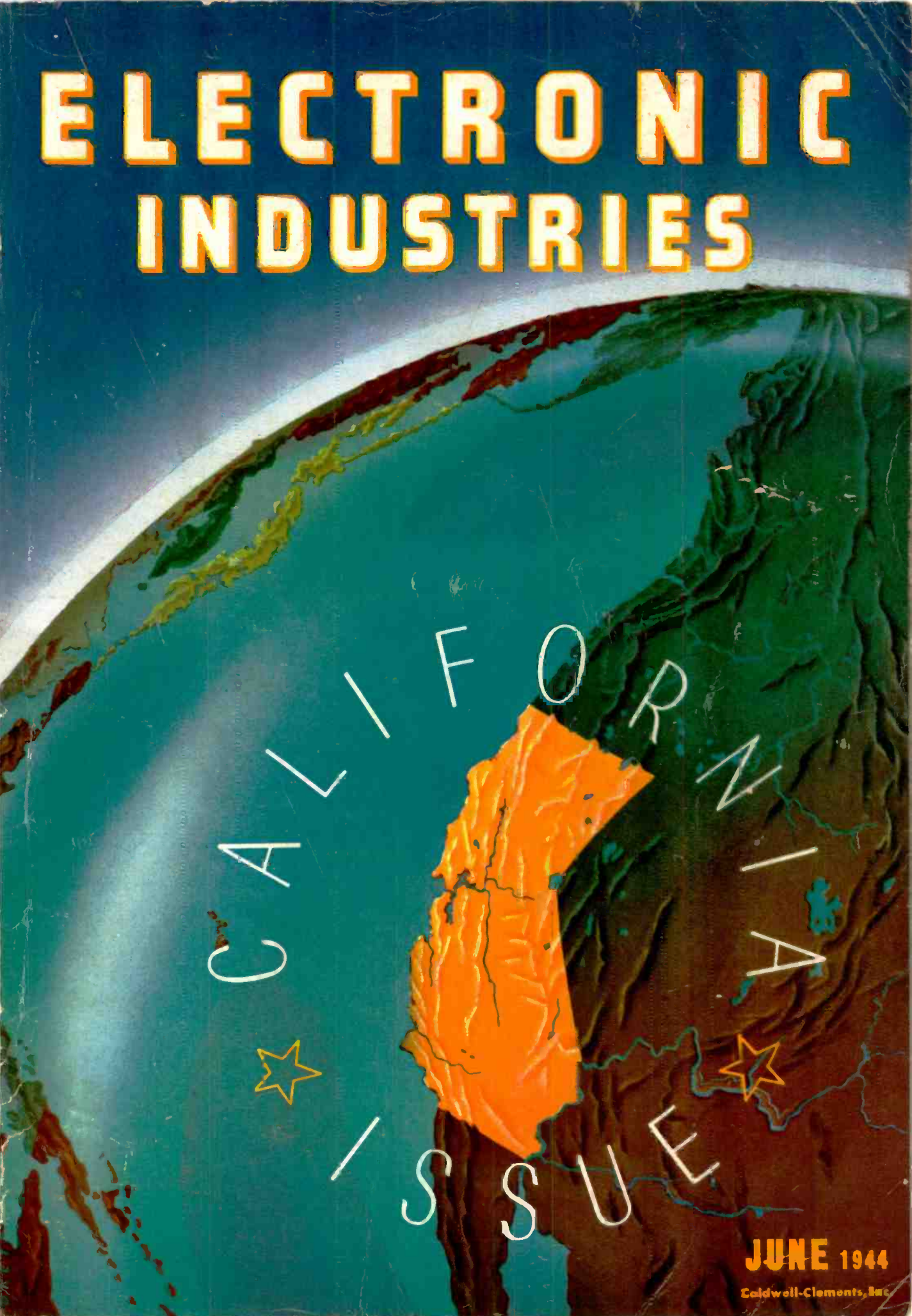
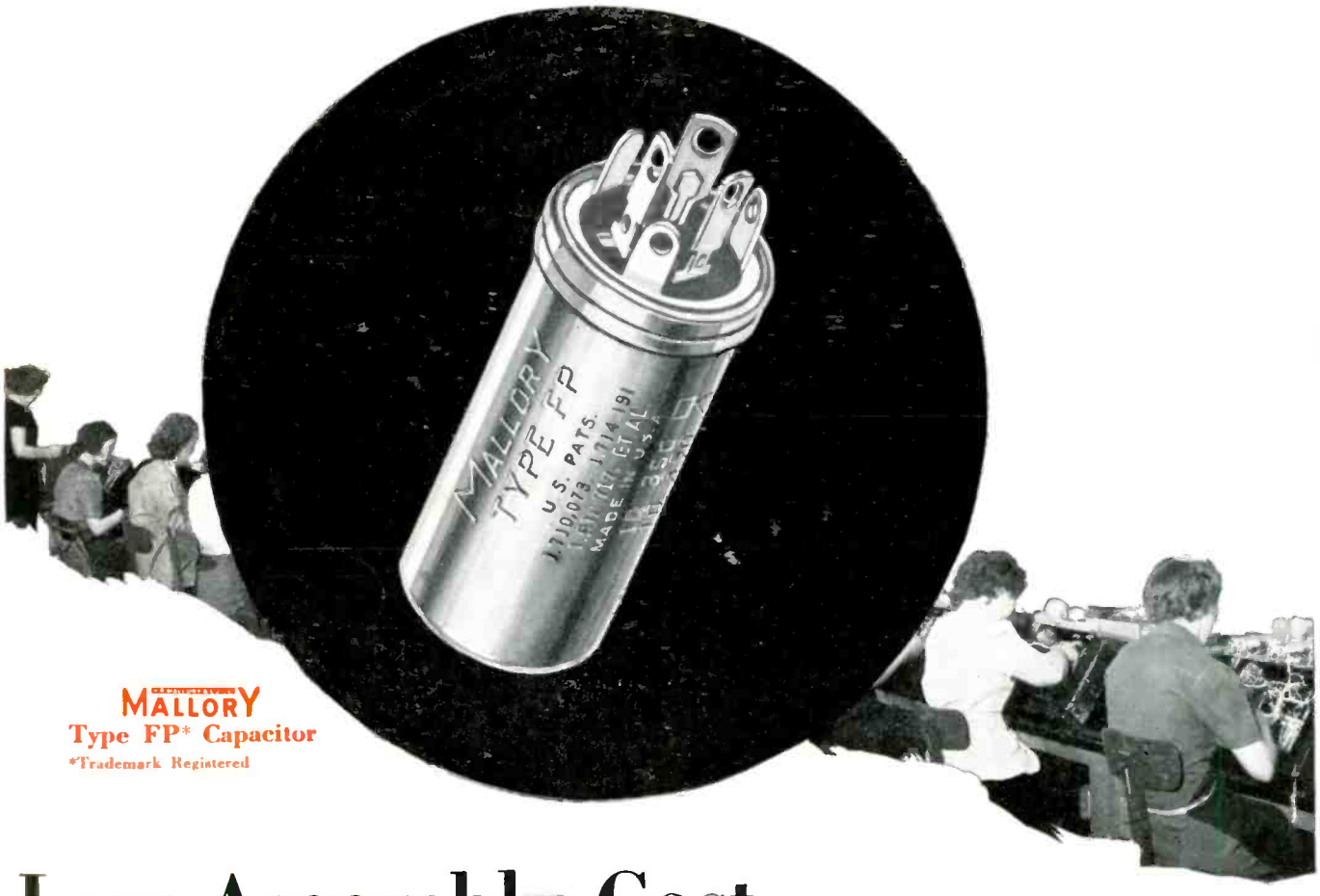
ELECTRONIC INDUSTRIES



JUNE 1944

Caldwell-Clements, Inc.



MALLORY
Type FP* Capacitor
*Trademark Registered

Low Assembly Cost

Simplification of assembly operations is the keynote to improved production. Mallory FP Capacitors are designed to combine long life with characteristics that speed assembly, thanks to simple, efficient methods of installation.

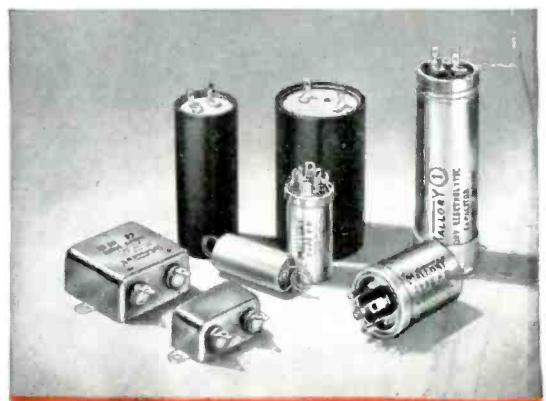
Remember the time when every new radio set called for special capacitors? That meant elaborate prints, lengthy life tests, costly experimentation. With Mallory FP Capacitors, all of that has been eliminated. One life test and a simple print solve formerly troublesome problems. The simplest check quickly shows the remarkable uniformity of Mallory FP Capacitors.

Mallory FP's, with their self-contained mounting feature, will certainly simplify your assembly. Regardless of rating, they mount identically, eliminate handling of extra hardware, avoid worker confusion, reduce servicing expense, simplify stock and catalog records.

See your Mallory distributor or write direct for free literature or information concerning your specific capacitor assembly problems.

P. R. MALLORY & CO., INC., INDIANAPOLS 6, INDIANA

Free the Valiant . . . Speed Victory . . . Buy War Bonds



P. R. MALLORY & CO. Inc.

MALLORY
ELECTROLYTIC,
FILM AND PAPER
CAPACITORS

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

★ IN THIS ISSUE — JUNE, 1944 ★

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Why AMPEREX

WATER AND AIR COOLED

TRANSMITTING and RECTIFYING TUBES

Major developments by Amperex engineers have considerably extended the working hours of our tubes. Out of this one "Amperextra" alone have come other desirable benefits. Economies in vital materials have been affected. Longer life has decreased the number of tube replacements. Operating life of devices for war has been prolonged. If you are designing equipment for current or peacetime pursuits, it will pay you to obtain full details of our "Amperextra" engineering service.

One of a series showing Amperex tubes in the making

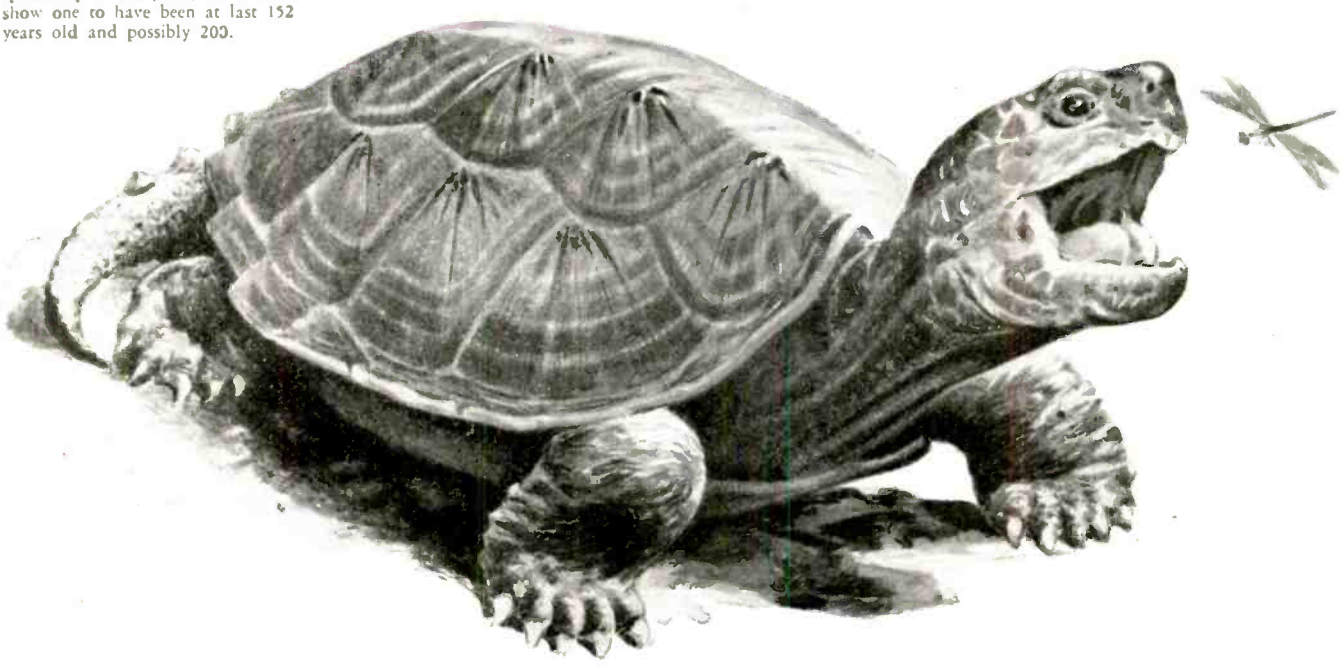
ARMY E NAVY

It's easy to give blood ... no aches, no pains, no ill after effects. See your local Red Cross.

AMPEREX ELECTRONIC PRODUCTS

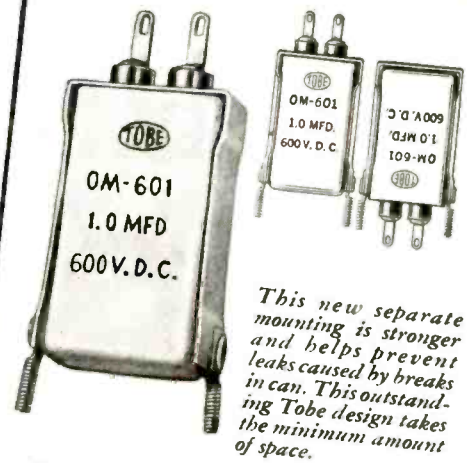
79 WASHINGTON STREET • BROOKLYN 1, N. Y.

THE GIANT TORTOISE, believed to outlive all vertebrae. Its usual life span is up to 100 years, but records show one to have been at last 152 years old and possibly 200.



STANDARD OF STAMINA

What you want most in a capacitor is what you are sure of getting in TOBE Capacitors: . . . *long life!* Your proof is in Tobe's enviable record of practically no "returns". Frequent, rigid inspections eliminate uncertainty. Constant research brings constant improvement. The original capacitor with hold-down bracket, Tobe OM-601, offers many definite advantages. This capacitor is strong, compact and space-saving. The hold-down bracket permits the use of either inverted or upright terminals, with wiring underneath or on top of chassis. Write for details and samples (1.0 mfd and 2.0 mfd). Tobe engineers are glad to be of service.



This new separate mounting is stronger and helps prevent leaks caused by breaks in can. This outstanding Tobe design takes the minimum amount of space.

LONG LIFE ASSURED!

SPECIFICATIONS TOBE OM-601 CAPACITORS

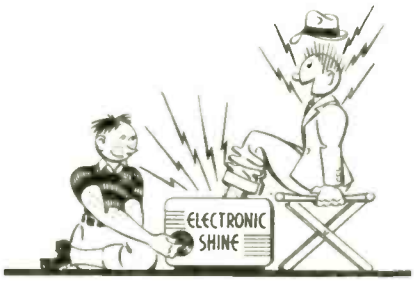
TYPE	OM
RATINGS	.05 to 2.0 mfd. 600 V. D. C. .05 mfd. to 1.0 mfd. 1,000 V. D. C.
STANDARD CAPACITY TOLERANCE	10%
TEST VOLTAGE	Twice D. C. rating
GROUND TEST	2,500 Volts, D. C.
OPERATING TEMPERATURE	55°F to 185°F
MOUNTING HOLE CENTERS	1½"
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms .25 to 0.5 mfd. 12,000 megohms 1.0 to 2.0 mfd. 12,000 megohms
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	Width ⅜", length 15/16", ht. 2¼"

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A small part in Victory Today . . **A BIG PART IN INDUSTRY TOMORROW**

Must Be the Sun!

Well, its probably alright for the record, so—Hollywood boasts an Electronic Bootblack; maybe he uses a tube of polish in place of the usual bottle. Anyway, he claims to give you an electric shine. There are a couple of Radio Barbers in downtown Los Angeles, and one enterprising gasoline filling station impresario on the road that winds through the hills to Inglewood has an illuminated sign advertising "Radar Supersensitized Ethyl".



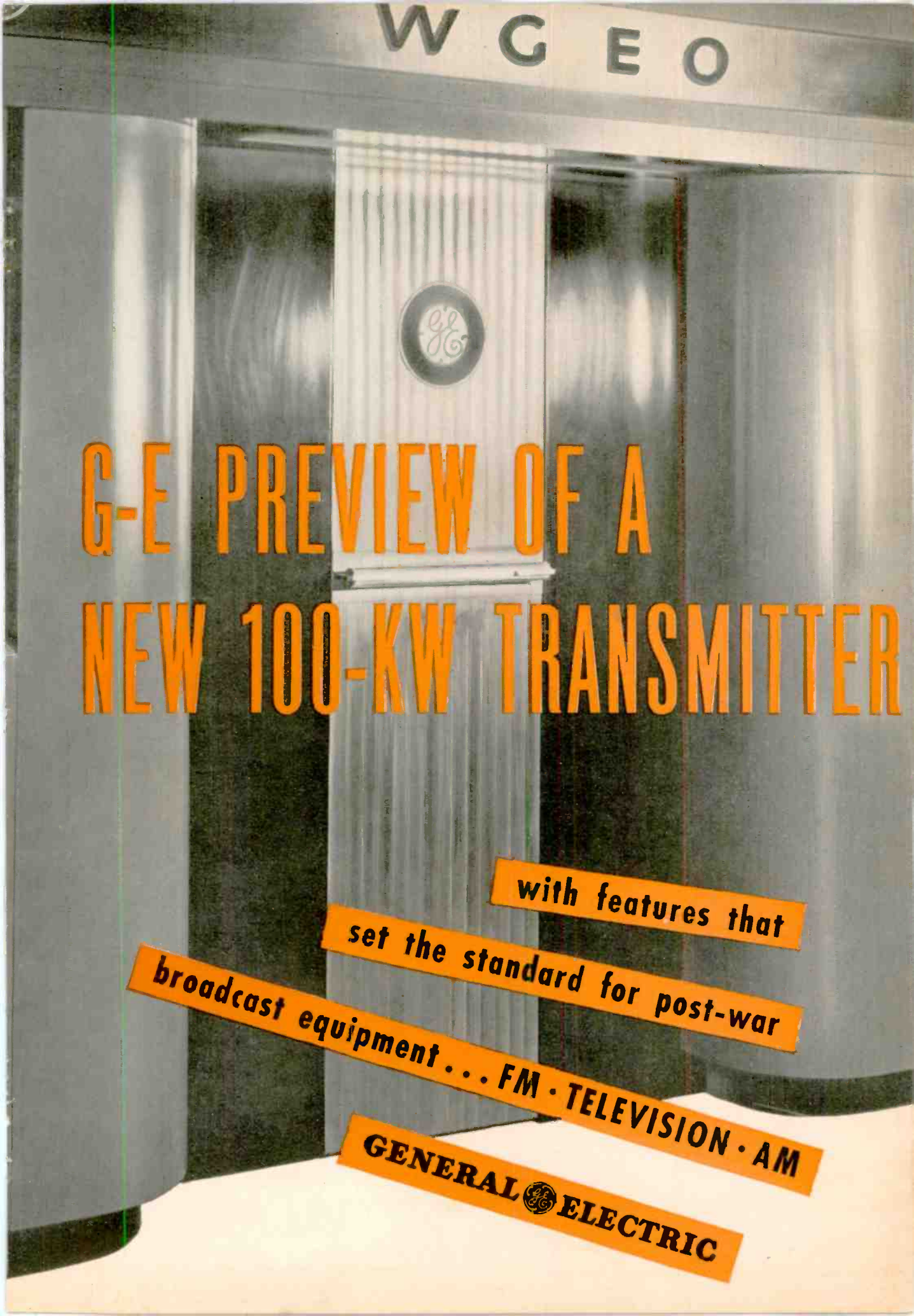
And speaking of illumination, it might surprise anyone less easily surprised to discover how many of the electric sign people have to some extent re-christened company names by the simple expedient of adding the term "Electronic".

But that isn't confined to the lighting people alone. It goes for manufacturers of therapeutic lamps and home vibrators, and one manufacturer whose principal business is rebuilding broken down phonographs has gone "Electronic", at least in title.

Even the chiropractors have felt the influence. One of 'em advertises "treatment with radio-electric waves"; another offers "radionics" along with colonics and dietics: still another is selling "radionic" laboratory tests; three or four more are satisfied that just plain "Radionics" will draw the trade. And there isn't a single mention of diathermy any more. Too old-fashioned.

And when those places that everyone else calls by the generic term "factory" goes slightly off the conservative beam it becomes either a "Laboratory", or maybe a "Research" organization. One such organization that goes whole hog by including both Electronic and Laboratory on its letterhead is an old-fashioned (very) factory producing optical equipment that may by some stretch of the imagination have some remote connection with either term.

Then there is the funny one going the rounds in Hollywood, which is quite db conscious, especially around its sound sets. Seems food has other things mixed up with it in addition to vitamins. You guessed it—db's. Celery and crisp toast, for example, definitely have db's, and some other foods to an only slightly lesser extent. At any rate it is reported that a group of supers had to eat "noiseless" lamb chops, fashioned out of mashed potatoes colored with gravy during the shooting of one big scene where the principals were required to talk through the banquet. —SPM.



G-E PREVIEW OF A NEW 100-KW TRANSMITTER

with features that set the standard for post-war broadcast equipment . . . FM · TELEVISION · AM

GENERAL ELECTRIC

10 outstanding new features

FOR PEAK EFFICIENCY—MAXIMUM ACCESSIBILITY—COMPLETE SAFETY—ADVANCED DESIGN

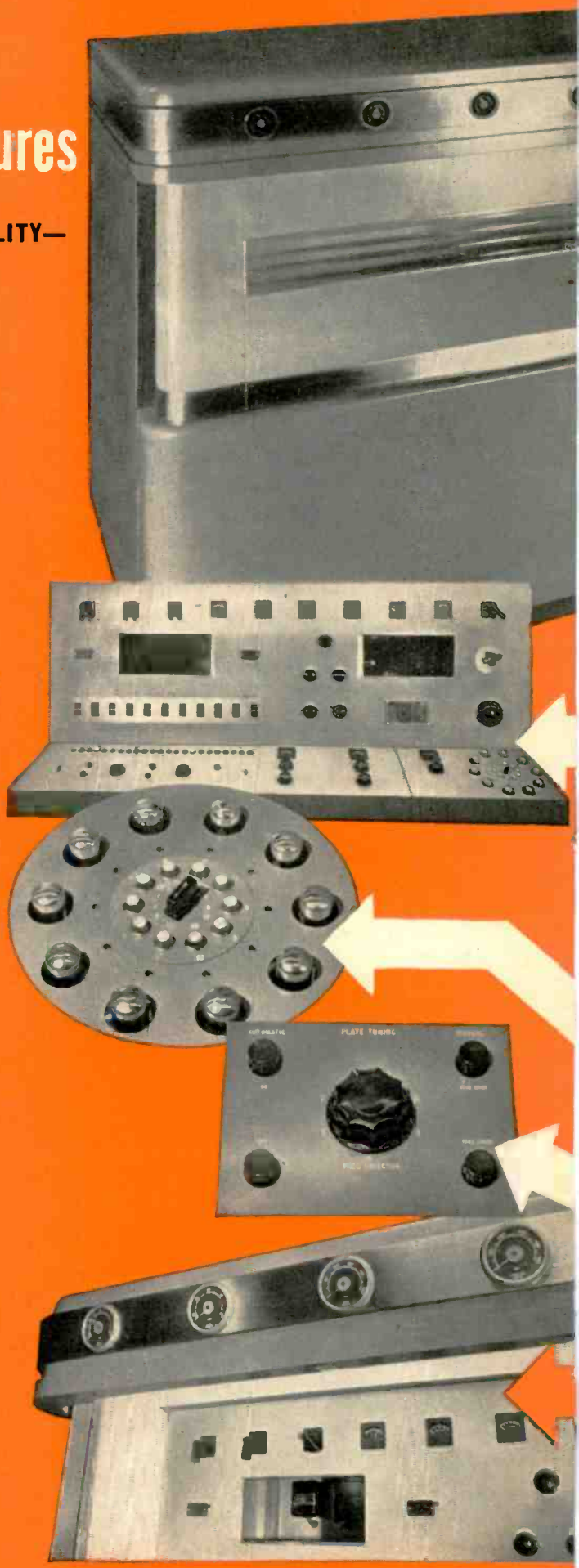
From General Electric's broad background of experience in building *all* of America's 100-kw international transmitters, has sprung a *new* transmitter so revolutionary in design and performance and operating features that it literally is setting the post-war standards for the entire "family" of G-E broadcast equipment . . . FM, Television, and AM.

Forty feet of streamlined beauty sets the pace in styling for the whole broadcast industry. . . . *Complete accessibility* of all components permits rapid and effective maintenance. . . . *Complete safety* is provided by both mechanical and electrical interlocks that make it impossible for operating personnel to enter the high voltage areas without manually operating *all* interlocks. *Transformers cooled with non-inflammable Pyranol** and enclosed air-break contactors provide additional safety features—reducing fire hazard.

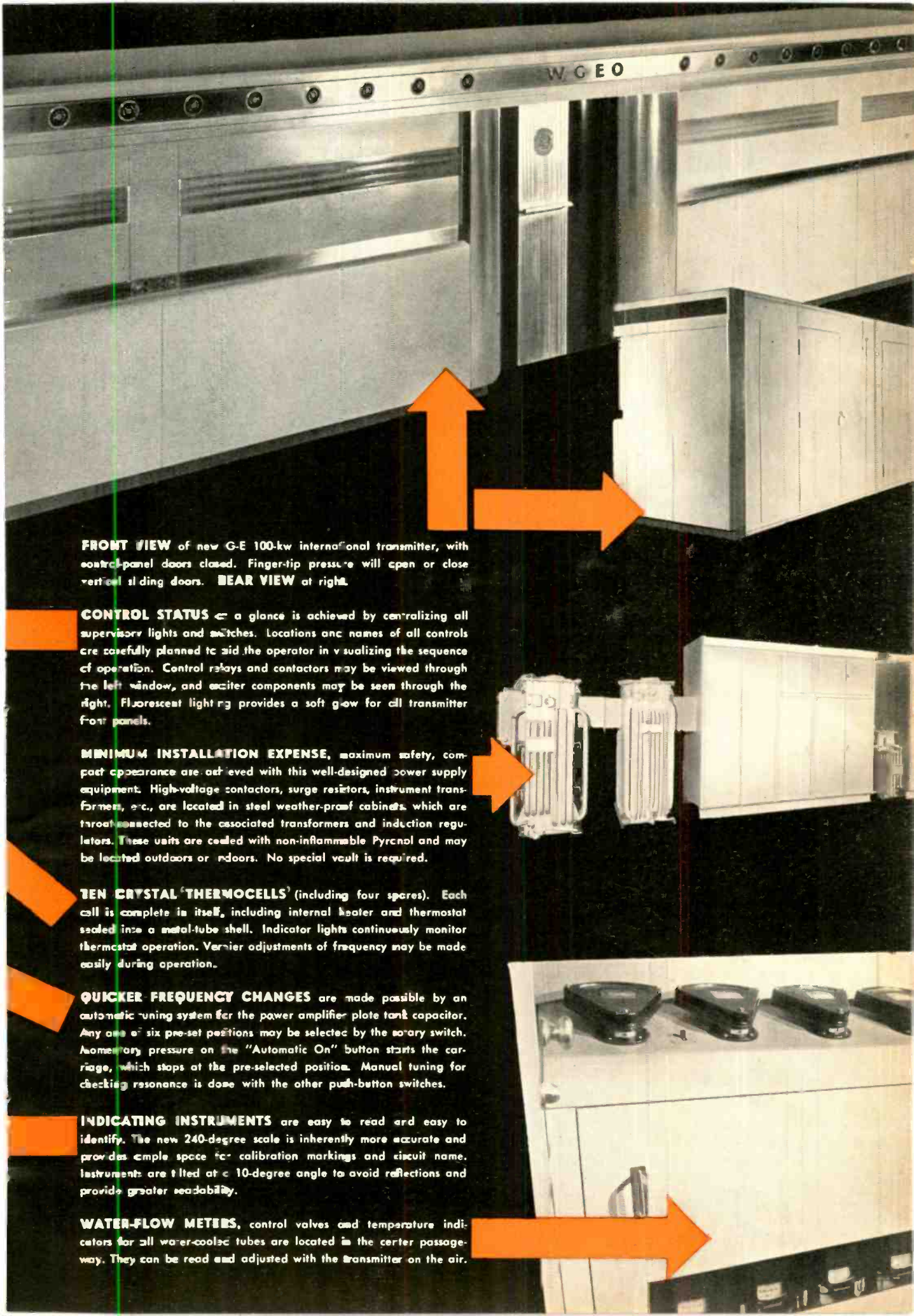
Centralized supervisory control tells at a glance the status of all circuits. . . . *Sectionalized construction*, using standard cubicles, makes installation simple, less costly, and results in improved appearance. . . . *Sturdy construction*, employing heavy steel sheets, provides strong, rigid cubicles that permit the compact assembly of heavy-duty components on walls and ceilings. Sub-assemblies need not be removed for adjustment or maintenance.

All instruments are easy to read and are grouped for easy observation. . . . *Peak performance* is assured by electrical features such as: Automatic filament voltage regulator. Supervisory light system. Continuous metering of power input. Automatic reclosure for short-duration outages. Improved automatic control of modulator bias. Protection of tungsten filament tubes against starting surges for longer tube life. . . . *Input power supply*—2400 or 4160 volts, 50/60 cycles. Easy to change after installation by a few connections.

Many of these added features will come to you with your post-war installation of a G-E transmitter; and in this forerunner of tomorrow's transmitters they re-emphasize the "know how," experience, research, and ability of General Electric to deal with your FM, Television, or AM problems. General Electric will be glad to discuss such problems with you. Write to *Electronics Department, General Electric, Schenectady, New York.*



*REG. TRADE-MARK



FRONT VIEW of new G-E 100-kw international transmitter, with control-panel doors closed. Finger-tip pressure will open or close vertical sliding doors. **REAR VIEW** at right.

CONTROL STATUS at a glance is achieved by centralizing all supervisory lights and switches. Locations and names of all controls are carefully planned to aid the operator in visualizing the sequence of operation. Control relays and contactors may be viewed through the left window, and exciter components may be seen through the right. Fluorescent lighting provides a soft glow for all transmitter front panels.

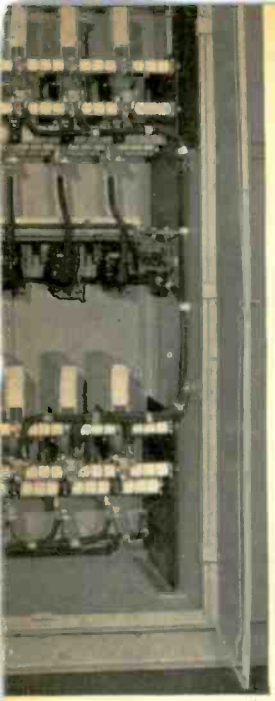
MINIMUM INSTALLATION EXPENSE, maximum safety, compact appearance are achieved with this well-designed power supply equipment. High-voltage contactors, surge resistors, instrument transformers, etc., are located in steel weather-proof cabinets which are throat-connected to the associated transformers and induction regulators. These units are cooled with non-inflammable Pyranol and may be located outdoors or indoors. No special vault is required.

TEN CRYSTAL 'THERMOCELLS' (including four spares). Each cell is complete in itself, including internal heater and thermostat sealed into a metal-tube shell. Indicator lights continuously monitor thermostat operation. Vernier adjustments of frequency may be made easily during operation.

QUICKER FREQUENCY CHANGES are made possible by an automatic tuning system for the power amplifier plate tank capacitor. Any one of six pre-set positions may be selected by the rotary switch. A momentary pressure on the "Automatic On" button starts the carriage, which stops at the pre-selected position. Manual tuning for checking resonance is done with the other push-button switches.

INDICATING INSTRUMENTS are easy to read and easy to identify. The new 240-degree scale is inherently more accurate and provides ample space for calibration markings and circuit name. Instruments are tilted at a 10-degree angle to avoid reflections and provide greater readability.

WATER-FLOW METERS, control valves and temperature indicators for all water-cooled tubes are located in the center passageway. They can be read and adjusted with the transmitter on the air.



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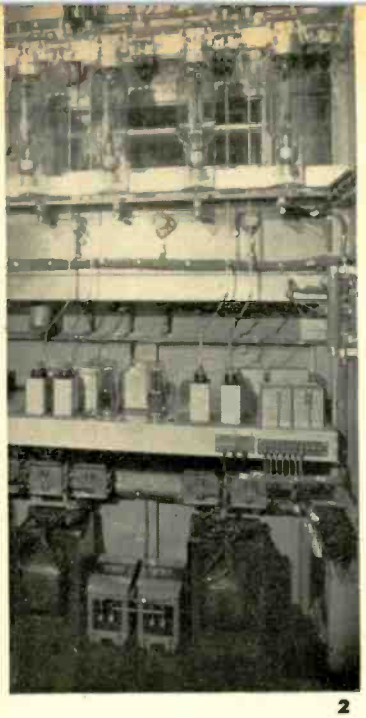

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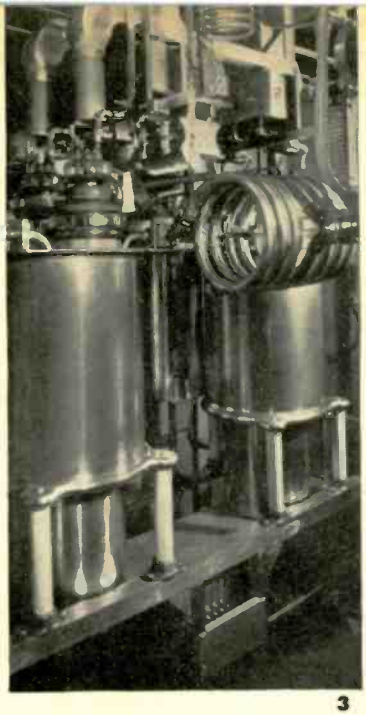

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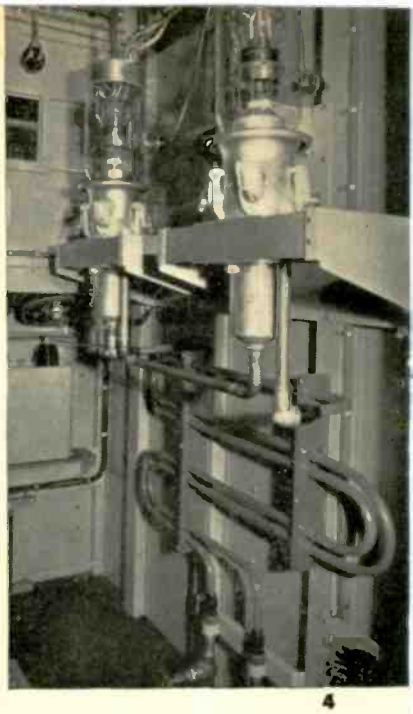


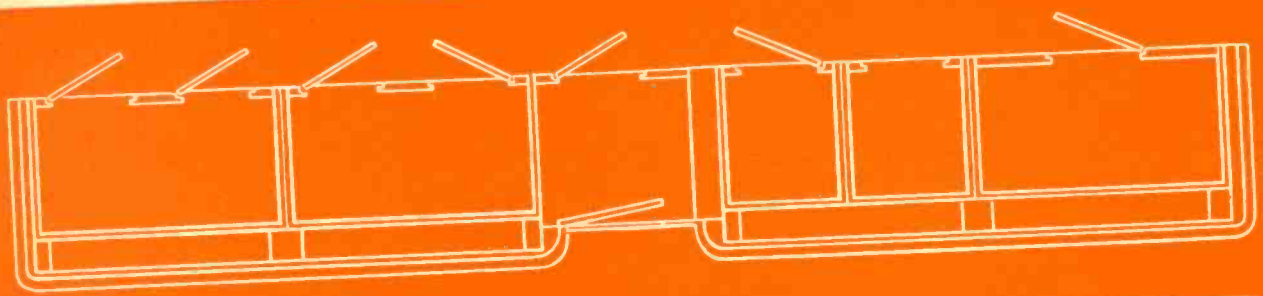
4

1 ***For reliable primary power control,*** 5000-volt air-break contactors are used for plate "start" and "run." These contactors are designed for highly repetitive operation, and for single-shat autamatic reclosure. These contactors can be safely cannected to a 150,000 kva power system, as they handle all averlaads an the secandary side af the connected transformers and are backed up by silver-sand fuses.

2 ***For effective inspection and maintenance,*** ready access is pravided to all electrical and mechanical parts. Heavy-duty cubicle canstructian permits mounting of components on walls, frant panel and roof. The audio-driver cubicle illustrated shows typical canstructian. Cubicle floors are covered with long-life intaid linoleum.

3 ***The power amplifier*** assembly is simple, compact, and trouble-free. For quick frequency changing, the inner cylinders of the concentric plate capacitars are raised and lawered by a motar-driven carriage to pre-set positions. All parts of this assembly are readily accessible fram an ample aisle completely surrounding the tube-and-circuit unit within the cubicle.

4 ***Water-cooling troubles ended!*** These modulator tubes, and the tubes for other high power stages, are water-cooled through semi-flexible plastic insulating tubing, transparent throughout its entire length. Transmitter cubicles are pressurized with filtered air for cooling and cleanliness.



FLOOR PLAN AND END ELEVATION. The total length of the transmitter is 39′ 6″; height 7′ 6″; depth 6′ 6″. The transmitter proper consists of four cubicles, each 8′ wide and 5½′ deep. A wide passageway is provided in the center of the transmitter; and electric interlocks prevent transmitter from being placed in operation until all entrance doors are closed.

COME TO SCHENECTADY: — to see the pattern of tomorrow's transmitters . . . to see G. E.'s proving-ground stations — FM, AM, and Television . . . to discuss how you can reserve the equipment you want for prompt post-war delivery.

• 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 NBC.

STATION AND STUDIO EQUIPMENT • TRANSMITTERS • ANTENNAS • ELECTRONIC TUBES • RECEIVERS

GENERAL ELECTRIC FM · TELEVISION · AM

160-C6

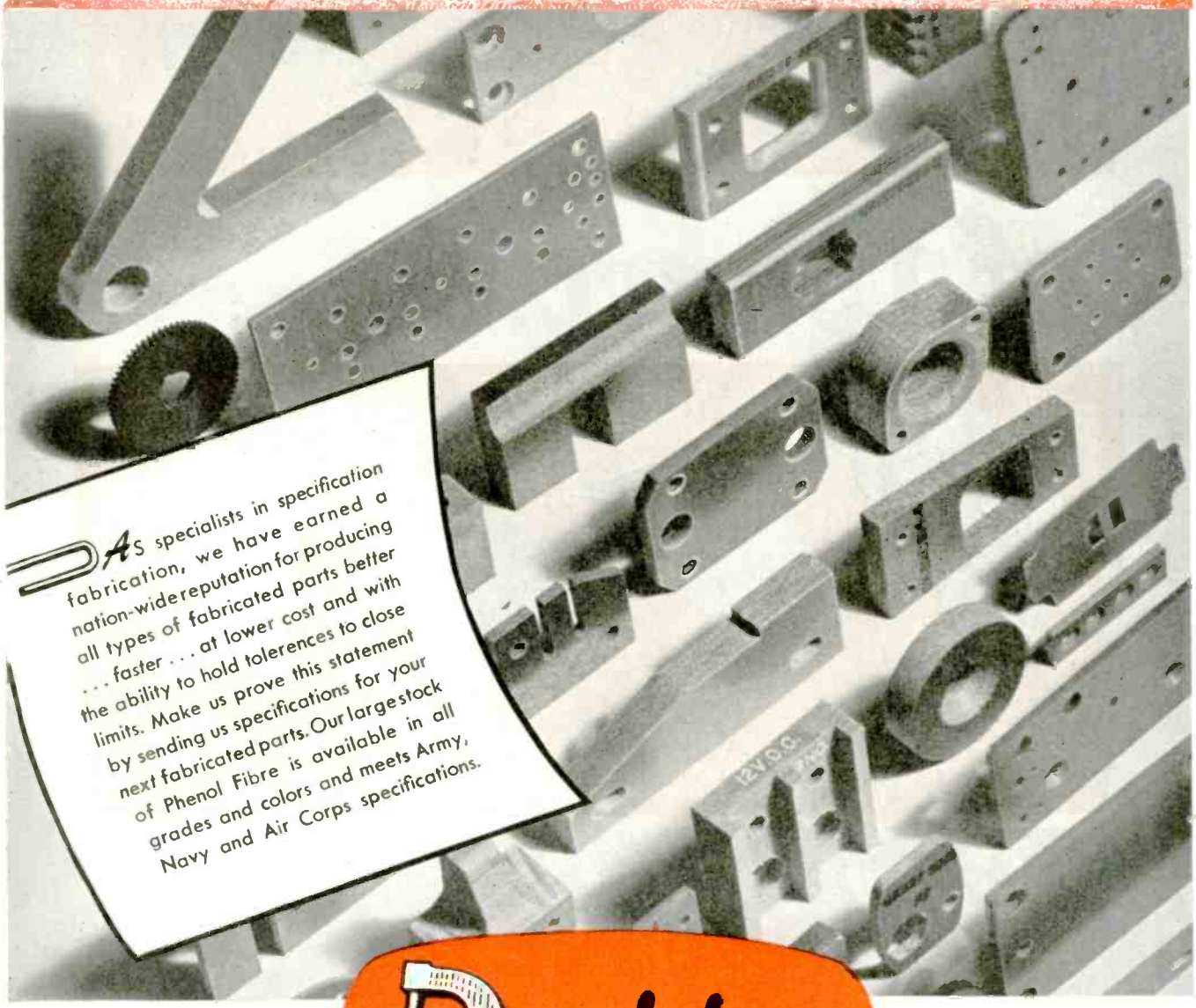
See G.E. for all three!

PHENOLIC

Laminated

MACHINED PARTS

MILLED, DRILLED, LATHED TURNED
SAWED, GROUND, SHAPED AND PUNCHED
FROM SHEET, ROD AND TUBING



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tuning up

One of the most impressive sights and sounds in human experience is a great orchestra *tuning up* for its opening overture. Every sensitive instrument stands poised to burst into the harmony of sound at the wave of the baton!

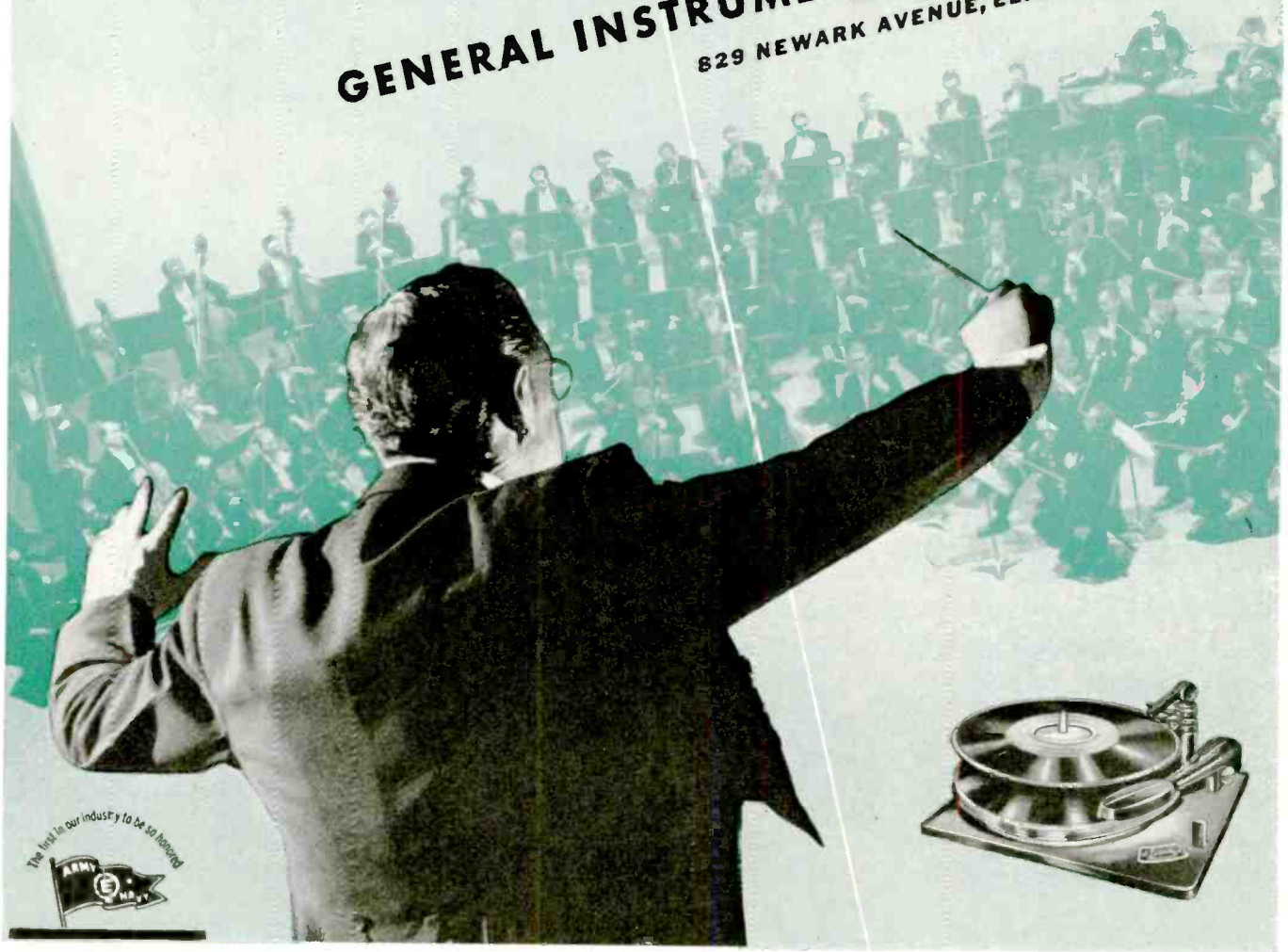
So it should be with the industry of a great nation, *tuning up for the opening march of reconversion.*

While our attention is concentrated on our score in the war production program, we at G. I. are planning constructively the shortest, surest route to peacetime operation.

For many months we have been turning out in record quantities such precision instruments in the electronic and radar fields as variable condensers, many with circuit applications never before possible, automatic tuning mechanisms, complete wired assemblies and sub assemblies. The result of this intensified effort has been the development of new techniques, improved methods, short cuts and economies certain to expedite materially this process of *tuning up for peace.*

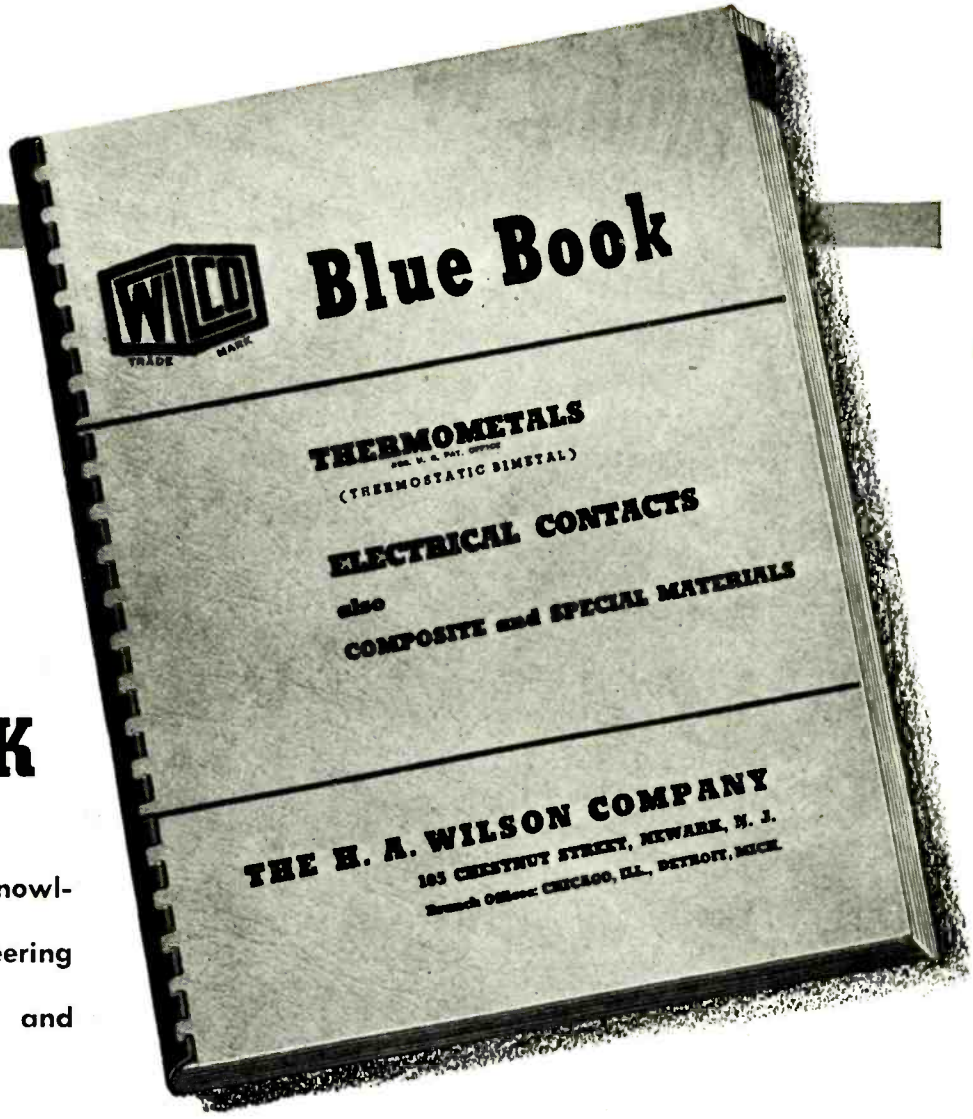
GENERAL INSTRUMENT CORP.

829 NEWARK AVENUE, ELIZABETH 3, N. J.



Announcing the New WILCO BLUE BOOK

An authoritative treatise—acknowledged as a complete Engineering Handbook on Thermometals and Contact Materials.



The Wilco Blue Book deals with the 29 Wilco Thermometals (thermostatic bimetals)—what they are—how they are made—their properties, functions, applications and temperature ranges. Particularly outstanding are the 37 pages of formulae and charts, which give detailed graphic data regarding deflection rates, corrosion resistance characteristics, resistivity, etc. A large part of the Thermometal section is devoted to formulae on the behavior of various shapes and types.

Wide Range of Contact Materials, Too

The Blue Book also fully describes the new developments in Electrical Contacts made during 30 years of pioneering research in this field. New and old Wilco contact materials listed and described include Silver, Platinum, Gold, Powder Metal and Tungsten Contacts; Wilco Aeralloy Magneto Contacts; Collector Rings and Brushes for use in rotating and control devices; Silver Faced Steel for bearings, shims and other industrial purposes; Gold-Filled and Rolled Gold Plate and Radio Wire: Wilco Small Castings.

What leading engineers say about the 1944 Wilco Blue Book

"A model for supplying the information needed by engineers for their use of manufactured products."

"A maximum of factual information—a minimum of adjectives."

"All the data necessary for the incorporation of such products into structures."

The new edition of the Wilco Blue Book makes available to you the extensive knowledge and research of a company, which since 1914 has been an outstanding producer of precision thermostatic bimetal and contact materials.

To get *your* FREE copy, write today.

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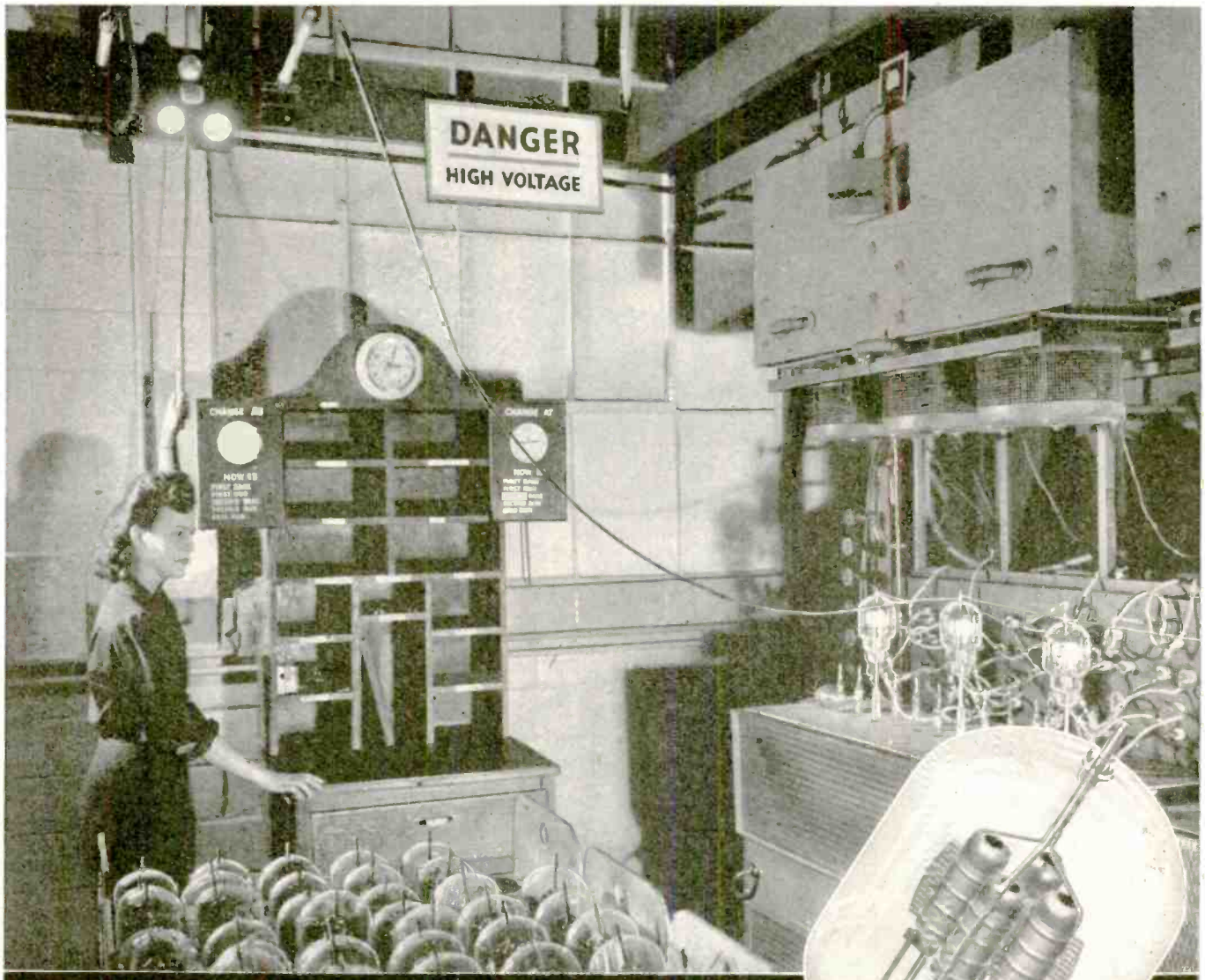


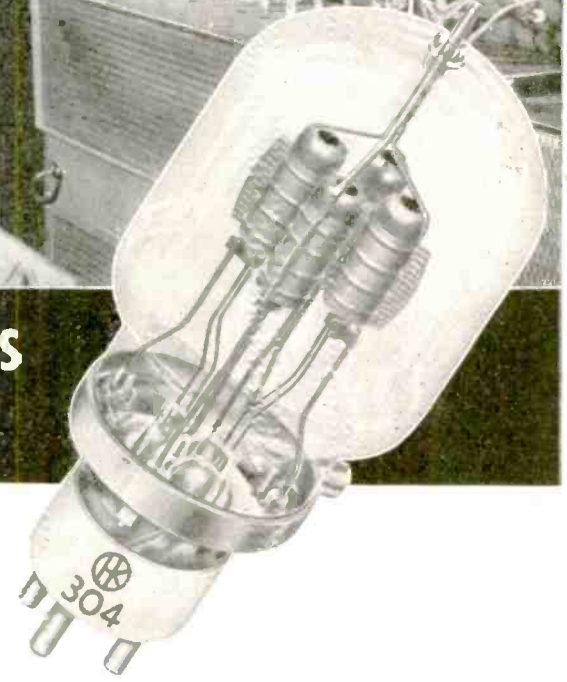
BLASTING OFF THE BARNACLES WITH 40,000 VOLTS

To protect Gammatrons against filament bombardment, one of the most common causes of untimely tube failure, Heintz and Kaufman Ltd. employs an exhaust process so rugged that only tubes made with tantalum elements can survive it.

"Blasting off the barnacles" occurs just before Gammatrons are sealed off. Already these tubes have been run at 3,000° F. for more than half an hour, and have been exhausted to 1/10,000,000,000 of atmospheric pressure.

A red light flashes, and a warning bell rings as 40,000 volts are applied between grids and plates. A blue-white flicker marks the passing of the last bit of gas.

Before a tube can endure such punishment it must be built like a Gammatron—clean and sturdy, without internal insulators or chemical getter. Then it will take the kind of exhausting that insures its staying on the air for thousands of hours.



THE HK-304H Gammatron is a high-voltage, low-impedance tube capable of passing large amounts of current. This unusual combination of features is made possible by the use of four separate sets of tube elements operating in parallel within one glass envelope. Max. plate dissipation, 300 watts.

★ *BUY AN EXTRA WAR BOND THIS MONTH* ★

HEINTZ AND KAUFMAN LTD.

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

Gammatron Tubes

X-Ray O.K.-your final assurance of a perfect tube from Federal.

Every Federal water cooled tube must pass this pre-shipment test.

It is only one of the "Multiple Tests" Federal makes to bring you the ultimate in vacuum tubes. Every known test of mechanical and electronic perfection is a Federal "must" . . . tubes are tested for high-voltage overload . . . shelf life is given to prevent shipment of tubes with glass strains or slow leaks . . . and a final, all-inclusive, operation test leaves nothing to conjecture.

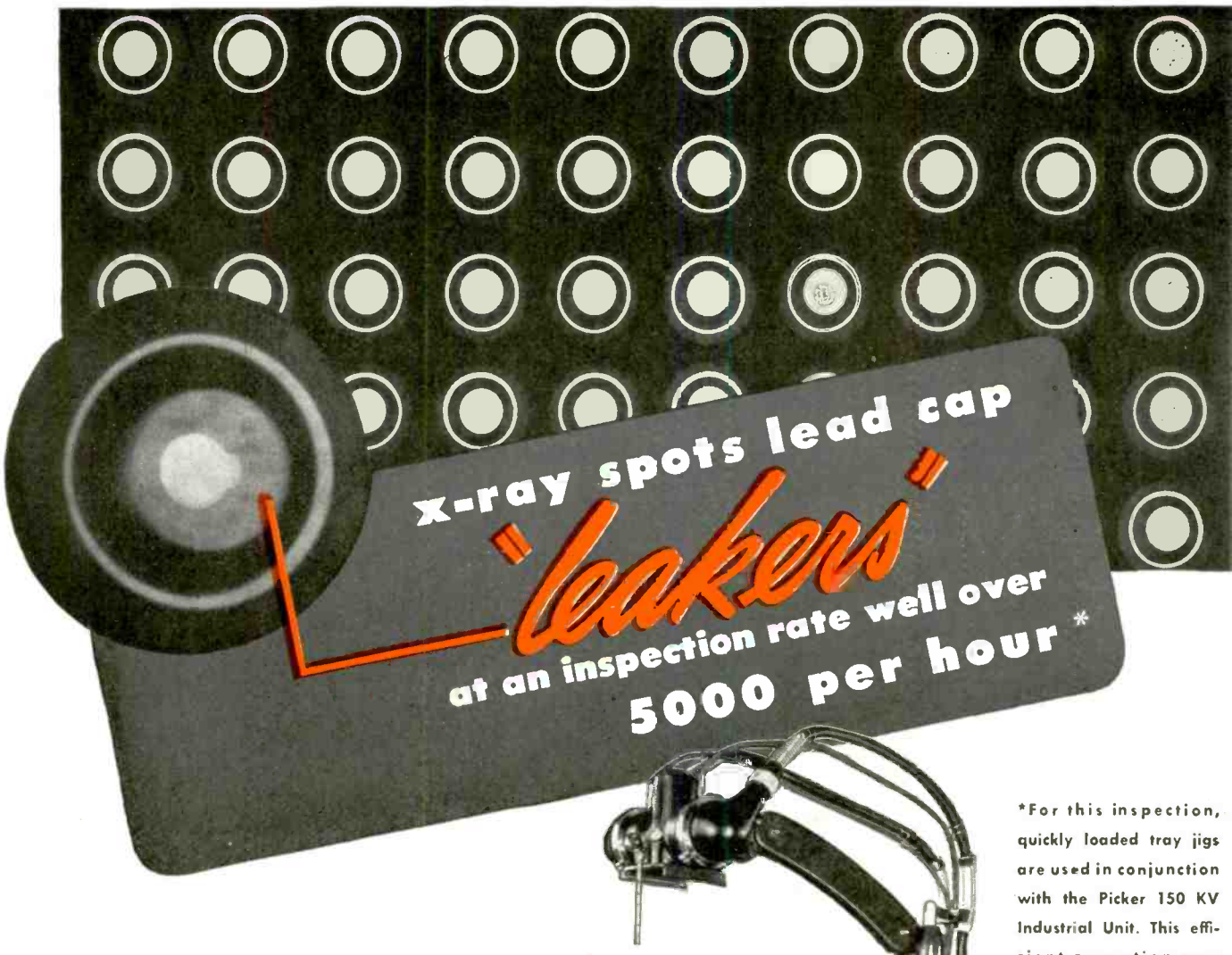
Federal's "Multiple Testing" adds up to longer tube life . . . uniform electrical characteristics . . . and lower cost of operation. Radio men acknowledge that "Federal always has made BETTER Tubes."

Radio Ranges and Instrument Landing Systems manufactured by Federal mark the principal air routes of the nation and control the landing at many leading airports. Pioneers in the development of Aerial Navigation Equipment, Federal has made spectacular contributions to aviation progress.

Federal Telephone and Radio Corporation

Newark 1, N. J.

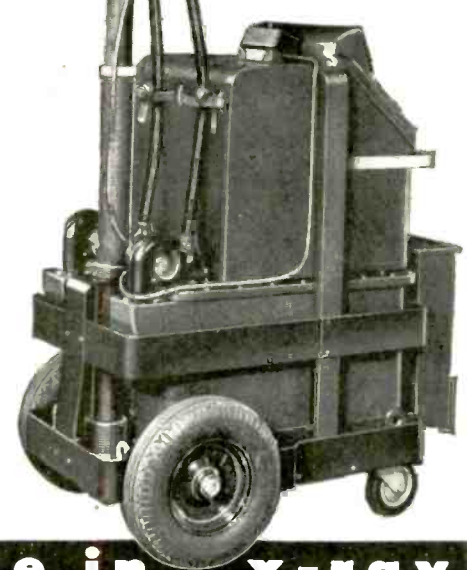
AN IT&T ASSOCIATE



*For this inspection, quickly loaded tray jigs are used in conjunction with the Picker 150 KV Industrial Unit. This efficient operation was worked out by Picker engineers in collaboration with plant engineers.

A leak in a cathode ray tube is a disaster . . . so the time to stop it is *before* precious man hours and material have been expended on final assembly. Tiny as it is, this terminal cap performs a vital function and must be structurally perfect if the vacuum is not to bleed through it. Routine x-ray examination sees to *that* by disclosing internal weaknesses, such as porosity or faulty welds, which would affect performance, *before* assembly.

In the electronic industries, radiography also provides spot-weld control . . . checks on accuracy of filament and grid alignments . . . discloses imperfect joints, broken leads, and similar common defects in condensers, resistors, assemblies. *The Picker 150 KV X-Ray Unit, either stationary or portable, rated at 150 KV, 8 MA operation, has been found ideal not only for such inspection, but also in hundreds of other applications where continuous production x-ray inspection is required.*



Industrial PICKER X-ray sets the pace in x-ray

PICKER X-RAY CORPORATION • New York, N. Y.
WAITE MANUFACTURING DIVISION • Cleveland, Ohio

YOUR LOCAL PICKER ENGINEER WILL BE GLAD TO DISCUSS YOUR OWN INSPECTION PROBLEMS WITH YOU

FUNGUS RESISTANT LACQUERS

Protecting The Lifeline of Communications

DULAC FUNGUS RESISTANT LACQUER #86-A

Contains non-mercury bearing Fungicide. High Solids and good moisture resistance.

DULAC FUNGUS RESISTANT LACQUER #96-A

Contains mercury bearing Fungicide. High solids and good moisture resistance.

Two high grade moisture and Fungus Resistant coatings made to meet Signal Corps Specification #71-2202-A dated April 12, 1944, the fungicides meeting the requirements of the Signal Corps and the Navy.

Fungus Resistant Varnishes available on request.

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

For a quick "Finish" Buy more WAR BONDS

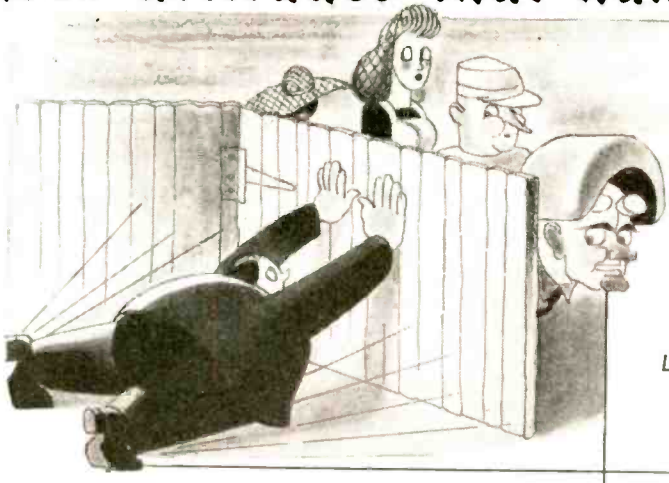
M&W

MAAS & WALDSTEIN COMPANY, NEWARK, N. J.

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

Branch Offices & Warehouses: 1658 Carroll Ave., Chicago, Ill. • 1228 W. Pico Blvd., Los Angeles, Calif.

Three attitudes that hamper war production

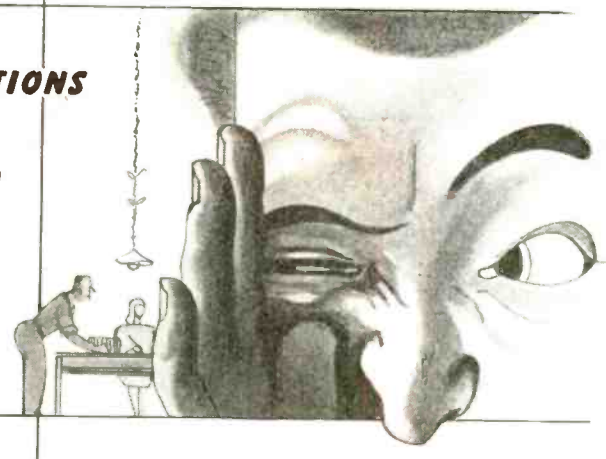


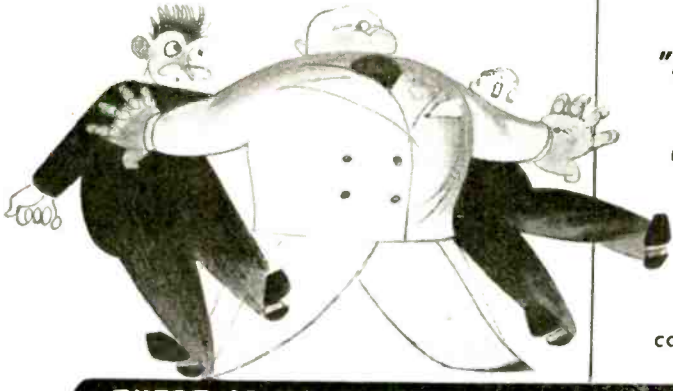
KEEPING LABOR ON LABOR'S SIDE OF THE FENCE

Ignoring successful examples of many progressive plants, some executives still choose to utilize the craftsmanship but not the wholehearted cooperation of labor. Labor appears to be non-essential around the conference table.

ONE EYE SHUT TO WORKING CONDITIONS

A healthy and contented worker is a good worker — but, unfortunately, some men close one eye to this well-established fact. Provisions for maintaining general comfort and morale on the production line are shrugged aside, and then there's wonderment if output lags.





"I'M BETTER THAN HE IS"

While boys of different colors and races and religions fight and die side-by-side, here at home there are those who practice an un-American form of discrimination. Overlooked is the actuality that harmonious relationships of all peoples can, and must, be achieved.

THERE IS NO PLACE IN THIS COUNTRY FOR SUCH ATTITUDES

At ECA, even as in your plant, we have questioned these three attitudes . . . experimented . . . eliminated them. Carrying the fundamental principles of the American dream into our organization, management and labor function as a single democratic unit. Periodic meetings have been established . . . ideas of benefit to both groups are exchanged. Here we gather suggestions for economy and efficiency. Here originate recreational facilities, group insurance and medicine plans, our extensive home front activities. Here developments are born whose value to the country have been effectively demonstrated. Here our policy of assigning jobs on the basis of merit rather than heritage is reaffirmed. Has our plan worked? Efficiency steadily increases and production, for example, today is six times greater than it was twelve months ago. This record gives added support to our proposition that, regardless of color or creed, to advance is the common birthright of all men . . . and that mutual cooperation between the man-in-the-front-office and the man-who-puts-things-together is not only highly desirable but highly essential.

ECA

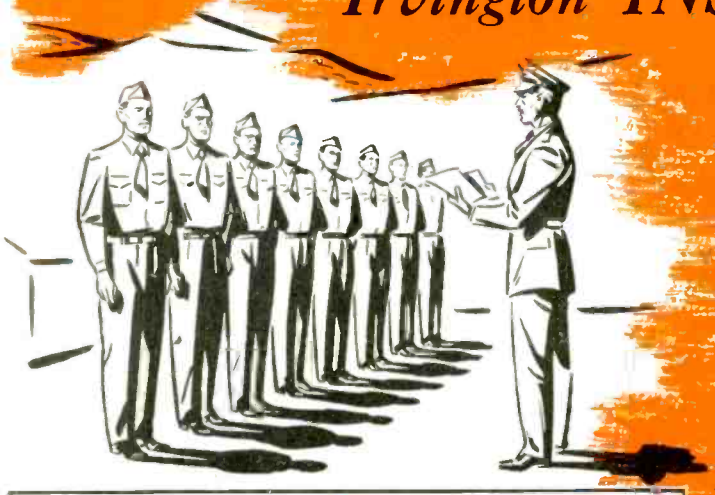
ELECTRONIC CORP. OF AMERICA

45 WEST 18th STREET • NEW YORK 11, N.Y. WATKINS 9-1870

REPRINTS OF THIS ADVERTISEMENT AVAILABLE

SHAPPE-WILKES INC.

RAPID-READING ROLLCALL of Irvington INSULATING Materials



Here is a quick over-all glimpse of Irvington's service to manufacturers in the electronic field.

What you see and read on this page merely highlights the many Irvington products currently available. Detailed product information to round out the picture will be sent on request.

What cannot be shown is the knowledge behind each product – the continuous and expanding research aimed at product improvement and development of new materials to meet the changing needs of industry.

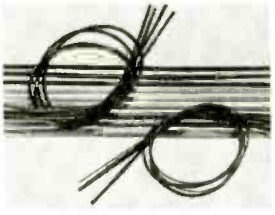
Irvington products – and the recommendations of Irvington technicians—have supplied the answer to many insulation problems. Enlist the assistance of both, today. Write *Irvington Varnish & Insulator Co.*, Irvington, New Jersey, Dept.

PLASTIC TUBINGS

Flexible extruded plastic tubings with excellent electrical and physical properties, suitable for use over a wide range of temperatures. Special types with low power factor for h. f. applications, such as Styraloy and Polyethylene.

VARNISHED TUBINGS

A complete line of flexible varnished tubings, meeting VTA and ASTM Standards, and including saturated sleevings, radio spaghetti, and varnished Fiberglas tubings and sleevings.

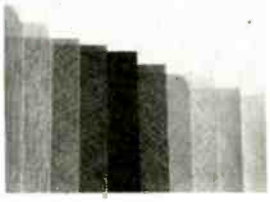


WIRE MARKERS

Clearly marked plastic or varnished markers for speedy wire identification and quick assemby of complicated equipment.

VARNISHES

A full range of insulating varnishes answering both ordinary and many special requirements. Catalog H2 describes each type in detail.

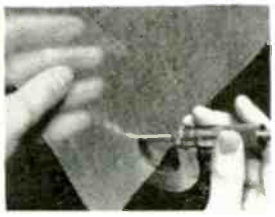


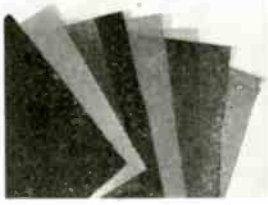
VARNISHED CAMBRIC

Widely used Irvington Varnished Cambric and Tape are obtainable in either black or yellow, in Straight Cut or Seamless Bias form, and in a choice of several finishes.

ALTERNATES FOR VARNISHED SILK

Include Yellow Varnished Nylon, Yellow Varnished Rayon, and thin Varnished Cambric, Style SIC. The last is available in black or yellow and can be furnished in continuous length rolls in Seamless Bias or Straight Cut form.



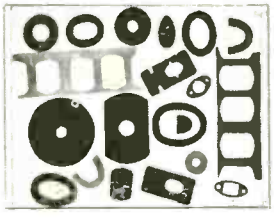


VARNISHED PAPERS

Range extends from thin condenser tissues and 100% rag to Kraft papers. All types are highly resistant to heat, oil and moisture.

PUNCHINGS

Fabricated pieces of Varnished Cambric, Canvas, Paper, Slot Insulation, etc. Dies available for many useful shapes; dies for special shapes constructed to specifications.

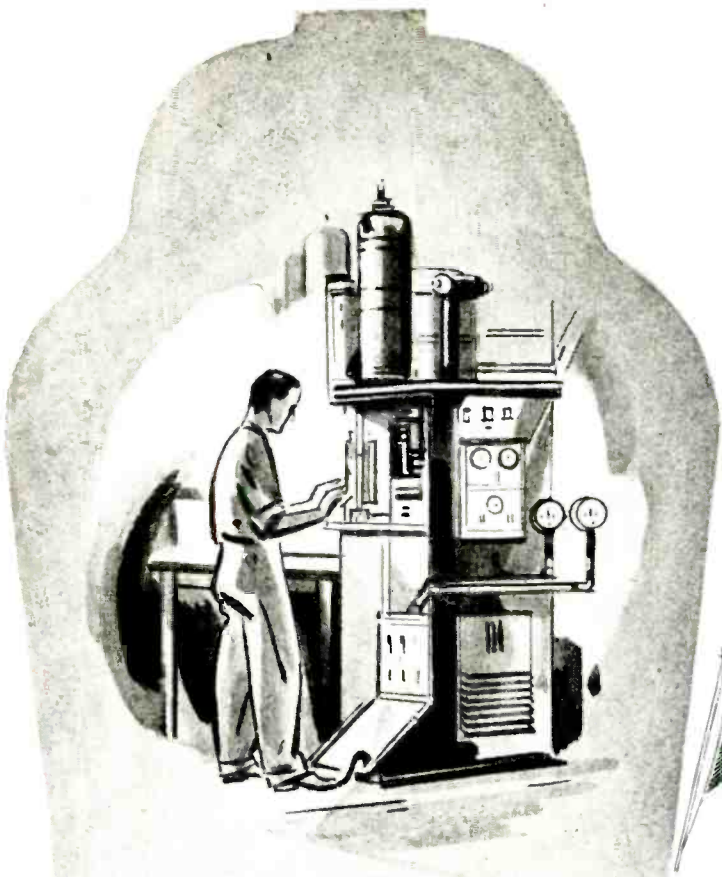


STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE MARK

IRVINGTON VARNISH & INSULATOR COMPANY

IRVINGTON 11, NEW JERSEY, U. S. A.

Plants at Irvington, N. J. & Hamilton, Ontario, Canada • Representatives in 20 principal cities



E-E Electronic Tubes...

...EPITAPH OF THE GREMLINS!

Through the years Dielectric, Hysteresis and Eddy current Gremlins bedeviled electrical designs. New visions, broader concepts and electronic vacuum tubes tamed this trio of power losses. Now, under the incognito of High Frequency Heating they play important roles in industry.

The widespread application of E-E power tubes and rectifiers in induction heating attests to their rugged, uniform characteristics—a result of precise engineering and rigid inspection. E-E specialization in power amplifiers and rectifiers has resulted in designs of unusual efficiency and merit. Why not investigate?

Complete information is contained in the informative E-E data book. Write for your copy today—there is no obligation.

Illustration of
Type 836 Half Wave
High Vacuum Rectifier
Peak Inverse Voltage 3000
Peak Plate Current 1.0 Amp

ELECTRONIC ENTERPRISES, INC.

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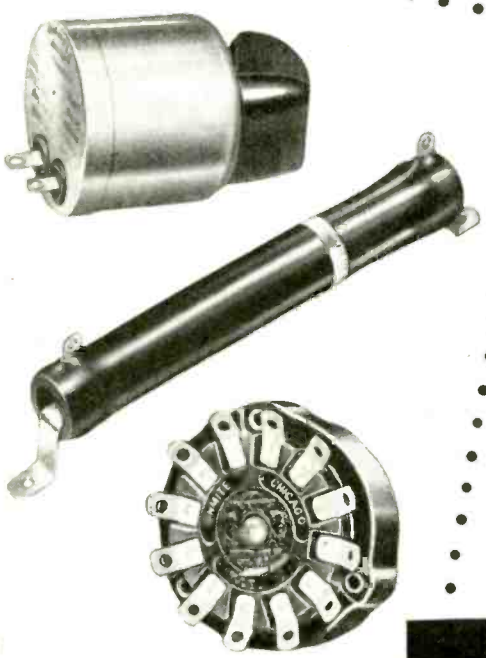
ELECTRONIC e ENTERPRISES

In Resistance Control

OHMITE EXPERIENCE MAKES A DIFFERENCE



You get the benefit of Ohmite experience in meeting the varied requirements of innumerable applications . . . in pioneering new rheostat, resistor and tap switch developments . . . in producing the widest range of types and sizes to answer every control need. Add to this, the long service-record of Ohmite Units—their proved ability to function under the most severe operating conditions.

Such experience in resistance control is invaluable to engineers designing new devices to defeat the enemy or planning new products for the postwar era.

Your Answer Book to Resistance Problems

Write on company letterhead for helpful 96-page Industrial Catalog and Engineering Manual No. 40.

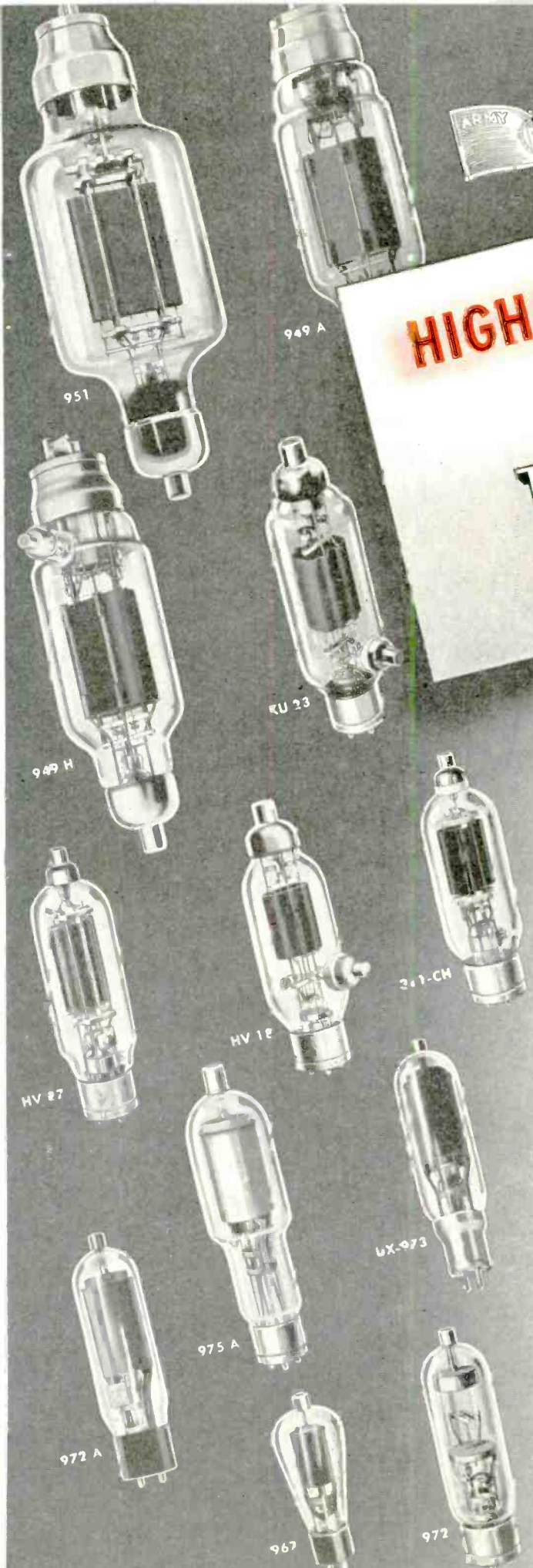
OHMITE MANUFACTURING COMPANY

Foremost Manufacturers of Power Rheostats, Resistors, Tap Switches

4984 FLOURNOY STREET ★ CHICAGO 44, U. S. A.

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES



HIGH FREQUENCY HEATING

TUBES by UNITED

HEAVY DUTY oscillator tubes are a very desirable nucleus for every electronic RF heating generator. The tubes should be specially designed to withstand the widely varying conditions of load and frequency which are encountered in the many specific applications of this equipment.

UNITED has been the leading producer of such tubes for the most widespread field of RF heating—namely, Diathermy. The fluctuating load conditions in this field are extreme, and have necessitated endless study of tube design. This company therefore is a front line pioneer in tubes for High Frequency electronic heating.

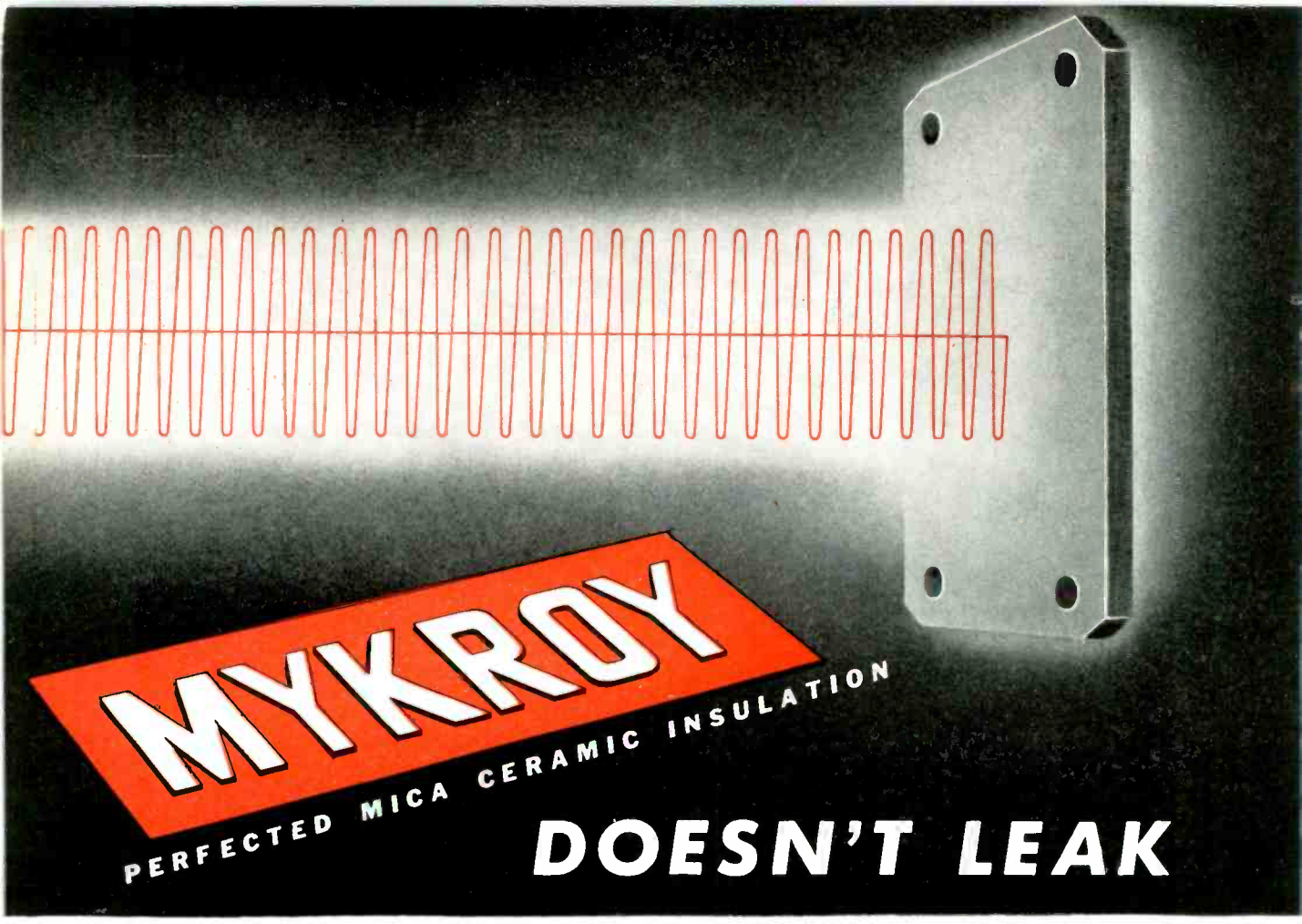
UNITED mercury rectifiers for the power supply are also well known for their rugged design and dependable service life.

The UNITED tubes illustrated are all popular among users of High Frequency heating equipment. Write for technical data and interchange information where it is desired to replace other makes of tubes.

UNITED ELECTRONICS COMPANY

NEWARK 2 NEW JERSEY

TRANSMITTING TUBES EXCLUSIVELY SINCE 1934



To engineers specializing in low-loss high frequency design, energy conservation throughout circuits is so important that a dielectric having the qualities of MYKROY with a ***loss factor of 1*** is extremely desirable. MYKROY—the perfected glass-bonded mica ceramic insulation, fills this vital need so dependably that it has opened the door to new and greater advances in high frequency research.

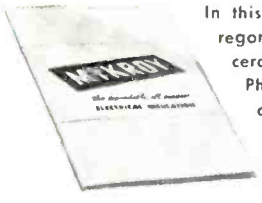
Circuits brilliantly conceived on the drafting board are successfully translated into practical application because of the many superior insulating properties of MYKROY.

In addition to possessing a ***high dielectric constant*** in combination with a ***low power factor,*** MYKROY is light —yet its mechanical strength is comparable to cast iron—resists arc-heat carbonization and is impervious to gas, water and oil—keeps its shape (will not warp) —bonds easily with metals—molds readily to any specifications and machines perfectly to closest tolerances.

MYKROY is maintaining the efficiency of such a large variety of electronic equipment of advanced design that your most difficult insulation problems will find a speedy solution in its application.

If you are confronted with a high frequency insulating problem, our engineers will welcome the opportunity to acquaint you with the performance of MYKROY. It is available in ample quantities on rapid delivery schedules from our Chicago, Illinois and Clifton, New Jersey plants.

IS THIS MYKROY ENGINEERS MANUAL IN YOUR FILE?



In this comprehensive manual you will find full information regarding MYKROY . . . the perfected glass-bonded mica ceramic insulation. It tells you about: Machinability, Physical, Chemical and Electrical properties — Applications and uses — Sizes and shapes of stock forms — Design criteria, and includes samples of MYKROY. A request on your letterhead will bring your copy by return mail.

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

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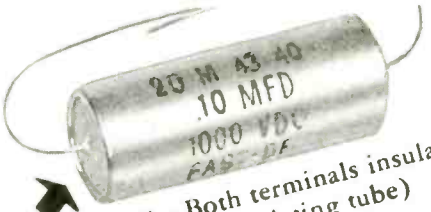
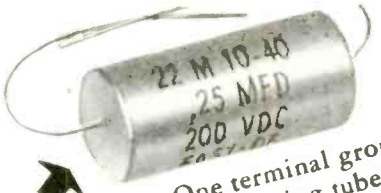
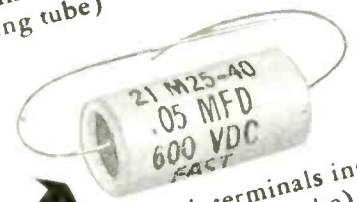
Chicago 47: 1917 NO. SPRINGFIELD AVENUE . . TEL. Albany 4310
Export Office: 89 Broad Street, New York 4, N.Y.



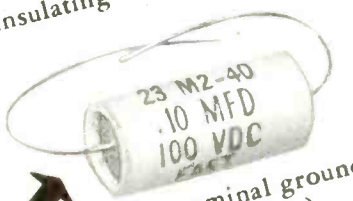
Class 20M—Both terminals insulated (without insulating tube)



Class 22M—One terminal grounded (without insulating tube)



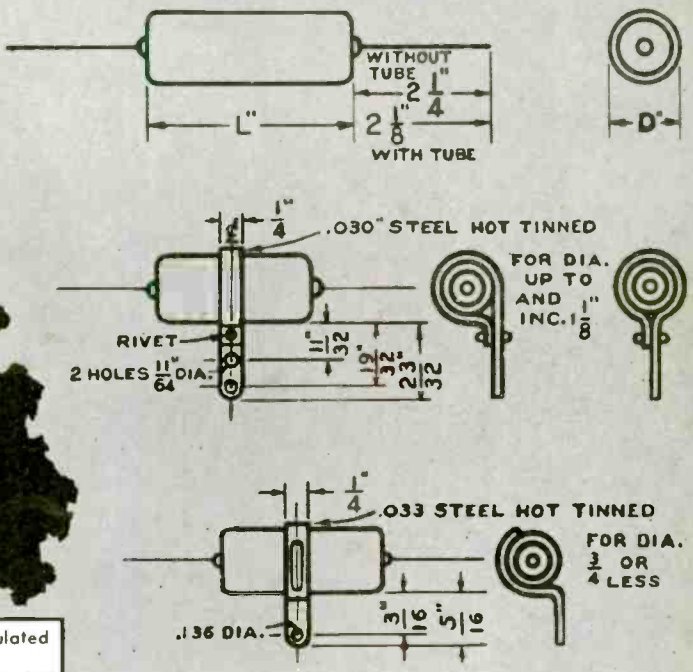
Class 21M—Both terminals insulated (with insulating tube)



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)			
CAP. MFDS.	VOLTS D. C.	SIZE (inches) D.	L.
.001	1000	1/2	1-3/16
.0025	1000	1/2	1-3/16
.005	1000	1/2	1-3/16
.005	600	3/8	15/16
.01	600	3/8	1-3/16
.02	600	1/2	1-1/16
.05	600	9/16	1-5/16
.1	200	9/16	1-13/16
.25	200	3/4	1-7/8
.5	200	1	1-13/16

Class 21M—Both terminals insulated (with insulating tube)			
CAP. MFDS.	VOLTS D. C.	SIZE (inches) D.	L.
.05	800	11/16	1-5/8
.1	800	13/16	1-7/8
.1	600	11/16	1-3/4
.25	600	13/16	2-5/16
.25	400	13/16	2-5/16
.5	400	1-1/16	2-5/16
1.	400	1-1/16	3-15/16
1.	200	1-1/16	3-3/16
1.5	100	1-1/16	3-3/16
2.	100	1-5/16	2-11/16

Class 22M—One terminal grounded (without insulating tube)			
.0075	1000	1/2	1-1/16
.01	1000	1/2	1-1/16
.05	1000	5/8	1-13/16
.5	600	1	2
1.	600	1	3-5/8

Class 23M—One terminal grounded (with insulating tube)			
.1	1000	13/16	2-1/16
.25	1000	1-1/16	2-1/2
.5	1000	1-7/16	2-13/16
.5	800	1-1/16	3-1/16
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"

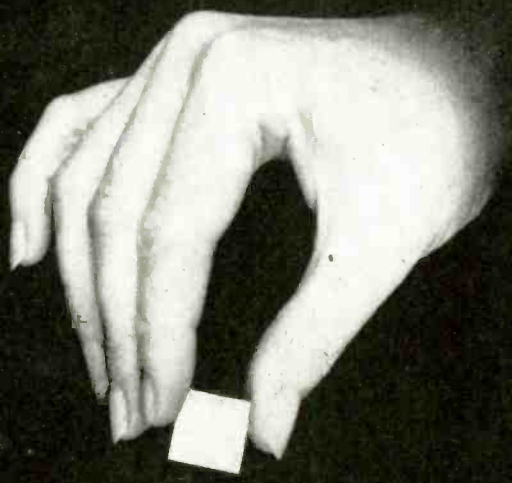
JOHN E. FAST & CO.

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

QUARTZ CRYSTALS



ANY TYPE, ANY SIZE, ANY QUANTITY

OUR PRODUCTION IS GEARED TO MEET YOUR DELIVERY SCHEDULES AND SPECIFICATIONS.

WE ARE MAKING THOUSANDS FOR THE SERVICES. CAN WE HELP YOU?

AVIATION RADIO EQUIPMENT

REX BASSETT

INCORPORATED

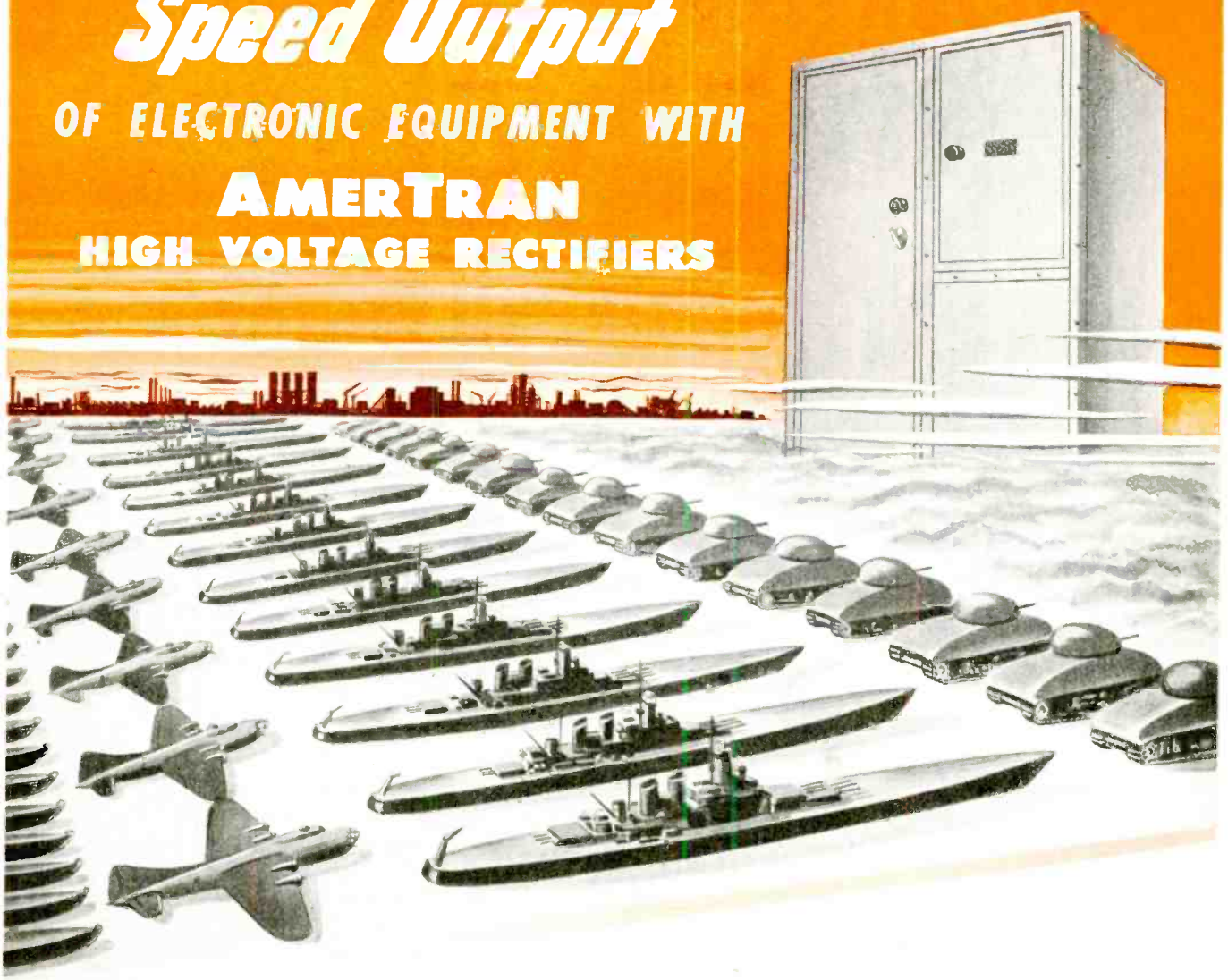
FORT LAUDERDALE, FLORIDA

Speed Output

OF ELECTRONIC EQUIPMENT WITH

AMERTRAN

HIGH VOLTAGE RECTIFIERS



Many manufacturers of naval, aircraft and land communications equipment know that they have better assurance of meeting exacting delivery schedules when the High Voltage Rectifiers are made by AmerTran. Acceptance is also assured through our familiarity with special applications, including navigating and locating devices.

AmerTran Rectifiers can be made to conform in general appearance with other apparatus with which they may be associated.

Delivery is assured by our access to stable material sources, plus a proved, fast production system that employs certain recently developed techriques.

In spite of the pressure of war production, AmerTran Rectifiers are built to the same quality standards that have characterized AmerTran products for forty-three years. Quotations will be forwarded promptly upon receipt of your specifications.

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

AMER TRAN

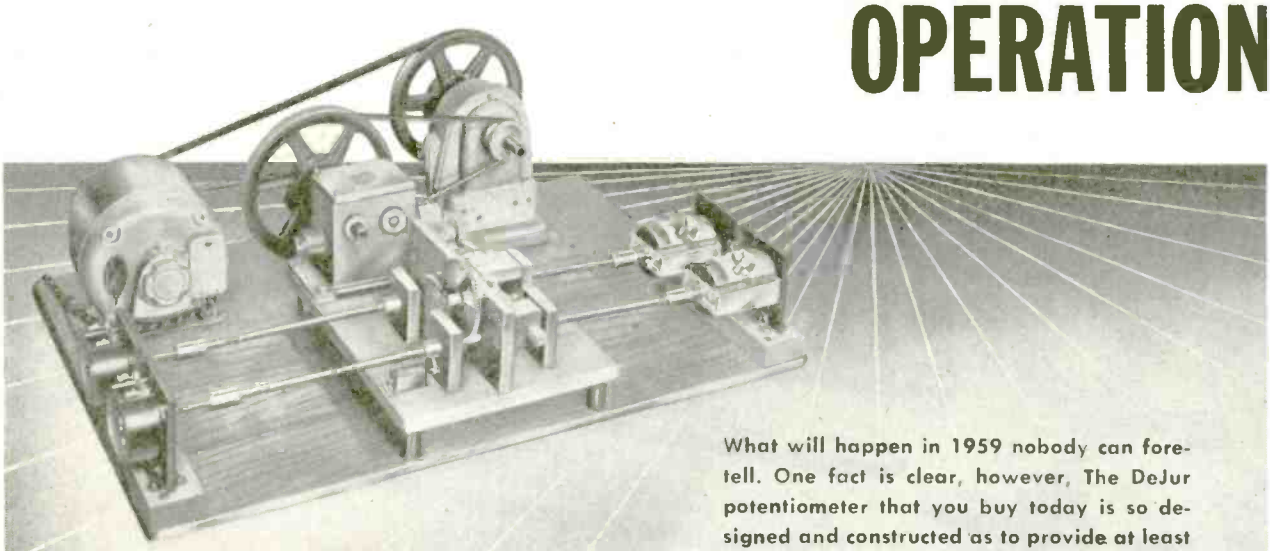
Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

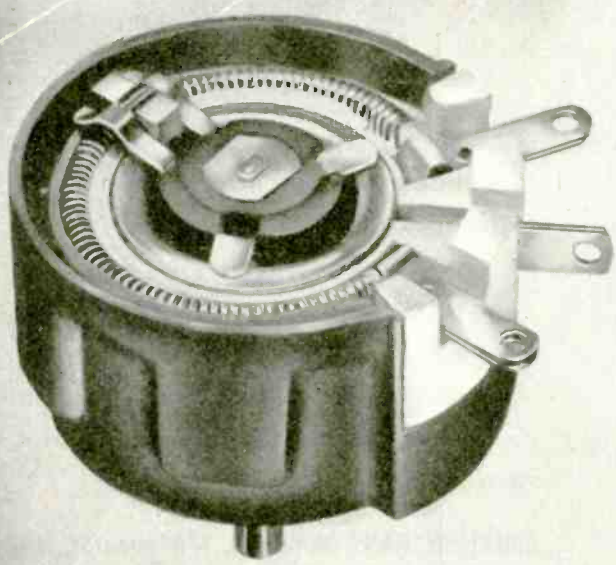
AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

24-HOUR TESTS FORECAST

15 YEARS OF SUSTAINED OPERATION





What will happen in 1959 nobody can foretell. One fact is clear, however, The DeJur potentiometer that you buy today is so designed and constructed as to provide at least 15 years of efficient operation. This figure . . . and it is a conservative one . . . is based on simulated production-line tests in our laboratory as well as reports from the field.

Operating at half-cycle, at as many as 2,500,000 revolutions over a 24-hour period, a specially-developed rotation tester checks the endurance of DeJur potentiometers. The wiper travels from minimum to maximum resistance at rates stipulated in American Standards Association specifications. Mechanical and electrical characteristics are checked under abnormal as well as normal conditions. Effects of day-in and day-out performance are analyzed. Out of these tests come DeJur potentiometers whose dependability can be counted on for extended period of time. Data sheets upon request.

Support the Fifth War Loan Drive

DeJUR

DeJur-Amsco Corporation

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

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NEW YORK PLANT: 99 HUDSON STREET, NEW YORK 13, N.Y.

AWARDED FOR EXCELLENCE IN PRODUCTION AND QUALITY OF MATERIEL

CANADIAN SALES OFFICE: 560 King Street West, Toronto

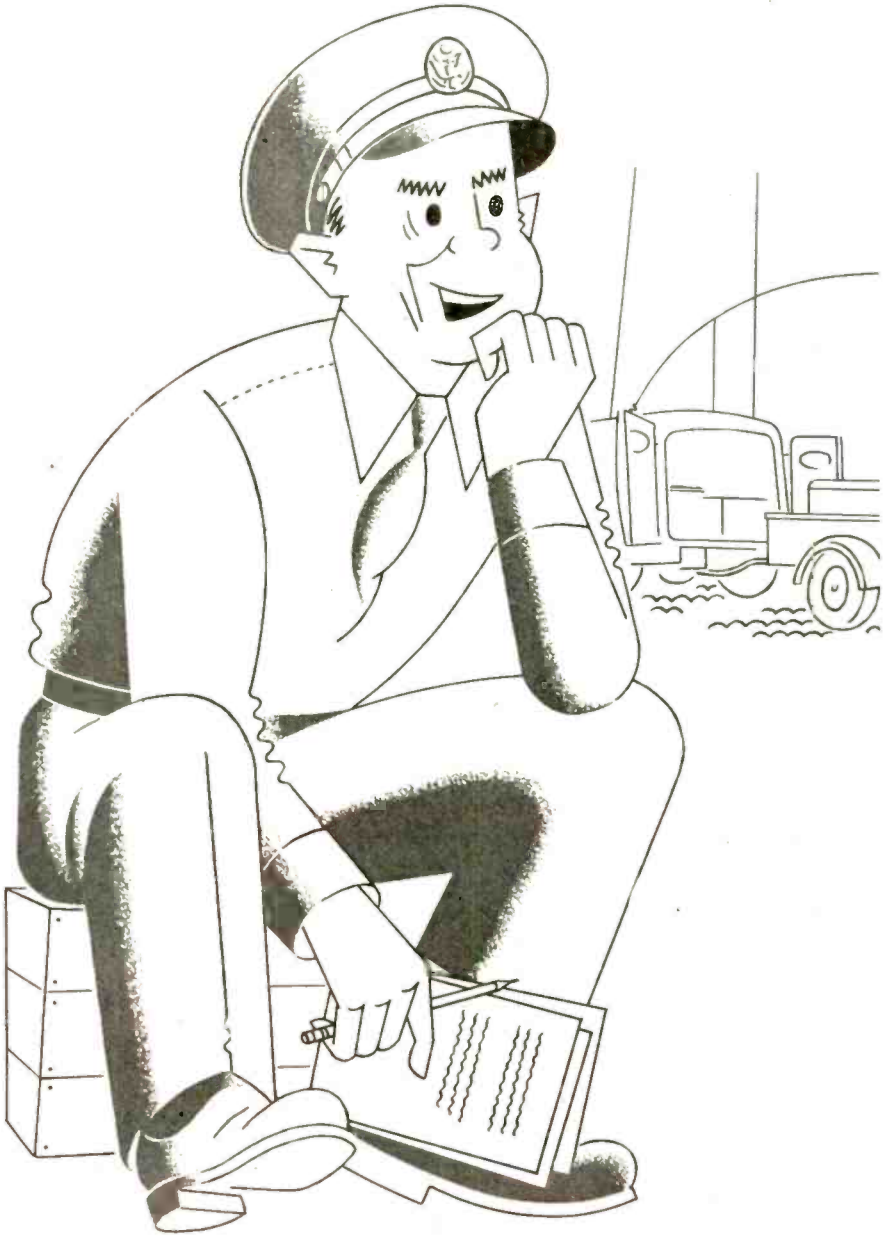
NEW LETTER CONTEST for SERVICEMEN!

ELEVEN 1st PRIZE WINNERS IN 5 MONTHS IN CONTEST No. 1!

Yes sir, guys, the hundreds of letters received were so swell that *double* first prize winners had to be awarded each of the first four months and there were *triple* first prize winners the fifth and last month . . .

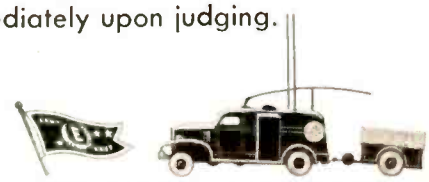
SO—HERE WE GO AGAIN!

Get in on this NEW letter contest—write and tell us your *first hand* experiences with *all* types of Radio Communications equipment built by Hallicrafters including the famous SCR-299!



RULES FOR THE CONTEST

Hallicrafters will give $100.00 for the best letter received during each of the five months of April, May, June, July and August. (Deadline: 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. . . . Military regulations prohibit the publication of winners' names and photos at present . . . monthly winners will be notified immediately upon judging.



BUY A WAR BOND TODAY!

hallicrafters RADIO

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

After two years of intensive research and development, the Mycalex Corporation of America, with pardonable pride, introduces MYCALEX 400.

