectady—by radio relay—(General Electric) and DuMont's W3XWT.

At the RCA Laboratories in Princeton, projection was viewed by 3000 on a standard 22 x 16 ft. motion picture screen illuminated by a projector 60 ft. away. This had a special 60,000 volt tube with an aluminized screen developed by Dr. D. W. Epstein, and was used in a Schmidt optical (reflection) system.

NBC had set up a microwave relay system for transmitting the picture to the studio but it was not used. It consisted of a 9300 mc, .05 watt unit with a 4 ft. parabolic reflector antenna having a 3 deg. beam width and a gain of 9000. The transmitter is only 10 in. x 10 in. exclusive of power supply and modulator units.

The Telicon Corp. held a press viewing party at its headquarters in New York and used its "intravideo" antenna system which makes use of an antenna and an RF booster amplifier for serving a number of sets.

NEWS OF INDUSTRY

(*Continued from page* 84)

ard division; Cyril M. Braum, chief of the FM division; and Curtis B. Plummer, chief of the television division of the broadcast branch of the engineering department.

Ripley Welds Three

A merger of three of Connecticut's electronic equipment manufacturers has resulted in the birth of the Ripley Co., Inc. The companies affected are United Cinephone Corp., The Ripley Co. and the L-R Mfg. Co. Headquarters will be maintained at Torrington, Conn. The company will design and manufacture electronic equipment for laboratory and industrial purposes and will also function in an advisory engineering capacity.

Reeves Makes Discs

Reeves Soundcraft Corp. has been formed with headquarters at 10 E. 52nd St., New York, for the manufacture of instantaneous recording discs. President of the new organization is Hazard E. Reeves, former president of Audio Devices and of Reeves-Ely Laboratories. Other officers are, vice presidents, Ray S. Dech and A. C. Travis, Jr.; secretary-treasurer, R. C. Marshall 3d.

BBC Starts Tele

British Broadcasting Corp. recommenced television operations early in June after a lapse of seven years of war imposed inactivity. It is estimated that 300,000 persons are able to see video broadcasts.

DUPLEX CRYSTALS

(*Continued from page 63*)

or 30,000 are readily obtainable. The ratio of the direct capacity of the duplex crystal to the capacity in the series resonant arm of the equivalent circuit is about 200, which is indicative of a fair electromechanical coupling. This ratio for a +5-degree X-cut crystal of the longitudinal type is about 120.

In using duplex crystals in oscillators, no connection ordinarily is made to the inner electrode. For filters, however, there is a decided advantage in using the bonding layer as one of the electrodes, since the impedance of the plate is then only one-fourth as great as when the connections are made to the outer surfaces.

A typical temperature-frequency characteristic of a duplex crystal is given in Fig. 3, which shows the relationship for a 4 kc crystal used for carrier telephone systems. Duplex crystals of other frequencies differ very little in temperature coefficient from this. Over the ordinary range of temperature encountered in a central telephone office, such a crystal does not depart by more than about 0.02 cycle from the frequency at mid-temperature.

AMPLIFIER TUBE

(*Continued from page 62*)

ling wave on the electrons they tend to slow down and in so doing, give up some of their energy to the wave. As a result the small amplitudes of the original wave are boosted by the additional amount of energy from the electron ray and as a result the tube makes possible a power gain of 10,000 over a bandwidth of 800 megacycles.

Isotopes For Industry

Tracerlab, Inc., has been formed with headquarters at 55 Oliver St., Boston, Mass., and will make available radioactive isotopes for use in industry. In addition the company will develop and manufacture instruments for determining radioactivity analyses.

Cinaudagraph to Indiana

Indiana Steel Products Co., 6 No. Michigan Ave., Chicago, has acquired the plant and facilities of the Cinaudagraph Corp., Stamford, Conn., and henceforth will operate the acquisition as Cinaudagraph Division of the parent company. Indiana has long been a producer of permanent magnets.

Westinghouse Undertakes Fundamental Research

A broad program of research into nuclear physics and the problems associated with the conversion of atomic energy into a useful source of power for the peacetime world is to be undertaken by scientists at the Westinghouse Research Laboratories. The program will be in direct charge of Dr. W. E. Shoupp, manager of the electronics department, whose research into pure science before the war culminated in the co-discovery of photofission —the splitting of uranium atoms by high-energy gamma rays with an accompanying release of large amounts of energy.

G.E. Flies Radar

To determine the practicability of radar as an anti-collision and weather-detecting device for commercial airlines, General Electric Co. and American Airlines have installed airborne radar equipment in one of the airlines' flagships. This equipment, a modified form of the radar set is developed for the Army Air Forces by G. E.

New Electrovox Factory

Electrovox Co., Inc., manufacturer of phono needles has moved factory and general offices to 31 Fulton Street, Newark 2, N. J. Branch offices will continue at 224 South Michigan Avenue, Chicago, and 2216 West 11th Street, Los Angeles.

Acme Drops Mfg.

Henceforth it is to be Acme Electric Corp., instead of Acme Electric & Manufacturing Co. The former Ohio corporation has been reincorporated under New York laws and will otherwise continue without changing. A new building adjacent to the main plant in Cuba, New York, has been occupied and is an addition to a recently purchased building in Allegany, New York.

920-960 mc Allocations

FCC has made a tentative service allocation plan for the use of the spectrum between 920 and 960 mc. The channels between 920 and 940 mc will be assigned for FM studio to transmitter links; 940-952 mc will be used for fixed circuits such as police facsimile, control circuits, etc. Assignments will be on multiples of 100 kc with a frequency tolerance of .01% and a band width of 500 kc advocated for FM studio to transmitter links.

A MESSAGE
to the Radio Industry

Standardization is Bringing Results . . .

Seamless and Lockseam Cathode Sleeves for radio tubes are of prime importance to relatively few companies—those who manufacture the tubes themselves. However, the statements which follow affect the radio industry in general.

Over the years, The Electronics Division of Superior Tube Company has been a major producer of Nickel Cathode Sleeves. With the cooperation of a number of radio tube manufacturers, sleeve designs, production tolerances, and metallurgical requirements have been standardized to a degree which points the way for further directed effort along the same lines.

This "meeting of minds" has given the industry something to hold fast to: it has defined and clarified specifications; it has enabled price reductions to be made; it has accelerated deliveries; it has simplified assembly techniques. In addition, it has given the developmental laboratories at Superior Tube Company, in conjunction with standards committees, raw material suppliers, and radio tube manufacturers, the opportunity to improve and predict the quality of cathode sleeves on a mass-production basis.

The Electronics Division of Superior Tube Company foresees even greater benefits to be derived from standardization in the future. The experimental and manufacturing facilities of The Superior Electronics Division are devoted exclusively to the production of still finer "electronic grade" tubing, at still lower costs, for the ultimate benefit of every member of the radio industry.

THE BIGGER NAME IN SMALL TUBING **Superior**

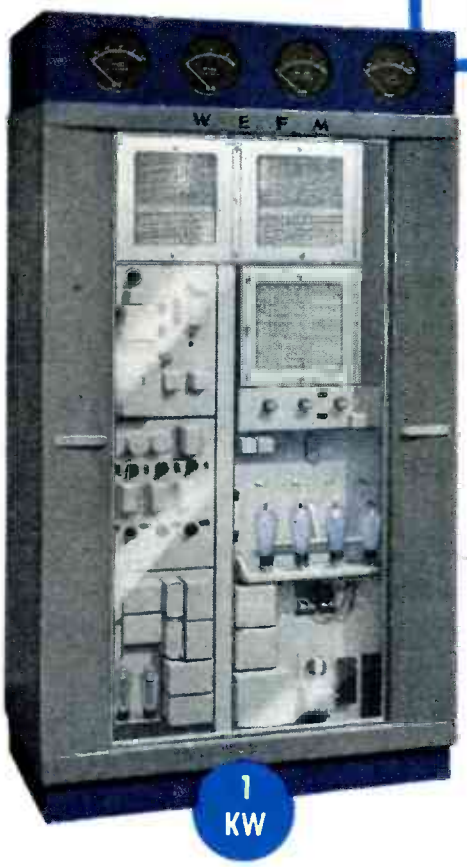
SUPERIOR TUBE COMPANY
ELECTRONICS DIVISION

Post Office Drawer 191 • Norristown, Pa.
Telephone Norristown 2070

NEW FM TRANSMITTERS

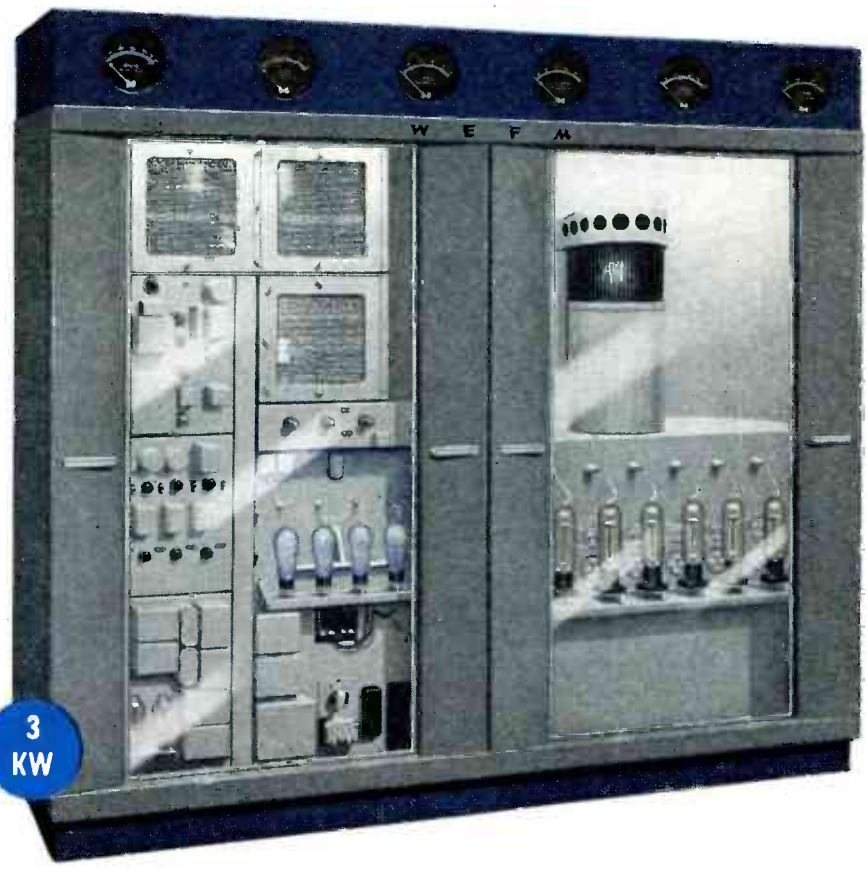
Unexcelled Performance of Western Electric FM Transmitters

Audio Frequency Response	± 0.25 DB from 30 to 15,000 cycles.
Harmonic distortion—for ± 75 KC swing	Less than 0.5% from 30 to 15,000 cycles.
—for ± 100 KC swing	Less than 0.75% from 30 to 15,000 cycles.
Intermodulation—for ± 75 KC swing	Less than 0.5% for 80% 50 cycles and 20% 1000 cycles; less than 1.0% for 80% 50 cycles and 20% 7000 cycles.
FM noise level	65 DB below ± 75 KC swing.
AM noise level	50 DB below 100% amplitude modulation.
Carrier frequency stability	Less than 2000 cycles deviation (no crystal heater).



1 KW

Not only a transmitter in itself, this unit serves as the basic driver for all higher powered transmitters.



3 KW

Has its own rectifier and power components, with completely shielded air-cooled triode in broad-band circuit.

