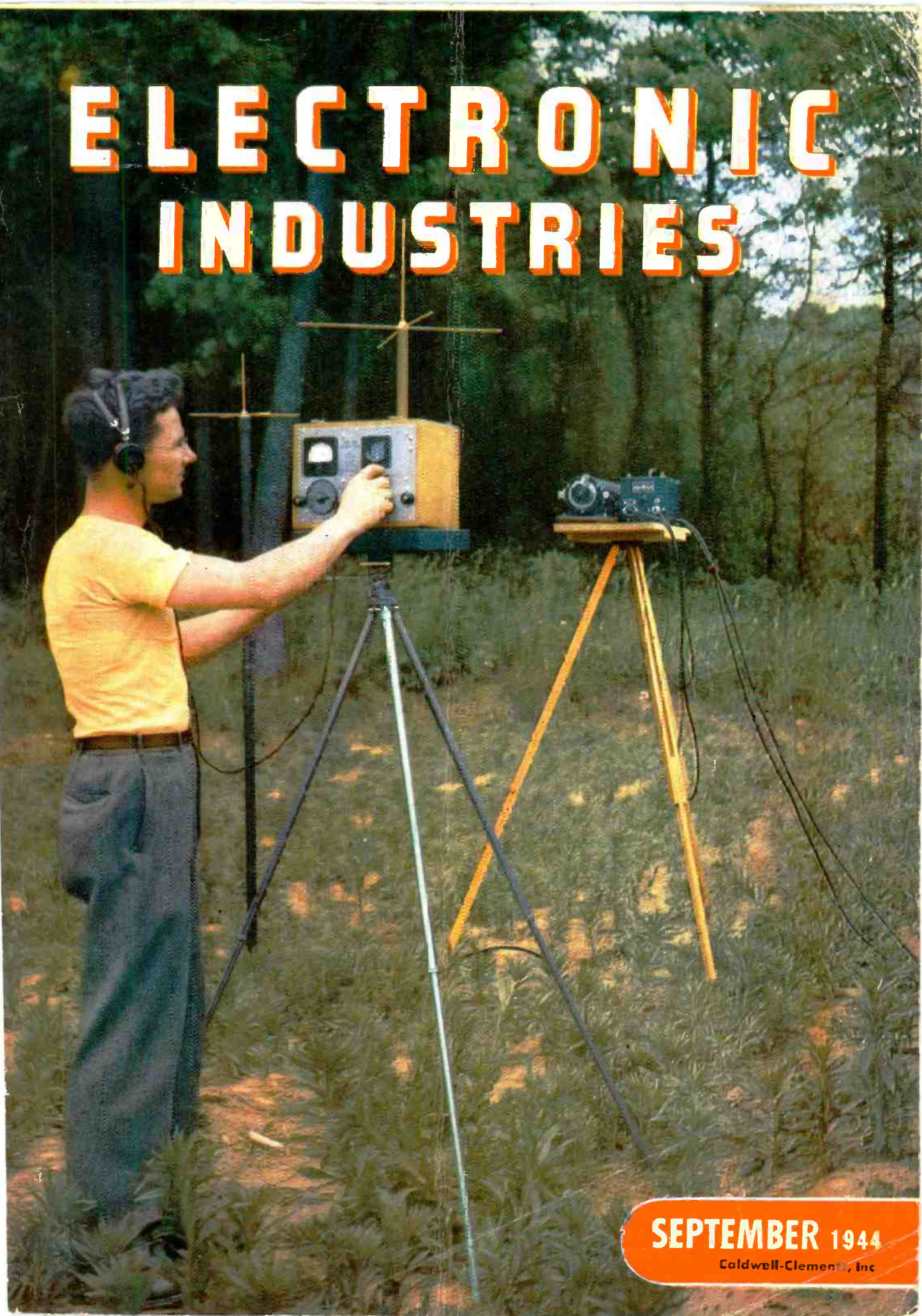
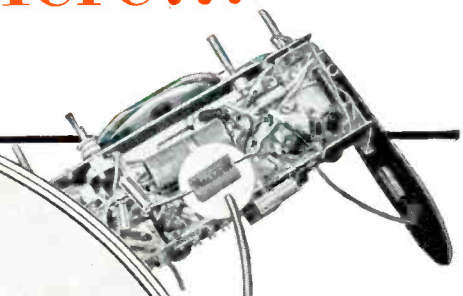
ELECTRONIC INDUSTRIES



SEPTEMBER 1944
Caldwell-Clements, Inc.

Not Much Space Here...



But The P. R. MALLORY & CO. Inc MALLORY Type WB Capacitor

Doesn't Need Much Space!

Keep Backing the Attack with War Bonds

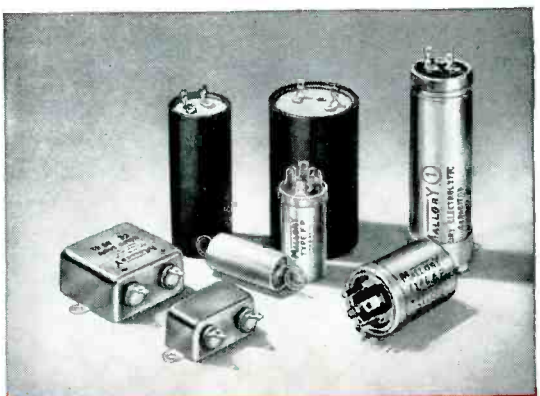
MALLORY has pioneered the manufacture of dry electrolytics through the age of "specials" and individual specifications . . . can still supply them upon demand. But developments have proved that industry can best be served by standardized types of capacitors. The Mallory WB type capacitor is such a unit: an example, too, of careful design and production offering maximum capacity in a minimum amount of space.

Mallory type WB capacitors are housed in aluminum tubes that provide an effective seal against moisture absorption and loss of electrolyte. A cardboard cover provides excellent insulation against shorts when the aluminum tube is assembled in close quarters.

These electrolytic capacitors are ideal for applications in AC/DC sets and wherever space is at a premium. They are shorter than most cardboard tubulars that require extra length for sealing wax at either end.

These advantages—plus the hermetic seal of WB's—makes possible a tubular capacitor that withstands humidity and temperature changes harmful to most cardboard types. See your Mallory distributor or write direct for further information.

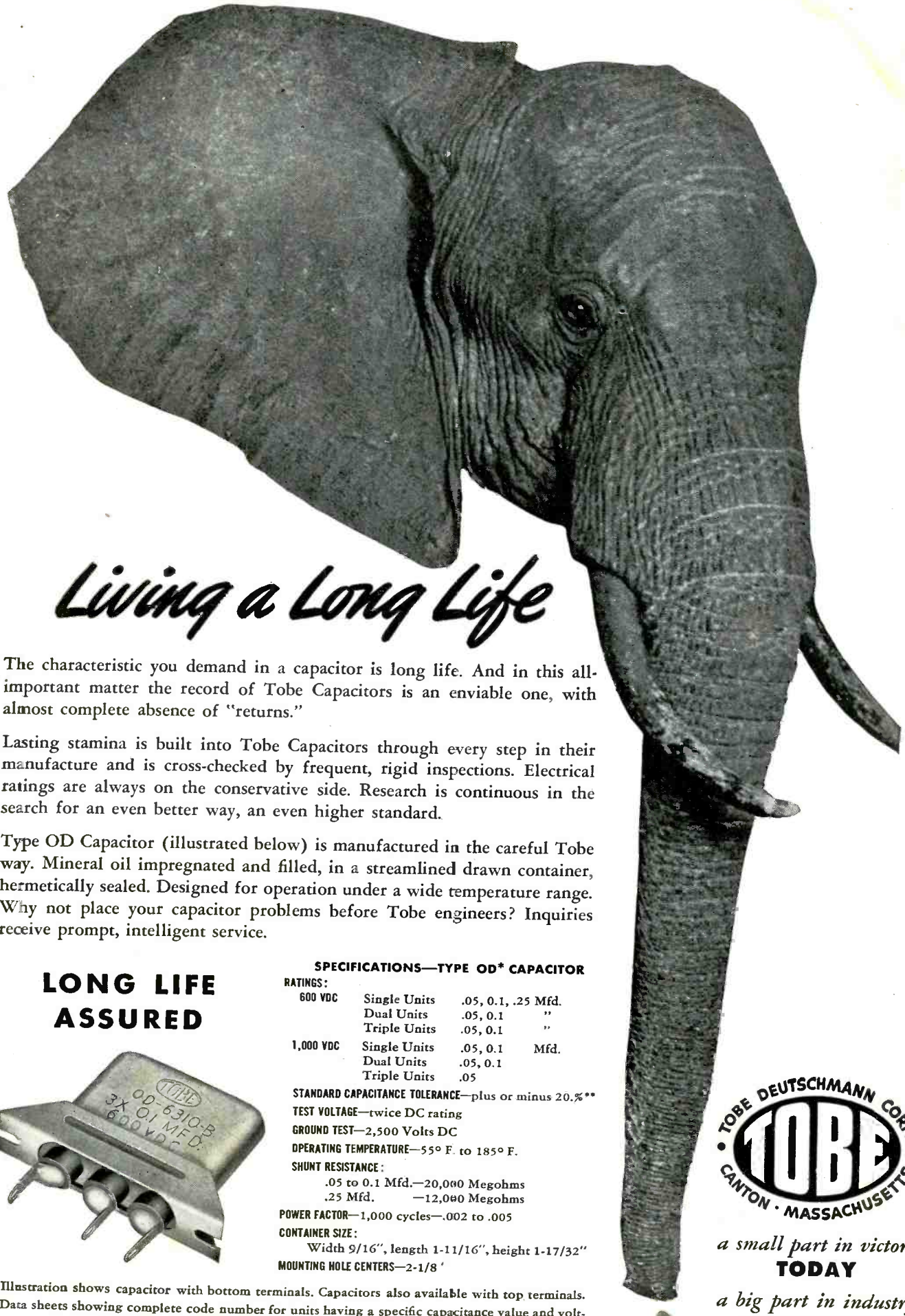
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



P. R. MALLORY & CO. Inc

MALLORY

ELECTROLYTIC, FILM AND PAPER CAPACITORS



Living a Long Life

The characteristic you demand in a capacitor is long life. And in this all-important matter the record of Tobe Capacitors is an enviable one, with almost complete absence of "returns."

Lasting stamina is built into Tobe Capacitors through every step in their manufacture and is cross-checked by frequent, rigid inspections. Electrical ratings are always on the conservative side. Research is continuous in the search for an even better way, an even higher standard.

Type OD Capacitor (illustrated below) is manufactured in the careful Tobe way. Mineral oil impregnated and filled, in a streamlined drawn container, hermetically sealed. Designed for operation under a wide temperature range. Why not place your capacitor problems before Tobe engineers? Inquiries receive prompt, intelligent service.

LONG LIFE ASSURED

SPECIFICATIONS—TYPE OD* CAPACITOR

RATINGS:

600 VDC	Single Units	.05, 0.1, .25 Mfd.
	Dual Units	.05, 0.1 "
	Triple Units	.05, 0.1 "
1,000 VDC	Single Units	.05, 0.1 Mfd.
	Dual Units	.05, 0.1
	Triple Units	.05

STANDARD CAPACITANCE TOLERANCE—plus or minus 20.%**

TEST VOLTAGE—twice DC rating

GROUND TEST—2,500 Volts DC

OPERATING TEMPERATURE—55° F. to 185° F.

SHUNT RESISTANCE:
.05 to 0.1 Mfd.—20,000 Megohms
.25 Mfd. —12,000 Megohms

POWER FACTOR—1,000 cycles—.002 to .005

CONTAINER SIZE:
Width 9/16", length 1-11/16", height 1-17/32"

MOUNTING HOLE CENTERS—2-1/8 '

Illustration shows capacitor with bottom terminals. Capacitors also available with top terminals.
*Data sheets showing complete code number for units having a specific capacitance value and voltage ratings available on request. **Other tolerances available.

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

a small part in victory
TODAY
a big part in industry
TOMORROW

This Month's Cover

The man on our cover is checking frequency and field strength of a low powered ultra-high frequency transmitter, preparatory to making a run on the general transmission characteristics. The test instrument is a Lavoie UHF frequency meter.

The transmitter is operating above 400 mc and it is necessary that it be monitored continuously, observing changes in frequency and output. The successful observation of general transmission characteristics over difficult terrain at these frequencies is largely dependent upon the transmitter output remaining constant, both in frequency and power, during the period of measurements. The operator must compensate immediately for any changes that occur in the transmitter.

★

Mystery Ray Stops Auto

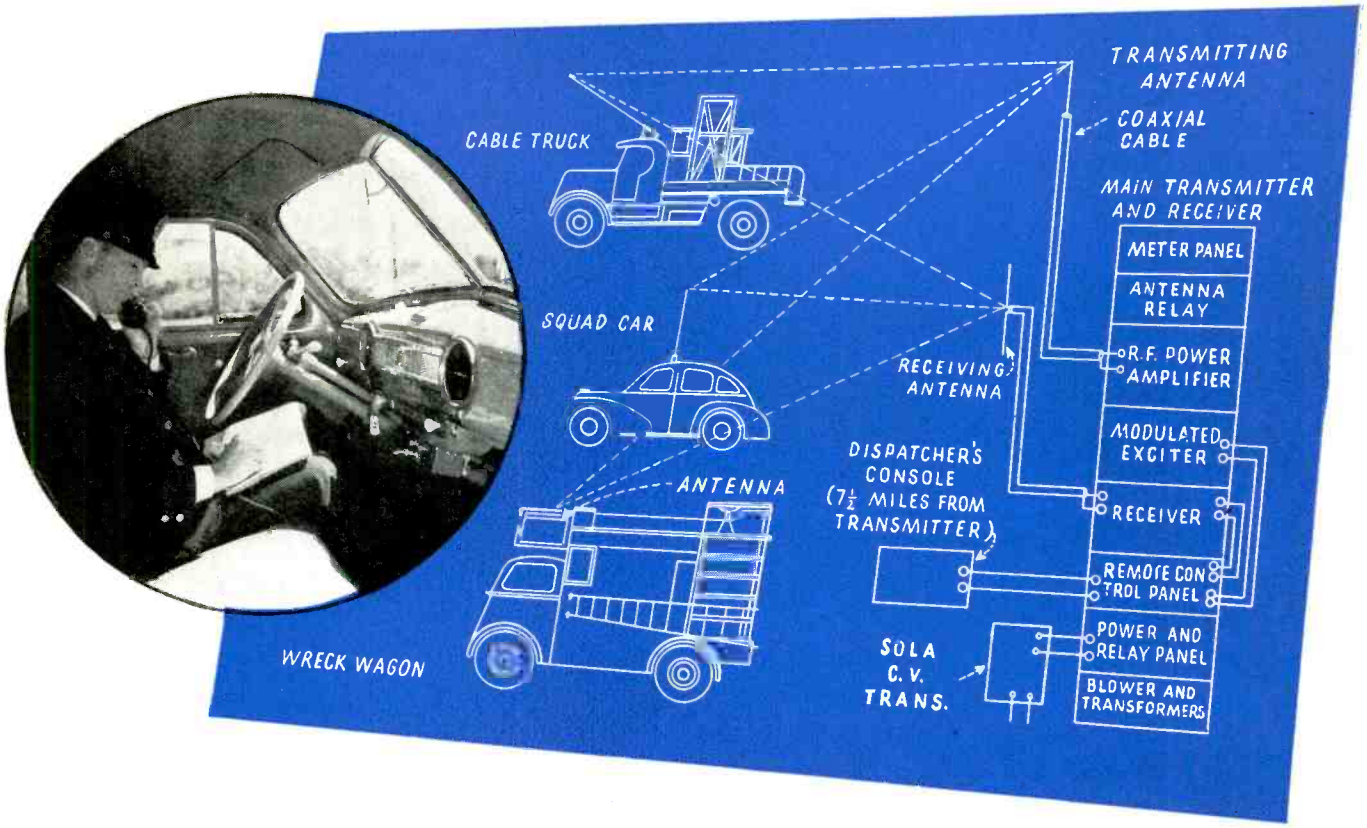
Ex-Governor Charles Edison of New Jersey, has his famous father's love of a joke. The inventor's distinguished son is an M.I.T. graduate and knows his way around in electrical and electronic matters, as might be surmised. Recently, after listening to an amateur electronics enthusiast become eloquent about postwar electronic marvels, Gov. Edison asked whether the spellbinder had yet witnessed a demonstration of "the electromagnetic ray that can stop an automobile." "No, I've heard about such a ray," replied the electronic prophet, "but I didn't know it was yet practical." "Well, jump into my car and come down to our laboratory, and I'll show you."

As the car approached the main street of Orange, N. J., the traffic signal turned red, and the Governor's chauffeur put on the brakes, bringing the car to a grinding stop. Pointing through the windshield at the red traffic light, Gov. Edison chuckled: "See, just as I told you, there's the ray that stops automobiles—and it IS thoroughly practical, too!"

★

"But if you don't explain radar to him, John, I'm afraid he'll pick it up from the boys on the street."—*A. John Kaunus in Collier's.*

RADIO COMMUNICATIONS operate with greater efficiency with built-in CONSTANT VOLTAGE

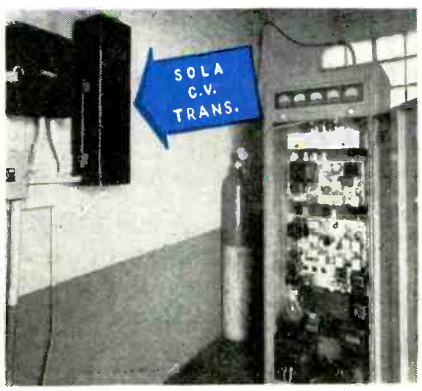


The safety and convenience of two and a half million passengers, carried daily by the Chicago Surface Lines, are guarded continuously by the elaborate, phase-modulated radio communication system by which all divisions of this vast transportation system are kept under constant surveillance.

Naturally, any communication system so important to human safety and well-being cannot take chances with its equipment. Line surges, voltage fluctuations that distort and interrupt signals or damage costly tubes and equipment, cannot be tolerated.

In this, and in many other radio communication systems, SOLA Constant Voltage Transformers are playing an important role—constantly on guard against line voltage disturbances, instantly correcting fluctuations as great as 30% to less than ±1% of rated requirements. SOLA Constant Voltage Transformers require no manual adjustments or supervision. They have no moving parts. They protect both themselves and their loads against short circuit.

When supplied as a built-in part of any type of electrical or electronic equipment SOLA Constant Voltage



Transformers insure longer tube life, fewer service calls and greater satisfaction to the user. Consider these transformers in your basic design.

Constant Voltage Transformers

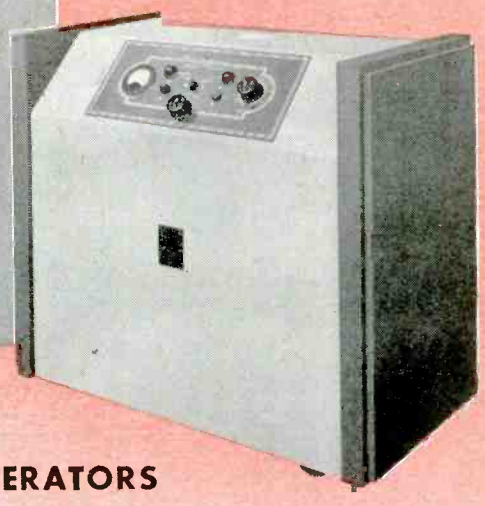
SOLA

To Manufacturers:
Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.
Ask for Bulletin 10CV-74

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

THE 20 KW RADIO FREQUENCY GENERATOR—This unit has a nominal output of 20 kw. Controls and meters are conveniently located on the front panel. The circuit breakers and relays are readily accessible through the lower door on left side of the cubicle. Dead-front construction provides maximum protection to operating personnel.

THE 2 KW RADIO FREQUENCY GENERATOR—This unit has a nominal output of 2 kw and is designed to take a minimum of floor space. Large, sturdy casters provide high mobility. The "table top" working surface eliminates the need for special worktables and all controls are centralized on the sloping panel.



WESTINGHOUSE RADIO FREQUENCY GENERATORS

Cut Heating Time

FROM HOURS TO MINUTES

Heating operations that used to take hours are now completed in *minutes* through radio frequency heating—with a uniformity and control of the heat never possible before. In fact, with Westinghouse Radio Frequency Heating, tricky heating jobs become simple "push button" jobs.

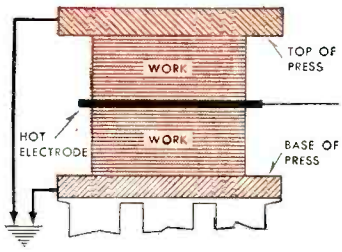
Westinghouse Radio Frequency Generators are designed for both induction and dielectric applications. With all the generating equipment and controls housed in a single cabinet, these units are literally radio frequency heating "packages" . . . simple to install and maintain. They are completely shielded to minimize radio communication interference.

The "long life" air-cooled tubes eliminate all the complications of water cooling. Air cooling also provides an extra margin of safety against failure and, at the same time, effects worth-while savings in both space and *initial* cost.

Westinghouse offers industry a complete line of radio frequency generators—1, 2, 5, 10, 20, 50, 100 and 200 kw units. The heavy-duty 50, 100 and 200 kw units employ water-cooled tubes. Ask for Bulletin B-3261-A and Descriptive Data 85-800. Or, for assistance on some specific application, send us an outline of your problem. Westinghouse Electric & Mfg. Co., P.O. Box 868, Pittsburgh 30, Pa. J-08074

Westinghouse RADIO FREQUENCY HEATING

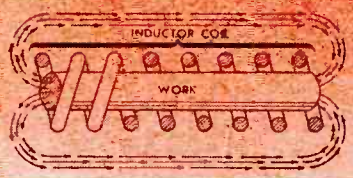
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



APPLICATIONS AND BENEFITS OF WESTINGHOUSE RADIO FREQUENCY HEATING

Dielectric Heating (for nonconducting materials)

INDUSTRY	APPLICATIONS	GENERAL BENEFITS
WOOD	Plywood • Compreg • Setting glue • Pressure banding • Drying	**Boosts Production** by creating the proper heat instantly throughout the material. No waiting for heat to "soak in" from the surface.
PLASTICS	Heating preforms • Curing • Setting • Processing of sheets	**Uniform Heating** throughout the material prevents damaging internal stresses caused by uneven heating.
TEXTILE	Heating forms • Twist setting • Drying • Bonding thermoplastic fabrics	**Rejects Reduced** because there is no surface charring—checking or drying out.
FOOD	Drying • Thawing • Dehydrating • Sterilization	**Cuts Equipment Costs** —Westinghouse Radio Frequency Generators can be used with most existing hot or cold plate presses. Fewer jigs, dies and presses needed.
RUBBER	Heating • Thawing • Curing • Vulcanizing • Devulcanizing	**Quickly Installed** on most existing presses, using either hot or cold plates.

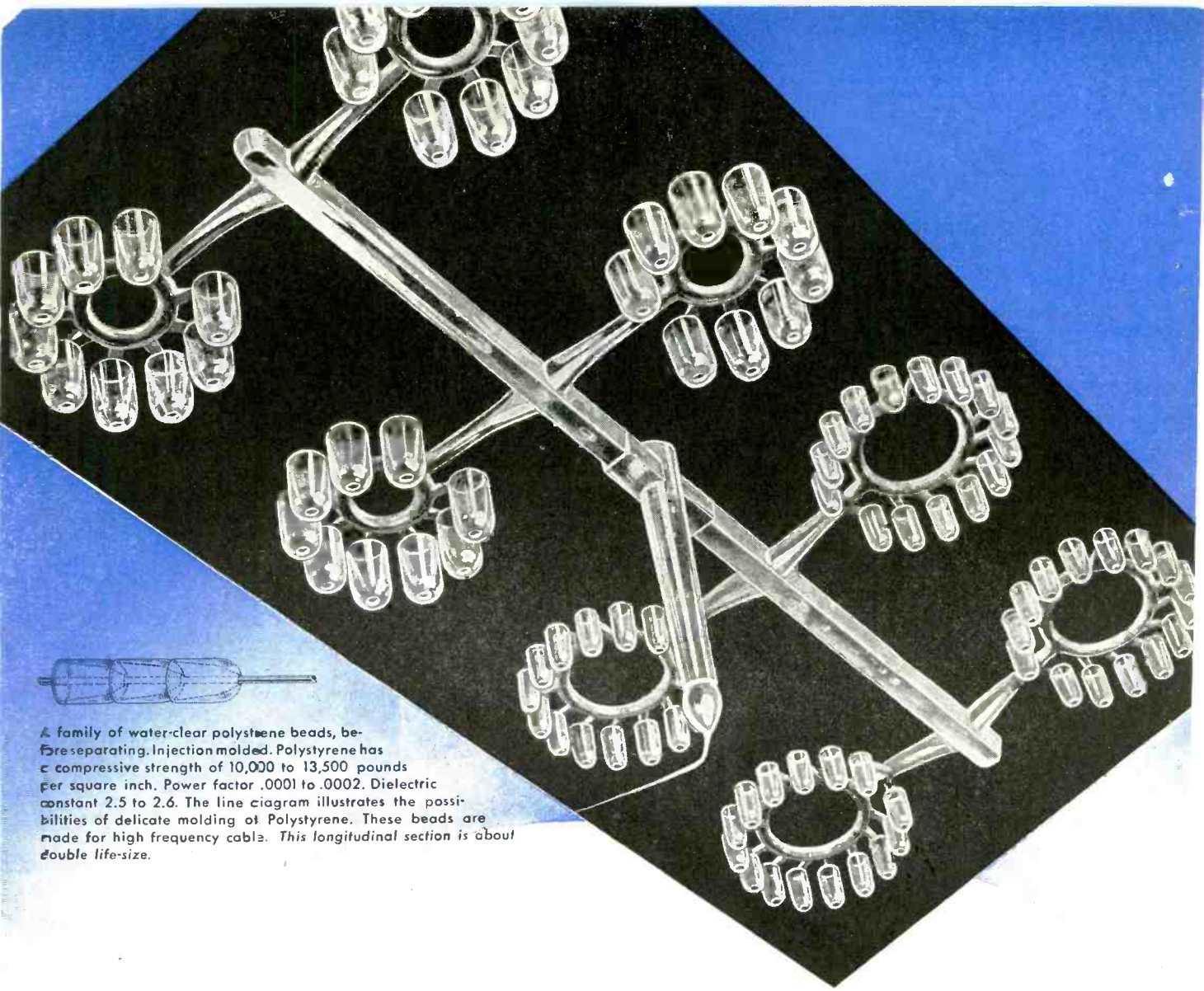


Induction Heating (for ferrous and nonferrous metals)

INDUSTRY	APPLICATIONS	BENEFITS
METAL WORKING	**ANNEALING** contact plugs • welded sections • tire rims. **BRAZING** spark plugs • aviation gas line fittings • spiral tubing • tool tips • piston assemblies. **HARDENING** spindles • cams • punches • ball bearing races • gears • sprockets • drill chuck bodies • camshafts • mandrels and many others. **SINTERING—SOLDERING**	**Saves Production Time** through instantaneous, accurately controlled heat. **Simpler—Low-Cost Designs** are made possible by multiple soldering and brazing operations. **Precise Control** of depth of hardening leaves strength and machinability of interior unaffected. **Automatic Operation** permits use of unskilled operators. **Heating Can Be Localized** externally or internally for specific applications.

Electronics at Work

WESTINGHOUSE



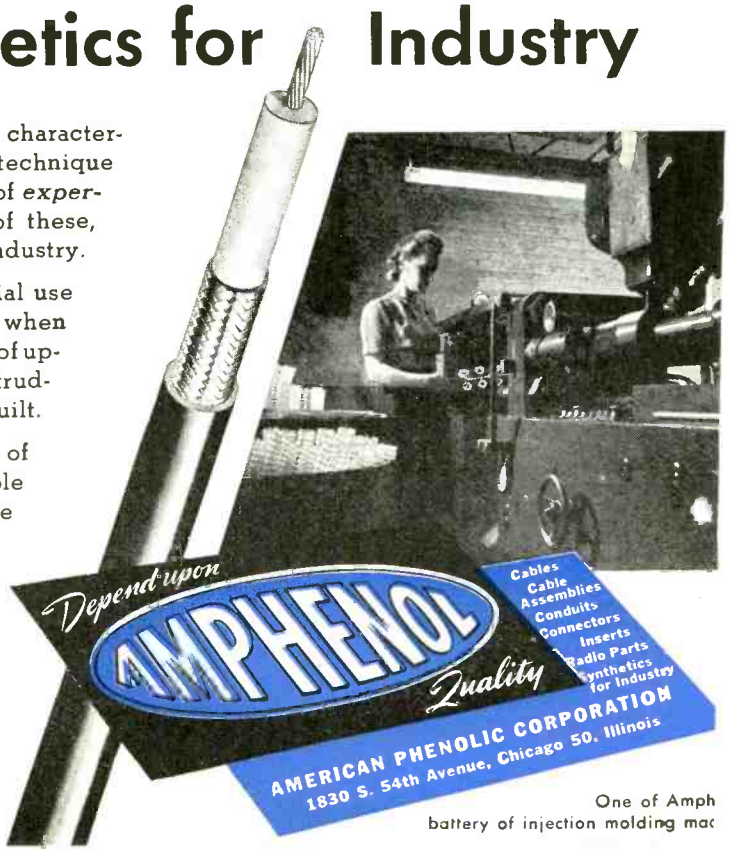
A family of water-clear polystyrene beads, before separating. Injection molded. Polystyrene has a compressive strength of 10,000 to 13,500 pounds per square inch. Power factor .0001 to .0002. Dielectric constant 2.5 to 2.6. The line diagram illustrates the possibilities of delicate molding of Polystyrene. These beads are made for high frequency cable. *This longitudinal section is about double life-size.*

Synthetics for Industry

In the handling of plastics a complete knowledge of the characteristics of the various synthetics, their possibilities and the technique of working with each is fundamental. That is equally true of *experience* and *skill* and up-to-date equipment. With all of these, Amphenol, has consistently been a leader in this rising industry.

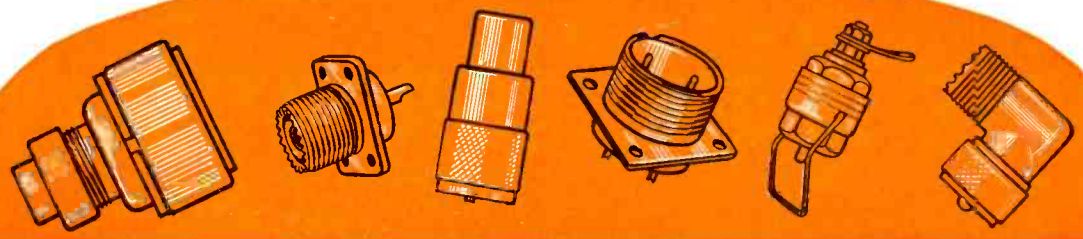
Practical experience in molding synthetics for industrial use dates back, at Amphenol, to the days, many years ago, when "plastics" meant Bakelite. Today Amphenol has batteries of up-to-date injection molding, compression molding, and extruding machines—many specially designed and custom built.

The help of Amphenol's engineers in the choice of materials, planning and designing of products is available to those interested in keeping step with the times in the use of plastics.



Ultra high frequency R. G. cables. Dielectric, polyethylene, extruded with inner conductor centered to within 10%. Diameter tolerance permitted .010". Vinylite outer covering extruded over wire, dielectric and braided copper shield.

One of Amph
battery of injection molding mac



A Good Firm to Connect With For Your Postwar Needs in:

CONNECTORS AND RELATED UNITS

Connector Division of IRC produces a comprehensive line of coaxial cable connectors, multiple contact connectors and cable plugs.

If your postwar products call for these or other small parts of a related nature, we suggest you avail yourself of our specialized knowledge, experience and volume manufacturing facilities. Inquiries are invited.

NEW COAXIAL ADAPTER

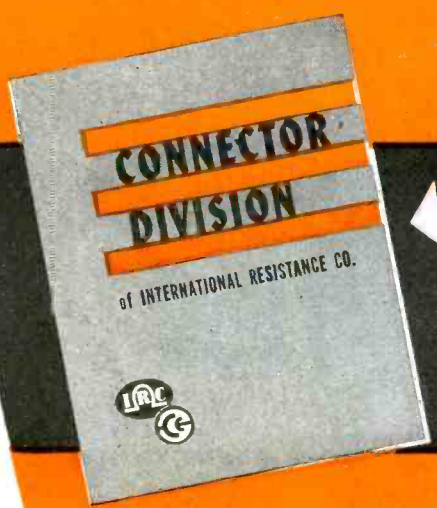
Adapts British to American Coaxial Connectors

Ever on the alert to meet industries' requirements, IRC offers this precision Adapter to fill a current need for this type unit. This Adapter is now available in production quantities.

HERE'S WHAT IT DOES

Connects British 10H/528 coaxial plug to the Navy 49195 plug and to the Signal Corps PL-259 plug.

Meets Navy Specifications RE49F242



Write for Your Copy of our Catalog

IRC

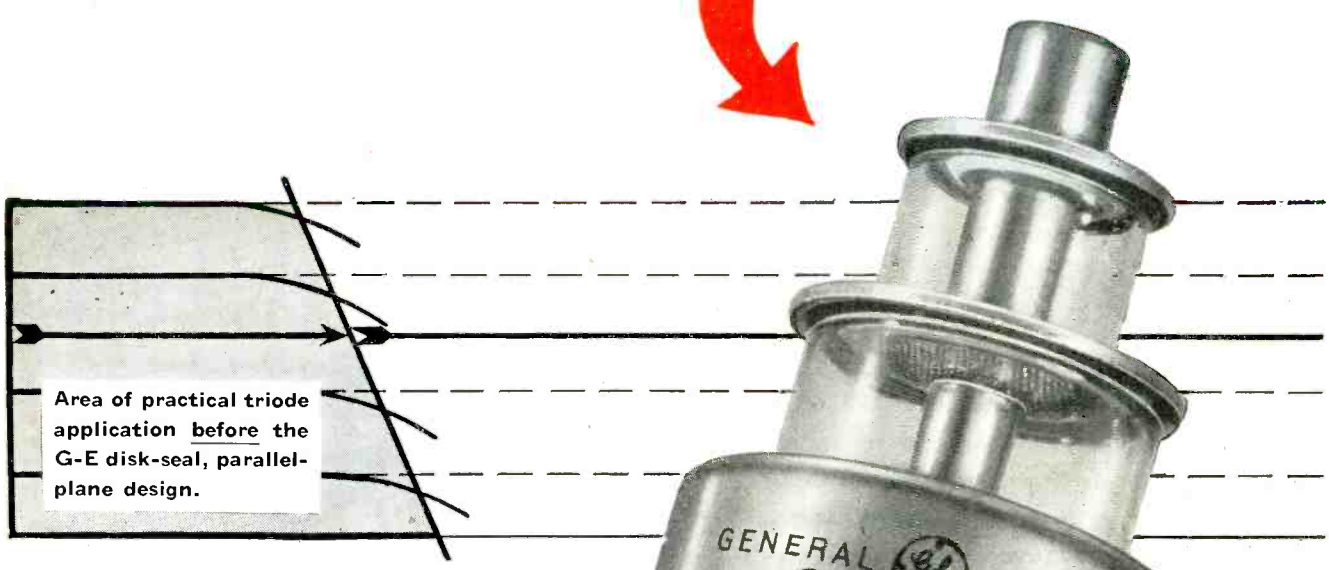
*CONNECTOR DIVISION OF

INTERNATIONAL RESISTANCE CO.

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

*FORMERLY CONNECTOR CORPORATION

HERE IS THE REVOLUTIONARY



Type GL-446
LIGHTHOUSE TUBE

This new G-E disk-seal, parallel-plane design advances by

MANY TIMES

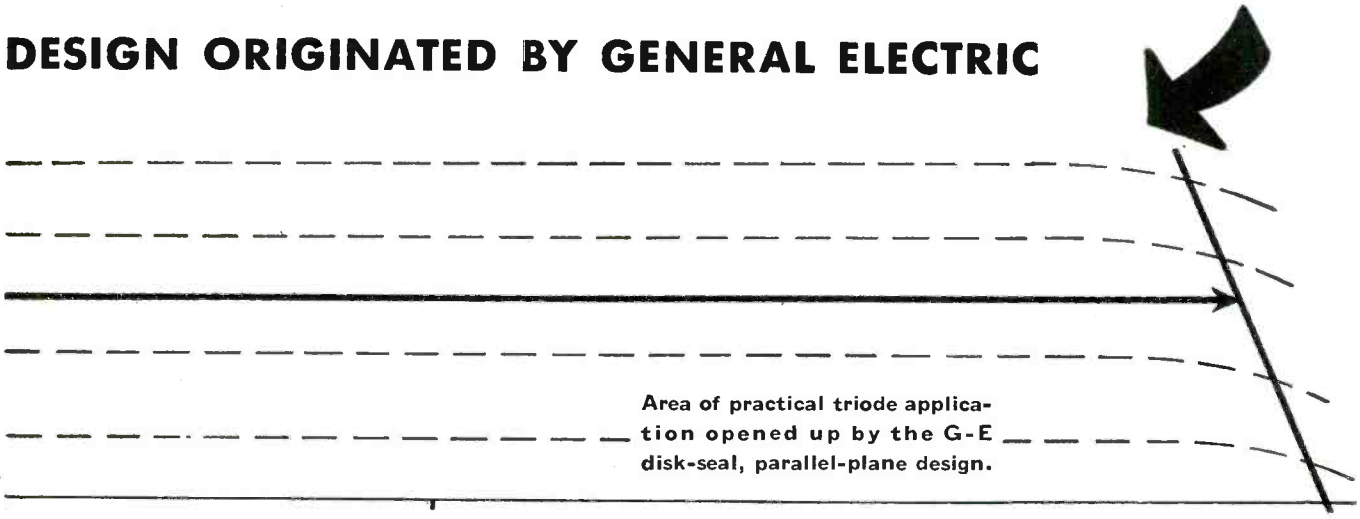
the power available at ultra-high frequencies for use in coming fields of electronics such as FM Radio and Television, Relaying, and Mobile Television.

• Tune in "The World Today" every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday listen to the G-E "All Girl Orchestra" at 10 P.M. E.W.T. over NBC.

another G-E electronic **FIRST!**

G-E LIGHTHOUSE TUBE

AN EXAMPLE OF THE NEW DISK-SEAL, PARALLEL-PLANE DESIGN ORIGINATED BY GENERAL ELECTRIC



Area of practical triode application opened up by the G-E disk-seal, parallel-plane design.

THIS new tube is one of the most important developments in electronic-tube history — ranking with such other G-E electronic firsts as the screen-grid tube, the high-vacuum tube, the mercury-vapor rectifier, and the thyratron.

The new G-E disk-seal, parallel-plane design*—developed by engineers of the G-E Electronics Laboratory — opens up a vast new field of radio frequencies for practical use. It extends the top frequencies at which electronics engineers can work . . . thus reaching into hitherto untouched segments of the ultra-high frequency spectrum.

The advent of this extraordinary new tube will make it possible to build greatly improved electronic devices for important post-war applications.

*MEGATRON IS THE GENERIC NAME ASSIGNED TO TUBES OF THIS DESIGN

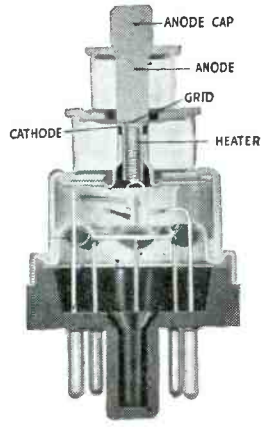
It will, for the first time, enable engineers to take advantage of high frequency channels that could not previously be used to advantage.

It will enable the relay transmitters of FM and television networks to function at even higher frequencies than heretofore anticipated and thus provide more communication channels.

It is quite possible—in fact, probable — that ultimately a large "family" of lighthouse tubes will be available for dozens of applications in the radio, television, and industrial-electronics fields. Thus is added another G-E "first" to support the fact that —

G. E. HAS MADE MORE BASIC ELECTRONIC-TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

For information on electronic tubes, write to *Electronics Department, General Electric, Schenectady, New York.*



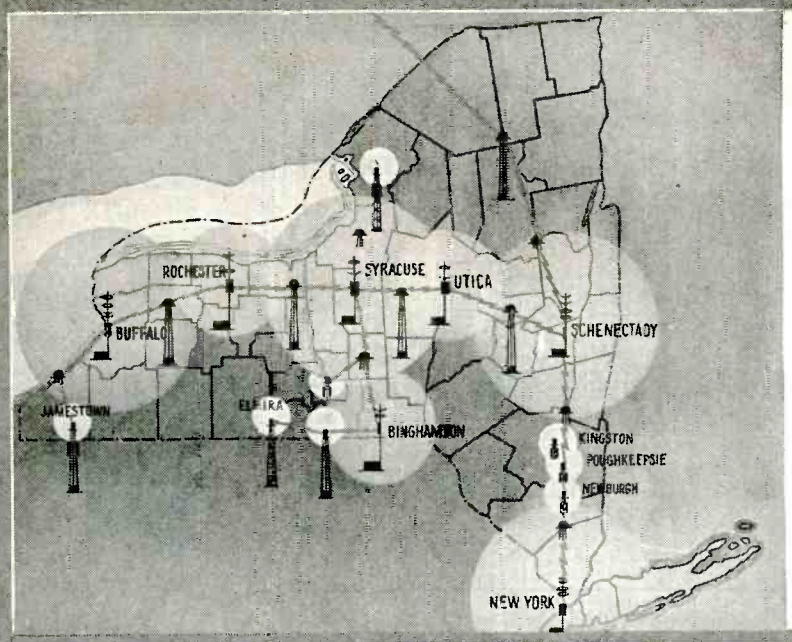
CONSTRUCTION AND CHARACTERISTICS

The disk-seal, parallel-plane design of the G-E megatron eliminates the conventional type of grid, anode and cathode. Instead of components being fitted *around* one another, they are constructed in simple, *parallel planes* or layers—with glass and metal fused together to provide a shock-proof construction. This design permits an extremely compact over-all tube structure.

For the first time, it makes possible the use of new circuits with which yesterday's dreams become today's realities.

GENERAL ELECTRIC

176-C6-8850



93% of the population of New York State could be covered by this regional network of five master television stations and nine satellite stations.

A television network relay station.

The G-E Satellite

will bring 1. Network Television 2. Television Revenue

G-E developments will make it possible to provide television program service in small and intermediate markets as well as large cities.

Master television stations, capable of originating television shows of network calibre, will be located in the larger centers of population. These master stations can be linked together in regional networks by G-E ultra-high frequency radio relay stations. Coast-to-coast hook-ups of regional networks logically will follow.

SATELLITE STATIONS THE NEXT STEP

From this broad framework will stem still other stations — hundreds! . . . to bring television to the smaller communities — to make it a still more attractive advertising medium for concerns doing a regional or nation-wide business.

Known as satellite stations, these smaller community stations will tie in with their respective regional networks by taking network programs from the nearest relay station, and rebroadcasting them over the local area. The satellite station can also produce and televise its own film programs, under local sponsorship, independently of the networks.

SATELLITE STATIONS ECONOMICAL TO BUILD AND OPERATE

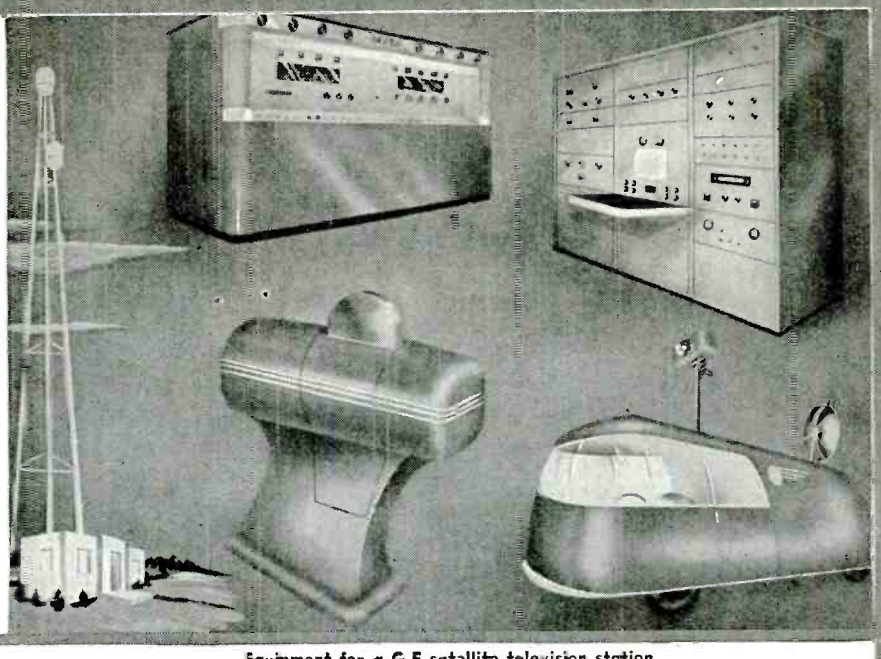
A satellite television station will be relatively inexpensive to install and operate — and will require a minimum of operating personnel.

The illustration at the far right, above, shows equipment required for a satellite television

STATION AND STUDIO EQUIPMENT • TRANSMITTERS

GENERAL ELECTRIC

The G-E disk-seal tube — a development that makes ultra-high frequency relaying possible.



Equipment for a G-E satellite television station. Antenna · 16-mm projector · Transmitter · Receiver-monitor · Mobile pick-up unit

Television Station

to small communities

to local station owners

station of the future. A simple building houses the equipment and a lattice tower supports both the broadcasting antennas and the antenna which picks up the picture and sound signals from the nearest relay station. The small transmitter will have sufficient power to cover the local market area. A receiver-monitor unit, an amplifier unit, and a 16-mm motion picture projector and film pick-up camera complete the essential station equipment.

For local revenue, a 16-mm silent motion picture camera will be used by the satellite station operator to take pictures of products or demonstrations local merchants may wish to advertise. A G-E magnetic wire recorder will add background sound and commentary. Local happenings—parades, fires, dedications, sports, and social events—can be filmed in similar manner to provide other local sponsored programs. For on-the-spot broadcasts of events as they happen, a small truck may be equipped as a mobile unit.

Let General Electric help you with your preliminary plans. Let General Electric provide your complete television broadcasting system. Benefit from G.E.'s experience in operating WRGB — the nation's most powerful television station.

If you are interested in television broadcasting, plan your visit to Schenectady now — Thursdays and Fridays are our "open house" days at WRGB. If you have not received the G-E brochure, "TELEVISION BROADCASTING POST-WAR," write *Electronics Department, General Electric, Schenectady, New York.*

• *Tune in General Electric's* "The World Today" *and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS network. On Sunday evening listen to the G-E* "All Girl Orchestra" *at 10 E.W.T. over N.B.C.*

I56-C3-3914

ANTENNAS • ELECTRONIC TUBES • RECEIVERS

FM–Television–AM

See G.E. for all three!

FOR SERVICES WELL RENDERED, I THANK THE MEN AND WOMEN WORKERS OF THE ELECTRO-VOICE MANUFACTURING COMPANY WHO HAVE BEEN AWARDED THE "E" BY THE ARMY AND NAVY OF THE UNITED STATES.

Albert Kahn

PRESIDENT, ELECTRO-VOICE MANUFACTURING CO., INC.

Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., INC. — 1239 SOUTH BEND AVENUE, SOUTH BEND 24, INDIANA


Sangamo Capacitors
Can Take It!
Mica capacitors play a vital part in the correct functioning of many types of equipment. Radio receivers, transmitters, hearing aids, underwater sound equipment, induction heating, and many other devices depend upon the faithful performance of capacitors to enable them to function properly.
Many applications of capacitors in these various equipments necessitate a wide range of sizes, shapes, voltages, and current carrying ability in order that the proper capacitor may be used depending upon the physical space limitations and electrical characteristics to be met.
As illustrated, Sangamo manufactures a large variety of capacitors from the small wire lead type having a body size of only 23/32" in length, 15/32" in width, and .20" thick to the large ceramic case type capable of operating at voltages up to 35,000 and handling large amounts of radio frequency current. This wide variety of capacitors insures the availability of the proper unit for almost any mica capacitor requirement.
SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS
SANGAMO

ACCES

Right—KT Terminal Strip. Strips of binding posts mounted in bakelite can be had in any number of pairs specified.

Left—Type K Distributing Strip combined with insulated metal fanning strip—a moulded bakelite strip of high insulating value and great strength. Studs of non-corrosive, high tensile strength metal. Can be furnished in exact number of pairs required.

Right—Type KS Terminal Strip is similar to the K Strip except that it is furnished with a row of solder clips under the nuts. Fanning strip is optional.

Left—Furnished for 6, 11, 16, 26 pairs or multiples thereof, these Distributing Panels are furnished wit. or without fanning strips. Single piece moulded bakelite faceplate and fanning strip is feature of latter. Non-corrosive studs.

Below—Cable Distributing Strip and Housing for low voltage circuits. Special type housing will accommodate various types of strips.

Below—Type 55 Terminal Strip for interior low voltage circuits. For mounting in instrument boxes and test cabinets.

Below—Type 65 Terminal Strip—Bakelite base, tinned brass connectors, furnished in various lengths.

Supplementing the line of Cook Relays, "Springlife" Bellows and Pressure Detector Switches, is a line of accessories, a representative group of which are shown here.

These are some of the items for which engineers in the aviation, communications, electrical and electronic manufacturing industries "Look to Cook" when planning their requirements.

Here are some facts about these line terminating and switching items that are of interest to you.

- Carefully designed to the high standards of Cook engineers.
- Tooled and fabricated completely under one roof.
- Precision manufactured with modern equipment.
- Assembled and tested with exacting care by skilled workers.
- Highest grades of all materials are used in all parts.
- Manufactured in a model plant with efficiency that provides capacity to produce in quantity.
- You can buy direct from manufacturer—if quantities warrant, we will tool for special requirements.

COOK ACCESSORIES

Left—Type 52 Interior Junction Box showing Type 52 Terminal Strip. Furnished in 10, 20 and 26 pair sizes. Special sizes up to 52 pairs to order. Solder connections for permanently low resistance. Terminal block of heavity tinned, formed metal clips set into hard rubber insulation.

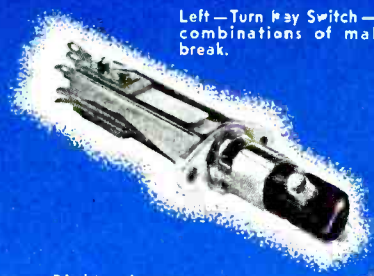
Left—Type 53 Interior Junction Box showing Type 53 Terminal Strip. Terminals providing solder clips on cable side and screw connections on drop side are mounted in specially selected kiln dried maple terminal strip. Furnished in 13 and 26 pair capacity.

Above—Type 54 Interior Junction Box showing Type 54 Terminal Strip. Similar to Type 53 except that heads are smaller, unit is more compact and has lighter weight studs.

SORIES

Left—Push Key Switch—sturdy type switch built to requirements.

Left—Turn Key Switch—various combinations of make and break.



Right—UX Cable Terminal—6, 11 or 16 pair cable terminal in patented water-tight chamber. Heavy studs set in bakelite. Outlet of box may be provided with patented compression couplings.

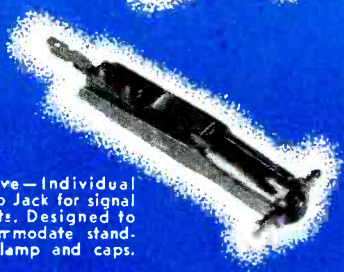
Right—JK-24 Telephone Jack, precision built for perfect contact. JK-47 also manufactured.

Right—Lever Key Switch—heavy duty key, built in various make and break combinations.

Right—Line Terminal Block is made of heavily tinned formed metal clips set into hard rubber insulation. Various types of terminal blocks are manufactured to accommodate the various types of terminal punchings

Left—JK-26 and 46A Jacks—two voltage connectors for radio headsets. JK-26 has bakelite housing and JK-46A has aluminum housing.

Above—Individual Lamp Jack for signal lights. Designed to accommodate standard lamp and caps.



Below—Porcelain connectors with non-corrosive studs.

Below—Terminal Punchings—plated, accurately tapped, have tinned solder connections.

Below—Lamp Jack Strip—strips of the lamp jack illustrated above can be had in any combination.

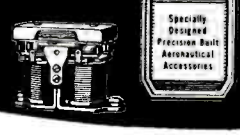
Below—Showing an additional variety of terminal punchings.

Above—Terminal Clip—various metals and types made to order.

A SERVICE SINCE 1897

Cook Electric Company has been manufacturing this type of equipment since before the turn of the century. Experience and "know how" go into the manufacture of every item manufactured at Cook

COOK ELECTRIC Company



2700 SOUTHPORT AVENUE CHICAGO 14, ILLINOIS

TAB-INDEXED FOR READY REFERENCE

Crystal Units are classified according to their fields of use. These include:

- Broadcasting
- Filter
- Test
- Amateur
- Aircraft
- Police-Marine
- Multiple Units

The latest developments in Crystal Holder design are described, as well as types of Crystal Blanks that can be engineered and finished to your own individual requirements.

WRITE NOW
For YOUR FREE COPY

Crystal PRODUCTS COMPANY
1519 McGEE STREET KANSAS CITY, MO.

Producers of Approved Precision Crystals for Radio Frequency Control

JUST OFF THE PRESS

THE First Completely Informative Catalog of Crystal Unit Designs and Specifications

Here, in one sensibly organized book, is the specific information you need on oscillator crystal units. Here is the first complete assembly of factual data on crystal unit design, construction, and application. It is yours, without obligation and without cost. Keep this new Crystal Products Company manual in your files. Use it as a workable tool in planning circuits and assemblies for precise radio frequency control.

A USABLE MANUAL FOR ELECTRONICS ENGINEERS

Profusely illustrated, with concise but complete explanatory descriptions, the pages of this book give:

- **Holder Illustrations**
- **Cut-Away Drawings**
- **Technical Specifications**
- **Functional Data**

This is not a treatise on the development of the Piezo-Electric properties of Quartz Crystals; it is a series of specific descriptions of approved Crystal Units that are now accepted and used in all types of practical electronic equipment, and that are available for present and future applications.

HOW TO SMOOTH OUT AIRCRAFT VOLTAGE VARIATIONS

BUY MORE WAR BONDS NOW!

VOLTAGE variations inherent in aircraft electrical systems may handicap the performance of precision electronic or other electrically powered devices you manufacture. If so, a Webster Voltage Regulator may solve the problem for you as it has for other manufacturers of airborne equipment. Tell us about your problem . . . we will be glad to analyze it for the applicability of Webster Voltage Regulators. No obligation, of course.

LOOK TO WEBSTER PRODUCTS

TODAY	*TOMORROW*
Dynamotors and Voltage Regulators	**World-Acclaimed Record Changers**

WEBSTER PRODUCTS

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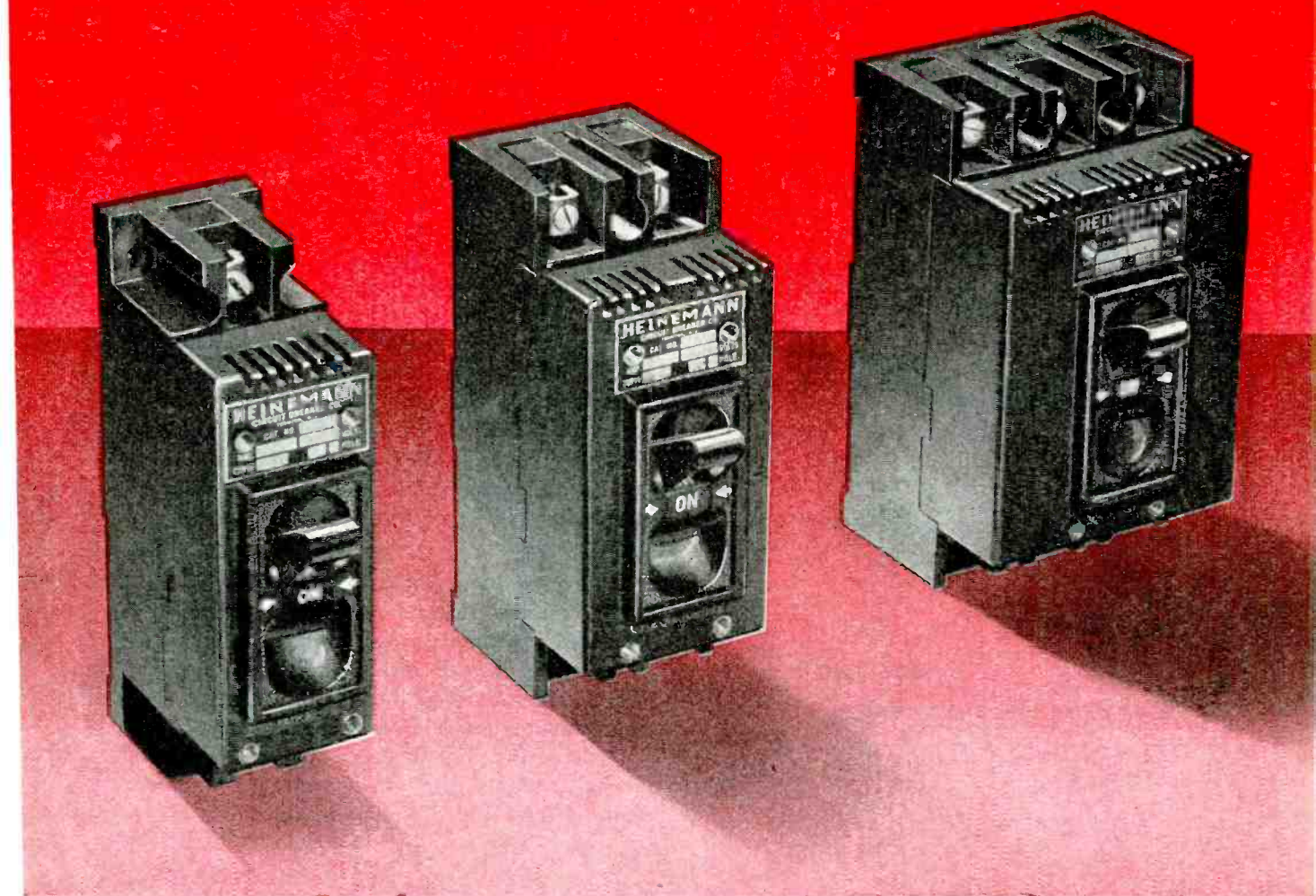
HEINEMANN

MAGNETIC CIRCUIT BREAKER

ASSURES POSITIVE PROTECTION BETWEEN LINE AND LOAD



SINGLE POLE

HEINEMANN CIRCUIT BREAKERS have a *fully electro-magnetic* trip unit that acts instantaneously on short circuits or dangerous overloads. They also have a true inverse time delay in a hermetically sealed unit which allows passage of inrush current. Continued overload, however, opens the breaker in time inverse to the ratio of the current.

TWO POLE

Same internal construction, except there are two trip units which will open simultaneously if an overload or short circuit occurs in *either* leg.

THREE POLE

Same internal construction, except there are three trip units which will open simultaneously if an overload or short circuit occurs *in any one leg.*

There is a choice of three time delays to match closely any individual application. Where no time delay is needed, breakers can be furnished with instantaneous trip units.

HEINEMAN CIRCUIT BREAKER CO.

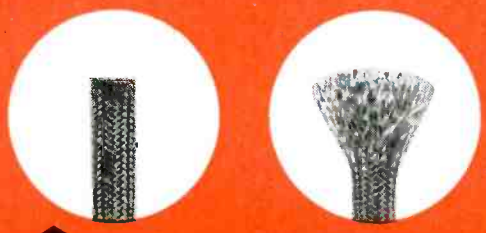
137 PLUM STREET (Subsidiary of Heinemann Electric Co., Estab. 1888) TRENTON, N. J.

NO FRAYED ENDS
NO FRAYED NERVES

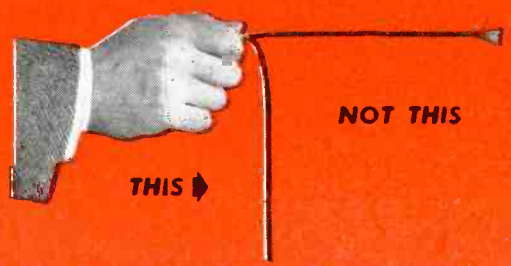
WHEN YOU USE BH FIBERGLAS SLEEVING!

BH *EXTRA FLEXIBLE* FIBERGLAS SLEEVING

2 WAYS BETTER



NON-FRAYING



NON-STIFFENING

Here's an Insulation that Handles Easier, Cuts Cleaner and Saves Time

IF you're exasperated by ordinary sleeving that frays on the ends, works stiffly and doesn't hold up in use . . . then you'll certainly want the low-down on BH *Extra Flexible* Fiberglas Sleeving! For this is a really *flexible* and definitely *non-fraying* sleeving—built around the excellent insulating qualities of Fiberglas by an *exclusive* BH process.

Fiberglas, you know, is moisture-resistant, high in dielectric and tensile strength and is shunned by fungus growths and unharmed by most chemicals. "Punishment" tests prove that BH *Extra Flexible* Fiberglas Sleeving has even more advantages. It is *permanently* non-fraying and non-stiffening. It won't burn because both yarns *and* impregnation are non-inflammable. And it lasts indefinitely without cracking or rotting.

Assembly and repair men say BH *Extra Flexible* Fiberglas Sleeving is a pleasure to handle and a sure bet for long life in the most severe service. So why tolerate a less efficient sleeving any longer? BH is available in all standard colors and all sizes from No. 20 to ⅝", inclusive. Write for samples today and make your own comparison!

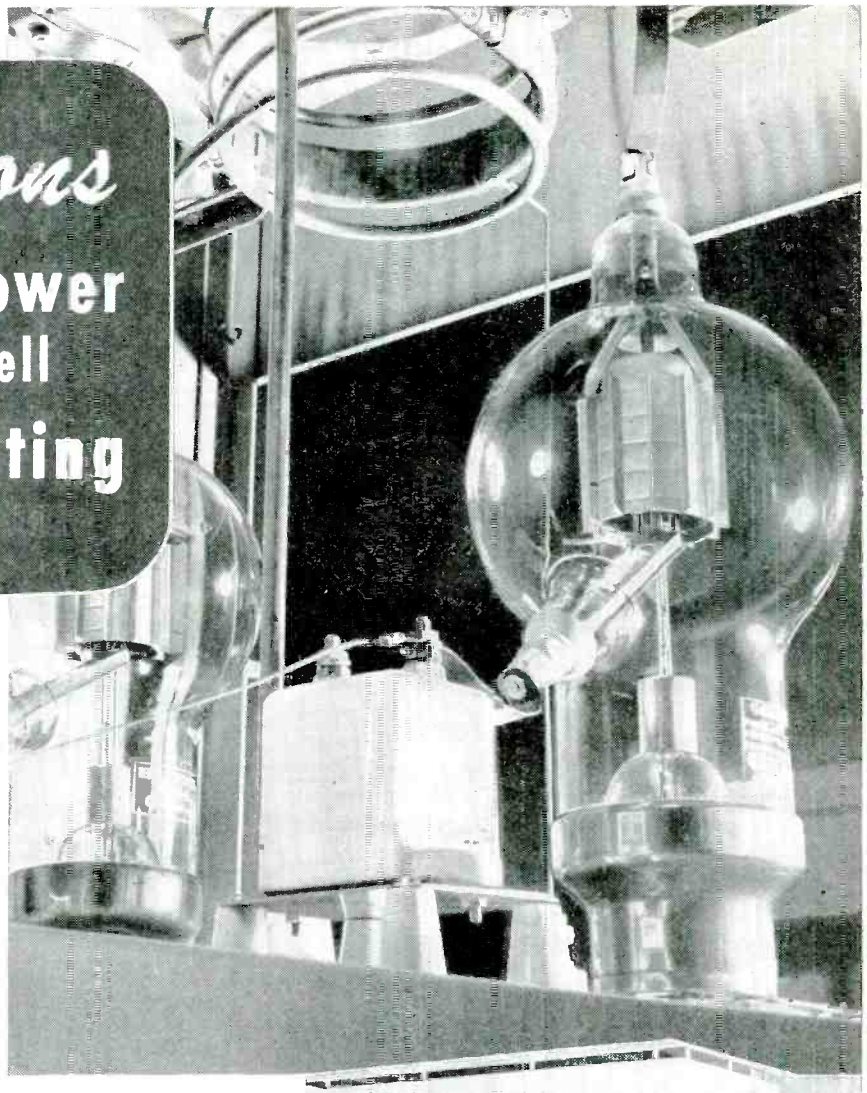
BH PRODUCTS

NON-BURNING IMPREGNATED MAGNETO TUBING • NON-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.

Dept. I, Conshohocken, Penna.

Gammatrons Provide R-F Power for Mann-Russell Dielectric Heating Generators



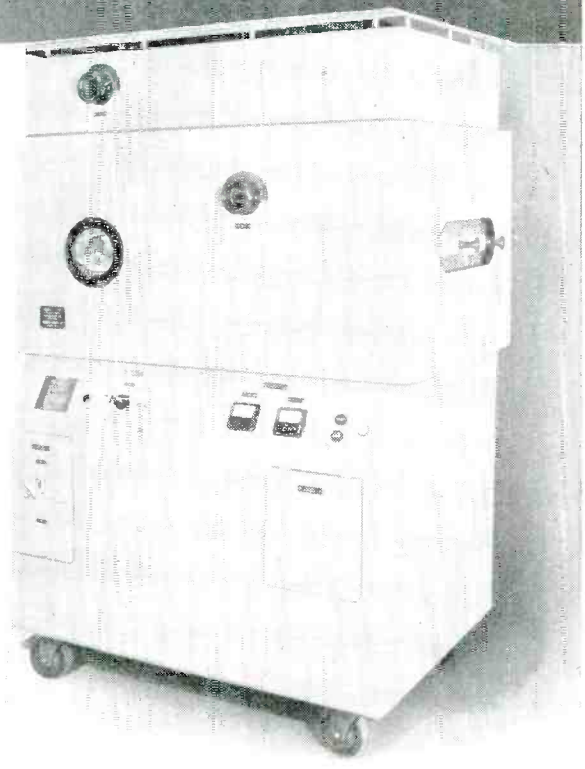
The pair of HK-1054 Gammatrons shown in the master oscillator of a Mann-Russell RF generator at upper right, provide a maximum of 13,300 BTUs per hour at 20 to 30 meters for dielectric heating applications.

10,000 BTU PER HOUR
FROM A PAIR OF HK-1054 TUBES

Radio-frequency generators, such as the Mann-Russell unit pictured here, require tubes capable of producing considerable power at high-frequencies, plus remarkable stamina when faced with overloading and abuse. Gammatron tubes are designed to meet such "cast iron" requirements.

For example, the enclosed plate in Gammatrons results in high efficiency at high-frequencies. It traps electrons which would otherwise escape, and at the same time eliminates electron bombardment, thus raising voltage limitations.

To designers of high-frequency heating equipment Heintz and Kaufman, Ltd. offers a type of tube that has the electrical stamina, the efficiency and long life which are so important to the economical operation of h-f generators.



MANN-RUSSELL R-F GENERATOR. High-frequency generators, such as the Mann-Russell unit above, provide a new, cleaner, faster and entirely different method of heating, drying, setting, baking, preheating, sterilizing, and dehydrating non-conducting materials.

HEINTZ AND KAUFMAN LTD.

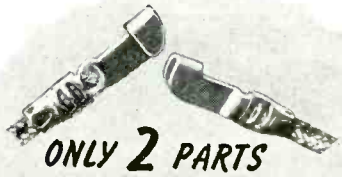
SOUTH SAN FRANCISCO • CALIFORNIA, U. S. A.

Gammatron Tubes

BUY ANOTHER WAR BOND THIS MONTH

THE AMP Solderless

KNIFE-DISCONNECT SPLICING TERMINAL



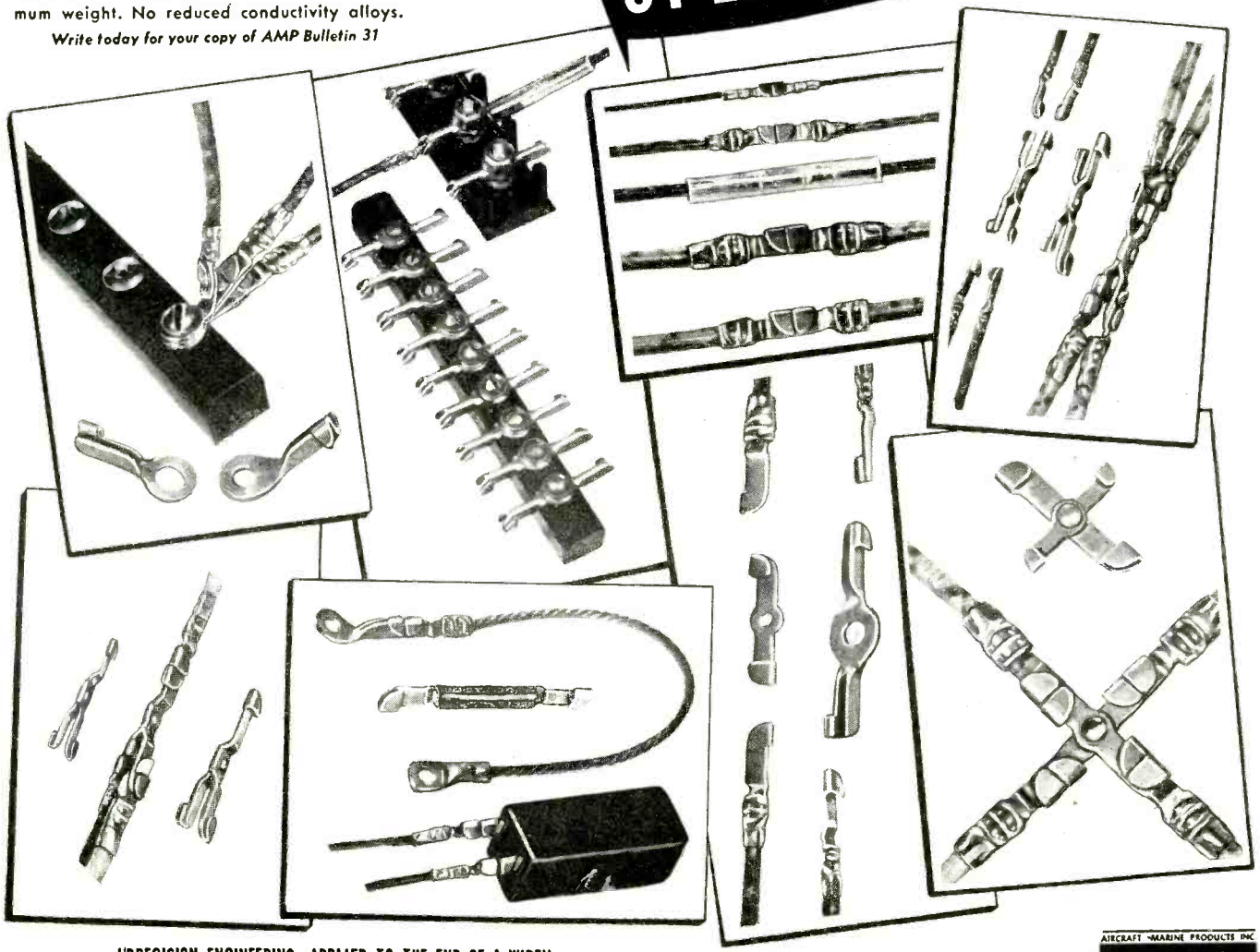
ONLY 2 PARTS
BOTH IDENTICAL

STAY TOGETHER UNTIL INTENTIONALLY TAKEN APART

The basic design of the AMP Splicing Terminal, using identical ends with a knife-switch wiping action, has proven so superior to conventional splicing methods that AMP now introduces a disconnect splicing system to cover a wide variety of adaptations. Typical examples are shown here. Each of these incorporates the same exceptional electrical and mechanical characteristics inherent in the basic design. All current carrying parts are integral stampings of pure electrical copper, having minimum weight. No reduced conductivity alloys.

Write today for your copy of AMP Bulletin 31

AND NOW AN AMP KNIFE-DISCONNECT SPLICING SYSTEM



"PRECISION ENGINEERING APPLIED TO THE END OF A WIRE"

AIRCRAFT-MARINE PRODUCTS, INC.

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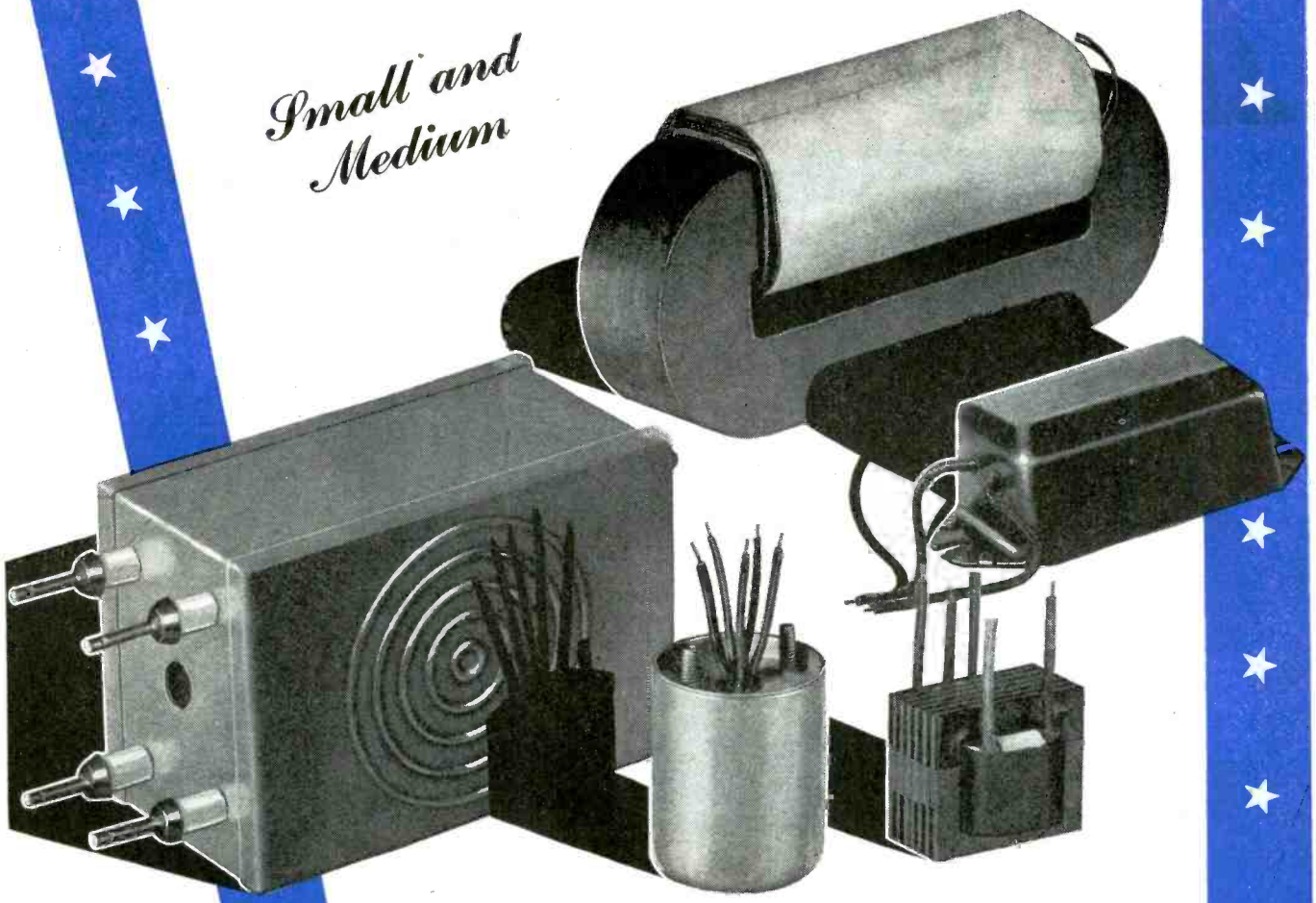
TELEPHONE: HARRISBURG 4-0101
A&M ACCESSORIES, LTD., TORONTO, CANADA

AIRCRAFT-MARINE PRODUCTS INC
AMP
SOLDERLESS WIRING DEVICES

TRANSFORMERS

Small and Medium



Control of all stages of production is the watchword at Consolidated Radio Products Company. That is why Consolidated's products can be depended on for quality, high efficiency, consistent performance and long life. International acceptance is the result of such high standards of production.

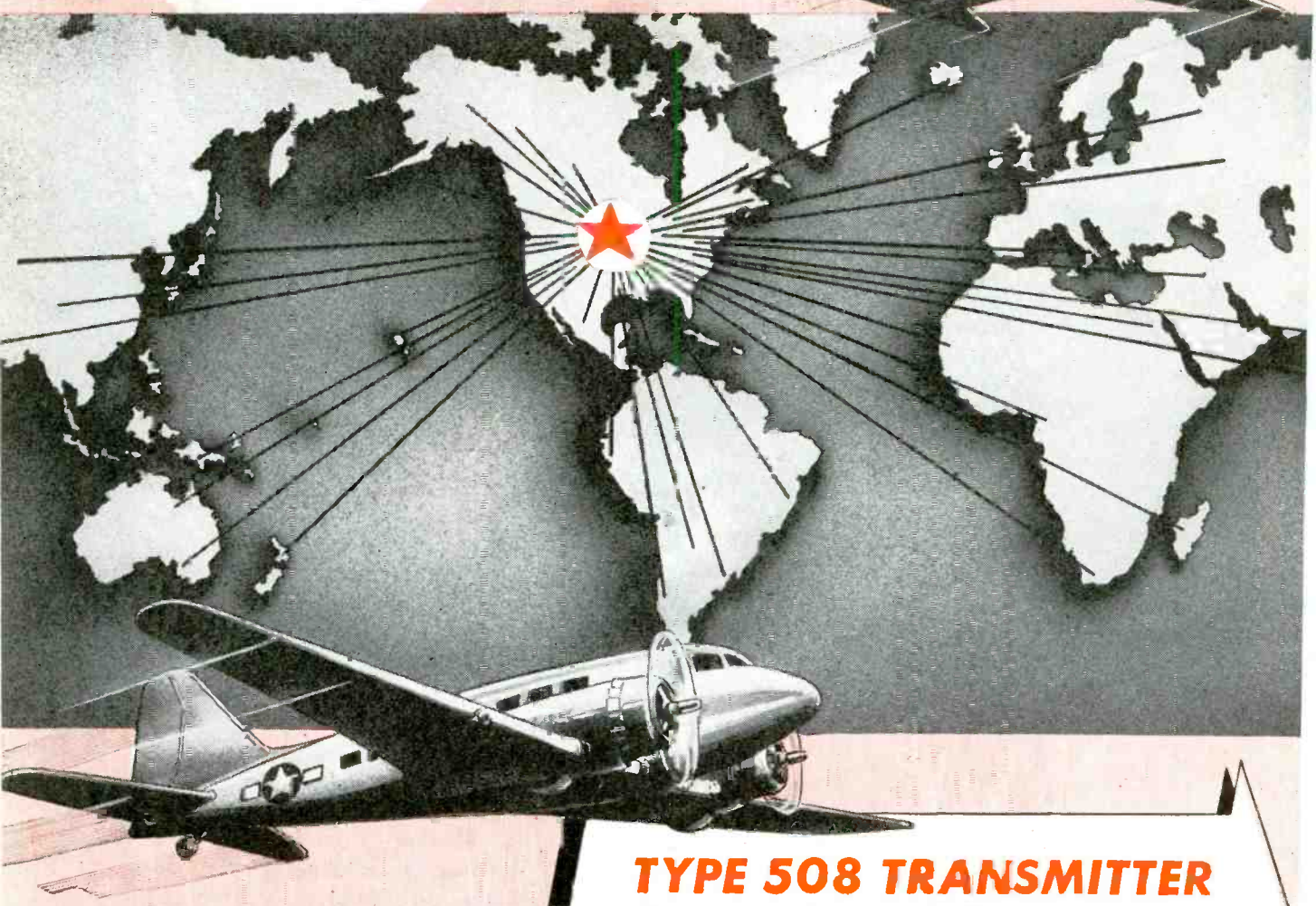
Electronic and Magnetic Devices

CONSOLIDATED RADIO

Products Company

350 W. ERIE ST., CHICAGO 10, ILL.

AAC TRANSMITTERS



TYPE 508 TRANSMITTER

(Illustrated at right). Type 508 Transmitter as designed by AAC for Army Airways Communications Service. Power output 450 watts each channel. Types of emission A1, A2, A3 and FM teletype. Five channels can be operated simultaneously. Single or dual modulator can be supplied.

E-34

AAC Products

AIRCRAFT PRECISION RADIO

Burbank, Calif. Kansas

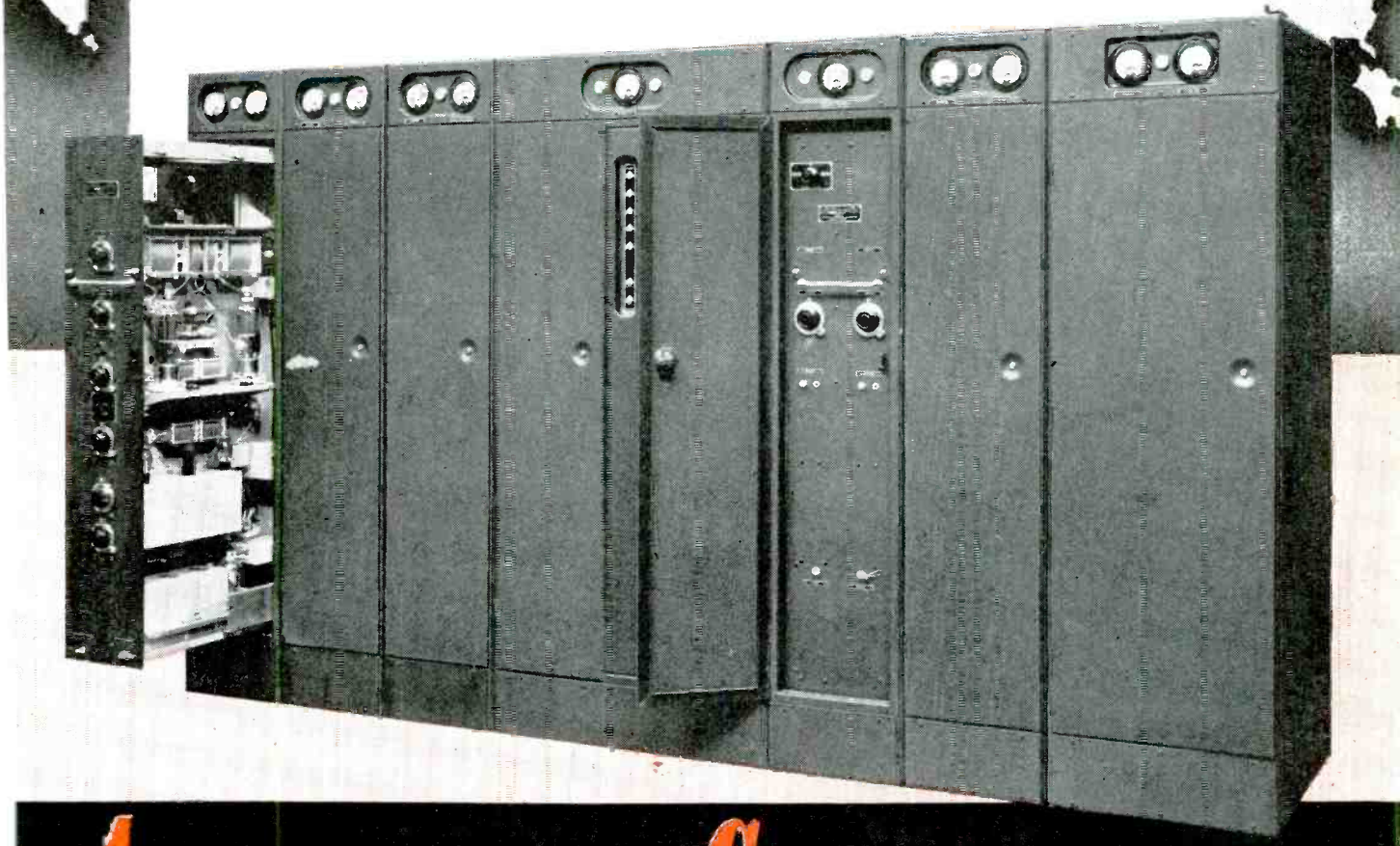
Serving the AIR TRANSPORT COMMAND Along Vital World-Wide Routes

THE Air Transport Command has become the greatest air transportation system in the world . . . delivering planes, materials and personnel to the Allied forces everywhere!

As ATC pilots fly the seven seas and girdle the earth they are served by communications systems of which Aircraft Accessories Transmitters are an important part. These "508 units" are an outstanding example of the engineering skill and production tempo of Aircraft Accessories. Designed specifically to performance requirements of Army Airways Communications Service (AACS), which sets up and operates radio facilities for the ATC, this equipment is now in operation at many of the widespread world outposts maintained by AACS.

This type of AAC equipment can be readily adapted to immediate use by other airlines. Deliveries can be made in remarkably short time, if adequate priority ratings are available.

ELECTRONICS DIVISION KANSAS CITY, KANSAS



ACCESSORIES CORPORATION

and ELECTRONICS • ENGINEERED POWER CONTROLS

City, Kans. New York, N. Y. Cable Address: AACPRO

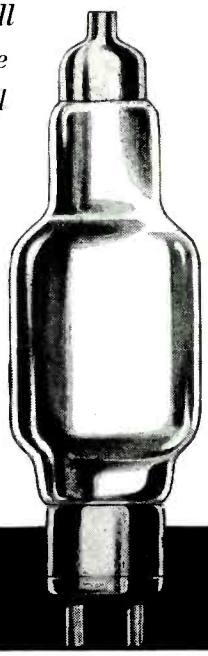
The demand for electronic tubes for industrial equipment has jumped by leaps and bounds, as more and more electronic equipment has been used for faster and more accurate production.

Like all tube manufacturers, Westinghouse until recently has been hard pressed to make deliveries.

Today our production is high enough to ease this situation. Many types of tubes are available in limited quantities. We can even deliver spare tubes for many electronic devices.

Looking ahead to continued development of electronic equipment in industry, postwar, we now have a plan to make Westinghouse Electronic Tubes quickly and easily available. Stocks of the most widely used tubes are now available through Westinghouse Electronic Tube Distributors and Westinghouse District Warehouses. As rapidly as possible additional types will be added to local stocks to make a complete line of Quality Controlled Westinghouse Electronic Tubes available to everyone.

Included in this new distribution setup is a plan for surveying the electronic tube needs of individual tube users to better serve their requirements. It will be to your advantage to have your plant included in this survey. Fill in the coupon below and without obligating you in any way, a representative will call and give you complete details and make the survey.



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

ELECTRONIC TUBES *at work*

Westinghouse Electric & Manufacturing Co.
Electronic Tube Sales Dept.
Bloomfield, N. J.

Please have your representative call and explain your plan for surveying our Electronic Tube needs.

Name .....

Address .....

PROBLEMS *pre-solved!*

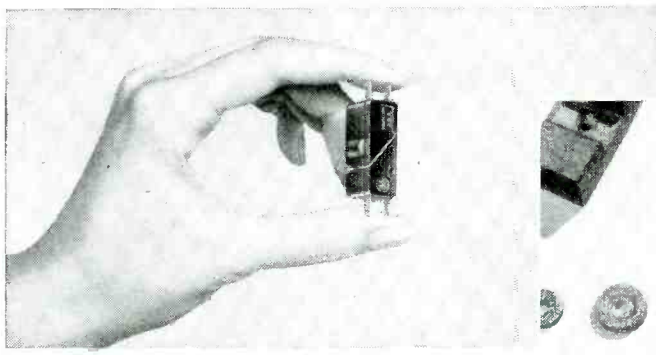
Switchettes and Alnico magnets afford examples of how G-E components save designers' time, make for better performance

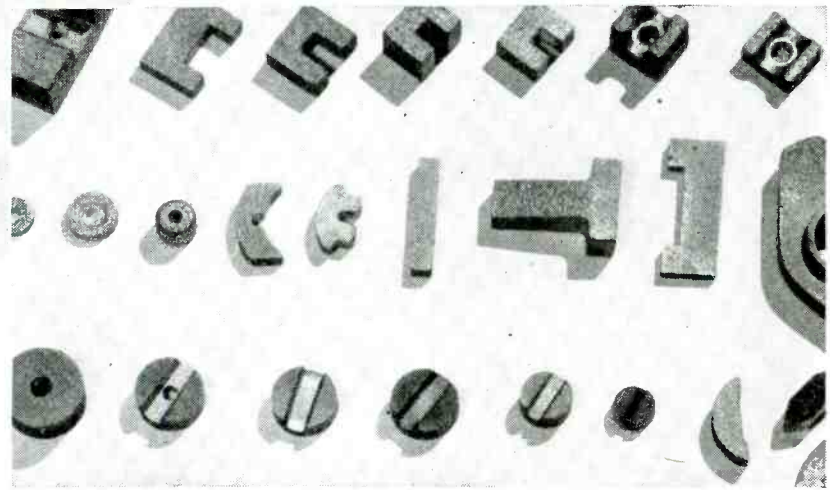
If you're puzzling over how to get the switching functions you want into the limited space you'd like to allow, the chances are that you'll find your answer *ready-made*—in the G-E Switchette.

Again, if yours is the problem of applying permanent magnets (perhaps of intricate shapes) in restricted space, you may find your problem *solved in advance*—by G-E alnico magnets.

These are but two of many examples of G-E electronic components that lift a big burden of detail from designers' shoulders, and give greater latitude in the design of new equipment. Each of these components is the product of close co-operation between designers—at G.E. and in the electronics industries. Each is precision-built. Each has proved its ability to maintain specified performance characteristics under severe service conditions.

In selecting components from General Electric's extensive line, you can count on practical help from qualified G-E representatives. Located in principal U.S. cities, these men will gladly co-operate with you on both application and procurement problems. Call on them through the G-E office nearest you. *General Electric Company, Schenectady 5, N. Y.*





THE G-E SWITCHETTE

Smaller than a woman's thumb, the Switchette shown weighs only 9 grams; yet it can handle up to 10 amperes at 230 volts a-c, or 10 amperes at 24 volts d-c. Low-inertia moving parts, high contact force, and double-break construction assure positive action, even in the face of the severe vibration encountered on combat aircraft. Actuation can be manual or mechanical, as by a cam, lever arm, or bellows. Switchettes are available in such a variety of contact forms and terminal arrangements that many perplexing contact problems are literally "licked to start with." Bulletin GEA-3818B describes more than 100 types and arrangements. Ask for your copy.

SINTERED ALNICO MAGNETS

Alnico magnets, of which there are several types, provide more external energy for a given volume than any other permanent-magnet material, more stored energy per dollar. Alnico is also more resistant to stray magnetic fields, temperature extremes, and vibration. Sintered Alnico II, because of its compactness, stability, and uniform flux distribution, facilitates the design of precision devices of small size. The sintered-alnico process employed by G.E. is a "natural" for large-scale, close-tolerance manufacture of both simple and complex shapes—for hearing aids, electronic measuring equipment, microphones, etc., and for numerous applications in connection with electronic tubes. Ask for Bulletin GEA-3682A.

GENERAL ELECTRIC

642-4

How many customers do your springs cost?

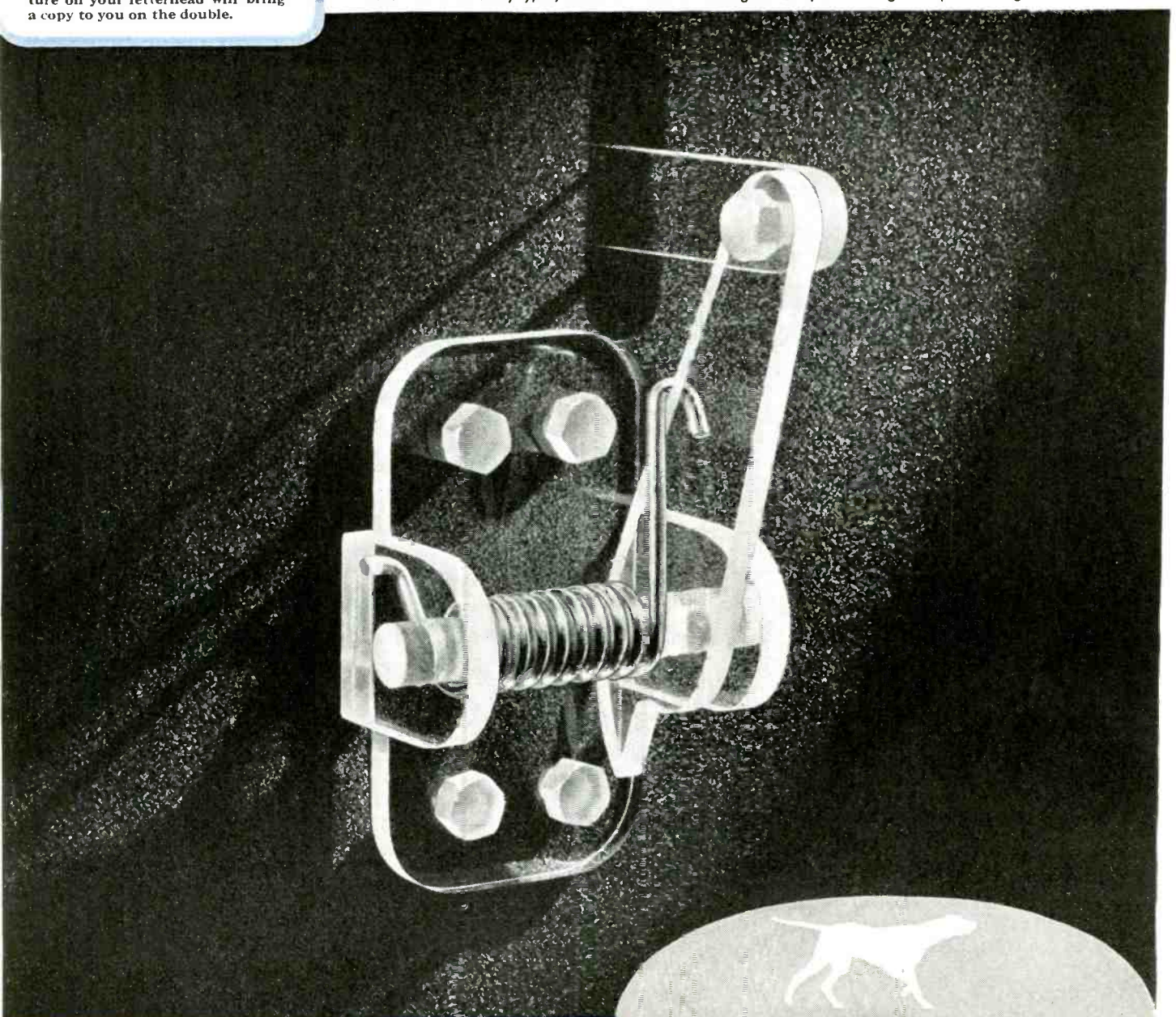
IF THEY COULD MAKE A WISH

If Hitler and his pal could make a wish, they'd suppress publication of the Hunter Data Book. Many springs now allied against them were designed out of this interesting, informative book. Your signature on your letterhead will bring a copy to you on the double.

THOUGH your product may not function at all without springs, springs are usually a fraction of the total cost of manufacture. This occasionally gives substance to a belief that any spring passing a routine factory inspection will do.

The acid test of a spring actually comes later—when your product goes to work for your customer. Then, if trouble develops, you'll hear about it . . . but quick. One of the most reliable preventives for spring failure is scientific design and manufacture or "*Science in Springs*". "*Science in Springs*" is a combination of design that pre-evaluates all specifications, and blueprints a spring's performance in advance . . . and manufacture that produces the right spring for the job. Mathematics and metallurgy, research and statistical control of quality, lunch table conversation at Hunter, are all ingredients of good springs. Figure springs in terms of customers held and lost, and we believe you'll agree Hunter Science in Springs is a bargain in customer insurance.

TYPICAL APPLICATION OF A TORSION SPRING AT WORK. *A torsion spring is a fundamental spring for resisting a turning movement of an arm about an axis, or for storing a turning force for an indefinite time until release is desired. There are many types, wound in round or rectangular wire, and in single or space-saving double coils.*



HUNTER

Science in Springs

HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNA.

This *NEW* Sturdy, Smaller Transtat AC Voltage Regulator OFFERS INCREASED DESIGN POSSIBILITIES!

The new TH 2½A Transtat A. C. Voltage Regulator is half the size and less than half the weight of the smallest previous TH Transtat. When used as a dual unit, a further space saving is made possible by base-to-base mounting. In attaining this extreme compactness, AmerTran also introduced several mechanical innovations: the unique die cast brush arm with its generous heat dissipating surface; smooth commutator with solid insulation between segments; the operating shaft that can be quickly changed for table, panel or gang mounting; the Phenolic Thermosetting Plastic Base with its terminal barriers and other features.

