ELECTRONIC INDUSTRIES

★ Training Pilots for Map-Course Flying ★ Newest Radio Allocations

★ Modern Methods in U.S. Shipbuilding Program

★ Doing Business with the Army Signal Corps

FEBRUARY

PRACTICAL HELP

FOR KNOTTY PROBLEMS THAT NEED QUICK ANSWERS

Your Questions on— Electrical Contacts Resistance Welding Current Rectification Electronic Components

Mallory has condensed "know-how" in books like these to help you find practical solutions to problems involving the selection of electrical contacts, welding processes and electrodes, current rectification, AC and DC power supplies, and industrial electronic components.

With the exception of the MYE Technical Manual, which is priced at $2.00, these books are yours for the asking. They may help break a development bottleneck, improve a product or process, and lower costs. Write us.

P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
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P. R. MALLORY & CO. Inc.
MALLORY
APPROVED
PRECISION PRODUCTS

"ELECTRICAL CONTACTS"

Complete, concise presentation of contact material data in convenient and readily usable form. Contact design is authoritatively covered as an indispensable factor for consideration. Also reviewed are facings, inlays, spring materials and general availabilities.

"RESISTANCE WELDING"

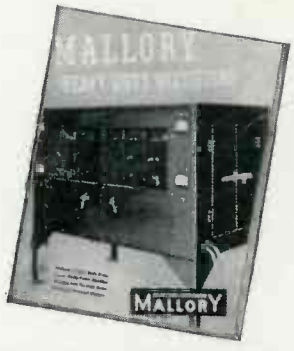
A 78-page book, treating subjects of spot, projection, roller seam, and butt and flash-butt welding, as well as properties and characteristics of various welded metals. Miscellaneous tables and application data on Mallory alloys are included.

"MYE TECHNICAL MANUAL"

A 408-page, hard-bound book with complete data on capacitors, noise suppression, receiving tubes, loudspeakers, television, frequency modulation, vibrators, phono-radios, automatic tuning, and other useful information. Priced at $2.00 per copy, net.

"APPROVED PRECISION PRODUCTS"

Descriptions, prices and specifications on potentiometers, rheostats, station selector and special switches, phone jacks and plugs, dial light assemblies, cable connecting devices, resistors, condensers, vibrators, rectifiers and battery chargers.

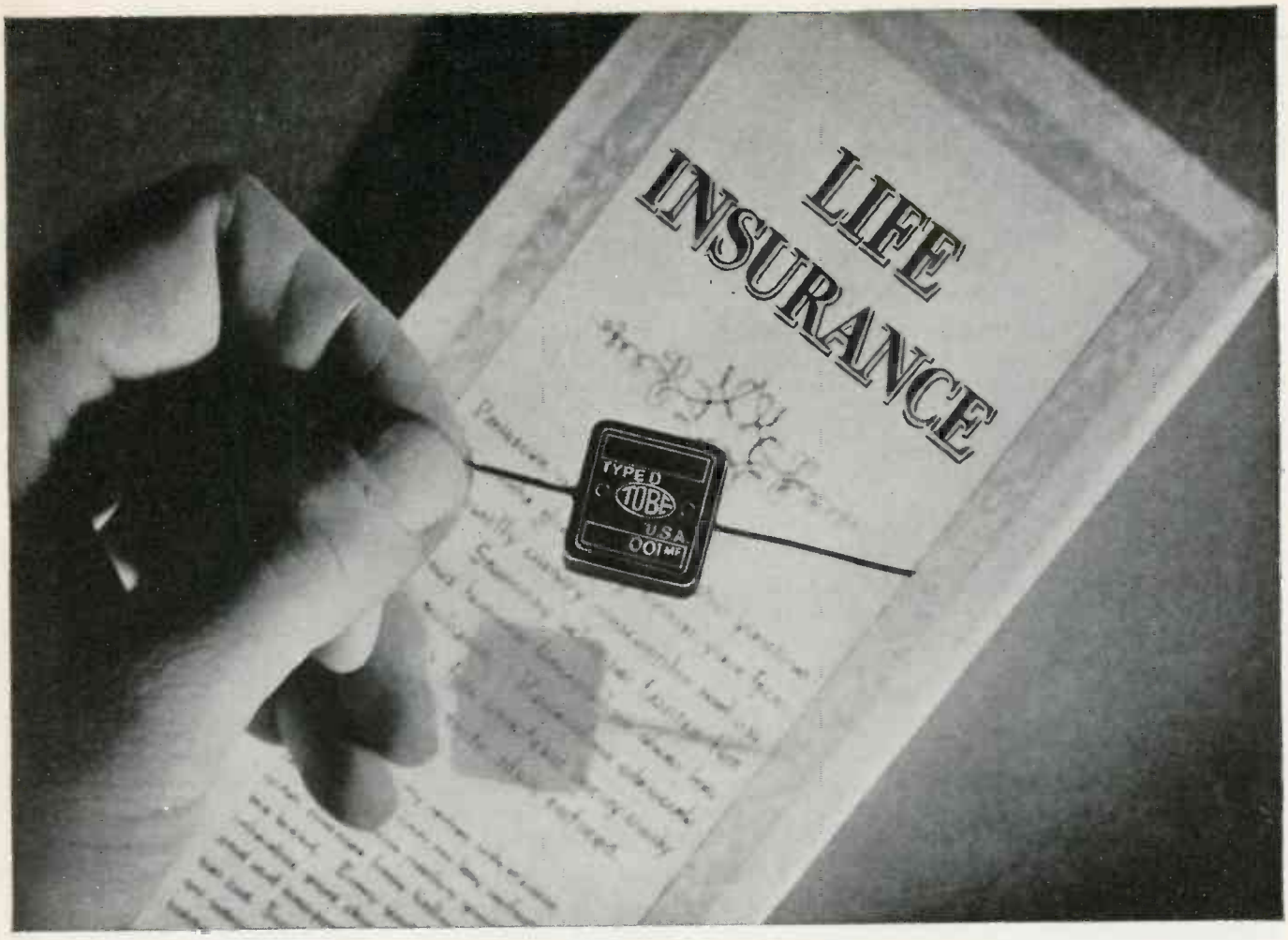


"HEAVY-DUTY RECTIFIERS"

General description of rectifiers in conjunction with advantages, applications, fundamentals of designing a power supply, special rectifier calculations. Supplemented with line drawings, charts and tables for easy understanding.

"VIBRAPACKS"

Complete information on vibrator power supplies for operating radio receivers, transmitters, public address amplifiers, direction finders and other apparatus where a source of commercial alternating current is not available.



OFFERING LONG LIFE INSURANCE!

To make a capacitor with long life expectancy, every step of manufacture from winding to impregnating must be meticulously supervised—rigid inspection must be standard procedure—electrical ratings must lean far to the conservative side.

By following these principles, Tobe offers you capacitors that are, in a sense, protected by our special form of "long life insurance." The soundness of this procedure is being proved every day by the virtually complete *absence* of "returns", i.e. condensers that *didn't* live.

Type DP Molded Paper Capacitor illustrated above is the first oil-impregnated condenser to be found physically and electrically interchangeable with the majority of mica capacitors used in the by-pass and coupling circuits of radio and radar equipment. We cannot fill new orders immediately, but early requests for samples will be given priority.

SPECIFICATIONS—TYPE DP CAPACITOR

CAPACITANCE	.001 to .01 mfd.
WORKING VOLTAGE	600 volts DC—flash test 1800 volts DC
SHUNT RESISTANCE	At 185° F.— 1000 megohms or greater
	At 72° F.—50000 megohms or greater
WORKING TEMPERATURE RANGE	Minus 50° F. to plus 185° F.
OPERATING FREQUENCY RANGE	Upper limit 40 megacycles
	Q at one megacycle—25 or better
POWER FACTOR	At 1000 cycles—.005 to .006

These capacitors meet Army and Navy requirements for immersion seal.

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

Special Assembly Method — *showing single metal washer which facilitates protective coating against corrosion*

Standard Assembly Method—*showing conventional petal-shaped brass contact washer*

Now I. T. & T. Selenium Rectifiers—in addition to the standard assembly—can be supplied with a special assembly, coated for protection against the corrosive action of salt spray, moisture and humidity.

This means that I. T. & T. Selenium Rectifiers, noted for trouble-free conversion of A.C. to D.C., can now be used under the extreme conditions of marine and other high-humidity service.

Compact, light in weight and electrically and mechanically stable—with no moving parts to wear out or cause failure—I. T. & T. Selenium Rectifiers are ready to tackle even tougher jobs than they have done in the past.

Consulting Engineering services available for specific requirements. For descriptive bulletins address Department F

IT&T Selenium RECTIFIERS

SELENIUM RECTIFIER DIVISION

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

1000 Passaic Ave.
East Newark, New Jersey

His Dreams Came True

JULES VERNE'S dreams had a way of coming true. Such are the dreams that make Electronics a word to conjure postwar visions today.

Wartime applications of electronic devices had advanced the science far beyond the late days of television. Recently a lay research organization surveyed the field of electronics and listed more than 200 important uses, ranging from laborsaving devices in industry to sixth-sense military methods of seeking out the enemy. But the report was qualified as "just a few widely scattered dabs at the present picture of electronics."

Since the first days of radio, Sylvania has worked at making electronic dreams come true in the laboratory and factory. Having established a reputation for quality radio tubes, Sylvania was an early pioneer and patent-holder in the field of electronics. After ten years of research, Sylvania was ready for war with a cathode ray tube, one of the latest devices of its kind.

SERVING INDUSTRY TODAY

Sylvania electronic tubes of many types are being proved in the hard school of war. Finer electronic tubes, with applications limited only by the human imagination, will be available in mass-production quantities to help you make Jules Verne dreams of the electronic future come true.

RADIO TUBE DIVISION

SYLVANIA ELECTRIC PRODUCTS INC.

FORMERLY HYGRADE-SYLVANIA CORPORATION
Emporium, Pa.

Incandescent Lamps, Fluorescent Lamps and Fixtures, Radio Tubes, Electronic Devices

ELECTRONIC INDUSTRIES

FEBRUARY 1943

In this Issue

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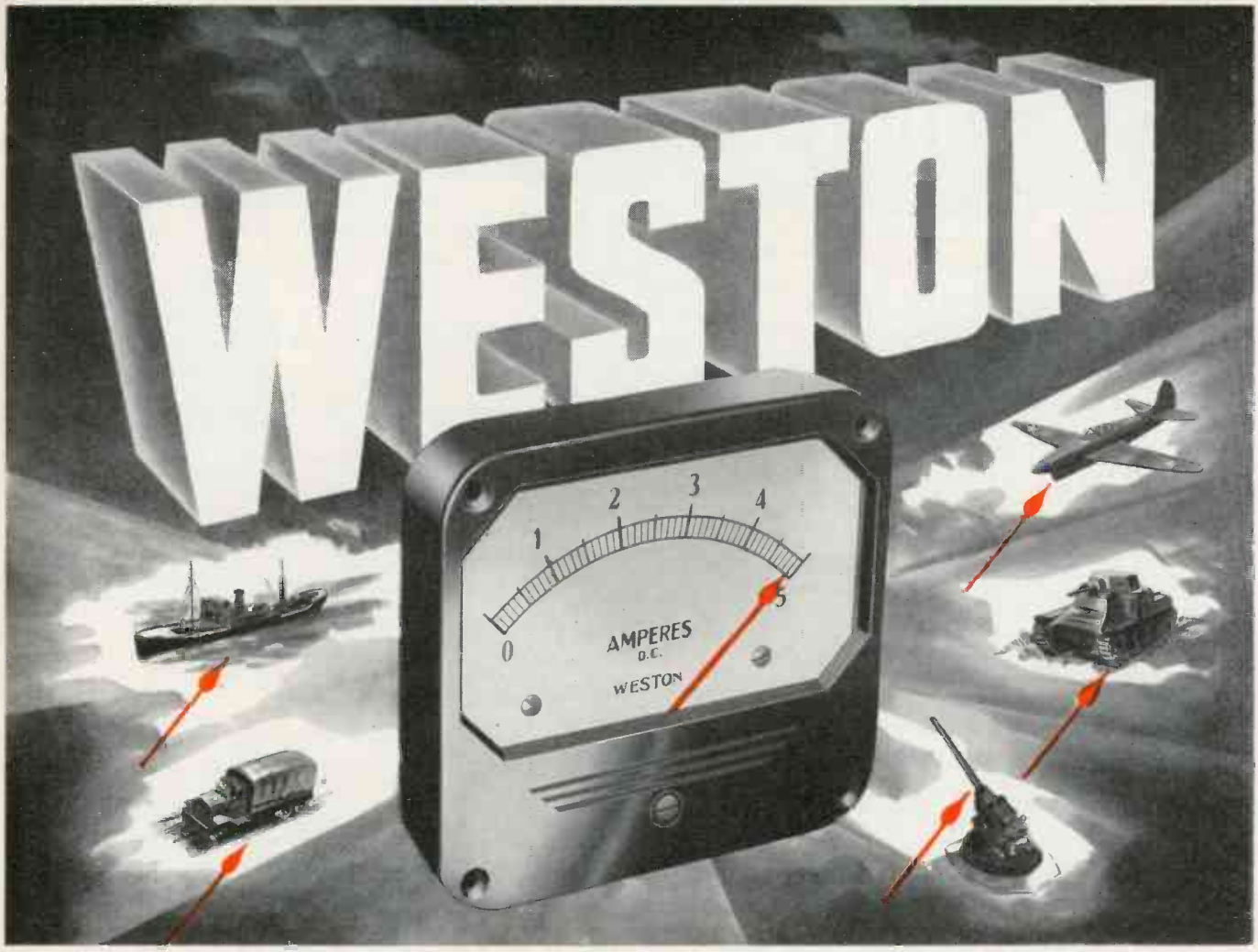


Doing the same fundamental Job in 1943 but so much more of it!

ARMY E NAVY

Most manufacturers engaged in war production are working on products foreign to their normal efforts. But it's a different story here at WESTON. We have exactly the same job to do because our job is *so fundamental;* but there's much more, *so much more of it.* For precise measurement is vital to the efficient functioning of equipment in *all* branches of a highly mechanized war machine. And while measurement fundamentals have not changed, the universal preference for instruments the way WESTON builds them *has not changed either.*

So WESTON'S job, as we enter the New Year, still remains the job of striving to keep abreast of the country's unprecedented and critical instrument needs. Production has been increased many fold through expanded and scattered manufacturing facilities. And the curve *continues* upward. But never to the point where we must relinquish, *one bit,* our quality standards — 'else some pilot's safety might be *less* secure . . . a ship's reckoning *less* accurate . . . a critical power plant *less* efficient.

But achieve the production goal *we will;* without jeopardizing quality . . . without interrupting our continuing development program now focused on instruments to help speed victory. And in accomplishing this goal, we will have equipped ourselves to serve *even better* the new and increased instrument needs of the future . . . the needs of American industry at peace. Weston Electrical Instrument Corporation, 597 Frelinghuysen Avenue, Newark, New Jersey.

Laboratory Standards . . . Precision DC and AC Portables . . . Instrument Transformers . . . Sensitive Relays . . . DC, AC, and Thermo Switchboard and Panel Instruments.

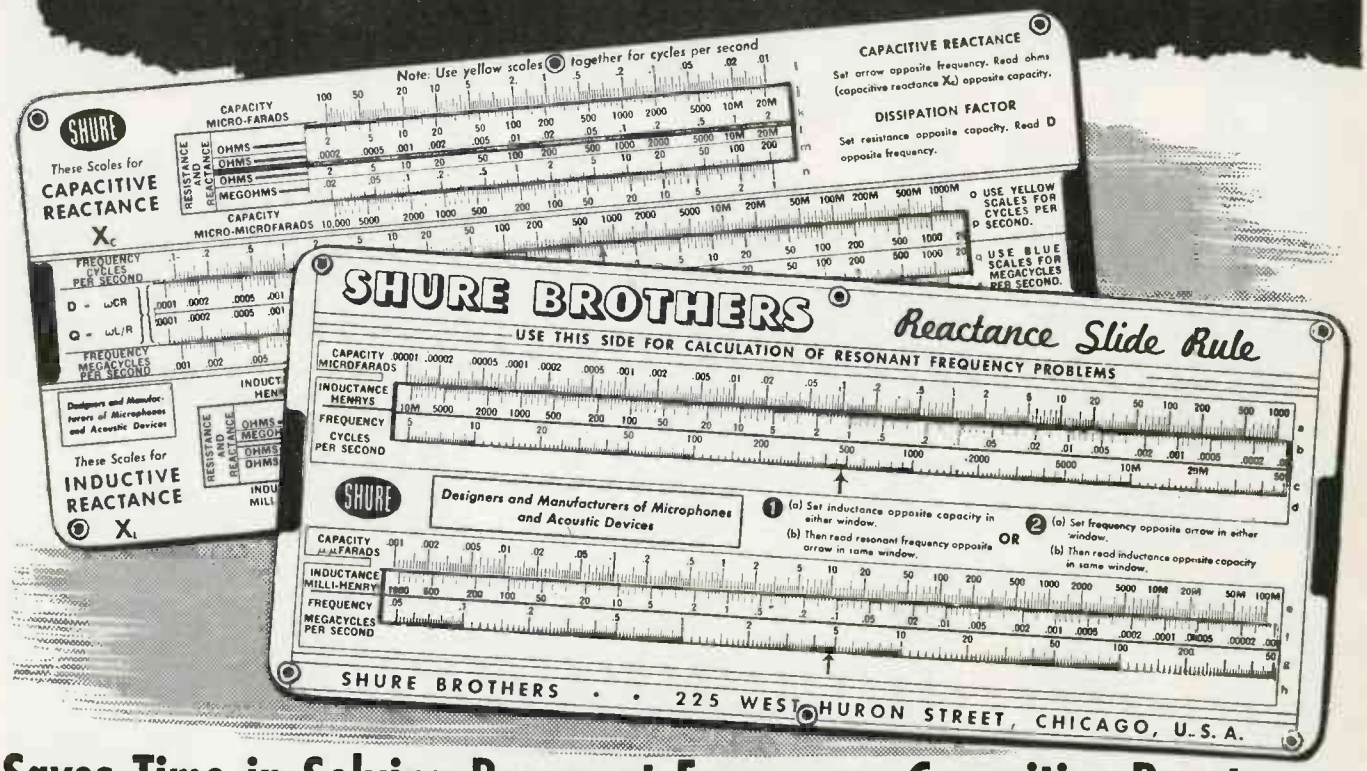
WESTON

Specialized Test Equipment . . . Light Measurement and Control Devices . . . Exposure Meters . . . Aircraft Instruments . . . Electric Tachometers . . . Dial Thermometers.

FOR OVER 54 YEARS LEADERS IN ELECTRICAL MEASURING INSTRUMENTS

Engineers • Technicians • Teachers • Students Send for this

NEW SHURE REACTANCE SLIDE RULE

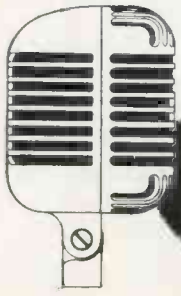


Saves Time in Solving Resonant Frequency, Capacitive Reactance, Inductive Reactance, Coil "Q" and Dissipation Factor Problems

Here's how it works

FRONT	EQUATION	SOLVES	RANGE
Resonant Frequency problems	$\omega^2 LC = 1$	1. Resonant Frequency if L and C are known 2. Various L and C values for desired resonant frequency	**Frequency** 5 cycles to 500 megacycles **Capacitance** .001 mmf. to 1,000 mf. **Inductance** .00001 mh. to 10,000 henrys
BACK Reactance problems	$X_L = 2\pi fL$ $X_C = \frac{1}{2\pi fC}$ $Q = \frac{2\pi fL}{R}$ $D = 2\pi fCR$	Any single unknown variable, providing remaining variables are known in equations for Inductive Reactance, Capacitive Reactance, Coil "Q", Dissipation Factor	**Frequency** 0.1 cycle to 10,000 megacycles **Capacitance** 1 mmf. to 100 mf. **Inductance** .001 mh. to 100 henrys

Write Shure Brothers, Dept. 174K, 225 W. Huron, Chicago, U.S.A. Sending 10c in Coin or Stamps to cover cost of handling and mailing



SHURE

Shure Brothers, designers and manufacturers of Microphones and Acoustic Devices, are supplying our Armed Forces and our Allies with rugged military microphones for duty on land, on the sea, and in the air. However, you can still obtain our standard line of microphones for vital civilian needs. See your local radio parts distributor—or write for catalog 154K.

AT SUB-ZERO TEMPERATURES

the INCO Nickel Alloys gain strength without becoming brittle

MECHANICAL PROPERTIES AT LOW TEMPERATURES

MATERIAL	Condition	Temperature °F.	Yield Strength (0.20% offset) psi.	Tensile Strength psi.	Elongation in 2 in. per cent	Reduction of Area per cent	Hardness Rockwell C	Charpy Impact Strength ft.—lb.
MONEL	Cold-drawn	Room	93,700	103,800	19.0	71.0	19	181
		—110	100,850	117,450	21.8	70.2	25	178
"K" MONEL	Cold-drawn Age-hardened	Room	125,900	157,300	15.5	37.4	33	27
		—110	134,600	171,550	17.3	41.1	36	27
INCONEL	Annealed	Room	36,800	93,800	37.3	64.1	82B	130
		—110	42,400	106,450	39.8	64.0	87B	134
	Cold-drawn*	Room	147,700	152,100	7.0	49.3	31	54
		—110	154,900	163,900	9.8	51.2	36	60
NICKEL	Cold-drawn	Room	97,400	103,400	16.3	66.9	19	204
		—110	101,800	112,300	21.5	60.9	22	215

* 50 per cent reduction in cross-sectional area by cold drawing.

Selecting the right metal for a given application is today more important than ever.

How drastically the possibilities narrow down is exemplified by *sub-zero* requirements.

At sub-zero temperatures, for example, most ferrous metals become brittle as their strength increases. INCO Nickel Alloys also increase in strength and hardness...but they retain room-temperature ductility and toughness as measured by Charpy impact tests (see table above).

Even at the —328° F. encountered in liquid air compressors, the INCO Nickel Alloys show no appreciable changes in elongation, reduction of area or hardness.

Also, "K" Monel retains another important property, non-magnetism... magnetic transformation point of this age-hardened alloy being —150° F.

A new technical insert, "Mechanical Properties at Low Temperatures" and the booklet "Individualized INCO Nickel Alloys" offer useful information. For copies of each write to:

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

Combat Line

MEASURING INSTRUMENTS

in Review

A Glimpse into the Future

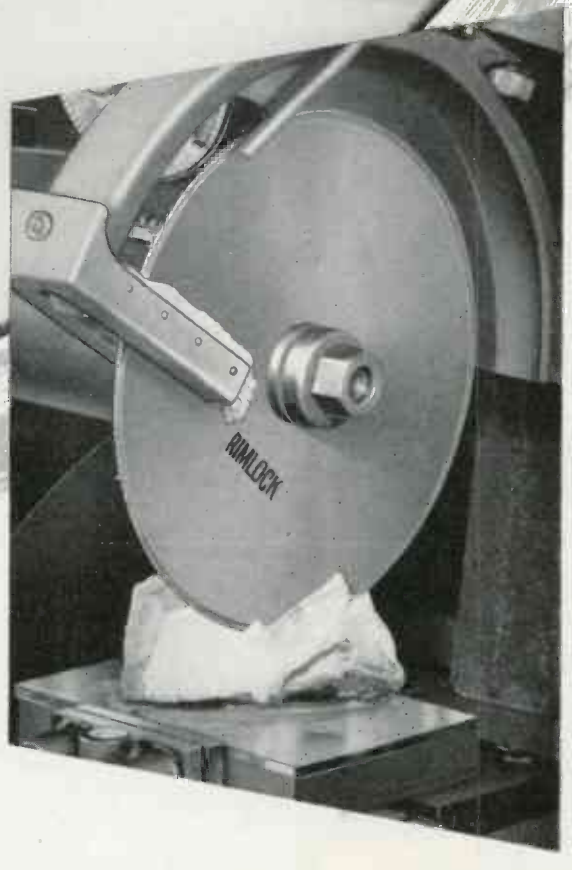
Out of the needs of war; out of tripled production lines and twenty-four hour days; out of the drive for "better performance under spectacular stress and vibration," comes Triplett precision instruments in volumes impossible by now outmoded peacetime methods. Today our country's needs come first—Tomorrow when America again takes up peacetime pursuits, the values of these experiences will be apparent, in savings, in performance, in technical superiority beyond the concepts of yesterday.

LUFFTON, OHIO ★ ★ ★ ★

TRIPLETT

ZIP IN EVERY BLADE

FELKER DI-MET
TRADE MARK REG. U.S. PATENT OFFICE
RIMLOCK



DI-MET Rimlocks

More Speed • More Life • More Production

For All Methods of Quartz Cutting

WHETHER you use fast through-cutting or the more precise down-feed Rimlocks can speed up your operations! These Di-Met Diamond Abrasive Wheels need no coaxing on quartz, Steatite, or other hard, brittle materials because they're designed for speed. The exclusive Rimlock bonding method anchors the diamonds solidly—yet without additional fracturing, and points the diamonds radially so that their sharpest cutting edges do the work. Graded diamonds and high operating speeds produce excellent, smooth surfaces.

Rimlocks are long lived cutters, too—over 700 quartz wafers, averaging 4 sq. inches of surface area each, have been cut with a single blade.

Let Rimlocks prove their superiority in your own quartz cutting operations. Available in many sizes and in two bonds—steel and copper. Write for our new bulletin.

FELKER MANUFACTURING COMPANY

1114 BROAD STREET, TORRANCE • CALIFORNIA

FELKER DI-MET

MANUFACTURERS OF DIAMOND ABRASIVE WHEELS

INTELLIGIBILITY

Built to Civil Aeronautics Administration specifications, CAA-515, the Electro-Voice Model 7-A microphone is widely used for airport landing control and is highly suitable for many other sound pick-up applications.

The smooth frequency curve, rising with frequency, gives extremely high intelligibility even under adverse conditions. Desk mounting incorporates easily accessible switch which can be operated by thumb of either right or left hand. Microphone may be moved without danger of pressing this switch.

SPECIFICATIONS

SWITCH: Push-to-talk Acro-switch, SPDT, for relay operation; positive action; slight pressure required for actuation; 1/16" over-travel; connections terminate on terminal strip in base.

OUTPUT IMPEDANCE: 25 ohms.

CABLE: Eight feet, 4 conductor, shielded, overall rubber jacket, equipped with MC4M connector.

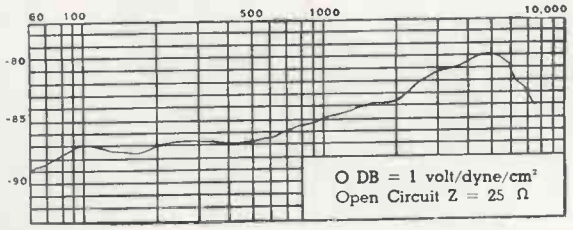
DISTORTION: Not exceeding 5% for sinusoidal sound waves from any direction from 100-4000 cps, up to 50 dynes/cm^2.

INSULATION: Leads from the moving coil are insulated from the microphone housing and stand, and are capable of withstanding 500 volts RMS, 60 cps.

STAND TUBE: Wear resistant, 1/8" XXM bakelite.

CORROSION RESISTANCE: The entire microphone is completely inhibited against corrosion and will successfully withstand a 20% salt spray atmosphere for 100 hours at 95° F.

NET WEIGHT: 3½ lbs.; Shipping wt.: 5 lbs.



This Model 7-A Desk Mounting Communication Microphone supersedes our previous Model S-7. Our Engineering Department may be able to assist you with your microphone problem. *Electro-Voice Manufacturing Co., Inc., 1239 South Bend Avenue, South Bend, Indiana. Export Division: 100 Varick Street, New York, N. Y., U. S. A. — Cable Address: "Arlab"*

Electro-Voice MICROPHONES

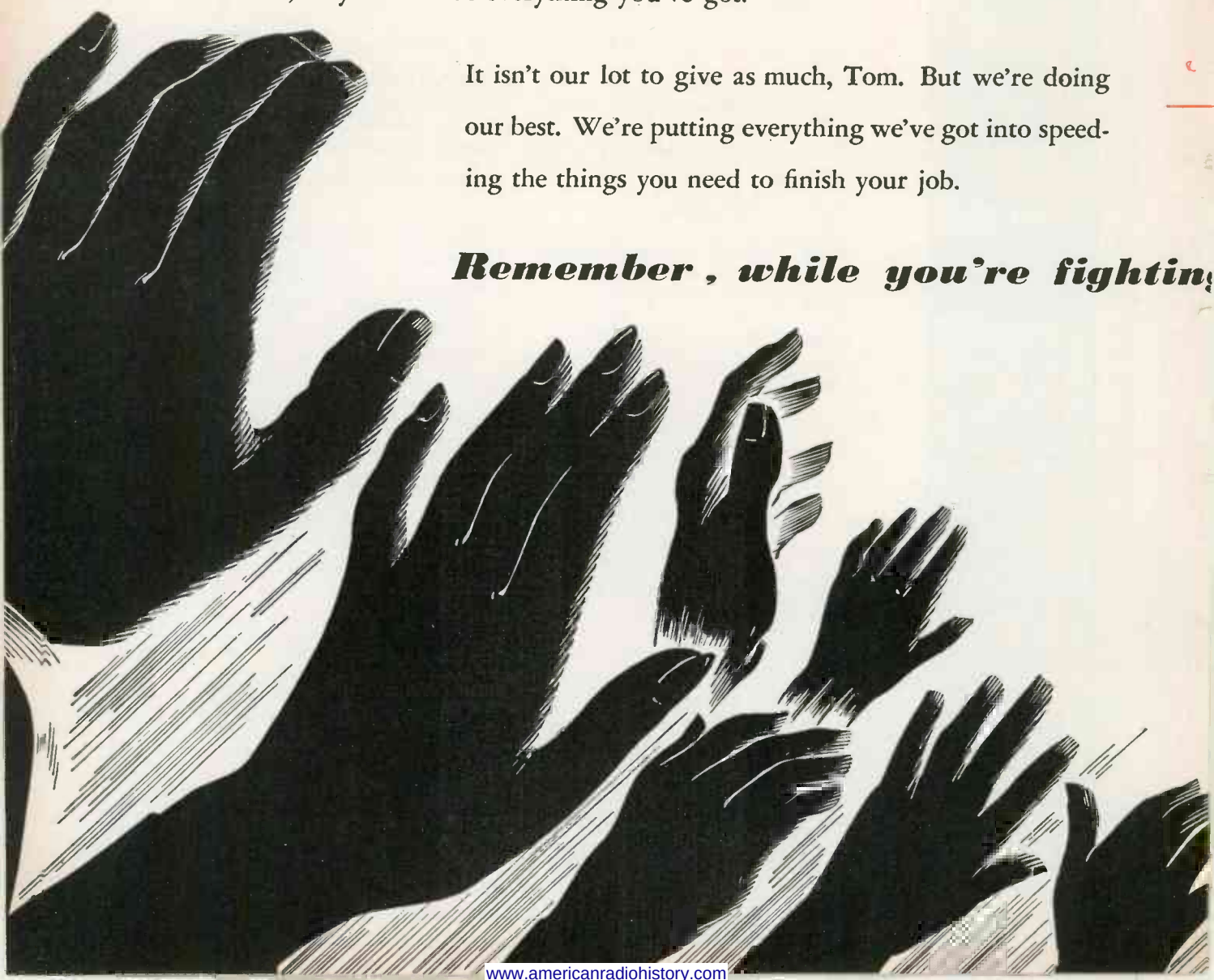
See You Soon, Tom!

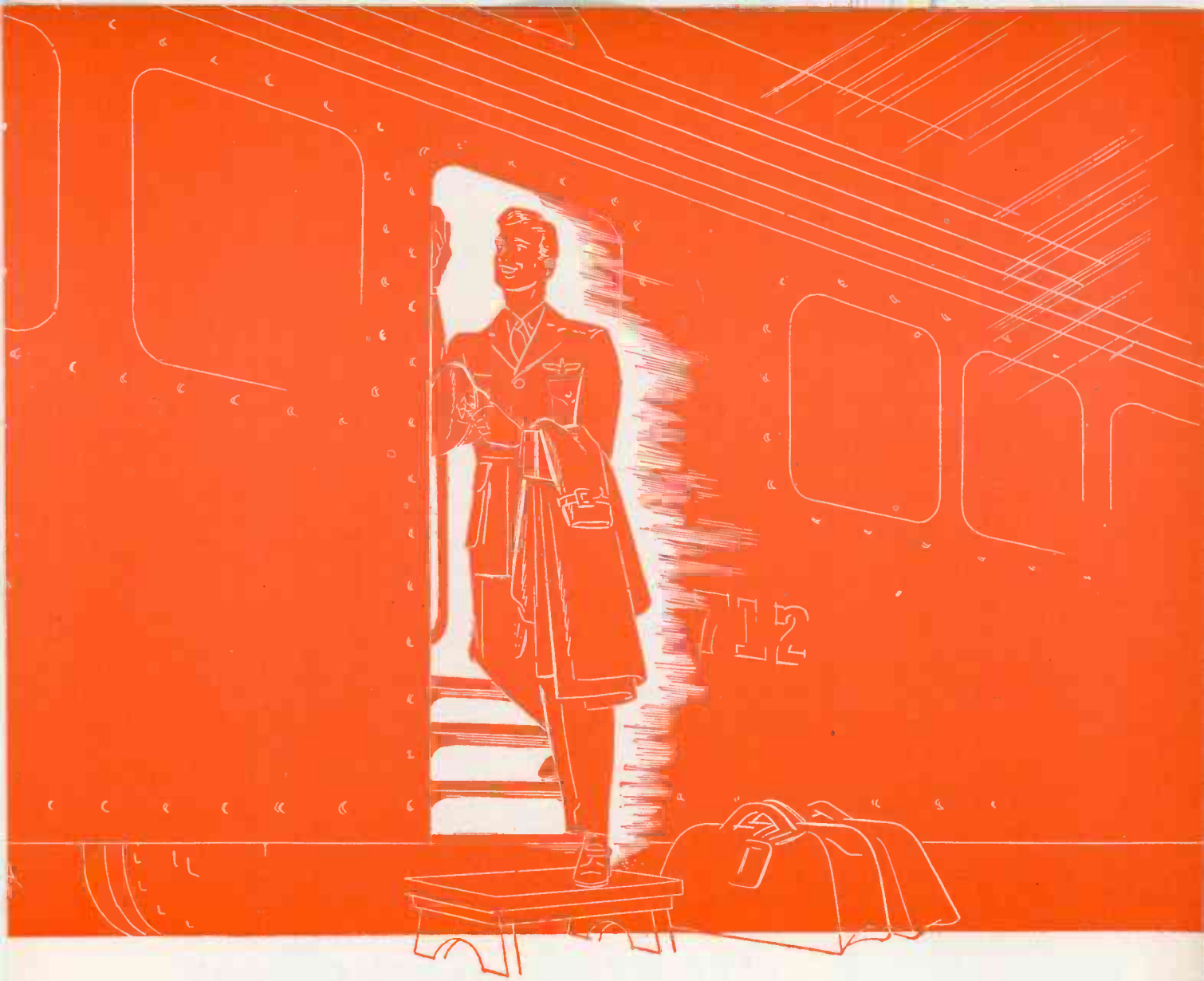
We don't know where you're going, Tom. We don't know when you'll be back. But it's got to be soon!

We know what you're giving up. Your swell job at the plant, your picnics with Jane, the workshop in your basement, your quiet dreams of the future. Your life, maybe. That's everything you've got.

It isn't our lot to give as much, Tom. But we're doing our best. We're putting everything we've got into speeding the things you need to finish your job.

Remember, while you're fightin





we're fighting, too!

Thinking about Tom—the hundreds of Toms who waved goodbye at American Lava and went to war—makes our seconds precious. So we work around the clock, create startling improvements in AlSiMag steatite ceramic insulation, devote ourselves exclusively to winning the War. In the process, we continually find ourselves saying "no" to the urgent needs of old friends who have bought our products for four decades or more. We regret that. Today, we answer the greater need.

ARMY E NAVY

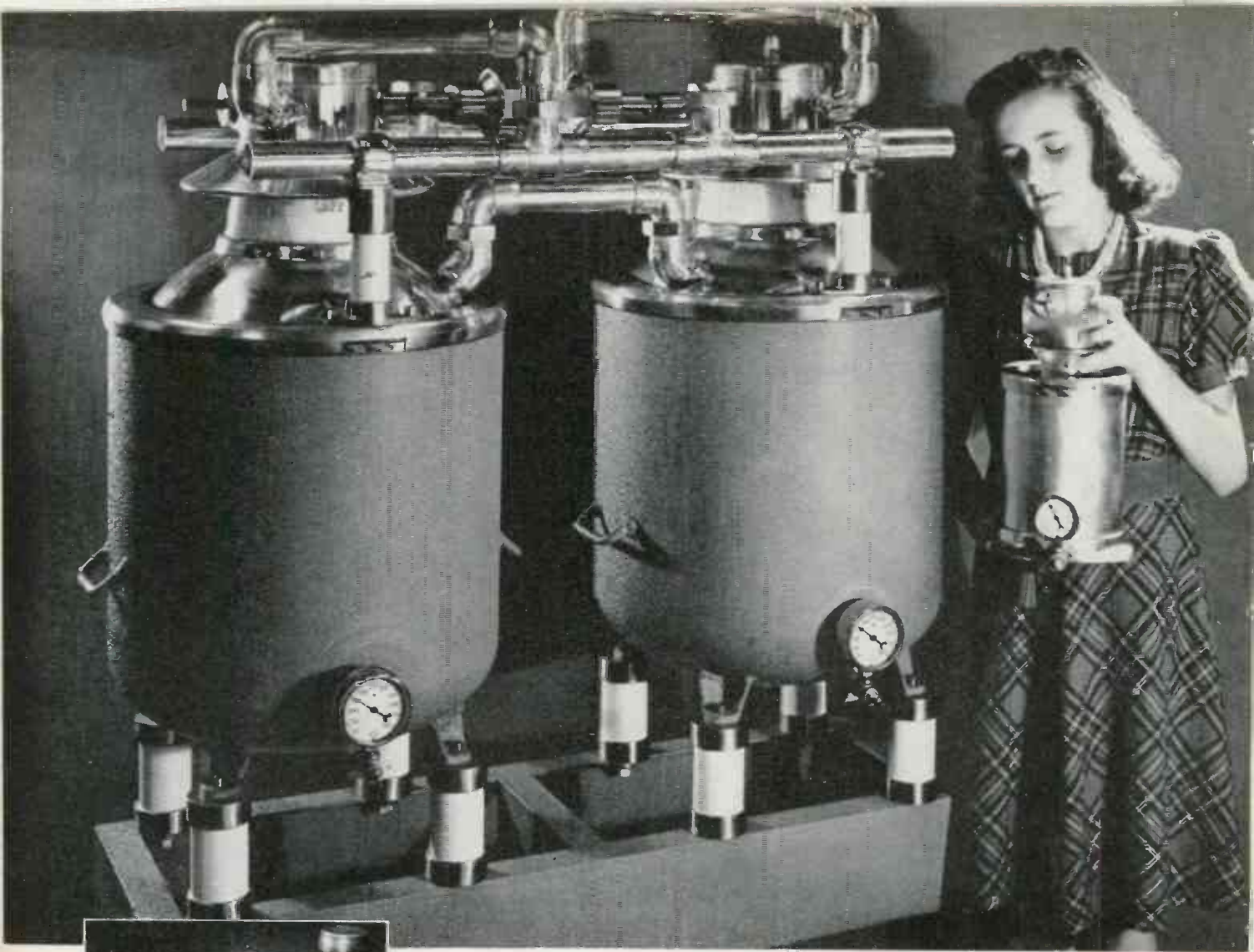
The ALCO plant was on the first list of 43 awards for excellence in quality and quantity of war production.

AlSiMag

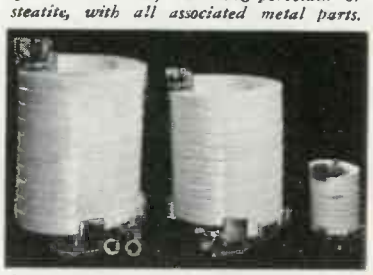
TRADE MARK REGISTERED U. S. PATENT OFFICE

AMERICAN LAVA CORPORATION

CHATTANOOGA, TENNESSEE



Standoff, bowl, and other special-purpose insulators are available in wide range. Lapp is also equipped for production of many special assemblies, including porcelain or steatite, with all associated metal parts.



Lapp porcelain water coils, porcelain pipe and fittings provide a means for cooling high-frequency tubes, without sludging, eliminating need for water changing or cleaning.

LAPP *high-capacitance* CONDENSERS FOR INDUSTRIAL ELECTRONIC CIRCUITS

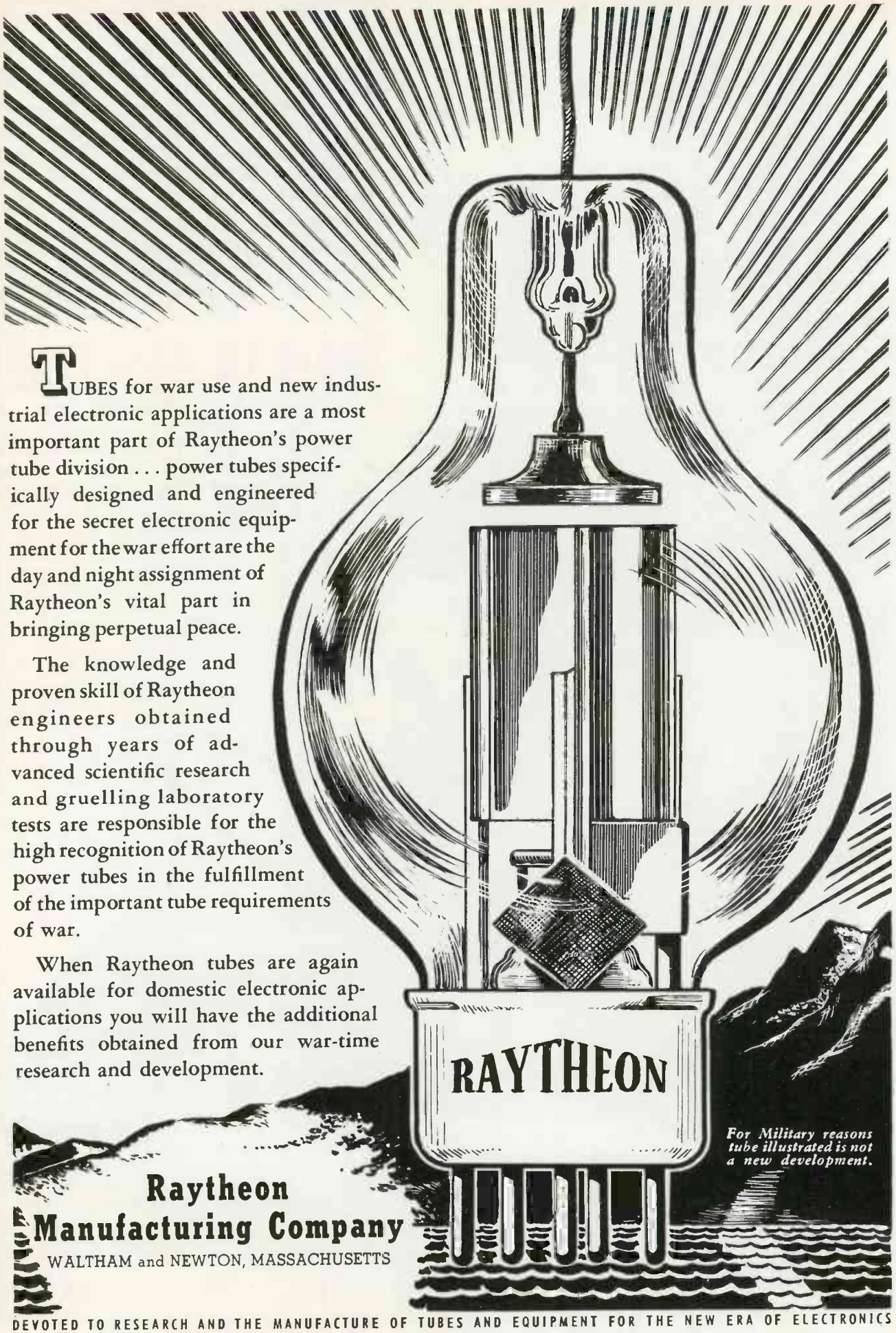
For lump capacitance in any high-frequency circuit, Lapp gas-filled condensers save space, save power, save trouble—and use no mica. Available for use at any needed voltage rating and capacitance, they operate with practically zero loss, are puncture-proof, fail-proof and constant in capacitance under temperature variation.

Above is Unit No. 26541, consisting of two No. 25934 units. The assembly provides pivoting bus conductors, arranged so that the units may be used singly, in series, or in parallel, providing capacitance continuously variable from .0022 mf. to .022 mf. Each unit is rated at 200 amp., 6500 volts, capacitance variable .0043 mf. to .011 mf.; the combination in series, 200 amp., 13,000 volts, .0022 to .0055 mf.; in parallel, 400 amp., 6500 volts, .0086 to .022 mf. In the girl's hands is Unit No. 23722, rated at 50 amp., 7500 volts, capacitance .000045 mf. to .000075 mf.

Lapp INSULATOR CO., INC.

LEROY, N. Y.

ARMY E



TUBES for war use and new industrial electronic applications are a most important part of Raytheon's power tube division . . . power tubes specifically designed and engineered for the secret electronic equipment for the war effort are the day and night assignment of Raytheon's vital part in bringing perpetual peace.

The knowledge and proven skill of Raytheon engineers obtained through years of advanced scientific research and gruelling laboratory tests are responsible for the high recognition of Raytheon's power tubes in the fulfillment of the important tube requirements of war.

When Raytheon tubes are again available for domestic electronic applications you will have the additional benefits obtained from our war-time research and development.

For Military reasons tube illustrated is not a new development.

Raytheon Manufacturing Company

WALTHAM and NEWTON, MASSACHUSETTS

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES AND EQUIPMENT FOR THE NEW ERA OF ELECTRONICS

EVEN war can bring out much that is good.

The gauging of thin mica sheets threatened to be a production bottleneck. Fingers, highly trained by the Braille system, were called upon to replace mechanical gauges and slower vision. The fingers responded.

Today a group of blind employees at SOLAR are gauging mica quicker and more accurately than ever achieved before. They and their "seeing-eye" dogs bring unusual talents to the production front.

"HANDS THAT SEE"

SOLAR is proud to be a pioneer in drawing upon the untapped reservoir of such able employees. SOLAR "Quality Above All" is well protected by these "hands that see."

Solar

SOLAR

SOLAR MANUFACTURING CORP., BAYONNE, N. J.
Makers of Capacitors (Mica, Paper and Electrolytic)

CAPACITORS

3260

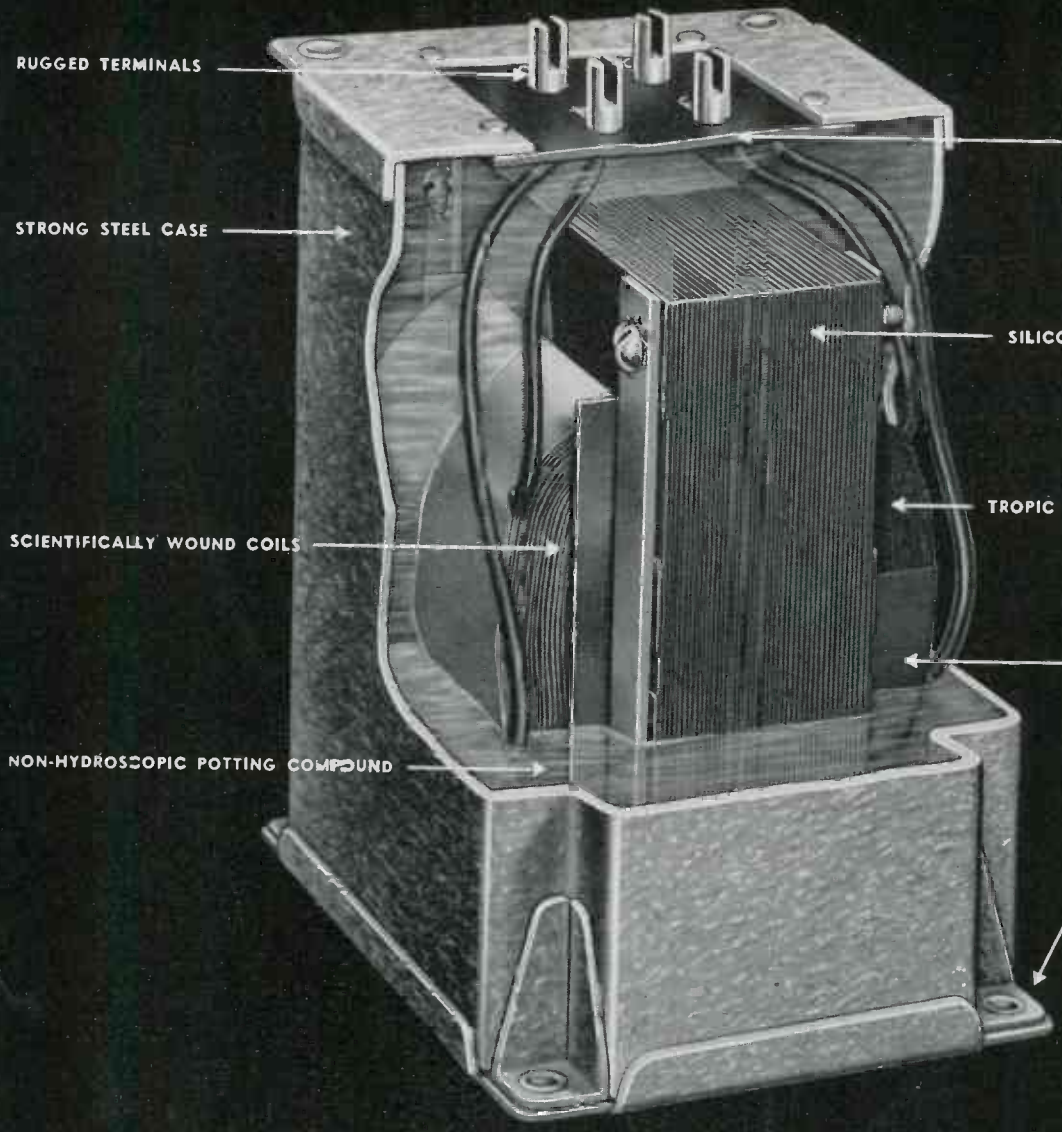
NEMA EXPANDS THE ELECTRONICS SECTION to Serve All Branches of Industry

Electronics in industry—a magic phrase and a reality of today, a magic phrase and a promise of superlative achievements tomorrow! To serve the needs of one of America's newest and fastest growing industries, the Electronics Section of the National Electrical Manufacturers Association has been reorganized and will undertake a constructive program of service to the Government, service to industry and service to the American people. Every applicable phase of the pattern of constructive organization characteristic of the operation of NEMA groups will be incorporated into the Electronics Section. Opportunities to serve the electronics industry are many and the Section plans to render every appropriate type of help within the scope of trade association activity. Its program will be (1) to aid in the realization of victory at the earliest possible time, and, (2) to aid in the development of a better world of peace in which the scientific magic of electronics in industry will be privileged to play a major role.

The following manufacturers are already in this Section and are taking active part in its operation:

Amperex Electronic Products, H. O. Boehme, Inc., Electrons, Inc., Faries Manufacturing Company, General Electric Company, Raytheon Manufacturing Company, RCA Manufacturing Company, Inc., Sylvania Electric Products, Inc., United Electronics Company, Western Electric Company, Inc., Westinghouse Electric & Manufacturing Company.

NEMA National Electrical Manufacturers Assn.



For Dependability... Stamina... Adaptability

STANCOR PROFESSIONAL SERIES TRANSFORMERS

BUILT TO MEET STRINGENT WARTIME REQUIREMENTS

THE Stancor Professional Series Transformers are the logical choice of Radio Engineers, Broadcast Engineers, Governmental Agencies, Radio Manufacturers and other equipment designers and users. They are built to meet stringent wartime requirements.

STANCOR quality assures you of sound engineering design, the finest obtainable raw materials, thorough inspections, and high standards of craftsmanship.

★ GENERAL SPECIFICATIONS ★

CASE DESIGN—
A rugged physical construction featuring reversible mounting has been combined with a smart uniform appearance.

INTERNAL MECHANICAL CONSTRUCTION—
Special brackets and/or blocks added in assembly prevent shifting of coil and core inside of case.

IMPREGNATION—
The traditional STANCOR vacuum impregnation provides thorough protection against the effects of humidity and moisture. The special compound, sealing each unit in its case, gives additional protection and adds to the long life and service obtainable from these units.

