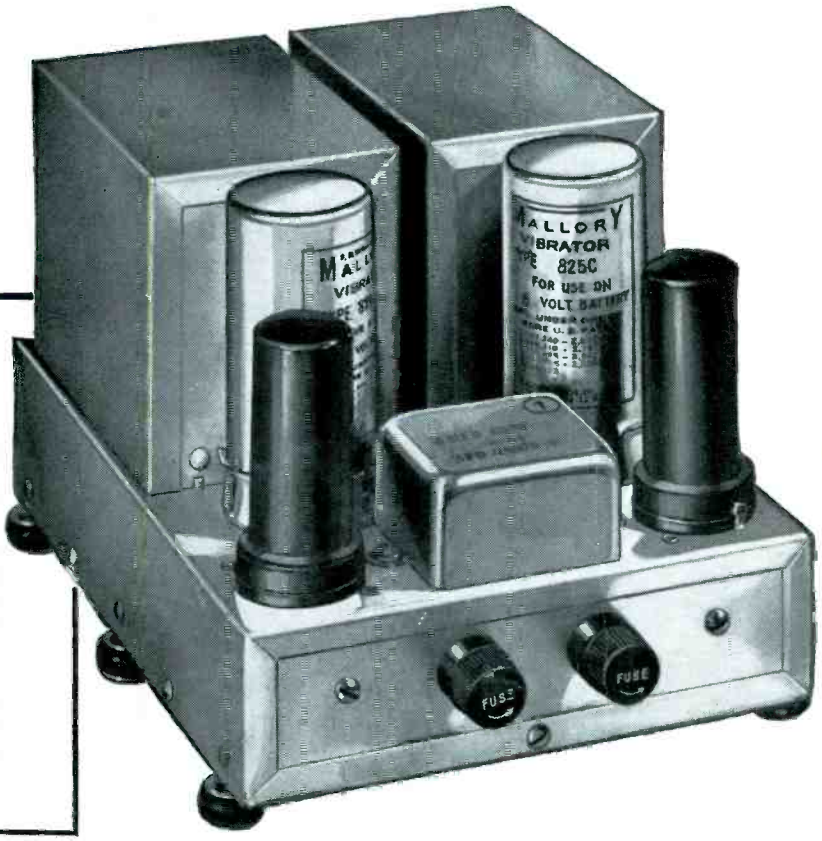
ELECTRONIC INDUSTRIES

1945
JUNE
Caldwell-Clements, Inc.

Plenty of POWER!



Specifications of Heavy-Duty Vibrapacks VP555, VP557

Input Voltage: 6 volts, nominal.

Output Voltage: VP555—300 volts, 200 ma.† nominal.
VP557—400 volts, 150 ma.† nominal.

Filtering: VP555 completely filtered for audio and RF vibrator hash. Ripple approximately 1½% at max. load.
VP557 has efficient RF filter for vibrator hash.

Applications: VP555—ideal for mobile PA systems and two-way radio service.
VP557—specially designed for radio transmitter service, automotive, aircraft and marine.

†Intermittent rating for transmitters and public address systems.

MALLORY HEAVY-DUTY DUAL VIBRAPACKS*

WITH 60-watt rated capacity, Mallory Heavy-Duty Vibrapacks VP555 and VP557 are giving excellent service in operating portable and mobile transmitters, PA systems, heavy drain receivers and other electronic applications requiring more power than a single unit vibrator power supply.

Like other Vibrapacks, these heavy-duty dual units are electrically and mechanically rugged . . . assuring trouble-free operation and high efficiency over a long life.

If you're designing portable or mobile electronic or radio equipment requiring high voltages from a low voltage DC supply, include Vibrapacks in your blueprints. Mallory Vibrators and Vibrapacks are available from your nearest Mallory Distributor. Ask him for your free copy of Booklet E555D, or write us today.

Inquiries are invited from manufacturers for Vibrators and Vibrapacks for use in original equipment.

Features of Mallory Standard Vibrapacks

Nominal input voltages of 6, 12 and 32 volts DC.

Nominal output voltages from 125 to 400.

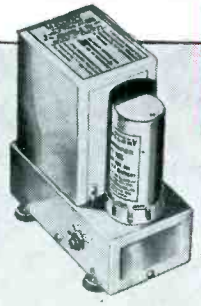
Models available with switch for four output voltages in approximate 25-volt steps.

All standard Vibrapacks are equipped with new Mallory Hermetically-Sealed Vibrators for top performance in extremes of atmospheric pressure or humidity.

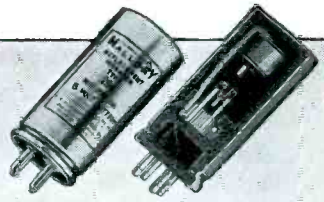
ARMY E NAVY

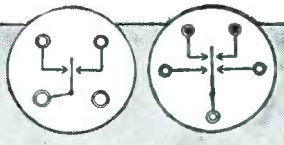
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

**Reg. U. S. Pat. Off. for vibrator power supplies.*



P. R. MALLORY & CO. Inc
MALLORY





VIBRATORS and VIBRATOR POWER SUPPLIES

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

★ IN THIS ISSUE JUNE, 1945 ★

ORESTES H. CALDWELL, Editor M. CLEMENTS, Publisher

EDITORIAL STAFF—Ralph R. Batcher, consulting editor; Stanley P. McMinn, managing editor; William Moulic, electronic theory and design; H. Gregory Shea, industrial engineering applications; Josepha Zentner, Ph.D., patents and foreign reviews; H. L. M. Capron, engineering management relations; E. T. Bennett, editorial records; Charles Dreyer, art director; Carl Buhrer, circuit diagrams; Roland C. Davies, 1290 National Press Building, Washington, D. C., Washington editor; Arthur H. Halloran, 1020 Union St., San Francisco, west coast editor.

READER SERVICE—J. Cosin, H. Mirtel; data research, H. Kulik.

CIRCULATION—B. V. Spinetta, circulation director; Subscriptions; list compilation: B. Gollub, M. Groening, B. Ruchaisky.

BUSINESS—M. H. Newton, business manager; John Samborn, eastern manager; Richard Fitzpatrick, western manager; O. H. Sutter, New England manager; Lee Robinson, district manager; Ben Morris, research; J. E. Cochran, make-up; E. P. Butler; W. W. Swigert, credit manager; W. Kenneth Reynolds, D. Williams, E. Callahan.

CHICAGO MANAGER—R. Y. Fitzpatrick, Tel RAN. 9225. 201 N. Wells Street.

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

Electronic Industries, June, 1945. Vol. IV, No. 6. Regular price per copy 35 cents. Published monthly by Caldwell-Clements, Inc., 480 Lexington Avenue, New York, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer; M. B. Clements, Assistant Secretary. Subscriptions: United States and possessions, Mexico, Central and South American countries, $3.00 for one year; $5.00 for two years; $6.50 for three years. Canada, $3.50 per year; $5.50 for two years; $7.15 for three years. All other countries $5.00 a year. Entered as Second Class Matter, September 20, 1943, at the Post Office at New York, N. Y., under the act of March 2, 1879.

Printed in U. S. A.

Another New "AMPEREXTRA" for Designers of Industrial Equipment

AMPEREX 235-R

R. F. POWER AMPLIFIER AND OSCILLATOR

The AMPEREX 235-R is a forced-air cooled triode, particularly well suited for high-frequency industrial use. Characteristics of the grid have been given especial attention so that operation to full output may be obtained at comparatively low plate voltages. This is an advantage which should merit the interest of industrial equipment designers now working on postwar products. Built into the 235-R, of course, are those notable ***"Amperextras"*** which give ***Amperex*** tubes peak performance over a greater period of working life.

GENERAL CHARACTERISTICS

Filament: Voltage	14.5-15.0 Volts	**Direct Interelectrode Capacitance (approximate)**	
Current	39.0 Amperes	**Grid to Plate**	9.0-$\mu\mu$f
Amplification Factor	14.0	**Grid to Filament**	10.0-$\mu\mu$f
Grid to Plate Transconductance @ 500 ma.	6500 Micromhos	**Plate to Filament**	1.5-$\mu\mu$f

Write for Additional Information

AMPEREX
the high performance tube

NOTE: The more popular types of ***Amperex*** tubes are now available through leading radio distributors.

AMPEREX ELECTRONIC CORPORATION
79 WASHINGTON STREET • • • • • BROOKLYN 1, N. Y.
Export Division: 13 E. 40th St., New York 16, N. Y., Cables: "Arlab"

Without Exception

these molded, oil-paper capacitors meet the performance requirements of American War Standard C 75/221.

AVAILABLE IN STANDARD RATINGS		
CAPACITANCE MMFD.	VOLTAGE D-C WKG.	TYPE DESIGNATION
SIZE: 13/16 x 13/16 x 19/64 INCHES		
3000	800	CN35-302
6000	600	CN35-602
10000	600	CN35-103
20000	300	CN35-203
SIZE: 11/16 x 29/64 x 7/32 INCHES		
1000	400	CN20-102
2000	200	CN20-202
3000	200	CN20-302
6000	200	CN20-602
10000	120	CN20-103
Other capacitances from 1000 mmfd. to 50000 mmfd., available in Tobe DP style, conform to the same high quality standard.		

★ **MOISTURE SEAL** . . . adequate to ensure compliance with thermal cycle, immersion, and humidity requirements.

★ **SHUNT RESISTANCE** . . .
40,000 megohms at 25° C.
1,000 megohms at 85° C.

★ **WORKING TEMPERATURES** . . .
— 55° C. to + 105° C.

★ **OPERATING FREQUENCIES** . . .
up to 40 megacycles.

★ **POWER FACTOR** . . . .
.004 to .006 at 1,000 cycles.

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY — A BIG PART IN INDUSTRY TOMORROW

THE COVER

It is the ubiquitous Handie-Talkie, developed originally by Motorola, and now used throughout all the war theaters, that appears so prominently in the Signal Corps Kodachrome photograph that adorns the cover this month. These little communication units measure 3 x 3 x 12 inches and weight a little over five pounds. Like the larger Walkie Talkie, carried on a soldier's back, it is frequency modulated and battery operated. Battery life varies from about 12½ hours when the set is used for both receiving and transmitting to about 60 hours when the receiver is alone is used.

$1000 Article Award

As was formally announced in the March issue of Electronic Industries, this publication and its publishers, Caldwell-Clements, Inc., have offered a series of three Special Awards for articles or papers of outstanding merit which appear as editorial contributions during the remainder of 1945.

This is the first time an award of this nature has been made by any publication catering to the needs of the radio-electronic field and the offer has been made as a means of stimulating the preparation of technical articles that will help in the development of electronic applications in communications and industry.

Three awards

The Awards are three in number: First, $600; second, $300; third, $100. There are no strings on the character of material that may be chosen by an author for discussion as long as the general text is suitable for publication in Electronic Industries in the judgment of its editors.

All papers and articles appearing in this publication between May 1 and December 31, 1945, automatically will be considered by a panel of competent judges, to be announced later, for participation in distribution of the awards. Copies of the original Award announcement are available and will be mailed upon request. In the meantime the editors will be glad to correspond with prospective authors. All correspondence should be addressed to Editor, Electronic Industries, 480 Lexington avenue, New York (17), N. Y. The awards are not available to any employe of the publishers of Electronic Industries. Otherwise, anyone is invited to contribute material for editorial consideration.
—Editor

DEPENDABLE

THIS POPULAR PLIOTRON FOR ELEVATOR CONTROL

TYPE PJ-8. $5.50.

Three-electrode, high-vacuum electronic amplifier tube, with directly-heated, filamentary cathode. Widely used for elevator control, where it amplifies the phototube or other floor-leveling signal. Filament voltage and current are 4.5 v and 1.1 amp. Maximum plate ratings are: voltage 350 v, current 40 ma; input 14 w, dissipation 10 w. Amplification factor 8.5.

Hear the G-E radio programs: "The World Today" news, Monday through Friday, 6:45 p. m., EWT, CBS. "The G-E All-Girl Orchestra," Sunday 10 p. m., EWT, NBC. "The G-E House Party," Monday through Friday, 4 p. m., EWT, CBS.

ELEVATOR owners and maintenance men know that no control tube for floor-leveling circuits excels the G-E PJ-8 pliotron in reliability—the kind of day-in, day-out performance you can count on to keep your equipment running steadily and well.

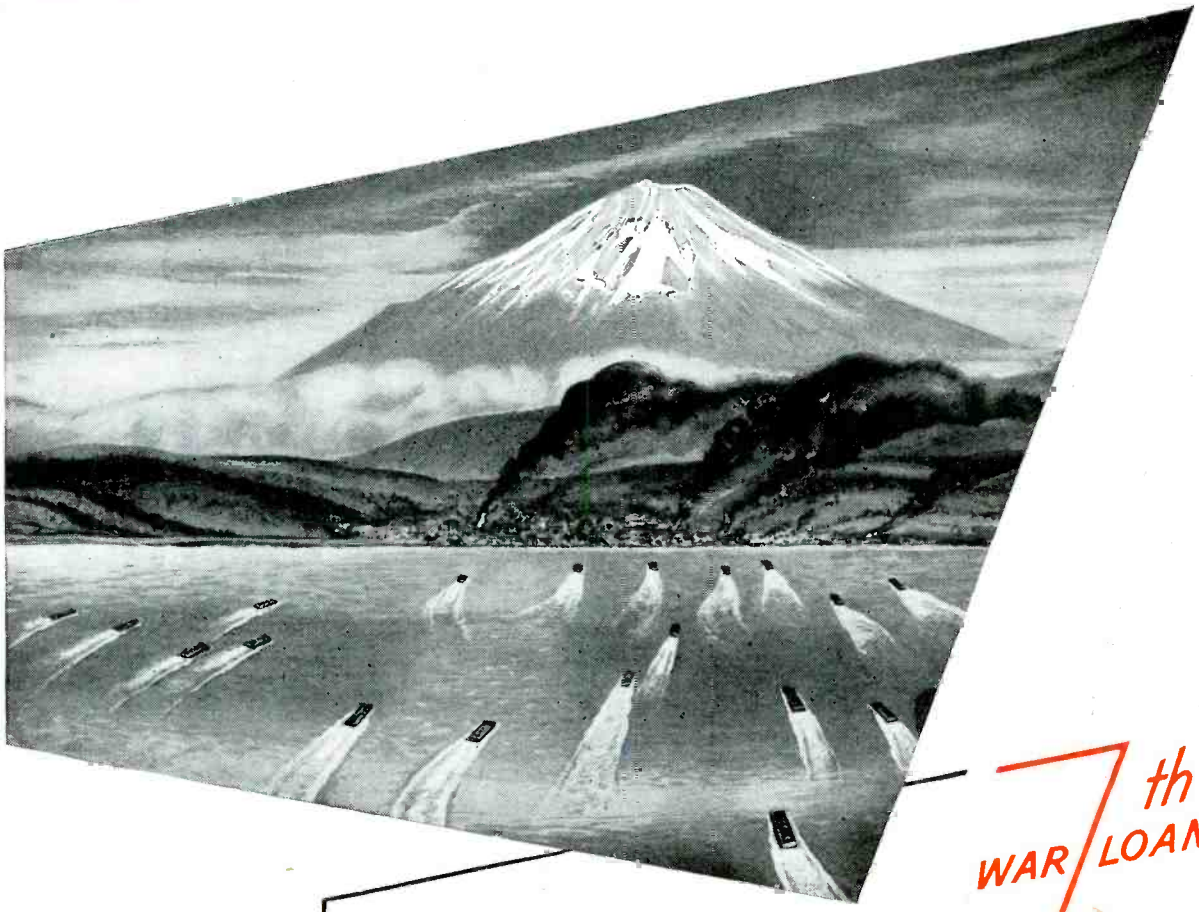
● The PJ-8 is compact—5⅛" high by 2 3/16" diameter — so mounts conveniently; of proved efficiency as thousands of installations testify; durably built throughout for long and hard service.

● ● A solidly braced cathode-grid-plate structure gives extra strength, while stability of operation is assured by the careful designing of internal insulation, with long leakage paths. For full information on this or other industrial tubes in G.E.'s *complete* line, see your nearest G-E office or distributor, or write to *Electronics Department, General Electric, Schenectady 5, N. Y.*

THERE ARE 265 MAIN SUPPLY OUTLETS FOR G-E ELECTRONIC TUBES, BACKED UP BY CENTRALLY LOCATED STOCKS IN 26 LARGE CITIES FROM COAST TO COAST

GENERAL ELECTRIC

162-DII-8850



7th WAR LOAN

We've just begun to fight

Our fighting men have accomplished miracles in the Pacific. Maybe that's led you to believe that Japan is a pushover. Think again. We still have to meet and crush the main body of the Japanese Army *inside the inner Empire.* To do this, we've got to move millions of fighting men—*freshly outfitted and equipped*—halfway around the globe! And *keep* them supplied over vast stretches of water. More of everything will be needed.

This is going to call for more money than your mind can grasp. Money that *has* to come from you. Not later, but *now*—during the 7th War Loan Drive. It'll take the larger part of a month's salary from most of us to meet the quota—*in addition* to the Bonds we're buying regularly. You *can* buy bigger extra bonds just as the Marines found a way to take Iwo Jima. *They* paid in coin they'll never get back. *You* get *yours* back with interest!

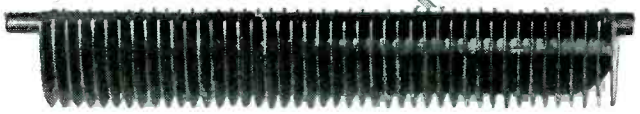
Aireon MANUFACTURING CORPORATION

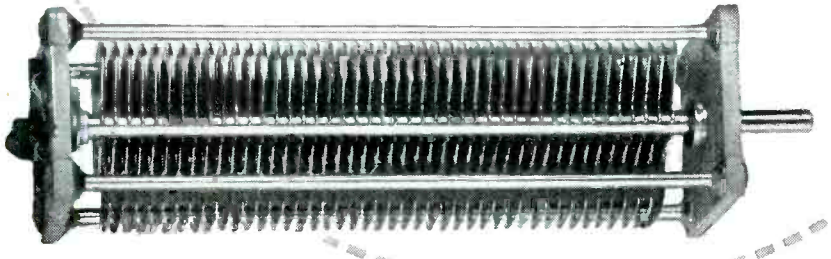
Formerly *AIRCRAFT ACCESSORIES CORPORATION*

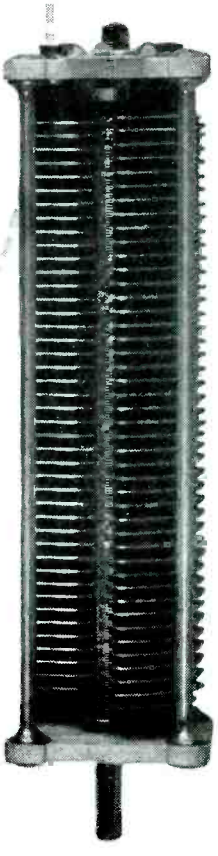
Radio and Electronics • Engineered Power Controls

NEW YORK • • CHICAGO • • KANSAS CITY • • BURBANK

Brass for variable condensers







. . . see REVERE

THE rods, shafts and plates of these variable condensers were made of brass furnished by Revere. We are especially proud of this because orders received for metal for this important purpose reflect our ability to hold gauges to the exceedingly close tolerances that are necessary in order to permit rapid manufacture of uniform units. Thus the critical distances between rotors and stators are maintained on a production basis. Brass is also highly desirable because of its low "creep" or drift with temperature changes, its strength and rigidity, and the ease with which it can be machined, stamped, soldered and plated if necessary.

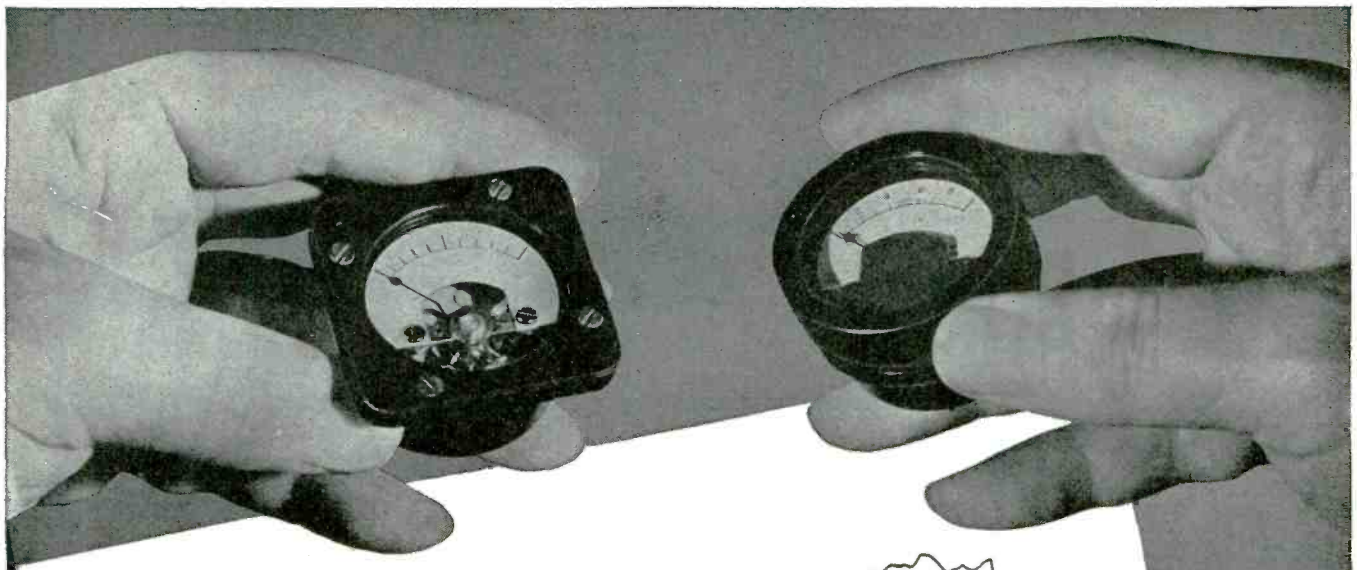
In addition to various types of brass and bronze, Revere also offers electrolytic copper, Free-Cutting Copper, O.F.H.C. copper, and other copper and copper alloys of special interest to the electronic industry. These may be had in the usual mill forms of bar and rod, sheet and strip, tube and pipe, and extruded shapes. When you do development work the question is sure to arise as to which material is best, and which form most economical to work. We have assisted a number of electronic manufacturers solve perplexing problems, and will be glad to work with you through the Revere Technical Advisory Service. Write the Revere Executive Offices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N.Y.



External Pivots

HELP THESE GREAT LITTLE METERS GIVE *A LOT* OF EXTRA PERFORMANCE!

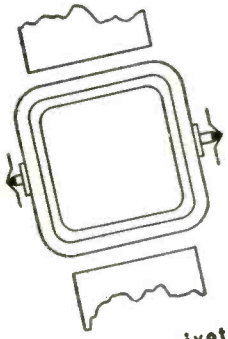
These two hermetically sealed 1½" DeJur Instruments — the Model 120 (right) and the Model 112 (left) — designed to aid in the development of small equipment for present and post-war applications, combine miniature size with the accuracy resulting from external pivot design.

External pivots used in both models, help provide better all-round performance because: external pivots provide maximum accuracy in mounting the moving element between the jewel bearings . . . prevent rocking of the pointer . . . reduce side friction between jewels and pivots . . . increase the life of bearing surfaces.

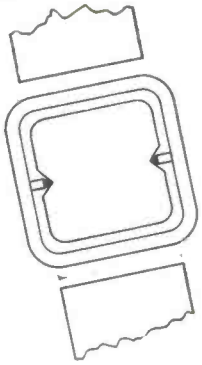
Alnico Magnets of the highest grade permit the use of high torque . . . afford instantaneous response under varying loads . . . insure stability . . . and provide protection against the damaging effect of surrounding magnetic fields.

Both Models are available either as D.C. or A.C. Instruments.

We are equipped to work with you on special models of all DeJur Products for present and postwar applications. Write for the latest DeJur catalog.



External pivots (above)—used in the design of DeJur 1½" Meters — provide greater accuracy in mounting the moving element between the jewel bearings. For this reason internal pivots (below) are not used in DeJur meters.



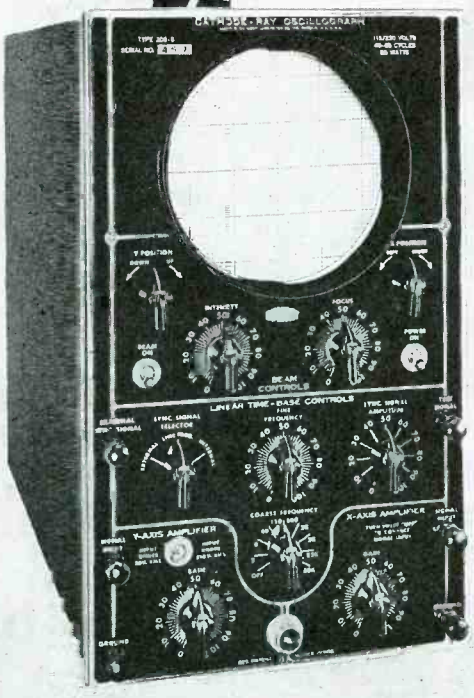
GIVE YOUR FULL SUPPORT TO THE SEVENTH WAR BOND DRIVE

ARMY NAVY

DeJUR-AMSCO CORPORATION

GENERAL OFFICE: NORTHERN BLVD. AT 45th STREET, LONG ISLAND CITY 1, N. Y.

Pioneering— continued



DuMONT Oscillography

A decade and a half ago Allen B. DuMont conceived the idea of commercializing the cathode-ray tube and exploiting to the full the many possibilities of this amazing device. Until then it had been a scientific curiosity limited to a few laboratories with lavish budgets.

In the few intervening years DuMont pioneering has evolved many types of cathode-ray tubes. Likewise oscillographs and allied equipment. And the DuMont application "know-how" has grown apace. Since 1941 the DuMont organization has engaged 100% in the war effort. Plans are now ready for the coming peace. Such is DuMont pioneering—past, present, *continued*.

TYPICAL DuMONT *Pioneering—*

- The first low-priced commercialized cathode-ray tubes for general use.
- Self-contained single-unit low-priced cathode-ray oscillographs.
- Oscillographs facilitating the investigation of transient as well as recurrent phenomena over a wide frequency range.
- Cathode-ray modulation monitor for checking and maintaining highest broadcast standards.
- Large-screen oscillographs such as DuMont 20" Type 233 for detailed analysis of fine-structure wave forms and for lecture demonstrations.
- Intensifier electrode in tubes for maximum sensitivity and increased brilliance.
- DuMont powder-testing oscillographs for evaluating explosives and meeting set standards.
- The exclusive DuMont Cyclograph for the non-destructive inspection of ferrous and non-ferrous materials and products compared with known standards, and providing a 100% quality-of-production control.
- The electronic switch which places the oscillograms of two signals on a single oscillograph screen for direct comparison or simultaneous study.
- The Resonoscope—the only visual method of determining the correct pitch of musical instruments or voice.
- Simplified television equipment from camera and control room to transmitting antenna, making telecasting service available even to the smaller population centers.
- DuMont Station WABD in New York which has an enviable record for scheduled programs and for the evolution of commercialized television.

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK

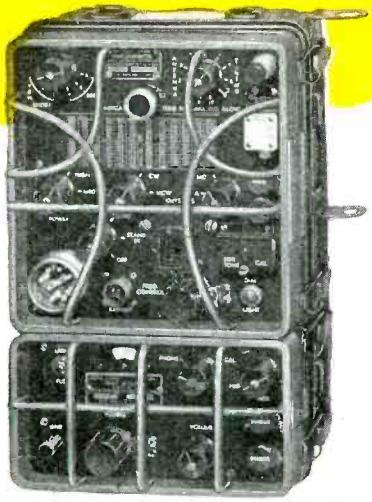
SCGSA
(SIGNAL CORPS GROUND SIGNAL AGENCY)

Fort Monmouth
Red Bank, New Jersey

*MYCOLOGISTS

*Mycologist: A botanical scientist specializing in the study of fungi

By the persevering research of Signal Corps Mycologists at Squier Laboratories, Fort Monmouth, the enemy's most powerful ally, fungus growth, was thoroughly whipped! When reports came in that myriad species of fungi were literally and quickly destroying our communications equipment, Squier Laboratories attacked the problem by duplicating jungle conditions at Red Bank, New Jersey. At the same time RAULAND became the first manufacturer to build its own jungle laboratory to study at first hand the destructive effects of fungus growth on electronic equipment. These efforts soon led not only to the correct "anti-fungus treatment" for communications equipment but to a complete tropicalization program which helped pave the way for the decisive victories which followed.



SCR-694 TRANSMITTER-RECEIVER

SCR-694 IS ANTI-FUNGUS TREATED . . . . .

Veteran of many U. S. invasions, the Rauland SCR-694 Transmitter-Receiver has battle-proved itself under all operating conditions. Compact, lightweight (22 lbs.), waterproof, fungus proof, this highly versatile and efficient two-way radio serves in vehicles, as a portable ground station or front line command post. Ideally adapted to either jungle or sub-zero operation.

EXCERPTS FROM FIELD REPORTS:

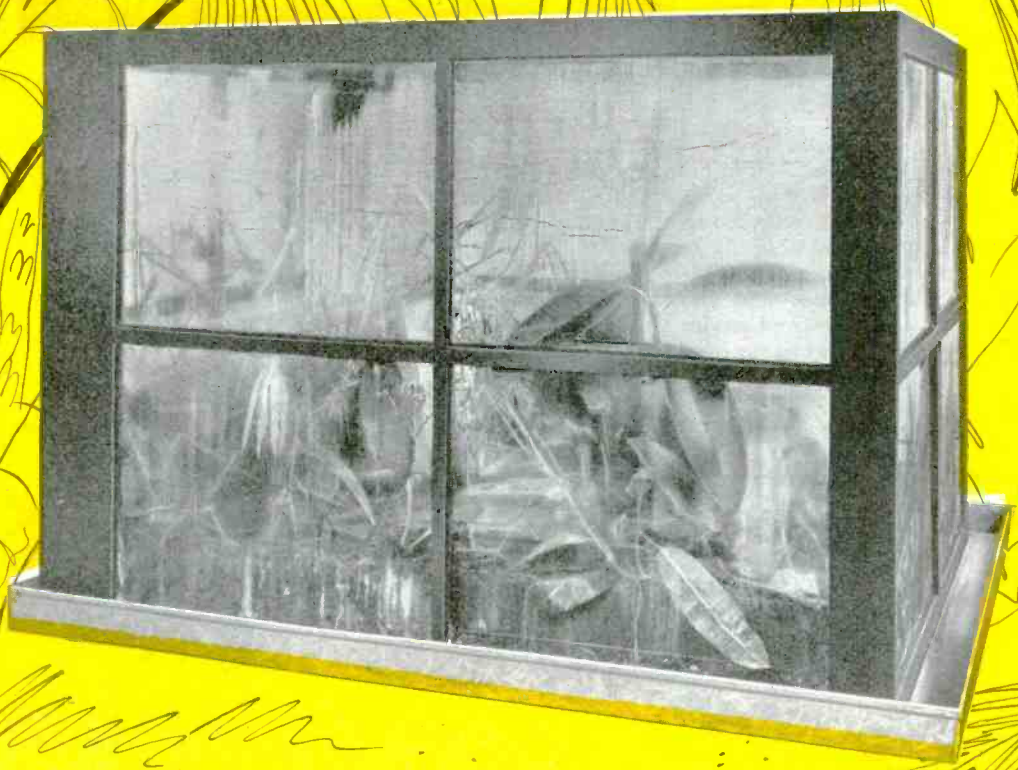
FROM THE PACIFIC: *"during a rainstorm the SCR-694's were the only sets in one section that remained operative."*

FROM ITALY: *"An SCR-694 set was mounted in a ¼-ton, 4 x 4, for demonstration purposes during instructional tours. In the two months of travel over typically rough Italian terrain visiting various units to be instructed, at no time was this set found to be inoperative."*

FROM AIR-BORNE SOURCE: *"one set (SCR-694) landed in a stream of water and although completely submerged (time undetermined) worked normally."*

RADIO • • RADAR • • COMMUNICATIONS

in the Signal Corps



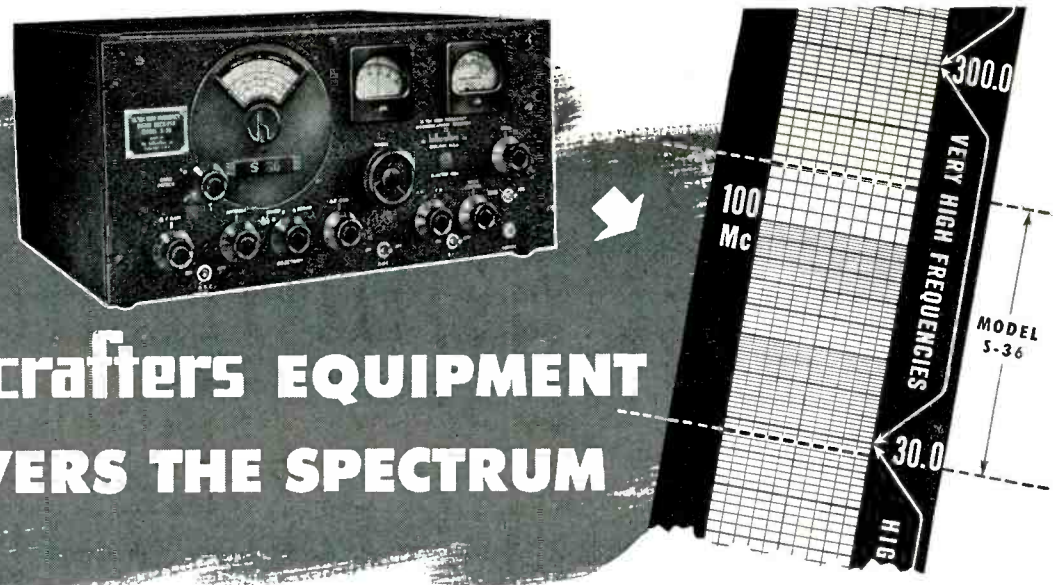
— brought the JUNGLE to CHICAGO

To study the vital problem of fungus destruction at close hand, RAULAND engineers created a miniature jungle in our own laboratories! Early in 1942 they built a large, glass-enclosed air-tight cabinet (pictured above) . . . filled it with the dripping wetness of saturated, super-heated jungle air, tropical plants and lush vegetation, deep rooted in mossy loam. Into this "torture chamber" went RAULAND Communications equipment . . . to finally emerge with the correct anti-fungus answers. A typical example of RAULAND engineering thoroughness in making certain that its precision electronic instruments serve dependably under even the most adverse conditions.

Electroneering is our business

SOUND **Rauland** **TELEVISION**

THE RAULAND CORPORATION • CHICAGO 41, ILLINOIS



HOW hallicrafters EQUIPMENT COVERS THE SPECTRUM

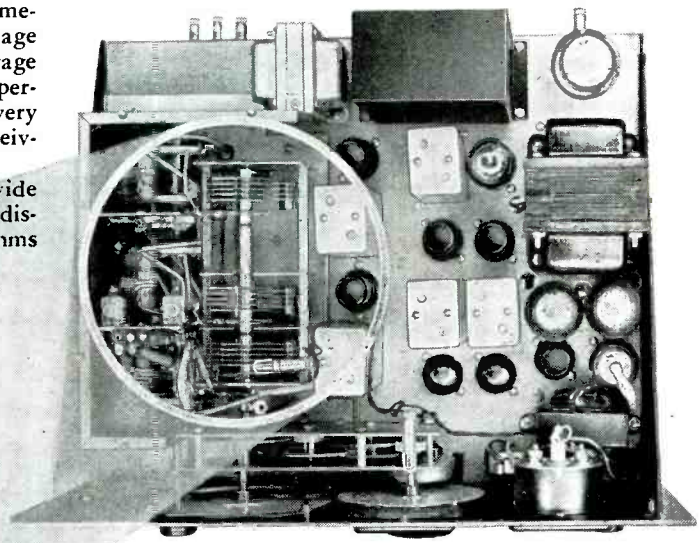
THE Model S-36 is probably the most versatile VHF receiver ever designed. Covering a frequency range of 27.8 to 143 megacycles it performs equally well on AM, FM, or as a communications receiver for CW telegraphy. Equipment of this type was introduced by Hallicrafters more than five years ago and clearly anticipated the present trend toward improved service on the higher frequencies.

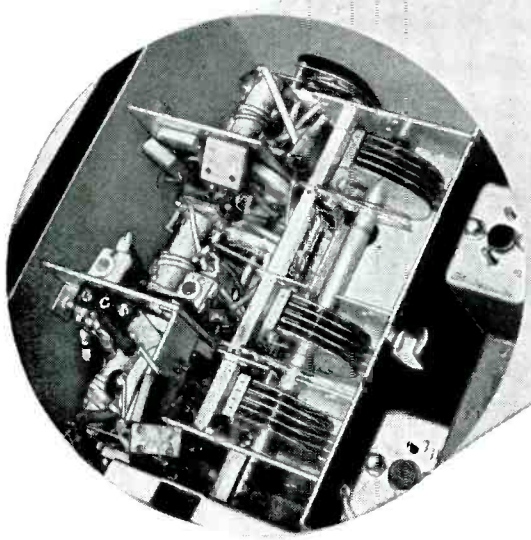
Fifteen tubes are employed in the S-36 including voltage regulator and rectifier. The RF section uses three acorn tubes. The type 956 RF amplifier in conjunction with an intermediate frequency of 5.25 megacycles assures adequate image rejection over the entire range of the receiver. The average over-all sensitivity is better than 5 microvolts and the performance of the S-36 on the very high frequencies is in every way comparable to that of the best communications receivers on the normal short wave and broadcast bands.

The audio response curve is essentially flat within wide limits and an output of over 3 watts with less than 5% distortion is available. Output terminals for 500 and 5000 ohms are provided.

Model S-36

FM-AM-CW
27.8 to 143 Mc.
Covers old and new FM Bands



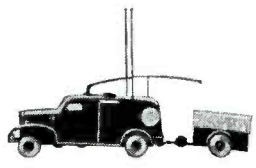


The RF section is built as a unit on a separate chassis which may easily be removed for servicing and incorporates a three position ceramic band switch. The positive action mechanical bandspread dial turns through more than 2200 divisions for each of the three ranges, 27.8 to 47, 46 to 82, and 82 to 143 megacycles.

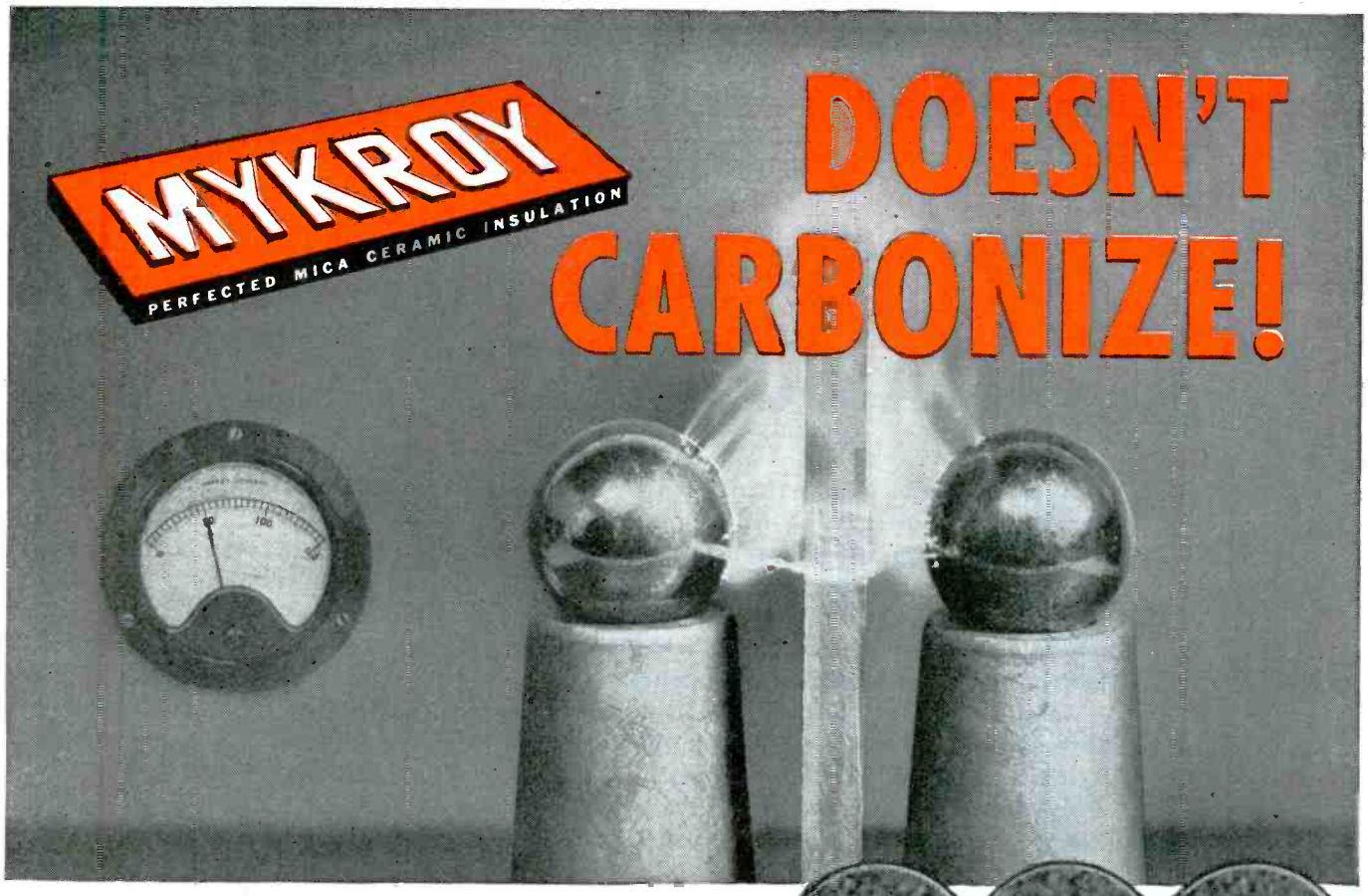
For details on the entire Hallicrafters line of precision built receivers and transmitters write for Catalog 36-D.

BUY A WAR BOND TODAY!

hallicrafters RADIO



THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT • CHICAGO 16, U. S. A.



This high frequency insulation will not carbonize under arc, yet it possesses dielectric properties of the highest order. Made entirely of inorganic materials, Mykroy cannot char or turn to carbon even when exposed to continuous arcs and flashovers.

The sheet of Mykroy in the photo was exposed to a 50,000 volt arc after which it was sectioned and carefully examined for signs of damage. None were found . . . not even the slightest excoriations were present, hence no low resistance paths formed to support breakdown.

Engineers everywhere are turning more and more to Mykroy because the *electrical characteristics of this perfected glass-bonded ceramic are of the highest order*—and do not shift under any conditions short of actual destruction of the material itself. Furthermore Mykroy *will not warp—holds its form permanently—molds to critical dimensions* and is *impervious to gas, oil and water*. For more efficient insulation investigate Mykroy. Write for copies of the latest Mykroy Bulletins.

Cross sections of the test sheet made at the point of exposure to the 50,000 volt arc (magnified 10 times) show no trace of damage.

MECHANICAL PROPERTIES*

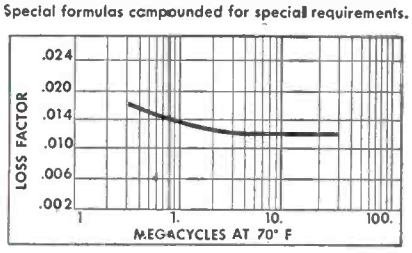
MODULUS OF RUPTURE	18000-21000psi
HARDNESS	Mohs Scale 3-4 BHN. BHN 500 Kg Load. 63-74
IMPACT STRENGTH	ASTM Charpy .34-.41 ft. lbs.
COMPRESSION STRENGTH	42000 psi
SPECIFIC GRAVITY	2.75-3.8
THERMAL EXPANSION	.000006 per Degree Fahr.
APPEARANCE	Brownish Grey to Light Tan

ELECTRICAL PROPERTIES*

DIELECTRIC CONSTANT	6.5-7
DIELECTRIC STRENGTH (⅛")	630 Volts per Mil
POWER FACTOR	.001-.002 (Meets AWS L-4)

***THESE VALUES COVER THE VARIOUS GRADES OF MYKROY**

GRADE 8 Best for low loss requirements.
GRADE 38. Best for low loss combined with high mechanical strength.
GRADE 51. Best for molding applications.
Special formulas compounded for special requirements.



Based on Power Factor Measurements made by Boonton Radio Corp. on standard Mykroy stock.

MADE EXCLUSIVELY BY

ELECTRONIC MECHANICS INC.

70 CLIFTON BLVD., CLIFTON, N. J.
CHICAGO 47; 1917 N. Springfield Ave., Tel. Albany 4310
EXPORT OFFICE: 89 Broad Street, New York 4, New York

MYKROY IS SUPPLIED IN SHEETS AND RODS ← MACHINED OR MOLDED TO SPECIFICATIONS

ENGINEERING DEPARTMENT
HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNA.

DATA BOOK
SEC 29 P 10

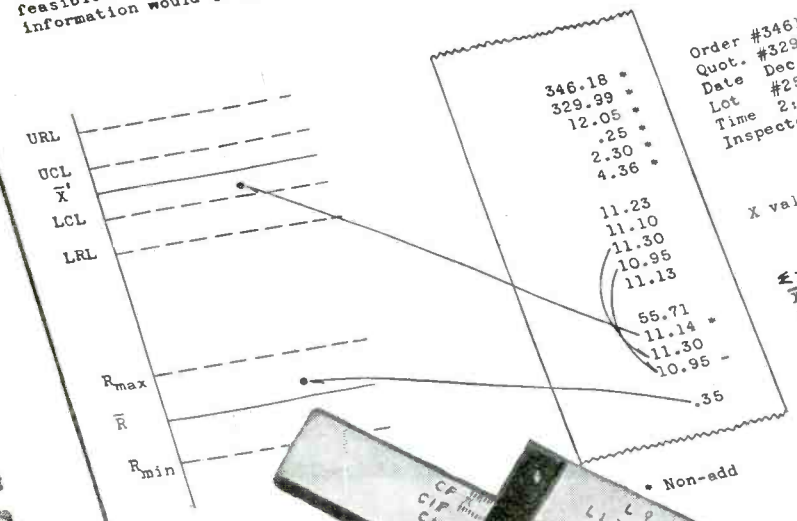
SUBJECT CONTROL CHART
SUBSTITUTION OF ADDING MACHINE TAPE FOR CONTROL CHART DATA SHEET

As indicated on pages 100, 103 and 105 Forms #218 (n=10) and Form #227 (n=5) are available for recording X readings of sample lots.

This practice has been superceded at some inspection centers by direct recording of measurements on small manually operated adding machines. To begin a record the full job and lot data are listed on the adding machine tape using the non-add key. The individual pieces are then measured and immediately listed on the tape. When 5 (or 10) values have been taken the column is added (by the machine).

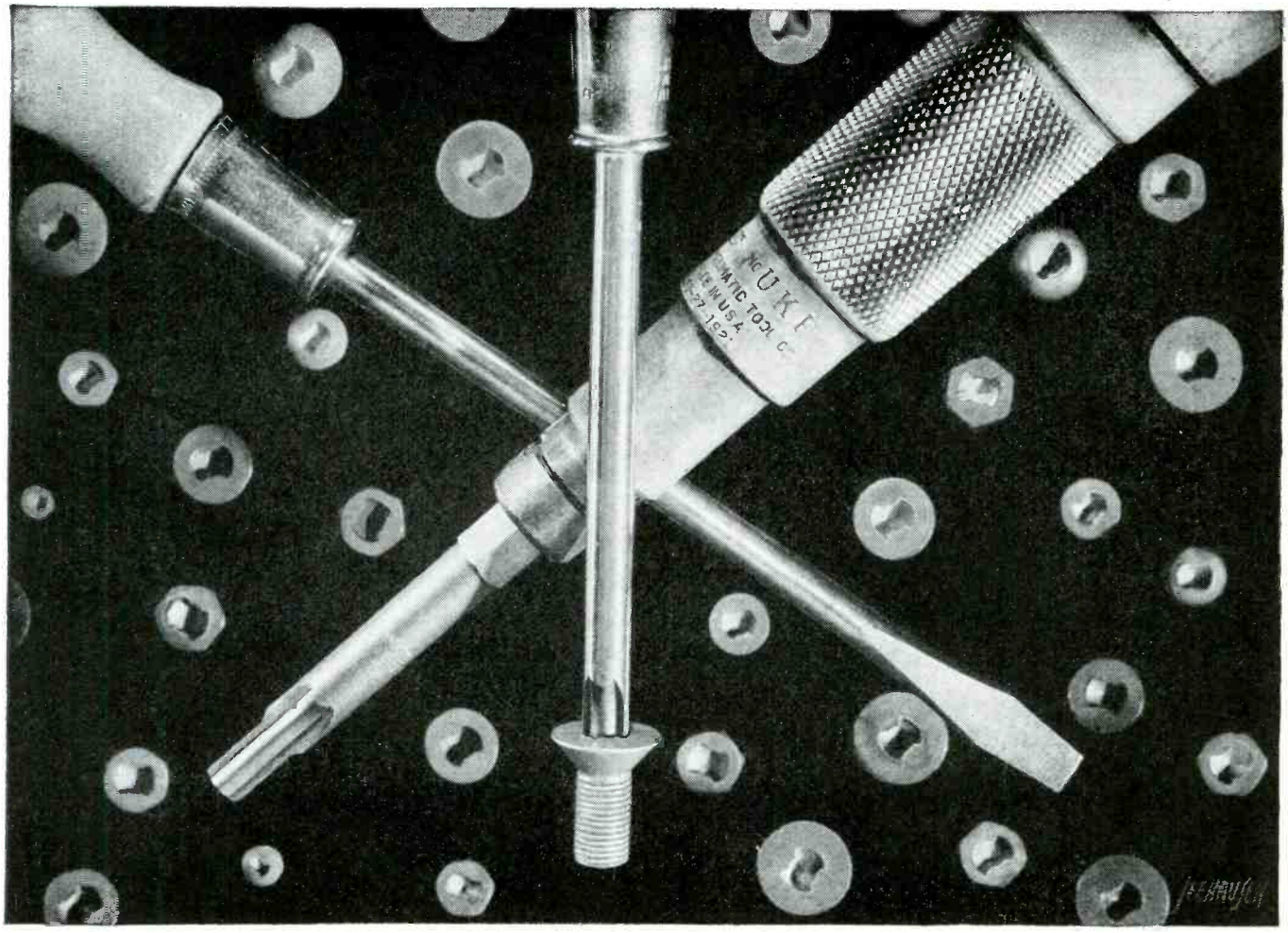
This tape is then torn off and clipped to the job board containing the control chart record sheet. Values of $\bar{X}$ and R are, of course, immediately plotted on the control chart.

This practice saves considerable time and its use is recommended wherever feasible. The appearance of the adding machine tape containing complete information would be as shown below.



Reissued: 8/4/44
ISSUED 9/20/43

PREPARED BY C.R.Arms



Clutch Head Screws Alone give you this broad range of operating facility . . . for shortcuts to faster, smoother, and safer driving on the line; plus the cancellation of field service handicaps that must be accepted with all other screws.

CLUTCH HEAD's straight-walled recess, matched by the straight-sided Type "A" Bit, accelerates assembly. This "square" engagement, as opposed to tapered driving, disposes of ride-out and the need for end pressure . . . thus eliminating at once a fatigue factor and the hazard of slippage. Then, the wide roomy Clutch is an easy-to-hit target and Center Pivot entry, for automatically straight driving, quickly inspires the "greenest" operator with speed born of confidence.

Equally important is CLUTCH HEAD's simplification of field service.

It is *the only modern screw* operative with an ordinary type screwdriver of reasonable accuracy in width, thickness of the blade being a secondary consideration. Add to this the advantage of the Type "A" hand driver for the easy withdrawal of screws, undamaged and held securely by the CLUTCH HEAD Lock-On for re-use. It will be found, too, that the Lock-On frequently saves the dis-assembling of surrounding units by reaching into hard-to-get-at spots.

There are other time and money saving CLUTCH HEAD *features, including simplified 60-second bit reconditioning. We invite your personal judgment on*

CLUTCH HEAD · SCREWS

these and will mail you, on request, package assortment of CLUTCH HEAD *Screws, sample Type "A" Bit, and the illustrated Brochure.*

UNITED SCREW AND BOLT CORPORATION

CHICAGO 8 CLEVELAND 2 NEW YORK 7

A WAR TIME SERVICE RECORD

SERVICE RECORD

Guadalcanal
Salerno
The Marshalls
Singapore
Normandy
Aachen
Tulagi

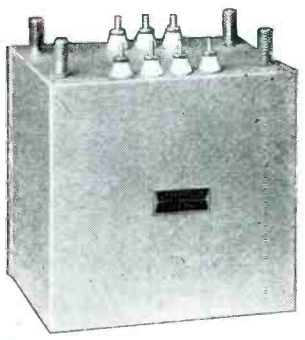
OF JEFFERSON

Sydney
Fedala
Murmansk
Attu
Kiska
Ain Toya
Makin

TRANSFORMERS

Florida Island
Cassino
Luxemburg
Corregidor
Manila
Bataan
Iwo Island

That Means Peacetime Superiority



All over the world—on the Western Front, in the humid tropics or polar wastes to the arid desert regions—the value of Jefferson Transformer quality is demonstrated daily in a variety of vital services to our armed forces. Despite the tremendous need occasioned by this round-the-world war activity, the principle of Jefferson's quality-with-quantity is consistently maintained.

Magnified demand from the military as well as essential war industries during the past few years, has resulted in far-reaching transformer developments and methods of production. New needs, and many new applications have built up a great fund of technical knowledge that Jefferson Electric will use in serving the increased industrial demand of the great new peace era.

This vast reservoir of added experience assures you that Jefferson Electric Transformers will continue, in the future as in the past, to offer the same superior service that means dependable, reliable performance at all times. . . . JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. In Canada: Canadian Jefferson Electric Co. Ltd., 384 Pape Avenue, Toronto, Ont.

JEFFERSON ELECTRIC

TRANSFORMERS

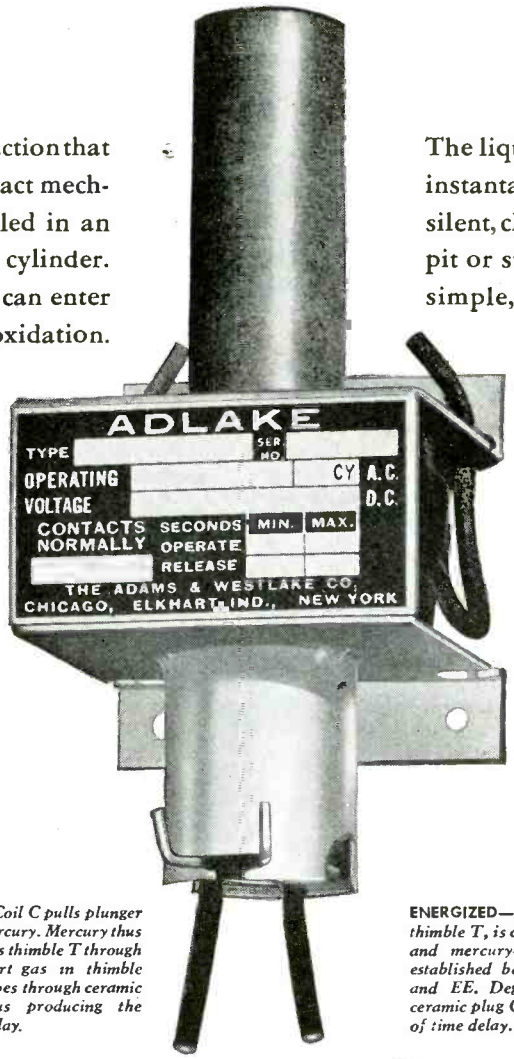
RELAYS THAT "Click" ON THE JOB!

SIMPLE, DEPENDABLE, POSITIVE ACTION

You can depend on silent Adlake plunger-type Relays to "make good" on every kind of equipment into which you design these modern, hermetically sealed mercury relays for timing, load and control circuits. May we co-operate with your designers by suggesting the type of Adlake Relays best adapted to your product?

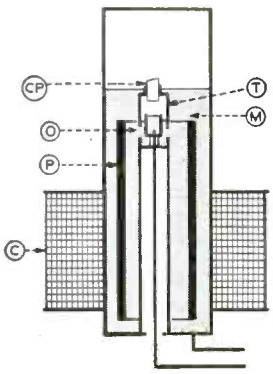
Adlake Relays have snap action that stays "snappy." The contact mechanism is hermetically sealed in an armored glass or metal cylinder. No dirt, dust, or moisture can enter . . . there is no danger of oxidation.

The liquid metal mercury contact is instantaneous, positive in action, silent, chatter-free, and cannot burn, pit or stick. No other relays are as simple, rugged and dependable. Write for bulletin.

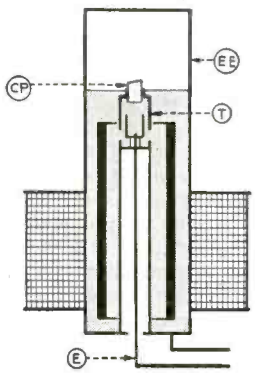


Adlake Model 1040 . . . for panel mounting . . . available with either quick or time delay action, normally open or closed.

Quick acting relays are available with contact ratings up to 50 amperes A.C. with proportional D.C. ratings.



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



ENERGIZED—*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 length of time delay.*

Adlake TRADE MARK

ARMY E NAVY

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

PLASTIC PARTS... Post-Formed

A New Production Technique

Recently developed methods of post-forming fully cured Formica laminated plastic sheets have adapted the material for very much wider use in a great many applications that were formerly thought impractical.

In this process the sheets are heated, and formed quickly with inexpensive wooden or Pregwood dies into many curved shapes.

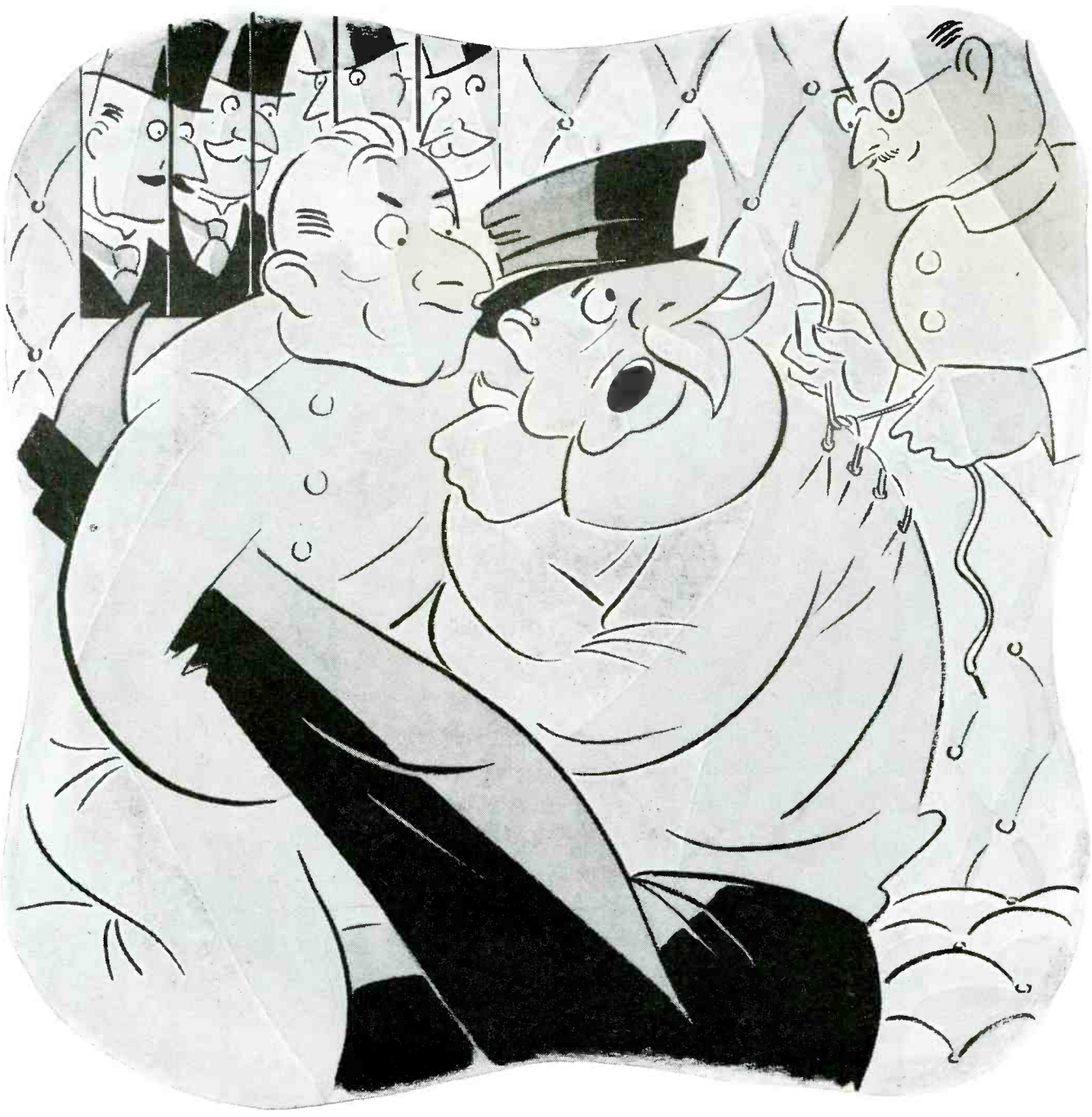
Previously to secure such shapes it was thought necessary to mold the material in curing with the use of very elaborate and expensive steel molds—which were impractical for any but a few large volume applications.

This shaping method provides a very light (specific gravity 1.35) material, that is strong, stable in dimensions, inert chemically and therefore possessing a finish that is free from corrosion and long of life.

Formica engineers will be glad to tell you the story.

FORMICA

THE FORMICA INSULATION COMPANY, 4647 SPRING GROVE AVENUE, CINCINNATI 32, OHIO



"I TELL YOU I'M NOT CRAZY. ALBION CAN SHIP US ALL THE COILS WE NEED."

SUPER-QUALITY COILS AT REASONABLE PRICES

More and more every day, the industry is turning to Albion for fast, quality and quantity production of coils, chokes, and transformers. That's because here you benefit from the unbeatable combination of management "know how," skilled workmanship, streamlined facilities, and central location. Your requirements will be given prompt and thoughtful attention.

ALBION

COIL COMPANY

ALBION, ILLINOIS

R. F. AND TRANSMITTING COILS AND CHOKES;
I. F. TRANSFORMERS

THIS WESTINGHOUSE

Thyratron

makes possible the design of an electronic speed control unit for motors rated 50-hp or more

This lightning fast electronic switch makes possible stepless speed control of heavy duty motors. With the WL-414, it is now possible to extend the range of electronic speed control to 50 hp motors at 500 volts by using six tubes in a suitable rectifier circuit.

This Westinghouse Thyratron is compact, streamlined and designed with the grid lead coming out the bottom, affording maximum protection for the metal to glass seal.

Designers of heavy duty lathes, milling machines, grinders and similar machine tools for high-torque, variable-load service, will find that this all-metal Thyratron will open new fields of electronic tube application.

Westinghouse engineers will be glad to advise you on applications of the thyratron. Write Westinghouse Electric Corporation, Lamp Division, Bloomfield, N. J.

THYRATRON WL-414

Grid Controlled Mercury Vapor Rectifier

General Characteristics	
Heater voltage	5 volts
Heater current	20 amp
Maximum Ratings	
Anode voltage, peak forward	2000 volts
Anode voltage, peak inverse	2000 volts
Anode current, average	12.5 amp
Anode current, peak	100.0 amp

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

Electronic Tubes at Work

"Instant Courier"

In one minute . . . Finch Facsimile will transmit any written, illustrated message, half the size of a letterhead, *as far as radio will reach.* Transmission by wire, depending upon the frequency characteristic of the line used, is somewhat slower. This is both the most rapid and the most accurate means of long-distance high-speed communication. It provides for 1500 words a minute without one error! It makes practical the first law of efficiency: *Never give or take an oral order — PUT IT IN WRITING!*

FINCH TELECOMMUNICATIONS, INC., PASSAIC, N. J.

N. Y. Office — 10 East 40th Street

Finch Facsimile also makes possible an illustrated, printed newspaper by radio, in homes. Over 80 U. S. Patents have been issued to Finch. At present, facilities are entirely devoted to Victory production.

SELF SYNCHRONIZING

finch facsimile

BUT WE DO KNOW ALUMINUM

When it comes to designing electronic equipment, we'll sit back and listen to the men who know how. But when it comes to using aluminum in this equipment, we can be of real help.

1. We can tell you about alloys that are nonmagnetic, have high electrical conductivity with light weight, high strength, resistance to corrosion.
2. We can help you decide how best to make parts from extrusions, die castings, formed sheets, sand and permanent mold castings or forgings.
3. We can show you how aluminum can be brazed, coated, electroplated and finished, to meet functional or assembly requirements.

So, even if electronics is still over our head, remember, there's a lot of aluminum experience under the baldpate which may be helpful to *you. Ask us about it.*

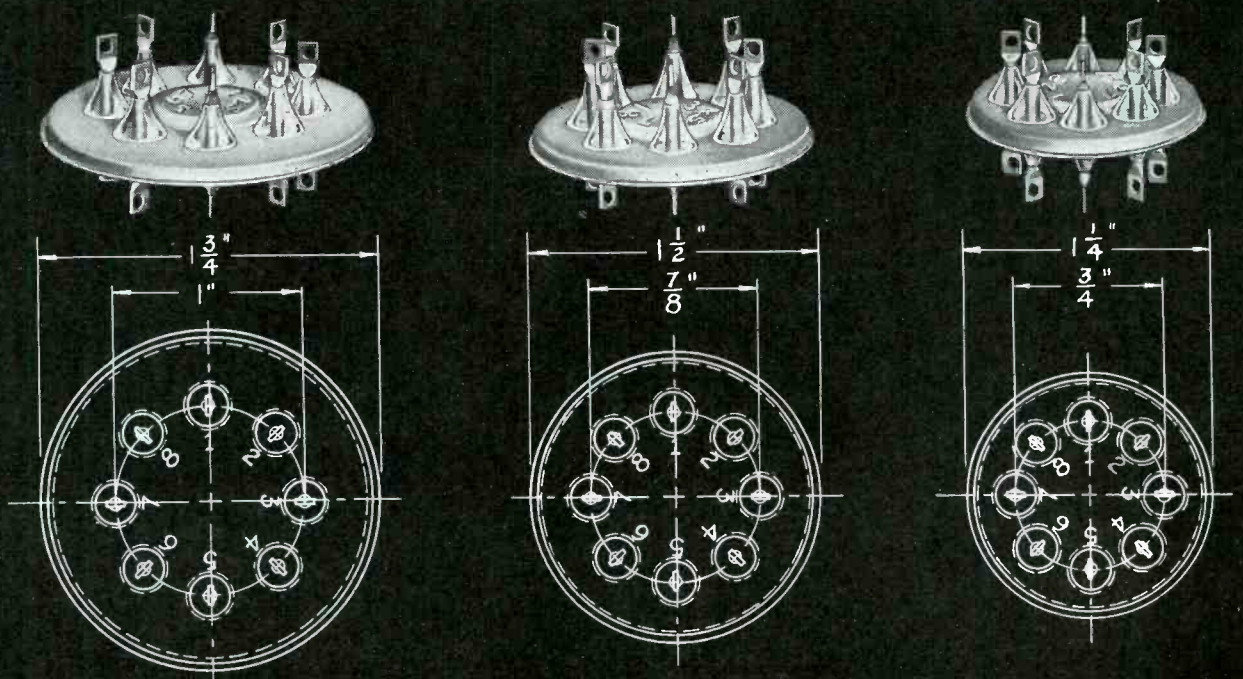
ALUMINUM COMPANY OF AMERICA, 2136 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

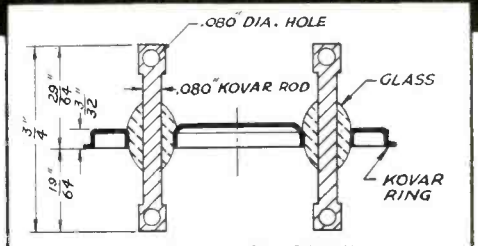
Reg. U.S. Pat. Off.

Multi-Terminal Hermetic Seals
BY
STUPAKOFF



PART 9093-3A PART 9093-2A PART 9093-1A

ALSO AVAILABLE IN STYLE B WITH 4 INSTEAD OF 8 TERMINALS AS SHOWN.
4 OR 8 TERMINALS STANDARD—OTHERS ON SPECIAL ORDER



CONSTRUCTION DETAIL
VERTICAL DIMENSIONS SHOWN COMMON TO ALL PARTS

THE Stupakoff Multi-Terminal Hermetic Seals illustrated were developed primarily for transformer application. They offer exceptional advantages to manufacturers concerned with the sealing of electrical components.

Each seal is individually tested to withstand a minimum pressure of 30 pounds—electrical breakdown of 3400 volts—insulation resistance of 500 megohms—thermal shock from 94° C to 4° C. Relatively low in initial cost, the one piece construction eliminates individual soldering of terminals, resulting in lower handling and assembly costs, fewer rejects in the finished product.

Stupakoff hermetic seals are made with the alloy, Kovar,* which matches the expansivity of certain hard glasses from −80° to +450° C (approximate annealing point of the glass). Through a heating process, the oxide of Kovar is dissolved into the glass to form a perfect bond—effective under the most extreme climatic conditions.

For users equipped for glass working, Stupakoff supplies Kovar as sheet, rod, wire, tubing, or fabricated into cups, eyelets, and special shapes. Completed seals in many styles are furnished with single or multiple, solid or hollow electrodes. Write Department K-56 for literature, samples, and deliveries on positive hermetic seals for your product.

ONE PIECE HEADER

Stupakoff pioneered in the construction of Multi-Terminal Hermetic Seals. The illustration at left is taken from Technical Data Sheet KV 7 published by Stupakoff in May 1937.

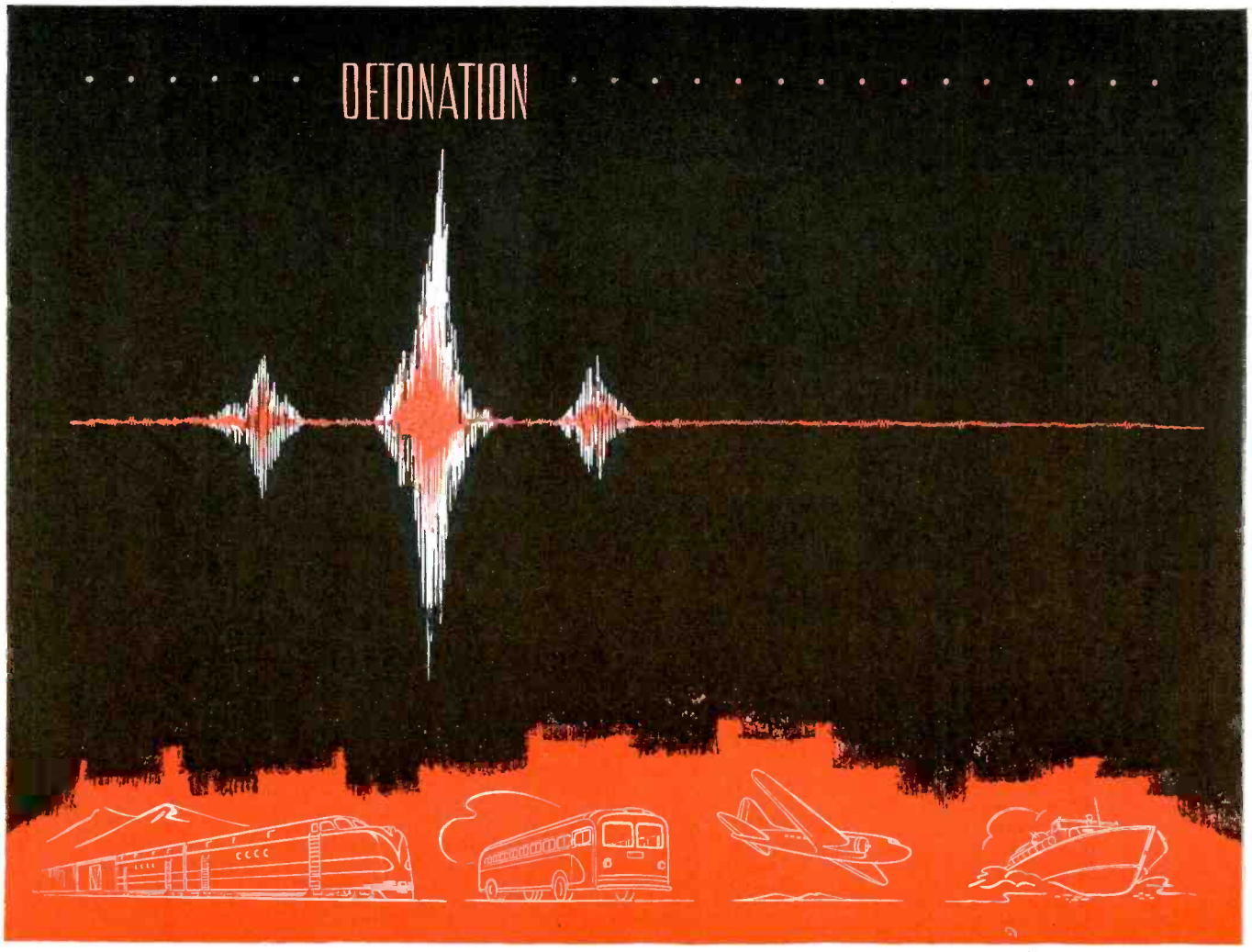
*TRADE MARK 337962 REGISTERED IN U. S. PATENT OFFICE

ARMY NAVY "FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Products for the World of Electronics

RMA RADIO MANUFACTURERS ASSOCIATION MEMBER



How electronics helps tell a knock from a boost...

THE MIT-Sperry Detonation Indicator is an engine instrument that discriminates between normal and abnormal combustion.

Through an electronic pickup, it *instantly detects detonation*—popularly called knocking or pinging—in most types of internal combustion engines. And it gives *immediate evaluation of detonation.*

As a result, warning is given at the time trouble *starts* . . . engine life is lengthened . . . mixture may be adjusted so that considerable fuel is saved . . . and the period between engine overhauls is extended.

No piercing of engine cylinders is required. Yet even the slightest detonation is signalled visually, and the faulty cylinder or cylinders spotted.

Use of the MIT-Sperry Detonation Indicator on airplanes results in remarkable fuel savings, longer engine life, greater safety.

The same is true of surface transportation which employs internal combustion engines.

Engine manufacturers find this instrument an invaluable aid in designing and testing. It also permits development of fuels exactly fitted to engine characteristics, thus increasing power output and lowering fuel costs. Also with the Knockometer, a special application of the Detonation Indicator, fuels with superior anti-knock characteristics can be developed and their quality production controlled.

Since 1937, Sperry engineers have been working on the perfection of a detonation indicator. This is but one of the many fields in which Sperry has pioneered in the field of electronic development.

Additional information on the MIT-Sperry Detonation Indicator is available on request.

SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

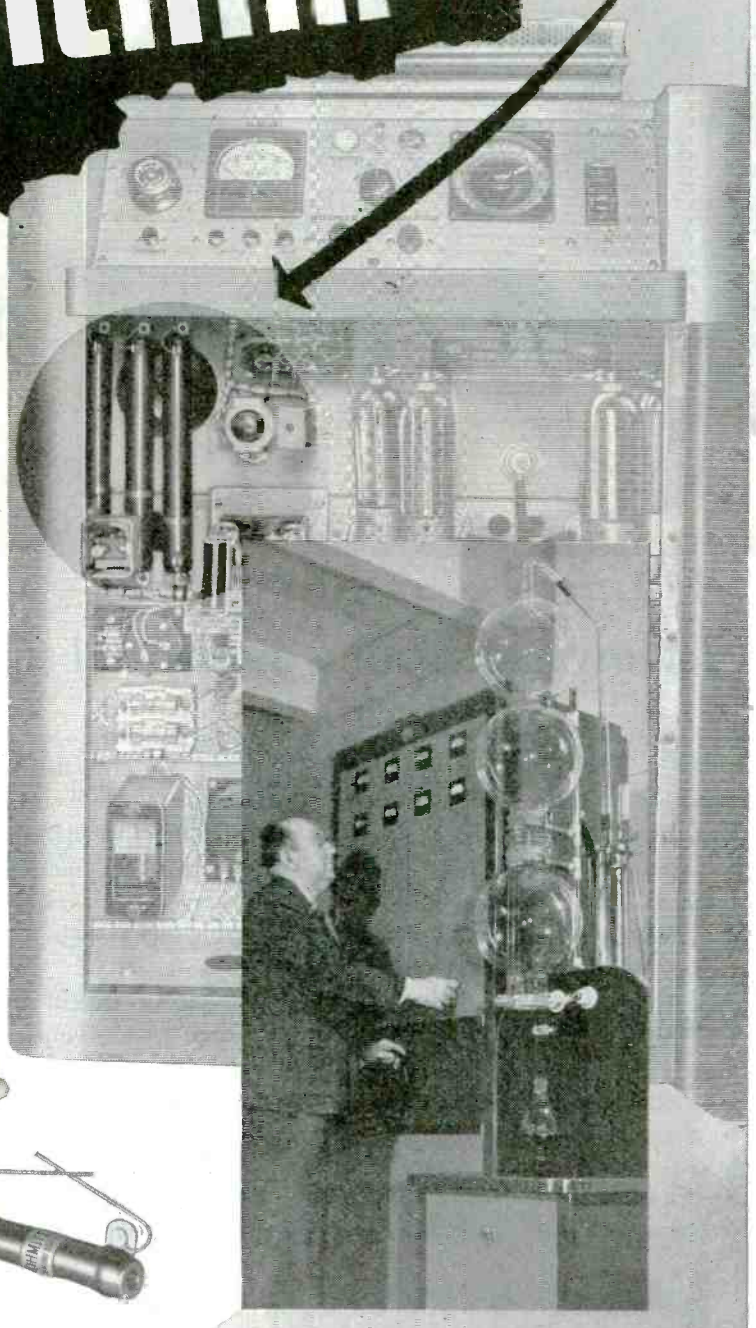
★

Division of the Sperry Corporation

LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS
CLEVELAND • BROOKLYN • HONOLULU

GYROSCOPICS • ELECTRONICS • RADAR • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

OHMITE
Rheostats and Resistors
IN PRODUCTION OF
Penicillin



USED IN

ELECTRONIC POWER GENERATOR

that dries Penicillin 48 times faster

● A new RCA electronic system, using high frequency current for the bulk reduction of purified Penicillin, accomplishes in 30 minutes what formerly took 24 hours.

In the RCA Electronic Power Generator are six Ohmite resistors and two Ohmite rheostats. Circled in the photo above are a 200 watt regulator plate resistor, two 200 watt cathode bias resistors for the two power tubes, and a 50 watt rheostat used as a cathode balancer. Not visible in the photo are two 10 watt Brown Devil resistors used for voltage dropping in the pilot light circuits, one 10 watt Brown Devil in a time delay relay circuit, and a 50 watt rheostat used as the output power control.

The use of Ohmite products in such vital electronic equipment is further proof of their complete reliability.

OHMITE MANUFACTURING COMPANY
4094 FLOURNOY STREET, CHICAGO 44, U. S. A.

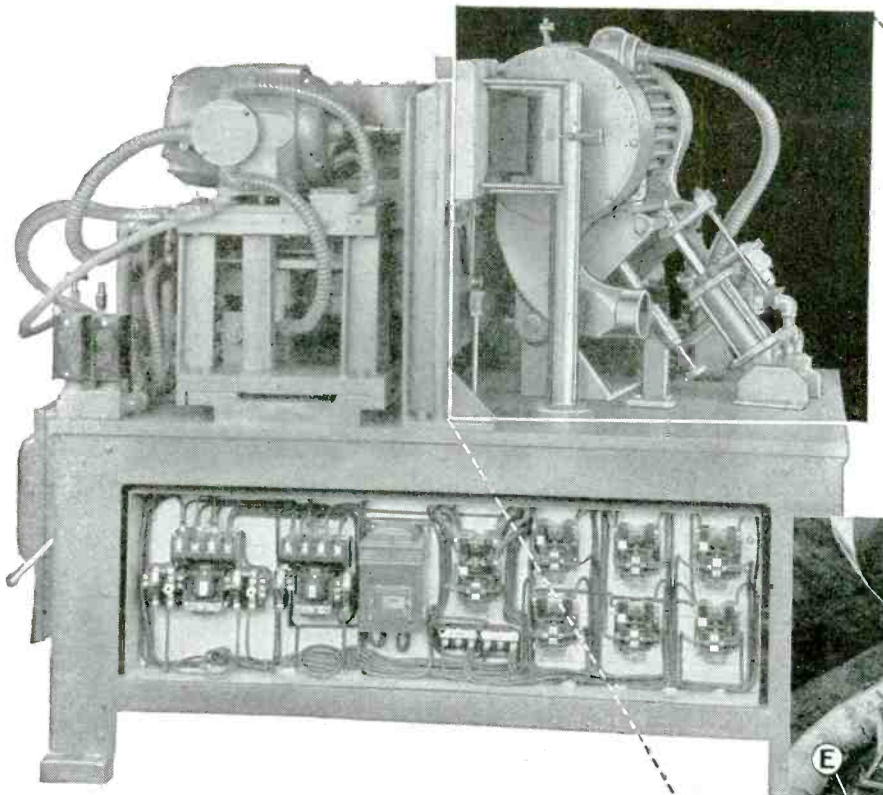
Write on company letterhead for Industrial Catalog and Engineering Manual No. 40. Address Ohmite Mfg. Co., 4984 Flournoy St., Chicago 44

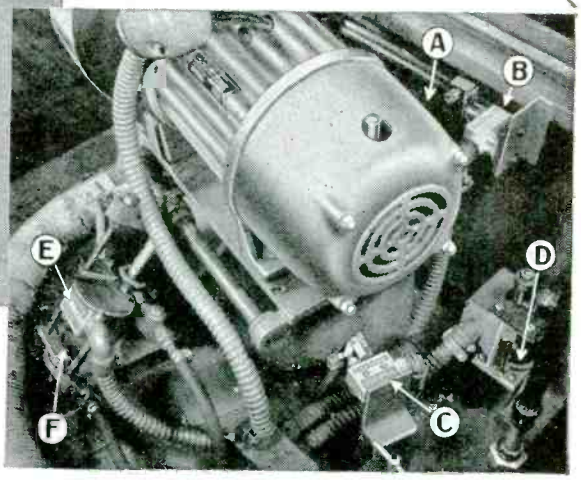
Be Right with **OHMITE**

RHEOSTATS • RESISTORS • TAP SWITCHES

Hand Holes to Pass the Ammunition . . .

Cut Automatically with aid of MICRO SWITCH *SNAP-ACTION*





Hand hole grooves and slots in the ends of ammunition cases are accurately made in short order by this automatic machine manufactured by the C. O. Porter Machinery Company of Grand Rapids, Michigan.

Five Micro Switch snap-action switches, three of which are shown in the photograph, provide the automatic sequence for the operation. The first switch starts the sequence when the stock is pushed into cutting position and the outer switches complete the cycle. A switch with a roller actuator, not shown, holds the position of the carriage until the boring operation is completed.

The switches employed are of the die cast enclosed type, two of them with sealed plungers to protect the operating mechanism from dust and wood shavings.

These Micro Switch products were chosen as electrical controls for this impulse-sequence cycle because of their long life and rugged dependability, plus the fact that the compact housings made them easy to fit into the design. Micro Switch snap-action switches, with housings and actuators supplied to make them fully usable under every condition, meet the demands of design engineers who are looking for a precise, accurate, tiny switch that will handle substantial amounts of power at line voltage. Whether for use in delicate instruments and gages, or in heavy machinery, Micro Switch products can be easily adapted as an integral part of a device.

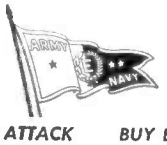
Whether your designs are for war or peace production, you will want to know all about Micro Switch. Send for Handbook-Catalog No. 60 today. If you are designing for aircraft, you will want to have a Handbook-Catalog No. 71, too. Write Micro Switch today.

Here is How it Works

Pushing the box end into the machine simultaneously saws the slot and moves rod "A" which contacts switch "B". This progressively operates a large contactor, solenoid air valve and cylinder to move the saw and drill carriage to drilling position.

At the end of this carriage stroke, the drill and hand hole cutter units move in unison to make their cuts. As the hand hole unit moves, switch "C" closes and through a contactor energizes stock clamp solenoid "D".

When the hand hole cutter bottoms in the cut, switch "E" is contacted by arm "F", reversing the movement of the cutter unit. As the cutter returns to the start position, switch "C" opens to de-energize the solenoid stock clamp.



LET'S ALL BACK THE ATTACK *BUY EXTRA WAR BONDS*

MICRO MS MARK TRADE SWITCH

A DIVISION OF FIRST INDUSTRIAL CORPORATION

Freeport, Illinois, U. S. A., Sales Offices in Principal Cities

The basic switch is a thumb-size, feather-light, plastic enclosed, precision, snap-action switch. Underwriters' listed and rated at 1200 V.A., at 125 to 460 volts a-c. Capacity on d-c depends on load characteristics. Accurate reproducibility of performance is maintained over millions of operations. Basic switches of different characteristics are combined with various actuators and metal housings to meet a wide range of requirements.

G.H.Q. *for Shielding Problems*

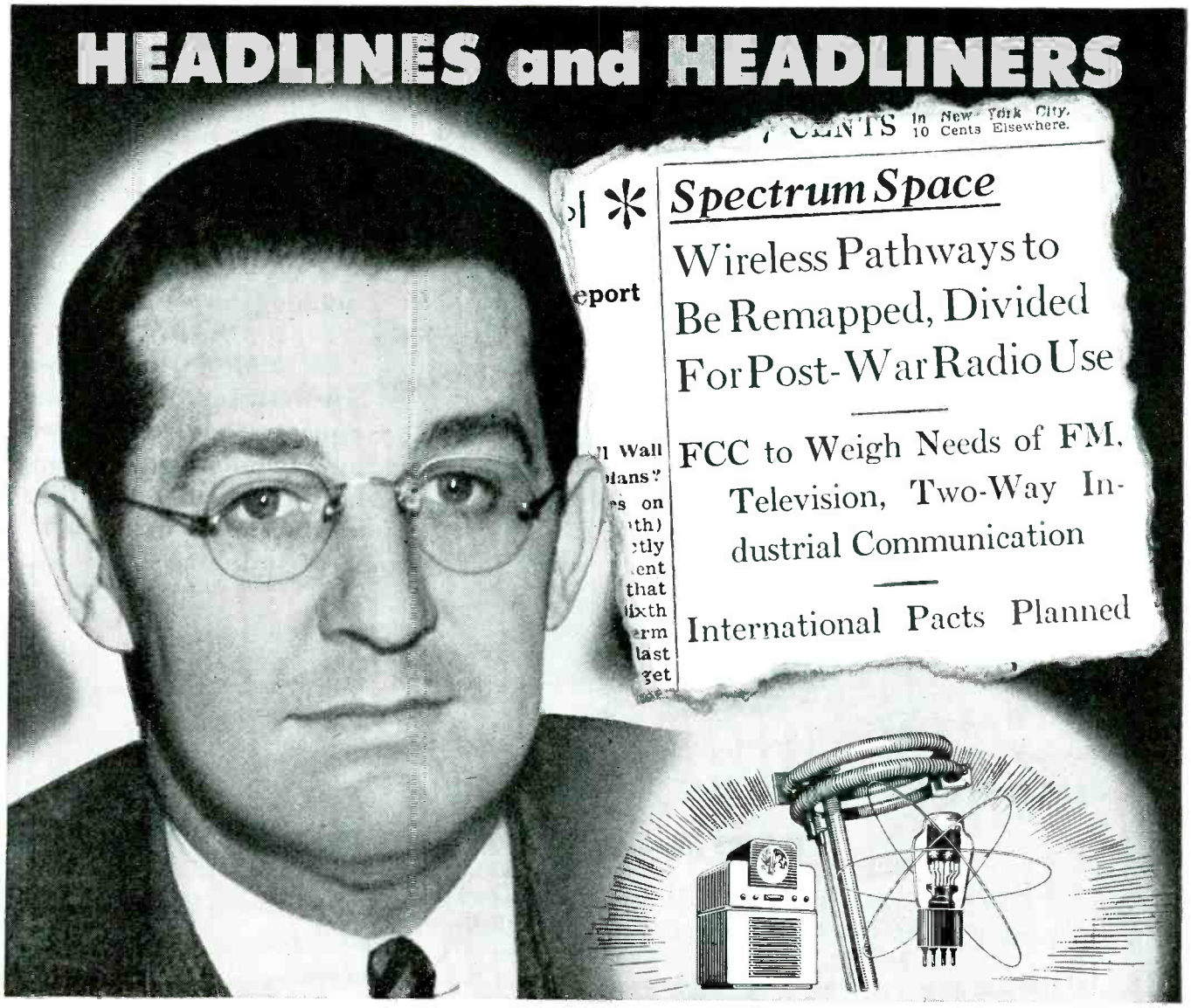
In order to eliminate the radio interference caused by high-frequency impulses radiated from almost every type of electrical apparatus, Breeze pioneered the engineering and manufacture of shielding for aircraft, automotive, marine and industrial engines. Each application presented specialized problems which Breeze, with its wide background of experience in the field, has been well equipped to overcome. Today Breeze Shielding has stood the tests of 18 years of service, and is constantly being improved to meet new needs.

In the electronic age of tomorrow, the thorough shielding of electrical equipment of all types will be of even greater importance. To manufacturers or users of such equipment, Breeze engineering and production facilities make it America's Headquarters for Radio Ignition Shielding. For a complete analysis and recommendation, call in a Breeze shielding engineer.

BREEZE MARK

Breeze CORPORATIONS, INC. Newark, New Jersey

HEADLINES and HEADLINERS



R. A. BOYCE, *Member of the Board of Directors and General Purchasing Agent,* Philco Corporation

"THE war has indeed created a great number of constantly changing problems for purchasing agents throughout the nation. In our wartime job of developing and producing radar equipment for the Army and Navy at Philco, it has been necessary to purchase countless items ranging all the way from stratosphere chambers to minute parts for delicate coil assemblies.

"In keeping abreast of the changes that are daily taking place in all phases of industry, I find the Wall Street Journal invaluable as a comprehensive source of exclusive business news. It presents the data we need, and interprets current developments in the way that is of greatest value to the purchasing agent."

R. A. Boyce

*Like most important business news, this story appeared first in The Wall Street Journal. That's why this national daily is "must" reading for business men who need to be fully, accurately and quickly informed. And that's what provides such an unusually responsive audience for advertisers.

The **ONLY** *National Business Daily*
Published simultaneously on both coasts

YES, you can obtain both molded plastic parts and small motor drives or assemblies from General Industries. Under one roof and one general management we have long supplied them to leading manufacturers in a wide range of industries.

INQUIRE ABOUT BOTH FROM GENERAL INDUSTRIES

Few things "stump" our molded plastics division. Whether it's a big job or a little one, we have the facilities and the "know-how" to turn it out in any quantity. Our engineers and mold makers have a habit of reading *between* your blueprint lines, to dig out some way to do the job better, more economically or faster. Our operators are skilled from many years of experience in compression, transfer or injection molding, to deliver work 100% to specifications and on time.

You'll find that same thorough competence in our small motors division. For many years our *Smooth Power* drives have been standard for leading makers of phonograph and radio equipment, automotive devices and other low-torque requirements. Many buyers obtain exactly what they need in our standard line, but if made-to-order units are called for, our engineers and plant can deliver them.

So, for molded plastic parts or low-torque motors or drives, ask General Industries. Our military commitments have priorities at present, but a general discussion now can pave the way for later details. We'll appreciate it if you'll address the division involved . . . *molded plastics* or *motors*.

THE GENERAL INDUSTRIES COMPANY
ELYRIA, OHIO

ARMY E NAVY

Advantage index-

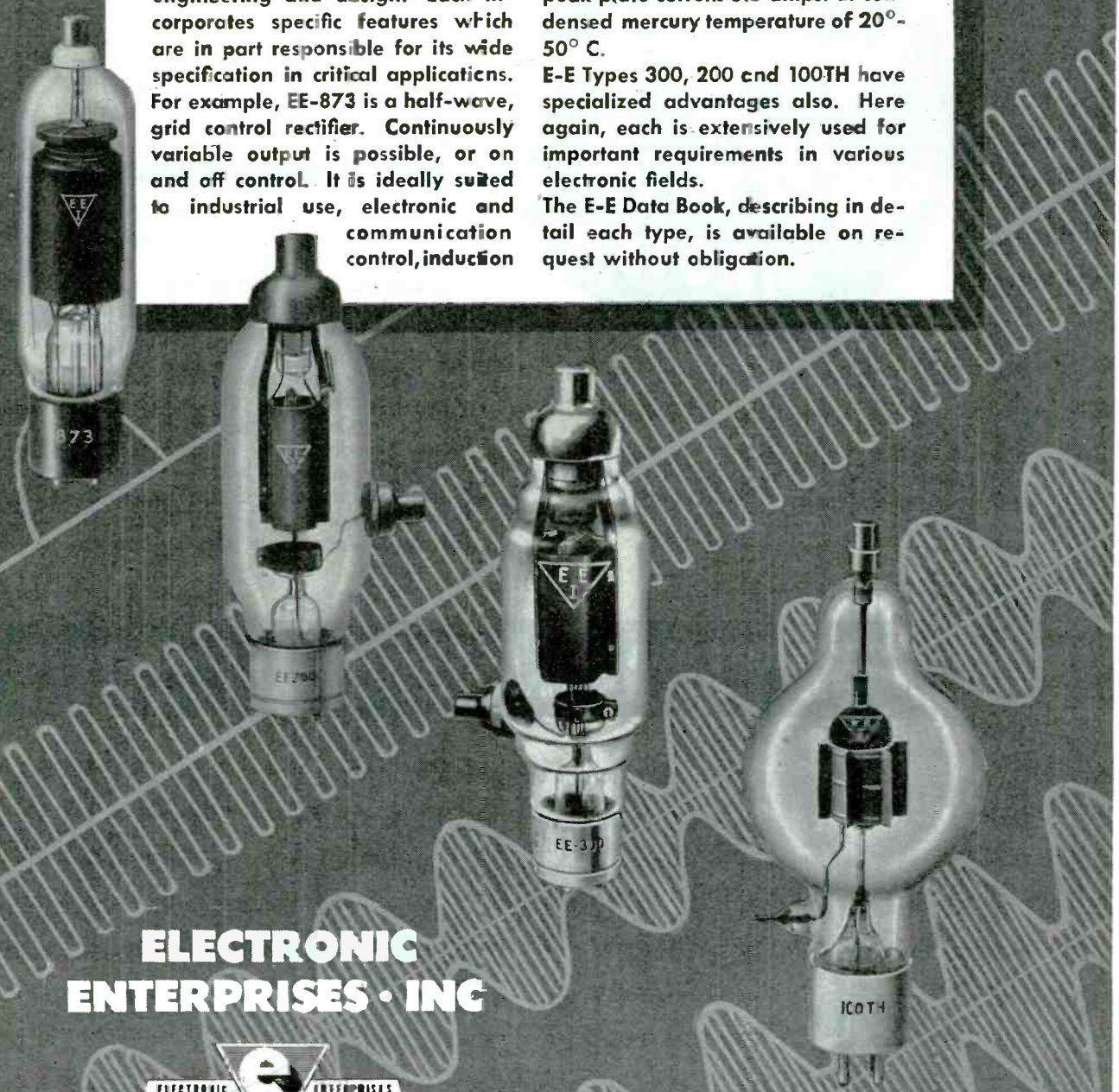
E-E

...for improved tube-equipment operation

Evidenced in these four E-E electronic vacuum tubes, is advanced engineering and design. Each incorporates specific features which are in part responsible for its wide specification in critical applications. For example, EE-873 is a half-wave, grid control rectifier. Continuously variable output is possible, or on and off control. It is ideally suited to industrial use, electronic and communication control, induction heating, keying transmitters, etc. Plate voltage rating is 10,000 max. peak plate current 5.0 amps. at condensed mercury temperature of 20°-50° C.

E-E Types 300, 200 and 100TH have specialized advantages also. Here again, each is extensively used for important requirements in various electronic fields.