Yet the TH-2½A Transtat's conservative rating is a working rating—output voltages are full load voltages. Exciting current is only 0.06 amperes. Control throughout working range never exceeds 0.4 volt increments. And like its larger brothers, it cannot disturb power factor, distort wave form or interfere with radio reception. Investigate its possibilities in your apparatus today.

Write for Bulletin 171-01

TYPE TH-2½A TRANSTAT FOR SINGLE PHASE OPERATION					
	VA	Frequency	Input Volts	Output Volts	Output Amperes
		50° Centigrade Rise			
Nominal	300	50/60	115	0-115	2.6
Maximum	340	50/60	115	0-130	2.6
TYPE TH-2X-2½A TRANSTAT DUAL UNIT. OPEN DELTA CONNECTED FOR THREE PHASE REGULATION					
		50° Centigrade Rise			
Nominal	520	50/60	115	0-115	2.6
Maximum	590	50/60	115	0-130	2.6

AMERICAN TRANSFORMER COMPANY, 178 Emmet St., Newark 5, N. J.

AMER TRAN

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Facts YOU SHOULD KNOW ABOUT RELAY SENSITIVITY

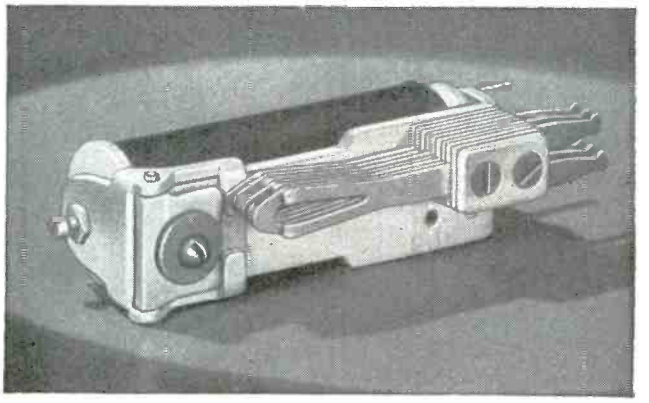
SO YOU would like a *sensitive* relay for that remote control circuit!

Sensitivity is important for many relay applications. And if that is *all* you want, there's no problem. It's easy to build a relay that will "operate" on a small amount of power.

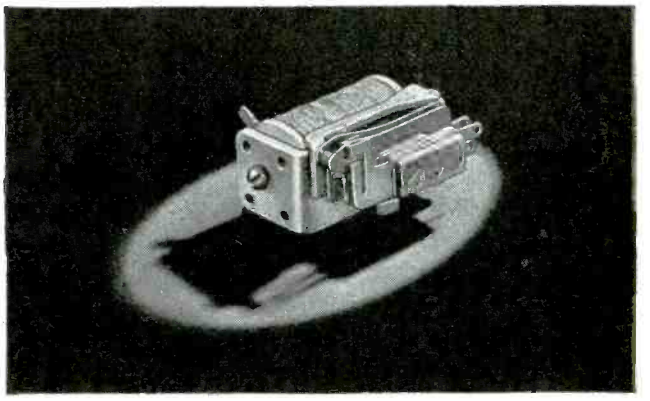
But sensitivity without contact reliability is useless. So what you *really* want is a relay that is not only sensitive, but also has the contact pressure needed for reliability under actual service conditions.

Sensitivity and contact reliability are opposing factors. To get a high measure of both qualities in one relay calls for an exacting balance between electrical, mechanical and magnetic design factors. We've been building such relays for years —to meet hundreds of requirements, from complex telephone switching circuits to simple control functions on aircraft and radios.

Next time you need a *sensitive* relay, let the Automatic Electric field engineer show you how to get sensitivity *plus* contact reliability. No matter what the nature of your problem, there is an Automatic Electric relay that will give you both.



The Automatic Electric Class B Relay shown here combines high sensitivity and contact reliability. It has a highly efficient magnetic circuit, long wearing mechanical structure, independent twin contacts, and capacity for any number of springs up to 26. Contact pressures average 20 grams per contact. Compare this with "sensitive" relays having contact pressures of less than five grams.



For high sensitivity and contact reliability in small space, your best bet is the Class S Relay shown here. Especially designed to meet the severe conditions of operation on fast modern aircraft, it is also recommended where space is at a premium. Because of the great demand for Class S Relays for vital war products, we urge that you avoid its use except where no other relay will serve.

Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

ARMY E NAVY

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

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PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

Solve Your Capacitor Problem with Oil Type EC CAPACITRONS

PROMPT DELIVERY!

Phone Your Requirements Now!

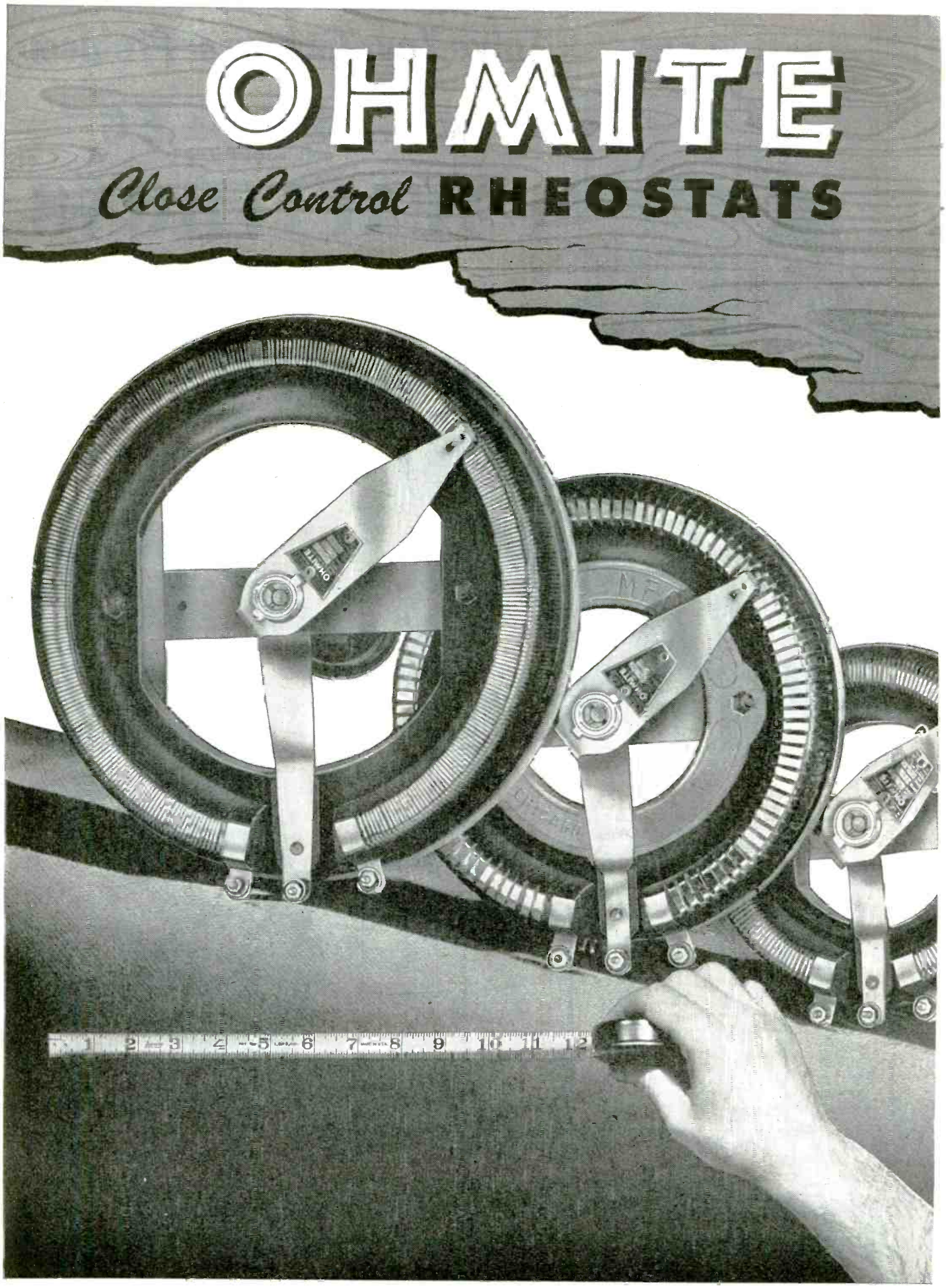
Catalog Number	Capacity in Mfd	Working Voltage D.C.	Height Inches	Diameter Inches
6EC200	2.0	600	2¾	1½
6EC300	3.0	600	4½	1½
6EC400	4.0	600	4½	1½
6EC600	6.0	600	4	2
6EC800	8.0	600	4½	2
6EC1000	10.0	600	4	2½
10EC100	1.0	1000	2¾	1½
10EC200	2.0	1000	4½	1½
10EC400	4.0	1000	4	2
10EC600	6.0	1000	4	2½
10EC800	8.0	1000	5	2½
15EC50	.5	1500	2¾	1½
15EC100	1.0	1500	4½	1½
15EC200	2.0	1500	4	2
15EC400	4.0	1500	4½	2½

CAPACITRONS Meet U. S. Signal Corps and Navy Specifications

Telephone: MIChigan 9656-7

The CAPACITRON Company

318 West Schiller St. Chicago 10, Illinois


OHMITE
Close Control RHEOSTATS

CLARE TYPE "C" RELAY

. . . For Applications Where Rapid Opening and Closing of Circuits is Required.

★

FEATURES

1. Contacts are made from precious metals and alloys, such as silver, palladium, palladium-iridium, tungsten and elkonium. They can be furnished in sizes from .062" silver, rated at 1 ampere, 50 watts, to .1875" tungsten, rated at 4 amperes, 500 watts. Various types can be incorporated in one relay.

2. Pile-up assembly is locked together under hydraulic pressure. Projecting wafer insulators which provide creepage path of ¼" between contact springs can be furnished. The entire assembly withstands very heavy breakdown tests.

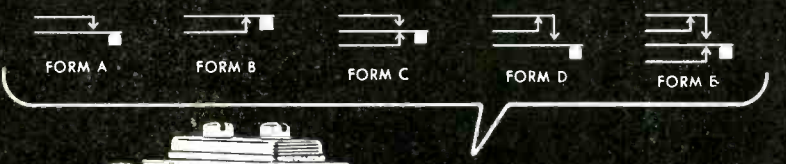
3. Heelpiece, coil core and armature assembly are of magnetic metal, carefully annealed. Where sensitivity and timing are important factors, a *special magnetic* metal is recommended to provide permeability.

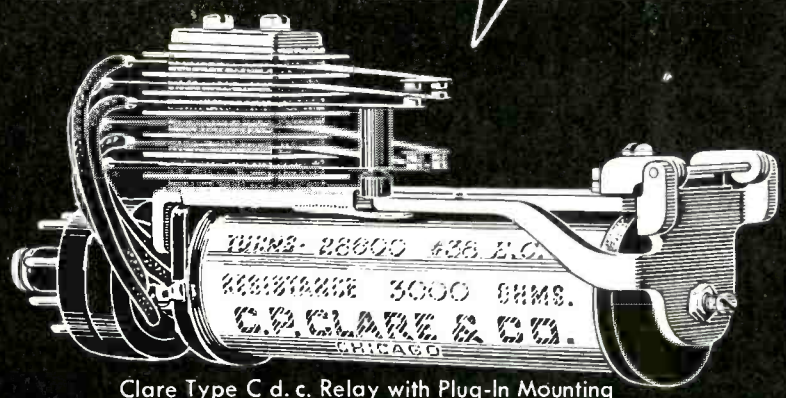
4. Spring bushing insulators of Bakelite rod give excellent service where heavy contact pressures are employed, where vibration exists, or heavy duty service is desired.

5. Coils are carefully wound to exact turns on precision machines. Lead out wires are securely soldered. Coils impregnated with special varnish are available. The coil is protected with a transparent acetate covering.

6. Relay illustrated is arranged for octal base plug mounting which makes for easy service and replacement. Other types of mounting, such as individual angle bracket, strip or panel can be furnished. Easy to handle slip-on Bakelite covers for individual mounting or metal covers for group mounting can be supplied.

Contact springs employing any of these forms can be furnished.

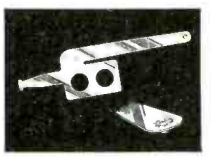




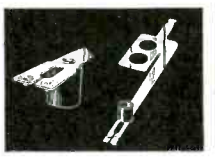
Clare Type C d. c. Relay with Plug-In Mounting

Data regarding turns and resistance appears on all coils—protected by transparent covering.

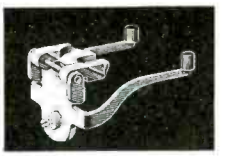
High voltage pile-up insulation withstands heavy break-down tests.



Contacts of rare metals and special alloys, welded to nickel silver springs.



Spring bushing insulators made by a patented process from Bakelite rod.



Double arm armature, stainless steel shaft in brass yoke can be furnished.

THE Clare Type "C" d.c. Relay is especially desirable for applications which require rapid opening and closing of circuits. It may be used for control of up to 12 circuits.

Special adjustment and special coil selection is necessary where operation of the relay involves limited coil current, extremely high speed operation, or other unusual requirements. In cases where unusually close operating limits are required, we recommend that complete data be submitted to Clare engineers.

Because of the wide range of contact arrangements possible with the Clare Type "C" Relay, Clare can "custom-build" you a relay that will most exactly fit your requirements. Standard spring assemblies may be equipped with any combination of the forms shown. Many different standard and special sizes of contacts may be provided.

So, whether your production problem involves sequence control of machine tools, electric eye controls, counting equipment, alarm systems, radio, radar or other electronic controls, it will pay you to know all about Clare "Custom-Built" Relays and what they can mean to you in the reduction of relay costs.

While the Type "C" is designed to be mounted in a horizontal position, it will operate satisfactorily in any position. Spring assemblies may be located on either the right or left hand side for convenience in mounting.

Let Clare engineers know your specific relay problem. Send for the Clare data book and catalog. Write to C. P. Clare and Co., 4719 Sunnyside Avenue, Chicago (30), Illinois. Sales engineers in all principal cities. Cable address: CLARELAY.

C L A R E R E L A Y S

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

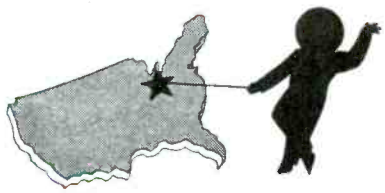
"Lost motion" these busy wartime days means lost efficiency and wasted dollars. Read below how *Centralizing with Central* can effect a triple saving for you with Centralized buying, driving and delivery.

1 SINGLE SOURCE

You save first with *Centralized Buying.* For at Central you can get virtually every type of cold-headed fastener—screws, bolts, nuts and rivets in all metals and finishes—standards from stock; specials to order. One order, one dependable source—no lost motion . . . with *Centralized Buying.*

2 CENTRALIZED DRIVING

The precision centering of cleanly slotted screw heads for concentric driving stops lost motion along your assembly lines. Central screws start easy, ride home on sharp, clean threads and hold fast to create a solidified assembly. *Centralized Driving* is a feature of both Standard Slotted and Phillips Recessed Head Screws.



3 QUICK DELIVERY

Ideally located, Central's shipments come to you direct from Chicago, the hub of rail, highway and air transport—Low rates . . . No delay . . . Again, no lost motion.

MACHINE SCREWS
STOVE BOLTS
LOCKWASHER SCREWS
SELF-TAPPING SCREWS

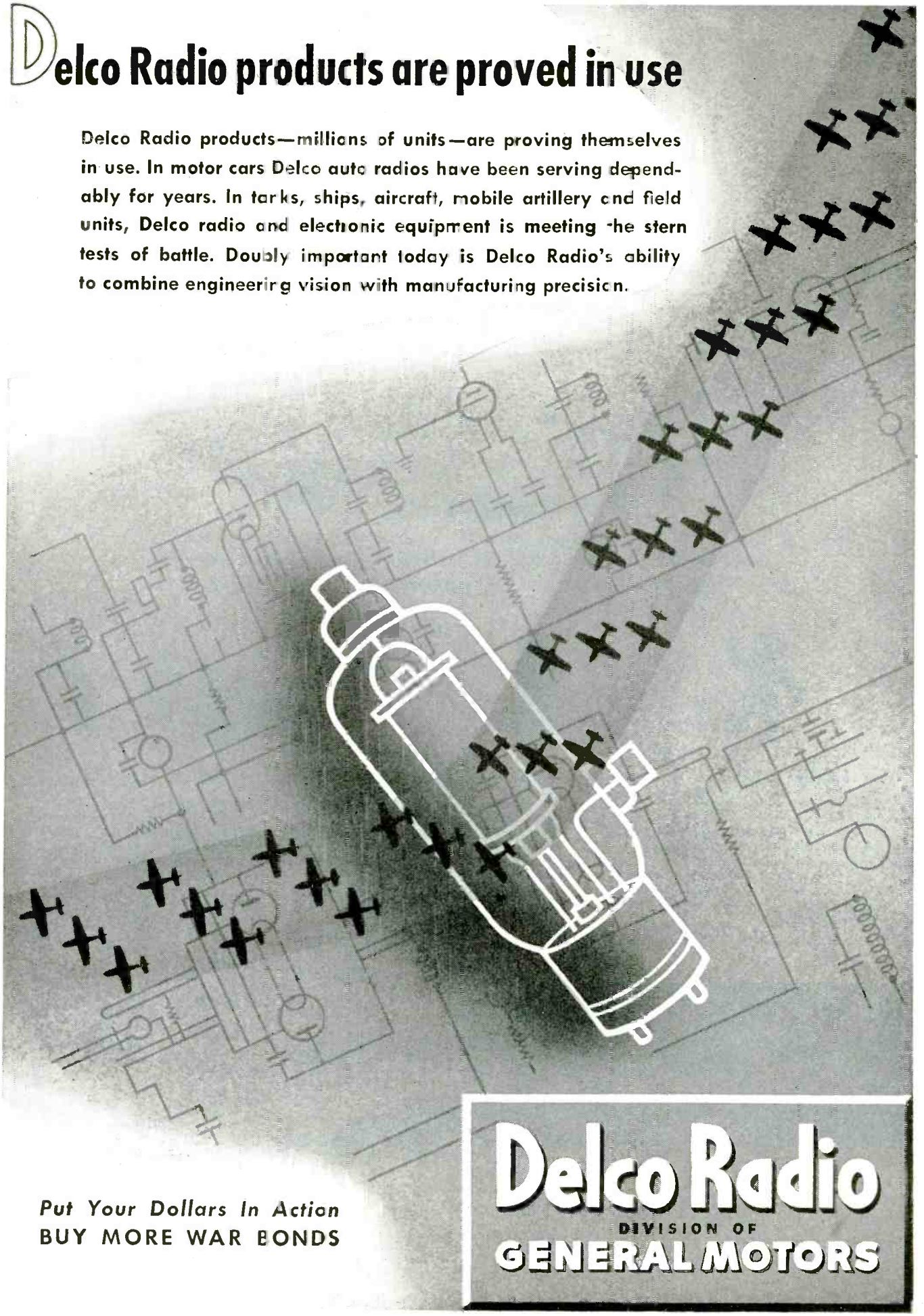
You can depend on Central

CENTRAL SCREW COMPANY
3523 SHIELDS AVENUE • CHICAGO 9, ILLINOIS

MACHINE SCREW NUTS · WING NUTS · THUMB SCREWS · CARRIAGE BOLTS · MACHINE BOLTS · RIVETS · STUDS · RODS

Delco Radio products are proved in use

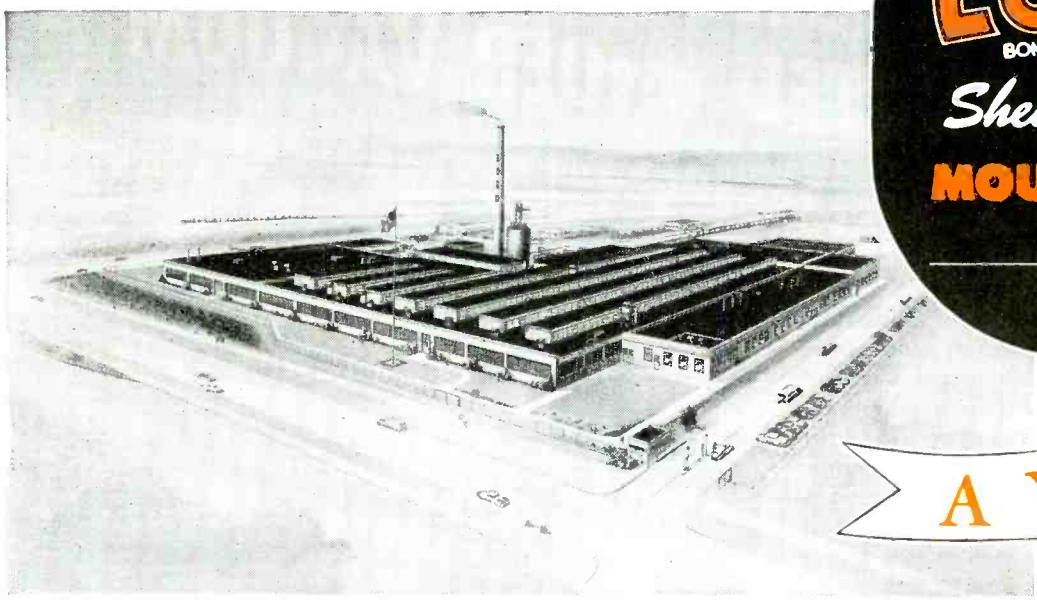
Delco Radio products—millions of units—are proving themselves in use. In motor cars Delco auto radios have been serving dependably for years. In tanks, ships, aircraft, mobile artillery and field units, Delco radio and electronic equipment is meeting the stern tests of battle. Doubly important today is Delco Radio's ability to combine engineering vision with manufacturing precision.



Put Your Dollars In Action
BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

MILLIONS OF LORD BONDED RUBBER Shear Type MOUNTINGS A YEAR



"LORD MOUNTS", as they are generally known, are being produced at the rate of many millions per year. A large proportion of this production is of *synthetic rubber*, which has proved in the main, to be as effective as natural rubber in flexible mounts for Vibration Control.

The entire facilities of the Lord factory are used to produce mountings and other bonded rubber products, and the energies of the research, development, and field engineering staffs, are devoted exclusively to the improvement of these products for industrial and military use. By specializing, Lord is producing mountings that are the criterion in the flexible suspension field.

The method of bonding rubber to metal, which Lord has developed, permits the use of the rubber in such manner that the stress is always in shear, thus providing the proper deflection for a given load. The final result is a mounting system which provides the greatest efficiency in vibration isolation.

Lord Mountings are small, compact, lightweight units, easy to install and load ratings range in small increments from a few ounces to several thousand pounds. They prolong equipment life, lower maintenance costs, insure greater accuracy of operation, reduce material weights by eliminating the necessity for inertia masses, increase personnel efficiency by eliminating nerve-wearing noise and vibration transmitted through solid conduction.

Send for literature on vibration control or call in a Lord Vibration Engineer for consultation on vibration problems. There is no obligation.

IT TAKES RUBBER *In Shear* TO ABSORB VIBRATION

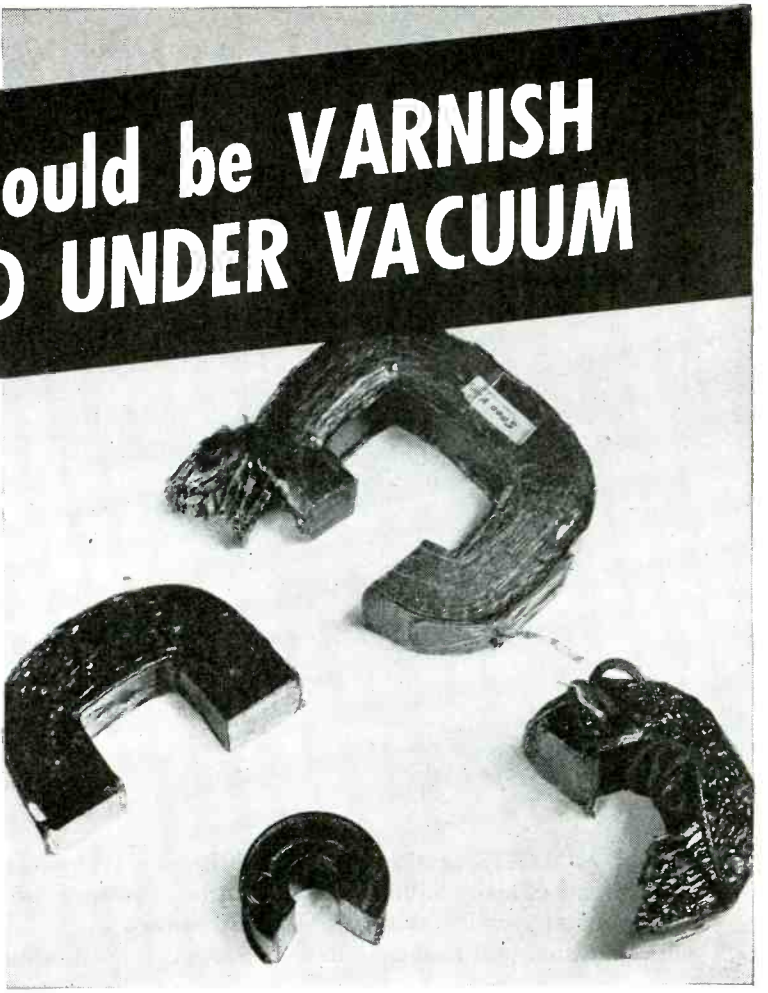
LORD MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

SALES REPRESENTATIVES
NEW YORK - - 280 MADISON AVE.
CHICAGO - 520 N. MICHIGAN AVE.
DETROIT - - 7310 WOODWARD AVE.
BURBANK, CAL. - 245 E. OLIVE AVE.
CANADIAN REPRESENTATIVES
RAILWAY & POWER ENGINEERING CORP., LTD.
TORONTO, CANADA

Originators of Shear Type Bonded Rubber Mountings

Do More Than Before—
Buy EXTRA War Bonds

Why coils should be VARNISH IMPREGNATED UNDER VACUUM



The photograph at the right illustrates tightly wound fine wire coils which have been treated with varnish under vacuum. Note the firmness at the points where the coils have been cut with a saw. This firmness was achieved by using the proper grade of varnish for deep penetration under vacuum. To further illustrate this point, it was necessary to use a hammer and a chisel in order to break apart a section of the large coil. For maximum penetration of varnish, impregnate coils under vacuum.

Here Are Some of the Advantages

First of all, it is possible through the use of a vacuum to remove air pockets between coil layers which under ordinary atmospheric impregnation would prevent the varnish from penetrating the interiors of the coils. Moisture which was not driven off during preheating will be removed under a vacuum due to the fact that the boiling point of water is greatly reduced at sub-atmospheric pressure. The air and water in coils which are removed under vacuum will be replaced with varnish when the vacuum is broken and atmospheric pressure restored. Those are only a few of the advantages of treating units with varnish under vacuum.

Further information on the treating of electrical units with varnish is contained in DOLPH'S Booklet on "Application of Insulating Varnishes." A copy may be had by making your request on your company letterhead.

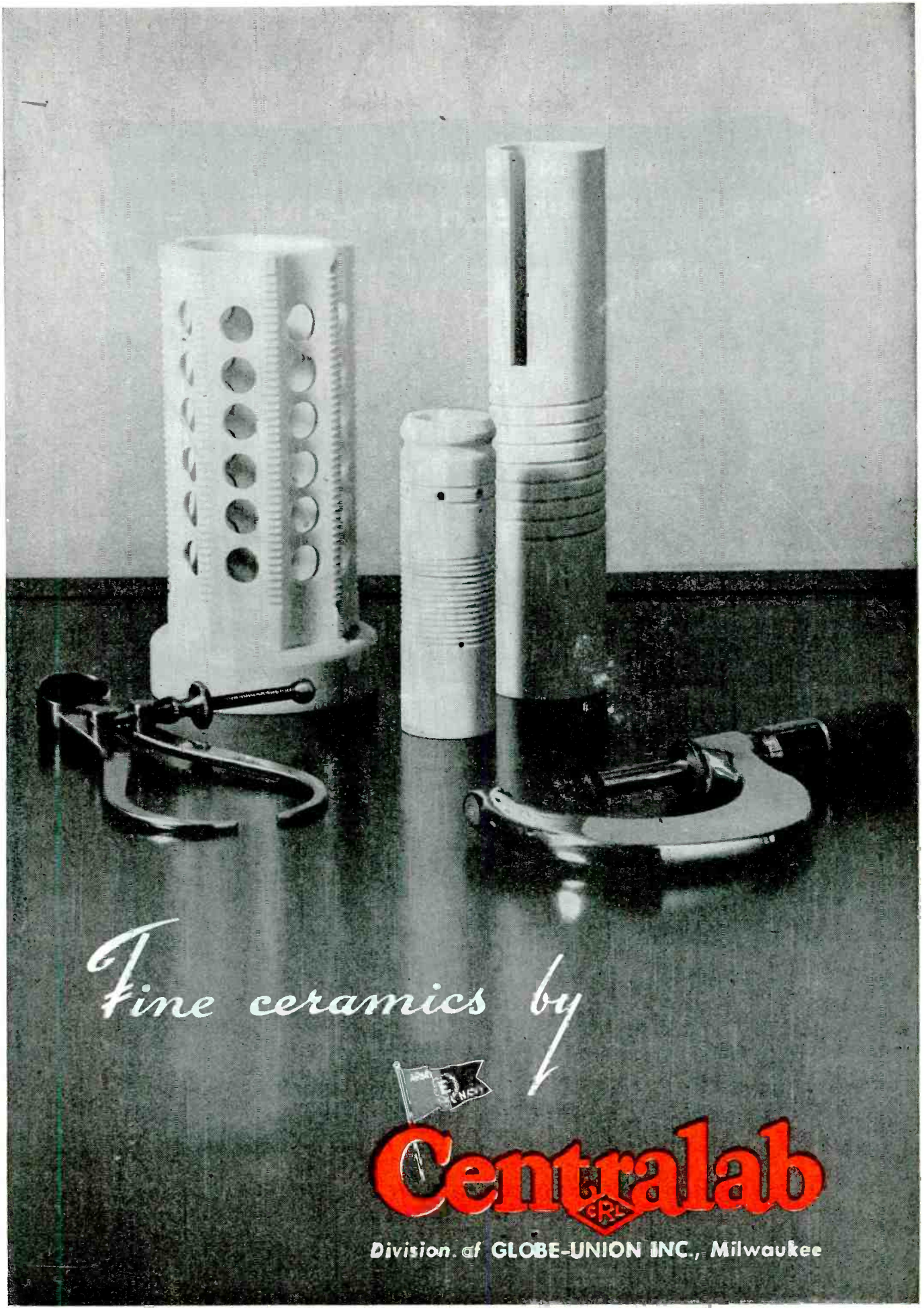
Coil Treatment Service

One section of our laboratory contains vacuum equipment having a 12-inch diameter vacuum tank and also modern electric thermo-control ovens. Through the use of these facilities, we are in a position to treat some of your newly designed electrical units which require varnish insulation. Upon completion of this experimental work, a report will be issued covering the several procedures followed and recommendations made accordingly. Of course, this service is offered without any obligation on your part.

MANUFACTURERS OF
CHINALAK Baking Varnish
SYNTHITE Baking Varnish

Dolphs

JOHN C. DOLPH COMPANY
Insulating Varnish Specialists
173C Emmet Street, Newark, New Jersey


Fine ceramics by
Centralab
CRL
Division of GLOBE-UNION INC., Milwaukee

PERMANENT MAGNETS MAY DO IT BETTER

Precision Built . . . by the Million!

Few products require more exacting manufacturing skill than permanent magnets. Yet this company, one of the armed forces' vital sources of supply, is producing them in almost unbelievable numbers.

The
INDIANA STEEL PRODUCTS
Company

6 NORTH MICHIGAN AVENUE • CHICAGO 2, ILLINOIS

★ **Specialists in Permanent Magnets Since 1910** ★

ARMY E NAVY

Our engineers have rendered important service to many manufacturers by solving their permanent magnet designing problems. They will be pleased to consult with you. Write for a copy of our "Permanent Magnet Manual".

Help Win the War in '44 — Buy War Bonds!

THERE IS NOTHING TO DO ABOUT A WAR EXCEPT WIN IT!

The purpose of this advertisement is NOT to brag about Thordarson's part in the war effort. While patriotism in a person or company may be something to be proud of, our own feeling is that it should not be exploited. Expressing patriotism in America is not even a duty; rather, it is a privilege . . . happily one that is understood and appreciated by the majority.

That is why, for nearly 3 years, Thordarson has talked little about the war and war production . . . except to make the bare statement that we were busy supplying materials for the armed forces.

Regardless of all this, we do think the time is now propitious to give a few more details as to what we are thinking and doing.

When war came, we were one of the first companies to be chosen for front-line production duty. The need was urgent . . . the demands were great. As Americans, we were glad wholeheartedly to tackle the job assigned to us.

Early and late . . . day and night . . . Sundays and holidays, we have continued to devote all of our efforts, 100% to winning the war. We have kept "eyes front" on this one task. We have had to forget, for the moment, personal considerations of "good business" . . . on occasion we have even had to turn down old and good friends who needed this or that which, under ordinary conditions, we would have been tickled to death to supply.

The time will come . . . it's coming shortly, we feel . . . when we again can think first and foremost of supplying civilian needs. That will be a far happier day for us than it could possibly be for you, no matter how much you have needed material you were unable to secure.

But meantime, the war goes on . . . and we, in our small way, must continue to stand guard at our appointed post until the "at ease" command is given. As we said in the beginning: THERE IS NOTHING TO DO ABOUT A WAR EXCEPT *WIN* IT!

ARMY (E) NAVY

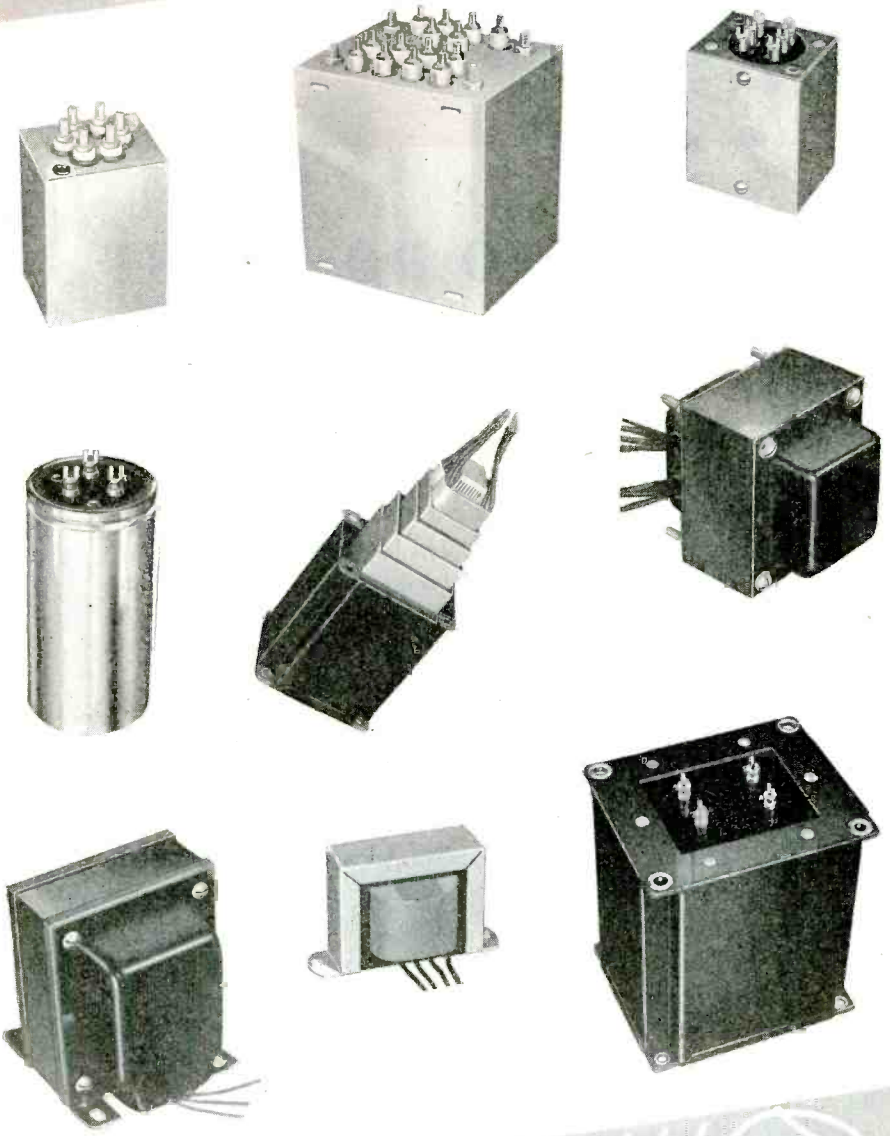
THORDARSON

TRANSFORMER DIVISION
THORDARSON ELECTRIC MFG. CO.
500 WEST HURON STREET, CHICAGO, ILL.

Transformer Specialists Since 1895

. . ORIGINATORS OF TRU-FIDELITY AMPLIFIERS

MEET THE FREED TRANSFORMER FAMILY



This is the first in a series of advertisements designed to inform you about Freed Transformers. The spectacular wartime developments originating in the Freed Laboratories are worthy of a page in Electronic History! The ingenious applications; the engineering efficiency; the reliable, unfailing performance of Freed units — all built to exacting specifications — are tributes to the resourcefulness and sound, basic knowledge of our engineering staff. . . . This staff is available to assist you, and we urge any engineer struggling with an intricate problem to submit it without delay.

FREED TRANSFORMERS

FREED TRANSFORMER COMPANY · 74 SPRING STREET · NEW YORK CITY

LUMARITH* protects the finest wiring from the BLACK HAND OF CORROSION

THE UNUSUAL corrosion-resistance of Lumarith insulating film is best shown by its application to coils of extremely fine copper wires where the tendency to corrode increases rapidly as the diameter of the wire decreases.

Even when used with wires as fine as #40 AWG, Lumarith gives protection due to the absence of electro-chemical decomposition—that built-in hazard of insulations containing an excess of water-soluble chemical salts. *Lumarith is entirely different chemically from paper, cotton and regenerated cellulose.*

Lumarith also provides an effective barrier to high humidity and moisture conditions, particularly important to the insulation of small relay coils operating at high voltages. Lumarith has a high softening point (146°—177° C depending on formulation).

Corrosion-resisting wrappers of Lumarith film and Lumarith molding powders in solutions for dipping, are high in dielectric and physical strength, low in moisture absorption. Films come in a special mat finish which increases visibility and decreases slippage in winding operatons.

Have you a copy of "Lumarith for the Electrical Industry"? It's well worth having on file. Celanese Celluloid Corporation, a *division of the Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

LUMARITH*

A Celanese Plastic*

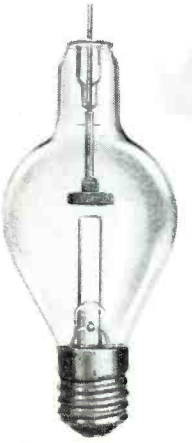
*Reg. U. S. Pat. Off.

The Complete Line
OF RECTIFIERS AND PHOTOTUBES
CETRON

Particularly sensitive to blue and violet light. RMA spectral sensitivity designation S-4. 5-Pin base interchangeable with other similar tubes.

Rectifier designed to meet rigid Army and Navy specifications. Incorporates numerous improvements insuring efficiency, ruggedness and long-life.

Grid control Rectifier (Thyratron) especially suited for industrial use. such as handling primary currents of small resistance welders—motor control, etc.

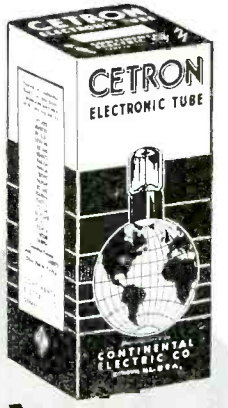


CE-235 is a half wave Argon-filled Rectifier with screw base, sturdily constructed for long, dependable service.

Cetron Rectifiers are available in gas and mercury filled, both full and half wave types in a wide range of ratings.

Cetron Phototubes are produced by us to take care of almost every situation . . . over 50 types, both blue and red sensitivity.

Continental's long experience and careful production methods insure you the utmost in satisfaction from all the many types of tubes we make. Write for complete catalog.



CONTINENTAL ELECTRIC COMPANY GENEVA, ILL.

★ CHICAGO OFFICE, 903 Merchandise Mart
NEW YORK OFFICE, 265 West 14th Street

TOOLS AND TECHNICIANS
..Yours On Contract

"like adding a wing to your plant"

Planning to add products to your line? Do it *without* manufacturing headaches . . . new equipment expenditures . . . tooling-up delays . . . employee instruction problems . . . sudden big increases in manpower demands!

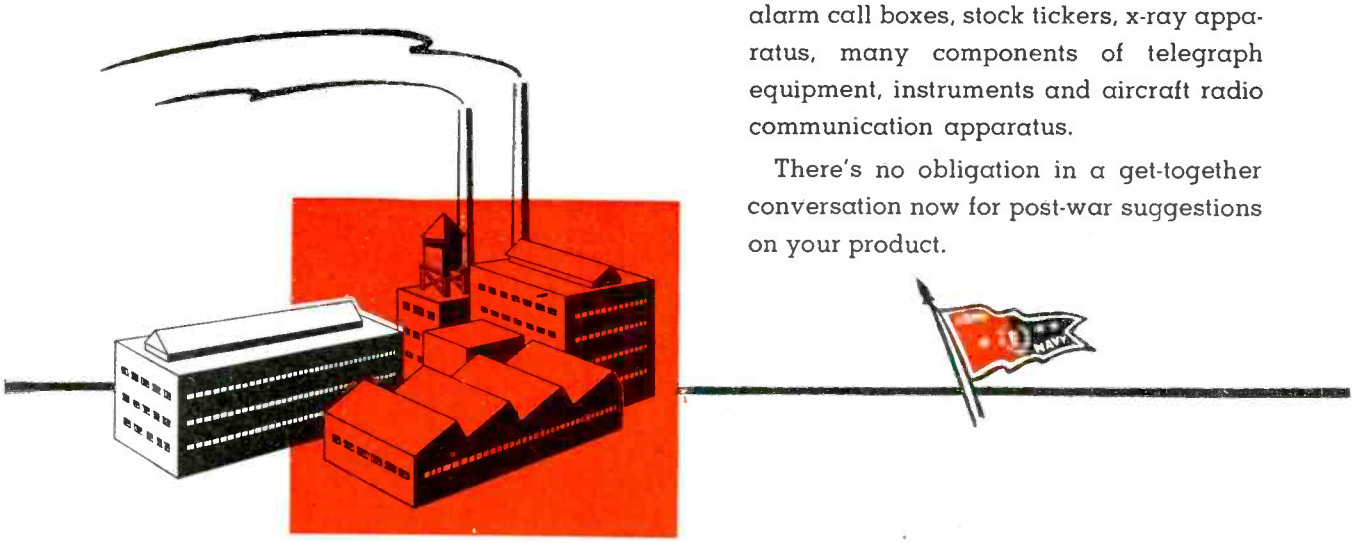
Do it in one of three ways. Let a *qualified organization* (1) make the parts that pose your problems, (2) make the entire new article, or (3) make and market the article.

Qualified should mean ample manufacturing facilities in plant and personnel, in machines and in technicians who supervise their use – and, in the case of Foote, Pierson, it means all that and more!

With Foote, Pierson's wide background goes a service which can include: machine shop, plating and metal finishing, assembly; inspection and checking; packing, warehousing and storage. Foote, Pierson's favorable location, in an area served by a number of main railroads, also offers shipping advantages by water and by air freight.

Foote, Pierson was among the first to produce non-interfering succession fire alarm call boxes, stock tickers, x-ray apparatus, many components of telegraph equipment, instruments and aircraft radio communication apparatus.

There's no obligation in a get-together conversation now for post-war suggestions on your product.



FOOTE · PIERSON & CO · INC

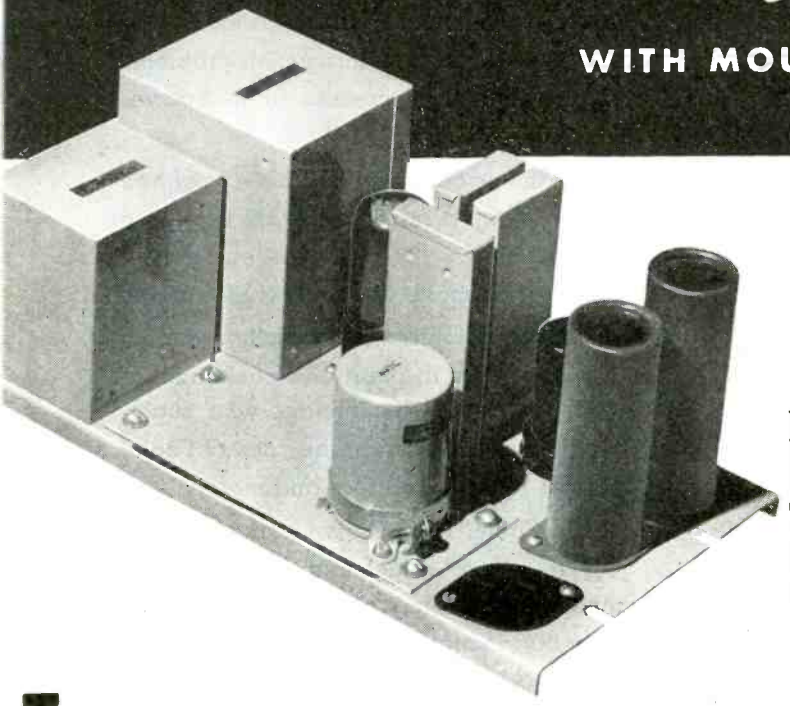
75 Hudson Street Newark 4, N. J.

Established FP *in 1896*

5961

102 SERIES *Amplifiers*

WITH MOUNTING ACCESSORIES



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

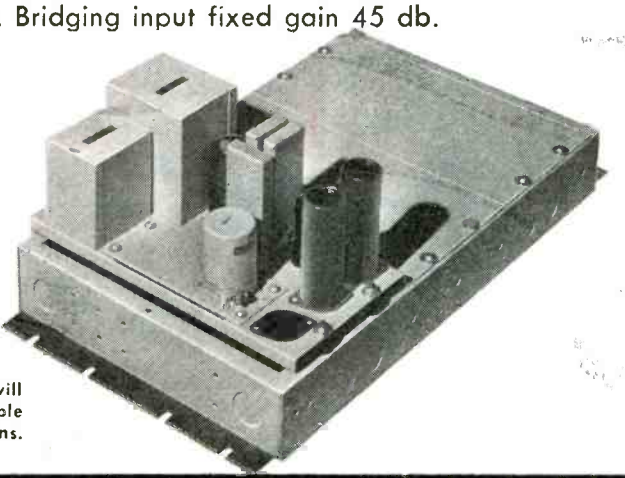
The 102 Series Amplifiers consist of four different amplifiers available simply by changing a small input panel on the master chassis. Except for the input panel, they all have the same transmission characteristics. Designed for the highest type audio service, they will meet frequency modulation requirements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

TYPE 102-A as illustrated and described above.

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

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

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



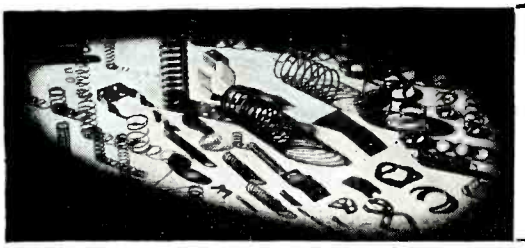
The 3A Mounting Frame, requiring 10½ inches rack space, will accommodate up to THREE 102 Series Amplifiers and is suitable for wall mounting cabinet or rack and panel installations.

The Langevin Company
INCORPORATED
SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK
37 W. 65 St., 23

SAN FRANCISCO
1050 Howard St., 3

LOS ANGELES
1000 N. Seward St., 38



The I-S SPRINGBOARD

VOL. 1 NO. 1

Published by INSTRUMENT SPECIALTIES CO., INC.

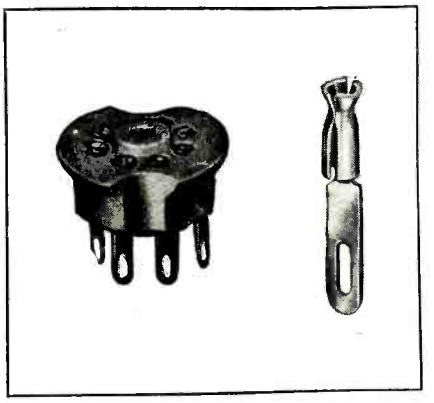
260 BERGEN BOULEVARD — LITTLE FALLS, NEW JERSEY

FILEWORTHY FACTS ABOUT MICRO-PROCESSED BERYLLIUM COPPER

OUTSTANDING TUBE SOCKET PERFORMANCE DIRECT RESULT OF MICRO-PROCESSED BERYLLIUM COPPER

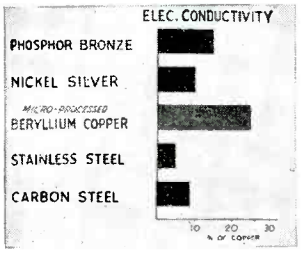
Instrument Specialties is producing in large quantities a new tube socket contact which assures uniform, constant pressure on the tube pins under conditions of extreme vibration and temperature. This contact was designed to take full advantage of beryllium copper, permitting intricate forming prior to heat treatment, and SELECTIVE HARDENING, a new heat treating technique. The spring end of the contact is hardened to a tensile strength of 180,000 lb. per sq. in. (Rockwell 15N-80) for maximum stability, and the tab end is heat treated to 60,000 lb. per sq. in. (Rockwell 15N-40) for ductility and ease of soldering leads.

These micro-processed beryllium copper contacts have maximum vibration stability, minimum drift under load, and high conductivity, giving low electrical losses.



The entire socket, produced by H. H. Eby, Inc., Philadelphia, was made to specifications and designs of the Signal Corps Laboratory, Ft. Monmouth, N. J.

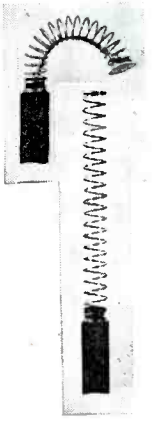
Micro-Processed Beryllium Copper Has Highest Conductivity Of all Spring Materials



Before heat treatment, the conductivity of Beryllium Copper is the same as phosphor bronze. Conductivity increases during heat treatment, and response varies with each lot of material. Micro-processing is the only sure way of obtaining the value shown above, and at the same time reaching maximum overall spring properties. Still higher conductivity values are obtainable at some sacrifice in other properties.

BRUSH SPRINGS WITHOUT SHUNTS SAVE UP TO 30% ON ASSEMBLIES

Beryllium Copper[mp], with its high conductivity (see chart) and ability to stand 100°F higher working temperature, plus closer tolerances on the ID has eliminated the need for pigtails on brush springs in many light duty applications. I-S unshunted brush springs are far easier to assemble, give longer service life at peak loads, and assure constant, even pressure at all times. Send drawings to I-S or write for I-S brush spring data sheet.



One order for 1,250,000 contact coil springs is being micro-processed by I-S at the rate of 250,000 per week.

WHAT DOES 200,000 LB. PER SQ. IN. TENSILE STRENGTH MEAN IN SPRING PERFORMANCE?

The higher strength of Certified "Silvercote" Beryllium Copper wire used in I-S coil springs allows a 25% increase in design stress over ASTM spec. wire. This makes it possible to design a satisfactory spring in a smaller space, and also greatly increases life under endurance service. Resistance to drift is increased 5 to 20 times, an important advantage in a variety of every-day spring applications.

LITERATURE

DO YOU HAVE ON FILE?

Recent technical article by Sheldon Klock, I-S Field engineer, points out contributions of Micro-processing in improving performance of electronic equipment, and accomplishing results impossible with conventional spring materials. Write for your copy today.

FROM THE I-S LABORATORY

Cleaning Beryllium Copper Springs in Preparation for Soldering and Electro-Plating

Two standard cleaning methods that give excellent results on Beryllium Copper:

1. Sulphuric-Bichromate Pickle

sulphuric acid	1 gal.
water	4 gals.
sodium bichromate	3 ozs. per gal.
temperature	140°-180° F
time	½ to 10 mins.

Parts should be agitated in solution to insure uniform attack. Time should be kept to the minimum needed to prevent loss of spring pressure and to avoid pitting. Rinse with cold water.

2. Bright Dip

Solution #1 may be used cold as a bright dip or a typical bright dip as follows may be used:

sulphuric acid	2 gals.
nitric acid	1 gal.
water	1 qt.
hydrochloric acid	1 oz. per 5 gals.
temperature	cold
time	5 seconds to 5 mins.

Rinse in cold water followed by a hot water rinse to aid in rapid drying.

Parts having a very light oxide surface such as results from salt bath heat-treatment, may be satisfactorily cleaned by using only the bright dip solution. Such parts will then readily electro-plate or solder.

A GIFT OF RESEARCH

TO THE ELECTRICAL INDUSTRY!

Recent Formica research assisted by new developments in the glass industry which produced glass mat and glass cloth fabrics, along with the perfection of new resins suitable for laminating, has made possible new Formica grades with many important electrical characteristics.

Formica grade MF-66 is a low loss insulator at high frequencies, which retains the high mechanical strength of other laminated grades, and can be machined for rapid production.

Grade FF-10 made with glass cloth base combines good insulating qualities with very high heat resistance, and is just what is needed for such applications as motor slot wedges.

Grade FF-41 made with glass cloth has been especially developed to resist surface tracking and arcing.

These valuable qualities are available in glass base Formica to a degree that was never offered before in laminated plastic materials. Perhaps they can solve some of your problems. Samples for testing on request.

"The Formica Story" is a moving picture in color showing the qualities of Formica, how it is made, how it is used. Available for meetings of engineers and business groups.

THE FORMICA INSULATION COMPANY
4647 Spring Grove Ave., Cinti. 32, Ohio

FORMICA

ARMY E NAVY

How full is "FULL RESPONSIBILITY" in Plastics?

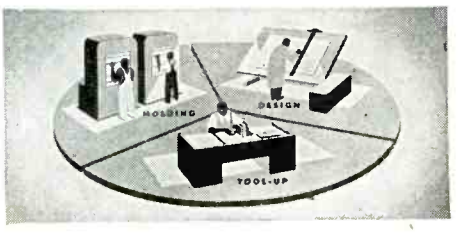
It even includes production of your inserts, here at Kurz-Kasch!

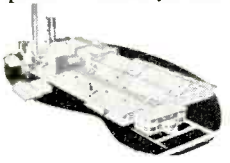
Because delayed deliveries on inserts—or a slip on tolerances—can snarl up the most carefully planned delivery schedule, we've set up a complete shop for insert production in our plant.

This shop is equipped to work zinc, monel metal, berrylium copper, aluminum, stainless steel, brass, chromium, steel and other materials—by stamping, screw machine work, drilling, tapping, reaming or whatever. Special finishing by dipping, plating, or pickling can be furnished.

By producing inserts under the same precision standards that have always applied to mold-making, molding and finishing at Kurz-Kasch, we can literally accept full responsibility for your plastic application from design to delivery.

Lay your postwar plastics problems on the Kurz-Kasch Round Table now for difficult plastics parts precisely produced—on schedule—at a fair price—when you'll need them.





One of the largest, best-equipped exclusive custom molding plants in the country—staffed by veterans of the plastics industry. At the Kurz-Kasch Round Table, experts in every phase of plastics production solve your engineering and production problems *first*—can help now with the applications you'll need soon.

NOW'S THE TIME FOR AN EXTRA WAR BOND—TODAY

KURZ-KASCH

For over 25 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1421 South Broadway, Dayton 1, Ohio
Branch Sales Offices: New York • Chicago • Detroit • Indianapolis • Los Angeles • Dallas
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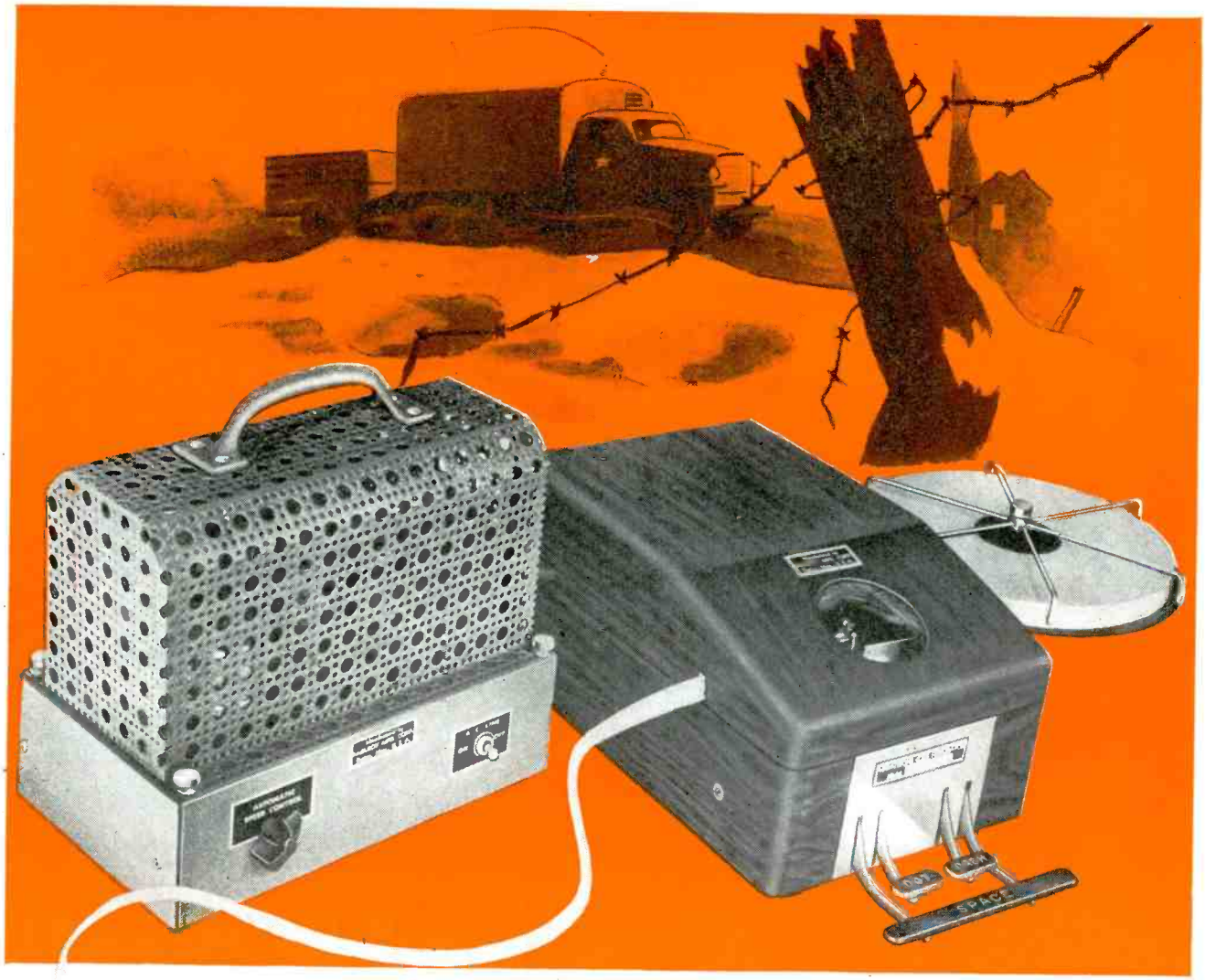


STANDING STILL, OR BOUNCING ALONG SHELL-TORN COUNTRY, THE NEW AND IMPROVED

McELROY WHEATSTONE CODE TAPE PERFORATOR

FACILITATES HIGH SPEED RADIOTELEGRAPH TRANSMISSION

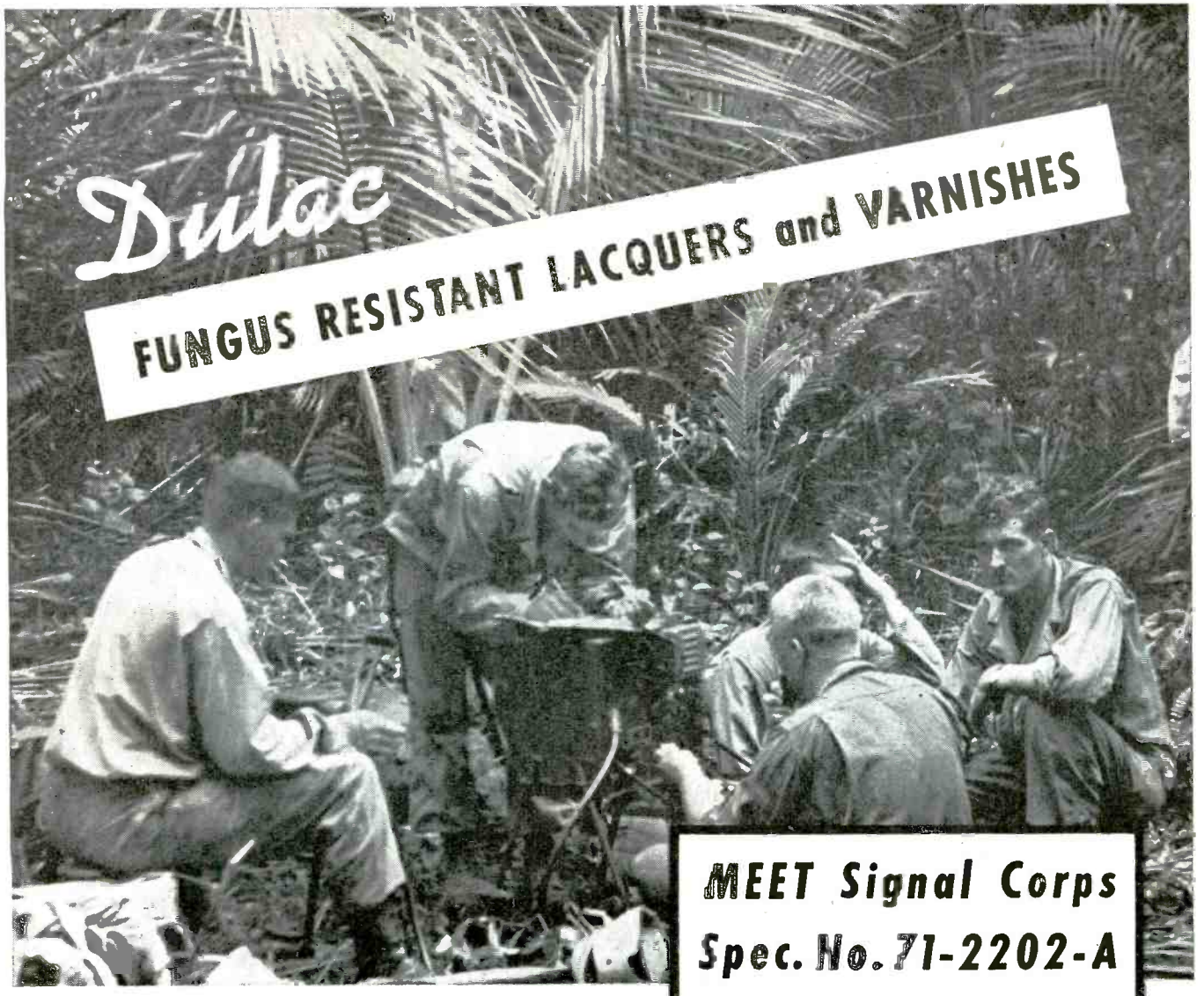
Shorn of bulk and complicated construction, the McElroy Model PFR-443-A prepares clean and accurate tapes for transmission at speeds up to 300 words per minute. Extremely simple to operate and requiring no more than ordinary typewriter attention, this unit is solidly constructed to give dependable performance—on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

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

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

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

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



MEET Signal Corps Spec. No. 71-2202-A

FUNGUS RESISTANT LACQUER #86-A

FUNGUS RESISTANT VARNISH #512-A

Contains non-mercury bearing Fungicide.

FUNGUS RESISTANT LACQUER #96-A

FUNGUS RESISTANT VARNISH #522-A

Contains mercury bearing Fungicide.

HIGH SOLIDS AND GOOD MOISTURE RESISTANCE.

Protecting the Lifeline of Communications

These four *Dulac* coatings, containing fungicidal agents which meet the requirements of the Signal Corps and the Navy, give protection against shorts due to moisture retained by fungus-growth. They are easily applied on all types of surfaces, both organic and inorganic, by brush, dip, or spray. They air dry tack-free to touch in 15 minutes and hard in 1 hour.

For a quick "Finish" Buy more WAR BONDS

M & W

Send for Bulletin "Dulac Fungus Resistant Coatings for Tropicalization of Radio, Signal and Communication Equipment."

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PRODUCERS OF LACQUERS, ENAMELS, SYNTHETICS AND SPECIALTY FINISHES FOR ALL PURPOSES

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LOOKING FOR A HIGH VALUE OF...

WATTS PER OUNCE?

This Little Giant Has It, And At 200 Mc, Too!

Imagine getting 90 watts continuous output* from a tube that weighs only 1.5 oz. and at 3 meters! Even at 1.5 meters (200 Mc) the output is still high, 65 watts. A couple of years ago such a tube was a dream, now it's a reality. In spite of its small size and weight, GENERAL ELECTRONIC'S DR-24G tri-ode is conservatively rated. Its superb performance results from the teamwork that goes into its manufacture . . . teamwork of design engineers who give careful attention to details and skilled hand craftsmen experienced in precision glassblowing and in the other steps of production and testing. There are no insulators or supports here to evolve gas on the first overload, no exposed filament to spray the envelope with energy-wasting electrons. The plate dome is just one of those details which distinguishes the DR-24G. A tantalum plate and grid eliminate the flashed-film type getter and allow the tube to run cooler, particularly at high frequencies.

TECHNICAL DESCRIPTION

Filament . . Thoriated Tungsten	
Volts	6.3
Amperes	3.0
Max. Plate Voltage	
100 Mc	2000 v
200 Mc	1500 v
Max. Av. Plate Current	75 ma
Max. Av. Plate Dissipation .	25 w
Max. Av. Grid Current	25 ma
Amplification Factor	25
Capacities	
Grid to Plate . .	1.7 uuf
Grid to Filament	2.5 uuf
Filament to Plate	0.4 uuf

4⅜" Overall Height, ½" Diameter
Nonex Glass Envelope
Base Standard Small 4 prong

* As a Class C, Unmodulated UHF Amplifier

GENERAL ELECTRONICS INC.

101 HAZEL STREET, PATERSON 3, N. J.

SALES OFFICE, NEW YORK 23, 1819 BROADWAY EXPORT DEPT., 85 BROAD STREET, NEW YORK 4, N. Y. CHICAGO 47, 1917 NO. SPRINGFIELD AVE.

SOME MAGNAVOX MILESTONES IN RADIO HISTORY

In 1915 Magnavox engineers produced this "daddy" of all loud speakers—the horn-type electro-dynamic speaker. Today the electro-dynamic loud speaker is the "voice" of modern sound reproduction in radio, sound motion pictures and other kindred fields.

Also in 1915 Magnavox produced the first public address system, shown above in use by ex-President Taft. Later developments of this equipment found widespread use, including the present wartime battle announcing systems aboard our naval vessels.

THESE EXAMPLES serve to remind us how closely the history of radio is interwoven with that of Magnavox.

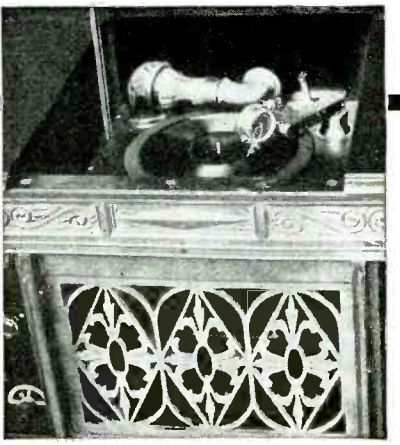
In 1911 the electro-dynamic reproducer, developed by this company's engineers, completely revolutionized the art of sound reproduction. The same principle is used in all radios today.

Magnavox for years has been not only the world's largest supplier of loud speakers, but also one of the largest producers of electrolytic condensers. This experience dates from the original "Mershon" to the current Magnavox type.

The experimental work that built the Magnavox reputation is constantly perpetuated—now intensified and broadened by highly diversified war work. Magnavox is your logical source for components and for cooperation in your future projects. There's no substitute for experience. The Magnavox Company, Fort Wayne 4, Indiana.

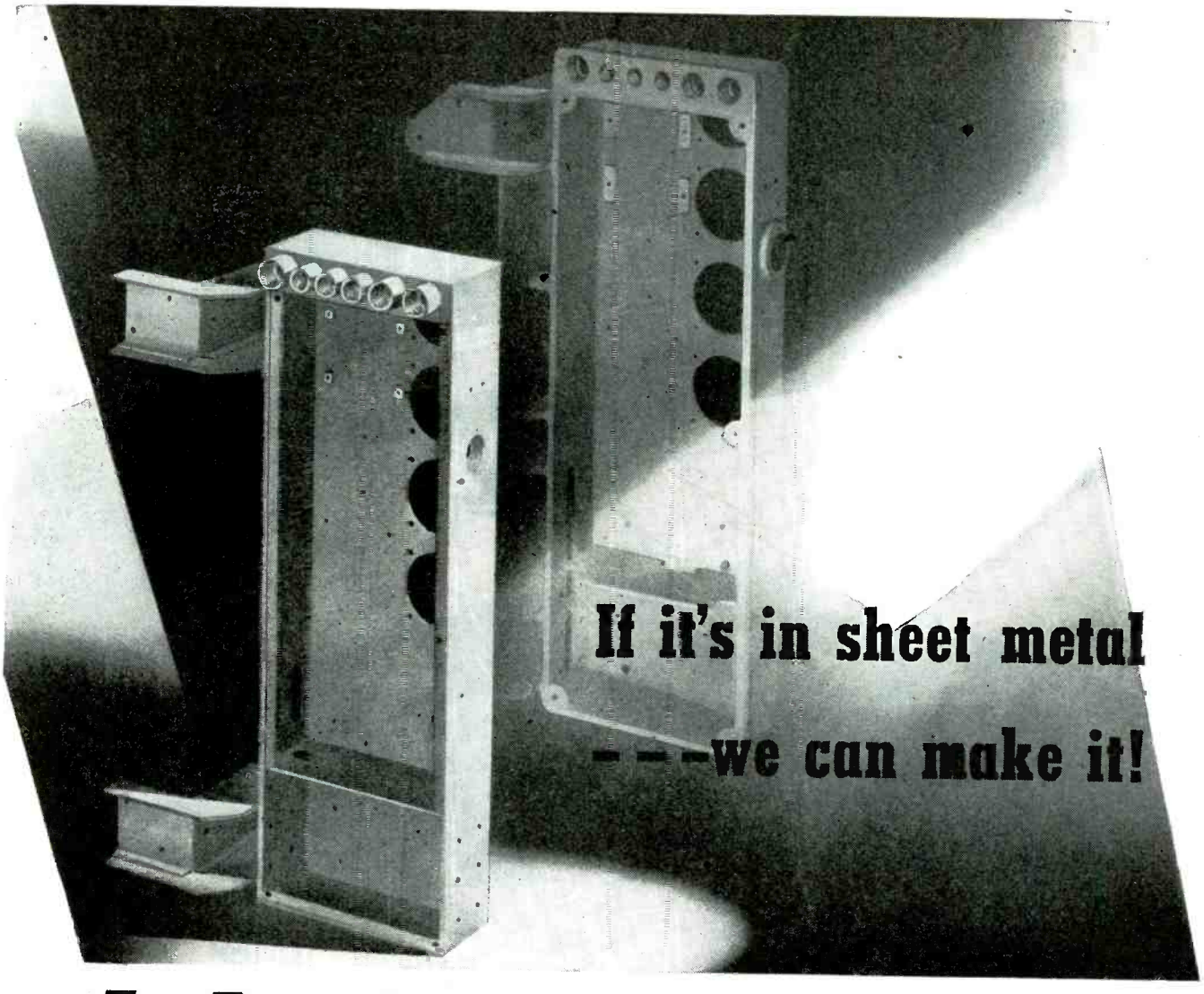
Magnavox
RADIO PHONOGRAPH

Loud Speakers • Capacitors • Solenoids
Communication and Electronic Equipment



In 1922 Magnavox engineers developed this historic instrument—the first amplified radio-phonograph. As the forerunner of all present day radio-phonograph combinations, it marked an important advance in the development of sound reproduction.

Another important step forward was achieved with this first single-dial radio produced by Magnavox in 1923. Its importance at the time is appreciated when we remember that all previous radio sets required the use of three dials for tuning in a station.



For Example . . . KARP was assigned the task of converting from cast aluminum to sheet steel a junction box in which are connected all wires operating an anti-aircraft searchlight. These are the results:

Manufacturing . . .

a sheet metal product was produced with standard equipment without any special dies.

Conservation . . .

critical material and vital machine tool time were saved, with no loss in the efficiency of the unit.

Quality . . .

the KARP-produced junction box has greater strength, is lighter in weight, and is better looking.

Savings . . .

in production costs and actual man hours, in addition to speeding up deliveries.

If it's in sheet metal, KARP can make it. The scope of KARP's service can be fully appreciated only when you see KARP on your production problem.

ARTISANS IN SHEET METAL

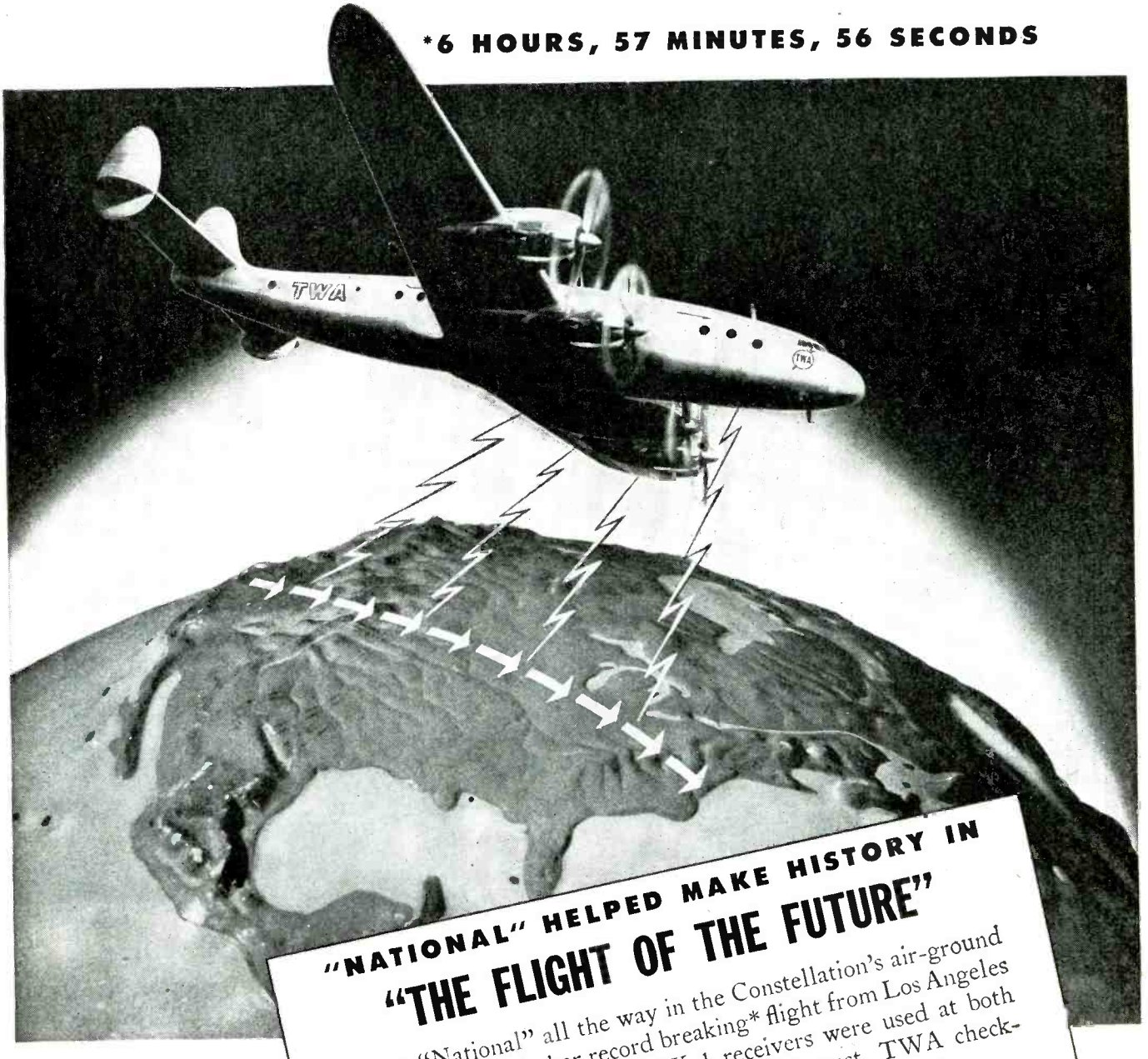
KARP METAL PRODUCTS CO., INC.

126 30th STREET • BROOKLYN 31, N. Y.

CABINETS
CHASSIS
RACKS
PANELS

Wastepaper is America's No. 1 Critical Material . . . Save Every Scrap

*6 HOURS, 57 MINUTES, 56 SECONDS

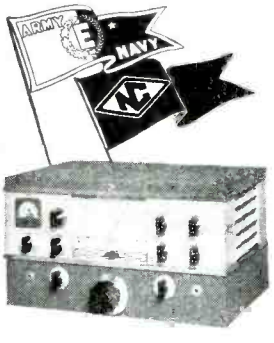


"NATIONAL" HELPED MAKE HISTORY IN

"THE FLIGHT OF THE FUTURE"

It was "National" all the way in the Constellation's air-ground communications in her record breaking* flight from Los Angeles to Washington! National RCK-1 receivers were used at both take-off and landing. And from coast to coast, TWA check-points monitored her flight on their NC-100 equipment.

TWA's mighty Queen of the Air has gone to war. But the lessons learned in her prophetic flight promise even greater feats for postwar passenger transport. New Constellations will flash through the skylanes, checked and guided, then as now, by National air-ground equipment.



NATIONAL COMPANY, INC.
MALDEN MASS, U. S. A.

*6 hours, 57 minutes and 56 seconds

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

WE HAVE AN OBJECTIVE, TOO!

Conversion from the frantic pace of wartime production to the tranquil ways of a world at peace will be another gigantic job. But it's one that must be done and done quickly when the time comes. For we must be ready for peace . . we must have jobs waiting for those boys who have been out there doing the biggest job of all for us!

That's one of the reasons why the WPB recently encouraged such planning and released materials for the development of new products.

This future-minded organization . . is still 100% engaged in war work. But it is already planning and perfecting Electronic control devices which may readily play an important part in *your* conversion plans.

Electronics will add to the comforts and conveniences of the home of the future, in the country as well as the city. Keep your eye on the Magic Eye. It's going places.

★ BUY MORE THAN BEFORE . . . BONDS

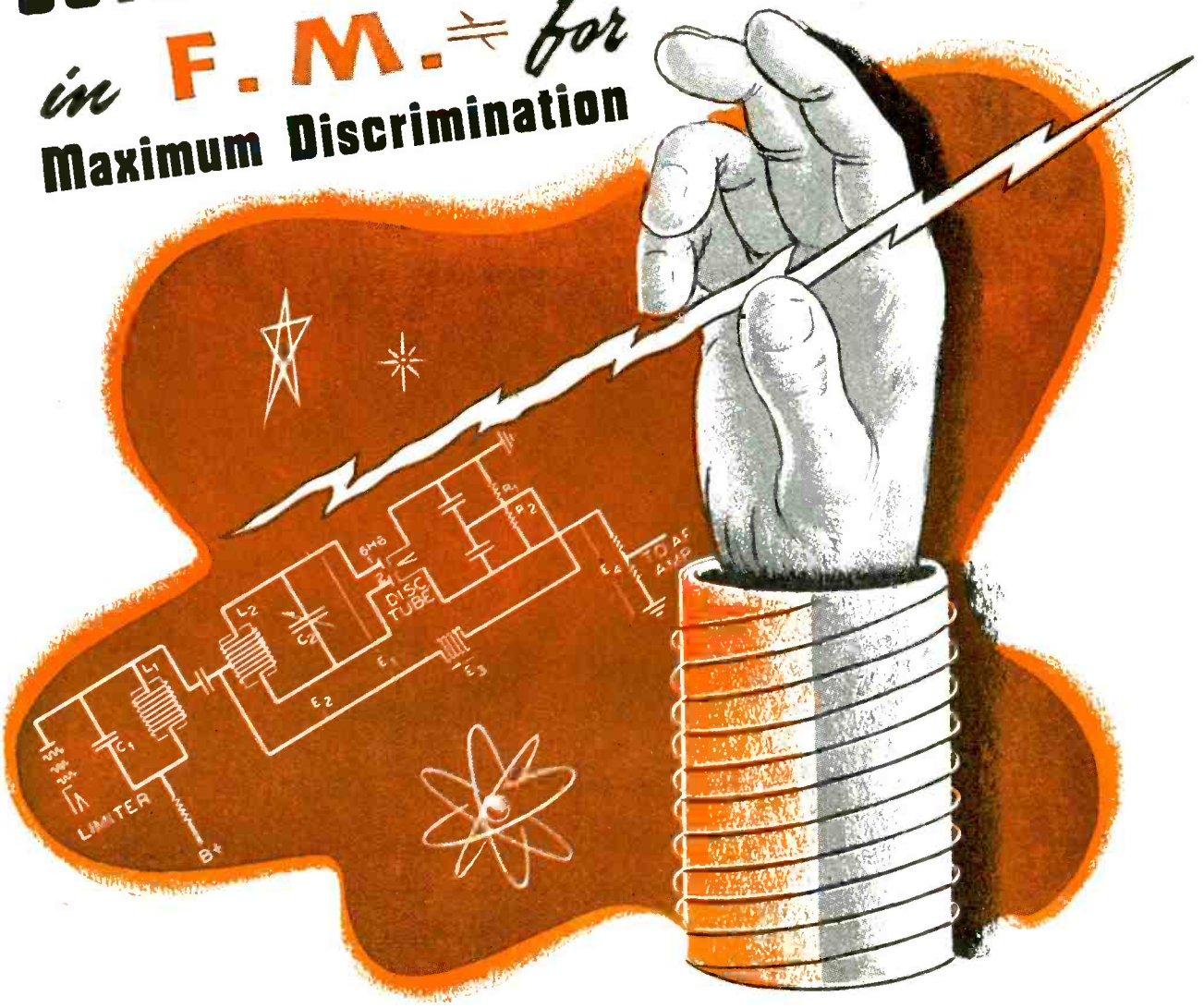
TRADE-MARK REG. U.S. PAT. OFF.

MAGUIRE INDUSTRIES, INC.
ELECTRONICS
division

MAGUIRE INDUSTRIES, INC., GREENWICH • STAMFORD • BRIDGEPORT • NEW MILFORD • NEW YORK

GUTHMAN *Discriminator* COILS

in F. M. *for* Maximum Discrimination



FREQUENCY MODULATION receivers require linear discrimination against undesirable signals. Guthman engineers have developed precise **DISCRIMINATOR COILS** to discriminate equally on both sides of the resonance curve, providing maximum discrimination.

GUTHMAN
Leader in Inductronics

DO YOUR BEST . . .
INVEST IN WAR BONDS!

EDWIN I. GUTHMAN & CO. INC.

15 SOUTH THROOP STREET · CHICAGO

PRECISION MANUFACTURERS AND ENGINEERS OF RADIO AND ELECTRICAL EQUIPMENT

STOP "Leap-Frog" Corrosion

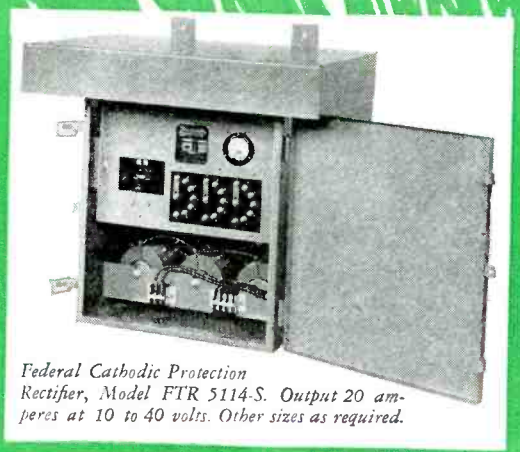
"Leap-Frog" Corrosion damages underground pipes and cables.

Pipes or other metal structures are in places electro-positive in relation to the soil and due to natural galvanic action corrosion results. Metal is taken away from one section of pipe and deposited somewhere else along the exposed pipe.

By using Federal Cathodic Protection Rectifiers, "Leap-Frog" corrosion is foiled. On constant guard is a direct current charge which cancels the harmful electrolytic corrosive action on oil, gas and water pipelines and underground cables.

These Federal units have no moving parts, so they last indefinitely — with the absolute minimum of attention. In desert heat or torrid dampness they keep on the job day and night.

Proper engineering for the corrosion problem at hand calls for the specialized consulting engineering service which is yours — when you look to Federal. Write today for full details.

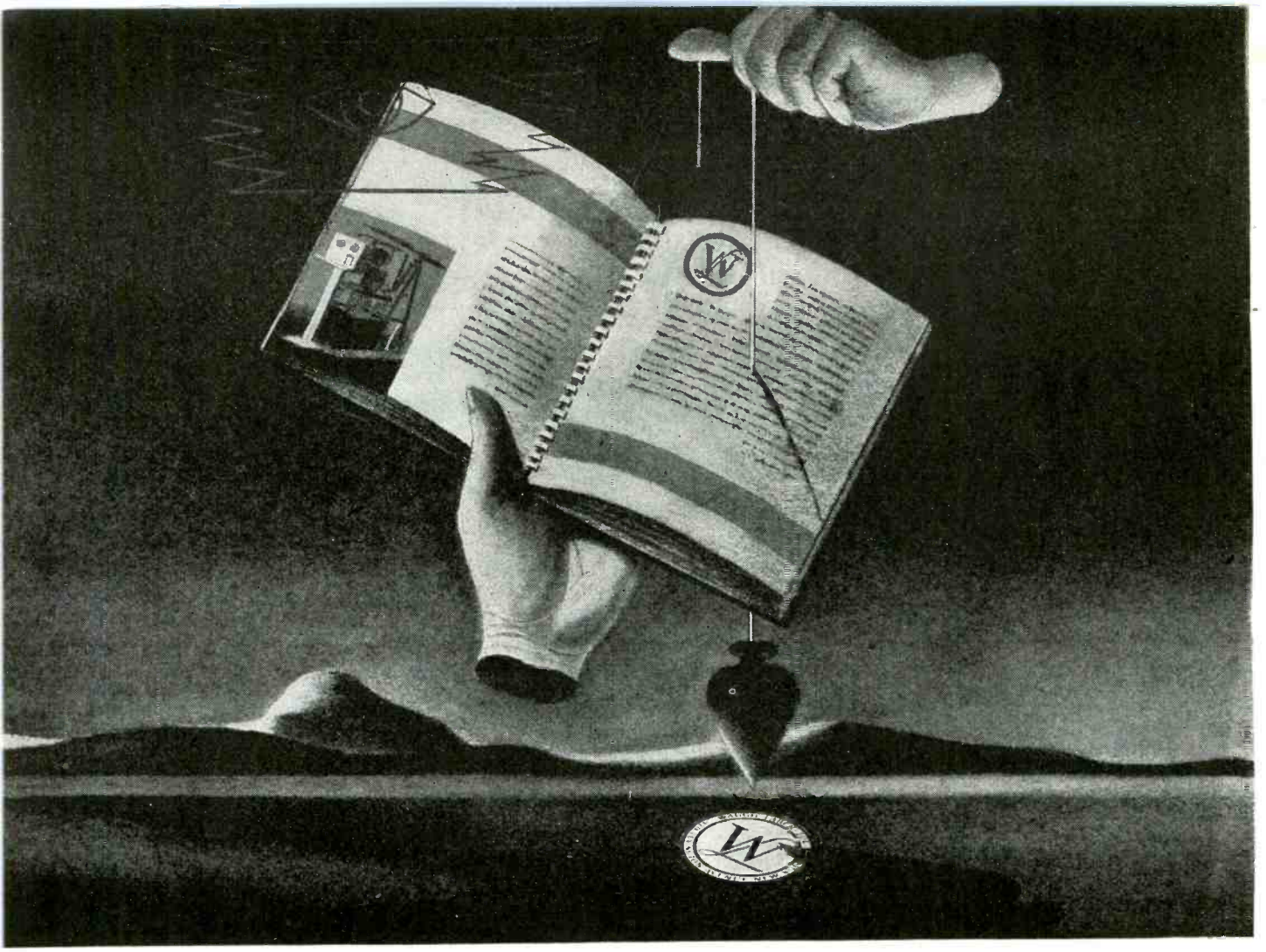


Federal Cathodic Protection Rectifier, Model FTR 5114-S. Output 20 amperes at 10 to 40 volts. Other sizes as required.

Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, N. J.



PLUMB TO THE SOURCE

MORE THAN an engineering laboratory developing extraordinary new instruments and devices . . . more than a test service for the armed forces and many of our largest industries . . . Waugh Laboratories is a *source of test instruments* . . . the one place where an engineer or industrial laboratory may obtain the particular instrument required for specific tests or as permanent equipment.

Given your problem, Waugh will gladly recommend an instrument or combination of instruments that seem most likely to offer a solution, and no matter how specialized, will endeavor to provide these instruments on order.

In addition to this procurement service, Waugh offers laboratory and field service in vibration, stress and strain determination and analysis, and also an instrument rental service.

Write us concerning your problem.

Our Service Manual and Rental List sent Free on Request.

WAUGH *Laboratories*

Pacific Coast Branch: 180 East California St., Pasadena 5, California • **420 LEXINGTON AVE., NEW YORK 17, N. Y.**

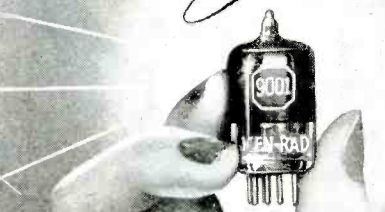
Co-ordinated Engineering

• An effective anti-aircraft battery requires co-ordinated team work, and in our business too, we are not content to only develop isolated items, but we constantly co-ordinate and engineer a *COMPLETE* line of related parts. For example, miniature sockets, shields and nut straps as illustrated . . . Write for samples.

CINCH MANUFACTURING CORPORATION, 2335 W. Van Buren St., Chicago 12, Ill.
SUBSIDIARY OF UNITED-CARR FASTENER CORPORATION, CAMBRIDGE, MASS.

KEN-RAD

"Little Giant"



Designed originally for space saving and fine reception in portable radio sets Ken-Rad miniature tubes easily adapted themselves to walkie-talkie and other military uses Expansion and future progress with this rugged Little Giant is limitless

• Write for your copy of "Essential Characteristics" the most complete digest of tube information available

TRANSMITTING TUBES
CATHODE RAY TUBES
SPECIAL PURPOSE TUBES
RECEIVING TUBES
INCANDESCENT LAMPS
FLUORESCENT LAMPS

KEN-RAD

EXECUTIVE OFFICES
OWENSBORO · KENTUCKY
EXPORTS 16 MOORE STREET NEW YORK

Improved INSULATED CERAMICONS

REG. U. S. PAT. OFF.

. . . now made with Molded Insulation by ERIE RESISTOR

RETAINING all of the inherent advantages of the ceramic case Erie Insulated Ceramicons, this new improved type, with a one piece molded phenolic case offers even better protection against humidity. It also insures more intimate contact between the silver electrode and the molded dielectric, eliminating the possibility of air gaps.

In all other respects the molded type Erie Ceramicons are the same as Ceramicons with ceramic insulation. Overall dimensions are unchanged. They cover the same standard range of temperature coefficients, from +100 P/M/°C to −750 P/M/°C.

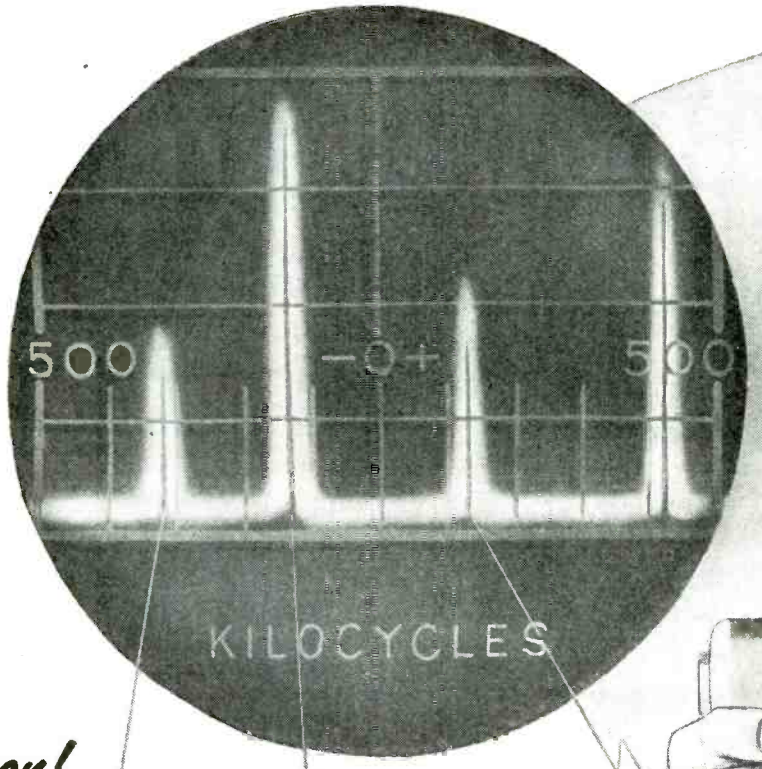
At present both types are available, but all production will be standardized on the molded-type in the near future.

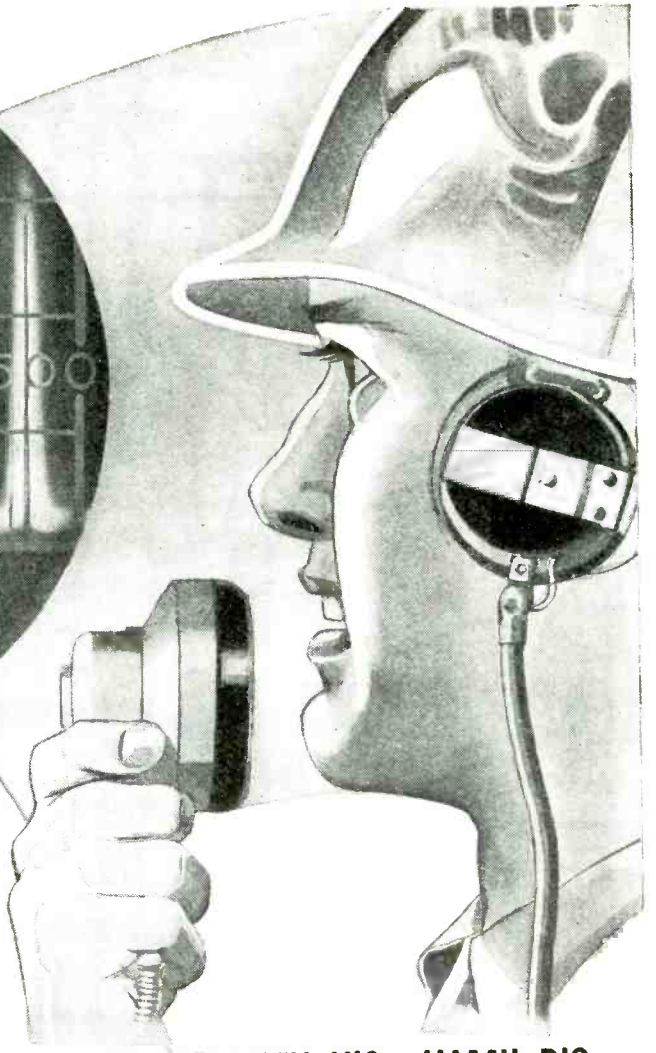
Samples have been submitted to the Army-Navy Electronics Standard Agency at Redbank, N. J., for approval against JAN-C-20. Orders are now being accepted for both the molded insulated and ceramic insulated styles against JAN-C-20. Write for cross reference sheet showing styles of Erie Ceramicons and corresponding JAN-C-20 designations.

Do More Than Before — Buy EXTRA War Bonds

ARMY NAVY
FOR HIGH ACHIEVEMENT IN WAR PRODUCTION

Electronics Division
ERIE RESISTOR CORP., ERIE, PA.
LONDON, ENGLAND • • TORONTO, CANADA



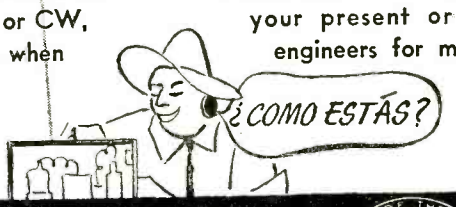


Soon!

