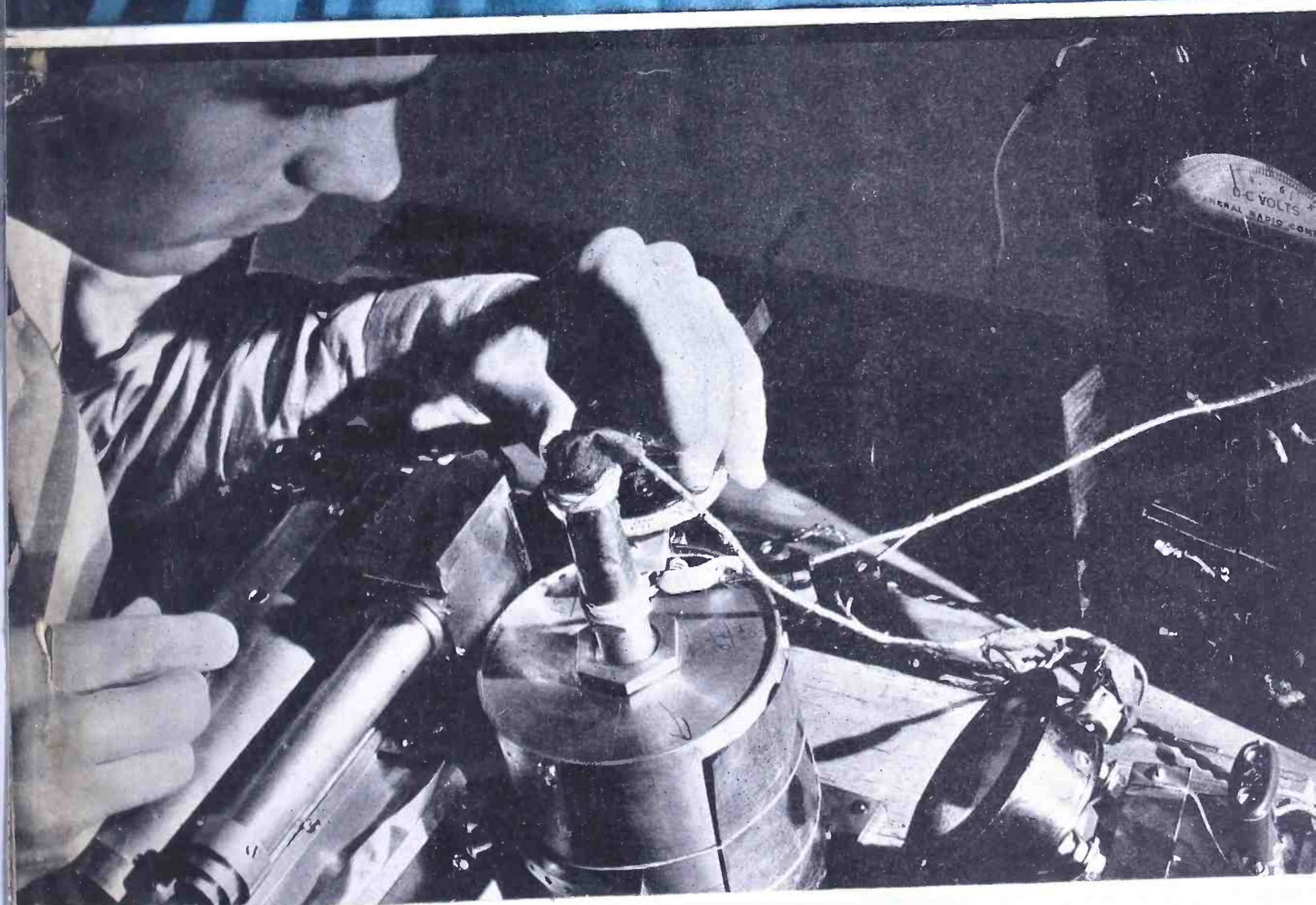
COMMUNICATIONS

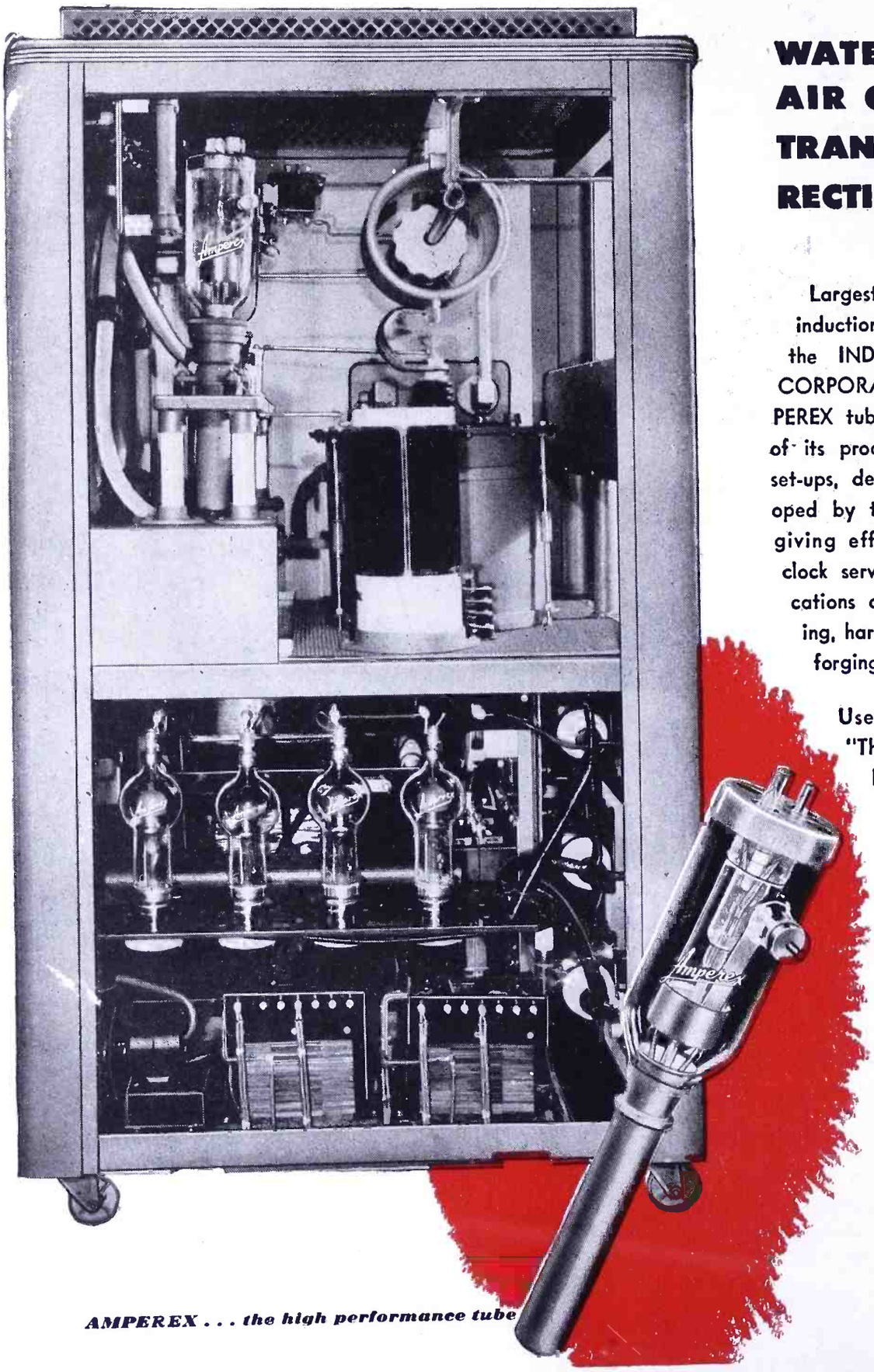


SEPTEMBER

★ RADIO ENGINEERING
★ FIRE SERVICE COMMUNICATIONS
★ V-H-F V ANTENNAS FOR AIRCRAFT
★ IMPEDANCE RELATIONSHIP OF ARRAYS
★ C-R TUBE PRODUCTION PROBLEMS
★ REPORT ON NAB CONFERENCE

1944

Why AMPEREX



WATER AND AIR COOLED TRANSMITTING AND RECTIFYING TUBES

Largest producer of electronic induction heating equipment, the INDUCTION HEATING CORPORATION utilizes AMPEREX tubes for the "heart" of its products. "Thermonic" set-ups, designed and developed by this company, are giving efficient round-the-clock service in such applications as brazing, annealing, hardening, melting and forging.

Used ever since the first "Thermonic" unit was marketed. AMPEREX tubes have provided consistently satisfactory service in all assignments. This, then, is another high endorsement for the performance of AMPEREX tubes. Consult an AMPEREX engineer for the solution to your present or peacetime problem.

ARMY NAVY

AMPEREX . . . the high performance tube

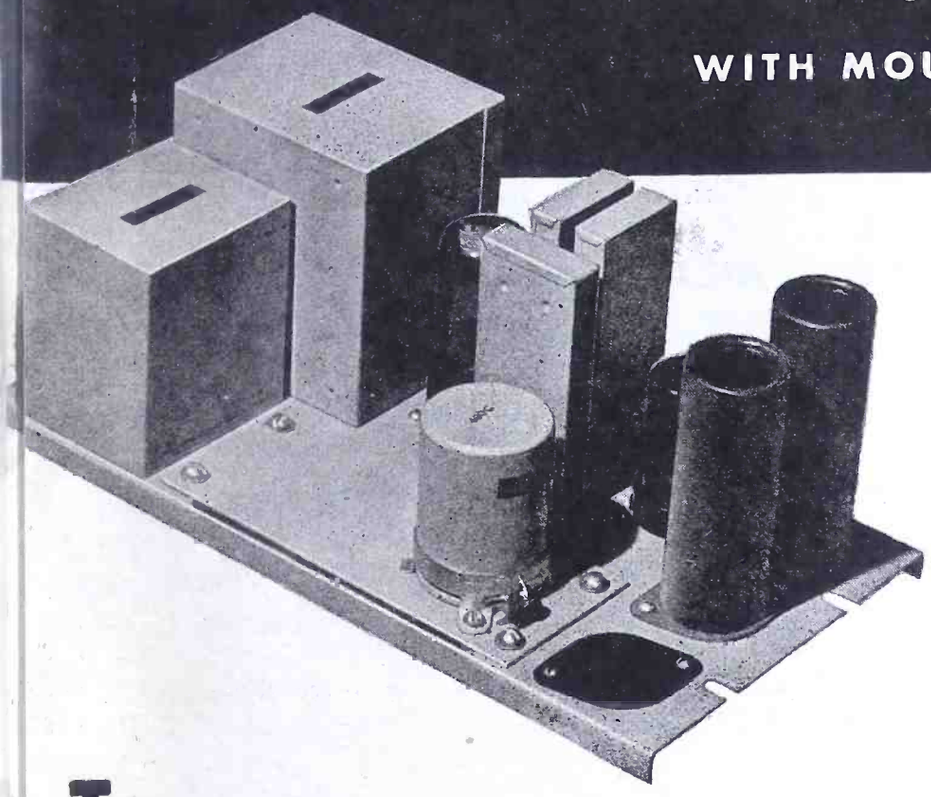
AMPEREX ELECTRONIC CORPORATION

79 WASHINGTON STREET . . . . . BROOKLYN 1, N.Y.

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

102 SERIES *Amplifiers*

WITH MOUNTING ACCESSORIES



TYPE 102-A—Two stage—Fixed gain 55 db. Input impedance 30, 250 or 600 ohms; output impedance 600 ohms. Frequency response 30-16,000 Cycles ± .5 db. Power output + 26 VU with less than 1% harmonic content. Requires external power supply 275 Volts DC 30 M.A., and 6.3 Volts AC .75 Amps. When a 102 Series Amplifier is used in conjunction with a 101 Series Amplifier, the latter is capable of supplying the necessary power.

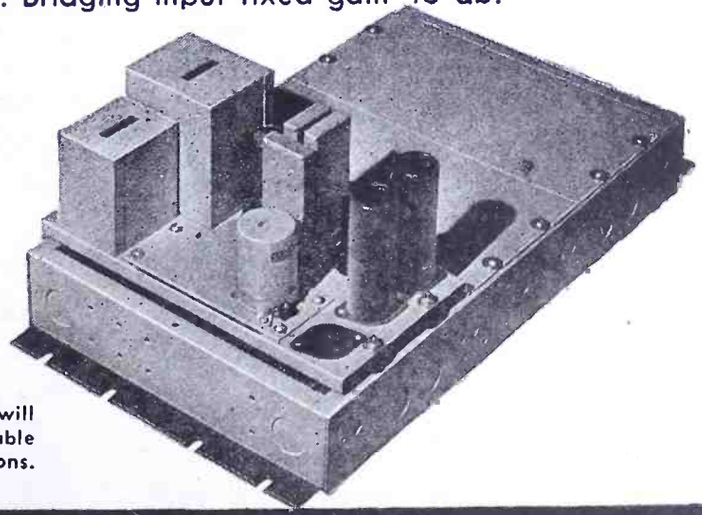
The 102 Series Amplifiers consist of four different amplifiers available simply by changing a small input panel on the master chassis. Except for the input panel, they all have the same transmission characteristics. Designed for the highest type audio service, they will meet frequency modulation requirements as to frequency response, power output vs. distortion and noise level.

TYPE 102-A as illustrated and described above.

TYPE 102-B—Three stage—Gain 95 db. Intended for high grade public address installations. Input stage electronic mixing.

TYPE 102-C—Three stage—Fixed gain 95 db.

TYPE 102-D—Two stage—Input impedance 600 ohms and bridging. Fixed gain 600 ohm input 61 db. Bridging input fixed gain 45 db.



The 3A Mounting Frame, requiring 10½ inches rack space, will accommodate up to THREE 102 Series Amplifiers and is suitable for wall mounting cabinet or rack and panel installations.

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

LEWIS WINNER, Editor
F. WALEN, Assistant Editor
A. D'ATTILIO, Assistant Editor

We See...

BROADCASTING IS DESTINED to play an intensely dominant postwar role, as an industry, a service and an economic force. This appeared to be the consensus of engineers and executives of government and industry at the recent NAB War Conference in Chicago. Commenting on broadcasting's import, FCC Chairman Fly said that broadcasting will contribute its share to the postwar goal of full production and employment. He said that at the very moment when returning soldiers are coming back for jobs and manufacturers are turning from war to peace production, broadcasting will be launching vast new projects for public service. Broadcasting, he declared, will do its share to see that the post war era is one of expansion ond prosperity rather than contraction and depression.

AN IMPORTANT STUDY OF F-M propagation characteristics has been begun by the FCC in Washington. A low-powered f-m transmitter operating in the 40-megacycle band, is being used to study channel interference, bursts, and other practical operating problems. The results provided by this study are expected to serve as a guide in preparing the f-m allocation proposal the FCC may submit to the State Department early in December.

IT'S THE 500-MEGACYCLE BAND and beyond that appears to be attracting the attention of communications specialists. At a conference in Washington, former FCC Commissioner T. A. M. Craven, now with the Cowles interests, said that all work of his company is being channeled to the ultrahighs, with *high* power, where unusual improvement in transmission and reception will be possible. Some network officials have concurred in this belief too. They predict a spectacular growth of ultrahigh uses!

ONE OF THE MOST IMPORTANT COMPONENT conferences of the year, the Electronic Parts and Equipment Industry Conference, will be held on October 19, 20 and 21, at the Stevens Hotel in Chicago. We will have a conference booth there, 69, in the Exhibition Hall. Hope we will have the pleasure of seeing you.—L. W.

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U. S. Patent Office.
Member of Audit Bureau of Circulations.

SEPTEMBER, 1944

VOLUME 24 NUMBER 9

COVER ILLUSTRATION

An experimental u-h-f signal generator under test. *(Courtesy General Radio Co.)*

AERONAUTICAL COMMUNICATIONS

V-H-F "V" Antenna for Aircraft ..... Henry Jasik 33

ENGINEERING CONFERENCE

A Report on the NAB Executive War Conference Symposium (*Covering the Postwar Future of Broadcasting*) 36
Television and F-M ..... William B. Lodge 36
Postwar Television ..... T. S. Joyce 37
Broadcast Problems ..... Paul F. Godley 38
Frequency Modulation ..... Major E. H. Armstrong 38
F-M Transmitters ..... Paul Chamberlain 64
Postwar Broadcasting Challenge ..... William S. Hedges 66
Facsimile ..... J. V. L. Hogan 80

EMERGENCY COMMUNICATIONS

Communications and the Fire Fighter ..... Herbert A. Friede 41

VIDEO TUBE ENGINEERING

Cathode-Ray Manufacturing Problems ..... J. R. Beers 44

ANTENNA MEASUREMENTS

Impedance Relationships of Broadcast Antenna Arrays ..... Wilson Pritchett 52

MONTHLY FEATURES

Editorial (We See) ..... Lewis Winner
News Briefs of the Month 60
Veteran Wireless Operators' Association News 70
The Industry Offers 80
Advertising Index 98

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Sylvania Radio Tube "Firsts"

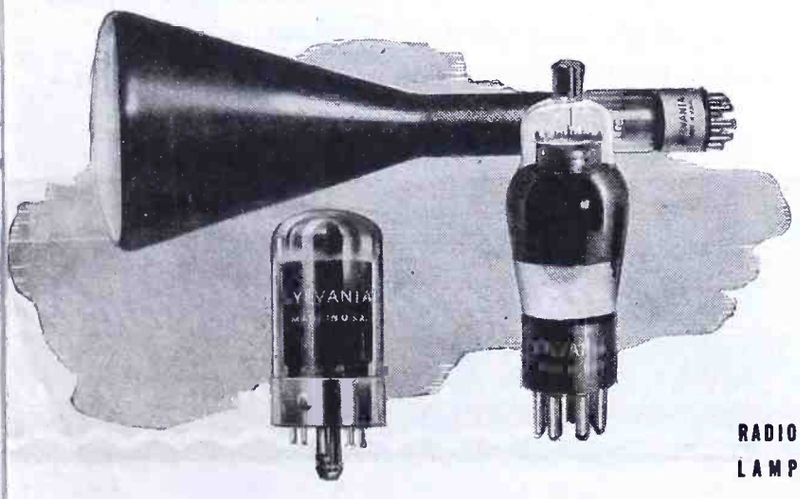
Sylvania was first to introduce a line of 1.4-volt tubes, which made the camera-type portable radio the rage of 1938 and later contributed to our military radio service.

Prior to this Sylvania development, the standard filament voltage for battery receivers was 2.0. This meant that two dry cells had to be connected in series to provide 3 volts. This power was reduced to 2.0 volts by means of a resistor, which dissipated one-third of the expensive voltage.

Sylvania 1.4-volt tubes operated, without resistor, on a single dry cell. Their low filament drain made it possible to build combination receivers that took their power from either a 110-volt power line or a single dry cell.

This development, which is typical of Sylvania's leadership in engineering of economical standardization, went to war in portable radio equipment for close-range military communication. On every front 1.4-volt tubes reduced by half, the battery weight that our boys have to carry.

Quality that Serves the War Shall Serve the Peace



RADIO DIVISION ARMY (E) NAVY EMPORIUM, PENNSYLVANIA

SYLVANIA

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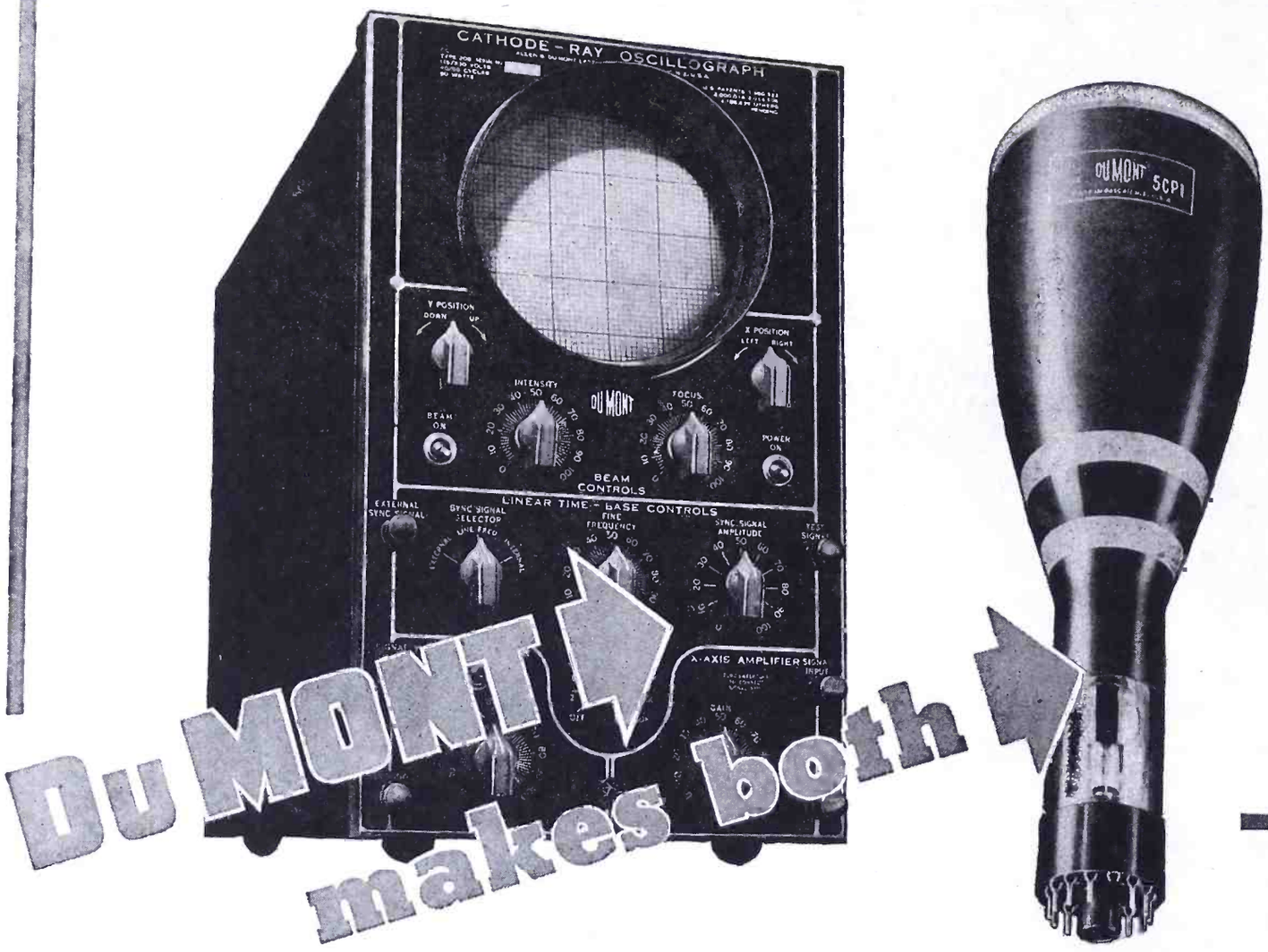
For complete, balanced, fully guaranteed instrumentation . . .



DuMONT makes both

ARMY (E) NAVY

DuMont cathode-ray specialists have compiled and published a manual and catalog just off the press. This book is replete with valuable data on cathode-ray principles and practice, as well as descriptions and listings of DuMont tubes and equipment. Write on your business stationery for your registered copy. And do not hesitate to submit your cathode-ray problems for engineering collaboration.

Yes, DuMont makes both — cathode-ray tubes and instruments. Pioneer of the commercialized cathode-ray art, DuMont has always insisted that such equipment be developed, designed and built as a thoroughly coordinated whole, since basically the equipment is but an extension of the cathode-ray tube itself.

That is why DuMont tube specialists and instrument makers work side by side. Latest tube developments are immediately available to DuMont instrument makers. Contrariwise, as DuMont instrument makers evolve new circuits or functions, they can count on corresponding tube characteristics. Meanwhile four DuMont plants translate that ideal coordination into up-to-the-minute tubes and instruments.

Always remember, DuMont makes both—tubes and equipment—for that complete, balanced, fully guaranteed instrumentation.

DUMONT *Precision Electronics & Television*

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

ATTENTION TO DETAIL ADDS UP TO DEPENDABLE PERFORMANCE

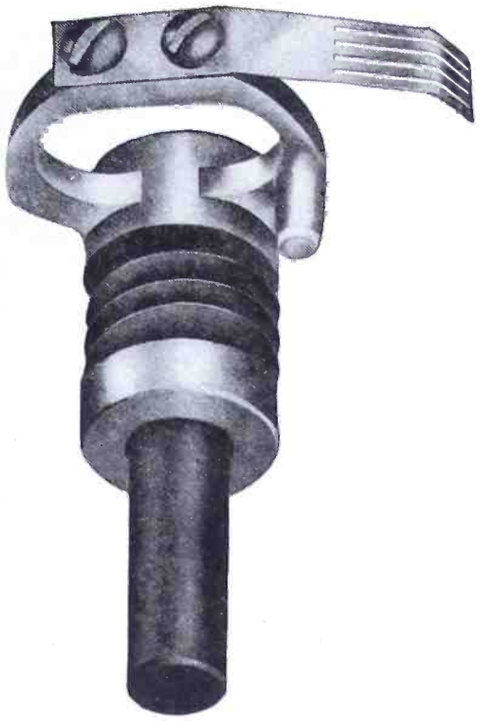
DeJUR U.S.A.

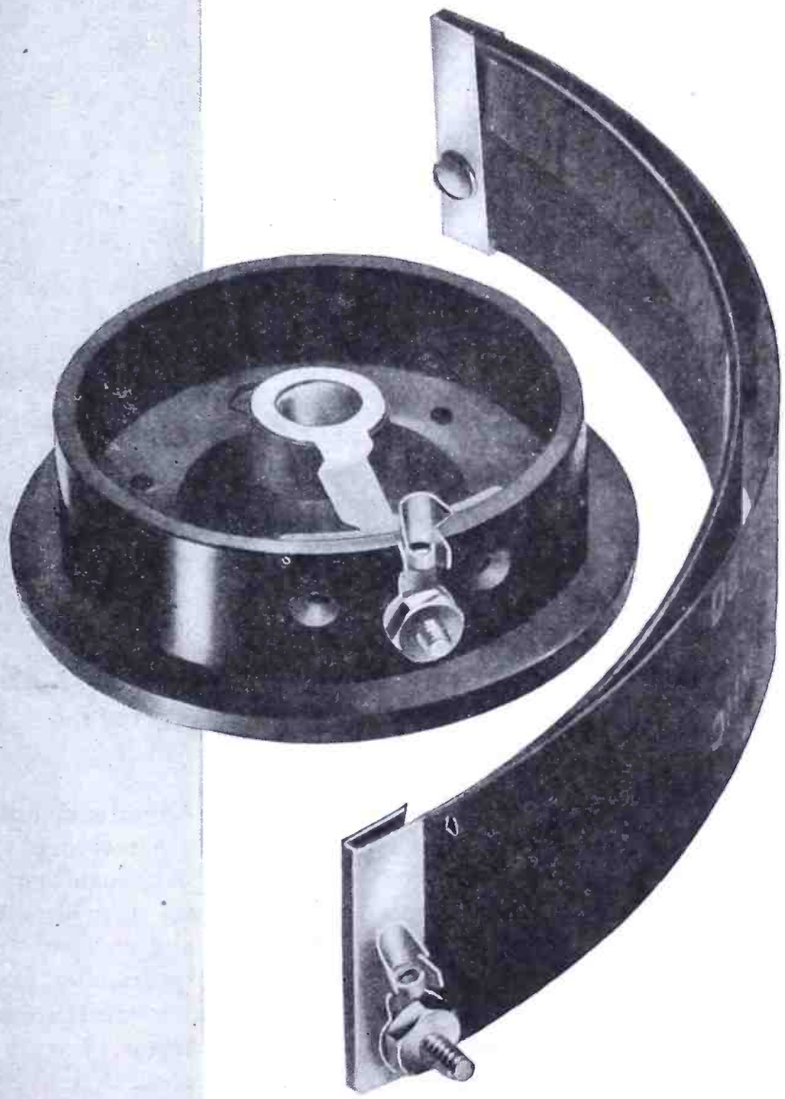
POTENTIOMETERS

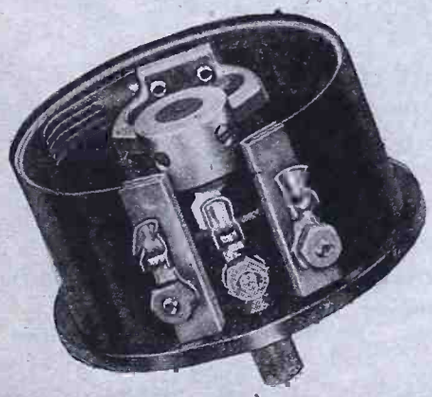
TYPES 260, 275, 261, 276, 281, 291, 292, 296

Twenty-five years of experience in the precision electrical instrument field assure quality and dependability in DeJur potentiometers. We have created a wide variety of standard models for practically all applications. Special attention is paid to individual specifications.

- Winding strip is wound on a linen bakelite card which has been carefully sanded before winding.
- Windings are made of either Nichrome or Advance wire, depending upon the resistance of the card to be wound.
- The card, wrapped around a moulded phenolic base, is held in position by heavily plated brass nuts and bolts.
- The wiper, incorporating five contacts, is made of plated bronze, carefully buffed where electrical contact is made with the winding.
- Types 261, 276, 281, 292 and 296 incorporate an "edge" type wiper for closer tolerances.
- The shaft may be either bakelite, cold rolled steel suitably plated, or solid brass, depending on whether the instrument is to have a live or dead shaft.
- The bushing which supports the shaft is made of precision machined brass.
- For ease of wiring installation, the selected terminal lugs are carefully tinned.
- In assembly, the cards are treated by dipping and baking to assure adhesion of the winding to the card; the entire unit is assembled to exacting specifications.







A DEJUR ENGINEER IS AVAILABLE FOR A DISCUSSION OF YOUR PRESENT OR POSTWAR APPLICATIONS

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MANUFACTURERS OF DeJUR METERS, RHEOSTATS, POTENTIOMETERS AND OTHER PRECISION ELECTRONIC COMPONENTS

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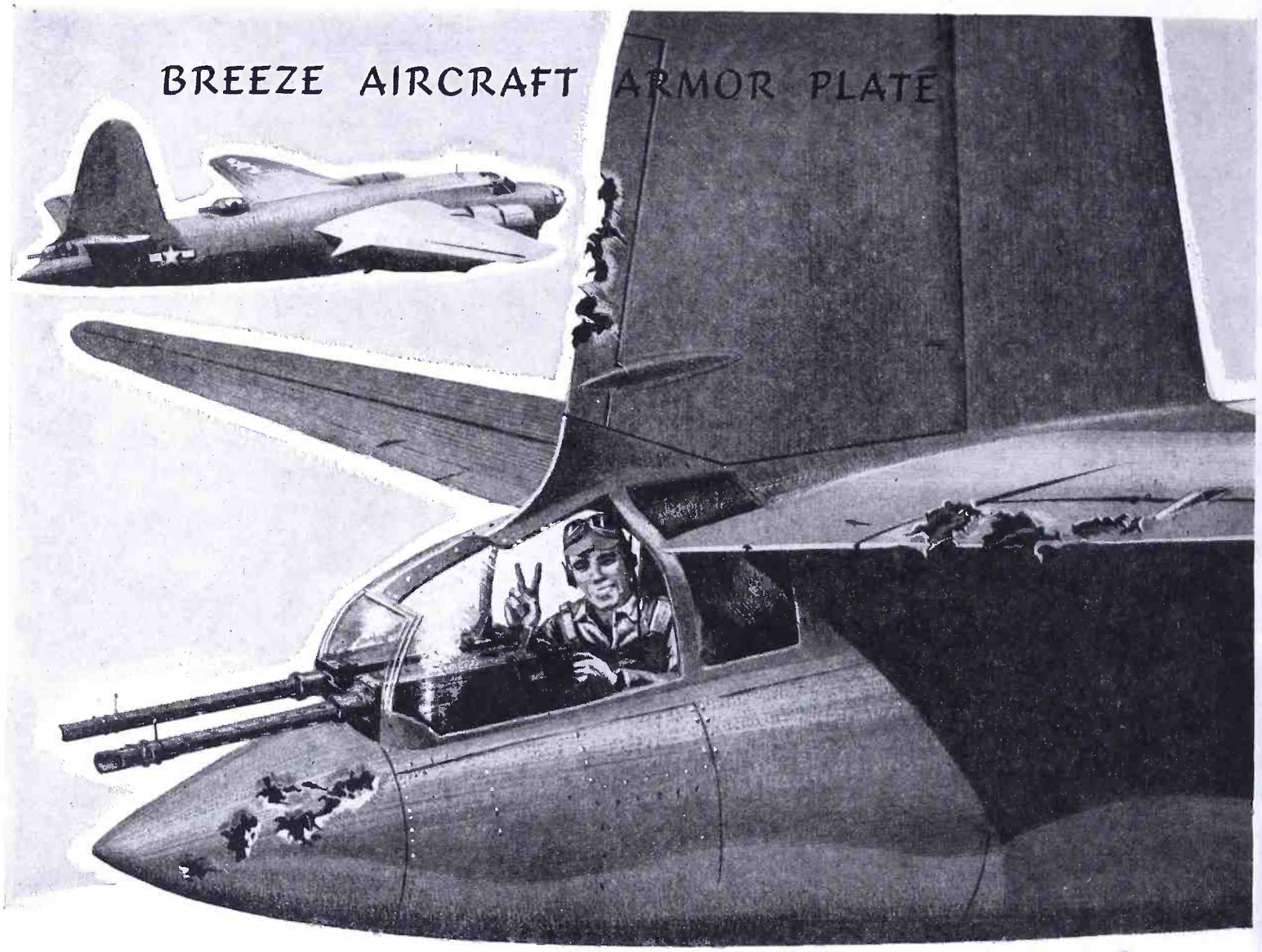
BUY MORE THAN BEFORE . . . KEEP "HOARDING" WAR BONDS

ARMY E NAVY

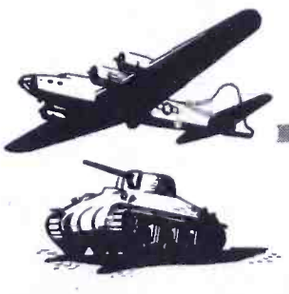


Homeward Bound

Breeze Aircraft Armor Plate Brings 'Em Back Alive In World-Wide Theatres of Warfare

Breeze Aircraft Armor Plate is in action today on Allied invasion fronts, providing dependable protection for pilots and gunners of America's hard-hitting bombers and fighters. Produced in quantity by the Breeze Electric Heat Treating Process, the fastest known for the purpose, this Armor Plate helps to bring home not only trained personnel but valuable equipment as well.

Breeze Armor is manufactured in two types: homogeneous and face-hardened. Although light in weight, it possesses the highest ballistic qualities and resistance to shatter. Complete assemblies to designers' special requirements are a specialty. Aircraft Armor Plate supplements the well-known Breeze line of equipment which is now in service on land, on the sea, and in the air.



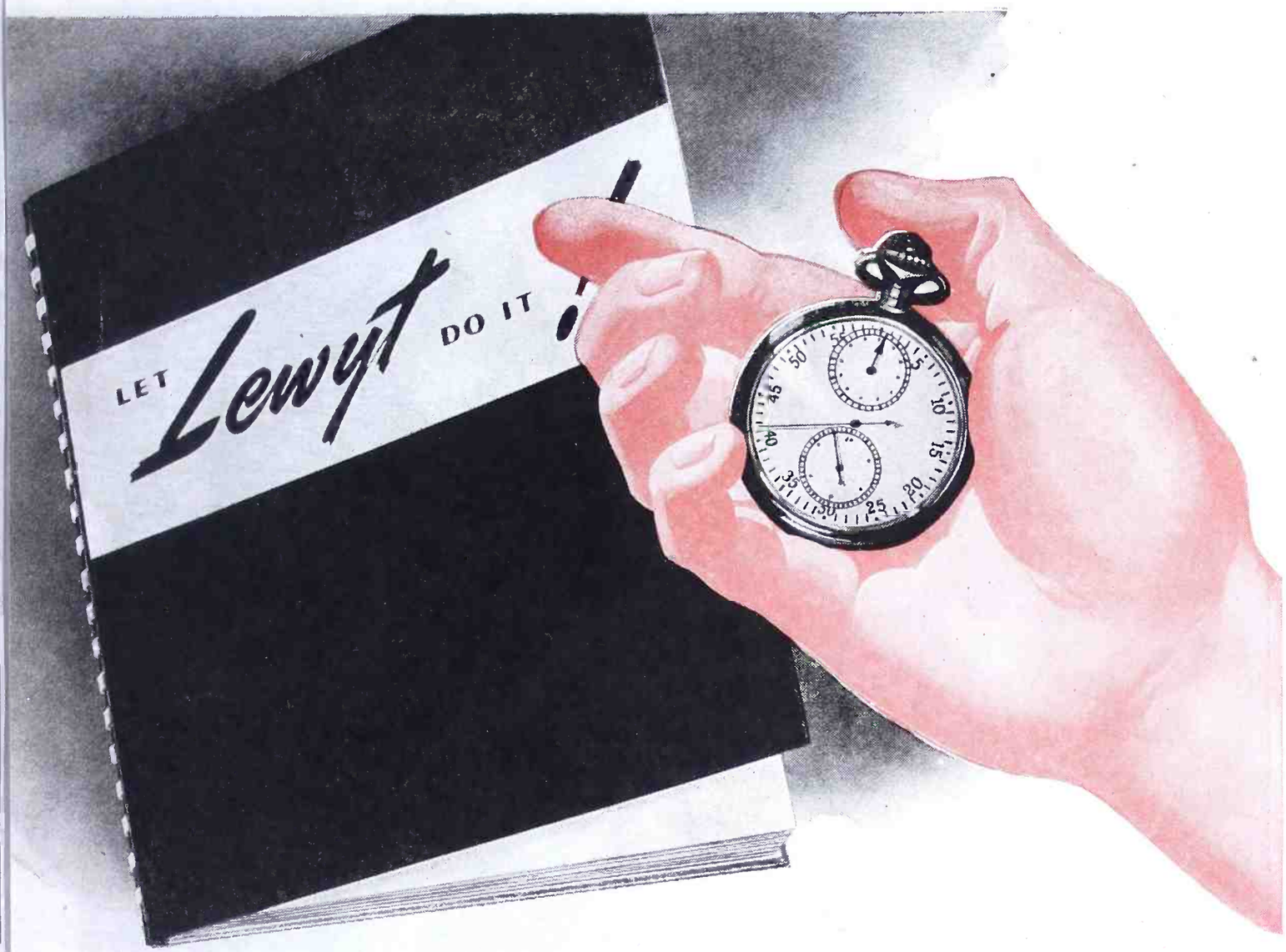
A Few of the Many Breeze Products in the Nation's Service

Radio Ignition and Auxiliary Shielding • Multiple Circuit Electrical Connectors • Flexible Shielding Conduit and Fittings • Cartridge Engine Starters • Internal Tie Rods • Elevator and Rudder Tab Controls • Flexible Shaft and Case Assemblies • Aircraft Armor Plate

Breeze BREEZE MARK

CORPORATIONS, INC. NEWARK, N. J.

PRODUCTION FOR VICTORY • PRODUCTS FOR PEACE



C-DAY WILL HOLD A STOP WATCH...

THIS BOOK is designed to help you prepare for CONVERSION DAY . . . it presents the story of a unique institution that may have the answer to your production problem . . . it suggests a plan for putting your new product development *in training* for the post-war starter's gun.

When materials are no longer ear-marked for war . . . when civilian goods are price-marked for peace . . . there will be no glory or profit at the *finish line* for any but the *winners!*

"Cost-Plus" profits will be outlawed . . . wartime regulations will give place to time studies . . . the stop watch will take over control in the competitive race for manufacturing economies.

Lewyt has set the pace in contract manufacturing ingenuity through two post-war periods of business readjustment. We've had long training in cost-sensitive specialization. We're ready to partner with other manufacturers in producing their component electrical and electronic assemblies, chasses and housings . . . or complete units.

With our exceptional facilities and skills in electrical and mechanical parts manufacture carefully developed through 56 years, it will pay you to talk with us . . . at least write for this 48-page book. Ask for "Series B". There is no cost or obligation.

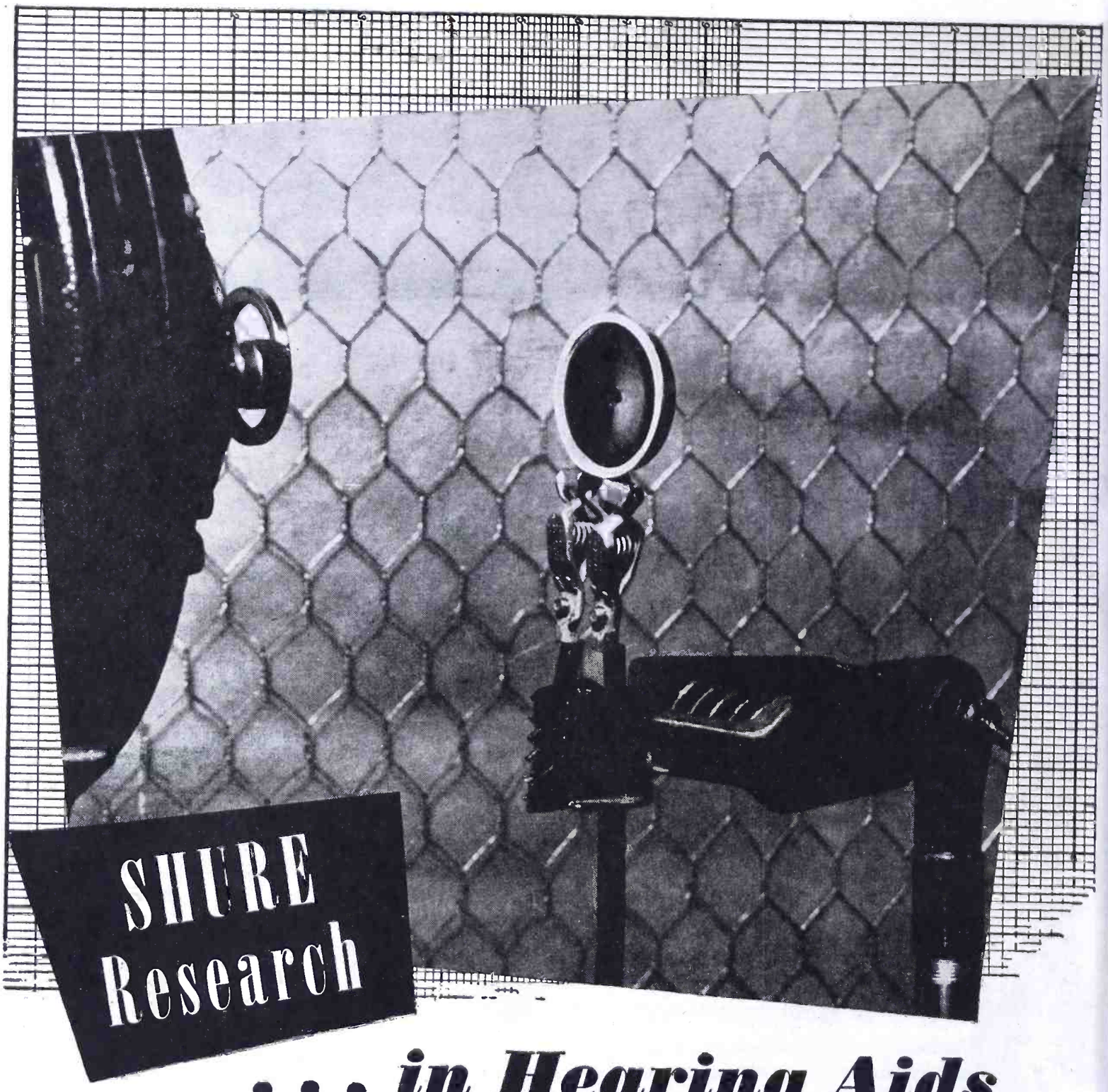
• • •

LEWYT CORPORATION, 76 BROADWAY, BROOKLYN 11, N. Y.