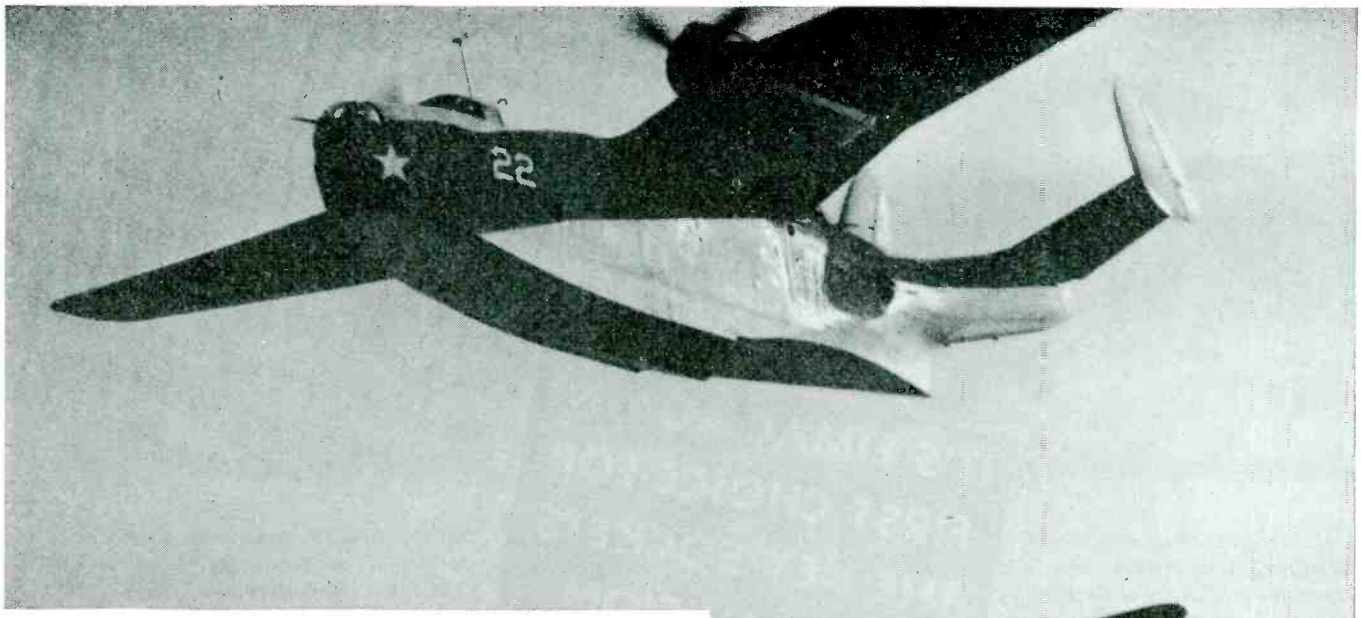
The E-E Data Book, describing in detail each type, is available on request without obligation.

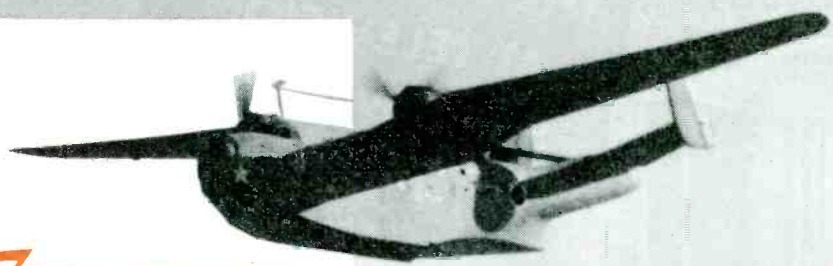


ELECTRONIC ENTERPRISES • INC

ELECTRONIC e ENTERPRISES

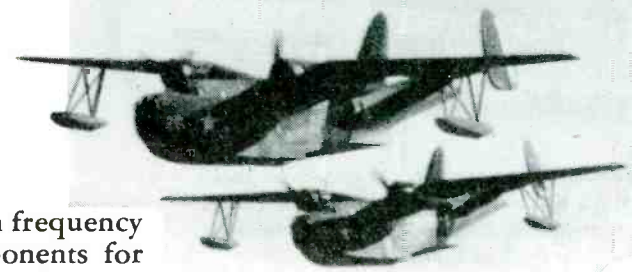
GENERAL OFFICES: 65-67 SEVENTH AVENUE, NEWARK 4, N. J.





MEC-RAD

ELECTRONIC COMPONENTS ARE VITAL EQUIPMENT ON NAVY PATROL BOMBERS



As a producer of intricate and precise high frequency mechanical and electro-mechanical components for electronic devices, Mec-Rad is today devoted 100% to war production.

Our work includes "fancy brass plumbing" of all types involving soft and hard soldering, close tolerances, precision machining, careful assembly and finishes ranging from lacquered to silver and rhodium plating.

Our organization, with years of experience designing and manufacturing similar products, will make its unusual facilities available to the electronic industry for peacetime needs. Our engineering "know-how" is at your service now to help you with your post-war planning.

Official U. S. Navy Photograph shows a formation of Martin Mariners — able to patrol vast areas and to hit hard when they sight the enemy.

MEC-RAD

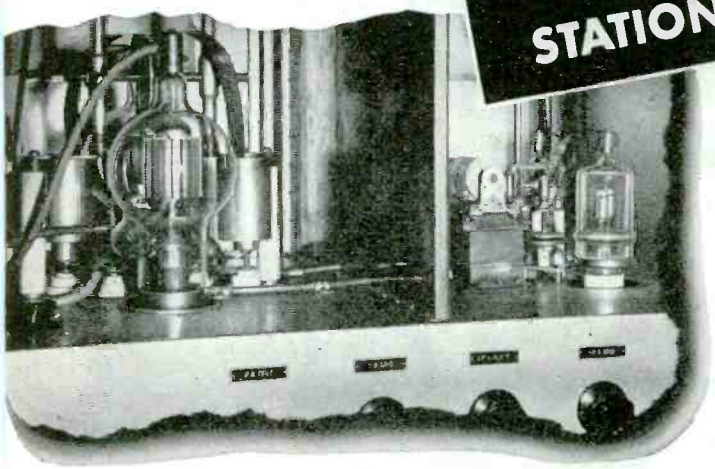
DIVISION-BLACK INDUSTRIES

1400 EAST 222ND STREET ☆ CLEVELAND 17, OHIO

A. H. Brolly . . . Chief Engineer of Television Station WBKB, Chicago, adjusts the grid circuit of the Eimac 304-TL's in the Class B linear stage of the video transmitter.

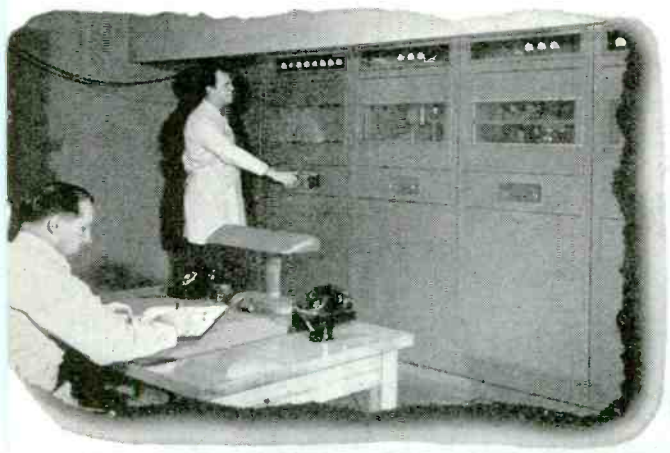
Mr. Brolly calls attention to the Eimac 1000-T's in the final stage of the Audio FM Transmitter which operates at 65.75 megacycles. It is a very stable amplifier of good efficiency.

IT'S EIMAC AGAIN! FIRST CHOICE FOR THE KEY SOCKETS AT TELEVISION STATION WBKB



The video transmitter operates at 61.25 megacycles; peak power output is 4 KW which provides a television service throughout metropolitan Chicago and reaches suburbs out to 35 miles or more.

Eimac 152-T's are used in the modulated stage and 304-T's in the first Class B linear amplifier of the video transmitter.



E. F. Cawthon and W. R. Brock are operating the station which has been broadcasting television programs with the present equipment since 1942 and began operation on a commercial schedule in October, 1943.

Grid modulation is employed at WBKB and a broad band of frequencies must be passed in all stages following the modulated amplifier. Multiple-tuned resistance loaded coupling circuits are used between stages.

Performance, stability, dependability are good reasons why Eimac tubes are to be found in the key sockets of the outstanding new developments in Electronics. Balaban & Katz, owners of television station WBKB of Chicago, offer potent confirmation of the fact that Eimac tubes are first choice of leading Electronic Engineers the world over.

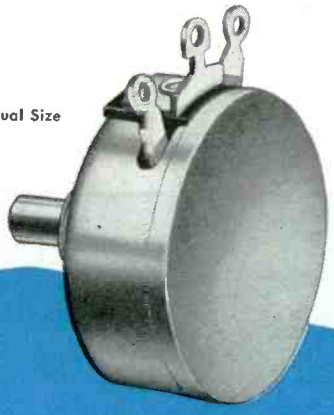
FOLLOW THE LEADERS TO

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

ELECTRONIC TELESIS—*fully illustrated. Send for a copy now. The Science of Electronics written in simple language. You'll find it of valuable assistance in explaining electronics to the layman. No obligation.*

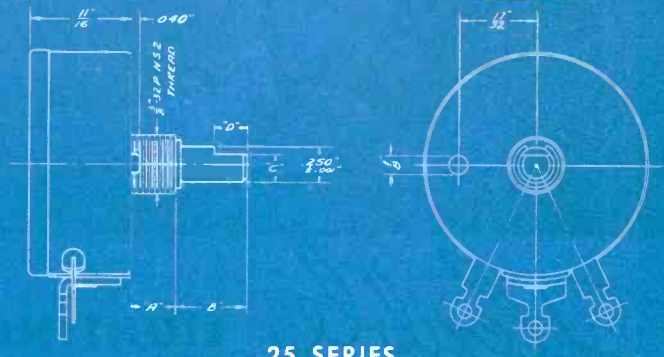
EITEL-McCULLOUGH, INC., 1032 San Mateo Ave., San Bruno, Calif.
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: Frazar & Hansen
301 Clay Street, San Francisco 11, California, U.S.A.

Actual Size

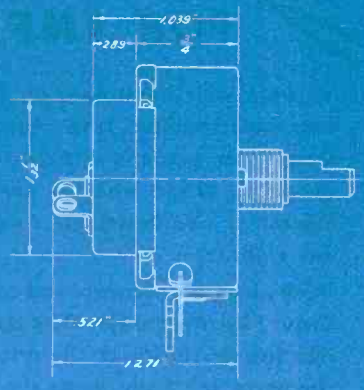


A Distinctive and Valuable Service....

SPACE REQUIREMENTS FOR 25 SERIES AND AC-25 SERIES



25 SERIES



AC-25 SERIES

CTS does considerably more than make variable resistors whose superlative quality is recognized all over the world. CTS makes *absolutely sure* that every resistor which they deliver is precisely the one to do its particular job.

Customers' specifications are thoroughly analyzed. A slight change has saved many a customer considerable money or time or both.

But whether or not alterations in specifications are necessary, it is CTS policy not to start production on orders for new applications until samples have been delivered, tested and found satisfactory. Thus costly delays are avoided because *CTS resistors always have the right characteristics to do the job.*

CTS delivery promises are as reliable as CTS service. Consult Chicago Telephone Supply Company for help in solving *your* variable resistor problems.

VARIABLE RESISTORS • PLUGS AND JACKS
SWITCHES • RINGERS • TELEPHONE GENERATORS

REPRESENTATIVES

R. W. Farris Co.
406 West Thirty-fourth Street
Kansas City 2, Missouri
Phone: Logan 7495

Frank A. Emmet Co.
2837 West Pico Boulevard
Los Angeles 6, California
Phone: Rochester 9111

BRANCH OFFICES

S. J. Hutchinson, Jr.
401 North Broad Street
Philadelphia 8, Pennsylvania
Phone: Walnut 5369

IN CANADA

C. C. Meredith & Co.
Streetsville, Ontario

IN ENGLAND

Chicago Telephone Supply Co.
St. John's Woods
103 Grove End Gardens
London, N. W. 8, England

IN SOUTH AMERICA

Jose Luis Pontet

Cordoba 1472
Buenos Aires, Argentina
South America

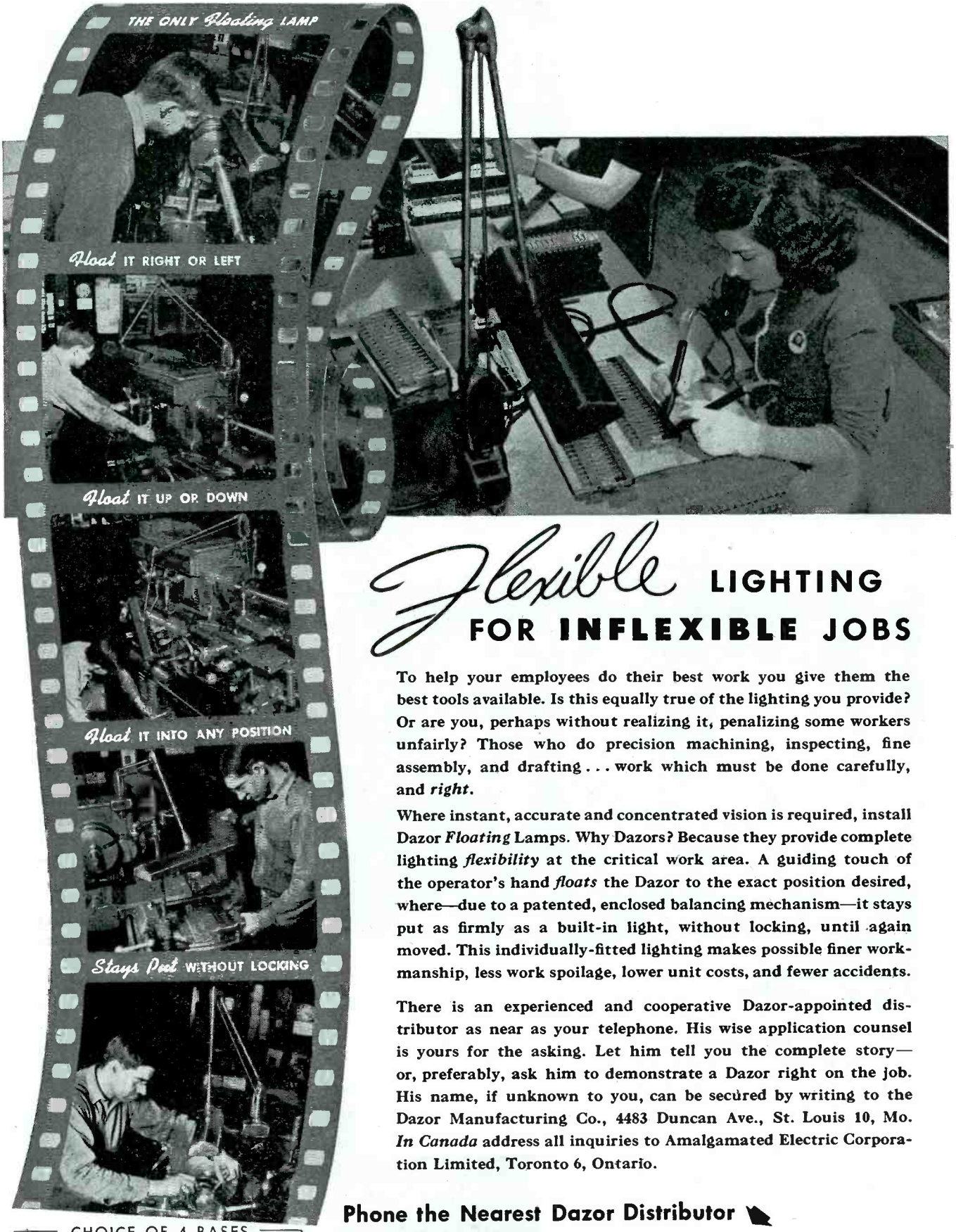
Masculino 2624
Montevideo, Uruguay
South America

Avda. Conselheiro Rodrigues
Alves 1067
Villa Mariana
Sao Paulo, Brazil
South America

CHICAGO TELEPHONE SUPPLY Company

ELKHART • INDIANA

Manufacturers of Quality Electro-Mechanical Components Since 1896

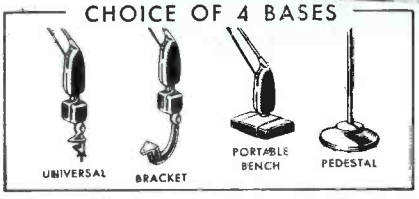


Flexible LIGHTING FOR INFLEXIBLE JOBS

To help your employees do their best work you give them the best tools available. Is this equally true of the lighting you provide? Or are you, perhaps without realizing it, penalizing some workers unfairly? Those who do precision machining, inspecting, fine assembly, and drafting . . . work which must be done carefully, and *right*.

Where instant, accurate and concentrated vision is required, install Dazor *Floating* Lamps. Why Dazors? Because they provide complete lighting *flexibility* at the critical work area. A guiding touch of the operator's hand *floats* the Dazor to the exact position desired, where—due to a patented, enclosed balancing mechanism—it stays put as firmly as a built-in light, without locking, until again moved. This individually-fitted lighting makes possible finer workmanship, less work spoilage, lower unit costs, and fewer accidents.

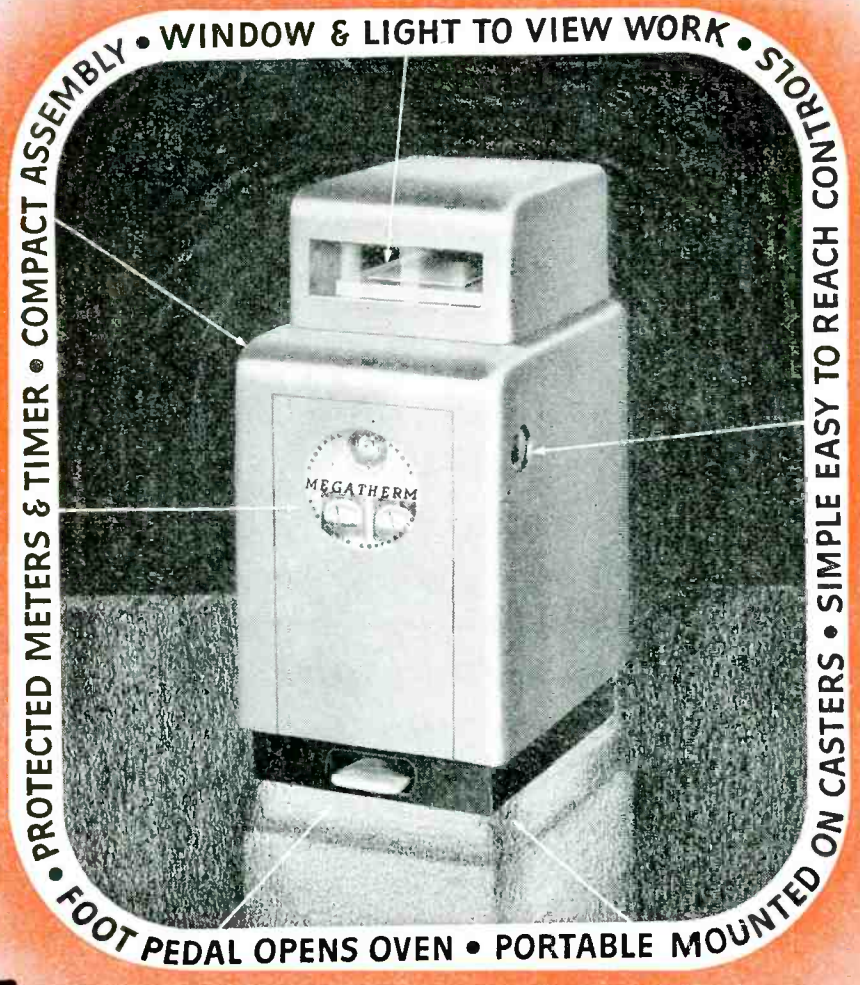
There is an experienced and cooperative Dazor-appointed distributor as near as your telephone. His wise application counsel is yours for the asking. Let him tell you the complete story—or, preferably, ask him to demonstrate a Dazor right on the job. His name, if unknown to you, can be secured by writing to the Dazor Manufacturing Co., 4483 Duncan Ave., St. Louis 10, Mo. *In Canada* address all inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ontario.



Phone the Nearest Dazor Distributor for Full Details and Demonstration

DAZOR *Floating* LAMPS

FLUORESCENT *and* INCANDESCENT



Framed in Features

*NEW . . . THE 1 KW MEGATHERM**

Here is the Megatherm you have been waiting for . . . a compact dielectric heating unit designed for maximum performance.

Ideal for production line use in plastics processing . . . quick, uniform heating of plastic preforms permits free flow conditions in the mold . . . allows lowered closing pressures.

Fitting easily between molding presses, the new Megatherm is only 20 inches wide . . . mounted on smooth-running casters with a special lock down feature.

The Megatherm MD-1A is versatile . . . handles a wide range of materials and work sizes . . . heats plastics, rubber, rubber substitutes, wood, glue and other dielectrics . . . defrosts frozen foods, and shows great possibilities in the sterilization of pharmaceutical and similar products.

Write now on your company letterhead for data on the NEW 1 KW MEGATHERM.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

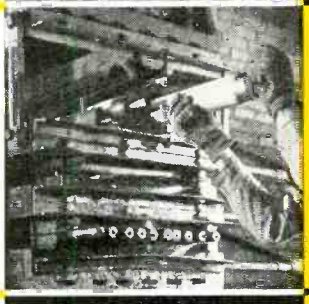
Newark 1, N. J.

*Reg. U. S. Pat. Office

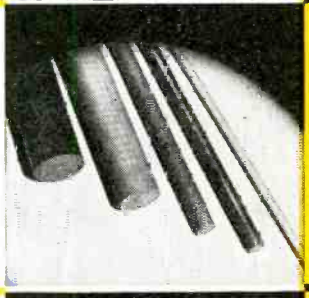
How many of these forms of Synthane do you recognize . . . and use?

1 SYNTHANE SHEETS
Made by curing layers or laminations of impregnated paper or fabric with heat and high pressure.

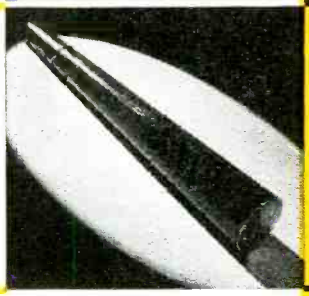
2 SYNTHANE WRAPPED TUBES
Made by curing impregnated paper or fabric, wound about a mandrel, with heat.



3 SYNTHANE MOLDED TUBES
Same as wrapped tubes except tubes are cured under heat *and* pressure in molds.

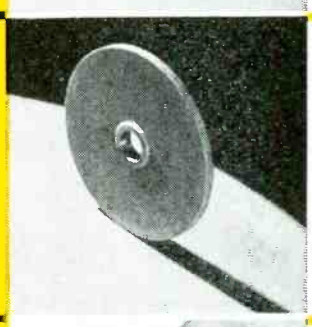


4 SYNTHANE RODS
Produced by a method similar to that used in processing molded tubes.



5 SYNTHANE MOLDED-LAMINATED
A means of producing parts in a finished or nearly finished form by curing layers of sheets under heat and pressure in molds. An economical way of making parts in quantity, retaining the desirable strength characteristics of Synthane sheet material.

6 SYNTHANE MOLDED-MACERATED
Flakes of impregnated fabric are cured under heat and pressure in molds. More intricate parts can be formed than are possible by molded-laminated. Strength surpasses ordinary powder molding, does not equal molded-laminated.



7 COMBINATION MOLDED-LAMINATED, MOLDED-MACERATED Some parts requiring strength in certain sections but intricacy in others may be made by a combination of the molded-laminated, molded-macerated methods.

8 COMBINATION MATERIALS
Synthane is sometimes bonded under pressure to other materials to achieve a combination of properties not obtainable any other way. The resiliency of rubber or Neoprene is often teamed with the strength and insulating characteristics of Synthane.

9 SPECIAL MATERIALS
Synthane is available in special forms such as this graphited anti-friction Synthane. The inclusion of graphite is desirable on some applications.

10 FABRICATED PARTS
Synthane produces finished parts by machining sheets, rods, tubes or by molded-laminated or molded-macerated processes or by combining machining and molding operations.

SYNTHANE CORPORATION, OAKS, PENNA.

SYNTHANE

Representatives in All Principal Cities

RCA Announces its New

195 VoltOhmyst

4 IMPORTANT NEW FEATURES

1. **Diode for a-c measurements. Flat 20 cycles to 100 kc.**
2. **Linear a-c scale for all ranges.**
3. **New plastic meter case with one-piece crystal-clear transparent front. No glass to break or loosen.**
4. **Shielded a-c cable and probe.**

Send for Bulletin:

A special bulletin showing and fully describing this new improved version of the well-known VoltOhmyst is now being printed. Fill in and return the coupon for your copy.

BUY MORE RCA WAR BONDS

TEST & MEASURING EQUIP., SECT. 126F
Rodio Corporation of America
Comden, N. J.

Nome _____

Street Address _____

City & Stote _____

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY LIMITED, Montreal

MALLORY FIXED AND VARIABLE RESISTORS

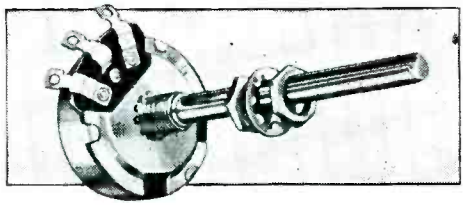
IT HAS become a habit with engineers responsible for designing and building all sorts of electronic and electrical equipment to specify Mallory Resistors. This saves time because of the complete Mallory line. It eliminates any worry about performance, because each Mallory Resistor is "as specified" or better—built of the finest materials to precision standards, electrically efficient and durable.

Quality above specifications is typical of Mallory Approved Precision Products . . . resistors, volume controls, potentiometers, switches, jacks and plugs, capacitors, vibrators, rectifiers, power supplies and other *standard* electronic parts . . . available from your nearest Mallory Distributor. Ask him for the complete Mallory catalog, or write us today.

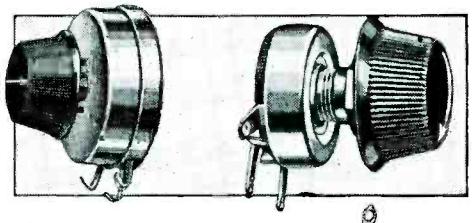
Make it a policy to consult Mallory for engineering assistance while your designs are still in the blue print stage.

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

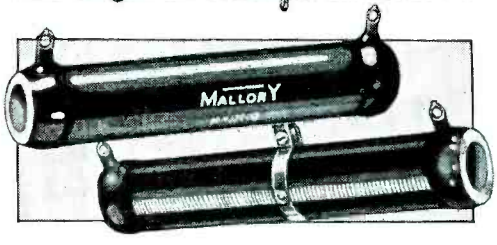
VARIABLE CARBON RESISTORS—Available in standard and midget types from 5000 ohms to 9 megohms. Noiseless in operation. Rugged terminal construction and improved resistance to humidity.

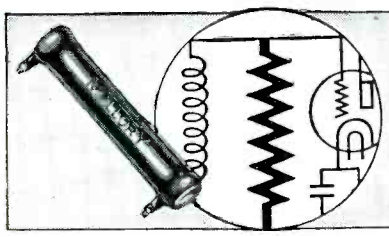


VARIABLE WIRE-WOUND RESISTORS—Available in three standard types, from 0.5 to 150,000 ohms resistance, 2 to 9 watts. Single and multiple units, with or without AC switch.



FIXED AND ADJUSTABLE WIRE-WOUND RESISTORS—Available from 1 to 100,000 ohms and 10 to 200 watts. Maximum wattage dissipation. Resistant to humidity.



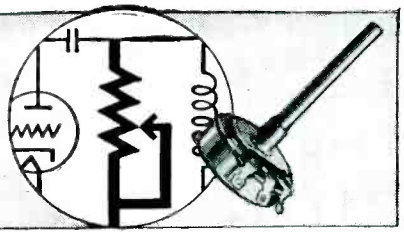


P.R. MALLORY & CO. Inc.

MALLORY

FIXED AND VARIABLE

RESISTORS



HOW FUNGUS-PROOFING KEEPS FIELD TELEPHONES FIT FOR COMBAT

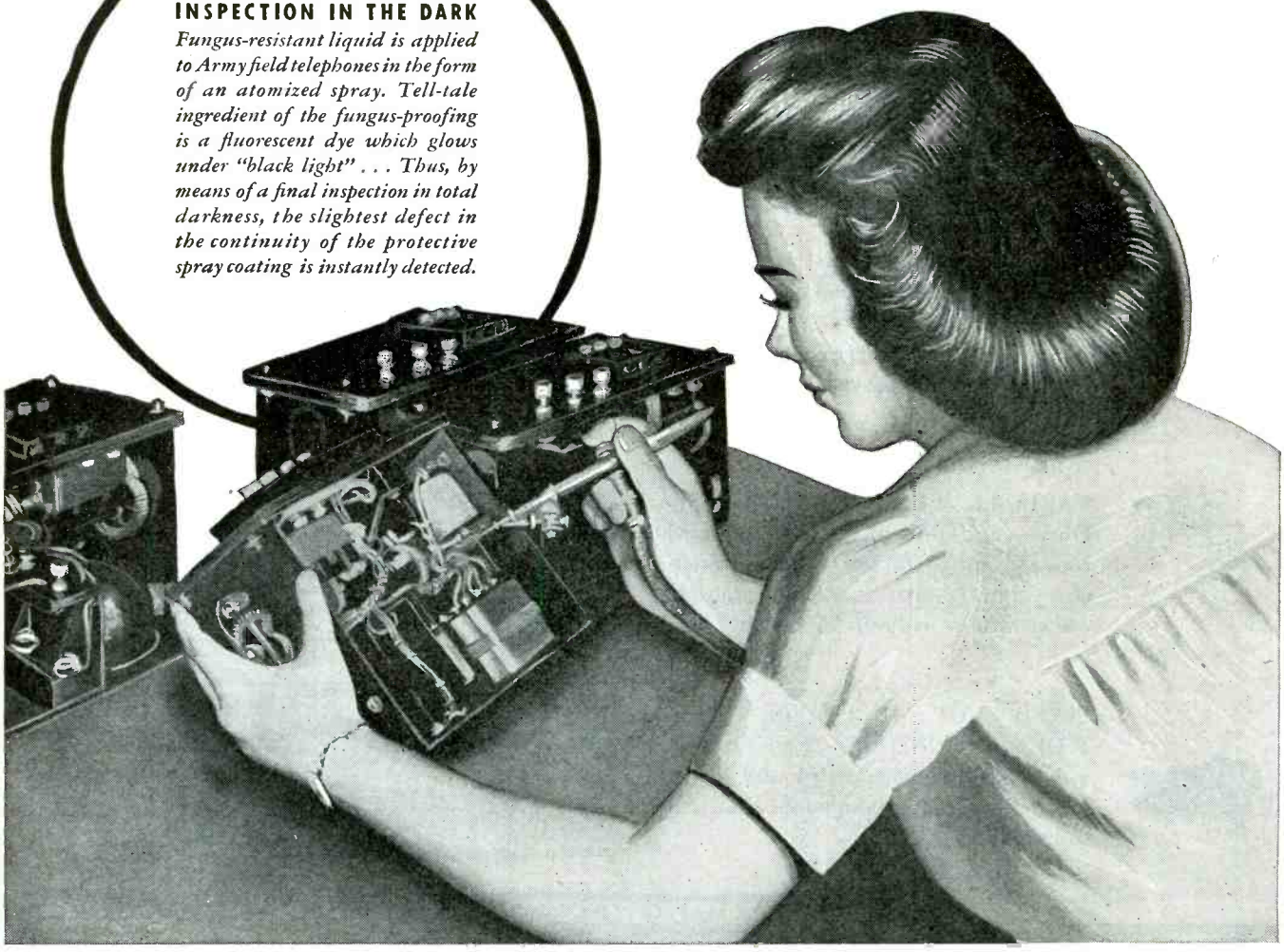
In the South Pacific the life of an ordinary field telephone might be measured in hours...were it not for fungus-proofing. Minute organisms, which thrive in the hot, humid islands of the Pacific, strip unprotected wires of their insulation...quickly corrode exposed metals and reduce untreated plastics to a moldy heap of uselessness.

To prevent this costly and dangerous destruction of precision instruments, the EE8-B field telephones we turn out for the U. S. Signal Corps are specially fungus-proofed during their manufacture. There can be no margin for error in this vital process—because men's lives depend on sure-fire communications.

You may not need fungus protection in the telephone instruments, electrical equipment, or electronic devices you will one day install in your plant. But you *will* be looking for sound, progressive engineering...adaptability to your particular needs . . . uniform high quality. Ask the returning soldier who has used Connecticut Telephone & Electric Division equipment in the field what he thinks of it. We'll rest our case with him.

INSPECTION IN THE DARK

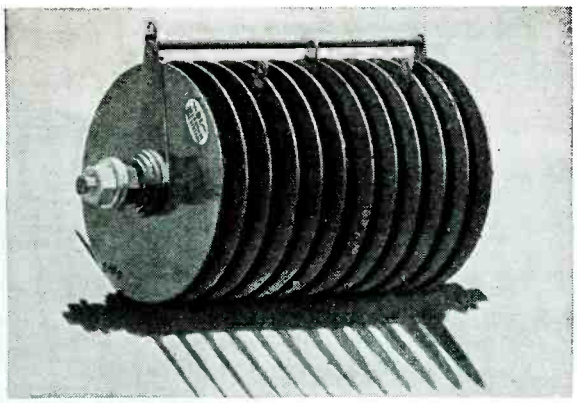
Fungus-resistant liquid is applied to Army field telephones in the form of an atomized spray. Tell-tale ingredient of the fungus-proofing is a fluorescent dye which glows under "black light" . . . Thus, by means of a final inspection in total darkness, the slightest defect in the continuity of the protective spray coating is instantly detected.



CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC. • MERIDEN, CONNECTICUT

TELEPHONIC SYSTEMS • SIGNALLING EQUIPMENT • ELECTRICAL EQUIPMENT • HOSPITAL AND SCHOOL COMMUNICATIONS AND SIGNALLING SYSTEMS • IGNITION SYSTEMS



POWER CONVERSION

from AC *to* DC *with* B-L RECTIFIERS

B-L SELENIUM AND COPPER SULPHIDE ELECTRICAL RECTIFIERS are used wherever direct current is required from an alternating current source. These rectifiers are compact—durable—silent; have no moving parts; are simple to install, require no maintenance. Ratings from milliwatts to kilowatts.

B-L RECTIFIER TRANSFORMER ASSEMBLIES *are built for many standard applications:*

B-L Laboratory Rectopacs for supplying the required voltage of direct current from the alternating current source.

•

B-L Heavy Duty Portable Railroad Battery Charger, for use in terminals.

•

B-L Fast Battery Charger for "no removal" automotive battery service.

•

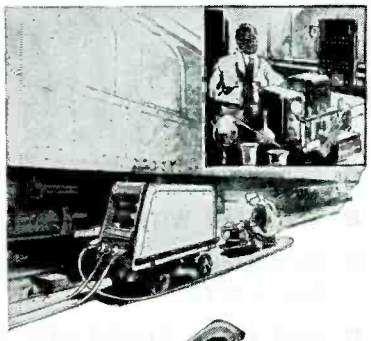
B-L Battery Booster for use in charging batteries and keeping them charged.

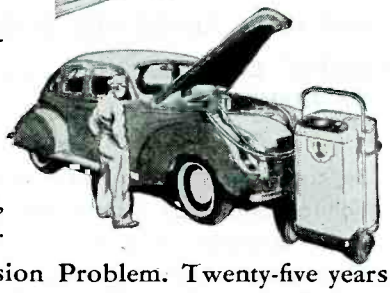
•

B-L Cathodic Protection for pipe lines.

•

B-L Filterpacs, eliminating the need of batteries, in operating 6-volt DC electrical equipment.





Consult us if you have a Power Conversion Problem. Twenty-five years of B-L specialized skill in AC-DC conversion problems is available to you. Address Dept. B.

SELENIUM — BL METALLIC RECTIFIERS SINCE 1923 — COPPER SULPHIDE

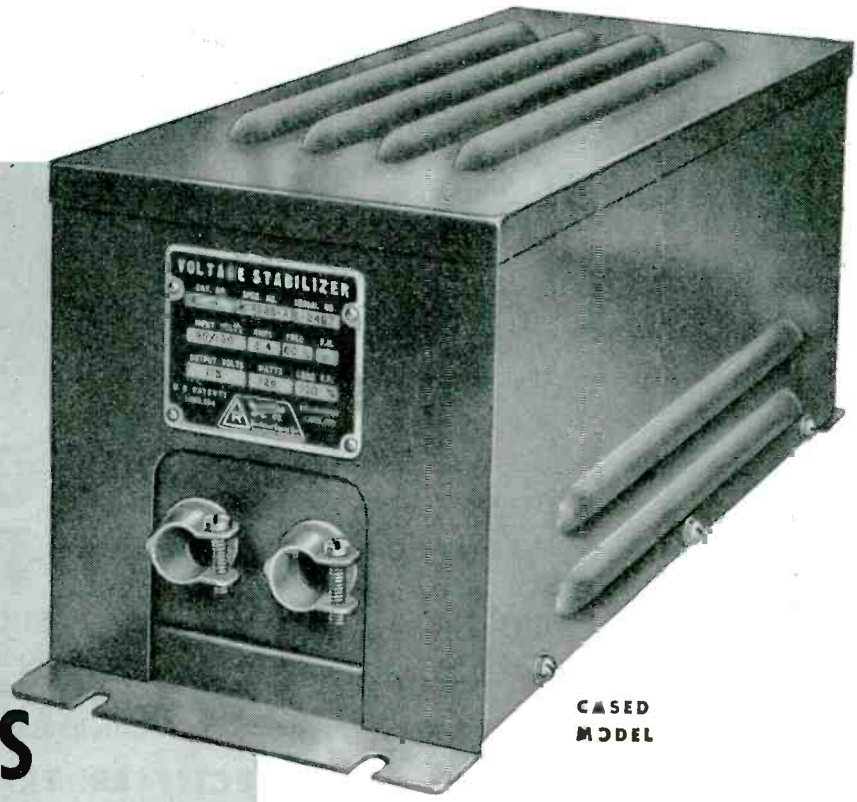
THE BENWOOD LINZE COMPANY
1815 Locust Street • • • St. Louis 3, Mo.
Long Distance Telephone CEntral 5830

New York Sales Office:
420 Lexington Ave.
New York 17, N. Y.
Murray Hill 5-5878

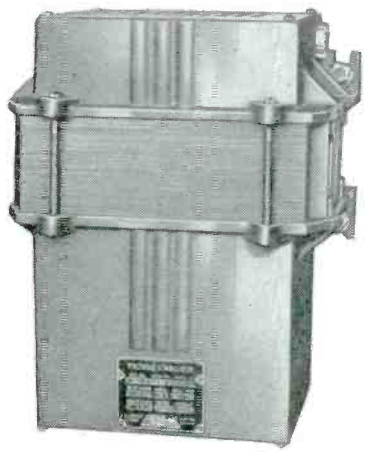
Chicago Sales Office:
20 N. Wacker Drive
Chicago 6, Illinois
Telephone CEntral 2379

Designers and Manufacturers of Selenium and Copper Sulphide Rectifiers, Battery Chargers, and DC Power Supplies for practically every requirement.

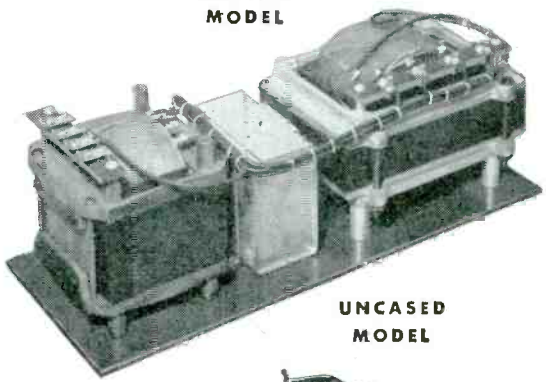
RAYTHEON VOLTAGE STABILIZERS



CASED MODEL



ENDBELL MODEL



UNCASED MODEL

- STABILIZE VARYING LINE VOLTAGES TO $\pm\frac{1}{2}\%$
- STABILIZE WITHIN 2 CYCLES
- STABILIZE VOLTAGES FROM 95 TO 130 VOLTS OR 190 TO 260 VOLTS
- ARE FULLY AUTOMATIC IN OPERATION
- SIMPLY CONNECT THEM . . . AND THEY'LL TAKE CARE OF THEMSELVES

By controlling varying input voltage to $\pm\frac{1}{2}\%$, Raytheon Voltage Stabilizers improve the performance and assure reliable operation of a wide variety of electrical equipment where close voltage regulation is a must for accurate operation. Entirely automatic in operation, they require no maintenance once installed. Raytheon Voltage Stabilizers are available in three styles, as illustrated, and many models to meet practically every installation requirement. They can be built into new equipment or incorporated in products already in use. Write for Bulletin DL48-537. It gives the complete story.

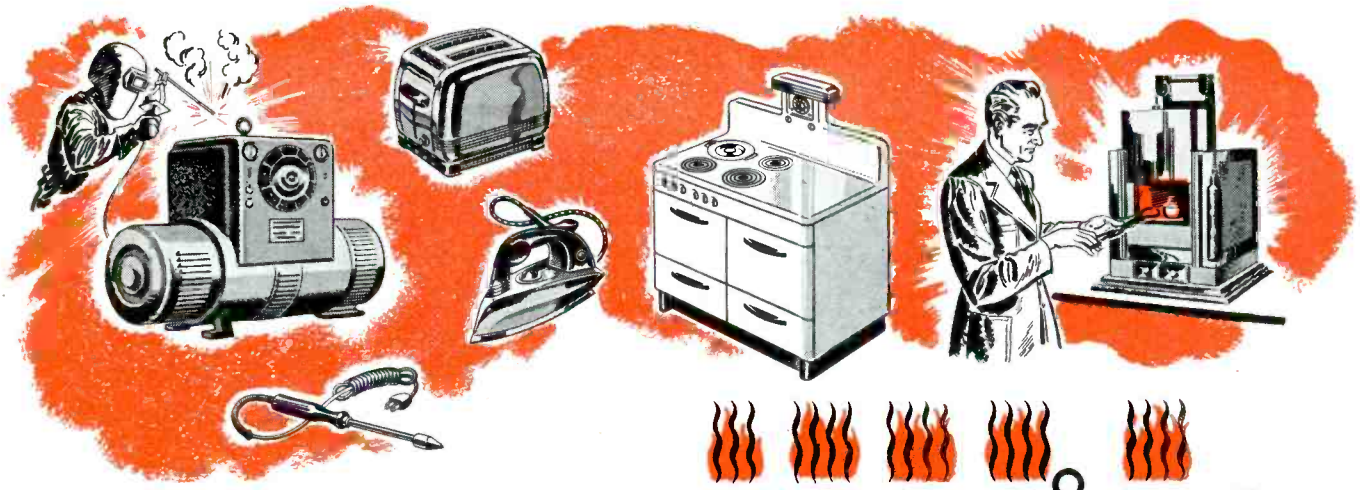
Tune in the Raytheon radio program: "MEET YOUR NAVY," every Saturday night on the Blue Network. Consult your local newspaper for time and station

RAYTHEON
MANUFACTURING COMPANY
Electrical Equipment Division
190 WILLOW STREET, WALTHAM, MASS.

The coveted Army-Navy "E," for Excellence in the manufacture of war equipment and tubes, flies over all four Raytheon Plants where over 16,000 men and women are producing for VICTORY.

Devoted to research and manufacture of complete electronic equipment; receiving, transmitting and hearing-aid tubes; transformers; and voltage stabilizers.

BH SPECIAL TREATED FIBERGLAS SLEEVING



HEAT RESISTANT TO 1200°F!

SNUB TEST

Proves BH Non-Fray Feature

Make this test yourself. Tap a piece of ordinary saturated sleeving on your desk top and see how easily it frays. Then do the same with BH *Extra Flexible* Fiberglas Sleeving. It only fuzzes a little—doesn't break down—doesn't fray.

THE RESULT

BH *EXTRA FLEXIBLE* FIBERGLAS SLEEVING

2 WAYS BETTER

NON-FRAYING • NON-STIFFENING

IF YOU NEED an electrical insulation that's not affected by temperatures up to 1200°F., yet is unusually flexible, workable and durable, you'll find it in BH Special Treated Fiberglas Sleeving. Even in direct contact with heat units this remarkable sleeving won't burn.

Reason? It's made of inorganic Fiberglas and treated by the exclusive BH process. No saturant is used, yet the sleeving won't fray when cut and it is *permanently* flexible. In addition to many other properties it is moisture, oil and grease resistant . . . works easier, simplifies assembly and lasts longer. Made in natural color only—all standard sizes. Get your free samples today and compare!

HERE'S ANOTHER NON-BURNING SLEEVING

BH *Extra Flexible* Fiberglas Sleeving won't burn because both yarns *and* impregnation are non-inflammable. This high quality sleeving has all the advantages of pure Fiberglas, is toughened against abrasion, is non-fraying and non-stiffening. It lasts indefinitely without rotting or cracking—the ideal all-purpose electrical insulation for all kinds of industrial equipment and home appliances. Available in all standard colors and sizes from No. 20 to 5/8", inclusive. Put it to the toughest tests you know and watch the results!

ALL BH PRODUCTS AVAILABLE IN STANDARD 36" LENGTHS AND 500-FT. COILS

BH PRODUCTS

ALSO SLOW-BURNING IMPREGNATED MAGNETO TUBING • SLOW-BURNING FLEXIBLE VARNISHED TUBING • SATURATED SLEEVING • A.S.T.M. SPECIFICATIONS

BENTLEY, HARRIS MANUFACTURING CO.

Dept. I, Conshohocken, Penna.

SENSITIVITY

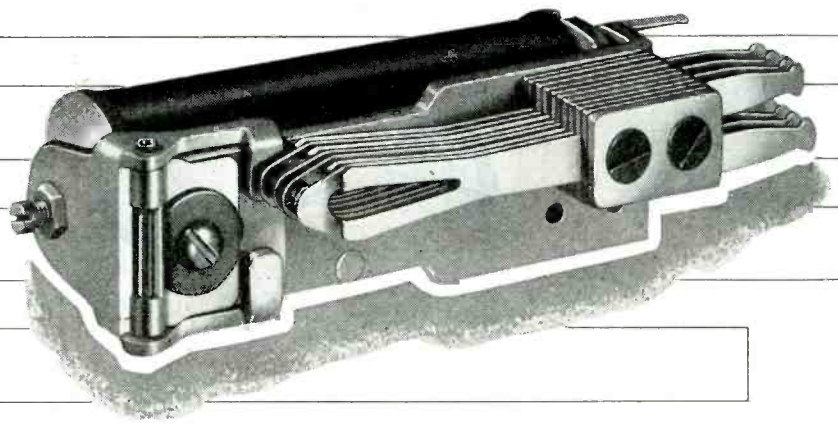
CONTACT PRESSURE

DEPENDABILITY

DURABILITY

COMPACTNESS

VERSATILITY



— *in Greatest Combination*

THE NEW AUTOMATIC ELECTRIC CLASS "B" RELAY

● When you need a relay that's sensitive enough to operate on minute current, yet has the high contact pressure needed for perfect closure, you'll find the Automatic Electric Class "B" Relay worth investigating.

If you need a relay that will switch many circuits, yet is compact enough for multiple mounting in small space, you'll find Class "B" the perfect solution.

Or perhaps you are interested in extra durability, for long service under tough conditions. Then you'll need the in-built quality for which Class "B" has become famous.

No other relay—even in the Automatic Electric line—can give you a greater combination of all these essential qualities. Get the full story on Class "B"—one of the forty basic types described in the Automatic Electric catalog. Ask for your copy of Catalog 4071.

CHECK THESE FEATURES of the New Class "B" Relay

Independent Twin Contacts—for dependable contact closure.

Efficient Magnetic Circuit—for sensitivity and high contact pressure.

Unique Armature Bearing—for long wear under severe service conditions.

Compact Design—for important savings in space and weight.

Versatility—Available for coil voltages to 300 volts d-c and 230 volts a-c, and with capacities up to 28 springs; also with magnetic shielding cover, when specified.

No other relay can give you a greater combination of all these essential qualities.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Illinois

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

THE BLACK HAND OF CORROSION

SHACKLED BY LUMARITH* CA

For more effective electrical insulation—typical applications of Lumarith CA:

- Turn insulation for magnet wire
- Major coil insulation
- Coil lead insulation
- Boot and pad insulation
- Layer wound cores for coils
- Slot insulation
- Laminated to paper, cloth, mica, etc.
- Backing for pressure sensitive tape
- Spiral wound for cables and spun-end grommets

EXECUTIVES! Just published, 136 page manual entitled, "FABRICATING METHODS FOR LUMARITH* CELLULOID* AND SIMILAR THERMOPLASTIC MATERIALS." Write for complimentary copy on your company letterhead. Additional copies, $1.00 each.
*Reg. U.S. Pat. Off.

APPLICATIONS of Lumarith CA (cellulose acetate) to fine gauge cooper wire—1 and 2 mil—stress the inherent advantages of this cellulosic base insulating material.

Here, where corrosion strikes quickest and hardest, Lumarith CA shows to the greatest advantage its freedom from the tendency to organic decomposition so inherent in many materials.

Rather, this synthetic by its very nature is chemically inert, for example, to transformer oil, and to the electrolytic action of humidity, moisture—even salt water in the presence of direct current.

The in-built dielectric strength and chemical resistance of Lumarith CA, and its physical resistance to abrasion, cracking, crease-breaks, is impressive even with the thinnest foil. Slippage in winding and usage is overcome by a special mat finish (A78) which also increases elongation, requires no lubricants.

Look into Lumarith CA for your electrical needs. In films, foils for winding, laminating. Spiral wound for light yet rugged tubing. Rods, sheets, regular tubes and molding materials. Send for the booklet, "Celanese Synthetics for the Electrical Industry." Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N. Y.

A Celanese Plastic*

Centralab

CERAMIC CAPACITORS FOR HIGH VOLTAGE

Type 850,851, and 852 shown above are double cup style ceramic capacitors engineered by Centralab for applications where high working voltages and loads are required.

Capacities: 850 — 25 MMF, NPO to 100 MMF, N750; 851 — 25 MMF, NPO to 200 MMF, N750; 852 — 10 MMF, NPO to 25 MMF, N750. Working voltages to 15,000 D.C. Types 853,854 and 855 shown below are also double cup design and have accumulative capacities ranging from 2 MMF to 20 MMF in zero T. C. to MMF to 40 MMF in maximum negative T. C. (N750). Working voltages to 7500 D. C.

Send for Bulletin 721 and 814.

ARMY E NAVY

Centralab CRL

Producers of: Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators • Button Type Silver Mica Capacitors.

★ *Every Utah speaker makes and breaks more than a billion contacts during its lifetime.*

NO GUESSWORK HERE!

The manufacture of electronic devices and radio parts is an exacting job. It's a precision job and Utah does it to a plus degree. Take the loud speaker for instance: Utah's "precision-plus" methods go 'way back to the buying of raw materials that make the speaker. They go even further.

The tools used in the manufacture of the speaker are likewise made at Utah, to Utah's specifications. You see, every single phase in the manufacture of Utah is guess-proof . . . tool making, welding, punch press, electroplating, and all the other steps, to the shipping of the final finished product. *Check, re-check, test . . . supervise* are Utah words. Here Utah workers (with Utalins* back of 'em) know their value. Know they make for "precision-plus" performance—the proof of Utah quality.

*Utah's Helpers

utah

ARMY NAVY

UTAH RADIO PRODUCTS COMPANY, 820 ORLEANS ST., CHICAGO 10, ILL.

Utah Electronics (Canada) Ltd., 300 Chambly Road, Longueuil, Montreal (23) P.Q. • Ucoa Radio, S.A., Misiones 48, Buenos Aires

SEND FOR THIS

RESISTOR DATA

For the convenience of designers of products requiring resistors, Ward Leonard offers this new Resistor Handbook. It describes in detail the full line of wire-wound resistors giving complete information on mountings, enclosures, terminals and resistance values. Write for your copy today.

BUY MORE WAR BONDS

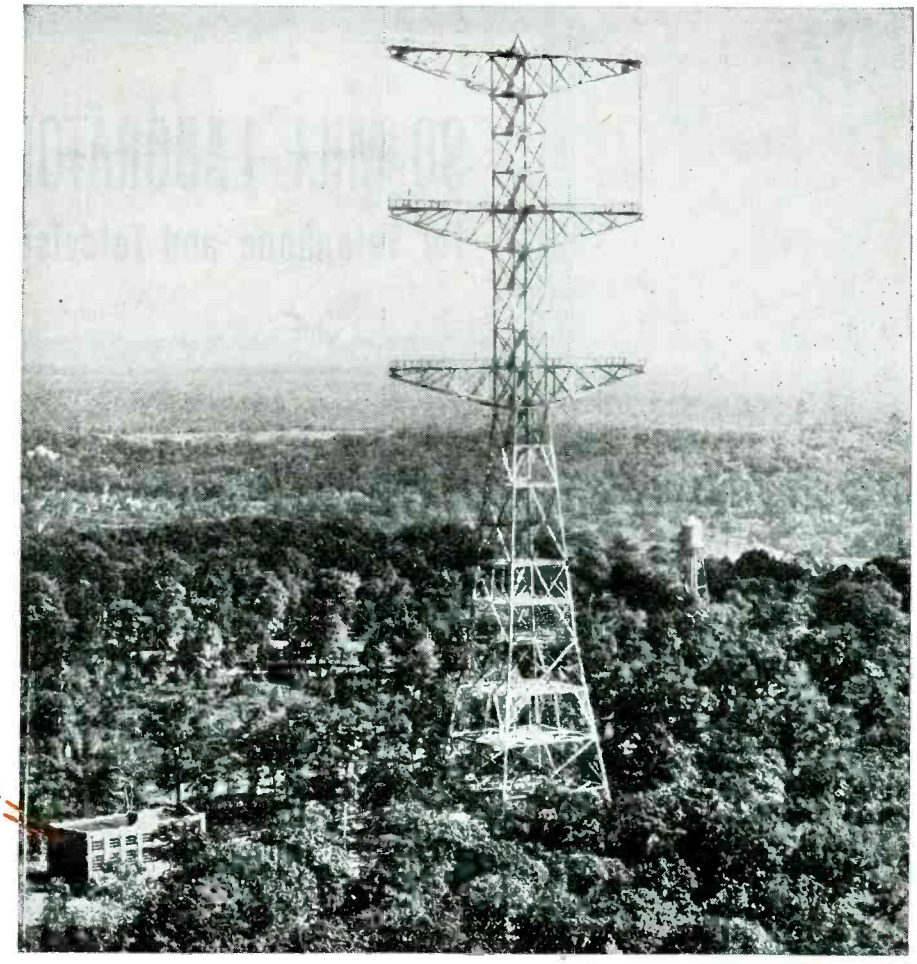
ARMY E NAVY

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) devices since 1892.

WARD LEONARD ELECTRIC COMPANY · 61 SOUTH ST. · MOUNT VERNON, N. Y.



Pioneer FM station uses BLILEY CRYSTALS

When Major Armstrong's station W2XMN went on the air from Alpine, New Jersey on July 18, 1939, radio history was in the making. This first FM transmitter to be put in service, built by REL, employed the Armstrong crystal-controlled phase shift modulation.

Bliley crystals are doing an excellent job in this outstanding pioneer FM installation.

For advanced engineering it is always worthwhile to specify Bliley crystals. An outstanding example of this is the discovery and development by Bliley engineers of ACID ETCHED CRYSTALS*. This technique was an established part of Bliley production before Pearl Harbor. It is now recognized as a prerequisite to dependable service in military equipment.

It is a good habit to consult Bliley engineers when new developments are in the making. Our specialized engineering can often be of real assistance toward solution of your design problems. This kind of service has made Bliley the foremost producer of quartz crystals for amateur and commercial radio in peacetime and for our armed forces in time of war.

+ + +

**Acid etching quartz crystals to frequency is a patented Bliley process. United States Patent No. 2,364,501.*

Bliley CRYSTALS

Do more than before...

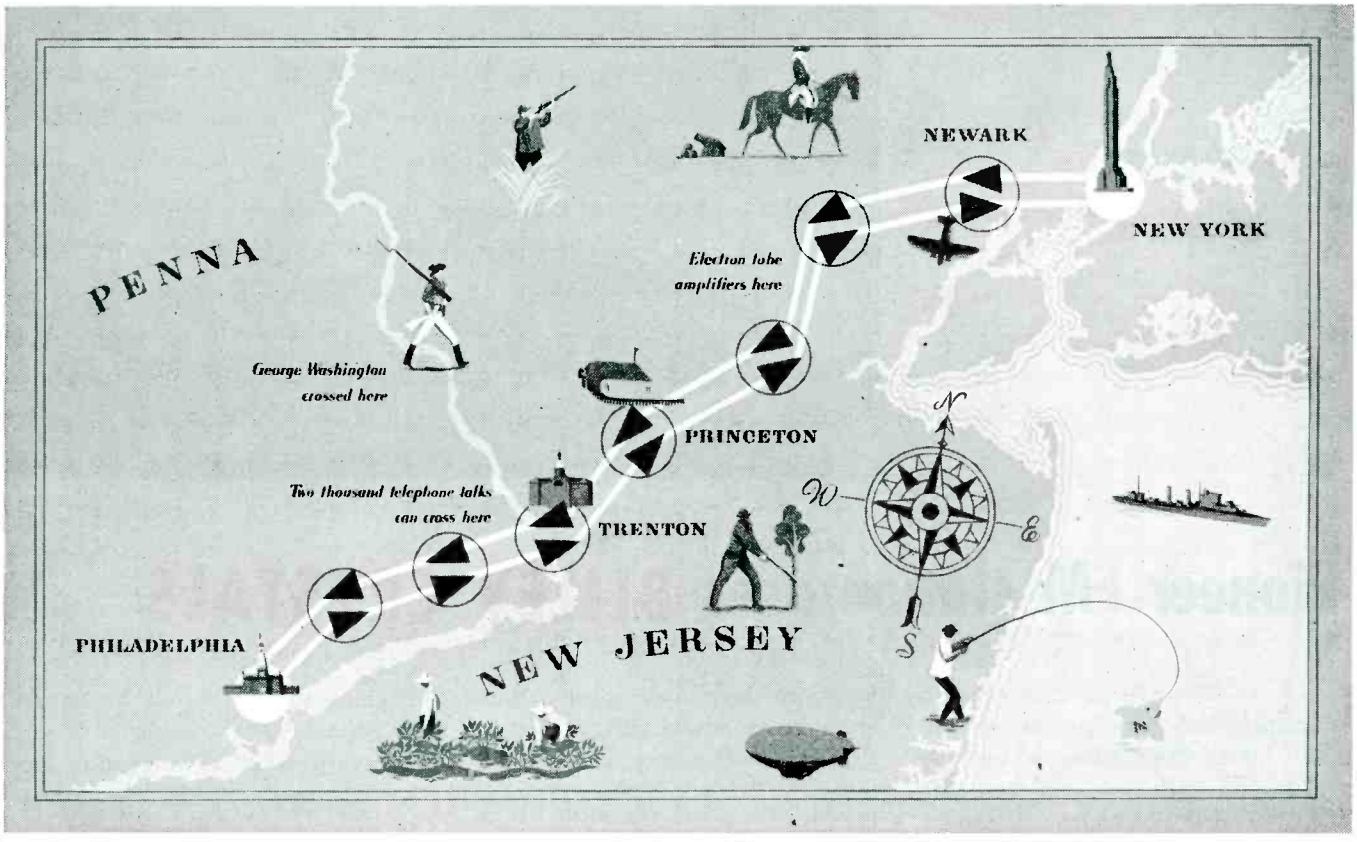
buy **extra** War Bonds

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING · ERIE, PENN.

90-MILE LABORATORY

for Telephone and Television



BETWEEN telephone offices in New York and Philadelphia once stretched a strange sort of laboratory. Most of the way it was underground; engineers made their measurements sometimes in manholes. It was a lead-sheathed cable containing two "coaxials" – each of them a wire supported in the center of a flexible copper tube the size of a lead pencil.

Theory had convinced engineers of Bell Laboratories that a coaxial could carry many more telephone talks than a full-sized voice frequency telephone cable; that it could carry adequately a television program. Experimental lengths were tested; terminal apparatus was designed and tried out. Finally, a full-sized trial was made with a system designed for 480 conversations. It was successful; in one demonstration people talked over a 3800-mile circuit looped back and forth. Now the cable is carrying some of the wartime flood of telephone calls between these two big cities.

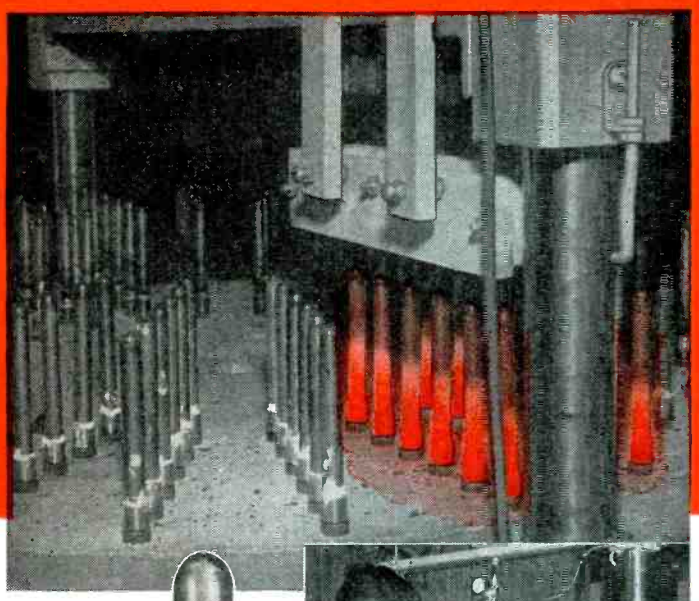
This cable made television history also: through it in 1940 were brought spot news pictures of a political convention in Philadelphia to be broadcast from New York. Bell System contributions to television, which began with transmission from Washington to New York in 1927, have been laid aside for war work. When peace returns, a notable expansion of coaxial circuits is planned for both telephone and television in our Bell System work.

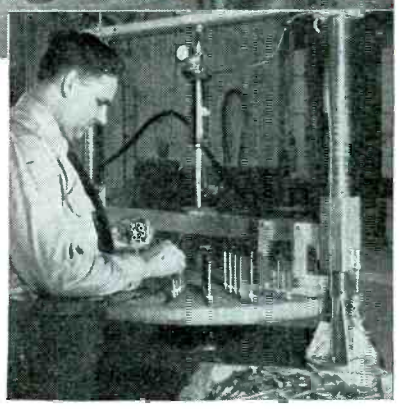
BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

INSIST ON PROOF BY TRIAL

before you buy an Electronic Heater





This is how Scientific Electric proved the value of electronic heating to the Progressive Welding Company of Norwalk, Connecticut . . .

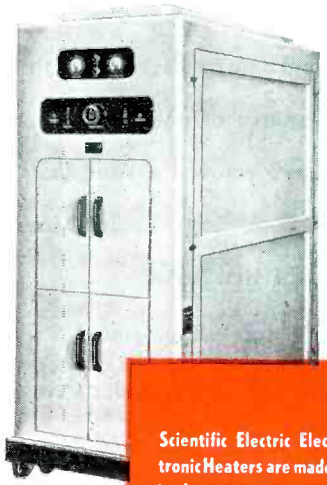
GREAT improvements in product quality and remarkable savings in time and money are being achieved by means of electronic heating. Industrialists everywhere are now acclaiming its many advantages. But don't let your enthusiasm lead you to invest in an electronic heater before you have seen it perform the work you expect of it.

Another important point is this . . . in order to work at maximum efficiency and live up to its reputation for doing things better, faster and cheaper . . . electronic heating must be "tailored" to the job. That is why we never sell a Scientific Electric unit until it has been satisfactorily demonstrated. Regardless of the amount of time and effort required, our engineers will not release a single machine for sale until it has fulfilled every claim we make for it.

So here is a word of counsel . . . get plenty of advice before you buy. Consult with our recognized engineers who have pioneered in electronic heating since 1921 and, without obligation, they will demonstrate what electronic heating can do for you.

Above: This practical automatic brazing turntable powered by a 40 KW. Scientific Electric heater speeded up production 700%—cut costs 87% and reduced rejects by 90%.

Left: Close-up of the finished two-piece tube assembly after being brazed by induction heating. Three complete brazing installations have been built for Progressive.



Write for a free copy of our handbook . . . *The ABC of Electronic Heating* which contains an easily understood explanation of this new heating method.

40 KW INDUCTION HEATER

Scientific Electric Electronic Heaters are made in these power sizes... and a range of frequencies up to 300 Megacycles depending upon power requirements.

3 KW	18 KW
5 KW	25 KW
7½ KW	40 KW
8 KW	60 KW
10 KW	80 KW
12½ KW	100 KW
15 KW	250 KW

Scientific Electric

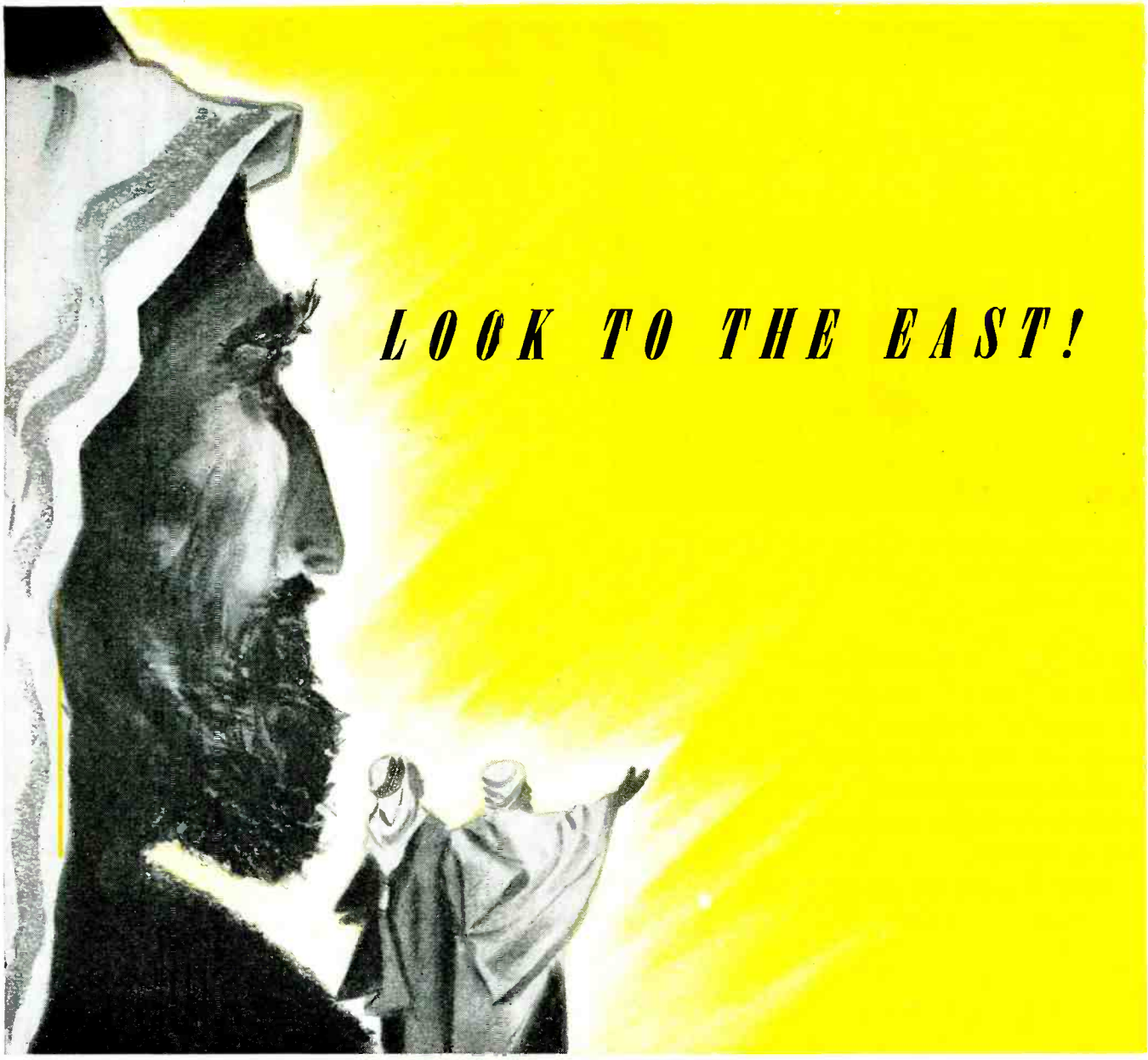
Division of

"S" CORRUGATED QUENCHED GAP COMPANY

119 MONROE ST. SCIENTIFIC ELECTRIC GARFIELD, N. J.

Manufacturers of

Vacuum Tube and Spark Gap Converters Since 1921



For years, set manufacturers have looked to the East as an important source of radio components. We at G. I. have always enjoyed a large share of this business, namely; Condensers, Tuning Mechanisms, Actuators, and associated items.

As a matter of natural development, a few years back we launched the famed and successful G. I. RECORD CHANGER.

Now we have inaugurated a full line of quality SPEAKERS as part of an expanded peacetime program.

Yes, big things are brewing at G. I.—plans that will make us in the peacetime years ahead, eastern headquarters for a complete quality line of major radio components—in volume—thanks to the "know-how", both physical and creative, vastly increased by the challenge of war needs.

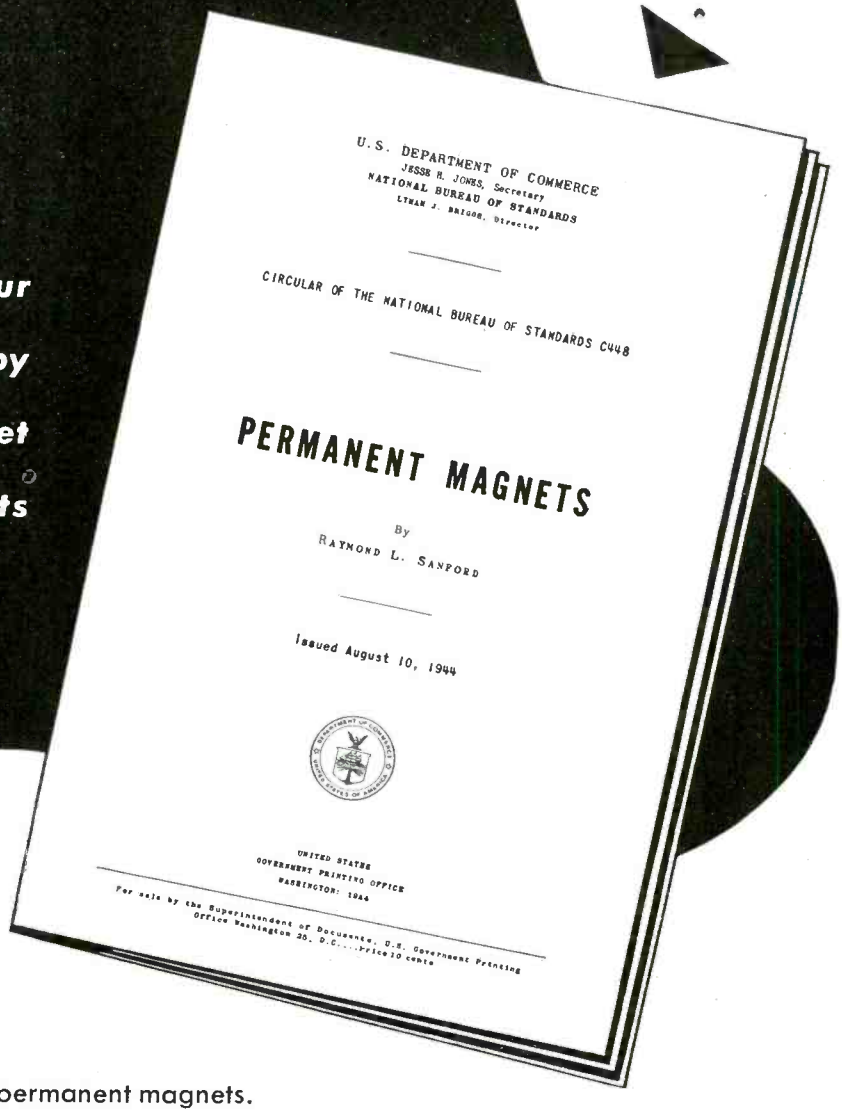
GENERAL INSTRUMENT CORPORATION

The first in our industry to be so honored

829 NEWARK AVENUE • ELIZABETH 3, N. J.

YOURS!

Just write us, on your letterhead, for your copy of this valuable booklet on permanent magnets


U.S. DEPARTMENT OF COMMERCE
JESSE H. JONES, Secretary
NATIONAL BUREAU OF STANDARDS
LYMAN J. BRIGGS, Director

CIRCULAR OF THE NATIONAL BUREAU OF STANDARDS C448

PERMANENT MAGNETS

By
RAYMOND L. SANFORD

Issued August 10, 1944

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON: 1944

For sale by the Superintendent of Documents, U.S. Government Printing Office Washington 25, D.C. ... Price 10 cents

● As a service to industry, The Arnold Engineering Company is "lending a hand" in the distribution of what Arnold engineers believe to be a very informative study on the subject of permanent magnets.

This 39-page book of permanent magnet theory, design data and references was published by the government. Arnold is pleased to make it available to you free of charge and without obligation. Write for it today!

ARMY E NAVY

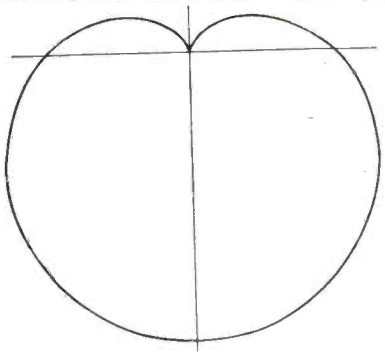
THE ARNOLD ENGINEERING COMPANY

147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

Specialists in the Manufacture of **ALNICO PERMANENT MAGNETS**

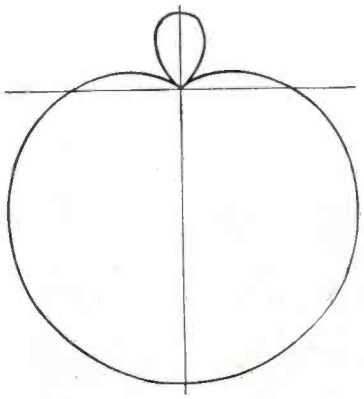
. . This is Cardioid

"Cardioid" means heart-shaped. It describes the pickup pattern of a microphone as illustrated in this diagram. Unwanted sounds approaching from the rear are cancelled out and the pickup of random noise energy is reduced by 66%. The actual front to back ratio of reproduction of random sound energy is 7 to 1.



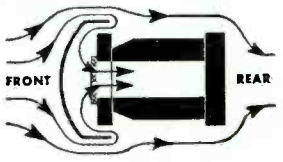
. . This is Super-Cardioid

"Super-Cardioid" also describes a pickup pattern and is a further improvement in directional microphones. The Super-Cardioid has a wide front-side pickup angle with greater exclusion of sounds arriving from the sides and the rear. The front to back random sound ratio is 14 to 1 which makes it twice as unidirectional as the "Cardioid." A 73% decrease in the pickup of random noise energy is accomplished.

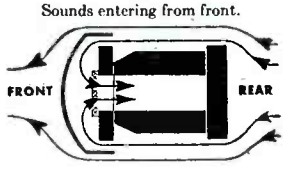


. . This is Uniphase

"Uniphase" describes the principle by which directional pickup is accomplished in a single Microphone unit. This is a patented Shure development and makes possible a single unit "Super-Cardioid" Directional Microphone eliminating the necessity of employing two microphone units in one case—it gives greater uniformity in production, greater ruggedness, lower cost for comparable quality and more uniform vertical pickup pattern.



Sounds entering from front.



Sounds entering from rear.

. . This is the result

The SHURE Super-Cardioid

A decrease in the pickup of random sound energy by 73%—reduction of feedback and background noise—simplification of sound pickup are among the many advantages offered by the Shure "Super-Cardioid" Dynamic. These, plus faithful reproduction, are the reasons why Shure "Super-Cardioid" Microphones are used by more than 750 Broadcast Stations in the United States alone, by our Armed Forces throughout the world, and on thousands of Public Address Systems everywhere.

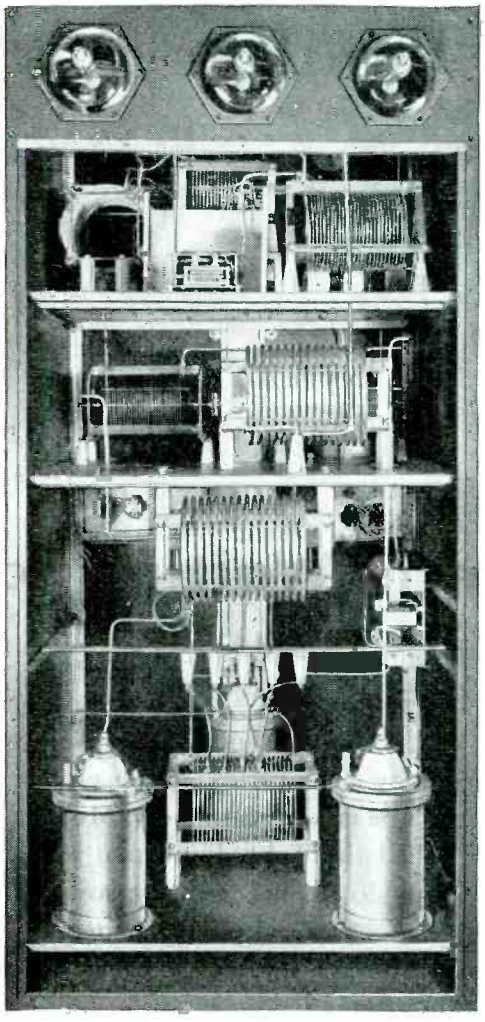
SHURE BROTHERS

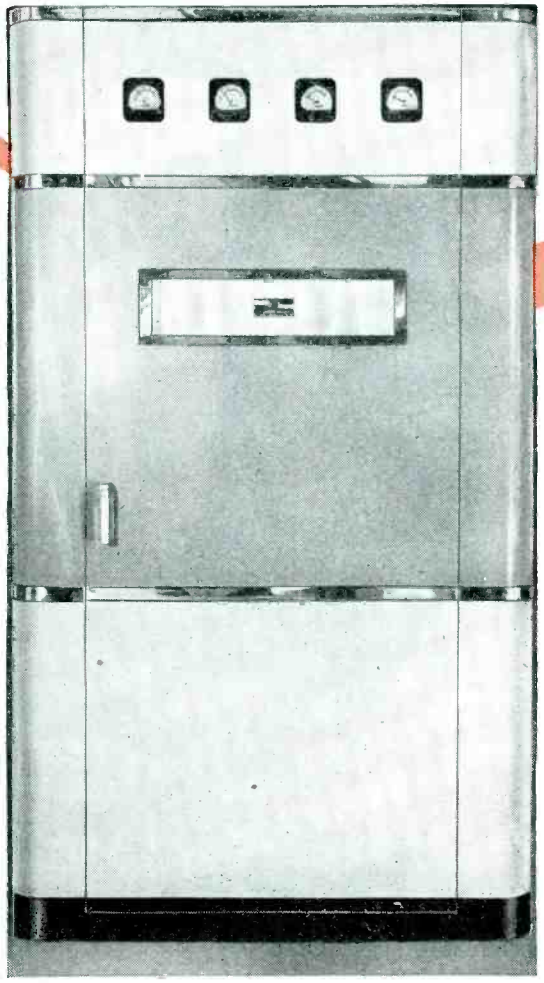
Designers and Manufacturers of Microphones and Acoustic Devices

225 West Huron Street **Chicago 10, Illinois**

SHURE MICROPHONES

DIRECTIONAL ANTENNA EQUIPMENT



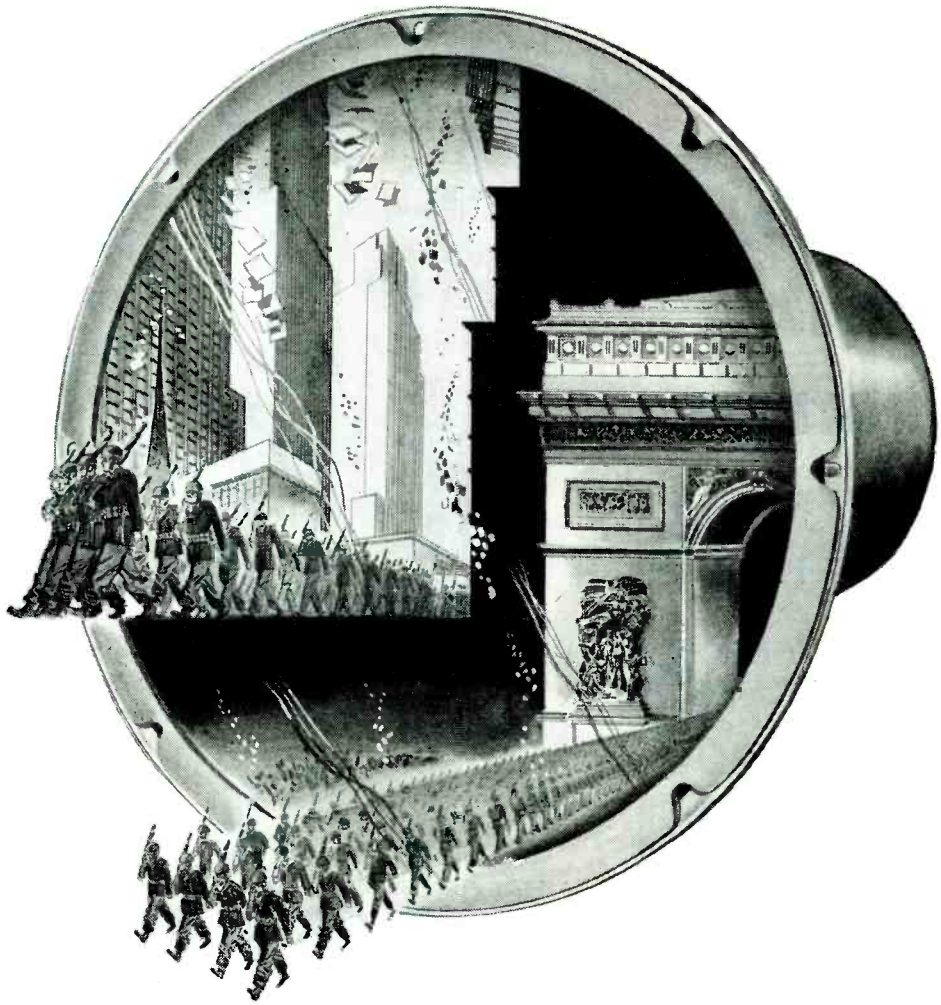


Johnson engineers have designed many highly successful installations of phasing and antenna coupling equipment to individual specifications. These units may be built to match any existing transmitter and thus become an integral part of your station. Let us help you and your consulting engineer plan your transmitting equipment for better market coverage. Orders received now will get first attention when priority restrictions are removed.

Here are two of the many installations of phasing equipment Johnson has furnished for Broadcast Stations, built to match existing equipment. Other items available from Johnson, made to individual specifications, are gas filled pressure condensers, coupling networks, tower lighting filters and special inductors.

JOHNSON
a famous name in Radio

E. F. JOHNSON COMPANY
WASECA, MINNESOTA



The Loudspeaker Everyone is Waiting for

NO, it isn't necessarily a Rola. The sound for which the Nation is so eagerly and confidently waiting is the news that Victory is ours . . . that men and women will come home . . . that the bright dawn of world peace is in sight.

In many homes it *will* be a Rola, for millions of radio sets have been Rola equipped, but regardless of who made it, the loudspeaker that brings this welcome news will be the sweetest sounding speaker anyone ever listened to.

Afterward will come still finer Rola speakers, improved by discoveries and developments that can't be talked about now. Meanwhile, busy as it is in highly important war work, Rola can do no more than provide speaker models for authorized experimental work and consult with Manufacturers on their peacetime plans.

THE ROLA COMPANY, INC. • 2530 SUPERIOR AVENUE, CLEVELAND 14, OHIO

ROLA

ARMY E NAVY

MAKERS OF THE FINEST IN SOUND REPRODUCING AND ELECTRONIC EQUIPMENT

STACK MOUNTING CAPACITORS

● Aerovox popularized this type. Originally a *special* item made only to order and at custom-built prices, it was Aerovox that selected and standardized the sizes, voltages and capacitances so that standard Aerovox stack-mounting units could be regularly produced, listed and properly priced. The rest is history.

Especially intended for various transmitting and electronic applications, these heavy-duty micas have found wide usage in military and peaceful applications alike. Such units are especially popular in heavy-duty transmitting applications such as grid, plate blocking, coupling, tank and by-pass functions. Also in carrier-current applications.

Special yesterday, *standard* today, Aerovox stack-mounting mica capacitors have contributed greatly to available quality equipment and outstanding performance.

● Literature on request . . .

Check list . . .

✓Low-loss glazed ceramic case for long creepage path between terminals.

✓Corona losses eliminated on inside and outside alike.

✓Cast-aluminum terminal ends for low contact resistance between stacked units.

✓Close-tolerance mica units equalize loading of series-connected sections

✓Mica sections rigidly clamped in low-loss non-magnetic clamps and heat-treated for maximum capacitance-temperature stability.

✓Mechanical design permits units to be stacked and thereby connected in series, parallel and series-parallel. Dummy units are available to support and insulate active units.

✓Units may be bolted together through holes in aluminum caps.

✓Standard listings; normally available without delay; at the right prices.

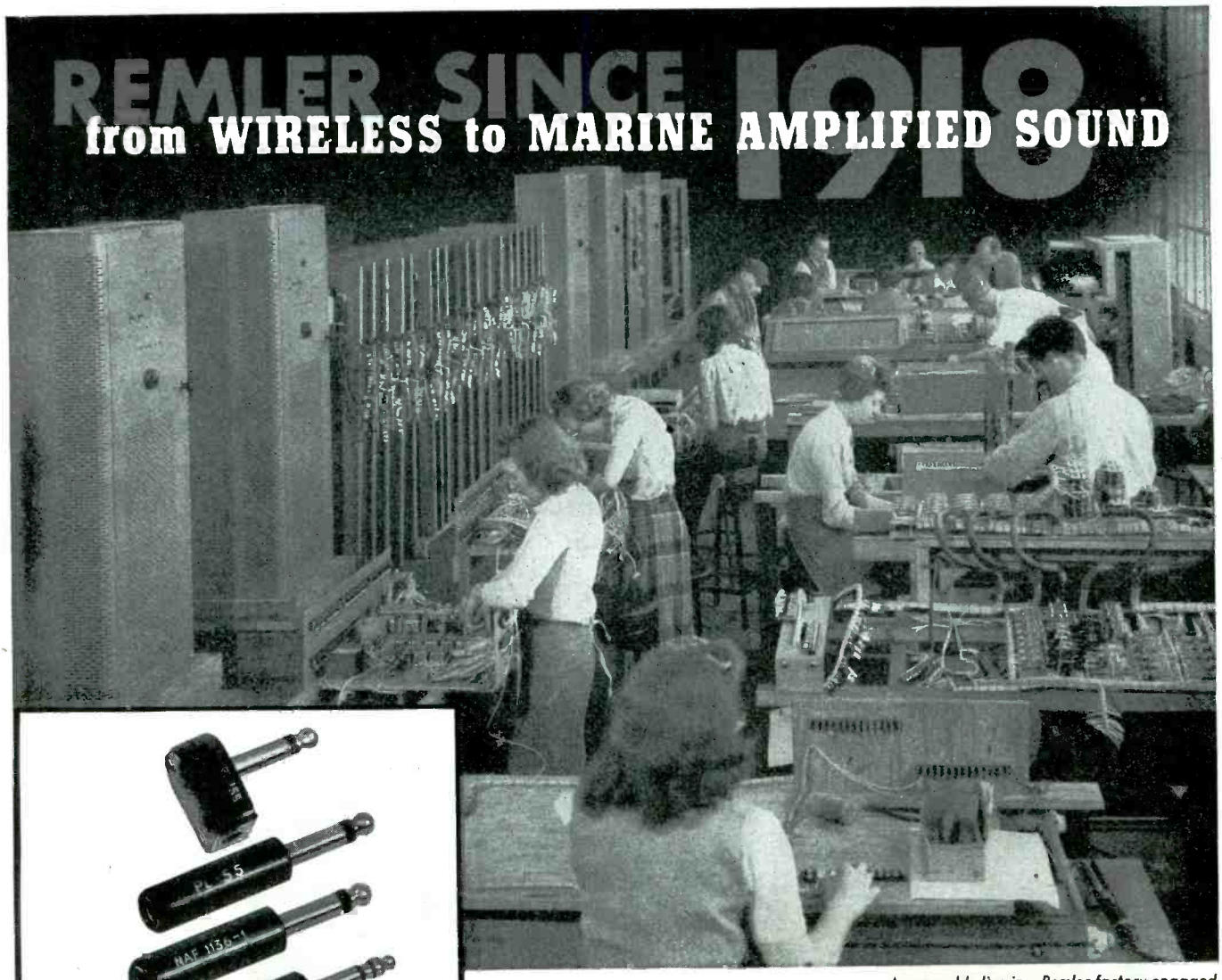
AEROVOX *Capacitors*

INDIVIDUALLY TESTED

AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. · SALES OFFICES IN ALL PRINCIPAL CITIES

Export: 13 E. 40 St., New York 16, N. Y. · Cable: 'ARLAB' · In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

REMLER SINCE 1918
from WIRELESS to MARINE AMPLIFIED SOUND



An assembly line in a Remler factory engaged in the manufacture of marine amplified sound systems for U. S. Maritime Commission.

Telephone Type Plugs

Signal Corps • Navy Specifications

PLUG NUMBER	NUMBER CONTACTS	TYPE SLEEVE	SEE NOTE
PL47	2	Long	
PL54	2	Short	1
PL55	2	Long	2
PL55K	2	Off Set	
PL68	3	Long	3
PL124	2	Short	1
PL125	2	Long	2
PL155	2	Long	2
PL354	2	Short	1
PL540	2	Short	1
B-180207	2	(Lock-Nut)	2
CAU-49109	2	Long	2
CRL-49007A	3	Long	3
NAF-1136-1	2	Long	2
NAF-212938-1	3	Long	3
NAF-215285-2	2	Short	1

Note 1 — Interchangeable with others Note 1.
Note 2 — Interchangeable with others Note 2.
Note 3 — Interchangeable with others Note 3.

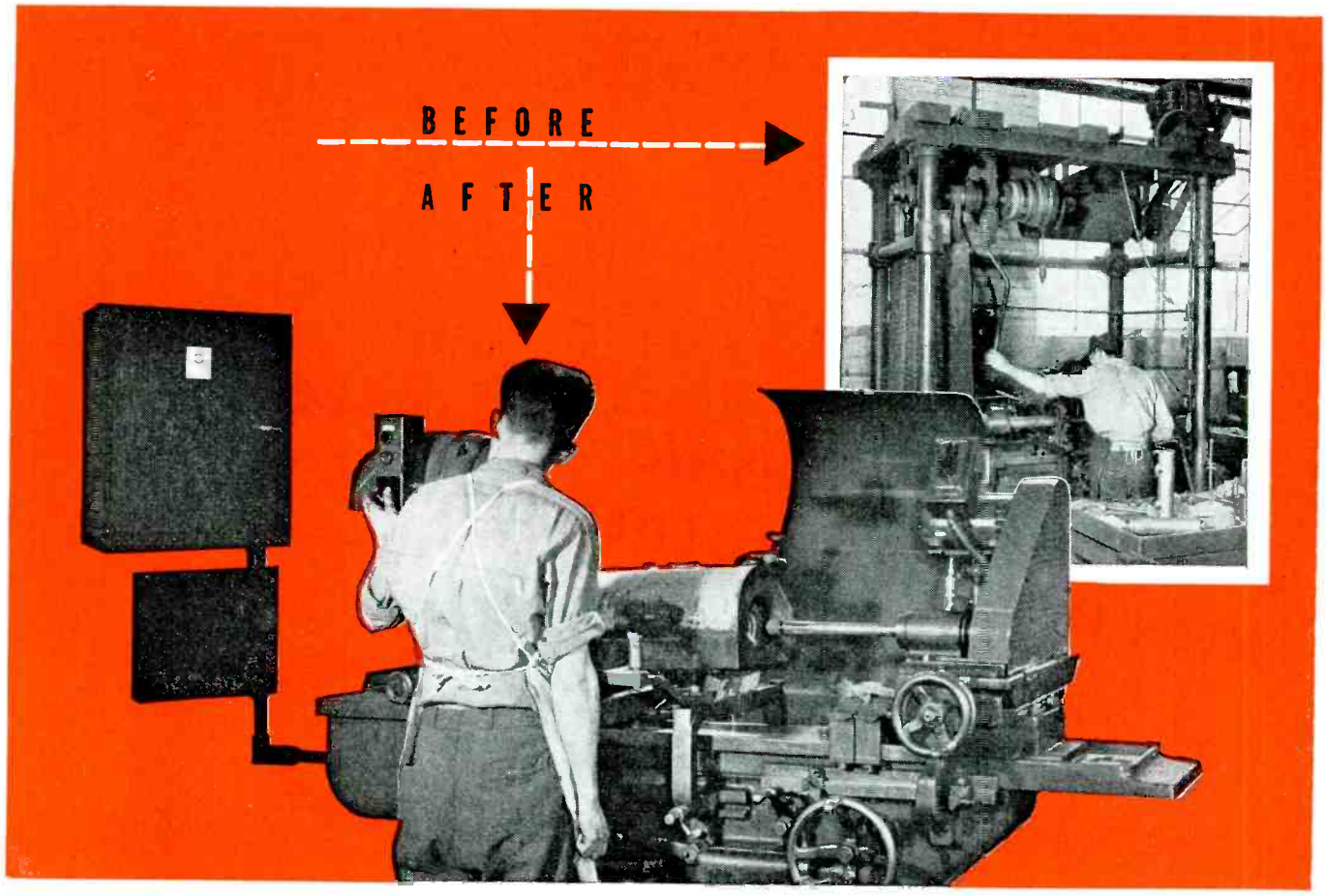
OTHER DESIGNS TO ORDER

REMLER'S EXPERIENCE in marine sound goes back to 1918; this firm was organized twenty-seven years ago to manufacture ship wireless. For five years before Pearl Harbor a division of Remler Company was busy with the design, manufacture and installation of inter-ship transmitting and amplifying equipment aboard passenger liners and merchant vessels . . . valuable experience for the manufacture of complete marine amplified sound systems for the U. S. Navy—built to withstand the shock and concussion of war as well as the corrosive action of salt air and water.

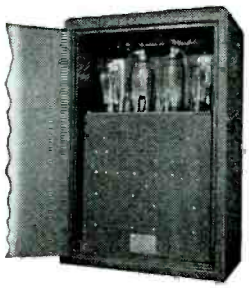
Further assignments in radio and electronics invited. Consult—

REMLER COMPANY, LTD. • 2101 Bryant St. • San Francisco, 10, Calif.

REMLER
SINCE 1918
Announcing & Communication Equipment



producing better than ever . . . after 30 years



ELECTRONIC MOTOR CONTROL

The Westinghouse Mot-o-trol . . . employing Thyratron tubes to convert a-c to d-c . . . provides wide-range stepless speed control through a 20 to 1 range, from an a-c *power source*. Pushbutton control station enables the operator to start, stop and control the speed while the machine is running. At any speed setting, variations in load cause little or no change in speed.

The Allies' urgent need for more oil recently created a demand for greatly increased production of hardened steel pump liners. To a leading West Coast manufacturer, this brought the problem of maintaining precision at a much higher production rate.

Internal grinding of these liners had been done on machines with overhead belt and pulley drives . . . providing only four speeds in definite steps. These grinders were unable to meet the stepped-up demand. Excessive vibration ground chatter marks into the liners. Subsequent honing became inaccurate. Setup time was high. To obtain delivery of a modern machine would require months.

Westinghouse engineers, working with the manufacturer, suggested modernizing the drives by applying Mot-o-trol, an electronic drive providing stepless speed control over a 20 to 1 range, with handy pushbutton control.

Result: the grinding operation showed immediate improvement. Vibration and chatter marks were eliminated. Setup time was reduced. And the new arrangement *saved 35% in floor space.*

This is typical of the modernizing possibilities with electronic equipment . . . not only in control, but in power conversion, processing methods, counting and sorting operations and countless other industrial tasks.

Your nearest Westinghouse office is ready to provide helpful assistance and information on electronic applications for *your* industry. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

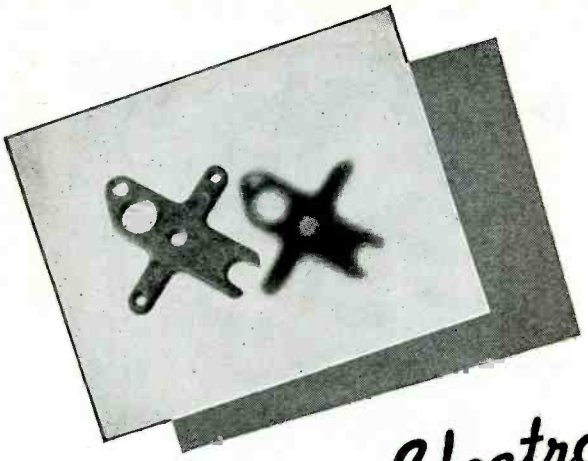
J-91072

Westinghouse

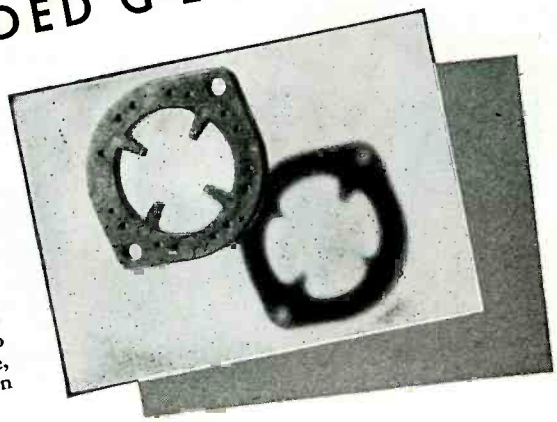
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

ELECTRONIC EQUIPMENT FOR INDUSTRY AND HOME—ELECTRONIC TUBES—RADIO AND TELEVISION



Superior Electronic Components
WITH INJECTION MOLDED G-E MYCALEX



G-E Mycalex is doing a big job for the electronic industry. A speedy yet precision type of injection molding developed by the General Electric Company allows intricate shapes to be molded to extremely close tolerances.