The Stancor Professional Series Catalog No. 240 lists and thoroughly describes many types of professional series transformers. Also valuable charts to help you. Request your copy today.

STANCOR

STANDARD TRANSFORMER CORPORATION
1500 NORTH HALSTED STREET • CHICAGO

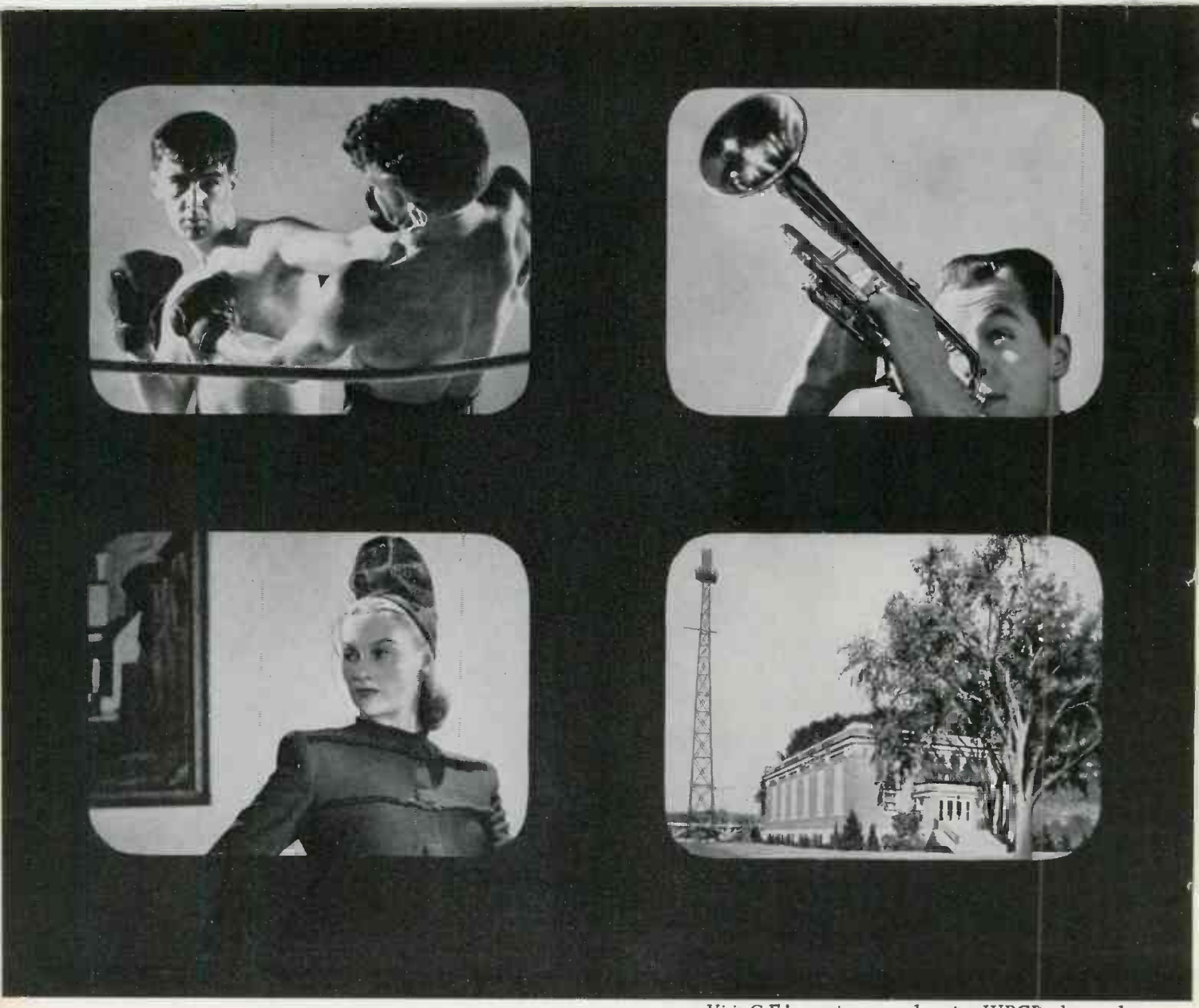
Recognize it?

This tube may be a stranger to you. But you should make its acquaintance—for it's the grand-daddy of commercial vacuum tubes!

It's the original type of telephone repeater tube—made by Western Electric—for use in Long Distance circuits. It made possible the trans-continental telephone line, opened in 1915—and showed the way to the amazing variety of vacnum tubes now used in radio telephony, in industrial and war-time applications.

Having pioneered the electronic art, it is natural that Western Electric and Bell Telephone Laboratories have remained leaders. Today—spurred on by the pressure of war—they are making startling advances.

Let your imagination be your guide to the almost limitless peacetime uses to which these new ideas in electronics may be put!



Visit G.E.'s proving-ground station WRGE, shown above

We're experimenting so you won't have to

WITHIN the limits of all-out war production, General Electric television broadcast equipment is undergoing rigid testing at G.E.'s own proving-ground Station WRGB, Schenectady. Flexibility of equipment is constantly being analyzed. Many improvements and changes are taking shape.

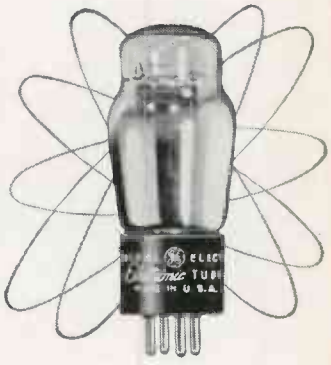
New television programming arts and skill are being studied and developed. Three times weekly live talent shows — such as boxing matches, menu planning, style shows, and operettas with full orchestral accompaniment — are being televised.

Techniques in staging, lighting, and make-up are being tried. The carefully checked results are providing a vast fund of practical experience for you to draw upon when television is again available to the broadcasting industry. This development of television at WRGB is greatly helped by a co-operative home television audience organized to criticize the programs broadcast.

And the G-E post-war television receiver for the home will come out of the same vast fund of television experience. It will be a receiver that will get the most out of the latest developments.

G-E television broadcast equipment, program experience and receivers are working together for your future television success. We are doing the experimenting so that you won't have to.

General Electric cordially invites you when in Schenectady to visit Station WRGB for a preview of your future television system. Radio, Television, and Electronics Department, General Electric, Schenectady, N. Y.

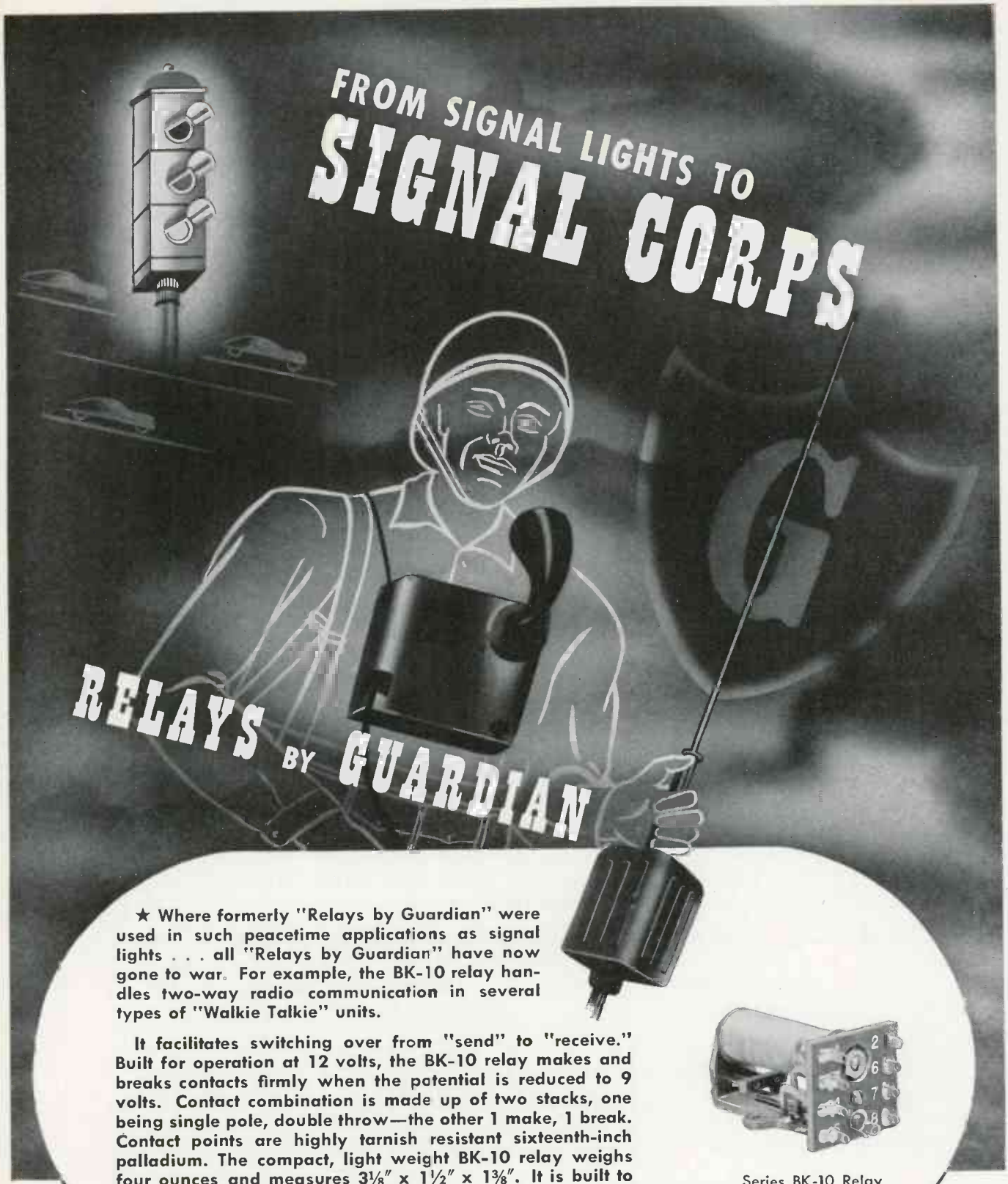


LEADER IN RADIO, TELEVISION, AND ELECTRONICS

GENERAL ELECTRIC

160-B2A-6912

TELEVISION



★ Where formerly "Relays by Guardian" were used in such peacetime applications as signal lights . . . all "Relays by Guardian" have now gone to war. For example, the BK-10 relay handles two-way radio communication in several types of "Walkie Talkie" units.

It facilitates switching over from "send" to "receive." Built for operation at 12 volts, the BK-10 relay makes and breaks contacts firmly when the potential is reduced to 9 volts. Contact combination is made up of two stacks, one being single pole, double throw—the other 1 make, 1 break. Contact points are highly tarnish resistant sixteenth-inch palladium. The compact, light weight BK-10 relay weighs four ounces and measures 3⅛" x 1½" x 1⅜". It is built to U. S. Army Signal Corps specifications.

Series BK-10 Relay

Planning for today or post-war? Send for Bulletin 195 describing this and other "Relays by Guardian" used in aircraft, ground and mobile communications.

GUARDIAN ELECTRIC

1622 WEST WALNUT STREET CHICAGO, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

MYKROY

CERAMIC INSULATING MATERIAL

A special bonded mica product

now serving widely in Army and Navy equipment

COMPARE!

These are some of the outstanding features and characteristics of MYKROY

INSULATING PROPERTIES—A low loss material that will not pass high frequencies nor dissipate h.f. energy. Will not carbonize under heat or arc, and therefore cannot create a path for leakage or short circuits.

MOISTURE RESISTANT — Absorption is negligible because it is non-porous, impervious to moisture, water, vapor, etc., thereby preventing failures otherwise due to improper insulation.

MECHANICAL STRENGTH—Nearly as strong in rupture as cast iron. Because it is not fragile it will withstand severe shock and vibration.

BONDING—Binds or seals perfectly to certain metals, thereby permitting its use in applications where bond or seal is critical.

MACHINABILITY—Machinable to high precision, either in simple surfaces or intricate parts.

NON-WARPING—No strain . . . no impairment of electrical contacts . . . no change in relation to associated parts . . . no change in form factor.

FROM REPORTS OF INDEPENDENT TESTING LABORATORIES

No. 4		No. 8
6.68	Dielectric Constant	(Dry) 6.75
6.73	Dielectric Constant	(Wet) 6.70
.00240	Power Factor	(Dry) .00164
.00241	Power Factor	(Wet) .00231
1.60	Loss Factor	(Dry) 1.11
1.62	Loss Factor	(Wet) 1.54
630 Volts per Mil	Dielectric Strength	660 Volts Per Mil.
22,000 lbs. per sq. in. rupture	Mechanical Strength	16,000 lbs. per sq. in. rupture

If you are confronted with an insulating problem, our engineers will welcome the opportunity to acquaint you with the performance of MYKROY. It is available in ample quantities and can be supplied for war and essential production requirements. For further information, please write to us or telephone today . . . PAssaic 3-4108.

MYKROY IS SUPPLIED IN SHEETS . . . MACHINED WITH PRECISION . . . MOULDED TO SPECIFICATION . . . MADE EXCLUSIVELY BY

ELECTRONIC MECHANICS INC.

70 CLIFTON BOULEVARD • CLIFTON, N. J.

*Formerly known as MYCALITE

"UNITED" skills operating within this organization are devoted exclusively to the designing and manufacturing of electronic power tubes. This intensive degree of specialization is reflected in tubes achieving an amazing record of performance through the gruelling punishments of war.

"UNITED" skills, cooperating hand in hand in this plant, include eminent engineers recognized by the industry as pioneers in development of electronics. On the grounds of priceless, time-tested experience alone, the products of these pioneers inspire confidence.

"UNITED" skills in electronics may be identified by the name "United" on each tube. Look for it when peace permits the enlarged use of electronic power tubes for radio, industrial and an ever-growing number of applications.

UNITED ELECTRONICS COMPANY • NEWARK, N. J.

UNITED *Skills in* ELECTRONICS

THE NEW AGE OF ELECTRONICS

IS BEING DRAWN ON THE

BLUEPRINTS OF WAR!

Men of the appliance trades may look with hope and confidence upon the part which the electronic industries have taken in producing the weapons of victory.

Philco, the world's largest radio manufacturer, has taken its proper place in the supply of electronic equipment for our armed forces. Philco's soldiers of industry are doing the work for which they have been fitted by the production of over seventeen million Philco products in electrical fields.

In this, their research laboratories have created miracles of electronic science, their engineering laboratories have developed marvels of ingenuity in production, their production lines have won honors from our fighting forces for the quality and quantity of their output.

Out of this have come new knowledge, new skill, new progress . . . *and new ideas!* When victory is won, the blueprints of war will bring the Age of Electronics, with untold wonders of comfort, convenience and entertainment for the homes of America.

And for the appliance dealers . . . *new opportunities.* For as Philco, before Pearl Harbor, had become the quality name in millions of American homes, it will be ready to carry on after victory to new heights of achievement and opportunity for the Philco dealers of America.

OUR WAR PRODUCTION PLEDGE:

MORE! BETTER! SOONER!

PHILCO CORPORATION

OHMITE RESISTORS

function under all variations of climatic conditions...

Extremes of climate are an old story to Ohmite Resistors. These rugged wire-wound vitreous enameled units have proved their worth in both the freezing cold of the arctic and the heat and humidity of the tropics. Often the same resistors face both extremes as they go from one climate to the other, yet they keep doing their job accurately, dependably, *because* they are built right. Ohmite Resistors are used today in endless variety and number in war and industry, and are ready to aid in the development of new devices for tomorrow.

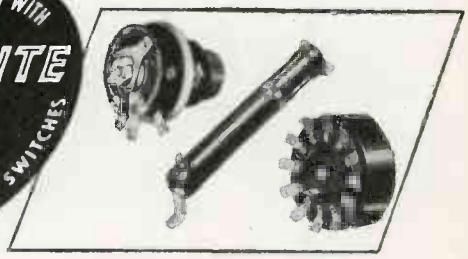
There are many types and sizes in regular and special units to meet practically every requirement. Units produced to Government specifications. Ohmite Engineers are glad to help you.

Write on company letterhead for 96-page Catalog and Engineering Manual No. 40—a helpful guide in the selection and application of Rheostats, Resistors, Tap Switches, Chokes and Attenuators.

OHMITE MANUFACTURING CO.

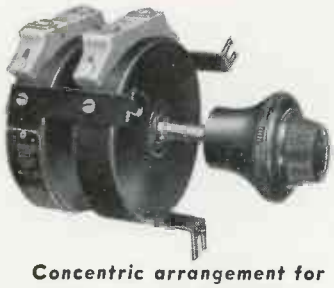
Foremost Manufacturers of Power Rheostats, Resistors, Tap Switches

4984 FLOURNOY STREET, CHICAGO, U. S. A.



FORTY-THREE STEPS OF CONTROL

in four inches!



Concentric arrangement for back of board mounting.

The new Ward Leonard 4-inch Pressed Steel Rheostat offers the happy combination of a small sturdy power rheostat with a large number of steps and ample current carrying capacity. Like all Ward Leonard Pressed Steel Rheostats this model may be arranged for front of board, rear of board and multiple assembly mounting. Other types and sizes also available. Send for descriptive bulletins.

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC COMPANY, 61 SOUTH STREET, MOUNT VERNON, NEW YORK

Dependable

DUNCO MERCURY RELAYS

NON-WELDING, DIRT-FREE CONTACTS

Dunco Mercury-Contact Relays have established enviable standards of performance on applications where high inrush loads, such as on lamps and motors, must be controlled, or for use where dust and fumes might foul ordinary contacts.

Rugged, heat-proof glass tubes keep the mercury in perfect condition, guarding it against fouling from contact with metal parts. On the Dunco Laminated Clapper Type Relays (Series 91), these tubes tilt over a wide angle, assuring positive contact without the need for any unusual mounting precautions. Dunco Mercury Swing Types (Series 22) require level mountings. These units have the advantage of making noiseless contact, and being lower in price.

Other Dunco Relay-Timer Types

30 ampere—Sensitive—Instrument Controlled—Low Voltage, Heavy Current, D.C.—Mechanical Latch-in (Electrical Reset)—Telephone Auxiliary—Lamp Controlling—Polarized—Overload—Timing—Industrial Control and Power Transfer—Sequence, Ratchet Type—Motor Reversing, and many others.

Write for the New Dunco Catalog and Relay Data Book.

STRUTHERS DUNN, Inc.

1321 ARCH STREET PHILADELPHIA, PA.

LET DUNCO DISTRICT ENGINEERS IN 28 STRATEGICALLY LOCATED CENTERS HELP SOLVE YOUR RELAY PROBLEMS

For the job that must be done

★ By the thousands, Simpson Instruments are going forth to assume vital responsibilities in America's march to victory—to help do the job that must be done. ★ You will find them in active service on the fighting fronts—maintaining vital communications, and keeping watch over the men and machines that carry the battle to America's enemies on land and sea and in the air. ★ On the home front they are helping importantly in the production of planes, tanks, ships and guns.

SIMPSON ELECTRIC COMPANY, 5200-5218 Kinzie Street, Chicago, Illinois

Simpson

INSTRUMENTS THAT STAY ACCURATE

★ ★ ★ BUY WAR BONDS AND STAMPS FOR VICTORY

Triple Checked ACCURACY

ON REPEAT ORDERS, too—

No Fumbling ON REPEATS

When you re-order steatite parts from us, triple-checking assures exact duplication of the original.

First, the original *working drawings* are consulted. These give precise production instructions such as dimensions, tools to be used, machining procedure, shrinkage calculations, and other necessary data.

Second, *manufacturing record cards* are studied. Figures on moisture, raw material weights, pressures, wet and dry weights and other factors insure the duplication of conditions whether pressing or extrusion is employed. Thus, the repeat order gets the benefit of previous research and hours of engineering time.

Third, *firing record cards* designate the method of setting the piece as well as other data concerning firing conditions.

This follow-through on repeat orders is added insurance that the steatite parts will match the most exact specifications. It is part of our quality-control that starts with a "preview" of parts or products prior to original fabrication.

General Ceramics

GENERAL CERAMICS AND STEATITE CORPORATION — STEATITE INSULATORS

5273

AND STEATITE CORP.

KEASBEY NEW JERSEY

For Sale—Electronic Production Aids

ELECTRONIC TIMERS

for SPLIT-SECOND and other short-interval TIMING

Here's the answer to your short-interval-timing problems. Five forms cover range from 0.045 second to 2 minutes. Continuously variable. Knob on front covers full range. Long life, too. Only one moving part—only one tube. Sturdy. Accurate. Times resistance-welding operations, process furnaces, honing machines, molding machines. Warns of tie-ups on conveyors. Controls laboratory tests. Thousands in use. Several timers combine to control series of operations. Priority rating required. Additional information in Bulletin GEA-2902B. Price, $28 net, up.

ENGINE DESIGNERS!

Measure ignition voltage of gasoline engines with new G-E electronic crest voltmeter. Gives you readings up to 30,000 volts, with accuracy of 3 per cent of full-scale value. Portable. Completely self-contained—needs no outside power supply. No special training required to operate it. Uses standard portable batteries and radio receiver-type tubes. Priority rating required. Cat. No. 5993877G4 (10,000 volts), -G5 (20,000 volts), -G6 (30,000 volts). Price, $375 net. Ask for Bulletin GEA-3619.

WEARING OUT mechanical limit switches too fast? Try photoelectric control. You can't wear out a light beam. Bulletin GEA-1755C for details. Prices, $18.50 and up. Priority rating required.

SHORT OF INTRA-FACTORY TRUCKS?

Install standard G-E photoelectric control to open and close doors whenever trucks enter and leave buildings frequently. One company with G-E photoelectric control on warehouse doors saves $30 a day, in truck time, operators' time, and heat. Now its truck drivers come and go without stopping. Easy to install on your motor-operated doors at low cost. Priority rating required. Ask for GEA-1755C.

SAVE TIN ★ SAVE TIME

Are you soldering joints that could be resistance-welded at a saving of both time and solder? Manufacturers tell us resistance welding with G-E electronic control cuts assembly time on such jobs in half; eliminates tin entirely. Ask for GEA-3045A and GEA-2791C on G-E electronic control for resistance welding. Priority rating required.

WIDE-RANGE, STEPLESS speed control is easy when you use Thy-mo-trol—G.E.'s new electronic motor control. Operates d-c motors from a-c lines. Full speed range of motor covered on a single dial, like a radio volume control. Preset speed before starting, or change speed without stopping. Reversing. A real electronic achievement! Bulletin GED-972A gives more information. Priority rating required.

ARE YOU RIVETING where you should be resistance-welding? Resistance welding is fast, uniform, economical. Speeds production for war. G-E welding engineers will be glad to help you. Write, stating your problem, to General Electric, Industrial Electronic Section, Schenectady, N. Y.

USING CONVEYORS?

Prevent tie-ups easily with G-E photoelectric control. Standard G-E photoelectric relays will warn of "piling up" on conveyors; count fresh-painted or fragile objects on a conveyor without touching them; keep two conveyors in step; stop conveyors at right position for processing; turn on paint sprayer as objects pass; sort objects on conveyor for size. Inexpensive. Low maintenance. Dependable. Frees workers from routine jobs for more production. For indoor or outdoor use. Bulletin GEA-1755C. Priority rating required.

SAVE MAINTENANCE

On Resistance-Welder Contactors

G-E electronic contactors eliminate time lost in tip dressing of mechanical contactors. Silent. Fast. Long life. Save factory space because you can mount them overhead. Use long-life G-E ignitron tubes. Range from 11 to 2400 kva. Low cost. Often pay for themselves in short time. Easy to install. Can be used with old or new a-c resistance-welding machines. Available for synchronous or nonsynchronous timing. Bulletin GEA-3058B gives you more details. Priority rating required.

General Electric, Sec. F645-21
Schenectady, N. Y.

I'm interested in speeding production electronically. Please send me the bulletins checked:

- ☐ GEA-2902B — Electronic timers
- ☐ GEA-3619 — Electronic crest voltmeter
- ☐ GEA-1755C — Photoelectric relays
- ☐ GEA-2791C — Electronic control for resistance welding
  GEA-3045A
- ☐ GED-972A — Electronic motor control—Thy-mo-trol
- ☐ GEA-3058B — Electronic contactors for resistance welding

Name.....

Company.....

Address.....

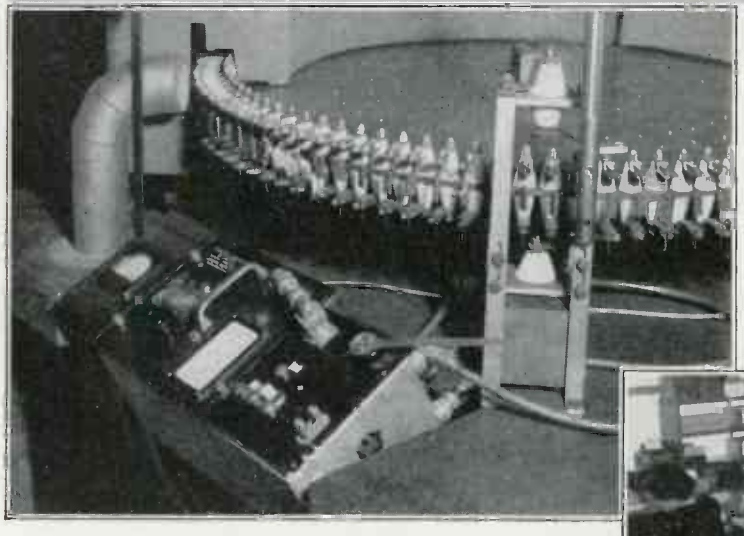
City..... State.....

Speed Production Electronically

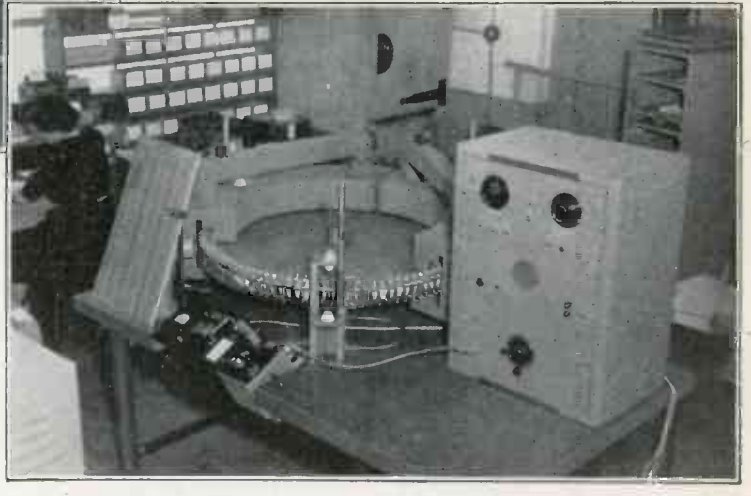
GENERAL ELECTRIC

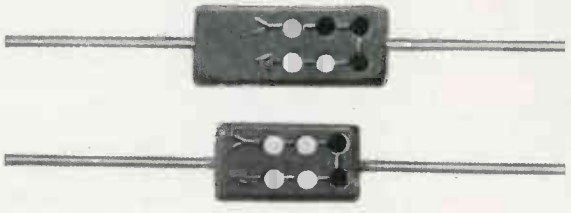
Individually Tested

for TEMPERATURE COEFFICIENT . . .
an example of ERIE'S leadership in
SPECIAL CAPACITORS



ERIE CERAMICONS





ERIE SILVER MICAS

RADIO engineers who are seeking mica and ceramic condensers for critical applications can, in most cases, find the solution to their problems at Erie Resistor.

For more than a year, we have been individually testing the temperature coefficient of Erie Silver Mica Condensers and Erie Ceramicons, in production quantities, for those customers whose orders specify units of extremely close temperature coefficient tolerance.

One type of testing equipment used in this operation is shown in the above illustrations. The standard range over which temperature coefficient of individual units is measured is from room temperature (approximately 25°C) to 85°C. This testing apparatus, which was designed and built by Erie Resistor engineers, is checked for accuracy against precision laboratory equipment at regular intervals.

Constant research, and exceptional facilities for production and testing are the prime factors responsible for Erie Resistor's leadership in special capacitors.

ERIE RESISTOR CORP., ERIE, PA. LONDON, ENGLAND · TORONTO, CANADA.

HELLO JANET, I'M TAKING THE NOON PLANE

The marvels in electronics developed during the war will not pass with the war. Their application to post-war life will be as wide and amazing as only American imagination and enterprise can make them.

More efficient hearing aids, inexpensive ship-to-shore phones for small craft, wireless intercommunications systems for business, improved counting and color sorting devices are but a few of the obvious developments of existing electronic applications. Even portable, personal two-way radio phones may become a reality. Where electronics will take us no one can foretell.

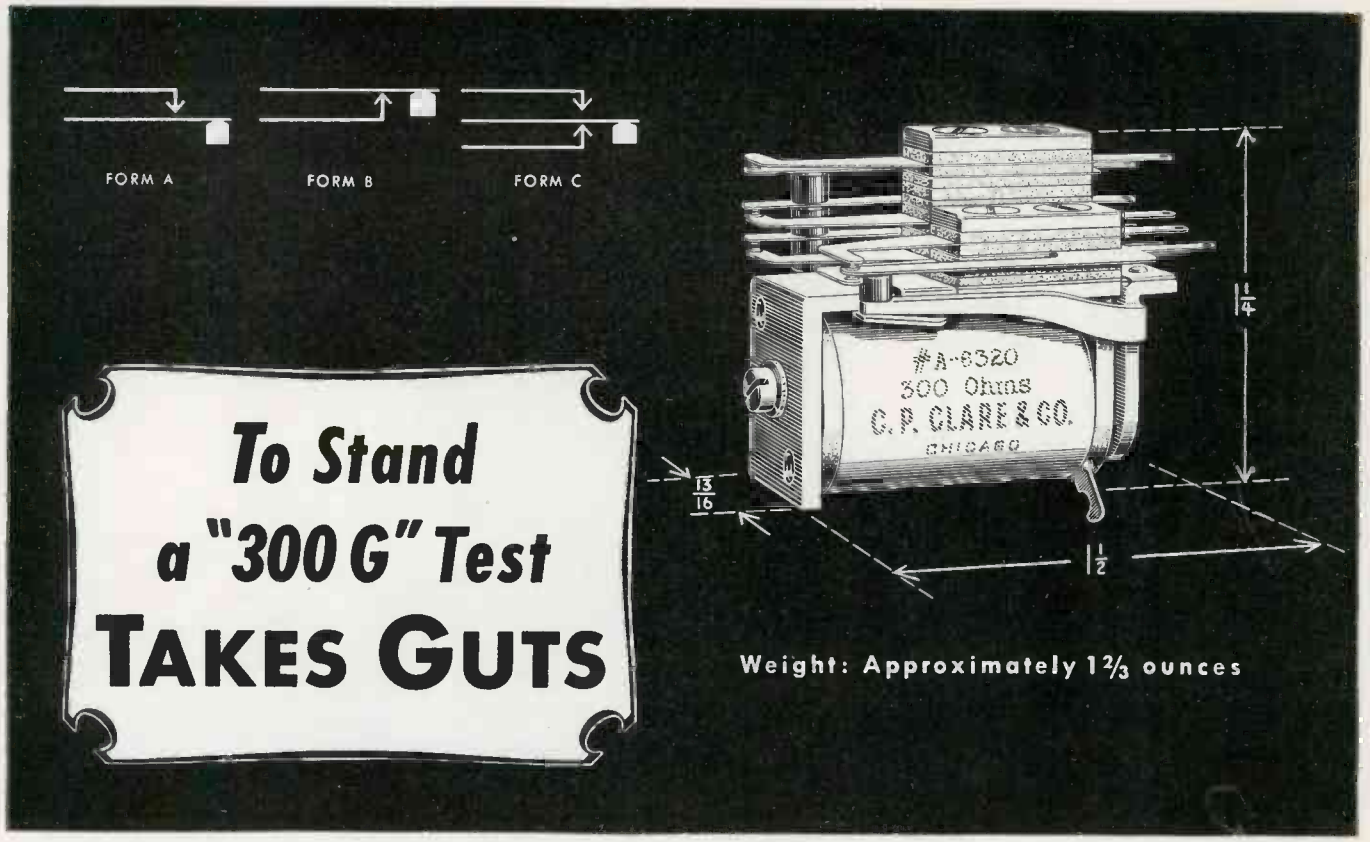
In this time of need, it is TUNG-SOL'S job to design and produce necessary transmitting, receiving and amplifying electronic tubes for our government. After the war the new experience so gained will be at the disposal of those who will be instrumental in building the new electronic era. Manufacturers will find at TUNG-SOL a wealth of equipment, engineering and production skill to help them make new or better electronic devices.

TUNG-SOL

vibration-tested

RADIO TUBES

TUNG-SOL LAMP WORKS INC., NEWARK, N. J., *Sales Offices:* ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK
ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS, ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERRUPTERS



To Stand a "300 G" Test TAKES GUTS

Weight: Approximately 1⅔ ounces

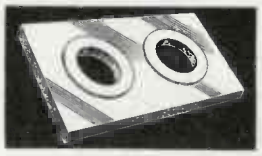
Should you be one of those engineers who is looking for a relay with plenty of guts, you will be gratified to learn that Clare Type K. d. c. Relays, according to reports by one of our large customers, withstand a "300 G" test. Here is a relay that not only stands up under this extraordinary test, but also fits perfectly into designs where inches and ounces count.

Only a product of character, constructed of the finest materials by skilled, painstaking craftsmen, can function properly under such rapid acceleration. Materials making Clare Type K. d. c. relays are the best procurable: contact springs of nickel silver, insulators of special heat-treated Bakelite, and all metal parts plated by a special Clare process to withstand a 200 hour salt bath test.

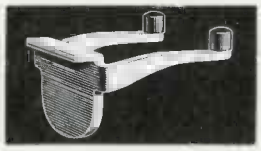
As illustrated, it is extremely small, measuring only 1½" x 1¼" x 13/16", and weighs approximately 1⅔ ounces... It can be furnished in the contact forms shown above with any number of springs, up to and including 12... Coil voltage range is from 1.5 volts to 60 volts d. c.... Contacts of either 18 gauge silver, rated one ampere, 50 watts, or 18 gauge palladium, rated two amperes, 100 watts can be furnished.

The design is such that the relay itself is capable of withstanding severe vibration. Therefore, no anti-vibration springs are employed ... The screws by which the contact spring pile-ups are fastened to the heelpiece are tightened under pressure and secured into the heelpiece by a coating of Glyptol as an added precaution.

The tiny size and featherweight of this relay are a definite contribution to design problems. Like all Clare Relays, it can be "custom-built" to meet your specific requirements. Write us regarding them. We will make suggestions. In the meantime, send for the Clare catalog and data book. C. P. Clare & Company, 4719 West Sunnyside Ave., Chicago, Ill. Sales engineers in all principal cities. Cable address: CLARELAY.

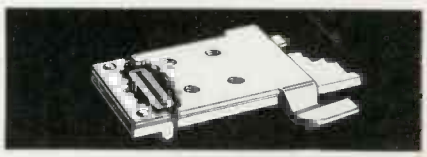


Spring insulators are made from special heat treated Bakelite that permits punching without cracks or checks and possesses minimum cold flow and low moisture absorption properties. Each Type K Relay is given a 1000 volt a. c. insulation breakdown test.

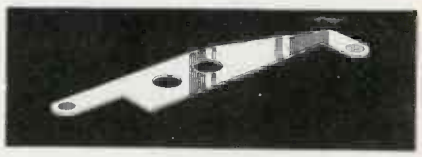


The armature assembly, heelpiece and coil core are made of magnetic metal, carefully annealed. The armature assembly is available with either single or double arm.

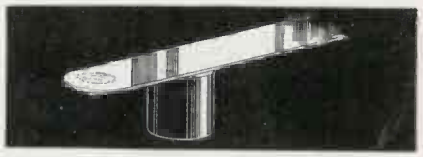
The small coil is equipped with a front spool head having a flat side. This locks the entire coil in place against the heelpiece, preventing it from turning or becoming loose. The screw holding the coil in the heelpiece is equipped with a split type lockwasher. The coil is carefully wound to exact turns on precision machines. Coils can be supplied impregnated with a special varnish. They are covered with a transparent acetate tape. Each coil shows data regarding resistance and type number.



Uniform armature movement is assured by a hinge of "fatigueless" beryllium copper, heat treated and designed to provide a wide margin of safety, insuring long life under vibration and permitting millions of uniform operations.



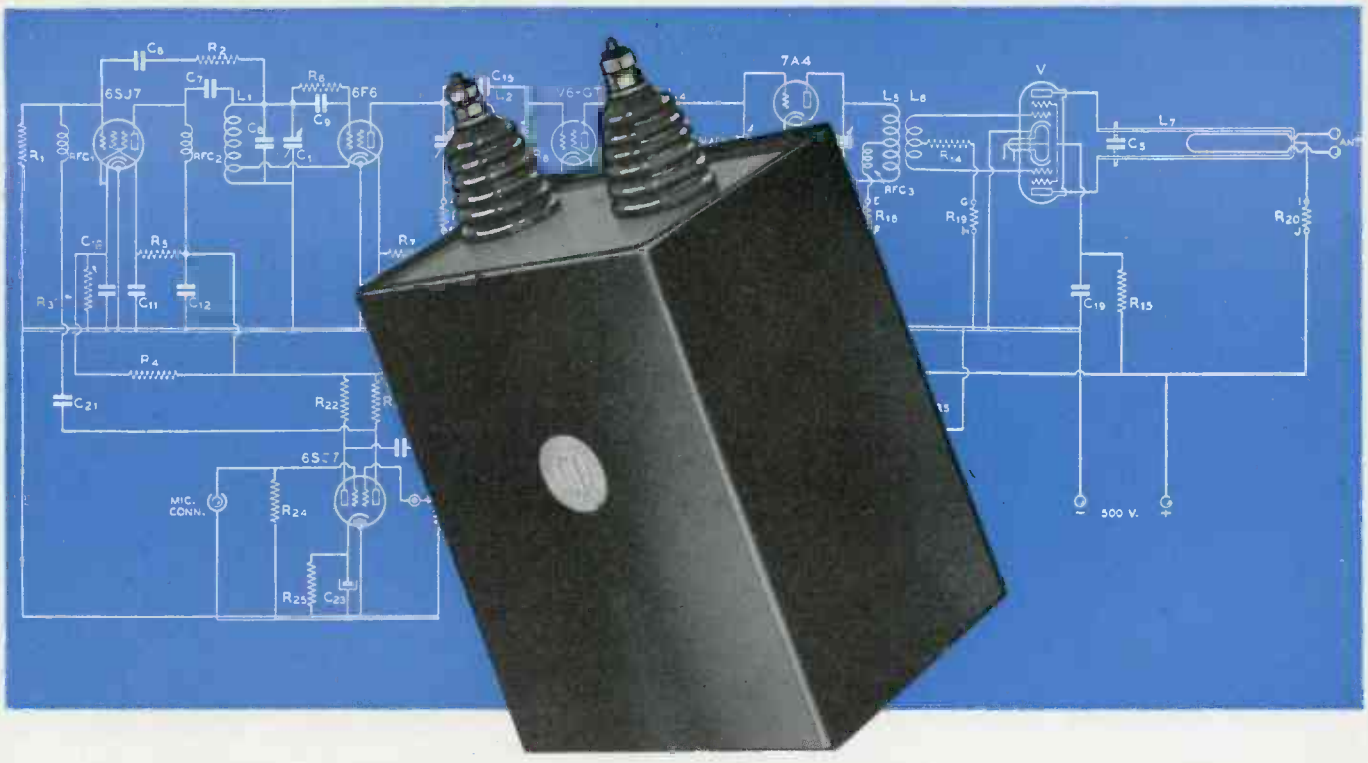
Contact springs are made of nickel silver to the manufacturer's specifications. The contacts are over-all welded to these springs by a special process.



Spring bushings of Bakelite are designed, constructed and attached to the springs so that the small springs used on this relay are not weakened. Uniformity of relay operation and long service life are thereby assured.

CLARE RELAYS

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



WHEN THE BLUEPRINT CALLS FOR CAPACITORS

give your equipment maximum reliability by using C-D CAPACITORS

Capacitors may look alike but C-Ds are engineered and manufactured by specialists who have made them their lifework. The combined, accumulated experience of 32 years' concentration on capacitors exclusively — is translated into the significant *extra* component that gives C-Ds their *extra* measure of stamina and longer life. C-D means "capacitors dependability"—a very good reason why there are more Cornell-Dubilier Capacitors in use today than any other make. Isn't that worth remembering . . . when the blueprint calls for capacitors?

C-D HIGH VOLTAGE DYKANOL CAPACITORS

Type **TK**

These capacitors are universally accepted as the finest ever offered in larger capacity and higher voltage for filter service. Because of their compact construction the design engineer will find them suitable where space limitations are a problem.

Typical features of these outstanding capacitors are:

- Impregnated and filled with non-inflammable, non-explosive Dykanol, the impregnant noted for its high dielectric constant and stability under all operating conditions.
- Hermetically sealed and therefore not affected by moisture, time or temperature up to 93°C.
- Dried, impregnated and filled under continuous vacuum resulting in lower equivalent series resistance, longer life.
- Conservatively rated—will safely operate continuously at 10% above rated voltage.
- Encased in sturdy, arc-welded steel case, painted with a special blue-gray weather-proof, non-corrosive lacquer.
- Supplied with heavy-duty wet-process glazed porcelain insulator. These insulators are pressure-sealed resulting in leakproof joints and high dielectric strength.

For further details write for Catalogue No. 160T
Cornell-Dubilier Electric Corporation
South Plainfield, N. J.

more in use today than any other make

Cornell Dubilier capacitors

CORNELL-DUBILIER CD CAPACITORS

Mica • Paper • Dykanol • Wet & Dry Electrolytic Capacitors

This is a "GLOBAL" war...

A man-made globe—the electronic tube—is today one of the key weapons of battle. Eimac tubes have assumed a rank of "high command" in this "global" war. Again they are "first choice in the important new developments in radio"

ARMY E NAVY

THE JOINT ARMY-NAVY "E" awarded September 4, 1942... first award of this kind to a manufacturer of electronic tubes.

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

Export Agents: Frazar & Comp[illegible]o, Calif.

Eimac TUBES

HANDLE TODAY'S CAPACITOR JOBS *with* SPRAGUE ELECTROLYTICS

Frankly, we're looking for the people, military or civilian, who "don't like electrolytics". We keep hearing about them, but never quite catch up with them. When we do, we're not going to argue. We simply want to find out what performance they need, then give it to them—in *electrolytic* capacitors that can be delivered almost in the time it takes to arrange priorities on certain other types.

Actually, Electrolytics have far more than small size and light weight to recommend them. They meet all specifications: salt-air, reduced pressure, reduced and elevated temperatures, transients, reversed voltage, r.f. impedance, and many more. They fly. They swim. They even sit unused for months and are still ready to go at the flick of a switch. They can be sealed as well as any condenser type—and they're adaptable to many designs and combinations, from the popular octal base types shown here right along the line to whatever may be required.

SPRAGUE SPECIALTIES COMPANY
North Adams, Mass.

GET THE PROOF! *—Put your capacitor problem up to Sprague engineers. Let them prove that Sprague Electrolytics will do your job—and do it right.*

SPRAGUE ELECTROLYTICS for PORTABLE EQUIPMENT!

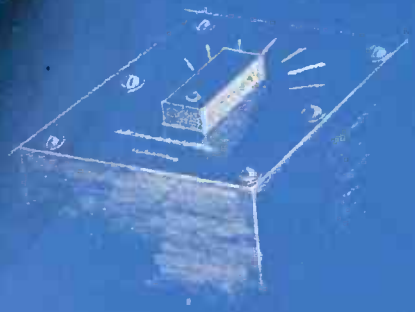
To those who question the use of electrolytics in portable equipment, we suggest: Find the smallest capacity of paper condenser (even if it is as big as a house) that will do your low frequency filtering job. Then tell us the low frequency you are trying to get rid of (20 to 120 cycles), and the voltage ranges . . . then . . .

You'll be unable to detect any difference in performance between this paper condenser and the Sprague Electrolytic we'll recommend. *The only difference will be in the greatly reduced size and weight of the electrolytic!*

MANUFACTURERS OF A COMPLETE LINE OF RADIO AND INDUSTRIAL CAPACITORS AND KOOLOHM RESISTORS

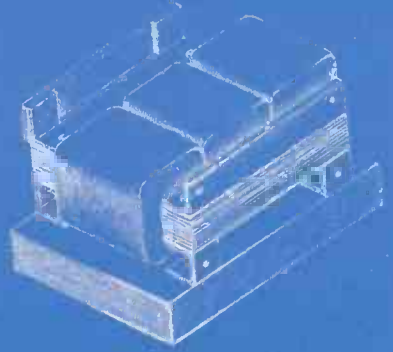
Combinations for Victory

Savings in materials and machine time are vital to victory. Substantial savings can frequently be effected by combining elements. Typical UTC design refinements of this type are illustrated.



The design of this unit combines switch plate, name plate, and cover.

This unit employs a special die cast housing which combines the mounting of six units, eliminating twelve sets of brackets, twenty-four screws, and a special outer case.



UTC three phase to single phase transformers combine the mounting facilities of the transformer and condenser. This and electrical design reduced the volume and weight of the UTC design forty per cent compared to contemporary design.

Two reactors, four condensers, and two shielded transformers are combined in this hermetically sealed container. Separately cased, the volume and weight would be doubled.

May we design a Victory Unit to your application?

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK [illegible] ORK N Y CABLES "ARLAB"

ELECTRONIC INDUSTRIES

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

Electronics Revolutionizes 1943 Warfare

Suddenly we have entered into a new phase of the war, in which electronic methods have become of the greatest importance.

Military strategy has been revolutionized in the last few months, because military men have at last accepted the possibilities which electronic devices have been offering them all the time!

It is the same old story of laymen failing to accept electronic possibilties—because they do not understand. And what laymen do not comprehend, they mistrust.

But so devastatingly effective have electronic methods proven themselves in their limited application during our first war year, that 1943 is seeing a tremendous stepping up of the whole electronic and radio program.

Help Exchange Factory Short Cuts

A production man in a New York City factory producing radar equipment rigged up an automatic feed to a hand-feed punch press stamping out transformer laminations. It sped up output 900 per cent. A worker in a New Jersey plant used his head to save his testprods and came up with a plug-in jig for faster coil testing. Put together enough good ideas and a factory pushes ahead to "125 per cent of capacity," the figure the War Production Board has suggested as a "must."

Ray Ellis, Chief, Radio and Radar Division, has asked "Electronic Industries" to continue and expand the "Factory Short Cuts" feature as a service to the war production effort.

With its own manpower problem, it's obviously impossible for EI's editors to visit more than a very few plants, in search of new kinks and methods. Won't you tell us about some of the new design, production, or testing short cuts you've worked out? Photographs and sketches are welcome, but they're not absolutely necessary. The "new ideas" don't have to be world-beaters —just so they've stepped up output.

Exploring Radio Spectrum Backwards

In our Frequency Allocation chart, sent as a supplement to this issue, some readers may be surprised at the inclusion of several bands marked also in "meters." Not so, however, those other readers who never have become fully reconciled to what they call the "upside-down thinking" required by kilocycle designations.

Which recalls a statement made at a meeting of the Institute of Radio Engineers by an eminent scientist, that "radio engineers started at the wrong end of the radio-frequency spectrum." He was calling attention to the utter simplicity and remarkable efficiencies of the tuning circuits for "centimeter" wavelengths. Marconi and his contemporaries spent years developing equipment operating at longer and then still longer wavelengths, to secure reliable wireless communication.

But the inference is not exactly true, because fifty years ago, scientists in many countries were repeating and studying the experiments of Hertz, using resonators set at wavelengths of the order of 20 to 500 centimeters!

Why were their efforts abandoned in favor of waves in so widely a different range, only to come back so slowly to the starting point by small jumps? Hertz built resonators that were simple and effective, but he could not excite them with enough energy with then available means, to be useful in transmitting signals. Marconi's tests used wavelengths that would radiate ample power. There is only one answer to the riddle: electron tubes now provide what Hertz lacked, the necessary excitation.

We Cut Our Page Size—for Uncle Sam

With this issue of "Electronic Industries" the reader will note that the outer dimensions of our pages have been trimmed down to a new size,—8⅛ by 11¼ inches.

This reduced page size results from the recent order of the War Production Board curtailing by ten per cent the supply of print paper to all magazines. Caldwell-Clements, Inc., are glad to comply with this order on the part of WPB as it affects both our publications, "Electronic Industries" and "Radio Retailing Today".

Fortunately for "Electronic Industries" readers, we shall be able to make this contribution to the saving of manpower and raw material in the production and transportation of print paper, without detracting from our essential engineering or news contents in serving the radio and electronic fields which are playing such a vital part in winning the war.

Supplement to This Issue

TWO important features —

LATEST RADIO FREQUENCY ALLOCATION for the WESTERN HEMISPHERE

Large folded chart of the complete radio spectrum, in colors,—compiled in cooperation with RCA Laboratories

AIEE-IRE RADIO WAR CONFERENCES

Full, last-minute news report of the January 27-28 engineering meetings on electronic war subjects at New York

Major General James A. Code, Jr.
Deputy Chief Signal Officer

Brigadier General D. M. Crawford
Director of Coordination

Above—Major General Roger B. Colton
Chief of Signal Supply Services

Below—Major General Harry C. Ingles
Caribbean Command

BUSINESS

The Army Signal Corps in its communications work has two functions—operational and supply.

The operational function consists in running the communications of the Army—by radio, telephone, teletypewriter, and other forms of signaling—all the way from the War Department Signal Center in Washington, down to the message center of every Army division in the field in every part of the world.

The supply function of the Signal Corps consists in developing, procuring, and issuing all types of communication equipment to be used not only by Signal Corps troops, but also by communication personnel of all branches of the Army Air Forces and Ground Forces. This function of supply makes the Signal Corps by far the biggest customer that the nation's electronic industries have ever had. The tremendous boom now under way in the electronic industry is, to a very large extent, a reflection of the multi-billion dollar procurement program of the Army Signal Corps.

In working with the Signal Corps on items of equipment under this procurement program, the electronic engineer and manufacturer will come into contact at various stages with different field agencies, laboratories, contracting officers, expediters, inspectors, and other agencies and individuals of the Signal Supply Services. Sometimes the new commercial supplier may be somewhat confused by the size of the government agency with which he must deal.

Streamlining procedures

Actually, the Signal Corps like other branches of the Services of Supply, is making every effort to simplify and streamline its procedures so as to hold down to a mini-

Using Army walkie-talkie in a jeep

Brigadier General H. L. P. King
Chief of Military Personnel

Brigadier General F. C. Meade
Director of Planning

Brigadier General R. B. Moran
now on overseas assignment

with the SIGNAL CORPS

by LT.-COL. C. J. McINTYRE
Office of the Chief Signal Officer, Washington, D. C.

What the electronic manufacturer and radio engineer should know about their biggest customer, the U. S. Army Services of Supply

mum the number of steps required between the initiation of a development and the issuance of completed equipment to troops. If the organization is ramified, this is because the task is enormous and unprecedented in scope.

The present article is designed to show the general structure of Signal Corps supply agencies that deal with the manufacturer and to clarify the role of the various agencies in carrying a project through all of the necessary steps.

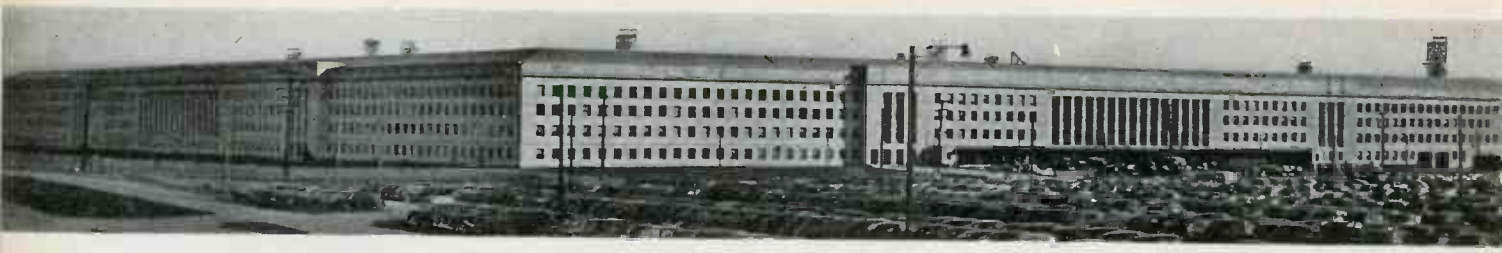
In general, all of the agencies concerned with the procurement of Army communications equipment are directed by the Chief of Signal Supply Services in the Office of the Chief Signal Officer. The Signal Supply Services include three divisions—Research and Development, Materiel, and Distribution.

Army mobile communications unit

Research, development

The Research and Development Division coordinates the inventive and developmental activities in connection with the provision of new equipment and improvements on old equipment for ground and air communication, for meteorological observation, for aerial navigation and altitude determination and for aircraft warning purposes. The Materiel Division is responsible for the purchase of equipment once it has been developed and standardized, and the Distribution Division supervises the movement of completed equipment to depots and to using troops.