ARMY E NAVY

Lewyt

LET LEWYT DO IT

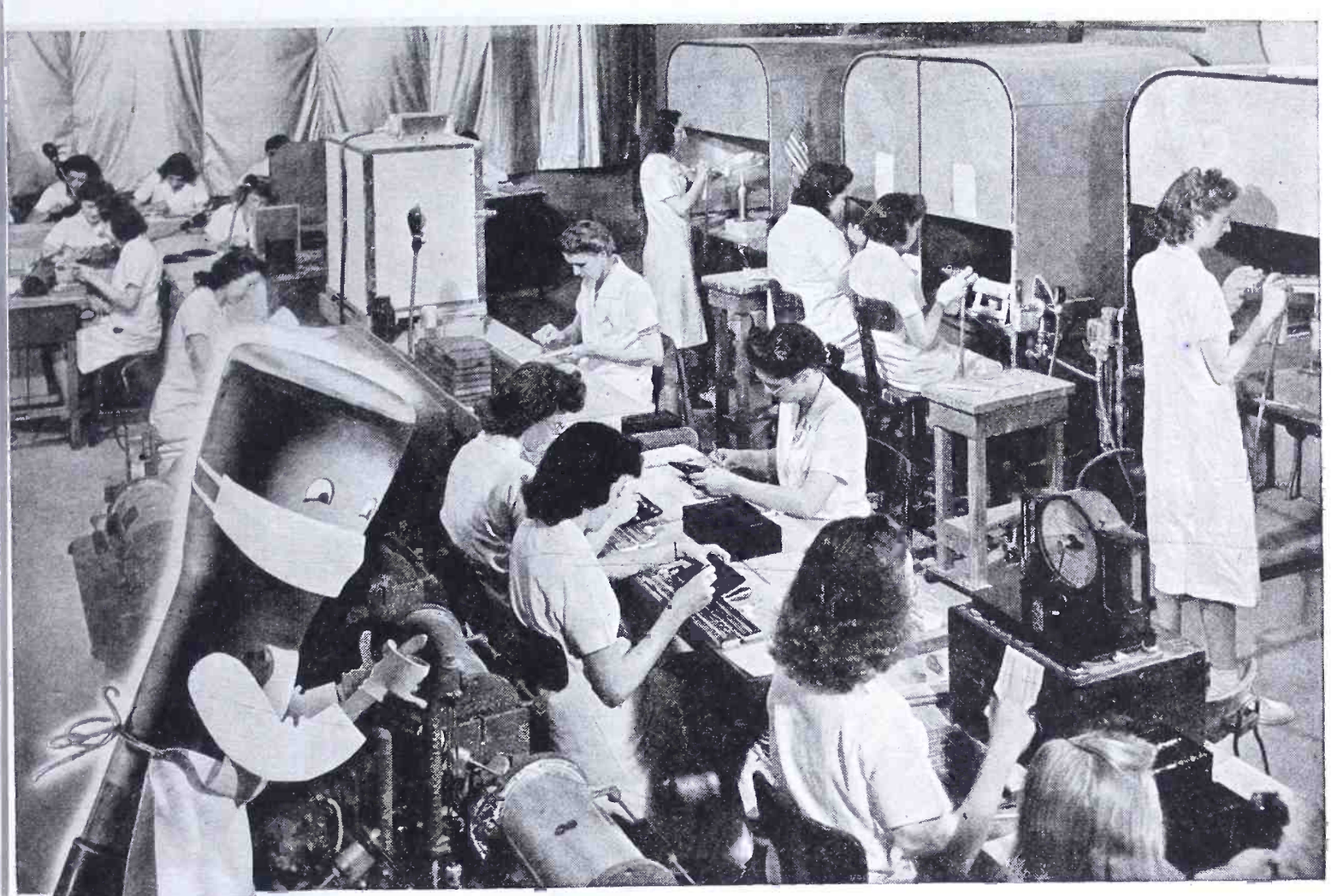


. . . in Hearing Aids

A vital component of the Hearing Aid is the Microphone which must be small, light, moisture-proof and possess the frequency response adapted to the Hearing Aid Device. Often the Microphone must be chosen to fit the threshold of hearing of the patient. Shure Research has succeeded so well in controlling the frequency response and output level of small size Hearing Aid Microphones that, today, Shure Brothers produces microphones for practically every major manufacturer of Hearing Aids.

SHURE BROTHERS, 225 West Huron Street, Chicago
Designers and Manufacturers of Microphones and Acoustic Devices.

SHURE MICROPHONES



NO SWEATER GIRLS, Please

Electronic tubes are as sensitive to lint, dust and minute particles of foreign matter, as a hay fever sufferer is to pollen. Unless the most stringent precautions are taken to keep tube parts free from impurities, trouble is sure to follow. Trouble—such as noisy receivers . . . discoloration or spots on the screen in cathode-ray tubes . . . power failure in transmitting tubes.

That is why National Union engineers go the limit to assure absolute cleanliness all along the production line. As an example, the model N. U. cathode spray room, pictured above, is not only clean—it's *hospital clean.* No fuzzy sweaters or lint-shedding dresses are worn here. There is no dust, no dirt, because it's air-conditioned. Humidity and temperature are precisely controlled. The whole room is washed from ceiling to floor once a week. Then, to make sure, the individual parts are sterilized —some in boiling water—others in special solvents—still others by hydrogen firing.

Even should other factors be equal, the cleaner tube is the better tube. Remember this—and *count on* National Union.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J.; Lansdale and Robesonia, Pa.

NATIONAL UNION

RADIO AND ELECTRONIC TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

JUST OUT!

. . . GET THIS TIMELY, NEW *Dry Electrolytic Capacitor* CATALOG

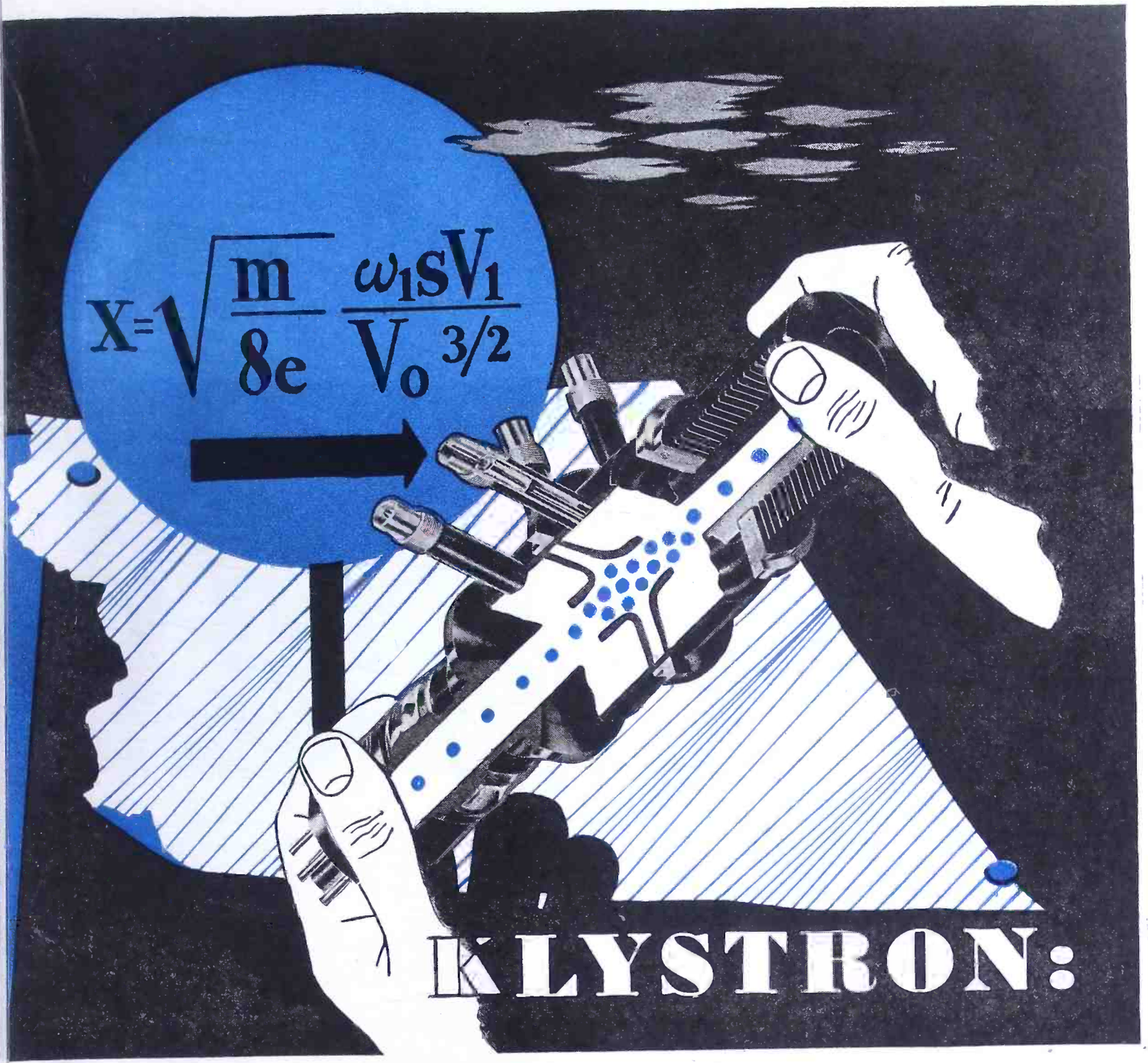
Every day finds dry electrolytic capacitors establishing new standards of performance in applications formerly reserved for other types. Small, light and inexpensive, dry electrolytics have been steadily improved to a point where they meet the most exacting specifications. These include salt air, reduced pressure, low and high temperature extremes, transients, r-f impedance, sealing, "shelf life," and many more. In addition, Sprague Dry Electrolytics are available in unlimited combinations of capacity and voltage ratings, with special electrical characteristics, and in containers for every mechanical requirement. You will find this big new catalog a handy guide to dozens of standard and countless special purpose types.

SPRAGUE ELECTRIC COMPANY, North Adams, Mass.
(Formerly Sprague Specialties Co.)

SPRAGUE

ARMY E NAVY

CAPACITORS · KOOLOHM RESISTORS



Mathematically, here's the inside story

THE FORMULA in the picture above is an expression of *bunching* as it takes place in the Klystron tube.

This Sperry tube converts DC energy into radio frequency energy by allowing an electron beam to become bunched, or pulsating, between spaced grids.

▶ The ultra-high-frequency micro-waves thus generated can be concentrated into a narrow beam and directed with great accuracy.

Various other forms of the Klystron have been developed by Sperry to aid in the amplification and reception of ultra-high-frequency waves. Today they are vital parts of many a device used by our Armed Forces.

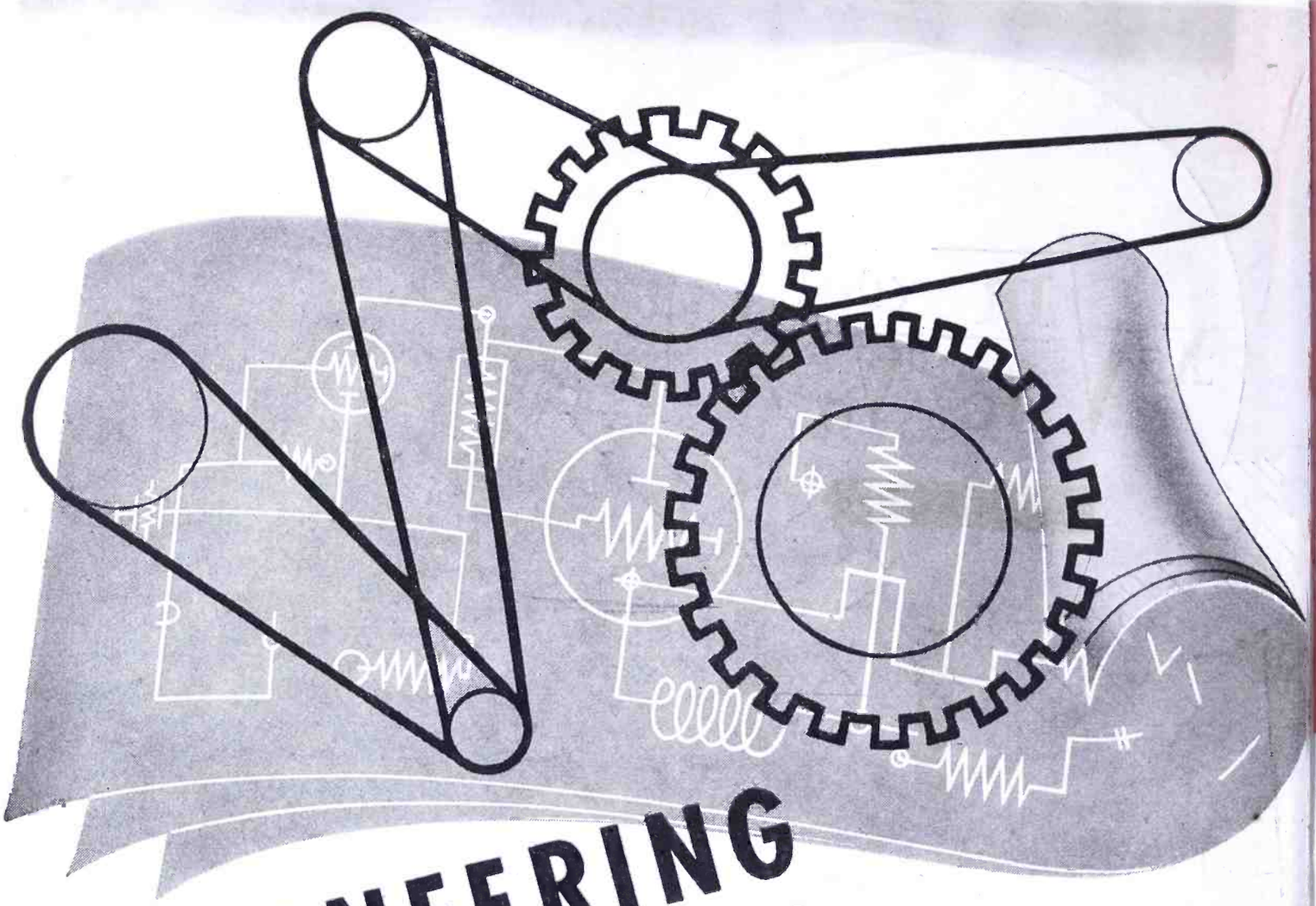
The name "KLYSTRON" is a registered trade-mark of the Sperry Gyroscope Company, Inc. Like other Sperry devices, Klystrons are also being made during the emergency by other companies.

▶ Klystrons are now being produced in quantities, and certain types are available. Write us for information.

Sperry Gyroscope Company INC.

GREAT NECK, N. Y. • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS



ENGINEERING AND PRODUCING

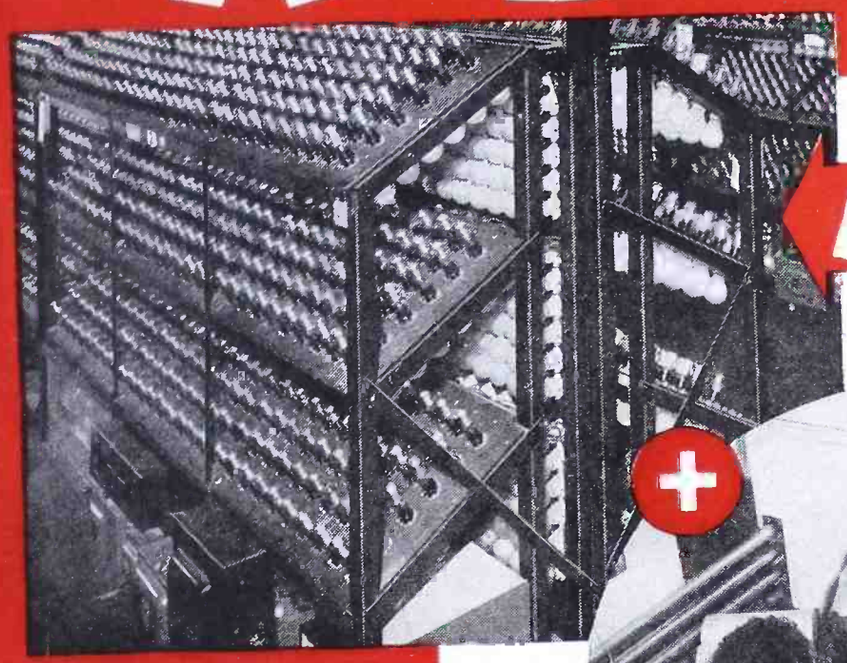
Doolittle Engineers are still designing and producing radio equipment for the *Naval Aircraft Factory* and the *Bureau of Aeronautics*. . . . Before the war began, "Specialized Communications Equipment" by DOOLITTLE was a consistent aid to aviation, broadcast and police radio engineers . . . Come tomorrow, our pre-war and war-born experience will be translated into many new benefits for a world of peacetime communications . . . *Look Ahead with DOOLITTLE!*

BACK THE ATTACK
Buy More War Bonds

Doolittle RADIO, INC.

Builders of Precision Radio Communications Equipment
7421 South Loomis Boulevard, Chicago 36, Illinois

A + B = X ★ ★ ★

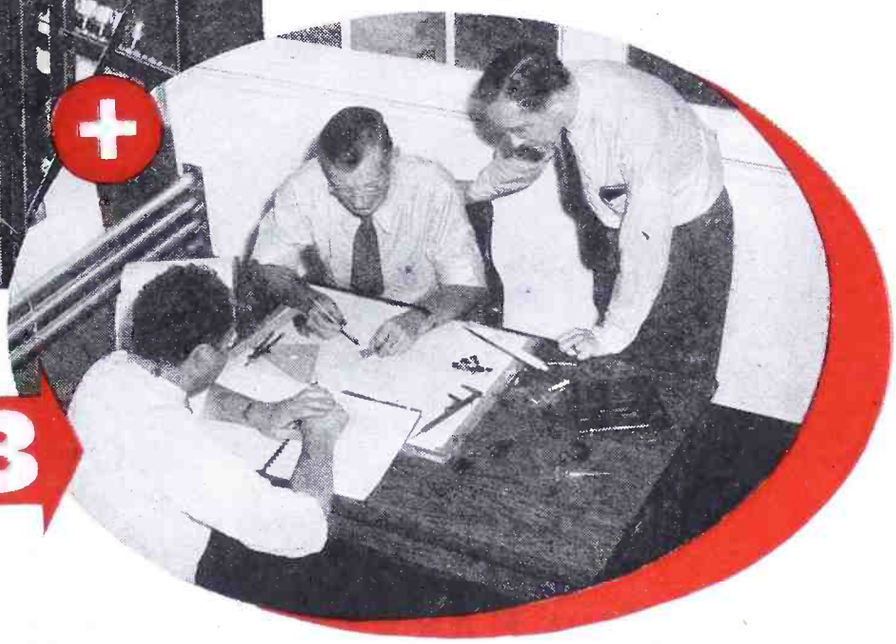


A

RECEIVING TUBE TECHNIQUE

Oldest manufacturer specializing on radio receiving tubes — the originator of the now standard BANTAM GT — Hytron has been developing skill in high-speed, soft-glass receiving tube technique since 1921.

+



B

SPECIAL PURPOSE ENGINEERING

Hytron engineers originated BANTAM JR. hearing-aid tubes —popular U-H-F types HY75, HY114B, HY615—instant-heating beam tetrodes HY65, HY67, HY69, HY1269—and numerous other special tubes.

=X

THE ANSWER

Add A to B, and you have the answer Hytron is able to give the Services when they demand special purpose and transmitting tubes in staggering quantities and at economical prices.

1616 Consider a few examples. Substituting soft for hard glass, a mesh for a ribbon filament, Hytron beat the promise by months on requirements for the high-voltage thermionic type 1616 rectifier—through application of mass production methods. Result: The Navy's, "Well done!"

OD3/VR-150 Hytron engineering refinements include new starting electrode, lower starting voltage, painstaking processing. Add to these still-increasing high-speed manufacture. Result: "When we think of the OD3/VR-150, we think of Hytron."*

*Quotation from expediter for one of largest electronic equipment manufacturers.

HY65 Typical of Hytron's instant-heating beam tetrodes for mobile communications, the HY65 combines high-speed techniques with a thoriated tungsten filament and special r.f. design features which gave the Services a rugged, power-conserving, all-purpose beam tetrode. (Cf. JAN-1A spec.)

2C26 Hytron solved a problem for the Services by designing a tube capable of performance and high ratings never before achieved in soft glass. Produced at receiving tube speed and priced at less than a fourth of the cost of tubes replaced, the little 2C26 delivers 2 KW of useful r.f. power under intermittent operating conditions.

WHAT ABOUT POST-WAR? Hytron design, development, and production facilities now serving our fighting men, will be yours to command. The A plus B of Hytron's know-how will supply answers to your special tube problems.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION

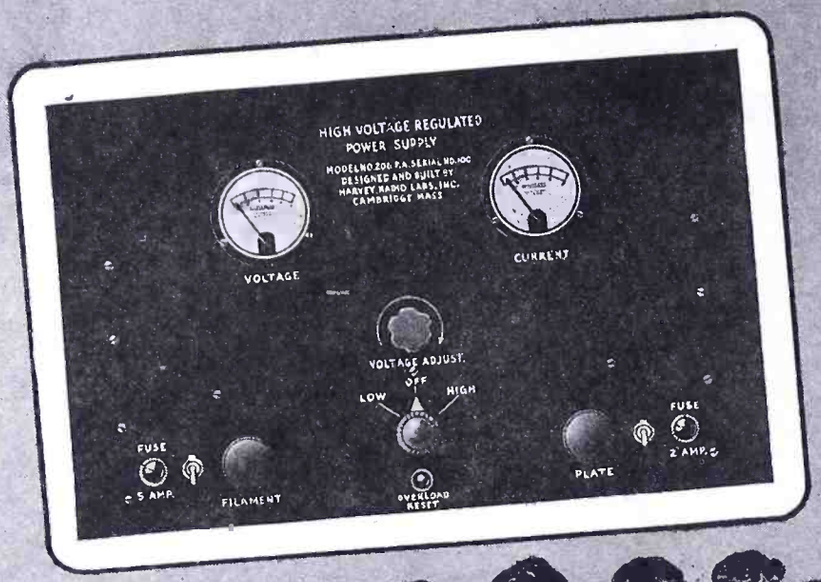
ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

ARMY NAVY

HYTRON RADIO TUBES

BUY ANOTHER WAR BOND



PREVIEW of a NEW HARVEY OF CAMBRIDGE HIT!

Featuring

The New HARVEY Regulated Power Supply 206 PA

RANGE 500 to 1000 VOLTS

This new Harvey development is bound to be a star, because it fills the need for a Regulated Power Supply in upper voltages. It may be operated in two ranges, 500–700 at ¼ of an ampere and 700 to 1000 at .2 of an ampere. Both ranges have accurate regulation to *one per cent or better.*

The new HARVEY Regulated Power Supply 206 PA is a model of efficiency and operating convenience. All parts are readily accessible to the operator. It is equipped with spare fuses, a 6 ft. heavy duty Tyrex cord with a handy two prong plug.

The HARVEY 206 PA is fused on the primary side and has both an overload relay and time delay relay. Two interlocks on the chassis afford the operator complete protection. A black, crackle-finish panel and copper plated chassis make the 206 PA an instrument of beauty as well as precision.

Although the HARVEY 206 PA is too new to picture publicly, it has been thoroughly tested and proved and is now in production. Made by the makers of the HARVEY 106 PA that is providing fine, dependable performance in the 200 to 300 volt range, the HARVEY 206 PA will provide equally fine performance in the higher voltages.

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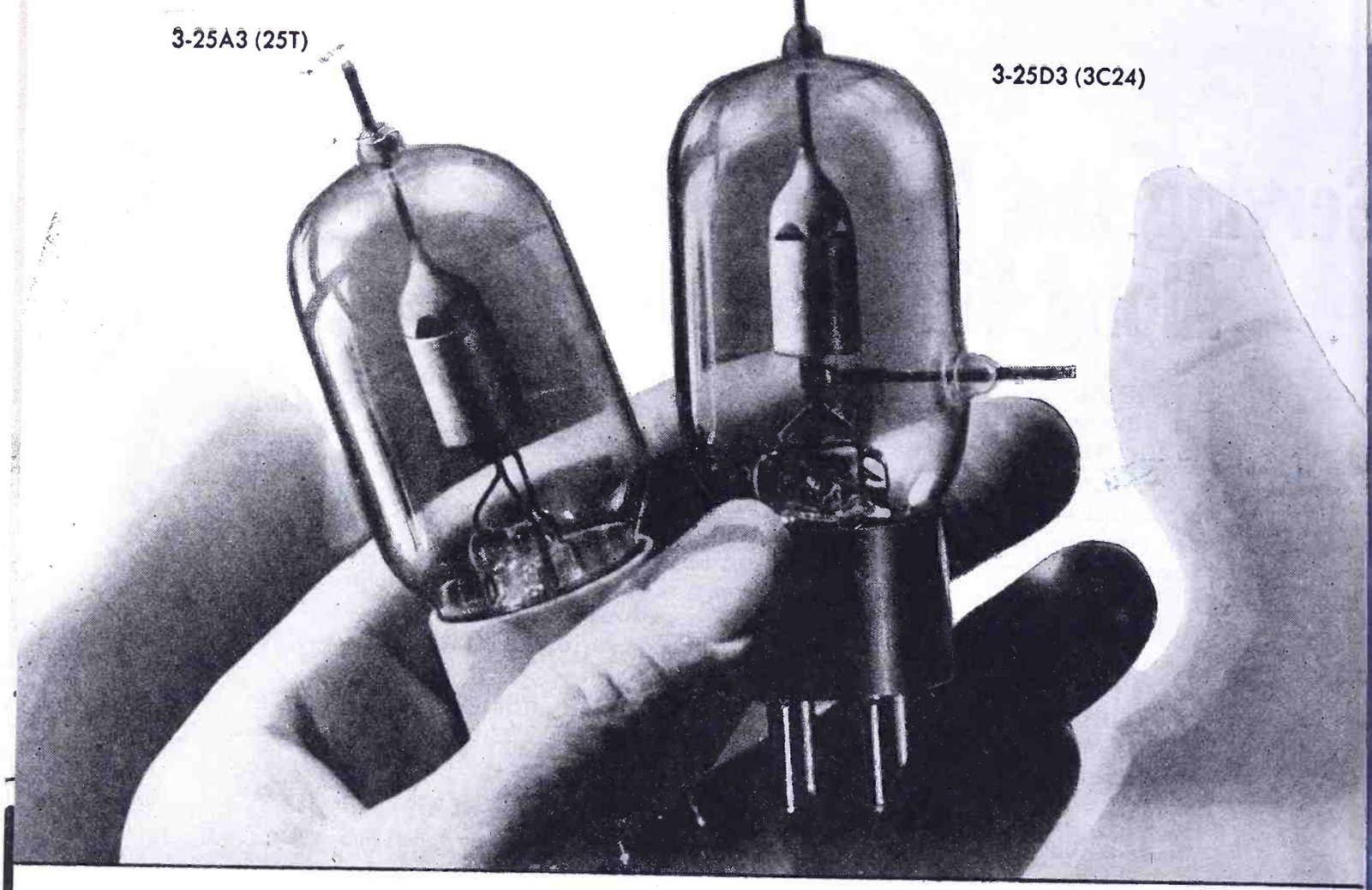

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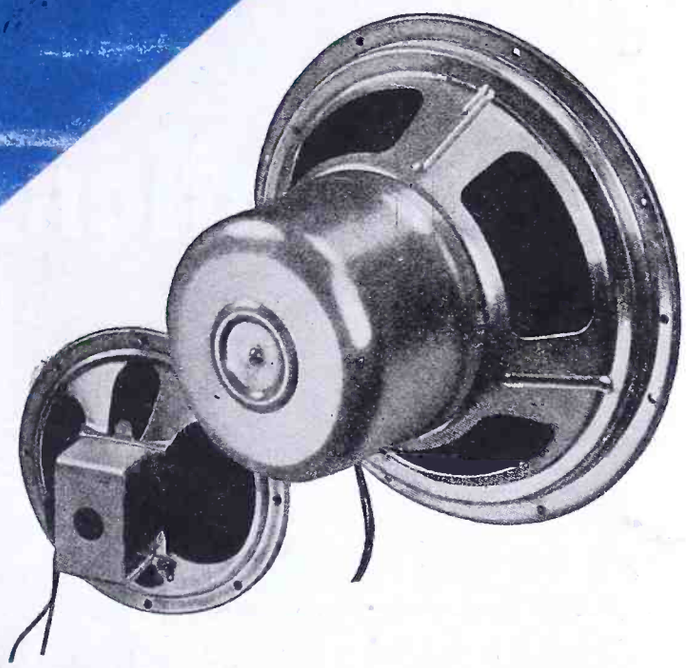

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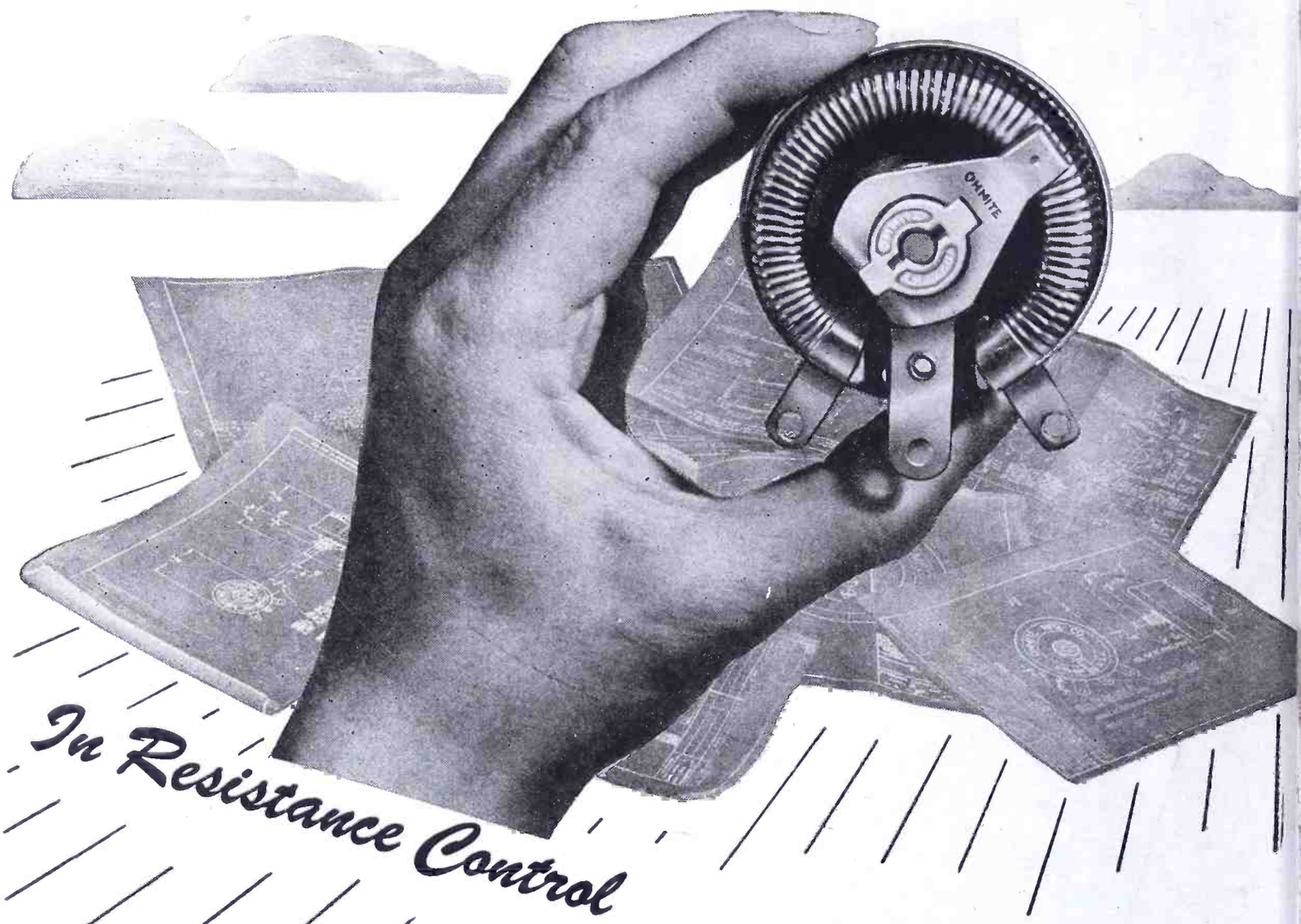

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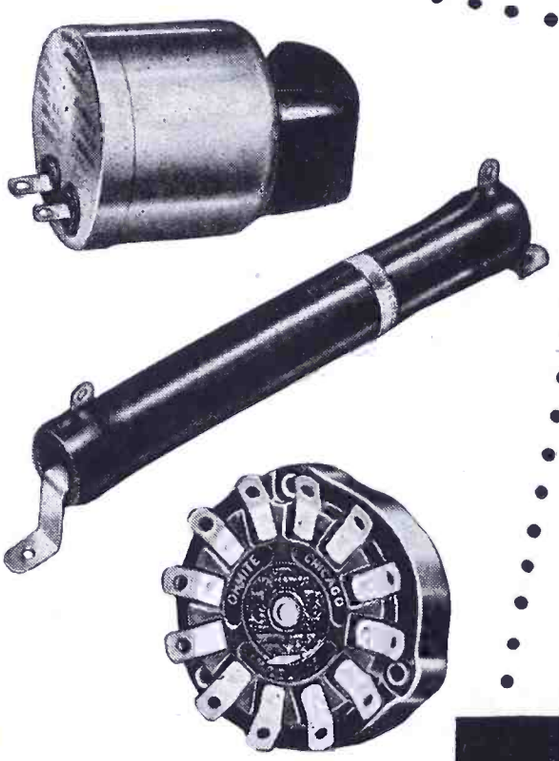

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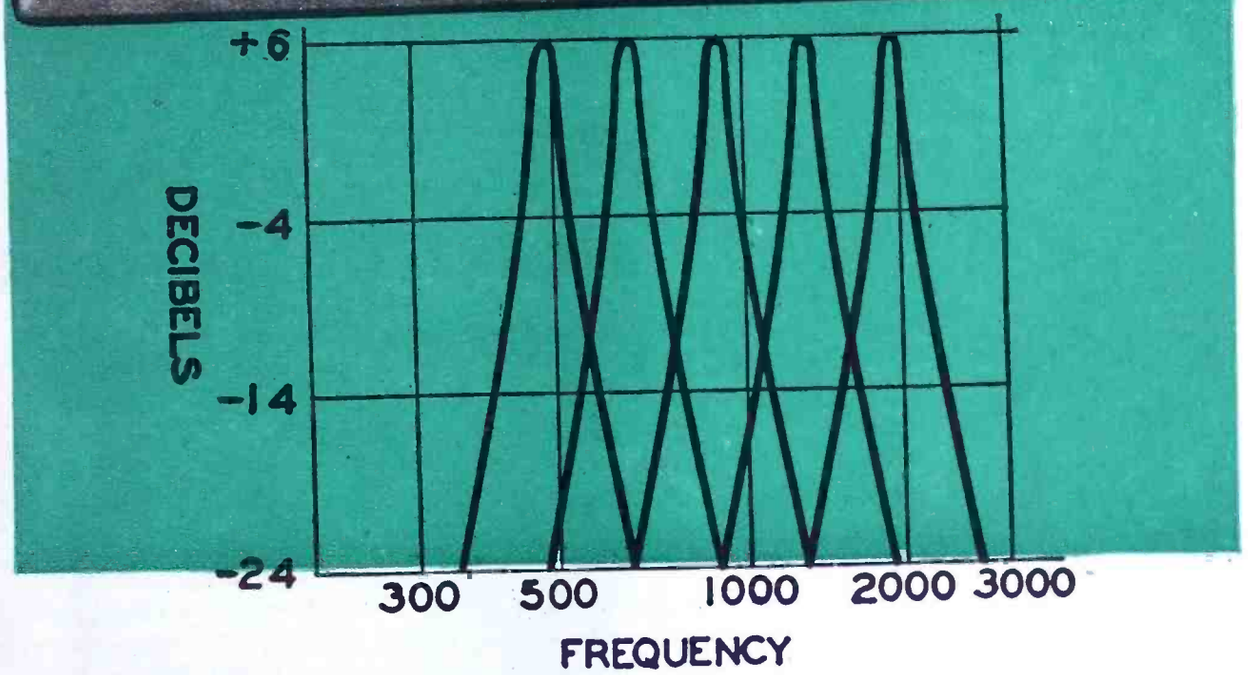

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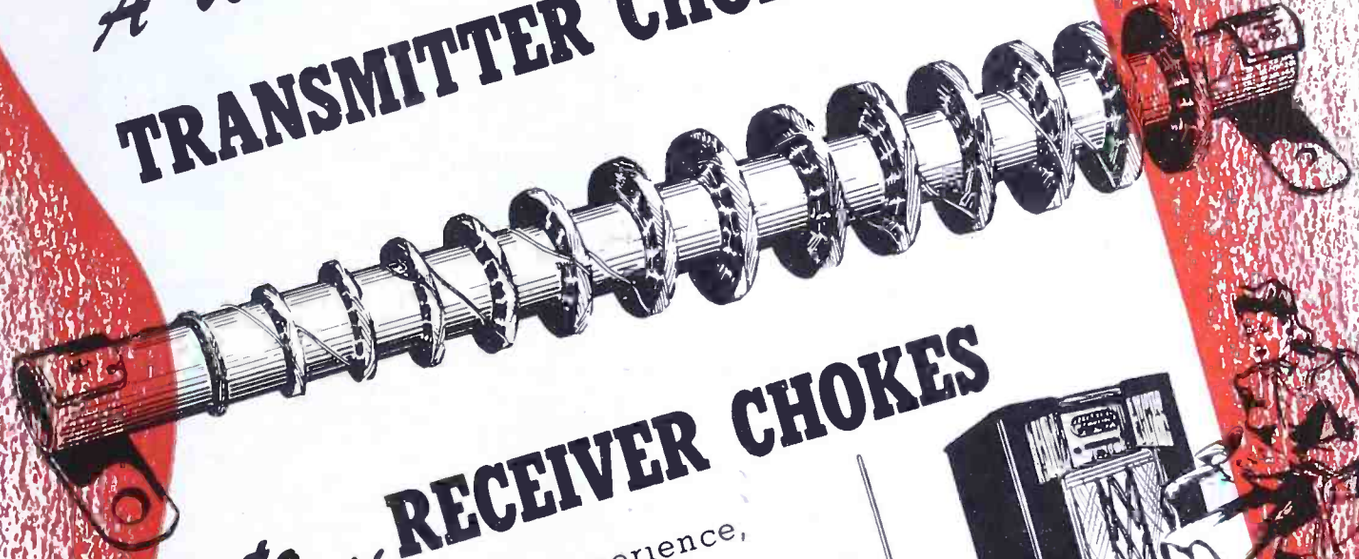

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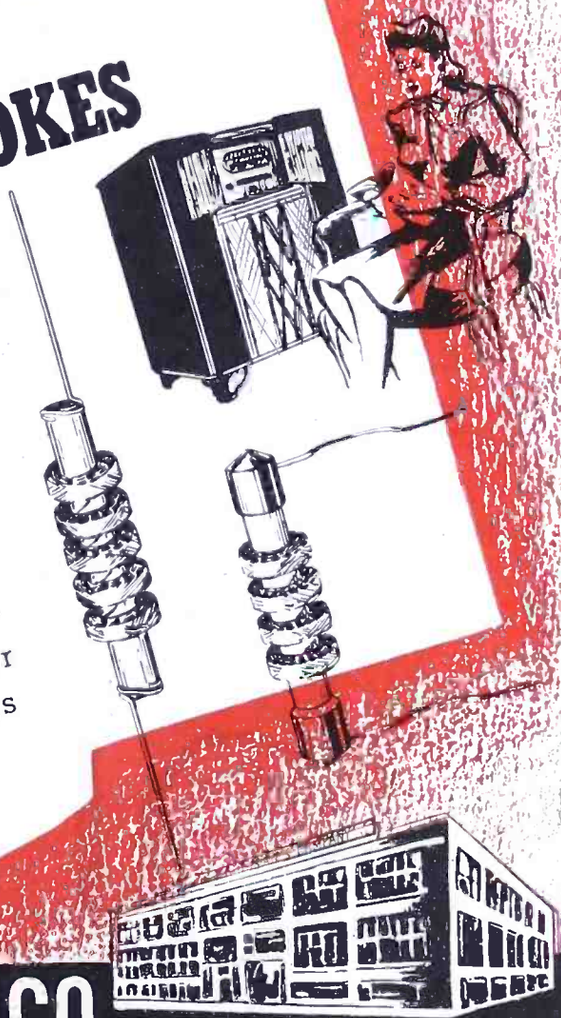

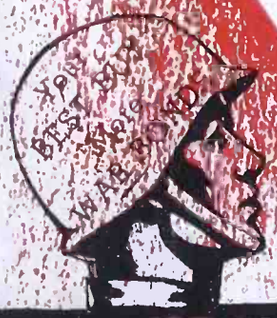

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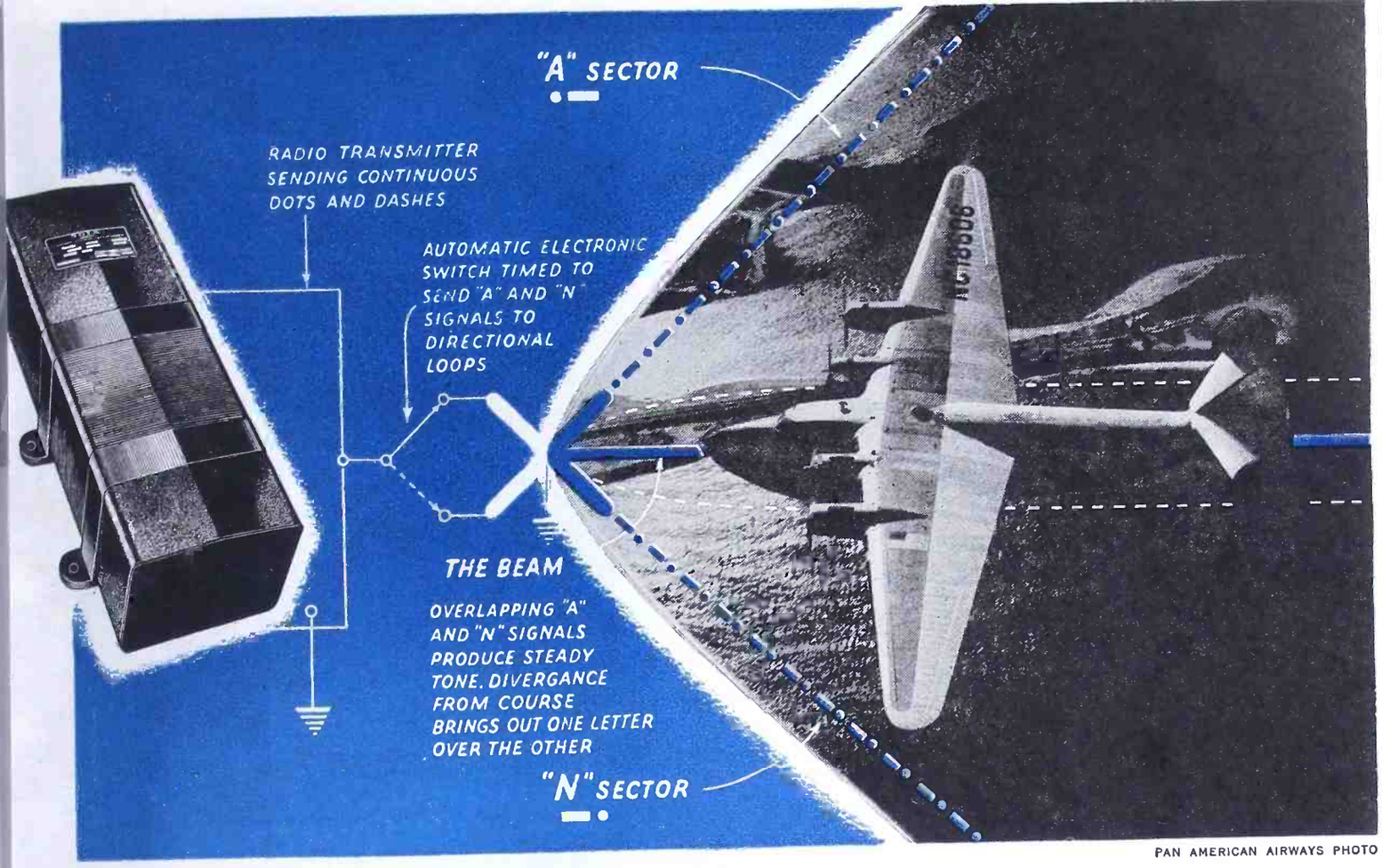

PAN AMERICAN AIRWAYS PHOTO

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Miles above familiar landmarks, with vision obliterated by fog, sleet or storm clouds, the steady, fused tone of the "dot dash—dash dot" in the head phones is like a soothing symphony to the ears of the airplane pilot. A fading, disrupted signal spells danger.