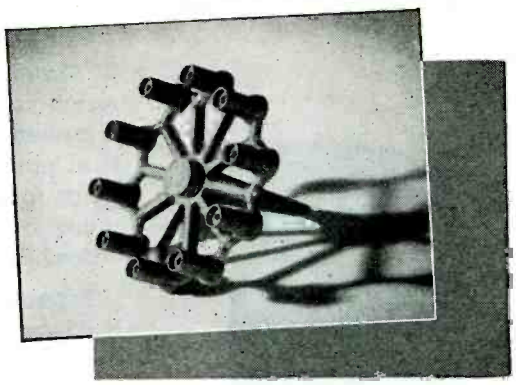
G-E Mycalex can be molded with metal inserts, and as a result, the metal and the G-E mycalex are fused into an unusually strong bond.

Having over-all electrical properties superior to porcelain products and refractory qualities superior to organic plastics, G-E mycalex remains the all-purpose, high-heat, high-frequency insulation material for use in the radio and electronic industries.

For further information write Section T-90, General Electric Company, One Plastics Avenue, Pittsfield, Mass.

G-E mycalex has the following properties:

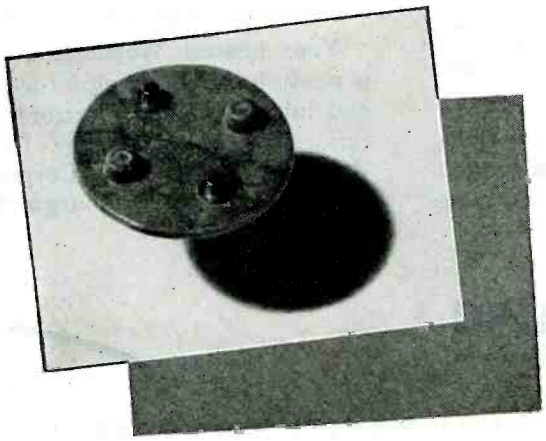
1. High dielectric strength. 2. Low power factor. 3. Prolonged resistance to electric arcs. 4. Chemical stability; no deterioration with age. 5. Dimensional stability; freedom from warpage, shrinkage, etc. 6. Imperviousness to water, oil and gas. 7. Resistance to sudden temperature change. 8. Low co-efficient of thermal expansion.

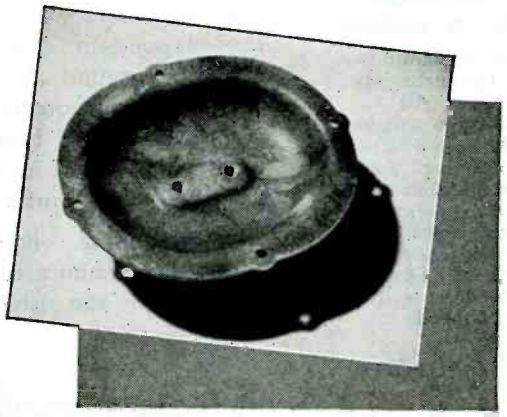


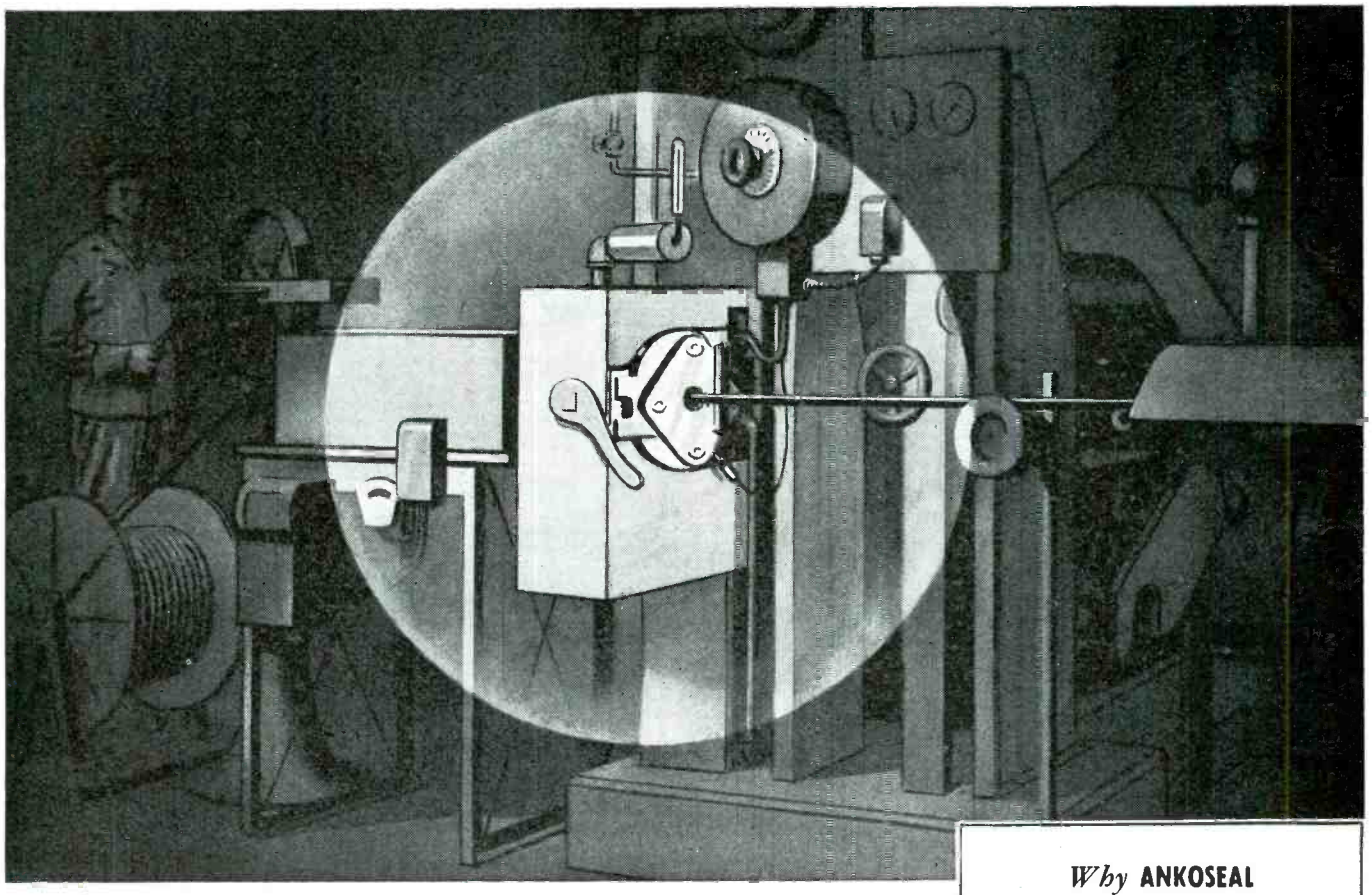
Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "G-E House Party" every weekday 4:00 P.M. EWT, CBS.

Buy War Bonds

GENERAL ELECTRIC PD-90







Where's the Engineer in this picture?

THE engineer isn't visible in the sketch—but he's there, behind every step in building Ankoseal cable! For, more and more, cables are engineered *and* manufactured to do particular jobs—especially here at The Ansonia Electrical Company!

Because of the many unusual cable demands of the Army and Navy which we have met, we are able to satisfy equally difficult requirements of other government agencies ...or of private concerns engaged in war work. Once we know what the function of the cable is to be, we take over—and from there to the finished product, in engineering and manufacturing, our organization works to deliver the form and type of Ankoseal cable best suited to that job.

That we stand ready to meet such requirements is indicated by our output record...made possible by "Yankee ingenuity" in manufacturing, implemented by emphasis on *continuing* laboratory research. These same facilities, this same ability, are offered to you.

So—if you have a cable problem—think of Ankoseal—and The Ansonia Electrical Company. We'll be glad to hear from you!

Why ANKOSEAL *solves cable problems*

Ankoseal, a thermoplastic insulation, can help solve many electrical engineering problems, now and in the future. *Polyvinyl* Ankoseal possesses notable flame-retarding and oil resisting characteristics; is highly resistant to acids, alkalies, sunlight, moisture, and most solvents. Polyethylene Ankoseal is outstanding for its low dielectric loss in high-frequency transmission. Both have many uses, particularly in the radio and audio fields. Ankoseal cables are the result of extensive laboratory research at Ansonia—the same laboratories apply engineering technique in the solution of cable problems of all types.

THE ANSONIA ELECTRICAL COMPANY

Specializing in "Ankoseal" a Thermoplastic Insulation

ANSONIA • CONNECTICUT

A Wholly-Owned Subsidiary of

NOMA ELECTRIC CORPORATION

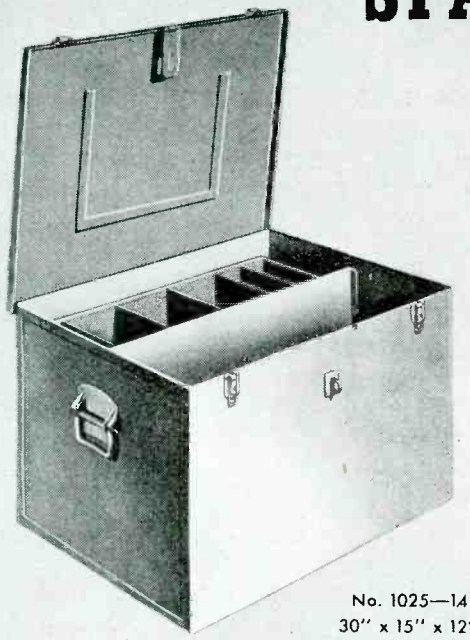
GENERAL OFFICES • NEW YORK, N. Y.

—In peacetime makers of the famous Noma Lights—the greatest name in decorative lighting. Now, manufacturers of fixed mica dielectric capacitors and other radio, radar and electronic equipment.

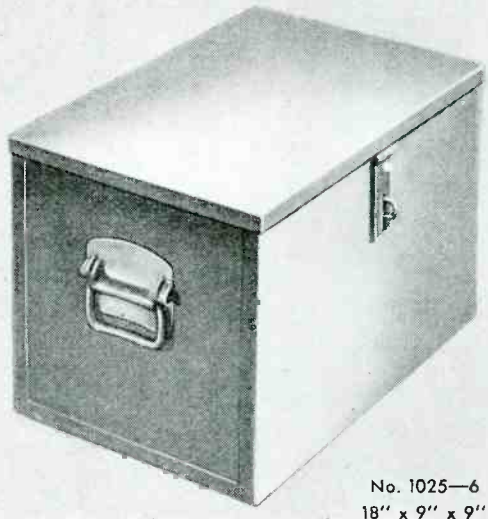
SPARE PARTS BOXES

...in every needed size!

...for every needed use!



No. 1025—14
30" x 15" x 12"
(Partitions not included)



No. 1025—6
18" x 9" x 9"

24 STOCK SIZES

As per specification 42 B 9 (Int) for shipboard use, Electrical and Mechanical. Navy grey finish. Immediate Delivery.

— WRITE FOR PRICE LIST —

Number	Length	Width	Height	Number	Length	Width	Height
1025- 1	12	6	6	1025-13	18	18	12
1025- 2	12	9	6	1025-15	24	15	12
1025- 3	12	12	6	1025-16	24	15	15
1025- 4	12	9	9	1025-17	24	18	12
1025- 5	18	9	6	1025-18	24	18	15
1025- 6	18	9	9	1025-19	24	18	18
1025- 7	18	12	9	1025-20	24	12	9
1025- 8	18	6	6	1025-23	30	15	9
1025- 9	18	15	9	1025-14	30	15	12
1025-10	18	12	6	1025-22	36	12	9
1025-11	18	15	12	1025-21	42	9	9
1025-12	18	12	12	1025-24	42	12	9

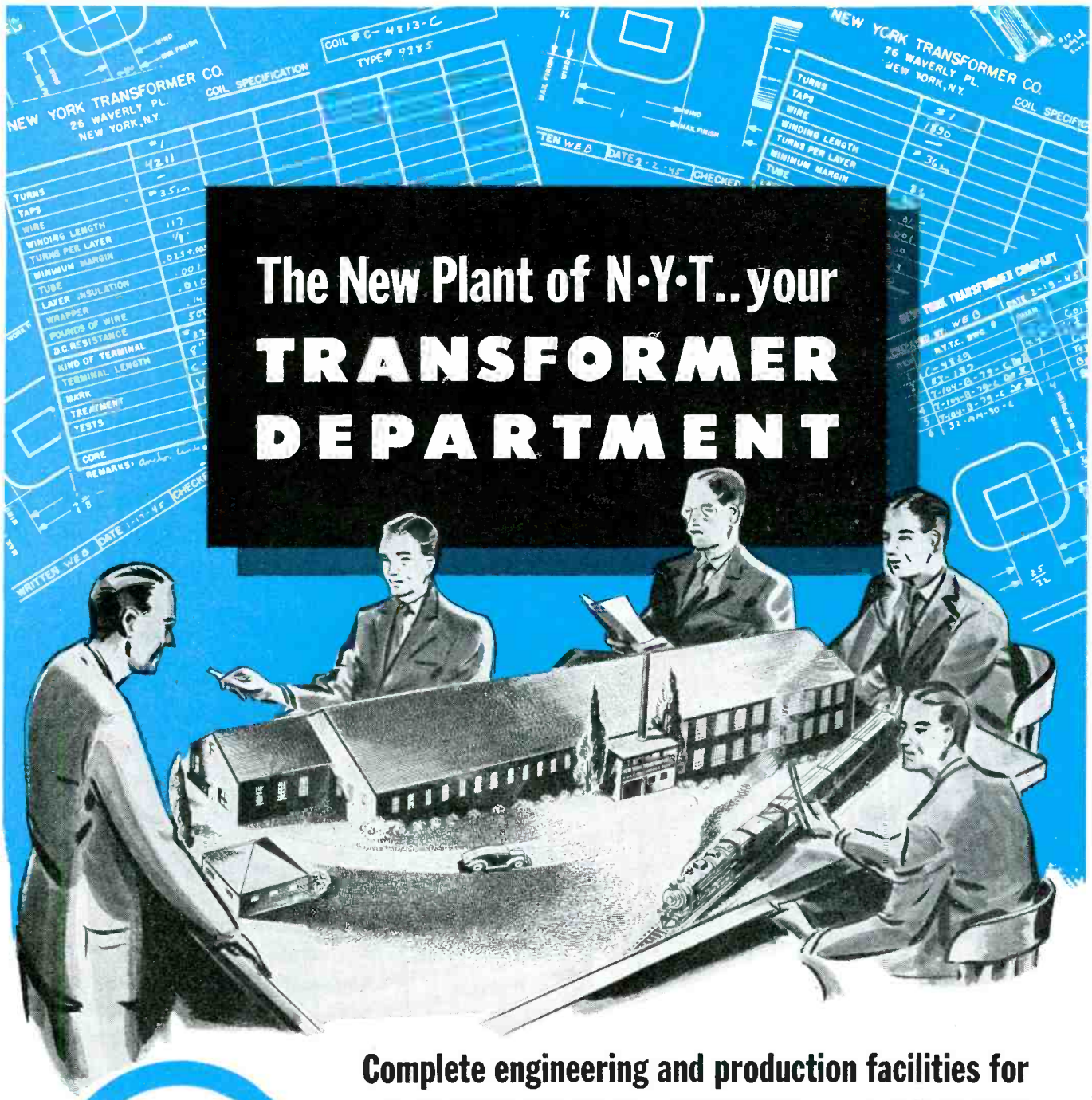
COLE

STEEL EQUIPMENT COMPANY

349 Broadway, New York 13, New York • Factory: Brooklyn, New York

COLE STEEL OFFICE EQUIPMENT

will again be available after the war



Complete engineering and production facilities for TRANSFORMERS, CHOKES and FILTERS

Tooled up and geared for full production, the latest addition to N-Y-T facilities is rapidly assuming the role of "Transformer Department" to leading electronic and electrical manufacturers.

Complete in every phase of manufacture, the Alpha Division is one of the most modernly equipped plants in the East.

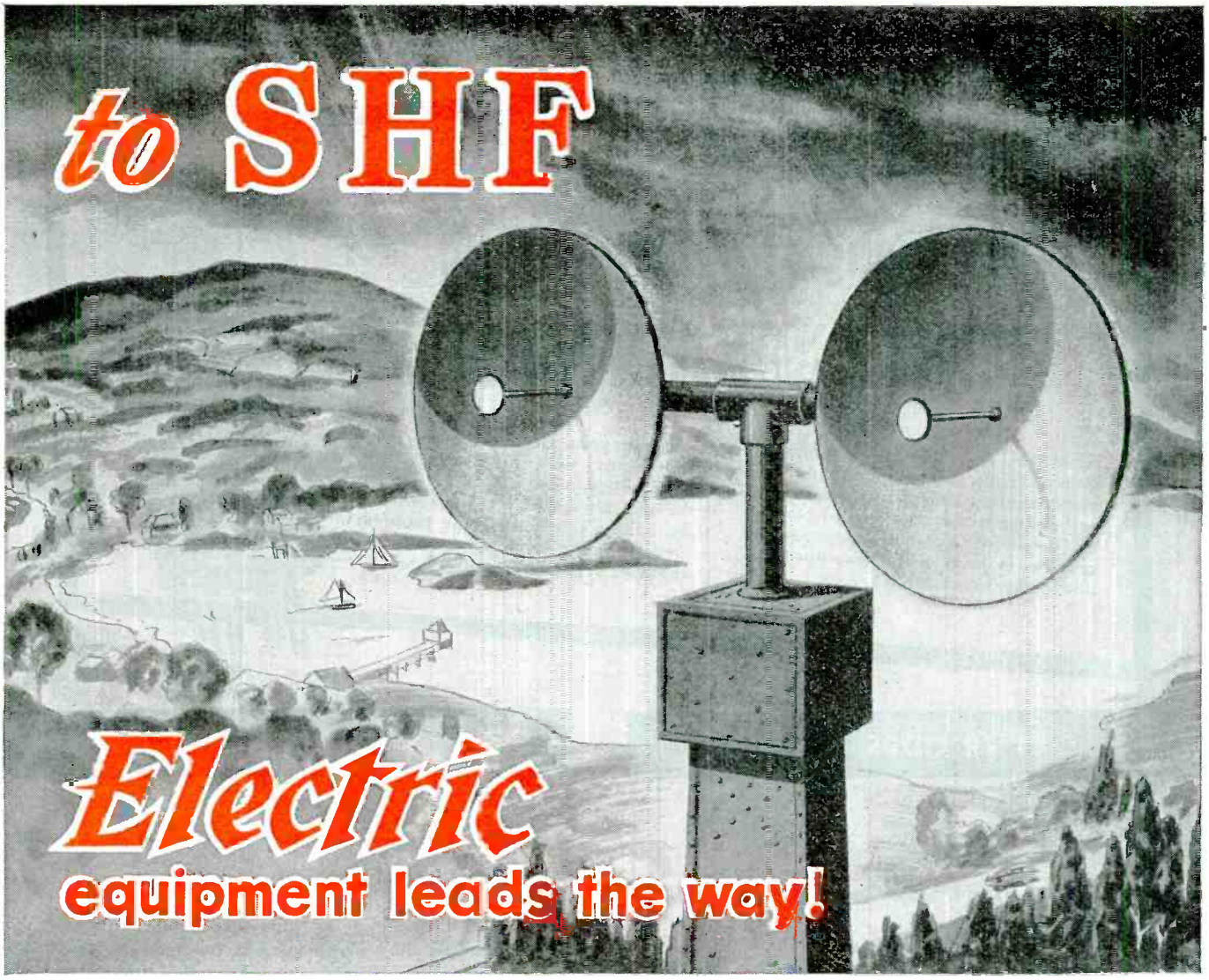
Important, too, is N-Y-T engineering collaboration — offering valuable assistance to engineers responsible for the design of electronic equipment. Close cooperation in this early phase of design inception results in better component suitability. It frequently effects over all economies and improvements. Inquiries are invited; there is no obligation.

N·Y·T
HERMETICALLY-SEALED TRANSFORMERS

The product illustrated typifies N-Y-T hermetically-sealed components — transformers, chokes and filters—designed to meet unusual operating conditions for every type of application.

Address Inquiries to Dept. N

NEW YORK TRANSFORMER CO.
26 WAVERLY PLACE, NEW YORK 3, N. Y.



cialized knowledge and its manufacturing techniques.

These wartime microwave developments hold great promise for the future of communications and television transmissions.

From the audio band and extending through the many services in the radio frequency spectrum up to the frontiers of super high frequencies, count on Western Electric equipment to lead the way!

Western Electric

Distributed by GraybaR ELECTRIC COMPANY

During the 7th War Loan Drive, buy bigger, extra War Bonds!

SOUND SYSTEMS

TELEVISION

SOUND MOTION PICTURES

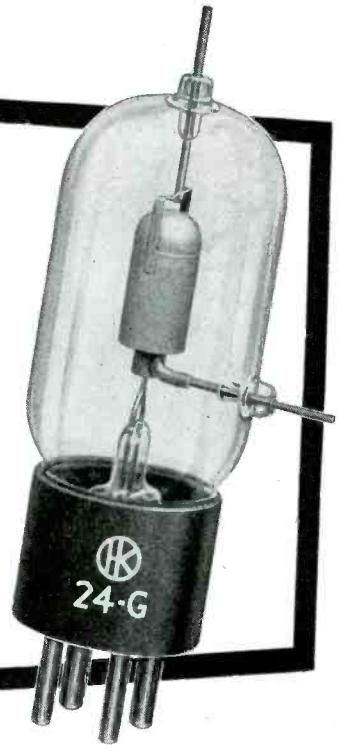
COMPONENT PARTS

knowledge in all of these fields

These 22 *Gammatron* types are being standardised by HEINTZ AND KAUFMAN LTD.

Heintz and Kaufman Ltd. is coming to the aid of equipment designers and manufacturers by standardizing the physical and electrical characteristics of 22 types of Gammatron tubes. These types will conform to Joint Army-Navy Specifications, where applicable.

So design your circuits around these Gammatrons—with the assurance that they will always meet the same high standards, and always be readily available, thus making unnecessary the problem of redesigning equipment because of changes or variations in tube types.



14 TRIODES

TUBE TYPE	PLATE DISSIPATION
HK-24	25 watts (Grid lead to base)
HK-24G	25 watts (Grid lead through envelope)
HK-54	50 watts
HK-254	100 watts
HK-354C	150 watts (Low Amplification Factor)
HK-354E	150 watts (High Amplification Factor)
HK-454L	250 watts (Low Amplification Factor)
HK-454H	250 watts (High Amplification Factor)
HK-654	300 watts
HK-854L	450 watts (Low Amplification Factor)
HK-854H	450 watts (High Amplification Factor)
HK-1054L	750 watts
HK-1554	1000 watts
HK-3054	1500 watts

1 PENTODE

HK-257B Plate Dissipation, 75 watts (Beam pentode)

4 RECTIFIERS

HK-253	Inverse Peak Volts, 15,000
HK-953B	Inverse Peak Volts, 30,000
HK-953D	Inverse Peak Volts, 75,000
HK-953E	Inverse Peak Volts, 150,000

3 IONIZATION GAUGES

VG-2 VG-24G VG-54

REPLACEMENT *Gammatron* TUBES

The following Gammatrons will be made available primarily for replacement use. Design engineers are asked to consider recommended standardized types when designing new equipment.

REPLACEMENT TUBE TYPE	DESCRIPTION	RECOMMENDED STANDARDIZED TUBE TYPE
HK-354	Triode, grid lead to base pin, ratings same as HK-354C	HK-354C HK-454L HK-454H
HK-354D	Triode, Medium Amplification Factor	HK-354C or E HK-454L or H
HK-354F	Triode, High Amplification Factor	HK-354E
HK-257A	Beam Pentode	HK-257B
HK-153	High Vacuum Rectifier, inverse peak volts, 5000	HK-253
HK-54S	Triode. Same as HK-54 except fil. current is 3.35 instead of 5 amps.	HK-54
HK-2054A	Triode	
HK-2054B	Triode	

HEINTZ AND KAUFMAN LTD.

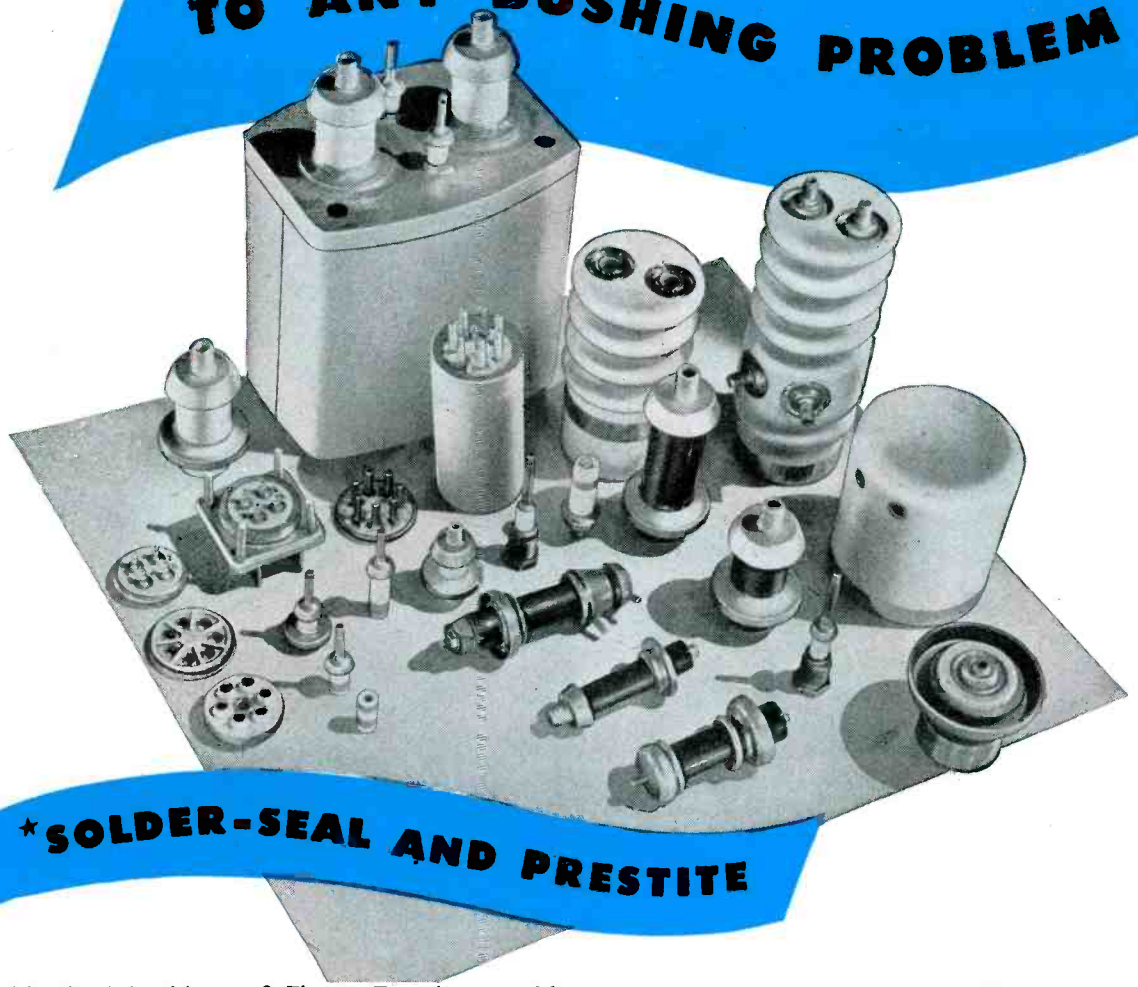
SOUTH SAN FRANCISCO • CALIFORNIA

KEEP BUYING WAR BONDS

Gammatron Tubes

Export Agents: M. SIMON & SON CO., INC.
25 WARREN STREET, NEW YORK CITY, N. Y

Two simpler answers* TO ANY BUSHING PROBLEM



*SOLDER-SEAL AND PRESTITE

Solder-Seal bushings of Zircon Prestite provide a better and simpler answer to any problem of obtaining a hermetic seal between the bushing and the casing of communications equipment.

Solder-Sealing joins Zircon Prestite directly to the metal stud to form a single unit that can, in turn, be directly soldered to the case. Perfect hermetic sealing is the result . . . sealing out damaging dirt, moisture and corrosive atmospheres . . . eliminating oil leakage . . . permitting operation under permanent pressure to stabilize dielectric strength.

This new and improved Westinghouse porcelain . . . Zircon Prestite . . . is mechanically strong and impervious to moisture. It has a low-loss factor and high resistance to heat shock (see table). Millions of Solder-Seal and Prestite bushing applications are in war service today . . . proving a simpler, quicker, more dependable answer to bushing problems as a result of 15 years of Westinghouse experience and engineering.

For complete information on Solder-Seal and Zircon Prestite, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-05155

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

COMMUNICATIONS EQUIPMENT

CHARACTERISTICS OF ZIRCON PRESTITE

Property	*Zircon Prestite	High-Tension Porcelain
Specific Gravity	3.68	2.4
Water Absorption, in %	0.00	0.00
Dye Penetration	None	None
**Linear Coeff of Thermal Expansion (20 to 7000 deg C) per deg C	4.9 x 10 $^{-6}$	5.3 x 10 $^{-6}$
Tensile Strength, lb per sq in	12,000	5,000
Compressive Strength, lb per sq in	90,000	48,000
Transverse Strength, lb per sq in	25,000	11,000
Impact Resistance (modified Charpy method) in gm per sq cm	17,800	6,000

*Approved as L-4 material by the Army-Navy Electronics Standards Agency.
**This characteristic gives Zircon Prestite its remarkable thermal shock properties and warrants comparison with other low-loss, high-frequency ceramic materials.

TRANSFORMER COMPONENTS

for every application

RADIO

Set components

Radio Filters

TELEPHONY

Loading Coils

Repeat Coils

Pulse Transformers

Mine Detection Components

DETECTION

Selective Amplifier Filters

Inter-phone Amplifier Components

AMPLIFICATION

Foremost Manufacturers of Transformers to the Electronic Industry

ARMY (E) NAVY ALL PLANTS

May we cooperate with you on design savings for your applications . . . war or postwar?

United Transformer Corp.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

ELECTRONIC INDUSTRIES
Including INDUSTRIAL ELECTRONICS

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

As Civilian Markets Loom Ahead

Conversion and cut-backs now have to be taken into consideration in all engineering planning. Elimination of the German front will mean substantial reductions in electronic output. A 50 per cent cut is likely; civilian and industrial markets must be found to keep production going ahead. The best engineering will be that which most flexibly adapts itself to the baffling but inexorable demands of the times.

Engineering Against Difficulties

The final list of frequency assignments is now forthcoming from the FCC, with attendant problems for radio designers. Engineers accustomed to solutions based on exact relations often arrive at greatly divergent answers when the importance of certain pros and cons must be weighted before using. No matter what happens, though, as to changing channels or rules, most engineers are not greatly perturbed if the cons are judged to be the more important, since making systems work in spite of difficulties is part of the engineer's everyday task.

Remember, also, that when perfection is reached, engineering ceases.

Old-Line Communication Turns to Radio

Only a few years ago, the old-line communications companies were consecrated to the theorum that if a wire circuit can be provided, it will not pay to go to radio.

But now in 1945 this Victorian thinking is being outmoded. The big wire companies today are eyeing the ether channels to replace copper circuits. President Gifford of A.T.&T. in his annual report officially chronicles the turn to radio by his own corporate giant. And tops of mountains across the Rockies, as well as hill-tops in New England, are being pre-empted by new common carriers of intelligence—audio, video and typo!

Even the conservative die-hards are thinking in new terms of radio and electronics.

Electronic First-Aid to DC

Direct-current departments of electric-motor manufacturers are taking a new lease on life with the development of packaged rectifier and control units. These compact electronic devices solve that weakness of ac motors, an inflexible rpm, and are applicable to any number of industrial jobs. Connected between the ac mains and a dc motor, they not only rectify the ac, but also by controlling the dc voltage, permit selection of any desired speed.

Industrial-plant operators are going to get well-acquainted with electron tubes from now on!

On the UHF Beam

The change to the new very-high-frequency airways guidance system, which will largely eliminate natural static, is now going forward. It will not be long before the "main line" of America's air highways, the route from New York to Chicago, will be fully converted and operating on the new system. As rapidly as possible, other sections of our airways will go over to the improved method of uhf.

With 5,000 airports promised for the United States, postwar, little time should be lost in getting the rest of the interconnecting avenues of the sky equipped for most efficient operation.

MERCURY ARC HEATING

By S. R. DURAND Application Engineer
Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

A mercury pool unit supplying 100 or more kilowatts at several thousand cycles for induction heating and melting

● The term "electronic induction heating" often is used to describe the application of high frequency vacuum tube oscillators operating at several hundred thousand cycles per second to the heating of metals, but this term should also include the use of "mercury arc electronic converters" which have recently been developed for operation at frequencies of the order of one thousand cycles per second.

Frequencies in the 1000 to 10,000 cycle range are used widely for induction heating for melting, forging, upsetting, bending, annealing, and steel hardening applications. For converting 25 and 60 cycle power into power at these frequencies there is a total capacity of several hundred thousand kilowatts of motor-generator equipment now installed in the United States. And for similar induction heating applications for forging and melting the first installations of mercury arc converters of 300 kw rating were made in 1944.

Mercury arc electronic frequency conversion equipment consists of a circuit-breaker, transformers, the water-cooled mercury arc converter, and a control and metering cubicle. The operating frequency is determined mainly by the circuit which consists of capacitors and the induction heating coil and by adjustment of the grid control, and this frequency bears no fixed relation to the power system frequency. Fig. 1 illustrates a typical method of installing this conversion equipment and Fig. 2 includes a circuit diagram.

In reference to these two illustrations, the delta primary winding of the 3-phase transformer unit can be designed for connection through a circuit breaker to any power system voltage. When power is available at up to 15000 volts ac, it is a preferred practice today to supply metal-clad switchgear equipment in which the vertical lift type oil circuit breaker or air blast breaker and ac metering equipment are inclosed in a sheet metal housing. This switchgear unit can be outdoor type throat connected to the transformer or

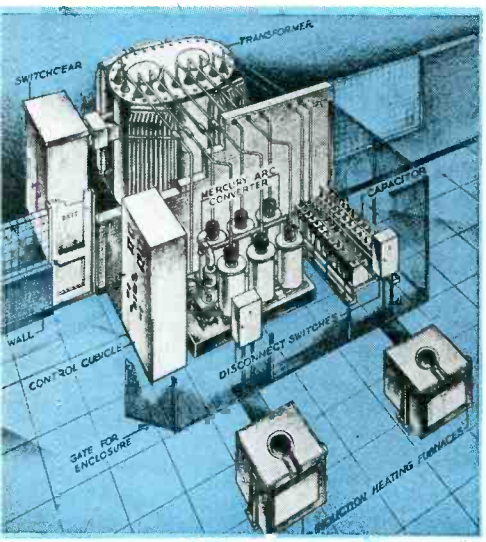
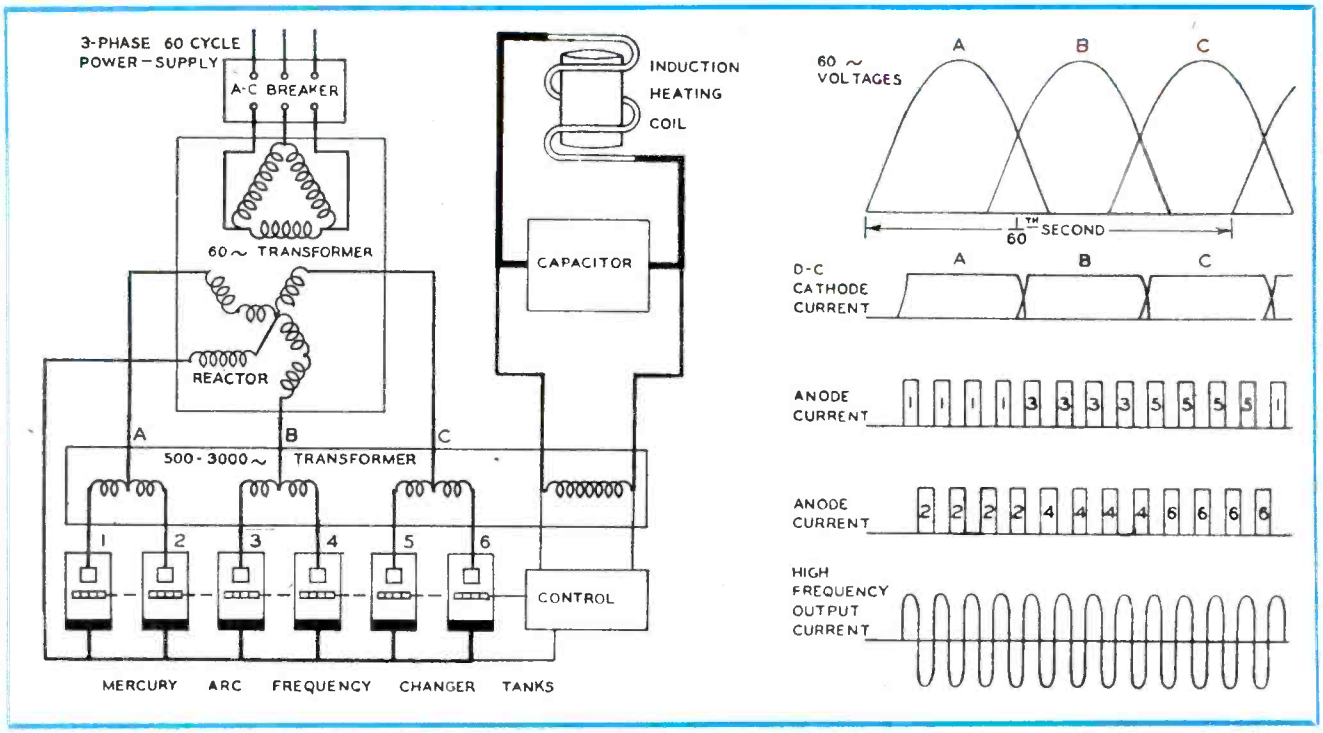


Fig. 1. At left is sketch of typical frequency converter installation of the Mercury Arc type

Fig. 2. Schematic of frequency changer using six grid controlled rectifiers. Anode current pulses are shown at right. Converted frequency is not harmonically related to line frequency



FREQUENCY CONVERTER

an indoor type with cable connection. When 3-phase power is supplied to an industrial plant at a voltage in excess of 15000, an outdoor type frame mounted oil circuit breaker most generally is used.

The transformer consists of a 3-phase, 60- or 25-cycle unit with neutral secondary reactor, and a single-phase high frequency unit with three center-tapped primary windings and a secondary output winding. The transformer components can be assembled in a single oil-filled case for ratings up to about 500 kw, but for higher output ratings, the size and weight make it more desirable to mount the high frequency transformer in a separate case.

The secondary winding of the three-phase transformer is zig-zag connected to avoid a steady component of residual magnetomotive force and thus prevent dc megnetization of the core. The neutral reactor of a few millihenries inductance serves effectively to smooth the dc in the cathode circuit and hence suppress the high frequency ripple component in the 60-cycle three-phase transformer.

The mercury arc converter unit for output ratings from about 150 kw to 300 kw can be the multi-anode type with six anodes and grids and a single mercury pool in an evacuated tank, or for higher ratings, it can be a group of six or twelve single anode rectifiers (such as the Excitron*) in which each evacuated tank has its own mercury pool, anode, and grid. The graphite anodes of these tanks are connected to the terminals of the three primary windings of the high frequency transformer, and the secondary winding of this transformer supplies high frequency power to the induction heating coil and capacitor circuit.

The circuit may be termed a self-rectified inverter, because if viewed from the ac input side, the power system is symmetrically loaded as though it were supplying power to a three-phase rectifier; if viewed from the single-phase output side, the induction heating circuit receives alternating current power produced from a supply source of a different frequency.

High frequency current does not flow in the windings of the three-

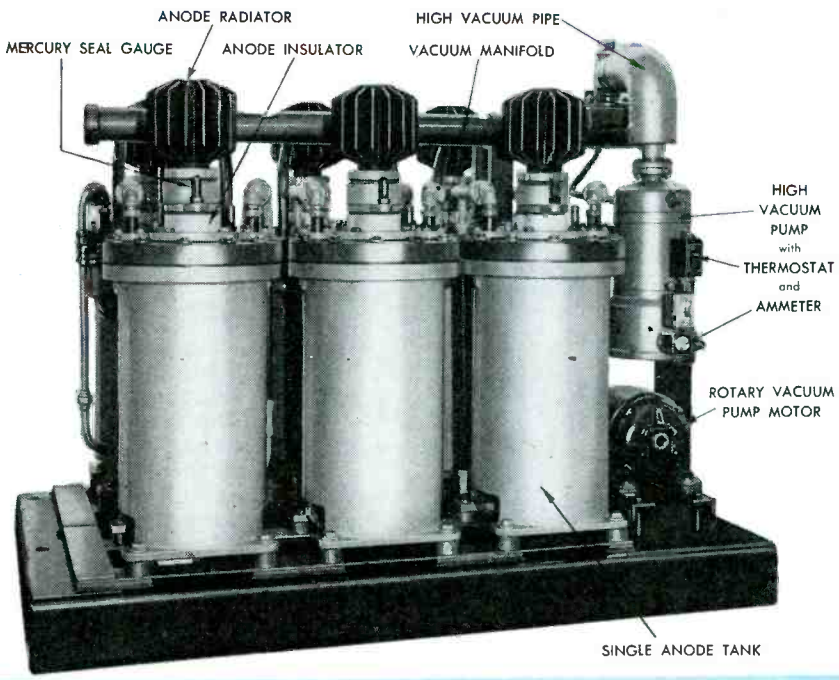
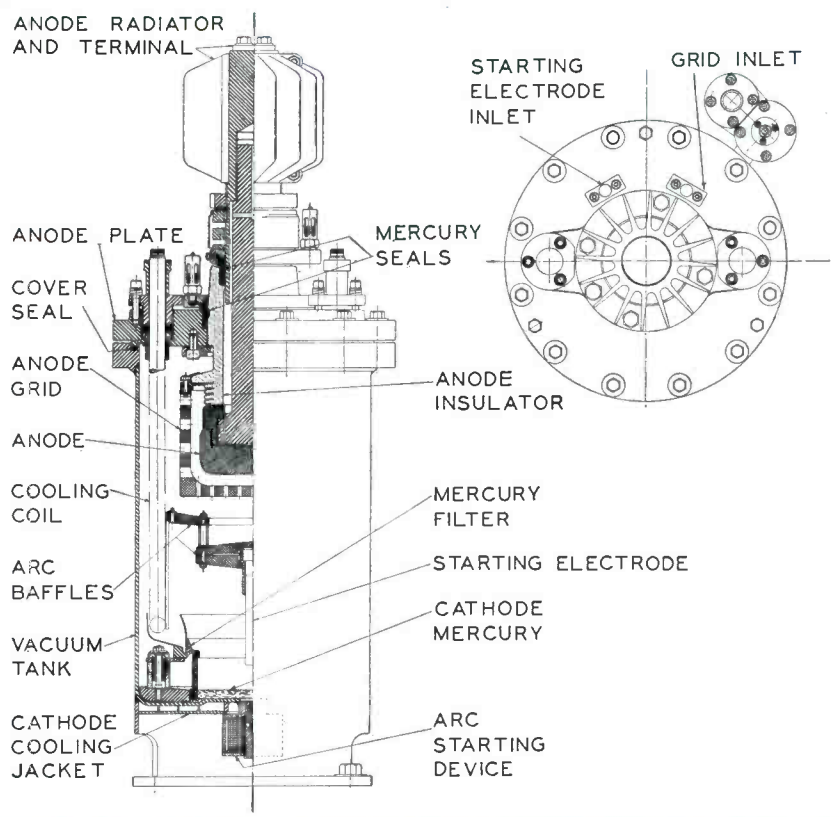


Fig. 4. Arrangement of six tanks and vacuum system. Note heat radiator fins on anodes

Fig. 3. Below is cross-section view of grid controlled single anode mercury arc rectifier used in frequency converter. Note internal water cooling coils, grid surrounding anode, and arc starter



*Allis-Chalmers Mfg. Co. type of single-anode rectifier.

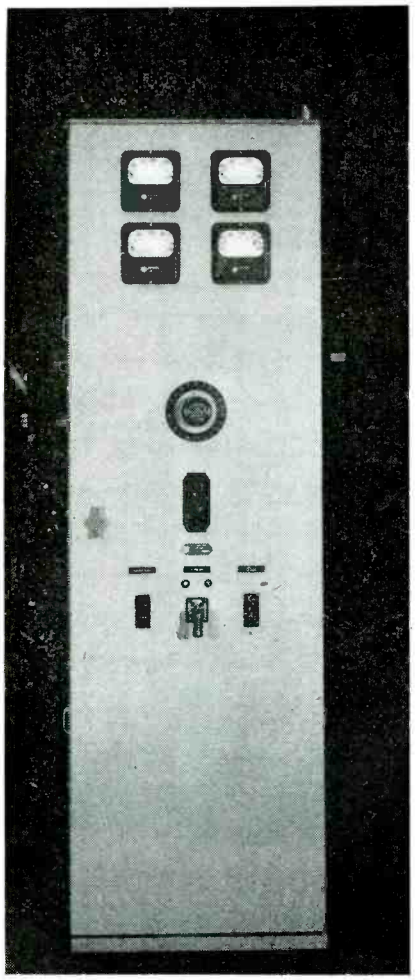


Fig. 5. Control cubicle necessary for operation of unit shown in Fig. 4 contains grid control, arc excitation, and vacuum measuring apparatus

phase transformer. The current returning to the neutral point of the secondary winding of this transformer is rectified ac. One important difference between an ordinary inverter supplied from a dc source and a frequency converter of this type is that if the high frequency potentials supplied from the induction heating circuit to the grids becomes inadequate, the frequency converter simply ceases to operate.

Operating frequency

The frequency of the generated single-phase power is independent of the frequency of the three-phase power supply system so that a flexible frequency coupling exists between the two circuits. The operating frequency is determined primarily by the inductance and capacitance of the heating circuit. During the heating of a metallic charge in the inductor heating coil, the impedance of the charge is subject to continuous changes and hence the impedance of the inductor also will change. As a result the operating frequency continuously shifts automatically to compensate for these changes in impedance. This is an important advantage for this type of electronic frequency converter in comparison with a motor-generator set because if it operated at a fixed frequency in relation to the power system frequency, it would be necessary repeatedly to switch in capacitors to compensate for the changes in impedance.

Power factor

The power factor of induction heating coils is in many cases of the order of only 10 per cent so that it is always necessary to furnish a large bank of static capacitors with motor-generator or mercury arc frequency changers to supply the high reactive inductor current. This capacitor bank relieves the converter of having to supply the very high reactive component to the inductor heating coil, and enables the power factor to be corrected to close to unity.

However, as the effective impedance of the inductor coil changes during a heating process, and if a fixed frequency is maintained as is done with a motor-generator operating at a constant speed, the generator will be forced to supply high reactive currents and may become seriously overloaded by these reactive currents unless a very careful watch is kept of a power factor meter and capacitors are repeatedly switched in to maintain the power factor close to unity. With a mercury arc frequency changer, the high power factor automatically is maintained.

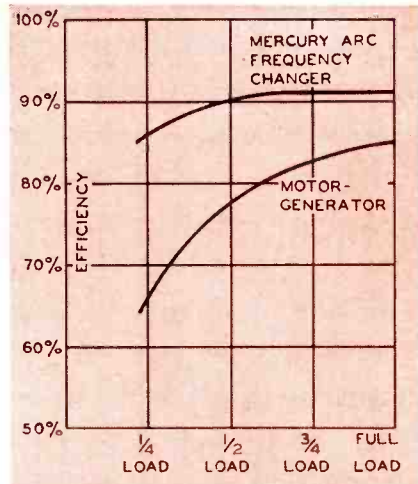


Fig. 6. Efficiency comparison between mercury arc and motor generator high frequency equipment. Mechanical windage losses reduce efficiency of MG sets at low output

A cross-section of a mercury arc tank is shown in Fig. 3. This type of mercury arc tank has a graphite anode surrounded by a graphite grid and supported by insulators on the top plate of the tank. Directly below the grid are graphite baffle plates to shield the anode from the cathode spot formed on the mercury pool at the base of the tank. An auxiliary anode is located just above the center of the mercury pool and serves to maintain an excitation pilot arc continuously on the pool during operation. The auxiliary arc is supplied with current from a small selenium rectifier located in the control cubicle associated with the converter unit. A magnetically operated ignition device below the mercury pool is energized momentarily to establish the auxiliary pilot arc when the equipment is to be placed in service.

Deionization control

The cross-section diagram shows that this type of tank contains an insulated internal cooling coil. This coil has a flow of water of the order of one gallon per minute passed through it during operation to provide a cooled condensing surface for the mercury vapor formed by the arc currents. After condensing the mercury runs back to the pool at the base of the tank and thus is never used up. The internal cooling coil controls the temperature at which the tank is operated and thus regulates the mercury vapor pressure which has an important influence on the deionizing time of the grid.

After the passage of arc current through the grid, it is essential that the grid regain full blocking control while another tank is carrying current, so that when it again becomes its turn to carry current, the grid will release the flow of current at the proper instant. By operating the tank at high voltage and correspondingly low current, by proper design of the grid, and by efficient control of the temperature by means of an insulated water cooling coil, the deionizing time for the grid is of very short duration, so that operation at high power output and at frequencies of the order of 1,000 to 2,000 cycles per second can be attained.

The illustration in Fig. 4 shows a 6-tank unit with automatic vacuum pumping equipment. The control cubicle for a frequency changer installation is shown in Fig. 5. This cubicle contains the excitation equipment, vacuum measuring equipment, the grid control equipment with power output adjusting rheostat for regulating the grid circuits, control switches, and high frequency metering equipment.

In placing a mercury arc frequency changer in service, a negative blocking bias of the order of one hundred volts is applied to the grids from a small selenium rectifier in the control cubicle. An-

other control switch is also closed automatically to establish excitation pilot arcs in the tanks, and to start up the water circulating pump of a small water-to-water heat exchanger on the converter frame which automatically controls the water temperature circulated through the tank cooling coils. The main ac breaker can then be closed by a control switch on the cubicle to energize the three-phase transformer, but the unit will not furnish high frequency power to the induction heating circuit until the grids are released.

Starting oscillations

Operation at high frequency can be started by a push-button station on the control cubicle or by another push-button station remotely located at the induction heating furnace. When the "start" button is pressed, a small contactor in the cubicle picks up to release the negative blocking potential on the grids and thus to allow arc currents to be established cyclically in the tanks at the frequency of the induction heating circuit. This capacitive-inductive circuit is effectively shock excited and caused to oscillate by the first application of voltage across it, and control potentials are then fed back to the grids in proper phase relation to maintain power at the operating frequency of the circuit.

To limit the magnitude of the arc currents during the first instant of starting, a resistor is inserted in the cathode circuit. This resistor is shorted out in a small fraction of a second by the automatic closing of a dc contactor connected across it, so that full power is quickly fed to the heating circuit.

The output voltage and thus the output power in the induction heating coil can be regulated by means of a rheostat on the control cubicle which varies the phase angle at which the high frequency potentials are fed back to the grids.

The operation of the mercury arc tanks in converting three-phase 60-cycle power into single-phase power at a frequency of the order of 1,000 cycles can be better understood by reference to the wave diagram included in Fig. 2. The top diagram shows the phase relation of the positive crests of the 60-cycle secondary voltage waves supplied successively to the centertaps of the three primary windings of the high frequency transformer.

While phase A is at highest positive sine wave potential in relation to the other two phases, current flows alternately to tanks 1 and 2 through primary winding A of the single-phase transformer. One-third of a cycle later when phase B of the 60-cycle supply voltage attains a higher positive value than phase A, tanks 3 and 4 carry current through the single-phase transformer winding B. During the last third of the 60-cycle frequency, tanks 5 and 6 carry current through winding C.

Each primary winding of the high frequency transformer thus operates cyclically, but because all these windings are on the same core with the secondary output winding, high frequency power is transferred continuously to the secondary winding and supplied to the induction heating resonant circuit.

Below the 60-cycle voltage wave diagrams are shown the dc cathode currents that flow successively through each secondary phase of the zig-zag winding of the 60-cycle transformer and back through the cathode reactor to the neutral point of the secondary winding. While this unidirectional current is flowing through phase A, for example, for 1/180th of a second, it is transferred back and forth several times between tanks 1 and 2 by electronic grid control of these mercury arc tanks.

During the short interval that current is flowing through tank 1, it flows through one-half of the primary winding A of the high frequency transformer. This causes the terminal end of this half of this winding to be effectively connected to cathode potential, and a high positive potential to be induced on the opposite terminal end which is connected to anode 2. A short interval later when the grid of tank 2 is released by a positive potential from the high frequency feedback control circuit, an arc current will be initiated in tank 2, and will cease in tank 1. The space around the grid of tank 1 is quickly deionized so that the grid regains blocking control until it again is released.

Current paths

It is evident from the anode current diagrams that although the anode currents always flow in the same direction through the tanks from anode to cathode, these currents flow in opposite directions through each half of the primary winding. It is thus apparent that the current and voltage induced in the secondary winding of the high frequency single-phase transformer will be essentially ac sine waves as illustrated by the lowest wave diagram in Fig. 2.

In this elementary diagram, the current flowing through half of the primary winding to anode 1 induces the positive half of the sine wave in the secondary winding, and the current flowing through the other half of the primary winding to anode 2 induces the negative half of the sine wave in the secondary winding of the single-phase transformer. Fig. 7 is a picture from a cathode ray oscillograph of a 1,000 cycle 1,500 ampere current wave in an induction heating coil circuit supplied by a mercury arc converter.

When current is transferred from anodes 1 and 2 after a third of a 60-cycle period to anodes 3 and 4, all four anodes may divide the current alternately at the transfer point until the positive ac 60-cycle

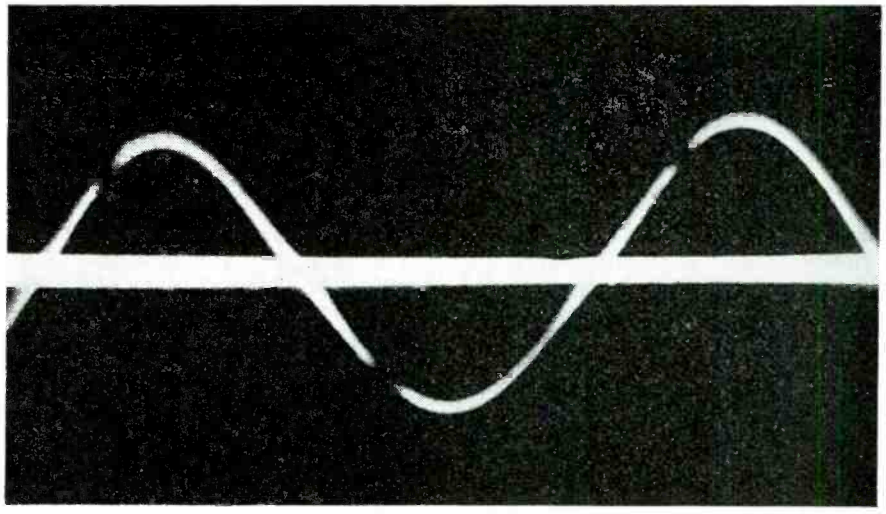


Fig. 7. Oscillogram of 1000 cycle 1500 amp. current in induction heating load coil of mercury arc converter. Resonant condition in load circuit produces sine wave output from shock excitation produced by block waves from tubes

voltage to anodes 1 and 2 becomes too low for them to continue to function. The entire current then will be transferred back and forth several times between anodes 3 and 4 during the next one-third of a 60-cycle period until the positive ac sine wave voltage becomes lower than that of phase C when anodes 5 and 6 will pick up and transfer current between them.

It is evident that the rate at which the pairs of anodes transfer current between them, and the momentary overlapping of four anodes when current is transferred between successive pairs is independent of the 60-cycle frequency, so that completely flexible coupling exists between the three-phase power system frequency and the single-phase induction heating circuit frequency.

Efficiency factors

The value of this feature cannot be emphasized too greatly because it means that the very high reactive currents required for the induction heating coil are continuously and automatically compensated by the capacitor without any direct demand on the active load current delivered by the mercury arc frequency changer.

Capacitor switching equipment and constant vigilance on the part of an operator as required by a motor-generator to maintain a high power factor in order to avoid overloading the equipment can be completely dispensed with, and the electronic type converter can be operated at high efficiency at all times without careful supervision.

The inherent arc drop in a mercury arc Excitron tank is approximately 15 volts. By designing the zig-zag secondary winding of the three-phase transformer to operate at an effective voltage of about 1,500 volts, the arc drop loss is only 1 per cent, and the conversion efficiency is about 99 per cent. The auxiliary equipment such as vacuum pumps, excitation circuits, and automatic water cooling equipment reduce the converter efficiency to about 98 per cent. The iron and copper losses in the transformers further reduce the efficiency so that at full load the overall electrical efficiency of the mercury arc frequency conversion equipment from the three-phase power supply system to the single-phase output transformer terminal is about 92 per cent.

Fig. 6 illustrates the efficiency of this type of electronic converter as compared with a motor-generator set. A highly efficient motor of about 95 per cent efficiency may be selected but the windage losses in the multi-pole high frequency generator usually result in the efficiency of this part of the machine being only about 90 per cent, so that the overall efficiency of the machine at full load is only about 85 per cent. Some machines of 1,000 kw rating and higher have been hydrogen cooled to reduce windage losses and gain 2 per cent to 3 per cent in efficiency.

The development of high power electronic frequency changing equipment for converting power into the higher frequencies required for efficient induction heating of large masses of metals is one more example where electronics offers a new and better means for the advancement of science and the production of goods for mankind.

When operating at less than full load, it is characteristic of mercury arc conversion equipment that a much higher efficiency can be maintained at light loads with this static type equipment than with rotating type equipment. This is one of the reasons why several million kilowatts of mercury arc rectifiers have been installed in the United States in recent years in preference to rotary converters or motor-generator sets. Fig. 7 illustrates the large difference in efficiency that exists over a wide loading range between a mercury arc electronic converter and a motor-generator set and indicates the substantial savings in power that can be effected with electronic conversion equipment.

Idling losses

In some applications of induction heating where power is used only intermittently, the idling losses of the mercury arc equipment would be negligible because the grids can be blocked electronically, even without switching out the breaker. It would not be practical in many cases repeatedly to start and stop a motor-generator in this type of service, so the idling power cost in keeping the machine rotating could be quite an expense.

Motor-generator sets for induction heating applications can be built with motors for 2,300 or 4,160 volt service, but it is not economical to design machines for connection to power system lines brought into industrial plants at higher voltages. It is often necessary therefore to obtain a step-down transformer and circuit breaker equipment to reduce the incoming power system voltage to a lower voltage for the motor. This results in an additional loss in efficiency of about 2 per cent for motor-generator frequency changers in comparison to mercury arc converters that can be designed for direct connection to the incoming power system line voltage.

One advantage of a motor-generator is that when the 60-cycle power factor load of an industrial plant is a problem, a synchronous motor can be supplied on the machine. If the induction heating unit is operated continuously at full load, the synchronous motor can be operated to help to improve the ac power factor to the extent of its rating in comparison to the poor power factor load of a plant. However, if the rating of the motor-generator is low in comparison to the plant load and if it is not run continuously at full load for induction heating, it will not be an important asset for power factor correction of the ac metered power.

Power factor

The three-phase mercury arc converter with six Excitron tanks operates at a lagging power factor of about 83 per cent. Higher power units with twelve tanks or two six-tank units can be operated at a lagging power factor of about 93 per cent equivalent to the power factor of a six-phase rectifier load. These power factors are generally well above the minimum limits allowed by the electric utilities, and so, in general, present no problem. The load on the power system is similar to that of a mercury arc rectifier of which there are many hundreds in service in this country today supplying dc power to electric traction systems, electrochemical plants, steel mills, mines, and many types of industrial plants.

The power factor of the ac system of an industrial plant can be improved, if required, by connecting static capacitors to the power lines, but the power factor of the self-rectified mercury arc inverter is so much higher than many other types of equipment that capacitors seldom are required because of a mercury arc converter load.

The power factor on the ac system should not be confused with the power factor of the high frequency induction heating coil which is automatically compensated by the capacitors and by the flexible coupling that exists between the power supply system and the high frequency circuit as previously described.

(*Continued on page* 150)

SHF POWER MEASURING

Modern technics involved in the accurate measurement of power in wave guides at frequencies over 1000 mc

By H. GREGORY SHEA
Associate Editor, Electronic Industries

• Measurement of high frequency power delivered out of a wave guide or coaxial cable in the ranges above 1,000 megacycles presents problems quite different from those existing in the lower frequencies. Even a slight amount of consideration makes it evident that leading the current into an indicating meter and obtaining a direct reading of the required quantity is impossible, because one of the principal points to keep in mind concerning centimeter waves is the ease with which they are attenuated, dispersed or reflected.

Consequently, not only must the basic method of measurement be sound, but there must be assurance that the power measured is actually the power available at the point where it is to be used. It must also be kept in mind that the power generated may, and in fact almost always does, contain harmonics of the frequency in which the user is interested. Therefore a question to be decided is whether the power to be measured is the total power of the fundamental plus the harmonics, or just the power of the fundamental. In the latter case, the question of harmonic suppression would be introduced immediately.

To illustrate the problem and a solution, let us assume that it is desired to measure the power of a wave of 3cm. length (in free air) appearing at the opening of a rectangular wave guide, and that adjustments are to be made in the supply apparatus to produce at this point a power level of 2 milliwatts. How can this be done to a high order of accuracy?

Heating effect

At present, the only satisfactory method is to make the measurement by a determination of the heating effect of this rf power. Since heat is difficult to measure directly with any degree of accuracy, a secondary effect derived from the influence of heat must be measured. An easy way of doing this is to measure a change of resistance produced by this heat in a resistance element.

However, it is necessary to make the rate of escape of heat reasonably constant with respect to the rate of input of heat, as otherwise, the temperature reached by the detecting element, and therefore its resistance change, would vary more or less from measurement to measurement. The more sensitive the resistance element is to temperature changes, and the more nearly it is operated at a temperature close to the ambient temperature, the greater the precautions will have to be to prevent variations in ambient conditions from affecting the readings.

The basic circuit of the power measurement method is shown in Fig. 2. Naturally, the first problem is to determine the material to be used as a power sensitive device whose resistance will vary with temperature. Two kinds of material have been successfully employed, namely fine fuse wires, and Thermisters.* Both of these materials have negative temperature coefficients. That is, their resistance drops as their temperature increases. Fine fuse wires suitable for this work have been obtained from small ten mil. glass enclosed fuses, but they have almost no overload capacity and hence burn out very readily.

High sensitivity

Certain metallic oxides, when formed as a junction blob between two fine wires, the whole being enclosed in a glass bead about ¼ in. long, are marketed under the name of Thermisters by the Western Electric Co. These have a much sharper change in resistance with temperature and are therefore more sensitive. They also possess substantial overload capacity. Changes from an initial value of about 800 ohms to about 40 ohms can be produced in such beads by direct currents increasing in value from one to 30 milliamperes as shown in Fig. 1.

*See pp. 76, Electronic Industries, Jan. 1945.

Fig. 1. Resistance in open air of a bead Thermister when dc is passed through it

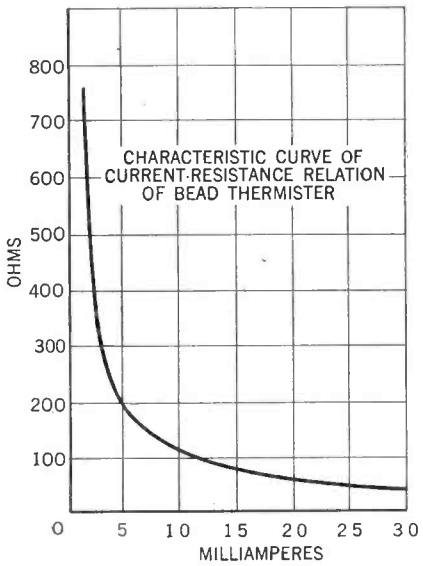
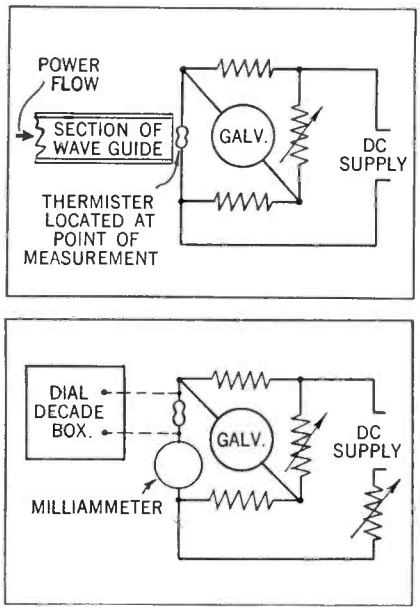


Fig. 2. Power dissipated in Thermister heats it and unbalances bridge

Fig. 3. Bridge is first balanced with known resistance equal to characteristic impedance of wave guide



Before power is turned on the circuit of Fig. 2 can be balanced either by changing the variable arm of the bridge, or by changing the amount of direct current flowing through the Thermister, thus altering its resistance. For reasons to be explained shortly, both of these methods are used.

When the power is turned on, some of it will be absorbed by the Thermister, and dissipated therein as heat. This will change the resistance of the Thermister, unbalancing the bridge and causing the galvanometer to read a value depending on the amount of unbalance. To make this reading quantitatively accurate, it is necessary to know the meaning of the relationship between power flow and meter readings.

Temperature control

Thermisters are not linear devices. The change in resistance with change of current flowing, or correspondingly, with change of temperature, depends on the operating temperature. Therefore, to permit the initial temperature of the Thermister to change is, if high accuracy is desired, to introduce undesirable complications. Furthermore, to measure the power in the wave, it is necessary that all of the power be absorbed by the Thermister. This means that no reflections can be permitted to exist, as these would seriously decrease the measured power by dissipation along the wave guide.

The wave guide is a transmission line having a characteristic impedance which should be purely resistive. To avoid reflections, it is necesary that the termination, or power absorbing device at the end of the line match the characteristic impedance of the guide exactly. If, during measurement, the resistance of the Thermister is allowed to change, exact matching will be lost and reflections will immediately be created. Hence, to make a correct measurement, it is obligatory to make the Thermister resistance equal to the characteristic impedance of the guide and keep it there during the measurement.

Balance maintained

Before starting, therefore, an accurate dial decade box, previously checked with a good Wheatstone bridge, is substituted for the Thermister, as shown in Fig. 3, and is set at the value of the characteristic impedance of the guide. The bridge circuit shown is then balanced by changing the variable arm of the bridge until the meter reads null. The Thermister is then reintroduced, and the dc supply is adjusted, thereby changing the Thermister resistance until the circuit is again balanced. After this, it is well to recheck the resistance with the decade box, as the change in total bridge current may have affected the value of one of the other arms, particularly if poor quality resistors have been used.

Now, when rf power is turned on, and the galvanometer in Fig. 3 deflects, indicating a change in Thermister resistance, it can be brought back to null by a decrease of dc bridge current. This restores the resistance of the Thermister to its previous value. If the dc through the Thermister was I_1, amps before rf power was turned on, and I_2, amps after, the power in the wave which has been substituted for the dc power to keep the Thermister at the same temperature and resistance value, can be calculated from the equation:

$$P = (I_1 - I_2)^2 R$$

Where P = Power in electric wave in watts, R = Constant resistance of Thermister in ohms.

It would not be unusual to wish to measure 100 microwatts with an accuracy of 2%. If the Thermister resistance is 200 ohms, 2% of 100, or 2 microwatts can be indicated by a change in current of 100 microamps. The dc meter used should therefore have a sensitivity such that this value can be read easily.

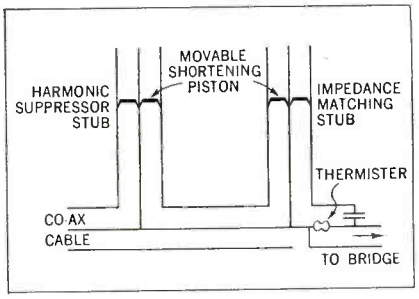


Fig. 5. Application of bridge to coaxial cable output. Stubs used to eliminate harmonics

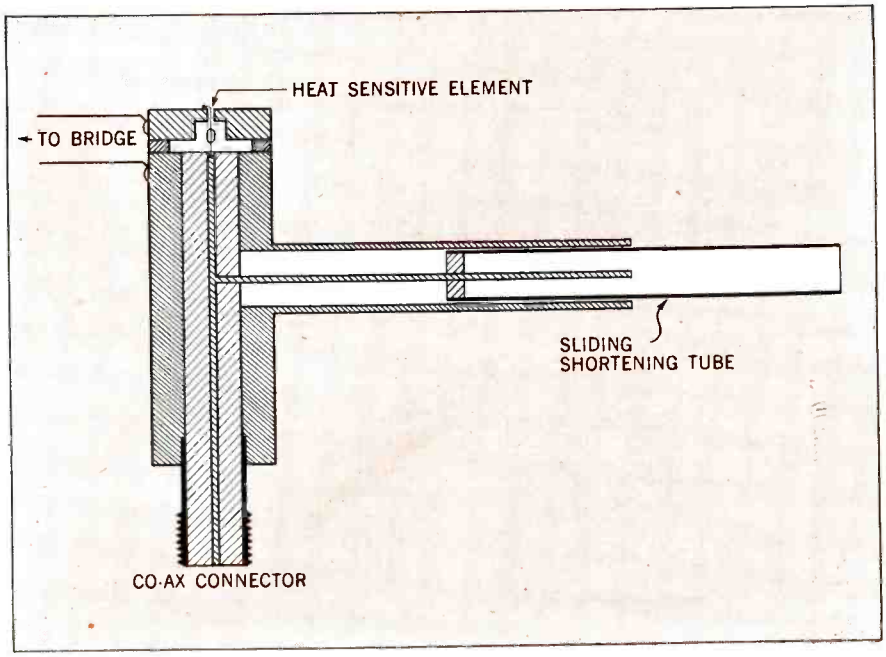
In order to avoid reflections, the Thermister must be placed in a mount which can be matched to the wave guide so that there is no change of surge impedance at the junction point.

Standing waves

To make sure of the absence of reflections or standing waves, it is necessary to introduce into the wave guide a pickup probe which can be moved along the guide and to which is connected a rectifying crystal and meter. Such a section of wave guide, called a slotted line, will indicate, by the variations in readings, the presence of nodes of voltage, or standing waves.

If the voltage is uniform as one progresses along the axis of the wave guide, there are obviously no standing waves. If the voltage is not uniform, the ratio of peak to valley voltages, or voltage standing wave ratio, will indicate the amount of reflections being intro-

Fig. 6. Construction details of a power measuring device for 1000 mc. The cap at top is insulated from main body



duced by some discontinuity further along the guide toward the power receiving end. By proper adjustment or alteration of the part creating the discontinuity, and simultaneous measurement of the voltage standing wave ratio until it reaches unity, it is possible to obtain optimum power transfer. For sensitive detection of variations in voltage picked up by a slotted line probe, it is often necessary to employ a high gain amplifier to actuate the indicating meter. Such an arrangement is shown in Fig. 4.

While the discussion so far has been related to very short waves, the method described is of equal usefulness with waves of about 1,000 megacycles, or around 30 centimeters. Here, wave guides are not used as their dimensions would be too large, and the wave, or current is handled by means of coaxial cables. The current to be measured is led to the Thermister by wire connection instead of by an electric field in space, but the same

(*Continued on page* 142)

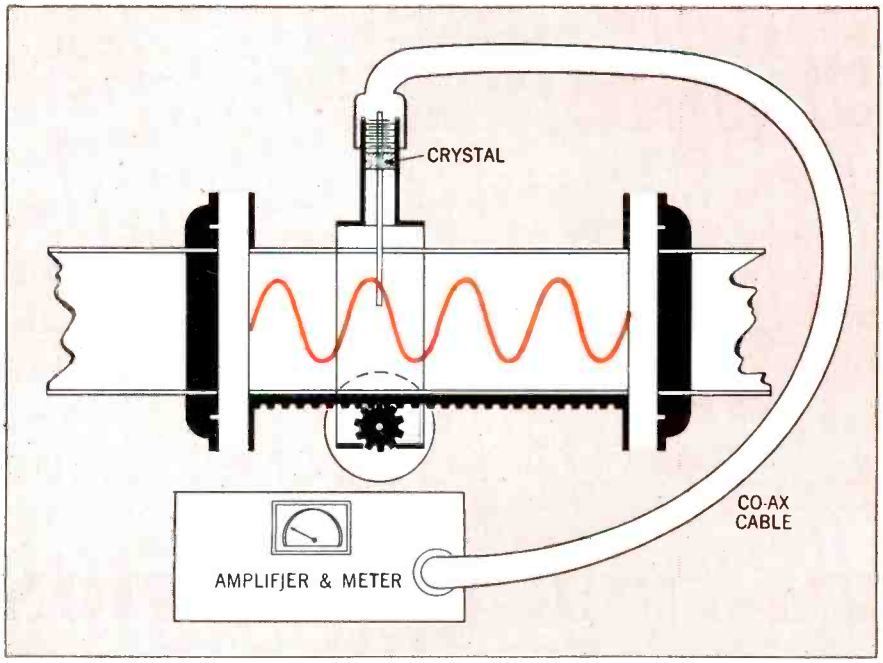


Fig. 4. Slotted section of wave guide with movable crystal bearing probe connected to high gain amplifier used to detect presence of standing waves

HIGH FREQUENCY POLICE EQUIPMENT

● A new experimental 161.775 mc FM transmitter and receiver for emergency police use was demonstrated by the General Electric Co., to a meeting of the New York Chapter of the Associated Police Communication Officers, Inc., at Schenectady, late in April. The communication officers were taken to the General Electric Helderberg mountain transmitter site, where the receiving set was installed. The transmitter was mounted in an automobile which was driven around while maintaining constant communication with the Helderberg station.

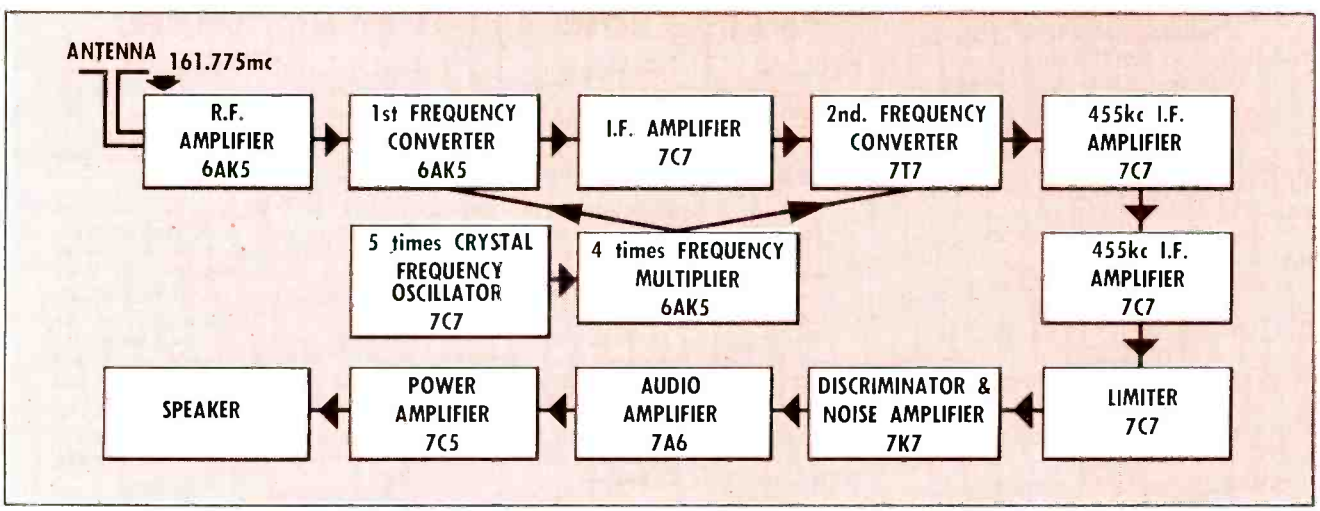
Reception from the car was perfectly clear at all times, and even when the car was passing under a bridge the transmission could be heard with normal volume. The car was driven to Glens Falls, a distance of about 51 miles, where the transmission was still well heard even though its transmitter has an output of only 4 watts.

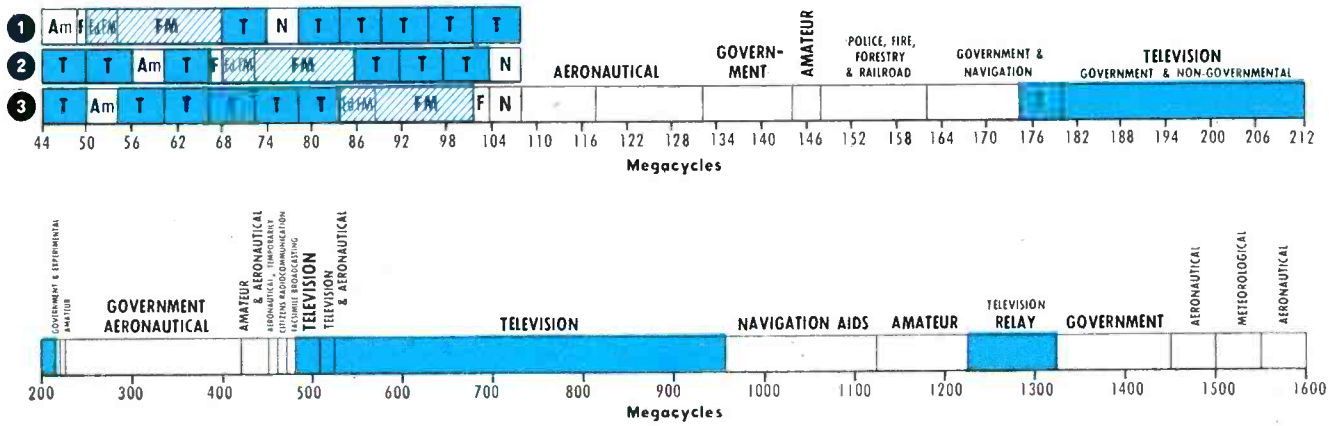
This new frequency (161.775 mc) is in that part of the radio spectrum which the Federal Communications Commission has proposed for new emergency communication uses by police and fire departments and by railroads, trucks, buses, etc. In order to obtain the transmission frequency, the transmitter multiplies its crystal controlled fundamental frequency 72 times.

The receiver, which has an unusual sensitivity of 0.1 microvolt,

(*Continued on page* 158)

Fig. 1. Block diagram of the circuit in the General Electric 161.775 mc police emergency receiver. Two frequency conversions obtained by heterodyning twice with a single oscillator reduce the carrier frequency to 445kc for if amplification





Three different arrangements of the 44-to-108 mc band are offered. In the simplified chart above, Am stands for Amateur; F, Facsimile; Ed. FM, Educational FM; T, Television, and N non-governmental fixed and mobile. Which of the three proposals will be adopted by FCC will be determined by engineering tests to be conducted during the summer

FM-TELE ALLOCATIONS DELAYED

Three alternatives suggested, with final determination resting on tests this summer—One more television channel making 13 below 300 mc—Industrial band widened

● FM is still up in the air—but not yet "upstairs". After more than six months' deliberations, set in motion as a result of the public hearings covering allocations of the radio-frequency spectrum instituted by Federal Communications Commission last October, the Commission on May 17 made official, except for a few changes, the "proposed" allocations made public in January.

According to the official version, FM is to occupy one of three spots in the spectrum, though that particular spot will not be known until later in the summer after FCC engineers, in collaboration with industry engineers, conclude a series of tests designed to determine definitely the best of the three alternatives. The tests will be conducted by a joint committee under the chairmanship of the Commission's chief engineer, George P. Adair.

Alternatives free tele

In the meantime, television remains in its present general position except that video service also has been allotted one additional channel lying between 174 and 180 mc, bringing the total television channels up from 12 to 13. It is pointed out that two of the three alternative allocations suggested for the 44-108 region would make possible immediate use of all television channels.

In the "proposed" report it was noted that the television channel from 72 to 78 mc would not be usable until the aviation markers centered on 75 mc were moved. Under alternatives 1 and 2 the band around 75 mc has been assigned to services other than television, and television has been given assignments that will not have to wait until other services move out. This would make available the 13 channels below 300 mc, all of which could be assigned to television immediately. There is also available much space above 400 mc for experimental and development purposes.

The new allocations table makes the unassigned space available as follows: 2 mc are added contiguous to the FM band of 18 mc width wherever that band is finally placed. Initially these 2 mc will be available for stations rendering a facsimile service exclusively, but manufacturers of FM receivers are urged to include these 2 mc in new FM receivers as eventually it is contemplated that facsimile may move above 400 mc. No separate assignment below 400 mc has been made for facsimile, except that FM stations may be authorized to use facsimile during hours when they are not rendering aural service.

As to when service is to be started under new allocations, nothing definite is stated. The wording of the report states: "These allocations

SOME HOME RADIOS BY MID-SUMMER?

The reconversion picture has already started to change from the original WPB forecasts with its two formulas of the transition for the radio-electronic industry to civilian production. Revaluation of the Signal Corps-Army Air Forces-Navy procurement programs is now in the works and may produce in the next 30 or 60 days some sharp cutbacks, particularly for the smaller end-equipment companies.

Out of this situation, ELECTRONIC INDUSTRIES through its Washington bureau secured speculation by authoritative WPB and OPA officials, together with hints from the military services, that some home receivers may be produced for the civilian market by mid-summer. One WPB competent official predicted such production by July. The OPA officials have geared their price-determination machinery so as to catch sets on the market in 90 days. WPB sources felt that end-equipment companies which have their military contracts greatly curtailed could get "spot authorizations" for civilian production out of components that are not needed by the armed services.

Components, including tubes, are still very tight, however. The backlogs of the component industry, notably tubes and transformers, are the largest since October.

will probably be ordered into effect service by service, with the Commission taking into account such factors as the availability of manpower and materials, the result of the Inter-American conference at Rio de Janeiro (slated for September 1—Editor) and the preparation of the Commission's rules and standards. Of course, any allocations made by the Commission are subject to being changed to conform to the provisions of international agreements."

The reason for not making FM allocations at this time is ascribed to the desire of the Commission to complete tests which will set at rest all questions regarding the best position in the spectrum for the best service. Ever since the hearings that were held in Washington last October, there has been concerted and practically continuous opposition to the proposal that FM be moved way "upstairs" to the proposed 84-102 band. Major Armstrong himself, has been the Commission's severest critic, and it is unquestionably as a result of his criticism and testimony, coupled with that of many others, that brought about the determination to make no further move without the result of conclusive tests to back it up.

That the tests may delay radio set production to some extent appears inevitable, though the Commission points out in its report that "the decision not to make a final allocation for FM at this time would not in any way hamper the future development of that service because the Commission has received advice from the War Production Board that the radio industry will not resume production of new AM and FM and television transmitters or receivers in 1945 or even in the first part of 1946 unless Japan capitulates. This is not to say that a small quantity of receivers and possibly a few transmitters may not be made available. However, this will have little or no effect on the future expansion of AM, FM and television services.' The War Production Board has also advised the Commission that in the event there is any change in its prediction, it will give 90 days' advance notice."

One other important change has been made from the "proposed" allocations. The band in the 27 mc region available for scientific, industrial and medical devices including diathermy machines, was enlarged in accordance with recommendations of manufacturers from a channel width of 30 kc to one of 270 kc.

NEW ALLOCATION CHARTS WILL BE DELAYED

The new four-color charts of the 1945 FCC Radio Frequency Allocations which have been in course of preparation for *Electronic Industries'* subscribers (see pages 73 and 222 of this issue) will now be delayed as the result of the Commission's postponement of definite announcement of the important FM and television channel locations.

As soon as authoritative channel assignments are available, the charts will be completed and made ready for subscribers.—Editors

INDUSTRY LEADERS COMMENT ON ALLOCATIONS PROGRAM

Of course it is impossible for us to plan for domestic radio set production with FM reception until FCC makes firm allocation of frequencies. I understand ninety days before WPB authorizations for peacetime radio production are granted, FCC will freeze allocation. Believe this is unworkable because: first, time is needed for design of FM equipment after frequency allocations are made and, secondly, believe WPB will grant production approval without being able to anticipate this time by ninety days. My personal position is that decision on frequency allocation should be made immediately; in fact, it is long overdue. The whole radio program for re-entry into civilian business will be severely handicapped by the announced program. If tubes, resistors, and capacitors become available due to reduction in military requirements, the industry can make domestic radio sets in substantial quantities within thirty days.—**R. C. Cosgrove, Vice President and Gen. Mgr., The Crosley Corp.**

The Commission's final frequency allocations above 25 megacycles will clear the way for many new and valuable applications of the radio art. The assignment of 13 channels below 300 megacycles to television and the announced intention of giving FM an 18 megacycle band with an eventual extension to 20 megacycles provides ample room for these services to develop their full usefulness to the public. The delay in determining the final position of FM will have no effect on Hallicrafter's plans as our line has included an FM receiver covering all three of the possible alternatives for the past five years. However, we feel that manufacturers of home radios may be hard pressed to complete their designs if actual production should start with only the 90-day notice promised by the WPB and we hope that the FCC's tests will be completed as soon as possible. We regret the slight reduction of some of the amateur bands below the widths which were announced in the FCC's original proposal, particularly the loss of 300 kilocycles in the 28 megacycle band and we hope that the Commission will be able to recompense the amateurs for this loss when the allocations below 25 megacycles are announced.—**W. J. Halligan, President, Hallicrafters Co., Chicago.**

FCC allocation report shows judicial attitude on final allocations in lower frequencies at the same time revealing unshaken determination to foster early advent of higher quality television in full color in higher frequencies. CBS is wholly committed to demonstrating such improved television pictures on the air at the earliest possible date and finds nothing but encouragement in the FCC report.—**Paul Kesten, Vice President and General Manager, CBS, New York.**

While the delay in exact television channel assignments by FCC will hold up the design of telesets by some months, we do not feel this delay will be serious to the new video art. When the Commission's decision is finally announced, television engineers will push the design of sets and the changeover of stations so that the new television industry can be ready to go immediately.—**J. R. Poppele, President, Television Broadcasters Association; Chief Engineer, WOR, New York.**

No comment.—**Edwin H. Armstrong, Professor of Electrical Engineering, Columbia University, New York.**

Excellent. I am delighted by the Federal Communications Commission's wise decision to conduct tests to determine the best wave band for FM, instead of arbitrarily kicking it upstairs to the undesirable and untried 84-102 megacycle band.

Although the preponderance of technical experts favored leaving FM in the 50 megacycle area where it was given unequalled service for the past five years, a series of tests to further prove that this is the best location will be helpful.

I am confident that these tests will indicate the desirability of assigning to FM the 50-68 megacycle band. Rather than the alternative bands of 68-86 or 84-102 megacycles which have been proposed. The selection of the 50-68 megacycle band will save the public millions of dollars in the purchase of new radios. If FM cannot use the 50 to 68 megacycle band, then certainly television cannot, because television is much more susceptible to interference than is FM.

Should, as I believe probable, the final decision be to place FM in the 50-68 megacycle band, I earnestly recommend that for a period of two or three years the Commission widen it to include also 48-50 megacycles. These are in tuning range of FM sets now in the hands of the public, and by assigning a number of stations to these frequencies present set owners would continue to get service from their receivers.

Unless FM is ready to go on the day we get the green light from WPB, tens of thousands of new jobs will be lost.—**Commander E. F. McDonald, Jr., President, Zenith Radio Corp., Chicago.**

SELECTING COAX CABLE

By DR. V. J. ANDREW
President, Andrew Co., Chicago

Economy, power, frequency and service involved in choice of proper type of transmission lines

This article gives an outline of the procedure used in determining the most economical type of high frequency cable for a given application. Where doubt may be entertained as to the particular type of cable best suited, the actual conditions of power loss costs and cable costs should be used.—Editor

New types of rf cables have been developed during the war which will influence the planning of all radio transmitter installations. The engineer will often have to decide between the recently developed solid dielectric cables and the more familiar air insulated cables. Each type has certain advantages, so an intelligent choice can be made only after the merits of each are weighed and compared.

In this article we attempt to measure the merits of each type of cable as closely as possible in the same unit—dollars. Once this is accomplished for a particular installation, the choice between cables is immediately seen. When we attempt to make general statements of price and cost, the accuracy may be much lower than an engineer likes. It is therefore suggested that in a specific application the reader may well make his own assumptions of cost and repeat the entire calculation, rather than accept the conclusions given in this article.

The usual practice in the past has been to select the smallest (and lowest cost) cable which will handle the power with a satisfactory factor of safety. In most installations this practice is uneconomical because power losses are rather high, and rf power is quite costly. We propose to make the necessary calculations to obtain a proper balance between original cost of cable with installation costs, and cost of power lost during operation. This kind of calculation is regularly used in planning large installations of 60 cycle power circuits.

Mechanical considerations

The commonly used types of cables which form the basis for the following examples are shown in Fig. 1 and data regarding them is given in Table 1 and Fig. 2.

In some services, operating conditions permit only one type of cable. For example, the organic insulation used in the solid dielectric type of cables will not stand up under high temperatures, so in certain locations only the air insulated cables with their steatite support beads can be used.* Where the cable is repeatedly bent, the flexible construction of the solid dielectric cables is necessary.

In mobile services such as automobiles, tanks, and aircraft, or in installations which must be quickly installed or frequently moved such as occur in some military equipment, the easy handling of the flexible, solid dielectric cables is so essential that they must be used in spite of their higher power losses.

The solid dielectric cables usually cost less than air insulated cables of similar power handling ability. The air insulated cables require numerous accessories and greater labor to install.

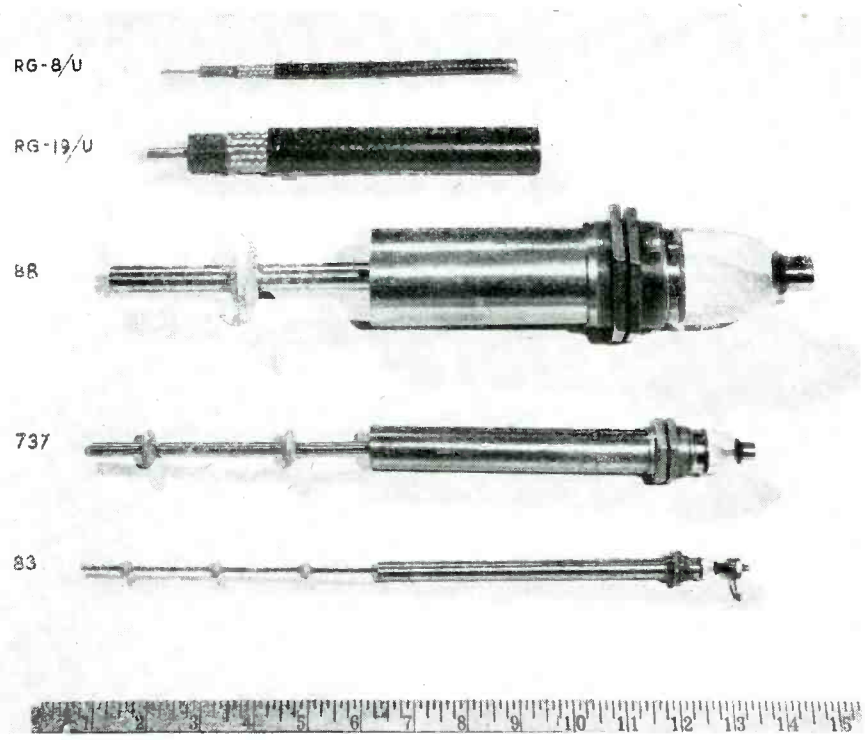
Power ratings

The transmitter power ratings and maximum power ratings for cables used in this article refer to carrier ratings of an amplitude modulated transmitter. For a CW, FM, or pulse transmitter, a value of ¼ of the peak power should be used.

The theoretical point of failure of a coaxial cable is about 50 times

(*Continued on page* 154)

Fig. 1—Illustrating the construction of typical transmission line designs upon which economic comparisons made in the text are based



*The safe operating temperature of the usual polyethelene insulated cable is under 85 deg. C. depending on the type.