Acting at a level between that of development and supply is the Communication Coordination Division. This agency advises the Chief Signal Officer as to whether the equipment developed is actually satisfac-



The gigantic Pentagon Building of the War Department which now houses the Signal Corps. A mile around, it comprises five concentric structures, the innermost enclosing an open area larger than a football field. Located in Arlington, Va., callers from Washington should allow half an hour to reach the Pentagon concourse information counter, and another twenty to twenty-five minutes for usher to arrive and escort visitor to the office destination

tory to the arm of service which will use it in operation and acts to avoid unnecessary duplication of equipment types for basically similar functions.

If we were to trace the history of a particular item of Signal Corps equipment, we might find that the idea for it may have originated with an officer in a troop unit in any branch of the Army, or with an engineer in the Signal Corps or in the industry. If the idea is found suitable for development, a development project is assigned to one of the three major Signal Corps laboratories. These are organized under the Signal Corps Ground Signal Service, with headquarters at Camp Evans, Belmar, N. J., and the Signal Corps Aircraft Signal Service, at Wright Field, Dayton, Ohio.

Fort Monmouth, N. J.

Suppose we take the Fort Monmouth Signal Laboratory, organized under the Signal Corps Ground Signal Service, as the one involved in this particular instance. This is the oldest of the Signal Corps laboratories and, like the others, it continues to be at the forefront of radio and communication research.

The Fort Monmouth Signal Laboratory, like the other laboratories, has research facilities of its own. But, in consonance with the regular Signal Corps policy of utilizing the research facilities of private industry and other government agencies to the greatest possible extent, it farms out a large proportion of its development work. This is done by means of development contracts. Contracts involving advanced research and development are in many cases allotted through the National Defense Research Committee to some of the most qualified scientists in the country. Similar contracts are made directly by the Signal Corps laboratories with commercial concerns.

Seller must qualify

In order to qualify for a development contract, a commercial concern must be able to show that it has available the engineering personnel and research equipment necessary to offer a satisfactory prospect that the development will be completed on time. No Signal Corps contract can be issued to a commercial concern which merely exists on paper or which appears to be trying to bite off more than it can chew.

The monetary value of a development contract would appear to be more difficult to determine than that of a production contract, but the experience of Signal Corps engineers in their own laboratory development work has provided some fairly reliable guideposts for determining the reasonable costs of a development.

It is the object in negotiating a development contract to see that the firm is fairly compensated for its development work whether or not the result of that development is ultimately accepted for production by the Chief Signal Officer and whether or not, if the development is standardized, the company con-

Fort Monmouth Laboratories

Modern field radio equipment showing engine-driven transmitter

cerned itself is awarded the contract for production. In some cases one concern may have the best research facilities to carry on the development of some form of equipment, while another concern is considered more suitable for the actual production of the standardized equipment on a quantity basis.

Renegotiation of prices

Like all Army contracts, those on development projects are subject to renegotiation of price, to forestall excessive profits at the expense of the government. This renegotiation is usually carried out at a time when the project is more than half complete, so that payment will not be delayed unreasonably beyond the time of completion.

When a development is completed, the laboratory so reports to the Chief Signal Officer. In some cases the results of more than one similar development project may be submitted simultaneously. It then becomes the province of several boards and committees advising the Chief Signal Officer to select the development best suited to the needs of the using arm or arms in view of the current strategic picture and the war plans of the General Staff. Sometimes a perfectly good solution to an engineering problem may be discarded at this point because the lessons gained during the interim in combat experience may have dictated a new approach to the military characteristics required for the particular type of communication involved. This is another reason why it is considered desirable to compensate firms which have carried out satisfactory development projects, and start with a clean slate, from the contracting standpoint, when actual production is initiated.

Handling production

In many cases, of course, and particularly with the larger suppliers which have extensive departments for both development and production, the same company which developed a satisfactory set also will carry on through the stage of production. It will find, however, that it now becomes necessary to deal with other agencies of the Signal Corps. The production contracts for large quantities of equipment are usually handled by the two major Signal Corps Procurement Districts—the Philadelphia Signal Corps Procurement District and the Wright Field Procurement District.

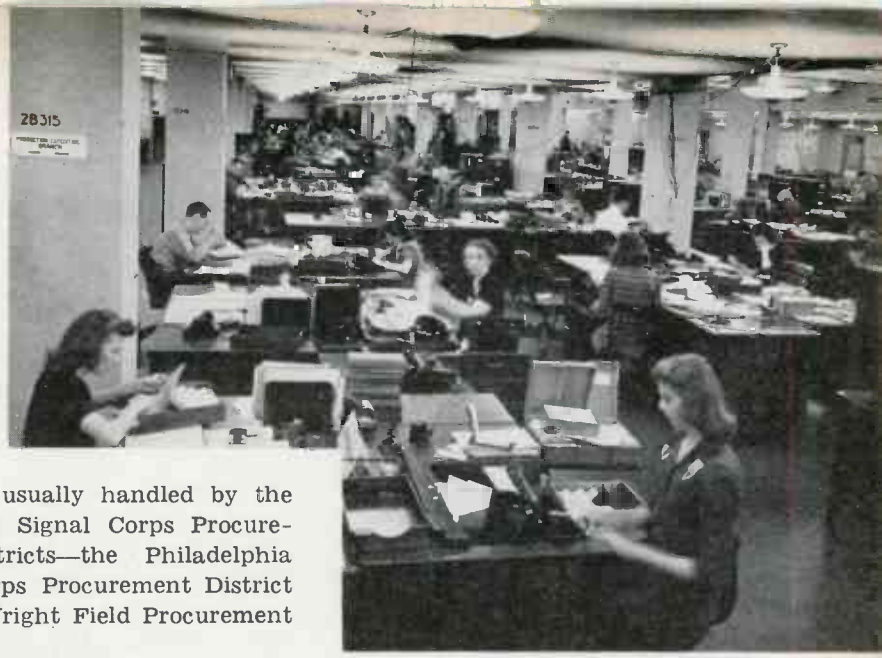
A project resulting from a development contract on ground communication equipment is likely to lead eventually to a large-scale production contract issued by the Philadelphia Signal Corps Procurement District. Such contracts are issued after consideration of which company has the facilities, personnel and experience to carry out the job without unduly interfering with other undertakings for Army and Navy supply.

Expediting agency

After production is under way, the manufacturer is likely to come into contact with another agency—the Army-Navy Electronics Production Agency. The staff of this agency is located in the Pentagon Building, Washington, D. C. There communications supply officers of both the Army Signal Corps and the Radio Division, Navy Bureau of Ships, work to expedite production of the equipment most urgently needed by the Armed Forces. On occasions this agency may even cause manufacturers to slow down the production of certain types of communications equipment. When this is done, it is because that equipment may be eating into the supply of some scarce component for lack of which highly critical equipment might be waiting on the production lines somewhere else.

The manufacturer will make contact with the Army-Navy Electronics Production Agency through field expediters, some of whom were formerly assigned from the Procurement Division of the Signal Corps. The recent establishment of

(*Continued on page* 120)



A typical office in the Pentagon, the huge building which contains 100 acres of floor space, 16 miles of corridors, 22,000 desks, 140,000 chairs, 200 rest rooms and 650 drinking fountains

Signal Corps soldier with latest type of walkie-talkie transceiver

ELECTRONIC METHODS

by GILBERT SONBERGH

Controlled resistance welding — Electronic feed arc-welding — X-ray radiography — Phototubes — Dynamic Balancing — Induction heating — Many secret applications

America has embarked on the greatest shipbuilding program in the world's history. In addition to many types of combat vessels, this program calls for vast tonnage in cargo ships. Today's "Liberty Ships" have far greater speed, better fuel economy, and more cargo capacity than those of the first World War. Three ships now do the work of four.

New construction methods are largely responsible for these improvements and for the fact that shipbuilding speed records are being broken every week. Electronically controlled resistance and arc welding, X-ray radiography, induction heating, and scattered applications of phototubes and other miscellaneous electronic devices play an important part in the shipbuilding and ship repairing program.

Resistance welding

One of the newer applications of electronics to ship construction is controlled resistance welding, used in the fabrication of numerous items from relatively light materials.

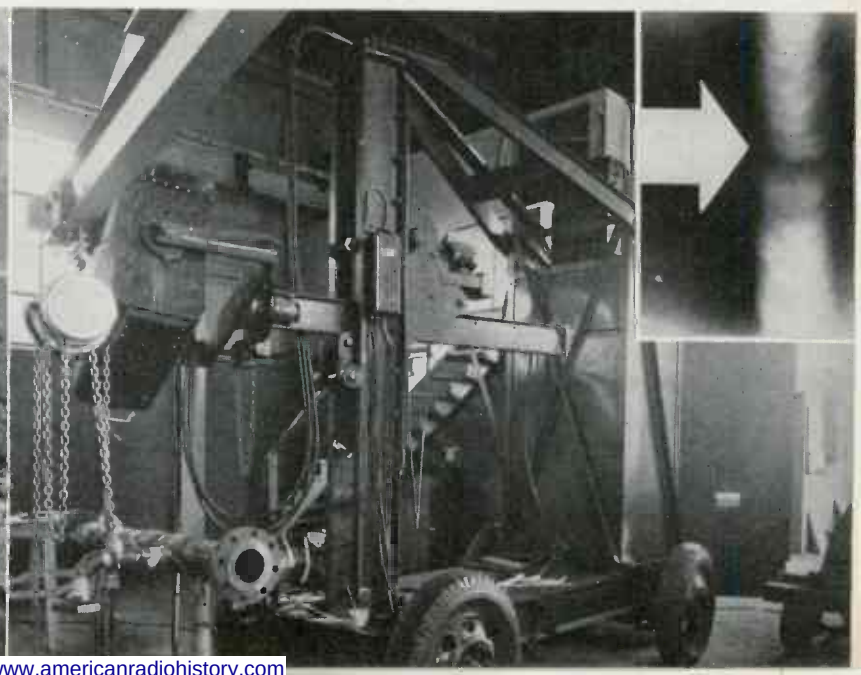
The precise control of welding heat and welding time afforded by an up to date electronic control system makes it possible to weld such temperature-critical materials as stainless steel and aluminum on a production basis and with safety. Without such precise control high-chromium steel would be very difficult to handle with consistent results. The "stainless" property is the result of the formation of a microscopic layer of chromium oxide on the surface, but this scale effectively prevents satisfactory resistance welding unless high current and high pressure, accurately controlled, are used.

One such tube-controlled system is the Budd Shotweld process, with which nearly 500 welds per minute are made in stainless steel in continuous seam welding operations. Welded-fabricated ship structures produced with this process include bulkhead doors, hatches, manhole covers, scuttles, quick-operating doors, smoke pipes, uptakes, boiler casings, and masts. Naval censorship prohibits dealing with these items in any but the most general terms at present.

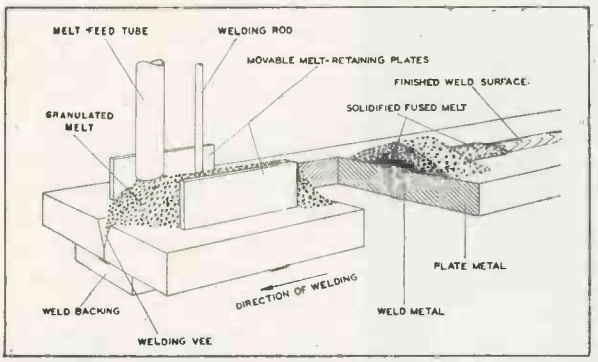
Controlled-feed arc welding

Electric welding has all but replaced riveting of ships' plates and other structures. Besides a saving of about one-half the weight, weld-

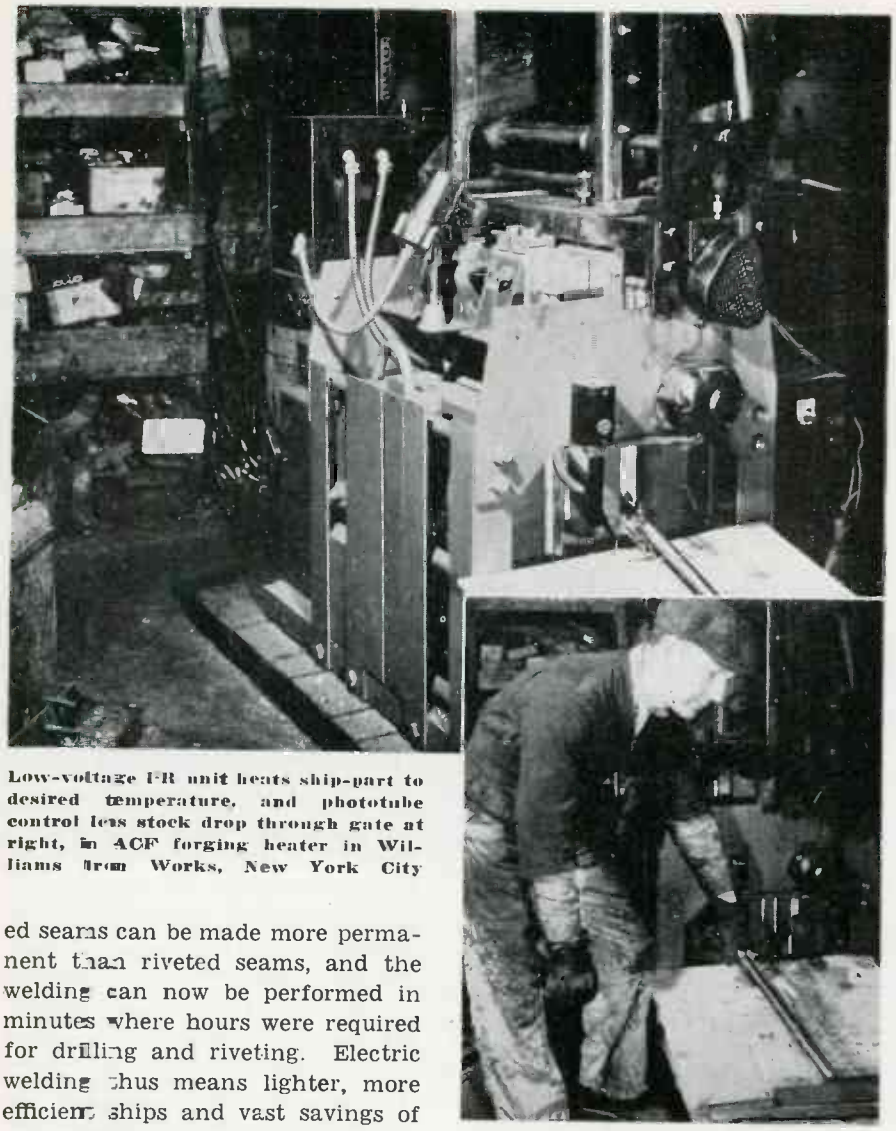
Shotweld equipment in use on three-layer stainless-steel structure for Navy vessel. Below: smothered-arc welding equipment making repair to freighter's plates. At right: X-ray set-up for high pressure steam piping. Insert is radiograph of perfect weld in pipe



IN SHIPBUILDING



Unionmelt welder, above, automatically welds deck plates of freighter. Diagram shows principle of operation. Thyratrons control arc gap by motor-feed of welding rod. Left: Launching of destroyer U.S.S. Stockton. Below, left: At sea in a rubber boat, plane or ship survivors fly box kite to raise antenna for lifeboat transmitter. Right: Marine radio unit combining twelve separate units in one "packaged" cabinet for Liberty Ship installation. Main and emergency transmitter on left, of 200 watts output on CW, 300 on MCW when used as main transmitter; 50 watts plus as emergency transmitter. Quick-change operation on five predetermined frequencies between 350 and 500 kc is provided. Auto alarm, main receiver and crystal receiver on the operator's right. Federal Telephone & Radio Corp. unit shown.



Low-voltage IR unit heats ship-part to desired temperature, and phototube control lets stock drop through gate at right, in ACF forging heater in Williams Iron Works, New York City

ed seams can be made more permanent than riveted seams, and the welding can now be performed in minutes where hours were required for drilling and riveting. Electric welding thus means lighter, more efficient ships and vast savings of war-critical steel.

One popular method of electronically controlled, automatic arc welding is the Unionmelt process, developed by the Linde Air Products Company, of New York. Widely used in the Liberty Ship program, it is often referred to as "smothered-arc welding." In this system, a thyratron-controlled dc motor feeds bare steel welding rod into the arc, automatically maintaining the gap at a pre-set limit in response to a grid-control voltage developed by the voltage-drop across the arc itself. As the rod is fed to the arc, the entire welding unit is continuously motor-driven along the seam to be welded, at a uniform rate predetermined by the thickness of the weld and other factors.

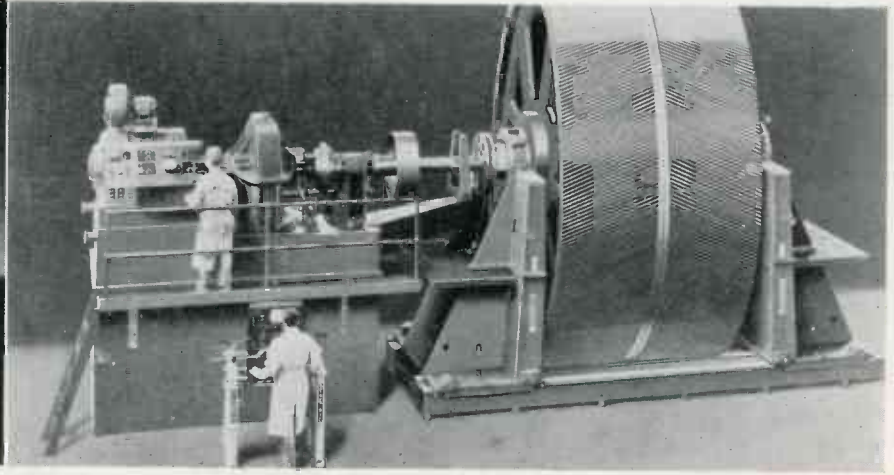
Through a feeder tube, granulated unionmelt composition—a silicate—is fed into the seam ahead of the welding rod. The composition fuses and protects the weld from oxidization. Its insulating property prevents loss of heat by radiation and allows considerably higher welding current than is practical with ordinary coated rod equipment for manual arc welding.

Currents on the order of 4,000 amp. are possible with this method. Current densities in the steel welding rod of up to 30,000 amp. per sq. in. and rod feeds from one-third lb. to one lb. per minute are used in average shipbuilding operations.

The smothered arc is started at the beginning of a seam by inserting a wad of steel wool between the rod and the work. It melts, heats the unionmelt composition, and the arc starts. From this point on, the operation is completely automatic. There is no visible arc or other evidence, normally, that the weld is being made. The weld is completed in one "pass." Tables of current strength, linear speed of the machine, and proper arc voltage allow presetting for various kinds and thicknesses of welds by relatively unskilled operators. Far less training is needed to operate this type of equipment than is necessary to pre-

(*Continued on page* 122)

Million-volt G-E unit X-raying cast steel stern post. Below: Fifty-ton marine reduction gear, set up for dynamic balancing by Gisholt equipment which measures and locates unbalance by electronic means. Variable voltage control on 200 hp drive is electronic



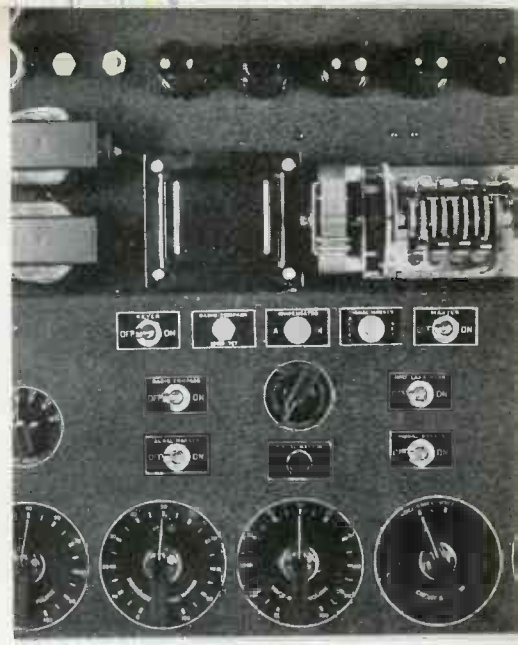
★ *Radio-Electronic* **WAR PRODUCTION**

ELECTRON TUBES In Simulated Flying

by **ALTON DECKER**

Development Engineering Dept., Link Aviation Devices, Inc.

Teaching map-course flying "on the ground" frees military planes for use at fighting fronts



Instructor's radio control chassis

As the rapidly growing aviation industry advanced, the need for great skill in "instrument flying" became increasingly apparent. Because of the expense of actual flight training, and the time required, new methods of training were sought. The fact that the mechanical nature of instrument flight lends itself to practice under simulated conditions led to the development and manufacture of the Link Trainer.

Simulated flight

The Link Trainer consists of a fuselage with wings and empennage, mounted on a universal joint in such a manner as to permit movement in excess of maneuvers normally done on instruments. The complete installation includes an instructor's desk, housing the radio and electrical equipment and controls for producing simulated radio signals and two-way voice communication. Included as part of the desk installation is an ingenious device known as the Flight Log or Recorder. The recorder is electrically connected to the trainer and faithfully traces on a map the exact course the student would have flown had he been actually aloft. Certain of the instruments on the student's instrument panel are duplicated at the desk to aid the instructor in maintaining an accurate check on the student's skill.

Beam and beacon signals

A number of radio aids to navigation are available to a pilot in actual flight. They must all be accurately simulated in the trainer to enable the student to become proficient in securing the maximum benefit of these facilities.

It is in the simulation of these radio facilities that vacuum tube applications predominate. A vacuum tube audio frequency oscillator generates the familiar radio range or beam signal. After being suitably keyed, the signal is applied through a special mixer control to the mixer tube. The mixer tube output is combined with the voice signals to simulate simultaneous voice-range transmission and after further amplification is applied to the student's headphones.

A second audio oscillator tube produces another frequency for simulation of the various marker beacon transmitters. This tone is likewise keyed and superimposed upon the beam signal. A portion of the marker beacon signal is applied to a vacuum tube having a relay in its plate circuit. The relay serves to control a visual marker beacon indicator on the student's instrument panel in synchronism with the aural marker beacon tone.

Pilot-to-ground 'phone

Microphones and headphones are provided at the control desk and in the trainer. These in conjunction with an amplifier are used to carry on two-way communication similar to that occurring between a pilot and the ground stations. The instructor is thus able to "broadcast" weather reports, landing instructions and the like. In addition, the

(*Continued on page* 126)

First lessons in blind flying are 100% safe. Instructor explains instruments

ELECTRONIC EQUIPME

by D. H. GARDNER and J. S. WATT
Geophysical Research Dept., Humble Oil and Refining Co., Houston, Tex.

Difficulties encountered from humidity and heat in tropical areas. Lessons for designers of military radio

The geophysical divisions of the Humble Oil & Refining Company have been using electronic equipment in exploration work since 1925. This equipment includes a number of high-gain audio amplifiers used for reflection and refraction seismic recording, high-, low-, and band-pass filter networks, seismic-operated control apparatus, portable radio transmitting and receiving equipment, thermostat relays, vacuum tube voltmeters, ohmmeters, oscillators, cathode ray oscilloscopes, and other auxiliary test equipment necessary for the proper maintenance of the field apparatus. The electronic equipment requires various types of transformers, inductance coils, condensers, resistors, vacuum tubes, tube sockets, meters, connecting plugs, control jacks, relays, cables, switches, and batteries. Since this equipment is often used in "pack locations" and on small boats, waterproof cases are used. The units are made as compact and light as possible without sacrificing quality of performance.

The organization of geophysical field parties and the nature of the work are such that failures in the electronic equipment are likely to result in serious delays in carrying out the exploration program which may prove extremely costly. From the beginning, therefore, component parts of the highest quality have been procured; nevertheless, many failures occurred after the equipment had been used for a relatively short time in humid climates.

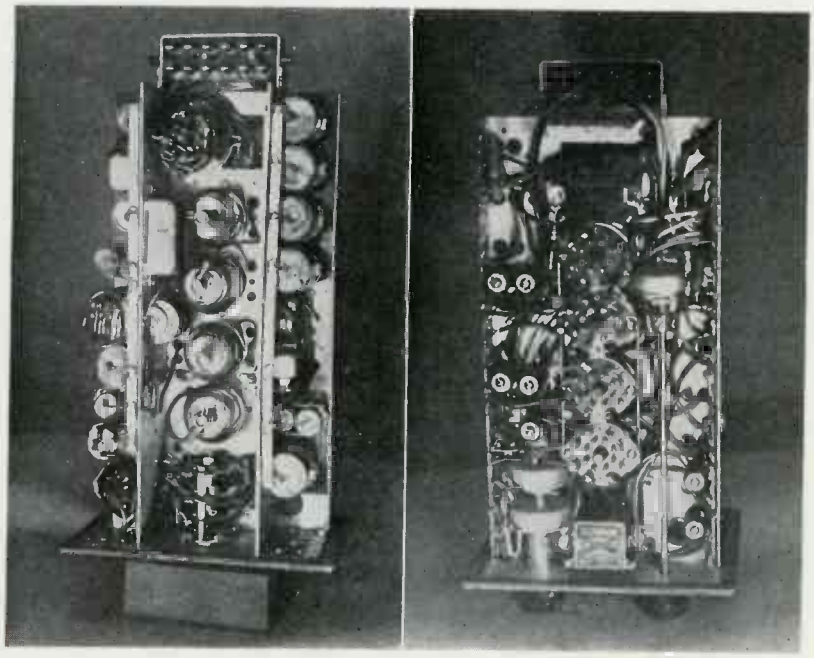
Special designs developed

In the early stages of Humble's field operations, the electronic equipment followed conventional designs. This was satisfactory until operations in swampy areas were undertaken. Some of the adverse effects on electronic equipment appeared within the first few weeks of swamp work, others became evident only after many months of such work, and still others appeared when work was done in tropical areas.

Many years of experience in these areas have resulted in the development of methods and techniques for overcoming some of these difficulties; therefore, it seems desirable that the results of this experience be made available to those concerned with the design of electronic equipment for use in humid areas.

Much work has been done in the swamps and tropical areas of Texas, Louisiana and Mississippi, as well as in the swamps and jungles of Mexico, Trinidad, Venezuela, Colombia, Ecuador, Surinam, Argentina, Sumatra, Java, Borneo, and New Guinea. In these tropical or semi-tropical areas, the relative humidity usually remains at a high level throughout the year and the temperature varies over a wide range during a twenty-four-hour period.

Type of amplifier construction which has proven satisfactory in tropical service. These components have been treated as described in text accompanying



Must keep moisture out

These cyclic variations of temperature cause moisture to be forced through any small cracks or pin holes in the protective covering of the component parts of the electronic equipment. Some moisture is absorbed during each temperature cycle resulting in final failure of the part. Unless all moisture is prevented from entering, breakdowns in electronic equipment will inevitably occur. These failures include: Open circuits in transformer windings, chokes, relays, wire-wound resistors, and molded resistors; the development of leakage in mica condensers molded in bakelite, paper condensers of the tubular type, bakelite terminal blocks, switches, jacks, and plugs;

SUPPLEMENT

ELECTRONIC INDUSTRIES

FEBRUARY 1943

AIEE-IRE WAR Conferences AT NEW YORK, JAN. 26-28

Maximum aid to the war effort was the objective of radio, electrical and electronic engineers numbering nearly a thousand, who attended in force the sessions of the AIEE and IRE held at New York, January 26-28.

First combined meeting of the two groups occurred with the dinner at the Commodore Hotel, January 26, addressed by Dr. Vannevar Bush, director Office of Scientific Research and Development, Washington, who spoke on "Research in the War Effort."

A democracy like ours gets along better when civilian organizations make the weapons with which the military forces fight, declared Dr. Bush, pointing out that scientific men can better take a long-range view than can military men who must plan immediate battle strategy. Such long-range scientific planning is now essential on our side, in view of Germany's long experience in adapting all science to war ends.

Radio must change with war

Modern war is constantly changing, and every phase of the weapons used must change with it. Although military men have been accused of being hidebound and resistant to change, Dr. Bush declared he found the percentage of stand-patters in uniform to be no higher than those to be met with among the engineers, educators and business men whom he previously contacted. Today the men who lead our Army and Navy, said the speaker, are as open to new ideas as is the American public itself, well known as it is, for its willingness to try out new things. And no worthwhile new idea or device, advocated by Dr. Bush's organization, had ever been found held up or blocked by the military people.

Getting most out of tubes

On Wednesday afternoon an informal discussion covered methods of operating electronic devices to improve their life and increase their usefulness under present wartime conditions. During this A. I. E. E. conference, with Dr. S. B. Ingram presiding, the question of adequate rating of electronic devices to permit obtaining of their maximum utility, was also considered, followed by discussion from the floor.

Scheduled speakers during the session were: D. W. Jenks, General Electric Co., "Industrial Electronic Tubes." E. E. Spitzer, Radio Corporation of America, "Radio Broadcasting Tubes." C. C. Herskind, General Electric Company, "Mercury Arc Rectifiers." G. H. Rockwood, Jr., Bell Telephone Laboratories, "Rating of Electronic Devices." In opening the session, Chairman Ingram imposed the restriction that neither prepared speeches or discussion be reported for publication.

RF high-voltage supplies

At the IRE Thursday morning technical session, O. H. Schade, RCA, showed that for the operation of cathode-ray tubes requiring high-potential dc sources ranging in voltage from one kilovolt to 30 kilovolts, the use of high-frequency power sources instead of 60-cycle power permits a substantial reduction in size and weight of component parts. In addition the limited input power, generated by vacuum-tube oscillators permits the construction of safe supplies when the current requirements are low.

For obtaining high efficiency, the tuned r-f step-up transformer windings must have high impedance

LOOK INSIDE FOR LARGE CHART (IN COLORS) OF

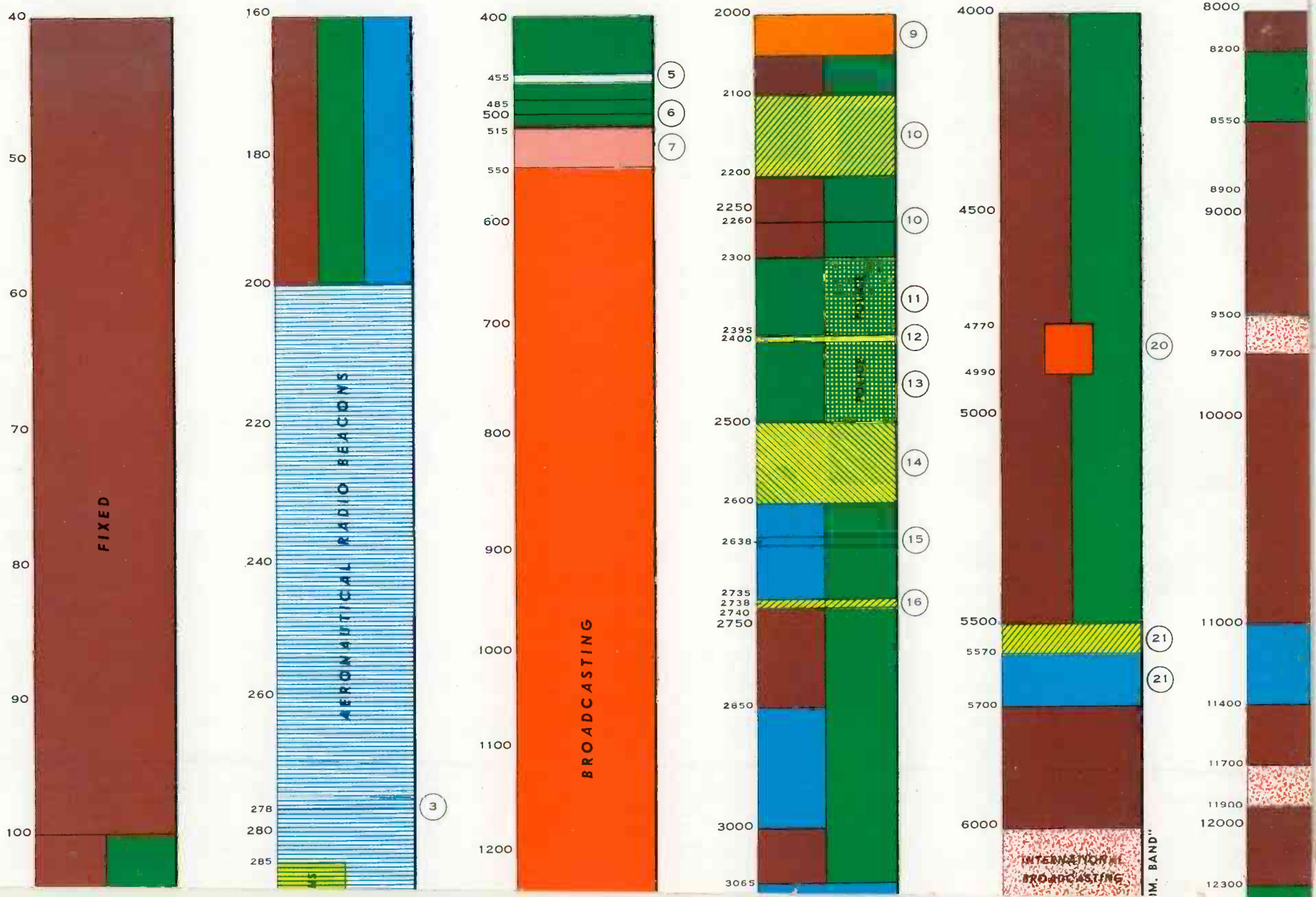
RADIO FREQUENCY ALLOCATIONS

Compiled by Electronic Industries in collaboration with RCA Laboratories

Supplement to
Electronic Industries
February, 1943

RADIO FREQUENCY ALLOCATIO

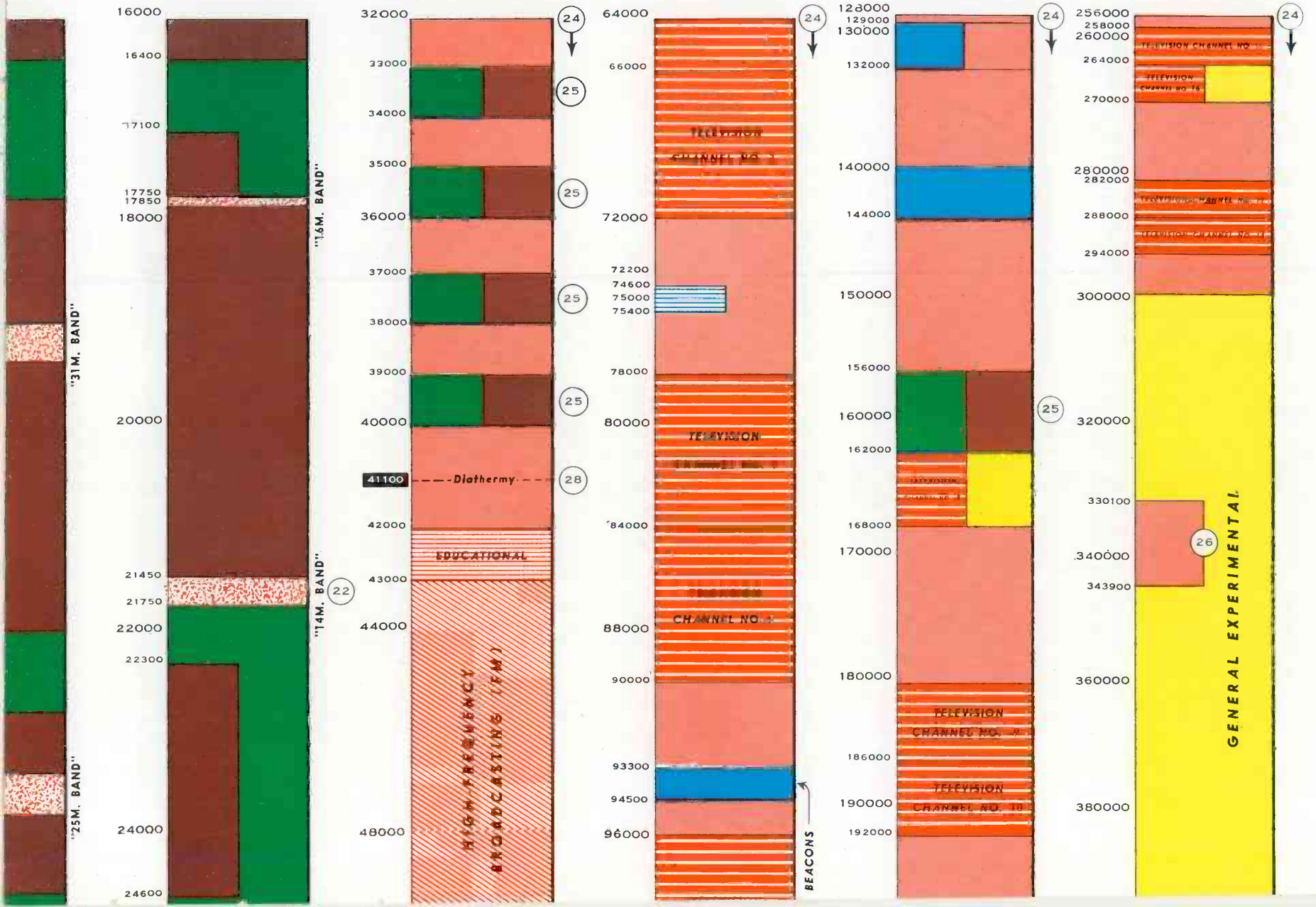
ALL INDICATED FREQUENCIES ARE IN KILOCYCLES • NOTE THAT ABOVE 2,000 KC, ALL FREQU

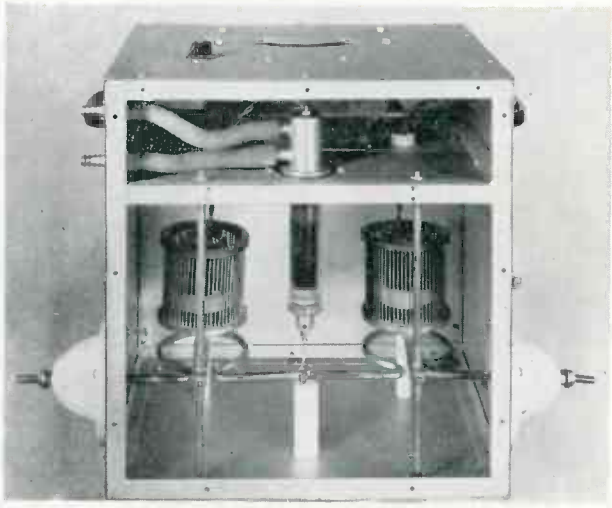


IS for WESTERN HEMISPHERE

AS OF FEBRUARY 1, 1943

NCIES OPPOSITE EACH OTHER IN ADJOINING COLUMNS ARE IN HARMONIC RELATIONSHIP





Direct-reading radio-frequency wattmeter

and a low power factor. When used in a self-oscillating circuit, primary and secondary tuned circuits must be over-coupled to obtain efficient energy transfer. The circuit has then, a double hump tuning characteristic, requiring that the oscillator frequency be stabilized at one of the peaks by feedback from the secondary winding.

The power loss at a given voltage is proportional to the tuning capacitance of the high-voltage circuit which is hence to be minimized by design. Cost and size of high-voltage supplies compares favorably with those of similar 60-cycle supplies. Results with developmental units in television equipment have been very satisfactory.

Polydirectional microphone

A paper by Harry F. Olson of RCA Laboratories, Princeton, N. J., described a polydirectional microphone consisting of a single ribbon, the back of which is coupled to a damped folded pipe and an inertance in the form of an aperture. A single infinity of directional characteristics, ranging from bidirectional, through all variations of unidirectional to nondirectional, may be obtained by simply varying the size of the aperture.

Wattmeters for radio frequencies

An unscheduled paper by George H. Brown, J. Epstein, and D. W. Peterson, RCA, described direct reading rf wattmeters, explaining that the principle on which the operation of these wattmeters is based, has been known for many years. The contribution of the authors lies in the application of the principle to a practical operating instrument for the measurement of high power at radio frequencies.

Two instruments were described. The first is useful in the range of frequencies from 500 to 2,000 kilocycles. This instrument contains circuits which permit operation at any frequency in this band with no tuning or other change in the instrument.

The second instrument operates in the region near 50 megacycles. It is inherently a single-frequency device constructed from sections of transmission lines.

The theory of operation was discussed, as well as calibration methods. Test data taken with the instruments with loads having a wide range of power factors are compared with power measurements made on water-cooled loads.

Annual meeting, IRE

With the new president, Dr. L. P. Wheeler, in the chair, the IRE's annual meeting of Thursday afternoon opened with a gracious message of international greeting from the Institute's new vice president, Dr. F. S. Barton of the British Air Commission, now stationed at Washington.

Retiring President Arthur Van Dyck followed with a thoughtful address outlining the Institute's achievements during 1942 and pointing directions for future development into broader fields of public service. IRE now has 8671 members, said President Van Dyck, a growth of 23 per cent during the year. He estimates that 350,000 persons are now engaged in making precision radio equipment for our fighting forces.

Engineers and scientists have come to a crucial point in the development of civilization, said President Van Dyck. For they have brought about progress that has culminated not in greater freedom, happiness and security, but in the most destructive conflict the world has even seen. Facing this, they have the opportunity now to decide to do something in the future which will give saner judgment and more scientific control of the forces unleashed by science.

Engineers are best trained

"These social, governmental and international matters have now assumed larger importance than the technical things to which we have heretofore confined ourselves," said the speaker. "For we are by training and experience better able to cope with the problems involved than others not so trained. But if we do not exhibit interest and activity in them, we shall find ourselves in a world of chaos. Isolationism is now impossible, for scientists, as well as for nations.

"Perhaps we can find a good lesson in the current performance of Soviet Russia. Many have wondered at the remarkable way in which that country has turned back the mighty German military machine. Perhaps the secret lies in the Soviet plan whereby economic control and industrial management were unified in the hands of young production engineers. This change has gone so far that nearly one-third of the government offices are now held by engineers. These men are not only better fitted technically to handle a technical economy, but are more interested in their professions, and less interested in political problems.

"As my retiring message, I submit the proposition that the time has come for us to think of larger

Ray C. Ellis, director of Radio & Radar Division, War Production Board

responsibilities, to seek them, and to accept them," said President Van Dyck. "Only by so doing can we do our full duty toward making this world safe for civilization."

March to higher frequencies

An unusual philosophic approach to radio-engineering trends was contained in the paper by Dr. Lloyd Espenschied, Bell Telephone Laboratories, who traced the history of communications in underlying physical dimensions of energy, time and space —defining message information as "energy patterns in space and time."

"The electronic method of energizing the wave path, with its extreme sensitivity and rapidity of response, has led to the attaining of higher and higher frequencies, whereby we recognize that in the extended frequency spectrum a great new dimension of exploitation is being opened for both wire and radio communication. The whole history of electric communications from its beginning about a century ago, up to and including the recent remarkable advances, can in fact be pictured in terms of this March to the Higher Frequencies." (At right.)

Navy's radio needs

The paper by Admiral S. C. Hooper, U. S. N., general consultant for radio, radar and underwater sound equipment, was read in his absence due to bronchitis, by Commander J. L. Allen, communication officer Eastern Sea Frontier. Admiral Hooper outlined the severe requirements necessary for military and navy radio. These new specifications reflect the demand for perfect performance; perfect reception by planes flying at 20,000 ft., battling ice and sleet as well as the enemy; perfect reception by pitching tanks, jolting through shell-holes in the heat of the African deserts; perfect reception for all our mobile equipment, whether in the battle of Midway, the Aleutians, or the green hell of steaming jungles in the Solomons.

$200,000,000 per month—Ellis

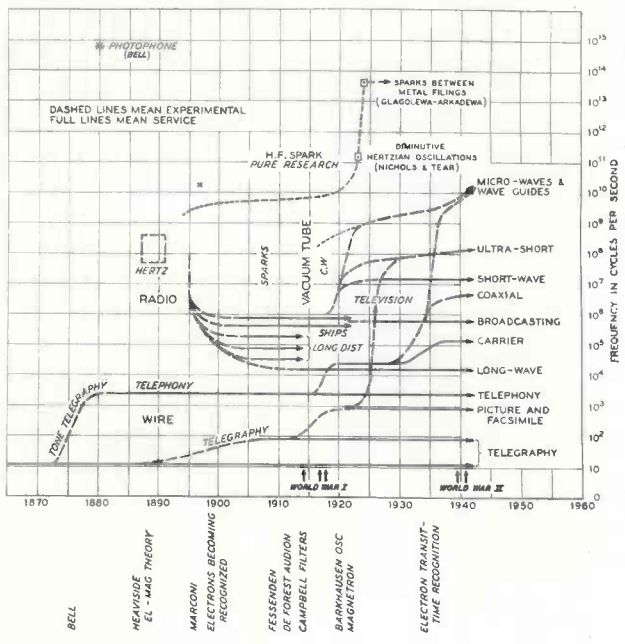
Radio sets for the military, said Ray C. Ellis, director Radio & Radar Division, War Production Board, Washington, are as much different from the home radio that sits in the corner of the living room, as a well-groomed civilian differs from a trained and toughened commando fighter. From military-radio productions of $8,000,000 per month, in July, 1941, and $15,000,000 at the end of 1941, WPB has increased production up and up, until this year the military-radio output is at the rate of $200,000,000 per month. Where formerly 50 concerns made home radios, 1500 manufacturers are now engaged in the vast radio-production program. To supply the materials and plants for this tremendous production, involves scrupulous care and constant ingenuity.

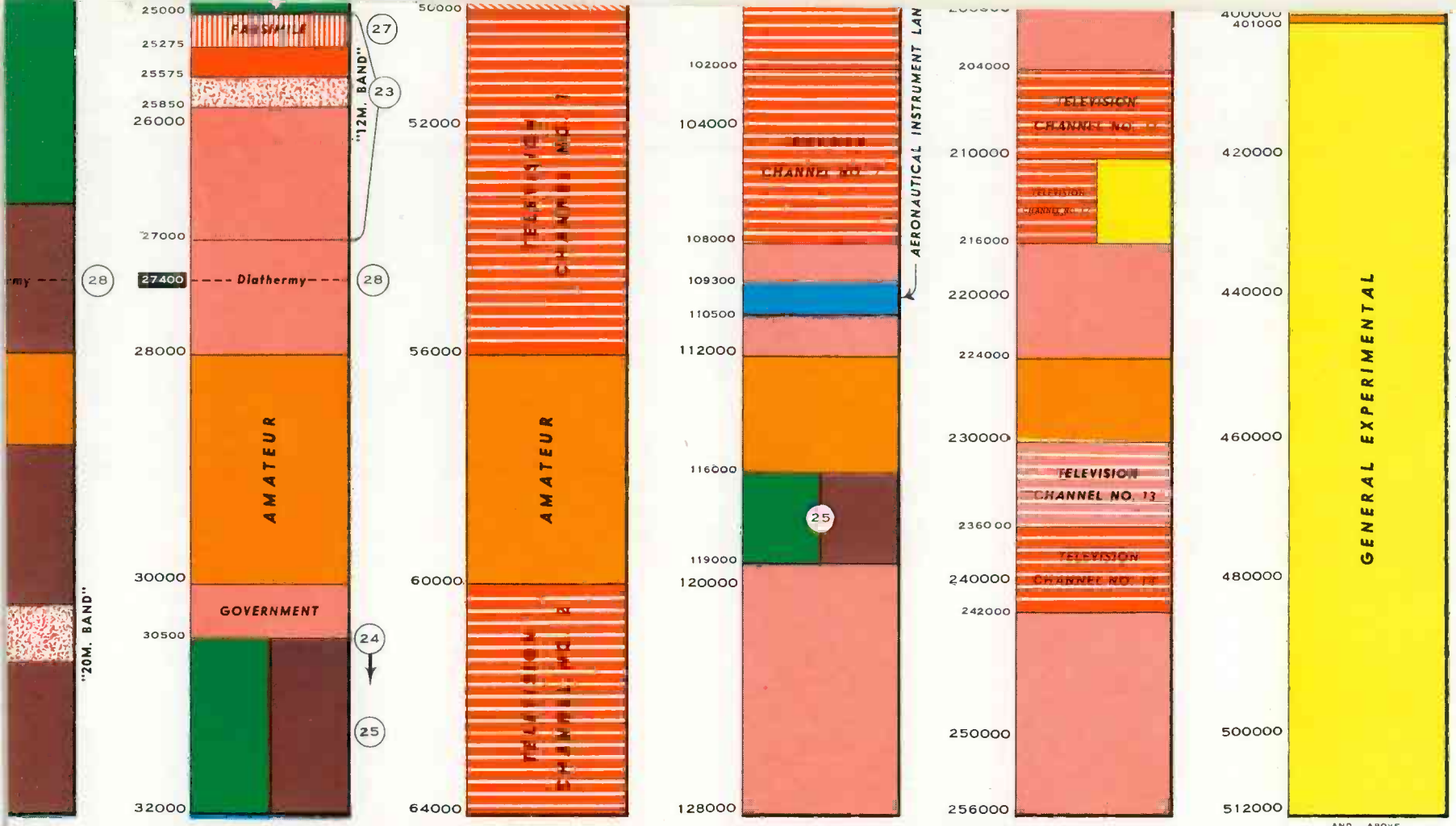
Along with this great military program, tubes and parts must also be made available to keep radio broadcast stations on the air and receiving sets in operation in American homes. This problem is being met in a way analogous to the food-rationing program. Housewives now know there is going to be sufficient food, though it may be of less variety. The civilian-radio situation can be expressed in about the same terms, commented Mr. Ellis. Meanwhile we are achieving our huge 1943 goals in military radio, although by the end of 1943, radio production will be far above even present levels.

Electronics Production Agency

Fred R. Lack, director Army-Navy Electronics Production Agency, explained how that new organization is supplementing, not supplanting, the efforts of the manufacturers' own expediters, with the aid of the "precedence list" of materials and the analysis and control of production. ANEPA has been able to get critical men furloughed from the army to complete training of successors in factories.

Dr. Espenschied's "historigraph" showing the continuous advance into higher and higher frequencies





BROADCASTING | TELEVISION | INTERNATIONAL BC | GOVERNMENT | AERONAUTICAL | AERO. RADIO BEACONS | AERO. DIR. FINDING

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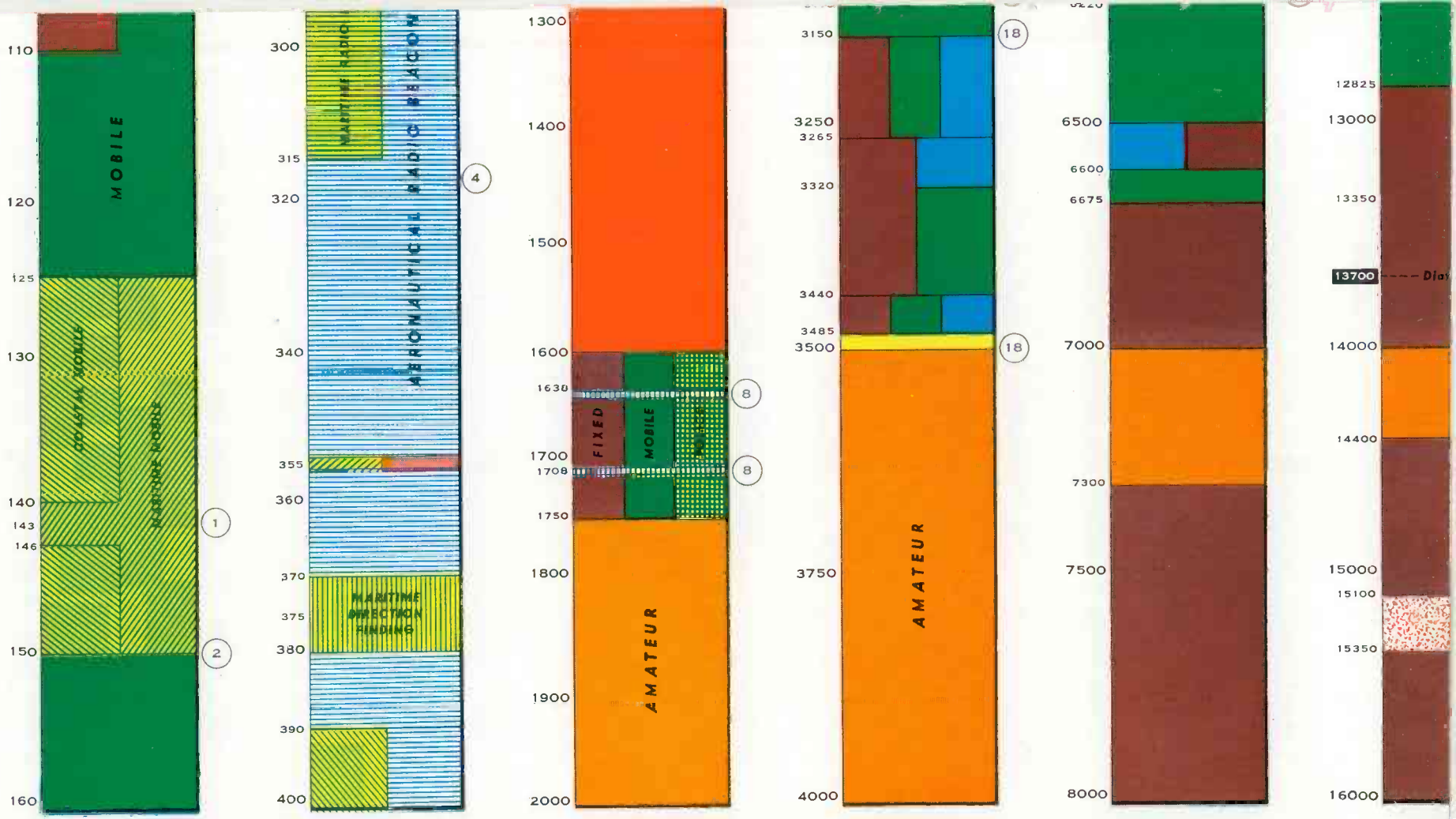
n of America

14. North and Central America, mobile primarily coast stations; South America, fixed and mobile.
15. North America, inter-ship frequency 2638 KC; Central and South America; aeronautical and mobile.
16. North and Central America, inter-ship frequency 2738 KC; South America, fixed and mobile.
17. Aeronautical calling frequency.
18. South American region, fixed and mobile.
19. Primarily aeronautical.
20. Broadcasting services permitted only in South America north of parallel 5 degrees S.
21. South America, general mobile service.
22. The U. S. reserves the right to use the band 21650-21750 KC for mobile as well as broadcasting service.
23. Allocations shown are those applied in the United States. Inter-American agreement assigns this band to broadcasting.
24. Allocations shown are those applied in the United States. (Inter-American agreement makes no allocation of frequencies above 300,000 KC).
25. The allocations in these bands are on a specified channel basis assigned for Government, relay, aviation, police, maritime, marine fire, forestry, fixed, experimental and miscellaneous radio communication services.
26. Studio to transmitter link transmitters for hf or international BC stations.
27. Experimental service only authorized. Commercial facsimile service is permitted in the U. S. only as an adjunct to high frequency broadcasting (FM) in the form of multiplex transmission.
28. Frequency assignments proposed for therapeutic devices (diathermy).