The new MYCALEX 400*..

For 25 years, MYCALEX has served in thousands of insulation applications. Its machinability to extremely close tolerances coupled with a low loss factor and high dielectric strength have made it invaluable. Frequently, no other suitable insulation was available to perform functions specified by engineers. Military demands since 1941 have become more exacting. Time after time, MYCALEX has made possible the production of equipment vitally needed by the Armed Forces.

However, as ultra and very high frequencies were employed, and insulation requirements became more exacting, it was evident to our engineers that an even better MYCALEX was imperative. This belief was strengthened as reports on insulation problems filtered back from the Solomons, New Guinea, Burma, from ships at sea and bombers over mountain tops.

In our search for a better insulation, startling and gratifying results were obtained, and, consequently, the pace of development was accelerated. Not only had we the problem of climatic conditions to overcome, but we were also aware of the demand in the electronic industries for a material of Grade L-4 characteristics which could be machined to close dimensional tolerances. Formerly the only insulators with Grade L-4 characteristics were made of ceramics. However, these materials could not be machined to precision requirements.

MYCALEX 400 . . . the All-Purpose MYCALEX . . . successfully meets both challenges. We have no hesitancy in recommending MYCALEX 400 as the finest glass-bonded mica insulation ever offered. In hot, moist air . . . in snow and ice . . . high altitudes . . . and sub-zero temperatures, MYCALEX 400 remains constant . . . unaffected by any changes in temperature and application whatsoever. Here you have an insulator that functions faithfully and well in the absolute dead heat and dampness of the jungle as well as in the frigid atmosphere of the Arctic Circle.

In addition, MYCALEX 400 exhibits all the characteristics and qualities sought by the electronic industries. It is mechanically more desirable in tensile, compressive, flexural and impact strength. It is interesting to note that the decrease in loss factor over that of present glass-bonded mica occurs throughout the range from 50 kilocycles to 10 megacycles. With many other insulating materials considerable improvement may be shown at high frequencies but only slight improvement at low frequencies. MYCALEX 400 is truly the All-Purpose

*PATENT PENDING

MYCALEX CORPORATION OF AMERICA

Exclusive Licensee Under All Patents of MYCALEX (PARENT) CO., Ltd.

The electronic industries are now provided with an electrical insulator of Grade L-4 characteristics . . . plus machinability to close tolerances.

. . . . . the All-Purpose Mycalex

MYCALEX . . . for all climates, all frequencies, all applications. We hope that users of ultra-high frequency insulation will try this new material in those assignments which have required frequent replacements of insulation.

Remember . . . MYCALEX is not the name of a class of materials. It is the registered trade-name for low-loss insulation manufactured in the Western Hemisphere by the Mycalex Corporation of America.

Immediate deliveries! Sheets and rods available for fabrication in your own plant or by us!

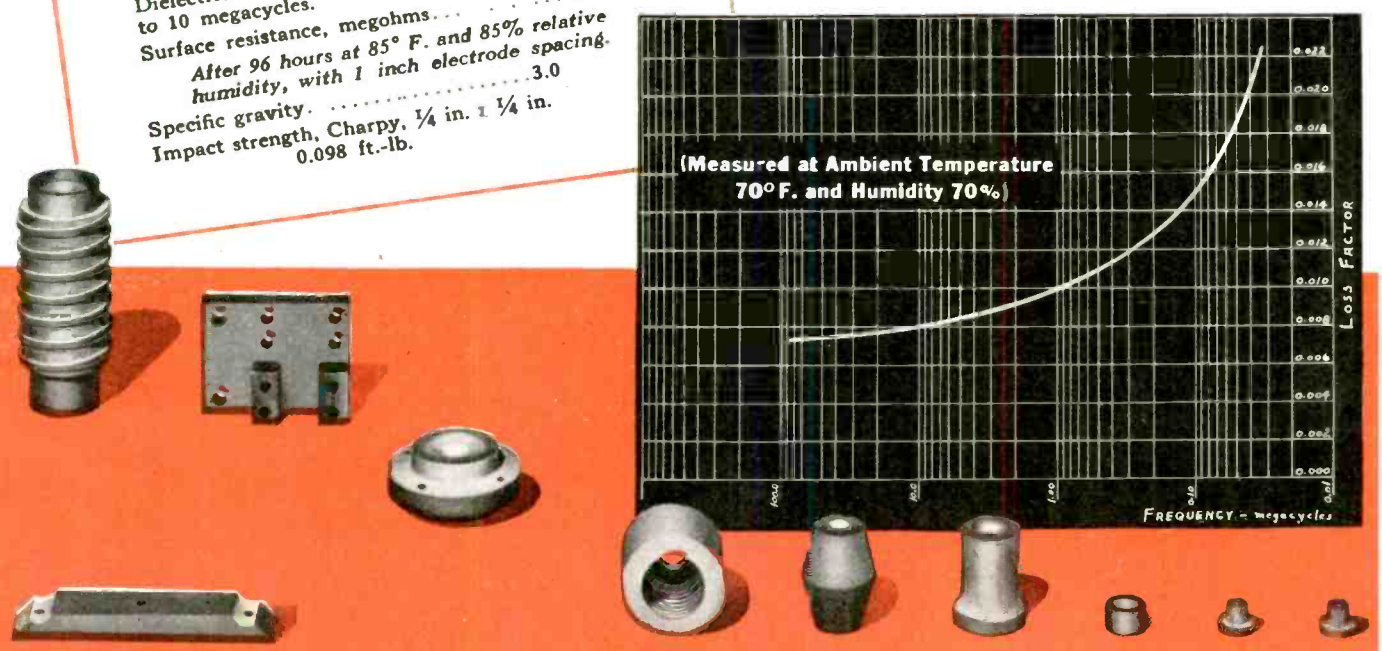
MYCALEX 400 . . . the All-Purpose Mycalex

Power factor, 1 megacycle	0.0018
Dielectric constant, 1 megacycle	7.4
Loss factor, 1 megacycle	0.013
Measured after 48 hours immersion in distilled water in accordance with American War Standard C-75.1-1943 (JAN.-1-10).	
Dielectric constant is unchanged from 50 kilocycles to 10 megacycles.	
Surface resistance, megohms	300,000
After 96 hours at 85° F. and 85% relative humidity, with 1 inch electrode spacing.	
Specific gravity	3.0
Impact strength, Charpy, ¼ in. x ¼ in.	0.098 ft.-lb.

PARTIAL LIST OF APPLICATIONS

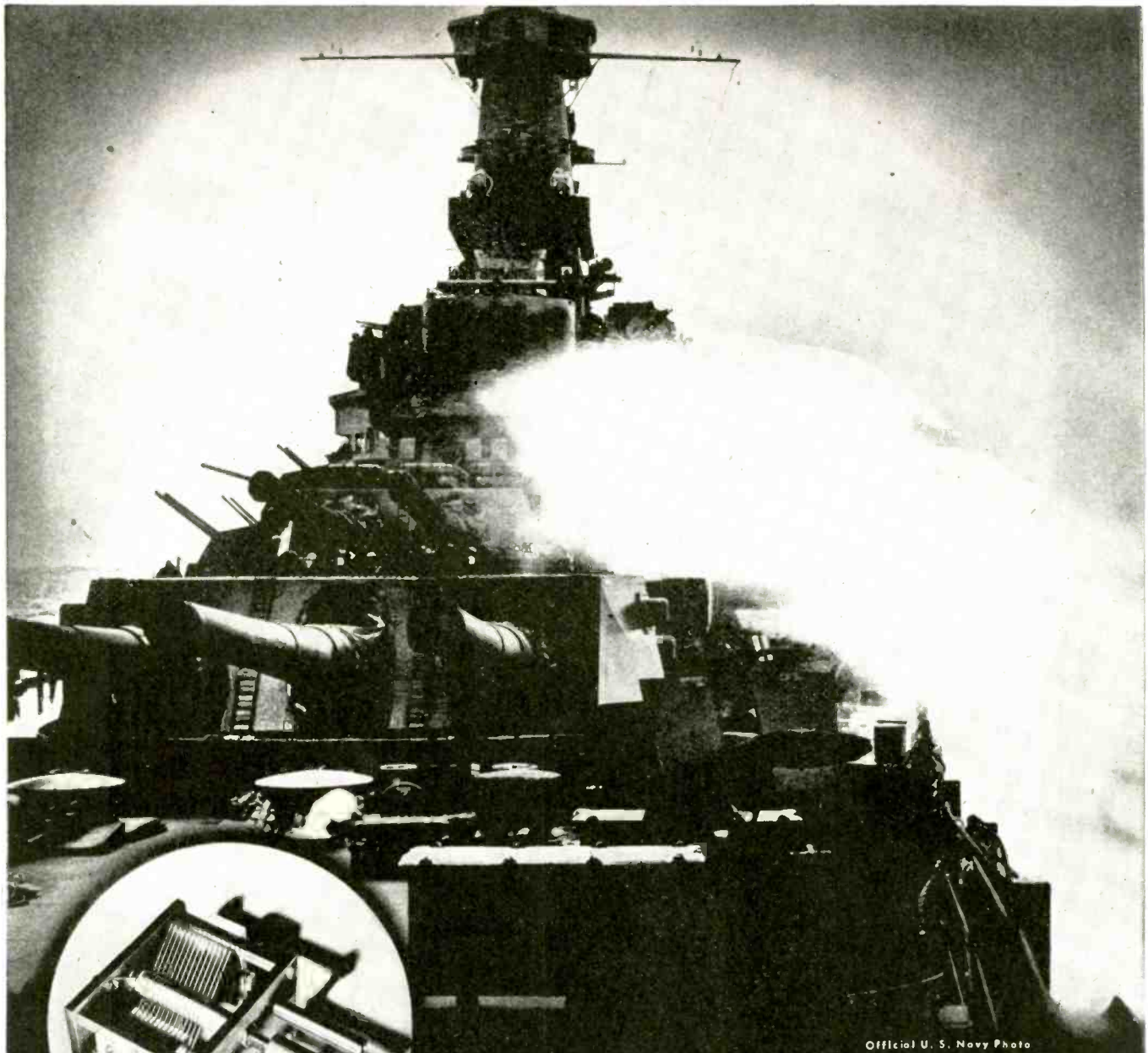
- Radio Transmitters
- Radio Receivers
- Television
- Radar Detectors and Locators
- Relays
- Gunfire Control Equipment
- Radio Remote Control Equipment
- Radio Compass
- Radio Frequency Terminals

...in fact, all radio and electronic equipment for communications, industrial and electro-medical applications



CLIFTON • NEW JERSEY

MYCALEX THE INSULATOR



Official U. S. Navy Photo

THE SALT SPRAY TEST!

Hammarlund Navy type radio components are put through a *mock trip to sea* to determine beforehand their ability to take it. The final proof of their quality is the excellent record established in commercial and naval ships.

"THE SIGN OF QUALITY"

THE HAMMARLUND MANUFACTURING CO., INC.

460 WEST 34th ST., NEW YORK, N. Y.

Established 1910

Electro-Voice DIFFERENTIAL MICROPHONE

Model T-45 is its U.S. ARMY DESIGNATION

Developed by Electro-Voice engineers in collaboration with the Fort Monmouth Signal Laboratory, this Differential "Lip Mike" carries the voice clearly and distinctly above the roar of battle. Ambient sounds and reverberation are reduced to negligible levels.

- *Frequency response substantially flat from 200-4000 cps.*
- *Low harmonic distortion*
- *Cancellation of ambient noise, but normal response to user's voice*
- *Self-supporting, to free both hands of the operator*
- *Uniform response in all positions*
- *Usable when gas mask, dust respirator or oxygen mask is required*
- *Unaffected by temperature cycles from —40° F. to +185° F.*
- *Ability to withstand complete immersion in water*
- *Physical strength to withstand 10,000 drops*
- *Weight, including harness, cord and plug, less than 2 ounces.*

Electro-Voice MICROPHONES

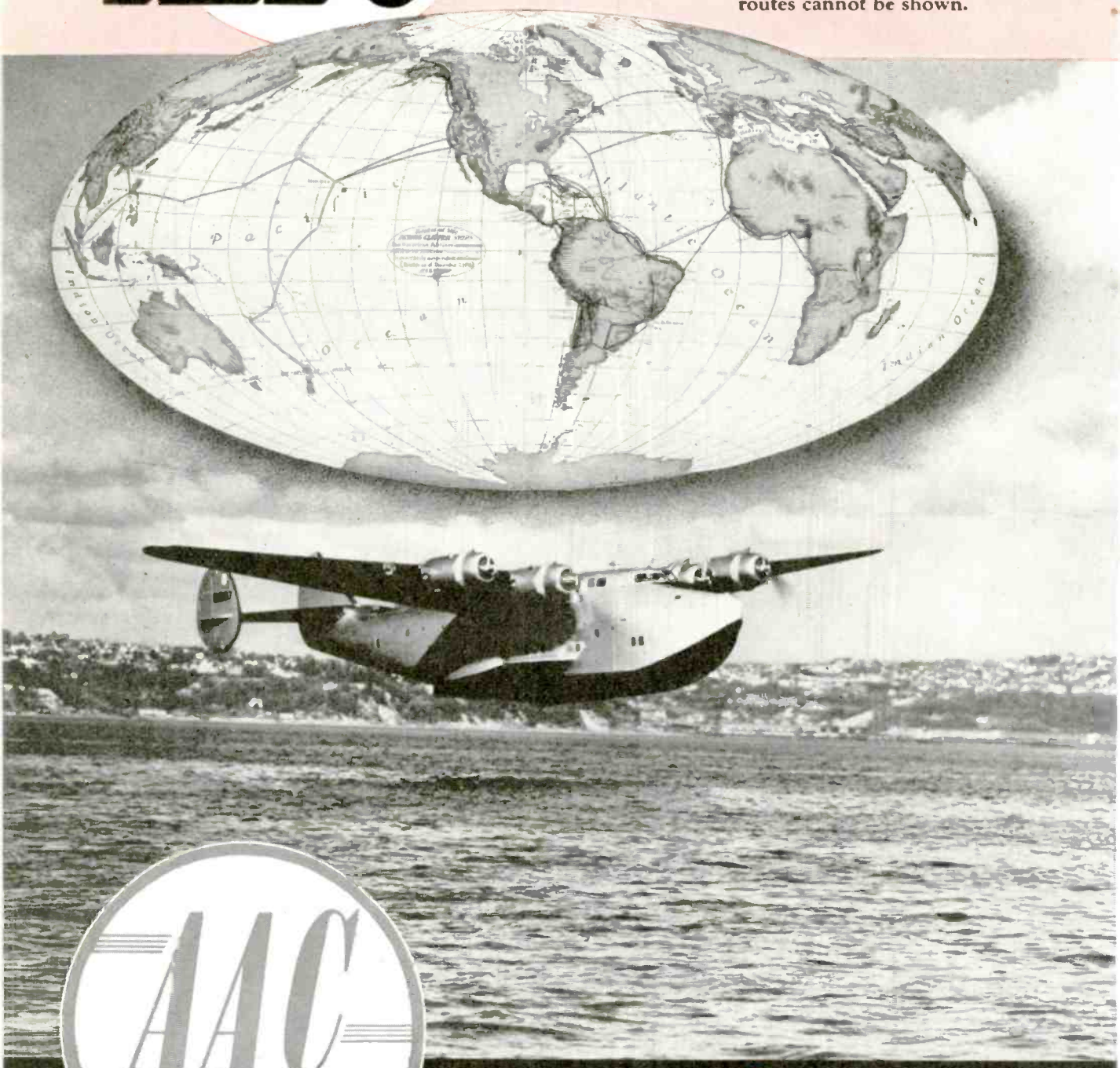
Our full line includes Carbon, Dynamic and Velocity models . . . all at popular prices . . . for public address, industrial sound, sound recording and speech transmission applications. Consult your local radio parts jobber.

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

Export Division: 13 East 40th Street, New York 16, N. Y. — U. S. A. *Cables: ARLAB*

AAC PRECISION

* The Pan American World Airways routes shown below are those in existence on December 7th, 1941. Present routes cannot be shown.



AAC Products

AIRCRAFT PRECISION RADIO

Kansas City, Kans.

RADIO PRODUCTS

Serve PAA

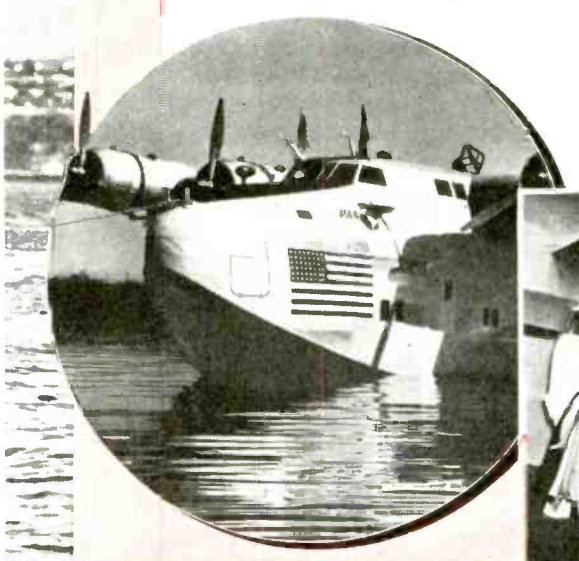
PAN AMERICAN WORLD AIRWAYS continues to perform a vital wartime service by speeding men and materials to every U.S. front and outpost . . . and AAC Precision Radio Products play an important part in this service.

As the giant *Clippers* spread their wings across the world, AAC Products help to maintain communications along the lifelines of this vast system which flies to every continent on the globe. These products are in use at operations bases, both here and overseas.

This is just one example of how the engineering and production skill of Aircraft Accessories Corporation serves the world's great airlines—as well as various branches of the armed forces. As one of America's largest producers of transmitters and other precision radio equipment, AAC offers the services of its Engineering Department in designing special equipment for you, without obligation.

ELECTRONICS DIVISION

KANSAS CITY, KANSAS



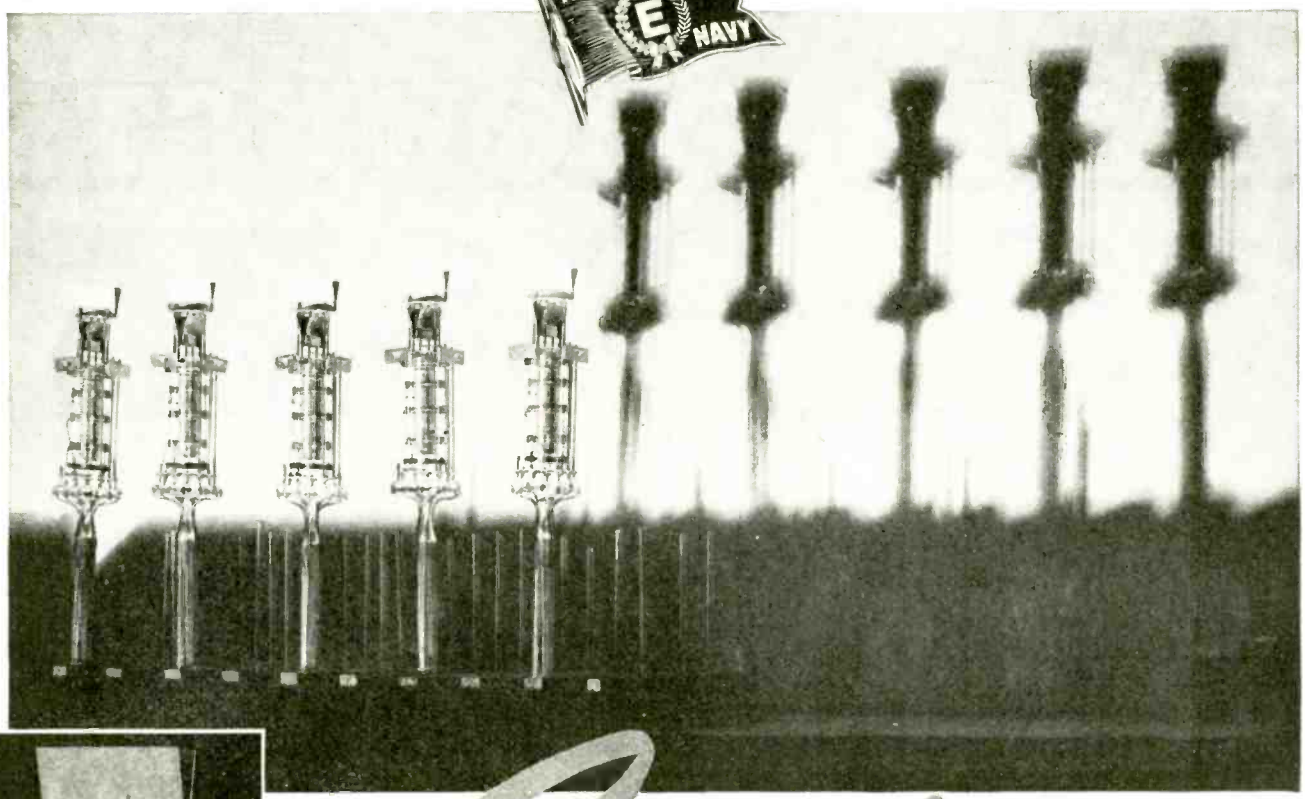
In war as in peace the PAA Clippers serve humanity. Here 1810 pounds of medical supplies go aboard at LaGuardia Field.

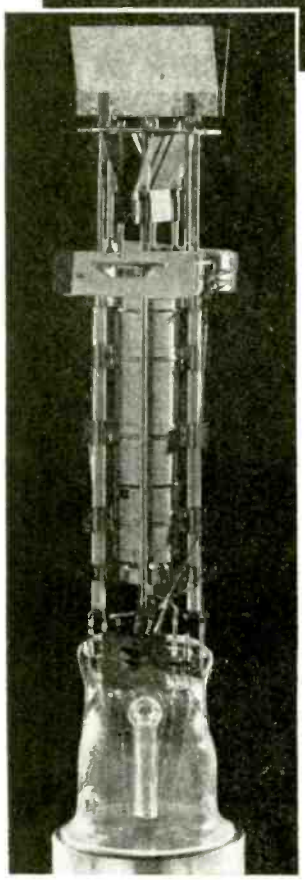
(E-54)

ACCESSORIES CORPORATION

and ELECTRONICS • ENGINEERED POWER CONTROLS

New York, N. Y. Burbank, Calif. Cable Address: AACPRO





Guns FOR VICTORY!

Recently the Army-Navy "E" for production excellence was awarded to Allen B. DuMont Laboratories, Inc. In accepting this high honor, Allen B. DuMont said in part:

"Originally the Navy 'E' went to that ship scoring outstanding marksmanship. Today that 'E' again reverts to its original meaning. We of the DuMont organization make *electronic guns*. Each cathode-ray tube contains an electronic gun. We make those guns as accurately as our skill, ingenuity and conscientious inspection can make them. Thus I hope that our 'E' is the direct result of good electronic marksmanship, as reflected by the reports from various battlefronts."

Electronic guns for victory! Such is the DuMont contribution to the war effort, made possible *qualitatively* by years of pioneering experience, and now *quantitatively* as well by a 400% growth in personnel. In four large DuMont plants and in several DuMont laboratories, continuing electronic victories are assured for winning today's war and tomorrow's peace.

➤ **The loose-leaf DuMont Cathode-Ray Manual and Catalog is yours for the asking. Write on business stationery for your copy.**

DUMONT *Precision Electronics & Television*

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

WHEREVER WIRING APPLICATIONS are exposed to conditions which ordinarily cause electro-chemical corrosion, Lumarith (cellulose acetate) insulation is particularly desirable. Guarded by Lumarith even hair-like copper wire shows no more corrosion than when suspended in free air.

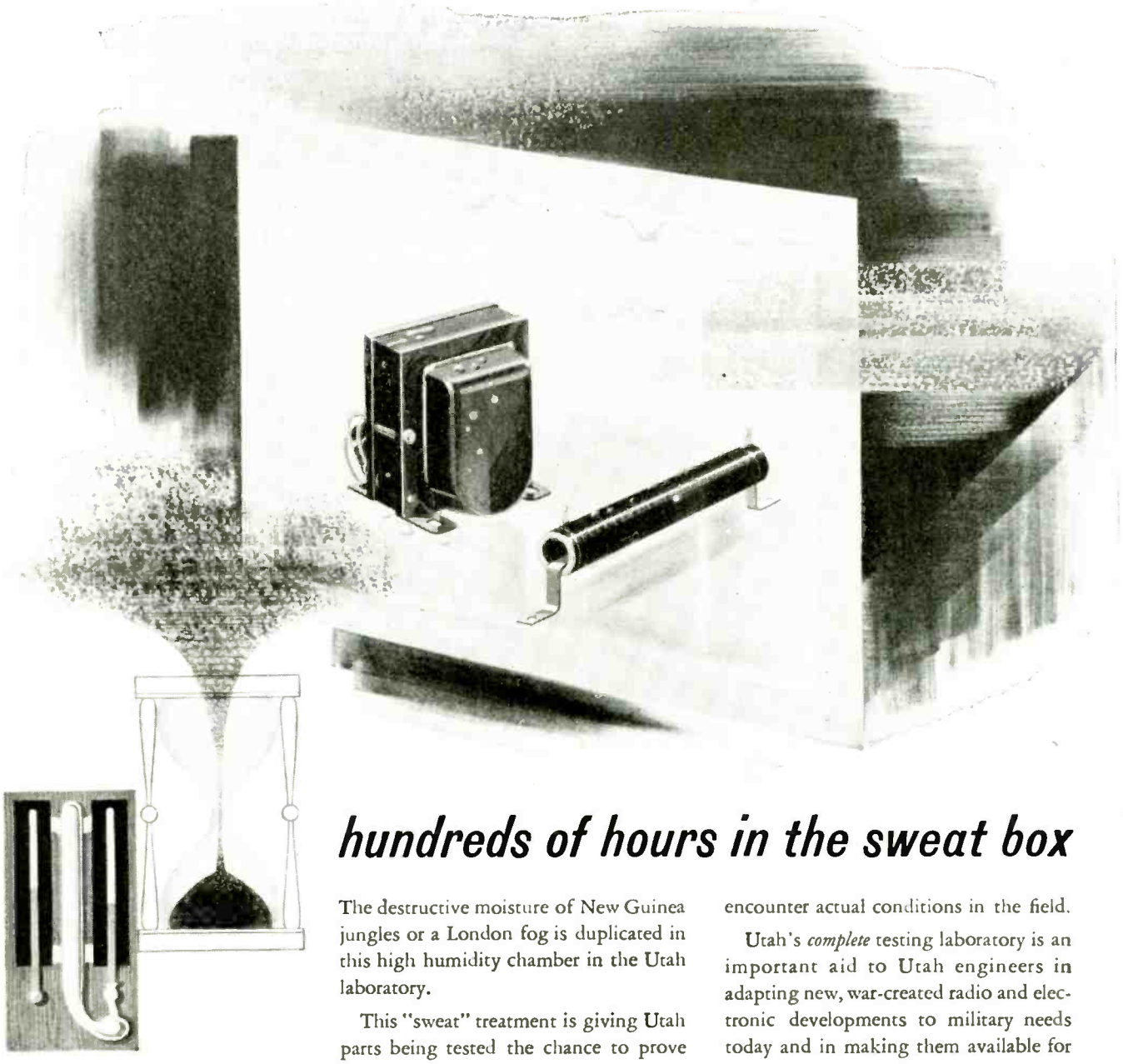
Lumarith has excellent dielectric strength. A new development—a special matte-finish—needs no lubrication and allows more elongation, a big plus in winding production.

Film . . . Foil . . . Molding material and other forms

It's really exciting news, Lumarith. Send for special new booklet packed with potent facts: "Lumarith for the Electrical Industry." Celanese Celluloid Corporation, The First Name in Plastics, a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16.

LUMARITH
A Celanese® Plastic

®Reg. U. S. Pat. Off.



hundreds of hours in the sweat box

The destructive moisture of New Guinea jungles or a London fog is duplicated in this high humidity chamber in the Utah laboratory.

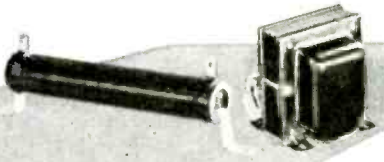
This "sweat" treatment is giving Utah parts being tested the chance to prove that they can take anything that excessive humidity can give them.

As a result, there will be no breakdowns or a lack of efficiency when these parts encounter actual conditions in the field.

Utah's *complete* testing laboratory is an important aid to Utah engineers in adapting new, war-created radio and electronic developments to military needs today and in making them available for commercial requirements tomorrow.

★ ★ ★

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.

utah

Radio Products Company, 850 Orleans Street, Chicago 10, Illinois

In the interests of those concerned with the design and manufacture of Army or Navy equipment, RCA reprints this latest

ARMY-NAVY PREFERRED LIST

OF RADIO ELECTRON TUBES

15 FEBRUARY 1944

RECEIVING										MISCELLANEOUS	
FILAMENT VOLTAGE	DIODES	DIODE TRIODES	TRIODES	TWIN TRIODES	PENTODES: REMOTE	PENTODES: SHARP	CONVERTERS	POWER OUTPUT	INDICATORS	RECTIFIERS	CATHODE RAY	CRYSTALS
1.4	*1A3*	1LH4	1LE3	*3A5* 3B7/1291	*1T4*	*1L4* 1LN5 *1S5*	1LC6 *1R5*	*3A4* 3D6/1299 *3S4*			2AP1 3BP1 3DP1 3FP7 5CP1 5CP7 5FP7 5JP1 7BP7 12DP7 12GP7	1N21B 1N23 1N27
5.0										5U4G 5Y3GT		PHOTOTUBES 918 927
6.3	*6AL5* 6H6* 559 *9006*	*6AQ6* 6SQ7* 6SR7*	2C22 *6C4* *6J4* 6J5* 7E5/1201 446A *9002*	*6J6* 6SL7GT 6SN7GT	6SG7* 6SK7* *9003*	6AC7* *6AG5* 6AG7* *6AK5* 6SH7* 6SJ7* 7W7 *9001*	6SA7*	6G6G 6L6GA 6N7GT/G 6V6GT/G 6Y6G	6E5	6X5GT/G 1005		VOLTAGE REGULATORS 0B3/VR-90 0C3/VR-105 0D3/VR-150
12.6	12H6*	12SQ7* 12SR7*	12J5GT	12SL7GT 12SN7GT	12SG7* 12SK7*	12SH7* 12SJ7*	12SA7*	12A6*	1629			
25 and above								25L6GT/G 28D7	991	25Z6GT/G		

TRANSMITTING								MISCELLANEOUS	
TRIODES		TETRODES	TWIN TETRODES	PENTODES	RECTIFIERS: VACUUM	RECTIFIERS: GAS	RECTIFIERS: GRID CONTROL	CLIPPER TUBES	GAS SWITCHING
2C26 2C44 6C21 15E VT127A 327B 434A 527 530	801A 809 811 826 833A 838 1626 8005 8014A 8025	5D21 715B 807 813 814 1625	3E29 815 829B 832A	2E22 803 837	2X2 3B24 5R4GY 371B 705A 836 1616 8016 8020	4B25 83 866A/866 872A/872	3C23 3C31/C1B C5B 884 2050	73 719A	1B32/532A 471A 532

*Where direct interchangeability is assured "GT" and "L" counterparts of the preferred metal tubes may be used.

Miniature tubes (shown in Italics) shall be used only when essential to Service requirements.

NOTE: THIS PREFERRED LIST SUPERSEDES THE ARMY-NAVY PREFERRED LIST OF VACUUM TUBES, DATED MARCH 1, 1943.

1. The above Army-Navy Preferred List of Radio Electron Tubes sets up a group of unclassified general purpose tubes selected jointly by the Signal Corps and the Bureau of Ships. The purpose of this list is to effect an eventual reduction in the variety of tubes used in Service equipment.

2. IT IS MANDATORY THAT ALL UNCLASSIFIED TUBES TO BE USED IN ALL FUTURE DESIGNS OF NEW EQUIPMENTS UNDER THE JURISDICTION OF THE SIGNAL CORPS LABORATORIES OR THE RADIO DIVISION OF THE BUREAU OF SHIPS BE CHOSEN FROM THIS LIST. EXCEPTIONS TO THIS RULE ARE HEREINAFTER NOTED.

3. The term "new equipments," as mentioned in Paragraph 2 above, is taken to include:

a. Equipments basically new in electrical design, with no similar prototypes.
b. Equipments having a similar prototype but completely redesigned as to electrical characteristics.
c. New test equipment for operational field use.

4. The term "new equipments," as mentioned in Paragraph 2 above, *does not* include:

a. Equipments either basically new or redesigned, that are likely to be manufactured in very small quantity, such as laboratory measuring instruments.
b. Equipments that are solely mechanical redesigns of existing prototypes.
c. Equipments that are reorders without change of existing models.
d. Equipments in the design stage before the effective date of adoption of this Preferred List.

Note: The foregoing statements in Paragraphs 3 and 4 above are explanatory in nature and are not intended to be all-inclusive.

5. In the event that it is believed that a tube other than one of those included in this Preferred List should be used in the design of new equipments for either the Signal Corps or Navy, specific approval of the Service concerned must be obtained. Such approval, when Signal Corps equipment is concerned, is to be requested from the Signal Corps Laboratory concerned with such equipment; the said Laboratory will then make known its recommendations in the matter to the Signal Corps Standards Agency where the final decision will be made and returned to the laboratory for transmittal to the party requesting the exception. When Navy equipment is concerned, the request for exception shall be addressed to the Radio Division, Bureau of Ships, Code 930-A, Navy Department.

6. The publication of this list is in no way intended to hamper or restrict development work in the field of radio electron tubes or radio electron tube applications.

7. This list is to take effect immediately.

The Chief of the Bureau of Ships
Navy Department

Office of the Chief Signal Officer
Headquarters, Army Service Forces,
War Department

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

RAYTHEON VOLTAGE STABILIZERS

CONTROL FLUCTUATING VOLTAGE TO ± ½%

A MAGNETIC UNIT WITHOUT MOVING PARTS

Nothing to replace or adjust

FOR

- **Television**
- **Colorimeters**
- **Radar & Radio**
- **Signal Systems**
- **X-Ray Machines**
- **Sound Recording**
- **Electronic Devices**
- **Testing Equipment**
- **Photo-Cell Devices**
- **Production Machinery**
- **Constant Speed Motors**
- **Motion Picture Equipment**
- **Comunications Apparatus**
- **Precision Laboratory Apparatus**
- **Other Applications Requiring Regulated Voltages**

New Stabilizer bulletin DL48-537. Contains operating characteristics, graphs and complete specifications. Write for your copy, today.

Constant AC voltage is essential for reliable, accurate operation of a wide variety of electrical equipment. When these devices are connected to ordinary supply mains, the unstabilized input voltage often varies as much as from 95 to 130 volts thus impairing the accurate operation of the equipment. A Raytheon Voltage Stabilizer, incorporated into the product, overcomes the disadvantages of fluctuating line voltages by providing an accurately controlled source of power held to ± ½%.

Entirely automatic in operation, the Raytheon Voltage Stabilizer has no moving parts . . . nothing to wear out, consequently requires no maintenance. Simply connect it to line and from there on it will take care of itself.

Raytheon Voltage Stabilizers built-in new equipment or offered as an accessory not only improve the performance but also increase the salability of the product.

Users of many types of electrical equipment not having voltage stabilization will find that Raytheon Voltage Stabilizers improve the performance and reliability of their equipment.

Raytheon Voltage Stabilizers are equally suitable for use in equipment for the laboratory, production or unattended locations.

The coveted Army-Navy "E", for Excellence in the manufacture of war equipment and tubes, flies over all four Raytheon plants where 12,000 men and women are producing for VICTORY.

RAYTHEON MANUFACTURING Company

190 WILLOW ST WALTHAM, MASS.

"Captain Dag"

trace THIS FIGHTER'S RECORD BY HIS MEDALS!

If there were decorations for industrial heroes, Mr. Dag would be a much be-ribboned gentleman. Perhaps we should call him 'Captain' Dag, because he commands so versatile a company of physical and chemical properties.

Captain Dag (a campaigner who will never be mustered out) represents Dag brand colloidal graphite, the smooth, black liquid concentrate which serves so many different war industries. Capt. Dag may take the form of a dry film, a fluid film, a surface coating, an impregnation, etc.

1, 3, 8, 14, 13, 6

CITATION: "We have been enthusiastic users of Dag colloidal graphite for more than ten years. We find it the only material which will prevent bolts, nuts and flanges from seizing under the high temperature and pressure conditions in our boilers and steam systems."

1, 3, 13, 14

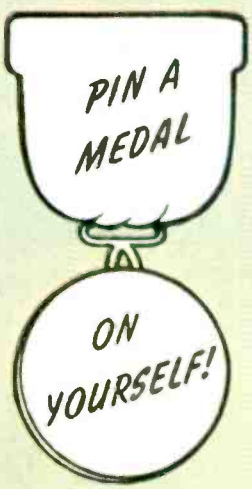
CITATION: "Dry films formed from Dag colloidal graphite supply durable lubrication on parts which could not be effectively lubricated otherwise. Such films are functioning at temperatures from (—60° F. to +1200° F.) and higher."

PHYSICAL AND CHEMICAL PROPERTIES

1. Slippery—A Good Lubricant Softer than Talc
2. Conducts Electricity
3. Withstands Temperature Extremes
4. Absorbs, Radiates and Conducts Heat
5. Maximum Purity
6. Low Coefficient of Expansion
7. Particles Bear Like Electric Charges
8. Insoluble in Acids and Alkalies
9. Black and Opaque
10. Gas Adsorbent
11. Little Photoelectric Effect
12. Miscible with Most Fluids
13. Films Adhere Tenaciously and Dry with Sharp Edges
14. Microscopically Fine Particles. Penetrates Fine Pores
15. An Excellent Suspension

2, 4, 13, 10, 11, 3

CITATION: "Graphite films when applied to the grids (and frequently the plates) of radio tubes for receiving and transmitting, are useful for minimizing secondary emission, 'back' emission and photoelectric effects."



For easy reference we've given colors to Captain Dag's most valuable properties. Match these colors with the performance "citations" above. Then pin a medal on yourself for putting Captain Dag to work in your plant. He's one campaigner who won't be mustered out.

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION

PORT HURON, MICHIGAN

A thousand meters had better be right . . .

WE'RE thinking not only of the metering and measuring instruments in the plane that toes the take-off line. To be sure, they are of great importance—but just as important are the hosts of metering, measuring, and testing instruments used in the creation of his plane, its guns, its accessories, its fighting efficiency. If any meter down the line was wrong—his chances of safety and success are dangerously reduced.

In a hundred thousand ways, the safety and progress of us all depend on the accuracy of measuring, metering, and testing instruments. To create such instruments—to build into them the priceless quality of *sustained accuracy**—is a responsibility that the Boes organization, thanks to its experience and skill, is qualified to shoulder.

. . . . . .

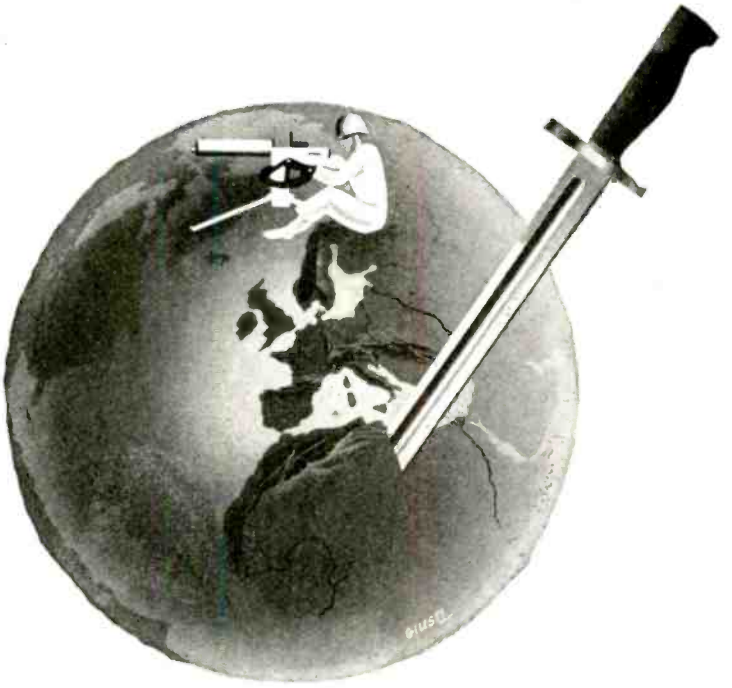
***SUSTAINED ACCURACY** is not an easy quality to achieve. It must take into account all factors of use—must then employ the design, the alloys, the construction that infallibly protect an instrument against all threats to its reliable performance. Such instruments, obviously, must be built with performance—not price—in mind. We invite the inquiries of those who are interested in such standards.

Boes instruments

for Measuring, Metering & Testing Equipment ☆ The W. W. Boes Co. Dayton, Ohio

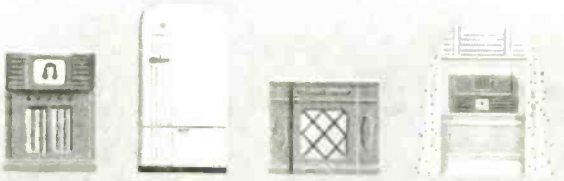
TODAY

the men and women of Philco are devoting the knowledge and skill that built over 17 million radios and refrigerators to the electronic miracles of modern warfare . . .



TOMORROW

. . . their research, engineering and mass production for war will be reflected in a new Philco leadership in electronics for the homes and industries of the nation.



Tune in the RADIO HALL OF FAME, Sundays, 6 to 7 P. M., EWT., Blue Network. The Top Hits of the Show, World, each week.

PHILCO CORPORATION

BACK THE ATTACK — BUY WAR BONDS

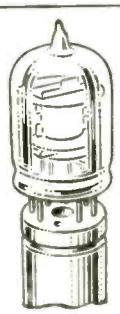
TUBES GET THE MOST UNEXPECTED ABUSE

Signal Corps tests for Electronic Tubes are exacting . . . and rightly so. For tubes to be totally satisfactory for civilian or military use, they must be built to operate under the most severe and unusual conditions. That is why "vibration testing" was a routine procedure at TUNG-SOL long before the war.

TUNG-SOL research engineers are continuously working to find "weak points" and developing ways and means of overcoming them. With the advent of the glass base tubes for instance, the cause of base fractures was discovered and a production procedure was developed to eliminate it.

Manufacturers and users of Electronic Equipment will find every tube in the TUNG-SOL line a tube of proven merit.

Why not have TUNG-SOL engineers think and work along with you while you are planning your new developments?



THE TUNG-SOL WAY

OF COOLING TUBES PREVENTS BREAKAGE OF GLASS BASES..

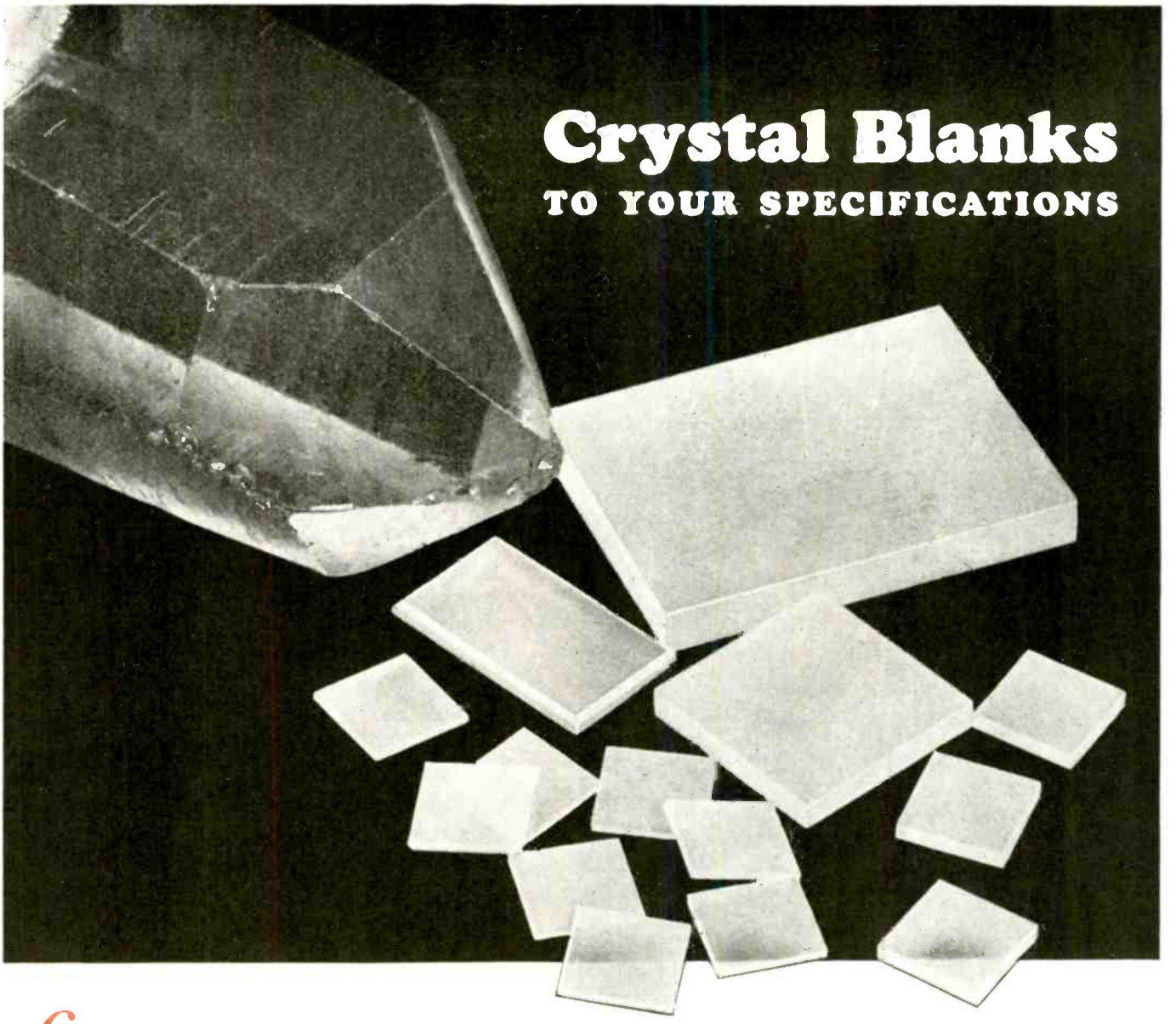
While a tube is cooling, during manufacture, air is blown against the center of the glass base through a hole in the holder thus cooling the base from the center out while natural cooling takes place from the edges in. This uniform cooling relieves internal stresses in the glass, a cause of breakage.

TUNG-SOL
vibration-tested
ELECTRONIC TUBES

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



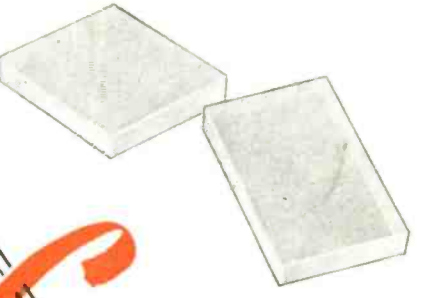
Crystal Products Company can supply Quartz Crystal blanks in any of the three stages of manufacture: (1) "rough-sawed" blanks, (2) "semi-finished" blanks, and (3) "electrically finished" blanks.

"Rough-sawed" blanks are cut to the specified angles and roughly sawed to dimensions.

"Semi-finished" blanks are blanks which have been brought to approximate dimensions by machine lapping, allowance being made for final hand finishing.

"Electrically-finished" blanks are finished by hand to the frequency desired and electrically tested.

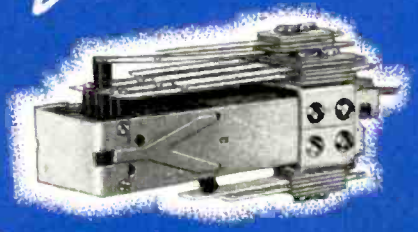
All crystal blanks are cut to specifications from selected Brazilian quartz and guaranteed free from all impurities such as optical twinning, electrical twinning, bubbles, fractures, scratches, mineral inclusions, and other mechanical and electrical imperfections. Dimensions, temperature coefficients, and frequencies are guaranteed within specifications listed. **Send us your holders for replacement of crystal blanks to exact specifications.**



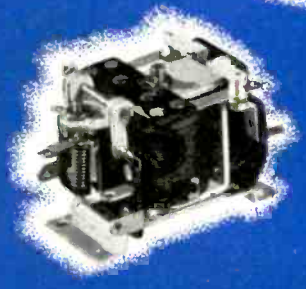
Crystal
PRODUCTS COMPANY

1519 McGee Street, Kansas City, Mo.
Producers of Approved Precision Crystals for Radio Frequency Control

Specify - RELAYS

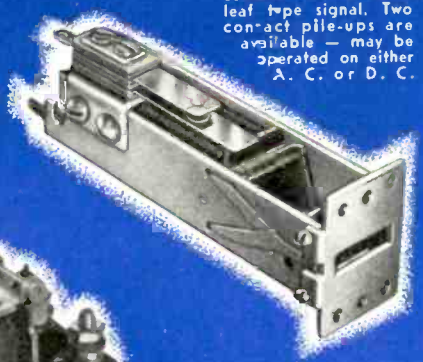


RIGHT—Step Relay—Combines lever operated and cam operated contact pile-ups. Lever action contacts operate only when the coil is energized, cam operated contacts operate until another impulse is received.



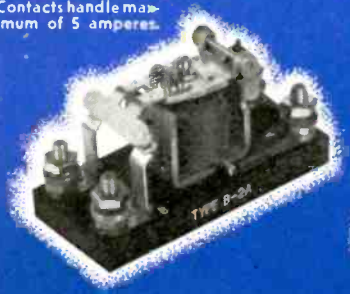
BELOW—Type 300—A double pole, double throw, latching relay arranged with two interlocking armatures. Either coil operates with a single impulse and contact remains until the other coil is energized.

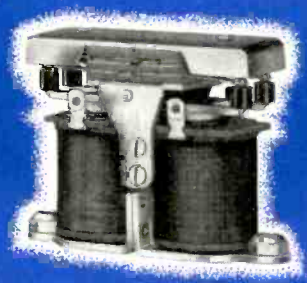
ABOVE—Type 301—A double pole, double throw, aviation type relay with 10 ampere contacts featuring a pin type bearing, adjustable residual and back-stop.



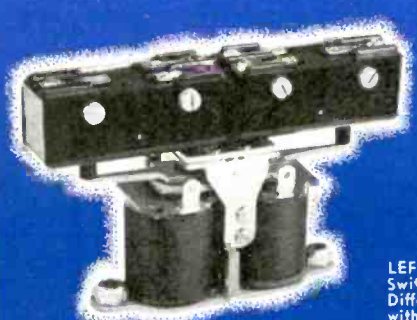
BELOW — Annunciator Relay—Combines relay contacts and a visual leaf type signal. Two contact pile-ups are available — may be operated on either A. C. or D. C.

ABOVE—Type M-3—Small, single pole, single throw relay available with coil resistance from 150 to 1500 ohms. Can be mounted in a 1" cube. Contacts handle maximum of 5 amperes.





ABOVE—Type E-2A—Conforms to Army Air Force specifications for a 25 ampere contactor. Features pin type bearing, double break contact arrangement which eliminates the necessity for current carrying pigtails. Adjustable residual and back-stop



ABOVE — Differential Relay—A two coil, sensitive relay with a balanced armature to make it less susceptible to vibration and shock. Can be made to balance with 3MA in each coil and to operate with 4MA in one coil and 2MA in the other coil for 60 volt operation or the equivalent in ampere turns.

LEFT — Differential Relay with Switches — Similar to standard Differential Relay, but equipped with small switches to obtain greater contact ratings.

Whether your requirements are for a standard type relay or a special relay for an unusual application, you can rely on Cook engineering to give you those "plus" features that make all Cook relays "extra-ordinary."

Here are some facts about Cook relays for you to consider when planning your relay requirements.

- Carefully designed to the high standards of Cook engineering.
- 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 of Cook relays.
- Manufactured in a model plant with efficiency that provides capacity to produce in quantity.
- Cook Electric Company has been engaged in the manufacture of precision electrical apparatus since 1897.

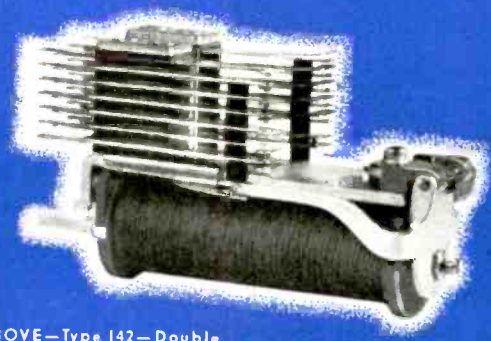
Illustrated here are a few of the standard types of Cook relays. Your requirements may be supplied with a standard type relay; however, it is when you have an unusual problem that Cook's engineering and manufacturing facilities, the ability to quickly design, manufacture and assemble all under one roof are of invaluable service. Cook special relays are built to meet customer requirements — not "just another relay" — not a combination of stock-bin parts, but a carefully engineered, designed and tooled product.

Cook's engineering staff is at your service to help you solve those unusual problems. A staff of field engineers located in various key cities throughout the United States is also available to you.

For complete service to the aviation, communications, electrical and electronics industries, Cook Electric Company also manufactures accessories, such as jacks, plugs, lamp jack strips, terminal strips, binding posts, solenoids, solenoid contactors, turn keys, lever keys, push keys, etc.

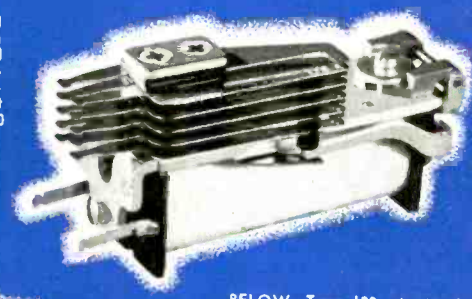
A new catalog of the complete line of Cook relays and accessories is now in preparation. A request on your letterhead will bring one to you immediately upon its completion.

by **COOK** — *All Cook Relays, whether special or standard type, are "Extra-ordinary"*

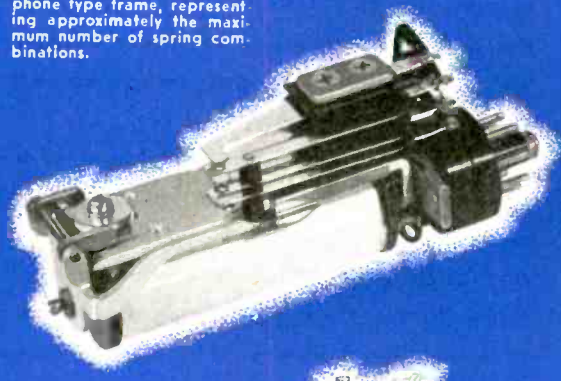


ABOVE—Type 142—Double pile-up relay on large telephone type frame, representing approximately the maximum number of spring combinations.

RIGHT—Type 124—Special keying relay using silicon steel armature and heel piece with a laminated silicon steel core enabling operation on direct current at keying speeds up to 40 words per minute.



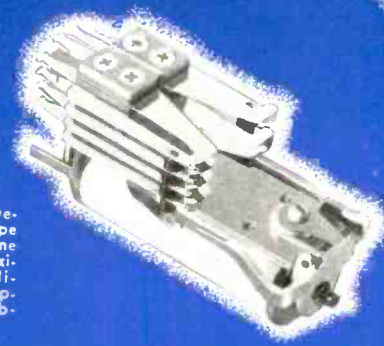
BELOW—Type 128—A standard short frame telephone type relay with bakelite impregnated, Air Corps approved coil.



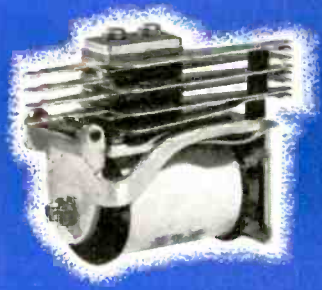
ABOVE—Type 400—New, small, telephone type relay, approximately ½ size of former small, telephone type relays. Available in single and double pile-ups and special spread terminals.

ABOVE—Type 113—An A.C. relay having a laminated core, heavy Oilite bearing yoke, special silicon steel armature and heel piece, and plug-in base.

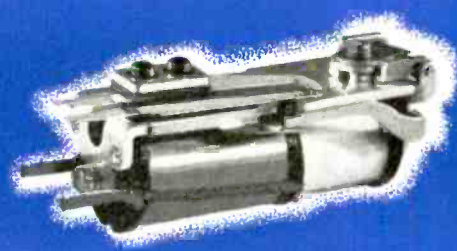
LEFT—Small Time Delay Relay—Slug type on a short telephone type frame, a maximum of 125 milliseconds delay in operation can be obtained.



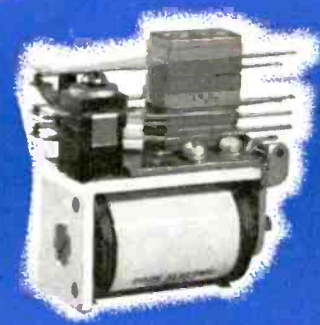
LEFT—Type 107—A large type telephone relay used for keying and antenna switching. Keys satisfactorily at 20 words per minute—Mycalex insulation in the antenna switching pile-up.



ABOVE—Type 100—Represents a typical contact pile-up combination on the short telephone type relay frame.



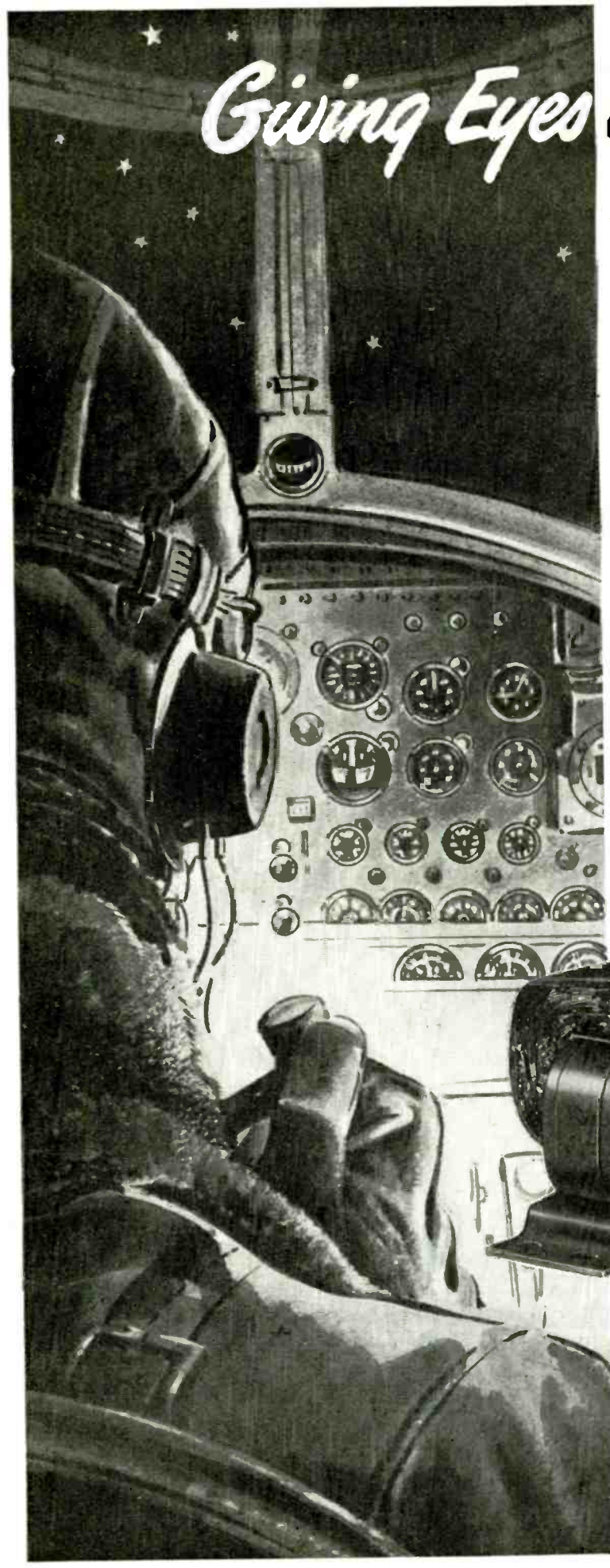
ABOVE—Type 102—Time delay relay of the slug type. Pure copper slug on heel end of core provides maximum of 300 milli-seconds delay in contact opening after circuit is broken.



ABOVE—Type 108—Antenna switching contact combination with Mycalex insulation. Has a side contact mount to reduce capacity between antenna circuit and ground.

COOK ELECTRIC Company

2700 SOUTHPORT AVE. CHICAGO 14, ILLINOIS



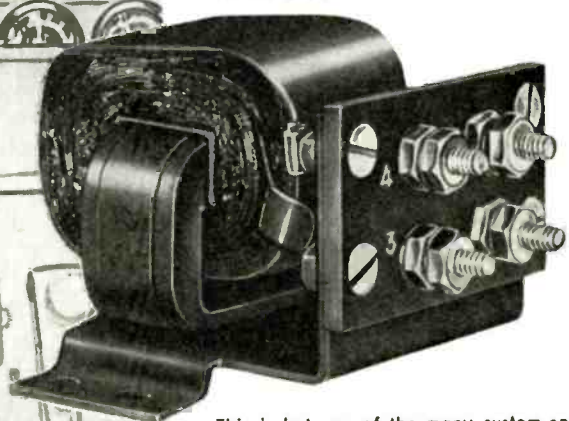
Giving Eyes to War Birds

. . 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.



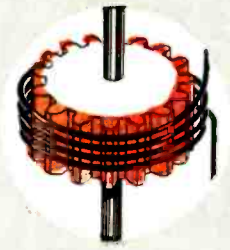
This is but one of the many custom-engineerings executed by N.Y.T. technicians, in hastening Victory through electronics; similar transformer products will aid immeasurably in the fulfillment of peace-time advancements.

NEW YORK TRANSFORMER CO.

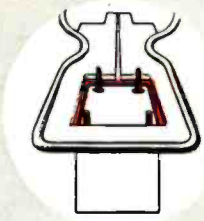
22-26 WAVERLY PLACE
NEW YORK 3, N. Y.

HOW *Scientific Electronics* HEATING EQUIPMENT CAN

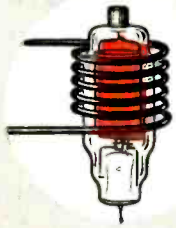
improve production . . . save time and money



Electronic heat can surface harden gear teeth or localized areas in seconds instead of hours . . . with precise control over depth and degree of hardness.

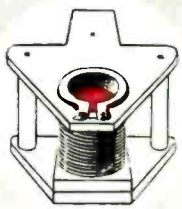


Electronic heat is revolutionizing brazing and soldering operations. Speed and efficiency are increased and wasteful after-cleaning operations are eliminated.

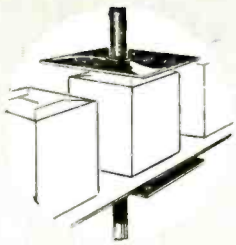


Electranic heat reaches through glass walls to degas metal elements in radio and fluorescent tubes without affecting the envelopes. Action is instantaneous.

Electronic heat can bond glass to metal faster with finer control of heated area. Often increases production units from hundreds to thousands per hour.



Electronic heat is ideal for soft metal melting pots. Lowers operating costs. Assures longer life of pot. Reduces gas inclusions of the smelt. Ends fire hazards.



Electronic heat seals packages rapidly and completely in matters of seconds on continuous production lines. Packaged goods containing foods are sterilized.

This company has been designing and building Electronic heating units (induction and dielectric) *since 1921*. We have the advantage of *23 years* of pioneering knowledge and experience in this specialty.

Our equipment (known as "bombarders") has been used with satisfaction by the nation's leading electronic tube manufacturers for almost a quarter of a century, for exhausting and testing tubes.

Our apparatus has been time-tested for high efficiency and economy of operation, and is built to minimize maintenance problems. Our greater *variety* of models permits choosing the unit which is exactly suited to your application, and offers the *correct combination* of *power and frequency* which your jobs demand. You cannot get a power-wasting "misfit" machine from us. Before selecting any electronic heater, it will pay you to write us.

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:

5 Kw
7½ Kw
10 Kw
12½ Kw
15 Kw
18 Kw
25 Kw
40 Kw
100 Kw

Scientific Electric

DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY

119 Monroe Street Garfield, New Jersey

Designers and Builders of High Frequency Converters Since 1921

NO Burning
NO Pitting
NO Sticking

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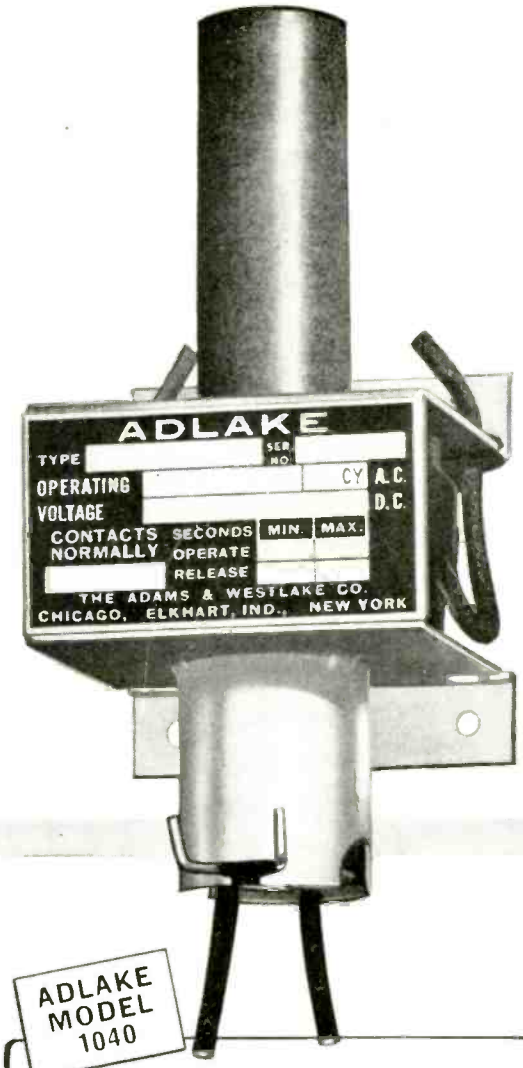


ADLAKE MODEL 1040

For panel mounting. Can be supplied with quick or time delay action; normally open or normally closed; and for A.C. or D.C. energization. Contact rating *up to 100* amps. A.C.; proportional D.C. ratings.

Automatic Control Is Really Automatic with Adlake Plunger-type Mercury Relays

Put Adlake Plunger-type Mercury Relays of correct capacity and rating on your control panel and you've really got *automatic* control. No inspection. No cleaning. No servicing. Here's why . . .

The contact mechanism of Adlake Plunger-type Mercury Relays is *hermetically sealed inside* a glass or metal cylinder.

Dirt and dust *can't get inside* to "gum up" operation. And, because contact is made by *liquid metal* (mercury), it is positive, chatterless, silent and *impervious to burning, pitting and sticking.*

For many kinds of service, particularly those considered "difficult," there is no other type of relay that can give such dependable service.

There's a lot more about Adlake Relays that every engineer should know.

Our complete bulletin tells the story. Ask for it —no obligation.

"BACK THE ATTACK — BUY BONDS"

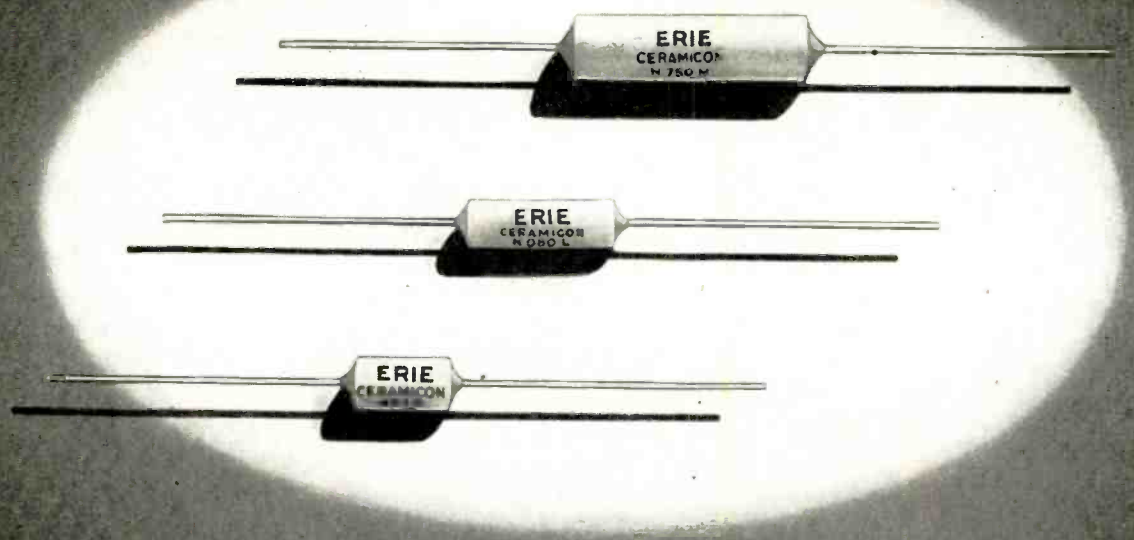
Adlake TRADE MARK

THE ADAMS & WESTLAKE COMPANY

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

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

for Inherent Stability in Capacity
Excellent Retrace Characteristics
Wide Range of Temperature Coefficient
Close Tolerances



Specify ERIE INSULATED CERAMICONS

REG. U. S. PAT. OFF.

OVER eight years ago Erie Ceramicons brought new standards of stability to pre-war broadcast receivers. For war-time military communications equipment these compact, sturdy silver-ceramic capacitors have been rendering excellent service in many critical applications that call for performance standards undreamed of when push-button tuning was in its infancy.

Today Erie insulated Ceramicons are available with basic characteristics that are essential for high frequency, F.M. and television applications.

1. Inherent Capacity Stability: Silver electrodes are in intimate contact with ceramic dielectric, eliminating any possibility of air or wax filled pockets between the two.

2. Excellent Retrace Characteristics: Since the temperature coefficient is a function of the molecular structure of the ceramic dielectric, change in capacity of Ceramicons with respect to temperature is definite and reproducable under normal operating conditions.

3. Wide Range of Temperature Coefficient: Erie Ceramicons are available in 10 standard temperature coefficients from +100 P/M/°C to —750 P/M/°C. Standard tolerance is ±60 P/M/°C, or ±15% whichever is the greater, as determined by measurement at +25°C and 85°C. Erie Ceramicons can be individually checked in production quantities for temperature coefficient to much closer limits.

4. Close Tolerances: Standard commercial capacity tolerance is ±.25 MMF or ±1%, whichever is greater. Ceramicons are now being produced in large quantities having capacity tolerances as close as ±0.1 MMF.

The Erie Engineering Department is continually working to further refine the characteristics of Erie Ceramicons. We will be glad to work with you on Ceramicons for commercial or special applications.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

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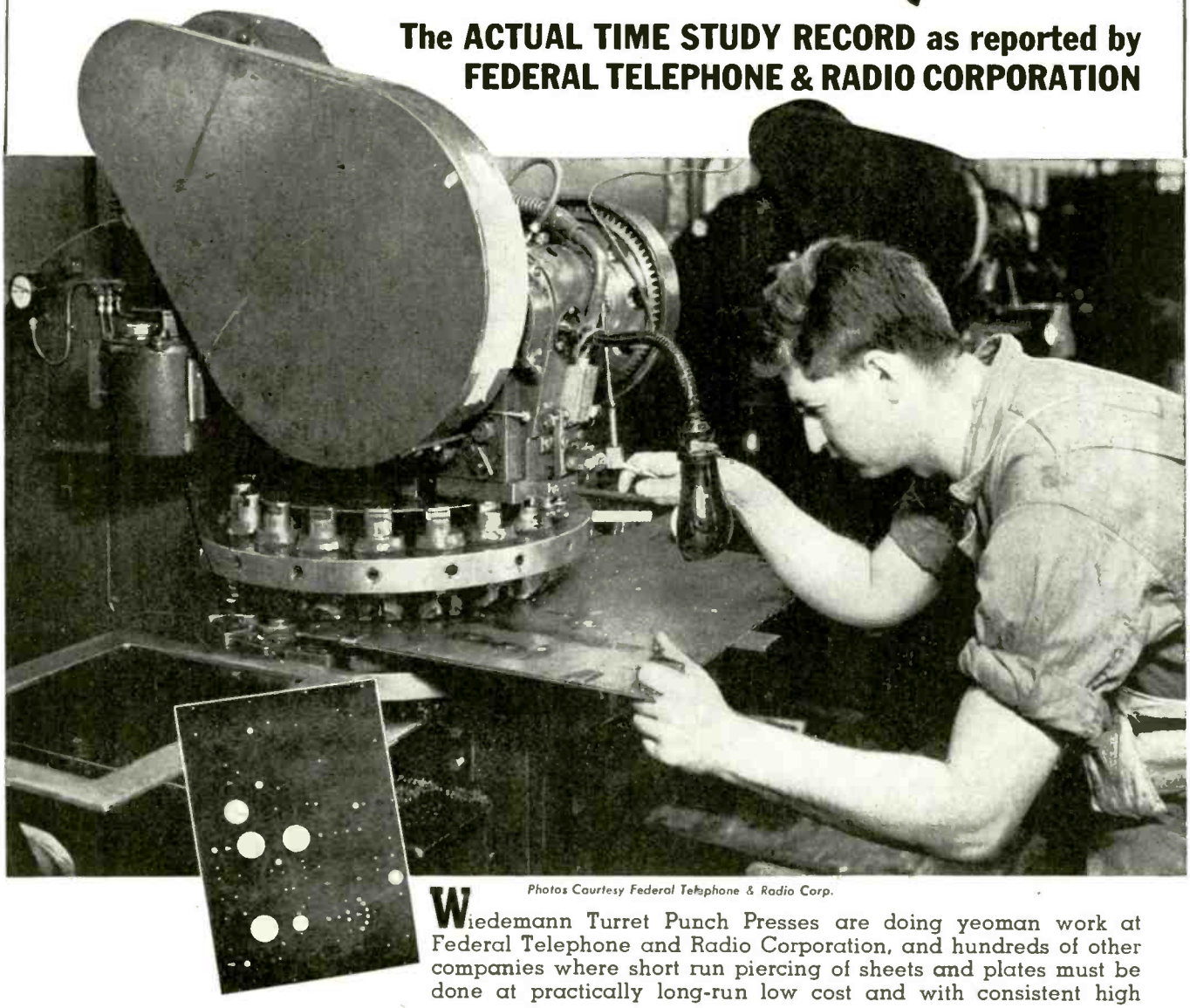
PRODUCTION MEN:

COULD YOU PIERCE 100 HOLES THROUGH A TEMPLATE IN 10.25 MINUTES?

The ACTUAL TIME STUDY RECORD as reported by FEDERAL TELEPHONE & RADIO CORPORATION



Photos Courtesy Federal Telephone & Radio Corp.

Wiedemann Turret Punch Presses are doing yeoman work at Federal Telephone and Radio Corporation, and hundreds of other companies where short run piercing of sheets and plates must be done at practically long-run low cost and with consistent high accuracy.

The Type R-44 Turrent Punch Press illustrated is especially designed for piercing through templates — and incorporates speed of location and piercing, with a unique safety device which makes it impossible for the operator to damage the template. A companion machine, the Type R-43 Micro-Turret Punch Press produces the templates . . . each hole accurate to ± .002".

You too can by-pass the high cost of short run piercing by putting Wiedemanns in your production line . . . for piercing holes up to 3" in ½" stock . . . 8 to 80 tons capacity . . . 8 to 24 punches and dies at your fingertips with a choice of labor-saving gauge tables.

MAKE THE COMPARISON! The significant time and labor-saving facts about Wiedemann Turret Punch Presses are detailed in Bulletin 92, "The Story of Short Run Piercing Economy." A copy will be sent by return mail. Savings up to 2000% have been reported by users!

WIEDEMANN MACHINE COMPANY

1833 SEDGLEY AVENUE, PHILADELPHIA 32, PA.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES

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...BUT TIME WILL REVEAL THE STORY OF Doolittle ENGINEERING

Long before Pearl Harbor . . ."specialized communications equipment by Doolittle" was well and favorably known to aviation, broadcast and police radio engineers.

Since then . . . Doolittle Engineers have constantly been at work developing and producing vital equipment for the Naval Aircraft Factory and the Bureau of Aeronautics, to hasten Victory.

Their added experience will bring important benefits to future peacetime communications. *Look ahead . . . with Doolittle.*

Doolittle RADIO, INC.

Builders of Precision Radio Communications Equipment

7421 South Loomis Boulevard, Chicago 36, Illinois

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Buy More War Bonds

Echophone Model EC-1

(Illustrated) a compact communications receiver with every necessary feature for good reception. Covers from 550 kc. to 30 mc. on three bands. Electrical bandspread on all bands. Six tubes. Self-contained speaker. 115-125 volts AC or DC.

Echophone Radio Co., 540 N. Michigan Ave., Chicago 11, Illinois

Silver Mica CAPACITORS

Capacities from 6 to 2000 MMF

Less than one half inch in diameter . . . capacities from 6 MMF to 2000 MMF . . . ideal for numerous UHF and VHF applications.

Mica discs of the highest grade, individually silvered for maximum stability and stacked to eliminate any book effect. The assembly is vacuum impregnated. Available in a variety of terminals. All units are color coded.

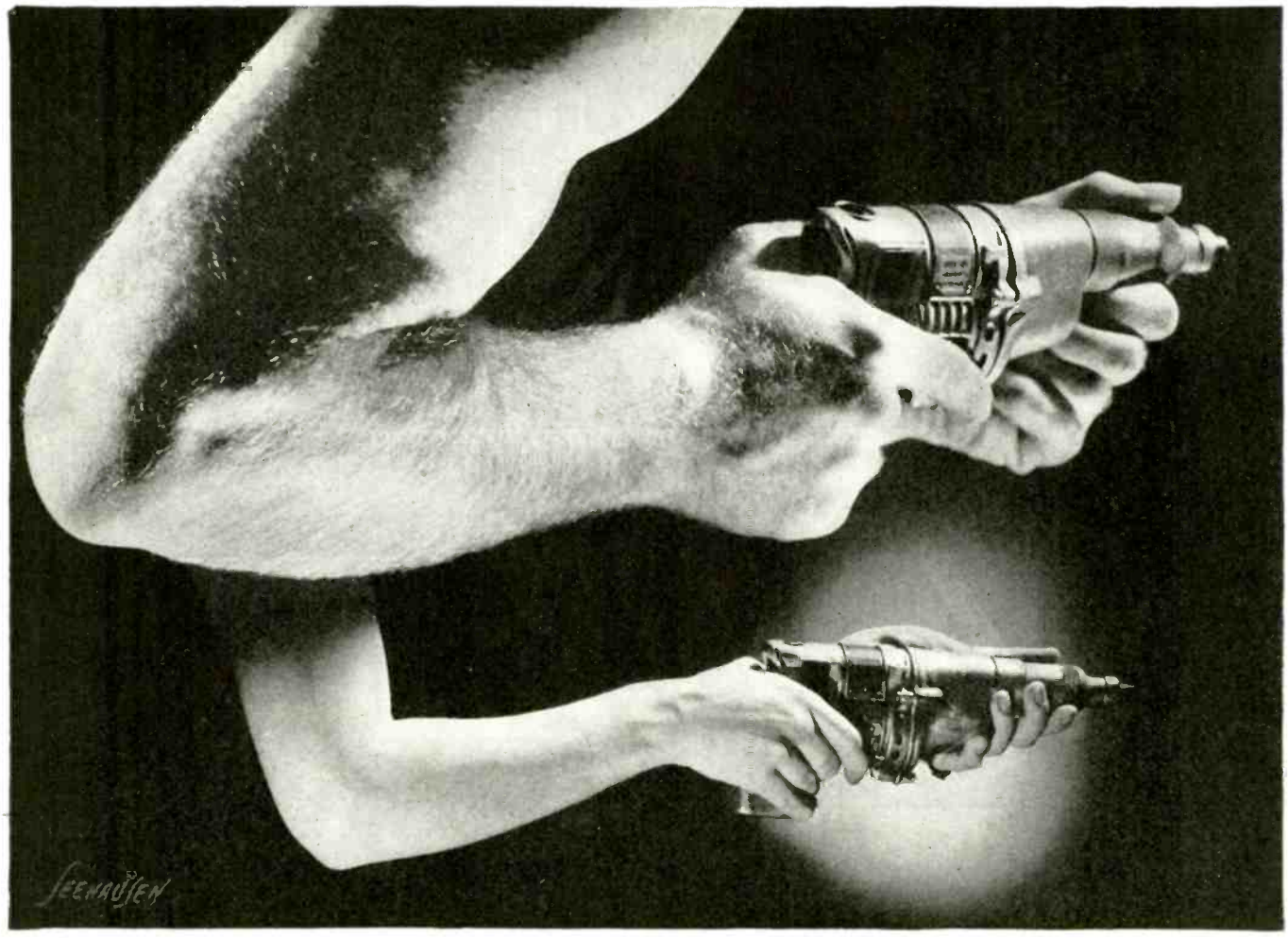
Form 586 is available for additional information on these CENTRALAB Silver Mica Capacitors.

Centralab

CRL

Division of GLOBE-UNION INC., Milwaukee

PRODUCERS OF VARIABLE RESISTORS · SELECTOR SWITCHES · CERAMIC CAPACITORS, FIXED AND VARIABLE · STEATITE INSULATORS



Compare The Effortless Ease

with which CLUTCH HEAD Screws are driven home . . . *employing the substitution of method for muscle* . . . with definite output gain at the end of the day. The explanation is simple. With the straight-walled Clutch recess, matched by the straight sides of the Type "A" Bit, there is no "ride-out" tendency and, therefore, no need for strenuous end pressure. This exclusive CLUTCH HEAD feature eliminates the fatigue factor set up by end pressure. In addition, the wide Clutch of this modern screw develops speed and confidence in line assembly work by presenting a safe, easy-to-hit target.

CLUTCH HEAD *contributes so many outstanding exclusive advantages for faster, better, safer, and lower cost production that it has come to be accepted as* "The Screw That Sells Itself." *You may demonstrate this to your own satisfaction by asking us* to mail you *package assortment of* CLUTCH HEAD *Screws and sample of the Type "A" Bit.*

The fact that CLUTCH HEAD Screws operate with the ordinary type screwdriver simplifies problems of field service. This feature has proved its value in many phases of the war effort. This modern screw is available in Standard and Thread-forming types for every purpose.

CLUTCH HEAD · SCREWS ·

This rugged Type "A" Bit delivers long uninterrupted service. A brief application of the end surface to a grinding wheel restores original efficiency. No delay, and no "back-to-the-factory" shipment for reconditioning.

UNITED SCREW AND BOLT CORPORATION

CHICAGO . CLEVELAND NEW YORK

The Test of High Standards of Manufacturing is in the TESTING

SHERRON TUBE TEST EQUIPMENT

SHERRON TUBE TEST UNITS MEASURE:
Inter Electrode. Capacitance. Gas. Power Cuput. Trans-conductance. Amplification Factor. Oscillctior and Frequency Cut-off. Power Rectificotion. Peak Emission. Pulse Tests. Mechanicol Impact. Noise. Vibration. Frequency Drift.

MANUFACTURING PROCESSES:
Aging—Life—Pre-Heat—Bombardment.

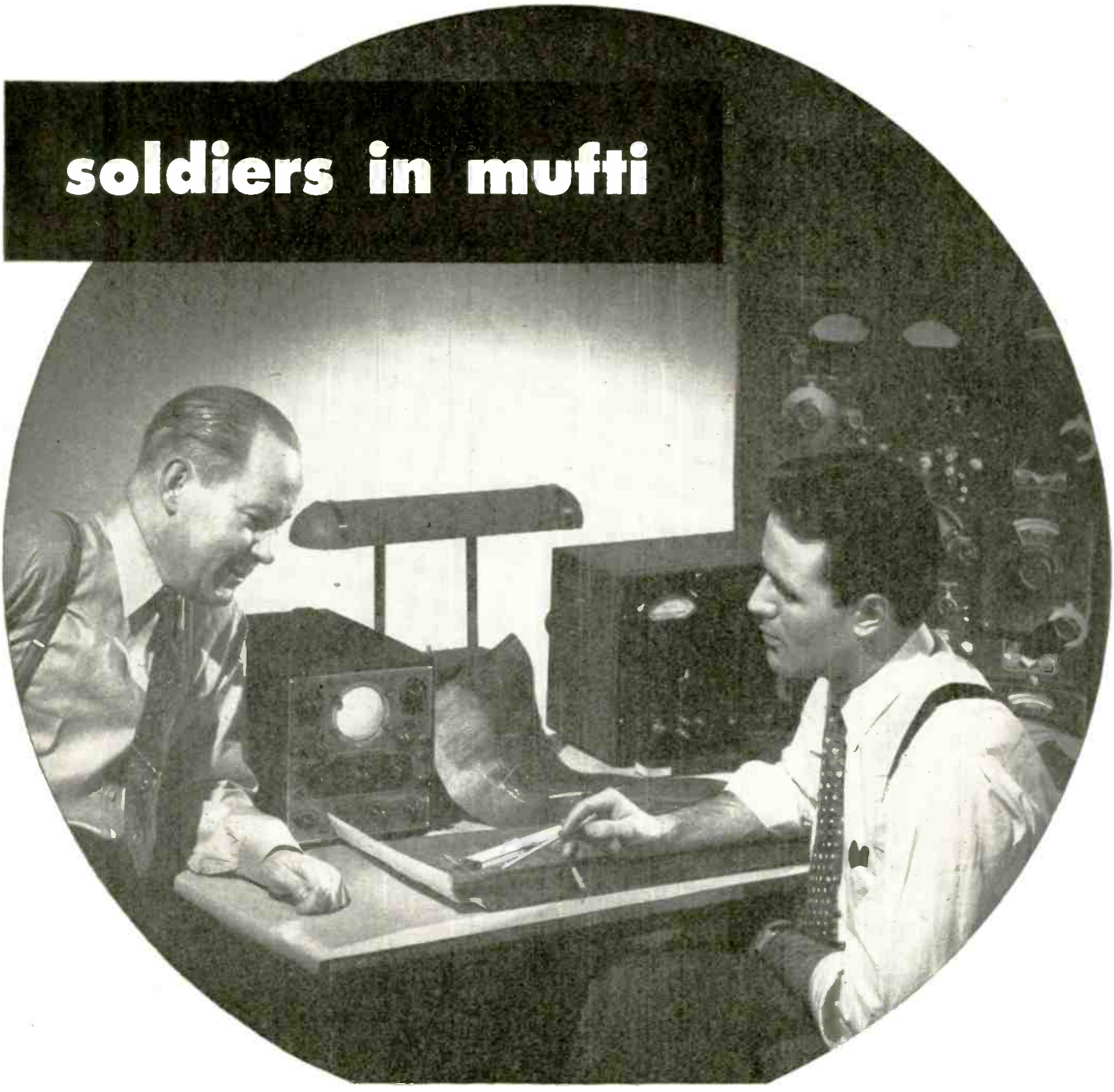
CATHODE RAY:
Life Racks — Persistency — Intensity — Pre-Heat. Voltage Breakdown — Gas — Leakage — and Chorocteristics.

● The vaunted magic of the electron tube evaporates just as magically—unless the tube does the job it is meant to do. Nobody knows that better than do manufacturers with a reputation for high standards of production. Every electron tube they turn out must be proved performance-perfect, before it is released for actual use. It is this rigorous, reputation-protecting code that has actuated many such manufacturers to install Sherron-engineered tube test devices. Increasingly, it becomes evident that . . . where the ideal is the standard, Sherron test units are standard equipment.

Sherron Electronics

SHERRON METALLIC CORP.
1201 FLUSHING AVE., BROOKLYN 6, N. Y.

soldiers in mufti



One of the most important men on the production front is the electronic engineer. Working long and hard hours, his time is spent devising and planning electronic equipment that will give the Allied forces overwhelming superiority on the battlefront. He was "drafted" early in the war and has devoted his special skills unstintingly to the successful prosecution of the war effort. The electronic engineer is truly a soldier on the homefront.

Raytheon engineers are continually devising new electronic products which contribute to the immeasurably important role that advanced electronic equipment is playing in winning the war. Raytheon electronic tubes and equipment are built to more than meet severe wartime requirements. The "Plus-Extra" quality, dependability and stamina of Raytheon products have established Raytheon as one of the leading manufacturers in the electronic field.

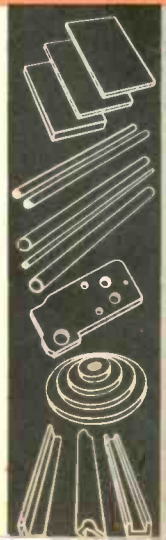
ARMY-NAVY "E" WITH STARS
Awarded All Four Divisions of Raytheon
for Continued Excellence in Production

RAYTHEON

RAYTHEON MANUFACTURING COMPANY
Waltham and Newton, Massachusetts

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

When Watt asked Why, Steam went to Work



SHEETS

RODS

TUBES

FABRICATED PARTS

MOLDED-MACERATED and MOLDED-LAMINATED FORMS and PRODUCTS

STEAM jiggled the lid of many a kettle before James Watt asked why . . . and went on to make steam work an engine that helped touch off the Industrial Revolution.

Plastics provide similar opportunities for investigation.

Possibly you haven't used plastics for as many applications as you profitably might. Perhaps you haven't looked into plastics at all . . . but should. So, a suggestion: If you, with your first-hand knowledge of the properties you need in a material, will tell us what your physical, chemical, electrical, or mechanical requirements are, we will quickly see whether our type of technical plastics can help you in any of your current or future applications. Write for the complete Synthane catalog. Synthane Corporation, Oaks, Penna.

SHEETS · RODS · TUBES · FABRICATED PARTS
MOLDED-LAMINATED · MOLDED-MACERATED

SYNTHANE

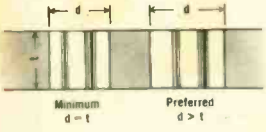
Plan your present and future products with Synthane Technical Plastics

SUGGESTIONS ON DESIGN FOR THE USE OF SYNTHANE

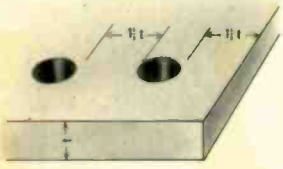
Synthane technical plastics are easy to machine by usual shop methods. However, the work of the production department can be simplified and costs and spoilage reduced by following these suggestions when designing parts:

PUNCHED OR SHAVED EDGES—Punching produces a relatively smooth edge in thicknesses up to 1/16 in. For extra smoothness, especially in thicknesses over 1/16 in., shaving should be specified.

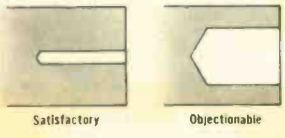
PUNCHED vs. DRILLED HOLES—Tolerance can be held closer on drilled holes than on punched holes but rarely is the accuracy of a drilled hole necessary if the hole can be punched.



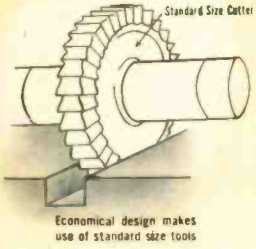
DIAMETER OF PUNCHED HOLES—The preferred ratio of hole diameter to thickness of material is not less than 1:1. That is, the diameter of a punched hole should not be less than thickness of sheet.



DISTANCE BETWEEN PUNCHED HOLES —PUNCHED HOLES NEAR EDGES—The distance between the circumferences of punched holes or between the circumference of a punched hole and the edge of a piece should not be less than 1-1/2 times the thickness of the piece.



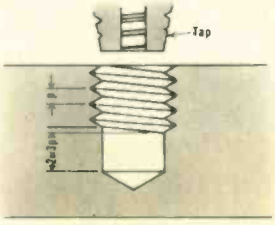
HOLES PARALLEL TO LAMINATIONS—Avoid large holes parallel to laminations where subsequent pressure, as from a screw, might injure the piece.



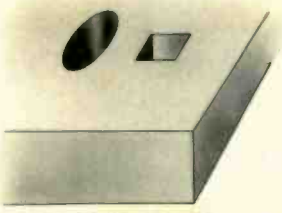
DESIGN FOR MACHINING WITH STANDARD TOOLS—Try to design parts so that machining can be done with standard tools or cutters. Specify standard size holes and slots wherever possible to avoid special tooling.

TOLERANCES—Give careful consideration to tolerances. It is poor economy to specify closer tolerances than are actually needed. As a matter of fact, laminated plastics cannot be held to tolerances such as .000"—.0005". The minimum tolerance advisable on dimensions under 1/2 in. is a total of .002". This tolerance is the absolute minimum and all parts should be designed with greater tolerances if possible.

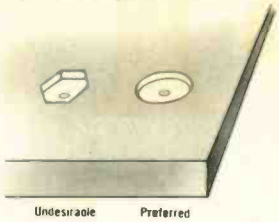
TAPPING TOLERANCES — Tapping should not be specified closer than a Class 2 fit with 65 to 70% of thread. Additional thread depth would add very little strength at the risk of breaking threads.



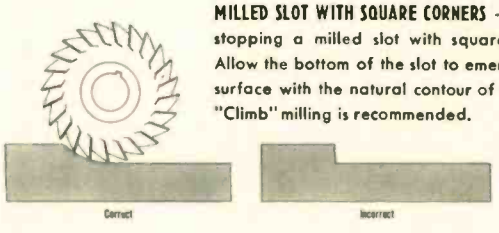
TAPPING IN A BLIND HOLE—When tapping in a blind hole, allow a depth of several threads from the bottom of the hole to first full thread for clearance.


Try to avoid irregular holes unless piece is thin enough to be punched

AVOID IRREGULARLY SHAPED HOLES—Eliminate, wherever possible, irregularly shaped holes unless the thickness of the piece permits punching. Irregularly shaped holes on thicker sections can be made, but special tools are required.



IRREGULAR COUNTER BORES AND RECESSES—Eliminate entirely all irregular counter bores and recesses (except round).



MILLED SLOT WITH SQUARE CORNERS — Avoid stopping a milled slot with square corners. Allow the bottom of the slot to emerge to the surface with the natural contour of the cutter. "Climb" milling is recommended.

MARKING PARTS—Most parts can be marked with a punch, engraved or printed by the Synthographic process. The thinnest of materials can be printed.

FORCED FITS—The close tolerances required for forced fits in metal are not at all necessary in Synthane. Males can be as much as .005" oversize.

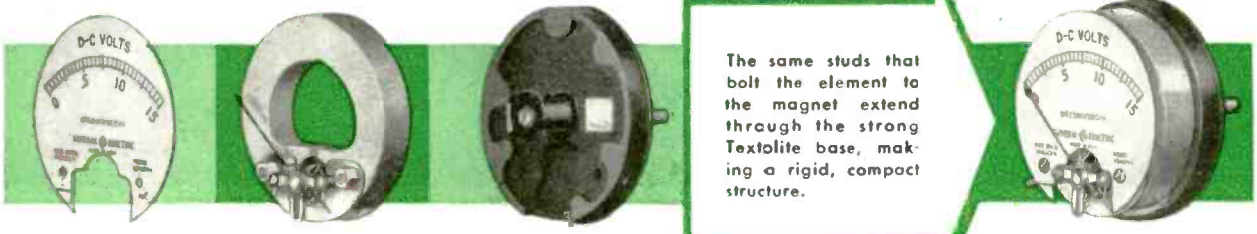
New INTERNAL-PIVOT 2 1/2-inch PANEL INSTRUMENTS ...1 inch deep

Type DW-53 d-c voltmeters, ammeters, and volt-ammeters. Designed to measure voltage and current in battery and battery-charging circuits on naval aircraft. They meet all applicable Navy specifications.

SEE THE SIMPLICITY AND STRENGTH OF THEIR DESIGN

Note the few simple parts, and how strength is built in by solidly bolting the element to the one-piece, cast-comol magnet.

ELEMENT + MAGNET + BOTTOM BRIDGE = ELEMENT ASSEMBLY



The same studs that bolt the element to the magnet extend through the strong Textolite base, making a rigid, compact structure.

SCALE PLATE + ELEMENT ASSEMBLY + BASE ASSEMBLY = STRONG THIN INSTRUMENT

...built for tough jobs and long life

COMBAT service on aircraft and in military radio is the crucial test for any electric instrument. To meet the requirements of such severe service, G-E engineers went to extremes to gain simplicity and strength in the design of these new panel instruments.

What isn't shown clearly in the pictures above is the internal-pivot construction and how the pivots are mounted to the inside of the armature shell instead of being secured to the outside of the armature winding. The pivot shank actually extends through the armature shell, and is anchored firmly on both sides of the shell by pressing two brass washers over the pivot shank. This construction makes the entire element assembly 20 per cent thinner.

There are many other features: large-radius pivots, hard-glass jewels, good damping, and ample clearances between stationary and moving parts. Added up, these features give you an instrument well able to withstand vibration and hold its rated accuracy.

If you want the complete story of how these instruments pack all-round fine performance in a small space, ask our nearest office for Bulletin GEA-4064, which covers instruments used for radio and other communications equipment; or Bulletin GEA-4117 which describes those suitable for naval aircraft. *General Electric Co., Schenectady 5, N. Y.*

For radio and other communications service: Type DW-51 d-c voltmeters, ammeters, milliammeters, microammeters; Type DW-52 radio-frequency ammeters (a-c thermocouple-type). Cases are brass or molded Textolite.

GENERAL ELECTRIC

602-45-6200

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

WE'RE TEARING OUR HAIR TOO!

● MANY of our customers have experienced numerous disappointments in changes in delivery dates on orders for G-R equipment; most do not know why deliveries cannot be made sometimes on the date promised.

All orders for electronic test equipment are scheduled by the War Production Board. The scheduled delivery date is based upon the tactical urgency of the order. These dates are changed principally for one of two reasons:

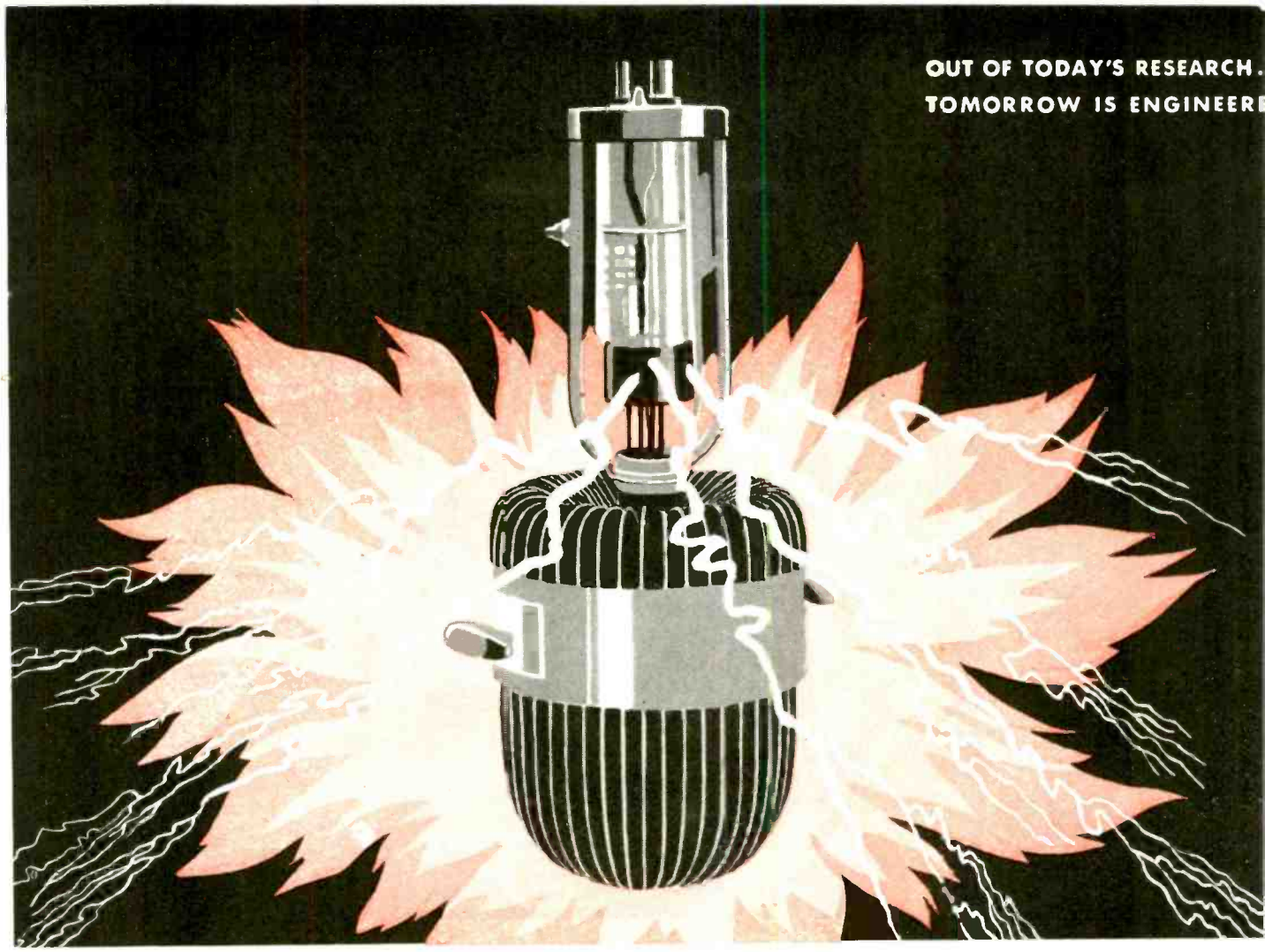
Very frequently the urgency of the order is altered due to the ever-changing war picture; a top-priority order today may be far down on the list tomorrow.

Due to shortages of raw materials, manpower and finished components purchased from outside suppliers, our production schedule lags at times.

When it becomes necessary for WPB to change a scheduled delivery date, we have no prior knowledge of that fact, nor any information as to the reason for the change. We are required by law to fill all orders in the sequence set up by the WPB schedule. Appeals directly to us to re-shuffle deliveries cannot be acted upon.

The present scheduling system at times results in considerable inconvenience to our customers, we know. The whole purpose of the system, however, is to supply war materials when and where they are most urgently needed at the moment. This after all seems to be the basic aim of war production, doesn't it?

GENERAL RADIO COMPANY Cambridge 39, Massachusetts
NEW YORK CHICAGO LOS ANGELES



RECORD BREAKING HEAT WAVE

INDUCTION HEATING through powerful high-frequency radio waves is breaking records in speeding up production of bonded plywoods, tin plating and in other industrial applications.

Of prime importance to the efficiency and stability of such high-frequency circuits is insulation whose composition and strength is master of both power and heat.

Permanent in their hardness, strength and rigidity, ALSIMAG Ceramic Insulators are not subject to distortion, warping or shrinking.

ALSIMAG bodies, each with its particular characteristics, are available to meet all insulating requirements. Our engineering and research people will gladly cooperate in today's design—tomorrow's production.

CHARACTERISTICS OF ALSIMAG INSULATORS

High Mechanical Strength
Permanent Rigidity
High Dielectric Strength
Low-Loss Factor
Will Not Absorb Moisture
Chemically Inert

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

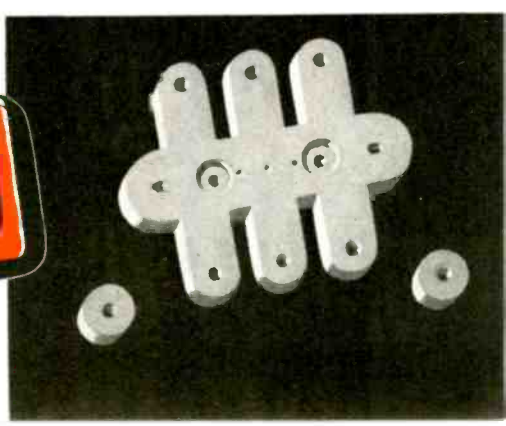
ARMY E NAVY

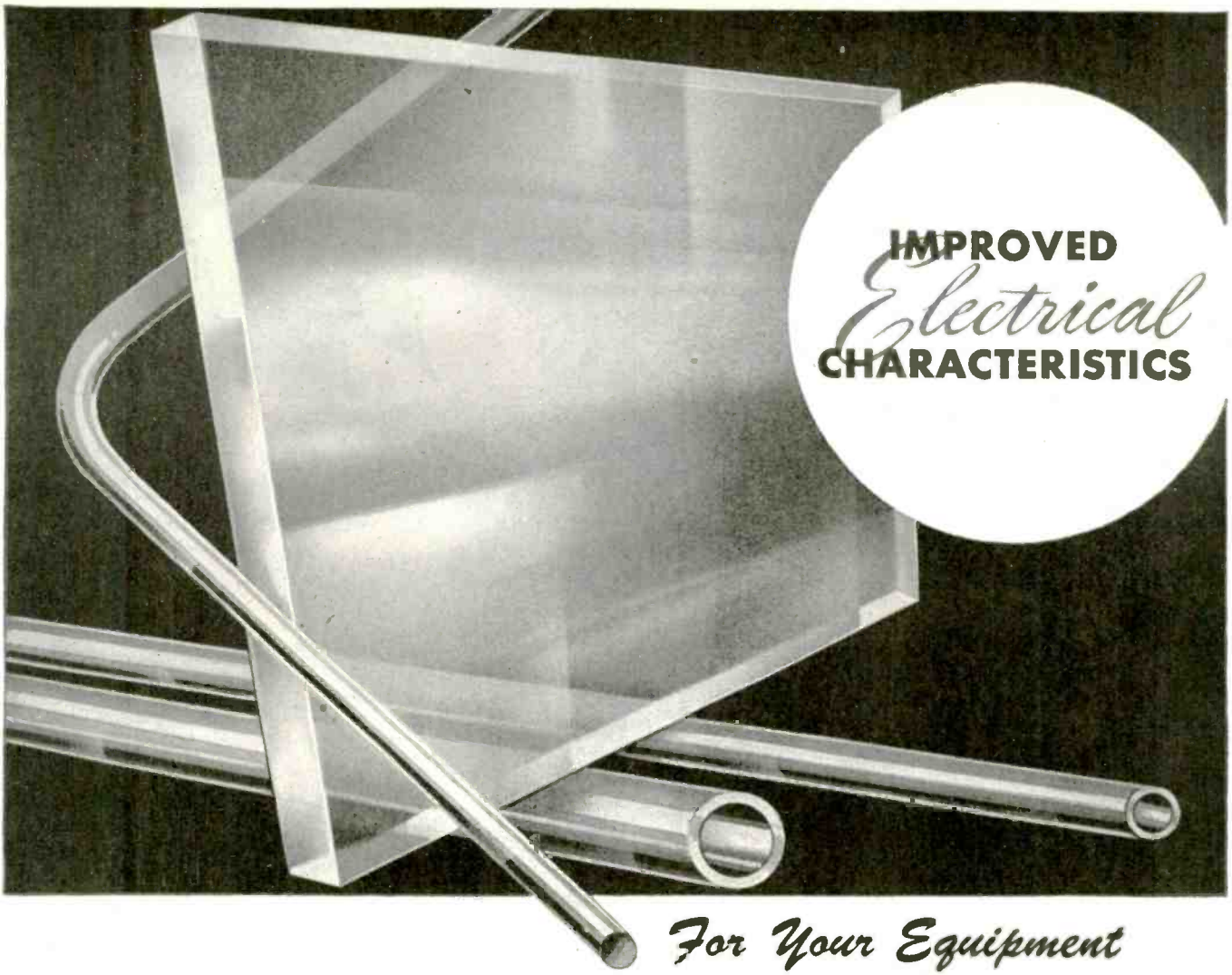
Army-Navy "E"
First Awarded July 27, 1942
Second Award: "Star" February 13, 1943
Third Award: "Star" September 25, 1943

ALSIMAG

TRADE MARK REGISTERED U. S. PATENT OFFICE

CERAMIC INSULATORS





IMPROVED *Electrical* CHARACTERISTICS

For Your Equipment

ACADIA POLYSTYRENE

Possessing unusual electrical *insulating* properties—among many others—Acadia Polystyrene is used as special insulation for radio and other high frequency equipment such as switch boxes, etc. In this role, Polystyrene refines the transmission of the electrical current.