BY Western Electric

NEW Line is Keynoted by 1, 3 and 10 KW Units

New in appearance, *new* in performance, these FM transmitters, specially designed for operation on the higher frequencies, incorporate Synchronized Frequency Control, developed by Bell Telephone Laboratories and Western Electric.

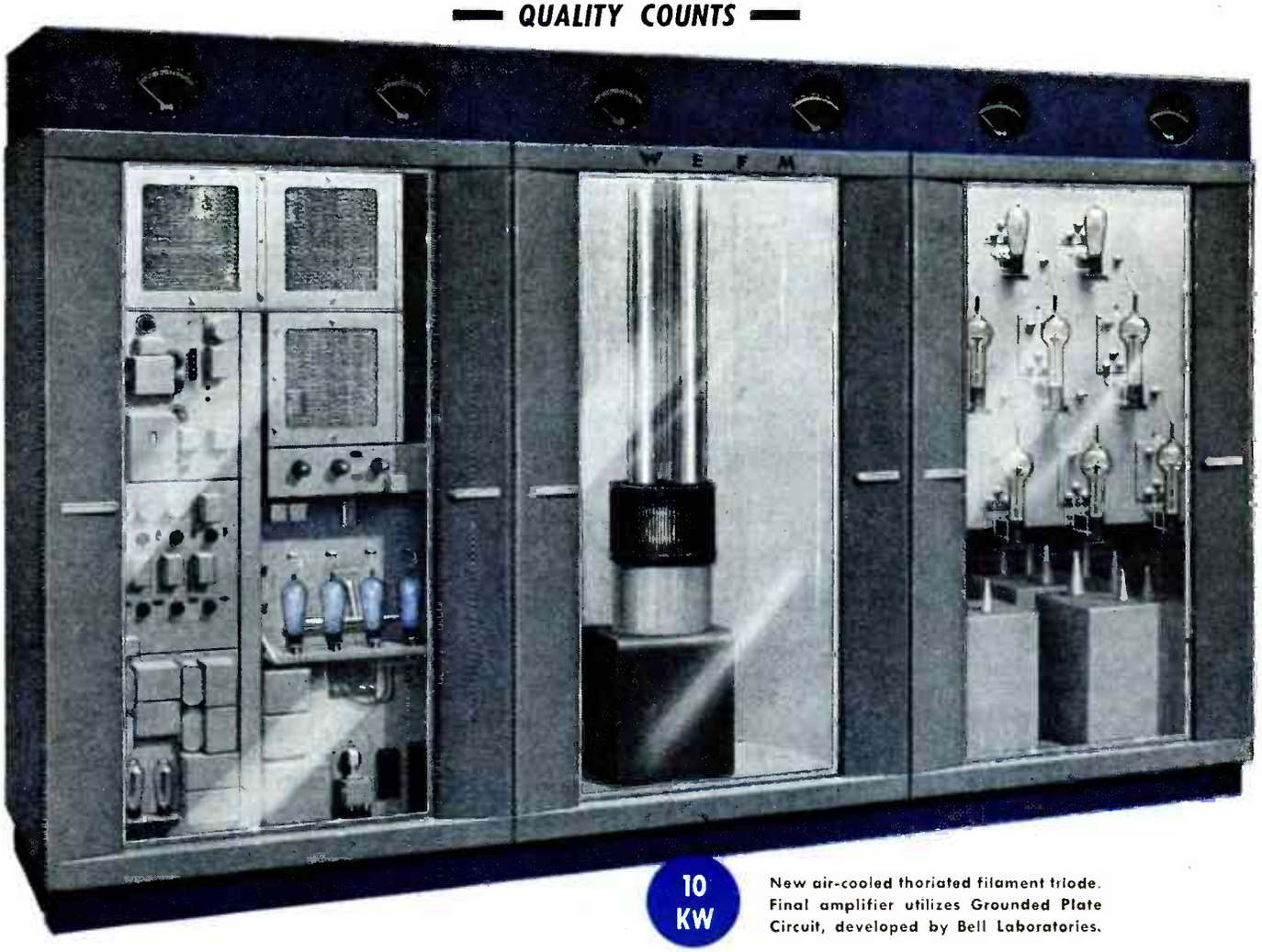
Outstanding new cabinet designs keep pace with circuit improvements. For the first time in FM broadcasting, all tubes are visible to the operator at a glance.

For your convenience, all units are standard width, make use of identical door assemblies and use the same top and side panels. Where more than one unit is used, a common base and meter panel provide single unit appearance.

In addition to the 1, 3 and 10 KW transmitters, Western Electric's full line will include 250 watt, 25 KW and 50 KW units.

For complete information, see your nearest Graybar Broadcast Equipment Representative, or write Graybar Electric Co., 420 Lexington Avenue, New York 17, N. Y.

— QUALITY COUNTS —



10 KW

New air-cooled thoriated filament triode. Final amplifier utilizes Grounded Plate Circuit, developed by Bell Laboratories.

Gulow Power Transformers

The Gulow Corp., 62 William Street, New York, manufacturer of Vari-Former, a voltage regulator, is now manufacturing a line of power transformers, both single phase and three phase. Single phase units are of both the isolation and auto transformer type. Capacities range in the standard voltages from .050 kva to 5 kva and the auto transformer from .250 kva to 50 kva. Three phase power transformers are for all standard voltages from .50 kva to 15 kva. There is also a line of Y connected auto transformers for 230 volts to 460 volts from 1 kva to 100 kva.

McHugh Products Succeeds Slater

McHugh Products, manufacturer of "Utility" incandescent street lighting lamps, has been formed to succeed Slater Electric & Mfg. Co. John J. McHugh, partner, and director of sales of the former company, has acquired full ownership. Engineering research, development and production management will continue under the direction of E. B. Saul. Manufacturing facilities have been enlarged and modernized in the plant at 728-736 Atlantic Avenue, Brooklyn, N. Y.

Selenium in New York

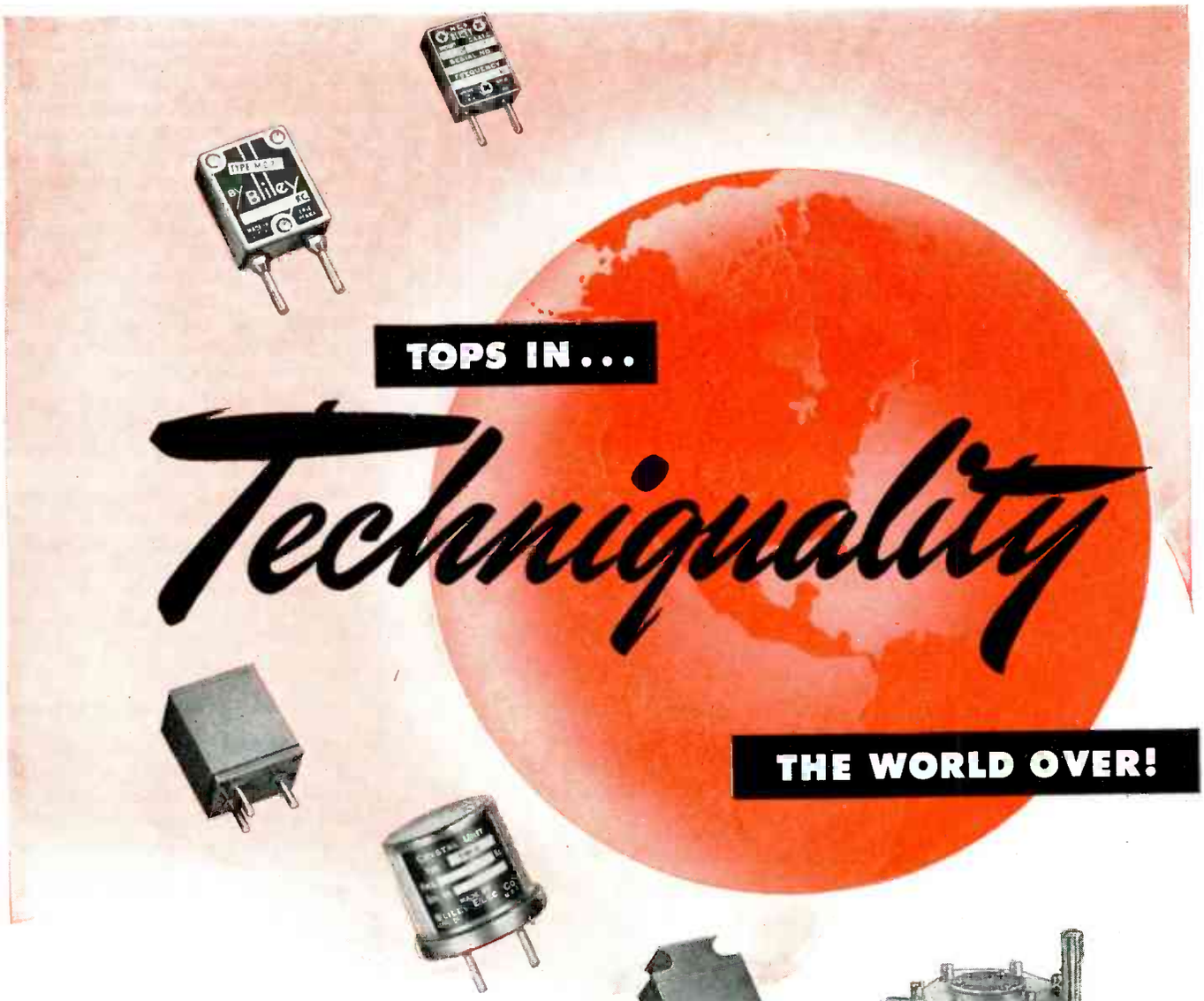
Selenium Corp. of America which is an affiliate of Vickers Inc., and has headquarters at 1719 W. Pico Blvd., Los Angeles, has opened a New York office. It is located at 31-10 Thomson Ave., Long Island City, and will be in charge of Harry E. Pappas.

Strippers By Excel

Excel Industries, Inc., has been organized in Sycamore, Ill., by Bert E. Holub and will manufacture automatic wire strippers of hand, foot and motor driven types. Holub was formerly associated with the Ideal Commutator Dresser Co.

Lear Adds Capacitors

Lear, Inc., with factories in Grand Rapids, Mich., has added to its activities the production of variable capacitors. The company makes electro-mechanical parts, magnetic wire and tape recorders and both home and aircraft radios. Production of its own line of variable capacitors will improve manufacturing facilities.



Creative engineering at Bliley is never at a standstill. Since the early days of home built sets to the present era of frequency modulation, radar and world wide communications, Bliley techniquality has kept pace with every important development in communications engineering. With Bliley techniquality "at the controls" frequency precision is never a problem. Bliley techniquality signifies original engineering and "follow-through" It's an ability that has been developed through 15 years of frequency control engineering exclusively To communications engineers the world over Bliley techniquality means the right crystal for the specific job.

Bliley CRYSTALS

Radio Engineers write for bulletin EI-27

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

Double-Channel Television

For a number of years proponents of high-fidelity radio reception, have advocated the authorization of double channels (20 kc wide) where quality reception could be obtained by receiver owners who go to the trouble of getting a set that will handle this increased frequency range. In addition, better-than-normal reception is assured at most of the other receivers on those channels. In any case the sets would pick up either 10 kc or 20 kc channels without changes.

The idea is going around, apparently starting from a remark at an FCC hearing, that double-band high-fidelity television (black and white), could be promoted using the same principles and with but minor changes in the receivers. This method of developing "by inference" is one that quickly gets its users out on a limb, for reasons apparent to any engineer.