FIXED | MOBILE | COASTAL MOBILE | MARITIME MOBILE | MARITIME RAD. BEACONS | MARITIME DIR. FINDING | GENERAL EXPERIMENTAL | A M

ALLOCATION NOTES

1. General calling frequency.
2. In the European region, the band 150-270 KC is used primarily for broadcasting.
3. Aeronautical (airport control) frequency.
4. In the Eastern European region, the band 320-445 KC is used also for broadcasting.
5. U. S. protected superheterodyne-receiver intermediate frequency.
6. Distress, calling, etc.
7. In the European region the standard broadcast band covers 520-1500 KC. The frequency 540 KC is assigned to a 50-KW Canadian broadcast station at Watrous, Sask., by special agreement between the U. S. and Canada.
8. North America, 1638 KC aeronautical direction-finding; Central and South America, 1638 KC and 1708 aeronautical direction-finding.
9. North America, exclusive amateur; Central America amateur, fixed and mobile; South America, fixed and mobile.
10. In South America, exclusively ship stations.
11. North America, primarily police; Central America, mobile, primarily police and broadcasting; South America, fixed and mobile with broadcasting authorized between latitude 5 degrees and 30 degrees S.
12. North and Central America, experimental, also broadcasting in Central America; South America, fixed and mobile and broadcasting (See Note 11).
13. North and Central America, primarily police; South America, fixed and mobile and broadcasting (See Note 11).

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RCA LABO
Radio Corpora

Manpower is still the major problem, for while general industry will need five million more men for present demands looking to doubling its output, three million workers must be passed to the Army, so that in all industry must shortly find eight million new workers not yet employed!

War standards for radio

Harold P. Westman, former secretary IRE, now spending full time on War Standards for Radio with ASA, said: "Needs of the military services have brought radio engineers face to face with the problem of standardizing to increase production and to husband the use of scarce materials. This process started in the last war, and with this war is taking another great spurt forward." Mr. Westman covered the history of radio standardization, and told what is being done by industry and government together, through the American Standards Association, to fill that need. Some war standards for radio have already been completed and many more are in the course of development.

Directional-antenna calculator

Carl E. Smith and Edward L. Gove of Hollywood, Calif., described an electro-mechanical calculator which automatically draws field-intensity curves and indicates rms values. Horizontal field intensity curves as well as curves for any elevational angle can be obtained and the vertical characteristics of the several antennas may be selected at will. Any number of antennas can be analyzed.

Radio sets and power systems

In a paper on measurements pertaining to co-ordination of radio reception with power apparatus, C. M. Foust and C. W. Frick, General Electric Company, treated of co-ordination between power circuits and radio receivers and particularly the measurements relating to this problem. The subdivisions — Radio-noise meter calibration, relation of apparatus noise levels to radio-receiver interference, radio-influence voltage for apparatus and radio-influence voltage variable in apparatus testing, indicate the scope of the paper.

The effect of radio frequencies of a power system on radio-receiving, was discussed by C. V. Aggers, W. E. Pakala and W. A. Stickel. Radio-frequency voltages and fields of power lines and their effect on radio antennas were investigated. The results indicate the influence of radio-frequency voltages incidental to the operation of power systems on radio receiving systems.

Switching

Determination of contact-making and breaking time, was subject of Walther Richter and William H. Elliot, Cutler Hammer Mfg. Co.

The device for quick determination of the operating time of a contact measures the charge accumulated on a condenser during the time interval to be determined. The constant loading current of condenser is controlled by a pentode biased beyond cut-off by the voltage drop in a resistor. The charge on the condenser is determined by means of a Wheatstone bridge.

Use of the cathode-ray oscillograph applied to long-time switching transients, was discussed by G. W. Dunlap and N. Rohats. A two-tube low-voltage oscillograph was successfully used in two special instances. It was shown how measurements of long-time transients may be made with portable, inexpensive, and relatively simple equipment.

Beyond the Ultra-short Waves

Among all groups there was wide interest in the address Thursday evening by Dr. George C. Southworth, Bell Telephone Laboratories, who pointed out desirable features of the "micro" waves above a billion cycles per second; their great number, their non-interference beyond the lines of sight and the small size and high directivity of their antennas.

For conducting radio waves from generator to antenna, ordinary insulated wires can be used in the broadcast range and beyond, but in the short-wave range special attention must be given to losses in the insulation, to radiation into space and into nearby conductors, and to the effects on tuning produced by stray capacity and inductance. The coaxial line, in which one conductor is formed into a tube, and the other is enclosed in it, is an excellent expedient. If the central conductor is completely removed, however, it is still possible to transmit energy down the tube which then becomes a "wave guide." If the tube is filled with insulating materials, even the outer conductor can be removed. The coaxial and the conducting tube or wave guide are the most promising of these arrangements.

Compared from the standpoint of attenuation losses, the coaxial is better at the lower frequencies; but in the microwave region, which is of most importance at the moment, the wave guide has decided advantages.

Admiral Hooper Recounts Radio's Deadly Aim at Casablanca

Rapid movement of armed forces in the air, on the ground, on and under the sea in World War II, makes success impossible without instantaneous, secure, and positive radio communication.

A dramatic illustration of this was provided during our invasion of North Africa. The deadly accuracy of firing by one of our battleships which destroyed the "Jean Bart," at Casablanca, was made possible by radio communication. As the first blast from our big guns, twenty-six miles away, struck the resisting French battleship, an observation plane flashed back the word of a direct hit on the deck, a damaging but not a fatal blow. A slight change in elevation was signalled for. The next salvo struck the side of the ship at the water-line, smashing her hull beyond repair!

NT in HUMID CLIMATES

in some instances, leakage due to fungus growth forming in critical parts of the circuit; and the breakdown of insulation between individual windings and between the windings and cases of transformers.

The solution of these difficulties has been found in the technique of driving the moisture from parts and keeping it out by the application of soft pliable waxes for impregnating and potting compounds. These waxes are applied to the part that is to be treated either by dipping the part for a period of a few minutes to several hours, depending on the part that is being treated, or by potting. In all cases, the moisture is first driven from the part to be treated. The waxes which have been most satisfactory are ceresin, Rust Ban and Superior Compound.

Ceresin is refined ozocerite, a natural earth wax. This wax is used for impregnating the surface of small coils and bakelite molded condensers and resistors. Ceresin serves as an excellent medium for transferring heat into a small coil or condenser in order to drive out the moisture. For this use, ceresin has a number of advantages over the other waxes tried. Its presence on lugs and terminals does not interfere with the soldering process; its surface resistance at 90 per cent humidity is much greater than that of paraffin, beeswax, or a combination of these. As a potting compound, however, ceresin is not satisfactory due to its tendency to chip, when solidified. Ceresin can be obtained from the J. T. Baker Chemical Company, Phillipsburg, New Jersey.

Impregnating compounds

Rust Ban is a rust preventive grease developed by Humble and listed as Rust Ban 327. It has been found satisfactory for impregnating resistors of the cement coated type because of its viscosity-temperature characteristics. Its use has resulted in eliminating troubles due to corrosion in the ceramic type resistors, especially where the resistors are used in circuits in which little heat is developed, or where the use is intermittent.

Superior Compound is a black tarry wax generally used as a potting compound. The success in the use of Superior Compound as an impregnating substance is due to the fact that it is a thin fluid at 140 deg. C, changing to a rubbery mass at normal temperatures. It does not become brittle or develop cracks when the normal temperature is reached. It can be used for potting at temperatures between 130 deg. and 175 deg. C, depending on the nature of the insulation and construction of the part being potted. This compound can be obtained from any Western Electric or Graybar distributor.

Tests by burying underground

As a test of the effectiveness of various waxes, many types of condensers, both treated and untreated, having insulation resistance around 20×10^9 ohms, were placed in a paper bag and buried under about three inches of moist soil in the spring of the year. In this way, the humidity remained high and some variation of temperature took place. Some of these condensers were treated with Superior Compound for the terminal and end seals only. Some of the mica molded condensers were treated with ceresin; others with beeswax and paraffin. At the end of six weeks, these condensers were retested. The tubular condensers having the regular factory treatment were ruined; those having Superior Compound impregnation at the end seals only showed no change from the original insulation resistance value of 20×10^9 ohms. These tests proved that the factory wax impregnation of the paper tube was effective in keeping out the moisture, but that the solid wax, used by the factory for end seals, was not effective. The bakelite molded condensers, which had been treated with ceresin or the beeswax-paraffin mixture, showed little change in leakage; those that had not been treated showed a large decrease of insulation resistance to 2×10^6 ohms or lower. Practical experience in tropical areas with ceresin and Superior Compound impregnating substances has substantiated these tests.

Typical seismograph amplifiers being tested under jungle conditions in Sumatra

The general use of Superior Compound and ceresin as impregnating substances and the technique of removing and sealing off the moisture have been responsible for eliminating failures of component parts in our electronic equipment. The technique described is quite simple and can be applied to electronic equipment in remote regions without elaborate apparatus.

An improvement in this technique might be found in a method of applying heat at reduced pressure for removing the moisture or a system of vacuum impregnation for applying the waxes. The use of vacuum tight cases for the

Procedure for Protecting Against Tropical Humidity

NAME OF COMPONENT PART	TREATMENT OF PART					REMARKS
	Drying Time	Oven T°C	Impregnating Substance	Bath Time	T°C	
SPECIAL HIGH VOLTAGE HIGH IMPEDANCE COILS			Ceresin	1 Hr.	140°	When cool dip in Superior Compound*
COILS: (With paper insulation)	16–24 Hrs.	†75°–85°	WE Superior Compound	Dip	150°–175°	*
COILS: (With Bakelite or fiber insulation)	16–24 Hrs.	†100°–120°	WE Superior Compound	Dip	150°–175°	*
TRANSFORMERS, Audio (paper insulation)	16–24 Hrs.	†75°–85°	WE Superior Compound	Dip	150°–175°	Dip winding out of case, seal off air bubbles, then pot in case*
TRANSFORMERS, High Voltage Power Type	16–24 Hrs.	†100°–120°	WE Superior Compound	Dip	150°–175°	Dip winding out of case, seal off air bubbles, then pot in case*
RESISTORS: Wire Wound, Ceramic Type, Cement Coated			Rust Ban 327	30 Minutes	140°	Heat until bubbles cease. As resistors cool, dip in Rust Ban until excess remains. Wipe off excess when cool
RESISTORS: IRC WW4 Type	16–24 Hrs.	†105°	WE Superior Compound	Dip	150°–175°	Scrape Superior Compound off one ceramic end and mark value*
RESISTORS: Bakelite molded high resistance	16–24 Hrs.	65°–75°	WE Superior Compound	Dip	140°	Seal bubbles when cool and identify*
CONDENSERS: Molded Mica (New) $R>10^9$ ohms			Ceresin		110°	Condensers are placed in ceresin after heater is removed and left until cool (<70°C)
CONDENSERS: Molded Mica (Old) $R<10^9$ ohms			Ceresin	3 Hours	140°–150°	Check for leakage when *cool*. Repeat treatment if necessary
CONDENSERS: Paper Tubular (NEW) $R>10^9$ ohms			WE Superior Compound	Dip	150°	Make sure wax covers each end—seal*
CONDENSERS: Paper Tubular (Old) $R<10^9$ ohms First Operation			Ceresin	1 Hour	140°	Tie wire leads against tube before heating to prevent leads breaking from foil. Check for leakage when cool
Second Operation			WE Superior Compound	Dip	140°	See that wax completely fills space at each end*
CONDENSERS: (Sealed in Cans) (for $R>10^9$ ohms)	5–10 Minutes	†100°–120°	WE Superior Compound	Dip terminals	150°	
SWITCHES AND JACKS: for High Voltage of High Impedance Circuits	12 Hours	†100°–120°	WE Superior Compound	Dip insulation	150°	Dip to cover insulation* *and seal air bubbles**
WIRING	USE PLAMENOL FOR THE HIGH IMPEDANCE CIRCUITS					

*Seal off air bubbles, when cool, by applying tip of hot soldering iron.
†Where no oven is available heat in ceresin from one to three hours.

smaller chokes and transformers might be effective if the coils were moisture free initially.

Treatment of transformers

Transformer failures were experienced from the very beginning of field operations. In audio transformers, the most frequent failures resulted from open circuits in the primary windings, where a dc potential existed between the winding and the case; however, some failures occurred in the secondary windings, where only a small potential existed. Other failures were due to leakage that developed between the windings and the case. The failures were usually preceded by intermittent noise. Of the leading makes of transformers available, none was found that would stand up in this service for more than a year. Inspections of many of these transformers revealed that the breaks in the winding were due to electrolytic corrosion. These inspections also revealed small cracks in the potting compound. The cracks in the impregnating waxes permitted moist air to enter the windings, causing the corrosion of the wire. In 1938, the practice of treating and impregnating the windings and repotting transformers was made general Humble practice.

No failures in any of the transformers that have been so treated have been observed since that time, although dozens of the untreated or, rather, factory treated transformers developed open windings. These transformers were of the same factory shipment and were used under identical conditions. For the past few years, all transformers used by Humble have been treated according to the procedure outlined in accompanying table.

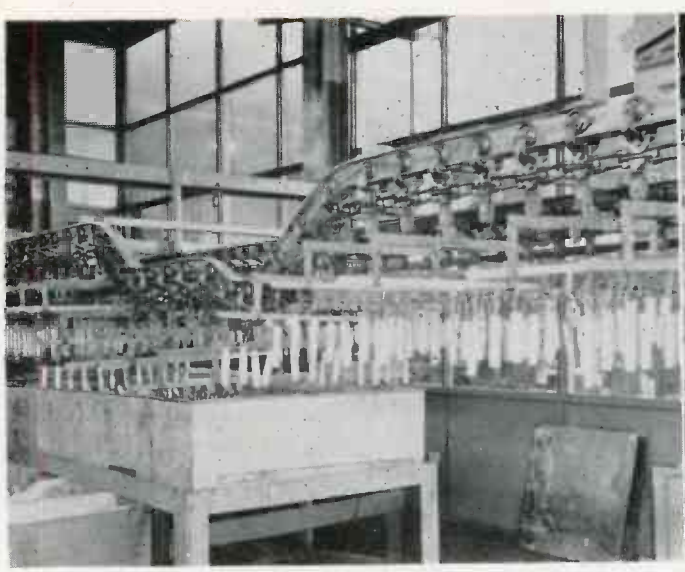
For the high-voltage power transformers used in low powered radio transmitters (up to 50 watts) and in cathode ray oscilloscopes, the most frequent failures were caused by breakdown of the insulation of the high-voltage winding. This was brought about by the presence of moisture. For preventing these failures, either the procedure outlined in the accompanying table can be used or the transformer can be heated in transformer oil at 130 deg. C until the small bubbles cease coming off, and then either sealed in its case in transformer oil or potted in Superior Compound. Either of these methods will keep the moisture out of the high-voltage windings. Whenever unprotected high-voltage transformers are used in intermittent service in humid areas, breakdowns are certain to occur.

Wire-wound resistors

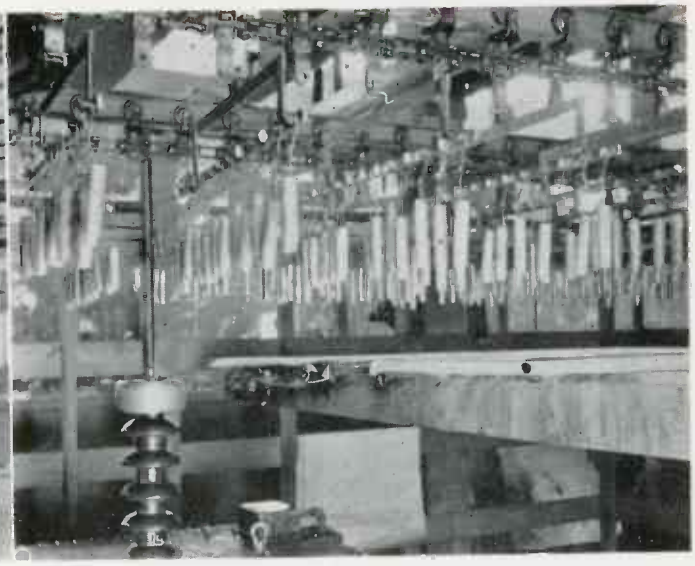
The failure of wire-wound resistors of the precision, ½ megohm type accounted for some of the difficulties with electronic equipment in the tropics. Open circuits developed in resistors used in either plate or grid circuits, but more failures occurred in high potential plate circuits. Since 1936, many of these resistors have been impregnated, using the technique as outlined in the table. None of the treated resistors have failed, although the untreated ones continued to give trouble. Small labels showing the values of the resistors may be held in place by means of cellophane tape.

High resistance relay coils, that had been impregnated with bakelite varnish, frequently failed in this service. These were wound with No. 44 wire and operated on less than 1 milliampere of plate current. Where practicable, these relays were moved from the plate circuit to the cathode circuit, thus reducing the potential existing between winding and case of the re-

(*Continued on page* 124)



Cartridge cases on conveyor enter dip-tank



Coated steel cases over high-voltage plate

★ *Radio-Electronic WAR PRODUCTION*

ELECTROSTATIC DIP COATING PROCESS

One of the major projects in the materials conservation program is the substitution of steel for brass in the production of cartridge cases. However, it has not been possible to apply the necessary protective coating to the steel with uniform results by ordinary spraying or dipping methods, because of the stringent specifications for the thin paint film and the close dimensional tolerances required.

Overhead conveyor

In a process developed by the Harper J. Ransburg Company, Indianapolis, Indiana, the inherent speed of the dip coating method is taken advantage of by using electrostatic attraction to remove droplets of excess coating material. The 85,000 volts used is supplied through vacuum tube rectifiers. Name and location of the cartridge case manufacturer are withheld for reasons of safety.

The steel cases are hung on an overhead conveyor which carries them through a dip tank, over a drain board, and allows a short air-dry period. When the material has practically ceased flowing, the conveyor passes over or between high-voltage plates. The attractive force between the plates and the grounded piece automatically removes the excess material from the drain-off points.

The manner in which the excess material leaves the drain-off point is influenced by its contour. The sharper the edge, the more it tends to leave in a fine stream or spray. If the drain-off point is of very small radius, the material will leave in heavier streams and in some cases will be "thrown off" very quickly in rather large globules. This is particularly true if the coating material is pretty well set up.

Timing cycle

The length of time the piece is in the electrostatic field will vary, depending upon the radius of the drain-off point and the characteristics of the coating material. In most cases, a few seconds is sufficient to remove the objectionable accumulation of material, leaving the desired film thickness.

The design of electrodes depends upon the article being treated and the speed of production. It is essential that each drain-off point be directly exposed to the high-voltage plate. In most cases a horizontal plate suspended beneath the dipped pieces is sufficient. Multiple rows of articles may be treated simultaneously and a tremendous production is made possible with one unit. Some articles have a number of drain-off points along their vertical plane which necessitates a single or double row passing between vertical plates.

Location of electrodes

The distance from the dip tank to the electrode structure is determined by the rate of production and the length of time required for the paint to flow down and set up properly. In general, this requires from two to four minutes between the dip tank and the electrostatic field.

The spacing of the electrodes from the drain-off point varies with different articles and is determined largely by the shape of the item at the drain-off point. On most articles this distance is not highly critical, but should be in the neigh-

(*Continued on page* 130)

FACTORY

ONE-SHOT induction heating replaces individual soldering of transformer-can terminals, speeds production, makes cleaner job

Foot controlled air-vise

Short cut to speedier drilling and tapping operations, small air-operated vise has also reduced troubles due to muscle-fatigue of workers' hands at Industrial Timer Co., Newark, N. J. "Mass production" part to be tapped was formerly held in special pliers on surface of drill-press table. With air-operated vise, V-blocks center part in position under tap. Air pressure of 20 lbs. per sq. in. gives mechanical pressure of 300 lbs. in vise jaws.

Saving materials

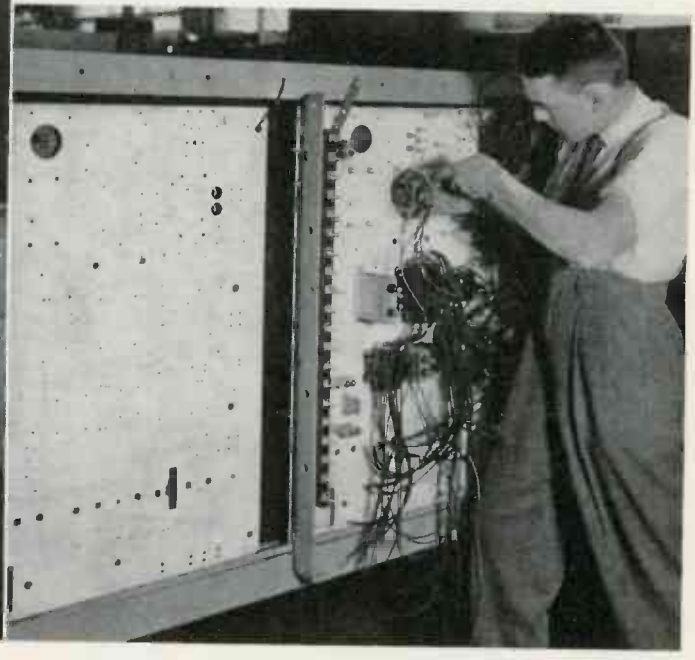
Drive to avoid waste of materials and spoilage of work at Federal Telephone and Radio Corp., Newark, N. J., has paid dividends. Workers are urged to keep tools sharp and in tip-top shape. Proper packing of parts in containers is emphasized, to avoid breakage in shipment. Dropping screws, nuts, and other small parts on floor, then reaching for another because "there's a whole box full" at arm's length results, for entire plant, in tremendous waste of hard-to-get materials. Workers are shown how total mounts up by looking at shoe-box full of parts salvaged from day's floor-sweepings. Patriotic motives are stressed.

Tool conservation

"Don't let **this** happen! Tool room CLOSED due to tool shortage. There is only so much tool steel available! Every time a tool is broken, that tool must be replaced if production is to continue. Today, it takes as much as six months to obtain tool replacements." Thus reads one of

← **HIGH TEMPERATURES** are no problem when objects are handled with air-conditioned asbestos gloves. Low-pressure air piped into gauntlet of each glove enables worker to handle heat-processed items without using tongs or waiting for objects to cool

WIRING DIAGRAMS on oil-resistant paper are pasted to panel boards or chassis in G-E welder-control plant. In addition to speeding assembly, templets assure uniformity of mounting of the various units and simplify maintenance work in the field ↓



SHORT CUTS

series of 2 1/2 x 3 1/2 foot 3-color posters obtainable from Genesee Tool Company, Fenton, Michigan. First poster shows tool crib with empty shelves, as start of campaign to give workers more respect for war-scarce tools.

It's in the bag

Having dust problems? Here's stunt, used by manufacturers of precision optical instruments, which might be of value in some branch of radio-electronic war production. Ordinary brown paper bags, opened and placed mouth-down over microscopes, etc., have proved effective in protecting delicate assemblies from dust between steps in manufacture, whenever any off-work period is at hand, or when units are to be moved to and from work rooms.

TO SAVE 90% of critical magnets formerly rejected because brittle metal chipped and spoiled close tolerances, William M. Gaffney suggested cutting oversize and machining as last step

ADJUSTING gang-shaft gears without removing condenser assembly, new method saves time for RCA

INSPECTION of lamp bases is speeded 400% by Westinghouse sloping "jiggle table." Note "turnover tubes" at middle of table

Ingenuity in expediting

Syracuse, N. Y., company working on order for a radio corporation found it could not continue because of lack of phosphor bronze rod required. Syracuse company had searched throughout its vicinity without success, and without rod delivery could not be made.

After many unsuccessful attempts to obtain material from recognized sources, field expediter, Robert E. Corbin, of Cortland, N. Y., found an unfamiliar source of phosphor bronze rod.

Since it was necessary to buy rod immediately, Corbin purchased it out of his personal funds.

Loading it into his car, Corbin delivered it to Syracuse company himself. Company immediately reimbursed him and gave definite promise of delivery on Nov. 18.

Climax of the story is the fact that company not only kept delivery date promise but evidenced its appreciation of the expediting by informing Corbin work was finished November 17—24 hours ahead of schedule!

A group of students at WFIL Radio School who are learning art of sending and receiving code messages for the Navy

★ *Radio-Electronic WAR PRODUCTION*

WFIL TRAINS RADIO MEN for NAVY

Broadcast engineers and staff teach code. Students get "tactical tests" under war conditions

WFIL broadcasting station in downtown Philadelphia is a member of the Blue network and also is the home of FM station W53PH. Its general manager, Roger W. Clipp, in addition to other war activities, in cooperation with Lieutenant K. B. Emmons, officer in charge of the Navy Recruiting station of the Philadelphia district, conceived the idea of establishing a new kind of a school for quickly training men to become expert wireless telegraph operators for the Navy.

At dedicatory broadcast, Comdr. S. W. Townsend, District Communications Officer, congratulates Roger W. Clipp, general manager of WFIL

Code messages

Realizing that the demand for a large number of fully trained first class telegraphers was becoming greater each day, these executives, with Jack Steck of WFIL's public relations staff, worked out the plan of organizing an exclusive school where the International code could be taught quickly, efficiently, and at no expense to the student. Unlike the many commercial and government schools organized to train men for radio engineering work, the new WFIL Radio School is designed only for the purpose of training students in the art of sending and receiving code messages. In addition, the student is taught the touch-system of rapid typewriter operation so as to be able to take down on the typewriter messages received.

The school rooms are located in the Widener building on the same floor as WFIL broadcasting studios and the first radio code classes started in July 1942. When the school opened applicants, in order to become eligible as students were required to be between the ages of 18 and 27, able to pass the regulation Navy physical examination in addition to being willing to enlist in the United States Navy upon completion of the course, or when they had attained a sending and receiving speed in the International code at the rate of 20 to 25 words per minute. Upon completion of the course the student receives preferential consideration for the Navy's V-3 rating, and is paid $78 monthly instead of apprentice's $50.

The personnel of the school is composed of the station's staff engineers or assistants who know the

(*Continued on page* 127)

HOW ENGINEERS CAN GET COMMISSIONS

by GEORGE W. BAILEY

Secretary Committee on Scientific Personnel, Office of Scientific Research and Development, 2101 Constitution Ave., N.W., Washington, D. C.

OSRD at Washington ready to help qualified candidates, including also draft inductees. Radio-electronic trained men needed by armed forces

DR. VANNEVAR BUSH

War originally bred engineers. That is where the name came from —from men who worked on the "engines of war" far back in history. In the short intervals of peace, these same men worked on roads and buildings, repairing the ravages of war, and so became known as "civil" engineers, as opposed to military engineers. Later came electrical engineers, radio engineers, and yesterday and today, electronic engineers.

To get a precise definition of the term "electrical engineer," I called upon several of the most distinguished and well known electrical engineers and was surprised to find that there was considerable variance in their individual recitals of the qualifications of an electrical engineer. For the field of the electrical engineer falls into one or more of three major categories: (1) power and electrical machinery; (2) transmission of power; (3) communications and electronics.

Electrical-engineer defined

"The qualifications of an electrical engineer are based upon either of two broad foundations. One is a degree in electrical engineering from an accredited college, or a degree in physics, with specialized study in the applications of electricity, followed in either instance by at least five years of practical experience. Such a man might be qualified as a research engineer, or as an engineer in the field of design, construction and operation. The other basis is experience of from ten to fifteen years in the field of electrical engineering. This must be evidenced by proof of having had responsible charge of technical electrical work, and a recognized standing in the profession."

Research at government expense

I have reason to believe that anyone who fulfills the requirements of this definition may be eligible for consideration for a commission in the armed forces.

Prior to our entry into the World War, the National Academy of Sciences, at the request of President Wilson, established in 1916 the National Research Council as its active agent to assist the Government in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems.

Contemporaneous with the National Research Council was the creation of the National Advisory Committee for Aeronautics (commonly known as the NACA) for the express purpose of establishing cooperative effort in aeronautical research between military and civilian groups. It was also provided by Congress with funds necessary to create and operate research facilities. This agency differed from the Academy and the Research Council in that it operates with government funds and has its own laboratories.

During the twenty-five years of its existence the NACA worked so well that, when it became apparent that a mobilization of scientists and engineers was again necessary, the pattern of the NACA was chosen as the kind of organization that would best function in this global war.

In June, 1940, President Roosevelt established the National Defense Research Committee as a division of the Office for Emergency Management and conferred upon it power to take the initiative in scientific matters which it believed to have military significance. The Chairman of the NDRC was Dr. Vannevar Bush, President of the

FOR LATEST ELECTRONIC NEWS FROM WASHINGTON

Turn to page 129 (Tinted Paper)

Complete summary of last-minute events of electronic importance

Carnegie Institute of Washington. Under the able leadership of Dr. Bush, this Committee almost immediately demonstrated its value to the war effort.

OSRD headed by Dr. Bush

It soon became apparent that a similar Committee was urgently needed for the medical sciences, with which the NDRC was not concerned. As a result, President Roosevelt established, in June, 1941, the Office of Scientific Research and Development, called OSRD, under the direction of Dr. Vannevar Bush. Under the jurisdiction of OSRD was placed NDRC, with President James B. Conant of Harvard as Chairman, and a new Committee on Medical Research, with Dr. Newton Richards of the University of Pennsylvania as Chairman.

To insure complete coordination of civilian and miltary research and development, Dr. Bush was provided with an advisory council consisting of the Chairmen of NDRC, CMR and NACA; the Co-ordinator of Naval Research; and a Special Assistant to the Secretary of War.

During the first year, the NDRC expended ten million dollars. This last year the OSRD received from Congress an appropriation of seventy-three millions.

Over 6000 researchers

The NDRC arranges with various scientific institutions and industrial concerns to carry on research and development on new mechanisms and devices of warfare. This work is carried on under contract by these institutions and paid by the funds granted to the OSRD. There are now in force nearly a thousand contracts with over one hundred universities and technical colleges and nearly five hundred contracts with almost two hundred industrial concerns. Many electronic men are working either full or part-time on these NDRC contracts.

As an example of the coordination of the scientific and engineering resources of the country, at one large institution there are over 700 scientists and engineers at work, representing nearly 150 different universities. In all the work encompassed in the OSRD contracts there are probably between six thousand and seven thousand scientists and engineers.

Electronics training group

The requirements for commission in the Electronics Training Group of the Signal Corps have been widely publicized. A candidate must be between the ages of eighteen and forty-five and must hold a college degree in electrical engineering or electronic physics. Note that a man of draft age is eligible for application for a commission. Note especially that if application has been made and the candidate is inducted he may still receive a commission if he is properly qualified. Our Committee on Scientific Personnel, located at 2101 Constitution Avenue, Washington, D. C., will gladly furnish details to applicants, and stands ready to qualify and recommend to the Signal Corps, men who fulfill the requirements.

When we were faced with the necessity of quickly locating and qualifying technically trained men we found the most fruitful source was the National Roster of Scientific Personnel.

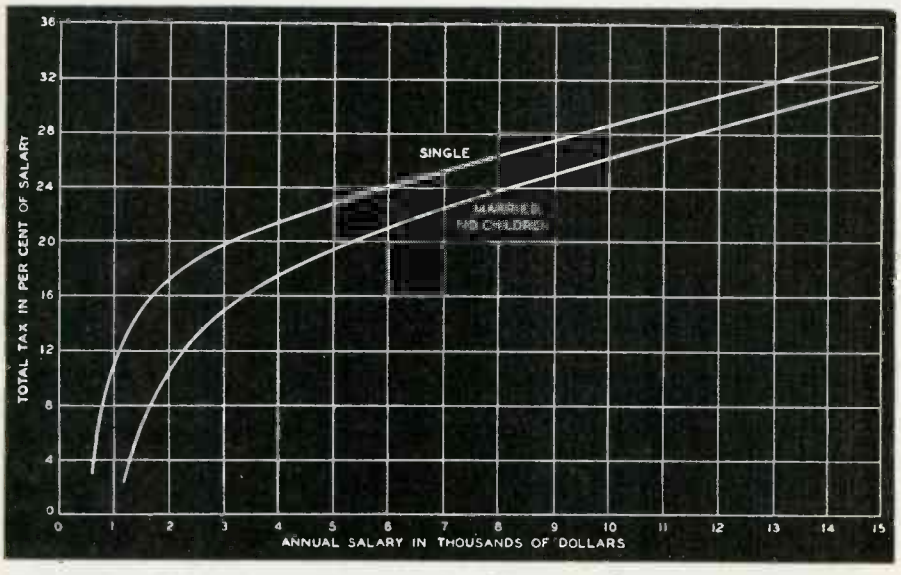
The organizer of the Roster is Dr. Leonard Carmichael, President of Tufts College, one of those who early recognized the necessity for a central register of technically trained personnel. It first operated under the National Resources Planning Board and the Civil Service Commission, but is now a department of the War Manpower Commission and remains under the direction of Dr. Carmichael.

Fill out questionnaire

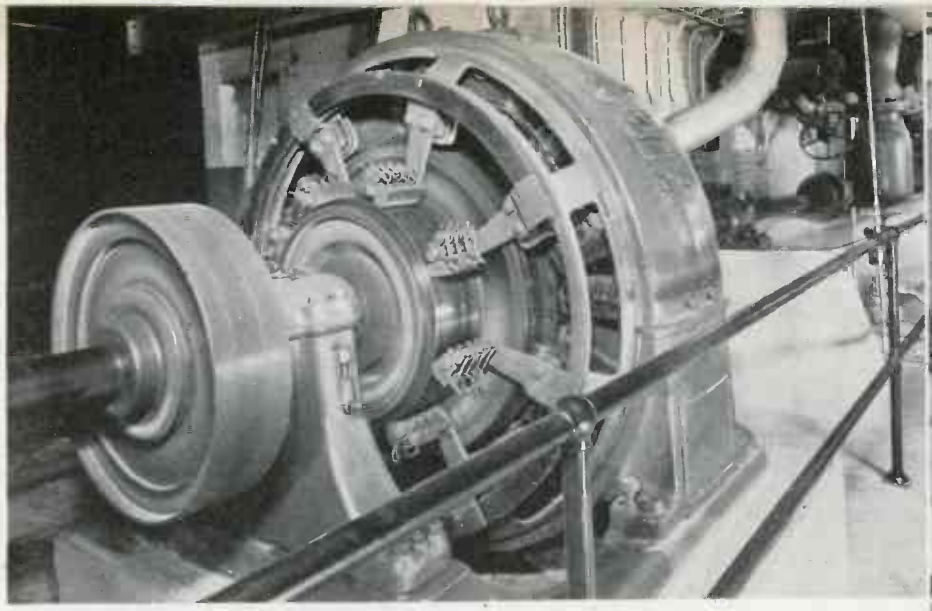
No doubt many electronic readers have received a questionnaire from the Roster. I sincerely hope that you have filled it out and returned it, because it is essential to the whole plan of mobilization that every engineer in the country register with the Roster. As an individual, you may never hear from this questionnaire. On the other hand you may have offers of opportunity for service from sources which you would not recognize as having originated with the Roster. Committees from numerous branches of science and engineering have looked over thousands of these questionnaires. We, personally, examined over six thousand when we started our search for electrical engineers. From these questionnaires individuals have been selected for positions where their services were urgently and immediately needed. From the examina-

(*Continued on page* 121)

Emissive Overload, March 15!



Recognizing that engineers can take bad news more easily if in graph form, we reproduce this chart showing personal-income taxes which will be due March 15 for various rates of 1942 annual earnings. These total tax curves were computed by Bell Laboratories statisticians, and take into account Victory Tax payments currently collectible



Main dc driving motor, in line shaft of paper machine. At right, old motor-driven rheostat, new electronic control panel, and main motor-generator set

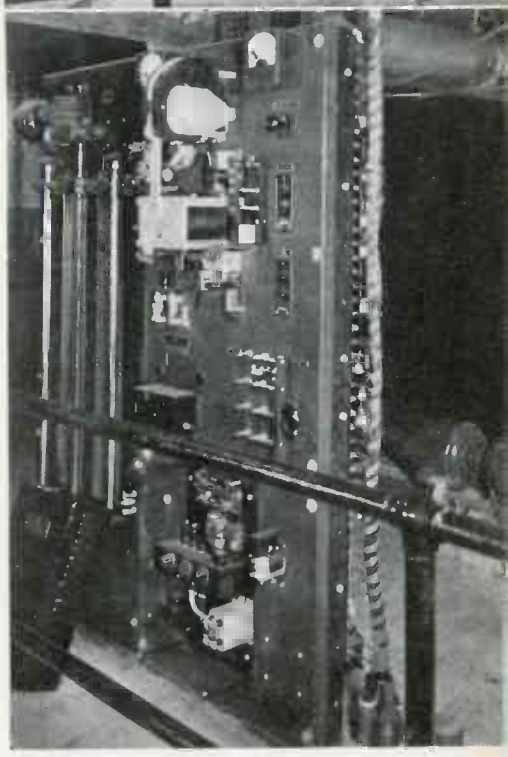
AMPLIDYNE Control for Paper Making

A control system installed on a paper-making machine of the Mead Corporation, Chillicothe, Ohio, combines an amplidyne generator and an electronic speed regulator to permit operation of the machine at speeds as high as 750 feet per minute and as low as 75 feet per minute. This wide range of speed has greatly increased the versatility of the machine. It is now possible to produce many different grades of paper on the one machine.

Before the installation of the amplidyne-electronic control system, which was built by the General Electric Company, speed was controlled by a simple motor-operated rheostat. However, considerable trouble was experienced at paper speeds below 150 fpm with this method, since the rheostat could not compensate for changes in load. Even slight changes resulted in speed variation.

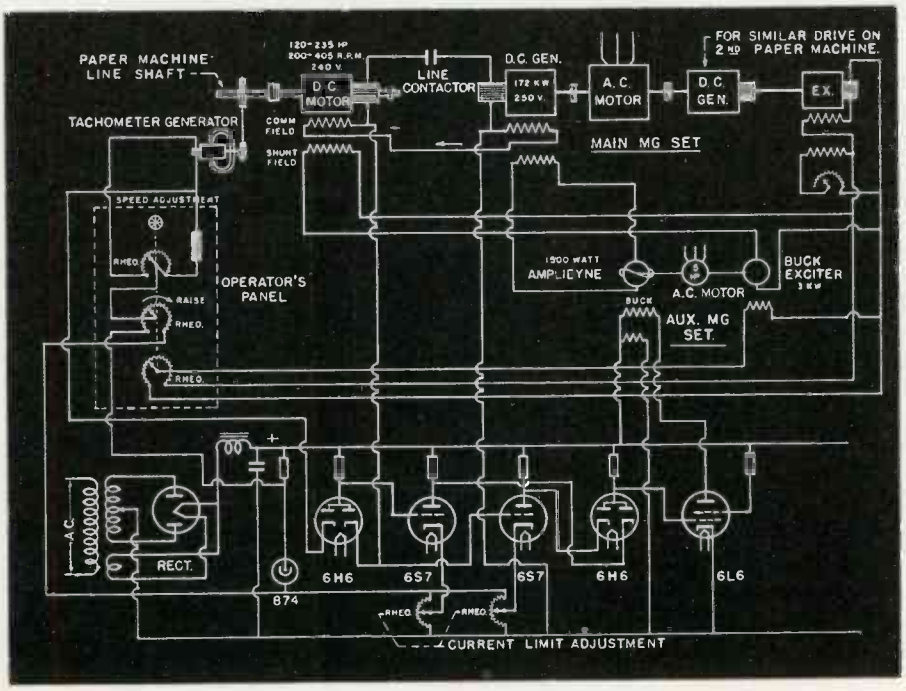
Although it would have been possible, through a two-speed gear or a jackshaft with double pulley reduction, to connect the motor to the line shaft and thus get the entire range in speed, this would have been costly, in addition to offering intricate mechanical problems.

The new control system, however, holds speed stable at any point in the entire speed range of 75 to 750 fpm and constitutes a relatively inexpensive solution to the problem.



Electronic regulator with cover removed. Amplidyne set in background

Simplified schematic diagram of amplidyne-electronic paper machine control



DIRECT HARMONIC STUDIES

Since one of the most popular applications of the cathode-ray oscillograph is the visualization of waveform, it seems strange that in so many cases little or no effort is expended to follow up these tests with an accurate analysis of the harmonic content in some of the resulting wave diagrams.

This problem, however, is destined to become more important in view of the growing tendency of analyzing numerous types of mechanical and other non-electrical movements by purely electrical methods of approach. For example, the relative movements of certain parts of a combustion engine during a cycle can be studied by an oscillogram on a cathode-ray tube, after converting the particular movements to equivalent electrical potentials.

The usual method of attack in analyzing waveform is a tedious procedure and requires an accurate reproduction of the oscillogram either by photographic means or its equivalent. Any simplification in this procedure may prove of importance since it will enable existing apparatus to make new tests.

Graphic process, in many cases, simpler

It is not very well known that there is a graphic process that is somewhat simpler in many cases, especially when the oscillogram is studied with a cathode-ray oscillograph, with an adjustable-frequency, linear time base. It has been found that, when the waveform remains on the screen for a considerable length of time, direct harmonic values can often be determined on the screen, without a photographic copy.

The system, (based on a plan that was disclosed almost fifty years ago by Wedmore) can be described by an example: Fig. 1 represents a single cycle of a wave that might appear on the screen of a tube. The return sweep of the spot may occur anywhere in the cycle since this is a matter dependent only on the sweep circuit in the oscillograph and not on the incoming wave.

Therefore the axis may be considered to be at any level without affecting the plan, except that measurements of a possible dc component will be concerned.

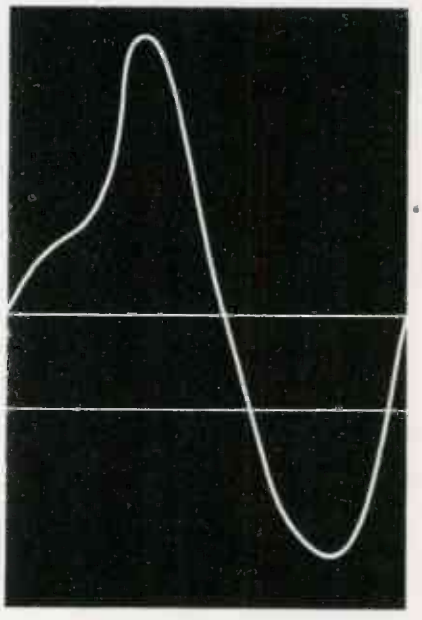


Fig. 1. A typical waveform with a synchronous time base

Double frequency

The first step is to set the time-base of the oscillograph to double the frequency used to get the picture Fig. 1. This is easily accomplished with the usual time base circuit. Thereafter the original wave will be split in two parts, a and b, which are superimposed on the screen, as in Fig. 2. It can be seen that the curve a represents the first section of the curve in Fig. 1, and curve b represents the second half. Curve c, Fig. 2, is a derived curve produced by adding curves a and b, based on the selected axis.

It will be found that curve c, which is the resultant of a and b, is a picture of the curve representing all the even harmonics existing in the wave. If curve c had happened to come out essentially sinusoidal, it would have indicated that the wave, Fig. 1, had a strong second harmonic with higher harmonics missing. Numerically the height of c, Fig. 2 (peak to peak) in an equivalent scale respective to a and b, is twice the actual relative value that the second harmonic bears to the original. In actual fig-

Fig. 2. Same wave (a+b) as it appears with a double frequency time base

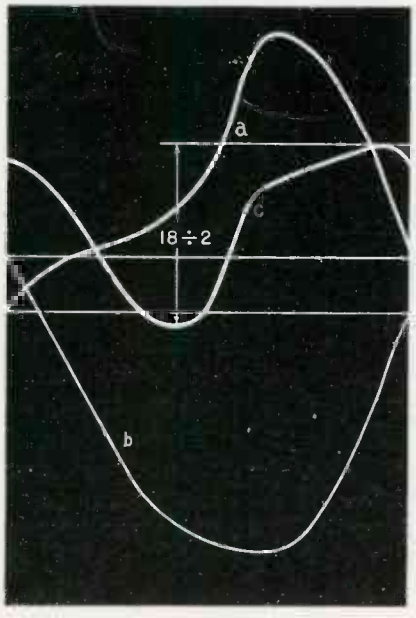
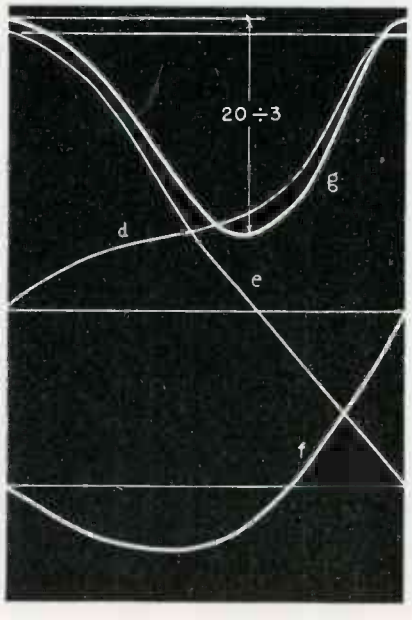


Fig. 3. Same wave (d+e+f) as it appears with a triple frequency time base



With An OSCILLOGRAPH

by RALPH R. BATCHER
Consulting Editor

A simple, graphical method of analyzing the harmonic content of a waveform, reproduced with a cathode-ray oscillograph. Adjustable-frequency, linear time base is required and return sweep must be comparatively instantaneous

ures the even harmonics will be seen to have 9 units of amplitude.

Triple frequency

In the next step the time base is changed to a triple frequency, as in Fig. 3, so that the wave appears in three sections, d, e, and f. Here the algebraic sum of the three components is shown as g. This latter curve represents the third harmonic and its odd multiples (9th, 15th, etc.) to a triple scale. These harmonics are indicated as having an amplitude of 20/3 units, according to measurements on Fig. 3.

Continuing the process of cutting in two, superimposing parts and getting the resultant, curve a in Fig. 2 can be broken down, so that a′ and a″ in Fig. 4 result. The arithmetic mean is again shown as curve h, which shows the even multiples of the second harmonic (i.e the 4th and higher). Their amplitude is 9.5/4 units.

Treating curve g in Fig. 3 in the same way, yields the even multiples of the 3d (i.e. the 6th, 12th, 18th, etc.) by adding the two sections g′ and g″ to form curve k. The latter has an amplitude of 1 unit.

Multiple subdivisions

In this way, all of the important harmonics can be analyzed directly, either by subdividing the original wave into four, five or higher sections, or by working on the resultant wave with additional subdivisions, as in Fig 4 and 5. If a good reproduction of the wave can be made, any particular harmonics when once found can be "subtracted" from the original curve by simple algebraic processes. It should be remembered that each time the wave is subdivided the resultant curve is enlarged by the same ratio, even though the gain of the oscillograph is unchanged.

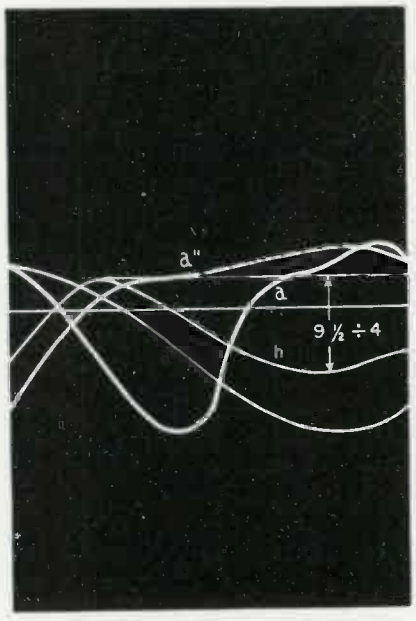


Fig. 4. Shows the higher multiples of the second harmonic

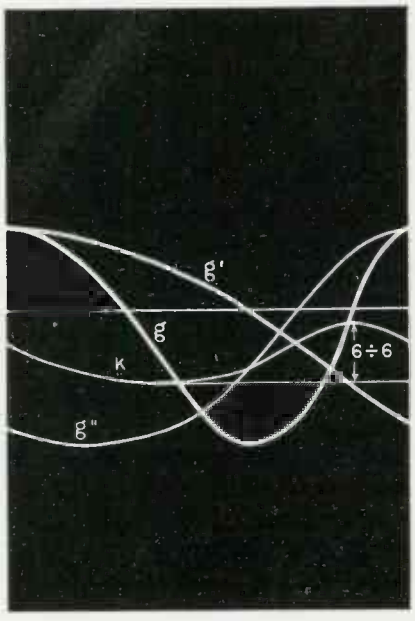


Fig. 5. Shows the higher multiples of the third harmonic

It is possible to determine the phase relations also from these curves by examining the location of the resultant curve after subdividing. Horizontal distances along the axis, it will be noted are always extended by a ratio equivalent to the frequency of the time base to the frequency of the fundamental wave being examined.

In this discussion it has been assumed that the sweep return line is instantaneous and so does not represent any loss of time that will be an appreciable part of any wave under observation.

Looking Ahead in the Electronic Industries

In electronics Man has a step-ladder to new achievement.—*J. C. McManemin, GE*

Growth of knowledge in electronics has increased tremendously since Pearl Harbor.—*V. K. Zworykin, RCA*

We all have something the other fellow hasn't got, I don't care who he is.—*G. W. Vaughn, Curtis Wright*

The fighting men who have the greatest resources of science, engineering and production back of them will be the victors.—*David Sarnoff, RCA*

The post-war world will come into an electronic era—with even more effective means of communications, including frequency-modulation broadcasting and television.—*James L. Fly, FCC*

We are convinced that FM will be one of the most important—if not the leading factor—in broadcasting after the war. We, along with other progressive manufacturers, are studying post-war conditions. FM is placed high in the list of developments which have great post-war possibilities.—*Dr. Ray H. Manson, Stromberg Carlson Mfg. Co.*

Research is the effort of the mind to comprehend relationships which no one has previously known. And in its finest exemplifications it is practical as well as theoretical; trending always toward worthwhile relationships; demanding common sense as well as uncommon ability.—*Harold de Forest Arnold, Bell Telephone Laboratories*

KMPC's DIRECTIONAL ARRAY at Beverly Hills

by R. M. PIERCE and L. C. SIGMON
Chief Engineer WGAR Chief Engineer KMPC

New 10-kw transmitter provides high field intensity for Los Angeles area, while protecting distant stations on 710 kc

KMPC was originally licensed February 19, 1927, as a daytime station on 710 kc. The Federal Communications Commission granted permission for full-time operation with a power of 5 kw. daytime and 1 kw. night-time on Jan. 15, 1940.