Thus you will find SOLA Constant Voltage Transformers powering the directional beams of most commercial air lines, and the instrument landing equipment of the C. A. A. Without this constancy of operating voltage, a steady projection of radio beams is impossible.

Radio range stations must necessarily be in constant operation and fully automatic. In most instances they are located at great distances from the airports. Anything short of instantaneous adjustment of the voltage fluctuations would be unacceptable to these instruments, too sensitive to tolerate variations exceeding ± 1%.

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In designing any device dependent on precise input voltage, the design engineer's responsibility does not end with specifying the operating voltage on the label.

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SOLA Constant Voltage Transformers are available in standard units with capacities ranging from 10VA to 15KVA. As a built-in part of electrically operated instruments or devices, special units can be custom built to exact product design specifications.

To Manufacturers:
Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.

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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.

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So keep this one salient fact before you at all times: *The backbone of our vital war financing operation is your Pay Roll Savings Plan.*

Your job is to keep it constantly revitalized. See to it that not a single new or old employee is left unchecked. See to it that your Team Captains solicit everyone for regular week-in and week-out subscriptions. And raise all percentage figures wherever possible.

Don't underestimate the importance of this task. This marginal group represents a potential total sales increase of 25% to 30% on all Pay Roll Plans.

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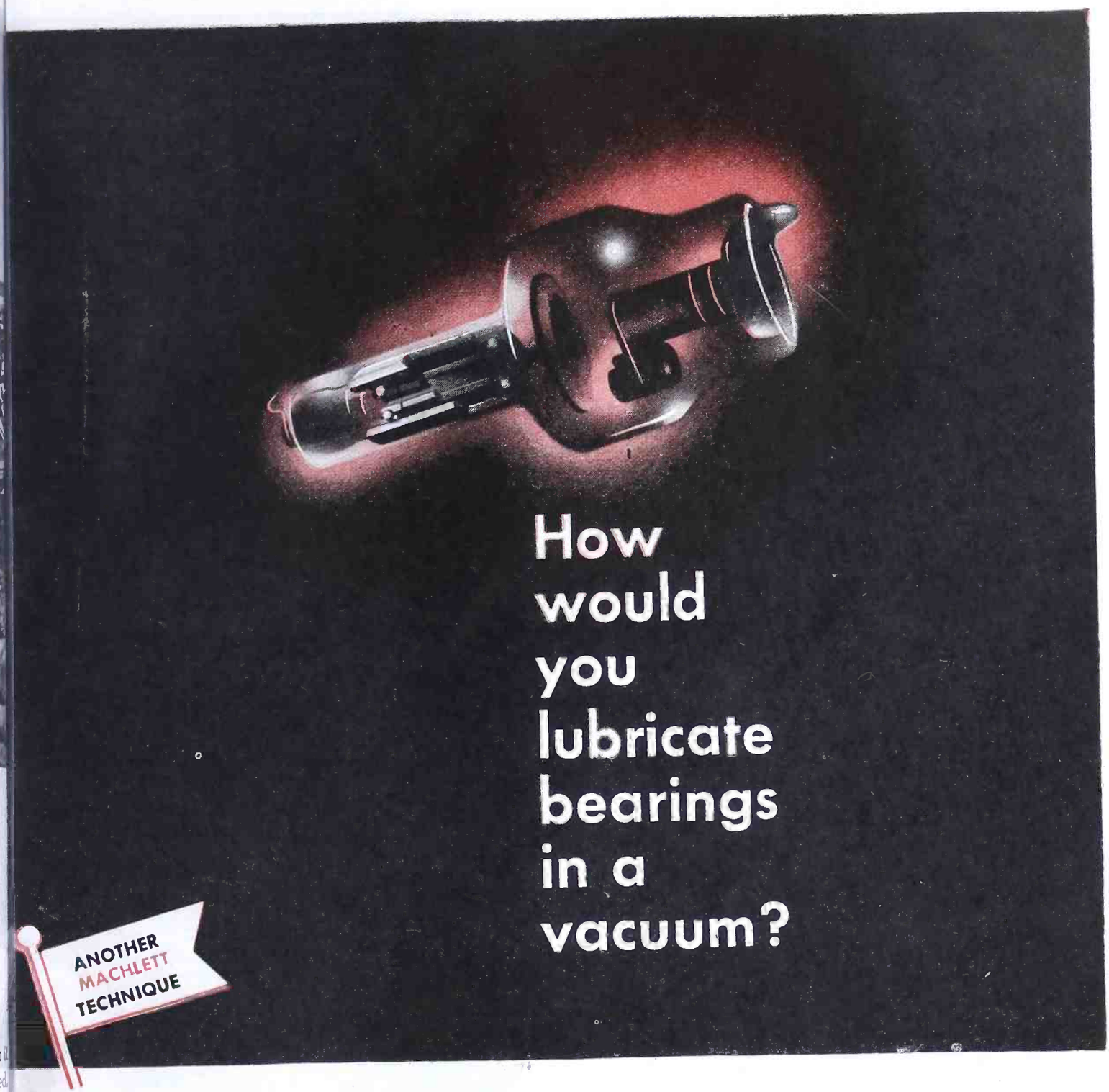


How would you lubricate bearings in a vacuum?

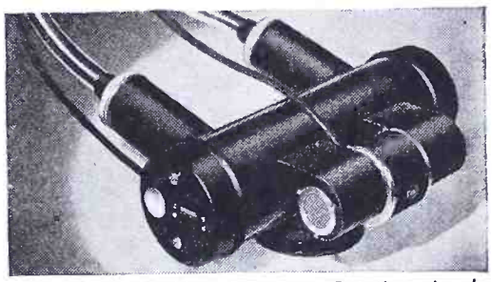
ANOTHER MACHLETT TECHNIQUE

his is a cross-section of the Machlett Dynamax X-ray tube. The ball bearings support the anode, which rotates at 3000 r.p.m., and reaches a temperature of 1000° F. The entire structure is in a vacuum of about 10^{-6} mm. of mercury, or a billionth of an atmosphere.

Conventional lubricants cannot be used, because they would destroy the vacuum and the tube. Machlett's scientific studies showed that a very thin film of certain metals can act as lubricant. Pure silver was found most advantageous. An almost molecular-thin film of it is deposited upon the balls in a vacuum, by a unique method.

So successful was this technique that Machlett, five years ago, guaranteed its Dynamax rotating anode tube for 10,000 exposures. Today it outlasts conventional stationary anode tubes. Some amazing records have been made with it, the best to date being 272,610 exposures, at the Army Examining and Induction Station, Pittsburgh, Pa.

This tube has a focal spot so small as to produce exceedingly sharp pictures, and an X-ray beam so intense as to make possible exposures as short as 1/60th sec. It was the solution of the lubrication problem that added reliability to these advantages. Machlett employs many other advanced techniques in the manufacture of its various types of high-vacuum tubes for medical, scientific and industrial purposes . . . Machlett Laboratories, Inc., Springdale, Connecticut.



This is the Machlett Dynamax Rotating Anode tube, 100 kilovolts, 50 kilowatts, as supplied in an oil-filled, shockproof housing with air circulator and vapor-proof cable terminals.

MACHLETT

X RAY TUBES SINCE 1898

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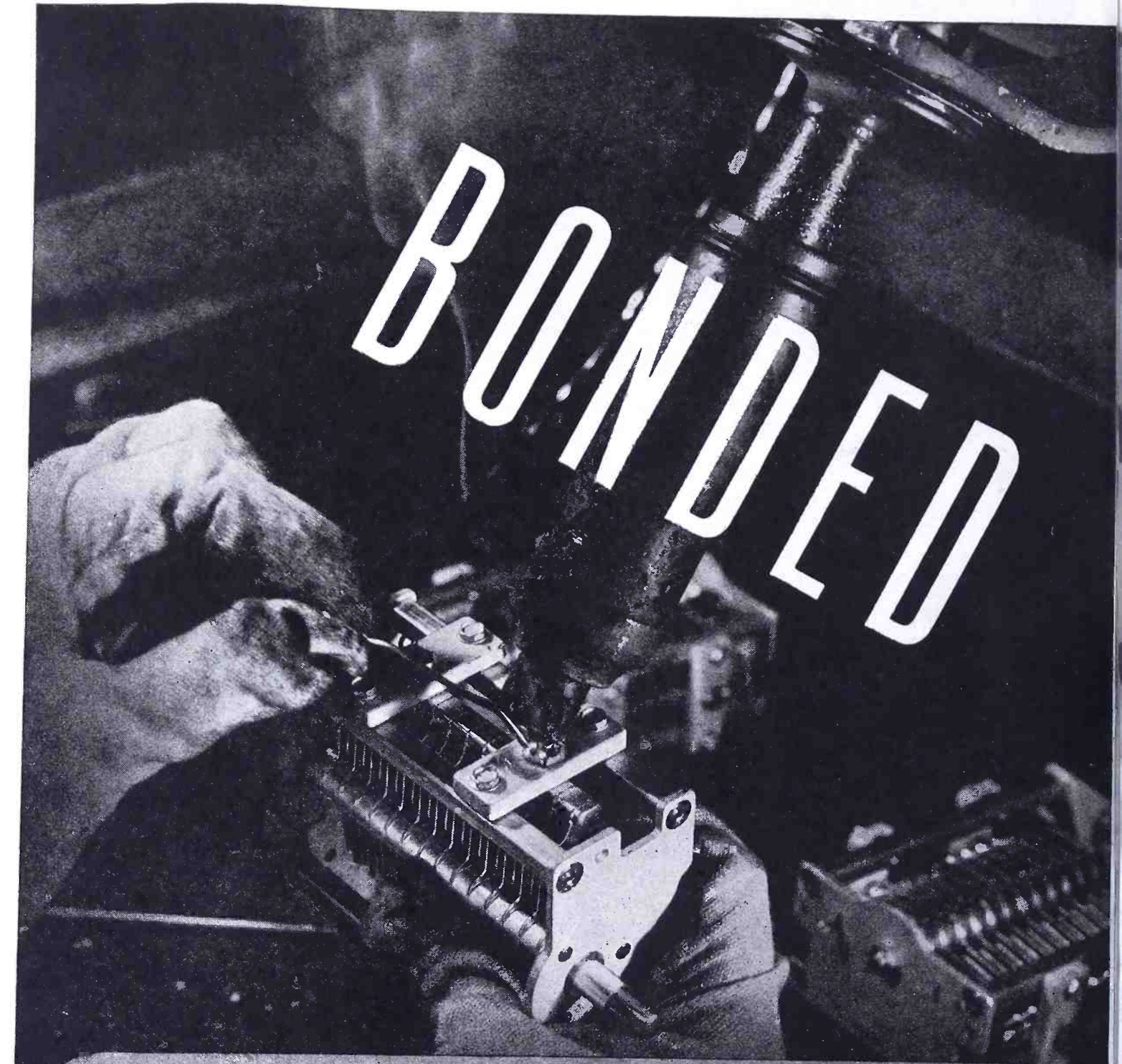

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COMMUNICATIONS

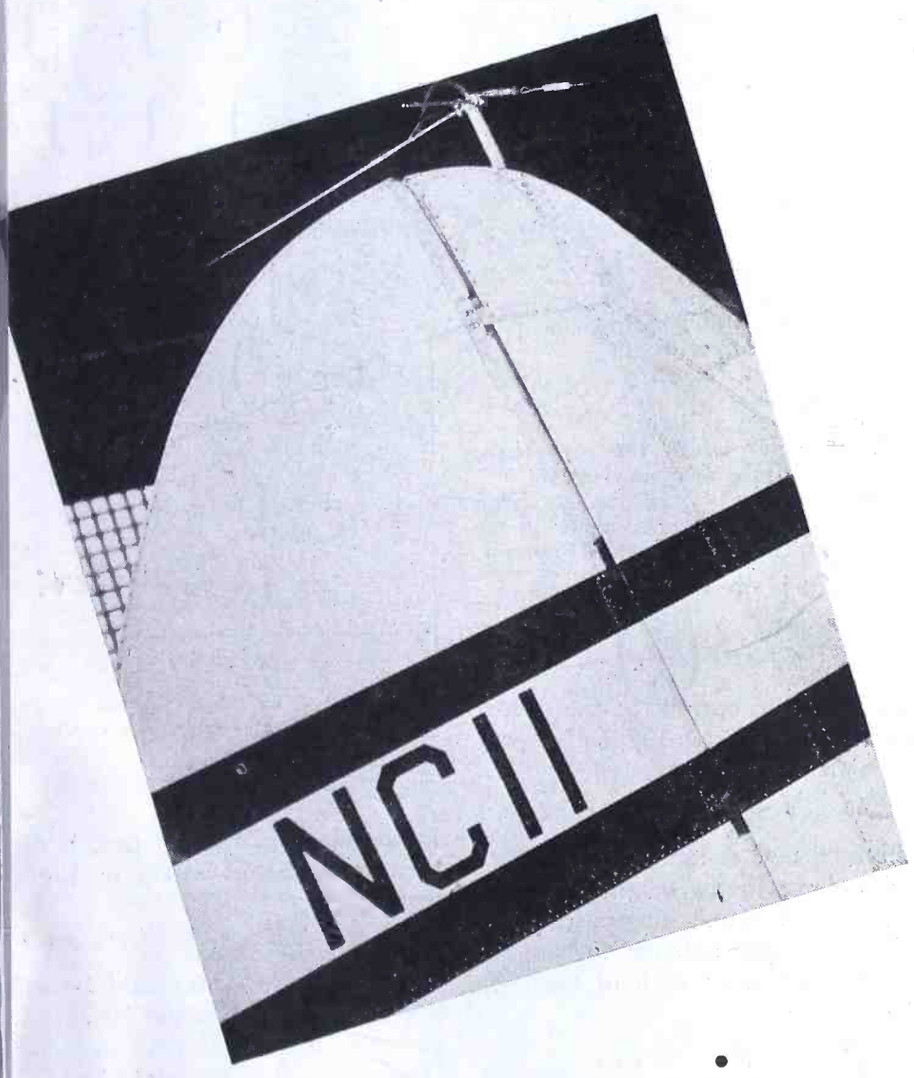
LEWIS WINNER, Editor

* * SEPTEMBER, 1944 * *

-H-F "V" ANTENNA FOR AIRCRAFT

by HENRY JASIK

Formerly with the Radio Development Section, Civil Aeronautics Administration; now on leave.



A "V" antenna on the vertical fin of a CAA Boeing NC-11.

BECAUSE of the increasing use of v-h-f for localizer and radio range facilities[1], the problem of suitable receiving antenna for aircraft use has assumed great importance. The problem is fairly simple for vertical polarization, since a quarter-wave vertical antenna utilizing the skin of the ship as the ground plane gives excellent directional characteristics (i.e. a circular pattern) and is easily matched to a transmission line. In addition, the low Q of such an antenna makes it useful over a fairly wide band of frequencies.

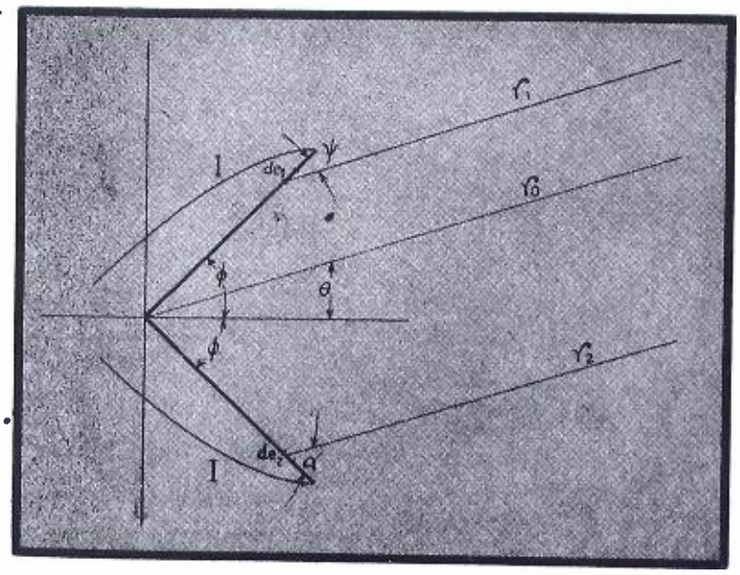
However, the best data available at the present time indicates that in the frequency range of from 100 to 130 mc, horizontal polarization is superior to vertical polarization for navigational facilities, particularly in view of the stringency of site requirements for the ground stations.* The instrument landing localizers and v-h-f radio range facilities which have been installed so far utilize horizontal polarization[4].

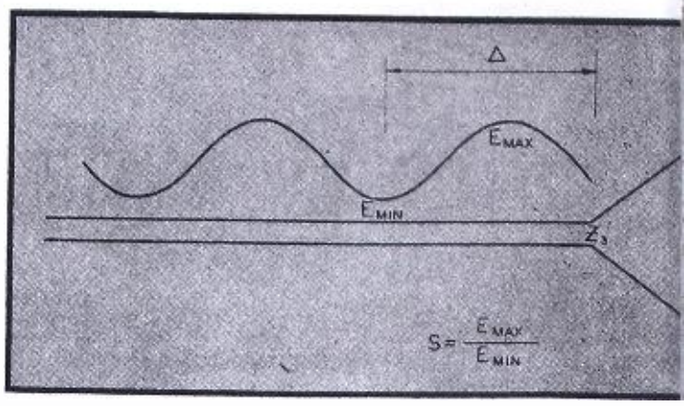
A horizontal dipole is the simplest type of antenna possible for v-h-f use. Because of the fact that its directive pattern has an absolute null along the axis of the antenna, it is not too desirable. It is true, of course, that the aircraft is going directly toward or away from the station most of the time, so that a null at right angles to the aircraft axis would cause no great inconvenience. There are times, however, when the aircraft is not lined up on its course or when it is performing certain maneuvers, that a certain amount of pickup to the sides is necessary. For this reason, the horizontal dipole has not been used to any great extent.

For a period of several years, the receiving antenna in common use was a horizontal loop of one type or another[3,5], whose directional pattern was approximately circular in shape. This type of antenna proved quite useful during the development stages of

The opinions expressed in this paper are purely those of the writer and are not to be construed as representing official policy of the Civil Aeronautics Administration.

*There is considerable experimental evidence available to substantiate this[2,3]. In addition, the writer is preparing data which discusses the theoretical aspects of the ground site problem and the effect of nearby objects on range and localizer courses. In general, the theoretical results agree with the available experimental information. It is hoped that these data can be published in the near future.





Figures 1 (left) and 2 (above).

the v-h-f localizers and radio ranges. The horizontal loop possessed several disadvantages, however, which made it impractical for use on a large scale. The chief drawbacks were the wind drag caused by the large mechanical structure of the loop and the high Q of the loop. The latter was due to the low radiation resistance of the loop. The associated tuning circuits were thus quite critical in adjustment. In addition, a slight change in frequency made it necessary to retune the antenna tuning circuits.

In the spring of 1942, a horizontal V antenna whose elements were a quarter-wavelength on a side was tried out.** It proved so satisfactory that it replaced all of the aircraft type horizontal loop antennas then in use and has since been used on all CAA aircraft carrying v-h-f receiving equipment. The directional pattern of the V, although not circular in shape, was nevertheless quite satisfactory, while the electrical characteristics of the antenna more nearly approached that of a dipole. The V was quite easy to match and it proved fairly non-critical to reasonable changes in frequency.

Because of the great usefulness of the V antenna, some further theoretical and experimental studies were made of its properties. Although a previous paper[6] had discussed this type of radiator quite thoroughly, its results applied to antennas whose legs were an integral number of half-wavelengths long and consequently were not applicable in this case. By assuming a sinusoidal current distribution, it was possible to calculate the field pattern for the quarter-wave transmitting case. By means of the reciprocity theorem, it can be shown that this pattern is identical to that obtained for the receiving case and therefore is applicable for our purpose. Figure 1 shows the geometry of the case.

At a large distance from the radiator, the electric field produced by the current I flowing through the differential elements dl_1 and dl_2 is given by

$$dE_1 = \frac{60\pi}{\lambda r_o} I\, dl_1 \sin\psi \cos\omega\left(t - \frac{r_1}{c}\right)$$

$$dE_2 = \frac{60\pi}{\lambda r_o} I\, dl_2 \sin\gamma \cos\omega\left(t - \frac{r_2}{c}\right)$$

where

E = electric field
λ = wavelength
I = current flowing in element
dl_1, dl_2 = elements of length
ω = radian frequency
t = time
c = velocity of light
ψ, α = angles which the rays make with the antenna elements
r_o, r_1, r_2 = distances from the receiving point to various points on the antenna as shown in Figure 1.

The current is given by

$$I = I_o \cos\left(\frac{2\pi l}{\lambda}\right)$$

where I_o is the current at the center of the antenna. From Figure 1, it can be seen that

$$r_1 = r_o - l\cos\psi \qquad r_2 = r_o - l\cos\gamma$$

The total field is found by substituting the above in the original expressions, expanding and integrating over the length of the antenna to sum up the contributions of each of the current elements

$$E = \int dE_1 + \int dE_2 = \frac{60\pi}{\lambda r_o} I_o$$

$$\left\{\left[\cos\omega\left(t - \frac{r_o}{c}\right)\sin\psi\right]\int_o^{\lambda/4}\cos\left(\frac{2\pi l\cos\psi}{\lambda}\right)\cos\left(\frac{2\pi l}{\lambda}\right)dl\right.$$

$$\left. - \left[\sin\omega\left(t - \frac{r_o}{c}\right)\sin\psi\right]\int_o^{\lambda/4}\sin\left(\frac{2\pi l\cos\psi}{\lambda}\right)\cos\left(\frac{2\pi l}{\lambda}\right)dl\right.$$

$$+ \left[\cos\omega\left(t - \frac{r_o}{c}\right)\sin\gamma\right]\int\left(\frac{2\pi l\cos\gamma}{\lambda}\right)\cos\left(\frac{2\pi l}{\lambda}\right)dl$$

$$- \left[\sin\omega\left(t - \frac{r_o}{c}\right)\sin\gamma\right]\int_o^{\lambda/4}\left(\frac{2\pi l\cos\gamma}{\lambda}\right)\cos\left(\frac{2\pi l}{\lambda}\right)dl$$

Performing the indicated integrati we obtain

$$E = \frac{30 I_o}{r_o}\left\{\left[\cos\omega\left(t - \frac{r_o}{c}\right)\right]\right.$$

$$\left[\frac{\cos\left(\frac{\pi}{2}\cos\psi\right)}{\sin\psi} + \frac{\cos\left(\frac{\pi}{2}\cos\gamma\right)}{\sin\gamma}\right]$$

$$- \left[\sin\omega\left(t - \frac{r_o}{c}\right)\right]$$

$$\left[\frac{\sin\left(\frac{\pi}{2}\cos\psi\right) - \cos\psi}{\sin\psi} - \right.$$

$$\left. + \frac{\sin\left(\frac{\pi}{2}\cos\gamma\right) - \cos\gamma}{\sin\gamma}\right]$$

In the plane of the antenna, it can seen from the geometry of Figur that

$$\psi = \phi - \theta \qquad \gamma = \phi + \theta$$

These expressions could be sub tuted into the expression for E to c pute the horizontal field distributi However since ψ and γ have b made general angles, it will be poss to obtain the expression for E terms of the elevation angle α as v as in terms of the azimuth angle θ the antenna angle ∅. In polar co nates, then

$$\cos\psi = \cos\alpha\cos(\phi - \theta)$$
$$\sin\psi = \sqrt{1 - \cos^2\alpha\cos^2(\phi - \theta)}$$

similarly

$$\cos\gamma = \cos\alpha\cos(\phi + \theta)$$
$$\sin\gamma = \sqrt{1 - \cos^2\alpha\cos^2(\phi + \theta)}$$

Then, for any azimuth angle θ any elevation angle α

$$E = \frac{30\,I_o}{r_o}\left\{\left[\cos\omega\left(t-\frac{r_o}{c}\right)\right]\left[\frac{\cos\left(\frac{\pi}{2}\cos\alpha\cos(\phi-\theta)\right)}{\sqrt{1-\cos^2\alpha\cos^2(\phi-\theta)}}+\frac{\cos\left(\frac{\pi}{2}\cos\alpha\cos(\phi+\theta)\right)}{\sqrt{1-\cos^2\alpha\cos^2(\phi+\theta)}}\right]\right.$$

$$-\left[\sin\omega\left(t-\frac{r_o}{c}\right)\right]\left[\frac{\sin\left(\frac{\pi}{2}\cos\alpha\cos(\phi-\theta)\right)-\cos\alpha\cos(\phi-\theta)}{\sqrt{1-\cos^2\alpha\cos^2(\phi-\theta)}}\right.$$

$$\left.\left.+\frac{\sin\left(\frac{\pi}{2}\cos\alpha\cos(\phi+\theta)\right)-\cos\alpha\cos(\phi+\theta)}{\sqrt{1-\cos^2\alpha\cos^2(\phi+\theta)}}\right]\right\}$$

This expression consists of two waves in time quadrature each other. The absolute amplitude can be found by ng the square root of the sum of the squares.

$$\frac{30\,I_o}{r_o}\sqrt{\left\{\frac{\cos\left[\frac{\pi}{2}\cos\alpha\cos(\phi-\theta)\right]}{\sqrt{1-\cos^2\alpha\cos^2(\phi-\theta)}}+\frac{\cos\left[\frac{\pi}{2}\cos\alpha\cos(\phi+\theta)\right]}{\sqrt{1-\cos^2\alpha\cos^2(\phi+\theta)}}\right\}^2}$$

$$+\left\{\frac{\sin\left[\frac{\pi}{2}\cos\alpha\cos(\phi-\theta)\right]-\cos\alpha\cos(\phi-\theta)}{\sqrt{1-\cos^2\alpha\cos^2(\phi-\theta)}}\right.$$

$$\left.+\frac{\sin\left[\frac{\pi}{2}\cos\alpha\cos(\phi+\theta)\right]-\cos\alpha\cos(\phi+\theta)}{\sqrt{1+\cos^2\alpha\cos^2(\phi+\theta)}}\right\}^2$$

In the plane of the antenna or $\alpha = 0$

$$\frac{30\,I_o}{r_o}\sqrt{\left\{\frac{\cos\left[\frac{\pi}{2}\cos(\phi-\theta)\right]}{\sin(\phi-\theta)}+\frac{\cos\left[\frac{\pi}{2}\cos(\phi+\theta)\right]}{\sin(\phi+\theta)}\right\}^2+}$$

$$\sqrt{\left\{\frac{\sin\left[\frac{\pi}{2}\cos(\phi-\theta)\right]-\cos(\phi-\theta)}{\sin(\phi-\theta)}+\frac{\sin\left[\frac{\pi}{2}\cos(\phi+\theta)\right]-\cos(\phi+\theta)}{\sin(\phi+\theta)}\right\}^2}$$

In the vertical plane when $\theta = 0$

$$E = \frac{60\,I_o}{r_o}\sqrt{\frac{\cos^2\alpha\cos^2\phi - 2\cos\alpha\cos\phi\sin\left[\frac{\pi}{2}\cos\alpha\cos\phi\right]+1}{1-\cos^2\alpha\cos^2\phi}}$$

These equations can be checked by king the limiting case of a half-wave pole or $2\phi = 180°$.

Then the expression for $\alpha = 0$ be- omes

$$E = \frac{60\,I_o}{r_o}\cdot\frac{\cos\left[\frac{\pi}{2}\sin\theta\right]}{\cos\theta}$$

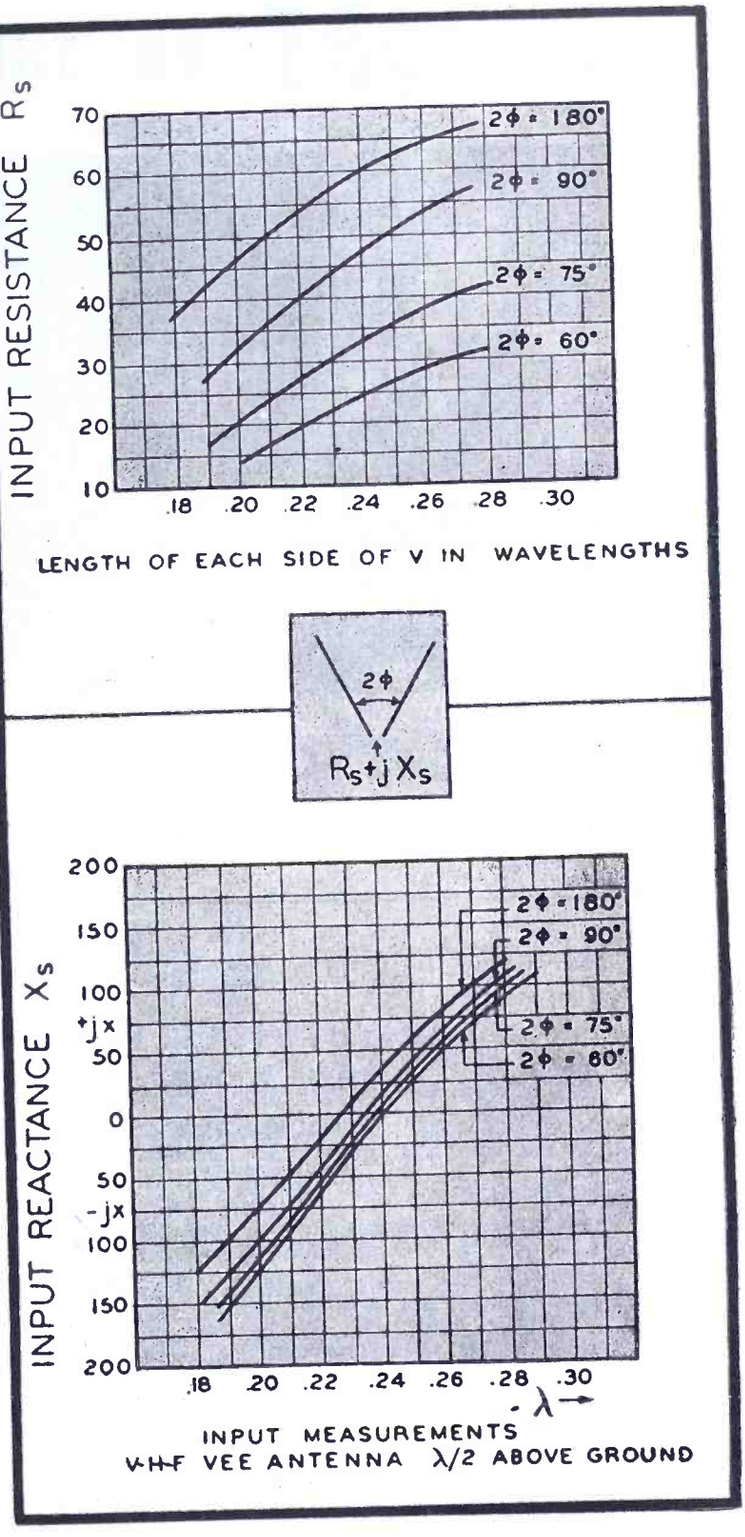


Figure 3
How the radiation resistance and antenna reactance vary with both length and apex angle.

This last equation agrees with those given in the literature for a half-wave dipole and thus serves as a check on the previous work.

The input impedance of the antenna is of considerable interest and can be found by any one of three methods: (*1*)—Poynting vector method; (*2*)—induced emf method; and (*3*)—by experimental measurements.

It is necessary to perform some complicated numerical integrations to

(*Continued on page* 83)

**Like many other devices in common use, it is a little difficult now to determine just whose idea it was to use this type of antenna. However, the writer believes it was originally suggested by *Andrew Alford*, formerly of Federal Telephone and Radio Corporation, now at the Radio Research Laboratory, Harvard University. In any case, the writer is indebted to Mr. Alford for having checked over his field pattern equations when they were originally derived several years ago.

A REPORT ON THE NAB EXECUTIVE

At the NAB War Conference symposium, left to right: Commander T. A. M. Craven, who presided; Paul F. Godley; Thomas S. Joy; Major Edwin H. Armstrong; William S. Hedges; William B. Lodge; John V. L. Hogan; and ye Editor.

TELEVISION AND F-M

WILLIAM B. LODGE, ACTING DIRECTOR OF ENGINEERING, CBS

IT IS quite evident to all who are engaged in the broadcasting business that radio is faced with a period of many changes. The present standard band is close to saturation with more than 900 stations now on the air. The questions raised by f-m and television will undoubtedly slow the expansion in this field and cause a-m station operators to question the advisability of proceeding with plans for power and frequency changes which do not give a substantial increase in coverage. It must not be forgotten, however, that the backbone of the broadcasting industry, today, is standard band a-m broadcasting, and that what it offers, namely, circulation, must also be offered by f-m and television before they become effective competitors. It seems safe to predict that the standard band will remain the broadcaster's breadwinner and chief source of income for a considerable number of years. Furthermore, it is doubtful if the high-powered clear channel a-m station will be replaced within the foreseeable future as a means of providing widespread rural service.

Much has been said about the future trend of f-m. We believe that the basic conclusions of the supporters of f-m are correct. It is in many ways, a superior method of sound transmission and a large percentage of existing broadcasting stations could give an improved service to a larger area if they changed over to f-m. In the long run this means better service to the public, and in my mind there is little doubt that most local and regional stations will have made considerable progress toward a changeover to f-m five years from now. There will undoubtedly be a substantial number of new operators entering the broadcasting business via f-m without ever having operated an a-m station. It is to be hoped, moreover, that the FCC will not impede the transfer to f-m by requiring separate programming of a-m and f-m stations. Such a course could only result in a longer and more confused transition period in which the public would have less incentive to buy f-m receivers if their present favorite a-m programs are not on f-m.

I would like to mention just briefly the fact that f-m stations are not nearly as limited in their coverage as is popularly supposed. They are not limited to the horizon. F-M signals are capable of following the curvature of the earth and of bending around buildings and behind hills. Even a 1-kw station will give satisfactory rural service 25 miles beyond the optical horizon.

I believe all of the parties interested in the future of television are now agreed that approximately 25 or 30 television channels are required to permit the growth of a comprehensive, competitive nationwide television system. This point is generally missed. In other words, regardless of the picture definition on whether postwar television is to be black and white or in color, a sufficient number of channels must be provided. It appears at the present time that the needs of various government agencies and safety-of-life services which cannot be shifted in frequency, severely limit the number of channels which can be assigned below 300 mc. Most of you know that the government's Interdepartmental Radio Advisory Committee found it possible to assign only nine channels between 54 and 108 mc and six scattered channels at higher frequencies for the present type of television transmission. This simply means that whether television is transmitted on 6-mc channels or 16-mc channels (or any other bandwidth you care to name) it will have to go up in frequencies where it can find sufficient space not likely to be preempted by other services. And since television must go to higher frequencies, I can see no engineering reason for not incorporating at the same time higher definition pictures and color. As you know, CBS has vigorously supported improved pictures not only for the above reason, but because its interest being solely that of a broadcaster, it believes a better picture would improve the chances of making television broadcasting a successful business. Eventual success or failure may well depend on whether the television pictures offered to the public are "good enough."

Television, in order to succeed, must avoid any unnecessary handicaps—and the greatest handicap would, I think, be the establishment of the service on the present 6-mc channels.

It is, therefore, my opinion that there will be only limited utilization of the present television channels. Columbia has already decided to build no additional stations on the lower frequencies with 6-mc bandwidth, and is devoting its entire energy to the development of television in the region, 500 to 1000 mc. We are sufficiently sure of our ground so that we will confine our immediate television broadcasting to New York on our existing station, WCBW, which, we believe will give us the necessary experience in the production of television programs.

Chairman Fly has referred to the obvious advantages of wide-band, high defi-

VAR CONFERENCE SYMPOSIUM

VERING THE POSTWAR FUTURE OF BROADCASTING

ighlights of Comments Offered By W. B. Lodge, T. S. Joyce, Major Armstrong, Paul Godley, J. V. L. Hogan, Paul Chamberlain and W. S. Hedges

television in the frequency range e 500 mc. The IRAC has also re- mended these frequencies as the per- ent home of television. As broad- engineers, we are not in a posi- as is IRAC, to judge the future ls of our armed services and the tion industry for radio frequencies veen 100 and 300 mc. But we believe vision should not be permitted, at the nse of these vital services, to reserve more channels than are now being for 6-mc television. Particularly is so, in view of the expected future donment of these channels when tele- n service is established on the higher uencies. Consequently, then, I think allocation experts are bound to view wholly unrealistic and untenable any proposal for substantial expansion of television service below 300 mc. Thus, the television panel of the RTPB, and the endorsement of the Board of TBA, in requesting the lion's share of the frequencies between 50 and 300 mc, completely ignore the informed opinion of the IRAC experts.

Columbia has a huge stake in television—certainly the largest stake of any broadcaster who is not affiliated with manufacturing activities. As broadcasters we believe that the period of red ink in television will be substantially shortened and its ultimate fruits substantially increased if we give the American people the best possible picture—as quickly as possible. We know this cannot be accomplished by the low definition inherent in the 6-mc band. On the other hand we believe that with high definition pictures, both in black and white and in color which can only be achieved in wider band transmission, television has a real chance of achieving its potentialities. Certainly television accomplishes a miracle that is offered by no other medium. I think we are wise enough to free television from the unnecessary shackles of postwar standards. If we are, we will be able to accomplish two things: first, we will avoid digging pits into which we ourselves may fall, and second, we will have done our part in making it possible for this infant industry to grow into what may be a giant, dwarfing anything we have known in radio.