Scanning problems

Even assuming that several of the problems that come up are easily solved;—such as getting the RF stages to respond satisfactorily over the wider range, and the cathode-ray tubes normally in use, to focus to the finer line structure; the big problems lie in the scanning-system circuits, in the IF stages, and in the video amplifier stages.

Suppose first that the extra 6-mc channel were to be "tacked on" to an assigned channel adjacent to and above the latter. (1) The sound intermediate frequencies would have to be shifted 6 megacycles (generally downward). This would require a complete new, and alternate, sound channel from a practical design standpoint. (2) The vertical and horizontal scanning frequencies would have to be shifted whenever the proposed 12 mc channel were used. This could probably be done by switching in new circuit components but the job would be a "messy" one. (3) The video circuit would have to be broadened (almost 2 to 1). This would require one or more extra stages since the product of gain and bandwidth remains about the same in such circuits, and one can be obtained only at the expense of the other. (4) The video intermediate frequency channels would have to be altered extensively. At the higher values being used in newly designed receivers this might not be too difficult except that the high frequency cutoff characteristics would have

to be altered in each stage.

If the extra 6 mc channel were to be added "below" the original, all of these changes except (1) would still have to be done, and even more extensively alterations would have to be applied to the video intermediate frequency channel.

All of this is stressed to point out what has been stated by competent engineers many times: the present fidelity of reproduction is still under that which a 6 mc band would permit, if the receiver cost factor did not enter in. The utilization of design expedients that appreciably reduce the picture quality below the capabilities of a 6-megacycle system must be discouraged. The public will soon become instructed as to what to expect in this line. Sets obtaining a 375-line quality (such as was the rule with most of the prewar receivers) even though 525 lines are standard, will probably not go over at any price.

57 FM Stations Now Operating

According to an announcement by the FCC June 27 there are 57 FM broadcasting stations now in operation throughout the country. This number includes 10 recently authorized stations which are either in operation or about to begin. The Commission noted that the majority of the stations listed were licensed before the war and that several prewar stations not included are temporarily off the air while constructing equipment for operation in the new FM band.

New York leads in number of stations with 13, followed by Pennsylvania with 7 and Massachusetts with 5. The 57 stations listed by the FCC included 3 on temporary assignments; 26 were shown to be operating in both the old and new bands and one station is operating only in the old band.

Astronomical Observing by Radio Reception

"Besides visible and ultraviolet light, the stars and other celestial bodies emit radiation of a very much greater wavelength including short radio waves, and the very short ones used in radar", points out Dr. Jan Schilt, astronomy professor of Columbia University, New York City, in the magazine "Think".

"Astronomy, so far, has depended on light, visible and photographic, of a wavelength ranging from a ten-thousandth of a centimeter to a little less than one half this amount. Since the stars emit their

partners in creating

Even K & E has never devised an instrument that would make it unnecessary to *think*. But we have spent 78 years designing and producing things that make it easier to *act* after thinking . . . drafting instruments and related materials that give the engineering hand and eye almost the same precision as the engineering brain. How well K & E products serve as partners in creating is shown by the reliance placed in them by engineers and draftsmen throughout the world.

So widely is this equipment used that practically every great American engineering project has been completed with the help of K & E. Could you wish any surer guidance than this in the selection of your own instruments and materials?

To make measurements with the greatest ease and the least chance of error, choose a WYTEFACE* steel tape or tape rule of the type made especially for your work. Their jet black markings against their white background are as easy to read in the brightest glare as in the dimmest light. They are readily kept clean, are rust-resisting and hard to kink. For full information about them write to your nearest K & E Distributor or to Keuffel & Esser Co., Hoboken, N. J.

*Trade Mark

WYTEFACE Steel Tapes and Tape Rules are protected by U. S. Pat. 2,089,209

G-E LAMINATED PLASTICS

FABRICATED TO YOUR SPECIFICATIONS

YOU GET ACCURATELY FINISHED PARTS MADE OF THE RIGHT MATERIAL READY FOR THE JOB

G-E Textolite sheets, tubes and rods are fabricated in an almost unlimited variety of sizes and shapes, and the General Electric Company has the necessary equipment to do this rapidly and economically—lathes, saws, shears, punches, hobs and mills . . . . even specially designed machinery to speed up and lower the cost on large production runs.

And because there are over 50 grades of G-E Textolite to select from, each having an individual combination of properties—electrical, mechanical, chemical, thermal—you get a grade that fits your needs.

Correctly machined and made of the right material for your application, you can be assured that when G-E Textolite fabricated parts reach you they will do the job.

Let us know your requirements. Write to Section T-8, General Electric Co., Plastics Divisions, One Plastics Ave., Pittsfield, Mass.

G-E Textolite tubing is shown being threaded to exacting mechanical and electrical specifications for radio coil forms.

G-E TEXTOLITE IS SUPPLIED IN THE FOLLOWING FORMS:

Sheets, Tubes, and Rods	Molded Laminated Parts
Fabricated Parts	Post-Formed Laminates
Nameplates	Translucent Laminates

Low-Pressure Molded Parts

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GENERAL ELECTRIC

radiation chiefly in this wave band, light is eminently suitable to their study. It has, however, long been recognized that the stars are not situated in empty space but that the vast spaces between the stars are filled with interstellar matter consisting of extremely tenuous particles. This interstellar bulk permeating the entire stellar system, or galaxy, gives very little light and, moreover, acts to absorb the light from the remoter stars.

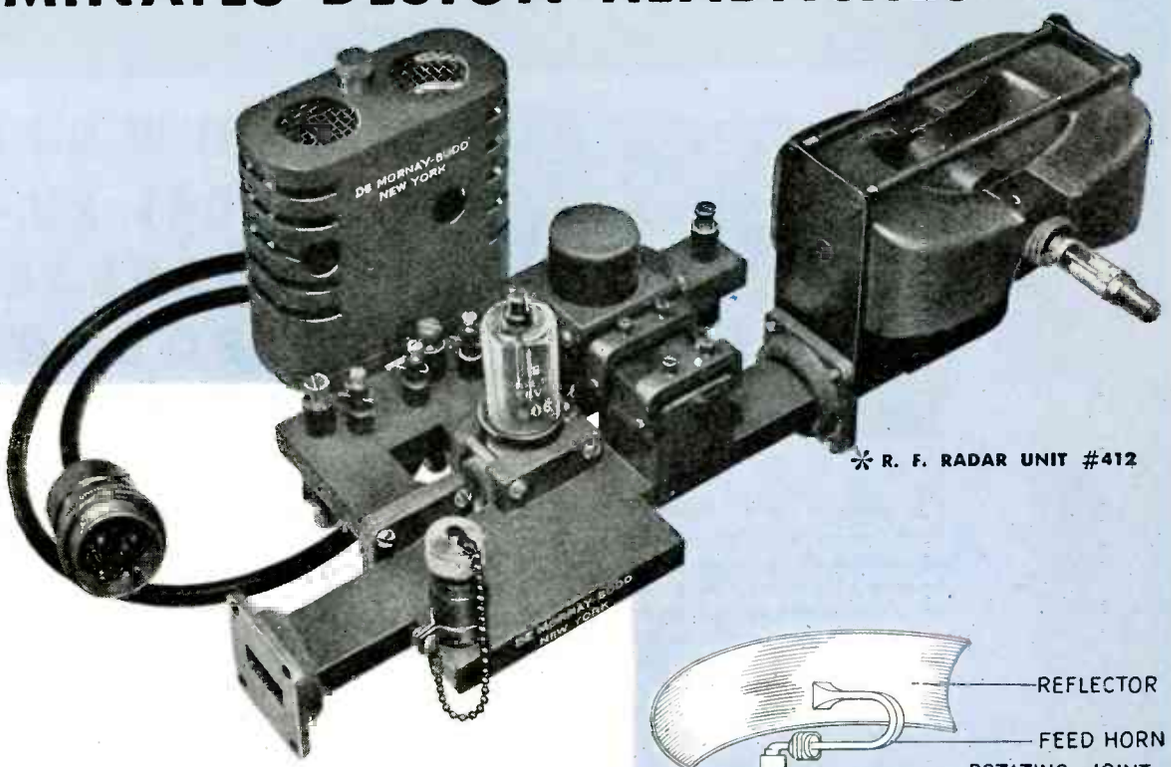
"Observations have already shown that the interstellar substance emits radio waves of a wave length of about six feet. The energy of this radiation is so weak that it can only be measured in directions where the galaxy extends to great distances and, since radiation of this kind, unlike the visible light, is not greatly absorbed, it will bring under observation the outlying parts of the galaxy and eventually answer the question as to its spiral structure.

Electrified instellar gas

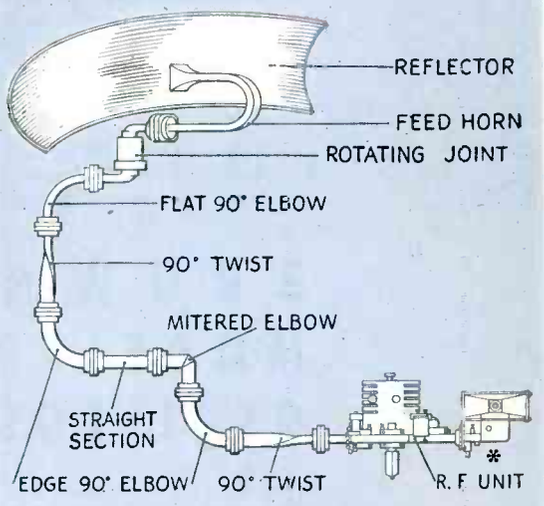
"When first discovered, this short-wave broadcast from the stellar universe was disrespectfully referred to as cosmic static. One of the first to record this radiation about six years ago was G. Reber, who successfully used a band of 162 megacycles. Reber, using what is probably the first radio-telescope, actually traced the outline of the Milky Way by means of the cosmic broadcast. In his case, the source of the waves was not in the stars but probably in the tenuous electrified particles that form part of the so-called interstellar gas. The intensity of these radiations is weak but there seems to be almost no limit at present to the technical improvements in selecting and modulating bands over the entire frequency range. It is known that the atmosphere of the earth will be an obstacle to the reception of certain fairly narrow bands but waves of most frequencies come through, and each will add its own story to our understanding of nature.

"Although astronomers have known for a long time that the galaxy is a flattened, disc-like system, the field of view has been so severely limited that the structure of the galaxy has, during pre-radio days, remained a dark secret. The question of whether our galaxy, like other galaxies, exhibits a spiral structure and the direction of winding of its hypothetical arms, may, however, now be near its solution."

PACKAGED R. F. RADAR ASSEMBLY ELIMINATES DESIGN HEADACHES



* R. F. RADAR UNIT #412



R. F. Radar unit #412 (indicated by asterisk) used in conjunction with standard DeMornay-Budd transmission line components.

Write for catalog of standard bench test equipment.

The DeMornay-Budd packaged R. F. Unit provides a complete R. F. assembly for microwave radar. It is now possible to obtain as standard items all the microwave R. F. components necessary in the fabrication of a complete radar—DeMornay-Budd Standard Transmission Line Components plus packaged R. F. Unit.

The R. F. Radar Unit is delivered complete and ready to operate. It is wired and contains all the necessary tubes and crystals. The unit uses a packaged magnetron capable of delivering 20 kw., peak power, at 9375 mc. Two type 2K25 local oscillator tubes are provided, one for receiver and A.F.C. and the other for beacon operation. A type 1B35 A-T-R tube, a type 1B24 T-R tube and the necessary type 1N21 crystals are included in the assembly. A 20 db. directional coupler permits accurate measurements to be made at any time with a maximum of convenience and safety.