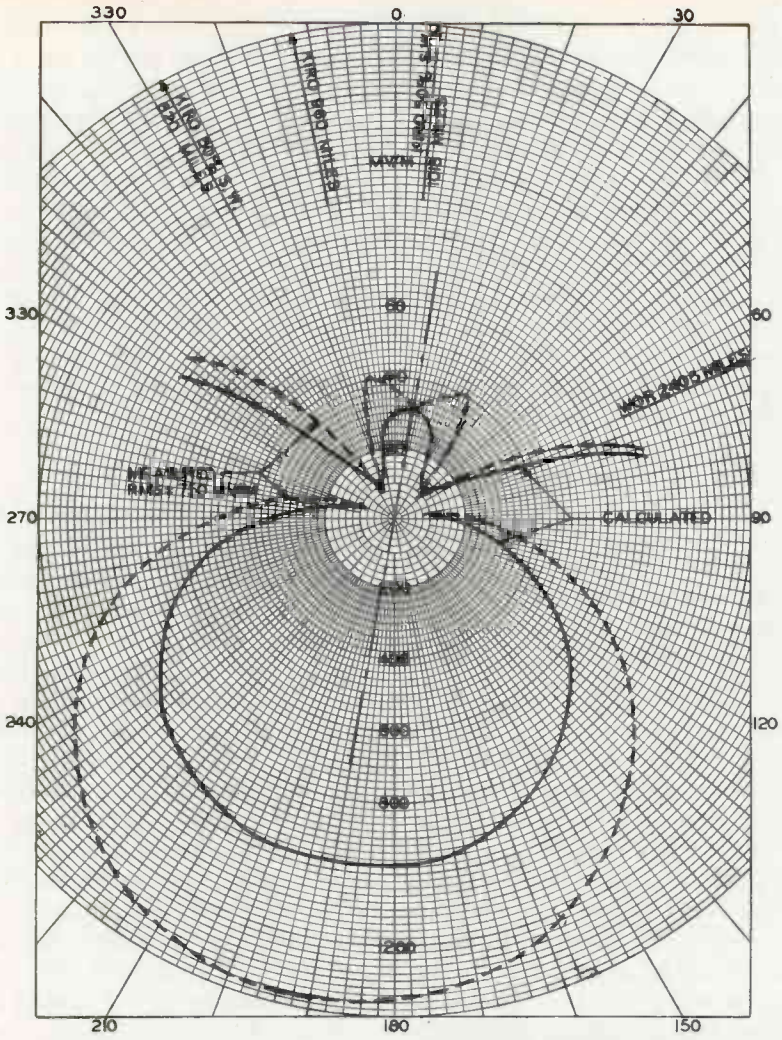
The Havana Treaty established 710 kc. as a Class I channel and assigned to it WOR, New York City, and KIRO, Seattle, Washington, with powers of 50 kw., and KMPC with a power of 10 kw. This made it necessary for KMPC to protect the 0.5 mv/m, 50 per cent sky wave service of Stations WOR and KIRO. The protection required towards these stations made it necessary for KMPC to move its transmitter location north of Los Angeles.

Selection of a site in the Los Angeles area is probably more difficult than in any other section due to the wide distribution of population and the unusual topographical conditions. Several sites were examined and measurements of the conductivity over the important paths were made. Different directional antenna patterns were then computed in an endeavor to determine the best possible coverage. A site in the San Fernando Valley was decided upon. It was determined that a three-element array in a line with towers spaced 70 deg. apart and oriented N. 10 deg. E. would provide the desired pattern both from the standpoint of protection and coverage. This required a level plot of land containing twenty-one acres. The site selected was situated so that the main lobe from the directional array pointed through a pass in the mountains towards downtown Los Angeles and was not too remote, from an economical standpoint, for power and telephone lines. The tower heights were limited to three hundred feet because the Los Angeles Union Air Terminal is only 3.7 miles east. Floods and earthquake faults were both given due consideration in selection of the site and in the design of the complete installation.

Transmitter

In designing KMPC's transmitter building, it was decided to make it as simple and practical as possible. The main transmitter room measures 24 ft. by 35 ft. The RCA 10-E transmitter divides the room into two parts, leaving the control room 19 ft. by 24 ft. with a ceiling height of 10 ft. The back portion of the transmitter has a 14 ft. ceiling with two large ventilating fans in the rear walls to remove the heat dissipated by the air-cooled tubes. Provisions were made so that the east wall of the transmitter room can be removed and the building extended to accommodate additional equipment in the event KMPC is granted an increase to 50 kw. in the future. The only equipment in the transmitter operating room is the master control console desk. All other equipment, such as speech input equipment, modulation monitor, phase monitor, etc. was built into a cabinet which was furnished as part of the transmitter.

KMPC's transmitter is an RCA 10-E 10,000 watt model. Features include easy accessibility from the



Horizontal radiation pattern of KMPC, Beverly Hills, Calif., with bearings of other stations on 710-kc channel

front through large metal doors; the simple straightforward circuit; only four rf stages are used to obtain 10,000 watts, including both the oscillator and final amplifier; high level modulation of a Class C amplifier with a feedback loop extending over the audio portion of the transmitter circuit; air cooling throughout greatly simplifying installation, the only rotating machinery being the blower motors.

The frequency response was found to be within ± 2db between 30 and 10,000 cycles. The overall distortion at any frequency between 50 and 7,500 cycles did not exceed 4 per cent at 100 per cent modulation with an average of 1.3 per cent. The distortion measurements were made with the transmitter working into the directional antenna phasing network.

The master control console desk contains, in addition to the usual equipment, meters to read the field strength of the directional array on the bearing 332 deg., the center antenna current, the per cent modulation, and the amount of audio compression. Interlocks are on all doors leading into high-voltage cabinets.

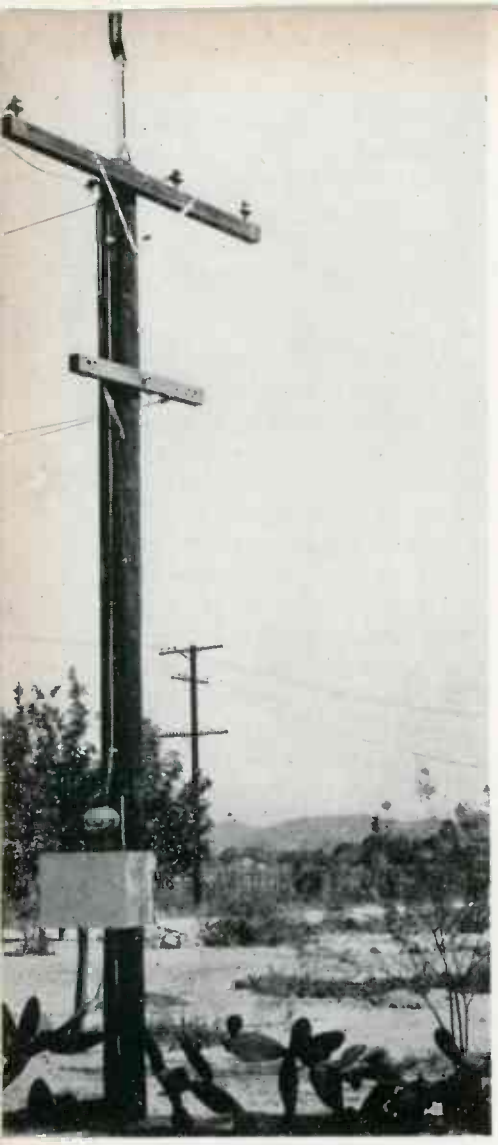
Antenna and ground system

The three radiators consist of three uniform cross-section, guyed towers. Each tower is 295 ft. high above the base insulator. The three elements of the directional array are spaced 270 ft. apart on a line bearing 10 deg. east of true north.

A Western Electric 2-A phase monitor was installed to properly adjust the magnitude and phase relationship of the antenna currents.

The ground system consists of 120 copper wire radials per tower, spaced 3 deg. apart. All ground radials extending between the towers are connected together by means of a 2-in. copper strip, extending the full length of the ground system and connecting with the outer ground ring surrounding the complete ground system. Ground wires are buried approximately 6 in. to 9 in. 175 copper

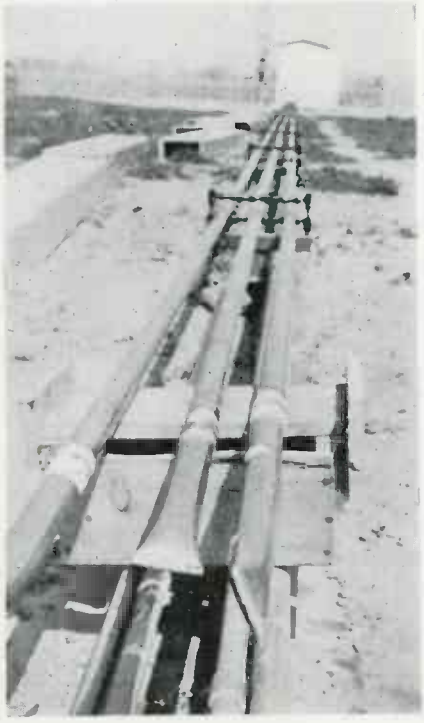
KMPC's 10-kw transmitter and transmitter control room



▲ Remote-reading field-intensity meter, 1½ miles from transmitter

Directional-antenna tuning and phasing equipment →

▼ Transmission line as sealed and tested daily during construction



ground rods, 5 ft. long, have been used at various points throughout the ground system. A ground screen 50 ft. square has been placed under each antenna over crushed gravel. The ground was treated with oil to kill all vegetation directly under each ground screen. The ground screens reduce the dielectric losses at the base of the towers, thereby increasing their radiating efficiency.

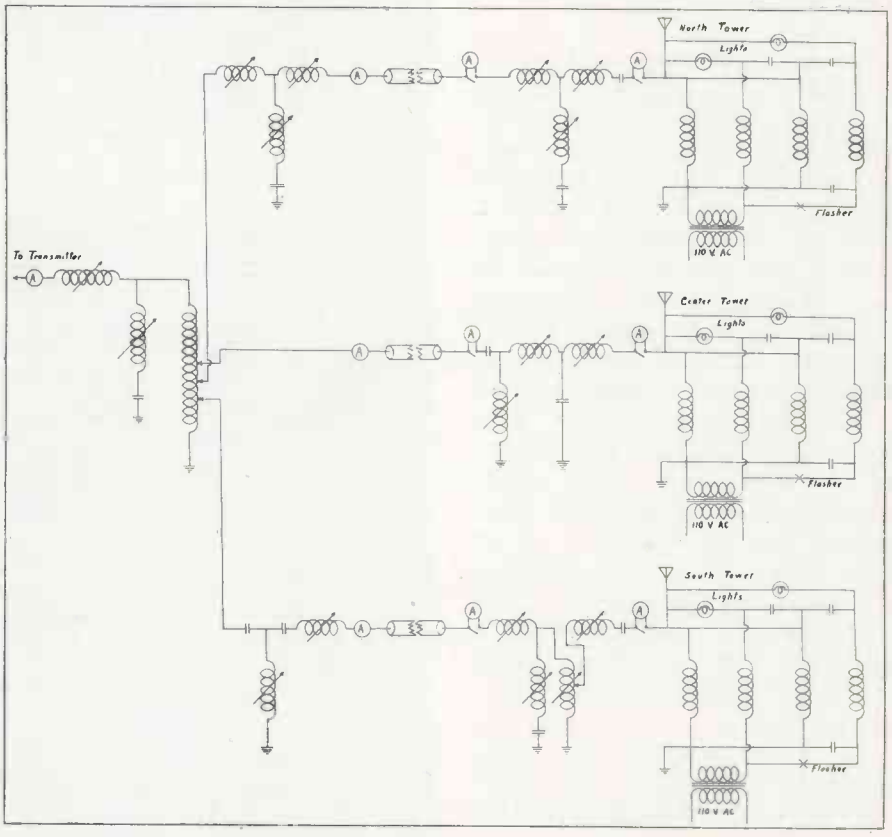
Each tower carries four 100-watt lamps in "aviation red" prismatic globes. Atop each tower is a 1,000-watt beacon, consisting of two 500-watt lamps. Each tower beacon light is flashed individually. All lights burn continuously from dusk to dawn, being automatically operated by a photoelectric cell. The correct operation of the cell is indicated by an indicator lamp on the master control desk.

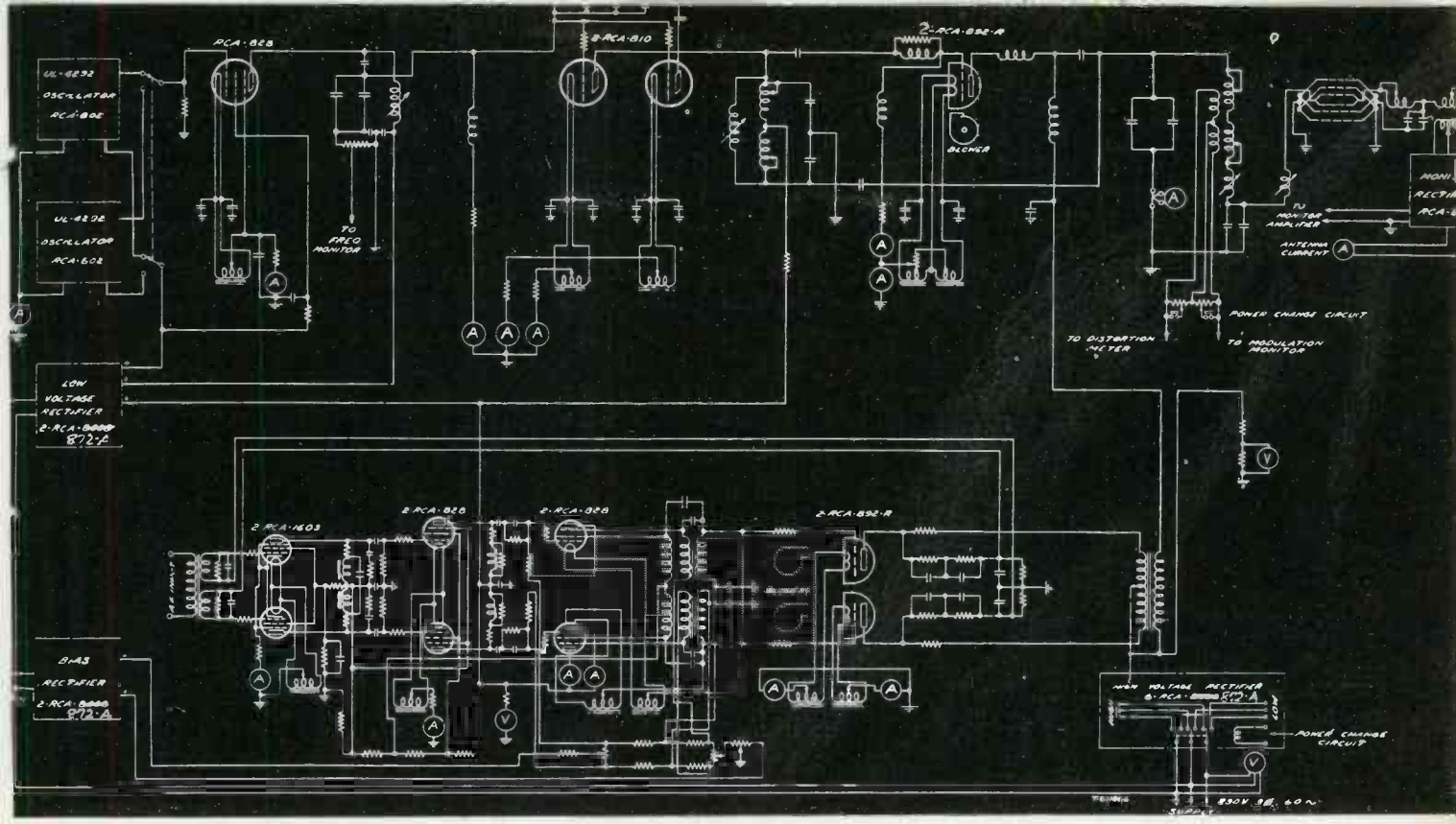
Field intensity meter

A continuously operating, remote-reading, field-intensity meter has been installed one and one-half miles from the transmitter on the bearing 332 deg. This field intensity meter consists of a loop antenna mounted atop a twenty-five foot pole and pointed on the center tower of the directional array. The loop's power is then fed through transmission lines to the field intensity receiver located in a specially constructed metal cabinet at the base of the pole. The field intensity receiver consists of a modified Hallicrafter receiver, Model S-19R. A meter network has been connected in the avc circuit in such a way that any change in the received signal intensity can be observed. The field-intensity remote meter is then extended to the transmitter plant by means of a leased telephone line.

Transmission lines

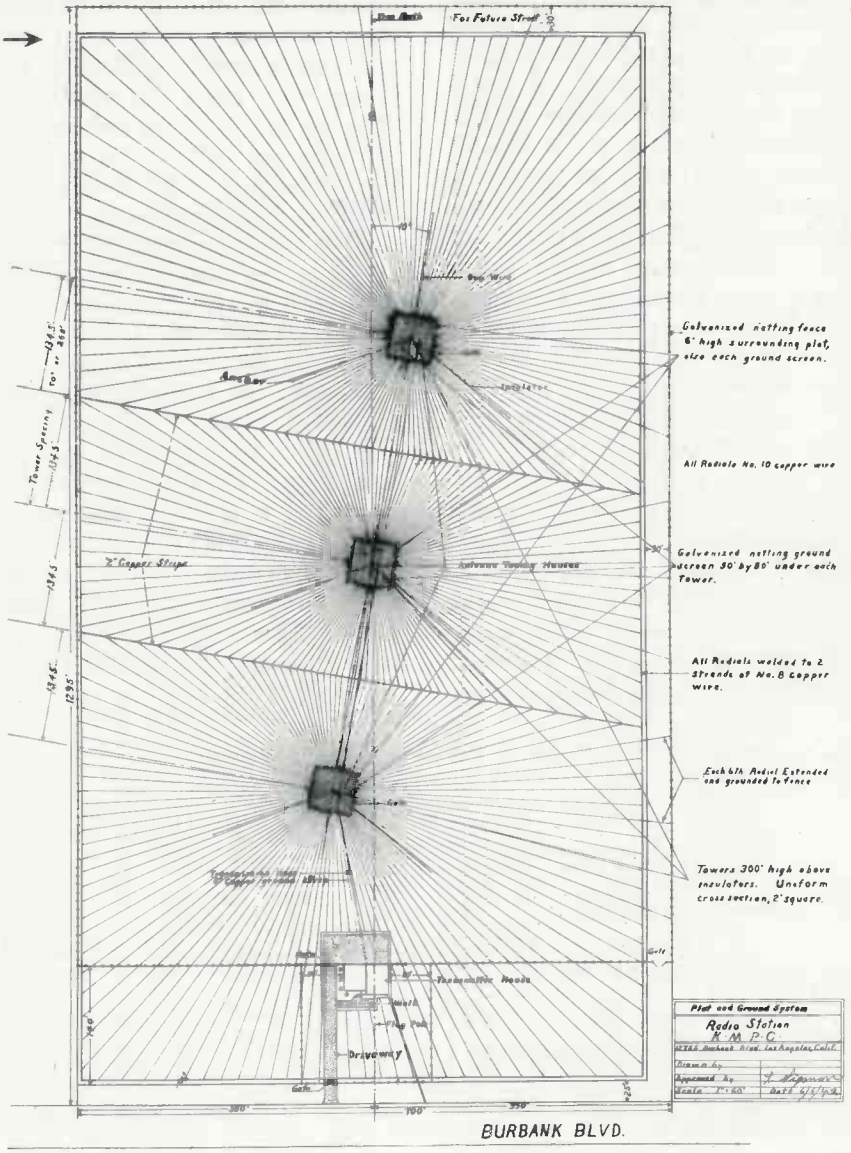
Three coaxial transmission lines are installed between the phasing and branching equipment cabinet and the three towers. The lines are 1 5/8-in. O. D. and are mounted on cast-iron rollers to allow for their free expansion and contraction. Due to the extremely long lengths of transmission lines required, it was necessary to divide the lines into sections to reduce the expansion and contraction of the lines to a minimum. This was done in the tuning house of each individual tower. The lines were terminated and re-connected by means of a jumper made from 1/4-in. copper tubing to allow for gassing of the





Schematic diagram of RCA 10-E transmitter ↑

Plot and ground system of KMPC towers →



lines from inside the transmitter building. In addition, the termination of the lines at each tuning house, provides for spare lines in the event of transmission line trouble, the loss of a tower or directional equipment. If this necessity arises, it is planned to operate the south tower, non-directional. This is the tower in which all three lines terminate.

Each individual line is anchored in the center allowing for expansion and contraction from that point, thereby reducing the overall expansion at any one point along the line. The mountings holding the coaxial line are spaced 12 ft. apart. The coaxial line is also grounded at this point to avoid standing waves on the line, and brought down to a 6-in. copper strip which extends the full length of the antenna system, terminating at the transmitter. This 6-in. ground strip is also tied in with the ground system wherever it crosses and provides the main ground bus for the transmitter building. In order to prevent condensation within the lines and to increase the breakdown voltage, oil-pumped nitrogen gas was added. The size of the lines is such that the presence of gas is not necessarily re-

(*Continued on page* 134)

PRINCIPLES OF SHORT WAVE RADIATION—II

by DR. ERNST WEBER

Professor of Graduate Electrical Engineering and Head of Department, Polytechnic Institute of Brooklyn

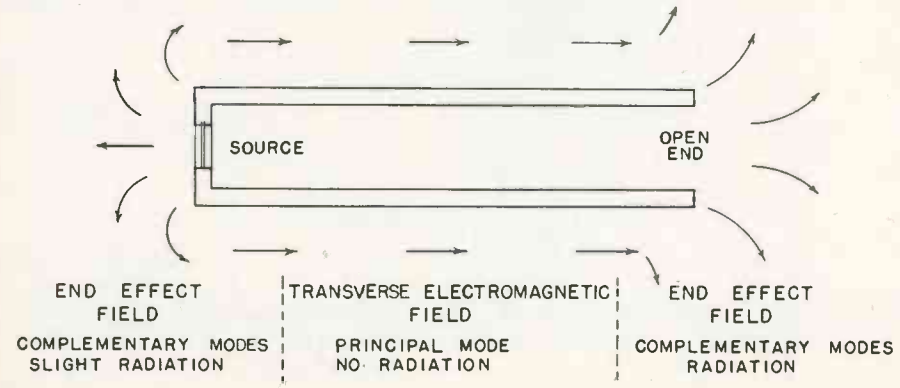
Terminating equipment concepts are applied to the transmission line guides, which were considered in Part I, January issue

Radiation from antennas

It is quite apparent now, that if one takes the transmission line of Fig. 3 and straightens it into a single line like in Fig. 4, the radiation effects become even much more predominant, and if the length of the line halves is a sizable fraction of a wavelength, then the "end" effect of the complementary mode will extend almost over the entire length of the wire, giving the impression that the whole conductor radiates power. This, of course, is the prototype of a "dipole" antenna which is used extensively and about which probably more discussion has been written than about any single other element in electromagnetic theory. For a long time the concept of radiation from antennas and transmission lines was rather confused and it has been cleared up only rather recently through the researches of J. R. Carson[3] and S. A. Schelkunoff[5].

The treatment of the general antenna problem is much too difficult to even attempt a mathematical formulation here. However, substituting for Fig. 4 the double-cone antenna of Fig. 5, one can deduce the principal characteristics with much less effort [6], [5]. If the voltage is applied over a very small gap at the apeces of the cones, a current-voltage wave will propagate out along the open system as in the case of the two wire transmission line, only that now the electric field has to span in space between cones and the magnetic field must surround each cone in closed field lines. By symmetry we can see that the magnetic field lines are concentric circles with their centers along the axes of the cones and the electric field lines are circles with their center in the apex of the cone, lying wholly in concentric spheres, in fact, being their largest circles. Using a polar coordinate system, then each point can be given by specifying radius r and colatitude Θ. On account of symmetry one can disregard the third coordinate, the longitude ϕ and consider only a meridianal plane. In this polar coordinate system, both field vectors have only one component each, namely, E_Θ and H_ϕ. Maxwell's equations reduce in this case to the simple system[7]

Fig. 3. Guidance and radiation of power by transmission line



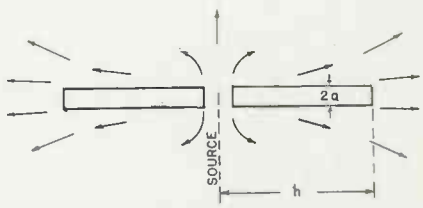


Fig. 4. Guidance and radiation of power by dipole antenna

$$\left.\begin{aligned} -\frac{\partial}{\partial_r}(r\sin\Theta\, H_\phi) &= \varepsilon\frac{\partial}{\partial_t}(r\sin\Theta\, E\theta) \\ -\frac{\partial}{\partial_r}(r\sin\Theta\, E\theta) &= \mu\frac{\partial}{\partial_t}(r\sin\Theta\, H\phi) \end{aligned}\right\} \quad (32)$$

which is quite similar to the systems (6) and (7). One can, therefore, proceed as there and obtain the single differential equation

$$\frac{\partial^2}{\partial_r{}^2}(r\sin\Theta\, E\theta) = \varepsilon\mu\frac{\partial^2}{\partial_t{}^2}(r\sin\Theta\, E\theta) \quad (33)$$

with the simple solution corresponding to (9)

$$r\sin\Theta.\, E\theta = A\sin\left(\omega t - \frac{2\pi r}{\lambda}\right)$$

or

$$E\theta = \frac{A}{r\sin\Theta}\sin\left(\omega t - \frac{2\pi r}{\lambda}\right) \quad (34)$$

where A is the arbitrary amplitude constant. Again we have a progressive wave, but of the radial type and on account of the expansion in the polar system, the amplitude decreases as 1/r. The magnetic field can be obtained from the second equation of (32)

$$H_\phi = \sqrt{\frac{\varepsilon}{\mu}}\cdot E\theta = \frac{1}{\sqrt{\mu/\varepsilon}}\frac{A}{r\sin\Theta}\sin\left(\omega t - \frac{2\pi r}{\lambda}\right) \quad (35)$$

and is in time and space phase exactly as the plane waves along the transmission line considered above. The field E_Θ, $H\phi$, has principally the

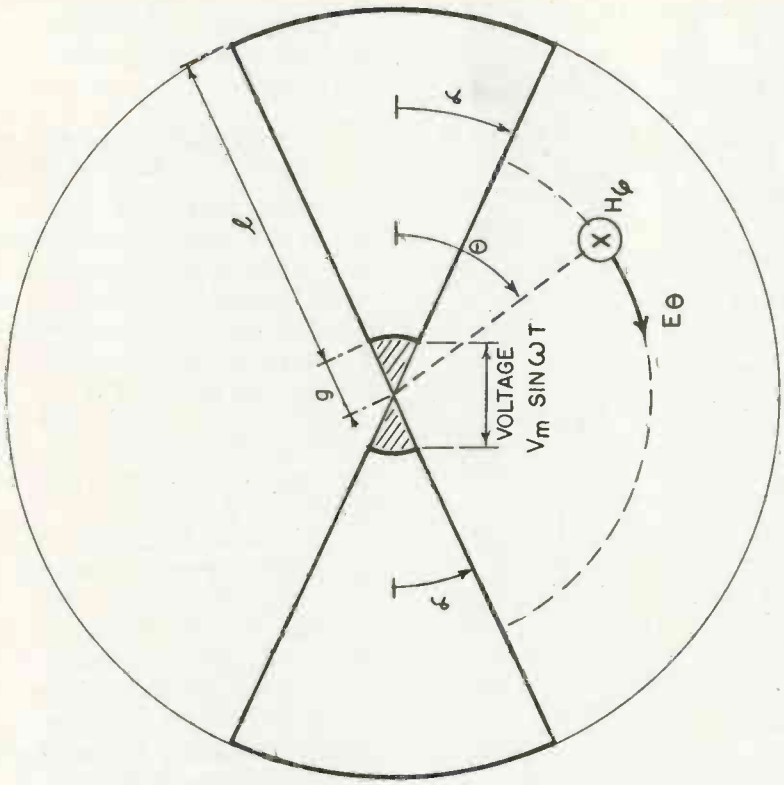


Fig. 5. Biconical antenna

same characteristics of transversality with respect to the radial propagation and is therefore called a principal mode of propagation of spherical type.

It is simple to derive voltage and current values by means of the basic relations (2) and (3). One has along a meridian from upper to lower cone

$$\left.\begin{aligned} v &= \int_1^2 E\theta \, r\,d\Theta = A \sin\left(\omega t - \frac{2\pi r}{\lambda}\right) \\ \int_\alpha^{\pi-\alpha} \frac{d\Theta}{\sin\Theta} &= 2A \ln\left(\cot\frac{\alpha}{2}\right). \sin\left(\omega t - \frac{2\pi r}{\lambda}\right) \end{aligned}\right\} \quad (36)$$

While the current follows from the line integral along a parallel circle

$$i = \int_{\phi=0}^{2\pi} H_\phi \, (r \sin\Theta)\, d\phi = 2\pi A \sqrt{\frac{\varepsilon}{\mu}} \sin\left(\omega t - \frac{2\pi r}{\lambda}\right) \quad (37)$$

Both current and voltage are again progressive waves of the type (9) and (10) and their ratio must be the characteristic impedance of the biconical antenna considered as a transmission line,

$$Z_o = \frac{v}{i} = \frac{1}{\pi}\sqrt{\frac{\mu}{\varepsilon}} \cdot \ln\left(\cot\frac{\alpha}{2}\right) \quad (38)$$

In free space, the value $\sqrt{\frac{\mu_v}{\varepsilon_v}} = 120\pi$,

so that $Z_o = 120 \ln\left(\cot\frac{\alpha}{2}\right)$ ohms

Fig. 6 gives a graphical representation of the values for varying angles of the cones. The interesting point is that the bi-conical antenna has a constant characteristic impedance and lends itself excellently to illustrate the basic ideas of radiation from cylindrical antennas, for which the relations are much more complex. In first approximation, one might consider the dipole antenna as a double cone whose angle α is given by $\tan^{-1}(a/h)$, where a is the radius and h the half length of the dipole.

One can also find the power flow connected with the outgoing spherical wave, by computing the Poynting vector. We have here only radial power-flow for which the surfaces of the cones act as guides, and the density of propagated power is

$$N_r = \sqrt{\frac{\varepsilon}{\mu}} E_\theta^2 = \sqrt{\frac{\varepsilon}{\mu}} \frac{A^2}{r^2 \sin^2\Theta} \sin^2\left(\omega t - \frac{2\pi r}{\lambda}\right)$$

or as time average

$$N_{rav} = \frac{1}{2}\sqrt{\frac{\varepsilon}{\mu}} \frac{A^2}{r^2 \sin^2\Theta} \text{ Watts/cm}^2 \quad (39)$$

A polar plot of this quantity against Θ gives the density of the outward radiation or the radiation pattern of the progressive wave. Fig. 7 shows this radiation pattern in arbitrary units, taking 100% as the minimum horizontal value. The directivity is very marked with a maximum of power flowing along the conical surfaces, "guided" by them as transmission elements.

In order to obtain the total radiation, one has to integrate (39) over a spherical surface up to the surface of the cones. Since the surface element of a sphere is $dS = r\,d\Theta \cdot r \sin\Theta\, d\phi$, the integral can easily be evaluated and gives

$$P_{rad} = \int\int N_{rad}\, dS = \frac{1}{2}\sqrt{\frac{\varepsilon}{\mu}}\, 2\pi A^2 \int_\alpha^{\pi-\alpha} \frac{d\Theta}{\sin\Theta} = \quad (40)$$

$$2\pi \sqrt{\frac{\varepsilon}{\mu}}\, A^2 \ln\left(\cot\frac{\alpha}{2}\right)$$

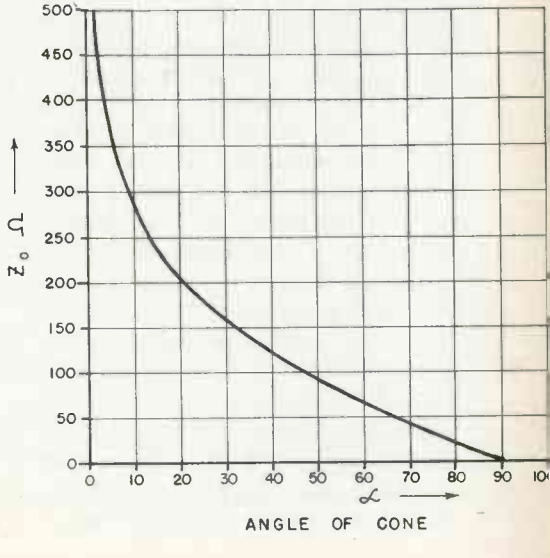
In the case of the single progressive wave it is also simple to define the current associated with this radiated power, namely (37). Dividing P_{rad} by the average square of the current, a quantity is obtained which is called "radiation resistance" R_r. It becomes in this case

$$R_r = \frac{P_{rad}}{I^2} = \frac{1}{\pi}\sqrt{\frac{\mu}{\varepsilon}} \ln\left(\cot\frac{\alpha}{2}\right) = Z_o \quad (41)$$

identical with the forward characteristic impedance. This should not surprise since we are dealing with a progressive wave.

Now, of course, the solution (34), (35) is only part of the total solution; it was given in more detail as

Fig. 6. Characteristic impedance of biconical antenna



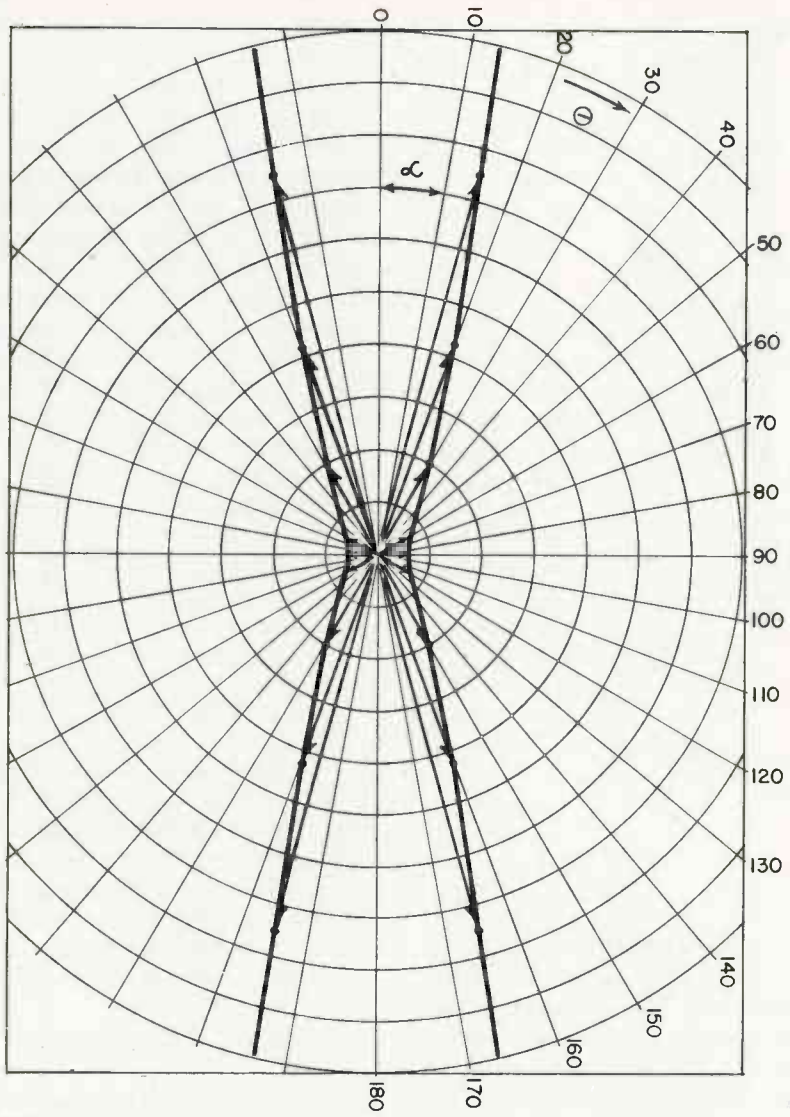


Fig. 7. Polar radiation pattern of biconical antenna (arbitrary units)

an illustration of the procedure. To obtain the complete solution one has to consider firstly the "reflected" wave, namely the wave returning from the boundary surface delineating the end of the antenna, and secondly all the complementary modes which superimpose and lead to the complete satisfaction of the boundary conditions, exactly as in the transmission line case. This is where the mathematical difficulties arise. Though one can arbitrarily assume that the boundary surface be given by the sphere through the top surface of the cones, the general solution is complex and laborious. A fuller discussion of the details was given by S. A. Schelkunoff[5]. The existence of the reflected principal and the most important higher modes is, of course, indicative of reflection at the "boundary surface" and therefore of standing waves, and therefore, as shown above, of energy that is not radiated into space but deposited as field energy to "take the shock of abrupt discontinuities" as it were. Obviously, for the general field, the radiation resistance will be lower than (41) and only most meticulous "matching" of the antenna to the free space can increase its useful radiation to anything near the value given by (41). Again, in the general case, the concept of characteristic impedance loses its significance and one can only define local impedance at the input to the antenna and at its output terminals. Generally, then, the input impedance of the antenna will be reactive and the amount of reactance is a good measure of the lack of overall matching that exists.

If one defines the input impedance Z_i as the ratio of voltage to current at the apex of the cone, one can then study the frequency dependence of Z_i and particularly design shapes for broad-band characteristics desirable for many practical problems.

Penetration of waves into conductors

Though conductors only act as guides for electromagnetic waves, even at the lowest frequencies, they absorb power on account of their finite conductivity. In order to find a measure of the losses within conductors, we may assume a plane uniform wave to move towards a conductor and in particular study that part of the wave that penetrates into the metal.

Take, then, the plane wave of simplest configuration, namely, uniform and with only two components, E_x and H_y, which carry power into the z-direction on the basis of the Poynting vector. The complete Maxwell equations in the chosen coordinate system, January issue, page 117, reduce then to

$$\left.\begin{aligned} -\frac{\partial H_y}{\partial z} &= \gamma E_x + \varepsilon \frac{\partial E_x}{\partial t} \\ +\frac{\partial E_x}{\partial z} &= -\mu \frac{\partial H_y}{\partial t} \end{aligned}\right\} \quad (42)$$

On account of the extremely high conductivity γ in metals, one can disregard

$\varepsilon \dfrac{\partial E_x}{\partial t}$ as compared with γE_x under all conditions and at all frequencies even up to light frequencies. The elimination of H_y then gives the single differential equation

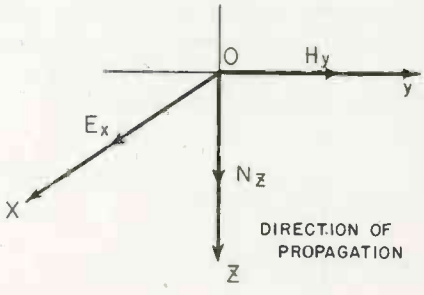
$$\frac{\partial^2 E_x}{\partial z^2} = \mu \gamma \frac{\partial E_x}{\partial t} \quad (43)$$

with the simplest solution as

$$E_x = F.\ \varepsilon^{-\alpha z} \sin(\omega t - \alpha z) \quad (44)$$

where F is the amplitude constant and where $2\alpha^2 = \omega\mu\gamma$, as can be eas-

Fig. 8. Plane wave penetrating into metal



ily verified. This is now a progressive wave in the positive z-direction, as expected, but it has a damping factor attached to it. Thus, the amplitude will decrease to $1/\epsilon$ if $z = 1/\alpha$, or also, the amplitude will have reduced to about 37 per cent of its surface value within the depth

$$\delta = \frac{1}{\alpha} = \sqrt{\frac{2}{\omega \mu \gamma}} \qquad (45)$$

This characteristic quantity is called "depth of penetration" and it is quite analogous to the concept of "time-constant" in circuit theory. It depends upon the metal and the frequency. For steel it has incredibly small values, though even in copper one finds $\delta = 6.6/\sqrt{f}$ cm, or about 6.6×10^{-4} cm or 0.00025 in. for a frequency of 100 mc.p.s. The very high frequency electromagnetic field, therefore, only penetrates the outermost skin of metals which is advantageous from the point of view of shielding and losses. This is responsible for the much higher values of Q that can be attained at ultra-high frequencies than at ordinary radio frequencies. Fig. 9 gives the variation of this depth of penetration for a few important metals.

The magnetic field component can be found by using the second equation (42)

$$H_y = \gamma \frac{\delta}{\sqrt{2}} F \epsilon^{-\alpha z} \sin\left(\omega t - \alpha z - \frac{\pi}{4}\right) \qquad (46)$$

It lags 45° in time behind the electric field everywhere within the metal! One can now define the internal impedance of the metal, or the "input impedance" Z_i, by taking the ratio of electric to magnetic field component just as in the case of the transmission line. On account of the extremely slight penetration, no reflection can take place in practical cases and only the forward progressive wave need be considered. But even so, since a phase angle exists between electric and magnetic fields, the input impedance must be complex and its value is found as

$$Z_i = \frac{\sqrt{2}}{\gamma \delta} \angle +45°$$

or in complex notation

$$Z_i = \frac{1}{\gamma \delta} + j \frac{1}{\gamma \delta} \qquad (47)$$

This must be interpreted in connection with the assumed field in Fig. 8. The electric field indicates the direction of current flow in the metallic conductor, since it can only be representative of the series "voltage drop" along the conductor surface according to (5). Equation (47), therefore, defines the resistance per unit length in the x-direction and unit width in the y-direction as $1/\gamma\delta$ ohms and gives the same value for the inductive reactance. If we apply that to copper with $\gamma = 5.82 \times 10^5$ mho/cms, for example, we find at 400 mc.p.s.

$$\frac{1}{\gamma \delta} = \frac{2 \times 10^4}{5.82 \times 10^5 \times 6.6} = 0.052 \text{ ohms}$$

a small, but not negligible value, which increases with the square root of frequency. The concept of a metallic "short circuit" is then not equivalent with practically zero resistance, and, indeed, a copper sheet of 0.001 in. thickness will be as good to use as any solid piece of copper.

In order to compute the losses, one uses again the Poynting vector on the surface of the metal $z = 0$,

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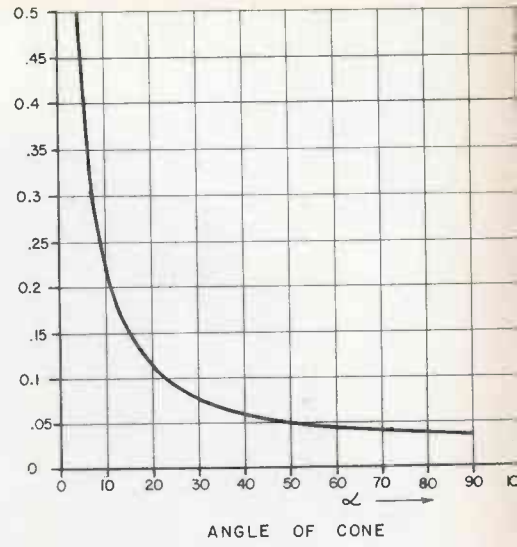
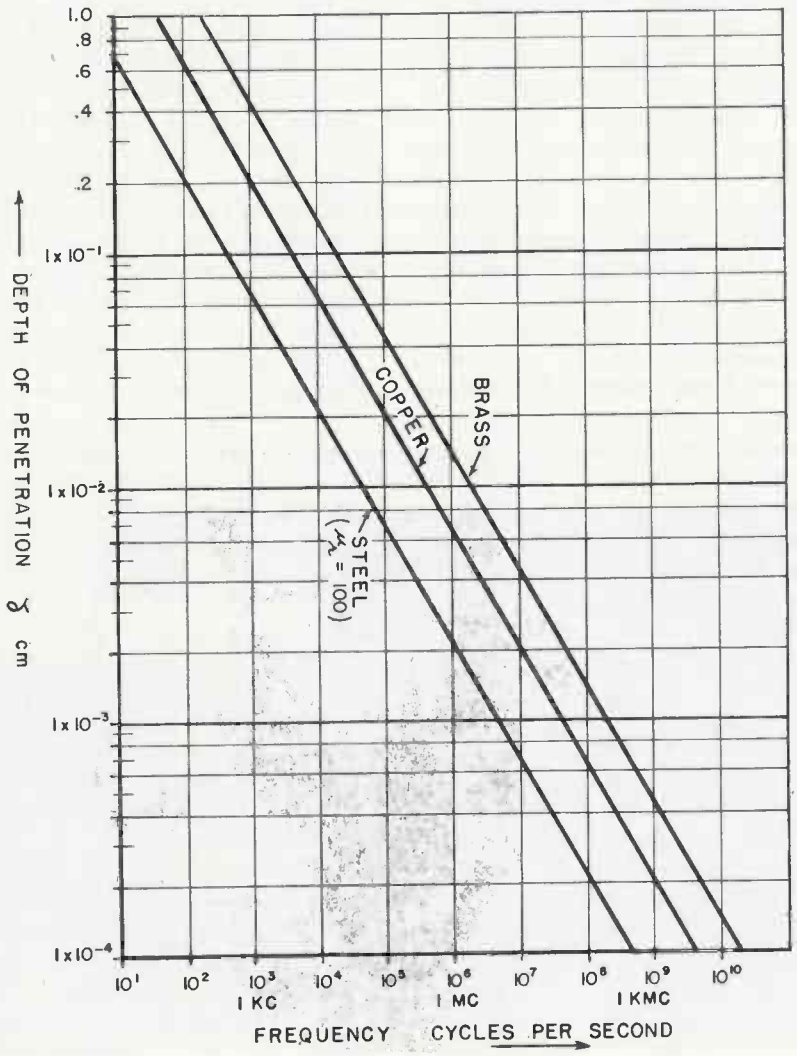
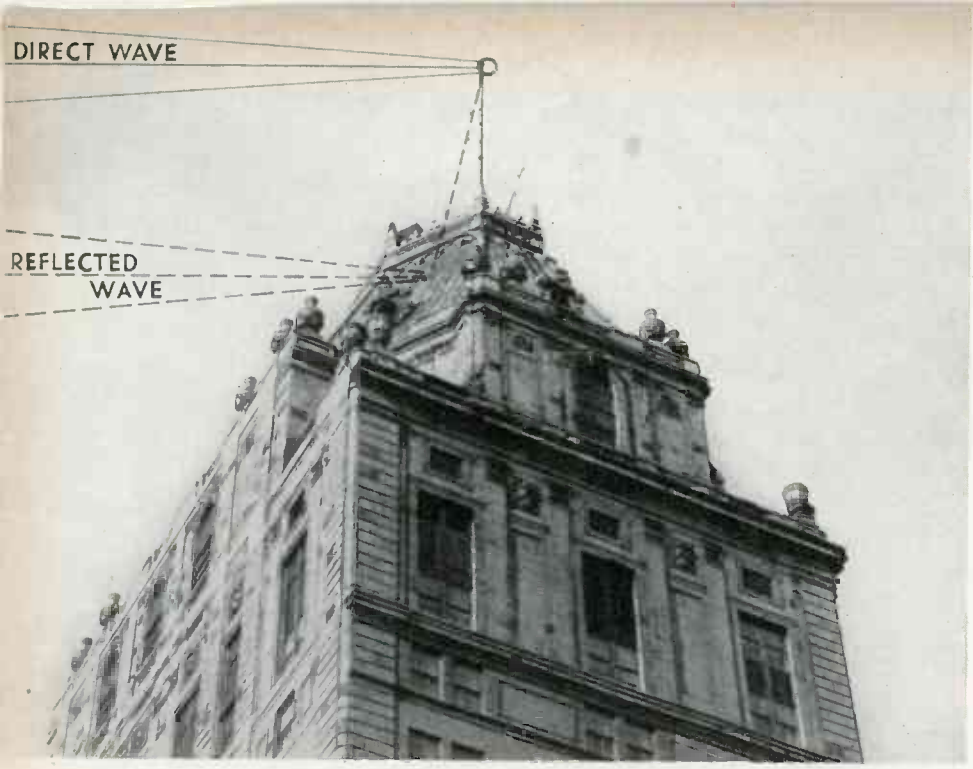


Fig. 10. Loss resistance of biconical antenna

Fig. 9. Depth of penetration of ultra-high frequency electromagnetic fields into metallic conductors





How copper roof of Hotel Pierre is believed to add reflected component to direct FM output

FM's NEW W75NY

Wide area covered by Bloomingdale's 1-kw station ascribed to 700-ft elevation and roof reflection

Probably the greatest problem in the design and installation of any new broadcasting equipment is to find and ultilize effectively the existing metropolitan skyline configuration. In many cases well-established architectural details on some buildings have proved engineering headaches for the introduction or extension of new radio facilities on that or neighboring structures. Such "radio abnormalities" are particularly important when the higher carrier frequencies used for frequency modulation and television services are considered. Some of these problems entered the picture when the new frequency-modulated station W75NY was developed, but were used to advantage.

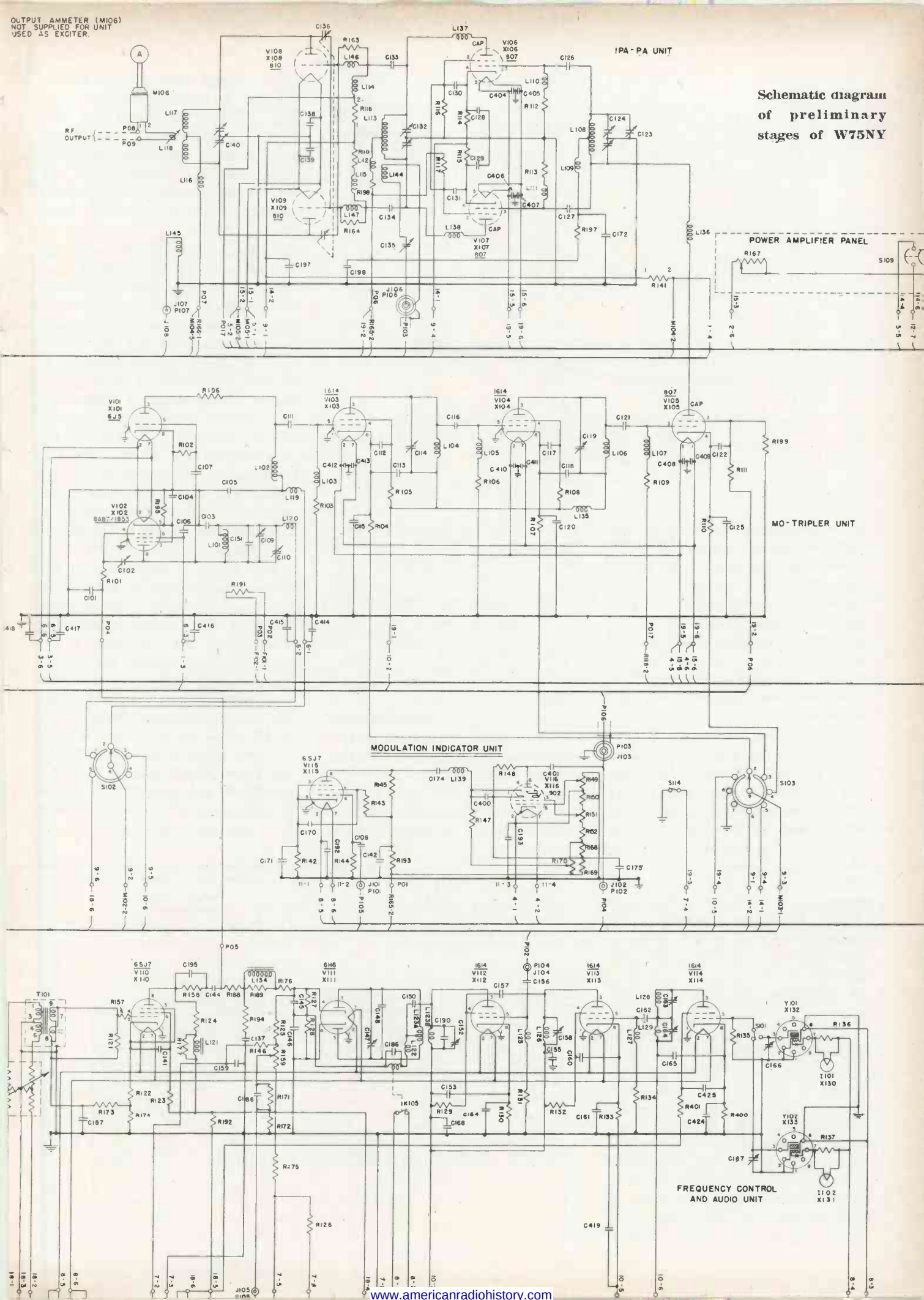
This station with studios atop the 22-story office building at 654 Madison Avenue, New York City, is owned and operated by Metropolitan Television, Inc. The FM station went on the air October 16, 1942, and was one of the last FM stations to receive an operating license from the Federal Communications Commission before the rigid restrictions of the War Production Board were imposed.