Type number	RG-8/U	RG-19/U	83	737	88
Insulation	solid	solid	air	air	air
Diameter, inches	0.405	1.120	0.375	0.875	2.125
Price per foot....	$0.18	1.08	0.25	0.60	1.35
Maximum power, watts	2,000	20,000	250	2,000	10,000

Table 1

Basic manufacturer's data used in cost calculations in table 2. Prices per foot are based on best present estimates

Cable type	RG-8/U	RG-19/U	83	737	88
Power loss, watts	70	22	47	18	6
Cost of power lost at $10 per watt	$700	220	470	180	60
Cost of cable	36	216	50	120	270
Cost of 10 cable connectors..	0	0	0	0	10
Cost of 3 junction boxes.....	0	0	0	0	42
Cost of 3 cable terminals.....	0	0	20	24	76
Cost of dry air pump.....	0	0	26	26	26
Cost of installation at $3 per hour	10	15	20	30	100
TOTAL COST	746	451	586	380	584

Table 2

Calculations for 200 foot transmission line carrying 1,000 watts at 1 mc

Fig. 3—Chart for 50 foot lines; Fig. 4, for 500 foot lines and Fig. 5 for 1000 foot lines. Fig. 3 assumes a non-pressurized line in the air insulated cases. Pressure maintenance is assumed for Figs. 4 and 5. In each case the horizontal dashed line boundaries are established by the safe power handling capacity, and the vertical dot-dashed line by the bead spacing in the air dielectric cables. The curved and sloping boundaries are set by calculations of loss and cost as described in the text

Fig. 2—Loss characteristics of cable types illustrated in Fig. 1. The exponential character of the losses with frequency makes it necessary to apply manufacturers' data at the desired operating frequency when making any comparisons of operating economy. Size is an important factor and a large, solid dielectric cable may have less loss than a smaller air dielectric cable

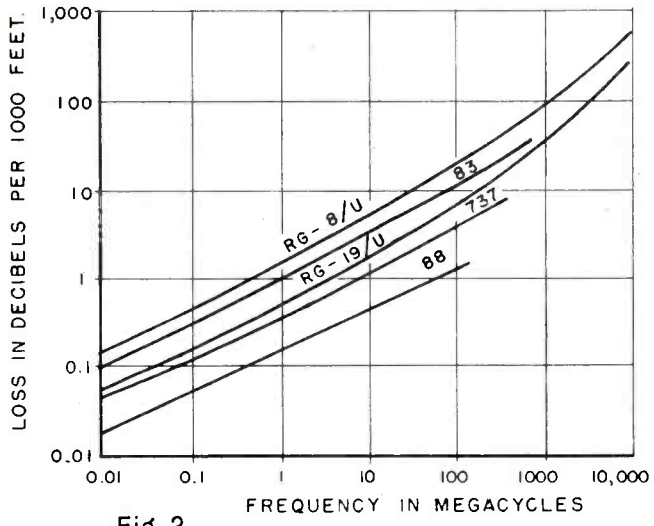


Fig. 2

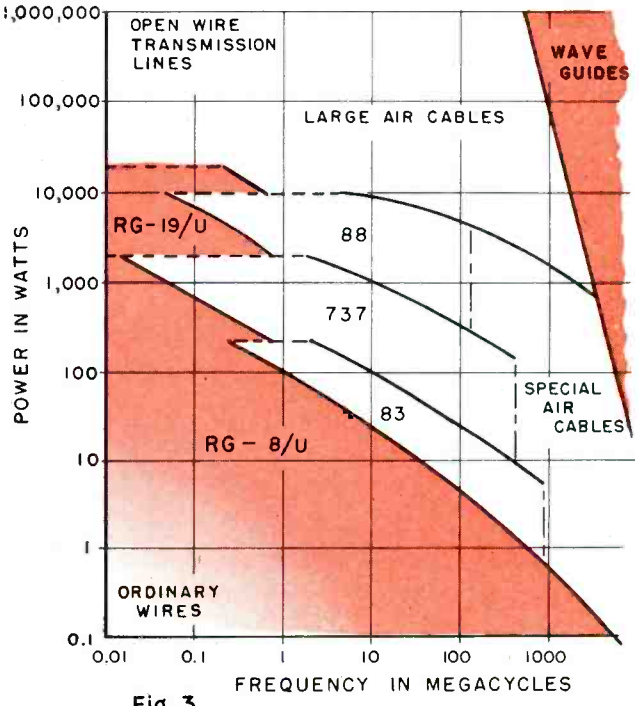


Fig. 3

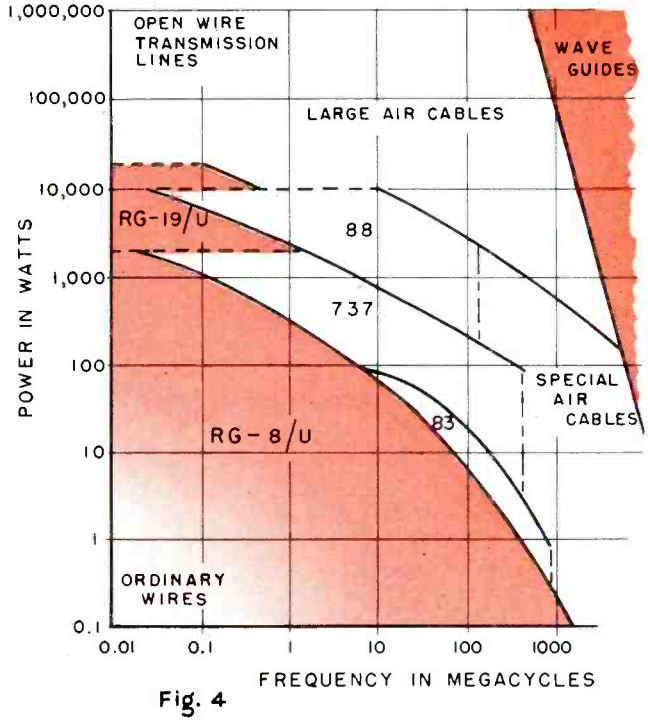


Fig. 4

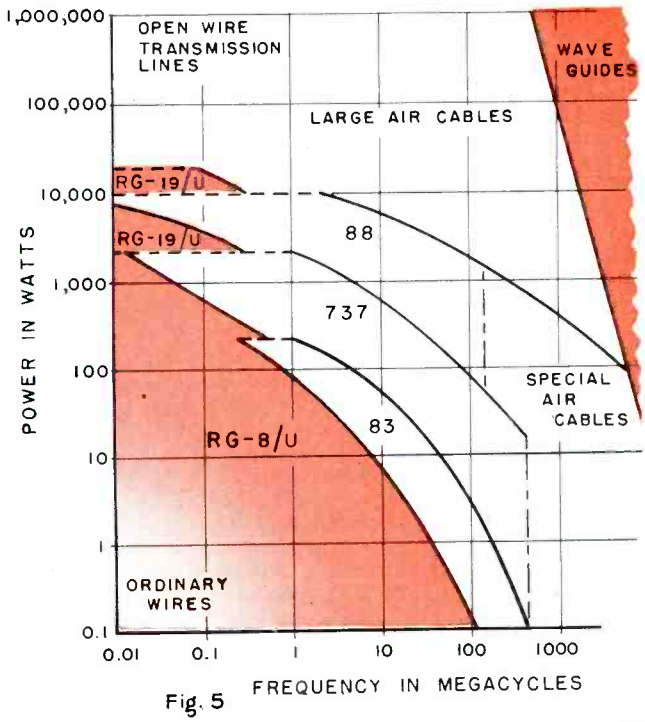


Fig. 5

VHF NETWORK

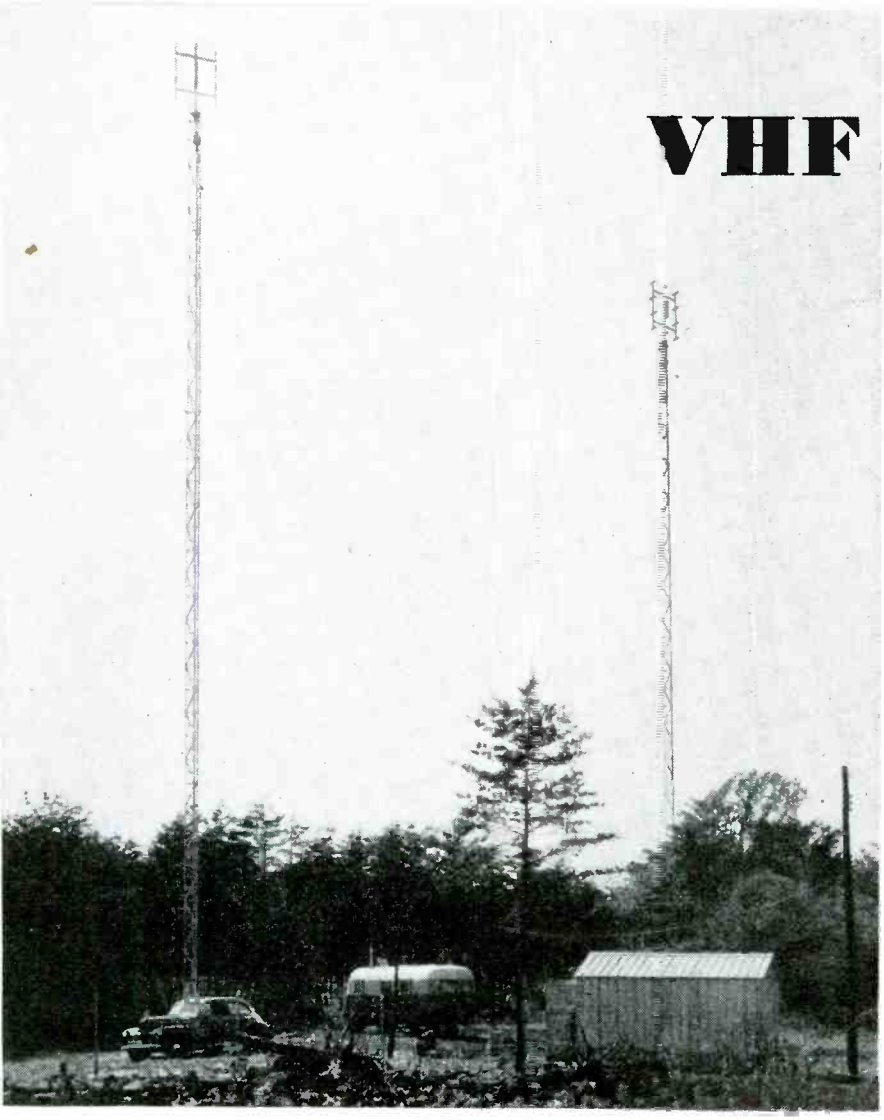


Fig. 2. The 24-dipole receiving (left) and transmitting (right) arrays used at Arlington, Vt., relay site

200 mc Multiple relay television network installed by Philco engineers connects Washington, D. C. and Philadelphia tele broadcast station WPTZ

Television radio relays and coaxial cable systems for chaining programs have been in operation for a number of years in this country. The 1940 Republican National Convention held in Philadelphia was brought to television receiver owners in the Metropolitan New York area over the Bell System coaxial cable from Philadelphia to New York—a distance of approximately 90 miles. A two-jump television relay network between New York and Schenectady has also been in operation for a number of years. This network consists of a main hop from the Empire State Building in New York City to a pick-up station on Helderburg Mountain outside Schenectady, and from there to a nearby broadcast transmitter, a distance of approximately 127 airline miles.

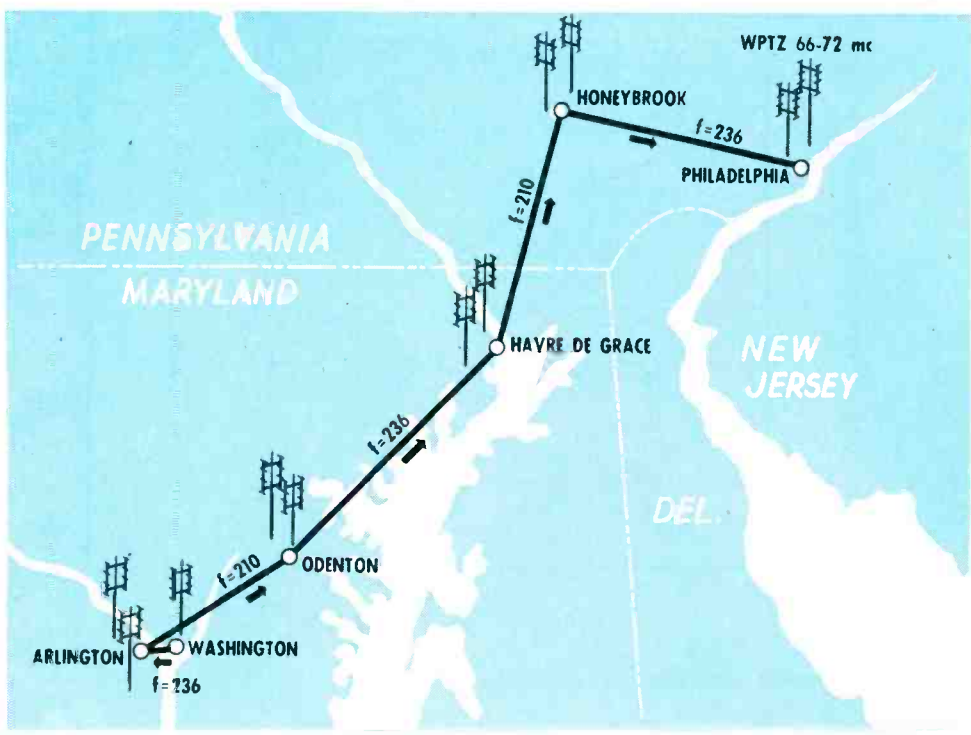
Since 1941, Philco engineers have operated a two-stage television relay system between New York and Philadelphia. New York telecasts are relayed by a booster station (now at Mt. Rose, N. J.), to their television station WPTZ in Philadelphia for re-broadcast to the audience in that area.

Another outstanding development in the field of television relay operation recently has been demonstrated by Philco engineers. This network is considerably more elaborate than others previously demonstrated. It consists of four jumps of approximately forty miles each from Washington, D. C., to Philadelphia. A total of six transmitters handle the television program as it originates in Washington.

Relay transmitters

Five of these transmitters are rated at 40 watts each and operate in the frequency channels of 204-216 mc or 230-242 mc. The location of the relays and their operating frequencies are shown in Fig. 1. That is, transmitters at alternate relay points operate on different channels so that received signals

Fig. 1. Locations of receiving and transmitting equipment in television network



FOR TELEVISION RELAY

Perhaps the foremost problem in the development of commercial television for domestic use is the one concerning network programs. The cost of staging a television program is considerably greater than that of a corresponding sound program and it becomes necessary and desirable, therefore, to chain together many cities for the same program. This chain operation will result in reduced costs and greater variety of programs and will therefore promote the expansion of the television broadcasting industry. The availability of sight and sound programs throughout large areas will of course speed the purchase of radio and television receivers by the public and in turn advance the growth of this new art.

at any relay point are not obscured by the transmitted signals from the same relay station.

The 40-watt relay transmitters use a lighthouse type tube in a transmission line type of frequency controlled circuit. The transmitters are housed, along with other equipment, in automobile type trailers which are located at the base of the 100-foot towers supporting separate transmitting antenna arrays and separate receiving antenna arrays. The antenna towers are of structural steel with a triangular cross section. The towers and equipment at Arlington are shown in Fig. 2.

Site selection

The sites at which the towers were erected were chosen with the idea of having each location in direct view of the relay point on each side and which gave a minimum terrain clearance of 100 feet at any point along the path. The principal reason for selecting the site to give a minimum of 100-foot terrain clearance, was to make it possible to use frequencies above 1,000 megacycles for future experimental work and not be troubled by power absorption by objects along the transmission path. The towers are within relatively close distances to power line facilities so that all four of the relay points

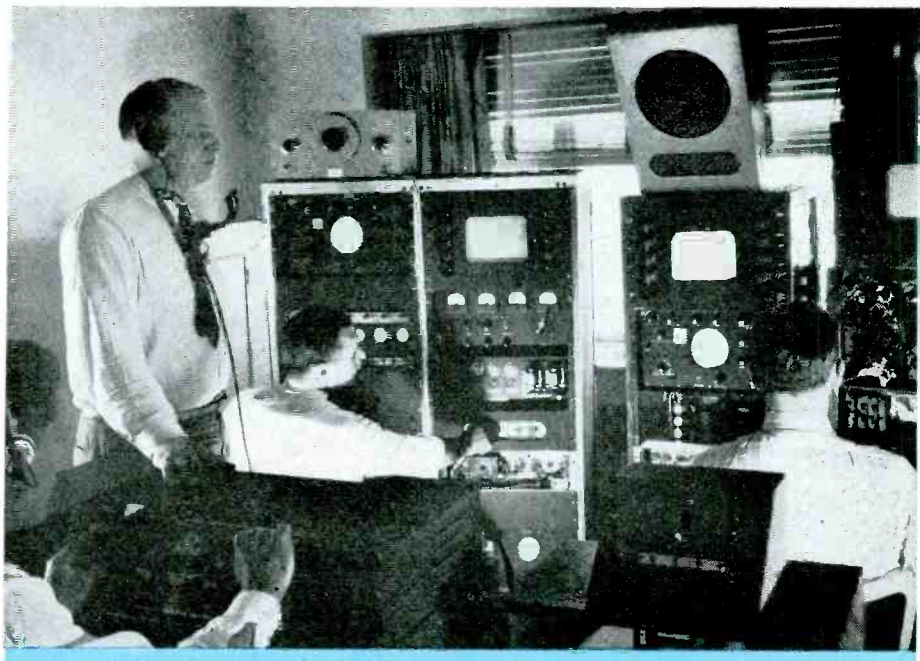


Fig. 3. Video monitoring equipment at Statler Hotel in Washington, reference marks are placed on the various monitor CR tubes for establishing synchronizing levels, etc.

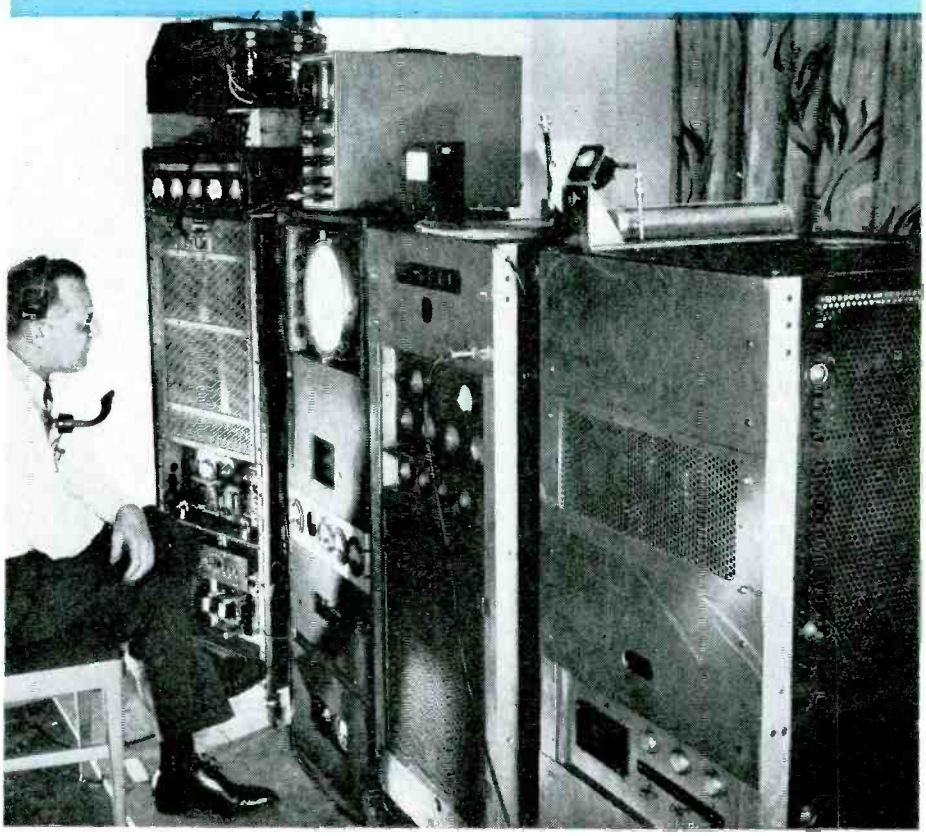
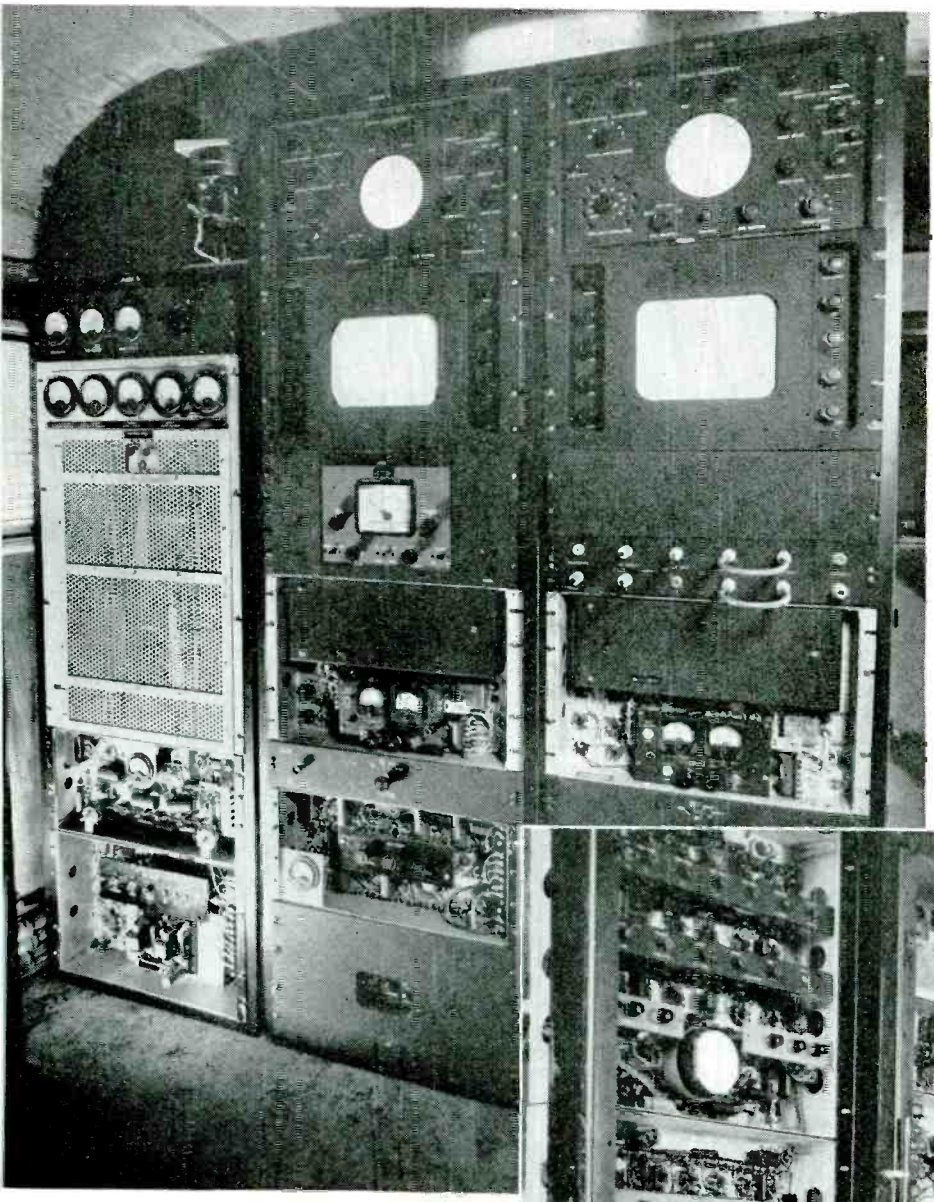
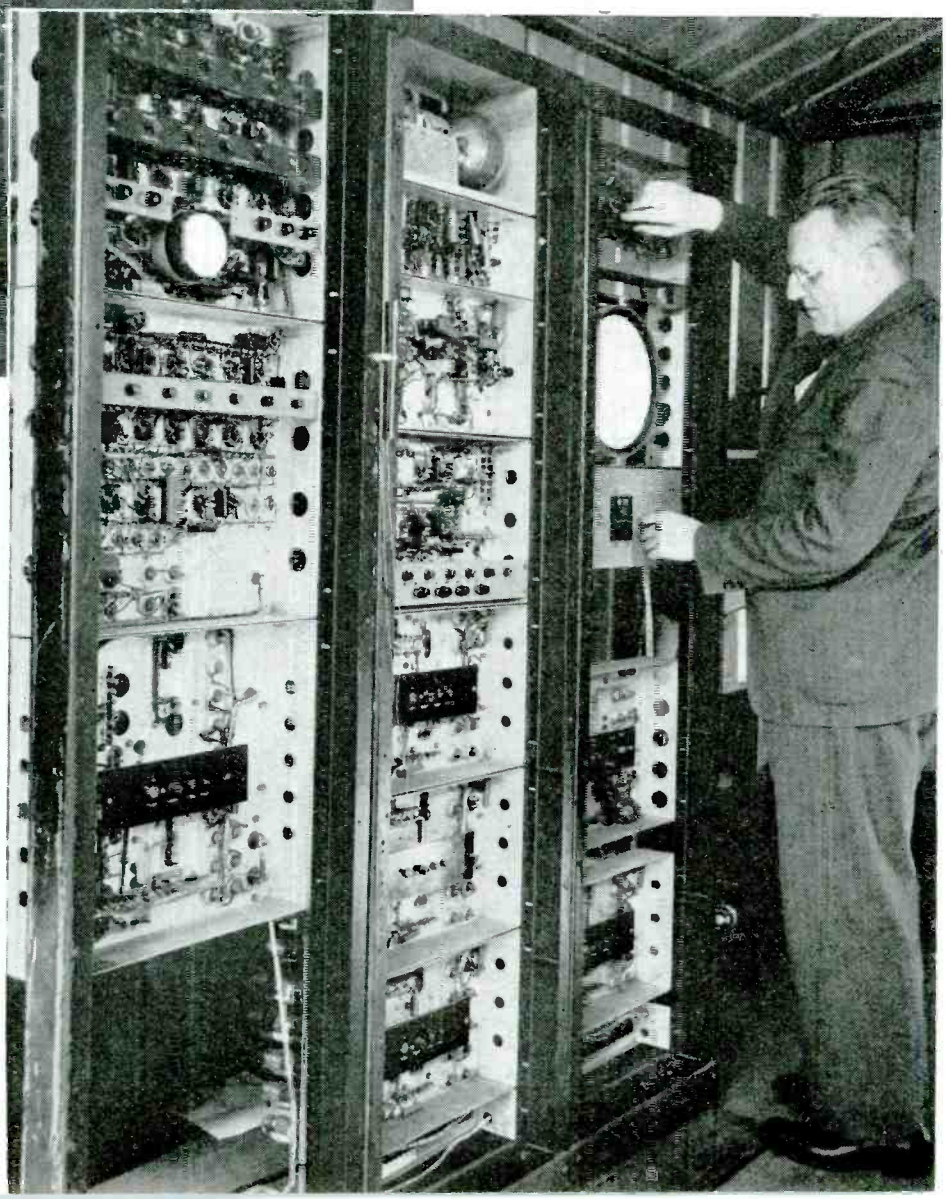


Fig. 4. Transmitter room at Statler Hotel showing main transmitter at far left, and stand-by equipment at right. Telephone circuit connects operator with all relay sites





are operated from commercial power. Emergency gasoline power generating equipment also is available at each point.

The antenna arrays mounted atop the towers are substantially identical. One tower is used to carry the receiving array, while the other mounts the transmitting array. The antenna system consists of 24 dipoles in a reflector-radiator combination, giving a gain of approximately 24. When used with the 40-watt transmitter, the overall reliability of the system is quite high.

Relay operation

To prevent interference between a transmitter and an adjacent receiver, different transmitting and receiving frequencies are used. Also the antenna arrays are oriented for minimum coupling. At present, the relay network operates in one direction only, from Washington to Philadelphia. However, equipment is available to make the network two-way operating.

Each relay point along the line is manned by engineers. This is done in order to permit study of actual operating conditions rather than a necessity of having an "attended" relay station. Each relay point consists of receiving, monitoring and transmitting equipment along with associated power apparatus.

Line controlled

The receiving equipment consists of a resonant line frequency controlled receiver with an if system at approximately 30 megacycles. The receiver is complete and independent of the transmitter. The picked-up signal is amplified and demodulated down to video fre-

Fig. 5—(Below) Monoscope, scanning and synchronizing generators for relay network testing at Arlington, Va., site

Fig. 6—At left is 40-watt relay transmitter, receiving and monitoring equipment for video as used at each relay point

quency. The video frequencies are then used to modulate the transmitter.

This system is different from that used in the General Electric New York to Schenectady relay in which the amplified signal as picked up by the receiver is kept at a radio frequency level and is then amplified by linear amplifiers, and the modulation is never rectified down to video frequencies except for bridging monitor purposes.

This Philco system in which the receivers actually demodulate the incoming television signal at each point, makes the system somewhat more flexible. It becomes fairly easy to inject video modulation into the transmitter at any point for test purposes.

The first relay point at Arlington, Virginia, shown in Fig. 2, is used to pick up the signal from Washington, D. C., where in the case of a recent demonstration of the network, a transmitter mounted atop the Hotel Statler in Washington, transmitted the video program to the first pickup point. The video monitoring equipment as set-up in the Hotel Statler is shown in Fig. 3. The 236 mc transmitter, monitoring, and standby transmitter are shown in Fig. 4.

Monoscope testing

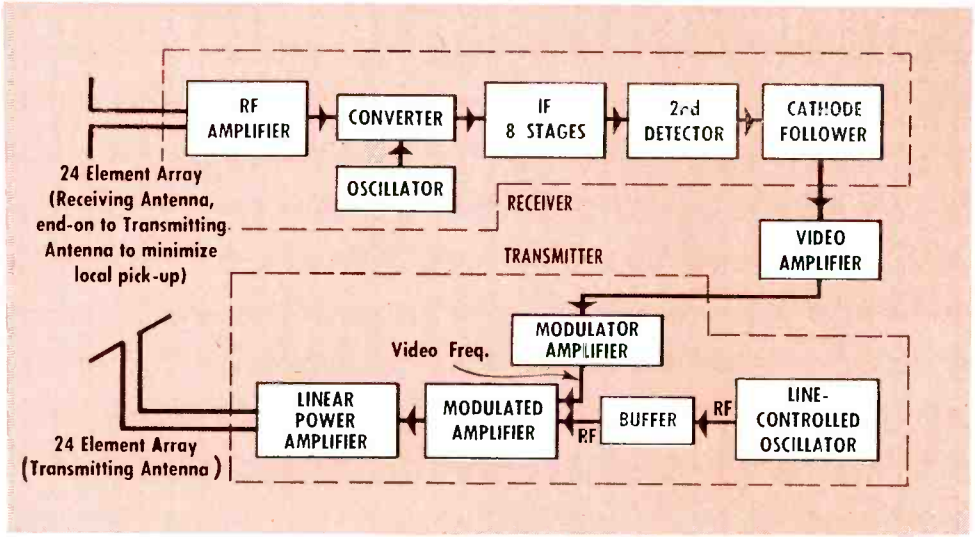
At this first pickup point additional testing equipment is used in the form of a monoscope, which can be used to inject a signal into the relay system for transmission along the circuits to Philadelphia where it can be analyzed and studied. Complete signal generating equipment in the form of scanning and blanking generators also is housed at this first relay point at Arlington. This equipment, shown in Fig. 5 is housed in the sheet metal building pictured in Fig. 2. The rack mounted equipment is arranged for convenient testing and maintenance.

To facilitate checking on the network, a complete wire telephone hookup is available for simultaneous communication with any or all of the five transmitter points. This whole system permits comparison of engineering data at each of the points along the route.

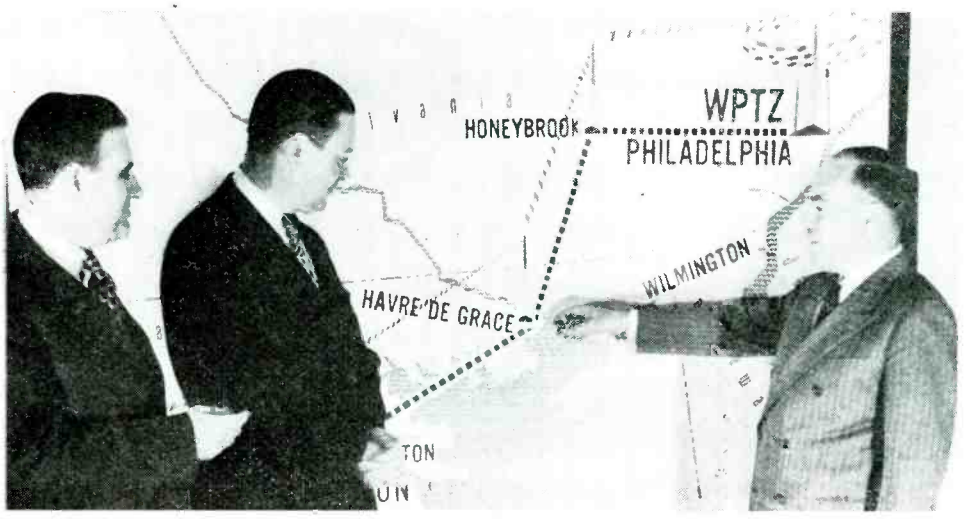
The receiving and monitoring equipment and 40-watt transmitter, as used in each of the four relay points are shown in Fig. 6. A block diagram of the essential equipment at each relay point is shown in Fig. 7. This equipment is housed in the automobile trailers located at each of the four points along the line. A standby transmitter (not shown) is opposite the relay transmitter at the extreme left. The television signal from the last relay point, Honeybrook, Pennsylvania, is picked up at Philadelphia for final broadcasting through the Philco Station WPTZ in Philadelphia.

The results of the relay system, from an engineering standpoint, were considered to be quite satisfactory. Signal strength was adequate to give reliable pictures over the entire circuit. The use of higher frequencies would permit a sharper antenna beam with consequent power gains. The use of an extremely high frequency, along with very narrow antenna beams will also present the problem of instability through shifting of the antenna beams with distortion of the towers as a result of wind and other factors.

Fig. 7—Block diagram of equipment used at each relay set-up. Frequency control of receiver and transmitter is by resonant transmission line sections. Note that received signal is rectified down to video



F. J. Bingley, chief television engineer for Philco, F.C.C. chairman Paul A. Porter (center) and Philco president John Ballantyne (right) look over map of relay network



Tower design

This particular problem of instability at very high relay frequencies undoubtedly will be solved in the postwar period by changes in antenna and tower design, now in the course of development.

A number of other uses for relay networks of this type present themselves. A network of such towers stretching across the country would form a very practical airway beacon system. In such periods when television may not be transmitted over the network, facsimile, multiplex telegraphy, etc., could be handled along the networks.

The radio relay methods of handling wide band information such as television, may be the answer to the necessary rapid expansion of television. It would probably require less time to establish a radio relay network than to perform the same chaining operation by other methods.

This television relay has proven successful on its first public trial. On April 17th a program originating in Washington was relayed by the

(Continued on page 162)

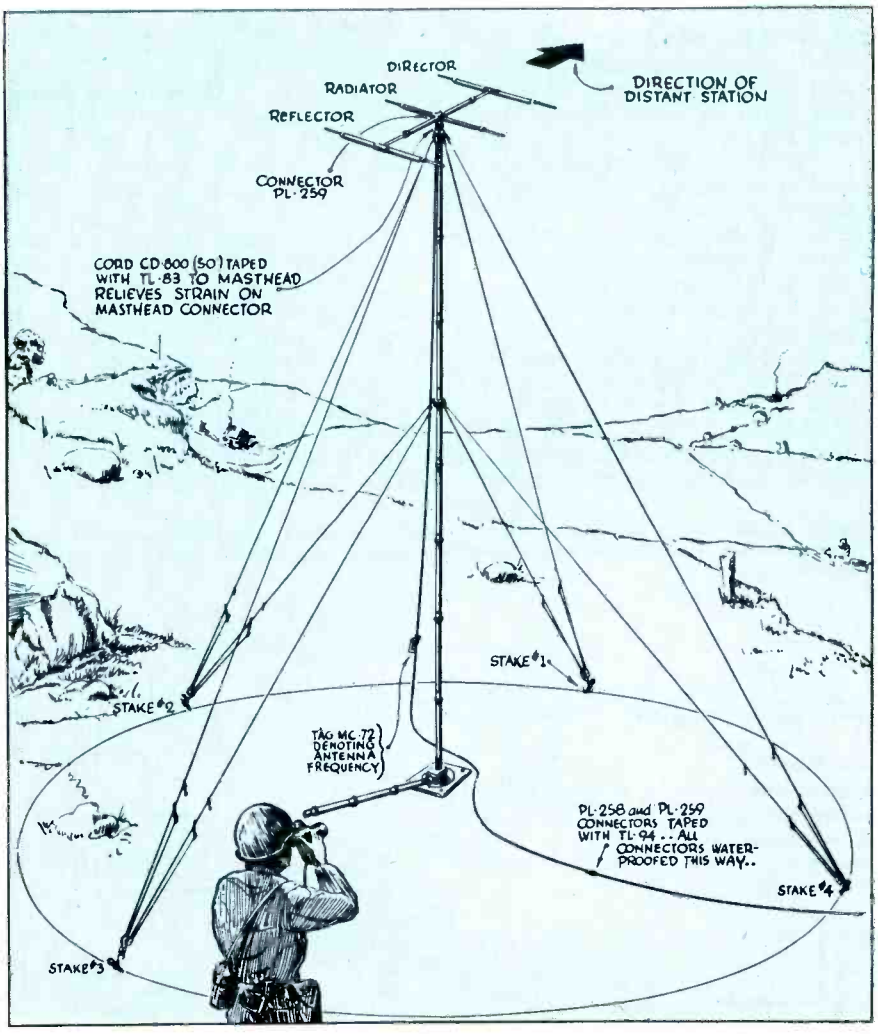
MULTI-CHANNEL ARMY

When General McAulliffe's 101st Division was completely surrounded at Bastogne last December, with all wire communications cut off, it was nevertheless able to maintain constant intelligence traffic with corps headquarters in substantial volume. What made this possible was radio link AN/TRC-3, the details of which are now revealed to the public for the first time. This series of equipments was used extensively during the invasion of France, not only for field communications, but also between London and the Continent.

One of these equipments was mounted in a truck with a spare in a trailer. When it looked as if the 101st Division was going to be surrounded, the corps signal officer sent the truck towing the trailer into Bastogne. It was the last vehicle to enter the town before the Germans completed their encirclement. The trailer was hit and destroyed. However, the truck was undamaged and throughout the entire period until the Division was relieved, it had telephone and teletype communications with corps headquarters entirely over this radio link.

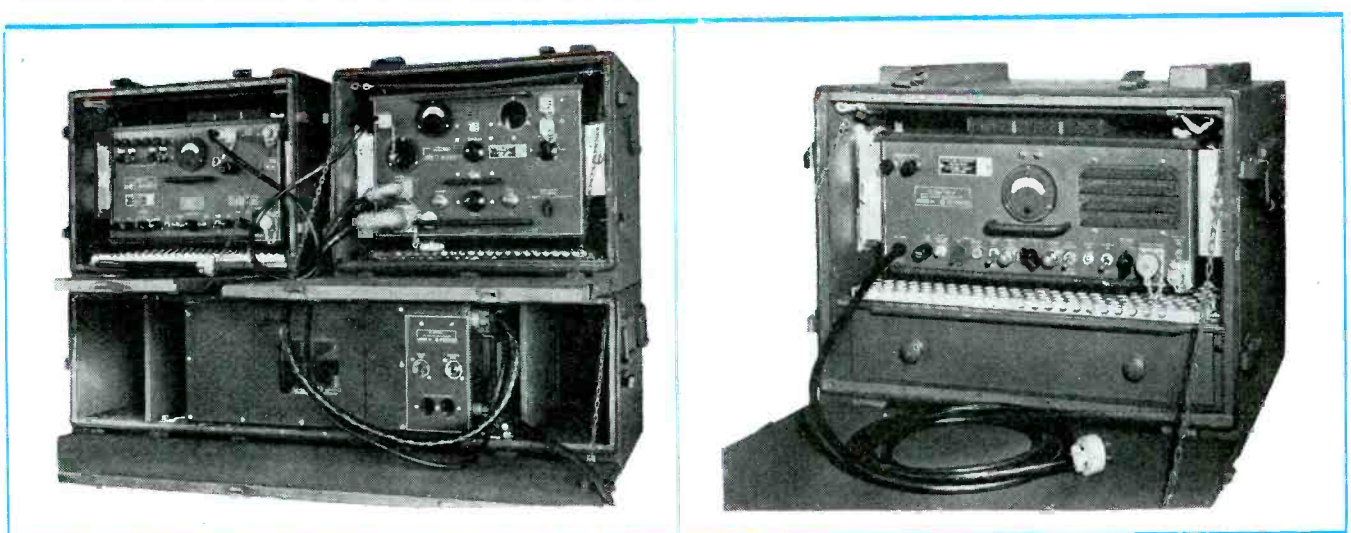
Complete systems

This series of equipments features complete communication systems ready to install and operate in a matter of four hours. Not only are transmitting and receiving sets supplied, but there also are antenna systems, spare parts, tools, rope, tape, in fact everything that



Antenna system completely installed in the field. The radiator, director and reflector element lengths and spacings must be adjusted for the operating frequency. Direction of transmission must be established by exact sighting

Transmitter, 250-watt amplifier and power supply conveniently arranged for field use (left) and receiver (right) in its field case



COMMUNICATIONS SET

Installable in four hours, equipment provides for code, voice, teleprinter, carrier and as automatic repeater

is needed to set up and operate in any location. The sets, designated AN/TRC-1, 3 and 4 were developed and manufactured by the Link Radio Corp. of New York. Set AN/TRC-1 consists of a radio receiver, a radio transmitter, two antenna systems kits, spare parts, tools and operating components, a power unit, maintenance equipment, connection cable and instructions.

Each basic set can cover a frequency range of 70 to 100 mc with a nominal power output of 50 watts on any one preset crystal controlled frequency within this range. Provisions are made for lowering the power output to less than 10 watts by means of a panel switch and increasing it up to approximately 250 watts by means of an auxiliary power amplifier. The set is designed for use in either a multi-channel or single channel radio relay circuit and as either a terminal or repeater station. Provision is made for coupling to spiral-four cable when used in multi-channel carrier telephone radio relay circuits. All equipment is powered from regular commercial power when available or by means of a gasoline engine driven alternator.

Radio Terminal Set AN/TRC-3 consists of two receivers, two transmitters and two antenna systems including sufficient equipment to insure continuous 24-hour a day service as a multi-channel carrier telephone radio terminal.

Radio Relay Set AN/TRC-4 consists of three receivers, three radio transmitters, four antenna systems and some additional equipment, enough to provide an independent two-way multi-channel radio repeater station consisting of two transmitters and two receivers, while a third of each unit is furnished as a spare.

Characteristics

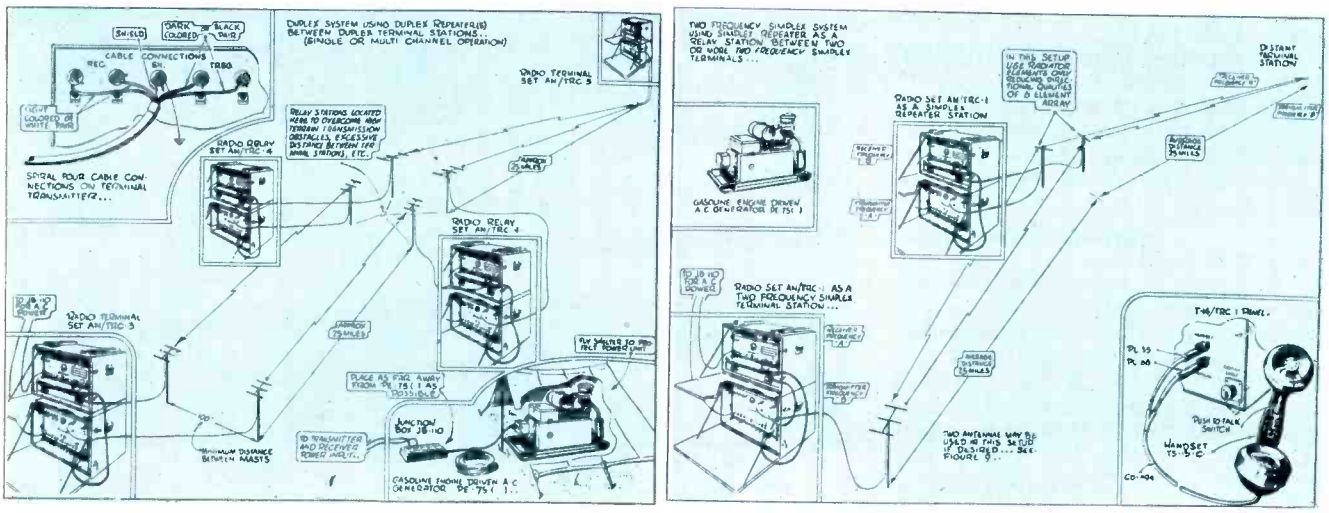
The radio receiver is a 16-tube single channel, crystal controlled superheterodyne designed for the reception of frequency modulated signals. Its more important characteristics are frequency deviation ± 30 kc maximum; audio response, high fidelity output circuit + ldb between 200 and 12,000 cps; low fidelity output circuit, + ldb between 200 and 2500 cps. At 3,000 cps and above the response is down 30 db. Its output level into a 500 ohm line varies from 0 dbm to + 20 dbm maximum. The loud speaker puts out 1 watt. A thermostatically-controlled fan circulates filtered air through the chassis when its temperature exceeds approximately 75 to 85 degrees F.

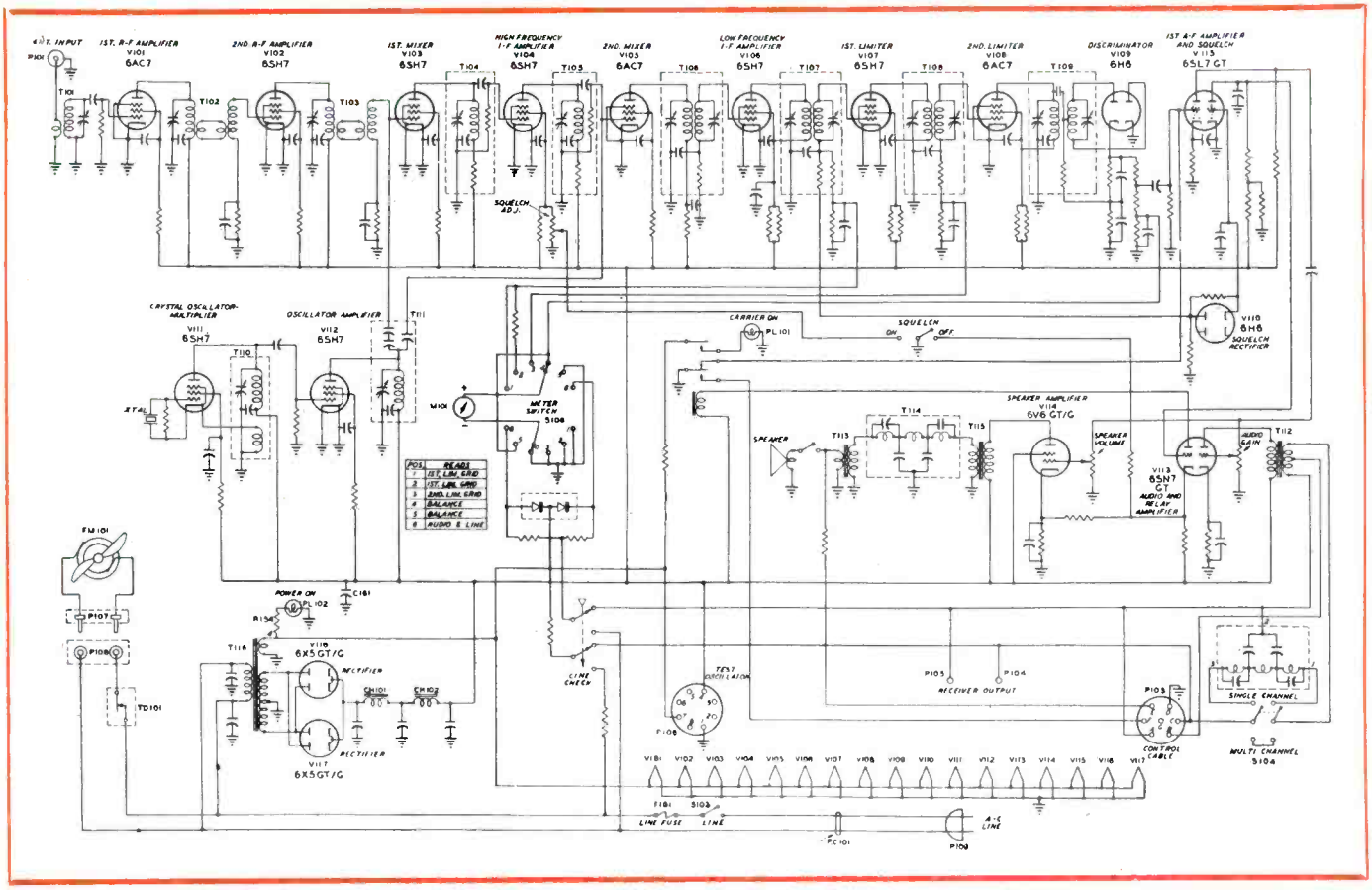
The oscillator (without cover) tunes receiving sets for any desired frequency

In order to facilitate tuning and adjustment of the radio receiver a test oscillator is furnished as a signal generator. This test oscillator utilizes the same crystals as the transmitting set and is self modulated at 1,000 cycles by an audio oscillator.

The radio transmitter has eleven tubes. Its basic crystal frequency range is from 729.167 kc to 1041.667 kc. At the audio input level be-

System arranged for relay operation between two terminal stations (left) and set up as a two frequency simplex repeater or terminal (right). Flexibility of arrangement and use makes this system of great value in a war of movement





Complete circuit diagram of receiving set. Low pass filters, center (T114) and lower right, permit the use of channel 1, audio frequencies below 3,000 cycles, for monitoring and break-in service when set is used at rely point

tween 0 and —12 dbm it utilizes a 9 kc peak deviation for each of the four carrier telephone channels. Input impedance in the high fidelity circuit is 500 ohms and in the microphone circuit is 30 to 50 ohms.

The amplifier AM8/TRA-1 is a push-pull class C radio frequency amplifier requiring an external source of power for filament, bias, screen and plate voltages. These voltages normally are supplied by the separate power supply PP-13/TRA-1. The latter gives the required 100 volts direct current bias, + 450 volts at 40 ma, and + 2,000 volts at 250 ma.

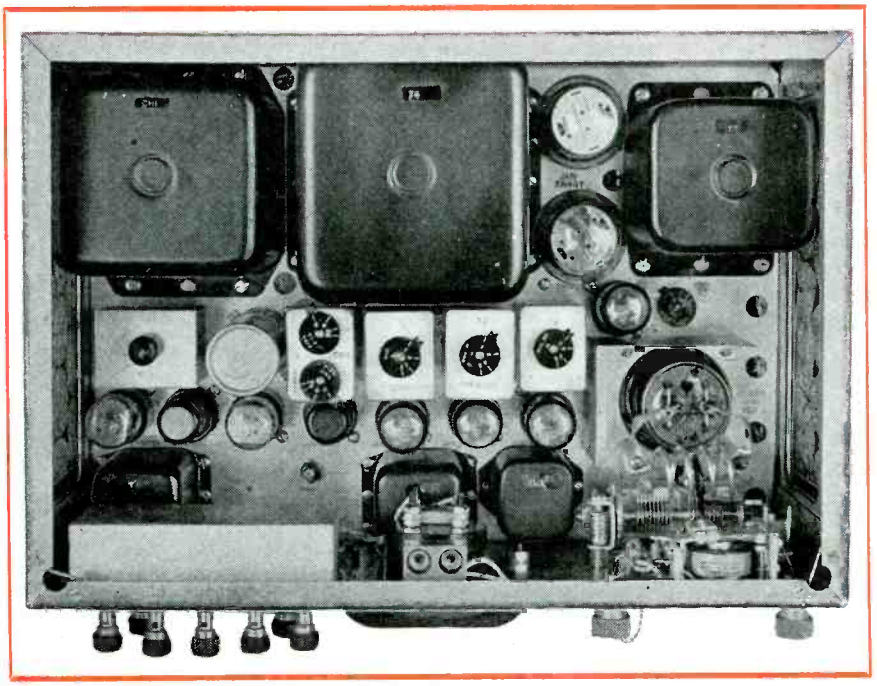
The amplifier utilizes two HK257B power pentodes in a push-pull tuned grid tuned plate circuit requiring no neutralizing adjustment. In addition, three VR150-30 serve to regulate the screen voltage supply.

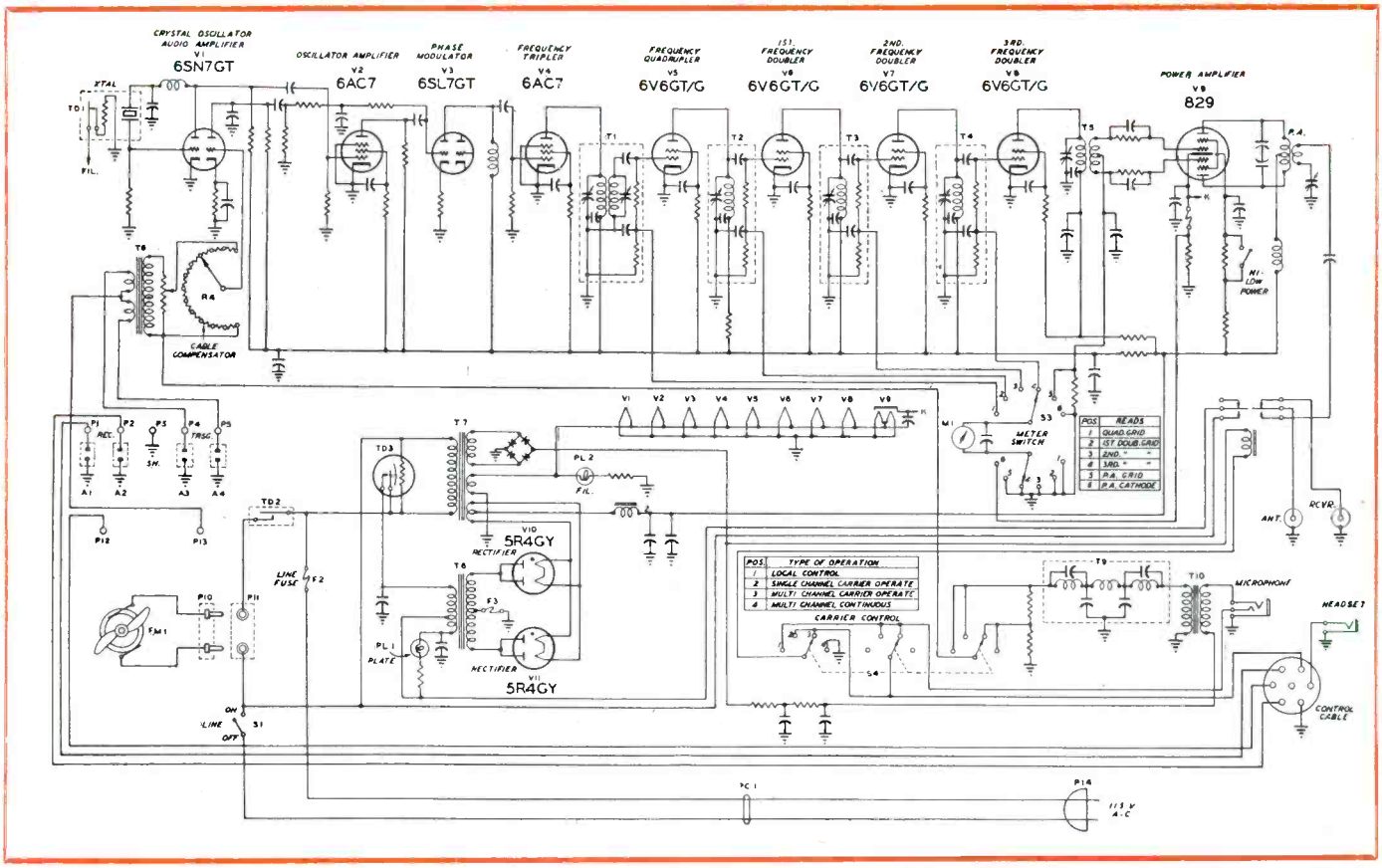
Antenna equipment

The antenna system contains all the necessary equipment to erect a horizontally polarized directional array used for transmitting or receiving. There is one driven half-wave dipole, one director and one reflector spaced approximately one-quarter wave. All linear dimensions are readily adjustable without tools to tune the antenna to any frequency between 70 and 100 mc. There are eight sections used to form a pole 40 ft. long and 2½ in. in diameter which is held in a vertical position by means of two sets of nylon guy ropes.

Simplex operation or, as it is more commonly called, push-to-talk operation, involves the use of one transmitter, one receiver and usually one antenna. The transmitter and receiver are normally

Top chassis view of transmitter. Crystal oven is at left center





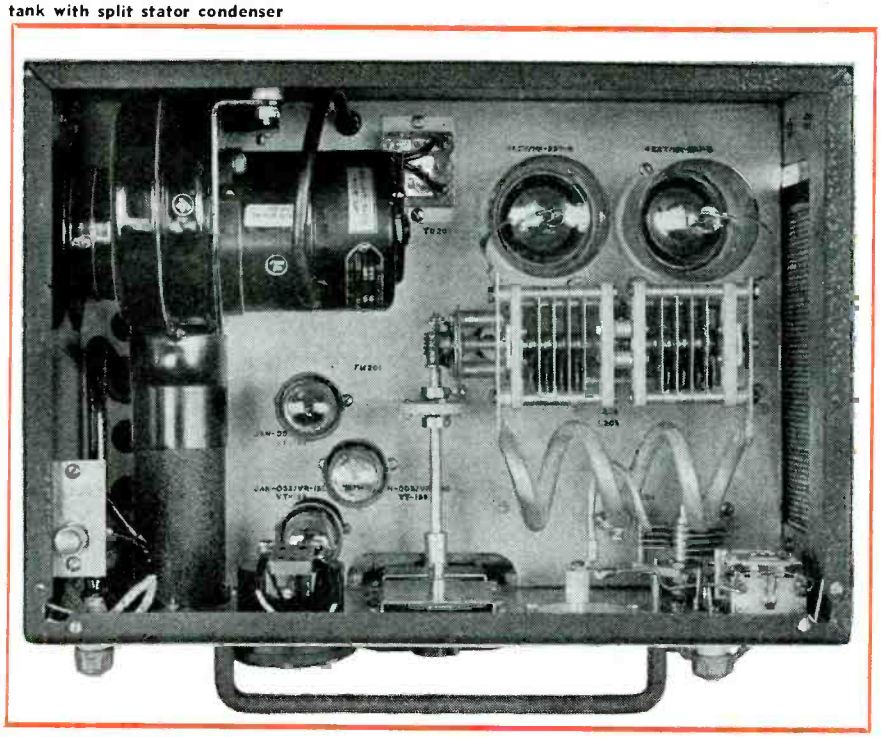
Circuit diagram of transmitter. Balanced push-pull output used with 829 power tubes. High-low switch limits power to permit tuning without damage by lowering the screen voltage. Spiral-four cable connections are p¹ to p⁵

tuned to the same frequency. If they are on different frequencies, two antennas may be used if high antenna efficiency and directivity must be maintained.

Duplex operation involves simultaneous transmission and reception and for this reason requires separate antennas for transmitter and receiver which must operate on different frequencies. Antennas in this case must be separated by 50 or more feet to prevent blocking of the receiver by the transmitter. A typical example of duplex operation is found in the application of radio terminal set AN/TRC-3 as a terminal station in a radio relay substitution for spiral-four cable. (Spiral-four cable is a multi-channel telephone cable used by the Army in the field).*

Another typical example of two frequency simultaneous transmitter and receiver operations is found in a simplex repeater arrangement. By this arrangement, two or more two frequency simplex stations out of range of each other may be connected by means of a simplex repeater operating alternately in either direction.

Top view of 250 watt amplifier. Single stage class C operation is used. Two power pentodes feed tank with split stator condenser



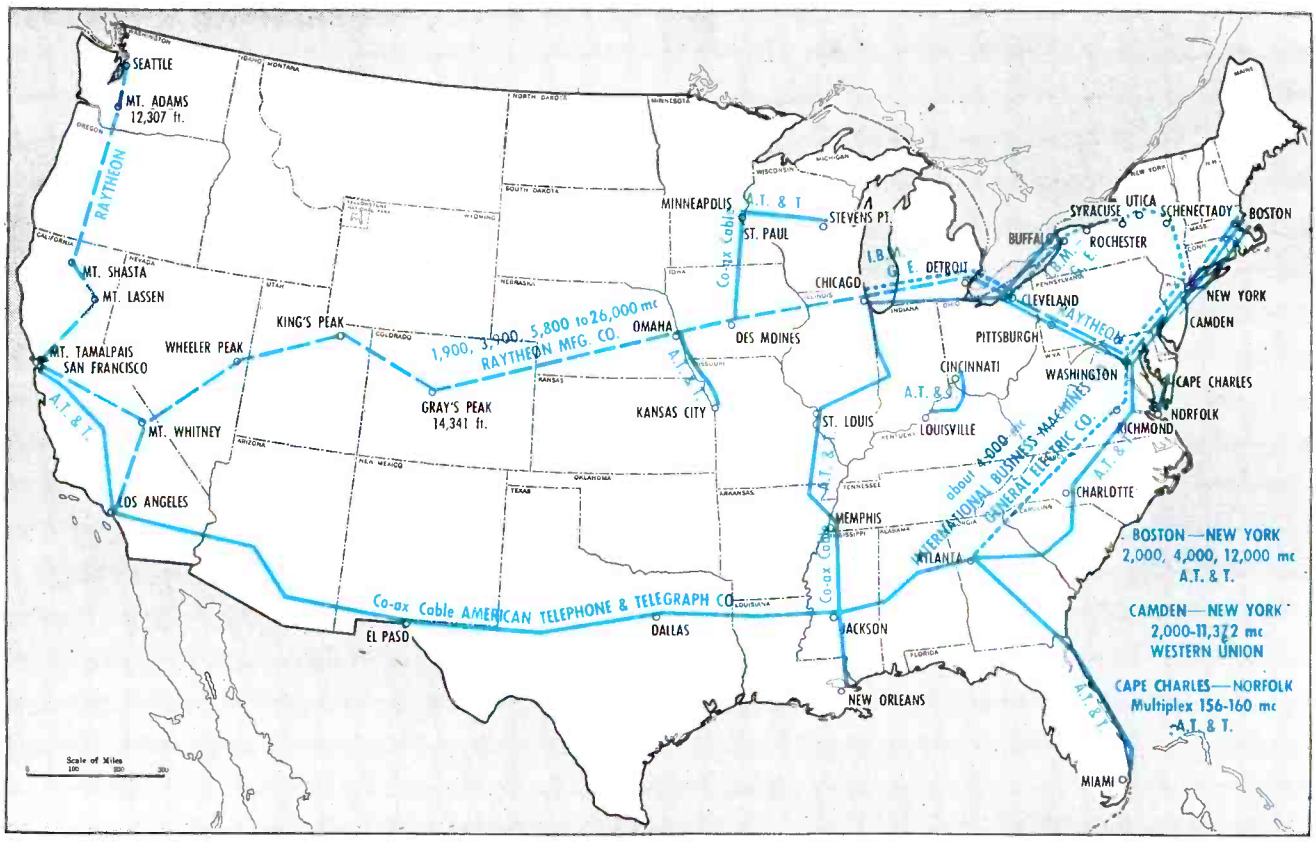
Four channels

Duplex repeater operation utilizes two simplex repeaters at the same point simultaneously relaying messages in opposite directions. Thus two transmitters and two receivers are needed and operate on four different frequencies and four different antennas. This type of two-way repeater is the basis for the application of radio relay set AN/TRC-4 to multi-channel spiral-four carrier telephone system.

This system utilizes the range from 200 to 2800 cycles for number

(*Continued on page 174*)

*See Electronic Industries May, 1944, p. 104.



Projected routes for Eastern and transcontinental radio relay and coaxial cable systems. Some small sections are already in existence. Relay systems will permit transmission of television, broadcasting, facsimile and other signals

RADIO RELAY NETWORK

Present status of developments for area hook-ups and for transcontinental links by radio and coaxial cable

• Several major communication companies are planning for immediate postwar development of radio relay networks covering the country. These chains will permit the relaying over multiplex channels of various types of emissions such as facsimile, sound, television and radio location signals on a common carrier as well as a private basis. The completion of these programs promises to provide one of the important new industries of the era.

Many relays

The American Telephone & Telegraph Co., for example, plans to construct a relay chain of seven stations between Boston and New York located on hills distant about thirty miles from each other and visible one from the next. Eight channels 20 mc. wide are to be used on an experimental basis in each of three frequency ranges, near 2,000, 4,000, and 12,000 mc. This company has already had a radio relay link in successful operation since 1941 from Cape Charles to Ocean View across 11 miles of the Chesapeake Bay connecting to Norfolk on the south and Onancock on the North by wire lines. This relay has been using 156.3 and 160.65 mc., and contains 12 multiplex channels. During the war extensive experience has been gained in the operation of portable radio relay sets operating in the 70 to 100 mc range.*

The Western Union Telegraph Co. has recently been authorized to establish an experimental radio relay chain between Philadelphia and New York operating at frequencies from 2,000 to 11,372 mc., and multiplexed with 32 channels for each transmitter. While the final system has not yet been set up, it is understood operation is taking place on an experimental basis.

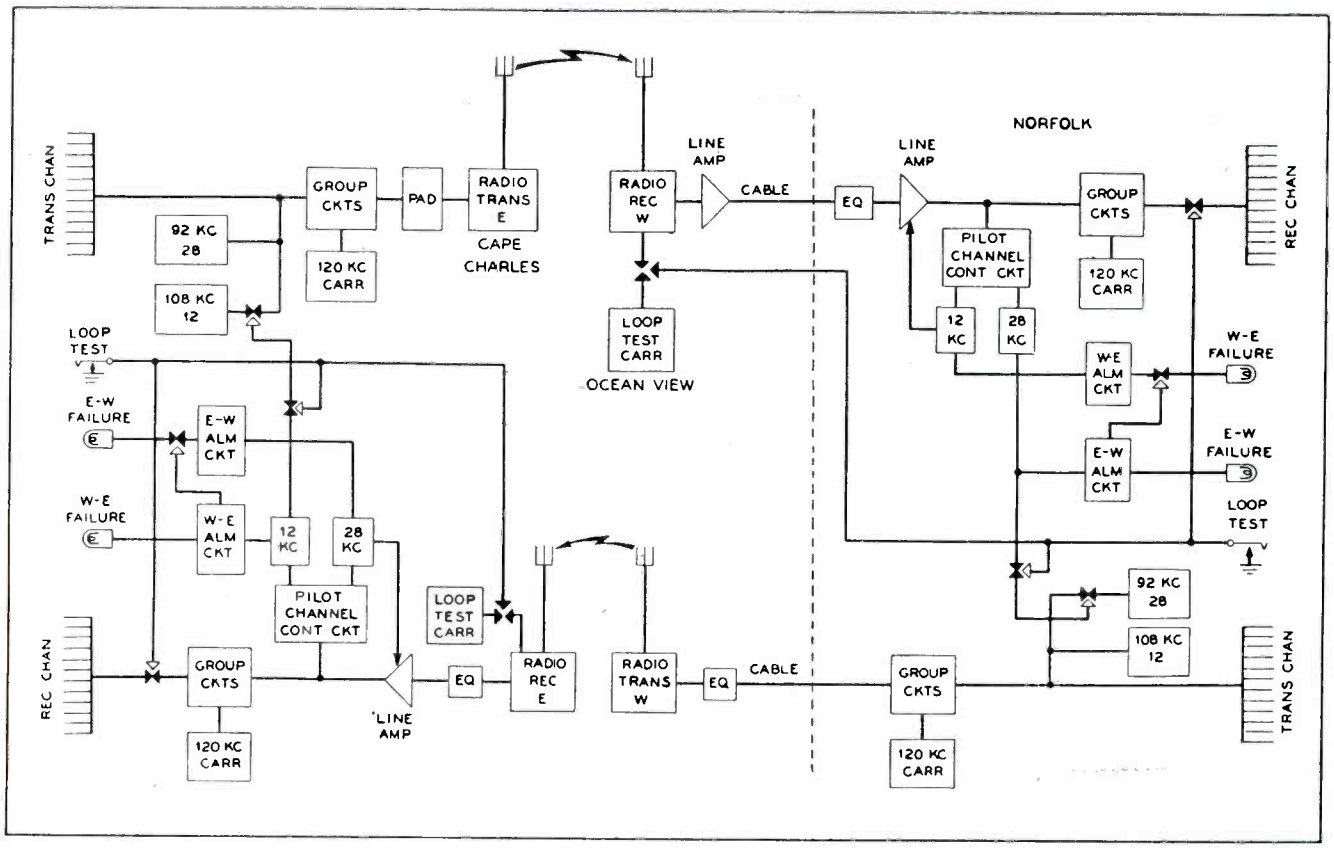
International Business Machines Corp., expects to build a radio relay system with General Electric Co. equipment. The first leg will be between Schenectady and New York. Extension will then be made to Washington and later to other cities in the East and middle West.

The IBM system is expected to handle two two-way television programs, eight sound channels for broadcasting, two radio photo or facsimile channels and 120 business machine channels in each direction at one time.

Emissions varied

Most ambitious of such plans has been filed with FCC by the Raytheon Mfg. Co., which contemplates a "sky-top" radio relay system with repeater stations on top of a number of high mountain peaks clear across the country. Frequency assignments requested include 1,900, 3,900 and 5,800 mc. Experimental channels up to 26,000 mc. have been asked for. A first leg is proposed from Boston to New York and Washington in 1945. This would be extended to Chicago in 1946 and

*See description of Army radio relay set in this issue.



Block diagram of the Cape Charles to Ocean view relay link now in use for two way transmission of 12 simultaneous messages. System operates at 156.3 and 160.65 mc. Proposed radio relays will use FM and much higher frequencies

PLANS FOR THE FUTURE

is planned to reach Los Angeles in 1947.

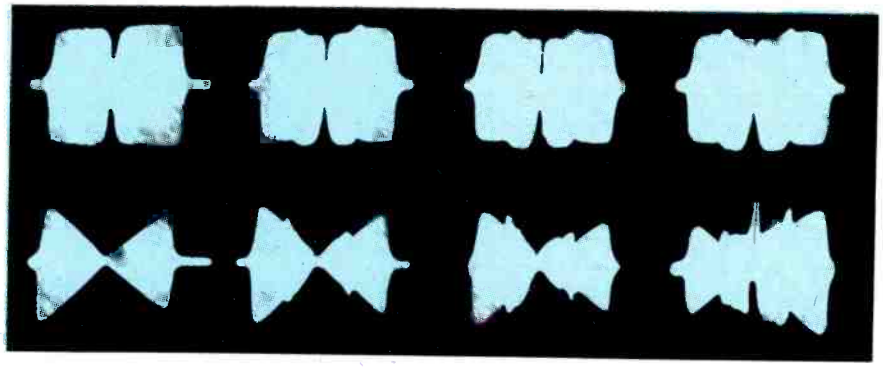
Services to be provided by these links range all the way from the transmission of telegraph and telephone messages to television, FM and AM broadcasting, a public call system, highway traffic control and police master stations, facsimile, as for train dispatching en route, communication with buses in motion, airplanes in flight via the nearest relay point, continuous radio location of airplanes and doubtless any other type of communication as it may develop.

Beaming used

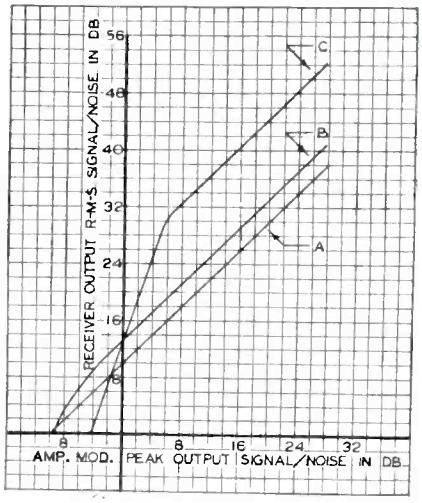
Obvious advantages of such relay systems are: only short range equipment is needed on the moving vehicle or local station; a high load factor on the system will justify high grade installations which individual carriers could not afford; enough traffic will be offered to justify full development of multiplexing with its attendant economies.

It is well known, of course, that for television transmission a comparatively broad band of frequencies is required. Such bands can be provided easily in the high fre-

Oscillographs of noise voltage transmitted by AM (upper row) and FM (lower row) receivers. Noise voltage was swept through a range of audible frequencies. Carrier to noise amplitude ratio first column 20/1, second 2/1, third 1.26/1, fourth 1/1 ▼



Signal/noise ratio (rms) in output of AM receiver, curve A compared with FM receivers for deviation ratios of one, curve B and four, curve C. Note 3 db improvement in signal noise ratio of FM over AM even with deviation ratio of unity ➤



Bell Telephone six-coaxial cable. Included are a number of regular telephone wires

Disc seal transmitting tube used in shf range. Cooling fins increase power

quency ranges requested and multiplexing has been highly developed. Furthermore the very short waves involved can be beamed effectively from sending to receiving antennas. This permits repeater stations to transmit onward at the reception frequency and even allows two-way transmission by adjacent antennas at the same frequency, thus multiplying the usefulness of any assigned channel. Other advantages at super high frequencies include a very much smaller power transmission and repetition requirement as compared with wire lines due to the lower attenuation involved. In fact, studies indicate (1) that over a 500 mile distance A T & T .257 in. cable transmitting 5 mc would have an attenuation of about 7,200 db whereas radio relay links operating at 10,000 mc would have a total attenuation of about 750 db. To obtain the same attenuation in a coaxial line would require a cable diameter of 2.45 in.

It should be stated, of course, that regular commercial transmission at these frequencies has not yet been carried on, and some important considerations favor cable construction as is evidenced by the program announced by the A T & T of constructing a nationwide broadband coaxial cable network of 6,000 to 7,000 route miles. This would have a capacity of 2.7 mc., although further technical improvements are expected to permit extension of this range to about 4 mc. These cables have as many as four to six coaxial conductors in them and can be used simultaneously for much telephone traffic.

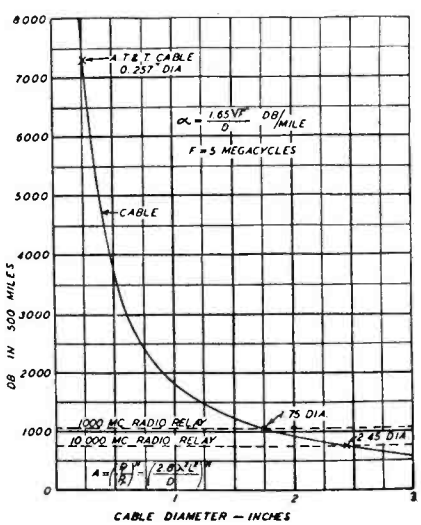
New technics

The Western Union Telegraph Co. is reported to be planning to use new transmission technics developed by the RCA Laboratories. Experiments have been carried on at about 500 mc. with signals broadcast from the Empire State Building, in New York, received and repeated at Hauppauge, Bellmore, Rocky Point and Riverhead on Long Island and also received at the RCA Building in New York.

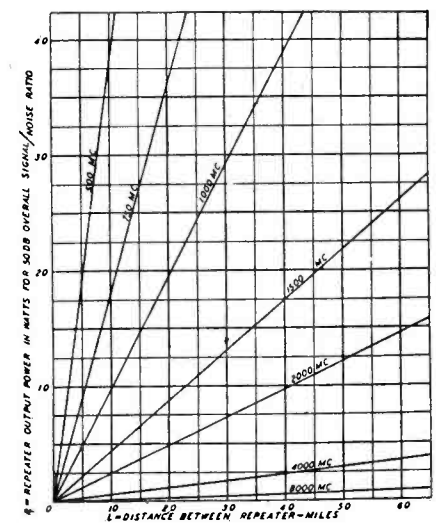
Beginning about 1936 Radio Corporation of America operated a facsimile and telegraph radio relay link between New York and Philadelphia. Relay stations were located at New Brunswick and Arney's Mount. The system operated on frequencies varying from 89.5 to 104 mc and had the following channels: two printer, one telegraph, one cue, one remote start-stop, making five 100 cycle channels un-

(*Continued on page* 182)

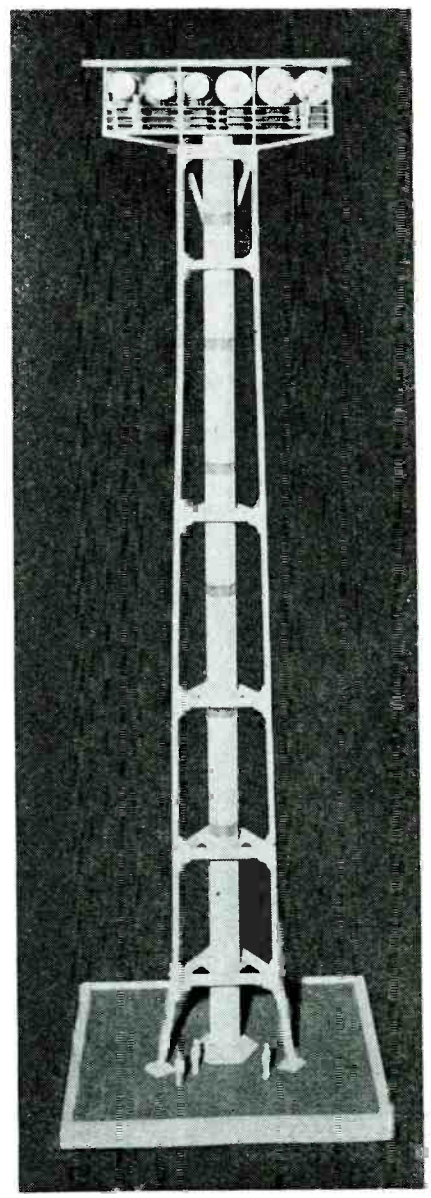
Relative attenuation in radio relay and cable systems with various cable sizes

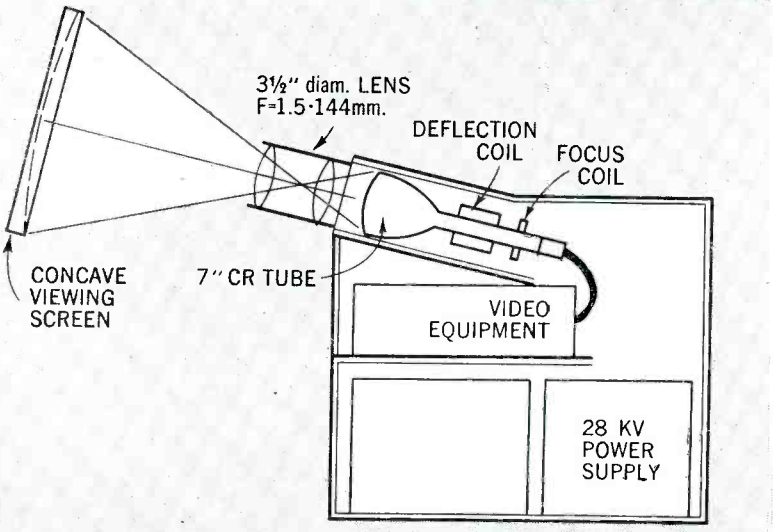


Showing reduction of repeater power needed as transmission frequency is raised



Model of transmitting and repeater tower to be used in International Business Machines Co.-General Electric Co. relay system





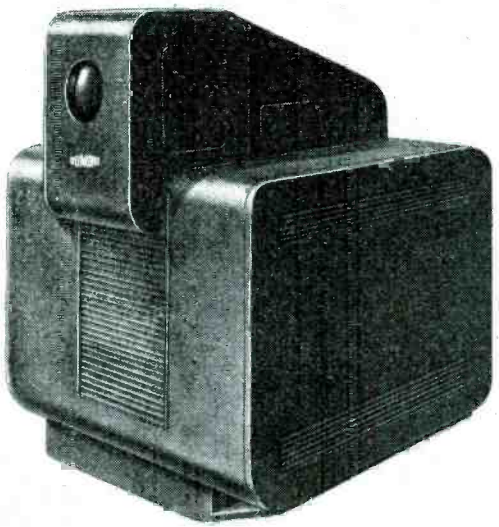


Fig. 1. Cross section and working model of television receiver. The image is projected on concave viewing screen by lens system

Du Mont's Projection Tele

Model with refracting lens system for pictures up to 4x6 feet and direct-view set with 20-in. tube revealed

● Most recent among public demonstrations of television receivers for post-war production, is the DuMont projection system based on refractive optics. Here a regular lens is used in place of the Schmidt mirror reflective optics as described in the April issue of Electronic Industries relative to the RCA projection receiver.

The Allen B. DuMont Laboratories recently demonstrated two forms of receivers, in operation from their television station WABD, New York, one, equipped with a 20 in. diameter screen for direct viewing of the received pictures, and the other a projection model designed for the home and also for use in public gathering places.

More spectacular in its demonstration and possibilities is the projection unit which produces pictures 3 by 4 ft., and up to 4½ by 6 ft. in size. This unit has a 7 in. diameter cathode ray tube operating at 28,000 volts on the second anode, and a conventional projection lens system to project the image onto a special screen. In the demonstration, a sufficiently brilliant image for an audience of nearly 100 people was produced with this equipment. The focus and definition were quite good.

Special screen

The brilliance of the picture is enhanced by the design of the viewing screen. This viewing screen is not a flat surface, but is very slightly curved in the horizontal plane (concave toward the viewing audience). The screen has a reflection power similar to the glass beaded screen used in motion picture work. The combination of the reflective properties of this screen, in addition to its concavity, makes it possible to view pictures from almost any angle without serious distortion. The brilliance of the screen drops off as the angle of viewing the screen increases. Measurements show a screen illumination of about four footcandles.

(*Continued on page* 138)

Fig. 2. At left is mechanism for moving 20 in. tube into position

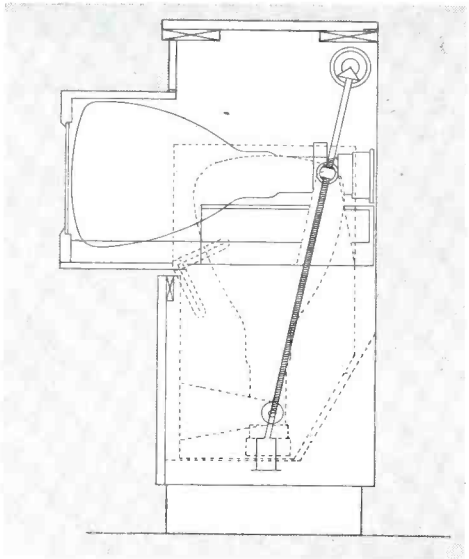
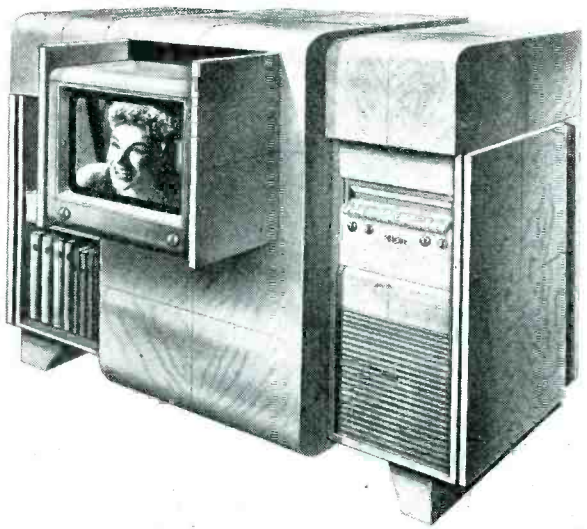
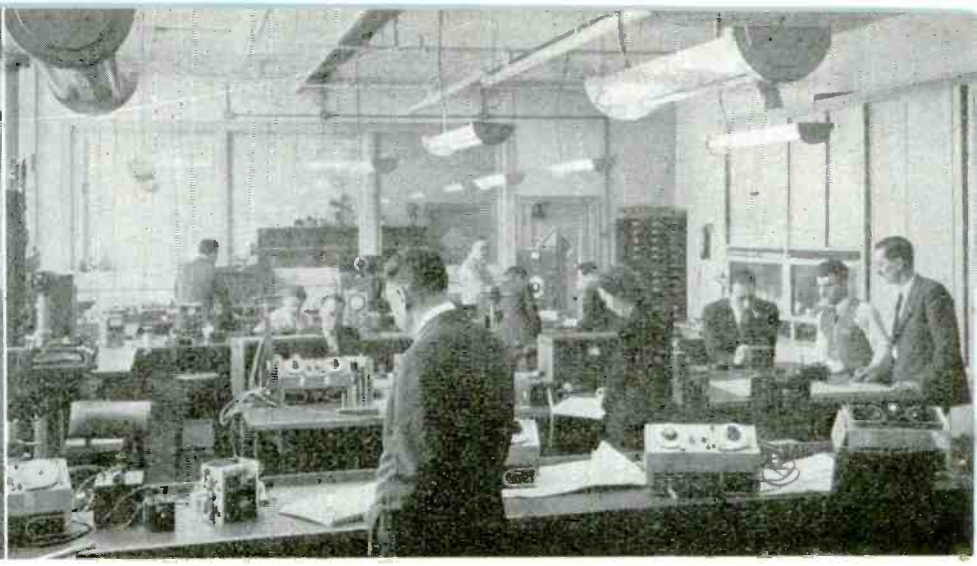


Fig. 3. At right is home cabinet design with tube in viewing position. Push-button operated motor moves tube when set is to be used

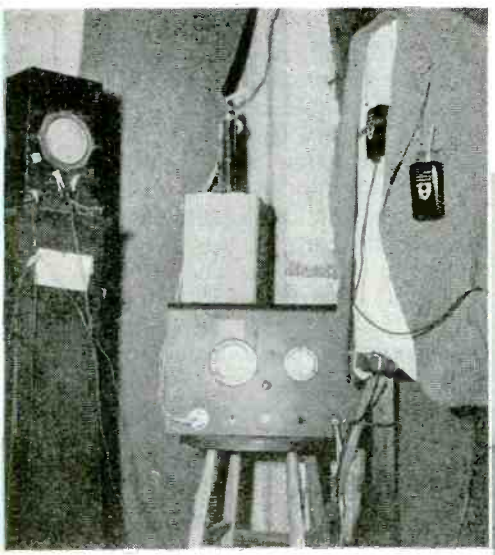


Measurements in millionths of an inch, are here made by light-wave interference patterns



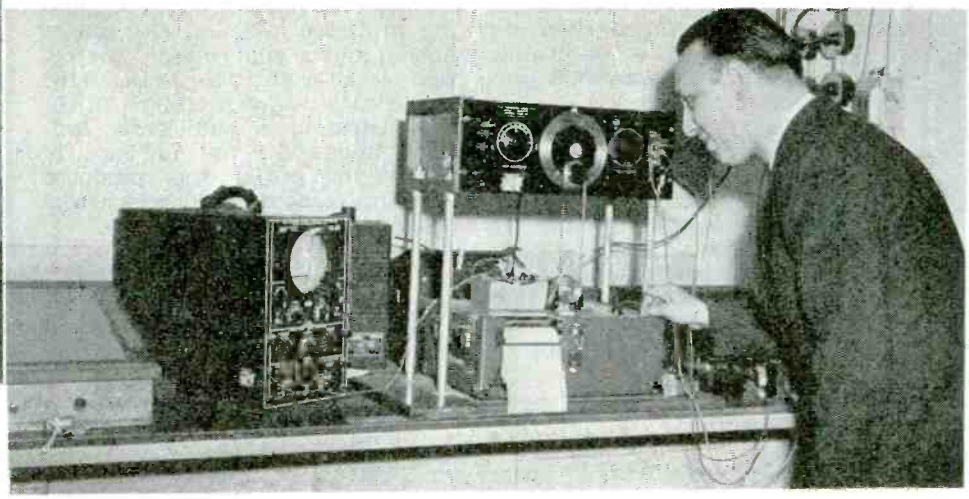
One end of the engineering laboratory where general development projects are completed, showing some of the extensive facilities for audio-frequency research work

MODERN DEVELOPMENT



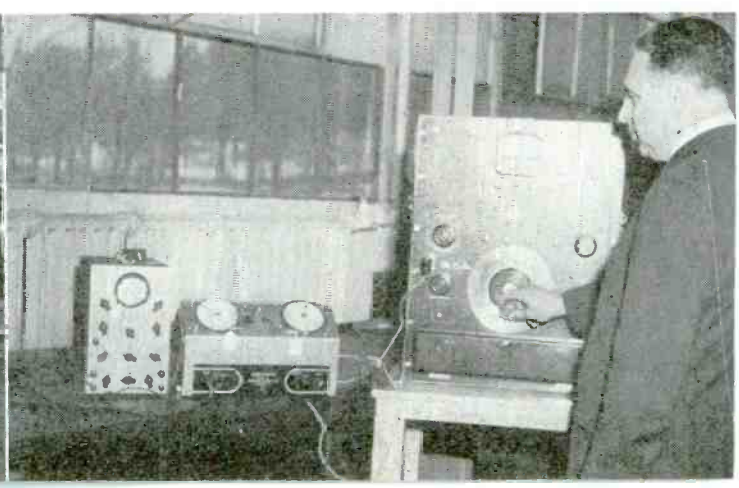
A non-union Oscar holds up hearing-aid devices for extended periods without tiring. Operating characteristics are measured under conditions precisely simulating those under which the equipment is normally used

Frequency response curves covering the whole audio range are completed and plotted in a matter of minutes by this automatic tracer



The compliance of each vibrating component must be carefully studied on specially designed test equipment. These instruments indicate force/displacement values of parts used in miniature Signal Corps head-sets

One phase of the study involves measurement of the harmonic output of each component. The output of a Sonotone Audiometer is being checked here on a wave analyzer

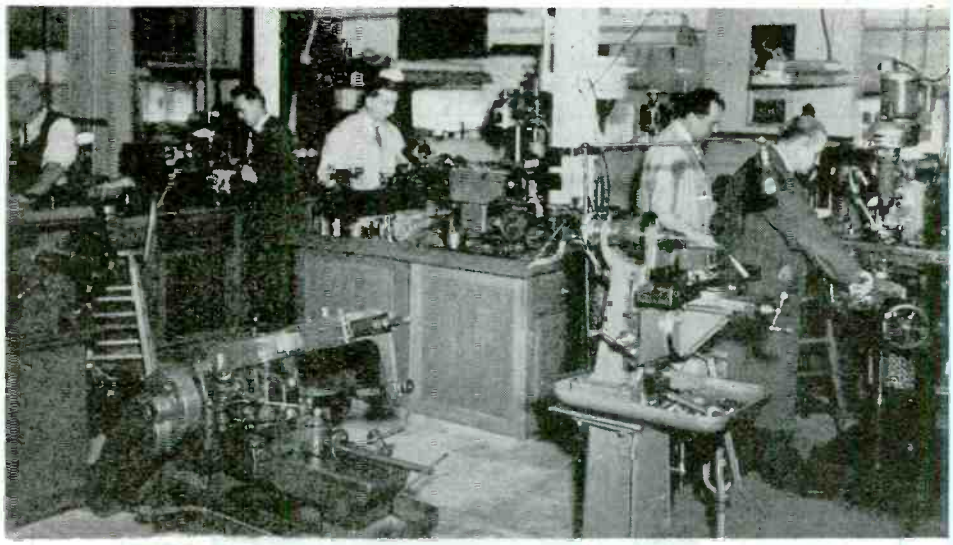


Part of laboratory devoted to acoustical research for war and peacetime products. The dynamic characteristics of certain components can be plotted automatically

Automatic recorder checks miniature Signal Corps receiver characteristics on artificial ear in adjoining sound-proof room

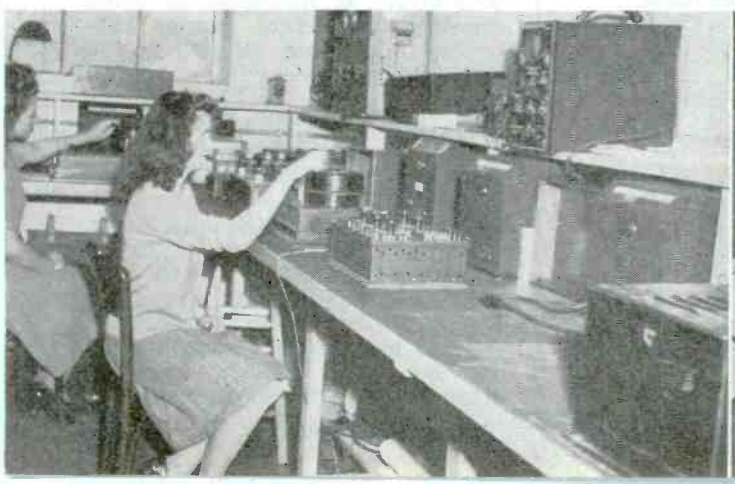
LABORATORY TECHNIC

These pictures, made in the laboratories of the Sonotone Corp., Elmsford, N. Y., show a part of the extensive research and service facilities that have been developed for the company's work in the hearing aid field and now extended to serve military needs. In addition to this work, Sonotone has designed and produced large quantities of miniature headsets, throat microphones and sound powered telephones for military purposes. In its Acorn tube work, Sonotone inaugurated an extensive program of original development involving the invention, design and construction of much new machinery to insure the uniformity in production so necessary in tubes of this size.



Part of tool room and model shop associated with development laboratories. Production test devices and research instruments of a special nature are handled here

Part of standards laboratory. Precision potentiometer being used to calibrate laboratory instruments



The usually compact arrangement of a new form of hearing aid is spread out for detailed tests in its preliminary stages of design

MARINE VOICE-CODE SET

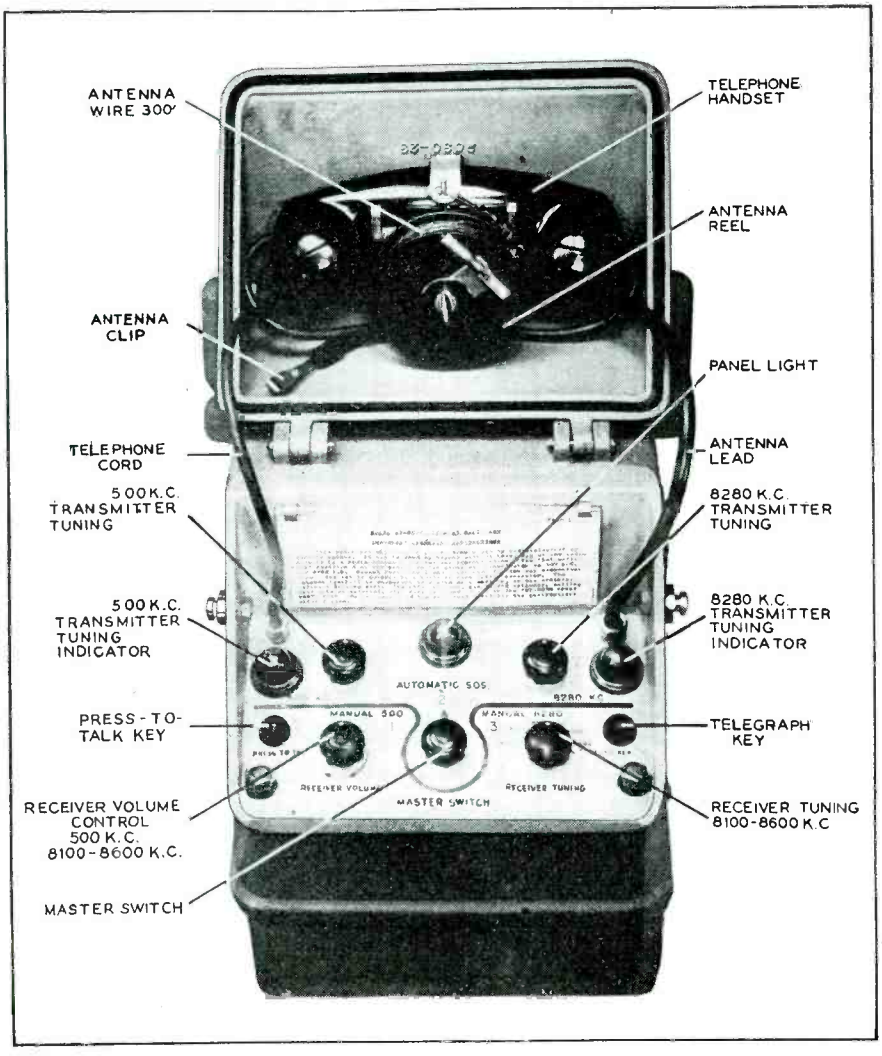
Water-tight lifeboat transmitter-receiver for merchant marine provides for automatic dual frequency operation

● Further progress in saving lives at sea has been achieved in the development of a watertight radio transmitter and receiver by Radiomarine Corp. of America for lifeboat use. These sets weigh about 150 lbs. and have a range from 50 to 1000 miles. The sets, approved by the U. S. Coast Guard and the FCC probably will be allocated two to a merchant ship and will be installed permanently in lifeboats ready for emergencies.

The transmitter, equipped for either voice or code, delivers five watts at frequencies of 500 kc., the international distress frequency, and at 8.28 mc. for longer range transmission. The transmitter also is arranged for completely automatic operation, sending out distress signals for half a minute at one frequency and then switching to the other frequency for the succeeding half minute. The signals consist of SOS for 15 sec., then a long dash for direction finder use. Power is furnished by hand cranking instead of storage batteries, to increase reliability, and when the equipment is set for automatic sending, cranking is the only function required of the operator. This has been made as convenient as possible, requiring .15 hp at 60 rpm.

Aerial equipment includes 300 ft. of wire, a kite for use in strong winds, a balloon for use in calm or light airs and if both means fail, a mast for regulation stretching of wire to fore and aft fastenings on the boat. The balloon, made of Neoprene of low perveance is de-

Fig. 1. Operating panel with water-tight cover raised. The tuning indicators are neon lights which are brightest when the output circuits are adjusted properly



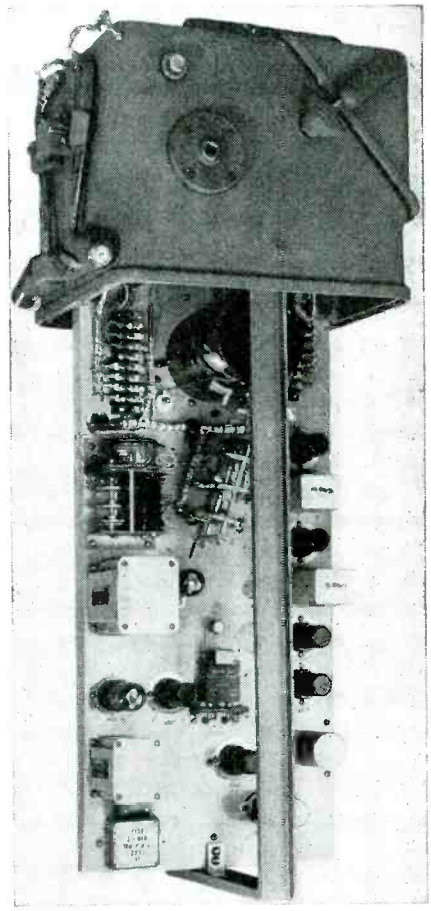


Fig. 2. Interior of set with water-tight base removed showing rugged construction

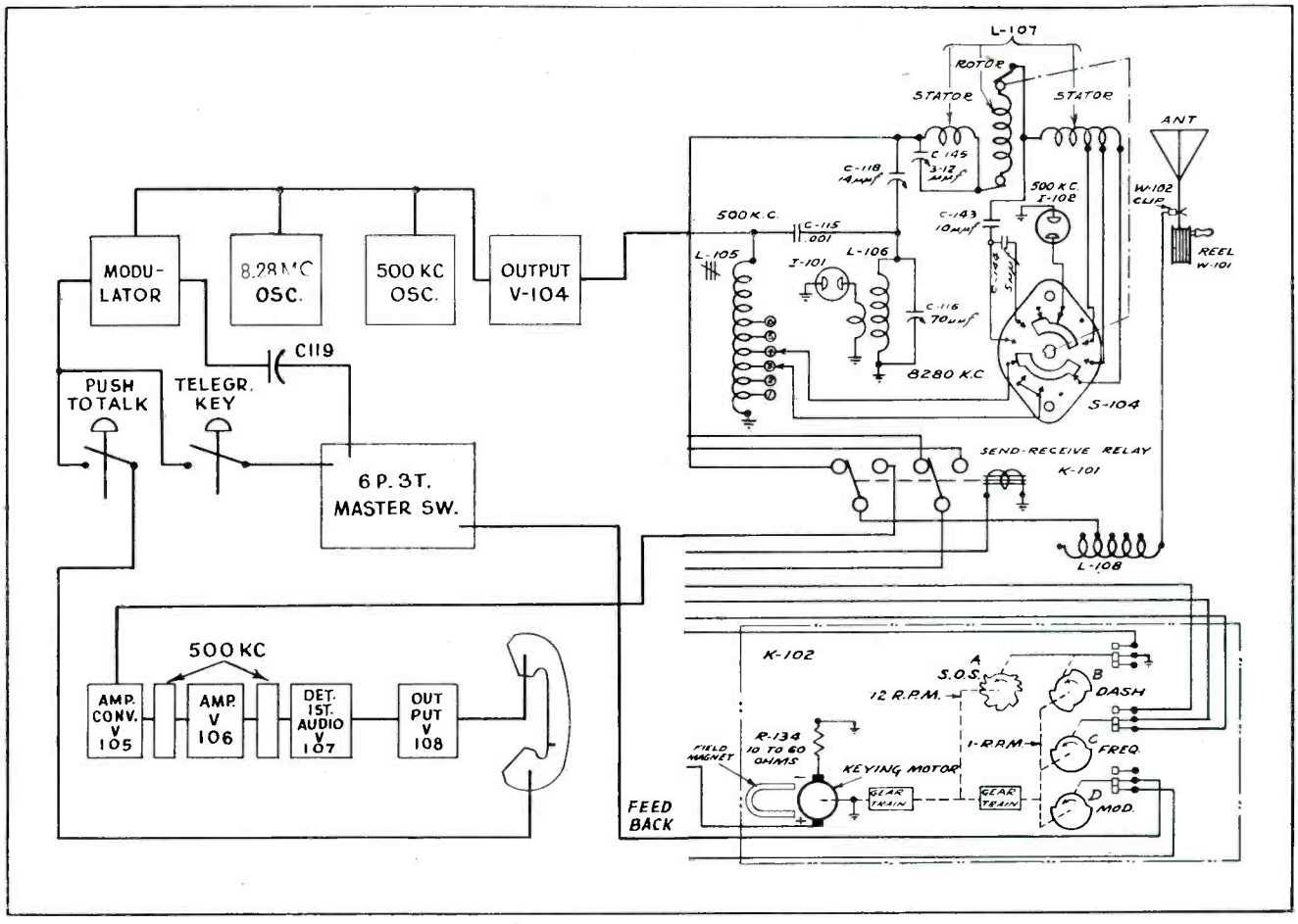
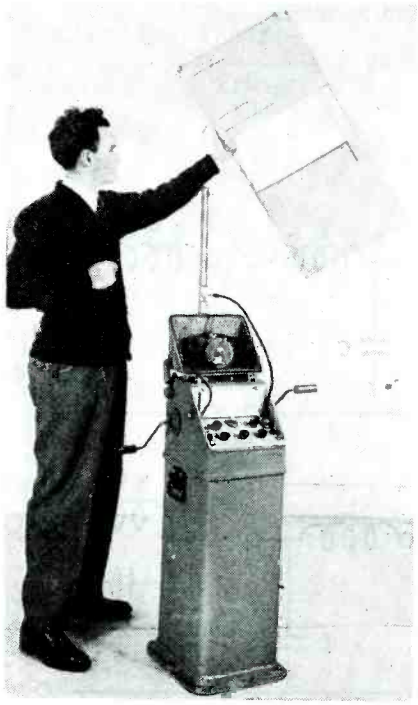


Fig. 3. Combination block and circuit diagram showing layout and noteworthy features of automatic keying mechanism and double output tanks. Rotation of L-107 for 500 kc tuning automatically changes taps on L-105 and L-107. A high impedance loop with C-145 blocks grounding of 8.28 mc output

Fig. 4. Set ready for operation showing box kite used for aerial in windy weather



signed to stay up a week or more when inflated to a diameter of 4 ft. with the helium gas supplied. It has a 20 oz. lift which gives it a margin over the 11 oz. of wire suspended from it. This lift decreases .1 to .2 oz. per hour. The balloon can be inflated only once. A compressed supply of helium is provided in a shatterproof steel cylinder. Although under 2000 lb. pressure, this cylinder will not explode when pierced by a projectile.