Since the use of radar beacons is contemplated in the near future, the unit has been designed with a beacon cavity and crystal mount. The unit can be supplied without the beacon cavity and crystal mount and beacon local oscillator, and a termination supplied in their place so that it becomes a simple matter to convert to beacon operation when necessary.

We offer complete laboratory research facilities and have available such production test equipment as: Standing Wave Detectors, Calibrated Attenuators, Slug Tuners, Power Supplies, Square Wave Modulators, in addition to transmission line components shown in diagram above. Write for information or catalog.

DE MORNAY BUDD

EQUIPMENT FOR 97% OF ALL RADAR SETS

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475 GRAND CONCOURSE, NEW YORK, N. Y.

TWO GREAT NEW LABORATORY INSTRUMENTS

BROWNING MODEL RH-10 STANDARD FREQUENCY CALIBRATOR

Full, accurate use of station WWV, the world's finest primary frequency and time standard, is obtained from the Browning Model RH-10 Standard Frequency Calibrator. The standard Browning RH-10 is pre-tuned for 5 and 10 megacycles per second reception, at sensitivities better than ½ microvolt on either band. A dual filter system provides selection of either the 440 or 4000 cycle modulation of WWV for use as a primary frequency standard.

Checking equipment against station WWV, at accuracies up to one part in five million, the Browning Frequency Calibrator enables comparisons to be made in three general categories:

1. Precision radio frequency standards measurements.
2. Precision audio frequency standards measurements.
3. Precision time and pulse standards for physical measurements.

The Browning RH-10 consists of a high Q antenna transformer, a sharply tuned R-F amplifier, converter, oscillator, two IF stages, detector, selective amplifier output stages and a cathode ray zero beat indicator. Although normally supplied for 5 and 10 megacycles per second operation, any two combinations of 2.5, 5, 10, or 15 megacycles may be had on special order.

WRITE FOR DESCRIPTIVE LITERATURE

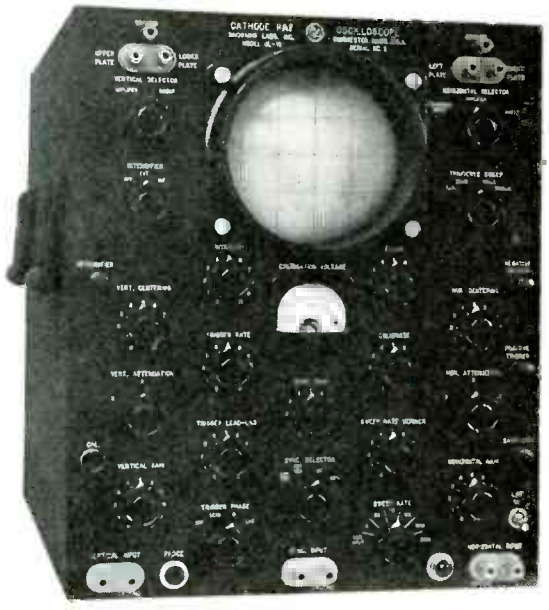
BROWNING MODEL OL-15 OSCILLOSCOPE

Designed for observing phenomena requiring extended range amplifiers and a wide variety of time bases, the Browning Model OL-15 Oscilloscope incorporates improvements that make it useful in numerous applications where ordinary oscilloscopes are inadequate.

For instance, the Browning OL-15 is particularly adaptable to television, radar and facsimile work, as well as with radio-frequency equipment where it is desirable to know actual r.f. waveform composition. The low repetition sweep gives visual observation when recurring phenomena of a few sweeps per second are encountered.

Suitable time base facilities for studying signals with a constant time difference, or those with an inconstant time separation between consecutive phenomena, are provided by the Browning OL-15. In general, the improved design and superior construction of the Browning OL-15 make it a highly flexible instrument for use in all laboratory work, production testing, or research applications.

WRITE FOR DESCRIPTIVE LITERATURE



BROWNING S-4 FREQUENCY METER

Especially designed for testing transmitters of marine, police, fire and other special service radio operators, the completely new Browning S-4 Frequency Meter includes many refinements perfected during our war experience building high-precision radar test equipment.

A vernier, added to the laboratory-type dial, permits reading accuracy to one part in one thousand. The telescoping whip antenna forms a convenient carrying handle, while big, easy-to-grasp knobs allow cold weather adjustment while wearing gloves.

Using 110-115 volt A.C. or D.C. current, the crystal-controlled Browning Frequency Meter checks both AM and FM equipment. The S-4 is custom built and hand calibrated for checking frequencies in any five bands from 1.5 to 100 Mc., with an accuracy of ± .0025% which exceeds the FCC requirements.

WRITE FOR DESCRIPTIVE LITERATURE

BROWNING MODEL GA-10 FREQUENCY METER CALIBRATOR and BROWNING MODEL PF-10 POWER SUPPLY

Precise checking of switchboard-type, direct-reading and 60 cycle frequency meters, and the measuring of line voltage frequency from 56 to 64 cycles, is readily accomplished with the Browning GA-10 Frequency Meter Calibrator. It is also especially useful in setting filters requiring accurate adjustment.

Featuring complete electronic voltage regulation, and built-in crystal standard for checking various points of the calibration, the Browning GA-10 has an accuracy of ± .05% over its entire range. The Calibrator and Power Supply are packaged in separate steel carrying cases for ease of portability.

For adjusting or checking equipment with different frequencies, such as sharply peaked filters, the Browning GA-10 is available on special order to cover a narrow range of any audio frequencies.

WRITE FOR DESCRIPTIVE LITERATURE

BROWNING LABORATORIES, INC.
WINCHESTER, MASS.

NEW BOOKS

Electricity and Magnetism

Vol. II of a series—Principles of Physics, by F. W. Sears, (MIT) published 1946 by Addison-Wesley Press, Cambridge (42) Mass. 448 pages. 311 illustrations, 6 x 9. $5.

A textbook for second year collegiate physics courses following courses on Mechanics, Heat and Sound (covered in Vol. 1). While this volume seems to reach a higher level than many current physics texts, its style and arrangement are such that anyone having a basic knowledge of elementary calculus should find it satisfactory either as a text or for a home study refresher course in modern physical concepts, and recent instruments of physical science.

Electronics in Industry

By George M. Chute, Application Engineer, General Electric Co. Published 1946 by McGraw-Hill Book Co., 330 W. 42 St. 461 pages, illustrated. Price $5.

This book, prepared for instrumentation men and operating technicians in industry, presents the operation and uses of the electronic equipment found installed in industrial plants. It covers this field quite extensively without side trips into the fields of equipment and circuit design or into the more intricate theories involved in the electronic tubes and components. All subject matter is arranged in 28 chapters for easy reference as to basic types of apparatus. Herein are shown and described basic circuits for common industrial instruments and equipment.

Understanding Microwaves

By Victor J. Young, published by John F. Rider Publisher, Inc., New York, 400 pages—price $6.

This book deals with the underlying principles upon which microwave technique is built. After examining familiar ideas on electromagnetic and electrostatic fields, transmission lines, radiation and reflection, Young proceeds to waveguides, resonant cavities and microwave antennas. Velocity modulation tubes used as oscillators are compared with those using ordinary tubes. An entire section of the book is devoted to a glossary of microwave terms and ideas.

Although the use of mathematics has been kept to a minimum, some basic math has been "written out"

and included as necessary for understanding and clearness. Practical examples parallel the mathematical explanations. Servicers who wish to prepare themselves for future work in the vital field of microwaves will find this book absorbing.

Instrumentation Show in Pittsburgh, Sept. 16-20

With space contracted for by just short of 100 exhibitors, plans for the "Instrumentation for Tomorrow" exhibition to be staged by the Instrument Society of America, move forward apace. The exhibit will be held in the William Penn Hotel during the four days starting Monday, September 16 and closing the following Friday night. Coupled with the show there is to be a lengthy program of papers devoted to all phases of instrumentation. Following is the list of exhibitors:

Aircraft-Marine Products, Inc., 4109 Empire State Bldg., New York
American Meter Co., Metric Metal Works, Erie, Pa.
Askania Regulator Co., 1603 S. Michigan Ave., Chicago
Baldwin Locomotive Works, Philadelphia
Ballantine Laboratories, Inc., Boonton, N. J.
Biddle Co., James G., 1211 Arch St., Philadelphia
Bristol Co., Waterbury, Conn.
Brookfield Engrg. Labs., Sharon, Mass.
Brush Development Co., 3405 Perkins Ave., Cleveland
Burgess Battery Co., Freeport, Ill.
Burling Instrument Co., 253 Springfield Ave., Newark, N. J.
Burlington Instrument Co., 214½ N. 4th St., Burlington, Iowa
Carson Micrometer Corp., Box 57, Little Falls, N. J.
Cinaudagraph Corp., 2 Selleck St., Stamford, Conn.
Communication Measurements Lab., 120 Greenwich St., New York
Consolidated Engrg. Corp., 620 N. Lake Ave., Pasadena, Calif.
Cook Electric Co., 2700 Southport Ave., Chicago
Davis Emergency Equipment Co., Inc., 45 Halleck St., Newark, N. J.
DoAll Pittsburgh Co., 507 Second Ave., Pittsburgh, Pa.
Electronic Industries, 480 Lexington Ave., New York
Electro-Tech Equipment Co., 117 Lafayette St., New York
Elgin National Watch Co., 932 Benton St., Aurora, Ill.
Engis Equipment Co., 431 S. Dearborn St., Chicago
Equipoise Controls, 100 Stevens Ave., Mt. Vernon, N. Y.
Federal Products Corp., 1144 Eddy St., Providence, R. I.
Fischer & Porter Co., Hatboro, Penn.
John Fuhrman, Jr., 6936 McPherson Blvd., Pittsburgh, Pa.
R. P. Gallien, 220 W. 5th St., Los Angeles
General Electric Co., 1 River Rd., Schenectady, N. Y.
Gotham Instrument Co., Inc., 149 Wooster St., New York
Hammel-Dahl Corp., 243 Richmond St., Providence, R. I.
Harris Pump & Supply, Brady & Sidney Sts., Pittsburgh, Pa.
Helicoid Gage Div., American Chain & Cable Co., Bridgeport, Conn.
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago
Instrument Society of America, 1117 Wolfendale St., Pittsburgh, Pa.
J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn.
Jacobs & Associates, M. S., Bessemer Bldg., Pittsburgh, Pa.
Kieley & Mueller, Inc., 2013-33 43rd St., No. Bergen, N. J.
Kollsman Instrument Div., Square D Co., 80-08 45th Ave., Elmhurst, N. Y.
Leslie Co., Lyndhurst, N. J.