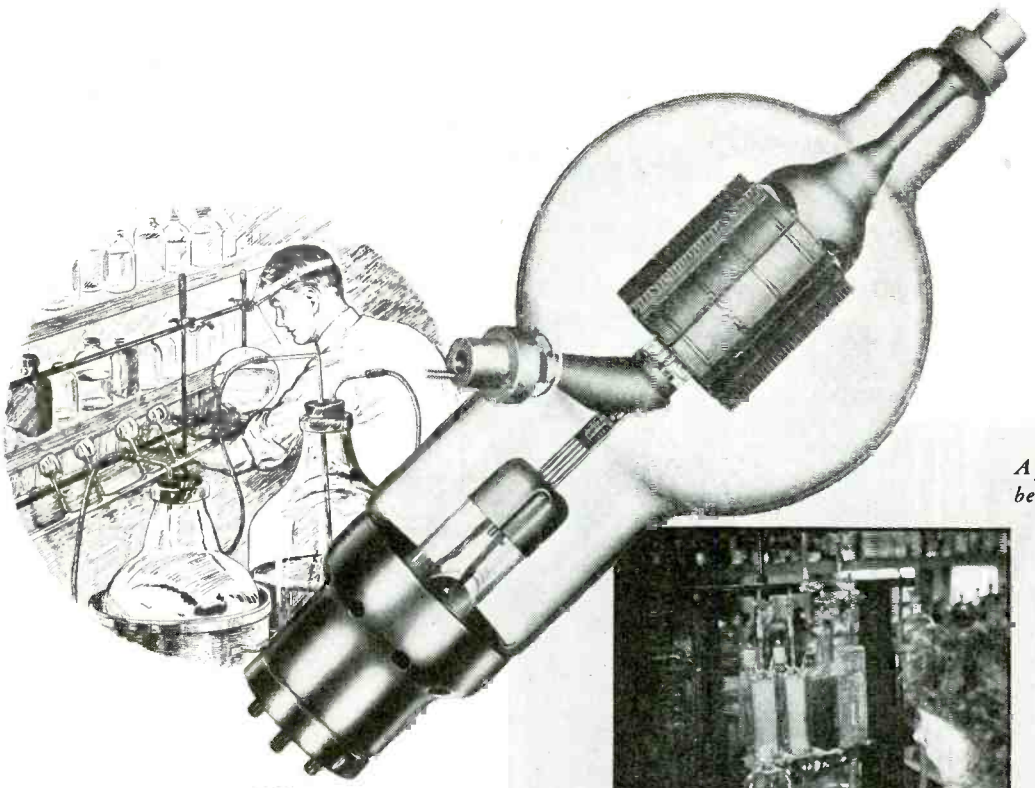
PANORAMIC RECEPTION WILL BE USED BY GI JOE WITH HIS "HAM" RIG

When GI Joe takes off his helmet, he will still remember many of the things he is learning in the Army. As a radio operator, he uses ***Panoramic*** reception for effective monitoring and for catching tricks in enemy field communications. He recognizes its value for peacetime as well as for wartime. On the basis of military experience, he will want to make use of ***Panoramic*** reception for many more pleasant hours at his own rig. Because it ***SHOWS ALL SIGNALS ON A GIVEN BAND OF THE RADIO FREQUENCY SPECTRUM SIMULTANEOUSLY***, GI Joe knows that ***Panoramic*** reception will tell him what stations are on the air, whether they are phone or CW, and what their signal strengths are when they reach him. Most important, he can be sure that he will miss very few calls in response to his CQ's.

Currently, ***Panoramic*** reception also is doing good work in laboratory development and industrial applications. Its ability to measure, interpret and compare variations in inductance, capacitance and resistance has created possibilities that are being utilized by far-sighted manufacturers. If ***Panoramic*** technique can be adapted to your present or future needs, ask our engineers for more detailed information.



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



the *Science* behind the science of electronics

The pattern of progress in the science of electronics is determined by the achievements in creating and developing new and more efficient electron vacuum tubes. Therefore, the whole complex task of vacuum tube development – involving the intelligent application of many sciences – comprises the real science behind the science of electronics.

To create and produce the modern vacuum tube requires experience and skill of the highest order in these many sciences in addition to complete facilities for their application. The list includes everything from chemistry and metallurgy – the technology of glass fabrication and vacuum pumping – to physics, optics, thermo-dynamics and most important of all – Electronics.

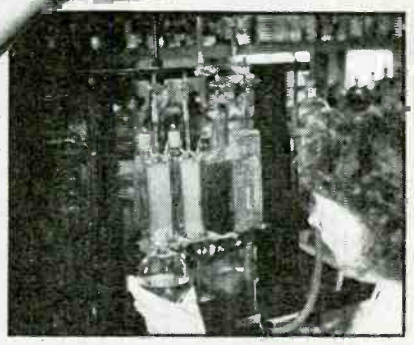
The resources and resourcefulness of Eimac laboratories have accounted for many outstanding contributions to the science of Electronics. A fact which is attested to by the leadership which Eimac tubes enjoy throughout the world. These comprehensive facilities are continuously being utilized to achieve better and better results for the users of Eimac tubes.

Eimac Engineering is devoted solely to the development and production of electron vacuum tubes. However, since the electron vacuum tube is the heart of all electronic devices it is advisable for users and prospective users of electronics to look first to the vacuum tubes required. A note outlining your problem will bring advice and assistance without cost or obligation.

• • •

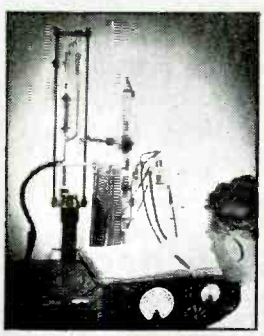
Write for your copy of Electronic Telesis – a 64 page booklet fully illustrated – covering fundamentals of Electronics and many of its important applications. Written in layman's language.

A few of the branches of the Science behind the Science of Electronics



CHEMISTRY—*Making Gas Analysis in the Eimac Laboratory*

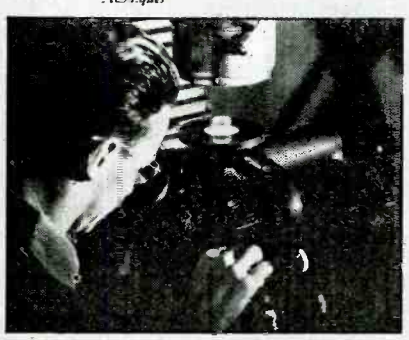
METALLURGY—*Spectrographic Analysis of the Rare Metals Used in Vacuum Tubes*



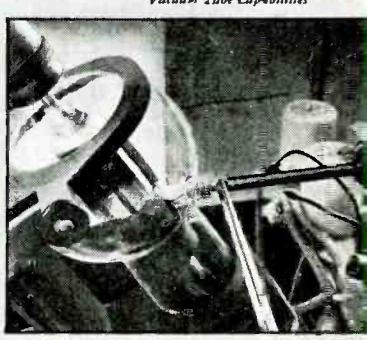
VACUUM TECHNOLOGY—*Constant Research to Develop Better Vacuum Techniques*

PHYSICS—*Actually Viewing Emission of Electrons with Electron Microscope*

ELECTRONICS—*Determining Facts about and Recording Data on Vacuum Tube Capabilities*



OPTICS—*Studying the Effect Processing has on the Structure of Materials Through Photomicrography*



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RAYTHEON VOLTAGE STABILIZERS

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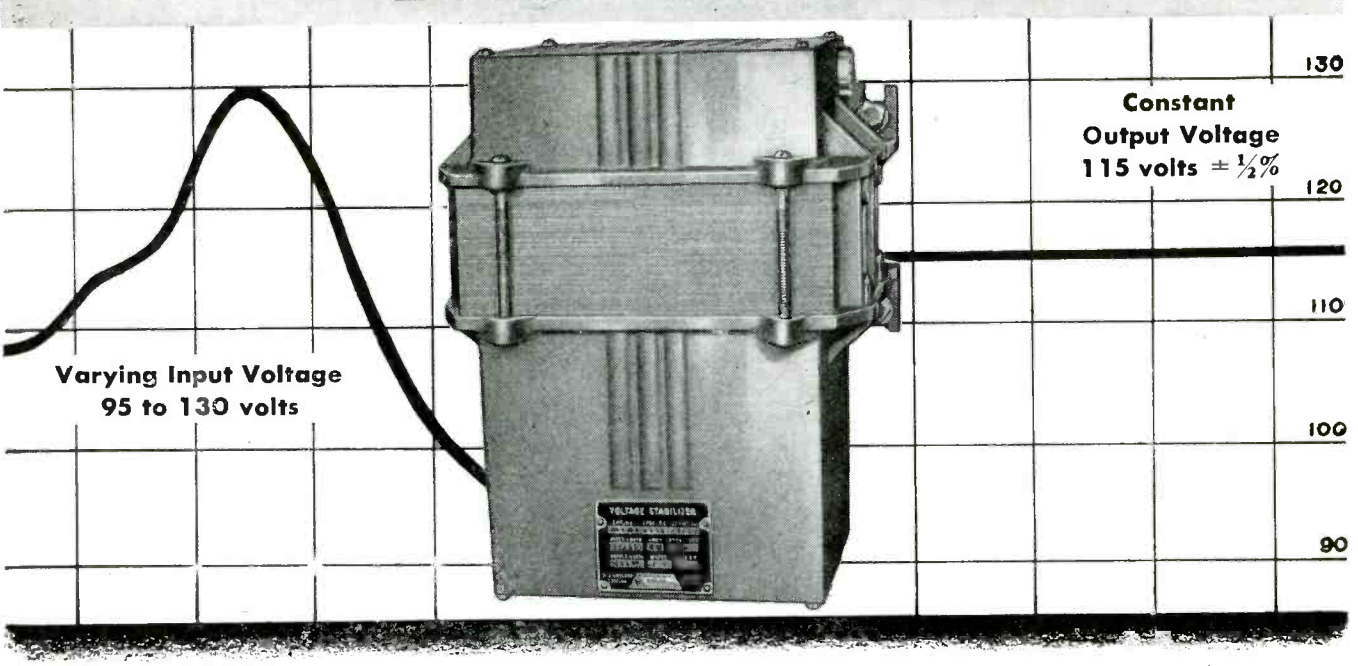

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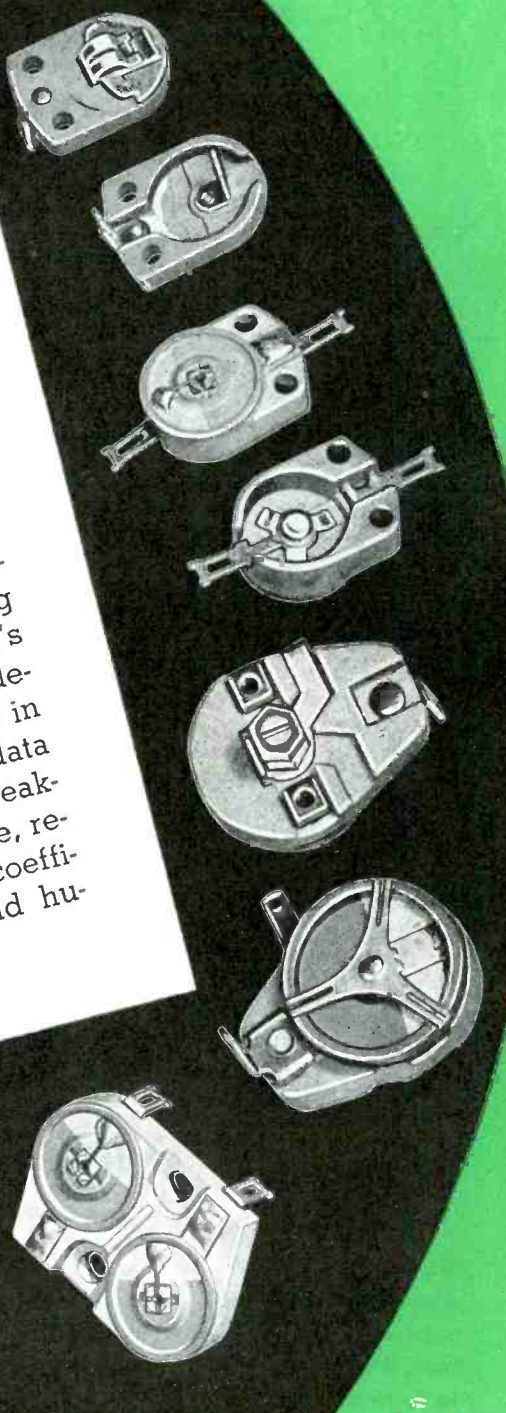

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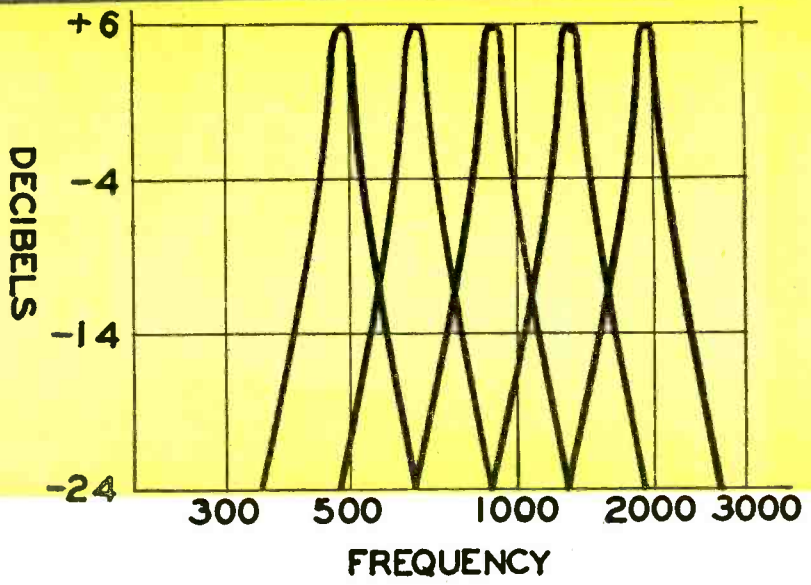
Division of GLOBE-UNION INC., *Milwaukee*

Producers of Variable Resistors • Selector Switches • Ceramic Capacitors, Fixed and Variable • Steatite Insulators.

MULTI-CHANNEL FILTERS BY...



Multi-Channel Filters lend themselves to remote control apparatus employing frequency selection. The unit illustrated is a five channel band pass filter of the interstage type with the inputs in parallel and 5 separate output channels designed to feed into open grids. This circuit arrangement provides a 2:1 stepup ratio, with a band pass attenuation of approximately 30 DB per half octave. The dimensions of this unit in its hermetically sealed case are 2½" x 3" x 6". Filters of this type can be supplied for any group of band pass frequencies from 200 to 7000 cycles.

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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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

In Time of War, Prepare for Peace

We are still grimly at war, but it is not too early for electronic and radio men to be turning their thoughts to planning those activities which must be entered into as the military production program tapers off.

Meanwhile, Electronic Industries' editors are reshaping our own publishing program to point the way in this conversion, and through our pages to show the industry how the lessons of its unparalleled wartime production can be utilized profitably in the peace-days ahead.

Electronic War Production Still "Urgent"

Some official statements from the War Production Board show radio-electronic schedules as levelling off or actually dropping, indicating a turn in the production tide. But the chart of estimated delivery of radio-radar equipment on this page (compiled by official sources and published exclusively in "Electronic Industries") emphasizes the continued "urgent" demand of Army, Navy and WPB for vital radio-electronic equipment for the armed services. As the graph shows, through the final months of 1944 the program calls for an average monthly estimated delivery of over a quarter billion dollars of electronic equipment per month!

Let Engineers Study War Inventions

Practically every technical and industrial expert has a record of noteworthy and responsible effort in war developments. But relatively few have had the privilege of seeing the whole project or to study the importance of the various components in a peaceful world. Without knowledge of the adaptability of wartime electronic-radio developments and inventions, the proper designing and planning for civilian production reconversion will be delayed and hampered.

The military services should now allow the industry a "look" at the secret electronic and radio inventions to ascertain their adaptability to civilian peacetime uses. In certain cases, where it is still deemed necessary for security reasons, this could be done in secret sessions. It certainly would be a step towards hastening the day of new products born out of the war inventions so that industry would be geared for reconversion.

"Electronic October" in Chicago

Two separate national electronic gatherings during different weeks, a fortnight apart, will feature October at Chicago. October 5 to 7, the National Electronic Conference will attract engineers to the Medinah Club, Chicago. Program of topics appeared on page 211 of our last issue.

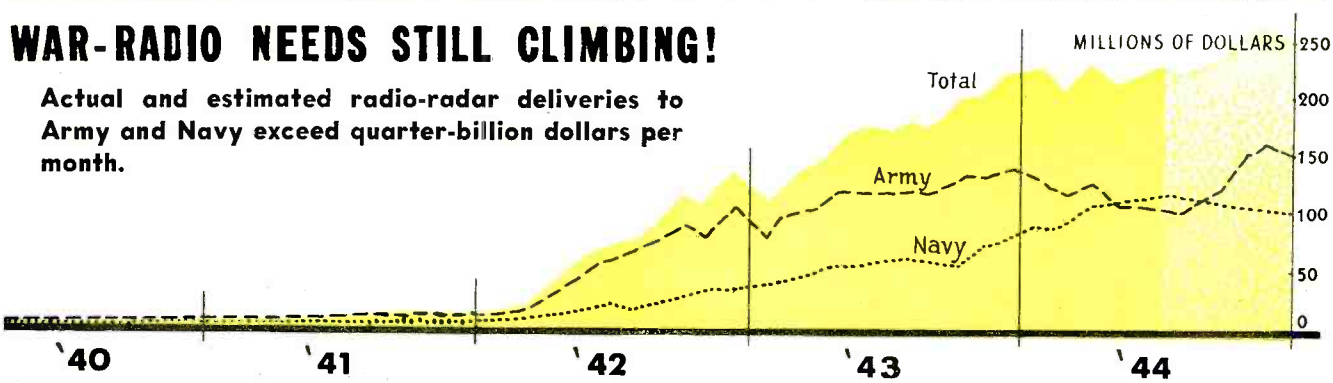
Two weeks later, the Electronic Parts and Equipment Industry Conference will be held at the Hotel Stevens, Chicago, October 19 to 21, with meetings of special interest to electronic manufacturers, distributors, representatives, and electronic-trade executives.

Can't Please Everybody!

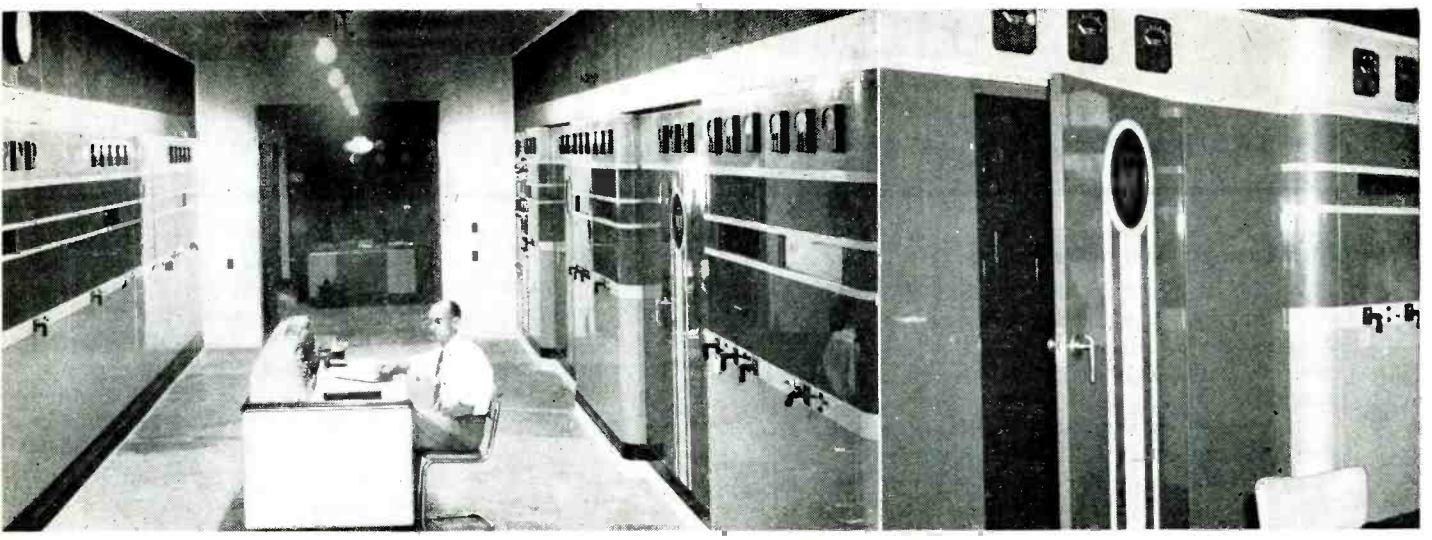
Plum cake or gooseberry pie? Eastern electronic manufacturers have looked with foreboding for many months on the apparent trend of pushing a great bulk of military production toward the West Coast. This is matched, in recent months, however, by equal worries by the Western electronic tycoons because they are afraid, being tied down by those same war contracts, that those Easterners will get the jump on them during reconversion to peacetime products. It seems a standardized menu is going to be a difficult thing to accomplish.

WAR-RADIO NEEDS STILL CLIMBING!

Actual and estimated radio-radar deliveries to Army and Navy exceed quarter-billion dollars per month.



OWI'S 300 KW INTER



The three RCA transmitters, shown above together with the console that controls them, are located in the wing of the building formerly occupied by wing at the back. Right, above, one of the technicians adjusts No. 4 for operation. Transmitters have duplicate radio frequency channels, at ends of

Technical details of the six 50 kw transmitters and steerable antennas now occupying WJZ's former location

● With the installation of four new transmitters of 50 kw each now nearing completion by National Broadcasting Co. on the old site of WJZ at Bound Brook, N. J., the "Voice of America" moves several steps nearer the ultimate 2750 kw of power represented by a total of about two score short-wave transmitters, all but a few of which OWI now has beamed toward allied and enemy countries.

Six of the transmitters are under the roof of WJZ's long-time transmitter house. In fact WJZ was moved out and into its new location at Lodi, N. J., in order to make room for the addition of four new units to the two already there under lease to OWI but for several years prior to Pearl Harbor used by NBC for international short wave broadcasting.

Thus these six transmitters aggregating 300 kw include NBC's two original units, three new ones built by RCA and one new one building by NBC. The three RCA transmitters are in one wing of the building; the NBC units are in another.

Physically, the new transmitters are alike and are distinguished by the inclusion of twin radio frequency channels. The equipment may be divided into several major parts according to function. These include the two radio frequency channels, the audio frequency channel and modulation equipment, the power supply and rectifiers, the cooling, the control, and the automatic transfer equipment.

The two radio-frequency channels are located one at each end of the transmitter enclosure, with the audio-frequency channel, rectifiers and control equipment between them. This is a logical arrangement, since all the units in the center section are used in connection with either one or the other radio-frequency channel, but not both at one time, and the circuits are so arranged that access may be had to either channel while the other is in operation.

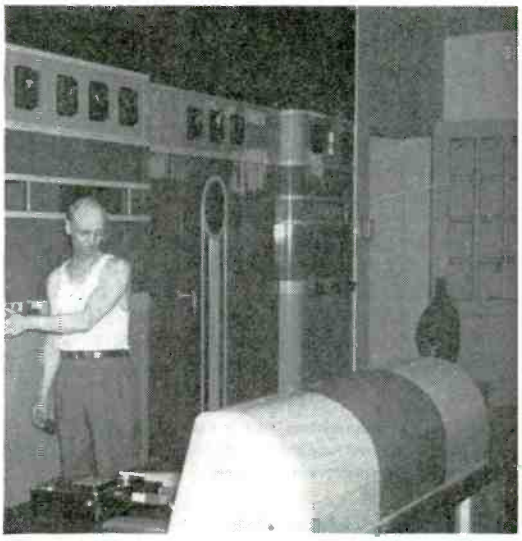
The relationship of the various units in the transmitter is illustrated in the block diagram. The two radio-frequency channels are equipped with components to cover all frequencies in the bands from 6 to 22 megacycles. Radio-frequency is generated by a crystal-controlled oscillator which operates at one-half the output frequency, that is, in the band from 3 to 11 megacycles. The oscillator stage is followed by a buffer-doubler stage, the output of which is always at the operating (output) frequency. The buffer-doubler stage is followed by three push-pull power amplifier stages the last of which supplies approximately 3.5 kilowatts to the push-pull final amplifier stage.

Incoming audio signals are fed through the transmitter control desk and hum-frequency feedback amplifier to the audio-frequency channel in the transmitter. Three audio amplifier stages are used, which, together with the bias rectifier, are mounted on the front, or driver panel of the channel.

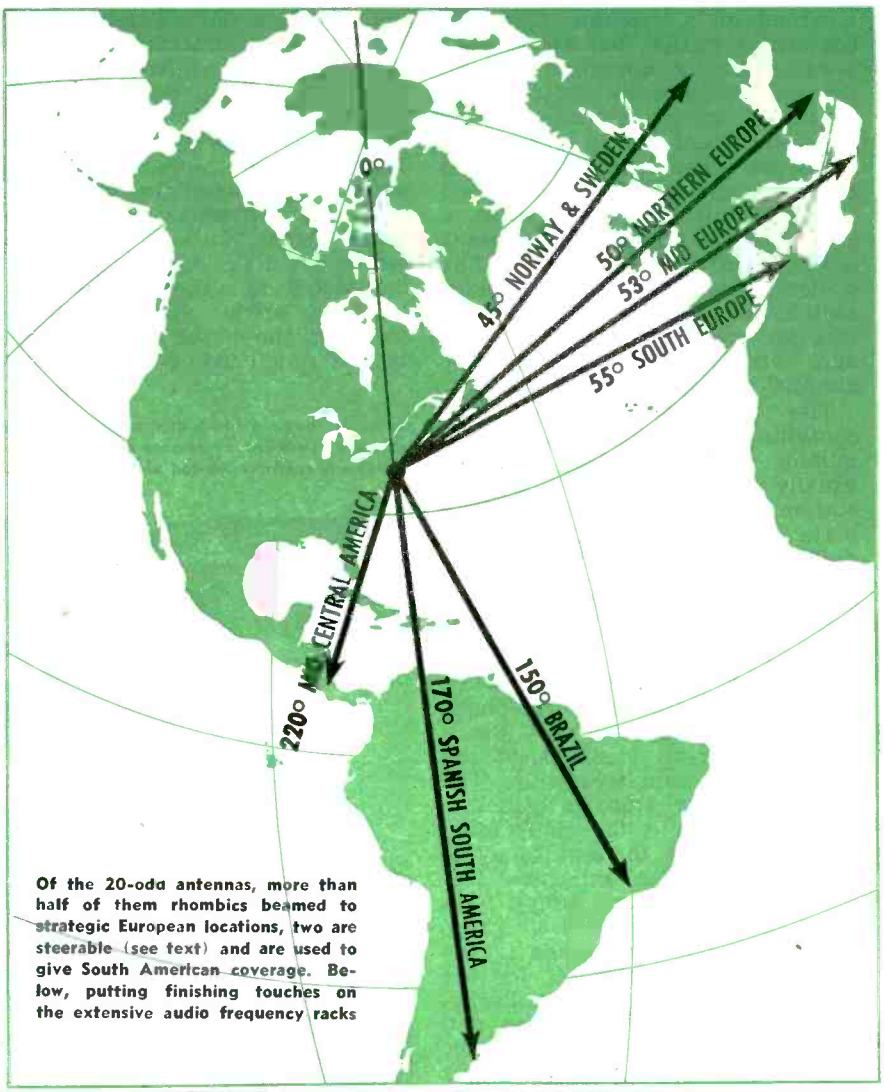
The third audio stage employs a "cathode-follower" circuit to drive the modulator tubes which are mounted on the rear of the audio-frequency channel. The class "B" modulator stage in conjunction with the modulation transformer and modulation reactor provides power for high level modulation of the class "C" final power amplifier in the radio-frequency channel. Degenerative feedback, applied from the modulator stage plate circuit to the input of the first audio-frequency amplifier stage, results in an audio-frequency output waveform which is a faithful reproduction of the audio signal at the input of the system.

Four separate rectifier circuits are used. The bias rectifier, mounted on the front panel of the low power audio channel, supplies bias voltage to the audio circuits only. The 1,500- and 5,000-volt rectifiers are both mounted on the low-power rectifier frame, except

NATIONAL BC SET-UP



WJZ. The three NBC-built transmitters are in the the enclosure with audio and controls between them



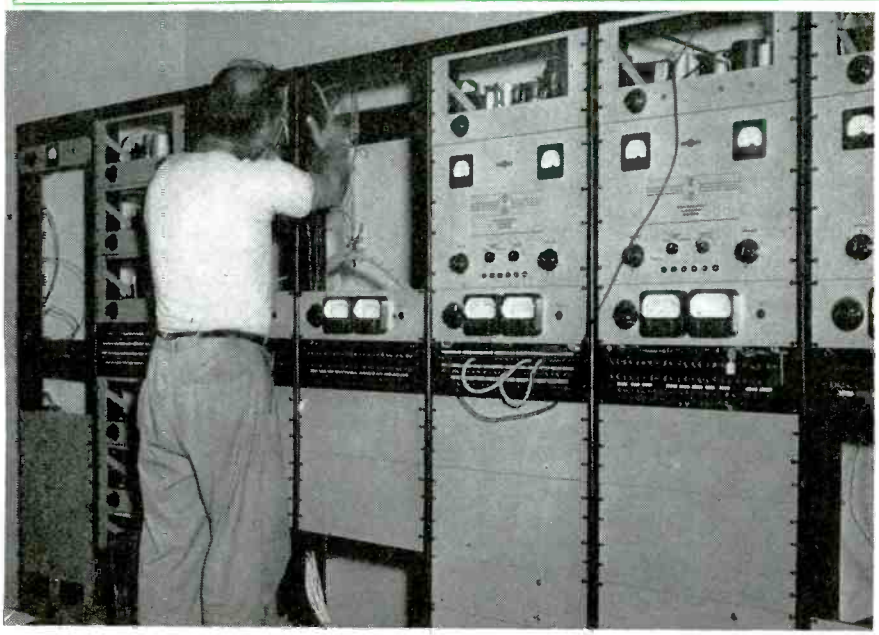
Of the 20-odd antennas, more than half of them rhombics beamed to strategic European locations, two are steerable (see text) and are used to give South American coverage. Below, putting finishing touches on the extensive audio frequency racks

that the 5,000-volt plate transformer is mounted separately.

The power feed for the whole transmitter comes through oil circuit breakers, and thence to the automatic voltage regulators, at 2,300 volts. The output from the regulators is split into two branches. One branch feeds the 10,000-volt rectifier plate transformers through a contactor. The other branch goes to the distribution transformers which step the voltage down to 230 volts. This voltage is used for all other transmitter circuits, including the various filament supplies, cooling system, and low-power rectifiers.

Water cooling is used on the power amplifier and modulator tubes. Distilled water is drawn from the storage tank by the water pump, fed through the cooler unit to the tubes in the transmitter and thence back to the tank. Two pumps are provided, together with the necessary switches so that either pump may be put into operation and the other shut down.

The transmitter control system includes a number of switches, relays and contactors which provide the means for starting up and shutting down the equipment, for protection of the operator against accidental contact with high voltage, for protection of the tubes against overloads and accidental



failure of water cooling, air cooling, etc. The control relays are mounted on a panel beside the distribution panel; the overload relays are on a separate panel, to the left of and just inside the enclosure center door. Contactors are mounted on a separate frame in the center section, but are not accessible during operation of the transmitter. Control switches are mounted at appropriate points along the front of the transmitter enclosure. Indicator lamps, also on the enclosure, and duplicated on the control desk, show at a glance the status of all important control relays and contactors. The control system includes a transfer switch and the necessary contactors for transferring the dc voltages from one radio-frequency channel to the other.

The transmitter control desk contains various audio-frequency mixing and switching facilities usually required at the transmitter station, and provides duplicate plate power switching as well as duplicate status lights. An extension modulation meter is provided and a dry rectifier furnishes power for the monitoring loud-speaker relay and for the transfer relay on the radio-frequency transfer panel.

The hum frequency feedback amplifier is a special unit which provides over-all feedback at the predominant hum frequency. The radio-frequency transfer panel is associated with it to supply radio frequency input to, and to automatically transfer, the hum frequency feedback unit along with the transfer of rf channels.

Provision has been made in the design of the transmitter for the addition of certain auxiliaries. These include a tube keyer and bias supply unit, which can be added to adapt the transmitter for high speed telegraph operation. Also, a master oscillator may be added to make possible the operation of the transmitter at frequencies for which crystals are not available. A monitor rectifier can be added to provide high fidelity monitoring of the transmitter output.

The transmitters function in pairs handling three programs, each on two frequencies simultaneously. All programs, incidentally, are fed through OWI's Master Control in New York (See Electronic Industries for August, pages 94 to 97).

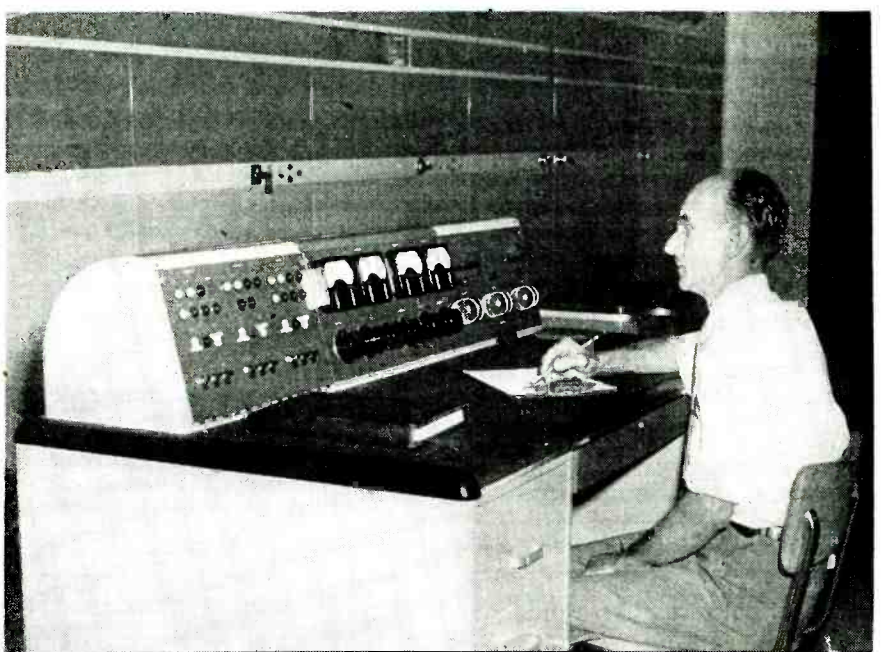
Altogether the transmitter site has some 20 antennas, about half of them rhombic. Two are specially designed "steerable" antennas beamed to give the most useful pattern in either of two locations to which they may be aimed.

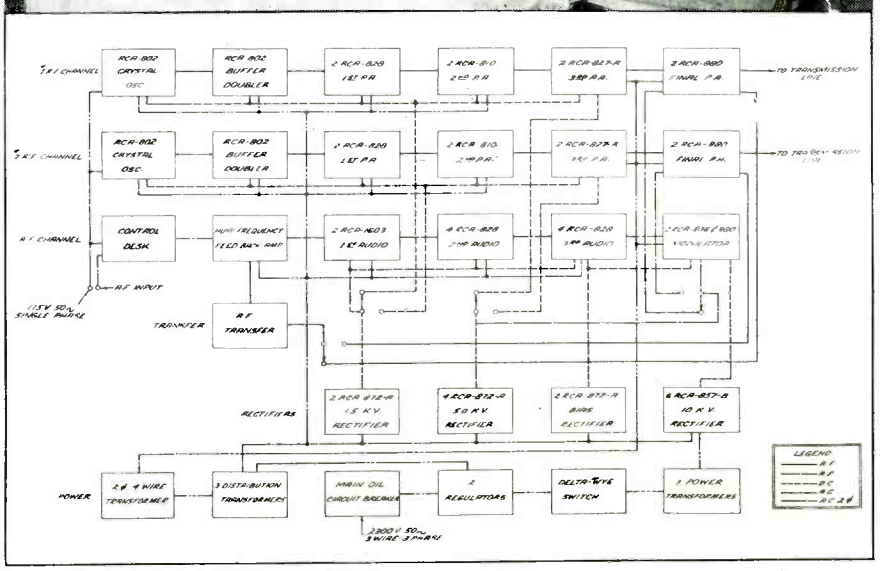
This pattern is obtained with a broadside antenna having a horizontal width of six half wave elements, two tiers of such elements being stacked vertically, with a complete duplicate set of such elements to the rear, making a total of 24 radiating elements. The 12 rear elements forming the reflecting tiers are parasitically excited.

The most important language areas of South America are centered around Rio de Janeiro and Buenos Aires. These areas are 20 degrees apart as viewed from New York. One of the earliest investigations conducted in connection with these antennas was to determine whether or not a single antenna could be built which could be steered to either of these two language areas. A study showed that for the lower frequency antennas which involve massive supporting structures and long spans, an electrically steerable antenna entirely satisfactory in performance would be preferable to the construction of separate antennas for the two areas.

The 12 elements which are driven are segregated into three groups, each fed separately, because it was determined that the desired radiation pattern could be obtained by separately feeding three bays. The center bay is always kept at zero degrees for reference to the outside bays. Steering this beam ten degrees to one side or the other of the center line to serve either Rio de Janeiro or Buenos Aires can be accomplished when one outside bay is retarded 75 degrees and the other one is advanced 75 degrees with respect to the center bay.

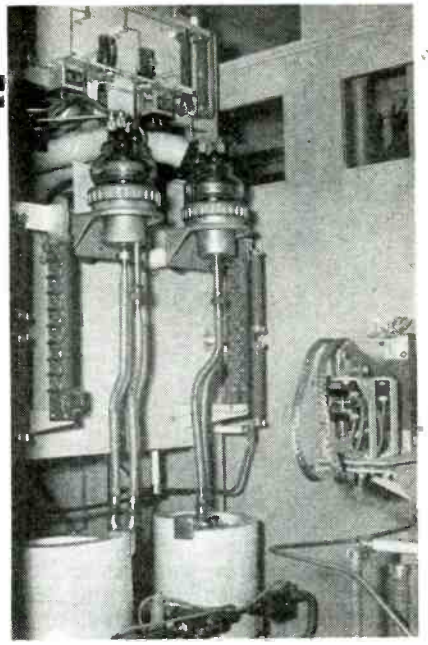
Below is shown a block diagram of one of the RCA 50 kw transmitters which have twin exciter channels, switched by remote control, and a single audio channel capable of 65,000 watts. The Console is centrally located and serves to control the three transmitters in the unit





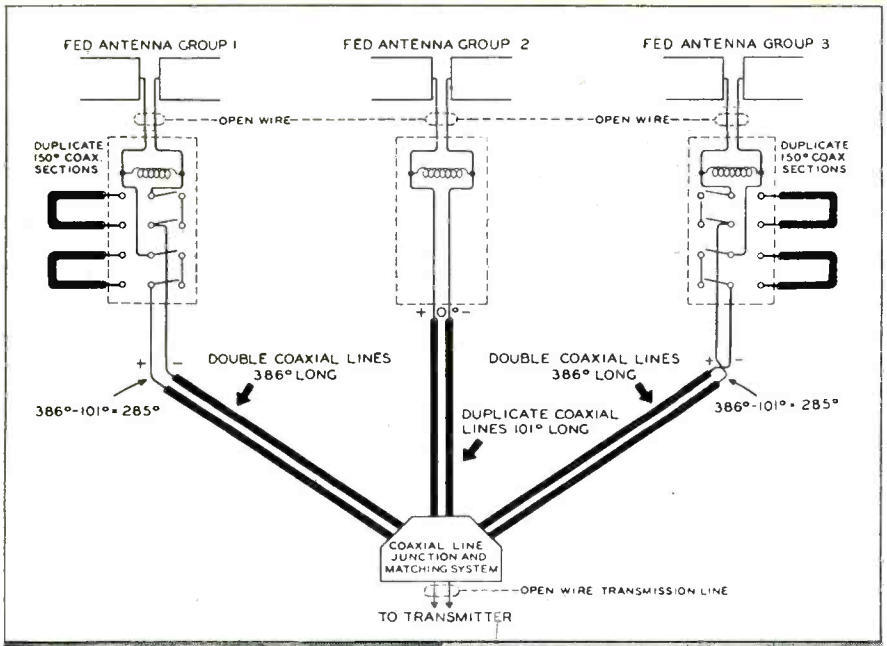
The transmission line from the station building divides into three coaxial branches, terminating in phasing boxes directly beneath the three sets of down leads. The branch to the center down lead is 101 electrical degrees long. The branches to the outer phasing boxes are 386 degrees long. The net result is that the outside phasing boxes lag 285 degrees with respect to the center box. The advance condition which makes reversible steering possible requires that both the outside boxes be 75 degrees ahead of the center box. This was easily accomplished by proper choice of the branch line lengths as described. In other words, a lagging phase of 285 degrees is equivalent to a leading phase of 75 degrees. Therefore, if all three of the down leads were connected directly through the phasing boxes to the transmission lines, the outside elements would each be advanced in phase 75 degrees with respect to the center box.

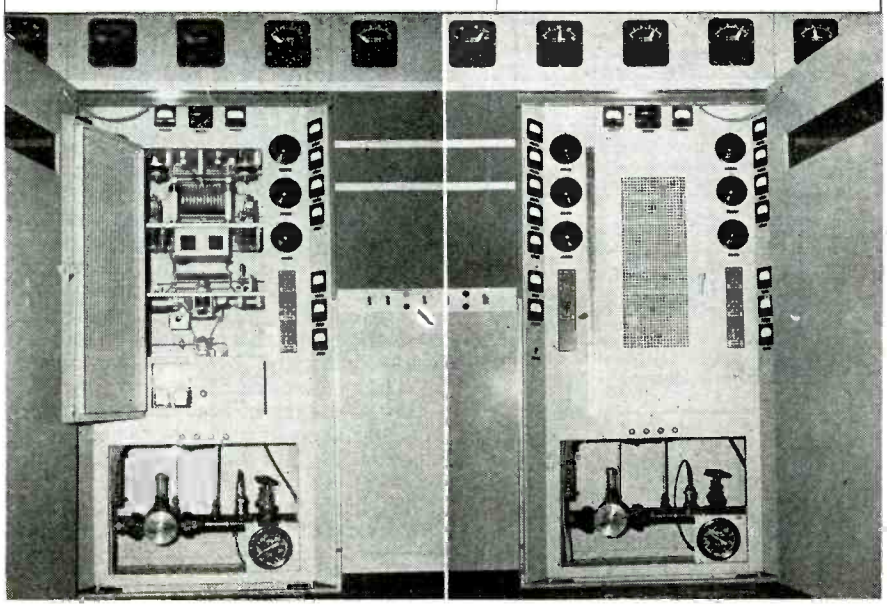
It was stated above that to steer the beam to the east or west, one outside box must be advanced 75 degrees and the other one retarded 75 degrees. Since, when connected directly through, both outside sections are advanced 75 degrees, it is possible to obtain the desired steering condition by retarding the phase of one or the other outside elements 150 degrees. This is accomplished by inserting by means of specially built high-frequency contactors, 150-degree "building out" circuits which introduce a lag of 150 degrees into one side or the other. The contactors are operated from the transmitter control point in the transmitter building by remote control and are interlocked with the main rectifier in such a way that the rectifier may be shut down, the antenna directivity changed and the rectifier re-energized in one operation. Coaxial transmission lines are used for the 150-degree phasing-out sections and also to connect the phasing boxes to the common junction of the three branches. The impedance of the down leads must be matched to the output of the phasing boxes and this is accomplished by circuit elements adjacent to the relays in the boxes.



The RCA type 880 modulator tubes are capable of supplying on maximum demand about 65,000 watts audio power

Two of the antennas beamed abroad are of the steerable type, the design permitting remote switching of phasing sections which move the beam pattern 20 degrees. Below are views of the low-power rf stage showing the protective door open, and closed for routine adjustments





Power gain

The power gain of the steerable antenna is 24, in comparison with the gain of a half-wave horizontal dipole. Actual field intensity measurements made in Argentina during alternate transmissions on the steerable unit and the comparison dipole showed that this gain was obtained within a few per cent. Thus, the effective power with 50-kw transmitter output is 1,200,000 watts.

The Central American antenna was built with a wide beam to cover the Central American arc of 60 deg. The requirements for serving this area are different than for South America or Europe. The power gain can be lower in this case to get the required wide pattern, while still maintaining high signal intensity, because Central America is comparatively close to New York. The power gain is 10 and, as a result, the effective power on this beam is 500,000 watts. Therefore, the combined effective powers on these two adjacent beams is 1,700,000 watts.

CIRCULAR AND POLAR SWEEPS

by **RALPH R. BATCHER**
Consulting Editor

A survey of special time base arrangements suitable for industrial oscillographic tests

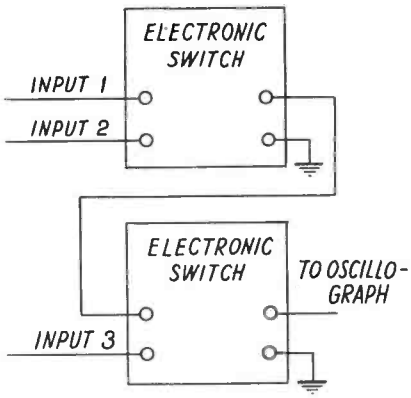
● In a series of articles appearing recently in these pages, a few basic principles were described whereby non-electrical physical quantities can be converted to a form suitable to control the vertical deflection system of a cathode-ray oscillograph. A great deal of time and effort is often spent in setting up oscillographic equipment for particular tests, to ascertain the amplitude of a certain effect, but all too often the time factor is left undetermined. In this work the "how much" factor is generally set up on the vertical deflection system, and the "when" factor on the horizontal. The timing factor generally is just as important, however, as is amplitude determination.

To most oscillograph users, however, the matter of horizontal deflection has never been considered a problem, since all one has to do is to switch in a self-contained sweep and set its controls to a suitable frequency. This convenience is, in fact, sometimes a detriment, inasmuch as accuracy and ease of interpretation of results often can be handled better in other ways.

This ease with which the modern linear sweep can be applied and synchronized seems to make its use almost mandatory, in the opinion of many investigators. The result is that the accuracy of many tests is obscured by assuming all effects under investigation are linear with time. Synchronization of the sweep at frequent intervals (say once a revolution) with the mechanism under study helps, but lots of irregularity can be introduced during a revolution, so that the assumption of constant linear velocity is doubtful.

When the whole industrial field is considered, a great many varieties of motion must be handled: linear displacement, linear angular velocity, irregular velocities (either linear or angular), and simultaneous displacements in two directions. These categories cover most of the usual industrial problems. While many physical effects showing up in an industrial test are represented by two factors—the independent and dependent variables—there are always a number of other factors that either must be maintained constant, or else three-dimensional graphs must be produced by the oscillograph.

Fig. 1 shows a form of electronic switch providing a method of superimposing two different factors with correct phase relations. To show three factors simultaneously, requires two of these switching circuits, illustrated in the oscillograms. The connections needed are shown in Fig. 2, below



A cathode-ray tube can reproduce faithfully movements along two dimensions, and there are several methods whereby a third factor also can be introduced: as by modulating the intensity of the beam, or the superposition of a rapid succession of two dimensional oscillograms, each differing from the predecessor by a factor proportional to the third "dimension."

An approach frequently used requires an electronic switch to show the multiple pattern. Here all factors (such as amplitude, position acceleration, pressure, etc.) are shown with respect to time. In this case, the accuracy of the horizontal movement is of lesser importance since all factors are shown as independent oscillograms superimposed on one another with respect to time. With careful switching, so as to avoid switching surges, several related factors can be delineated in this manner. They are always represented by aligned oscillograms, although possibly offset vertically in some cases. In rotating machinery tests, one channel must represent angular displacements during a revolution by the use of a linear or horizontal deflection. This is by no means easy, if momentary acceleration forces are present at any points in a revolution. This factor will be discussed later.

While all these methods utilize the factor of persistence of vision, still this is nothing unusual, since the whole system of cathode-ray operation is based on the same effect. It is quite easy to show two effects on a screen by the use of a push-pull type electronic switch shown together with typical oscillograms in Fig. 1.* It is, of course, possible to add more factors in the curve by using additional electronic switches, but the chances of amplitude distortion become greater.

This extension is shown by the simple diagram Fig. 2, where two factors are alternately connected by means of one switching stage, to one of the input terminals of a second switching unit. The latter has an extra input terminal that

* Another example of this system is shown in Fig. 3, page 104 of this issue.

permits a third factor to be applied. The output of the second switching unit goes to the vertical deflection system of the oscillograph. The horizontal deflection system of the latter is usually driven by a normal sweep circuit, for simplicity in interpreting the oscillograms. Other connections, however, are possible as will be evident later.

It frequently is found that certain effects associated with the study of a mechanism can be represented by a single pulse initiated whenever this effect starts or stops. These usually can be accurately delineated by a superimposed surge on one of the other oscillograms or by a momentary change in brightness, and so its introduction does not complicate the problem of interpretation unduly.

The use of electronic switches should not be confused with staged tests or sampling tests where a number of items are checked successively by switched connections using a self-actuated, ratchet-driven telephone switch or some similar variation. While about ten or twelve different things can be delineated per second in this way with a total of around twenty different checks, no two items are shown simultaneously. On the other hand, the electronic switch can be set to transfer the connections many thousands of times per second, and a fairly accurate comparison between the two quantities can be made.

Continuous oscillograms

Several forms of circularly-shaped oscillograms sometimes have been given the general designation of polar diagrams in certain places. This designation is not accurate in most cases, as for instance in the case of the following possible circuit arrangements, all of which give continuous oscillograms that are basically circular or oval in form (disregarding distortion from harmonics), but they are not polar curves. They have one advantage that no time is lost during a fly-back interval, as is true in the ordinary linear sweep system. Arrangements most frequently used include:

1. Circular diagram, using phase splitting circuit.
2. Circular time base.
3. Cyclogram.
4. Sinusoidal time base, running at frequency equivalent to that of the effect being studied.

In the first, a circle results only when the wave is free from harmonics. Inasmuch as there is little to be learned about a sine wave in addition to its amplitude and frequency, the usual waveform oscillogram is of value only in the study of nonsinusoidal waves, so this method is generally of doubtful utility, since the harmonics in the wave are handled differently across each branch of the phase-splitting circuit (see Fig. 3). This makes this type difficult to analyze.

In the second method a sine wave of known frequency, applied to a similar "rotator" (as in Fig. 3), gives a circular trace, to which the unknown wave is applied to give supplementary radial excursions. This system often provides the preferred method of handling industrial machinery tests, if the rotation speed is synchronous with the machine under test, when the answer is mainly one of timing comparisons, and where the amplitude of the effect is secondary.

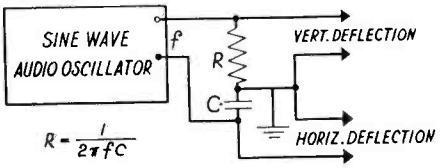


Fig. 3—Basic form of circular time base "rotating" circuit

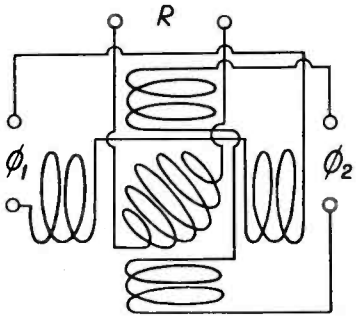


Fig. 5—Internal connections of rotatable transformer with two-phase output

The third form, the cyclogram, represents a form of oscillogram where effects having a common frequency are applied to the two deflection systems: volts and amperes, B-H, etc. In this form of oscillogram, however, angular measurements around the center point have no significance.

The fourth group refers to a form of Lissajou figure where a synchronous sinusoidal timing wave is applied to the horizontal deflection system, and the wave under investigation produces vertical deflections. This system is frequently used. The advantages are the absence of a dead period during the wave, representing the return sweep and, in the viewpoint of some, greater ease in interpreting harmonic content, than when a saw-tooth waveform produces the sweep.

Polar curves

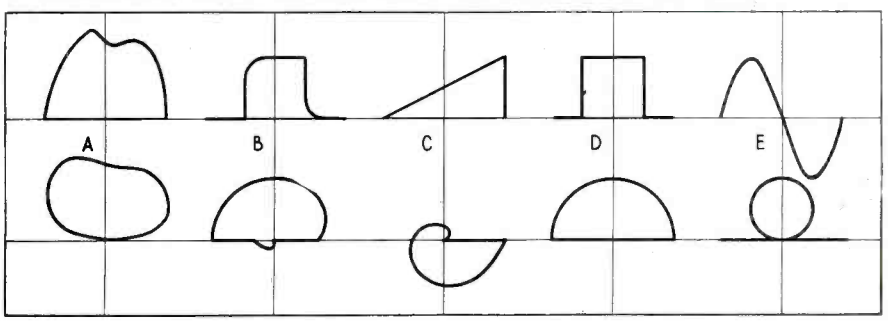
The delineation of quantities in terms of polar coordinates forms a useful method of analyzing many effects, especially when they are of a recurrent nature. The production of such curves directly on a cathode ray oscillograph is difficult, however, although several variations giving other types of curves are common.

The utility of a polar coordinate system in oscillographic tests is marked in some instances but far more complicated as to analysis in others. In this regard, the advantages are found in the same class of problems that are best solved by mathematical analysis using polar coordinates. It is necessary to compare both systems (when there is any doubt as to which should be used) by plotting a curve similar to those expected in the test with both rectangular and polar coordinates, to determine whether a saw-tooth or a polar time base should be used, with the former getting the breaks if there is but little choice. Fig. 4 shows several common waveforms as they would appear with polar coordinates.

In a polar curve, the radius vector is at all times proportional to the quantity being measured, and the angular movement of this vector either is linear with time, or is proportional to some other factor involved in the problem (such as position).

True polar curves are not easy to obtain with a cathode-ray tube, although rotating magnetic fields co-

Fig. 4 compares typical waveforms with their polar equivalents below. A—an irregular wave, B—distorted square wave, C—saw-tooth wave, D—true square wave, E—sine wave



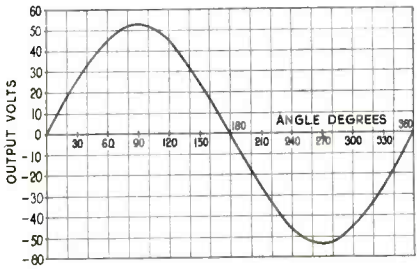


Fig. 7—Output characteristics of one of phase windings for the Kollsman type 787-01 rotatable transformer with an input of 32 volts

axial with the neck of the cathode-ray tube and operating synchronously with some factor under investigation have been used in some equipment. The complexity of mounting and rotating such a set of coils is a disadvantage that makes the use of such methods less advisable.

A simple device, known as a rotatable transformer, consisting of a generator with a rotatable winding (primary) and two secondaries disposed at 90 deg. (electrical and physical) from each other has certain features for this work. The windings on a typical model, such as in Fig. 5, are accurately disposed and balanced so that a 90 deg. phase difference between the outputs from each of the fields is assured. The windings and magnetic parts are such that operating ranges extend over the audio frequency range.

Considering a steady current input to the rotor, voltages are introduced in both stator windings whenever the rotor is moving. If the rotor is stationary, no voltage is produced. The voltages in the secondary always reach maximums successively, at positions 90 deg. apart in the mechanical positions of the shaft. The magnitude of the voltage depends on the current applied to the rotor winding and the speed—being directly proportional to both factors. Fig 6 shows a unit of this type, a form of Telegon, a design making use of a light weight rotor with ball bearings. The two stators have complete electrical balance with respect to the rotor. The correct pole face shape relations between rotor and stator have been developed to provide true sinusoidal output with a constant speed, as shown in Fig. 7.

Machine testing

There are several ways by which this device can be used in oscillographic studies. In industrial work involving rotating machinery, it is of course desirable to couple the rotor shaft directly to the prime mover, so that all movements of the latter, steady or varying, are followed by the shaft of the Telegon or some other equivalent unit. The two field windings are electrically independent and can be connected to the vertical and horizontal deflection systems of the oscillograph.

Nothing happens, however, at any speed until the rotor is connected to some source of potential.* Assume first that a dc source of a suitable voltage is applied to the rotor, 12 volts or less being satisfactory on the unit shown in Fig. 6. Here a circular trace of the spot is obtained and follows the movements of the driving shaft, the diameter of the circle being proportional to the speed. Therefore, a "bump" on the circle indicates sudden acceleration. To get suitable accuracy it is necessary to balance the deflection amplifier systems as to their outputs to give a trace initially circular. Any irregularity in velocity will change the diameter of the circle so that momentary acceleration at a point becomes apparent if of sufficient magnitude.

Another method of indicating speed variations is to apply a high frequency pulsating current to the rotor, whereupon a spoked pattern results; the separation of the spokes shows the points where speed variations occur. In this case, the flux rate of change in the rotor is so great (on account of the high frequency) that variations in the voltage output from either stator, caused by speed changes are of no importance.

Checking lost motion

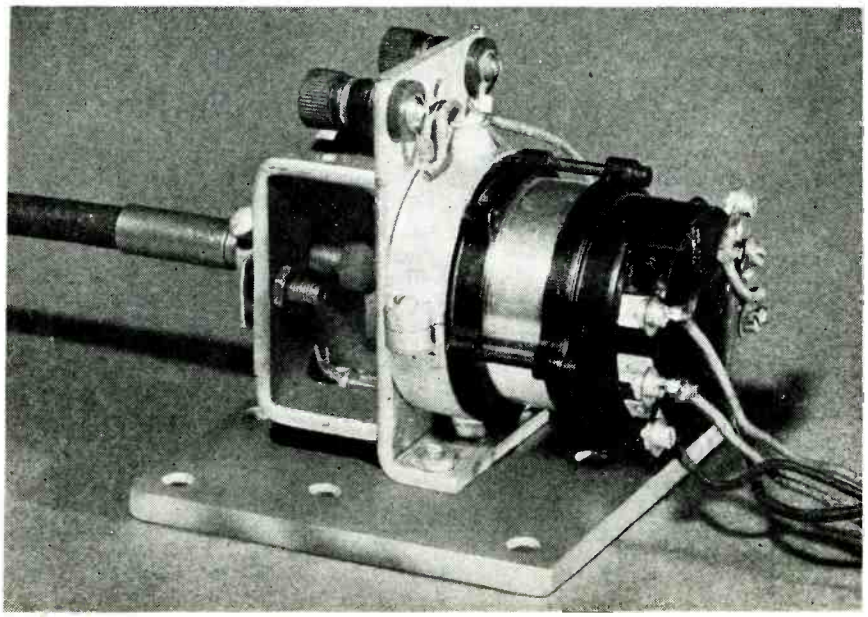
This method is reliable only when no lost motion exists in the drive assembly to the motor. This leads up to another type of test which can be used to determine lost motion, eccentricity and irregularities in power drive systems with belts, gears, etc. Here the rotor is driven from one end of the power system and the stator (suspended in a rotable cradle) is driven at the same speed and in the same direction, by a power take-off at the other end of the system. The generator delivers no output except when there are momentary speed losses in the system.

If the generator is driven at a convenient speed, the application of a surge or impulse (that is to be measured) to the rotor winding will result in a true polar diagram, the radius vector being proportional to the potential of the surge, under the conditions of constant speed. One difficulty is in the selection and maintenance of a speed that will produce such a polar diagram with an angular duration that has a definite relation with respect to the duration of the surge. If the shaft makes several revolutions while a simple half-wave sinusoidal pulse is taking place a combination of right and left handed spirals will be seen. Whether or not this is a disadvantage depends on what information is wanted from the test.

Extensions of these principles to particular industrial problems where speed and acceleration values must be determined, will follow in a forthcoming issue.

* Unless the amplifier gain is sufficient to take note of voltages generated by the field of the earth, see Electronic Industries," December, 1943, page 94, "Gyro Fluxgate Compass."

Fig. 6—Kollsman two-phase transformer in special mount, with flexible shaft drive connecting to machine under test



POSTWAR HOME RECEIVERS

● The public at least (if not the radio engineers) is well informed as to what wondrous radio receivers to expect immediately after "V" day. Anyone making a cold survey of actual plans, however, may discover that in all probability there will be but few innovations and that these may be of relatively minor importance. Many companies have already planned some of the items in their lines, even if a complete set of specifications and models are yet to come. All have flexibility in their plans to absorb any new items in order to meet last-minute "secret weapons" developed by competitors.

The recent regulations* permitting work on postwar reconversion plans, and the development of models will enable many to participate more actively in working up designs. Investigations now in progress in five groups, will determine combinations that will be available to the public:

1—AM reception in the standard range
2—AM reception of foreign programs
3—FM reception
4—Television
5—Accessories, such as record changers, remote controls.

In addition, great emphasis is being placed on numerous circuit variations, such as crystal control, mainly by component manufacturers who have facilities for making these and other items that did not have universal acceptance in prewar receivers. An appraisal of some of these innovations from both the engineering and the economic viewpoints, as determined by a survey, will be included in this series in "Electronic Industries." What is a useful device in a receiver in one price range, may be an impractical gadget in another range, where the cost of adequately engineering and producing it is not met by income from its sale.

All companies, faced with the problem of postwar planning, have two factors to consider: their prewar models, specifications and tools which in most cases represent as high a quality as many price ranges require. To this the best utilization of war-developed improvements must be decided on. This latter problem is the most difficult, because of the wide differences in the interpretation, by individual engineers, of the utility and best method of handling various applications of radio tubes. Postwar conversion must also be concerned with the problem of stocks of components and raw materials now in the hands of both manufacturers and various military procurement agencies and the method of their disposal finally decided upon.

It is evident that probable increased labor costs will have a considerable effect on the ultimate price of a receiver, but on the other hand, many new "methods of thinking" in production processes and the utilization of new technics may offset these advances, at least for those concerns that can establish production rates at a level where those improvements are worth while. In a critical analysis of technical trends it is convenient to break down the design problems and to handle each subject separately, such as:

1—Speakers
2—Audio amplifiers
3—Detection and volume level regulation
4—IF circuits
5—RF circuits and conversion arrangements

In the matter of timing it is not essential that all classes of receivers appear immediately after the termination of hostilities. The first models inevitably will reflect prewar styles and features. Hurried immature designs which might appear from organizations that want to get there first with most, may well destroy any general public acceptance of many new services or features.

This is well illustrated in the matter of frequency modulation. This word (to the public) represents a new service having a combination of features non-existent in reception in other ranges. This meaning is wholly divorced from the engineers' interpretation of FM, and even includes many features inherent with the frequency range utilized by the service, irrespective of the method of modulation.

A narrower interpretation of FM is but a quibble, and the public should be given a service that is, in every way, consistent with the best that can be provided with that service, no matter what particular circuit or principle is used. Receivers having lower standards using crude hybrid circuits just to "get" FM, will do much toward slowing down acceptance of an otherwise

(*Continued on page* 220)

LOOKING AT SOME DESIGNERS' PROBLEMS

● **RECEIVER CHARACTERISTICS**
Signal handling capacity
Sensitivity
Adjacent channel interference
Noise level
Amplitude distortion
Frequency ranges
Cross modulation
Distortion
Image signal suppression
Microphonics
Ranges provided
Tone compensation

● **RECORDERS and REPRODUCERS**
Disk-record changers
Tape recorders Wire recorders

● **TUNING**
Variable capacitors Permeability tuning
Crystal oscillators Variable inductors

● **DIALS and CONTROLS REMOTE CONTROLS**
Push button Slide rule Clock

● **TUBES (Basing)**
Octal Loctal Miniature

● **TUBES (Types)**
Best filament voltage
Using tubes of a simple structure or a lesser number with higher "Gm"

● **CONTROLS**
Volume control systems
Noise suppression
Volume expansion
Remote controls
Tone controls

● **PORTABLE SETS**
Storage battery operation
Dry cell operation
Combination line and battery operation
Short wave FM

● **SPEAKERS**
Style
Number
Provision for extension speaker
Provision for headphone

● **AUDIO CIRCUITS**
Negative feedback
Cathode coupling
Synthesized bass
Volume expansion

● **AUDIO INPUTS**
Microphones
Phono-pickup
Tele-FM sound

● **INTERMEDIATE FREQUENCY**
Variable selectivity
Selective band pass characteristics
Dual IF systems in FM-AM sets

● **FREQUENCY STABILITY**
Circuit improvements
A.F.C.
Signal-seeking systems
Crystal control

● **STANDARDIZATION**
Capacitors Resistors
Transformers Tubes

* Interpretation 2 of Electronic Equipment Order L-265.

SIMPLIFIED PULSE GENERATOR

by W. E. MOULIC
Associate Editor

Sources of pulses of controlled frequency and time duration useful in radar, television, and FM testing

● The generation and utilization of special shaped pulses of electric energy are two quite important advances in the field in recent years. The first comprehensive use of automatically generated pulses was in electronic television. Here the precisely shaped and timed pulses act like teeth on a gear to keep the transmitter and receiver in synchronism. Even as short blasts of sound are useful in estimating distances by timing the echo, short duration pulses of a radio carrier have long been used to determine the distance to a reflecting surface, particularly the ionosphere, by timing the reflection.

Generation of high amplitude short duration pulses of current or voltage may be accomplished by two general means; the use of special relaxation types of electronic circuits, such as the multivibrator, blocking oscillator, etc.; and the modification of a sine wave by rectification, clipping, and differentiating to produce the required pulse. In general cases, the requirements for the pulse are: (1) Adjustable pulse repeat frequency; (2) Adjustable pulse duration; (3) Steep wave front (usually expressed in volts rise per microsecond); (4) Rapid decay of pulse at end of predetermined interval; (5) Substantially uniform amplitude during pulse interval.

Fig. 2—Panel controls of generator regulate pulse frequency and duration

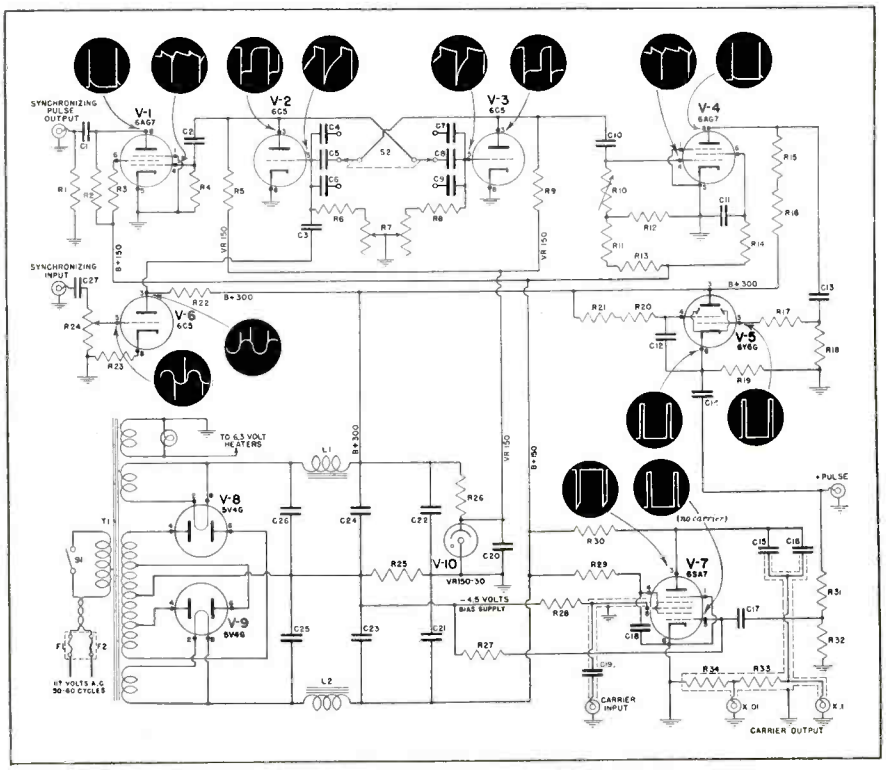
A simplified pulse generator designed for test of pulse operated circuits made by Measurements Corp., Boonton, N. J., uses a multivibrator to generate the basic pulse. Identified as model 79, the unit generates a voltage pulse of approximately 150 volts peak, over a frequency range of 60 to 100,000 cps. The width of the pulse is continuously variable from 0.5 microseconds to 40 microseconds.

The circuit is shown in Fig. 1. The two triodes V_2 and V_3 act in a multivibrator circuit to generate the conventional wave shapes shown adjacent to the corresponding tube elements. The frequency of oscillation in this circuit is adjusted by the dual grid potentiometer R_7 which is controlled by the calibrated dial at the left of the instrument (see Fig. 2). A decade multiplier consisting of capacitors C_4, C_5, C_6, C_7, C_8, C_9, controlled by switch S_2 gives a frequency range up to 100 kc.

The frequency control dial attached to R_7 is calibrated and is sufficiently accurate for general applications. Where more exact pulse frequency is required a synchronizing signal from a standard oscillator can be connected to the synchronizing amplifier tube V_6. This synchronizing input can be sinusoidal or of other wave shape. The synchronizing signal is applied to V_2 to stabilize the oscillator.

The output of the multivibrator has a wave shape as shown in Fig. 1. The wave shape at the plate of V_3 is applied through a capacitance - resistance network operating as a differentiator. Capacitor C_{10} and R_{10} form this network at the grid of V_4. The voltage across R_{10} depends upon the rate of change of voltage at the plate of V_3. Negative voltage pulses are formed across R_{10} and produce corresponding positive pulses in the plate circuit of V_4. These positive pulses at the output of V_4 are applied to a cathode follower stage V_5. The cathode resistor R_{19} biases

Fig. 1—Model 79 pulse generator showing oscillograms of voltage waves at tube input and output. Peaks on sinusoidal synchronizing wave at V_6 are due to stray coupling from multivibrator. R_7 is frequency control and R_{10} is pulse width control



V_5 to a low current value and the incoming positive pulse as shown at pin 5 of V_5 causes an increase in plate current and a corresponding output wave across R_{19}.

The "tooth-pick" wave at the plate of V_4 is of sufficient amplitude to drive the grid of V_5 to approximately saturation thus producing the flat topped wave at both grid and plate of V_5. Resistor R_{17} is for the purpose of protecting the grid of V_5 during this peak interval. The polarity of the output pulse at the cathode of V_5 is positive and impedance at this point is approximately 1000 ohms.

The output pulse from V_5 rises to its peak amplitude in 0.25 microseconds at all frequency ranges. The output level of 150 volts thus gives a rate of rise of 600 volts per microsecond. The decay rate of the pulse is approximately 20 per cent of the duration of the pulse and at approximately 0.5 microsecond duration, the pulse shape is approximately an isosceles triangle. The pulse width, which is controlled by the resistor R_{10}, should not exceed one-fourth of the interval for one cycle since the pulse shape and frequency will be unreliable. The full 40 microsecond duration can be employed at frequencies up to 6.25 kc.

An output similar to that at the plate of V_3 is available at V_2 for application to the synchronizing pulse amplifier V_1. C_2 and R_4 behave as a differentiator to produce a "tooth-pick" pulse at grid and plate. The synchronizing pulse output of V_1 has the same frequency as the main pulse but is delayed by one-half cycle, approximately. The width of this pulse is less than 3 microseconds. The pulse amplitude is approximately 40 volts and the polarity is positive. The output impedance is approximately 2500 ohms. The half period delay in the synchronizing pulse output is obtained by taking the sync. pulse from V_2 while the main pulse is taken from V_3 thus giving the 180 degree relationship.

In order to synchronize the oscillograph with the pulse produced by the generator the output of V_1 is used to synchronize or trigger the sweep circuit in the oscillograph depending upon the type. The half period time difference between the sync. pulse and the main pulse gives a locking action with the pulse to be observed located approximately in the center of the cathode ray screen. Where a continuously adjustable time is desired between the synchronizing pulse and the main pulse, the circuit of Fig. 3 can be added externally. This circuit will give an adjustable delay from zero to 1500 microseconds of the synchronizing pulse thus permitting sliding pulses for comparison and other purposes. Since the circuit of Fig. 3 is a conventional flip-flop unit, either positive or negative pulses can be selected from respective plates of the 6SN7. The wave shape of the voltages at various points in the circuits are shown by the curves on Fig. 1.

Tubes V_1 and V_4 act as limiting amplifiers and are operated at saturation. Any positive pulses appearing on the grids of these tubes will have no effect on the plate current. Negative pulses from the multivibrator tubes will periodically reduce the plate current to produce the positive pulses across the load resistors R_2 in the case of V_1 and R_{15} and R_{16} in the case of V_4.

The adjustable resistor R_{10} is the pulse duration control since it regulates the discharge time of C_{10}. The larger the resistance of R_{10} the longer the discharge time for C_{10}. Consequently the duration of the pulse will be longer. The pulse width control at the right of Fig. 2 regulates R_{10}. The pulse output amplifier V_5 operates at a constant level and the amplitude of the pulse delivered is not adjustable. Where adjustable amplitude is desired, it can be produced by the addition of an external cathode follower stage with a simple grid potentiometer and with circuit constants similar to the V_5 stage.

Since it is often required to pulse modulate an rf carrier, a modulator, V_7 is incorporated in this unit. A carrier frequency up to approximately 100 mc. and a level of approximately 0.1 volt can be connected to the modulator grid of the 6SA7. The square topped positive pulse from V_5 is connected to the number one grid of V_7 and thus will pulse modulate any rf carrier. A simple resistance attenuator in the plate circuit of V_7 gives a pulse modulated carrier of 1/10 and 1/100 the carrier input level.

A block diagram of the general setup for observing the pulse or a pulse modulated carrier is shown in Fig. 4. Units to be tested can be connected between the output of the pulse generator and the oscillograph.

Many uses of pulse modulation equipment are of a war secret nature. There are many applications of pulse generators to timing, triggering, synchronizing and testing problems. As an example, in the

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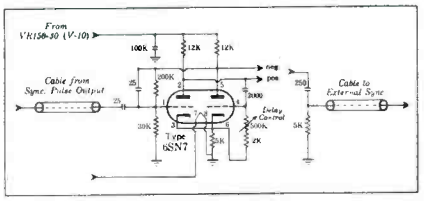


Fig. 3—Flip-flop circuit which can be used to give sliding pulses

Fig. 5—Interference discrimination characteristic of typical FM set in which a 40 microsecond 60 cps. pulsed wave produced the interference

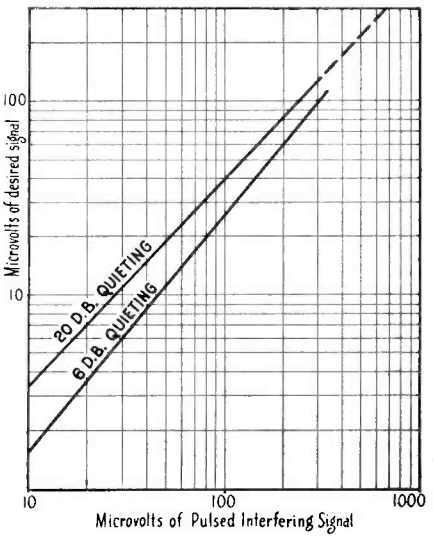
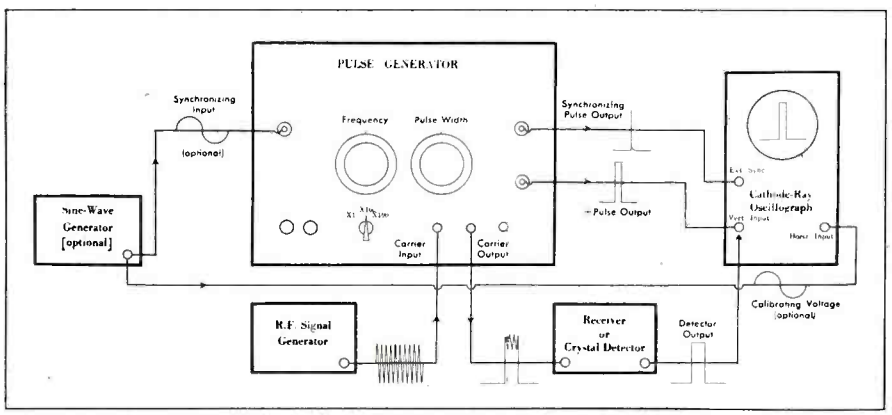


Fig. 4—Block diagram of typical equipment set-up for pulse wave testing



BEHAVIOR OF RESISTORS

by R. G. ANTHES, B. A. Sc.*

Determination of the conditions by which complex circuit effects are introduced by simple resistors

● Nearly every piece of electrical equipment contains resistors. In direct current circuits almost any type resistor functions as a resistance at its nominal value, but with alternating current the effective resistance may depart widely from this. In some cases this resistance may increase with increasing frequency until a maximum is reached, and then continue decreasing indefinitely. In other cases, the resistance appears to decrease from its nominal value, for any frequency. In addition, reactance effects occur and the behavior of a resistance may appear to be erratic as the frequency is altered.

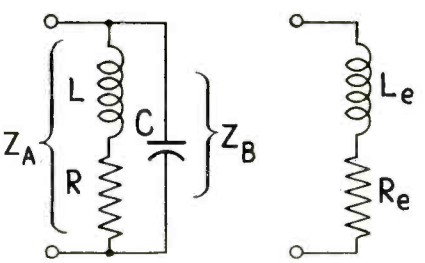
For example, a wire wound resistor may act as an excellent radio frequency choke over a limited range of radio frequencies. These effects are of vital importance, especially when resistors are used in measuring equipment where accuracy of measurement is paramount. These effects may appear to be erratic, but when the cause is understood, it will be found that such is not the case. The data presented in this article were determined by the writer in investigating the error with frequency of some radio frequency measuring equipment, and explains these effects.

In practice it is not possible to obtain pure resistance; inductance and capacitance always exist simultaneously with it. Because of this fact, resistors exhibit impedance, this impedance depending upon frequency. If pure resistance existed, there would be no reactance effects, and skin effect (and radiation at very high frequencies) would be the only factors affecting the effective resistance. It is the inductance and capacitance associated with a resistor that cause reactance effects and the marked change in effective resistance as frequency varies. The engineer usually seeks a resistance which will maintain resistance as nearly constant as possible, with a minimum of reactance, over a maximum frequency range.

The idea of distributed resistance, inductance and capacitance is easy to visualize. Consider a piece of straight wire of uniform diameter. Such a wire has a definite resistance per unit length. The property of resistance is not bunched at one spot in the wire, but extends, uniformly in this case, throughout the length.

A straight piece of wire also has inductance, although small. Current passing through a wire has associated with it an electromagnetic field. During one half cycle energy is being fed into this field and during the next half cycle energy is being fed back from the field. Whenever this effect occurs, inductance is present.

A little thought also will show that a straight wire has capaci-



Figs. 1 and 2—Equivalent networks that a resistor introduces in high frequency circuits

tance. An electrostatic field exists between two points at different electrical potential, which are separated by some dielectrical material. Similar to the electromagnetic field, energy is fed into the electrostatic field during one half of the cycle, and is given back during the succeeding half cycle. When this occurs capacitance is present. Along the wire there are points of different electrical potential due to the voltage drop along it, and an electrostatic field is built up between them. Consequently capacitance exists along the wire. It is evident that this effect is not concentrated in one spot in the wire, but occurs throughout the entire length. The distribution is rather complex.[1]

An ordinary radio frequency coil is an excellent example of distributed R, L and C. The resistance is the same as for the straight wire used. The inductance, however, is greatly increased due to mutual inductance between turns. The capacitance is also increased due to the proximity of turns. In this example, the resistance is small, because the wire used has low resistance. The inductance is high and the capacitance is by no means negligible. The three effects are distributed throughout the whole coil.

The rod type resistor, which is used extensively today, has very little inductance. This is because it is a short straight cylinder. However, the capacitance is appreciable and predominates over the inductance at all frequencies.

Some equipment used at radio frequencies uses wire wound resistors. The wire is wound on thin cards, to reduce inductance. If two wires could be wound concentrically and carry equal currents in opposite directions, the inductance would be zero as the two electromagnetic fields would cancel. If the wire is wound as a coil on thin cards, the adjacent turns on opposite sides of the card are adjacent and parallel, and the inductive effect is tremendously reduced. However, the capacitance effect is large.

Method of analysis

It must be remembered that in a resistor, R, L and C are inseparably intermingled. Thus to determine accurately the performance of a resistor at very high frequencies, the resistor must be analyzed as a network of distributed resistance, inductance and capacitance. If these parameters were uniformly distributed, transmission line formulas could be easily applied. Unfortunately the parameters are not uniformly distributed and the solution is not an easy one.[2]

*Lecturer in electrical engineering, University of Toronto.

[1] See "The Behavior of High Resistances at High Frequencies," by Prof. G. W. O. Howe, Wireless Engineer for June, 1935.

[2] Prof. G. W. O. Howe, loc. cit.

AT RADIO FREQUENCIES

In his early electrical training, the engineer is taught to think of lumped resistance, inductance and capacitance. The coil used as an illustration is considered as a lumped resistance in series with a lumped inductance. At power frequencies, this analysis gives accurate results. At higher frequencies, these results are in error due to the shunting effect of the distributed capacitance. The lumped circuit of a coil is then altered by adding a lumped shunt capacitance across the series inductance and resistance as shown in Fig. 1. This equivalent circuit can then be used at radio frequencies, as is well known.

A resistor can also be represented by the circuit of Fig. 1. The only practical difference in this circuit for a coil and a resistor is in the values of R, L and C. This lumped circuit can be readily solved to show the performance of a resistor at radio frequencies. The results from the equivalent lumped circuit will ultimately be in error if frequency continues to increase. The results have been determined only up to the resonant frequency, with the intent that the resistors would be operated considerably below this frequency. The conclusions drawn from the results do not apply for frequencies higher than the resonant frequency.

Circuit eqivalents

The lumped circuit of Fig. 1 is equivalent (at any one frequency) to a simple series circuit consisting of resistance R_e, and inductance L_e in series as shown in Fig. 2.[3] In deriving the expressions for R_e and L_e, which occur in equations 1 and 2 below, the resultant impedance of the circuit of Fig. 1, was simply equated to the impedance of Fig. 2.[4]. Thus the equivalent series reactance X_e equals $L_e\omega$. Since the resultant reactance can be inductive or capacitive in practice, a negative equivalent inductance can occur. When this happens, it signifies that the reactance is capacitive. The value of this capacitive reactance can be determined by multiplying the negative equivalent inductance by ω. If the equivalent series capacitance is desired, in this case, it can be obtained from the capacitive reactance, since X_e will then equal $1/C_e\omega$.

[3] See Circular C74 of the U. S. National Bureau of Standards.

$$R_e = \frac{R}{(RC\omega)^2+(1-LC\omega^2)^2} \qquad (1)$$

$$L_e = \frac{L(1-LC\omega^2) - R^2C}{(RC\omega)^2+(1-LC\omega^2)^2} \qquad (2)$$

$$X_e = \frac{L\omega(1-LC\omega^2) - R^2C\omega}{(RC\omega)^2 - (1-LC\omega^2)^2} \qquad (3)$$

(*Turn page*)

[4] This conversion can be carried out as follows:

$$Z_A = R + jL\omega \quad \text{and} \quad Z_B = \frac{-j}{C\omega}$$

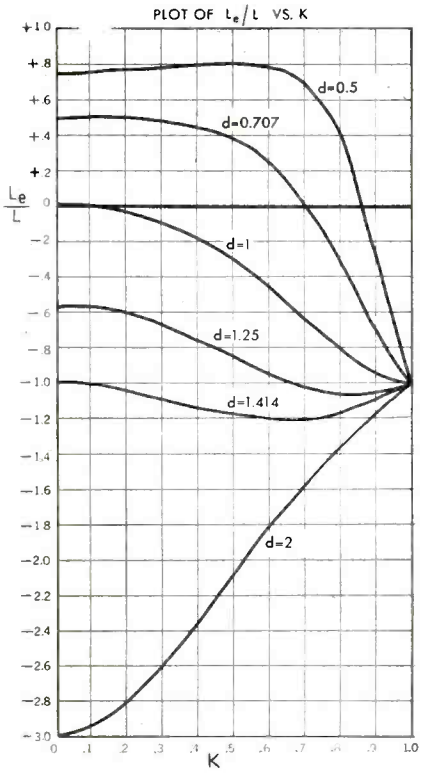
$$\frac{Z_AZ_B}{Z_A+Z_B} = \frac{(R + jL\omega)\left(\frac{-j}{C\omega}\right)}{R + jL\omega \frac{-j}{C\omega}}$$

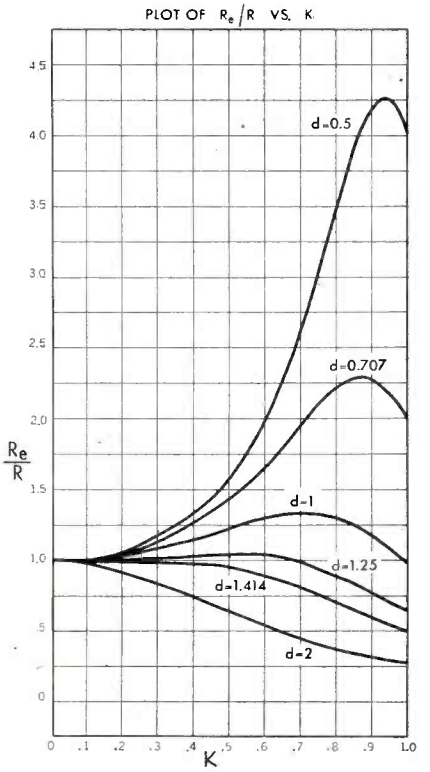
$$= \left[\frac{-jR + L\omega}{RC\omega + j(LC\omega^2-1)}\right]\left[\frac{RC\omega - j(LC\omega^2-1)}{RC\omega - j(LC\omega^2-1)}\right]$$

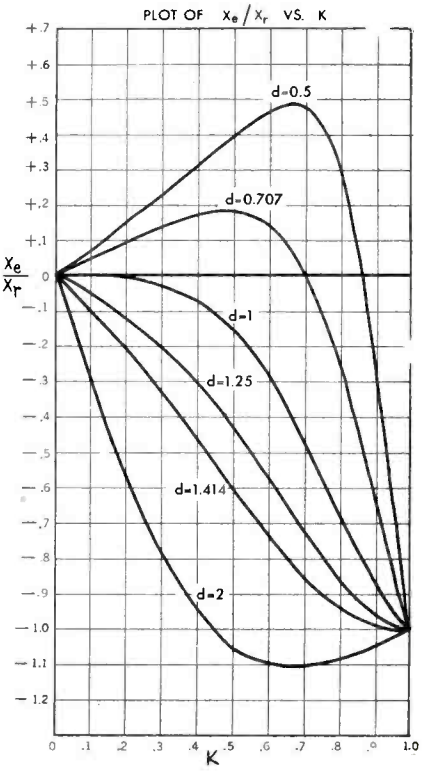
$$= \frac{R + jL\omega(1-LC\omega^2) - jR^2C\omega}{(RC\omega)^2 + (LC\omega^2-1)^2}$$

$$R_e + jL_e\omega = \frac{Z_AZ_B}{Z_A+Z_B}$$

from which eq. 1 and 2 can be derived directly.







These are exact formulas, assuming that L, R and C remain constant with frequency. The results obtained, however, will be modified by skin effect.

R_e, L_e and X_e can be solved for a range of frequencies, and the results expressed in graph form. This has been done by different authors,[5] for a high Q circuit, to show the performance of a parallel resonant circuit near resonance. The curves in this article belong to the same family, but have been solved for low Q, which is the condition applicable to a resistor. It is useful to have curves of both L_e and X_e.

The curves can be conveniently plotted by expressing $R = d\sqrt{L/C}$ where d is a constant. (Note: $d = R/X_r$.) The value of d is important in the performance of a resistor, as will be seen.

Frequency can be expressed readily as a fraction k of the resonant frequency. R_e can then be solved in terms of R, d and k; L_e in terms of L, d and k; and X_e in terms of X_r, d and k, where d and k are variables. For given values of k and d, R_e can be expressed in terms of R alone, L_e in terms of L alone, and X_e in terms of X_r alone. Since R, L and X_r are constant, the ratios R_e/R, L_e/L and X_e/X_r can be plotted against k for various values of d, to conveniently express the results. An ideal resistor would have R_e/R a straight line with varying k and L_e/L and X_e/X_r would be zero for all values of k.

Equations 4, 5 and 6 can be obtained from equations 1, 2 and 3, by making use of the relationship that $LC\omega_r^2 = 1$.

$$\frac{R_e}{R} = \frac{1}{k^2d^2+(1-k^2)^2} \qquad (4)$$

$$\frac{L_e}{L} = \frac{1-k^2-d^2}{k^2d^2+(1-k^2)^2} \qquad (5)$$

$$\frac{X_e}{X_r} = \frac{k(1-k^2-d^2)}{k^2d^2+(1-k^2)^2} \qquad (6)$$

Results obtained

The curves show that as long as $d < 1.414$, R_e increases with increasing frequency, to a maximum value, and then keeps decreasing as frequency increases. The lower the value of d, the greater is R_e maximum and the nearer it occurs to the resonant frequency. This maximum value occurs when $k = \sqrt{1-d^2/2}$. When $d > 1.414$, R_e does not reach a maximum, but continues to decrease as frequency increases.

When $d > 1$, X_e is always capacitive. When d lies between 1 and 1.414, this reactance keeps increasing with increasing frequency until it reaches X_r at the resonant frequency. When $d > 1.414$, X_e reaches a maximum below the resonant frequency, this maximum being greater than X_r. X_e then decreases to X_r as frequency is increased to the resonant frequency.

The condition for X_e maximum is given by the expression $k^6 + k^4(2d^2-1) + k^2(d^4-3d^2-1) + 1 - d^2 = 0$. When $d < 1$, the reactance is inductive at lower radio frequencies. As frequency increases, the inductive reactance reaches a maximum and then it decreases, passes through zero (unity power factor) and changes to increasing capacitive reactance. It reaches the value X_r at resonance. The lower the value of d, the higher is the maximum inductive reactance and the nearer it occurs to the resonant frequency.

The equivalent inductance L_e behaves differently from the equivalent reactance X_e, because frequency occurs as a multiplying factor in converting L_e to X_e.

The equivalent inductance L_e is negative whenever $d > 1$. When d lies between 1 and 1.618, L_e reaches a maximum, this maximum being greater than L. When $d > 1.618$, L_e is always greater than L at any frequency, and decreases as frequency increases. When $d < 1$, L_e is positive up to the frequency where $k = \sqrt{1-d^2}$. At this frequency, L_e is zero (Unity power factor). Beyond this frequency L_e is negative and increases to a value L at resonance. When d lies between 0.618 and 1, there is no maximum. When $d < 0.618$ a maximum positive value occurs; the lower the value of d, the more nearly this maximum point approaches the resonant frequency. L_e maximum occurs when $k = \sqrt{1-d^2}\pm d$. This frequency is not coincident with the frequency for R_e maximum, or X_e maximum.

LIST OF SYMBOLS

- R = Resistance
- L = Inductance
- C = Capacitance
- R_e = Equivalent series resistance
- L_e = Equivalent series inductance
- C_e = Equivalent series capacitance
- X_e = Equivalent series reactance
- $\omega = 2\pi$ x (frequency)
- $\omega_r = 2\pi$ x (resonant frequency)
- $k = f/f_r = \omega/\omega_r$
- $X_r = L\omega_r = 1/RC\omega = \sqrt{L/C}$
- $Q = X_r/R$
- $d = 1/Q = R/X_r = R/\sqrt{L/C}$
- $1 - LC\omega^2 = 1 - k^2$
- $kd = RC\omega$

Practical conclusion

The curves show that reactance will not be zero at all frequencies, but if $d = 1$, $(R = \sqrt{L/C})$, reactance is almost zero for frequencies up to about 0.25 times the resonant frequency. For this condition R_e is nearly equal to R, increasing only about 5 per cent over this frequency range. The condition that $R = \sqrt{L/C}$ is the only condition where reactance is very small over a range of frequencies. At least one radio manufacturer has endeavored to meet this condition in its resistors.

To get maximum frequency range, L and C should be as small as possible so that the resonant frequency will be as high as possible. The higher the resonant frequency, the greater is the frequency range of operation for the resistor.

Skin resistance

The above results do not include skin effect, which increases the effective resistance with increasing frequency. When $R = \sqrt{L/C}$, R_e increases with frequency even without skin effect. Thus skin effect aggravates the situation and should be minimized. The product referred to uses fine wire to keep this effect to a minimum.

The capacitance of a resistor to chassis increases C and thus affects the performance of a resistor. This fact must not be overlooked in practice.

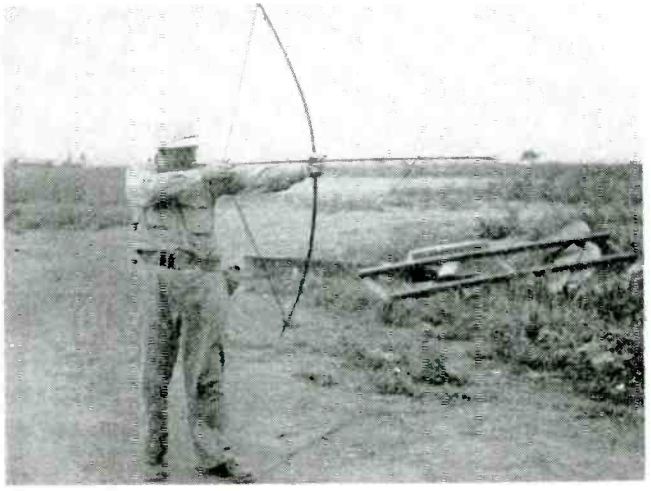
If $d = 1.25$ $(R = 1.25\sqrt{L/C})$, R_e would not vary more than 5 per cent from zero frequency up to almost 0.75 of the resonant frequency. This is a very wide frequency range. Unfortunately, as reactance is far from zero over this range, this condition does not give a satisfactory resistor. When $R = \sqrt{L/C}$, 5 per cent increase in R_e occurs when frequency reaches 0.224 of the resonant frequency. The frequency range for this condition is less than one-third that when $d = 1.25$. The condition that $R = \sqrt{L/C}$ does not give the least variation in R_e with frequency, but gives the least reactance.

[5] See Terman—Radio Engineering, or Everitt —Communication Engineering.

IRE's Presidential Nominee in South Pacific

Lt. Col. Sidney K. Wolf, Chief Operations Analysis Section, Far East Air Forces, helps Dr. Everitt navigate a small power boat

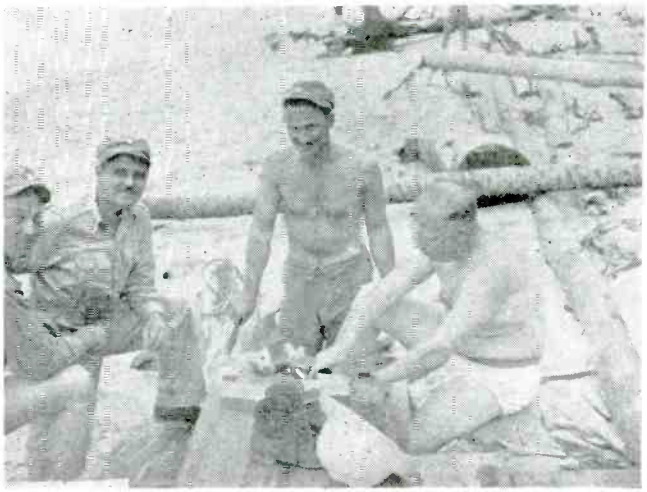
An engineer's life is not all beer and skittles as these photographs from faraway Dutch New Guinea would indicate. They have come from Lt. Col. Sidney K. Wolf (ex Radio Division, WPB), and show this energetic gentleman together with Dr. W. L. Everitt who has been nominated by the Board of Directors of the Institute of Radio Engineers to be its next president. Dr. Everitt, joined Col. Wolf in the South Seas on a mission to investigate radar and radio installations on some of the South Sea Islands, has recently returned to Washington. Dr. Everitt, who is a Fellow of the Institute of Radio Engineers, and has been a member of that organization's board of directors since 1942, is a professor in the Department of Electrical Engineering at Ohio State University, Columbus, O.



Dr. Everitt, Chief Operational Research Division of the U. S. Signal Corps, without benefit of radar, tries out a native weapon

The natives, it must be presumed, are part of the organization that helped in carrying on the radar investigation by the engineers

Here are Major H. L. Cadwallader, Col. Wolf and Dr. Everitt in a characteristic pose amid characteristic scenery on New Guinea



Food apparently was no particular problem to the investigators; the chef was Uncle Sam and the rations were the familiar "K"

TELEVISION and FM Plans

All but a few have video sets ready with projection units.

● If anything can be nailed down as sure, at the present stage of the unpleasantness in Europe and in the Pacific theater—it is that there will be new home receivers ready for the public some time during the fore part of 1945!

The radio and electronic industries still have a truly tremendous job of work to do in supplying the armed forces with needed equipment. But the back of the military-production job certainly has been broken, output is proceeding smoothly, and if the present rate is maintained (as appears likely), there must soon come a gradual tapering off, presaging quite general cut-backs. Some cancellations have occurred already, but these have been mostly to permit the substitution of revisions dictated by battle experience, and to allow production of new types more suitable to tasks with which the military is daily becoming more familiar.