POSTWAR TELEVISION

T. S. JOYCE

General Manager
Radio-Phonograph-Television Dept.
RCA Victor Div., RCA

F 11,000 women who expressed an opinion on television (a women's magazine survey), 67% said they and may get" a television receiver, 16.5% said they "must have" a tele- n receiver—a prospective market of %. This compares with 35.7% who and may get" a radio-phonograph, 30% who "must have" a radio-phono- h—a prospective market of 65.7%.

the period since last November 1, vision applications have increased 7 to 63. There has been an increase 800% in the past 10 months. The mption that television broadcasters ld come forward, following assurance an acceptable television receiver d be produced, well within the peo- capacity to pay, seems to have had e than a reasonable foundation.

ur figures show the probable growth elevision coverage as follows:

Period I (Now)

	Est. Coverage (miles radius)	Popula- tion in Coverage Areas	Electri- cally Wired Homes	Buying Power % of U.S.A.
ew York....	50	12,748,900	3,628,574	15.032
iladelphia ..	50	4,321,100	1,141,488	3.951
henectady .	30	775,800	222,854	.684
ncinnati ...	30	1,056,000	287,813	1.027
icago	50	5,069,900	1,409,972	5.136
s Angeles .	50	3,252,700	1,097,153	4.068
otal Period I..		27,224,400 (19.73% of U.S.A.)	7,787,854 (25.63% of U.S.A.)	29.908
otal Adjusted to exclude county areas not included in coverage areas		25,907,500	7,410,922	28.46

Period II (1 Year Postwar)

	Est. Coverage (miles radius)	Popula- tion in Coverage Areas	Electri- cally Wired Homes	Buying Power % of U.S.A.
Washington ..	30	2,053,500	518,868	2.646
Detroit	30	2,592,900	694,929	2.777
San Francisco.	50	1,779,400	590,578	2.456
Total Period II..		6,425,800 (4.45% of U.S.A.)	1,804,775 (5.73% of U.S.A.)	7.879 (7.20% of U.S.A.)
Cumulative Total.		33,650,200	9,592,629	37.787
Adj. Cumulative Total		31,758,600	9,066,219	35.663

Period III (2 Years Postwar)

	Est. Coverage (miles radius)	Popula- tion in Coverage Areas	Electri- cally Wired Homes	Buying Power % of U.S.A.
Hartford	40	2,550,200	680,607	2.745
Baltimore	30	87,700*	15,966*	.062*
Milwaukee ...	30	1,004,000	287,037	1.053
Minneapolis .	30	1,098,000	294,388	1.074
Boston	30	2,824,900	768,642	2.773
Total Period III..		7,564,800 (4.72% of U.S.A.)	2,046,640 (5.72% of U.S.A.)	7.707 (6.25% of U.S.A.)
Cumulative Total.		41,215,000	11,639,269	45.494
Adj. Cumulative Total		37,963,100	10,720,959	41.905

**Not covered in Washington figures.*

Period IV (3 Years Postwar)

	Est. Coverage (miles radius)	Popula- tion in Coverage Areas	Electri- cally Wired Homes	Buying Power % of U.S.A.
Springfield, Mass.	30	*	*	*
Providence ..	30	1,077,900	293,834	3.947
Pittsburgh ...	50	3,527,700	772,636	2.865
Cleveland	30	1,818,200	505,756	2.046
St. Louis	30	1,524,300	423 959	1.331
Buffalo	30	1,230,700	333,310	1.096
Rochester ...	30	688,400	187,322	.627
Kansas Cities	30	994,000	266,933	.812
Total Period IV..		10,861,200 (7.17% of U.S.A.)	2,783,750 (8.30% of U.S.A.)	12.724 (11.05% of U.S.A.)
Cumulative Total.		52,076,200 (36.07% of U.S.A.)	14,423,019 (45.38% of U.S.A.)	58.218
Adj. Cumulative Total		47,373,700	13,120,512	52.961

*No new coverage—already covered by Hartford and Boston.

These figures do not include a considerable number of smaller communities which could no doubt be served within a reasonable time.

The cities in bold face in the foregoing charts have made applications for television licenses. You will note that there are very few not in bold face. However, at the time this information was first compiled the reverse was true—most of them had not yet made such application.

Note the adjusted cumulative total of 13,120,512 wired homes having television service within four years after the war. At the time these figures were compiled, over a year ago, there were those who

considered this total highly optimistic. The fact is that now, only a year later, coverage provided by operating stations and applications actually on file with the FCC equals 13,439,098 wired homes, or 400,000 over the estimate. If the FCC grants all these licenses, and provided television transmitters can be manufactured and installed rapidly enough, this means that 46.4% of the potential television market (which these figures represent) will be covered in from 18 months to two years after the war, rather than in three to four years, as we originally estimated.

In approximately five years after the resumption of commercial television, transmitters serving 157 key cities should be making television service available to a primary market consisting of 72,159,000 people, 17,252,000 wired homes, or 61.5% of U. S. purchasing power. An additional ten-million people should have television program service available to them by secondary television network developments. When television service is available to this area, receiver sales should be at the rate of approximately 2,500,000 units per year at an average retail price, based on 1940 costs, of about $200.

What about television standards? Are they satisfactory? There are two ways of answering that question, and one is to ask the experts. But who are the experts? Are they those well-known perfectionists, the engineers? Are they the station owners, or station managers? There is a great deal of disagreement on this point. The time-honored method of settling disputes of this character is to go to those who, in the last analysis, are most directly affected—the people themselves.

Well, we went to the people. Not just any people, but those who should be in a position to judge . . . people with television sets in the area of New York City. Our purpose in contacting them was to procure badly needed receivers to take care of people who have a professional interest in television and are trying to obtain receiving sets from us. ... offered the present owners a price of ... for relieving them of RCA television ... which we sold them in 1939 for $395 ... which in many cases are now mop... tive because the cathode-ray tubes ... other components, cannot be repaire... replaced due to war shortages. ... *Joyce offered recorded comments of t... interviewed, which revealed that all ... fused to sell*).

If the present owners of television ... ceivers, in these times of severely lim... broadcasting conditions and meagre ... gram fare, place such a high valu... on the prewar instruments they pos... how much more eager will they be, ... how much more eager will be the g... public they represent, under the v... more favorable conditions that will ... prevail. It is expressions of this ... added to our own knowledge and ... victions, that give us infinite faith ... television ready to surge forward as ... as practicable after the last shot has ... fired.

BROADCAST PROBLEMS

PAUL F. GODLEY, CONSULTING RADIO ENGINEER

THERE have always been arguments about broadcasting, and I hope that always may be. They are highly educational. To a large degree, of course, arguments developed around and about any pioneering work are, of necessity, based on assumption.

Remember the assumption that one broadcasting station could serve the whole of the continent? That 50,000 watts would prove to be a blanketing, superpower? That about 500 broadcasting stations would saturate the band? That "directional - antennas - for - broadcast - stations" was silly? Time has properly labeled these.

In the allocation of new sound broadcasting facilities, it is my own opinion that consideration should be given in the following order:

(*1*) To those proposals which involve service to unserved or poorly served areas.

(*2*) To those proposals which, in parallel with the existing service, involve major extensions of service to include areas poorly served or without service.

(*3*) To those proposals which *principally* involve but a paralleling of existing services within already well served areas.

(*4*) To those proposals which involve new and additional outlets within an area already amply served, or for which ample service has been projected.

Present a-m services are amenable to considerable further profitable extension and magnification in the instant public interest; and, perhaps it needs to be added, in the interest of the new services. I believe it now in order to add needed outlets wherever feasible, and to include the 540, 530 and 520 kc channels within the band for the benefit, principally, of numerous small city, town and rural communities heretofore without, but now able to support their own services. (The 1 mv/m area of 50 watts at these frequencies approximates ½ mv/m area of 250 watts at the average local frequency over average U. S. soils.)

In the main our present a-m broadcast services—plus many more—appear to me to be destined for operation through at least the coming decade; and I believe these will be currently augmented by many f-m stations which may, very well, finally replace a number of stations in the local class, some stations in the regional class, and a few stations in the clear-channel class.

Taking the objective view, I have not been concerned about the relative importance of f-m stations and receivers now extant; nor am I greatly impressed by the argument that the considerable number of applications for new f-m stations is an evidence of an industry-wide d... to immediately exploit f-m as origin... allocated. As anyone may quickly le... these applications develop not as the ... sult of comprehensive study and c... parison of engineering, service, or ... nomic factors,—but rather from a d... on the part of "lay-minded" and sc... what confused broadcasters to take ... quick and cheap insurance against an ... certain future; or by would-be br... casters who, mayhap, slept through ... ing day of the *maiden trip* of the r... *show boat*.

Currently, keen interest centers a... exchanges of view on the relative ... portance of 40-50-mc sky-wave prop... tion. Perhaps I have missed it, but I ... heard no reference to the 60-mc data ... lected across the late sun-spot cycle ... by the amateurs. They have a recor... qualitative data over a period of m... than eleven years which appears to ... to have considerable value and sig... cance.

Time bars my discussion of the op... tunities wrapped up in facsimile,—o... television. But I wish to say this ... television: it greatly broadens the h... zons of broadcasting, and, it seems to ... is the desirable, ultimate, medium. H... ever, I have no expectation that it ... within the foreseeable future, spell qui... for sound broadcasting.

FREQUENCY MODULATION

MAJOR EDWIN H. ARMSTRONG, PROFESSOR ELECTRICAL ENGINEERING, COLUMBIA UNIVERSITY

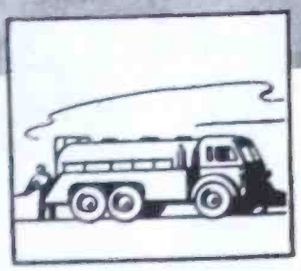
IN June, 1936, an opportunity was afforded to present before the FCC and the broadcasting and manufacturing industry a sound recording taken during a thunderstorm, showing a comparison between a 50-kilowatt a-m station (WEAF) and a 2-kilowatt f-m station at a distance of 85 miles. The difference in noise level was of the order of tens of thousands of times. The record contains the following statement:

"The conclusion must not be drawn that ... difference between these two recordings is ... entirely to frequency modulation. Part of ... due to the frequency of transmission. ...

(*Continued on page 64*)

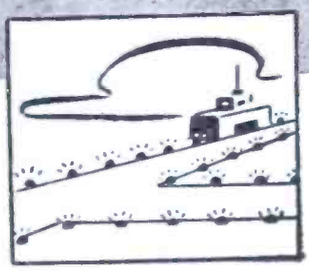
Your Airport may have all of these

RUNWAYS



SERVICE

HANGARS



LIGHTS

But it still is not a modern airport serving your community to best advantage, if it does not have radio facilities

Essentials of a modern airport, in the order of their importance, might be listed this way:

1. Adequate all-weather runways.
2. Sufficient service for normal requirements.
3. Hangar space.
4. Lights.
5. Control tower.
6. Radio navigational facilities.
7. Weather information.
8. Terminal facilities including restaurants, taxi service, etc.
9. Accessible location.
10. Safe approaches from all directions.

and — an able, adequately paid airport manager who can make the fullest use of his facilities in the interests of the public, flyers and the airlines.

Our job—that of RADIO RECEPTOR—is the provision of radio facilities for navigation—for traffic control—for communication. Chances are RADIO RECEPTOR ranges — supplied to the CAA — may guide the planes to your airport. Let RADIO RECEPTOR traffic control equipment continue the job and bring them down to the runways and up to the gates.

Competent counsel on airport traffic control radio now available—equipment supplied when conditions permit. *Plan* now—*purchase* later.

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which discusses radio navigation and traffic control in all its phases, military and civilian—past, present and future. Free to those writing on their letterhead.

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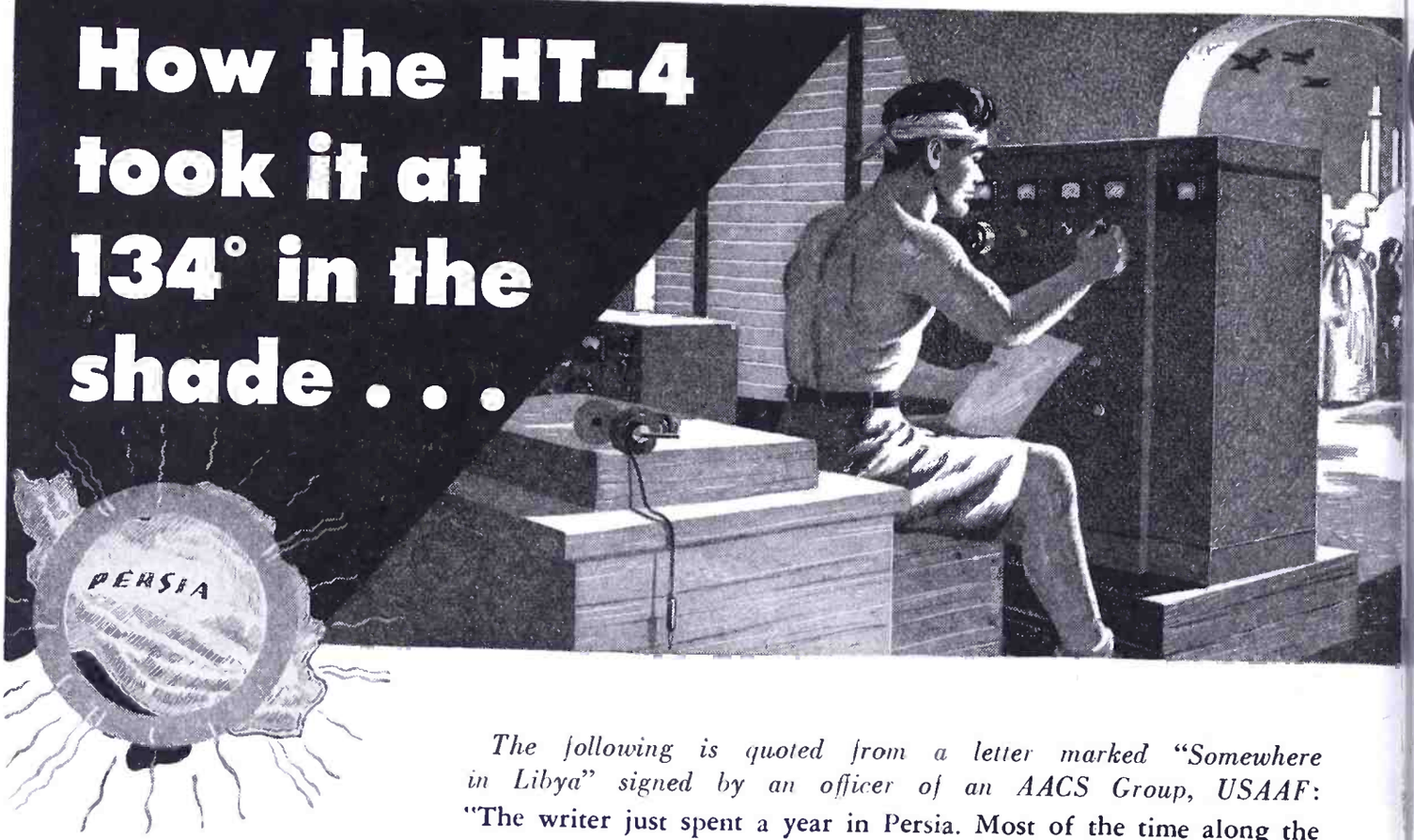
SINCE 1922 IN RADIO AND ELECTRONICS

How the HT-4 took it at 134° in the shade . . .



The following is quoted from a letter marked "Somewhere in Libya" signed by an officer of an AACS Group, USAAF: "The writer just spent a year in Persia. Most of the time along the Persian Gulf where it really gets HOT! We operated one of your HT-4-B Transmitters near a place called Abadan. The transmitter performed very satisfactorily under the most unfavorable conditions. I doubt that your engineers ever dreamed that one of your rigs would be called upon to perform in a place where for 5 days and nights the temperature never dropped below 117 degrees and in fact it got up to 134 degrees during the daytime, that is "in the shade" temperature, the humidity was high and the air salty. Actually the transmitter got much hotter than that as it was installed in a brick building and no air conditioning, not even an exhaust fan. The HT-4-B was used on voice and gave very little trouble. One day the piece of bakelite under the phone/cw switch caught on fire but this was easily repaired. During the so called winter season, the temperature actually got as low as 36 degrees one day, we had a little trouble with mice crawling under the rig, which was set up on two 4x4 wooden sleepers. It seems the mice liked the heat and they would crawl up under the transmitter and get lodged in between the rectifier sockets and the frame when the operator switched on the transmitter the mice would fry, usually a fuse would blow but no other damage was done. We never did figure why the mice liked the Hallicrafters best. There were several other transmitters in the room but they always seemed to pick the HT-4-B; guess they were pretty smart mice!"

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ARMY E NAVY

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THE HALLICRAFTERS COMPANY · MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT CHICAGO 16, U. S. A.

COMMUNICATIONS AND THE FIRE FIGHTER

by HERBERT A. FRIEDE
Chief, Emergency Communications
Fire Alarm Headquarters
Washington, D. C.

In this paper, Mr. Friede offers an analysis of the requirements of the fire service for more adequate communications facilities, particularly radio. He points out that such facilities are essential to the fire suppression forces *(the fire fighter)* to cope with our ever increasing fire waste, keeping in mind that all our recent large industrial fires can be attributed to the delayed alarm. These data were used as the basis of an RTPB committee presentation.

Herbert A. Friede (at right) with a typical emergency radio communications patrol car.

WITHIN the classification of the *fire service,* the service represents and is charged with the protection of life and property of every citizen of these United States against fire.

The President of the United States made the following statement: "This Nation's war program is menaced by an alarming increase in *preventable* fire losses. The losses suffered by fire since Pearl Harbor, in the United States, is comparable to the damage caused by all enemy bombing over England during the first two years of war."

Jesse H. Jones, Secretary of Commerce, made the following statement: "Whenever, wherever, and however, anyone in this nation observes a rule or performs an act which will assist in preventing fires, he is helping to intern an enemy as ruthless and destructive as any which we face today."

The nation is faced with an annual fire loss of approximately four-hundred and fifty-million dollars per annum; in addition, more than ten thousand lives are lost annually. This figure is steadily mounting.

Experience has taught us that fire has greater potential capabilities of extensive damage to industry, human life, and property than any other hazard that is subject to physical control.

The history of all our large fires in recent years shows conclusively that lack of adequate communication facilities were a contributing factor to the sacrifice of life, the painful price of injury, and the irreplaceable loss of man hours of labor.

We have also found that no fire department today has a sufficient amount of apparatus or equipment to cope with all types of emergencies which may develop in a community, and under such conditions it is necessary to call upon adjacent communities for assistance. Therefore, in order to facilitate this coordination, an adequate and rapid communication system is imperative.

A plan designated as *mutual aid* has been developed that makes coordination and cooperation feasible, and which is in effect in many of our cities.

The Mutual Aid System

The *mutual aid system* of the fire service is predicated upon the obvious but often overlooked fact that the agency first called, and first to respond with professionally trained men, apparatus and equipment to cope with any emergency, is the fire department of our municipalities.

Upon the immediacy of the response of the fire department, the quick thinking, professional analysis, and appraisal of the situation by its trained officers, and upon their instant action, may depend the size of the disaster and the extent to which outside aid may be required.

For this reason the spearhead of effective *mutual aid* plans and procedures are the duty of the fire service, whose professional personnel are thoroughly trained, continuously tested and experienced by actual participation in functioning under the tense pressure coincident with emergencies. This emphasizes the importance of control and of adequate rapid communication facilities at this level.

Every citizen has a very considerable stake in the fire protection of this Nation and, consequently, in communication developments that will help to reduce our ever-increasing national fire waste. The records prove conclusively that the time required for the response and action of the fire department may determine the intensity and size of the fire. Communications are the nerve center of every fire department.

Present Wire Facilities

The modern fire departments of our municipalities are mostly all equipped with fire alarm systems consisting of fire-alarm boxes, located on the street

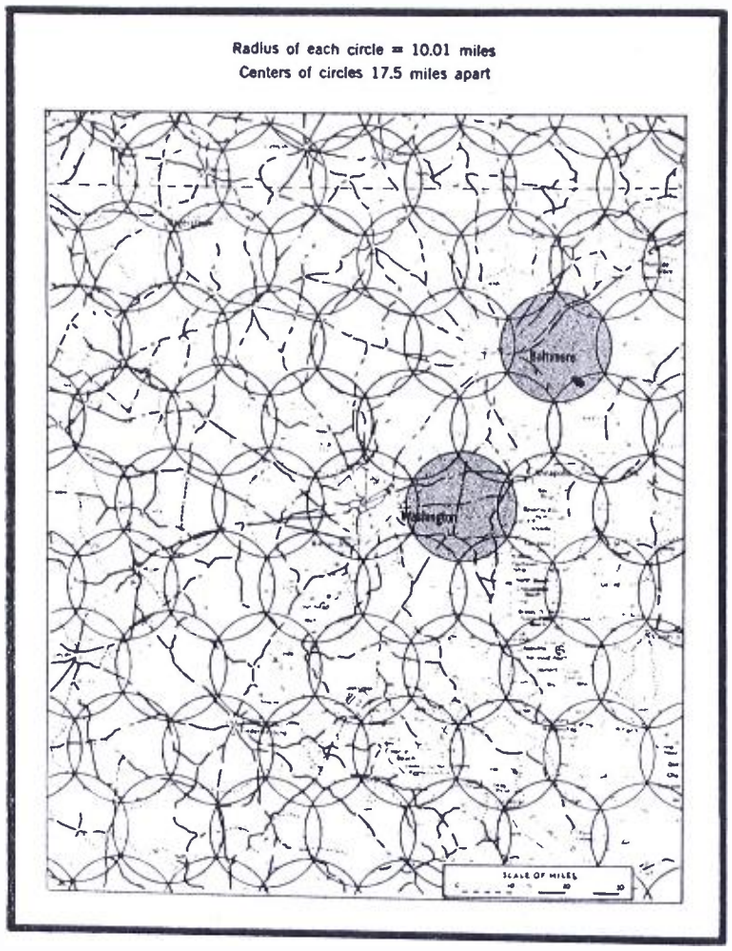

Figure 1
An idealized frequency allocation plan for general vehicular service.

corners, from which the citizens can report fires to the *municipal fire alarm headquarters*. This department in turn dispatches the fire apparatus to the scene of the fire or disaster. In smaller communities the fire-alarm boxes automatically transmit their alarms to the fire companies. These wire facilities are all operated and maintained by the municipalities. However, these facilities are woefully inadequate, and many cities and towns are without any such adequate wire facilities.

The above facilities are all supplemented by the commercial telephone service and in numerous cities by the manual and automatic fire-alarm services furnished to private establishments by *central station* protective signaling companies.

When apparatus leaves its station, under present conditions, it is lost as far as the fire department headquarters is concerned. The apparatus is also at the mercy of its own resources.

The existing wire facilities for inter-communication between fire departments or dispatching headquarters are woefully inadequate for proper operation of the service.

Fire departments in the majority of our municipalities are separated by considerable distance, and are located many times in areas where telephone communications between the units require too much time to be useful in the fire service, because, fire waits for no man.

To install municipal wire facilities or tie lines between *fire alarm headquarters* to supplement conditions as outlined above, would be prohibitive in cost to the taxpayers of a community.

In rural communities telephone wire facilities are so sparsely located, and in many instances lacking, so as to make their use for fire department impractical.

In case of large conflagrations, the telephone and wire facilities are generally rendered inoperative by the conflagration itself, therefore, placing a hardship on the fire-fighting forces when it is necessary to call into action additional services.

When forest or large brush fires occur, they are generally in locations well removed from all wire facilities.

In case of fire or other emergencies to which fire departments respond, it is very necessary to depend upon rapid communication facilities, as time is a very important factor. It is necessary sometimes upon reaching the scene of a disaster to call for additional assistance to respond to definite locations. Assistance required may be medical (ambulances), additional pumping units, special tools, gas masks, acetylene cutting equipment, heavy jacks, etc., not normally carried. The speed and accuracy with which this equipment can be summoned may be the determining factor on the loss of life. When it is necessary to call upon neighboring communities for *mutual aid* assistance, they must then be kept fully informed of the status of both departments, and the progress being made in handling the emergency, so that anticipated needs can be met.

It is also essential to provide adequate communications between the mobile units of a fire department; otherwise, a unit may become lost to the department when it leaves the fire station. If equipped with radios, the dispatcher could direct the unit should conditions change. It is often discovered that incorrect addresses have been given by persons under the stress of excitement, which is discovered after the unit has started on its response. Much valuable time is lost because it is impossible to contact the unit responding incorrectly. Many large fires and the loss of life are the result. If equipped with radios they could quickly be directed to the correct location of the fire.

Radio contact is also very essential to the officers of the battalion, particularly the *chiefs*. This makes it possible for them to be constantly in touch with *fire alarm headquarters* and the chief of the department. Otherwise, they are handicapped in properly directing the activities of the fire fighting forces.

It is also very essential that fire fighting forces working on fires in large buildings be provided with a channel of communications between the fire and the chief officer in the street, so that additional manpower or other equipment can be called for and dispatched without the necessity of sending foot messengers, who in many cases, must travel many flights of stairs to secure these facilities, particularly in our large buildings. Elevator service is discontinued during fires. Radios would facilitate rescue work in cases where entire companies become trapped while fighting a fire. It would also provide facilities for the *chief* to order evacuation when conditions become critical, so as not to endanger the life of the men fighting the fire.

Present Status

There are at present but six municipal fire stations, licensed as such, under the recently revised rules of the Federal Communications Commission. These are:

WSKW—New Orleans, La. a3	1630 k
WDRE — Portland, Me. a3	35580 k
WEY —— Boston, Mass. a3	1630-37740 k
WKDT — Detroit, Mich. a3	1630 k

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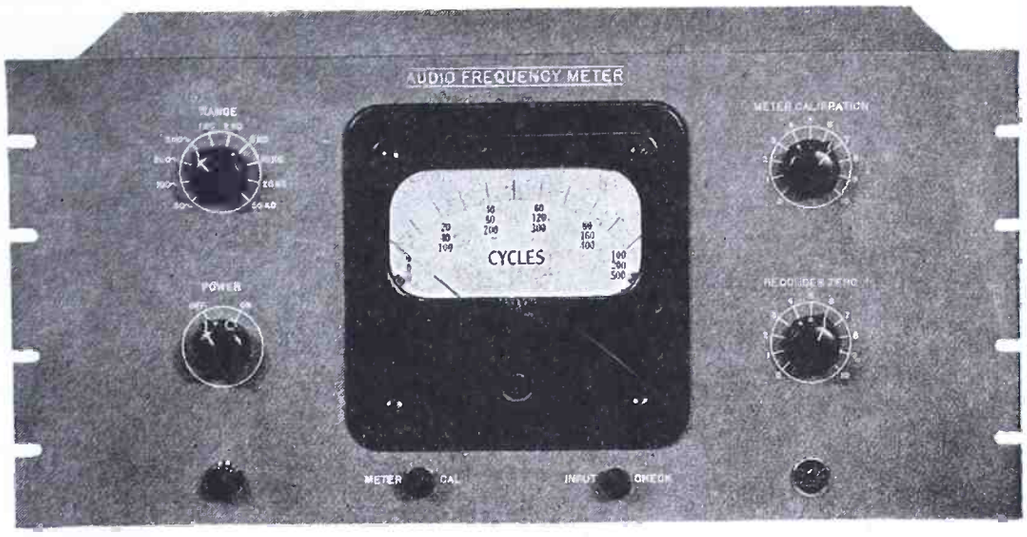

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WDCS is operating as a municipal police station at present. The other stations were formerly operating under marine fire class of stations. All other fire departments using radio at present on a limited basis were forced into coordinated service with municipal police stations, because of the lack of adequate frequency channels assigned to the fire service.

Estimate of Future Development of Service

In general, *municipal fire* and *police departments* should be permitted to operate separate and distinct radio communications systems, and to be assigned specific frequencies for the exclusive use of the service. This opinion is based upon several important findings:

(*1*) The peak message traffic load at any given period is the governing factor in the amount of radio equipment and number of frequencies necessary to provide adequate communications facilities for any municipality. Generally, during any large fire both the *fire department* and the *police department* reach their maximum peak message load simultaneously, and at which time the prompt coordinated action of both departments is imperative.

When a multiple alarm of fire occurs, both *fire* and *police departments* must act promptly and efficiently. The *fire department* is concerned with prompt and immediate response to the fire, and the *police* with the control and diversion of vehicular and pedestrian traffic.

Traffic congestion would seriously hamper the response of the fire-fighting apparatus, which would result in a serious fire and probably the loss of life. Since the coordinated action of both departments occur simultaneously, the total number of emergency messages required to be transmitted may reach such proportions that existing radio police facilities would be entirely inadequate.

(*2*) The operating procedure and the terminology used in the messages will vary with the respective services. Hence, radio operating personnel familiar with the phraseology and operating procedures pertinent to the municipal service with which they are affiliated leads to an efficient communicati service, which cannot be obtained oth wise.

It must also be remembered that municipal wire-alarm system, if stalled in a municipality, has no bea ing on the *fire department's* need f radio communications service.

Since radio affords the only mea of contacting the mobile units of t *fire department* or at the scene of fire where no wire facilities are ava able, it is similar to *police,* who mu depend upon the public telephone fro which the public in general call the into action and apprise them of a ro bery or attempted robbery. Upon r ceipt of such messages, they go in action and the radio becomes an i portant part of their operating co munications system. It is also used contact mobile units on patrol.

The *fire-alarm system* is the on means whereby the general public ca apprise the *fire service* that a fire h occurred. Then the *fire departme* like the *police,* goes into action, ar radio facilities become an importa channel of communications, not on between mobile units and the *fi alarm headquarters,* but between th chief engineer, his officers at the fi ground, and for intercepting mobi units and directing water pressure etc. Radio is also important for co tacting battalion chiefs, who patr their battalion daily so that they c direct such chiefs to fires of whic otherwise they would not be apprise until their arrival at a fire statio This may be quite some time after th fire occurs. With radio they can b dispatched at once.

In small communities the maximu radio peak load may not at any tim reach the point where separate facil ties are required. In such cases a co ordinated communications syste would be desirable, from both an ec nomic and operating standpoint. If small municipality's fire service was part of the organized *mutual aid* wit in a fire district, then, it should ope ate on the municipal fire frequenc assigned to the district, or participa and coordinate its service with adj cent small communities.

Economic Factors

The economic factor does not ente into the problem of radio communica tions for the *fire service,* as most uni now operating are loaned to the fi

(*Continued on page* 78)

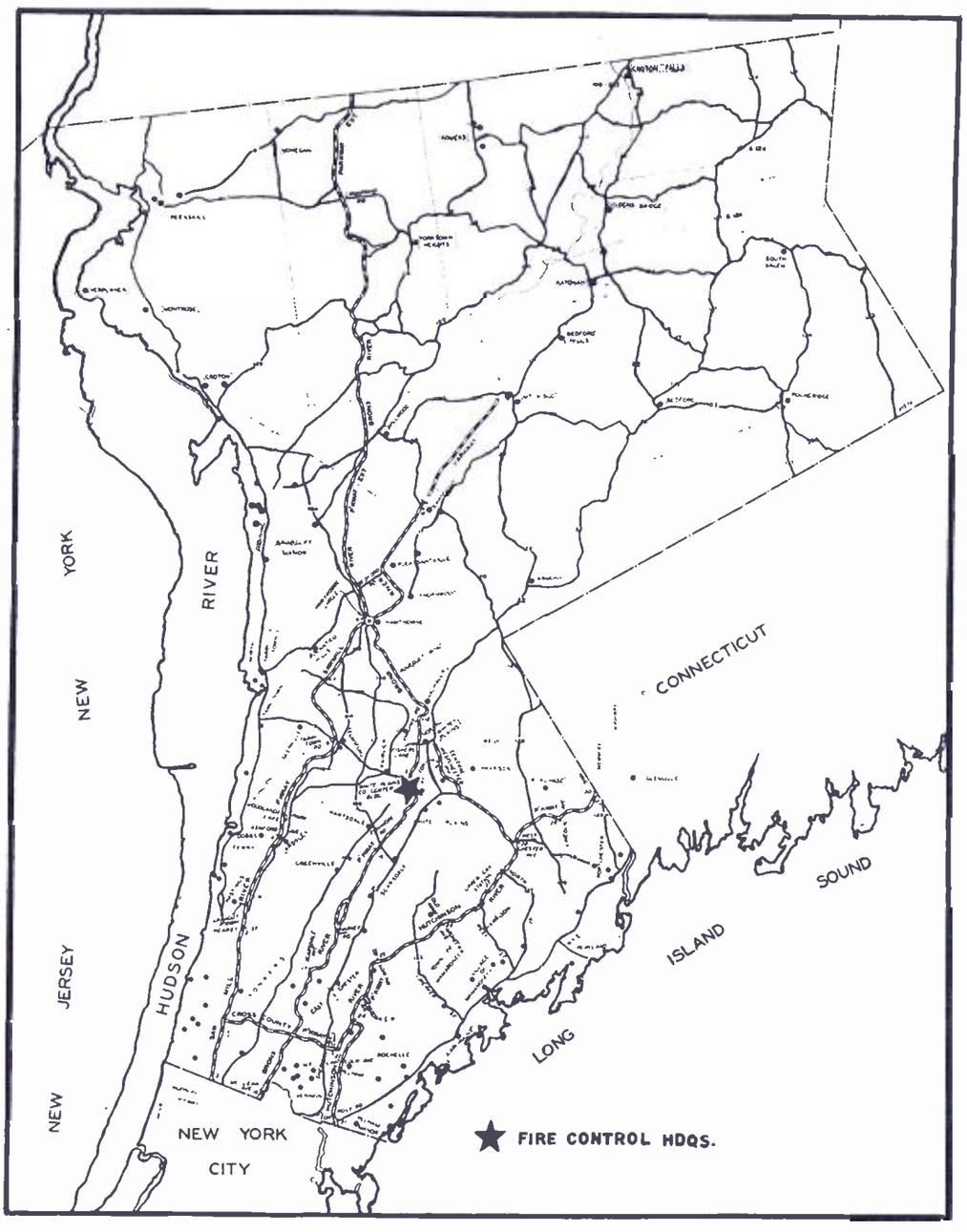

Figure 2
Coordinated communications plan in Wes chester county, on a county fire departme basis. Dots indicate fire houses.

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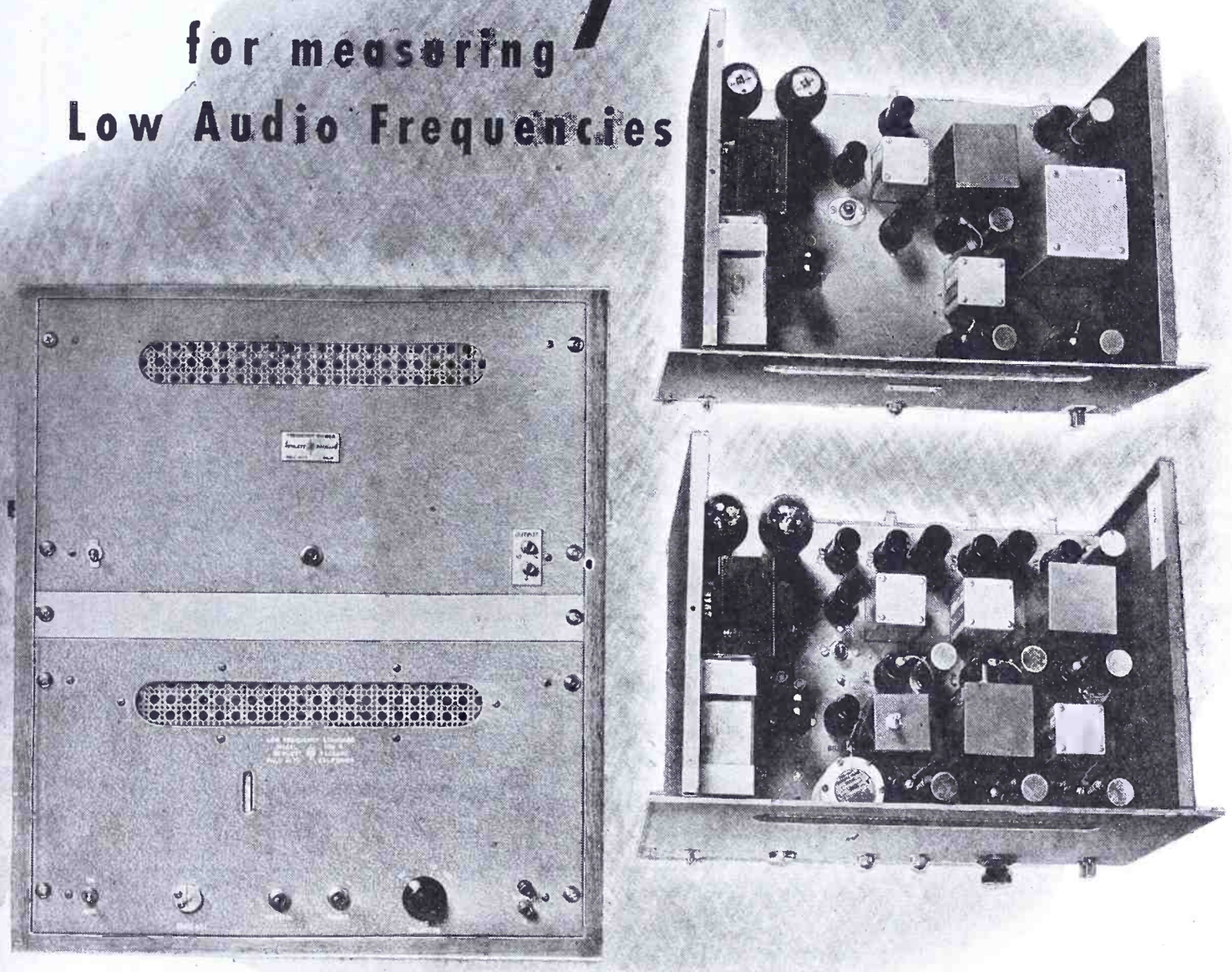

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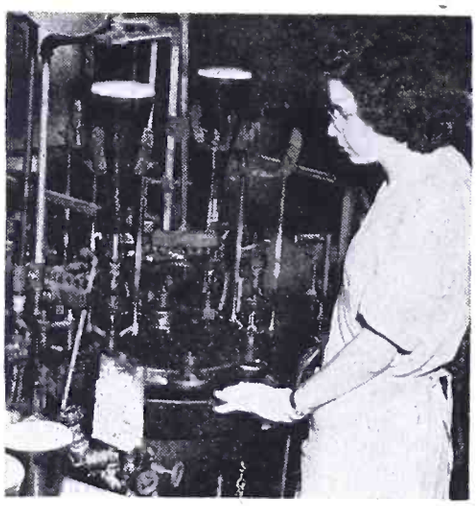

Figure 5
Machine operation where glass seal is made between stem and envelope of cathode-ray tube.

Fabricated parts formed of stainless steel may be treated in an inert or reducing atmosphere at temperatures in excess of 1,000° C. This procedure renders the metal impassive, although certain precautions must be observed to prevent oxidation since a bright finish is necessary for welding purposes.

Following the choice of proper materials for cathode-ray gun construction, there are certain general precautions which must be observed in the finishing processes of the fabricated materials.

All sharp or feathered edges on metallic parts must be eliminated. This applies to anode and grid-cylinder terminals, edges of deflection plates, edges of apertures (in grids and anodes), as well as to spot welds made to any of these elements. Th is essential to reduce secondary ar stray emission effects. A minimu amount of handling, either with glove or bare hands, is necessary to kee electrical leakages and gas at a min mum.

In the heater element of the tub the most satisfactory material is pur non-sag tungsten. This, preferabl formed into a non-inductive helix, coated to approximately 3 or 4 time its original diameter with pure alum inum oxide, which is subsequently sin tered at 1,600° C to form a perma nently adherent insulation.

The cathode cylinder must be forme from the purest nickel obtainable After fabrication it must be electro lytically cleaned. The cylinder is the fired in hydrogen at 700° C, just prio to spraying its top surface with pur barium and strontium carbonates. Th application of these carbonates is o utmost importance and the prope technique is learned only after con tinued practice. Following the emit ter application, the cathodes must b handled with tweezers.

As previously stated, the contro grid of a cathode-ray tube is a cylinde having its top end closed with a disk In the center of the disk is an apertur for the control of electrons supplie to the system. The spacing betwee the under side of this disk and the sur face of the cathode coating is ver critical. For satisfactory results thi spacing must be maintained at a pre determined value within ±.001".

Next in importance to cathode prep aration and mechanical spacing (wit respect to control grid), we have me chanical alignment of grid cylinde and aperture with respect to first an second anode cylinders and apertures Misalignment of these elements wi cause certain distortions and disturb ances. The most common are stra emission and astigmatism. Residua magnetism will also produce these de fects and therefore must be reckone with and eliminated. Cylinders an apertures must be concentric and coax ial within ±.002"; planes of all aper tures must be as nearly parallel wit each other and as near 90° to th tube axis as is practical.

Deflection plates must be solidly an accurately mounted; spacing betwee plates of each pair must be held withi ±.003" of a predetermined value. Th vertical pair must be positioned at 90° angle (±2°) with respect to th horizontal pair; the center of th square (or rectangle), bounded by th inner surface of both pairs, must b

(*Continued on page* 51)

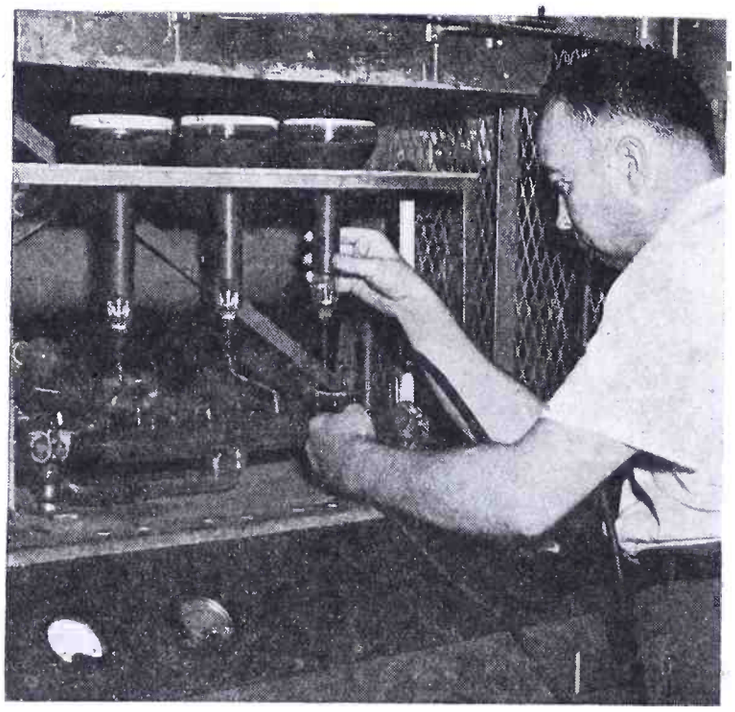

Figure 6
Sealing the exhaust tube to the manifold on stationary exhaust position.