Circuit details

Automatic operation is controlled by a small 6-volt motor driving a set of cams. The set will transmit either type A2 (modulated cw), or A3 (phone) emissions on 500 kc, and either type A1 (CW) or A3 emissions on 8.28 mc. When the short inverted V mast antenna is used instead of the kite or balloon, power output is reduced to 2 watts at 500 kc and 3 watts at 8.28 mc.

The radio receiver on 500 kc delivers 6 mw of audio power into an 80 ohm load with a signal to noise ratio of 10/1 with an input of 25 microvolts modulated 30 percent at 400 cycles. On 8.28 mc, the input required is 100 microvolts. The bandwidths are 20 kc and 30 kc respectively at 20 db off resonance, while the fidelity is within 4 db from 400 to 2,000 cycles (reference point, 1,000 cycles).

A rubber gasket between the head and the binnacle of the set, the watertight seals inside the head at each control shaft, lights, push buttons, as well as seals at the antenna lead and handset cord, make use possible in heavy weather. Inside moisture is kept low by the use of a silica gel cartridge.

Referring to the circuit diagram, the 500 kc oscillator for the transmitter is a 6SS7 tube. The frequency is adjusted by a movable iron core coil. The 8.28 mc oscillator, is controlled by a crystal and an adjustable inductor. During automatic operation, the frequency cam C on the automatic keying unit K-102, alternately places plate and screen voltages on the 500 kc and 8.28 mc oscillator tubes.

The power amplifier is V-104, and grid drive is taken through a

(Continued on page 146)

DESIGNING FILTERS FOR

By ARTHUR H. HALLORAN
West Coast Editor, Electronic Industries

Theoretical formulas for determining characteristics of low-pass and high-pass units for various purposes

• An understanding of why the circuits in Figs. 2-5 are frequency separators can readily be gained by letting x denote the reactance of a series element and y denote the susceptance (reciprocal of reactance) of a shunt element. For low-pass, x is $2\pi fL$ and y is $2\pi fC$. For high-pass, x is $1/(2\pi fC)$ and y is $1/(2\pi fL)$. Fig. 6(a) then represents a half-section with series input and shunt output, whereas Fig. 6(b) shows a half-section with shunt input and series output. Fig. 6(c) represents either Fig. 6(a) or 6(b), depending upon the direction in which the input impedance is measured. To distinguish them, let Z denote the impedance looking from left to right, and Z′ denote the impedance looking from right to left. Two of these unsymmetrical half sections are combined to provide a symmetrical full section.

Thus when the circuit in Fig. 6(a) precedes that in Fig. 6(b) they form a T-section with series input and output, as shown in Fig. 7. The output impedance of the first matches the input impedance of the second, and the output impedance of the second is designed to match the resistance (R) of the load. Or when the circuit in Fig. 6(b) precedes that in Fig. 6(a) they form a π-section with shunt input and output, as shown in Fig. 8. The output impedance of the first matches the input impedance of the second and the output impedance of the second matches the resistance (R′) of the load.

Half-section impedances

To define Z or Z′ in terms of x and y, let Fig. 9 represent a half-section which is terminated at 1-1 by a matching impedance Z and at 2-2 by a matching admittance $Y = 1/Z'$. Looking to the right of 1-1 it thus represents a half-section with a series input and a load of Y mhos (or $Z' = 1/Y$ ohms). Looking to the left of 2-2 it represents a half-section with a shunt input and a load of Z ohms.

Looking to the right of 1-1, Z is seen to be equal to x in series with a parallel circuit consisting of y and Y, as expressed by

$$Z = x + 1/(y + Y) \quad \ldots\ldots (1)$$

Looking to the left of 2-2, Y is seen to be equal to y connected in parallel with a series circuit consisting of x and Z, as expressed by

$$Y = y + 1/(x + Z) \quad \ldots\ldots (2)$$

Substitution of the value of Y from eq(2) into eq(1) and algebraic solution of the resulting equation yields

$$Z = \sqrt{x^2 + x/y} = \sqrt{x/y}\,\sqrt{1 + xy} \quad \ldots\ldots (3)$$

Similar substitution from eq(1) into eq(2) yields

$$Y = \sqrt{y^2 + y/x} = \sqrt{y/x}\,\sqrt{1 + xy}$$

whence

$$Z' = \frac{1}{Y} = \frac{\sqrt{x/y}}{\sqrt{1 + xy}} \quad \ldots\ldots (4)$$

For either low-pass or high-pass

$$\sqrt{\frac{x}{y}} = \sqrt{\frac{2\pi fL}{2\pi fC}} = \sqrt{\frac{L}{C}},$$

a constant quantity, independent of frequency, and thus having the properties of a resistance. Consequently, a filter for which the quotient of series reactance and shunt susceptance is constant is called a K-type of filter. Furthermore, for low pass filters,

$$xy = -(2\pi fL)(2\pi fC) = -(2\pi f)^2 LC$$

where LC can be defined in terms of f_c, the cut-off frequency at which the total reactance of the circuit is zero. This is expressed as

$$2\pi f_c L - 1/(2\pi f_c C) = 0$$

whence $LC = 1/(2\pi f_c)^2 \quad \ldots\ldots (5)$

Consequently, for low-pass

$$xy = \frac{-(2\pi f)^2}{(2\pi f_c)^2} = \frac{-f^2}{f_c^2} \quad \ldots\ldots (6)$$

and for high-pass

$$xy = \frac{-1}{(2\pi f)^2 LC} = \frac{-(2\pi f_c)^2}{(2\pi f)^2} = \frac{-f_c^2}{f^2} \quad \ldots\ldots 6(a)$$

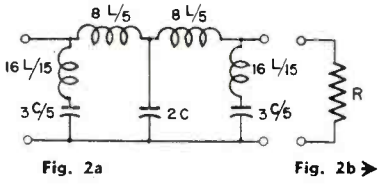


Fig. 2a

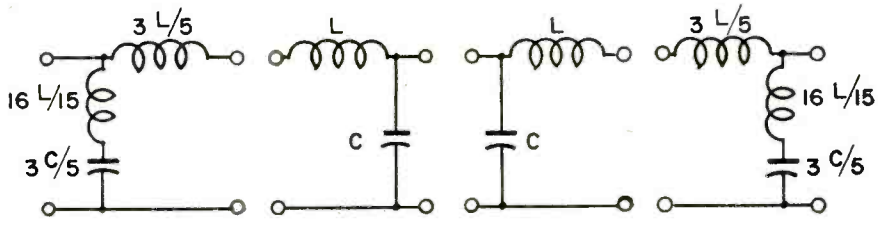


Fig. 2b ➤

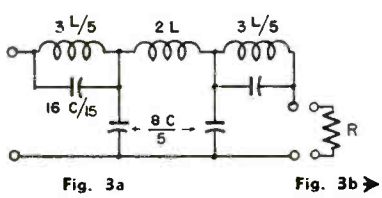


Fig. 3a

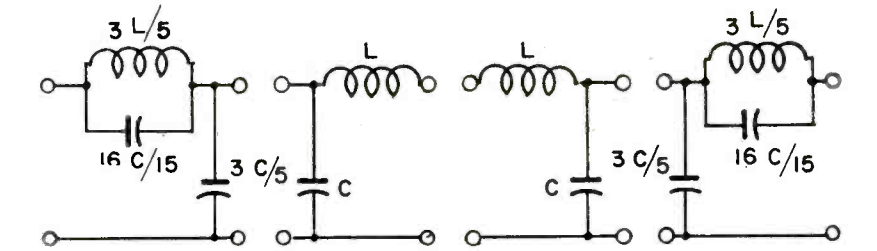


Fig. 3b ➤

SPECIFIC JOBS—PART II

Part I of this article by Mr. Halloran, appearing in the April issue of Electronic Industries, covered specific design considerations for various filter types. Part II has to do with the mathematical derivation of components.—Editor.

It is of interest to note that $f_c = f_r$ where f_r is the frequency at which the circuit is resonant, when the inductive and capacitive reactances are equal. For the sake of convenience and generality now let F denote either f/f_c, for low-pass, or f_c/f, for high-pass and substitute the value of xy given by eq(6) or (6a) in eq(3) and (4) to obtain

$$Z = \sqrt{L/C}\,\sqrt{1-F^2} \quad \ldots\ldots\ldots\ldots\ldots (3a)$$

$$Z' = \frac{\sqrt{L/C}}{\sqrt{1-F^2}} \quad \ldots\ldots\ldots\ldots\ldots (4a)$$

as general expressions for the impedance of half-sections with series input and shunt input, respectively.

The values of L and C are found by letting

$$k = \sqrt{L/C} = R,$$

whence $\sqrt{L} = R\sqrt{C}$ and $\sqrt{C} = \sqrt{L}/R$.

Also from eq(5) we have $\sqrt{LC} = 1/(2\pi f_c)$,

whence $$\sqrt{L} = \frac{1}{2\pi f_c \sqrt{C}} = \frac{1}{2\pi f_c \sqrt{L}/R}$$

and $$L = \frac{R}{2\pi f_c} = \frac{0.159\,R}{f_c}\ \text{h} \quad \ldots\ldots\ldots (a)$$

$$\sqrt{C} = \frac{1}{2\pi f_c \sqrt{L}} = \frac{1}{2\pi f_c R\sqrt{C}}$$

and $$C = \frac{1}{2\pi f_c R} = \frac{159000}{f_c R}\ \mu f \quad (b)$$

Transfer constant

An important factor in determining the performance of a half-section is the ratio of the output to the input volt-amperes, which will be defined in terms of a transfer constant (θ). In Fig. 10, looking from left to right, the series input at terminals 1-1 is E_1I_1 and the shunt output is E_2I_2. From an elementary analysis of the circuit it may be shown that

$$\frac{E_2\ I_2}{E_1\ I_1} = \frac{Y\ (Z-x)^2}{Z} \quad \ldots\ldots\ldots\ldots (7)$$

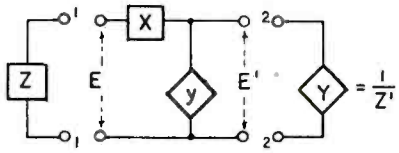


Fig. 9

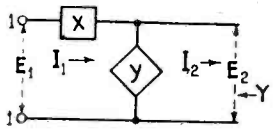
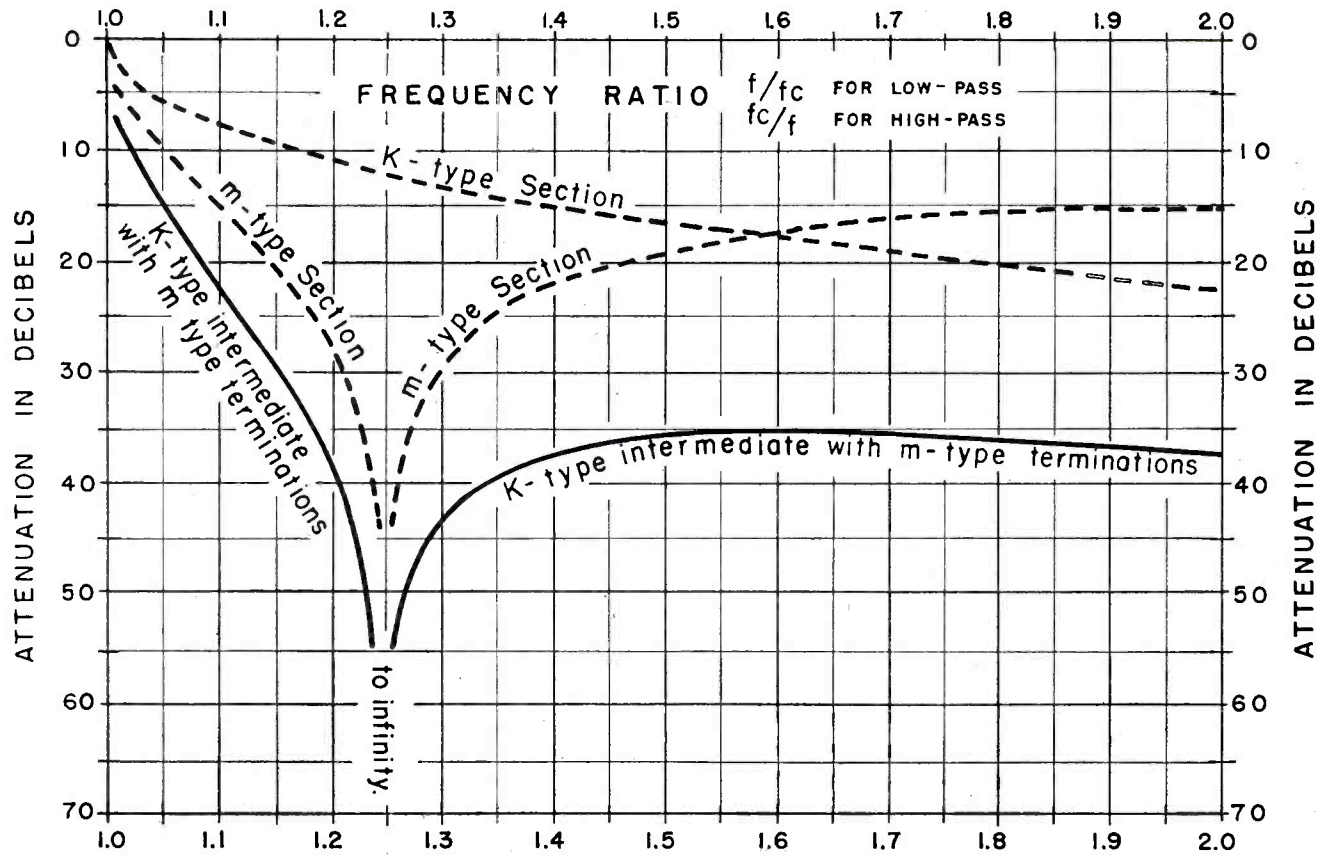


Fig. 10

Substitution of the values of Z from eq(3) and Y from eq(4) into eq(7) gives

$$\frac{E_2\ I_2}{E_1\ I_1} = 2xy + 1 - 2\sqrt{xy}\,\sqrt{1+xy} \quad \ldots\ldots (8)$$

Fig. 1. Attenuation as function of frequency ratio for one-section filters. This chart permits design simplification for k-type sections and for m-type sections (computed for m equal to 0.6)



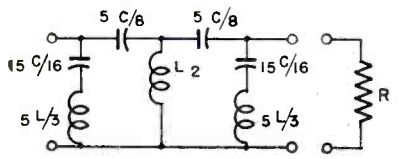
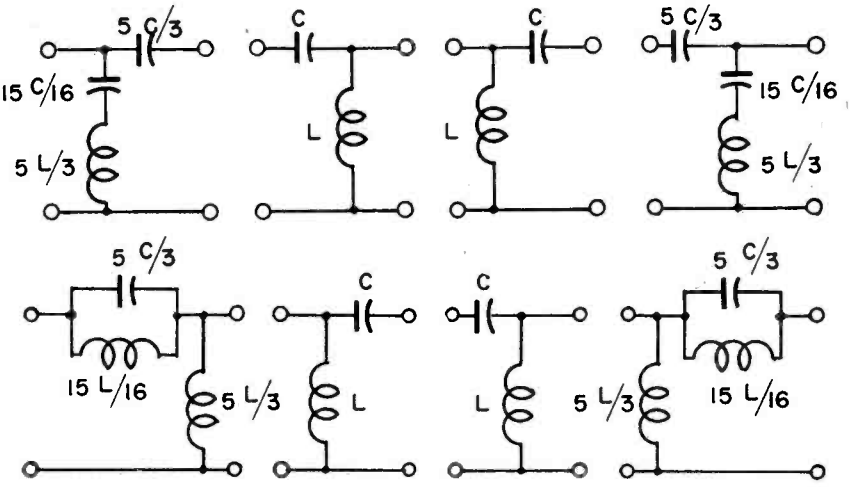


Fig. 4a

Fig. 4b ➤



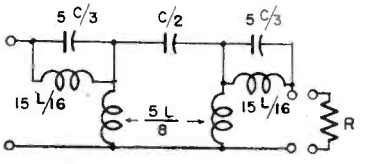


Fig. 5a

Fig. 5b ➤

For shunt input in Fig. 10, looking from right to left, the ratio is obviously the reciprocal of that in eq(8).

Since a ratio can be expressed as an exponential function, let

$$\frac{E_2\ I_2}{E_1\ I_1} = e^{-2\theta}$$

$$= \cosh 2\theta - \sinh 2\theta \quad \ldots\ldots\ldots (9)$$

where e = 2.718 is the base of the natural system of logarithms and θ is the volt-ampere transfer constant. Also since $\cosh 2\theta = 2\sinh^2\theta + 1$ and $\sinh 2\theta = 2\sinh\theta.\cosh\theta$, eq(8) and (9) yield

$$2\sinh^2\theta + 1 - 2\sinh\theta.\cosh\theta$$

$$= 2xy + 1 - 2\sqrt{xy}\sqrt{1+xy}$$

which is seen to be an identity when

$$\sqrt{xy} = \sinh\theta, \text{ and } \sqrt{1+xy} =$$

$$\sqrt{1+\sinh^2\theta} = \cosh\theta \quad \ldots\ldots\ldots 10$$

Eq(10) is our objective and there is no present need for evaluating the ratio in terms of hyperbolic functions.

The transfer constant (θ) is, in general, a complex quantity

$$\theta = A + jB \ldots\ldots (11)$$

where A is the attenuation constant and B is the phase constant. From eq(6) and (6a) it is seen that $xy = -F^2$, where $F = f/f_c$ for low-pass and $F = f_c/f$ for high-pass. Consequently,

$$\sqrt{xy} = jF.$$

This condition characterizes the k-type of structure, wherein the signs of the series and shunt reactances are unlike. (The situation when the signs are like is discussed later in connection with m-derived structures.) Consequently, eq(6), (6a), (10) and (11) yield

$$\sqrt{xy} = jF = \sinh\theta =$$

$$\sinh(A + jB) = \sinh A.\cos B +$$

$$j\cosh A.\sin B \quad \ldots\ldots\ldots\ldots\ldots (12)$$

Since an imaginary cannot be equated to a real quantity, eq(12) is valid only when the real quantity, sinh A.cos B is zero, under which condition

$$F = \cosh A.\sin B \ldots\ldots (13).$$

The real quantity can be made zero either by cos B = 0 or sinh A = 0.

When cos B = 0, then $B = \pi/2$ radians, sin B = 1, and F = cosh A

$$\text{or } A = \cosh^{-1}F \ldots\ldots (14)$$

Eq(14) defines the attenuation constant for the frequencies which are not freely passed by a k-type half section, those frequencies (f) which are higher than f_c for low-pass and lower than f_c for high-pass. This constant is given in terms of a unit known as a neper which can be converted into decibels, as explained later. For these frequencies, the phase constant is seen to be $\pi/2$ radians.

When sinh A = 0, the attenuation constant (A) is zero,

$$\cosh A = 1, \text{ and } F = \sin B$$

$$\text{or } B = \sin^{-1} F \ldots\ldots (15)$$

Eq(15) defines the phase constant for the frequencies which are freely passed without attenuation by a k-type half-section, those frequencies which are less than f_c for low-pass and higher than f_c for high-pass.

The performance of a filter is determined from the ratio of output to input volt-amperes. This is expressed by $E_2I_2/E_1I_1 = e^{-2\theta}$ or by $E_2I_2 = E_1I_1e^{-2\theta} = E_1I_1e^{-2(A+jB)} \ldots (16)$

To express 2A in decibels let $E_1I_1 = P_1$ and $E_2I_2 = P_2$, whence can be written $P_1/P_2 = e^{2A}$, or

$2A = \log_e P_1/P_2 = 2.3026 \log_{10} P_1/P_2$.

Since the number of decibels is defined by

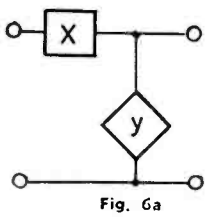


Fig. 6a

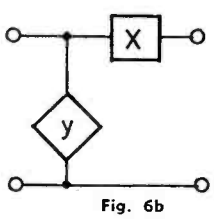


Fig. 6b

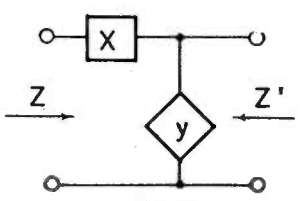


Fig. 6c

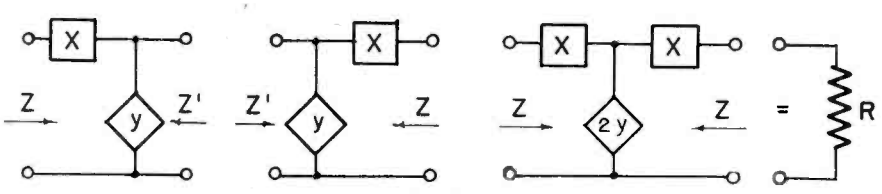


Fig. 7

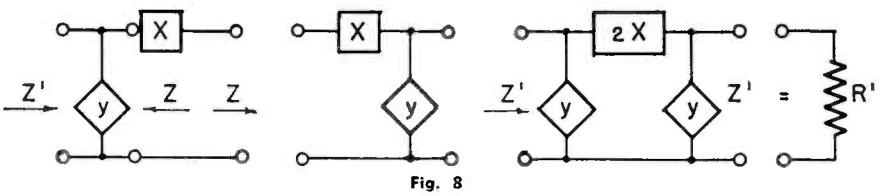


Fig. 8

$$N_{db} = 10 \log_{10} \log P_1/P_2$$

we have $\frac{10(2A)}{2.3026} = 8.686\ A = 10 \log_{10}$ $P_1/P_2 = N_{db}$. In other words, a half-section causes an attenuation of 8.686 A decibels, where A is the angle whose hyperbolic cosine is f/f_c for low-pass or f_c/f for high-pass.

When a number of half-sections are connected in series, the output of the first becomes the input of the second, the output of the second becomes the input of the third, etc. Upon denoting the input of the first by P_0, the output of the first by P_1, the output of the second by P_2, etc., and the output of the nth half-section by P_n, eq(16) becomes

$$P_1 = P_0 e^{-2\theta} = P_0 e^{-2(A+jB)}$$
$$P_2 = P_1 e^{-2\theta} = P_0 e^{-4\theta} = P_0 e^{-4(A+jB)}$$
$$P_n = P_0 e^{-2n\theta} = P_0 e^{-2n(A+jB)}$$

This means that the attenuation due to a section consisting of two half-sections is twice that due to a half-section, the attenuation due to two sections is four times that due to a half-section or twice that due to a section, etc. The same comment obviously applies to the phase angle that is introduced.

A T- or π-section thus causes a db attenuation of 17.372 A for the frequency ratios which are not passed and a phase shift of -4B radians for the frequency ratios which are passed. These attenuation values are used in plotting the k-section curve in Fig. 1. The values for a half-section are plotted in Fig. 11. The curve and scale at the right show the attenuation and constant phase shift for the frequency ratios which are not freely passed. The curve and scale at the left show the phase shift and zero attenuation for the frequency ratios which are freely passed.

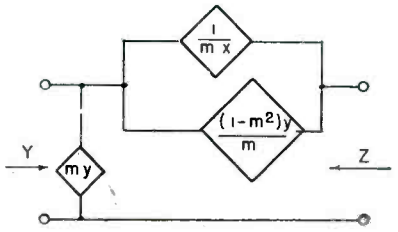


Fig. 13

From Fig. 11 it is evident that frequencies remote from f_c can be highly attenuated by connecting several k-type sections in series, inasmuch as the attenuation due to each section is additive. This method, however, does not greatly attenuate frequencies close to f_c. A much sharper cut-off could be provided if some frequency (f_m) close to f_c could be highly attenuated. This can accomplished by so modifying a k-type half-section as to provide zero shunt reactance for f_m without changing the impedance (Z or Z') of the half section. Then the k-type section can be terminated at both ends with a matching half-section of the modified type.

Let the series arm have a reactance of $x' = mx$ and the shunt arm have a susceptance of y' having a value such that

$$Z = \sqrt{x'/y'}\ \sqrt{1 + x'y'} =$$

$$\sqrt{(x')^2 + x'/y'} = \sqrt{m^2x^2 + mx/y'} =$$

$$\sqrt{x^2 + x/y}$$

thus not changing the value of Z in order that it may match the impedance of a following k-type section. This equation is easily solved to yield

$$\frac{1}{y'} = \frac{1}{my} + \frac{(1-m^2)x}{m}.$$

The configuration appears in Fig. 12 with the shunt arm shown as a reactance (1/y'). Looking to the right provides the impedance (Z) and looking to the left provides the admittance $Y = 1/Z'$. For zero shunt reactance to the frequency f_m

$$\frac{1}{my} + \frac{(1-m^2)x}{m} = 0$$

$$\text{whence } m = \sqrt{1 + 1/xy} =$$

$$\begin{cases} \sqrt{1-f_c^2/f_m^2} & \text{for low-pass} \\ \sqrt{1-f_m^2/f_c^2} & \text{for high-pass} \end{cases} \quad \ldots\ldots (17)$$

An alternative structure can be provided by letting the shunt arm have a susceptance of $y' = my$ and the series arm have a reactance of x' with a value such that

$$Y = \sqrt{y'/x'}\ \sqrt{1 + x'y'} =$$

$$\sqrt{(y')^2 + y'/x'} = \sqrt{m^2y^2 + my/x'} =$$

$$\sqrt{y^2 + y/x}.$$

This equation is readily solved to yield

$$\frac{1}{x'} = \frac{1}{mx} + \frac{(1-m^2)y}{m}.$$

The configuration appears in Fig. 13 with the series arm shown as a susceptance (1/x'). Looking to the left provides the impedance Z and looking to the right provides the admittance $Y = 1/Z'$. For zero series susceptance to the frequency f_m

$$\frac{1}{mx} + \frac{(1-m^2)y}{m} = 0,$$

$$\text{whence } m = \sqrt{1 + 1/xy} =$$

$$\begin{cases} \sqrt{1-f_c^2/f_m^2} & \text{for low-pass} \\ \sqrt{1-f_m^2/f_c^2} & \text{for high-pass} \end{cases} \quad \ldots\ldots (17)$$

which is the same as that for the other structure.

Because m was the factor originally used in deriving these structures, they are generally known as m-derived or m-type structures to distinguish them from the K-type

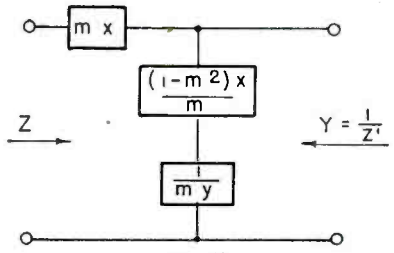
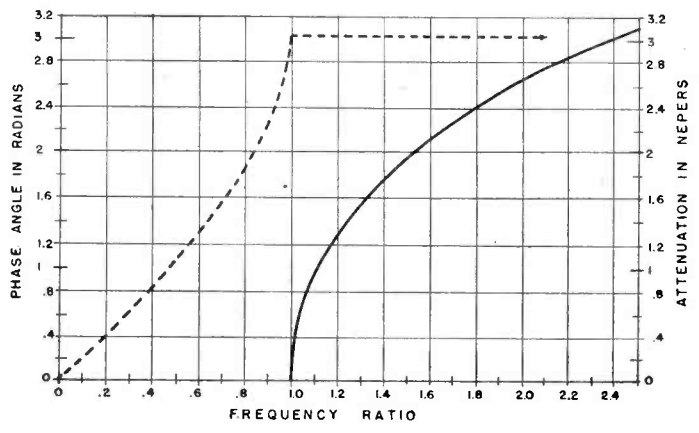


Fig. 12

Fig. 11—Frequency ratio vs. phase angle and attenuation for K-type half section filter



from which they are derived. The factor may have any value from 0 to 1, corresponding to frequency ratios from 1 to 0. When $m = 1$, the structure resumes the form of the k-type. When $m = 0.6$, whence $(1 - m^2) = 0.64$, the value of Z or or Z′ is found to be more nearly constant throughout the greater portion of the frequency range than is the case for other values. The broken-line m-type curve in Fig. 1 is plotted for $m = 0.6$, which value is also used in Figs. 2 to 5.

In the equations for

$$Z = \sqrt{x'/y'}\ \sqrt{1 + x'y'}$$

$$\text{and } Y = \sqrt{y'/x'}\ \sqrt{1 + x'y'}$$

first note that, except for $m = 1$, the factor

$$\sqrt{x'/y'} = \sqrt{mx\left\{\frac{1}{my} + \frac{(1-m^2)x}{m}\right\}} =$$

$$\sqrt{x/y}\ \sqrt{1 + (1-m^2)xy} = \sqrt{L/C}\ \sqrt{1-(1-m^2)F}$$

$$\text{or } \sqrt{y'/x'} = \sqrt{my\left\{\frac{1}{mx} + \frac{(1-m^2)y}{m}\right\}} =$$

$$\sqrt{y/x}\ \sqrt{1 + (1-m^2)xy} = \sqrt{C/L}\ \sqrt{1-(1-m^2)F}$$

is not constant, independent of frequency, when the inductive and capacitive values for low-pass and high-pass structures are substituted for x and y.

Also with regard to the equation for attenuation, note that in place of

$$j\sqrt{xy} = F = \cosh A/2$$

for negative values of x in the k-type, the m-type has

$$j\sqrt{x'y'} = \frac{\sqrt{m^2xy}}{\sqrt{1 + (1-m^2)xy}} =$$

$$\frac{mF}{\sqrt{1-(1-m^2)F^2}} =$$

$$\frac{m \cosh A/2}{\sqrt{1-(1-m^2)\cosh^2 A/2}} \quad \ldots\ldots\ldots (18)$$

In a k-structure $m = 1$ and xy is always negative, which is to say that x and y are unlike in sign. On the other hand, in an m-structure x′y′ is negative only up to a certain point, beyond which x′ and y′ are alike in sign and x′y′ becomes positive. This critical point is reached when the series and shunt reactances are equal, corresponding to

$$\frac{1}{y'} = \frac{1}{my} = \frac{1-m^2)x}{m}$$

for the circuit in Fig. 12 and to

$$\frac{1}{x'} = \frac{1}{mx} = \frac{(1-m^2)y}{m}$$

for the circuit in Fig. 13. In both circuits this point is defined by

$xy = 1/(1-m^2) = \cosh^2 A/2$,

whence

$$\sqrt{x'y'} = \frac{m \cosh A/2}{\sqrt{1-\dfrac{\cosh^2 A/2}{\cosh^2 A/2}}} =$$

$$\frac{m \cosh A/2}{\sqrt{1-1}} = \infty$$

At this point, corresponding to frequency f_m, the attenuation thus becomes infinite in value, when the reactance (x′) or the susceptance (y′) changes from inductive to capacitive, or vice versa.

For positive value of xy eq(14) becomes

$$\sqrt{xy} = F = \sinh A/2.\cos B/2 +$$

$$j\cosh A/2.\sin B/2.$$

The result of equating imaginaries to imaginaries and reals to reals is

$$F = \sinh A/2.\cos B/2$$
$$\cosh A/2.\sin B/2 = 0$$

The latter equation is true for $\sin B/2 = 0$, when $B/2 = 0$, $\cos B/2 = 1$, and

$$\sqrt{xy} = F = \sinh A/2.$$

Substitution of these values for those in equ(18) then yields

$$\sqrt{x'y'} =$$

$$\frac{m \sinh A/2}{\sqrt{(1-m^2)\sinh^2 A/2 - 1}} \quad \ldots\ldots\ldots (19)$$

For $m = 0.6$ the equations for an m-type structure thus become

$$\sqrt{x'y'} = \frac{0.6 \cosh A/2}{\sqrt{1-0.64\cosh^2 A/2}} =$$

$$\frac{0.6F}{\sqrt{1-0.64F^2}}$$

for negative values of xy and

$$\sqrt{x'y'} = \frac{0.6 \sinh A/2}{\sqrt{0.64\sinh A/2 - 1}} =$$

$$\frac{0.6F}{\sqrt{0.64F^2-1}}$$

for positive values of xy.

The numerical values for 2A in decibels shown in the m-type curve of Fig. 1 were obtained by means of these equations. An illustrative example of calculations with F = 1.1 and F -1.3 follows:

$$\frac{0.6F}{\sqrt{1-.64F^2}} = \frac{0.66}{\sqrt{1-.7745}} = \frac{0.66}{.475} =$$

$$1.39 = \cosh 0.855,$$

whence $2A = 1.37 \times 0.885 = 14.8$ db.

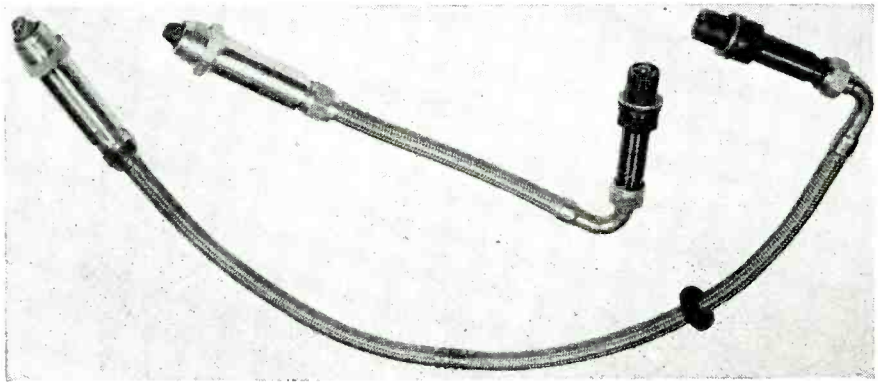
$$\frac{0.6F}{\sqrt{.64F^2-1}} = \frac{0.78}{\sqrt{1.0816-1}} = \frac{0.78}{.286} =$$

$$2.72 = \sinh 1.725$$

when $2A = 17.37 \times 1.725 = 30$ db. The values of the inductances and capacitances in structures for which $m = 0.6$ are shown in Figs. 2(b), 3(b), 4(b), and 5(b).

From eq (18) and (19) it may be seen that almost any desired attenuation characteristic can be obtained by using different values of m for several sections connected in series. Frequencies that are slightly attenuated by one section can then be highly attenuated by another section. Although such complicated structures are seldom required in ordinary practice, they can readily be designed in accordance with the basic principles that have been outlined above.

HIGH FREQUENCY AVIATION IGNITION SYSTEM



Illustrated is the heart of the new high frequency (2,000,000-3,000,000 cps) ignition system developed by P. R. Mallory & Co., Indianapolis, and now undergoing flight tests in Army Liberators. It consists of an impulse type frequency converter (in the housing at the right end of the flexible lead) and a special transformer sealed into the barrel of a standard spark plug. Use of high frequency results, among other advantages, in ability to fire even badly fouled spark plugs, and increases reliability at high altitudes

Shortage in Receiver Tubes?

By J. ALBERT STOBBE,
Engineering Consultant, 63 Wall Street, New York

Forecasting probable postwar demand and correlating it with possible factory production facilities

● During the war it has proved difficult to arrive at satisfactory demand figures to correlate with peace-time figures. The War Production Board stated during October, 1944, that military requirements averaged 10,000,000 tubes per month permitting 1,300,000 to be scheduled for civilian replacement purposes. Later government figures integrate the diversion of certain military rejects and surplus acquisitions to civilian channels. Probably the closest figure of tubes reaching civilian sets during 1944 would be 22,000,000, including 18,000,000 scheduled by WPB and 4,000,000 military releases or rejects.

The annual replacement demand for tubes for civilian receivers now considerably exceeds that of the last normal year (1941). Shortly after the close of that year there were estimated to be 60 million radio sets in the public's homes and cars. For these approximately 40 million tubes per year were in need of replacement. Latest estimates indicate at least 55 million of these sets are still in use. However, due to the fact that most of these are five years or more old, many more tubes are in need of replacement. In addition, dealer and jobber stocks are completely depleted of all popular types and are nearly so on other types.

Unsatisfied demand

It is estimated that the present 1,700,000 per month deliveries are satisfying no more than 30 per cent of the demand for replacements. In other words, deducting the 22 million from the 70 million demand leaves an unsatisfied demand of 48 million tubes per year for replacement purposes only. If civilian production could be authorized 100 per cent immediately after V-E day, these 48 million tubes plus another 60 million to stock dealers' shelves could be shipped by manufacturers as soon as they could be made. In the 8 to 10 months necessary to accomplish this, not only would another 50 million tubes require replacement, but new sets then authorized and being manufactured would require about 100 million tubes.

ESTIMATED DEMAND FOR RECEIVING TUBES (MILLIONS)

	YEAR					
	VE	VE+1	VE+2	VE+3	VE+4	VE+5
Military Demand	125	75	75	40	20	5
Civilian Replacement	80	64	46	57	62	68
For New Civilian Radio Sets	24	140	160	160	120	150
Television and Facsimile	—	2	10	18	30	40
Industrial and Miscellaneous	—	1	3	5	10	20
Total Domestic	229	282	294	280	242	283
Export	5	25	25	30	40	45
Total Demand (Millions)	234	307	319	310	282	328

During this entire period, however, military requirements would be continuing at a rate not too far from the present 10 million per month requirement. Other types made on similar equipment in the same plants will raise this to about 13 million per month. Even cut 50 per cent which is doubtful within 12 months of V-E day, military requirements would total 75 million tubes during the year.

The above estimated demand table has been prepared based on the European war ending half way through the year V-E.

Capacity non-existent

The capacity does not exist in the radio receiving tube industry to produce tubes in the volume required in the estimates noted.

In 1938, an exceptionally careful and detailed survey of the entire industry's productive capacity was made by an independent industrial engineering firm. Sealing and exhaust machines were used as the control point and a figure of 185,000,000 tubes per year of 250 eight-hour days was arrived at. Of these 155 million were glass tubes and 30 million metal. Since that time metal tube machine capacity has probably increased 50 per cent. Loctal machine capacity, to something less than 10 per cent of total industry capacity, has been added. Three companies, Triad, Champion and Arcturus, have withdrawn from the industry. Their equipment has stayed in being, however, because of its purchase by the seven remaining companies. A sizable amount of miniature and smaller glass tube capacity has been added or converted from old machine capacity. There has occurred some obsolescence which has, in turn, been offset by higher production on existing and newly built machines.

Thus from a standpoint of machine and equipment, the present capacity of the industry would seem to be in the neighborhood of 225 million tubes per year of 250 eight-hour days. This capacity is being increased currently and the increase will probably be continued as newer methods and technics are perfected.

However, the manufacture of radio tubes by highly automatic processing requires very specialized machines as well as highly trained personnel to operate them. In 1938, it was felt that the machines themselves were the bottleneck. Time and the war period have proven this to be an error of judgment.

Before the tube is processed (air evacuated and parts degassified by induction heating) it must be assembled. Starting with a stem or header containing supporting lead wires the various elements are spot welded into place. This operation calls for highly specialized skill for which the training period is long. Practically all of this mounting work is done by women because of the higher degree of manual dexterity and hand-eye coordination required.

During the war it has been impossible to secure adequate num-

(*Continued on page* 130)

POWDERED IRON CORES

By C. T. MARTOWICZ,
Engineering Department
Henry L. Crowley & Co., Inc., West Orange, N. J.

Design factors that influence realization of the superior electrical characteristics of iron cored coils

● Although iron cores have been used in communications equipment for many years, they have not attained real prominence in this field until recently. Yet only a few years after modern iron cores became generally known in this country, their acceptance was so tremendous that most of the foreign and domestic radio receivers made use of them as early as 1935.

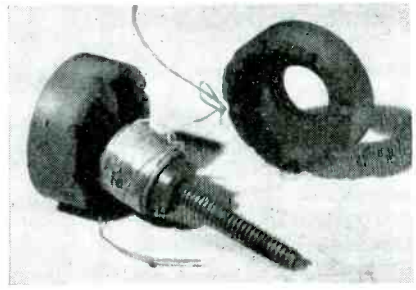
The original iron cores either were bundles of wire, laminations, or metallic iron filings imbedded in shellac. They were intended primarily for loading coils for telephone circuits. The modern iron core, on the other hand, is a molded slug of finely divided magnetic material, each particle of which is carefully insulated and bound to its neighbor to form the core.

The iron powder used in most present-day hf iron cores may be classified into three important varieties: (1) hydrogen-reduced iron; (2) carbonyl iron; and (3) magnetic iron oxide commonly known as magnetite. The latter is obviously the most inexpensive since it is a natural product requiring generally only magnetic separation before use. The carbonyl irons are high in purity and relatively high in cost. Their superior electrical characteristics in most cases, however, justify the added cost. The hydrogen-reduced iron is primarily a low-frequency material offering good electrical characteristics at a nominal cost. Each of the above materials and their variations offer very definite properties, and it is not uncommon to use one or more in combination to secure unusual properties for given applications.

Unlimited variety

Modern iron cores are made with an almost endless variety of characteristics to meet the requirements of intricate design problems in many parts of the radio-frequency spectrum. The latter statement should be particularly emphasized, since many engineers still are under the impression that iron cores are efficient only in a restricted range up to one megacycle.

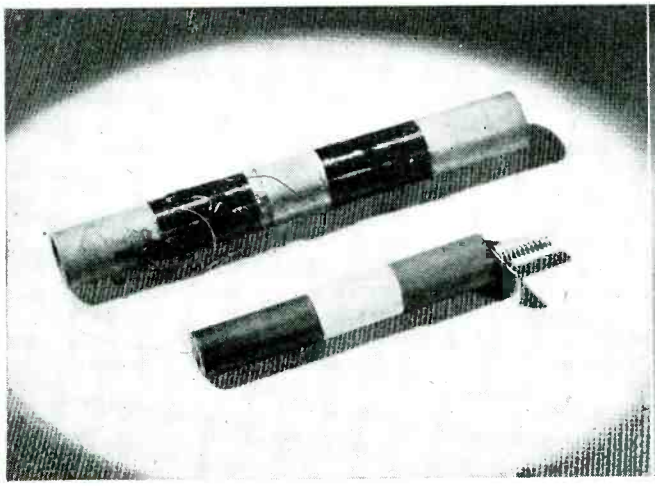
The mechanical shape or size of the iron core, for example, is limited only by the manufacturer's available processing facilities. Intricate parts often may be partly molded and if necessary machine-finished. Plastic components may be molded with the iron core as an integral part of the complete unit. Iron cores may be fabricated in sheets, rods and tubes, with or without inserts as required. Due to the economy resulting from simplicity and flexibility in methods of manufacture, and the exceedingly close tolerances, electrical as well as mechanical, which can easily be maintained in production, it is obvious that their use will increase.



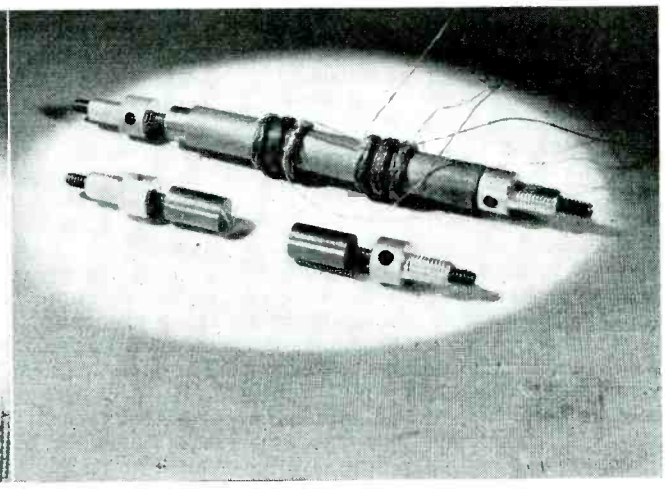
Small pot type assembly consisting of two cup cores and a center slug surrounding the compact coil. The center slug can be adjusted to vary the inductance

The advantages derived from iron-cored coils are numerous. An iron-cored coil can be made much smaller physically yet with a higher Q than an air-core coil of the same inductance. Furthermore, the cost of such a coil is much lower than an air-core coil when the Q is high, because less turns of expensive Litz wire are required. The net result is better gain and selectivity per stage at lower cost with iron-cored

Two movable iron cores with common adjustment screw for single adjustment of both antenna and oscillator coils



Typical multi-pi iron if transformer. Each core is adjustable in its winding by means of the extended screws



coils. In the case of if transformers where permeability tuning is substituted for the usual capacity tuning, the iron-core unit is cheaper than the air-dielectric type, much more stable than the compression mica condenser, and provides higher gain and selectivity. In single-tuned or untuned if transformers, iron cores can be used to increase the coefficient of coupling.

Properly designed iron-cored coils

Disassembled miniature double-tuned 456 kc if transformer of pot type construction and providing for capacity coupling between windings

used in the antenna and rf circuits provide better signal-to-noise ratio, better selectivity, better gain and better image ratio in superheterodynes. Highly efficient and economical iron-core coils for these circuits are usually made by simply using a coil containing a fixed cylindrical iron slug usually ⅜ in. in diameter. In some instances (universal replacement coils, for example) the slug has a screw molded in one end for adjustment. Permeability adjustment of such replacement antenna rf or oscillator coils offers the advantage of rapid tracking with a simple screwdriver adjustment of inductance rather than the customary and laborious process of removing turns.

Efficient adjustable iron-cored coils are widely used for wave-traps and permeability-tuned station selectors. In the latter the oscillator is tuned by a variable inductance. Where only one adjustment is desired for both the antenna and oscillator coils, both moving iron cores are mounted on a common adjusting screw. A typical unit is illustrated. A number of such units may be mounted on a push-button switch. The principal advantage of using iron cores in such an assembly is superior frequency stability. A similar unit having compression mica tuning condensers drifts rather badly, necessitating readjustments so frequently as to make it impractical.

In the design of iron-cored coils the small pot type assembly consisting of 2 cup cores and a center slug offers the best possible constructional unit. The wire is mechanically protected and cannot be damaged or displaced, thus causing undesirable inductance change. Furthermore, adjustment of the inductance by movement of the center slug does not change the losses —a particular advantage of the modern iron-cored coil.

Best construction

To develop the full efficiency of such a coil, the form should be made of low-loss insulating material such as polystyrene, etc., and conventional insulators should be replaced with low-loss ceramic dielectric materials. The electrical characteristics of such miniature coils are much more critical than those of large and spacious coils, so that relatively small mistakes in construction will affect the coil considerably. As an illustration, using Litz wire of identical structure but having a higher loss insulation, the efficiency of an iron cored coil decreased approximately 30 per cent. Use of a hard paper tube as a coil form material instead of a low-loss dielectric resulted in a decreased efficiency of about 15 per cent.

Drift compensation

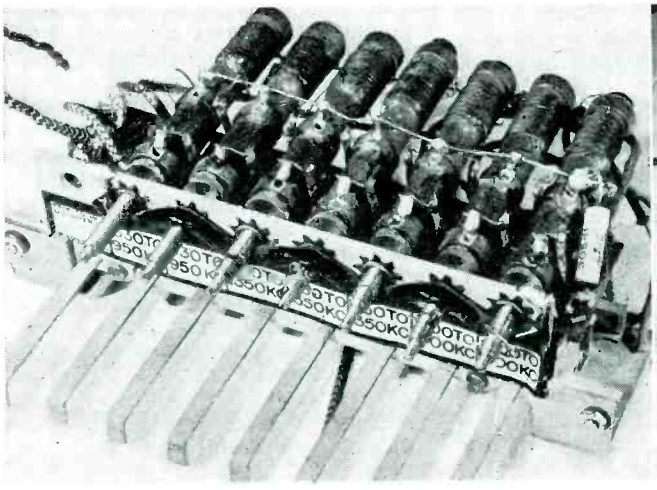
A sectionalized coil form is often best in pot type iron core assemblies. If two chambers are provided, one may be used for coupling windings. In certain applications, the coil form may be dispensed with entirely by winding the coil directly on the iron core itself providing the core material is of the high-resistance type generally available. Relatively thin and cheap Litz wire should be used for best all-around results.

If frequency drift with temperature is an important consideration in particular designs of adjustable iron cores, the adjusting screws used on such components should be made from cold rolled steel or invar and low-drift core materials should be utilized. The latter normally exhibit the extremely low thermal drift of .001 per cent per °C.

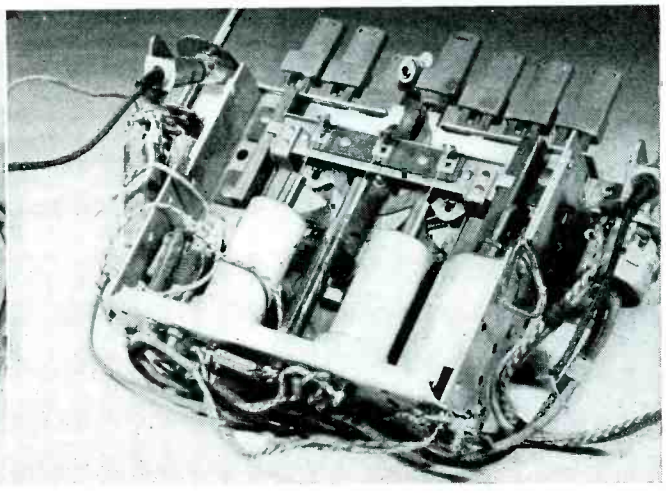
It should be noted that the effect of the addition of steel adjusting screws into iron-core components is to reduce the effective Q and consequently the efficiency of the core. This effect is not quite as marked when non-magnetic materials such as brass are used, but the average loss in efficiency over the usual working frequencies will still be about 10 to 15 per cent. This loss, however, can be materially reduced by the simple expedient of removing the adjusting screw from the core material and using thin rods instead.

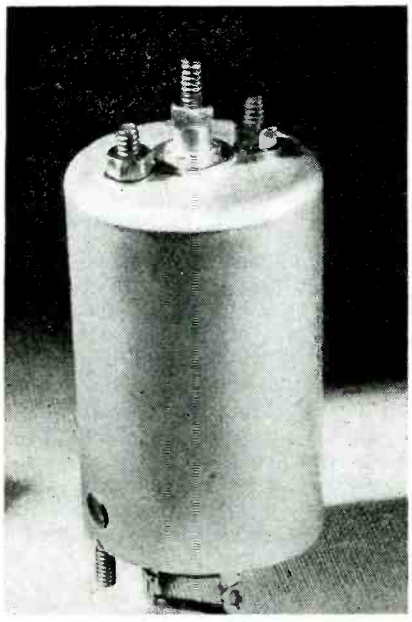
Typical designs of efficient iron-cored if transformers are illustrat-

Push-button tuner with iron core tuning coils, providing superior frequency stability with low cost requirements



Permeability tuner with three movable iron cores which are controlled by the cam action push-buttons



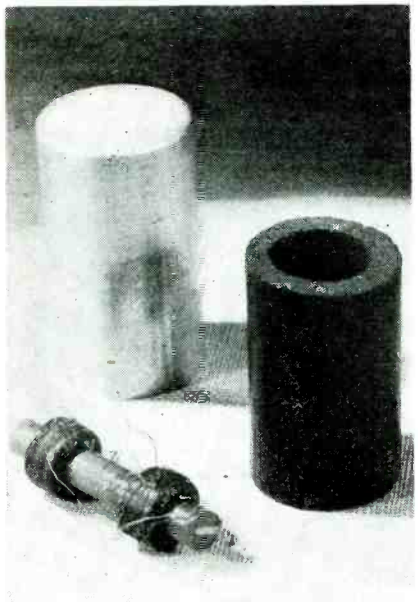


Efficient iron cored rf transformer in aluminum shield can with permeability adjustment of inductance

ed, one a disassembled miniature double-tuned 456 kc if transformer utilizing the pot type construction outlined previously and having capacity coupling between windings. The cup cores are 15/16 in. in diameter with .200 in. center slugs having 3-48 adjustment screws molded in one end. The entire assembly is 15/16 in. dia. x 1¼ in. long, including the housing, and is ideal for compact receivers. The gain is higher than that provided by a high-quality standard air-core type unit which is 6 times as large.

The well-known end-to-end construction of iron-cored if transformers requires one adjustment to

Type of transformer with fixed iron cores, adjusted by means of a separate trimmer



be made on top of the can and one on bottom. If only two adjusting cores are used, multiple pi construction should be utilized since if single pi construction is attempted the coupling will vary too much with the tuning to be of any practical value. If, however, the windings are surrounded by a third fixed core, in the form of a sleeve, a highly efficient unit will result with the single pi construction. In addition practically no coupling variation with tuning will be experienced since most of the coupling between windings will be due to the magnetic shield and not the adjusting cores. The latter type of assembly presents the most economical form suitable for manufacturing on a large scale and is definitely highly competitive in comparison with the price of the usual type of air-cored if transformers.

Shield material

The shield material is generally of the magnetite variety and as such is rather inexpensive. The adjusting cores may be of the same material but are generally made of a higher permeability material to increase the overall transformer efficiency.

An important use of magnetic materials is also found in permeability tuning where iron cores are moved by mechanical means to vary the inductance of fixed coils and so replace the conventional coil and ganged variable condenser. Such a unit is equipped with cam action push buttons controlling the travel of the three movable iron cores.

The unit is provided with variable-pitch oscillator windings to give straight-line frequency tuning. There is reason to believe that this type of coil eventually may be displaced by the use of standard easily-wound solenoids of uniform pitch in conjunction with improved iron cores having a variable permeability along the axis to produce the same final result. Under most circumstances permeability tuning of this type offers very definite advantages.

Mounting practice

Because a high degree of fixed circuit capacity can be tolerated the entire tuning unit may be mounted some distance away from the tube circuits and the two units interconnected by long shielded wires. This has been a frequent practice by auto-radio manufacturers permitting the small tuning mechanism to be mounted on the instrument panel with the remainder of the receiver fastened to the fire wall of the car. Mechanically the permeability tuned mechanism offers less ineria than a gang condenser and consequently is better adapted to push-button selectors which are operated by means of cams. In addition the former is usually cheaper than gang-condenser tuning when used with a properly designed cam action push-button station selector.

Permeability tuning

Electrically, permeability tuning offers extraordinary values of inductance for tuning the low-frequency end of the broadcast band with a consequent improvement in circuit performance.

Properly - designed permeability tuners provide a greater frequency range with better stability and performance than can ever be attained with gang-condenser tuning. Tuning ratios of 3.3 can easily be attained with permeability tuning units employing iron cores .200 in. in diameter and 1½ in. in length because of the favorable coil form factor. In the FM band, permeability tuning can offer the superior performance demanded of the tuned circuits.

Among some of the other applications, high - permeability iron cores are used rather extensively for loading coils in carrier current telephone circuits as well as low and high pass filters of high efficiency. Magnetic shielding of coils, tubes and circuits offers an effective control of rf leakage at high frequencies. With the development of special inorganic binders capable of withstanding extremely high temperatures, the use of iron cores in transmitter inductances dissipating considerable power is now a common occurrence.

Other applications

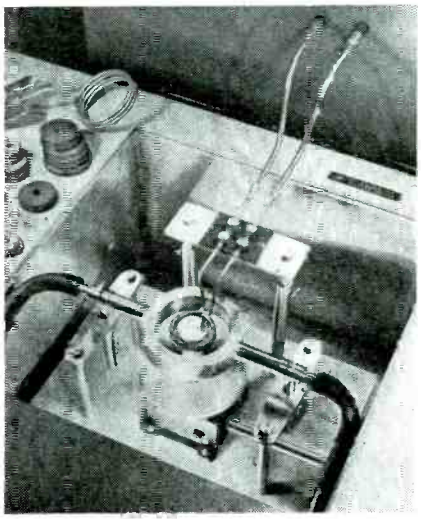
Among the many and unsual uses to which iron cores have been successfully applied are those of sensitive solenoid plungers providing controlled tension for various types of winding machines, substitutes for laminated parts in small motors, generators, transformers, etc., and the selective heating by induction of metal parts through the medium of controlled fields. In the latter application the controlled electromagnetic fields are sustained by properly-shaped iron cores of special low-cost materials placed in or around the part to be induction heated, as required. The numerous advances of importance in the iron core art and its applications in recent years are indicative of what the continued effort on the part of this relatively new industry may be expected to produce in the near future for electronics and its allied fields.

TUBES ON THE JOB

VT Furnace Control

A new type of vacuum-tube thermocouple device, characterized by its anticipating nature has been developed in the research laboratories of the Westinghouse Electric Corp. It increases the sensitivity and response of conventional temperature controls by a thousand per cent. This instrument consists of two thermocouples of different thermal capacity and an electric heating element, enclosed in an evacuated glass envelope to cause heating of the thermocouples by radiation, to minimize room temperature effects, and to prevent deterioration of the elements. Changes in electric furnace temperatures are anticipated and corrective steps taken to minimize the cyclic swings in temperature characteristic of most furnace controls.

When the furnace current is on, the anticipater heating element heats both thermocouples, but one heats faster because of its lower thermal capacity. This increases the thermal voltage and the control swings to cooling, preventing overshooting. When the furnace control current is cut off, current to the anticipator heater also ceases and both couples begin to cool. The second thermocouple, having a greater thermal capacity, cools more slowly. The thermocouple current drops because of the reverse polarity, and the control swings to heating, preventing overshooting.

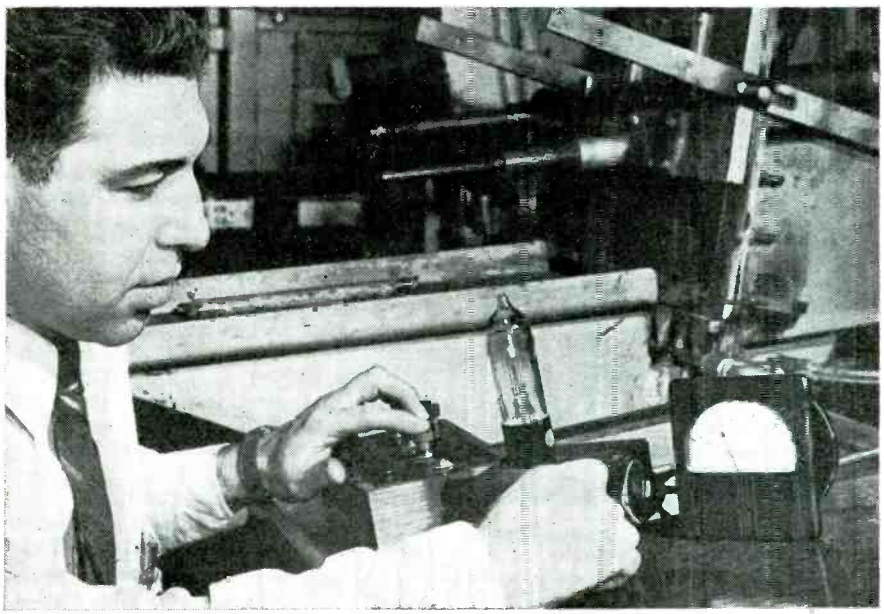


Lepel rotary induction gear heater and quencher automatically controls heat, improves quality

Rotary Gear Heater

A new application of the principle of high frequency induction for hardening gears and pinions has been developed by the Lepel High Frequency Laboratories, 39 West 60th St., New York, in the form of a roto-heating and quenching unit, which reduces the hardening time to a matter of seconds. The new device causes the parts in process of hardening to revolve at a predetermined speed within the load coil during the automatically-controlled heating and quenching cycles.

Westinghouse thermocouple controlled equipment operates to maintain furnace temperatures within close limits through application of a new principle which permits anticipation of temperature changes



Taxis Use Motorola

The Yellow Cab Co., Cleveland, is now using Motorola radio FM transmitting and receiving units to direct and control operations of part of their taxicab fleet by two-way radio employing a wavelength of 118.65 mc. This experiment of the Galvin Mfg. Corp. in the use of the 118 mc spectrum for mobile units has been pronounced such a success by General Manager J. T. Smith of the cab company that he has started proceedings to obtain permission of the FCC to install Motorola mobile units in 100 additional taxicabs.

Dust Free Room For Lens Coating

Lenses for naval combat instruments are given a coating of magnesium fluoride in the optical shop at the Mare Island Navy Yard, Vallejo, Calif., to improve their light transmission and field definition characteristics. Although this operation is carried out in a vacuum, it is imperative that the room in which the lenses are washed and prepared for coating be free of dirt and dust—since a speck of dust no larger than 1/100,000 of an inch could create an image behind which an enemy ship or factory might hide while the periscope or bombsight is in use.

Air entering this coating room is kept free of dirt by an electrostatic air cleaner, the Westinghouse Precipitron, capable of cleaning 23,000 cfm.

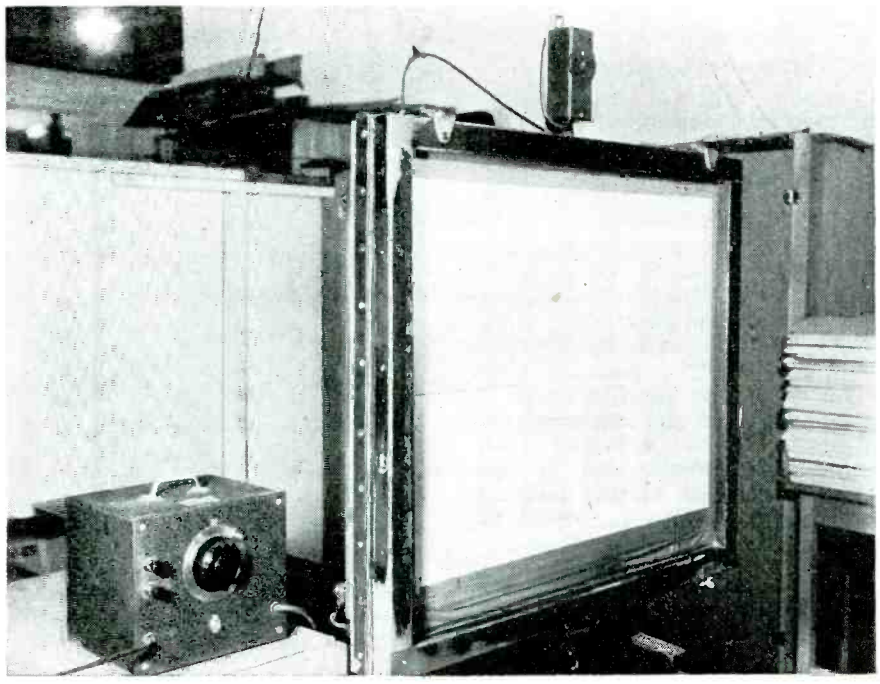
Automatic Tuning to Generator Load

An automatic tuning device in which small thyratron tubes and a reversible motor are used to provide

continuous automatic tuning of an electronic power generator was described at a meeting of the Philadelphia Section of the Institute of Radio Engineers by Dr. Wesley M. Roberds, RCA Victor development engineer. The small thyratrons and the motor so control the oscillator that any pre-determined power can be fed to the work continuously, regardless of changes in the electrical properties of the work material produced by heating.

The tube plate-current and grid-current are used in opposite arms of a bridge and the thyratrons are actuated to keep the bridge balanced by rotating the reversible motor, which in turn varies an inductance in series with the load. The load circuit is closely coupled to the tank circuit and all tuning is done on one slope of the first hump of the resonance curves. The load circuit is never completely tuned, but always presents a capacitative reactance to the tank circuit.

CONTROLLING BOOK PRODUCTION BY LIGHT



General Electric Totalux equipment in lithoprint plant of Edwards Bros., Ann Arbor, Mich., accurately determines photographic exposure time and compensates for fluctuations in light intensity

Sound Waves Measure Elasticity

Sound waves, which have been put to a variety of unusual scientific tasks in the past, have now been assigned the job of appraising women's hosiery yarns. Two Du Pont scientists, Dr. J. W. Ballou and Dr. Shirleigh Silverman, told the American Acoustical Society at a recent meeting how they had aimed a very high note, above the highest whistle range of man or piccolo, at nylon stocking yarn and at other textile fibers.

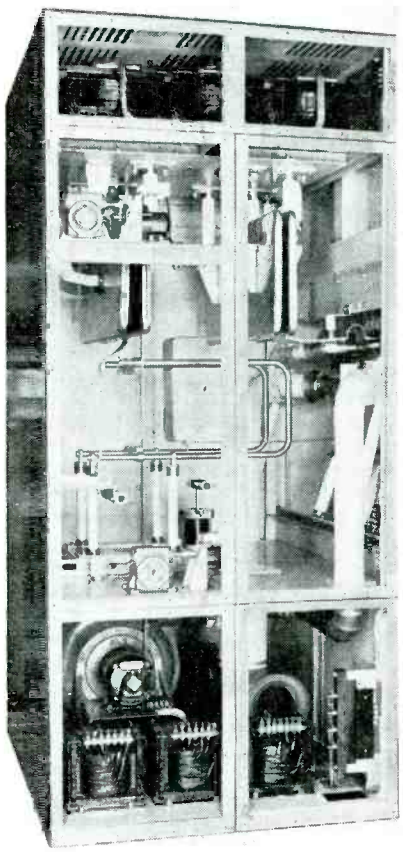
Purpose of the work was to measure accurately the elasticity of the fibers. This is a factor of importance to the wearers of stockings and of such stretchy articles as garters and girdles, as well as to the users of automobile tires. But exact knowledge of the degree of elasticity is even more important to the manufacturers of these articles and of many textile products which are not obviously elastic in themselves. For the elasticity of any yarn must be taken into consideration in adjusting the loom or knitting machine in which it is to be fashioned into a fabric.

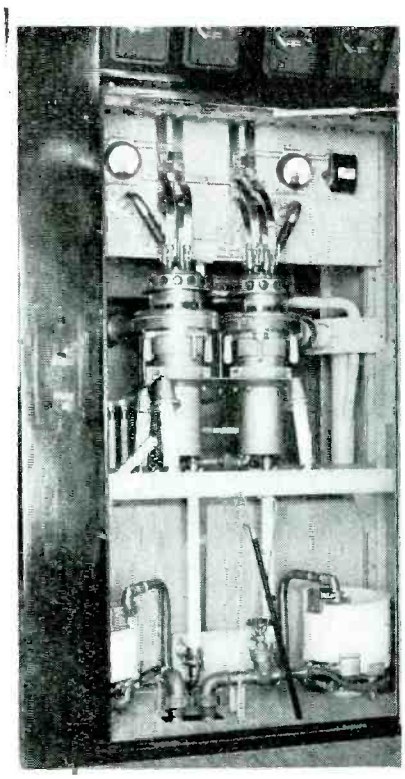
10 kc sound waves

The experiments reported here were carried out on textile yarns—linen, rayon, nylon and wool—and on various types of cellophane. Dr. Ballou and Dr. Silverman did the work while they were connected with the Rayon Technical Division of the Du Pont Company, although today they are on loan to the Government, Dr. Ballou at the Underwater Sound Laboratory at Harvard, and Dr. Silverman at the Johns Hopkins Applied Physics Laboratory at Silver Springs, Md.

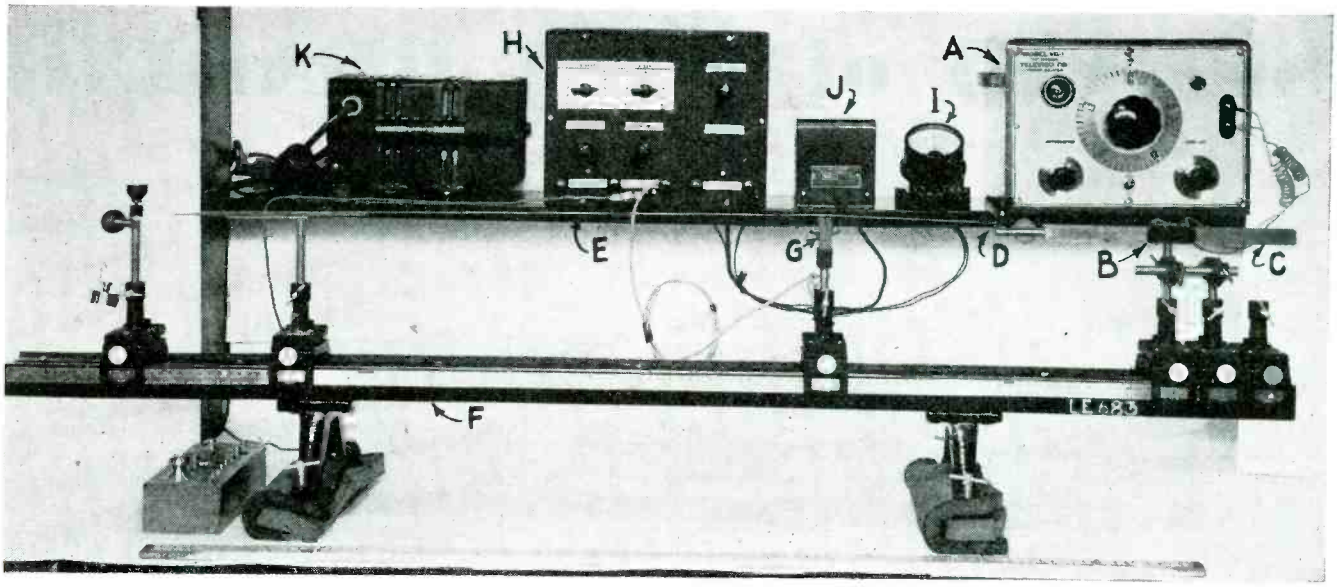
The specific property measured by the 10-kilocycle (10,000 cycles

POWER GENERATOR FOR INDUSTRIAL HEATING





Back of the RCA 150 kw electronic power generator, which puts out 150 kw at 400 kc or 125 kw at 13.7 mc, and (right) a side view of the generator arranged for 27.4 mc



Apparatus used for determining Young's modulus of elasticity for fibers and sounds by velocity measurements. (A) audio oscillator; (B) rochelle salt crystal; (C) steel resonating bar; (D) yarn clamp; (E) yarn sample; (F) optical bench mounting; (G) crystal pickup; (H) amplifier; (I) out-put meter; (J) filter to remove 60 cycle from I; (K) voltage regulating transformer for power supply

per second) sound waves is expressed as Young's modulus of elasticity, which indicates the extent to which a material is elongated when a stretching force is applied. The usual method of measuring this factor in fibers has been to hang a weight on the fiber and note the load required to bring about a certain amount of stretch. But Dr. Ballou and Dr. Silverman pointed out that this slow application of the force or load often not only produced elastic stretch but also permanent deformation, which spoiled the results.

To find the value of the elastic component alone, they argued, it is necessary to apply a small force rapidly—in other words, stretch the material so little and so quickly that it doesn't have time to get permanently out of shape. Passing sound through the fiber or film does just this. It causes the material to go through rapid stretching and recovery as it vibrates. This application of sound, the Du Pont scientists said, had been previously used by two other investiators, Meyer and Lotmar, but in a less versatile form than the one described in this paper.

Sound velocity

Since velocity of sound through any medium, whether it be air, water, rayon, nylon, cellophane or steel, is determined by two properties of the medium, its density and its modulus of elasticity, it is necessary only to find out how fast sound passes through the test material (the density of which is already known) to calculate its elastic modulus. The Rayon Technical Division apparatus, therefore, is set up to measure the velocity of sound through the fiber or film.

To one end of a horizontal bar of steel, about eight inches long, is fastened the test fiber or strip of film. The other end of the material is strung over a pulley and held taut by a weight. When a radio tube audio oscillator is turned on, the steel bar vibrates at the 10-kilocycle frequency, emitting a very high note. The sound energy passes along through the test fiber or film, which in turn vibrates like a violin string. The wavelength of these vibrations is accurately measured with a sliding crystal and this figure, with the frequency (which is known), enables one to calculate the velocity of the sound.

Measuring the Brightness of Printing Paper Stock

There can no longer be any question regarding the whitness of white paper. Gaging paper color has been reduced to a science through development of a reflection meter by General Electric. Approximately 130 instruments have been built and put in use in the United States, Canada, Norway, Sweden and Finland.

The G-E reflection meter is a so-called abridged spectrophotometer, equipped with nine narrow-band filters. On plotting reflectances obtained with this instrument at the "effective wavelengths" corresponding to the nine filters, one obtains a "color curve." The spectral reflectivity obtained in this way is sufficiently precise for control of color in the paper mill.

The major use of this instrument is in the measurement and control of "brightness" of pulp and white papers—the instrument is familiarly known to the pulp and paper industry as the "brightness tester." The instrument is carefully standardized and calibrated for the evaluation of this quantity, which is reflectivity at an effective wavelength of 457 millimicrons. Of all the chemical and physical properties that are measured, "brightness" correlates best with the quality of bleached pulps. From a colorimetric point of view, this quantity predicts the potential whitness of paper made from the pulp.

GE "reflection meter" in use by Institute of Paper Chemistry, Appleton, Wisc., for determining the whiteness of paper pulp

SURVEY of WIDE READING

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

Wave-Guide Filter

H. Gutton and J. Ortusi (Academie des Sciences, Comptes Rendues, Paris, Vol. 217, No. 1).

The problem of filtering electromagnetic waves propagated in a waveguide is treated. Discontinuities in a guide cause reflection of the waves; complex reflection coefficients R_n and transmission coefficients T_n indicate changes in amplitude and phase of the reflected and the transmitted waves.

The wave guide is assumed to be separated into three sections, A, B, C, by two conducting diaphragms establishing discontinuities as illustrated. The resulting overall reflection and transmission coefficients R and T are computed as functions of the transmission and reflection coefficients T_1, T_2, T_3 and R_1, R_2, R_3 at the discontinuities and of the phase angle θ corresponding to the distance between the discontinuities. The formulae are:

$$R = R_1 + \frac{R_2T_2T_3e^{-2i\theta}}{1 - R_2R_3e^{-2i\theta}}, \qquad T = \frac{T_1T_2e^{-i\theta}}{1 - R_2R_3e^{-2i\theta}},$$

The ratio of the output to input amplitude, or the absolute value $|T|$ of the overall transmission coefficient, is given by:

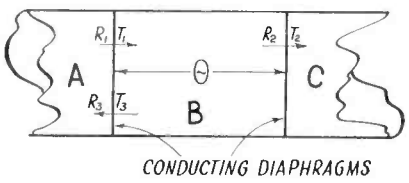
$$|T| = \frac{|T_1||T_2|}{\left[1 - 2|R_2||R_3|\cos(2\theta - \varphi_2 - \varphi_3) + |R_2|^2|R_3|^2\right]^{\frac{1}{2}}},$$

where ϕ_2 and ϕ_3 are the arguments of the complex quantities R_2 and R_3. The dependency of $|T|$ on θ and consequently on the wavelength indicates the filtering properties of the device.

Filter properties

The transmission coefficient $|T|$ will be a maximum if the cosine in the denominator is equal to unity; this is the resonance condition of the wave guide section. At the resonance frequency, if T_1 and T_2 are close to unity, the transmission coefficient $|T|$ will also be close to unity; if $T_1 = T_2$ and $R_2 = R_3$, $|T|$ will equal unity.

It is shown that for $T_1 = T_2 = T_3$ and $R_1 = R_2 = R_3$, the transmission coefficient as a function of θ will be equal to:



$$|T| = \frac{1 - |R_2|^2}{\left[1 - 2|R_2|^2\cos(2\theta - \varphi_2 - \varphi_3) + |R_2|^4\right]^{\frac{1}{2}}}.$$

The method of computation may be applied to a succession of filter sections. A filter network comparable to the conventional filter networks can be set up within a wave guide; band pass filters are feasible.

Experiments were carried out with the H_{01} wave propagated in guides having square cross-sections of 4 cm and 30 cm side lengths, respectively. The reflecting discontinuities were formed by two conducting diaphragms provided each with a slit one millimeter wide and at right angles to the electric field. The distance between these slits was varied and the transmission measured. The experimental curve showed good agreement with the formula.

Sound Waves in Rooms

P. M. Morse and R. H. Bolt (Review of Modern Physics, April, 1944).

An extensive survey of the subject, extending over 80 printed pages, is given, followed by two and one-half pages of bibliography. Geometrical acoustics, wave acoustics, acoustic impedance, steady state and transient phenomena in rectangular rooms, effects of room shape, and free wave calculations are covered in detail.

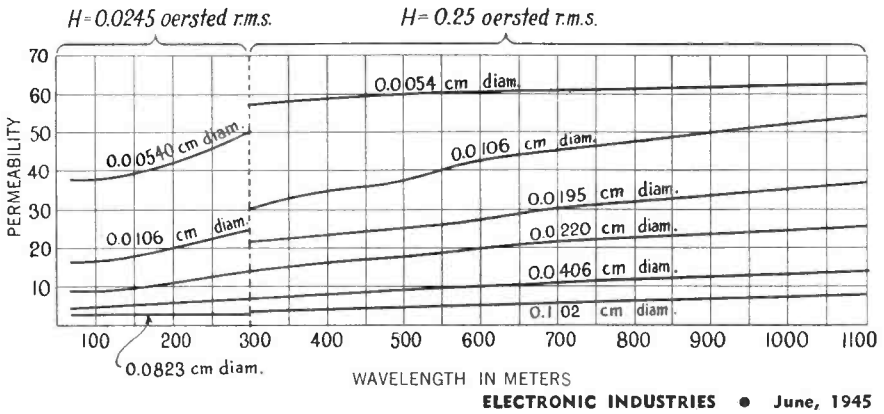
Permeability of Iron Wires

A. W. Smith, F. P. Dickey and S. W. Foor (Journal of Applied Physics, January, 1945).

The magnetic permeability of iron wires of selected diameters in the range of from 0.0054 cm to 0.102 cm (44 to 18 gage B. & S.) is measured at wavelengths from 54 to 1,150 meters (5.556 to 261 kilocycles). The permeability values were determined from the change in inductance of a specimen coil in an oscillating circuit resulting from the introduction of the sample. Changes in inductance were calculated from changes in capacitance required to restore the initial oscillating frequency; variations in the oscillating frequency were indicated by a heterodyne method. The circuit used is described; provisions were made to maintain the current through the specimen coil at a constant and known magnitude and to prevent any dc current component from magnetizing the specimen. Specimen and coils were carefully shielded.

As will be seen from the graph, the permeability decreases with decrease in wavelength and with increase in diameter. These effects are attributed to the reduction in flux produced by the eddy currents as the cross section of the wire is increased and the wavelength is decreased. Logarithmic plots of permeability against diameters of wires at specific wavelengths indicate that the permeability varies inversely as the 0.9 power of the diameter, or to a rough approximation inversely as the diameter.

Permeability as function of wavelength and wire diameter



Variation of Inductance with Core Position

T. R. W. Bushby (A. W. A. Technical Review, Sidney, Vol. 6, No. 5, 1944).

Examination of empirical data revealed a striking resemblance of the core-position vs. inductance-change curve to the normal probability curve used in statistics; this relation seems to hold for any cylindrical core. The experimental arrangement is described in detail. Results are tabulated and deviation from the expected values evaluated.

Analysis of Transmission Line Networks

N. Marchand (Electrical Communication, Vol. 22, No. 2).

The paper outlines a method of reducing a complex transmission line network to an equivalent simple transmission line circuit, permitting application of conventional equations. The equivalent transmission line circuit is obtained by theorems on the current flow in the network; the current relationships in the original and the equivalent network must be identical.

The four current theorems involved in the derivation of the current relationships in the complex transmission line network are: A—The current on the inside of the shield of a well shielded co-axial transmission line is equal and opposite to the current on the inner conductor. B—The current flowing on the inside of the shield of a well shielded, balanced, two-wire transmission line is equal and opposite to the vector sum of the currents on the balanced lines. C—At any point in a transmission line network, the sum of all the currents flowing in and out of that point is zero. D—If there are two equal and opposite currents flowing into a passive transmission line network it can be replaced by an impedance, the magnitude and phase of which may be a function of frequency.

The method is illustrated by application of the theorems to a break in the shield of a balanced line and in the shield of a coaxial line, to a shielded loop where the shield consists of two sections, and to a complex network consisting of several transmission line sections.

Chemical Analysis by X-ray Absorption

H. A. Liebhafsky and E. H. Winslow (General Electric Review, March and April, 1945).

An apparatus has been designed for the measurement of X-ray absorption upon passage through matter. The possibilities of using this phenomenon as a means of chemical analysis are discussed and compared with methods using absorption of light.

Velocity-Modulated Electron Beams

By F. Borgnis and E. Ledinegg (Annalen der Physik, Berlin, Vol. 34, No. 5).

The effect of the space charge on the focusing of a velocity-modulated electron beam is studied. It is to be expected that the mutually repulsive forces of the electrons in a beam of high current density prevent the electrons from approaching one another very closely and therefore, these forces influence the focusing properties of the beam.

A straight beam of finite cross-section emerging from the modulating grids is subjected to two effects: radial expansion and axial deconcentration. The first of these effects will be neglected, it can be counteracted by the action of electric or magnetic lenses; the second effect cannot be counteracted and is the subject of the following investigation.

A plane electron current extending to infinity in both directions at right angles to its propagation is considered. The electric field due to the electron space charge has only a component in the direction of propagation; its influence on the focusing of the electrons is computed.

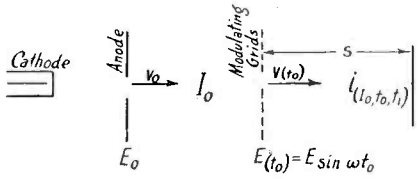


Fig. 1. Conditions in velocity modulation

Electron paths

The electrons leaving the grids (see figure 1) at the time t_o are assumed to be velocity-modulated by a sinusoidal voltage $E_{(to)} = E \sin \omega t_o$ applied to the modulating grids. Consequently, the electrons have an initial velocity $v_{(to)}$ at the grid:

$$v_{(to)} = v_o \sqrt{1 + \alpha \sin \omega t_o} \simeq v_o \left(1 + \frac{\alpha}{2} \sin \omega t_o\right), \quad (1)$$

where v_o is the electron velocity corresponding to the accelerating voltage E_o, a is the modulating index or the ratio E/E_o (modulating voltage amplitude to accelerating voltage).

The distance s of an electron from the modulating grid as a function of the time interval t_1, elapsed since the electron left the grid, is given by the expression:

$$s = v_{(to)}\, t_1 + \Theta t_1/6,$$

$$\text{where } \Theta = e I_o / m\epsilon. \quad (2)$$

m is the mass of an electron, e its electric charge, ϵ a constant equal to 0.886×10^{-13}, and I_o the current density at the grid which is assumed to remain constant. The second term in the expression for s, which is zero for zero current density, describes the effect of the space charge. The equation is valid under the condition that the electrons have not overtaken one another during their travel; it does not apply to a beam if electron paths have crossed.

Electrons overtake one another, or their paths cross, if

$$\frac{dv_{(to)}}{d_{to}} > 0, \text{ and}$$

$$2\Theta v_{(to)} < \left(\frac{dv_{(to)}}{dto}\right)^2. \quad (3)$$

The first condition is met for electrons leaving the modulating grid during alternate half cycles of the modulating wave.

Based on these computations a value for the maximum grid current density I_{om} which still permits crossing of the electron paths is derived.

$$I_{om} = 13.27\, \alpha^2 \sqrt{E_o} / \sqrt{(1-\alpha)^3}\, \lambda^2 \text{ in A/cm}^2. \quad (4)$$

For current densities exceeding this value the mutual repulsion of the electrons within the beam will prevent crossing of the electron paths.

For instance, for an accelerating voltage E_o of 1,600 volts, a wavelength λ of 20 cm, and a modulating index a of 0.1, the maximum current density I_{om} will be 15.6 mA/cm^2.

It is shown that the space charge effect may be neglested for small modulating indices provided:

$$I_o \ll 13.27\, \alpha^2 E^{\frac{1}{2}} / \lambda^2. \quad (5)$$

Current densities

The current density i at a point behind the modulating grids is given by the equation:

$$i = I_o \frac{1 + \Theta t_1^2 / 2v_{(to)}}{1 - \frac{dv_{(to)}}{dt_o} \frac{t_1}{v_{(to)}} + \Theta t_1^2 / 2v_{(to)}} \quad (6)$$

Fourier analysis of the formula for the current density as a function of time leads to the following expression for i_p/I_o, where i_p is the amplitude of the pth harmonic:

$$\frac{i_p}{I_o} = J_p \left\{ p \frac{\alpha \omega v_{(to)} t_1}{2\left[v_{(to)} + \frac{\Theta}{2} t_1^2\right]} \right\}^3 \quad (7)$$

(Continued on page 166)

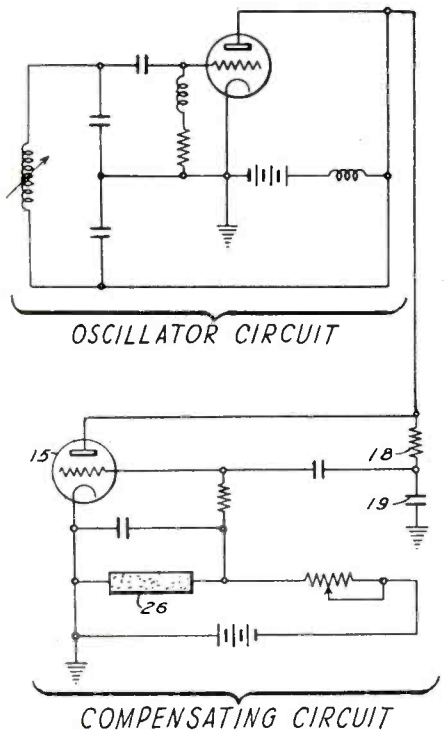
NEW PATENTS ISSUED

Compensating Humidity Effects

Changes are caused by variations in humidity which affect the component parts of an oscillator circuit, particularly capacitors. It is proposed to connect a humidity-controlled reactance-tube circuit to an oscillator in such a way as to compensate for the frequency shift due to the influence of humidity on the oscillator.

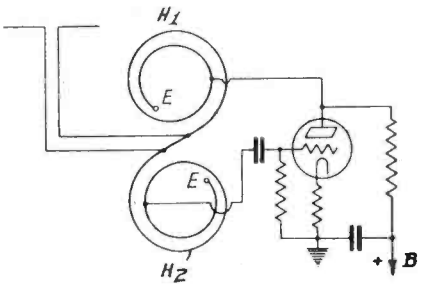
The resistance of resistor 26 is a function of the relative humidity of the surrounding atmosphere. It was found that a resistor made of lithium chloride had a resistance variation from 800,000 ohms to 2,000 ohms for a relative humidity variation from zero to 100 per cent. It will be seen that the bias voltage on the grid of the reactance tube 15 varies with the resistance of resistor 26 and in turn will effect a change in the frequency of the oscillator. Consequently, the reactance tube circuit can be so dimensioned as to compensate for the frequency drift caused by the relative humidity of the surrounding air. It may be required to interchange capacitor 19 and resistor 18 to obtain the correct frequency-humidity dependence.

M. R. Briggs, Westinghouse Electric & Manufacturing Co., (F) July 24, 1941, (I) January 23, 1945, No. 2,367,924.



UHF Resonant Circuit

The invention contemplates a tuned circuit wherein different transit time distances, which result in a low Q-value, are compensated for by subjecting the electrons in the tuned circuit to different accelerating potentials so that their transit times are substantially equalized. The tuned circuit proposed by the invention consists of a conductive space-wound ribbon-like spiral or helix possessing inductance and distributed capacitance to resonate at the desired frequency, and subjected to a progressive potential gradient intended to compensate for differences in electron transit distances.



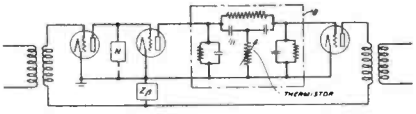
The figure shows two ribbons H_1 and H_2 connected in series in a balanced transmitter or receiver. To provide tuning facilities, the ends E of the ribbon may be adjusted by a winch, screw or cord for altering the space between the turns of the spiral and changing its distributed capacitance.

As shown by a graph, the device exhibits a Q-value of approximately 1100 to 1300 over a tuning range of from 250 to 475 megacycles for a metal ribbon of 3½ inches in length and ¼ of an inch in width. The same or higher Q-values may be achieved with smaller spirals at frequencies upwards of 1000 megacycles.

R. L. Harvey, RCA, (F) April 1, 1942, (I) January 16, 1945, No. 2,367,576.

Wide Band Amplifier

Negative feedback amplifiers frequently have a tendency to sing at some high frequency well above the transmitted band. This presents the problem of so controlling the gain and the phase shift around the feedback loop as to secure the maximum amount of feedback in the pass band while maintaining a suitable margin against singing at potential singing frequencies; absolutely stable amplifiers are secured. As an alternative it has been suggested that this margin be sacrificed in the interest of increased useful gain, provided the sing amplitude is held down to so low a level that no harmful overloading is produced by it. This is accomplished by controlling both the gain and phase shift characteristics of the feedback loop in response to the singing condition; the feedback factor is reduced over the cut-off region and simultaneously increased in the useful range.



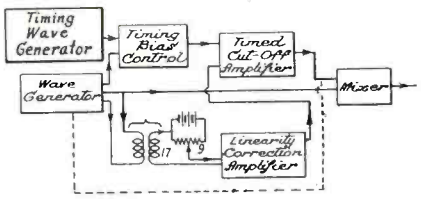
A thermistor in the interstage network 8 provides for the changes in phase and amplitude characteristics of the feedback loop. A steady heating current may also pass through the thermistor to bias it to the desired operating range. At all gains lower than that to produce the sing condition at the controlled frequency range, the amplifier is made to have unconditional stability. The design requirements for network 8 in relation to the rest of the amplifier are discussed.

H. W. Bode, Bell Laboratories, Inc., (F) January 12, 1943, (I) January 23, 1945, No. 2,367,711.

Sawtooth Wave Generator

A method and apparatus are proposed for modifying a non-linear sawtooth wave to become perfectly linear. For this purpose a control voltage is derived conforming to the instantaneous deviation from linearity of the sawtooth wave section to be corrected, and this voltage is used to compensate for the non-linearity of the original wave.

A voltage proportional to the slope of the generated wave will be impressed across coil 17 and the difference between this voltage and a constant voltage on resistor 9, which corresponds to the desired slope of the wave, constitutes the input to the linearity correction amplifier. If the generated wave has the desired slope, no input will be applied to the linearity correction amplifier; any deviation from the desired slope will cause the amplifier to operate. Its output is made equal to the necessary voltage for correction of instantaneous non-linearity; it is proved mathematically that this required voltage will be proportional to the difference in slope of the desired voltage and of the voltage to be corrected. The amplifier has a short time constant so as to be responsive to high frequencies.



The timed cut-off amplifier is introduced to permit correction of the sawtooth wave only during the major portion of the rising wave; obviously no linearity control is to be introduced close to the minimum and maximum values of a sawtooth wave. The timing bias control provides suitable interruption of the timed cut-off circuit; it may be operated by the wave generator or by an additional timing wave generator synchronized with the wave generator.

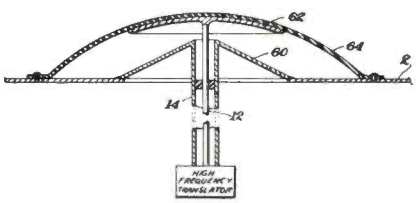
Alternatively, the output of the timed cut-off amplifier may be applied to the wave generator, and no mixer included in the circuit.

A. N. Goldsmith, RCA, (F) January 31, 1942, (I) January 9, 1945, No. 2,367,116.

Broad Band Antenna

The small, rigid antenna developed for installation on aircraft offers comparatively little wind resistance so as not to impair the performance of the aircraft; it is further designed to operate at high frequencies and over a wide frequency band.

The antenna consists of a metal cone 60, a metal disc 62 and a connecting transmission line 12, 14; the disc may be slightly concave. The antenna is mounted on the fuselage 2. A shield 64 of non-conducting material may be provided to minimize wind resistance. The metal layer 62 may be



sputtered or otherwise deposited on the inner or outer surface of the shield 64. Alternatively, the metal disc 62 may form

(Continued on page 194)

ASSOCIATION NEWS

Happenings of the month concerning industry organizations

RMA Canadian-American Gathering to Be Repeated

Radio Manufacturers Association wound up its first joint American-Canadian meeting late in April after two days that brought together thirty-one American and an equal number of Canadian industry leaders. The gathering was held April 25 and 26 at the Mount Royal in Montreal. The Canadians were the hosts. It is planned for the Americans to be hosts at a similar joint meeting tentatively scheduled for the Westchester Country Club in Rye, N. Y., during September.

At the Montreal meeting, "off the record" general outlines of war production of radio and radar equipment both in the United States and Canada were detailed by high-ranking officials of the two countries, and the industry conferees discussed mutual problems and means of bettering relations. Highlights were talks by Major General William H. Harrison, Chief of Procurement and Distribution Service, U. S. Signal Corps; Captain Jennings B. Dow, Director of Electronics Division, Bureau of Ships, Navy Department; Director Louis J. Chatten, of WPB Radio & Radar Division, and Ray C. Ellis, special WPB consultant with the Johns Hopkins University and former Radio & Radar Division director. Other speakers included J. A. Beckingham, Director General, Signals Production Branch, Department of Munitions and Supply, and M. C. Lowe, Administrator of Capital Equipment and Electrical Products, Wartime Prices & Trade Board.

UHF Radio Relays

Two more applications for use of portions of the UHF spectrum have been filed with the Federal Communications Commission. One is by Radio Corp. of America which has asked for permission to establish a Washington-New York relay with eight relay points between RCA general offices in New York and Washington. Peak power would be 500 watts.

The other request has been filed by Federal Telephone & Radio Corp., Newark, N. J., which proposes to use pulse-time methods in a circuit between air terminals, intermediate air fields and planes en-route with terminals on the I. T. & T. building in New York and in Washington. Frequencies requested are 4,200,000 to 5,200,000 kc inclusive; 1,225,000 to 1,325,000 kc inclusive; and 7 to 8,500,000 kc inclusive using A2, A3, A4, A5 and special emission. Power would be 10 watts.

The ultimate purpose is to serve as an ultra high frequency radio relay system supplying coordinated information to the airways serving the terminal cities, their intermediate air fields and planes in flight. In addition, the link is to be used for the transmission of weather and traffic information.

Postpone Inter-American Radio Conference

The Department of State has been advised that the Brazilian Government has decided to postpone to September 3, 1945, the Third Inter-American Radio Conference which was scheduled to take place in Rio de Janeiro on June 1, 1945. The Conference is being postponed in order to afford the governments participating in the Conference more time to prepare their preliminary proposals.

Vertical Radiators

War Production Board has authorized production of a limited number of vertical radiators by John E. Lingo & Son, Camden, N. J. Construction and sale of the equipment is to be permitted without priorities, from materials on hand with the proviso that the entire job must be completed within 60 days of the authorization date, which was April 21.

RMA Membership Gains

Admission of ten additional new members to RMA by the Association's Board of Directors at its meeting April 25 in Montreal, brought the RMA membership to a total of 246, a now high watermark. The Armour Research Foundation of Chicago was admitted to associate membership. Other new RMA active members include: A. R. F. Products, River Forest, Ill.; Bell & Howell Co., Chicago; Tobe Deutschmann Corp., Canton; Finch Telecommunications, Inc., Passaic, N. J.; Hewlett Packard Co., Palo Alto, Calif.; Jefferson-Travis Radio Mfg. Corp., New York; Permo, Inc., Chicago; The Radio Craftsmen, Chicago, and The Radiotechnic Laboratory, Evanston, Ill.

IRE Building Fund Over Half Subscribed

The Building Fund program of the Institute of Radio Engineers has more than reached the half-way mark of $500,000. As of May 3, a total of $320,000 had been collected representing some 608 subscriptions, of which 437 came from individuals and 171 from corporations. The universal appeal of the cause for which the fund is being raised is indicated by the fact that the first 500 subscriptions came from 37 States, Canada, Hawaii, Alaska and the District of Columbia. Dr. Austin Bailey (AT&T) heads the IRE Section solicitation committee which includes membership in 33 U.S. and Canadian Sections. Of these Sections, Cincinnati has the distinction of being the first to reach its quota, and, in fact, has gone over the top with 128 per cent of its goal.

Sir Ambrose Fleming

Another radio pioneer who will always occupy a unique niche in the history of the development of the art, has succumbed at the age of 95. Sir Ambrose Fleming, who ranks with deForest in making possible all modern communication development, died in England on April 19. He originated the diode vacuum tube, which originally was known as the Fleming valve. His invention, based on the now well known "Edison effect," made it possible to rectify radio signals in a manner much more certain and satisfactory than had previously been possible through the use of crystals and by other mechanical or chemical methods. It was deForest who added the grid, thus making it possible to control the functions of a vacuum tube.