Linotone Corp., 563 W. 35th St., New York
Macbeth Corp., 227 W. 17th St., New York
Madison Electrical Products Corp., Madison, N. J.
Mason-Neilan Regulator Co., 1190 Adams St., Boston
Meriam Instrument Co., 10920 Madison Ave., Cleveland
Mine Safety Appliances Co., Braddock St., Pittsburgh
National Research Corp., 100 Brookline Ave., Boston
Permo, Inc., 6415 Ravenswood Ave., Chicago
Physicists Research Co., 343 So. Main St., Ann Arbor, Mich.
Pittsburgh Equitable Meter Co., 400 N. Lexington Ave., Pittsburgh, Pa.
Pomeroy Stereograph Co., 1783 E. 11th St., Cleveland
Precision Thermometer & Instrument Co., 1834 Brandywine St., Philadelphia
Precision Tube Co., 3824 Terrace St., Philadelphia
Process Control Co., Inc., 2 E. End Ave., New York
Pyrometer Instrument Co., 103 Lafayette St., New York
Rack Engineering Co., 5102 Butler St., Pittsburgh
Ramsey Pump & Supply Co., 529 Fulton Bldg., Pittsburgh
R-B-M Mfg. Co., Logansport, Ind.
Refinery Supply Co., 621 E. 4fh St., Tulsa, Okla.
Revere Co., 322 No. Cherry St., Wallingford, Conn.
Ring Balance Instrument Co., 740 N. Franklin St., Chicago
Robinette, W. C., 802 Fair Oaks Ave., S. Pasadena, Calif.
Rowe Radio Research Co., 2422 N. Pulaski Rd., Chicago
Sarco Co., Inc., 475 Fifth Ave., New York
E. J. Deckman Co., Oliver Bldg., Pittsburgh, Pa.
Schutte & Koerting Co., 12th & Thompson Sts, Philadelphia
Size Control Div., American Machine & Gage Co., 2500 Washington Blvd., Chicago
Sola Electric Co., 2525 Clybourn Ave., Chicago
Specialty Screw Machine Products Co., Dillerville Rd., Lancaster, Pa.
Sperry Products, Inc., 1505 Willow Ave., Hoboken, N. J.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Statham Laboratories, 8222 Beverly Blvd., Los Angeles
W. A. Stoeltzing, 1222 Empire Bldg., Pittsburgh, Pa.
Superior Electric Co., 83 Laurel St., Bristol, Conn.
Televiso Products Co., 919 N. Michigan Ave., Chicago
Trimount Instrument Co., 37 W. Van Buren St., Chicago
Triplett Electrical Instrument Co., Bluffton, Ohio
Union Carbide & Carbon Corp., 30 E. 42nd St., New York
Victoreen Instrument Co., 5806 Hough Ave., Cleveland
Waldes-Kohinoor, Inc., Long Island City, N. Y.
Wallace & Tiernan Products, Inc., Main & Mill Sts., Belleville, N. J.
Webber Gage Co., 12900 Triskett Rd., Cleveland
W. M. Welch Scientific Co., 1515 Sedgwick St., Chicago
Weston Electrical Instrument Corp., Newark, N. J.
John Worley Jewel Co., Waltham, Mass.

Second TBA Conference Includes Exhibition

Arrangements for Television Broadcasters Association's second conference and exhibition are rounding into shape. The affair is to be held in the Waldorf-Astoria hotel in New York, Thursday and Friday, October 10 and 11. Ralph B. Austrian, 500 Fifth avenue, New York, is chairman. Present plan is to stage a pretty complete exhibition of both home receivers and transmitting and studio equipment. In addition there will be special telecasts to be seen by those who attend as well as a couple of luncheons, the annual banquet on the first evening, and a program of technical papers.

PERSONNEL

James L. Middlebrooks has been appointed director of engineering for the National Association of Broadcasters. He goes to NAB from Field Enterprises, Inc., Chicago where he was engineering director. He served three years in the U. S. Navy with the rank of Commander, and before that was in charge of construction for the general engineering department of Columbia Broadcasting System.

J. L. Middlebrooks Carl J. Biver

C. R. Knight and **Carl J. Biver** have been appointed application engineers in the Tube and Ken-Rad Divisions of General Electric Co.'s Electronics Department. Both will be responsible for application and field engineering on receiving tubes, Knight from headquarters in Schenectady, and Biver from Owensboro, Ky., Ken-Rad plant.

C. R. Knight Dr. B. S. Ellefson

Dr. Bennett S. Ellefson has been appointed director of the central engineering laboratories of Sylvania Electric Products Inc. He will direct planning, organization and coordination of fundamental and applied research and development for the company's radio, electronic and lighting products.

Edward J. Content, prominently identified with the engineering staff of broadcast station WOR since 1926, has left that organization to set up for himself as an acoustical consultant specializing in studio design. His headquarters will be at Roxbury Rd., Stamford, Conn.

George C. Hale has been elected vice president in charge of operations for the Jefferson-Travis Corp., New York. Following a stint of three years as communication equipment officer for the Army Air Forces, he joined Emerson Radio & Phonograph Corp. as director of that company's special products division. Was formerly connected with Philco.

Dr. Gordon M. Lee has been awarded The Institute of Radio Engineers' Browder J. Thompson Memorial Prize. He is technical director of Central Research Laboratories, Inc., Red Wing, Minn.

Dr. Gordon M. Lee

Ralph P. Glover

Ralph P. Glover has joined Technology Instrument Corp., Waltham, Mass., and will head that organization's sales engineering staff. In addition, he will continue his general consulting engineering practice.

Richard G. Leitner has been appointed chief electronic engineer for Lear, Inc. of California. He will headquarter in Los Angeles.

Richard G. Leitner

Harry S. Jones

Harry S. Jones has been appointed assistant chief engineer in charge of research and development for Lear, Inc., Grand Rapids, Mich. He was formerly chief engineer of the Instrument Division, Thomas A. Edison, Inc.

Hugh M. Beville, Jr., director of research of National Broadcasting Co., Inc., has been awarded the Croix de Guerre with Gold Star by General Charles de Gaulle. The citation is for exceptional war service in the course of operation for the liberation of France.

Max J. Manahan has been appointed director of engineering for the Hoffman Radio Corp., Los Angeles. He has been chief electrical engineer for the Delco Radio Division of the General Motors Corp., Kokomo, Ind. Coincidentally, **Al Bennett** has been appointed chief engineer of the Hoffman receiver section; **Stanley Cutler,** chief engineer of the special apparatus section, and **Elmer Gertsch,** manager of the special apparatus division. Retiring Walter S. Harmon, who has been engineering vice president for the past ten years, will open his own office in Los Angeles as a manufacturers' agent.

Fred P. Andrews has been elected vice president of Press Wireless, Inc. He has been in charge of the Alaska Communications System.

Fred P. Andrews

Renald P. Evans

Renald P. Evans has been made president of the Turner Co., Cedar Rapids, Ia. He has been general manager of the company for the past three years. David Turner, founder of the company, is now chairman of the board; John B. Turner is executive vice-president.

Glenn E. Webster, who a short time ago was appointed chief engineer of the Turner Co., Cedar Rapids, Ia., was formerly in charge of speech equipment for Collins Radio Co. In his new position Webster will head the engineering department of the Turner microphone and electronic division.

Dr. Felix L. Yerzley has been appointed director of research and engineering of Mycalex Corp. of America. He is a specialist in insulation and his former connections include Bell System, where he was a product engineer, Western Electric, Bendix Aviation Corp. (Pioneer-Eclipse Division), Weston Electric Corp. and E. I. DuPont de Nemours, where he was a physicist in charge of research and development.

Dr. Edmund S. Rittner has joined the research staff of Philips Laboratories, Inc., as an associate chemist. He will specialize on photocell research.

NEW BULLETINS

Fluorescent Lamp Guide

A 24-page booklet explaining operating characteristics of fluorescent lamps and auxiliaries has been issued by the Westinghouse Lamp Div., Bloomfield, N. J. Ratings are listed for standard types including Instant Start, Slimline and Circline. Construction and function of ballasts, starters and lampholders is described and the factors affecting lamp life and maintenance are covered. A large number of sketches, diagrams and tables help to make the booklet a valuable reference guide.

Microphone Catalog

The 1946 catalog of Universal Microphone Co., Inglewood, Cal., covers, in addition to the standard line of dynamic, velocity and carbon microphones, which are illustrated and described in detail, the new A 132 recording head for home recording. The magnetic recording head cartridge designed for replacement use in home recorders is provided with an accentuated high frequency range to compensate for losses common to home recorders and has a response range extending from 50 to 5000 cps.

Synchronous Clock Motors

Two bulletins have recently been issued by Telechron Co., Ashland, Mass. A four-page folder contains descriptions, photographs and dimensional sketches of two models of radio preselector clocks and three models of "Minitmaster" range signal timers. Two of these are combination electric clock and audible signal timers having an interval of 60 minutes or 3½ hours. A 12-pg. catalog has complete listings of 12 models of synchronous motors and an instrument movement adaptable to most instrumentation purposes. Photographs, dimensional drawings, electrical characteristics and synchronous torque ratings are given.

Sound Systems

Stromberg-Carlson Co., Rochester, N. Y., is distributing a folder containing a listing of sound components and systems. Included are three complete sound systems, two power amplifier cabinets, seven models of amplifiers, portable systems and a variety of microphones and loudspeakers.

Variable Transformers

Powerstat adjustable transformers for supplying varying voltages are described in a pamphlet of the Superior Electric Co., Bristol, Conn. A large range of sizes is available and convenience of connection and fusing are featured.

Technical Services

Associated Electronics Co., 132 Nassau Street, New York 7, has published a 32-page booklet describing its activities in this field which include the preparation of technical manuals, brochures, catalogs and sales presentations. The organization has technical facilities for research, engineering, sales planning, drafting, designing, analysis, and the development of improved technics and products. It also prepares industrial advertising.

Quick Fasteners

A bulletin containing engineering and procurement data on the new Shakeproof Q-Two quick-operating fastener for removable and hinged panels has been published by Shakeproof, Inc., 2501 North Keeler Avenue, Chicago. Its eight pages introduce the Q-Two addition to the Shakeproof line, present the advantages to general industrial users, include installation instructions, parts data and many illustrations.

12 Equation Computer

A four-page folder by Consolidated Engineering Corp., 620 North Lake Ave., Pasadena, Cal., explains the basic principles and some of the applications of the new Consolidated electrical computer. This instrument because of its rapid calculation of simultaneous linear equations is of particular value for solving mass spectrometer and infrared spectrophotometer data and for analytical and statistical studies.

Relays For Industry

Eleven new series of relays for industrial applications are illustrated in a folder put out by Price Electric Corp., Frederick, Md. Operating features, power requirements and physical dimensions are described. Among types shown are general purpose and multi-contact, automatic stepping, time delay, polarized, latching and a compactly designed switching relay for use with coaxial cables.

Power Transformers

Jefferson Electric Co., Bellwood, Ill., has issued a 12-page illustrated bulletin on the use of power circuit transformers of the dry type. Wiring diagrams and mounting suggestions are included along with a detailed table giving dimensions and data on double-wound and single-wound auto-type transformers. Also given is a method for determining transformer capacity requirements.

Electronic Gages

A variety of indicator and comparator gages which are unaffected by voltage fluctuations, have a small gaging head and no temperature- or warming-up errors are described in catalog No. 1000 distributed by the Electronic Div., Jack & Heintz, Inc., Cleveland 1, Ohio. The catalog is devoted to an electronic comparator, an electronic height gage, an internal comparator and two types of automatic ball separator gages. The instruments though designed for laboratory precision are available for general shop applications.

Time-Count Relays

Eagle Signal Corp., Moline, Ill., is distributing bulletin 291 on time-count relays. The 12-page bulletin after giving a number of illustrations of industrial timer applications goes into detailed descriptions of a variety of timers, such as: one cycle reset timers, multiple circuit reset timers, repeating cycle timers, count relays and miscellaneous special units. Technical specifications, operating arrangements, wiring diagrams and application data are included.

Resistors, Capacitors

A new 40-page catalog has been issued by the Sprague Products Co., North Adams, Mass., containing much helpful data on Koolohm resistors, capacitors, test equipment and radio interference filters. Among new units cataloged are type LM universal vertical chassis mounting replacement capacitors; Filterol, a peacetime derivation of wartime engineering research for reducing man-made radio noises; a complete line of mica capacitors ranging from the tiny "toothpick" types to giant potted-case units; new transmitting capacitors. Listings including dimension diagrams of all units.

Wirewound Resistors and Rheostats

Vitrohm resistor catalog D-2 giving data on wire-wound vitreous enameled resistors used by the radio and electronic industries is available from Ward Leonard Electric Co., Mount Vernon, N. Y. Fixed resistors of various values and wattage ratings, adjustable resistors, "Stripohm" resistors and "Discohm" resistors are listed as well as ring type, tubular and heavy duty rheostats. Specifications, dimensions, prices and illustrations are included.