Add to the facts presented here, Acadia's wide experience in the plastics field, and you have the reasons why Acadia Polystyrene merits your investigation.

Complete details are available on request—for quick reference some of Polystyrene's values are given at right:

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
Diel. Strength, Volts/Mil ⅛"	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 175° F.
Softening Point	190° F. to 250° F.
Specific Gravity	1.05

Combining a favorable dielectric constant, strength, and power factor, Acadia Polystyrene is equal to ceramics and mica, and *is electrically superior to any other commercial plastic.*

Consider also the values: zero water absorption; relative freedom from adverse effects by acids, alkalies, alcohol, stack gases, weather, and etc; an excellent dielectric constant value, and high tensile strength of 3500 to 5000 lbs. per sq. in.

Write Today

Send for complete data giving physical properties of Acadia Polystyrene, plus a table of specifications on its electrical properties.

Acadia Styraloy

Flexible at—100° F. and has many of the electrical properties of Polystyrene. Ideal for numerous applications. Write for information on forms now available, and data on physical and electrical properties.

ACADIA *Synthetic* PRODUCTS

Processors of Synthetic Rubber and Plastics · Sheets Extrusions · Molded Parts

DIVISION WESTERN FELT WORKS

LARGEST INDEPENDENT MANUFACTURERS AND CUTTERS OF FELT

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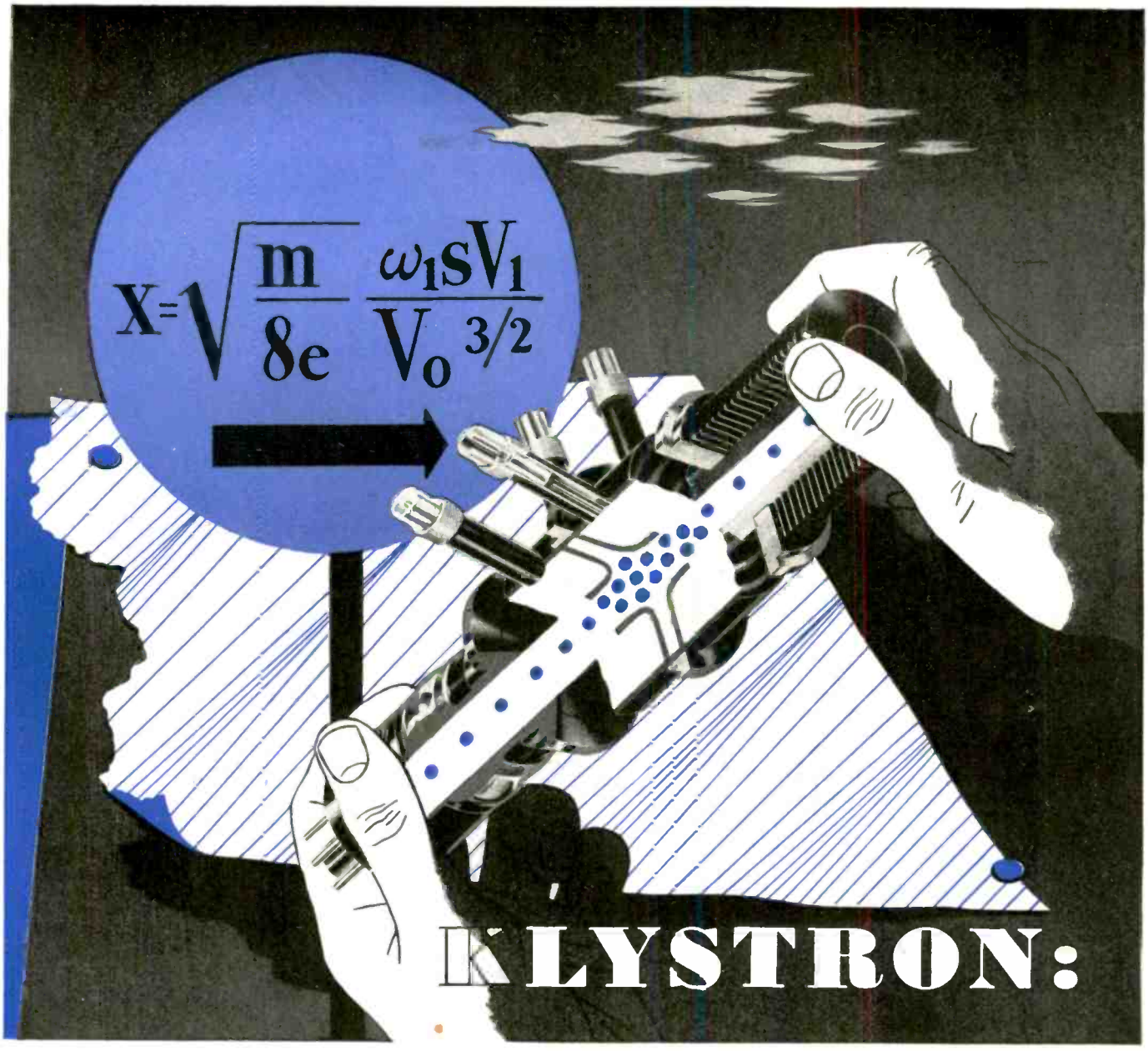


Mathematically, here's the inside story

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

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

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

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

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

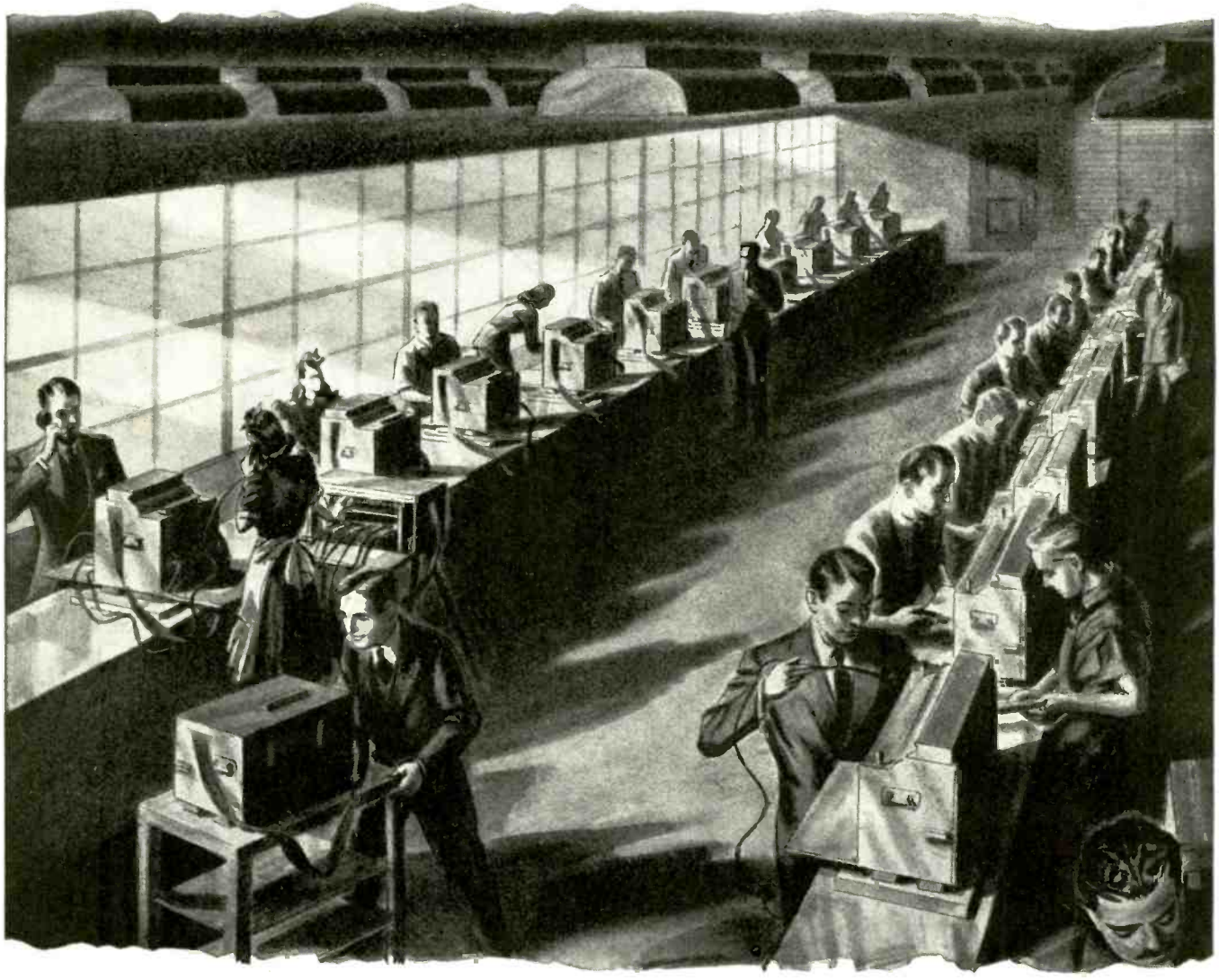
▶ **Klystrons are now being produced in quantities, and certain types are available. Write us for information.**

Sperry Gyroscope Company INC.

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

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

Meeting the CALL for MORE and still MORE



This year our armed forces need thirty-five per cent more communications equipment than in 1943. The men and women of this division are tackling their share of this biggest assignment yet, with the same enthusiasm they have shown from the start . . . and with three years' practical experience behind them.

They have good reason to be enthusiastic, for pictures, news stories, and soldiers returning from all over the world, tell of the heroic use that is being made of the equipment we turn out.

Here is a group of skilled engineers, designers and production people who are proving their ability to handle a big and difficult assignment. We tell about it here because we think that is the kind of organization you will want to have working on your postwar needs, such as:

COMMUNICATIONS SYSTEMS • SIGNALING EQUIPMENT
PRODUCTION CONTROL EQUIPMENT AND INSTRUMENTS
HOSPITAL SYSTEMS • ELECTRONIC EQUIPMENT • PRECISION
ELECTRICAL MANUFACTURING • IGNITION SYSTEMS

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

Meriden, Connecticut

CHALLENGE!

As you look through the ads in this magazine...

FIND THE GLASS PARTS NOT MADE AT CORNING

IT'S really not much of a gamble on our part. The truth is that most of the electronic glass equipment built today comes from Corning Glass Works.

Bulbs, flares, insulators, transformer bushings, tubing, resistor tubes, coil forms, are just a few of the hundreds of electronic glassware products produced under our Army-Navy "E" flag. Here you will find glasses with high electrical insulating qualities; glasses with an expansion coefficient practically equal to that of fused quartz; glasses extremely resistant to mechanical shock; glasses that can now be made into intricate shapes formerly considered impossible. And behind them all, 75 years of pioneering in glass research and experience gained in the development of more than 25,000 glass formulae.

We hope this doesn't scare you. All it means is this: If you have a problem you think glass might be helpful in solving, feel free to call on Corning! Everything we know about glass is at your service. Just to get started we'd like to send you a copy of an informative new booklet, "There Will Be More Glass Parts In Postwar Electrical Products." If interested, write Electronic Sales Dept. 1-6 Bulb and Tubing Division, Corning GlassWorks, Corning, New York.

CORNING *means* Research in Glass

Electronic Glassware

CORNING PYREX

"PYREX" and "CORNING" are registered trade-marks of Corning Glass Works

ON 9 OUT OF EVERY 10

Today 9 out of every 10 American military planes have Western Electric equipment aboard. Supplying Command Sets by the tens of thousands to keep pilots in touch over every front has been a vast and intricate production job.

But that is just one part of Western Electric's war work. Add to it radio transmitters and receivers for many other uses, mikes, headsets, crystals by the millions and scores of other items for the Army, Navy, Marine Corps and Coast Guard.

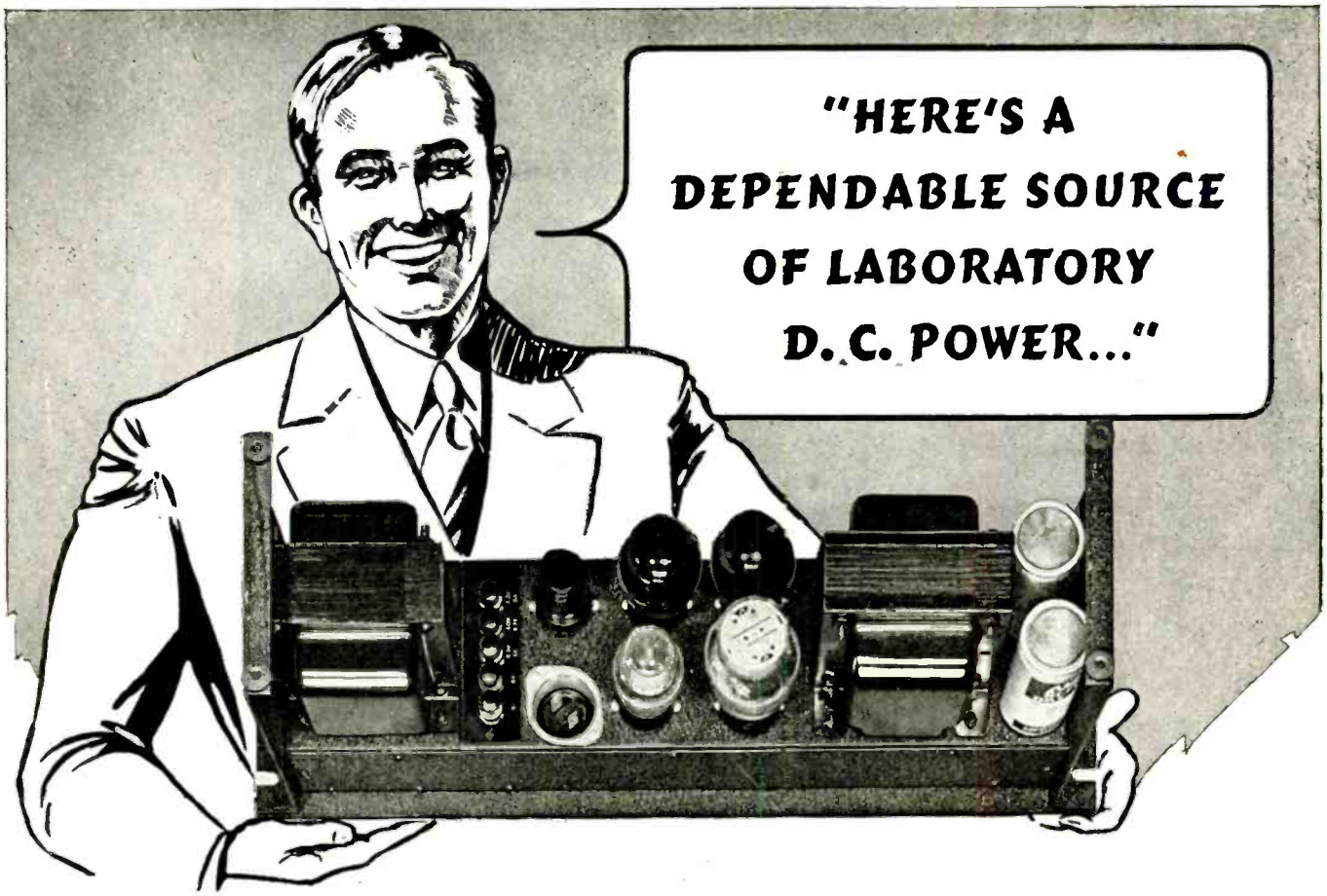
Then you will begin to understand why Western Electric is today *the nation's largest producer of electronic and communications equipment for war.*

Buy War Bonds regularly—all you can!

75TH ANNIVERSARY

Western Electric

ARSENAL OF COMMUNICATIONS EQUIPMENT



The HARVEY Regulated Power Supply 106 PA

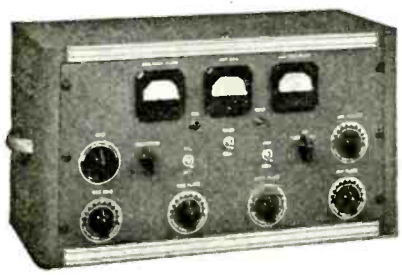
You'll find it ideal for operation with pulse generators, measurement equipment, constant frequency applicators, amplifiers and any other equipment requiring a constant flow of D.C. voltage.

Designed to operate from 115 volts A.C., the HARVEY 106 PA has a D.C. voltage output variable from between 200 to 300 volts and accurately controllable *to within one per cent.* A model of efficiency and convenience, it has separate fuses on each transformer primary as well as the D.C. output circuit: pilot lights on each switch; a D.C. voltmeter for measuring output voltage and a handy two-prong plug or binding posts to permit easy hook-up.

For complete information on this precision-built, thoroughly dependable source of constant voltage, write for the new HARVEY Regulated Power Supply bulletin. Address your requests for this useful new bulletin to

HARVEY
OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.
441 CONCORD AVENUE • CAMBRIDGE 38, MASS.



HARVEY UHX-25

A 25-Watt
General Purpose
Radio Telephone
Transmitter

Available for operation between 1.5 M.C. and 30 M.C.

HARVEY "AMPLI-STRIP"

FOR I-F AND AUDIO
AMPLIFICATION

● Aerovox silvered-mica capacitors are designed for the most critical applications requiring precise capacitance values and extreme stability. Although otherwise similar in external construction and dimensions to the smaller molded bakelite units, they are encased in molded XM low-loss *red bakelite* for immediate *silvered-mica* identification.

A silver coating is applied to the mica and fired at elevated temperatures. This insures not only a positive bond but permanent stability of the capacitance with respect to time, temperature and humidity. Units are heat-treated and wax-impregnated externally for ultimate protection against moisture penetration.

Ideal for use in circuits where capacitance must remain constant under all operating conditions. These capacitors are specifically designed for use in push-button tuning, oscillator padding circuits, fixed tuned circuits, and as capacitance standards, etc., where accuracy and stability are prime considerations.

● Write for literature . . .

Average positive temperature coefficient of only .003% per degree C.—a remarkably low value.

Excellent retrace characteristics; practically no capacitance drift with time; exceptionally high Q.

Available in three types, 1000 v. D.C. test: Type 1469, .000005 to .0005 mfd.; Type 1479 (illustrated), .0001 to .001 mfd.; Type 1464, .00075 to .0025 mfd., and .001 mfd. in 600 v. D.C. test.

Standard tolerance plus minus 5%. Also available with tolerances of plus/minus 3%, 2% and 1%.

Minimum tolerance for capacitances up to and including 10 mmf. (.00001 mfd.) plus/minus ½ mmf. Minimum tolerance available for all other capacitances, plus/minus 1% or plus/minus 1 mmf., whichever is greater.

• • •

Aerovox Is prepared and ready to accept orders for Mica Capacitors which will meet American War Standards.

AEROVOX Capacitors

INDIVIDUALLY TESTED

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

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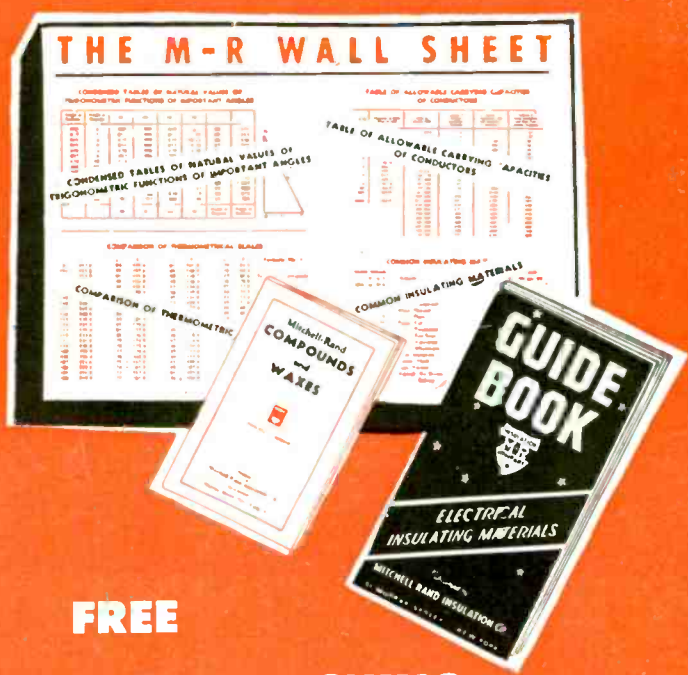
the one dependable source of supply for every type of ELECTRICAL INSULATION to meet any requirement

MITCHELL-RAND *for* 55 YEARS THE ELECTRICAL INSULATION HEADQUARTERS



FREE FOR THE ASKING

Write today for 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.

WAXES and COMPOUNDS
(more than 3500 formulas)

•

SLEEVINGS and TUBINGS
(cotton, extruded, fiberglas)

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TAPES . . CLOTHS

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WEBBINGS . . PAPERS

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TWINES . . MICA

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INSULATING VARNISHES

MITCHELL-RAND INSULATION COMPANY, INC.

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

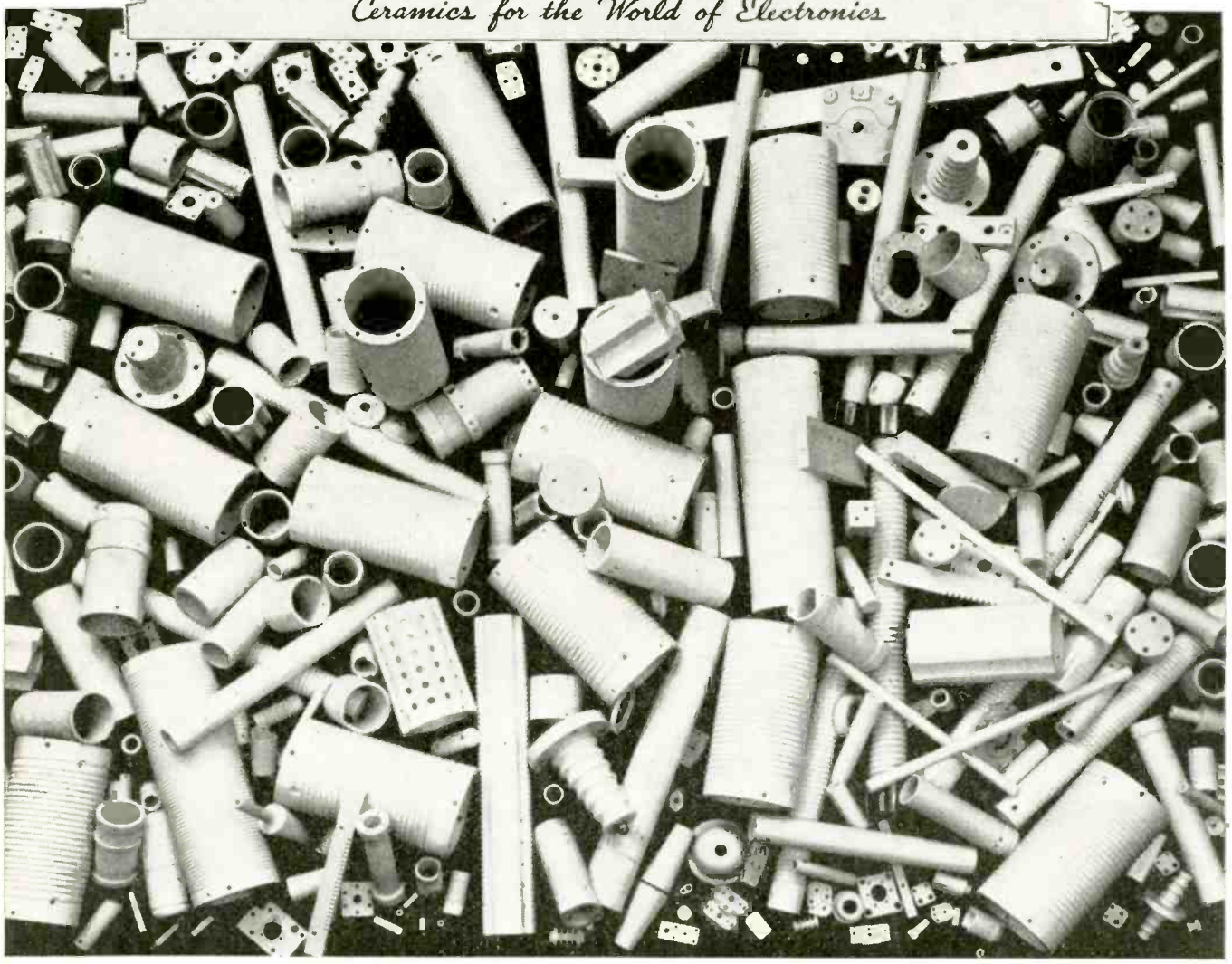
Fiberglas Braided Sleeving
Cotton Tapes, Webbings and Sleevings
Impregnated Varnish Tubing
Insulating Varnishes of all types

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

STUPAKOFF

FOUNDED IN 1897

Ceramics for the World of Electronics



Unlimited Styles and Sizes . . .

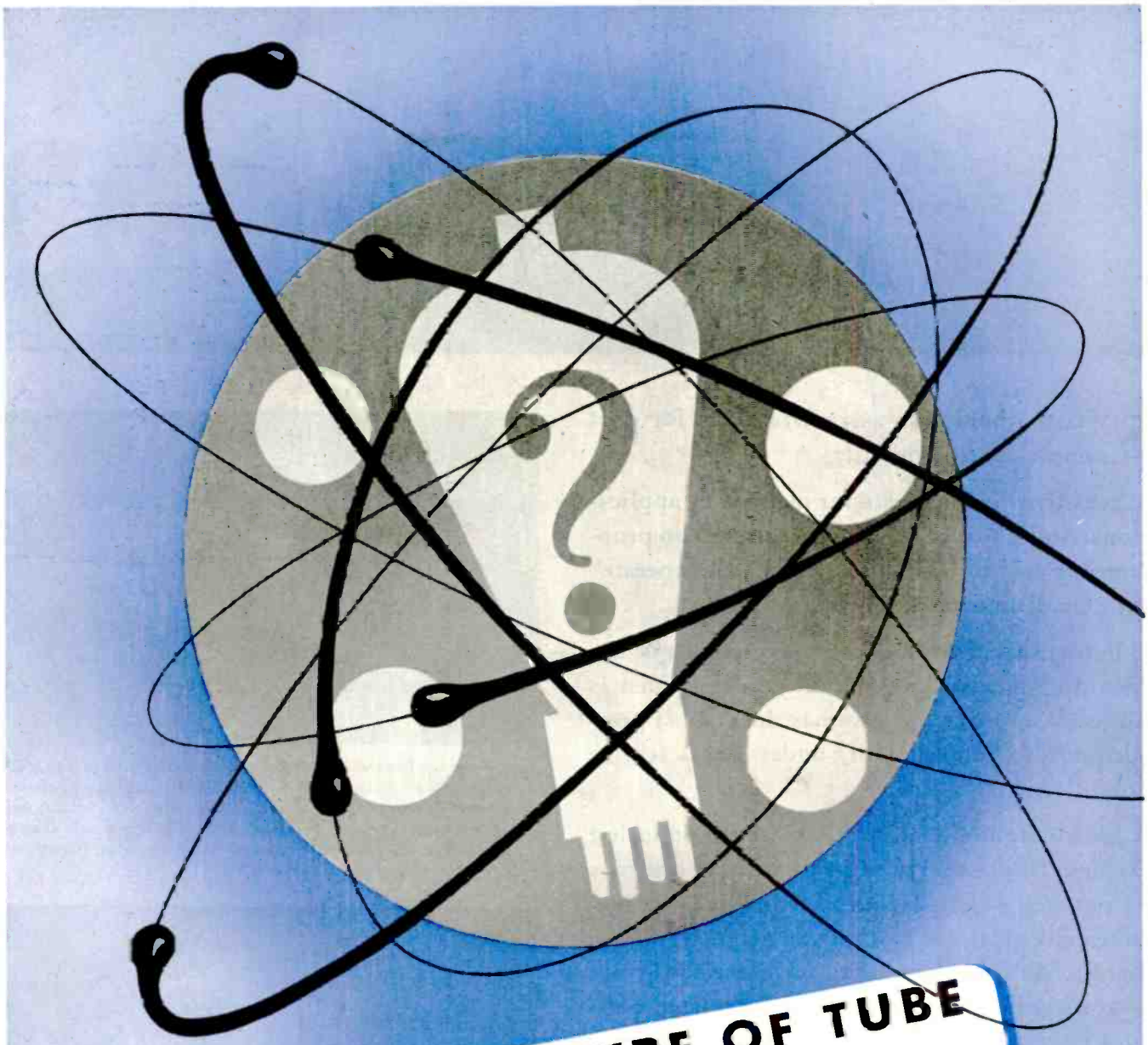
PRECISION MADE INSULATORS of Steatite and other materials — glazed or unglazed—to your exacting specifications.

STUPAKOFF
Ceramic
INSULATORS

Years of experience—wide technical and engineering knowledge—modern manufacturing facilities enable STUPAKOFF to produce every type of ceramic for the electronic industry.

Let's All Back The Attack — Buy EXTRA War Bonds

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.



WHAT TYPE OF TUBE DO YOU NEED?

You can probably find the answer in the great variety of tubes we make. But if not, write us what sort of tube you need . . . what you wish it to accomplish . . . how it is to be used. Our engineers will study your problem and, without obligation, tell you if such a tube is practicable. Further, you will receive complete information on what Continental, with their exceptional laboratory facilities and long experience, can do to help you solve your problem. Write today: remember, there is no obligation!

CETRON

Electronic Tubes · Rectifiers · Phototubes

Set New Quality Standards

CONTINENTAL ELECTRIC COMPANY

CHICAGO OFFICE
903 MERCHANDISE MART

GENEVA, ILL.

NEW YORK OFFICE
265 W. 14th ST.

Facts YOU SHOULD KNOW ABOUT RELAY SENSITIVITY

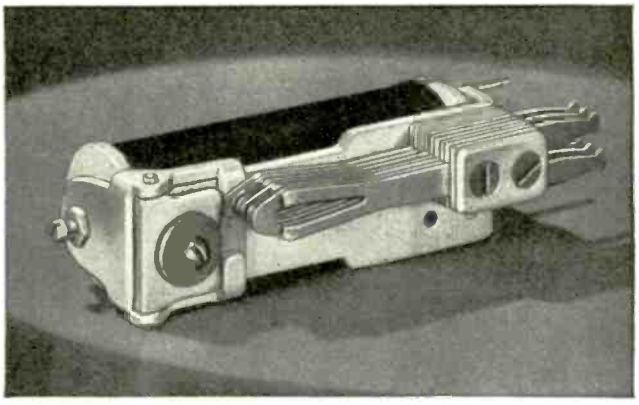
SO YOU would like a *sensitive* relay for that remote control circuit!

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.

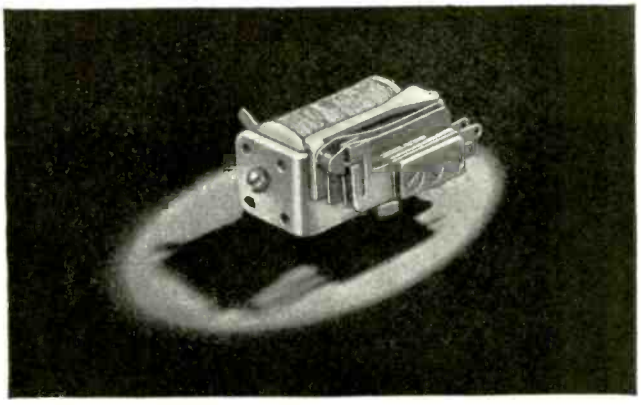
But sensitivity without contact reliability is useless. So what you *really* want is a relay that is not only sensitive, but also has the contact pressure needed for reliability under actual service conditions.

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

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

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

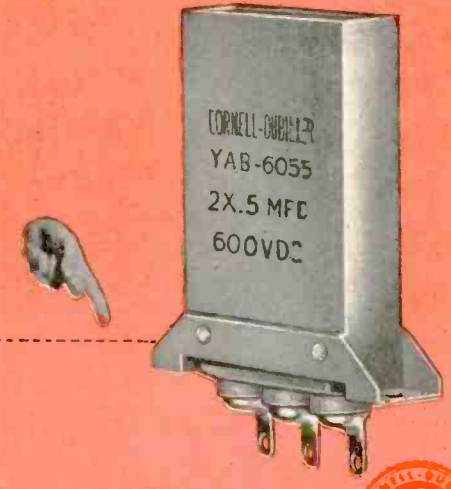
why engineers choose

C-D CAPACITORS!

In a recent independent inquiry, 2,000 radio and electrical engineers were asked to name the capacitor they prefer. Four out of five said Cornell-Dubilier.

You can be sure that such emphatic preference is based on present dependable performance rather than on past reputation, solely. *And now, what does this mean to you?*

It means, that no matter how tough your capacitor problem may be . . . no matter how intricate the equipment required to solve it . . . no matter how much research may be required to find the answer: you will get all this and more at C-D. There is scarcely a capacitor type that we haven't already made, and if we haven't, the experience acquired in thirty-four years of manufacture will certainly enable us to design the capacitor you need. Write to Cornell-Dubilier Electric Corporation, So. Plainfield, N. J.



another C-D development

Type YAB is a compact low-capacity, dykanol impregnated and filled bypass capacitor: hermetically sealed;
range at 600 W. .05 mfd. to 1 mfd.,
range at 100 W. .05 mfd. to .5 mfd.

Cornell-Dubilier Capacitors

MICA • DYKANOL • PAPER • WET AND DRY ELECTROLYTICS

1910 1944

Reg. U. S. Pat. Off.

W. A. PATTERSON, *President of United Air Lines*

"...YOU SAY VIBRATOR POWER SUPPLIES CAN INCREASE SAFETY AND COMFORT IN PLANES?"

MR. W. A. PATTERSON, *President of United Air Lines, recently said—*

"It is our belief that the war has advanced public acceptance of the airplane as a mode of transportation by 20 years. The airlines, like every other service that caters to the public, must anticipate their passengers' expectations of new facilities for greater comfort and safety. United will put in service new, huge 44-50 passenger Mainliners offering comforts, conveniences and thoughtful appointments surpassing anything heretofore known, and flying from coast to coast in 11 hours with new devices to assure safe flight."

E-L is ready right now with Vibrator Power Supplies to bring passengers the greater comfort of fluorescent lighting as well as the convenience and safety of radio and radio-telephone. E-L Black Light equipment is available as a safety device for instrument panel illumination at night to eliminate blinding interior glare and to provide clear, sharply defined instrument calibration. Engineered to specific space and voltage requirements, Electronic Laboratories products are used wherever current must be changed in voltage, frequency or type. E-L engineers invite inquiries.

E-L STANDARD POWER SUPPLY MODEL 307

For the operation of standard 110 volt AC equipment, such as radios and small motors, from a 6 volt battery. Characreristics: Input voltage, 6 v. DC; Output voltage, 115 v. AC; Output power, 100 watts: Output frequency, 60 cycles.

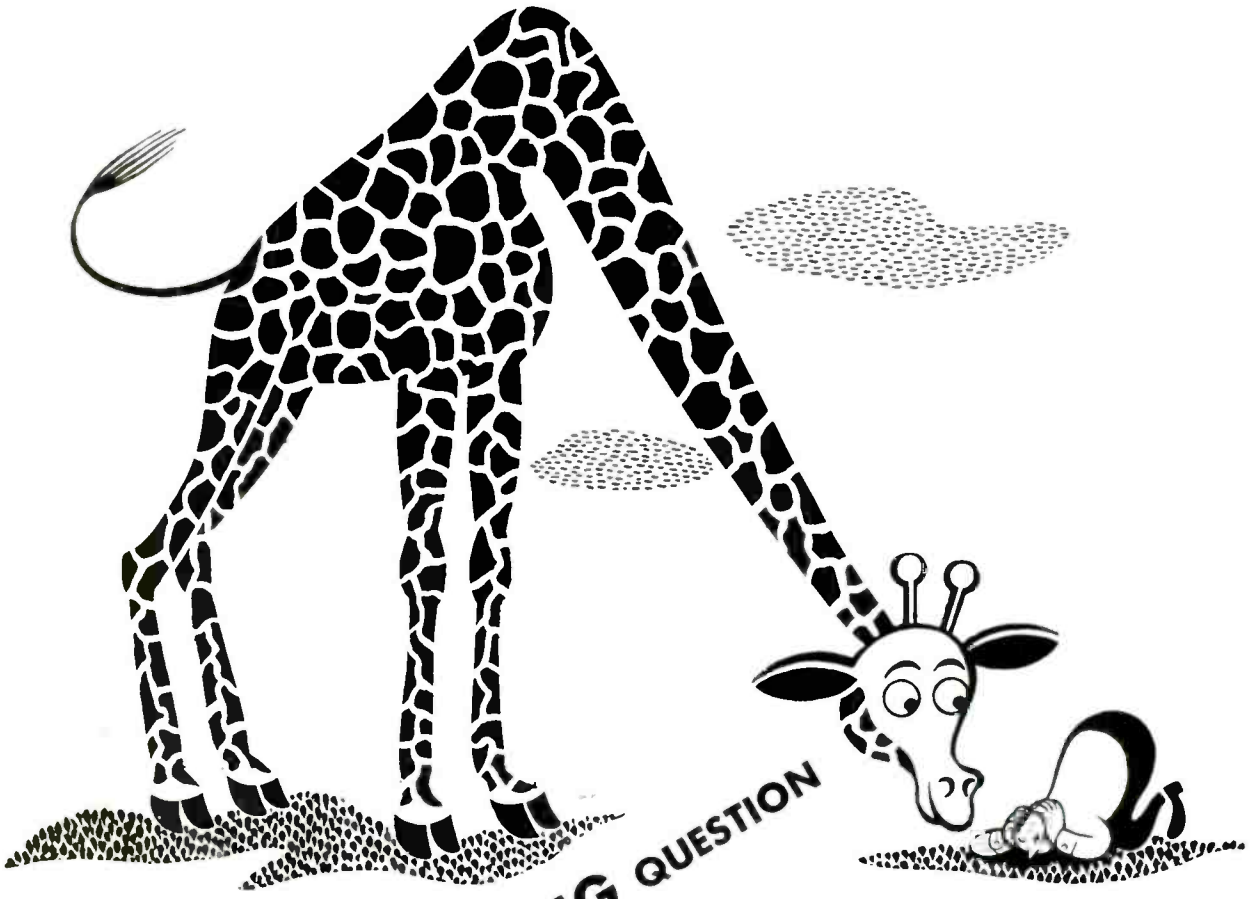
Dimensions: 7½x8¼x10¼ in. *Weight:* 23½ pounds.

Write for further information of this and other models of the extensive E-L line.

Electronic LABORATORIES INC.

INDIANAPOLIS

VIBRATOR POWER SUPPLIES FOR LIGHTING, COMMUNICATIONS, AND ELECTRIC MOTOR OPERATION • ELECTRIC, ELECTRONIC AND OTHER EQUIPMENT



THE LOW-DOWN ON A BIG QUESTION

WHERE can you find a proven source for such requirements as panels, chassis, mounting or shelf assemblies, transformer housings or cabinets?

We're in no sense sticking our necks out like the fellow above when we say, "Right HERE!"

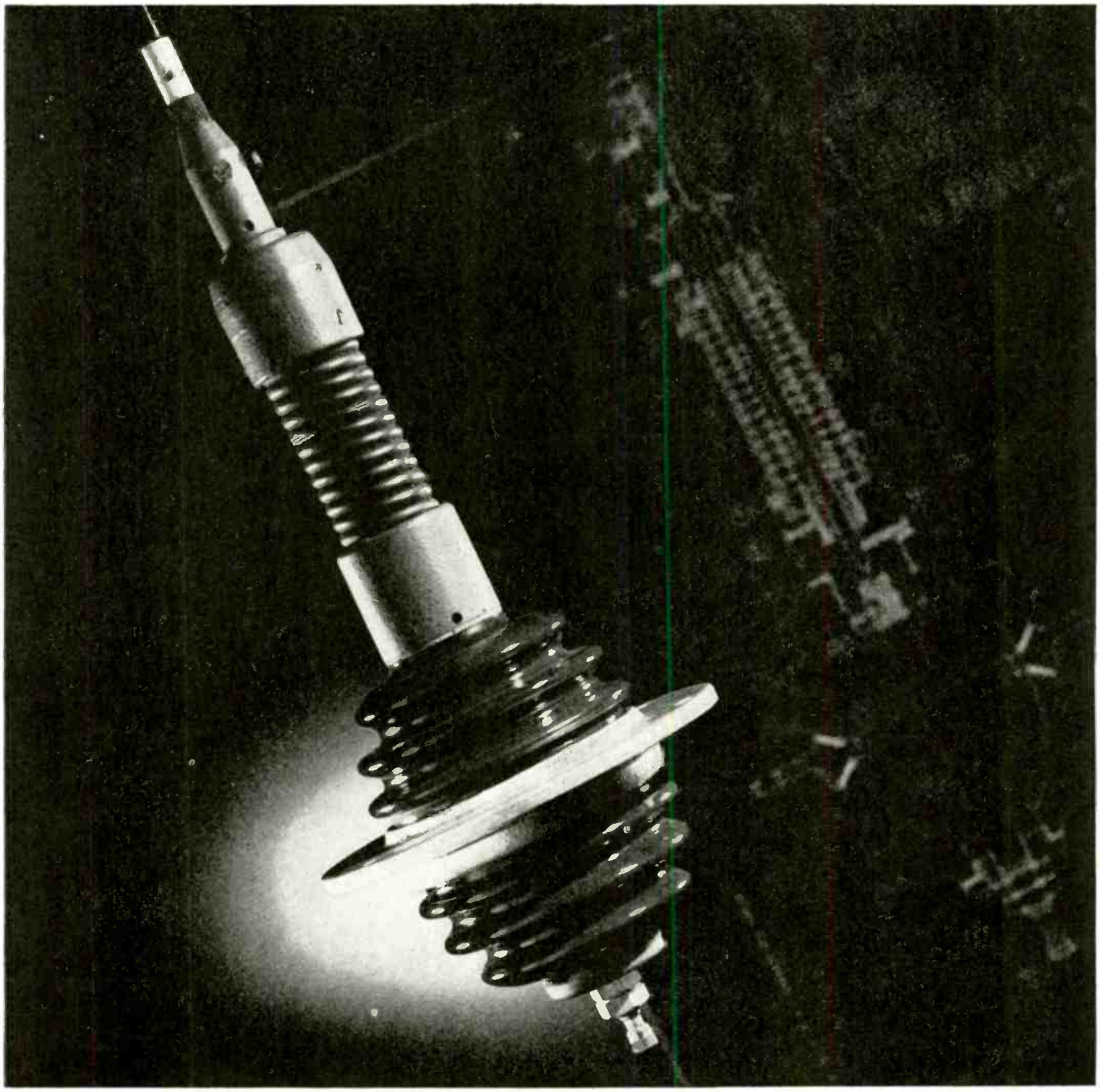
Corry-Jamestown is already working in steel, stainless steel and aluminum for many firms who have rigid specifications to meet. They have paid us high compliments on our fine precision and our fair prices.

We just thought you might be interested. If so, why not send us *your* specifications.

Steel Age

CORRY - JAMESTOWN

MANUFACTURING CORPORATION ★ CORRY, PENNA.



LAPP-DESIGNED, LAPP-BUILT—TO DO A SPECIFIC JOB

This is an antenna base insulator for use on a communications center transmitter. It is one of several Lapp designs for transmitter and receiver mast bases for military vehicular radio—on jeeps, halftracks, tanks and other rolling equipment.

Whether or not this special-purpose gadget has application to anything you build or propose to build, there's a moral in it for you. In this case, as in hundreds of others, an original and impractical design was modified by Lapp engineers—to provide a part that meets all electrical and mechanical requirements, and that Lapp can build economically and efficiently.

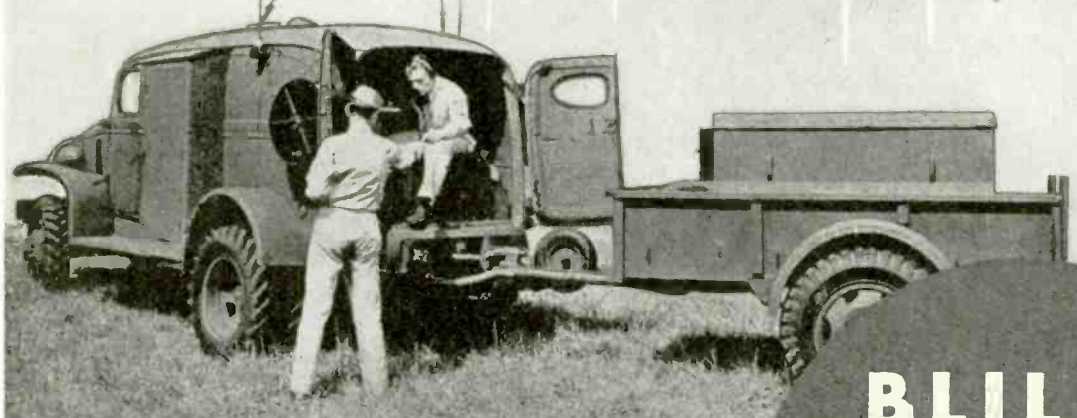
Lapp engineering talent and Lapp production methods are such that we can say, "If it's an assembly that can be made of porcelain or steatite and metal parts, tell us what the requirements are and how you think it might be made; Lapp will tell you how it can best be made—and will make it." Our right to that claim has been proved over and over in military electronic production; it's going to be a competitive advantage to smart post-war electronic producers. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Lapp

Standard of Excellence

Bliley Crystal Units are doing a great wartime job. Increased engineering knowledge, expanded facilities, and improved production techniques have emerged from this effort. This wartime experience will be reflected in peacetime application.

Bliley Crystals will again take their rightful place with their pre-war record of dependability, accuracy and user acceptance. Not counting applications covered by wartime secrecy necessities, there will be Bliley Precision-made Crystals for diathermy, ultrasonic generators, pressure gauges, carrier-current communications systems, radio frequency filters, and precision interval timers. And, of course, in greater quantities than ever before, frequency controlling crystal units for all radio communication necessities, F. M. or A. M., fixed, portable, mobile or air borne. As always, Bliley Engineers are ready to extend their assistance to you . . . call on them freely.



OFFICIAL SIGNAL CORPS PHOTO
SCR-299 MOBILE RADIO STATION

BLILEY CRYSTALS
Accurate Dependable

BLILEY ELECTRIC COMPANY - - - ERIE, PA.

Bliley Crystals

TKL

THE *newest* MEMBER OF ALLIED'S

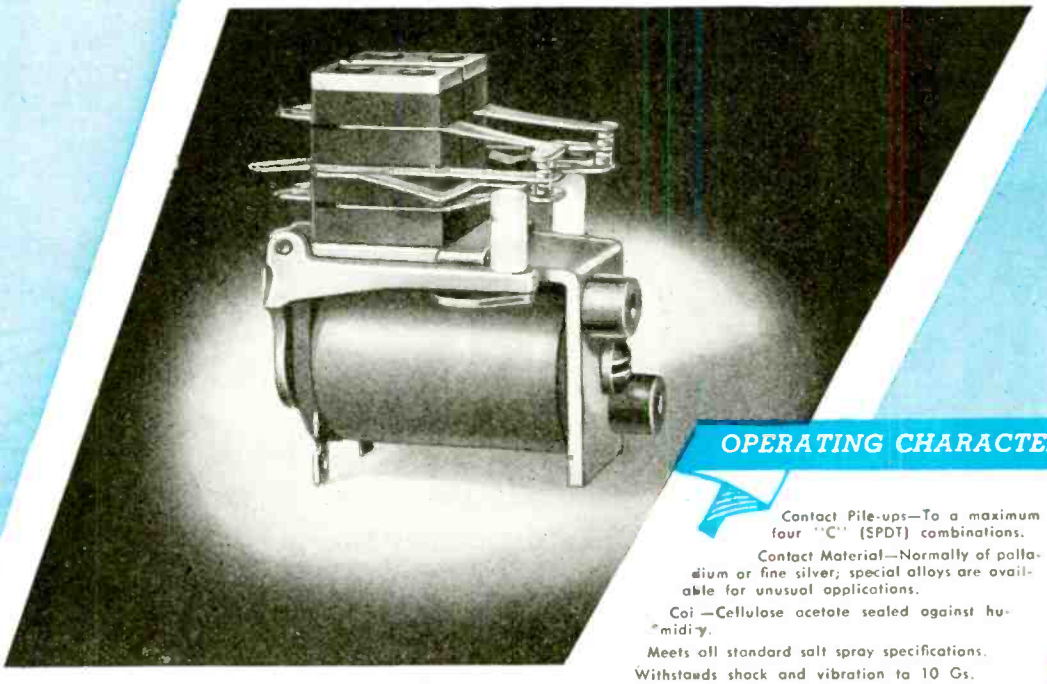
TELEPHONE TYPE RELAY LINE

MAXIMUM MAGNETIC EFFICIENCY . . . MINIMUM SIZE

TKL, latest of the Allied telephone type group, is an unusually compact relay with double contact pile-ups especially developed to meet the insistent demand for a small feather-weight relay of high magnetic efficiency.

TKL has a maximum rated power consumption of 1.5 watts for continuous duty. . . . Maximum sensitivity with a single A or B contact arrangement is 0.3 watts.

The unit illustrated features the use of Mycalex insulation for high frequency, low loss operation. It is also available with varnish impregnated bakelite insulation for standard switching service.



OPERATING CHARACTERISTICS

Contact Pile-ups—To a maximum of four "C" (SPDT) combinations.

Contact Material—Normally of palladium or fine silver; special alloys are available for unusual applications.

Coil—Cellulose acetate sealed against humidity.

Meets all standard salt spray specifications.

Withstands shock and vibration to 10 Gs.

Designed to conform with Army, Navy and CAA specifications.

Dimensions—1-7/16 by 15/16 by 1-1/16 inches (minus contact pile-ups).

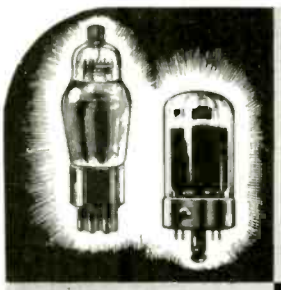
Weight—1½ ounces (minus contact pile-ups).

ALLIED CONTROL COMPANY

INCORPORATED

2 EAST END AVENUE • (AT 79th STREET) • NEW YORK 21, N. Y.

FACTORIES: NEW YORK CITY • PLANTSVILLE, CONN. • CHICAGO, ILL.



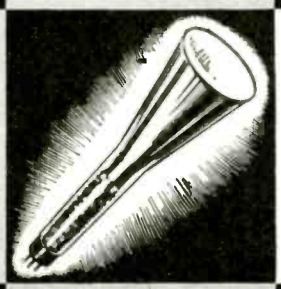
STANDARD TYPE RECEIVING TUBES

SYLVANIA "LOCK-IN" RECEIVING TUBES

TRANSMITTING TUBES

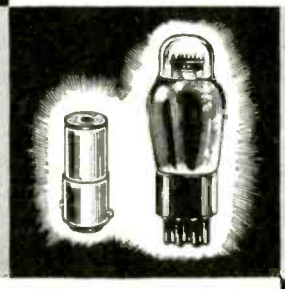
MINIATURE RADIO RECEIVING TUBES

CATHODE RAY TUBES

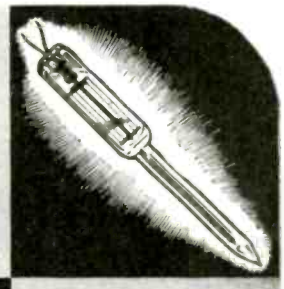


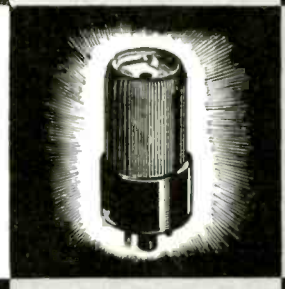
STROBOTRONS

GAS VOLTAGE REGULATOR TUBES MINIATURE AND STANDARD SIZE



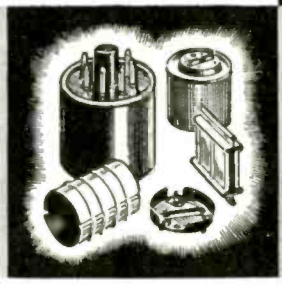
PIRANI TUBES





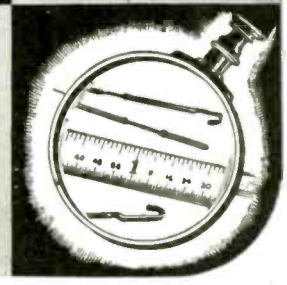
FACSIMILE RECORDING TUBES

THERMOCOUPLE TUBES



RADIO TUBE PARTS

WELDS AND LEADS



SPECIFY SYLVANIA AND BE SURE

AN ELECTRONIC DEVICE is no better than its most vital part—the electron tube. A reputation for high quality manufacture won many important wartime assignments in electronics for Sylvania. A few of the electronic devices, tubes and parts made by Sylvania are shown here. There are many more, some of which are military secrets. For information about Sylvania quality electron tubes and products, write Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, New York.

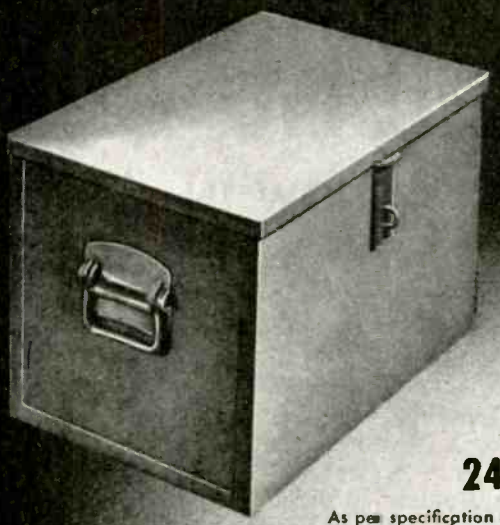
"To Serve an Electronic World"

SYLVANIA

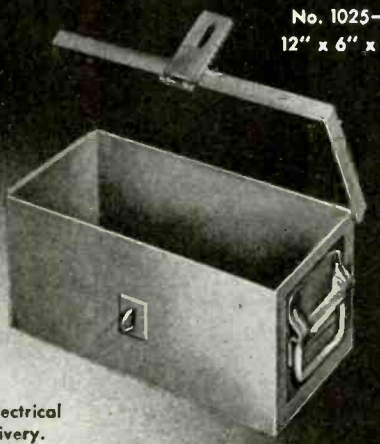
ELECTRIC PRODUCTS INC.

500 FIFTH AVENUE, NEW YORK 18, N.Y.

SPARE PARTS BOXES



No. 1025—0
18" x 9" x 9"



No. 1025—1
12" x 6" x 6"

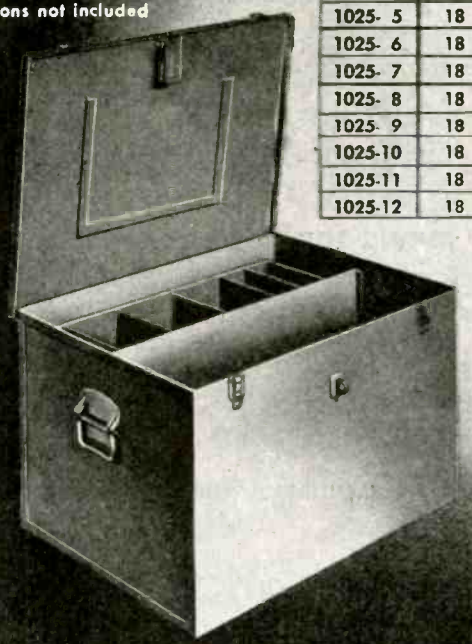
24 STOCK SIZES

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

— WRITE FOR PRICE LIST —

Number	Length	Width	Height	Number	Length	Width	Height
1025- 1	12	6	6	1025-13	18	18	12
1025- 2	12	9	6	1025-15	24	15	12
1025- 3	12	12	6	1025-16	24	15	15
1025- 4	12	9	9	1025-17	24	18	12
1025- 5	18	9	6	1025-18	24	18	15
1025- 6	18	9	9	1025-19	24	18	13
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
30" x 15" x 12"
(Partitions not included

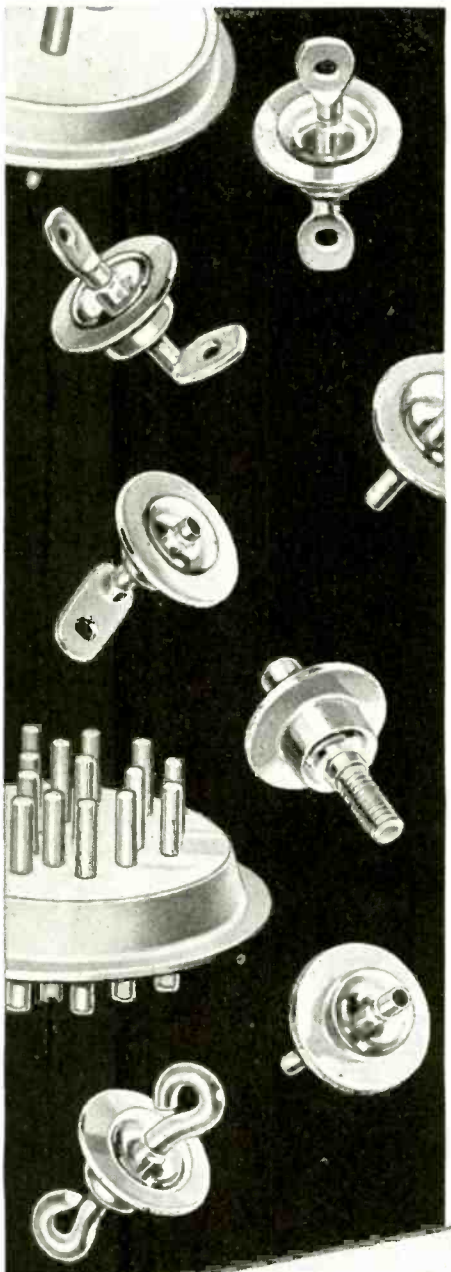


Cole steel office equipment will again be available after the war

COLE STEEL EQUIPMENT CO.

349 BROADWAY, NEW YORK 13, N. Y.

FACTORY: BROOKLYN, N. Y.



Sperti

HERMETIC SEALS

NOW IN

Volume production

Arm your equipment to meet tough military conditions—anywhere—with these improved Hermetic Seals that seal out dust, humidity, moisture and fungus from transformers, relays, vibrators and other sensitive component parts.

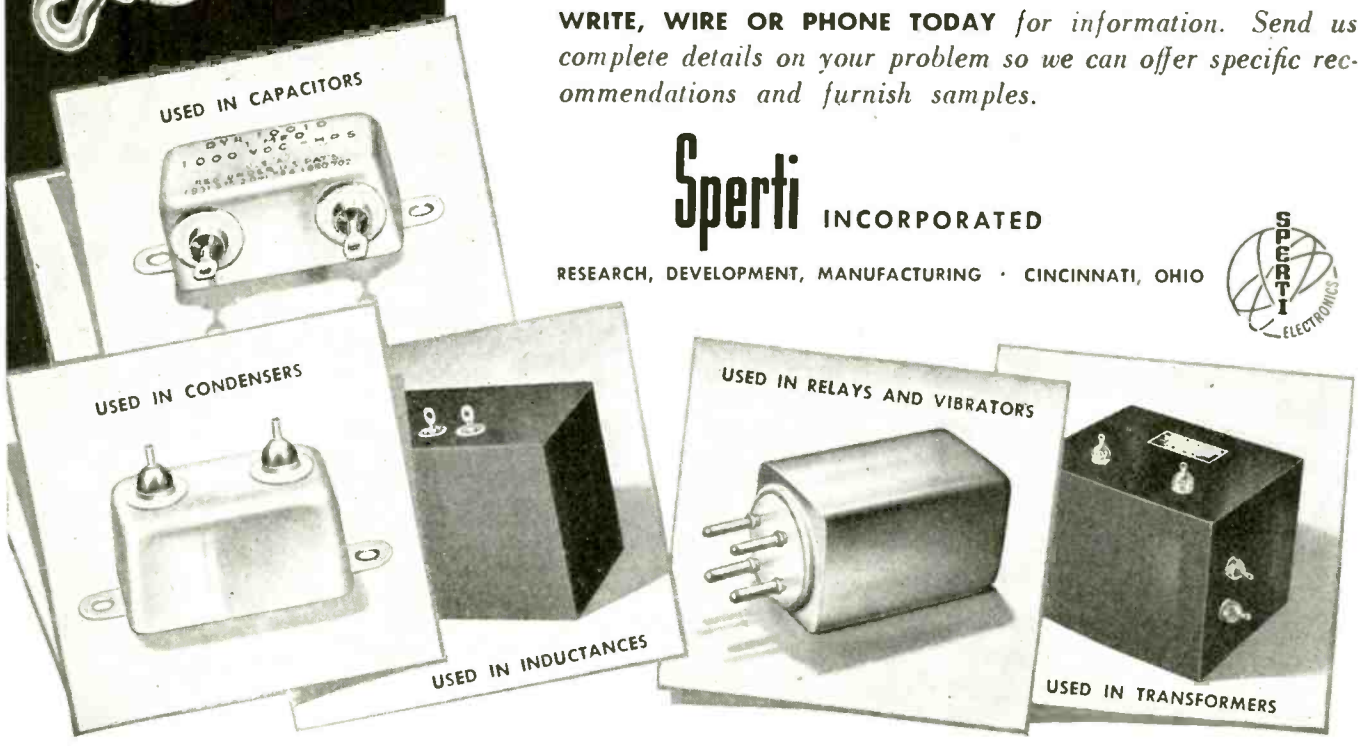
FUSED INTO ONE PIECE. Vacuum tight hermetic bond. Resists corrosion. Has thermal operating range of −70° C to 200° C. Insulation leakage resistance, 30,000 megohms, minimum, after Navy immersion test.

SOLDERING TEMPERATURE NOT CRITICAL. Simple, easy to attach by means of high frequency, oven-soldering, or standard soldering iron.

WRITE, WIRE OR PHONE TODAY *for information. Send us complete details on your problem so we can offer specific recommendations and furnish samples.*

Sperti INCORPORATED

RESEARCH, DEVELOPMENT, MANUFACTURING · CINCINNATI, OHIO



Franklin

SOCKETS

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CRYSTAL HOLDER
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BANANA PINS
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METAL AND NON-METALLIC STAMPINGS

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BUYERS' GUIDE

self-bound for convenience

Through the courtesy of the publishers of Electronics we are able to distribute to purchasing agents, engineers, etc., bound copies of the 1944 Buyers Guide of Electronic and Allied Equipment . . . requests on Company Letterheads should be addressed to Dept. BG, A. W. Franklin Manufacturing Corp., 175 Varick Street, New York City 14.

A.W. FRANKLIN

MANUFACTURING CORP.
175 VARICK STREET NEW YORK 14, N. Y.

for ACCURATE TEMPERATURE CONTROL

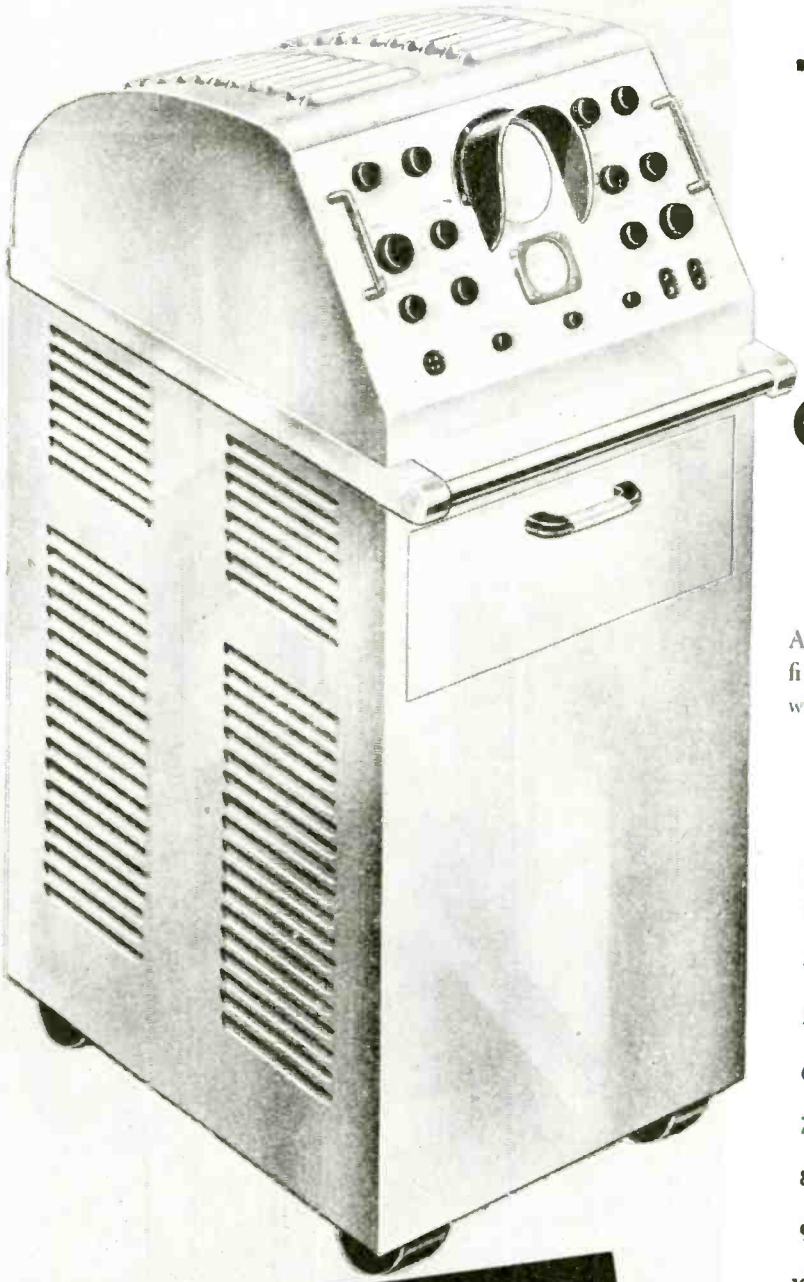
in all latitudes ...in all altitudes

#1½ Blower reduces space requirements for heat dissipation. Unexcelled for applications in electronic equipment.

OUTPUT . . . *15 C.F.M. at 8000 R.P.M.*
HOUSING . . . . . *High impact plastic*
WHEEL . . . . . *Turbo type 1½" diameter*
WEIGHT . . *Housing and wheel 2 ounces*

Bulletin including complete performance specifications available on request.

L-R MANUFACTURING COMPANY
TORRINGTON, CONN.



The NEW RCA Type 715-A

Laboratory-type OSCILLOSCOPE

Triggered Sweep and Time-Base Marker

A "custom-built" design now available for the first time for general use—especially suited for war work—ideal for post-war problems.

10 Important Features

1. Triggered sweep—individually triggered by each signal.
2. Time-base marker; one microsecond intervals.
3. Sinusoidal horizontal spot deflection at power line frequency with adjustable phase control.
4. Extended frequency range — vertical amplifier flat to 10 megacycles.
5. High vertical deflection sensitivity (.66 volts/inch).
6. Precisely compensated attenuator for vertical amplifier.
7. Calibration meter to permit direct determination of amplitude of any voltage component in signal.
8. Low input capacity and high input resistance for vertical amplifier.
9. Complete absence of cross-coupling between horizontal and vertical deflection circuits.
10. Regulated power supply to insure steady pattern on screen independent of line voltage changes.

For complete details, send for bulletin

Deliveries of this instrument will be as scheduled by WPB approved Form 3243 under Scheduling Order M-293. Please address inquiries to Test and Measuring Equipment Section, RADIO CORPORATION OF AMERICA, Camden, New Jersey.

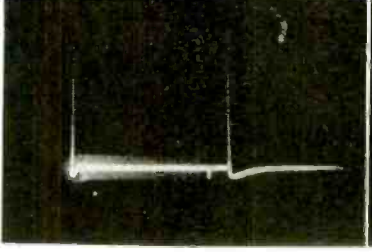
RCA

RADIO CORPORATION OF AMERICA

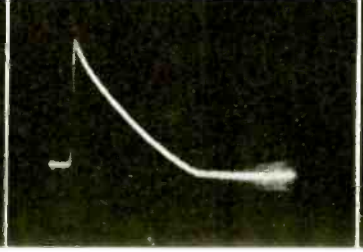
RCA VICTOR DIVISION • CAMDEN, N. J.

LEADS THE WAY.. *In Radio.. Television.. Tubes.. Phonographs.. Records.. Electronics*

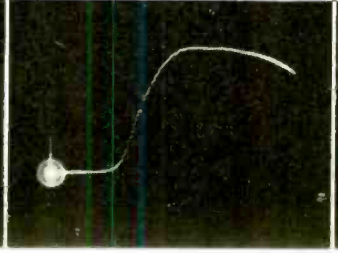
1 Sudden condenser charge and subsequent discharge as seen on ordinary oscilloscope.



2 Externally synchronized and expanded 50 times, revealing the true form of one of the charges in Fig. 1.



3 The same charge, expanded 1000 times, permits detailed observation of the wave front.



4 Applying a one-microsecond time-base marker allows determination of time intervals during the cycle.

KARP

SPARE PARTS BOXES

Made-to-order at no extra cost

For the many years that sheet steel has been designated for spare parts boxes, Karp has been a major national supplier. Vast experiences, coupled with unusual production facilities, permit us to lay out and design boxes to *individual order* . . . at no extra cost. Each is built in accordance with U. S. Navy specifications. Tightly welded seams are vermin-proof. Special corrosion resisting paint is applied. Partitions, fittings, supports and trays are added as the case demands. Sizes range from 12" x 6" x 6" (and smaller where special existing conditions require) to boxes of sufficient length to house long motor shafts. *Rapid deliveries, too.*

Artisans in sheet metal, Karp craftsmen produce a varied line of products . . . from a chassis small enough to be handled by two fingers to a heavy rack which requires a crane to lift. We save you time, cost and manpower. A Karp engineer will gladly consult with you.

ARTISANS IN SHEET METAL

KARP METAL PRODUCTS CO., INC.

124 30th STREET • BROOKLYN 31, N. Y.

CABINETS
CHASSIS
RACKS
PANELS

HELP SHORTEN THE WAR . . . BUY MORE WAR BONDS

HERMETIC SOLDER-SEALING

MAKES **PRESTITE**

TERMINAL BUSHING

Leakage-proof

ACTUAL SIZE

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

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

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

J-05142

Westinghouse

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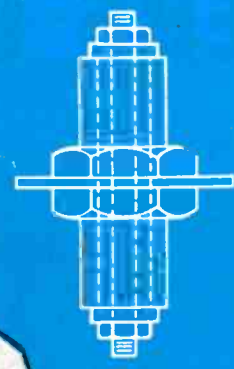
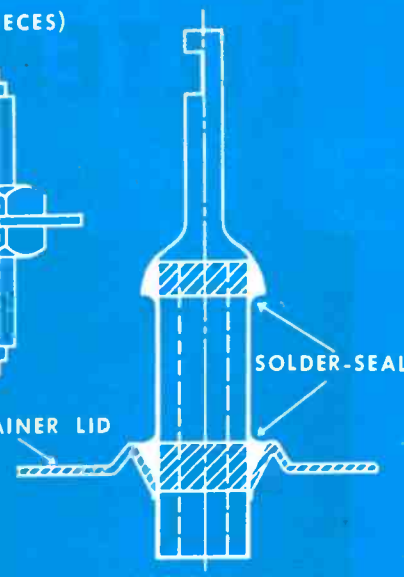
RECTOX RECTIFIERS
INSULATING MATERIALS

OLD WAY

(SEVEN PIECES)



CONTAINER LID



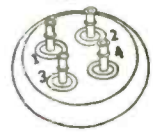
NEW WAY

(ONE PIECE . . . HERMETICALLY SEALED)

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

Other PRESTITE methods of taking leads through partitions

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

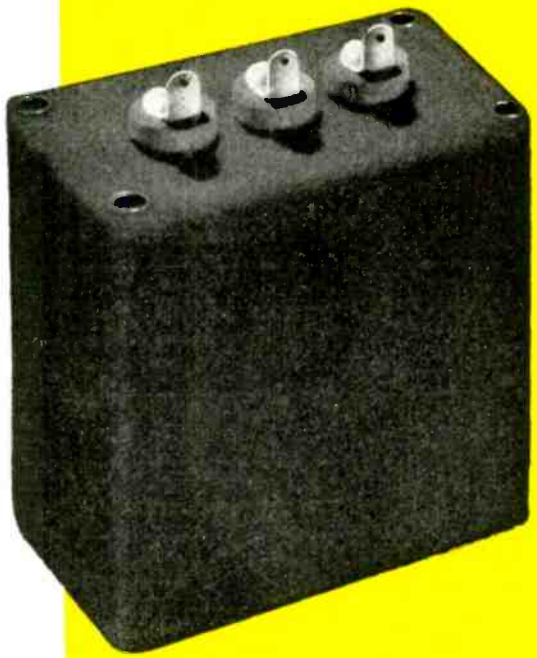


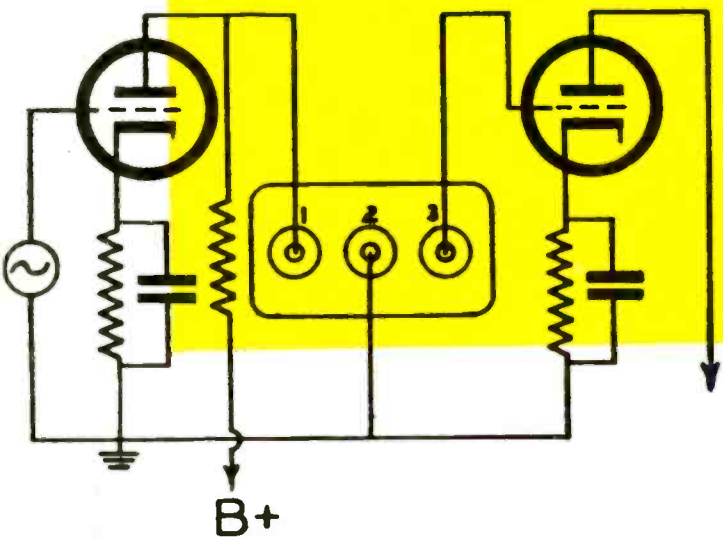
SOLDER-SEAL ASSEMBLY—for vibrator packs, but can be used in similar apparatus, combining jack and terminal board.

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

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

INTERSTAGE FILTERS BY





Interstage filters lend themselves to effecting gain simultaneously with their frequency discrimination. The unit illustrated is a band pass unit which provides a 2:1 step-up ratio, with band pass attenuation of 40 DB per octave. This unit employs a dual alloy magnetic shield which reduces inductive pick-up to 150 Mv. per gauss. The dimensions in its hermetically sealed case are 1½ x 2½ x 2½. Filters of this type can be supplied for any band pass frequency from 200 to 10,000 cycles.

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

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ELECTRONIC INDUSTRIES
Including INDUSTRIAL ELECTRONICS

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

Electronic Markets After V-Day

California is going great guns, no mistake about that. There, as elsewhere, manufacturers of electronic equipment are solidly behind the war effort, so much so in fact that there has been no time for postwar planning, and, it is to be feared, little inclination to put minds to work on problems which appear far removed, inevitable as they may be.

Every Pacific Coast industry has grown tremendously. Plants have doubled, and tripled and quadrupled in area and in personnel. Under war stimulus production has stepped up to undreamed-of totals. Everybody is busy. And if any shadow of doubt regarding the future of war-materiel-swollen factories has begun to appear on present happy horizons, at least it isn't visible yet, and no one speaks about it.

Nevertheless, the inexorable fact remains that some day sooner or later when war shall have ended, and more than likely a bit before that, wheels in some plants are going to stop turning—suddenly. Belatedly it is going to be necessary to face squarely the need for ways and means of keeping them turning, or just go out of business.

Potential buyers, too

The eleven Western States, California in particular, represent a great potential market, as is well revealed in an article in this issue. Up to the present time, that great region has produced only a picayune portion of the radio-electronic equipment which it has bought and uses. Conceivably, it could produce a whole lot more, what with the impetus war work has given industry. The will to do so is there, and so are the means.

But—it is going to take some pretty careful planning—pretty quick—to convert the will into a way. The transition from war to peace may be tough, but it can be done and the rewards appear great. Industry is rapidly taking up with electronic methods; FM broadcasting gives promise of blossoming as brightly on the West Coast as it has on the East—and in between; there is a great and growing interest in television. In short, the signals are set to give manufacturers the go-ahead toward the greatest market they have ever had.

Manufacturers must specialize

Specialization will help in smoothing the bumps in the transition road. Up North, several manufacturers have developed highly stabilized transmitting tube operations; Southern California manufacturers have long specialized in laboratory equipment and in and around Hollywood others, as might have been expected, have done very valuable work in advancing the technic of recording and the perfection of recording equipment.

There still remains much room for specialized effort. It is self-evident that not all manufacturers are going to find it possible to go right along making in the future what they have made in the past. For them, the only solution to the problem of continued existence will come from intelligent planning NOW. Nor is this admonition applicable only in the Golden State. It goes, as well, for a lot of other manufacturers in a lot of other localities.

SURVEYING CALIFORNIA

What of the Golden State—her greatly expanded electronic industry; her production facilities; her products; her markets; and her potentialities for the future? ★ Who makes what, and where? ★ The answers, as complete as a searching survey by editorial representatives of this publication—who spent eight weeks traveling from one end of the state to the other—can make them, are in this issue. ★ Supplementing, and completing the word picture of California there is a more complete Directory of the state's electronic industry than has ever been compiled before. ★ It lists everything anyone might like to know, and will have great reference value. For California Directory, see pages 132-139.

KLYSTRON

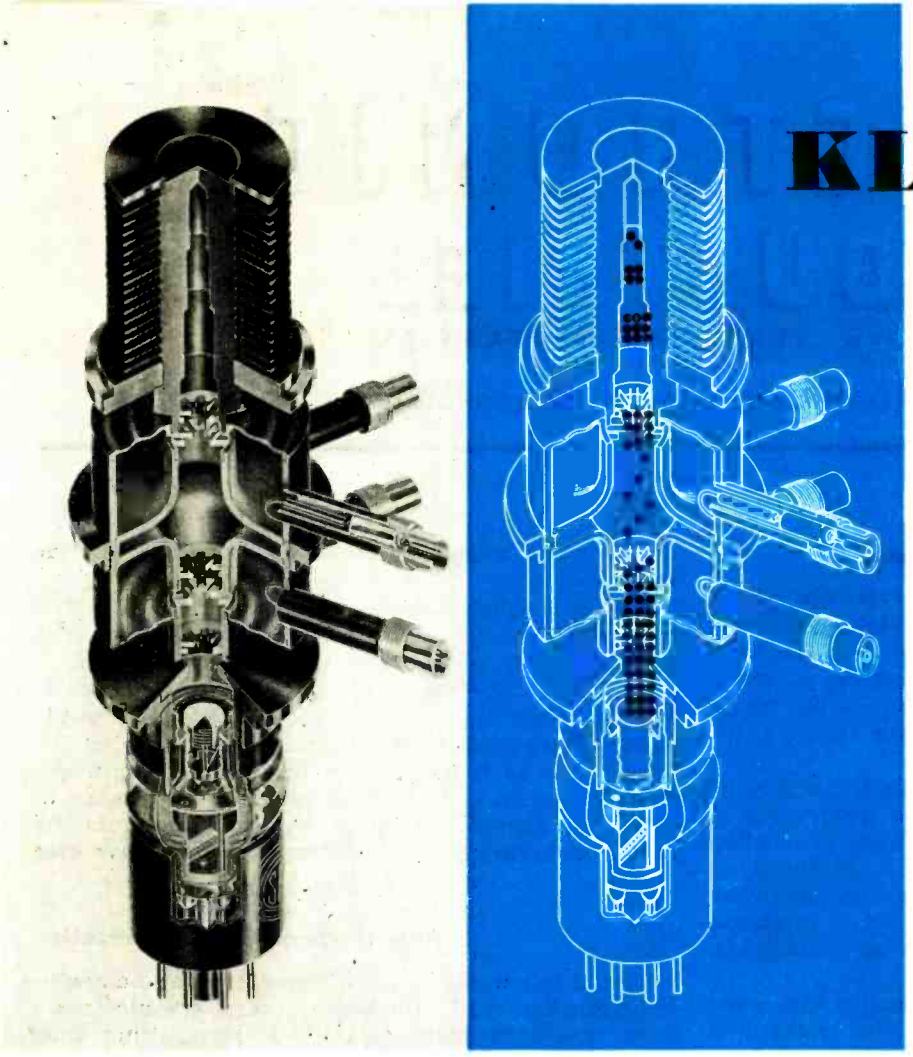


Fig. 1—Sectional view of 410R showing electron gun at bottom, lower (buncher) cavity, upper (catcher) cavity, pickup loops with seals, and heat radiating collector at top. At right, buncher action is shown altering electron velocity. Groups form at catcher and deliver energy

Operating principles, electrical and mechanical details of type 410R Klystron. Performance curves and data

● The generation of voltages at frequencies above 1000 mc/sec. by conventional grid-control tubes is difficult as well as low in efficiency and power output. One of the principal reasons for these conditions is the relationship of the transit time of the electrons from the cathode to the grid in the ordinary tube as compared to the time for one cycle of the frequency being generated.

Thus in a common triode or pentode, with its normal plate voltage, a certain definite time is required for the electrons to make the trip from cathode to the plane of the grid. This time is a fraction of a microsecond. However, at a frequency of 1000 mc. the time for one cycle is 10^{-3} microseconds and in all but special tubes such as the acorn type, etc., electrons cannot reach the plane of the grid in this short space of time and consequently the grid voltage passes through a large portion of its cycle during the time the electron is in flight. Only a few if any get beyond the plane of the grid since when the grid voltage is great enough to allow electrons to proceed toward the plate this voltage will pass through half or more of its cycle and repel the electrons which have not yet reached the grid. In most instances, the transit time must be less than 1/10th the time for one signal cycle for satisfactory operation. Excessive transit time reacts as increased input loading.

There are a number of other limitations to conventional tubes at ultra high frequencies, radiation losses, internal circuit parameters, etc.

In order to develop frequencies much in excess of 1000 mc. it becomes necessary to use a tube in which the transit time need not be limited to a fraction of the time required for one cycle of the frequency to be generated. One solution is velocity modulation of the electron stream from a gun similar to that employed in cathode ray tubes. The basic principle is that of periodically changing the velocity of electrons passing a certain point in a tube and allowing these electrons of different velocities to form bunches by drifting through the required distance. These bunches will form due to the faster electrons catching up with the slower ones at a given point in the tube. They occur once each cycle of the frequency to be generated if they are allowed to travel through the tube for some convenient distance since time is required to form the bunches or groups. Internal forces in the beam cause de-bunching through repulsion but in practical tubes good design holds this to a minimum.

These bunches of electrons can be made to deliver their energy to a resonant circuit of a special type. The groups of electrons, coming as they do at periodic intervals, act in a manner similar to a periodic impulse applied to a pendulum causing it to oscillate at a regular frequency and amplitude.

One group of tubes employing velocity modulation is known as the Klystron.* These tubes are a development of R. H. Varian and S. F. Varian and the Sperry Gyroscope Co., Inc., Brooklyn, N. Y.

A typical model type 410R made by Sperry is shown in the cut-away view Fig. 1. This tube consists of a cup-shaped cathode and internal heater element which is noninductively wound, and a control grid both near the base of the tube. The control grid of the tube is so constructed as to aid in focusing the electrons into a beam. Both of these structures, the cathode and the control grid, are quite similar to those found in cathode ray tubes.

The next electrode in the stream is a "smoother" grid similar in some respects to a screen grid in a cathode ray tube. A pair of grids which are separated approximately 0.030 in. are located a little beyond the smoother grid. These grids are connected to the side walls of a cavity resonator. These resonators, which will be described in more de-

* Trademark of Sperry Gyroscope Co., Inc.

CHARACTERISTICS

by **WILLIAM E. MOULIC**
Associate Editor, Electronic Industries

tail later, are basically a resonant circuit similar in electrical action to the common parallel coil-capacitor tuned circuit.

These cavities are hollow metal cylinders and in the case of the Klystron shown, are under vacuum with the rest of the tube. The cavity resonator nearest the cathode is commonly called the buncher since it is the action of this tuned circuit and its associated grids to group the electrons of the stream into the required bunches.

Note that the grids in this tube are radial fins similar to spokes of a wheel in which the hub has been removed. This construction permits a more uniform field between the grids and at the same time offers a minimum physical obstruction. The next section of the tube is an evacuated chamber commonly known as the drift space. In this drift space, the electrons whose velocity has been increased by the buncher "catch-up" with those which were slowed down by buncher action.

A second cavity resonator, commonly called a catcher, follows the drift space and is identical (in the tube shown in Fig. 1) to the buncher. The catcher resonator grids are identical in construction to those of the buncher and are spaced by the same amount. Beyond the buncher is a collector electrode, which in the case of the tube shown in Fig. 1, consists of a metal cylinder with heat radiating fins and a series of different

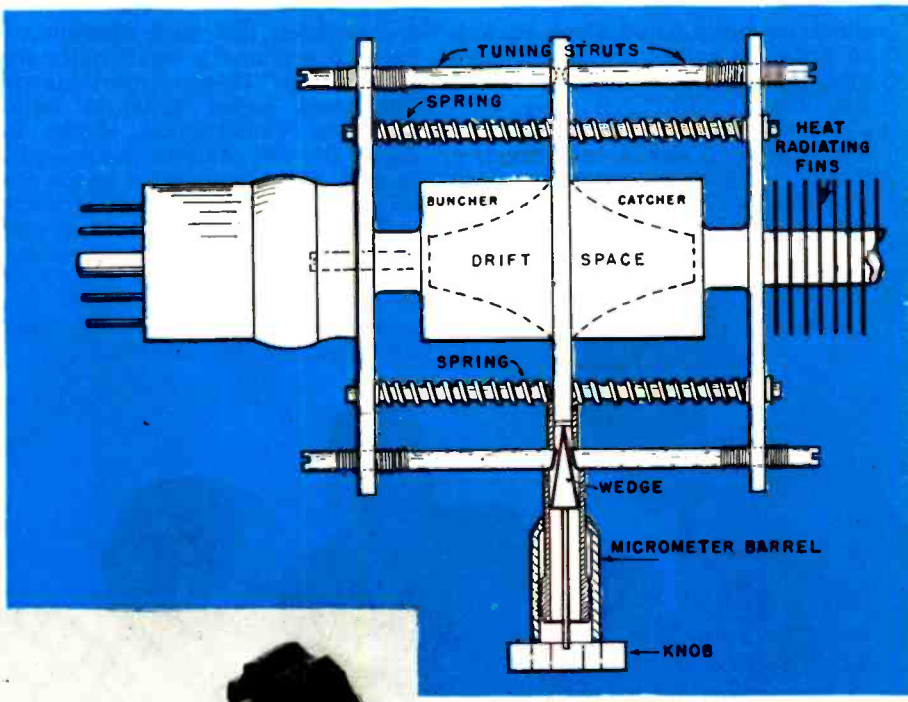


Fig. 2 (Below)—410R Klystron showing tuning knob and coaxial feedback cable. Note springs and struts of tuning mechanism

Fig. 3 (Right)—Basic features of cavity tuning mechanism in 410R. Wedge expands one strut only to alter distance between grids

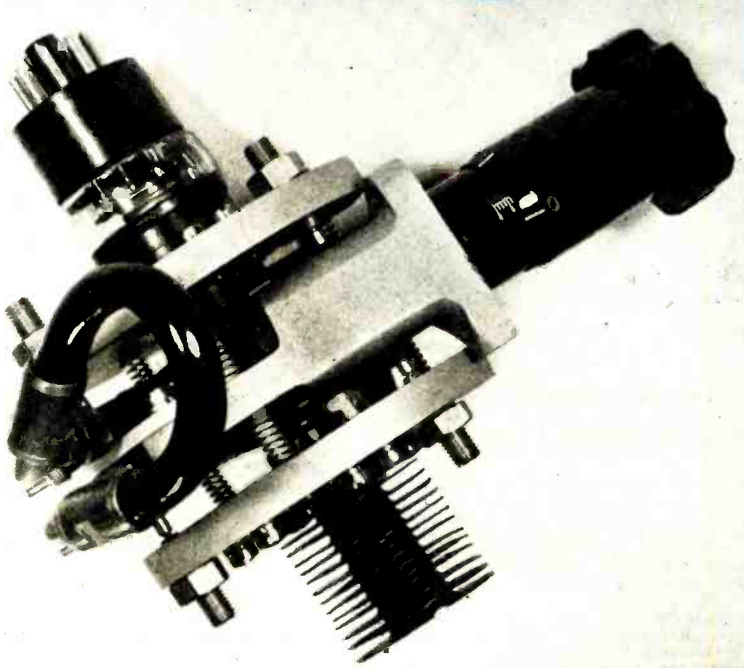
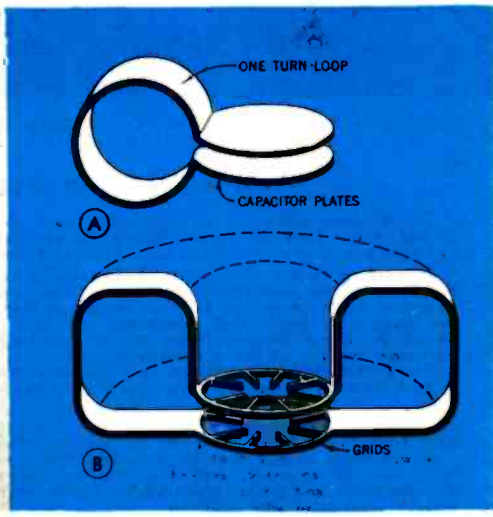


Fig. 4—Simple tank circuit at A has low Q at uhf because of radiation of energy. Increasing number of loops as at B develops into cavity as used in Klystron and other tubes



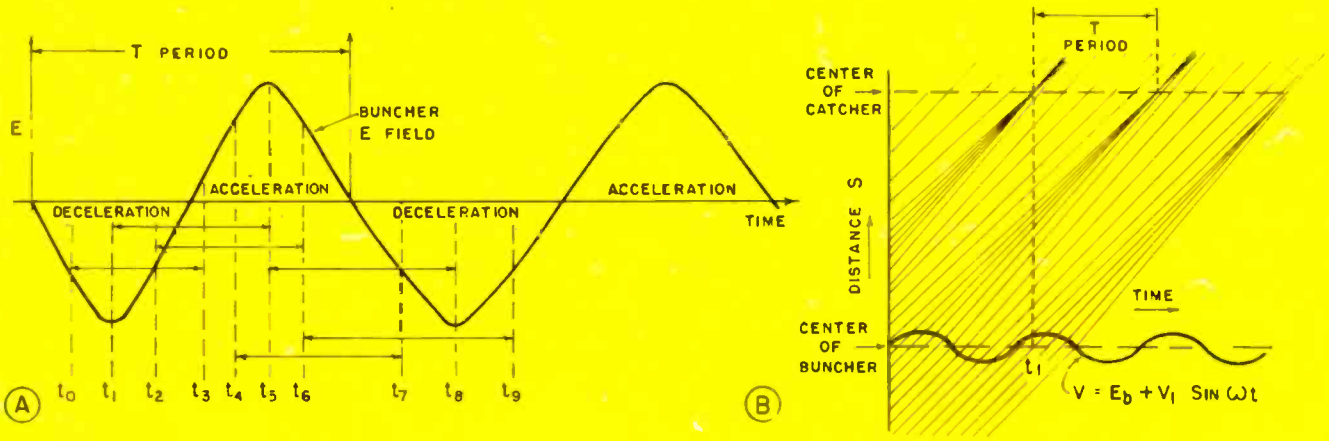


Fig. 5. Effect of buncher field on electron velocity at A and Applegate diagram of bunching at B. Slope represents velocities

diameter holes bored along its axis in order to collect the spent electrons and radiate the heat caused by them.

To take energy from the cavities and also to inject it into them, a number of pickup leads are sealed into the two chambers. They consist of a short section of coaxial transmission line with appropriate vacuum seal and a small half-turn pickup loop. These connections are sometimes called antenna seals.

In the construction shown in Fig. 1, the two cavities, the smoother grid, and the collector anode are all connected together electrically to the positive terminal of the dc power supply. The only insulation in the tube is the small glass ring at the base which insulates the cathode and grid structure from the remainder of the tube.

The ends of the cavities are made flexible by the concentric rib construction. The frequency at which the tube operates is adjustable over a range of several per cent of its fundamental frequency by means of mechanically "stretching" the tube to change the distance between the buncher grids and the catcher grids. In this tube the distance from buncher grid to catcher grid is normally very near one inch.

The tuning mechanism is shown attached to the tube in Fig. 2 and a diagram of the operation is shown in Fig. 3. The frequency of the tube may be altered over a rather wide range by means of the three tuning struts for each cavity. These three struts operate against the center ring midway between the two resonators and stretch the anode end and the cathode end away from the center thus altering the distance between the buncher

RUSSELL H. VARIAN SIGURD VARIAN DR. W. W. HANSEN

CALIFORNIANS WHO DEVELOPED THE KLYSTRON

The Klystron came out of California; three men were responsible for the final development of the tube. They are Russell Varian, his younger brother Sigurd, and Dr. William W. Hansen, associate professor of Physics at Leland Stanford University.

Subsequent to the conception of the original idea of the Klystron, which occurred to Sigurd Varian while he was Flight Captain for Pan American Airways on the Mexican and Central American flight lanes, the brothers retired to Halcyon, Calif., to work out the basic theory and the preliminary paper work. After the idea had been worked into a practical form, they contacted Dr. David Webster, head of the department of Physics at Stanford, with the hope of obtaining the use of the University laboratories. This was a logical move because it was from Stanford that Russell graduated in 1925 with the Degree of A.B. Doctor Webster consented to take them on as research associates without pay.

It was during this period that the brothers met Doctor Hansen who worked with them in developing the final design based on the "velocity grouping principle." The final model was built from this design by Sigurd. It worked just as expected during the preliminary tests.

It was mere chance that Dr. H. Hugh Willis, vice-president, Sperry Gyroscope Co., and then chief research engineer, arrived at the Oakland airport just as the instrument was ready for demonstration, and Doctor Willis was invited to see the new instrument. That was the beginning of Sperry's association with Klystron.

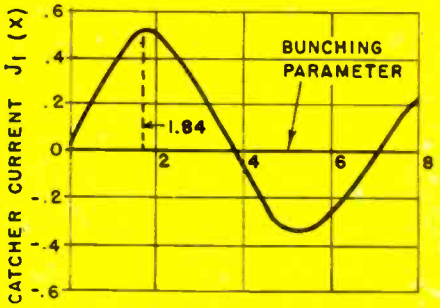


Fig. 6. (Above)—Variation of rf catcher current for bunching parameter X as given by equation 3

Fig. 8. (Right)—Experimental curves of multiple oscillation points for values of $1/\beta$

Fig. 9. (Right center)—Experimental frequency deviation with beam voltage for 410R

Fig. 10. (Far right)—Dial calibration determined experimentally for 410R

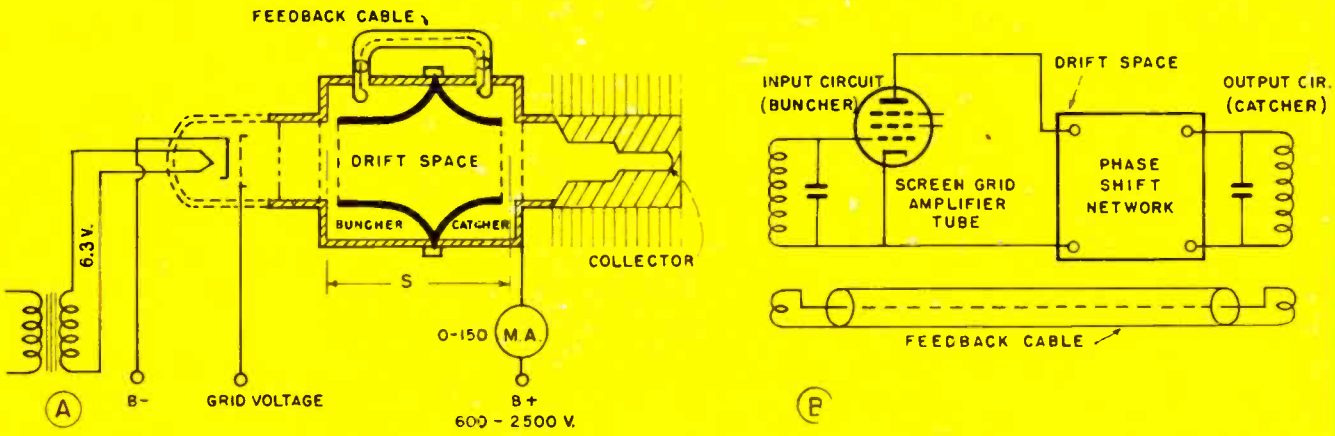


Fig. 7. Klystron tube at A showing bunching distance S and equivalent conventional tube circuit at B. Phase-shift network replaces drift space

and catcher grids. Tension springs are used to keep the end plates bearing against the struts.

A vernier tuning mechanism is employed and the control knob and graduated scale on the 410R are shown in Fig. 2. A micrometer type barrel operates a screw and wedge to expand or contract the length of one of the three tuning struts.

The extension of the analysis of ordinary lumped constant circuits (circuits including inductance, capacitance and resistance), to the ultra-short wavelengths obtained with Klystrons presents a number of difficulties. Consider the single wire loop and capacitor shown in Fig. 4 (A). As the size of the loop is decreased to reduce the wavelength, the losses become tremendous and the loop practically vanishes before the desired wavelength is reached. By adding a number of larger loops in parallel to decrease the inductance; this would lead to the shape shown in Fig. 4 (B) which resembles the resonators actually used in Klystrons.

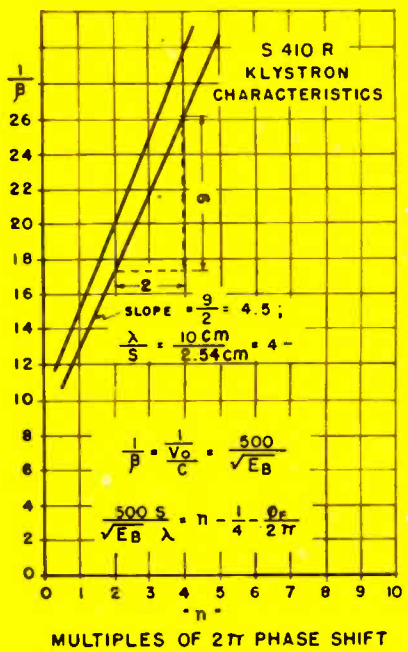
Cavity resonators, like transmission lines, have more than one resonant frequency. A simple coil and capacitor circuit, in which all dimensions are negligible compared with the wavelength, has only one resonant frequency. A long transmission line has an infinite number of resonant frequencies which occur when the length is an integral number of quarter or half wavelengths, and a single number suffices to specify the order of a harmonic.

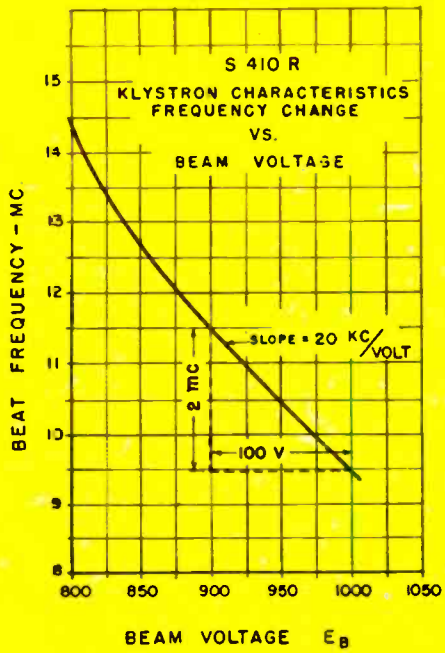
In a cavity resonator all three dimensions are in general comparable with a wavelength, and nodes can exist in three different directions. Not only are three numbers now required to specify the order of a certain "harmonic", but the higher resonant frequencies are no longer integral multiples.

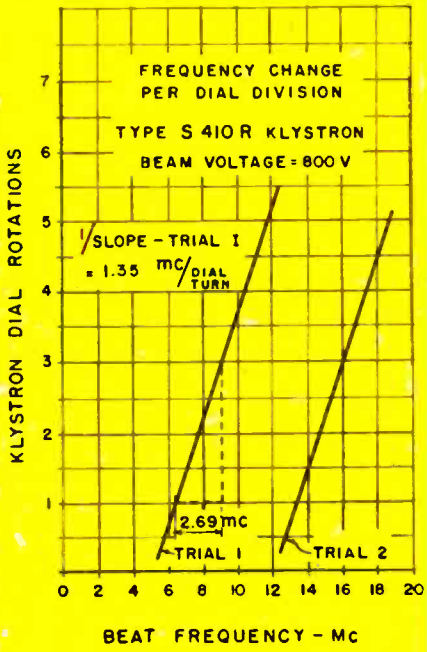
It is possible to divide the fields within a cylindrical cavity resonator into two main types: one type has the electric field E parallel to the axis. The second type is a similar family with the electric and magnetic fields interchanged. The relations are analogous to the fields in waveguides (c.f. Slater-Microwave Transmission), but the usual waveguide notation will be replaced in the discussion below by the Bessel function describing the boundary conditions, since this allows convenient computation of the resonant wavelength of a cylindrical cavity. If b is the length of the cavity and a is the radius:

$$\frac{1}{\lambda^2} = \left(\frac{m}{2b}\right)^2 + \left(\frac{k}{2\pi a}\right)^2 \qquad (1)$$

(Continued on page 150)







MASS SPECTROMETER —

by **CLIFFORD E. BERRY**
Electronics Research Engineer
Consolidated Engineering Corp., Pasadena, Calif.

Sorting atoms and molecules in structure of hydrocarbons provides accurate control routine and aids developments

• It is only in the last few years that technics in electronics and high-vacua have advanced to such a point that workers in these fields could develop commercial mass spectrometers for routine industrial analysis work. The growing number of instruments in industrial use, together with their all-electronic nature, makes the subject one of current interest to the electronics engineer.

Though its commercial application is new, the principle of the mass spectrometer is relatively old. It was in 1918 that Dempster constructed the first mass spectrometer, and in 1919, Aston constructed the first mass spectrograph. Earlier than that, J. J. Thompson and others had done much work on positive rays.

In the years following this pioneer work scientists constructed a large number of mass spectrometers and mass spectographs in physical laborotories all over the world, and did much important work on the masses and isotopes of the elements. This paper will describe one commercial instrument and discuss briefly its applications, particularly in the field of hydrocarbon analysis.

A mass spectrometer is a device for sorting atoms and molecules according to their masses. The basic method of accomplishing this sorting is to give each particle an electric charge, then to act on the charged particles by a combination of electric and magnetic fields in such a manner that particles of the same mass follow the same path, and particles of different masses follow different paths. Although the principle applies to substances of any mass, we will consider here only those substances which can exist in the gaseous state at ordinary temperatures.

Sorting atoms

Many different arrangements of electric and magnetic fields have been used to accomplish this sorting action. The instrument to be described here is the 180 deg. type, commonly called the Dempster type. In this the ions are generated at one point in a magnetic field, and are speeded up to a high velocity over a short distance by an electric field. Then they follow circular paths in the magnetic field, the radius of each path depending on the respective masses of the ions.

A collector, placed 180 deg. from the source, collects that particular beam of ions which travels a path with a radius equal to half the distance between the source and the collector. In practice this radius is fixed, and the particular mass beam which follows a curve of this radius is selected by varying either the electric field or the magnetic field, or both. The relation between the mass, the radius of curvature, the accelerating voltage, and the magnetic fields is given by

$$m = \frac{r^2 e\ B^2}{2Vc^2}, \text{ (esu), (1)}$$

where m is the mass, e is the charge of the particle, V is the voltage to which the ion is accelerated, r is the radius of the curvature, c is the velocity of light, and B is the flux density.

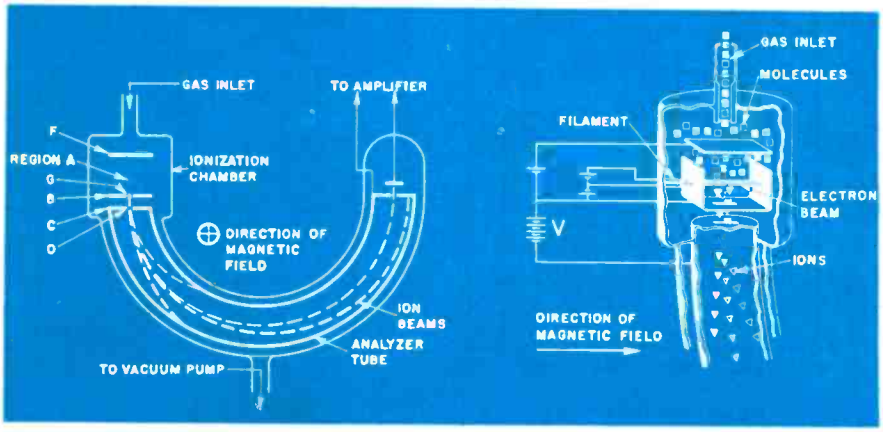
To give a typical numerical example, with a tube radius of five inches and a flux density of 2100 gauss, ionized molecular oxygen, O_2^+ (mass 32) strikes the collector at 1075 volts, and ionized atomic oxygen, O^+ (mass 16), at twice that voltage.

The above equation shows that, for a given radius of curvature, varying either the accelerating voltage or the magnetic field will bring a given mass into focus. Varying the voltage is the more practical method when the spectrum is to be scanned continuously, and is the method used in the Consolidated instrument.