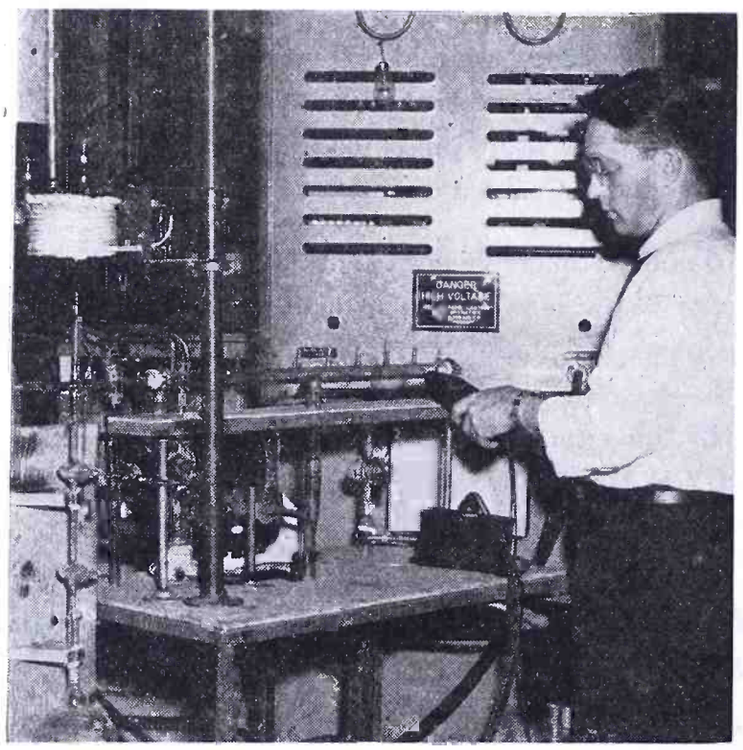

Figure 7
Mechanical vacuum pump with motor (lower deck) and glass diffusion pump with manifold (upper deck) which are used for cathode-ray tube evacuation.

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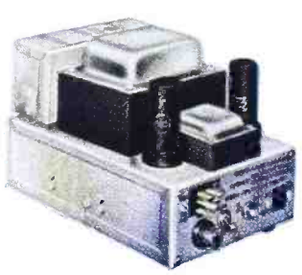
Dimensions: 9¾ x 5¾ x 6 inches. Weight: 14½ pounds



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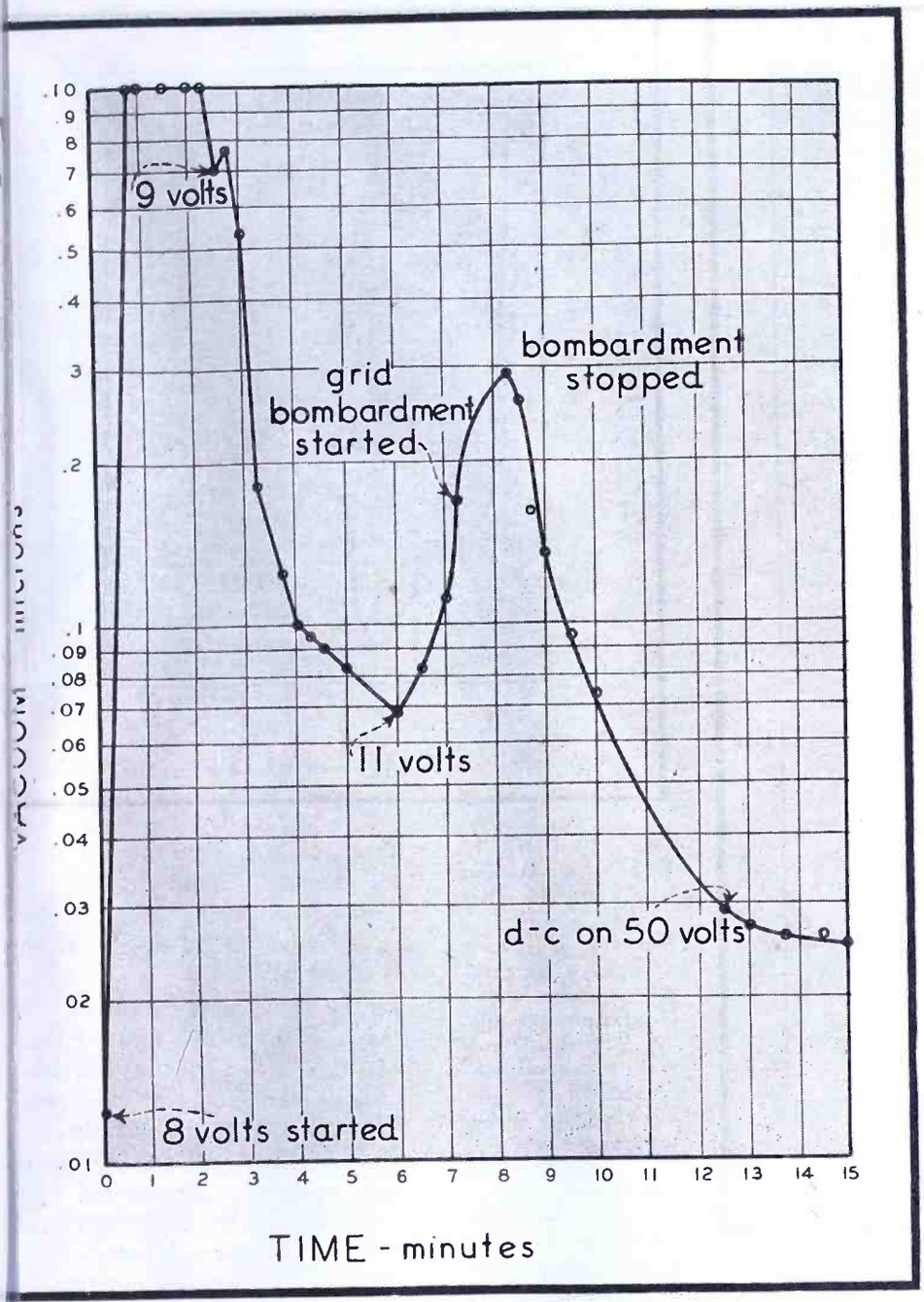


Figure 8
Vacuum-time curve for cathode-ray tube showing gas pressure during activation.

ial with anode and grid apertures. ure to line these up properly will t in beam cut off, Figure 1.

e assembled gun, as described, is mounted on a glass stem.[1] In operation all connectors must be ly welded and have sufficient rance; otherwise, subsequent oper- ns may cause opens or shorts h result in patterns such as are vn in Figures 2 and 3. The pat- of a good tube appears in Fig- 4.

sealing the stem to the bulb, Fig- 5, mechanical pressure must be ied to the entire mount, when the is forced over supporting snub- . Sometimes a weak or poorly ed connector will buckle or be laced, thus causing later failure of tube.

the exhausting operation, tubes sealed to the exhaust manifold or ey as shown in Figure 6. Ex- sing equipment consists of a me- chanical force pump, in series with an oil aspirator, Figure 7.

Typical exhaust schedules for a 5" tube (6.3-volt heater) are:

(1)—Light heater 2 minutes at 8 volts.

(2)—Bombard by high frequency to red heat.

(3)—Light heater 4 minutes at 10 volts.

(4)—Bombard grid with heater at 10 volts.

(5)—Flash *getter* with heater at 10 volts.

(6)—Light heater 1 minute at 11 volts.

(7)—Light heater 4 minutes at 10 volts with +25 d-c on grid.

(8)—Light heater 2 minutes at 9 volts.

(9)—Tip off tube.

In this operation, the barium and strontium carbonates are converted to their oxides. Then they are treated further to reach an optimum condition for continuous delivery of pure barium at the cathode surface.

During the conversion process, large quantities of gas are released from the carbonates, Figure 8. Grid temperature is raised by increasing the voltage of the heater and by external high-frequency bombardment. From the curve it is apparent that once conversion is complete, evolution of gas stops and the pump reduces residual gas to an extremely low pressure.

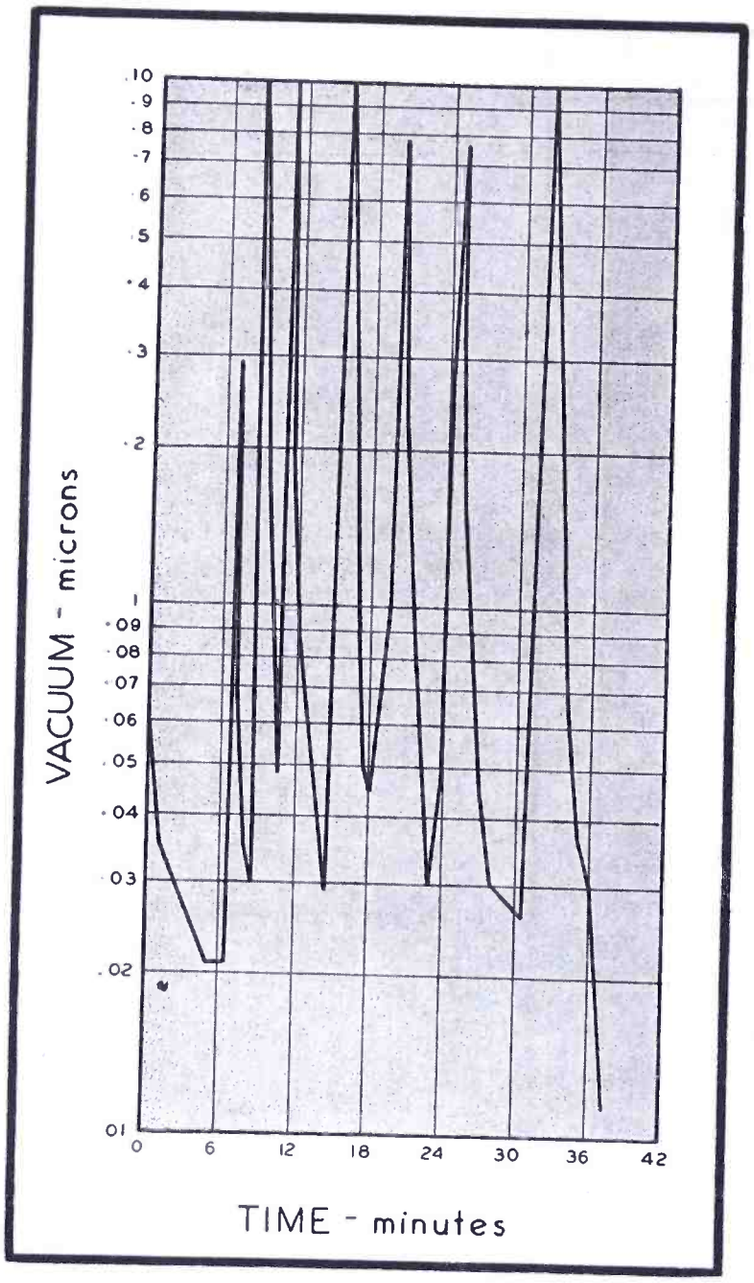
Before conversion and activation of the barium and strontium salts, the gun assembly is heated by induction two or more times at approximately 700° C to drive the gas from the metal. For demonstration purposes, several curves were prepared for cases where bombardment was interrupted when gas pressure reached 1 micron, then resumed after recovery. In practice, the first bombardment is continued for a much longer period and the gas pressure goes considerably beyond 1 micron; thus, subsequent bombardment releases very little gas.

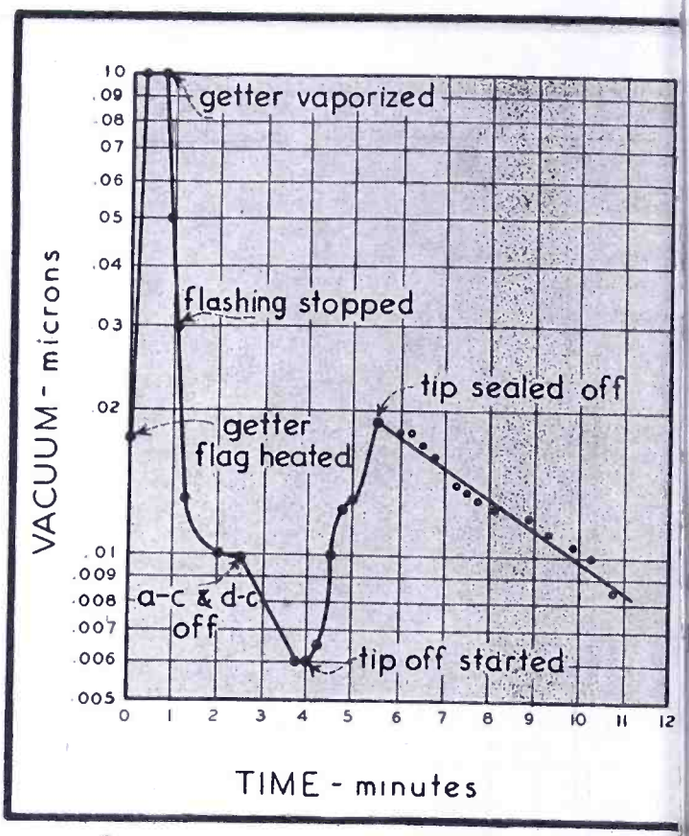
Cathode activation is continued until pressure is reduced in the tube to the lowest possible degree, within limits determined by equipment and previously described schedules. Next, it is necessary to reduce pressure further by chemical means. To accomplish this, extremely active metals are vaporized and deposited upon the inner walls of the tube. This is called *gettering the tube.* The best *getter* for cathode-ray tubes is pure barium. Its action in reducing pressure is shown in Figure 10.

Finally, after exhausting, the tube is tipped off. This operation adds a slight amount of gas, mostly carbon dioxide to the tube, Figure 10. Subsequently, the carbon dioxide is eliminated by reaction with the active *getter.* In some practices additional *getter* is released within the tube (after the tip off) to take up the carbon dioxide and other gases that will be released during normal life. After the base is attached, the tube is seasoned and given final tests. This completes the processing.

At approximately the midpoint of tube construction the mount is sealed within the bulb. Obviously, to prepare for this operation the bulb supply must be made ready simultaneously

[1] COMMUNICATIONS, July, 1944, pp. 46.





Figures 9 (left), 10 (top), 11 (below, left), and 12 (below, right)

Figure 9, a vacuum-time curve for cathode-ray tube, showing gas pressure during bombardment. Figure 10, a vacuum-time curve for cathode-ray tube showing gas pressure during *getter* flashing and tip-off. Figure 11, a vacuum-time curve for c-r tube showing gas pressure during *getter* flashing at test. Figure 12, method of inductively heat-treating metal parts of c-r tube during exhaust process.

with parts and mounting of the
Bulb preparation and cleaning is
important since the inner walls
surfaces must be chemically clean
free of flaws.

In the spray application of scre
which is probably most comm
used, it is necessary that particle
of fluorescent materials be care
controlled. This is usually acc
plished by fixed-ball milling sched
using materials of selected par
sizes. The carrier used may be wa
acetone or similar solvents.

Spraying is semi-automatic. A
heating the face to about 200° C,
bulb is fastened in a rotating ver
chuck and the nozzle of a high-p
sure spray gun is inserted into

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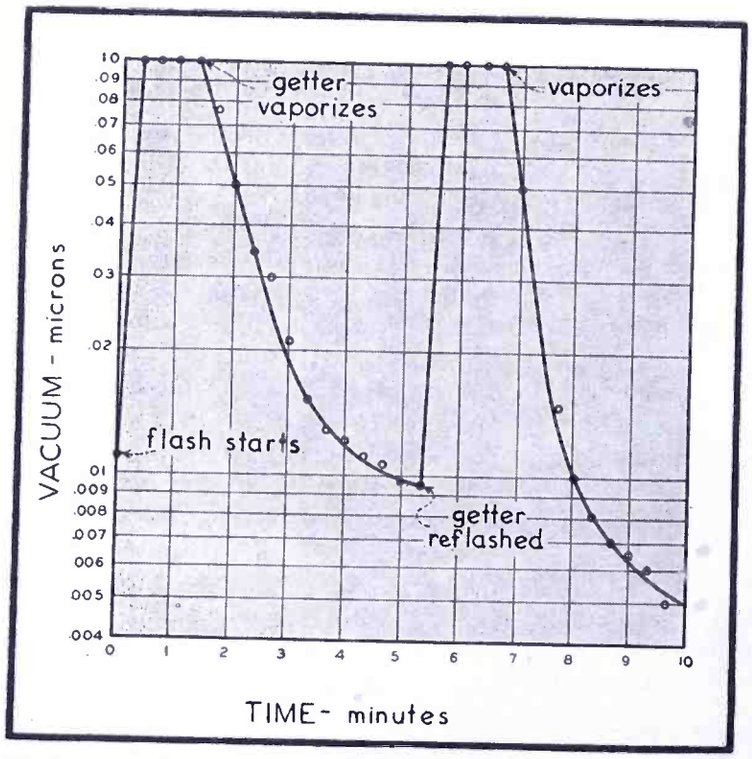
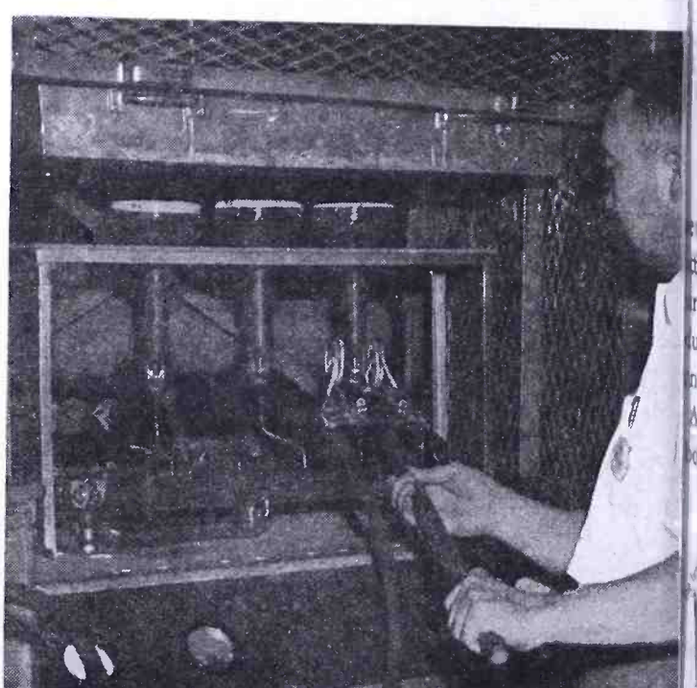
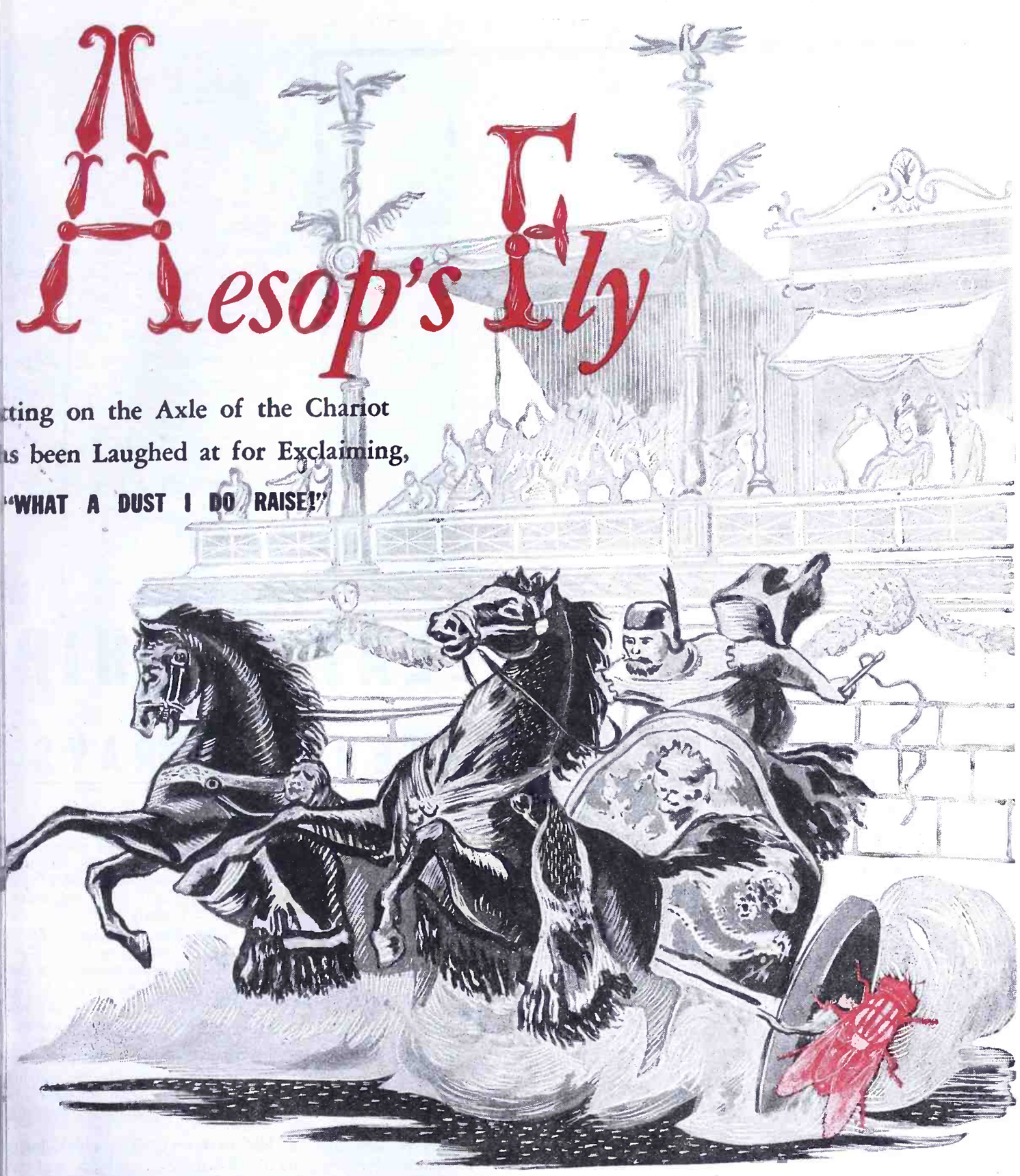




Aesop's Fly

tting on the Axle of the Chariot
as been Laughed at for Exclaiming,
"WHAT A DUST I DO RAISE!"



wheels of American enterprise geared to war-paced pro-
con have been raising a high dust for the past few
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strial unit to claim a large share of credit for this
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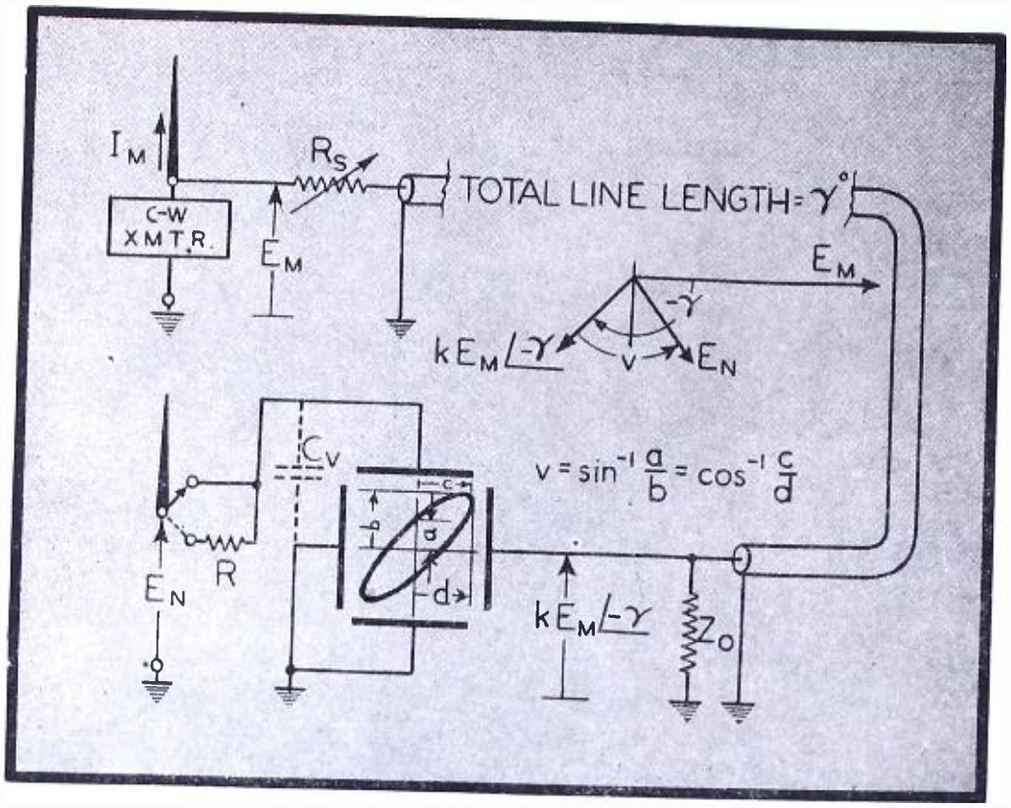

Figure 7

How a small transmitter and cathod oscilloscope can be used to determine tual impedance. The transmission line feeding the antennas are connected so each end of a continuous line of k length is accessible near the driving minals of each antenna.

[PART TWO OF A TWO-PART PA

IMPEDANCE RELATIONSHIP

OF BROADCAST ANTENNA ARRAYS

by WILSON PRITCHETT

Radio Engineer
E. F. Johnson Company
[Formerly E. E. Instructor, Oregon State College]

A direct method, independent of antenna heights and methods of excitation, for adjusting multi-element antenna arrays is outlined in this portion of the paper. It is assumed that the relative magnitude and phase of the currents at the driving points of each antenna is specified.

AFTER the antennas have been erected and the transmission lines installed, preliminary impedance measurements are made at the driving points of the antennas with an instrument designed for the purpose[10]. The details of the measuring technique have been described[11,12] and thus only the measurement procedure is given.

For the maximum accuracy in determining the mutual impedance of the antennas, it is necessary, first, that we have two separate series of bridge measurements at each pair of antennas input terminals. We must then establish the algebraic sign of the mutual impedances computed from the bridge measurements.

Use is made of the general network equations defining the self and mutual impedances

$$\begin{aligned}
E_1 &= I_1Z_{11} + I_2Z_{12} + \cdots + I_PZ_{1P} + I_QZ_{1Q}\\
E_2 &= I_1Z_{21} + I_2Z_{22} + \cdots + I_PZ_{2P} + I_QZ_{2Q}\\
&\cdots\\
E_P &= I_1Z_{P1} + I_2Z_{P2} + \cdots + I_PZ_{PP} + I_QZ_{PQ}\\
E_Q &= I_1Z_{Q1} + I_2Z_{Q2} + \cdots + I_PZ_{QP} + I_QZ_{QQ}
\end{aligned} \qquad (13)$$

E_N = Impressed voltage at the driving terminals of antenna N. Positive direction of voltage from ground terminal to antenna terminal.

I_N = Current flowing through the terminals of antenna N. Positive current into antenna terminal and out of ground terminal.

Z_{NN} = Impedance measured at the driving terminals of antenna N with all other antenna terminals open-circuited and their currents equal to zero.

Z_{MN} = A complex number, which when multiplied by I_N, gives the voltage at the open-circuited terminals of antenna M, when all other terminals are open circuited. Antenna N, of course, is excited.

Z_{NM} = A complex number which when multiplied by I_M gives the voltage at the open-circuited terminals of antenna N when all other terminals are open circuited. This time antenna M is excited.

By means of these relations and the reciprocity theorem

$$\begin{aligned}
Z_{MN} &= \pm\sqrt{R_{NN}\,(Z_{MM} - Z_M{}^N)}\\
&= \pm\sqrt{R_{MM}\,(Z_{NN} - Z_N{}^M)}
\end{aligned} \qquad (14)$$

Z_{MN} = The mutual impedance between antennas M and N.

Z_{MN} = Self impedance of antenna N is measured at the driving minals of antenna N, with the d ing terminals of *all other* ante open circuited.

Z_{MM} = Is the same for antenna M.

R_{NN} = The resistance component of

R_{MM} = The resistance component of

$Z_M{}^N$ = The impedance measured at driving terminals of antenna with a reactance $-X_{NN}$ conne across the terminals of antenna

$Z_N{}^M$ = The impedance measured at driving terminals of antenna with a reactance $-X_{MM}$ conne across the terminals of antenna

The first series of bridge measu ments obtains Z_{MM} and Z_{NN} and enal the operator to connect and adjust series reactors $-X_{MM}$ and $-X_{NN}$ that the bridge sees R_{MM} and This is done with all others open. practice the resulting resistance lo ing into the terminals with the reac in series is slightly different from resistance component of the s impedance of the antenna. This is to losses in the series reactor toget with its shunting capacitance ground. The discrepancy is usu immaterial, and the only correct that may be made is to add the equi lent series resistance of the reacto This first series of measurements volves the application of the measur

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The Case of the Flying Gull . . .

ring the storm season of 1942, *The Fly-*
Gull ran into heavy seas in the Gulf
Mexico.* Running before a terrific wind,
all but made port. Then, just as she
putting about near Hunter's Point, she
ped a gigantic wave and foundered.
hands were saved. But *The Flying Gull*
ed in eight fathoms of Gulf water.

Salvage operations were started. Later in
2, when The Flying Gull was in the
k and her electrical equipment ripped
, an amazing thing occurred. George
ng, of The Harris Salvage and Drydock
mpany of Galveston, put the Therma-
transformer equipment on a shelf in
sunshine—mentally assigning it to the
ap metal drive. Three days later, out of
iosity, he hooked the transformers onto
esting bench and flipped on the current.
his amazement, they still showed signs
life. He then ran standard tests. To his
ther astonishment, all twelve of the
nsformers were not only working—they
were working perfectly.

Harvy Stark, owner of the boat, had already ordered a complete new set of transformers from Thermador. He cancelled the re-order. And today The Flying Gull sails with her original Thermador transformers. Not designed for the briny deep—but they could take it!

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equipment to each pair of antenna terminals. The second series of measurement begins at the last antenna visited and consists in measuring the impedance directly into the antenna terminals with each of the other antennas in turn closed to ground through their series reactors previously adjusted. Data have now been obtained for use in equations (*14*). The two values obtained should check each other.

It is seen that a choice of $\pm Z_{MN}$ exists, and in reality only one algebraic sign is correct. One of several methods may be used to establish the sign of the mutual impedance. An estimate may be made with the aid of certain published curves and formulas[14]. A phase monitor may be used[4]. Figure 7 shows a method employing a small c-w transmitter and the deflection plates of a cathode-ray oscilloscope. The transmission lines for feeding the antennas are connected so that each end of a continuous line of known length is accessible near the driving terminals of each antenna. The line is properly terminated as shown so that the phase shift (γ) is approximately equal to its electrical length. Two possible connections are provided on the upper deflection plate of the cathode-ray tube; the first applies E_N to the plates directly and the second provides a slightly lagging phase shift for the purpose of establishing which of the two voltages E_N or $kE_M/-\gamma$ leads. For example in the cyclogram shown, ($\sin \nu$) is approximately 0.5 and ν is 30° for the first connection. The second connection introduces the resistor R (having a resistance of about one-fifth the reactance of the capacitance C_v, which is usually about 20 mmfd.). If the cyclogram closes it is easy to see that E_N was leading ($kE_M/-\gamma$) by the angle ν. If ν is defined as positive for E_N leading, and k is adjusted so that the horizontal and vertical deflecting voltages are equal, the vector diagram of Figure 7 and consideration of equations (13) show that

$$Z_{MN} = k\,Z_{MM}/\nu - \gamma \qquad (15)$$

This simply means that for this method the angle of the mutual impedance is equal to the angle of the self-impedance of the driving terminals plus the algebraic sum of the two angles ν and γ. The magnitude and sign of the former is established in observing the cyclogram under the two conditions described, and it is to be remembered that the latter is always negative.

The magnitude of the mutual impedances in broadcast arrays may vary from about one-tenth or slightly less to about one-half the self impedance. This means that in order to obtain a readable deflection on the cathode-ray oscilloscope the transmitter should be capable of making E_M sufficiently large. Assuming the ratio of Z_{MN} to Z_{MM} equal to one-tenth and a deflection sensitivity of the oscilloscope of forty-volts/inch, the power rating of the resistor Z_o is in the order of four watts and of R_B, thirty watts. A transmitter capable of delivering 50 watts is satisfactory.

Attention is called to the fact that the terminals of antenna N are assumed open circuited for these measurements, although the capacitance C_v draws a very small current. to eliminate stray voltages (s power-line pickup, etc.) from the circuited terminals of antenna is usually necessary to connect a low-loss parallel-resonant c across these terminals during measurements.

Figure 8
Solving the proper excitation and proper line termination problem. After checking the power represented by the vectors against the power in the respective antennas, the correct vectors shown are drawn.

Final Operating Impedance

The final operating impedance and Z_N, seen by the antenna cou networks can now be found equations 13. First it is necessa determine the ratios of the relative rents at the feed points from the inal specified excitation.

Let k_{fN}/φ_{fN} be the relative cu and phase at the feed point of ant N, then

$$K_1 = \frac{I_1}{I_1} = \frac{k_{f1}/\varphi_{f1}}{k_{f1}/\varphi_{f1}} = \text{unity}$$

$$K_2 = \frac{I_2}{I_1} = \frac{k_{f2}}{k_{f1}}/\varphi_{f2} - \varphi_{f1}$$

$$K_P = \frac{I_P}{I_1} = \frac{k_{fP}}{k_{f1}}/\varphi_{fP} - \varphi_{f1}$$

$$K_Q = \frac{I_Q}{I_1} = \frac{k_{fQ}}{k_{f1}}/\varphi_{fQ} - \varphi_{f1}$$

The operating impedances are

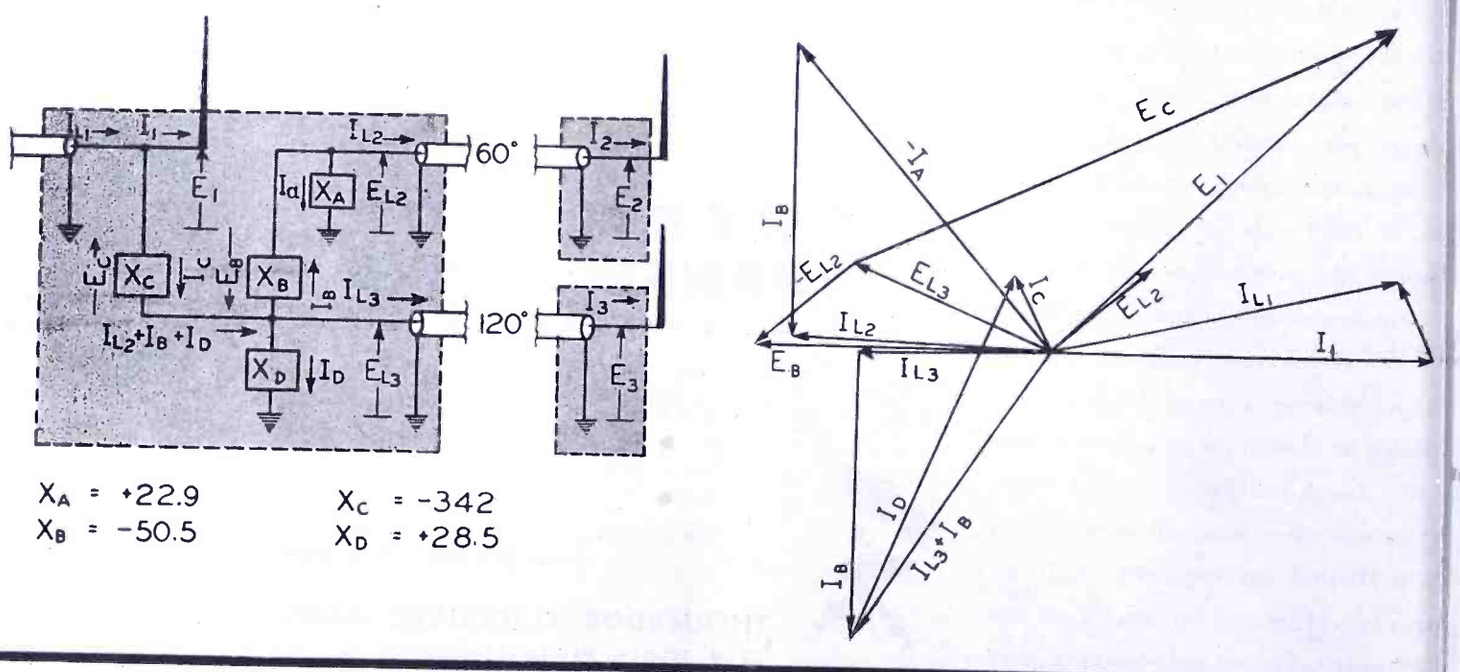
$$Z_1 = Z_{11} + K_2 Z_{12} + \cdots + K_P Z_{1P} + K$$

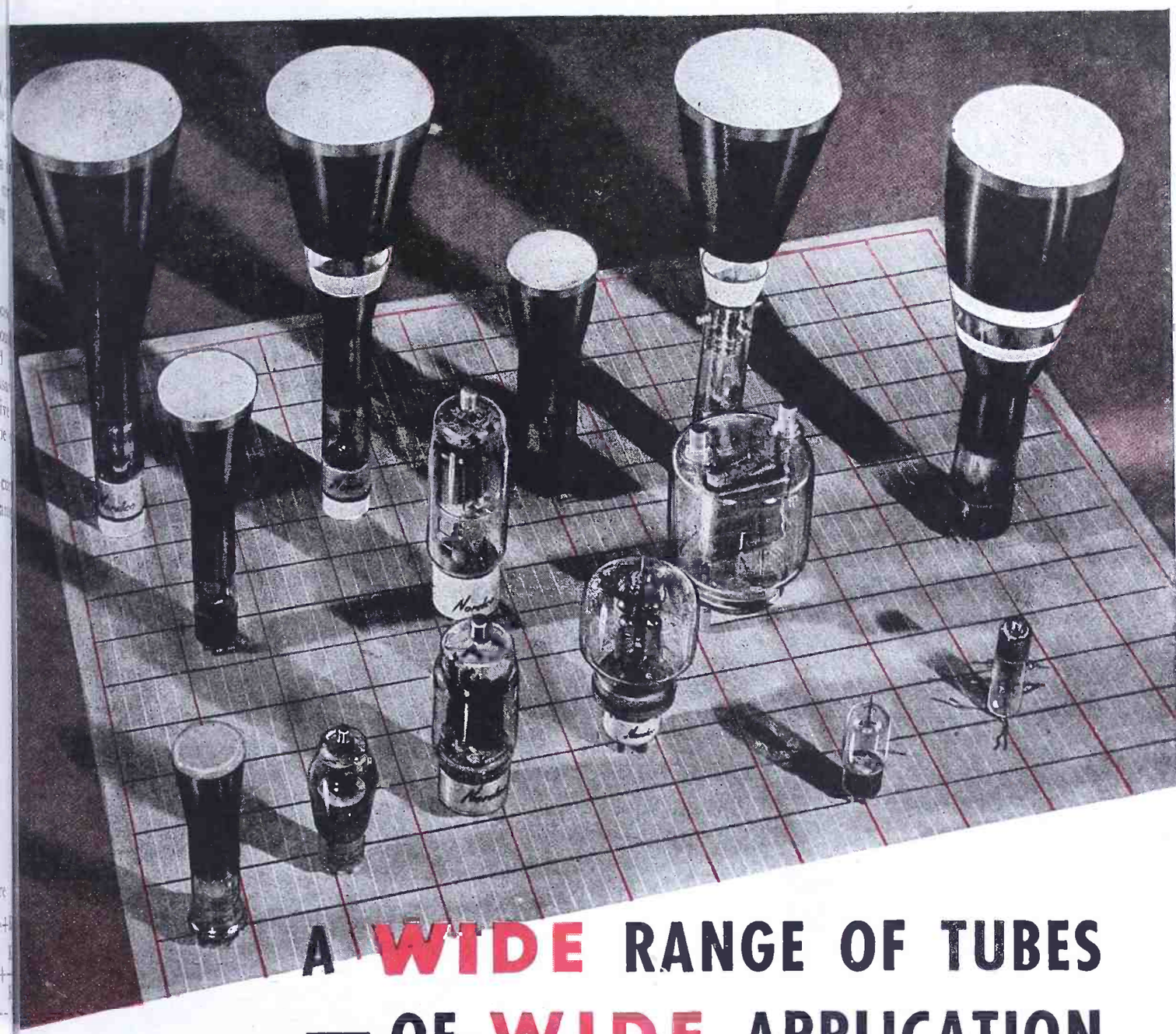
$$Z_2 = \frac{Z_{21}}{K_2} + Z_{22} + \cdots + \frac{K_P}{K_2} Z_{2P} + \frac{K}{K}$$

$$Z_P = \frac{Z_{P1}}{K_P} + \frac{K_2}{K_P} Z_{P2} + \cdots + Z_{PP} + \frac{K_Q}{K_P}$$

$$Z_Q = \frac{Z_{Q1}}{K_Q} + \frac{K_2}{K_Q} Z_{Q2} + \cdots + \frac{K_P}{K_Q} Z_{QP} +$$

The resistance and reactance c





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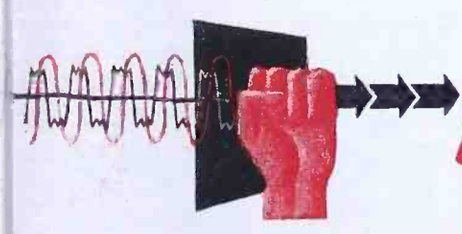

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IMPEDANCE RELATIONSHIPS

(*Continued from page 56*)

ponents of these impedances are

$$Z_N = R_N + jX_N \qquad (18)$$

The total power, P_T, in watts delivered to the array is equal to the summation of the power delivered to the individual feed points. It follows that

$$I_1 = \sqrt{\frac{P_T}{R_1 + K_2^2R_2 + \cdots + K_P^2R_P + K_Q^2R_Q}} \text{ amperes} \qquad (19)$$

Substitution of this value of I_1 into equations *16* gives the other currents. The voltages are obtained by multiplying the currents by the operating impedances

$$E_N = I_N Z_N \qquad (20)$$

In certain arrays excited in a certain manner, it may happen that the resistance component of one or more of the operating impedances is negative. This merely means that the power flow is back out of the antenna terminals, but it should be remembered that the positive directions of current and voltage are as defined in equations (13).