While offices and studios occupy the top floor and penthouse at 654 Madison Avenue, the transmission equipment and antenna are located atop the 45-story tower of Hotel Pierre, corner of 61st Street and Fifth Avenue.

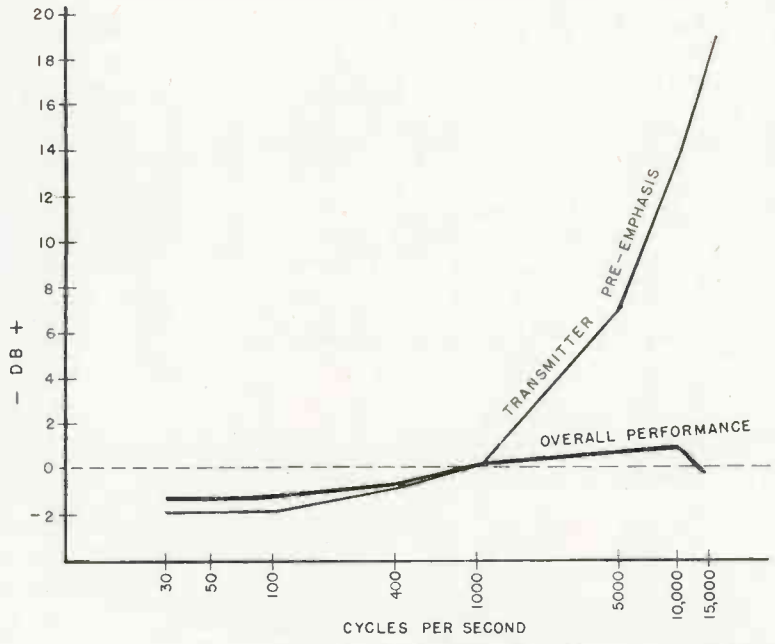
As this station was developed during a time when the procurement of equipment and labor was most difficult, the administrative staff had to show great skill in carrying out most of the desired features.

In the design of the studio and control-room areas, it was necessary to convert an existing penthouse apartment into broadcasting facilities. Adjoining the living quarters

The new FM transmitter is installed alongside a television transmitter. At the right are the FM transmitter for television sound, and the video modulator. Separate picture at extreme right shows speech input for FM transmitter



Schematic diagram of preliminary stages of W75NY



Curves showing the amount and effect of pre-emphasis in the W75NY transmitter

of the penthouse there was a fully equipped kitchen which had to be dismantled. Perhaps it was fortunate that this dismantling was necessary, because the kitchen equipment was transferred to the transmitter location where it was re-installed for the use of the transmitter personnel, at a time when plumbing equipment was unavailable.

In the former kitchen area where the control-room was to be, a raised floor was built on sound-insulated posts so that vibration issuing from the building elevators would not be transmitted to the control and transcription equipment. A wide-angle control-room window was built between the control-room and studio to give the operator full vision of the entire studio area, the design of which is such as to minimize both sound wave and light reflections to the operator as well as to the announcer and studio artists.

The studio proper is an area approximately thirty feet by forty feet, originally finished in oak paneling, broken up with large casement windows and with a floor of solid dowelled oak board completing a luxurious music-room effect. This design was left intact with the exception of the addition of the necessary rugs because it was felt that with decorative (and black-out) heavy drapes added to the casement windows, it would be possible to arrive at a balanced ratio of reflective to absorptive surfaces in order to reach optimum acoustic conditions. The acoustical effect thus obtained is most desirable and shows a brilliance and quality of sound not to be found in studios too heavily padded or treated.

Control room

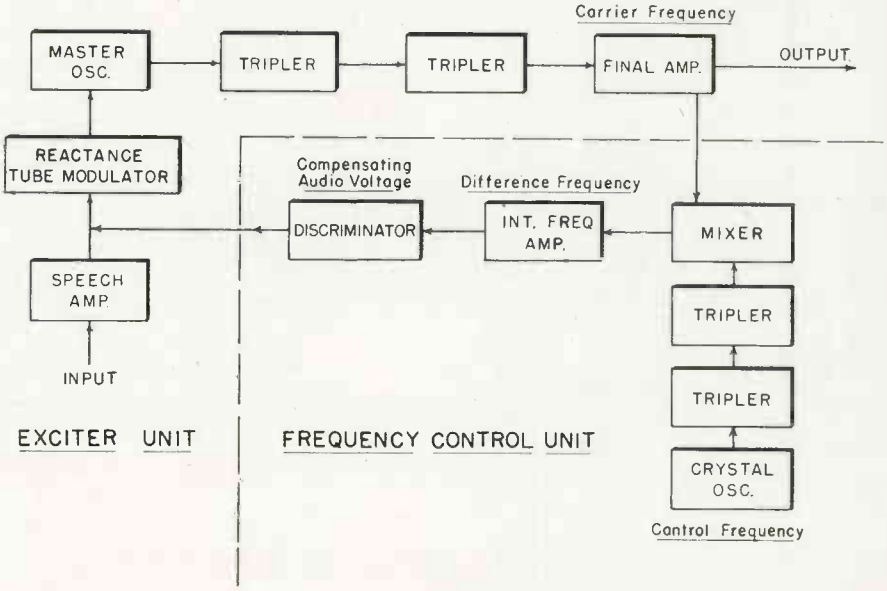
The control-room equipment consists of an RCA 76—B2, FM consollette with which it is possible to mix four microphone positions, two turntables and any of six incoming, remote lines. At the present, one of these remote lines goes to a permanent installation at the news and editorial offices of the New York Herald-Tribune from which are obtained regularly scheduled news programs, commentaries and special features, as well as reports of special news events as they happen.

To further increase the range of service to the public, W75NY also has direct lines to CBS from which are obtained programs of vital national interest. Monitoring of programs is done "off the air" rather than off the consollette, because it is felt that only by actual air-check is it possible to make sure that actual wide-range transmission is accomplished. The microphones used are Western Electric combination ribbon-dynamic-cardioid types. The transcription equipment of Presto turntables is mounted with Western Electric 9-A Universal reproducer heads.

The studio is connected to the transmitter through six pairs of direct telephone lines. Two of these are high-fidelity lines capable of transmitting the full range of 20-15,000 cycles-per-second sound spectrum characteristic of frequency-modulated signals. These two lines are used on alternate days so that at all times the condition of both of these program lines is checked. The third pair of lines is a private telephone communication circuit between the control and transmitter

(*Continued on page* 132)

Block diagram of the reactance tube modulating system showing automatic frequency stabilization



POLICE FM for MOTORCYCLES

by JAMES H. GENTRY
Delaware State Police

Conversion of old AM motorcycle receivers to FM meets equipment shortage

The State of Delaware recently began installation of a new FM two-way emergency radio system to replace the original medium-frequency AM system. The new system consists of five main stations and 33 mobile units.

Most of the old equipment was turned in. It was suggested to the Superintendent that inasmuch as the State desired to operate motorcycles for reasons of economy, and that as yet radio equipment to receive FM signals was not available for motorcycles, it would be practical to rebuild the old receivers.

The circuit decided upon is a simple, crystal controlled, straight superhetrodyne, with one limiter and conventional discriminator. As it was necessary to consider maximum battery drain, a minimum number of multi-purpose tubes is used. The noise level on a motorcycle in operation is high enough to override the normal hiss of a wide-open FM receiver, and in view of that fact, it was decided to eliminate the squelch circuit.

Used original parts

The chassis layout was planned to make all wiring as short and isolated as possible. In the interests of economy, all original parts possible were used. The final tube line-up called for two more tubes than the original chassis used. The socket hole for the oscillator tube was cut in the chassis in the position formerly occupied by the by-pass block. The power amplifier and its components were moved over into the power supply case, and the necessary wiring pulled in through the loom.

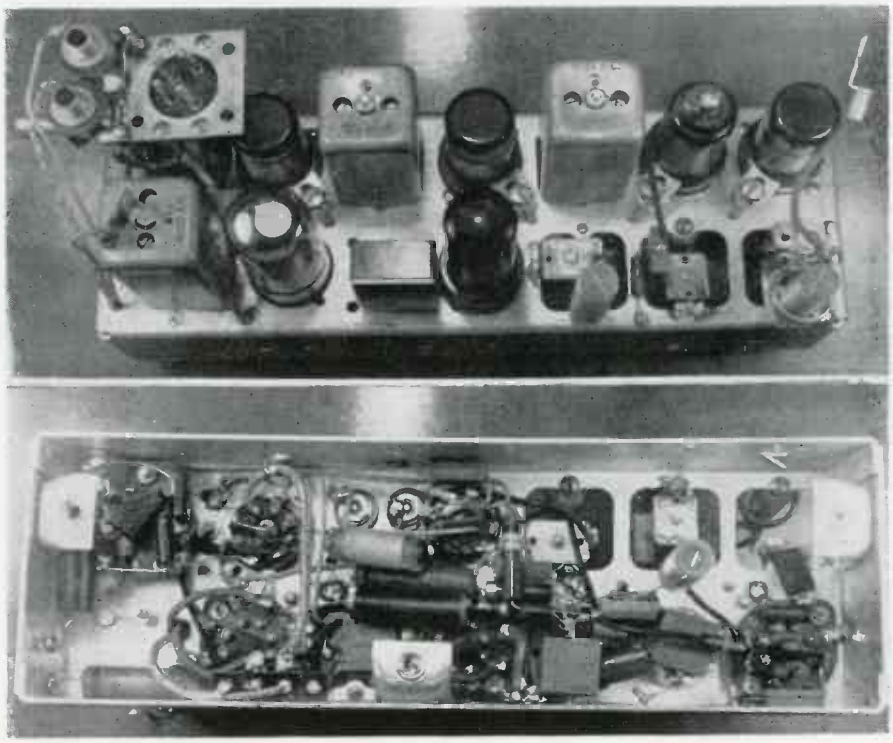
The original or test model was built and installed on a motorcycle and given thorough tests and a shakedown period of use. Several troubles developed. The first was apparently either lack of sensitivity or loss of sensitivity or both. The check on this showed a detuning of the rf, amplifier circuit. This was found due to the use of a mica padding condenser, and its use was discontinued in favor of an air dielectric condenser. Further checks showed a lack of sensitivity, due to low plate voltages, and insufficient volume. The substitution of a vibrator transformer of 250 volts output instead of 125 volts increased the battery drain but little and brought up both the sensitivity and the audio power to a more than necessary level. In re-designing the power supply unit, the parts were re-arranged so as to allow for mounting the power amplifier and its components directly on the P.S.U. chassis. This made a more compact, rigid, and neater job.

Material and cost saving

From the data gathered in the construction and tests of the first model, the second model was built incorporating all the improvements called for, together with several layout and construction changes designed to give better mechanical strength. Air-dielectric condensers are used in the high-frequency end for better stability. This second set has given about six months service

(*Continued on page* 131)

Top and under-deck view of converted automobile receiver used for motorcycle FM reception by Delaware State Police. Oscillator crystal is in center foreground of top deck view



RADIO In AIR TRAVEL

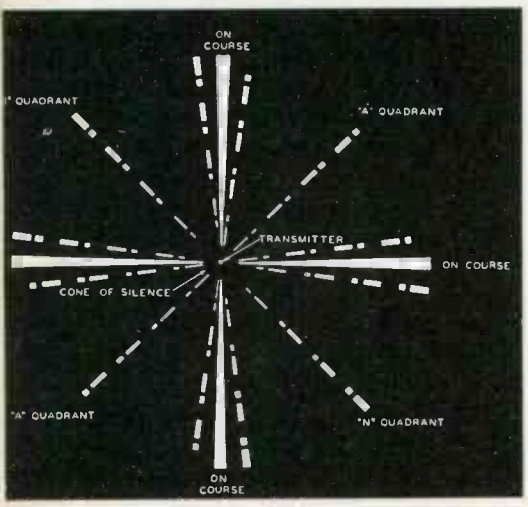
Communication, beam flying and landing guides. Current practice in airline transmitters and receivers

Aviation radio can be broadly classified under two headings: aircraft radio, and ground-station equipment. The first classification includes all radio equipment carried in the plane and depends entirely on the use to which that plane is to be put. A passenger-carrying airliner, which often operates out of visual contact with the ground, carries an array of powerful, dependable radio equipment, whereas a small private airplane of short cruising range is rarely out of sight of landmarks on the ground and needs only a simple, inexpensive radio installation.

Ground stations

Commercial ground station equipment is owned and operated by the government, the airlines, and by airport operators. The government, through the Civil Aeronautics Administration, operates all Civil Airways radio range or beacon transmitters, of which there are approximately 309 in the United States. The CAA maintains also radio control over traffic on and around certain crowded airports, and operates communications stations for the delivery of weather data and other information to all pilots.

Coded quadrant signals are spaced so as to merge into one single tone at the on-course beams. For simplicity, four 90-degree quadrants are shown, but the angles between beams may be varied



Airliner showing main transmitting and receiving antenna and two "Belly T" antennas

An idea of the large part played by radio in airline operations may be had by noting the design and function of each piece of equipment in a typical airline installation. First is the plane's radio transmitter, usually rated at 50 to 75 watts output power. It is customary to control this unit from a remote control box located within easy reach of the pilot and co-pilot. From two to ten fixed crystal controlled frequencies may be available, and selection is made by means of a push button control or by a simple selector switch. Power is supplied from a dynamotor power supply either self-contained or separate from the transmitter unit. The dynamotor is supplied from the plane's storage battery system, which in turn is charged by generators driven by the main engine units. Plate voltage for the transmitting tubes is applied when a button on the microphone is pressed. Thus the transmitter is in actual operation only for relatively short periods of time.

Energy is radiated from the aircraft transmitter through the main transmitting antenna, which is usually strung from the top of the vertical stabilizer to a short mast above the pilot's compartment. Maximum radiation efficiency is obtained from this antenna by providing variable coupling and variable loading circuits in the transmitter so that all carrier frequencies may use the same antenna length. The main antenna is usually connected through an antenna change-over relay so that this antenna may also be used as a communications receiving antenna.

An airliner usually carries from two to five different receivers. Most used among these is the main beacon or radio range receiver, which is depended on constantly during a flight to check the position of the plane with respect to the range transmitting stations. This receiver covers the frequency band of 200 to 400 kc, and usually is provided with a switch so that the control-tower frequency of 278 kc may be received without disturbing the tuning of the beacon signal.

Auxiliary beacon receiver

An auxiliary beacon receiver is often incorporated in an airliner's radio installation. This receiver is similar to the main beacon receiver

but is smaller and may be powered either from a separate storage battery and generator system or from a dry battery pack. It is common practice for the modern twin-engined airliner to have two separate generators, one driven from each engine, and each charging its own storage battery. However, when only one electrical supply system is provided, auxiliary receivers are powered separately from dry batteries.

In conjunction with the transmitter the plane is equipped with a communications receiver. Like the transmitter, this receiver provides operation on several fixed frequencies, each controlled by a crystal oscillator circuit. The frequency band covered is usually about 2,500 to 7,000 kc, and the purpose of this unit is to give the crew of the airplane communication with high-frequency ground stations or with other planes.

Several types of receiving antennas are used in addition to the main antenna described above. The "V" antenna can be rigged to three short masts, usually projecting down from the belly of the airliner. One mast is generally forward under the nose with the other two placed one under each wing near the engine housing. The "T" antenna requires only two masts, usually on the bottom of the fuselage and along the longitudinal axis of the plane. On the latter type the antenna lead-in is taken from the mid-point of the antenna wire, and on the former usually from the apex of the "V." The design of these antennas provides minimum distortion in the reception of radio range signals, so they may accurately guide the pilot along a radio beacon course.

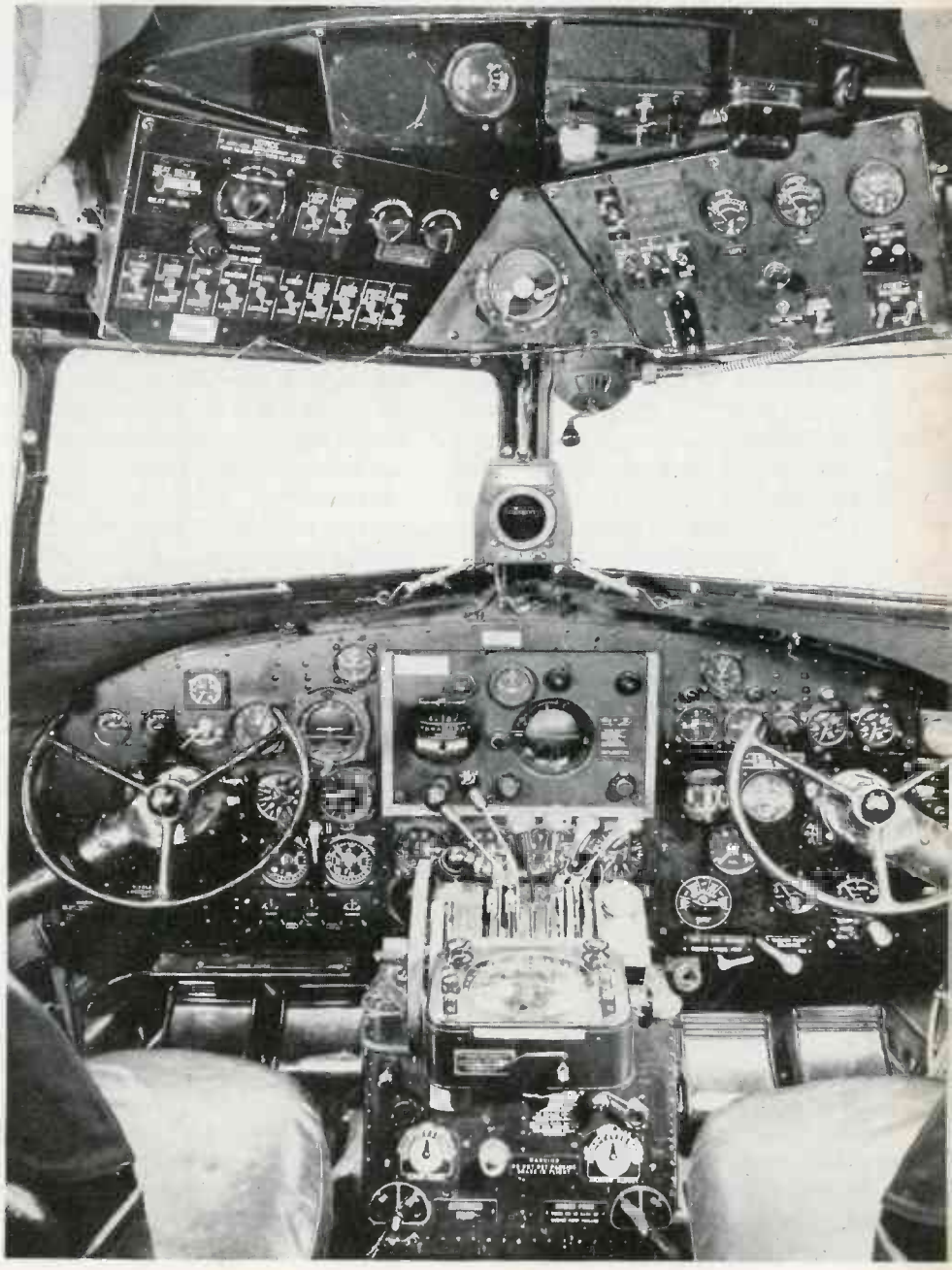
Automatic direction finder

One of the most ingenious radio aids to air navigation is the automatic direction-finder. Most modern airliners are equipped with one of these instruments, although some still use the manually controlled direction-finding receiver or the radio compass. The essential components of the automatic direction finder (ADF) are a sensitive receiver and a rotatable loop antenna. A visual direction indicator is usually used so that the pilot may determine the bearing of a transmitting station by reference to an instrument on the panel. A more advanced type of direction finder uses two separate receiving circuits which, when the loops are tuned to two separate stations, will provide constant and automatic triangulation on the same indicating instrument. Rotation of the loop on the ADF is accomplished through a thyratron control circuit to a dc motor with a center-tapped field winding which is geared to the shaft of the loop. When the loop is turned to one side of the null, or point of minimum reception, the received signal fires one of two thyratron tubes and the motor rotates the loop toward the minimum.

The loop antenna may be manually controlled by a crank handle or by a potentiometer control on the driving motor. The bearing indication is aural, giving a tone in the headphones which may be adjusted to minimum level.

The automatic direction finder usually covers a frequency range of 200 to 1,500 kc, which enables the pilot to take a bearing on either a radio range or a standard broadcast station, and the loop antenna

Instrument panel of an airliner showing automatic direction finder control and indicator in the center foreground with the dial facing upwards. At the top of the picture is the dial and tuning control for the auxiliary beacon receiver, and to the right of that is the transmitter and receiver master switch box



is operated in conjunction with a conventional receiving antenna, giving the desired single-null (i.e., cardioid) pattern. Thus it is possible to do without one of the two beacon receivers mentioned and fly the range with the ADF in case of failure in the main beacon receiver. When this is done the loop is disconnected from the input circuit and grounded, for range flying requires an accurate measurement of relative field intensity which is not given by the rotatable loop antenna.

The last major item of equipment in a typical airliner's installation is the high-frequency marker beacon receiver. Before the function of this receiver can be understood, it is necessary to understand the operation of the radio range beacons and how they are used by a pilot for navigation.

A radio range station utilizes a directive antenna array to transmit four "on course' beam signals. These signals are identified by an unbroken audio-frequency tone, interrupted only by a coded station identification. In the areas between these on-course beams, a code signal is transmitted to identify the quadrants: "N", or "— ·" in the north and south quadrants, and "A", or "· —", in the east and west quadrants. Thus if a pilot is flying along one of these on-course signals or "legs" of a range, he can tell when he starts to deviate from his course by the change in keying of the audio tone he receives. By reference to a radio chart of the area he can tell which way he has deviated and correct his error.

On-course signals

The bearings of the four on-course signals may be set as desired by proper location and phasing of the station transmitting antennas, and by driving each tower of the array in the desired power ratio to the others. Directly over the transmitting antenna is a "cone of silence," or vertical space where no signal is heard. When the pilot flies through this space his position is accurately defined.

The coded range signal of a radio beacon transmitter is periodically interrupted by a station identification, also in code, consisting of one or two letters. Thus the pilot can determine which range he is tuned to, in addition to being able to determine his bearing with respect to that range.

Tower for uhf landing and other electronic traffic controls at LaGuardia Field

The pilot's bearing from the range station and his direction of flight may be established by reference to a map showing the bearing of the beacon signals, but the range gives him no definite fix on his actual position along his course of flight until he passes over the cone of silence. This is where the marker beacon enters the picture. One of the most common types of marker beacon is the fan marker, radiated by a low-power transmitter in a fan-shaped signal pattern extending vertically upward from an antenna array. Such a transmitter may be placed at a given distance from the main beacon transmitter and directly on one leg of the range.

Let us assume that a pilot wishes to land at an airport which is located near a range station transmitter. He is flying along one leg of the range and is headed toward the airport and the transmitter. When he passes through the signal of the marker beacon he then knows his exact position, and is able to tell how soon he will be over the airport, how high he should be flying and what speed he should maintain in order to make a correct landing approach. All this has been done without visual contact with the ground.

The marker beacon is transmitted on a frequency of 75 mc, and so requires only a simple, fixed frequency receiver. At this frequency, the physical dimensions of the receiver and its antenna may be small, so the unit is easily incorporated in an aircraft installation. The output of the receiver is usually fed into the headphone circuit of the regular beacon receiver, and is also used to actuate a colored light on the instrument panel, so the pilot has visual and aural indication when he passes through the signal of a marker beacon.

The progress of the aviation industry has always been distinguished by a fight against weather. The action of the elements has been one of the greatest obstacles to be overcome in order that airline travel might be regular and reliable. The marker beacon is a fore-runner of a variety of ultra-high-frequency radio equipment that will enable airlines of the future to improve on the high standards of safety and reliability under which they operate today. Much of this equipment has already been developed and used in many test flights. Success has been reported in instrument landing procedures controlled entirely by radio signals.

Radio-Controlled Ship Convoys

Overcoming the submarine menace has become one of war's major problems. The search for means to combat this undersea danger now has resulted in the development of a new and revolutionary system of marine transport, using radio controls devised by a well-known radio engineer. Ultra-modern in its concept and operation, this new development employs a covey of cigar-shaped robot ships made of reinforced concrete, riding so low in the water that they cannot be seen more than two miles away by a marauder. Traveling in a convoy of ten or twelve, these concrete ships, without superstructures of any kind, except small whip antenna rods, are without crews, are self-powered by Diesel engines and are guided by remote radio control from a heavily armed mother ship, manned by expert gunners.

The method of secret radio steering and control marks a distinct advance in circuit design, the details of which are a closely guarded secret because of military value in time of war. However, it can be said that a system of selective high-frequency waves are employed. Because of the nature of these waves and the manner of radiation employed, their range does not exceed a few miles, which is declared to be well within danger range to any prowling enemy submarine.

Control combinations quickly changed

An enemy craft would have to be floating on the surface and not more than two miles away in order to detect the presence of this phantom convoy. Chances of enemy detection of the radio control would be very slight, the inventor claims, and its normal control could be changed instantly if trouble developed. Each ship of the convoy is individually and separately controlled, governing automatically all function, such as speed forward or backward, turning sidewise or zig-zagging in any direction — maintaining at all times any spaced location of all ships in relation to fleet formation. If trouble of any sort arises aboard any of the concrete ships enroute such as Diesel engine stoppage, sudden shift of course due to high seas, rudder shifted hard off-course or any unforeseen disruption of normal operation, the alarm is instantly transmitted to the navigating control aboard the mother ship from which

(*Continued on page* 130)

F. B. Woodworth proposes radio-controlled robot barges like that below

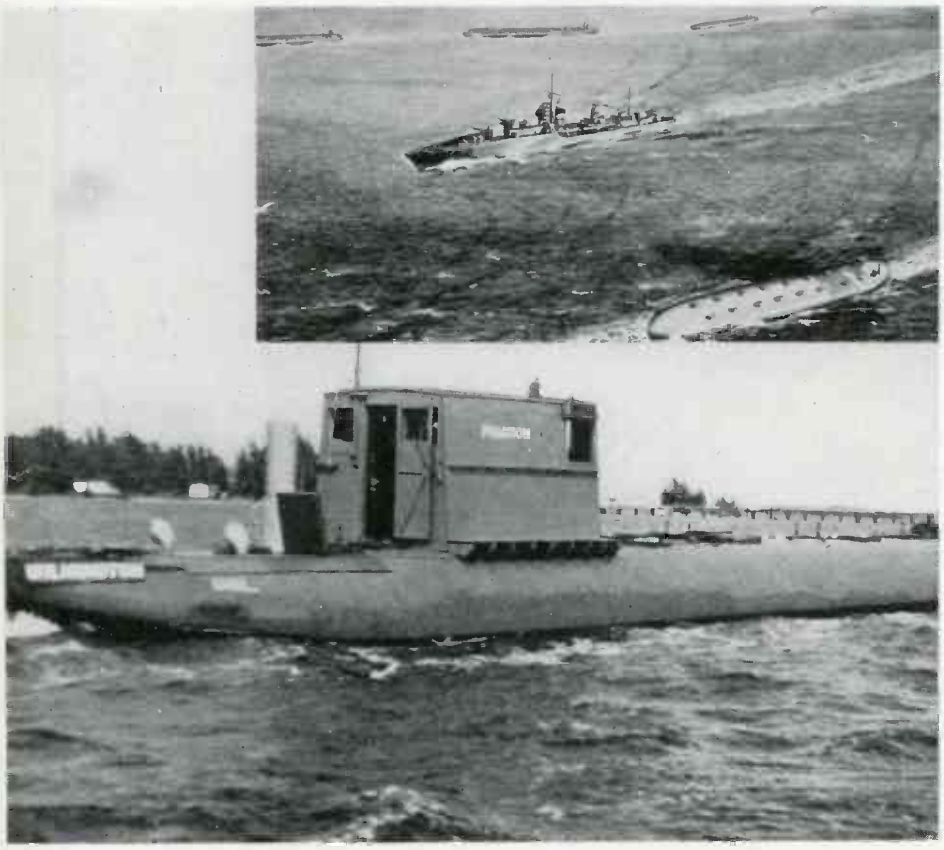


Chart of Latest Radio Allocations— Supplement with this Issue

A number of changes in frequency assignments and several bands marked for new services are presented in the large chart of Radio Frequency Allocations for the Western Hemisphere, sent as a supplement with this issue of "Electronic Industries." The chart has been thoroughly revised to date in accordance with modifications recently made on the basis of the Inter-American agreement. Among the many new features on the chart, special attention is called to:

Instrument-landing beacons for airfields, at 93,300 to 94,500 kc and at 109,300 to 110,500 kc.

Studio-transmitter links for high-frequency broadcast and international-broadcast stations, at 330,100 to 343,900 kc. These channels are to be used for sound broadcasts. (For television rebroadcast links the higher-frequency television channels, above Television Channel No. 7, are made available.)

Diathermy channels at 13,700 kc, 27,400 kc, and 41,100 kc. These diathermy chanels are so far merely "proposed" and not yet adopted. They are still under discussion and final determination has not yet been settled. While all three channels are proposed for diathermy operation, it will be noted that the second and third channels are respectively the second and third harmonics of the first.

The new Radio Frequency Allocation chart, sent as a supplement with this issue, was prepared by the editors of "Electronic Industries" in collaboration with RCA Laboratories of Radio Corporation of America, through their Frequency Bureau which operates under the direction of Dr. B. E. Shackelford, engineer in charge, with C. E. Pfautz as manager of the Frequency Bureau.

Electronic Tubes ON THE JOB

Glass-rod larynx in use

Dr. Firestone's Synthetic Singing

Radio audiences are now fairly familiar with the sounds of the Wright Sonovox on the air, and the program effects in which fog-horns talk and locomotive whistles sing.

Another form of the electronic larynx is that developed by Prof. Floyd A. Firestone, Ann Arbor, Mich. which makes use of a loudspeaker attached to a glass rod inserted in the mouth and reaching far enough back into the throat so as almost to touch the user's own larynx. The loudspeaker sounds conducted by the glass rod, are then modulated by the user's vocal mechanism and voice cavities. This permits comparatively high levels, and Dr. Firestone can even sing loud enough to be heard directly by a group in an auditorium.

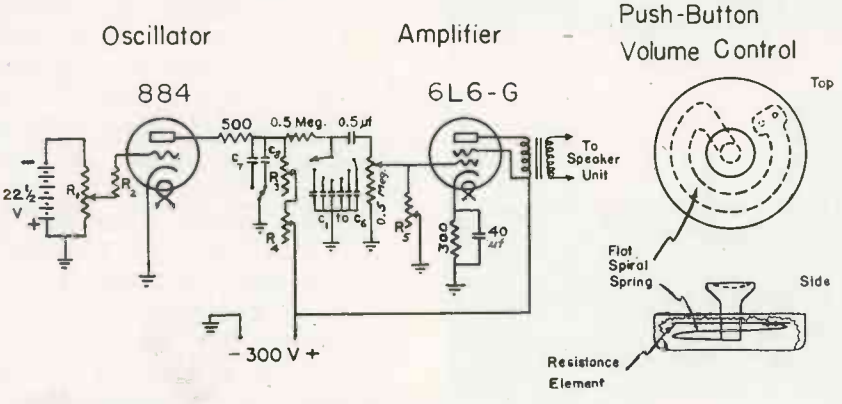
In singing quartets, since the operator's hands are free, Dr. Firestone himself plays the Novachord which supplies sufficiently good timing between keyboard and mouth manipulation to distinguish between the voiced consonants and the unvoiced. If such distinction is not made and one tries to sing "Here's to the maid in the lily white smock, who tripped to the door and pulled back the lock," it will come out "Here's do the maid in the lily whide smog, who dribbed do the door and bulled bag the log." It is necessary to release the keys at the instant when the unvoiced consonants f, s, th, sh, p, t, ch, k and h are whispered, which requires that the person doing the whispering also play the keyboard.

Dr. Firestone has given a number of one-hour lectures demonstrating this equipment before radio and acoustic engineering bodies and has demonstrated the following tricks:

Using the relaxation oscillator as source he can make a speech without using his vocal cords. He can also show how if one works the pitch control wrong, one gets the emPHasis on the wrong sylLAble. By simultaneously using his own vocal cords he can speak with two voices at once. Thus he can sing "Sweet Adeline" with the oscillator while using his own vocal cords to supply a whiskey tenor, singing a duet.

He can take a phonograph record having only orchestra and no words, and make it sing the words of the song.

Circuit devised by Dr. Firestone to drive glass-rod larynx



R_1 - 0.1 Megohm
R_2 - 25,000 Ohms
R_3 - 1.0 Megohm
R_4 - 1.0 Megohm, tapered
R_5 - 0.1 Megohm, Push-Button Volume Control

C_1 - .00005 μf
C_2 - .0001 μf
C_3 - .00025 μf
C_4 - .0005 μf
C_5 - .001 μf
C_6 - .005 μf
C_7 - .02 μf
C_8 - .04 μf

Photocells Guard 2700-ft Waterfront

Photoelectric protection on an unparallelled scale is given four Staten Island, N. Y., piers, each about one-thousand feet long, and an adjoining rectangular strip of land of about thirty acres, known as the New York Free Port.

Protection is accomplished on the land side by a twelve-foot barbed-wire steel fence extending for one and one-quarter miles, around three sides of the Zone. As the fence approaches the water boundary at each end it passes down to the dock, close to the shed, providing a narrow walk-way to the end of the pier. Between each of these points, a light-beam barrier extends to close the Zone.

Waterside barrier a light ray

Confronted with the formidable problem of carrying the protection across the waterside boundary, the Department of Docks studied mechanical methods, such as a cordon of pontoons, or a chain net, but both were rejected as expensive and cumbersome, and incomplete in the protection they afforded. The War Department engineers also objected to such schemes as a menace to navigation. Then the problem was brought to the attention of the American District Telegraph Company. After a preliminary study of the problem by their engineers, it was evident that these stringent requirements would represent a tremendous extension of standardized photoelectric protective system.

The problem was not only to produce a one-half mile protecting beam of radiant energy, capable of penetrating all sorts of atmospheric conditions, but also to develop suit-

able supports for this apparatus. The supports not only had to rise and fall with tide variations, but they had, during all of this, to keep the sender and the receiver pointed accurately towards each other. If the energy from the source could be allowed to diverge in a wide cone as it approached the receiver such super-accuracy would be unnecessary, but where it was essential to concentrate the protecting beam into as narrow a pencil of light as possible in order to increase the intensity, the slightest variation would cause the beam to be misdirected and not reach the receiver.

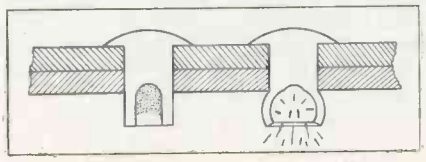
The light source, generating a beam of high intensity, so controls the beam that it goes on and off many times a second at a speed not visible to the human eye. When this energy reaches the receiver, electrical apparatus translates the changing light into mechanical power to operate alarm bells, pilot lights, and a siren. This receiver, although hyper-sensitive to the transmission from the source, is unaffected by any other extraneous light, such as sunlight, beams from searchlights, etc. Only the slightest trace of the beam has to get through fog and snow to the receiver to provide an impregnable barrier of defense. The A.D.T. engineers originally intended the beam to be invisible, but the customs officers preferred a visible beam making a definite white line across the water surface to mark the limits of the Zone.

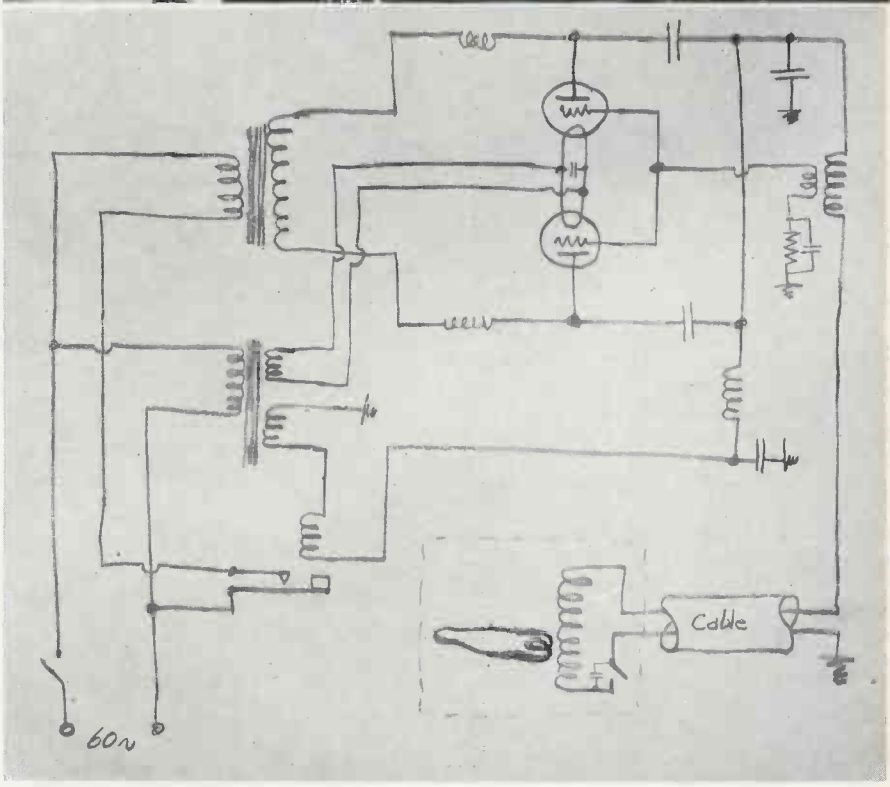
Induction Heating Explodes Blind Rivets

A low-power, portable induction heating oscillator for use with Du Pont's explosive rivets, used principally in aircraft construction, has been announced by RCA.

Standard riveting practice calls for one man to drive the rivet while another "backs up" the other end, to flare it. Various aircraft companies have employed midgets to crawl inside small structures. Development of the dynamite-filled,

Sketch shows action of explosive rivets





At top, portable electronic rivet detonator in use. Below, last-minute sketch of circuit of pp self-rectifying oscillator, exclusive with EI. Note relay to energize high voltage primary. In rush, grounded ct's of hv and filament secondaries were not shown

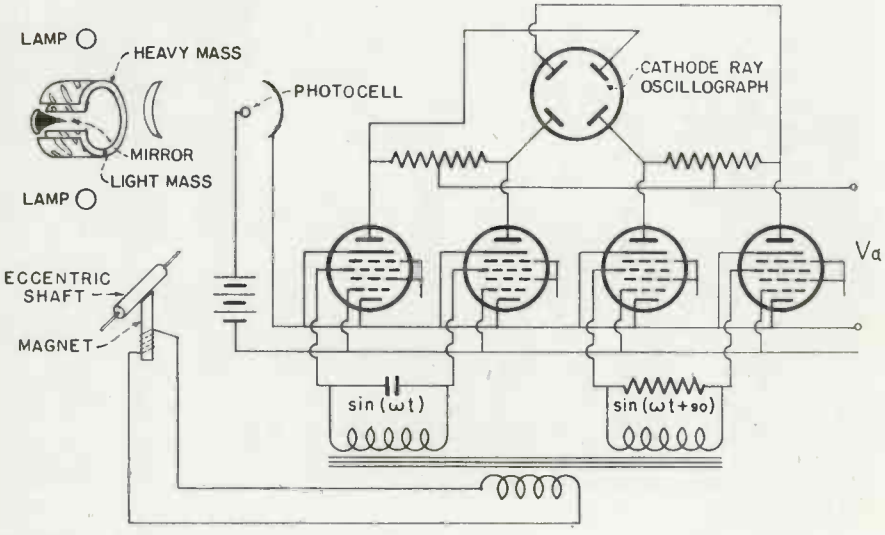
heat-detonated rivets made riveting possible in still smaller structures, and speeded "setting" of rivets from two to fifteen a minute.

The induction-heating unit, with special heat applicator "gun," is designed to replace slower "soldering-iron" type of rivet detonator. Better temperature control is obtained, since the power-output of the oscillator can be quickly controlled to suit the requirements of various sizes of rivets. A number of rivets can be inserted ahead of the riveter and held in place by scotch tape, since the tape does not interfere with the action of the high-frequency current.

Quicker detonation of the rivets is possible, since heat is generated directly in the metal body of the rivets.

SURVEY of WIDE READING

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



Torsion indicator

Photoelectric Torsion Indicator

W. Spillman (Schweizer Archiv, Zurich, 1942)

The device is intended for measurements of torsional vibrations on the shaft of internal combustion engines for aircrafts or cars.

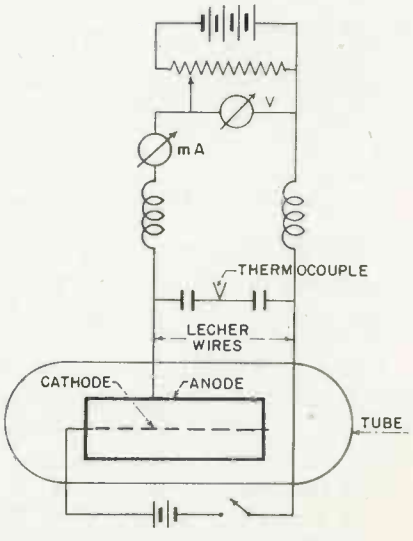
A heavy and a light mass are connected to the shaft to be investigated in such a manner that the heavy mass, owing to its considerable inertia, revolves with constant speed, while the light mass follows the torsional vibrations of the shaft. Referring to the figure, both masses are provided with a series of slits and surrounded by several lamps. The intensity of the light beams, upon passing through the slits, becomes modulated in dependency of the relative movement of the two masses. A mirror and lens arrangement projects the thus modulated light on a photocell, the current variations of which may be registered by a cathode-ray oscillograph.

It is preferable to adapt the cathode-ray oscillograph for polar diagrams. This is accomplished by a specially constructed amplifier. A magnet in combination with an eccentrically mounted shaft provides two sine voltages 90 deg. out of phase, the period of which coincides with one complete rotation of the masses. These two voltages are amplified and applied to the two pairs of the oscillograph so as to cause a circular pattern. The photocell controls another grid of the amplifier tubes impressing the rhythm of the torsional vibrations of the shaft on the plate current. Consequently, the radius of the signal on the polar diagram varies in dependency of the torsional vibrations.

Oscillations in Plasma of Gaseous Discharge Tubes

A. A. Sluzkin and A. P. Maydanov (Journal of Physics, Moscow, Vol. VI, No. 1-2, 1942)

The oscillations in the plasma of a glass tube filled with mercury vapors were investigated. A Lecher system and either a thermocouple, a detector or, for very small intensities, a superheterodyne receiver, were used for conducting and measuring the oscillations.



Measuring oscillations in plasma

Anode voltage was impressed through the Lecher wires.

Dependency of intensity and wavelength on anode voltage and current as well as on shape and relative position of electrodes and on pressure in the tube were studied. A possible mechanism of these self-excited oscillations based on the experimental results is presented.

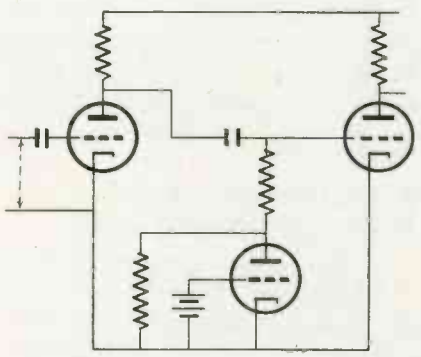
Improvements in Loudspeakers

A. Von Lupke, (Zeitschrift fuer technische Physik, summarized in Wireless Engineer, Oct. 1942)

It is pointed out that the distortion of a pentode or tetrode tube output stage in combination with a loudspeaker characteristic is usually not compensated for, but made less noticeable by cutting off the high frequencies. A circuit is proposed for making the loudspeaker impedance practically independent of frequency and real, thus eliminating distortion.

Gain of Low Frequency Amplifiers

A. S. Rao (Indian Journal of Physics, Vol. XXV, Part II)



Gain of low frequency amplifiers

The formula for the effective grid voltage at the second stage of a low-frequency resistance-capacitance coupled amplifier is computed from the equivalent circuit, and its dependency on the grid resistance of the second tube investigated. It appears from the computation that the maximum voltage gain occurs for a negative grid resistance and that it may be substantially higher than for any positive value.

To check the formula by experiments, a dynatron was inserted be-

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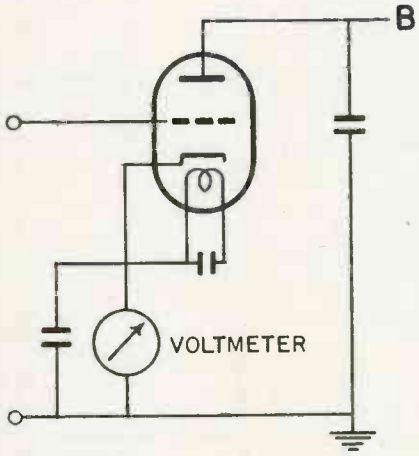
tween grid and filament of the second tube of an amplifier, and its resistance, providing the grid resistance of the tube, was given different positive and negative values, while the grid voltage was measured with a thermionic voltmeter. The observed voltage gains closely approached the computed values.

Secondary Radiation from X-ray Filters

G. A. Wrenshall & H. J. Nichols (Canadian Journal of Research, Nov. 1942)

Forward transmitted secondary radiation from X-ray filters, made of aluminum, copper, tin and lead, respectively, is measured under operating conditions as commonly used in industrial and medical radiology. The arrangement is shown and exact dimensions are given. Intensity and intensity distribution for different wavelengths of the secondary rays as function of thickness of filter and distance between filter and measuring point are tabulated for practical use.



Tube voltmeter

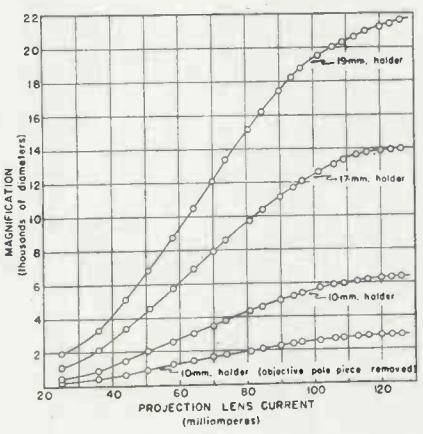
Tube Voltmeter

W. F. Lovering (Philosophical Magazine, London, Nov. 1942)

A cathode-follower, an extreme form of negative feedback circuit, is used as tube voltmeter with the effect of an approximately linear calibration curve, comparative independence of tube constants and operating voltages applied, and reduced sensitivity. The device, contrary to the normal tube-voltmeter, is particularly suitable for dc measurements.

A high-resistance voltmeter is used and a tube with high amplification factor chosen. The potential drop across the voltmeter will be a linear function of the input voltage, provided the tube has a linear characteristic and the voltmeter resistance is much higher than the plate resistance divided by the amplification factor plus one. If the input voltage considerably exceeds the battery voltage divided by the amplification factor, changes of the battery voltage will have very little effect on the calibration of the instrument. The instrument is recommended for the range of from 5v to 250v, but may be used up to 1000v.

The same circuit may also be used for peak readings on ac if a condenser is inserted to by-pass the voltmeter, the steady bias developed by the dc plate current through the voltmeter keeping the tube biased nearly to cut-off with no signal applied.



Calibration curves for electron microscope

Practical Use of Electron Microscopes

Charles J. Burton, R. Bowling Barnes, and T. G. Rochow (Industrial and Engineering Chemistry, December 1942)

An RCA electron miscroscope can be used directly at any magnification between approximately 1,100 and 15,000 diameters, but only the range between 4,000 and 10,000 may be conveniently used.

The difficulties of interpreting electron micrographs are pointed out. Preliminary examinations with optical microscopes, obviously, facilitate the interpretation, and it is suggested to use small magnifications of the electron microscope to completely cover the range between optical microscope and usually employed electron microscope magnifications.

For this purpose, the RCA electron microscope may be adapted to cover a range from 250 to 21,900 diameters by corresponding changes in the distance from object to lens and in the focal length of the objective lens. Specimen holders of different lengths are provided, to vary the distance from object to lens and the corresponding change in focal length is obtained by control of lens current.

Several methods of calibrating the electron microscope are discussed, and the use of replicas obtained from diffraction gratings, the spacing of which is determined by means of a spectrometer, is found preferable to comparison with visual microscopes, because of higher accuracy of about 1 per cent.

Element 85

(The New York Times, Jan. 10, 1943)

Element 85 which is of a very unstable character, is said to have been separated from its radioactive parent substance by Drs. Walter Minder and Alice Leigh-Smith, Berne, Switzerland. Minder announces that enough has been isolated to permit photographic studies of spectral lines. However, there is some reason to believe that element to be so unstable that it disintegrated long ago.

Discharge in G-M Counters

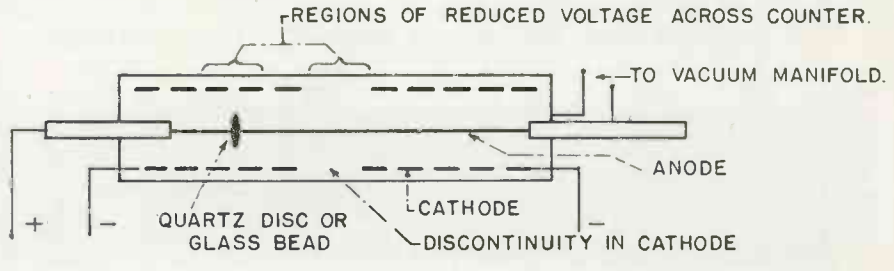
M. H. Wilkening and W. R. Kanne (Physical Review, Dec. 1942)

Localization of discharge in fast Geier-Muller counters may be obtained by local reduction of the electric field along the counter tube. Such a reduction occurs where the cathode is discontinued, or where glass beads or quartz discs are placed on the anode wire, owing to surface charges accumulating on the insulator. Localization of discharge may be helpful in determining the direction of travel and the range of the ionizing particles causing the discharge.

Various arrangements to effect localization are experimentally investigated and compared. It is suggested that localization is obtained if the propagation of photons, considered responsible for the spreading of the discharge, is effectively interrupted by absorption in the region of reduced voltage.

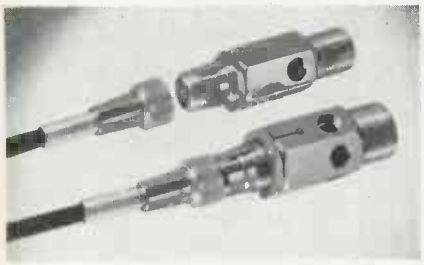
(*Continued on page* 117)

G-M counters



WHAT'S NEW

Devices, products and materials the manufacturers offer



Pressure and Detonation Pickups

Electro pressure and detonation pickups are used with Diesel and gas engines, also pumps, compressors and similar mechanisms to record instantaneous pressures and other phenomena occurring within the firing or compression chambers.

It consists of a magnetic type pickup, having a diaphragm, which is exposed to the explosion or pressure forces within the cylinder. The vibration of the diaphragm produces magnetic flux variations in a coil assembly which provides an output voltage having identical characteristics to the varying pressures developed in the cylinder.

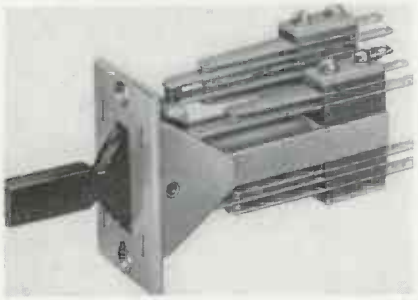
Two types are available from Electro Products Laboratories, 549 W. Randolph St., Chicago. Model 3000 fits into a hole in the cylinder which is tapped to receive a ⅞ in. 18 thread. Model 3000-A fits into the standard aircraft engine 18 mm spark plug hole.

Cathode-Ray Oscilloscope

A cathode-ray oscilloscope, model 555, is announced by Radio City Products Co., Inc., 127 W. 26th St., New York City, which uses a 5 in. cathode ray tube operating on 2000 volts. Maximum voltage at input terminals of amplifier is 600 volts, dc, and direct to deflection plates 500 volts, rms. Input resistance is 3 megohms. The frequency response is constant within ± 3 db from 20 cycles to 2 megacycles and the voltage gain is approximately 275 times. Ultra wide frequency range of sweep signal generator is from 30 cycles to 350 kc, linear from 50 cycles. The instrument, which is housed in a black crackle, noncorrosive steel case, operates from standard 115-230 volt, 50-60 cycle ac power supply.

Lever Switch

A lever switch primarily designed for use in aircraft, radio, communication, annunciator and fire alarm systems, testing apparatus and a wide range of industrial applications, is available from Donald P. Mossman, Inc., 6133 Northwest



Highway, Chicago. The O-42 switch is manufactured in a series of combinations of contact assemblies. Contacts, pile-ups and lever action is assembled to meet specific requirements.