Galvanometers and Dynamometers

Complete specifications and prices for an extensive line of ac and dc galvanometers of the reflecting and the pointer type and for astatic dynamometers are given in a 40-page catalog distributed by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. The characteristics, selection and use of these instruments, which are intended for research, teaching and testing applications, are discussed and accessories such as telescopes, scale reading devices, shunts, damping coils etc. are listed.

Machinery Mounts

Bushings, Inc., Royal Oak, Mich., has issued a 5-page illustrated folder on Vibro-Levelers (machinery mountings used to stop transmission of vibration and allow precision leveling of machines). Various sizes are described together with their load capacitance, design features and prices.

Permanent Magnet Manuel

Indiana Steel Products Co., 6 North Michigan Ave., Chicago 2, Ill., has issued the third in a series of permanent magnet manuals containing a wealth of descriptive and engineering information on various phases of magnetism within its 34-pages. The history of the magnet is traced from the lodestone to alnico V. The role of magnets in the transformation of mechanical to electrical or electrical to mechanical energy is discussed and the basic types of magnets and airgaps are shown. Later chapters are devoted to the characteristics of permanent magnet materials such as sintered alnico and the design and manufacturing of specific types. A large number of illustrations and charts is included.

Receiving Tube Data

The Tube Division, General Electric Co., Schenectady, 5, N. Y., has issued a new 40-page brochure giving the electrical design characteristics, maximum ratings and typical operation conditions for each of their receiving tube types. The booklet also shows outline drawings and basing connections and has several pages on the interpretation of ratings and technical data and the recommended tube types for engineering applications.

Industrial Electronics

A short concise education on what the vacuum tube can do for industry and production is covered in a new 28-page Westinghouse booklet—"The Business Man's Guide to Electronics". Illustrations and descriptive data show applications of vacuum tubes in many lines of work, among them, induction and dielectric heating, controls for welding, regulators for mixing and packaging, power conversion, safety devices, measuring and inspection equipment. The six fundamental functions of electronic tubes are also carefully described. Published by Electronic Tube Dep't, Westinghouse Lamp Division, Bloomfield, N. J.

Hf Heating

Thermex Division, Girdler Corp., 224 East Broadway, Louisville 1, Ky., has illustrated many of the uses of dielectric heating in a 24-page brochure. Examples of the jobs electronic heating is doing in the plywood, plastic, rubber, laminates and such widely diversified industries as the food and textile fields. This booklet also covers the engineering service behind Thermex equipment. Several pages are devoted to portable and stationary units and accessories.

Mycalex Properties

A new 24-page booklet on G-E mycalex, a stone-like product composed of mica and a special glass, has been published by the Chemical Department of the General Electric Co., Pittsfield, Mass. The bulletin lists the properties, available types, molded parts, fabricated parts, machining practice and how and where to order the material. A feature is a properties chart of six grades of mycalex of both the compression and injection molded types.

Product Development

A booklet containing a number of typical examples of product development and production in the metal fabricating field has been issued by Bernard Rice's Sons, Inc., 325 Fifth Ave., New York. Of special interest to the electronic industry are sections devoted to "Resonant cavity for vacuum tubes", "Electro-Forming", "Vacuum Tube Components", "Dry Loads", and "RF Transmission Line Components". A large number of diversified products developed for specific uses are shown in each category. Also included are sections on "Diverse Metal Fabrication" and "Fabrication of Unusual Metals".

Phenolic Plastic

Catalog D050, 42-pg. engineering treatise containing description, characteristic properties and uses of Dilecto laminated phenolic plastic is being distributed by Continental-Diamond Fibre Co., Newark 50, Del. It includes in addition to a large number of engineering tables, photographs and application data a new center spread chart showing electrical and mechanical properties of Dilecto sheet grades.

Capacitor Catalog

Centralab's new Catalog No. 25 contains 20 pages and features additions as well as deletions to the regular jobber line. New parts described, illustrated and priced include eighteen transmitting capacitors, six high accuracy capacitors, three HDC capacitors and twelve silver mica capacitors. Tubular capacitors have expanded to include four more capacities in the zero temperature coefficient and seven in the negative coefficient. Five new items have been included in the trimmer line. Manufacturer is Centralab Division, Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee, Wis.

Color Code Indicator

A handy vest-pocket size color code indicator for showing the resistance values of RMA color coded resistors has been brought out by the International Resistance Co., Philadelphia, Pa. As the color combinations are set up in small windows, resistance values appear automatically. The reverse side gives the standard values of resistors and a comparison of the new and the old color codes.

Precision Timers

Bulletin 129 listing precision timers, chrono - tachometers and electrical test panels for government and industry is available from Standard Electric Time Co., Springfield. Mass. Included are a variety of jacks and plugs, connectors, lugs and illustrations for a number of test set-ups, such as millisecond timers, transformer and circuit breaker tester and a tachometer calibration panel.

Panel Instruments

Burlington Instrument Co., Burlington, Iowa, has issued meter catalog No. 46. The catalog contains a description of the precision movement used in six types of panel instruments, which are illustrated together with auxiliary equipment. Operating advantages, dimensional drawings and panel layouts are given for each model as well as ranges, scale division, resistance and prices.

Transformer Handbook

Acme Electric & Mfg. Co., Cuba, N. Y., has issued a bulletin illustrating plant facilities for manufacturing a wide variety of transformers. Industrial and commercial types of transformers for cold cathode lighting, luminous tube transformers, fluorescent lamp ballasts, radio transformers and air-cooled units used in power distribution are described together with highlights of their various stages in production and testing. The same company has also issued a handbook devoted to luminous tube transformers, which gives engineering specifications and reference data on heavy duty transformers, cold cathode transformers and weatherproof transformers. A "fluorescent footage" chart is included.

Rectifiers

A four-page bulletin describing selenium rectifiers, copper oxide rectifiers and photo-electric cells is being distributed by Bradley Laboratories, Inc., 82 Meadow St., New Haven, Conn. Five types of selenium rectifiers for high voltage and power uses and eight types of copper oxide rectifiers are illustrated and technical specifications are included. "Luxtron" photo-electric cells are shown on the back page of the bulletin, and in another four-page folder (20101) giving photocell characteristics and engineering data.

Cardioid Crystal Microphone

Description, technical data, frequency response, specifications and applications on the model 950 Cardax microphone are contained in a 4-page bulletin issued by Electro-Voice Inc., 1239 South Bend Ave., South Bend 24, Ind. The unidirectional microphone has a frequency response selector, which provides either a "flat" characteristic or a rising response at higher frequencies for speech intelligibility.

Ion Gages

For their special products handbook the General Electric Co., Schenectady, N. Y., has issued new sheets covering vacuum gages and ion gages. The vacuum gages are of the McLeod type adaptable to measurements within the range of 0 to 200 or 0 to 2000 microns absolute. The ion gages measure pressures of 0.1 to 0.0001 microns and consist essentially of a control unit and an ion gage tube.

Measuring Instruments

An 18-page booklet describing ammeters, voltmeters and wattmeters of the moving coil, electromagnetic and electro-dynamometer type is being distributed by Norton Electrical Instrument Co., Manchester, Conn. Eight types of standard instruments are described and their prices, specifications and dimensions are given. Also included are special instruments, shunts, resistors and other accessories.

Noma Sells Oxford

Oxford Radio Corp. which has been a wholly-owned subsidiary of Noma Electric Corp., has been disposed of by the latter organization. Oxford will continue to manufacture certain components for Noma.

Federal Field Meter Approved by F.C.C.

Official engineering approval of the FTR Type 101-C field intensity meter has been given by the Federal Communications Commission. This is understood to be the first time that the F.C.C. has extended approval to such equipment, regardless of manufacture. As the result of F.C.C. action, it is no longer necessary to have Federal meters calibrated by the U. S. Bureau of Standards, and field measurements submitted to the Commission will be considered official.

WHAT'S NEW

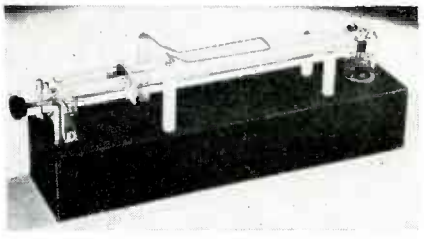
(*Continued from page 92*)

Oscilloscope

The CRU Oscilloscope, an instrument particularly suitable for amateurs for modulation measurements and adjustment of equipment, has been brought out by National Company, Inc., Malden, Mass. It has a 2AP-1A tube with a 2 in. screen and is provided with a built-in power supply and internal 60-cycle sine wave sweep. A panel switch permits use of external audio sweep. The oscilloscope is supplied as a table model, but may be converted to the rack model type.—Electronic Industries

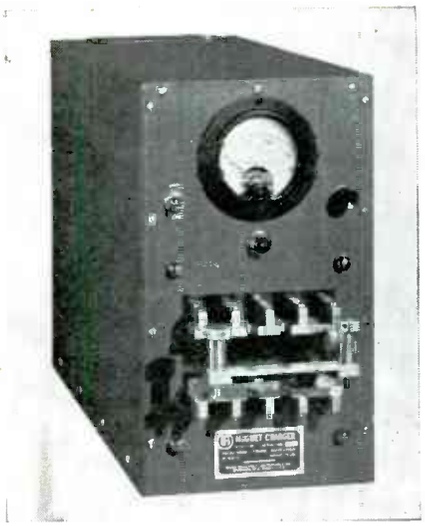
Coaxial Dipole

A coaxial dipole antenna for mobile or fixed station use in the 144 mc band has been brought out by Engineering Electronics, 50 Fairfield St., Montclair, N. J. The center conductor of the transmission line is extended ¼ wave beyond the end of the line and acts as top half of a half wave antenna. The dipole is supplied with two standoff insulators, feed through bolts and 4 ft. of transmission line—Electronic Industries



VHF Transmitter Kit

Components for construction of a vhf linear oscillator designed for operation on the 220 and 144 mc amateur bands are supplied in the HY-Q 75 kit available from Hytron Radio & Electronics Corp., Salem, Mass. With the HY 75 tube a useful power output of 14 watts on cw and 11 watts on phone may be obtained. Low-loss insulators, a silver plated tank circuit, coaxial plate blocking condenser and micrometer tuning from 135 to 250 mc are features. The kit is also supplied, wired and tested.—Electronic Industries



Magnet Charger

A magnet charger adapted to charge almost all permanent magnets now in use with a unidirectional magnetizing force sufficient to approach magnetic saturation is in production at Radio Frequency Laboratories, Inc., Boonton, N. J. Model 107 consists principally of a 500 volt power pack, a 100 mfd capacitor and a current transformer, the secondary of which is connected to a charging bar. It operates on 110/120 volt, 50/60 cycle ac and consumes 25 watts. —Electronic Industries

Center-Loaded Antenna

A center-loaded antenna, which is weatherproofed and salt-spray resistant for through-deck or cabin-side attachment on small boats, has been developed by Islip Radio Mfg. Corp. and is in production at Isolantite, Inc., 343 Cortlandt St., Belleville (9), N. J. Designed for operation on 2 to 3 mc the antenna is constructed of etched and lacquered aluminum and chrome-plated brass. It has a removable, collapsible whip section.—Electronic Industries