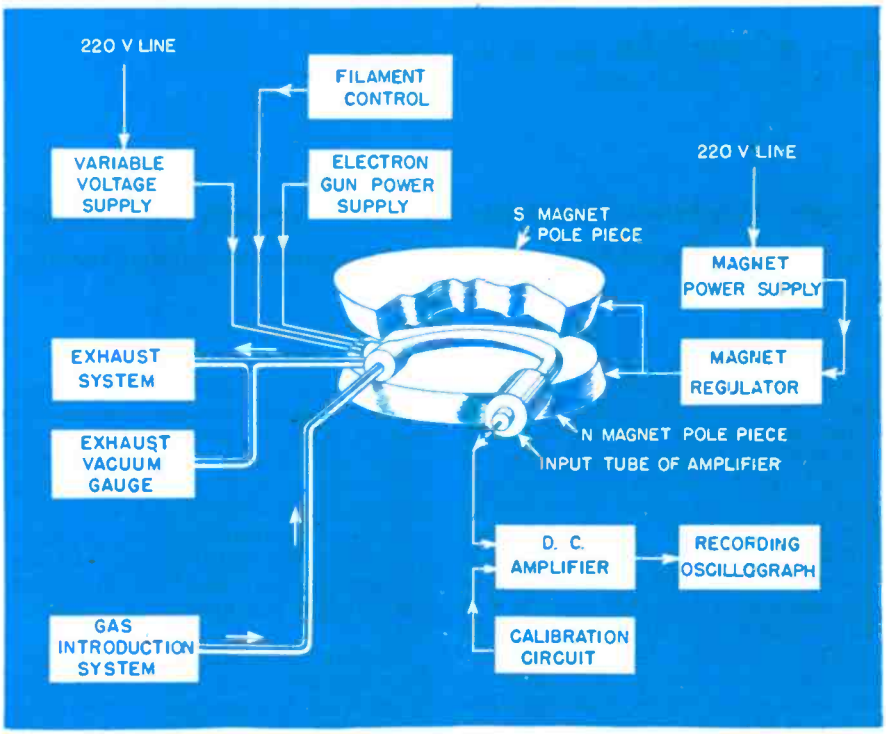
Fig. 1 illustrates the foregoing. Neglecting for the moment the method by which the ions are generated, assume that in the region A ions of several masses are being formed simultaneously at a continuous rate. These ions are pushed through slit G by a small voltage between F and B. Then, under the

Fig. 1—Basic arrangement of mass spectrometer. Accelerated ions, formed at A, travel in arc due to magnetic field. Ions of some particular mass will strike target connected to amplifier

Fig. 2—Details of region A in Fig. 1. Electron beam ionizes gas sample by collision. Voltage V gives forward velocity to ions which in combination with magnetic field and their mass determine path radius

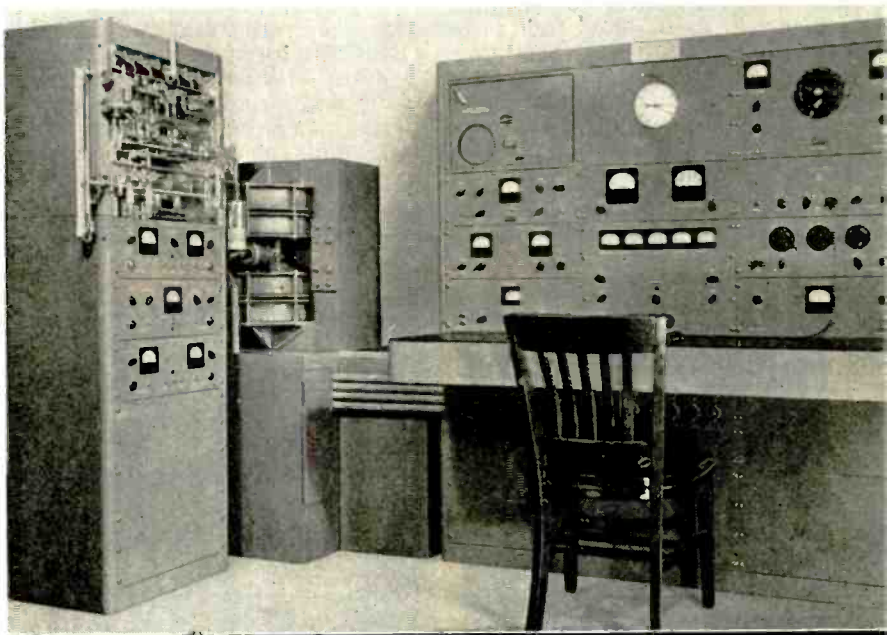


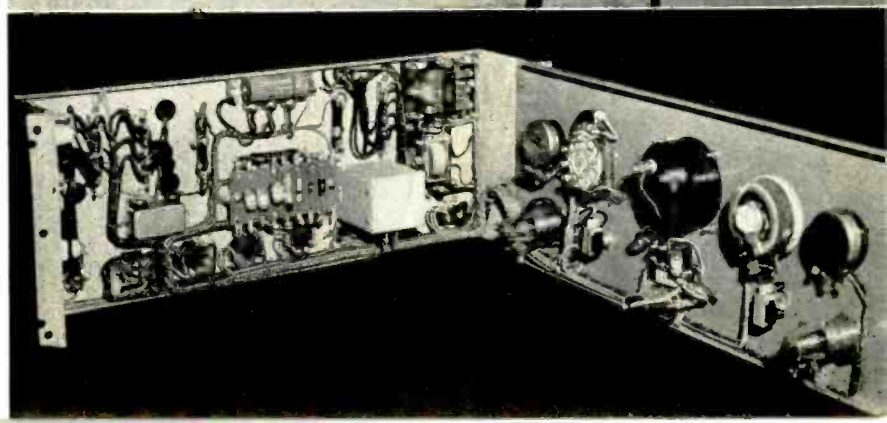
NEW INDUSTRIAL TOOL



▲ Fig. 3—Block diagram of mass spectrometer equipment showing tube between poles of magnet

Fig. 4—Commercial version of mass spectrometer, showing complete equipment and arrangement of components. Fig. 5 (Below)—Typical chassis arrangement, this view showing inside of one of the front panels ➤





influence of the voltage V (Fig. 2), they are accelerated between plates B and C, and emerge from slit D with velocities dependent upon V and upon their masses. A uniform magnetic field, perpendicular to the plane of the paper, causes the various groups of ions to follow different circular paths, in accordance with equation (1).

The heavier ions follow paths of larger radius and strike the outside wall of the tube, while the light ions follow paths of smaller radius and strike the inside wall. For certain values of V, however, ions of one mass will follow the tube for its entire length and strike the collector. The current carried by these ions is a measure of the number of ions of this particular mass which are formed per second at A. If the voltage V is varied from high to low values in a continuous manner, all masses, starting with light ones, are successively brought to focus at the collector, and a record of this collector current constitutes a *mass spectrum*.

At this point it is desirable to differentiate between the mass spectrograph and the mass spectrometer; in the mass spectrograph the ion beams impinge directly on a photographic plate. Usually several beams strike the plate simultaneously at different points and the relative densities of the lines thus formed are the measures of the intensities of the beams. In the mass spectrometer, on the other hand, the ion current is collected on a target and measured by an electrometer or a dc amplifier.

The mass spectrograph is well adapted to measurement of mass, but is less convenient and less accurate than the mass spectrometer for chemical analysis work in which beam intensities must be measured. For these reasons the mass spectrometer rather than the mass spectrograph is used for modern analytical work.

(*Continued on page* 194)

CARRIER SYSTEMS FOR

by L. G. ERICKSON and F. W. LYNCH
Lenkurt Electric Co., San Francisco

Single sideband, multiple channel speech and signal equipment applied to conventional communication circuits

● Since the early experiments conducted almost thirty years ago, carrier telephone transmission has been developed rapidly. The first carrier telephone or "wired wireless" systems used low radio frequencies and considerable amounts of power. It was not uncommon to have a carrier power of several hundred watts. The carrier and both sidebands were transmitted.

The frequency bands occupied a large range of territory and operation of more than one carrier channel over a circuit was a difficult technical feat. The transmission losses were large due to the high frequencies used and the noise susceptibility was high. In addition, crosstalk to other wires on the same telephone lead made it inadvisable to operate more than one or two systems on a pole line.

With the development of sharply tuned wave filters, it became possible to suppress the carrier and one sideband and reduce the transmitted power involved. Transmission gains were made by lowering the frequency. It was found that intelligible speech could be transmitted with a 1600 cycle band and the amount of territory used in the transmission of intelligence was further reduced. Most of the development of carrier transmission has been confined to wire lines because of the cost reduction in plant maintenance and operation.

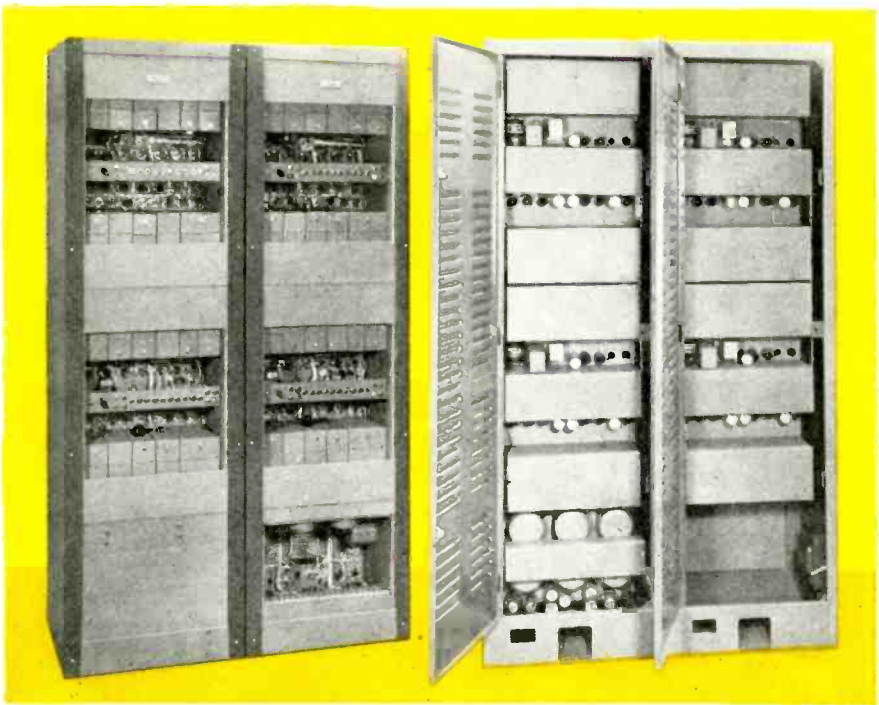
Experimental carrier communication over radio facilities has been investigated for a number of years. A form of carrier over radio has been used for a long time to provide semi-privacy on the talking channel. This means of carrier communication is called "scrambling," or inversion of the voice frequencies and is accomplished by generating upper and lower sidebands of approximately a 3 kc carrier and transmitting only the lower sideband. Unscrambling is accomplished by the reintroduction of the carrier at the receiving end and suppressing the unwanted components.

Carrier telegraphy—or tone keying—has been also extensively used to increase the services offered by a particular radio link. A small amount of distortion results only in inter-channel interference and, in modern radio links, is not of sufficient magnitude to degrade the telegraph communication.

Where short distance communications over radio circuits are vitally important, carrier telephony presents many obvious advantages in the installation of communication circuits. The installation of a single radio link and the associated carrier equipment offers a quick and easy means of obtaining urgently needed telephone and telegraph circuits.

Frequency modulated transmitters and receivers offer a particularly adaptable carrier transmission path as they present low distortion and a relatively noise-free circuit easily modulated to the higher frequencies involved. They are highly stable with respect to overall audio gain and make wire line termination simple.

Front view with covers removed, and rear view of the four terminal carrier equipment which provides four complete communication channels and termination to two-wire line



Design details

The number of carrier channels that can be transmitted over a radio circuit is limited by the upper frequency modulation capability of the transmission medium and its power capabilities.

The carrier apparatus to be described, offers four channel communication complete with drop to drop signaling and termination to a 2-wire line. The upper frequency used is 12.5 kc. Channel No. 1 communication is transmitted at

normal audio frequencies. Channels Nos. 2, 3 and 4 are operated on a carrier basis. It is possible to use ten channels of tone telegraph on any one channel procuring ten channels of telegraph and three of voice. A fifth channel may be added if desired and the upper frequency limit becomes 16 kc.

The terminal as shown in the photograph, consists of two standard relay racks, mounted side by side, housing four receivers and four transmitters for voice communication as well as four carrier signal receivers and four carrier signal transmitters. The power supplies are included in one rack and matching transformers are mounted in the remaining rack.

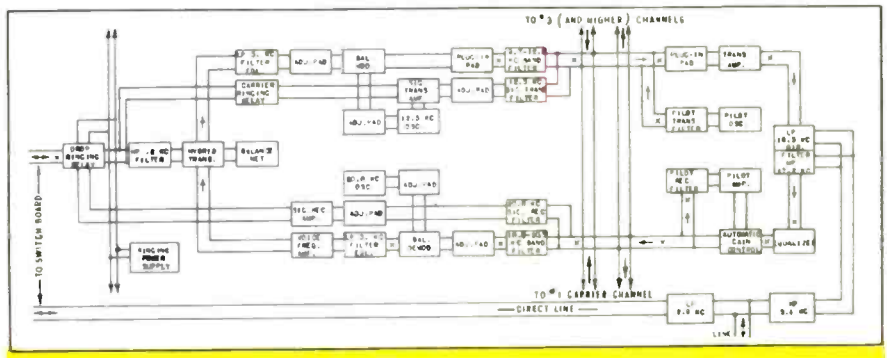
When properly installed on a radio link, a pair of these terminals —one pair at each end of the circuit—will provide facilities, without mutual interference, for four talking channels and four signaling, or ringing, channels. All tubes are of the 6N7 type with the exception of the rectifier tubes. The racks are 18 in. deep, 22½ in. wide and 76 in. high and weigh approximately 750 lbs. each.

One rack of a terminal contains Channel No. 1 (the physical), Channel No. 2 and the matching transformers which connect the carrier apparatus to the radio link. Space is provided for a ringing machine to be used in conjunction with ringing circuits or to ring the bells of the telephones associated with the terminal, if desired.

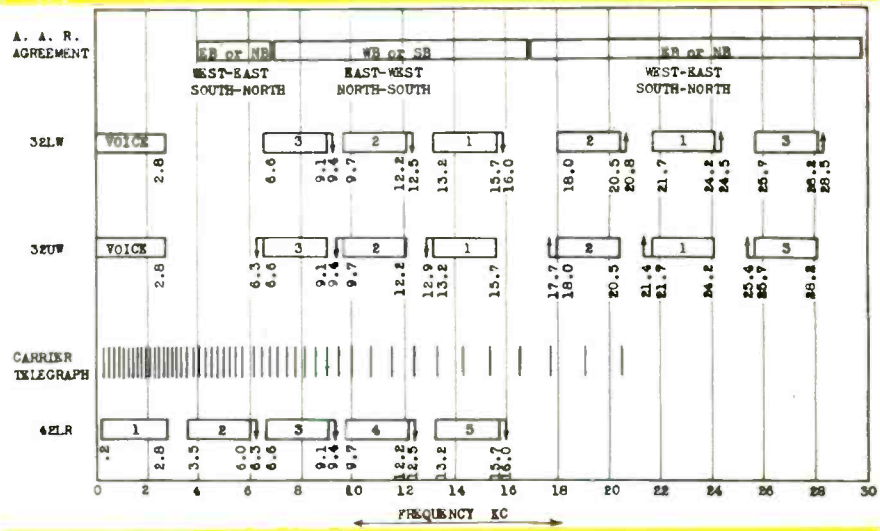
The other rack contains Channels Nos. 3 and 4 and the power supplies. The power supply provides the necessary high voltage and filament voltage for the operation of all channels. Facilities are provided for the adjustment of the various voltages encountered on standard ac lines.

The power supply consists of three units: one to supply all channel receivers; one to supply the transmitters; and one to supply the signaling apparatus. They contain fuses associated with the transmitting, receiving and signaling branches of each channel—a separate fuse being used to supply each component of each channel. Failure of one channel in this way would not disable other channels operating from the same power supply. A voltage regulator tube supplies the oscillator voltages on the four channels with a relatively constant voltage regardless of line voltage variations.

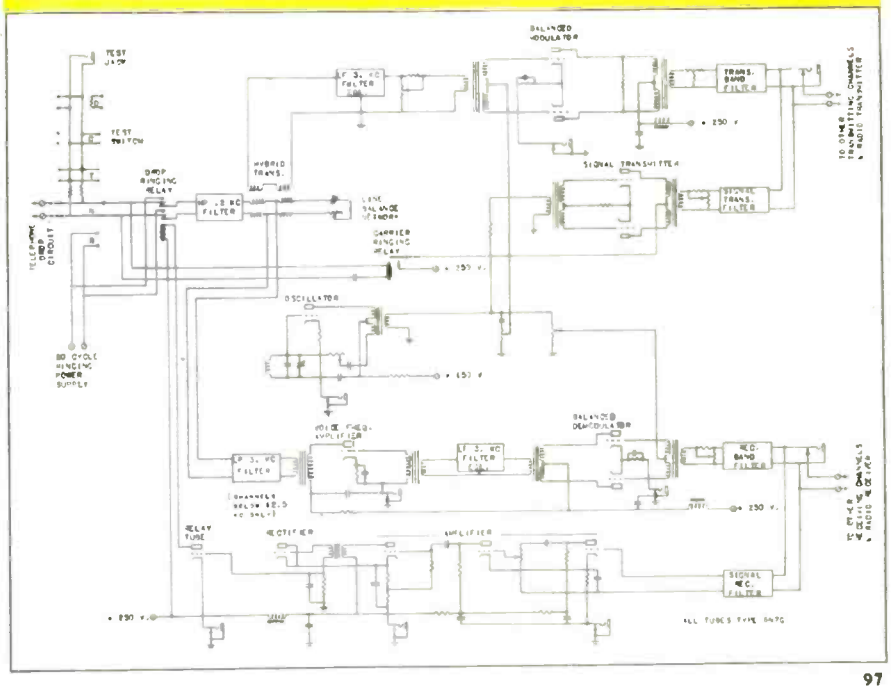
The relay racks are equipped on the front with individual channel

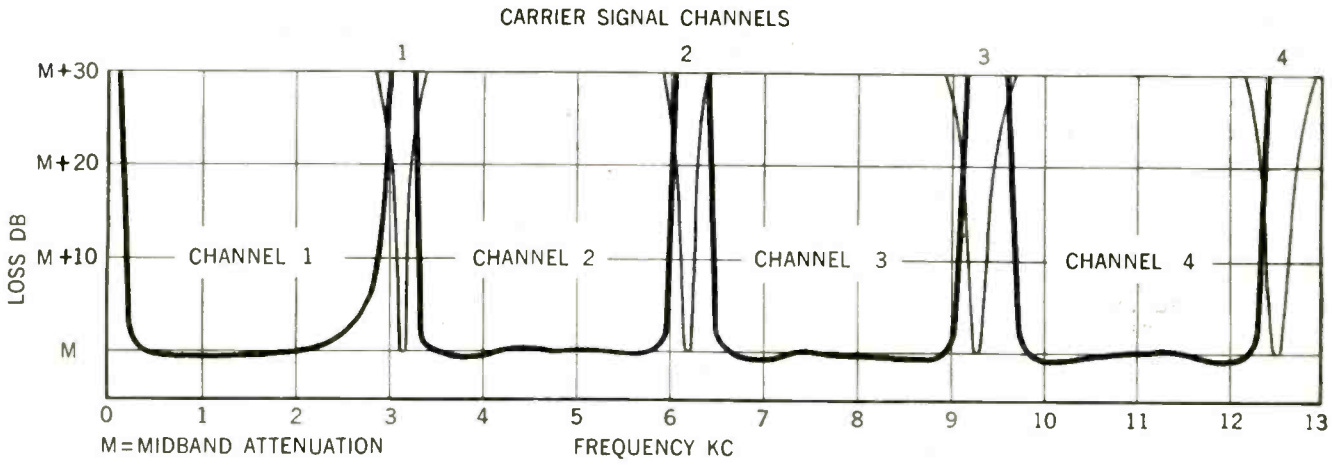


Block diagram of direct line and No. 2 carrier channel as applied to wire lines. Frequencies of filters and oscillators in other channels are shown on the chart below, which illustrates assignments for several typical systems



Basic circuit diagram for one channel of system shown in block diagram above





Relative overall transmission frequency characteristics of four-channel radio carrier telephone system. Channel bandwidths are representative of overall audio transmission characteristics measured between two-wire terminations

doors which are removable to facilitate testing and servicing. These doors may be locked.

The reverse side of the rack is accessible by means of a hinged door. This side of the rack contains the bandpass filters, relays associated with the signaling circuits, vacuum tubes and terminal strips for rack inter-wiring. Terminal strips are also supplied to obtain various voltages derived from the signaling circuits. These derived voltages may be used to block the grids of associate radio transmitters, receivers, or to control other apparatus.

The terminal strips are covered by removable safety shields. Telephone and radio drop connections are also made here. The terminal is operated from 110 volts ac 50-60 cycles current and draws 250 watts. The apparatus operates on a 4-wire basis between terminals using the same transmitting and receiving frequencies.

The respective gain of the transmitting and receiving branches of the carrier apparatus is such that a zero loss drop circuit may be obtained over a minus 27 db circuit between terminals. The output of each channel is 1 mw into 600 ohms. The equipment is wired so that a ring initiated at one channel of the terminal will ring the bell of the associated telephone on the same channel of the far terminal.

In the center of each individual carrier chassis (which in itself is a complete unit less only the power supplies) is a jack test strip. The cathode circuits of all vacuum tubes are brought to this strip to provide easy testing of the various tubes and the condition of various circuits.

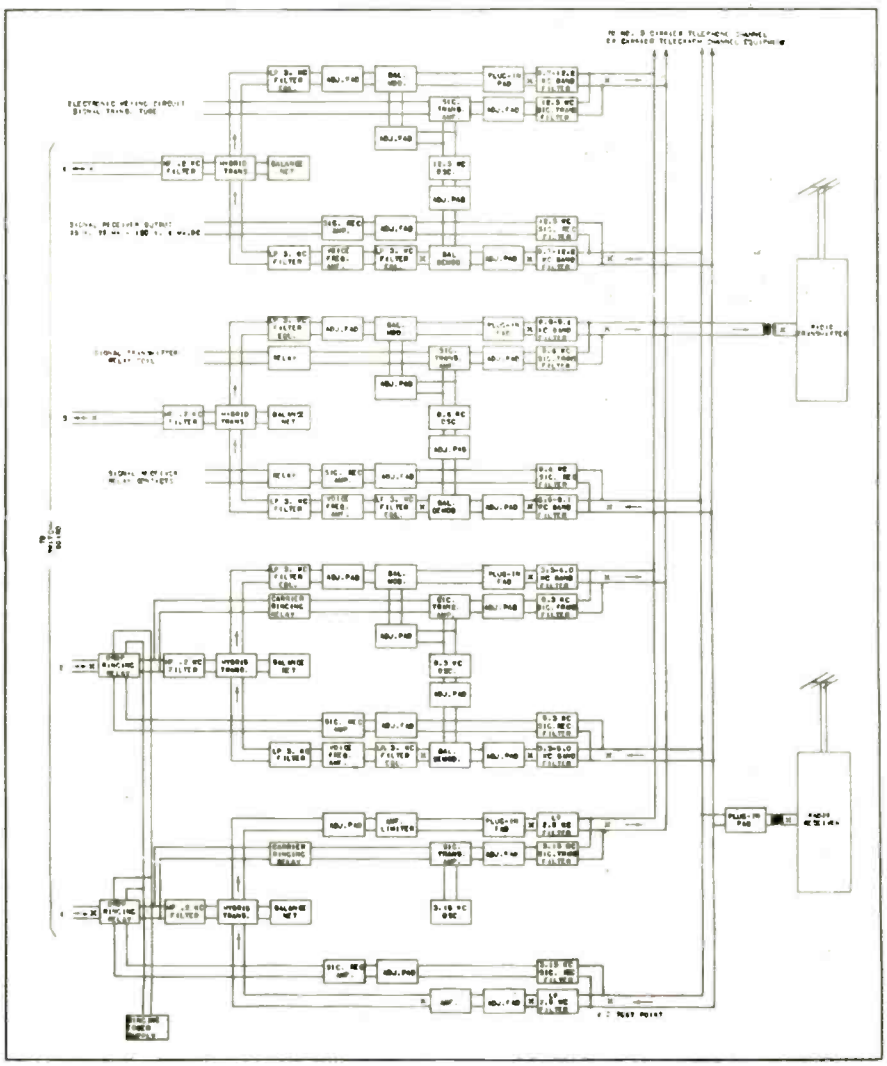
A rotary switch is provided with each channel to switch a telephone set to the circuits associated with the carrier terminal for test purposes.

Audio frequencies from 250 to 2750 cycles per second are transmitted from drop to drop. This band width is considered standard for high quality telephone circuits.

Due to the design of the band filters and signal channel filters it

(*Continued on page* 176)

Block diagram of four (or more) two-way carrier channels applied to radio system



CALIFORNIA—Pacific Gateway

by MAJOR GENERAL JAMES A. CODE, JR.
Assistant Chief Signal Officer, U.S. Signal Corps

Strategic importance of West Coast in maintaining supply lines to Japan is centering attention on that area

● War conscious California has done a job. Closest to our western enemy, manufacturers of the Golden State have produced and are producing a great stream of vitally necessary electronic material that is helping to implement a war that eventually must be fought through supply lines leading largely from the West Coast of the United States across the broad reaches of the Pacific to the home grounds of the Japanese.

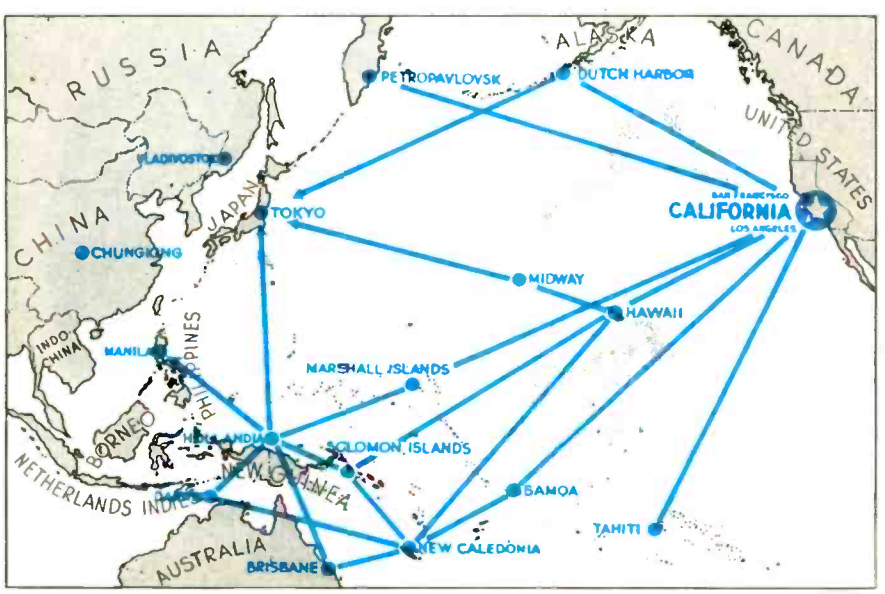
When the European phase of the war has been brought to a successful conclusion, all our effort can be focused on the Pacific battleground, and the strategic position of the West Coast becomes apparent, representing as it does, the last stepping stone to battlegrounds daily being pushed closer to Japan's home bases. With California's fine harbors full of ships heavily laden with war material, we are steadily forging a steel bridge that will lead directly to the enemy's doorstep. The West Coast of the United States naturally becomes the American end of this long supply line.

That the Pacific phase of the war likely will represent a considerably drawn out affair is generally conceded and that the Armed Forces will continue to need vast quantities of electronic equipment is perfectly clear.

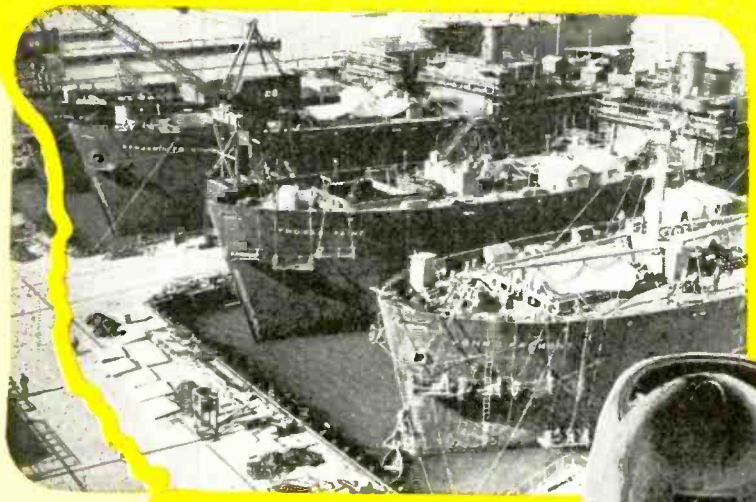
Electronic equipments play an ever-increasing part in the operations of the Armed Forces and the electronic industry is constantly contributing new and improved devices to aid in the defeat of the enemy. Exactly what electronic equipments are being used and what they do must remain untold for the duration, but it can be said that they are used in every aircraft, in every ship and submarine, in tanks, trucks and jeeps, and on the ground. They are used for the protection of our troops as well as for the destruction of the enemy. The mobility of this war with its necessarily long supply lines places growing responsibility on communications and its equipments.

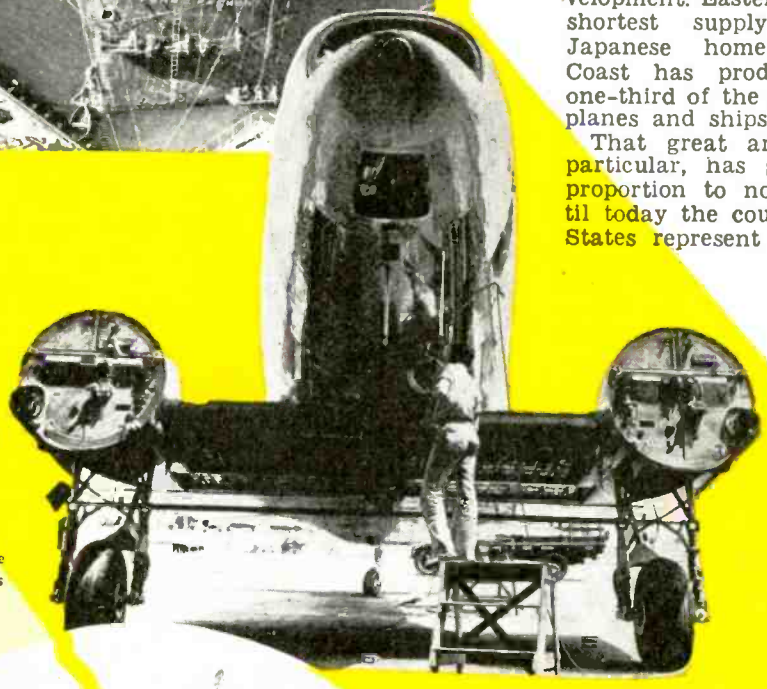
The electronic procurement program of the Armed Forces has been expanding each year and present estimates indicate further expansion next year. California's teeming factories play a substantial part in this vast program and its products range from small radio crystals and components to some of the largest electronic equipments produced.

With California's fine harbors full of ships heavily laden with war materials, we are forging a bridge of steel that will lead directly to the enemy's doorstep. The West Coast of the United States naturally becomes the American end of this long supply line

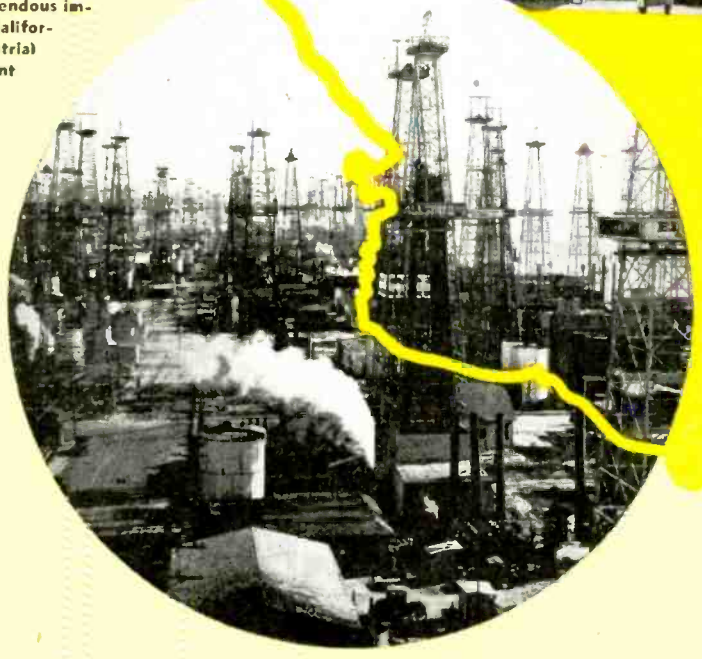


CALIFORNIA PLANS





Supplying in endless streams the sinews of war—ships, oil, airplanes and the vital electronic products without which global warfare would be impossible—has given tremendous impetus to California's industrial development



• War has brought a second gold rush to California. And her electronic industry has grown to the point where it now represents a very substantial part of the industrial development that is serving to focus attention on the Pacific-washed shores of the United States.

It is natural that great production projects should center on the West Coast. California's geographic position, closest to our Asiatic enemies, lends point to such development. Eastern terminal of the shortest supply lines to the Japanese homeland, the West Coast has produced more than one-third of the nation's output of planes and ships.

That great area, California in particular, has grown out of all proportion to normal growth until today the country's 11 Western States represent approximately 15 per cent of the purchasing power of the whole country—with but 10.7 per cent of its population. And with that growth has come similarly war-stimulated expansion of the electronic industry that practically over night has made the West almost, if not quite, virtually self-supporting, an industry complete within itself with a steadily decreasing need to "go outside" for anything.

The Rocky Mountains, great natural barrier, have had an important bearing in influencing California manufacturers to play in their own backyards. But what with the expansion that has marked practically every plant remotely connected with electronic equipment, more than a few have pretty definitely laid plans to invade markets long considered, if not inaccessible, at least undesirable from a competitive point of

HER ELECTRONIC FUTURE

by STANLEY P. McMINN
Managing Editor, Electronic Industries

Golden State factories, natural source for fastest growing and greatest regional market, see bright postwar era

view. For if they are to hold their organizations together they realize, big as the West Coast market unquestionably is, their own backyards are no longer going to be big enough territory. They are cocking business eyes at the national market.

Others, secure in their belief of a tremendous demand for electronic products from South America and the Asiatic countries, China in particular, and visualizing the strategic advantage of their location, look to exports as a logical outlet.

In any case, and despite what qualms they may have for the future, practically to a man, factory executives insist that postwar they will carry on, that they will continue to be manufacturers of electronic products—maybe not exactly the same products, for this, manifestly, would be impossible when demands for strictly war material have slackened to the stopping point—but something electronic, if not a complete unit of some sort, at least a component part.

A goodly percentage of California's plants have been doing just that anyway—producing great quantities of components and subassemblies. Here, as elsewhere, sub-contracting has grown tremendously and in large measure has been responsible for big production. Few are the companies that have not made and are not making something for somebody else.

Hundred factories

At the present time California has just under a hundred factories intimately connected with the production of electronic equipment, parts and components, with perhaps a dozen or so more in what might be termed a fringe group producing such things as hardware, tools and parts not strictly electronic but nevertheless highly necessary and thus important.

By far the majority of plants are relatively small. If you eliminate nine really large plants, of which the largest carries something over 2000 employes on its payroll, with the other eight tapering off to 450 employes, you find that 85 plants employ an average of 90 people. The figure, though is a little misleading for the reason that among the 85 are perhaps a dozen that have in the neighborhood of 300 employes which makes the average figure for the others a bit higher than it should be. Otherwise, personnel for these smaller plants ranges from a minimum of six to a maximum of about 300. The larger plants, previously mentioned, employ in the neighborhood of 8000 people all told, which gives that group an average of around 880 per plant. If you count noses in all the plants, the total comes up to a bit over 15,000, for a grand average of 172 people per plant.

Two-thirds of the state's electronic industry, or some 63 plants, are located in Southern California, due in large part to the factor of favorable climate which simplifies building construction and eliminates heating problems, and in some measure to the aggressive promotion of that part of the state by the Los Angeles Chamber of Commerce. Up North, clustered in and around San Francisco and Oakland, you find the other third. Which gives substance to the claim of the Southern people that the big producers are in or near the City of the Angels. In fact, only a couple of the big producers are up North.

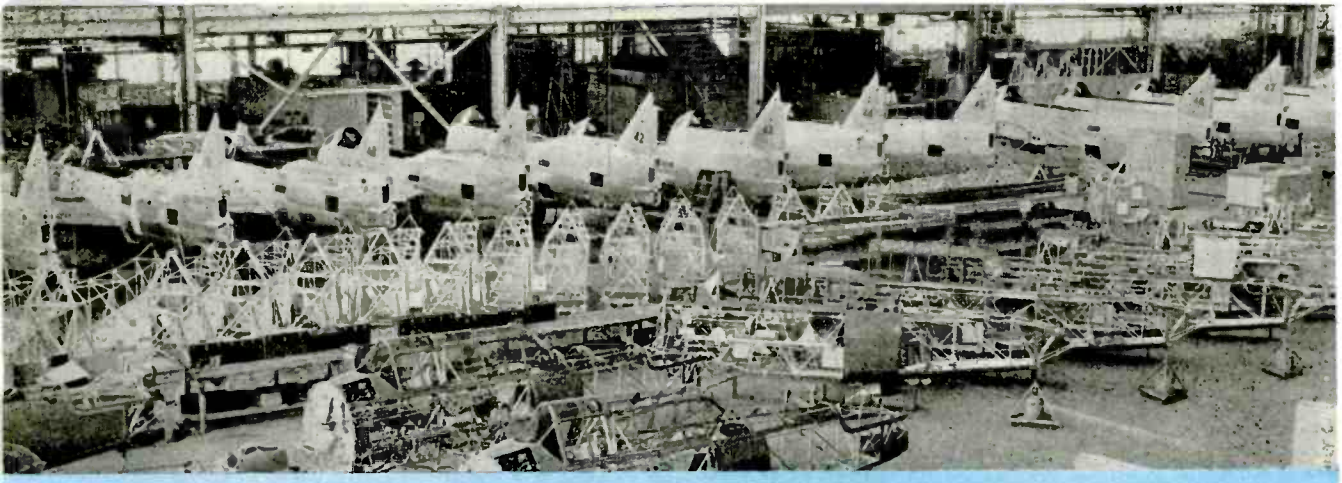
As to who makes what, a study of the Directory which appears in this issue will give a clear picture though no table of statistics can tell the whole story. California manufacturers, for example, have always been short of facilities for the production of some of the common components that are a vital necessity in almost any electronic equipment. This means such things as fixed capacitors, wirewound resistors, electrolytics, sockets. Such things have always had to come from the middle west and the east, and while this has entailed no particular hardship other than occasional delay, Californians have long felt the need for buying such things from "foreigners" to be somewhat of a reflection upon their ability to be truly self-supporting.

Components situation

Now, at least a start has been made at remedying the condition. In fact affairs have improved to the point where one fairly large producer of complete units for the army is able to point with pride to his ability to buy 85 per cent of his

PACIFIC EMPIRE

Occupying more than half the Pacific coastline of the United States, California is a State of solid achievement in industry, of romance in history. Yet few, even among those who live within its borders, have a clear picture of the true greatness California represents as a growing market for electronic products in industry and in homes: as a rapidly developing distributing center; as a science center through its institutions of learning; as an important production center for the armed forces and the vast civilian population for which it is the hub; as a center of engineering achievement: and as a broadcasting empire complete within itself.



ceivers, in addition to a varied assortment of other communication equip-With some heavy bombers carrying several complete transmitters and re industry, which has produced one-third of US planes, becomes apparentment, importance of electronic manufacture to California's aviation

component needs within a few miles of his own factory. Part of such needs, including variable condensers, he has started to make himself, with the ultimate view of supplying other manufacturers as soon as the present urgent need for military equipment eases. Another manufacturer has also taken up production of variable condensers. The same condition prevails with a number of other manufacturers who have gone into production of components for their own use but plan eventually to supply the California market. This goes for oil-filled and paper capacitors, and wire-wound resistors. Thus there is forming the nucleus of a components industry that may in time emancipate California factories.

That there may be even greater need for a close-by source of supply for such parts in the not too far distant future is revealed by the fairly common knowledge that at least three of the larger eastern manufacturers of home radios, looking to the time when they may be permitted to produce for the eye-filling market represented by the 11 Western States, actually have started negotiations looking to the establishment of branch manufacturing plants on the Pacific Coast and in the neighborhood of LA. Another, already established there, is understood to have something on the griddle that when thoroughly cooked up will represent a Western source of supply for one of the bigger Eastern mail order houses.

Potential market

As a matter of sober fact, California and the contiguous territory included in the ten other Western States, represents probably the greatest potential market for home radio sets, and certain other electronic products, in the country. And it is small wonder radio manufacturers are casting sheep's eyes in that general direction.

As friend Al Smith says: "Let's look at the record". In the period of three short years bringing us up to the first of this year, population of the area increased 8.5 per cent, with California heading the parade increase with a boost of 14.8 per cent. This during a period when, due to the transition of many males from civilian to military duties, the population of the United States as a whole, went off by 3.1 per cent.

War work accounts for most of the increase, of course. But even before the great aviation and shipbuilding concerns commenced to recruit labor by the carload there had been a noticeable shift in population from East to West, a shift that has been accelerated by war needs and that has culminated in what has become virtually a great mass migration. And it is all highly paid help, with plenty of money to spend, an insistent yen for brand new radio sets complete with all the gadgets—and no sets to be had, yet.

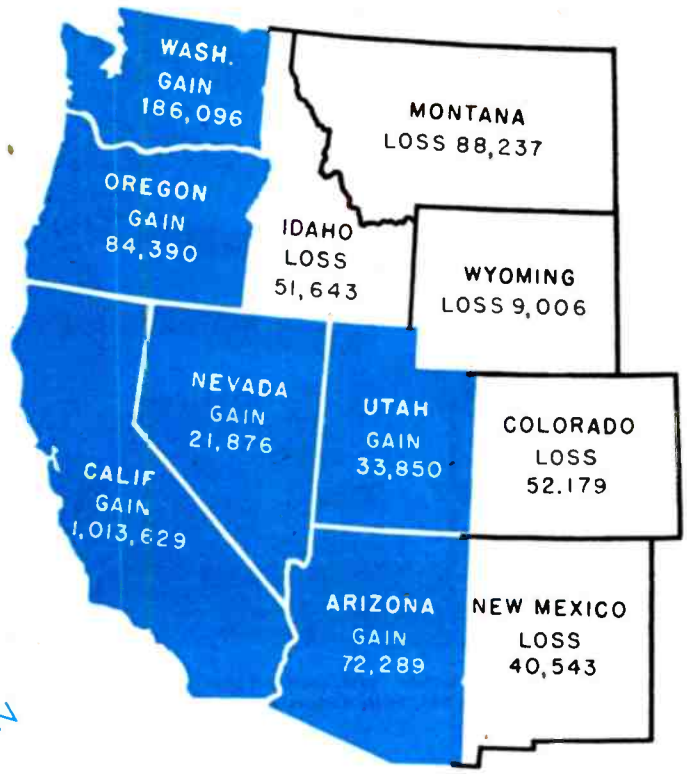
The population of California alone has boomed well over a million, and despite the fact that all the State's people are spread over an area that puts only 49 souls to a square mile (as compared with 275, for example, in New York) the radio set density of the Golden State is higher than any other State in the country—2.37 sets per person. In other words, in the last year before the war, Californians bought more radio sets per family than did the residents of any other State, not omitting New York, Illinois and Pennsylvania with the highly concentrated metropolitan markets represented by New York, Chicago and Philadelphia.

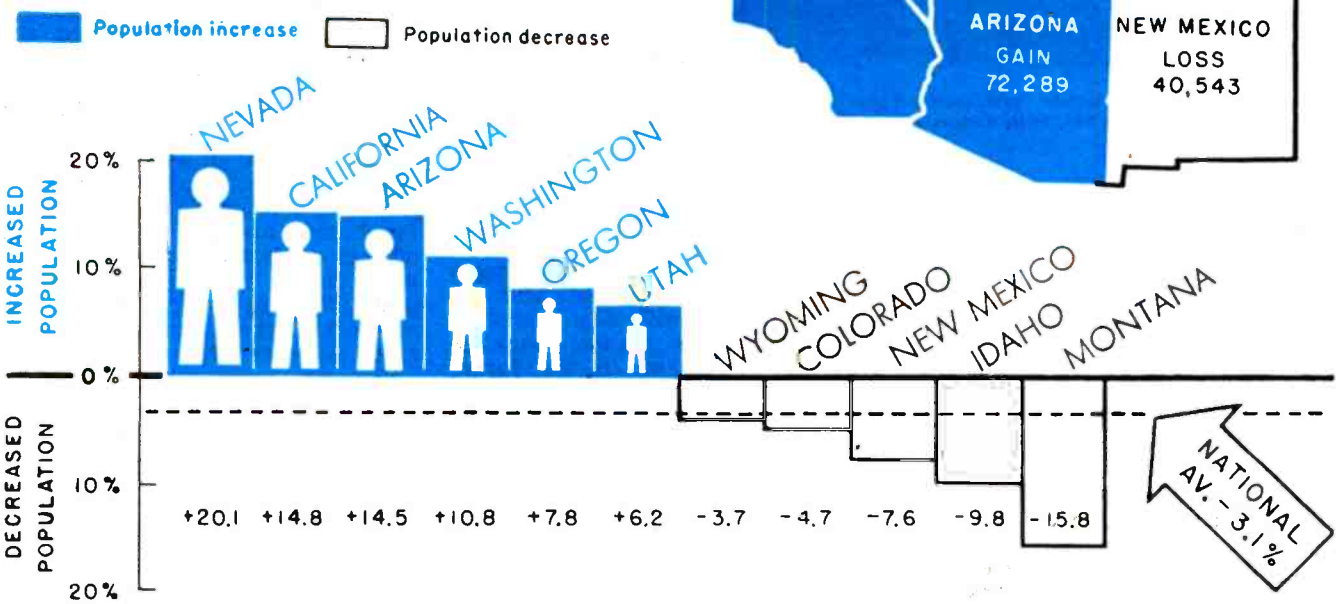
Consider another statistic. Those 11 Western States, with only 10.7 per cent of the total population,

It is in this stage of production that much of the electronic equipment—radio, radar, direction finding, interfones and allied communication and control apparatus—is built into modern fighters and bombers, enough on a 2000-plane raid to exceed total investment in American broadcasting

STATISTICAL PICTURE OF THE WEST

With greater per capita ownership of home radio than any other region in the United States; with more automobiles and telephones, California has forged far ahead of every other state in population increase. More than a million people have crossed the borders of the Golden State in the past four years, highlighting the great growth that has marked most of the eleven Western states and making of that area the greatest potential postwar market in the country.





State	Population	Population Change 1940-1944	Wired Homes	Radio Sets	B C Stations	KW Hours Consumption (000)	Motor Vehicles	Telephones
Arizona	497,068	+14.5%	98,500	177,000	11	855,674,	141,005	78,800
California	7,814,700	+14.8%	2,184,500	3,835,000	59	14,740,557,	2,907,001	2,258,500
Colorado	1,119,274	—4.7%	233,900	584,000	14	953,583,	359,860	262,700
Idaho	524,809	—9.8%	112,500	238,000	7	816,172,	157,106	80,350
Montana	558,270	—15.8%	96,000	236,000	9	1,920,838,	175,227	83,600
Nevada	108,761	+20.1%	26,500	59,000	2	158,351,	50,406	26,400
New Mexico	530,662	—7.6%	61,000	120,000	9	198,486,	115,916	50,260
Oregon	1,088,284	+7.8%	283,700	590,000	22	3,013,383,	417,566	252,600
Utah	549,722	+6.2%	144,100	236,000	8	1,253,647,	154,107	113,000
Washington	1,719,143	+10.8%	522,000	944,000	27	8,058,285,	610,309	415,375
Wyoming	244,745	—3.7%	43,400	118,000	5	153,835,	86,786	43,300
Total	14,755,438	+8.5%	2,813,501	7,137,000	173	32,122,811,	5,175,289	3,714,885
U.S. total	131,329,104		10%	13%	18%	17.3%	15%	14.8%
% of U.S. total	10.7%	—3.1%	28,000,000	59,000,000	947	185,889,261,	32,582,242	26,381,000

Columbia Broadcasting Systems west coast programs, routed to eight affiliated stations in the area and 141, in its nationwide network, originate in these studios

now have some 13 per cent of all the radio sets—yet California, natural source of supply for the area, can lay claim to producing only a picayune 1.5 per cent of the sets the area bought. It is hardly to be wondered that California's manufacturers see a rose tint on the future.

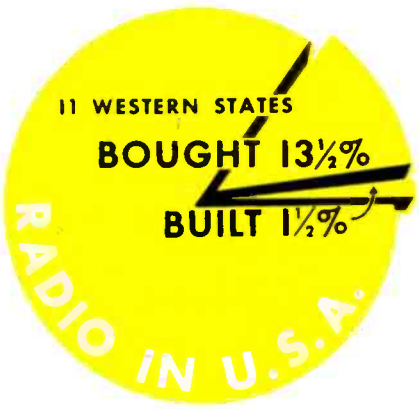
They're on the edge of a tremendous market. The area has well over its quota of motor vehicles and telephones; it has no less than 18 per cent of the broadcasting stations and consumed 17.3 per cent of the total electricity produced in the United States, a large part of that being taken by the aviation and ship building industries, of course. It has its full quota of wired homes, though.

Homes increase

And building construction is on the up. During the years 1939-42, there were 60 per cent more dwelling units constructed in the State of California than there were in New York. California was about equal to New York in 1939, but exceeded that state in residential construction by 44 per cent in 1940. Here are the figures:

	1939	1940	1941	1942
California	51,727	64,850	71,441	43,624
11 Western States	67,653	88,045	98,275	88,042
New York	51,882	45,035	33,189	13,411
United States	342,107	397,468	439,582	264,397

Those new homes represent pretty solid citizenry. They represent people who have settled down and taken root and will stay there, lured as much by the California sunshine, no doubt, as by the opportunity for steady employment at good wages in congenial surrounding and offering advantages to be had nowhere else. And the most of them will stay there. A percentage may wander back to previous homes but if the future of the area is as bright as the promise makes it appear, they won't be leaving because of any difficulty in getting work.



The West boasts the largest per capita radio ownership of any U. S. Regional area

Aside from the great potential market for home radio sets which these 11 Western States represent, a market as immediate and as insistent as civilian production can supply, the long range picture reveals a steadily increasing use of other electronic equipment as industry learns its uses and becomes better educated to the economic advantages of doing electronically many of the things that now are being done by other means. The needs of the war have been a great teacher. The great aviation industry could hardly have grown so quickly to its present proportions without the aid of electronic methods, notably resistance welding, and the dozens of other measuring, testing and inspection technics, many of which the industry has developed itself.

Reconversion no problem

And even though these mammoth plane builders probably will not go on building anywhere near as many ships after the war as they turn out now, at least the plants will be building something and it is logical to expect that electronic methods will play as important a part in other production as they do in aviation. There is a not inconsiderable market, for example, for metal furniture both for homes and for factories and offices; prefabricated houses loom large on the horizon as a postwar possibility and the production line methods of the aviation people are made to order for such projects.

The ship building industry is in much the same boat, to risk a pun. At least one builder has let it be known that railroad gondolas and metal box cars look good to him. Here, again, is an ideal set-up for prefabricated buildings. Undoubtedly some California manufacturers at present up to their ears in production of electronic equipment for the military will turn their talents to the production of household appliances, refrigerators and things, or components thereof. All in all, the picture for the future looks brighter rather than darker and electronic applications will play an important part in all these coming developments.

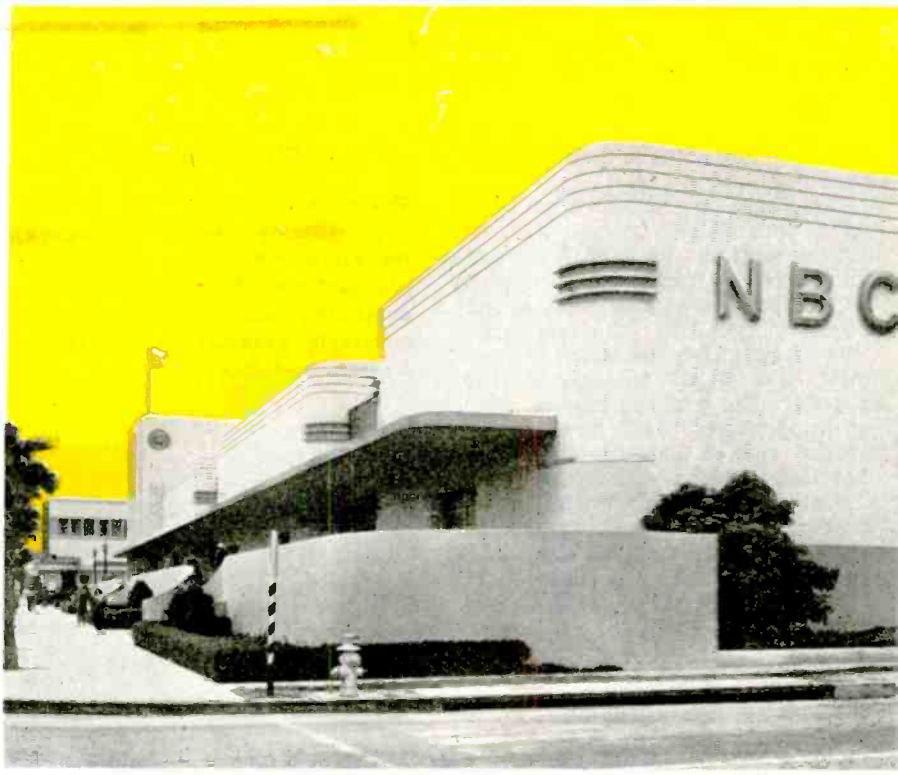
Agriculturally, California is second to none in the production of citrus fruits, yet in that great industry you find practically no application of electronic principles. The orange growers have been experimenting with the use of X-rays for the detection of frost damage and granulation. However, for a year or more they have suffered from neither of these troubles and the equipment has remained dormant. Some use has been made of electric eye equipment for the sizing and grading of fruit.

Similarly, the walnut growers did some experimenting with electric

eye equipment for sorting and grading nut meats, but the application did not turn out as successfully as had been anticipated and the experiment has been abandoned.

The oil industry has used electronic equipment for quite a while to help in the location of probable crude deposits though the market for such apparatus is a quite limited one with the oil companies themselves handling a good bit of the development work. Due to the nature of the work a great deal of experimenting is necessary and this is not conducive to standardization of equipment.

And of course the great motion picture studios, spawned in the California sunshine, are something more than important users of large quantities of electronic equipment and will remain users for many years to come. From the days of the original disk synchronized recordings that heralded the advent of the talkies to today's modern multiple sound track recordings represent a long period of laborious research during the course of which the use of vacuum tubes has multiplied hundreds of times over. That development, of course, is still going on and when current restrictions due to the war effort lift just a little, it is predicted that we'll all be pretty sick of what we have today in the light of what we are going to get.



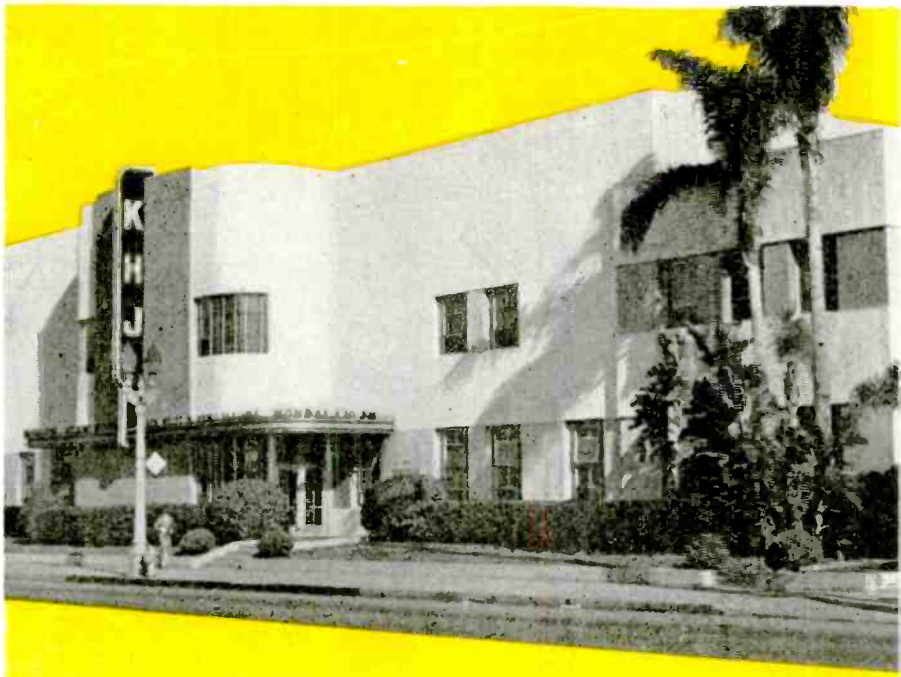
National Broadcasting Company, which has 11 affiliated stations on the west coast, and a total of 145 in its national network occupies this Hollywood headquarters

Television possibilities

The liaison between the motion picture people and the television group has always been close and appears to be growing closer what with the essential need of each learning from the other. Both groups have worked hard and long and enthusiastically toward the solution of mutual problems and the misfortune that the public must suffer in not immediately enjoying the fruits of those labors can only be laid to the need for greater war effort. Engineering has very definitely advanced.

There is considerable interest in television though there are only two transmitters and an estimated 300 receivers. Don Lee operates one of the transmitters but only once in two weeks for hour and a half periods. Television station W6XYZ, owned by Television Productions, Inc., presents 5 hours of live talent a week from a 600-watt transmitter feeding a bi-conical antenna. Boasting the largest studio in the West, W6XYZ is under the direction of Klaus Landsberg who is pioneering in studio and technical methods. A new transmitter and a tower atop Mt. Wilson are planned.

Don Lee also operates the only FM transmitter in California which is regularly transmitting programs. There is another small FM transmitter operated sporadically by one of the institutions of learning, but it is not a commercial factor. Before Pearl Harbor the Don Lee FM station operated 12 hours a week, but since then the schedule has been limited to half that. It is estimated that there may be 10,000 FM receivers in the area served by the transmitter. The aim is to give effective coverage in the area represented by greater Los Angeles which includes all the surrounding towns. The signal from the 1 kw 503A WE transmitter gets into San Diego, roughly 120 miles away, with what is described as good volume though



Station KHJ, in Hollywood, is the key station of the Don Lee network, pioneer West Coast broadcaster and the only one operating AM, FM and Television transmitters

no serious attempt is made to serve that city.

Don Lee has made application for a construction permit covering the installation of a 50 kw transmitter for FM and the equipment will be put to work as soon as may be possible. In the meantime there are other construction permits and it is anticipated that postwar FM will assume a place of importance. Just now the listening public has to depend on AM broadcasting and inasmuch as there are some 59 transmitters in California coverage is quite complete with all four of the large Eastern chains tied into West Coast networks for national broadcasts.

OWI set-up

From an international point of view, California is the natural jumping off point for a considerable amount of the short wave broadcasting that reaches far-flung American outposts and other friendly, as well as not so friendly, listeners. Propaganda has always been one of the major sinews of war and OWI is operating as elaborate a set-up on the West Coast as it is on the East and the California equipment is shortly to become even more formidable.

FIRST HAND

This survey is born of first-hand knowledge. During a period of six weeks the author visited and talked with the principal executives and engineers of practically every factory producing electronic products in the state of California—Editor.

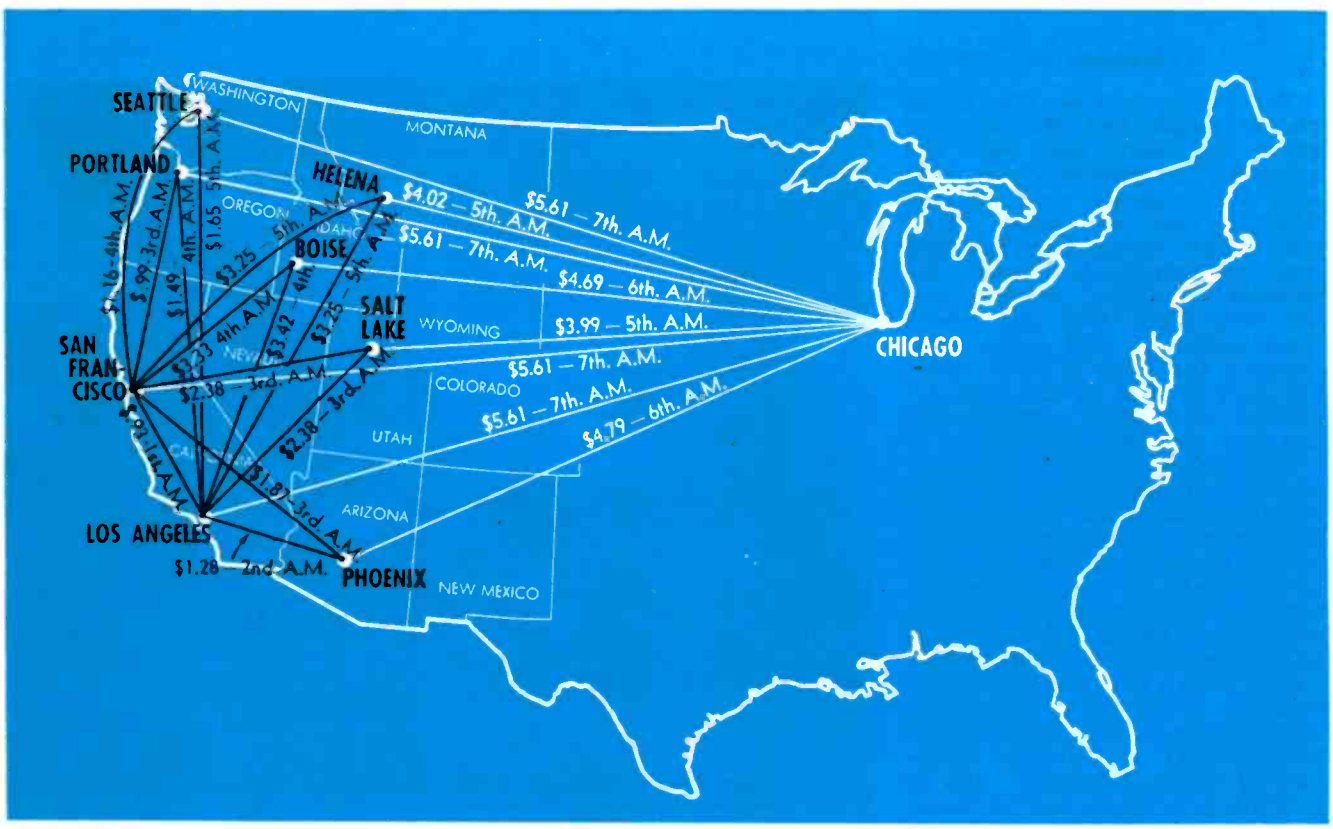
Under contract to OWI and the Coordinator of Inter-American Affairs, Columbia Broadcasting System is soon to open what has been described as the most powerful shortwave transmitter to be operated. It is designed to reach every dot and spot in the Pacific.

To return, just for a moment, to the military, the strategic importance of California and the rest of the West Coast in global warfare, which depends so unquestionably on the maintenance of communication lines, is revealed by a recent Navy release giving some details of its major advanced base for Pacific operations. Hueneme, which is about 80 north of Los Angeles, has capacity for loading eight Liberty ships at one time and is sending across the Pacific more war material than the ports of Los Angeles and San Francisco combined. It has the largest Seabee station on the Pacific Coast, an anti-aircraft school, an amphibious operations training area; more than 40,000 men make up its personnel; it covers some five square miles.

Second gold rush

Yes, war has brought a second gold rush to California. And if those people who so proudly claim their Golden State for home have not found the formula for compounding men, materials and machines into a peacetime prosperity better than any that went before, the aggressive spirit and dynamic drive of Western industrial leaders will seek it out and the chances that they will find it are better than good.

As a manufacturing center California offers definite advantages to both shippers and buyers in the eleven Western States by reason of the shorter distance involved and the saving in time and transportation costs. Chicago, for example, is 5 days ($3.99 per cwt) from Salt Lake whereas from California the rate is $2.38, the time but 3 days with similar savings in time and rate between other points



CALIFORNIA SEES BRIGHT EXPORT FUTURE

by O. C. HANSEN
Frazar & Hansen, San Francisco

O. C. Hansen, managing partner of the firm of Frazar & Hansen, which for more than 100 years has been closely identified with exports

Electronic manufacturers plan big business with "natural" foreign markets and are after their share

• Some indication of the abiding faith business and industrial leaders of the West Coast have in its postwar export possibilities is well exemplified by rapidly maturing plans for the establishment in San Francisco of a great World Trade Center through which it is confidently expected millions of dollars' worth of electronic and other commodities will flow to the growing foreign markets bordering on the Pacific.

Before the war, exports of radio and electronic equipment and parts from the United States had reached the altogether substantial total of over twenty-two million dollars, and although only a very small percentage of this total passed through Pacific ports, manufacturers of electronic apparatus see the possibility of California's share expanding to the point where it could be one-fourth to one-third of the requirements of foreign neighbors.

Thus, to markets which are looked upon as being a "natural" for California, something over seven million dollars' worth of radio-electronic parts and equipment were shipped from United States ports during 1940. The figures follow:

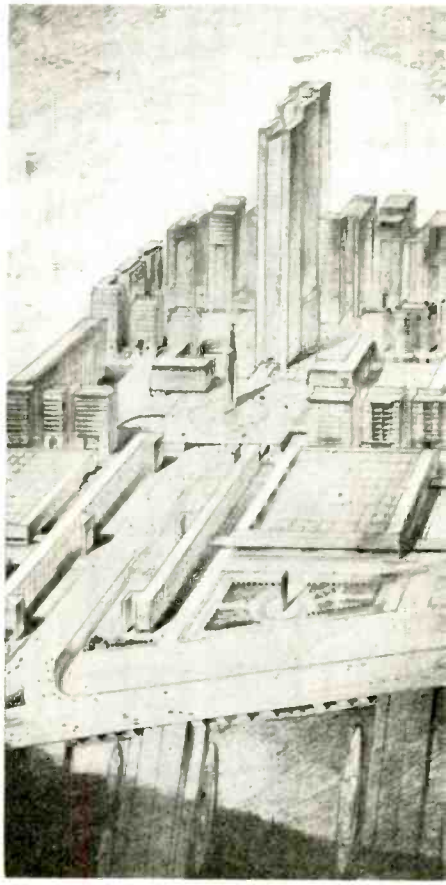
Country	Electronic Imports
British Honduras	$ 30,384
Costa Rica	78,393
El Salvador	42,928
Guatemala	112,863
Honduras	38,314
Nicaragua	44,257
Panama	239,797
Panama Canal Zone	154,411
Mexico	1,990,579
Chile	774,604
Colombia	646,572
Ecuador	202,525
Peru	221,553
British Malaya	118,753
Burma	44,312
Ceylon	8,303
China	417,579
Netherlands Indies	126,319
French Indo China	85,365
Hong Kong	278,926
Japan	23,608
Philippines	648,566
Thailand	113,741
Australia	307,772
British Oceania	939
French Oceania	4,950
New Zealand	299,274
Total	**$7,055,587**

In considering possible postwar operations, Californians see many of these countries which have been important users of electronic equipment as their particular pigeons and they are preparing to go after the business in no desultory fashion. They point out, among other things, that freight rates from California to these destinations are competitive with those from the East.

In the past there has been relatively little actual exporting of manufactures from the Pacific Coast, although there has been plenty of cargo handling as such. Today the picture is changing, due in no considerable extent to the concentration of shipbuilding activities in the area and to the centering of Naval activities around

(*Continued on page 254*)

Looking to an expanding postwar export business, San Francisco businessmen plan this $25,000,000 World Trade Center



EVOLUTION of TANTALUM

by DR. WINFIELD G. WAGENER
Chief Engineer, Heinz & Kaufman, Ltd., South San Francisco

Experimental and research work that have made advantages of the metal for grids and plates in trans

• The introduction of the metal tantalum into transmitting tubes so as to make use of its peculiar gas characteristics was more of a problem than just building tubes with tantalum plates and grids. As frequently happens in development work the good idea does not come free of disadvantages. It is the overcoming of the associated disadvantages that constitutes the problem and puts the challenge to the engineer.

Furthermore in the work and redesigns that accompany the removal or neutralizing of the disadvantages, one often discovers or introduces factors which later prove to be more valuable. Such was the case with the family of tubes which resulted from the introduction of tantalum metal, and which was not to be fully realized until the art of radio communication advanced from its medium frequency status in the middle nineteen twenties to the realm of "very high frequencies", or to the region from 30 to 300 megacycles. These advances are mostly evolutions, i.e., steady growth as the story "unfolds", and represent the contributions of many people. Man-hours of thought, tests, correlations of evidence, are all required.

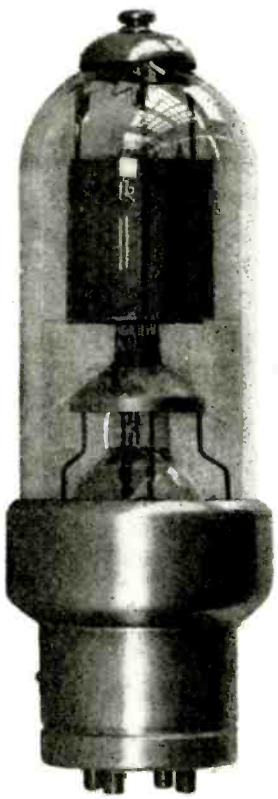


Fig. 1—Early HK-354 Gammatron, one of the first transmitting tubes using tantalum

17 years development

The evolution of the type of tube structure which has of late come to be known as the tantalum-type tube started in 1927. A few facts will indicate that the radio art also at that time had some evolution ahead of it for the next seventeen years. In 1927 a new large broadcasting station consisted of a 15 kw oscillator modulated directly in the plate circuit by nine modulator tubes operating in parallel. In the realm of the now common short waves, the basic investigations of propagation effects on wavelengths as low as 20 meters were being carried out. The total number of receiving tube types was fifteen and a UX112 could be bought for $6.50.

At this time Ralph Heintz first used the newly available metal tantalum in vacuum tubes. It offered a metal which was relatively free of occluded gases and could be completely outgassed easily in a practical length of time on the exhaust pumps. Not only was it capable of being readily cleaned of the occluded gases but it had an affinity for gases thereafter and an ability to absorb and hold such gases as would be destructive to thoriated tungsten filaments. It thus had something definite to offer to the tube industry.

In addition, tantalum offered ready workability, high melting point and low vapor pressure. Against it were a higher price than molybdenum and nickel and the requirement that the structures be capable of being heated uniformly to temperatures of about 3000 deg. F. if one were to take full advantage of its gas characteristics. Fig. 1 illustrates an early transmitting tube design employing tantalum. It was somewhat different from other tubes of the time partly as result of the introduction of the tantalum plate and grid. The possible advantages of the structure were not to be tested until the evolution of the radio art was to make unusual demands on the tubes by going to the higher and higher frequencies, known in those days as the "ultra-high-frequencies".

In order to out-gas tantalum properly the temperature used was far higher than that used to exhaust vacuum tubes employing the standard materials for plate and grids, i.e., nickel and molybdenum. As a consequence it was impossible to use the common insulators placed within the tube to hold the plate, grid, and filament in proper position. At such elevated temperatures

MAGIC METAL

Tantalum is relatively free of occluded gases

Tubes can be outgassed easily in a practical time

The metal has an affinity for and holds gases destructive to thoriated tungsten filaments

Tantalum is readily workable, has high melting point and low vapor pressure

Eliminates the need for any "getter"

possible utilization of the mitting tube structure

all the known insulating materials would decompose and be a continual source of gas and vaporized products which would ruin the vacuum and dirty the otherwise clean glass bulb. In order then to take full advantage of tantalum it was necessary to design a tube which had no internal insulators between the active electrodes.

A second incidental contribution resulting from the proper use of tantalum was that no additional getter material had to be vaporized within the bulb to absorb the small quantities of gases liberated within the tube over the normal life of a power tube. Thus the surfaces of the glass walls, which provide the only insulation between the plate, grid, and filament and their respective leads, were not contaminated with "metallized resistor" areas. These areas do not have to be in contact with the leads to provide trouble at the very high frequencies. The eddy currents on the surfaces of such areas, or the attraction of electrons to such metal surfaces, can produce many damaging effects which are otherwise inexplicable. If the tube doesn't "suck-in" due to the localized heating and softening of the glass in such areas, the tube may merely die prematurely and one isn't sure just what caused the sorrowful demise.

Structural design

Thirdly, in order to support the elements without internal insulators it was necessary to design electrode leads capable of rigidly supporting the electrodes as well as providing electrical connections. The supports to the electrodes had to be short and sturdy. It may not have been appreciated at that time what the full effect of such lower lead inductance would be at frequencies of a hundred megacycles or so. Likewise without internal insulators the electric losses between the electrodes were reduced, which played an important part later at very high frequencies.

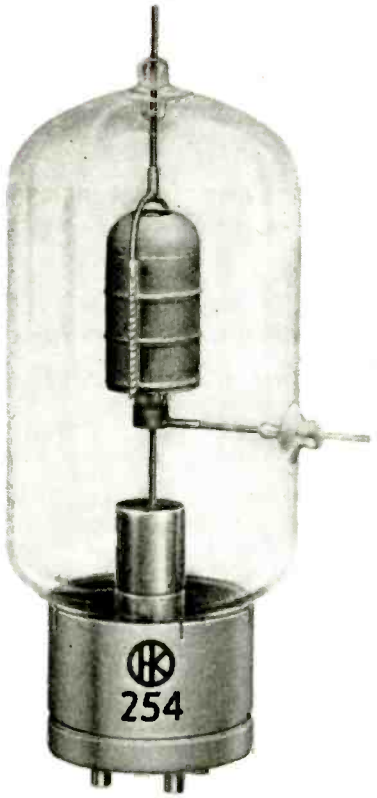


Fig. 2—HK-254, 100-watt tantalum tube

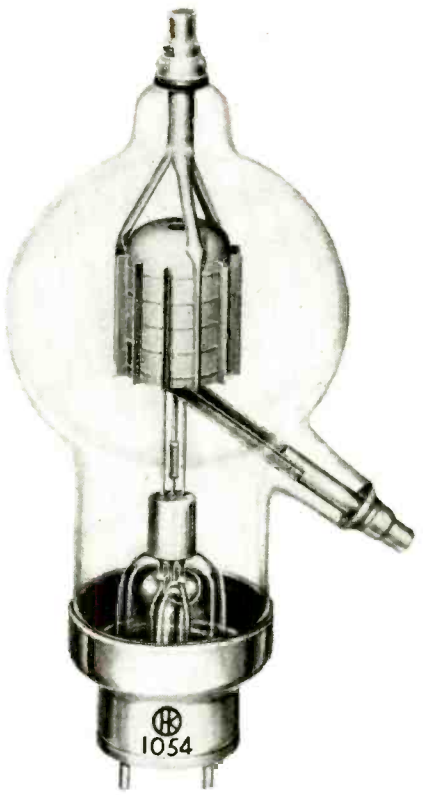


Fig. 3—HK-1054, 750-watt tantalum tube

MODERN TRANSMITTING TRIODES

A fourth advantage was the appeal to the early experimenters at very short waves. Experimenting in regions which are not fully explored, the unexpected is always happening. Also experimenters have a bad habit of crowding the usual safety factors. Both of these resulted in many accidents where the tube had to "take it" when something else couldn't. Because tantalum tubes had been completely outgassed at six to eight times their normal-life ratings, no severe or destructive evolutions of gas would occur, and the tube remained undamaged. Tantalum tubes soon had the enthusiastic support of many advanced experimenters.

It is thus interesting to see that four consequences of the single new idea of using tantalum, which perhaps in themselves were not all present in the mind of the original contributor, were to shape the acceptance of a product in a yet undeveloped field. "Hindsight" having such an unfair perspective over "foresight," it is hardly necessary to review the importance at frequencies between 30 and 300 megacycles of eliminating internal insulators in a power tube structure, of clean clear bulb surfaces, of low inductance leads and low interelectrode losses, and the ability to avoid the evolution of gas during periods of short-time overloads.

Most equipment builders by now are well aware of the amazing losses that can occur in poor insulating material located in high field gradients at very high frequencies. Inside an operating tube these losses are accentuated by the shorter spacings and consequently higher field gradients. Such insulators must operate at elevated temperatures and it is characteristic of insulators to have poorer electrical characteristics at higher temperatures. Also it is difficult to avoid the very slight insulator contaminations which result when the insulators are adjacent to the hot tube electrodes.

Insulator problems

Such "metallized-resistor" deposits again have very destructive consequences. Most engineers by now have seen the results of the run-away, decreasing-resistance-versus-temperature characteristics of insulators at very high frequencies. The faster the resistance is lowered the greater the rate of generation of heat until finally the insulator actually melts and boils if no relief is had.

These features gave the tantalum type tube an upper hand in the early skirmishes at very high

(*Continued on page 242*)

LOW FREQUENCY VTVM

by **CORTLANDT VAN RENSSELAER**
Engineer, Hewlett-Packard Co., Palo Alto, Calif.

New instrument bridges the gap for measurements in range between direct current and audio frequencies

● The spectrum of frequencies between zero and twenty cycles per second presents obstacles to measurement which are not present at higher frequencies or in direct current measurements. Most metering devices do not respond satisfactorily to voltages in this low frequency range.

There are a number of applications for the use and measurement of very low frequency voltages. Wide band amplifiers intended for reproducing pulses of low repetition rate must have response characteristics extending to a few cycles. Audio oscillators which operate down to two cycles per second are available, and one of these in conjunction with a low frequency voltmeter makes an excellent combination for a quantitative determination of amplifier low frequency characteristics.

Vibrations are frequently analyzed with Rochelle salt crystal or magnetic pickup devices which transform mechanical energy into electrical energy, in which state their nature can be more readily determined. When subjected to vibration, large structures often have natural periods in the order of a fraction of a second, resulting in very low frequency voltages from the transforming devices. An instrument for making direct measurements of these voltages is useful.

Several methods are available for measuring very low frequency voltages. One of the more common is the use of the deflection of an oscilloscope for comparing the peak amplitude of the unknown voltage with a standardized dc voltage. Through the use of a direct coupled amplifier in conjunction with the oscilloscope any desired sensitivity can be obtained. The drawback to this procedure is that a fairly elaborate set-up of equipment is required and that a considerable amount of care must be taken in making measurements. There is, however, virtually no limit to the degree of accuracy which can be obtained.

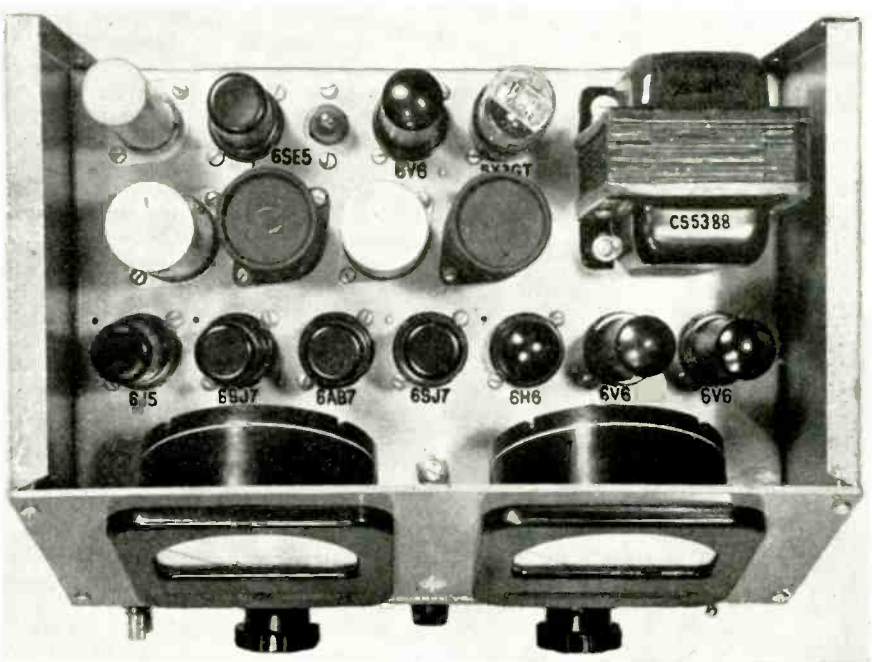
A recording oscillograph can also be used for low frequency measurements. This instrument gives a permanent photographic record of the wave of voltage under test and for this reason allows waveform corrections if such are required. Again a large amount of equipment is required, including photographic darkroom apparatus. Although this type of measurement finds occasional application, it is not generally used because of the complexity of the procedure and the expense of the equipment.

A thermo-couple meter is generally satisfactory for measurements above ten cycles. Below this frequency the meter fluctuations often become objectionable and neither the average nor the peak of the fluctuations represents the true value of the voltage. Rectifier circuits such as are commonly used in vacuum tube voltmeters are equally unsatisfactory. A full wave bridge rectifier circuit using a standard one milliampere meter is difficult to use below fifteen cycles as a result of meter fluctuation.

Diode voltmeters, which find considerable use at audio and radio frequencies, are unsatisfactory at low frequencies because of the large time constant required in the rectifier load. As an example, a voltmeter of this type intended for use at one cycle per second may require several minutes to attain a final reading.

A modified form of the slide-back voltmeter is particularly well suited for measurement of voltages in the range between one cycle and several hundred kilocycles. This arrangement, known as a plate-rectifier slide-back vacuum tube voltmeter uses the cut-off point of a

Looking down on the chassis showing the tube arrangement of the instrument which is described as a plate rectifier slide-back vacuum tube voltmeter



tube to indicate the equality in magnitude between an applied voltage and a known voltage. A circuit of such a voltmeter is shown in Fig. 1. The input voltage is applied to a sharp cut-off triode, T_1, through an RC network, R_1, C_1. The dc voltage is divided with a network, R_4, R_5, R_3 and C_3, to provide a fixed bias for the tube and a variable voltage for comparison. Condenser C_3 maintains the plate at ac ground potential. The comparison voltage is measured with V_1, while the cut-off of plate current is indicated by a high impedance voltmeter, V_2, connected across the cathode load impedance, R_2, C_2.

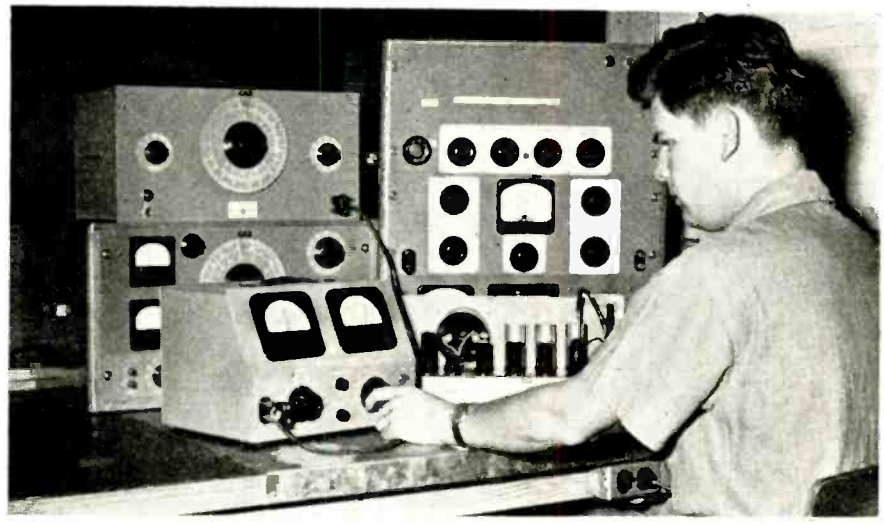
The operation of the circuit is explained graphically by Fig. 2. The transfer characteristic of the tube for the applied plate potential is plotted. As a result of the blocking condenser, C_1, the applied voltage centers about the total bias voltage E_t, which is the sum of E_4, the initial bias voltage, and E_5, the comparison voltage. When the bias voltages are properly adjusted, the input voltage drives the grid just into the plate current region at the positive peak of each cycle.

Calibration method

The transfer characteristic suffers a considerable curvature very near cut-off. Since the sensitivity of the cut-off indication is in proportion to the slope of this curve, it is more satisfactory to use a small reference value of current for the end-point, than the actual cut-off point of the tube. For this reason the plate current meter is calibrated with two lines, one to indicate cut-off and the other the reference value of current. At extremely low frequencies and with proper circuit adjustment the plate current meter pulsates between these lines during each cycle. At higher frequencies, the condenser shunting the voltmeter input remains charged during the cycle and there is a continuous reading.

The voltmeter is calibrated with the initial bias setting resistor, R_5. With no applied voltage and with the comparison voltage at zero, the initial bias is adjusted so that the reference value of plate current flows. Then applied input voltages are properly related to the comparison voltage, E_1.

The plate current meter, V_2, is a vacuum tube voltmeter using two tubes in a balanced bridge circuit. The tube grids are connected to opposite ends of the cathode resistor and a milliameter is connected between the plates. The circuit is similar to that used in many of the popular make volt-ohmeters. The sensitivity obtained with this arrangement is 0.5 microampere per 1/8 in. division.



General view of the low frequency voltmeter (instrument with sloping panel) in use for the measurement of the low frequency characteristics of an amplifier

When an input voltage in excess of the comparison bias voltage is applied to the voltmeter, a relatively large plate current will flow. This seriously overloads the plate current metering circuit and as a protection to the milliameter a limiter is used. This consists of a 6H6 biased rectifier connected across the voltmeter input to limit the input voltage to the value which gives full scale deflection of the meter.

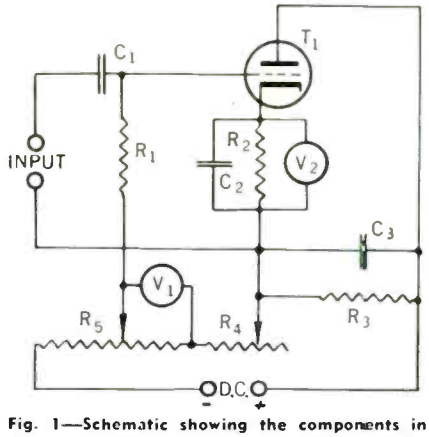


Fig. 1—Schematic showing the components in the vacuum tube voltmeter for low frequencies

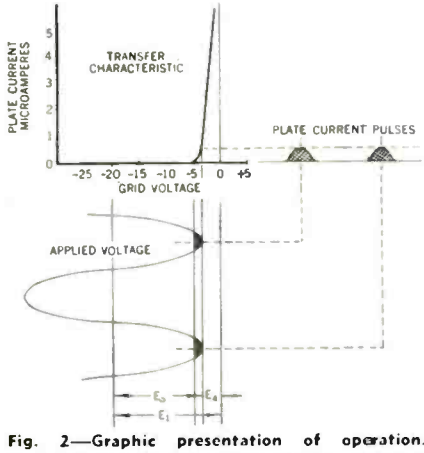


Fig. 2—Graphic presentation of operation. Transfer characteristic of the tube for the applied plate potential is plotted

Voltmeters of the plate-rectifier slide-back type have a non-linear indication characteristic with applied voltage. The magnitude of the error involved is inversely proportional to the applied voltage and depends upon the kind of cathode and the sharpness of cut-off of the rectifier tube. In the practical form of the voltmeter described here, the error is in the order of several per cent at very low voltages, but this is compensated for in the calibration of the comparison voltmeter.

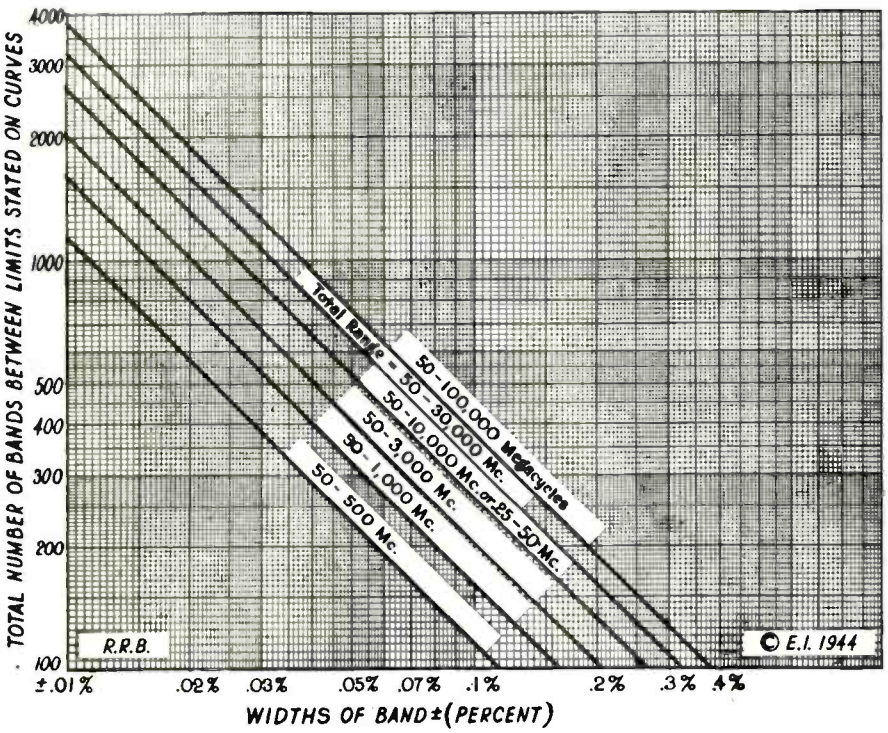
With proper adjustment of the calibrating voltage, E_5, the accuracy of this circuit over a wide range of frequencies is entirely dependent upon the calibration of the reference voltmeter and the ability of the operator to adjust for the reference plate current.

At frequencies below ten cycles, where pulsation of the indicating meter occurs, there is some error introduced in the reading due to the dynamic stability of the meter. This effect becomes progressively worse as the frequency is lowered, but it has been found that with a spacing between the calibration lines of one-eighth inch the error is a maximum of one per cent at one cycle. The reference voltmeter calibration can be held to one per cent of full scale value so that a maximum circuit error of two per cent is the tolerance.

This meter measures the peak value of the wave, although the calibration is in terms of the rms value of a sine wave. It is therefore subject to the same waveform errors and "turn over" effects as is any peak reading meter. However, in many applications these effects are not of considerable importance.

(*Continued on page* 232)

SPECTRUM DIVISION



Showing number of useful communication channels which become available when the width of the band is limited to various percentages of the fundamental frequency

• It is difficult to keep track of the many communication services that have asked for channels in the communication spectrum. In the transportation industry alone, when the air, sea and land facilities are considered, the future services (those in use and those being considered) run into thousands of channels. The fact that Nature is kind, at times, is shown here, where the area of coverage for at least part of the available spectrum is quite limited. Local services can thus operate on frequencies giving adequate local coverage but which do not extend out so as to prevent other localities using the same frequencies.

It may have appeared to many that there are a practically inexhaustible number of bands in this uhf spectrum barrel. Such views are based on dividing up 100 megacycles, or 1,000 megacycles or even 100,000 megacycles into normal 10 kc bands!

Actually, as has been pointed out repeatedly, the useful sideband frequencies that carry the information are relatively narrow and are lost when variations due to temperature drift, or those with voltage, humidity, aging, etc., are considered (except with television). Such shifts may be many megacycles in some parts of the range, from some normally trivial effect.

Again, there is but little known as to the production of tuning controls that will give repeatable settings, so that one can tune in, at will, the useful part of any 10 kc band to, say, 500 or 1,000 mc or higher. Most of these drift variations are found to follow a percentage law, since inductive and capacitive shifts in the circuit represent a percentage change in frequency—at 1,000 mc the drift will be twice that at 500 mc with equal design precision.

A frequency-stable circuit (in the parts of the radio spectrum where greatest prewar experience in design exists) with a 0.01 per cent frequency drift at normal frequencies, represents excellent design, especially if precise laboratory operating conditions need not be provided. The drift encountered under the normal conditions of a portable transceiver are indeed much larger than this. In many services it is necessary to add the probable shift in both receiver and transmitter to arrive at the actual interference band.

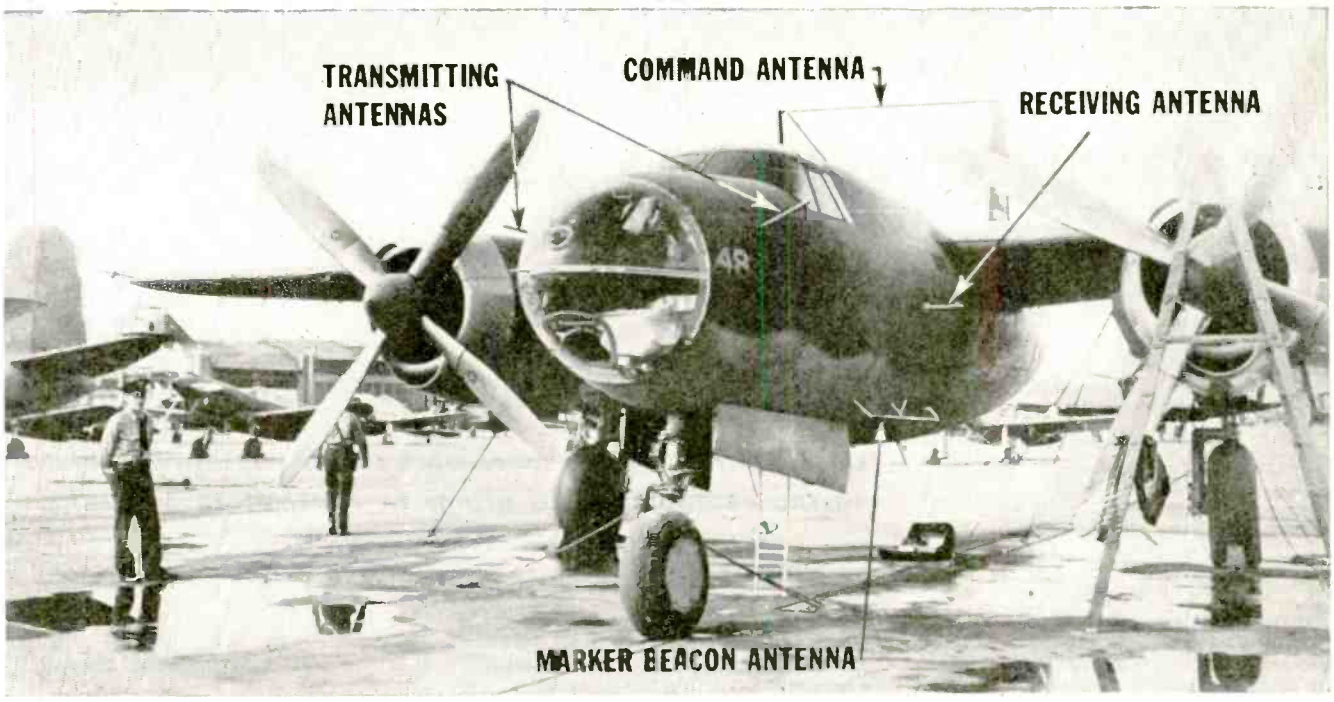
Bands available

With these rules in mind it is possible to plot curves that show how many operating bands are actually available in any part of the radio wave spectrum. The curves herewith, showing these relations, indicate that there are relatively few usable bands actually available. On this basis it is seen that the use of bands between 50 and 30,000 megacycles, would only double the number now available between 250 kc and 50 megacycles, if the same circuit stability can be maintained in both ranges!

Developments tending toward extending the range upward will of course have some effect, but permitting the narrowing of the bands by improving stability, ease of tuning, repeatability of settings, etc., will do more. This points out an interesting method of attack toward the most effective utilization of all the spectrum, and one to which all engineers can contribute.

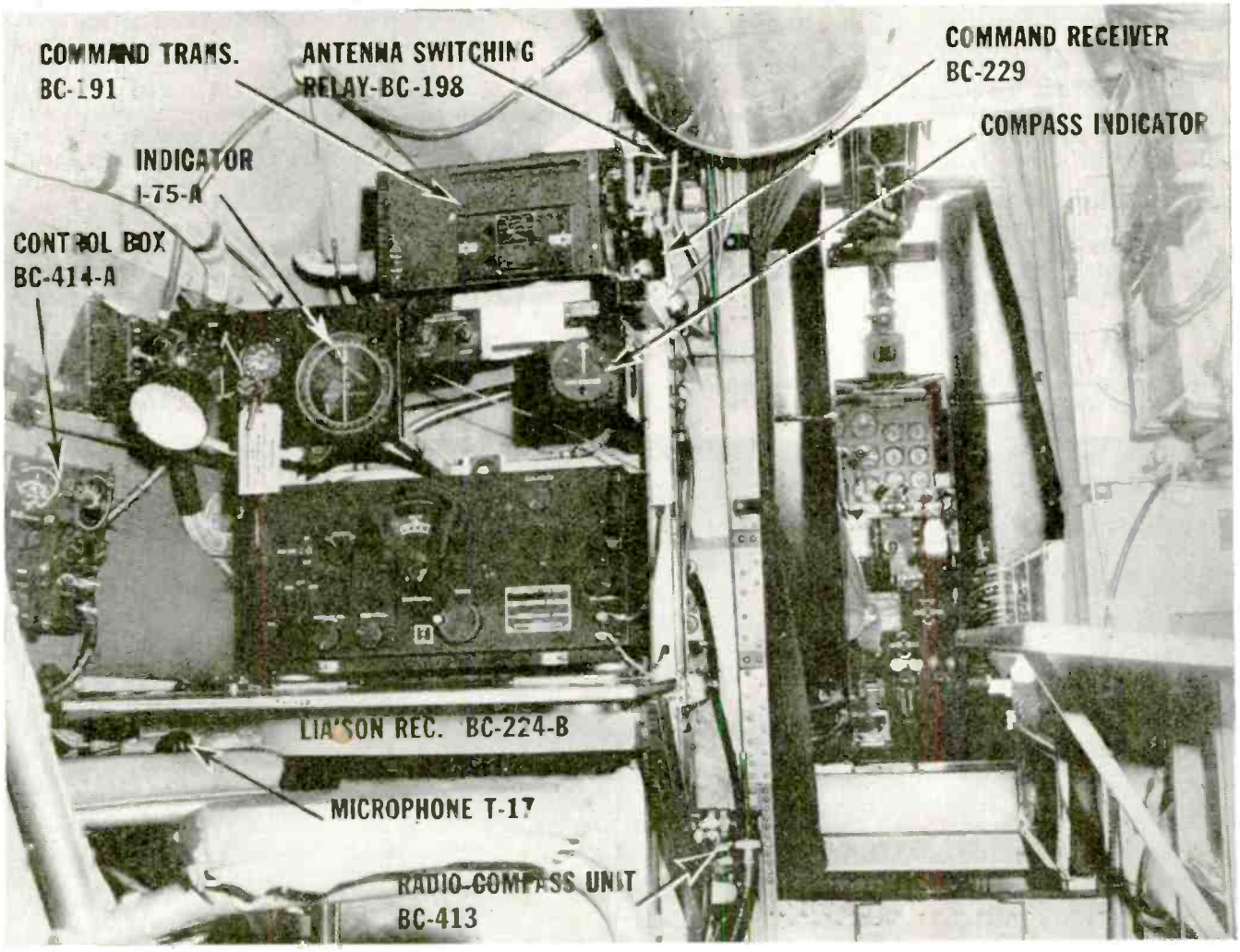
INCREASING THE NUMBER OF CHANNELS AVAILABLE

Dividing the spectrum into bands having equal sideband-to-fundamental percentages, instead of into bands with equal frequency width, greatly reduces the number of bands available. Difficulties in finding and maintaining communication within bands established in accordance with intelligence considerations will probably make the second method impractical until greater circuit precision is attained. The latter becomes a major engineering problem, to permit greater utilization of newly extended ranges.



RADIO ON BOMBERS

These previously unpublished photographs, made at the Aircraft Radio Laboratories, Wright Field, Ohio, show (Above) the arrangement of the various types of antennas used for specific purposes on the Army's B-26 low altitude bomber. The lower picture, of the radio operator's position in a Marauder bomber, shows the compact installation of command and liaison transmitters (SCR-283) and receivers (SCR-287A) and radio compass units. The photographs were especially released for Electronic Industries



LIGHT SPECTRA ANALYSIS

by **C. A. VAILE**
Applied Research Laboratories, Glendale, Calif.

Methods of using the spectrograph for rapidly determining the composition of alloys in controlling production

• Many recent magazine articles have tended to glamorize the spectrograph by extolling the ease and rapidity with which analytical work can be done by its use. This probably reached its climax in a recent advertisement which listed a spectrograph for sale at $15 and stated that it would give the chemical composition of any material in a few minutes' time. The spectrograph is doing a marvelous job for industry but not before much time has been spent on the analytical method to be used in a particular laboratory and at least five hundred times the $15 has been spent for equipment.

The instrument lends itself particularly well to routine analysis where small cast samples of alloys can be taken from furnaces and analyzed for trace elements and percentage composition. As many as four thousand elementary analyses may be made in a twenty-four-hour day with one instrument in a well established laboratory. This would require three or four operators on a shift, only one of whom need be technically trained. In general, the analysis could be made within an hour after the sample is received. Where necessary, a single sample can be analyzed in ten minutes. The accuracy of the work is usually within three per cent of the quantity being measured. The same number of analyses, if done by wet analysis methods, would require approximately four times the personnel, many of whom would have to be technically trained, and some of the results would not be available until the next day.

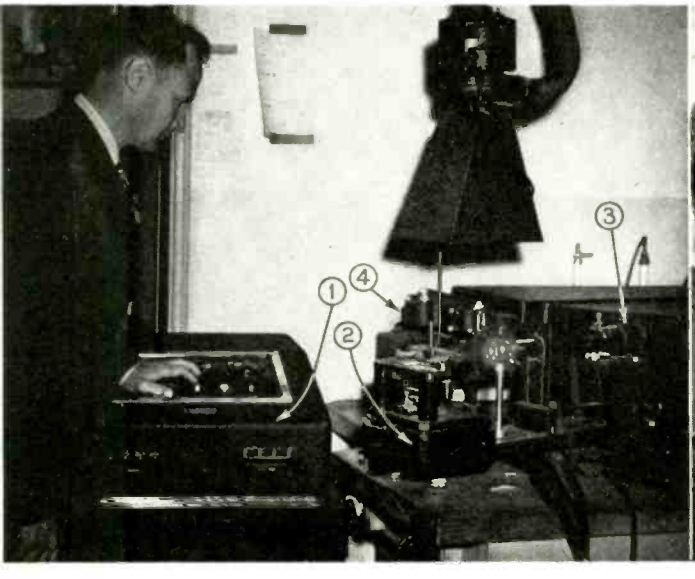
Identifying raw materials

In laboratories where the work is more varied, routine methods may be set up for the more common problems in quantitative analysis and a qualitative analysis may be made quite rapidly by an experienced spectrographer. This is of great help to the chemist before starting on a complete chemical analysis.

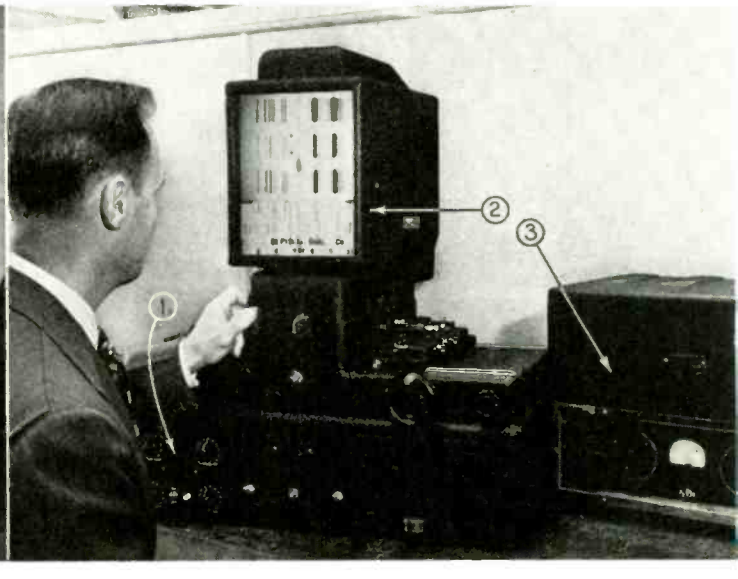
Often it is necessary to identify castings or raw materials. Sorting of large stocks which have become mixed, such as pure copper spot welding electrodes from those containing beryllium, and steel stock from which the color code has been removed, can be rapidly and accurately done by means of the spectrograph.

In the West, the analysis of ores is of great importance. This presents special problems to the spectrographer. The nature of the base material, the interfering lines of many elements, the mixture of volatile and refractory substances and the effect of the presence of certain elements on others, all tend to complicate this type of analysis so that results are not as uniformly accurate as they are in the case of pure metal alloys. However, with new methods and better equipment, rapid progress is being made.

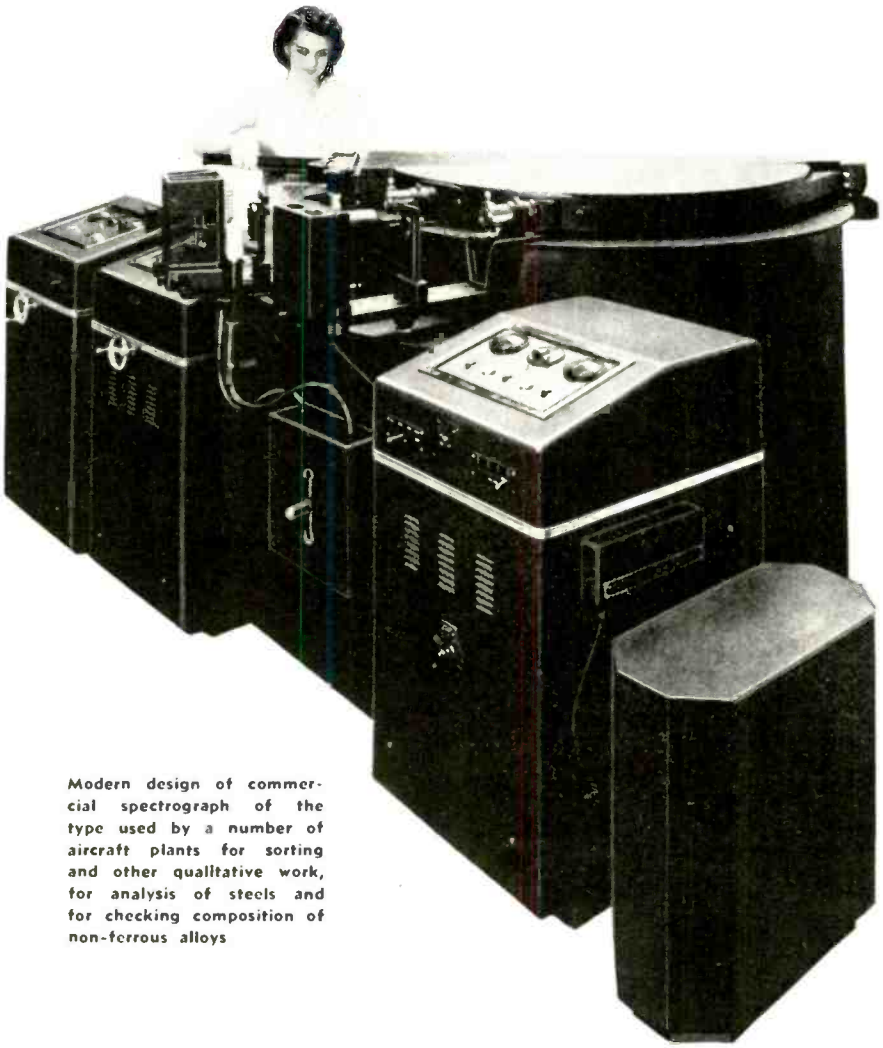
Exposing the spectrogram: 1—High voltage excitation unit; 2—sample and excitation stand; 3—primary slit; 4—camera



Viewing the spectrogram: 1—Densitometer amplifier; 2—projection comparator with master plate at bottom of screen; 3—voltage regulator



The remarkable industrial development on the West Coast due to the World War has resulted in a corresponding increase in the use of spectrographic equipment in this area. Seven aircraft plants use this method for sorting and other qualitative work, for analysis of steels and for checking the composition of non-ferrous alloys. Eight aluminum plants use it for control analysis and alloy determinations. Two steel plants run partial analysis on all types of material from crude ore to finished products. Three Navy yards have a wide variety of problems in handling inspection requirements. Several government agencies and private mining companies use it for ore analysis. Over a dozen colleges and universities have spectrographic equipment for research and instructional purposes. The list could be expanded to include magnesium plants, non-ferrous foundries, police departments, water companies and many commercial laboratories.