Sets in early '45

At any rate, the public is a lot nearer now to satisfying its desire or need of a new receiver than it was a few short months ago. It is the estimate of the more optimistically inclined that at least some new receivers may be coming off the lines by February next year; even the pessimists are favoring June.

One or another of the two dates does not appear too unlikely. Conversion from military to civilian products will be a relatively simple process involving many problems that have already been solved as a military necessity, and that experience is going to help tremendously. Futhermore, most companies have their plans in pretty complete shape, maybe a little indefinite only because they are not completely finished.

Finally, imminence of the appearance of early home sets is revealed by estimates that cut-backs in existing military radio production of only about 8 per cent would release sufficient production facilities and materials to make possible production of a whole year's supply of civilian sets.

Television and FM

What sort of sets are on the boards? What about television, and FM? In an effort to draw the veil at least partly from a possible postwar picture, the publishers of "Electronic Industries" questionnaired a majority of the leading producers. The results are given

Manufacturer's Name	Television			Radio		Recording	
	Do you expect to make television sets?	Estimated retail price range	Will you make projection type sets?	Will broadcast sets include FM?	Will you manufacture auto sets?	Will you manufacture recording equipment?	Professional or home recording
Admiral Corp.	yes	$175–$450	yes	yes	no	yes	pro.
Air King Products Co., Inc.	yes	$250–$750	yes	yes	no	yes	home
Andrea Radio Corp.	yes	$70–$700	yes	yes	no	no	
Ansley Radio Corp.	yes			yes	no	no	
Automatic Radio Mfg. Co.	yes			yes	yes		
Belmont Radio Corp.	yes			yes	yes	yes	home
Browning Laboratories, Inc.				yes	no	no	
Colonial Radio Corp.	yes		yes	yes	yes	yes	home
The Crosley Corp.	yes	$125 $200[1]	yes	some	no	yes	home
Delco-Radio				yes	yes		
DeWald Radio Mfg. Corp.	yes		prob-ably	yes	no	yes	home
Allen B. DuMont Labs. Inc.	yes		yes	[2]	no	no	
Eckstein R. & Tele. Co.	no			some	yes	yes	home
Electrical Research Labs.	yes			yes	no		
Electronic Corp. of America				yes	no	yes	home
Emerson R. & Phono. Corp.	yes		yes	yes	no	yes	both
Espey Manufacturing Co.	yes	$200–$500		yes	no	yes	home
Fada Radio & Electric Co.	yes	$300-$1000	yes	[3]	no	[4]	[4]
Farnsworth Tele. & R. Corp.	yes		yes	yes	yes	prob-ably	
Freed-Eisemann Radio	yes	phono comb. $600 up	yes	yes	no	yes	home
Galvin Mfg. Corp.	yes			yes	yes	yes	home
Gared Radio Corp.	yes		yes	yes	no	yes	home
General Electric Co.	yes	$200 up	yes	yes	no	yes	both
General Tele. & R. Corp.*							
Gilfillan Bros., Inc.	yes	$375–$750	yes	yes	no	yes	home
Hallicrafters Co.	yes		no	yes	no	no	
Hamilton Radio Corp.	possibly	$400–$600	yes	yes	[5]		

*Indicates that no reply to questionnaire was received at the time of going to press. 1-, and up; 2-, FM in Television Sets; 3-, Special FM Sets; 4-, Only as required for Combination units; 5-, On contract basis; 6-, Table Models; 7-, for Manufacturers only.

# of Receiver Manufacturers

on boards; some expect to be
Most AM sets to include FM

in the appended table, which, it will be understood represents today's answers to questions that could be better answered half a year hence, and probably will. At least, the answers represent current planning and may well be a surprisingly accurate guide as to what will be forthcoming.

Projection tele

Thus, not all manufacturers pretend to television aspirations, though the percentage who do, if not astonishing in view of general interest, is at least remarkable. The fact that there is not now available a satisfactory type of projection tube suitable for home-television, has not deterred engineers from planning for the use of such equipment and may conceivably force faster development. Much work that has been done in the secrecy of government laboratories may, sooner than is expected, reveal technics that will make such tubes commercially practical.

Prices still obscure

Prices are still in too chaotic a state to make much mention of them and in all probability will undergo quite some revision before sales tickets are written. But if tabulated promises are kept, there will be FM in a very large percentage of receivers at whatever the price. In fact almost none except the smaller and cheaper "compacts" will be without it.

Very few radio manufacturers by their replies, indicate interest in automobile sets, though the car-makers themselves express the belief that automobile production will reach the rate of five million cars a year probably within the first year after hostilities cease.

The radio production picture is still quite hazy, as it logically should be what with the war job that remains to be done. But at least the outlines are visible, and the half-tones and highlights are beginning to be filled in.

Nebulous as that picture may be, however, it is extremely unlikely that there will be any extensive differences, electronically, between whatever new sets we may get, and the ones we have been getting along with since all the factories went all-out for war. Few "secret" developments are readily applicable; fewer will find application for quite some time to come. In the meantime, cabinet designers are whipping together '45 designs that at least will be different, combining utility and appearance.

Manufacturer's Name	Television			Radio		Recording	
	Do you expect to make television sets?	Estimated retail price range	Will you make projection type sets?	Will broadcast sets include FM?	Will you manufacture auto sets?	Will you manufacture recording equipment?	Professional or home recording
Hammarlund Mfg. Co.*							
Hoffman Radio Corp.	yes			yes	no	yes	home
Howard Radio Co.	yes			yes	no	yes	home
International-Detrola Corp.	yes	$150–$300		some	yes		
Magnavox Co., Ltd.	yes			yes	no	yes	both
Majestic R. & Tele. Corp.	yes	$200 up		yes	no	yes	home
Meissner Mfg. Co.	yes		yes	yes	no	yes	home
National Co. Inc.*							
Noblitt-Sparks Industries	yes			yes	no	no	
Packard-Bell Co.	yes	$200–$500	yes	yes	no	yes	home
Philco Corp.	yes	$125–$150[6]	yes	yes	yes	yes	home
Philharmonic Radio Corp.	yes			yes	no	yes	
Pilot Radio Corp.	yes	$500	yes	yes	no	no	no
RCA Victor Div., R.C.A.	yes	$200–$400	yes	yes	[7]	yes	pro.

Manufacturer's Name	Television			Radio		Recording	
	Do you expect to make television sets?	Estimated retail price range	Will you make projection type sets?	Will broadcast sets include FM?	Will you manufacture auto sets?	Will you manufacture recording equipment?	Professional or home recording
Remler Co. Ltd.	yes	$150–$300	yes	yes	no	yes	home
Setchell-Carlson Co.	yes			yes	yes	yes	
Sonora R. & Tele. Corp.				yes	yes	yes	home
Sparks-Withington Co.	yes			yes	yes	yes	home
Stewart-Warner Corp.	yes			yes	no	yes	home
Stromberg-Carlson Co.	yes		yes	some	no	yes	home
Templetone Radio Co.	yes	$125–$495	yes	yes	no	yes	both
Trav-Ler Karenola R. & T. Co.				yes	yes	yes	home
Warwick Mfg. Corp.	no			yes	no	no	
Watterson Radio Mfg. Co.	yes			some	no	yes	both
Westinghouse Elec. & Mfg.	yes			yes			
Wilcox-Gay Corp.				yes	no	yes	both
Zenith Radio Corp.	yes						

*Indicates that no reply to questionnaire was received at the time of going to press. 1-, and up; 2-, FM in Television Sets; 3-, Special FM Sets; 4-, Only as required for Combination units; 5-, On contract basis; 6-, Table Models; 7-, for Manufacturers only.

RADIO EQUIPMENT ON

● The Superfortresses, the B-29s, of the American Army Air Forces, which have already so successfully bombed Japan and are visualized as a major weapon in the "final kill" of Hirohito and Tojo and their war machine, are more dependent in their operations on communications and electronic-radar navigational aids than any other combat air command of the United Nations. "Electronic Industries" is able to publish for the first time photographs showing the two radio-electronic compartments on the Superfortresses, but, naturally for security reasons certain portions of the equipments' designations had to be eliminated because of the secrecy of the devices.

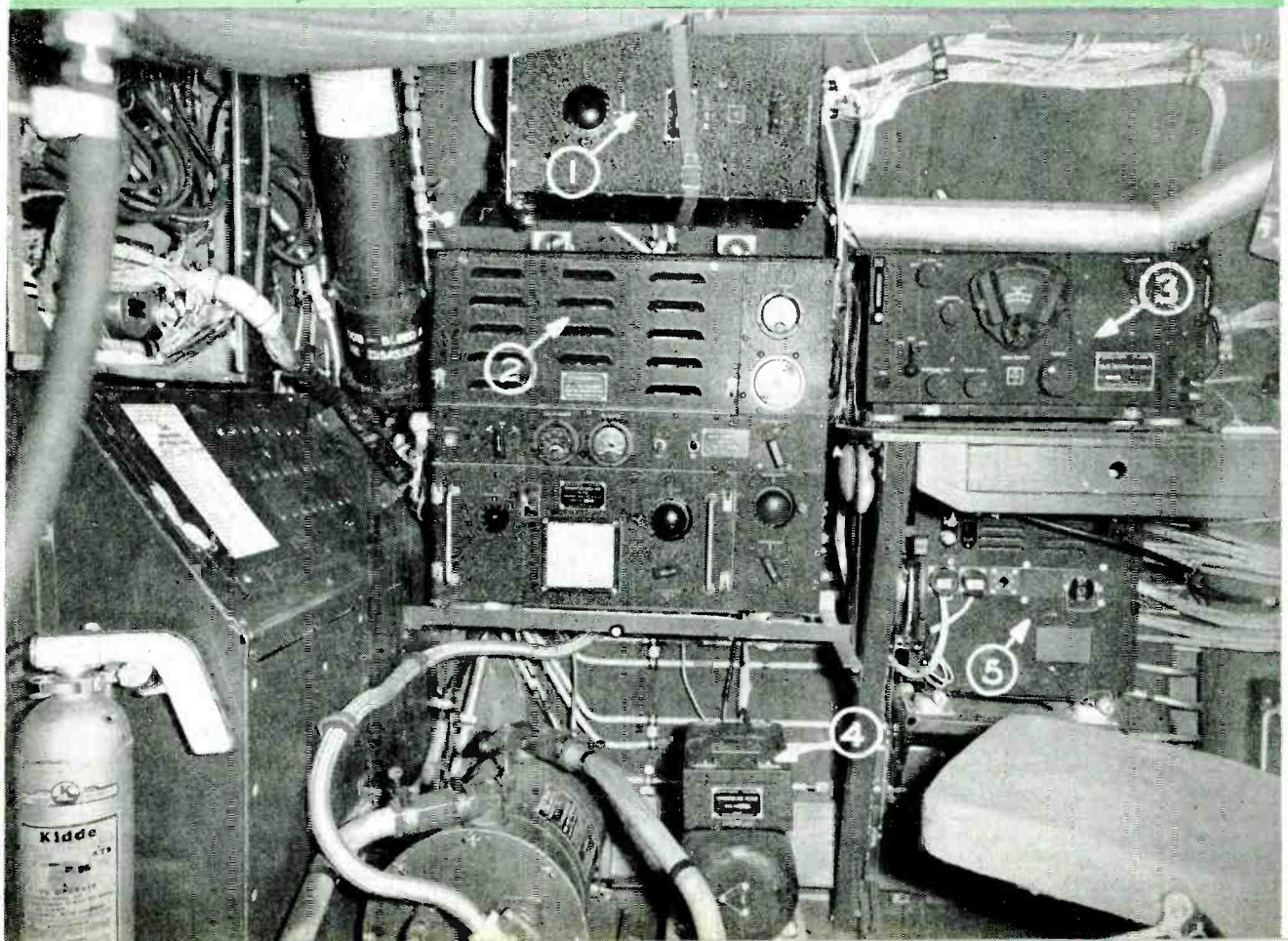
The B-29 is practically a flying radio laboratory and it is equipped with approximately a ton of aircraft radio and electronic devices—double the amount carried in the Flying Fortress, Liberators and other heavy bombers both in weight and in the number of apparatus units. It also is manned by three times the usual bomber radio personnel—a communications commissioned officer and two non-commissioned radio operators.

The B-29 is equipped with the most up-to-date types of radio communications apparatus and radio navigational aids and electronic devices of the latest design and development because in the long flights, communications and navigation perfection are more vital to the Superfortresses than in any other combat aviation operations of the Allied forces. The world-wide radio teletype systems of the Army, both of the Army Airways Communications System and the Signal Corps, form a most important communications medium in these B-29 bombing operations.

The electronic devices on the B-29s which are used to get the planes to their target and to get them safely home over thousands of miles to and from their bases present a phase of military development and research in the radio-electronic-radar fields that will be of tremendous usefulness after the war because the same air communications and navigational aids will be utilized in postwar long distance transoceanic and continental flights. The electronic navigational devices on the B-29s mean that, even though weather conditions for long distances cannot be predicted accurately, safety in navigation and flights to and from destination is virtually fool-proof.

The 20th Air Force is directly under the control of the Joint Chiefs of Staff and General H. H. Arnold, Commanding General of the Army Air Forces, has assumed personal direction of this Bomber Command. Brigadier General Harold M. McClelland, Air Communications Officer for the Army Air Forces, is also the Communications Officer for the 20th Air Force and the planning for the radio and electronic apparatus, used by the B-29s, was performed by General McClelland and his staff. To illustrate the extremely close liaison between the B-29 bombing operations and Generals Arnold and McClelland and the AAF Headquarters in Washington, on each

These two photos, made by Aircraft Radio Laboratory, Wright Field, show the radio operator's position in the new B-29 Superfortress Bomber and show (Left view) 1—Receivers for radio set SCR-274-N; 2—Transmitter BC-375; 3—Receiver BC-348; 4—Receiver BC-966-A; 5—Dynamometer unit PE-86; 6—Switch box BC 706-A; 7—Radio control box BC 434-A; 8—Indicator box BC-727; 9—Jack box BC-366; 10—Headset adapter



B-29 SUPERFORTRESS

raid over Japan or Nipponese-occupied territory, a code word is flashed back by the B-29 bombing squadron to AAF Headquarters when the Superfortresses are over their targets.

The development, research and specifications for the radio requirements of the B-29 were a major task, performed by the Signal Corps Aircraft Radio Laboratory at Wright Field, Ohio, in collaboration with the Army Air Forces. It was a long task and hazarded with numerous technical problems, Colonel Hobart R. Yeager, Commanding Officer of the Signal Corps Aircraft Signal Agency, revealed.

The Aircraft Radio Laboratory developed and improved the many different radio sets and electronic devices, which total in weight 2,000 lb. for each Superfortress. The radio devices and sets on the B-29 range in weight from half a pound to 550 lb. and the radio complement for the Superfortress is the largest single installation ever undertaken at Wright Field.

Virtually none of the radio equipment in the B-29 was designed specifically for it since most of the devices and sets have been used for some time in various combinations in both fighter and bomber aircraft. But, wherever a choice existed between two or more different sets of a similar type, the Aircraft Radio Laboratory staff and technical experts made a selection after exhaustive tests of the equipment to determine which would give maximum performance on long range flights.

The development work and formulation of specifications for the radio requirements of the B-29 were inaugurated in early 1940 by the Aircraft Radio Laboratory and the first installation in a production model was completed late in 1943. Since then, there has been continuous research and analysis of the equipment so as to incorporate all the latest developments.

Numerous technical problems were encountered by the Signal Corps Aircraft Radio Laboratory because of the great number of different types of radio equipment which had to be installed in the Superfortress. These equipments had to be made to operate without conflicting with, or neutralizing each other. As new developments in aircraft radio apparatus and electronic devices were perfected, the B-29 installations had to be revised. Other problems, necessitating most intensive research and experimentation, arose in the altitude range of the Superfortress which flies higher than any other enemy plane.

All eventualities in the way of communications and navigational requirements are provided for in the B-29's radio-electronic equipment. These include navigational devices to allow the pilot to fly direct or diverse routes, as desired; to locate the bases on return from the bombing raids with most exact precision; and to execute safe landings. The communication equipment provides for conversations between aircraft in flight, between the bombers and their far-distant bases and between the crew members of the Superfortress.

MC-385; 11—Liaison antenna change-over switch; 12—Reel control box BC-461; 13—Radio control equipment RC-255-A; 14—Socket SO-158. (Right view) 1—Antenna tuning unit BC-306-A; 2—Transmitter BC-375; 3—Receiver BC-348; 4—Dynamometer unit PE-78; 5—Radio receiver BC-966-A. The two photos, first to be published, were especially released for "Electronic Industries"

ACORN TUBE TECHNICS

by LOUIS GERARD PACENT*

Production problems involved in design and manufacture to insure long filament life and stable characteristics

● The spiralling demand for more and more communication channels as new classes of service are introduced, and as greater facilities are scheduled for the older fields of activity, is probably the most important problem for the radio engineering profession to tackle, after military needs are satisfied. The prewar research trend was usually toward the development of new systems and tubes for the production of UHF energy, in an effort to provide increased channels. Of late, it has become evident that quite as much good can be accomplished by refinements in the technic which permit more channels within a given range.

Such refinements generally start with reduction in frequency drift, improvements in tuning methods and stabilization in a given communication channel so that a lower margin of safety from cross-modulation interference is permissable. It is true that the useful communication range is but a small part of the band assigned, in most services (except television), on account of the greater chance for a station wandering up and down on its assigned frequency due to stabilization difficulties.

In the 100-600 megacycle range the prewar acorn tubes then available, found almost universal use, mainly because there were no other alternate types, although their short life and non-adherence to listed characteristics (compared with those of larger tubes) were exasperating matters to their users. It is of interest therefore to investigate their present state of development in such matters so as to evaluate their utility in future civilian services.

The requirements for tubes used in this range are well known: small physical size to reduce the inductance and capacitance of the leads necessary to connect the tube to the rest of the circuit components. In addition, the transit time of electron movement across the cathode-anode spacing introduces a more or less definite frequency ceiling for practical operation. In the usual oscillator circuit this ceiling is reached when the transit time approaches about 2/3 of the duration of a quarter cycle.

Actually the efficiency of an amplifier tube drops off about 1 per cent for every degree of transit time, with respect to the period of the operating frequency. In oscillator circuits the efficiency drops at almost double this rate and oscillations are impossible with transit times equal to 60 degrees, no matter how efficient the rest of the circuit is. When selectivity and adequate voltage gain is important, serious consideration must be given transadmittance and input conductance in amplifier circuits or the useful frequency range may be curtailed.

Here, one may wonder just how the transit time can be computed, since it differs between the cathode and grid and between the grid and plate, and with the impressed voltages which vary throughout the impressed cycle. The effective transit time is usually considered as equal to the ratio of the transit time between cathode and grid at the peak grid voltage.

The conflicting requirements of high operating voltages to produce higher transit speeds and small closely spaced electrodes, necessarily have led to a compromise, but production method precision, now in use for tubes of the acorn type, has now relieved the situation considerably. The manufacturing technics described here are those which have been developed at the Elmsford (New York) plant of the Sonotone Corp. by Paul Schwerin, manager of the tube division and his assistants and associates. This organization has specialized in acorn tubes, as well as hearing aid tubes, (both shown in Fig. 1), with the result that these types have

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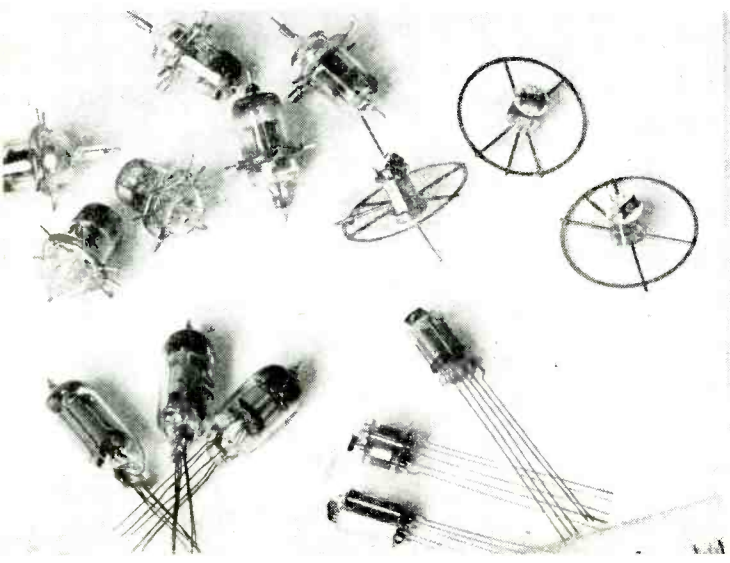
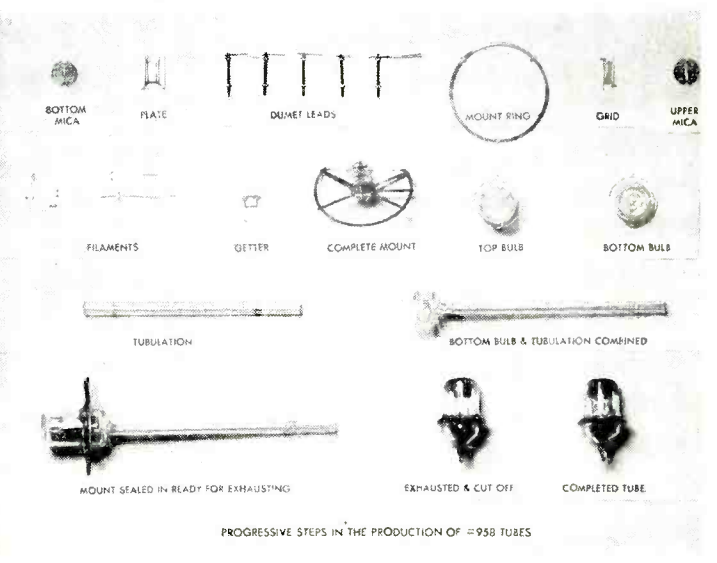
Fig. 1—Completed tubes and uncompleted acorn and hearing aid tubes, the latter before the glass envelope is put around them, give a comparison of the physical size of both styles. Fig. 2—Complete set of parts used and progressive steps in the assembly of a type 958 Acorn tube





become practical items both to manufacture and to use in critical circuits.

Both considerations are important, since a seemingly inconsequential (from the viewpoint used with larger tubes) change in some detail of a production process may change the output record from 90 per cent acceptance after complete electrical tests, to a complete rejection. Reliability in adherence to standard characteristic specifications is of prime importance to the circuit designer.

The fundamental principle underlying the acorn tube development is that many of the important tube constants remain unchanged if all physical dimensions are reduced to scale, while other characteristics can be improved according to an inverse ratio. These are shown in Fig. 4. Practically, it is not physically possible to reduce all dimensions equally. For example, to maintain a constant plate current with a cathode area of $1/x^2$ requires either, increased operating temperature or the use of a more efficient cathode emission material. This is not a matter of primary importance to the circuit designer, however, since the tube engineer has taken advantage of other design expedients, wherever possible, to minimize the loss of effectiveness caused by the reduction of dimensions.

From Fig. 4 it is noticed that the reduction of the effectiveness of characteristics listed in group B, is the main advantage of using acorn tubes in UHF circuit design. For example, designers must be extremely conscious of circuit capacitance. Low impedance tuning circuits are the rule and some designers, accustomed to lower frequencies must revise their methods and rules.

[As it is, a considerable amount of the circuit inductance and capacitance may lie inside of the tube, an effect sometimes known as the "swallow up" factor.[1]]

A tuning capacitor with 100 mmf maximum has a reactance of only a few ohms at these frequencies and so the resonance inductance to equal this reactance must have an equal reactance. This means using a coil having "negligibly" small inductance by usual standards. Also another factor which must be realized is that a limited tuning range is the rule, and that unless drastic methods are used to reduce the fixed capacitance, a tuning range of possibly 1:1.5 or less may be expected.

It is here that tubes with small electrode structures are obligatory.

[1] Term suggested by S. Y. White.

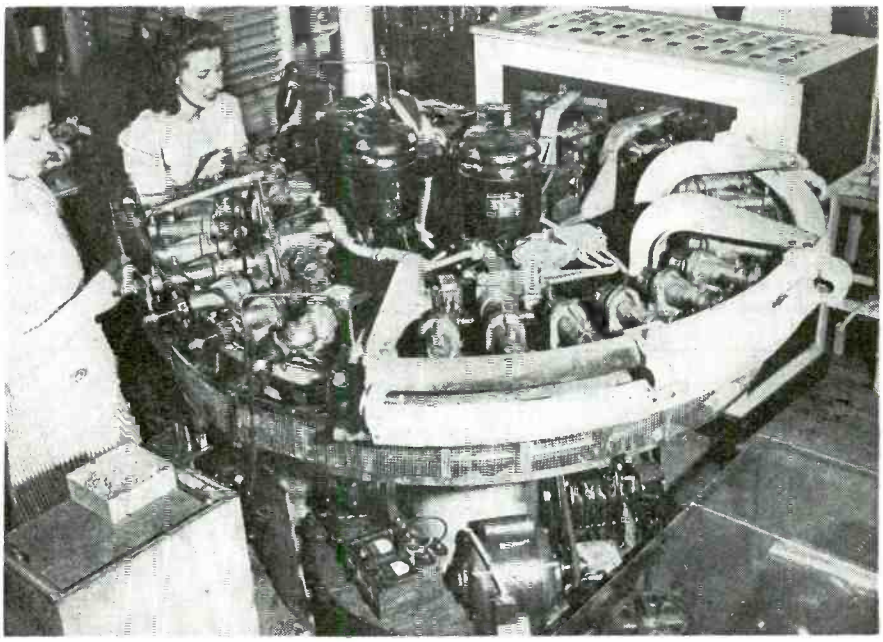
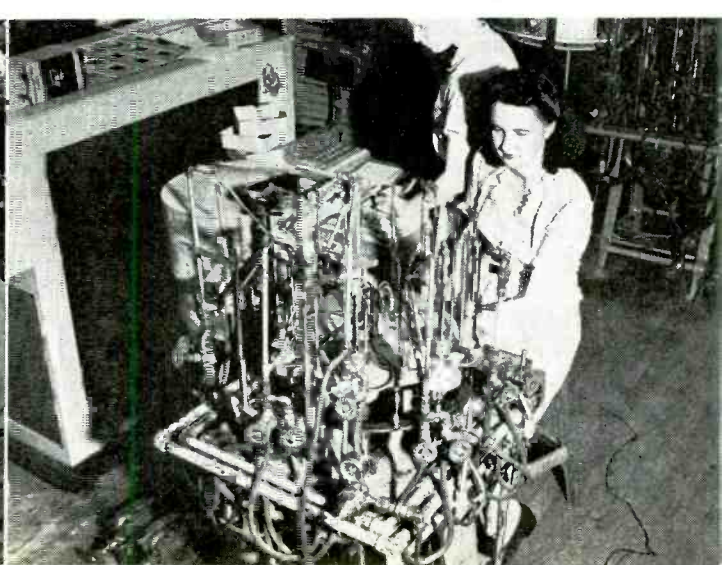


Fig. 3—The automatic exhaust machine (original with Sonotone) controls the evacuating and degassing processes and then seals up the tube. Fig. 4—(below) Effect of a scale size reduction on operating characteristics of tubes

	CHARACTERISTIC	REDUCTION FACTOR
A	Plate current	No change
	Transconductance	" "
	Amplification factor	" "
	Plate resistance	" "
B	Inductance (leads)	$1/x$
	Capacitance (leads and tube electrodes)	$1/x$
	Transit time	$1/x$
C	Plate dissipation	$1/x^2$
	Emission	$1/x^2$

Fig. 5—At the end of each production line final inspecting and adjusting is done under a magnifying optical system. Fig. 6—Sealing machine, used for fusing the glass around the mechanical parts of the tube, after which the mount ring is removed. Tube is then inspected and exhausted



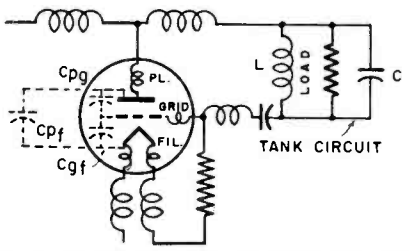


Fig. 7—In uhf operation the inductance and capacitance of the leads, shown here as lumped values, become important circuit components

the acorn design has certain advantages, since all parts are mounted rigidly and welded on a mechanically strong ring, shown in Fig. 1, which remains in place throughout its construction until the exhaust process. This arrangement permits the assembly to be inspected thoroughly before any glass elements are added. There is also a possible saving of wiring length, since the leads are spread out in all directions, and the input and output circuit components associated with the tube are not necessarily bunched around the socket. It is here that one of the inherent advantages of the acorn tube shows up, when compared with other shapes of UHF tubes (even those having similar electrode sizes and structures).

INTER-ELECTRODE CAPACITANCES

m m f	954	955	957	958	959	6J5	6J5GT
$C_{G,P}$	0.007	1.4	1.2	2.6	0.015	3.4	3.8
$C_{G,F}$ or $C_{G,K}$	3.0	1.0	0.3	0.6	1.8	3.4	4.2
$C_{P,F}$ or $C_{P,K}$	3.4	0.6	0.7	1.1	2.5	3.6	5.0

It must be realized that the design of the tube assembly—cathode, grids and anodes and their positional relations—make the tube what it is. The same electrode assembly might conceivably be used in another type glass bulb, with another socket and basing system. Equal care in the assembly and in the refinements of methods for decontamination and exhaustion must be used in any case, to produce tubes having a reputation for reliability to maintain.

In the present form of assembly,

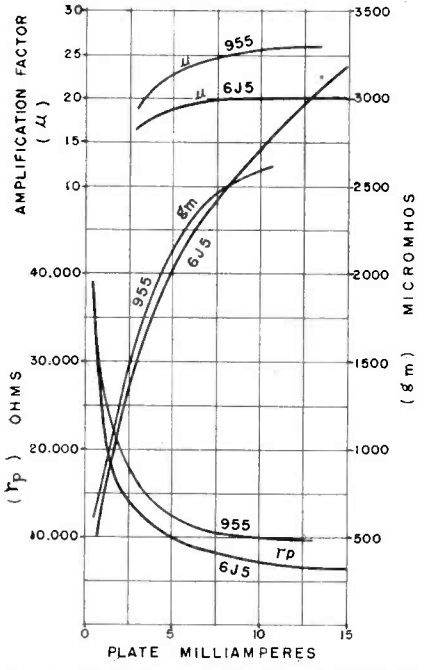


Fig. 9—Comparison of transfer characteristics of the Type 955 acorn and the commonly used octal type tube 6J5

Internal degeneration, from impedance common to the input and output circuits due to the cathode lead which carries both currents can be reduced substantially by introducing two cathode leads, directed out to points convenient to those circuit elements. This one factor may more than double the operating frequency limit in some cases.

It is also quite simple with the acorn design of the 955 and 958 types to bring out two leads from the grid and two from the plate. This variation, when used in a special oscillating circuit makes it possible to reach frequencies of 2000 megacycles or more. This puts the acorn in the part of the frequency spectrum which is now occupied by special expensive and complicated tubes and circuits. This improvement is reached, for example, when a parallel line reactance element extends from each side of the tube, so that its elements are at a nodal point on the resonating system. With these improvements it is believed that the acorn tube will be used widely in the post war period, since the range from one hundred to several thousand megacycles includes the "cream" of the spectrum considered useful in a great many services.

The assembly is quite strong mechanically and with properly designed sockets there is no greater chance of breakage when the radial leads are used than there is with miniature types.

Before embarking on a design program that makes use of acorn type tubes, however, the engineer will want to look into the matter of tube reliability, life and constancy of characteristics. The Sonotone Corp., having had experience in the design and production of hearing-aid tubes, undertook the job of producing acorn tubes for military needs which were to meet the exacting requirements of the circuit designer accustomed to the reproducible characteristics and the long life in tubes of the commoner low-frequency varieties.

It was found that almost every item of construction had to undergo a review so that dimensions and positioning could be maintained at some five-fold greater accuracy than was needed with larger tubes. It may be of interest to call attention to a few of these problems as they were handled.

In any tube, the item that has greatest influence on the tube's operation is the grid structure. The grid in an acorn is wound on a carboloy mandrel, since a few hours wear on an ordinary mandrel would change the dimensions with-

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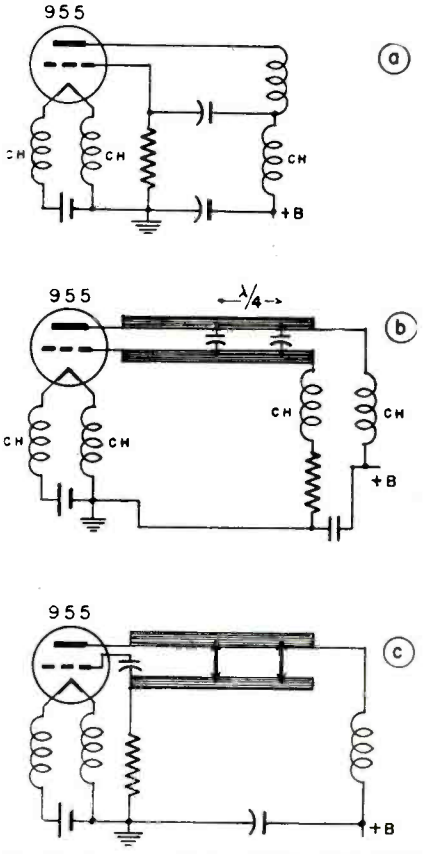

Fig. 10—Typical oscillator circuits using acorn tubes

LOW FREQUENCY UNIT

10 kw long wave transmitters especially developed by Federal for 24-hour communication from Arctic area by CAA

• When the U. S. Signal Corps late last year completed the installation of a number of long wave communication systems in the North Atlantic and Arctic circle areas for the Army Air Transport Command* Federal Telephone and Radio Corp., Newark, N. J., had previously spent a long time and much effort on the design and construction of the transmitting equipment.

As a result of investigations carried on by the Civil Aeronautics Authorities it had been determined that low frequencies are not seriously affected by the magnetic storms which at times have completely blanked out higher frequency transmissions for considerable periods. Hence the decision to install low frequency equipment in order to insure 24-hour communication.

To meet these service conditions and requirements, Federal developed a low frequency transmitter for the use of and in accordance with the specifications of the Civil Aeronautics Administration. The various units comprising this transmitter include an exciter unit, power amplifier unit, main rectifier unit and a set of antenna tuning house equipment.

*See "Electronic Industries" for December, 1943.

Most of these transmitters would be located either adjacent to or within easy reach of an airfield. Accordingly, they have been designed with aluminum frames and of a size and weight that permits them to be carried in a large transport plane.

The entire transmitter operates from a 230-volt, 3-phase, 60-cycle power supply. In cases where the supply does not give this voltage, adjustments are provided so that any voltage between 215 and 250 volts can be used. Power requirements can be economically met with a Diesel-engine-driven generator of the type commonly used in isolated communities. Complete control of the transmitter for single-frequency operation is possible from a remote point. This can be accomplished through the use of a dial and relays similar to those used on home telephones.

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

The power amplifier unit is normally used at one operating frequency, but it can be set up for use on any frequency in the range of the exciter unit. At any operating frequency within this range it will deliver 10 kilowatts of power. This output is obtained through the use of a single, Type 892R, tube with conventional grid and plate tuning circuits. Since this tube is of the air-cooled type, the danger of freezing, that would be present with a water-cooling system, is eliminated.

The main rectifier unit has six Type 872A, mercury-vapor rectifier

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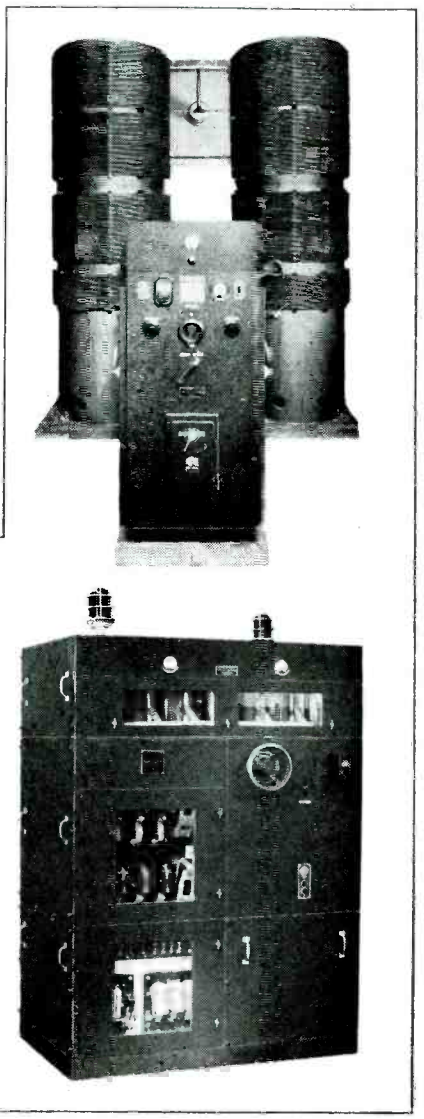


Left—The crystal-controlled exciter is a complete transmitter in itself and is used to feed the 10-kw final amplifier (center). At right is the rectifier unit, supplying all power to the amplifier and above it the antenna tuning house equipment and loading inductors

$13,000,000 fire at Fall River, Mass., destroyed priceless crude rubber stores. Such conflagrations can be checked by adequate radio facilities

POSTWAR FIRE RADIO

New FCC rules, following RTPB report, presage wide use of radio by fire departments after the war

● Recommendations of the Radio Technical Planning Board, contained in the tentative report of Committee Two of Panel 13, mark a significant step forward in the development of municipal fire department communications services. Extensive use of three phases of fire-radio (on-the-scene, local, and mutual-aid area services) may mean as much to the future of fire-fighting as police-radio has meant to law-enforcement.

The benefits of fire department radio communications have been demonstrated over a period of years in several ways. Many inland cities have up until now been using the frequencies and transmitter facilities of their police departments. Six large U. S. ports have operated marine fire stations on their own frequencies, New Orleans, Portland, Me., Boston, Detroit, New York, and Seattle, licensed as marine fire stations, operate fire boats, communication with which must obviously be by radio, and at the same time provide one and two-way service to certain cars and fire fighting trucks on land. Inland cities, obliged to share spectrum space and transmitters with the police, have been at a marked disadvantage, since peak demands on the fire communications service invariably coincide with peak demands on the police activities.

FIRE DEPARTMENT RADIO REQUIREMENTS

Units	Service
65,000	Pumping Units
15,000	Ladder Companies
20,000	Chiefs, Battalion Chiefs, Service Cars, Fuel Wagons, Etc.
10,000	Squad Cars, Ambulances, Utility Trucks & Boats
18,000	OCD Pumping Units
128,000	Receivers & Two-Way Sets

New FCC rules

Now in effect, new rules laid down by the Federal Communications Commission provide a considerable measure of relief from this situation by permitting municipalities of over 150,000 population to operate their own fire department radio system independent of the police, on frequency assignments up until now used exclusively by the aforementioned port cities and the City of Washington. All of these, previously licensed as "Marine Fire Stations," will, with the inland cities, henceforth be known as "Municipal Fire Stations."

SERVICE

This nation is faced with an annual fire loss of approximately four hundred and fifty million dollars. In addition, more than ten thousand lives are lost each year.

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

Mutual aid system

The history of large fires in recent years shows conclusively that lack of adequate communication facilities is a large factor in the great loss of life and property and man-hours of labor.

No fire department today has a sufficient amount of apparatus or equipment to cope with all types of emergencies which may develop in a community. It is often necessary to call upon adjacent communities for assistance. In order to coordinate these activities, an adequate and rapid communication system is imperative.

A plan designated as Mutual Aid has been developed to make coordination and cooperation feasible. Experience under this plan has emphasized the importance of control, and of adequate, rapid communication facilities.

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

Present wire facilities

The modern fire departments of our municipalities are generally equipped with fire alarm systems consisting of fire alarm boxes, located on the street corners, from which the citizens can report fires to the municipal fire alarm headquarters. This department in turn dispatches the fire apparatus to the scene of the fire. In smaller communities the fire alarm boxes automatically transmit their alarms to the fire companies. However, these facilities are woefully inadequate in most cases.

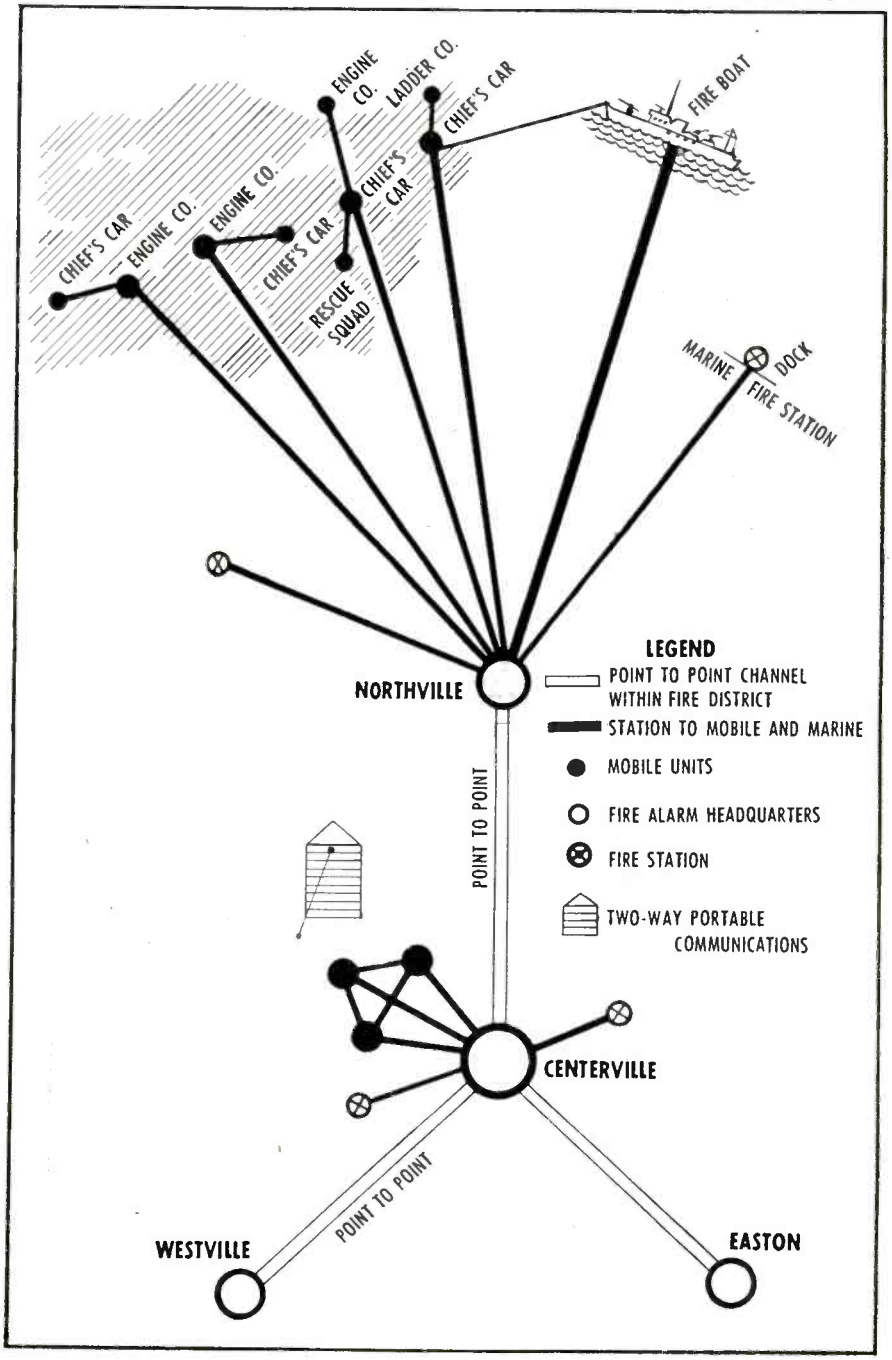
Fire alarm boxes are supplemented by the commercial telephone service and in numerous cities by the manual and automatic fire alarm services furnished to private establishments by central station protective signaling companies.

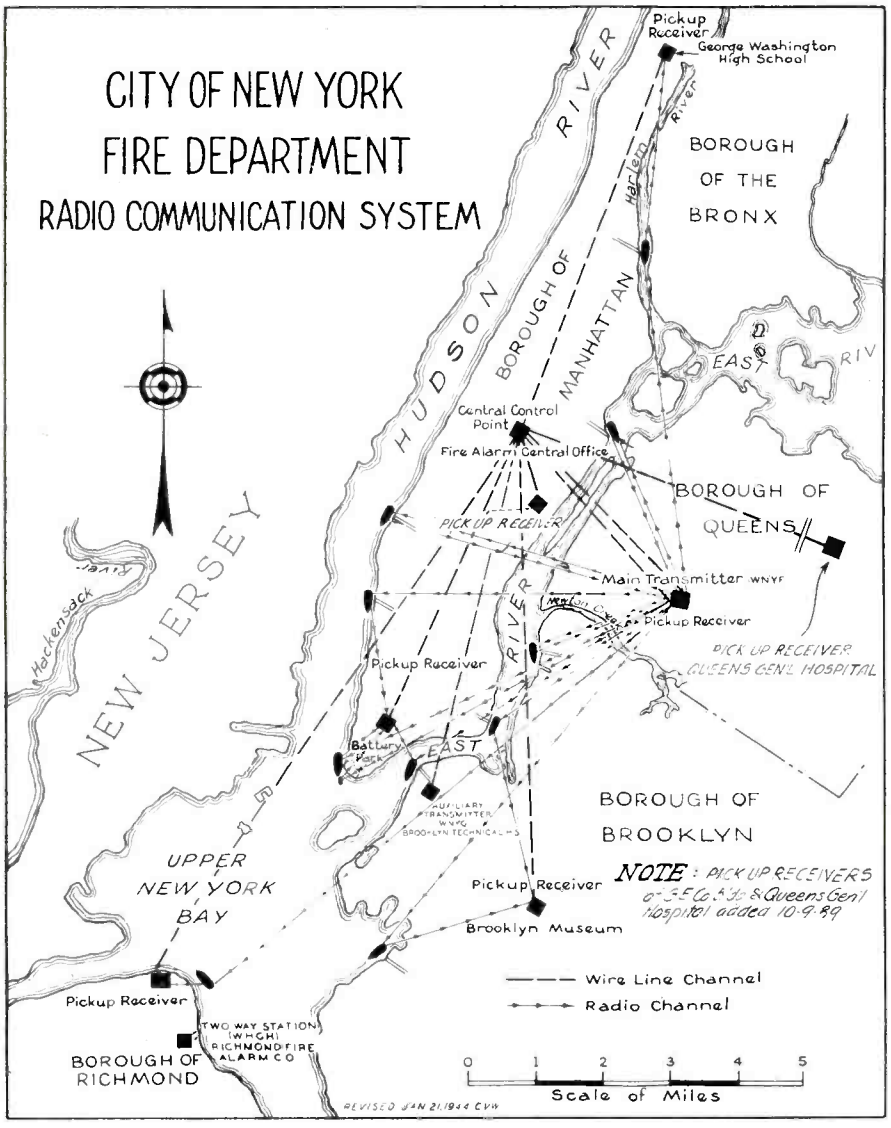
But when apparatus leaves its station, under present conditions, it is lost as far as fire headquarters is concerned.

Existing wire facilities for intercommunication between fire departments or dispatching headquarters are likewise woefully inadequate for proper operation of the service. Fire departments in the majority of our municipalities are separated by considerable distances, and many are located in areas where telephone communications between the units require too much time to be useful.

To install municipal wire facilities or tie-lines between fire alarm

Map of typical city area, showing communications within fire district, point to point service among adjacent communities, and two-way portable service on fire grounds. Northville is a typical fire alarm headquarters with radio channels to mobile, portable, and marine fire fighting units





New York enjoys extensive radio system. Main and auxiliary 500 watt remote controlled transmitters on 1630 kc reach all fireboats, trucks, and cars. The 50 watt mobile transmitters on 35,580 kc reach one or more of seven pickup receivers placed at strategic intervals through the city, thence via land wires to headquarters. About 20 fire fighting units and cars are equipped for two-way operation, 20 one way. Nearly 300 fire houses in all boroughs are equipped to receive 1630 kc headquarters transmissions. Postwar plans for New York include many more two-way uhf FM equipments in cars of battalion chiefs and deputies

headquarters, to ameliorate this condition, would be prohibitive in cost to the taxpayers of a community. In rural communities telephone wire facilities are so sparsely located as to make their use impractical.

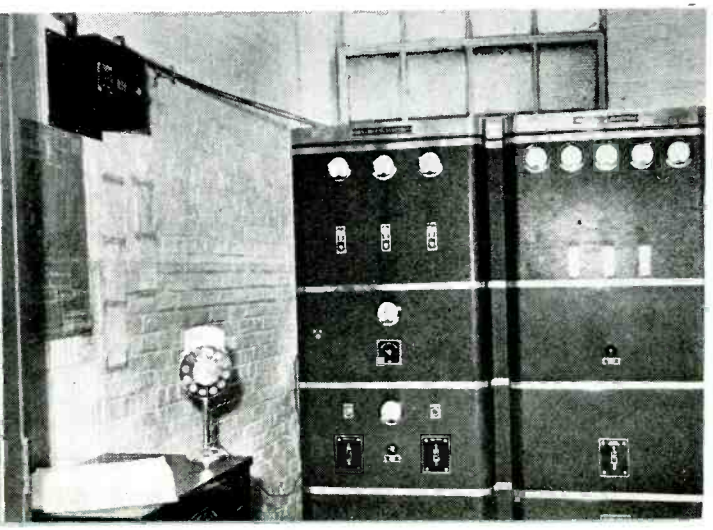
In large conflagrations, the telephone and wire facilities are generally rendered inoperative by the fire itself, making it difficult to call additional forces into action without radio facilities. When forest or large brush fires occur, they are generally in locations well removed from all wire facilities.

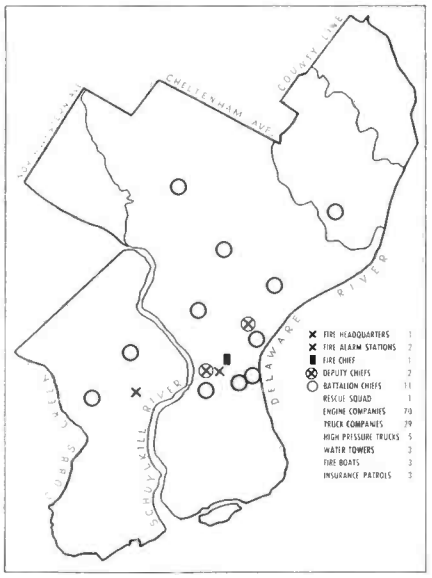
It is necessary sometimes upon reaching the scene of a disaster to call for additional apparatus to respond to definite locations, for medical assistance, for ambulances, additional pumping units, special tools, gas masks, acetylene cutting equipment, heavy jacks, etc. The speed and accuracy with which this equipment can be summoned may be the determining factor in the loss of life. When it is necessary to call upon neighboring communities for mutual aid assistance, all departments must then be kept fully informed on progress being made in handling the emergency, so that other anticipated needs can be met.

It is also essential to provide adequate communications to the mobile units of a fire department. Otherwise, a unit may become lost to the department when it leaves the fire station. If equipped with radios, the dispatcher could direct the unit should conditions change. It is often discovered after a unit has started that an incorrect address has been given by a person under the stress of excitement. Much valuable time is lost because it is impossible to contact the unit en route. Large fires and unnecessary loss of life result. If equipped with radio, apparatus could quickly be re-directed correctly.

No. 1 of three rescue squad trucks equipped with two-way radio. Insert shows set, in corner of cab

Main 500 watt G-E transmitter WNYF in Long Island City, remote controlled from Headquarters in Central Park





Fire radio map of Philadelphia, Pa. System covers 135 square miles, 2,000,000 population

Radio is also essential to the officers of the battalion, particularly the chiefs, making it possible for them to be constantly in touch with fire alarm headquarters, and the chief of the department. Without such communications, they are handicapped in directing the activities of the fire-fighting forces.

Fire-fighting forces working in large buildings should be provided with a channel of communications between the fire and the chief officer in the street, so that additional manpower or equipment can be called for and dispatched without the necessity of sending foot messengers, who in many cases must ascend and descend many flights of stairs. Elevator service is discontinued during fires. Radio would provide facilities for the Chief to order evacuation when conditions become critical, so as not to endanger the life of men fighting a fire. It would also facilitate rescue work where entire companies become trapped.

Point to point communications is most necessary to the fire service, in connection with its mutual aid, to provide a channel of communications among cities within a fire district. In many of our rural areas wire facilities are not available, or in many cases toll circuits are so overloaded as to be totally unsuitable for the fire service in reporting fires or calling for assistance needed to meet abnormal conditions during emergencies.

Frequencies needed

It is felt that frequencies in the 30 to 40 megacycle band are most desirable for the point to point and station to station or mobile units and marine services. It is felt that for the two-way communications service at the fire grounds, the band between 100 and 200 megacycles may be desirable.

In considering channel widths and their relation to the quality of service, it is felt that a minimum of 2,500 cycles would be required.

Point to point service within districts would best be provided by authorization of ten channels for the entire United States. It is recommended that station to mobile, marine and engine company station would require 20 channels for the entire United States.

Two-way portable communications at the fire grounds between fire-fighting units ought to have 4 channels for the entire United States.

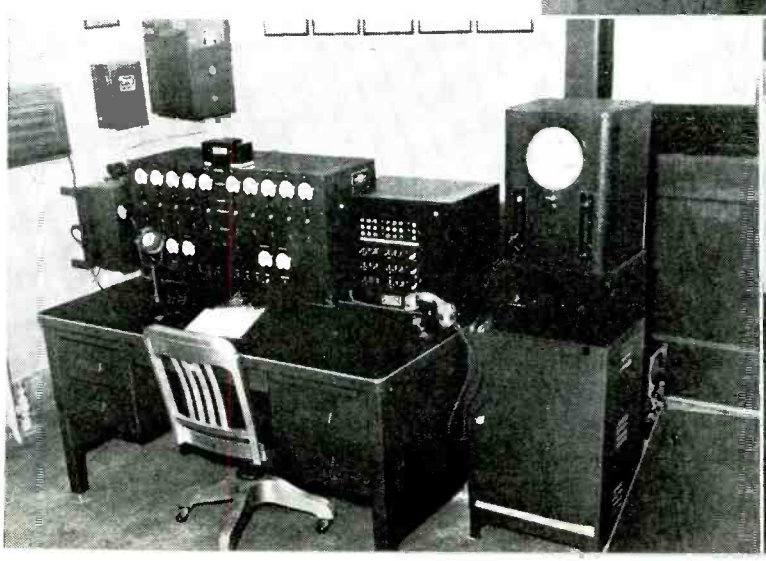
Equipment details

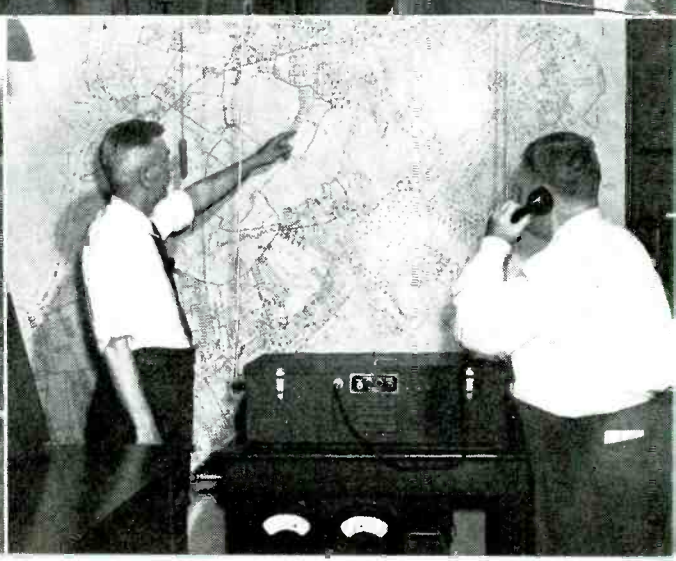
The estimated feasible accuracy of carrier frequency for each service, and recommended limits within which the carrier frequencies should be maintained are: Point to point, .005 per cent; Station to mobile, etc., .01 per cent; Portable, .01 per cent. No guard bands would be necessary except on the end bands.

Antenna peak input power considered necessary for each type of service is: Point to point, maximum of 250 watts; Station to mobile units, maximum of 250 watts—mobile, 50 watts; Two-way communication at fire grounds, maximum of 10 watts.

A New York fireboat tests on-the-scene walkie talkies. Insert shows Fred M. Link type 695-B FM uhf pack-set. Below, Staten Island headquarters unit (WHGH) handles an emergency with the Manhattan central headquarters. Self-contained Link FMTR-W unit is battery operated

Central control point of New York's fire radio system, showing control and response panel, monitor receiver and frequency monitor unit. Meters on seven pick-up receivers show which is getting best signal from mobile units





STABILIZATION AT UHF

by **AUGUST M. SCHMELING**
Chief Engineer, Lavoie Laboratories, Morganville, N. J.

• The production of stable frequencies with appreciable amplitude above 500 mc is a difficult accomplishment at the present time. One conventional method makes use of a low frequency crystal oscillator and by successively doubling or quadrupling, it is possible to produce a stable frequency at uhf.

In the high frequency spectrum above 500 mc, however, few of the tubes available at the present time are able to amplify much. The system, therefore, offers very little possibility of producing a stable frequency for use as a secondary standard or for receiver use above 500 megacycles. Another disadvantage is the great number of tubes needed to multiply a stable low frequency up to high frequencies.

The need for stability at uhf has led to the development of stabilized oscillators. The general practice for most applications is to make use of a transmission line type of oscillator. It is generally conceded that the transmission line oscillator, sometimes referred to as a line oscillator, has considerable advantage over the lumped inductive and capacity type of oscillator. This is especially true when operating near the frequency limit of oscillation for a vacuum tube, because for a given uhf tube it is possible to produce oscillations at a higher frequency than it is possible to amplify with the same tube.

Considerable success has been obtained with these oscillators, and various methods and means too numerous to mention here have been applied to obtain a low drift oscillator. The criticisms that might be made of at least some of these circuits are that they are bulky, relatively expensive, and require skilled personnel for testing and servicing. For some applications, where it is necessary to change rapidly from one frequency to another and at the same time maintain excellent stability, such stabilized circuits are not suitable.

Fig. 2—Conventional uhf oscillator stability

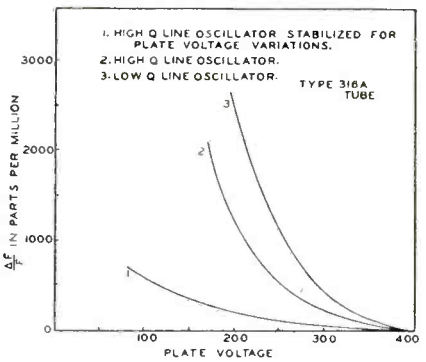


Fig. 1—Block diagram of the harmonic signal generator with regenerative feedback

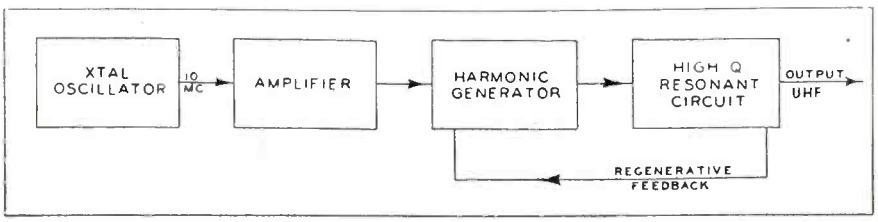
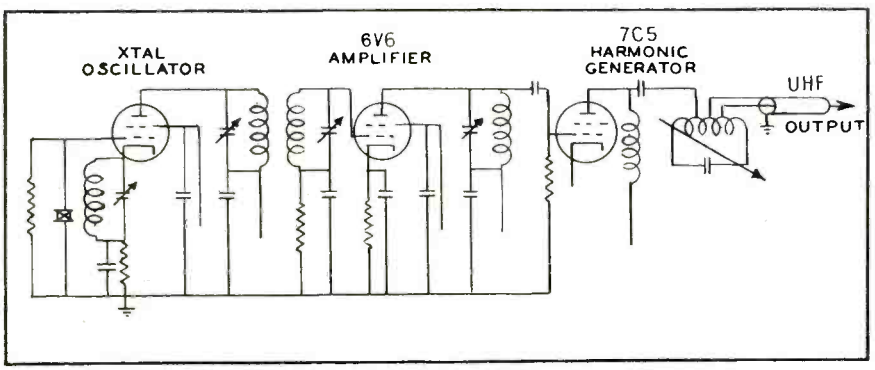


Fig. 3—Simplified schematic diagram of the frequency multiplier



Curves for oscillator stability are shown in Fig. 2 with variation of plate voltage only; temperature and filament voltage variations must also be considered because they contribute to oscillator drift and cause the oscillator to have less stability than shown by the curves. Curve No. 3, for example, is for a small line oscillator. With plate voltage variation alone, a drift of two megacycles at seven hundred megacycles may be observed with this oscillator. This drift could be reduced to one and one-half megacycles for a high "Q" line oscillator, as shown in curve No. 2. Curve No. 1 shows three-tenths of a megacycle drift in frequency for the same plate voltage variation in a temperature compensated oscillator. This compensation for drift may be obtained from the circuit itself and has been described in previous publications.

It must be pointed out that these curves show variations due to plate voltage only, and the variations due to filament voltages, changes in circuit constants, and variation with temperature must also be considered. Under the most favorable conditions, the best stability that can be expected in stabilized oscillators is .05 per cent. If the variations produced by temperature and variation in other circuit constants are considered, values for circuit stability greater than .05 per cent can be expected.

These curves for a frequency of seven hundred megacycles with a 316A tube represent extremely unfavorable conditions since the tube is operating near its cut-off frequency. If taken at a much lower frequency, better stability would result.

If a crystal oscillator output could be multiplied with good economy in tubes and provide a usable output, it would be well suited for uhf receiver and secondary standard applications. The method which is about to be described has a high economy of tubes.

As shown in Fig. 1, a five megacycle crystal oscillator has frequency doubling in the plate circuit in order to obtain a large output at ten megacycles. The amplifier may be any one of a number of tubes, depending upon the particular application for which the circuit is to be designed. In general, the higher the frequency, the smaller the size of the tube used

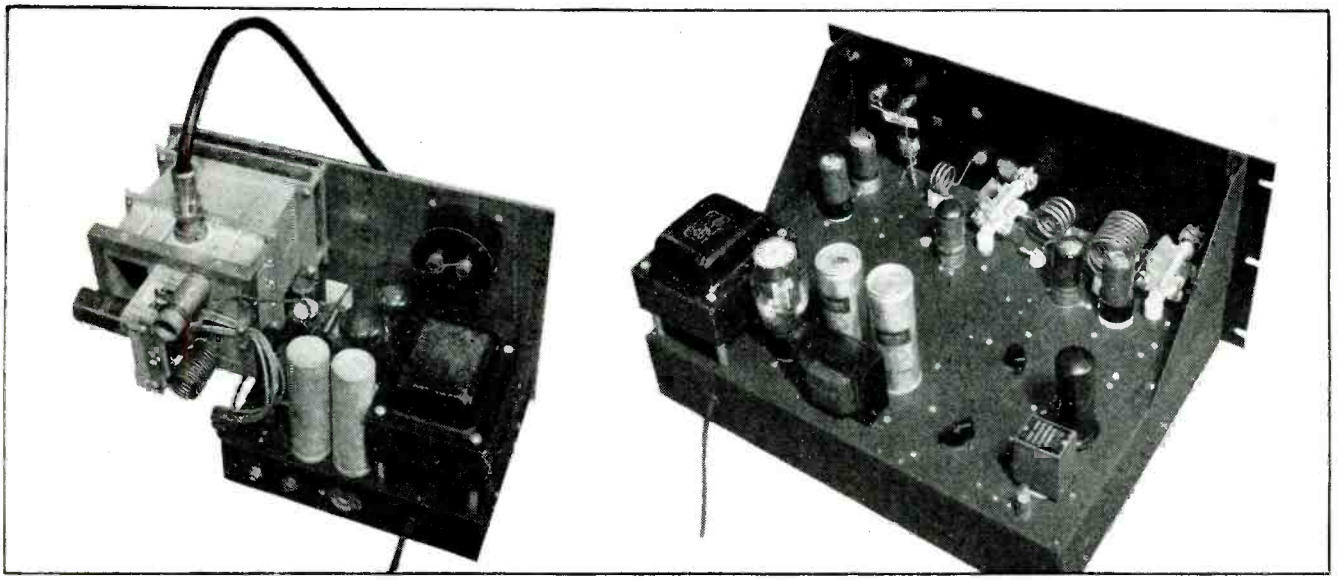


Fig. 4—At left, original model with power supply and modulator. At right, secondary standard for operation above 1,000 mc using 5 mc crystal

and the lower the voltage obtained. When the harmonic generator tube is excited with a large injector voltage at ten megacycles, harmonics up to the two hundredth are obtained with comparatively high amplitude. The relative voltage of each harmonic is quite variable.

One method now used is to select some particular harmonic frequency, some multiple of ten megacycles, segregate it and transform its voltage upward as much as possible. Because of unwanted voltages of adjacent harmonics, it is necessary to have a high order of selectivity in the frequency selecting circuit. The frequency selecting circuits developed for this purpose exhibit this quality to a high degree.

To illustrate this method of harmonic production the circuit as shown in Fig. 1 may be considered. It can be shown that two voltages exist in the plate circuit of the harmonic generator; one, the voltage whose frequency is the same as the grid voltage and the other a uhf voltage which is to be isolated and made as large as possible. The plate circuit is tuned to the frequency of this voltage. If regeneration is then introduced through the tube at different frequencies, it is possible to further increase this voltage. The plate circuit in the tube proper may be tuned to a lower frequency than the one being reinforced, by the use of standing waves.

It was hoped, when this investigation started, that one volt at seven hundred megacycles could be realized. However, voltages of one to two-tenths were about all that were realized with a reasonable power input. In Fig. 3, a schematic layout for this type of circuit is shown. The first unit consists of a crystal oscillator and, for the purpose of illustration, assumed to be five megacycles.

The plate circuit is tuned to ten megacycles and the first stage is used as an oscillator-doubler. The type of tube used was selected to provide a strong oscillator and swing a fairly large ten megacycle voltage on the plate. This particular type of circuit was tested and chosen because it gave good circuit stability and excellent performance. The coil in the plate circuit operating at ten megacycles was designed to give us as high a "Q" as possible, keeping in mind a reasonable size. It was necessary to have as much rf voltage as possible across the coil and a typical circuit provided about four hundred volts of rf across this coil.

The amplifier tube consisted of a type 6V6 operated as a frequency doubler to provide twenty megacycle output. The harmonic voltage of the 6V6 at twenty megacycles is used to drive the 7C5 output tube. Considerable ten megacycle voltage is present in the output of the 6V6 and it has been found useful, in some cases, to allow this voltage to remain.

For certain applications, the ten megacycle voltage may be filtered out, leaving a twenty megacycle voltage on the grid of the 7C5. It will be found that many harmonics exist in the plate circuit and that it is necessary to apply some high "Q" resonant circuit of the band-pass type that will exclude everything but the wanted signal. Regeneration may be applied to effectively increase the isolation of the signal, whose voltage may thus be increased more than ten times.

With a voltage indicator on the output, this resonant circuit is adjusted for maximum output. Very satisfactory filtering action is possible with the resonator type of filter with which it is possible to obtain a "Q" of approximately four thousand for a frequency of seven hundred megacycles. The seventieth harmonic is used and with adjustment for the maximum output for this harmonic, it is found that the strength of the sixty-ninth, sixty - eighth and sixty - seventh gradually decrease and then increase as the frequency is lowered, indicating a phasing due to the standing wave system.

It should be pointed out that use of regeneration at seven hundred megacycles would never produce oscillation in the tube because this is far beyond the limit of oscillation possible in this particular tube and feedback present should never be such that twenty megacycle oscillation could exist. Generally speaking, the amount of regeneration and the type and kind of coils used would not produce much regenerative effect on the twenty megacycle signal.

It is interesting to note that sizable voltages up to frequencies well above one thousand megacycles have been produced by this method. While it is impossible to produce as high a voltage as at seven hundred megacycles with the tubes tried, excellent and useful results were obtained in this region. It is also interesting to note that these voltages were produced well beyond the cutoff region of the tubes used. It appears logical to assume that tubes with a higher frequency cutoff should give better results in general, but this was found to be only partially true.

These principles have been applied to receiver and secondary standard applications; further development should make this system applicable to other uhf problems.

MEASUREMENT of STATIC

by C. E. GRINSTEAD, R. N. FRAWLEY, F. W. CHAPMAN and H. F. SCHULTZ

Research Laboratories Division, General Motors Corp.

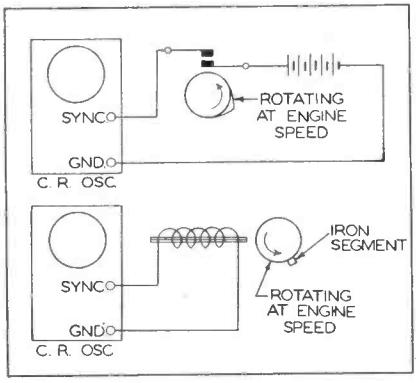
Part II.—Development of a multi-element galvanometer oscil equipment for viewing and recording pressure phenomena

● For viewing and recording of pressure phenomena in high-speed internal combustion engines, equipment that will respond to the highest frequencies to be measured must be used. In general, there are two types of equipment that are practical, namely, cathode ray and galvanometer oscillographs.

The cathode ray oscillograph is essentially a voltage-operated device which may have practically unlimited frequency response, whereas the galvanometer oscillograph is essentially a current-operated device and has a definitely limited frequency response. With practical electrical circuits, the frequency response of the galvanometer oscillograph is sufficient for most engine indicator instrumentation.

Two methods are available for recording with a cathode ray oscillograph: (1) by using a moving film to provide for a time axis, and (2) by using stationary film with an electrical time axis.

When an electrical time axis is used, the oscillograph sweep circuit may be synchronized at engine speed by connecting the external synchronizing circuit of the oscillograph to a voltage-impulse arrangement driven by the engine. Either a battery and contactor arrangement as shown in Fig. 1 or a magnetic impulse generator as shown in Fig. 2 may be used. Fig. 3(A) is a pressure card taken in the combustion chamber of a detonating engine by the use of a rotating drum for a time axis; Fig. 3(B) shows the electrical time axis method, the latter (an indicator card) being taken with stationary film.



Two methods for getting a cathode-ray oscillograph to follow the variations in speed of the engine. Fig. 1 (above) uses a cam-driven contactor to initiate the synchronizing pulse. Fig. 2 uses a magnetic pulse generator

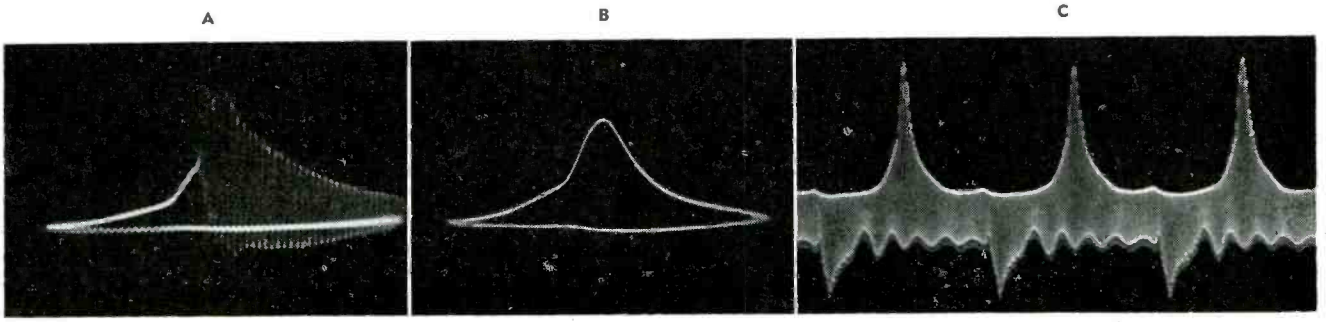
Under some conditions it is possible to view two indicator diagrams simultaneously on a conventional cathode-ray oscillograph by means of an electronic switch. Two pressure records taken simultaneously by the above method are shown in Fig. 3(C). The upper and lower records show pressures measured in the combustion chamber and intake manifold respectively.

While the cathode ray oscillograph can be used for recording, it is particularly well adapted for viewing. On the other hand, the galvanometer oscillograph is a relatively poor viewing mechanism, but is well adapted for recording. A multi-element galvanometer oscillograph has been developed especially for use with engine indicators. The design of this oscillograph includes the following features:

Convenient and simple operation; a tungsten-filament light source; an optical system that gives a uniform time axis and permits simultaneous viewing and recording; revolving short focal length lenses give high photographic speed with stationary film; provision for four galvanometers used simultaneously; daylight loading and unloading of standard roll film; a rapid film advancing mechanism with automatic spacing and exposure counting device; a device for phasing the oscillograph time axis with the engine crankshaft during operation; a barrel-type shutter with a simple timing mechanism.

In the optical system of the oscillograph shown in Fig. 4, the galvanometer mirror, OM, is shown acting as a pinhole instead of as a small mirror. The rotating mirror is octagonal and rotates at one-half the angular velocity of the

Fig. 3—Three forms of cylinder pressure records obtained with apparatus described, using mechanical time axis at left, electrical time sweep, center, and electronic switching of two records, at right



and DYNAMIC PRESSURES

lograph to function with condenser indicators and associated in the cylinders of high speed internal combustion engines

lenses, which are four in number. This mirror splits the image of the tungsten filament, T, reflecting part of this light to the cylindrical lens, L, and part to L_1. Each of the two 11/16 in. focal length lenses receives light from a portion of the filament and forms an image of this portion of the filament on the viewing screen or film.

Obviously the length of the image of this portion of the filament depends upon the relative distance of image and object from the lens. A rotating lens arrangement shown in Fig. 5 makes it possible to use short focal length lenses close to the viewing screen and film, resulting in exceedingly fine traces. It has been shown experimentally that the optical system does not introduce an error in the time axis.

Uniform light intensity throughout the entire time axis is obtained by making the image of the filament overlap the cylindrical lenses, see Fig. 4. In this way the light overlaps the face of the lenses enough to take care of the shifting of the light beam as it leaves the reflecting surface of the rotating octagonal mirror. The trace from the number four galvanometer is normally used for timing marks because the quality of the trace is lowered by its extreme angular position.

The viewing screen and recording film each extend over 30 degrees of arc in the rotating optical system. In order to record 360 degrees of engine crankshaft rotation on the 30-degree arc, it is necessary to use a 12:1 reduction gear between the engine crankshaft and the oscillograph. Any desired angle of crankshaft revolution can be viewed or recorded by use of a suitable gear reduction.

Very often in engine indicator work, it is desirable to study different parts of the engine cycle. To obtain the desired phase of the oscillograph with respect to the

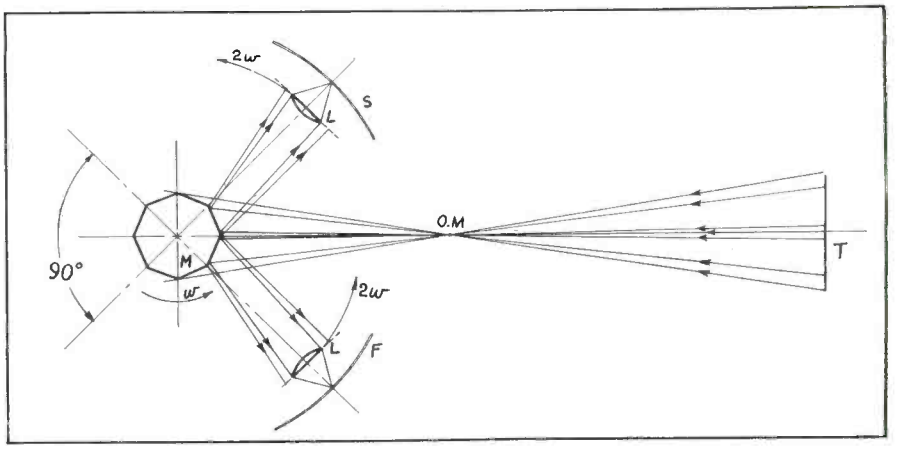
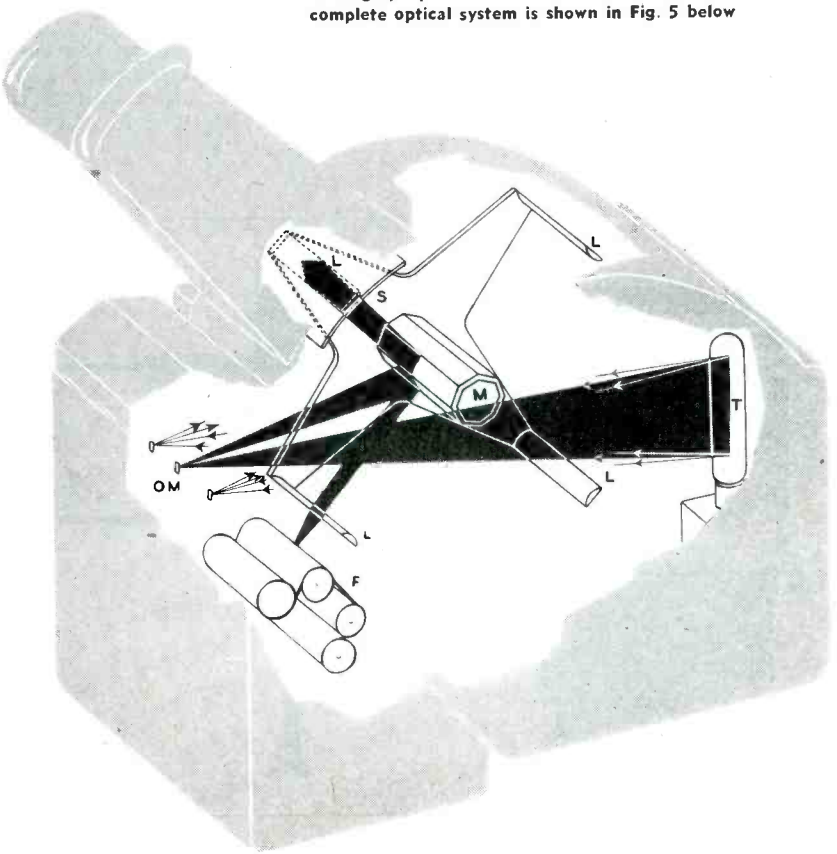


Fig. 4—(above). The rotating mirror system provided in the oscillograph provides simultaneous viewing and recording. The complete optical system is shown in Fig. 5 below



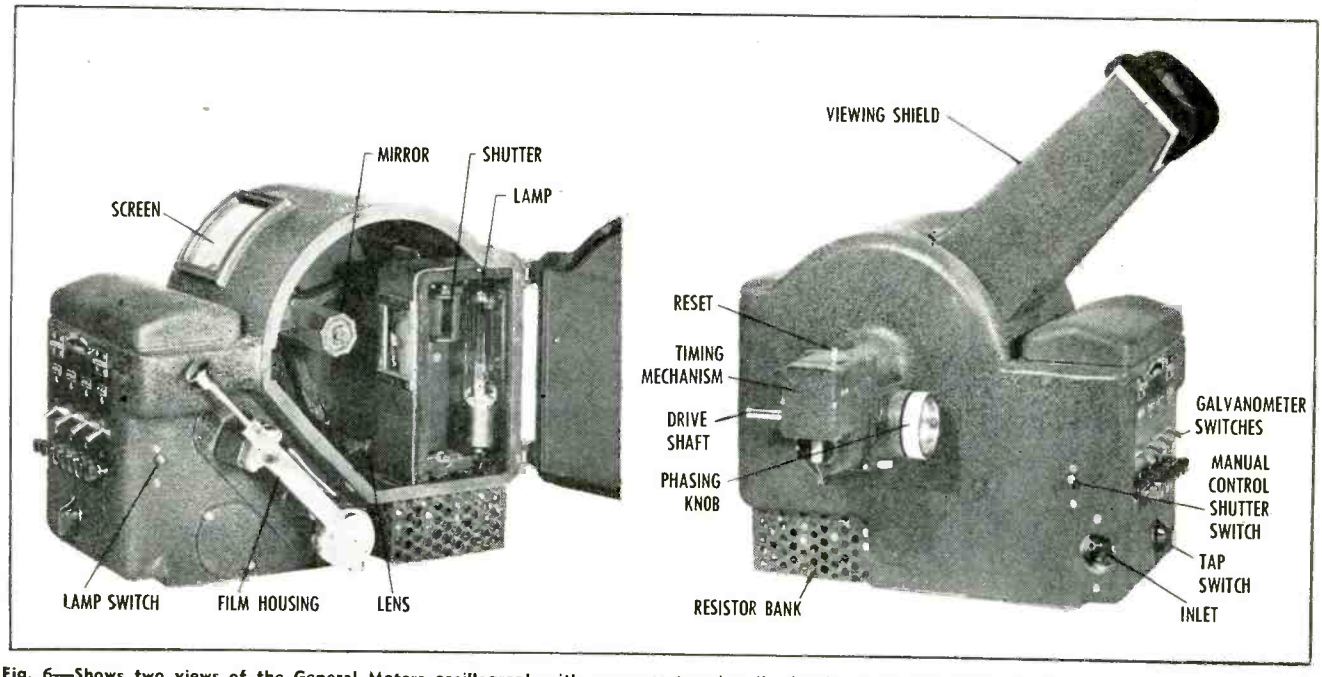


Fig. 6—Shows two views of the General Motors oscillograph with components primarily developed for the study of the combustion engine research problems of that organization in the viewing and recording of engine indicator diagrams

phase of the engine crankshaft, a phase-changing device, shown in Fig. 7, consists of two spiral gears in mesh with their shaft angles at 90 degrees and a method of sliding one of these gears perpendicular to the axis of the other gear. The driving spiral gear is mounted on the oscillograph drive shaft in such manner that it may be moved back and forth across the mating spiral gear. This sliding movement causes the driven gear which is attached to the oscillograph mirror to revolve, thus changing the phase of the oscillograph with respect to that of the engine. The phase of the oscillograph may be changed with or without the engine running. Its position on the completed oscillograph is shown in Fig. 6 which represents a general view of the design.

In order to permit continuous viewing, it is necessary that the shutter mechanism does not interrupt the light falling on the viewing screen. An inspection of Fig. 4 shows that the lower half of the light filament is used for viewing, whereas only the upper half is used for recording. Therefore, a shutter is needed only on the upper half of the filament. A barrel-type shutter, shown in Fig. 6, is synchronized with the engine by means of a suitable timing device located on the mirror shaft.

The light intensity is varied to accommodate various engine speeds by a tapped switch which changes the resistance in series with the lamp. A 110-volt dc supply is used to operate the lamp and shutter circuits. The camera film housing,

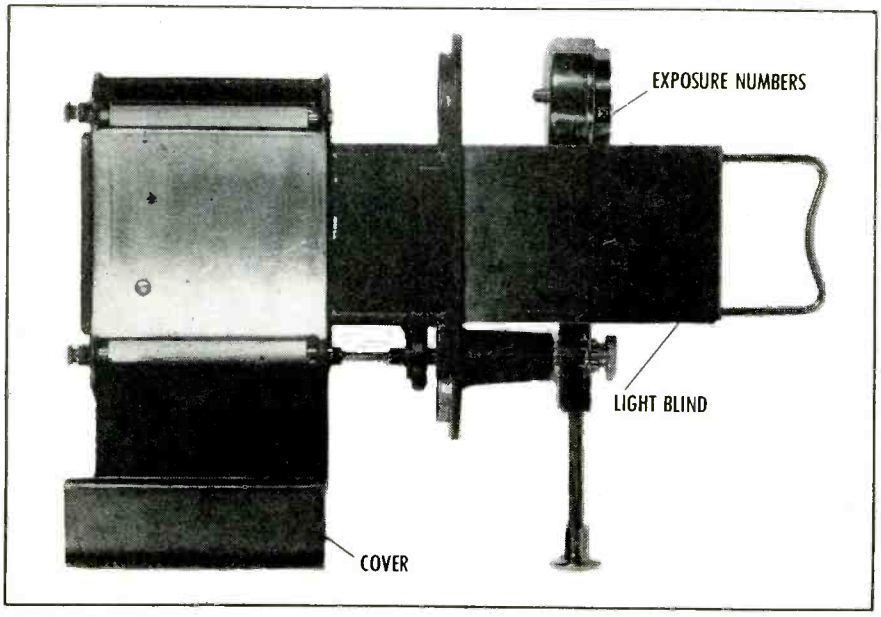


Fig. 8—View of indexing mechanism associated with film holder

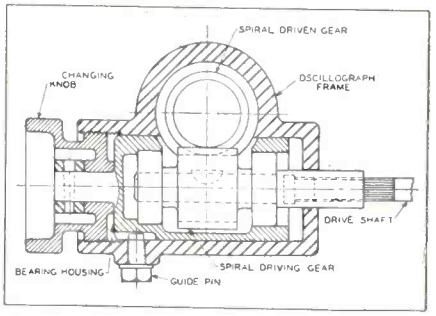


Fig. 7—Phase shift control is effected by advancing minor shaft using spiral gears

Fig. 8, is an assembly of a light-tight film holder, film indexing mechanism, and light blind.

The film indexing mechanism shown associated with the film holder is also shown detailed in Fig. 9. A rack and pinion drive advances the film 3¾ in. for each index, thus giving ten single exposures on a standard Kodak day-

POSSIBLE INDUSTRIAL USES FOR OSCILLOGRAPHIC APPLICATIONS OF CAPACITOR INDICATORS

Measurement of stress and strain.

Measurement of flywheel deflection.

Measurement of cylinder head and block deflection.

Obtaining valve-lift diagrams.

Use in propeller-shaft balancing machines, etc.

Measurement or indication of unbalance in high-speed rotating machinery.

Vibration measurement.

Pressure surges in oil-circuit breakers.

Measurement of water hammer and other hydraulic surges.

Gun pressures.

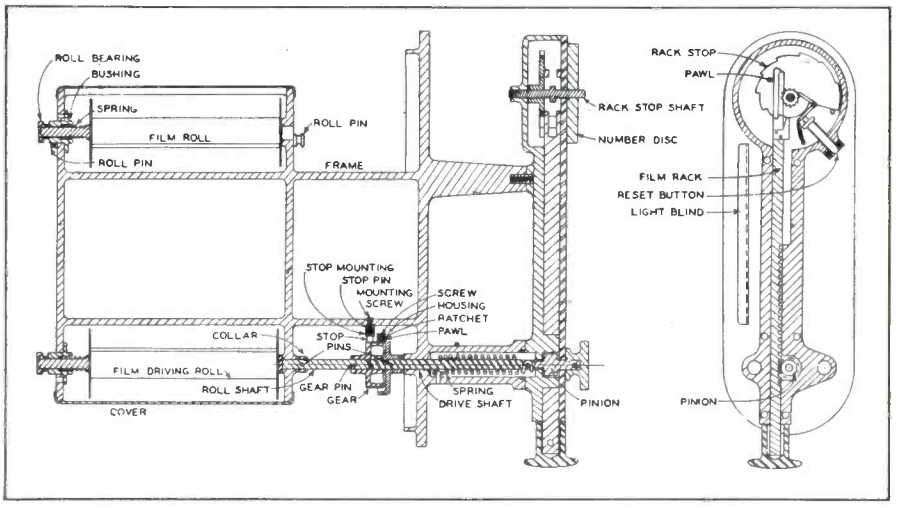


Fig. 9—Shows the controls and indexing details of the film holder. Standard roll type film used

light loading No. 122 roll film. The disk carrying the exposure numbers is restored to number 1 at the beginning of each new film roll by pressing the reset button. To index the film, the rack is pushed down against the rack stop. This forward motion of the rack turns the drive pinion and thus turns the film driving roll. The ratchet mechanism on the pinion drive shaft prevents the film from unwinding on the return stroke of the indexing rack.

As the film is wound on the film driving roll, the diameter of the roll naturally increases and, therefore, requires fewer revolutions with each successive index. In order to advance the film the 3¾ in. required for the 3-in. oscillograms' spacing, the number of revolutions is controlled by the length of rack travel for each index, regulated by a stop, moved one step per index by a pawl on the end of the film rack.

A typical card taken with the multi-element oscillograph is shown in Fig. 10. This oscillogram shows three pressure records taken simultaneously on a four cycle gasoline engine. From top to bottom, the records show pressures measured in the exhaust pipe, intake manifold, and combustion chamber respectively. The combustion chamber pressure record was taken with a low-pressure indicator developed for use in the combustion chamber.

A single card indicator diagram with superimposed calibration marks is shown in Fig. 10. The distortion produced on the single card indicator diagram can thus be eliminated by using the multi-element oscillograph for recording individually and simultaneously the indicator diagram and the breaks produced by the diaphragm indicator.

For certain types of detonation studies the indicator equipment has been used in conjunction with a General Radio type 760A wave analyzer to amplify the detonation frequency components of the indicator card. The output from the oscillator-detector is fed through the wave analyzer which has been tuned to the detonation frequency. The output from the wave analyzer can then be viewed with a conventional cathode ray oscillograph. A high pressure combustion chamber record taken under detonating conditions is shown in Fig. 11. The detonation frequency components of the indicator card under these conditions are amplified approximately thirty times with respect to the lower frequency components of the indicator card itself.

Development of the condenser indicator and associated electrical equipment is far from complete. Much work is yet to be done to make it entirely free from vibration and temperature effects that may be encountered in some applications.

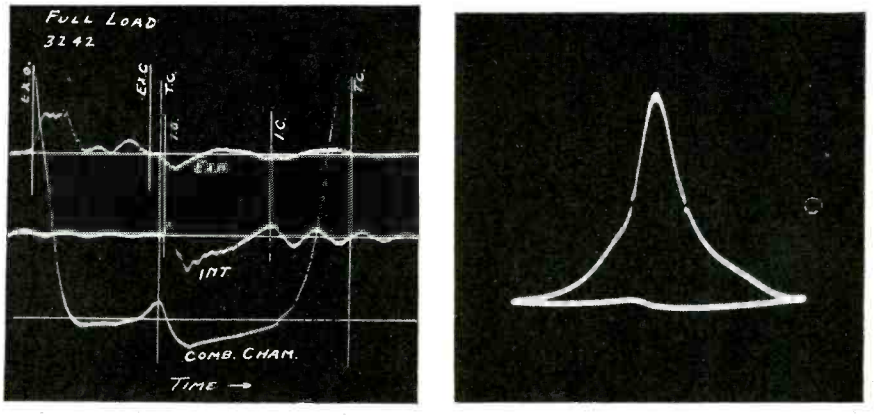


Fig. 10—A typical oscillogram with three pressure effects shown simultaneously (left). At right, a regular indicator diagram with calibration marks appearing at a predetermined level

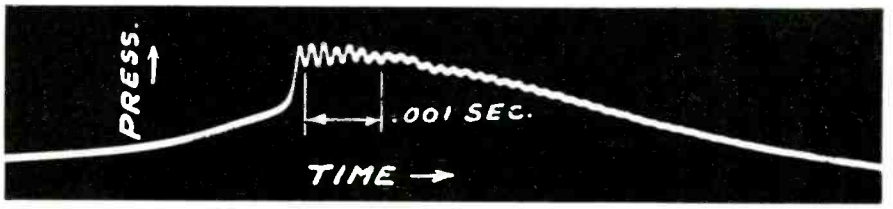


Fig. 11—High frequency detonation waves show up on high speed pressure diagram taken with new oscillograph

Simple torque gage for transmitting condensers consists of a weight-loaded spindle carrying a pointer and calibrated scale. Test is for smoothness of action as well as torque inch-ounces. Lower front plate is provided with stops to limit travel of weights (behind plate) for rapid inspection of condenser types where specs do not require extremely close torque-tolerances

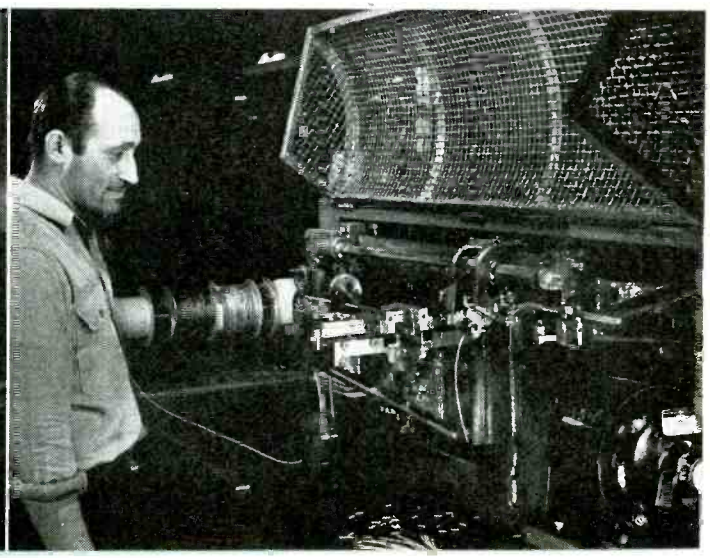
Special torque and smoothness tester for midget APC's (air padding condensers) was hurriedly improvised from old radio and condenser frames a year ago and has been in constant use ever since, testing four to five thousand condensers a day as opposed to only two hundred by old method. Condenser is plugged in at front. Spring-loaded scale reads inch-ounces torque

MILITARY RADIO

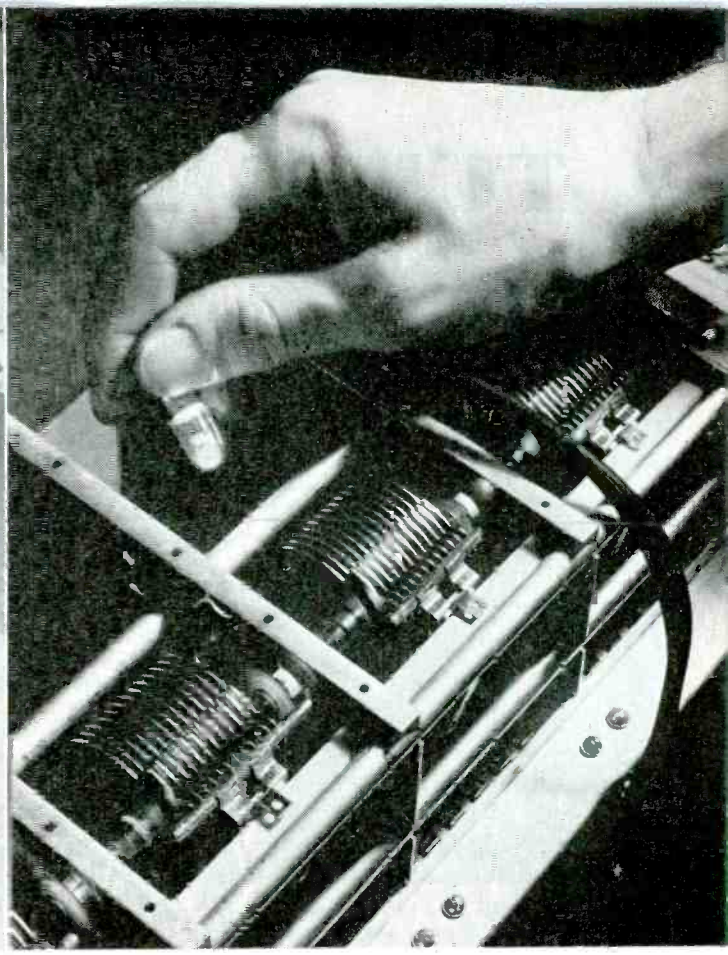
A photographic factory tour showing interest testing methods in production of variable receivers for the Army and Navy at plant of

The APC's get their final 1,000 volt hipot test right in the shipping cartons, saving time and insuring that further handling will not cause defects. The air padding condenser, developed by Hammarlund twelve years ago, is currently being produced at the rate of a million a month by about 10 manufacturers—most widely used variable condenser made

Wire cutting and trimming machine cuts leads to exact preset length and strips insulation from both ends all in one operation, automatically producing hundreds of thousands of leads with a single attendant. Using prewar methods, such operations would require a large corps of employes working 'round the clock. Machine is considered indispensable



Time—even a lot of it—spent on a jig or fixture is quickly repaid in labor savings on the production line. This two-sided steel dimension gage checks accuracy of fifteen dimensions in two simple go, no-go operations. The ceramic plates are end pieces for variable condensers. If hole placements after firing aren't kept within close limits, strains cause gradual changes in characteristics of finished condensers



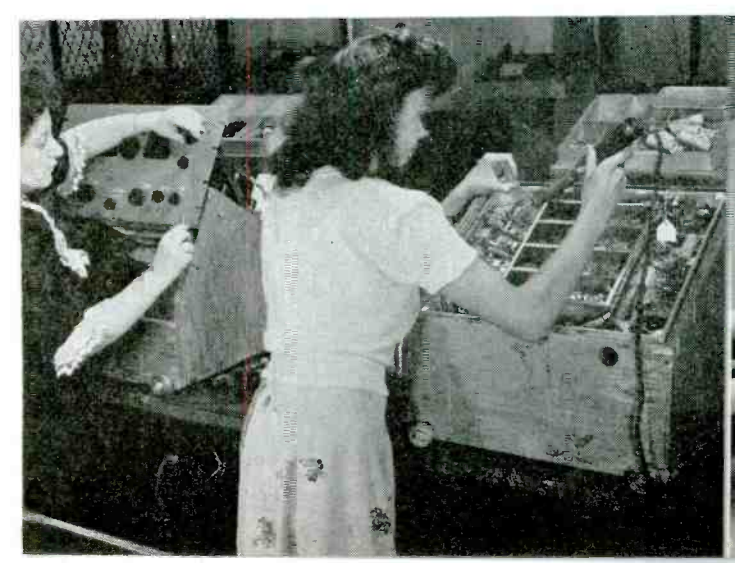
Tom Thumb drop-light idea should be useful in many radio manufacturing operations. Six volt radio pilot lamp on end of long cord is here used to enable operator to peer into tuning unit of Super Pro to check assembly and locate any foreign matter that may have become lodged between condenser plates during the many previous operations

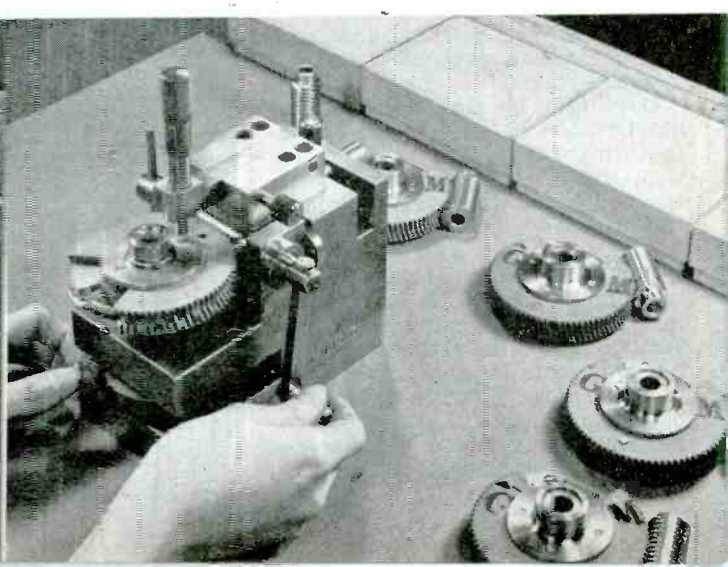
PRODUCTION TECHNICS

ing and widely applicable fabrication and capacitors for the industry and Super Pro Hammarlund Mfg. Co., Inc., New York City

An assembly line that really rolls was necessitated by vast boost in production of military receivers. Remedy was to build wood cradles, to hold Super Pro either right side up or upside down, with four roller-skate wheels at the corners. Guide rail near back of bench keeps cradles on the track as they are rolled from one operator to the next

Special jig for tests on precision worm gear sets cost over $1,000 but pays for itself many times over in daily use. Variable condensers for which it was designed must tune to one part in a hundred thousand smoothly and accurately. For prevention of backlash, worm gear is milled from three sections; center section is later spring-tensioned





TUBES ON THE JOB

Motorola Handie-Talkie used to relay play results direct to the press room and scoreboard from the playing greens at Chicago's Victory National Open Golf Tournament

Postwar Handie-Talkie Uses

A possible postwar use of one war-radio item was demonstrated at Chicago's Victory National open golf tournament when scorers and sports writers tested the Signal Corps' "Handie-Talkie" radio equipment in charting the progress of the golfers.