Antenna Coupling Networks

Now that the operating impedances are known, the network components needed to give the proper impedance match and phase shift can be determined. The analytical method is frequently used to design π, T, and L networks to secure the desired results[15]. Another method, graphical in character, and called *network synthesis* has been described[16], and illustrations of the design of single π, T, and L networks were given. The procedure for using this method in the design of the more complex coupling networks of multi-element arrays will be demonstrated with examples.

The considerations involved have been very recently described[17]. In the material to follow examples only are given, but they are extended to include the case of one antenna delivering power back into the system. The examples illustrate the procedure for matched and unmatched transmission lines. As in any graphical solution care expended in construction is repaid in accuracy of results.

Example of Network Design

The following values of self and mutual impedance in a three-element array have been determined by measurement:

$Z_{11} = 47.0 + j\ 40.0$ $\qquad$ $Z_{12} = 32.0\ /\underline{-10°}$
$Z_{22} = 50.0 + j\ 70.0$ $\qquad$ $Z_{13} = 25.0\ /\underline{-60°}$
$Z_{33} = 45.0 + j\ 55.0$ $\qquad$ $Z_{23} = 21.0\ /\underline{-75°}$

The required excitation to give the desired pattern is

$K_1 =$ Unity;
$K_2 = 0.500\ /\underline{+160°}$; $\quad K_3 = 0.500\ /\underline{+}$

Substitution of these values in equation *17* gives the operating impedances seen by the networks feeding the antennas:

$Z_1 = 44.9 + j\ 43.73 = 62.7\ /44.25°$
$Z_2 = -33.3 + j\ 64.34 = 72.45\ /\underline{117.37°}$
$Z_3 = 51.15 + j\ 20.55 = 55.1\ /\underline{21.9°}$

The total power needed to give the desired pattern is 10,000 watts. From equations *18* and *19*, I_1 is found, and substitution into *16* gives the other currents I_2 and I_3. The voltages are obtained from equation *20*. All these are

$I_1 = 14.27\ /0$ $\qquad$ $E_1 = 893\ /44.25°$
$I_2 = 7.12/\underline{+160°}$ $\qquad$ $E_2 = 516\ /\underline{277.37°}$
$I_3 = 7.12/\underline{+40}$ $\qquad$ $E_3 = 392\ /\underline{61.9°}$

The first example will show a design to secure the proper excitation, but the lines will be mismatched intentionally to reduce the number of reactors needed. The second example will show a design to secure both proper excitation and proper line termination.

Figure 8 shows the complete solution which will be described step by step. It is noted that in this example the lines are connected directly to the antennas and so no network need be designed to the tuning houses of lines *2* and *3*. To find the current and voltage of lines *2* and *3* in the tuning houses, *1*, we solve the general transmission line equations[18] for E_{12}, I_{12}, E_{13}, and I_{13}. Assuming no losses in the lines and remembering that the receiving end of line *2* is in tuning house *1*

$E_{12} = 237\ /40°$ *volts*
$I_{12} = 9.67\ /\underline{177.5°}$ *ampere*
$E_{13} = 400\ /\underline{157°}$ *volts*
$I_{13} = 7.00\ /\underline{180°}$ *ampere*

We then check the power represented by these vectors against the power in the respective antenna. If correct, the vectors, as shown in Figure 8, are drawn.

The work of obtaining a solution consists in satisfying Kirchhoff's laws within the tuning house. The objective is to connect all high terminals together and to the source of power, line *1*. Series and shunt reactors are used so that the current and voltage magnitude and phase relations specified are undisturbed. Usually a number of simple solutions are possible and these can be seen from the circuit and vector diagram. The choice made for the final design should consider at least efficiency, cost, ease of adjustment, and harmonic attenuation.

We begin this operation by joining

(*Continued on page 60*)

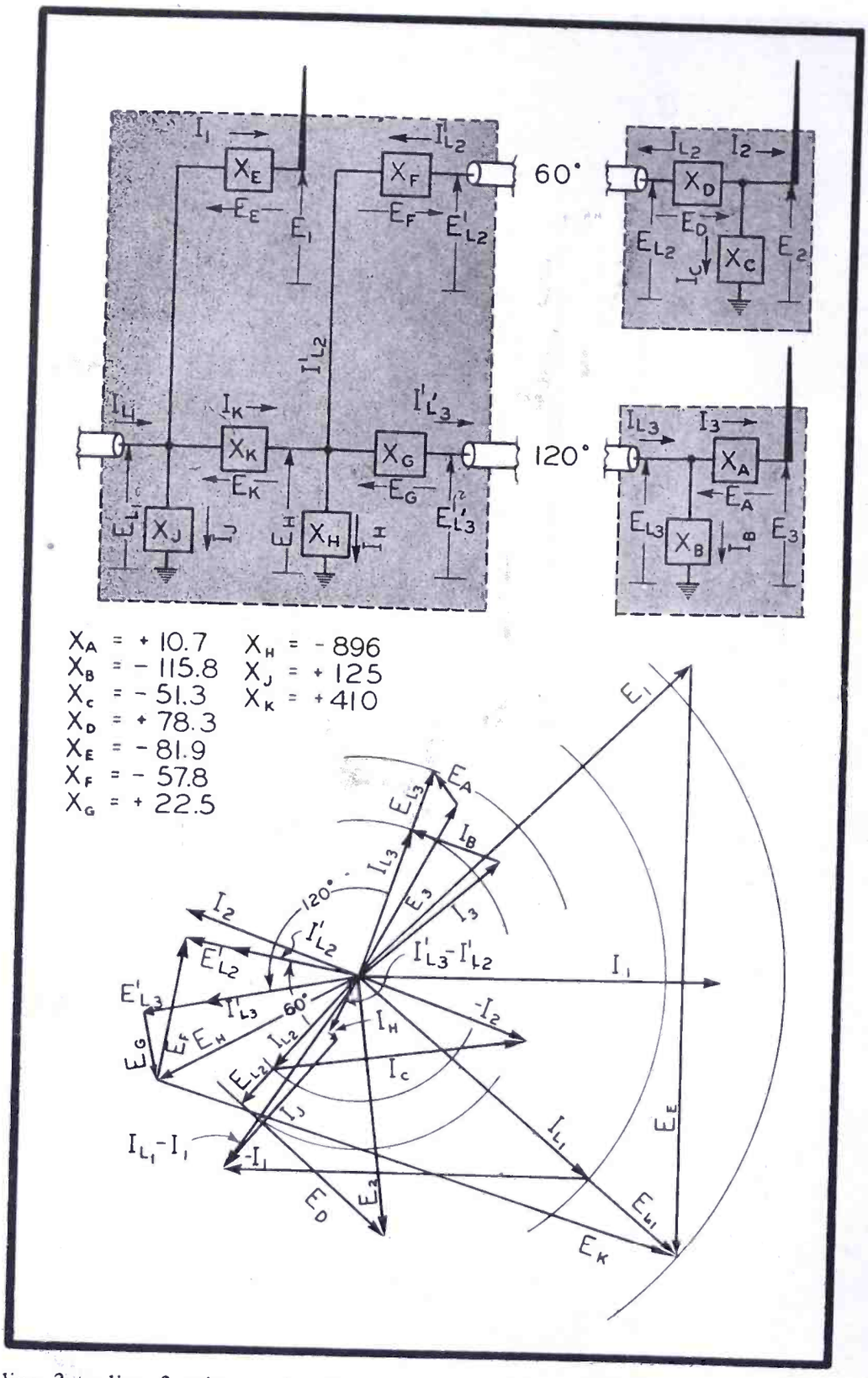

Figure 9

line *2* to line *3* using a shunting reactor at line *2* and a series reactor between the lines. Kirchhoff's laws are

$$E_B = E_{L3} - E_{L2}$$
$$I_{L2} = I_B - I_A$$

Vectors E_B are drawn and an indefinite line is drawn through the termination of I_{L2} perpendicular to E_B. Also an indefinite line is drawn through the origin and perpendicular to E_{L3} for I_A. The intersection of these lines determines $-I_A$ and I_B.

Then I_B is added vectorially to I_{L3} and through its terminus we draw an indefinite line perpendicular to E_{L3}. In addition, we draw a line connecting the terminus of E_{L3} to E_1 and an indefinite line through the origin and perpendicular to it. These are seen to intersect determining I_C and I_D. Now I_{L1} can be found

$$I_{L1} = I_1 + I_C$$

A check on the accuracy of the work is provided in computing the power delivered by line *1*.

The second example secures nonresonant operation of all lines. First, we compute the power of each antenna and then from this we compute the line currents and voltages

$I_{L1} = 11.95$ *amperes* $\quad E_{L1} = 837$ *volts*
$I_{L2} = 4.92$ *amperes* $\quad E_{L3} = 426$ *volts*
$I_{L3} = 6.08$ *amperes* $\quad E_{L2} = 344$ *volts*

Figure 9 shows the circuit and the vector diagram for one solution which will be described. The procedure begins with drawing all known vect
Since only the magnitudes of the
currents and voltage are known
their locii can be drawn.

Let us consider first the tun
house of antenna *3*. Examination
the vector diagram shows that no
rent can be passed by a reactor
nected across E_3 such that the curr
vector drawn begins on the termi
of I_3 and ends on the locus of I_{L3}.
then allow I_3 to flow through reac
X_A producing a voltage rise E_A
pendicular to I_3. Two possible soluti
are seen to exist, satisfying

$$E_{L3} = E_3 + E_A$$

One involves a condenser and the othe
coil for X_A. The choice made has an
fluence on the possible solutions to
undertaken in tuning house *1*. Let
choose the coil, and E_{L3} is established
shown with E_A leading the current
producing it.

It is now necessary to satisfy Kir
hoff's law with respect to the current
the end of line *3*. A current I_B must
passed by a reactor X_B under the inf
ence of the voltage E_{L3} to satisfy

$$I_{L3} = I_3 + I_B$$

Since I_B leads E_{L3} the reactor
is a condenser. Power flow in line
is in the direction of antenna *3* and
the phase of E'_{L3} and I'_{L3} is 12
leading E_{L3} and I_{L3}. Work beyond t
input to line *3* is now completed.

Let us now consider antenna *2*.
is remembered that power flows in
the antenna *2* end of line *2* and out t
other end. Therefore, I_{L2} is tak
positive into the line and I'_{L2} positi
out the other end and lagging I_{L2}
60°. The antenna current I_2, howeve
is positive into the antenna termina
We first allow the current equation
be satisfied

$$I_{L2} + I_2 + I_C = 0$$
$$\text{or } -I_2 = I_{L2} + I_C$$

We lay off $-I_2$ on the vector di
gram and connect X_C from antenna
to ground. The current I_C perpe
dicular to E_2 and terminating on $-$
may begin at either of two points o
the locus of I_{L2}. Both involve co
densers for X_C. If the larger co
denser is chosen, I_{L2} and E_{L2} ar
established as shown. Allowing I_{L2} t
flow through X_D the voltages are satis
fied

$$E_2 = E_{L2} + E_D$$

and X_D is a coil. If the smaller con
denser had been chosen for X_C, X
would have been a condenser also.

Next I'_{L2} and E'_{L2} are drawn 60°
behind I_{L2} and E_{L2}, and the next ste
is to satisfy Kirchhoff's laws within
tuning house *1*. This may begin wit
any of the terminals. It can be see
that one of two condensers in serie
with line *1* and antenna *1* may b
chosen to satisfy

$$E_{L1} = E_1 + E_E$$

The current and voltage of line *1*

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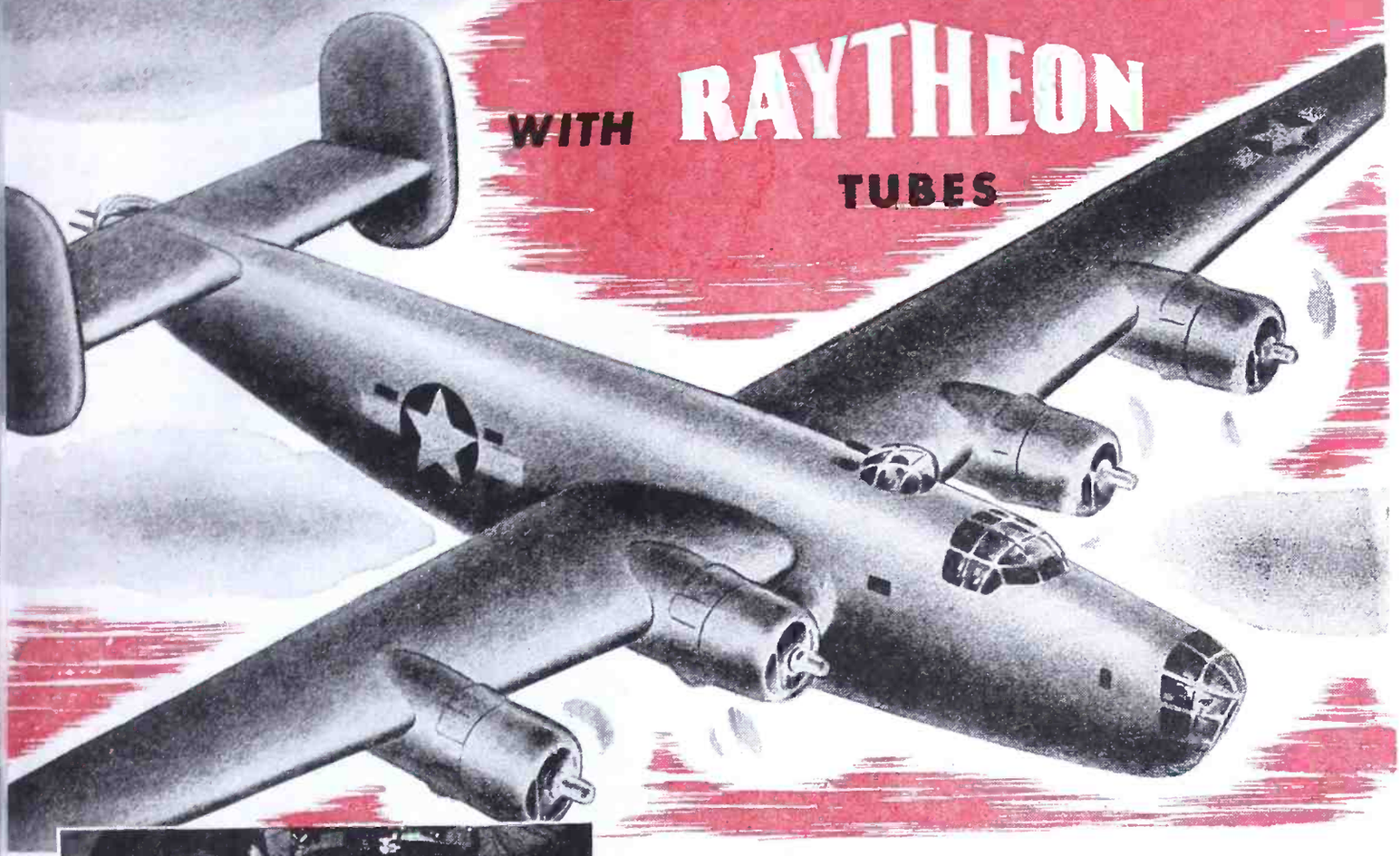

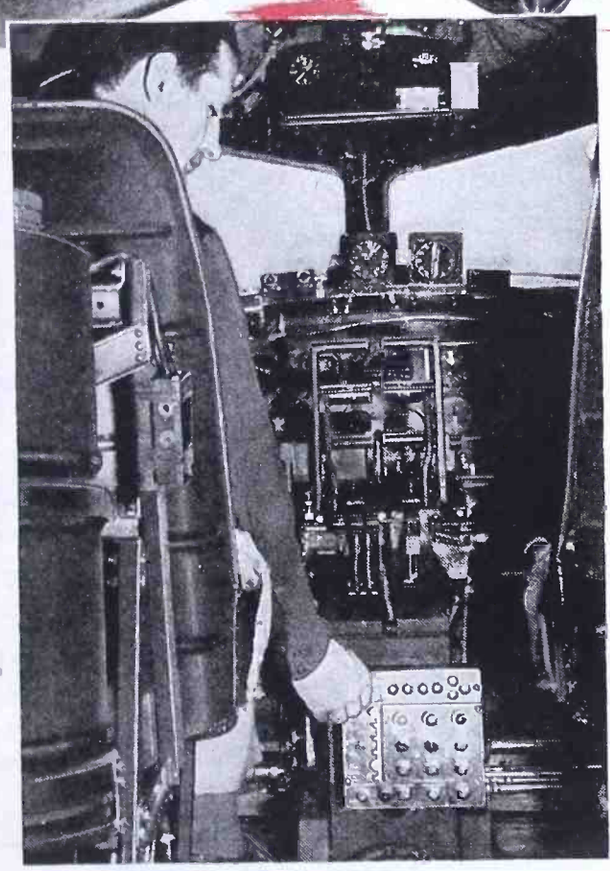

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IMPEDANCE RELATIONSHIPS OF ARRAYS

(Continued from page 60)

are established by choosing the smaller condenser as shown. The vector diagram shows that series reactors are needed at the terminals of lines *2* and *3*. Let us allow $+ I'_{L2}$ to flow through X_F and draw E_F of indefinite length through the end of E'_{L2} perpendicular to I'_{L2} and then allow I'_{L3} to flow through X_G and draw vector E_G of indefinite length perpendicular to I'_{L3} through E'_{L3} and

$$E'_{L2} = E'_{L3} + E_G + E_F$$

are seen to be satisfied. The potential of the junction of X_F and X_G is $E_H = E'_{L3} + E_G$. A current I_H may be drawn perpendicular to E_H and of indefinite length through the terminals of $I'_{L3} - I'_{L2}$. Let us then draw a current I_J perpendicular to E_{L1} and of indefinite length through the terminus of $I_{L1} - I_1$. These indefinite lines intersect satisfying

$$(I_{L1} - I_1) = (I'_{L3} - I'_{L2}) + I_H + I_J$$

A reactor X_K is needed to satisfy

$$E_{L1} = E_H + E_K$$

and E_K is perpendicular to $I'_{L3} - I'_{L2} + I_H$

The magnitudes of the reactors are obtained by dividing the voltage rises by the currents passing through them. Currents and voltages not already tabulated are measured.

Discussion of Solution

It has been obvious that the above is only one of several possible solutions to this problem.

In the actual installation of the components allowance should be made for the shunting capacitance of the series elements. In the above example the small condenser, X_H, may not be needed at all due to the shunting effects of parts of X_F, X_G, and X_K. It is conceivable that in this case advantage would be taken of the capacitance needed at X_H to mount condenser X_F and coil X_G as closely as possible to their respective lines. Also the capacitance to ground of the supports should be on the X_H side and the free ends of X_G and X_F connected to the line bushings. Likewise X_K would be supported on its X_H end if needed. These shunting capacitive effects can be measured directly with a radio frequency bridge [11] by disconnecting the elements from their lines. The shunt capacitance to ground of X_E is in parallel with the coil X_J. This reduces the inductance needed.

R-F Bridge Uses

In addition to obtaining the data for designing the coupling networks of a multi-element array the radio-frequency bridge is a loyal friend in the work of adjustment. The procedure is direct and is concerned with only one or a connected group of elements at a time in contrast to the trial and error procedures sometimes followed in the adjustment of arrays.

After the elements are in place and adjusted in the best manner possible or necessary, as described, any further trial and error adjustments after the array is brought into operation are apt to be detrimental.

The choice of resonant or non-resonant lines is immaterial as far as securing the desired excitation is concerned. Antennas, as the ones considered in the examples, produce a mismatch that is not severe. Direct connection to the lines, where possible, eliminates the losses in the coupling networks at the expense of slightly more line loss and the possibility of some voltage loops on the lines. Although the example solutions illustrated would be discarded in favor of one giving better harmonic attenuation, it is clear that resonant operation of the lines greatly simplify the network design.

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●

PART II OF WRIGHT PAPER ON RESISTIVE NETWORKS TO APPEAR IN OCTOBER

The second part of the Paul B. Wright paper on *Resistive Attenuator, Pad, and Network Theory and Design*, scheduled to appear in this issue, will appear in the October issue.

NAB SYMPOSIUM

(*Continued from page* 38)

natural static is decidedly less on the high frequencies. The recording does, howev show what broadcasting might be.

"Now if the art draws the same conclusi from these recordings that I do, it will visual the ultrahigh frequencies playing not a su sidiary, but the leading role in the aural broa cast field."

A very few broadcasters, manufacture and engineers drew the same conclusio The major part of the industry did not

The investigation of the phenomen of "bursts", which was, I believe fir studied by DeMars, Pickard and myse in 1940, has disclosed that our concl sions in this respect were correct—th it is not a serious detriment to f-m.

The much publicized "multiple-path di tortion" bugaboo—recently trotted out has now been shown to be a matter no importance—to f-m. It was invest gated by me and that conclusion reache in 1938. What is of importance, hov ever, is that it was recently presente to the art in a manner obviously designe to mislead it—and constrict the f-m ban

The more recently expressed fears possible evil results of future sun-spot ac tivity are based on a phenomenon whic is annoying and which we would rathe did not exist. The period of time so fa indicated when trouble from the sporadic E may be expected over any appreciabl area of a station's coverage appear negligible. The best opinion on the sub ject is that the disturbance will not b serious. It is important to keep in min the fact that there is no perfect wave length. Whatever the annoyance facto may be, the f-m system is the one bes able to combat it.

But quite aside from the mere sup planting of existing stations by an f-m service, there has emerged a circumstanc that completely overshadows all othe considerations. It has now become pos sible for every community, however small to have a voice on the air, provided i can support it. Economic conditions rather than shortage of technical facili ties, now limit the number of stations Problems which have defied solution by Congress, the FCC and the industry alik now disappear, as this new art advances

And now in closing I want to leav with you one question. Ask yourselve this: "Wouldn't both this country an the broadcasters in general have been bet ter off if more attention had been paid to what engineers like De Mars. Jansky and Bailey and Hogan, and broadcasters like Sheppard, Doolittle and Damm were doing, rather than that council of a course of action which could only result in a continuing shortage of channel facilities? A free radio does not lie in that direction.

•

F-M TRANSMITTERS

PAUL CHAMBERLAIN

General Electric

MANY a-m stations will modernize and others will switch to f-m. New postwar transmitters—which will improve transmission and materially cut operating costs—will make modernization attractive for many medium and high-power a-m stations. The expansion of f-m will bring a reduction in the number of a-m stations. The expansion of f-m

l bring a reduction in the number of
h stations as low-power and some
dium-power stations change to f-m.
ssibly in the future—500-kilowatt and
n 1000-kilowatt a-m stations can be
rated to provide long-range coverage.
ese trends will result in improved re-
tion and an increase in the value of
lio as an advertising medium.

The trend of f-m is established. Fifty-
ee commercial f-m transmitters now
er a population of approximately 50,-
),000. Over half a million f-m receivers
in use. A conservative estimate is
t 500 f-m stations will be in operation
e years after the war and we estimate
t a-m stations will drop from over
) to about 750 by that time.

Why should you bother about f-m?
hat does it offer? There are several
od reasons aside from the advantages
the listeners. Further expansion of the
n system is impractical and since all
the United States does not have satis-
tory service—f-m provides the only
ans of improvement and expansion.
lding a-m stations would reduce the
verage of existing stations and add
nfusion to that already prevalent. The
n system has already been expanded
the point of diminishing returns.

F-M is of particular advantage to the
ver power stations. As an example—
sed on average ground conductivity, a
00-kc 250-watt a-m station with a
1-foot vertical antenna has a daytime
nge of 13 miles and a nighttime range
4.8 miles. A 250-watt f-m transmitter
th an antenna of the same height will
liver consistent day and night coverage
er a radius of 29 miles and will neither
use interference with other stations or
affected by interference from other
ations.

FMBI and RTPB are studying the
esent FCC Allocation Plan for f-m
ations with the objective of recommend-
g certain changes. Briefly—the con-
mplated changes are—

(*1*) An increase in the present band-
width now allocated for f-m broad-
casting.

(*2*) A complete elimination of classes
of stations—or at least a reduction
in the number of classes.

(*3*) A separation of the present rigid
coupling between trading areas and
service areas of the f-m stations.

(*4*) A modification of the present rules
to permit f-m applicants to start
with less power than their ultimate
plans call for—or in other words—
not require all f-m broadcasters in
a given area to install facilities
for the same coverage.

If these changes are put into effect—
ıe establishment of f-m stations will be
overned mostly by economics and the
bheres of influence which the applicants
an justify in the eyes of the Commission.

As to our future plans f-m will *do-
inate our product design* and mer-
handising and advertising program.
entative plans call for f-m receivers in
ll but the lower priced brackets. Omit-
ng the a-c/d-c sets from the picture we
xpect our postwar line to consist of f-m
ets to the extent of 80 to 90 per cent.

We believe the industry will produce
million f-m receivers in the first full
ear of unrestricted postwar production
nd in the following four or five years
his total will grow to about twenty mil-
ions.

We said earlier that many a-m stations

(*Continued on page* 66)

(*Continued from page 65*)

will modernize their facilities and possibly some would increase power. To illustrate what we mean by modernization, the old WGY transmitter could be replaced by a modern a-m transmitter and save approximately $600 each month on the power bill alone. If superpower in the order of 500 to 1000 kilowatts is permitted for a-m stations General Electric's facilities for development and manufacture of high-power tubes and transmitters will be utilized to the fullest extent.

It seems reasonable that f-m will eventually supplant all local—most regional—and some high-power stations. The present a-m band would be cleared up—making more clear channels available for high-power and possibly superpower a-m stations.

There will be two major applications for television after the war. The first is *industrial television*—where pictures and sound will be carried by wires or radio from one point to others for various private commercial uses. The second is *broadcast television* which adds a new dimension to home entertainment and provides one of the most powerful mass advertising media ever developed.

Let us consider the probable growth of broadcast television.

One major economic problem facing television is reaching larger audiences—thus increasing the circulation and reducing the programming cost-per-listener.

The first step involves the construction of master television stations in larger cities. These stations would have studio facilities and staffs capable of originating programs such as musical comedies a plays.

One of the first u-h-f radio relay c cuits will be installed between Sche ectady and New York City by the Int national Business Machines Corporat —subject to FCC approval—just soon as conditions permit. This syst will be a multi-channel two-way circ operating above 2000 mc. We will d sign and build the equipment. A seco radio relay will connect New York C with Washington, D. C. and intermedia points and extension to other cities contemplated. Such facilities will ma programs from master television statio available to other stations on the n work. There are about 80 television st tions scheduled for construction bas upon licenses granted or applied f These stations will serve areas with population of more than 30 million.

We anticipate that within five yea after the war there will be at least on hundred master television stations in t country with 67,000,000 people in the service areas. Smaller areas which c be covered by satellite stations and ne work television stations are not include in this figure.

The higher-priced television sets wi be designed with a projection tube tha will provide an exxcellent picture up t 18" by 24".

Satisfactory projection type televisio sets are inherently more expensive t produce than direct-view types.

We plan to make new television re ceivers available as soon as governmen authorization allows us to do so.

POSTWAR BROADCASTING CHALLENGE

WILLIAM S. HEDGES
Vice President, NBC

THE postwar commercial development and expansion of f-m and television confront American broadcasters with immediate problems more serious than any they have ever encountered since they went into business.

For the present—but for the present only—the broadcasting industry has an inside track in the race to establish these new services. But no broadcaster should comfort himself with the idea that he can maintain a position of watchful waiting indefinitely and can step into a place of leadership in f-m and television whenever he gets good and ready.

There are various interests and groups and individuals who see in f-m an opportunity at comparatively modest expense to make their first entrance into the field of broadcasting. As a matter of fact, we welcome them to our ranks and look to them to make valuable fresh contributions to the art and industry. F-M provides more elbow room in the radio spectrum than has been available since the earliest days of broadcasting. It offers places for many new broadcasters.

Television presents a far more difficult problem to the broadcaster than f-m. It is not just a technological change in his present business. In many respects it is

(*Continued on page 79*)

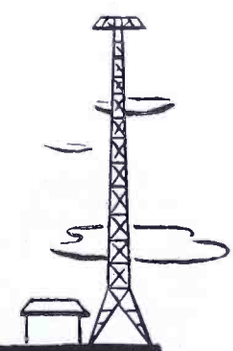
MONITOR with PANORAMIC

See a wide band- all at once

In the typical monitoring station—up to the present time—each received signal has required the active attendance of an operator and a receiver—the operator turning the dials ceaselessly and recording the signals on the air. With the aid of PANORAMIC RECEPTION, however, just one piece of equipment can do the work of many. Because PANORAMIC RECEPTION SHOWS ALL SIGNALS ON A GIVEN BAND OF THE RADIO FREQUENCY SPECTRUM SIMULTANEOUSLY, one operator can cover wider bands of the spectrum with more accuracy and less operator fatigue. Without dial manipulation, he can see immediately open channels and intermittent signals. Moreover, the patterns on the screen tell him the frequencies of the stations; their stability; their signal strength as they reach him; whether the station is AM, FM, or CW; and the type and extent of interference.

In monitoring, as in direction finding, navigation, production, and laboratory procedure, PANORAMIC RECEPTION is becoming an indispensable timesaver. Its unique capabilities will offer new solutions to your industrial and laboratory problems. Allow one of our engineers to explain how PANORAMIC RECEPTION may be used to your best advantage.

New and interesting booklet "From One Ham to Another." Available on request. Fully illustrated.



PANORAMIC RADIO CORPORATION

242-250 WEST 55TH ST., New York 19, N. Y.

NEWS BRIEFS OF THE MONTH...

RMA PARTS DIVISION CO-SPONSORS EPEI CONFERENCE

The RMA Parts Division (Robert C. Sprague, chairman), has become a co-sponsor of the Electronic Parts and Equipment Industry Conference, scheduled for October 19-21 at the Stevens Hotel, Chicago. This will give the October meeting of parts manufacturers, distributors and sales representatives sponsorship of four industry organizations, including the National Electronic Distributors Association, the newly organized Association of Electronic Parts and Equipment Manufacturers (formerly Western Sales Managers Club), and the Sales Managers Group, Eastern Division.

More than a thousand have already registered for the convention.

In keeping with the limitations of wartime, this will be a streamlined conference. While there will be booths for manufacturers, these are only conference booths, where manufacturers can conveniently meet with jobbers and others, for visits and discussions, but no merchandise, displays, decorations or other trimmings will be permitted.

* * *

SYRACUSE, N. Y., TO BECOME G. E. ELECTRONICS HEADQUARTERS

All of the G. E. electronics department activities, under the direction of Dr. W. R. G. Baker, will be centered soon in an industrial development on the outskirts of Syracuse, N. Y., near Liverpool.

It is expected construction of the plant on a 150-acre plot will begin as soon as wartime restrictions are lifted. The new plant will include an administration building, research laboratory and assembly shops.

The centralization project will not affect the operations of General Electric's present radio and television stations in Schenectady.

* * *

F-M SYSTEM IN CANAL ZONE

A two-way f-m radiotelephone communication system has been installed in the Panama Canal Zone by engineers of the Galvin Manufacturing Corporation, Chicago.

The system is being used by public administrators. The equipment is said to provide communication contact throughout the length of the Canal.

* * *

EPEM ASSOCIATION ELECTS NEW OFFICERS

E. G. Shalkhauser of Radio Manufacturing Engineers, Inc., Peoria, Illinois, has been elected chairman of the Electronic Products and Equipment Manufacturers Association. J. A. Berman, Shure Brothers, Chicago, Illinois, was named vice chairman; H. A. Staniland, Quam-Nichols Company, Chicago, Illinois, treasurer; and J. Arthur Kealy, executive secretary pro-tem.

Correspondence should be addressed to office of the secretary, Kenneth C. Prince, 77 West Washington Street, Chicago, Illinois.

* * *

UNITED ELECTRONICS APPOINTS PROF. HERTZLER

Professor E. A. Hertzler, formerly of Pratt Institute, has been named director of war research at United Electronics Co., 54 Spring Street, Newark, N. J.

At Pratt Institute Professor Hertzler taught u-h-f techniques and directed the electrical engineering laboratories.

SIGNAL CORPS HONORS S. RUBEN

Samuel Ruben, who during the past twenty years has been granted several hundred patents covering inventions in the electric-chemical, electronic and electrical fields, was recently awarded a Certificate of Appreciation for extraordinary contributions to the war effort.

Mr. Ruben is one of only ten civilians to receive this recognition from the War Department, which was originated to honor achievements not eligible for Army-Navy "E" awards.

Mr. Ruben has his own laboratory in New Rochelle, New York. Many of his commercialized inventions have been introduced and sponsored by P. R. Mallory & Co. Inc., Sprague Electric Co., etc.

While Mr. Ruben has contributed many important inventions to the electrical industry, this award was made primarily in recognition of his work in inventing the new Mallory dry battery. This battery is now in production by P. R. Mallory & Co. Inc., who in turn has licensed the Ray-O-Vac Company, the Magnavox Company and Sprague Electric Co. under the controlling patents.

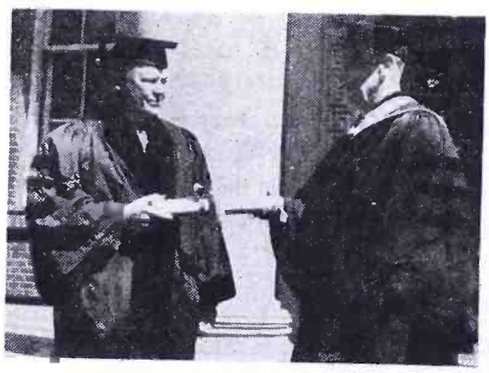
Another of his contributions is the ceramic coated resistor. A continuous process for coating wires at high speed with heat resistant ceramic materials is provided in this development. It allows the production of electrical resistors in multilayer non-inductive forms and in hermetically sealed structures. This device was first introduced as the Sprague Koolohm resistor and is now manufactured by the Sprague Electric Co. and P. R. Mallory & Co., Inc.

* * *

RPI CONFERS DOCTORATE UPON DU MONT

During its 120th commencement exercises, Rensselaer Polytechnic Institute conferred the honorary degree of Doctor of Engineering upon Allen B. Du Mont, president of the Allen B. Du Mont Laboratories, Inc., Passaic, N. J., and graduate of the Class of 1924.

Mr. Du Mont was cited particularly as a pioneer in the development and use of the cathode-ray tube.



* * *

AAC TRAIN RADIO USED BY KANSAS CITY R.R.

A main line railroad radio-telephone communications system, designed and built by the Aircraft Accessories Corporation, Kansas City, has been installed by the Kansas City Southern Lines. This new system provides conductors and engineers on moving trains voice communication with each other, with other trains, and with wayside stations and with dispatchers and other railroad offices.

The new communications system, tested on the Kansas City Southern for the past eight months, is now installed and in daily use on the railway between Kansas City, Missonri and Shreveport, Louisiana, a distance of 560 miles.

HALLICRAFTERS' RADIO SCHOOL

A model classroom which offers introductor and advanced courses in radio, phasing, mathematics, management, training within industry, and methods, has been employed to trai employees at Hallicrafters Company, Chicag Many who have completed the courses hav been promoted to more responsible position

The company's policy is definitely one o upgrading its own employees. Rather tha hire new people for many supervisory positions the company takes into consideration the ad vanced knowledge of present employees wh have successfully completed the courses an promotes the latter to greater responsibilities.

In the last year more than 300 employees en rolled in the courses.

Since June, 1943, six classes in "Elements o Radio," a combination lecture and laborator course, have been given, the enrollment be ing more than 100 workers. New, advance courses with certain prerequisites in radio ar planned for this fall.

A 16-week orientation course in radio wa given for office workers only.

These classes have been conducted in cooper ation with the Engineering Science Manage ment War Training program under the Unite States Office of Education, the Illinois Institute of Technology, or under the sole direction o Hallicrafters.

Radio classes have been under the direction of Neil Garity, a former Air Corps instructor.

Three phasing schools, conducted thus far for workers from the assembly lines and inspection departments, have been supervised by Stewart McKechnie, assistant factory superintendent. The mathematics classes were taught by Kurt Beam of the company's engineering department.

* * *

BENDIX TO MAKE HOME RADIOS

The Bendix Radio division of Bendix Aviation Corporation will, for the first time, manufacture and market a line of home radio sets as soon as the military situation permits.

Home radios will be manufactured in the company's plants in Baltimore.

* * *

ASA MOVES

The American Standards Association has moved to the Grand Central Terminal Office Building, 70 East 45th Street, N. Y. 17, N. Y.; telephone, Murray Hill 3-3058.

* * *

CLIPPINGER TO LEAVE ADMIRAL

J. H. Clippinger, vice president in charge of sales of Admiral Corporation, Chicago, has resigned. John B. Hurarisa has become executive vice president in charge of production and engineering.

Mr. Clippinger will remain with Admiral until present war contracts have been completed.

* * *

J. M. DAVIS APPOINTED NAB COUNSEL

John Morgan Davis, Philadelphia attorney, has been appointed general counsel of the National Association of Broadcasters and placed in charge of labor relations.

* * *

HAJEK BECOMES TAYLOR TUBE PRESIDENT

Frank J. Hajek has been elected president of Taylor Tubes, Inc., 2312 Wabansia Ave., Chicago. He was formerly secretary and treasurer. James C. Filmer has been appointed vice president in charge of engineering. Joseph F.

(*Continued on page* 70)

Insulators
BY ENGINEERS

ANTENNAS

CONDENSERS

TUBE SOCKETS

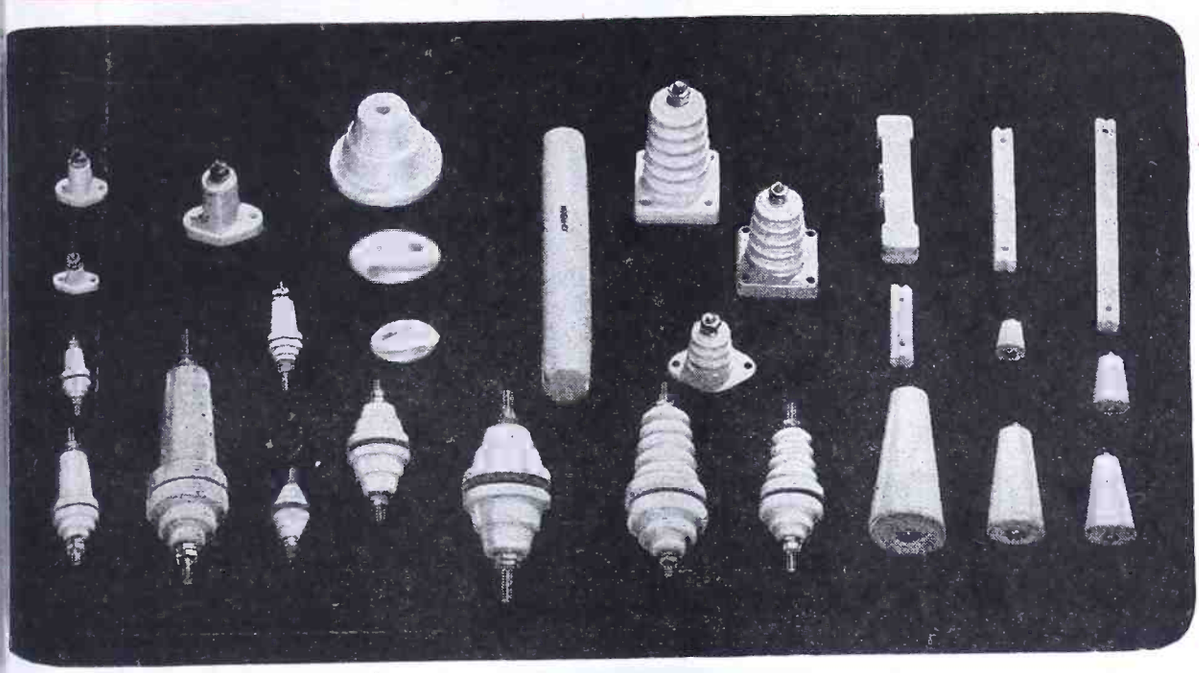
PLUGS & JACKS

INSULATORS

INDUCTORS

BROADCAST EQUIPMENT

CONCENTRIC LINE



Johnson Radio Engineers have been specialists in insulator design for radio frequencies for almost a quarter of a century. Shapes to provide strength for strains and stresses—reinforced mounting holes and carefully designed mountings —high internal resistance to radio frequency voltage—long leakage path—careful treatment to present a surface that will not collect dirt and foreign matter—quality hardware, not punched nuts and poorly formed parts—materials selected for their radio frequency characteristics, not the "flower pot" variety of ceramics.

To Johnson Engineers an insulator is a piece of radio apparatus and given the same careful attention in design and production. As a result you can't buy a better insulator than Johnson. Send your next insulator problem to Johnson for recommendations and quotations. No obligation.

Ask for Catalog 968E.

JOHNSON

a famous name in Radio

E. F. JOHNSON CO.
Waseca, Minnesota

NEWS BRIEFS

(*Continued from page 68*)

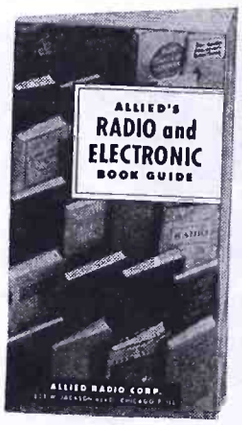
Hajek becomes secretary and Jerry Wo treasurer.

* * *

ALLIED RADIO AND ELECTRONIC BOOK GUIDE

To permit rapid selection of radio and electr ic books by title, author, publisher, subj or application, Allied Radio Corp., 833 W Jackson Boulevard, Chicago 7, Illinois, has leased, for free distribution, a booklet conta ing a wide selection of such publications.

The listings are divided into two major par (1)-classified directory by subject (aeronaut electricity, engineering, basic training, etc (2)-Listing under publisher, by author and ti with a brief summary of contents, size, nu ber of pages, price, etc.



* * *

A. R. KAHN BACK FROM SURVEY TRIP

A tour of the various government agenci and leading radio parts distributors in k cities in the East, has just been concluded Albert R. Kahn, president of the Electro-Voi Mfg. Co., Inc., R. E. Siekman, vice preside and R. W. Augustine, production manager.