Light in weight, this positive action switch, has locking, non-locking and no throw stops. Rating maximum recommended; 5 amperes, 110 volts, ac (non-inductive).

X-Ray Crystal Orientation Apparatus

The Philips Metalix Corporation, 419 Fourth Ave., New York, announces a device for fast and precise angle measurements of mother quartz, sections, bars, wafers and blanks. The apparatus has two working positions for natural-face orientation and checking of blanks, respectively, and consists of a

Philips Metalix Type No. 37000 X-ray tube with two lindemann glass windows and horizontal filament. The diffracted X-ray beam is received in an ionization tube.

In operation, the reflecting plane which most nearly coincides with the surface of the crystal is used to check the angle of cut. The ionization tube is set at the reflection angle for this atomic plane, the crystal is rotated until the diffracted beam is received in the ionization tube, and the angle read on the scale is compared with the angle obtained with a perfectly cut crystal.

Safeguarding Against Static Charges

Realizing that static electricity is a great potential hazard in industrial plants certain shoe companies designed conductive soles to drain off the static charge from the body of the wearer. It could be proved that the sole was conductive in itself but it could not be proved that the person wearing the shoe was completely grounded.

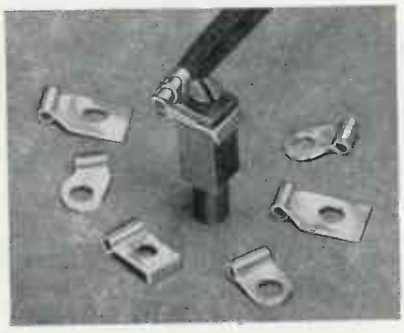
To meet this problem, the resistometer was developed by the Davis Emergency Equipment Co., Inc., 45 Halleck Street, Newark, N. J. Every morning before going to work in the area which might be the least hazardous, employees are asked to stand on two plates. Immediately, their resistance to ground is indicated on a meter calibrated in two zones: safe and unsafe. Also in ohms from zero to 20 millions. The use of this instrument thus eliminates the hazard of a man with a static charge on him working around high explosives in a refinery or repairing a gas main.

Vacuum Tube Voltmeter

The Model 400-A vacuum tube voltmeter, manufactured by Hewlett-Packard Co., 395 Page Mill Road, Palo Alto. Calif., is a wide band feedback amplifier which operates a diode voltmeter of the average reading type. The circuit is independent of line voltage variations and tube characteristics to a high degree. A special input amplifier circuit is used to provide a high input impedance and also to allow the use of an accurate voltage divider to select the voltage range. The power supply is self-contained, thoroughly filtered and electrostatically shielded from the primary voltage source.

Solderless Flag Terminal

Aircraft-Marine Products, Inc., Dept. D, 286 N. Broad St., Elizabeth, N. J., announces a new solderless flag-type terminal which meets the need for stacking a series of parallel terminal connections on a single stud block without loss of space or electrical conductivity. This is made possible by a unique design



plus a sufficiently flexible tongue to permit multiple stacking after wiring. These solderless terminals may be used for either right or left-hand application—since the terminal barrel is symmetrically located with respect to the plane of the tongue. This eliminates the necessity of distinguishing between and stacking two different terminals, thereby simplifying installation and speeding production.

For wire sizes 22 and 10, these new terminals are pure copper of maximum conductivity and hot electro-tinned for maximum corrosion resistance.

No solder is necessary—the terminals are crimped on wire with hand, foot or power tools, and are speedily installed.

Testing Transformer

Type T-4173 Isolating Transformer has been designed by the Acme Electric & Mfg. Co., Cuba, N. Y., particularly for use in testing radio and communication equipment by the Signal Corps or other Service Branches who require special accuracy. The transformer, to eliminate interference, makes use

of a secondary completely enclosed in a copper shield. Secondary terminal connections are provided by means of a lead shielded cable, the sheath of which is integrally joined to the copper enclosing shield of the secondary winding.

Normally rated at 2 kva, the instrument is claimed to be capable of handling an overload of 50 per cent or a total load of 3 kva. The regulation of the transformer is 1 per cent at 1 kva. Lighting in a shielded test-room, use of soldering irons, instruments, etc., may all be operated from the shield secondary without causing objectionable voltage drop.

Motorelay

For use with any floating contact device in applications where the control current exceeds the contact rating of the control instrument, Barber-Colman Co., Rockford, Ill., manufactures a motorelay.

The construction includes a shaded-pole, reversible-geared head

motor, totally enclosed switches and switching mechanism. An enclosed type drawn steel cover is available. Switch contacts have a non-inductive load capacity of 10 amperes at 110 volts, 5 amperes at 230 volts ac. Control circuit current is 0.35 amperes at 25 volts.

Ceramic Condenser

Erie Resistor Corporation, Erie, Pa. announces a new type ceramic condenser that combines unusual compactness and high capacity. Known as Erie Disc Ceramicons, these capacitors provide all the inherent properties of ceramic dielectrics, such as low loss, capacity stability and excellent retrace characteristics.

They are made in two sizes, basic type 1770 which is ¾ in. in diameter and basic type 170 which is 15/16 in. in diameter. Height of the units vary in accordance with capacity; the maximum height, excluding mounting stud and terminal is ¾ in.

Erie Disc Ceramicons can be supplied in a wide variety of mounting studs and terminals. The design of these condensers is such that their resonant frequency is considerably higher than that of conventional condensers, an important characteristic for ultra-high frequency applications. The Disc Ceramicons are hermetically sealed, to provide maximum protection against humidity.

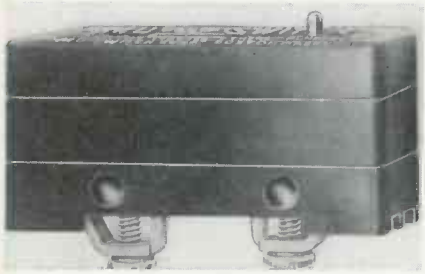
Electronic Siren

"Raid-Warn," an electronic siren for broadcasting air raid alarms and all clear signals is announced by Lektra Laboratories, Inc. 30 East 10th St., New York City. This device is used on 115 volt, 50-60 cycle current only and is available in three models: where PA systems are in use, RW-1 H with high impedance of 50,000 ohms; RW-1 L low impedance of 200 ohms. Where no PA system is available model RW-2 can be furnished complete with speaker having a power output of 4 watts. The siren is 10 in. long, 5 in. wide, 9 in. high and can be clearly heard.

Snap-Action Switch

Type DX Mu-Switch is a compact, precision made, sensitive snap-action switch designed specifically to make or break moderate direct current loads with extremely slight travel of the actuating button and relatively light operating pressure.

The use of special contact alloys insures maximum freedom from sticking. A powerful permanent magnet is so located with relation



to the contacts that the destructive dc arc is blown out and the burning of contacts is thereby held to a minimum.

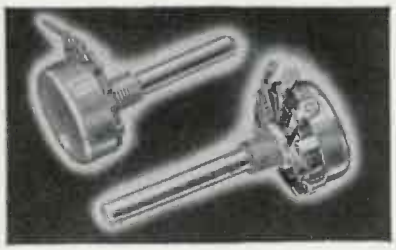
The switch will handle up to 30 amperes of non-inductive load at 28 volts at altitudes to 45,000 feet. Rating at 125 and 250 volts is one kw, non-inductive load.

Housing is cold-molded of heat resisting material. Manufactured by Mu-Switch Corporation, Canton, Mass.

Sealed Variable Resistors

Two new closed-cover, sealed variable resistors recently announced by the Stackpole Carbon Company, St. Marys, Pennsylvania, meet today's demands for units which will perform faithfully under intensely humid or dusty conditions, and in either standard radio or high-frequency equipment.

The resistors are designed for use under conditions of extreme humidity or salt spray, and where internal and external leakage must



be held to a minimum. A leakage resistance on the order of 300 megacycles after 48 hours in 95 per cent humidity at 40 deg. C is obtained in this new design. Spacing of current-carrying parts is greater, and the surface insulation of the molded base is several times that of previous laminated-base units.

Fluorophotometer

Pfaltz & Bauer, Inc., Empire State Bldg., New York City, announces its model C Fluorophotometer, designed to accelerate routine control work in the determination of vitamins and minerals.

Incorporating a simple electrical circuit, eliminating the use of amplifier and stabilizer, this is a self-contained unit, which has a novel slide carriage accommodating both the blank and sample to be tested and an automatic shutter which shields the sample from the light beam and cuts the measuring circuit. The fluorophotometer has universal application in fields of fluorometry, colorimetry and turbidimetry using wavelengths of narrow bands over the entire range of the spectrum from 3000 to 8000 Angstroms. It may be used either with absorption cuvettes or test tubes.

Interceptor Detection System

The Mechanical Guardsman, manufactured by Telecron Engineering Co. Div. of the Megard Corp., 381 W. 38th St., Los Angeles, Calif., is an alarm system for the protection of wire mesh fences against trespass. It operates on the principle that any attempt to

climb over, cut through or tunnel under a wire fence inevitably results in mechanical vibration of the mesh. Such vibration actuates the electro-mechanical apparatus of the system and produces at the receiving station an audible signal to attract the attendant and a visual signal to indicate the location of the disturbance. The complete system consists of interceptor pickup units and amplifier units.

A News Service for Readers

Announcements of new products which appear on these pages are prepared by the editors as a service to our readers, and are published as news, without any advertising consideration whatever.

Engraves, Cuts and Hammers

A unique tool, recently developed, that will engrave, cut, slice, carve and hammer on steel, leather, wood, stone, cardboard, rubber and even glass is now being adapted by defense plants everywhere for the important job of writing out identification tags "while you wait," and putting identifying marks on tools, dies, jigs and production parts in process.

The tool, which was developed in the laboratories of the Handicraft Division of the Burgess Battery Co., 180 N. Wabash Ave., Chicago, is known as the Burgess Vibro-Tool.

Spot Welding Control

A new electronic half-cycle, synchronous control for the precise operation of resistance-welding machines has been announced by the General Electric Company. Mounted in a protecting cabinet, the control is furnished in two types: one which includes a welding transformer and is designed for bench mounting, and another which is without a transformer and is designed for wall mounting.

The control features a new tube, the easily replaced GL-415 and a new circuit which makes higher-speed welding possible.

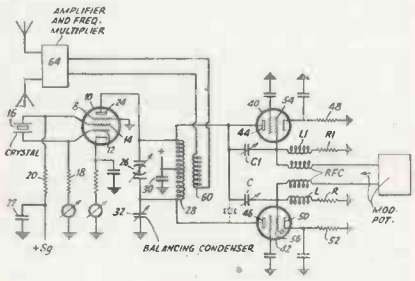
NEW PATENTS ISSUED

Summaries of inventions relating to electronic uses

Note: Date application was Filed shown by (F). Date patent Issued, (I). For the reader's conenience, patents most recently issued are presented first.

FM and PHASE MODULATION

Phase Modulation Circuit—Tube 10 is a crystal-controlled generator tube, the output of which is phase-modulated by tubes 40 and 56. These two tubes constitute a substantially capacitive and inductive reactance, respectively, owing to the almost 90° phaseshift caused by phaseshift networks CLR and



C'L'R'. As the reactances of the tubes are varied in phase opposition by the audio input, one tube will add or reduce shunt capacity and the other increase or decrease shunt inductance to the output circuit of tube 10, thus controlling its resonant frequency. H. E. Goldstine, RCA (F) Dec. 21, 1940, (I) Dec. 22, 1942, No. 2,306,052.

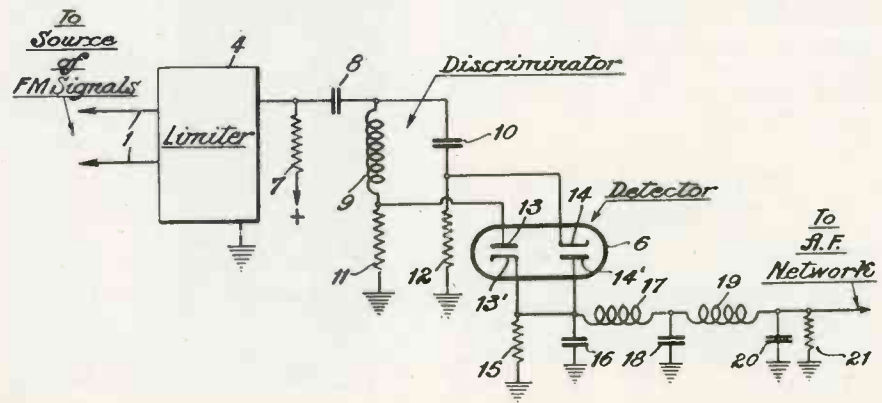
Discriminator-Rectifier Circuit — The discriminator essentially comprises two parellel connected reactive paths, each path including a small resistance and a capacitance or reactance, respectively, which capacitance and reactance are of equal magnitude at the center frequency of the applied modulated carrier wave. Consequently, the alternating voltages developed across the resistances are almost 180 deg. out of phase and differ in magnitude in dependence on the frequency deviation of the carrier. After rectification, these voltages are combined in polarity opposition, producing the demodulated voltage. At the center frequency, the average voltage developed across the common load resistor will be zero, and it will vary according to frequency deviation of the carrier.

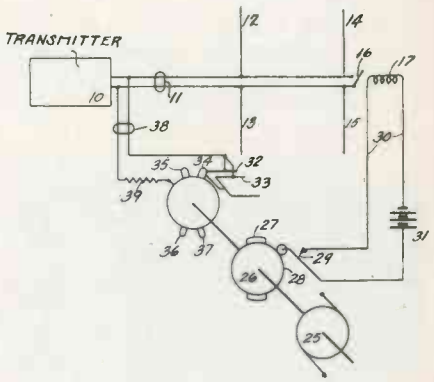
A modified arrangement permits full-wave rectification. In this case the voltages developed across the resistors are amplified in twin triodes, the plates of which are connected across two transformer primaries. Two twin diodes connected to the secondaries of the transformers provide for full-wave rectification. Warren H. Bliss, RCA, (F) Dec. 3, 1940, (I) Nov. 24, 1942, No. 2,302,834.

AIRCRAFT RADIO

Directional Radio Beacon—The phase shifter which periodically reverses the direction of transmission of a directional antenna comprises a phase shifting condenser. Rotor or stator plates of this condenser have trailing edges curved in the direction of rotation in a manner to avoid abrupt capacity changes when the rotor plates enter or leave the stator plates. A. H. Hermansson, Aga-Baltic Radio Akt., (F) Dec. 11, 1940, (I) Jan. 19, 1943, No. 2,309,068.

HF Directional Radio Beacon—The bridge circuit of conventional radio beacon transmitters, causing the required phaseshift, can not readily be tuned to higher frequencies and thus gives raise to undesirable damping. In the present invention, intended for hf transmission, the two dipole antennas 12, 13 and 14, 15 are spaced about





a quarter wavelength apart and, with the switch 16 open, will radiate in a cardiodic pattern pointing to the left (see figure), the interfering waves compensating one another in the right-hand direction. Upon closing of contact 16, antenna 14, 15 no longer acts as transmitter but as reflector, reversing the radiation pattern. To avoid the clicking sounds due to operation of the switch, means, thus as condenser 32, 33, 34, 35 short circuiting the antenna feeder, may be provided to interrupt transmission during closing and opening of the switch. Carl-Erik Granqvist, (F) Oct. 29, 1940, (I) Dec. 29, 1942, No. 2,306,623.

HF and UHF

HF Tube—The electron stream of a gaseous discharge tube is hf modulated between two parallel planes transverse to the electron path. Plate voltage and distance between the two planes are such that the electron transit time through the hf field equals the period of a whole number of cycles plus one-quarter cycle of the field. F. B. Llewellyn, Bell Telephone Labs., (F) Feb. 17, 1940, (I) Jan. 19, 1943, No. 2,308,523.

UHF Oscillator—Static and magnetic fields are produced by oscillations in a single tank circuit, the magnetic and electric field being preponderant in different parts of the tank. A beam of charges passes transverse to the chief component of each field. W. van B. Roberts, RCA, (F) Aug. 22, 1940, (I) Jan. 12, 1943, No. 2,308,391.

HF Transmission—Two or more different and independent signals are fed to as many antennas propagating angularly spaced directive radio beams. The beams sweep

Important Openings for ENGINEERS & TECHNICAL MEN

★

The following engineering positions with Bendix Radio, Division of Bendix Aviation Corporation in Baltimore, Maryland, are open. The salary is open and depends only upon the ability and experience of the engineer.

1 Electronic and radio engineers to design electronic navigation and communication equipment for aircraft.

2 Mechanical engineers familiar with and interested in the design of small precision equipment and familiar with shop practice and tools.

3 Engineers familiar with the design of components for electronic equipment.

4 Technical men able to write technical material for instruction books.

These positions are not for the duration only, and can be permanent for the right men. There are excellent opportunities for advancement.

Engineers with experience as outlined are preferred, but the right persons do not need experience if they have the ability to learn and the required aptitude. Applicants may be male or female. Persons already engaged in war work cannot be considered.

Write directly to Chief Engineer, Bendix Radio Division, Baltimore, Maryland, giving complete details of education and experience

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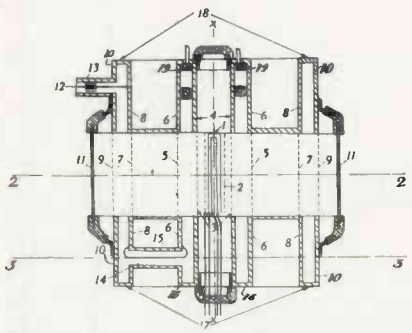
over a complete circle maintaining their angular relationship so that substantially no interference between the different signals occurs. Thus, the signals are propagated successively and periodically to each point in a circle. F. Motawetz, Radio Watch Co., (F) June 18, 1940, (I) Jan. 12, 1943, No. 2,308,019.

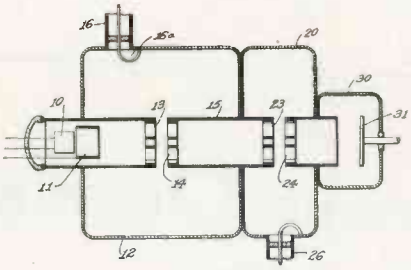
UHF Discharge Device— As the power handled by a velocity-modulating tube depends largely on the intensity of the electron stream high intensity is desirable. The invention consists in providing a cathode having a comparatively large surface and concentrating the electron beam after emission by means of a magnetic field symmetrical about the axis of the beam, and the field lines of which converge towards the axis of the beam. J. H. Fremlin, Int. Stand. Electrical Corp., (F) Dec. 11, 1940, (I) Dec. 29, 1942, No. 2,306,875.

UHF Discharge Device — Cathode 1 is arranged in the axis of cylindrical grids 2, 3, 5, 7 and 9. Grids 3 and 5 form part of a resonator with cylindrical walls 4 and 6; grids 7 and 9 form part of a resonator with cylindrical walls 8 and 10. If energy is fed to the inner resonator, the passing electrons will be velocity modulated and, provided there is suitable tuning, will excite oscillations in the outer resonator.



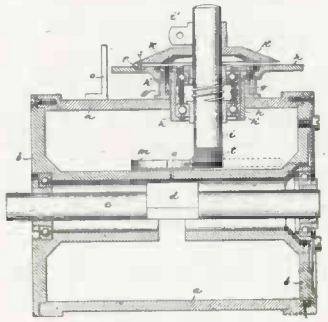
Feedback may be obtained by a wire loop connecting the resonators and arranged in a passage 14. It may be found that the grids must be placed closer together than is desirable for the spacing between the corresponding cylinders. For this purpose, the grids may be made of strips of metal set radially. D. H. Black, Int. Stand. Electric Corp., (F) Aug. 29, 1940, (I) Dec. 29, 1942, No. 2,306,860.

UHF Frequency Multiplier — The electron beam passing resonant circuit 12, excited by line 16, is velocity modulated in accordance with the resonant frequency of circuit 12. Upon passage through tube 15 and bunching, these electrons excite circuit 20—which is tuned to a harmonic of circuit 12 and has a high Q value—to oscil-



late with its resonant frequency. The harmonic energy is derived from output line 26. Electrode 31 serves to prevent heating of grid 24. Alternatively, a uhf generator consisting of two chambers and feedback loop replaces chamber 12 and line 16. C. V. Litton, Int. Stand. Electric Corp., (F) July 13, 1940, (I) Dec. 22, 1942, No. 2,305,883.

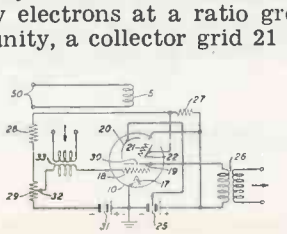
High-Frequency Oscillator — A high-frequency tuned oscillatory circuit comprises an outer conductor in the form of a metallic casing and a hollow inner conductor divided by a gap of varying width into two stator parts located end to end. Electrically conductive end

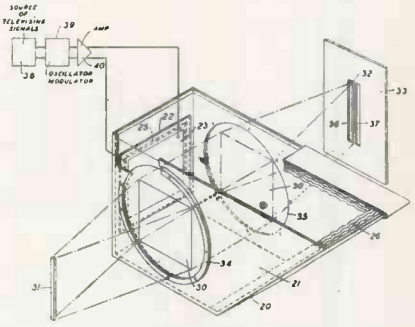


plates connect both ends of the casing to the stator parts. An electrically conductive rotor is adapted to be rotated within the stator parts and in capacity coupling relation to both stator parts. A shaft is secured to the rotor and extends externally of the tuned circuit. Siegfried Knoch, Alien Property Custodian, (F) May 14, 1941, (I) November 3, 1942, No. 2,301,163.

MISCELLANEOUS

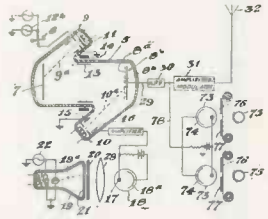
Secondary Electrons as Relay or Trigger— The tube, also disclosed in the Aug., 1942, issue of the Journal of Applied Physics, consists of a conventional triode the plate of which has an aperture 30, an auxiliary anode 22 emitting secondary electrons at a ratio greater than unity, a collector grid 21 positive with respect to the auxiliary anode and attracting secondary electrons, and a deflector 20 guiding the electron stream towards anode 22. Auxiliary anode 22 is so connected to control grid 18 that an increase in potential of anode 22, due to electron bombardment and secondary emission, decreases the negative bias on control grid 18, thus allowing more electrons to pass. At a certain auxiliary anode potential, depending on tube characteristics and circuit dimensions, the arrangement becomes stable and constant current flows in the tube. Grid 18 maintains complete control over the space current during operation of the tube. A. M. Skellett, Bell Telephone Labs., (F) Oct. 23, 1941, (I) Jan. 19, 1943, No. 2,309,019.





Light Modulating Method—The supersonic light valve described comprises a liquid contacting a mechanical vibrator. Different portions of the mechanical vibrator, having different dimensions in a given direction, vibrate depending upon the frequency. They set up supersonic waves in the liquid. Light is directed through the liquid parallel to the supersonic wave fronts. I. E. Fair, Bell Telephone Labs., (F) Nov. 15, 1939, (I) Jan. 12, 1943, No. 2,308,360.

Jam-Proof Transmission — To hinder interference with transmission of messages, a wave adapted for selection by means of a filter is distorted to a wave unadapted for such selection and a carrier is modulated by the distorted wave,



itself modulated with a message. Simultaneously, the carrier wave is modulated with a different wave also unadapted for selection from all other waves by means of a filter. F. C. P. Henroteau, (F) May 31, 1941, (I) Oct. 13, 1942, No. 2,298,562.

(*Continued on page* 114)

IN the manufacture of precision instruments for the Armed Forces we strive for short cuts in production—but not in *quality*. There can be no expediency, no compromise, no half-way measures. The success of the bomber's mission depends as much upon the efficiency of the instruments as it does upon the skill of the officers and men.

Meeting the specifications of the United States Armed Forces is in itself an eloquent testimonial to the *quality* of DeJur meters, potentiometers and rheostats. However, we do not rest upon these laurels alone. Behind DeJur workers is the stern tradition of New England . . . honesty of craftsmanship, pride of skill, the deep, personal delight in doing a job and doing it better than anyone else—anywhere.

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ASSOCIATION NEWS

Sound Synthesis Extends Tone of Radio System

Much as the human eye sees railroad tracks meet, which never do, so does the human ear "hear" sounds which were never originated. This fact underlies the demonstration made by Dr. A. De Rosa of I. T. & T., before the Radio Club of America, meeting at Columbia University, and is being utilized by Dr. De Rosa to improve sound technique in general.

To quote a report by Volney D. Hurd, veteran radio writer, and director of broadcasting for the Christian Science Monitor, "the human ear is an intermediary between the actual sound caused by air waves and the human brain and in transmitting these sensations, the ear actually distorts a large part of the musical band. Thus the highest sound ordinarily heard by humans is 16,000 cycles, in the form of a cricket chirp. In this upper area are produced the overtones which give richness and quality to music and voice. The human ear, however, in transmitting these sounds, does not send anything over 4,000 cycles. All impressions of sound higher than that are mere suggestions, a sort of synthetic sound impression."

Frequencies by "suggestion"

Accordingly, if there is such a distorting effect which makes the human ear pass on to the human brain, nothing higher than 4,000 cycles but suggests up to 16,000 cycles, wouldn't it be a great advance if this process, now done in the ear, could be done in the radio apparatus before it reached the ear? Thus radio transmitters and sets would never need to go above 4,000 cycles.

Dr. De Rosa also worked out percussion effects. Percussion does not mean just drums or cymbals. It is any sudden attack of sound. Certain musical scores have sudden attacks of great volume. That is percussion. But, further, so is the plucking of a harp string or the striking of the hammer on a marimba. Dr. De Rosa demonstrated recordings made by his system of both harp and marimba, and the tremendous gain in effect due to the sharpness and volume of the percussion effects was remarkable.

High fidelity with 4000 cycles

Having worked on the upper end, Dr. De Rosa also took advantage of his knowledge of the ear by using its adaptive ability on low notes, too. This idea is not so new. Organ builders have synthesized low notes for years when the space for big pipes was not available.

Combining this idea with high-note and percussion gains, Dr. De Rosa believes cheap radios of the future might equal or better the best sets of today because only 150 to 4,000 cycles need be passed.

Conventions and Meetings Ahead

Radio Club of America (11 West 42nd Street, New York), Feb. 11, Columbia University, New York.

Electrochemical Society (Colin G. Fink, Columbia University, 3000 Broadway, New York), April 7-10, Hotel Roosevelt, Pittsburgh.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York), District Technical Meetings (April 8-9, Pittsfield, Mass., and April 28-30, Kansas City, Mo.; National Technical Meeting, June 21-25, Cleveland, Ohio.

American Chemical Society (Alden H. Emery, 1155 Sixteenth Street, N.W., Washington), April 12-16, Indianapolis.

National Electrical Manufacturers Association (W. J. Donald, 155 East 44th Street, New York), Spring Meeting, April 19-23, Chicago; Annual Meeting, Oct. 25-29, Waldorf-Astoria Hotel, New York.

American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Spring Meeting, April 26-28, Davenport, Iowa.

American Institute of Chemical Engineers (50 East 41st Street, New York), May 10-11, New York.

Acoustical Society of America (Wallace Waterfall, 120 South LaSalle Street, Chicago), May, New York.

Associated Police Communication Officers, Inc. (Buffalo, New York), July, Buffalo, New York.

American Welding Society (Miss M. M. Kelly, 29 West 39th Street, New York), Oct. 18-21, Chicago.

Lt. Donovan With Marines

Lt. William E. Donovan, for many years technical advisor to the American Philips organization, headed by L. P. Graner, is now in the Marine Corps. Lt. Donovan is an Annapolis graduate

Westman Working on War Standards

Harold P. Westman, formerly secretary of the Institute of Radio Engineers, has joined the staff of the American Standards Association to spend full time on the work on War Standards for Radio.

Mr. Westman has had a long association with the Institute of Radio Engineers, having first gone with the Institute as assistant secretary in July 1929. Throughout these fourteen years he has been active in the standardization program of the Institute; and when the war work on Radio Standards was started early last year at the request of the War Production Board, the U. S. Army, and the Navy, Mr. Westman was loaned to the ASA by the Institute on a part-time basis. Mr. Westman has now resigned his position as IRE secretary to give full time to this war work of the ASA.

War's Effects on Radio-Electronic Industries

Business men, advertisers, and electronic engineers should be prepared to see four basic changes in the pattern of the radio-electronic industries as a result of the present international conflict. First, a new opening up of the frequency spectrum. Second, introduction of new materials. Third, new impetus to FM. Fourth, vast expansion of industrial electronics.

New knowledge of the ultra-high frequencies gained in wartime may constitute a revolution in radio. There will be ample room for new services of various kinds, such as wide-band color television according to Dr. W. R. G. Baker, G-E vice president in charge of radio, television, and electronics, in a talk before the New York Section of the American Marketing Association January 14. The fact that there has been a tremendous wartime demand for picture-tubes, the largest single item in the cost of receivers, will bring some changes in the economic aspects of television.

Physicists Discuss Electronic Topics

Dr. Albert W. Hull of Schenectady, N. Y., was elected president at the 253rd meeting of the American Physical Society, held January 22 and 23, at Columbia University, New York, N. Y. Following are summaries of a few selected papers which may be of interest in connection with electronics.

Photoelectric work function

The action of oxygen, nitrogen and hydrogen in lowering the photoelectric work function of zirconium, titanium and thorium was discussed by Dr. H. C. Rentschler and D. E. Henry, Westinghouse Lamp Division, Bloomfield, N. J.

The photoelectric work function is defined as the light energy quantum necessary to cause electron emission, and the energy quantum being proportional to frequency, the work function is determined by the longest wavelength, or threshold wavelength, required for emission. The thermionic work function, or the amount of energy used in electron emission from heated substances, e.g. cathodes, is theoretically expected to be equal to the photoelectric work function. A reduction of the binding force between electrons and emitting substance would diminish both.

The experiments show that zirconium, titanium and thorium, when heated in oxygen, hydrogen or nitrogen, dissolve a considerable amount of these gases and, further, that a reduction in the photoelectric work function, indicated by a shift in the threshold wavelength to longer waves, is thus obtained.

Non-linear circuits

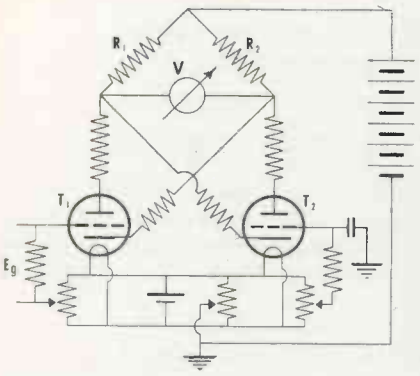
A method of graphical treatment of non-linear circuits was presented by Dr. P. I. Wold, Union College, Schenectady, N. Y.

This simple graphical method, especially useful when non-linear circuit elements are to be treated, was explained. The characteristic of a network branch may be determined by means of a V-I diagram, bearing in mind that for series resistances, the voltages have to be added, while for parallel resistance the currents add up in the plot.

DC amplifier

The compensation of random fluctuations in a dc bridge amplifier, was outlined by J. C. M. Brentano and E. R. Schleiger, Northwestern University, Evanston, Ill.

The arrangement, also disclosed in British Patent No. 526869, consists of a compensated symmetrical bridge circuit including two tetrodes having the grid closer to



Random fluctuations compensation

the cathode of one tube connected to the plate of the other and vice versa. The potential difference to be measured is applied between cathode and the grid closer to the plate of one of the tubes.

With this arrangement, the circuit dimensions may be so chosen that an increase in the plate current of $T_1(T_2)$ due to an increase in cathode emission causes an equal increase in the current through R_2 (R_1) so that no unbalancing of the bridge circuit occurs. The unsteadiness level can thus be reduced by a factor of thirty.

Piezo pressure pickup

After some introductory remarks on previous methods, piezo-electric pressure measurements of internal combustion engines were described. A high voltage is obtained; however, it is necessary to introduce grid leak for the amplifier tube to obtain a high enough time constant for low frequencies. A capacity is therefore inserted parallel to the crystal. It does not interfere with the high-frequency response.

When a cathode-ray oscillograph is made, voltage for the second deflection is preferably obtained by a small armature on the rotating shaft of the machine arranged in a magnetic field. Marks may be obtained at any desired point of the cycle of the combustion engine. The pressure limit that can be registered is 30,000 to 40,000 lbs. per sq. inch, and the sensitivity is 3 millivolts per 100 lbs.

Impedance measurements

The difficulty at hf in making impedance measurements arises from the impossibility of constructing a pure resistance, capacitance or inductance. The only possible way, therefore, is to determine the combination values at low frequencies and then extrapolate for hf. Formulas were derived and constructions of comparatively pure resistances or capacitances shown. Several variations of the Schering bridge for comparison methods were discussed.

Essential Occupations Recommended for Draft Deferment

Engineers, skilled workers, and production men in the radio-electronic war industries have long been classified as being in "essential occupations," and recommended for draft deferment when their replacement is difficult.

In its January 9, 1943, directive the Selective Service Bureau of the War Manpower Commission recommended to local boards consideration of 15 additional groups as "essential." They include persons engaged in "the supplying of technical, scientific, and management services to establishments in war production; and union-management negotiation services."

The directive also acknowledged the importance of the engineering press by including workers engaged in "the publication of technical and scientific books and journals."

Wartime Use of Solderless Connections

For years most designers and production men have thought only of soldering lugs, when cable and wire terminations are considered. With no restrictions on the tin-content of the solder, a skilled worker would always produce a satisfactory joint.

But now, with the combination of low-tin-content alloys and newly trained operators, a good joint cannot be assured. And of course, one poor joint in the hundreds or thousands that make up an installation, may cause a whole system failure.

In many recently applied production short cuts, the substitute method sometimes surpasses the original in reliability and speed. This seems especially true of the solderless wire terminals now being used in a number of factories, and which can be attached to the wire permanently by a simple crimping process. Already this method has been applied to several hundred types of terminals, for all styles and sizes of wire larger than No. 22 B & S.

Temperature and corrosion

A feature of modern equipment design in many fields is to increase the safety factor by preventing power and circuit failure under abnormal temperature conditions. Insulation material is today available that is capable of withstanding temperatures that will cause solder to melt. With a mechanically locked terminal having a copper-to-copper junction instead of one with an intermediate solder layer, certain types of corrosion can be avoided.

A factor which contributes the necessary uniformity in all connections is the use of a special crimping tool, using foot or hand pressure, which permits pre-setting to produce the definite pressure on the wire to give the lowest connection resistance, without undue stress on the strands. In fact the system can be made so foolproof that work of this kind is being done by blind persons in one New York factory.

Experience of users

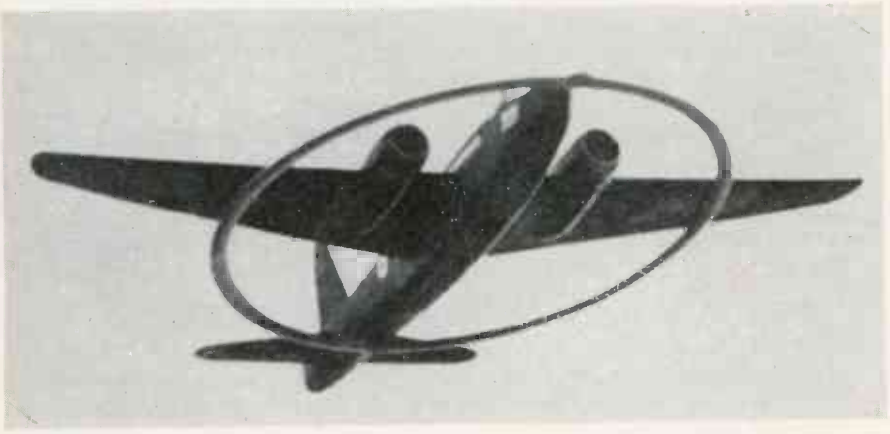
With tools now available the installation of solderless connectors is so simple, so easy of precision adjustments and so positive in action that even unskilled women operators can be taught to use the method and obtain uniform results without any long period of special training, thus reducing to a minimum, failures through poor connections caused by improper soldering, cold joints, heat brittling, blind connections and other failures.

There seem to be many satisfied users of the solderless method in the radio manufacturing field and reports from these users appear uniformly favorable. E. D. Gibbs, chief engineer of Radio Receptor Company, 251 West 19th Street, New York, told "Electronic Industries" he finds the use of these connectors a great time-saver on stranded wires of No. 14, 16 and 18 sizes, for with this method there are no more slow-ups in production because of soldered joints, and no more taping to support the installations. There is also no more guessing about results, as the new kind of solderless terminal permits easy, quick visual inspection.

Then there is the case reported by T. D. MacCoun, development engineer of Link Radio Corporation, 125 West 17th Street, New York City, which uses terminals on large transmission cables of 300 leads of No. 12 and 14 wires or more. Mr. MacCoun says that because of the ease and accuracy of applying solderless connectors, several blind persons who have quickly become so adept in the use of these tools as to produce finished jobs equal in every respect to that performed by experts or persons with normal eyesight.

(*Continued on page* 106)

Secret Answer to Hitler's Secret Weapon



When Germany developed the "magnetic mine," in which delicately poised magnetic relays were set off by the residual magnetism of ships' hulls at 75 to 100 ft. distance, one answer was the deGaussing cables now wrenthed around every Allied ship. Kept continuously energized, these cables demagnetized the hulls making them magnetically inert.

A second answer was this flying minesweeper with its large-diameter coil energized by a generator driven by a Ford V-8 motor. Flying near the water's surface, the powerful magnetic field was sufficient to set off the submerged mines, severely jolting the plane crew, but doing no damage

QUESTIONS & ANSWERS ABOUT

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Serving war NOW—and peacetime industry when the war is over.

ELECTRONIC INDUSTRIES was first, and quite alone, in establishing a clearing house for the exchange of ideas and methods in speeding war production—a move requested and commended by Washington.

So it is not surprising that its pioneer publishers, with a record of 20 years' service, should also bring the electronic industries their first complete, double-indexed directory of suppliers. This *most important issue in 1943* will raise advertising value to the nth degree.

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q How can you increase your wartime and peacetime business? ?

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q What advantage does this directory offer to the advertiser? ?

a It is the only complete directory having both alphabetical and product classifications, enabling engineers, purchasing agents, procurement executives and others to quickly locate sources of supply.

q Who publishes ELECTRONIC INDUSTRIES? ?

a Caldwell-Clements, Inc., (Orestes H. Caldwell and M. Clements, editor and publisher respectively, the pioneers and present-day leaders in radio-electronic publishing).

q Will it reach the real buying power of the government, the war plants and the industries using electronic equipment? ?

a Most emphatically! It goes straight to the men who initiate, authorize and direct electronic activity. And hundreds of large non-radio concerns who are now making electronic war equipment — whose names have NEVER appeared in any published list.

q Will there be other notable features in the March issue? ?

a Yes — a valuable supplement containing a complete Marketing Chart of all electronic industries.

q What is the closing date? ?

a February 24 for advertisers requiring composition and proofs. February 27 for complete plates.

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*Address*_____

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Solderless Connections

(*Continued from page* 104)

The Aircraft Marine Products, Inc., of Elizabeth, N. J., has designed and manufactured over 300 standard items of solderless terminals together with special tools for quickly and safely applying lugs to the ends of wire or cable. These tools, for foot operation or for precision hand use, provide mechanical and electrical efficiency in the terminal connection, and higher speed and installation accuracy on the production line. When such solderless lugs are thus installed they become an integral part of the wire or cable itself and are so strong mechanically that they will stand the most strenuous performance required in gun control and gun-pointing. Electrically they produce the kind of corrosion-resisting connection that will give superior performance under the exacting conditions of radio.

"Phase-Inverter Analysis and Design"

It has been pointed out by Henry Wallman, 37 Alma Ave., Belmont, Mass., that it is possible to extend the usefulness of the principles outlined in the paper of Henry Jacobowitz of the above title appearing in the December, 1942, issue of "Electronic Industries."

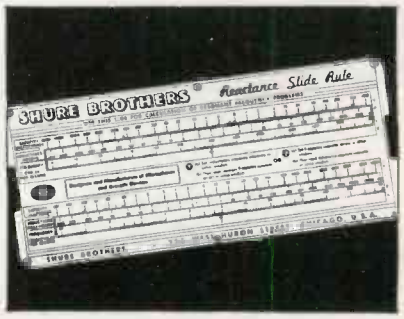
If the relation between Rg_1 and Rg_2 is not made equal to unity, as suggested by Mr. Jacobowitz, but follows the relation (using the nomenclature of that article):

$$\frac{Rg_2}{Rg_1} = \frac{a_2 + 1}{a_2 - 1} + \frac{1}{a_2 - 1}\,\frac{Rg_2}{R_f}$$

then it is possible to produce a "perfect balance—self balancing" phase inverter amplifier system, wherein $U = O$ and $E_a = E_b$. The principles used in arriving at this relation have been published by Mr. Wallman in the October, 1941, and December, 1941, issues of "Radio".

Reactance Slide Rule

A handy new Reactance Slide Rule that speeds up the solution of reactance and resonant frequency problems has been devised by Shure Brothers, 225 W. Huron St., Chicago, designers and manufacturers



of microphones and acoustic devices. This new rule saves time solving resonant frequency problems, capacitive reactance problems, inductive reactance problems, coil "Q" problems, and dissipation factor problems.

On one side of this new rule, resonant frequency problems are solved with one setting of the slide, using $w^2LC = 1$, with ranges of 5 cycles to 500 megacycles, .001 mmf. to 1,000 mf., and .00001 mh. to 10,000 henries.

On the other side of the slide rule, reactance, dissipation factor and coil "Q" problems are solved with one setting of the slide. The ranges on this side are 0.1 cycle to 10,000 megacycles, 1 mmf. to 100 mf., and .001 mh. to 100 henries.

This new rule is available at a nominal charge of 10c to cover the cost of handling and mailing.

Army Gets a Jeep

The employees of the Turner Company, Cedar Rapids, Iowa, makers of crystal and dynamic microphones, gave up a Christmas bonus to buy a jeep for the army. A meeting was held and the 60 employees voted unanimously to donate their annual gift for this purpose. Henry Morgenthau, secretary of the Treasury, sent a citation "in recognition of the patriotic and generous donation made to the United States."

Engineer Becomes Manager

Leslie J. Woods, for many years engineer with Philco at Philadelphia, has just been appointed vice president and general manager of the National Union Radio Corp., Newark, N. J., one of the largest manufacturers of radio and electronic devices

Frederick C. Young

Who has just been named vice president in charge of engineering of the Stromberg-Carlson Tel. Mfg. Co.

Seeks Radio Engineer

The Titanium Alloy Manufacturing Company, Niagara Falls, N. Y., has an opening of permanent character for a radio engineer with background in basic electricity and physics dealing with insulating and allied materials in electronic applications. The company will be glad to hear from interested persons.

Plan to Increase Plant Production

United Electronics Company, 42 Spring St., Newark, N. J., has instituted a campaign called "Top the Top", to stimulate employee suggestions. Contests have netted at least 25 ideas which have already increased production, eliminated bottlenecks and improved morale at the plant.

It's Lt. Comdr. Gerald Gross, U. S. N.

Gerald C. Gross, Assistant Chief Engineer of FCC, has received a leave of absence for the duration of the war to become a Lieutenant Commander in the Navy. He has held a commission in the Naval Reserve since 1932.

Mr. Gross participated in the formation of the Engineering Division of the Federal Radio Commission in 1928. Since the formation of the FCC, he has headed both the International and Broadcast Divisions and represented the Government in twenty-one international conferences on communications.

Mr. Gross obtained his B. S. degree from Haverford College, Haverford, Pa. in 1926. At Haverford he was instrumental in setting up WABQ, one of the first college broadcasting stations in the country. He served as a radio and communications officer in the American

Merchant Marine and worked for the United States Bureau of Standards where he was engaged in research on plane radio and on the radio beacon.

Electronic Mechanics Changes Name of Product

Electronic Mechanics, Inc., 70 Clifton Boulevard, Clifton, N. J., announces that its insulating material formerly known as Mycalite is now called Mykroy. The latter name was assigned to the product when it was found that the original name conflicted with two similar trade names in related fields.

Advertising copy currently appearing in the trade publications announces the fact that the name, Mykroy is new, "but its performance as an outstanding insulation material of high efficiency has been well established."

C. R. Smith, Lack's Successor at Western

Charles R. Smith has been named acting manager of the radio division of Western Electric Company, with offices at 120 Broadway, New York. He succeeds Frederick R. Lack, who resigned to enter Government service as Director of the Army-Navy Electronics Expediting Agency.

Starting as assistant chief of the Power Service Department at Kearny, in January, 1925, Mr. Smith rose through various managerial posts in the manufacturing department. On October 1, 1940, he was transferred to specialty products as engineer of cost and production. On June 1, 1941, he became manager of government sales. Subsequently, when the present radio division was formed, Mr. Smith became manager of Government radio contract service. Prior to joining the Bell System, he was a

Lieutenant in the United States Navy, spending four years on sea duty and two years pursuing post graduate studies. He graduated from the U. S. Naval Academy in 1918 and attended the Naval Academy Post Graduate School.

New UHF Landing System at LaGuardia Field

H. T. Kohlhaas who is delegated to handle approvals of technical articles for the International Telephone and Telegraph Corporation and associated companies, asks us to point out the following corrections for the article on "UHF Landing System at LaGuardia" beginning on page 62 of our January issue, these changes having been received too late to be incorporated in the text as printed:

Paragraph 6, Sentence 1 states: "This vertical guidance or 'Glide Path' is provided . . . from a point about five miles from the airport of the boundary of the runway." This last should read: "From a point about five miles from the airport boundary to the runway."

Par. 6, Sent. 2. The phrase "at the airport traffic control tower" should be deleted.

Par. 7, Sent. 3 should be changed to read: "And the course which the plane follows lies within the overlapped region where 90-cycle and 150-cycle pattern signals of equal intensity are received. These signals are made to operate the cross-pointer instrument which is a simple dial indicator located on the instrument board in front of the pilot."

Par. 7, Sent 4 should be deleted in its entirety.

Par. 7, Sent. 5, the following should be deleted: "A few inches to the right of the marker lamps is located." Also omit the word "which" from page 63, center column, third line from top.

Par. 11, Sent. 4 should read: "Three frequency. . . ."

On page 107 change to read as follows: "The system was developed jointly by the engineers of the Civil Aeronautics Administration and the Federal Telephone and Radio Corporation, the International Telephone and Telegraph Company's manufacturing subsidiary in the United States which manufactures and installs equipment for the C.A.A."

Has Charge of Purchases

The Ward Leonard Electric Co., Mount Vernon, N. Y., announces that Charles J. Otis now has complete charge of purchases. The experience of Mr. Otis in his systemization of purchases has led to this appointment.

NEW BOOKS

Communication Circuits

By Lawrence A. Ware and Henry R. Reed, published by John Wiley and Sons, Inc., New York, and Chapman & Hall, Ltd., London, 1942, 287 pages, $3.50.

The text is intended as first-course material for those interested in communication engineering, some knowledge of calculus and ac circuits is, however, required. Transmission lines for a frequency range from voice frequencies through uhf are treated, and, consequently, part of the text had to be based on network equations and filter theory — differing from network theory only in the particular consideration given frequency characteristics of the circuits involved —and part on Maxwell's equations. Numerical examples illustrating the formulas derived and problems to be worked out by the student are included.

The Inductance Authority

By Edward M. Shiepe, published by Gold Shield Products, 350 Greenwich St., New York, N. Y. 1942. Price $2.50.

By the use of charts, the author enables the reader to dispense entirely with all computation for the construction of solenoid coils for tuning with variable or fixed condensers of any capacity, from uhf to audio frequencies. By employing the charts, accuracy within one per cent is promised. The 38 charts cover various wire sizes, types of insulation, and diameters of coils. With the aid of the information presented graphically, the user can replace or design any type of coil construction. The charts are introduced by a dozen pages of text by Mr. Shiepe who explains with circuits and mathematical quantities the consideration for accuracy of results in using the charts.

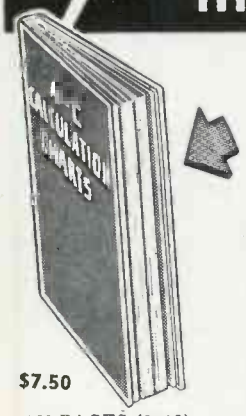
Electromechanical Transducers and Wave Filters

By Warren P. Mason, Ph.D., Bell Laboratories, published by D. Van Nostrand Company, Inc., New York, 1942, 329 pages, $5.00.

The differential equations governing mechanical, acoustical and electrical oscillating systems are the same, and, consequently, solutions satisfying one set of equations, satisfy all. In such cases, the results obtained for one system may be readily applied to a corresponding system, just by identifying variables and parameters.

A well known fact and frequently used in derivations, the analogy

Faster THAN A SLIDE RULE



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Reactance—0.01 ohms to 10 megohms
Susceptance—0.1 micromho to 100 mhos
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with electrical networks has now been made the basis for a thorough and extensive study of mechanical, acoustical and electromechanical phenomena. Upon deriving and discussing equations of network theory, the analogies are established, and valuable results computed for acoustic wave propagation, acoustic filters, mechanical vibrators including membranes and plates, and electromechanical systems.

Science Remakes Our World

By James Stokley, published by Ives Washburn, Inc., New York, 1942, 299 pages, $3.50.

Presented in engaging popular style by a well-known scientific writer, this book should be of considerable general interest to technical men in the electronic and related fields.

Briefly touching upon early research in each branch of practical science, the author, carefully selecting essential material, traces through their last two or three decades of revolutionary progress such subjects as explosives, plastics, synthetic rubber, metallurgy, aviation, fuels and power sources, atomic physics, and many others.

Principles of Aeronautical Radio Engineering

By P. C. Sandretto, published by McGraw-Hill Book Company, Inc., New York, 1942, 393 pages, $3.50

Chapters headed "aircraft radio" and "landing systems," in standard works on radio and electronics, have been of little practical value to the practising aircraft radio—electronics engineer. In this, the first book of its kind, a competent author has set out to deal exclusively with aeronautical applications of electron tubes.

Following an introductory chapter in which the scope of these applications is discussed, Sandretto takes up standard and uhf radio range systems, the various types of direction finders, markers, blind landing systems, and sonic and electronic altimeters, all in some detail. Each avigation problem with the electronic and other attempts to solve it, is developed historically. This is of interest, because most of the present day equipment evolved gradually or had some older piece of apparatus as the point of departure. Design and operation considerations, electrical and mechanical, for aircraft equipment are discussed frequently.

The last third of the book is devoted to aircraft radio, medium high and ultra high frequency communications equipment.

NEW LITERATURE

Insulators for Radio

A twenty-eight page booklet, describing the various types of insulators for radio reception and transmission, manufactured by the company, has recently been issued by Locke Insulator Corporation, Baltimore, Md.

Stand-off, entering, strain, spreader and transmission line insulators of wet process porcelain or steatite are illustrated and specified. A complete line of tower base, large guy, and other insulators used in radio stations is listed in another publication available upon request.

Emby Bulletin

A ten-page bulletin describing electrical characteristics and technical data of blocking layer photoelectric cells is announced by Emby Products Co., 1800 W. Pico Blvd., Los Angeles, Calif. This type of cell does not require any additional power source and delivers a photo current of over 450 ma per lumen. The bulletin has all necessary information for applications of photocells of this type in different branches of industry and science.

Electronics—A New Science for a New World

"Electronics—A New Science for a New World" is the name of a colorful pictorial booklet GED 1024 issued by General Electric presenting the general story of electronics—its past, its present, and its great possibilities for the future.

Colorful accounts by word and illustration are told of how the electron is working today in war combat to perform many marvelous functions; in research to reveal more of nature's mysteries; in industry to step up production, increase human efficiency, and reduce material waste; in radio and television to extend the range and quality of sound and sight over the air waves; in agriculture to improve quantity and quality; and in medicine to reveal more and more of the structure and behavior of the human body.

Temperature Indication, Recording and Control

Wheelco Instruments Co., Harrison & Peoria Streets, Chicago, has issued five new bulletins describing its complete line of industrial indicating, recording and control thermometers.

Bulletin G23-2 contains details on the performance of vapor-pressure and gas-filled instruments, as

well as information to assist in the selection of bulb and socket material and of capillary and its armor.

Bulletin G503-2 covers recording-control thermometers, Bulletin G603-2 indicating-control thermometers. Both discuss the electronic principle basic to these instruments, and various specialized devices.

Bulletin G303-2 and G403-2 describe indicating and recording thermometers, respectively.

Fifth Printing of Technical Manual

A new printing of a Technical Manual is now ready for distribution to radio technicians. One section has been devoted to listing all new types of tubes released since the previous issue, and a section pertaining to panel lamps has also been added.