The equipment was used by observers stationed on greens throughout the course to flash scores back to the club house as each competing foursome holed out. This enabled press and spectators to follow the progress of the tournament stroke by stroke and to know instantly where each of the nation's great golfers ranked.

It marked the first time that such equipment had ever been used at a sports event.

Developed by the Motorola Radio Division of the Galvin Manufacturing Corp. in conjunction with the U. S. Army Signal Corps, the equipment is manufactured at the company's Chicago plant for the armed forces only.

With this transceiver, troop units in combat areas are enabled to keep in instant communication with each other and with their field headquarters. It is considered one of the most essential pieces of equipment, particularly in beachhead landings where the absence of bulky equipment lends mobility to striking forces.

The variety of uses to which it has been put in the war alone is almost endless. In addition to its potential postwar use at major sports events, it could provide communication facilities in sparsely settled areas. Every policeman might be equipped with a set. Regardless of where his beat was located, he would be in constant touch with police headquarters and able to answer calls much more quickly than at present. News events could be reported directly to the newspaper's city desk by reporters equipped with the radiotelephone. Relief parties working in floods and disasters could more easily be directed. Firemen have already put such equipment to good use.

Recently, a searching party of 200 forest rangers, police, and civilians used Handie-Talkies to coordinate their search for a six-year-old boy lost in the Adirondack mountains.

Coal Mine Installs Portable Ignitron

Portable Ignitron rectifier equipment rated 300 kw has been installed at No. 3 mine of Reitz Coal Co., Central City, Pa.

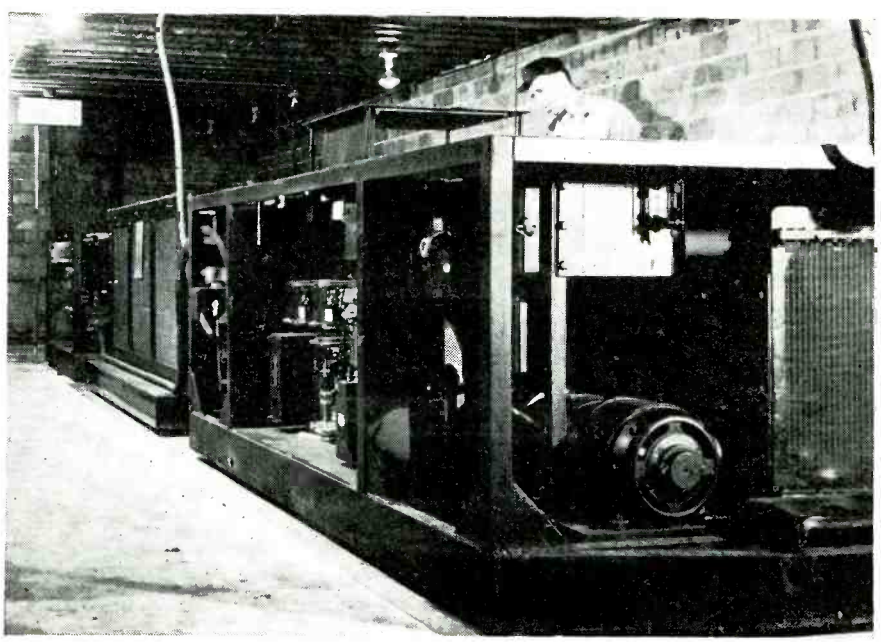
Arranged on three cars, the mine-car type wheels facilitate movement into the mine and allow for quick changes in location. Power is supplied by means of a borehole cable at 2300 volts, 60 cycles, three phase ac. The rectifier converts the energy to 275 volts dc for the trolley system.

Latest type Westinghouse developments built into the unit include an air circuit breaker that eliminates oil hazards and an air-cooled transformer that minimizes fire danger. The portable rectifier makes it possible to maintain better voltage at the working face, and production has been increased.

VHF RR Radio

American Railroads will receive the benefit of the war-spurred rapid developments in the very high frequency radio field as a result of current experiments being carried out by the Radio Division of Bendix Aviation Corporation in close cooperation with a number of the major carriers, according to W. P. Hilliard, General Manager of the Division.

Preliminary tests under actual operating conditions have yielded gratifying results even under adverse conditions. Continuous communication has been maintained over the entire yards of the Atchison, Topeka and Santa Fe Railroad in Los Angeles; end to end radio contact on a mile long freight train was tested in a run on this line from Bakersfield, California, to Chicago; and similar experiments are under way with Baltimore and Ohio Railroad, Chicago, Burlington



Dc end of Ignitron unit in coal mine showing water-to-air heat exchanger for cooling tubes

and Quincy, Seaboard Airline Railway and the Chicago, Rock Island and Pacific Railroad.

Experimental station licenses and very high frequency channel allocations for such tests have been authorized by the Federal Communication Commission. First installations made on these roads were VHF multi-channel equipment consisting of a transmitter, receiver and power unit in a single compact case. Radiotelephone operation is used and signals are heard in the locomotive and caboose by means of loudspeakers. A hand set similar to that on the ordinary telephone is supplied and operation is quite similar to telephoning with the exception that a "push to talk" button is pressed when transmitting.

"Bendix Radio is the first to use radio frequencies above 150 megacycles in railroad operations," Mr. Hilliard declared.

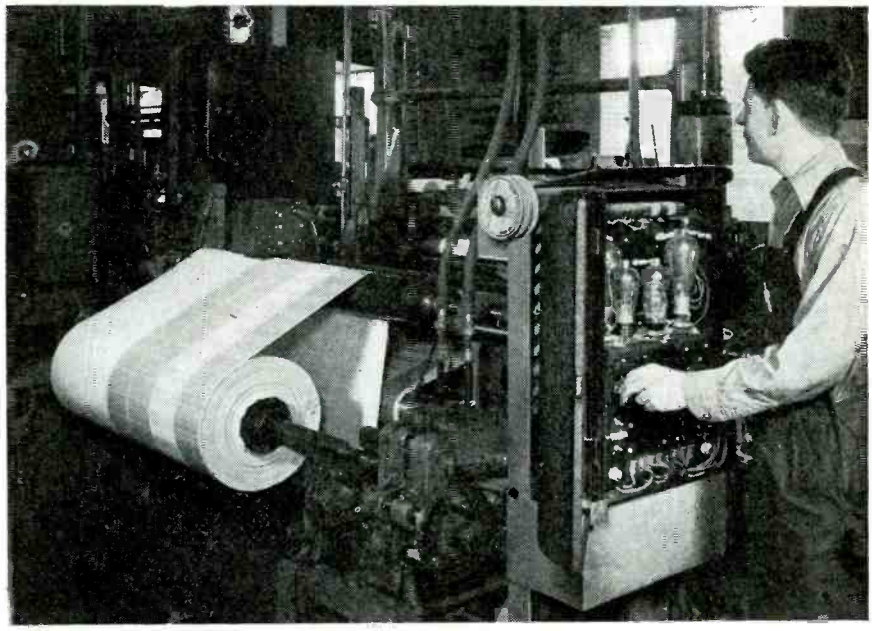
The fact that radiations at the frequencies being used for these tests are similar to light, in that their range is optic and limited to the horizon, is a distinct advantage, since it would be possible for many railroads to use the same channel assignment over and over again at intervals of approximately 50 to 75 miles, thus enormously increasing utilization of the radio frequency spectrum.

It is anticipated that the successful completion of these tests will make it possible for railroads to supplement existing signal systems and increase the effectiveness of their communications. Improved communications will result in operating economies and contribute to the efficiency and safety of a great many railroad operations.

Electronic Controls in Paper Industry

Electronic controls that compare impulses and set in operation the mechanism to apply correction to the feed roll are helping increase production in paper conversion plants in the West. In label and other roll-fed printing production, where it is essential that the printed matter be centered in the finished product, this method of positioning the web has enabled an appreciable saving in paper and production man hours.

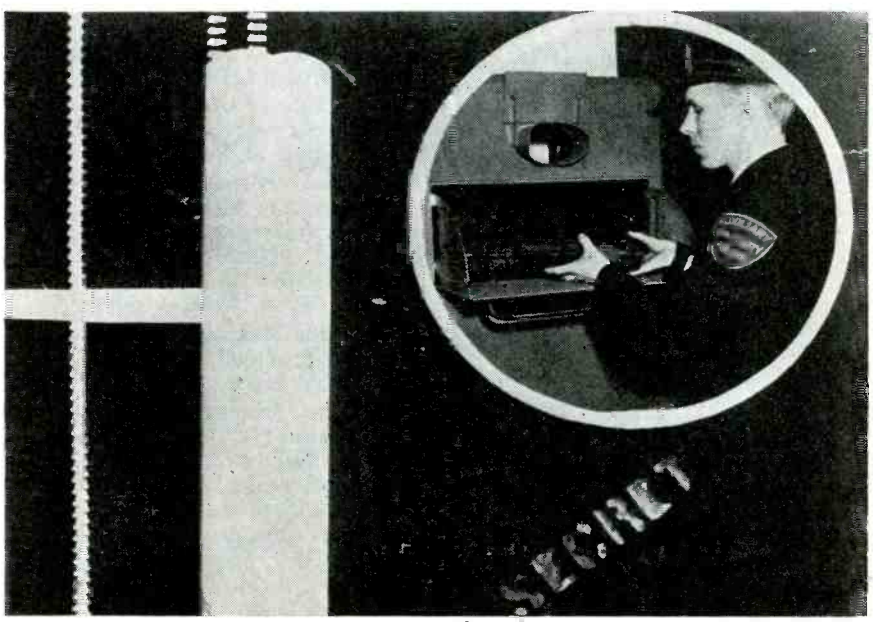
The combination of photoelectric cell and an arrangement of thyratrons is employed on slitters and winding machines to make this efficient control of production possible. An installation of this type of control, manufactured by Westinghouse Electric & Manufacturing Co. is illustrated in the accompanying photograph. This is one of a number of similar machines in Western wax paper label plants. In operation, the photoelectric eye or scanner follows a register line printed on the paper as it travels from the roll towards the cutting knives. The scanner sends an electrical impulse to the electronic panel to tell the control how far the roll has wandered from alignment—a function that takes place in a fraction of a second. Mechanism is then set into operation to correct the position of the feed roll. In this manner the position of the web can be maintained within plus or minus 1/32 of an inch at speeds of more than 1000 ft. per minute.



Photoelectric control regulating the feed of a roll of printed labels passing through a slitting operation in a Western label plant

When electronic controls are not employed, presetting of the roll and web guides in relation to the knives can guarantee accuracy of only ¼ of an inch total variation, due to the characteristics of paper to vary with temperature and humidity.

Secret X-Ray Ink Detects Marked Documents



A new marking compound, developed by North American Philips Company, Inc., New York, is used to mark secret documents. The photo shows how such a paper, marked with the compound, looks in the Searchray machine—the secret paper was hidden in a stack of literature 1½ in. thick and was enclosed in a zipper bag. The insert view shows a plant guard placing the bag into the compartment of a Norelco industrial X-ray unit where he will view it by means of a fluoroscope

ASSOCIATION NEWS

Chicago's Conferences

October looms large on the electronic horizon. With two quite different gatherings on the slate, both to be held in Chicago, the Windy City may well be something more than Mecca to anyone who has anything to do with matters in the electronic fields.

National Electronics Conference is first on the calendar. Scheduled for Thursday, Friday and Saturday, October 5, 6 and 7, meetings are to be held at the Medinah Club, where conferees will consider some two score discourses under nine topics. The program was published in "Electronic Industries" for August, on page 211.

Two weeks later, same days, but on October 19, 20 and 21, Electronic Parts and Equipment Industry Conference gets under way at the Stevens Hotel. This gathering is for the sales and distribution ends of the extensive electronic industry. Radio Manufacturers Association Parts Division has become a co-sponsor of the affair, along with the Sales Managers Club (Eastern Division) and the Association of Electronic Parts and Equipment Manufacturers (formerly the Sales Managers Club, Western Division).

National Electronics Conference, as its title implies, is for the engineering fraternity. Both are expected to be well attended, likely will draw from the four corners of the United States, and beyond.

RMA Outlines Work

A realignment of committees, including the addition of two new ones; reorganization and expansion of the Transmitter Division; the addition of five new Parts Sections, constitute recent RMA activities under direction of its new president R. C. Cosgrove, following the Chicago convention. New are the School Sound Systems Committee, headed by L. A. King, St. Charles, Ill., as chairman, to work with the bureau of education, FCC committees and other industry groups on school apparatus; and the RTPB Television Reporting Committee headed by chairman Ray H. Manson, which will review the recently completed report of RTPB Television Panel No. 6 and formulate official RMA views on the development and promotion of television. The five new Parts Sections which have been organized are: Crystals, F. D. Bliley, chairman; Insulations, John W. Apgar; Metal Stampings and Metal Specialties, W. W. Barry; Plastics and Molded Parts. R. R. Titus; Speakers and Parts, Henry C. Forster.

H. W. Clough, Belden Mfg. Co., who is General Chairman of the Electronic Parts and Equipment Industry Conference

The organization and work of the RMA Transmitter Division, under the chairmanship of C. J. Burnside of Westinghouse Electric Mfg. Co., Baltimore, is being reorganized and expanded for the ensuing year and six division Sections established. The former Aviation-Marine Section has been divided into two new sections, one for Aeronautical Equipment and another for Marine Equipment. The chairmen of the other four sections are being continued, under decisions reached at a meeting July 14 in New York of the Division's Executive Committee. Following are the six sections of the Transmitter Division and their respective chairmen: Transmitter Tube, H. C. Vance; Broadcast Transmitter, C. W. Miller; Emergency Service Communications, F. A. Gunther; Aviation Equipment, J. W. Hammond; Marine Equipment, F. R. McMullen; Piezoelectric Quartz Crystal, G. E. Wright.

Following are the various committees together with their chairmen:

STANDING COMMITTEES

By-Laws and Organization, Chairman, Leslie F. Muter, Chicago.

(*Continued on page* 238)

Conventions and Meetings Ahead

Institute of Radio Engineers (330 West 42nd Street, New York City), September 6, October 4, New York. Rochester Fall Meeting, November 13-14, Sagamore Hotel, Rochester, N. Y.

American Association for the Advancement of Science (Smithsonian Institution Bldg., Washington 25, D. C.), September 11-16, Cleveland, Ohio.

Radio Club of America (11 West 42nd Street, New York City), September 14, New York.

Associated Police Communication Officers (J. M. Wherritt, Police Dept., Jefferson City, Mo.), 11th Annual National Conference, September 18-20, Commodore Perry Hotel, Toledo, Ohio.

Society for Measurement and Control, September 27, 2 Park Avenue, New York City.

American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Fall Meeting, October 2-5, Cincinnati, Ohio.

National Electronics Conference (B. Dudley, 520 N. Michigan Ave., Chicago), October 5-7, Medinah Club, Chicago.

Electrochemical Society (Colin G. Fink, Columbia University, New York City), Fall Meeting, October 12-14, Hotel Statler, Buffalo, N. Y.

Society of Motion Picture Engineers (J. Haber, Hotel Pennsylvania, New York), Semi-annual Fall Conference, October 16-18, Hotel Pennsylvania, New York.

Society for Experimental Stress Analysis (Central Square Station, Cambridge 39, Mass., P.O.B. 168), 1944 Fall Meeting, October 17-20, Carter Hotel, Cleveland, Ohio.

Electronic Parts and Equipment Industry Conference (H. Clough, Belden Mfg. Co., Chicago), October 19-21, Stevens Hotel, Chicago.

American Welding Society (M. M. Kelly, 29 West 39th Street, New York City), Oct. 16-19, Hotel Cleveland, Cleveland, Ohio.

Optical Society of America (A. C. Hardy, M.I.T.), October 20-21, Hotel Pennsylvania, New York.

American Mathematical Society (531 West 116th Street, New York), October 28, New York.

Society of Rheology (R. B. Dow, Aberdeen Proving Ground, Maryland), November 17-18, New York.

Television Broadcasters Association, Inc. (500 Fifth Ave., New York 18, Room 1038), first annual conference, December 7-8, New York City.

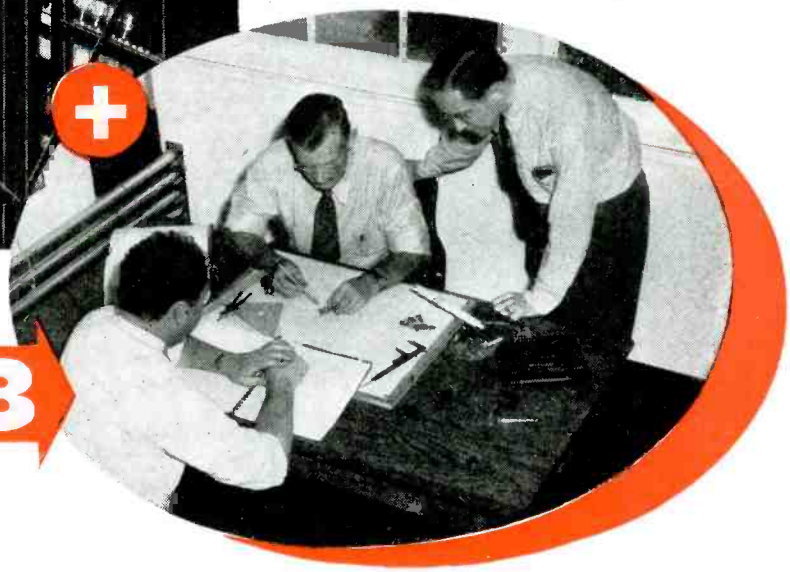
A + B = X ★ ★ ★

A

RECEIVING TUBE TECHNIQUE

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

+



B

SPECIAL PURPOSE ENGINEERING

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

=X

THE ANSWER

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

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

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

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

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

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

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

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION

ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

ARMY NAVY

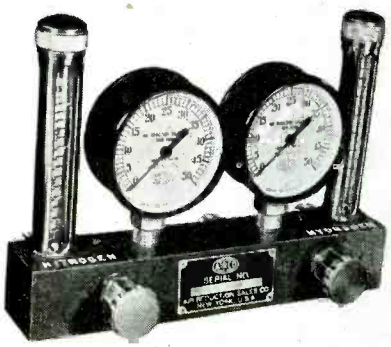
BUY ANOTHER WAR BOND

WHAT'S NEW

Devices, products and materials the manufacturers offer

Gas Proportioner

This new piece of apparatus was developed to meet the demands of tube manufacturers and others who use mixtures of gases for protective atmospheres. It is designed to produce an accurately proportioned mixture of such gases at a pressure not in excess of 5 lbs. per sq. in. It consists of a mixing block incorporating accurately sized orifices and on which are mounted flowmeters, pressure gages and needle valves for the gases as well as inlet and outlet nipples. It can be furnished with any two of six available flowmeters permitting a wide variation in the proportions of the two gases to be mixed. Flowmeters for hydrogen service cover a range from approximately 2 to 200 cu. ft. per hour and for nitrogen the range is from approximately 6 to 140 cu. ft. per hour. Manufacturer is Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

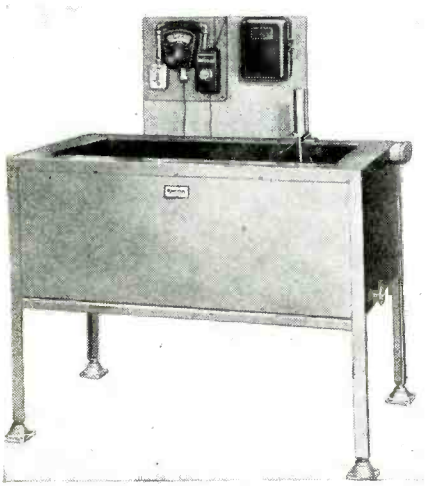


Soldering Tips

Five new interchangeable soldering tips, each a different design to meet every soldering requirement, have been added for the soldering pencil made by H. A. Ungar, Inc., Los Angeles. The soldering unit, complete with handle and cord set, and any one of the five tips, sells for less than $2.

Wax Dipping Bath

Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass., has developed a new, electrically heated and automatically controlled wax dipping bath which provides fast, efficient and economical wax coating of coils, resistors, condensers, panels and other electrical parts. This unit can also be used to wax-coat wrapped packages. Electrically heated by low density type strap-on heating elements, the bath temperature is automatically controlled by adjustable thermostats fitted with dial thermometers. The bath temperature can be adjusted from 100 deg. to 550 deg.

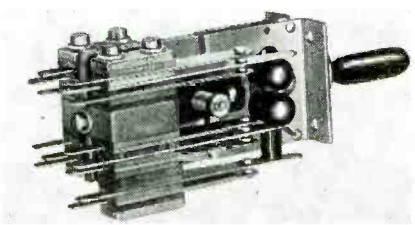


Electronic Flame Cutter

The new ISC electronic flame cutter, made by Struthers Wells Corp., Titusville, Pa., is entirely automatic in operation, utilizing the space on both sides of the machine for cutting. This new machine translates markings into movement; its electronic control accurately guides the cutting torches along any desired contour in a horizontal plane as predetermined by markings placed on cylindrical records. The plastic control records are small, light, durable and easily handled. Plates may be reproduced from the original records either successively, intermittently or in widely separated locations and re-used an unlimited number of times. Where duplicate work is being done in separate plants, the records may be transferred from one plant to another for duplication of the job as originally laid out.

Cam Lever Switch

A new cam lever switch (Model MCL-CS) has been developed by General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass. The positive positioning cam has roller detents which eliminate friction and contact bounce. Coil springs are used on both sides of the cam so that equalized pressure is assured regardless of the number or arrangement of contact assemblies. The switch is static shielded and is of non-corrosive construction. All contacts can be removed from frame by removing a single bolt. Control knob can be supplied with light or stiff action. Contact rating is 10 amps., 125 volts ac, and 2 amps., 125 volts dc.

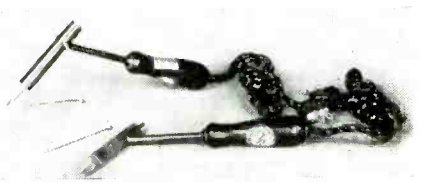


Electrocardiograph

Electro-Physical Laboratories, Inc., 45 West 18th St., New York, has developed an inkless, direct-recording electrocardiograph giving instantaneous standard readings. The new instrument has been designed to eliminate all photographic procedures. Ordinary interfering electrical fields do not affect the operation. An advantage of the electrocardiograph is that small momentary changes in the subject's cardiac action appear immediately, thereby making possible further immediate investigation. The recorder may be used in conjunction with other equipment for laboratory research. It provides an amplifier and recorder which will give a graphic record between .1 cycle and 80 cycles per second at a sensitivity of 1 millivolt for 2 cms total deflection; or a range from zero to 80 cycles for 60 millivolts for 2 cms deflection. A high speed writer can be supplied which will extend the frequency range to approximately 200 cycles. Because of the special damping circuit employed, excellent transient response is secured.

Angle Head Iron

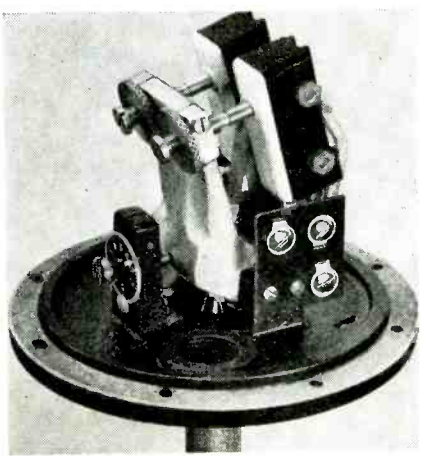
The Kelnor electric soldering iron, produced by Kelnor Mfg. Co., Central Tower, San Francisco, has a balanced angle head adapting the tool for use in hard to reach places. The extendable tip turns straight through the center barrel, making the tool quick heating and reducing current consumption. Heating element coils are sealed in ceramic insulation. There are three sizes, 65, 100 and 125 watts, the smaller size weighing 8 oz.

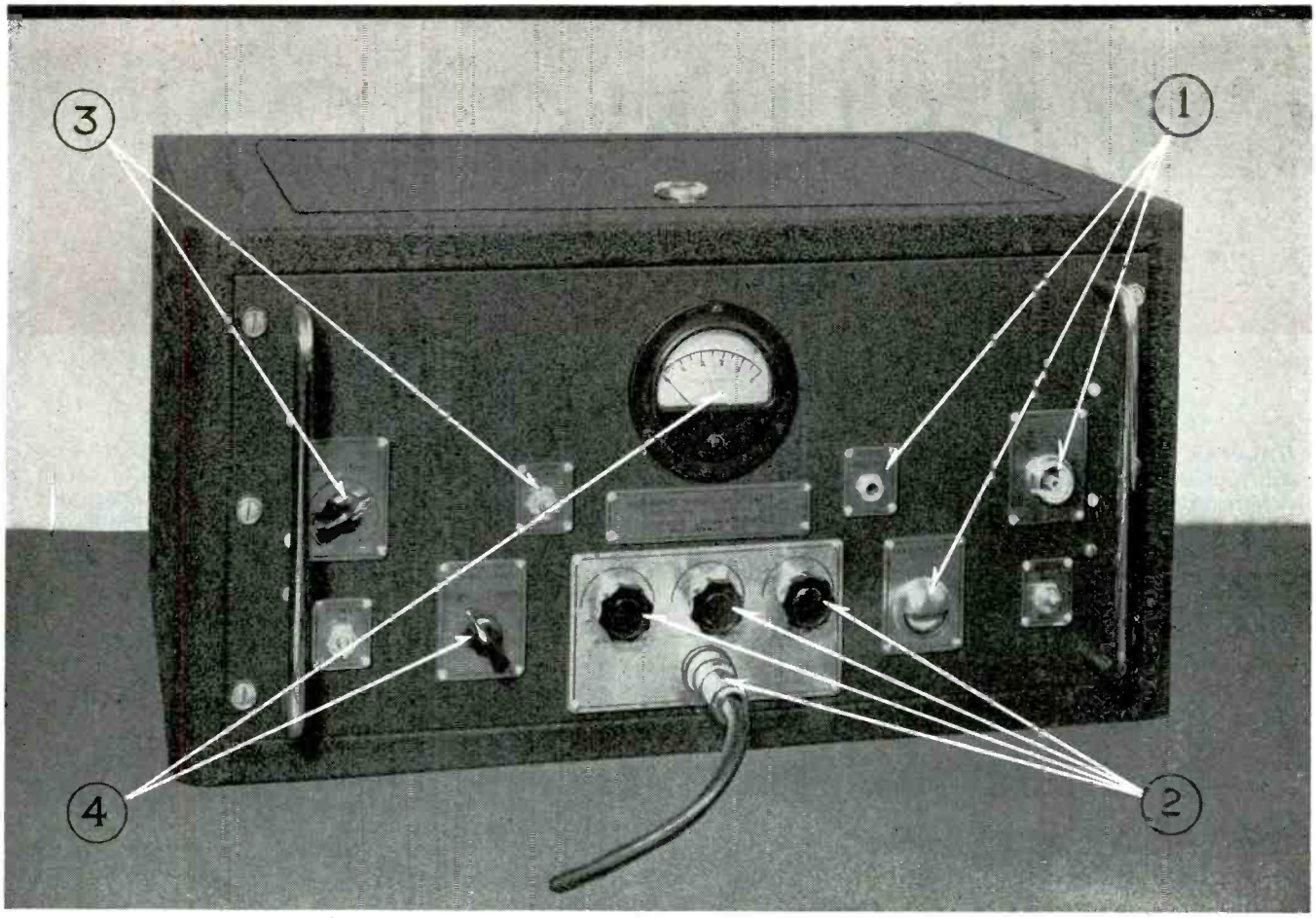


Temperature Switch

Burling Instrument Co., 253 Springfield Ave., Newark, N. J., has produced a new temperature limit switch which is water- and vapor-tight, may be used for any temperature from minus 100 to 1400 F. The instrument has recently been re-designed, reducing weight by 5 lb. and greatly simplifying setting and locking of temperature controls.

(*Continued on page* 178)





4 REASONS WHY . . .

the *New* LAVOIE C-200 Calibrator

EASILY Establishes CRYSTAL-CONTROLLED Frequencies at UHF Up to 2000 Megacycles!

1. BEAT DETECTOR UNIT provides easy calibration of signal generators or oscillators with either aural or visual indication of zero beat.
2. OUTPUT and ADJUSTMENTS give crystal-controlled harmonic frequencies up to 2000 megacycles.
3. MODULATION CONTROLS permit selection of either modulated or unmodulated output as well as degree of modulation.
4. MILLIAMMETER and SELECTOR SWITCH facilitates easy adjustment of output controls.

Write for detailed information.

Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS

MORGANVILLE, N. J.

Specialists in the Development of UHF Equipment

WASHINGTON

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

HELPFUL THOUGH ABSENT—While the electronic-radio industry was conspicuously absent from the list of products given the "green light" for limited civilian production August 15, by WPB Chairman Donald M. Nelson, there is a feeling among the most competent observers in the industry that there are some manufacturers in many of the fields, now able to enter limited civilian production, provided the materials, manpower and facilities are not needed for the Army-Navy requirements. These are particularly the factories which were "converted" to the making of electronic-radio components and parts, to carry the immense load of the Signal Corps two years ago when the electronic-radio industry was called upon to mushroom overnight into a six-billion-dollar production.

RETURN TO PREWAR ACTIVITIES—By the return to their prewar fields, these companies will now not be "tempted" to keep on with their electronic-radio enterprises when hostilities cease. Then, too, a number of major "regular" companies in the electronic-radio industry engage in manufacture of electrical appliances, electrical refrigerators, etc., so that permission to return to civilian production in those fields will help their overall future outlook and planning.

RAILROAD FIELD JUST OPENING—The use of radio by the railroads for dispatching and other safety purposes will be unfolded at the series of hearings to commence before the FCC September 13, but from the standpoint of any large immediate market for equipment, the railroads do not loom as substantial customers in the near future. The FCC will have to determine what, if any, frequency space should be set aside for railroad radio communication and other electronic uses, including radar for anti-collision. This will take a considerable time of engineering study.

FORTY RAILROAD SYSTEMS APPLIED FOR—Railroad communication is a field which should be assiduously watched by radio manufacturers because already over 40 applications for radio systems have been filed with the FCC. Commission Chairman Fly feels that some day not only will the railroads use radiotelephone for dispatching and communication with the engineers and conductors of moving trains, but that passengers will be able to talk to their homes and offices while traveling and that television will be a new form of entertainment on passenger trains.

COAST GUARD PIONEERING—Back in 1903, the U. S. Coast Guard—now 154 years old—pioneered in radio and undoubtedly was one of the main movers that led to the progress of early "wireless." With the old "spark" set, the Coast Guard operators probably contributed more than any other group of the ship-shore radio personnel of that time at the turn of the century to the adoption of the 500-kc. distress calling wave which has been continuously used over the past 40 years.

WHY 600-METER SOS BAND WAS CHOSEN—The 500-kc. frequency (600 meters) in those days of crude and simple apparatus was adopted by ship operators because it was the average natural and "loudest" wavelength emitted from the antennae. The Coast Guard also pioneered in aircraft radio, especially in the use and development of direction finders because Coast Guard airplanes have been used for the past decade or more in sea rescue work. Modern direction finding equipment on airplanes, together with the use of the cathode-ray tube, owes much of its development foundation to the work of the Coast Guard.

SURPLUS PLANNING—The policy of the Surplus War Property Administration to have the electronic-radio manufacturers, who have achieved such a notable record in war production, act as the agents of the Federal Government on a commission basis in handling the disposal of the surplus military apparatus and equipment components and parts into the regular civilian marketing channels has met with general approval and support from the industry's leadership.

BLOCKING SPECULATORS—The above plan will certainly block off speculators and "gyps" from obtaining large allotments of the surplus equipment, tubes and other parts, and will also mean the most orderly method possible for the manufacturers in the reconversion. Of course, the final format of the program awaits the enactment of the Surplus Property Disposal legislation by Congress so that the progress up to date has been naturally slow and has been confined to industry-government discussions on the different types of disposal machinery.

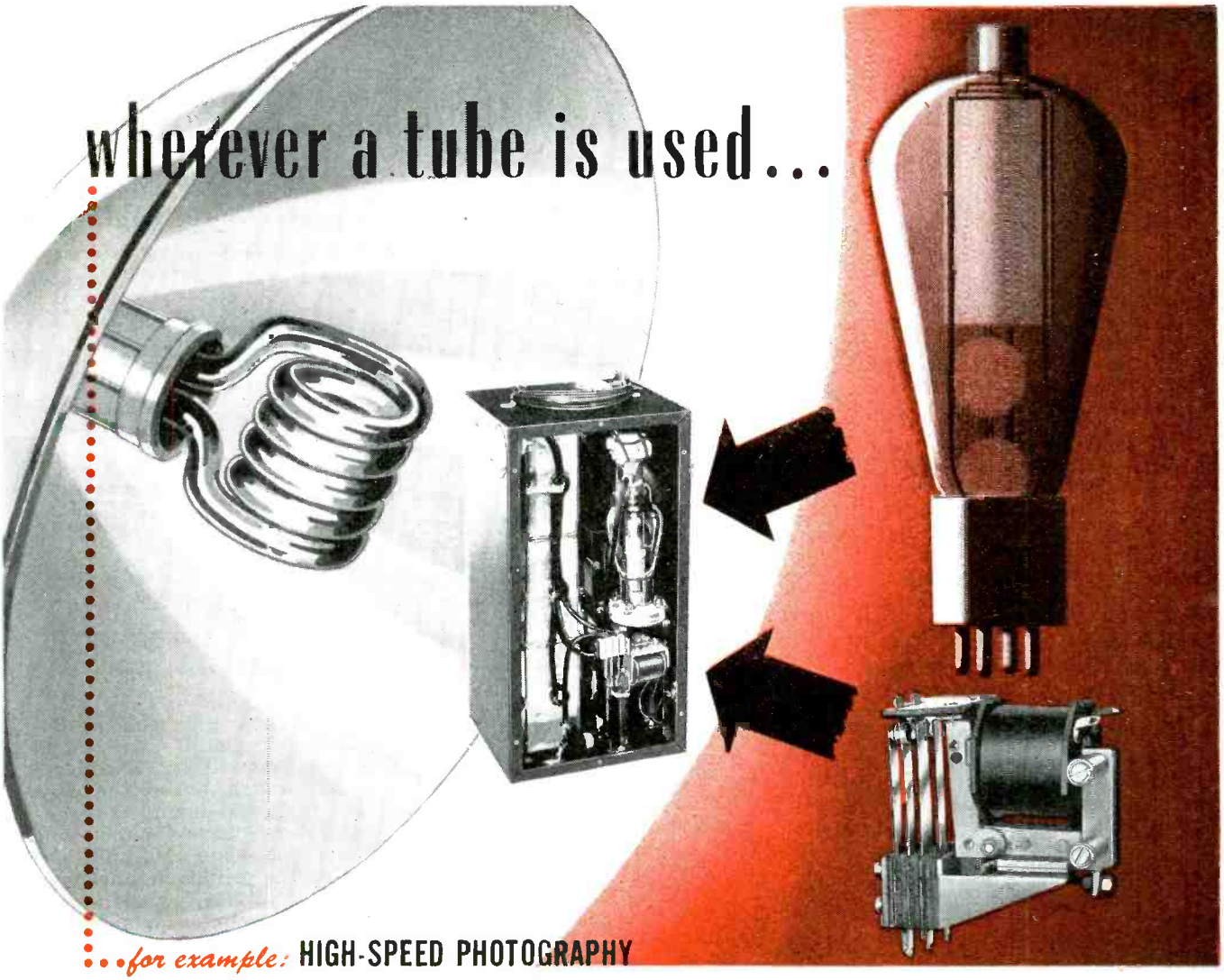
COOPERATION WITH INDUSTRY—The Defense Supplies Corporation, the RFC branch which has been designated by the Surplus War Property Administration to handle the vast bulk of the electronic-radio surplus disposal planning (the excess home radio receivers only being under the jurisdiction of the Treasury Department's Procurement Division), has been cooperating most satisfactorily with the leadership of the industry. There have been numerous conferences between the DSC officials and the different branches of the industry—committees representing the so-called "end" products, tubes, capacitors, resistors, etc.

WILL USE RMA FACILITIES—One of the most important sessions was a mid-August meeting with the RMA Postwar Conversion Committee. The Defense Supplies Corporation and the SWPA officials, it was understood, have agreed to utilize in an advisory capacity the facilities of the Radio Manufacturers Association Committees, especially in engineering and marketing, in blazing the future disposal course.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

wherever a tube is used...



...for example: **HIGH-SPEED PHOTOGRAPHY**

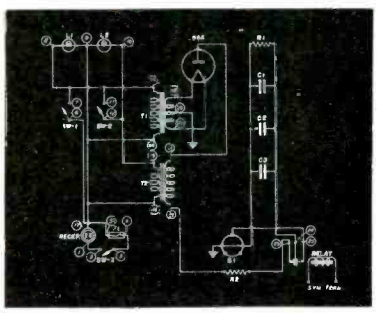
The Lee Strobo-Speed lamp stops action of rapid movement with a flash of about one thirty-thousandth of a second. One flash exceeds in light intensity the illumination of 2,000 kilowatts of ordinary tungsten lamps. Operates on 115 volts, 60 cycles, A.C.

THERE'S A JOB FOR *Relays* BY GUARDIAN

In the Lee Strobo-Speed lamp a rectifier tube is employed to build up a high charge on a bank of condensers. These are discharged through the flash lamps when the Guardian Series 15 relay is energized. This special application illustrates the flexibility of design incorporated into Guardian relays. The Guardian standard Series 15 was selected for the job and engineered to meet the high voltage requirements and other special conditions.

Another Lee Strobo-Speed unit with three flash tubes operating from three banks of condensers also employs the Series 15 relay. In this application the relay is equipped with additional switches to handle three circuits instead of one. Contact switches in both units are specially insulated to withstand the high voltages.

The Series 15 is a compact unit having a maximum switch capacity of 10 pole, single throw with 1½ amp. contacts; 6 pole single throw with 8 amp. contacts; 4 pole double throw with 12½ amp. contacts. Coils for standard voltages range up to 220 volts and may be equipped with copper slug time delay on release or attract.



Single Flash Tube, Single Circuit Diagram.

Consult Guardian whenever a tube is used—*however*, Relays by Guardian are NOT limited to tube applications but are used wherever automatic control is desired for making, breaking, or changing the characteristics of electrical circuits.

For D. C.—write for Series 15 bulletin. For A. C.—write for Series 30 bulletin.

GUARDIAN ELECTRIC

1622-K W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

SURVEY of WIDE READING

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

Remote Control Circuit

J. E. Benson and A. G. Brown (A.W.A. Technical Review, Sydney, Vol. 6, No. 3, 1943)

Remote control of two double-conversion superheterodyne receivers (Fig. 1) over a single-band non-loaded telephone line with ground return is described. Either of the two receivers may be selected and the following facilities are then connected to the selected receiver: fine tuning over a range of ±10 kc, smooth control of rf gain, and on-off control of a beat oscillator for continuous-wave reception. The overall bandwidth of the system is approximately 2.2 kc.

The four switching operations required to control receiver selection and beat oscillator on-off switching are obtained through switches S_1, S_2 (Fig. 2) by application of positive and negative dc pulses between either leg of the line A, B and ground. MR 1-4 are metal rectifiers separating the negative and positive pulses. On the application of the positive pulses, relays C, E, respectively, operate and close auxiliary holding circuits C_1, E_1, respectively, for a local power supply, thus holding the relays C, E, in the operated position in spite of removal of the initial pulses. E operates G and H which change over the various control and output circuits from one receiver to the other, while C controls the power supply for the heterodyne oscillator. Application of the negative pulses trips the holding circuits (D_1, F_1, respectively, open) restoring the operated relays to their initial conditions. The two legs of the line are isolated for dc, the ac circuit being completed through coupling capacities C1, C2, shown on the line transformers T1, T2. P1, P2, P3 are pilot lamps indicating the positions of switches S1 and S2.

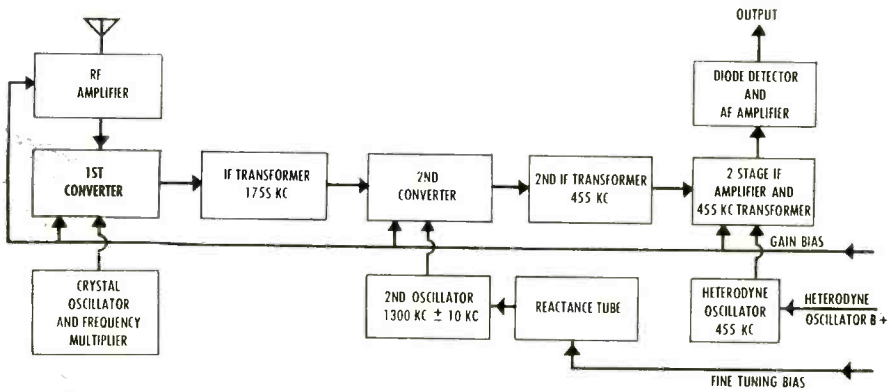


Fig. 1—Double-conversion superheterodyne receiver in remote control circuit

The rf gain control at each receiver is performed by means of a variable dc bias potential applied to the variable g_m grids of the rf and if amplifier tubes. The fine tuning is performed by means of a similar potential applied to the control grid of a reactance tube connected across the frequency determining circuit of the second heterodyning oscillator. Three frequencies located above the pass band of the audio channel are generated in the three-channel tone oscillator and combining unit. The output of the center channel is of constant amplitude, while the outputs of the two outer channels can be changed independently from the operator's desk. These three tones are separated from the receiver audio output channel coming in from the line by means of the balanced hybrid unit and low-pass filter. On reaching the three-channel filter amplifier and rectifier unit in the receiver, the three tones are separated and rectified to produce dc bias potentials.

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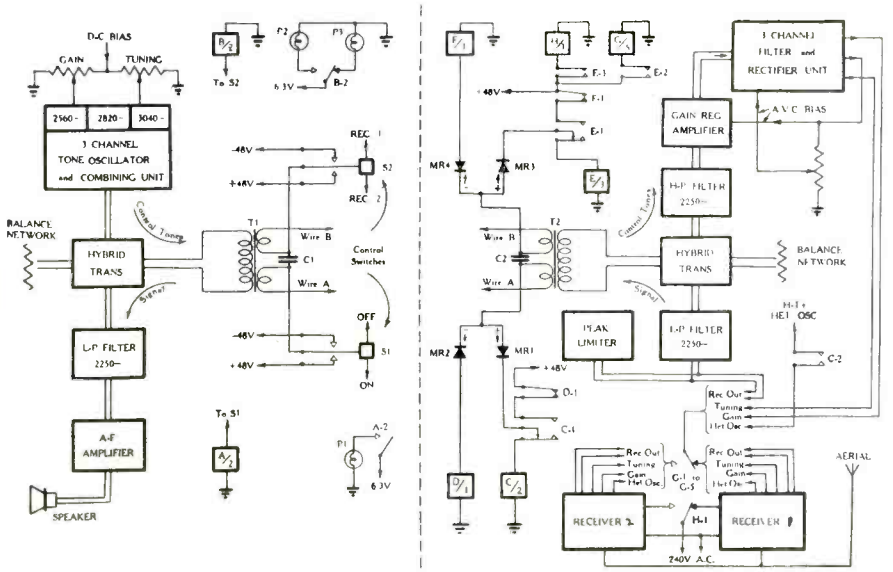


Fig. 2—Remote control installation for two receivers

Measuring FM Wave Characteristics

W. Staeblein (Bulletin Suisse des Electriciens, Zurich, 1944, No. 4)

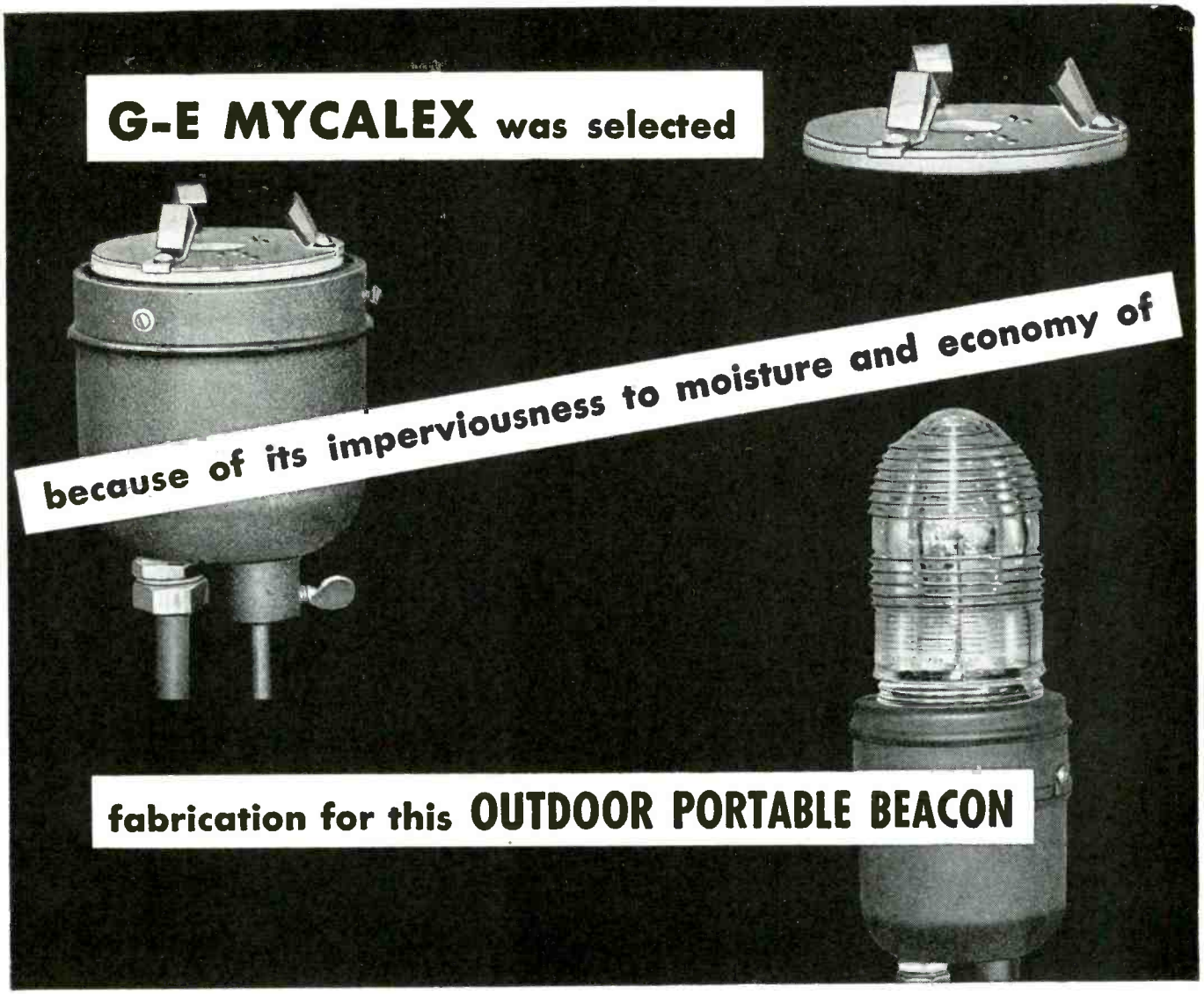
A frequency-modulated wave of unit amplitude may be represented by the expression:

$$\sin\left(\omega_0 t + \frac{\Delta\omega}{\omega_m}\cos\omega_m t\right) = \sin\left(\omega_0 t + \Delta\varphi\cos\omega_m t\right)$$

which can be interpreted as an oscillation with constant frequency and variable phase. Δ is the modulation index.

If the phase-modulated wave is heterodyned with the carrier frequency wave having the same amplitude and a constant phase opposite to that of the unmodu-

(Continued on page 224)



G-E MYCALEX was chosen for the socket of the G-E Novalux Portable Flashing Beacon for three reasons: First—the performance of this amazing material under high humidity conditions; second, because of guaranteed high mechanical strength of at least 14,000 lbs. per square inch; third, it eliminates expensive molds. G-E mycalex can be fabricated from sheets with common machining operations.

In addition, G-E mycalex has chemical and dimensional stability. It does not deteriorate with age and is free from warpage and shrinkage. It offers high resistance to sudden temperature changes.

Whatever your specialized insulation needs may be, it will pay you to investigate this all-purpose insulating material. For a list of specialists in the fabrication of G-E mycalex — for a free sample and a copy of the data bulletin, "G-E Compression-Molded Mycalex"—please fill out the coupon. . . . *General Electric, Schenectady, N. Y.*

• *Tune in General Electric's* "The World Today" *and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday evening listen to the G-E* "All-Girl Orchestra" *at 10 E.W.T. over NBC.*

FREE—
G-E MYCALEX
BULLETIN

ELECTRONICS DEPARTMENT
GENERAL ELECTRIC CO.
Schenectady, N. Y.

Please send me a free sample of G-E mycalex and your descriptive bulletin explaining the methods and tools to use in machining G-E mycalex.

(If you wish a list of fabricators of G-E mycalex, check here_____.)

*Name*_____

*Company*_____

*Address*_____

_____

Over 21 Years of Mycalex Experience—Your Assurance of Quality

GENERAL ELECTRIC

177-M-C6-9915

TELEVISION TODAY*

New Developments in the Video Field

GE-IBM Propose Tele-FM-Facsimile Relay

Following on the heels of the AT&T FCC-approved plan for the establishment of a television-FM relay network linking New York and Boston, General Electric and International Business Machines Corp. have now entered the picture with a proposal to link New York, Schenectady and Washington together with a high-frequency relaying system suitable for the handling of two television programs, a channel for facsimile and FM, simultaneously.

Prime purpose, according to Walter S. Lemmon, general radiotype manager of IBM, would be the transmission of business documents by facsimile, a project with which IBM experimented during the New York World's Fair in 1939-40. The plan contemplates the erection of transmitter-receiver terminal stations by IBM at Washington and New York with relay stations between the two cities, and the operation of a terminal station by GE at Schenectady with a relay point at New Scotland, near Albany.

Whereas the AT&T project will utilize frequencies in the higher portion of the spectrum, bands sought by IBM-GE are six in number: 1,900,000 to 1,960,000 kc; 1,960,000 to 2,020,000 kc; 2,020,000 to 2,080,000; 2,120,000 to 2,180,000 kc; 2,180,000 to 2,240,000 kc; 2,240,000 to 2,300,000 kc. Power specified is 15 watts for the transmitters; antennas would be highly directional. All development work is to be done by GE with the initial research to be carried out on the New York-Schenectady link, though the systems would be jointly owned and operated by GE and IBM.

Television Directory

American Television Society is to distribute a membership directory, develop an active program laboratory, prepare a glossary, bibliography and review of current books on television and establish a speakers' bureau. The directory will list members' names, addresses, business affiliations and their respective fields of interest in television.

The ATS program laboratory will produce and present voluntary non-commercial television programs over leading television stations with members participating in the preparation and production of shows. Charles Kleinman is Executive Director of the laboratory. He is assisted by Prof. Edward Cole of the Yale University Department of Drama; Ted Huston, Director of Production; John Flory, Director of Scripts, and Miss Jean Rosenthal, Director of Station and Agency Relations.

TBA Schedules Conference

Television Broadcasters Assn., Inc., has scheduled its first annual conference for Dec. 7 and 8, this year. It is to be held in New York city. O. B. Hanson, vice-president and chief engineer of NBC, and a director of TBA, is chairman of the conference committee. Jack Poppele, secretary and chief engineer of WOR, is to be conference coordinator; Will Baltin, secretary-treasurer of TBA, is in charge of press and public relations.

Minor Changes Suggested by Television Panel

The Television Panel of RTPB has made public its recommendations, which are that the basic standards developed out of the NTSC-FCC group in 1941 be adopted with but minor changes. The band width for commercial television stations remains at 6 mc and the synchronizing wave form remains the same, with the exception that the duration of the vertical blanking period has been reduced from 0.075H to 0.05H. The serrated type of horizontal synchronization is standardized the same as has been in common use since 1941.

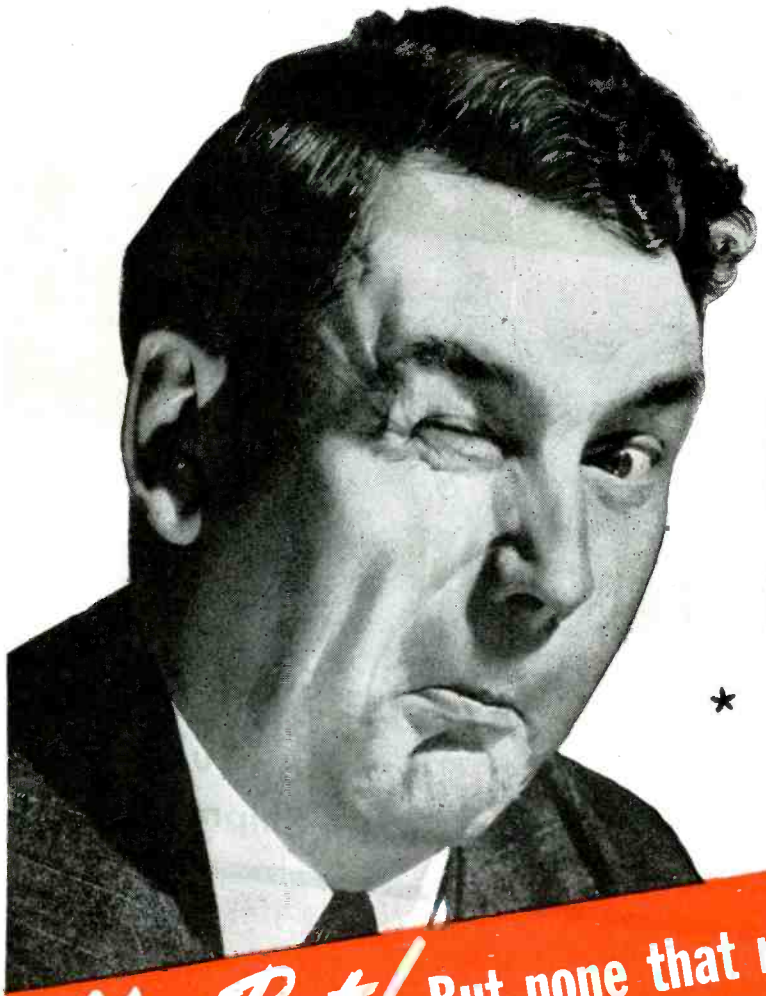
An important change has been made in the aural channel standards. The adoption of 75 kc deviation FM in 1941 proved the difficulty of maintaining the local receiver oscillator frequency stability. The use of higher frequencies for television places extreme requirements of stability on the circuits where wide band FM is employed. The new proposals call for a 25 kc deviation for FM sound. This will permit less exacting control of the oscillator frequency and still provide good sound quality. In order to compensate for the lower signal-to-noise ratio produced by the decreased deviation, the panel suggests an increase in sound power from 100 to 150 per cent of the picture carrier. Frequency modulated video is ruled out for commercial stations because of the greatly increased problems with multi-path transmission and consequent ghost signals.

The frequency allocations as suggested include 26 channels, beginning at 50 mc and extending to 246 mc. This is in contrast with the present allocations of 18 channels between 50 mc and 294 mc. The new proposal brings the channels closer together, that is, it moves certain government, aviation and other service channels which now lie in between groups of television channels. This proposal covers commercial broadcasting stations. For relaying and similar station link networks, 10, 12 and 20 mc channels are proposed in a region from 162 mc to 3,000 mc; 20 mc experimental channels are proposed in the region from 600 mc to above 10,000 mc. All these allocation suggestions, of course, must still be interfiled with the suggestions of the other channel groups studying other services.

Quarter Million Cost for 25 Kw Station

It probably would cost $258,500 to equip a first-class television station of 25 kw video and 12.5 kw audio power, and an additional $177,500 to operate it annually, according to Leonard F. Cramer, vice-president of Allen B. DuMont Laboratories, Passaic, N. J. He gave the figures to the New York Radio Executives Club. Total initial investment breaks down thus:

Two Iconoscope cameras, with push dollies and studio control desk, $23,000; electrically controlled camera dolly, $2,500; two special film projectors, $12,000; two film pickup cameras, $6,000; master control board, $35,000; studio lighting and audio equipment, $10,000; field pickup equipment, including two cameras, $24,000; field audio pickup equipment, $1,500; field relay transmitter, $8,000; relay receiver, $2,000; truck with generators and antenna, $5,000; 25 kw peak video and 12.5 kw peak audio transmitter with control console, $65,000; installation cost, $15,000; suitable antenna for above transmitter, located on same building, $25,000; fireproofing of film projection room, $1,500; spares and test equipment, $13,000.



MIRACLES OF SCIENCE?

You Bet! But none that replace SOLID SELLING

Scientific and technological progress have been kicked forward at a tremendously accelerated pace. To win wars there *must* be miracles of development and production. However, let us not lose sight of the somewhat slower tempo which prevails under normal competitive selling conditions.

Check the facts: **1.** There *will* be a tremendously swollen consumer demand. **2.** With their accumulated war savings, people will be ready, willing, able and anxious to buy.

But, if past experience can be trusted at all, Mr. and Mrs. America will be very careful and twice as cagey about what they buy and where they buy it. They will have to be *sold*.

Manufacturers and retailers alike should take Mr. Miracleman off the payroll now. He always looks pretty in pictures, but he wilts fast when Mr. Solid Selling takes off his coat, rolls up his sleeves and goes to work.

Motorola Radio

CAVALRY GUIDON SET

Developed and built by Motorola Engineers in co-operation with Engineers of the U. S. Army Signal Corps.

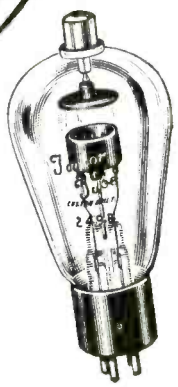
GALVIN MFG. CORPORATION • CHICAGO 51

ARMY E NAVY

Motorola Radio

F-M RADIO ★ PHONOGRAPHS ★ RADAR ★ TELEVISION ★ F-M POLICE RADIO ★ MILITARY RADIO COMMUNICATIONS

Rectifiers—



IMMEDIATE DELIVERY!

All of These Standard Taylor Tube Rectifiers Are In Stock - Ready for Shipment

TAYLOR ENGINEERS ARE AT YOUR SERVICE—READY TO HELP ON RECTIFIER PROBLEMS—

When it's advice you need, Taylor Tubes Engineering Staff, with it's extensive background of solving unusual rectifier problems, is ready and anxious to help with your plans. Taylor consultants will gladly study your requirements and make specific design recommendations. You'll find them able and willing to help you work out the best possible solution at a saving of time and money. In addition, if you require a special type of rectifier tube, we may be able to help you on that score too. Let us know about your rectifier problems — we shall be happy to direct our skill and experience in your direction.

Buy More WAR BONDS For Victory!

Taylor HEAVY CUSTOM BUILT DUTY Tubes

TAYLOR TUBES INC., 2312-18 WABANSIA AVE., CHICAGO 47, ILL.

JUST OUT!

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

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

SPRAGUE ELECTRIC COMPANY, North Adams, Mass.

(Formerly Sprague Specialties Co.)

SPRAGUE

ARMY E NAVY

CAPACITORS · KOOLOHM RESISTORS

CUT-BACKS to bring PRODUCTION

WPB to permit resumption on civilian radio immediately following collapse of Germany—Assigned quotas unlikely

• Upon the collapse of Germany, civilian production to the extent of military cutbacks after the Nazi capitulation will be allowed the electronic-radio manufacturing industry. This was the determination of the leading WPB, Army and Navy officials at the mid-August WPB Radio and Radar Industry Advisory Committee. This view came on the day of the invasion of Southern France.

There will be an excellent opportunity when the collapse of Germany comes that civilian production could be resumed by the industry without governmental regulations and without any quotas of production assigned to the respective manufacturers. The resumption of civilian production is predicated on the premise of enough materials and labor being released by the cutbacks.

No civilian production is slated until 1945, it was emphasized, unless there should be a sudden unanticipated collapse of Germany during this Fall. When the Nazi surrender comes, it is expected that the cutbacks of military requirements after the Army and Navy reappraise their needs in the conquest of Japan will range from 25 to 30 percent of the present war production scheduling and that this amount of cutbacks can be translated into civilian production.

The electronic-radio manufacturing industry was not among those listed by WPB Chairman Nelson August 15 to be permitted limited civilian production provided sufficient materiel and labor were available. But it was felt that this omission was actually helpful to the industry because it would return to their prewar productive operations a number of manufacturing businesses such as those in the electrical appliance field, makers of golf clubs, bicycles, etc., which had been "drafted" in 1942 and early 1943 by the Army into the production of the simpler types of electronic-radio components and parts. This will clear out from the postwar electronic-radio industry a number of these so-called "new comers" into this field.

At the Industry Advisory Committee meeting, a feature subject of discussion was the actual and estimated deliveries of radio and radar end equipment from now until the end of the year. This was explained by L. J. Chatten, Assistant Director in charge of Production of the Radio and Radar Division, as remaining at a climbing rate of requirements which are 16.4 percent greater in October and November than during the first half of 1944. The Army-Navy requirements will total about $265,000,000 during October, an all-time peak of military production. The Navy requirements are maintaining a somewhat level status for the remaining months of 1944, but the Army scheduling took a still further rise during September and October from its dip which occurred last June, due to the requirements in airborne electronic apparatus.

Under WPB Priorities Regulations 23, factories have the right to produce experimental or development models for postwar by procuring parts of a value up to $5000 under Interpretation 2 of Electronic Equipment Order No. L-265, under a P-43 priorities rating—Editor.

At the meeting, WPB Executive Vice Chairman Charles E. Wilson, former president of General Electric, praised the war production record of the electronic-radio industry and, together with Radio and Radar Division Director Ray C. Ellis, who presided at the meeting, asked the manufacturers to engage in a final sprint for the next two or three months "to keep up their good record." Brigadier General J. H. Gardner, Assistant Director of the Signal Corps Procurement and Distribution Service and Commander P. K. Lieberman, Director of Procurement of the Navy Bureau of Ships' Radio Division, outlined to the manufacturers the requirements for the war's prosecution.

When the collapse of Germany comes with the concomitant military production cutbacks and terminations, it was felt by the manufacturers that the residue of materials and labor will be sufficient for all companies to start reconversion to the extent of the Army-Navy reduction of schedules. It was pointed out that at present the volume of materials is three to four times the amounts available in 1941, the last year of civilian production. The manufacturers have been authorized to prepare models of new designs which cannot be displayed or utilized for sales purposes, but with the development of new civilian models, the planning for the production tools and dies can be formulated and possibly orders for such production equipment can be placed.

The question of prices for the civilian products is a highly knotty problem. The Office of Price Administration is considering the formulation of ceiling prices upon the basis of the 1941 volume with the reconciling of increased costs between 1941 and the present wages and the 1941 amount of hours of work and the present war production work schedules. However, the OPA has not taken into consideration in its formula the merchandising expenses of electronic-radio manufacturers and it is hoped that these latter costs will be given full consideration in the setting of ceiling prices.

Industry committees of set and parts manufacturers to advise the OPA are to be established by that agency and will hold their first meetings during the middle of September.

At the August 15 meeting of the WPB Advisory Committee, those present were: Monte Cohen, Sales and General Manager of the F. W. Sickles Co.; W. P. Hilliard, Vice President of Bendix Radio; W. F. Hosford, Vice President of Western Electric; E. E. Lewis, Sales Manager of RCA Victor Division; Percy L. Schoenen, Vice President and General Manager of Hamilton Radio Corp.; A. S. Wells, President of Wells-Gardner & Co.; Dr. W. R. G. Baker, Vice President of General Electric; William Balderstone of Philco Corp.; R. C. Cosgrove, Vice President and General Manager of the Crosley Corporation; and J. P. Rogers, Vice President and Treasurer of Farnsworth Television & Radio Corp. Among the government representatives were Deputy Director John S. Timmons of the WPB Radio and Radar Division; Stuart K. Barnes, Vice President of Defense Supplies Corp.; and Daniel Jacobs of OPA in charge of radio industry prices.

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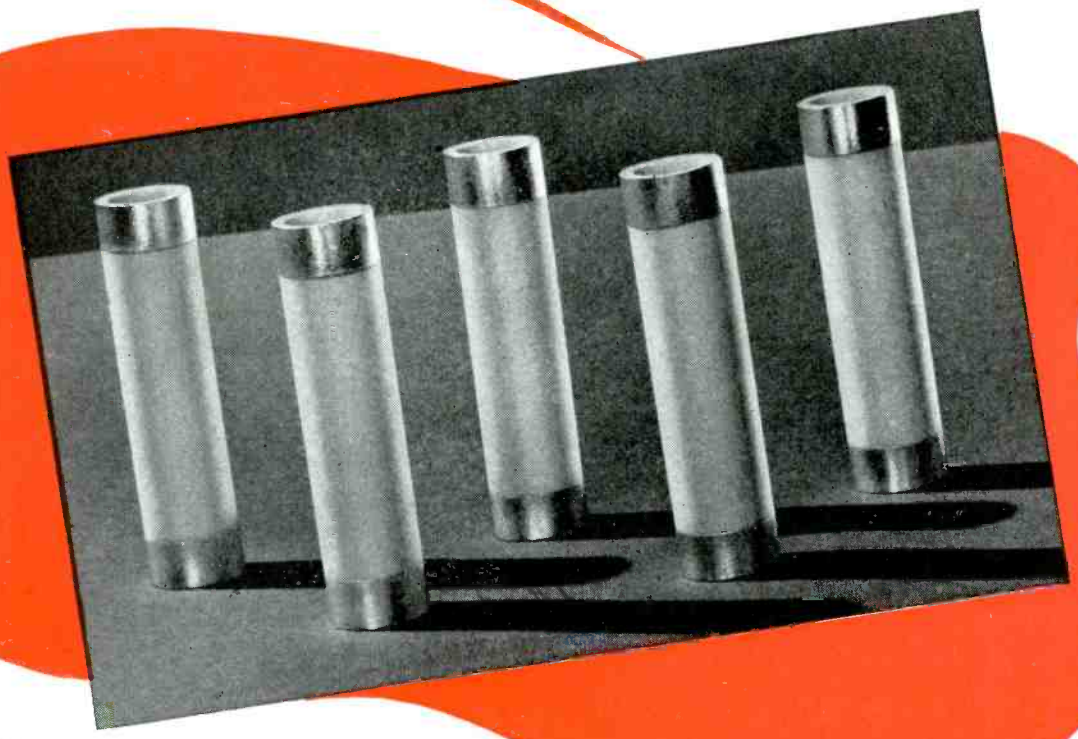
METALIZED STEATITE



OUTSTANDING BECAUSE IT PROVIDES

1. STEATITE INSULATION YET HERMETIC SEAL
2. QUICK, AND EASY PRODUCTION SOLDERING
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INSPECTION ON THE LINE

MAKING HISTORY IN COMMUNICATIONS

Inspection before assembly, quality control . . . more than that . . . team work from material dispatcher, assembler, inspector, to the girl on the packing line . . . have made possible the fine achievement represented by the Army and Navy "E" Award presented to the men and women of the Universal Microphone Company.

In production of military microphones before Pearl Harbor, Universal had the necessary "know how" for immediate war production. The engineering experience and production efficiency of war production will be reflected in the electronic voice communication components offered by Universal to consumers in the future. Until then — BUY WAR BONDS.

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA

A NEW COMPACT, SHOCK-PROOF IMPULSE-INITIATED TIMER

. . . . . 71.8% smaller than previous conventional units used for similar applications, Struthers-Dunn Type PSEH-1 impulse-initiated timer has the added advantages of rugged shock-proof construction, easily-accessible contacts, and dust-proof cover. Made in both AC and DC types, it operates the contacts at the end of a delay interval after power has been applied, or after receipt of a momentary impulse from a push-button, limit switch, or other source. The adjustable timing range is 20-to-1. The mechanism is immediately recycling. A double-pole, double-throw auxiliary relay is built in to provide a variety of circuit arrangements common to, or isolated from the control circuit. It can be supplied for AC operation on 110 V. 60 cycles or 25 cycles; 220 V. 60 cycles or 25 cycles; or for DC operation at any specified voltage from 6 to 120 volts. Size of a typical PSEH-1 Timer is 3½" x 3⅝" x 3¾".

WRITE *for copy of the Struthers-Dunn Catalog and Relay-Timer Data book.*

●

For details on the Timer illustrated above, please specify Type PSEH-1.

STRUTHERS-DUNN, Inc., 1321 Arch St., Philadelphia, Pa.

STRUTHERS-DUNN

5,288 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND
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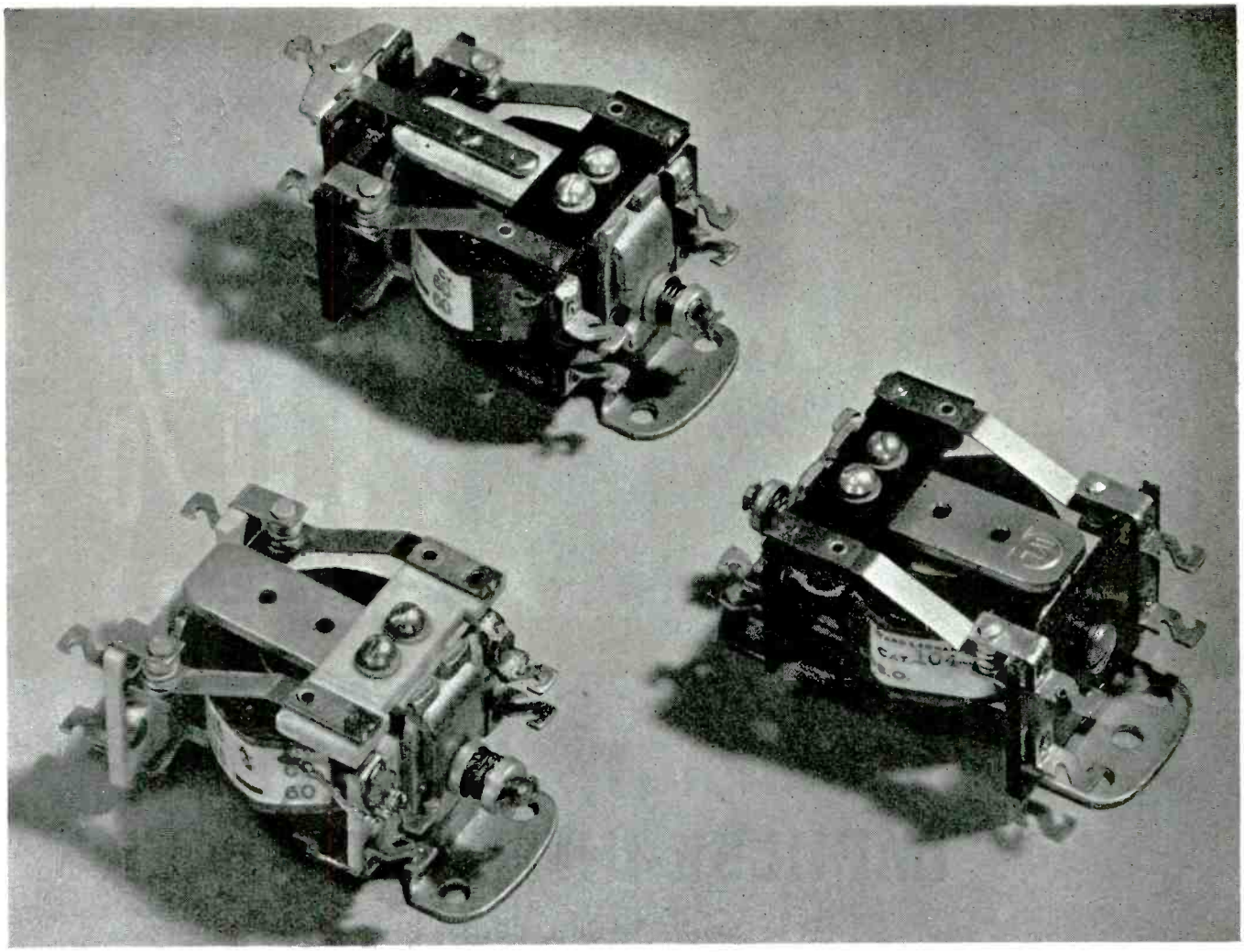
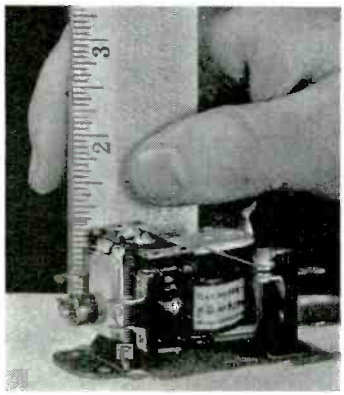
NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON



ADAPTABLE . . .

FOR MANY PURPOSES

The Ward Leonard Midget Metal Base Relay has proven so satisfactory and dependable that several adaptations have been made in it to give it even wider application. The relays shown above are the original relay, one with auxiliary contact and one with porcelain insulation. These relays may be furnished with studs in place of metal bases.



Only 1¼ inches in height. For continuous operation on AC and DC voltages up to 110-115. Double pole, double throw. This Relay described in data Bulletin 104. Send for a copy.

ARMY E NAVY

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) devices since 1892.

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

"I'M THROUGH WITH PLASTICS!!!"

The old man was really sore. His production engineer couldn't get a word in edgewise. "I'm through," he repeated. "These plastics are no good. Just *look* at what's happened to those units. If that plastics salesman comes around here again, just send him in to me!"

We sympathize with the "old man," but he really ought to learn that the term "plastics" embraces scores of different materials having widely varying characteristics. He bought trouble when he was sold a highly regarded plastic that was totally unsuited to his job.

If you have a production problem which you think might well be solved in plastics, you can proceed in two ways. One method is to thumb through a list of plastics manufacturers and give each salesman a chance to push his product. The other method is to "Call on Creative" and let an expert, with no particular material to sell, study your problem and advise you which type of plastic, *if any*, will do your job best.

Creative has no plastic axe to grind. It produces plastic parts made from laminates, cast phenolic resins, methacrylates and acetates, to mention only a few materials.

We have no ties to any particular type of plastic and we decide independently which plastic we will recommend for your job.

Get the habit of applying our "know-how." . . . Call on Creative.

Creative

PLASTICS CORP.

968 KENT AVE, BROOKLYN 5, NEW YORK

N. Y. Electronic Mfrs. Organize to Handle Production Problems

At a meeting of radio and electronic manufacturers operating in the New York metropolitan area, held at the Hotel Waldorf-Astoria, August 2, the formation of the Electronics Manufacturers Association, Inc., was completed by the election of officers and directors. Principal functions of the new association are to handle production problems, establish harmonious labor relations, and represent local electronic employers before governmental agencies. A similar organization has been operating in the Chicago area for a number of months.

Association officers

The New York association comprises manufacturers of radio sets, radio parts and other electronic products operating in the metropolitan and adjoining areas. Its officers are: I. Walter Wyckoff, Pilot Radio Corp., president; Arthur Freed, Freed Radio Corp., vice-president; Samuel J. Novick of Electronics Corp. of America, secretary-treasurer; all of whom are also directors. Other directors are David Wald, United Scientific Laboratories, Inc.; Jack M. Marks, Fada Radio & Electrical Co., Inc.; Percy Schoenen of Hamilton Radio Corp.; and Harold Shevers, Espey Mfg. Co., Inc.

RMA to Standardize Fixed Capacitors

Unanimously agreeing on the necessity for the standardization of fixed capacitors, particularly of the mica, paper and electrolytic types, the Fixed Capacitor Group of the RMA Engineering Committee has actively started work looking to the adoption of satisfactory standards that will eliminate existing duplication and confusion.

After a discussion led by L. C. F. Horle, manager of the RMA Data Bureau, it was proposed that a general RMA Engineering Committee on fixed capacitors be organized, with subcommittees on mica, paper and electrolytic capacitors, so that the standards of these several groups may be integrated and coordinated. J. I. Cornell of New York was appointed chairman of the committee and the subcommittees are headed by: Electrolytic capacitors: H. E. Rice, North Adams, Mass.; Paper capacitors: L. Kahn, New Bedford, Mass.; Mica capacitors: A. DiGiacomo, Brooklyn. The subcommittees were instructed to prepare recommendations and standard proposals to be brought before a meeting of the general committee tentatively set for Sept. 14.

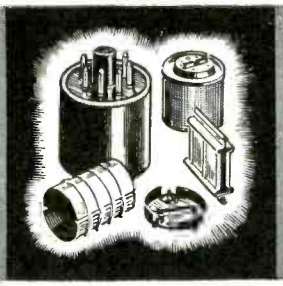
. . . in Hearing Aids

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

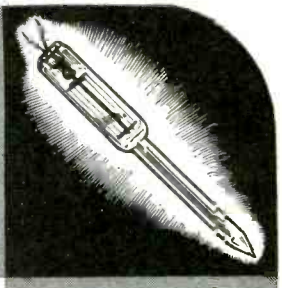
SHURE BROTHERS, 225 West Huron Street, Chicago
Designers and Manufacturers of Microphones and Acoustic Devices

SHURE MICROPHONES

THERMOCOUPLE ◀ TUBES



RADIO TUBE ◀ PARTS



▲ PIRANI TUBES

STROBOTRONS ▼

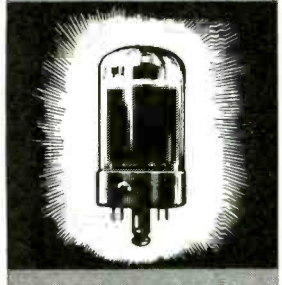
CATHODE RAY TUBES ▼

▲ FACSIMILE RECORDING TUBES

STANDARD TYPE RECEIVING TUBES ▼

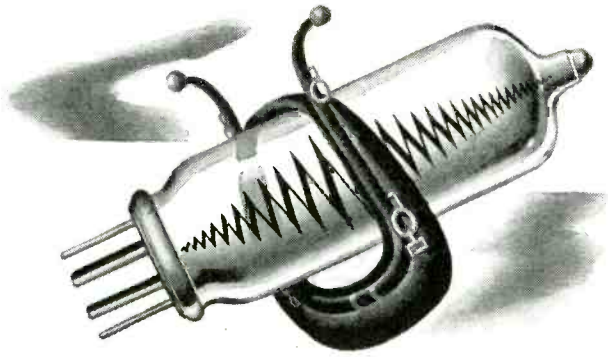
▲ TRANSMITTING TUBES

MINIATURE SIZE GAS VOLTAGE ▼ REGULATOR TUBES



▲ SYLVANIA "LOCK-IN" TYPE RECEIVING TUBES

GLASS HARNESS FOR SALE



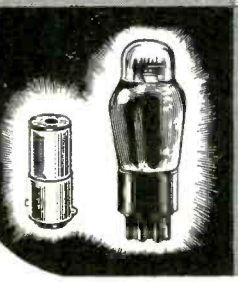
THE purpose of the electron tube is simply to harness electrons to useful work. What shape the electron tube takes in glass depends upon the type of work to be done. As the result of fulfilling many important wartime electronic assignments, Sylvania now makes a wide variety of electron tubes and now has the experience to design even more. A few of them are shown here. There are many more, some of which are still on the restricted list. For information, write Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, N. Y.

one standard—the highest anywhere known

SYLVANIA

ELECTRIC PRODUCTS INC.

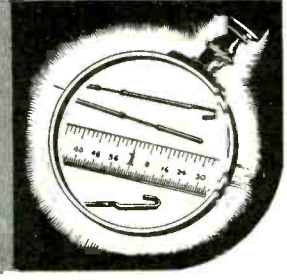
500 FIFTH AVENUE, NEW YORK 18, N. Y.



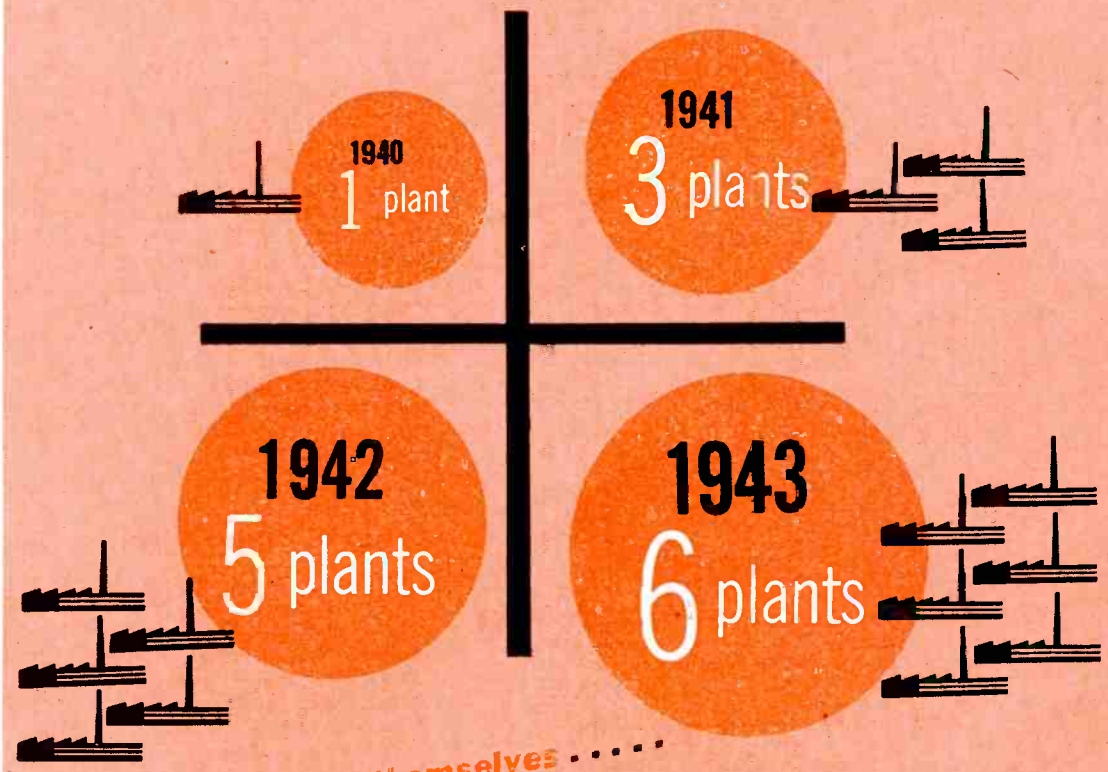
STANDARD SIZE ◀ GAS VOLTAGE REGULATOR TUBES

WELDS AND LEADS ▶

MINIATURE RADIO ◀ RECEIVING TUBES



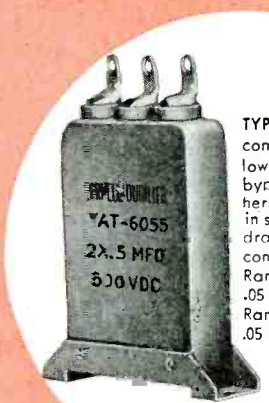
an outstanding record of achievement



the facts speak for themselves . . . . .

With the skill and experience of 34 years of capacitor specialization, Cornell-Dubilier meets the urgent needs of war production. Since 1910, thru every phase of capacitor development, our growth parallels that of the electronic industry. We have not only kept pace with it but have anticipated new trends.

Today there are more C-D capacitors in use than any other make. This tremendous increase in production has been accomplished while maintaining C-D's high standards of quality and dependability. Our name is synonymous with reliability . . . that's why C-D's are first with 4 out of 5 engineers. Our facilities and specialized skills are at your service. Write today to Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.



TYPE YAT
compact, low capacity Dykanol "G" bypass capacitor; hermetically sealed in specially-treated, drawn metal containers. Range at 600V, .05 mfd. to 1 mfd. Range at 100V, .05 mfd. to .5 mfd.

Cornell-Dubilier Capacitors

1910 - 1944

MICA • DYKANOL • PAPER • WET AND DRY ELECTROLYTICS

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

Reg. U.S. Pat. Off.

Postwar Aviation Radio

The Radio Technical Commission for Aeronautics, activities of which were halted with the war, has been reactivated for the study of postwar radio aviation problems, through the establishment of three special committees to develop plans for the improvement of aeronautical equipment. These committees are: the Airborne Radio Communication and Navigation with Colonel D. C. Doubleday, Army Air Forces, Office of Air Communications, as chairman; the Ground Radio Communication and Navigation, under the chairmanship of Commander D. S. Little, Bureau of Aeronautics, Navy Department; and the Test Procedures and Standards Committee headed by L. M. Sherer, of the CAA. The RTCA is the agency through which the government agencies, military services, air transport companies and manufacturers plan for aviation radio betterment.

Longest Radio Circuit

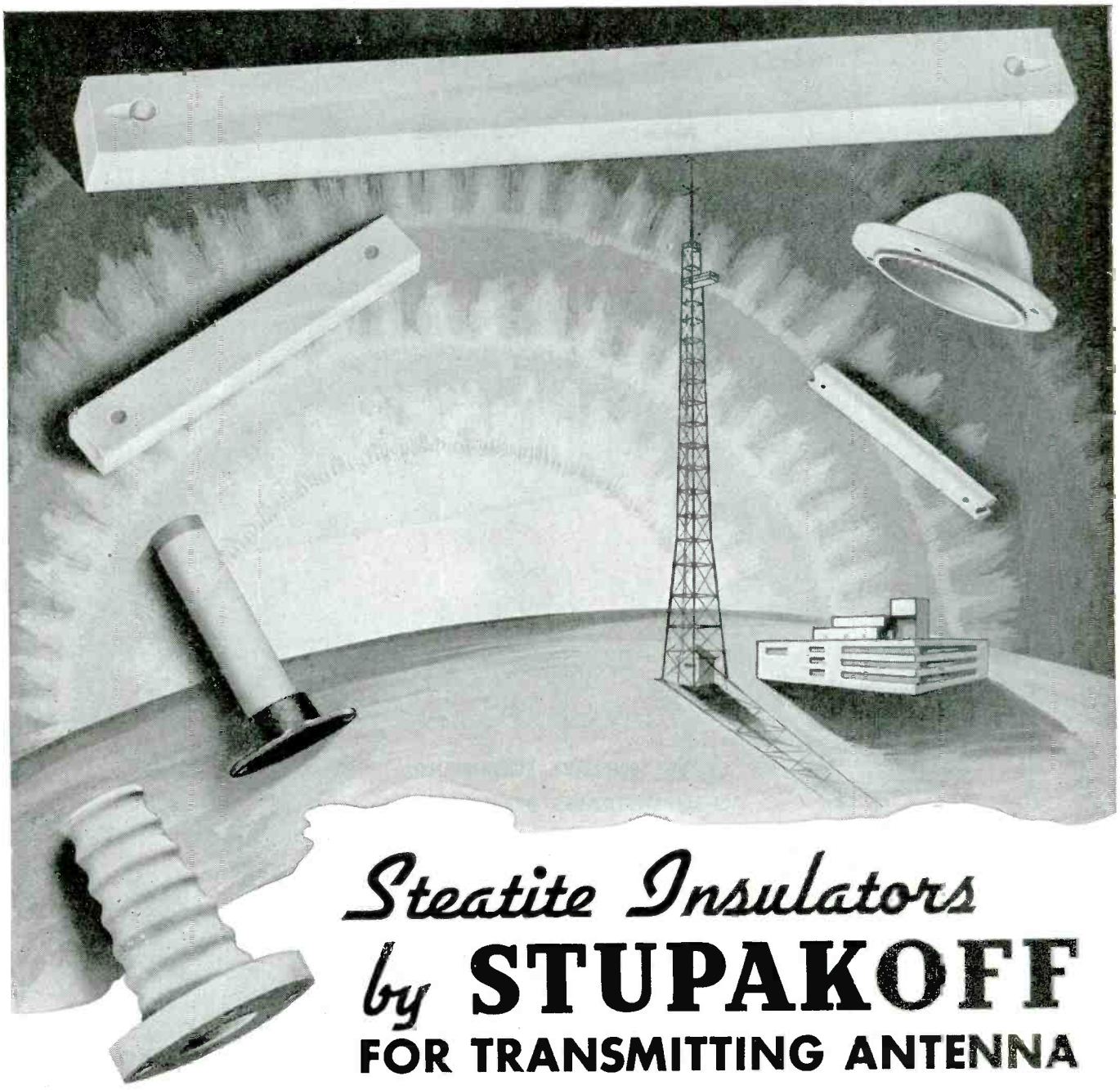
Longest radio communications circuit in the world, between New York and Bombay, India, was opened this month by RCA Communications, Inc. The circuit totals some 8000 miles, was established in cooperation with the Indian Radio and Cables Communications Co., Ltd. Telegraphic speeds up to 200 words per minute are being attained.

Amerex-Philips Alliance

Amperex Electronic Products, Brooklyn, N. Y., through reorganization, has become affiliated with North American Philips Co. Except for the retirement of senior partner N. Goldman, due to protracted illness, the personnel, management and policies of the company remain unchanged and the corporate style remains the same. Officers and directors of Amperex are: President, Dr. A. Senauke; vice-president in charge of manufacturing, Nicholas Anton; vice-president in charge of sales, Samuel Norris.

Audio Enlarges

Audio Development Co., Minneapolis, has completed construction of a new building which now houses the general and engineering offices, experimental and design laboratory and the model shop. Floor space formerly occupied by these units will be taken over by the production department to provide a 25 per cent increase in manufacturing facilities for transformers and other electronic equipment.



Steatite Insulators by STUPAKOFF FOR TRANSMITTING ANTENNA

IN AM, FM and Television broadcasting, Stupakoff low loss steatite insulators have proven their superiority for high frequency installations.

Illustrated are a few styles of precision made lead-in, strain and post insulators by Stupakoff. They provide unfailing service with the ultimate in electrical performance.

Laboratory control—years of engineering experience—modern production facilities—manufacturing skill—combined, enable Stupakoff to produce a complete line of dependable ceramic insulators of unequalled quality for the electronic industry.

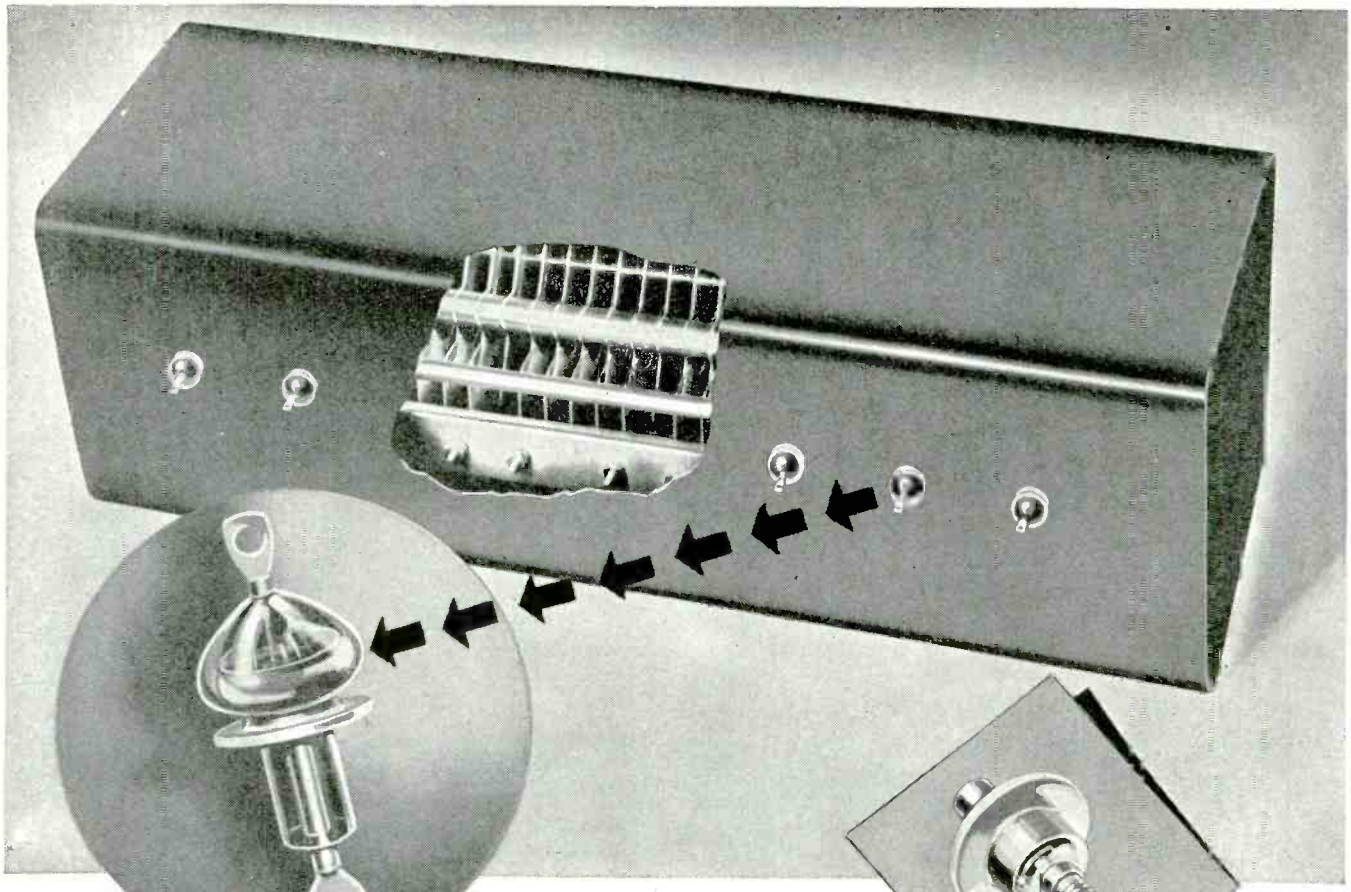
Stupakoff engineers, supported by two generations of experience in the manufacture of ceramics, are at your disposal and are ready to assist you in planning projects in the transmitting field.