Modern design of commercial spectrograph of the type used by a number of aircraft plants for sorting and other qualitative work, for analysis of steels and for checking composition of non-ferrous alloys

Emission spectra theory

The West Coast also contains one of the best equipped research laboratories specializing in the development and manufacture of this type of equipment. Both methods and equipment are constantly being improved as a result of this research work. During the past two years more densitometers, source units and original gratings have been produced here than by all other manufacturers of such equipment. Other research laboratories include those working on agricultural, metallurgical, petroleum and secret problems.

The spectrograph may be defined as an instrument for producing and photographing light spectra. The spectrogram recorded on the film is a series of line images of the primary slit of the instrument. The light falling on this slit is dispersed and brought to a focus so that the component waves are arranged in order of their wavelength. In practice, the sample to be analyzed is made to give off energy in the form of light through the electronic bombardment of its atoms in the presence of some type of electrical discharge, usually an arc or spark. A brief discussion of the theory of emission spectra and its application to quantitative analysis will make the reader more familiar with the operation of the instrument and the problems connected with it.

In accordance with Bohrs' theory of atomic structure, when the electrons which are rotating around the nucleus of an atom are displaced from their orbit through bombardment, they absorb a certain amount of energy. As they return to their original position, or to other lower energy levels, this energy is released in the form of light. The light is monochromatic and always of the same wavelength when originating from the same element and the same displacement of the electron.

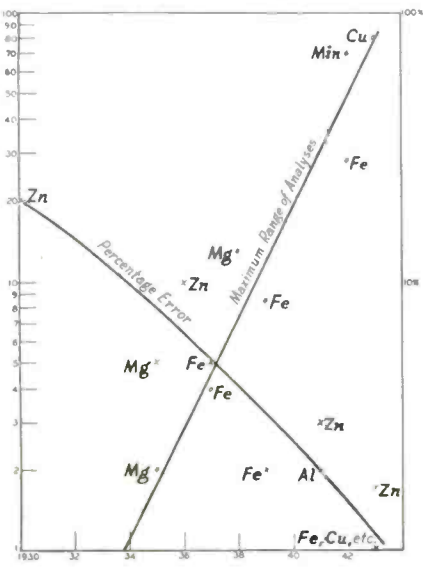
As these electrons are displaced further from the center, or as the electrons in other orbits are displaced, they may come back to the original energy level or may stop at intermediate energy levels. The wavelength of the light will change for the orbit from which the electron comes and also for the energy level to which it returns.

Thus, a great many lines of varying wavelengths may be expected from the elements having a large number of electrons in their outer orbits. The important point to bear in mind is that the wavelengths of lines are always constant for the same element and the same electronic displacement.

The intensity of the spectral lines produced by constant excitation will be in proportion to the number of atoms present. Because the absolute level of intensity cannot be kept uniform in the discharge, it is necessary to establish an internal standard upon which to base the relative intensity of the discharge. This is done by using some element present which does not vary, or which is present in large amounts.

(*Continued on page* 220)

Increases made in quantities measured, and reduction in error by spectrographic analysis

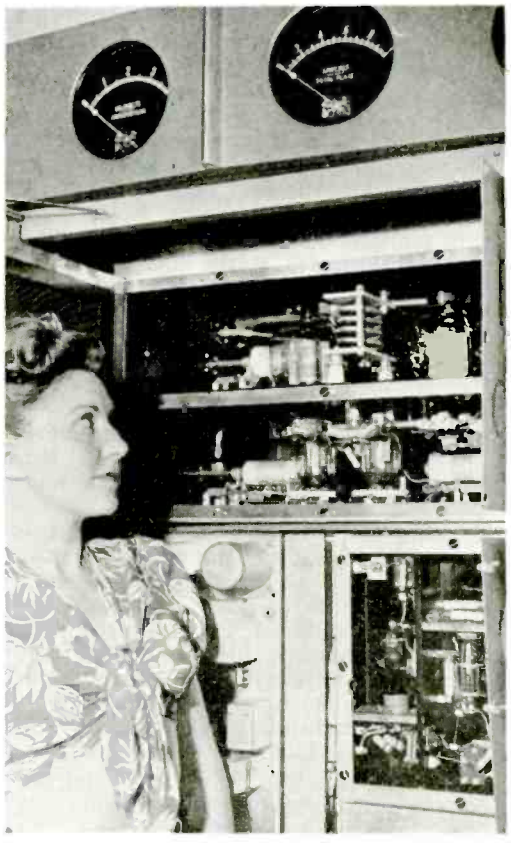


PIONEER WEST COAST NET

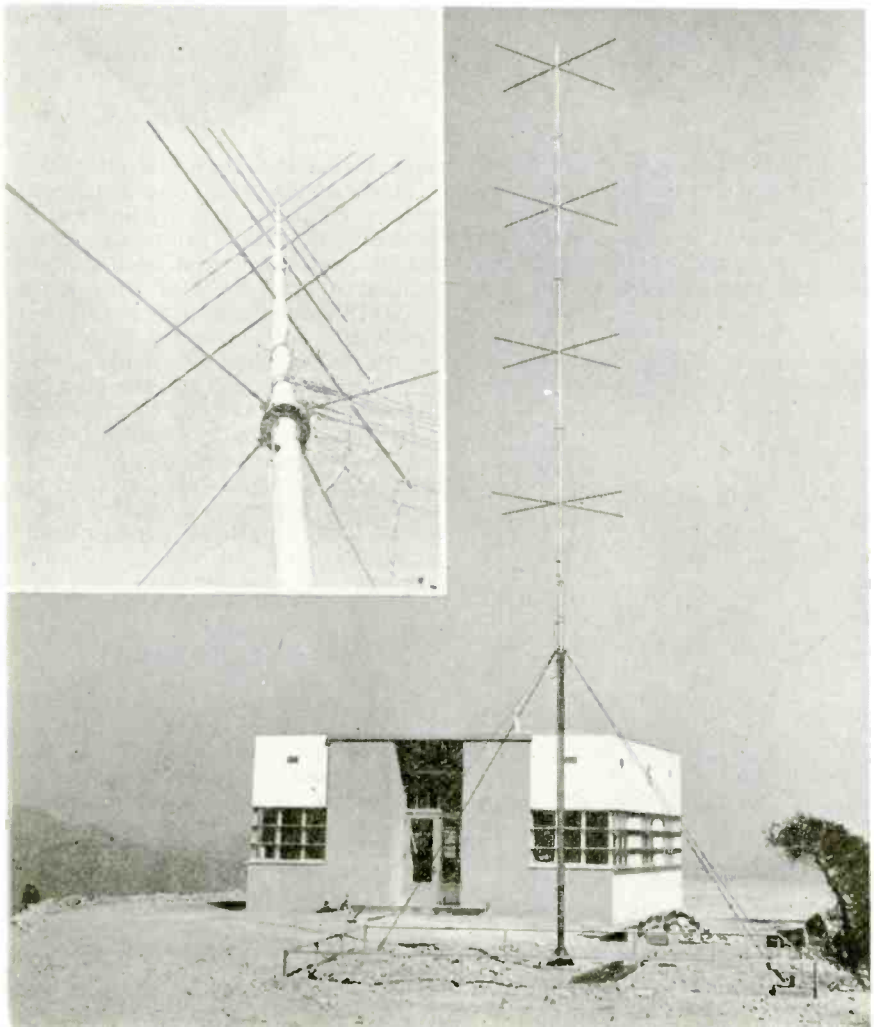
Don Lee, only California broadcaster to operate both in addition to AM, links 36 transmitters in greatest

• Phenomenal growth, characteristic of practically everything bearing a California label, is no more in evidence than it is in the case of the Don Lee Broadcasting System. And it is still growing. At the time this was written, middle of April, the network had joined together some 34 stations in California, Washington and Oregon, not to mention links to Hawaii and Alaska. Since then, two more stations have been gathered into the fold, making a total of 36, and leaving no room for doubt that the chain is the largest regional network in the United States. In addition, the organization owns and operates the only FM station on the Pacific Coast and the only television station in all of the 11 Western states.

Don Lee is a pioneer in all three broadcasting fields. When the organization in the late 20's took over KHJ, its key station in Los Angeles, it became the owner of the first broadcasting station to operate in that southern California metropolis. Almost immediately the chain began to grow, and at the time it became affiliated with Mutual in 1937 had linked together eight stations which became the nucleus of the present Pacific empire. Six years before that, on December 23, 1931, W6XAO, the Don Lee television station, had gone on the air,



Looking into W.E. 1 kw FM transmitter; final on top shelf; multipliers below



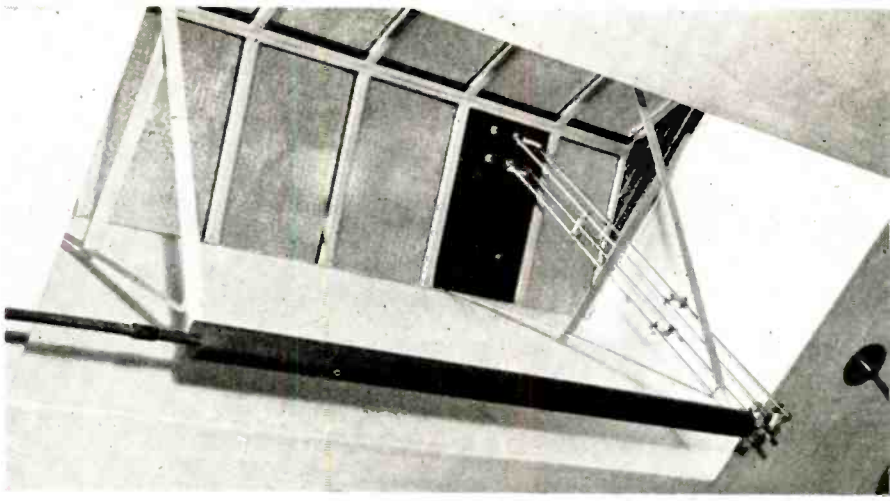
Temporary 4-bay turnstile used by KHJ-FM is ¼-wavelength brass tubing, grounded, shunt fed with 250-ohm line. Inset shows the three transmission line matching stubs

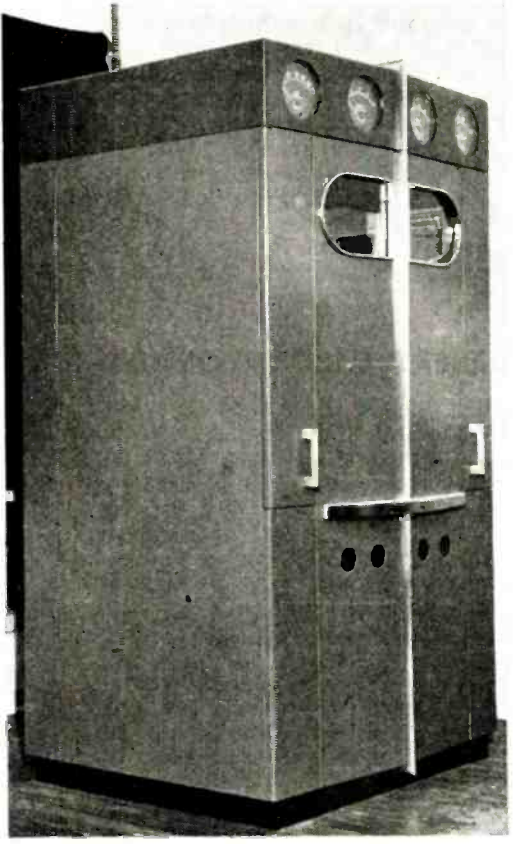
following a previous period of six years of research and experiment. And in August, 1941, the FM station first started broadcasting.

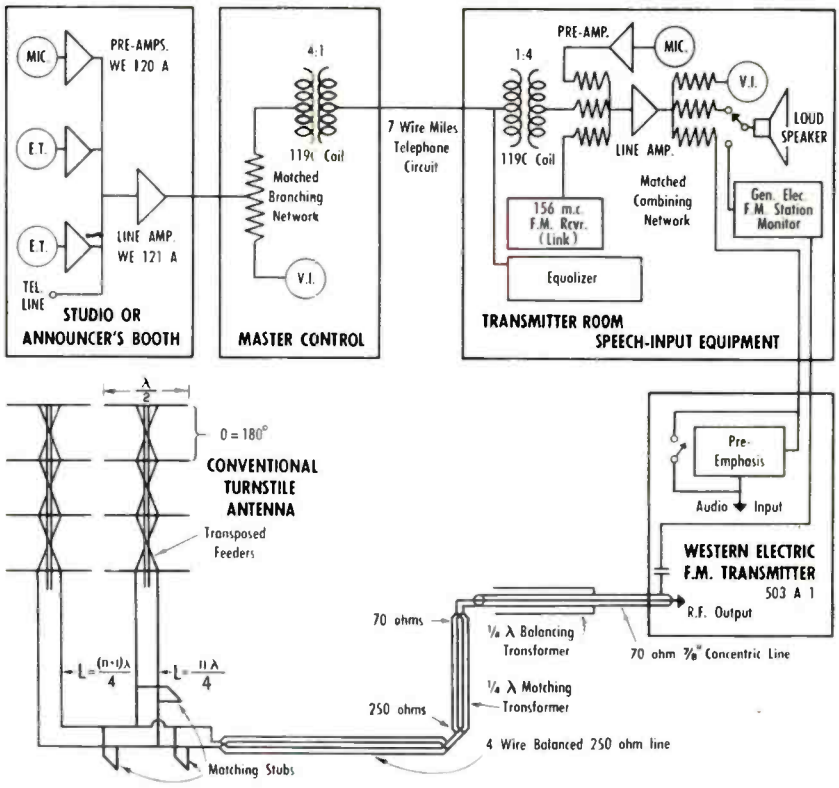
From an engineering point of view, organization of the network and its development have been influenced very largely by the topographical formation of the territory to be covered. With practically every community of any size in the area ringed around by mountains, local coverage has been attained by linking together transmitters within those mountain-screened communities. Coverage

WORK

FM and television regional group







The model 503A Western Electric FM transmitter feeds antenna through coaxial line

Photograph above shows arrangement of the 7/8-in. coaxial line, the 1/4-wave balancing transformer, the 1/4-wave matching transformer, and start of the 250-ohm line shown schematically

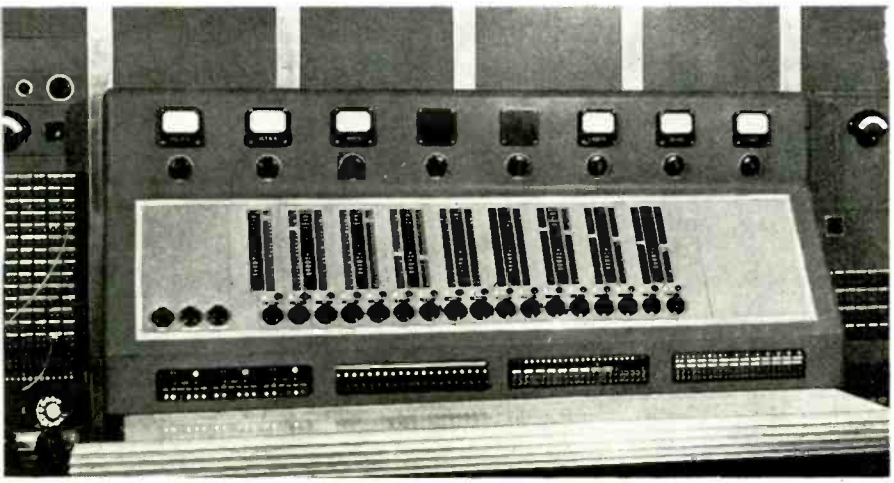
from within, it is called. In consequence, the network can boast, and does, that more than nine of every ten radio families on the Pacific Coast live within 25 miles of one of its stations.

Individual transmitters vary in power from little fellows of 100 watts such as KXO in El Centro, and 250 watts such as KFRE in Fresno and KMYC in Marysville, up to 5 kw, which is the power rating for KHJ in Los Angeles and KFRC in San Francisco. Within California itself there are 16 transmitters in the network; there are six in Oregon and 12 in Washington. In addition, there are links to KGMB in Honolulu, KHBC in Hilo, and KGBU in Ketchikan, Alaska. Altogether the complete network is calculated to reach considerably over four million radio families.

KHJ, the Don Lee key station, has always specialized in remote pickups. Prewar this meant from the decks of battleships anywhere within the area, from Flying Fortresses somewhere over the territory, from submarines, shipbuilding yards, industrial organizations and wherever there was something going on that gave promise of being good programming. Today it means important sport events and gatherings of other kinds that have news or entertainment value to the listening public.

Such a program has required development of no little paraphernalia. Included are three 100-watt portable transmitters operating in the 1600 to 2900 kc band which may be rushed by truck to any location promising good program material; another 100-watter operates in the 31 to 40 mc band, and is supplemented by an 8-watt pack transmitter; in addition there are three uhf transmitters varying in power from 2 to 8 watts that are used on occasion for remote location to studio links. There is thus available a wide variety of equipment that can be used to insure proper coverage of almost any sort of a function anywhere.

The FM equipment at present in use, consisting of a Western Electric model 503A 1 kw transmitter, is temporary and eventually will be superseded by a new transmitter rated at 50 kw for which a con-



In the KHJ master control room there are 17 separate switching systems which can be individually controlled or as many as desired group switched by a master button. The board is used to route programs north, south and east to the Don Lee network, and east to Mutual

struction permit has been filed. In the meantime and in order to get sufficient elevation to nullify as effectively as possible the screening effect of the high hills that separate the Los Angeles area into a series of small communities, it was found necessary virtually to shave the top off a mountain. A space of 22 acres right on top of Mt. Lee, which rises 1700 feet above the surrounding territory, was leveled and it is on this space that both the FM transmitter and the television transmitter have been installed. The result is that while the object was merely to insure adequate FM coverage of the Los Angeles area, the signal actually gets into San Diego, roughly 125 miles away, with what is described as very good volume.

In order to put a signal of at least 50 microvolts in any part of the area to be covered, required considerable study of antenna design. The type eventually chosen consists of a four bay turnstile type arranged to give a figure 8 pattern and concentrate power effectively within the area intended to be served by the transmitter. In fact, so effective has the arrangement proven that, although the antenna for the television station is only 500 feet from the FM turnstile, there has been no interference at all between the two transmitters.

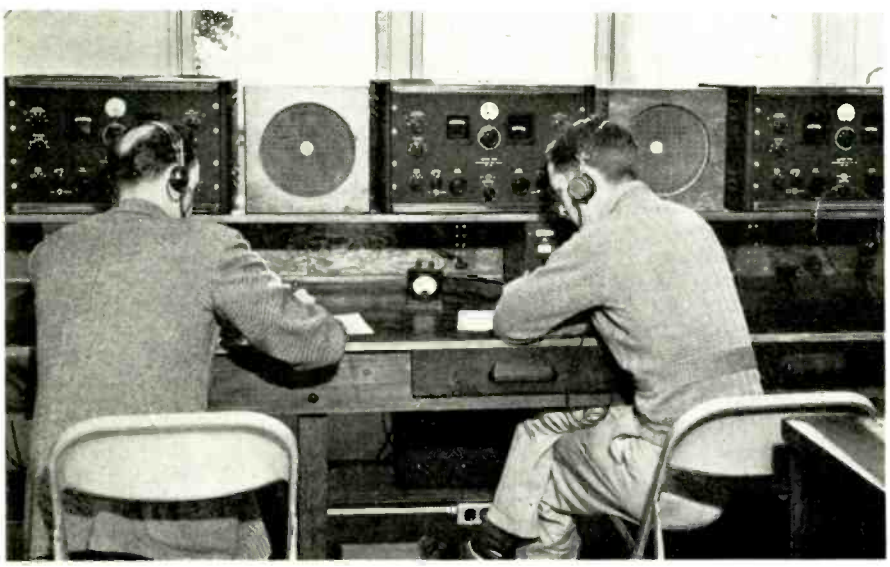
FM audience

Before Pearl Harbor KHJ-FM was operated 12 hours a week, but since that time the schedule has been cut in half as a war conservation measure. It is estimated that there are about 10,000 receivers in the area and that this total will be very considerably swelled when civilian production of receivers is again permitted and when the new transmitter is put on the air.

As is the case with the AM transmitter, quite a bit of remote pickup work is done on FM, too, and for this purpose the station relies on a 50-watt portable set-up consisting of a studio to station link transmitter and receiver, both operating from a 12-volt storage battery.

The television transmitter, occupying its own structure about 500 feet from the FM transmitter and including one of the largest studios ever built for the purpose, 100 by 60 feet and 30 feet high, was built by Don Lee engineers under the supervision of Harry Lubcke, director of television for the organization. It is rated at 4 kw, peak, and operated at a frequency of 51.25 mc. A large percentage of time is devoted to programs having to do with the war effort. For remote pickups reliance is placed on a portable transmitter operating at 324 mc.

The Don Lee short wave listening post is equipped for dual diversity reception. Receivers are fed by 10 antennas which are switched into use by remote control



DESERT LABORATORY ➡

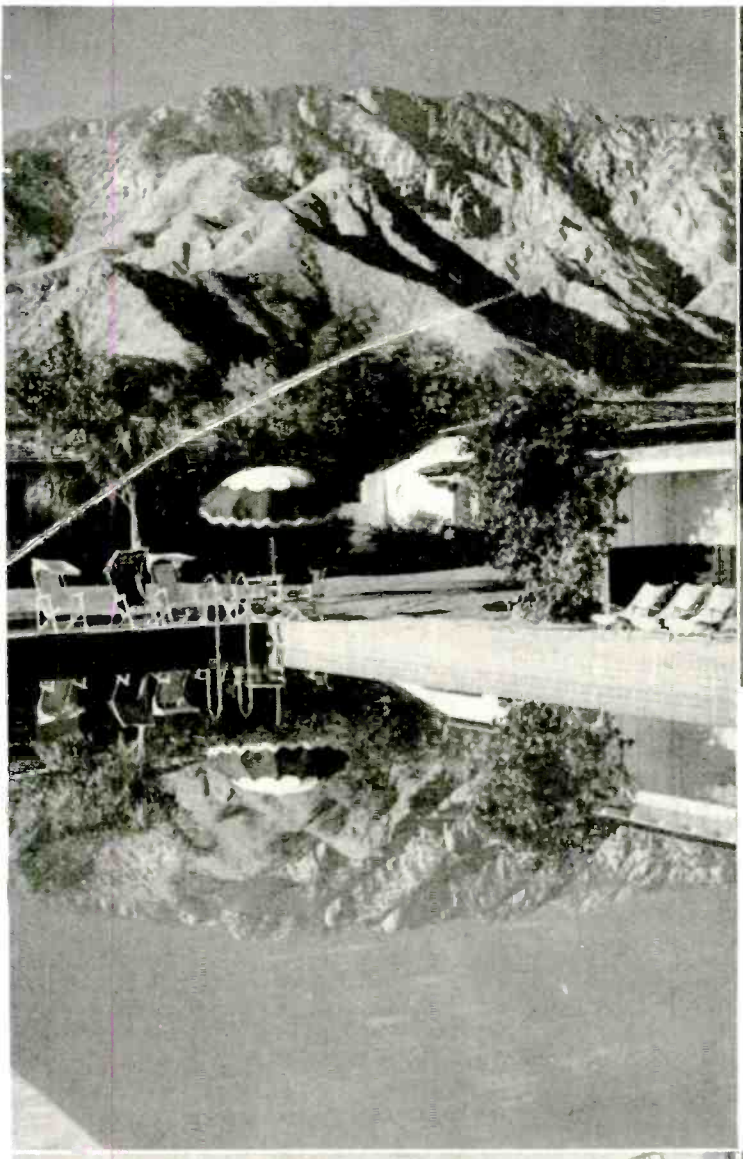
The desert laboratory operated by Electron Equipment Corp. in Palm Springs, California, is unique; there is probably nothing even remotely approaching it in the United States in so far as location, surroundings and facilities are concerned. Says Dudley B. Clark, chief engineer:

"The laboratory, which has been maintained for the past 20 years, is situated in the middle of the desert, 125 miles from Los Angeles. It consists of a small village of its own in the center of an oasis at the foot of Mt. San Jacinto, a towering wall of rock 10,800 ft. high and covered with snow most of the year.

"Everything in this settlement is operated by electronic control, from its own city water plant with 1,000 gal. of pure soft water per minute to its electronic guards covering 20 acres of grounds. All buildings are air conditioned and the swimming pool is filled with natural warm water in the Winter. The grounds are covered with date palms and fruit trees; there are horses for riding, a farm animal department, and a bar. The whole place is closed to the public.

"This laboratory has developed hundreds of industrial electronic items for manufacturers where some control or operation is necessary to attain an object by reducing weight, cutting costs, simplifying functions, etc. One example is the development of an electronic motor control which gives wide speed control to a dc motor operating from an ac line."

DESERT LABORATORY

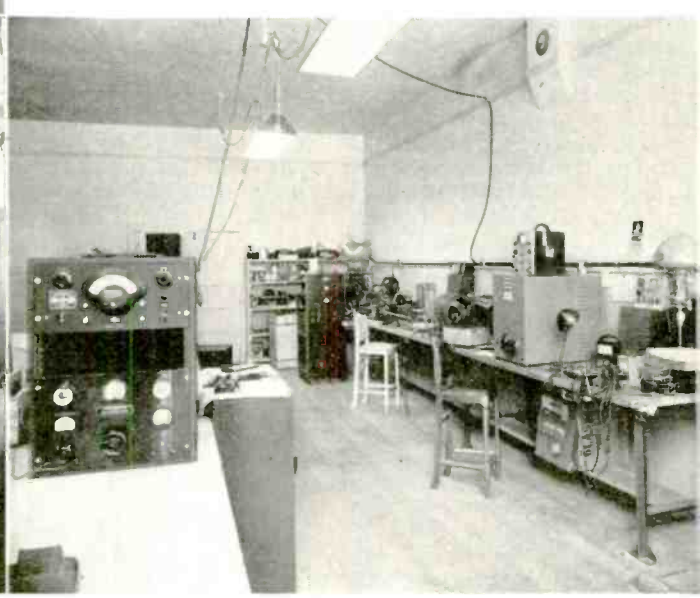


Above is a view of a portion of the tube laboratory, this building in common with all the others in the group being completely air-conditioned

Among other features this unique laboratory in an oasis has its own swimming pool, filled with warmed water from the company's own wells

Located 125 miles from Los Angeles in the shadow of snow-capped mountains the desert laboratory of Electron Equipment Corp., Palm Springs, California, is a complete electronic village. (See text opposite)

Below are two views of a part of the development laboratory where much work is done on a variety of industrial electronic projects



The weather is good in this Signal Corps picture but it might easily have been bad, with high winds, a heavy surf and rain, which lends point to the need for careful waterproofing. Says Major General Harry C. Ingles: "Communication equipment takes an awful beating in being unloaded"

INVASION RADIO HAZARDS

by **ROLAND B. DAVIES**
Washington Editor, Electronic Industries

Proper packaging and the incorporation of protective features into the design of military equipment insures resistance to water and fungi

● The fact that this global war is an electronics war as well as an air war, a mechanized war, an amphibious war, and a jungle war is and has been well known to all readers of "Electronic Industries."

But the mixture of electronic equipment in the amphibious and jungle phases of the war has created important problems for the electronics engineers and the manufacturers — water - proofing and fungi-proofing problems.

The dangers to electronic equipment of moisture, and its corollary in humid climes, fungi, is well known. As a conductor, water nullifies the insulating qualities of insulators. It also decreases the resistance of a resistor. Similarly, fungus growths destroy the insulating qualities of the material upon which it feeds.

To the Army, the problem of water vapor and its effect on communications equipment is not new. For more than four decades—in the Philippines, the West Indies, and in Central America—the Army has known the havoc wrought by moisture penetration and fungus growth on delicate electrical apparatus. Work has gone on constantly to overcome these difficulties. Success, to a relative degree, attended these efforts. These efforts took many forms: better chassis construction, finer tolerances, frequent inspections and repairs, and the substitution of new equipments for those whose efficiency was lowered by the rainfall and humidity of the tropics.

In this war, the story of the water-proofing and fungus-proofing of signal apparatus is one of constant attempt to control and overcome the damage of this double evil. Failures have been overcome by expedients. Expedients have been superseded by standard practices based on research and experimentation. Even now those practices are being outmoded by what is believed to be the solution—partial, but promising.

During the past six months, the Signal Corps of the Army has begun including in all its procurement contracts a proviso for the water- and fungus-proofing of communications items during the production stage. Existing contracts are also being amended to include those specifications.

It is believed that the answer to the problem of water and fungus control is the incorporation of protective features into the design of the equipment as it goes through the assembly line on the production front. It has been found that if equipment is treated at the factory,

it successfully resists the effects of moisture and fungi for a considerable period. It is necessary to retouch the equipment after some length of time, but on the whole equipment operates most effectively with the preventative part of its design and production.

The amending of existing contracts, to add the provision for this type of protection, is a slow and painstaking task. It is a delicate procedure that must not disrupt present schedules.

Suppose, however, that equipment is not so treated at the factory. What does the Signal Corps do to ensure the proper working of an important piece of combat equipment—and communications instruments are highly vital cogs in the materiel of combat? What does it do to protect apparatus that may be used in a spray-drenching amphibious landing or in a rain-soaked highly humid jungle operation?

First, it makes sure that the equipment is packaged correctly—packaged so that no matter what kind of a drenching it takes, it still will click into instant operation when it is unpacked and set up on an atoll in the Pacific or on a mountain top in Italy.

Packing requirements

Each instrument used by the Army has its individual packing requirements to effect, among other things, that it does not suffer from water. Dry batteries are a good example of the extreme care taken by the shipping men of the Signal Corps.

Each battery is packed in a unit package that is wrapped in a waterproof bag. A number of unit packages are then placed in a standard, moisture-proof fiber carton, which in turn goes into a protective bag made of laminated film, heat-sealed for added safety. Finally the sealed bags, with their contents, are put into a packing case which includes a waterproof liner.

Even then nothing is left to chance. The entire case is tested rigorously. It is temperature-tested in several ranges of climates; it is given water immersion tests twice, and it is drop-tested for strength. If water has penetrated to the cartons, the packing is considered inadequate for the purpose.

Soldier expedients

Let us assume now that the equipment has arrived overseas and is to be used operationally in an overwater landing. Here expedients are definitely in order. Anything that will protect the equipment from the salt spray is used—rubber bags, sealing compounds, gaskets.

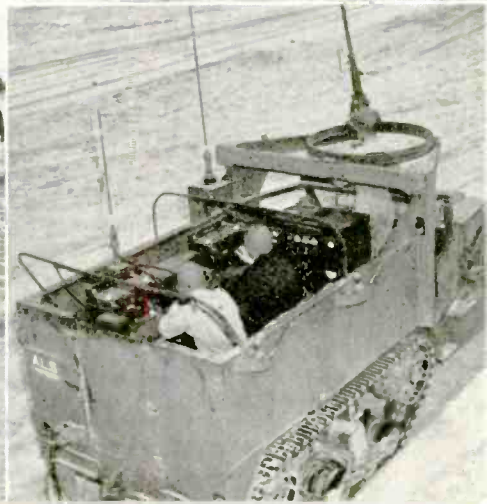
The American soldier, sailor and Marine has exhibited the ingenuity that typifies our nation in the protection of equipment. For example, in the invasion of Guadalcanal, Marines, before climbing down the landing nets, secured from the mess galleys the cellophane and rubber tops used to cover jars and cooking dishes and snapped them over the mouthpiece and receivers of their handie-talkies. This performance was really the beginning of the protection of the individual items of equipment carried by our armed forces.

Improvements have followed improvements along these lines, until today a communications soldier can step off a landing boat, wade through pounding surf, and advance across the beach in continual touch with his command post a mile or more offshore. Waterproof bags have been so constructed that equipment, such as portable radio sets, will operate even while they are enclosed.

The vehicular radio sets likewise are protected in this manner. Mounted on jeeps and other combat vehicles that come tumbling out of landing ships, the sets are fully covered with rubberized bags to protect them from the water. Even as the jeep or half-track moves through the water, its radio instruments are in operation efficiently.

"The prime purpose of waterproofing radio sets . . . is to prevent the equipment from being damaged by water action," Colonel

These Signal Corps photographs showing actual conditions under which military equipment is landed and used emphasize the importance of adequate protective measures against water



Even the ubiquitous "Handi-Talki" must be adequately waterproofed, here with a special type of covering put on as an expedient by the soldier himself to permit operation under all conditions

R. C. Hildreth, Director of the Signal Supply Division, Headquarters, Services of Supply, Eastern Theater of Operations, said recently. "The water-proofing must be 100 per cent effective. . . . It must be done thoroughly to assure successful operation of the radio set while in the water or after reaching land."

Finally, as the assault troops plunge on into the interior of their target, supplies come rolling ashore. What this means to communications equipment has been well described by Major General Harry C. Ingles, the Chief Signal Officer. Speaking at a press conference upon his return from a five-week tour of the Pacific, he said: "Communications equipment takes an awful beating in being unloaded. There are no piers or docks at any of these places in the Pacific. The equipment comes in on a ship and is taken off in a net, usually in a driving rain, run to shore in an open barge, and dumped there with no shelter. It may lie on the beach for a month or more. It's the best that can be done. . . ."

Two methods of water-proofing and fungus control have been found most effective: drying and varnishing. Both are done on the spot by the men who operate the equipment—"first echelon maintenance," the Army calls it. In some areas an empty gasoline drum, wired for half-a-dozen 100-watt bulbs and powered by a portable generator, is used. A gas burner under a salvaged steel chest is another expedient found effective. Even the Quartermaster Corps' field kitchen.

Varnishing all the parts has been found to be the better method, however. This is done by spray gun or by brush and serves to protect the vital elements of a piece of equipment from the corrosive and electrically damaging damp of the sea and the jungle. It is still, however, an improvisation.

Recently, the Army has been distributing moisture and fungi-proofing kits. These kits contain brushes, spray guns, varnish (which contains a fungicide), lamps for heating and drying, switches, thermometers, and various other tools for the job. To the grimy, sweaty GI crouching over a field switchboard in a bamboo-thatched hut "somewhere in the Pacific" they have proved to be a godsend.

Batteries also suffer greatly in the jungle areas. To again quote General Ingles: "We have to be prepared for a considerable deterioration loss in equipment there. It is higher than it would be in other places. In that constantly high, humid temperature, dry batteries go bad very quickly; much more so than in the States.

"The only way we can keep them in good condition is to keep them in cold storage. That is what we are doing. The men build refrigerators there, packing the space between the inner and outer shells with sawdust that they get from sawmills that are operated in their zone. Then we send them refrigerator power units, and they keep the batteries in the refrigerators until they are needed."

The latest step in this campaign against water and fungus took place in March of this year. All signal depots in the continental United States were directed to varnish all equipment that goes through their repair shops.

It is only through the application of waterproofing protective measures in the design of the equipment that military radio can be made universally effective under conditions of use such as this, which is common in amphibious warfare, more common when the big push is started

ENGINEER AS EXECUTIVE

by JOHN M. KAAR, E.E.
Kaar Engineering Co., Palo Alto, Calif.

Executive success comes from knowing where and by whom to get a job done rather than in knowing how

• Just how successful an executive will an engineer make? While this is no new question in the radio and electronic industry, nevertheless it is causing deeper concern as economic developments continue to change the old order of business. The staid business executive confronted with a myriad of products and policies unknown to him in years past is hardly in a better position than the engineer without formal business training who suddenly finds before him the opportunity to be manager.

Straight thinking

An engineer should be capable of becoming a new and better kind of executive. Many changes of thought and the molding of his knowledge and experience into something useful to him as an executive obviously are necessary. An engineer's schooling does not ordinarily include business and management. By his very nature he thinks straight to the point along specific channels and deals with specific problems, so it is not surprising if there has been no deviation of interest into such an unrelated field as business management until the definite need exists.

Must drop details

When he finds himself in an executive position it may be very difficult for the engineer who has been used to solving problems in their entirety to realize that he cannot work on the details, and it may be even more difficult to break himself of the urge to do detail work. Detail can waste a great deal of the engineer-executive's worth. When a subordinate's work is laboriously checked item by item and figure by figure, the executive is not **checking** the work, he is **doing** the work.

If the same work is done by both, then one or the other is wasting his time. If the subordinate's work is so unreliable as to require such checking, he should be replaced. A fallacy, probably originating in a shop and adopted by too many engineers, is the thought "I can do it myself faster than I can show so-and-so how to do it." However, as long as this ordinary labor is done by the manager, "so-and-so" never learns to do it and the manager goes on doing it himself indefinitely.

JOHN M. KAAR

1908—Born in Bakersfield, November 28

1933—Graduated from Leland Stanford University

1935—Degree of Electrical Engineer

1935—With Remler Co., San Francisco

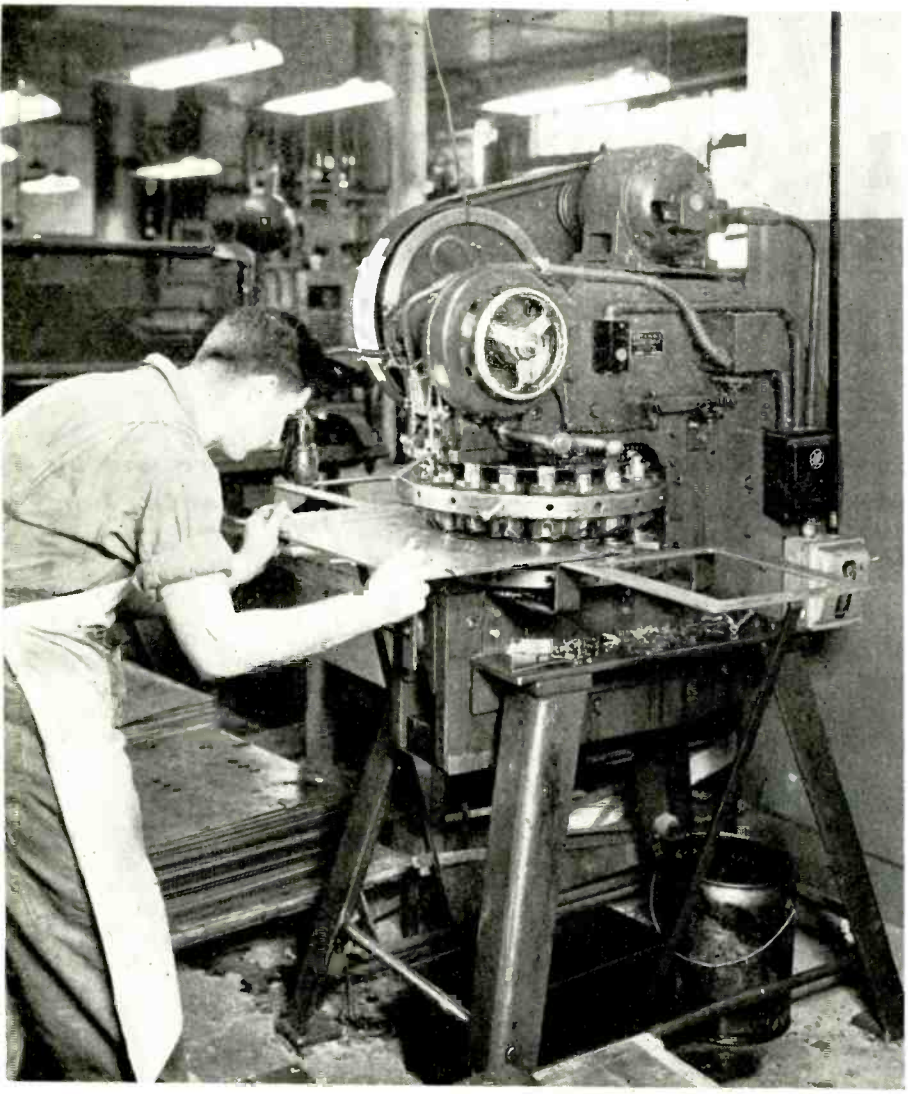
1935-36—Design engineer, Western Wireless, Ltd., San Francisco

1936—Owner and general manager, Kaar Engineering Co., Palo Alto, Calif

To those engineers who have aspirations to become executives, it might be mentioned that stability is one of the most important rungs in the ladder of advancement. Many who wonder at their inability to get into executive positions do not realize that possibly they have not stayed with any one firm long enough to become fully acquainted with its functions, and to gain the necessary confidence of their superiors. Bosses are usually made from employes of long, faithful service. Many are the engineers who have resigned their positions suddenly for a mysterious "great opportunity" on the eve of a promotion into an even greater opportunity with their own company.

Getting jobs done

If you would be an executive, be wide awake to what is going on around you. Know why you were required to do a job a certain way. Know the policies of your firm, the men behind it and the kind of job they are doing. Learn about business in general by reading business magazines, and learn about other fields associated with yours. A little knowledge of machine shop technic or plastic design would be invaluable to an electronic engineer managing a company making electronic equipment. Just as real education does not necessarily require a knowledge of all the answers but instead consists of a knowledge of where the answers may be found, so executive success is knowing where and by whom to get a job done rather than in knowing how to do it all yourself.



PUNCHING 100 HOLES in radio chassis needed in small lots at Federal Telephone and Radio Corp., Newark, N. J., with turret-head punch press designed for short run piercing operations

• The photograph above, made in a plant of the Federal Telephone and Radio Corp., Newark, N. J., illustrates one of a number of radio and radar plant installations of "turret punch presses" manufactured in a variety of types and sizes by the Wiedemann Machine Company, Philadelphia, Pa., and designed to speed output and cut costs of sheet metal piercing jobs when production runs would not be long enough to justify the relatively expensive punch and die sets built to make all the knock-outs on a panel or chassis at one punch.

Hand-powered unit

In simplest form, this new type of punch press is a hand-powered bench unit consisting of an upper and lower turret holding eleven punches and matching dies. The two turrets are geared together to insure that the corresponding punch and die will be together when the turret head is positioned under the ram. Various sizes and shapes of punch and die sets are left in place indefinitely for instantaneous availability.

Larger, power driven turret presses range up to 80 tons capacity, with throat depths up to 60 in. and with as many as 32 punch and die stations, holding dies up to five inches in diameter. Wherever possible, multiple or gang punches are used, punching two to five or more holes in each small area. The heavier presses do clean work on mild steel sheets up to one-half inch thick. Several gage-tables and associated control equipment are available for different kinds of work, providing accuracies up to .002-in. tolerance in positioning. For work on curved surfaces, one model has the lower turret built to rotate in a vertical rather than horizontal plane.

Typical of the time and money savings effected is the case at Federal Telephone and Radio Corp., whose time-study clocked an operation of punching 100 various sized holes through a template in less than ten and one-half minutes. Another short run job which formerly cost $7.83 in labor to punch one piece came down to seventy-eight cents by the turret press method.

IDEAS

Four Points for a Stake

A suggestion from Republic Aviation, Farmingdale, N. Y., should have application to the electronic industries. After an operation press-fitting bushings into housings, the housings were then point-staked at the edge of the bearing in four places with a center punch or staking tool and a hammer. By incorporating staking points on the ram which presses the bearing home, faster and more precise operation was achieved. A pilot was also added to insure accurate entry of the bushing into the hole in the housing.

Jobs for Vets

A double-barreled plan to provide war veterans with employment opportunities on their discharge from military service and thereby secure needed help, has been initiated by the Brown Instrument Co., Philadelphia, Pa.

The Brown Company is providing each of the draft boards within a 35-mile radius with a list, weekly, of the jobs open at the plant, the type of men required and what experience, if any, is needed for each.

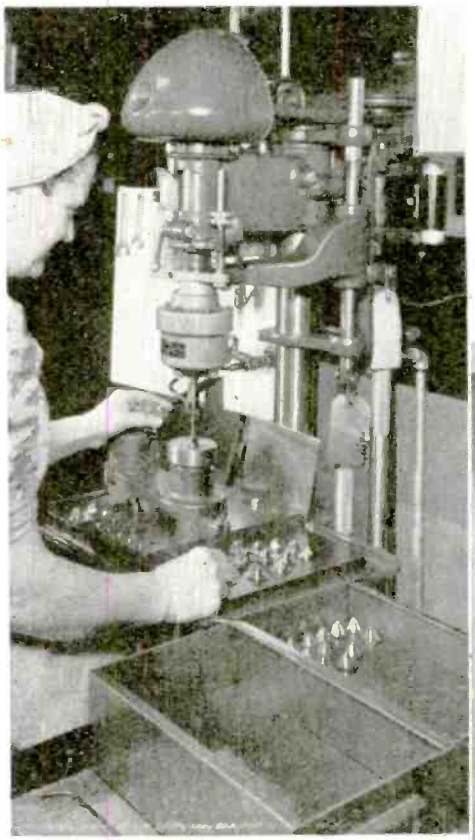
Results should be advantageous to the veteran, to the continued production of war goods and to the company. Long periods of waiting to find work are overcome, and red tape is reduced to a minimum.

Draft boards in the Philadelphia area reported their appreciation of the Brown plan and commended the company for providing a short-cut to veteran job placements. All vets are required to visit their draft boards as soon after their discharge as possible, making the boards an ideal intermediary.

Small Holes from Big

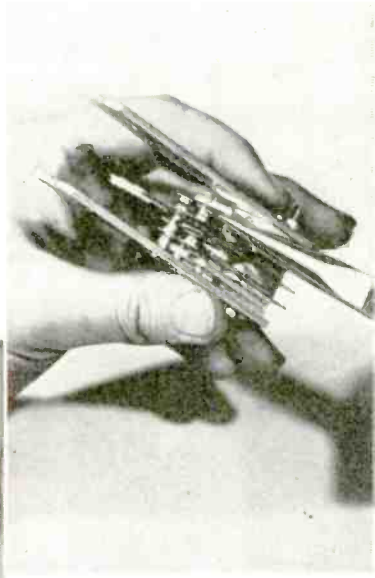
At Sonora Radio and Television, Chicago, a shipment of a thousand aluminum chassis frames arrived with certain holes drilled out .004-in. oversize. An employe built a simple jig with a guide pin corresponding to the smaller, correct size of hole, mounted it in a standard arbor hand press, and the problem was solved. Pressure on the surrounding metal caused enough cold flow to fill the excess hole exactly. The employe, Leo Begun, was acclaimed for his ingenuity on a nationwide Blue Network hook-up of the Ford Motor Company's "Watch the World Go By."

TO SPEED PRODUCTION



↑ AIR OPERATED CHUCK speeds precision work on small round parts and largely does away with need for special jigs and fixtures. Tapping operation illustrated. Air chucks, made by Redmer Air Devices Corp., Chicago, give collet capacity up to one and three-fourths inches

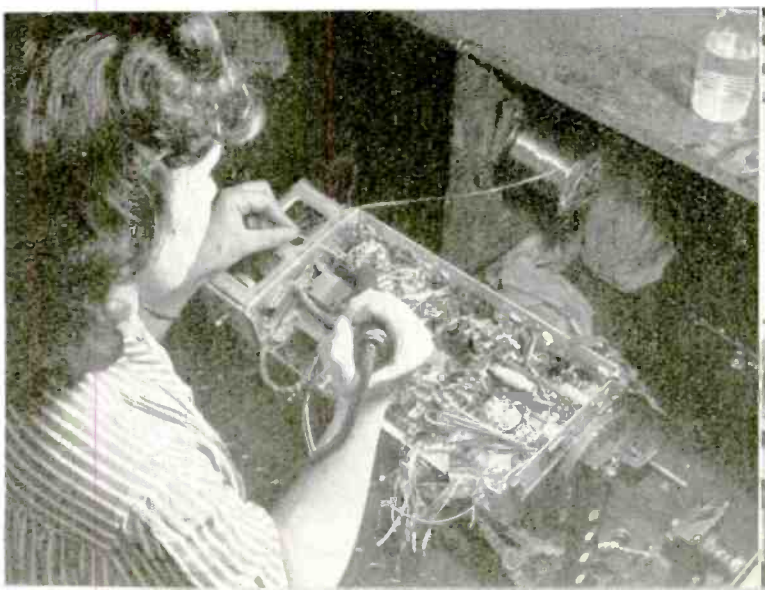
SECOND FRONT against womanpower shortage resulted in employment of large numbers of badly needed workers at Continental Electric Company, Geneva, Ill. Complete equipment for several sealing and other tube-making operations was set up in show windows on Geneva's Main Stem to show potential personnel that work is clean, quiet, interesting, and not at all dangerous ↓



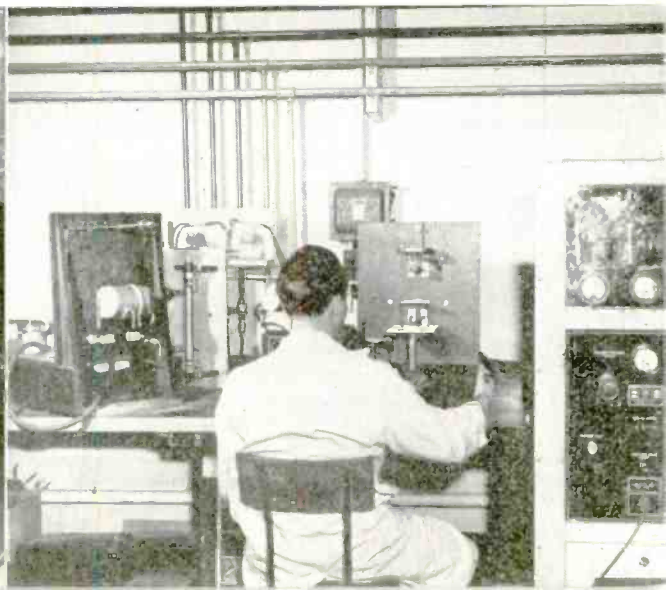
↑ CROSS BETWEEN tweezers and a pair of pliers, this tool is used by Electronic Labs., Indianapolis, Indiana, for removing broken screws or nuts from between reeds in vibrators. Just a pair of tapered half-round nose pliers with points ground down to be ultra-narrow, but a handy tool for any work in close, confined quarters. Sides must be ground slowly and carefully to avoid overheating and removing temper

To renew worn serrations and ragged cutting edges on pliers, heat to dull red and "bite" a file between the jaws on an anvil, then close pliers to make jaws parallel. Side-cutters are closed in while hot, later filed to clear edges. Jaws and cutting edges are then heat-treated in the standard way for hardness and long life

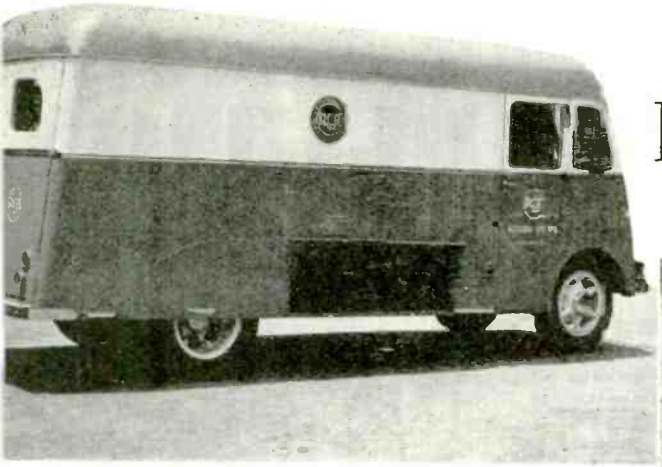
AWKWARDNESS of handling one to five pound spools of solder prompted installation at the Crosley Corp., Cincinnati, of simple spool holder dispenser shown here ↓



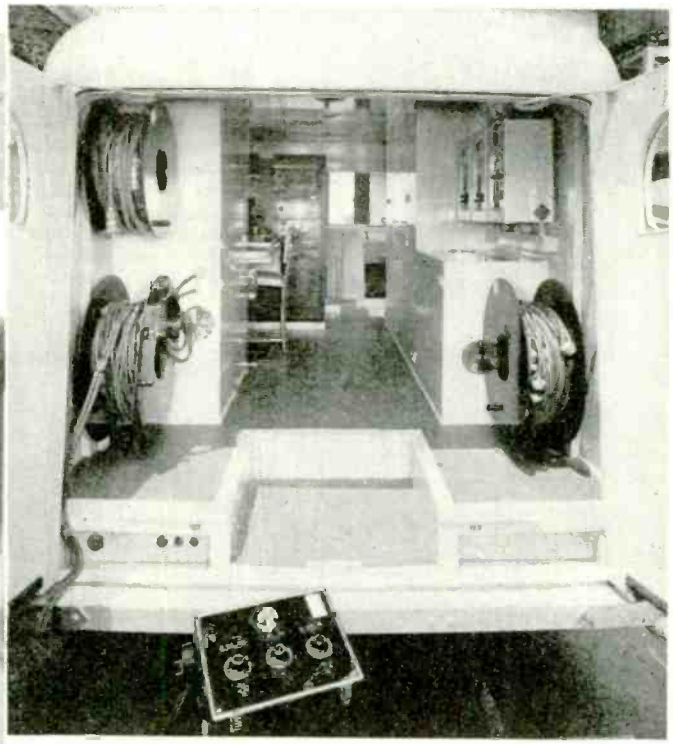
INDUCTION HEATING scores a new success in metal-to-glass seals of Klystron tubes. Process soon to go on production line at a Long Island plant of the Sperry Corporation, New York City ↓



HOLLYWOOD



Battery compartment is located under the floor of the truck with batteries accessible through doors in side

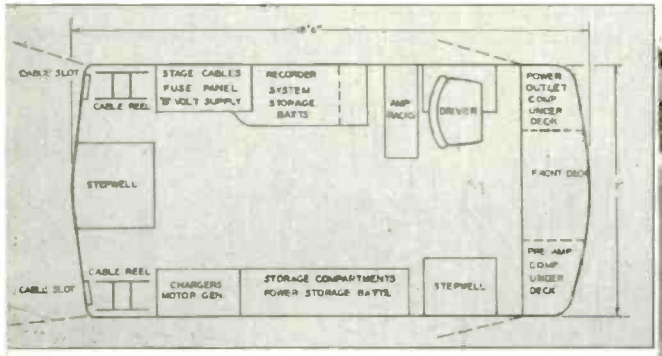


Interior view of the mobile studio showing stepwell, cable reels and general arrangement of the complete equipment

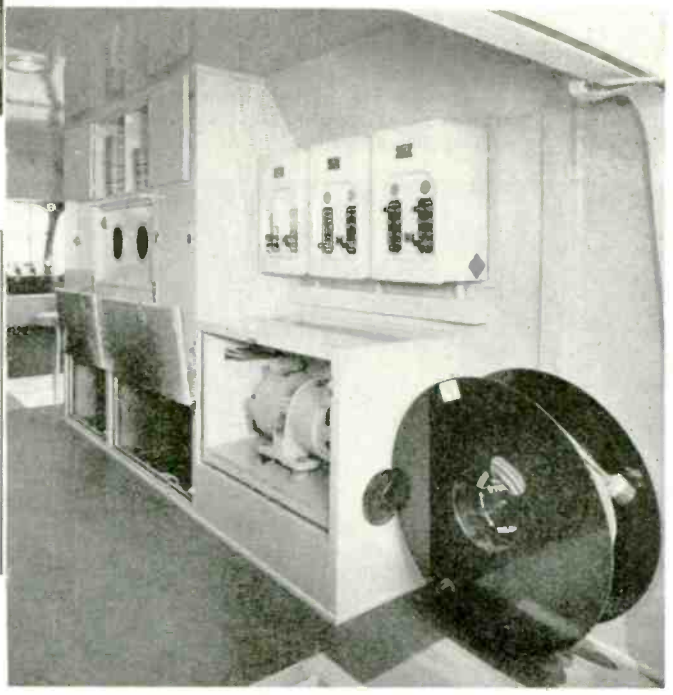
Cable reels, provided with brakes, are at the left rear with motor generator and B battery compartment just ahead

• Built on a cowl type Studebaker truck chassis with a wheelbase of 152 in., the latest type of mobile recording unit built by RCA Victor Division of the Radio Corp. of America is an unusually compact and complete studio on wheels. Several units have been built.

Aside from the careful planning that went into the

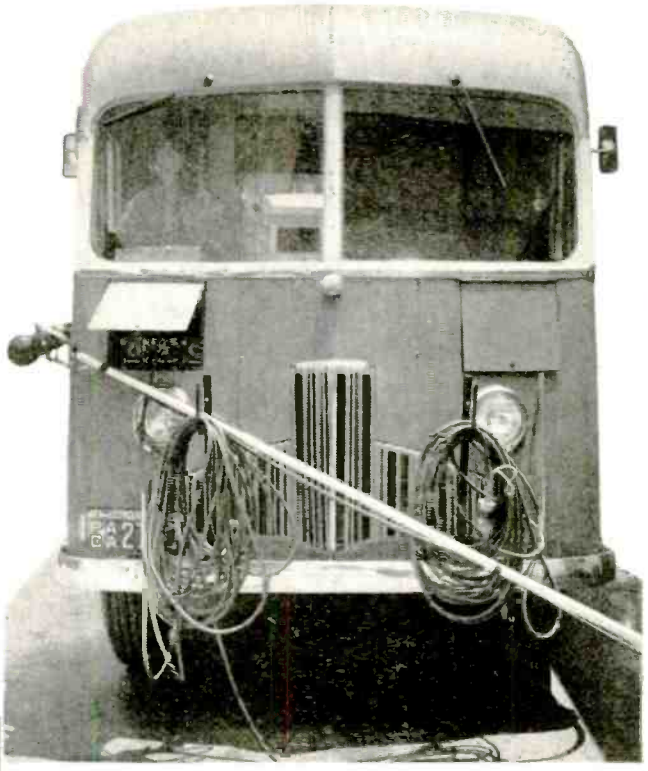


lan of vehicle showing arrangement of batteries, power equipment nd cable reels, etc. At right, the battery compartment from → he inside with the soundproof motor-generator compartment adjacent

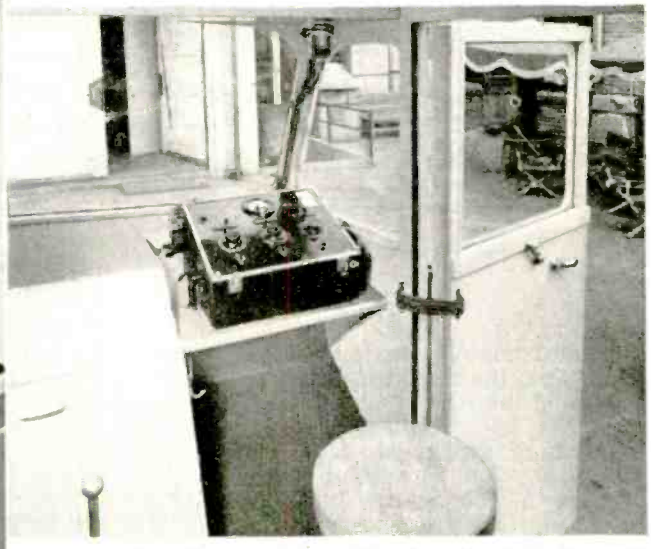


ON WHEELS

design in order to provide for every conceivable recording necessity, a feature of the equipment is that it is completely self-contained, thus may be used anywhere. Design requirements called for an arrangement that would provide maximum accessibility both for use and for service maintenance. Among other unusual features, the driver's compartment and the recording compartment are combined in a single "room". A full six-foot headroom clearance is provided and the aisle type construction makes all the equipment instantly and easily accessible. Storage batteries for operating the motor-generator set, the B-voltage dynamotor, for filaments and for the recorder are located in compartments below floor level, accessible from outside.

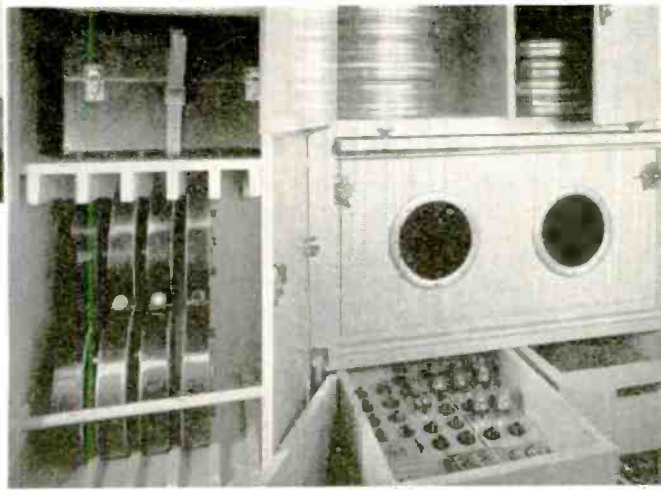


Front view of mobile studio showing position of the recording operator in a compartment alongside the driver



Recording operator's position from the inside in a wide compartment which he shares with the vehicle's driver

The sound film track recording equipment is mounted on a convenient shelf with its controls and meters built into the bulkheads adjacent to it. Beneath the machine one of the below-floor externally accessible battery compartments is shown with the floor up

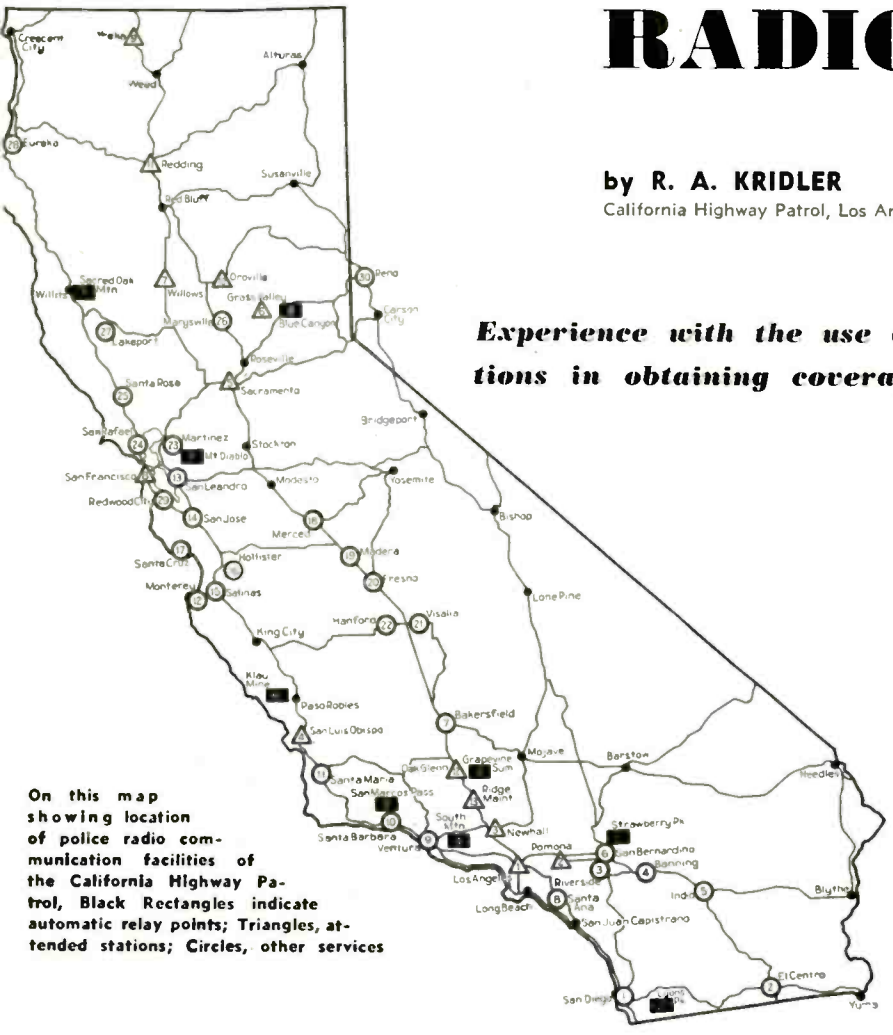


Equipment storage compartments are built in above the power battery which is below the floor. Illustrated are spare tube and parts drawers, cupboards for holding raw film and film loading equipment

RADIO RELAY

by R. A. KRIDLER
California Highway Patrol, Los Angeles

Experience with the use of repeater station installations in obtaining coverage in mountainous country



On this map showing location of police radio communication facilities of the California Highway Patrol, Black Rectangles indicate automatic relay points; Triangles, attended stations; Circles, other services

• Approximately two and a half years ago, the California Highway Patrol of the State Department of Motor Vehicles began an extensive program of expansion of its radio facilities. This work was commenced in recognition of the need for a more adequate and complete radio system in order that the department might better be equipped to fulfill its assignments and duties. Previous to this time the California Highway Patrol had maintained a few land stations in various locations, but with the exception of certain counties in scattered sections of the state, the department had no two-way equipment in operation.

California is traversed for almost its entire length by two major ranges of mountains, namely, the coast range and Cascade-Sierra Nevada range; the Coast range, in general, follows quite closely along the coast line and the Cascade-Sierra Nevada range is located at a distance varying from 100 to 300 miles inland.

For the entire length of the state, from the Mexican border to the Oregon line, there is a major highway between the Coast range and the ocean (U.S. 101), and in between the Coast range and the Cascade-Sierra Nevada range there is still another major highway (U.S. 99); both of these highways are approximately 900 miles in length. These two major highways carry a great volume of the state's north-south traffic and it was necessary to give thorough consideration to an adequate two-way coverage of these routes.

Many portions of the state, particularly the northern section, are an almost continuous expanse of mountainous country with relatively small sections of valley territory which in turn are surrounded by high mountains ranging in elevation up to 8,000 or 9,000 ft.

We have the extreme in elevation variations here in California with Mt. Whitney 14,496 ft. above sea level and Death Valley 300 ft. below sea level; the highest and lowest locations in the United States. Many of the east-west roads and highways pass through such territory and the difficulty of providing radio coverage in such locations is readily apparent.

In addition California is divided

Illustrated is the simple type of equipment, transmitter and receiver, used in each of the repeater stations for automatically receiving and relaying police communications

LINKS IN POLICE WORK

into 58 counties, and many of these county lines extend completely through one or the other of the major ranges of mountains. In every instance it was necessary to plan on providing for two-way coverage from, as nearly as possible, all points in a given county to a given central county office or dispatching point.

While the California Highway Patrol is a unified state police agency, it is organized into county units or squads and in almost every one of the 58 counties of the state a separate local office is maintained. In effect, we found ourselves confronted with the problem of installing almost 58 separate communications systems.

To date the California Highway Patrol has installed 13 stations at strategic locations in the state. These are situated at Los Angeles, Pomona, Newhall, Oak Glenn, Ridge Maintenance (on Ridge Ronte) San Luis Obispo, San Francisco-Oakland Bay Bridge, Sacramento, Redding, Oroville, Yreka and Willows. Most of these are 500 watt stations with the exception of the Sacramento station which is licensed for 5,000 watts. The 2 stations on the Ridge Route are 50 watt stations used for traffic control during winter months. In addition the Patrol has installed remote control facilities on approximately 27 county and municipally owned land stations in locations where they provided a satisfactory degree of coverage or where our own stations could not be installed due to present wartime restrictions.

Our own stations operate on a frequency of 1682 kc and those owned by other governmental agencies operate on frequencies from 1600 kc to 2490 kc. We also operate approximately 400 two-way patrol cars throughout the state and 377 one-way motorcycles. Patrol cars are equipped with frequency modulated transmitters and operate on 39.78 mc. They are equipped with tunable receivers of the push-button station selector type and can thus be sent to any part of the state should an emergency arise.

Automatic repeaters

In nearly every one of the 58 counties of the state we have installed at least one high-frequency 39.78 mc station receiver in order to provide for reception of these mobile units, and in many of the larger counties such as Los Angeles, Riverside, San Bernardinc, etc., where more than one land station is installed, there are several receiving locations providing for communication with several different land stations. An extensive system of inter-land station monitoring is also established and, in an emergency, radio communications can be dispatched almost anywhere in California or the surrounding states.

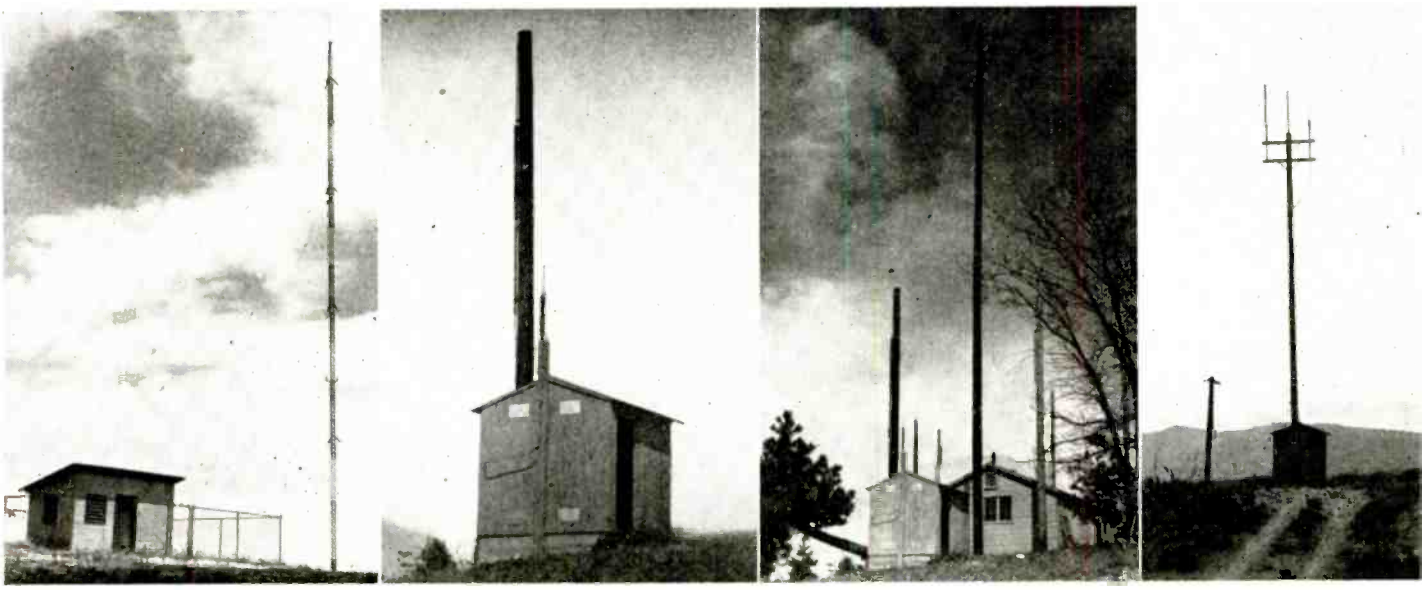
In order to provide for greater coverage from our mobile units we have also installed 9 automatic radio relay stations in various parts of the state and six additional ones are now being placed in operation. When it is realized that the total area of the State of California is 158,693 square miles and there are some 117,760 miles of roads and highways in the state, it is readily appreciated that we were confronted with an enormous task in providing at least a fair degree of coverage for the entire state.

It was apparent that it would be necessary to place high frequency receiving locations at some high point in a given territory in order to expect any great degree of coverage from our mobile units; this in turn brought on the problem of returning the audio output of these receivers back to the dispatching point, as it was found in some instances that the best receiving location was from 5 to 55 miles from the squad office and telephone lines were usually not available. It was at this phase of our planning that it was decided to utilize a series of ultra-high frequency radio relay or repeater stations for this purpose. We were then confronted with the problem of securing locations that were reasonably accessible by road and where commercial power lines were within close proximity. It was also necessary to give consideration to the question of year around service of equipment and whether or not the location would be snowed in during the winter months.

At the commencement of this program the writer was given

(*Continued on page* 210)

Various types of antennas used in the California Highway Patrol police system. Left to right: High frequency coaxial receiving antenna atop 1,682 kc transmitter tower; receiving and transmitting antennas on one of the automatic repeater stations; San Bernardino station which functions for a number of services (see text); installation near San Marcos Pass in Santa Barbara County



ELECTRON MICROSCOPES

• Two quite new electron microscopes and considerable revision of a third appeared last month. General Electric and RCA are the sponsors. Two of the instruments, G-E's and the smaller of the RCA models, are of the console type, about the size of an office desk and are intended primarily for industrial uses. These are styled "simplified" versions, less powerful and lacking some of the adjustments found on larger models intended for research where maximum flexibility is required.

The G-E desk model is essentially the same as the "war model" brought out about a year ago, except for the streamlined console. The fluorescent screen of this microscope is capable of producing images which can be magnified to about 10,000 times the size of the specimen.

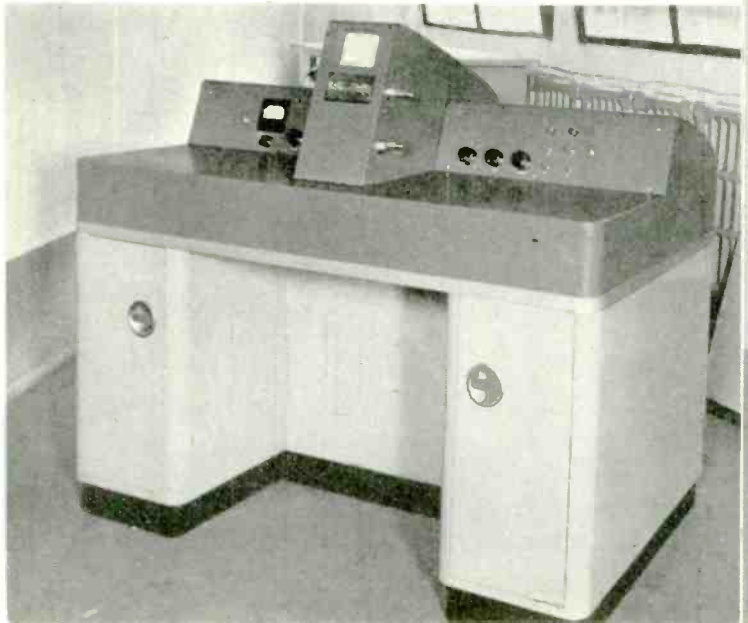
The RCA console model type EMC is somewhat similar in appearance and arrangement. There are two magnification positions, 500 times and 5,000 times in the instrument providing useful photographs which can be enlarged up to several hundred thousand diameters. Single exposures on a 2 x 2 slide are made or visual examination is accomplished on a vertical fluorescent screen at eye level. Power consumption is 1,000 watts at 115 volts.

RCA's Universal research model

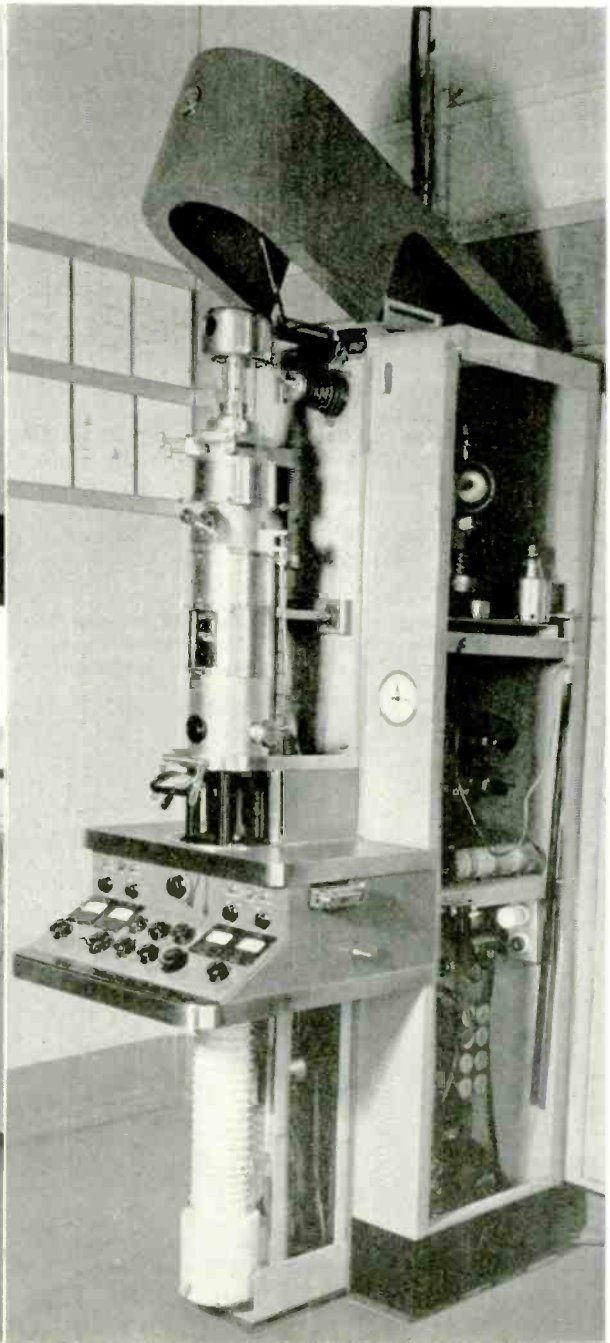
(*Continued on page* 208)

The new G-E instrument, intended for industrial laboratories, is a simplified unit housed in a console and provides only visual inspection

RCA's type EMC electron microscope is a simplified version of the larger model in console form intended primarily for industrial use



Type EMU is the universal RCA model, shown open, and has been considerably revised to simplify getting it into operation



Revolving door with photoelectric control, in the American National Bank, Vincennes, Indiana

TUBES on the JOB

Fishing via Ultrasonics

It's hard to say whether it's an industrial or a maritime application of electronic lore (or is it "lure"?), but a new ultrasonic note was struck on the sports page of the "New York Times" of April 28, 1944.

Not even the ungentle art of tuna fishing is going to escape the benefits of war's research and development if A. Paul King, who is active in New Jersey fishing circles, is right. The electronic age will descend upon sport fishing via ultrasonic detection, which will be used to locate fish just as it now locates our underwater enemies.

"Our tuna boats, manned with expert fishermen, will join the attack on game fish much in the same manner that our fighters now engage the enemy in battle at sea," says King. "We shall probably make agreements by inter-ship radio on just which boats will strike for the kill. But all this will be conducted with the highest regard for the principles of good sportsmanship and fair play," he hastens to add.

Mr. King thinks the deep-sea boats will be equipped with electronic detection units which will make it possible to determine the size of the schools within a 100-mile radius and will also tell the direction of their travel. He said that the Fish and Wildlife Service is testing the ultrasonic device for this purpose.

The contention is that to thousands of ardent young fishermen the use of electronic detection for fun will be a holiday after they learn it through the grim necessity of war.

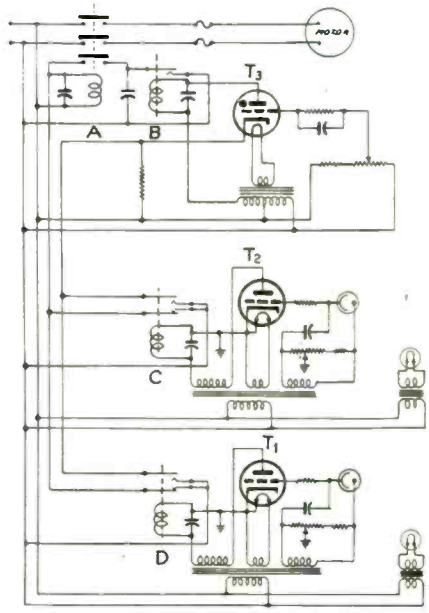
Arrangements are now being made between the Office of the Coordinator of Fisheries and the Navy for a full-scale test of echo-sounding devices on surface vessels as a means of locating schools of fish, in waters off California.

(*Continued on page 206*)

Phototubes Revolve Doors

The latest in photoelectric door-openers is a system marketed by the Revolving Door Division of International Steel Co., Evansville, Indiana, covered by patents issued to Thurloe Hagenbook.

Near the floor on the right-hand side of each entrance to the door infra-red light sources are installed. The beams are directed to phototubes mounted above the left-hand side of the entrances so that a signal to operate the mechanism is normally given only upon entering. The motor-drive mechanism includes a friction clutch designed to slip to avoid injury to a person or object, or to the mechanism itself, in the event that the doors are jammed. An overrunning clutch is also provided to make it possible to operate the doors manually if desired or if the automatic mechanism becomes inoperative for any reason.



Schematic of revolving door control system

Operation of the control may be visualized by referring to the circuit diagram, in which all elements are shown de-energized. With the circuits energized by the 115 volt ac line, triodes T_1 and T_2 are conductive, maintaining relays C and D energized. When either light beam is interrupted, the corresponding triode assumes cut-off bias, de-energizing the relay in its plate circuit. One set of contacts closes, energizing relay A to start the motor which revolves the door. The other set of contacts opens, placing a plate potential on the thyratron, T_3, and energizing relay B to hold relay A for a period of time determined by the constants and adjustment of the thyratron grid circuit, actually 5 to 15 seconds, to allow sufficient operation of the motor for one person to pass through the revolving door. If the person is followed immediately by others, each interruption of the light beam renews the positive charge on the grid condenser to inaugurate a new interval. No cumulative effect is present, the last person in a long line having only the normal time interval in which to pass through the door.

Machining Irregular Surfaces

A new automatic tracer mechanism, with the Westinghouse Silverstat regulator as its operating medium, has been applied successfully to jobs formerly requiring tedious hand work, such as propellers, dies, and cams. In operation, a probe mounted in connection with the Silverstat is used to follow the contour of an accurate model—either actual size or to scale. As the probe is moved across the model, it affects the position of the Silverstat. Through an amplifier, the cutting tool is moved correspondingly with respect to the work.

The accuracy of the tracer mechanism is such that, with a well designed machine tool and an actual size model, the contour of the model

(*Continued on page 206*)

CALIFORNIA ELECTRONIC

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*A. B. C. Products Co. 11952 Montana Ave. W. Los Angeles	Betty Wilson—P, GM	Arthur L. Wilson—CE	Lord shock mount holders, cord sets, radio assemblies	Lord shock mount holders, cord sets, radio assemblies
Advance Electric Co. 1260 W. Second St. Los Angeles	F. W. Falck—P Fred W. Falk, Jr.—GM F. Schaumburg—CPE	V. C. Huckabee—CE	ADVANCE—Relays	Relays
Aero Electric Corp. 6916 Romaine St. Los Angeles	E. B. Babcock—P R. E. Campbell—VP O. E. Davidson—GM R. H. Townsend—CPE	R. H. Townsend—CE F. M. Heidenry—OE	AERO—Cable connectors	Cable connectors
*Air Associates, Radio Div. 5827 W. Century Blvd. Los Angeles	H. I. Crow—P R. E. Acre—VP E. P. Gertsch—GM C. S. Knowlton—CPE	J. A. Rhoads—CE S. Cutler—DE C. Hicks—OE M. Eliason—OE J. Lewchuk—OE	Airport and aircraft transmitters and receivers, radio ranges, amplifiers, radio beacons	Airport and aircraft radio
Airtronics Mfg. Co. 5241 San Fernando Rd. Los Angeles	Ralph Hemphill—P Herman Harms—VP Paul Ivey—GM, CPE	V. Elconin—CE, DE F. O. Temple—OE	AIRTRONIC—Electronic heating units	Electronic heating units
*Altec Lansing Corp. 1680 North Vine St. Hollywood	G. L. Carrington—P A. A. Ward and J. B. Lansing—VP A. A. Ward—GM E. D. Zunker—CPE	J. K. Hilliard—CE E. B. Harrison—DE C. A. Campbell—OE A. K. Davis—OE	ICONIC AND DUPLEX—Speakers, horn systems, public address, audio amplifiers, transformers	Speakers, transformers, horn systems
*American Microphone Co. 1915 S. Western Ave. Los Angeles	F. A. Yarbrough—P	K. V. Martin—CE	AMERICAN—Microphones and accessories	Microphones
Applied Research Labs. 4336 San Fernando Rd. Glendale	M. F. Hasler—O R. W. Lindhurst—O G. Cooper—GM D. Moore—CPE	E. Schrotzberger—CE F. Cheatham—DE	A.R.L. DIETERT—Grating spectrograph, arc rectifier unit, ac arc unit, high-voltage spark unit, multi-source unit, projection comparator, densitometer, developing equipment, calculating board	Grating spectrograph, arc rectifier unit, ac arc unit, high-voltage spark unit, multi-source unit, projection comparator, densitometer, developing equipment, calculating board
Audio Products Co. 2101 W. Olive St. Burbank	A. J. Edgcomb—P		Commercial sound equipment	Commercial sound equipment
Avia Products Co. 7266 Beverly Blvd. Los Angeles	A. B. Norris—PT L. E. Stanley—PT G. B. Raymond—GM F. G. Perry—CPE	C. F. Booher—CE	Aircraft radio equipment, heavy duty resistors, indicator lamps	Electrical appliances
Aviola Radio Corp. 703 W. Ivy St. Glendale	John J. Ross—P W. K. Jackson—VP Paul Schmidt—CPE	R. P. Adams—CE Wm. Bone—M, FM	AVIOLA—Communication equipment	Home radio receivers, aircraft radio equipment, television & automatic record changers

*Member Western Electronic Manufacturers Association.

P—President; VP—Vice President; GM—General Manager; CE—Chief Engineer; CPE—Chief Purchasing Executive; DE—Design Engineer; OE—Other Engineers; LE—Liaison Engineer; PT—Partners; O—Owners; LBE—Laboratory Engineer; ATP—Ass't to President; CPE-E—Chief Purchasing Executive—Electronics; CPE-A—Chief Purchasing Executive—Aircraft; DE-R—Design Engineers—Receivers; DE-T—Transmitters; PL SU—Plant Supt.; G.PT—General Partner; SD—Sales Director; PE—Product Engineer; PM—Production Manager; SM—Sales Mgr.; ME—Mechanical Engineer; M—Manager; SP—Sales Production; EE—Executive Engineer; FE—Field Engineer.

INDUSTRY DIRECTORY

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*Bendix Aviation Corp. Pacific Div. 11600 Sherman Way North Hollywood	Palmer Nicholls—GM Mel M. Burns—AGM R. L. Galbraith—CPE	Dave Brown—CE Henry Winchel—DE W. C. Trautman—DE	ALTAIR — Hydraulic aircraft equipment units and systems, radio transmitters, receivers, and accessory equipment	Hydraulic aircraft equipment units & systems, radio transmitters, receivers and accessory equipment
Birtcher Corp., The 5087 Huntington Dr. N. Los Angeles	C. J. Birtcher—P G. S. Thompson—VP C. J. Birtcher—GM A. G. Babeaux—CPE	A. G. Babeaux—CE Hal. C. Mettler—DE	Relays and molded plastic components	Electromedical and electrosurgical equipment and allied electronic devices
Burnett Radio Lab., Wm. W. L. 4814 Idaho St. San Diego	Wm. W. L. Burnett—P	W. W. L. Burnett—CE	Radio frequency meters, crystals and holders, rf chokes, transmitters, receivers, temperature control ovens	Radio frequency meters, crystals & holders, rf chokes, transmitters, receivers, temperature control ovens
*Butte Electric Co. 124 Russ Ave. San Francisco	R. R. Armstrong—PT H. M. Armstrong—PT	R. W. Randolph—CE	Traffic counters, photo-electric alarms	Traffic counters, photo-electric alarms
Cannon Electric Development Co. 3202 Humboldt St. Los Angeles	James H. Cannon—P R. J. Cannon—VP, GM Richard Rowen—CPE	Edw. J. Niefing—CE Paul Foote—ACE	CANNON — Electrical connectors, cable terminals, solenoids, limit switches, signal systems	Electrical connectors, cable terminals, solenoids, limit switches, signal systems
*Cinema Engineering Co. 1508 W. Verdugo Rd. Burbank	A. C. Davis—O, DE Paul Keeler—GM, CPE	H. Woodbury—CE	VARITEN, VARITAP—Attenuators, wire wound resistors, potentiometers, tap switches, meter-multipliers	Attenuators, wire wound resistors, potentiometers, tap switches, meter-multipliers
Clark Co., Robert H. 9330 Santa Monica Blvd. Beverly Hills	Robert H. Clark—P Don L. Lenzi—GM John A. Stieber—CPE	L. A. Smith—CE, DE Harry C. Wilson—OE	CLARK "CC" — Adjustable hole and gasket cutters, surface facers, counterbores and flycutters, quartz orientation replacement table	Tools
*Communications Equipment Corp. 134 W. Colorado St. Pasadena	S. W. Cunningham—P R. Kimball—VP, GM Fred'k Griggs—CPE	Ralph Seiler—FE Ebert Mattson—DE Harvey Smith—OE	Transmitters, receivers, remote controls, power supplies, amplifiers	Transmitters, receivers, remote controls, power supplies, amplifiers
Consolidated Engineering Corp. 1255 E. Green St. Pasadena	Herbert Hoover, Jr.—P Philip S. Fogg—VP W. E. Spicer—GM R. W. Reid—CPE	E. E. Hoskins—CE B. F. McNamee—DE	Mass spectrometer, strain & vibration measuring instruments, seismic instruments	Mass spectrometer, strain & vibration measuring instruments, seismic instruments
Cook Research Labs. 950 Crane St. Menlo Park	Lawrence H. Cook—O	Leo W. Ruth—DE	Navy, Ordnance, C.W.S., tools and precision parts	Navy, Ordnance, C.W.S., tools and precision parts
Cryco, Inc. 1516 Mission St. South Pasadena	Walter N. Johnson—P H. E. Blaiser—VP Robt. W. Bethke—GM	Frank N. Wilcox—OE	Quartz crystal holders	
Cyclotron Specialties Co. Moraga	D. R. Tibbetts—P, CE L. S. Tibbetts—VP	John L. Annis—DE	Geiger-Mueller counter, impulse registers, Geiger tubes	Geiger-Mueller counter, impulse registers, Geiger tubes

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*Dallons Labs. 5066 Santa Monica Blvd. Los Angeles	Oscar Dallons—PT, GM, CE	John Seiler—DE Franz Dallons—OE	Precision crystals, vacuum tubes	Precision crystals, electro-therapy equipment
*Dalmo-Victor, Inc. 620 York St. San Francisco	T. I. Moseley—P Earl S. Douglass—VP Harry E. Grant—CPE	Paul F. Byrne—CE	Loudspeaking telephone system, Inter-communication telephone equipment	Inter-communication telephone equipment
*Dine, F. E. Trustee for Higgins Industries, Inc. 2221 Warwick Ave. Santa Monica	F. E. Dine—GM, CE George J. Steil—CPE	F. Berberich, Jr.—DE Jim Henderson—OE	Crystals, frequency meters, radio transmitters and receivers	Radio transmitters and receivers, recording equipment
*Eitel-McCullough, Inc. San Bruno	W. W. Eitel—P J. A. McCullough—VP G.F. Wunderlich—GM E. F. Sanderson—CPE	G. T. Howes—CE H. B. Becker—LE	EIMAC — Transmitting tubes, vacuum condensers and switches, rectifiers, vacuum tubes, diffusion pumps	Transmitting tubes, vacuum condensers and switches, rectifiers, vacuum tubes, diffusion pumps
Electrical Facilities, Inc. 4224 Holden St. Oakland	S. M. Gardner—P Geo. M. Thomas—VP	Harold Knapp—CE	Precision measuring and testing transformers, power rectifiers	Precision measuring and testing transformers, power rectifiers
*Electrical Products Corp. 1128 Venice Blvd. Los Angeles & Oakland	H. R. Owen—P W. J. Vaughn—VP L. A. Rice—VP, CE M. R. Manshardt—VP G. C. Greenlund—GM D. E. Baldwin—CPE	G. W. Thunen—CE E. O. Erickson—LbE	Electrical aircraft parts, Midget relays, crystals	Relays
Electron Equipment Corp. 917 Meridian St. South Pasadena	D. B. Clark—P, CE, DE H. Matthews—VP Florence Klingel—CPE		ELECO—R.P.M. controls, rectifiers, battery chargers, converters, inverters, high-frequency changers, induction heating units, transformers	R.P.M. controls, rectifiers, battery chargers, converters, inverters, high-frequency changers, high-frequency induction heating units, electronic transformers
*Electronic Specialty Co. 3456 Glendale Blvd. Los Angeles	David A. Marcus—M	Stuart K. Babcock—CE	RANGER—Aircraft radio receivers, transmitters, interphones and related equipment	Aircraft radio receivers, transmitters, interphones and related equipment
Excel Transformer Co. 2809 38th Ave. Oakland	J. Wasylina—P, CE		Special audio transformers	Special audio transformers
Federal Radio & Television Mfg. Co. 700 E. Florence Ave. Los Angeles	Geo. W. Berger—P, CE Gilbert A. Berger—VP Claude B. Andrews—GM L. V. Willat—CPE	Gilbert A. Berger—DE	Broadcast and police communications equipment	Communication equipment
*Fisher Research Laboratory 1961 University Ave. Palo Alto	Gerhard Fisher—O Curt Fisher—GM O. K. McCoy—CPE	J. Soderquist—CE Ed. Amsler—DE	Transmitters, receivers, M-scopes, antennas, power supplies, leak detectors	Transmitters, receivers, M-scopes, antennas, power supplies, leak detectors
Frazar & Hansen 301 Clay Street San Francisco	O. C. Hansen—PT E. W. Frazar—PT Wm. Morgan—CPE		(Export representatives)	(Export representatives)
*Gardner Elec. Mfg. Co. 4227 Hollis St. Oakland	S. M. Gardner—P, CE R. S. Wahlgren—VP C. R. Fisher—CPE D. G. Taylor—Sls.M, GM	M. G. Freeman—DE Ed. Mazzola—OE	GARDNER—Special transformers	Special transformers

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
General Controls Co. 801 Allen Ave. Glendale	W. A. Ray—P, CE A. W. Ray—VP, GM J. Fudge—CPE	Don Lewis—DE H. J. Matteson—OE L. C. Biggle—OE	HYDRAMOTOR — TRIM-THERM—Automatic electronic controls	Automatic electronic controls
*Gilfillan Bros., Inc. 1815 Venice Blvd. Los Angeles	S. W. Gilfillan—P J. G. Gilfillan—VP J. A. Brown—S I. B. Sparks—A, VP J. H. Miles—E, VP C. F. Wolcott—ATP A. L. McDermott—CPE, E J. Forrest—CPE, A	H. G. Tasker—CE, DE Wm. Lindsay—SP C. L. Johnson—OE J. Stokes—OE Keith Mealey—OE Glen Gerken—OE George Edlen—OE Wm. Hargens—OE Albert Albrecht—OE	GILFILLAN—Inter-phone amplifiers, hydraulic valves, hydraulic pumps, strainer assemblies, wiring assemblies	Radios, refrigerators, television
*Girard-Hopkins 1000 40th Ave. Oakland	A. R. Stack—PT J. C. Hopkins—PT	Chas. Lasswell—CE	Oil and wax filled capacitors	Oil and wax filled capacitors
Glenn-Roberts Co. 1009 Fruitvale Ave. Oakland	Geo. G. Glenn—P, GM James L. Vosburg—VP J. C. Weaver—CPE	D. C. Girard—CE	Welding equipment, relays, fixed capacitors	Welding equipment, relays, fixed capacitors
Robert M. Hadley Co. 707 E. 61st St. Los Angeles	Robert M. Hadley—O, VP, GM	H. Howard Hill—CE	HADLEY — Radio sheet metal specialties, transformers and chokes	Radio sheet metal specialties, transformers & chokes
Harvey Machine Co., Inc. Electronics Div. 6200 Avalon Blvd. Los Angeles	Leo M. Harvey—P Lawrence A. Harvey—VP Herbert Harvey—GM E. Kretzman—CPE	Wm. C. Aboussleman—CE John Novak—DE	HARMAC—HARCRAFT—Radio transmitters and receivers	Radio transmitters and receivers
Harwood Co., The Div. of Los Angeles Corp. 540 N. La Brea Ave. Los Angeles	E. C. Simmons—P R. F. Ingold—VP G. J. Levingston—VP, GM F. A. von Baum—CPE	A. C. Pearson—CE E. R. Griffin—DE Jack Byrd—OE	Cable connectors	Cable connectors
*Heintz & Kaufman, Ltd. So. San Francisco	Jack Kaufman—P S. Dollar—CH, BD W. Noel Eldred—GM	W. C. Wagener—CE	GAMMATRON—Transmitting tubes	Transmitting tubes
*Henry Mfg. Co. 2213 Westwood Blvd. West Los Angeles	Robt. E. Henry—PT J. T. Henry—PT J. Ewing Irwin—GM	Walter C. Elleby—CE	Quartz crystals	Radio products
*Hewlett-Packard Co. 395 Page Mill Rd. Palo Alto	David Packard—P G. Zieber—GM, CPE	Brunton Bauer—CE Chas. L. Watson—DE	Laboratory and measuring equipment, automatic welding control equipment, resistance tuned audio oscillators, audio signal generators, vacuum tube voltmeter, harmonic wave analyzer, distortion analyzer, etc.	Resistance - tuned audio oscillators, audio signal generators, vacuum tube voltmeter, harmonic wave analyzer, distortion analyzer, attenuation & voltage-dividers, etc.
*Hoffman Radio Corp. 3430 So. Hill St. Los Angeles	H. L. Hoffman—P, GM W. S. Harmon—VP, CE P. L. Fleming—CPE		HOFFMAN — MITCHELL — HUGHES — MISSION BELL — Communication equipment	Radios, phono combinations
Hollywood Transformer Co. 645 N. Martel, Hollywood	Ed. O. Woodward—O Jas. D. Corbett—CPE	Louis Katz—DE	HOLLYTRAN — Audio transformers and filters	Audio transformers and filters
Howard Pacific Corp. 932 N. Western Ave. Los Angeles	T. W. Keller—P L. E. O'Neil—VP, GM D. L. Keller—S, T E. V. Bialik—PA R. Atterbury—PA	W. F. Frankart—CE C. A. Briggs—PE M. Glatt—PE	Military radio equipment, special transformers	Home receivers, test equipment, amateur equipment

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*Industrial & Commercial Electronics Belmont	R. C. Shermund—P, GM C. V. Litton—VP M. C. Keil—CPE	D. G. Clifford—CE H. E. White—DE	Transmitting tubes and relays	Transmitting tubes
*Jennings Radio Mfg. Co. McLaughlin Rd. San Jose	J. E. Jennings—PT F. W. Gillmeister—PT		Vacuum condensers and tubes	Vacuum condensers and tubes
*Kaar Engineering Co. 619 Emerson St. Palo Alto	J. M. Kaar—O, GM, CE E. W. Mersereau, Jr.—CPE	N. C. Helwig—R, DE S. P. French—T, DE Geo. Callander—OE Carl Schneider—OE Carl S. Chambre—OE	KAAR—Receivers, transmitters, marine radiotelephones, quartz crystals, microphones, variable air condensers, vibrator power supplies, mobile antennas	Receivers, transmitters, marine radiotelephones, quartz crystals, microphones, variable air condensers, vibrator power supplies, mobile antennas
Lake Mfg. Co. 2323 Chestnut St. Oakland	H. H. Edgar—O, GM J. Aletoo, Jr.—CPE, CE		VOYCALL — Intercommunicating equipment, amplifiers and paging equipment, electric signal bells, lamp annunciators, telephone relays, special signaling devices	Intercommunicating equipment, amplifiers and paging equipment, electric signal bells, lamp annunciators, telephone relays, special signaling devices
Lenkurt Electric Co. 1138 Howard St. San Francisco	L. G. Erickson—PT, CE, DE K. E. Appert—PT, OE F. I. DuFrane—PT		LENKURT — Carrier telephone and telegraph equipment for wire lines and radio	Carrier telephone & telegraph equipment for wire lines and radio
*Lewis Electronics 16 Lyndon St. Los Gatos	M. Shaw—P, GM, CPE Weldon G. Drew—VP	Garrett W. Lewis—CE N. V. Bramley—DE Eldred Hodges—OE	Transmitting tubes, repair and rebuilding, transmitting tubes	Transmitting tubes, rebuilding tubes
*Littelfuse, Inc. 200 West Ong St. El Monte	E. V. Sundt—P, CE Ashford M. Wood—VP, GM W. J. McKay—CPE		Circuit protecting fuses, signal lights	Circuit protecting fuses, signal lights
*Litton Engineering Labs. Redwood City	Charles V. Litton—O, CE J. G. Copelin—GM L. K. Bolender—CPE	Charles V. Litton—CE	Glassworking lathes, sealing machines, vacuum pumps, tube parts	Relating to radio and radar
*Marine Radio Service, Inc. 330 Broad Ave. Wilmington	Paul F. Wiser—P, DE E. T. Wiser—VP R. Lewis—GM E. Smith—CPE	G. M. Urey—CE J. W. Elliott—OE	SEAPHONE—Communications equipment	Marine electronic equipment
McColpin-Christie Corp. 4920 S. Figueroa St. Los Angeles	S. L. Christie—P, DE H. R. Jaenecke—PM R. E. Sanderson—CPE		C&C—Battery chargers & testers, rectifiers, industrial boiler water analyzers	Battery chargers and rectifiers
Megard Corp. 1601 So. Burlington Ave. Los Angeles	J. D. Funderberg—P, GM	C. E. Taylor—CE	Communication equipment, amplifiers, home radio	Communication equipment, amplifiers, home radio
*Memovox, Inc. 9242 Beverly Blvd. Beverly Hills	Walter M. Fagan—P Peter C. Bryce—VP W. J. Hopkins—CPE	Geo. P. Brubaker—CE T. E. Graham—DE P. B. Ugrin—OE	MEMOVOX — MEMO DISK—Recording equipment	Recording equipment
Lee J. Meyberg Co., Inc. 70 10th St. San Francisco	A. H. Meyer—P E. E. Young—VP W. J. Lancaster—SM J. H. Moulthrop—CPE	H. D. King—CE B. Barney—DE A. Grenn—OE	Commercial sound systems, crystal holders	Commercial sound systems, crystal holders
Miller Coil Co. 5917 So. Main St. Los Angeles	J. W. Miller—P	Paul O'Connor—CE	RF coils	RF coils

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
Wm. Miller Corp. 362 W. Colorado St. Pasadena	Wm. W. Miller—P, CE D. A. Kelly—VP Geo. W. Downs—VP R. F. McKernan—CPE		Galvanometers, oscillographs, strain gages, vibration testing equipment	Galvanometers, oscillographs, strain gages, vibration testing equipment
*Monitor Piezo Products Co. 815 Fremont Ave. South Pasadena	H. E. Blasier—P, CE Dwight H. Reay—VP J. G. Rasmussen—VP W. N. Johnson—PL, SU A. G. Wallsworth—CPE		Quartz crystals	Quartz crystals
National Technical Labs. 820 Mission St. South Pasadena	A. O. Beckman—P C. A. Mason—GM E. H. Polkinghorne—CPE	H. H. Cary—CE R. E. Vaniman—DE	pH meters, Spectrophotometers and Helipots	Spectrophotometers and Helipots
Newcomb Audio Products Co. 2815 S. Hill St. Los Angeles	Robert Newcomb—P		ROBOTROL — Commercial sound systems	Commercial sound systems
Pacific Clay Products SteaPACtite Div. 306 W. Ave. 26 Los Angeles	Roy Lacy—P Vincent Palmer—VP R. M. DePrez—CPE	R. W. Huber—EE	SteaPACtite — Coil forms, choke coils, heater cores, insulators, posts, coaxial cable beads, welding ferrules, lapping plates, crystal holders, tube bases	Coil forms, choke coils, heater cores, insulators, posts, coaxial cable beads, welding ferrules, lapping plates, crystal holders, tube bases
*Pacific Radio Crystal Co. 1035 Post St. San Francisco	Gerald A. Stoff—PT A. S. Matthews—PT	R. E. G. Dewar—CE	Quartz crystals	
Pacific Sound Equipment Co. 1534 Cahuenga Blvd. Hollywood	R. G. Metzner—P, CE Andrew Charles—GM Wm. L. Maas—CPE	A. B. Rotenberg—DE C. B. Stegman—OE	PORTELEC — Transcription players, combination P-A system & transcription players	Transcription players, combination P-A system and transcription players
*Packard Bell Co. 1115 S. Hope St. Los Angeles	H. A. Bell—GPT J. M. Splain—SD H. D. Thomas, Jr.—GM Frank A. Ware—CPE	A. R. Ellsworth—CE R. W. Hill—PE E. H. Veeke—PE J. Goode—PE	PACKARD—BELL—Radio and test equipment	Radios—radio phonographs and phonocords
*Peerless Electrical Products Co. 6920 McKinley Ave. Los Angeles	John O. Aalberg—P L. W. Howard—VP John E. Tippie—GM E. P. Curtis—CPE	E. M. Keillor—CE Ray Davidson—OE	PEERLESS — Transformers, radio and radar, solenoids & motor windings, fluorescent ballasts	Transformers — radio & radar, solenoids and motor windings, fluorescent ballasts
Plastic Fabricators Co. 440 Sansome St. San Francisco	I. M. Montalto—P		DURASHIELD — Plastic nameplates, panels, directional signs, aircraft label plates, dial faces	Plastic nameplates, directional signs, aircraft label plates, dial faces
Precision Specialties 210 No. Western Ave. Los Angeles	J. Rabinowitz—PT, SD L. H. Glaser—PT, GM G. I. Taylor—CPE	Z. Goodman—CE H. C. McLean—DE	Sockets and terminal strips	Home radios, recorders
*Remler Co., Ltd. 2101 19th at Bryant San Francisco	E. G. Danielson—P, GM Robt. C. Gray—VP Geo. Coleman—CPE	H. E. Greene, Jr.—CE, DE H. L. Parker—OE, SE	REMLER — Battle announcer equipment, marine amplifiers, microphones, signal cords, plugs and connectors, custom plastic molding of electrical and electronic parts	Radio broadcast receivers, electronic intercommunications, radar and present merchant and navy announcing equipment

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*Rieber Inc., Frank 11916 W. Pico Blvd. West Los Angeles	Chas. Griffith—P, GM Richard G. Leitner—VP, CE, DE R. Stanley Clarke—VP J. Cherrett—CPE	Wm. K. Rieber—OE Frank Gilbert—OE	CGS—Caltron, recorders and reproducing equipment, airplane instruments, radio equipment, meteorological instruments, amplifiers, ammeters and voltmeters, frequency meters, photoelectric devices, public address systems	Recording and reproducing equipment
Robinette Co., W. C. 802 Fair Oaks Ave. South Pasadena	W. C. Robinette—P, O, CE, DE V. A. Robertson—GM C. F. Tinsman—CPE	L. R. Pugh—OE	MOTRON—Electronic devices and controls, relays	Electronic devices and controls, relays
*Sargent Co., E. M. 212 9th St. Oakland	E. M. Sargent—P	L. C. Ragment—CE	SARGENT—Communications equipment	Communicating equipment
*Schott Co., Walter L. 9306 Santa Monica Blvd. Beverly Hills	Walter L. Schott—P Arnold Schott—GM P. D. Molen, Jr.—CPE	Frank Wilburn—CE	WALSCO—Cord assemblies and component parts, radio parts and chemicals	Cord assemblies & component parts—radio parts and chemicals
Searle Aero Industries Orange	M. O. Searle—P, CE G. M. Marco—VP M. W. Kiphart—CPE	F. Harrington—OE Fred Aves—OE	AMERFLEX—Searle indicator light, conduit, aircraft radio	Searle Indicator Light, Amerflex conduit, aircraft radio
Selenium Corp. of America 1719 W. Pico Blvd. Los Angeles	C. O. Rich—P Eric Lidow—VP, CE M. Burlin—GM Ellwood Reich—CPE	Marc Holzman—DE Alfonze Quindry—OE	SELCO, EMBY — Photocells, instrument & relay rectifiers, power rectifiers	Photocells, instrument & relay rectifiers, power rectifiers
Signal Electric Supply Co. 234 9th Ave. San Francisco	N. P. Kafoury—P, GM	Philip Garner—CE, DE	Electrical-electro mechanical devices for Armed Forces	Electronic & signal equipment, interphones, induction heating
*Sound Equipment Corp. of Calif. 6245 Lexington Ave. Hollywood	Norman S. Lawson—P Wm. A. Lower—VP Delmar Wright—GM E. J. Kershner—CPE	D. H. Jones—CE, DE Joe E. Turner—OE Lawrence Rector—OE Clarence Addis—OE	Test equipment, aircraft radio & interphones, control panels, interference filters, radio frequency coils, chokes and transformers, custom built portable radio, communication equipment, custom built phantom antennas, audio amplifiers & accessories, public address systems, supersonic amplifiers & accessories	Test equipment, aircraft radio & interphones, control panels, interference filters, radio frequency coils, chokes and transformers, custom built portable radio, communication equipment, custom built phantom antennas, audio amplifiers and accessories, public address systems, supersonic amplifiers and accessories
*Speedex Mfg. Co. 530 Gough St. San Francisco	Leslie Logan—P		SPEED X — Telegraph keys and practice sets	Telegraph keys and practice sets
Stoddart Aircraft Radio Co. 6630 Santa Monica Blvd. Hollywood	R. R. Stoddart—P Sam Timbrell—GM	Paul J. Holmes—CE C. L. Fleissner—OE W. G. Hodson—OE Nathan R. Silk—OE Orrin Bowers—OE	Aircraft transmitters and receivers, power supplies, remote control antenna tuning units, dummy antenna type DA-3, VHF transmitters, VHF receivers, microvolter	Aircraft radio and equipment
*Thermador Electrical Mfg. Co. 5119 So. Riverside Dr. Los Angeles	H. H. Fogwell—P	H. Bolderson—CE	Transformers, laboratory equipment	Transformers, laboratory equipment

COMPANY & ADDRESS	CHIEF EXECUTIVES	ENGINEERS	TRADE NAME & PRODUCTS	POSTWAR PRODUCTS
*Technical Radio Co. 275 Ninth St. San Francisco	C. F. Bine—P, CE Geo. Weiss—VP, CPE E. E. Olson—GM	F. D. Wells—DE H. Warner—DE S. Konigsberg—OE J. Suparich—OE	TECRAD — Transmitters, receivers, direction finders	Transmitters, receivers, direction finders
*T. W. T. Co. 6127 So. Western St. Los Angeles			Receivers, transmitters, amplifiers	
Ungar, Inc., Harry A. 615 Ducommun St. Los Angeles	Sidney Ungar—P, CE		Space wound coils, rf coils, soldering pencils	Space wound coils, rf coils, soldering pencils
*Universal Microphone Co. Centinela & Warren Lane Inglewood	James L. Fouch—P Cecil L. Sly—VP LeRoy Hannan—PM Karl Mautz—CPE	L. A. Willyard—CE H. S. Baumgarten—ME Floyd Long—TE Gerrald Kane—TE	UNIVERSAL — Microphones, plugs, jacks, switches, cord assemblies	Microphones, electro-acoustical, electro-mechanical components
Vaidaphone Co. 1323 Venice Blvd. Los Angeles	J. E. Vaida—O A. M. Hyne—CPE	K. Wennenwetch—CE Paul Rowe—DE	VAIDAPHONE — Electrical connectors, voice powered telephones	Detector unit headsets, plastics
*Wellman Mfg. Co. 7122 Melrose Ave. Los Angeles	W. N. Wellman—GM	Carl Eliassen—CE H. Nesbit, Jr.—OE	Crystal hardware, solenoids, switches	Solenoids and phonette music boxes
Western Electro-Mechanical Co. 300 Broadway Oakland	W. J. Foster—P, GM W. W. Scherer—VP, CE		Electrical instrument equipment, transformers, meters, special applications	Electrical instrument equipment, transformers, meters, special applications

*Member Western Electronic Manufacturers Association.