Meck Moves in Chicago

John Meck Industries, Inc., Plymouth, Indiana, has moved its Chicago expediting office to 35 East Wacker Drive. It is under the direction of Fred Arnold.

NEWS OF THE INDUSTRY

Bendix to Launch Plane Radio Program

A separate engineering and sales organization to coordinate development, manufacture and marketing of a complete line of efficient, low cost radio communications and navigation equipment for personal airplanes is to be established by Bendix Radio Division of Bendix Aviation Corp., Baltimore. George Myrick, at one time administrative consultant to the Civil Aeronautics Authority and more recently marketing director for Bendix radio, will be Manager of the division. Charles F. Luscombe, former domestic and foreign field service representative for the division in both the European and Pacific theaters of the war, has been named Sales Engineer. Engineering development has been assigned to Vernon Moore, who was responsible for the original design work on the Bendix radio compass now generally used by commercial airlines. General supervision of personal plane engineering and sales program will be in charge of W. L. Webb, director of engineering, and John W. Hammond, communications radio sales manager of the division.

Westinghouse Shortens Name

Hereafter it is to be Westinghouse Electric Corporation. At the annual meeting of the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., stockholders voted to change the company's name to the shorter title in the interest of simplicity and brevity. At the same time stock in the company was split four for one.

Raytheon New York Move

Receiving tube division of the Raytheon Mfg. Co., has been moved from 420 Lexington avenue, New York, to 60 East 42nd street. General sales headquarters remain at Newton, Mass.

McMinn Broadcasts Talk on Electronics in Industry

Stanley P. McMinn, managing editor of "Electronic Industries," outlined many modern applications of electronics in industry in a radio talk broadcast middle of April over station WMCA sponsored by the Commerce and Industry Association of New York. Associated with him on the program, devoted to "The Electron — Your Invisible Servant", were John Mills, Bell Telephone Laboratories, and Dr. Otto S. Shairer, staff vice-president of RCA.

John Mills (Bell Labs), Thomas Jefferson Miley (Commerce & Industry Assn. of N. Y.), and Managing Editor Stanley P. McMinn before WMCA's mikes

Standard Resumes

Standard Electrical Products Co., 400 Linden Avenue, Dayton, Ohio, has resumed production of relays, transformers and other electronic control devices. Originally operated in St. Paul-Minneapolis, the plant was closed in 1941, when its owner entered military service.

Belmont Acts for DPC on Disposals

With the leasing of additional factory space in Chicago, the Belmont Radio Corp. in April assumed management, as agent of the Defense Supplies Corporation, of a central plant for the disposal of surplus military electronic equipment. The plant, which will ultimately occupy 72,000 sq. ft. of floor space, will serve as a regional redistribution center for electronic and radio material that is obsolete or surplus for military needs or has been salvaged.

Equipment to be disposed of through the Belmont-operated plant will be that released by the Signal Corps or the Navy and not returned to the original manufacturers for disposal as agents of the Defense Supplies Corporation. While many manufacturers have agreed to serve as agents of the DSC in handling surplus materials which they originally produced, others do not have the space or facilities to reconvert them to peacetime needs. Estimates on the value of military electronic equipment which may be declared surplus range from three to fifteen billion dollars.

(*Continued on page* 218)

NEW TRADE LITERATURE

Industrial X-Rays

Industrial x-ray units for low voltage radiography are described in a new booklet issued by the Picker X-Ray Corp., 300 Fourth avenue, New York. The instrument is adjustable to operate at 5 to 50 kv, and features convenience in handling. A number of illustrative x-ray pictures are shown.

Coaxial Accessories

Pressurized coaxial cable lines and accessories are illustrated in a new catalogue from the Andrew Co., Chicago, Ill. Both rigid and soft temper copper lines with bead supported center conductors are offered. Various junction boxes, glass terminals and other plumbing fittings are available.

Selenium Rectifiers

Selenium rectifiers, their principles, properties and construction are fully discussed in a new engineering manual just published by the Fansteel Metallurgical Corp., North Chicago, Ill. Efficiency, regulation, temperature range, voltage and current characteristics, forward and reverse resistance characteristics and ratings at elevated temperatures are all reported in detail, with illustrations, tables and curves.

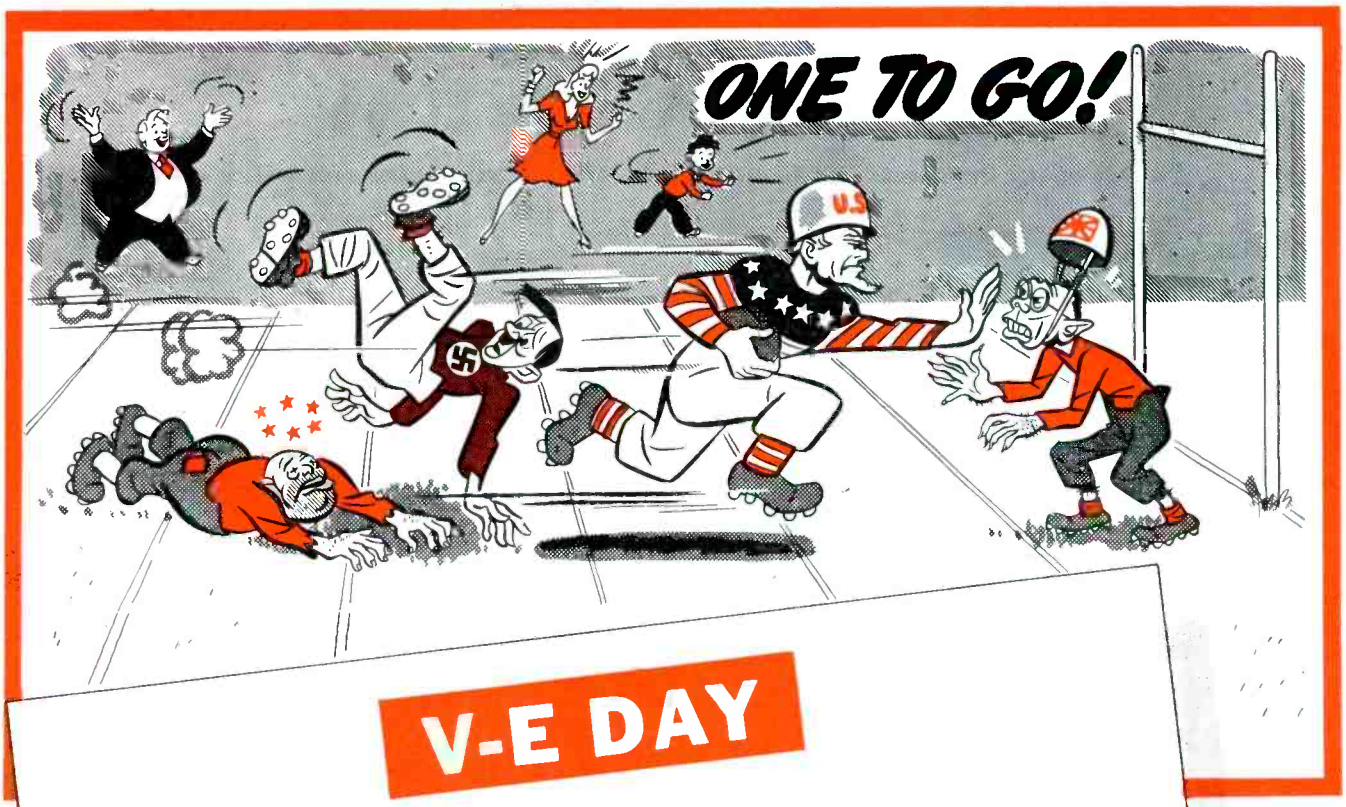
Panoramic Reception

"From One Ham to Another," a new book dealing with the technic of panoramic reception for the amateur radio operator has been published by the Panoramic Radio Corp., 242-250 West 55th street, New York 19. The book describes the problems that confront amateur radio operators and proposes solutions in reducing the number of missed signals, in determining quickly which frequencies are free and in stepping-up efficiency. Precise diagrams appear throughout the booklet.

Liquid Polystyrene

A new technical bulletin giving full information on Polyweld, which is a pure polystyrene in solution

(*Continued on page* 202)



V-E DAY

To All Hytron Employees:

Put yourself in the shoes of that friend of yours who is now a combat infantryman fighting Japs. How is he going to feel on V-E Day?

Sure, he is going to be pleased and proud that the Nazis have got the thrashing they asked for -- but his joy in that Victory is going to be overshadowed by the grim realization that he has a long, hard fight ahead.

All of us at Hytron will have a tough job ahead, too, after Victory in Europe. The production demands of the Navy alone for the Jap war are staggering. The tubes we are producing will go far toward making possible the bombing raids, the bold fleet actions, the many invasion thrusts that will bring Japan to her knees.

GI Joe will have no time out for celebrations. He doesn't want that now. He wants to finish the job, so that he may come home and join with us all in a real celebration.

The management feels that we, too, have no time to spare -- will have none to spare until final Victory is won. Hytron plants will not close down on V-E Day.

Those boys overseas expect us to keep on backing them up; the management believes you want to do just that. On V-E Day -- and until V-J Day -- let us all give vent to our enthusiasm by redoubling our production efforts for final Victory.

Bruce A. Coffin
General Manager

Post: 3-31-45
Remove: After V-E Day

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON

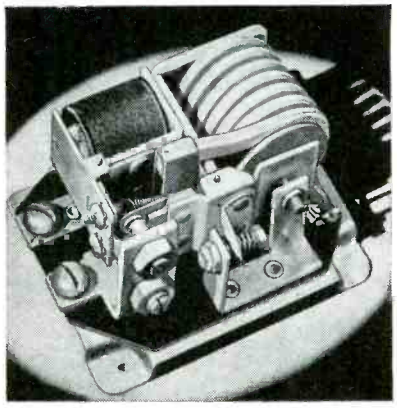
RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS
PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE

FORMERLY HYTRON CORPORATION

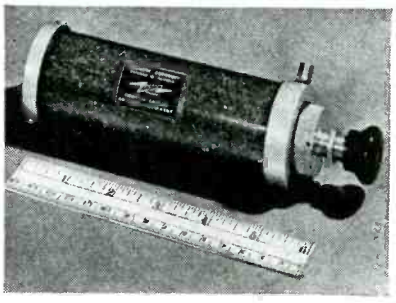
WHAT'S NEW

Devices, products and materials the manufacturers offer



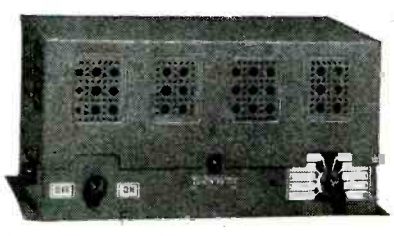
Reverse Current Relay

A reverse current relay, Type 9100, is being manufactured by the R-B-M Mfg. Co., division of Essex Wire Corp., Logansport, Ind., for low voltage dc application. The design incorporates a magnetic latch which prevents accidental closing of armature and contacts due to vibration up to 10G, or heavy shock. Contacts rated 100 amperes at 30 volts dc maximum. Physical dimensions: width, 4 1/16 in.; depth, 3 7/16 in.; height, 2 1/16 in. Another model, Type 9000, without a magnetic latch, is available for use where severe vibration and shock are not encountered.



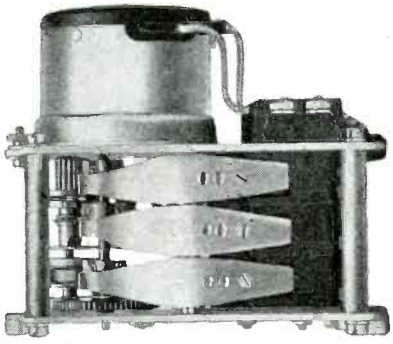
Midget Air Pump

A midget, panel-mounted dry air pump has been developed by the Andrew Co., 363 East 75th St., Chicago 19, Ill. It is 6 in. long (behind panel) and 2 in. in diameter. The small size makes it possible to mount this pump directly on a panel, making it an integral part of the apparatus which it pressurizes. Output is 3 cu. in. per stroke. Weight 10 oz. The pump has a transparent plastic cylinder which contains the drying agent. The latter is blue until its dehydrating capacity is exhausted. Then it turns pink, at which time it may be re-activated or replaced.



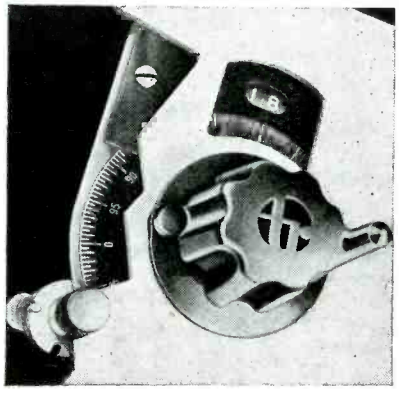
Power Booster

The improved HP-16 power booster, development of the Talk-A-Phone Electronic Laboratories, 1512 So. Pulaski Rd., Chicago, delivers a minimum of 15 watts, sufficient to cover the average paging system requirements. The booster will work with the majority of inter-communication systems, though certain models have been specially designed for it. The unit measures 6 x 12 x 6¼ in. high, is equipped with on-off switch pilot indicator and variable volume control. All controls are easily accessible and the unit may be placed anywhere near the master station. The units are connected to the master station by four wires.



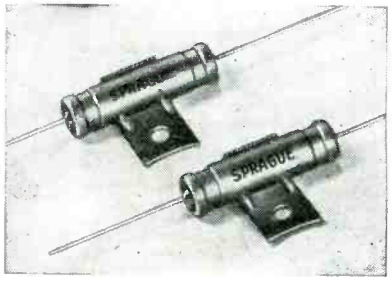
Time Delay Relay

A new type motor-operated time delay relay has been developed by the R. W. Cramer Co., Centerbrook, Conn. The relay is operated by a permanent magnet type motor arranged for any voltage from 6 to 30 dc or for operation on 110 v or 220 ac, 50 or 60 cycle. The time range extends from 1.25 seconds, minimum setting, to 10 minutes, maximum. Switch units are SPDT with quick double make, double break contacts rated at 0 a1mp. at either 24 v dc or 110 v ac.



Interpolating Counter Dial

An interpolating counter dial is being manufactured by the Technical Radio Co., 275 Ninth St., San Francisco, with scale graduations from 0 to 100 for each revolution of the dial. Each graduation has two marked divisions making a total of 200 readable parts on the dial, with a practical possibility of estimating accurately at least 200 more settings. An additional counting mechanism records each dial revolution, either forward or backward, thereby giving an accurate log of the setting in revolutions and fractions of a revolution. There is no back lash because the dial is coupled directly to the driven apparatus. When used with a roller coil variable inductor it is possible to obtain an exact record of the number of turns or fractions thereof at any setting.

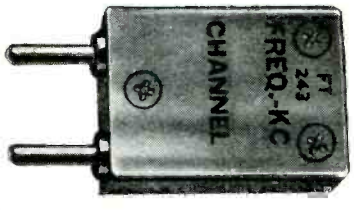


Non-Resonant Capacitors

The Sprague Electric Co., North Adams, Mass., has developed capacitors that do not show resonance at frequencies as high as 50 megacycles and, in many instances, even up to 300 megacycles. These capacitors are installed by connecting them in the circuit in the same manner as a low-pass filter would be connected. Their two terminals are connected in series with the circuit, and the container is grounded in the usual manner.

Variable Voltage Unit

The Superior Electric Co., Bristol, Conn., is manufacturing a compact, portable source of variable ac voltage, for connection to a single-phase outlet. Voltage setting is indicated by a one per cent voltmeter. A circuit breaker prevents overloading. Model U-1000 voltbox operates from a 115-volt line to deliver an output variable from 0 to 135 v. at 7.5 amps; model U-800 has twice the voltage rating and an output current of 3 amps. A regulated unit, R-500, containing a voltage stabilizer, designed for operation on 115-volt lines, with a maximum output of 500 va., also is available.



Crystal Holders

A new line of crystal holders is being offered by the National Electronic Mfg. Corp., 22-78 Steinway St., Long Island City, N. Y. A feature of the holders is the fact that they prevent deterioration of the crystal by repelling water vapor under tropical conditions.

UHF PRECISION INSTRUMENTS

UHF PRECISION FREQUENCY METER

Completely portable *Accuracy 0.1%*

Battery or AC-Operated

Models available from 100 to 2000 megacycles with 2 to 1 frequency coverage on each model. Available only on high priority.

RECOMMENDED FOR:

- *Production testing*
- *Measurement of oscillator drift*
- *Independent alignment of transmitters and receivers*
- *Precise measurements of frequencies*

UHF HARMONIC FREQUENCY GENERATOR

PROVIDES output voltages which are multiples of 10 or 40 megacycles with CRYSTAL-CONTROLLED accuracy.

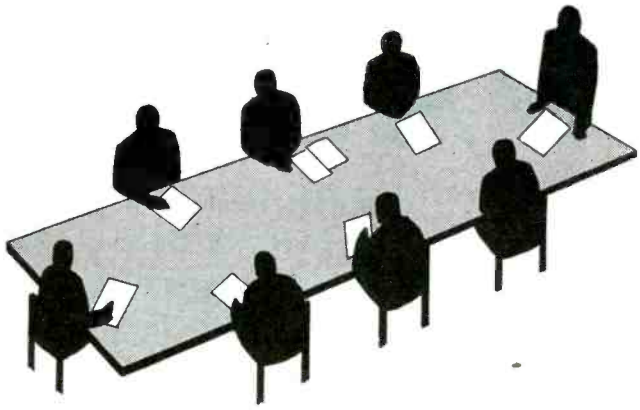
SELECTS 10 or 40 megacycle series and IDENTIFIES any one of these harmonics by means of a Frequency Identifier* which consists of a filter providing high attenuation of all voltages except that of frequency to be identified.

RECOMMENDED FOR:

. . . the calibration of receivers, wavemeters, or using internal beat detector for calibration of oscillators and signal generators.

**Specify frequency of Identifier wanted.*

WRITE FOR FULL DETAILS



ASSISTANCE WITH YOUR UHF PROBLEMS

If you need assistance in the design, manufacture or improvement of UHF equipment, LAVOIE LABORATORIES can be of real, practical help for two basic reasons:

First, LAVOIE Engineers are specialists in the UHF field.

Second, LAVOIE shop technique and equipment are especially developed for ACCURATE, economical UHF production.

We are prepared to give you the benefit of this service either in the form of technical advice in the improvement of new or old products . . . or in the actual development of new ideas "from the ground up." Your inquiries are solicited.

UHF

Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS

MORGANVILLE, N. J.

Specialists in The Development of UHF Equipment *and in* The Manufacture of UHF Antennas

WASHINGTON

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

RECONVERSION "BLUEPRINT" — "Blueprint" for civilian radio production has been gaged to the falling off of military requirements below two percentage levels —one which permits production of replacement tubes and non-broadcasting end-equipment and the other probably after the surrender of Japan when broadcasting, FM and television sets can be manufactured. This plan was unanimously approved by the WPB Radio and Radar Industry Advisory Committee and was announced by the Radio & Radar Division Director Louis J. Chatten. General Limitation Order L-265, the basic order regulating the production of electronic equipment during the war, is the key which will open the door for civilian production. Plan is for revision of the order during Period One between V-E and Japan's surrender and then its revocation after V-J day.

FLOW OF COMPONENTS—Because component production is completed two or three months in advance of end-equipment deliveries, the WPB Radio & Radar Industry Advisory Committee plan calls for the making of the revision and the revocation of Order L-265 effective three months in advance of the month in which military requirements are scheduled to reach stated reduced levels.

PATTERN FOR REVISION—Revision to come when scheduled military orders for electronic equipment recede below 90 per cent of the average monthly delivery rate for the first quarter of 1945 and will permit unrestricted production of components, including tubes for replacement purposes and all electronic end-equipment, except broadcasting, receiving and reproducing equipment for entertainment purposes.

PRIORITIES TO CONTINUE—Revocation is slated when scheduled military requirements recede below 75 per cent of the delivery rate for the first quarter of 1945, but a two-band rating system (priorities) is to be continued to assure preference for military and highly essential civilian requirements over other civilian deliveries. Director Chatten emphasized that this program will permit practically unrestricted sale of such components as are needed for repair and replacement purposes and production and distribution of a very limited quantity of non-military end-equipment to be channelled into the most essential uses.

FULL CIVILIAN PRODUCTION—Big "if" is whether Japan will capitulate more quickly now that its Axis partner, Germany, has been completely beaten. Considerable Washington thinking leans toward this possibility, but war effort cannot be geared on hopes so military production will go on—example, Navy's plan for scheduling $80,000,000 of radio, radar and sonar equipment per month for next twelve months.

IF JAPAN SURRENDERS—If Japan surrender comes, manufacturers can rush into broadcast-FM-television production and all should plan for deliveries of components; component manufacturers at the same time must plan now to get the materials and metals to go into their products.

SOME PRODUCTION NOW— Under the 90 per cent level communications, aviation and emergency equipment (police, fire, etc.) can be produced. When 75 per cent of military deliveries is attained, broadcast transmitting equipment and apparatus for buses, trucks, taxis and other mobile services can be produced. Railroad radio apparatus is classed with the emergency essential category. For mobile services only experimental equipment can be delivered at present; one fixed and two or three portable sets. No immediate change in FCC freeze order of Jan. 16, 1945, is projected despite the fact that the Commission has on file over 700 applications for new standard, FM and television stations. Only relaxation in broadcasting by WPB has been for a limited number of antenna towers.

STUDY PATENT RELATIONSHIPS—Relationships of leading American companies on patents with Philips and other foreign electronic radio interests is likely to be a facet of investigation, particularly on the theme of cartel controls. Senate inquiry presents significant potentialities in regard to current government patent study under Secretary of Commerce Wallace and it is noteworthy that Senate Subcommittee Chairman, Senator Briggs, was personal choice of President Truman to succeed latter in Senate. American manufacturers, not in big company category, may join in investigation in terms of radio-radar-electronic patent licensing policy revision.

MILITARY SURPLUSES OUTLOOK—Accumulation of surplus Army-Navy equipment is expected to flow into Surplus Property Board jurisdiction in much greater quantities during next few months than in the past. This will mean a good testing of the disposal procedure, set up by the RFC's Defense Supplies Corporation and in which around 70 end-equipment and 170 component companies have joined to act as the agents for the government in selling the excess equipment and parts to civilian users.

QUANTITIES QUESTIONABLE—No certain estimates of the amount of surplus equipment to be available can be determined because the military authorities have not yet accurately evaluated the amount of apparatus which may have to be left in Europe with the occupation forces or for the rehabilitation of European communications. Another important factor is that a large precentage of the surplus apparatus and components to date, particularly tubes, is not useful in civilian equipment and has to be channelled back to military production or scrapped. The latter case is best exemplified by the former bulky radar sets, now discarded for improved equipments.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

relays
IN MARINE COMMUNICATIONS

From ship to ship and from ship to shore—whether on war craft or on peacetime boats of commerce and travel—marine radio communications equipment plays a major role. Leading manufacturers of such equipment use Relays by Guardian, two of which are shown installed in the DC power supply unit of the HT-11 Radiophone manufactured by the Hallicrafters Company, Chicago.

Hallicrafters HT-11 Radiophone Unit Showing DC Power Supply

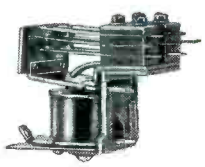
for Automatic Control of Electrical Circuits...

THERE'S A *Relay* BY GUARDIAN

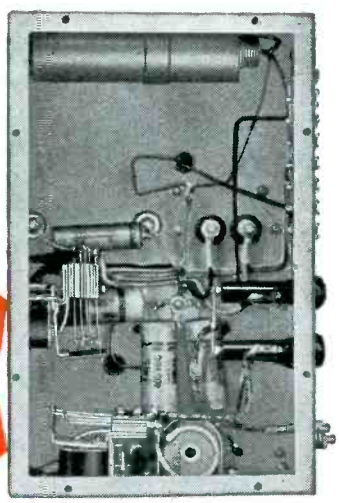
In this application one Guardian relay in its normal position feeds the input of the Vibrapack for receiving purposes. On the changeover from receiving to transmitting it disconnects the Vibrapack and simultaneously energizes the other relay. This in turn connects the Dynamotor input and output circuits.

Both relays are Guardian Series 115 with double wound coils for operation on 6 or 12 volts D.C. with the 6 volt winding in parallel and the 12 volt winding in series. It is a small, compact relay, ideal for use where space is limited.

Its use in Marine Radiotelephone is but one illustration of the many applications of relays in radio and electronic equipment. For complete description of numerous types of Relays by Guardian, write for Guardian's new Catalog No. 10.



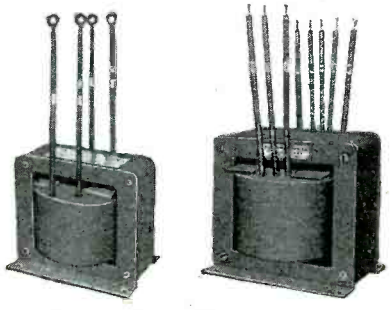
Series 115 DC Relay



GUARDIAN ELECTRIC
1622-G W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

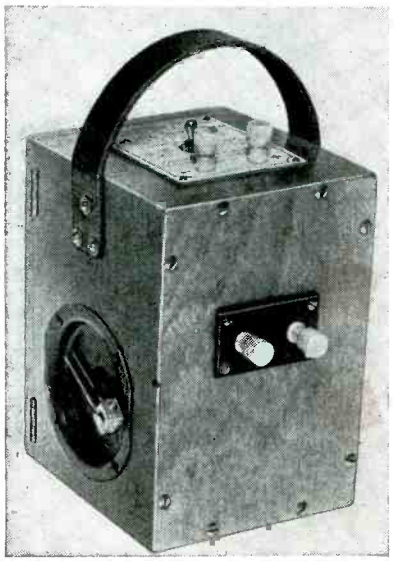
Extension Speaker

A miniature, molded plastic extension speaker for private listening is being manufactured by the Brush Development Co., Cleveland, Ohio. Tone quality is comparable to large cone-type speakers. Sufficient volume is produced with only .01 watt power consumption. Flat, disc shape (4 3/16 x 1 1/16 in.), makes it suitable for under pillow use. Hermetically sealed. Can be dipped into disinfecting solutions (not above 120 deg. F). A light-weight bimorph crystal is the actuating element.



Dry Type Transformer

R. E. Uptegraff Mfg. Co., Scottdale, Pa., has developed a new dry type F transformer, for indoor use. They are built in standard capacities from 100 VA to 7½ KVA, single phase, and with upper voltage limit up to 2500 volts. Larger capacities can also be supplied.



Circuit Tester

A new multipurpose circuit tester for acceptance tests of residential and commercial wiring has been developed by the Connecticut Telephone & Electric Division of Great American Industries, Inc., Meriden, Conn.

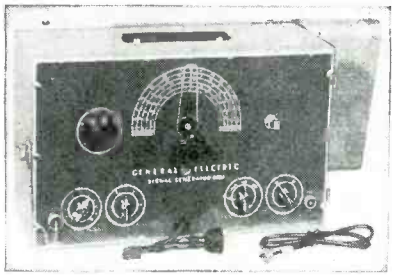
A special indicator attachment visually determines the polarity of wires. The tester operates on a hand-cranked generator which develops 500 volts dc, regulated to assure a uniform test regardless of cranking speed.

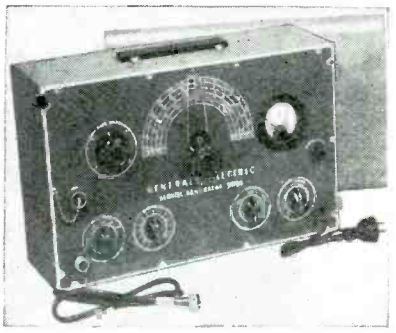
AC Voltmeter

Simultaneous readings of alternating current and voltage are taken with a new voltammeter, Model 601, being manufactured by Associated Research, 221 South Green St., Chicago 7, Ill. The ammeter measures from 0.2 to 500 amperes in eight current ranges: 0-1, 0-5, 0-10, 0-25, 0-50, 0-100, 0-250, 0-500. The voltmeter measures from 30 to 600 volts in three ranges: 0-150, 0-300, 0-600. The voltmeter can also be used on dc at these ranges. An inserted primary current transformer with 8 ft. secondary leads facilitates the measurement of current on the 0-100, 0-250, and 0-500 ampere scales without subjecting the meter to the stray magnetic fields. User can locate the meter where it can easily be read, regardless of the current transformer's location. The range selector switch on the panel permits quick reading of currents in all the eight ranges.

AC Generator

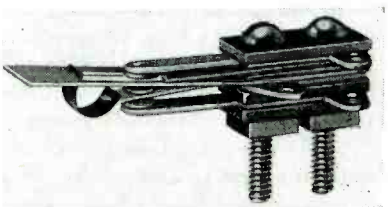
A lightweight ac generator which consists of a permanent magnet rotor and two independent 750 ohm windings 90 degrees apart has been developed by Ampex Electric and Mfg. Co., 1414 El Camino Real, San Carlos, Calif. When driven at a speed of 1200 rpm, this generator has an output of 20 cps with an rms voltage of 60. Without the use of filters the harmonic content under these conditions is less than 2 per cent. Corresponding frequencies and voltages can be obtained with other driving speeds. Another model is available with an output voltage of 25 rms at 1200 rpm.





Signal Generators

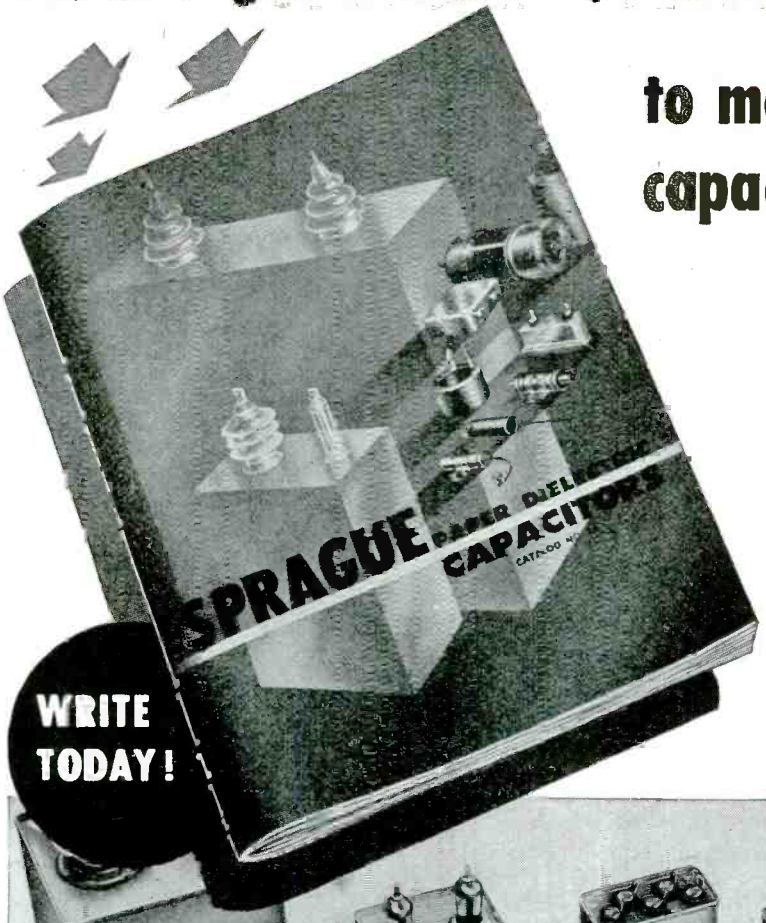
Two new signal generators, Types SG-2A and SG-3A, have been developed by the Specialty Division of the General Electric Company's Electronics Department, Schenectady, N. Y. Separate units have been designed, one to provide a signal source only, the other to make possible calibrated output readings. The Type SG-2A signal generator was built to give an efficient signal source. On fundamental frequencies the range covers 100 kilocycles to 32 megacycles in five bands which are selected on the front panel. Modulation of the unit (30 per cent), is effected by the constant current method on the plate of the oscillator tube. Changes in line voltage and attenuator settings do not affect the frequency of the instrument. The Type SG-3A signal generator permits directly calibrated readings of radio frequency output, with subdivided readings of signals of 0.5 to 100,000 microvolts, at all frequencies from 100 kilocycles to 32 megacycles. By using second harmonics, signals up to 64 megacycles are available. A vacuum tube voltmeter monitors the output of the modulated oscillator to the attenuator while a panel control is used to maintain a constant level. Five complete reading scales are possible on the large full-vision dial with coincidental bands from 100 kilocycles up to 32 megacycles.



Open Blade Switch

A small single-pole open blade switch is being put out by the Acro Electric Co., 1308 Superior Avenue, Cleveland 14, Ohio. Engineered with the beryllium rolling spring, overall dimensions are approximately 2 1/32 x 10/16 x 23/64 in. Contact arrangements are for normally open, normally closed or double throw circuits. Means of actuation provided by the user. Standard operating pressure at the end of the blade is 3 to 6 oz. Rated at 15 amp., 115 volts ac.

HERE IS YOUR GUIDE



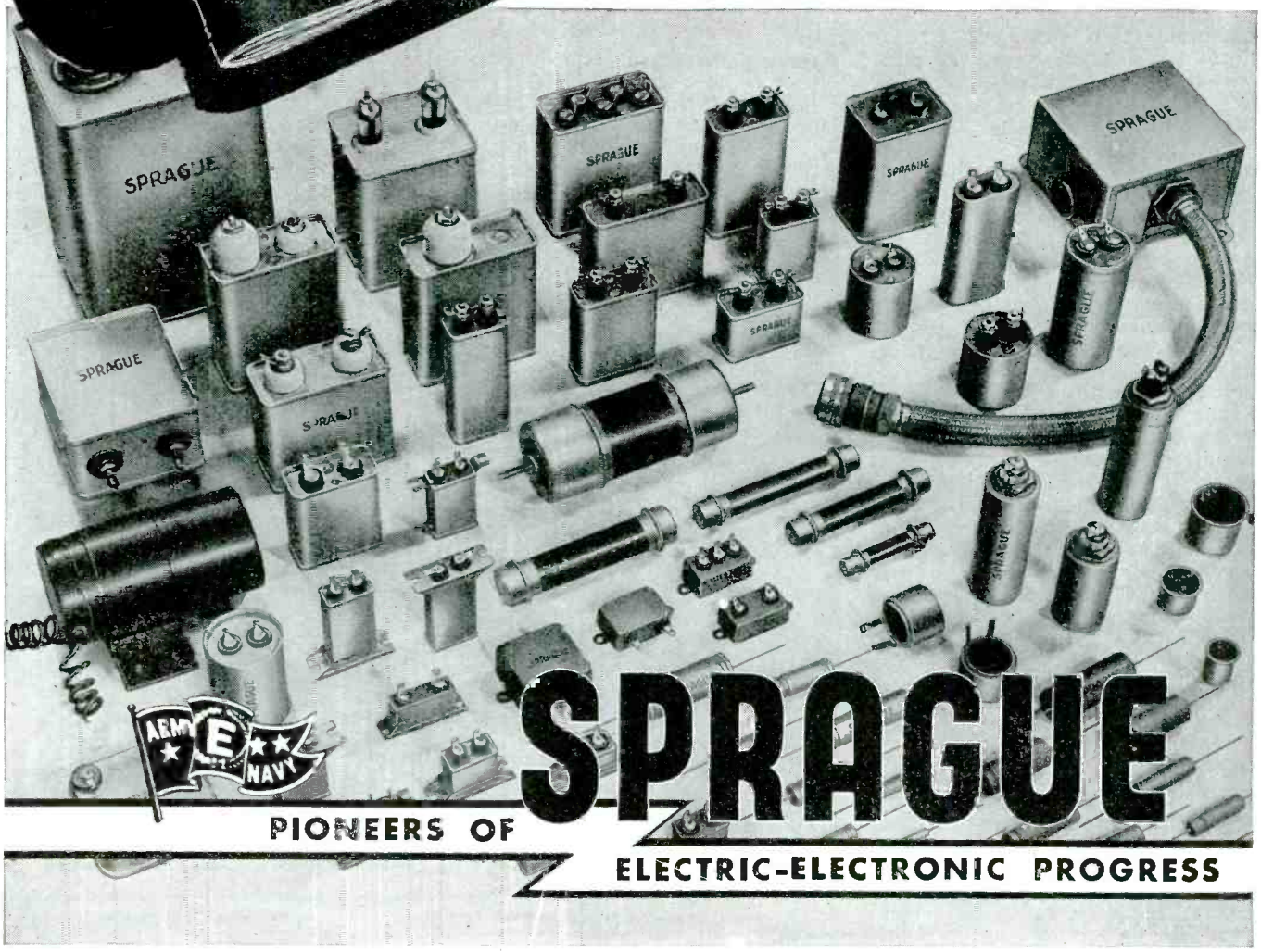
WRITE TODAY!

to modern paper dielectric capacitor selection and use

Months of painstaking work have gone into making this 56-page Sprague Catalog a complete guide to the design and engineering possibilities inherent in today's greatly enlarged line of Sprague Paper Dielectric Capacitors in hundreds of standard and special sizes and types.

Write for your copy today. You'll find it unsurpassed as a guide to the exact matching of up-to-the-minute Capacitor requirements!

SPRAGUE ELECTRIC CO.
North Adams, Massachusetts



PIONEERS OF **SPRAGUE** ELECTRIC-ELECTRONIC PROGRESS

★ TELEVISION TODAY ★

New Developments in the Video Field

French Tele Prepares For Postwar Operation

With respect to the status of television in France, the International Telephone and Telegraph Corp. has received a cablegram from Guy Rabuteau, French scientist in charge of the laboratories of Le Materiel Telephonique, Paris, the IT&T associate which designed and installed the television station in the Eiffel Tower in Paris in 1938, in which Mr. Rabuteau states:

"Robert Buron, French broadcasting administrator, speaking on behalf of Jean Guigenbert, broadcasting director, held a conference on March 1 to inform French television manufacturers of his administration's plans for television. He explained that at the outbreak of war France was about to start television on a wide scale.

"Despite German occupation, French research organizations have continued developing television technique and manufacturers are now in a position to deliver pick-up equipment, transmitters, receivers suitable for black and white high definition television and later on full color television. French Administration considers that the public will insist on a television service having a quality as comparable as possible to that of the movies and the French Broadcasting Administration feels bound to make this available at the earliest possible moment.

"Their plans for 1945 are to order from the various manufacturers experimental equipment so as to be able to choose in about a year's time an up-to-date television standard. Experiments will be made on both 750 and 1,000 line black and white images. Low power transmitters will be ordered to enable field tests on 1,500, 600 and 150 megacycles. Meanwhile, the prewar Eiffel Tower station working on 455 lines with 30 kw peak power temporarily will resume."

Military Reveals More Electronic Equipment

Military secrecy was lifted, middle of April, on a number of hitherto unmentionable electronic devices. The revelation was made at a press demonstration arranged at Fort Myer, Va. Among new equipment was a portable mobile radar aircraft detection set which is compact enough for use even in a foxhole, and will spot a plane 120 miles away. Another was an electronically operated locator, so linked to a searchlight battery that aircraft are automatically kept in the beams of the searchlight. A third equipment was a radio controlled detonator with which it is possible to fire mines up to a distance of 20 miles away by dialing a series of numbers on a dial similar to an ordinary telephone.

Philco Puts Telecast in New Division

Philco Radio and Television Corp. Philadelphia, has formed a Television Broadcasting Division, which will be headed up by Ernest B. Loveman as vice-president in charge of all telecasting activities. The new division will direct all the company's station, broadcasting and network activities, including WPTZ and the new network linking Washington and Philadelphia.

Enemy Patents

Short descriptions and illustrative drawings of approximately 37,000 mechanical and electrical patents may be obtained for $25 from the Office of Alien Property Custodian, 311 Field Building, Chicago 3, Ill. Sections dealing with any particular subject are available at proportional cost; an index of these sections may be procured free of charge from the Alien Property Custodian.

Tele and FM Separate

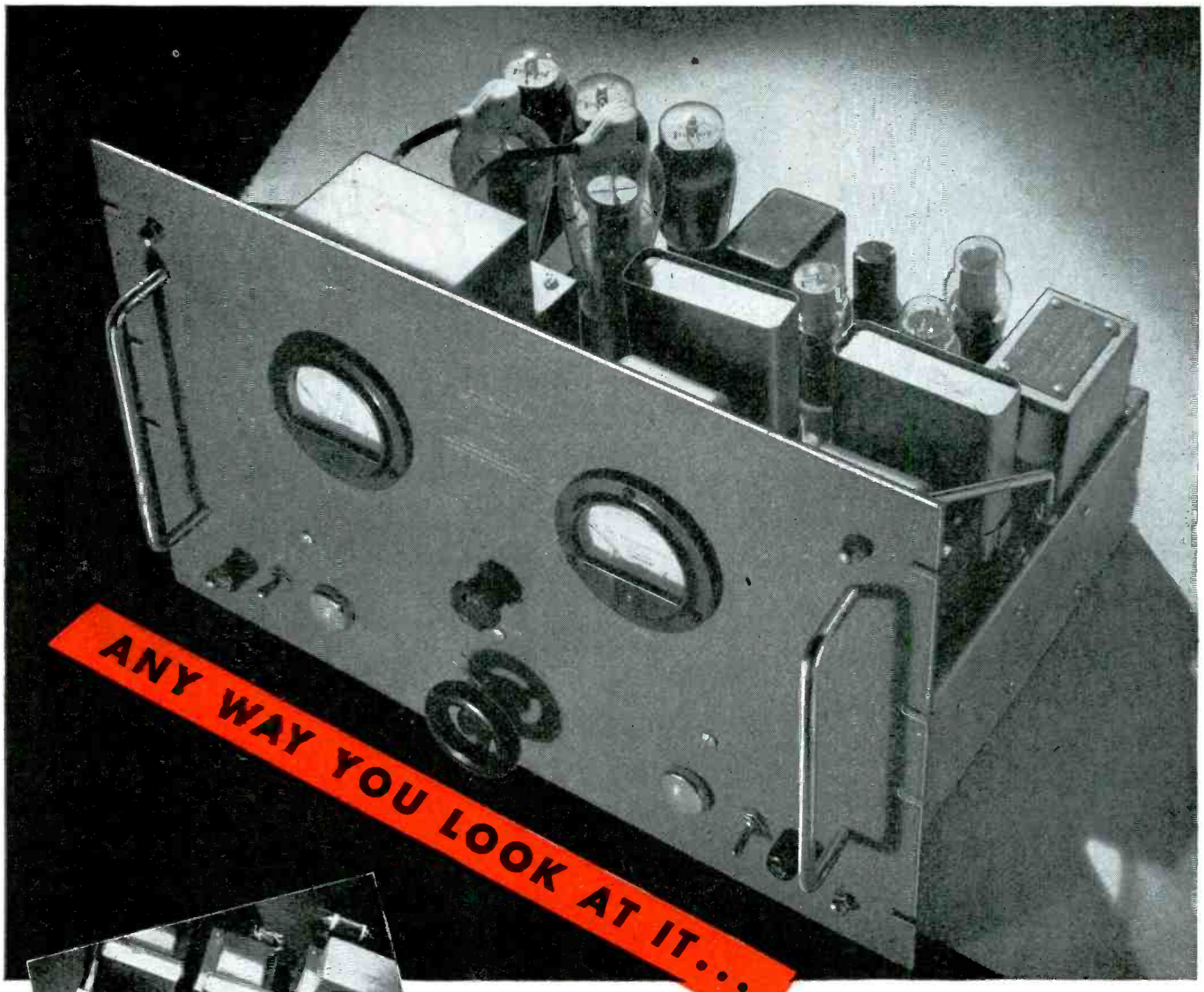
There have been one or two proposals suggesting that television broadcasters be permitted to use their voice channels for FM broadcasts during certain hours when transmission of pictures is impractical, but FCC frowns on the idea. First proponent of the plan was A. J. Mosby, general manager of KGVO, Missoula, Mont., and the idea was advanced during the recent FCC allocations hearings in Washington. Now, however, FCC Commissioner Paul Porter has made it plain that the commission views FM and tele as two separate and distinct services, each to be developed in its own right. There is to be no mixing of the two in the manner proposed.

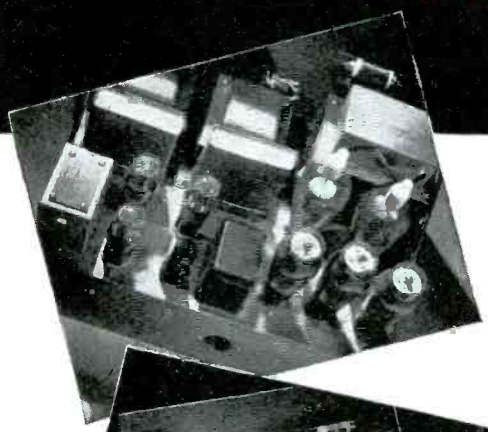
Boston Video Station

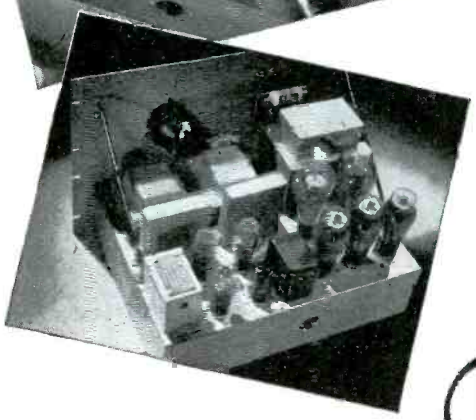
The 20th Century Fox Film Corp., which recently leased former television station W1XG from the General Television Corp. in Boston, has asked FCC for permission to erect an experimental video station of its own in that city. The request seeks assignment to channel No. 1.

TELEVISION STUDIO OPERATION TECHNIC

Much picture material is telecast from film and this photo made in one of the control rooms of the DuMont studios (WABD) in New York shows monitoring equipment and adjacent Presto turntables used for introduction of musical interludes and backgrounds, fanfares and sound effects



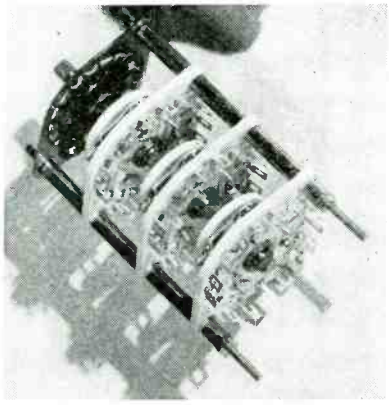




The HARVEY Regulated Power Supply 206 PA is your best source of laboratory D.C. power between ranges of 500 to 1000 volts. The HARVEY 206 PA operates in two ranges — 500–700 volts at ¼ amp., 700 to 1000 volts at ⅕ amp. Regulation is 1% or better in both ranges and output remains constant even though line voltage varies between 95 and 130 volts . . . The HARVEY 206 PA is designed for safe and convenient operation. It has overload relay and interlocking relay protection at all voltages. Time delay for high voltage circuit applications and pilot lights to indicate unit in use. It is mounted on a standard relay rack *panel* and all components are easily accessible. Sturdy, precision-built, its dimensions are 12¼" x 19" with a depth of 13". Weight but 72 pounds. . . . *For complete information write*

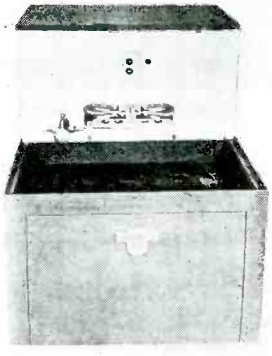
HARVEY
OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.
441 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS



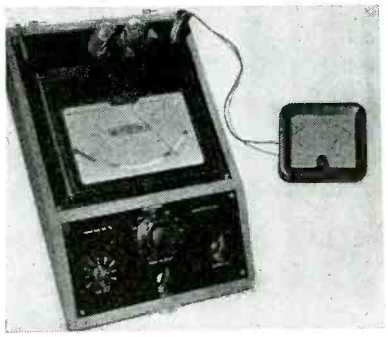
Power Switches

A new switch series for power applications is going into production at Centralab, 900 East Keefe Ave., Milwaukee, Wis. These "J" switches will be available in one to five sections, with shorting or nonshorting type contacts. Sections and indexes will be available separately for individual assembly in any desired combination. The switching combinations for the present will be one pole, 17 positions (18 positions, continuous rotation, with 18th position "off") and 3 poles, 5 positions (6 positions, with 6th position "off".) All units will be furnished with adjustable stops for limiting the desired number of positions. Switches rated at 7½ amp. at 60 cycles, 115 volts. The minimum voltage breakdown between critical points will be 3000 volts rms.



Induction Heating Table

A single-position, general-purpose work table, for use in any application of induction heating, is being put out by the Induction Heating Corp., 389 Lafayette Street, N. Y. 3, N. Y. It is equipped with a standard Thermonic output transformer, so mounted as to effect interchangeability from one type transformer to another. The table bench includes a sink for use in spray quenching operations. Water piping provisions for spray quenching are incorporated together with a solenoid-operated valve and a quench flow regulator for controlling the timing and volume of the quench. The control circuit contains two timers; one for controlling the quenching period and the other for controlling the delay period from the end of the heating cycle to the start of the quench cycle. Accessory equipment includes a rotating spindle mounted below the work coil and quench ring to provide for rotation of the work during the operating cycle. This feature has found extensive use in gear hardening applications, where automatic control of heat and quench cycles assure economical, uniform results.

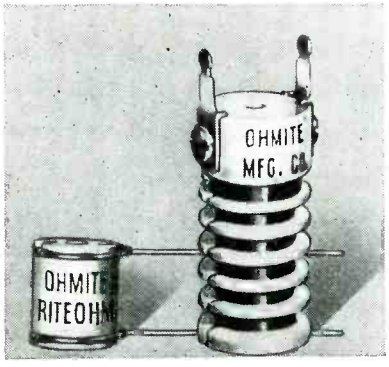


Multi-Range Meter Tester

A multi-range tester has been developed by the Marion Electrical Instrument Co., Manchester, N. H. It is a multi-range instrument with self-contained regulated power supply and control equipment for use on 110 volts ac, 60 cycles and is composed of a stepless vacuum tube voltage control; a large 8½ in. mirror scale standard equipment and a decade of .1 per cent accurate wire wound resistors. The range of the unit is 25 microamps full scale, 10 ma full scale and 0-100 volts full scale. Overall accuracy is better than ½ of 1 per cent. Basic sensitivity 10 ma. Resistors are wound of manganin wire on ceramic forms to an accuracy of .1 per cent and are triple impregnated and tropicalized. The vacuum control, using a type 6N7 as a grid controlled variable resistor, gives complete and smooth control of power. The power supply is a conventional unit with a 6X5 full wave rectifier with a type VR150-OD3 voltage regulator to the tubes.

Synthetic Insulation

A synthetic tubular wire insulation has been developed by the Walter L. Schott Co., 9306 Santa Monica Boulevard, Beverly Hills, Calif. Dielectric strength at room temperature averages 15,000 volts, with a guaranteed minimum of 12,000 volts for all sizes. Forty-eight hours immersion in water results in a reduction of less than ten per cent of original dielectric strength. Will not become hard or brittle under temperatures ranging from minus 35 deg. C. to plus 75 deg. C. This insulation is practically impervious to oils, grease, alcohol, hydro-carbons, alkalies and acids; it is, however, affected by ketones and some chlorinated hydro-carbons. Average tensile strength is 3,000 psi.

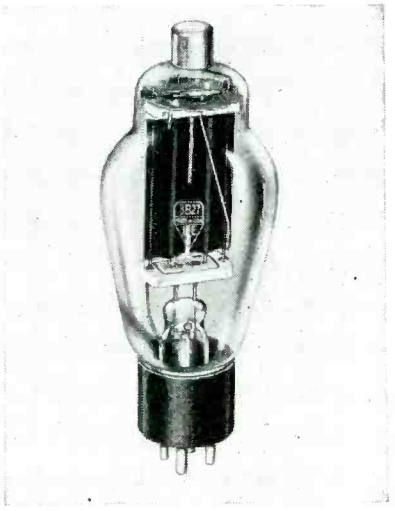


Precision Resistors

Two new series of resistors (series 82 and 83) are being manufactured by the Ohmite Mfg. Co., 4984 Flournoy St., Chicago 44, Ill. Both units are pie wound to 1 per cent accuracy. Specially enameled alloy resistance wire is non-inductively pie-wound on a non-hygroscopic ceramic bobbin which has a hole through the center for a No. 6 screw. After being wound, the units are vacuum impregnated with a special varnish which provides additional insulation and protects the winding against humidity. The resistors can be supplied with a varnish coating containing a fungicidal agent.

Decade Unit

Harvey-Wells Electronics, Inc., Southbridge, Mass., has developed a decade unit which makes immediately available almost any desired value or combination of values covering capacitance, inductance, resistance, transformer ratios, etc., over a wide range. Circuit components in this decade unit will dissipate heat and power and stand up under operating conditions.

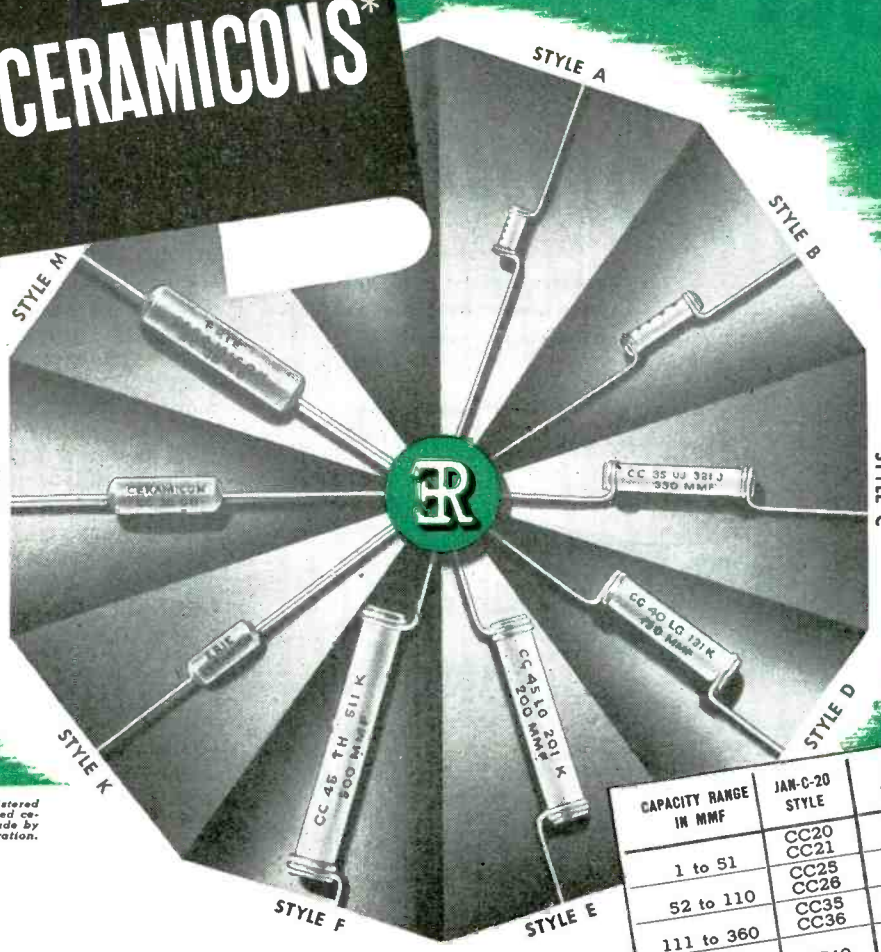


High Vacuum Rectifier

This new type 3B27 rectifier is a high vacuum type resulting in excellent applicability where disturbance from power supply must be kept to a minimum. Unusual construction features include double heaters and cathodes, ceramic spacers for low leakage and extra heavy supports for immunity to severe vibration and mechanical shock. Ratings are: peak inverse voltage 8,500, peak plate current 0.6 amps., average plate current 0.150 amps. Filament draws 5.0 amps. at 2.5 volts. Base is medium four-pin bayonet. It is a product of Electronic Enterprises, Inc., 65-67 Seventh Ave., Newark 4, N. J.

Superior WARTIME PERFORMANCE Dependable for POSTWAR APPLICATIONS

ERIE CERAMICONS*



* Ceramicon is the registered trade name of silvered ceramic condensers made by Erie Resistor Corporation.

CHARACTERISTICS

CAPACITY RANGE IN MMF	JAN-C-20 STYLE	ERIE STYLE	MAXIMUM OVERALL DIMENSIONS
1 to 51	CC20 CC21	A K	.200 x .400 .250 x .562
52 to 110	CC25 CC26	B L	.200 x .656 .250 x .812
111 to 360	CC35 CC36	C M	.265 x 1.125 .340 x 1.328
361 to 510	CC40	D	.375 x 1.110
511 to 820	CC45	E	.375 x 1.560
821 to 1100	CC45	F	.375 x 2.00

as GENERAL PURPOSE CONDENSERS

The superior performance of Erie Ceramicons as general purpose condensers in wartime communications equipment assures their more than meeting your requirements for peacetime applications.

For general purpose use where a moderate degree of capacity change with temperature is permissible, JAN-C-20 characteristic "SL" should be given. If Erie designation is used, specify—"Any temperature coefficient between P100 and N750." These units will have a temperature coefficient between +150 and –870 parts/million/°C. Capacity ranges are shown in the table above.

For peacetime applications up to 375 MMF, where silver mica condensers are specified on prewar parts lists, zero temperature coefficient (NPO) Ceramicons will provide excellent stability and retrace characteristics. Standard temperature coefficient tolerance on these units is +30 parts/million/°C, as measured between +25° and +85°C.

In many cases, particularly in the lower capacity ranges, prompt shipments can be made from stock. Samples of these condensers in any desired capacity range will be sent on request.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

Back the 7th War Loan Buy More Bonds

ARMY E NAVY

FOR HIGH ACHIEVEMENT IN WAR PRODUCTION

TUBE SHORTAGE

(*Continued from page* 107)

bers of trained mounters. In addition over the last fifteen years tubes have become increasingly complex. Where it was once possible to achieve production of 40 or more mounts per operator-hour, smaller and more complex mounts in present and prospective postwar tubes show figures in the 10 to 20 region depending on type.

Because of the nature of the work and the assurance of continuous employment after the war, large numbers of women are expected to be attracted to this field when cutbacks in other industries come. There will be a long training and sifting period. It takes years to develop a really good mount operator. Some show good results after a few months but few become proficient in so short a time.

No satisfactory means for automatically mounting radio tubes (one type excepted) has been devised. Present technique, barring methods and time study, is exactly the same as it was 15 years ago. It is believed that no outstanding advance will occur in the next five years.

It is obvious that the industry machine capacity in itself will not determine the probable output of radio tubes because of the influence of the factors just noted. The following table is an estimate of the radio receiving tube machine capacity based on 250 eight-hour days per year and an estimate of the probable output, taking into account these other factors:

Radio Receiving Tubes Per Year

Year	Machine Capacity	Probable Output
VE	225,000,000	160,000,000
VE+1	243,000,000	195,000,000
VE+2	267,000,000	212,000,000
VE+3	293,000,000	235,000,000
VE+4	323,000,000	261,000,000
VE+5	355,000,000	290,000,000

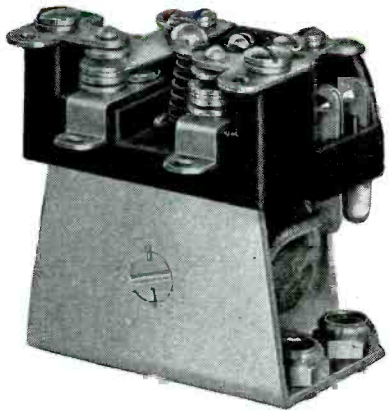
During the five-year period following the end of the European war, all indications are that demand will far exceed supply. Although there is a discussion of 20 million radio set years, experts do not believe more than 17 million radios per year will be produced in the first few years following cessation of hostilities. In addition, there are estimates of a million television sets per year, each set with 20 to 25 tubes. It, therefore, seems unlikely that the radio tube shortage will be alleviated for some years to come. The following table compares the **potential** demand with the estimated supply:

(*Continued on page* 134)

"BO" POWER RELAY

The "BO" relay is an all-purpose double pole power relay. Like other Allied types it is ruggedly designed yet features compactness and minimum weight. This relay utilizes molded Bakelite insulation throughout. Contact rating is 15 amperes at 24 volts DC or 110 volts AC non-inductive. The "BO" relay can be furnished normally open, normally closed or double throw and is available for either AC or DC service. Weighs 4 ounces.

Height 1⅞"; Length 1⅝"
Width 1 13/32"

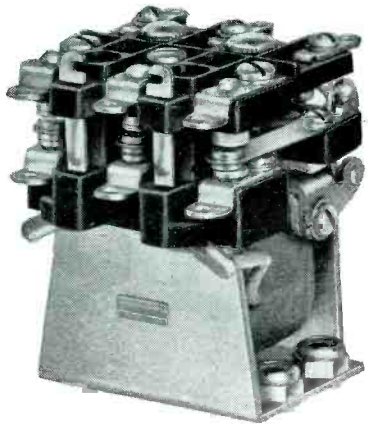


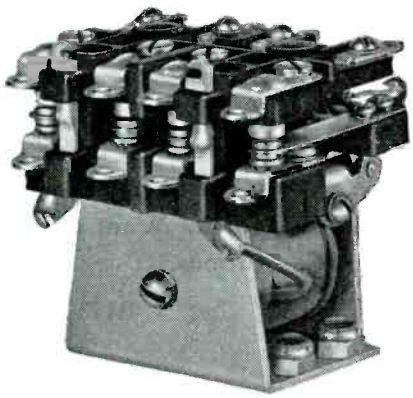
constant progress MARKS ALLIED RELAY DESIGN

"DO" TYPES 3 and 4 POLE

The "DO" three and four pole relay is similar in function to the "BO" type described above. It supersedes the old three and four pole type and features such modifications as simplified terminal arrangements, adjustable contacts, and improved mechanical structure. By using molded Bakelite insulation throughout, greater electrical clearance is provided. Contacts are rated at 15 amperes at 24 volts DC or 110 volts AC non-inductive. Can be furnished normally open, normally closed, double throw and for AC or DC service as specified. Weight for three pole type 7 oz., four pole 7½ oz.

Three pole Height 2¼"; Length 1⅝"; Width 1⅞"; Four pole Height 2¼"; Length 2 1/16" Width 1⅞".





Marking time or "resting on laurels" in no way reflects Allied's engineering and business philosophy. A specific control does a good job . . . but can it be improved? Allied engineers and field staff check its working performance . . . seek possibilities to better or broaden its usefulness.

Thus refinements, revisions and modifications in basic types of relays come about—as in the three and four pole "DO" and the all-purpose double pole "BO" types described herein. Keeping pace with the constant engineering progress of manufacturers whose products require electrical control . . . anticipating their requirements . . . epitomizes Allied's philosophy. Let your control problems become our engineering projects.

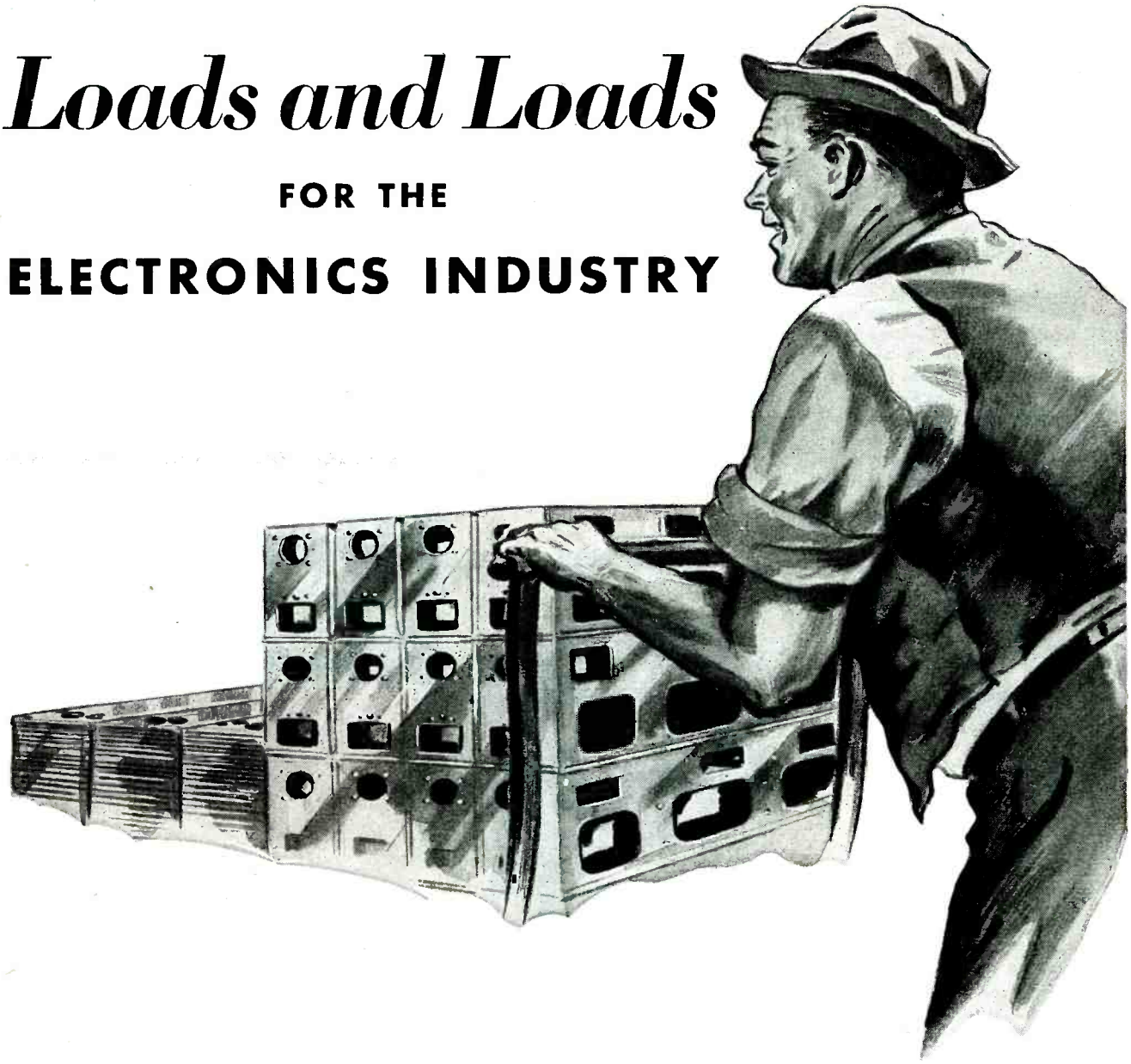
ALLIED CONTROL COMPANY, INC.

GENERAL OFFICES: 2 East End Ave. (at 79th St.) New York 21, N. Y. *Factories:* New York City (2 East End Ave.)—Plantsville, Conn. *Chicago*—4321 Knox Avenue, Chicago 41, Illinois. *In California:* Allied Control Co. of California, Inc. 1633 South Hope St., Los Angeles 15, Calif.

Loads and Loads

FOR THE

ELECTRONICS INDUSTRY



The start of the war brought an abrupt stop to our civilian business. We shifted to electronic equipment, learned fast to build cabinets, shelf assemblies and a great variety of steel, stainless steel and aluminum units of quality—in quantity—at interesting prices.

When the war ends, our Electronics Division continues. We've grown pretty fond of our war baby—nursed him into quite a sizeable fellow and we want to keep him in the fold. If doing a good job at a fair cost is the formula for success—we think we've got it. Want proof? Send in your specifications.

BUY WAR BONDS

CORRY-JAMESTOWN
MANUFACTURING CORPORATION
CORRY, PENNA.

Steel Age

HANDLING is believing. Get the finger tips of your left hand on the control ring of a PARAGON Drafting Machine. The lightest pressure is all you need to set the scales at the angle you want, anywhere on the drawing board. Your right hand is always free. For the full story of PARAGON features, convenience and handsome modern appearance, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J.

KEUFFEL & ESSER CO.
EST. 1867

K+E

Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules. Measuring Tapes.

CHICAGO • DETROIT • ST. LOUIS • NEW YORK • HOBOKEN • SAN FRANCISCO • LOS ANGELES • MONTREAL

TUBE SHORTAGE

(*Continued from page* 130)

Millions of Radio Receiving Tubes

Year	Demand	Supply	Unsatisfied	Per cent Unsatisfied
VE	234	160	74	31.0
VE+1	307	195	112	36.5
VE+2	319	212	107	33.5
VE+3	310	235	75	24.0
VE+4	282	261	21	7.5
VE+5	328	290	38	11.5

It goes without saying that the military, aircraft and naval portion of the demand during the remaining years of the Japanese conflict will be satisfied come what may. This injects a leverage that would raise the first three years' potential shortage from thirty odd per cent to a probable fifty per cent when regarded from the civilian demand standpoint. Each year a portion of this unsatisfied demand would carry over to inject further leverage and probably raise VE+4 and VE+5 to flatten out the whole five-year period.

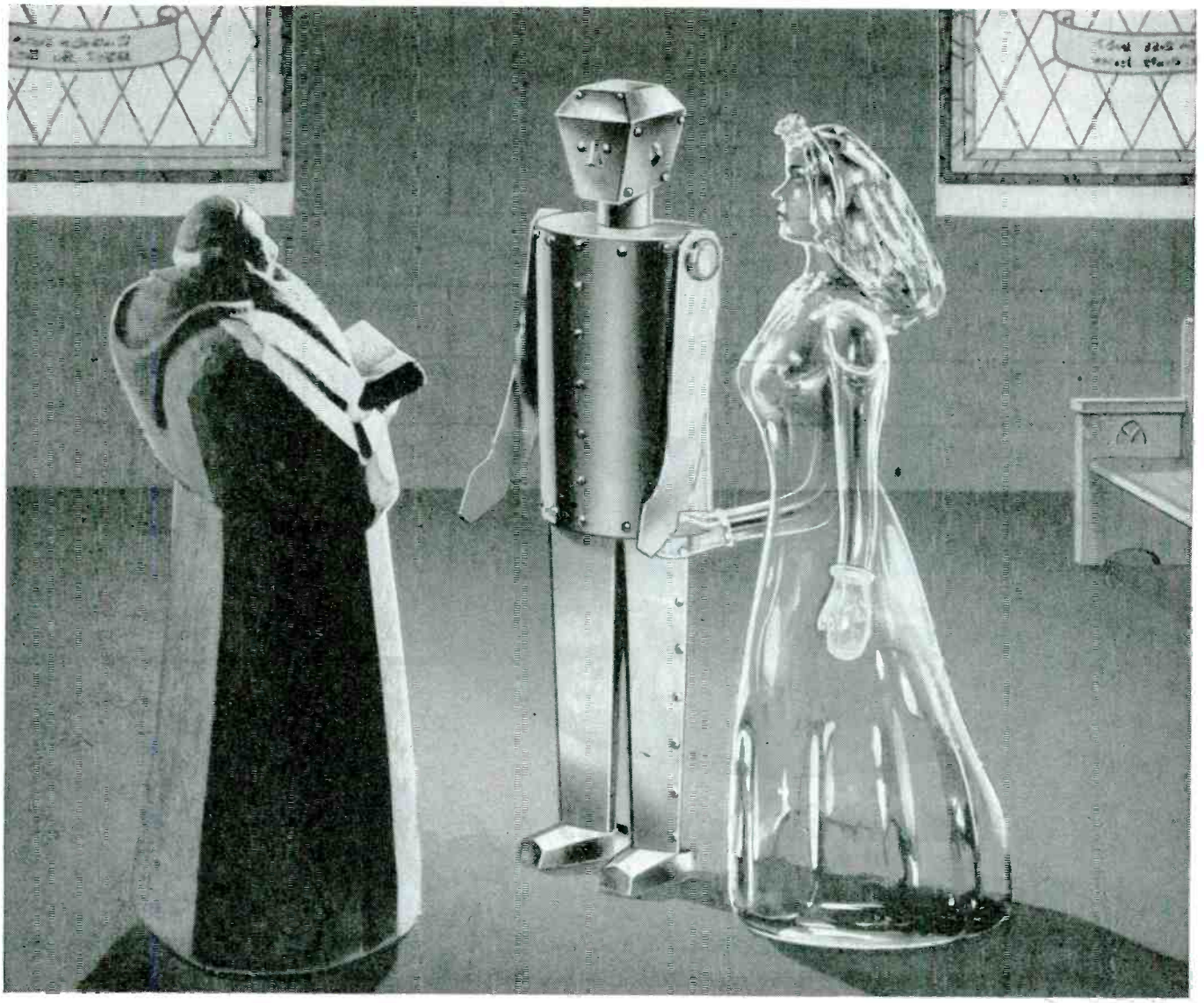
Only a fraction of the public demand for radio sets will be satisfied during the early years due to necessary government agency restrictions. While this will result in the actual set output being below public demand, it will not bring tube requirements down anywhere near supply levels.

Receiving Tube Production before the War

Year	Millions of Tubes	Per cent of 1941	Per cent of 1929
1941	130	100.0	188.5
1940	110	84.5	159.5
1939	98	75.3	142.0
1938	80	61.5	115.9
1937	91	70.0	131.8
1936	98	75.3	142.0
1935	71	54.6	102.9
1934	58	44.5	84.0
1933	59	45.4	85.5
1932	44	33.8	63.7
1931	53	40.8	76.8
1930	52	40.0	75.4
1929	69	53.0	100.0
1928	50	38.5	72.5
1927	41	31.6	59.4
1926	30	23.1	43.5
1925	20	15.4	29.0
1924	12	9.2	17.4
1923	5	3.9	7.3
1922	1	0.8	1.5

Mosquito's Love Call

Even mosquito control will depend on electronic equipment in the scheme developed by Dr. Morton C. Kahn of the Cornell Medical College faculty together with his two associates William Offenhauser and William Celestin. The unsuspecting female mosquitos have had their private lives invaded. Their love call has been amplified in high gain audio amplifiers and permanently imbedded in phonograph records. Loud speakers placed in mosquito traps will blare forth this call, bringing all males within range into captivity and preventing further reproduction of the species.



JOINED...FOR LIFE *through Corning Metallizing!*

REMEMBER when glass and metal just wouldn't stay hitched? They joined together readily but when the going got rough they parted company in the best Hollywood tradition.

Things are different now. *Corning's* metallizing process weds glass and metal with a bond that lasts like an old-fashioned marriage. Through heat and cold . . . under severe conditions of stress and strain, they stick together in a lasting union.

This happy union can boast a whole family of fine qualities:

HERMETIC SEALING . . . PRECISION METALLIZING . . . SUPERIOR PHYSICAL PROPERTIES . . . PERMANENCE . . . THERMAL ENDURANCE . . . MECHANICAL STRENGTH

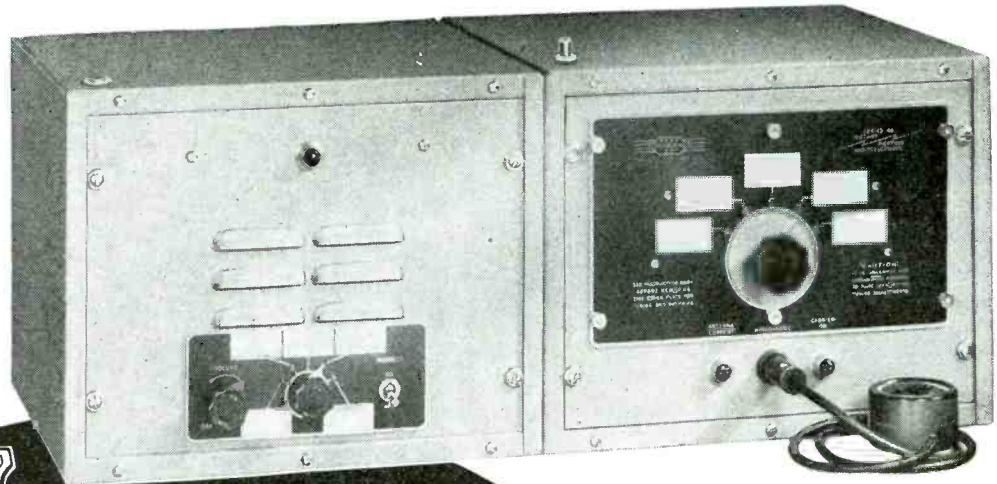
Which of these can you use? Write us about it. We'll be glad to work with you to see if metallized glass can help solve your problem. Address Electronic Sales Department, I-6, Bulb and Tubing Division, Corning Glass Works, Corning, New York.

CORNING *means* Research in Glass

Electronic Glassware

VYCOR · CORNING · PYREX

"PYREX", "VYCOR" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.



KAAR Series 46

KAAR INSTANT HEATING RADIOTELEPHONES

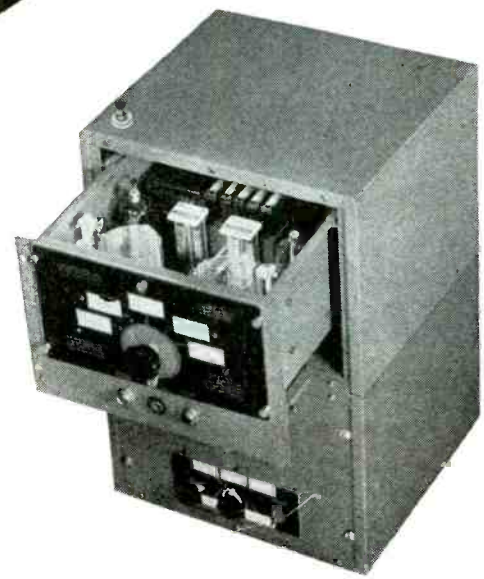
ABOVE: Series 46 KAAR radiotelephone, showing 5 chonnel transmitter ond crystal-controlled receiver mounted side by side.

BELOW: Same units mounted in a different manner, and showing how tronsmitter slides out for servicing.

This new KAAR 50-watt series offers lower battery drain

Low battery drain, obtained through the use of instant-heating tubes, is one of the many special features in the new KAAR Series 46 radiotelephone which make this equipment so popular for police, fire, sheriff, utility, and other emergency use.

Kaar engineers packed years of experience into the development of this new equipment, making it unsurpassed for almost any emergency requirement. The 50-watt transmitter is designed for either five channel or single channel operation—mobile or fixed—with a standard frequency range from 1600 to 6000 Kc. The receiver may be either tuneable or fixed tuned crystal-controlled, as desired. Furnished with separate power supply for operation on 117 volts, 60 cycle AC; or 12, 32, or 110 volts DC.



Easily accessible! MANY SPECIAL FEATURES

- **SIMPLE TO SERVICE** . . . when four screws are released, the transmitter slides out like a letter file.
- **ZERO STANDBY CURRENT,** made possible by instant-heating tubes, reduces drain on batteries, yet there is no waiting period for tubes to warm up before sending a message.
- **ONLY ONE TUBE TYPE** is used in the transmitter. This simplifies replacement.
- **FITS ANYWHERE** . . . transmitter may be secured above or below the receiver, or on either side of it. Transmitter and receiver cabinets are 10" high, 13" wide, 13" deep.

KAAR ENGINEERING CO.

KAAR ENGINEERING CO.

PALO ALTO, CALIFORNIA, U. S. A.

Export Agents: FRAZAR & HANSEN, 301 Clay St., San Francisco, Calif.

NO. 4 IN THE IRC NEW PRODUCT PARADE

Seaworthy!... and IRC-Worthy

GRADE 1 — CLASS 1 RESISTORS

Exhaustively tested for dependable performance and sound construction, IRC's Type GRW *GRADE 1—CLASS 1 RESISTORS* are now available. Only after every requirement of Army-Navy specification Jan-R-26 had been met or surpassed would our Engineering Department approve this product for the applications for which it is designed.

Resistant to salt water immersion following thermal shock, they are capable of continuous efficient operation at a total temperature of 275° C. (ambient plus rise).

Made in 7 standard sizes with power ratings from 15 to 140 watts and resistance ranges of from 0.1 to 63000 ohms, the GRW's are enclosed in special heat-treated glass for optimum strength. Non-corrosive ferrules are hermetically sealed to the tube with pure lead. Nickel alloy leads pass through the centering devices and are welded to the outer ferrule cups. All resistors are *space wound.*

These IRC GRADE 1—CLASS 1's are engineered to "take it" far beyond normal requirements and can stand transverse loads as high as 100 pounds without failure or damage of any kind.

ENGINEERED FOR PERFORMANCE
IRC
FIXED & VARIABLE RESISTORS

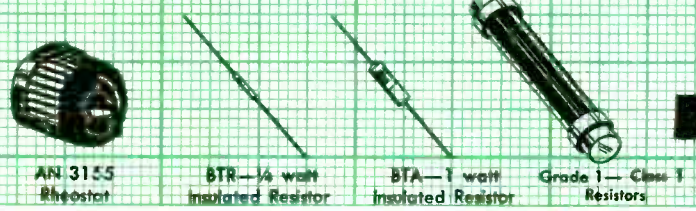
Write today for special Engineering Bulletin containing dimension drawings, temperature rise and de-rating curves as well as other technical data.

INTERNATIONAL RESISTANCE CO.

Dept. 2-F

401 NORTH BROAD STREET, PHILADELPHIA 8, PA.

IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.



AN 3155 Rheostat | BTR—¼ watt Insulated Resistor | BTA—1 watt Insulated Resistor | Grade 1— Class 1 Resistors

COMING....COMING....COMING....

PROJECTION TELE

(*Continued from page 97*)

The cross section of this projection unit is shown in Fig. 1. The lens system is 3½ in. in diameter and has a speed of f/1.5. The focal length is 144 mm.

This lens system can be of relatively inexpensive construction at least for black and white pictures, when produced in mass quantity. The DuMont Laboratories report that a number of simple and inexpensive lenses have been tried with this projection equipment and that the results are satisfactory.

The 7 in. projection tube used in this unit has a flat screen face. The actual image on the tube is approximately 4 x 5 in. Magnetic deflection and magnetic focusing are used.

A feature of this particular form of television projection is that the color system in which a rotating color filter wheel is used can be rather easily adapted to it. It is a fairly simple matter to interpose a color wheel in front of the rather small cathode ray tube for the purpose of producing the three primary color images which are then enlarged by the lens system. Such a color filter wheel cannot be easily interposed between the tube and the spherical mirror employed in the Schmidt projection system as they are presently mounted in proposed home projection receivers.

However, the color system can be used with the Schmidt projector provided the projection tube is mounted back of the spherical mirror and a suitable reflecting surface is placed where the screen of the cathode ray tube would normally be. In this way, a color wheel can be placed between the screen of the cathode ray tube and the hole which is cut through the bottom of the spherical mirror and suitable color projection obtained.

The DuMont projection unit produces a picture with a magnification of 9:1. The demonstration was made with the video signal from the studio being wired directly to the projection unit. No radio circuit was involved. At a viewing distance of approximately 8 ft., no line structure was visible. The standard 525-line transmission was used. Focus over the entire area was good and the illumination was uniform. This projection unit is designed both as a home unit and as a commercial unit for schools, clubs, hospitals, small theatres, etc. The latter is planned to sell as a unit for approximately $1,800.

The second model is based on the direct viewing principle in which a 20 in. diameter cathode ray tube is used to produce a 13½ by 18 in. picture. The principal feature of this equipment is the arrangement to reduce the depth of the cabinet

(*Continued on page 142*)

- VARNISHED TUBINGS
- PLASTIC TUBINGS
- INSULATING VARNISHES
- INSULATING PUNCHINGS
- VARNISHED FABRICS AND TAPES
- VARNISHED PAPER
- DUPLEXED INSULATIONS
- WIRE MARKERS

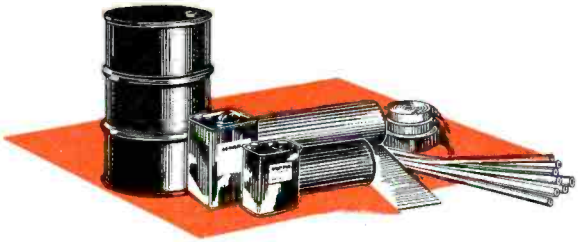
Completely Insulated

by the Leader in Insulation

More and more, radio and components manufacturers are writing into their specifications "Insulation by IRVINGTON". For IRVINGTON provides *every* varnished type of insulation required in radio manufacture . . . for all the *new* needs as well as the old. And each product bearing this outstanding name is formulated and manufactured under exacting IRVINGTON control . . . to assure 'balanced' service when used with others of the same name. Thus this single specification "Insulation by IRVINGTON" assures efficient, long-lasting protection to every part; the kind of service that builds and keeps dealer and user good-will. Complete cooperation on insulating problems involving radio or any other type of electrical circuit is freely offered. Write Dept. 106, or communicate with the IRVINGTON distributor in your territory.

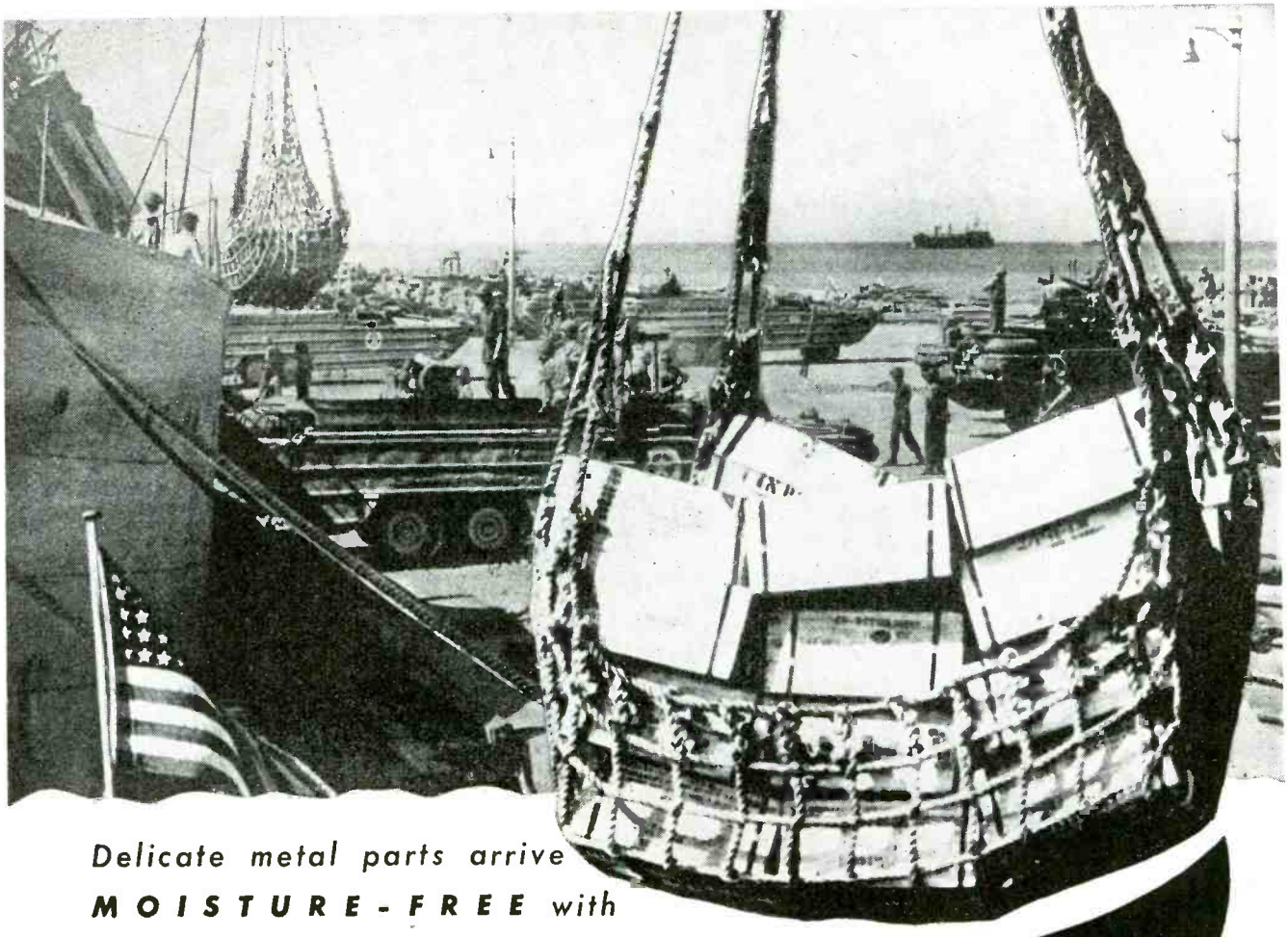
IRVINGTON PRODUCTS include:

Varnished Cambric and Tape
Varnished Fiberglas
Varnished Rayon, Nylon and Silk
Plastic Tape
Cardolite Compounds



STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE REG. U. S. PAT. OFF. MARK

IRVINGTON
VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey, U. S. A.



Delicate metal parts arrive
***MOISTURE-FREE** with*

Joliet SILICA GEL

The ideal drying agent....

THOUSANDS OF PACKAGES of delicate, precision metal parts are being delivered to our fighting fronts . . . moisture-free and rust free . . . because of Joliet Silica Gel.

The power of crystalline Joliet Silica Gel to absorb atmospheric moisture within containers is almost phenomenal. Its drying action prevents rust and corrosion. Moreover, it is widely used as a drying agent in cartons and boxes of foods, fabrics, chemicals and other commodities.

Joliet Silica Gel is strictly a quality product. It is clear white; passes a rigid section test; meets exacting government specifications. Write today for full information.

Opportunity for Jobbers

There are excellent opportunities for jobbers to build profitable business on Joliet Silica Gel in a few territories. Write for details.

JOLIET CHEMICALS, LTD.
INDUSTRY AVENUE
JOLIET, ILLINOIS

NEW TRANSFORMER CATALOG

Lists 600 ratings

Valuable for Engineering, Drafting, and Purchasing Departments

THREE general types of transformers and a complete line of reactors are included in this catalog:

Power transformers, including plate and plate-and-filament units

Filament transformers, embracing both conventional types and special high-voltage units

Audio-frequency transformers (built to your specifications), including microphone, input, interstage (or grid), modulation, and output types

Reactors—microphone, plate, filter (conventional or swinging), and modulation units

Both the transformers and the reactors are built in three mechanical designs—hermetically sealed, conventional compound-filled, and core-and-coil (uncased). The type of construction depends upon the application.

In many cases you will be able to pick exactly the transformer you want from this catalog, and thus gain the benefits that come from standardization, such as simplified purchasing, lower cost, and quicker shipment. If you don't find the unit you need, please let us know. We'll be glad to furnish you with cost and delivery estimates of transformers built to your specifications.

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

403-73-5205

- **Easy-to-read, easy-to-use tables and diagrams**
- **Large, full-color photographs of representative types**

It's Yours for the asking

GENERAL ELECTRIC COMPANY,
SECTION 403-73
Schenectady 5, N. Y.

YES! I would like a copy of your new catalog on transformers for electronic equipment.

NAME .....

COMPANY .....

ADDRESS .....

.....

PROJECTION TELE

(*Continued from page* 138)

necessary for such a large tube. The 20 in. diameter tube, which is approximately 32 in. long, is mounted on a framework within the cabinet and so arranged that the tube and frame may be tilted about a front pivot point and the tube lowered into a vertical position when the cabinet is closed and not in use.

This arrangement and the necessary electrically operated mechanism for moving the tube are shown in Figs. 2 and 3. The lifting mechanism is entirely automatic and is operated by a push-button on the receiver panel. The use of this arrangement allows the cabinet depth to be held to 24 in. The tube and its housing project approximately 10 in. beyond the front of the cabinet when the set is in operation.

The home receiver employing this 20 in. direct view tube will also contain record playing equipment as well as standard receiving tubes and apparatus for FM and AM. These direct view units will be available in at least two cabinet styles — modern and period furniture respectively.

DuPont Joins TBA

Television Broadcasters, Inc., has admitted to membership its first film manufacturing organization with the addition to its roster of the Photo Products Department of E. I. DuPont de Nemours & Co., Wilmington, Del. Several picture producing groups are affiliated with the organization.

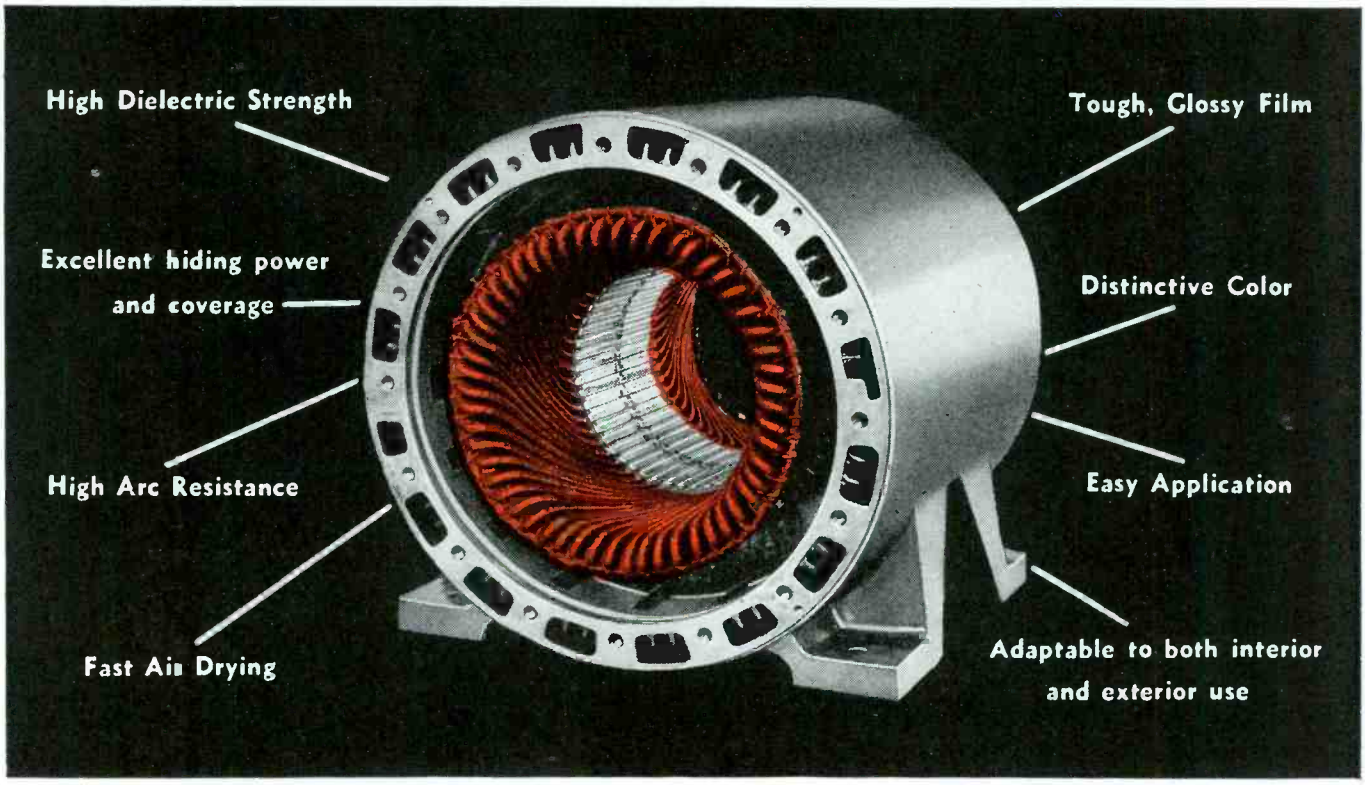
SHF POWER

(*Continued from page* 81)

bridge measuring circuit can be used. Reflections can be eliminated by mounting an open or closed end stub of variable length near the Thermister. This is illustrated in Figs. 5 and 6. These illustrations also indicate the method of eliminating harmonics from the measured power by placing a variable stub in the line. Its length is made equal to a half wavelength of the harmonic to be suppressed, and since it is shorted at the end its input impedance at the frequency in question is zero, and it effectively short circuits it.

The adjustment of the length is of course critical and must be done by obtaining a minimum power reading. The process is to make the adjustment in length while watching the bridge galvanometer and looking for the least deflection. The terminal impedance matching stub must be adjusted in the same manner except that in its case a maximum deflection must be looked for, indicating the least amount of reflections.

Protection DOLPH'S #10 RED INSULATOR



Illustration—Stator of Continental Electric Explosion-proof Motor

"WET DIELECTRIC UNCHANGED AFTER 3500 HOURS OF HEAT-AGING AT 275°F."

Yes, * SYNTHITE #10 Red Insulator was actually subjected to this severe test and passed it with "flying colors." SYNTHITE #10 Red Insulator was applied over two coats of clear baking varnish on a brass surface, and HEAT-AGED FOR 3500 HOURS AT 275°F. After this period, the test specimens were immersed in distilled water for 24 hours. The wet dielectric strength of the varnish after this treatment did not vary materially from the wet dielectric determined before the test, and the varnish film was in good condition.