ARMY (E) NAVY
"FOR GREAT ACHIEVEMENT"

Do More Than Before—Buy EXTRA War Bonds

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Ceramics for the World of Electronics



GIVE SENSITIVE EQUIPMENT
AN IMPENETRABLE DEFENSE WITH

Sperti Hermetic Seals

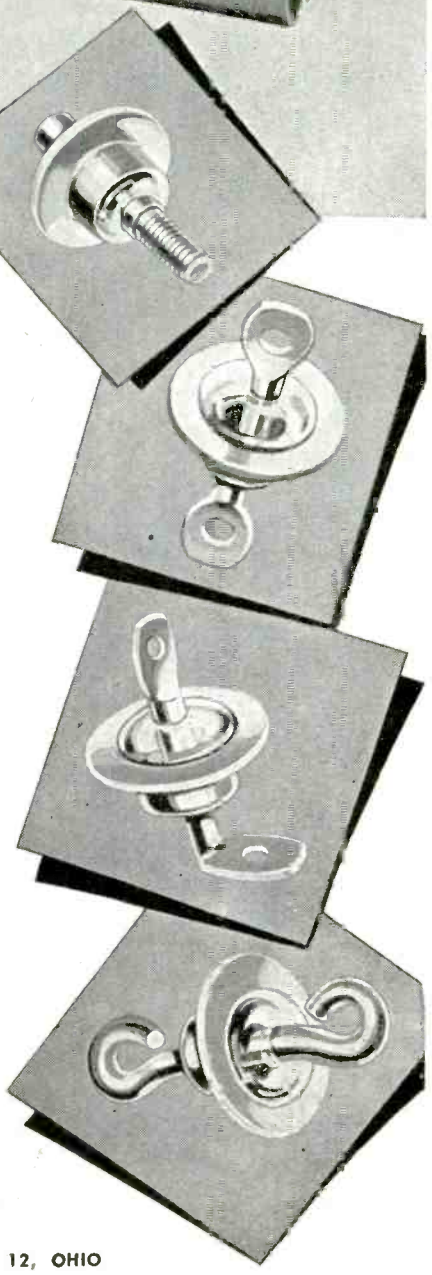
Volume production! Prompt deliveries!

Block the only points of entry for dust, fungus, moisture and other external elements that threaten the efficiency of equipment under tough military conditions. Adopt Sperti Hermetic Seals for capacitors, condensers, inductances, relays, vibrators, transformers and other component parts.

ONE PIECE. Glass and metal are fused into one piece to form a vacuum-tight hermetic bond. Resist corrosion. Have a thermal operating range of –70° C. to 200° C. Insulation leakage resistance, 30,000 megohms, minimum, after Navy immersion test

SOLDERING TEMPERATURE NOT CRITICAL. Simple, easy to attach by means of high frequency, oven-soldering or standard soldering iron.

WIRE, WRITE OR PHONE TODAY for information. Full details of planned use of Sperti Hermetic Seals will bring proper recommendations and desired samples, promptly.



Sperti INCORPORATED

SPERTI ELECTRONICS

Electronic Division, Dept. EI-4

RESEARCH • DEVELOPMENT • MANUFACTURING • CINCINNATI 12, OHIO

In designing a new electronic tube, mathematical calculations are invaluable, but as every designer knows, they are but preliminaries. After them, there usually come many tests of various experimental tubes. Machlett thought the cut-and-try method not only wasteful, but not productive of the best results. So we shortened and simplified the procedure by what our laboratory people call the "rubber model."

Here is a stretched rubber sheet. At the high end is a model of the cathode (electron emitter) of a proposed tube, and at the other end the anode, or target of an X-ray tube, plate of an oscillator or rectifier. The slope between the two is proportional to the desired potential difference. By means of an electro-magnet, a steel ball can be held in any position along the cathode, then released to roll under gravity to the anode, where the point it strikes can be observed and measured. *This is an electro-mechanical analogy.*

By means of this rubber model technique, months have been shortened into days, weeks into hours. More than that, new and higher performance has been achieved in the final product, so that when you buy a Machlett tube, you are assured of precise results, longer life, greater economy . . . Machlett Laboratories, Inc., Springdale, Connecticut.

The Machlett 880 is a radio oscillator tube for use in transmitters, and has a maximum output of 60 KW.

MACHLETT

RAY TUBES SINCE 1898

TODAY THEIR LARGEST MAKER

Mitchell Heads RCA Communications

Lt. Col. Thompson H. Mitchell has been appointed general manager of RCA Communications, Inc. He succeeds the late William A. Winterbottom who had served as vice-president and general manager of RCAC since formation of the Company until his death on July 8. Colonel Mitchell, who first joined RCA seventeen years ago, recently has served as Chief of the Traffic Operational Engineering Section of the Engineering Branch of the U. S. Army Communications Service, Washington. He has been assigned to inactive duty after nearly two and a half years with the Signal Corps.

New Merit Plant

Merit Coil & Transformer Corp., Chicago, has completed a new plant at 4427 North Clark St., will soon move general offices to the new location. Provision has been made for further expansion.

DeJur-Amsco Expands

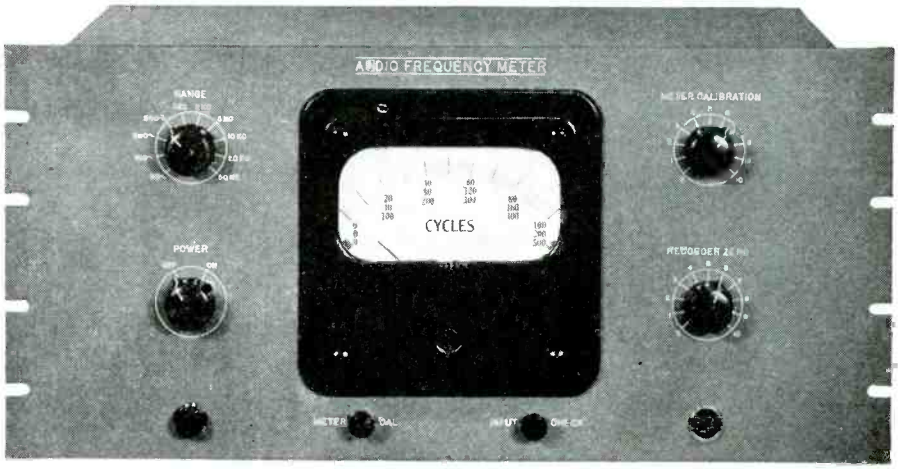
DeJur-Amsco Corp., has occupied another building, in Long Island City, N. Y., to house production facilities needed to augment its output from present New York and Connecticut plants. It is a modern daylight building of 75,000 sq. ft. on Northern boulevard between 45th and 46th Streets.

Wins Award

Samuel Ruben, who for the last nineteen years has been closely associated with P. R. Mallory & Co., Inc., has been awarded a Certificate of Appreciation for extraordinary contributions to the war effort. He is one of only ten civilians to receive this recognition from the War Department, which was originated to honor achievements not eligible for Army-Navy "E" Awards. The award was made primarily in recognition of his creative work in inventing the Mallory dry battery, a new development at present available only for military applications.

RCA WIDE-RANGE AUDIO FREQUENCY METER

306-A



10 Cycles to 50,000 Cycles

A BASIC INSTRUMENT IN LABORATORY AND INDUSTRIAL WORK

- Used extensively with recorders in crystal laboratories for checking crystal characteristics.
- Used with an accurate crystal oscillator and radio receiver for checking transmitters at distant points.
- Checks calibration of beat frequency oscillators or other generators.
- Indicates beat note frequency produced by a standard high frequency oscillator and a radio transmitter.
- Used with special generator as a highly accurate tachometer for indicating or recording rotational speeds.

DESIGN AND OPERATING ADVANTAGES:

Quick, accurate, direct reading. Has six-inch indicating meter with ten scales respectively calibrated for 50, 100, 200, 500, 1,000, 2,000, 5,000, 10,000, 20,000, and 50,000 cycles.

Limiting circuit makes readings independent of input voltage over a range of several hundred to one.

Self-contained regulated power supply compensates for changes in line voltage. Operated from 110 volts, 50 to 60 cycles.

Wave form errors practically eliminated by unique circuit.

Operates recording meter directly—with no additional amplifier.

Accurate to within 2% of full scale.

Please Note Deliveries are subject to the regulations of WPB Limitation Order No. 265.

WRITE FOR BULLETIN

containing complete description and specifications. Address Engineering Equipment Department, Radio Corporation of America, Camden, New Jersey.

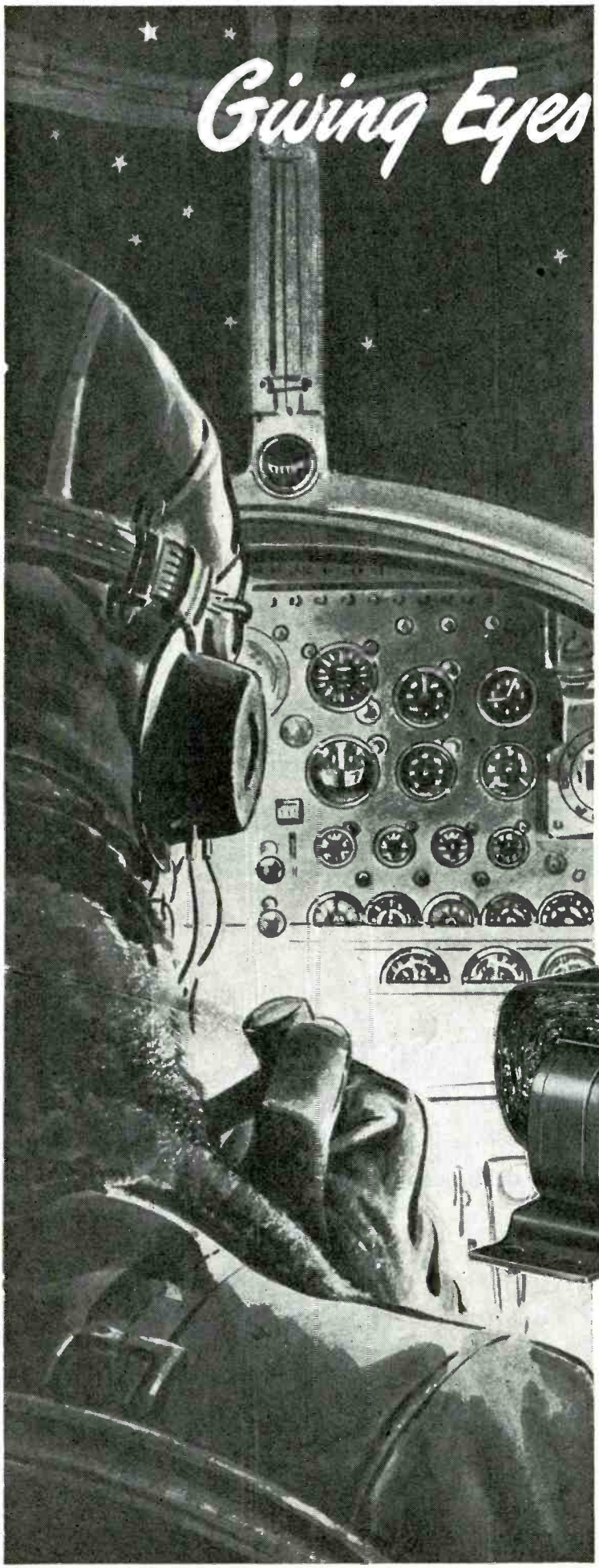
RCA

BUY MORE WAR BONDS

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

LEADS THE WAY.. *In Radio..Television..Tubes..Phonographs..Records..Electronics*



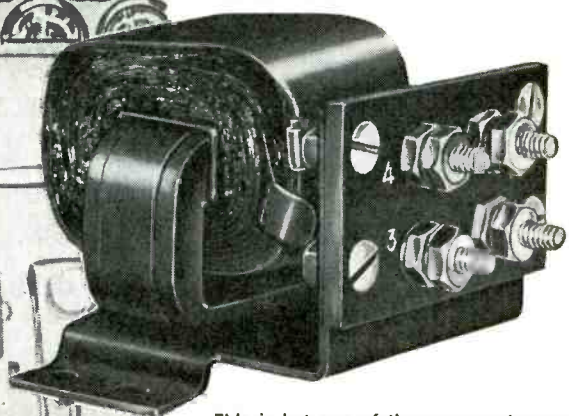
Giving Eyes to War Birds

. . AT 50,000 FEET AND — 57.4 DEG. F

To the combat pilot, high up in the inky blackness of night, the glowing instruments are more than a mechanism . . . they're his security, his strategy and his return ticket! These lights must not fail!

To further this dependability in aircraft lighting systems, the N-Y-T Sample Dept. has produced the 8 ounce transformer illustrated—lighter in weight by 40% than any component of the same output previously used.

Conservative, from the standpoint of electrical and mechanical characteristics, this N-Y-T unit has a temperature rise of only 30 deg. C. and permits operation over all ambient from minus 65 deg. C. to plus 70 deg. C. Its diversity of application is illustrated by the fact that output voltages and currents may be varied without affecting size and weight, if the output is held to 30 V.A.



This is but one of the many custom-engineerings executed by N.Y.T. technicians, in hastening Victory through electronics; similar transformer products will aid immeasurably in the fulfillment of peace-time advancements.

NEW YORK TRANSFORMER CO.

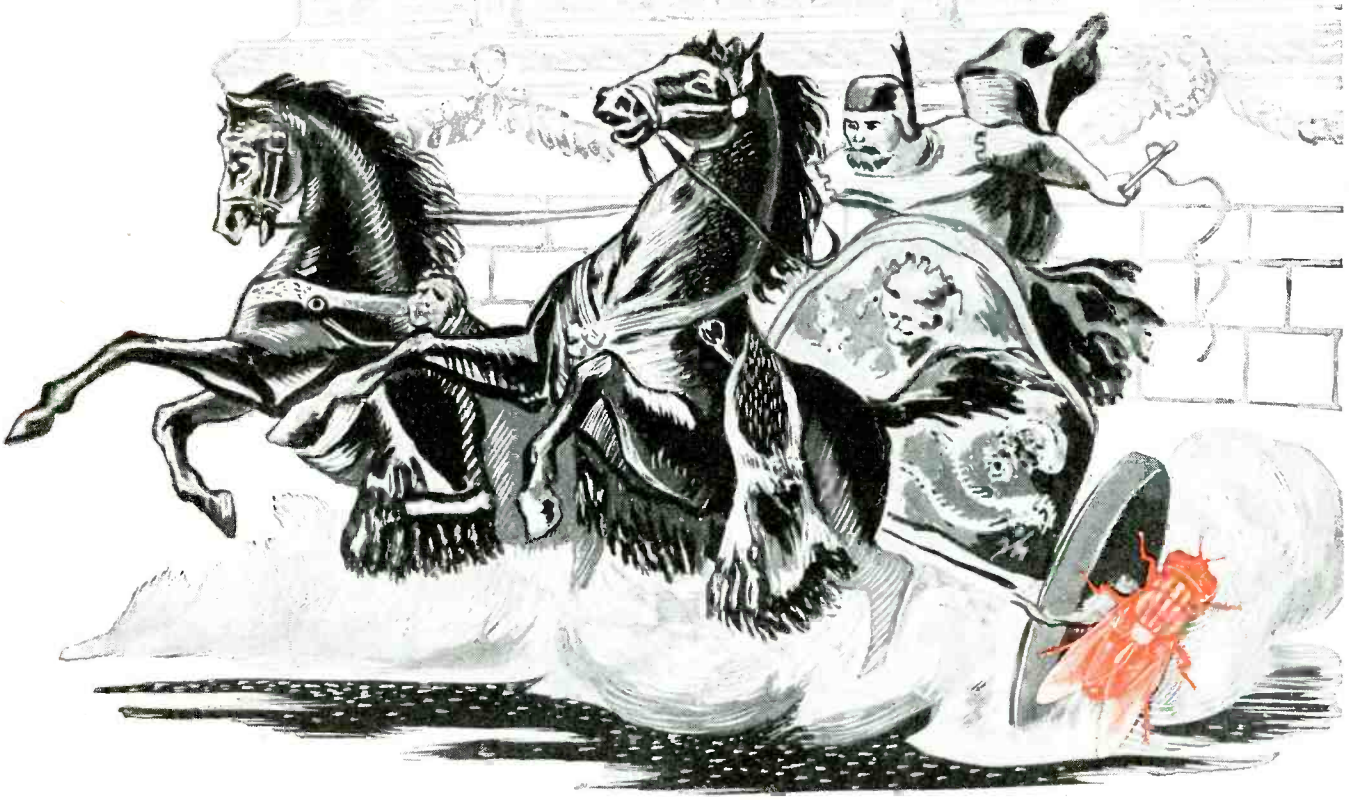
22-26 WAVERLY PLACE

NEW YORK 3, N. Y.

Aesop's Fly

sitting on the Axle of the Chariot
has been Laughed at for Exclaiming,

"WHAT A DUST I DO RAISE!"



The wheels of American enterprise geared to war-paced production have been raising a high dust for the past few years. But it would be both absurd and naive for any one industrial unit to claim a large share of credit for this giant accomplishment.

As a part of the over-all effort, G. I. was assigned to break a bottleneck in its special field of electronics and radar. By official admission this has long since been accomplished.

Variable condensers, many with circuit applications never before possible, automatic tuning mechanisms, complete wired assemblies and sub assemblies are all part of G. I.'s story. What we have learned in the way of new techniques short cuts and cost cuts will be of high interest in our industry when the last gun cools.

The first in our industry to be so honored
ARMY E NAVY

GENERAL INSTRUMENT CORP.

829 NEWARK AVE., ELIZABETH 3, N. J

PERSONNEL

Siling to RCA

Philip F. Siling joins RCA Oct. 1 and will handle matters pertaining to frequency allocations and licenses for RCA, its subsidiaries and services. Siling, who has been associated with FCC for the past nine years, latterly as assistant chief engineer in charge of broadcasting, will maintain offices at 30 Rockefeller Plaza, New York, and at 1625 K Street, N.W., Washington.

Charles L. Saunders, former vice-president of Minneapolis-Honeywell Regulator Co., has resigned as branch chief of the WPB Office of Civilian Requirements, to become vice-president of Wheelco Instruments Co., Chicago. Saunders joined WPB in March, 1942, to organize an instrument branch to correlate manufacturing problems of the instrument industry with war production.

Charles R. Wexler, formerly assistant chief engineer for Emerson Radio, has been named chief engineer, and Homer R. Denius, formerly chief production engineer for the radio division of the Crosley Corp., plant manager of the Electronic Division of the John Meck Industries, Plymouth, Ind. More recently, Mr. Wexler has been connected with the Ken-Rad Tube and Lamp

C. R. Wexler — Homer Denius

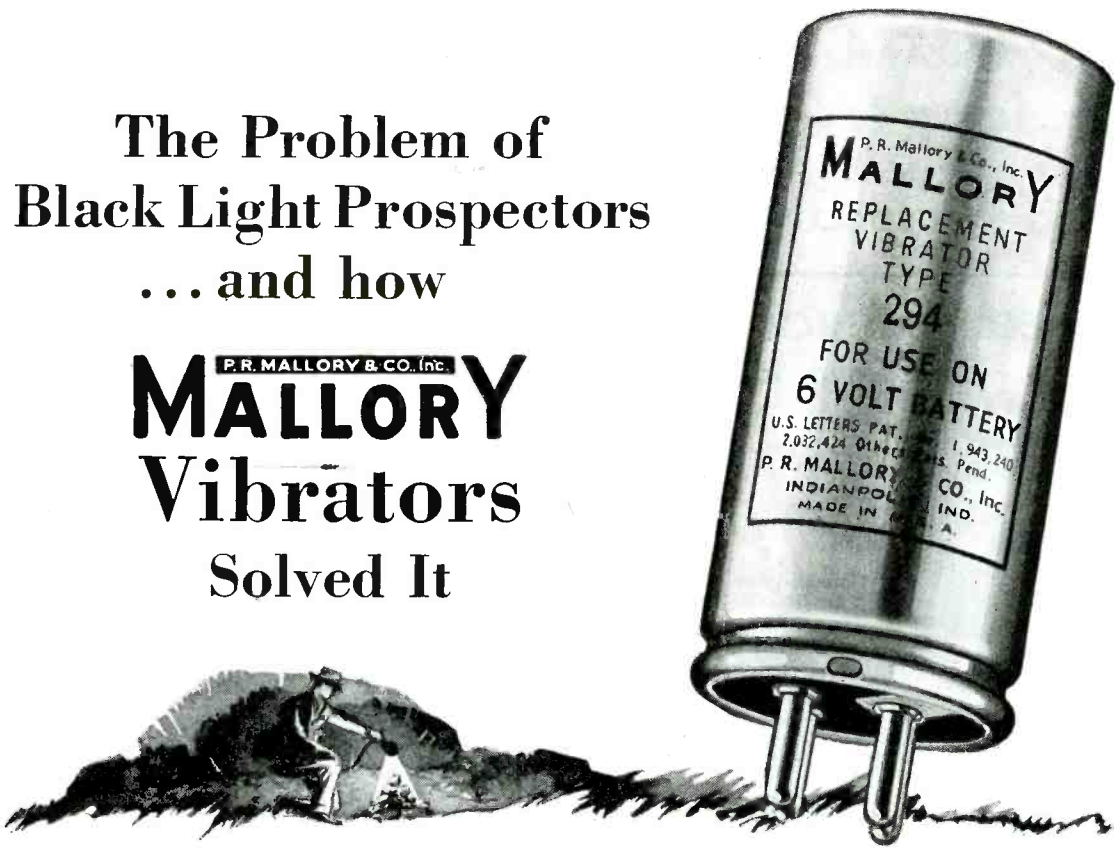
Works in charge of the radio laboratories and with the Magnavox Corp., of Fort Wayne, Ind. Mr. Denius, a graduate of the University of Cincinnati with a degree in radio and electrical engineering, was connected with the radio division of the Crosley Corp. for ten years in various production capacities.

Professor E. A. Hertzler (formerly Pratt Institute) has been named director of war research at the United Electronics Co., Newark, N. J. He has been associated with Bell Telephone Laboratories, Western Electric, Michigan Bell Telephone Co., Spooner and Merrill, Consulting Engineers and the General Electric Co.

The Problem of Black Light Prospectors ... and how

P. R. MALLORY & CO. Inc.

MALLORY Vibrators Solved It



The Mineralight is a quartz ultra-violet lamp which, when used in darkness, excites vivid color responses from fluorescent objects. It is especially valuable in assaying minerals; and in all parts of the world its magic black light rays are uncovering hidden wealth in scheelite, mercury, zinc and other ores.

In ordinary prospecting, no source of commercial alternating current is available to operate the lamp. So the makers of the Mineralight came to Mallory for help in obtaining high voltage direct current from a low voltage storage battery. Standard Mallory vibrators were recommended, and proved their long life and dependability in arduous service. Today the Mineralight is an indispensable instrument in mill and mine operations.

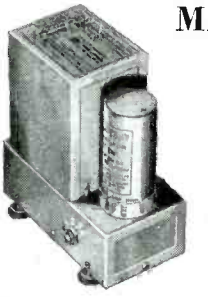
This performance record, like those established by Mallory vibrators in millions of automotive, aircraft and electronic devices, is not a happen-so. It was earned the hard way—by long experience, quality workmanship, and the most extensive research ever undertaken by a vibrator manufacturer.

If the use of your product depends on the conversion of power from low voltage or battery sources, Mallory "know how" can serve you well.

Buy More War Bonds

Preferred by the Armed Forces—

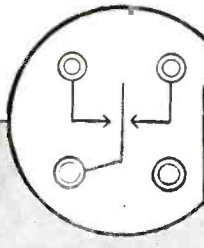
MALLORY Vibrapack*



Flexible, heavy-duty vibrator power supply, built to take rough handling and to operate under great extremes of heat, cold and humidity. Widely used under war conditions. Ideal for peacetime products.

**Vibrapack is the registered trademark of P. R. Mallory & Co., Inc., for vibrator power supplies.*

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



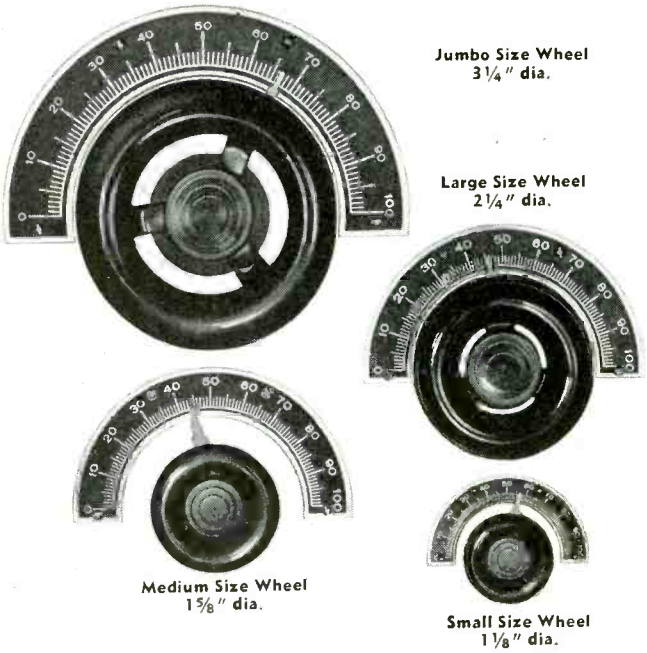
P. R. MALLORY & CO. Inc.

MALLORY VIBRATORS

AND VIBRATOR POWER SUPPLIES

Expanded Facilities Now Permit
FASTER SERVICE TO OUR CUSTOMERS
and Prospective Users of Our Products

HANDWHEEL CONTROLS
with or without Pointers and Scales



Jumbo Size Wheel
3¼" dia.

Large Size Wheel
2¼" dia.

Medium Size Wheel
1⅝" dia.

Small Size Wheel
1⅛" dia.

• Four sizes to cover all requirements. Made of thermo setting plastic with brass bushings for 1/4", 5/16" or 3/8" shafts. Chromium plated scales and pointers are available for each size. Scales, either standard or to your specifications, are not listed below.

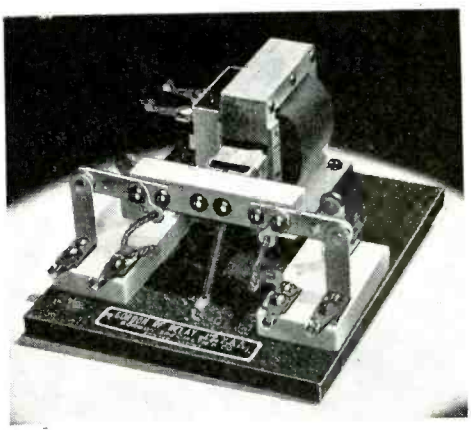
No.	Diameter	Pointer
308	3¼"	yes
309	3¼"	no
310	2¼"	yes
311	2¼"	no

No.	Diameter	Pointer
312	1⅝"	yes
313	1⅝"	no
314	1⅛"	yes
315	1⅛"	no

VERNIER PLANETARY TUNING UNIT No. 599

• Dual ratio approximately 6 to 1 vernier and 1-1 direct drive. Positively no lost motion or backlash which is most essential in many applications. Widely used in radio tuning controls, as well as in industrial apparatus. End slotted for screwdriver adjustment.

HEAVY DUTY RF OR POWER RELAY No. 1000



• A heavy duty D.P.D.T. relay providing many desirable electrical and mechanical characteristics. Alsimag 196 insulation which, because of its extremely low power factor of .04, shows negligible losses even at frequencies up to 300 mc.

When the control circuit is closed, a solenoid actuated plunger goes home instantly—powerfully holding the husky 3/8" silver, self-wiping contacts together with a 4 lb. pull! Contacts are spaced approximately 1/2" apart—generous leeway for high potentials—infinitesimal capacity effects. Absolutely no contact chatter or bounce. For 90-125 V 50-60 cycle AC. Size 4 3/4" x 5 9/16" x 3".

RUBBER GROMMETS
High Dielectric Strength

Insulate holes in metal sheets up to 1/16" or 14 ga.

No.	Fit Chassis Hole	Inside Dia.
901	¼"	⅛"
903	5/16"	3/16"
905	⅜"	9/32"

No.	Fit Chassis Hole	Inside Dia.
907	7/16"	5/16"
909	11/32"	11/32"
911	½"	13/32"

RUBBER BUMPER FEET

No.	Diameter	Height
111	17/32"	¼"
511	⅝"	5/16"

No.	Diameter	Height
112	⅝"	⅜"
113	23/32"	7/16"

For 6/32 or 8/32 machine screws or No. 6 or No. 8 wood screws.

Mention your preference ratings and quantities desired. Prices and delivery date will be quoted by return mail.

GORDON SPECIALTIES COMPANY
823 South Wabash Avenue, Chicago, Ill.

post-war problem

If you're in the blueprint stage now on your post-war products you couldn't pick a better time to find out how Laminated Plastics by Taylor can help to improve your products. The engineers in our Post-War Planning Department are doing wonders with Phenol Fibre and Vulcanized Fibre. Let's get together on your post-war problem. Take it to Taylor . . . now.

POST-WAR PLANNING DEPARTMENT OF

TAYLOR FIBRE COMPANY

LAMINATED PLASTICS: PHENOL FIBRE · VULCANIZED FIBRE · Sheets, Rods, Tubes, and Fabricated Parts

NORRISTOWN, PENNSYLVANIA · OFFICES IN PRINCIPAL CITIES · PACIFIC COAST HEADQUARTERS: 544 S. SAN PEDRO ST., LOS ANGELES

Leslie G. Thomas has been appointed works manager of the Solar Mfg. Co., Bayonne, N. J. He was formerly vice-president and works manager of the International Resistance Corp.

Carl Christiansen has joined the engineering staff of the John C. Dolph Co., Newark, N. J. He was formerly in charge of electrical construction for Pan-American Airways in the South Pacific, before that was associated with Curtiss-Wright and International Motor Co.

Edmund A. Laport, known for his installations of broadcasting transmitters both here and abroad, has been appointed staff engineer for international communications systems and special apparatus at Camden, N. J., for RCA Victor Division, Radio Corporation of America.

James B. Knox E. A. Laport

James B. Knox succeeds Mr. Laport as chief engineer for engineering products at RCA's Canadian subsidiary, RCA Victor Ltd. In his new position, Mr. Laport will be responsible for the company's engineering in connection with international communications systems and engineering products for sale in the international field.

William C. Speed, one of the founders, vice-president and a director of Audio Devices, Inc., and the Audio Mfg. Corp., has been elected president of both companies following the resignation of Hazard E. Reeves, former president.

William C. Speed, who has become president of two Audio companies

V. T. Peterson, formerly of Acme Electric Co., recently joined the staff of Walker-Jimieson, Inc., Chicago, in the capacity of Field Engineer.

Frank J. Hajek, formerly secretary and treasurer and associated with the company since its beginning, takes over all phases of management by being elected to fill the post of president of Taylor Tubes,

Frank J. Hajek, elected president of Taylor Tubes

Inc., 2312 Wabansia Ave., Chicago. James C. Filmer, for many years a leading electronic tube engineer, has been appointed vice-president in charge of engineering. Joseph F. Hajek becomes secretary and Jerry Worrell treasurer of the company.

Burgee for Burgess

Dr. C. F. Burgess, Founder and Chairman of Burgess Battery Co., smiling with Brig. General Edgar L. Clewell over award of Army-Navy "E" to Burgess Freeport (Ill.) plant

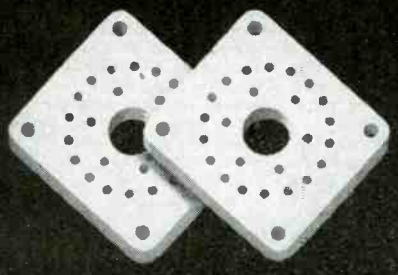
ONE ALWAYS STANDS OUT

IT'S THE QUALITY OF PERFORMANCE THAT COUNTS

ALSIMAG

TRADE MARK REGISTERED U. S. PATENT OFFICE

STEATITE CERAMIC INSULATORS



Where stability is an important requirement, ALSIMAG Steatite ceramics are unsurpassed for lending rigidity and permanence of alignment to electronic circuits.

The chorus is good, but it's the lovely voice of the Prima Donna that stands out. Years of training and experience have produced the exquisite tone, range and color of a great voice.

Grand opera or electronic insulation—it's the *quality* of performance that counts. Custom-made to your design . . . formulated for specific characteristics . . . processed with the knowhow gained from 42 years leadership in the ceramic field . . . ALSIMAG Steatite Insulators lend stand-out performance to high frequency circuits.

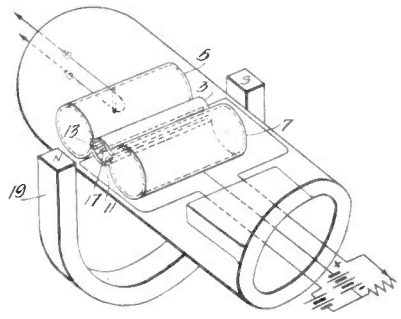
AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE

42nd YEAR OF CERAMIC LEADERSHIP

NEW PATENTS ISSUED

Magnetron

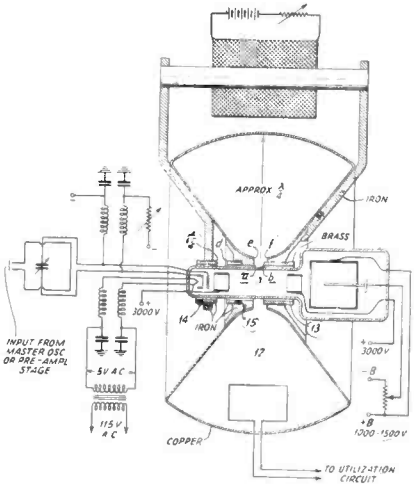
Resonant cavities 5 and 7 act as tank circuits for the magnetron which consists of cathode 17, anode 3 and magnet 19. As the electrons spiral past the slits 11 and 13, some of them deliver energy to rein-



force or establish standing electromagnetic waves within the cavities. The device may be used as detector, amplifier or generator of uhf waves. E. G. Linder, RCA, (F) Oct. 24, 1940, (I) May 16, 1944, No. 2,348,986.

UHF Tube

It is intended to obtain a minimum feedback between output and input circuits and to provide a high shunt impedance for the output circuit. The resonant frequency of the tank 12 may be changed by varying the width of the gap a-b and consequently the capacitance between the sides of the gap. For this purpose a threaded, non-magnetic sleeve 13 is mounted next to gap a-b. The electron beam is focused by means of a

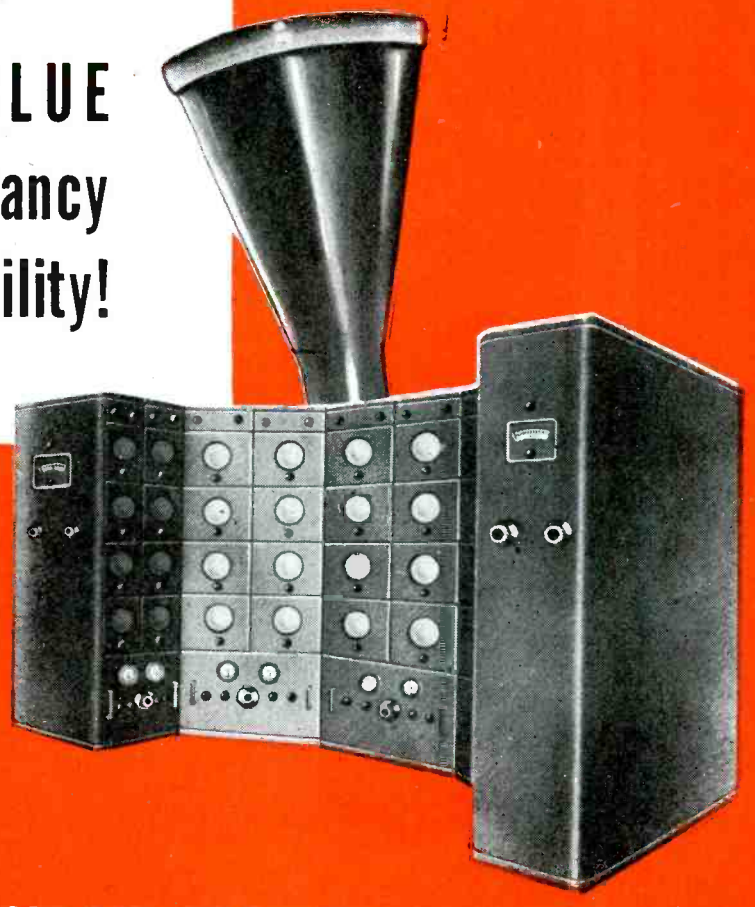


pair of magnetic lenses constituted by gaps c-d and e-f. The threads on sleeves 14 and 15 enable the variation of the length of the magnetic gap c-d. The band width of this type of tube is much greater than that of conventional types because of the higher shunt impedance possible at the gap. F. H. Kroger, RCA, (F) Sept. 22, 1939, (I) June 6, 1944, No. 2,350,907.

Compensating Echoes

Undesirable echoes in radio-telegraphic or radio-telephonic systems, produced by reflection of the signals from the ionosphere, are compensated for. Two modulated carriers, λ_1 and λ_2, are transmitted so that there will be received two direct waves and their respective echoes. The two direct waves will be received simultaneously and

POSITIVE CLUE to Life Expectancy and Dependability!



SHERRON TUBE TEST EQUIPMENT

- CATHODE-RAY LIFE RACKS
- PULSE LIFE RACKS
- OSCILLATION LIFE RACKS

It is axiomatic in the field of electronics that no piece of equipment is worth its salt until it has been checked for performance. Axiomatic—and an inexorable specification, as we who make Sherron Test Equipment are in a position to know. Electronic standards are high; come-down or compromise is taboo. Quality control is the ruling consideration. In the case of life tests, this means that the racks must not only simulate, but exceed every operational condition of the tube in actual use. Endurance and durability must be built into the racks, if they are to stand up under the punishing routine of intensive checking. Designed and engineered to anticipate the most rigorous, realistic demands, Sherron life racks are serving the country's leading tube manufacturers.

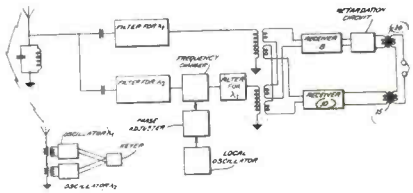
Sherron Electronics

"Where the Ideal is the Standard, Sherron Test Units Are Standard Equipment"

SHERRON METALLIC CORP.

1201 FLUSHING AVENUE BROOKLYN 6, N. Y.

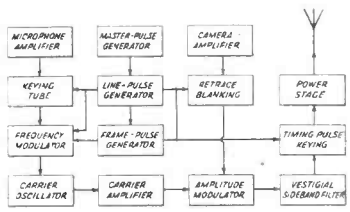
NEW PATENTS

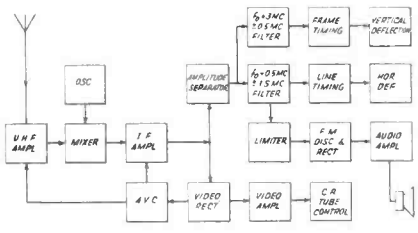


separated by two appropriate filters; so will be the two first echoes, the two second echoes and so on. By modifying the wave length and the phase of all λ_2 waves by a local oscillator and a phase adjuster, the direct λ_2 wave can be made equal in frequency and phase to the direct λ_1 wave so that the two direct waves will add in receiver 8 and cancel out in receiver 10. The first echoes, taking longer for their travel, will, at their arrival at the receiver, have a difference in phase shift which is not equal to the difference in phase shift between the two direct waves. Under certain conditions, the heterodyned and phase shifted echo of the λ_2 carrier will be of opposite phase to the received echo of the λ_1 carrier, and the two echoes will add up in receiver 10 and cancel out in receiver 8. Upon rectification in the receivers, the phase of the audio wave resulting from the directly transmitted carrier is adjusted to coincide with that derived from the echoes and the two waves are combined in the output transformers 14, 15. Three or more different wave lengths may be used. The time lag between the direct wave and the different echoes will be constant over long periods of time, and frequency adjustment about once every hour will suffice. E. H. Ullrich, International Standard Electric Corp., (F) Nov. 8, 1941. (I) June 6, 1944, No. 2,350,702.

Television System

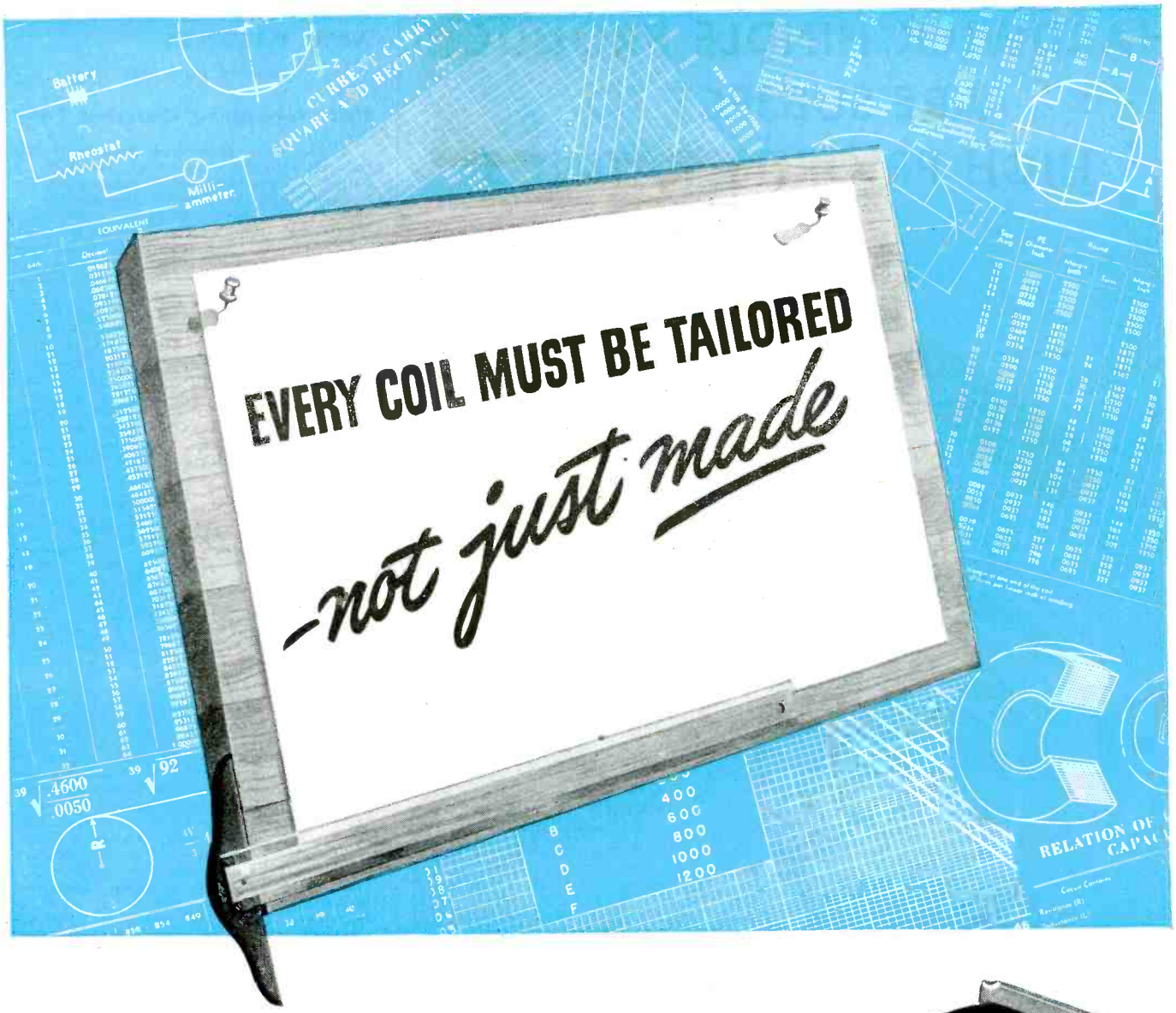
According to the invention, the carrier wave of a single transmitter is amplitude- or frequency-modulated with video signals. During the fly-back interval, the carrier is shifted in frequency to provide the line synchronizing pulses; simultaneously the shifted carrier is frequency-modulated by the sound signals so that the sound signals are transmitted for 10 to 15% of the time.





but over a wide frequency range of 2 mc. Periodically at the end of each frame the carrier is shifted to a third frequency to provide the frame synchronizing pulses. The amplitude of both synchronizing signals exceeds the black level. The figures, block diagrams of a transmitter and a receiver, respectively, are self-explanatory. H. E. Kallmann, RCA, (F) Aug. 27, 1941. (I) June 6, 1944, No. 2,350,902.

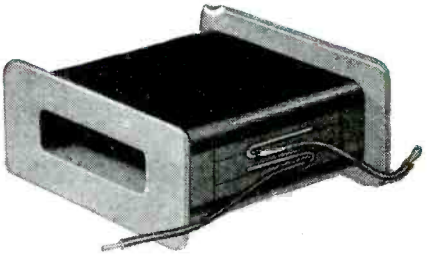
(*Continued on page* 154)



A GOOD COIL is strictly an engineering proposition. For the greatest efficiency it must be tailored to fit the application. That's why every Anaconda Coil is *designed*—not just *made*.

Anaconda coil engineers weigh and determine all the many factors entering into producing the correct coil for the intended use: type, shape, size, winding, insulation, treatment, cost. Obviously, there are well-nigh limitless variables possible.

There is also another important advantage Anaconda Coils have—good magnet wire. The very copper used in the manufacture of Anaconda Magnet Wire is mined, refined and fabricated into wire by the one organization—its quality directly controlled at every stage.



It's a highly effective triple combination. Copper producer to magnet wire manufacturer to coil engineer.

Add to it modern plants . . . efficient, engineered manufacturing equipment . . . experienced skilled personnel—

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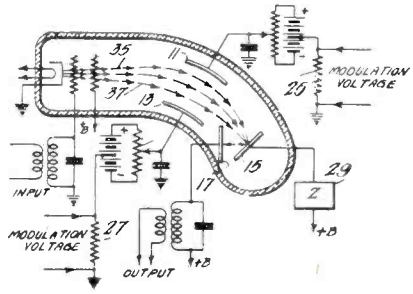
NEW PATENTS

(*Continued from page 152*)

UHF Secondary Emission Tube

It has been discovered that when the resonant circuits have been tuned to a period corresponding to 500 megacycles, for example, and the electron transit time is of the same order, variations in the electron transit time have a reactive influence on the circuit. The reactive influence may be readily controlled by changing the potentials applied to either or both deflecting electrodes 11,13. By making electrode 11 more positive, the electrons take the longer path 35; if electrode 13 is more positive, the electrons follow the shorter path 37.

For constant electron velocity, the path length determines the electron transit time and thus magnitude and sense of the reactive effect. By way of example, a 4 per cent voltage change in the outer deflecting electrode 11 produced a frequency change of at least 0.25 megacycle at 500 megacycles.



If a square wave voltage is applied to resistors 25 and/or 27 alternate response to two different frequencies is obtained, and by applying a sawtooth modulation wave the response curve may be continuously shifted through a desired frequency range. If the sawtooth frequency is very high, a band pass characteristic will result.

Regeneration and response frequency range may be controlled by varying the impedance 29 in the secondary emission electrode lead. The same effects are produced by a straight tube having the emissive electrode 15 arranged at an oblique angle to the direction of electron flow. The insertion of impedance 29 makes it practical to employ a push pull output circuit taken off electrodes 15 and 17. Suitable transmission line section arrangements for the various impedances and resonant circuits in the device are shown in the illustrated embodiments. R. M. Smith, RCA, (F) July 31, 1941, (I) May 16, 1944, No. 2,349,011.

Phase Angle Indicator

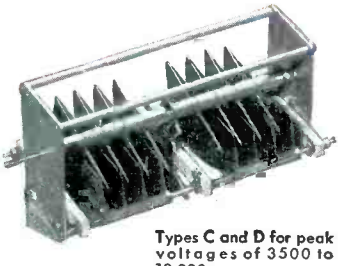
Two channels including amplifiers and limiters for the two waves to be compared are provided. Their square wave, equal-amplitude output is combined in a common output resistor of the last amplifier tubes, rectified, filtered and applied to a current meter. The instrument reading is independent of amplitude variations of either or both applied waves; its calibration covers a wide frequency range, for example, the entire audio range. E. L. Ginzton, Sperry Gyroscope Co., (F) Feb. 13, 1942, (I) May 23, 1944, No. 2,349,261.

Frequency Drift Indicator

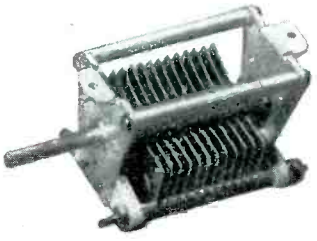
Essentially a subharmonic of the frequency to be checked is compared with a subharmonic of a standard frequency; both subharmonic frequencies are obtained by means of multivibrators. The subharmonic of the frequency to be checked drives a synchronous motor, and the standard-frequency subharmonic supplies current flashes to a neon lamp rotating with the motor. If the two frequencies are equal, the lamp will appear to remain fixed in space, any difference in frequency will simulate a slow rotation of the lamp which can be read on

New Development

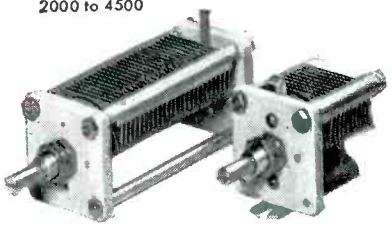
Decreased Spacing
Shorter Length
Lower Minimum
Less Inductance



Types C and D for peak voltages of 3500 to 13,000



Types E and F for peak voltages of 2000 to 4500



Type H for peak voltages of 1500 to 3000

Type N neutralizing condensers in 5 sizes

Again Johnson scores a first with newly designed thick plates which allow much higher voltages, particularly at high frequencies.

It has long been known that plates with rounded edges have higher breakdown voltages in variable condensers, but it remained for Johnson Engineers to work out ratios of plate thickness, design, voltage, and spacing for maximum advantage.

Greatly decreased length (as much as one-third in some cases) results in lower minimum capacity and lower inductance due to shorter frame rods and other metal parts, which is extremely important at high frequencies.

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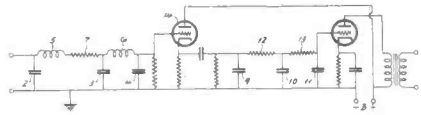
NEW PATENTS

a fixedly mounted circular scale. The device permits the immediate indication of small frequency drifts. A. Kahn, RCA, (F) Aug. 28, 1941, (I) May 23, 1944, No. 2,349,501.

Discriminator Circuit

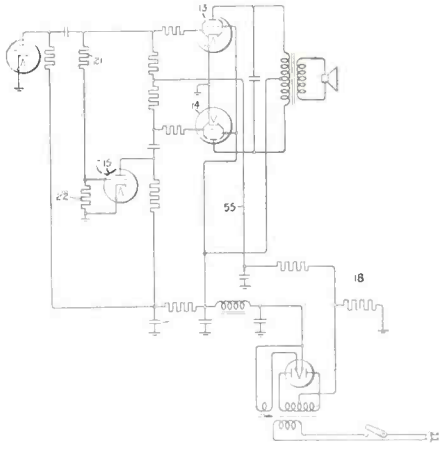
Having a much greater range of linearity than the usual converter, the discriminator is particularly suitable for the transmission of pictures or facsimile telegraphy. There are essentially two filter sections, 2,3,4,5,6,7,



and 9,10,11,12,13, respectively, connected by a high-impedance tube 14 and so dimensioned that the resulting voltage-frequency characteristic is straight over a considerable frequency range. W. H. Bliss, RCA, (F) Sept. 24, 1941, (I) June 6, 1944, No. 2,350,869.

Push-Pull Amplifier

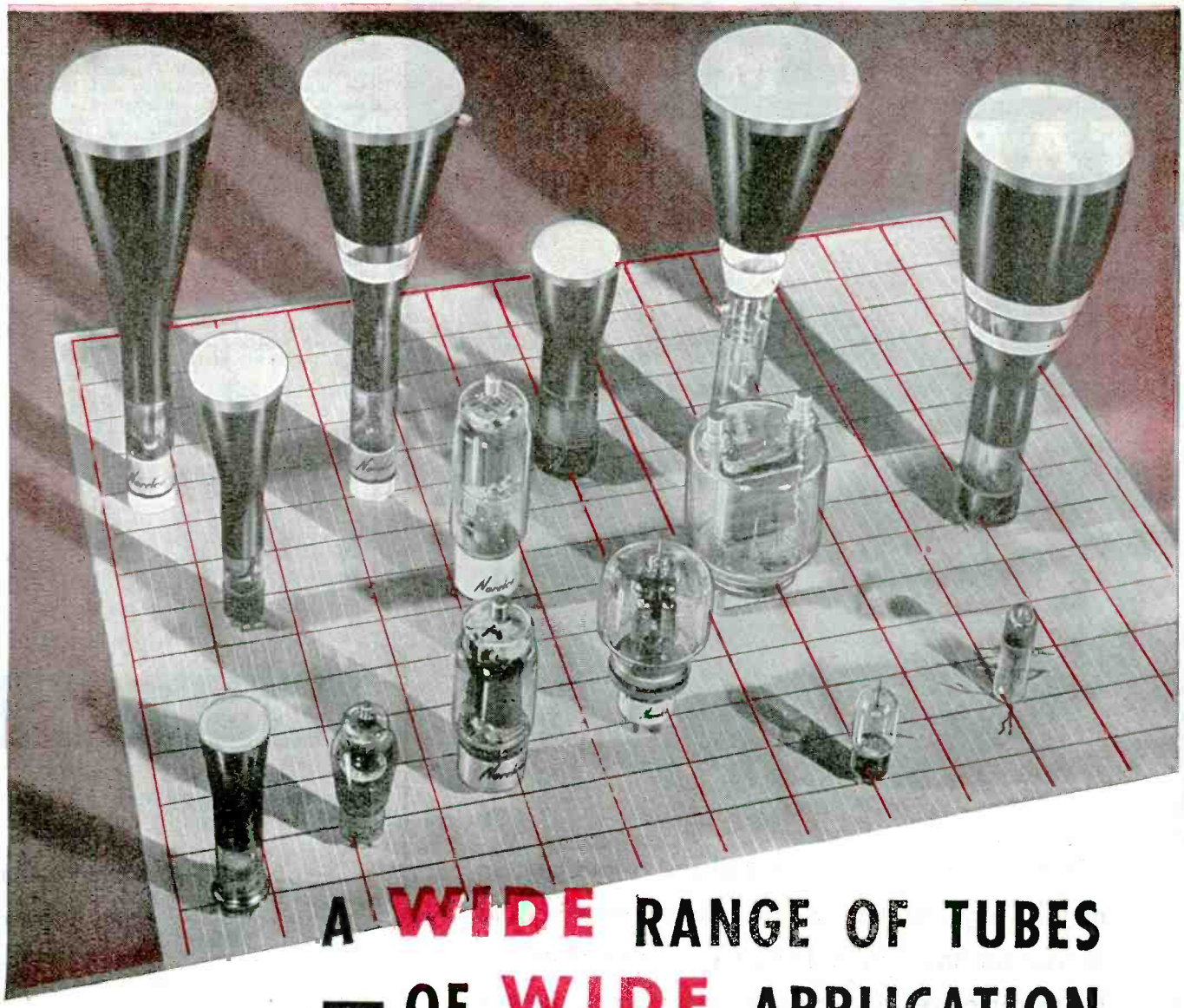
The circuit is designed to minimize power-supply hum. To prevent amplification of the hum voltages by the phase inverter 15, resistance 21 is made large with respect to resistance 22, and the ratio of the sum of resistances 21 and 22 to resistance 22 is made equal to the amplification factor of the phase inverter tube 15. In this manner, the hum at the plate of the inverter tube is kept to the same level as that at the bias source, i.e., at



power supply 18. Bias is supplied over conductor 55 to the control electrodes of amplifier tubes 13 and 14. The result is that the hum voltages supplied to the grid of tube 14 from the bias source cancels that supplied thereto from the phase inverter circuit, leaving in the output circuit only the hum supplied to the grid of tube 13. J. A. Worcester, General Electric Co., (F) March 27, 1943, (I) June 6, 1944, No. 2,350,858.

Radio Beacon Receiver

The glide path for the blind landing of aircraft should be substantially straight for the greater part of the landing operation and flatten out just before the craft reaches ground so that it will land smoothly. If the signal emitted by the source farther away from the ground increases in strength as the craft approaches ground, the equal-signal path will turn away from the ground and will become less steep; the desired flattening of the glide path is obtained. The automatic amplification of one of the two overlapping transmitted glide path signals



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THE enviable engineering tradition on which the foundation of the North American Philips Company, Inc., rests, is reflected in the superior quality and performance of electronic tubes bearing the NORELCO stamp. Contributing to the long life and uniform characteristics of these tubes are many exclusive manufacturing techniques and inspection methods developed over a long period.

Among the types we now manufacture — some of which are illustrated — are a number of special-purpose, cathode-ray and transmitting tubes for high and ultra-high frequency applications, r-f and a-f power amplifier tubes, and low- and high-power rectifiers. Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of the tube types we are especially equipped to produce will be sent on request.

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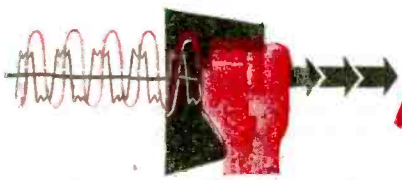

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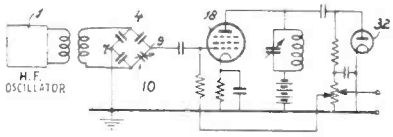
NEW PATENTS

at the receiver is accomplished by suitably applying avc signals, which increase in amplitude as the craft approaches ground, to the signal to be amplified while the other signal amplitude is maintained constant. W. T. Cooke et al, Sperry Gyroscope Co., Inc., (F) Sept. 1, 1943, (I) May 23, 1944, Re. 22,484.

Linear Pressure Gauge

High frequency generator 1 supplies oscillations to bridge 4 and to the input of tube 18. The pressure to be measured varies the capacitance of capacitor 10. However, the relationship between pressure and capacitance, and consequently between pressure and the envelope of the hf voltage between points 7 and 9, is non-linear and it is the object of the invention to provide



compensating means for this non-linearity. For this purpose, part of the output of rectifier tube 32 is fed back in phase opposition to the input wave, thereby reducing the excessive change in input voltage at high pressures. P. H. Dijksterhuis, Alien Property Custodian, (F) April 9, 1941, (I) May 9, 1944, No. 2,348,245.

NEW BOOKS

Automatic Control Engineering

By Ed Sinclair Smith, Member, American Society of Mechanical Engineers; Registered Patent Agent: Research Engineer, Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., published by McGraw-Hill Book Company, New York, N. Y. 1944, 367 pages, $4.00.

This is a design manual covering the fundamentals of the automatic control of industrial processes. The content material is beyond that of mere description of possible methods, and undertakes to provide the theoretical engineering basis for prescribing the elements of a system that will do a particular job, and for adjusting its controls when installed.

Much has been said about the utility of electronic methods in the field of control. It may be a surprise to many in electronic fields to discover that automatic control goes so far beyond the mere starting of motors or opening of valves.

The elements of plants and regulators (electrical, hydraulic, vacuum, and mechanical) are considered in terms of the basic control rate requirements. An important section is that of terminology, since the designations given various components and methods are often at variance with those in other engineering fields.

For many years, control methods have been developed from various combinations of components hav-

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Mounting ring diameter . . . . . 2 5/16"
Overall length . . . . . 3 1/8"

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ing various degrees of operating speeds and degrees of stability, etc. Tables I and III in this text contribute a means of comparing systems, based on fundamental concepts applicable to any system. This analysis correlates all effects on a reasonable basis and shows a method whereby components can be combined to handle any process requirements.

A good part of the book is included in several appendices, covering interesting phases of this work—Tables, Review of Physics, A Review of the Mathematics of Transients, etc.

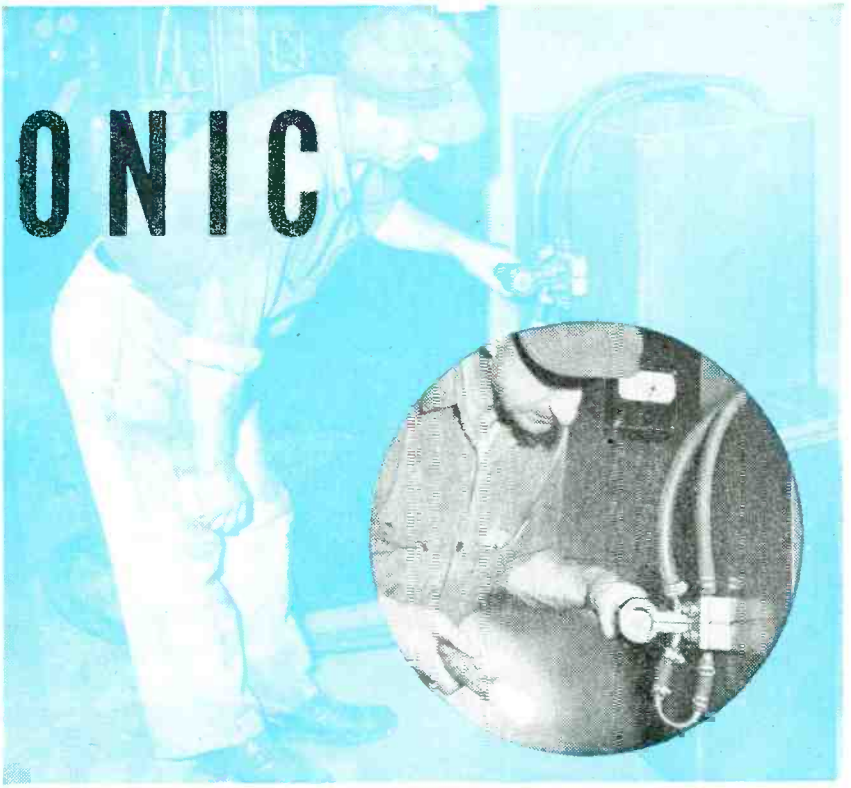
Certain electronic methods are brought into the picture in Appendix B, but the scope is limited mainly to a few observations now in use in a particular application of phototubes. The value of the book is mainly in the application of the more modern theoretical methods to a problem which all too often has involved cut-and-dry procedures. The whole book has a rather abbreviated style, and without his making a supplementary study of some parts, a newcomer might have trouble in using this as a home study text. It is believed that it will find a satisfactory acceptance in the modern industrial control field. References are liberally noted and a diligent reader will find here plenty of supplementary reading in all phases of the art. Electronic engineers have an unparalleled opportunity in the control field today, since they are working with one of the most effective elements used, and are experienced in the use of electrical mathematics for the analysis of damped oscillations, which have their counterpart in control work. The Appendices also help non-electrical engineers in using these electrical methods of analysis.

Get Ready Now to Sell Television

By John L. Stoutenburgh, William F. Moulic, William C. Alley and Jean Mayer. Published by Caldwell-Clements, Inc., 480 Lexington Ave., New York 17, N. Y. 180 pages, 110 illustrations.

This handbook—pioneer in its field—describes the accomplishments and postwar possibilities of domestic television, along with the technical aspects of television receivers, transmitters, relaying and installation. Prepared particularly for the radio dealer, it contains chapters on the probable styling and technical features of postwar receivers, the operation of studio staging, the effect of television standards on receivers in use, problems of installation and maintenance of television sets, the technical function of the components in the electronic television system, a chapter of questions and answers

ELECTRONIC *Heating*



Thrust one end of a steel bar into an Ajax-Northrup heating coil and its surface becomes white hot in seconds — ready to quench for hardening. Or hold it in the coil until the white heat penetrates, and the bar is ready to forge.

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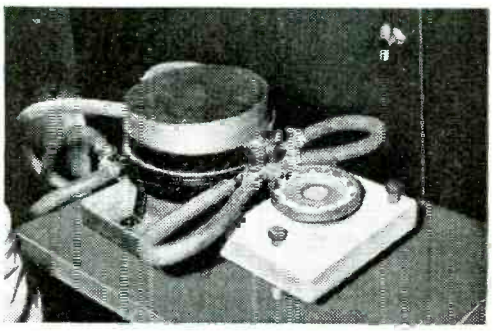
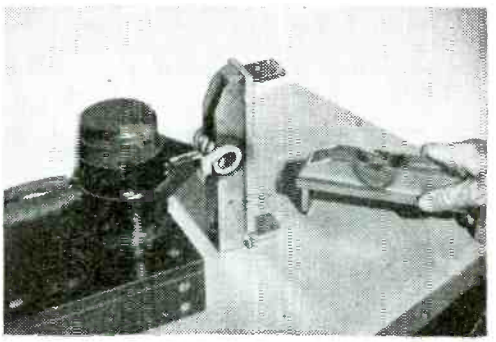
Ajax-Northrup provides the experience that has successfully pioneered hundreds of unusual heating problems during a quarter of a century. Call on us when planning better heating on your production lines.





A 20-kw. Ajax-Northrup tube converter provides power for hardening sprocket teeth above. Below, 6-kw. spark-gap set hardens ordnance part in 35 seconds.

62

AJAX-NORTHRUP

HIGH-FREQUENCY HEATING

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MELTING

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AJAX ELECTRIC FURNACE CORPORATION. Ajax-Wyatt Induction Furnaces.
AJAX ELECTRIC COMPANY, INC. Ajax-Hultgren Salt Bath Furnaces.
AJAX ENGINEERING CORPORATION. Aluminum Melting Furnaces.

on the subject of television and a vocabulary of technical television terms as well as retail selling data. The results of a survey among radio manufacturers is included and indicates the proposed plans for manufacturing television sets as regards to appproximate price and as to whether projection type sets will be built. A list of television broadcast stations, both planned and in operation, is also included The names and addresses of television organizations and associated groups are given in the appendix.

Fundamentals of Radio Communications

By Austin R. Frey, Lehigh University, published by Longmans, Green and Co., New York City, 1944, 393 pages, $4.00.

According to the author "the purpose of this book is to present, in as concise a form as possible, the fundamental principles of radio communications," and "the primary purpose has been to develop an appreciation of the methods of analysis that are available, and of the manner in which they can be applied to the solution of circuit problems."

It can be said that the text has been written with both these objects well in mind. The clear and thorough treatment of the selected basic circuits, including derivations of essential facts, will be effective in teaching the student how to handle various problems in radio communications.

Starting with a discussion on resonant circuits and the different type tubes, the text proceeds to explain amplifiers, oscillators, and modulators. Chapters on transmission lines and on radiation are also included.

Marine Radio Manual

By M. H. Strichartz, Editor. Published by Cornell Maritime Press, New York City. 1944. 528 pages, illustrated. Price $4.00.

M. H. Strichartz, Ship Radio Officer, USMS, while serving as operator aboard ship, has collected all the diverse information necessary for ship radio officer training and needed by the operators themselves on the job. Included are sample radiotelegrams and charts; maps of Navy and commercial coast stations with their wave lengths, and maps of the American radiobeacon system. Sample items from the Table of Contents include:

Maritime Radio History, description of the Ship's Radio Station, Maritime Radio Operator, Laws Affecting Radio Officers, Work in Port and at Sea, Radio Operating, Types of Service, Distress and Emergency Communications, Bookkeeping Methods, Navigation Aids, etc.

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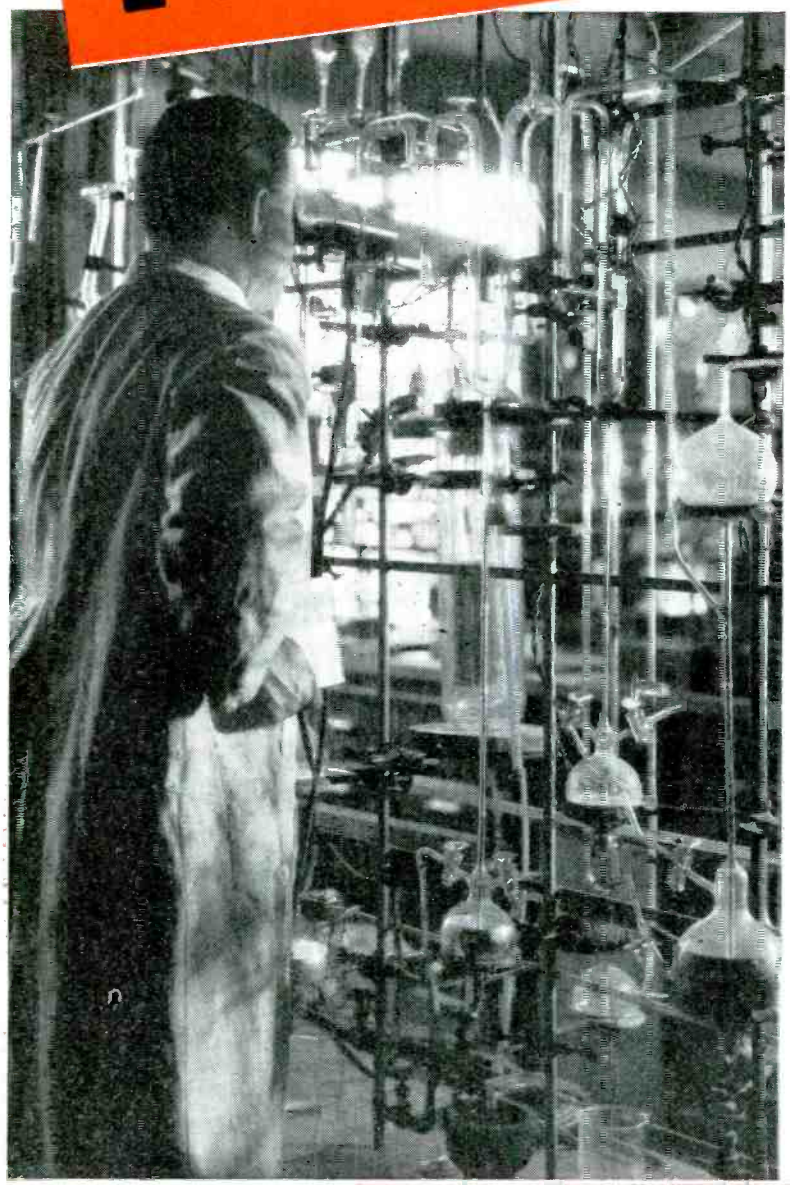

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Actually, many of Corning's developments come properly under the head of "near miracles". It was only yesterday, for instance, that it became practical to solder metal to glass. But Corning Research did it. And today the Corning metallized bushing is performing an important job in the electronic equipment of the industry's leading manufacturers . . . a proven time and money saver. And we could quote a dozen other examples just as good.

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NEW BULLETINS

Availability Lists

Walker-Jimieson, 311 South Western Ave., Chicago, publish each month an industrial availability booklet showing items available on priority for immediate delivery from stock. With the August issue the booklet has been expanded to 24 pages. This issue lists such items as tubes, test equipment, timers, relays, X-ray machines, constant voltage transformers, condensers, resistors, coaxial cable, pencil soldering irons, industrial switches, photoelectric units, steel tool room equipment, electric drills, saws, grinders and other tools available from stock.

Postwar Television

Just published, a booklet by RCA's information department is titled "Television — Progress and Promise." The publication reviews the progress of television both from the technical and program standpoints, and forecasts wide acceptance of home and theater television after victory. Home sets will, according to the booklet, use projection-type Kinescopes. Color is

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Complete details are available on request—for quick reference some of Polystyrene's outstanding values are given here:

Dielectric Constant	2.5 to 2.6 at frequencies 10^6
Power Factor, 60 cycles	.0001 to .0003
10^3 cycles	.0001 to .0003
10^6 cycles	.0001 to .0008
Dielectric Strength, Volts/Mil $\frac{1}{8}$" thickness	
Short time	500 to 700
Step by Step	450 to 600
Volume Resistivity, ohms-cms	10^{17} to 10^{19}
Heat Resistance	150°F to 250°F
Softening Point	190°F to 250°F
Specific Gravity	1.05

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NEW BULLETINS

inevitable, but may take as many years in coming to television as it did in coming to the motion picture screen.

Frequency Meters

A new model of its frequency indicating meter, to match other 2½-in. instruments, is illustrated and described in a catalog sheet being distributed by J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn. The sheet gives characteristics of the instrument, model 21-FX, which is available in three frequency ranges, 60, 120 and 400 cycles.

Dry Air Pumps

Several types of dry air hand-operated pumps designed to supply dehydrated air wherever moisture must be eliminated to permit proper operation of equipment, are illustrated and described in a new catalog sheet issued by the Andrew Co., 363 East 75th St., Chicago. Included is engineering data on performance.

Laminated Metals

D. E. Makepeace Co., 30 Church St., New York, makes a specialty of supplying sheet, wire, tubing and special shapes and assemblies of laminated or solid precious metals and explains its productions and process in a four-page catalog insert that tells how, and why, precious metals may be combined with baser ones for particular applications. Even wire as fine as 0.005 may be given a precious metal coating held to a tolerance of 0.0001 in.

Altitude Chambers

The Kold-Hold Mfg. Co., Lansing, Mich., has issued a bulletin describing a line of altitude chambers in which a manufacturer can see exactly how products and materials will react and perform at any given altitude, temperature, and degree of humidity.

Welding Controls

A technical Bulletin No. WTH-44, containing descriptions, applications, specifications and features of a new improved line of Weltronic "package unit" heat controls—which provide dial-controlled infinitely variable phase-shift regulation of welding current—has been released by Weltronic Co., 19500 West Eight Mile Rd., Detroit 19, Mich. Models are now available for virtually every resistance-welding process, including spot, seam, pulsation, butt, flash and forge

Build *higher* "Q" Inductances with MYKROY

PERFECTED MICA CERAMIC INSULATION

MYKROY is the outstanding choice of FEDERAL TELEPHONE & RADIO CORP. for insulating supports in all coils large and small. For coils up to 1½" diameter MYKROY is available in solid rods or can be molded to requirements with pre threaded surfaces. Illustration shows 10 KW Transmitter coils and small 100 watt inductance . . . both built with MYKROY.

$$Q = \frac{\text{Inductance}}{\text{Losses}}$$

"Q" is high when losses are low. That's why Engineers at Federal Telephone & Radio Corp. build their inductance coils on MYKROY supports . . . *to keep losses down to a negligible minimum!* For MYKROY combines inherent physical stability with remarkably low loss characteristics at high frequencies . . . the ideal mechanical and electrical properties so essential for efficient performance in the high frequency magnetic fields to which coil bars are exposed.

Leading manufacturers of electronic equipment everywhere are now turning more and more to MYKROY for dependable high frequency insulation, since this *perfected mica ceramic* is proving to be one of the best and most usable insulating materials ever developed.

Don't let another day go by without learning more about it. Write for your copy of the **MYKROY Engineers Manual** containing the facts about this perfected insulation.

HERE'S TECHNICAL PROOF OF MYKROY SUPERIOR INSULATING PROPERTIES

***MECHANICAL PROPERTIES**

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

***ELECTRICAL PROPERTIES**

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

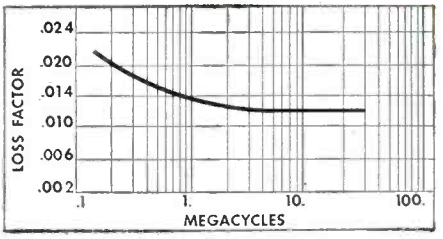
***THESE VALUES COVER THE VARIOUS GRADES OF MYKROY**

GRADE 8. Best for low loss requirements.

GRADE 38. Best for low loss combined with high mechanical strength.

GRADE 51. Best for molding applications.

Special formulas compounded for special requirements.



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

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

MADE EXCLUSIVELY BY ELECTRONIC MECHANICS INC. 70 CLIFTON BOULEVARD • CLIFTON, NEW JERSEY
Chicago 47: 1917 NO. SPRINGFIELD AVENUE . . TEL. Albany 4310
Export Office: 89 Broad Street, New York 4, N. Y.

NEW BULLETINS

welding, etc. Models for dual and triple heat controls are essentially combinations of the standard models and provide accurate pre-selective current adjustment for two or more welding operations performed with the same machine or gun.

Stock models being manufactured are listed in the bulletin, together with explanations of the applications of these control units to single point, multiple point, pulsation and automatic heat rise welding. Also included is a list of major features available such as quick warming type tubes (eliminate warm-up delays); infinitely variable adjustments rendering unnecessary the use of "too hot" and "too cold" transformer taps; safety devices; and the electronic precision control. Detailed specifications are given together with photographs of various models.

Capacitor Catalog

With almost every day finding dry electrolytic capacitors establishing new standards of performance on applications formerly reserved for more costly types, the new Sprague dry electrolytic Catalog No. 10 presents graphic evidence of the rapid advancement in dry electrolytic types in recent years, including types to match exacting war equipment needs. As explained

Don't Handicap Important Designs

for Lack of a SMALL Electric Switch

3 basic contact arrangements

single-circuit, normally open

single-circuit, normally closed

double-circuit, one normally open and one normally closed

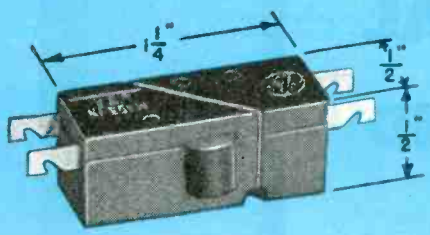
And many special forms. For example:

three-point structure

single-break, normally open

single-break, double-throw

THE G-E SWITCHETTE IS ONLY THIS BIG



(This one is ACTUAL SIZE)

WHEREVER you need a tiny contact mechanism in ratings up to 10 amperes at 24 volts d-c—an enclosed, self-contained unit that's light and compact, yet can withstand thousands of operations—there's a G-E Switchette to do the job.

This tiny switch weighs only 9 grams, and is suitable for use at altitudes up to 50,000 feet and in ambient temperatures from 200 F to −70 F. It's corrosion-proof—meets 50-hour salt-spray tests. It's vibration-resistant. The contacts will not chatter when subjected to mechanical frequencies of 5 to 55 cycles per second at 1/32-inch maximum amplitude (1/16-inch total travel), or to a linear acceleration of 25 g in any direction.

Two terminal arrangements are available—out the ends of the case as shown above, or out the top through the cover. This makes for easy mounting in any position.

More than 200 design modifications of the G-E Switchette are available to provide for a wide variety of electrical and mechanical arrangements.

SHIPMENT FROM STOCK

Some forms are now available from warehouse stocks in substantial quantities, to give you quick delivery for your important war jobs.

For your copy of our new catalog (GEA-3818B) which gives dimensions, ratings, and ordering directions for both standard and modified Switchettes, call our local office. *General Electric Co., Schenectady 5, New York.*

SWITCHETTES

GENERAL ELECTRIC

676-140-8940

BUY WAR BONDS

NEW BULLETINS

in this new 28-page catalog, they are available in unlimited combinations of capacity and voltage ratings, with special electrical characteristics and in containers for every mechanical requirement. Types cataloged include cardboard and metal tubulars, cylindrical metal container types, high-capacity low-voltage, cylindrical "FP" types, octal base, ac motor starting, and special purpose types. Of particular importance to engineers and designers, many pages are devoted to application notes, including a number of typical characteristic charts.

Noteworthy in "streamlined" catalog design is the fact that lengthy listings have been eliminated. Compact "Size Factor Tables" replace the endless listings otherwise required, and make it easy to select a capacitor of the proper size, shape, voltage and capacity, or any desired combination of the latter.

Published by Sprague Electric Company (formerly Sprague Specialties Co.), North Adams, Mass.

Permanent Magnet Manual

A new permanent magnet manual of interest to everybody concerned with the application of permanent magnets to various industries has been prepared by The Arnold Engineering Co., 147 East Ontario St., Chicago 11, Ill. This is an authoritative, up-to-date monograph of valuable information on the design, production and use of the modern magnet. Contents include such subjects as Magnet Materials, Resistance Comparisons, Physical and Magnetic Properties, Demagnetization and Energy Curves, Fabrication, Design and Testing. Charts and tables are included to illustrate and explain various aspects of the discussion.

Short Wave Coverage

As long ago as September 1941, the Federal Telephone and Radio Corporation, an affiliate of the International Telephone and Telegraph Corporation, submitted a proposal to United States government authorities for an American shortwave super-broadcasting system that would be capable of complete world coverage. And now IT&T has published the history of that proposal in an elaborate board-covered brochure (11 x 14) under the title, "Beyond Our Shores the World Shall Know Us." Primary considerations prompting this presentation are: the conviction that comprehensive broadcasting facilities, second to those of no

M-R

Friction and Sealing Tapes

M-R FASTHOLD FRICTION TAPE

Double Coated With Rubbery Compounds ... Tensile Strength more than 44 lbs. — Adhesive Strength more than 50 lbs.

In the manufacture of FASTHOLD FRICTION TAPE the best procurable cotton sheeting (long staple 56/60) is first dried to eliminate moisture . . . then the fabric is thoroughly impregnated with a filler coat of insulating, waterproofing and preserving compound ... after several days of drying a second coat, exceptionally heavy in rubber content, is forced through the fabric by means of enormous rollers ... then follows another period of drying out before cutting and wrapping in tin foil for protection. The materials used and the precision and control exercised in the manufacture of FASTHOLD FRICTION TAPE enables it to meet all known electrical tests and requirements ... and to Guarantee it against Unraveling or Drying Out. FASTHOLD FRICTION TAPE is New York warehouse stocked in widths of ⅜ — ½ — ¾ — 1 — 1½ and 2 inches.

M-R ANHYDROUS SEALING TAPE

IMPROVES WITH AGE AND SERVICE

25.58% Cotton Sheeting • 74.42% M-R Insulating Compounds

Weatherproof ... Waterproof ... Acid, Alkali, Oilproof ... Permanently Flexible . . . Will not Vulcanize or Dry Out ... Tensile Strength 30 Pounds . . . Dielectric 1,000 volts

ANHYDROUS SEALING TAPE contains nothing which will injure fabrics or metals. It is made of the best procurable cotton sheeting and special M-R Bituminous Compounds. A wrapping of ANHYDROUS TAPE gradually becomes one solid mass (glass hard on the outside and soft inside) that excludes air, moisture, vapors, etc. It can be used to great advantage under conditions which disintegrate ordinary tapes; inside work where acids or alkali fumes or spray prevail; outside for cable joint insulation in conduits transformer connections, extreme high or low temperatures, etc., mines and damp places where atmospheric conditions and constant friction demand maximum wearing qualities.

A joint, properly taped with ANHYDROUS, is absolutely waterproof even after complete submergence for many weeks.

ANHYDROUS SEALING TAPES are New York warehouse stocked in widths of ¾ and 1½ inches ... other sizes are available, as ordered.

FREE FOR THE ASKING

Write today for samples of M-R Friction and Sealing Tapes . . . also your Free Card of Varnished Tubing with samples ranging from size 0 to 20 to fit wires from .032 to .325 inches . . . other valuable aids, are the M-R Guide Book of Electrical Insulation . . . the Wall Chart with reference tables, electrical symbols, allowable capacities of conductors, dielectric averages, thicknesses of insulating materials and tap drill sizes . . . and the M-R Wax and Compound Guide Book . . . they are full of valuable information . . . write for them on your letterhead.

MITCHELL-RAND *for* **55 YEARS THE ELECTRICAL INSULATION HEADQUARTERS**

MITCHELL-RAND INSULATION COMPANY, INC.

EST. 1889

51 MURRAY STREET COrtlandt 7-9264 **NEW YORK 7, N. Y.**

A PARTIAL LIST OF M-R PRODUCTS

Fiberglas Varnished Tape and Cloth
Insulating Papers and Twines
Cable Filling and Pothead Compounds
Friction Tape and Splice
Transformer Compounds
Fiberglas Braided Sleeving
Cotton Tapes, Webbings and Sleevings
Impregnated Varnish Tubing
Insulating Varnishes of all types
Fiberglas Saturated Sleeving and Varnished Tubing
Asbestos Sleeving and Tape
Extruded Plastic Tubing
Varnished Cambric Cloth and Tape
Mica Plate, Tape, Paper, Cloth and Tubing

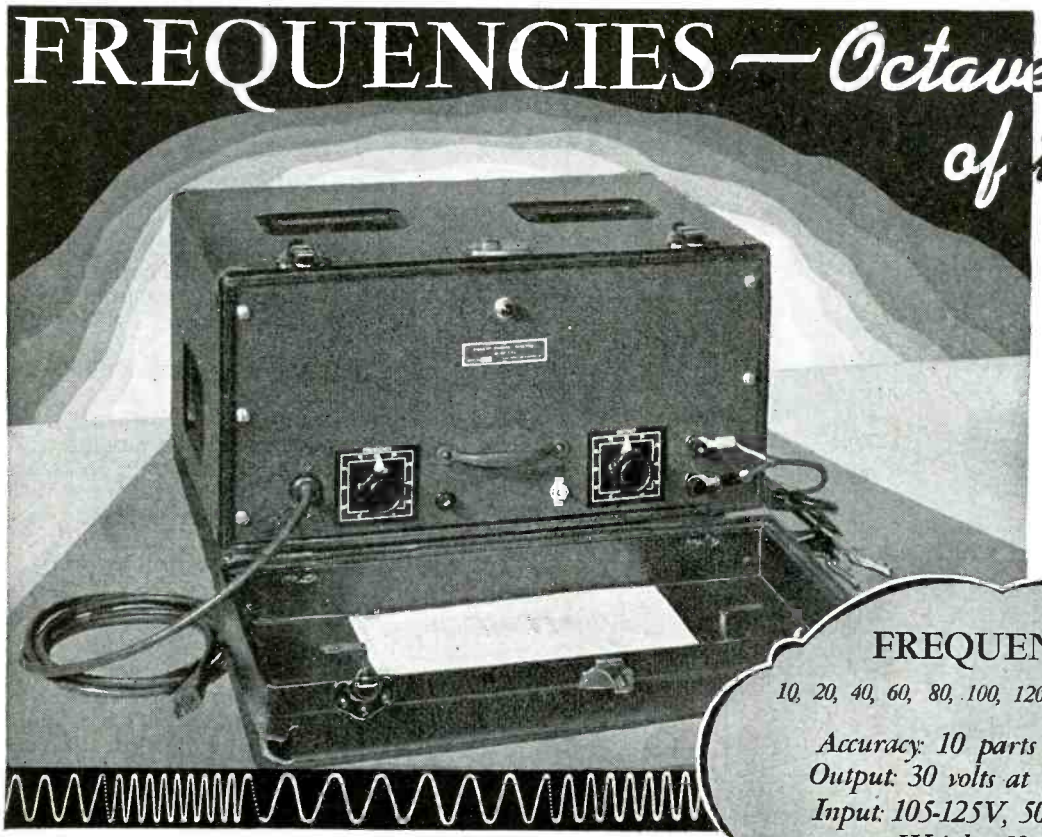
NEW BULLETINS

other nation, are essential to the promotion of American prestige throughout the world. Further, that facilities of this character are destined to become increasingly important as our war effort tends towards its climax and merges into the world readjustment period. The book is beautifully printed in four colors, illustrates the typical ideal transmitter and gives a complete physical and technical layout for a modern 200-kilowatt broadcasting station.

Moisture Meter

A new type of dielectric moisture meter is illustrated and described in a four-page pamphlet issued by C. J. Tagliabue Co., Brooklyn, N. Y. This new instrument is designed for precisely measuring the moisture content of a test sample of powders or granular materials such as dehydrated foods, soaps, flour, plastic molding materials, etc. for which other electrical conductance instruments are not suitable. The instrument is electrically simple but extremely sensitive. This sensitivity is not only the result of a unique electronic method but also advantage is taken of the fact that the dielectric constant of water is about 80 while that of common substances is less than 10. Thus, a

STANDARD FREQUENCIES—*Octaves of them*



FREQUENCIES

10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 190

Accuracy: 10 parts in 1,000,000
Output: 30 volts at 500,000 ohms
Input: 105-125V, 50-60c., 40 watts
Weight: 50 pounds

Impossible? Well, here it is—

This Multi-frequency generator furnishes the frequencies shown above at the turn of a switch. All frequencies are obtained from a temperature-compensated tuning fork and voltage-stabilized circuit.

With this unit it is possible to calibrate oscillators at many selected points without encountering complex oscilloscope patterns. One of the uncertainties involved in development work on tuned circuits, filters, reeds—and in time measurement can be minimized with the aid of this instrument.

Developed primarily to check frequency meters for precision war work, this Multi-frequency generator possesses a rugged durability and dependability in service that will prove an extra value to many laboratories.

Additional information available on request.

Manufacturer of the Watch Master

and distributor of Western Electric Watch-rate Recorders

American Time Products, INC.

580 Fifth Avenue New York 19, N. Y.

slight change in moisture content has a marked effect (in nearly all cases) on the dielectric constant of a substance. Moisture determinations can be made in less than two minutes.

Transformer Catalog

A new, standard size, 8½ x 11, two color illustrated catalog entitled Radio Transmission Transformers has been prepared for engineers and designers by The Acme Electric & Mfg. Co. of Cuba, N. Y. It lists specifications and other essential data on plate supply transformers, both air-cooled and oil insulated types; filament transformers, high leakage reactance transformers, filter reactors, interstage transformers, and plate modulation transformers.

Tube Catalog

A new catalog of all Taylor tubes (Taylor Tubes, Inc.; 2312 Wabansia Ave., Chicago) will contain full information on all tubes manufactured by the firm in the past, as well as some of the newer tubes developed for the War. Sixteen pages will be devoted entirely to tube characteristics, and a large section will contain pertinent technical information on transmitters and transmitter tubes. Simultaneously with the release of the catalog, Taylor will announce several new tubes for the ultra and very high frequencies.

Multi-Circuit Switches

Selection of multi-circuit switches for simultaneous control of independent or interconnected electrical circuits is simplified in the new Maco catalog ME448. Including details of dimensions, circuits, and mechanical actions, this catalog shows how any of twenty standard spring-and-contact assemblies can be combined to handle any desired number of circuits in a single switch. Maker is Metallic Arts Co., 243 Broadway, Cambridge, Mass.

Hallicrafters Bulletin

The Hallicrafters Co., Chicago, has just published a very much deluxe booklet reproducing in all their original colors a great many of the magazine and trade paper advertisements that are being given a circulation that aggregates some sixty-eight million readers. The booklet (32 pages) is printed on heavy coated stock, includes a number of beautiful photos of research and production operations.

(*Continued on page* 176)

WARNING TO FIRST-TIME USERS - - - -

DON'T LOOK FOR A JACK-OF-ALL-TRADES IN ELECTRONIC HEATING MACHINES

ELECTRONIC HEATING is rapidly outmoding many industrial heating processes because of its numerous advantages, recognized and acknowledged by all leading industries.

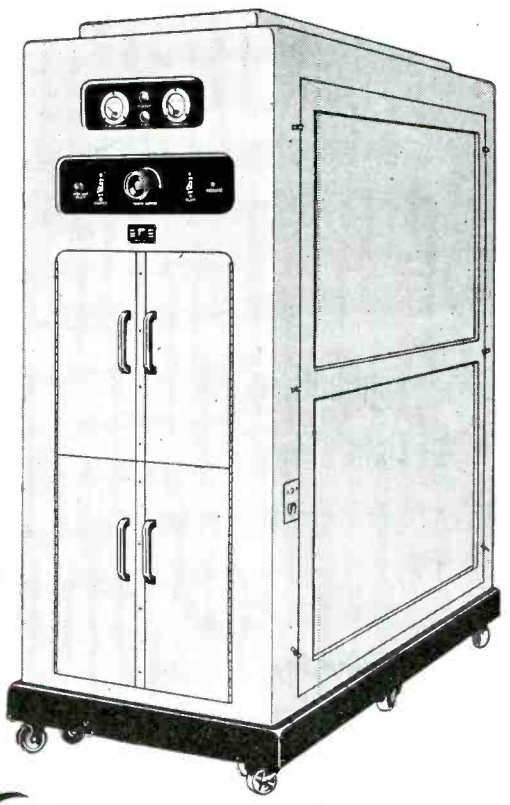
It is, however, important to realize that the maximum time-and-money-saving advantages of the process can only be realized by *using it correctly in every application.* Each heating process requires a definite FREQUENCY and POWER combination.

To use any combination of frequency and power other than the one ideally adjusted to the process implies a waste of power and the use of a "misfit" size machine.

No electronic heater has ever been built that can provide a large enough variety of frequency and power combinations to permit economical application to more than one type of heating operation.

For 23 years we have pioneered and specialized in electronic heating. As recognized experts we urge all first-time users to consult our engineers and to investigate the many advantages of our complete variety of units before buying. Write to us for detailed information.

Our equipment offers you a selection of frequencies up to 300 megacycles—and the following power range, with stepless control from zero to full load: 3, 5, 7½, 10, 12½, 15, 18, 25, 40 and 100 Kw.



Scientific Electric

DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY
119 MONROE STREET GARFIELD, NEW JERSEY

Manufacturers of Vacuum Tube and Spark Gap Converters
Since 1921

NEW BULLETINS

(*Continued from page* 174)

Capacitor Specs

In a supplement to its Catalog No. 12, Solar Mfg. Co., 285 Madison Ave., New York, has included in 36 pages complete JAN (joint Army-Navy) specifications for mica capacitors of all sizes, types and styles. In addition there is included complete engineering data and characteristics as well as much technical data.

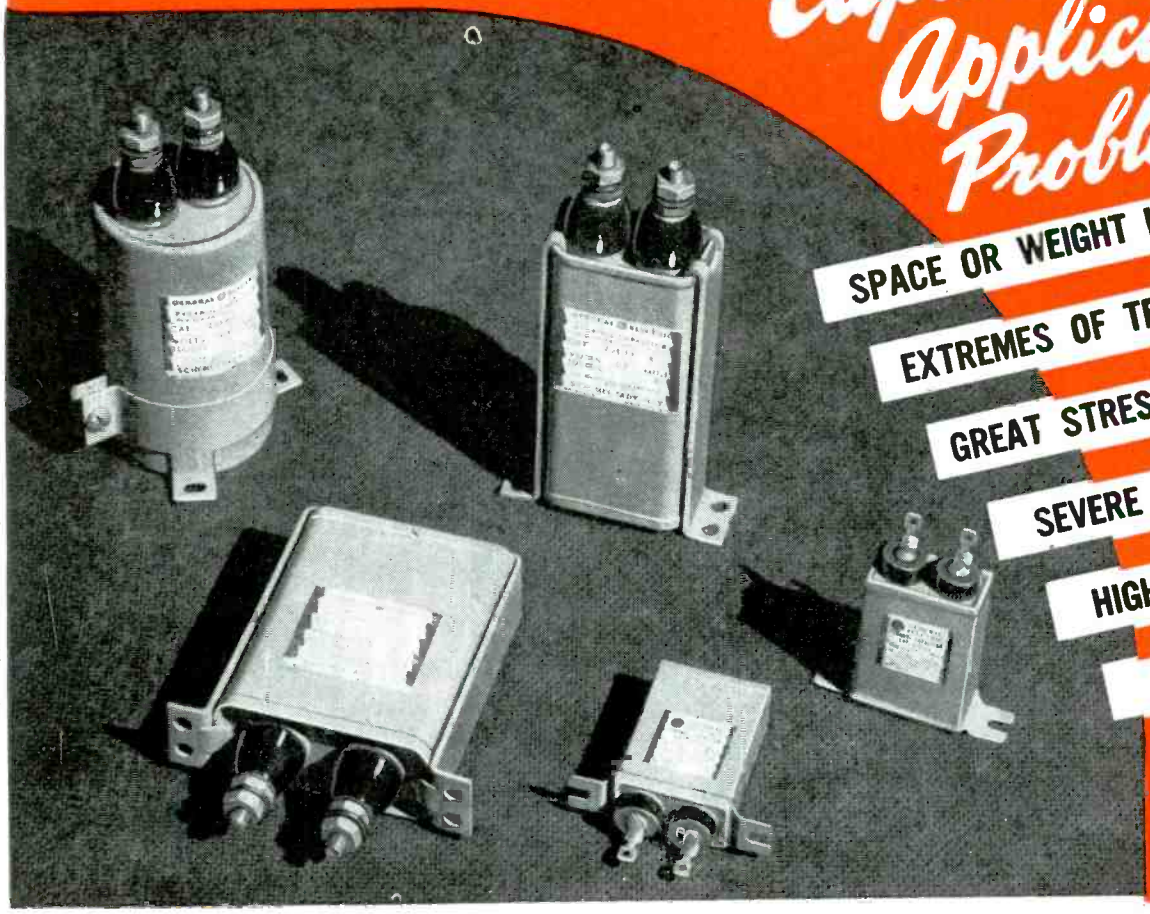
X-Ray Unit

Norelco Searchray 150, a complete, self-contained industrial X-ray unit, is described in a new folder by the North American Philips Co. The folder tells how the unit works, and lists its applications. Photographs illustrate its use in X-ray examination of aluminum, steel, copper, hard rubber parts, plastics, die castings, etc.

Pilot Light Data

A new catalog containing 24 pages of pilot light illustrations, diagrams, specifications, prices and other pertinent information has just been published by the Gothard Mfg. Co., 1300 North Ninth Street, Springfield, Ill. Presented are pilot light models for a wide range of applications and voltages.