P—President; VP—Vice President; GM—General Manager; CE—Chief Engineer; CPE—Chief Purchasing Executive; DE—Design Engineer; OE—Other Engineers; LE—Liaison Engineer; PT—Partners; O—Owners; LBE—Laboratory Engineer; ATP—Ass't to President; CPE-E—Chief Purchasing Executive—Electronics; CPE-A—Chief Purchasing Executive—Aircraft; DE-R—Design Engineers—Receivers; DE-T—Transmitters; PL SU—Plant Supt.; G.PT—General Partner; SD—Sales Director; PE—Product Engineer; PM—Production Manager; SM—Sales Mgr.; ME—Mechanical Engineer; M—Manager; SP—Sales Production; EE—Executive Engineer.

DIRECTORY OF CALIFORNIA MANUFACTURERS' REPRESENTATIVES

Following is a list of manufacturers' representatives resident in California and representing manufacturers both in that state and throughout the rest of the United States. Following each name is the representative's telephone number, local to the city in which he headquarters:

Alameda

Watkins, E. J., 1531 Morton St., LA 2-6784

Hollywood

Fry & Roberts, 6406 Sunset Blvd., GL-0115
Miller, Gerald B., 1051 North Havenhurst Drive, GL-6932
Neely Enterprises. Norman B., 5334 Hollywood Blvd., HI-9133

Long Beach

Wallace, Don C., 4214 Country Club Drive, Long Beach 4-3459

Los Angeles

Barbera Co., A. A., 417 South Hill St., VA-7121
Booth Co., Arthur E., 210 West 7th St., VA-5226
Bower, Fred B., 923 East Third St., MI-5906
Cohn Sales Co., S. H., 2533 South Hill St., PR-8836
Ealy, M. D. 1425 South Flower St., RI-9121
Ellis, R. G., 1005 North Crescent Heights Blvd., HE-6119
Emmet Co., Frank A., 2837 West Pico Blvd., RO-9111
Evans, Evan, 324 North San Pedro St., MU-7808
Farnham & Cunningham, 601 West 5th St., MU-8995
Fox Associates, 1157 S. Hill St., RI-0383
Henry Co., Paul, 2037 South LaCienega AS-4-2722
Hill Sales Co., J. T., 800 West 11th St., PR-7503
Hitt Co., W. C., 1341 South Hope St., RI-9121
Hoppe & Co., W. A., 516 East 4th St., TU-3768
Hughes, Emmett N., Room 505, 1709 West 8th St., FE-8441
Jordan, E. J., 650 South Grand Ave., TR-7403
Joslyn Co. of California, 5100 District Blvd., JE-4251
Knight, Inc., W. Bert, 908 Venice Blvd., RI-6362
Lasure Co., Harry A., 2216 West 11th St., DR-1263
Lippincott Co., Inc., 311 South Spring St., MU-8186
Lombard Smith Co., 2032 Santa Fe Ave., KI-3297
Lynch, C. R., 210 West 7th St., VA-3805
Marshall Tool & Supply Co., 1224 South Santa Fe Ave., TR-6456
Marshank Sales Co., 2022 West 11th St., DR-6842
Noel, R. J., 2710 South Hill St., PR-3672
Perlmuth & Associates, J. J., 942 Maple Ave., TR-7353
Pope, Jr., James C., 1425 S. Flower St., RI-9121
Porter, Don, 1440 South Robertson Blvd., BR-2-1473
Radio Products Sales Co., 238 West 15th St., PR-2488
Rodman & Co., 1827 South Hope St., PR-1381
Rupp, Vern T., 1406 S. Grand Ave., PR-9516
Sanford Co., D. E., 1049 South Hill St., PR-1481
See, C. C., 453 Powell St.
Sievers, Edward S., 417 South Hill St., MI-3691
Sperry, Lewis E., 1406 South Grand Ave., RI-0941
Stone Co., Carl A., 1406 South Grand Ave., PR-2818
Tivy, George S., 1406 South Grand Ave., RI-6191
Trade-Wind Motorfans, Inc., 5725 South Main St., AD-5217
Twomey Co., Inc., E. F., 725 Mateo St., TR-9467

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SURVEY of WIDE READING

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

Dielectric Constants and Power Factors at Centimeter Wavelengths

C. R. Englund (Bell System Technical Journal, January, 1944).

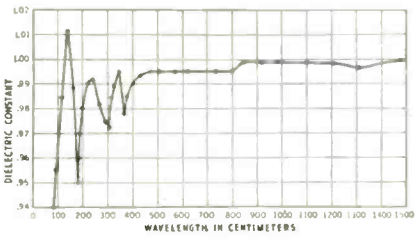
A resonance method has been developed to determine the power factor and the dielectric constant of various dielectrics in the centimeter wavelengths range. The underlying theory is explained, method and apparatus used described and results tabulated.

Dielectric Constant of Ionized Air in a Tube

Nurul Alam and S. R. Khastgir (Indian Journal of Physics, Calcutta, August, 1943).

The effective dielectric constant of ionized air in a discharge tube has been measured for wavelengths from about 80 cm to 1,500 cm. The discharge tube was inserted between two capacitor plates connected to the input terminals of a pair of Lecher wires. A conventional oscillator was used to induce oscillations in the system and a short-circuiting bridge moved until resonance was indicated by a detector, also coupled to the input terminals of the wire system. The resonance lengths for discharge and no discharge condition of the tube are required to compute the dielectric constant.

Three distinct minima in the value for the dielectric constant at 175 cm, 310 cm and 370 cm were established, as will be seen from the diagram. The minima are closely connected with resonant oscillations in these frequency ranges which could be detected when the oscillator was not working. Further, layers of different electron density were observed in the plasma, justifying a theory which attributes a resonant frequency to an ionized medium and gives a relation between this resonant frequency and the electron density. The resonance oscillations explain the unusual minima in the curve of the dielectric constant as a function of frequency, so that all three experimental phenomena are tied up by the theory.



Ground and Cloud Scatter of Electromagnetic Radiation

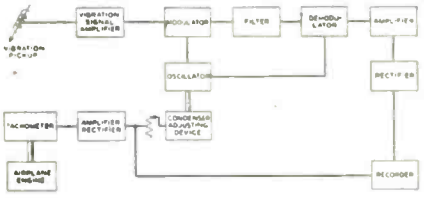
T. L. Eckersley, G. Millington and W. Cox (Nature, London, March 18, 1944).

Experiments in the frequency range of from 7 to 20 megacycles have been carried out to investigate whether the echo phenomena observed are due to scattering by clouds in the E layer or by the ground. The shortest possible delay time for both cases was calculated and comparison with the experimental results definitely showed cloud scattering to be responsible. However, it is not proved that ground scattering does not exist and, as the cloud scatter will diminish for higher frequencies, it is thought possible that ground-scatter will predominate at frequencies greater than 30 megacycles.

An Automatic Vibration Analyzer

F. G. Marble (Bell Laboratories Record, April, 1944).

The device is designed to measure the power plant and airplane vibration characteristics in flight. Speed in obtaining the data and in their analysis to locate the source of the trouble is of great importance. For rapid evaluation of the data, it is necessary to determine the amplitude of vibration at a frequency equal to a number of selected multiples of engine rpm, when the engine speed is continuously changed. The device can be used with a recorder to draw curves of the amplitude of vibration of selected multiples of engine rpm as a function of engine speed, which is assumed to range from 500 to 3,000 rpm. It is desired to cover a frequency range from 3.33 to 500 cycles per second, but because of the difficulty



in separating very low frequencies, the full accuracy of the analyzer is not guaranteed below 5.5 cycles.

The nature of vibration at some point on the engine or airplane is indicated by the electrical output of a pickup device attached at that point. The output of the tachometer is amplified and rectified and controls the motion of the chart on the recorder so that it takes a position that represents the engine speed. The oscillator and its accessory equipment is designed and adjustably controlled by the tachometer output to have a frequency of 92,000 + F, where F is equal to the particular multiple of the engine rpm to be measured. It will be seen that the oscillator, modulator, filter, demodulator combination will pass only the frequency F, provided the filter has a narrow pass band around 92,000 cycles per second; the pass band of the crystal filter used is 4 cycles wide. The output of the amplifier and rectifier controls the position of the recording pen.

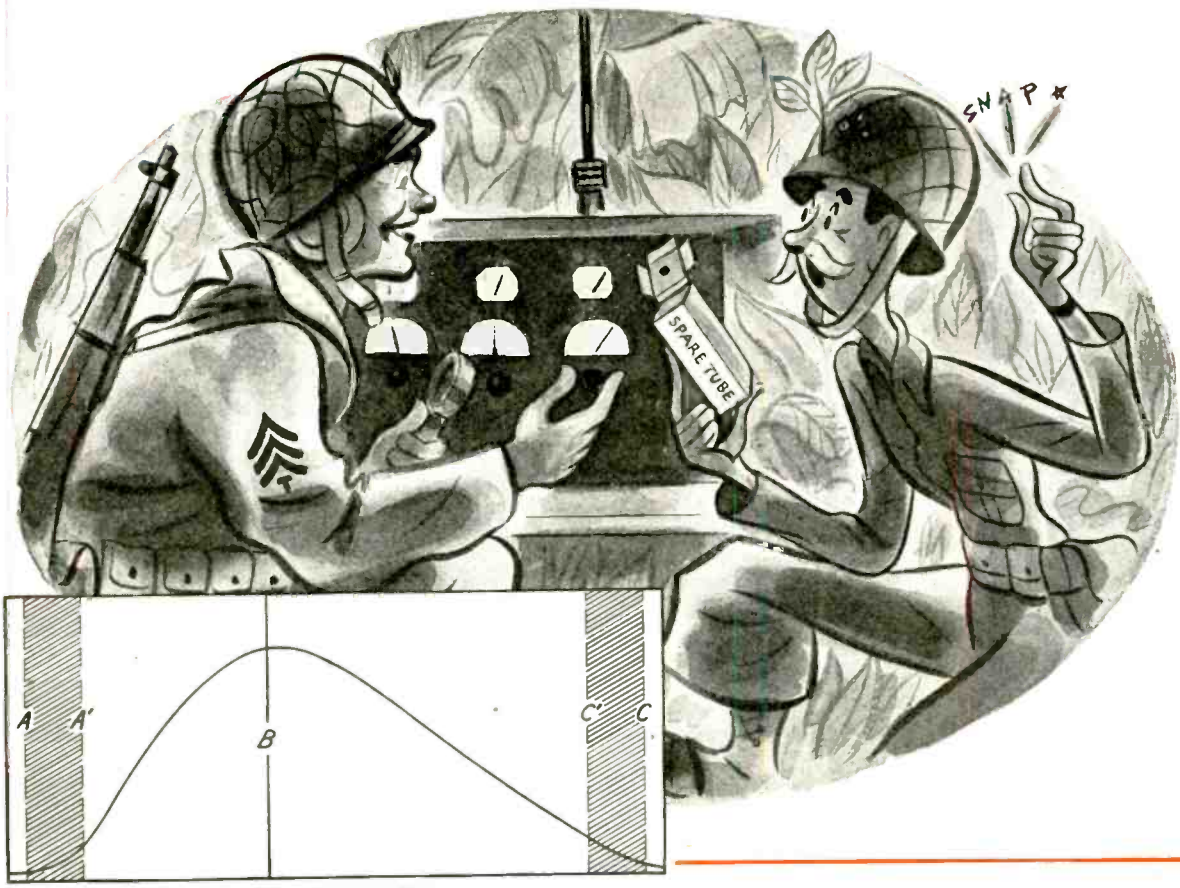
Expander Circuit

M. O. Felix (Wireless World, London, March, 1944).

A volume expander to increase the high amplitudes (reduced before transmission or recording) is suggested. In the cathode follower circuit shown, the variable mu-tube is connected in parallel with output resistor R_2 and if its impedance—the inverse of its mutual conductance—is negligibly small compared to R_1 and R_2, the output voltage will be proportional to the tube impedance; this will be seen if only the circuit components R_1, R_2 and the tube, considered as an impedance in parallel to R_2, are studied. With the type of tube used in the figure,

(*Continued on page* 202)

"Right On The Button"



DISTRIBUTION CURVE—TRANSCONDUCTANCE

Conscientious electronic equipment manufacturers avoid special selection of tubes. When a battlefront tube replacement is made, they want "on the button" performance. They allow for possible additive effects of tolerances for other components — and for the many minor differences of equipment assembly, wiring, and adjustment. Also they realize it is impracticable to manufacture all electronic tubes of a given type exactly alike. Yet they demand and deserve close observance of their tolerances for each tube characteristic. (See A and C on the distribution curve.) Hytron insists on still tighter factory specifications. (Compare A′ and C′.)

Hytron goes still further. Based on past experience — its own and others' — whenever practicable a "bogie", or desired goal, for each characteristic is set. (Compare B.) Controlled design and production aim at producing the majority of tubes with this preferred value, which is not necessarily and arbitrarily midway between tolerances. It is rather the ideal for peak performance—dictated by experience and attainable if exact duplication were possible.

Specify Hytron for tighter specifications — for "bogie"-controlled production — for uniform performance.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND

WHAT'S NEW

RCA Plastic Preheater

RCA Victor Division of the Radio Corp. of America has put in production for June deliveries an automatic electronic oven for pre-heating plastic materials to ready them for the molding process.

The new unit, model 2-B Electronic Power Generator, is a compact, self-contained package item. Proportioned somewhat along the lines of a small electric refrigerator, the cabinet is designed with a built-in, easy-to-reach heating electrode assembly in a chamber at the top. A wire mesh lid is closed over the heating chamber when in use, insuring safety without shielding the work material from view. The cover of the heating chamber opens automatically and shuts off the power at the expiration of a pre-determined heating interval.

Timer, power controls and indicators are mounted on a tilted control panel. Access to tubes and components of the generator equipment is provided by front and rear doors equipped with power disconnect switches and key locks to prevent entry except by authorized maintenance personnel.

To pre-heat plastic preforms for molding, the operator simply places the preform on the bottom electrode, then closes the counter-balanced lid, automatically bringing the retracting upper electrode into contact with the work, and presses the starter button. The top electrode mounting and operating mechanism is designed to permit the electrode to seat flat and exert uniform pressure on any thickness of preform within its operating range. At the end of the heating cycle, the pre-set timer automatically opens the lid and shuts off the power. The synchronous motor timer, adjusted by means of a knob on the front panel, may be set for time cycles from two seconds to 120 seconds.

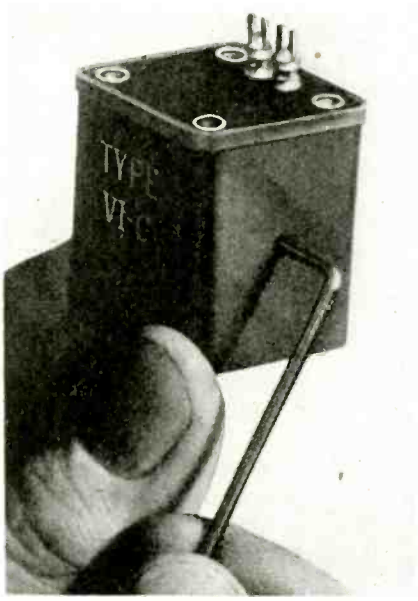
The generator delivers up to 2000 watts of power, or 6800 BTU per hour, into a dielectric load of average characteristics, with an input of approximately 4.5 kw maximum and a line voltage of 200-240 volts, 50-60 cycle, single phase. Ultra-high operating frequency (approximately 27.4 megacycles) insures rapid heating of a wide variety of materials without danger of arc-over between plates. The unit is equipped with two RCA 833A oscillator tubes, four RCA 8008 rectifier tubes, and two RCA 2050 control tubes.

Automatic overload relays guard against tube overloads, and an automatic time-delay relay prevents damage which might otherwise result from starting the unit without an adequate filament warm-up. The unit is completely shielded to minimize the possibility of radio interference. An automatic filament voltage regulator, capable of handling a line voltage range of 190 to 260 volts, supplies constant voltage to tube filaments.

An additional ingenious feature consists of two infra-red lamps installed in the heating chamber, providing auxiliary radiant heat to prevent cooling of the preform surfaces by the surrounding air. The entire mechanism is cooled by filtered air from a built-in blower system. Dual filters are used in order to insure maximum cleanliness of the cooling air.

Variable Inductor

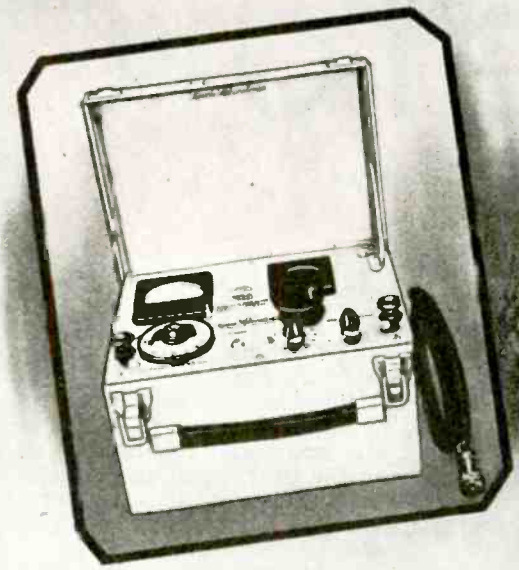
This new VI-C inductor, developed by United Transformer Co., 150 Varick St., New York, has an adjustable inductance variation of plus 90 to minus 50 per cent from a mean value. It is thus suitable for use in oscillators, (a model with 30 per cent tap for Hartley circuits is available), tuned amplifiers, equalizers and filters. It is housed in a die cast case, weighs approximately 5 oz. and the inductance is varied by means of an Allen wrench. There are nineteen standard types, from .0085 to 33.0 henries.



Orientation Table

A new type of quartz orientation table has been developed by the Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif., with which standard X-ray readings may be duplicated accurately. The table can be rotated 360 degrees and has a plainly visible scale and pointer for indicating X-ray corrections. Adjustments are provided which automatically compensate for wear; spring-loaded gears eliminate backlash. The table and mechanism are cast bronze, chromium plated. Simple micrometer cross adjustments are provided for horizontal travel in both directions and these together with the 10½-in. 360 degree primary rotation scale make possible a simple and positive orientation method.

(*Continued on page 269*)



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WASHINGTON

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

AIRBORNE ELECTRONIC EQUIPMENT UP SHARPLY—Airborne electronic equipment production is rising very steeply and as projected over the latter half of 1944 will be nearly double the requirements of last year, but at the same time, the schedules for ground radar and ground radio, fixed and mobile, as blueprinted by the armed services will dip downward sharply for the remainder of this year. The Signal Corps' requirements up to now have been the chief indicator for the radio-electronic industry, but the Navy's increased scheduling of production is at present above the Army and is expected to advance substantially in the next few months.

NAVY REQUIREMENTS A CUSHION—The Navy's requirements are viewed definitely as a cushion to maintain the high level of radio-electronics production that has been the fare of the industry for the past 18 months. Radio and electronic equipment requirements, as revealed by the Army and Navy, as of March 1 constitute 4 per cent of the total munitions needs of the armed services.

PLAN TO REMEDY DISLOCATION—Because of the sharp shift to airborne equipment the WPB Radio and Radar Division is endeavoring to cooperate with the manufacturers and armed services to have the airborne electronic producers on a voluntary basis and as far as is feasible subcontract portions of their Army-Navy orders to the plants which have been specializing in ground radar and ground radio.

BEST USE OF FACILITIES—This subcontracting move is aimed to get the best possible maximum use of all existing production facilities and to give the armed services greater flexibility in the scheduling and fulfillment of their equipment orders. It likewise is aimed to extend subcontracting both for end-products and for components. It is felt that this plan will aid in preventing dislocations of production by the ground radar and ground radio manufacturers. It also will bring to the forefront in the minds of the management of the latter branch of the industry that reconversion to civilian production is not "just around the corner."

STUDY RESEARCH TRENDS—The WPB Radio and Radar Division Director who has achieved such a notable record in his government career in the coordination of military electronic production made an extensive inspection of the research trends, the types and quantities of products being manufactured in Russia and the organization and facilities of the Soviet radio and radar industry. The results of his observations are most important for the American industry in its planning for the immediate future of the next two years.

SOVIET REQUIREMENTS—The two months' study of Soviet electronic equipment requirements, made by Director Ray C. Ellis of the WPB Radio and Radar Division, brought out the forecast that Russian requirements for radio tubes and parts are expected to increase in 1944 and 1945. It was stressed that if these Soviet requirements are to be met by the American industry it is essential that Russian orders to the American industry cover products currently being produced and not items becoming obsolete. Mr. Ellis visited representative radio and radar laboratories and factories in Moscow and the Ural region and discussed at numerous conferences with Soviet officials the general production plans of the industry in the United States so that the Soviet requirements could be synchronized as much as possible with the manufacturing program in America.

SURVEY OF TUBE STOCKS—A most important study to determine what can be released from Army and Navy stocks of vacuum tubes, featured by a stock control survey of the Signal Corps' inventory at the Philadelphia Signal Depot, has been launched. The Signal Corps is planning a control of both its inventories and future scheduling so as to secure tubes on the basis of actual requirements and not on estimates.

ANALYSIS OF TUBE REQUIREMENTS—The vacuum tube industry, the WPB and the Office of Civilian Requirements, in addition, are planning an analysis of the complete and true tube requirements of the armed services and civilian users. For the immediate present there is to be no upturn in the production quotas of civilian home receiver tubes. In regard to future surplus tubes, released by the armed services, the tube manufacturing industry has made a most important recommendation that it should assume the responsibility of testing and reconditioning such tubes before their sale to civilian users and services—this seems to be an excellent pattern for all industry to follow in the disposal of surpluses from the armed forces.

CHANGE IN DRAFT—Until the fortunes of war clearly define the requirements of the armed services, the radio-electronic industry can keep its key workers in the age group from 26-30 until next December 1 and the men from 30 to 38 will remain in essential civilian war work untouched by induction indefinitely. It is hoped that Selective Service can maintain this policy; of course, General Hershey and his aides are in a most difficult spot to forecast the Army-Navy manpower needs. The armed forces cannot take any chances in fighting such tough foes and, if the policies for the draft have to be continuously changing—as witness the situation which prevailed before the May issue of ELECTRONIC INDUSTRIES went to press—it can only be chalked up to another situation of "C'est la guerre."

MISCELLANY—The WPB requires its advance written permission before critical electronic components and parts can be sold to jobbers and distributors for civilian use; prime contractors and component manufacturers must heed carefully the early May warning of Radio and Radar Division Assistant Director John S. Timmons . . . FCC has launched comprehensive study of use of radio communications by railroads, will take two years to complete.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

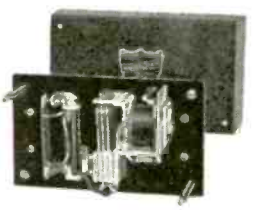
wherever a tube is used...

for example

R. F. SHORT WAVE THERAPY

Radio Diathermy is used in therapeutic treatment of bruises, sprains, dislocations, arthritis, fractures, respiratory and sinus diseases. Oscillator type tubes generate the required high frequency.

T-100 Laminated Time Delay Relay
Send for Bulletin R-5



T-110 Time Delay Relay (not laminated)
Send for Bulletin R-5

THERE'S A JOB FOR

Relays BY GUARDIAN

The filaments of oscillator type tubes require a "warm up" of 20 to 30 seconds which is usually provided by a time delay relay such as Guardian's Type T-100. In this relay the time delay is adjustable between 10 and 60 seconds and is accomplished by means of a resistance wound bi-metal in series with a resistor. The contact capacity of the T-100 is 1500 watts on 110 volt, 60 cycle, non-inductive AC. The power consumption of coil and time delay during closing of the thermostatic blade is approximately 10 VA; after closing, 5.5 VA.

A similar relay giving almost the same performance but costing somewhat less is the Series T-110. This relay may be equipped with an extra set of open or closed contacts, if desired. In industrial control, both relays may be used in applications requiring the changing of circuits after a predetermined interval.

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.

GUARDIAN ELECTRIC

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A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

ASSOCIATION NEWS

Municipal Signal Assn. at Boston, in October

The 49th annual meeting of the International Signal Association, Inc., will be held at Hotel Statler, Boston, Mass., October 2-3-4-5, 1944. Theme of the meeting will be "Today's Work—Tomorrow's Plans" and outstanding authorities will deliver papers on all phases of municipal signaling work — fire alarm, police telegraph, radio communication (for both fire and police depts.), traffic signals, etc. There will also be open forums participated in by members of the association for discussion of various divisions of the work. It is expected that leading manufacturers in this field will have displays and demonstrations of equipment.

All those interested in, or affected by, municipal signaling work, whether members of the association or not, are cordially invited to attend this annual conference, by Irvin Shulsinger, secretary, 8 E. 41st St., N. Y.

Chicago "Electronic Hub" —sez Pres. Ill. Mfrs. Assn.

Chicago's postwar role as the leading production center of electronic, radar and radio equipment was forecast during an April statement by J. C. McKeever, president of the Illinois Manufacturers' Association and head of The Gerlach-Barklow Co. of Joliet, Ill.

"More than 100 plants, large and small, are planning for big expansion in this relatively new industry," he said. Growth of radio and radio tube manufacturing in the Windy City, McKeever observed, has vastly exceeded the 1939 figure of $70,000,000. He cited Western Electric, the largest electronic plant in Chicago with a personnel of 29,000, which had rolled up estimated war sales for last year amounting to $575,000,000.

Envisioning a tremendous postwar market for home radio sets alone, McKeever declared that, due to the shortage of skilled servicemen, the rate at which radio sets have been discarded and thrown out of service has increased from 10 per cent a year to about 18 per cent.

"That gives us a two-year backlog of 25 to 30 per cent," he computed, "plus the normal 10 per cent of the current year in which production is resumed. That means 30 to 40 per cent, if production were to be resumed this Spring. And there were an estimated 60,000,000 radios in service at the outbreak of the war."

Conventions and Meetings Ahead

Society for Measurement and Control (New York Section Meeting), June 6, Newark, N. J.

Radio Manufacturers Association (B. Geddes, 1317 F. Street, Washington, D. C.), 20th annual meeting, June 6-7, Chicago, Ill.

Institute of Radio Engineers (330 West 42nd Street, New York City), June 7, September 6, October 4, New York.

Radio Club of America (11 West 42nd Street, New York City), June 8, New York.

American Society of Mechanical Engineers (Ernest Hartford, 29 West 39th Street, New York), Semi-Annual Meeting, June 19-20, Pittsburgh.

American Physical Society (K. K. Darrow, Columbia University, New York City), June 23, 24, Rochester, N. Y.

American Society for Testing Materials (260 S. Broad Street, Philadelphia), June 26-30, New York City.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York); Summer Technical Meeting, June 26-30, St. Louis, Mo.; Pacific Coast Technical Meeting, Aug. 29-Sept. 1, Los Angeles.

Electronic Parts and Equipment Industry Conference (Herb Clough, Beldon Mfg. Co., Chicago), October 6-9, Edgewater Beach Hotel, Chicago.

Electrochemical Society (Colin G. Fink, Columbia University, New York City), Fall Meeting, October 13-14, Hotel Statler, Buffalo, N. Y.

American Welding Society (G. Sykes, 30 East 42nd Street, New York City), October 16-19, Hotel Cleveland, Cleveland, Ohio.

Speeds War News

Difficulties in transmitting war news—ofttimes a plague to press correspondents — have been overcome on the Italian front by the first American wholly-owned commercial radio station on the continent of Europe. Reports reaching offices of RCA Communications, Inc., in New York, tell of a remarkable feat in which engineers of the company installed the station from scratch in less than one month and now are flashing on-the-spot news accounts at a rate as high as 240 words a minute.

NEMA Electronic Section Discusses Tubes, Charts, etc.

Reports by committee chairmen of the National Electrical Manufacturers' Association Electronics Section occupied the meeting held by the section at NEMA headquarters in New York April 13. Henry J. Hoffman, sales manager of Machlett Laboratories, Inc., Norwalk, Conn., chairman of the section, presided.

Charles A. Rice, vice-president of the United Electronics Co., Newark, N. J., discussed the work of the RMA-NEMA tube coordination committee, which is headed by O. H. Caldwell, editor of "Electronic Industries" as impartial chairman.

N. A. Woodford, electronic-tube commercial manager of the North American Philips Co., chairman of the section's business development committee, presented a detailed report on the activities of his group, including industry-diagram charts, which the NEMA Section has proposed to prepare in cooperation with the electronic magazines.

D. Y. Smith, of the Radio Corporation of America, reported on a section prospectus.

Next meeting of the NEMA Electronics Section will be held the first week of June at the Sagamore Hotel, Bolton Landing, N. Y.

Trade Meeting in October

The Electronic Parts and Equipment Industry Conference will be held at the Edgewater Beach Hotel, Chicago, October 6th to 9th inclusive (instead of in June), and will be attended by the Sales Managers Club (Eastern Group), the Association of Electronic Parts and Equipment Manufacturers (Western Group), the Representatives Club, and the National Electronic Distributors Association and other parts distributors. Herb Clough of Belden Mfg. Co., has been elected chairman of the conference, heading the conference committee consisting of: Robert P. Almy (Sylvania), Charles Golenpaul (Aerovox), Harry Kalker (Sprague), Roy S. Laird (Ohmite), A. E. Schaar, (Talk-a-Phone), Jack Berman (Shure Brothers), A. H. Petersen (Amphenol), A. E. Akeroyd (Raytheon), and Jesse Fishel (Federal Mfg. Co.).

The usual June date proved unfeasible this year, due to the Presidential Nomination Convention being held on June 17th in Chicago.

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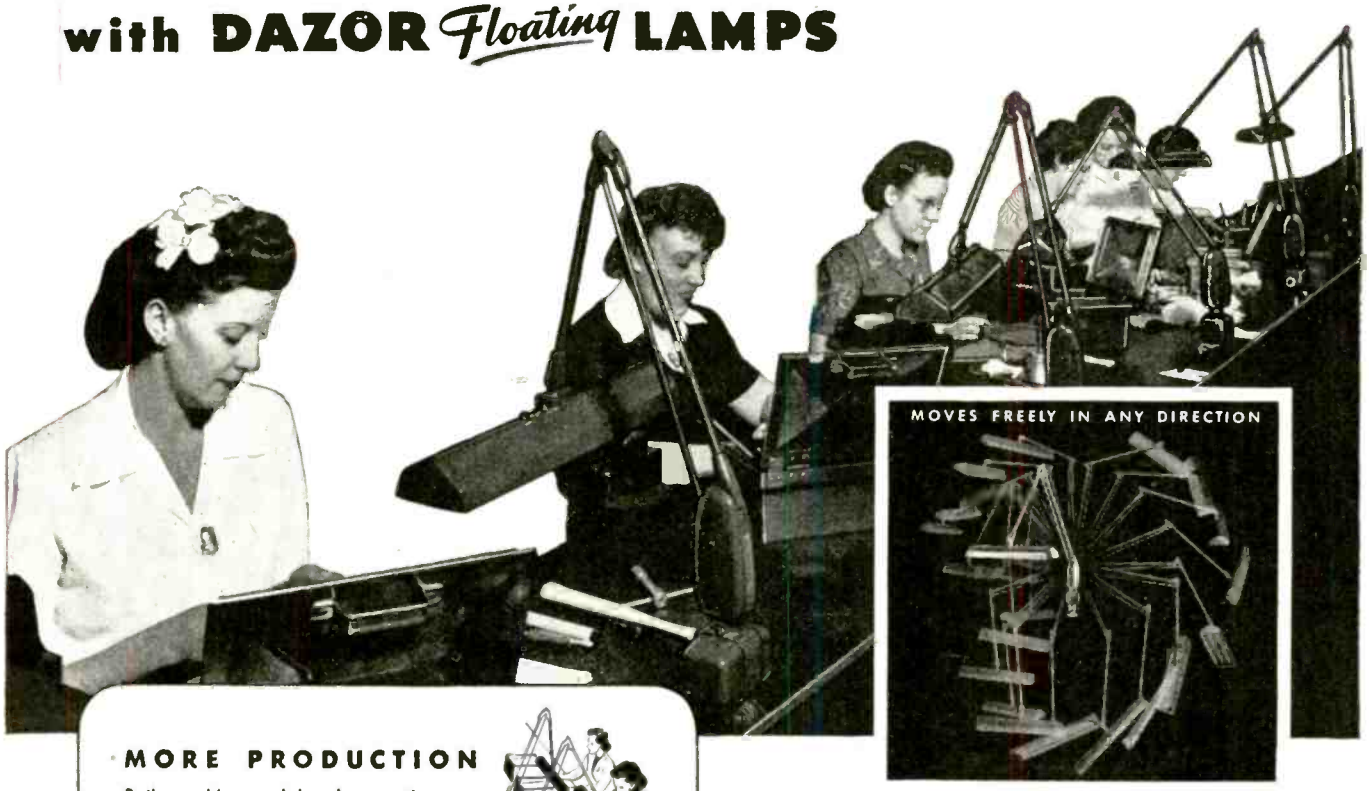

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At the left are typical advantages of Dazor illumination on machine tools, assembly lines, inspection benches and drafting boards. To gauge these economies fully, get details from your experienced and cooperative Dazor-appointed distributor. If you'd like this 16-page descriptive booklet, ask for Booklet "E"; we'll send it promptly. Dazor Manufacturing Co., 4463 Duncan Ave., St. Louis 10, Mo.

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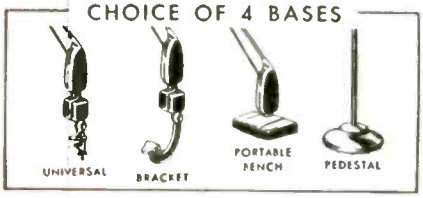

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★ TELEVISION TODAY* ★

News Developments in the Video Field

Columbia Urges Immediate Television Improvement

Documenting its decision to urge and work for an early adoption of better standards for postwar television with an elaborately printed report, Columbia Broadcasting System late in April drew together a large gathering of representatives of the press, technical experts and station executives to set forth the CBS position and policy. The report makes plain that CBS believes technical advances have reached the stage where greatly improved standards for both black and white and color television are possible now and that a year's intensive study of the few remaining problems undertaken immediately and pushed to fruition by the nation's laboratories would save fully five years and bring a far better grade of postwar television just that much nearer.

But no matter what else is done, it is believed that the 18 narrow television channels now available will never be adequate and that at least twice this number, obtainable by "moving upstairs" should be provided. When these things are done CBS envisions "large pictures in color or in black and white which do not 'go to pieces'; a broader field of vision, more distant views clearly seen; better close-ups with a realistic showing of details, texture of clothing and of small lettering on packages, and finally a television picture that can be viewed with no more eye fatigue than going to the movies."

TBA stands pat

It is the considered opinion of the Television Broadcasters Association, however, according to a statement from that body that "the present standards, based on sound engineering judgment, provide an excellent basis for commercial television in the postwar era." The public statement issued by CBS, it is claimed by TBA "is contrary to the carefully considered recommendations of engineers of the industry comprising the television panel of the Radio Technical Planning Board. The CBS statement deals in the realm of speculation and is not based on experience or sound technical principles. It is a reflection upon the competence and in-

(*Continued on page 256*)

* Title registered U. S. Patent Office.

How Many Televisors in Use in East, Now?

To get up-to-date information on the present operating status of the television receivers now in the hands of the public, NBC recently made a survey during which 4,590 questionnaires, in letter form, were mailed to the NBC television mailing list. Of this group, 189 were returned by the post office indicating that the addressee had moved.

From the 4,401 valid mailings, 1,412 returns—some 32.1 per cent—were tabulated.

The first question asked was—"What make of television receiver do you own?" Reports on 1,434 receivers (22 returns reporting more than one receiver), indicated:

	Per cent
870—RCA	60.7
149—DuMont	10.4
146—G-E	10.2
84—Andrea	5.9
21—Westinghouse	1.4
157—Other Makes	10.9
7—Don't Know and No Answer	0.5
	100.0

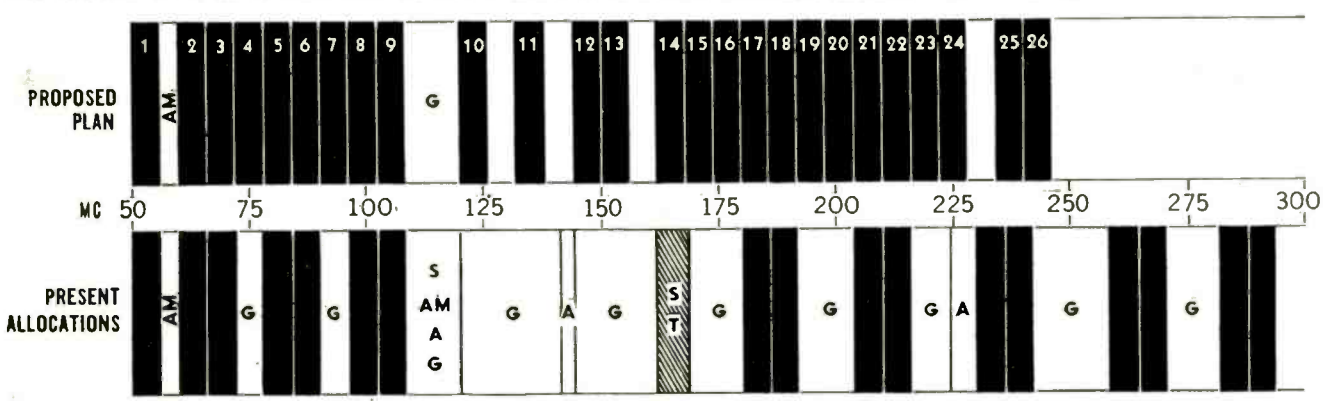
(*Continued on page 254*)

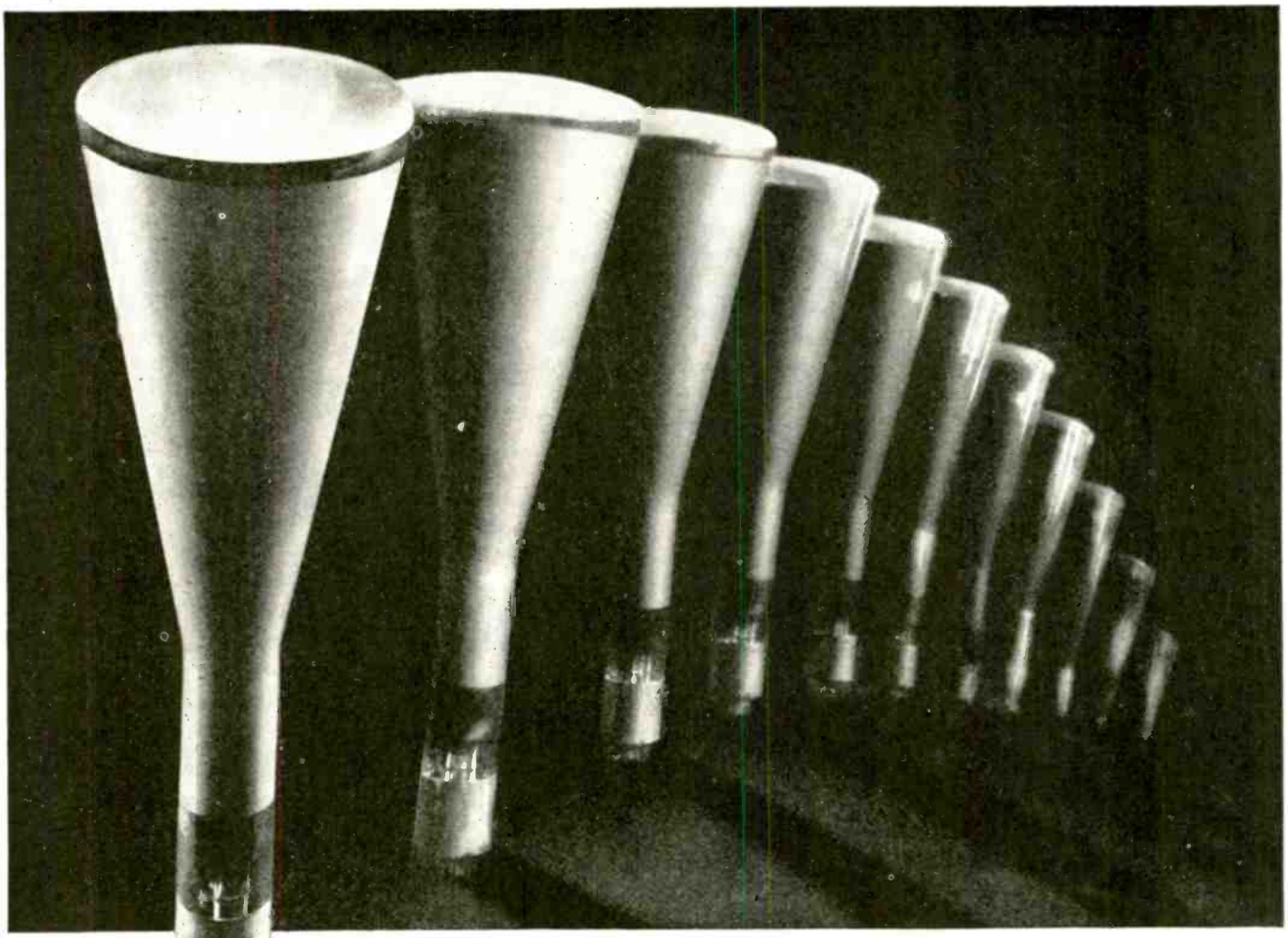
RTPB PANEL SUGGESTS VHF TELEVISION ALLOCATION

A preliminary layout of the VHF portion of the spectrum that involves television was tentatively reported by Sub-committee of Committee 4 Panel 6 RTPB. This report represents only preliminary studies, and is illustrated by the allocation diagram below, compared with the presently assigned frequencies. In certain locations, as for instance, Philadelphia and New York, where television signals from each area might overlap, a division of the 26 bands between the two localities is suggested. Each of the bands would have a nominal width of 6 mc.

It is generally agreed among engineers of industry that engineers of television must be allocated frequencies in the lower portion of the VHF band if television is to become immediately available to the general public as a broadcast service. The RTPB as a whole has not yet made any formal recommendations with respect to television's place in the frequency spectrum however, because the work of the television panel of the board has not yet been completed.

More television bands are in black; AM—indicates amateurs; A—aircraft; G—government services; S—special services





GOOD NEWS FOR TELEVISION!

Since National Union established new production records on cathode-ray tubes—the dream of low-cost television for the average post-war home has taken a long step toward fulfillment.

Consider the fact that National Union has succeeded in raising its cathode-ray tube production to a volume many times greater than the combined pre-war C-R tube output of the entire industry! To achieve such a production miracle required, of course, completely new techniques, new mechanical aids to operators, new quality control measures. But above all, it required imagination and technical capacity to cut loose from the long prevalent conception that the manufacture of cathode-ray tubes was strictly a laboratory project. N. U. engineers proved that these laboratory techniques *could* be adapted to high speed streamline mass production. And, it is significant that N. U. C-R tubes have acquired at the same time an international quality reputation, with special distinction for their superior fluorescent screens.

In the post-war expansion of television, as in other applications of electronic tubes for home and industry, National Union achievements in engineering and production have set new horizons. Remember to *count on* National Union.

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KLYSTRON CHARACTERISTICS

(*Continued from page 93*)

for the TM (transverse magnetic) modes where k is defined by:

$$J_n(k) = 0$$
$$n = 0,1,2,3,..$$
$$m = 0,1,2,3,....$$

For the TE (transverse electric) modes the resonant wavelength is determined by Bessel function derivatives, J'n (K')

$$\frac{1}{\lambda^2} = \left(\frac{m'}{2b}\right)^2 + \left(\frac{k'}{2\pi a}\right)^2 \qquad (2)$$

$$J'_n(k') = 0$$
$$n = 0,1,2,3,....$$
$$m' = 1,2,3,...(m' \neq 0)$$

Resonator characteristics

Shape and size obviously determine the resonant wavelength of a cavity resonator. The losses in the inner wall of the metal cavity and the ratio of volume to surface area determines Q, so that in general a shape which provides an increased ratio of the volume to the surface area improves the Q of the cavity. It is also true that the same shape with larger dimensions and longer resonant wavelength has a higher value of Q. A sharp reentrant point in a resonator may increase the current concentration tremendously and greatly reduce the Q.

The electron beam passing the grids of a Klystron resonator also influences Q. Since the space charge between the resonator grids depends on both current and velocity, both the beam current and the acceleration voltage affect the amount that Q is reduced by the presence of an electron beam in a resonator. Secondary electrons, if present, may have a considerable effect on the Q of a resonator.

Losses in a resonator are not only introduced by the resistivity of the conducting material of which it is constructed, but may be introduced by circuits coupled to the resonator and by losses in the load and input coupling loops. Losses in the conducting material are not proportional to the first power of the resistivity of the conductor, since rf resistance depends on the depth of penetration of the current, or the skin depth, as well as the resistivity itself.

Actually, losses in a cavity resonator of nonmagnetic material are proportional to the square root of resistivity. A resonator of brass with a resistivity four times that of copper may have a Q one-half as great if no other losses are

(*Continued on page 154*)

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CO · MEMOVOX
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Suite 204, 2714 South Hill St.
Los Angeles 7, California

(*Continued from page* 150)

present. Losses in magnetic materials are usually much higher so that the Q of resonators of magnetic material may be very much lower than that indicated by the resistivity itself.

The shunt impedance of a resonator is determined by a shape factor, and for a given shape and size, the shunt impedance is reduced by losses to the same degree that the losses reduce Q. Since the shunt impedance is an important factor in determining the minimum current required to sustain oscillations in a Klystron, its importance in Klystron resonator design is evident. Decreasing the shunt impedance increases the starting current (the minimum value of beam current to sustain oscillations). The beam impedance of the tube (accelerating voltage divided by cathode current) is proportional to the shunt impedance of the cavities.

Reentrant shapes

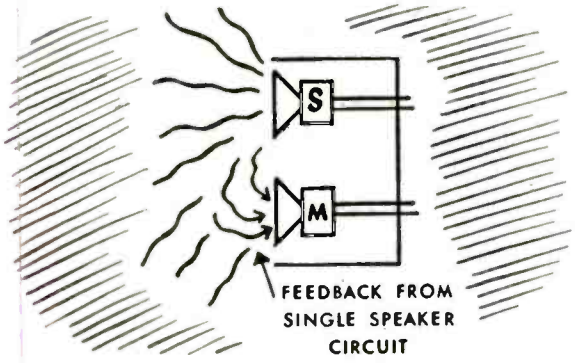
Cavity resonators with reentrant shapes are particularly useful for velocity modulation tubes because they furnish a strong uniform electric field over a considerable area and possess satisfactorily high shunt impedance. A strong electric field exists at the capacitance section of the grids of the resonator. In the 410R, tuning is accomplished

(*Continued on page* 158)

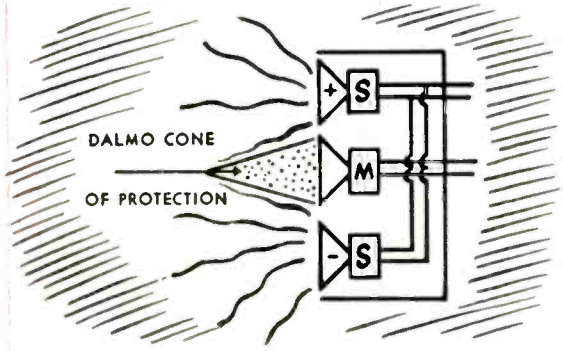
DALMO DEVELOPS TWO NEW CIRCUITS . . . and paves the way to better loudspeaking telephone systems

Two-way conversations at commercial voice volume, without the use of talk-listen keys, is provided by a loudspeaking telephone development perfected, proved and ready for intercommunication. Dalmo commercial and industrial systems are available for installation right now, on priorities.

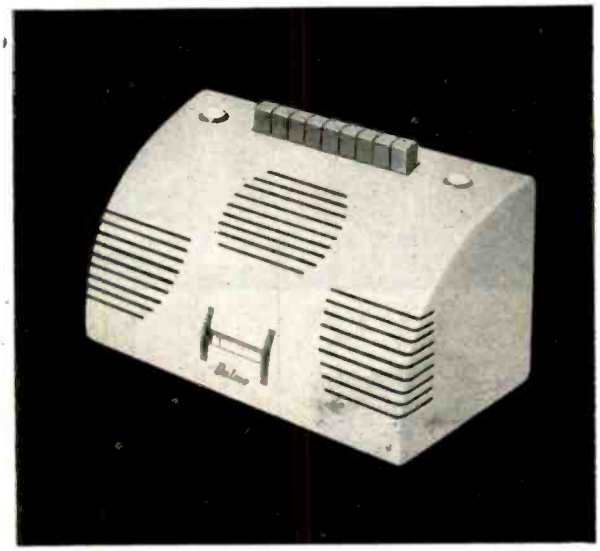
Commercially acceptable volume without talk-listen keys has heretofore been impractical in two-way circuits because of sound feedback into the microphone, like this . . .



The Dalmo circuit commercially eliminates sound feedback by the use of two speakers and a microphone, symmetrically located and connected out of phase, like this . . .



Pre-Heat Circuit. Dalmo eliminates the need of a warm-up period by operation of tubes in a pre-heat circuit. Besides providing instant, full-volume communication, this pre-heat circuit assures virtually unlimited length of service and eliminates moisture condensation.



The Dalmo Loudspeaking Telephone for commercial and industrial installations

APPLICATIONS

Dalmo Hospital Systems provide for communication and patient's observation; improve floor service by saving nurse's time.

Dalmo School Systems give efficient communication between principal and classrooms and between classrooms; eliminate breakage and pilferage of equipment and reduce maintenance expense.

Commercial and Industrial Systems provide for two-way conversations without the use of talk-listen keys; eliminate repairs; reduce maintenance costs.

Apartment and Residential Systems provide permanent peak performance; reduce maintenance costs; eliminate repairs; guarantee safety to tenants through ready voice recognition.

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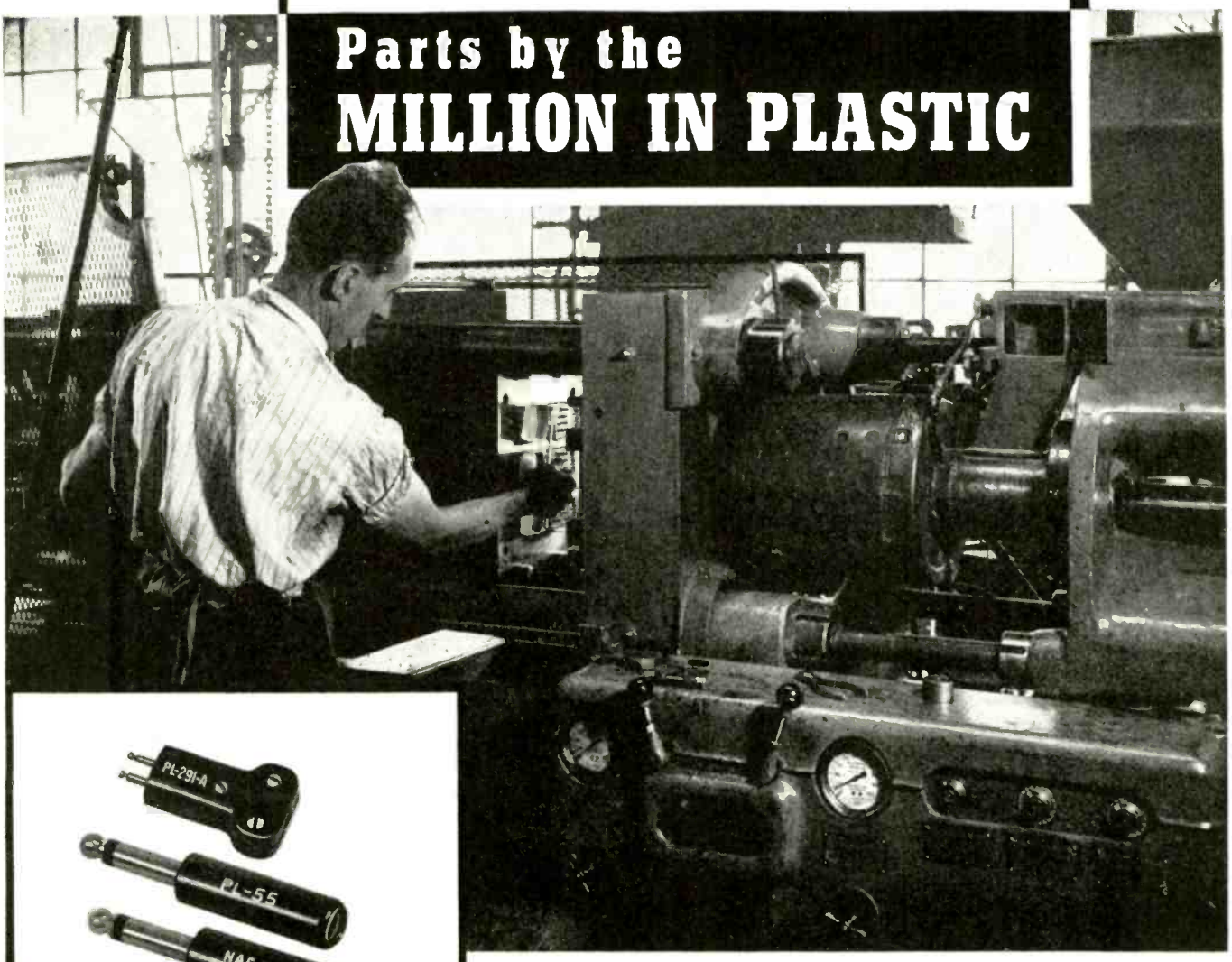

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56	64	104	124	291-A	
58	65	108	125	354	No.
59	67	109	127		212938-1
60	68	112	149		

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			

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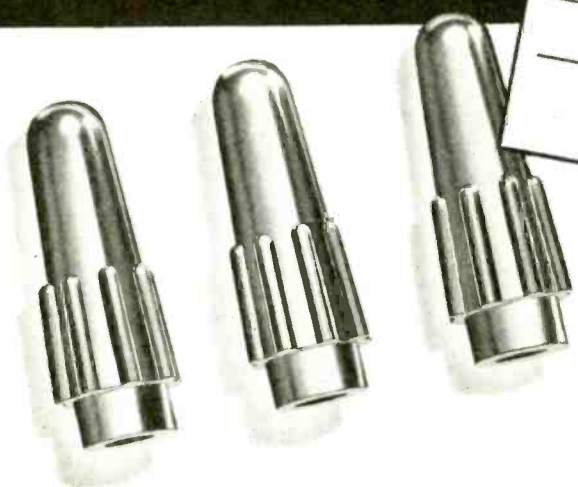


ALLISON ELECTRODE HOLDER Tip Data

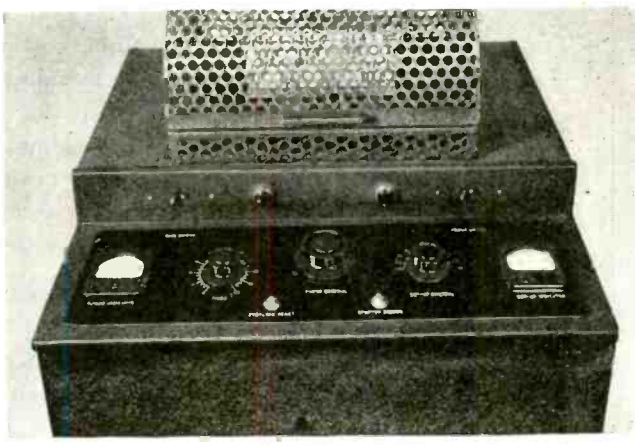
Former Method	Operation	Preheating by Airtronics
20 min.	HEATING PREFORMS	1½ min.
150° F.	CORE TEMP. OF PREFORMS	325° F.
1½ min.	**CLOSING TIME**	**20 sec.**
15 min.	**CURING TIME**	**5 min.**

In molding these asbestos-filled phenolic-compound welding rod holder tips, the maximum of impact strength and heat resistance had to be achieved—and yet on a commercially practical cost-basis. Attempts to preheat the preforms by convection methods were tried, but sufficient production could not be reached. AIRTRONICS engineers were then called in, and tests quickly proved that two-thirds the time required for closing the dies and curing could be eliminated through the use of *Airtronics* preheaters.

A saving of 11 minutes 10 seconds on closing and curing time was achieved by AIRTRONICS' preheating. Higher impact strength and heat resistance of the finished product resulted from better plasticizing. A stronger bond was obtained between the six-ounce hollow steel insert and the phenolic. And, six holder tips can now be molded at one time from the one-pound preforms.

Quoting Windman Brothers, West Coast molders specializing in difficult molding jobs: "The AIRTRONICS preheater will pay for itself within six months, and in addition we are delivering a product of vastly higher quality." Such user-acceptance as this is typical among those operating AIRTRONICS heat generators, and the more difficult the molding job, the more important to them are the advantages of AIRTRONICS preheaters.

SEND FOR YOUR COPY of new bulletin. Find out about AIRTRONICS dependability . . . about their self-contained electrodes, safety devices, and simplified controls . . . find out how your plant can increase production, reduce unit costs and improve quality of moldings with this advanced equipment. Send for your copy today.



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(*Continued from page* 154)

by the variation of this capacitance as the grid spacing is changed by moving the flexible diaphragms. The magnitude of the capacitance is approximately inversely proportional to the spacing. This capacitance change is of principal importance in tuning, since the cavity volume change introduced by the moving diaphragm produces only a second order effect.

Two factors affect the tuning range of a Klystron using variable grid spacing to control frequency. The electrons must traverse the electric field between the Klystron grids in less than one-half cycle. This transit time limitation governs the minimum electron velocity and maximum grid spacing which can be used. The other limit to the tuning range is imposed by the fact that a Klystron fails to operate if the grids are spaced too closely. An additional practical limitation is introduced by the fact that tuning becomes too critical before the failure to produce proper bunching is effective. These factors limit the practical tuning range to several per cent of the average wavelength. Considerably greater tuning range is easily obtainable at reduced output.

Klystron electron beam

The electrons from the cathode of the Klystron are given the necessary forward velocity by a direct voltage of a few hundred to several thousand volts applied to the cavities and smoother grid. The average beam current of the tube is not altered by the action of rf fields in the cavities. The beam current, and thus the dc power input are a function of only the direct accelerating voltage.

The formation of the homogeneous stream of electrons into bunches once each 360 degrees of the signal frequency cycle is accomplished by the action of the electric fields which exist within the cavity resonators parallel to the motion of the electrons through the tube. The basic requirement for bunching of electrons into groups is that they pass through the bunching field, i.e., between the buncher grids, in not more than approximately the time for one-half cycle of the signal frequency.

In order to explain the action of the Klystron, consider that it is being used as an amplifier and that a voltage of the resonant frequency of the cavity is injected into the buncher by means of the antenna seal and loop. This voltage may be extremely small but because of the Q of the cavity (1000 or more) an intense electric field will exist between the buncher grids at resonance.

This electric field will reverse its direction each cycle. Thus the in-

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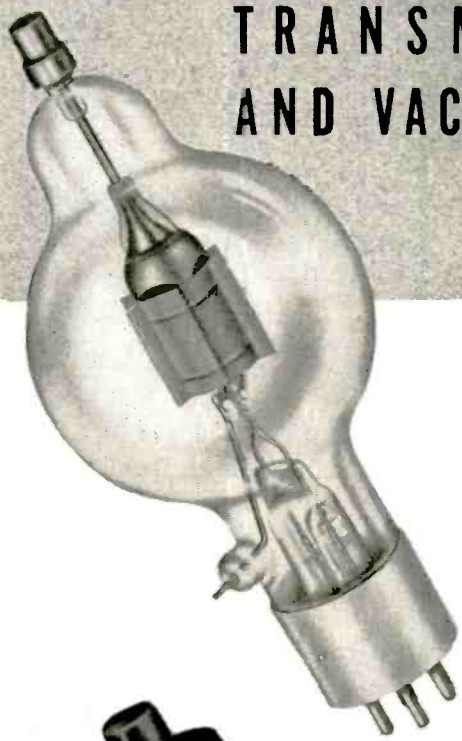

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ner wall and grid nearest the cathode will be positive with respect to the grid just beyond for one-half cycle and negative with respect to the same grid for the next half cycle. Electrons which pass through this reversing electric field will be (1) unchanged in velocity, (2) accelerated, (3) or decelerated depending upon the instant in the cycle of the electric field that they enter the buncher. This can be shown by the diagrams of Fig. 5.

Fig. 5 (A) shows two cycles of the electric field in the buncher. The half cycles are labeled accelerating and decelerating to indicate the action on the electrons during that particular interval. Thus when the electric field is operating against the forward motion of the electrons they will be decelerated and when the far buncher grid is positive with respect to the grid nearest to the cathode the electrons will be accelerated. In the following analysis, the velocity change due to the buncher is small compared to average electron velocity.

As an example, consider the electrons which enter the buncher at some time t_1 which corresponds to the instant when the buncher electric field is maximum "negative," i.e., acting to decelerate the electrons. These electrons will pass through the buncher grids in less than one-half cycle and will, therefore, leave at some time approximately t_5. These electrons will be decelerated during one-quarter cycle and accelerated for one-quarter of a cycle and their velocity on leaving the buncher will be the same as the velocity at which they entered the chamber.

Electrons which entered the buncher at some instant t_0 before t_1 will be decelerated for a greater amount of time than they are accelerated and will emerge from the buncher at some time t_3. This group of electrons will have a final velocity beyond the buncher less than their initial velocity and will thus tend to fall back and meet the group which went through at time t_1.

Consider another group of electrons which entered the buncher at time t_2 after t_1. This group will be decelerated for a short portion of the first half cycle and accelerated for a large portion of the second half cycle and emerge from the buncher at approximately t_3. This group which went in the buncher after the group at t_1 will have a velocity greater than their initial value and thus catch up with those that went through just before them.

It is seen that during the half cycle that the buncher field is opposing the motion of the electrons, bunching will take place since those which go in first will be slowed down and those which go in later will be accelerated. The electrons

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Today, through the use of Universal Microphones and voice communication components, vital communications of War are speedily transmitted equally as well from small sea-craft and battle cruiser to home port.

Many new types of Universal microphones shall be developed from the experience obtained from the production of military units, for the private citizens in the marine pleasure-craft in the days after Victory is ours.

< Model T-30-S, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

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do not group together immediately after the buncher but the change in velocities becomes apparent during the passage through the drift space and the tube is operated in such a manner that the slow electrons, fast electrons, and those which are unchanged in velocity will all meet at approximately the center of the catcher.

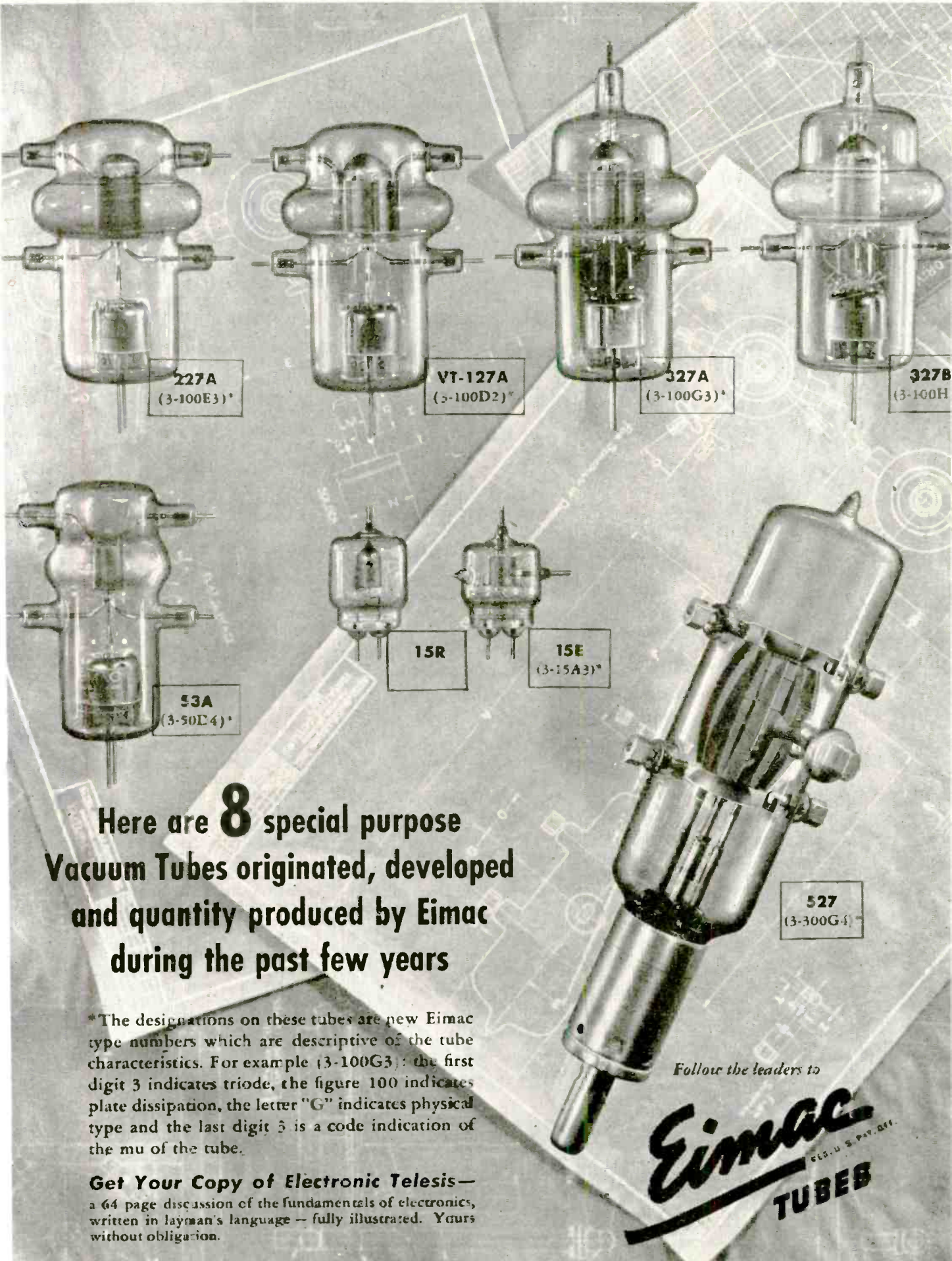
On the next half cycle, i.e., when the electric field in the buncher is accelerating the electrons, a debunching action will take place. Those electrons which entered the buncher at time t_5 when the field is maximum accelerating, will emerge with their velocity unchanged. However, those electrons which enter the buncher before t_5, for example t_4, will be accelerated for a considerable part of that half cycle and decelerated for a fraction of the following half cycle and emerge from the buncher with an increased velocity at approximately t_7. Electrons entering the buncher after t_5, as t_6, will be accelerated for a short part of the half cycle and decelerated for a considerable portion of the following half cycle emerging with their velocities reduced at approximately t_9.

Velocity increased

It is thus seen that for electrons which enter the buncher during the time when the field is acting to accelerate them, those which go in first will have their velocity increased and those which go in late will have their velocity reduced. In the drift space these electrons will tend to separate since those that went in first are going still faster and those that went in late have been slowed down. It is probable that the accelerated electrons during the de-bunching time will catch up with the previously bunched group and likewise the slow electrons may fall back into the oncoming bunched group. During this half cycle the electron stream is thinned out and. therefore, the bunching of the electrons takes place only once each cycle of the signal frequency.

While the bunching action has been described on the basis of the electrons passing through the buncher in approximately ½ cycle, the transit time for actual tubes is from a ¼ cycle to 1/16 or less. The bunching action will then center around some time t_2 instead of t_1. As the transit time through the grids becomes shorter with increased accelerating voltage, groups of electrons form around those which pass through the buncher later in the decelerating half cycle.

The amount of increase and decrease in the average velocity of the electrons by the action of the buncher is small in comparison to their average velocity. This is



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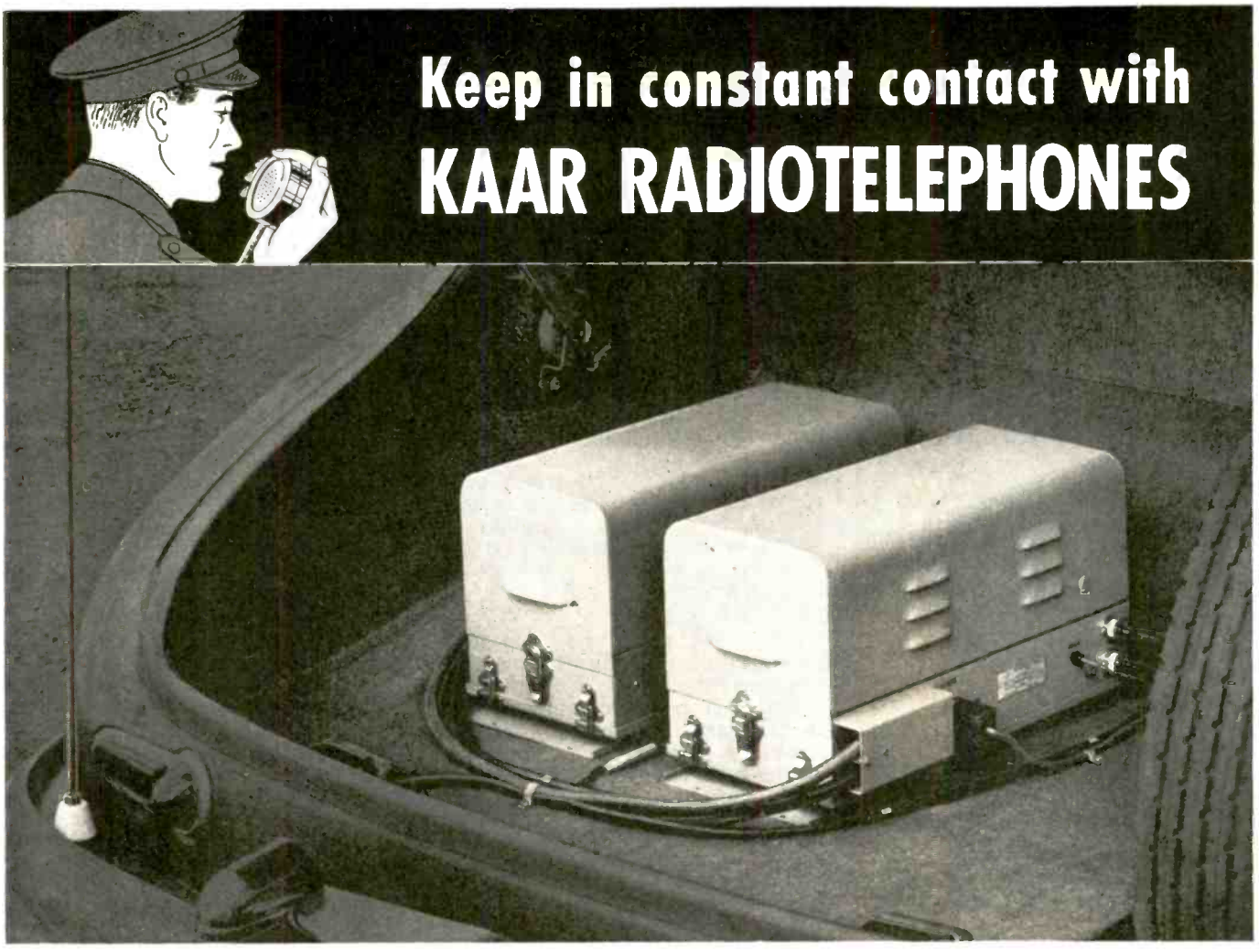
necessary to limit the required buncher driving power.

Another diagram for showing the bunching action is the so-called Applegate diagram of Fig. 5 (B). In this diagram the slope of the lines indicate the velocity of the electrons. The velocity is constant up to the buncher and through the action of the buncher the velocity is modified as represented by the changed slope of the lines. These lines converge at a point shown which is the center of the catcher. The distance along the horizontal axis is time and the intersections of the sloping lines repeat at intervals which are the periods for a fundamental frequency. The vertical distance on the diagram represents the distance between buncher and catcher and the concentration of sloping lines on any vertical intercept shows the current density at any point in the tube at any instant.

The bunches of electrons which form at the catcher excite that resonant circuit and set up oscillating electric and magnetic fields inside. This is caused by the electron bunches, which are groups of negative charges, that in their periodic passage through the catcher induce charges on the walls of that cavity. The kinetic energy of the moving electrons is transformed into magnetic and electric field energy within the cavity because the bunches of electrons are slowed down during their passage through the catcher.

One approximate explanation of catcher action may be as follows: The first bunch of electrons passing through the catcher will cause a large positive charge to appear on the inside cavity wall and grid nearest the cathode. Free electrons in the cavity wall will be forced by the proximity of the group of electron charges around the inner surface of the cavity toward the far wall and grid. The first bunch will induce a similar positive charge in the far wall of the cavity as it approaches, but the original shock excitation starts the field in the cavity. The electric field produced in the cavity acts to decelerate the oncoming bunches since they are approaching the far wall which is negative. The electron bunches are slowed down and their loss of kinetic energy is translated into the fields within the cavity.

Once the oscillating field is started within the catcher, succeeding bunches of electrons will each be slowed down by that field and thereby deliver their quota of energy. The catcher field must lag the buncher field by 90 degrees in time phase. That is, the catcher field must be starting its "decelerating" half cycle when the buncher field reaches the peak of its decelerating half cycle. The electron bunches



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22 WATTS—30-40 MC

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The standby current is zero, as instant heating tubes are used, lowering the demands on the battery of the vehicle. Transmission is completely controlled by a "push-to-talk" button on the microphone. This button lights the tubes, starts the dynamotor power supply, silences the receiver, and switches the antenna to the transmitter—all in a fraction of a second!

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A remote control box, mounted on the dash of the vehicle, controls the receiver located in the trunk compartment. The box contains a combined *on—off* switch and volume control, a red jewel light to indicate when the receiver is on, and an *off* switch for the no-signal squelch circuit.

The no-signal squelch circuit automatically silences the receiver except when calls are actually being received. In addition, an automatic noise silencer circuit makes difficult reception understandable by reducing electrical and ignition interference.

For swift checking and servicing, both the transmitter and receiver may be removed from the vehicle by releasing four luggage-type catches. The dust covers are likewise removed by releasing two catches.

For transmission in the 1600-2900 KC range inquire about Kaar PTL-22X transmitter and 11X receiver. Other ranges available on special order.

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enter the catcher at the beginning of the deceleration half cycle. This point is important in calculating the total phase shift through the tube.

As an amplifier the signal voltage to be amplified is injected into the buncher by means of the antenna seal, and the output is taken from the catcher cavity.

The affect of variation in buncher rf voltage can be shown by figure 6. The bunching parameter X is given by,

$$X = \pi N \frac{V_1}{E_b} \qquad (3)$$

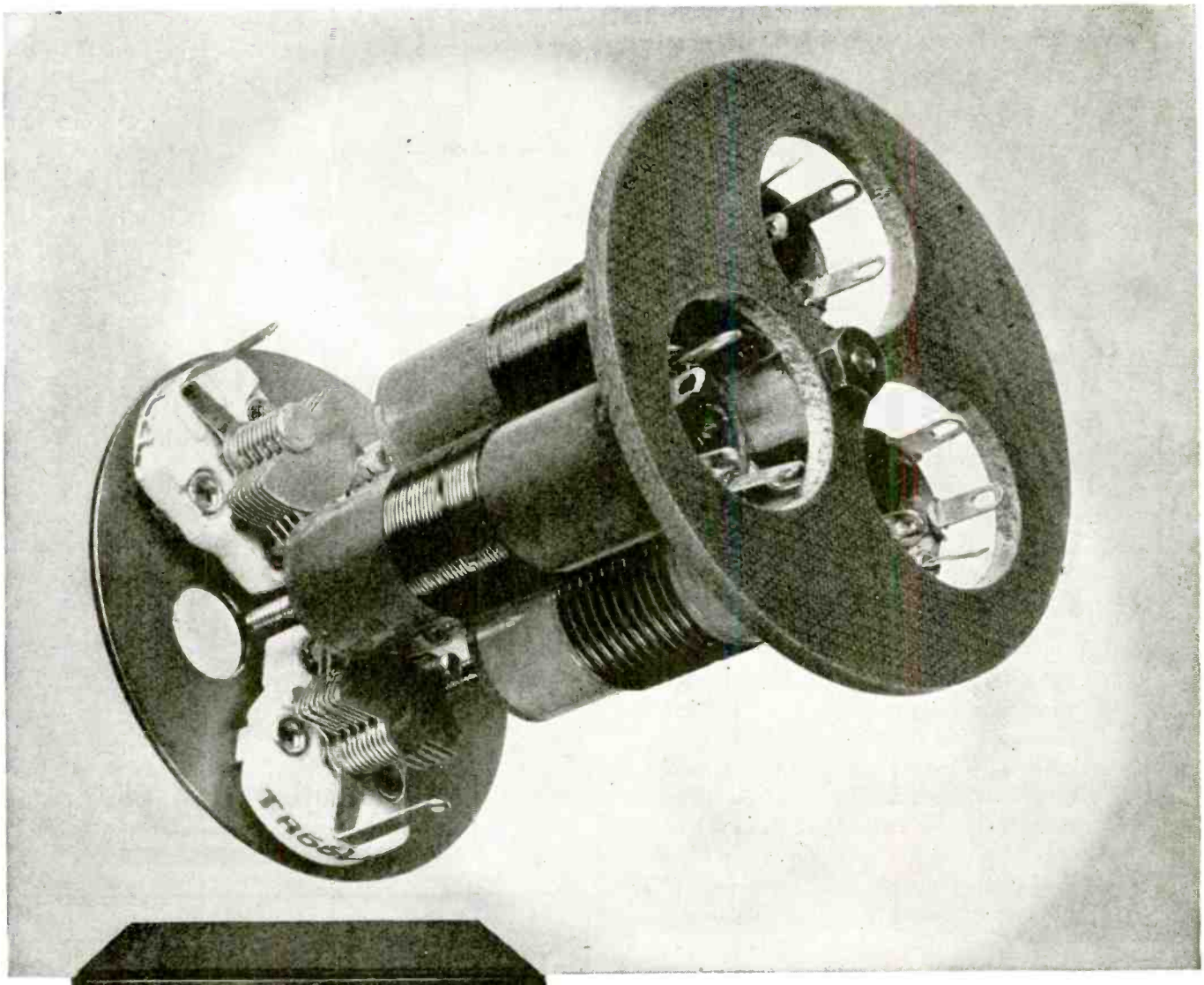
where N is the number of cycles which occur during transit between buncher and catcher; V_1 is peak rf voltage across buncher grids; and E_b is acceleration voltage of the beam (direct voltage on cavities)

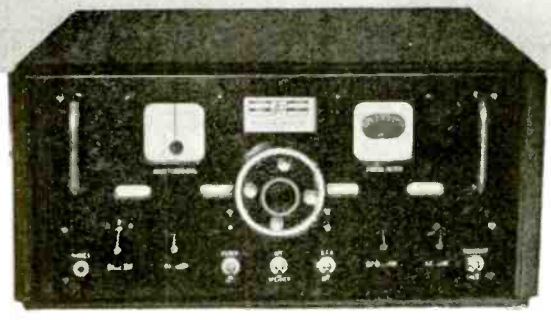
$$N = Tf \qquad (4)$$

where T is transit time (sec.) from buncher to catcher and f is buncher frequency in cycles.

Fig. 6 gives the catcher current in arbitrary units in terms of the bunching parameter, X. The curve (a Bessel function of first order and kind) shows maximum catcher current for X = 1.84. Increased buncher rf voltage will reduce the catcher current to zero. A further

(*Continued on page* 170)





LRR-4

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Having a front well designed *is* important but it is what goes behind the panel that really counts.

In Techrad products the greatest artistry is in the technical engineering behind the panel. This is true of the product as a whole and it is true of each individual component. A case in point is the LRR-4 low radiation receiver pictured above together with one of its components... a Techrad designed turret coil. This receiver is F.C.C. approved for low radiation. The excellence of design and construction is clearly visible here. These thoroughly shielded, low-loss coil sections are one of the outstanding contributions to the performance of the receiver. They are typical of the kind of thorough engineering every Techrad product gets.

Years of experience have taught Techrad engineers the value of such close attention to even the smallest detail. This is one of the many reasons why you can have confidence in the name Techrad... *Remember, master engineering takes nothing for granted.*

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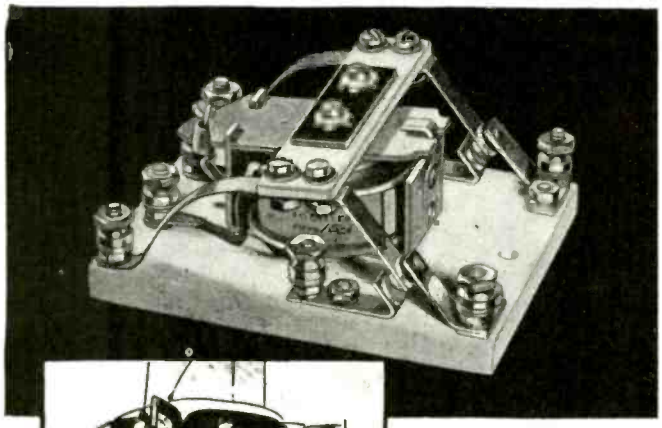

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TO WIN battles today, there has got to be constant clear radio communication between the Command and all fighting units. Every Headquarters has one or more big mobile Signal Corps Communication Sets, marvels of unfailing efficiency, to receive radioed field reports and beam out orders and so insure correlation of effort. Vital components of these "nerve centers" are Advance Type 400 Relays . . . thousands of them in active action on all Allied fronts.

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THIS new relay, incorporating many improvements, is ideal for transmitting purposes where high radio frequency is being used, It is constructed to provide the same quiet, dependable operation on *alternating* current, free from all "hum" and "chattering" that is normally expected only on *direct* current. Assembly methods and skillful adjustments eliminate any necessity for changing the tension on either the armature spring or moving contact leaves, both of which are set to provide perfect "balance" and complete wiping of the stationary contacts. For further data, write for Bulletin: *Advance Transmitter Relay Type 400.*

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Having what it takes for War, Advance Relays may well be what you will want in Peace!

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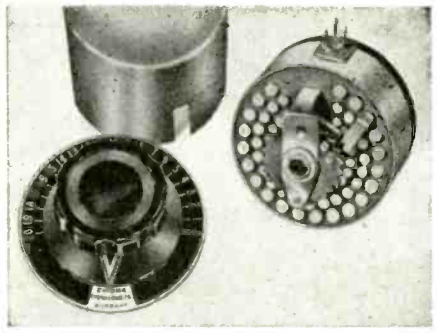

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Sound the Alert!

MANAGEMENT
LABOR

—for the 5th War Loan drive during June and July. The need for the 5th War Loan is immediate, crucial. For impending events may make the 5th the supreme financial effort of the war.

The U. S. Treasury has set the overall goal at $16,000,000,000 — $6,000,000,000 from individuals alone. This is the biggest sum ever asked of the American people—*and it must be raised.*

That's why the U. S. Treasury asks Management and Labor to sit down together and organize—NOW!

For organization—good organization—has been responsible for the excellent showing of the payroll market. And its most important single superiority has been personal solicitation—desk to desk, bench to bench, machine to machine personal solicitation. 71% of all persons on payroll deductions were solicited for the 4th War Loan.

Now, to personal solicitation, add the sales incentive of a definitely established plant quota. Build your campaign around a quota plan. Set up departmental goals. Stress percentage of participation figures. Stimulate group enthusiasm.

In planning your quota campaign, work in close cooperation with the Chairman of your War Finance Committee. Everything is set to make the 5th War Loan drive a huge success—with your help!

(Note: You've read this message. If it doesn't apply to you please see that it reaches the *one* person who can put it in action!)

Here's the Quota Plan:

1. Plant quotas are to be established on the basis of an *average* $100 *cash* (not maturity value) purchase per employee.
2. Regular Payroll Savings deductions made during the drive accounting period will be credited toward the plant quota.
3. 90% of the employees are expected to contribute toward raising the cash quota by buying extra 5th War Loan Bonds: 1—Outright by cash. 2—By extra installment deductions. 3—By extra installment deductions plus cash.

Example: **JOHN DOE Mfg. Co.** — 1,000 Employees

1,000 employees x $100 Regular Payroll deductions during the eight weekly payroll Accounting Periods of June and July = $100,000 Cash Quota

30,000
$70,000 (to be raised by sales of extra Bonds to at least 900 employees)

ORGANIZE • SOLICIT • DELIVER

The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRONIC INDUSTRIES

★ ★ *This is an official U. S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council.* ★ ★

(Continued from page 166)

increase will produce a second peak of lesser amplitude.

Excessive buncher voltage produces "over bunching." This is characterized by a double peak of catcher current as the buncher is tuned through resonance. At resonance the catcher current will be low when over bunching occurs. Over-bunching causes reduced output and increases rf driving power requirements.

The multiple cavity Klystron will also serve as an efficient frequency multiplier. The pulse nature of the catcher excitation produces good outputs up to the 10th harmonic. The optimum bunching parameter X' for frequency multiplier action is,

$$X' = \pi \frac{N_2}{M} \frac{V_1}{E_b} \qquad (5)$$

where N_2 is number of cycles during transit time from buncher to catcher calculated for the catcher frequency. M is frequency multiplication factor, V_1 and E_b are as in (4).

For M = 3, X' should be 1.4 and for M = 10, X' should be 1.2. In practical tubes, the bunching voltage V_1 must be increased approximately by the frequency multiplication factor to give optimum bunching parameter. The Klystron is theoretically about 50 per cent efficient, operating at 10th harmonic as compared to operation on fundamental; however, this efficiency is not obtained in practical tubes.

Klystron oscillators

When the Klystron of Fig. 1 is operated as a feedback oscillator, a short coaxial cable is connected from catcher to buncher. This cable is shown connected to the tube in Fig. 2. The oscillation is started by random impulses and fly-wheel action of the resonant cavities.

In any feedback oscillator the total phase shift around the circuit must be $2n\pi$ radians. Where n may be any integer but zero. Zero is excluded because of time required for bunching in the drift space.

In the Klystron, three phase shift factors are present. The largest phase shift is that due to the transit time in the drift space. In Fig. 7A a basic diagram is shown, and s is the distance from center of buncher to center of catcher. Fig. 7B is an equivalent circuit using a pentode amplifier tube. As in a Klystron, only electron stream coupling exists from input to output. The dimension, s, is approximately 2.54 cm. in the 410R. The transit time in this space for simple bunching is

$$T_1 = \frac{S}{V_0} \qquad (6)$$

where s is bunching distance in cm, and v_0 is average velocity of the

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electrons in cm/sec. where,

$$v_o = 6 \times 10^7 \sqrt{E_b} \text{ cm/sec} \quad (7)$$

E_b is direct accelerating volts and (7) is correct to approximately 7000 volts.

As an example, in the 410R $s = 2.54$ cm. and for an accelerating voltage $E_b = 900$, the transit time T is, $2.54/6 \times 10^7 \sqrt{900} = 1.41 \times 10^{-9}$ sec.

The equivalent phase shift in practical cases is approximately 1500 degrees.

With an accelerating voltage of 900, the average time for electrons to pass through the buncher or catcher grids for spacing of 0.03 in. is,

$$\frac{0.03 \times 2.54}{6 \times 10^7 \sqrt{E_b}} = 4.22 \times 10^{-11} \text{ sec.}$$

This corresponds to about ⅛ cycle in practical cases.

$$\frac{l}{\beta} = \frac{c}{v_o} = \frac{500}{\sqrt{E_b}} \quad (8)$$

where c is velocity of light.
Let ϕ_F be phase angle between catcher and buncher voltages, then

$$2n\pi = \frac{500}{\sqrt{E_b}} \frac{s}{\lambda} \cdot 2\pi + \frac{\pi}{2} + \phi_F \quad (9)$$

The $\pi/2$ factor is due to the 90 degrees relationship which must exist between catcher and buncher fields for operation as described before. Note that phase shift in the drift space is the only factor influenced by direct accelerating voltage E_b.

From (9) it is apparent that the Klystron will oscillate at only discrete values of E_b, i.e., those values which satisfy (9).

Equation (9) may be written,

$$\frac{500s}{\sqrt{E_b}\lambda} = \frac{s}{\beta\lambda} = n - \frac{1}{4} - \frac{\phi_F}{2\pi} \quad (10)$$

If values of $1/\beta$ (for values of E_b at which oscillation occurs) are plotted against a series of integers n, alternate values will yield a pair of straight lines as shown in Fig. 8. These lines have a slope equal to λ/s. The two lines are displaced horizontally by ½ unit of n which is 180 degrees in the total phase shift. The presence of these double oscillation points at half units of n is due to double resonant peak characteristic of closely coupled cavities.

The frequency of the voltage generated by the Klystron is a function of E_b and frequency modulation may be easily accomplished by injecting a signal voltage in series with E_b.

It can be shown that the frequency change per volt of E_b is,

$$\frac{\partial f}{\partial E_b} = \frac{500\pi f_o S}{2Q\lambda E_b^{3/2}} \quad (11)$$

Fig. 9 is an experimental curve of

SELF-GENERATING PHOTO-ELECTRIC CELLS

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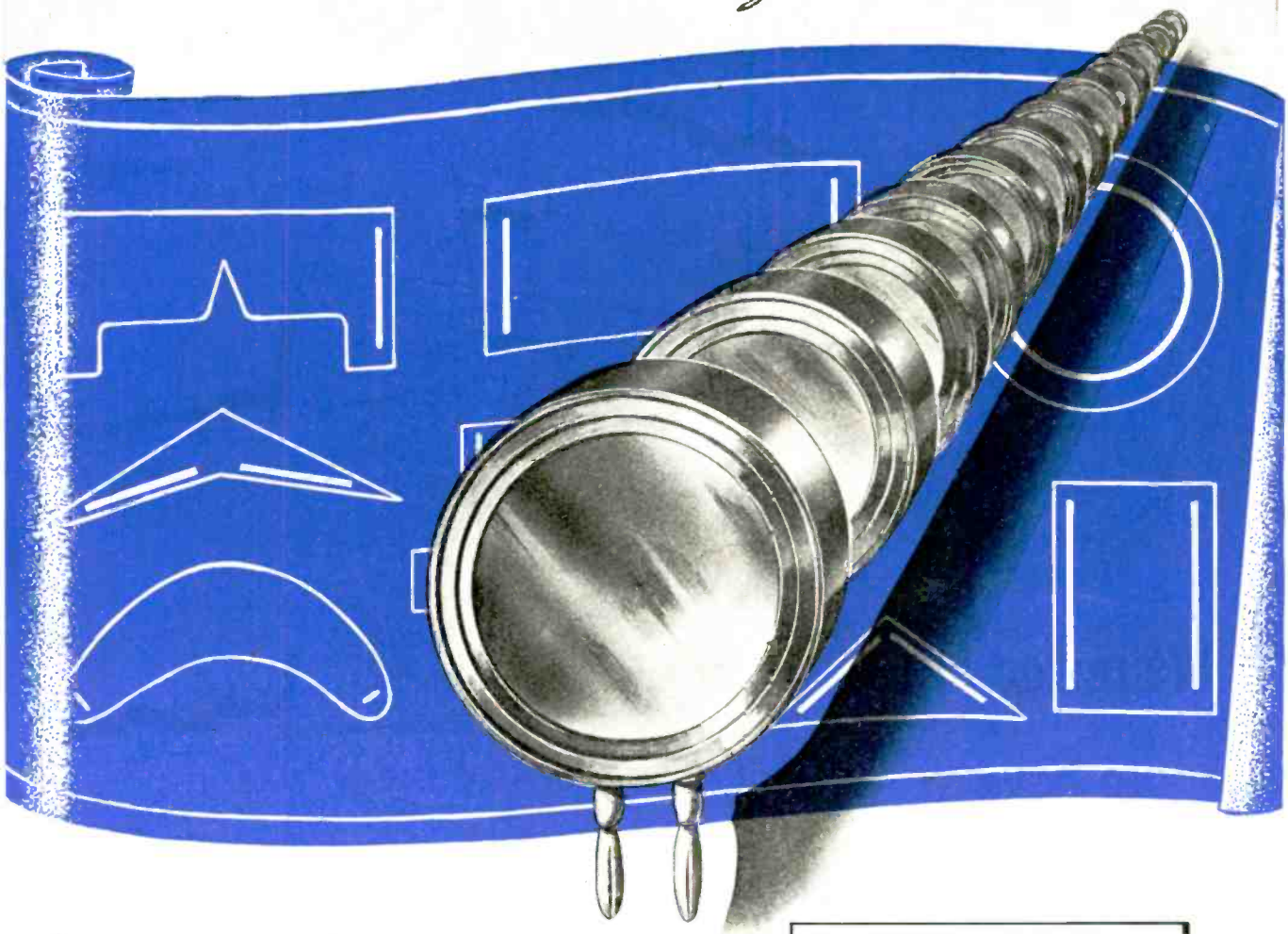

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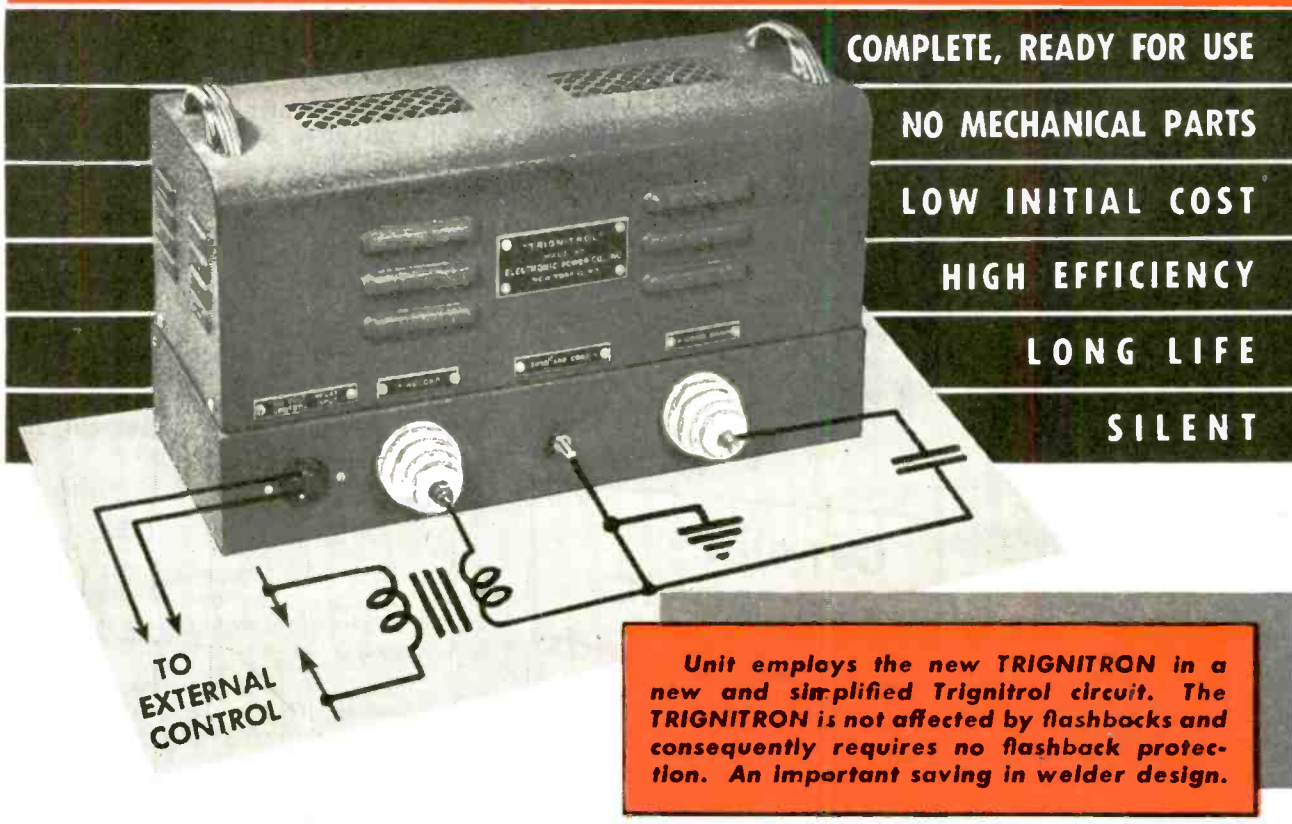

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Superseding the usual switching mechanism for discharging the condenser through the welding transformer, the TRIGNITRON discharges the condenser electronically. In this way, *all* energy is transferred from the condenser to the welder.

The TRIGNITRON operates on the principle of a mercury pool conduction tube fired capacitively by a small, compact low-power trigger circuit. When the external relay circuit is closed, a pulse is applied to the tube which fires once, discharging the condenser bank through the load.

Regardless of the time interval that the external contactor is held closed, the tube will not fire again until the contactor is opened and reclosed. The device can be fired as fast as the condenser bank can be recharged. Deliveries are prompt on rated orders.

This device and the TRIGNITRON used therein are licensed for exclusive use in welding equipment under the U.S. Pat. 2,287,541. Other patents pending.

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frequency shift vs. beam voltage E_b for a 410R. The slope at a beam voltage of 950 volts is 20 kc/volt. From (11) the calculated deviation is 19.6 kc/volt. In the experimental curve of Fig. 9, thermal drift is also included.

Tuning characteristics

The vernier tuning dial of the 410R gives a frequency change vs. dial rotation value of 1.35 mc/ turn as determined experimentally and shown in Fig. 10.

The Q of the cavities varies widely with loading. The Q may be determined experimentally by resonating a cavity and then detuning above and below resonance to points at which the current in the cavity (as observed with a crystal detector and microammeter connected to the antenna seal) falls to 0.707 of resonant value.

The resonant Q is,

$$Q = \frac{f_0}{2\Delta f} \qquad (12)$$

where Δf is frequency shift required to bring current down to 0.707 value.

The output of the 410R is approximately 20 watts.

Certain material in this article is quoted from the Klystron Technical Manual, by A. E. Harrison with permission of the Sperry Gyroscope Co.

"The importance of human relations is at the front. It is so broad in its scope as to be interrelated with all the functions of a business organization, because all these functions are performed by people, and today the individual employes are by far the most important components of a business enterprise."—*W. E. Poor, president Sylvonia Electric Products, Inc.*

CARRIER APPLICATIONS

(*Continued from page 98*)

is possible to talk and signal without mutual interference. This permits the control of the remote transmitter, turning on and off power while conversation is being conducted over the link.

Inter-channel crosstalk between carrier terminals is inaudible and when applied to a radio link any crosstalk resulting is due to distortion in the radio link. If the overall radio link distortion is held to less than 2 per cent, inter-channel crosstalk is unimportant. Higher distortion results only in unintelligible crosstalk between channels.

Operation

Channel Transmitting Circuits—Channel No. 1:—Speech currents arrive from the telephone line or switchboard and pass through a .2 kc high-pass filter and the hybrid

(*Continued on page 180*)

FIRST OF THE U. H. F. CABLES

Offered in 1937 by AMPHENOL

First Today—

Is Amphenol Polyethylene, Solid Dielectric, Low-Loss, High-Frequency, Coaxial Cable

That first ultra-high-frequency cable was a polystyrene bead cable—born of much study and endless laboratory work. It took the place of ceramic and fibre insulated lines. Thus, Amphenol became the pioneer in low-loss cable manufacture—a logical development of leadership in quality radio equipment—firmly established with radio experimenters and "ham" operators long before war developments required the mass production of U. H. F. cable.

Since that first polystyrene bead cable Amphenol has worked shoulder-to-shoulder with the designers and developers of equipment for radio, frequency modulation, television... since 1941 at the right hand of Army and Navy engineering officers playing an important part in wartime electronic developments.

Today, Amphenol's RG Polyethylene standard—Army-Navy type—cables feature quality materials, Amphenol workmanship in every inch . . . product of Amphenol's latest type extruding equipment, skilled personnel, seasoned staff and second-to-none laboratory. Write for the catalog of AMPHENOL RG Cables.