As a result of the tour, a merchandisi campaign is now under way at the Electr Voice plant in South Bend, Indiana, utilizi the suggestions from dealers, distributors, jo bers and governmental agencies visited.

* * *

USAAF HONORS FAIRCHILD

Fairchild Camera & Instrument Corp., Ne York, has been assigned an "approved quali control" rating by the U. S. Army Air Force

* * *

JENSEN MONOGRAPH ON SPEAKER SELECTION AND USE

A series of monographs covering the selectio installation and use of loud speakers has bee prepared by Jensen Radio Manufacturing Com pany, 6601 South Laramie Avenue, Chicago 3 Illinois.

The first of the series, "Loud Speaker Fr quency Response Measurements," is ready no This monograph analyzes frequency respons curves and their use in judging the perform

●

LIP-MIKE INSPECTION

Electro-Voice's T-45 differential microphone better known as the "lip-mike," being inspecte by government and company officials. Left t right: Robert E. Siekman, company excutive Albert Kahn, president of Electro Voice; Lt Comdr. Arthur H. Castelazo; Lt. Col. John M Niehaus; and Louis Burroughs, Electro-Voic chief engineer. The Army-Navy "E" won b Electro-Voice recently can be seen in the back ground.

ıce of loudspeakers. The use of measured equency response as essential data in develop- ent and design work is also discussed. Some the equipment and methods that may be sed are described.

The second in this series covers "Impedance atching and Power Distribution in Loud- peaker Systems."

One of the many subjects described and illus- ated is a comprehensive sound system for a ilitary installation.

Copies of all issues are free on request to en of the Armed Services and to libraries nd technical schools. There is a 25c charge to thers who may obtain the issues from radio bbers and dealers, or the company direct.

* * *

. R. DUNCAN JOINS WLW

R. Duncan has joined the staff of WLW as ief television engineer.

Mr. Duncan is the inventor of the popular ocking tube oscillator system.

* * *

HIRD GOLD STAR TO RADIOMARINE PENNANT

The Radiomarine Corporation of America has been awarded the third gold star for the Maritime "M" pennant.

* * *

I. M. STAHR OF W. E. DEAD

John M. Stahr, comptroller of manufacture of the Western Electric Company, died suddenly, recently.

* * *

ARNOLD P-M MANUAL

A permanent-magnet manual covering the de- sign, production and use of the modern mag- net, has been prepard by The Arnold Engineer- ng Company, 147 East Ontario Street, Chi- cago 11, Illinois.

Subjects discussed are magnet materials, resistance comparisons, physical and mag- netic properties, demagnetization and energy curves, fabrication, design and testing. Charts and tables are included to illustrate and ex- plain various aspects of the discussion.

* * *

WESTINGHOUSE APPOINTS SCHAEFER ASS'T MANAGER OF RECEIVER UNIT

Harold W. Schaefer has been named assistant manager of the newly-formed radio receiver division of the Westinghouse Electric and Manufacturing Company.

Mr. Schaefer will be in charge of the

(*Continued on page 72*)

●

TUBE CHECKER

Testing transmitting tubes with the aid of an oscilloscope at the Eimac plant.

NEWS BRIEFS

(*Continued from page 71*)

division's engineering and production activities, under H. B. Donley, division manager.

* * *

LAFAYETTE SUPPLEMENTS

A 4-page folder, 96, describing available components and equipment, has been published by the Lafayette Radio Corporation, 901 W. Jackson Blvd., Chicago.

Another catalog, 94, with a substitution tube chart, has also been released by Lafayette.

* * *

TIGHE AND MABRY WIN WESTINGHOUSE HONORS

Frank E. Tighe, superintendent of the Westinghouse Lansdowne, Md., plant and Forrest Mabry, section engineer, were recently awarded the Westinghouse Order of Merit, for their outstanding activities in designing and producing radar equipment.

* * *

PRITCHARD NOW DIVISION TUBE MANAGER AT SYLVANIA

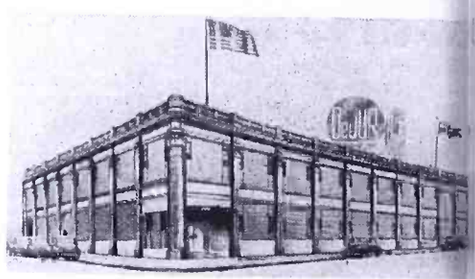
Philip M. Pritchard, a member of the sales staff of Sylvania Electric Products Inc., radio division, for the past eight years, has been promoted to manager of equipment tube sales for the East Central division.

Mr. Pritchard will be at 500 5th Ave., N. City.

* * *

DE JUR IN NEW PLANT

A new plant in Long Island City has been opened by the DeJur-Amsco Corporation. It was designed to house production facilities needed in addition to its present plants in Connecticut and New York.



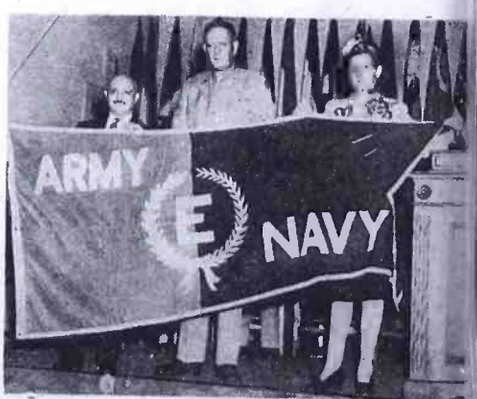
* * *

LAWRANCE AERONAUTICAL TO MAKE AUTOMATIC PILOTS

Two new types of automatic pilots will be produced by the Lawrance Aeronautical Corporation, Linden, New Jersey, for the government services.

The company has also recently entered into

AT INSULINE "E" AWARD



Samuel Spector, president of Insuline Corp. of America, Long Island City, N. Y.; Col. Kenneth B. Johnson, Signal Corps, Washington, D. C.; and an Insuline employee displaying the Army-Navy "E" pennant which Insuline won recently.

tracts to do research work for various gov- mental agencies, according to Rowland rnstan, president.

* * *

CO WINS WHITE STAR

co Radio Laboratories, Inc., 231 Main Street, mpstead, L. I., has won a white star for "E" pennant.

* * *

CKFORD NOW BUFFALO CA VICTOR DISTRIBUTOR

ckford of Buffalo, Inc., has been appointed olesale distributor of RCA Victor radios, onographs, records, tubes and television in Buffalo area.

The Bickford of Buffalo organization is aded by Faul and Louis Wolk.

* * *

A. DUVALL JOINS RUNZEL

anley A. Duvall, consulting engineer, has en appointed chief engineer for the Runzel rd & Wire Company, Chicago.

* * *

YLOR TUBES PREPARING CATALOG

new catalog on Taylor tubes is now in eparation, according to Rex L. Munger, sales d advertising manager.

Simultaneously with the release of the catalog veral new tubes for the ultra and very high equencies will be announced.

* * *

J. HANLON GOES TO HARVILL

J. Hanlon has been named production man- ger of the Harvill Corporation, 6251 West entury Boulevard, Los Angeles, Calif.

Mr. Hanlon recently retired as manager of e production department of The International ickel Company.

* * *

ALKER-JIMIESON VAILABILITY LISTS

industrial availability booklet showing ms available on priority for immediate de- ery from stock is now being published month-

(*Continued on page 74*)

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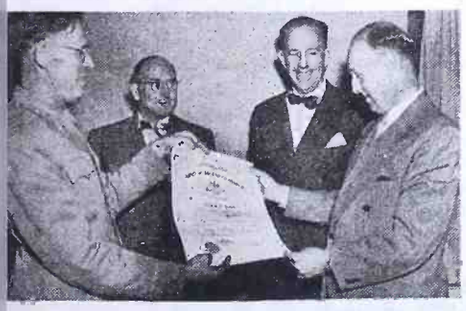
SMITH OF CROSLEY HONORED



eorge E. Smith (extreme right), vice-president nd treasurer, The Crosley Corporation, Cin- nnati, receiving from Col. Merrill G. Beck, ignal Officer of the Fifth Service Command, J. S. Signal Corps, Ft. Hayes, Columbus. Ohio, Signal Corps' Certificate of Appreciation. Be- ind Mr. Smith is Powel Crosley, Jr., presi- ent, Crosley Corporation; and behind Colonel eck is R. C. Cosgrove, vice-president and general manager of Crosley.

NEWS BRIEFS

(Continued from page 73)

by Walker-Jimieson, 311 South Western Avenue in Chicago. It contains 28 pages and lists such items as tubes, test equipment, tubes, relays, x-ray machines, amplifier voltage transformers, condensers, resistors, coaxial cable, pencil soldering irons, industrial switches, photoelectric units, steel tool room equipment, electric drills, saws, grinders and other tools available from stock.

SOLAR CATALOG WITH A-N MICA CAPACITORS DATA

A 36-page illustrated catalog describing Solar mica capacitors built to Joint Army-Navy specifications, JAN-C-5 of April 30, 1946, has been published by Solar Manufacturing Corporation, 285 Madison Ave., New York 17, N. Y.

Complete specifications are cited. On pages where receiving type micas are described, a detailed 6-dot color code is given.

MERIT COIL ADDS PLANT

A new plant has been opened by the Merit Coil and Transformer Corporation at 4427 North Clark Street, Chicago 40, Illinois. Plant will be under the direction of Harold Jones, chief engineer. General offices will shortly be moved from the present address at 311 North Desplaines Street to the new plant.

W. C. SPEED NAMED PRESIDENT OF AUDIO DEVICES AND AUDIO MFG.

William C. Speed has been elected president of Audio Devices, Inc., and Audio Manufacturing Corp., succeeding Howard E. Rhoades. Speed was formerly vice president, and is one of the founders of both companies.

LITTELFUSE NAMES ALLIED RADIO DISTRIBUTOR

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Illinois, has been appointed authorized distributor for Littelfuse, Inc., manufacturers of fuses, neon indicators, fuse clips, mountings and accessories, the "Signalette" panel type signal indicator, and other circuit protective products.

HYTRON WINS "E"

The Army-Navy "E" pennant has been awarded to the Hytron Corporation, Salem, Massachusetts.

Lt. Col. Frank Prina, Commanding Officer of the Newark Signal Corps inspection zone, presented the flag to Bruce A. Coffin, treasurer and general manager of Hytron.

Governor L. Saltonstall presented the address of welcome.

MACO SWITCH CATALOG

A 4-page catalog, MA 448, describing selected of multi-circuit switches for simultaneous

l of independent or interconnected electrical cuits, has been published by Metallic Arts mpany, 243 Broadway, Cambridge 31, Massaisetts.
ncluded are details of dimensions, circuits, l mechanical actions, and a discussion of 3-ounce Maco high-inpact phenolic frame handling any desired number of circuits in single "Featherweight" switch.

* * *

H. MILLER NOW ESTON CHIEF ENGINEER

hn H. Miller has been promoted to chief elecal engineer of the Weston Electrical Instrunt Corporation, Newark, N. J.
rank X. Lamb, formerly project engineer, been made assistant chief electrical engir. Karl M. Lederer, formerly assistant chief gineer, is now assistant director of research. V. N. Goodwin, Jr., continues as vice presnt in charge of research and engineering.

John H. Miller

Frank X. Lamb

* * *

DERAL H-F CABLE ND TRANSMITTER FOLDERS

Three folders, describing Intelin coaxial bles, a 10-kw l-f transformer and a 50-kw ndard broadcast transmitter have been reued by Federal Telephone Radio Corporation, wark, N. J.
The coaxial cable folder contains nomograms vering the characteristic impedance and pacitance of Intelin cables using polyethyne.

* * *

RADIUS TEACHING TELEVISION TO ENTRAL DIVISION NBC ENGINEERS

50-week course in technical television was rently begun for the engineers of the central vision at NBC Chicago. The course is being ught by Clarence Radius, former chief inuctor of RCA Institutes' Chicago school and w head of the Audio-Video Engineering Dertment of the school's New York branch.
As far as possible, lectures will be devoted the practical engineering problems of an erall television system.

* * *

MPLETONE EXPANDS

he radio and woodworking divisions of Temetone Radio Company, Mystic, Conn., will on move to larger quarters.
The radio plant will be located in the Templene Building, New London, Connecticut. The odworking division will occupy the space rmerly used by the radio division in Mys. Connecticut.
Dr. Dale Pollock assumes the position of e president, in charge of engineering.

* * *

NDREW AIR PUMP FOLDER

2-page folder describing all-purpose and avy-duty dry air pumps, has been released

(*Continued on page 87*)

●

AEROVOX "E" CEREMONIES

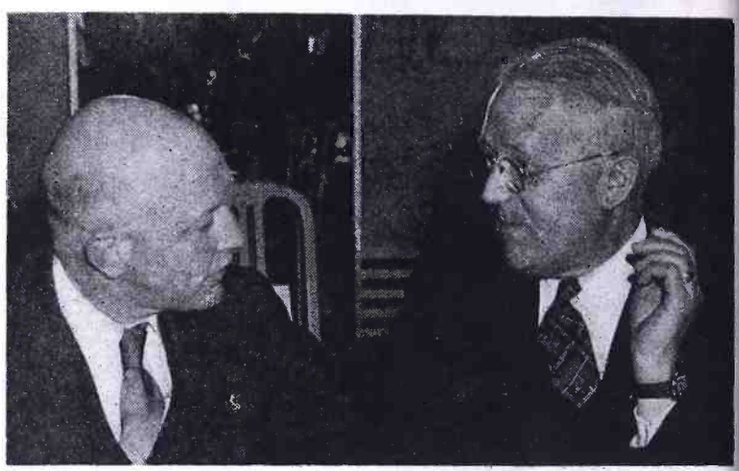
. I. Cole, president of Aerovox Corporaon, with the "E" flag recently presented.

Personals

THE president had an interesting chat recently with George W. Bailey, assistant to the VWOA president, and chief of scientific personnel of the National Research Council in Washington. George has done a superb job as our special Washington representative during the past few years. He has been reelected to another two-year term as president of the American Radio Relay League. Sincere thanks GWB for your hearty cooperation and get ready for increased activity as the date of our twentieth anniversary approaches. Yes, some time in February 1945, the VWOA will hold a *Victory* Dinner-Cruise. Keep your eye peeled for the exact date and further details. . . . We've received a grand note from W. A. Ready, president of the National Company and honorary member of VWOA. Expect to see him at our twentieth-anniversary affair with some of the National personnel. . . . Leroy Bremer, who was back up at Anchorage, Alaska, in charge of several radio stations for the fishing season sent in an interesting letter. Always glad to hear from you, Leroy. . . . We understand that our own Fred Muller has received his fourth full stripe, making him a Captain in the United States Naval Reserve. He is now stationed down in the Carribean. Congratulations, Fred. . . . Captain Pierre Boucheron, USNR, now in Africa, states that he would like to hear from some of his old cronies. By the way he recently visited a small settlement in Africa with his family name: Boucheron. Drop a note to headquarters for the addresses of our overseas members.

Boston

YES, there is no question about it, Boston boys do make good. Take Ted McElroy, who has always maintained a residence and manufacturing plant in the 'Hub' city. He is a life member of VWOA, and has been awarded a trophy as the World's champion radio telegraphist by our association. Last year his plant was awarded the Army-Navy "E" pennant as a result of which he received the VWOA Marconi Memorial Medal of Achievement. And six months after the original award of the "E" his organization was awarded a white star for the "E" pennant. Congratulations, Ted and may the stars continue.



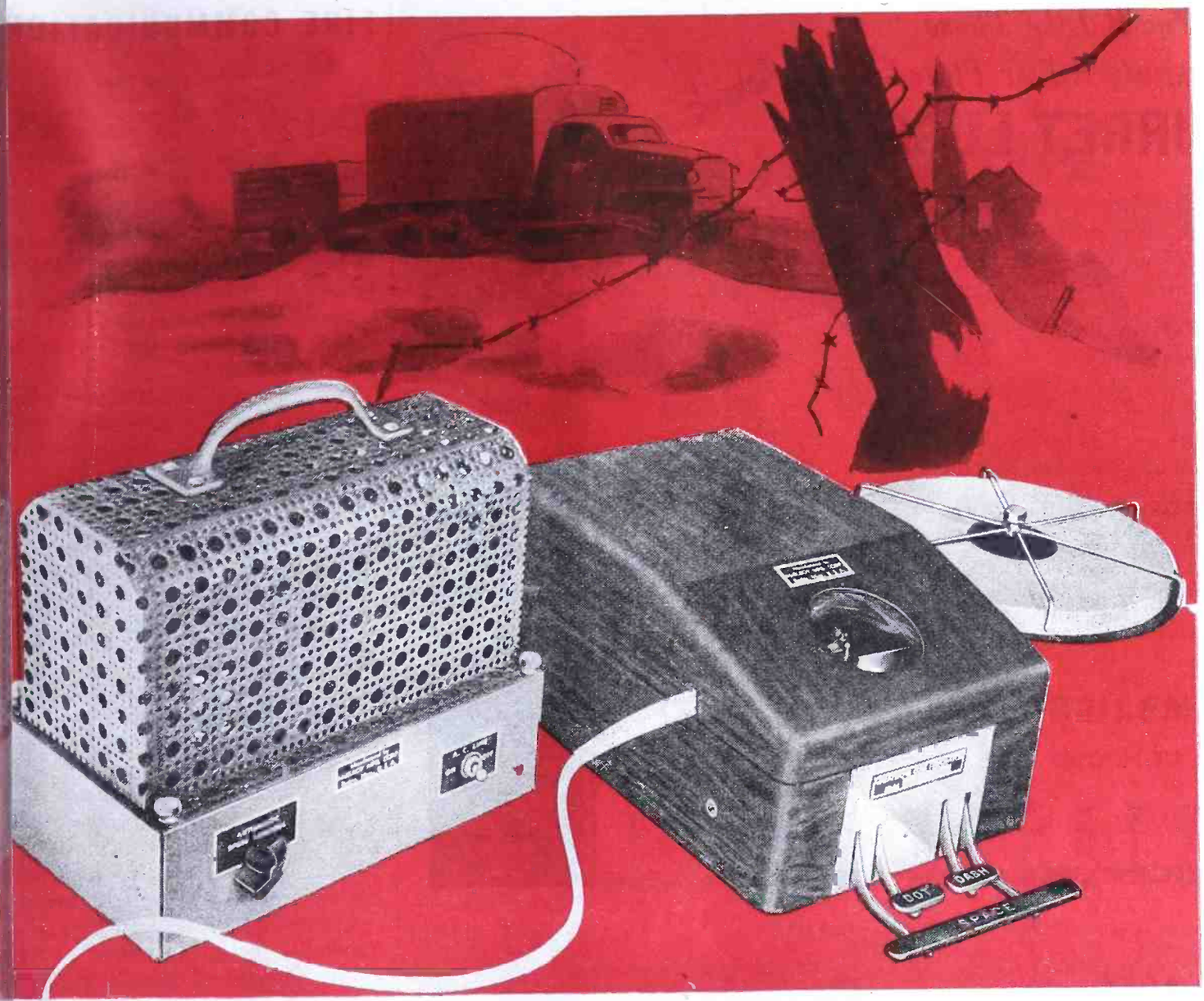
Fred P. Guthrie, chairman of the Washington chapter of the VWOA discussing postwar problems with Charles D. Guthrie, radio supervisor, Maritime Commission.

Pioneers

IN accepting VWOA honorary membership, Major General Harry C. Ingles, Chief Signal Officer of the Army said: "I wish to express to you my most sincere thanks and appreciation for the honorary membership in your association. I feel highly honored to be considered a veteran wireless operator and deeply appreciate your recognition given me as an old timer in the wireless game." . . . From the Communications Officer of one of our latest aircraft carriers, Lt. Cmdr. V. H. C. Eberlin, II, we have received a thrilling letter. Describing a night of action, he said: "This is the night before we run in to take a crack at the enemy, and having received a load of mail today (150 sacks) I've been lolling away the few hours before dawn reading COMMUNICATIONS. Good ole Uncle Sam's mail and COMMUNICATIONS both follow us and catch up at just the right time. I was interested to see Robert Pheysey's picture in the group photograph at the 77 Club. Note, too, that 'Bill' Simon is touring TRT's stations. Hope he enjoys Miami. Also glad to see George Clark looking hale and hearty. If that was the same G. Mathers that sailed with me give him my 73." A postscript reads: "Couple of days later—everything went fine—we are rapidly aiding the enemy in expanding his 'underwater fleet'."

DR. LEE DE FOREST, father of radio, and honorary president of our association dropped us a note recently, commenting on his VWOA award. He said: "I wish to thank you, George Clark, and the Veteran Wireless Operators Association for the embossed honorary membership certificate which I have just received, together with numerous birthday greetings. It is a deep comfort to know that my old pals in wireless never forget the occasion of my birthday, a custom which I trust may be perpetuated for many years to come. (*We sincerely hope so, too, Doc*). It may be that I shall be in New York for a few days during September and if so, one of my chief delights will be in meeting you fellows again."

We are grateful to Jack Poppele for the information that WOR and the Mutual Broadcasting System paid tribute to Dr. de Forest on the occasion of his seventy-first birthday on August 26, 1944 on the musical programs, *Music for an Hour* and *Music for Remembrance*, from coast-to-coast. The programs were undoubtedly heard by Doc over the Mutual outlet KHJ in Los Angeles. Through Jack's good offices a recording of each of these programs was presented to Dr. de Forest. A splendid tribute to the *Father of Radio*.



STANDING STILL, OR BOUNCING ALONG SHELL-TORN COUNTRY, THE NEW AND IMPROVED

McELROY WHEATSTONE CODE TAPE PERFORATOR

FACILITATES HIGH SPEED RADIOTELEGRAPH TRANSMISSION

Shorn of bulk and complicated construction, the McElroy Model PFR-443-A prepares clean and accurate tapes for transmission at speeds up to 300 words per minute. Extremely simple to operate and requiring no more than ordinary typewriter attention, this unit is solidly constructed to give dependable performance—on land and sea—stationary or rolling.

Two easily carried units comprise the PFR-443-A—the keying device and the electronic drive. Both are compact and self-protected against jolts and jars. In the hands of experienced operators, speeds of between 30 and 40 words a minute can be maintained in all Morse combinations assigned to the Russian, Turkish, Greek, Arabic and Japanese alphabets and languages. We cannot say for sure, but it is almost a certainty that this McElroy development landed with the Armies of Liberation and will continue to help provide high speed transmissions until V-Day. We will be glad to supply additional technical information.

McElroy engineers never copy and never imitate. We create . . . design . . . build. We are never satisfied with mediocrity.

ARMY E NAVY

BACK THE INVASION WITH YOUR BLOOD . . . DONATE A PINT TO THE RED CROSS

McElroy **MANUFACTURING CORP.**
82 BROOKLINE AVE., BOSTON, MASS.

FIRE COMMUNICATIONS

(*Continued from page 44*)

service by municipal police stations, and may not be carried as property of the fire service.

The present investment is such that when the postwar period arrives most of the present equipment will have become obsolete.

No serious problems will be introduced by required changes in frequency.

The estimated period of turnover of equipment does not affect the fire service.

Allocation Plan

Under the present rules, but three frequencies have been made available for municipal fire-station class of service. These are inadequate and were made available for the duration to relive a critical situation.

In taking into consideration the allocation of frequencies, so that skip interference would be eliminated, it was found that a minimum of 30 channels would be necessary in the 30- to 40-mc band. Approximately a minimum of four channels in the 100- or 200-mc band for portable fire-ground communication service are needed.

Congested area allocations are not as vital to the fire service as to police since coordination is centralized and two or three channels would be the maximum required under the most exacting conditions, plus the channels for portable units.

Channel Requirements

Fire-service radio communications requirements, as outlined below, are most necessary minimum requirements.

(*1*)-10 channels, *phone* point-to-point, 40-kc wide in the 30- to 40-mc range.

These channels are required for communications purposes, between the central fire dispatching point and sub-control points, and between fire departments of adjacent municipalities and other services closely coordinated with the fire suppression forces of a municipality, such as airports, private fire brigades, railroads, or other agencies depending upon the fire service for prompt assistance, water pressure control, etc.

(*2*)-20 channels, *phone* station-to-station-to-mobile units, 40-kc wide in the 30- to 40-mc range.

These channels are the main requirements necessary to provide channels of communication for the mobile units of the fire service, as well as its marine service.

(*3*)-4 channels, *phone* "walkie

(*Continued on page 79*)

alkie," 80-kc wide in the 100- to 200-nc range.

The channels are the minimum requirements necessary to provide channels of communications necessary at the cene of a fire, to coordinate the activities of the fire fighters in large buildings, or in forest fire fighting, exclusive f that performed by the forest service.

(4) Experimental channels should lso be made available to the service, or its postwar study and needs, which ay develop as a result of the national tudy now in progress.

n accordance with the 1940 census, re are now approximately 1,000 es of 10,000 population and up, all which have organized fire departnts. This figure does not include large number of smaller communies of our less populated states, who o have a very serious need for radio mmunications facilities, and who st depend upon their neighbors for equate fire protection.

The number of mobile units now in vice, and which will require radio vice, are approximately as follows:

65,000	Pumping units.
15,000	Ladder companies.
20,000	Chiefs, battalion chiefs, service cars, fuel wagons, and miscellaneous cars connected with the *fire service.*
10,000	Squad cars, ambulances and utility trucks and boats.
18,000	OCD pumping units.
28,000	Units.

The above is a conservative figure the number of fire-fighting units t will use radio, as soon as equipnt can be made available.

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NAB SYMPOSIUM

(*Continued from page* 66)

new business. It calls for a capital lay of serious proportions. It demands v skills and techniques of engineering l program production.

Television is the greatest challenge ever sented to American broadcasters. It a challenge which, as an industry, we ve accepted. But to accept it is one ng, and to put our acceptance into ae effect is another. It will take an ending supply of courage and patience follow through. Inspiring though the ad social and economic aspects of teleion may be, the risks and toil of get-g it under way will not be a matter inspiration but of perspiration.

In the field of sound broadcasting, obously the most important technical deopment will be the expansion of f-m. e radio manufacturing industry, for most part, is planning to incorporate n along with a-m in practically all cept the cheapest models.

This estimate of the early post-war owth of f-m is necessarily the roughest nd of an approximation. It is just ess-work. But if it is a good guess, it ll be a remarkable showing. When the ational Broadcasting Company was

(*Continued on page* 80)

(*Continued from page 79*)

formed in 1926, there were only 5,000,000 receiving sets in the entire United States. There may be more than that number of f-m receivers in use after little more than a year of full postwar production.

Up to the present time there has been reason to think of the owner of an f-m receiver as quite a different sort of person than the average radio listener. The estimated half-million people who have bought f-m sets up to now include a high proportion of lovers of fine music. Their listening habits probably register a pretty low rating for serial dramas and comedy programs.

But as f-m receivers begin to be sold in quantity, this picture is going to change rapidly. The typical owner of an f-m set will come more and more closely to resemble the run-of-the-mill listener, until the time comes when the two are indistinguishable. The bigger and more widespread the sales of f-m receivers, the more the program likes and dislikes of the average f-m set owner will become identical with those of the entire national radio audience.

Television is going to help American industry prime its own pump and keep it pumping. It is altogether likely that for every new job which television creates on its own account—in the building of apparatus and the production of programs—television advertising may create ten jobs in American factories and the stores which distribute their output.

I can sum up briefly. As for f-m any technical advantages it possesses should be made available to the public by present broadcasters who can, to a large extent make the highly popular programs currently available only to the standard band listeners, likewise available to the f-m listeners. As for television NBC is prepared to establish a television service as soon as men and materials are available on the best possible practical standards as authorized by the FCC. We believe that experimentation should continue with the end in view of supplying the public with constantly improved television service. We do not believe in the principle of withholding a practical four-cylinder automobile from the public because a theoretical eight-cylinder engine is about to be developed.

•

FACSIMILE

J. V. L. HOGAN
Consulting Engineer

IN 1933, facsimile was limited to the transmission at about 3 square inches of pictures, or about 60 words of text, per minute. That was too slow to provide a really good service, but by the time of Pearl Harbor the speed had been increased to about 10 square inches of pictures or 200 words of text per minute.

At speeds even lower than this, at about 100 words per minute, a number of broadcasters began checking public reaction to this new visual broadcasting service. Among them should be mentioned WTMJ of Milwaukee, KSD of St. Louis with its first daily facsimile newspaper in 1938, WOR of New York, and WBNS-WELD of Columbus. But Pearl Harbor was the stroke of midnight for this cin-

rella of the broadcast industry, and fac-
nile went back to industrial and war-
ne service.

Why should broadcasters now become
erested in facsimile? Because it has
w truly become *the home-printing press*
the magic typewriter that can set down
paper, by radio control, any size or
ce of type and any sort of chart or pic-
re. It can deliver a printed magazine,
stantly and simultaneously, to every
dio home. Its techniques have advanced
far that it can now deliver a 48-square
:h picture (that is, 6" by 8"), or
out 1000 words of text every minute.
nd it can do that at relatively low costs
d on a standard f-m broadcast sound
annel. We must forget the technical
nitations that characterized facsimile
rformance in the prewar days.

ıcsimile and Television

What are the similarities and the dif-
rences between facsimile and television.
hey are alike in that they are both
sual, can be used for entertainment,
lucation and advertising, and can be net-
orked or syndicated. They differ as a
otion picture and a magazine differ;
levision being the motion picture, and
icsimile, the magazine. Television has
ovement, attention value, but is costly.
acsimile offers a permanent record, at-
ntion value, too (not necessary, but an
ıtertaining feature), low cost, and proof
sale and circulation.

Facsimile is simpler to network and the
ansmitter cost is the same as a sound
it. The studio cost of a facsimile sta-
on is less than a sound studio. The cost
a facsimile receiver is the same as a
und receiver, plus the cost of recorder.
his might be from $20 to $100, depend-
g upon the quantity and details of de-
gn. The cost, however, is much less
an of a television unit. It is also cheaper
program a facsimile effort than a sound
oduction.

What is needed to initiate a broadcast
ıcsimile service? Standardization, FCC
ules, multiplex channels and release of
ıaterials and manpower by the WPB and
VMC.

robable Standards

The probable standards will be: 4" by
" columns, 9" paper, 100 lines-per-inch,
00 to 800 wpm, reading speed to allow
or photos. And all standards must pro-
ide for interchanging.

A number of newspaper-radio stations
ı large cities have studied facsimile and
re planning to deliver f-m/facsimile
roadcast services as soon as standards
re adopted, FCC rules are cleared up
nd WPB gives the green light. The three
ervices of sound, television and facsimile
re non-competitive. Each has something
ıat neither of the other has. And I expect
see all three of them grow enormously
fter the war. However, because of its
nherent merit and economy as a broad-
ast service, I believe that after, say, the
irst five years, facsimile will be provid-
ng more receiver-hours of use than tele-
ision, and at a far lower cost-per-hour
f service.

CATHODE-RAY TUBES

(*Continued from page* 52)

neck. The speed of the chuck is approximately 120 rpm, and a harmonic motion of approximately 20 cpm is applied to the gun.

Screen efficiency depends upon the sensitivity of the fluorescent material and upon the particle size and thickness of the applied coating. Since only the surface of the fluorescent screen facing the cathode-ray gun is activated by the electron beam, the light transmission factor of the screen becomes critical. To eliminate cathode glow and still maintain best results, a transmission of from 54% to 58% is most satisfactory.

Bibliography

For complete fluorescent screen data, see paper by H. W. Leverenz, IRE, May 1944.

Credits

The author gratefully acknowledges the assistance of M. Silverman, who prepared curves and photographs to illustrate this paper.

•

Figures 13 (above) and 14 (below)

Figure 13, flashing the *getter* by high frequency after the tube has been pumped and has had its base attached. Figure 14 checking electrical characteristics and light output on cathode-ray tubes. Preheater at lower right makes preliminary test for short and voltage breakdown.

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CRAFT "V" ANTENNA

(Continued from page 35)

n an answer by either of the first methods and since the amount of involved is all out of proportion e information obtained, it was de- to measure the input impedance rimentally.

l measurements were made at 125 n a horizontal *V* antenna which constructed of ¼" brass tubing so arranged that both its length apex angle could be varied. The nna was placed at a half-wave- h above the ground, and a gradu- circle laid out around it so that of the calculated field patterns d be checked with a diode type of strength indicator.

he input impedance of the antenna determined by measuring the volt- distribution along a section of smission line of known character- impedance, Z_o. Referring to ire 2, if Δ is the electrical distance the antenna to the voltage mini- m and S is the standing wave ratio, the antenna impedance can be d from the following relationship

$$Z = Z_o \left[\frac{S(1+\tan^2\Delta) + j\tan\Delta(1-S^2)}{S^2+\tan^2\Delta} \right]$$

theory of this method has been ted in the literature many times is familiar to most v-h-f engineers. might be pointed out that it is icult to get accurate results by the ve method when the Q is greater n 8 or 10 to 1. Should this be e, it is more convenient to terminate transmission line with a building- section so that the standing waves removed and then compute the gnitude of the standing waves and location of the voltage minimum n the length and position of the lding-out section.

n measuring the *V* antenna, lantite 170 ohm two wire balanced without the outer conductor was d. The characteristic impedance of line without the shield is 215 ohms le the wavelength constant is 0.90. e standing wave measurements were de with a dual probe detector. ure 3 shows how the radiation re- ance and antenna reactance vary h both length and apex angle. The nner of variation is about what ght be expected. That is, the radia- n resistance decreases both as the gth and the apex angle are de- ased. The reactance is negative en the length is shorter than the onant length and positive for lengths ger than the resonant length.

The gain from the *V* antenna with

(Continued on page 84)

respect to a dipole can be found by comparing the relative field due to each antenna, assuming each one is supplied with the same amount of power and neglecting the losses in the coupling circuit.

The maximum field from the V antenna is

$$E_v = \frac{60\,I_o}{r_o} \cdot \left[\frac{\cos^2\phi - 2\cos\phi\,\sin\left(\frac{\pi}{2}\cos\phi\right)+1}{1-\cos^2\phi}\right]^{1/2}$$

$$= \frac{60\,I_o}{r_o} \cdot \left[\frac{\cos^2\phi - 2\cos\phi\,\sin\left(\frac{\pi}{2}\cos\phi\right)+1}{\sin^2\phi}\right]^{1/2}$$

The maximum field from a dipole is

$$E_d = \frac{60\,I_o}{r_o}$$

Since for a given amount of power, the current would be inversely proportional to the square root of the radiation resistance, the relative field of the V with respect to a resonant dipole is,

$$\text{Relative Field} = \frac{E_v}{E_D} = \left[\frac{\cos^2\phi - 2\cos\phi\,\sin\left(\frac{\pi}{2}\cos\phi\right)+1}{\sin^2\phi} \cdot \frac{R_D}{R_v}\right]^{1/2}$$

The radiation resistance of a dipole is approximately 70 ohms so that the relative field becomes,

$$\frac{E_v}{E_d} = \left\{\frac{70\left[\cos^2\phi - 2\cos\phi\,\sin\left(\frac{\pi}{2}\cos\phi\right)+1\right]}{R_v\sin^2\phi}\right\}^{1/2}$$

The apex angle of the antenna finally adapted was determined by compromise between pattern shape a radiation resistance. For an anter where $2\phi = 180°$ or an ordinary pole, a high value of radiation resistar would be obtained but the patte would have a null along the anten axis. For an antenna with a ve small apex angle, the pattern would more or less uniform in all directio but the radiation resistance would very low. The antenna finally us had an apex angle of $2\phi = 80°$. T field at the sides of this anten dropped to 40% of the maximum fie but its radiation resistance was ohms. Thus, the antenna had a re tive field only 0.95 db below that of half-wave antenna, while at the sar time it had sufficient pickup to t sides to make it usable for all headin of the aircraft.

The horizontal field pattern for tl 80° case was both calculated and me sured and is shown in Figure 4. Tl vertical field pattern for the 80° cas was calculated, Figure 5.

For actual installation on the ai plane, the antenna was grounded at th center and the transmission line co nected by tapping out on the elemen rather than by breaking it in th

(*Continued on page* 86)

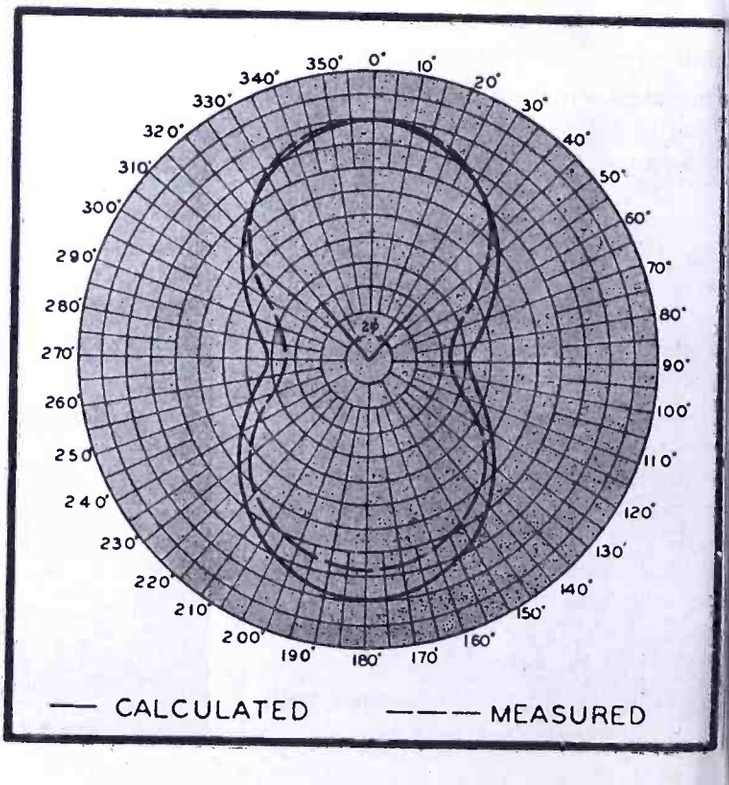

Figure 4

Field patterns in horizontal plane for a quarter-wavelength V antenna; $2\phi = 80°$.

AIRCRAFT "V" ANTENNA

(*Continued from page* 84)

center and feeding it at that point. This provided a more substantial mechanical support and eliminated the necessity for an additional matching section.

The *V* antenna was compared directly with a horizontal loop antenna while in flight. The distance range on the same station when using the *V* was increased approximately 20% over that obtained when using the loop. This was due to the increase in gain due to the lower matching losses incurred when using the *V* and the fact that the lightness of the *V* assembly made it possible to place the antenna on the tail fin where ignition noise from the engine was practically non-existent.

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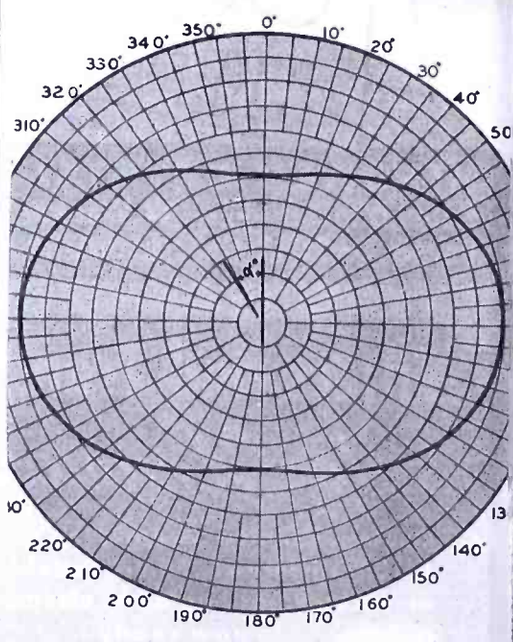

Figure 5

Calculated vertical field pattern through apex bisector for a quarter-wavelength *V* antenna; $2\phi = 280°$.

NEWS BRIEFS

(*Continued from page 75*)

Andrew Company, 363 East 75th Street, Chigo 19, Illinois.
Performance curves are also presented. Data spare parts and a pressurizing kit are also fered.

* * *

F. JOHNSON CATALOGS

n 8-page general catalog, 968, and a 24-page ochure covering development and production tivities have been published by E. F. Johnn Company, Waseca, Minnesota.

* * *

H. McGEE LEAVES WPB

harles H. McGee, Sr., of the WPB Radio and dar Division, has resigned to return to prite industry as a manufacturers' representae in Washington. His new offices are in the rry Building, 927 15th Street, N.W., Washgton, D. C.
Mr. McGee was Chief of the Orders and Apals Section of the Domestic and Foreign anch.

* * *

I. P. SEGEL OPENS HARTFORD BRANCH

enry P. Segel, field engineer and manufactur's representative, Boston. Mass., has opened branch office in Hartford, Conn.

* * *

RESS WIRELESS MOVES TO N. Y.

he executive offices of Press Wireless, Inc., ave been moved from Chicago to New York ity. The new headquarters will be at 1475 roadway.

* * *

ATTIG PROMOTED BY G. E.

V. L. Fattig has been appointed Southeastern istrict representative of the G. E. electronics epartment.

* * *

AER PHENOL FIBRE CATALOG

A six-page compilation of specification data n phenol fibre and vulcanized fibre for parts abrication has been released by N. S. Baer ompany, 9-11 West Montgomery Place, Hillside, New Jersey.

* * *

A. G. HELLER OF INSULINE DEAD

Alexander G. Heller, treasurer and chief engineer of the Insuline Corporation of America, ong Island City, N. Y., died recently.

* * *

OPTI-FLAT BOOKLET

ssue 105 covering opti-flats, the glass surface late polished by optical methods and said to be uaranteed accurate well within 50-millionths f an inch, has been released by the George cherr Company, 200 Lafayette Street, New York 12, N. Y.

* * *

FUNGUS PROOFING MANUAL

An 8-page manual on fungus proofing has just been released by The Insl-x-Company, Inc., 857 Meeker Avenue, Brooklyn, N. Y.

* * *

G. E. GLYPTAL UNIT EXPANDS

Expansion of the glyptal alkyd resins field force has been announced by G. E.
In the new glyptal field force, F. M. Hastings will be in charge of the New York area with offices at 570 Lexington Avenue, New York City. C. H. Gross will handle the Atlantic seaboard district except for the New York area with headquarters in Schenectady, N. Y.; P. E. Doell, in charge of the East Central district will make his office at 1966 Woodland Avenue, Cleveland, Ohio; J. R. Reid and R. C. Reid, in charge of the Central district will have their offices at 840 South Canal Street, Chicago.
The Paul W. Wood Company of San Francisco and Los Angeles represents glyptal on the Pacific Coast. J. E. Russell acts in a similar capacity in the states of Arkansas, Louisiana, Oklahoma and Texas.