AM-FM Signal Generator

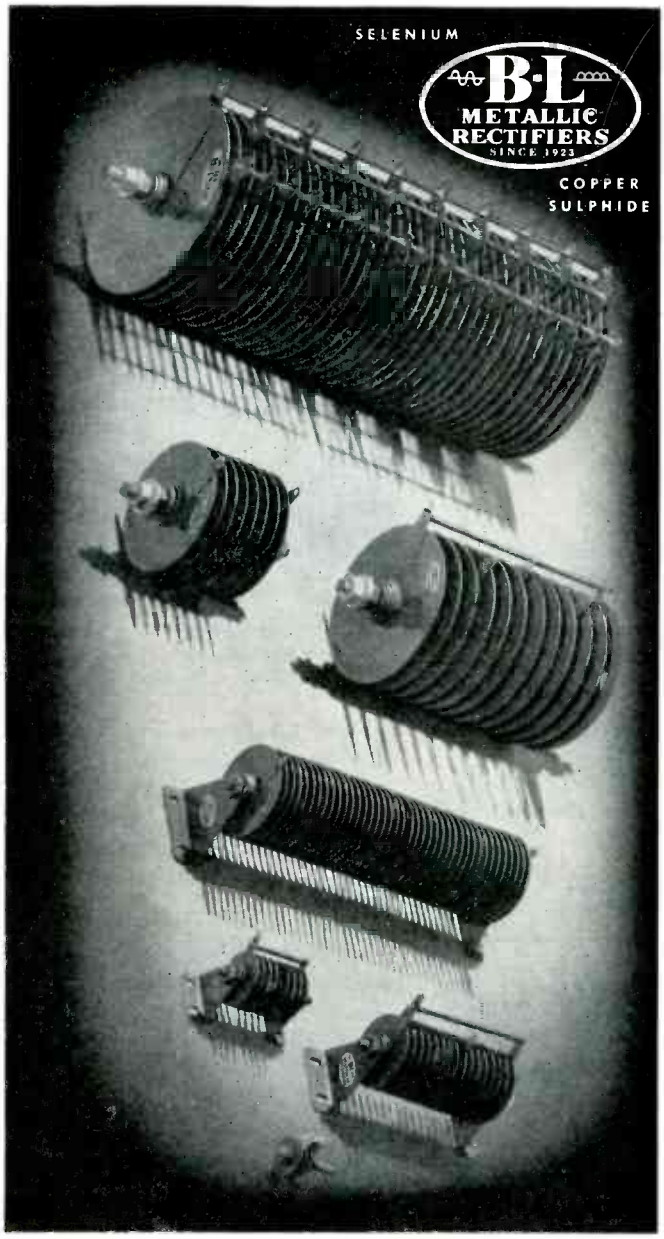
A laboratory-type wide range signal generator for AM and FM has been developed by Simpson Electric Co., Chicago. Model 415 is practically independent of line voltage variations and has constant RF output voltage throughout the frequency range. The instrument is provided with either internal 400-cycle sine wave modulation from 0 to 100% or with external modulation from below 60 cycles to over 10 kc.—Electronic Industries

Sub-Miniature Tube Socket

A new type socket permitting quick replacement of sub-miniature tubes having coplanar leads with a spacing of .05 in. or more has been developed by Instrument Specialties, Little Falls, N. J. The socket consists of the required number of "flea" contacts made of thin beryllium copper mounted on a panel of insulating material.—Electronic Industries

Interval Timer

A range of 60 to 80 intervals per minute may be controlled by a new-type timing device developed by P.M. Co., 222 South Twelfth St., Newark 7, N. J. Consisting of a thermal timing unit in combination with a miniature relay the timer finds application in the aircraft, marine and industrial field. Standard types range from 5 to 15 amps., for 32 volts dc or up to 220 volts ac in DPDT or SPDTDB combination. Normal operating current is approx. 200 ma.—Electronic Industries



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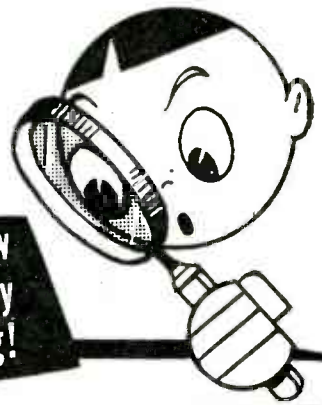

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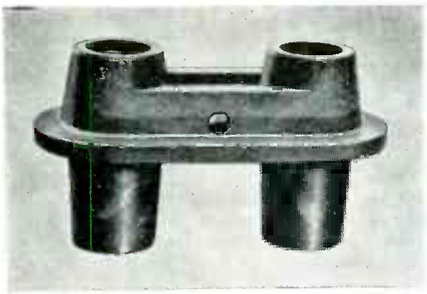
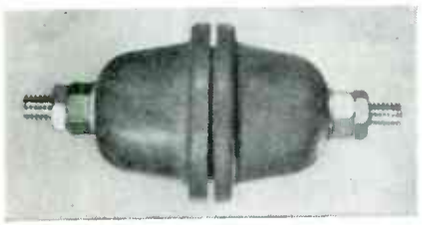


Transformer Bushing

A transformer bushing having less bulk than the conventional types because of superior dielectric properties has been brought out by Electronic Mechanics, Inc., 70 Clifton Blvd., Clifton, N. J. The bushing is Mykroy, a glass-bonded mica ceramic, and is designed for high voltage transformer secondaries used in neon signs, cold cathode lighting, oil burner ignition systems and similar applications.—Electronic Industries



Feed-Through Insulators

Electron Mechanics Inc., 70 Clifton Blvd., Clifton, N. J., has brought out glass bonded mica ceramic feed-through insulators molded out of Mykroy. The insulators are mechanically strong, available in a size range from ¾ in. to 5 in.—Electronic Industries

Signal Tracer Probe

A probe for locating defective circuits and components in radio receivers has been designed by W. W. Boes Co., Dayton, Ohio. The unit requires connection to an auxiliary amplifier and speaker by means of a special receptacle supplied with it. It may be used for rf, IF and af stages.—Electronic Indus-

High Conductivity Alloy

Callinite Type SM, a silver-molybdenum alloy particularly suitable for facing of contact surfaces in switch gear designed to handle heavy currents is available from Callite Tungsten Corp., Union City, N. J. The alloy may be had in three grades for a variety of hardness and conductivity ratings.—Electronic Industries

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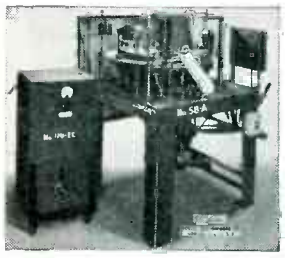

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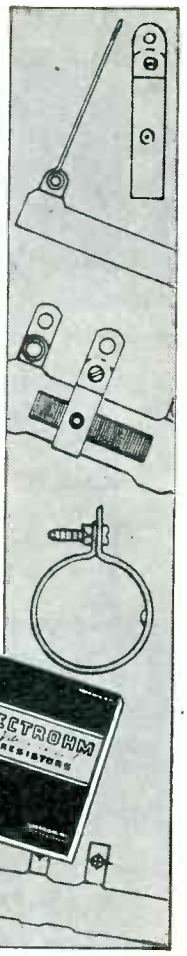

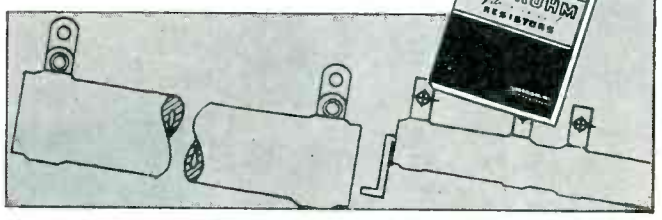

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Recording Head

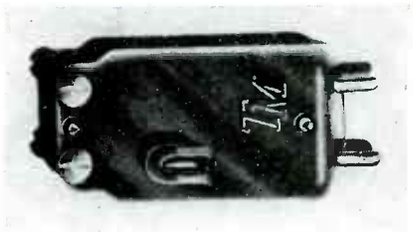
Universal Microphone Co., Inglewood, Cal., is producing a new magnetic recording head cartridge for replacement use in home recorders. The unit accentuates the high frequency range to compensate for equipment losses. It has a frequency range from 50 to 5000 cps and a sensitivity comparable with commercial units in home recorders. Available in the standard impedance of 3.2 ohms—Electronic Industries

Crystal Microphone

The Comet Model 902, a combination crystal microphone and desk stand is in production at Electro-Voice, Inc., South Bend, Inc. Molded of butyrate plastic the microphone supplies an output level of 48 db below 1 volt/dyne/cm² and has a substantially flat frequency response from 70 to 7,000 cps.—Electronic Industries

Inter-Communication Equipment

The Master Utiliphone, a two-station intercall set, which may be operated on 110 volts, ac or dc, is being made by Electronic Laboratories, Indianapolis, Ind. The equipment incorporates a three tube amplifier and is provided with 50 ft of wire. Each unit consumes 25 watts.—Electronic Industries



Magnetostriction Phono Pickup

The torsional magnetostriction principle is utilized in the model TM phono pickup developed by Magnetostriction Devices Co., 739 Boylston St., Boston, Mass. The unit provides high fidelity and low harmonic distortion at low cost and will withstand severe physical shock and high ambient temperatures. It has an output comparable with microphones.—Electronic Industries

Phonograph Amplifier

A 30 watt phonograph amplifier is in production at Newcomb Audio Products Co., 2815 S. Hill St., Los Angeles, Cal. The amplifier has two inputs, separate bass and treble controls, a gain of 85 db, distortion of less than 5%, frequency response from 20 to 20,000 cps within 1 db and provides a variety of output impedances. It has 7 tubes, consumes 144 watts.—Electronic Industries

Thyratron Rectifier

Electrons Inc., 127 Sussex Ave., Newark 4, N. J., has developed a Xenon gas filled grid controlled rectifier tube type C16J for welding control, power rectifier and vibration motor applications. The tube requires filament voltage of 2.5, at 31 amps. Peak forward voltage is 1000. Steady dc current is 12 amps. and peak current 100 amps.—Electronic Industries

Raytheon Expands Production Facilities

Raytheon Mfg. Co. has more than trebled production facilities of its broadcast equipment division by taking over a two-story building addition to the original Chicago plant. The original plant at 7517 No. Clark St. will be retained as a metal working shop while the new building at 7475 Rogers Ave. will house all administrative, engineering, drafting and assembly operations.

Electronic Conferences Program Completed

The program for the Second National Electronics Conference which is to be held at the Edgewater Beach Hotel in Chicago, October 3, 4 and 5, is practically complete. In addition to a number of exhibits of electronic equipment, there will be approximately 50 papers covering communications, instrumentations, industrial electronic applications and research. The Conference is sponsored by the Illinois Institute of Technology, Northwestern University and the University of Illinois together with the Chicago sections of A.I.E.E. and I.R.E.

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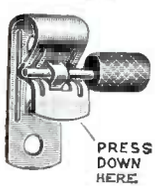
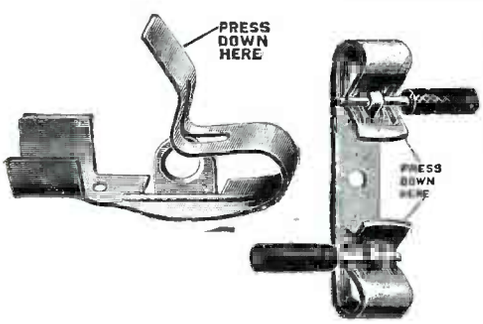
Fahnestock Clips
RADIO'S GREATEST CONVENIENCE



FAHNESTOCK SPRING BINDING POST GRIPS THE WIRE BY THE ACTION OF A SPRING

No tools required to make the connection. Grips the wire with just the right pressure for good electrical contact. Simply press down, insert the wire and let go. Does not injure wire, hence connection can be made or opened as often as desired. Available in large variety of types and sizes to fit any radio purpose and any requirement as to position, space or method of attachment. You will find them in the better sets.