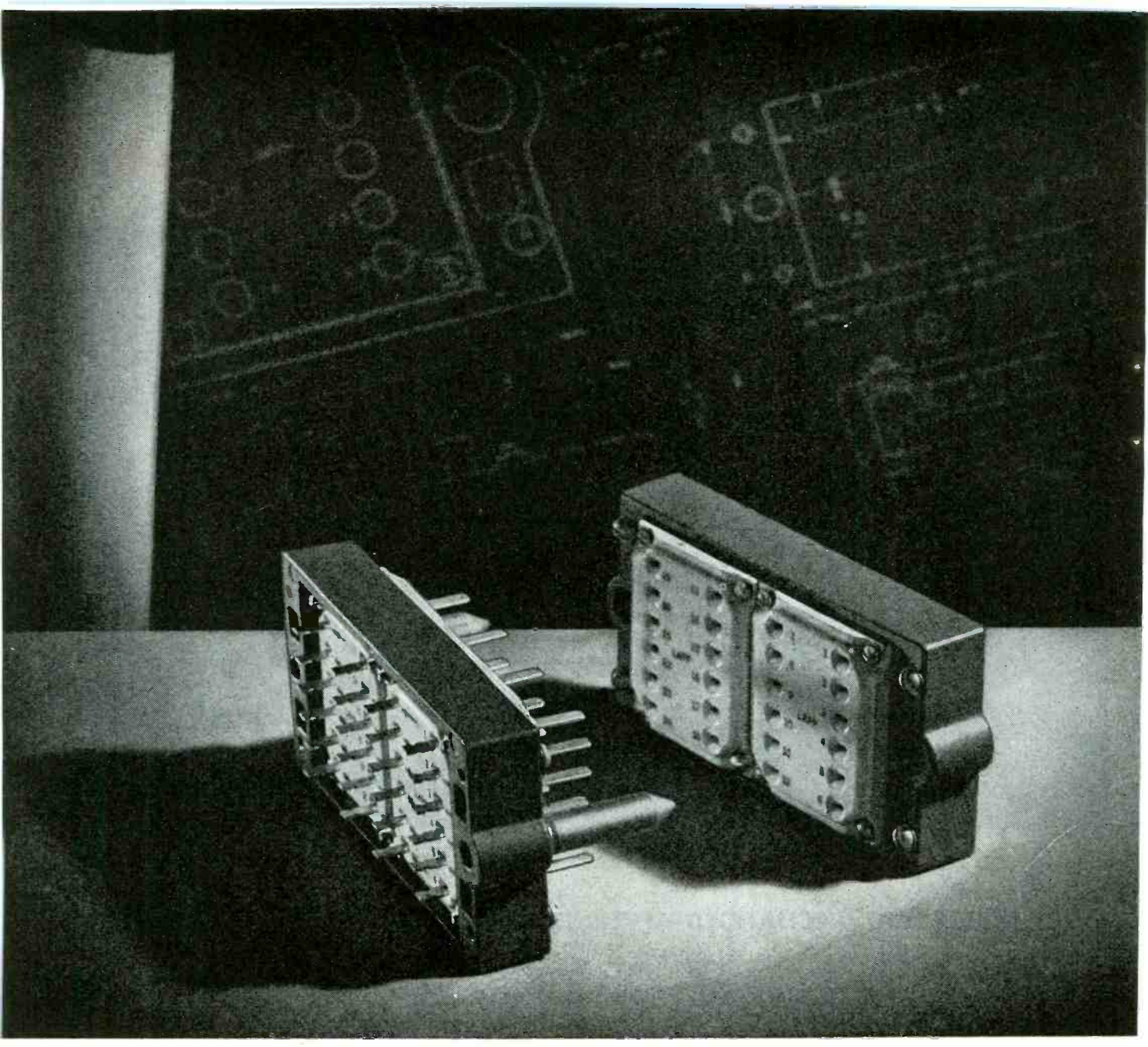
Applied by brush or spraying over prevarnished surfaces, SYNTHITE #10 Red Insulator affords maximum protection against chemical fumes, oil, water, acids and alkalies. In fact, the chemical resistance of SYNTHITE #10 is so great that engineering departments of various industries such as paper mills, refineries, cement plants, copper mines, coal mines, quarries and steel mills, are using this enamel for protection against chemical fumes.

Insulating Dolph's Varnish Specialists

JOHN C. DOLPH COMPANY

168 EMMETT STREET • NEWARK 5, N. J.

* Reg. U. S. Pat. Off.



An Electronic Part... ENGINEERED TO A SPECIFIC NEED

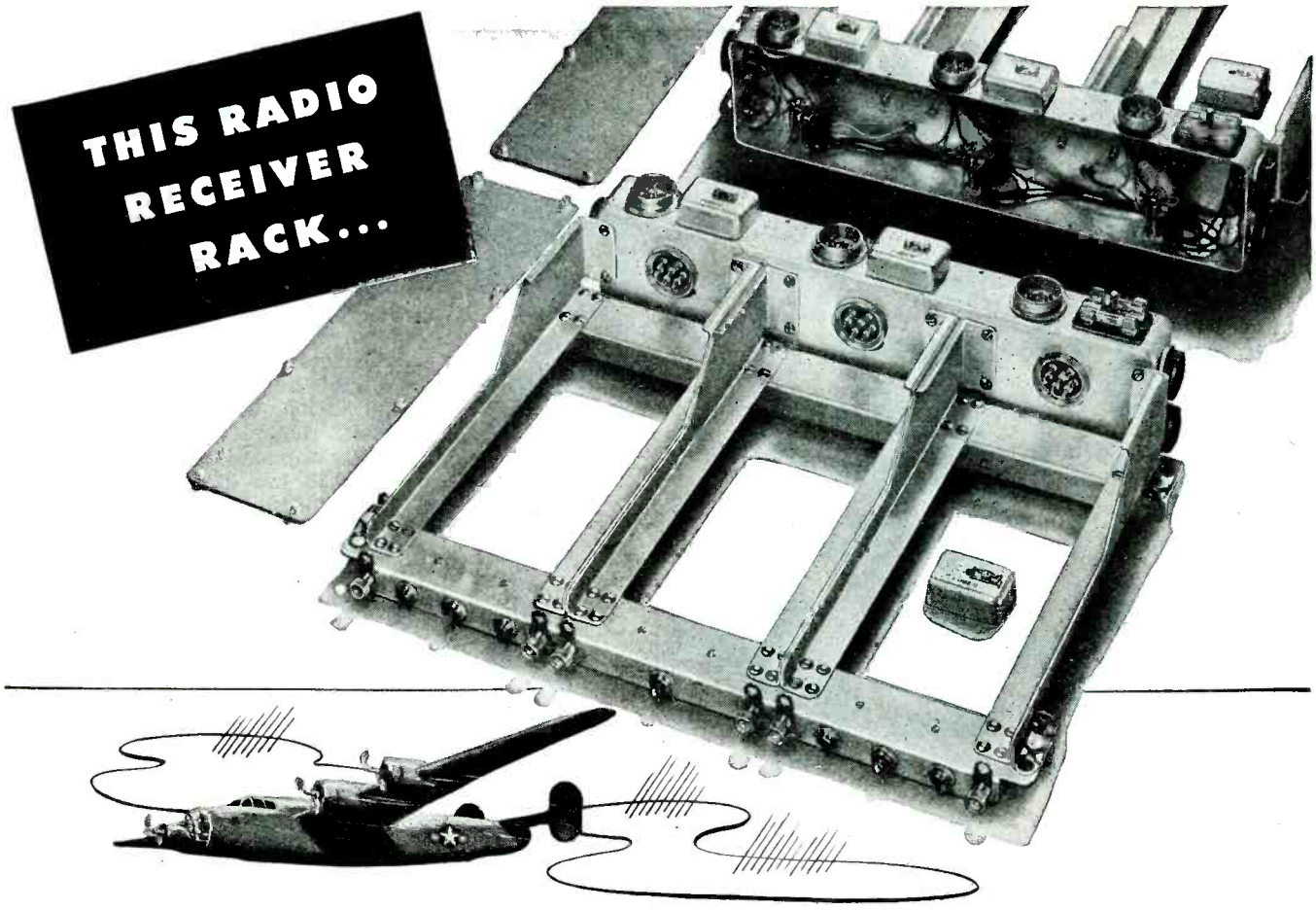
This is a special-purpose electronic part. It is a plug-receptacle assembly for use with rack-panel type of mounting. Twenty-four silver-plated phosphor-bronze contacts are provided, each male and female contact full floating between steatite plates. Heavy guide pins and matching holes in the frame assure perfect alignment.

We don't know that your product has any need for such a part as this. We do know, however, that this part is most exactly suited to its special requirement, just as are hundreds upon hundreds of other parts which have been created through Lapp engineering and Lapp production facilities directed to the solution of specific problems.

With a broad basic knowledge of ceramics—their capabilities and their limitations—Lapp has been able to simplify and to improve many types of electronic equipment through engineering and production of sub-assemblies that make most efficient use of porcelain or steatite and associated metal parts.

There may be a way you can improve performance, cut costs and cut production time through use of Lapp-designed and Lapp-built sub-assemblies. We'd like to discuss your specific requirements with you. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Lapp



*contains more than 500 Electrōnents**
. . . all made and assembled by Scovill

This three-position, high-frequency radio receiver rack for big bombers . . . one of the most intricate manufacturing and assembling problems ever entrusted to Scovill . . . shows how Scovill's versatile production facilities can meet requirements for electronic components or complete assemblies.

More than 500 individual parts are assembled in this rack. Materials used range from plastics to metal alloys in the form of sheet, rod, wire and tubing. Scovill makes all except glass and plastics components. Methods include forging, stamping, drawing, heading, machining, and wire forming.

Even complicated wiring does not stump Scovill's production engineers. Every wire is cut to length, stripped and soldered into correct position. Relays are manufactured, tested and adjusted by Scovill technicians.

In other words, Scovill engineered the whole job for assembly-line production . . . a service that can help you, too, save time, trouble and money on the production of small electronic components as well as large assemblies. For further details about the scope of Scovill's ingenuity and facilities, send for literature. Fill in coupon below and mail today.

*Electrōnents = Electronic Components

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

Please send me a free copy of *"Masters of Metal"* booklet describing your facilities. I am interested in the ELECTRONENT* applications checked.

- ☐ Batteries
- ☐ Dials
- ☐ Panels
- ☐ Record Changers
- ☐ Escutcheons
- ☐ Sockets
- ☐ Clips
- ☐ Jacks
- ☐ Stampings (misc.)
- ☐ Condensers
- ☐ Lugs
- ☐ Tubes

Other applications .....

SCOVILL MANUFACTURING COMPANY

Electronic Division
23 Mill Street, Waterbury 91, Connecticut

Name .....

Company .....

Address .....

MARINE VOICE CODE

(*Continued from page* 101)

resistor. The plate circuit is coupled to the 500 kc and 8.28 mc tank circuits through a condenser. The two tank circuits, L-105, C-115 and L-106, C-116 function independently without switching, an unusual feature. On 500 kc the antenna circuit is resonated by means of L-107 (tapped) while the antenna coupling voltage is obtained from taps on L-105. When knob A is rotated it engages a star wheel which changes the taps on L-107 and L-105. This action takes place when the variometer rotor of L-107 is adjusted. All taps are preset. On 8.28 mc coupling is obtained from C-118. Antenna resonance is maintained by panel controlled capacitor C-116.

Phone input is stepped up by a transformer and applied to the modulator. For A2 automatic modulation and A2 500 kc manual sending, feedback through C-119 permits the modulator to function also as an audio oscillator.

Automatic keying

The automatic keying unit is run by a 6 v 900 rpm dc motor. Cam A running 12 rpm transmits SOS. Cam B controls the long dash by blocking cam A. Cam C changes frequency by switching plate voltage. Cam D controls the modulator feedback circuit to give modulation on 500 kc and not on 8.28 mc. The hand-driven double current generator delivers 325 volt .11 amp. dc, and 6 volt, 2.5 amp. dc.

The receiver has four tubes in the rf, if and af circuits, and a voltage regulator tube. For 500 kc, V-105 and 106 function as rf amplifiers. For 8.28 mc V-105 operates as a pentagrid converter to deliver an if of 500 kc. Under these conditions the oscillator section of V-105 is tunable to permit reception from 8.1 to 8.6 mc. V-107 functions as a detector and first audio and provides avc. V-108 is the output tube, and a voltage regulator tube maintains 105 volts. The volume control is connected in the cathode circuits of V-105 and 106.

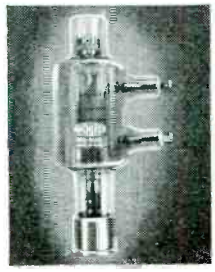
The send-receive relay, K-101 is de-energized in the transmit position to permit the set to function as an automatic sender anyway in case of relay failure. In connection with the 500 kc variometer, one section of the stator with C-145 form a high impedance trap for 8.28 mc to prevent shunting to ground by L-107.

Two way communication can be achieved by turning one master switch. The receiver is pretuned to 500 kc and can also be swept from 8.1 to 8.6 mc. Thus communication can be established either with ships, shore stations or other lifeboats.

CAN YOU TELL WHICH TUBES ARE BETTER ?

Two tubes of the same type may look exactly alike, but if one was assembled in the Machlett "White Room" while the other was put together under average factory conditions, there would be a considerable difference between them. In lighting, cleanliness and conditioned environment, the "White Room" resembles a hospital operating room, and tubes passing through it remain free of internal contamination that would lessen their stability, shorten their life. Such tubes will give full-rated, predictable performance, and prove uniformly economical and satisfactory. It was to achieve such improved results that Machlett built the first "White Room" in the industry — subsequently adopted by others. Many still newer Machlett techniques, such as this, continue to improve the quality and performance of our products. In this way, Machlett leadership in the electron tube field is maintained.

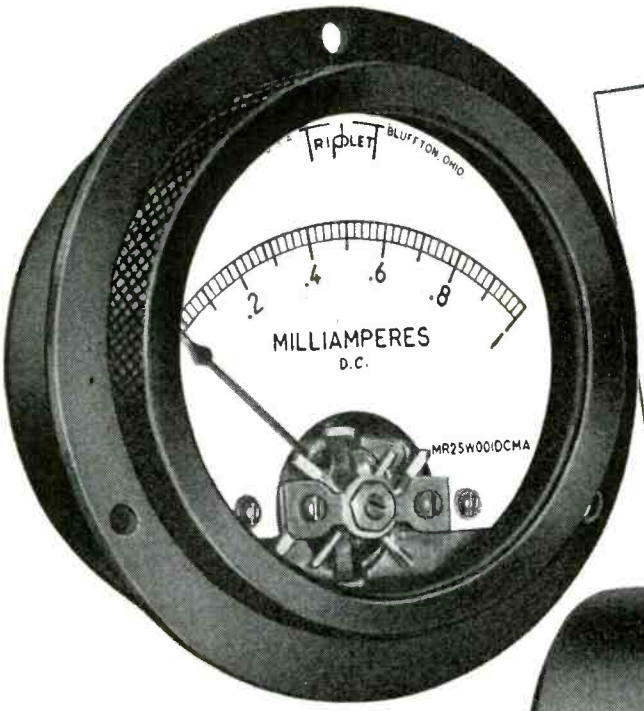
When you need a medical or industrial X-ray tube, or an oscillator, amplifier, or rectifier for radio or industrial purposes, select a Machlett. It will pay you in stability of operation and long life. For information as to available tubes, write Machlett Laboratories, Inc., Springdale, Connecticut.



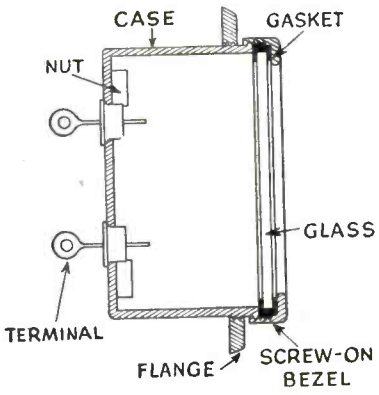
ML-500, a high-frequency triode. Maximum plate dissipation 500 watts with full power input at frequencies up to 50 megacycles.

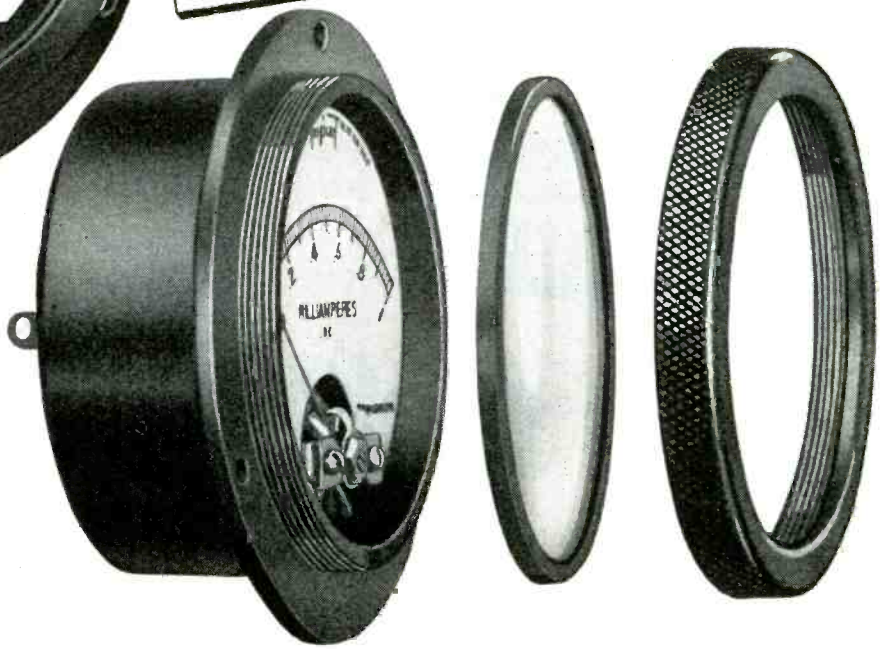
MACHLETT

APPLIES TO RADIO AND INDUSTRIAL USES ITS 15 YEARS OF ELECTRON-TUBE EXPERIENCE



INTRODUCING THE NEW TRIPLETT LINE OF HERMETICALLY SEALED INSTRUMENTS





ALL THE FEATURES of STANDARD INSTRUMENTS RETAINED

Withstands submersion tests at 30 feet

A screw-on bezel provides uniform pressure for hermetically sealing the glass to the case. The gasket is pressed into every crevice around the edge of the glass and the top of the case, where the permanent seal is made.

Tempered glass window and ceramic sealed terminals are used.

The knurled screw type bezel permits servicing when necessary and resealing without replacing a single part or the use of special tools or equipment.

Complete dehydration of the interior is readily accomplished by recognized temperature difference method (the bezel loosely attached for the escape of all moisture, after which the bezel is tightened to make the permanent seal). Interior is completely dry at slightly above atmospheric pressure.

These instruments comply with thermal shock, pressure and vibration tests. They also are resistant to corrosion. Instruments conform to S.C. No. 71-3159 and A.W.S. C-39.2-1944 specifications.

Furnished in 1½", 2½" and 3½" metal cases with 1/16" thick walls, in standard ranges. D.C. moving coil, A.C. moving iron and thermocouple types.

Write for circular

Precision first ...to last

STANDARDS ARE SET BY TRIPLETT

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

STOP "Leap-Frog" Corrosion

Federal Cathodic Protection Rectifier, Model FTR 5114-S. Output 20 amperes at 10 to 40 volts. Other sizes as required.

"Leap-Frog" Corrosion damages underground pipes and cables.

Pipes or other metal structures are in places electro-positive in relation to the soil and due to natural galvanic action corrosion results. Metal is taken away from one section of pipe and deposited somewhere else along the exposed pipe.

By using Federal Cathodic Protection Rectifiers, "Leap-Frog" corrosion is foiled. On constant guard is a direct current charge which cancels the harmful electrolytic corrosive action on oil, gas and water pipelines and underground cables.

These Federal units have no moving parts, so they last indefinitely — with the absolute minimum of attention. In desert heat or torrid dampness they keep on the job day and night.

Proper engineering for the corrosion problem at hand calls for the specialized consulting engineering service which is yours — when you look to Federal. Write today for full details.

Federal Telephone and Radio Corporation

Newark 1, N. J.

AN IT&T ASSOCIATE

MERCURY ARC

(*Continued from page 78*)

There is one other power factor consideration of importance in the design of the high frequency single-phase transformer, but of only relatively minor importance in connection with the rest of the equipment. In the high frequency part of the inverter circuit, including the high frequency transformer and mercury arc unit, current flows to the anodes (which are released by grid control) in advance of the high frequency voltage so that the inverter delivers high frequency power at a leading power factor. This leading power factor is normally about 70 per cent, but depends upon the output power regulation selected by the grid control rheostat. The kva rating of the high frequency transformer must be somewhat higher than the kw rating of the equipment because of the fact that the inverter operates at a leading power factor.

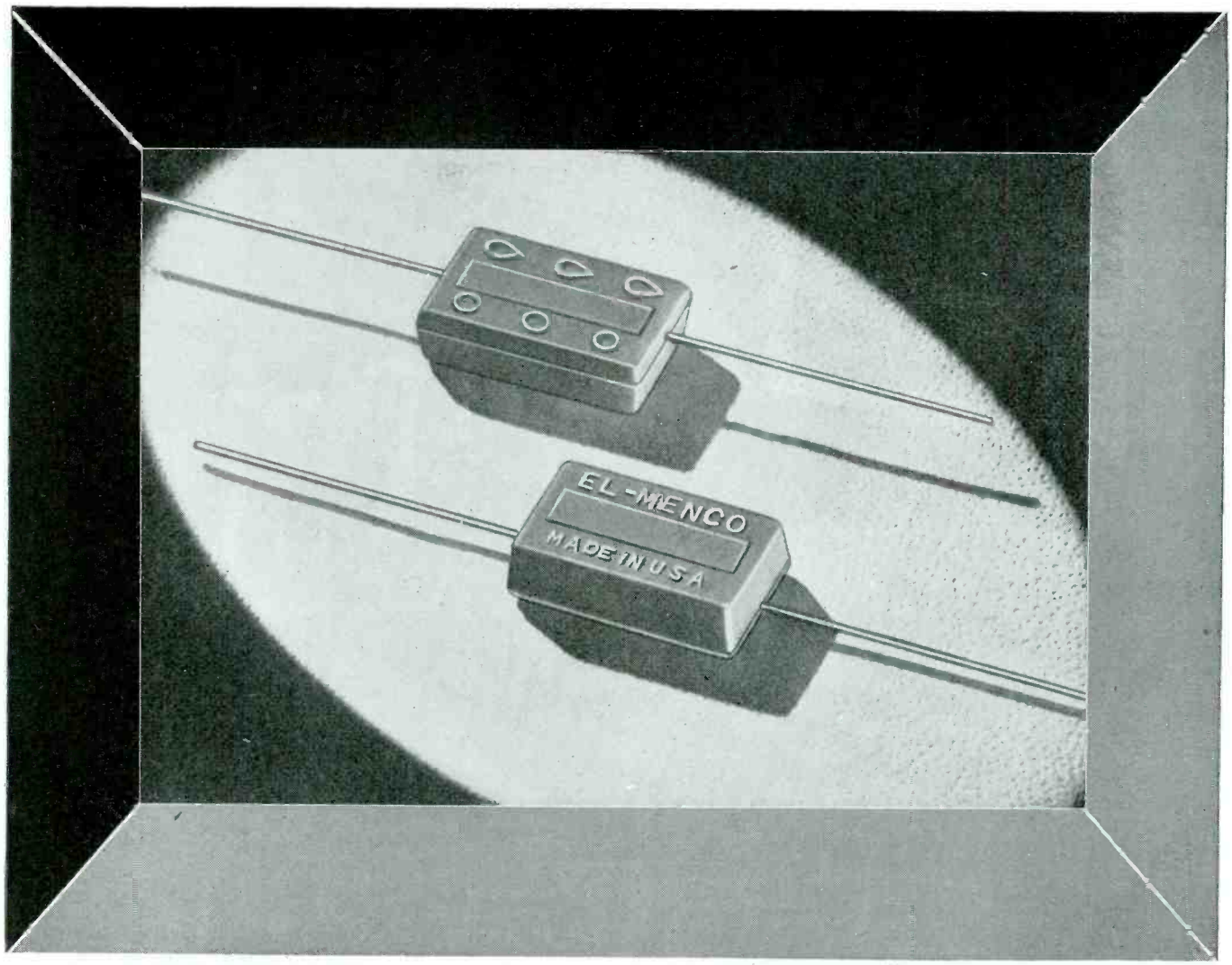
The single-phase transformer can be designed to provide any output voltage desired for the induction heating coil circuit; it is simply a matter of designing for the proper ratio of turns between the primary windings and the secondary winding of the transformer. If for safety reasons for operating personnel, it is desired to keep the induction heating coil voltage at not over about 250 volts between either terminal and ground, the output secondary winding could be designed to provide a maximum of about 500 volts and could be built with a center-tap for grounding.

Power transmission

If high frequency power is to be transmitted for a long distance through a plant, it would be more economical to design the single-phase transformer to supply a potential of about 2,300 volts to a coaxial transmission line or cable, and to provide a high frequency step-down transformer at the end of the line for the coil circuit. By transmitting high frequency power at a high voltage and low current, the losses in a coaxial line can be kept at a minimum.

The control cubicle can be mounted on the mercury arc converter frame or adjacent to it so that the auxiliary control wiring does not have to be run through conduit. The cubicle frame can be grounded for protection of operating personnel, but an inclosure is necessary around the converter because the anodes are supplied with high voltage for high efficiency operation.

(*Continued on page 155*)



PORTRAIT OF *Precision*

Precision marks every step in the manufacture of El-Menco Capacitors, for well we know the vital role our products must play, and how much depends upon their unfailing performance. That this precision is appreciated is best evidenced by the Army-Navy award we so proudly display.

Postwar products in which El-Menco Capacitors will be used will undoubtedly be *fine* products — products of quality in *every* detail.

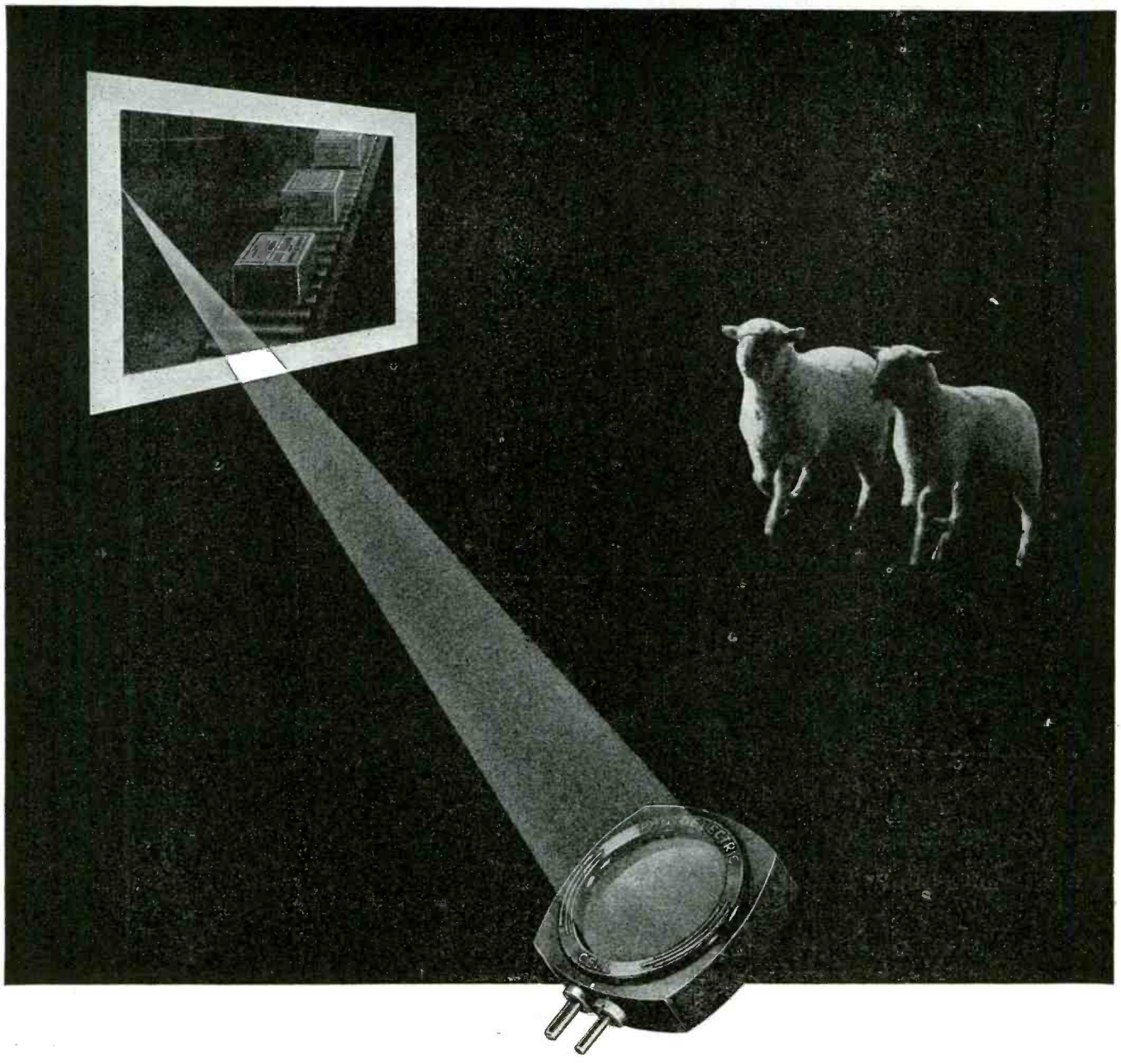
Manufacturers of
Electronic Equipment:

ARMY E NAVY

Send, on firm letterhead
for new Capacitor Catalog.

THE ELECTRO
MOTIVE MFG. CO.
Willimantic, Conn.

El-Menco
MOLDED MICA–
MICA TRIMMER
Capacitors



HOW TO COUNT WITHOUT FALLING ASLEEP

From sheep to shoes, the photo*cell* will replace the human eye and never fall asleep or fail on any counting job. Luxtron* photo*cell* advantages in counting, and in countless other control and measurement applications, lie in these facts: Luxtron cells transform light into electric energy. They are small and weigh little. Vibration does not reduce their efficiency or longevity.

Simplicity and stamina typify all Luxtron photo*cell* applications — from matching colors to putting out a fire. The energy they generate requires no amplification to operate meters or meter relays. If you have an idea for putting photocells to work, write Bradley for samples and application help.

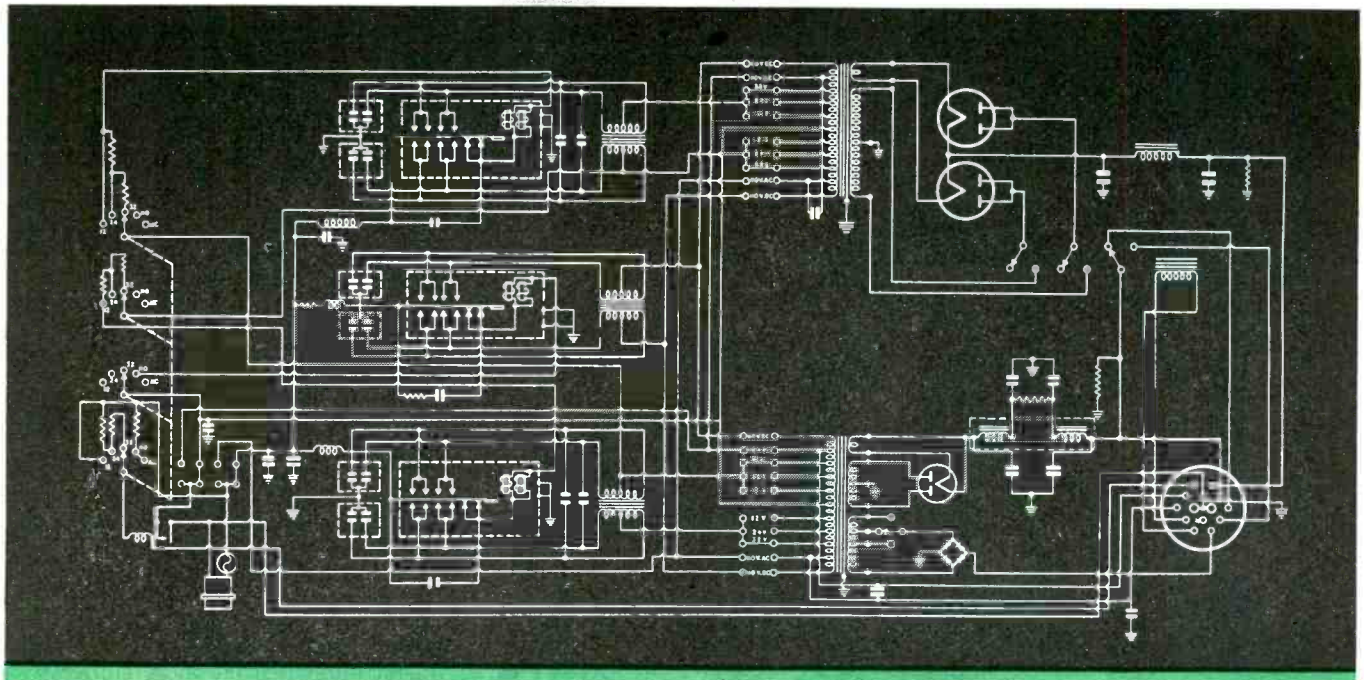
Another Bradley Development

Mounted in a tube base and potted in wax, this ring-connected copper oxide rectifier is one of the unique line of "Coprox" rectifiers being produced by Bradley with the same understanding of electrical and plymetallic phenomena exhibited in Luxtron photocells. Write for "Coprox" bulletin.

* TRADE MARK REG. U. S. PAT. OFF.

PHOTOCELLS—MASTERS OF LIGHT **BRADLEY** *MASTER OF PHOTOCELLS*

BRADLEY LABORATORIES, INC., 82 MEADOW STREET, NEW HAVEN 10, CONNECTICUT



E·L DEVELOPMENTS PROVIDE MULTIPLE INPUTS AND OUTPUTS IN VIBRATOR POWER SUPPLIES

● Electronic Laboratories has greatly increased the flexibility of power supply design and versatility of power conversion circuits, through special new developments during the war period. One of these, resulting from intensified research to meet military needs, is vibrator power equipment capable of delivering various voltages, circuits and frequencies from a variety of input voltages. This naturally has vastly broadened the field for vibrator power conversion equipment.

The typical circuit diagram shown above illustrates a multiple input and output system. This power unit is designed to be operated from either 12, 24, or 32 volts from storage batteries, or 110 volt DC or AC power lines. Various outputs are available to supply the high voltage plate current required for the grid, and the AC voltages suitable for operation of the filaments. In addition, a source of alternating current power for the operation of the automatic timing system which is incorporated in this unit, has been provided. There is a current division system associated with the contacts of the vibrators and the circuit is so designed that the phase displacement provides equivalent performance of a two-phase rectifier system, assuring low hum level with a minimum amount of filter.

During the war period, E·L has designed many other similar units having a multiplicity of input and output voltages. In addition to DC sources, in many cases, AC sources of any frequency between 18 and 180 cycles have been made available to meet specific engineering problems.

The requirements for power equipment reach into many fields as war born inventions are applied to postwar needs. E·L Vibrator Power Supplies will have wide application because they are the most economical, efficient and versatile means of solving the many power supply problems that will arise. Electronic engineers will soon be at your service to help meet the power requirements presented by postwar industry.

E·L STANDARD POWER SUPPLY MODEL 1200

This E·L unit is a typical Vibrator Power Supply with multiple inputs and outputs and was designed for transmitter and receiver use. Inputs: 12 volts DC, 24 volts DC, 32 volts DC, 110 volts DC and 110 volts AC, 50-60 cycles; Outputs: 60 volts DC at 150-250 MA; 300 volts DC at 75-150 MA; 6-8 or 10 volts DC at 1 amp.; and 110 volts AC (50-60 cycles) at 75 watts. Dimensions: 26-1/16" x 15" x 13-9/16". Weight: 160 pounds.

Electronic
LABORATORIES INC.
INDIANAPOLIS

VIBRATOR POWER SUPPLIES FOR LIGHTING, COMMUNICATIONS, ELECTRIC MOTOR OPERATION · ELECTRIC, ELECTRONIC AND OTHER EQUIPMENT

MERCURY ARC

(*Continued from page* 150)

Because the equipment is static in nature, there are no serious vibration problems to contend with and so heavy and expensive foundations are not required. Also, because the heat loss in the tanks is so small and is controlled by automatic water cooling, there is no problem of air-ventilation and air - filtering for the converter equipment unless it is desired to install the transformers indoors in a small room. In this event, some air ventilation is required for the self-cooled transformers.

The advantages and disadvantages of the depth of penetration of induced heating currents and the problems of the design of induction heating coils or furnaces for melting, forging, and other applications are beyond the scope of this article. Excellent data have been published on these subjects.

The efficiency of induction heating coils in transferring electrical energy into heat energy in the charge depends to a large extent on the insulation thickness requirements, size of charge, and type of metal being heated. In heating steel, coil efficiencies as high as 80 per cent sometimes can be attained, which, multiplied by a converter efficiency of better than 90 per cent, result in an overall efficiency of the order of 70 per cent.

Typical uses

In heating better conductors such as aluminum and copper, lower efficiencies result, but this is offset by the fact that the working or melting temperatures of these metals are lower than that of steel. Induction heating is being used extensively for alloy steel melting where carbon content must be controlled accurately, and it is anticipated that it will be used to a very great extent for forging, and for heating of limited areas of bars, tubes, and other fabricated parts in order to perform upsetting, bending or forming operations.

Bigger Bell Labs

A substantial increase in the Bell System's laboratories will be made as soon as war restrictions permit.

SELECTING COAX CABLE

(*Continued from page* 84)

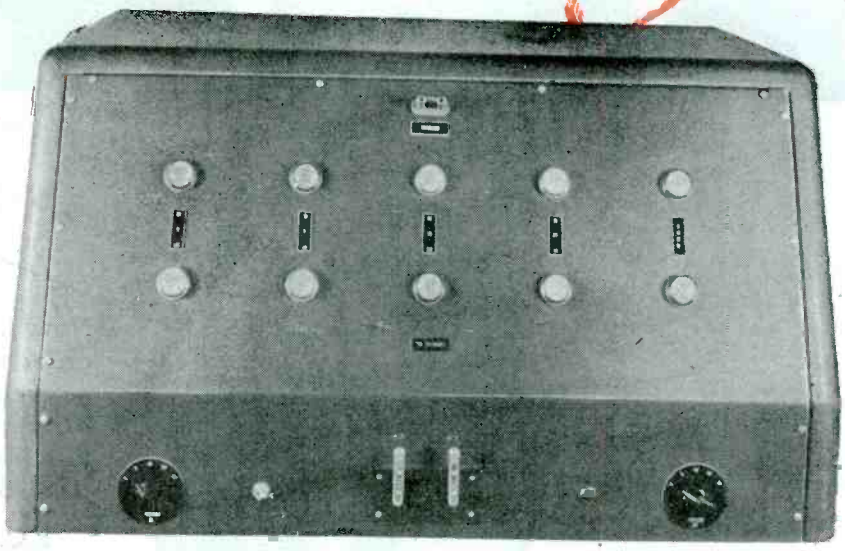
the power for which it is rated. A smaller factor of safety than 50 has proven to be unsatisfactory. This large factor is required because several causes of failure occur simultaneously and their effects are cumulative. Among these factors are over-modulation or switching surges in the transmitter, mismatch

(*Continued on page* 158)

Visual and Audible indication

ACCURATE TO .1%

PRECISION TOLERANCE BRIDGE



MODEL SE 10

Quality Control Minus Risks of Human Failure

Electronically, "GO-NO-GO" Visual Gauge Can Be Used As:

- Inspection Tool—for incoming inspection of components (condensers and resistors) to act as a safeguard against faulty components and as a quality safeguard for the equipment manufacturer.
- An indispensable tool on the production line, this unit serves as an automatic filter to grade compopents for their individual tolerance.
- Overall precision of unit is .1%.
- Checks A.C. resistance and impedance, capacitance and Inductance.
- No controls for operator to adjust or set.
- Test is automatic.
- Human error is eliminated by substitution of indicating lights for tolerance reading.
- Visual and audible indication of rejects, instead of meter readings.
- Each tolerance in percentage steps has its individual light.
- Can be used by anyone; knowledge of inspecting procedure is unnecessary.
- Eliminates the error of parallax in meter readings.

Sherron Electronics

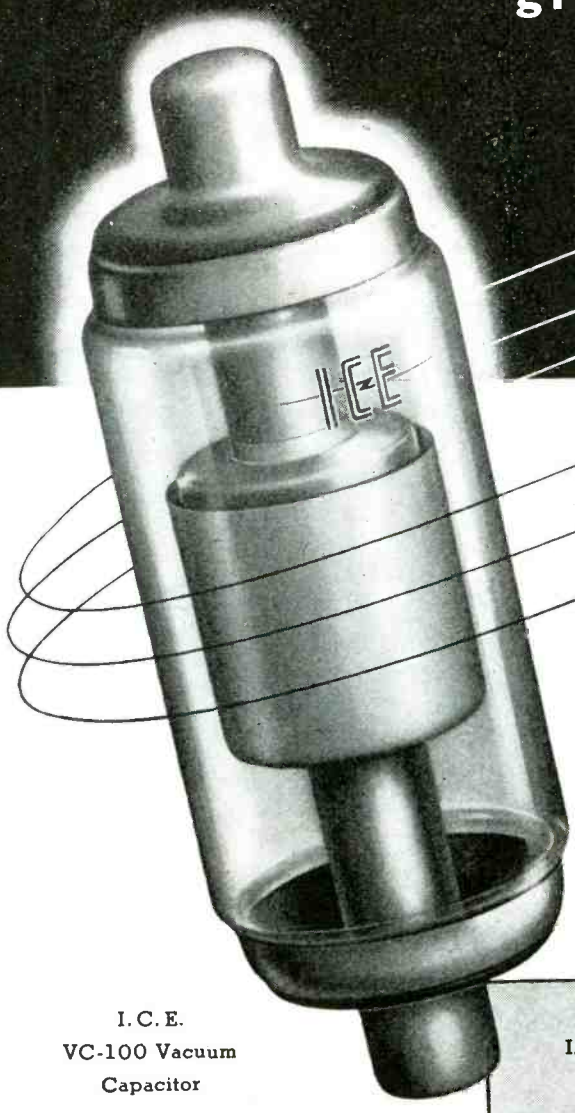
SHERRON ELECTRONICS COMPANY

Division of Sherron Metallic Corporation

1201 FLUSHING AVENUE, BROOKLYN 6, N. Y.

"Where the Ideal is the Standard, Sherron Units are Standard Equipment"

ONLY I-C-E VACUUM CAPACITORS give you the precise capacitance value you want



I. C. E.
VC-100 Vacuum
Capacitor

Now I. C. E. makes it possible for you to order vacuum capacitors with the correct capacitance value to meet requirements of your equipment. I. C. E. Vacuum Capacitors are now available in any value range from 6 to 110 mmfd. in steps of 1 mmfd.

I. C. E. Vacuum Capacitors Give You Close Tolerances

Beside offering you a wide range of capacitance values, I. C. E. Vacuum Capacitors are built to give you previously unobtainable tolerances.

I. C. E. PRECISION GRADE VACUUM CAPACITORS

Value Range	*Accurate to*
6 mmfd. to 25 mmfd.	±0.5 mmfd.
26 mmfd. to 60 mmfd.	±1.0 mmfd.
61 mmfd. to 110 mmfd.	±1.5 mmfd.

I. C. E. XX GRADE VACUUM CAPACITORS

Value Range	*Accurate to*
6 mmfd. to 25 mmfd.	±0.2 mmfd.
26 mmfd. to 60 mmfd.	±0.3 mmfd.
61 mmfd. to 110 mmfd.	±0.5 mmfd.

I-C-E
ELECTRONIC TUBES
RESEARCH • DESIGN • PRODUCTION

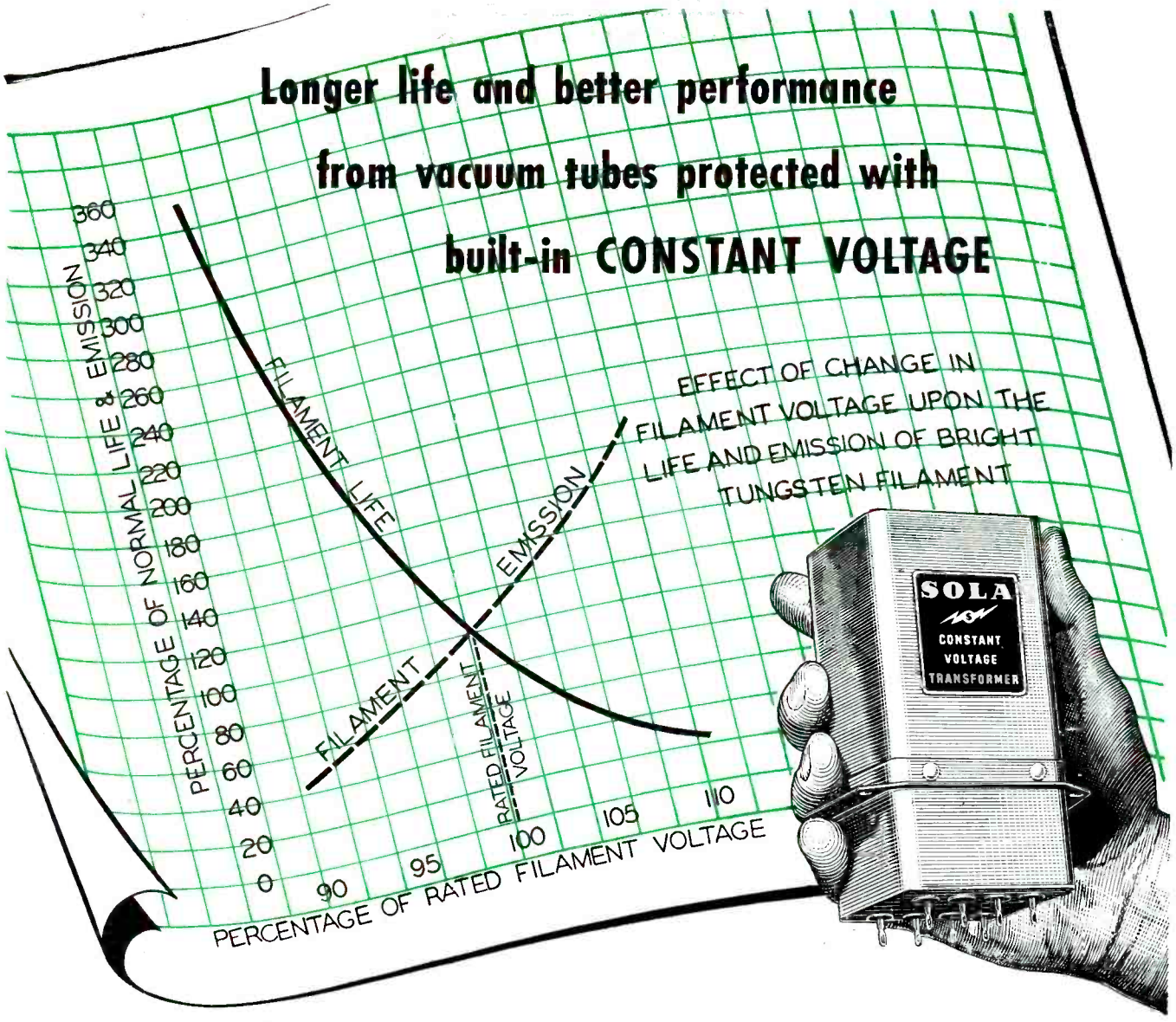
Full Details in the New I. C. E. Catalog

For full information on these outstanding I. C. E. Vacuum Capacitors, as well as other precision I. C. E. products, write today for the new I. C. E. Catalog.

INDUSTRIAL & COMMERCIAL ELECTRONICS

BELMONT, CALIFORNIA • NEW YORK CITY, N. Y.

Longer life and better performance from vacuum tubes protected with built-in CONSTANT VOLTAGE



A 5% over-voltage will reduce the life of a tungsten filament by 50%.

A 5% under-voltage will cut filament emission by 33%.

Commercial line voltages today may vary as much as ± 20%.

With a SOLA Constant Voltage Transformer as a built-in component of your equipment, these line voltage variations can be ignored. No need to depend upon operator adjustments. No need to worry about operator forgetfulness. You can depend on it—the right voltage is *always* there.

Vacuum tubes protected by SOLA Constant Voltage Filament Transformers require no starting resistors or high reactance transformers. Filaments are automatically and positively protected against damaging inrush currents. Tube life is noticeably prolonged.

SOLA Constant Voltage Transformers require no supervision, or manual adjustments by the operator. They eliminate the need for voltmeters. They are fully automatic, have no moving parts, tubes or networks, and are self-protecting against short circuit.

Standard units are available in capacities from 10 VA to 15 KVA either for the operation of equipment now in use or as built-in units. Where special problems confront the designer, consultation with SOLA engineers may provide a positive and economical solution.

Constant Voltage Transformers

To Manufacturers:

Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.

Ask for Bulletin 10CV-102

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells • and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

SELECTING COAX CABLE

(*Continued from page* 154)

of the impedance of the transmission line, and lightning striking the antenna.

Power loss

The power loss in air insulated cables is substantially lower than in solid dielectric cables of similar diameter. Power loss information is usually available from the manufacturer of the cable, and is provided with considerable accuracy.

The most difficult step in these calculations is putting the proper value in dollars on the power lost. The recommended method is to assume that each watt lost is worth $10 to the station. This figure is based on the fact that the cost of a radio transmitter, plus power to operate it over its normal life, plus tube and component replacements during its life totals about $10 per watt. This figure is approximately true regardless of the power and frequency of the transmitter.

The next step is to assume that if large changes in power of the station cost $10 per watt, then small changes in power are also worth a proportional amount.

Table 2 shows a typical calculation for a radio transmitter operating with an antenna power of 1000 watts, on a frequency of 1 megacycle, and using a 200-foot transmission line. Type 83 cable is included in this calculation to show its cost data, although actually it is too small to use for 1000 watts power with safety. In the example used, it is seen that the lowest total cost is obtained with type 737 cable, so this cable should be chosen for this application.

A series of calculations such as that in the preceding example were made for different powers and frequencies. The optimum cable type for any power and frequency is presented in Fig. 3. These results as based on the same cost data used in the example, and on a line length of 200 ft.

POLICE EQUIPMENT

(*Continued from page* 81)

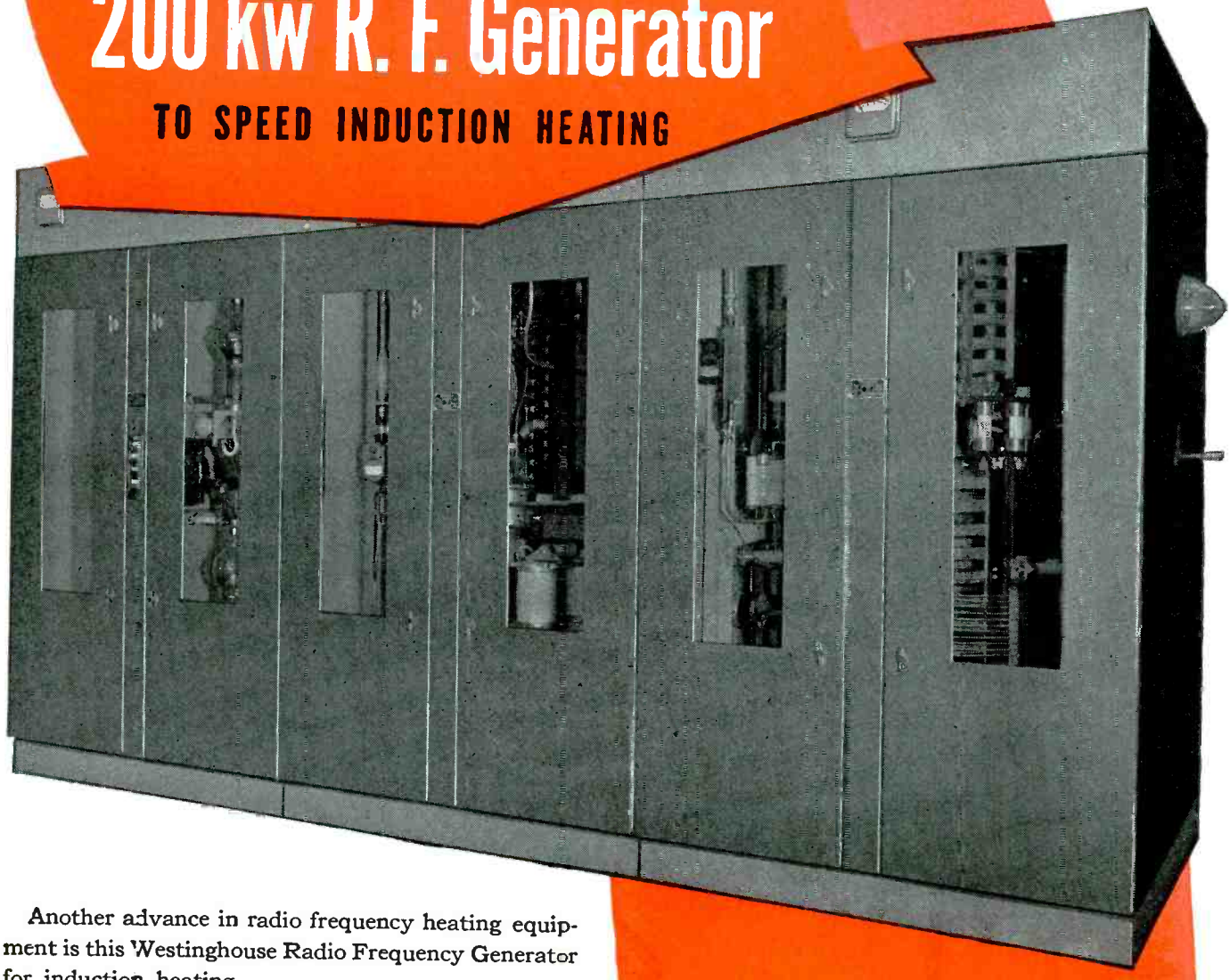
incorporates a squelch circuit to block the set when the signal falls below this value. The limiter saturates at 0.3 μv. The set uses several miniature type 6AK5 pentodes as shown in the block diagram. The transmitter generates a crystal-controlled carrier frequency which is first phase modulated, then becomes equivalent FM. A frequency deviation of approximately 30 kc is used. A particularly noticeable feature of the demon-

(*Continued on page* 162)

Here's a

200 kw R. F. Generator

TO SPEED INDUCTION HEATING



This 200kw, 450kc r.f. generator may be installed adjacent to the work, or at a remote point. Dead-front construction safeguards operators. From left to right, cubicles contain rectifier and control panel, radio frequency oscillator and tank circuit.

Another advance in radio frequency heating equipment is this Westinghouse Radio Frequency Generator for induction heating.

This 200kw generator is a complete power source, built with all the performance characteristics of Westinghouse industrial equipment. Timing, for example, is automatic according to a predetermined load cycle and power consumption is determined by the work being done.

Consecutive heats can be repeated automatically without interruption or duplicated at any future time with accuracy. Once the generator is adjusted to a process, operation requires only pushing buttons and setting dials to calibration data.

The 200kw generator is one of a complete Westinghouse line including 2, 5, 10, 20, 50 and 100kw sizes. For more information, ask for Descriptive Bulletin 85-800, or give your nearest Westinghouse representative your specific problem. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

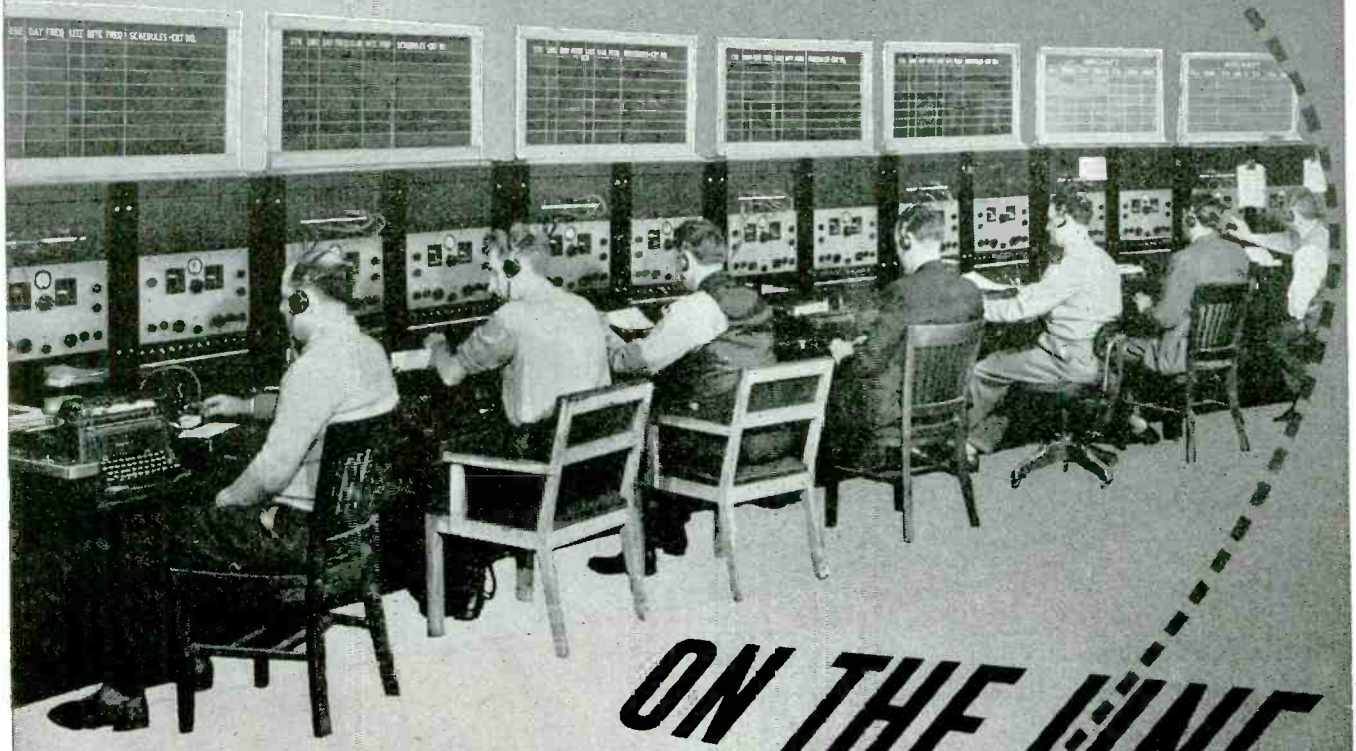
J-08188

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

"SUPER-PROS"



ON THE LINE

Five thousand hours of continuous operation demand good engineering. The "Super-Pro" receivers in the CAA installation at La Guardia Airport have been on duty twenty-four hours a day for over four years.

THE SIGN OF QUALITY

ESTABLISHED 1910

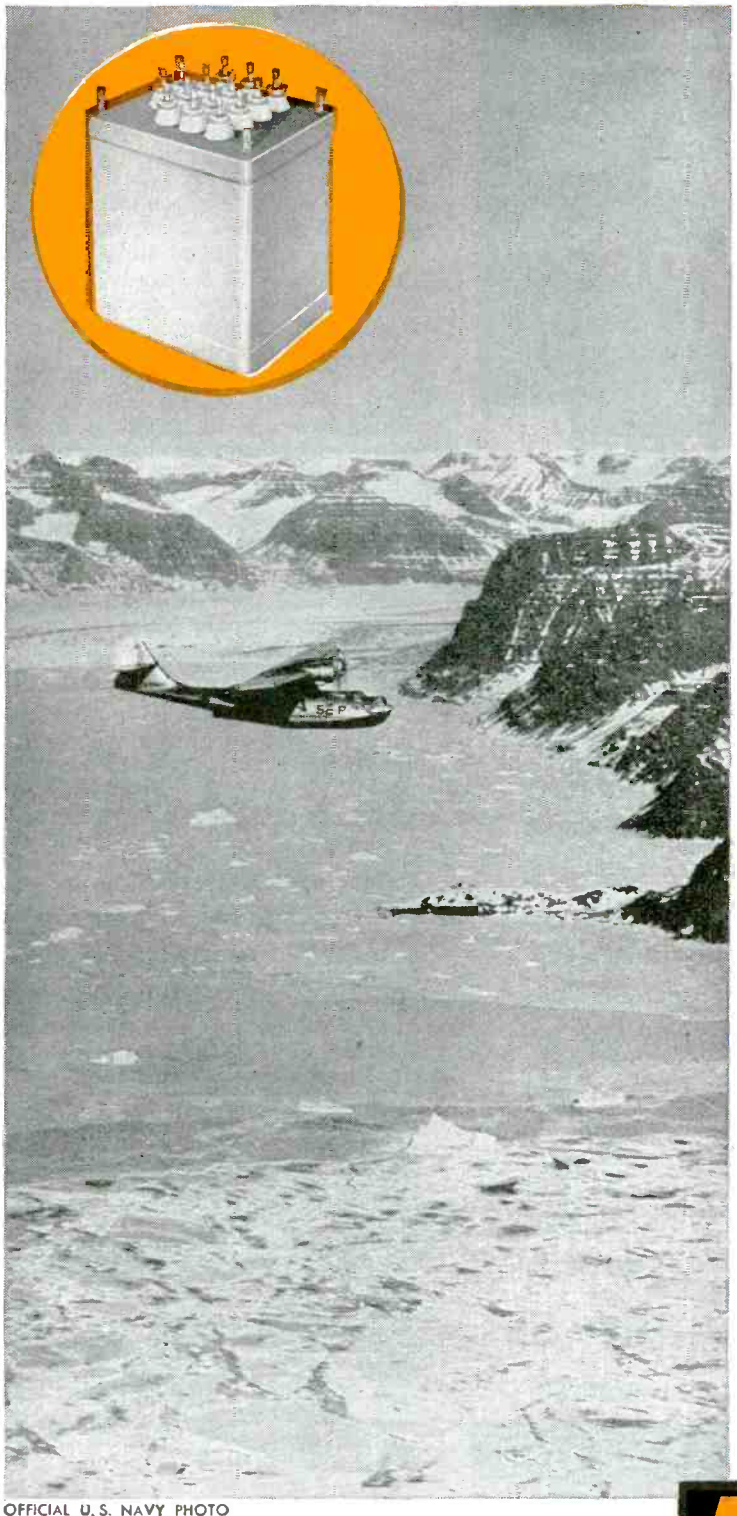
HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.

MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

HERMASEAL

HERMETICALLY SEALED TRANSFORMERS —DEPENDABLE IN ARCTIC WARFARE



OFFICIAL U. S. NAVY PHOTO

Hermaseal Hermetically Sealed Transformers are as effective in the intense cold of the Arctic as in torrid zones. For moisture cannot penetrate nor does it remain in the enclosing cases to deteriorate insulation.

At AmerTran, moisture is removed in the vacuum varnish impregnation of core and coil and the whole unit is thoroughly dried by pre-heating before filling with compound. To make each unit impervious to moisture, all case seams are induction soldered and the terminals are solder sealed or pressure type according to requirements. Every unit, not just random units, is tested by vacuum immersion—upon which it receives the symbol of perfect Hermetic Sealing—the Hermaseal.

Submit your specifications covering magnetic components for airborne communications equipment to AmerTran.

AMER TRAN HERMASEAL

THE AMERICAN TRANSFORMER CO., 178 Emmet St., Newark 5, N. J.

AMERTRAN ASSIGNED "APPROVED" QUALITY CONTROL RATING BY AIR FORCES

On March 14, 1945, the Air Technical Service Command of the Army Air Forces delegated to the American Transformer Company full responsibility for meeting contract requirements. This assignment of on "Approved" Quality Control Rating which eliminates duplicate inspection during fabrication was awarded on the basis of AmerTran's record in adhering to quality standards.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

POLICE EQUIPMENT

(*Continued from page 158*)

stration, associated as is well known with FM, was the complete absence of audible static or other noise.

Radiotype equipment

Radiotype equipment of the International Business Machines Corp. also was demonstrated to the police communications officers. The radiotype equipment uses a standard electromatic typewriter applied to communications apparatus. In full automatic operation, copy is typed on a sending typewriter which perforates a tape. This tape is "read" by an automatic transmitting head which keys the electronic communications unit sending out a tone signal. This tone signal is sent over a radio circuit, in this case using the standard 35.46 mc police frequency, and at the receiving end the tone is fed into an electronic unit which selects the proper keys on the receiving typewriter which prints the message.

This unit operates at 100 words per minute. A GE wire recorder was used in one stage of the demonstration to record the keying signals as heard over a loudspeaker. These signals were later repeated into a microphone by the wire recorder and fed back in to the radiotype system to operate the receiving typewriter.

VHF NETWORK

(*Continued from page 89*)

network to the television audience in the Philadelphia area. Appearing on this inaugural telecast from Washington, were the Honorable Paul A. Porter, Chairman of the Federal Communications Commission, Doctor Karl T. Compton, President of the Massachusetts Institute of Technology and Chairman of the Research Board for National Security and John Ballantyne, President of Philco Corporation. FCC Chairman Paul A. Porter speaking on this telecast said:

"The opening of this new multiple-relay is an example of the vigor with which the problems of television are being attacked. The creation of networks is the heart of the problem of how to expand television into a nationwide service.

"The Philco Corporation is to be congratulated on pioneering in this vital aspect of the television art. Its vision and enthusiasm thus give it a distinguished 'first.' This demonstration is a harbinger of exciting things to come."

. . . . But you can see the results

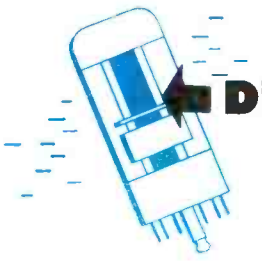
Pieced together this picture shows one step in the making of dials for Simpson Instruments. We have scrambled it deliberately to emphasize the fact that Simpson employs many processes others do not in manufacturing electrical instruments and testing equipment. To the man who knows instruments this extra measure of engineering skill and craftsmanship is evident in every detail—a reflection of Simpson's never-ending quest for refinements in design that will at once improve performance and permit more efficient production. It is the experience gained through more than 35 years of such study which promises you, in Simpson Instruments, the ablest application of the great advances that will be forthcoming.

SIMPSON ELECTRIC COMPANY
5200-5218 W. Kinzie St., Chicago 44, Ill.

Simpson

INSTRUMENTS THAT STAY ACCURATE

Buy War Bonds and Stamps for Victory



DEEP IN THE HEART OF EVERY TUBE...

THE HEART of every radio and electron tube is its *cathode.* And National Union electronic engineers are in many ways the heart specialists of the tube world.

They have developed high-emission cathode coatings for a wide variety of tube types. They have perfected improved methods of controlling the torrent of electrons that is emitted by every *good* cathode. And, of course, they have their own ways of determining that a cathode *is* good. For example, microscopic magnifications up to 2500X enable N. U. scientists to tell at once that a cathode coating of millions of minute crystals, has the desired density and texture.

As the cathode is the heart of the tube, so the tube is the heart of radio, communications and industrial electronic equipment. And the day is coming when N. U. research, N. U. mass-producing facilities, and N. U. "know how" with the elusive electron will aid in speeding the return of many peace-time products to our homes and industries.

NATIONAL UNION RADIO AND ELECTRON TUBES

NATIONAL UNION RADIO CORPORATION · NEWARK 2, N. J.

WIDE READING

(Continued from page 115)

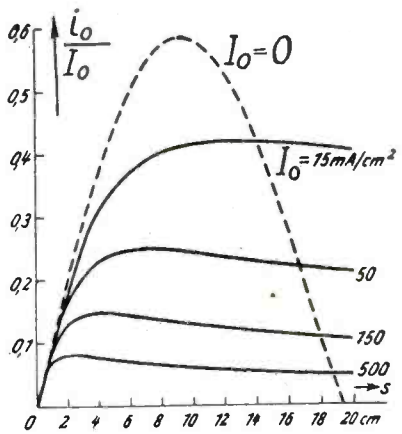


Fig. 2. Relative amplitude of fundamental as function of distance from modulating grids

J indicates a Bessel function. Numerical results obtained for the fundamental wave are illustrated in Fig. 2, for an accelerating voltage $E_o = 1{,}600$ volts, a wavelength $\lambda = 20$ cm, and a modulation index α of 0.1.

The expression for the ratio i_p/I_o, or for the efficiency of the pth harmonic, reduces to

$$\frac{i_p}{I_o} = J_p\left\{p\,\frac{\alpha\,\omega\,s}{2v_{(to)}}\right\} \qquad (8)$$

if the current density is so small that the space charge effect can be neglected; compare equation (5).

Computations concerning the maximum possible efficiency lead to the following relations for the maximum efficiency of the pth harmonic i_{pm}/I_o, the distance of the locus of maximum efficiency from the grid s_m, and the electron traveling time to that locus t_{1m}, respectively:

$$\frac{i_{pm}}{I_o} = J_p\ 3.64p\ \frac{\alpha E_o^{\frac{1}{4}}}{I_o^{\frac{1}{2}}}$$

$$s_m = 6.1 \times 10^{-3}\ E_o^{\frac{3}{4}}/I_o^{\frac{1}{2}}$$

$$t_{1m} = \sqrt{2v_{(to)}/D}, \qquad (9)$$

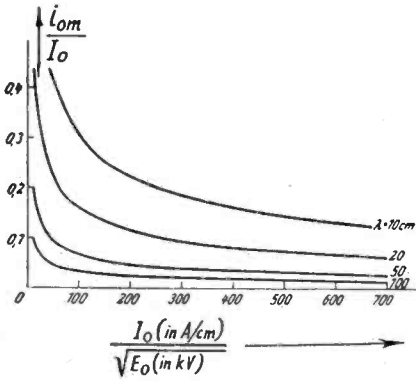


Fig. 3. Maximum efficiency of fundamental wave; modulating index is 0.1

(Continued on page 170)

Presenting

THE BENDIX TG-15 500 WATT TRANSMITTER

for operation

on

L.F. LOW FREQUENCY
200-540 Kilocycles

H.F. HIGH FREQUENCY
2-13 Megacycles

and

V.H.F. VERY HIGH FREQUENCY
108-132 Megacycles

A four-channel transmitter, capable of simultaneous operation on any two channels, the Bendix TG-15 transmitter is rated at a full 500 watts for continuous Commercial Service at any frequency in the L.F. and H.F. ranges and 300 watts C.C.S. in the V.H.F. range.

Ease of maintenance, flexibility and traditional Bendix reliability make this transmitter particularly suited for aeronautical services in this country and in foreign operations.

A bulletin describing the TG-15 transmitter is available. Write for your copy.

Bendix Radio DIVISION

BALTIMORE 4 (BENDIX RADIO REG U.S. PAT OFF) MARYLAND

PRODUCT OF BENDIX AVIATION CORPORATION

STANDARD FOR THE AVIATION INDUSTRY

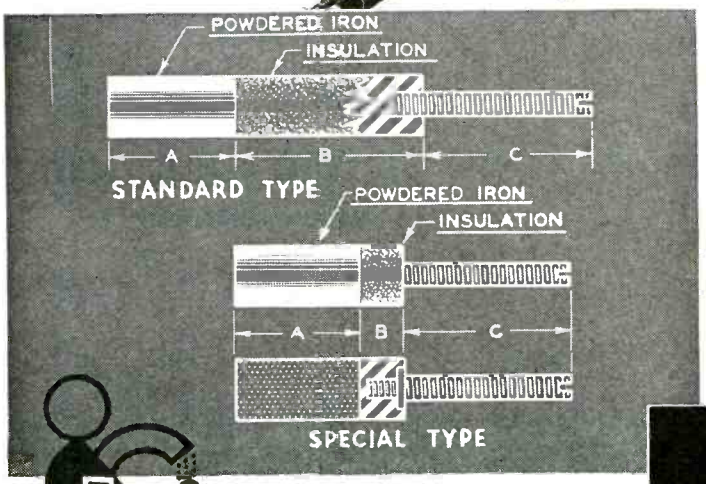
IRON CORES

Standard and High-Frequency Types

Long the acknowledged leader in Iron Core manufacture, Stackpole can supply practically any desired type from 100 cycles to 175 megacycles and even higher. Both the Stackpole Standard and High-Frequency types are produced in an almost infinite variety of shapes, sizes, and characteristics to match your needs *exactly*. Also available is a complete line of Stackpole High-Resistivity Cores in either insulated or non-insulated types, and showing a resistance of practical infinity.

Insulated Types

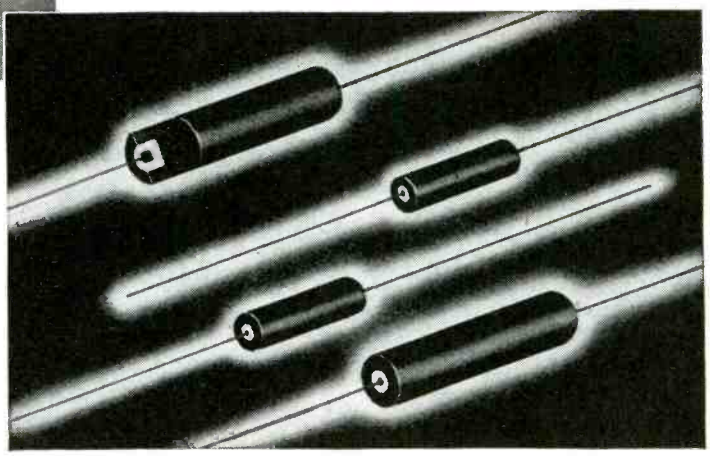
The screws in these integrally-constructed units are insulated from the iron cores. Thus, the screw is kept out of the coil field and "Q" is greatly increased. The distributed capacity of the coil is reduced and, in applications where the screw is not grounded, there is also a big reduction in hand capacity effect. Ask for Stackpole Engineering Bulletin No. 7.



Brushes—Contacts
Sintered Iron Components—Carbon
Regulator Discs—
Battery Carbons—
Fixed and Variable
Resistors—
Switches, etc., etc.

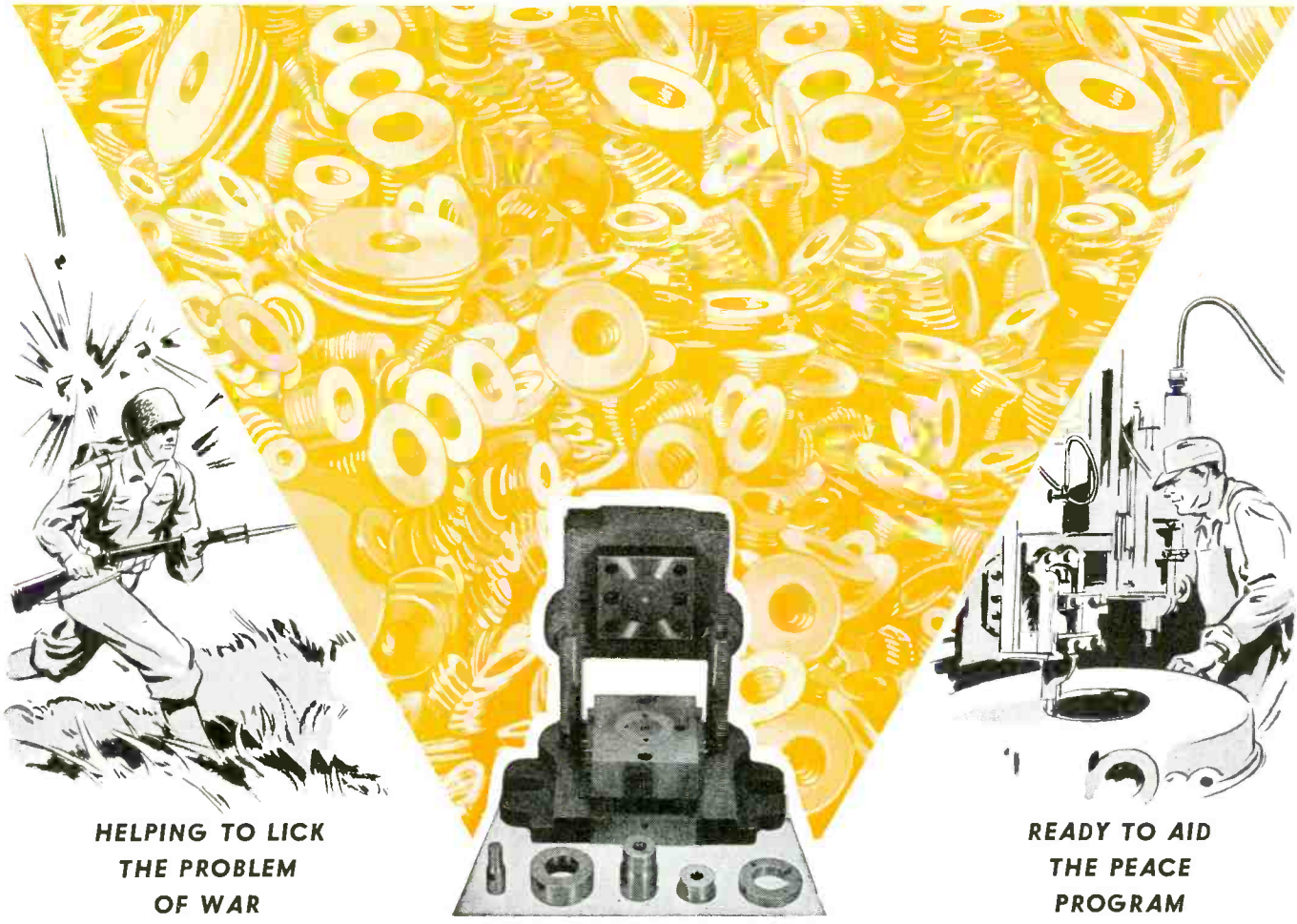
Iron Cores for CHOKE COILS

These popular Stackpole Cores are designed for use with audio chokes, "hash" chokes, r-f chokes, etc. Not only do they permit reductions in choke coil dimensions, but the iron materially increases the "Q". Insulated leads serve as coil connections and permit convenient point-to-point wiring.



STACKPOLE

STACKPOLE CARBON COMPANY, ST. MARYS, PA.



HELPING TO LICK THE PROBLEM OF WAR

READY TO AID THE PEACE PROGRAM

Made in 5 sizes:
¾"—1½"—2½"—4"—6".

HOVIS UNIVERSAL MASTER WASHER DIES

THE MASTER DIES DO NOT BECOME OBSOLETE

• The Hovis method of making washers has been widely adopted during the wartime program and its use will continue in increasing measure when peacetime production is resumed. Outstanding manufacturers recognize its great advantages in eliminating process engineering, tool-designing, tool-making and tool try-out, and the saving of time, storage space, material and labor.

Once having made a nominal initial investment in Master Washer Dies, which do not become obsolete, FIVE SMALL INTERCHANGEABLE PARTS are all that is necessary to purchase to make any size washer for your new product.

Ask today for illustrated, descriptive literature.

HOVIS SCREWLOCK COMPANY

8096 E. NINE-MILE ROAD Suburb of Detroit Phone: Centerline 1575 **VAN DYKE, MICHIGAN**

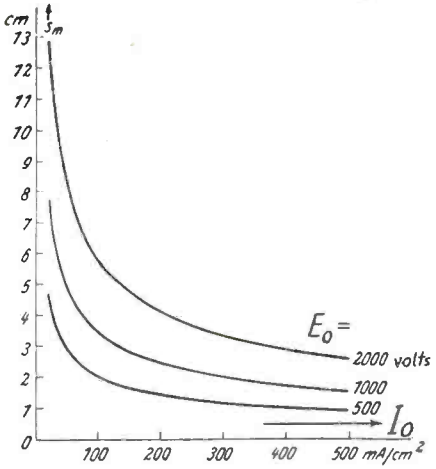
WIDE READING

(*Continued from page* 166)

Fig. 3 shows diagrams of the maximum efficiency of the fundamental wave as a function of $I_o/E_o^{\frac{1}{2}}$ for different wavelengths; the grid current intensity is in mA/cm² and the accelerating voltage in kV. The modulating index is 0.1. Fig. 4 gives the distance s_m of maximum current density variations from the grid as a function of the grid current I_o with the accelerating voltage E_o as parameter.

In practice the conditions are expected to be more favorable than indicated by the formulae, the neglected phenomena tending to improve the results.

Fig. 4. Distance from grid at which maximum current density variations occur



Intermittent Behavior in Oscillators

W. A. Edson (Bell System Technical Journal, January, 1945).

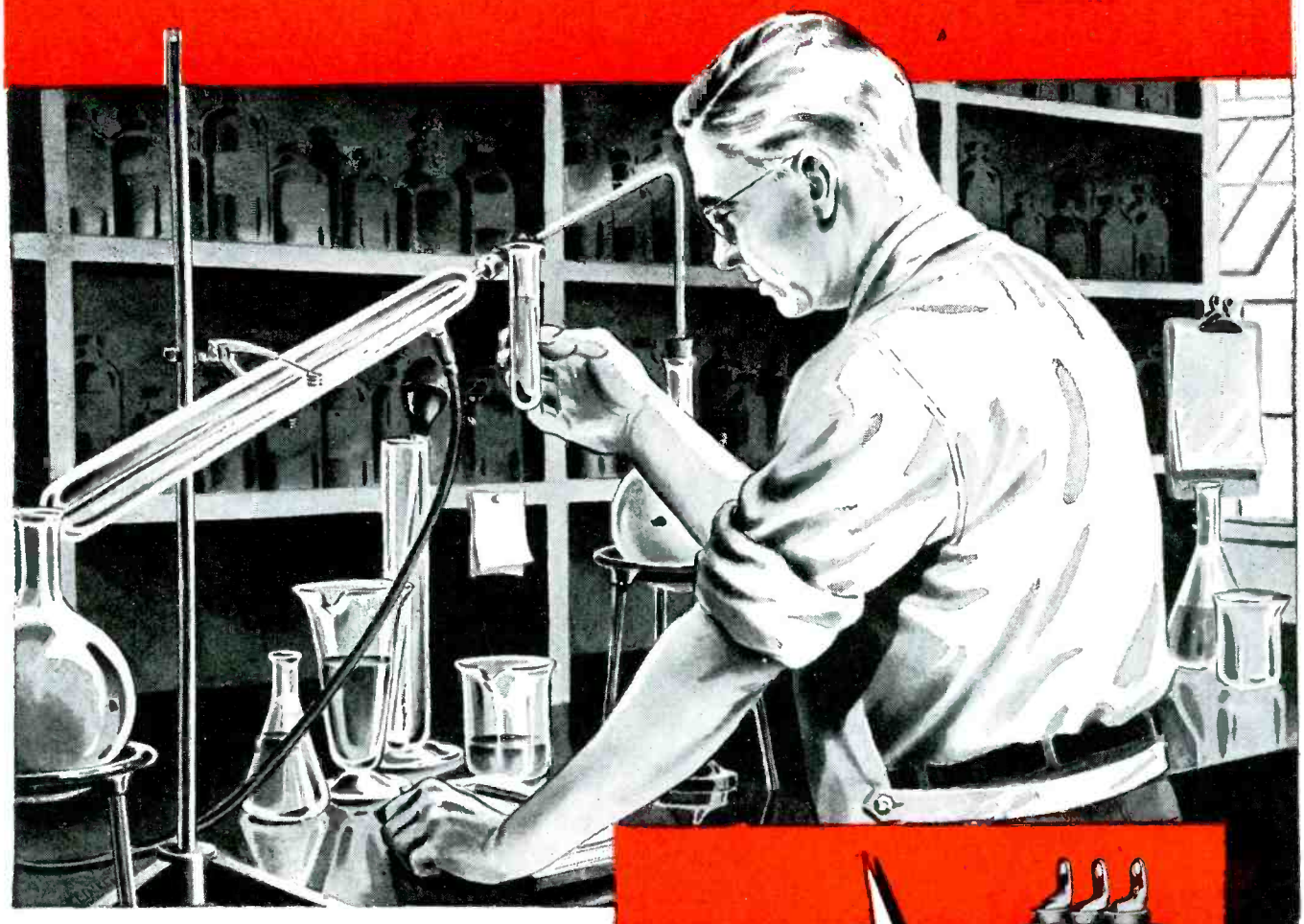
A method is developed of applying known feedback theory to analytically and experimentally investigate the tendency of a feedback oscillator to self-modulation or intermittent oscillations. The oscillator circuits studied consist essentially of an amplifier, a limiter and a filter. Circuit modifications promoting stability are determined. The intentional generation of a modulated wave by control of the low frequency behavior of the oscillator is also considered.

The method is illustrated by analyzing several circuits such as oscillators with separate automatic output control, involving a rectifier, a lamp circuit or varistors, and Hartley oscillators where the amplifier tube also serves as limiter.

(*Continued on page* 174)

chemical analysis

means better materials and manufacturing processes



What have test tubes to do with capacitors?

A great deal. Here in our laboratory, every process used in manufacturing Cornell-Dubilier capacitors comes under the patient, searching scrutiny of expert capacitor chemists.

The evidence must be positive. These specialists are meticulous people. They take nothing for granted. No detail is too insignificant, too commonplace to merit their closest attention.

They apply their research to practical purposes. Their tests and keen analysis insure better materials for making capacitors.

That is why more engineers specify C-D than any other make. If you have a capacitor problem, get the help of a specialist. Write to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey. Other plants: New Bedford, Brookline, Worcester, Mass., and Providence, R. I.

TYPICAL C-D ADVANCEMENT IN DESIGN IS THE TYPE YAT

a compact, low capacity Dykanol "G" bypass capacitor — hermetically sealed in specially-treated drawn metal container.

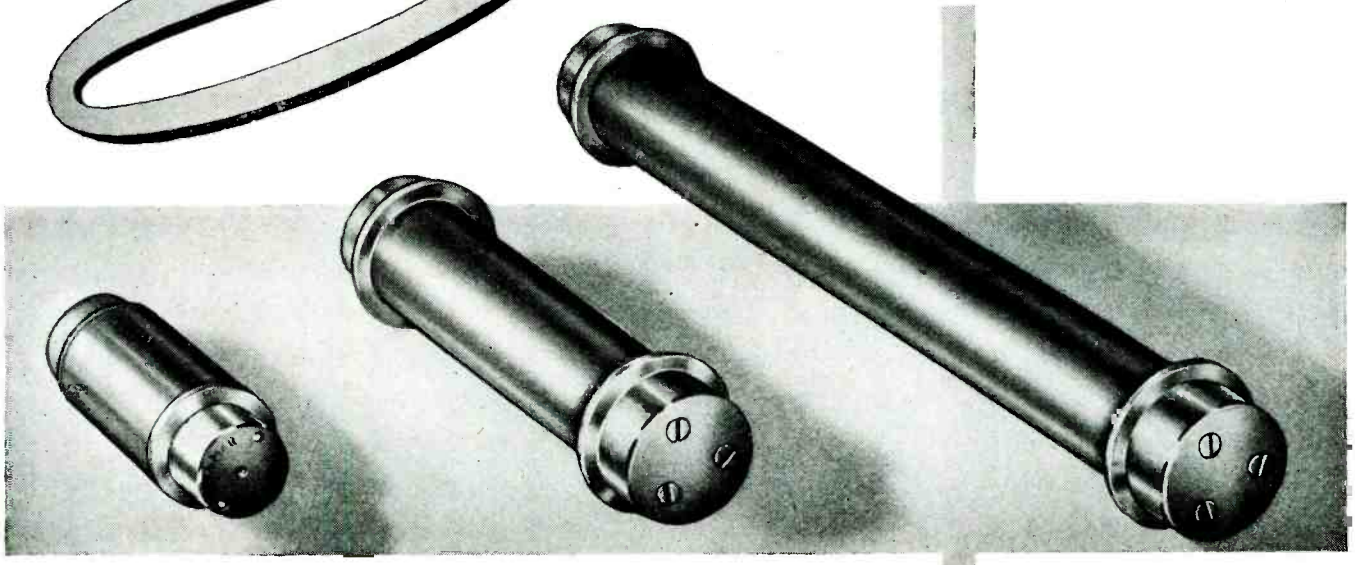
600V—.05 mfd. to 1 mfd.; at 100 V—.05 mfd. to .5 mfd.

CORNELL-DUBILIER CAPACITORS

1910 1945

WET AND DRY ELECTROLYTICS · MICA · DYKANOL · PAPER ·

ALL THE Stability THE NAME IMPLIES!



WESTON TUBULAR RESISTORS

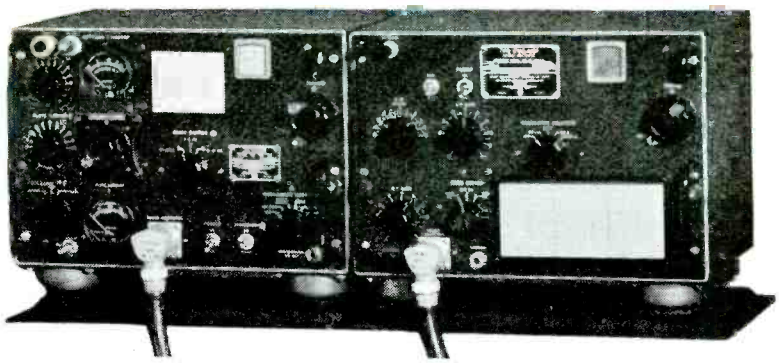
WESTON tubular resistors . . . widely used since their introduction over a decade ago . . . furnish another outstanding example of *sound engineering* coupled with *engineering foresight.* For no new 'hurried' resistor design was needed in order to meet exacting military specifications that called for protection against tropical humidity, arctic and high working temperatures, and salt air. The WESTON tubular resistor met these new specifications . . . and in a rugged, non-fragile design *tried and proved* throughout the years. These resistors conform to and are approved under joint Army Navy Spec. JAN-R-29. Bulletin A-12 gives complete specifications. Send for your copy . . . Weston Electrical Instrument Corp., 666 Frelinghuysen Ave., Newark 5, N. J.

Weston Instruments

ALBANY • ATLANTA • BOSTON • BUFFALO • 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.

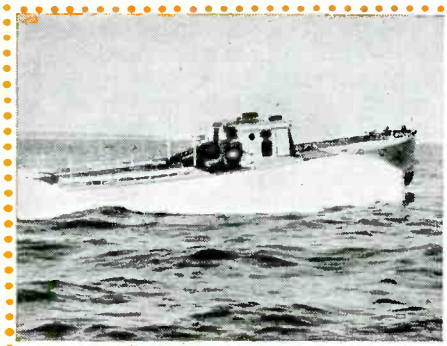
P-T BOAT*

Collins Radio Equipped

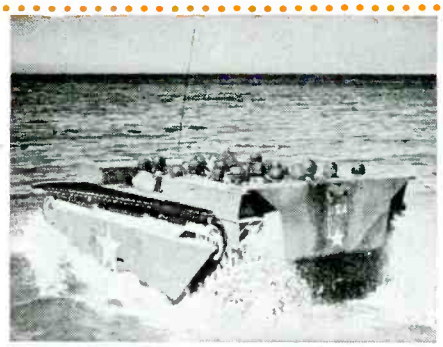


HERE ARE A FEW of many types of the Navy's small craft which maintain communication with this Collins designed TCS radio transmitter and receiver combination. This equipment is so sturdy, handy and reliable, and packs so much power and sensitivity into so little space, that it finds numerous Naval applications ashore as well as afloat. Usually the first radio installation on the beach-head, it is also standard on fire, rescue and crash trucks, and is often used on jeeps and command cars. The TCS is another example of the variety and quality of radio communication equipment Collins will be able to supply to industry after the war. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

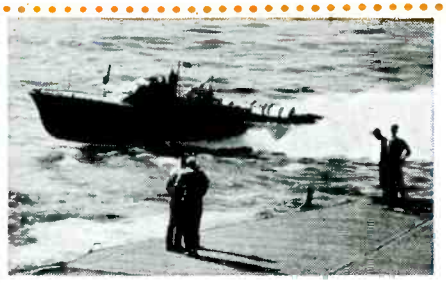
Official U. S. Navy Photo



BOMB TARGET BOAT*



LVT-4 LANDING VEHICLE TRACK*



AIRCRAFT RESCUE BOAT*

ARMY E NAVY

IN RADIO COMMUNICATIONS, IT'S . . .

COLLINS

WIDE READING

(*Continued from page* 170)

Theory of the Multivibrator

H. W. Webb and G. E. Becker (Journal of Applied Physics, December, 1944).

A graphical method has been developed to evaluate the period and the currents in a symmetrical multivibrator. The theory is checked against experimentally obtained values and found to be in good agreement.

COMMUNICATIONS SET

(*Continued from page* 93)

1 channel and the remainder of the spectrum from 3000 to 12,000 cycles for the other three channels.

The radio circuit can be satisfactorily operated over distances varying from a few miles to more than 50 miles depending upon the nature of the intervening terrain, the antenna heights and the noise level at the receiving location. The antenna has a gain of approximately 6 db with the reflector and director elements attached. If it is used as a two element array it has a gain of 2 db over the dipole alone.

In order to prevent interference from small spurious frequencies above and below the carrier frequency which occur at intervals equal to the crystal frequency, frequency interference charts are included in the instruction book to quickly show if a particular transmitting frequency will interfere with a particular receiving frequency.

Crystal equipment

Sixteen crystals are furnished with each transmitting and receiving set, eight in the 70 to 80 mc range and eight in the 90-100 mc range. In addition, each terminal set has a bank of 600 transmitting and 300 receiving crystals, providing 300 channels. To insure operating accuracy the transmitter contains a regulated crystal oven which maintains crystals well above ambient temperature.

The system of phase modulation used is of interest. It consists in coupling the output of the oscillator amplifier to the grid of a 6SL7GT. The plate circuit of this tube is untuned, but it is terminated in a high impedance rf choke. One triode section of this tube acts as a phase modulator. Radio frequency voltage is fed from grid to plate

(*Continued on page* 178)

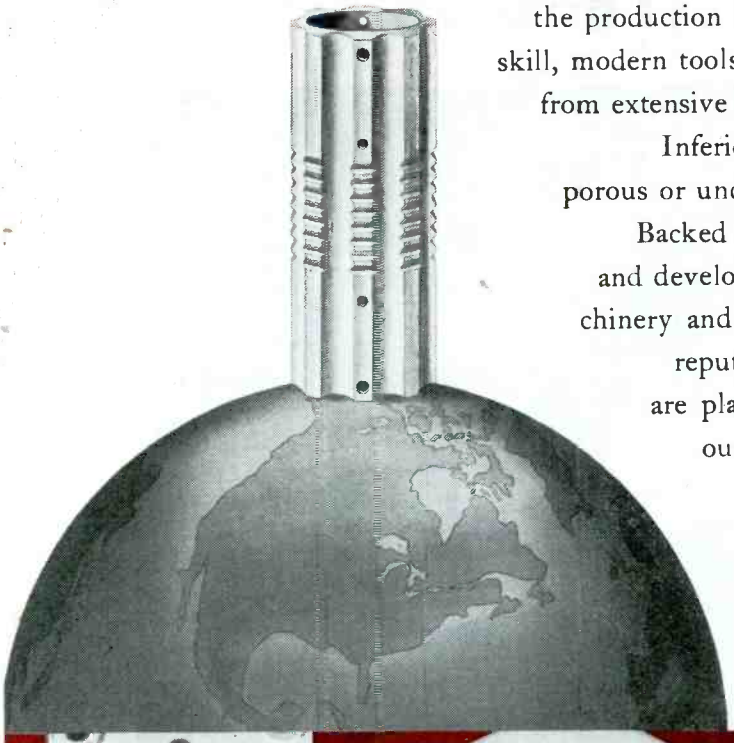
± OR + QUALITY

It's not wise to think that all Steatite Ceramic Insulators are equivalent in quality. From selection of materials through the processes of mixing, extrusion or stamping; on through the kiln to final inspection, the production of a high grade Steatite Insulator requires experience, skill, modern tools and machinery, plus the KNOWHOW that comes from extensive research and development.

Inferior Steatite Insulators may be produced. They may be porous or underkilned or overkilned.

Backed by 43 years of Ceramic Leadership, constant research and development, highly trained workers, the most modern machinery and production methods, ALSIMAG has fully earned its reputation as "Tops Among the Steatites". Whatever you are planning in the electrical or electronic field, we believe our specialized knowledge will be helpful.

Let's work together.



AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE
43RD YEAR OF CERAMIC LEADERSHIP

ALSIMAG
TRADE MARK REGISTERED U. S. PATENT OFFICE

CHARACTERISTICS OF ALSIMAG STEATITE INSULATORS

- Permanent Rigidity
- Cannot Char
- Resistant to Thermal Shock
- Resistant to High Temperatures
- High Mechanical Strength
- Low-Loss
- Does Not Absorb Moisture
- Chemically Inert

TOPS IN STEATITE CERAMICS

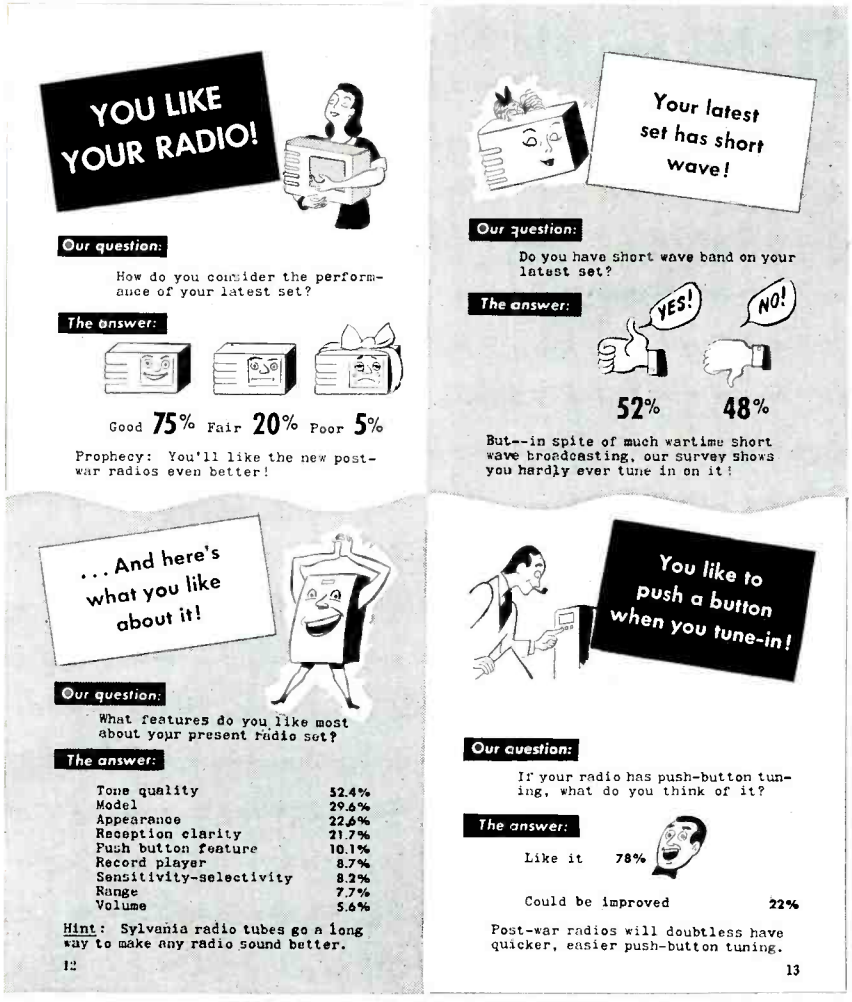
ALCO has been awarded for the fifth time the Army-Navy "E" Award for continued excellence in quantity and quality of essential war production.

SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

JUNE *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

SYLVANIA ISSUES NEW BOOKLET ON PUBLIC'S POST-WAR WANTS IN RADIO AND TELEVISION



Here is a typical two-page spread from the booklet "They Know What They Want," which summarizes the results of a nation-wide survey of public preferences in radio sets.

Summarizing the results of a recent nation-wide survey, a new booklet, "They Know What They Want," is now being widely distributed. This survey was conducted by one of America's leading market research organizations—at the request of Sylvania Electric's Sales Research Department.

CIRCULATION AMONG CONSUMERS

The booklet is being mailed to consumers in response to inquiries stimulated by questionnaire-type advertisements appearing in national magazines. Through these advertisements Sylvania Electric is continuing its study of public preferences in radio sets. Public distribution of the booklet is expected to be helpful in maintaining the popular interest in post-war radio sets which has been created by Sylvania's advertising.

VALUE TO INDUSTRY

In addition, "They Know What They Want" is being widely circulated among the electronic equipment manufacturing industry. Providing a convenient digest of the public's desires, the booklet should prove helpful to set manufacturers in planning post-war designs that will appeal to buyers' tastes.

Copies of the booklet are available on request to set manufacturers for distribution to their engineering departments and sales forces. A more complete and detailed presentation of the survey findings has also been prepared, and will be shown to interested manufacturers on request to the nearest Sylvania sales office.

COMMUNICATIONS SET

(*Continued from page* 174)

in two ways. One is direct grid to plate capacity and the other by the electronic amplification of the tube. Degeneration in the cathode circuit by means of a 14,000 ohm cathode resistor keeps the two voltages nearly equal and slightly less than 180 deg. out of phase. The magnitude of the electronically amplified voltage varies as the bias is varied by the audio input. The resultant is a current in the rf choke in the plate circuit which is varying in phase (and frequency). After modulation the frequency is multiplied 96 times by a frequency tripler, a frequency quadrupler and three frequency doublers.

In the receiver, the same heterodyning frequency is used for the two successive frequency conversions of the signal frequency. This heterodyning frequency may be determined by adding 5 mc to the signal frequency and dividing the sum by two.

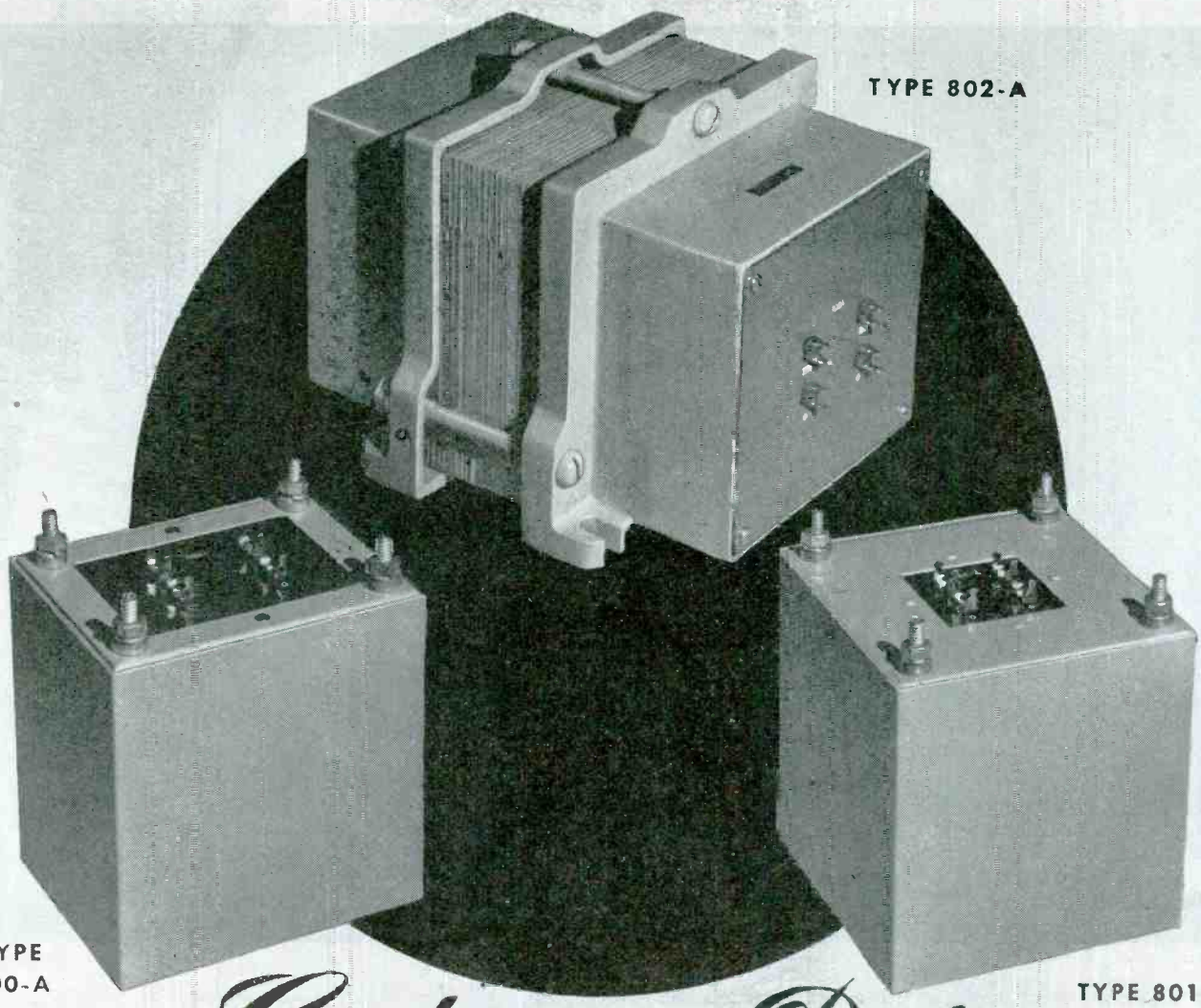
Cascade limiters

To obtain substantially perfect limiting, two limiters in cascade are used, and sufficient gain is incorporated in the receiver so that the smallest incoming signal, comparable with the noise generated in the grid circuit of the first tube, causes saturation of the second limiter.

After the 6H6 discriminator, the audio frequency is applied to one grid of a dual triode, 6SL7GT by a coupling capacitor. This grid is also connected to one contact of a carrier operated relay in such a manner that when no carrier is being received and the relay is not energized, the grid is shorted to ground and no audio signals are passed. This relay is in the plate circuit of and is energized by one half of V113 (6SN7GT), which in turn is controlled by the squelch amplifier V115 (6SL7GT) and a received signal. A portion of the rectified rf voltage on the first limiter grid is fed through a noise trap at diode V110 (6H6) and is applied to the grid of one half of V115 (6SL7GT), causing plate current cut off in that section. The grid of one half of V113 (6SN7GT) is connected to this plate and assumes the same potential of about 75 volts. The cathode of this half of the double triode is also held at a positive potential of about 75 volts.

This condition permits plate current to flow, energizing the relay and permitting the receiver to function. If there is only a weak signal, or no signal at all, insufficient rectified negative grid voltage

(*Continued on page* 182)



Continuous Duty
AUTO TRANSFORMERS

Continuous-duty Auto Transformers—These units incorporate heavy lugs on black bakelite terminal boards and are finished in standard baked gray enamel. Types 800 and 801 are manufactured with exclusive Hermi-lock case construction. They are also available in hermetically sealed units to strict Army-Navy specifications.

TYPE 800-A — primary 220 volts, 60 cycles; secondary 110 volts, 250 watts; 5AS case, length 4 5-16", width 3 13-16", height 5". Weight 10 lbs.

TYPE 801-A — primary 220 volts, 60 cycles; secondary 110 volts, 500 watts; 6AS case, length 5 1-16", width 4 15-16", height 5". Weight 16 lbs.

TYPE 802-A — primary 220 volts, 60 cycles; secondary 110 volts, 1000 watts; housed in #6 casting poured with humidity-proof compound, length 9¼", width 7¼", height 6¾". Weight 33 lbs.

SEND TODAY FOR COMPLETE LITERATURE ON OTHER TYPES OF LANGEVIN APPARATUS

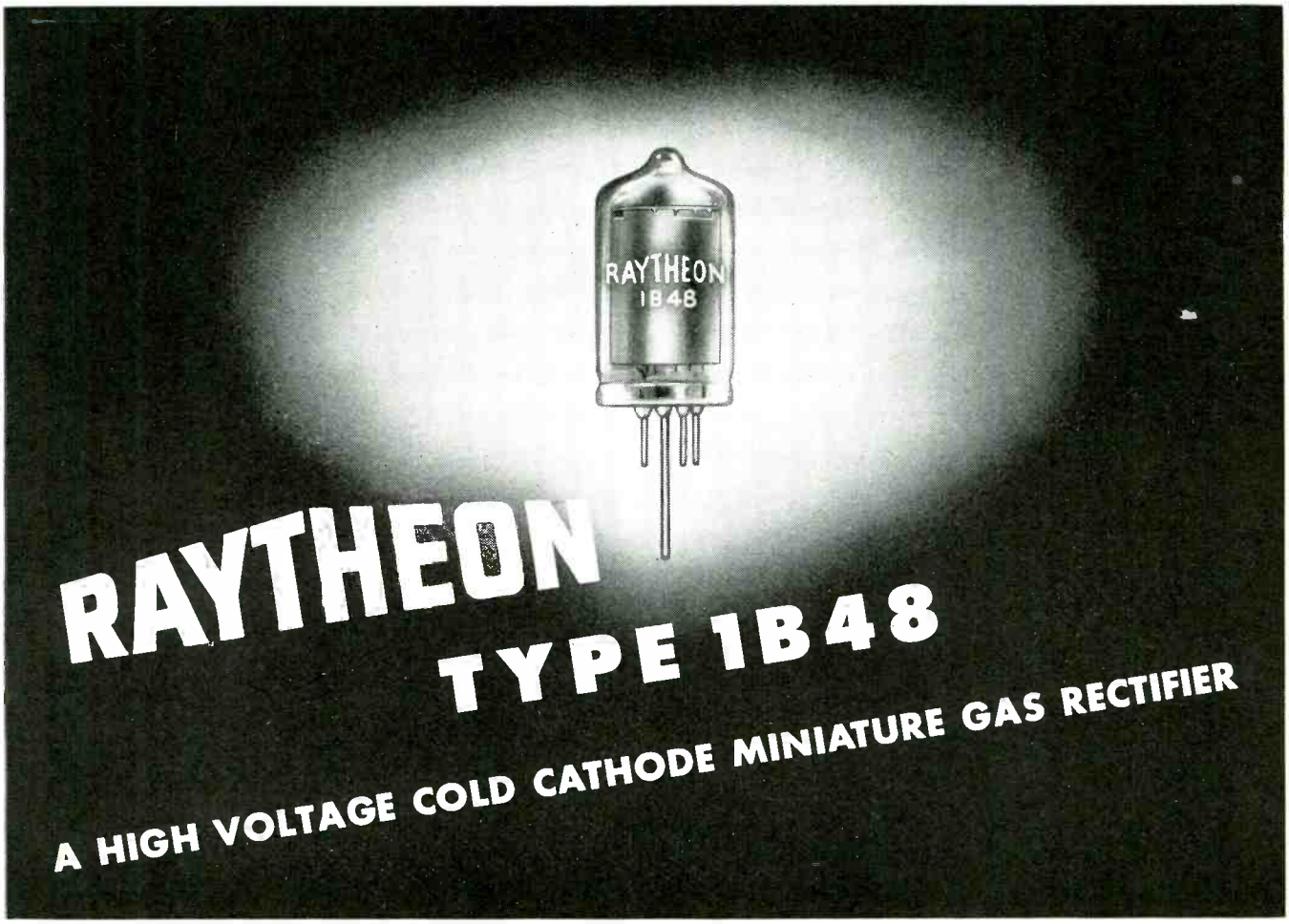
The Langevin Company
INCORPORATED

SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK
37 W. 65 St., 23

SAN FRANCISCO
1050 Howard St., 3

LOS ANGELES
1000 N. Seward St., 38



RAYTHEON TYPE 1B48

A HIGH VOLTAGE COLD CATHODE MINIATURE GAS RECTIFIER

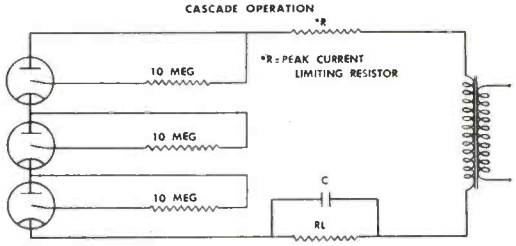
● There are many applications in which a high DC voltage, at a relatively low current, must be obtained in a minimum space and with maximum power efficiency.

If tubes necessitating a heater voltage supply are used, the space and weight requirements of a filament transformer insulated to withstand high potentials—and the additional power consumption—are often detrimental factors. Numerous oscilloscope applications are in this category.

Thus there is often a real need for a small modified miniature type cold cathode gas rectifier like the 1B48—which can easily deliver 1000 volts DC at 6 milliamperes average current. Furthermore, several tubes may be operated in series to obtain even higher voltages.

Shown below are the physical and electrical features of the 1B48. The schematic diagram indicates cascade operation in a half wave circuit. Full wave rectification may be accomplished in the conventional manner.

This Raytheon tube represents just one more entry in Raytheon's record of tube development . . . a continuing engineering program that is making possible still finer tubes for *your* postwar products.



SPECIFICATIONS OF 1B48

PHYSICAL:		
Maximum Over-all Length	2-1/4	inches
Maximum Seated Height	1-9/16	inches
Maximum Diameter	3/4	inches
ELECTRICAL:		
Maximum Peak Inverse Voltage	2700	volts
Maximum Peak Plate Current	50	ma
Average DC Voltage Drop at 6 ma	100	volts
Maximum DC Output Current	6	ma
Minimum Peak AC Starting Voltage	800	volts
Maximum Starter Anode Current	100	μa

RAYTHEON
MANUFACTURING COMPANY
RADIO RECEIVING TUBE DIVISION
Newton, Massachusetts • Los Angeles • New York • Chicago • Atlanta

Listen to
"MEET YOUR NAVY"
Every Saturday Night
AMERICAN BROADCASTING CO.
Coast to Coast
181 Stations

All Four Divisions
Have Been Awarded
Army-Navy "E"
With Stars

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONICS

Photo U. S. Signal Corps.

SPEAKER FOR THE HOUSE

WHEN a battery of "heavies" speaks, the enemy heeds . . . hurries out of range. And as the foe retreats, Spencer precision-made wire goes forward with our fighting men, to direct the inexorable battering of Axis defenses. Battle-tested Spencer steel and alloy wires, serving with distinction in war, will be insurance against wire failure in your peace-time product.

★ ★ ★ SPENCER *Precision* WIRE ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

FINE STEEL AND ALLOY WIRE

Spencer Wire Company
WEST BROOKFIELD PLANT
WEST BROOKFIELD • MASS.

COMMUNICATIONS SET

(*Continued from page* 178)

is generated in the first limiter grid to cause the plate current cut off mentioned above. Flow of plate current then causes the plate voltage of V115 (6SL7GT) to drop much nearer to ground making the grid of V113 (6SN7GT) negative with respect to its cathode, effectively cutting it off, deenergizing the relay, and making the set inoperative. This squelch point is adjustable. The other pair of contacts in the relay are used to turn the transmitter on or off automatically. (HGS)

RELAY NETWORK

(*Continued from page* 96)

der 1,200 cycles, and two facsimile channels, one from 1,200 to 12,500 and the other from 12,500 to 20,000 cycles.

In the present RCA system technical thinking is leaning to the use of hybrid phase and frequency modulation obtained by suitable pre-emphasis of the modulation currents in either a phase or frequency modulated terminal transmitter. This simplifies the technical problems, permitting the incorporation of amplitude limiting in the repeaters to overcome atmospheric noise and doing away with the need for pilot currents with automatic volume controls such as are needed in AM or single sideband systems. Here the high gain obtainable from secondary emission amplifier tubes becomes important by permitting the use of a small number of intertube coupling circuits. This is desirable as these coupling circuits are frequency selective and tend to introduce modulation wave form distortion.

Deviation ratio

A deviation ratio of one is being considered in connection with this system. That is to say, the ratio of maximum frequency deviation to the maximum signal frequency to be transmitted would be one instead of the more usual FM broadcast ratio of five. The necessity for this is apparent when it is considered that at relay points signals as received will be heterodyned to a lower frequency for amplification and then again brought up to the transmission frequency. With the wide band of almost 15 mc already required for picture transmission, a deviation ratio of 5 would result in a channel which would be too large

(*Continued on page* 187)

WHEN MAGNET WIRE Must take the RAP!

FORMEX* helps keep down rejects—lowers cost of completed windings.

Few operations put magnet wire to a tougher test than bench assembly of armatures and stators. And rough treatment is intensified by today's push for high production despite high labor turnover.

Because of its exceptionally tough and flexible insulating film, FORMEX magnet wire can take a lot more such abuse than conventional enameled wire. When coils are being wound, bonded, baked, formed, or handled, this extra toughness (and extra resistance to heat-shock and solvents) helps to reduce rejects without requiring "babying" techniques.

As the world's largest user of magnet wire, General Electric makes the same sort of comparisons of installed costs as you might make. These comparisons show that, even in those few cases where the cost of Formex may be slightly higher than the cost of conventional magnet wire which it replaced, the higher first cost is definitely offset by lower costs of manufacturing the completed coil or installed winding. In addition, the choice of Formex for *new designs* permits more compact windings, which, in turn, save space, copper, and frame materials.

Why not, right now, ask your G-E representative for complete information and samples of Formex wire. *General Electric Company, Schenectady 5, N. Y.*

Round wire sizes: No. 8 Awg to .001 in.
Rectangular wire: Full range of sizes

Buy all the BONDS you can—*and keep all you buy*

FORMEX MAGNET WIRE

*Trade-mark Reg. U.S. Pat. Off.

GENERAL ELECTRIC

503-22-1200

The untold story of "B-29" Long Range Bombing

LORD'S contribution to the remarkable success of "B-29" long range bombing is the Lord RS-40F Dynafocal Suspension. These assemblies harness over 8,000 horsepower from the four Wright Cyclone Engines powering the Army "B-29 Super Fortress". Essential to the operation of the "B-29", the RS-40F Dynafocal Assembly affords a resilient means of attaching the engine to the airframe, protecting the plane, precision instruments and other auxiliary equipment, as well as the crew, from the destructive and fatiguing forces of vibration.

Designed and developed by Lord, the RS-40F Dynafocal Assembly incorporates the combined use of rubber, steel and dural forgings, and compo bronze bearings, all integrated to effect an efficient, flexible suspension, to fulfill the rigid vibration-control and load-carrying requirements. Only six sub-assemblies (RS-40F-SA) are required to attach a Wright Cyclone Power Plant and Propeller to the airframe, thus meeting the aircrafters' challenge of weight saving.

Thousands of various Dynafocal Suspensions and other types of Lord Mountings are used in all American combat planes for vibration control and isolation on engines, instrument panels and countless instruments and auxiliary equipment.

The "know-how" developed in meeting the critical problems involved in safeguarding the lives of our combat fliers will result in greater refinements of resilient mountings for the aircraft and other industries, and for scientific applications in the future.

IT TAKES **BONDED RUBBER** *In Shear* TO ABSORB VIBRATION

Back the 7th War Loan Buy More Bonds

LORD MANUFACTURING COMPANY

ERIE, PENNSYLVANIA

SALES REPRESENTATIVES
NEW YORK - - 280 MADISON AVE.
CHICAGO - 520 N. MICHIGAN AVE.
DETROIT - - 7310 WOODWARD AVE.
BURBANK, CAL. - 245 E. OLIVE AVE.
CANADIAN REPRESENTATIVES
RAILWAY & POWER ENGINEERING CORP., LTD.
TORONTO, CANADA

Originators of Shear Type Bonded Rubber Mountings

A NEW MINIATURE TUBE—

THE RCA-OA2

Actual Size

New RCA Miniature Voltage-Regulator Tube Operates at 150 Volts—Is Practically Equivalent to Standard OD3/VR150

FOR the first time, equipment designers have available in a miniature envelope a voltage-regulator tube capable of performing the functions previously requiring a standard-size tube. This space-saving feature is especially valuable where compact military equipment is being designed. The OA2 will provide as many hours of service as standard-size tubes.

Like standard-size voltage-regulator tubes, the OA2 is a cold-cathode, glow-discharge tube. It is intended for use as a voltage regulator in applications where it is necessary to maintain a constant d-c output voltage across a load, independent of load-current and moderate line-voltage variations.

The OA2, like other voltage-regulator tubes, can also be used for spark-over protection.

For information on this and other RCA Electron Tubes, mail the coupon or write to RCA, Commercial Engineering Section, Dept. 62-32J, Harrison, N. J.

TECHNICAL DATA

Maximum Overall Length, Inches	2⅝
Maximum Seated Height, Inches	2⅜
Maximum Diameter, Inches	¾
Bulb	T-5½
Base—Miniature Button, 7-Pin	Mounting Position—Any
D-C Anode Supply Voltage, Minimum, Volts*	185
D-C Operating Current	
Continuous Maximum, Milliamperes	30
Continuous Minimum, Milliamperes	5
Ambient Temperature Range, Degrees C	−55 to +90
D-C Starting Voltage, Approx. Volts	155
D-C Operating Voltage, Approx. Volts	150
Regulation (5 to 30 Milliamperes), Volts	2

*Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

The Fountainhead of Modern Tube Development is RCA

MAIL THIS TODAY FOR FREE DATA SHEET

RCA, Commercial Engineering Section, Dept. 62-32J, Harrison, New Jersey.

Please send data sheet on RCA's new miniature voltage-regulator tube, the OA2, giving ratings, operating and installation notes, terminal connections, and typical circuits.

Name .....

Position .....

Company .....

Address .....

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

62-6136-32

BUY BONDS

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

RELAY NETWORK

(*Continued from page 182*)

a proportion of the amplification frequency to permit easy handling.

Large deviation ratios, of course, have a noise suppressing effect, but even a ratio of unity produces better results in this respect than AM as is shown in Figs. 3 and 4 (2).

Signal/noise ratio

Based on a brightness range of 20 to 1 in the picture to be transmitted and other considerations, a signal to noise ratio of about 50 db seems desirable. Assuming that equipment noise power in the input of each repeater is $20 \times 10^{-20} \times$ (bandwidth) watts, cascading of the repeaters multiplies this noise power by the number in cascade, and application of the 50 db ratio mentioned above permits a calculation of signal reception power required at each repeater, as shown in Table 1.(1) If the transmitted to received power ratio using short, capacitance loaded dipole antennas is $70\ L^2$, where L is the distance between repeaters expressed in wavelengths, repeater power requirements are quickly obtained.

Table I
2,000-Megacycle Television Radio-Relay System

Repeater Spacing in Miles	Repeater Gain in Decibels	Repeater Power in Watts	Antenna Height in Feet
10	53	2.41	59.8
15	56.6	3.62	87.1
20	59.2	4.825	119.4
25	61	6.03	157.1
30	62.6	7.25	200.9
35	64	8.45	250.9
40	65	9.65	306.6
45	66.2	10.9	368.8
50	67	12.1	437.5
55	67.9	13.3	513.8
60	68.6	14.5	595.2
65	69.4	15.7	681.8
70	70	16.9	778.3
75	70.6	18.1	877.5

Antenna gain

Besides, by the use of highly directional parabolic reflectors, an important additional ratio gain can be obtained. For the condition where the radiating dipole is placed in the plane of the mouth of the paraboloid (the ideal condition as it prevents the reflecting surface from receiving out of phase radiations from the front of the dipole and at the same time collects all the rearward radiation) the gain (3) can be expressed by $\left(\frac{\pi D}{2\lambda}\right)^2$ where D is the mouth diameter and λ the wave length. This gain is effective at both the transmission and reception points. If the radiating dipole's forward radiation is concentrated back on the reflector by means of a hemispherical shield instead of being allowed to scatter,

(*Continued on page 190*)

SIMPLE— ISN'T IT?

— yet, sealed for all time!

MARION

Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

A One-piece drawn steel cup-shaped case with high frequency induction soldered Kovar glass bead terminals. Black phosphate finished to meet 200 hour salt spray test.

B Marion Alnico magnet and moving system, with hardened beryllium copper instrument frame.

C Lithographed metal scale plate, individually printed.

D Double thickness glass window with Corning Glass Works metallized band on rim — high frequency induction soldered to steel case.

E Aluminum cover plate and flange, with anodic black satin finish.

"How is it done?" — this is the question on the tongues of hundreds of engineers from coast-to-coast. A simple basic design in conjunction with electronic production methods is the answer. And with it comes the final solution to the problem of completely tropicalizing electrical indicating instruments. There are no rubber gaskets and no cement seals. These instruments can be immersed in boiling brine or frozen in a cake of ice, for weeks, without deterioration of their seals or harm to their operating efficiency. And they are *positively* interchangeable: Type HM 2 with AWS Types MR 24 and 25 and Type HM 3 with AWS Types MR 34 and 35. Available in all DC ranges, for present or postwar applications. Write for additional information.

***SPECIAL NOTE:** Marion Glass-to-Metal Truly Hermetically Sealed Instruments cost no more than standard unsealed instruments.*

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

RELAY NETWORK

(*Continued from page* 186)

the above gain is doubled. Whether these large gains can be entirely realized in practice will be determined by further experimental evidence.

Production of high frequency oscillations of sufficient power for the repeater requirements mentioned has been developed to a considerable extent during the war. Pulses of thousands of kw are in common use in radar equipment, but of course the duty cycle involved is a small proportion of any time period, and as with all electrical equipment, the average power output of a magnetron, Klystron or lighthouse tube used to generate this power is limited by its ability to dissipate heat.

Modulation problems

Modulation problems existing as they do similarly at lower frequencies are conveniently soluble by established technics. Of course wave guides must be used extensively when several thousand megacycles are involved. Power measurements can be made by means of power absorbing thermisters, and the power level can be suitably controlled by linear attenuators made of dielectrics coated with resistive materials and mechanically movable into the denser field regions inside the wave guides. Radiation at high efficiency is available by means of horns at frequencies beyond those for which parabolic reflectors with dipoles are suitable.

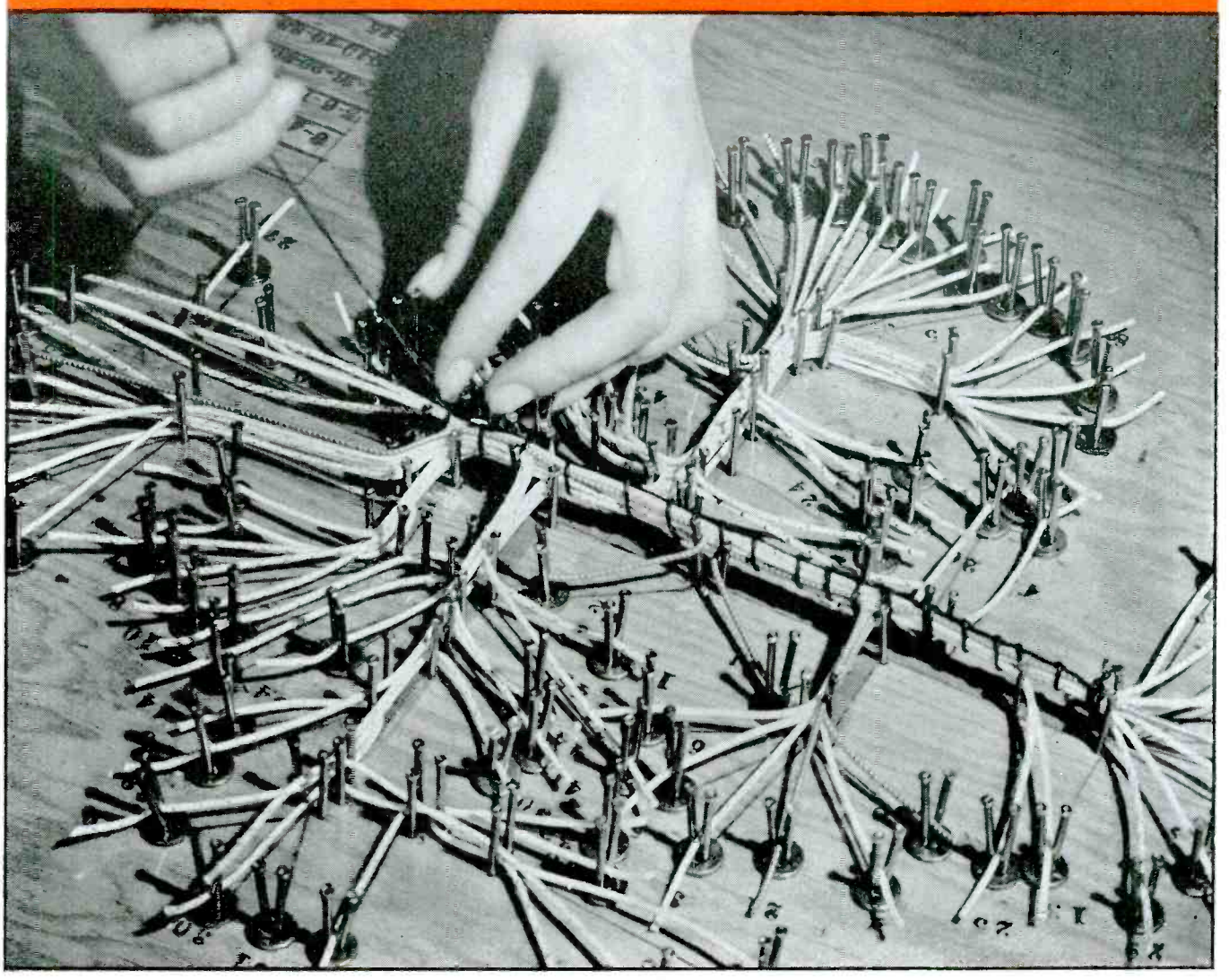
As for reception at these super high frequencies, cascade Klystron amplifiers are available to develop the weak received signals. In these tubes several resonant cavities are placed end to end, and the rf produced in the electron stream by the first buncher grid is applied to the second buncher grid, so that the final catcher operates at considerable amplitudes. By this means the effect of several amplifier stages is produced in one tube without any external circuits.

Terminal equipment

In connection with its wire as well as radio circuits, the AT&T has been using for several years a standardized style of multiplexing terminal equipment known as the type K equipment. This scheme provides 12 communications channels operating at frequencies from 12 to 60 kc. Separation, first of groups and then of individual channels is accomplished by means of crystal filters. This company recently revealed that it was using crystal filters in transmitting 480 messages over single circuits. Some-

(*Continued on page* 194)

. . . TRAINED HANDS assure PERFECT WORK



Let WHITAKER produce your wiring assemblies!

A lower cost of manufacturing is one of many important advantages Whitaker offers you on Cables, Wiring Harnesses and Assemblies you may require to produce finished products . . . We are wiring *specialists,* and the trained hands of our skilled workers assure perfect work.

You can avoid grief, and save time and money through our specialized service. You have everything to gain by utilizing the full benefits of our 25 years of experience, our ample engineering and production facilities, trained manpower, exacting inspections, and the economies resulting from our use of modern methods, and special equipment.

Whitaker Can Wire It

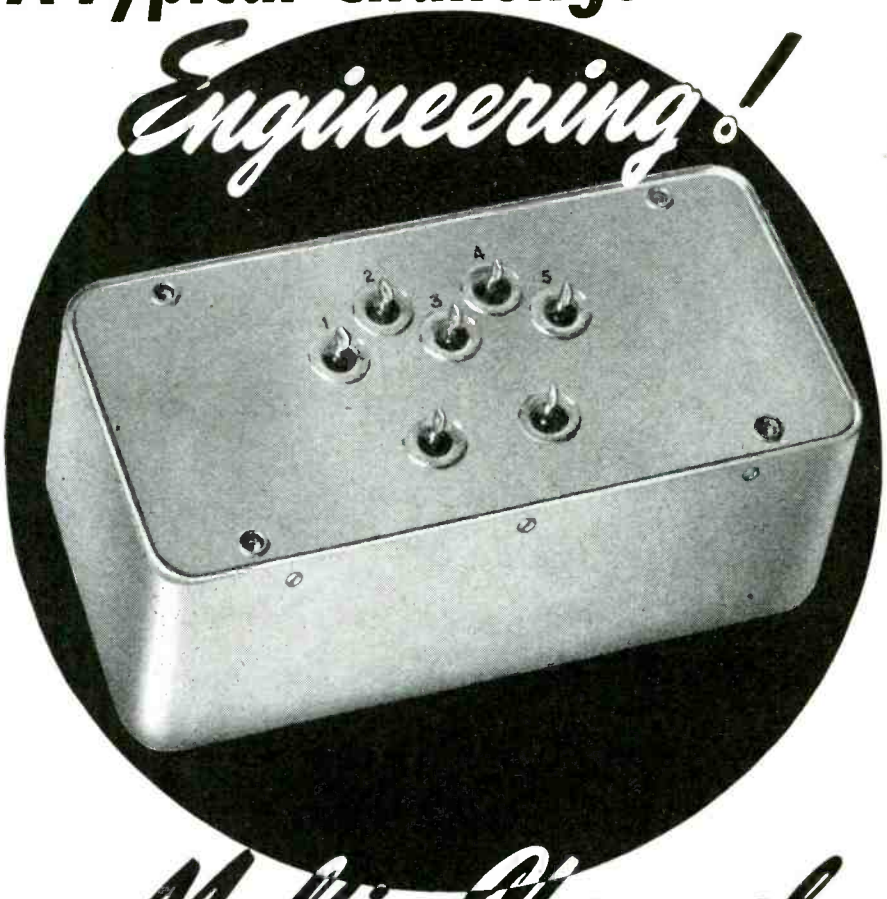
In addition to an engineered wiring service, Whitaker also offers a quality line of standard cable products.

We cordially invite you to write us.

WHITAKER CABLE CORPORATION

General Offices: 1311 Burlington Avenue, Kansas City 16, Missouri
Factories: Kansas City, Mo. • St. Joseph, Mo. • Philadelphia • Oakland

A Typical Challenge to ADC Engineering!



Multi-Channel

NARROW BANDPASS FILTER UNITS

● Like many of the problems brought to the Audio Development Company, this one involved a definite performance improvement with reductions in size and weight.

From an originally specified maximum weight of 40 oz. for potted one-channel interstage filters, the weight of this ADC five-channel unit was reduced to less than 10 oz. per section, hermetically sealed. Volume was reduced by over 50%.

Electrical performance was improved to provide a midband gain of 14±1½ db when the original specifications permitted a loss from 0 to 6 db. In addition, attenuation characteristics were improved to provide approximately 25 db discrimination at 1/3 octave with bandpass ±1½ db over ±3% of mid-frequency.

These filters are available in single or multi-channel units for frequencies from 200 cps to supersonic and carrier range. Frequencies lower than 200 cps are available with some size increase. Units can also be supplied in combination with high or low pass filters to permit tone channeling on voice circuits, thus allowing several remote control functions to be superimposed on a single voice circuit without interfering in any way with regular service.

We are ready to help with your filter and transformer requirements. Why not consult with us on your specific problem?

ADC

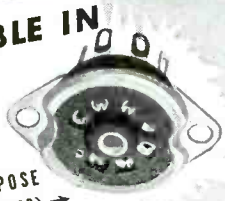
Audio Development Co.

2833 13th Ave. S., Minneapolis 7, Minn.

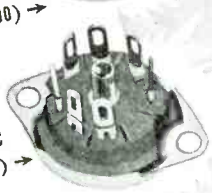
EBY

SADDLE TYPE MINIATURE TUBE SOCKETS

AVAILABLE IN



GENERAL PURPOSE PHENOLIC (EBY #8100) →



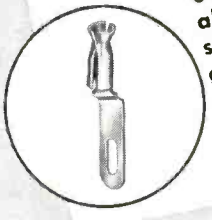
LOW LOSS PHENOLIC (EBY #8082) →

STEATITE (EBY #8083) →

The castings and beryllium copper contacts are identical with JAN S-28 Types SO 10M and SO 10C except that the shield base is replaced with a saddle. These EBY sockets meet the need for quality replacement of sockets of the saddle type. Write today for prices and samples.

LONG LIFE CONTACTS

The self-aligning beryllium copper contacts have been especially designed and Micro-processed to assure constant, even pressure on all parts of the socket pin without fatigue in contacts after continuous use.



IF IT'S IN A CIRCUIT . . . EBY COMPONENTS AND SERVICES WILL HELP YOU DO IT BETTER

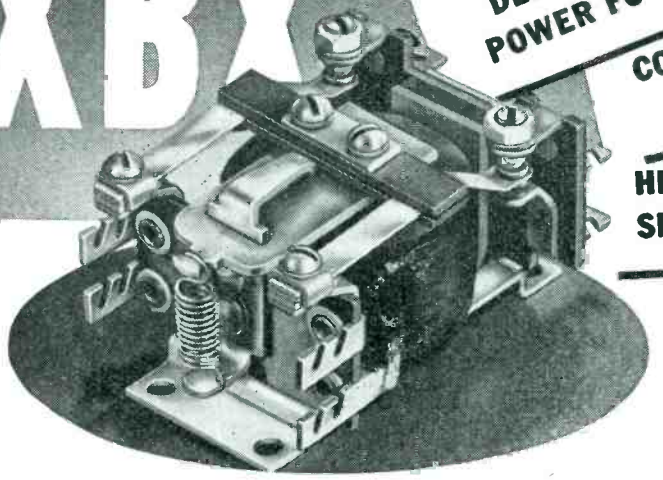
HUGH H. EBY INCORPORATED 18 W. CHELTEN AVE. PHILADELPHIA, PA.

10XBX

DELIVERS A LOT OF POWER FOR ITS SIZE

COVERS A WIDE RANGE OF APPLICATIONS

HIGHLY RESISTANT TO SHOCK AND VIBRATION



. . . A GOOD RELAY TO KNOW!

If any Relay type ever deserved the name "All-Purpose" it is Type 10XBX of the Struthers-Dunn 10-frame series. While new and special types come and go, this popular 2P. D.T. relay continues in heavy favor with leading users to whom its extreme versatility on a wide range of applications holds strong appeal. From audio frequency circuits to motor control circuits; from naval battle announcing stations where shock resistance is important, to aircraft use where vibration is a big factor, 10XBX relays are performing competently and well.

These relays are light, small, and sturdy. Highly electrically efficient, they deliver a lot of power for their size. Contact pressures up to 50 grams are available. Bakelite insulation is supplied for power circuit applications, and ceramic insulation for radio-frequency use. A-C coils to 115v, 60 cycles; or d-c coils to 115v are available. Contacts may be in any desired combination up to and including 3 pole, double throw. All 10XBX relays withstand 10G vibration and are highly resistant to shock. Other relays of the 10-frame series are available in either single or three pole contact arrangements.

STRUTHERS-DUNN, Inc., 1321 ARCH ST., PHILADELPHIA 7, PA.

WRITE *for the big Struthers-Dunn 48-page Catalog and Relay Engineering Data Book.*

STRUTHERS-DUNN

5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: 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 • WASHINGTON

RELAY NETWORK

(*Continued from page* 190)

what similar schemes can be used in the radio relay systems with suitable modifications for operation by means of FM.

Thus the apparatus problems in the shf region do not seem to present any insuperable difficulties although they do involve a number of war developed technics not generally known to the public.

---

*See description of Army radio relay set in this issue.

1. Radio relay systems—C. W. Hansell, proc. I.R.E., March, 1945.
2. Frequency modulation noise characteristics—Murray G. Crosby, proc. I.R.E., April, 1937.
3. Reflecteurs et lignes de transmission pour ondes ultra courtes—Renée Darbord-L'Onde Electrique, Vol. 11, 1932.

NEW PATENTS

(*Continued from page* 116)

a continuation of the non-conducting shield 64, their rims abutting against one another.

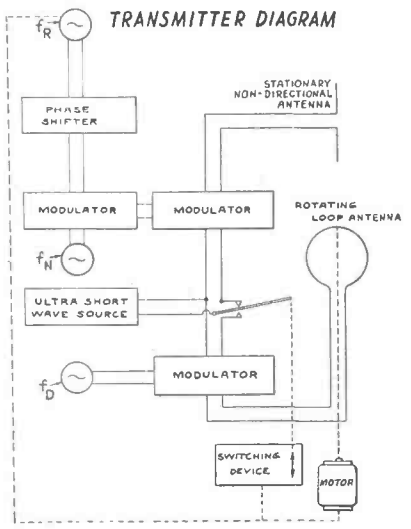
If the surface 2 is of metal it acts as an extension of the cone shaped antenna element 60 and has the effect of lowering the frequency band over which the antenna operates.

A. G. Kandolan, Federal Telephone and Radio Corp., (F) May 15, 1943, (I) February 6, 1945, No. 2,368,663.

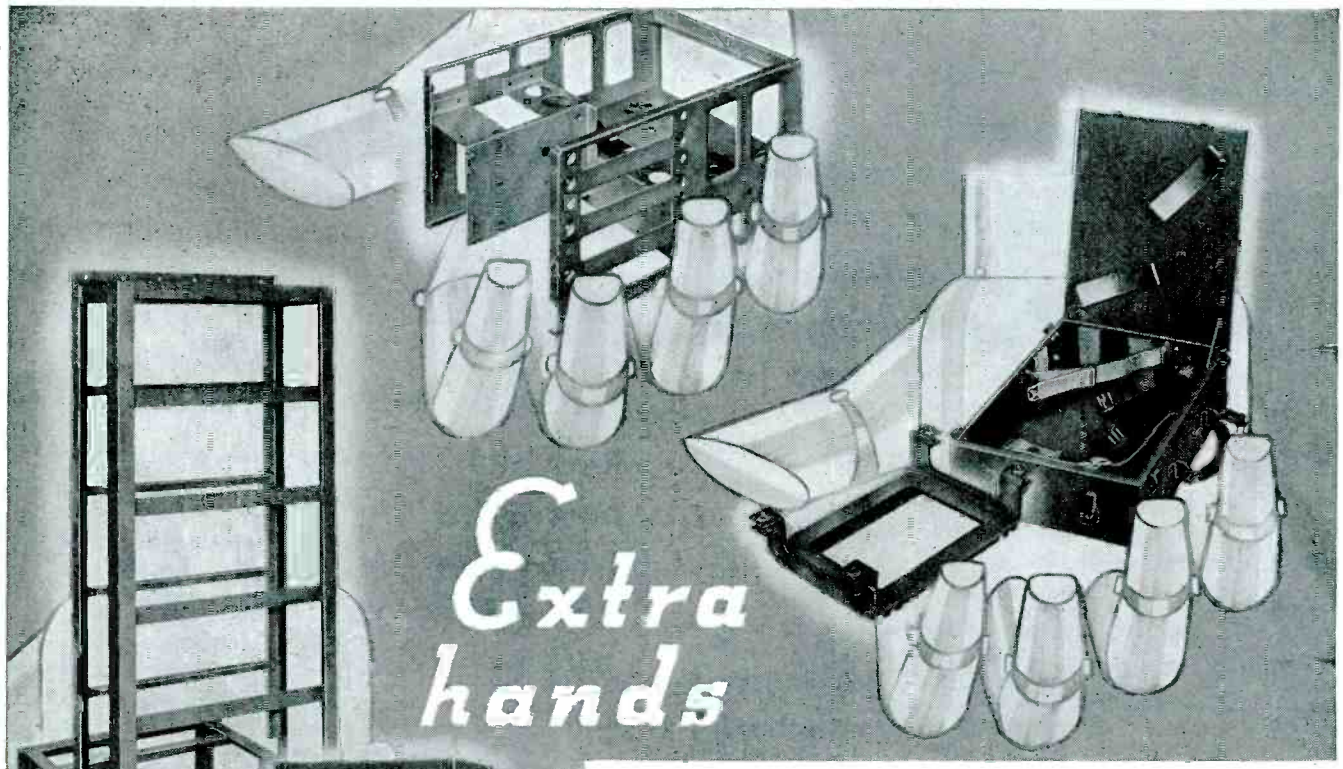
Radio Beacon

Only one transmitter and one receiver are required to produce and receive, respectively, directional and non-directional radiations the phase of which is compared and used for orientation.

Two radiations of identical carrier frequency are emitted alternately by the stationary non-directional antenna and by the rotating loop antenna. In order to separate these patterns at the receiver, the transmitter when emitting the directional pattern is modulated with a frequency f_D (for instance 4000 cycles per second) and when emitting the non-directional pattern is modulated with a frequency f_N (for instance 5000 cycles per second) and which is in turn modulated with the frequency f_R (for instance 50 cycles per second) at which the directional antenna is rotated.



(*Continued on page* 199)



KARP facilities and men, skillful in engineering and fabricating metal parts and products of simple or complex design, are your *extra hands*. In *design*, our engineering department has helped solve the knottiest of problems. In *production* and *deliveries*, our facilities have been praised for maintaining and beating standards and schedules. In *cost*, KARP extensive stocks of dies have saved thousands of dollars for customers.

ANY QUANTITIES — ANY METAL — ANY SIZE — ANY FINISH

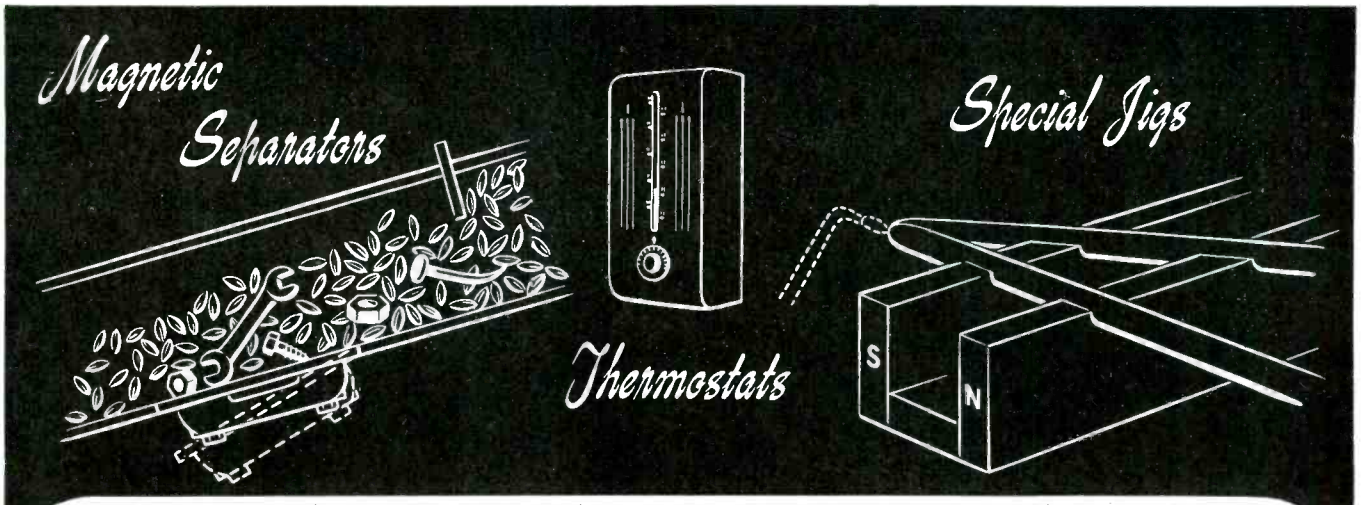
ARTISANS IN SHEET METAL

KARP METAL PRODUCTS CO., INC.

126 30th STREET • BROOKLYN 32, N. Y.

CABINETS
CHASSIS
RACKS
PANELS

KEEP BACKING THE ATTACK . . . BUY MORE WAR BONDS



(This is the third in a series of four advertisements discussing the major functions of permanent magnets)

TRACTIVE EFFORT from PERMANENT MAGNETS

The power to attract magnetic materials led to the discovery of the lodestone—the earliest known form of permanent magnet. The same force has served mankind, since antiquity, in the compass. This tractive effort is now employed industrially in three ways.

1. *For holding and lifting magnetic materials.* Magnetic materials are held in place for assembly or other operations, by means of magnetic chucks or jigs. Magnetic separators extract tramp iron or other magnetic substances from non-magnetic materials. They function in such devices as coin selectors in vending machines.

2. *To produce tension*—replacing mechanical springs in various applications where tension in another form is required. This principle is used on thermostats, pressure controls, switches, and similar devices.

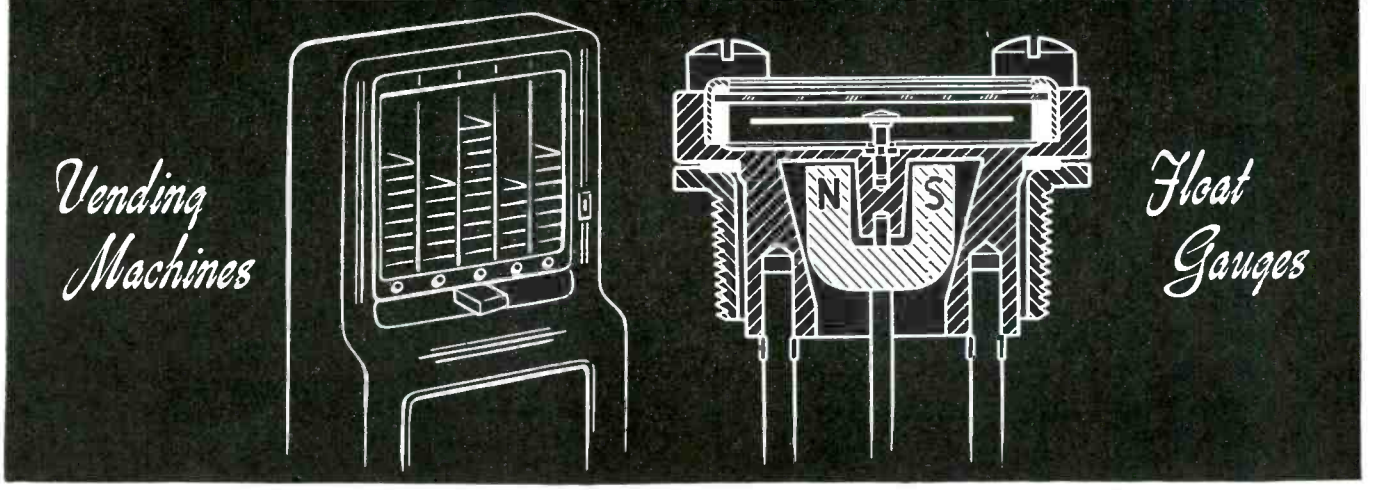
3. *To transmit motion without mechanical connections.* Permanent magnets can reproduce motion from one part to another through a seal—as in the flow meter and other packingless drives.

Indiana Steel is the largest exclusive manufacturer of permanent magnets, established for over 35 years. Without obligation, our engineers will be pleased to consult with you on any of your problems involving their possible application. Write for copy of technical booklet: "Permanent Magnets Have Four Major Jobs."

THE INDIANA STEEL PRODUCTS COMPANY

6 NORTH MICHIGAN AVENUE • CHICAGO 2, ILLINOIS

Specialists in Permanent Magnets Since 1910



NEW PATENTS

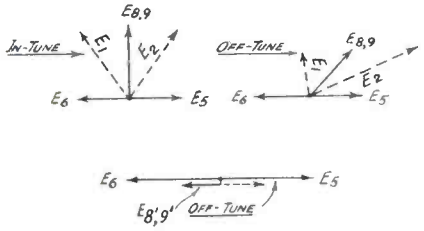
(*Continued from page* 194)

At the receiver, the two frequencies f_D and f_N are separated by filters, rectified and the two resulting waves of frequency f_R compared as to their relative phase; their phase difference is used as an indication of the direction from which the signals have arrived. It is proposed to have two generators of frequency f_R controlled by the two incoming waves so that continuous instead of intermittent waves may be obtained.

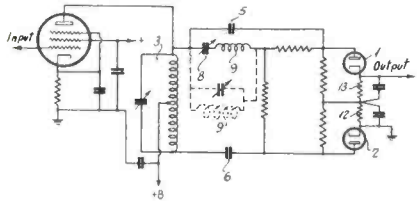
E. Mueller, Alien Property Custodian, (F) October 10, 1941, (I) January 30, 1945, No. 2,368,318.

Discriminator

A pair of opposed rectifiers 1,2 is fed by a discriminator which consists of a resonant circuit path 8,9 for feeding both rectifiers in parallel with retarded signal energy, and additional paths 5,6 for feeding the rectifiers with unretarded signal energy of opposite polarity. The amount of retardation is a function of frequency.

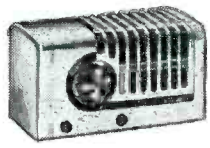


The series resonant circuit 8,9 is tuned to the mean frequency of the applied signal. At the mean frequency, the phase of the voltage $E_{8,9}$, which is fed to both rectifiers through the series resonant path 8,9, will not be changed by its passage through series resonant circuit 8,9. The voltages taken off the ends of coil 3 will be of opposite polarity and they will be shifted in phase by 90 deg. by capacitors 5 and 6, respectively. (See left-hand vector diagram.) The resultant voltages E_1 and E_2 applied to diodes 1 and 2 will be of equal amplitude, as shown in the diagram. Zero output voltage will be obtained across resistors 12 and 13. The phase of the voltages E_5, E_6 will not be changed for off-tune frequencies, however, the circuit 8,9 shifts the phase of the signal voltage to an increasing degree for frequencies departing from the mean frequency. Consequently, the conditions as illustrated by the right-hand vector diagram prevail, and, the two voltages E_1, E_2 across the diodes 1,2 being of different magnitude, an output depending on the instantaneous frequency deviation of the input will be obtained.

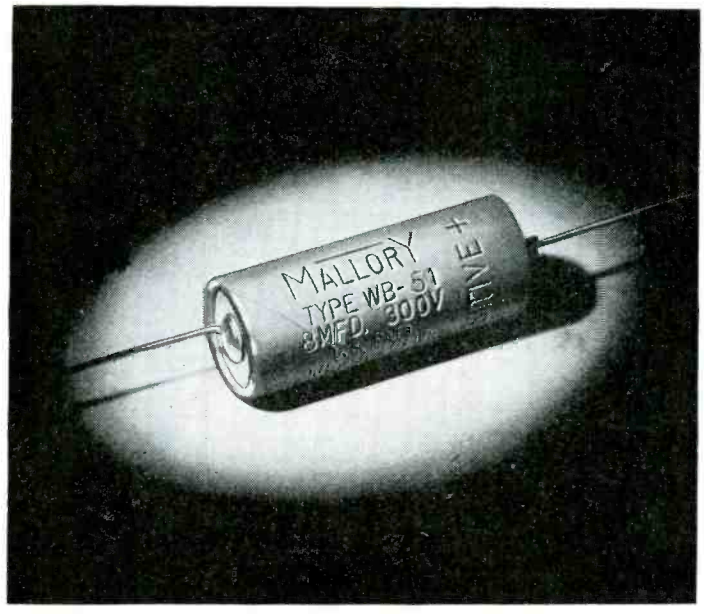


In another embodiment of the invention, indicated by the dotted line circuit elements, the series resonant circuit is replaced by a parallel resonant circuit 8', 9' which acts as an infinite impedance at the mean frequency. At off-tune frequencies, the parallel resonant circuit will act as an inductance or capacitance of decreasing impedance as the frequency deviation increases; the vector $E_{8',9'}$, will vary in amplitude and will be in aiding phase with either of vectors E_5 or E_6. The corresponding vector diagram indicates that a similar amplitude-frequency conversion as

(*Continued on page* 202)



Save Chassis Space with
MALLORY "WB" CAPACITORS



WHEREVER chassis space has to be figured in fractions of an inch . . . in small AC/DC receivers, for instance . . . you'll be wise to specify Mallory "WB" Capacitors. These dry electrolytics are designed and built to combine top efficiency with minimum size for their capacity rating.

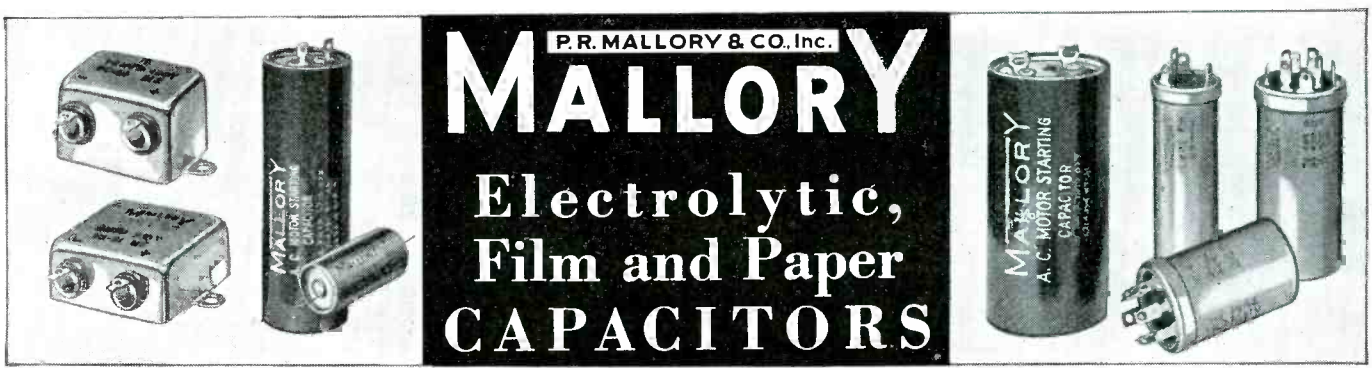
To prevent moisture absorption, loss of electrolytic, and to withstand destructive temperature changes, each "WB" capacitor is hermetically sealed in an aluminum case and is covered with a waxed cardboard tube that avoids shorting in crowded installations.

End-sealing wax has been eliminated to reduce the length still further.

Mallory "WB" Capacitors are available from stock in rated capacities from 10 mfd. at 25 volts to 16 mfd. at 450 volts.

The Mallory catalog, listing characteristics of "WB's" and other Mallory precision capacitors, variable and fixed resistors, switches, vibrators, rectifiers and other electronic parts, is available *free* from your nearest Mallory Distributor. Ask him for a copy, or write us today.

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



NEW BULLETINS

(*Continued from page* 118)

and carries the product number "912," has been released by American Phenolic Corp., Chicago 50, Ill. Containing full data together with information on this liquid's dielectric constant, power and loss factor, the bulletin explains the uses and electronic characteristics of both Polyweld and Acryweld, product number "901," which is similar to the former but for different applications.

Terminal Blocks

A new booklet available describing ten styles of controlled terminal blocks, originally developed for central station and sub station cable connections, and now widely used as junction point in any control wiring installation complete with styles, cross section views, dimensions and prices, has been issued by Burke Electric Co., Erie, Pa.

Replacement Capacitors

The new catalog No. 195 just issued by Cornell-Dubilier Electric Corp., South Plainfield, N. J., contains complete data on capacities, sizes and prices of electrolytic capacitors—can-types and cardboard tube types, paper capacitors, wax impregnated and Dykanol tubular capacitors, drawn metal shell units, replacement paper units, photo-flash units, auto radio units and transmitting paper types, and various types of mica capacitors. Capacitor test instruments filters also are included.

(*Continued on page* 206)

NEW PATENTS

(*Continued from page* 199)

in the previously discussed embodiment will result.

M. G. Crosby, RCA, (F) April 29, 1943, (I) November 28, 1944, No. 2,363,652.

Parallel Amplifiers

Frequently instability occurs if two negative feedback amplifiers are connected in parallel during a short switching operation when one is to be replaced by the other. It is proposed to prevent unstability by separating the resonant frequencies of the transformers connecting the two amplifiers to the input and output lines. One way in which this may be done is to connect the second amplifier at each end through an impedance network which slightly modifies the impedance presented to the transformer of the first amplifier so that it resonates at a different frequency. The network may consist of a single inductance connected in series with the conductor corresponding to the central conductor of the co-axial cable. In a balanced system, two equal inductances would be used, one connected in series with each wire. In a practical case of amplifiers used in a co-axial cable system, the inductance connected in series with the central conductor was about 4½ microhenries.

A. H. Roche and T. W. Elliott, Standard Telephones and Cables Ltd., (F) Nov. 29, 1943, (I) Dec. 5, 1944, No. 2,364,389.

WILCO NOW EQUIPPED

for large scale production of

JACKETED WIRE

WILCO wire, tubing and other products are used in various electronic applications for the Army and Navy. In response to the wartime demand for these various products, the H. A. Wilson Company has enlarged its plant, increased its manufacturing facilities, added essential new equipment and developed new products and techniques. Both present and future customers will find these new WILCO developments of great advantage.

The H. A. Wilson Company manufactures and is interested in receiving inquiries regarding the following typical products—

WILCO JACKETED WIRE

Silver (Fine, Sterling or Coin)
Silver Jacketed Copper
Silver Jacketed Invar
Silver Jacketed Brass
Silver Jacketed Steel
Gold Jacketed Silver (Fine, Sterling, Coin)
Gold Jacketed Brass or Bronze
Copper Jacketed Monel
Nickel Jacketed Copper

WILCO JACKETED TUBING

Silver Tubing (Fine, Sterling or Coin)
Gold Tubing (any Color or Karat)
Silver Jacketed Brass or Bronze (one or both sides)
Gold Jacketed Silver (one or both sides)
Gold Jacketed Brass or Bronze (one or both sides)

WILCO STRIP MATERIAL

Silver (Fine, Sterling or Coin) on Brass or Bronze (Inlay or Overlay)
Gold on Silver (any Karat on Fine, Sterling or Coin)
Gold on Brass or Bronze

Other WILCO products include Electrical *Contacts*—

Silver, Platinum, Tungsten, Alloys, Powder Metal. *Thermostatic Bimetal* (High and Low Temperature with new high temperature deflection rates.) *Precious Metal Collector Rings*—For Rotating controls. *Silver Clad Steel. Rolled Gold Plate. Special Materials.*

Let us analyze your problems.

THE H. A. WILSON COMPANY

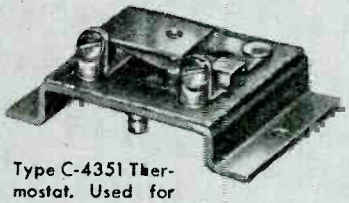
105 Chestnut Street, Newark 5, N. J.

Branches: Detroit • Chicago

Type C-722C Precision Snap Switch. 12 amps. 30 Volts D. C., 125 Volts A. C.

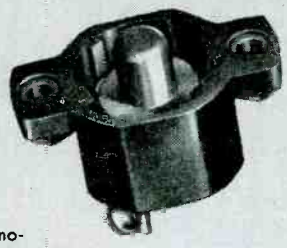
Type C-2851 Thermostat. For such use as Roughing Controls on Outer Crystal Ovens.

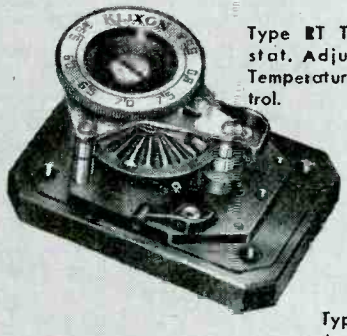
Simple Actuating Disc Eliminates Complicated Operating Mechanisms...



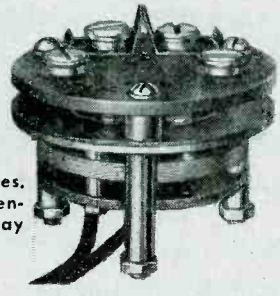
Type C-4351 Thermostat. Used for Tube Warming, Tube Cooling. High Limit Controls, etc.

Type PM (NAF-1131) Circuit Breaker.

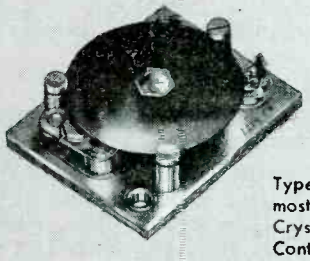




Type BT Thermostat. Adjustable Temperature Control.



Type ER Series. Ambient Compensated Time Delay Relays.



Type B-3120 Thermostat and Heater, Crystal Dew Point Control.

ASSURE ACCURATE CONTROL OR PROTECTION WITH KLIXON DISC-OPERATED CONTROLS

Take a control that has *no* relays, toggles, magnets or other complicated operating parts and you are bound to get reliable, positive control or protection.

Klixon disc-operated Controls have *none* of those fussy parts . . . nothing to wear out or get out of adjustment. The actuating element . . . the simple scientifically calibrated Spencer thermostatic disc . . . snaps open the circuit to a quick, clean break or snaps close to a solid make no matter how often it operates.

Klixon Controls are small, compact, light in weight . . . easily installed in circuits. Their accurate dependable operation withstands shock, vibration, motion or altitude. They are available in many types and ratings for such control applications as motor or transformer overheat protection, thermal time delays or temperature control for radio equipment.

No matter what your control or protection problem, investigate Klixon Controls for trouble-free performance. For information or assistance on your problems, write:

KLIXON

SPENCER THERMOSTAT COMPANY, Attleboro, Mass.

NEW BULLETINS

(*Continued from page* 202)

Tangent Bender

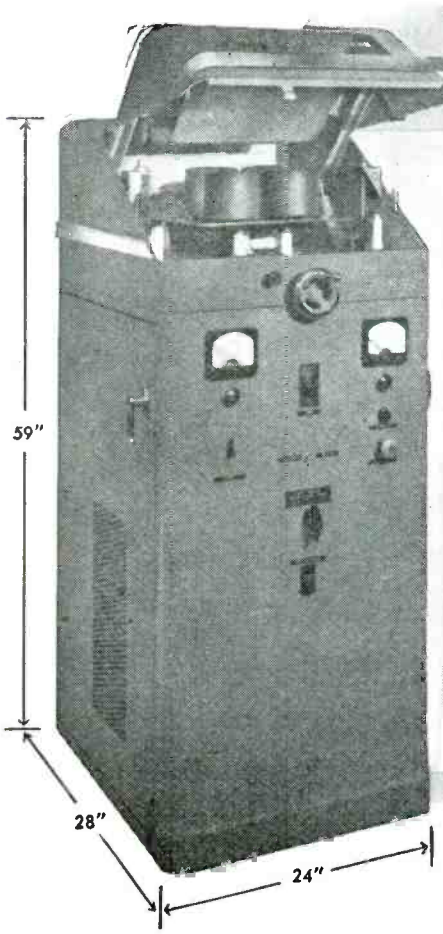
A new 16-page bulletin, pictorially describing in detail many of the suggested products than can be produced on improved types of tangent benders, has been released by Struthers Wells Corp., Titusville, Pa. The bulletin provides comprehensive data on the single wing, double wing and the newly developed stretch wing tangent bender machines, with important engineering information, special features, product shapes and designs that can be formed in a single operation. While tangent benders were originally designed for the edge bending of metal sheets, the efficient bending of large and small parts is now possible through further improvements in design.

Insulating Materials

An informative booklet on insulating materials, (Engineering Bulletin E D 44) is being mailed by the Continental-Diamond Fibre Co., Newark, Del. Electrical and physical properties of hard fibre and phenolic materials are described in detail. Test specifications and methods are explained for important properties of insulating materials such as specific gravity, water absorption, power factor, dielectric constant and dielectric strength, tensile flexural and compressive strength and Izod impact strength. Effects of heat, moisture and steam are also mentioned. Tables of values for the various grades of materials made by the company provide necessary data for the design engineer. Information is also given on frequency effects, arc and insulation resistance. Machinability characteristics are discussed and a useful table is given showing what tolerances can be maintained. Standard sizes of the various grades are shown.

Fastening Devices

A comprehensive, 83-page engineering catalog has been issued by Allmetal Screw Products Co., 33 Greene Street, New York, specialists in the manufacture of stainless steel machine parts. This book is designed to assist designers, engineers, and other plant executives to select the right size and type of non-corrosive fastening device for any particular job. Included is a brief introduction to stainless steel, stock sizes and physical dimension of various bolts, cap screws nuts, pipe fittings, etc., and several pages on special screw machine parts that can be made to order. The book also has an extensive section devoted to engineering tables and data.



"Built-in Brains"

THE NEW

Thermatron "HEATMASTER"

ELECTRONIC DIELECTRIC HEAT GENERATOR

5 KW — 17,000 B.T.U. Per Hour Output

The new "Heatmaster" has its "brains" built in — so that in production it may be operated safely by unskilled help. Operation is truly automatic — being limited to the insertion and removal of preforms on any designated time cycle.

For laboratory work, or manual operation, its advantages are equally outstanding. Owing to its one major control, the technician is enabled to concentrate his attention on the effect of high frequency rather than in the manipulation of electrical controls to produce a desired result.

The inclusion of fluorescent lighting in the electrode cage — while only a detail — illustrates the carefulness of design. The use of new long-life radial fin tubes cuts down operation expense. It has power to heat a 3.3 pound preform in one minute — 5 pounds in 90 seconds.

For plastics or for general purpose use, for research or production, the **THERMATRON** "Heatmaster" with its rugged construction, simplified controls, and generous power represents an outstanding development in electronic dielectric heaters.

All **Thermatron** *ratings based on output*

Send for new circular describing the 5 KW "Heatmaster" and other models in the **THERMATRON LINE,** ranging from 500 watts to 30 KW in output. Address Desk. EI-6

Thermatron Division

RADIO RECEPTOR COMPANY, Inc.

251 WEST 19th STREET **NEW YORK 11, N.Y.**

Engineers and Manufacturers of Airway and Airport Radio Equipment

SINCE 1922 IN RADIO AND ELECTRONICS

How you can get a quick start in post-war selling

IS YOUR FIRM an established manufacturer of electronic equipment which will be faced with the post-war problems of selling your products in a highly competitive market? Then here is your chance to obtain *immediate national distribution!*

We are an organization of fifteen manufacturers representatives located in principal cities in the U. S. and Canada—with a staff of sixty-one people. Most of us have been working together for six years or longer. We have specialized in selling electronic equipment to manufacturers and distributors and in helping distributors sell to their customers.

An example of how we are equipped to build business, solve merchandising problems and improve the competitive position of our accounts is shown by the way in which we increased the sales of one manufacturer from $18,000 a month to an average of $400,000 a month in only a few short years.

By availing yourself of the services of this trained organization you will be prepared to move into post-war selling fast—and capitalize on the lucrative sales potential that awaits the ending of the War. Through men who know exactly where and how to sell your products you will enjoy the advantages of long established contacts with top-flight distributors of unquestioned credit standing. And, you will find distribution costs under this plan surprisingly low.

ADDRESS BOX 6592

Electronic Industries, 480 Lexington Avenue, New York 17, N. Y.

PERSONNEL

Dr. Alfred V. de Forest

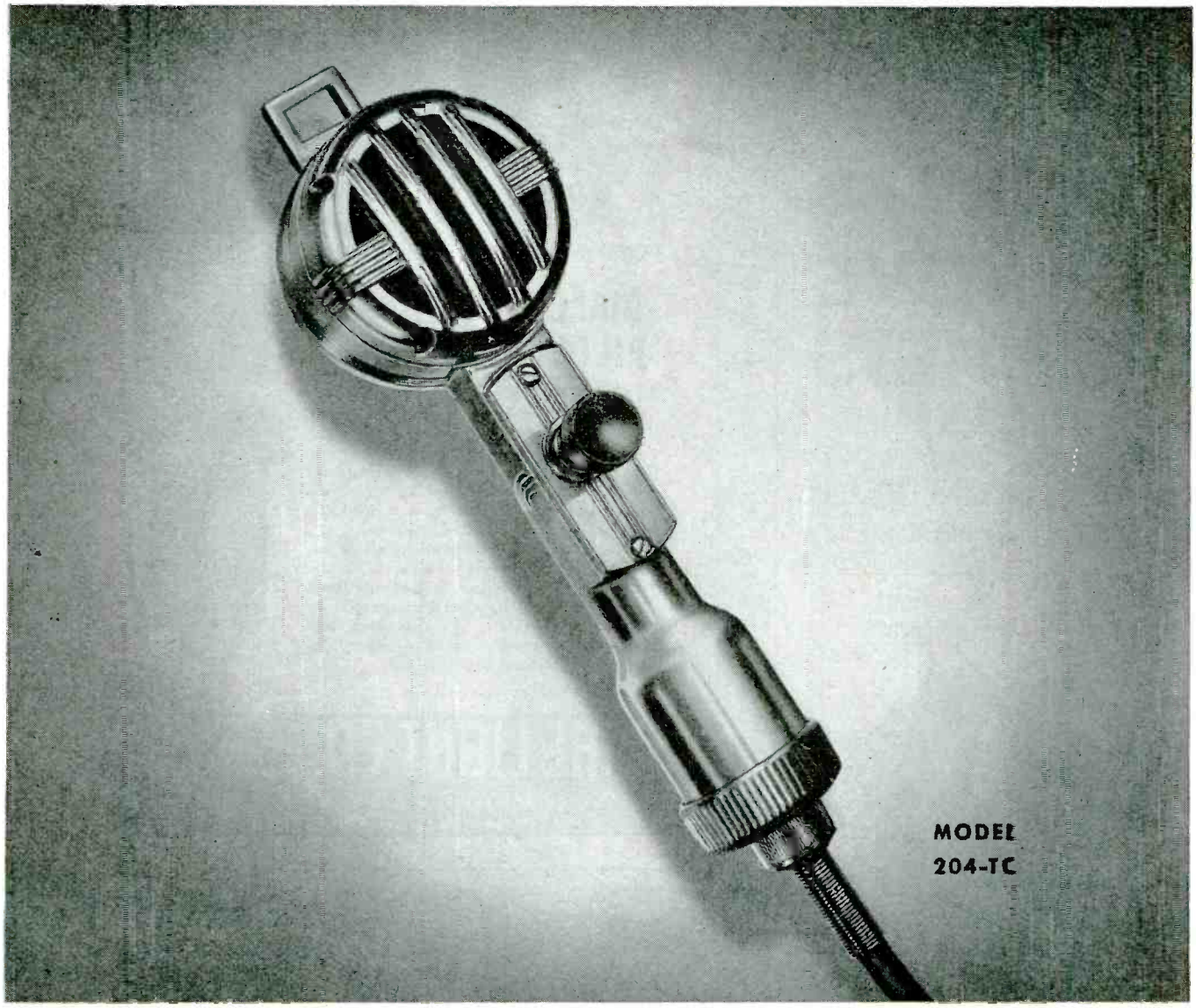
Dr. Alfred V. de Forest, associate professor of mechanical engineering at the Massachusetts Institute of Technology, died April 4th in Cambridge, Mass. Dr. de Forest was the recipient of many honors in the mechanical engineering field, and a pioneer in many new methods of measurement and inspection using new and unusual technics. His developments included cathode ray oscillographic methods for magnetic analysis, the use of electronic oscillators and amplifiers in fatigue testing of materials, Magnaflux processes of inspection, the Zyglo inspection methods using fluorescence and the wire strain gage technic. He was president of the Magnaflux Co., and a partner in the Ruge-de Forest Co., Cambridge, Mass.

A. R. Ellsworth

A. R. Ellsworth since 1933 chief engineer of the Packard-Bell Co., Los Angeles, has been made director of research and will head a new division of the company devoted to research on electronic matters. Enlarged quarters have been acquired through lease of an additional building; headquarters remain at 1115 South Hope street.

Timothy E. Shea, formerly chief engineer of the Electrical Research Products Division of Western Electric Co., has returned to Western following four years' service as director of research for Columbia University Division of War Research, which operates under the National Defense Research Committee. Mr. Shea has been appointed superintendent in charge of manufacturing engineering at the company's vacuum tube shop in New York.

D. D. Jones has been appointed assistant chief engineer of Tech Laboratories, Jersey City, N. J. For the past six years he has been connected with the engineering department of CBS, prior to that was chief engineer at radio station WAAT.



DYNAMIC HANDI-MIKE

TECHNICAL DATA
MODEL 204-TC

IMPEDANCE: 35-50 Ohms.

FREQUENCY RESPONSE: 200-7500 Cps.

OUTPUT LEVEL: Into 50 ohm input; 44 db below 6 milliwatts for 100 bar signal.

SWITCH: Type "T." Press-to-talk. Vertical toggle with snap action.

CORD: 6 feet long. Rubber jacketed. 2 Conductor and shield.

CIRCUIT: Two wires direct to microphone. Switch "makes" independent circuit. For use in connection with control circuit of transmitter or other relay operated device.

DIMENSIONS: Length overall 8 inches, head diameter 2¼ inches.

SHIPPING WEIGHT: 2 pounds.

There are seven other dynamic handi-mike models from which to make a selection.

Universal Handi-Mikes have been, through these years of progress in Radio-Electronics, as common a part to specialized sound equipment as the vacuum tube is to your home radio. The same microphone restyled and redesigned progressively has met the wanted need of a rugged hand held microphone. The Handi-Mikes are now available in both carbon and dynamic microphones with a variety of switches and circuits from which to choose.

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

REPRESENTATIVES: New York, Chicago, Kansas City, Cleveland, Boston, Tampa, Houston, Philadelphia, Detroit, Seattle, St. Paul, Salt Lake, Los Angeles, San Francisco, and Asheville.

NEW BOOKS

New Radio Amateur's Handbook

Published by the American Radio Relay League, West Hartford, Conn., 728 pages with a 12-page topical index, over 1,200 illustrations, 1945 edition, $1.00 in the U.S.A. and $1.50 elsewhere.

The 1945 edition is divided into three main parts. An introductory section, and the principles and design section contain all the material treating with fundamentals of theory and design consideration, written in a non-mathematical style. There are ten chapters under Equipment Construction, containing practical information on the design and construction of all types of amateur receivers, transmitters, associated equipment.

Introduction to Practical Radio

by Durward J. Tucker
Published by the MacMillan Company, New York
322 pages — price $3.00

This new book on elementary radio is proposed by the author to serve as a single text covering the basic fundamentals of radio by confining the text to material on first principles, and providing at each step the necessary mathematical tools as required.

Chapter contents

The first chapter includes the relationship of radio to electricity, some mathematics and sample problems in electricity. The second chapter deals with elementary electricity, giving the electron theory, symbols, ohms law relationships and examples in electrical circuits. Common electrical component parts illustrations are included. Additional chapters include more complex resistance circuits, direct current power, equipment wiring, Kirchhoff's laws, magnetism, electromagnetism, alternating current, electrical instruments, inductance, capacitance, impedance, and an appendix of logarithms, trigonometric functions and a table of powers, roots and reciprocals.

A complete list of the symbols as used in the text precedes the first chapter. The illustrations in the book include a number of photographs of component parts and a number of schematic circuit drawings. Considerably more emphasis is placed on the electrical relationship in radio than on radio equipment itself.

BUY WAR BONDS

SOLDERING IRONS ©
SWITCHES · RELAYS
RESISTORS · CONDENSERS
CONTROLS · HEADPHONES
BATTERIES · TRANSFORMERS
TOOLS · WIRE · TUBES · CABLE

In a Hurry!

● Try DALIS "KNOW-HOW" to avoid those expediting headaches. Here's an outstanding stock of radio-electronic parts, materials, equipment—at your call!!

And DALIS has the well-trained organization, long experience and exceptional factory connections that deliver hard-to-get items in a hurry. A dependable source of supply since 1925. An indispensable source, today.

Dalis Service

Try DALIS — just wire, 'phone or write . . .

H. L. DALIS Inc

Wholesale Distributors
RADIO-ELECTRONIC SUPPLIES & PARTS
17 Union Square
NEW YORK 3, N. Y.
Phones: ALgonquin 4-8112-3-4-5-6-7

SURPLUS MATERIAL

TRANSFORMER LAMINATIONS

LARGE QUANTITY STANDARD SHAPES and SIZES

Sealed Bids may be submitted until
JUNE 26, 1945

Ask for Sales Catalog No. B-216N

NAVY MATERIAL REDISTRIBUTION and DISPOSAL OFFICE
342 MADISON AVENUE, NEW YORK 17, N. Y.

JONES BARRIER TERMINAL STRIPS

2-142

2-142-¾W

2-142-Y

Bakelite Barriers placed between Terminals increase the leakage path and prevent direct shorts from frayed wires at Terminals. Terminals and screws are of nickel plated brass. Insulation is of BM 120 molded Bakelite.

Illustrated are three types: Screw Terminals, Screw and solder Terminals and Screw Terminal above panel with solder Terminal below. For every need.

Six series cover every requirement: No. 140 — 5-40 screws, No. 141—6-32 screws, No. 142—8-32 screws, No. 150—10-32 screws, 151—12-32 screws and No. 152—¼-28 screws.

These sturdy Terminal Strips will not only improve your electrical connections but will add considerably to the appearance of your equipment. A truly modern Terminal.

Write today for catalog No. 14 listing our complete line of Barrier Strips in addition to other Electrical Connecting Devices.

HOWARD B. JONES COMPANY
2460 W. GEORGE ST. CHICAGO 18

Wanted ENGINEERS

Radio
***Electrical**
Electronic
***Mechanical**
***Factory Planning**
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R.L.D., EMPLOYMENT DEPT.

Western Electric Co.

100 CENTRAL AV., KEARNY, N. J.

***Also: C.A.L.**
Locust St., Haverhill, Mass.

Applicants must comply with WMC regulations

INDUSTRY NEWS

(*Continued from page* 118)

The plan of operation provides that surplus equipment received will first be checked for possible reconversion for civilian use. If engineers find that no plan can be devised for reconverting for civilian use, the equipment will be disassembled and the parts will be inspected, sorted and itemized. Any parts so recovered which were originally produced by manufacturers who have signed the DSC agency agreement will be returned to those manufacturers for sale. Prices for the sale of the reconverted equipment or parts will be set by the DSC at the prevailing market values and catalogs will be issued regularly to the trade.

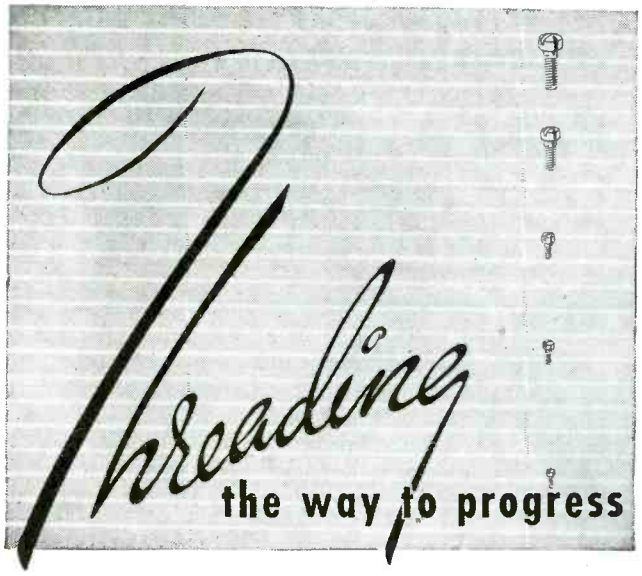
Sees War Cutback to 50%

More than two-thirds of the capacitor industry's pre-war production was used in the assembly of radio receiving and transmitting apparatus, but a substantially enlarged post-war output, according to Paul Hetenyi, Solar's newly - elected engineer president, should find this ratio reduced to approximately 50 per cent with the remainder going into such divergent lines, among others, as automotive equipment, household appliances, electric razors, business machines, safety devices, hearing aids and telephone and telegraph equipment.

Paul Hetenyi

"Production for war has taken the capacitor and filter trade into many new fields," Mr. Hetenyi said, "and engineering developments in our own line have kept pace with those in the growing number of consuming industries. Particularly so is this the case in FM radio and television, with their extensive capacitor and filter requirements, the increasingly important field of electronic controls and, among others, the refrigeration, air conditioning and fluorescent lighting trades."

In Mr. Hetenyi's opinion, the physical volume of initial post-war production should be substantially greater than pre-war totals, due primarily to the huge pent-up demand for the large number of civilian products. Dollar volume, on the other hand, was seen as somewhat lower than war-time peaks, because industrial specifications are less rigid than those of the armed services, which have been taking the bulk of present output.



Screw Machine Products

- Progress — in the vast field of mechanics is to a great extent dependent upon fine screw machine products.
- Experienced Producers of screw machine products are essential to expedite efficient operation.

Your Source—
Waltham Screw Company because

- Of sufficient equipment to produce in any quantity screws, tubes, shafts, inserts, nuts and other screw machine products in any thread to meet close tolerance requirements.
- Our experience gained in over half a century of development and production of screw machine products is available to you.

Send for our catalogue and call upon our Engineering Staff for solutions to your problems in screw machine products.

WALTHAM SCREW
COMPANY
77 Rumford Ave.
Waltham, Mass.

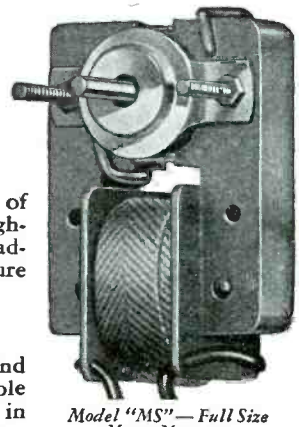
1,001 USES

Condensed Power for Years of Service

VERSATILITY and dependability were paramount when *Alliance* designed these efficient motors—*Multum in Parvo!* . . . They are ideal for operating fans, movie projectors, light home appliances, toys, switches, motion displays, control systems and many other applications . . . providing economical condensed power for years of service.

Alliance Precision

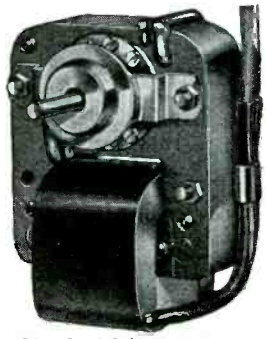
Our long established standards of precision manufacturing from highest grade materials are strictly adhered to in these models to insure long life without breakdowns.



Model "MS"—Full Size Motor Measures 1¾" x 2 x 3⅛"

EFFICIENT

Both the new Model "K" Motor and the Model "MS" are the shaded pole induction type—the last word in efficient small motor design. They can be produced in all standard voltages and frequencies with actual measured power outputs ranging upwards to 1/100 H. P. . . Alliance motors also can be furnished, in quantity, with variations to adapt them to specific applications.



New Model "K"—Full Size Motor Measures 2⅛" x 2⅜" x 3⅛"

DEPENDABLE

Both these models uphold the *Alliance* reputation for all 'round dependability. In the busy post-war period, there will be many "spots" where these Miniature Power Plants will fit requirements . . Write now for further information.

Remember Alliance!
—YOUR ALLY IN WAR AS IN PEACE

ALLIANCE MANUFACTURING CO.
ALLIANCE . OHIO

WHEN READY

1945 FCC Frequency Allocations Chart

The FCC will soon announce new wavelengths covering broadcasting in channels above 25,000 KC. As soon as they are officially released we are publishing a four-color chart showing the frequencies newly-assigned as well as presently operative, from 100 KC to 100,000 MC.

You may have a copy of this chart which measures 14" x 20", if you already are a subscriber. Mail us the coupon below, or if you'd rather not cut up the magazine, write us, giving company name, title, address. A copy will be sent you as soon as the chart is published.

Electronic Industries, Dept. El6
Caldwell-Clements, Inc.
480 Lexington Avenue
New York 17, N. Y.

Gentlemen:

I am a subscriber to ELECTRONIC INDUSTRIES and I wish to take advantage of your free offer of the new 1945 FCC Frequency Allocations Chart. I understand you will send me o copy as soon as it is ready.

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

Company .....

Street .....

City or Town ..... Zone ..... State .....

TBA-IRE Tele Meet

Further plans for the continued advancement of commercial television before and after V-J Day will be discussed at the mid-summer meeting of the Television Broadcasters Association, scheduled on the afternoon of June 15 at the Commodore Hotel, New York City. An important schedule of papers is being planned, dealing with equipment procurement and other production difficulties.

This meeting coincides with a meeting of the New York section of the Institute of Radio Engineers, who are planning a program on Wednesday evening, June 15 on the problems involved with projection television receiver design, at which aspects of each of the presently-planned methods will be discussed by representatives of each system. In all probability, this meeting will also be held at the Commodore Hotel where demonstrations of the various television projection methods may be given.

Philips Licenses

As previously reported, a twenty-year contract on patent licenses between N. V. Philips' Gloeilampenfabrieken and RCA, General Electric Co., and Westinghouse Electric Corp, will terminate on July 1, 1945. Otto S. Schairer, vice-president of RCA, announced that this company is considering the advisability of an arrangement with the Philips Co. which will enable RCA to continue to grant licenses on Philips patents to other companies.

About 700 U. S. patents are involved, representing a selection from the original Dutch patents several times greater in number. Some of these patents are on pentode structures, feedback circuits, automatic volume control circuits, timing circuits, mixer circuits, etc. Further, as pointed out by a high official of the Philips Co., research on a large scale is being carried out in their laboratories in Holland and the resulting new methods and devices will be covered by U. S. patents.

A plan is being worked out under which it will be possible for any concern now licensed under the present agreements or desiring a license to obtain licenses directly from the Philips Co.

Bendix to Expand

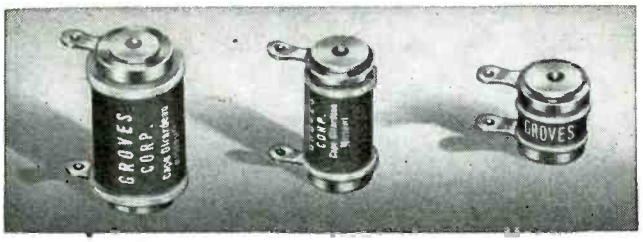
Bendix Aviation Corp., Santa Barbara, Calif., will manufacture in its Pacific division a complete line of radios and radio-phonograph combinations for marketing in west coast trading areas. The company's engineering and manufacturing organizations have set in motion joint plans for launching production.

New! GROVES PRECISION *wire wound* RESISTORS

Effectively processed to withstand high humidity conditions. Moisture and fungus resistant. 3 Types immediately available.

Type	Watt	Length	Diameter	Resistance Range min.	max.
GW-3	1/3	9/16"	9/16"	1.0 ohm	100,000 ohms
GW-4	1/2	1"	9/16"	0.1 ohm	400,000 ohms
GW-5	1	1¼"	3/4"	0.25 ohm	800,000 ohms

Lug type terminal, low temperature coefficient wire, tolerances 1%; 0.5%; 0.25%; 0.10%.



High Production capacity, good delivery.

Catalog on request

GROVES CORPORATION

CAPE GIRARDEAU . . . . MISSOURI

Solder Fast

TRIGGER HEAT... EASY HANDLING

Pats. Pending

● The BAKER Flash is the revolutionary gun-type soldering iron that answers industry's demand for a FASTER, HANDIER tool.

The tip flashes to soldering heat almost instantly following pressure on the trigger control. Correct temperature for most efficient work is easily maintained, over-heating and unnecessary oxydation avoided, cleaning and re-tinning time saved.

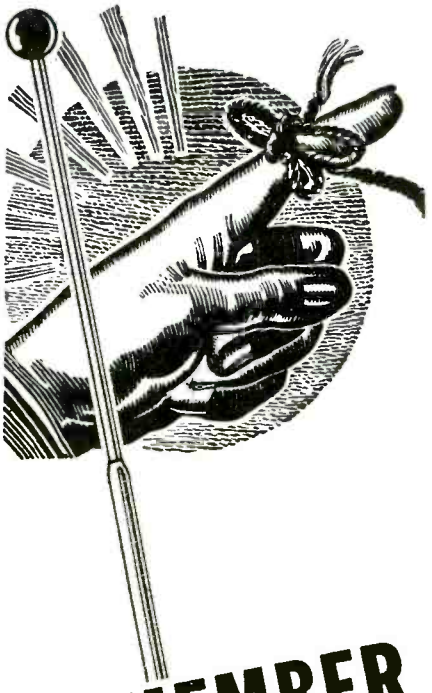
Natural gun grip; cool, protected plastic handle; light weight; perfect balance—these are advantages that make the BAKER Flash extremely easy to use, *ideal for work in close places.*

Completely equipped for immediate operation from 110-volt transformer or from standard storage battery.

Write or Wire for Complete Information

BAKER ELECTRONIC MANUFACTURING CO.

3017 LYNDALE AVE. SO. MINNEAPOLIS 8, MINNESOTA



REMEMBER

. . . remember this—when you buy antennae. Snyder offers superior quality (because of controlled manufacture)—better price—prompt delivery. Be certain of customer satisfaction. Recommend Snyder.

ANTENNAE
by

SNYDER
MANUFACTURING CO. • PHILADELPHIA

COMPLETE MANUFACTURERS FROM START TO FINISH

ELECTRONIC INDUSTRIES

Advertisers—June, 1945

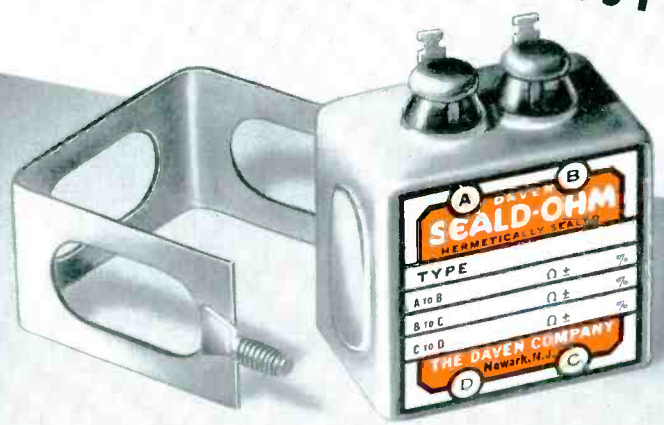
While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Presenting the...

DAVEN

WIRE-WOUND
SEALD-OHM

HERMETICALLY-SEALED PRECISION RESISTOR



Totally unaffected by extremes of humidity and temperature, highly resistant to vibration and shock, with provision for rigid mounting . . . these were "specs" that could not be met by any resistor on the market. In response to a direct request, DAVEN, applying the know-how of over two decades of precision resistor engineering, carefully designed and built a new, completely hermetically-sealed resistor. DAVEN SEALD-OHMS squarely meet these specifications. This was proven by exhaustive tests conducted by a famous research laboratory.

SEALD-OHMS are ruggedly constructed throughout, with special attention given to combining vibration and shock resistance. Their physical design enables the combining of several circuits within a single unit. A unique mounting bracket arrangement adds to the broad adaptability of these resistors. SEALD-OHMS are intended for use in any equipment subjected to humidity and temperature extremes. They fully meet both Army and Navy Specifications. Typical applications include as secondary standards, resistor elements in bridge networks, in voltage divider circuits, in attenuation boxes, etc.

ELECTRICAL DATA

RESISTOR WINDINGS: Either spool or mica-card type, depending upon engineering requirements. Non-inductively wound and carefully aged to remove strain before final calibration.

RESISTANCE RANGE: Any desired value may be had; maximum 1,600,000 ohms depending upon type of resistance wire employed.

TEMPERATURE CHARACTERISTICS: Four types of resistance wire of different characteristics are available.

ACCURACY: May be had to tolerance as close as $\pm 0.1\%$.

FREQUENCY CHARACTERISTICS: No appreciable effect over the audio range. This range may be exceeded to meet many other applications.

CIRCUIT COMBINATIONS: Resistors available with 2 terminals at one end or 2 terminals at two ends. A single four terminal unit is designed to take up to four separate spool-type resistors of different values and accuracies.

MECHANICAL DATA

SHIELDING: Drawn brass, completely hermetically-sealed. Thermal-shock tested for faulty seals before shipment. Treated to withstand 200 hours salt spray test (f-13 AWS Spec C75.16-1944).

TERMINALS: Electrical connections are brought out through fused glass seals which are soldered in the resistor shield.

MOUNTING: A specially designed steel bracket with spade lugs welded to the sides is supplied with each unit. Cut-outs on this bracket engage with embossings on the side of the brass shielding to enable firm mounting of the unit in a vertical, inverted or horizontal position.

DIMENSIONS: 1-9/16" wide, 1½" high, ⅞" deep. Add terminal height, 9/16" Studs on mounting bracket, 1-11/16" between centers.

For additional information, write to **THE DAVEN CO.,**
191 Central Avenue, Newark 4, New Jersey

DAVEN **pioneer** *maker of precision resistors*

DESIGNING TELEVISION, FM, OR SHORT-WAVE EQUIPMENT?

90 - AN/TRC-1, 3, 4 radios

RCA PREFERRED-TYPE METAL TUBES

CAN BE A BIG HELP TO YOU

100 - RMCA lifeboat radio

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

BUY MORE WAR BONDS

● Intrinsic features of RCA Preferred-Type Metal Tubes offer many advantages to set-designers.

Because metal tubes are little affected by stray fields, you get greater flexibility in mechanical layout, resulting in compact, stable circuits, which are economical to manufacture and easy to service.

Other features are simplified grounding through the No. 1 socket terminal, standard octal base, sturdy appearance, and wide acceptance among designers and servicemen. And there are 55 types from which to choose. A substantial number of these were on the prewar RCA Preferred-Type list, and many are sure to be retained on the postwar list.

First to manufacture metal tubes, RCA has introduced over 90% of the metal types now available—and has built more than 150,000,000 metal tubes since 1935.

If you have a design problem involving receiving tubes, investigate RCA Preferred Types—metal, glass, or miniature. RCA tube-application engineers will be glad to help. Write to RCA, Commercial Engineering Section, Dept. 62-30J, Harrison, N. J.

62-6136-30

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.