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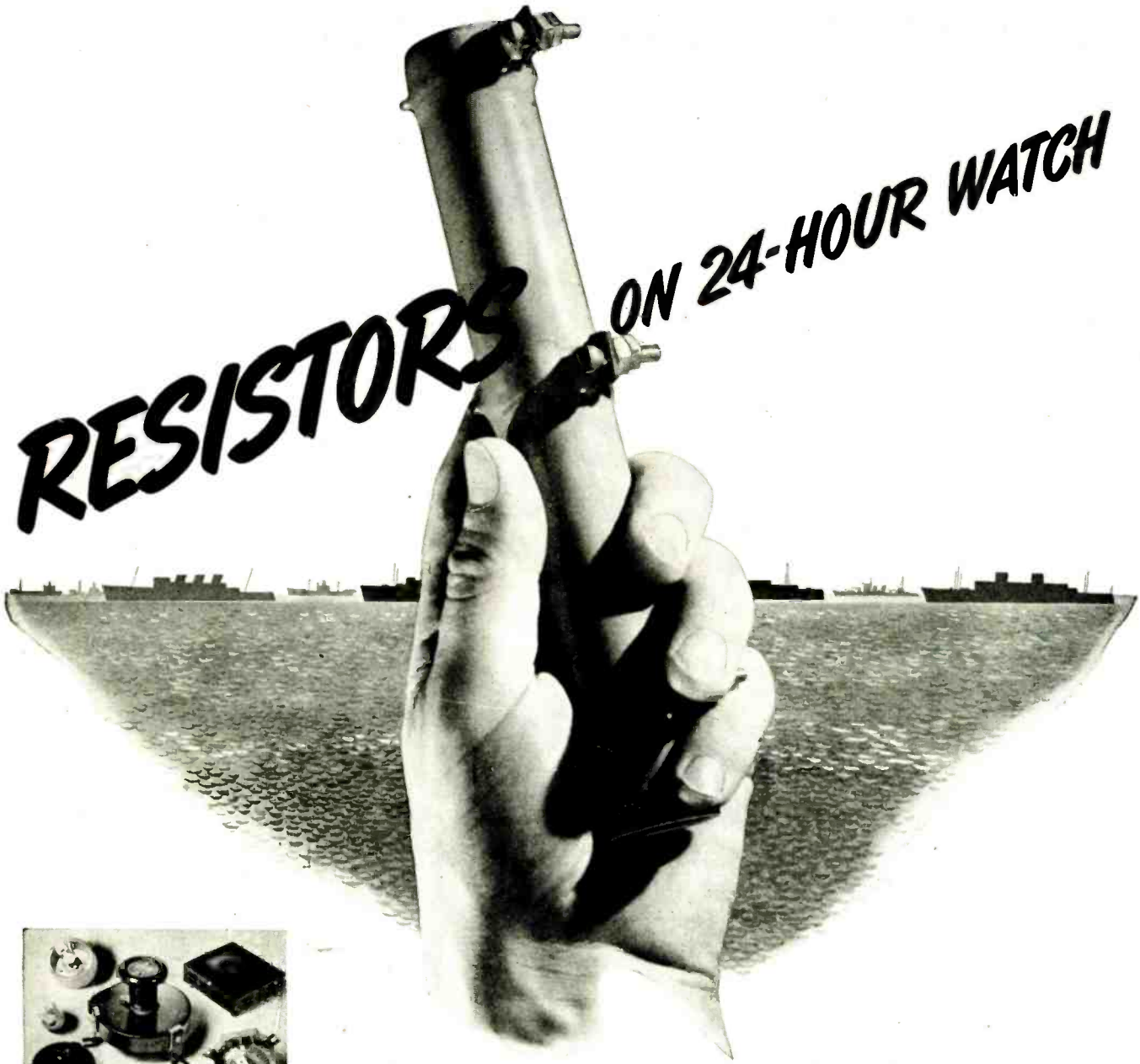

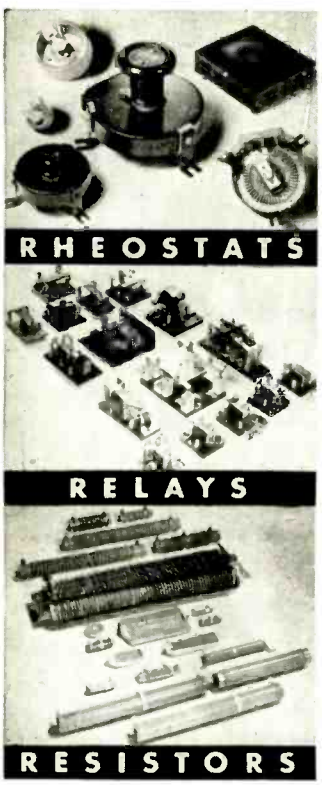

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SUPERIOR Seamless in various analyses. WELDRAWN Welded and drawn Stainless, "Monel" and "Inconel"

SEAMLESS and Patented LOCKSEAM Cathode Sleeves

(Continued from page 176)

coil. Frequencies below 200 cycles are greatly attenuated by the filter. From the hybrid coil the speech currents pass through the channel gain control to a 6N7 amplifier tube. In an amplified condition they pass through a minus 15 db pad to a low-pass filter which restricts the band to about 2800 cycles. The pad reduces the maximum output to that of other channels. The output of this filter is connected to a path common to all channels for transmission to the distant terminal. The oscillator associated with this channel is only for signaling purposes.

Channel Transmitting Circuits—Channels Nos. 2, 3 and 4:—These channels differ from Channel No. 1, in that, the speech currents are shifted to other frequency bands for transmission over the radio link. At the input to the modulator 6N7 tube a low-pass filter-equalizer corrects for losses at the band filter edges and assists in attenuating frequencies transmitted above 2800 cycles. Used in conjunction with the band filter, frequencies are prevented from overlapping to another channel.

An oscillator common to both the transmitter and receiver provides the carrier frequency, which, combined with speech frequencies in the modulator tube, produce upper and lower sidebands. The band filter suppresses the unwanted components and transmits only the lower sideband.

The modulator tube is arranged in a balanced circuit and no carrier frequency appears in its output. Limiting is inherent in the transmitting branches and protects the radio transmitter from overload.

The oscillator frequency is determined by a tuned circuit consisting of a coil and capacitor and is preadjusted. A vernier capacitance is provided for fine frequency adjustment.

The table below gives the carrier frequencies and the carrier bands transmitted:

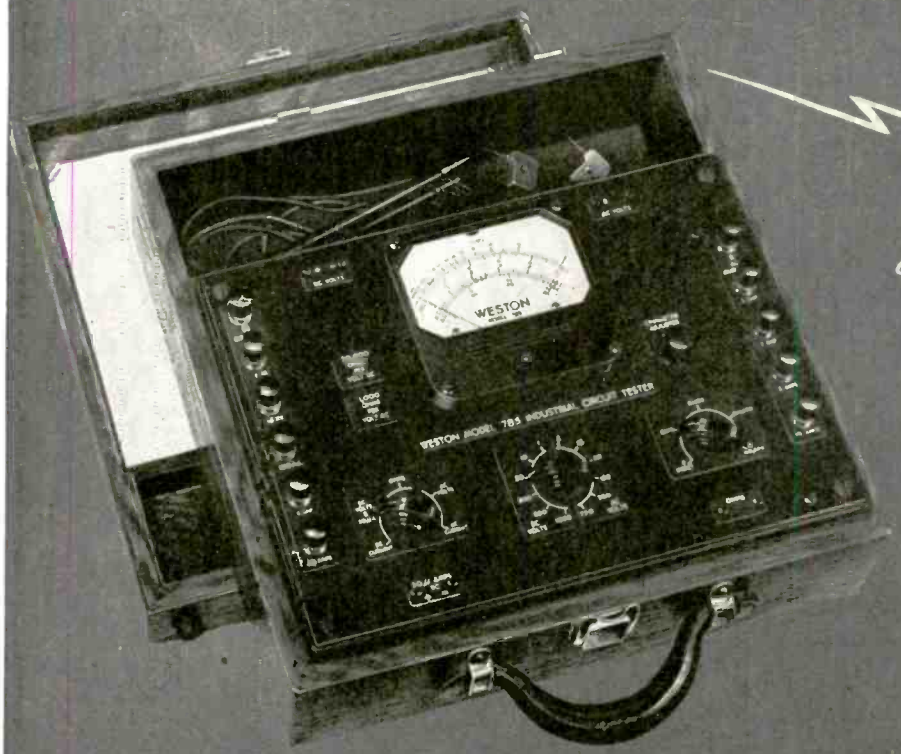
Channel No.	Carrier & Signal Frequency	Band
1	3.15*	.25 to 2.75 kc
2	6.3	6.0 to 3.5 "
3	9.4	9.1 to 6.6 "
4	12.5	12.2 to 9.7 "

Channel Receiving Circuits—Channel No. 1:—The low-pass filter selects the frequencies of Channel No. 1 and rejects the other frequencies common to the input lines as fed from the radio receiver. The voice speech amplifier following this filter raises the output level for application to the hybrid coil. A gain control is incorporated with

* Used for signaling only.

(Continued on page 184)

MEASURES THE *new* MAINTENANCE VALUES



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D-C Voltage — *Measurements from 10 millivolts to 1000 volts (20,000 ohms per volt) in full scale ranges of: 1/10/50/200/500/1000 volts. (Up to 5000 volts with very compact external multiplier.)*

A-C Voltage — *Measurements from 0.1 to 750 volts (1000 ohms per volt) in full scale ranges of: 5/15/30/150/300/750 volts.*

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A-C Current — *Measurements from 10 milliamperes to 10 amperes, in full scale ranges of: 5/1/5/10 amperes. Higher ranges, up to 1000 amperes, with externol current transformers.*

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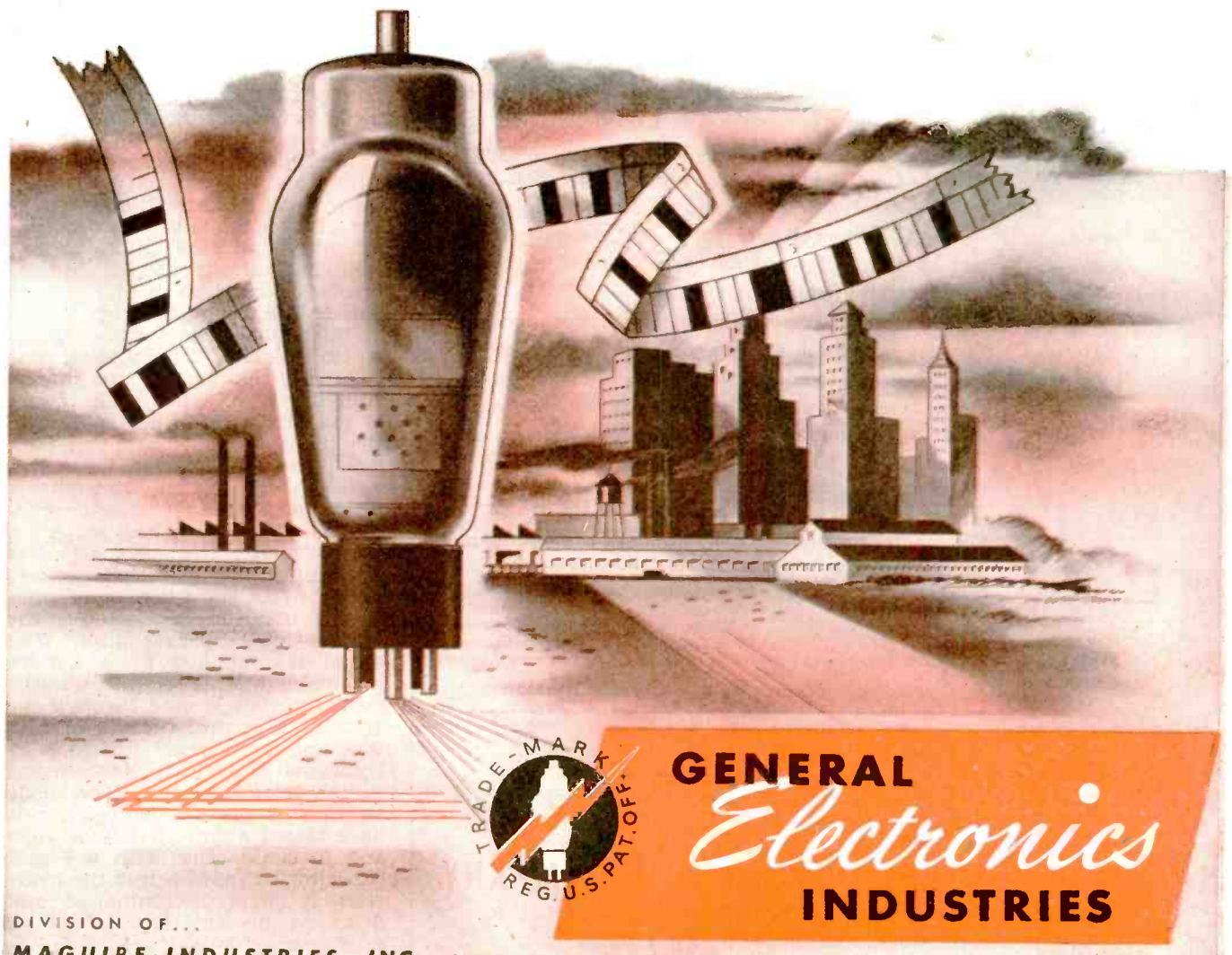


DIVISION OF...
MAGUIRE INDUSTRIES, INC., GREENWICH • STAMFORD • BRIDGEPORT • NEW MILFORD • NEW YORK

(*Continued from page* 180)

the amplifier tube and filter so that the channel receiver gain may be adjusted independently.

Channel Receiving Circuits—Channels Nos. 2, 3 and 4:—In Channels Nos. 2, 3 and 4 the receiving filter is a band filter of the same type as is used in the corresponding transmitting circuit. Each channel filter selects the required band and rejects all others. Following the band filter is a gain control and the balanced demodulator tube. This tube is supplied by a carrier voltage of the same frequency as used at the transmitting terminal. Two sidebands are again produced as in the modulator; one sideband of which corresponds to the original voice frequency band. This demodulator is followed by a low-pass filter-equalizer which partially removes the unwanted products. This filter-equalizer also corrects the audio frequencies for transmission losses at the edge of the receiving band filter. An audio amplifier 6N7 tube is employed to raise the gain to a suitable level for application to the hybrid coil. This tube is followed by a low-pass filter which eliminates the unwanted products.

The oscillators are extremely stable but an occasional adjustment is required to maintain the synchronism of the carrier frequency at the sending and receiving stations. If the sending and receiving oscillators differ in frequency by more than 25 cycles, the naturalness or quality of the speech transmitted over the system will be degraded. Maintaining the synchronism in these limits is relatively simple with suitable oscillator design.

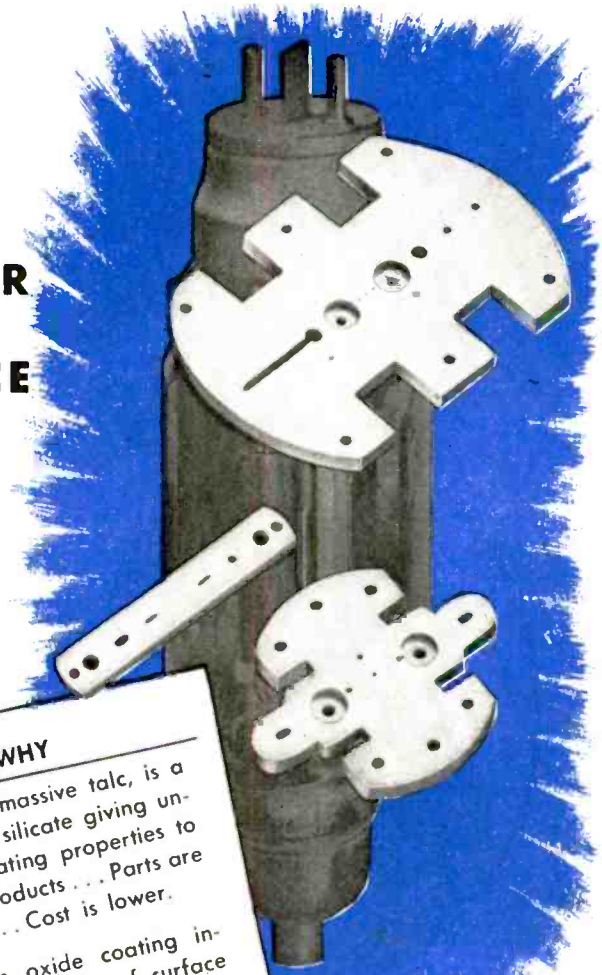
Ringing current entering the telephone connections of a channel unit is blocked by the high-pass .2 kc filter but causes the ringing relay to operate. This applies plate voltage to the plates of the ringing amplifier tube, a 6N7. The power of the carrier frequency emitted to the line is controlled by a gain control. The signal is fed through a narrow band signal transmitting filter which removes noise or harmonics generated in the amplifier.

This carrier frequency signal is transmitted over the radio link to the receiving end where the carrier ringing frequency is selected by the proper signal receiver filter. The signal is amplified by a 3-stage audio amplifier, is rectified and the resultant voltage used to block the grids of a control tube to operate the ring-down relay. This relay transmits 20 cycle ringing current to the telephone line. The diode rectifier in the ringing receiver is back biased approximately 25 volts and in conjunction with a 7 mfd capacitor strapped across the diode resistor, offers discrimination and delay to prevent false rings on random noise pulses.

(*Continued on page* 188)

3 outstanding

INSULATORS GIVING BETTER VACUUM TUBE PERFORMANCE



Vacuum tubes today operate under a wider variety of conditions than ever before. Insulators of quality and durability must meet all load and temperature requirements.

General Ceramics offers for your choice three types of insulators to obtain better results in meeting specified tube performance.

INSULATOR	RECOMMENDED	WHY
1. Special Steatite	Where tubes command high frequencies and high temperatures.	Steatite, or massive talc, is a magnesium silicate giving unusual insulating properties to ceramic products . . . Parts are stronger . . . Cost is lower.
2. Steatite with aluminum oxide coating	Where there is danger of distilled metal condensing on surface of the insulator.	Aluminum oxide coating increases roughness of surface preventing formation of metallic leakage paths on the insulator.
3. Aluminum Oxide compositions	Where severe operating condition of ultra-high frequency and temperatures are used.	Has insulating properties superior to steatite at elevated temperatures. Because of abrasive quality and constant tool wear, costs are slightly higher than other two.

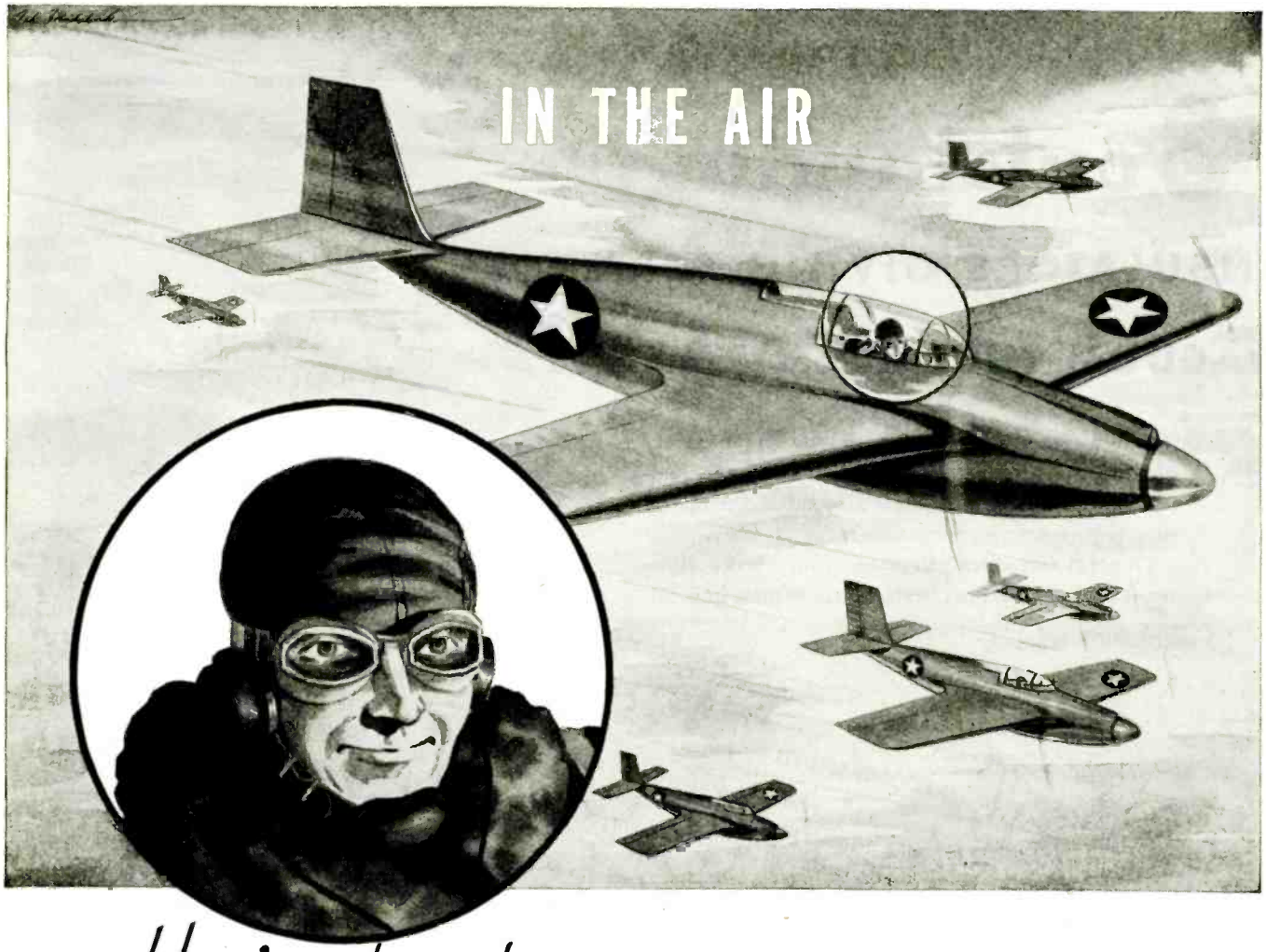
These insulators can be supplied by General Ceramcis in pressed or extruded shapes for every type of vacuum tube requirement. The same excellence of material, design, and workmanship that has won General Ceramics a wide reputation in the ceramics field, has been put into these insulators to meet your most exacting requirements.

ARMY E NAVY

GENERAL CERAMICS AND STEATITE CORPORATION

KEASBEY NEW JERSEY

GENERAL CERAMICS AND STEATITE CORPORATION — STEATITE INSULATORS



Here's what the

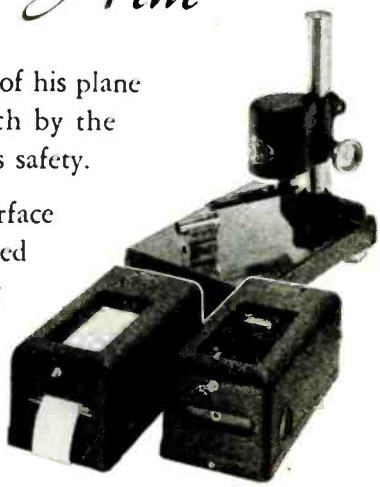
BRUSH SURFACE ANALYZER

means to Him

Surface smoothness on the vital moving parts of his plane has been measured to one-millionth of an inch by the Brush Surface Analyzer. Such precision assures his safety.

The diamond stylus of this instrument explores surface finishes, and its movement is amplified up to one hundred thousand times, then immediately recorded on a moving paper chart for permanent record.

If accuracy is essential in your business, write today for a fully illustrated bulletin on what the Brush Surface Analyzer can do for you.



THE BRUSH DEVELOPMENT COMPANY

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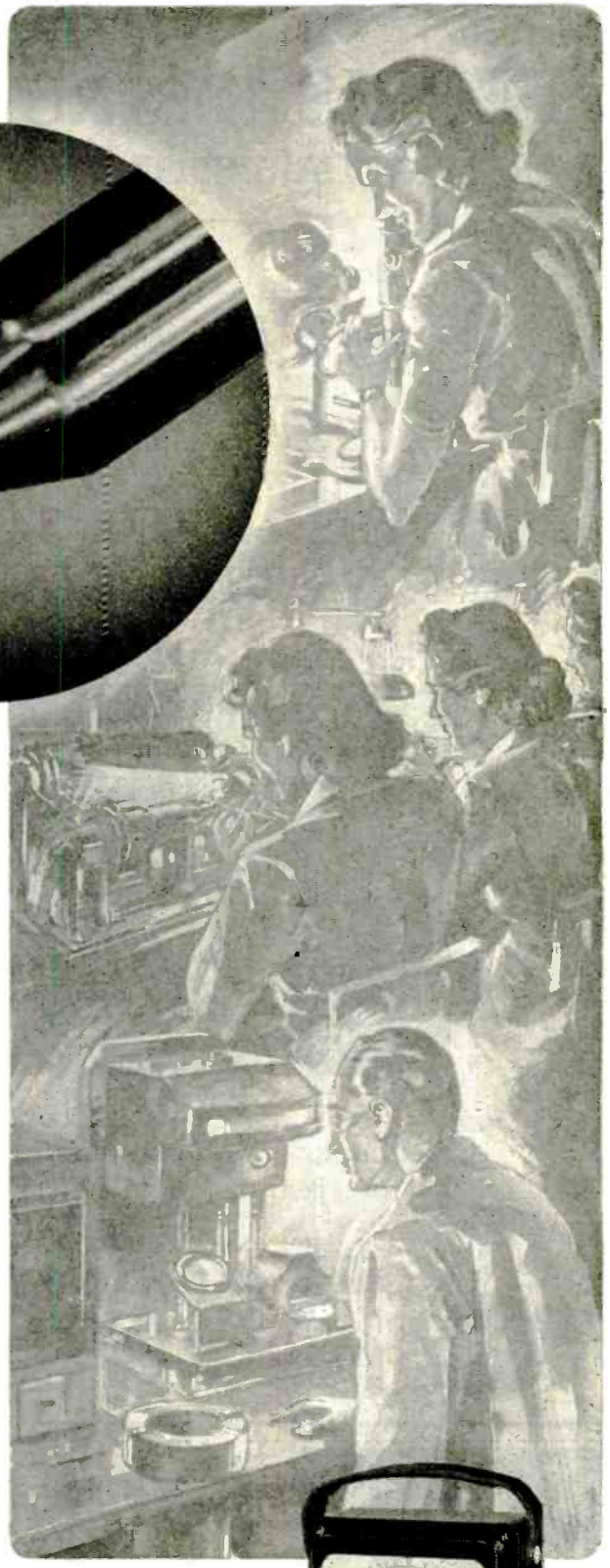
THIS PIVOT PROVES A POINT



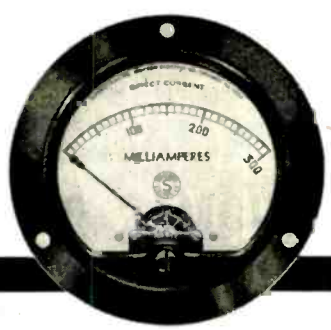
THIS unretouched photomicrograph, approximately 50 times actual size, shows pretty clearly what we mean by the value of experience, when it comes to the making of electrical instruments and testing equipment.

Pivots play an important part in determining an instrument's life and accuracy. In the Simpson-made pivot above, you have what is truly a masterpiece of its kind . . . perfect in contour . . . all surfaces brilliantly polished to prevent rusting . . . rounded end properly correlated with radius of jewel to minimize friction and withstand vibration and shock . . . heat-treated for an unusual combination of strength and hardness.

The obvious explanation for this excellence rests in the fact that Simpson employs some processes others do not, and safeguards every step of manufacture by the finest and most complete control modern science can provide. But in the final analysis, it is only Simpson's long experience which makes such a pivot possible.

That experience reaches back more than 30 years. From it has come new shortcuts in manufacture, new refinements in design, which today permit Simpson to make "instruments that stay accurate" in greater volume than ever before. From this long specialization has come too a sound basis for further advance; in your postwar Simpson Instruments you will see still more forcefully the value of this experience.

SIMPSON ELECTRIC CO.
5200-5218 Kinzie St., Chicago 44, Ill.



Simpson

INSTRUMENTS THAT STAY ACCURATE

Buy War Bonds and Stamps for Victory

(*Continued from page* 184)

The operation of the equipment so far described pertains essentially to carrier communication over radio. The principles involved in wire transmission are basically the same, but the following important changes are made. With the transmission medium a single 2-wire circuit, easterly and westerly transmission is accomplished in different frequency bands. Separate oscillators are therefore used in the transmitting and receiving branches of each channel.

Illustrated, schematically, are three carrier channels—Nos. 1, 2 and 3—derived from a pair of wires over which is routed the normal voice frequency circuit. Directional filters separate the east to west, or lower portion of the carrier spectrum, from the west to east, or higher frequency portion. At the terminals the receiving portion and its three carrier channels are equalized. The transmitting channels are all amplified as a unit. Equalization is necessary to offset the line attenuation slope which varies for each wire line over which the carrier operates.

The output level of the radio carrier apparatus described is 1 mw into 600 ohms. For use on wire lines an output level of plus 18 db is recommended as the nominal spacing between terminals or repeaters may be in excess of 30 db. This output level affords a higher signal-to-noise ratio at the receiving end and is a good compromise to reduce interference to other wires on the same telephone lead. For this reason the transmitting amplifier is used in the common transmitting branch.

Since it is possible that carrier telephone currents may be repeated many times, consideration must be given to attenuation losses of line facilities which vary widely with moisture conditions and appreciably with temperature and other factors.

In multi-channel carrier systems the large variations due to weather, require continual adjustment of the gain of the carrier amplifiers. This is done automatically by a pilot channel regulator. For each direction of transmission the pilot channel oscillator supplies to the line a current of constant amplitude which is emitted through a narrow band filter between channels. At the repeaters and terminals this pilot channel oscillator is separated from the other frequencies and amplified. This amplified current is used to control relays which automatically adjust a motor-driven variable attenuator to compensate for line losses. These pilot channel regulators are designed to maintain the level on the carrier system.

High-pass and low-pass filters are used to separate the physical telephone currents and the carrier channels.

Small and Medium
TRANSFORMERS
to meet airborne communications equipment specifications

Consolidated Radio Products Company specializes in 400 cycle transformers to meet Army and Navy specifications on airborne communications equipment, and also, supplies prime contractors of the Signal Corps and Maritime Commission.

Greatly expanded production facilities on a wide range of small and medium transformers include Pulse Transformers, Solenoid Coils, Search Coils. Other products include Range Filters and Headsets.

Consolidated Engineers will also design transformers for special applications or will build to your specifications.

Electronic and Magnetic Devices

CONSOLIDATED RADIO

Products Company

350 W. ERIE ST., CHICAGO, ILL.

ENGINEERS COMMENT ON NEW ELECTRONIC ENGINEERING HANDBOOK

Following are comments received by the editors of this magazine, regarding the new Electronic Engineering Handbook just issued under the editorial direction of Ralph R. Batcher and William E. Moulic. As previously explained, the entire issue of the new Handbook has been purchased by the publishers of Electronic Industries for the benefit of new paid subscribers to the magazine. At the present time the Handbook is not for sale separately.*

From Commissioner E. K. Jett, FCC, Washington, D. C.—"There has been real need for a convenient up-to-date reference book of this kind. . . . It will be regarded as a necessary addition to the libraries of all interested in tube applications."

From H. J. Hoffman, Machlett Labs., Chairman, Electronic Section, NEMA—"A splendid job! . . . The Handbook is comprehensive, while maintaining an excellent balance between practical and theoretical aspects of this new science."

From Dr. C. B. Jolliffe, Chief Engineer, RCA Victor.—"Of value to anyone interested in the application of electronic equipment to industry. . . . The section on industrial tubes is quite complete, and many up-to-date circuits are shown."

From Walter Evans, Westinghouse vice-president, Electronic Div.—"The section on high-frequency heating (information on which does not appear in other well-known handbooks), will be especially appreciated by engineers."

From Allen B. DuMont, president, DuMont Laboratories.—"Very complete. . . . Contains down-to-earth practical information for the industrial or development engineer, bridging gap between electronic manufacturer and practical everyday applications."

From Virgil M. Graham, Sylvania, Assoc. Director RMA Engineering Div.—"The authors have done a very good job in presenting a book which meets the requirements. . . . The material seems very much up-to-date and well presented."

From W. C. White, director, Electronic Labs, General Electric Co.—"Particularly useful to engineers applying electron tubes to various industrial problems. . . . Wealth of useful circuit diagrams and other figures are outstanding."

From C. A. Rice, vice-president, United Electronics Co.—"The chapter on high-frequency heating will be very useful to those who are for the first time undertaking experimental projects in either induction or dielectric heating."

From Lewis M. Clement, Crosley, vice-president in charge of engineering.—"Contains up-to-date and pertinent information of great practical value. Editors are to be congratulated on preparing this timely and useful book."

From Dr. W. R. G. Baker, vice-president, General Electric, Director RMA Engineering Div.—"A very creditable job! . . . The new Electronic Engineering Handbook should prove especially useful to engineers engaged in designing electronic equipment for industrial applications."

From A. C. Monteith, Mgr., Industry Engineering Dept., Westinghouse.—"A very fine treatise on the subject of tubes and tube characteristics, as well as the fundamentals of circuits. . . . It is prepared in a very interesting manner. . . . A fine job done in giving a word-picture without involved mathematical terms."

From Lloyd L. Call, Chief Engineer, General Electric X-Ray Corp., Chicago.—"I think you have done a very fine job on the Electronic Engineering Handbook, and it should be very useful reference for electronic engineers."

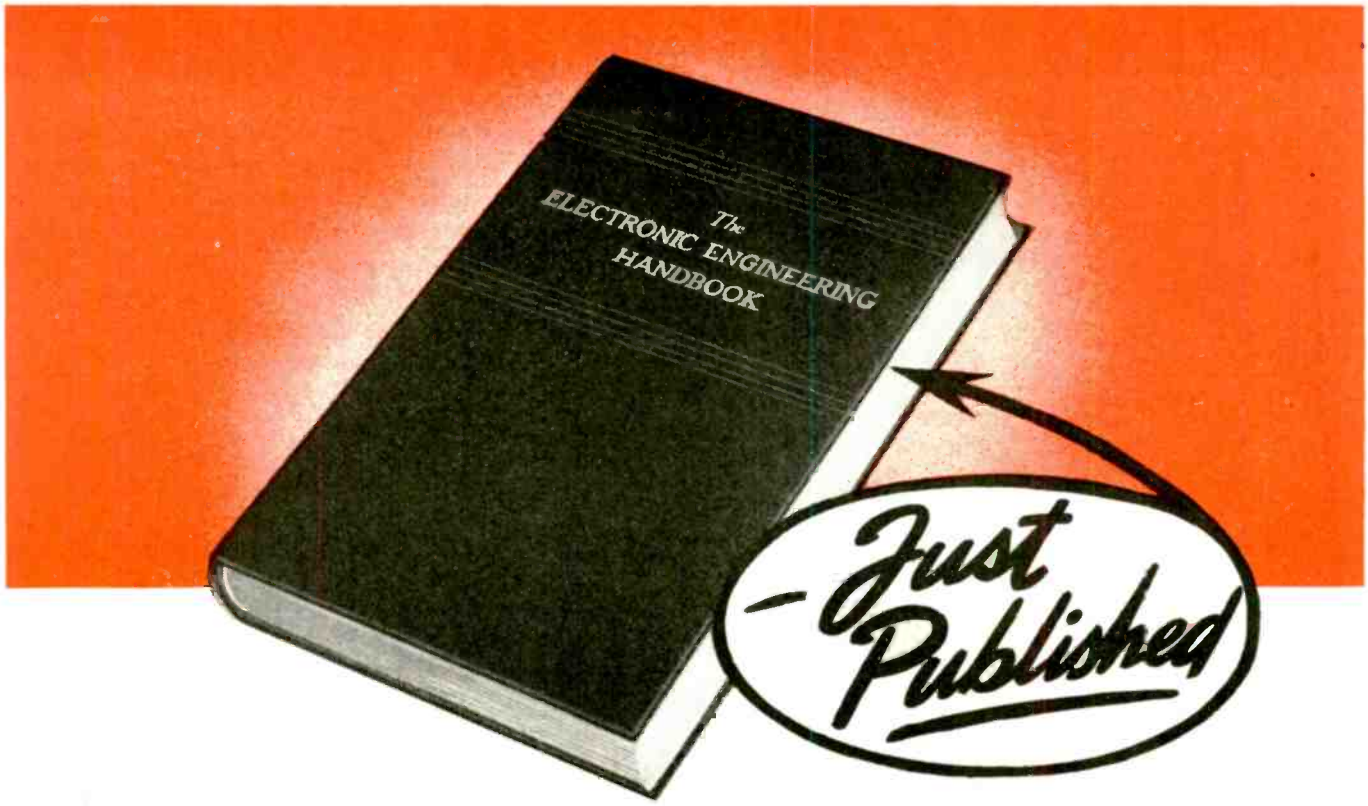
From Dr. L. Grant Hector, director of engineering, Nat'l. Union Radio Corp.—"Specialists in particular fields of electronics will find the handbook useful for obtaining a correct understanding of phenomena in related electronic applications. . . . This handbook appears to fill a long felt need for a reference book of this type."

From David B. Smith, Director, Research Div., Philco.—"Unusual in that Handbook is directed to industrial designers of electronic equipment rather than communication engineers, and contains much information in summarized form of interest to the former."

From N. A. Woodford, Commercial Mgr., Electronic Tube Div., North American Philips.—"The salesman or executive who takes pride in knowing his business will find that Messrs. Batcher and Moulic can tell him much which he will be expected to know. . . . And the job of learning it will be a pleasant one."

From Dr. B. E. Shackelford, Radio Corporation of America.—"A quite inclusive book which has brought together much fundamental information on the tools of the electronic engineer, the methods of using them, and a few instances of their use."

* At present the Handbook is not for sale separately but is being offered only with renewals and new subscriptions to Electronic Industries. For detailed information, address Subscription Manager, Electronic Industries, 480 Lexington Ave., New York 17, New York.



New Handbook Unanimously Praised!

Swift and unanimous is the praise accorded the ELECTRONIC ENGINEERING HANDBOOK which has been just published. Designed as a working tool for every engineer interested in electronic developments and applications in the industrial and communications field, most of the material has never before been published in any form.

Regarded by many critics as a necessary addition to the reference libraries of all interested in tube applications, it contains down-to-earth practical information while maintaining an excellent balance between practical and theoretical aspects for engineer specialists in the radio-electronic field.

Original, authoritative and comprehensive, it is edited by Ralph R. Batcher and William Moulic of the staff of ELECTRONIC INDUSTRIES. Because of paper restrictions only a limited edition has been published. *Obtainable only with subscriptions to ELECTRONIC INDUSTRIES, they will be taken in order of receipt and this offer may be withdrawn without notice.*

With electronic applications spreading to every conceivable industrial field the thorough-going job done in the ELECTRONIC ENGINEERING HANDBOOK may be viewed in the light of its worth to all who would keep apace of present trends.

★

Set In Clear, Legible Type
464 Pages: 4 Sections: 560
Charts, Diagrams, Tables,
Drawings, Photographs;
Completely Indexed for
Reference Purposes.

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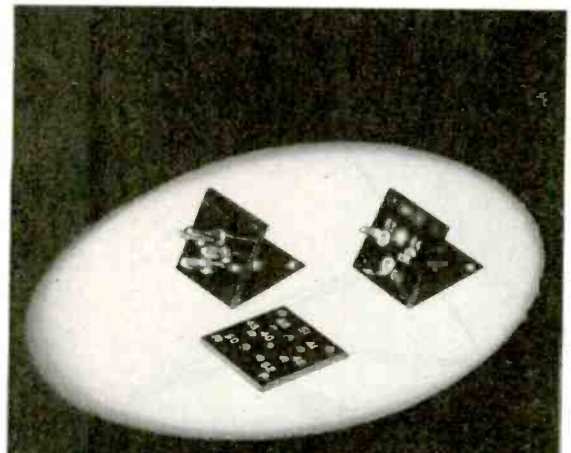
ELECTRONIC INDUSTRIES

480 Lexington Avenue **New York 17, N. Y.**

NO LIMIT TO CALLS—IN JAP WRECKAGE



Parts of National Vulcanized Fibre and Phenolite, laminated Bakelite are used widely in communication instruments of every description. This is because of their great dielectric strength, lightness in weight and exceptional wearing qualities.

THE ruins of shattered Jap buildings on captured Namur lay around these Marine Signalmen as they hurriedly set up communications. There's no limit to calls here—the advance moves on—thanks to the skill of our signalmen and the high efficiency of our communications equipment. Important in the dependable operation of these instruments are the countless parts made of plastics like National Vulcanized Fibre and Phenolite, laminated Bakelite.

The electronic engineers of America are doing a great job at the battle front—and on the home front.

NATIONAL VULCANIZED FIBRE CO.

WILMINGTON *Offices in* DELAWARE *Principal Cities*

Acme Photo

GUTHMAN I·F Coils in F·M

for MAXIMUM FREQUENCY STABILITY

Guthman Engineers recognize that the important need in Frequency Modulation receivers is to have excellent wide band I F coils. Guthman high gain I F coils operate on frequencies from 4.3 mc to 30 mc, and provide maximum frequency stability.

GUTHMAN *Leader in Inductronics*

Do Your Best . . . Invest in Bonds!

EDWIN I. GUTHMAN & CO. INC.

15 SOUTH THROOP STREET·CHICAGO

PRECISION MANUFACTURERS AND ENGINEERS OF RADIO AND ELECTRICAL EQUIPMENT

MASS SPECTROMETER—NEW INDUSTRIAL TOOL

(*Continued from page* 95)

Various methods of producing ions have been used in the past. The best method for use with the light gases considered here is that of electron bombardment. An electron gun of more or less conventional nature shoots a thin ribbon of electrons, with energies of the order of 100 volts, through the gas (Fig. 2). A small number of these electrons strike gas molecules and knock an electron from each, or in the case of complex molecules knock off an electron and sometimes an atom or group of atoms. The ionization chamber, as well as the analyzer tube, is in a uniform magnetic field, and the electrons move parallel to the lines of force. The action of the magnetic field is to prevent any electrons from straying off to the side; this is similar to magnetic focusing in cathode ray tubes.

Gas analysis

At the low sample pressures used, roughly 10^{-4} mm. Hg, the rate of formation of any particular kind of ion is directly proportional to the partial pressure of the gas which yields the ion, and directly proportional to the electron current. If two or more kinds of gases are present, each behaves as though the others were not there; thus linear superposition results and the analysis of gas mixtures is possible. This will be discussed more fully later.

Commercial design

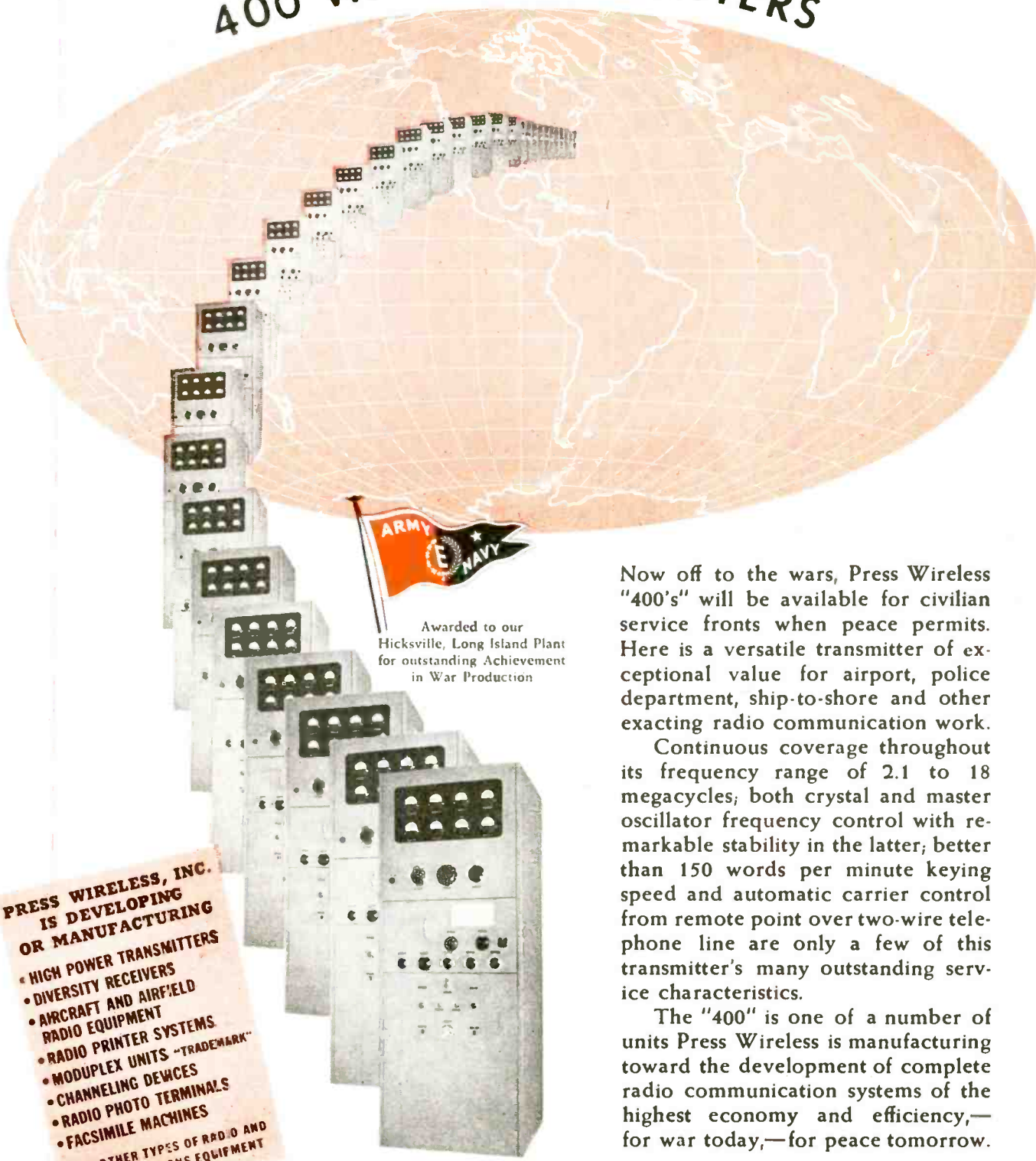
The design of a mass spectrometer naturally centers around the ionization chamber-analyzer tube combination, which is the heart of the instrument. Fig. 3 is a schematic diagram of the commercial mass spectrometer manufactured by Consolidated Engineering Corp. In the center is the magnet with the ionization chamber and analyzer tube enclosed in a glass envelope between the pole faces. The directions of the arrows indicate the relation of the "M.S. tube" to the other components of the system. We will consider the various elements in turn.

Pre-focused tube

The ionization chamber and the analyzer tube are constructed of non-magnetic materials of the types often used in vacuum tubes. Extremely close tolerances are held on all parts so that a "pre-focused" tube results. This means that once the tube is aligned in the gap, no adjustments are necessary to produce proper focusing. Pure tungsten is used as a filament material

PRESS WIRELESS

400 WATT TRANSMITTERS



Awarded to our Hicksville, Long Island Plant for outstanding Achievement in War Production

PRESS WIRELESS, INC. IS DEVELOPING OR MANUFACTURING

- HIGH POWER TRANSMITTERS
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AND OTHER TYPES OF RADIO AND COMMUNICATIONS EQUIPMENT

Now off to the wars, Press Wireless "400's" will be available for civilian service fronts when peace permits. Here is a versatile transmitter of exceptional value for airport, police department, ship-to-shore and other exacting radio communication work.

Continuous coverage throughout its frequency range of 2.1 to 18 megacycles; both crystal and master oscillator frequency control with remarkable stability in the latter; better than 150 words per minute keying speed and automatic carrier control from remote point over two-wire telephone line are only a few of this transmitter's many outstanding service characteristics.

The "400" is one of a number of units Press Wireless is manufacturing toward the development of complete radio communication systems of the highest economy and efficiency,—for war today,—for peace tomorrow.

Sales Office, Manufacturing Division
1475 BROADWAY, NEW YORK 18, N. Y.

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Executive Offices
435 N. MICHIGAN AVENUE, CHICAGO

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because of its greater emission stability with regard to the presence of gases, and because the total emission required is small.

Power supplies

The power supply for the electron gun is a conventional low-voltage power supply which uses VR-tube regulation, and furnishes up to 100 volts to the electron beam. The entire unit floats at a high-voltage and is supplied through an isolating transformer from a line-voltage regulator. In Fig. 4 this unit is the lower panel in the center of the main control cabinet.

The high voltage for accelerating the ions is derived from a conventional high-voltage power supply. This voltage is automatically varied over any desired range, so that any portion of the mass spectrum can be scanned in a continuous manner. Thus, all masses within the range selected will be brought in succession to a focus at the collector and recorded. This naturally is a much faster and more accurate method than the older point-by-point method of plotting each peak separately.

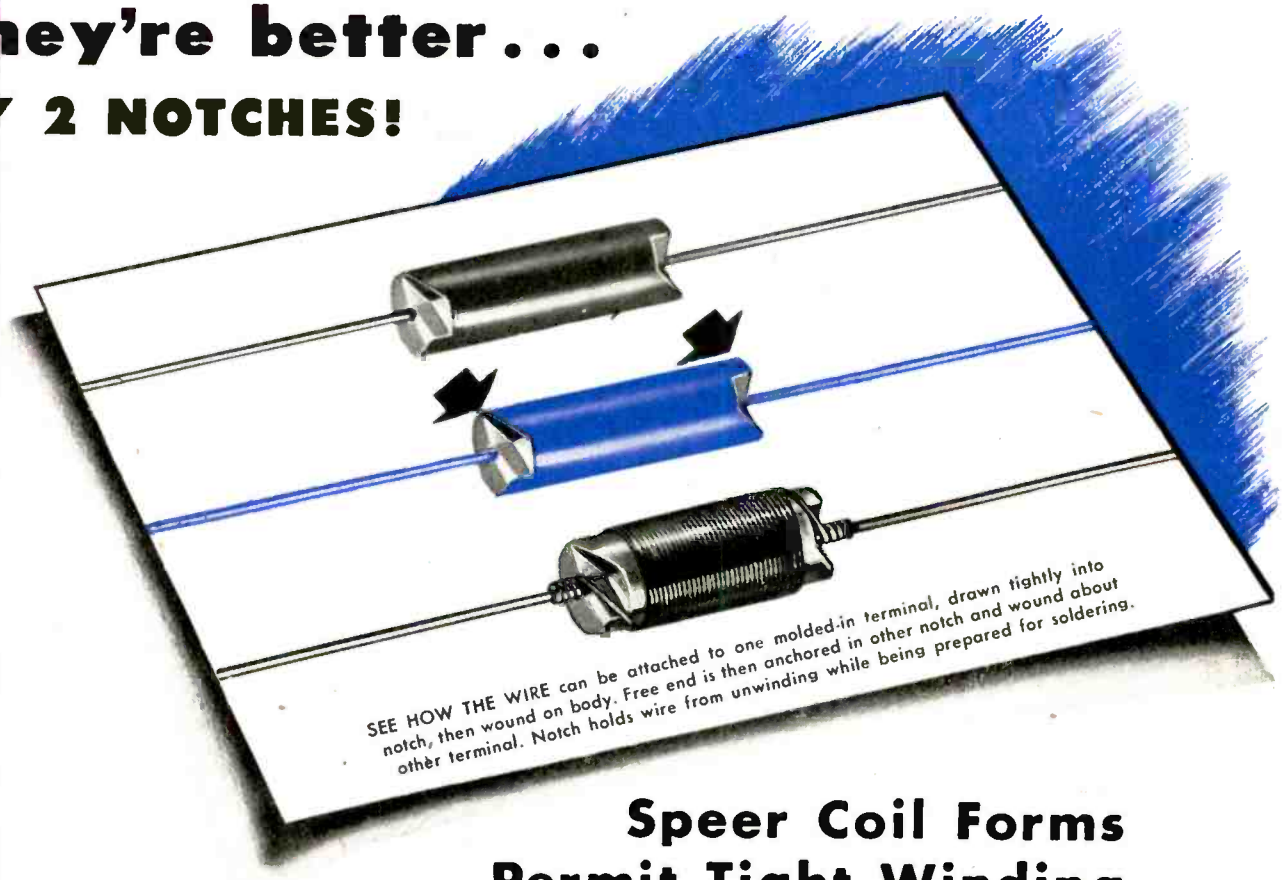
The magnet power supply uses two 872 rectifiers. Two stages of dc amplification ahead of the series tubes in the regulator are necessary to secure sufficient regulation. Twenty-two 6A3's in parallel serve as the series tubes, providing regulated current up to 1.5 amperes. Normally, a current of about .5 amperes is used when scanning the spectrum from mass 12 to mass 70. For the heavier mass range a somewhat larger current is used, and for masses 1 through 4 a current of about .15 amperes is used.

DC amplifier

A 3-stage dc amplifier amplifies the ion current striking the collector. Since this current is very small, ranging from 10^{-15} to 10^{-10} amperes, extremely high grid-leak resistance must be used in the input stage of the amplifier. The range of grid-leak values used from 10^9 to 10^{12} ohms. This requires that the input tube be operated under conditions which give rise to low grid current; namely, low filament current and low plate and screen voltages. In addition, in order to prevent surface leakage due to moisture films on the grid-leak and the envelope of the input tube, the tube and resistor are enclosed in an evacuated shield which is mounted on the end of the MS tube assembly. Heavy inverse feedback is used in the amplifier to give high stability and a linearity of $\pm$ .1 per cent.

The output of the dc amplifier drives a recording oscillograph of the electromagnetic type, which uses high-speed galvanometers. Record paper 8 in. in width is used,

They're better...
BY 2 NOTCHES!

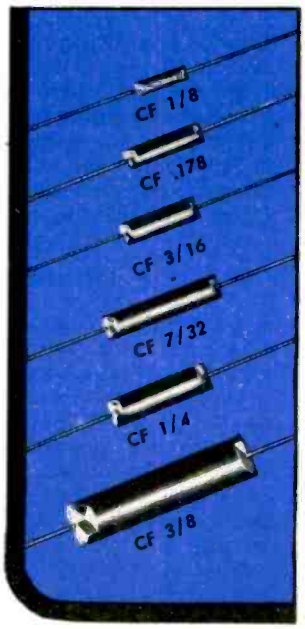


SEE HOW THE WIRE can be attached to one molded-in terminal, drawn tightly into notch, then wound on body. Free end is then anchored in other notch and wound about other terminal. Notch holds wire from unwinding while being prepared for soldering.

Speer Coil Forms Permit Tight Winding

Makers of radio sets and other electronic communications equipment find Speer coil forms unusually easy to wind. Here's why: Notches on the ends of each form help anchor the wires . . . make possible extra tightness in winding. This exclusive feature is only one reason for the popularity of Speer Resistor Coil Forms, one of the most economical component parts on the market. Another reason is that anchorage of coil ends is accomplished without use of elaborate terminals. By its construction and by the choice of its materials, this Speer winding unit insures peak performance. Simultaneous molding increases heat transfer efficiency and as a result, improves load conditions.

These Speer winding coil forms – available in the sizes shown in the table – draw upon 15 years of molding experience. They are produced by the makers of the most complete line of carbon resistors in the country. Write for further information, including additional Coil Form data.



YOU CAN GET SPEER COIL FORMS IN THESE DIAMETERS AND LENGTHS

PART NUMBER	DIAMETER	MAXIMUM LENGTH	WIRE
CF .107	107"	3/8"	22
CF 1/8	1/8"	7/16"	22
CF 5/32	5/32"	1/2"	21
CF .178	178"	3/4"	21
CF 3/16	3/16"	3/4"	21
CF 7/32	7/32"	1"	19
CF 1/4	1/4"	1"	19
CF 3/8	3/8"	1-1/2"	18

The lengths given above are the maximum lengths to which these can be made. They can be made in any shorter size

We normally require a tolerance on length of plus or minus 1 32" and on the diameter of plus or minus .008".

SPEER RESISTOR CORPORATION

ST. MARYS, PENNSYLVANIA

and the scale lines are photographed simultaneously with the galvanometer traces, so that paper shrinkage has no effect on reading accuracy. The oscillograph has a removable magazine which contains 200 ft. of paper. After each run the paper is cut by a knife in the camera and the exposed portion is transported to the darkroom in a lightproof "sleeve." This method of recording has great merit in providing accurate, permanent records. The oscillograph can be seen in Fig. 4 in the upper left hand part of the control cabinet.

The system for continuously evacuating the MS tube consists of a two stage mercury diffusion pump backed by a small mechanical pump. This arrangement produces a vacuum of less than 10^{-6} mm. Hg. An ionization gage of the type well known to vacuum tube engineers is used for measuring the degree of vacuum. Backing pressure is measured with a Pirani gage. The two-lower panels in the left-hand rack in Fig. 4 contain the pump controls and the vacuum-measuring circuits.

Introduction system

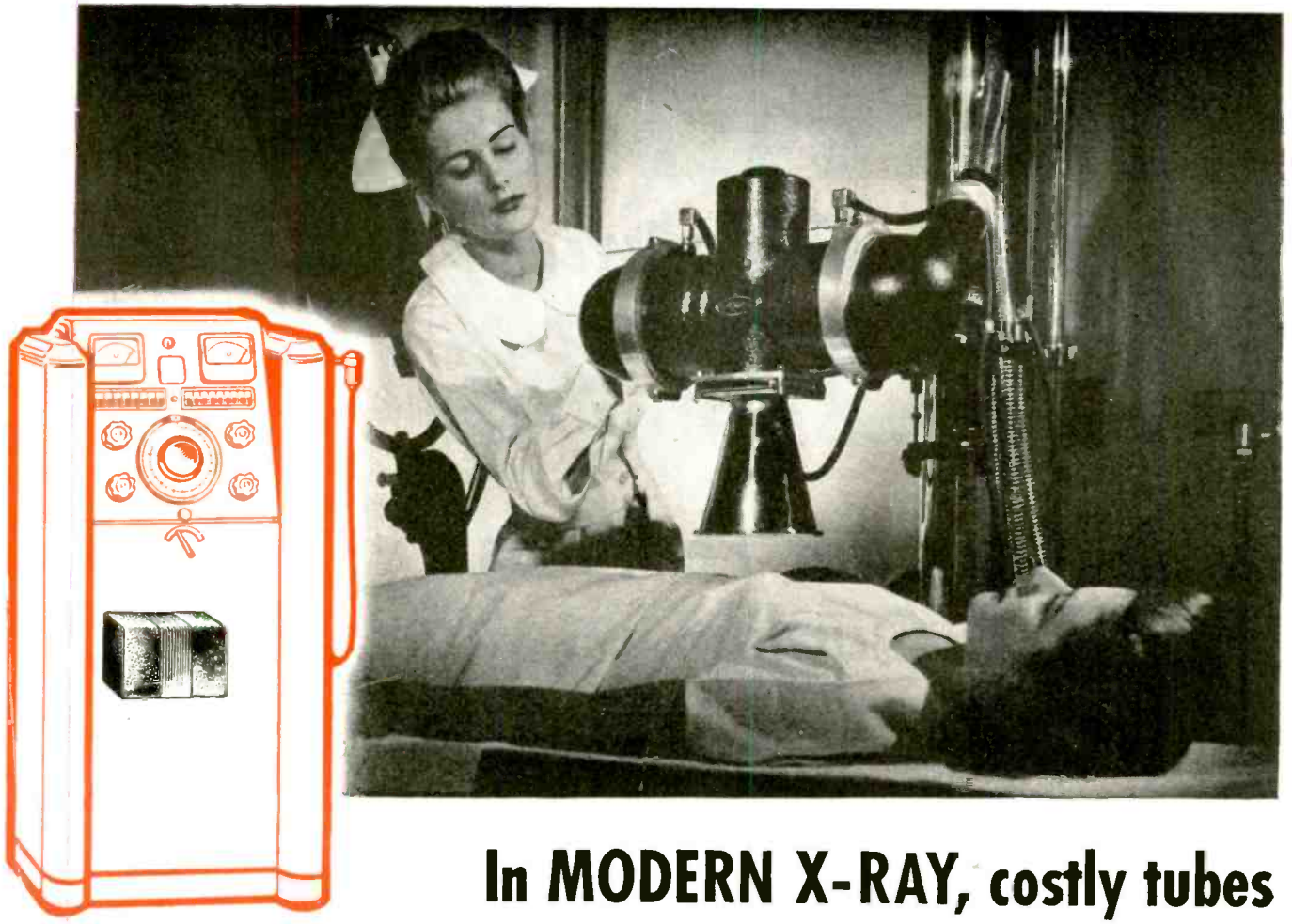
In the upper portion of the left-hand rack in Fig. 4 is the sample introduction system. This system has its own vacuum pumps, a two-stage oil diffusion pump, and a mechanical backing pump. Their purpose is to pump out those parts of the introduction system into which a sample is to be introduced, so that there will be no contamination from preceding samples or from air.

The sample is bled from its container into an evacuated chamber in the inlet system. From here the flow of gas to the ionization chamber takes place through a capillary leak, so that when the sample arrives at the ionization chamber, its pressure has been reduced to roughly 10^{-4} mm. Hg. The amount of sample required is usually less than 0.1 cc. at atmospheric pressure.

Chassis construction

An unusual chassis construction has been used throughout the instrument: Fig. 5 shows the inside of a typical chassis and the rear view of its panel. The panels can be removed and hooked on to the cabinet at right angles, thus permitting operation of a unit in place, at the same time allowing ready access to wiring and parts for testing and servicing. Design of the instrument is conservative, on the basis of 24-hour-a-day operation.

The mass spectrometer is ideally suited to many problems in chemical analysis—one problem which will receive much attention in the future is biological tracer work using isotopes as tracers. At pres-



In MODERN X-RAY, costly tubes are protected with built-in CONSTANT VOLTAGE

Voltage surges, which have been responsible for the destruction of many costly X-ray tubes, no longer harass the operators of modern X-ray equipment.

Recognizing this common enemy, design engineers of most leading manufacturers of X-ray equipment have incorporated SOLA Constant Voltage Transformers as a built-in part of their newer models, thus substantially reducing one of the costly factors of X-ray work—tube replacement.

Economy of operation, however, is only one of the improvements made possible in X-ray by this dependable means of voltage control. In the de luxe push button model of the F. Mattern Manufacturing Company illustrated above, the built-in SOLA Constant Voltage Transformer maintains a perfectly stabilized cathode temperature thus eliminating film distortion or fogginess and greatly reducing the chance for diagnostic error.

During fluoroscopic examinations, patient and technician are protected against sudden intensification of rays. In X-ray treatments the *exact* dosage can be administered with no chance for error.

With the expansion of the use of X-ray into vast new fields of industrial research, constant voltage has become mandatory. Here speed and accuracy in the examination and testing of basic elements, raw materials and manufactured products must keep pace with the swiftly moving tempo of industry.

Here is another typical example of improved product design made possible by the SOLA Constant Voltage Transformer. As a built-in part of modern X-ray equipment it absorbs primary voltage fluctuations as great as 30%, reducing them to the safe voltage limits as specified on the label.

SOLA Constant Voltage Transformers require no supervision, are fully automatic and self-protecting against short circuit. Standard units are available in capacities from 10VA to 15KVA, or special units can be built to design specifications.

SOLA Constant Voltage Transformers

To Manufacturers:

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

Ask for Bulletin 10CV-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.**

ent, however, the primary commercial application of the mass spectrometer is in the analysis of the hydrocarbon mixtures encountered in refining operations. Here the mass spectrometer is being used both as an aid to the development of new processes and as an instrument for routine control work.

When a hydrocarbon gas is admitted to the ionization chamber, ions are formed not only with the mass of the molecule, but with many lower masses as a result of "cracking" by the electrons. Thus, in the case of methane, CH_4, the following ions appear: CH_4+, CH_3+, CH_2+, $CH+$, $C+$. The relative numbers of these different ions are constant no matter what the pressure and no matter what other gases are present. By running a sample of pure methane these numbers are determined, and are called the **pattern** of methane.

Similarly, other hydrocarbons are found to crack into various ions, each substance having a distinctive pattern of its own. In mixtures of gases the various patterns often contribute to the same mass peaks, but because of the linear nature of the ionization chamber, mixture patterns are linear superpositions of the component patterns. The amount of each component is thus readily found by solving a set of simultaneous equations. Readers interested in the details of computing mixtures and in the patterns of a number of materials are referred to the literature cited at the end of this article.

Since a typical mixture analysis may take only 15 minutes of instrument time plus a few minutes to two hours of a computer's time, it is plain that a large number of samples can be run in one day. This speed is of great importance in refinery control, since the plant operator can ascertain the results of changes as much as 24 hours sooner than with the older methods of analysis. One practical result of this closer control is more and better aviation gasoline.

Literature:

Washburn, Harold; Taylor, D. D.; Hoskins, E. E.; Langmuir R. V.—Proc. Calif. Nat'l Gas Assoc.—**15**, No. 11, 7-9 (1940).

Hoover, Herbert, Jr., and Washburn, Harold—Calif. Oil World, **34**, No. 22, 21-2 (Nov. 1941).

Hipple, John A.—Journal of Applied Physics, Vol. 13, p. 551-560 (Sept. 1942).

Jordan, E. B., and Young, Louis B.—Journal of Applied Physics, Vol. 13, p. 526-538 (Sept. 1942).

Jordan, E. B., and Coggeshall, N. D.—Journal of Applied Physics, Vol. 13, p. 539-550 (Sept. 1942).

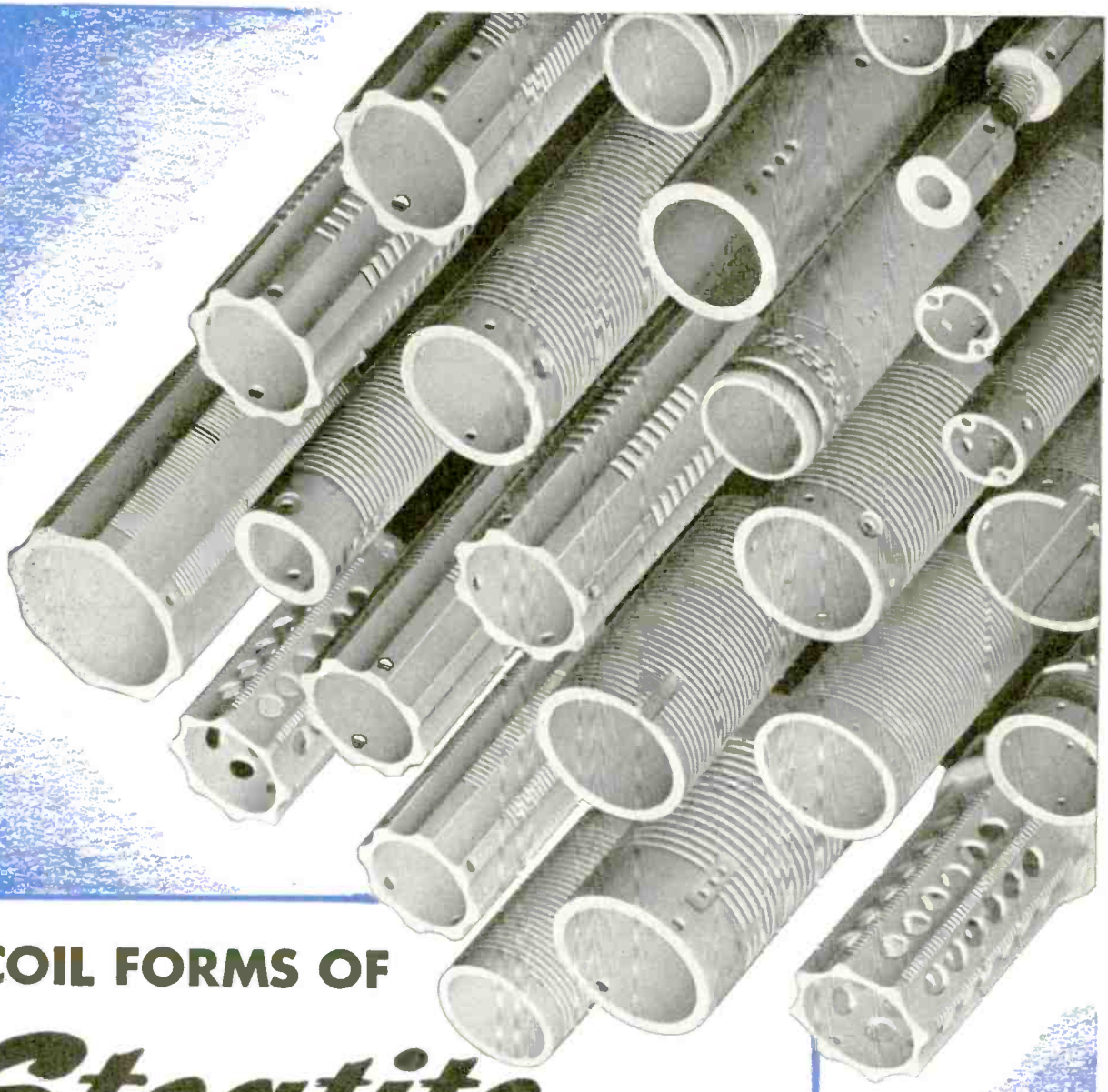
Rittenberg, D.—Journal of Applied Physics, Vol. 13, p. 561-569 (Sept. 1942).

Roberts, O. L.—Petroleum Refiner (May 1943).

Washburn, H. W.; Wiley, H. F.; Rock, S. M.—Ind. & Engr. Chem., Analytical Ed., Vol. 15, p. 41 (Sept. 15, 1943).

Hipple, John A.—Electronics, Vol. 16 No. 11, p. 120-124 (Nov. 1943).

Shaafsma, J. G.—The Oil and Gas Journal, Vol. 42, No. 48, 57-63 (April 6, 1944).



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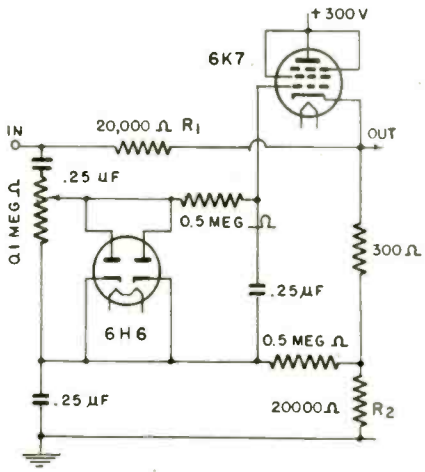
Centralab

Division of GLOBE-UNION INC., Milwaukee

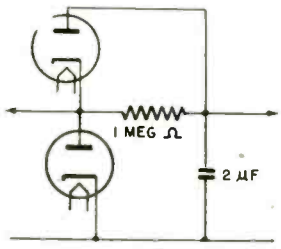
WIDE READING

(*Continued from page* 140)

a change of 10 volts in grid bias varies the tube resistance from 0.5 to 5 volt/mA, corresponding to a change in output by 18 db. The variable grid bias is supplied by the



Expansion unit diagram



Modified rectifier circuit

rectifier tube. Inputs of 20 volts or more will be handled without distortion.

It has been mentioned that until controlled compression is introduced at the transmitting end, better results can be obtained by having different times of charge and discharge in the rectifier circuit. In the modified rectifier circuit shown, the time constants are about 0.02 and 2 for charge and discharge, respectively.

If no expansion is desired for small amplitudes, a suitable dc bias should be applied to the rectifier; it would, however, depend on the carrier level. The detector input is, therefore, taken through a separate rf amplifier, rectified and smoothed, and a proportion of the voltage fed in series with the expander diode.

Pressure Gage

J. Yarwood (Electronic Engineering, London, April, 1944).

Color and structure of the electric discharge in a tube depend on the type of gas in the tube and on the pressure. This fact may be used to indicate the pressure in a system undergoing evacuation by the processes in a discharge tube sealed to a side-tube of the system.

Colored pictures typical for different pressures when the gas orig-

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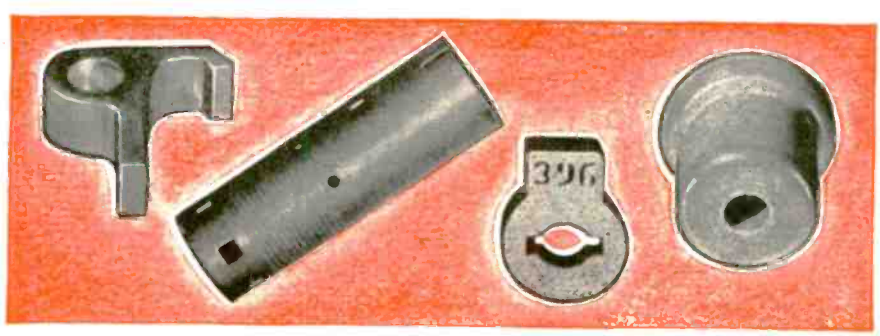

inally in the vessel is air are shown, as well as colored pictures for several other gases. It is also possible to trace impurities in the form of condensable vapors, for instance, water-vapor or grease-vapor from stop-cocks.

Capacitor Charging

V. Wouk (Communications, April, 1944).

The energy balance during the charging of a capacitor by a constant emf is investigated. Mathematical analysis shows that an amount of energy, equal to the amount finally stored on the capacitor, is expended in I^2R losses during the charging process; this is true for any circuit provided no tubes are incorporated and the resistance is neither zero nor negative.

Charging of a capacitor through a resistance and through a resistance plus inductance, as well as an open circuited RC cable are shown to obey the theorem. It also applies to non-linear systems where the resistance is a function of the current.

Photometer

J. McG. Sowerby (Journal of Scientific Instruments, London, March, 1944).

A photoelectric photometer for measuring the light scattered by the surface of a transparent plastic has been designed in connection with the study of abrasion of plastics, the amount of light scattered before and after a defined abraiding process being a measure of the resistance of the surface to abrasion.

The output of the photocell is amplified in a cathode follower stage connected to the control grid of a tuning eye indicator. Dimensions of the circuit elements are given and discussed. The results were reproducible to within 2 per cent.

Determining Water Vapor Content in Fuel Gases

R. J. Pfister and D. J. Kerley (Bulletin of the American Society for Testing Materials, March, 1944).

A technic is described for determining moisture in fuel gases, using a change in the light transmission of a 0.1 per cent solution of cobaltous bromide in butanol. A sample of condensed water is frozen out from a measured volume of gas, added to the solution and the transmission measured with a photoelectric calorimeter. Results from both field and laboratory tests indicate that water contents may be determined to within ± 3 per cent of the amount of moisture present.

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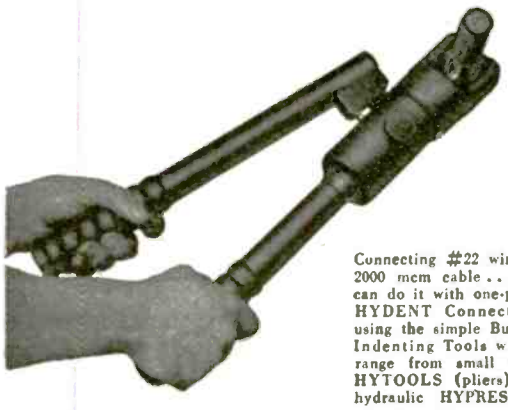
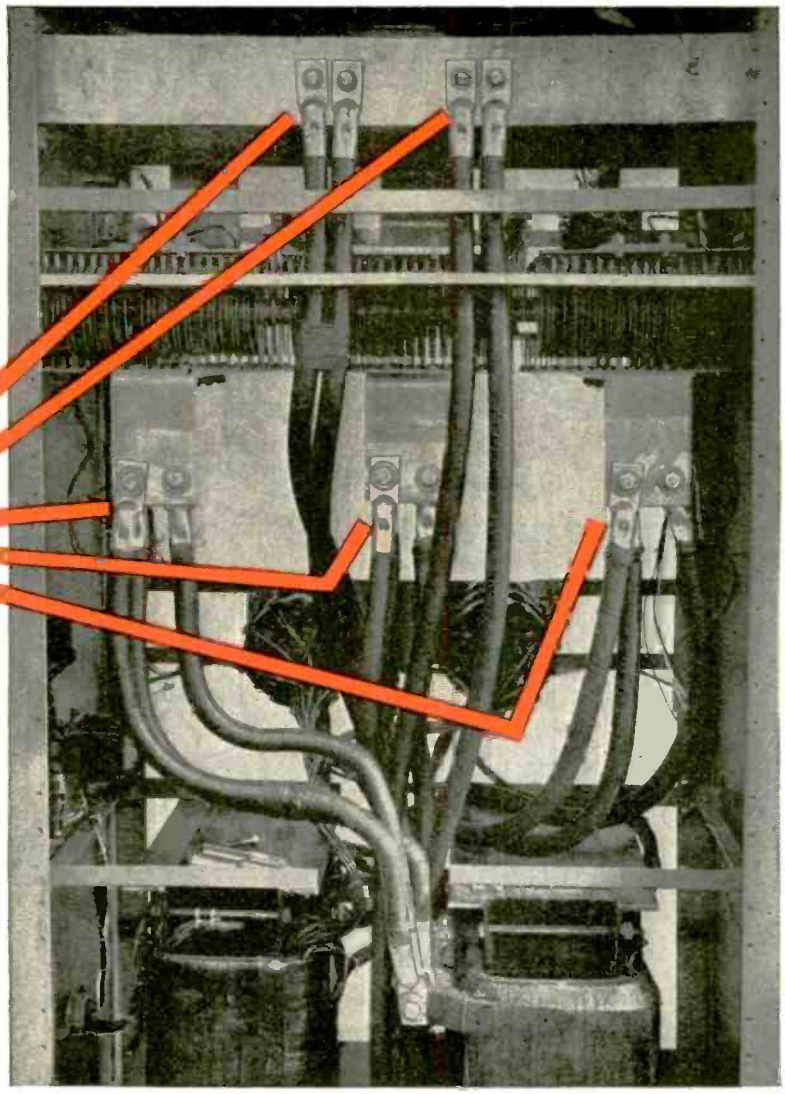


Connecting #22 wire or 2000 mcm cable . . . you can do it with one-piece HYDENT Connectors, using the simple Burndy Indenting Tools which range from small hand HYTOOLS (pliers), to hydraulic HYPRESSES.



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On circuits everywhere, you now see modern Burndy HYDENT (Indent Type) connections like those above . . . in place of old-fashioned connections made by methods which were time-consuming and uncertain.

The Indent connection has been widely adopted because the indenting principle removes all uncertainty over the strength and permanency of the connection. Further, the HYDENT connectors used are of *one-piece, pure copper* construction . . . assuring highest electrical conductivity. And they are installed in a *fraction of the time* . . . another feature industry likes, too.

Pioneered and proved by utility engineers, the HYDENT connection has been a significant aid to our war effort . . . and will contribute materially to product and production efficiency in the days to come. Bulletin on HYDENT Connectors gladly sent on request.

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FISHING

(*Continued from page* 131)

The echo-sounding devices now a part of the equipment of Navy patrol vessels are believed to be the finest in the world. Present devices are regarded as infinitely superior to those in use just before the war.

Tests of echo-sounding devices in locating schools of herring were begun by the British in the North Sea just prior to the war. Similar tests made in waters off British Columbia during the past fall gave promising results. The series of tests planned for the west coast will be the first large-scale experiment in American waters.

Echo-sounding equipment has been of great value to vessels engaged in fishing for species known as "bottom fish" by permitting easy exploration of the floor of the ocean, thus protecting nets from rocks and locating undersea valleys where some bottom fish congregate.

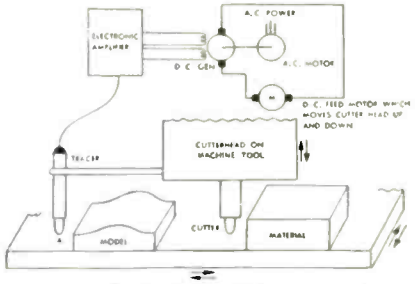
With sensitive equipment and trained operators it is believed possible not only to locate schools of fish but to determine the size and direction of the schools. As soon as arrangements have been completed, representatives of the Fish and Wildlife Service will be allowed to make tests aboard the Navy's patrol vessels during their routine operations.

Chief purpose of the experiments is to aid fisherman in catching pilchards, or California sardines. The pilchard season closed this week and will not be reopened until August 1. It is hoped that by then the experiment with the sounding devices will be far enough along for effective use during the next season.

AUTOMATIC TRACERS

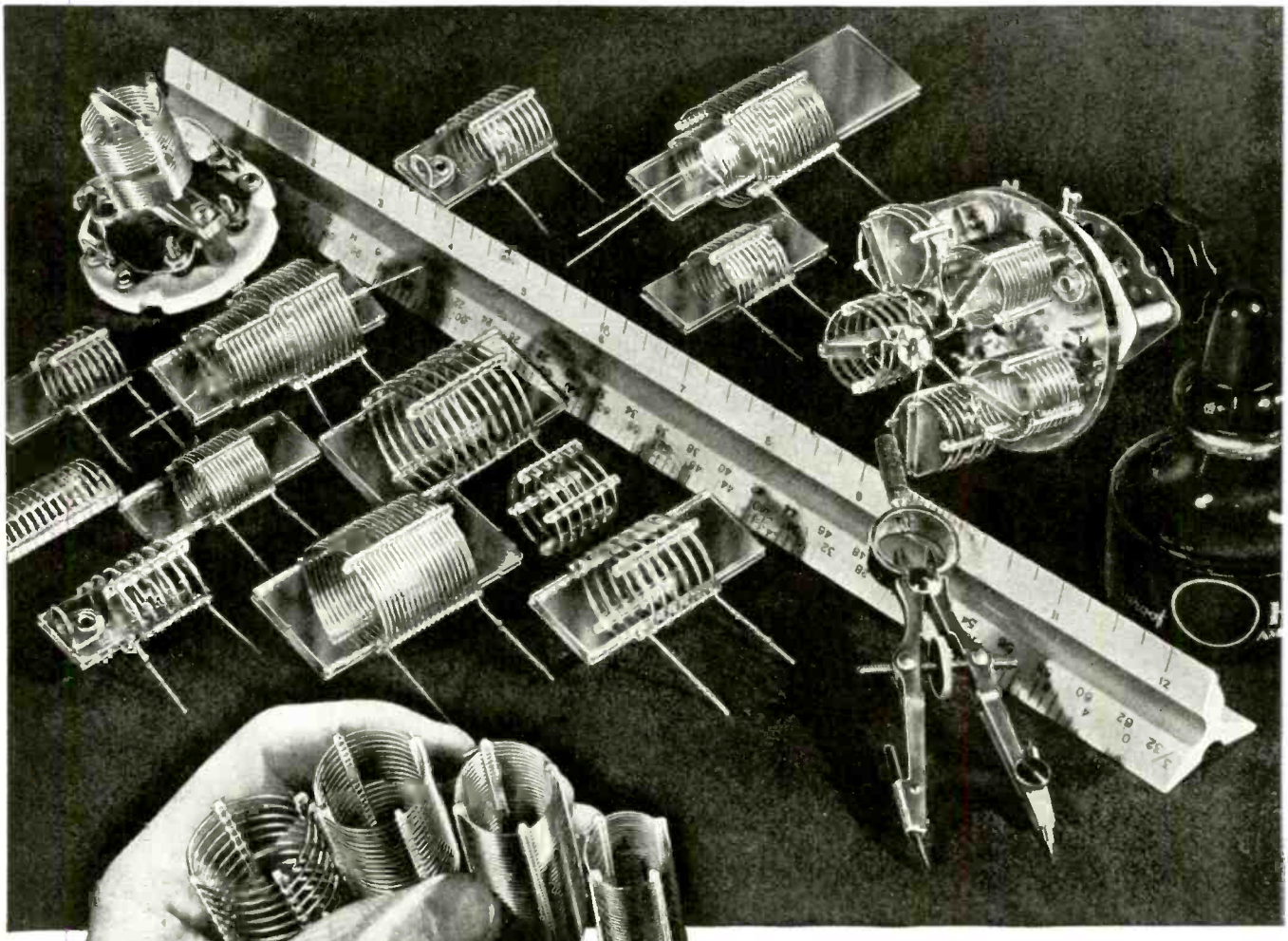
(*Continued from page* 131)

can be duplicated within two or three thousandths of an inch when feed speed of twenty to thirty inches per minute is used. The schematic drawing illustrates operation with a full-scale model. As the probe A moves up and down in passing over the model, the cutterhead is moved correspondingly by its feed motor, controlled by the signal from the amplifier.



Tube-controlled tracer mechanism for intricate surface-machining

Real "He Man" Coils IN MINIATURE!



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Now for the first time, you can get B & W Air-Wound Coils in very small sizes from ½" to 1¼" diameter, in ⅛" steps, and in winding pitches from 44 to 4 turns or less per inch. Almost any type of mounting can be supplied.

Applications for these tiny coils include: coil switching turret assemblies; intermediate frequency transformers; high-frequency r-f stages (low-powered transmitter or receiver); all types of test equipment involving tuned r-f circuits; high-frequency r-f chokes, and numerous others.

The coils have a high Q, due to the almost total absence of insulating material in the electrical field. They are exceptionally light in weight and extremely rigid. Normally wound with tinned copper wire in sizes from #28 to #14, they can also be supplied with coin silver, coin silver jacketed, bare copper, or phosphor bronze wire. All types may be equipped with either fixed or variable internal or external coupling links, or other non-standard features. Samples on request to quantity users. Send us your specifications!

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ELECTRON MICROSCOPE

(*Continued from page* 130)

type EMU has been considerably revised with a view to simplifying adjustments and the routine necessary in placing specimens and putting the microscope in operation. Internal magnification ranges from 100 to 22,000 times, adjustable in 40 steps. The photographic arrangement permits five exposures on a standard 2 x 10 in. plate. One of its most important features is the third-dimension measuring system based on stereoscopic photography, and an attachment for producing electron diffraction patterns of crystals.

MANUFACTURERS' REPS.

(*Continued from page* 139)

Van Luven Co., H. H., 307 East Third St., MU-5173
Warburg Co., Ed., 1207 East 8th St., TR-2981
Warren Co., C. W., 646 North Fuller Ave., WH-2122
Zeagler, K. S., 1709 West 8th St., EX-6921

North Hollywood

Lee, J. Max, 4249 Navajo St., SU-1-1732

Oakland

Otis, W. I., 608 16th St.

Piedmont

Ward, Charles, 135 St. James Drive, Olympic 3937

San Francisco

Barricks Co., A., 615 Belvedere St., MO-7857
Bushnell Sales Co., Western Merchandise Mart, 1355 Market St., UN-2727
Cribbins Co., Walter W., Suite 505, Rialto Bldg., DO-8155
Detsch & Co., 341 10th St., MA-2788
Emmet Co., Frank M., 420 Market St.
Frazar & Hansen, 301 Clay St., EX-5112
Gilran Pacific Co., 1204 Hearst Bldg.
Hauch, Ernest F., 278 Chronicle Bldg., EX-7058
Henkel, Harry, 163 Second St., DO-3007
Hermans Co., James P., 235 Ninth St., MA-4166
Hines Co., Russ, 234 9th St., HE-2625
Hitt Co., W. C., 1355 Market St., UN-2727
Hodges & Glomb, 1264 Folsom St., UN-2367
Honn Co., George E., 420 Market St., SU-7565
Huber Sales Agency, 1280 Mission St., UN-6374
Hunt, Clarence R., 237 Rialto Bldg., SU-6517
Joslyn Co. of California, 180 Potrero Ave., UN-7313
Lippincott Co., Inc., 461 Market St., EX-2687
Logan Co., Les, 530 Gough St., HE-5281
Marshall, Harry E., 104 Olive St., OR-2173
Marwedel & Co., C. W., 1235 Mission St., UN-2125
Nickerson & Rudat, 383 Brannan St., DO-8530
Noble Co., Thomas D., 210 12th St., MA-4326
Orcutt, Walter E., 420 Market St., DO-2085
Politeo, Dom, 547 Howard St., GA-0350
Purdy Co., Wm. J., 420 Market St., SO-6027
Routh Co., T. R., 1045 Bryant St., KL-2-0146
Sinai, Arnold A., 1280 Mission St., UN-6374
Spector Co., Rialto Bldg., GA-2009
Topping, Joseph, Jr., 325 Miguel St., AT-4201
Totten, E. J., & Jack, 14 Santa Clara Ave., MO-5428
Waltham, DeWitt & Krusl, Monadnock Bldg., GA-5054
Wilcox Co., E. A., 277 7th St., HE-6672

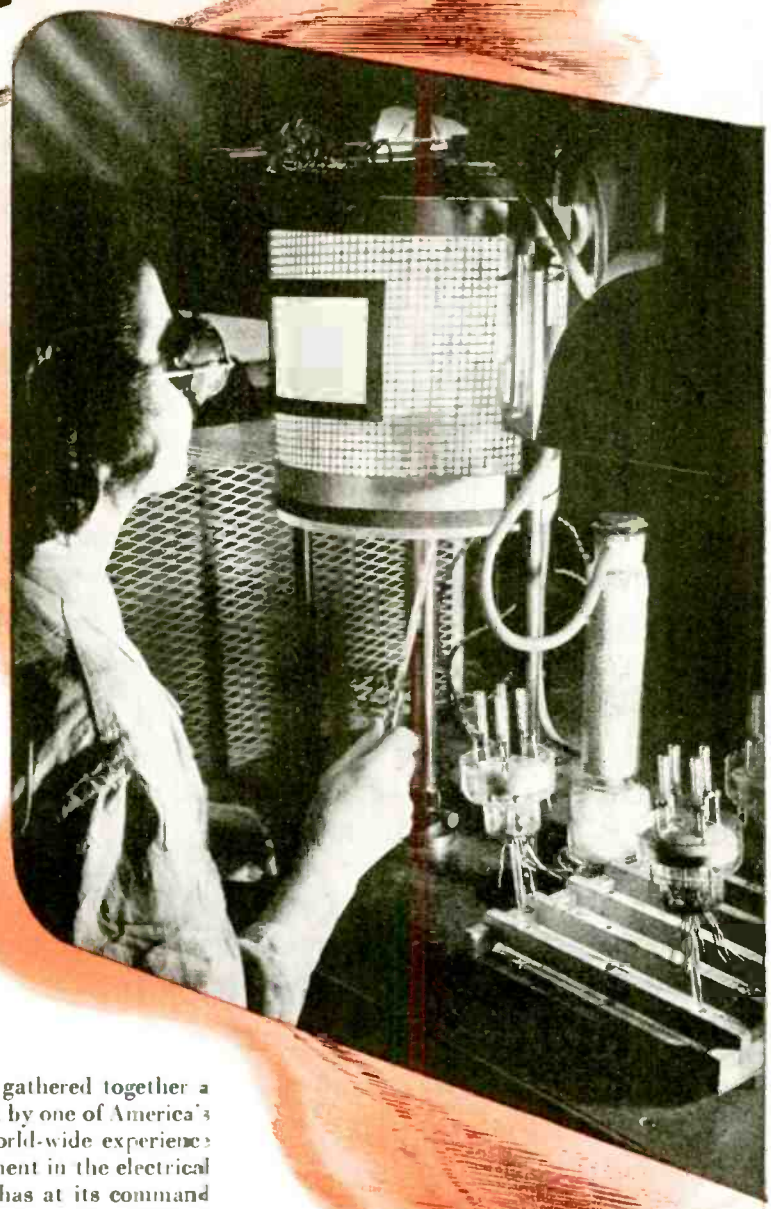
San Marino

Condon, Earle S., 405 San Marino Ave., SY-6-5934

Los Angeles

Swartz, Wm. P., 10792 Ashton Ave., AR-30850

FLASHING LONG LIFE INTO POWER TUBES



IN transmitting tubes operating in military communications at ultra high frequencies, long life and uniform electron emission are imperative requirements. The photograph illustrates one interesting tube manufacturing operation with the tungsten filaments being "flashed" in a hydrogen atmosphere as a protection against oxidation.

North American Philips engineers build long life expectancy, optimum electron emission and all-round satisfactory performance into every NORELCO tube they manufacture.

Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of tube types we are especially equipped to produce will be sent on request.

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In the North American Philips Company, there is gathered together a team of outstanding electronic engineers, captained by one of America's leading physicists, and coached by a group with world-wide experience resulting from fifty years of research and development in the electrical field. This new combination of technical talent has at its command many exclusive processes that insure electronic devices of the highest precision and quality. Today, North American Philips works for a United Nations' Victory; tomorrow, its aim will be to serve industry.

NORELCO PRODUCTS: Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes; Secrecy (X-ray) Apparatus, X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Electronic Measuring Instruments; Direct Reading Frequency Meters; High Frequency Heating Equipment; Tungsten and Molybdenum products; Fine Wire; Diamond Dies. When in New York, be sure to visit our Industrial Electronics Showroom.

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RADIO RELAY LINKS

(*Continued from page* 129)

supervision of the radio communication facilities in the southern part of the state which includes the counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange, San Diego, Imperial, Riverside, San Bernardino and Kern. Conditions in each of these counties are typical of those in almost the entire part of the state and for the purposes of this article it is deemed advisable to limit the discussion to this section, since it will adequately illustrate all points. This part of the state embraces some of the most mountainous sections as well as some of the more level parts of the state and an average communications problem is thus presented.

To date six repeater stations have been installed in the above ten counties; San Luis Obispo County near Cambria, elevation 2700 ft.; Santa Barbara County near San Marcos Pass, elevation 2600 ft.; Ventura County near Santa Paula, elevation 3000 ft.; Kern County near Lebec, elevation 5200 ft.; San Bernardino County near Crestline (Strawberry Peak), elevation 6150 ft. and San Diego County, on Lyons Peak near the Mexican Border, elevation 3700 ft. All of these automatic radio relay stations operate on 118.55 mc which is our uniform relay frequency throughout the state.

These stations provide an excellent degree of coverage for mobile units operating in their respective counties and in many instances provide inter-county coverage from mobile units as some of the repeater stations are received at several different locations.

Experience has shown that 118.55 mc channel transmission definitely is not limited to line-of-sight distances. In the case of the installation in Santa Barbara County the 118.55 mc receiving location at the dispatching point is not within optical range and the intervening terrain is quite rugged and mountainous and rises from 50 to 100 ft. within about two miles of the repeater station location. The total distance, in this instance, between the repeater location and the dispatching point is approximately 8 miles. Similar variations have also been noted in the 39.78 mc band although to a greater extent. In some instances it has been possible to receive from mobile units operating on this frequency and separated from the receiving location by mountain ranges with an elevation of 2,000 to 5,000 ft., the mobile units being as much as 60 or more miles distant.

An accompanying photograph illustrates our installation in San Bernardino County. The equip-

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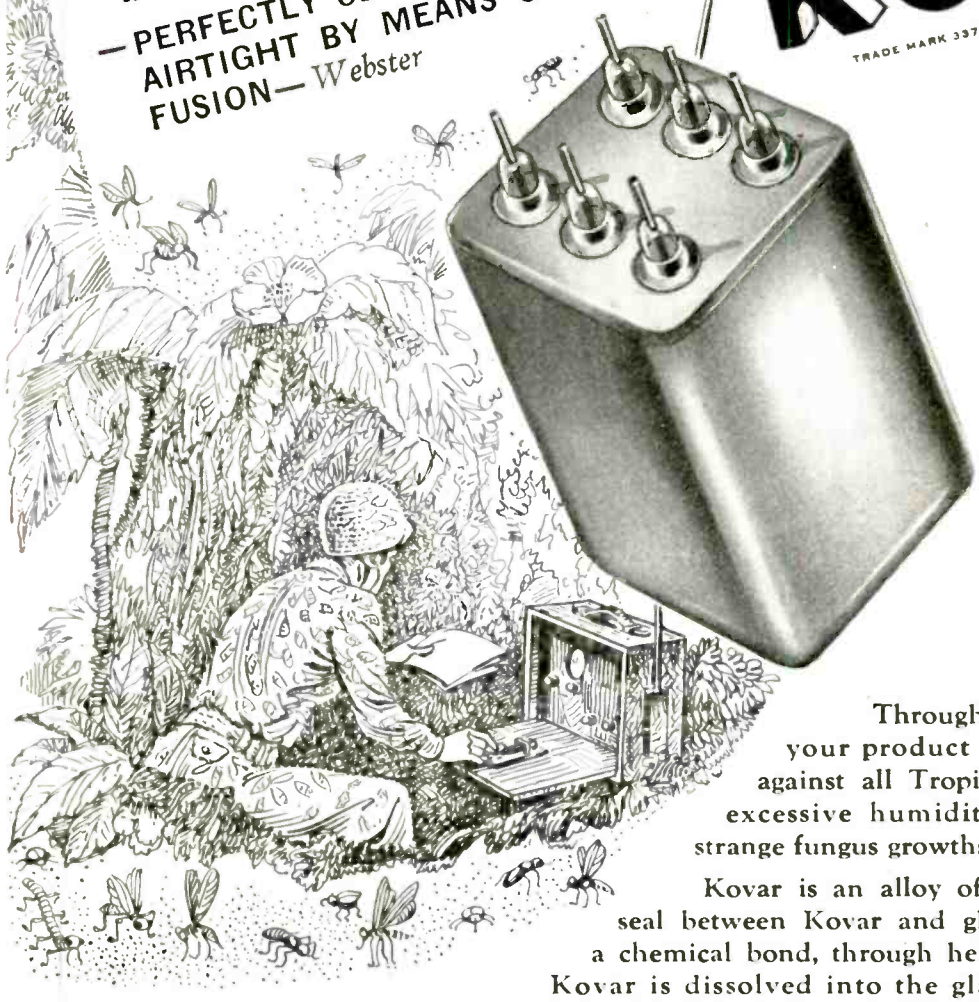

Single Terminal Kovar-glass lead-through readily soldered to apparatus.

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Stupakoff supplies Kovar in sheet, rod, wire, tubing or fabricated as eyelets, cups, flanges, etc., also Kovar-glass seals complete, ready for soldering, welding or brazing to metal containers.

Kovar IS the answer to permanent vacuum or pressure tight sealing. For further information on your specific problem, write Stupakoff today.

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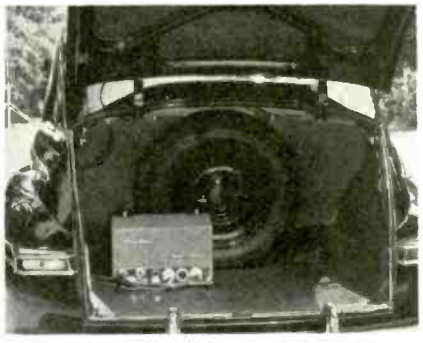
ment consists of a 118.55 mc frequency modulated repeater transmitter with a rated output of 10 watts and a 39.78 mc control receiver. The transmitting antenna is a half wave vertical coaxial type radiator cut to the proper operating frequency; the receiving antenna is of the same type and designed for use on 39.78 mc. These antennas are fed through 7/8 in. copper concentric transmission lines.

The whip portion of the 39.78 mc antenna is supported at two points on its length by stand-off insulators. This was done to prevent breakage of the whip for at this elevation extreme icing conditions have been experienced. Due to the relatively shorter length of the 118.55 mc antenna, no support was used and no trouble has been encountered with it. The equipment at this location has been in operation for about two years and to date there have been no failures.



Method of mounting the FM transmitter in one of the California Highway Patrol cars

In addition to the regular source of power, an 800 watt gasoline driven ac generator is installed to provide emergency power as needed. This auxiliary power supply is fully automatic and will take over the equipment load on any failure of power.

All equipment is housed in an 8 x 8 ft. pre-fabricated type wooden building erected on a concrete floor and foundation. While this type of structure presents some advantages in its ease of original installation, its use is not recommended to anyone planning a permanent installation. This Department had several of these on hand and due to priority requirements, etc., they were used with the thought in mind of replacing them at a later date with a structure of concrete or brick.

It will be noted from a study of the photographs that there are several antenna systems in evidence at this location. In addition to our repeater installation, the County of San Bernardino has installed a repeater in our same building; their ultra-high frequency transmitting antenna is on the short pole immediately to the left of the highest pole and their receiving antenna is on top of the higher pole. There are also two additional repeater

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TOUGHNESS . . . in terms of abrasion resistance

Type of wire	Number of scrapes per mil of insulation before failure
Conventional heavy-enameled wire	0.9
Synthetic A	10.0
Synthetic B	9.0
Formex wire	28.0

Abrasion or wear resistance, as determined by the repeated-scrape tester, provides the best single measure of film toughness.

FLEXIBILITY . . . measured by tapered-mandrel test

Formex wire (bottom) compared with enameled wire (top). The outer surfaces of the films have been elongated by stretching around a tapered mandrel and heating the samples to 150 C. Note the cracks on the enameled wire.

Its tough, flexible insulation enables you to produce tighter coils in less time

● When you're using Formex* magnet wire, you can literally "go the limit" in speed of coil winding and in tension. Its insulation film is so flexible that it can be wound around its own diameter without cracking.

It is so tough that it has thirty times the abrasion resistance of conventional enameled wire so tough that, even in the ultrafine sizes, the tension limit is determined by the strength of the copper conductor, not by the insulation.

Formex wire is smoother and more flexible than either enameled or fabric-covered wire. It pulls into place readily without forcing or jamming.

Because of this extra strength and flexibility, you can wind coils tighter and faster—and these same qualities will insure more coils passing final inspection.

For more information on Formex magnet wire, get in touch with the nearest G-E apparatus office. *General Electric Company, Schenectady 5, N. Y.*

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station installations within 75 ft. of our building. All these facilities operate on channels immediately adjacent to ours and no interaction is experienced between the various units.

The 118.55 mc signal from this repeater station is received at three locations, namely: San Bernardino, about 10 miles away; Riverside, about 20 miles; and Los Angeles, approximately 55 miles distant. At San Bernardino and Riverside a very strong signal is received and of sufficient strength to provide excellent noise reduction; a satisfactory signal is received at Los Angeles, though noise reduction is not so great. In each of the above locations a coaxial type antenna of the same physical dimensions as the one used at the relay transmitter is used.

Recent tests, made at our Sacramento office, indicate the desirability of utilizing a 60 degree corner reflector with a single directive element ahead of the coaxial element proper. Other types of conventional directive arrays are also effective and their use is definitely recommended, especially in cases where the repeater location is at considerable distance from the 118.55 mc receiving location or dispatching point.

Length of radio link

From our own experiences, it appears that a power of perhaps 3 to 5 watts, properly installed, with a directive array at both the receiving and transmitting end of the radio link, would permit satisfactory operation over distances of 100 miles or more. These distances would necessarily vary with the elevation of the repeater location, the presence of any intervening physical objects between the repeater location, etc.

Particular attention should also be given in the selection of a suitable receiver* with which to receive the repeater station signal; in all our installations we use a conventional type high-frequency station receiver with a converter ahead of it to provide for ultra-high frequency reception. These receivers are designed with an "off" signal noise silencing circuit and are entirely free from noise when the repeater is not in operation.

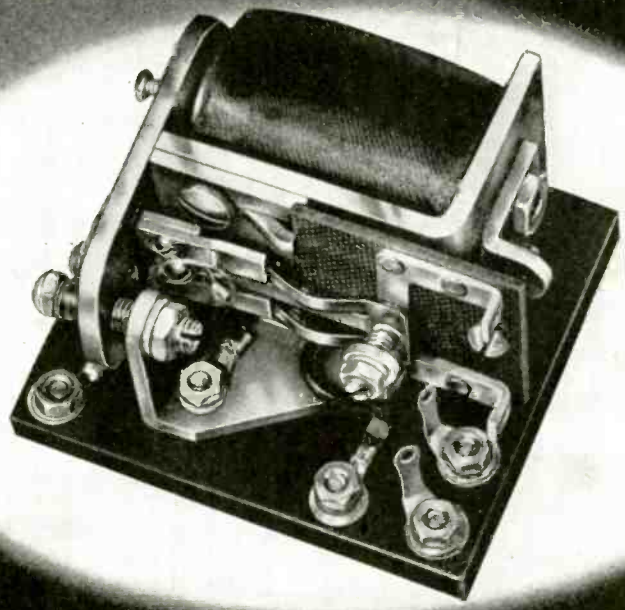
At the present time the greatest distance at which any of our repeater stations is received is in the installation above described in San Bernardino; in this respect it is surprising to note the relatively small degree of signal attenuation between Riverside, 20 miles from the repeater station and Los Angeles, 55 miles away.

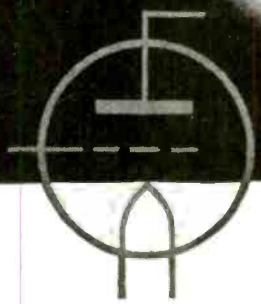
At each of the above locations the repeater station is within line-

*All repeater equipment was furnished by Galvin Mfg. Co., Chicago.—Ed.

STRUTHERS-DUNN

RELAY TYPE 79XAX





Sensitive, Snap-Action Operation

FOR USE ON SLOWLY-VARYING COIL CURRENTS

In addition to all of the advantages of conventional sensitive relays, Struthers-Dunn Type 79XAX is designed so that its armature practically completes its travel *before* the contacts snap-operate to the corresponding position. This, plus the fact that contacts remain closed *with full pressure* up to the instant of transfer, permit this relay to be used in a number of unusual ways. Such applications include overcurrent protection particularly in the range of 1 to 100 milliamperes, or in connection with shunts furnishing potentials in the range of 1 to 100 millivolts; pulsing circuits where the relay must "pump" or "scratch its own back"; sensitive vacuum tube circuits, and various others.

Normal sensitivity is 0.01 watt, although this sensitivity can be heightened by means of various circuit arrangements. Contact arrangement is S.P.D.T., and contact rating 10 amps. 110-V a.c., and 10 amps. 24-V d.c. Balanced construction withstands 10 G vibration and shock. Write for Data Bulletin describing this relay and giving circuit diagrams.

EXTREMELY CLOSE DIFFERENTIAL

. . . between pick-up and drop-out for either current or potential operation may be obtained by use of a resistor across the coil of the 79XAX, thus reducing coil current to a value just sufficient to hold the contacts closed. Any further decrease in current or voltage will operate the contacts.

Extreme sensitivity can also be obtained by use of a resistor, and the addition of a special coil to the 79XAX. These maintain the relay in a balanced condition. Any slight unbalance of the bridge or other power source will, through the upper coil, buck or boost the lower coil and cause the contacts to snap-operate.

STRUTHERS-DUNN, INC., 1321 ARCH STREET, PHILADELPHIA 7, PA.

ONE OF THE STRUTHERS-DUNN 5,288 RELAY TYPES

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

of-sight distance which further illustrates the importance of selecting a good location for the installation wherever possible. It should be noted here that a stronger signal is received in Los Angeles from the San Bernardino repeater than is received in Santa Barbara from the repeater transmitter installed in that county in which latter case the length of the radio link is only 8 miles. However, it is not line-of-sight distance.

In each of the six counties mentioned, where we have installed these relay stations, they have provided almost a blanket coverage of the entire area for which they were designed and when it is realized that some of these counties, particularly San Bernardino County with an area of 20,131 square miles, are larger than some entire states, it can readily be appreciated what a valuable addition they are to a communications network. Results have definitely demonstrated that our mobile units can be received through these repeater stations at distances up to 100 miles.

At the present time our mobile units are able to travel from one end of the state to the other on U.S. 101 or U.S. 99 and rarely be out of contact with at least one of our land stations or dispatching points. This is particularly true in the southern 10 counties where the six repeater stations are located.

Pomona land station, which is one of the control points of the California Highway Patrol

Once a relay station is properly installed, service and maintenance is usually limited to routine checking of tubes and minor tuning adjustments. Some service has been required on control relays and in one or two instances failures have developed in the 7/8 in. concentric lines, but as a general rule such failures can be minimized by a good original installation. In this respect I should like to point out the necessity of preventing antenna supporting structures from swaying and thus causing fractures in these concentric lines where they leave such antenna masts or towers and enter the transmitter house.

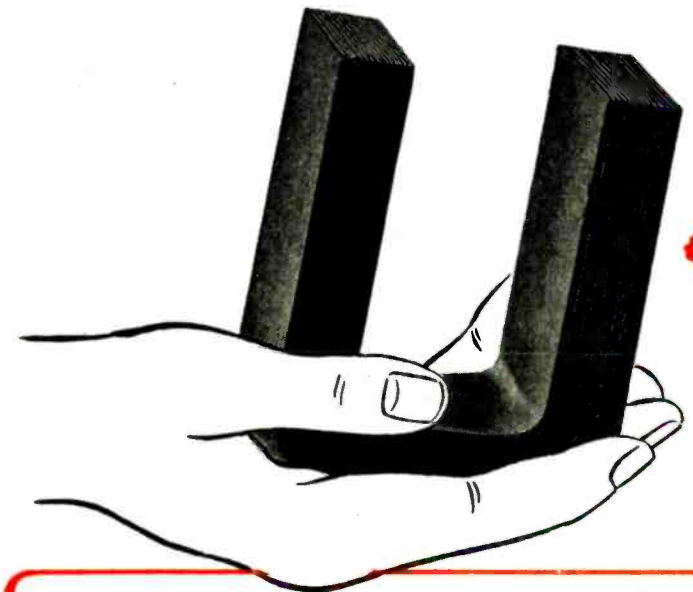
It is also recommended in installations where copper concentric transmission line is used, that in all instances it be fitted with proper end seals and made airtight

CHECK THIS FASTER HF COIL ASSEMBLY METHOD . . .

WITH PRE-ASSEMBLED

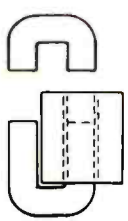
Two-piece

HIPERSIL* CORES

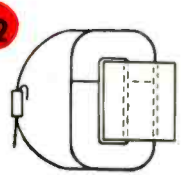


COMPARE THIS WITH YOUR PRESENT CORE ASSEMBLY METHODS

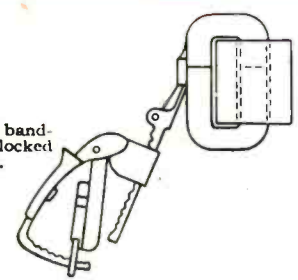
1 Core is placed around coil.