* * *

HAYDON TIMING MOTOR CATALOG

A 24-page catalog describing the design and application of timing motors has been published by Haydon Manufacturing Company, Inc., Forestville, Connecticut.

* * *

SOLAR VICTORY LINE CAPACITOR DATA

Helpful hints on the use of 19 types of victory line capacitors appear in a 4-page bulletin released by Solar Capacitor Sales Corporation, 285 Madison Avenue, New York 17, N. Y. A handy electrolytic replacement chart also appears in the bulletin.

* * *

C. H. ODELL JOINS EDISON

The instrument division of Thomas A. Edison, Inc., West Orange, N. J., has named Carl H. Odell as assistant manager, in a move to increase its activities in the aeronautical field.
Mr. Odell was formerly with the Federal Telephone and Radio Corp. as an executive in its direction finder division.

* * *

MEC-RAD EXPANDING PLANT FACILITIES

The Mec-Rad Division of Black Industries will move soon to a new building adjacent to the present plant at 1400 East 222 Street, Cleveland, Ohio. The new structure, which is now under construction, will more than double Mec-Rad's present plant facilities.

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CENTRALAB CAPACITOR BULLETINS

Two 4-page bulletins describing tubular ceramic

(*Continued on page 88*)

NEWS BRIEFS

(*Continued from page 87*)

capacitors and silver mica capacitors have bee released by Centralab, 900 East Keefe Avenu Milwaukee, Wisconsin.

Bulletin 819 describes the ceramic unit and 586, the silver micas. Dimension drawin and a capacity chart for the various temper ture coefficients; power factor, toleranc voltage rating and humidity; and the meth of complete vacuum wax impregnation, appe in the ceramic bulletin.

The silver mica bulletin describes capacito with ranges from 6 to 2400 mmfd and vario types of terminals now in production on speci orders.

* * *

N. A. PHILIPS SEARCHRAY FOLDER

The Norelco Searchray 150 industrial X-r unit, is described in a 4-page folder prepare by North American Philips Company, Inc., 1 East 42nd St., New York 17, N. Y.

* * *

REVISIONS IN G.E. DATA BOOK

Revised pages by their "Radio Transmittin Tubes Data Book" have been released by Ge eral Electric Company. The pages, which r place many of the changes made last Decemb cover technical descriptive bulletins on tub GL-204A, 502, 807, 816, 815, 833A, 836. 842. 84 869B, 889R, and 892; instructions on wate cooled transmitting tubes GL-816, 807 842. ar 837. A check list of the complete handboo which includes new and revised pages, may l had from G. E.'s headquarters, 1 River Roa Schenectady 5, N. Y.

* * *

SYLVANIA PROMOTES ROBINSON

Frederic J. Robinson, former Gillette Safet Razor Company export manager, has bee named sales manager for the new Latin Ame ican division of Sylvania Electric Products, In Mr. Robinson has been with Sylvania sinc 1942.

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ACCELERATION CHART

Issue No. 79 of the Sylvania Engineering New Letter contains an acceleration chart tha provides acceleration factors prompted by rota tional or vibrational motion.

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NEW SHURE REPS

Walter and Harold Berggren (center), newl appointed representatives of Shure Brothers Chicago, welcomed by S. N. Shure (right), gen eral manager, and Jack Berman (left), sale manager.

•

THE INDUSTRY OFFERS . . .

CARTER DYNAMOTORS AND GENERATORS

Dynamotors, "magmotor" type which have no field coils, using a permanent magnet for this purpose, have been built for railroad radio application by Carter Motor Company, 1608 Milwaukee Ave., Chicago. They are designed for an input of 28-volts d-c and an output of 350-volts at 100 ma.

A dynamotor for marine use, marine "generator," has been also added to the Carter line. It has been designed for high humidity locations with spray-resistant, verdigris-repellant construction. Bearings are said to be packed with pre-worked grease of marine type.

Units are available with inputs ranging from 6 to 115-volts d-c and outputs up to 600-volts at .25 ampere. The size of the largest dynamotor is 7⅛" long by 4⅛" wide by 3½" high, and without the filter (available on order) it weighs 9 pounds.

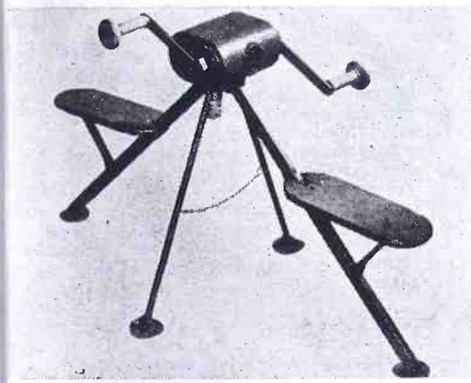
A hand generator with a maximum output of 100-watts also has been developed by the Carter Motor Company.

Output is to a 4-pin connector, but other type output connections can be furnished on demand.

The stand comes complete with seats and is totally collapsible.

Drive is by means of direct gears. One of the gears is bakelite-constructed, helical cut. The unit is said to have waterproof seals on the shafts. Metal needle is tipped with phosphorescent material as is a "correct operations line" on the meter scale for nighttime service.

Made of cast aluminum. Delivers outputs up to 500 volts d-c and a filament output voltage; 17 volts a-c output also available; weight, 37 pounds.



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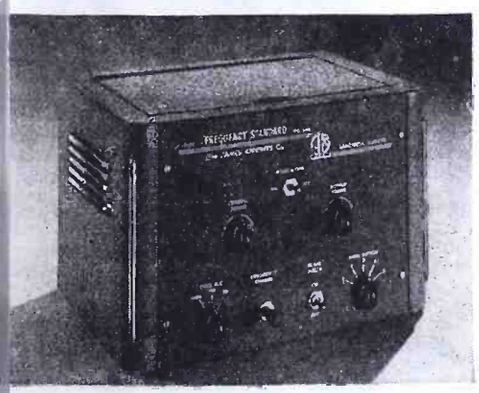
KNIGHTS FREQUENCY STANDARD

A secondary frequency standard, crystal controlled, with a hermetically sealed MD-cut dual-frequency crystal has been produced by The James Knights Company, Sandwich, Illinois. Instrument is said to provide a useful output up to 40 megacycles at 1,000 kilocycle, 100 kilocycle and 10 kilocycle intervals. Operates from 60-cycle 115-volt line.



* * *

CLARK ADJUSTABLE TOOL HOLDER

An adjustable tool holder for use in lathes, shapers, and planers has been announced by the Robert H. Clark Company, 9330 Santa Monica Boulevard, Beverly Hills, California. Holder is said to be capable of holding four or more sizes of tool bits in the same holder. Models available are the 15° sloping cutter channel type and the horizontal or parallel channel type in both right and left hand offset. Each type is available in several shank sizes.

Tool holder is also said to have a special vise-grip jaw.

Manufacturer claims that holders are especially suitable for using stellite and other extra-hard cast alloy tool bits.

Holders are drop forged of tool steel, heat-treated and hardened.

* * *

TURCO PAINT STRIPPER

A water-soluble paint stripper that is said to loosen paint for removal with water has been developed by Turco Products, Inc., 6135 South Central Avenue, Los Angeles, California. According to the manufacturer, the hosing off of an application of this stripper leaves a paint-free, water-break-free surface.

The new material, known as Turco Stripper L-780, is claimed to be non-corrosive on metals. It is said to be safe on wood with no tendency to cause warping.

* * *

RICHMONT SCREW-BOLT DRIVER

A torque-screw and bolt driver has been announced by Richmont, Inc., 215 W. 7th Street, Los Angeles. It is 7¾" long, with a 1.30" diameter handle.

Known as the Livermont Roto-Torq, the driver may be adjusted to any torque desired between 1-inch-pound and 25-inch-pounds for setting screws, small nuts, bolts, etc.

The mechanism operates on a spring principle.

Two models are available; one with a screw driver as an integral part of the shank, the other with ¼" square drive.

* * *

TAYLOR 803 PENTODE

A pentode, type 803, is now being manufactured by Taylor Tubes, 2312 Wabansia Ave., Chicago. The tube is 9⅜" maximum overall length by 2 9/16" maximum diameter. It is fitted with a 5-pin micalex base.

Filament voltage is 10 volts, a-c/d-c. Filament current is 5 amperes. Interelectrode capacitances, grid-to plate (with external shield) 0.15 mmfd; input 17.5 mmfd, output 29 mmfd.

For r-f amplifier and oscillator use, d-c plate voltage is 2000; suppressor voltage (grid 5) 500; screen voltage (grid 2) 600; grid voltage (grid 1) -500; d-c plate current 175 ma; d-c grid current 50 ma; plate input 350 watts maximum; suppressor input 10 watts maximum; screen in-

(*Continued on page* 90)

THE INDUSTRY OFFERS . . .

(*Continued from page 89*)

put 30 watts maximum; plate dissipation watts maximum; driving power, approximate 2 watts; power output, approximately, watts. Maximum frequency at full output said to be 20 megacycles.

* * *

FEDERAL U-H-F CABLES

Five types of coaxial cables are now bein produced by the Intelin Products Division Federal Telephone and Radio Corporatio Newark, New Jersey. They are: coaxial, dua coaxial, twin-conductor, coaxial air-spaced ar spiral delay. Designed, generally for 50 to ohms impedance.

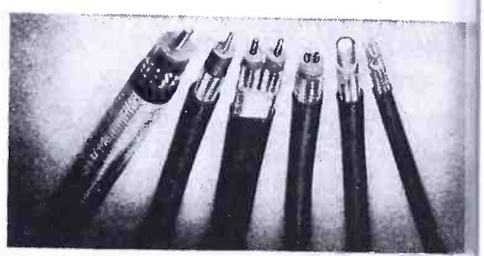
Coaxial lines include sizes from 3/16" outsi diameter up to and including cables over in outside diameter. Standard designs inclu single and double-braided constructions wi standard and armored covering.

Dual-coaxial lines have been developed f parallel circuits.

Twin-conductor lines, sometimes calle "Twinax" are balanced shielded pairs, usuall somewhat smaller than dual-coaxial lines.

Coaxial air-spaced cables are available fo low capacitance requirements. Cables are sai to have capacitances as low as 8 mmfd pe foot.

Spiral delay lines have been developed fo special test sets requiring lines with an appre ciable delay or very high impedances.



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U. S. RUBBER SYNTHETIC RUBBER

Nubun, a synthetic rubber latex insulation fo communication cable, has been developed b United States Rubber Company, Rockefelle Center, N. Y. City. The insulation is mad from a modification of buna S.

According to the manufacturer, Nubun in sulation offers flexibility, impermeability te water, laminated construction, and centering of the conductor. The synthetic insulation i said to be exceptionally homogeneous following vulcanization.

According to the company's engineers voltage breakdown of the insulation after sub mersion in water at room temperature is 65(volts/mil. Insulation resistance constant K afte submersion in water at room temperature i 54,000.

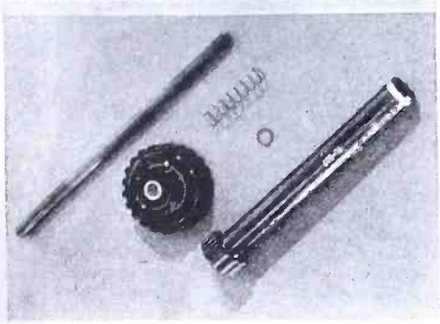
* * *

GENERAL CEMENT ALIGNMENT TOOL

A padding condenser alignment tool, TL-207 has been developed by General Cement Mfg. Co., Rockford, Illinois. The tool is constructed of two basic parts molded from Durez plastic. In the barrel is a small knurled head which accommodates a spring controlled plunger with a larger control knob. The barrel is hexagonal shaped in its working end to accommodate the condenser adjustment lock nut. The plunger

has a metal insert in its lower end resembling a screw driver tip.

Adjustment is made by the plunger when it is pushed forward to mate itself into the cloven pin end of the condenser adjusting screw. Movement of the barrel loosens or tightens the hexagonal locking nut which collars the condenser adjusting pin. Movements of magnitude and direction are indicated by the arrow engraved on the control knob end.



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SPRAGUE CERAMIC WIRE INSULATION

A process for depositing a thin ceramic (inorganic) coating on copper, nickel, and other types of wire has been announced by the Sprague Electric Company, North Adams, Massachusetts.

This new insulation is known as Sprague Ceroc 200. When applied to copper wire it is said to maintain desirable electrical characteristics at a continuous operating temperature of 200° C.

Because of its inorganic ceramic composition, Sprague engineers believe that Ceroc 200 meets all requisites of a Class C insulating material as classified under AIEE standards. Space factor is said to be extremely good, in that Ceroc 200 is thinly deposited on the wire. Typical space factor for Ceroc 200 expressed in percentage of copper area to total cross-sectional area of finished wire is 98% for AWG 16 wire, and 95% for 24 wire.

The preferred thickness is ¼ mil. Present preferred wire sizes for applying Ceroc 200 are from 3 to 30 mils in copper wire (40 to 21 AWG) and from 1½ to 12 mils (46 to 28) in nickel wire.

Ceroc 200 is said to be sufficiently flexible so that round coils can generally be wound satisfactorily on existing equipment. In the case of rectangular coils or motor armatures, however, winding technique may require modification to assure that the wire is not stretched more than 10%.

Based on wire having a coating of the preferred ¼-mil thickness voltage breakdown between 2 wires of a twisted pair 4" long, standard condition (25°C) is said to be 300 volts a-c; humid conditions (95% relative humidity), 300 volts a-c; hot condition (200°C), 300 volts a-c. Leakage between two wires of a twisted pair 4" long at 95% relative humidity is said to be greater than 100,000 megohms.

* * *

MINIATURE MACHINE SCREWS

The range of sizes of MSP miniature type machine screws has been increased by Manufacturers Screw Products, 216-222 W. Hubbard Street, Chicago 10, Illinois.

These screws are now available in 0-80, 1-64 and 1-72 thread diameters, both in steel and brass.

* * *

BRUNO ADJUSTABLE HOLE CUTTERS

An adjustable hole-cutting tool has been announced by Bruno Tools, Beverly Hills, California. This tool is said to be capable of cutting holes in wood, steel, brass, hard rubber, aluminum, fibre, and plastics. Two sizes are available, each equipped with a high-speed steel blade. One model cuts holes to any diameter from ⅝" to 1¼" through ⅛" thickness. The other model covers all expansions from 1" to 2½" through thickness up to ⅜". The tools are designed to operate in light drill presses, portable drills, or breast drills and are also available with square shanks for use in hand braces.

The Bruno cutter consists of a drill which starts the hole and also serves as a pilot for the tool, a hardened body with a milled slot into which is set a high-speed steel tool bit, and a hardened and ground shank. Adjustment is obtained by loosening the hexagon bolt which holds a firm locking clip, and sliding the blade to the correct distance from the pilot.

* * *

M-W FUNGUS RESISTANT COATING

A fungus-resistant coating, for phenolic parts used in tropical climates, has been developed by Maas & Waldstein Company, 438 Riverside Avenue, Newark 4, N. J. It is designed for application on phenolic insulators, terminal blocks, junction blocks, and the fixed windings of motors, generators and dynamotors.

Marketed as Durad Fungus Resistant Coating 524, this fungus-resistant coating is a varnish and is applied by spray, dip or brush.

* * *

RCA TUBES

Four tubes, 6AL5 twin diode (miniature type), 6F4 oscillator triode (acorn type with radial 7-pin base), 1P29 gas phototube, and 3B25 half-wave gas rectifier (hot-cathode type), have been announced by RCA.

The 6AL5 is particularly suitable for use as a detector in circuits utilizing wide-band amplifiers. In such circuits, the low internal resistance of the 6AL5 is said to make it possible to obtain increased signal voltage from a low-resistance diode load. Each diode unit has its own plate and cathode base-pin connections and can, therefore, be used independently of the other or combined in parallel or full-wave arrangement. The 6AL5 is an Army-Navy preferred type.

The 6F4, an acorn triode of the heater type, is intended for use primarily as an oscillator at

(*Continued on page 92*)

THE INDUSTRY OFFERS . . .

(*Continued from page 91*)

frequencies up to about 1200 megacycles. Operation of this ultrahigh frequency is made possible by a close-spaced electrode structure and the use of a radial 7-pin base which provides two connections each for plate and grid.

At moderate frequencies, a single 6F4 operated in class C oscillator service with 150 volts on plate is said to be capable of giving a power output of approximately 1.8 watts. At 1200 megacycles, and with 100 volts on plate, approximately 45 milliwatts are said to be available.

The 1P29 gas phototube spectral response occurs over the spectral range from about 4000 to 8000 angstroms, with maximum sensitivity at approximately 4200 angstroms. Its sensitivity at maximum response is 0.10 microamperes per microwatt of radiant flux.

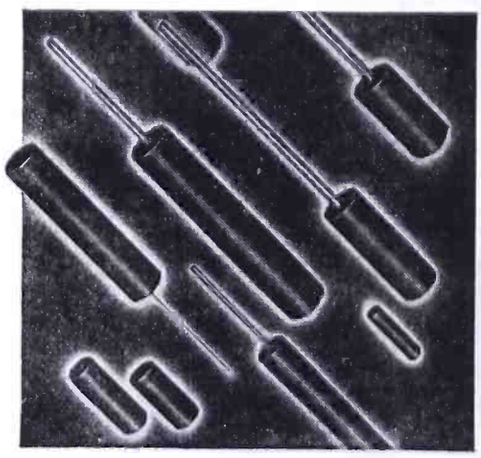
The 3B25 is a xenon-filled half-wave rectifier tube. Can be operated under conditions where ambient temperatures in the order of —75° C to +90° are likely to be encountered. The 3B25 is capable of withstanding a peak inverse anode voltage of 4000 volts and of delivering an average anode current of 0.5 ampere.

* * *

STACKPOLE SIDE MOLDED IRON CORES

Iron cores molded by means of pressure applied from the sides rather than from the ends have been introduced by the Stackpole Carbon Co., St. Marys, Pa. These cores are said to be applicable for permeability tuning applications at broadcast frequencies. Similar side-molded cores are now available for short-wave frequencies including television and frequency modulation.

In side-molded cores, any density resulting from molding pressure is said to extend evenly over the entire length of the core.



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FAIRCHILD MAGNETIC CUTTERHEAD

A wide-range magnetic cutterhead, unit 541, is now in production at Fairchild Camera & Instrument Corporation, 475 Tenth Avenue, New York 8, New York.

Effective damping is said to have been achieved through the use of exceptionally long cushion blocks and a positive means of adjusting the armature in correct balance.

The frequency response, as revealed by the light method of measurements, is said to be 8000 cycles, ± 2 db.

The unit is mounted in an especially designed adapter which attaches to the mounting casting on the carriage assembly with one bolt, making the cutterhead available as an addition to existing equipment.

Has a sapphire advance ball. The ball is on a swivel type mount which can be adjusted instantly to permit in-out or out-in direction of cut without additional parts or special tools.

Distortion is said to be less than 1%, 400 cycles. Impedance is 500 ohms; audio power required is 0.6 (plus 20 db); 5/8" long, .0062" diameter stylus accommodated.

* * *

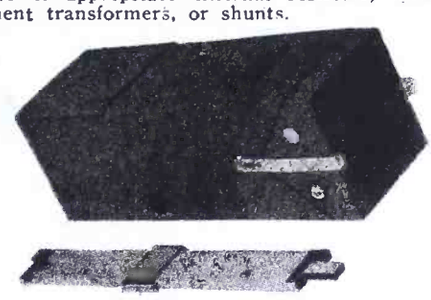
G. E. MINIATURE OSCILLOGRAPH

A permanent-magnet, miniature oscillograph has been developed by G. E.

Known as the type PM-17-A1, it consists of three principal systems: first, the optical system; second, six parallel galvanometer channels; and third, photosensitive-material transporting mechanism with internal motor and removable film holder, which are all enclosed in a metal case 4½" by 4½" by 14". The

weight of the complete instrument is approximately 10 pounds.

Designed to directly record small values of potential or current, such as the output of amplifying equipment. A wide range of potentials or currents can be recorded by the use of appropriate external resistors, instrument transformers, or shunts.



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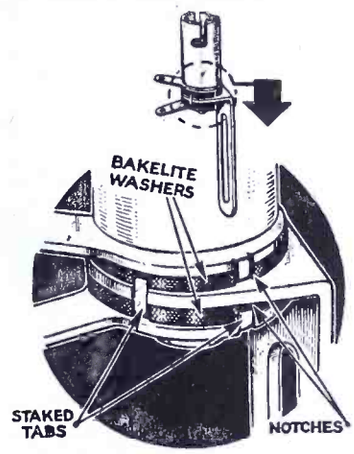
DIALCO PILOT LIGHTS

Improved pilot-light assemblies which have a miniature screw, miniature bayonet, or candelabra type socket, have been announced by the Dial Light Company of America, Inc., 900 Broadway, New York 3, N. Y.

The improvement is said to make the sockets permanently anchor-tight and fool-proof. The shell, bracket, and lugs are permanently secured by tab and notch devices.



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PRE-WAR CENTRALAB CONTROL CONSTRUCTION

Centralab has announced that it has begun the manufacture of volume controls according to pre-war prints. Work was started on some types of midgets and eventually the entire line will be affected. No substitute materials will be used in the entire production process.

The new parts have aluminum shafts that extend 3" from the end of a ⅜" bushing. They feature Universal fluted mills.

* * *

FTR L-F TRANSMITTERS

Low-frequency transmitters for use in Arctic regions have been developed by Federal Telephone and Radio Corporation, Newark, New Jersey. Transmitter includes an exciter unit, power amplifier unit, main rectifier unit and a set of antenna tuning house equipment.

Units use aluminum frames.

The entire transmitter operates from a 230-volt, 3-phase, 60-cycle power supply. In cases where the supply does not give this voltage, adjustments are provided so that any voltage between 215 and 250 volts can be used.

Complete control of the transmitter for single-frequency operation is possible from a remote point.

The exciter unit is a complete, continuous-wave transmitter and can be used independently of the power amplifier and main rectifier unit. It will deliver at least 500 watts of power on any frequency between 80 and 200 kilocycles. Keying speeds up to 200 words per minute are obtained through the use of an electronic keyer.

The power amplifier unit is normally used at one operating frequency but it can be set up for use on any frequency in the range of the exciter unit. At any operating frequency within this range it will deliver 10 kilowatts of power. This output is obtained through the use of a single 892R tube with conventional grid and plate tuning circuits.

The main rectifier unit employs 6 872A mercury-vapor rectifier tubes in a conventional three-phase, full-wave circuit. It supplies all of the plate power required by the power amplifier.

Each of the three transmitter units is provided with terminal boards and is arranged so that interconnecting leads can be placed in

(*Continued on page 94*)

THE INDUSTRY OFFERS . . . —

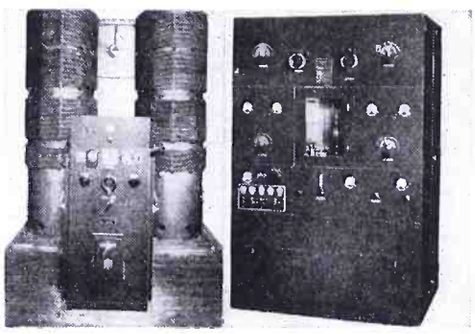
(*Continued from page 93*)

sheet metal ducts located in the floor. The radio-frequency connection between the exciter and the power amplifier can be made with a two-conductor, shielded r-f cable placed in these same ducts. Connections to the antenna tuning house can be made with a flexible coaxial cable. Both of these cables have a characteristic impendance of 70 ohms.

The antennas commonly used with this transmitter are of the flat-top type and their effective lengths are considerably less than a quarter wave. Their effective capacity at the operating frequency may be between .00125 and .00250 mfd. The effective resistances of the antennas vary with the frequency and may be as low as 2 ohms.

To properly tune these antennas, considerable loading is required and for efficient operation this loading should introduce little loss in the antenna circuit. The inductors have been designed to meet these conditions. Their Q at the operating frequencies is said to be at least 1500. Losses are kept to a minimum by surrounding the inductors with a Faraday screen.

All tuned circuits are adjusted with variometers. If variable capacitors were employed for this purpose, they would be either excessively large or would give only a very limited tuning range.

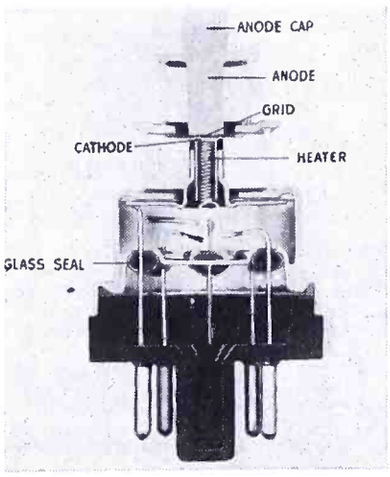


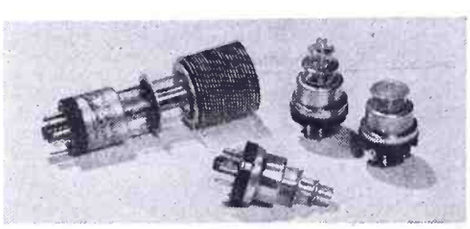
Antenna tuning house unit (left); exciter unit (right).

* * *

G. E. DISK-SEAL TUBE

Preliminary data on the u-h-f disk-seal electronic tube developed by G. E., has just been released. The tube is said to eliminate the conventional type of grid, anode and cathode. Instead of components being fitted around one another as in the past, they are now constructed in parallel planes or layers, with glass and metal fused together in inseparable units. This design is said to permit high frequency and high power output. It is said to offer uniform co-planar electrode design, and low plate-to-cathode interelectrode capacitance.





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KNOPP VOLTAGE TESTERS

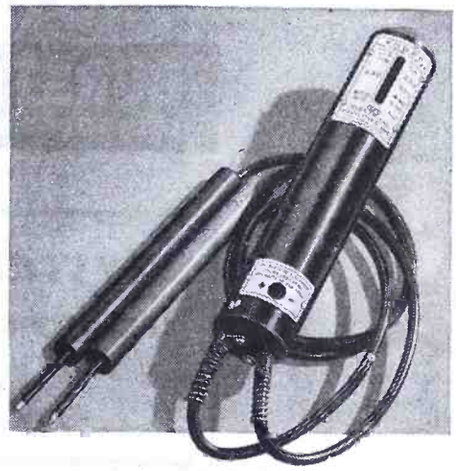
Voltage testers operating on the solenoid principle, and indicating nominal a-c circuit voltages of 110, 220, 330, 440, and 550, and nominal

d-c circuit voltages of 115, 230, and 600 have been announced by Electrical Facilities, Inc., 4230 Holden Street, Oakland 8, Calif.

Tester, SPD-2 type, has a neon-light polarity indicator in base which is said to show the polarity of a d-c circuit under test, and permit differentiation between a-c and rectified d-c current as well as between a-c and pure d-c.

Testers also contain a mounting in the top of the case into which one prod may be inserted so that only the tester and one prod need be handled during tests. Incoming leads are physically separated from each other within the case.

A junior model, the SDP tester, is also being offered, which does not have the neon polarity feature, but which is otherwise identical with the SDP-2.



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KURMAN FLAT KEYING RELAY

An improved model of the "Old Timer" relay (200 series), has been produced by Kurman Electric Co., 35-18 37th Street, Long Island City, N. Y. The unit features an energy absorbing material, sealed within a contact carrying cage which is said to remove chatter.

The relay input is 50 milliwatts. Will key up to 150 words per minute, or 60 impulses per second. Armature is mica insulated; said to be suitable for keying a 50-mc r-f signal. Contact will carry up to 2 amps.

* * *

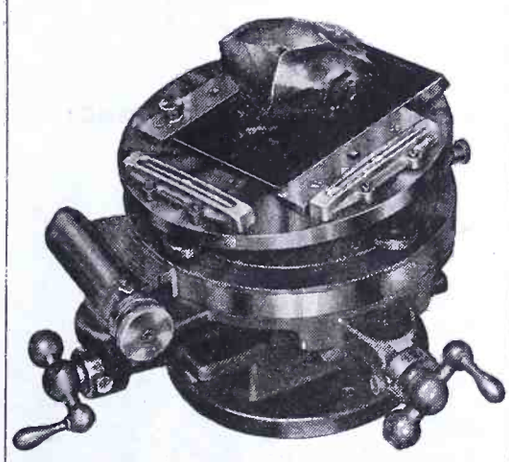
QUARTZ COMBINATION SLIDE TABLES

Combination slide tables, series 600 orientation heads, for the controlled processing of quartz crystal wafers are now available from F. & M. Sales Co., 1054 Cahuenga Blvd., Hollywood 38, California.

Interchangeable work-holding plates upon which the quartz is cemented are used, and placed in exact register with reference to the abrasive saw.

The work-holding table carrying the work-plate is said to be capable of being tipped in any direction similar to the adjustment of a surveyor's transit, for correctly positioning the quartz with respect to the X axis.

The orientation head to which the work-table is pivoted may be rotated throughout a 360° circle, with orientation controlled within 1 minute of arc in either direction.



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G. E. NOISE-SUPPRESSION CAPACITOR

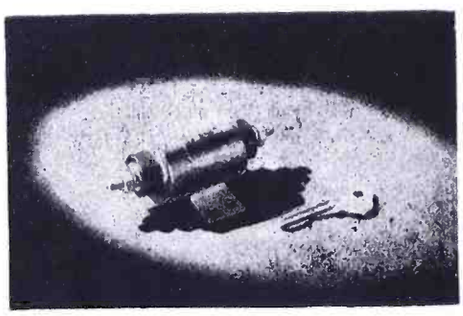
Pyranol radio-noise-suppression capacitors, have been announced by G. E. The capacitors are of the thru-stud type with a terminal at

(*Continued on page 96*)

each end. One line of a d-c or a-c power circuit can be "fed" through the unit.

Capacitors are approximately 1¼" x 3⅝"; weight, 4½ ounces. They can be mounted in any position and said to be capable of operating over a temperature range of +50° C to −50° C.

Rated 0-100 amperes, 250 volts maximum a-c or d-c, 0.55 mfd.



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FLOATING CAGE TYPE SPEED NUT

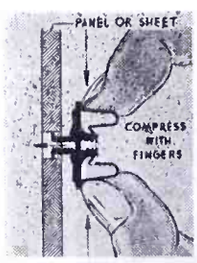
Self-locking speed nuts are now available from Finnerman Products, Inc., 2012 Fulton Road, Cleveland 13, Ohio. In use the cage is compressed and legs inserted into clearance hole. The legs spring apart when pressure is released, the turned-up ends just clearing the back side of the panel. The nut will hold tight against the force of inserting the screw and the screw-tightening torque. Floating speed nut within the cage is said to allow for any misalignment of clearance holes.

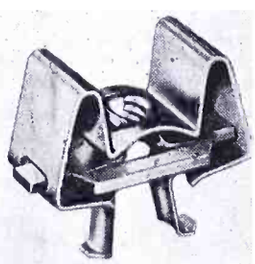
Originally designed for front mounting of aircraft instruments (approved by Army Air Forces), the cage nut may be used for any type of blind attachment. Available in two styles: A6939, made of brass and phosphor bronze, for use with standard 6-32 machine screws, and A5939, made entirely of spring steel, for use with standard 6Z sheet metal screws. Both styles are available to fit panel

THE INDUSTRY OFFERS . . .—

(*Continued from page* 95)

thicknesses from .062" up, and require only one clearance hole of .171" diameter to attach.





* * *

WESTINGHOUSE HIGH FREQUENCY GENERATORS

For induction and dielectric heating loads, a line of high-frequency generators with ratings of 1, 2, 5, 10 and 20 kw, conforming to NEMA standards, has been announced by Westinghouse Electric and Manufacturing Company.

Units are self-contained. The primary voltage is 220 or 440 volts, single phase for ratings of 5 kw or lower and 3 phase for 10 kw and higher. Housed in the single cabinet are the oscillator, power supply, blower, and necessary switchgear. The high-frequency section is completely shielded to minimize the possibility of interference with nearby communication circuits. An automatic timing control permits load cycle adjustment to a predetermined time, which can be automatically repeated. Terminals are provided for remote control.

Air-cooled tubes are used in the standardized generators.

In the 2-, 5- and 10-kilowatt generators, the load can be coupled to the work without the use of an external impedance-matching network when the work and generator are close together. A separate network is available for greater distances to the work and for use with the 20-kw unit.

Generators are available for frequencies of 450 kc, 5, 15 and 30 mc for ratings through 10 kw and 450 kc, 2 and 10 mc for 20 kw and higher.

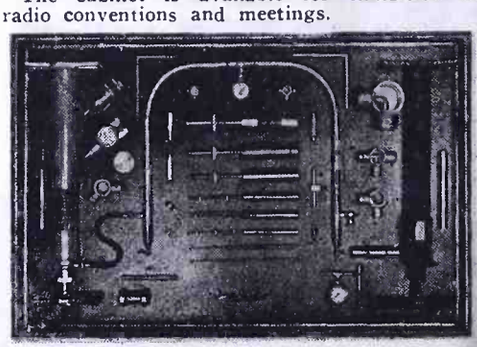
Single-phase, full-wave mercury-vapor rectifiers provide the anode current for generators under 10 kilowatts. For capacities of 10 kilowatts and larger, a three-phase, full-wave rectifier, utilizing six mercury-vapor tubes is used. Time-delay switches are standard on all rectifiers. Step starters are used in the 20-kw capacity unit and larger types.

* * *

ANDREW U-H-F DISPLAY CABINET

A display cabinet with a collection of coaxial-transmission lines of various diameters with some of the commonly used connectors, junction boxes and terminals, two dry-air pumps (all-purpose and a military model) has been prepared by the Andrew Co., 363 East 75th Street, Chicago 19, Illinois.

The cabinet is available for exhibition at radio conventions and meetings.



* * *

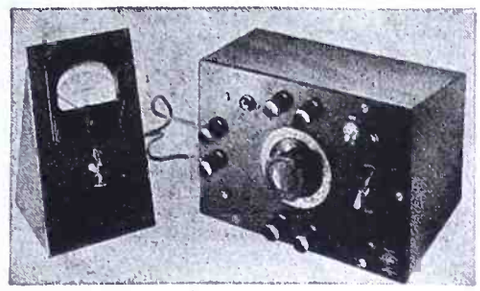
DIRECT READING COMPARISON BRIDGE

For production tests of resistors, capacitors or

inductors, Industrial Instruments, Inc., 17 Pollock Ave., Jersey City, N. J., have developed a direct-indicating comparison bridge.

This production-test instrument, type LB, is an a-c slidewire bridge with a vacuum-tube null indicator. Ranges are: capacitance, between .0001 and 1.0 mfd; resistance, between 2000 ohms and 20 megohms; inductance, between 5 and 50,000 mh. The slidewire is uncalibrated; external standards are used. Limits may be set with any combination of high or low value, such as minus 6% plus 14%.

The instrument comprises the main unit with separate meter on stand, the former measuring 7"x8"x5½". Net weight, 6 lbs.



• • •

WESTINGHOUSE SPOT WELDING TIMER

A welding timer with heat control for timing intervals of one-half cycle or less, suitable for welding small objects of high conductivity such as aluminum or copper, has been announced by Westinghouse Electric and Manufacturing Company.

The timer, SP-18, is designed for welding of such items as radio tube parts and sockets, pig-tail resistors to terminal lugs, watch and instrument parts, contact tips on electrical relays and other small parts. It is furnished as a separate control for use with existing small bench welders and also in combination with a small welding transformer. A thyratron is used to rectify a-c to charge a firing capacitor and also fire the small ignitron power tube. Heat control is accomplished by a phase shift method, the adjustment dial for which is mounted on the cabinet door.

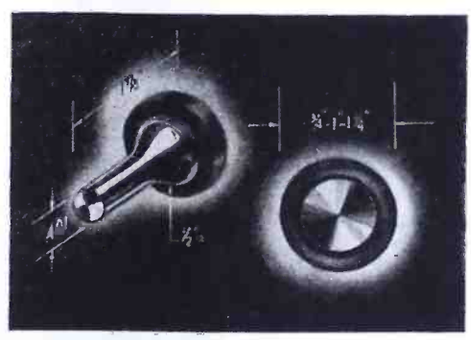
Rated at 230/460 volts, 50/60 cycles.

• • •

EMERSON RIVET SET

A flush rivet set, Double EE Saf-T-Set, that is said to permit driving of rivets with one hand and installing of next rivet with other hand, has been announced by The Emerson Engineering Co., 1418 South Flower Street, Los Angeles 15, California. The flush rivet set includes a protective rubber ring slightly higher than the driving surface which acts as a guard.

The rivet set face is very slightly crowned and highly polished. The set is available with various face and shank diameters.



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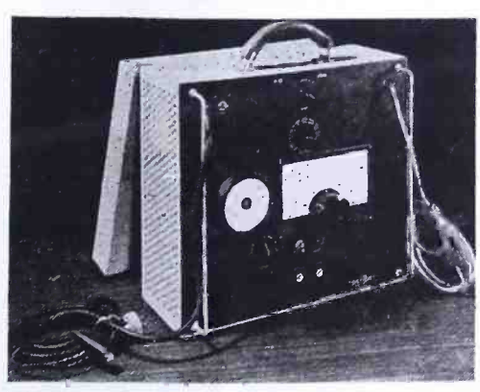
TRANSMISSION MEASURING SET



Western Electric's unit for measuring transmission gain or loss; said to be capable of measuring levels up to 150 kc.

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FEDERAL TELEPHONE & RADIO CORP. 8, 9
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A. W. FRANKLIN MFG. CO. 50
Agency: Sam J. Gallay

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Agency: H. W. Fairfax Agency, Inc.
GENERAL RADIO CO. ..... Inside Back Cover
GOAT METAL STAMPINGS, INC. 97
Agency: Lewis Adv. Agency
GOTHARD MFG. CO. 84
Agency: Merchandising Advertisers
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Agency: Burton Browne, Advertising
HARVEY RADIO CO. 74
Agency: Shappe-Wilkes, Inc.
HAMMARLUND MFG. CO., INC. 32
Agency: Roeding & Arnold, Inc.
HARVEY RADIO LABS. 16
Agency: Walter B. Snow & Staff
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Agency: L. C. Cole, Advertising
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Agency: Turner Adv. Agency
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HOWARD MFG. CORP. 64
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Agency: Terrill Belknap Marsh Associates
LEWYT CORPORATION 7
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LITTELFUSE, INC. 95
Agency: Merrill Symonds, Advertising

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Agency: Shappe-Wilkes, Inc.
MACHLETT LABORATORIES, INC. 31
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THE MAGNAVOX CO. 91
MEASUREMENTS CORPORATION 94
Agency: Frederick Smith
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Agency: Ross Llewellyn, Inc.
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PREMAX PRODUCTS DIV. CHISHOLM-RYDER CO., INC. 93
Agency: Norton Adv. Service
PRESTO RECORDING CORP. 17
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Agency: Kenyon & Eckhardt, Inc.
RADIO RECEPTOR CO., INC. 39
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FOR VOLTAGE CONTROL

170 va

2000 va

7000 va

THE VARIAC . . . the *original* continuously adjustable, manually operated a-c voltage control . . . has these features:

- **SMOOTH CONTROL** — The VARIAC may be set to supply any predetermined output voltage with absolutely stepless variation.
- **HIGH EFFICIENCY** — Exceptionally low losses both at no load and at full load.
- **HIGH OUTPUT VOLTAGES** — VARIACS supply output voltages 17% higher than line voltage.
- **LINEAR OUTPUT VOLTAGE** — Output voltages are continuously adjustable from ZERO by means of a 320 degree rotation of the knob.
- **SMALL SIZE** — VARIACS are smaller than any other voltage control of equal power rating.
- **CALIBRATED DIALS** — VARIACS are supplied with reversible dials which read directly in output voltage both from zero to line voltage and from zero to 17% above line voltage.
- **ADVANCED MECHANICAL DESIGN** — Rugged construction; no delicate parts or wires; two or more units may be ganged on the same shaft for multi-phase operation.

VARIACS are stocked in nine models with power ratings from 170 va to 7000 va; prices range between $10.00 and $100.00.

Because all of our facilities are devoted to war projects, VARIACS are available at present only for War work; all orders must have a priority rating.

VARIACS are made *only* by General Radio

GR

GENERAL RADIO CO. Cambridge 39, Mass.
NEW YORK CHICAGO
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- **WRITE FOR BULLETIN 888**

HERMETIC SOLDER-SEALING

MAKES **PRESTITE**

TERMINAL BUSHING

Leakage-proof

ACTUAL SIZE

High altitudes . . . humidity condensation . . . thermal shocks . . . cannot affect the performance of Solder-Sealed apparatus. The 100% hermetic bond assured by the metal-to-PRESTITE seal assures trouble-free service of terminal bushings.

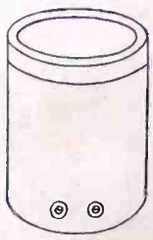
The bushing consists of a PRESTITE tube on which are Solder-Sealed a terminal cap and a stud. Similar bushings are available without hardware for Solder-Sealing to other parts on the manufacturer's own production line.

Solder-Sealed PRESTITE assemblies offer immediate help to manufacturers in many available standard forms. They also open up many new and added possibilities in postwar uses. For complete information, send for booklet B-3244. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

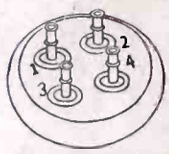
J-05142

Westinghouse Solder-Sealed PRESTITE Terminal Bushing, S # 1309164.

Other PRESTITE methods of taking leads through partitions



APPARATUS ENCLOSING SOLDER-SEAL BUSHING—combination insulator, cover and terminal board—has a hollow construction which permits placing small devices inside.



SOLDER-SEAL ASSEMBLY—for vibrator packs, but can be used in similar apparatus, combining jack and terminal board.

SOLDER-SEALED BUSHING—for use with thicker gage covers of larger size transformers and capacitors. Bushing is Solder-Sealed to a metal ring which is soldered to the container cover.

PRESTITE is a dense nonporous ceramic compacted under high pressure and vacuum by the patented PRESTITE method of manufacture. This eliminates minute air pockets in the material, thus minimizing distortion in voltage gradients and eliminating internal corona discharges. PRESTITE is impervious to moisture and all chemicals except hydrofluoric acid. The quality of PRESTITE is consistently uniform, thus eliminating the need for the exaggerated safety factors common in other ceramics.

Westinghouse

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IIPERSIL CORES

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