Positive contact; cannot jar loose. Brass or bronze — nonrusting.



FAHNESTOCK ELECTRIC COMPANY, Inc.
46-44 ELEVENTH STREET, LONG ISLAND CITY 1, N. Y.

Please send us at once, Descriptive Literature, Prices and Delivery Schedule on

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Mobile Radiotelephones Along More Roads

Three more inter-city highways totalling over 800 miles in length have been added to the two previously announced routes on which the Bell System plans to provide mobile radiotelephone service to vehicles. The American Telephone and Telegraph Co. will construct transmitter-receivers along the highways between Washington and New York; Buffalo and New York, via Albany; and Los Angeles and San Diego.

Dedicate Ohmite Labs

The Ohmite Laboratory of precision electrical measurements of the Armour Research Foundation of Illinois Institute of Technology was formally dedicated at special ceremonies in the middle of June. The laboratory, fully equipped with modern instruments, was made possible by a grant from David T. Siegel, founder and president of the Ohmite Mfg. Co., Chicago. Facilities of the laboratory are available to industry.

Pacific Takes Lewis

Pacific Electronics has been formed in Los Gatos, Calif., and has taken over the former Lewis Electronics organization. The Lewis Los Gatos plant will be operated as a branch of Pacific's Spokane, Wash. plant which manufactures receivers and other electronic equipment for the export field. The Los Gatos branch will manufacture and repair transmitting and rectifier tubes which long has been a specialty of Lewis.

E. I. MICROFILMED

(*Continued from page 4*)

than one pound, with overall dimensions of 3½" x 4" x 4". Corresponding savings are expected as the Microfilm Library is expanded to cover all electronic and radio engineering literature.

Many engineering firms are making use of microfilm for conveniently filing and storaging original schematics, production drawings, etc. For this type of material, larger readers are necessary, the average price being about $300. For reading material of smaller dimensions, such as magazine pages, the Eastman Recordak, retailing for approximately $75 is suitable. A still lower priced, efficient reader is the Spencer product of the American Optical Co. This reader sells for $56.50.

ELECTRONIC INDUSTRIES

Advertisers, August 1946

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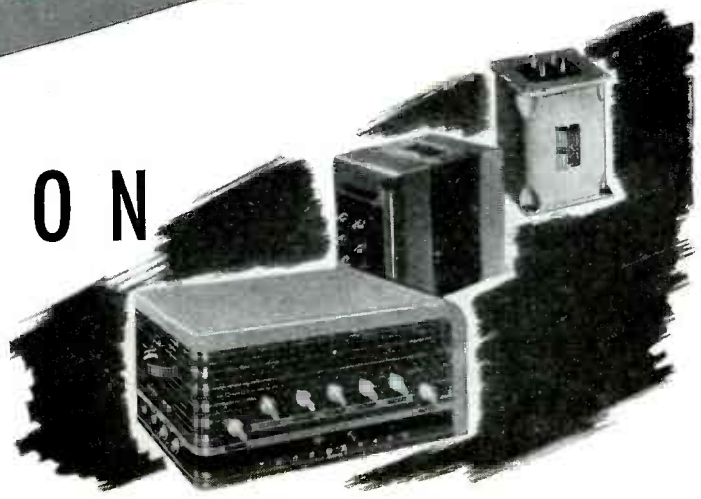

TRANSFORMERS for all requirements... communications, sound amplifier, industrial, experimental and amateur.

TRU-FIDELITY AMPLIFIERS with advanced tone compensation, conservative ratings, multiple input channels, low hum level, etc.

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COMPONENTS. Standard, plastic and Ferrocart transformers; antenna, R.F. and oscillator coils; accessories.

SERVICE INSTRUMENTS. Meissner Analyst... a complete servicing instrument; Signal Calibrator... self-contained and portable.

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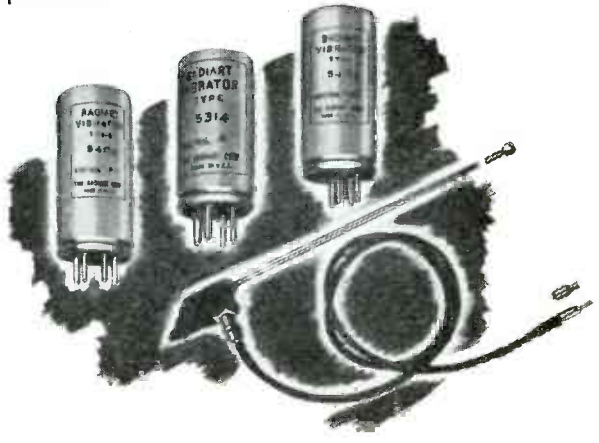

VIBRATORS. Exact duplicate Vibrators, individually-engineered... long life, low noise level, minimum interference.

RUST-PROOF AERIALS. A complete line, newly designed to fit all cars...cowl, hood and under hood types. Many exclusive features.

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DIEFLEX VARNISHED TUBING PRODUCTS

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FLEXIBILITY

Flexibility is as necessary in varnished tubing products as it is in skating to insure a perfect performance. All Dieflex varnished tubings and saturated sleevings —whether made of cotton or Fiberglas base sleevings —have extreme flexibility and pliability. Due to their workability in "hard to assemble" applications, in close quarters and around corners, Dieflex products speed production and cut costs.

Besides their extreme flexibility, Dieflex products are completely impregnated with electrical insulating varnishes, have a smooth inside bore to prevent snagging, are non-fraying, and have excellent "push-back" and electrical qualities.

Dieflex varnished tubings and saturated sleevings are made in all standard VTA or ASTM grades. Immediate shipments, usually from warehouse stocks, can be made in all standard sizes and colors.

If you don't already have it, be sure to write for your free copy of the *Third* Issue of the VTA standards, revised to January 29, 1945.

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MADE WITH BRAIDED COTTON SLEEVING BASE

VTA Grade A-1 Magneto Grade Varnished Tubings
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Heavy Wall Varnished Tubings and Saturated Sleevings

MADE WITH BRAIDED GLASS SLEEVING BASE

VTA Grade A-1 Magneto Grade Varnished Fiberglas Tubings
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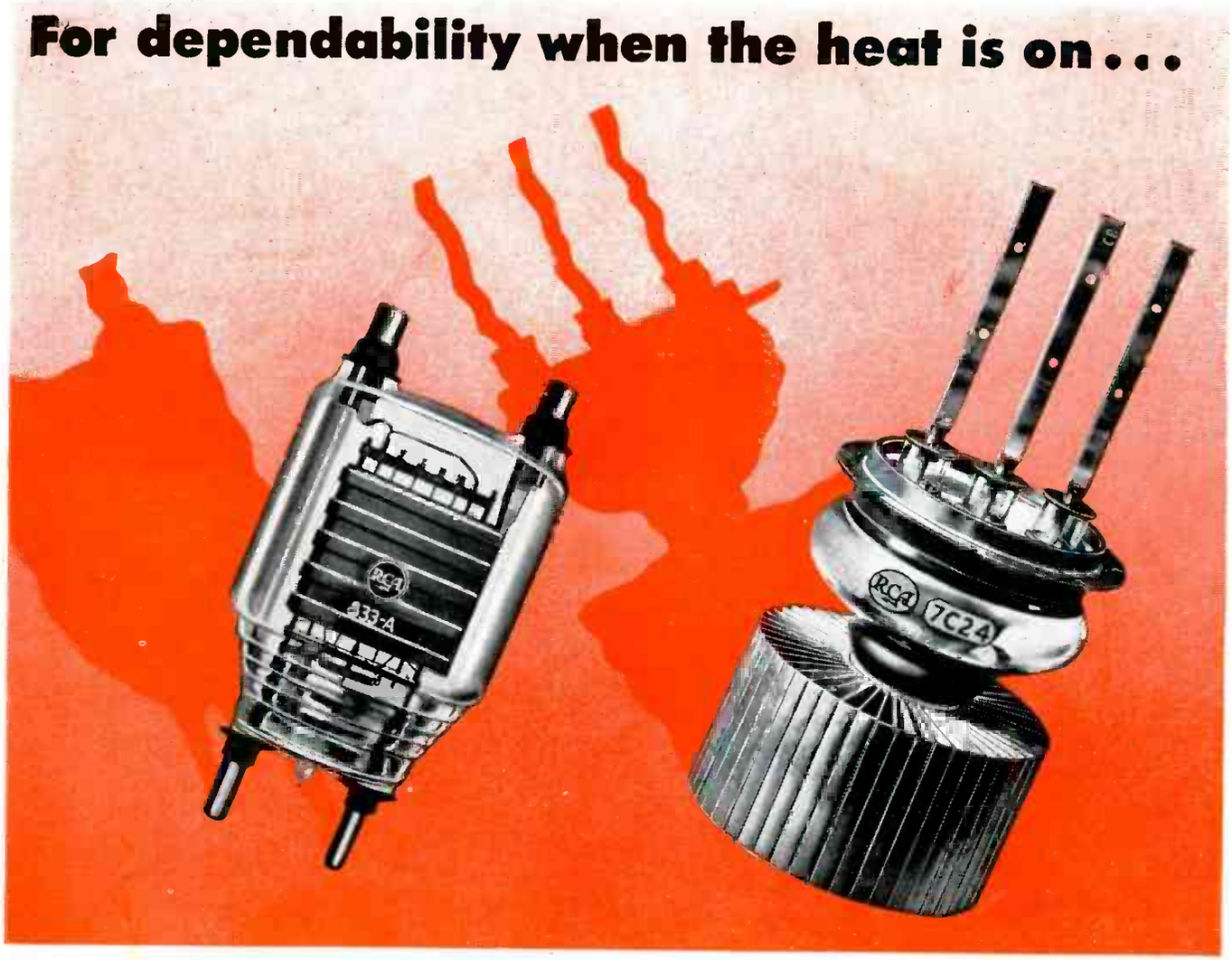
VTA Grade C-1 Extra Heavily Saturated Fiberglas Sleevings
VTA Grade C-2 Heavily Saturated Fiberglas Sleevings
VTA Grade C-3 Lightly Saturated Fiberglas Sleevings
Silicone-Treated Fiberglas Varnished Tubings and Saturated Sleevings

For dependability when the heat is on . . .



Two outstanding RCA power triodes for electronic heaters of 1 to 8 kw

THE RCA-833-A and 7C24 power triodes offer the manufacturer of dielectric or induction heating equipment considerable latitude in designs involving outputs ranging from 1 to 8 kw.

Both triodes provide good stability under changing load, with moderate excitation requirements, because they are in the medium-mu class. Being air-cooled, they permit simplified designs of apparatus having complete mobility.

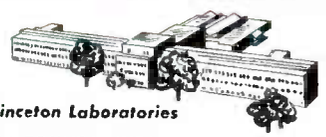
The RCA-833-A delivers 1.0 kw to the load with natural air-cooling—1.4 kw under forced-air-cooled conditions. It operates at full ratings up to 30 Mc., and as high as 75 Mc. at reduced ratings.

The RCA-7C24 forced-air-cooled triode is a high-perveance tube of rugged construction having a large efficient copper radiator. It delivers 4.0 kw to the load and operates at full ratings up to 110 Mc.

Higher outputs are readily obtained by using these tubes in push-pull.

The steady and increasing demand for these tubes assures you of unfailing quality and uniformity.

RCA tube application engineers will be glad to cooperate with you in the adaptation of these or other RCA tube types to your equipment designs. Just write RCA, Commercial Engineering Department, Section D-7H, Harrison, New Jersey.



Princeton Laboratories

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.