HAVE YOU ANY OF THESE *Capacitor Application Problems?*



- SPACE OR WEIGHT LIMITATIONS
- EXTREMES OF TEMPERATURE
- GREAT STRESS OR SHOCK
- SEVERE VIBRATION
- HIGH ALTITUDE
- HUMIDITY

Whatever your specifications, we're likely to have the answer

WE are in an excellent position to provide you with hermetically-sealed capacitors for wartime applications. Our extensive engineering, research, and manufacturing facilities are at your service.

In some cases there will be no need to look further than our standard line of Pyranol* capacitors for built-in applications.

The line includes more than 350 ratings in space-saving shapes and sizes. Many of the ratings are available in three shapes—oval, cylindrical, rectangular—to make your design problems easier. And they can be mounted in any position.

BE SURE TO GET your copies of our time-saving catalogs on d-c (GEA-2621A) and a-c (GEA-2027B) types. Ask your G-E representative for them by number, or write to General Electric, Schenectady, New York.

**Pyranol is the G-E trade mark for capacitors and for askarel, the synthetic, noninflammable liquid used in treating G-E capacitors.*

PYRANOL CAPACITORS

BUY WAR BONDS

GENERAL ELECTRIC

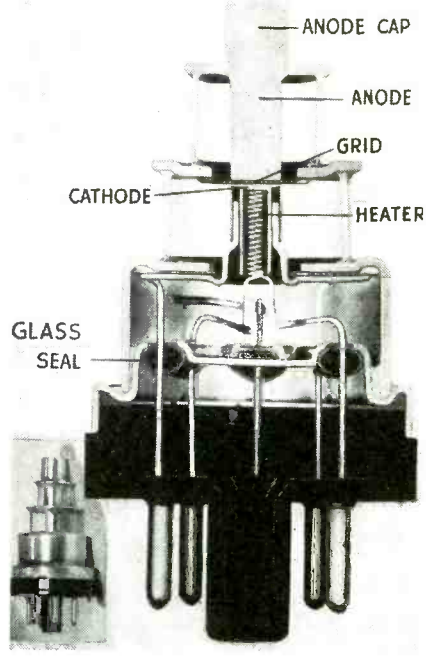
407-60-5700

WHAT'S NEW

(*Continued from page 114*)

Lighthouse Tube

General Electric Company's disk-seal electronic tube is widely known as the "lighthouse" tube. The new tube, developed by engineers of the G-E Electronics Laboratory (megatron is the generic name assigned to tubes of this design) advances by far the frequencies and power available for use in the electronics field. It has made possible a large new family of ultra-high frequency electronic tubes, circuits, and apparatus which now operate in parts of the spectrum impractical of use before



the war. The new tube eliminates the conventional type of grid, anode and cathode. Instead of components being fitted around one another as in the past, they are now constructed in simple, parallel planes or layers, with glass and metal fused together in rigid, inseparable units. This design permits an extremely compact over-all tube structure, while providing high frequency and high power output.

Fungus Coating

A new fungus-resistant coating for phenolic parts of communications equipment has been developed by Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J. Marketed as Durad fungus resistant coating No. 524, the product is a varnish, applied by spray, dip or brush.

Shockproof Relay

The R. W. Cramer Co., Inc., Centerbrook, Conn., has developed a new Type (TD5) time delay relay to take care of conditions where a time delay relay is subjected to momentary shocks without affecting the switch circuit. It has a unique cam operated switch mechanism. The particular construction gives the timer shock resisting quality which is most desirable for uses in Navy and aircraft applications.

Hand Generator

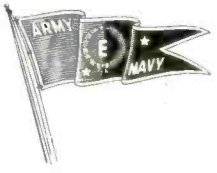
A new type hand generator (37 lb.) with a maximum output of 100-watts has been developed by the Carter Motor Co., 1608 Milwaukee Ave., Chicago. The unit is the largest permanent magnet hand generator manufactured, thus saving about 10 watts of power usually required for activating the field coils. Two men turning improved

A New TWIST ... to CRYSTAL CLEANING

THIS is an actual photograph of the centrifugal air drier, or "spinner," used in Bliley production to facilitate clean handling of crystals during finishing and testing operations. Quartz blanks are dried in 5 seconds in this device which is powered with an air motor and spins at 15,000 r.p.m.

Little things like lint or microscopic amounts of foreign material can have a serious effect on crystal performance. The "spinner" eliminates the hazards encountered when crystals are dried with towels and makes certain that the finished product has the long range reliability required and expected in Bliley crystals.

This technique is only one small example of the methods and tests devised by Bliley Engineers over a long period of years. Our experience in every phase of quartz piezoelectric application is your assurance of dependable and accurate crystals that meet the test of time.



BLILEY ELECTRIC COMPANY - - - ERIE, PA.

Bliley Crystals

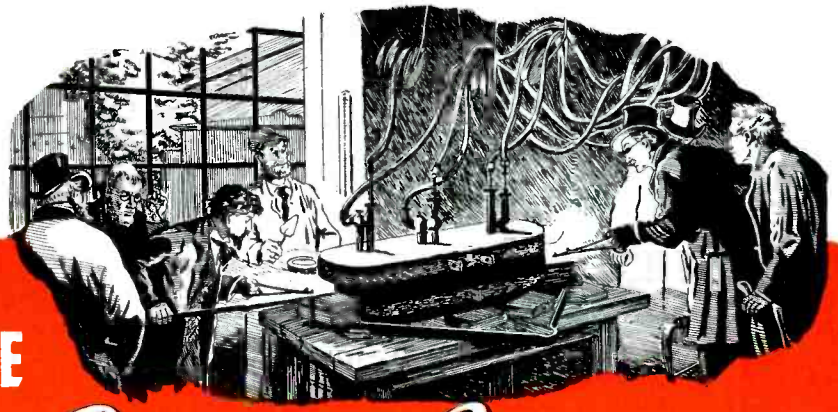
WHAT'S NEW

cranks which are designed to prevent breakage due to operational leverage, can, by watching the shatterproof-enclosed meter observe that the output is held to the correct value. Within the frame is contained a ripple filter; crank handles are readily demountable without the use of tools. Output is to a 4-pin connector, but other type output connections can be furnished. The stand comes complete with seats and is totally collapsible, while a chain keeps the legs from spreading beyond holding position when the unit is set up. Drive is by means of direct gears, and one of the gears is bakelite-constructed, helical cut to reduce operation noise to a minimum. The unit has waterproof seals on the shafts. The generator delivers a wide range of outputs up to 500 volts dc and a filament output voltage; 117 volts ac output is also available.

Buna S Insulation

Nubun, a new synthetic rubber latex insulation for power, lighting and communication cable, has been developed by United States Rubber Co., New York, N. Y. The new insulation is a result of wartime developments in rubber technology and will permit the design of new types of wire and

Casting the International Meter Rods in Paris 1874. The degree of accuracy attained 1/10,000,000 of a quadrant of a terrestrial meridian.



WHO SETS THE *Quality Standard* FOR TRANSMITTING TUBES

UNITED

TRANSMITTING TUBES

IN every art or craft, the work of some acknowledged master sets the standard.

Since 1934 UNITED has won recognition by specializing exclusively in the engineering, design and building of transmitting tubes which are unchallenged for excellence. UNITED tubes excel in every electronic application . . . including radio communication, physiotherapy, industrial control and electronic heating. In these and other applications, tubes by UNITED continue to win top honors for uniformly dependable performance.

In communication equipment for airlines, commercial broadcasting, police radio stations and other vital civilian services, UNITED transmitting tubes set the standard. Accept nothing less than UNITED quality tubes for your requirements.

Order direct or from your electronic parts jobber.

UNITED ELECTRONICS COMPANY

NEWARK, 2 New Jersey

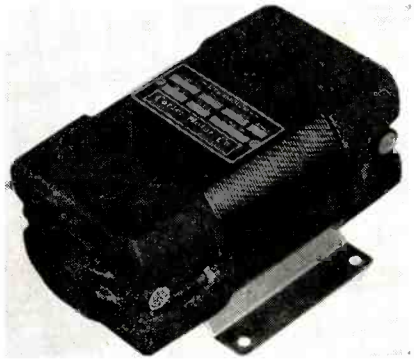
Transmitting Tubes EXCLUSIVELY Since 1934

WHAT'S NEW

cable with improved electrical and physical characteristics. Made by the latex continuous dip method, Nubun is based on modification of the 75 per cent butadiene—25 per cent styrene composition and a new reaction technic. The following electrical and physical values have been established by laboratory test: Physical: Tensile strength—2,500 lb.; elongation—2-13 in.; set—5/16 in. Electrical: voltage breakdown after submersion in water at room temperature—650 volts/mil; insulation resistance, constant K, after submersion in water at room temperature—54,000; specific inductive capacity at 70 deg. C: (a) After one day in water—3.0; (b) After three days in water—3.2.

Marine Dynamotor

A dynamotor for marine use has been added to the line of the Carter Motor Co., 1608 Milwaukee Ave., Chicago. Built so as to be suitable for use in high humidity locations with spray-resistant, verdigris-repellant construction, bearings are packed with pre-worked grease of marine type.



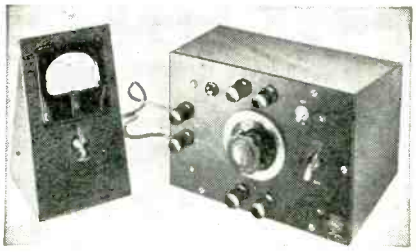
Units are available with inputs ranging from 6 to 115 volts dc and outputs up to 600 volts at .25 ampere. The size of the largest dynamotor is 7⅛ in. long by 4⅛ in. wide by 3½ in. high, and without the filter (available on order) weighs 9 lb.

Explosion-Proof Battery

From Navy designs, the storage battery division of Philco Corp., Trenton, N. J., is in production on an explosion-proof storage battery for industrial truck use, that is steel cased, automatically vented under pressure so that released gases become incombustible, automatically disconnected when it must be opened for charging after completing its duty cycle. It is intended for use where any fire or explosion hazard exists.

Production Tester

Speedy testing of resistors, capacitors or inductors in terms of ohmage, microfarads or henries, respectively, is the purpose of Type LB direct-indicating comparison bridge developed by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City, N. J. This production-test instrument is an ac slide-wire bridge with vacuum-tube null indicator arranged so that resistors, capacitors or inductors can be compared with a similar standard. Ranges are: capacitance, between .0001 and 1.0 mfd.; resistance, between 2,000 ohms and 20 megohms; induc-

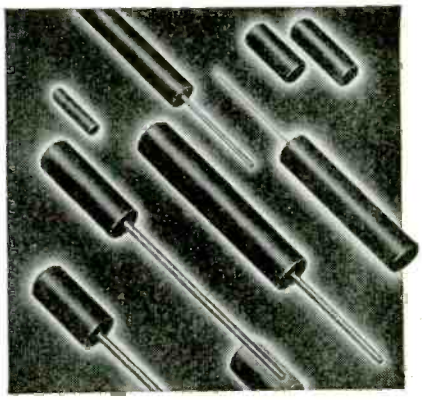


WHAT'S NEW

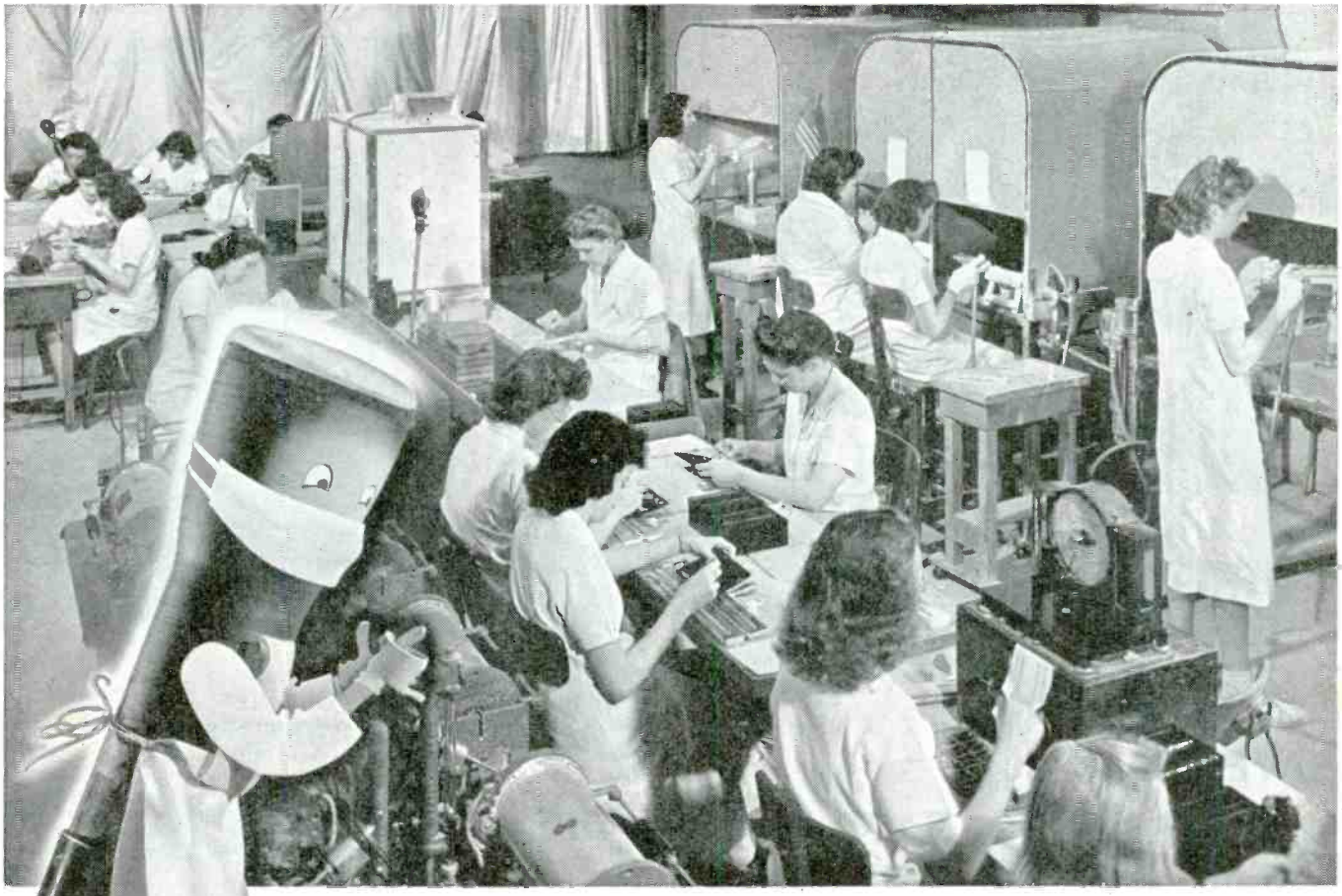
tance, between 5 and 50,000 henries. The slidewire is uncalibrated; external standards are used. The instrument comprises the main unit with a separate meter on a stand, the former measuring 7 x 8 x 5½ in.; net weight, 6 lbs.

Molded Iron Cores

Molded by means of pressure applied from the sides rather than from the ends, a line of iron cores recently introduced by the Stackpole Carbon Co., St. Marys, Pa., has advantages for permeability tuning



applications at broadcast band frequencies. Similar side-molded cores are now available for short wave frequencies including television and frequency modulation. Conventional cores molded by applying pressure to the ends, result in a dense grouping of iron particles at these points, thus interfering with uniform permeability. In side-molded cores, however, any density resulting from molding pressure extends



NO SWEATER GIRLS, Please

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

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

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

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

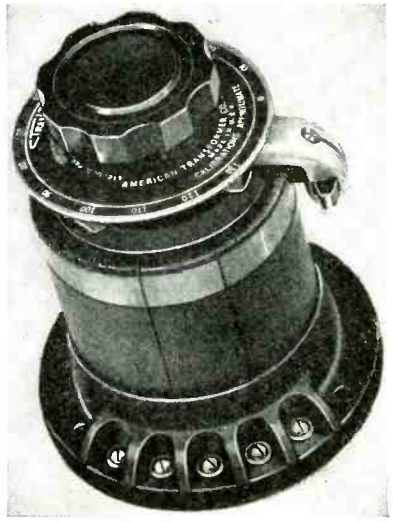
NATIONAL UNION

RADIO AND ELECTRONIC TUBES

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

WHAT'S NEW

evenly over the entire length of the core, thus assuring uniform permeability with respect to length.

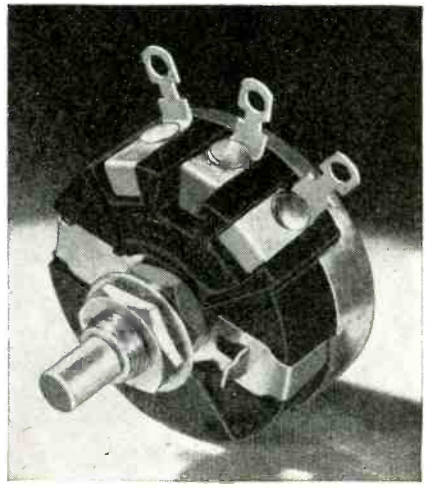


Transformer-Regulator

A new model TH Transtat ac voltage regulator incorporates a number of developments. The brush arm, an accurately machined die casting which permits good heat dissipation, provides a simple means of changing brushes and protects the commutator against short circuiting contact with the brush holder. The shaft is independent of the brush arm assembly and can be removed by drawing one pin. Thus, the unit can be quickly changed from panel mounting to table mounting or ganged with other units for polyphase or simultaneous single phase control. By employing a phenolic thermosetting plastic of new design, high dimensional conformance is assured and accidental lead shorting is prevented. Among refinements are vinyl acetal insulated wire, impregnation of core and coil with a synthetic phenolic resin varnish of the polymerizing type, followed by baking, corrosion-resistant fittings, and a new dual mounting arrangement for open delta three phase control that reduces waste space to a minimum. Maker is American Transformer Co., Newark, N. J.

Wire-Wound Control

The new design of Type 58 Clarostat differs somewhat from the previous Type 58. A metal strap on the shaft face provides for the two-position locating pin which cannot break or tear off. Also, the metal strap



HE who needs a source of supply for chassis mounting assemblies, panels, transformer housings or cabinets—and doesn't move fast when one is available—may not be able to move at all.

Right now Corry-Jamestown can supply your needs, in steel, stainless steel or aluminum. Our work meets the most rigid Army or Navy specifications. Our list of satisfied customers includes many leaders in the field of electronics.

Our suggestion is—write us today!

Steel Age

CORRY - JAMESTOWN

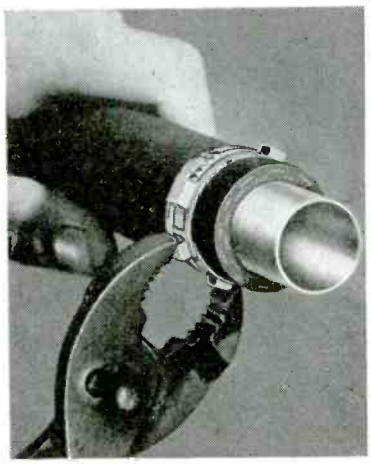
MANUFACTURING CORPORATION ★ CORRY, PENNA.

WHAT'S NEW

grounds the metal cover which is clinched to it. The dustproof cover is keyed in place on the casing and therefore will not loosen or turn. The bushing is keyed into the bakelite case and therefore cannot slip or turn when the locking nut is drawn up tightly. A high-grade molded bakelite can eliminates corrosion and electrolytic action especially when control is used on dc. The center rail and terminal comprise one piece. There is also a direct connection between the winding and the "L" and "R" terminal lugs. Terminals are so constructed that melted solder cannot get inside the case to cause trouble. There is zero hopoff at terminal; 1500 volt breakdown insulation between winding and shaft; switch can be added. Tandem units with two or more controls on common shaft, are available. Ratings: linear, 3 watts; V and W tapers, 2 watts; L, N and U tapers, 1.5 watts. Resistance values: linear, 1 to 75,000 ohms; tapered, 10 to 50,000 ohms. Maker is Clarostat Mfg. Co., 285 No. 6th St., Brooklyn, N. Y.

One-Piece Clamp

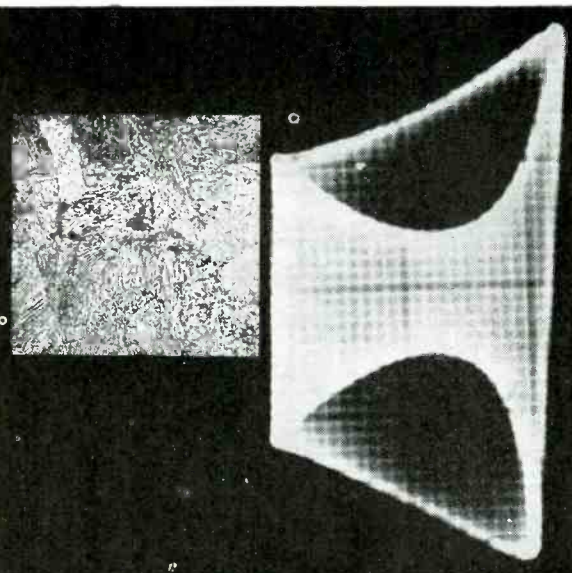
This one-piece hose clamp has no gears, thumb screws or intricate locking means. The clamp may be snapped over the hose into pre-latched position by hand. Final lock is made with hand pressure on ordinary pliers. The clamp may be quickly released



for removal with a screwdriver. Made of S.A.E. 1060 spring steel with parkerize and zinc chromate primer finish. Available for all sizes of AN and Ordnance specification hose in a wide range from ½ in. O.D. and up. Manufactured by Tinnerman Products, Inc., 2106 Fulton Rd., Cleveland 13, Ohio.

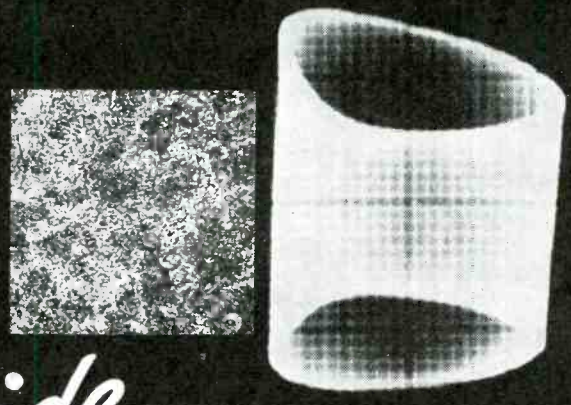
Rotary Relay

Ro-Trol is a new type relay, operating on a rotating balanced principle instead of the conventional method. It is designed especially for applications involving severe vibration, temperature and humidity specifications. The basic unit is a compact driving mechanism providing up to 30 degrees of clockwise or counter clockwise rotation. When used to operate switch wafers, it

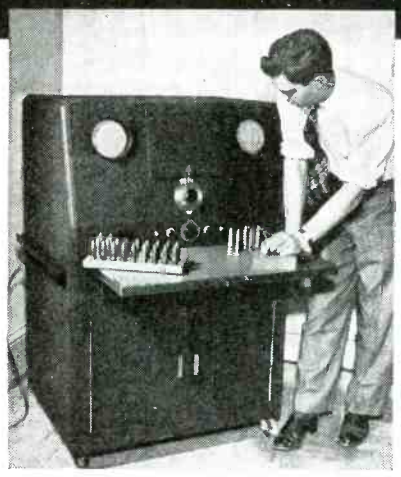


(Left) Photomicrograph of bottom of 57 mm. shot, Brinell hardness 247, with corresponding cyclogram.

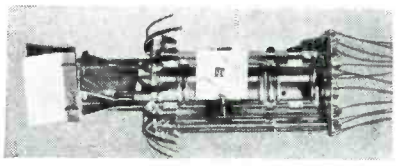
(Below) Photomicrograph of top of same shot, Brinell hardness 451. Cyclogram shows corresponding change in structure.



They wanted to LOOK *inside* METALS



GOOD *bad* GOOD GOOD *bad*... 6,500,000 bullets, rejected because of a mix-up in copper cladding measurements, were re-sorted by the DuMont Cyclograph... 99% of them salvaged!



ALL METAL PARTS OF CYCLOGRAPH TUBES ARE *NICKEL & NICKEL ALLOYS*

... Nickel is de-gassed readily... has strength to endure de-gassing bombardment at 1850° F.

It resists warpage and distortion... has high stiffness and damping capacity to minimize vibrations of delicate parts.

It does not rust... is highly resistant to corrosion.

When carbonized, it supplies ductile easily-formed strip of very high thermal emissivity.

The high work function of Nickel minimizes back emission.

It is unsurpassed as a base for stable, oxide coated cathodes of high electron emissivity and long life.

It resists deformation in handling during manufacture... makes strong spot welds and resists oxidation during welding.

...and DuMont Laboratories found that pure Nickel and Nickel alloys provided all the properties they sought to make the electronic eyes of their Cyclograph

The Cyclograph gives an immediate electronic view of the inner make-up of metals.

Its cathode-ray tube reveals differences in magnetic and electrical properties of metals which may be correlated with differences in one of the following: chemical composition, hardness, toughness, internal stresses, case depth, thickness of plating or cladding, and other characteristics.

These readings, to be accurate, require cathode-ray tubes free from tube-caused errors which might affect the Cyclogram.

Naturally the cathodes of DuMont cathode-ray tubes—as in the majority of modern tubes—are pure Nickel.

For Nickel provides the combined mechanical, electrical and electronic properties which give the DuMont cathode-ray tube its long life.

This use of pure Nickel and other Nickel alloys in the DuMont cathode-ray tube is typical of the unique service given by Nickel and its alloys, for Nickel alloys offer the electrical, expansion, magnetic and non-magnetic characteristics required in electronic devices.

If you have a problem involving the selection of the right metal for an electronic application, you are invited to consult INCO Technical Service. Address: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

NICKEL (INCO) **ALLOYS**

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

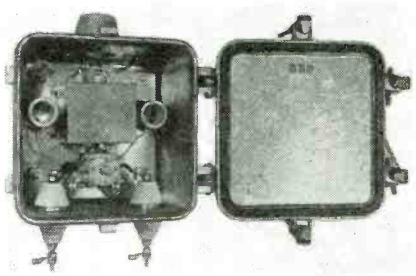
Sheet... Strip... Rod... Tubing... Wire... Castings

WHAT'S NEW

makes a relay providing a great variety of contact arrangements adaptable for spaced wafer switches or switches in separate compartments. Where switch wafers are not used a special self-contained coil break switch is provided. The unit is compact, measuring 2½ x 1½ x 1¾ in. Maker is Price Brothers Co., Frederick, Md.

Antenna Transformer

The Andrew Co., 363 East 75th St., Chicago, has brought out a new antenna transformer unit to couple an unbalanced 70-ohm coaxial cable transmission line to the 700-ohm terminals of a rhombic receiving antenna (or to any antenna terminal stub of 700-ohm impedance). The efficiency of the equipment holds losses down to less than 1 decibel over a frequency range of from 4 to 22 megacycles. The transformer unit is designed for out-of-doors installation and is weather-proof.



Circuit design of the transformer unit provides for the distinct advantage of simple dc continuity checking throughout the whole length of the antenna.

(*Continued on page* 192)

"The high quality of their product, which comprises telephones, switchboards and electrical supplies, has placed them in the position of the largest manufacturer of their goods in this section of the country."

. . . from
A CENTURY OF MERIDEN
published in 1906

If "skill to do comes of doing," this thirty-eight year old commentary explains the record of Connecticut Telephone and Electric in manufacturing telephones, switchboards, and electrical supplies for the military needs of this war.

We look forward to the *next* thirty-eight years, confident that this is the dawn of the most important era yet, in the development of communications, and every other branch of electrical science.

If our seasoned, but progressive, experience can be of help to you in connection with your communications requirements or the development and manufacture of electrical or electronic devices, we shall be glad indeed to talk with you.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

MERIDEN, CONNECTICUT

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

WHAT'S NEW

Simplifies Coax Soldering

A new feature developed by Andrew Co., Chicago, Ill., makes soldering of coaxial plugs and jacks an "out in the open" job. Built in sliding sections, the plugs and jacks are easily disassembled and the conductors to be soldered are easily and quickly exposed by removing one screw and sliding

the sections apart. Plugs and jacks are machined from bar brass stock and have positive connection between outer conductor and inner conductor. Inner conductor contacts are silver plated to give maximum conductivity. Insulation is Mycalex.

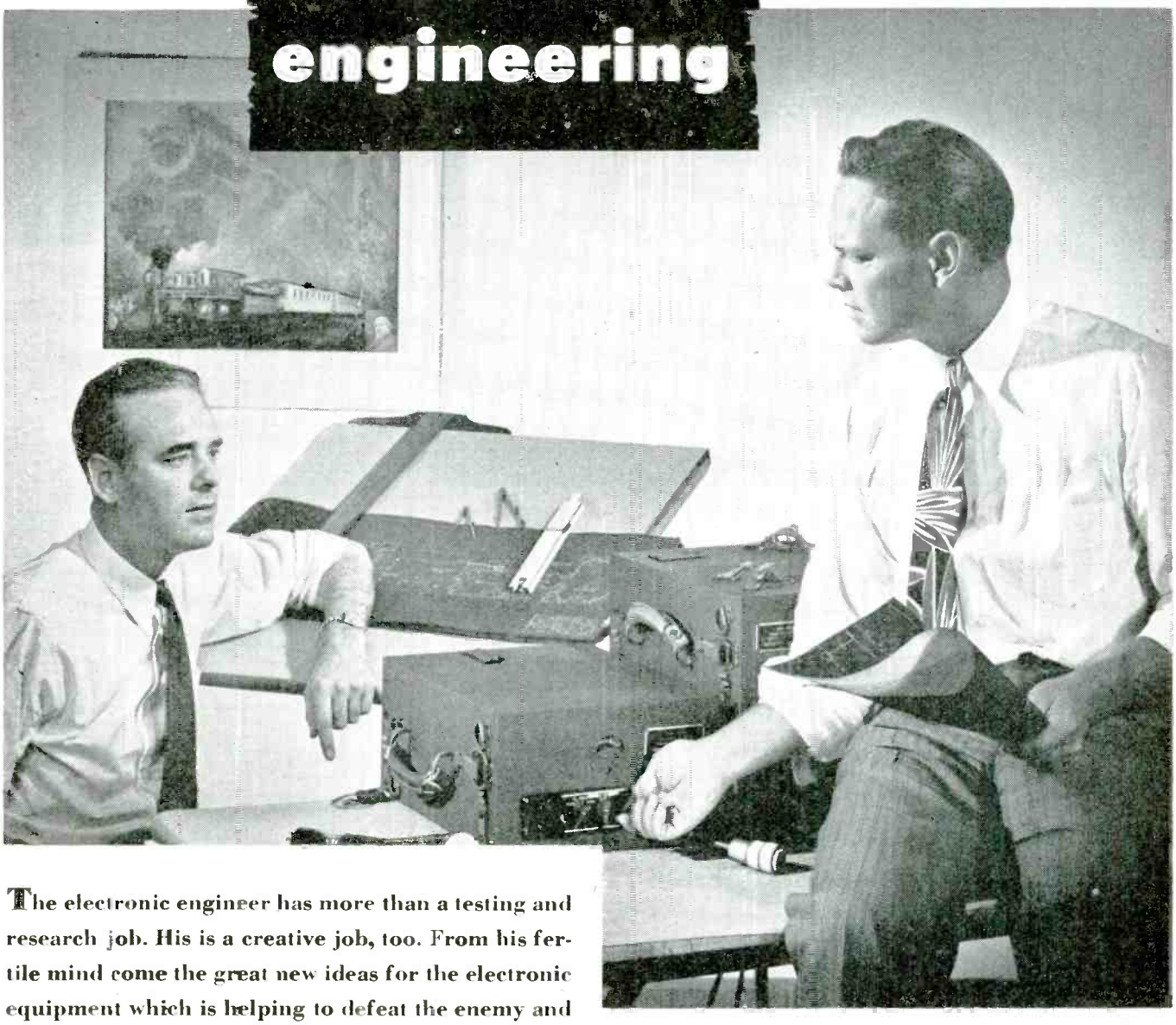
Insulating Tape

Fibron, a new many-purpose plastic tape of widely divergent applications, has been developed by Irvington Varnish & Insulator Co., Irvington 11, N. J. Flexible and elastic, Fibron tape is manufactured from Vinylite resin. It is heat-sealing, flame resistant, and high in dielectric and mechanical strength.

Precision Shear

This new Di-Acro shear represents a number of improvements over previous models and is designed for rapid, accurate duplication of metal parts varying in gage up to 18-gage steel plate at the full shearing width of 12 in. Substantial, adjustable bearings hold tolerance of cuts to 0.001 in.; blades, which are reversible, are heavy tool steel, hardened and tempered. There is a precision adjustment for accurately stopping blade travel, permitting the shear

creative engineering



The electronic engineer has more than a testing and research job. His is a creative job, too. From his fertile mind come the great new ideas for the electronic equipment which is helping to defeat the enemy and which will mean a glorious peacetime era when peace is assured. Most all industries will benefit from the highly specialized technical and scientific knowledge of the electronic engineer and the discoveries he has made.

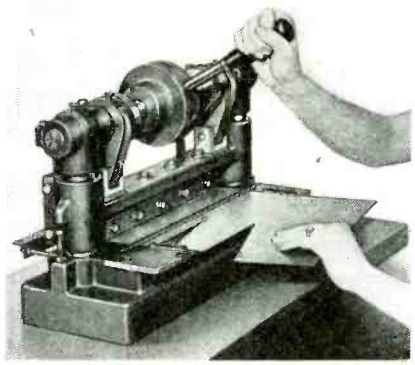
Raytheon is proud of its part in the immeasurably important role that advanced electronic equipment is playing in winning the war. When peace comes, Raytheon's research and wartime production knowledge will be used to doubly protect the electronic equipment requirements of post-war radio and industrial products manufacturers, and to assure Raytheon's continued leadership in the electronic era.

ARMY-NAVY "E" WITH STARS
Awarded All Four Divisions of Raytheon
for Continued Excellence in Production

RAYTHEON
Raytheon Manufacturing Company
ELECTRICAL EQUIPMENT DIVISION
Waltham and Newton, Massachusetts

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

WHAT'S NEW



to be used for a wide variety of slitting and notching operations to close tolerances. The unit is equipped with a stripping guide and a delivery chute to allow sheared parts to be automatically loaded into a receptacle. The shear weighs approximately 150 lb. Manufactured by O'Neil-Irwin Mfg. Co., Minneapolis 15, Minn.

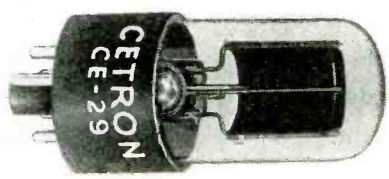
Terminal Block

The Curtis feed-through terminal block consists of individual terminals, molded in bakelite, permanently held in a metal strip in any combination. Production now includes blocks having any number of units between 1 and 16. Terminals have ample

clearances and leakage distances for circuits carrying up to 300 volts, 20 amperes. Center to center distance between terminal units is 5/8 in. Maker is Curtis Development and Mfg. Co., 1 No. Crawford Ave., Chicago, Ill.

Phototube

Continental Electric Co., Geneva, Ill., has in production an improved type of blue sensitive phototube using an octal five-pin base, interchangeable with similar tubes. The CE-29 is particularly sensitive to blue and violet light near the short wavelength limit of visibility. It is, therefore, particularly useful with light sources rich in violet, blue, and green light. In many applications this tube will possess advantages even with light sources which produce considerable



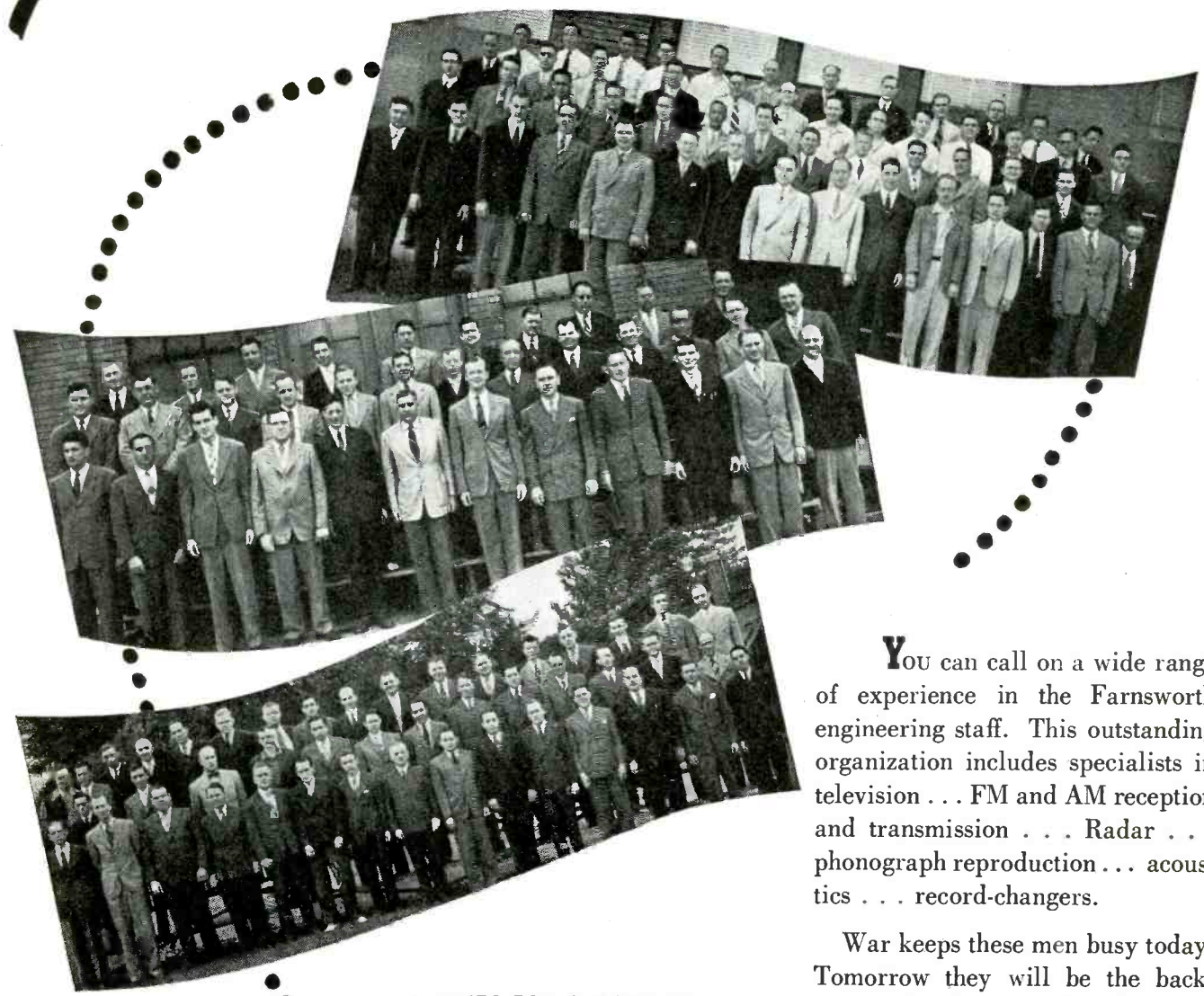
red and infra-red light. Though the CE-29 is not sensitive to red and infra-red light, its basic sensitivity on an energy basis is at least ten times that of conventional red sensitive phototubes. RMA spectral sensitivity designation is S-4. Several other types with different dimensions will be available in the near future.

Portable DC Supply

This portable dc power supply, manufactured by P. R. Mallory & Co., Inc., Indianapolis, Ind., is designed for use on assembly lines, in laboratories and maintenance departments. It provides a source of dc power for manufacturing, testing and operating all electrical and electronic equipment in aircraft and other units employing 12 or 24 volt systems. The power

Farnsworth engineers...

AT YOUR SERVICE



• **WRITE FOR A COPY OF** *"The Story of Electronic Television"* —a new brochure for which you'll have many uses.

You can call on a wide range of experience in the Farnsworth engineering staff. This outstanding organization includes specialists in television . . . FM and AM reception and transmission . . . Radar . . . phonograph reproduction . . . acoustics . . . record-changers.

War keeps these men busy today. Tomorrow they will be the background for Farnsworth radio, phonograph and television equipment . . . drawing upon a rich experience of more than 19 years in electronics research and development . . . a guarantee of leadership.

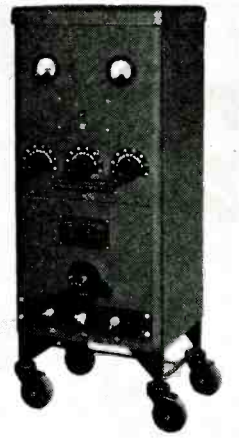
. . . And they will welcome your questions regarding all phases of radio and television transmission and reception. You'll find Farnsworth engineers leading in more and more fields . . . Farnsworth experience and Farnsworth equipment belong in your plans for the future.

FARNSWORTH

Television · Radio · Phonographs

Farnsworth Television & Radio Corporation, Fort Wayne 1, Ind. Farnsworth Radio and Television Transmitters and Receivers; Aircraft Radio Equipment; Farnsworth Television Tubes; the Farnsworth Phonograph-Radio; the Capehart; the Capehart-Panamuse.

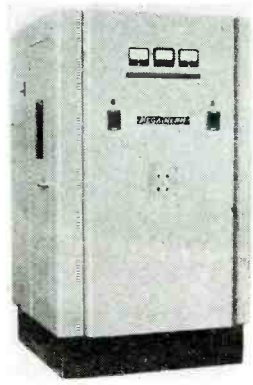
WHAT'S NEW



supply can be used to taper charge batteries or battery carts of similar voltages. The unit is designed to operate from 3 phase ac lines of 208 and 230 volts. Three models are offered: No. VA1500, with dc output of 10 to 16 volts at 100 amperes or 20 to 32 volts at 50 amperes; No. VA3000, with dc output of 10 to 16 volts at 200 amperes or 20 to 32 volts at 100 amperes; No. VA4500, with dc output of 10 to 16 volts at 300 amperes or 20 to 32 volts at 150 amperes. Models with similar dc output for operation on 460 volts ac, are also available. Silent, motionless rectification is provided by Mallory magnesium-copper sulphide dry disk rectifiers.

Induction Heating Unit

A new 25 kw Megatherm induction heating unit particularly adapted to high speed surface hardening, brazing and silver soldering, has been introduced by the Industrial Electronics Division, Federal Telephone and Radio Corp., Newark, N. J., manufacturing associate of International Telephone and Telegraph Corp. This equipment functions on frequencies between 2-5 million cycles per second and makes possible the effective and speedy heating of brass, copper and



aluminum alloy pieces as well as the usual steel parts. The heating fixture is a simple coil of from one to five turns which can be constructed readily from standard copper tubing. The unit is designed to deliver 25 kw of output continuously at frequencies adjustable within the 2-5 million cycle range and measures 4 x 4 x 7 ft.

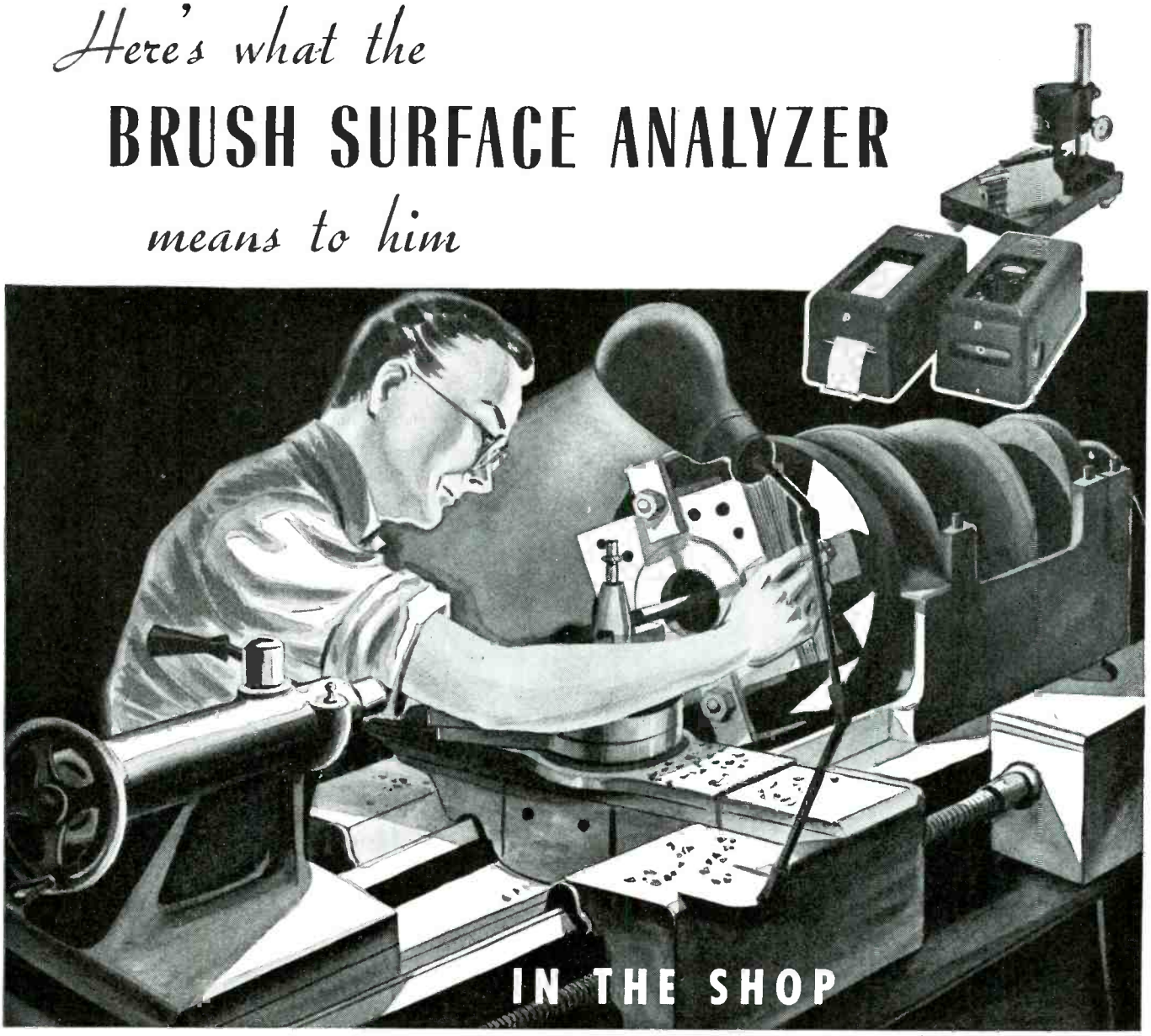
HF Generators

For both induction and dielectric heating loads, a complete line of high frequency generators with ratings of 1, 2, 5, 10 and 20 kw is being made by Westinghouse Electric and Mfg. Co. Completely self-contained, the units require only electrical connection to a 60-cycle power supply and have no external cooling or other auxiliaries. Units of 50 to 200 kw capacity can be supplied in addition to standard one to 20-kw rat-

Here's what the

BRUSH SURFACE ANALYZER

means to him



Yes, war has its good points too. War stimulates progress. Industry is called upon to deliver as never before — to produce greater quantities of finer equipment. Higher standards of quality insure our equipment of longer life, dependability and ease of operation. Surface finish is vital to fine quality. The mated surfaces of precision-built parts designed to move at high speeds are but one example of the need for microinch (.000001") smoothness. Such finishes are accurately measured and recorded for laboratory study or production-line inspection by the Brush Surface Analyzer.

Write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.

THE BRUSH DEVELOPMENT COMPANY

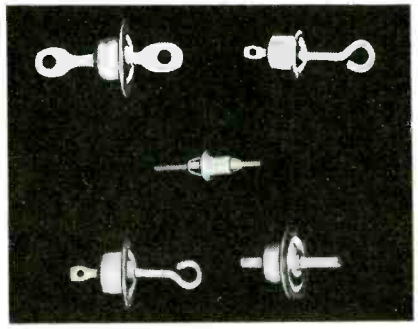
3433 PERKINS AVENUE • CLEVELAND 14, OHIO

WHAT'S NEW

ings. The primary voltage is 220 or 440 volts, single phase for ratings of 5 kw or lower and 3 phase for 10 kw and higher. Housed in the single cabinet are the oscillator, power supply, blower, and necessary switchgear. The high frequency section is completely shielded to minimize the possibility of interference with nearby communication circuits. An automatic timing control permits load cycle adjustment to a predetermined time, which can be automatically repeated. Terminals are provided for remote control. Air-cooled tubes are used in the standardized generators. An air blower provides a circulation of air throughout the entire equipment. Generators are available for frequencies of 450 kc, 5, 15 and 30 mc for ratings through 10 kw and 450 kc, 2 and 10 mc for 20 kw and higher.

Sealed Leads

These sealed leads, a product of Electrical Industries, Inc., 42 Summer Ave., Newark 4, N. J., are constructed of pyrex glass with Kovar electrodes and Kovar metal collars. Standard shapes and sizes are available in a wide variety of shapes.



TECHNICAL NOTES

Excerpts from New Home Study Lessons Being Prepared under the Direction of the CREI Director of Engineering Texts

Phase Inverter Circuit

Last month, CREI presented the first part of a technical article describing the Phase Inverter Circuit. Part 2, which appears in the September issue of "THE CREI NEWS," gives a typical numerical example of the Phase Inverter Circuit and indicates the type of performance that can be expected.

Derivations are then made of the gain and stability of gain of such a stage and it is shown that very good results can be expected. Finally, an analysis of the input admittance is made, as well as remarks on some practical features of the circuit.

Each month "THE CREI NEWS" features such a technical article, in addition to other interesting features concerning The Institute and the industry. We shall be glad to add your name to the mailing list without obligation. Simply write to The Institute at the address below and request the September issue of "THE CREI NEWS" containing the article on the Phase Inverter Circuit.

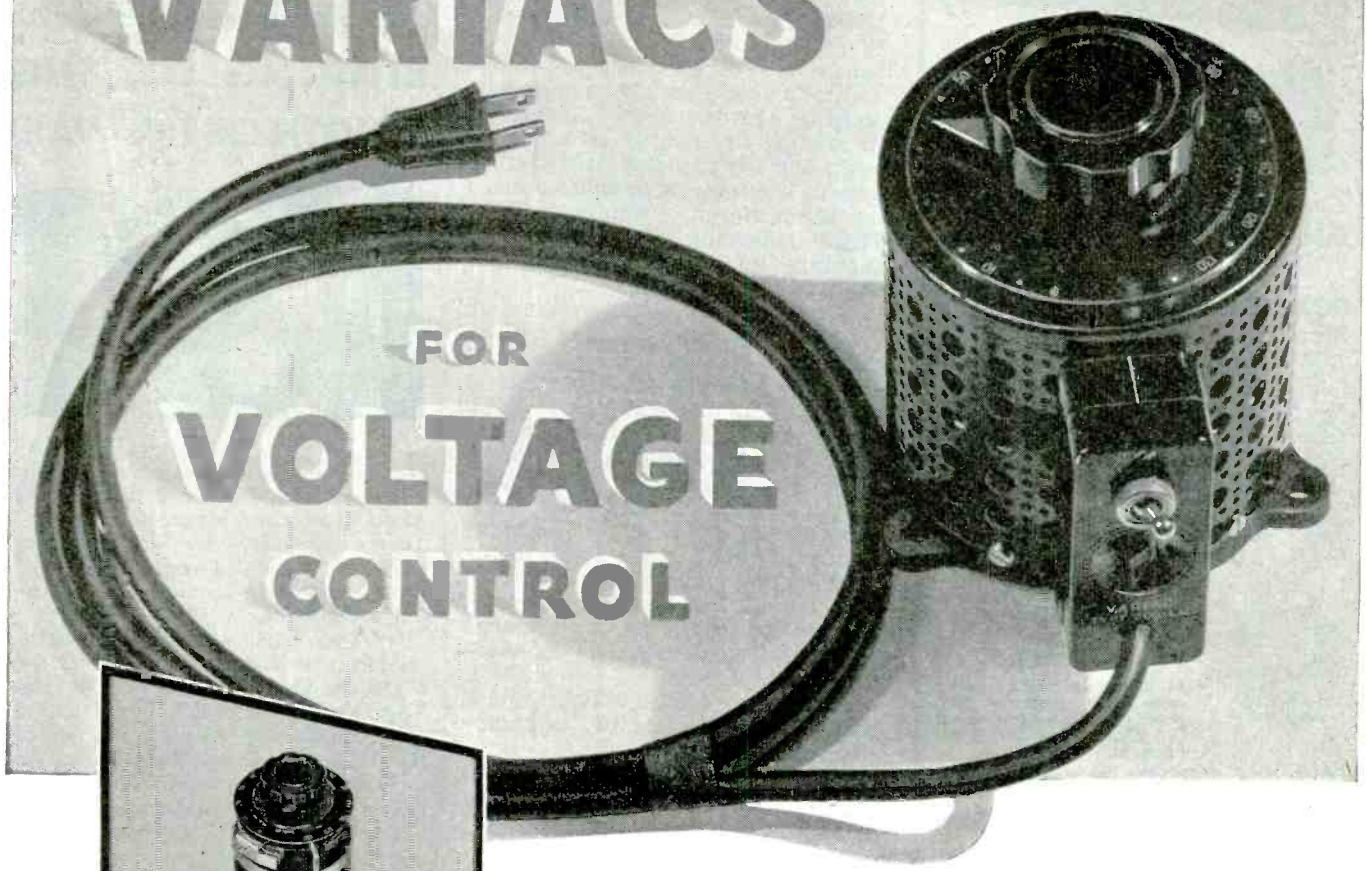
★ ★ ★

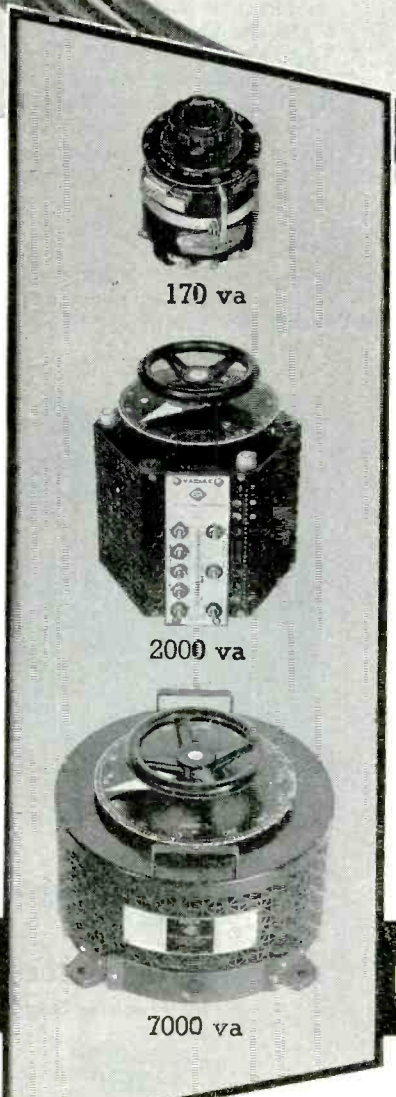
The subject of "Phase Inverter Circuit" is but one of many that are being constantly revised and added to CREI lessons by A. Preisman, Director of Engineering Texts, under the personal supervision of CREI President, E. H. Ritzke. CREI home study courses are of college calibre for the professional engineer and technician who recognizes CREI training as a proven program for personal advancement in the field of Radio-Electronics. Complete details of the home study courses sent on request. . . . *Ask for 36-page booklet.*

VARIACS

FOR

VOLTAGE CONTROL





170 va

2000 va

7000 va

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

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

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

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

VARIACS are made *only* by General Radio

GR **GENERAL RADIO CO.** Cambridge 39, Mass.
NEW YORK CHICAGO
LOS ANGELES

● WRITE FOR BULLETIN 884

Navy's Electron Tubes

The important role of the electron tube—the heart and brain of the Navy's Fleet—which means the Navy afloat, under the sea and in the air—has adequate communications and can use so successfully radar and other detection equipments in tracking down the enemy, warning against enemy attacks and in making fire control so accurate, is graphically depicted in these figures of the number of tubes carried on the different elements of the Fleet. Following are the figures on the tubes of the different craft of the Navy:

A battleship has approximately 1,680 electron tubes of hundreds of different types doing a thousand and one different jobs to make it an efficient fighting ship.

A heavy cruiser must have at least 855 tubes installed in dozens of types of equipment.

An aircraft carrier has 1,549 tubes which are vital for the operations of pilot, navigators, bombardiers and gunners.

A submarine carries approximately 200 tubes as replacement for 111 tubes installed in its electronic equipments.

The terrier of the Navy, the PT boat, has 140 tubes in its radio-electronic apparatus.

The LST has to have 69 tubes in its equipments to function properly in amphibious operations.

Recruiting Electronic Workers via Show Windows

Jerry Kahn, president of the Standard Transformer Corp., Chicago, Ill., was convinced that his type of war work not only was well paid but that it was strangely fascinating to prospective workers and that seeing was believing. So when the personnel department signalled real distress, Mr. Kahn took his factory to the worker: set up an assembly line in a store not far from the main plant and waited. His windows stopped housewives and other potential workers right in their tracks.

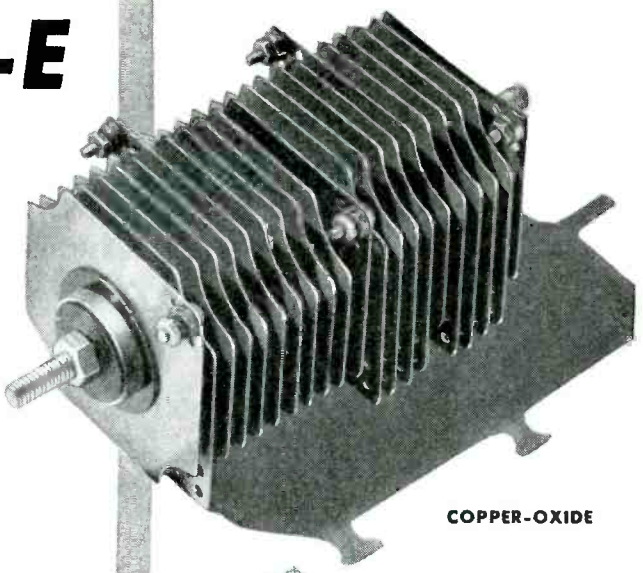
In three weeks' time the windows brought in enough applications to mark the plan a success — better than was obtained by many other contractors who offered higher wage-rates; which proves that workers are just as much interested in the kind of work they do as in the hourly pay.

The windows used showed a complete work bench and typical employes working on Signal Corps radio, walkie talkie and other types of field communication equipment, and were designed in cooperation with the War Manpower Commission. Both male and female operators of all ages were shrewdly distributed throughout the set-up to

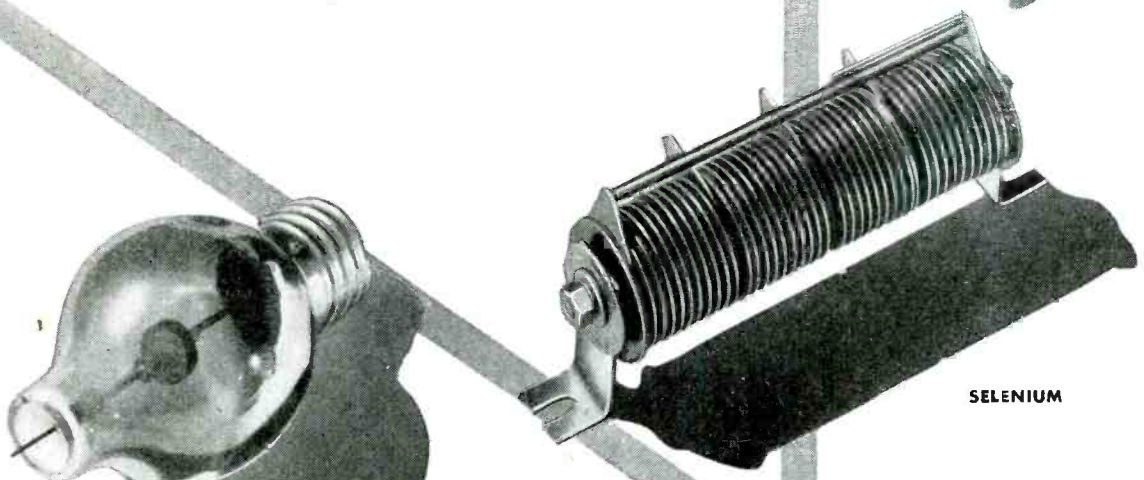
LOOK TO G-E

For an Impartial Answer to Rectifier Problems

Only G-E Builds All Three



COPPER-OXIDE



SELENIUM

TUNGAR

Where other manufacturers offer one or two of the three popular types of low voltage rectifiers, General Electric alone designs and manufactures all three. The most efficient type for one application may be least efficient on the very next. It is in determining which type to use for each application that G-E can help you most. Having all three types, G-E engineers can give you impartial advice about the rectifying unit you should use. For further information, write to Section A947-124, Tungar and Metallic Rectifier Division, General Electric Company, Bridgeport, Conn.

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

BUY WAR BONDS AND KEEP THEM

GENERAL ELECTRIC

impress upon the window shopper that anyone could do war work and that it was easy and pleasant.

In addition to the actual set-ups, murals of the main factory illustrated the magnitude of Stancor's war work. Posters described advantages, such as rest periods and change-offs to assure diversity and a general "clubby" feeling among the employes.

The New ELECTRONIC ENGINEERING HANDBOOK

Congratulatory letters and requests to purchase copies of the new "Electronic Engineering Handbook" continue to pour into this office. This Handbook —compiled by Ralph R. Batcher and William Moulic, of the editorial staff of Electronic Industries—is becoming generally recognized as incorporating a new and particularly useful approach to technical information needed by engineers in the electronic field, and so will be in increasing demand.

Again we point out, however, that the new Handbook is not for sale separately at this time, but is being offered only with renewals and new subscriptions to Electronic Industries. For detailed information, address Subscription Manager, Electronic Industries, 480 Lexington Avenue, New York 17, N. Y.

PREVIEW of a NEW HARVEY OF CAMBRIDGE HIT!

Featuring

The New HARVEY Regulated Power Supply 206 PA

RANGE 500 to 1000 VOLTS

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

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

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

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

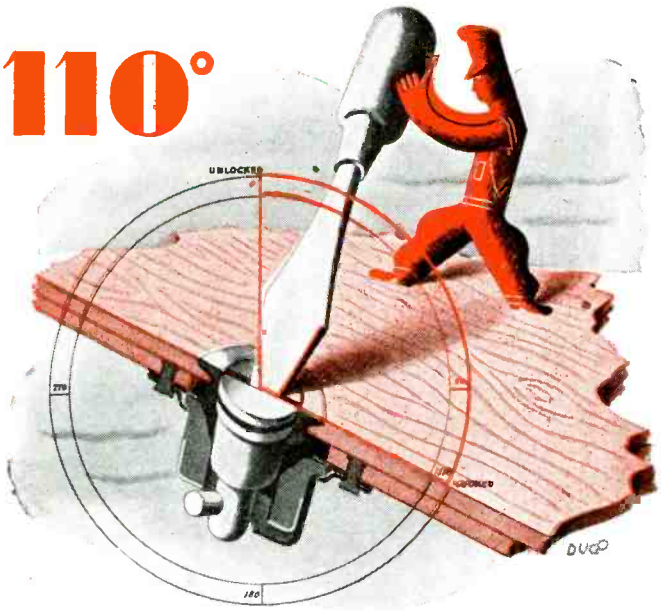
Now is the time to get the complete story on this important new contribution to the radio-electronics field. Write, phone or wire

HARVEY OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

441 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

110°



QUARTER TURN LOCKS OR UNLOCKS

Designed in answer to the aircraft industry's urgent need for quick easy operation of doors and access panels . . . millions of Camloc fasteners today serve round the world.

Camloc designs fasteners to fit precise needs. Whether you plan to make radios or vacuum cleaners, automobiles or washing machines, you'll find Camloc has much to offer. For the accumulated knowledge and intensive experience that solved aircraft's fastener problem is at your service.

CAMLOC FASTENER CORP.
420 Lexington Avenue, New York 17, N.Y.

Designers and Manufacturers

CAMLOC
SPEED FASTENERS

SKILL

To Meet Your Specifications

PERFORMANCE is the real measure of success in winning the war, just as it will be in the post-war world. New and better ideas—production economies—speed—all depend upon inherent **skill and high precision** . . . For many years our flexible organization has taken pride in doing a good job for purchasers of small motors. And we can help in creating and designing, when such service is needed. Please make a note of Alliance and get in touch with us.

ALLIANCE DYNAMOTORS

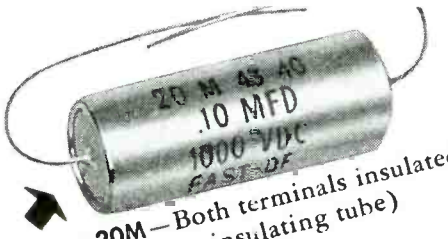
Built with greatest precision and "know how" for *low ripple, high efficiency—low drain* and *a minimum of commutation transients.* High production retains to the highest degree all the "criticals" which are so important in airborne power sources.

ALLIANCE D.C. MOTORS

Incorporate precision tolerances throughout. Light weight — high efficiency — compactness — continuous duty. An achievement in small size for continuous duty and in power-to-weight ratio. Careful attention has been given to distribution of losses as well as their reduction to a minimum.

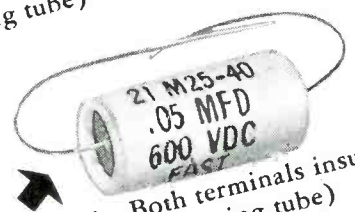
Remember Alliance!
—YOUR ALLY IN WAR AS IN PEACE

ALLIANCE
MANUFACTURING CO.
ALLIANCE . OHIO

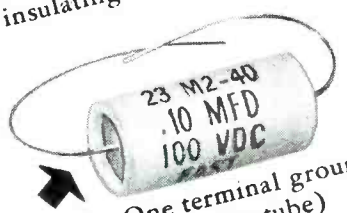


Class 20M—Both terminals insulated (without insulating tube)

Class 22M—One terminal grounded (without insulating tube)



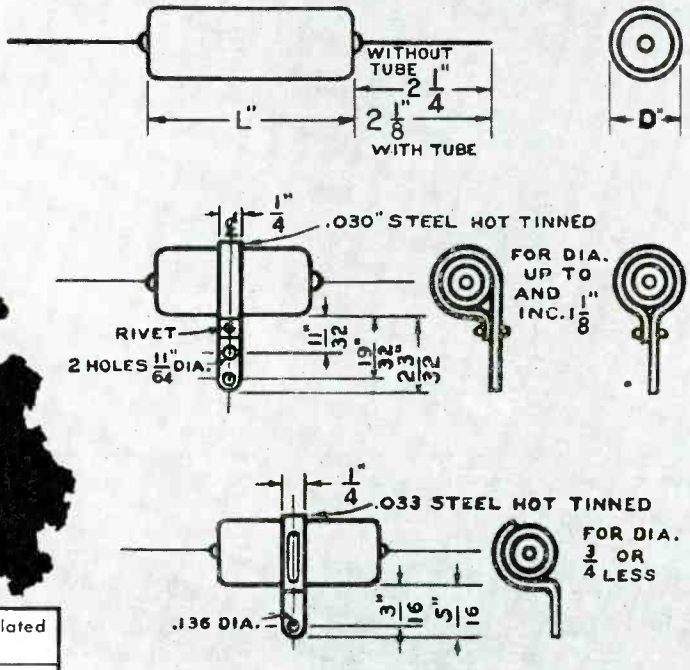
Class 21M—Both terminals insulated (with insulating tube)



Class 23M—One terminal grounded (with insulating tube)

MEMO:

To Designers, Engineers and Manufacturers of Electronic, Radionic and Electrical Devices, thinking in terms of quality for POST WAR production . . . Here is a convenient "abbreviated listing" of METAL-CASED TUBULAR OIL-PAPER CAPACITORS—hermetically sealed to meet unusual operating conditions.



Class 20M—Both terminals insulated (without insulating tube)				Class 21M—Both terminals insulated (with insulating tube)			
CAP. MFDS.	VOLTS D. C.	SIZE (inches) D.	L.	CAP. MFDS.	VOLTS D. C.	SIZE (inches) D.	L.
.001	1000	1/2	1-3/16	.05	800	11/16	1-5/8
.0025	1000	1/2	1-3/16	.1	800	13/16	1-7/8
.005	1000	1/2	1-3/16	.1	600	11/16	1-3/4
.005	600	3/8	15/16	.25	600	13/16	2-5/16
.01	600	3/8	1-3/16	.25	400	13/16	2-5/16
.02	600	1/2	1-1/16	.5	400	1-1/16	2-5/16
.05	600	9/16	1-5/16	1.	400	1-1/16	3-15/16
.1	200	9/16	1-13/16	1.	200	1-1/16	3-3/16
.25	200	3/4	1-7/8	1.5	100	1-1/16	3-3/16
.5	200	1	1-13/16	2.	100	1-5/16	2-11/16
Class 22M—One terminal grounded (without insulating tube)				**Class 23M—One terminal grounded (with insulating tube)**			
.0075	1000	1/2	1-1/16	.1	1000	13/16	2-1/16
.01	1000	1/2	1-1/16	.25	1000	1-1/16	2-1/2
.05	1000	5/8	1-13/16	.5	1000	1-7/16	2-13/16
.5	600	1	2	.5	800	1-1/16	3-1/16
1.	600	1	3-5/8	1.	800	1-7/16	3-1/4

(Standard Capacity Tolerance on the above units is ± 20%. Closer or wider tolerances may be obtained if required.)

Standard or Special Units to Meet Every Need

FAST Capacitors are produced in many types and sizes in standard or special designs. We can supply paper capacitors—oil or wax impregnated—rectangular or tubular—in sizes from the smallest to the largest.

This line of FAST Capacitors have containers made of brass with a heavy tin dip. The terminals are made with bushings of NEOPRENE and BAKELITE and are painted with glyptal. They have excellent stability over a wide range of temperatures and frequencies—will pass recognized thermal and salt water immersion tests.

Inquiries are particularly invited from organizations planning to build that *better* equipment for the new day ahead. Please feel free to call us on any capacitor problems.

"When You Think of Capacitors . . . Think FAST"

JOHN E. FAST & CO.

Capacitor Specialists for a Quarter-Century

3129 North Crawford Avenue, Chicago 41

Canadian Representatives: Beaupre Engineering Works Reg'd. 2101 Bennett Avenue, Montreal, for Power Factor Correction
J. R. Longstaffe, Ltd., 349 Carlaw Avenue, Toronto, for Special Applications

Electronic Dew Point Indicator

"The conventional method of detecting the presence of unwanted water vapor in heat-treating atmospheres," reports the Journal of Applied Physics, "is to pass the gases over a surface chilled to between —40 and —10 deg. C, and observe the temperature of condensation. At these low temperatures, even skilled operators differ in their estimate of the dew point. Furthermore, the process is not continuous. The operators must take periodic samples for test.

"Westinghouse has developed an experimental electronic device which furnishes a continuous report and also measures the equally undesirable oxygen content of the furnace gases. A tiny stream of the gas mixture is drawn across an electron beam. As long as the gas is free of impurities, the electron current remains constant. However, the presence of even minute concentration of oxygen or water vapor causes a sharp decrease in the beam current because these molecules are more readily ionized than the furnace gases."

British Producing More Home Radios This Year

The following statement on radio-receiver production for the current year has been issued by the English Radio Manufacturers' Association:

"For 1944 arrangements are well advanced for the production of wartime receivers in this country. There is a great need for replacement sets and the production of these is being carried out with the full approval of the Government. The sets will be made to a standard design by various manufacturers, but will not be sold under the trade names of their makers.

"There will be sets for ac mains and battery operation, and distribution will be through normal trade channels with preference to those areas most urgently in need of sets, but substantial quantities are not likely to be available before June, 1944. The prices of these wartime sets will be covered by Maximum Prices Orders.

Peacetime 1,250,000 sets

"The annual peacetime output of the radio industry was in the neighborhood of 1,250,000 sets. Few have been made since the war began, and the numbers now planned will not provide for the replacement of sets in good working order. They are intended for members of the public without means of listening, and existing sets should receive careful treatment to keep them in working order."

The new English sets referred to in this statement are the standard-

THERE'S GOLD HERE!

another new letter contest

$200.00 in prizes every month

$100.00 first prize, $50.00 second prize, $25.00 third prize, $15.00 fourth prize, $10.00 fifth prize, plus $1.00 for every letter received.

Here we go again. Another great Hallicrafters letter contest for service men. Wherever you are, whenever you see this announcement, drop us a line. Write and tell us your first hand experience with *all* types of radio communications built by Hallicrafters, including the famous SCR-299.

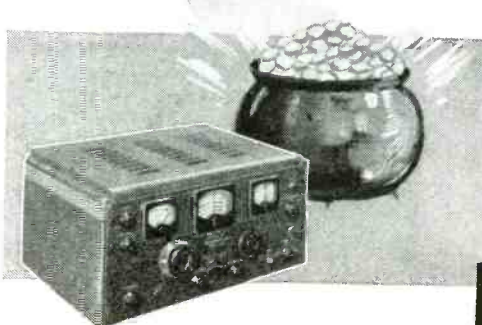
There is gold here! Write today to get your share. Tell us your story in your own way. You can't lose and you *can* win as high as $100.00.

Rules for the Contest

Hallicrafters will give $200.00 for the best letters received during each of the six months of September, October, November, December, 1944, January, and February, 1945. (Deadline: Your letter must be received by midnight, the last day of each month.)

For every serious letter received, Hallicrafters will send $1.00 so even if you do not win a big prize your time will not be in vain. Your letter will become the property of Hallicrafters and they will have the right to reproduce it in a Hallicrafters advertisement. Write as many letters as you wish. V-mail letters will do.

Open to servicemen around the world. Wherever you are, whenever you see this ad, drop us a line. Monthly winners will be notified immediately upon judging.



There's gold here at the end of the rainbow in Hallicrafters great letter contest—and there's a great and exciting future ahead for short wave enthusiasts. In peace time Hallicrafters will continue to build "the radio man's radio" and that means the best that can be made. There will be a set for you in our postwar line.

BUY A WAR BOND TODAY!

hallicrafters RADIO

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

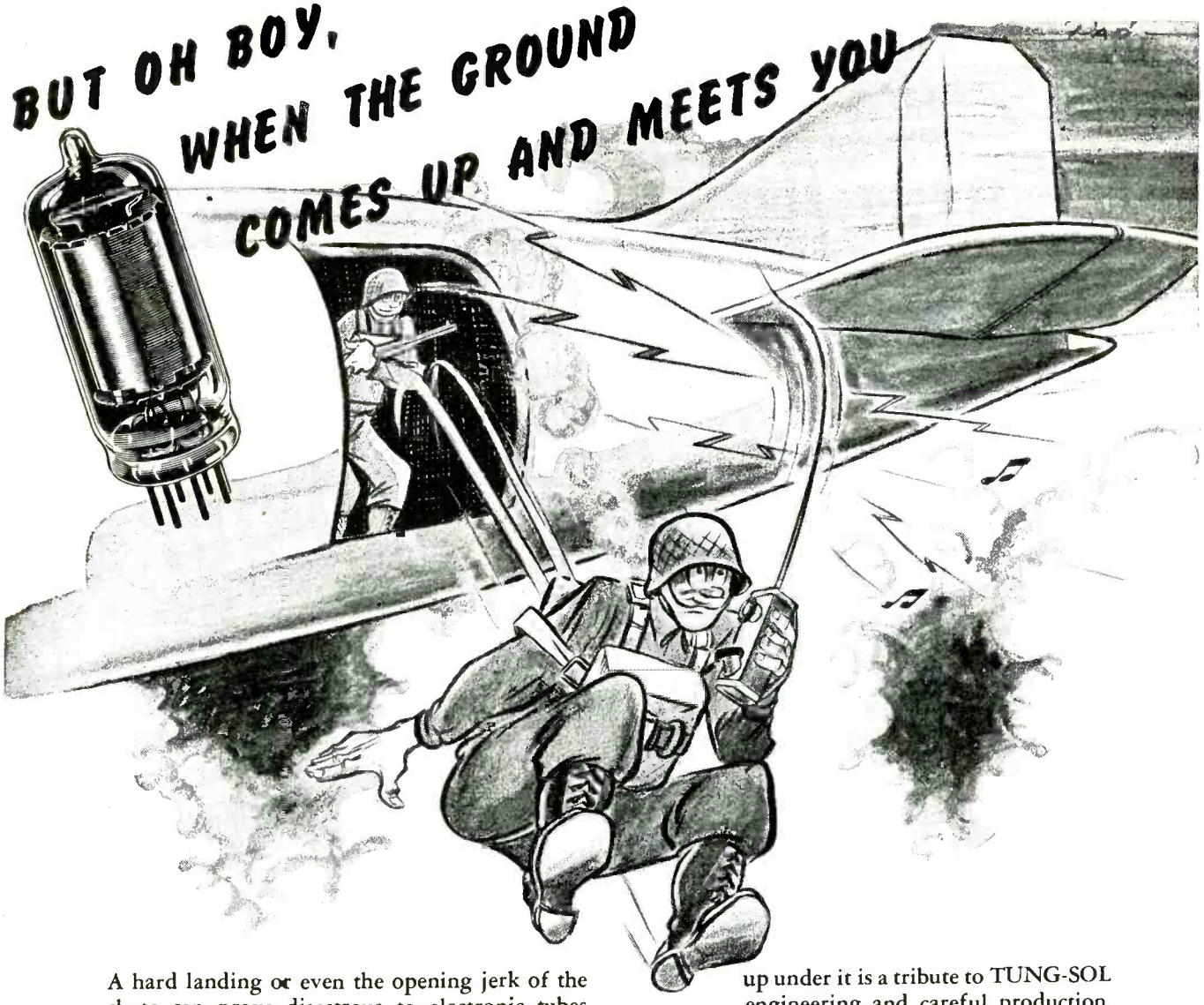
ized "Victory" receivers. They are, of course, additional to the 75,000 sets which English manufacturers were permitted to complete late in 1943.

Wired Video Uses

Most persons in close contact with the development of television foresee wide and significant applications in the postwar world. Not the least of these, from the industrial standpoint, are the "wired video" ideas. Walter Lawrence, a field engineer of the RCA Service Co., claims, "Wired television, in which camera and receiver are connected by cable in a complete 'closed circuit' system may, for example, help American industry in the docking of ships, and in remote control of steel mill and chemical processes." For the big job of berthing a big ship, the video equipment will literally give the pilots eyes in the back of their heads. Properly designed telecamera equipment may be able to survive under extreme conditions of heat which would be fatal to man, thus allowing close-up examinations of processes hitherto unseen. In extremely hazardous industrial operations, remote handling by wired television promises much in the way of safety. All this is not meant to overlook the importance of general wired television in large plants to provide a general video coverage at a central point of everything going on in various sections of the plant, promising a new high in production coordination.

Lip-Mikes by the Pound

Albert Kahn, left, president of Electro-Voice, South Bend, Ind., looks on while Louis Burroughs, at right, tells Army and Navy officers about T-45 Lip Mike on occasion of "E" Award presentation



A hard landing or even the opening jerk of the chute can prove disastrous to electronic tubes unless they are designed and built to take it. Tubes have no knees to bend or body sway to relieve the shock . . . their ability to withstand shock and still maintain design characteristics has to be built into them at the factory.

To be sure that the TUNG-SOL Electronic Tubes used for this and other severe services are able to withstand rough usage, they are given the "Tumble Test". The admirable way they stand up under it is a tribute to TUNG-SOL engineering and careful production.

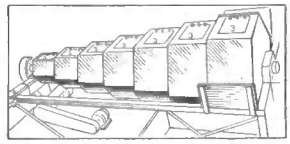
Many of the ruggedness features demanded by the Army and Navy were characteristic of TUNG-SOL Electronic Tubes before the war. Manufacturers and users of electronic equipment and controls will find at TUNG-SOL a complete line of war-proven tubes that will meet every peace-time requirement. Let our engineers think with you when you are planning your post-war products.

TUNG-SOL

vibration-tested

ELECTRONIC TUBES

The "Tumble Test" at TUNG-SOL is regularly made on all tubes of new design and tubes picked out at regular intervals from production. Tubes are put into the various sized angular chambers and tumbled. The larger the chamber the greater the shock. Thus the amount of abuse each tube will withstand is determined, giving our engineers accurate data for design and construction improvements.



ARMY E NAVY

TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY

ALSO MANUFACTURERS OF MINIATURE INCANDESCENT LAMPS, ALL-GLASS SEALED BEAM HEADLIGHT LAMPS AND CURRENT INTERMITTORS

Andrew's Field Service

The Andrew Co., Chicago, coaxial line specialist, has added a field engineering and allocation service as an aid to standard and FM broadcasters. Walter F. Kean, for the past three years in charge of radio and radar project testing for Western Electric, heads up the new division.

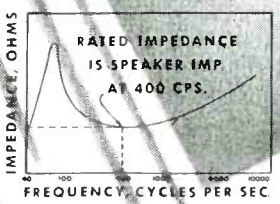
ACORN TUBE TECHNICS

(*Continued from page 96*)

in microscopical tolerances sufficient to change the characteristics. Even the taper at the end that permits the grid to slide off readily, has an angle that is guarded within one minute of a degree of a critical angle. After winding, each grid is further formed and stabilized as to size, by special dies.

The grid wires are mechanically staked in notches in the support "rods," (the latter are not much bigger than the grid wires of an ordinary tube), to avoid the contamination and oxidation of a welded structure. The whole structure is mounted between mica plates, shown in Figs. 1 and 3. These plates are in themselves fabricated with tolerance limits much stricter as the dimensions are smaller, than those used in octal tube counter-

How to Match Impedance and Distribute Power in Loud Speaker Systems



Here is Number 2 in the series of practical, instructive Monographs prepared by the Jensen Technical Service Department. The title, "Impedance Matching and Power Distribution in Loud Speaker Systems," suggests the scope and treatment of a subject in which everyone concerned with loud speakers and the reproduction of sound, is vitally interested. ¶ The reading material is supported by twenty-eight drawings and tables. More than a score of questions are described, illustrated and solved. One of the problems is that of a comprehensive sound system for a military installation. ¶ Like Monograph Number 1—"Loud Speaker Frequency-Response Measurements"—Number 2 is offered by JENSEN in the interest of *improved sound reproduction*. Get either copy, or BOTH, from your jobber or dealer, or fill out the coupon and mail it with 25c for *each* book, to:

IMPEDANCE MATCHING and POWER DISTRIBUTION in LOUD SPEAKER SYSTEMS. The second of a valuable and important series of treatises on the selection, installation and operation of loud speakers.

FREE to men in the Armed Services and to Libraries and Technical Schools.

Jensen

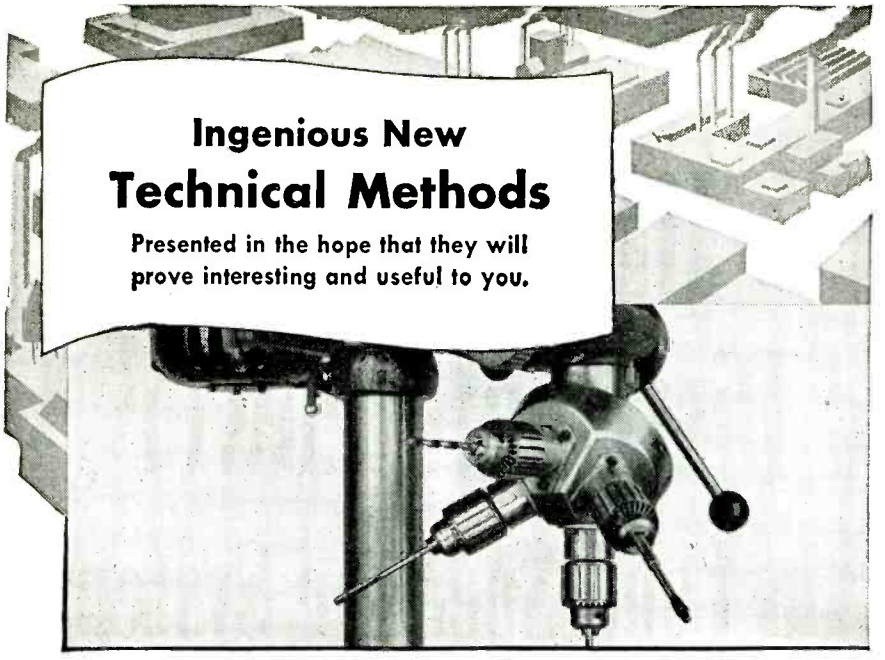
RADIO MANUFACTURING COMPANY

6617 SOUTH LARAMIE AVENUE

CHICAGO 38, ILLINOIS

JENSEN RADIO MANUFACTURING COMPANY
6605 South Laramie Avenue
Chicago 38, Illinois
Send me at once:
☐ Impedance Matching and Power Distribution in Loud Speaker Systems.
☐ Loud Speaker Frequency-Response Measurements.
(Check one or both. Send 25c for each book ordered.)

NAME _____
ADDRESS _____
CITY _____ ZONE ____ STATE ____



Ingenious New Technical Methods

Presented in the hope that they will prove interesting and useful to you.

Amazing New Four Spindle Turret Attachment for Drill Press!

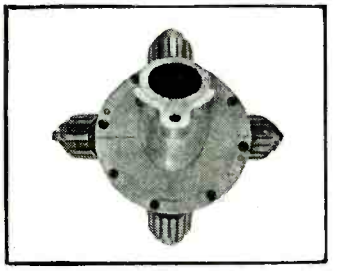
Now one drill press can do the work of four and, at the same time, effect a savings of up to 75% in floor space, with the "Quadrill" attachment. This rotary device will accommodate four boring or cutting tools at the same time, yet one tool *only* is in motion when the head is in operating position.

The entire unit is assembled to the quill of the drill press and is driven from the drill press spindle. Accuracy and rigidity of alignment of the "Quadrill" are assured by the special construction of the driver and spindles, thus efficiency is only limited by the accuracy and power of the drill press itself.

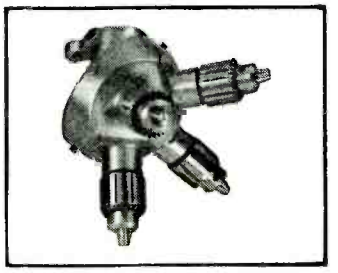
Foolproofing in indexing is accomplished by visual markings and by the relationship of the index pointers on the index disc, as well as the extension of the spring retainer. Four hardened and ground spindles are fitted for No. 32 Jacobs chucks or their equivalent. To provide correct positioning at all times, the entire spindle assembly is located by means of an accurate fitting of recess and undercut, between turret and bearing housings. The hardened friction starter and driver have been so constructed that at any speed proper synchronization of the driver teeth is accomplished without clashing.

It goes without saying that our fighting men must have the finest possible quality materials home industry can produce. So, although the stock of quality raw materials from which Wrigley's Spearmint chewing gum is made is growing steadily smaller, they are still maintaining pre-war standards. However, they can now make only a portion of their former output, so all of this limited production is going to our fighting men and women overseas only . . . where it is an "on-duty" need.

You can get complete information from Chicago Drillet Corporation, 919 N. Michigan Ave., Chicago 11, Ill.



Quick and positive indexing assured by pointers on index disc



Quadrill assembly complete ready for attachment to drill press

Y-140

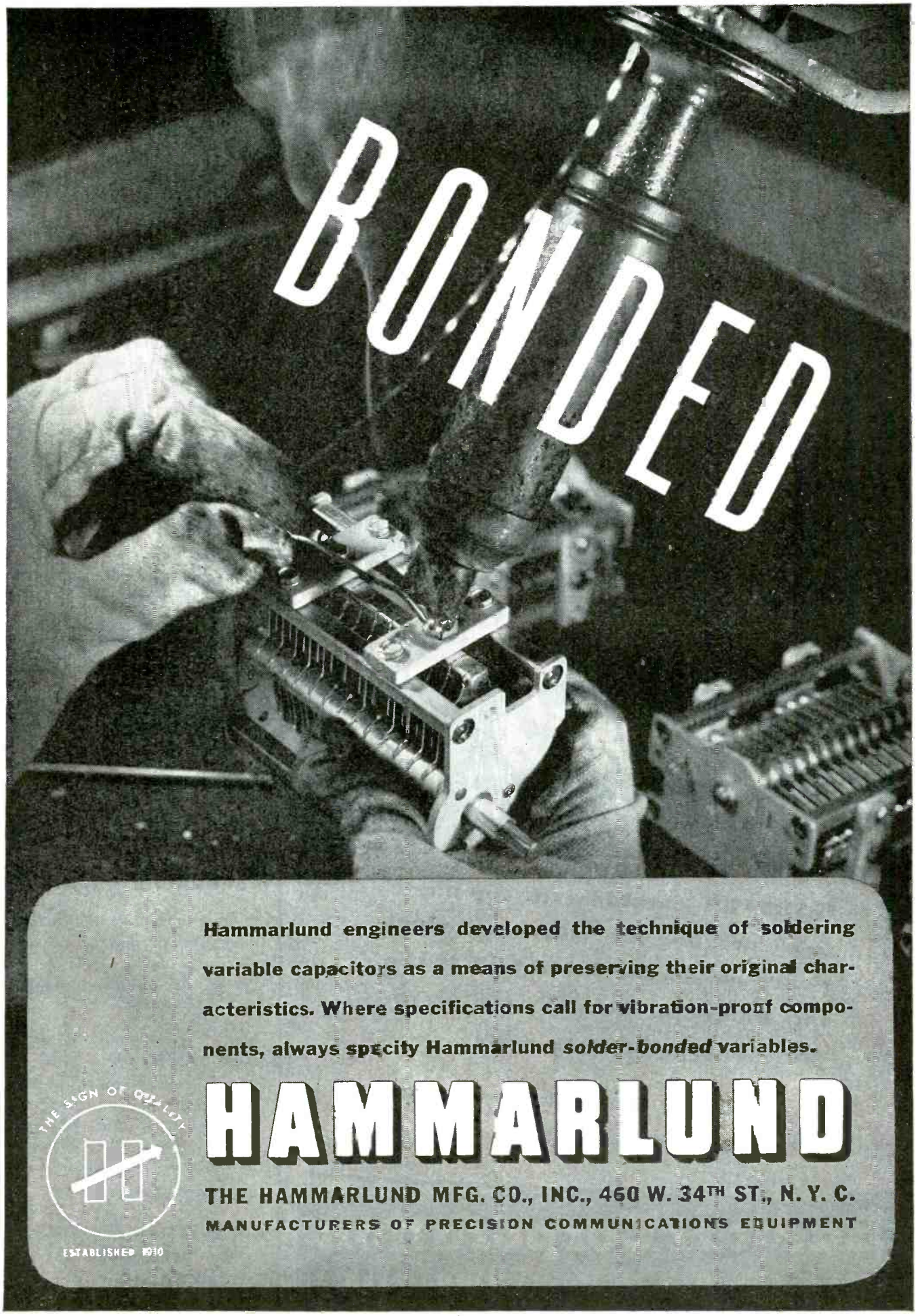
part. Of great advantage is the see-through construction, since the leads are brought off radially in an acorn, and there are no basing obstructions to prevent microscopic examination at several points along the construction line, as in Fig. 4.

As to its outward appearance, a recent acorn tube looks the same as it always did. This is because the improvements in general are not visible—such as a refinement that keeps part "x" within 0.0001 inch from part "y". From another viewpoint, small tube refinements are not so much the adding of new items as they are their elimination: reducing the sources of contamination, be they microscopic pieces of lint or a film of oxide left by a welding process. For this reason the improvements for the most part lie in the processes and machinery developed to make the tubes.

After a short attempt to produce tubes with previous methods, it soon was decided to conduct a long program of development work involving the invention, design, development and reduction to practice of machinery especially directed solely toward this problem of uniformity. This work is illustrated in the refinements which have taken place in the equipment for cleaning and coating the filament and in the equipment used for automatically winding the grids.

Sealing-in is done on a special and completely original machine, Fig. 5, after every trace of air is replaced by an inert gaseous atmosphere during the glass sealing, to eliminate completely any possibility of internal parts being oxidized or discolored by the sealing flames, which might afterwards react with the emission material to cause contamination and thus lead to reduced emission. The gas from commercial cylinders furnishing this temporary atmosphere is refined again just before use to guard against even small amounts of unwanted components being introduced here.

The method of exhaust shown in Fig. 6 is one which has been designed primarily for the acorn tube. The tube is visible to the operator who is constantly aware of the integrity of the pumping system. Out-gassing of the glass is done in a long oven. Out-gassing of metal parts is next carried out to completion, and finally out-gassing and activation of the cathode is carefully controlled as to temperature and time. Tubes at this phase of completion are considered so valuable that they are sealed off by hand by operators especially trained for this job. This results in the elimination of a complaint of long standing with acorn tubes, the weak tip. The tubes are now found to have strong blunt



Hammarlund engineers developed the technique of soldering variable capacitors as a means of preserving their original characteristics. Where specifications call for vibration-proof components, always specify Hammarlund *solder-bonded* variables.

THE SIGN OF QUALITY

ESTABLISHED 1910

HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., N. Y. C.

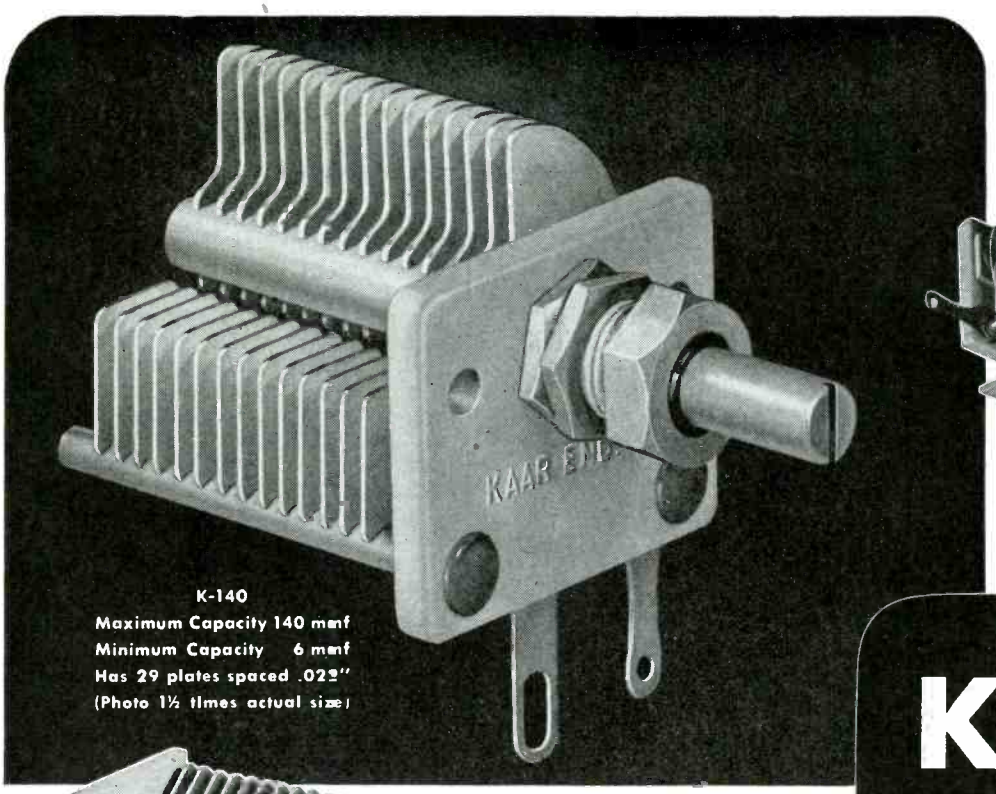
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

tips capable of withstanding an unusual amount of abuse.

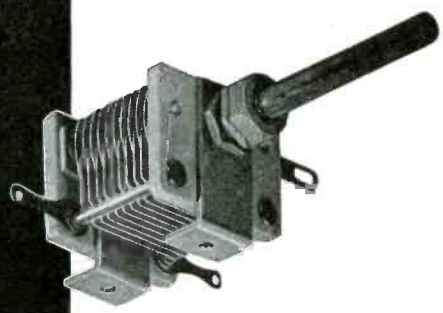
The ultimate vacuum obtained is such that all acorn tubes completing this processing may be run for a considerable length of time at 200 per cent overload without loss of vacuum or otherwise impairing the quality of the tube in any respect. As a result of the refinement of the manufacturing processes outlined above, these present day tubes have a life three or four times that required by government specifications.

With regard to the span of the characteristics of these tubes, the utility of small tubes in any circuit set up for UHF operation is found only when emission is maintained at a uniformly high level. High emission capability was shown to be the basic factor that lets a tube retain its useful characteristics in spite of small sized electrodes. Here refinements in processing result in emissions which run very uniformly at about double the minimum requirements, when coupled with components mechanically accurate and with a controlled vacuum in the order of 10^{-8} mm.