The general arrangement of the technical data of the reprinted Manual remains the same, and index tabs are still supplied, glued and marked for easy installation on the proper pages.

The new revised Technical Manual sells for 35c a copy, and may be secured from Sylvania Electric Products Inc., Emporium, Pa.

Ears for the Armed Forces

Karadio Corp., 1400 Harmon Place, Minneapolis, Minn., has issued a four-page pamphlet on "Ears for the Armed Forces." This describes the company's reception set R-103 and 1179-SC receiver.

Circuit Breakers

For lighting, distribution and power circuits up to 600 amperes, the complete line of Nofuze "Deion" Circuit Breakers is described in a new 40-page booklet by Westinghouse Electric and Manufacturing Company.

The breakers are available for panelboards, switchboards, built-in applications, individual mountings and separate enclosures. In this booklet principles of arc quenching action are explained, and quick facts are given on design and operation of each breaker.

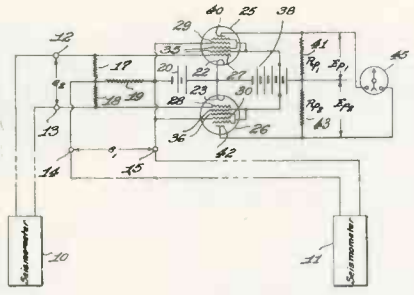
Radio and Electronics

"Radio and Electronics," described as the "dawn of a new era in science" is the title of an attractive 16-page booklet issued by RCA. Telling of the discovery and development of the electron and electronic tube, the booklet shows how war speeds scientific progress, both in the past and now. The present and possible future applications of electronics to industry and home life are discussed.

NEW PATENTS ISSUED

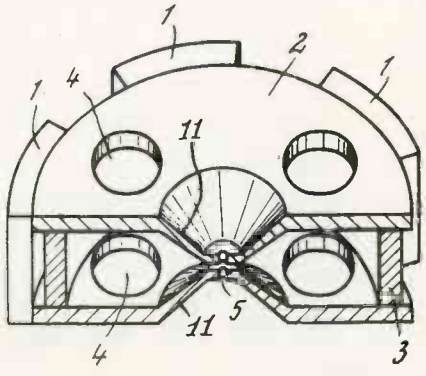
(*Continued from page 98*)

Recording Products—In seismic surveying, especially when observing reflected waves, it is sometimes desirable to discriminate against, but not necessarily eliminate, energy which arrives at spaced points in out-of-phase relation. This may be accomplished by recording the product of two or more seismometer outputs. One embodiment of the invention consists in applying $e_1 + e_2/2$ to grid 27 and $e_1 - e_2/2$ to grid 28, as will be seen from the diagram. Both tubes are



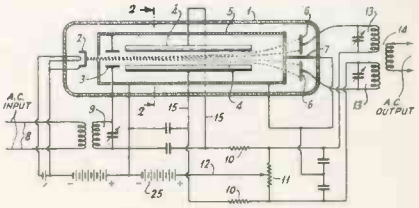
caused to operate on parabolic grid-voltage plate-current characteristics and are normally biased to the apex of the parabola. Consequently, the output currents and voltages will be proportional to the squares of the input voltages, and their sum, as indicated or recorded by instrument 45, will be proportional to the product $e_1 e_2$. W. H. Mayne, Olive S. Petty, (F) June 1, 1940, (I) Dec. 29, 1942, No. 2,306,456.

Electron Lens— The permanent-magnet electron lens consists of two pole plates 2, two pole pieces 11, having an aperture 5 for passage of the electron beam, and permanent magnets 1. The non-magnetic tubular supporting member 3 forms a wall portion of the vacuum vessel. Thus, small focal length is obtained; coarse regulation may be effected by removing some of the permanent magnets, fine regulation by varying the contact between



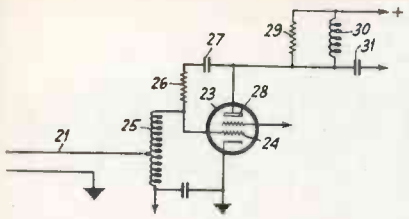
permanent magnets and pole pieces. B. Borries & E. Ruska, Alien Property Custodian, (F) March 7, 1939, (I) Dec. 22, 1942, No. 2,305,761.

Cathode-Ray Tube Amplifier—Rods 4 and cylinder 5 provide an electric field of such configuration that it increases the initial deflections of electrons caused by deflecting plate 3. Electrons travelling along the axis of tube 5 are not affected; the deflecting force



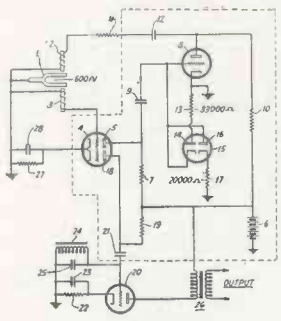
increases with distance from the axis and, consequently, with original deflection. The electrons are collected on plates 6, their distribution corresponding to their deflection. The potentiometer 11 acts to keep the electron beam properly centered with respect to dc or slow ac. Other arrangements may be employed. C. W. Hansell, RCA, (F) March 15, 1940, (I) Dec. 22, 1942, No. 2,305,617.

Johnson-Noise Reduction—Johnson noise, due to the heat motion of electrons within the input impedence of a tube and proportional to the square root of the resistance,



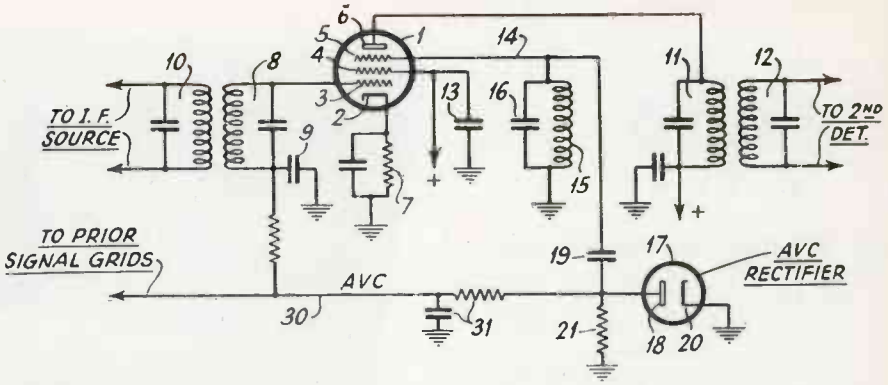
may be reduced as compared to the signal voltage, proportional to the impedance, by using a high resistance. This, however, may result in a high input impedance, causing attenuation of the higher frequencies or mismatching. The same difficulty may arise in damping a circuit. The high input resistance provided to eliminate the Johnson noise may be adjusted to the desired value by means of negative feed back, reducing the effective input resistance. A transformer is included in the negative feed back, and the resistance is reduced to at least one third of its original value. W. C. Percival, Electric & Musical Industries Ltd., (F) April 20, 1940, (I) Nov. 24, 1942, No. 2,302,798.

Tuning-Fork Oscillator— A mechanical vibrator, generating low-frequency electrical oscillations, is connected to a two-stage amplifier. A feedback circuit for sustaining oscillations in the vibrator contains an electron tube having means coupled to its anode for exciting the vibrator, the grid of the tube



being connected through a condenser to the anode of the first amplifier stage. A double-diode rectifier tube is connected between cathode and grid of the electron tube for maintaining a negative bias. James N. Whitaker, RCA, (F) September 5, 1940, (I) October 27, 1942, No. 2,300,271.

Suppressor-Grid Signals— The virtual cathode between screen grid and suppressor grid, the intensity of which varies with signal frequency induces current in the suppressor grid. Corresponding voltage is derived from a tuned, resonant circuit, inserted in the negative suppressor grid lead. This voltage is amplified with respect to the grid input, and may be put to different uses. It may be rectified and avc

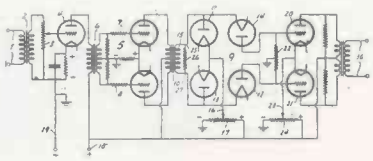


voltage derived or the output of the rectifier amplified and utilized as audio. Though no external coupling is provided between plate circuit and suppressor-grid circuit, oscillation or regeneration, according to tuning and grid bias, takes place. In the regenerative state, selectivity and gain of the amplifier are considerably enhanced. If no regeneration takes place, the bandwidth of the plate circuit is broadened owing to the influence of the suppressor grid circuit. Seymour Hunt, RCA, (F) Dec. 1, 1939, (I) Nov. 24, 1942, No. 2,302,866.

Peak Velocity Indicator — A peak voltage indicator is described comprising a condenser, a rectifying tube and a source of negative bias voltage in series with the voltage the peak value of which is to be measured. A voltmeter is connected across the condenser and a circuit for compensating leakage current of the rectifying element is provided. Theodore R. Brown, General Electric Co., (F) June 10, 1942, (I) October 27, 1942, No. 2,300,198.

Harmonic Transmission — A source of deflection voltage is connected across the deflection coil of a cathode-ray tube, an additional impedance being effectively in the circuit with the coil. This impedance in combination with the impedance of the deflection coil presents an impedance to the source, which simulates at all frequency components of the source the impedance of a transmission line having a length of a half a wave length of the source frequency. Robert D. Dome, GE, (F) May 10, 1941, (I) October 20, 1942, No. 2,299,671.

Voltage and Current Limiter— Two pairs of series-connected rectifiers are connected across the input terminals conducting current in opposite directions. Two resistors are so connected as to impress a negative potential on the input electrodes of an amplifier, and the output voltages of the two amplifiers are combined. J. E. Smith et al, RCA, (F) April 27, 1939, (I) Oct. 13, 1942, No. 2,298,657.



Circuit Protection— A circuit interrupter for an ac circuit is controlled by a fault-responsive means consisting of a pair of serially connected electronic tubes. The interruptions are in accordance with the balance between the instantaneous values of a plurality of electrical quantities at a predetermined instant during the ac cycle. Maurice E. Bivens, GE, (F) September 6, 1940, (I) October 20, 1942, No. 2,299,561.

Neutralization— A system for eliminating detuning of tuned circuits which are coupled by an electron tube. Two circuits tuned to the same frequency and having a certain effective resistance coupled by a tube with an input and output circuit include a portion common to both circuits. An inductance is connected in the common portion and is of such magnitude as to reduce the coupling impedance between the tunned circuits below the effective resistance. Sven G. Johannsen, Western Electric,, (F) March 26, 1940, (I) October 20, 1942, No. 2,299,481.

Noiseless Sound Reproduction— The sound waves are converted into corresponding light variations which in turn are translated into the corresponding electrical currents; the currents are then amplified and re-converted into sound waves. A feedback system from the output of the amplifier controls the efficiency of translation of the light variations into electrical currents, whereby light variations below a predetermined level are substantially eliminated from the current-to-sound translating device. Barton Kreuzer, RCA, (F) April 30, 1941, (I) October 20, 1942, No. 2,299,398.

WIDE READING

(*Continued from page 92*)

Antenna Coupling

S. W. Amos (Wireless Engineer, London, Dec. 1942)

The equivalent circuit of an inductance-load shunt-capacitance antenna is discussed for the case of the antenna circuit being resonant within the frequency range received. Expressions are derived for selectivity, amplification and effect of coupling on the frequency of the tuned circuit.

A Stable Negative Resistance

Cledo Brunetti & Leighton Greenough (IRE Proceedings, Dec. 1942)

A two-stage positive-feedback amplifier behaves as a negative impedance equal to the feedback impedance plus the internal output impedance of the amplifier divided by one minus the amplification factor of the arrangement. Stability of the circuit may be considerably increased by negative feedback between the two amplifier stages. Circuit requirements for obtaining a negative resistance with practically no reactance are introduced. Frequency response and other circuit characteristics, as function of both feedback resistances and supply voltage are discussed and experimental results shown.

M-Derived Filters

W. J. Cunningham (Journal of Applied Physics, Dec. 1942)

For a filter composed of several m-derived sections, the highest minimum discrimination above cut-off will be obtained if the successive minima of insertion loss in the attenuation band are equal. A great number of experiments has been carried out to establish values of m conforming to this requirement. The curves found are shown, so as to enable ready construction of low or high pass filters from desired specifications.

Attenuation in Pipes Smaller Than Critical Size

E. G. Linder (IRE Proceedings, Dec. 1942)

A mathematical expression for the propagation constant of the E-type wave is investigated at cut-off and for longer wavelengths.

It is shown that the attenuation constant as a function of wavelength rises very steeply at cut-off and then asymptotically approaches a comparatively high value.

An approximation is derived, and it is concluded that below cut-off i.e. for frequencies lower than the critical value, the attenuation depends only on the wavelength and not on the material of the tube

which is assumed to be of high conductivity. An investigation of the expression for the propagation constant of the H wave shows that the same formula for attenuation applies below cut-off.

UF Transmission in Wave Guides

L. A. Ware (Electrical Engineering, Dec., 1942)

The configuration of the $TE_{0,1}$ mode in a rectangular guide, and of the $TM_{0,1}$ and $TE_{1,1}$ modes in circular guides are described and shown, and the results of calculations as to cut-off frequencies and propagation constants are given. Practical considerations in the choice of the type of guides, its dimensions and the frequency to be used, as well as feeding methods and examples, are included in the article.

Liquid Level Indicator

S. C. Coroniti (Review of Scientific Instruments, Nov. 1942)

A metallic, coaxial, cylindrical container filled with a liquid acting as dielectric constitutes a condenser, the capacity of which is proportional to the liquid level. This condenser is arranged in the tuned-plate circuit of a crystal oscillator. Upon detuning, caused by a change in liquid level and consequently in capacity, the plate current decreases. A milliammeter in the cathode circuit measuring the plate current continually indicates the liquid level.

Formulas for the dependency of the plate current on the capacitance are derived, and the influence of a dielectric material between inner electrode of container and liquid is discussed. The circuit is described in detail, and curves showing the change of plate current with liquid level are shown.

Circuit for Studying Hunting

Manuel J. DeLerno and Robert T. Basnett (Electrical Engineering, Dec., 1942)

Fluctuations in speed of a synchronous motor upon a change in load, called hunting, may be made visible on the screen of a cathode-ray oscillograph by means of an electronic circuit.

Mirrors are arranged on the shaft of the motor under observation and flashes of light reflected from these mirrors and received by a photocell eventually cause the discharge of a condenser. Charging of this condenser at a constant rate and starting at a predetermined point of the cycle is obtained by connecting a pentode and a gaseous tetrode in series.

Thermal EMF

M. Surdin (Nature, London, Nov. 7, 1942)

The thermal movement of electrons in a resistor causes an emf to be set up, which is known to be the cause of the Johnson noise; a method for reduction of the Johnson noise is claimed in Patent No. 2,302,798, described in this issue.

The mean-square emf of thermal fluctuations per cycle in a resistance R, at temperature T, equals 4RkT, k being a constant. In this article, the formula is derived from microscopical considerations for conductors obeying Ohm's law and supposing equipartition of energy.

Coupled and Resonant Circuits

Jesse B. Sherman (IRE Proceedings, Nov. 1942)

The coupled impedance of a two-mesh, inductively coupled circuit with tuned secondary is studied and compared with a parallel-resonant circuit having dissipation in the inductive branch. Impedance, resistance, reactance and inductance are computed and plotted as a function of the ratio between natural frequency and frequency used and for various values of Q. Similar and different behaviour of the two arrangements, especially at resonance, is pointed out.

Stereoscopic Moving Pictures

Gordon L. Walls (Journal of the Optical Society of America, Nov., 1942)

The object is mounted on a turntable and two revolutions, each taking about one minute, are photographed. It will be seen that, if one of the two identical films is advanced a few frames with regard to the other one, two sets of pictures, corresponding to left and right eye viewing, respectively, are obtained. These may be projected on a screen, side by side, and, if looked at through viewing goggles, the impression of rotating, three-dimensional objects is accomplished. Of course, this method is not adaptable for movements of parts of the object relative to one another, but only for a movement of the object as a whole; otherwise no left and right-eyed pictures would result by merely advancing the film a few frames.

Saving Welding Electrodes

Canadian General Electric Co. (Electrical News and Engineering, Toronto, Nov. 1942)

The Canadian General Electric Co. suggests a method to save up to 15 per cent of electrodes by welding the two inch stub, remaining every time an electrode is used to a new electrode of smaller size. One end of the new electrode is grounded and the stub is touched to the other end.

RF Measurements

W. H. Cazaly (Wireless World, Oct. 1942)

In a series of articles on instruments, a survey of methods for measuring capacity and inductance at rf is presented. Bridge circuits, substitution methods, and arrangements making use of negative resistances are discussed and diagrams shown.

Transmission Line Constants

J. C. Simmonds (Philosophical Magazine, London, 1942)

The primary constants of a transmission line, characteristic impedance and propagation constant can be calculated from the open- and closed-circuit impedances of a line. Approximate formulas for the radio frequency range are derived so as to simplify computations, and the errors involved are indicated.

Substitute Insulation Materials

Harry Barron (G. E. C. Journal, London, 1942)

An extensive report is given on the properties of substitutes for insulating materials, and their characteristics are listed in several tables.

Proposes "Victory" Receiver to Save Material

During the sessions of the War Committee on Replacement Parts for Civilian Radio, Garrard Mountjoy, member representing the RCA License Laboratories, New York, proposed that as an alternative to providing replacement parts for a wide variety of home receivers of all vintages, it might be more economical to ask the set owner to "turn in" his old invalided radio, enabling him to purchase in exchange a small special "Victory model" receiver.

In a letter to the chairman, Mr. Mountjoy gives his specifications for such a minimum replacement receiver:

Dear Dr. Caldwell:

At your request I am listing some specifications for the Victory receiver discussed at the first meeting of our committee.

The receiver might be a five-tube ac-dc type, housed in a wooden compact cabinet, of not more than two furniture styles. It might have a 5-in. dynamic speaker.

The tube complement should serve the following functions:

1—Converter-oscillator tube
1—IF tube
1—Second detector -a-v-c — 1st. audio
1—Audio Output tube.
1—Power rectifier.

Signal pickup could be accomplished by a loop antenna with terminal provision for an external antenna.

Tuning range would be 1600 kc to 540 kc, accomplished by a two-gang variable capacitor.

These specifications should be subjected to comment from manufacturers formerly engaged in civilan receiver construction

Garrard Mountjoy

SIGNAL CORPS

(*Continued from page* 47)

this agency was a forward step in relieving manufacturers of the dilemma they might have faced when under simultaneous pressure for production from both the Army and the Navy—and with the supply of certain critical components insufficient for all purposes. When the supply of any component runs down, the manufacturer can now get an answer from the expediter representing the joint agency as to which contract shall be given precedence.

Tests by inspectors

All during manufacture and as the finished products begin to come off the final assembly line, they are examined and given thorough tests by Signal Corps inspectors.

Products which pass the inspection are shipped by the manufacturer in accordance with instructions from the contracting officer. Those produced in the Northeastern part of the country are likely to be shipped to the Philadelphia Signal Depot. Often, however, the manufacturer is directed to ship his products directly to the agency of the Army which will put it to immediate use.

This is no time for the accumulation of large stocks in warehouses. Materiel is needed immediately in the training camps and on the fighting fronts—both our own and those of our allies. The Services of Supply keep a constant running analysis of material in production as compared with the requirements of our own armed forces and those of the other United Nations.

The recognition that this is a United Nations war against the Axis has resulted in the incorpora-

tion of International Aid requirements to a great extent directly into the Army and Navy Supply programs. When completed materiel becomes available, it is assigned either to the service for which it was originally contracted or to other services having a more urgent use, depending on the current strategic situation. These decisions are made by special committees responsible to the Combined Chiefs of Staff. In the case of military communication equipment, the decision is relayed to the International Aid Branch of the Signal Supply Services.

It is the manufacturer's job to produce the required equipment on schedule and in conformity with specifications. The Signal Corps will see to it that the equipment arrives in time at the point where it can do the most good in coordinating the mechanism of our armed forces—and most harm to the common enemy.

COMMISSIONS

(*Continued from page* 68)

tion of thousands of these questionnaires valuable statistics have been prepared which have furnished the foundations for training plans, to fulfill the tremendous need for technical men in this war.

The programs of training engineers for the armed forces are well known, but certain types of engineers cannot be trained in time for their effective use on devices now in operation. There is right now an urgent need for skilled electrical engineers in the armed forces. Commissions are still available to qualified applicants in the Army, Navy and Marine Corps.

The demands of programs of research and development and of production exceed the supply of trained men, as you all well know. It then becomes the individual problem of every electrical engineer to decide where his own skill and experience may best be used in the war effort. The need for officers in the armed forces must be weighed against the importance of research and development and production as civilians. Education, experience, age, marital status, draft classification, all have a bearing upon the suitability of electrical engineers for their best particular use in the winning of the war. (*Turn page*)

The Committee on Scientific Personnel of the OSRD is prepared to assist electronic men in these matters. Over ten thousand electrical engineers, radio engineers and otherwise technically trained men have been extended the facilities of this Committee.

Facilities for the mobilization of scientists and engineers are available and at your service. I believe that the necessity for the immediate use of services of engineers in the armed forces is so great and urgent that every engineer should give thoughtful consideration to his own individual case. The armed forces need trained engineers at once. The men they need are undoubtedly busy in industry or in research. These engineers should and must weigh their present responsibilities against the requirements of the services. They should consider whether they are absolutely essential to the research or production program to which they are assigned and how essential that program is to the immediate and victorious conclusion of the war, which is, after all, the common aim of every one of us.

ELECTRONIC METHODS IN SHIPBUILDING

(*Continued from page 58*)

pare a worker for competent manual arc welding.

In the smothered-arc process, one thyratron circuit provides forward feed only of the welding rod. A General Electric automatic arc welding unit makes use of two, to provide forward and reverse action. The reverse is usually "on" only during the instant after the arc is started by touching the rod directly to the work. This unit is not a "single pass" welder, but lays about one-eighth in. of metal each time across. Although slower than single pass methods, the retracing process causes a refinement in the grain structure of the weld metal laid down on the previous pass. Ship boilers and other parts subjected to extremely high pressures or strains are being fabricated with this type of equipment.

X-raying manual welds

In Naval and other marine power plant installations, steam piping must be able to withstand pressures up to 600 lbs. per sq. in. and temperatures up to 850 degrees. Most connections in high pressure piping are welded, and the quality of the welded joints must be watched very carefully. In the Fore River Yard of the Bethlehem Steel Company, one building houses the facilities for complete fabrication, treatment, and radiographic inspection of high pressure piping.

All welds in pipes over two in. in diameter are subjected to X-ray inspection. Faulty welds are rejected, of course, but equally important is the fact that the number of defective welds is reduced to an insignificant number merely by the presence of the X-ray equipment. The welder who knows that every weld he makes is going to be inspected by X-ray will seldom let a "questionable" one slide through. When a defect is revealed, even though it may not be serious enough to cause rejection, the negative is shown to the welder involved. If the job is a reject, the actual defect is chipped out for him to see. The results at Fore River were marked. One welder has not produced a weld with even the

slightest flaw in over six months of work.

X-ray techniques are used which provide sensitivity and contrast considerably in excess of that required by the standards for acceptance of welded piping. An X-ray sensitivity of 1 per cent has shown over 98 per cent of the welds to be flawless and 99 per cent acceptable by X-ray standards.

Eight-inch concrete walls seven feet high form the exterior of the X-ray section of this piping plant. Ten-inch walls separate the room from the office and darkroom. The X-ray equipment itself is a mobile 220 kilovolt G-E unit.

X-ray radiography of castings is of equal importance to the shipbuilding program. A number of "million volt" units are in use, as well as many of the more common types.

Other electronic applications

Many interesting applications of electron tubes in the shipbuilding industry are classified as "restricted" as we go to press. It is impossible even to speculate on the importance of these applications, but it can be said that induction heating is being widely used, in brazing and heat treating operations in shipyards, drydocks, and fabricated parts suppliers' plants. There are installations of photoelectric equipment for temperature measurement and control, for plant intrusion protection, and for a few other purposes.

No details of the newer—and more interesting—applications of electronics are available for publication. This is also true, of course, of direction-finding equipment, radar, underwater sound apparatus, and the numerous cases of electronic control of many operations on board combat vessels, which are of vital military importance.

HUMID CLIMATES

(*Continued from page* 62)

lay. After these relay coils had been impregnated in the same manner as precision wire-wound resistors, there were no further failures.

Bakelite molded resistors

In a control circuit, a 3-megohm 1-watt bakelite molded resistor was used as a series dropping resistor in the screen circuit. These resistors operated at a small fraction of their wattage rating, yet, after a short period of use in the tropics, a gradual increase in resistance was experienced, finally resulting in a completely open circuit. To remedy this failure, these bakelite molded resistors were impregnated with Superior Compound, and none have shown any significant change in resistance since this treatment. The IRC BT ½ watt molded resistors have given excellent service without special treatment, probably because these resistors have been coated with some type of wax by the manufacturer.

Mica molded and paper condensers

In high gain RC amplifiers, the coupling condensers used between plate and grid circuits must offer a high resistance to dc, in order that the grid bias will not be affected by the plate voltage. In seismic amplifiers, the leakage resistance should exceed 1000 megohms. Most mica molded condensers, when new, will have a higher resistance than this, but after a few weeks, unless they have been properly treated by the manufacturer, the leakage resistance decreases to a few megohms under conditions of high humidity and cyclic variations of temperature. However, this difficulty may be prevented by impregnating the condensers with ceresin as outlined in the table.

It must be borne in mind that heating a mica condenser will change its capacity permanently. Moreover, the value will continue to change for a considerable period of time. The initial change will usually be a decrease of around 5 per cent but may exceed 20 per cent. The slow change will usually be from 2 to 5 per cent, which is probably small compared to the changes in untreated condensers. The magnitude of these changes will depend on the temperature and time of immersion and on the condition of the condenser. If 1 per cent tolerances are required, either factory treated parts should be used or sufficient curing time allowed.

Mica condensers that have become leaky in use or in storage may be reclaimed by heating in ceresin

at 140 deg. C for several hours, or until the small bubbles cease. They should then remain in the ceresin until the temperature has fallen to approximately 60 deg. C. Hundreds of these condensers, ranging in values from 0.0001 to 0.02 mfds. have been reclaimed by this method. Tests over the past two years indicate that the seal against moisture is quite effective.

Soldering precautions

A source of difficulties in humid climates, which must be carefully guarded against, is the use of acid-core solder, acid fluxes or soldering salts. In spite of the fixed practice of using resin core solder in making the electrical connections, a few failures have occurred due to leakage at the tube socket and other terminals. This leakage was found to be due to traces of the soldering iron cleaning fluid carried by the iron to the terminals. The salts of these cleaning fluids are hygroscopic, and troublesome leakages eventually develop after exposure to high humidity. This difficulty is particularly pronounced if acid core solder has been used to "tin the iron." Long and hard experience in wiring electronic equipment has demonstrated that the best soldering practice is to use resin core solder exclusively. The iron should be tinned by filing the point clean and applying resin core solder; never by the use of any cleaning flux.

Vacuum tubes

The tubes used in special amplifiers by Humble's seismic field crews are first given laboratory tests for microphonics. Gain vs. grid bias curves are then run, the plate and screen voltages being held at the operating point. These tests eliminate tubes that are likely to give trouble. The glass type tubes are generally used in preference to the metal tubes. The 6C8G and 6K7G are the types used in almost all Humble's high gain audio amplifiers. These tubes have given excellent service. In the radio equipment the common types of tubes are used.

Connectors

Pin contacts have been used only in tube sockets. For multi-channel

circuits, with the connectors exposed to the weather, Humble has used either spade connectors (wing nut and binding post type) or Howard B. Jones Plugs. For maintaining positive contacts in circuits having a load impedance lower than approximately 50 ohms, the spade connectors are far superior to any others tried. This is especially evident in low-voltage circuits in which it is necessary that the current be held constant. For higher impedance loads, the Jones plug connectors, with the original contacts replaced by contacts made of stainless steel, have been found to be very satisfactory. The material used for the spring contacts was KA2 Resistal, a cold rolled flat spring made by the Crucible Steel Company.

Radio communication in jungles

The Federal Communications Commission assigned certain frequencies in the 1600-1700 kilocycle band to geophysical exploration crews. For many years, Humble has been licensed to use the frequency of 1652 kilocycles on all its portable radio equipment. The output of these transmitters is generally about 10 watts, although in some instances it is necessary to use as much as 50 watts to obtain a transmitting range of 10 miles. Voice communication is desirable but CW and ICW are much more reliable. Transmitters that are reliable at 50 miles in fairly open country, may not be satisfactory for even 5 miles in dense jungles, and if the trees are wet, the attenuation of the signal is even more pronounced.

No definite data are available on the reliability of jungle operations on other frequencies; however, government stations in the jungles of Venezuela, Colombia and the Dutch East Indies, commonly use a frequency around 6000 kilocycles for communication between fixed stations fifty or more miles apart. Satisfactory results were also obtained with the frequency of 1652 kilocycles for fixed stations where it was possible to erect efficient antennas higher than the surrounding trees.

Editor's Note: Additional information on Humble's experience with component parts, including sockets, connectors, clip-ons, wire and cable, batteries, battery-chargers, volt-ohmmeters, electrolytic condensers, volume controls and carrying cases, is available in the complete paper by the authors, copy of which may be obtained by addressing Humble Oil & Refining Co., Houston, Tex.

SIMULATED FLYING

(*Continued from page 59*)

instructor is able to offer constructive criticism at the instant the student makes an error and while the particular condition is fresh in the student's mind.

Oscillator-amplifier energizes Telegon units of remote instrument indicators and transmitters

The instructor has numerous controls at his disposal for varying the character and amplitude of the signals. Several selector switches enable him to simulate up to five different range stations with their associated marker beacon transmitters. While watching the course being traced on the map by the trainer, he is able to produce accurately the signals which the student would hear, if he were actually flying over that section of the country.

Remote instrument system

Another important vacuum tube application concerns the system of remote instrument indications. This system consists of a Telegon transmitter unit located at the source of measurement and electrically connected to two indicating units, one of which is mounted on the trainer instrument board, and the other at the instructor's desk. The transmitter unit is actuated by an instrument mechanism similar to a standard aircraft instrument. The indicator consists of a

Telegon unit which is similar to the transmitting unit and is provided with an instrument dial and pointer. There are a total of nine Telegon units used in a standard trainer and the necessary electrical excitation can best be obtained through the use of vacuum tubes for reasons of economy, quietness of operation and a minimum of maintenance. A 6L6G beam tetrode in an audio oscillator circuit having a resonant frequency of 700 cycles is coupled to a pair of 6L6G amplifier tubes in push-pull. The push-pull amplifier is transformer coupled to the nine Telegon primary windings, thus energizing the complete remote instrument system.

The above mentioned applications apply in a large measure to all trainers produced. A number of special trainers have been produced however, employing actual radio transmission between desk and trainer to give students practice in tuning, distinguishing signals through interference, and to acquaint them with the use of radio direction finding equipment with all its ramifications. Details of these applications as well as many others being developed from day to day to increase pilot training efficiency must be withheld for the duration of the present emergency, lest they reveal information concerning the latest radio aids to our Armed Forces.

WFIL TRAINS MEN

(*Continued from page* 66)

code, and the secretaries of executives who voluntarily teach typing to those not familiar with the touch system. At first, classes were held five evenings a week from 7 until 10 p. m. because most of the students were employed during the day. However, operations of the school expanded to such a degree it was found necessary to form afternoon classes and in these were included a few Navy WAVES who are studying the wireless code to take certain positions not subjected to actual combat. The girls show keen interest and skill in this new occupation and are eager to complete the course in shorter time than their male fellow-students.

The Radio Code School courses are absolutely free to accepted students, all costs being borne by

WFIL Broadcasting Company and the United States Navy.

Each school room is equipped with a group of long flat tables upon which are mounted transmitting keys and head phones for six students. At the head of the room is the instructor's desk equipped with a telegraph key, control board, amplifier and a tape transmitter employing a photo electric cell. This apparatus permits the instructor, to raise or lower the speed of transmission at will. Code receiving is also taught by hand, starting of course at a very slow speed and working up to the required rate as the student progresses. As the student advances he is given practical problems in both transmission and receiving, typical of the work required at sea. In addition to the head phones a loud speaker is installed in the class room from which the students take certain classes of messages.

Get taste of battle mix-ups

In the more advanced operations the students have "tactical tests" during which each student at his station or key represents a ship in a squadron, with code messages flying back and forth between and among them. It is the duty of each operator to keep "his ship" in constant communication with the rest of the fleet, and in these tests of muddled messages he gets his first taste of what is to be expected in actual operation. L. E. Littlejohn, WFIL's chief engineer, is in charge of the Radio Code School.

The U. S. Navy hopes that enough broadcasting stations will establish similar schools over the country in order to fill the need for more telegraph operators. Commenting upon this Mr. Clipp says: "If the broadcasting stations of America will carry on the work started here, we can and we will, meet the Navy's demand for radio men in the field. I will gladly place at the disposal of any interested station any and all information necessary to the organization and maintenance of a Navy Radio Code School."

The method of obtaining students has been through simple announcements from WFIL's studio over the radio with immediate results. The caliber of applicants was the very highest and at the present time

LATEST

NEWS FROM WASHINGTON

Concerning the Electronic Industries

PRODUCTION INCREASED, DELIVERIES SPEED UP — Production during 1943 is steadily climbing so that weapons will get into hands of armed services — now, not later. The WPB Radio leadership urges electronic and radio companies to gear their plants to a variety of end-product uses both in completed apparatus and in the making of components, tubes and other parts. Their staffs, both engineering and on the assembly line, must be flexible so as to turn to making new products when the Army and Navy call for them. "No war material is subject to as much change in plans as radio," when new war fighting needs arise, cites WPB Radio Director Ellis. Right now the emphasis is on aircraft and ship apparatus — but this might change overnight with new battle fronts.

NAVAL COMMUNICATIONS COORDINATES NAVY ELECTRONICS PROGRAM — Generally concentrated on "getting the messages through" for the Navy, the Office of Naval Communications under the command of Captain Carl F. Holden has just established an Electronics Branch which is charged with the duty of coordinating the requirements of the Navy with respect to precedence and allocation of electronic equipment, cooperating closely with the Radio Division of the Bureau of Ships.

NEW FIELD OFFICES IN WPB RADIO DIVISION STRUCTURE — Twelve of the projected field or regional offices, established by Radio Division Director Ellis with Field Service Chief Frank Horning in direct charge, are handling the problems of electronic and radio manufacturers in their respective areas in the same fashion as the Washington office (except for granting priority ratings). They are being staffed with radio-trained men and the field offices are to aid in securing materials, checking inventories (a big aid with CMP), handling decisions on the New Victory model sets and parts and even helping with the WMC Manning Plan tables and in issues before War Labor Board. In Washington the Division has its program group which follows requirements for military electronic equipment; the components sections; and the resources group to see the industry has the equipment and facilities necessary to meet production schedules. An important Engineering Advisory Section closely observes developmental work in the laboratories.

FCC COMPILES CATALOG OF BROADCAST SURPLUS MATERIALS — A bulky 1100-page catalog of surplus equipment held by standard broadcast stations has been compiled by the FCC and this month will be distributed to interested government departments, inspectors-in-charge of regular and sub-field Commission offices as well as to a list of 124 strategically located broadcast stations. Since the so-called "Catalog of Surplus and Salvagable Equipment" assumed much greater bulk than originally anticipated, the FCC stated it would not be possible to distribute one copy to each station. Material contained in the catalog was compiled from FCC questionnaires mailed Nov. 20 to the nation's 8,000 radio-transmitter licensees including all except amateurs.

FCC UNDER FIRE ON CAPITOL HILL — The Congressional investigation of the FCC, threatened at every session of Congress in the past decade, has at last materialized, when the House approved a probe, sponsored by fiery anti-New Dealer Cox of Georgia and mainly directed at Chairman Fly and an alleged group of "Reds" on the Commission's staff. Hearings are slated for mid-March. FCC also on the grill before other committees for increased appropriations and war activities and for over-staffing, its force having grown in the past two years from 600 to 2,000. Results of Congressional investigations are significant because FCC will regulate post-war television and FM.

MANPOWER AND DEFERMENT — The training of electronics and radio engineers and the securing of more complete draft exemptions of technicians and production workers in electronics plants constitute two of the most important recent problems of the industry. Most significant in the draft situation is the establishment of a labor-management subcommittee to advise the War Manpower Commission on a plan to have group consideration for draft exemption of skilled electronic workers — an entire group of skilled categories of employees — rather than the present system of draft boards' consideration of workers individually. This recommendation was made to WMC after conferences between representatives of the Army Signal Corps and SOS, WPB Radio and Radar Division, industry and the CIO and AFL unions. It was felt that electronic workers, with their valuable contributions of equipment to the armed forces, deserved definite draft-exemption consideration just like farm laborers.

there is a long waiting list. Several classes have already been graduated and are now on duty in the Navy and in every case their training at this school has proven to have been adequate and successful.

This patriotic undertaking on the part of WFIL executives and engineering staff is a challenge to other broadcasting stations to follow suit so that a hundred thousand fully trained telegraphers could be turned over to Uncle Sam within the next year.

RADIO-CONTROLLED SHIP

(*Continued from page 87*)

a crew could be sent to the robot vessel to fix things up.

Possibility of the enemy taking radio control from the mother ship would be exceedingly slight, as the chance of finding the right control combination would be like finding a needle in a haystack. The system uses a combination of signals in such a way as to form a code system or "combination" and each vessel has its own code signals. The mother ship may travel alongside the fleet of phantom ships or in the middle, or it may lead or follow them, maintaining a closely grouped or widely separated group as desired, just so long as all of the group are kept within a two-mile range of the protective radio range. The signals used to whip back in location or to detect faulty movement of any ship are quick and single instead of long drawn-out waves which might lead to detection. The speed of the fleet would be approximately ten knots per hour and the size of each ship may be varied, though the radio control on all must be the same.

F. B. Woodworth, radio inventor

Operation of ships at sea by remote control is not new, for the U. S. Navy has been running target ships in such a manner for years, but the system of remote radio control on this new system is different. It was developed by Frederick B. Woodworth, formerly with Bell Laboratories who was prominent in the perfection of the ship-to-shore radio telephone. The idea of the concrete boat is the creation of Vladimir Yourkevitch who designed submarines for the Russian Navy in World War No. 1 and also assisted in the design of the great French liner "Normandie."

A full size concrete ship is approximately 260 feet long with a cargo capacity of 2,000 dead weight tons. A series of ten to fifteen watertight compartments has been incorporated in the design of the ships to make them fairly invulnerable to torpedo attack. Should a torpedo strike one of these compartments, its flooding with water will make little appreciable difference in the ship's buoyancy, while the ballast tanks with automatic pumps will, in most cases, restore an even keel. In order to wreck or blast one ship of the fleet at least four direct hits of torpedo would have to be scored and by the time of such an occurrence, the mother ship with its guns and depth charges would have taken care of the enemy submarine.

DIP COATING PROCESS

(*Continued from page 63*)

borhood of from seven to eleven inches.

The process works very effectively with most non-metallic objects, such as wood, pottery, etc.

A totally enclosed oil-immersed power pack supplies the proper voltage to the electrodes. High-vacuum rectifiers produce dc at about 85,000 volts between the plate and the grounded article. No filter is used. The power supply is so designed that it will not permit more than 5 milliamperes even on a dead short. This particular power pack requires 220 volts 60 cycle ac. The current consumption on the average installation is between 300 and 500 watts.

The automatic dipping arrangement has been designed so that the mouth of the shell is higher than the head while it is immersed in the liquid. This eliminates the possibility of an air pocket, which might otherwise leave an uncoated section.

The cartridge case has an intermittent treatment, passing over the high-voltage plate at two stages. By this means, almost any balance of solvents may be used in the coating material without the possibility of reaching the plate after the fatty edge has "set up" excessively or the

possibility of leaving the field before the excess has completely finished flowing.

Facilitates mass-production

In this application, the dipping and detearing process has several advantages over spraying. It gives the greatest assurance of an overall protective coating. Its operation is very simple, requires no skilled labor, it results in the most economical use of the coating material. Maintenance is negligible. The cartridge cases may be hung in multiple rows, facilitating large-scale production with a minimum of floor and oven space and conveyor length.

A uniform bake is greatly facilitated by suspending the shell, mouth down, by a wire hook, rather than by supporting it with a rotating pin which conducts heat from the head. The head, being many times heavier than the mouth, requires a much higher percentage of the heat. Some heating engineers estimate that bringing the head up to temperature requires 80 per cent of the heat needed by the whole shell.

Those who are using this process in production are enthusiastic about its simplicity of operation and repetitive results. It is being considered for a number of other war production applications.

POLICE FM

(*Continued from page* 83)

with only trouble being the breaking of leads on two condensers in the P.S.U. due to not being tied down securely enough.

Several improvements in coil forms, using polystyrene as a pregrooved coil form, makes the high frequency end remarkably stable. Alignment is very critical, but straightforward, and is accomplished by using a 50-0-50 microamp galvanometer and a precision signal source, in this case our frequency meter-monitor.

All in all, the saving represented considering the value placed on the AM sets, plus the parts and time necessary to make the changeover, would be considerable even if such a set were on the market, and considering that such sets are not yet available, the saving and the utility show time well spent.

FM's NEW W75NY

(*Continued from page 82*)

for purpose of coordination and check. The remaining three lines are spares for whatever needs may arise.

Roof-top transmitter

The transmitter proper is installed in a most ideal location in its lofty perch above Hotel Pierre at the entrance to Central Park, commanding an uninterrupted line of sight for ether-wave transmission in all directions over the city. The transmitter consists of a General Electric FM combination of a 250-watt exciter unit followed by a 1000-watt amplifier. The exciter unit is reactance-tube modulated, and is maintained on its assigned carrier frequency of 47.5 megacycles by means of the GE feedback system. Its principle of operation is as follows:

The output carrier frequency is sampled by a pick-up loop L-144 which feeds some of the output energy into a frequency converter tube V112. In this mixer there appears the output frequency and a locally generated crystal controlled frequency from the frequency stabilizing unit associated with tubes V113 and V114. The difference between the carrier frequency and the ninth harmonic output of the crystal oscillator is then fed to a discriminator circuit tubes V111 and V110. This discriminator circuit converts this difference frequency into an audio voltage which will vary with the frequency difference. Thus, the greater the deviation of the carrier frequency from that of the ninth crystal frequency harmonic, the greater will be the audio voltage developed by the discriminator. This audio voltage is then fed back to the reactance modulator system tube V101 in proper phase to bring the modulated oscillator circuit, tube V102 back to its assigned carrier frequency. These functions are illustrated in the accompanying block diagram.

Amplifier unit

The amplifier unit is a straightforward Class C amplifier with GL 833-A's in the output stage. This amplifier has coupled to it a dual concentric transmission line made up of two seventy-ohm lines in parallel. These lines are under constant air pressure, kept at a given level by means of an automatic pump with a dehydrating unit so that the air within the transmission lines is always dry and above atmospheric pressure. This insures that no moisture will enter the line to upset the electrical characteristics. This dual concentric transmission line rises 75 feet to the roof of the building, then another 50 feet to reach the top of a copper bearing steel mast, on top of which—700 feet from the ground—is mounted a General Electric circular-bay or so-called "doughnut antenna". This doughnut is normally of 25 ohm impedance and needs to be matched to the impedance of the dual concentric transmission line, the impedance of which is 32 ohms. This matching unit is comprised of a quarter-wave unit, as illustrated.

The circular-bay antenna itself has a variable condenser bridged across its gap for precise tuning. A GE frequency-modulation carrier frequency monitor permits the deviation frequencies to be read at all values down to zero.

Roof reflection

Owing to the present difficulty in procuring tubes of the required types the full 10-kw output has been reduced to one kilowatt capacity. Nevertheless, W75NY has been heard clear and distinct as far as New Haven, Bridgeport, Schenectady, Bethlehem and other cities within a range of 150 miles. It is believed that this phenomenal reception may be directly traceable to the slanting copper roof on the tower of the Hotel Pierre, its slant being such as to re-direct into space the energy being thrown down to it by the doughnut antenna, and so the effective signal strength in the horizontal direction is intensified.

Administration

W75NY's policy of maintaining a regular daily schedule of high quality entertainment and information was conceived by Ira Hirschman, vice-president of Bloomingdale's department store at 59th Street and

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Personnel in charge of construction of the station and maintenance of its high standard of operation is made up of Operations Manager L. L. Thompson; Chief Engineer Abraham B. Cohen, Program Supervisor Charles H. Kleinman, and assistant to Mr. Thompson, Anita deMars. This administrative staff had the required energy, skill and resourcefulness to complete and put into operation this station dedicated to high program ideals, during a time when the procurement of equipment and labor was most difficult.

KMPC AT BEVERLY HILLS

(*Continued from page 75*)

quired for their operation, but it does increase the safety factor. Over the lines has been constructed a wooden cover that can be removed in 12 ft. sections. The cover protects the transmission lines both from mechanical damage and from the sun's rays.

As explained, the directional array consists of three towers in a line, with a spacing of 70 deg. between adjacent towers. The design called for phasing the current in the north tower of 125 deg., center tower 0 deg., south tower 235 deg. The field ratios are 1.0 north tower, 2.03 center tower, and 1.0 south tower.

The San Fernando Valley is completely surrounded by mountains. The transmitter being located in the Valley made the available length of the measuring paths very short. Considerable time was spent in the actual adjustment of the directional array because of these peculiar conditions. Hundreds of measurements were made in determining that the antenna was properly adjusted.

KMPC's new plant was placed in operation September 19, 1942. An extensive field survey was made to determine the location of the 10.0 mv/m, 2.5 mv/m and the 0.5 mv/m service contours. These show that the selection of the station site and antenna fulfills all expectations. The measured rms field of the antenna was found to be much higher than computed. The listening response has been very satisfactory and the mail response has shown excellent correlation with the field survey. The installation has proven satisfactory in every respect.

PRINCIPLES OF SHORT WAVE RADIATION—II

(*Continued from page 79*)

which has here only a component into the metal

$$N_z = (E_x H_y)_{z=0} = F^2 \frac{\gamma \delta}{\sqrt{2}} \sin \omega t . \sin \left(\omega t - \frac{\pi}{4}\right)$$

and its time average is

$$N_{zav} = F^2 \frac{\gamma \delta}{4} = \frac{1}{2} \cdot \frac{1}{\gamma \delta} \cdot (H_m)^2_{z=0} \quad (48)$$

giving the loss in watts per unit area of metal, if F is the amplitude of the electric field on the surface of the metal. The last form is of value if, as is frequently the case, only the amplitude of the tangential magnetic field on the sur-

face of the metal is known, which according to (46) has the value

$H_m = (F \frac{8\gamma}{\sqrt{2}})$. If it is possible, in some manner, to find the surface field value, either electric or magnetic, (48) will immediately give the loss per unit area. For example, one can find the losses in the conical antenna, knowing the magnetic field on the surface of the cone from (35) with $\Theta = \alpha$

$$(H_\phi)_{\theta=\alpha} = \sqrt{\frac{\varepsilon}{\mu}} \frac{A}{r \sin \alpha} \sin\left(\omega t - \frac{2\pi r}{\lambda}\right)$$

The average loss per unit area is then from (48)

$$N_{av} = \frac{1}{2\gamma\delta} \cdot \frac{\varepsilon}{\mu} \cdot \frac{A^2}{r^2 \sin^2 \alpha}$$

becoming extremely high near the apex of the cone. One can easily introduce the current amplitude from (37) as

$$I_m = 2\pi A \sqrt{\frac{\varepsilon}{\mu}}$$

and by integrating over both conical surfaces, find for the total loss due to the principal outgoing wave alone

$$P_{loss} = \frac{1}{4\pi\gamma\delta} \frac{\ln (l/g)}{\sin \alpha} I^2_m \qquad (49)$$

where l is the length of the cone and 2g the gap between the cone ends to which the voltage is applied. The total equivalent resistance is then defined by

$$R_{loss} = \frac{2 P_{loss}}{I^2_m} = \frac{1}{2\pi \gamma \delta} \cdot \frac{\ln (l/g)}{\sin \alpha} \qquad (50)$$

For copper, a ratio $l/g = 100$, and a frequency of 400 mc.p.s., one finds the total loss resistance as

$$R_{loss} = \frac{0.052}{2\pi} \cdot \frac{\ln 100}{\sin \alpha} = \frac{0.0381}{\sin \alpha} \text{ ohms}$$

which is shown in Fig. 10 as a function of α.

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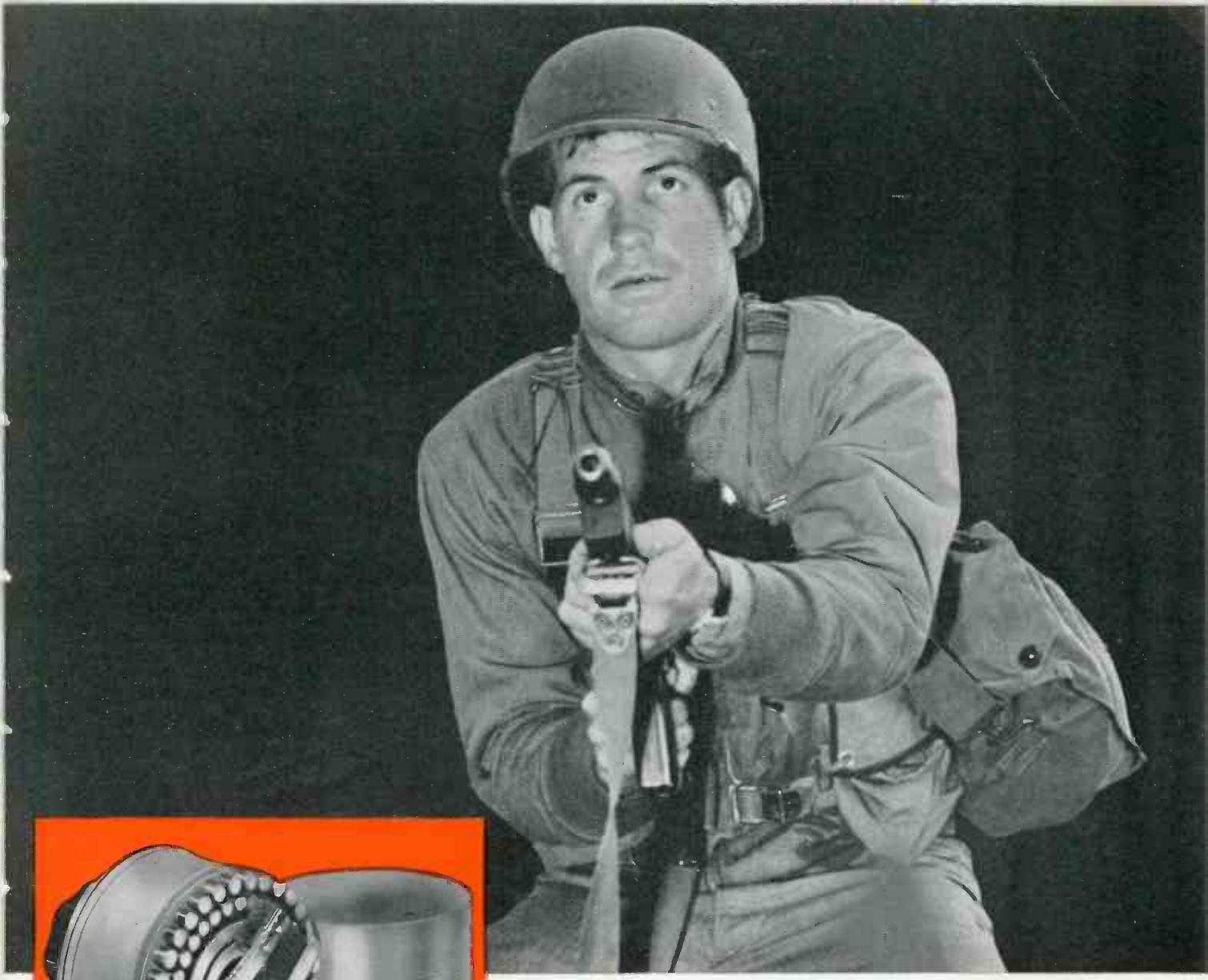

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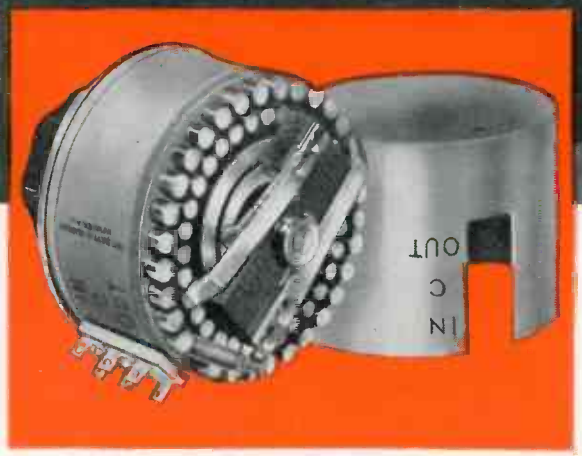

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