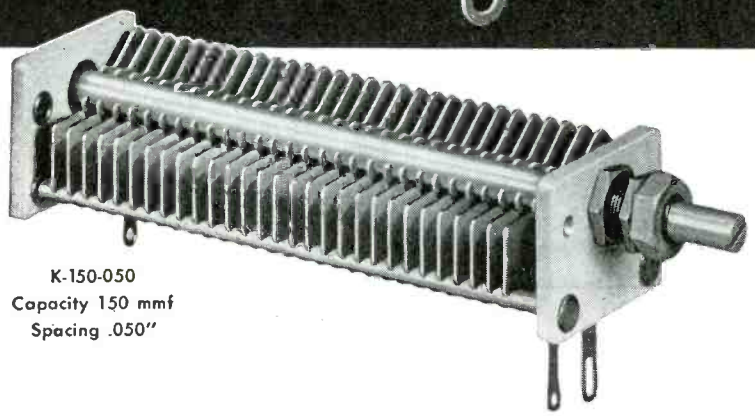
It may be of interest to note that not only must the intensity of the emissivity be maintained at a level higher than in larger tubes, but it is important that the center of emission be held at a definite point,



K-140
Maximum Capacity 140 mmf
Minimum Capacity 6 mmf
Has 29 plates spaced .022"
(Photo 1½ times actual size)



K-100-2B
Capacity 100 mmf
Spacing .022"



K-150-050
Capacity 150 mmf
Spacing .050"

KAAR

VARIABLE AIR CONDENSERS

FOR TANK CIRCUIT AND ANTENNA TUNING

Use this reliable West Coast source for Variable Air Condensers

Kaar Engineering Company now offers prompt delivery of standard and special types of variable air condensers suitable for many applications in radio transmitters and receivers. They are particularly useful as tank and antenna tuning capacitors in low and medium power transmitters.

The small cross-section of Kaar condensers allows a number of them to be assembled in multi-channel radio equipment in a minimum amount of space. Every Kaar capacitor is substantially constructed with soldered and plated brass rotor and stator plates. Shafts can be furnished slotted for screwdriver adjustment, and tapered lock nuts and split bushings assure positive locking without disturbing the adjustment.

Special types are available with very wide air gaps, double rotors and stators, high maximum capacities or special mounting brackets. Further information will be gladly furnished upon request.

KAAR
ENGINEERING CO.
PALO ALTO, CALIFORNIA

Export Agents: **FRAZAR AND HANSEN**
301 Clay Street • San Francisco, Calif.

MOBILE RECEIVERS — Crystal controlled superheterodynes for medium and high frequencies. Easy to service.

CRYSTALS — Low-drift quartz plates. Fundamental and harmonic types available in various holders.

TRANSMITTERS — Mobile, marine, and central station transmitters for medium and high frequencies. Instant heating, quickly serviced.

MICROPHONES — Type 4-C single button carbon. Superb voice quality, high output, moisture-resistant.

POWER PACKS — Heavy duty vibrators and power supplies for transmitters, receivers. 6, 12, 32 volts DC.

since the distance between the grid to this center of emission is the factor that greatly influences all of the useful operating characteristics.

The problem of coating the emission surface, whether of the filament or the cathode type, called for an immediate and extensive development program. The regulation of the composition of the coating material is but one of the factors that are under rigorous control. When the cathode-grid or filament-grid spacing normally involves only a few thousandths of an inch, the position of the effective center of emission becomes a primary factor in attaining the required constancy of tube characteristics. This program produced early results and this coating process now is a routine matter. A special control routine is followed at every point in the assembly, up to its final de-gassing and evacuation within the tube.

In the case of cathode type tubes, a special heater coating insulation material has been developed in which the controls, the material and the processings are such that the heater to cathode voltage may be unusually high, without any fear of breakdown or burn-outs between the heater and cathode. This extremely high insulation value makes the operation of cathode type tubes utterly safe in circuits which normally use voltages from 100 to 125 volts between heater and cathode.

In certain filament type tubes, such as the 958A, two filaments connected in parallel are used, resulting in greater emission area, and at the same time avoiding greater differences in the internal distances to the expected point of emission. Parallel filaments represent an advance over the former series filament arrangement.

Simple as a tube might appear by inspection, at frequencies of several hundred megacycles, the internal inductances and capacitances contribute a substantial amount to the circuit. A simple triode oscillator, Fig. 10 (a), appears somewhat as in Fig. 7 if these items are added to the circuit. These inductances and capacitances not only prevent the application of more efficient items toward building up the values required for a particular frequency, but at the higher frequencies it may be found that no additional values are needed, and the frequency ceiling is reached.

Fig. 8 lists the internal capacitances found, with the addition of a few octal tube characteristics for comparison. Here, together with the curves in Fig. 9, will be seen that the 6J5 and the 955 are not unlike except in the matter of power limits. Other types of acorn

JAMES KNIGHTS *Crystals*

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The engineers of the James Knights Company pioneered in the development and manufacture of *Etched* quartz crystals. For some time now, we have been supplying quantities of these definitely better type crystals in hermetically sealed holders. James Knights *Etched* Crystals are available to improve the performance of your equipment. Catalog on request.

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SANDWICH, ILLINOIS

JK CRYSTALS

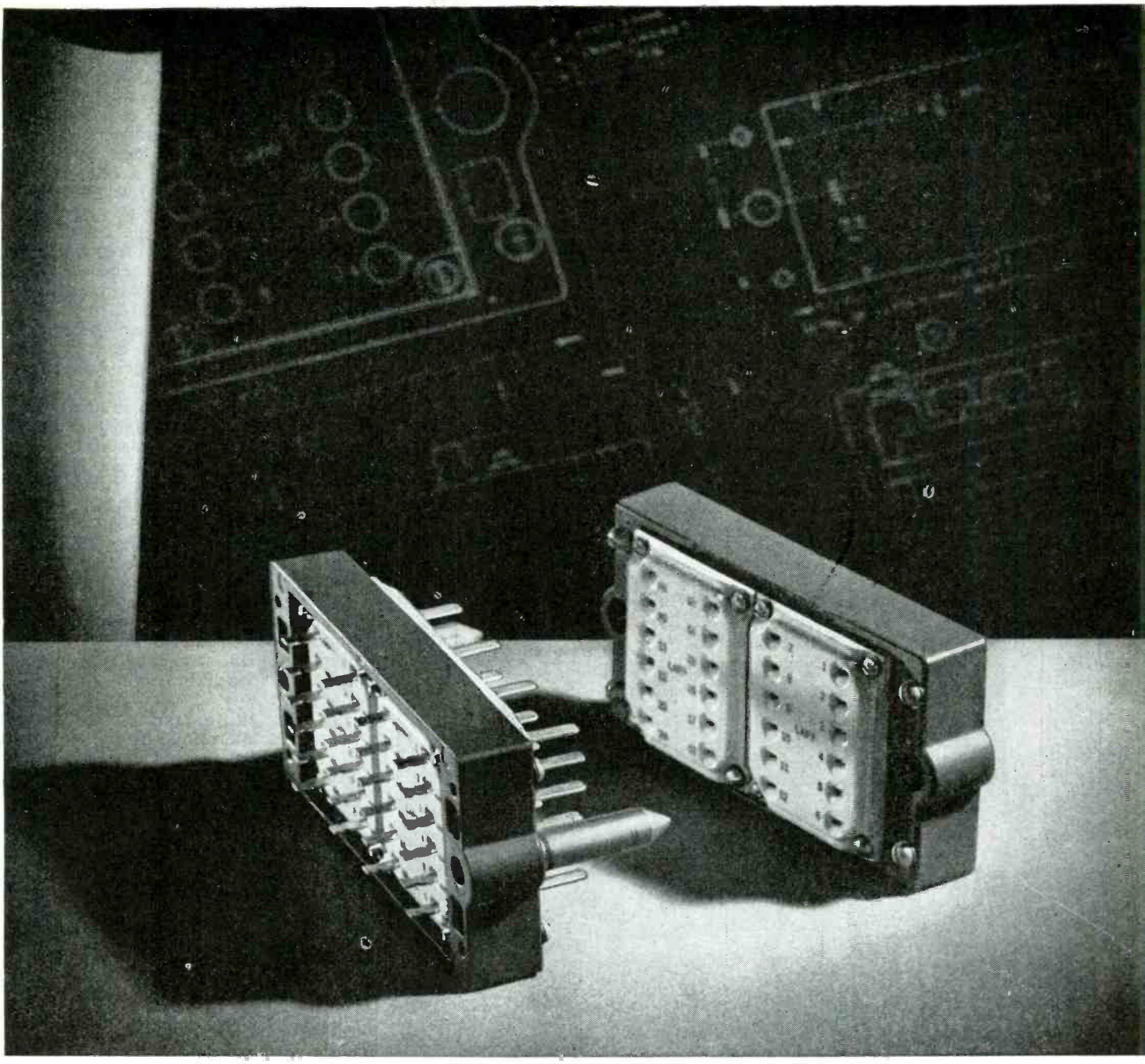
CRYSTALS FOR THE CRITICAL

tubes will be found to have counterparts in frequently used octal base tubes, when the latter are used within the voltage limits found safe for the acorn. Each 958 acorn is given an oscillation check at 125 volts E_p, to deliver at least 0.3 watt at 60 megacycles. Each 955 is tested for oscillation capabilities at 600 megacycles.

In high impedance tuning circuits a few ohms resistance is of little consequence, but where a circuit impedance consists of elements with only a few ohms reactance it is extremely difficult to obtain a high enough Q to attain satisfactory selectivity, except with special inductance - capacitance structures (cavity resonators, etc.).

Nearly every factor works against efficient operation when the ordinary circuit components are considered for use at, say, 300 megacycles. The increasing skin effect, which makes surface imperfections and corrosion quite important, greater losses through charging of the capacitances between circuit components, higher dielectric losses in the insulators, greater eddy current losses and what often proves to be the most important greater losses by direct radiation from the circuit and tube.

At frequencies in excess of 300 mc it is necessary in many cases to replace parallel line resonating circuits with coaxial line arrange-



An Electronic Part... ENGINEERED TO A SPECIFIC NEED

This is a special-purpose electronic part. It is a plug-receptacle assembly for use with rack-panel type of mounting. Twenty-four silver-plated phosphor-bronze contacts are provided, each male and female contact full floating between steatite plates. Heavy guide pins and matching holes in the frame assure perfect alignment.

We don't know that your product has any need for such a part as this. We do know, however, that this part is most exactly suited to its special requirement, just as are hundreds upon hundreds of other parts which have been created through Lapp engineering and Lapp production facilities directed to the solution of specific problems.

With a broad basic knowledge of ceramics—their capabilities and their limitations—Lapp has been able to simplify and to improve many types of electronic equipment through engineering and production of sub-assemblies that make most efficient use of porcelain or steatite and associated metal parts.

There may be a way you can improve performance, cut costs and cut production time through use of Lapp-designed and Lapp-built sub-assemblies. We'd like to discuss your specific requirements with you. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Lapp

ARMY E NAVY

ments. Here quite high Q circuits can be arranged when larger diameter tubes or even cavity resonators are used, on account of low resistive components and reduced radiation. Large short rods must be used for connections. One inch of No. 18 wire may have a reactance as high as 50 ohms at 400 megacycles.

An LC circuit can be made to function efficiently at frequencies above 100 mc, but, in general, the parallel-line systems are mostly used in the range of 100-300 megacycles, since the Q of an ordinary LC circuit drops very rapidly at frequencies above 100 mc, resulting in poor stability. Above 300 megacycles, it is difficult to mount the parallel wires close enough together to avoid radiation, losses and (except in cases where this is not useful) coaxial lines or else three element lines are provided, the two outer rods being paralleled. In the circuits illustrated in Fig. 10, numerous RFC chokes are called for—each made from spaced bus-wire with a couple of dozen turns, or from smaller wire wound on a wooden dowel, 3/8 in. to 1/2 in. in diameter. In any case, the wire must be spaced by about its own diameter.

In Fig. 10 (b) and C the frequency is determined by the length of line to the first shorting bar (augmented by the "swallow-up" factor of the tube). The second bar, about 1/4 farther along, takes care of the effects that would be introduced by the overhanging ends of the lines. The circuits shown are all modifications of the Colpitts oscillator know as the "ultraudion" (a term well known to old-timers) and is the same as that of Fig. 7.

POSTWAR RECEIVERS

(*Continued from page* 83)

valuable service, one that will provide an enormous market for the enlarged production facilities of the industry as a whole.

The many avenues of approach to this subject require that various phases of the problem be discussed by different groups, and in succeeding issues the various engineering answers will be considered.

Many developments have been made in tubes and their characteristics, but it happens that most of the new designs deal with types that have little immediate use at broadcast frequencies. Almost every tube of importance in modern circuits has improvements in its characteristics, such as sensitivity and reliability, and great advances have been made in the utilization of these characteristics. Operational procedure and associated circuits and methods have been revamped in many cases, and the technic of getting superior results from an amplifier stage, be it selectivity, sensitivity or wider oper-

Blasting Wolf Packs....

with Conversation

Sinking U-boats . . . blasting enemy planes . . . silencing hostile batteries . . . these are but a few of the many "missions" now being carried out by Transformers, the "bombs" that are activated by TALK instead of TNT.

Thus Transformers, along with the other important components that make up the Communications Systems for our armed forces, are doing their "talking" where it really counts . . . which is a fine example for us at home to follow.

THE ROLA COMPANY, INC., 2530 Superior Ave., Cleveland 14, Ohio

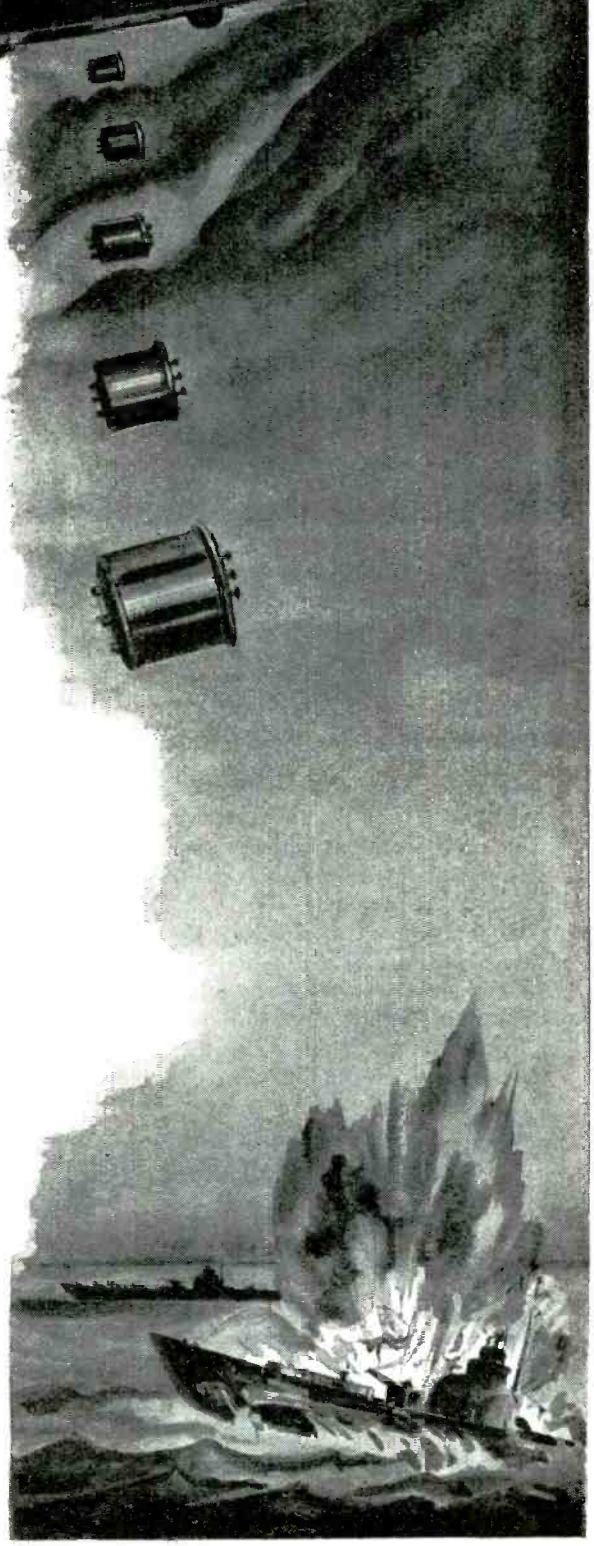
Let the man with the

"Mike" do the talking

ROLA

Help Shorten the War ARMY E NAVY *Buy More War Bonds*

MAKERS OF THE FINEST IN
SOUND REPRODUCING AND ELECTRONIC EQUIPMENT



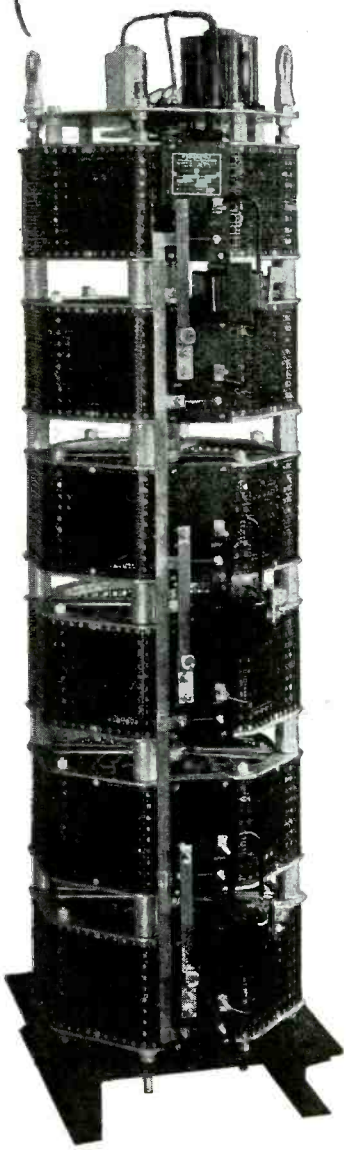
ating ranges, is now widely known.

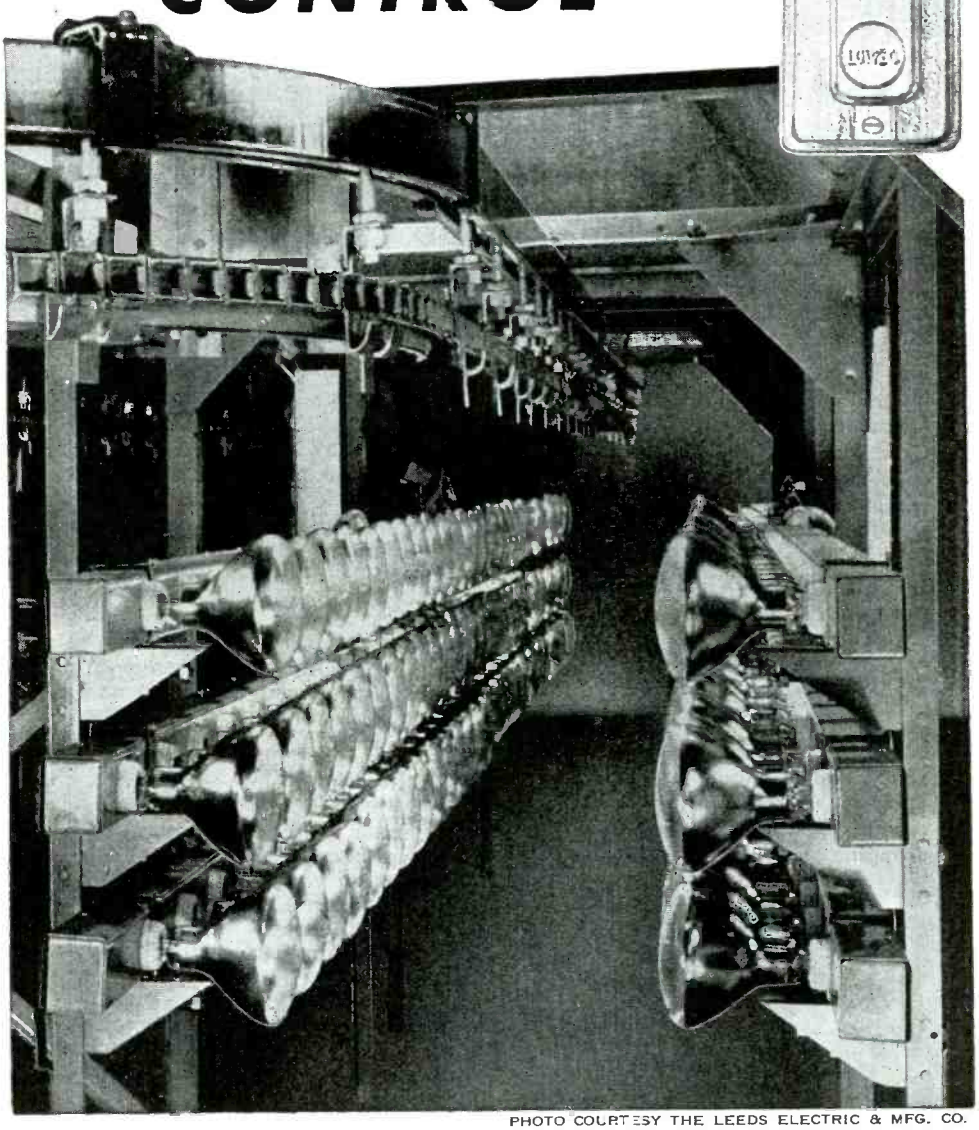
While on the subject of tubes, great strides have been made in the establishment of the JAN preferred list which contains the types most often used in circuits of all types. However, there is bound to be a great deal of controversy as to the relative merits of the various basing methods. It seems that the present trend is leaning toward the use of smaller tubes, physically, and the use of smaller bases. However, octal, loctal, miniature bases, etc., will be judged by their merits by each designing group, and probably a more complete line of tubes may be added to the list

This matter of tube styles probably is the first question in the minds of designing engineers. Many matters, not all of which are on a purely engineering basis, go to make up the final answer here.

The introduction of many new materials with selected characteristics for specific uses provides lower circuit losses, improved temperature, humidity and operating voltage frequency drift rates and other features which will show up in the more efficiently engineered designs. While home receivers may never withstand the hard usage that military equipment must be designed for, still more substantially built components, a "must" for military usages will inevitably improve reliability in general.

INFRA-RED
with POWERSTAT CONTROL





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When the push-button is pressed, this 42.8 KVA lamp bank is under finger-tip control for instantaneous adjustment of the 171 infra-red 250 watt lamps to the exact energy output required by each production demand. Controlling this installation is a type M1256L-6 wye connected, 3 phase, 440 volt input, POWERSTAT variable voltage transformer.

If your application is smaller or larger, our engineers will recommend a POWERSTAT to — control infra-red to produce a better job faster . . . increase lamp life . . . reduce operating costs and eliminate the need of adjusting cumbersome lamp brackets. Send for Bulletins 149 IE and 163 IE

Superior Electric Co., 284 Laurel Street, Bristol, Conn.

SUPERIOR *Electric Company*

PULSE GENERATOR

(*Continued from page* 85)

study of automobile ignition interference it is highly desirable to have a source of noise voltage which can be controlled accurately during tests. Tests have shown that a pulse wave of approximately 60 cycles per second, each pulse with a 40 microsecond duration, very closely simulates automobile ignition interference. The use of a 40 microsecond 60-cycle pulse on a standard type of home FM receiver is shown in Fig. 5. These curves show that this particular receiver produces a 20 db. quieting of a 10 microvolt pulse interfering signal with approximately 3½ microvolts of desired signal. Approximately 1½ microvolts of desired signal produces a 6 db. quieting of the same intensity interfering signal. The desired signal peak deviation was 25 kc.

WIDE READING

(*Continued from page* 118)

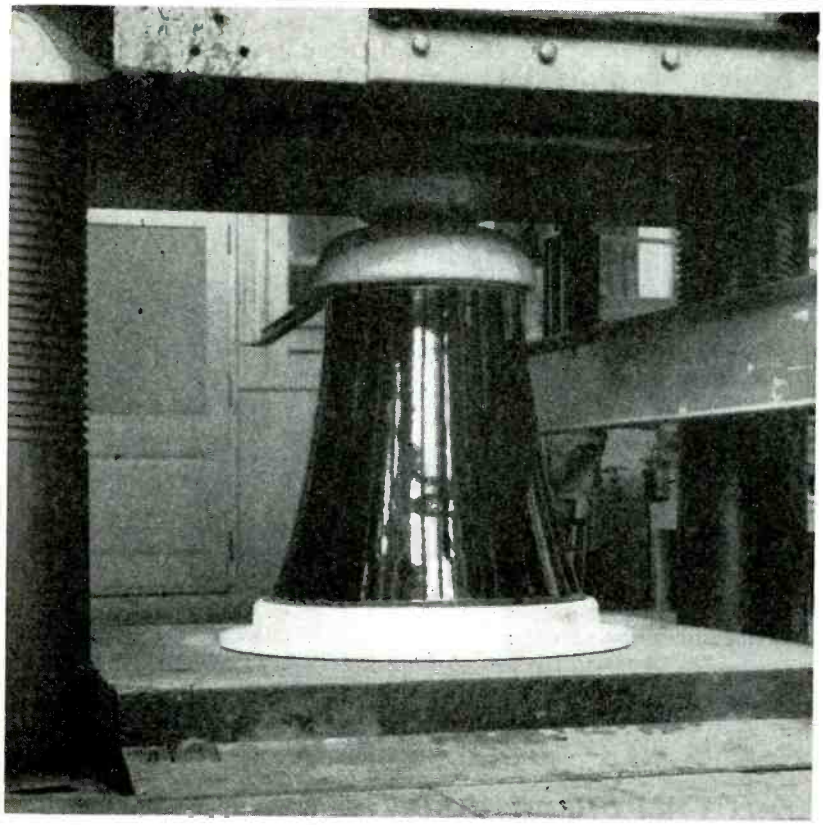
Remote Control Circuits

The purpose of the fixed-amplitude mid-frequency tone is to control the variable gain amplifier through which the two outer tones also pass. Any change in line attenuation that would normally cause a change in tuning and gain bias is thereby compensated; a fraction of this control signal is fed to the tuning amplifier in the three channel unit, the tuning adjustment being very critical, while it is desirable that the gain control signal be not completely compensated, an additional change in gain being produced when the audio signal is transmitted over the line.

Measuring FM Wave Characteristics

lated carrier, there will result an amplitude-modulated wave, the amplitude of which will vary between zero (for opposite phase of the two oscillations) and double the carrier amplitude (for equal phase of the oscillation).

In an oscillogram of these heterodyned oscillations over one period of the modulating frequency T_m, as shown in Fig. 1, every zero amplitude will indicate that the two voltage vectors are of opposite phase, i.e., that the phase angle $\frac{\triangle\omega}{\omega_m}\cos \omega_m t$ has increased by 2π. It will then be easy to construct the phase angle as a function of time, as indicated in the diagram. The maximum of the phase angle is equal to the modulation index; in the example shown it is equal to 11.5π. An approximate value for the modulation index will be found by counting the number of zeros in one period of the modulating frequency. From the phase angle diagram, the shape of the modu-



An armchair for a two million pounder

Those were the requirements for the base insulator of one of America's great stations. And this insulator is the one that met them.

The insulator you need may be only a tiny standoff or entrance insulator with practically no mechanical requirement at all, but at Locke these get just the same attention to engineering and manufacturing detail that is given spectacular developments such as this two million pound insulator.

Because your requirements are small, don't hesitate to call on us. You will get the same consideration and service as the biggest jobs get.

A COMPLETE "CLAY"RAMIC SERVICE

for every electrical, chemical and mechanical application.

Locke has unrivalled facilities for the production of fired clay pieces by every known method.

(1) Dry Process — Porcelain and Steatite

A process ideally suited to the production of certain pieces with reasonable tolerances and adequate mechanical and electrical strength.

(2) Vacutite Process—Porcelain and Steatite

A process developed by Locke for forming intricate pieces. Close tolerances. Mechanical and electrical strength almost equal to wet process.

(3) Wet Process — Porcelain and Steatite

The standard process for the production of high voltage insulators, and porcelain for mechanical and chemical applications. Exceptionally strong mechanically and electrically.

Locke Wet Process porcelain and Locketite is produced by the following methods, the selection of method depending upon the piece.

(1) Pugging
(2) RamExtrusion
(3) Wet and Dry Turning
(4) Plunging
(5) Jiggering
(6) Plastic Press
(7) Core Casting
(8) Drain Casting
(9) Throwing

and certain other methods which at the present have only limited application.

Other clayramic products will be available in the future to meet special conditions. Whatever your problem, our experienced electrical, mechanical and ceramic engineers will be glad to help. Their services have resulted in material savings in money, time and critical materials to other manufacturers. Perhaps they can help you.

Locke **INSULATOR CORPORATION**

BALTIMORE, MARYLAND *"Leaders in Clayramics"*

WIDE READING

lating oscillation, which is proportional to $\Delta\omega \sin \omega t$, can be computed or constructed by finding the differential quoefficient; see top curve in Fig. 1.

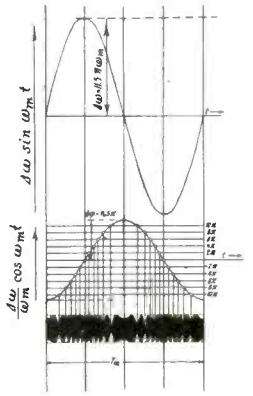
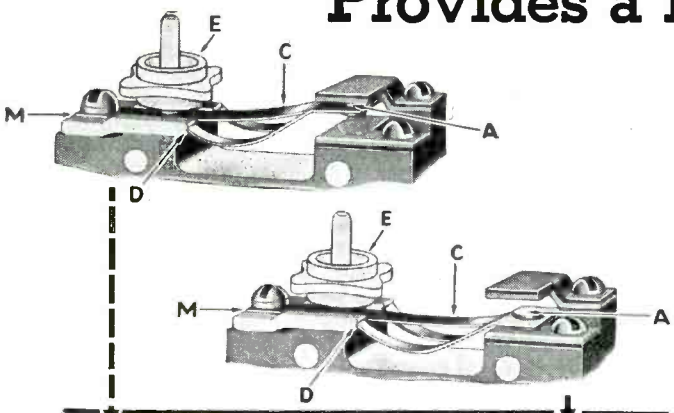


Fig. 1—Constructing phase angle and shape of modulating wave from oscillogram

Fig. 2, similar to Fig. 1, illustrates the oscillograms, phase angles and original modulating voltages for symmetrical and unsymmetrical square-wave modulating pulses and for a saw-tooth modulating pulse. In the first instance, the heterodyne frequency is constant, because the difference between modulated carrier frequency and unmodulated carrier frequency does not change. In the second instance, two different heterodyne frequen-

Why MICRO SWITCH

Provides a Long Snap-Action Life



Micro Switch Operating Principle

The operating principle of the Micro Switch as illustrated here is simple and fundamentally correct. The long member of the one-piece spring "C" is supported as a cantilever at "M". The two shorter compression members of the spring rest in specially shaped (patented) V's. When the plunger "E" deforms the long tension member, the cantilever force overcomes the vertical force supplied by the compression members and the free end of the spring "A" snaps the contact from one stop to the other with lightning-fast speed. Snap action in the reverse direction occurs when the deformation of the tension members of the spring by plunger "E" is removed.

This one-piece beryllium copper spring is heat treated to provide the high fatigue resistance necessary to insure a minimum of 5,000,000 trouble-free mechanical operations, at full overtravel.

The rivet type contact is of superfine silver 99.95% pure.

The operating plunger is a highly polished, hard, stainless steel pin molded into an accurate Bakelite head. This head is so shaped that it cannot rotate, hence bears on the switch spring at the same point through millions of operations.

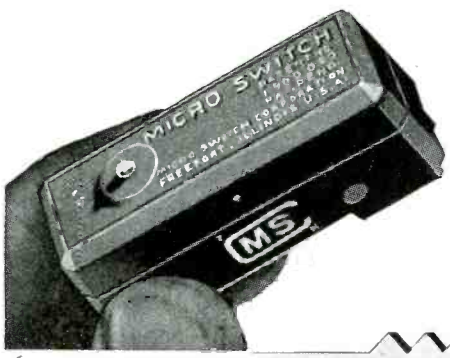
Micro Switch provides lightning-fast, snap-action control of electric circuits with reliable and positive operation accurately repeated over millions of cycles.

This performance is made possible by use of the unique, field tested, and proven operating principles of the Micro Switch. The snap motion of the Micro Switch contact is in the same direction as that of the operating plunger. There are no reverse bends in the Micro Switch spring, and there is no life-limiting "oil can" action.

The experience of design engineers with millions of Micro Switches in a great variety of applications has shown performance ability and operating characteristics never before found in snap-action switches.

Its small size, its high electrical rating, its ability to operate satisfactorily for millions of operations on minute movement and force differentials, its availability in various types of housings and a wide range of actuators . . . have made Micro Switch the choice of design engineers for precise operation of many types of plant equipment.

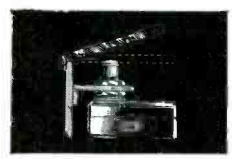
Micro Switch Handbook-Catalog No. 60 will give you complete details as to electrical characteristics, construction, applications and dimensions. If you happen to be specializing in aircraft equipment, also send for Handbook-Catalog No. 70.



The basic Micro Switch is a thumb-size, feather-light, plastic enclosed, precision, snap-action switch, Underwriters' listed and rated at 1200 V. A., at 125 to 460 volts a-c. Capacity on d-c depends on load characteristics. Accurate repeat performance is experienced over millions of operations. Wide variety of basic switches and actuators meets requirements varying from high vibration resistance to sensitivity of operating force and motion as low as 2/1000 ounce-inches. Many types of metal housings are available.

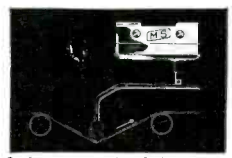
HUNDREDS OF SPOTS FOR MICRO SWITCHES

An explosion-proof Micro Switch is used with a spray gun to cut off the ventilating system of the spray booth automatically when the gun is hung up.



Micro Switches are used as safety switches on high tension cabinet doors. A normally open switch breaks circuit as door is opened.

Two Micro Switches with spring type plungers are used to insure correct position of material in jigs and fixtures.



Spring plunger Micro Switches serve as break indicators in textile and paper mills.

MICRO MS SWITCH

TRADE MARK

A DIVISION OF FIRST INDUSTRIAL CORPORATION

FREEPORT, ILL., U.S.A., Sales Offices in New York, Chicago, Cleveland, Los Angeles, Boston, Dallas, Portland, (Ore.)

. . . . USES  UNLIMITED

"Uses Unlimited"—a dramatic talking motion picture of Micro Switches, in color, is available to industrial groups, training classes, schools and colleges, through Y.M.C.A. Motion Picture Bureau, New York, Chicago, San Francisco. Size: 16 mm. Length: 40 minutes. Write us for details.

A star has been added to our "E" flag as further recognition to the men and women of Micro Switch for maintaining our war production standards.

Let's All Back the Attack—Buy Extra War Bonds

WIDE READING

cies will be obtained each lasting for one half cycle. Fig. 3, shows the oscillograms obtained for various phase differences between modulated carrier and unmodulated carrier waves.

In producing these oscillograms, the sweep frequency is synchronized with the modulating frequency. A deviation of the unmodulated frequency from the modulated carrier frequency will be indicated by a movement of the oscillogram. If the carrier frequency is too high for recording by an oscillograph, the heterodyned wave can be rectified so that only the envelope will be seen on the screen or photo.

The method is also applicable to the measurement of additional amplitude modulation. With the aid

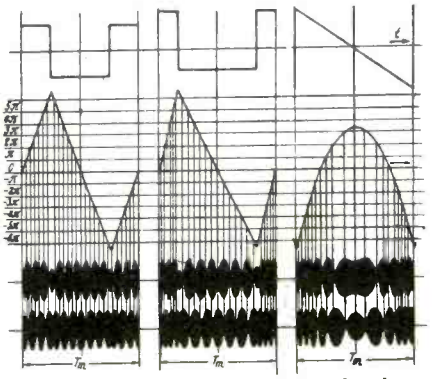


Fig. 2—Oscillograms for different pulse shapes

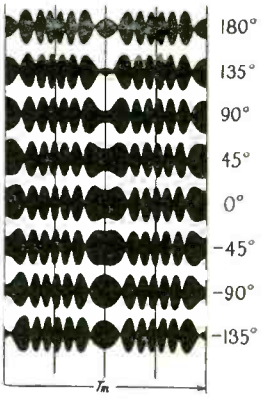


Fig. 3—Oscillograms for various phasing between modulated and unmodulated carrier

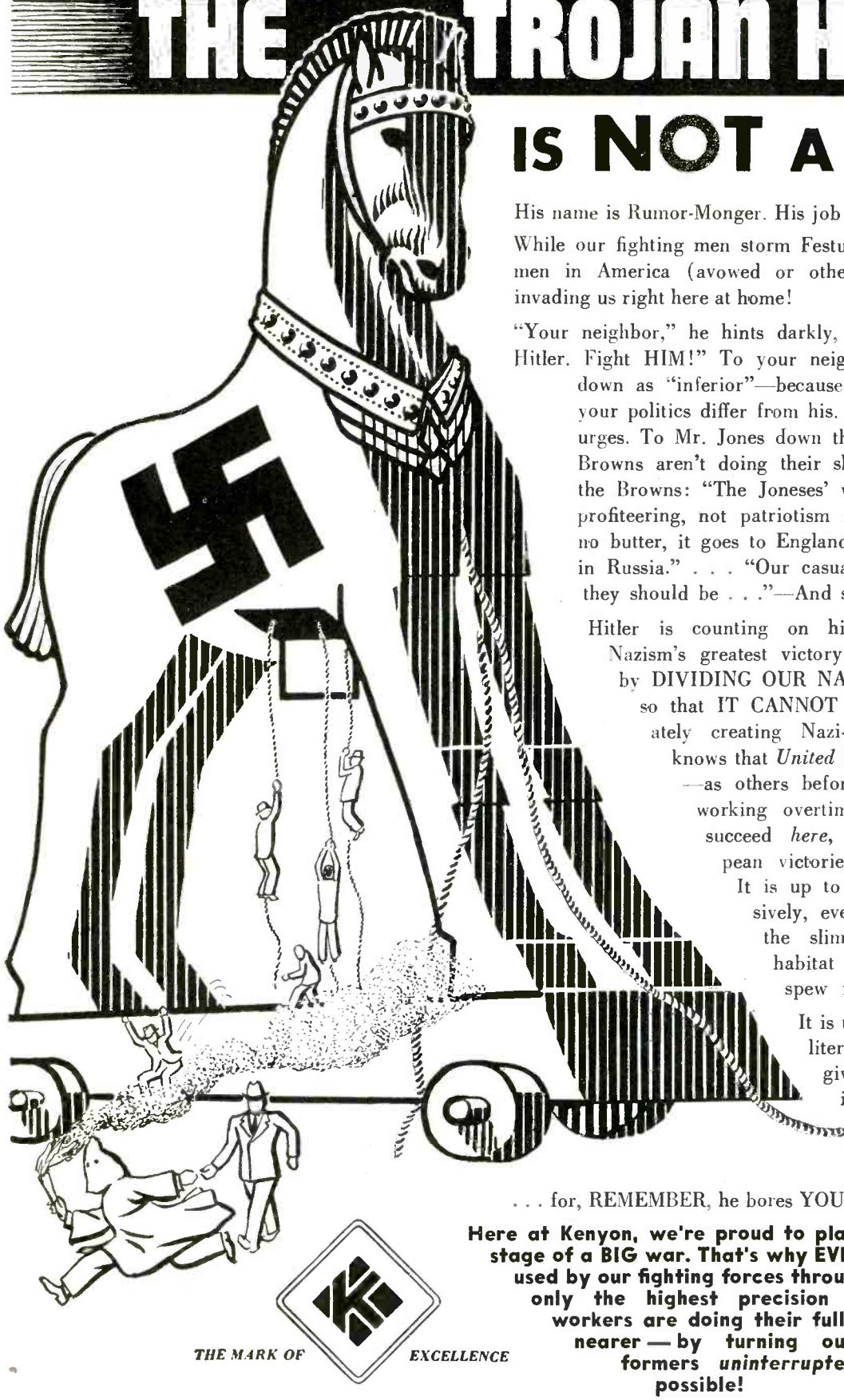
of a calibrated high frequency generator, the exact value of the carrier frequency of a frequency-modulated wave may be determined.

Screened Loop Antenna

R. E. Burgess (Wireless Engineer, London, May, 1944)

The reactance, resonant and anti-resonant frequencies, and the effective height of a symmetrical, single-turn loop antenna are derived and current and potential distribution on the loop and screen are determined. It is assumed that the inductances and capacitances are uniformly distributed and that resistance and leakance are negligible. The paper concludes with an account of measurements of the

THE TROJAN HORSE IS NOT A MYTH!



His name is Rumor-Monger. His job is to divide us *from within.* While our fighting men storm Festung Europa, Hitler's henchmen in America (avowed or otherwise) bore from within, invading us right here at home!

"Your neighbor," he hints darkly, "is your real enemy—not Hitler. Fight HIM!" To your neighbor, he slyly builds you down as "inferior"—because your faith, your color or your politics differ from his. "Put him in his place," he urges. To Mr. Jones down the street he whispers, "The Browns aren't doing their share to win the war!" To the Browns: "The Joneses' war efforts are spurred by profiteering, not patriotism . . ." "No wonder there's no butter, it goes to England." . . . "OUR beefsteak is in Russia." . . . "Our casualties are way higher than they should be . . ."—And so on and on, ad nauseum.

Hitler is counting on his Trojan Horse to win Nazism's greatest victory over America, *internally*, by DIVIDING OUR NATION AGAINST ITSELF, so that IT CANNOT STAND—through deliberately creating Nazi-like racial disunion. He knows that *United We Stand, Divided We Fall*—as others before us fell! Therefore, he's working overtime to divide us. Will he succeed *here*, cancelling-out our European victories into American defeats? It is up to YOU to defeat him decisively, every time he crawls out of the slime which is his natural habitat to rear his ugly head and spew forth his loathsome bilge.

It is up to YOU to throw out his literature, cast out his words, give no credence to the noxious thoughts he seeks to plant in your mind. You can't simply dismiss him as a crackpot or a bore . . . for, REMEMBER, he bores YOUR COUNTRY from *within!*

Here at Kenyon, we're proud to play our small role on the stage of a BIG war. That's why EVERY Kenyon transformer used by our fighting forces throughout the world reflects only the highest precision craftsmanship. Kenyon workers are doing their full share to bring Victory nearer — by turning out top quality transformers *uninterruptedly* — and as fast as possible!

THE MARK OF *EXCELLENCE*

KENYON TRANSFORMER CO., Inc.

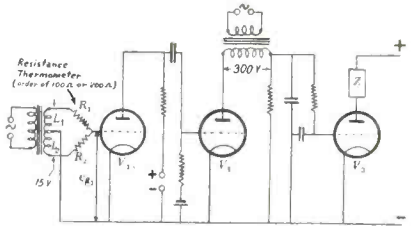
840 BARRY STREET
NEW YORK, U. S. A.

reactance of a square loop of 150 cm. side; fair agreement between theory and experiment is obtained, and the general reasons for any discrepancy are mentioned.

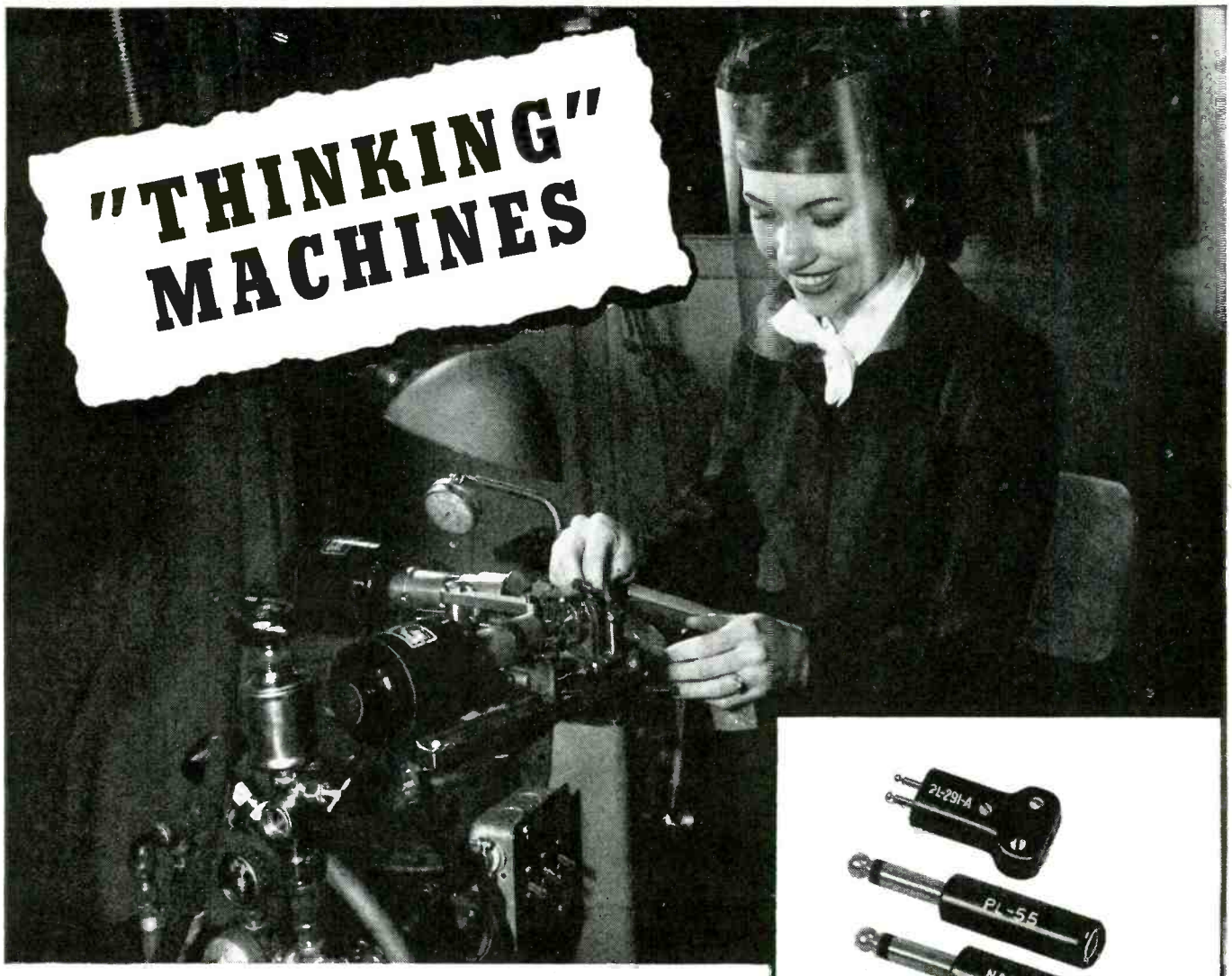
Thermoregulator

G. E. Coates (Journal of Scientific Instruments, London, May, 1944)

A suitable relay, operated by the current through Z, controls the temperature which is to be maintained constant. When the ac bridge L_1, L_2, R_1, R_2, is balanced, i.e., for $e_{g1} = 0$, the relay is just about to trip. If the temperature is too low, the resistance of the platinum resistance thermometer increases, unbalancing the bridge, and a small voltage is impressed on the grid of V_1. The amplified voltage at the grid of V_2 will be of opposite phase to the plate voltage of V_2 so that the plate cur-



Temperature control



Machine designed by Remler to perform multiple operations: automatic slotting; indexing; drilling; milling and reaming.

REMLER ENGINEERS design and build robots with "brains" to improve production techniques. Ingenious jigs and dies, and in many instances entire machines are constructed to combine intricate operations. These innovations contribute to the precision accuracy of Remler products; release manpower for other tasks; reduce costs and speed up deliveries. • For complete sound transmitting systems; radio; plugs and connectors and other electronic components in metal and plastic, consult . . .

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SINCE 1918

Announcing & Communication Equipment

PLUGS & CONNECTORS

Signal Corps · Navy Specifications

Types:		PL			NAF
50-A	61	74	114	150	
54	62	76	119	159	
55	63	77	120	160	1136-1
56	64	104	124	291-A	
58	65	108	125	354	No.
59	67	109	127		212938-1
60	68	112	149		

PLP		PLQ		PLS	
56	65	56	65	56	64
59	67	59	67	59	65
60	74	60	74	60	74
61	76	61	76	61	76
62	77	62	77	62	77
63	104	63	104	63	104
64		64			

OTHER DESIGNS TO ORDER

WIDE READING

rent through V_2 will decrease and the current through controller Z increase.

If the temperature becomes too high, the resistance of the resistance thermometer will decrease and the ac bridge output will be of opposite phase to the output for low temperature. Consequently, grid and plate voltage on V_2 will be of equal phase, the plate current through V_2 will increase and the current through the controller Z decrease.

In an experimental model, which has been in use for three years without attention, controlling a paraffin thermostat operating between -30 deg. C. and $+30$ deg. C., a sensitivity of ± 0.001 deg. C. has been obtained at -20 deg. C.

Measuring Dye Concentration

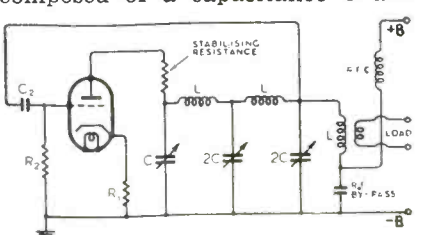
T. B. Davenport (Journal of Scientific Instruments, London, May, 1944)

The change in light absorption of a dyestuff solution, which is being circulated through a mass of textile material, is continuously indicated by a photoelectric apparatus. A light beam is passed through the solution to be tested and made to impinge on a photocell. The photocell is so connected in the plate circuit of a pentode that the voltage developed between plate and cathode is a logarithmic function of the photo current. This voltage is applied to the input of a three-stage resistance-capacitance coupled amplifier, the output of which is rectified by a double-diode, and indicated by a galvanometer of low sensitivity. There will be a linear relation between the concentration of the dye in the solution and the galvanometer reading. During the process, the temperature of the dye solution is maintained constant by a thermostat. Optical arrangement, thermostat, and amplifier circuit are described, and exact dimensions are given.

Oscillator Circuit

F. Butler (Wireless Engineer, London, July, 1944)

The oscillator shown has been designed for high frequency stability and low harmonic content. It employs an equivalent half-wave line with lumped inductances and capacitances. If operated at the resonance frequency of a circuit composed of a capacitance C and



Stable oscillator with low harmonic content

No complicated operating mechanisms such as relays, toggles, magnets, springs or other fussy parts—nothing to get out of adjustment—that's why Klixon disc-operated controls provide complete security and protection.

What actuates Klixon controls? A simple scientifically calibrated Spencer thermostatic disc that snaps to a quick, clean break or a solid make. And because this disc does away with complicated parts, Klixon Controls are highly resistant to shock, motion, vibration, and altitude.

Klixon snap-acting controls are small, compact, and light in weight. They are available in a wide range of types for such applications as motor and transformer overheat protection, electrical circuit overload protection, thermal time delays or temperature control for radio equipment. Write for complete information.

KLIXON

TRADE MARK REG. U.S. PAT. OFF.

SPENCER THERMOSTAT COMPANY, ATTLEBORO, MASS.

WIDE READING

an inductance L, (1) the input impedance will be non-reactive and equal to the terminating load, (2) the output voltage will be equal to the input but reversed in phase, and (3) a quadrature voltage will be available across the mid-shunt capacitor. If the terminating load resistance is so chosen that $R^2 = L/C$, the quadrature voltage is equal in magnitude to both input and output voltages. The network acts as a low-pass filter and gives strong attenuation of harmonic voltages.

Theory of Electron Beams

J. Aharoni (Philosophical Magazine, London, January, 1944)

A mathematical method of establishing the effect of space charge on an electron beam as it emerges from an electron-optical system is presented. The space charge considered is that of the electrons constituting the beam and repulsing one another; stationary conditions are assumed. The equation for the acceleration of an electron in an electric field, the equation of continuity, and Maxwell's equations are made the basis of the analysis.

The general differential equations derived are solved (1) for the case where the entrance opening for the electron beam is a very

ARMY E NAVY

Hairline

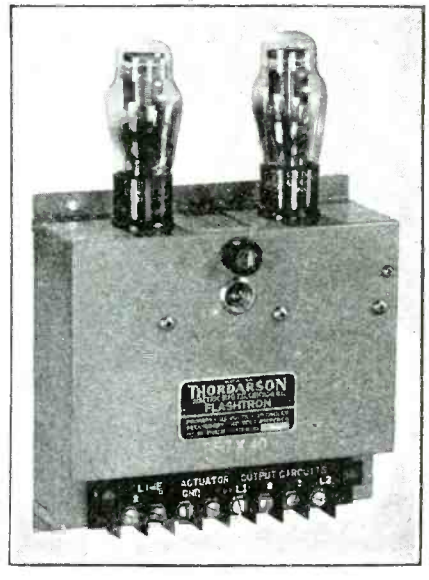
PRECISION in all types of CONTROL by means of FLASHTRON

THE HEART OF MODERN ELECTRONIC CONTROL

For manufacturers of machinery . . . for manufacturers of varied types of products where extreme accuracy of control is highly desirable — for instance, stopping a machine within 1/10,000th of an inch—Flashtron opens new vistas of electronic control.

Requiring only very small energizing currents, Flashtron provides precision control by the most minute movement of contacts. Instantaneous reversible control may be had with Flashtron since its output circuits accomodate motors, solenoids or other power control devices.

Control manufacturers, as well as users, will be sent the complete Flashtron story on request.



Model T-50 x 40

Power Source — 115 Volt 60 c. p. s.

Control Circuit—Operation of one pair of contacts produces orientation of power output.

Output—Two circuits supply 115 Volts up to 40 V. A.—Only one output circuit functions at any given instant. Other sizes available, special order.

THORDARSON

CONTROL DIVISION

THORDARSON ELECTRIC MFG. CO., 500 W. Huron St., Chicago 10, Ill.

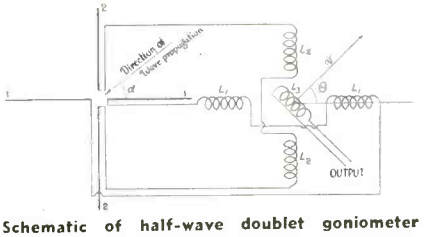
WIDE READING

long rectangular slit which the electrons enter with a very high velocity component at right angles to the plane of the slit and zero velocity in the two other directions, (2) for a circular beam under similar circumstances, and (3) for a rectangular slit of finite length and width, the electron beam having an arbitrary velocity but for a high velocity component in the direction at right angles to the plane of the slit. Expressions for the change in the electron density along the path as well as for variations in beam cross-section along the path are found for these particular cases.

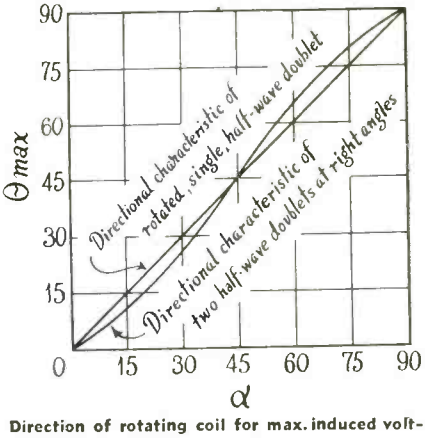
Directional Characteristic of a Half Wave Doublet Goniometer

R. J. Dweyer (Journal of Applied Physics, June, 1944)

The directional characteristic of the goniometer shown, using two half wave doublet antennas 1,1 and 2,2 mounted at right angles, is derived. If two loop antennas are used instead of the doublets, the



Schematic of half-wave doublet goniometer

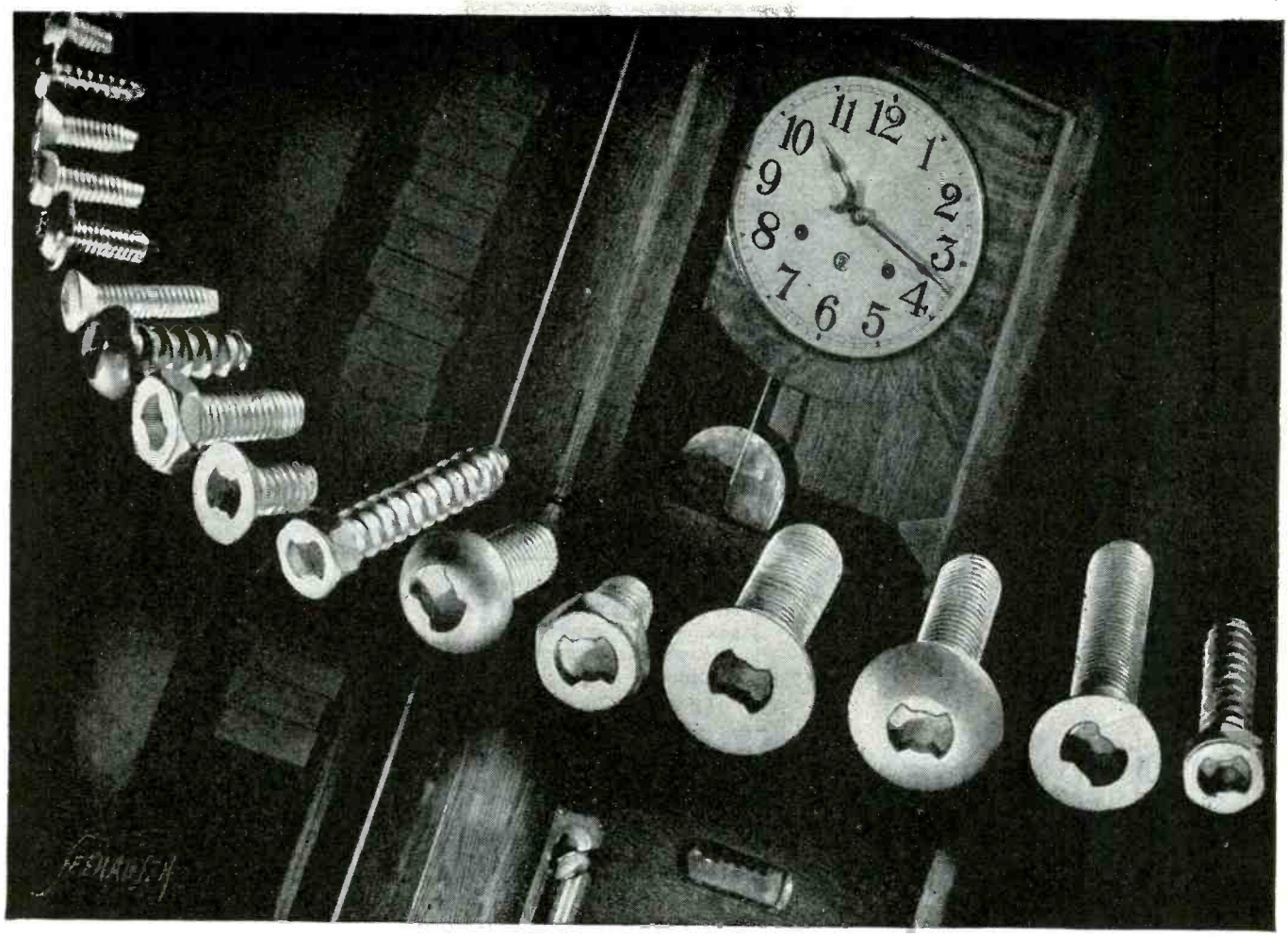


Direction of rotating coil for max. induced voltage as function of direction of wave propagation

directional effect is the same as that obtained when a single loop is rotated. For the two doublet antennas, however, the directional characteristic is not identical with that of a single half wave doublet that can be rotated. The deviation is very slight, as can be seen from the diagram representing the equation:

$$\tan\theta_{max} = \frac{\cos\left(\frac{\pi}{2}\cos\alpha\right)}{\cos\left(\frac{\pi}{2}\sin\alpha\right)}\cot\alpha$$

α is the angle between the direction of doublet 1,1, and the direction of wave propagation, while θ is the angle between vector v (at



You Can't Argue with the Clock

Time is adamant. It measures the output . . . *and the cost* . . . of production. For several definite and easily provable reasons you will find that CLUTCH HEAD Screws pace Assembly Line production at every step.

The testing and proving of these time-saving features . . . plus others that contribute to smoother, safer operation and lessened fatigue . . . may be done right at your own desk. To this end, your request will bring you, *by mail,* a package assortment of CLUTCH HEAD Screws and sample Type "A" Bit, along with fully illustrated Brochure.

Your own appraisal will show you that this modern screw has advanced engineering design to challenge the march of production time; that it has everything . . . *AND MORE* . . . offered by any or all other screws on the market . . . explanation enough why CLUTCH HEAD is accepted as "The Screw That Sells Itself."

You may order CLUTCH HEAD Machine Screws in regular and thread-forming types. Production is backed by this organization and by responsible Licensees.

Check the perfect operation of this screw with an ordinary type screwdriver, or any flat blade, of proper width. This exclusive CLUTCH HEAD feature has proved its value in war and peacetime service.

CLUTCH HEAD · SCREWS ·

This rugged Type "A" Bit is restored to its original high efficiency by a 60-second application of the end surface to a grinding wheel. No delay. No expense. No "back-to-the-factory" shipment for reconditioning.

UNITED SCREW AND BOLT CORPORATION

CHICAGO CLEVELAND NEW YORK

right angles to the axis of coil L_3) and the pair of coils L_1 connected to doublet 1,1. θ_{max} indicates the position of coil L_3 for maximum induced voltage. The voltage will be a minimum for a position of coil L_3 at right angle to the position of the maximum.

RMA OUTLINES WORK

(*Continued from page* 112)

Credit, Chairman, T. A. White, Chicago; Eastern Vice Chairman, Henry A. Pope, Newark, N. J.; Western Vice Chairman, J. T. McKenna, Chicago.

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Resistor Catalog

A new 28-page catalog recently issued includes specifications and engineering data on the complete line of Sprague Koolohm wire wound resistors, in addition to listing various types not included in previous publications. Among the types presented are both standard and hermetically-sealed power wire wound resistor types up to 120 watts; 10- and 15-watt voltage divider sections; bobbin-type resistors; hermetically-sealed precision meter multipliers; and Megomax high-voltage, high temperature resistors. The catalog is from Resistor Division, Sprague Electric Co., North Adams, Mass.

At WESTON . . . RELAY SENSITIVITY has been advancing with seven-league boots!

1935 . . . Sensitivity 1 milliampere

1938 . . . Sensitivity 10 microamperes

1940 . . . Sensitivity 5 microamperes

1944 . . . Sensitivity * *

** Sensitivity many times greater than in 1940, with amplification factor 2,000,000,000 to 1, or better!

With today's emphasis on electronics, WESTON developments in the field of Sensitive Relays assume utmost interest to design engineers. Even prior to the war, these relays provided positive control at input values low as 2 microamperes or 1 millivolt. Employing WESTONS exclusive *magnetic contact* principle, they handled 5 watts at 110 volts, with complete freedom from contact troubles.

But relay development at WESTON has kept pace with the more exacting *control* needs of this war. Relays with sensitivity *for exceeding* that of pre-war days already have proved their reliability on critical equipment, and under the most rigorous conditions!

More than likely, these relays provide the answer for many of tomorrow's products; for they provide the simplest, most compact means of controlling at minute energy levels.

Have the full story on "what's ahead" in sensitive relays and instruments at your fingertips. Check WESTON, too, on all *war instrument* needs!

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.

Weston Electrical Instrument Corporation, 666 Frelinghuysen Ave., Newark 5, N. J.

Tube Production

Tube production operations are pretty familiar to most engineers, but Amperex Electronic Products, Brooklyn, N. Y., have shown their particular methods in an attractive way in a new 24-page booklet that emphasizes the importance of tubes in current military operations. A number of different types of Amperex tubes are illustrated.

LOW FREQ. UNIT

(*Continued from page 97*)

tubes in a conventional three-phase, full-wave circuit. It supplies all the plate power required by the power amplifier unit. Included in this unit are the contactors required for starting the rectifier and for remote control.

Each of the three transmitter units is provided with convenient terminal boards and is arranged so that interconnecting leads can be placed in sheet metal ducts located in the floor. The radio-frequency connection between the exciter unit and the power amplifier unit can be made with a two-conductor, shielded rf cable placed in these same ducts. Connections to the antenna tuning house can be made with a flexible coaxial cable. Both of these cables have a characteristic impedance of 70 ohms.

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

To properly tune these antennas, considerable loading is required and for efficient operation this loading should introduce little loss in the antenna circuit. The inductors have been designed to meet these conditions and include a number of features which are normally disregarded at higher radio frequencies. Their Q at the operating frequencies is at least 1,500. Losses, which would arise if the materials normally used to construct a building entered the field of the inductors, are kept to a minimum by surrounding the inductors with a Faraday screen.

Some of the circuit details employed in the equipment shown may appear quite novel to those accustomed to high-frequency equipment. For example, all tuned circuits are adjusted by means of variometers. If variable capacitors were employed for this purpose, they would be either excessively large or would give only a very limited tuning range.

SEEBURG RECORD CHANGERS

WILL BE THE

CHOICE OF QUALITY

RADIO COMBINATION

MANUFACTURERS

AFTER VICTORY!

ARMY E NAVY

Awarded to the J. P. Seeburg Corporation for outstanding production of war materials in each of its four plants

Seeburg

FINE MUSICAL INSTRUMENTS SINCE 1902

J. P. SEEBURG CORPORATION · CHICAGO

Parts for Distributors Relaxed by WPB

Wholesale radio distributors can obtain a priority rating of AA-5 or better to purchase electronic parts or equipment without special sales authorization from the War Production Board, cut of the idle and excess component stocks in the hands of manufacturers. This relaxation was announced Aug. 21 by Ray C. Ellis, Director of WPB Radio and Radar Division.

The lifting of the restriction resulted from a revision of the Radio and Radar Section of Priorities Regulation 13 of the WPB. Prior to this revision of PR-13, wholesale radio distributors were not permitted to purchase electronic parts or equipment without special sales authorization from WPB.

"E" Awards

Burgess Battery Co., Battery Div., Freeport, Ill.

Electro-Voice Mfg. Co., Inc., 1720 Mishawaha Ave., South Bend, Ind.

Erco Radio Labs., Inc., 231 Main St., Hempstead, L. I. (white star added).

Litton Engineering Laboratories, Redwood City, Calif.

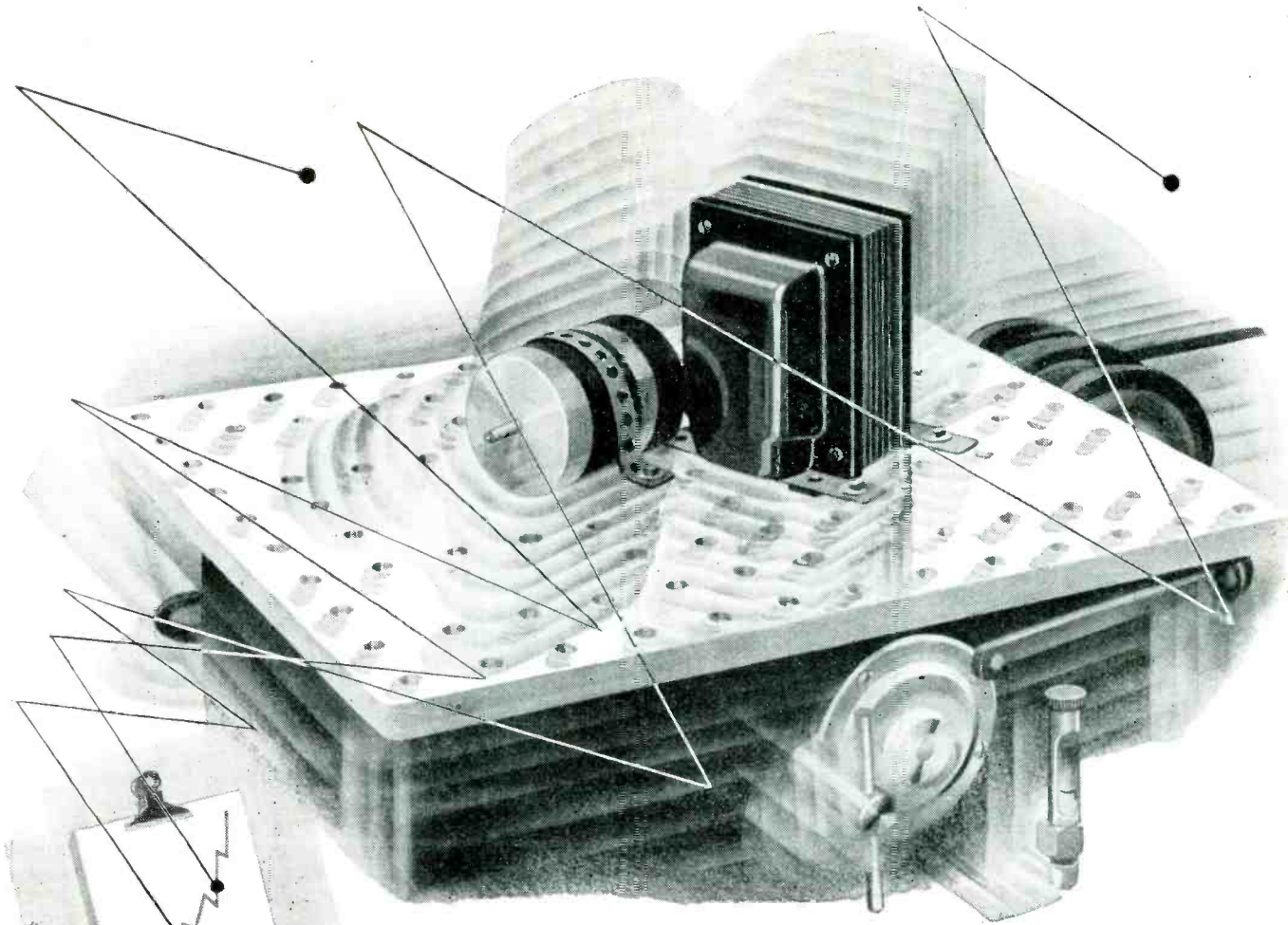
Philco Corp., Tioga & C Sts., Philadelphia, Pa. (3rd star added).

Zenith Radio Corp., 6001 Dickens Ave., Chicago 39, Ill. (3rd star added).

Signal Corps Cites SCR-300

• The new walkie-talkies, the SCR-300 type, went into operation at H-Hour and worked continuously with uniform success in the recent Italian operations and the Anzio beachhead assault, reports from that combat zone to the Chief Signal Officer, Major General Harry C. Ingles, have stated. The reports from the Italian front which were released recently by the War Department stated that the SCR-300 sets, using Frequency Modulation transmission had range and reliability which "met and exceeded every expectation and established them as the most valuable item of radio equipment" in the assault division at the Anzio beachhead operation.

Further commendation of the new walkie-talkie was contained in another official report from Italy to the Chief Signal Officer. It related that the SCR-300 radio sets were used in all radio nets from Division to Infantry companies as well as in cub airplanes used for observation, and the characteristics and performance of this set in-



shaking out the "bugs"!

Vibration is a deadly enemy. Unless equipment and parts can withstand its destructive force, irreparable damage results at crucial moments.

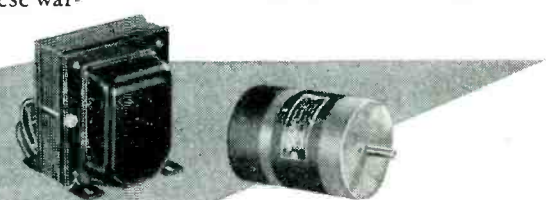
Parts tested on Utah's *Vibration Life-test Equipment* have the "bugs" shaken out of them before they are ready for quantity production; are again proved by this "power dive" test of production runs . . . assuring unfailing performance.

Equipment being tested is subject to vibration up to 25G.

As a result of this and other tests, many engineers' "brain children" grow up in the Utah Laboratories and on the production lines to play their parts in today's war effort. *Tomorrow*, these war-created radio and electronic improvements will be adapted to peacetime needs — aided by these new and more comprehensive testing techniques.

★ ★ ★

Every Product Made for the Trade, by Utah, Is Thoroughly Tested and Approved



Keyed to "tomorrow's" demands: Utah transformers, speakers, vibrators, vitreous enamel resistors, wirewound controls, plugs, jacks, switches and small electric motors.

ARMY E NAVY

utah

Utah Radio Products Company, 850 Orleans Street, Chicago 10, Ill.

Army's SCR 300 portable FM equipment in use

fluenced the decision to rely on it heavily for the (Anzio) operation. Forecasting its future major role in the European invasion operations, the report in connection with the Italian landings stated that the SCR-300 "is the most successful instrument yet devised for amphibious communications."

The walkie-talkie, the man-packed radio set used by front line troops for short and direct communications, is now being supplied in quantity to troops overseas and at home. Due to the use of Frequency Modulation which permits transmission and reception without static, its range is triple that of the old model and it has remarkable clarity of tone.

Other improvements include an improved superheterodyne instead of the old type super-regenerative receiver which facilitates "netting" or the use of two or more sets on the same frequency for intercommunication. Two antennas are provided instead of one and in addition to the standard vertical antenna, a goose-neck type is included so that the soldier can use the set while prone on the ground or in a foxhole. A headset is included with the new model enabling the operator to listen in for calls while a handset is available for use by the officer in command. Miniature radio tubes are used with a resultant increase in the life of batteries and in compactness. The entire set which weighs about 35 pounds is carried by the soldier like a haversack. It is treatede against rain and immersion.

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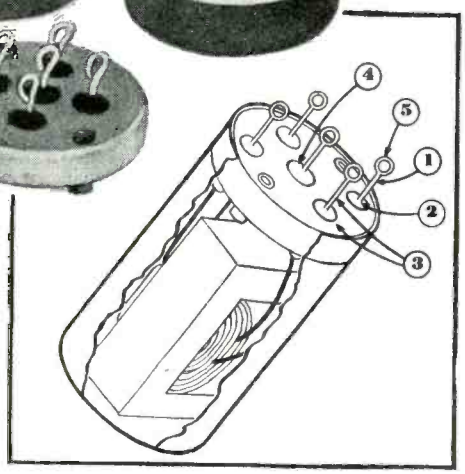
FOSTER TRANSFORMERS

MEET EVERY NEW NEED WITH THE SAME DEPENDABLE PERFORMANCE THAT HAS MADE THEM *"FIRST"* IN ELECTRONIC REQUIREMENTS.



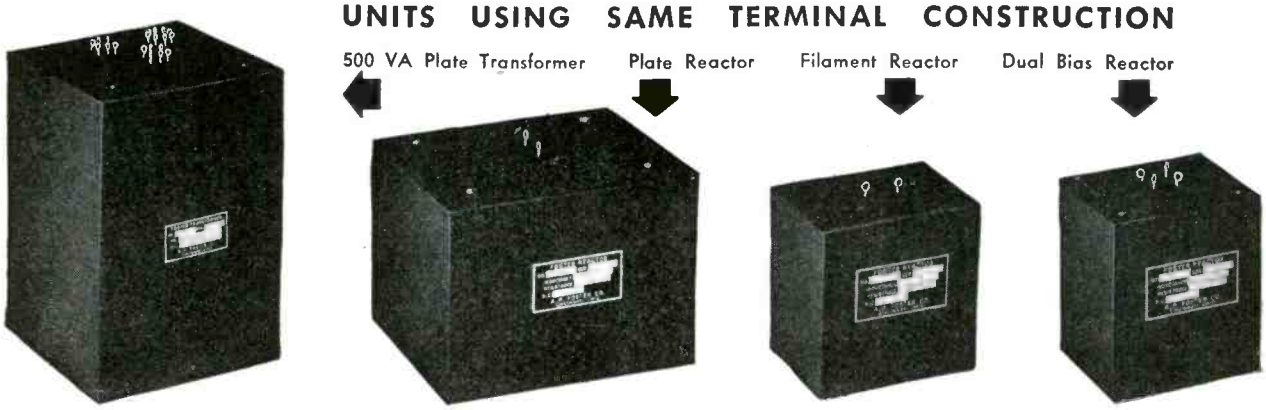
FOSTER IS FIRST AGAIN WITH THEIR NEW "VITROSEAL" TERMINAL

a development that has definite advantages over other types of hermetic seals for tropical use.

1. The electrode can be bent at an angle 90° from the upright position without breaking the glass in the seal. In fact, it can be bent and straightened several times and then the terminal will break *before* the glass is damaged.
2. Extremely high resistance to thermal shock.
3. The metallic parts are cold rolled steel, rather than expensive alloys.
4. The terminals are fused directly into the metal in multiple. Ordinary seals are made up individually and are soldered into holes in the transformer case.
5. A loop is provided for easy hook-up.

UNITS USING SAME TERMINAL CONSTRUCTION

500 VA Plate Transformer | Plate Reactor | Filament Reactor | Dual Bias Reactor



SPECIALISTS IN BUILDING TRANSFORMERS SINCE 1938

A. P. FOSTER COMPANY

TRANSFORMER ENGINEERS & MANUFACTURERS

719 WYOMING AVENUE, LOCKLAND 15, OHIO

SOLVING SURPLUS PROBLEMS

Government machinery, plus cooperation and intelligent planning by manufacturers will ease burden

● For several years industry has been concerned only with building up a wall of safety for the preservation of democratic civilization, in the form of equipment for military uses. The policy of making every useful type of apparatus available to an extent that would satisfy all possible requirements of any type of warfare, has undoubtedly saved a vast number of lives and has made the final outcome certain.

For each piece of equipment a stock of spares has been assembled in service depots in many countries. In many cases unusually rugged construction of equipment resulting from changes in manufacturing technic which has been brought about by experience and progress, will make vast stores of spare components and completed equipment available for disposal after each stage of demobilization.

These stocks, in some instances, might be enough to satisfy peacetime consumption for many years. Their sale indiscriminately at distress prices would certainly demoralize certain industries completely, at a time when postwar employment must be maintained at any cost.

One extreme policy advocates the dumping of all surplus products in the ocean, if those products have any conceivable utility for civilians. Although this may seem extreme, it is advocated by a surprisingly large group. On the other hand the time-honored American custom of auctioning off such surplus material to the highest bidder, would, unless carefully controlled, result in the disastrous dumping so feared by labor and management.

What appears to be a well-conceived plan following a medium path has now been set up by the RFC, investing in the Defense Supplies Corporation control over surplus war property and its disposal.* The DSC plan endeavors to secure full utilization of surplus component parts as practicable, both within the Government and for civilian consumption, and to distribute such surplus component parts as economically as possible with a minimum of disturbance of the industry and through existing channels of distribution.

This means that the agencies that produced the apparatus originally must cooperate to the fullest extent in furnishing facilities and services for disposing of any surplus in an orderly manner.

Many classes of apparatus are involved: (1) complete receivers and transmitters for a special purpose. These will probably be of use only by other government agencies (forestry reclamation, etc.), and by a certain number of radio amateurs, experimenters and college laboratories. Some items may even be convertible for special industrial uses, as by railroads. (2) Components such as resistors, and other parts, and receiving tubes which probably can be mostly absorbed by civilian demand to fill the existing "vacuum." (3) Laboratory equipment of many types, transmitting tubes and such components that are available in such quantities, that normal production would have to be curtailed for many years when these surpluses are made available to public buyers.

In all of these classes, the DSC plan forms an admirable working basis although in the first and third categories some additional planning will be found necessary. For example, take the matter of radio transmitting tubes:

It seems that already several million transmitting tubes covering some forty-odd types are ready to be assigned to the surplus status, and it is quite possible that several times this number, in foreign warehouses, near the scene of operations, may ultimately be added to this list. It is assumed that military procurement agencies are aware of both the inventory figures and the projected needs and that no feverish and inexcusable activ-

**The DSC, organized pursuant to Executive Order No. 9425 of the Surplus War Property Administrator, proposes to handle the sale of such material through the existing organizations that have manufactured and sold such items and have full facilities and personnel available for such sales receiving a commission for such services. The rules and methods governing such disposal have been carefully outlined by the DSC, and it is believed a substantial portion of the surplus may come within those restrictions.*

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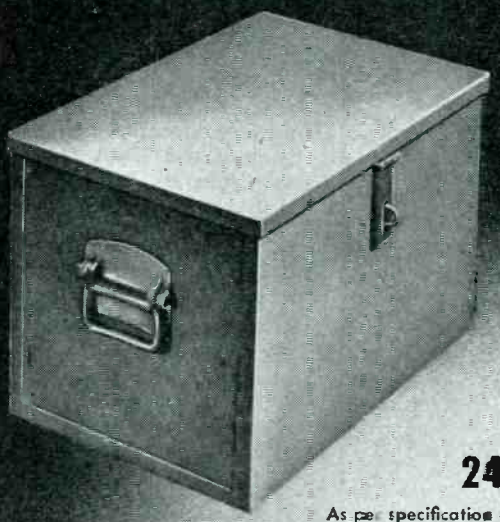

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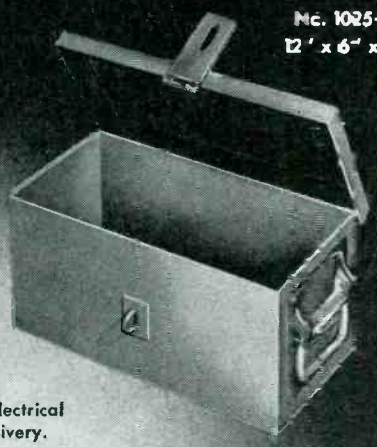

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1025- 3	12	12	6	1025-16	24	15	15
1025- 4	12	9	9	1025-17	24	18	12
1025- 5	18	9	6	1025-18	24	18	15
1025- 6	18	9	9	1025-19	24	18	18
1025- 7	18	12	9	1025-20	24	12	9
1025- 8	18	6	6	1025-23	30	15	9
1025- 9	18	15	9	1025-14	30	15	12
1025-10	18	12	6	1025-22	36	12	9
1025-11	18	15	12	1025-21	42	9	9
1025-12	18	12	12	1025-24	42	12	9

No. 1025—14
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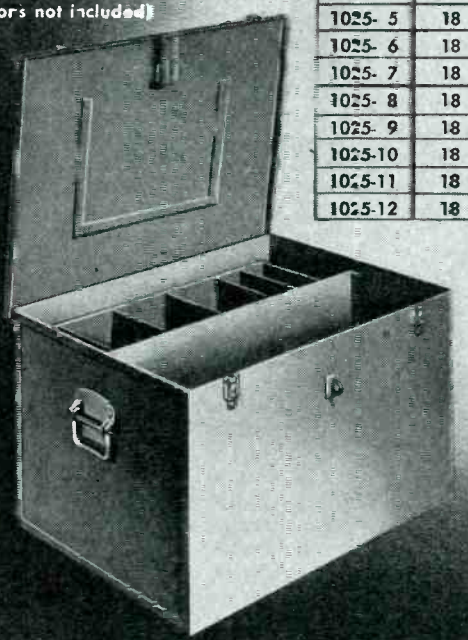

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ity is exerted in building up this stock to higher levels, where surpluses are already indicated.

It is manifestly a job for the transmitting tube industry as a whole, to provide for the resale as one example of 250,000 tubes of a particular 100-watt type, especially when many other types (having nominally competing characteristics) are also made available as surplus at the same time.

To be able to make recommendations and to take care of the DSC commitments, a Marketing Research Committee has been formed among members of the Tube section of the RMA to study this resale market and to produce an equitable plan that will enable all tubes to be usefully employed, even if their disposition covers several years.

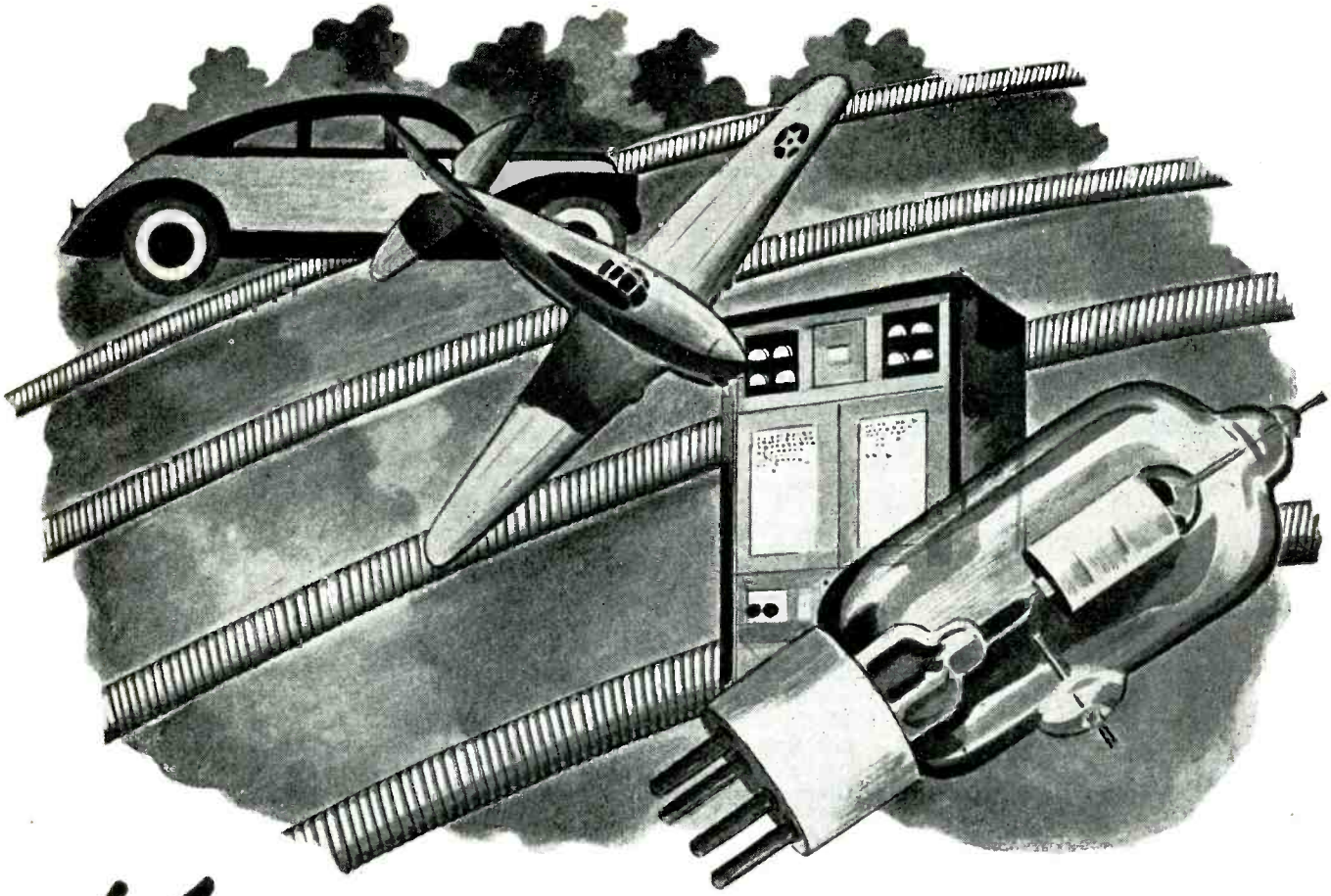
This committee expects to map out the normal needs of the industry for the next few years, securing information as to the immediate replacement needs in all fields, and would endeavor to secure a cooperative program as to tube renewals for its members with the plan of slowly disposing a certain amount of this production surplus over a period of several years, along with a certain amount of new production.

Such a survey will doubtless find a future market for X per cent of the listed surplus, leaving (100 — X per cent) still to be considered. Here is where the fullest use of American ingenuity can come into the picture. There are a great many potential fields of activity for electronic products, that are handicapped by the cost of development and the cost of service for the first few years of operation. It generally happens that experience and continued research makes what are uneconomic processes at the start, of value in later years, in fact the start of whole new industries. It is suggested, therefore, that numerous projects be investigated with the idea of opening up new services.

Industrial cooking of foods comes to mind, and has proved possible if not economically comparable with present methods. Could enough pilot installations be established in the many factories of this field, subsidized with access to these surplus stores of components at a reasonable figure, to tide these projects over the first few years, where development costs, rapid obsolescence due to progress, and lower cost of competing methods all form a hurdle that is often not easy to pass.

Other developmental projects having similar future prospects are: electronic cooking in homes, precipitation, greater amount of electronic equipment made available to college laboratories, uhf and television relays to outlying districts,

(*Continued on page* 256)



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IRAC WOULD INCREASE FM AND TELEVISION SPACE, GIVE NONE TO INTERNATIONAL BC

Joint industry-government conference staged by State Department to pave way for revision of Madrid-Cairo

• Formulated on the premise that the maximum needs of the various radio services cannot be fulfilled on the basis of the present spectrum and holding to the principle of giving as adequate treatment as possible to the so-called radio safety services, notably aviation and navigation aids, the proposed international radio frequency allocation of the Interdepartment Radio Advisory Committee seemed certain to remain the basic structure of the United States allocation revisions for the coming world telecommunications conference. Of course, out of the deliberations of the government and industry representatives which commenced in Washington August 11 and 12 under the auspices of the State Department's technical communications planning committee preparing the American position for the postwar conferences, there will be a number of changes before the final draft, but it was felt by the majority of the approximately 200 persons at the meetings that the IRAC allocation plan would not suffer any drastic overhauling.

Some doubts, however, arose from certain groups of industry representatives as to the broad scope of the proposed Central Frequency Registration Board, projected as a revision of the International Radio Regulations. While the members of the State Department's technical subcommittee of the Special Committee on Communications, headed by Dr. J. H. Dellinger, radio chief of the Bureau of Standards, contended that such a registration bureau was most desirable because of the present advances in international radio, several spokesmen, including Admiral S. C. Hooper and Col. W. R. Blair of Automatic Electric and Commissioner E. K. Jett, felt the United States position must be fully protected. Col. Blair proposed that the Board's membership should represent each region of the world; Admiral Hooper warned that international boards might start out satisfactorily but often ended up as political agencies; and Commissioner Jett wanted the Board's powers carefully defined so that it would remain largely advisory rather than regulatory. The Berne Bureau was agreed to be operating satisfactorily despite the exigencies of the war, but new machinery for radio frequency registration and to prevent international interferences was greatly needed in the opinion of the governmental proponents of the change. It is felt that a compromise proposal for the Board will be evolved in later preparatory meetings.

Both Francis Colt deWolf, Chief of the State Department's Telecommunications Division who made the opening address Aug. 11, and Dr. Dellinger, who presided at both the general meeting and over the allocations committee, emphasized that the IRAC plan was a nucleus for discussion and that the industry and government representatives should regard it as a starting point for their deliberations. Mr. deWolf stressed the need for the utmost speed in the formulation of the American position for the coming conferences — the Inter-American parley at Rio de Janeiro early next year and the postwar world conference—and asked the government-industry groups to finish their studies by December 1 at the latest so that the Berne Special Committee on Communications could forward the recommendations to the State Department's Postwar Planning Committee. Dr. Dellinger asked that the Radio Technical Planning Board help the preparatory group with all technical data which will be useful in the international field, especially that related to television.

The only notes of opposition to the IRAC proposed allocation came from the spokesmen for the International broadcasting group—at least a segment of that field as represented by Walter S. Lemmon, President of the Worldwide Broadcasting Foundation, and his chief engineer E. K. Cohan, former CBS chief engineer. Both Mr. Lemmon and Mr. Cohan protested the de-

FCC Plans Hearing On Frequency Allocations

With the aim of determining the frequency requirements of non-governmental radio services in the United States, the FCC decided a few days after the IRAC meeting that it will start public hearings beginning September 28 to obtain information and views on postwar frequency allocation policy.

The FCC, it is understood, is particularly interested in reexamining the IRAC proposal for television, FM, and shortwave broadcasting with the possible purposes of giving these services more space. The FCC disclosed that it planned to work closely with the Radio Technical Planning Board in its studies.

cision of IRAC that no special space should be set aside for an international broadcasting band or bands and contended that this was most harmful to the interests of the United States because American shortwave broadcasting through the operations of the OWI and CIAA had been built up to a No. 1 position throughout the world during the war. (See page 76, this issue.)

One group, headed by Captain E. M. Webster of the Coast Guard, discussed proposed changes in the operational portion of the International Radio Regulations and met again on August 23. There was general agreement that a new distress call frequency of 2070 kc, besides the universal 500 kc wavelength, should be approved. This would enable aviation and small boats to operate on the proposed new wavelength. It was emphasized that the distress call had not been changed for 40 years. Another group, headed by Harvey Otterman of the State Department, dealing with the revision of the Madrid Convention of 1932, will hold another meeting in early September. The most important preparatory body, that on Allocations, headed by Dr. Dellinger, met August 11 and 12 and will hold another session after Labor Day.

Former Commissioner T. A. M. Craven, now Eastern Vice President of the Cowles Radio interests who had headed the IRAC committee on allocations which prepared the plan, explained the IRAC allocation in detail, showing the percentage breakdown for each service in connection with the various frequency ranges. He cited that the reason for leaving out shortwave broadcasting was that in the 3.5 to 18 megacycle range, useful for long distance communication, the present international broadcasting of the United States and Great Britain comprised 36 stations each, and Russia had many more so that if all nations were given room in this range most of this portion of the spectrum would be assigned to broadcasting.

Commander Craven expressed the belief that allocation under the IRAC plan of nine 6 mc channels between 54 and 108 mc for television was adequate because of the proposal for thirty 16 mc channels between 460 and 956 mc for color television and eventual use of 31 television channels of 16 mc width between 450 and 1000 mc. He declared that the lower portion of the spectrum was only temporary for video and that the RTPB panel expects television to go higher. Dr. B. E. Shackelford of RCA, together with Robert Shelby of NBC, later countered this view by emphasizing that the small space allotted to television in the lower portion might well prevent the new tele-

vision industry from launching into full bloom after the war. Mr. Shelby disagreed with the thought of Commander Craven, which had also been uttered the previous day by CBS Engineer William B. Lodge, that the manufacturers through war inventions could speedily produce color television transmitters and receivers.

Del Rentzel, President of Aeronautical Radio, stressed that aviation because it operates both over land and water needed special attention in radio communications navigation and safety aids. Many new devices, developed during the war, will add to the safety of flying, he cited.

The IRAC plan had recognized and had emphasized the need for radio space for the aviation industry in its proposed allocations for intercontinental and overseas flying in the high frequency portion. It was visualized that air-ground services will share maritime mobile frequencies for the same type of traffic and will communicate with maritime land stations.

Broadcast services—FM and television and their relay links—were assigned approximately 61 per cent of the spectrum between 42 and 1000 megacycles. FM broadcasting was allotted a projected group of sixty 200 kc channels in the band between 42 and 54 megacycles. But it was brought out that propagation interferences might have to be studied in this field to determine FM's final location. The IRAC was understood to have regarded as absolutely essential that sufficient space between 100 and 400 megacycles should be provided for maritime and aviation services, especially aids to air and sea navigation through the new radar developments.

Under the new war-devised engineering technics IRAC's plan indicated fixed communications can utilize their space—53.03 per cent between 3.5 and 18 megacycles and 85.07 per cent between 18 and 25 megacycles—to the fullest possible efficiency after the war when it envisaged there may be necessary 150 United States transoceanic channels to provide an efficient and flexible worldwide radio communication service. International broadcasting can utilize the point-to-point circuits to carry their programs. It may become necessary to consider the use of cables to a more intensified degree to meet the expanded communications requirements of the globe. If international broadcasting is to take precedence it would curtail international radio communications most severely.

Amateur radio service was recognized with space proposed in the long and short distance ranges and in the 125 to 1125 mc range. The amateurs not only have been

most useful in radio pioneering but form an extremely valuable nucleus of radio personnel for the Armed Services and their frequencies too can be taken over by the services in time of war. Industrial electronic services should concentrate on reducing radiation from such devices to an insignificant amount by filtering and insulation.

There will undoubtedly be a considerable amount of revision on the proposed IRAC assignments when the RTPB reports and studies are correlated with the work of the government experts. Certain mobile services, including short-range marine radiotelephone, bus and taxi dispatching and more police spectrum space, are felt to need added attention before a final decision.

SURPLUS PROBLEMS

(*Continued from page* 248)

civilian airways guidance, automatic weather observation stations, harbor guide systems, etc.

At all events, immediate activity in some of these fields forms a potential backlog for future business that will be ready when the first flush of producing to fill the vacuum that exists in consumer goods (brought about by three years of all-out production of military goods). These subsidies would be in fields where immediate postwar activity would not be expected, and

so all new projected uses of tubes here would not influence normal production for a while, but would in many cases provide new markets a few years hence.

There would be many details to be worked out to satisfy all concerned. It would be desirable that such equipment consignments be made only of components for which an abnormal surplus is indicated, more than, say, three years' needs based on the marketing survey, and that each consignment have the approval of the D.S.R.D., as to the technical importance of each individual development as to its probable ultimate chances in providing additional contentments for peaceful living.—R.R.B.

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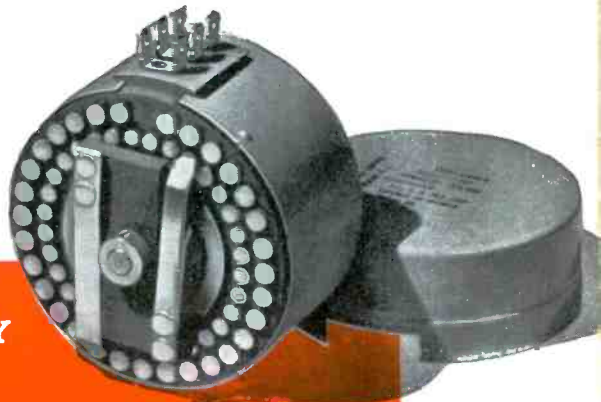

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