2 Core parts are butted together. Strap is threaded through seal and . . .



3 . . . tightened with banding tool. Band is locked in place with seal.



Banding Straps, Seals and Tools available from Westinghouse. See Page 9 of booklet B-3223-A.

Now you can eliminate the time-consuming operation of stacking hundreds of tissue-thin core laminations by hand for High-Frequency Communications Equipment. Pre-assembled Type C HIPERSIL cores are delivered to you in just TWO ready-to-assemble pieces per loop. Westinghouse winds a thin strip of HIPERSIL to form, bonds it, then cuts it in two.

These split-type cores of HIPERSIL are available in a complete range of standard sizes, or they can be furnished uncut in rectangular or circular shapes if desired.

GET THE FACTS ABOUT HIPERSIL TYPE C CORES . . . write for **HIPERSIL BOOK, B-3223-A.** It contains performance facts and application data that will help speed production of vital communications equipment to the fighting forces. Address: Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-70423

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HIPERSIL CORES

in order to prevent the line from "breathing" and accumulating an excess moisture content. The line should also be filled with a proper type of gas and maintained at a pressure in order to give some indication of line condition and prevent damage to the inner conductor and insulating materials.

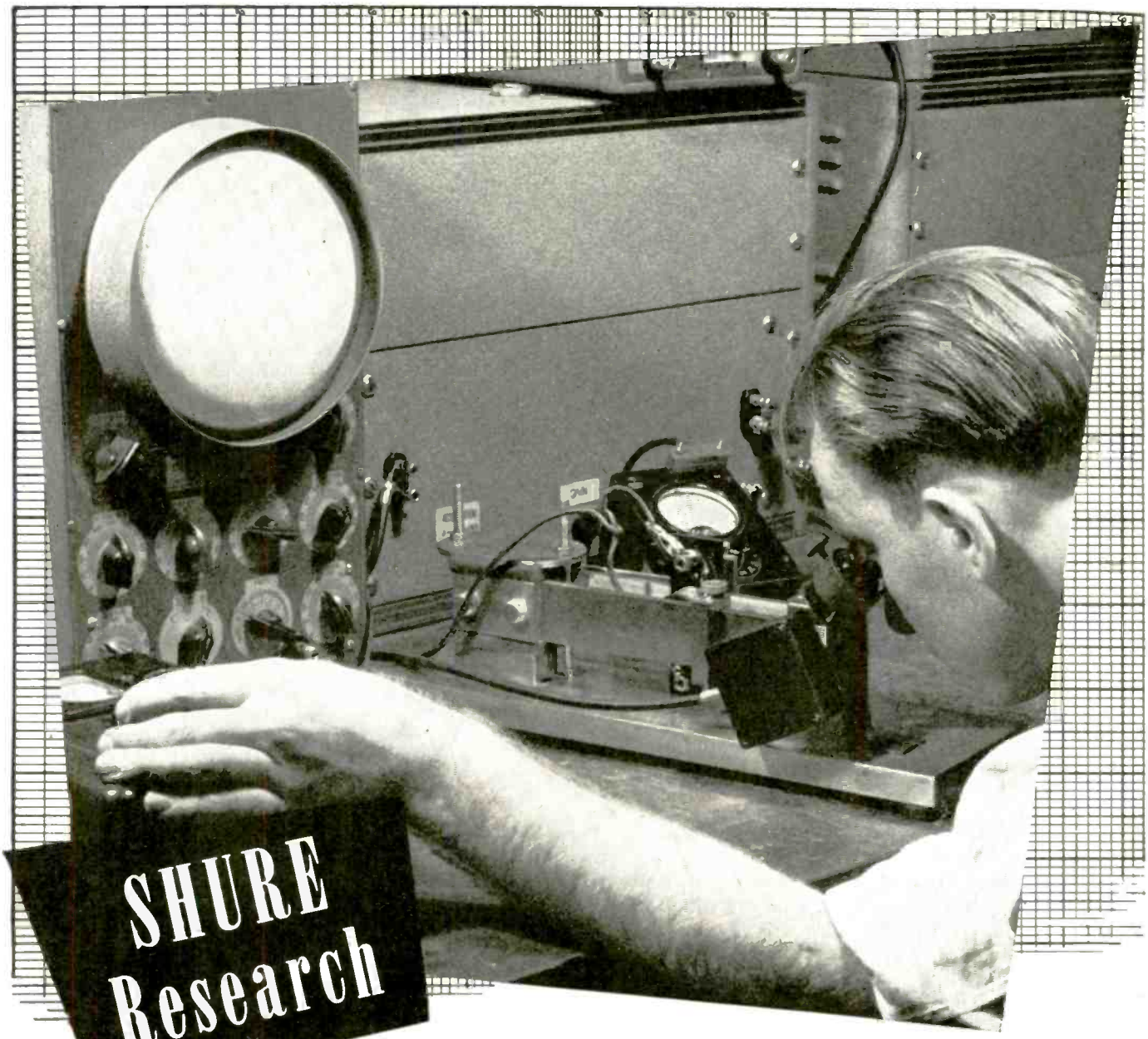
All our repeater stations in these ten counties have been installed during the past two years and the equipment should be considered as relatively new; during this period we have averaged about one service call per month to each location. Due to distances involved and other factors beyond our control, it has been impossible to maintain a regular schedule of maintenance calls to all the locations, but it is felt that if a regular 30-day schedule could be maintained on these stations, it would rarely be necessary to make emergency trips in between.

In order to insure having necessary materials available as needed, we attempt to keep a reasonable stock of spare tubes at each location; and this has proven to be a good policy, especially when an emergency service call is necessary. In order to provide for automatic starting of the auxiliary power supply a battery source of power is required; it has been found during the summer months it is necessary to add water to these batteries at quite frequent intervals. These batteries are maintained on a trickle charge at all times and it has further been the service policy to cycle these cells at intervals.

Relay advantages

The advantages to be derived from the installation of such automatic radio repeater stations are many and varied, but they all make for a more satisfactory communications network, especially where large rural areas are to be served. If sufficient care is taken in the design and installation of the radio link, the quality of the repeated signal is such that it is superior to many otherwise borderline signals that one might attempt to read on some local receiver placed in a mediocre location. In mountainous sections of the country which are traversed by roadways it seems the repeater station is the only solution to the problem of providing a fair degree of coverage from mobile units. In such terrain the location of a repeater station at some high point generally overlooking the lower mountainous sections eliminates many of the usual "dead" spots found in such territory.

A further advantage in the use of repeater stations situated at some distance away from metropolitan areas lies in the fact that such places are usually remote from man-made sources of interference such as diathermy, power line dis-



...in Vibration Pickups

Shure research has pioneered in the development of vibration measuring instruments. These instruments are important in the determination of leakages in water pipes, the vibration of machinery, buildings, electrical appliances. Among its many uses, vibration pickups have been successfully used in locating termite infested wooden members. Shure engineers have devised special vibration actuators and special standard pickups capable of measuring vibration accurately throughout the greater part of the audio frequency range. Another significant contribution is the development of integrating networks which permit the measurement of either acceleration, velocity or displacement with a single Vibration Pickup.

SHURE BROTHERS, 225 West Huron Street, Chicago

Designers and Manufacturers of Microphones and Acoustic Devices

SHURE MICROPHONES

turbances, etc. Such locations permit the adjusting of receivers for operation on lower signal levels and many transmissions are thus received which otherwise might not open the squelch circuit of a locally installed receiver.

The installation of a repeater station further relieves a radio network from entire dependency on land lines and their possibility of being out of service during storms, floods, earthquakes, fires, etc., and just when all communication facilities are most needed. In most instances, except where small areas are served, a remote receiving location of some type is used and a radio link often proves to be a valuable safeguard. Even where the distance between remote receiver and control point is relatively small, the radio link, as a standby, is valuable; land lines can normally be used for returning receiver outputs and proper provisions made to have the radio link go into operation when a line failure occurs. It is readily apparent, however, that entire dependence should not be placed on a repeater station as a means of covering a given area with two-way radio communication; in every instance possible a local receiver should be provided even though the coverage through it is limited. This will be a valuable safeguard during such times as the repeater may be out of service and will at least permit limited operation.

SPECTRA ANALYSIS

(*Continued from page* 115)

Thus, analyzing for copper in an aluminum alloy, the intensity of an aluminum line is first determined to obtain the relative exposure and then the copper line is determined to obtain its relative intensity. This latter intensity then will be an indication of the amount of copper present as the intensity of the lines are in proportion to the number of atoms present. The above procedure is called the internal standard of quantitative analysis as opposed to the older method by comparison of standard plates.

The following five steps are necessary in making a spectrographic analysis:

First, the sample must be prepared. If a metallic solid is used, it is faced on a shaper or lathe. For turnings, filings, or powders, the sample may either be placed in a carbon electrode, or it may be briquetted into a pellet under high pressure.

The second step is the excitation of the sample. When the sample is in the solid form, a high voltage spark is passed between a counter electrode of carbon and the prepared surface of the sample, or the spark may be passed between two pins of the material. When the

IT WILL SOON BE ANOTHER DAY

The lush days of "Cost Plus" that have placed so little emphasis on production economy will disappear when "C-Day" arrives. Conversion to civilian goods will again place a premium on efficiency that springs from a cost "know-how." But cost-sensitive production comes only of long experience. It is not born of wartime . . . it is a stranger to war production.

Peace-time manufacture survives only as it demonstrates the principles of profit-and-loss accounting. There is no room for carelessness, or laxity, or indifference to costs.

Lewyt is *not* a war baby. Lewyt is a "manufacturer's manufacturer" with 56 years of cost-conscious "know-how". It returns to peace-time contract manufacturing with long experience in meeting the needs of production engineers who will have only costs and efficiency in mind.

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Lewyt's business is Contract Manufacturing. We specialize in electric and electronic instruments, chassis and housings; mechanical and electrical assemblies; highest precision machine work; sheet metal fabrications; all types of welding, product finishing, etc.

We also provide advanced engineering facilities as service assistance to our clients in connection with the design and re-design of their products under development.

Write on your business stationery for 48-page book, "Let Lewyt Do It" . . . the story of the Lewyt Organization told in pictures.

Lewyt

LET LEWYT DO IT

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sample is of the powdered nature and is placed on the carbon electrode, a dc or ac arc is used and the sample burned with the carbon.

The light from the discharge passes through the primary slit of the spectrograph and is dispersed into a spectrum by means of a ruled grating or prism. A record of this light is photographed on the film or plate of the camera portion of the spectrograph, forming a spectrogram.

The third step in the series is the photographic processing of the film. For quantitative work this must be done very precisely as the development must be reproducible, or a film calibration curve made for each film developed. The whole photographic process includes development at constant temperature and time, short stop, fixing, washing and drying. This may all be accomplished in less than four minutes under optimum conditions.

Fourth, a trained observer may estimate the quantity of the elements present by the general darkness of lines of the various elements. However, for quantitative analysis, the density of a line for each element present must be read on the densitometer which gives precisely the degree of blackness of the spectral lines, usually in percentage transmission.

The fifth and last step is the calculation of the concentration of

Notice to Advertisers

Several advertisements were omitted from this issue because they did not reach us before our final closing date.

We regret it. Advertisers, too. But under the existing manpower situation, paper shortage and transportation delays, we are forced to close on our announced closing dates.

The final closing date applies only to space in the final form. We cannot produce the entire magazine in the brief time allowed for one final form. By that time, 90% of the pages should be printed and ready for the bindery. Here are the deadlines for July:

June 1 — The announced closing date.

June 5 — Final date for copy to be set (no proofs).

June 10 — Final date for complete plates in last form.

No exceptions. Please do not ask for any. Late copy WILL BE omitted.

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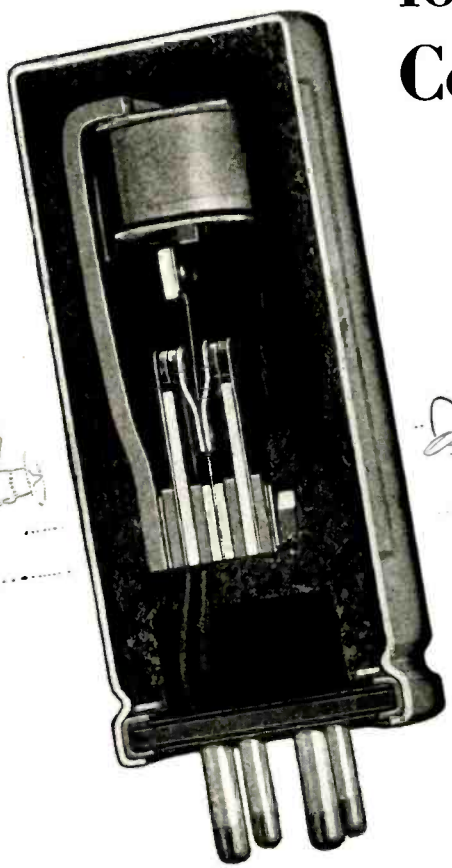
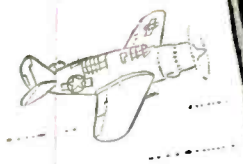
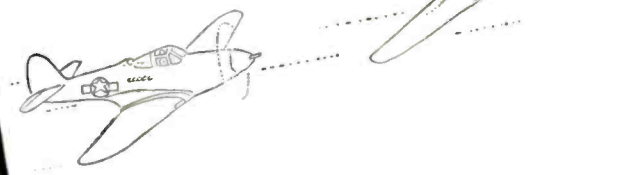






Today's airplanes, military and commercial, fly at amazingly high levels. We think of these altitudes as nothing uncommon, although only yesterday they were considered abnormal. But they were achieved only by overcoming tremendous difficulties—some of them dealing with radio equipment.

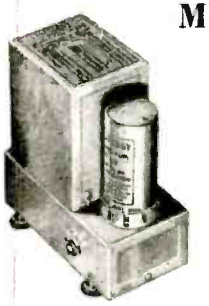
Take vibrators, for instance. When a ship flies in the stratosphere, the effectiveness of electrical insulation is so reduced that vibrator efficiency may be seriously impaired, if not completely nullified. It may even be possible for the electrical contacts to sustain an arc. Mallory solved this problem with a special hermetically-sealed vibrator.

The Mallory vibrator is rendered completely airtight at a normal atmospheric pressure of 14.7 pounds per square inch after the hermetic seal has been tested under 20 pounds of pressure. Regardless of altitude or atmospheric conditions, it functions at full efficiency.

If you manufacture receivers or transmitters for aircraft use—or any other battery-powered equipment subject to unusual atmospheric or climatic stresses—complete facts about Mallory hermetically-sealed vibrators will interest you.

For Dependability and Efficiency—

MALLORY Vibrapack*



Made by the oldest manufacturer of commercial vibrator power supplies, the Vibrapack offers the most dependable, low cost method of obtaining high voltage direct or alternating current from a low voltage storage battery. Consult us about your application requirements.

**Vibrapack is the registered trademark of P. R. Mallory & Co., Inc., for vibrator power supplies.*

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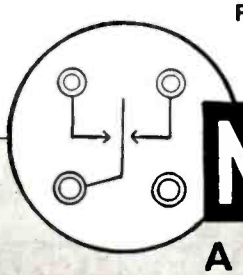
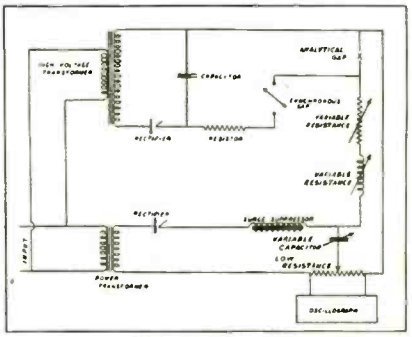


P.R. MALLORY & CO. Inc.

MALLORY VIBRATORS

AND VIBRATOR POWER SUPPLIES



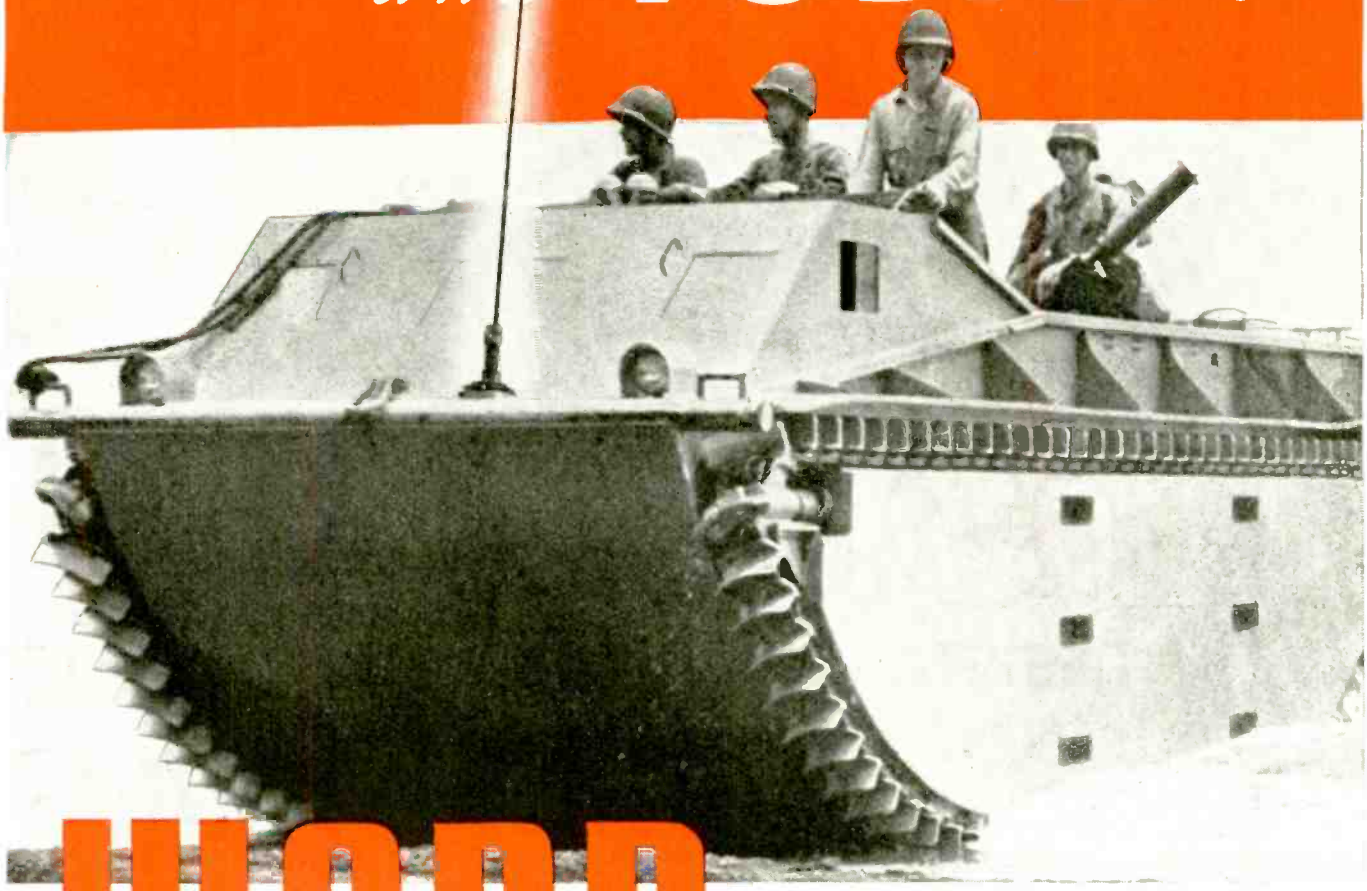
Basic circuit of the multisource spectrographic excitation unit

each element by changing the densitometric reading of a line by means of a film calibration curve into a relative intensity value for that element line. This intensity value may then be converted into percentage by comparison with standard intensity values which have been previously determined.

Let us return to some of the new equipment which has been developed in the West. The latest apparatus to be added to the spectrographic field is the new multisource unit, which was put on the market last November. This unit is designed to give a greater degree of reproducibility in the excitation of the sample and a greater degree of flexibility in the control of the discharge conditions, than heretofore obtainable.

By charging a capacitor to exact-

Yesterday and TODAY!

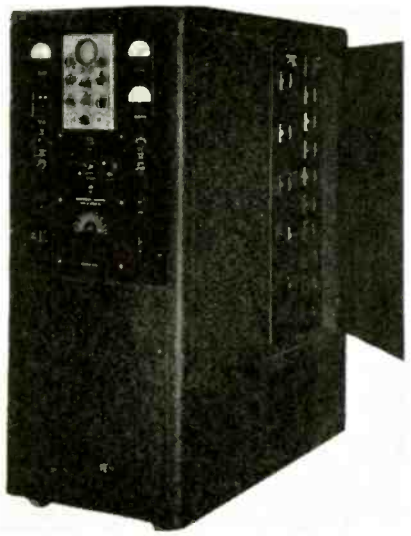


WARD ANTENNAS

In the last peacetime year alone, **THE WARD PRODUCTS CORPORATION** made two million antennas. This established **WARD**, by an overwhelming margin, as the leading producer of aerials used by manufacturers of automobiles, radios and portable radios before the war.

Since Pearl Harbor all production has been going to further the war effort. **WARD PRODUCTS** may be found on communication equipment used on all fighting fronts. Men in tanks, planes, command cars, P-T boats—on communication units of all kinds—are becoming familiar with the name **WARD**. . . . When we return to the arts of peace, the superior designing ability, manufacturing knowledge and production efficiency that made **WARD** the leader in the pre-war period and in wartime will be supplemented by knowledge gained from the war effort. There will be new and better products for the post-war period. If your post-war planning includes the use or specifying of antennas, look to **WARD**!

THE WARD PRODUCTS CORPORATION, 1523 E. 45TH STREET, CLEVELAND, OHIO

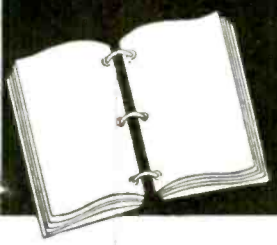


The multisource unit, designed for great flexibility in control of excitation discharges

ly the same voltage and triggering its discharge across the analytical gap, this condition is achieved. Having a variable capacitance from one to sixty microfarads in the circuit gives a tremendous range of power in the discharge and by means of a variable reactance and resistance, the nature of the discharge may be governed to enhance either the arc or spark-like lines.

Another instrument emerging from West Coast research is the

Designing Molded Plastics Parts: G-E MYCALEX



From the engineering files of One Plastics Avenue

G-E mycalex is an inorganic compound composed of ground mica and a special glass, having unique heat and electrical properties, and ranking above all other insulators for certain applications because of a combination of features possessed by no other material. Because it is singularly different from other molding compounds, special consideration must be given in designing parts to be made from G-E mycalex. This material is particularly valuable for use in ignition, radio and electronics equipment.

Desired Design Characteristics of G-E mycalex Parts

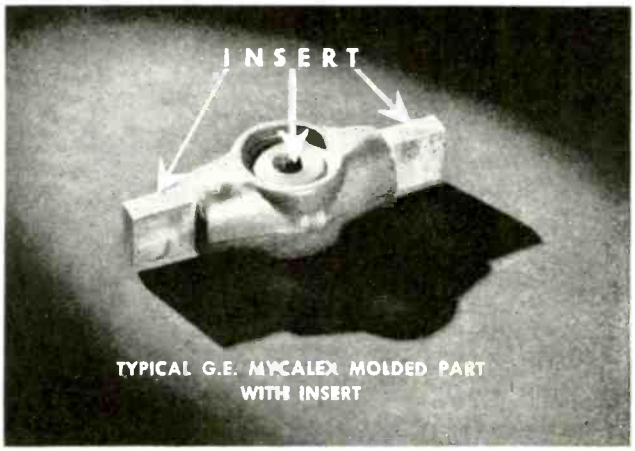
1. Well rounded corners and fillets.
2. Three to five degree taper on mold walls is desirable.
3. Minimum wall thickness of parts $\frac{1}{16}$ inch.
4. Minimum hole diameter $\frac{1}{16}$ inch.

Advantages of G-E mycalex

1. Ready anchorage of metallic inserts in material during molding.
2. Molding of holes in part.
3. Close tolerances in molding.
4. Ability to produce intricate shapes.
5. Reduction or elimination of finishing and machining operations.

Properties

1. High dielectric strength.
2. Low power factor.
3. Prolonged resistance to electric arcs.
4. Chemical stability; negligible deterioration with age.
5. Dimensional stability; freedom from warpage, shrinkage, etc.
6. Imperviousness to water, oil, and gas.
7. Resistance to sudden temperature changes.
8. Low coefficient of thermal expansion.
9. Exceptional heat resistance.
10. Insulating properties compare favorably with porcelain.



TYPICAL G.E. MYCALEX MOLDED PART WITH INSERT

Types of G-E mycalex

#2801—General purpose grade for all molded parts. Used where mechanical strength is of primary importance.

#2800—Lower loss factor, lighter weight and smoother finish. Unaffected by changing atmospheric conditions; has superior stability of power factor after prolonged immersion in water.

GENERAL ELECTRIC is the nation's largest molder of plastics. The combined experience and plastics "know-how" of its chemists, designers, product engineers, toolmakers and molders is available to all interested. Write for G-E mycalex booklet, Section O-250, General Electric Co., Plastics Divisions, Pittsfield, Mass.

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.

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PD-250

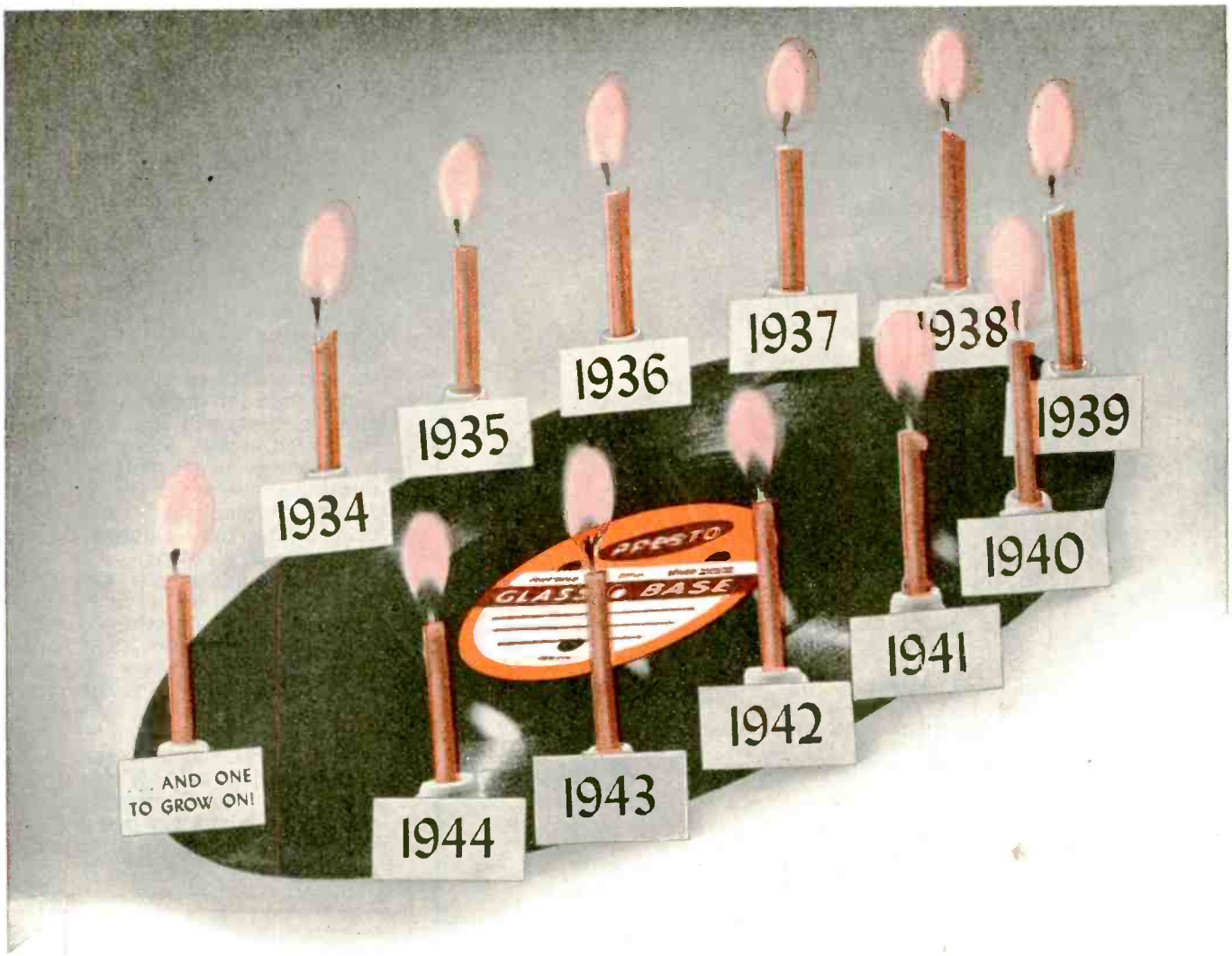
GENERAL ELECTRIC

spectroquantometer. Perhaps the name would bear explanation. It is not a spectroscope, as the operator does not see the spectrum. It is not a spectrograph because no photographic process or recording pen is used. It is best described by calling it a "direct reading instrument."

The excitation of the sample is the same as in any of the accepted spectrographic methods. The light passes through a primary slit and is diffracted into its various wavelengths by a ruled grating, as is the case in a spectroscope or spectrograph, but the element lines are focused on phototubes instead of on film. The energy falling on these phototubes is then amplified and transferred to impulse counters.

The length of excitation is determined, not by a given length of time but by a definite amount of energy given off by the internal standard line, thus making more reproducible the conditions of the analysis. The counters may then be calibrated to read directly the percentage of the element present.

The value of such an instrument lies in its extreme rapidity of analysis. For example, in a large furnace holding many tons of molten metal, two procedures are possible. Either the melt must be held until a spectrographic analysis may be made to check the composition, or else it is poured and the chance taken that it may have to be re-



PRESTO IS 10 YEARS OLD

In 1934 Presto made the first commercial cellulose coated recording disc. At the time there were perhaps 3 or 4 instantaneous recording studios in New York making recordings on plain aluminum. We sent these studios samples of our new coated disc and a steel needle to cut them.

They were amazed. Never had they heard a record with so little surface noise . . . such perfect musical response.

Presently we received an order for 100 discs and the entire plant personnel (all 5 of us) worked a week to fill the order.

Already we had made a few recording turntables which we offered, among others, to broadcasting stations and schools. Often as not they asked, "What use would we have for those things?"

Today thousands upon thousands of Presto recorders are in daily service all over the world. On this, our 10th birthday, we want to thank you for having helped us to grow and to assure you that we will continue to do our darndest to give you the best recording equipment we know how to build.

Buy more Bonds during the 5th War Loan — *Double* what you did before.

Presto Recording Corporation, New York 19, N. Y., U. S. A.

World's Largest Manufacturers of Instantaneous Sound Recording Equipment and Discs

melted if subsequent analysis shows the composition to be outside specifications. Either method is bound to be expensive, for one cannot afford to tie up a large furnace for fifteen minutes while waiting for an analysis, nor can the remelting of an alloy be done inexpensively.

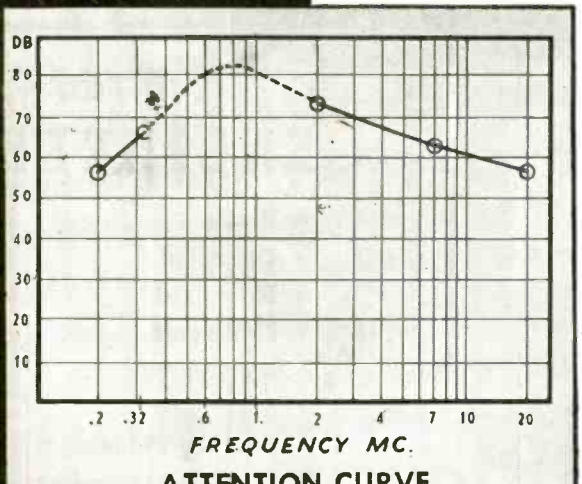
The spectroquantometer may be placed near the furnace, a sample taken in a chilled mold and immediately put on the sample stand. The answer to the composition of the material will then be known as soon as the dials can be read after the excitation period is over. Thus the furnace is tied up for very little longer than for the usual procedure and no rejects will be found among the cooled ingots. Many other uses for this new instrument will come to mind where speed is essential. It really accomplishes what the glamor boys have claimed for the spectrograph all along.

The demands of the global war upon American industry have resulted in a rapid improvement in the methods of spectrographic analysis and a wide increase in the use of these methods. But the return to peace time conditions with its keen competition between industries and products should result in an ever expanding field for this type of equipment. The spectrograph, until recently a laboratory research instrument, has become an essential tool of modern industry.

.....RADIO NOISE SUPPRESSION PROBLEMS *Answered*

POWER EQUIPMENT (25 to 400 ampere ratings)—For heavy-duty radio noise suppression service, Sprague offers a standard Filter line to match exacting military specifications (Wright Field 22331). Long service has proved their ability to answer problems of noise suppression on airplane motors, generators, inverters, and similar equipment.

LOW CURRENT APPLICATIONS (25 amperes and less)—Although designed to the same performance specifications as the foregoing heavy-duty line, sizes and weights of these Sprague Type JX Filters have been reduced. High attenuation characteristics assure high-fidelity radio reception under adverse conditions of man-made interference. They are exceptionally compact, mount in any position, have negligible power consumption, and operate efficiently over a broad temperature range.



ATTENTION CURVE

for Sprague Type JX-51 10 ampere filter with unshielded leads. Weight .37 lb., overall size, 2¾" x 2" x 1⅛".

Whatever your radio interference suppression problem "ASK SPRAGUE." A broad background of experience in this field over many years covers almost every type of equipment—military, naval, industrial, or home.

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

ARMY E NAVY

SPRAGUE

CAPACITORS · KOOLOHM RESISTORS

LOW F VTVM

(*Continued from page* 111)

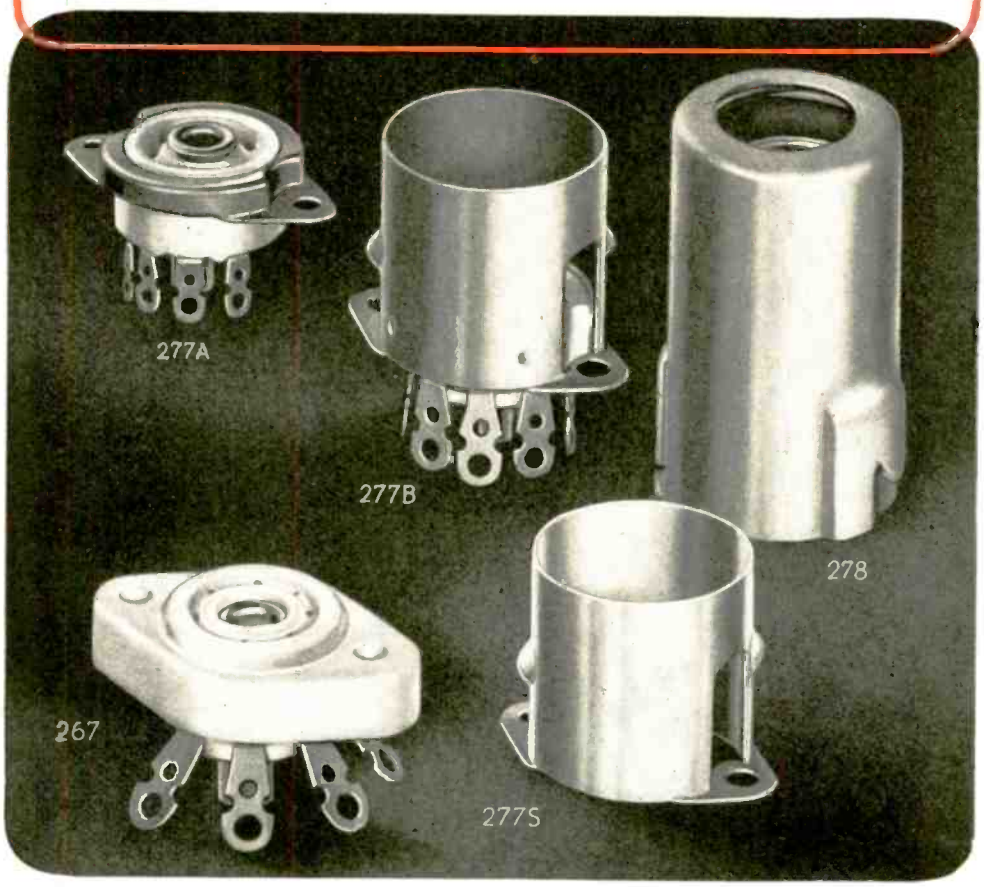
For gain measurements of an amplifier which does not introduce appreciable frequency or phase distortion, the ratio of input to output voltage only is required and this can be obtained regardless of the waveform of the applied voltage. In many applications where the waveform departs considerably from a sine wave, a measurement of the peak value may be more important than the rms value. For example, this meter may be used to measure the peak value of sharp pulses with good accuracy. In this case the peak voltage is equal to 1.41 times the meter reading when the voltmeter is set to give just a slight indication on the cut-off indicator.

VTVM circuit

Whereas the voltage measuring circuit represents the important element of a vacuum tube voltmeter, the operating characteristics generally depend upon the other circuits.

Input impedance, frequency range, sensitivity and accuracy are determined primarily by the input circuit and the amplifier. A block diagram of the complete instrument is shown in Fig. 3. The input voltage is applied to a high input im-

JOHNSON MINIATURE SOCKETS



Pre-eminent in the ceramic socket field, it was to be expected that Johnson was asked in 1941 to develop the first miniature ceramic socket (No. 267), or that it was quickly approved and widely adopted a year or more ahead of the field, and today is going into critical equipments by the hundreds of thousands.

The same Johnson skill in engineering both ceramics and metal has gone into the No. 277, and the associated shields and shield base (usable with other sockets as well). These Johnson sockets not only meet standards (developed jointly by us, the W. P. B. Socket Sub-committee, Signal Corps, Navy and private laboratories); in each of them you may count on that EXTRA value that's typical of products bearing the Viking mark. High grade steatite insulation with long creepage and arcing paths and low inter-contact capacity; accurately formed and processed contacts of silver plated beryllium copper or phosphor bronze, freely floating and with just the right tension, feature this series of sockets.

If you have a socket problem, whether it's engineering, design, substitution, or delivery, first try Johnson.

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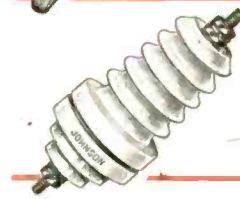
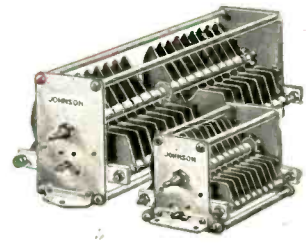
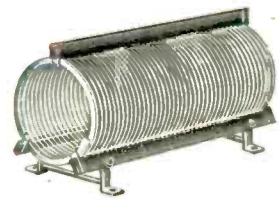
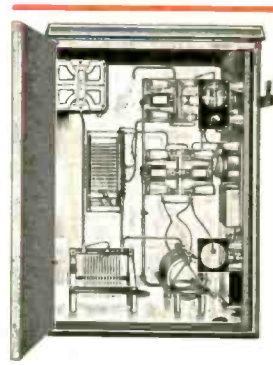








E. F. JOHNSON COMPANY • WASECA • MINNESOTA

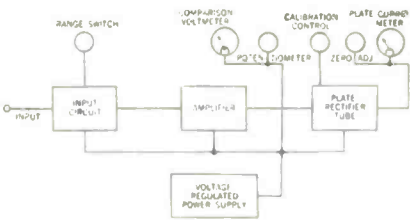


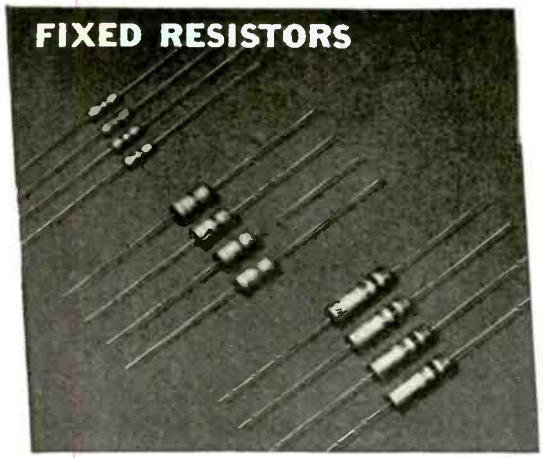
Fig. 3. Block diagram of the vacuum tube voltmeter designed to measure very low frequencies

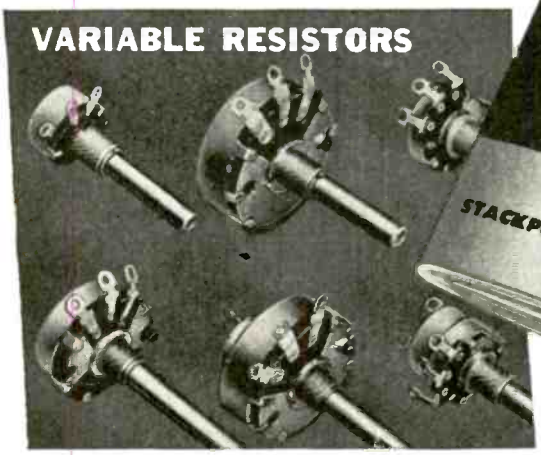
pedance cathode follower which has the range switch as its load impedance. The range resistor operates into a stabilized amplifier which feeds the plate rectifier voltmeter. Dc voltages for the unit are obtained from a voltage-regulated power supply which maintains consistent operation of the circuits with variation in line voltage.

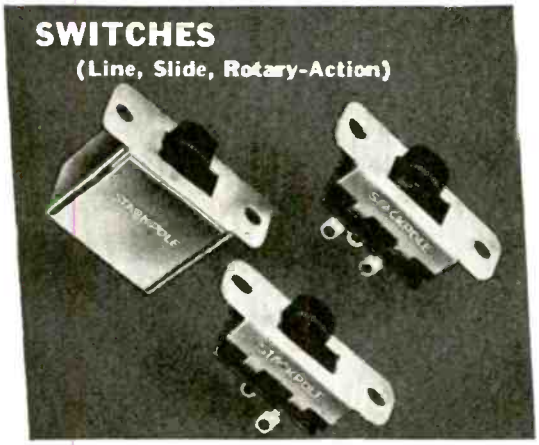
High input impedance

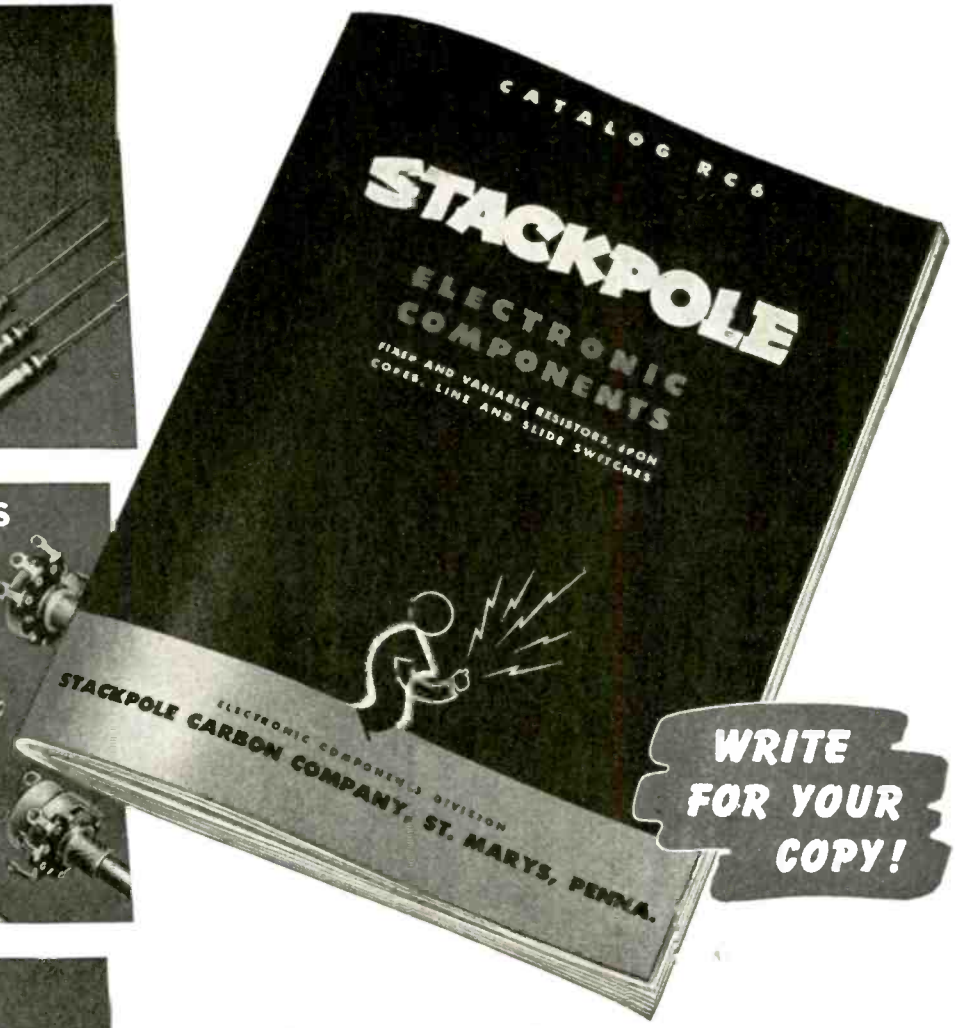
Circuits which operate at extremely low frequencies generally use rather high resistance grid and plate resistors to limit the size of coupling condensers required. In order to affect the operation of these circuits as little as possible, measurements must be made with a very high input impedance voltmeter. The instrument described here has an input resistance of ten megohms shunted by approximately twenty micromicrofarads.

An impedance of this magnitude is secured through the use of a









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USE this new 1944 Stackpole Electronic Components catalog as your guide to up-to-the-minute Fixed or Variable Resistors; Iron Cores; and inexpensive line, slide, or rotary-action Switches. In addition to *complete* information and dimension diagrams on the components, you'll find data pages and charts that will prove mighty handy in your daily work. Please ask for Catalog RC6.

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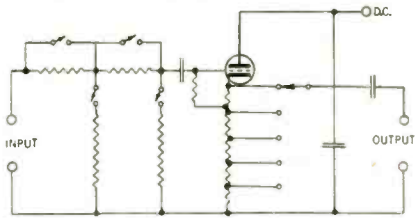


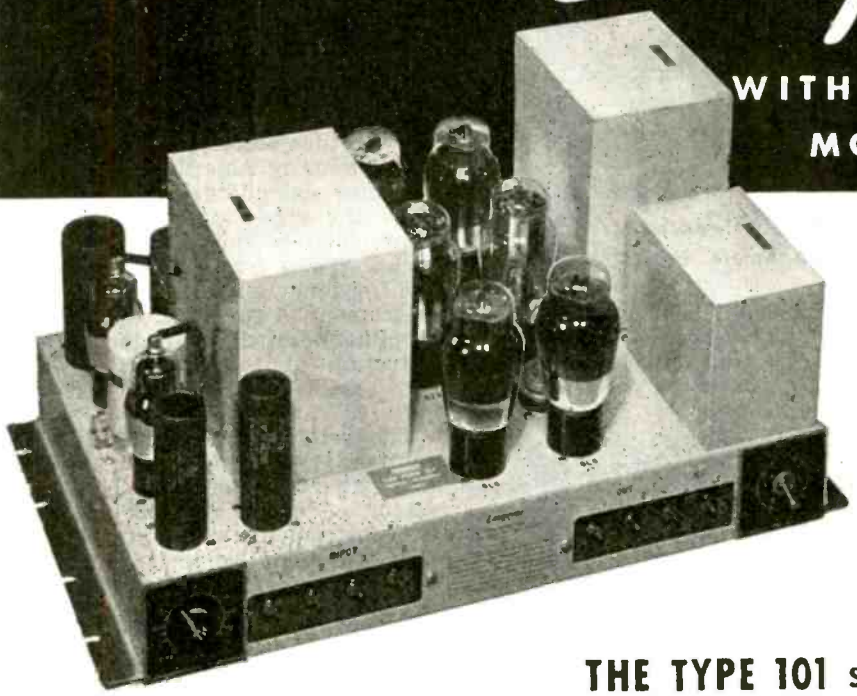
Fig. 4. Input circuit of the low frequency VTVM, which uses a ladder type divider

cathode follower in which the grid leak resistance is tapped down on the load resistance. This arrangement increases the effective input resistance by a factor of approximately ten times the grid leak resistance, thereby eliminating danger from grid emission. The full scale voltage range of the instrument is from one-tenth of a volt to three hundred volts in seven steps. The cathode follower overloads at input voltages in excess of fifty volts; consequently voltage division for the two top ranges is accomplished ahead of the input tube. The cathode load impedance is tapped for the other ranges.

The input circuit is shown in Fig. 4. A ladder input divider rather than a more conventional type is used for two reasons: First, the input resistance is maintained at a constant value from range to range through the use of this type of divider. Second, the resistors used must be of the order of five meg-

101 SERIES *Amplifiers*

WITH RACK PANEL OR WALL MOUNTING ACCESSORIES



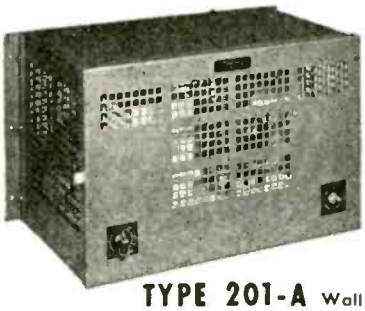
Input impedance 600 ohms and bridging. Gain 600 ohm input 61 db., bridging input 46 db. Frequency response 30 to 16,000 c.p.s. either input—600 ohm output ±.5 db., 30 ohm output ±1 db. Power output—production run average: +47 V.U. with less than 3% RMS harmonic content.

THE TYPE 101 Series Amplifiers are the results of twenty years' experience in the sound engineering field. They are identical with the exception of the output coil.

Type 101-A has output impedance adjustments to match loads from 1 to 1000 ohms and possesses excellent low frequency waveform at high output levels.

Type 101-B with a single nominal 6 ohm output is intended for use with wide range loudspeakers representing an 8 to 16 ohm load. Its output coil with a single secondary provides improved efficiency and even better waveform at high levels of low frequencies.

Type 101-C answers the demand for a good amplifier at lower cost. This lower cost is obtained by the use of a less expensive output coil with the only change being that the low frequency waveform is not as good as the A or B types but is equal to or better than any contemporary commercial amplifier. Output impedance is adjustable to loads of 1 to 1000 ohms.



TYPE 201-A Wall Mounting Cabinet permits universal installation of 101 Series Amplifiers to any flat surface. Well ventilated and designed for maximum accessibility for servicing and convenience of installation. Standard aluminum gray finish.

TYPE 7-A Modification Group permits 101 Series Amplifiers to mount on standard 19" telephone relay racks. Occupies 12¼" rack space. Allows servicing from front of rack. Standard aluminum gray finish.

The Langevin Company

INCORPORATED

SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK
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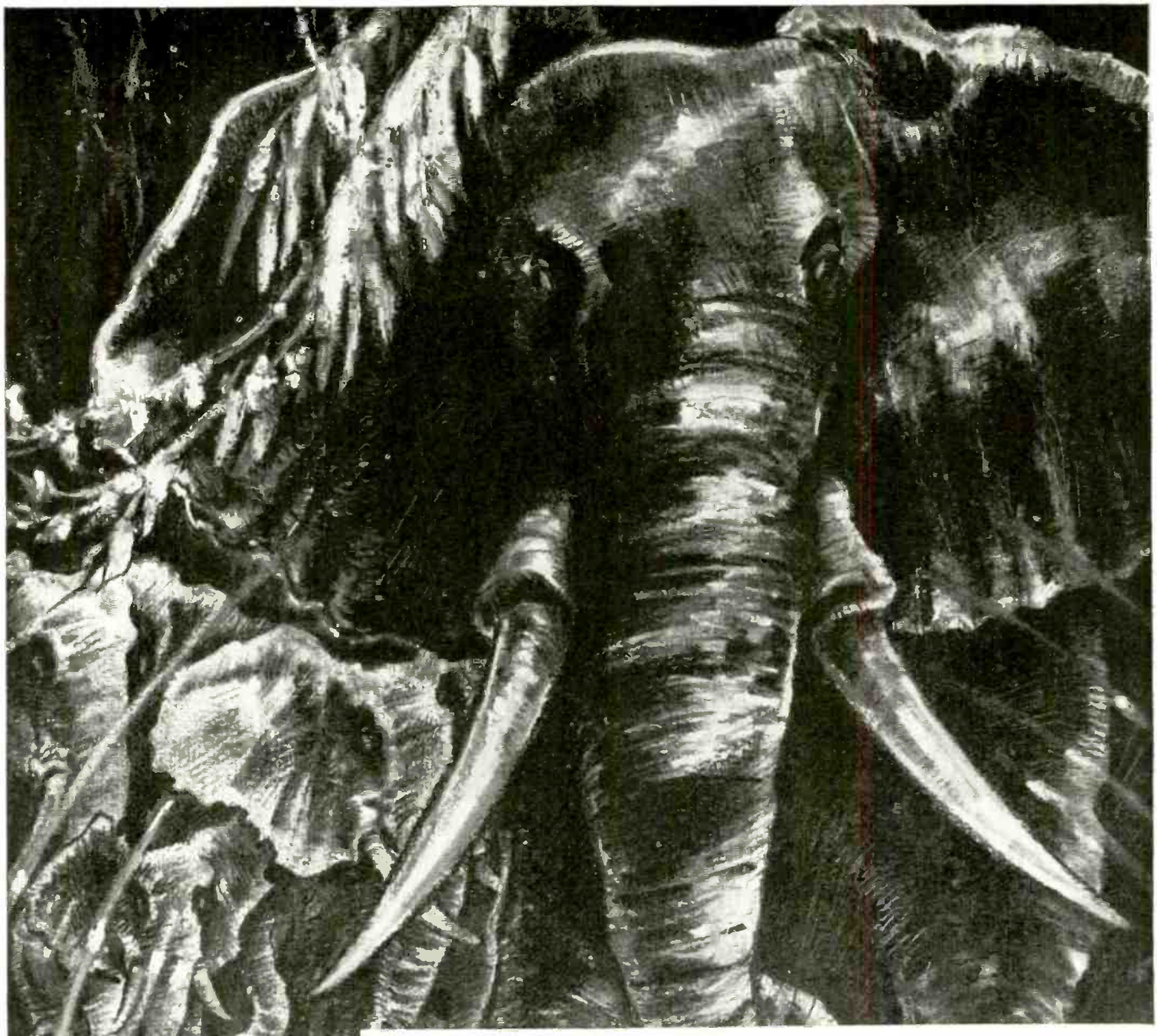
ohms. Resistors of this magnitude are available only in composition types and these have a pronounced non-linear characteristic with applied voltage. This non-linearity is balanced out in the ladder type divider but creates a considerable problem with other type circuits.

Voltages through the circuit are such that a gain of approximately three hundred is required in the amplifier. The use of a direct-coupled amplifier was considered but this idea was discarded in favor of the more rellable RC type. With response extending down to one cycle the upper practical limit is approximately one hundred kilocycles. These frequencies represent the frequency response range of the instrument. A two tube, 6SJ7-6AB7, amplifier is used. A feedback gain reduction of twenty decibels insures stable operation of the circuit.

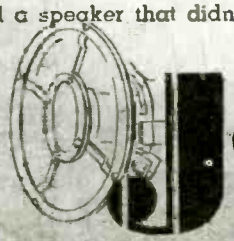
The voltage regulator is a conventional type using a neon tube as the stabilizing element. The regulator maintains the accuracy of the instrument within three per cent of nominal value for line voltage variations from 105 to 125 volts.

The comparison voltmeter is calibrated in three ranges of 0-10 rms volts, 0-3 rms volts and —12 to + 2 decibles at a 1 mw —600 ohm reference. The actual full scale deflection of the 0—3 volt range is 3.16 volts so that a relation of ex-



DURABILITY

The relationship between pachyderms and JENSEN speakers is, of course, obscure. It will take another hundred thirty-five years or so to determine positively whether JENSEN speakers actually have the ruggedness and the longevity of an elephant, but we do know of many JENSEN speakers in use fifteen years and more that still are operating more than adequately. JENSEN engineers have never designed a speaker that didn't have durability as one of its major qualifications.



Jensen

RADIO MANUFACTURING COMPANY
6601 SO. LARAMIE AVE., CHICAGO 38, ILL.

Manufacturers and Designers of Fine Acoustic Equipment

actly ten decibels exists between ranges. This feature is of particular value in gain measurement.

The physical layout of the instrument is shown in the photographs. The four controls are arranged on the panel with the meters, input terminals, power switch and pilot light. The tubes are arranged in a line in the order which they occupy in the circuit. The input circuit and range switch are located in the front left-hand corner of the sub-chassis. The calibration voltage potentiometer is opposite the range switch. The potentiometer in the front center of the sub-chassis is used for making final adjustments on the amplifier gain. Most of the resistors in the circuit are mounted on a terminal board at the rear of the sub-chassis. The three interstage coupling condensers and the fuse are also mounted on this terminal strip. The power supply occupies the rear portion of the chassis.

This low frequency voltmeter is unique in that it bridges the gap for measurements in the range between direct current and audio frequencies. There are certain applications today in which this group of frequencies plays an important role, and one can postulate that with the increase in electronic devices following the war there will be added uses for the very low frequency range.

"triple Six S"

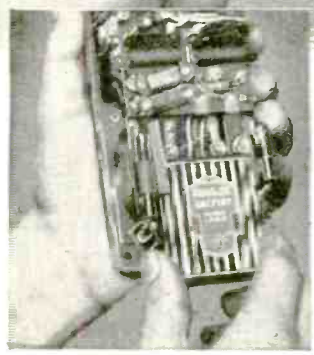
MODEL No. 666S

All-Purpose Pocket Size Volt-Ohm-Milliammeter

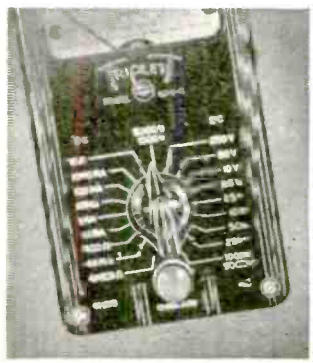
A new modernistic styled, compact unit that provides an answer to all Volt-Ohm-Milliammeter requirements. Incorporates all the testing facilities of larger, more costly equipment. A.C. and D.C. Volts 0–2.5–10–50–250–1000–5000 (D.C. at 10,000 ohms per volt; A.C. 1000 ohms per volt); 0–.1–1–10–100–1000 D.C. Milliamperes, at 100 millivolts; 0–10 D.C. amperes at 100 millivolts; Resistance 0–400 Ohms (10 ohm center scale); 0–40,000 ohms (500 ohms center scale) 0–4 Megohms (50,000 ohm center scale). Self contained batteries. Selector switch control for all ranges.

Completely insulated black molded case and panel, attractive streamlined design. (Leather carrying case also available to hold tester and accessories.)

The Triplett Line—more comprehensive than ever—goes today for war needs but its exacting services in war assure you the final answer for post-war equipment requirements.



Battery slides into place. Easily inserted or removed.



Twenty position selector switch control for all ranges.

Triplett

ELECTRICAL INSTRUMENT CO.

BLUFFTON STANDARDS ARE SET BY TRIPLETT OHIO ★ ★ ★

TANTALUM TUBES

(*Continued from page* 109)

frequencies. However, these were initial advantages only and merely gave a headstart to the acceptance of this family of tube types. Many shortcomings of the early designs were to show up as the demands of operating conditions in the higher frequencies became greater. As equipment designers and operators became adjusted to the new realm they expected performance better than that of just being able to do the job at all.

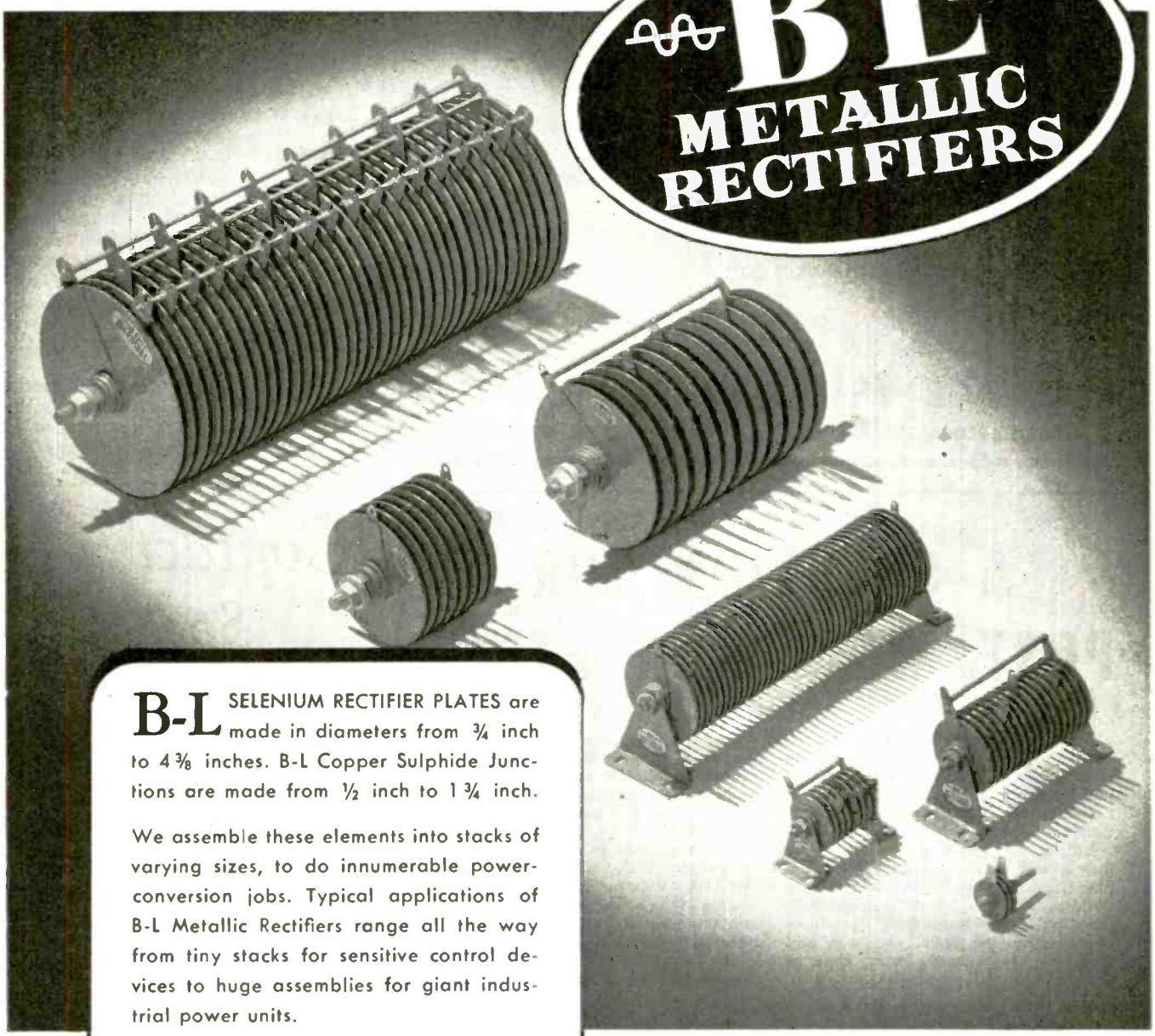
At this point in history most any tube available on the market, if run at its maximum ratings at 60 megacycles or so, would fail after a fraction of its normal life expectancy. The failures were apt to be any one of the following: the glass would suck-in with a small hole at some inexplicable point on the bulb, the filament stem would crack, the grid bead would crack, or the plate seal would crack or sometimes even soften to the extent that the whole plate structure would swing over and short to the grid. If the tube didn't fail utterly, the power output of the tube would be disappointingly reduced from its performance at medium radio frequencies. Obviously more development work was required to keep the tubes up to the advancing demands of the industry.

Fortunately the remedies could

IN EVERY NEEDED SIZE --

for Every Needed Purpose!

BL
METALLIC RECTIFIERS



B-L SELENIUM RECTIFIER PLATES are made in diameters from ¾ inch to 4⅜ inches. B-L Copper Sulphide Junctions are made from ½ inch to 1¾ inch.

We assemble these elements into stacks of varying sizes, to do innumerable power-conversion jobs. Typical applications of B-L Metallic Rectifiers range all the way from tiny stacks for sensitive control devices to huge assemblies for giant industrial power units.

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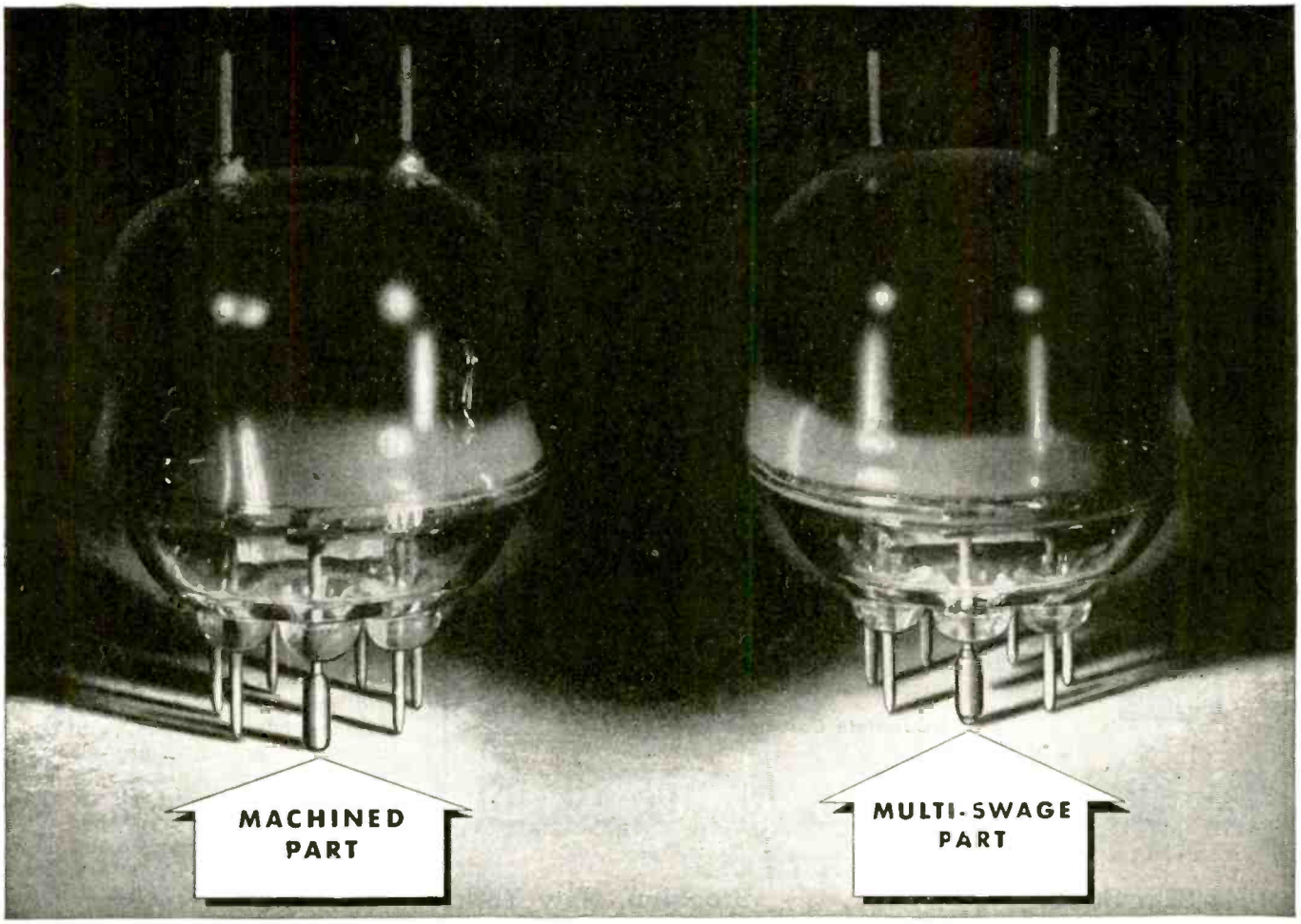
Designers & manufacturers of Copper Sulphide & Selenium Rectifiers, Battery Chargers, and D. C. Power Supplies for practically every requirement.

be applied without losing the previous advantages in tube design and further evolution could take place. One of the first steps was to help confine the electrons to the intended simple path from filament to the plate. Because of the short period of time required for one rf cycle at 60 to 100 megacycles, the electron was no longer confronted with a steady field condition during its flight across from the filament, through the grid to the plate. Now appreciable changes in field intensities even to the extent of a reversal of direction of the field could occur while the electron was in flight.

Thus, at these frequencies certain electrons obtained excess energies or were caught in mid-space and drawn out to stray charges on bulb walls. Such electrons or their related secondary electrons could arrive at the plate late in the rf cycle and considerably reduce the plate circuit efficiency. Even if this circuitous path of the electrons existed at low frequencies, its effect was not great because the electrons or their related secondary electrons arrived at the plate in sufficient time to deliver energy at the proper part of the rf cycle.

In the case of electrons being drawn out to the bulb wall, the effect apparently is aggravated at very high frequencies because of



THE MOST ECONOMICAL METHOD

LOCATING sleeves for the electronic tubes shown above were once machined down from solid nickel rod and then drilled. Now they are formed without waste out of sheet stock by MULTI-SWAGE. This saving of metal is but part of the economy. MULTI-SWAGE sleeves are formed in one operation and at a higher rate of production. All of these facts contribute to the substantially lower price of the MULTI-SWAGE product.

While reducing cost, MULTI-SWAGE has provided a bonus of certain improvements. For example, with the old sleeve, a copper washer was put on the tube pin ahead of it. Heat was then applied, melting the washer and thus brazing the sleeve at its upper end. MULTI-SWAGE sleeves are made from copper-surfaced stock. The copper becomes a lining, which when melted, runs to both ends where the sleeve touches the pin. The result is a more secure assembly without the extra cost or need for handling separate washers.

This case for MULTI-SWAGE is presented with the idea that it may suggest where this process can help you reduce the cost of small, solid or hollow, cylindrical metal parts and perhaps improve your product. Write to our Research and Development Division for further information.

These are typical "Multi-Swage" products. This process will turn out large volume speedily while maintaining close tolerances accurately.

Back the Attack — BEAD CHAIN **multi·swage PROCESS** — *Buy War Bonds*

THE MOST ECONOMICAL METHOD OF PRODUCING SMALL METAL PARTS TO CLOSE TOLERANCES WITHOUT WASTE

THE BEAD CHAIN MANUFACTURING COMPANY

102 MOUNTAIN GROVE STREET, BRIDGEPORT 5, CONNECTICUT

the rapidly changing electric fields. The trouble behaves as though the number of electrons ejected from the open ends of the plate increases as the frequency of operation increases. Thus the bombardment of the glass bulb walls may increase to the point where the heat generated is sufficient to soften the glass until it sucks-in and destroys the vacuum.

The cure for this effect was found to be a brute force method. By enclosing the open end of the plate with a dome the electrons could not "see" the inviting high potentials of the glass in the neighborhood of the plate bead. Hence their path was intercepted by a portion of the plate surface as desired. Similar shields were placed at the filament end of the open plate, but their influence was not appreciable.

The contrast between the behavior at this end of the plate and the end of the plate carrying the plate support is probably due to the fact that at the filament and grid end of the plate only low voltage leads are present and these themselves prevent many electrons from escaping. This simple expedient of keeping the electrons on the direct route to the plate brought the plate power output up and stopped suck-ins and failures of the plate bead. Figs. 2 and 3

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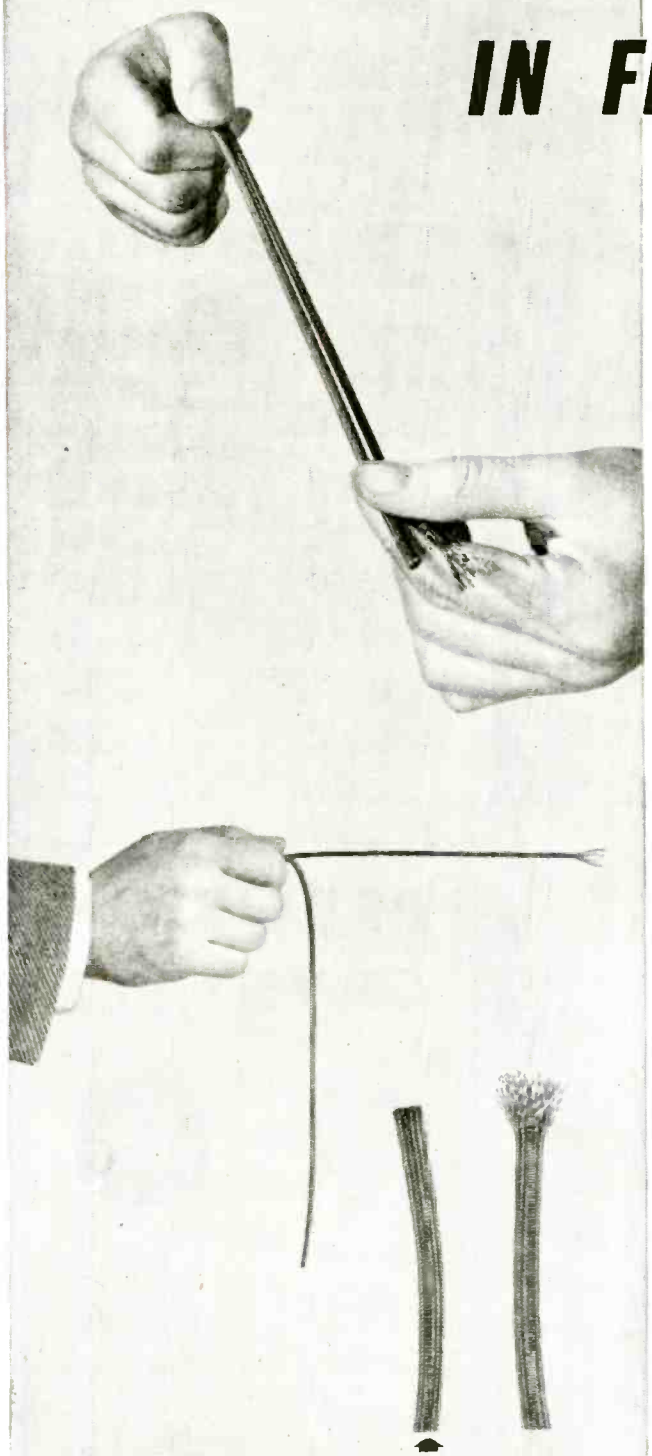

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That new BH Fiberglas "extra Flex" Sleeving is more flexible than saturated sleeving

WE'VE TOLD YOU about the non-fraying quality of the new BH Sleeving. But don't forget the extra flexibility we've built into it. You can prove this to yourself with the five-second test of sleeving flexibility:

Obtain from us a sample of BH Extra Flexible Fiberglas Sleeving equal in size to the saturated sleeving you use now.

Following Figure 1, hold eight-inch lengths of both BH Extra Flexible Fiberglas Sleeving and saturated sleeving between the thumbs and fingers of both hands. Stretch both sleevings to make them straight.

Now release the sleeving ends held in your left hand. Instantly, the new BH Fiberglas Sleeving will fall limp, proving its extra flexibility. The saturated sleeving will remain straight, practically inflexible. The comparison is shown in Figure 2.

NON-FRAYING • FLEXIBLE • HEAT-RESISTANT
NON-INFLAMMABLE • WATER-RESISTANT
NON-CRYSTALLIZING at LOW TEMPERATURES

The new BH Extra Flexible Fiberglas Sleeving is woven from the choicest continuous-filament Fiberglas yarns. It possesses high dielectric strength, is water-resistant and, like all BH Sleeving and Tubing—is non-inflammable.

All sizes from No. 20 to $\frac{5}{8}$", inclusive, are available. Write for samples of this radically new and different sleeving today—in the sizes you desire. Seeing is believing! Bentley, Harris Manufacturing Co., Dept. I, Conshohocken, Pa.

BH PRODUCTS

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

BENTLEY, HARRIS MANUFACTURING CO.
Conshohocken, Penna.

permit one to visualize how a plate dome shields the plate lead area from electron bombardment.

With the plate seal, bulb suck-in, and plate efficiency problems corrected, there still remained the problems of cracking filament presses and grid lead seals. The failure of these seals seemed to be one associated with high temperature and electrolysis of the glass at the juncture between the glass and metal leads. It was found that a simple shield over the filament stem as shown in Fig. 2 and Fig. 3 corrected the stem failures.

One has only to realize that an insulator carries some current and that glass is a frozen solution or electrolyte as well as an insulator, to understand that all the usual electrolytic actions may take place in the metal-glass-metal arrangement of seals in a vacuum tube. The small conducting metal film around the grid bead shown in Fig. 2 intercepts and diffuses these electrolytic actions.

Without protection, the chemical changes in the glass electrolyte took place at the grid bead and changed the glass to the extent that it no longer matched the expansion characteristics of the metal of the seal. The consequences were a cracked seal and destruction of the tube. The electrically conducting film was found to intercept such destructive elec-

trolytic currents with the result that the chemical changes took place away from the region of the bead and at the edge of the conducting film. Further the action is diffused over a much greater area and no chemical changes occur in sufficient intensity to cause rupture of the glass.

Proof of the effectiveness of these corrective contributions in the evolution of the tantalum-type tube for very high frequencies has been demonstrated repeatedly on life tests at 60 and 125 megacycles and in field service conditions.

These generalized comments do not mean that all tube seals fail at very high frequencies. They do mean that where particular designs result in such failures, that corrective means can be applied to preserve the otherwise advantageous design. Or as a corollary, it means that more compact tube designs are possible where seals are subjected to severe strains or temperatures. More latitude of design is opened to the tube engineer with benefits accruing directly to the radio art.

This discussion of the tantalum-type tube does not presume that it is the only generic group which can operate satisfactorily in the very high frequency region. Nor does it presume that the general structural configurations constitute the optimum design of tubes for the frequency region discussed. The intention has been to discuss an aspect of a particular design arrangement which has become known lately as the "Tantalum-type" of tube. The "Tantalum-type" need not necessarily employ the metal Tantalum, though the use of that metal permitted, or even forced, the features described above which are generally taken as definitive of this family of tubes.

By reviewing the evolution of one family of tube types one has an interesting picture of the impact of the requirements of very high radio frequencies on tube designs. Even within that family further evolution was desirable to remain ahead of the demands of the advance into higher and higher frequencies. This within-the-family evolution is vividly brought out by comparing Fig. 1 with Figs. 2 and 3.

No one person is responsible for such an evolution. A group of persons united in a common cooperative effort have considerable to do with it. The background, of course, is laid by the work of many engineers and scientists who have contributed their efforts over many years. It should also be recognized that many more contributions lie hidden under the cloak of war security and someday will form an interesting sequel to the story.

Effect of Television Standards

Disagreeing with the predictions and fears of a few principals in the current dispute that the granting of licenses for broadcasting 525-line pictures might discourage future research and development, Dorman Israel, vice-president in charge of engineering of the Emerson Radio & Phonograph Corp., New York, declares that television sets made according to present standards definitely would not become obsolete if and when specifications for more detailed black and white or color images were established, nor would the broadcasting equipment already installed have to be scrapped.

"By the simple expedient of using two or more transmitters for the same programs," he suggests, "just as more than one transmitter is presently used by radio broadcasting studios for standard broadcasts and FM, the earlier 525-line receivers can continue to receive the same programs as those which might later be televised for reception by later models. There are three important phases of television presentation when carrier frequency is considered. Present 525-line television pictures require a band width of 6 megacycles for combined sight and sound. To

transmit this, a carrier frequency of at least 40 megacycles must be used. Since other conditions of transmission make it desirable to use the lowest possible carrier frequency, the present 525-line system is operating in the region of 50-90 megacycles.

"While it may not be justified to consume an entire series of allocations from 50-200 for this present system, a substantial portion of this band should be allocated for 525-line television."

"Two other classes of television presentation," says Mr. Israel, "should also be considered and provision made for their future allocation. First, it has been determined that an 1800 to 2000-line picture is the maximum definition under any and all conditions. Such a picture requires a greatly expanded band. The carrier frequency should, therefore, be above 200 megacycles. We suggest that suitable plans for allocation be made for such a high definition system in the region of 500-1000 mc.

"The second television presentation requiring consideration and planning is full-color video. A general-purpose color television system could operate in the 500-1000 megacycle band of the high definition black and white system indicated above. However, a high definition color television system will require an even wider band."

EXPORTS

(*Continued from page* 107)

and between Los Angeles and San Francisco.

The new air lines across the Pacific are the nucleus of others. The Matson Navigation Co. and the American President Lines are preparing to engage in trans-Pacific air services on a large scale. These, with fast new passenger and freight ships, will be of immense assistance to California manufacturers, a great many of whom will look to export markets as a logical means of keeping their wheels turning as nearly as may be possible at today's top speed. Chambers of Commerce already have taken steps looking to the establishment of offices in foreign markets, and a heavy advertising and publicity campaign is planned to encourage buyers to do business with these aggressive California business people.

At any rate, plans for San Francisco's World Trade Center are well along toward fruition, and there is to be $25,000,000 of private capital behind the venture. Plans visualize a great group of buildings, already including the Custom House, the Appraiser's Building and the Federal Reserve Bank. Otherwise there will be modern office space for importers and exporters; for foreign governments and consular offices; for a Post Office; for the foreign departments of banks, communications companies, shippers and shipping, bus, rail and air lines; for freight forwarders and the World Trade Department of the San Francisco Chamber of Commerce.

TELEVISORS IN EAST

(*Continued from page* 148)

Question 2 read — "What size screen does your receiver have?" The same 1,434 receivers indicate screens of the following size:

	Per cent
56—Over 12 inches	3.9
721—12 inch	50.2
292—9 inch	20.5
323—5 inch	22.5
42—Don't Know and No Answer	2.9
	100.0

NBC was particularly concerned about the operating condition of all television receivers, explains John T. Williams of the network's television department. There had been much loose talk in the industry concerning the percentage of receivers not currently operating. Interest was heightened because the problem of finding television service

men had become acute. Results on question 3 — "What is the present operating condition of your television receiver?" — were most encouraging:

	Per cent
957—Excellent or Good ...	66.7
202—Fair ...	14.1
68—Poor ...	4.8
160—Not Operating ...	11.2
47—Don't Know and No Answer ...	3.2
	100.0

In spite of long use, inability to get repairs or service, more than 80 per cent of the receivers are still in "Fair" or better operating condition.

Question 4 concerned the size of the audience before each receiver. The home is always the point of greatest interest, because the commercial program aspect of television will be dependent upon the size of the home audience. 1,113 home returns, or 92.1 per cent of the total of that category, reported an average audience of 8 people before each home receiver. In round figures, this is composed of an average of 3 men, 3 women, and 2 children.

155 public places, 78.3 per cent of all those public places returning their questionnaires, reported an average audience of 46 individuals viewing the programs at their receivers. This group is composed of approximately 31 men, 11 women, and 4 children.

Today's audience is limited to the use of television receivers manufactured mainly during 1941 and prior to that date. There are approximately 5,000 receivers in the New York City area. Some 800 receivers are in the Philadelphia area, and approximately 400 in the Albany-Troy-Schenectady area.

TELEVISION IMPROVEMENT URGED

(*Continued from page* 148)

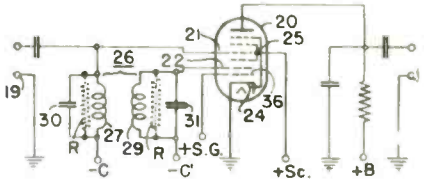
tegrity of television engineers who have carefully considered all these matters. The present-day television system is capable of reproducing pictures of equivalent or even better quality than 16 mm. home movies. Television receivers will be available in the postwar period to fully utilize the potential quality of the present transmission system."

"When this conflict is over, much of the radio we knew at the time of Pearl Harbor will be old and obsolete. The trumpets which signal 'Cease Firing' at the end of this war will sound the reveille for the Age of Television."—General J. G. Harbord, board chairman RCA.

NEW PATENTS ISSUED

Discriminator Circuit

The transformer 26 is double-tuned to the center frequency of the frequency modulated input so that the signal voltages developed across transformer windings 27 and 29 have a quadrature phase relationship at this frequency; the phase relationship varies with the deviation of the signal frequency from the center frequency. To make this dependency linear, the resistance in the resonant circuits 27,30 and 29,31 is increased for instance by the insertion of resistors R. The space-charge grid 36 causes the plate current of vacuum tube 20 to saturate at a relatively low value of input electrode voltage, acting as a limiter. Electrode 21 is biased to a large positive potential at which



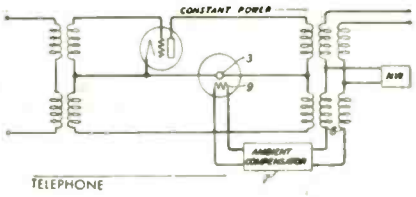
it normally would produce plate current saturation, and the bias of electrode 22 is then adjusted to a value midway between cut-off and saturation bias. With this arrangement, plate current will flow only for a short period of time during each cycle; the period of time will depend on the phase relationship of the voltages on grids 21,22, and will in turn determine the average plate current, providing an output amplitude proportional to the input frequency. An increase in amplitude of the input signal will have practically no effect as it would only tend to increase current intensity which is limited by grid 36, but will not change the period of current flow which is determining for the average output amplitude. J. J. Okrent, Hazeltine Corp., (F) May 6, 1942, (I) March 7, 1944, No. 2,343,263.

Color Television System

It is proposed to illuminate the scene with a succession of colored light flashes during the blanking intervals of the field scanning periods. For instance, a high intensity red light is flashed during a blanking interval, the scanning of the field performed, a blue light flashed during the next blanking interval, the mosaic scanned again, and flashed with a green light followed by another field scanning. Each colored picture is projected upon the screen during the return line time to charge the mosaic. Since the scene is illuminated for each field by only one primary color component, there is no necessity for a color filter disk in front of the camera. Apparatus for providing these light flashes at the correct instances of time synchronously with the scanning is described in detail. A. N. Goldsmith, (F) March 5, 1942, (I) March 14, 1944, No. 2,343,971.

Temperature Compensation

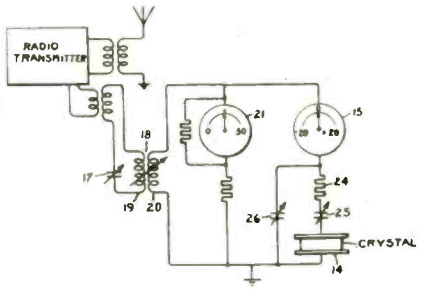
To provide a constant power output, a resistance element 3 having a high negative temperature coefficient of resistance is inserted in the negative feedback path of the amplifier. For further improvement, heating resistor 9 is included; the heat supplied from heater 9 to resistor 3 tends to vary, as the amplifier output changes, in a sense to restore the original output. However, frequently, variations in the ambient temperature, which influence the amount of heat lost by the resistor to the surrounding medium, cause changes in power output. It is intended to compensate for these variations without the necessity of a constant current source which is required in prior



arrangements. To correct for the heat loss, ambient compensator 7 is provided. It includes another high negative temperature coefficient resistor shunted across heater 9, and a positive temperature coefficient resistor in series with one of the windings 6 and shunted by a resistance equal to the resistance of heater 9. If these elements are suitably dimensioned, compensation for variations in the ambient temperature is obtained. Harold S. Black, Bell Telephone Labs., (F) July 25, 1941, (I) Feb. 8, 1944, No. 2,341,013.

Frequency Meter

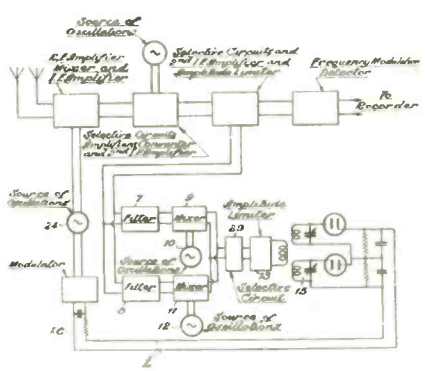
The change in impedance with frequency of a quartz crystal, which is linear between its series and parallel resonant frequencies, is used to determine an unknown frequency. Variable transformer 18 and capacitor 17 are provided to maintain the voltage across the transformer secondary 20 constant, this voltage is indicated by voltmeter 21. The impedance change of the crystal will then be measured by the current meter 15 which is calibrated in deviations from the center frequency. To extend the frequency range over



which the crystal may be used, variable capacitor 25 is inserted; the resonant frequencies of the quartz, and consequently the useful frequency range, is lowered when its capacitance is increased. The sensitivity of the device, or the slope of the impedance-frequency curve within the useful range, may be regulated by varying capacitor 26; an increase in capacitance will cause an increase in sensitivity. C. F. Baldwin, General Electric Co., (F) Oct. 7, 1941, (I) March 7, 1944, No. 2,343,633.

Frequency Control

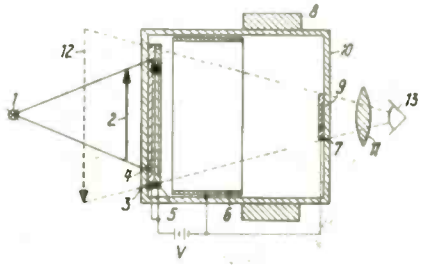
A mark-space wave, for instance in telegraphy, consists in the alternate transmission of two frequencies for shorter or longer periods of time. The frequency is shifted from one value to the other in accordance with signals. A special frequency control



for receivers of these waves is required because the frequency may remain for long or short periods of time on either the mark or the space frequency. To maintain the intermediate frequency constant at either the mark or the space signal value, two filters 7, 8, two mixers 9, 11 and two oscillators 10 and 12 are provided, each combination maintaining one of the frequencies constant while having no effect on the other frequency. Each filter passes one of the frequencies, and oscillators 10 and 12 are so tuned that the beat frequency for either combination is the same; it controls the frequency of oscillator 24 and so maintains the intermediate frequency for either signal frequency. H. O. Peterson, RCA. (F) May 23, 1941. (I) Feb. 15, 1944. No. 2,341,649.

Neutron or X-Ray Pictures

It is intended to increase the intensity of X-ray or neutron pictures so that an object may be investigated with a comparatively

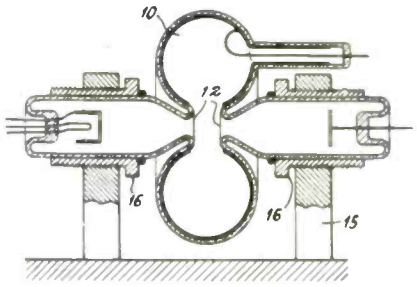


weak source. The latent image 4 of object 2 causes reactive layer 3 to give off charged particles or gamma rays which in turn release electrons within layer 5. The electron image so produced is reduced by an electron-optical lens system 6,8, so that the image 9 produced on screen 7 is much smaller than the latent image 4 and of comparatively high intensity. If 7 is a luminous screen, the image is

viewed through a strong magnifying lens 11; if it is a photographic plate, the image may be developed and enlarged. H. I. Kallmann et al, Alien Property Custodian, (F) July 3, 1941, (I) March 14, 1944, No. 2,344,043.

Glass UHF Tube

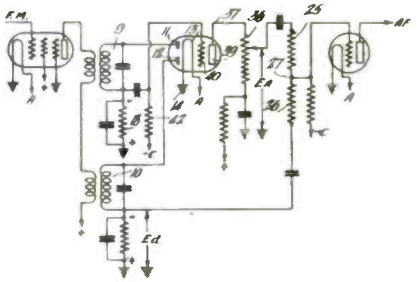
The resonant chamber 10 consists of a toroidal shell of metallized glass which is connected to an axial glass tube traversed by the electron beam. The manufacture of



this type of tube from a glass pipe is extremely simple. To tune the resonator, pressure is exerted by turning screw 16 so that the two openings 12 come closer together. The glass yields sufficiently to permit tuning of the circuit within limits. Several resonant chambers may be blown consecutively in the same glass pipe. E. Steudel, General Electric Co., (F) Aug. 30, 1941, (I) March 7, 1944, No. 2,343,487.

Discriminator Circuit

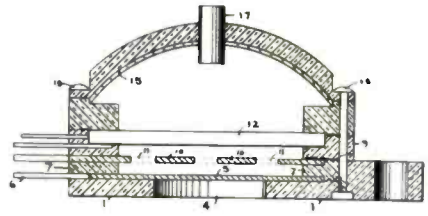
The balanced discriminator is designed to permit the cathodes of the tubes in the circuit to be at ground potential. Diode rectifiers, 11,13 and 12,13 are connected to frequency discriminator circuits 9,10, tuned slightly above and slightly below the mean intermediate frequency, respectively. Output of diode 11,13 is applied to grid 40 of phase inverter tube 13,40,39 and over the gain



adjusting resistor 36 to output resistors 25 and 26. Output of diode 12,13 is connected directly to the other terminal of resistors 25,26. It will be seen that for suitable adjustment of the tap on resistor 36 amplitude modulation signals will be balanced out, while frequency modulation may be taken off point 27 between resistors 25 and 26. W. R. Koch, RCA, (F) July 31, 1941, (I) Feb. 8, 1944, No. 2,341,047.

Radio Tube

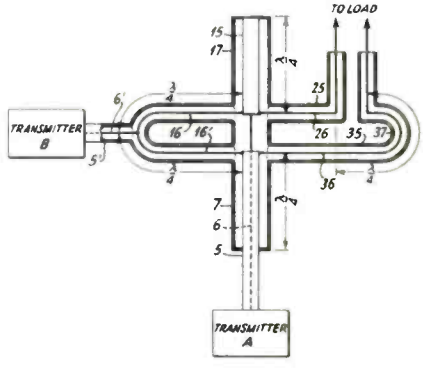
The demountable vacuum tube is designed for high frequency operation; it may be constructed as a multi-element tube. The base 1 is a disk of hard plastic, porcelain or other dielectric material; plate 5 is tightly sealed to the base 1 by a ring of soft plastic or cement 7. Grid 10 is a circular metal plate having perforations 11, and cathode 12 may be a cylindrical or flattened tube with ends embedded in a porcelain or hard plastic ring 9. Bolts 18 removably clamp together the successive disks and rings of mica, cement, porcelain or plastic material. Exhaust tube 17 may be long enough to pinch off, cut, and pinch off again



after a second exhausting of air, or replaceable if threaded into the cap 16. A. Binneweg, (F) Aug. 8, 1942, (I) March 7, 1944, No. 2,343,849.

Antenna Feed System

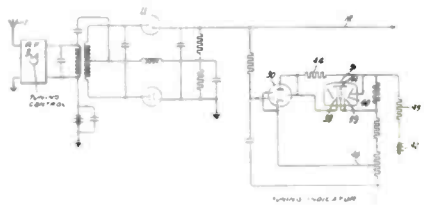
The two transmitters operate at different frequencies; their output is fed to the antenna in such a manner that there is no reaction between the transmitters over a wide frequency range. A transformer converts from single-sided circuit 5, 6, to the circuit 26, 36 which is balanced with respect to ground. Energy from transmitter B is introduced into the balanced or "push-pull" circuit in a "push-pull" relationship. To obtain a phase quadrature relationship at the output, line 36, 37 is made a quarter wave longer than line 25, 26. The energy on one conductor at the point of connection



of the load has, therefore, a relationship with respect to the other, carrying phases P_A and P_B from the two transmitters, of $P_A \pm 180° \pm 90°$ and $P_B \pm 90°$. Line 15, 17 counterbalances any reactive component introduced into the lines due to the connection between the single-sided and push-pull circuits. Nils E. Lindenblad, RCA, (F) May 31, 1940, (I) Feb. 8, 1944, No. 2,341,408.

FM Tuning Circuit

Two independent shadows are controlled by the grids 38 and 39 of the electric eye tube 31. The pattern determined by electrode 39 is a reference pattern which is independent of the tuning; the pattern controlled by electrode 38 is adjusted to be of equal size for correct tuning, or zero potential of the control electrode of tube 30, by



moving tap 48. With this adjustment, positive input voltages will cause more current to flow in resistor 44 and make the control voltage of electrode 38 less positive, opening the shadow angle of the corresponding pattern. Negative voltages on conductor 12 will decrease the shadow angle. J. E. Maynard, General Electric Co., (F) Feb. 8, 1943, (I) Feb. 15, 1944, No. 2,341,936.

AAF Training Combat Communication Groups

In order to supply its combat requirements for specialized communications personnel, the Army Air Forces is now utilizing a large training center at Camp Pinedale, Calif., to activate, train and process groups of 8,000 communications specialists every seven months in unit "teams" for assignment to overseas duty. The Signal Corps had previously supplied the type of communications unit, now trained at Camp Pinedale, to the Army Air Forces, but with the expansion of the AAF activities in combat, bombing and transport, the necessity arose for the AAF to train its own units. The function of the Pinedale Training Center is to furnish complete combat units and individual replacements to existing units in the overseas theaters.

The planning and the training procedures for the Western Signal Aviation Unit Training Center are formulated by the Assistant Chief of Air Staff Training in cooperation with the Office of the Air Communications Officer. The Center itself is under the command of Colonel William H. MacDonald and it falls under the jurisdiction of the Fourth Air Force, of which Colonel D. Schelenker is Signal Officer.

Training process

There are four stages in the training process. The "A" stage is the classification of personnel, basic physical training and military drill and preliminary Signal communications instruction. The "B" stage forms the specialized communications training, wire and radio, for the officers and men, while the "C" stage is the classification of the officers and men into units and their preliminary unit instruction. The final "D" stage, which lasts two months, gives the officers and men their toughest courses in team and unit training under simulated combat conditions, much of it in the field in the mountains and plains and desert of northern California, southern Oregon and western Nevada. The trainees establish field headquarters Signal Centers in which they maintain 24-hour communications, while advance communications posts in fox holes and other simulated combat conditions are set up. Blackout conditions and gas drills, together with camouflage discipline, also are part of the combat course.

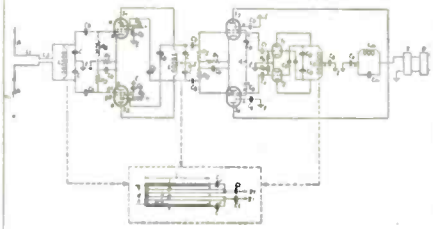
One of the most interesting features of the radio training for operators and aircraft warning and radio intelligence specialists is instruction in the reception of communications which had been recorded under actual battle and combat-interference conditions.

NEW BOOKS

Moderne Kurzwellen-Empfangstechnik (Modern Short Wave Receiver Design)

By M. J. O. Strutt, Ph.D., published by Authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Michigan, 1943, 245 pages, $7.50, German text.

Intended primarily for college students and communication engineers concerned with short wave or television receivers, the text treats antennas, transmission lines, meters, amplifiers, and complete receivers for decimeter waves. It is a practical book containing many circuit diagrams with proper dimensions, and explaining the difficulties encountered in the construction of short wave apparatus and how to avoid or overcome them. An extensive bibliography including English and German references is added for more detailed information on particular problems.



Reproduced from the book is a receiver for 1 meter waves. Push-pull connected tubes S_1 and S_2 (S_3 and S_4) are double pentodes having electron-multiplier electrodes h. In this tube type, the electrons are deflected to move in curved paths before reaching the plate and the multiplier electrode; in its construction, the tube resembles the trigger tube described by A. M. Skellett, in the Journal of Applied Physics, August, 1942, however, its electric connections and operation are entirely different. The secondary emission electrons set free at multiplier electrode h are attracted by the plate and contribute to the plate current, so that the transconductance of a single pentode so constructed is about 15 mA/V. For 1 meter waves the multiplier electrode output is about 130 out-of-phase with the plate output and of approximately the same magnitude; it is also applied to the tank circuit of S_1 and S_2 and increases the amplification factor by about 70 per cent. With these tubes a maximum amplification factor of 40 for the high-frequency push-pull input stage may be reached in the 1 meter range, and an amplification factor of from 4 to 7 for 20 cm waves.

For 1 m waves, the overall am-

plification of the circuit shown will be equal to 30 (high frequency stage) x 70 (mixer stage) x 200 (intermediate frequency stage) = 4.10^5; an input voltage of 5μV can be amplified, the ratio of tube noise voltage to signal voltage being as low as 0.1. Similar results for 20 cm waves will be obtained with two high frequency stages in tandem.

It will be seen that the book describes a number of tubes and circuits not in common use in this country, and which may be of considerable interest for development work in high frequency communication and in television.

Infrared Spectroscopy

By R. Bowling Barnes, Robert C. Gore, Urner Liddel, and Van Zandt Williams, Stamford Research Laboratories, American Cyanamid Company, Stamford, Conn., published by Reinhold Publishing Corporation, New York, April 10, 1944. 236 pages, $2.25.

No small part of the remarkable production records that have been attained in synthetic rubber, high octane fuels, etc., has been due to the development of infrared spectroscopy. Almost all organic substances introduce absorption effects at certain frequencies. Those frequencies in the infrared range with wavelengths as long as 300,000 A° are particularly useful in this art.

This book surveys the presently used principles of operation and analysis, and is followed by charts showing the infrared spectrum curves of 363 common organic compounds. A bibliography on this subject of some 2,700 items is included, cross referenced for easy use. It is of interest to note that these curves are recorded according to so-called frequency units (or cm^{-1}) where 1,000 cm^{-1} = 10 μ.

The pictured curves cover the range 800-2,000 frequency units (12.5 μ to 5 μ).

Control of Electric Motors

By P. B. Harwood, Manager of Engineering, Cutler-Hammer. Second edition 1944, published by John Wiley & Sons, Inc., New York. 479+VIII pages. Price $5.00.

This book is devoted to methods whereby the characteristics of various types of motors can be most effectively utilized. All types of motors: shunt, series, squirrel-cage, wound rotor, synchronous, etc., are discussed, from the viewpoint of adapting the proper starting and regulating equipment to it. This is a practical book for operating engineers and designers, and is also useful as a text for engineering classes. Many of the less complicated types of electronic motor control processes are described.

NEW BULLETINS

Which American Way?

The idea that everyone should have freedom in earning his living is deeply set in American thinking . . . but the "American way" has never been one of complete freedom from "government interference" in economic matters, declares Maxwell S. Stewart, author of the pamphlet, "The American Way—Business Freedom or Government Control?", published May 8th by the Public Affairs Committee, New York City.

The real issue today is not whether we shall have free enterprise or government control. "If democracy is to survive," Mr. Stewart concludes, "it must find a positive way to break the deadlock without sacrificing either public welfare or freedom for the individual."

Finding such a middle ground will not be easy, but it can be done, according to the pamphlet, if we will stop the "name-calling" long enough to find an arrangement incorporating the advantages of both approaches. Basic requirements of such an arrangement are listed.

The article is the ninetieth in the series of popular, ten-cent pamphlets published by the Public Affairs Committee, Inc., a non-profit, educational organization at 30 Rockefeller Plaza, New York 20, N. Y.

Capacitors at Work

Solar Mfg. Co., 285 Madison Ave., New York, has published a 40-page booklet that contains 16 pages of Signal Corps equipment in use in the field of battle, reproduced in full color. Reason for the pictures is to illustrate a few of the ways in which capacitors are used. In addition there is considerable information on capacitor uses as well as a long list of where these small but important components are being used.

Measuring Micro Inches

"How to Measure in Micro Inches" is a 20-page booklet edited for both the novice and expert. Inspectors, machinists, and plant engineers will find this booklet of value in demonstrating new uses for precision measuring instruments. It deals with the fundamentals of precision measurements, showing how these principles are applied to production in the daily control of product quality. Photographs are used to show many new and highly useful applications for gage blocks, vernier

gages, sine bars, master parallels, flats, and other precision measuring instruments. Charts and drawings illustrate the relationship of various dimensions as affected by the temperature of materials being measured.

A number of new gaging instruments are introduced, and a brief description of the new mobile inspection unit is given. The booklet is available from Continental Machines, Inc., 1301 Washington Ave. So., Minneapolis 4, Minn.

"OK Methods"

The first issue of a unique series of booklets, "OK Methods," has been released by the American Phenolic Corp., Chicago. American Phenolic plans to assemble from all possible sources the best methods of handling and using materials and products that go into electrical and electronic work, including anything from practical shop hints to time and motion studies.

In this first number considerable attention has been given to efficient and neat methods of soldering. There is a page on safety wiring and another on the ferruling of flexible conduit. There are descriptions of neat, effective ways of stripping cable and wires. And there is a valuable explanation on avoiding damage to beaded insulation in tinning the braided copper jacket of coaxial cable.

There are twenty-four pages of this sort of information in this first book. How-to-do-it pictures run up to six or seven per page.

Production Stamping

"Metal Stampings in Small Lots", published by the Dayton Rogers Mfg. Co., 2835 South 12th Ave., Minneapolis, describes in 12 nicely illustrated pages the company's process of producing die cut metal stampings in small lots where the cost of conventional dies would be prohibitive. The process differs from the usual method of using "permanent" type dies. In their place, so-called "temporary" dies, inexpensive and permitting alterations at small cost during development, are used. The process is particularly adapted to small-lot production.

Crystals and Holders

In a series of ten catalog sheets, James Knights Co., Sandwich, Ill., has illustrated and described a number of the many various types of crystals and mounts which the company is producing. Included are phenolic and ceramic holders as well as waterproof and gas-filled waterproof types. Frequencies range from 10 kc to 10,000 kc.

WHAT'S NEW

(*Continued from page* 142)

Vacuum Capacitor

The new Jennings VC-250 vacuum capacitor, though of the same physical dimensions as the 50 mmfd unit, has five times greater electrical capacity, with a 20,000 volt peak rating. The capacitor is a plug-in unit, thus permitting its use interchangeably with others and giving a wide selection of capacities. Features are low corona loss, unity power factor and high current rating. The manufacturer is Jennings Radio Mfg. Co., San Jose, Calif.

HF Welding Component

A commercialized design of the mercury discharge tube for capacitor storage welding systems is illustrated by the Trignitrol unit of the Electronic Power Co. Inc., 19 West 44th St., New York 18, N. Y. This circuit contains a two-pool mercury tube of the external capacitive field triggered type, capable of discharging bank of welding capacitors of a value up to 1400 mfd, charged to 4000 volts. It is based on the welding principles of Alfred Vang and In a properly designed welding circuit, the process produces an instantaneous weld (or the high frequency welding system) as described in the Nov. 1943 "Electronic Industries"—page 101.

Hermetic Seals

The Sperti W-100 hermetic seal makes possible the sealing-in of vital communications equipment. Made of glass and of a metal (with the identical expansion coefficient as glass and capable of withstanding severe thermal shock) the seal permits a vacuum-tight bond that resists corrosion, atmospheric or liquid. Being a small one-piece unit, it can be soldered to plates and cases. Two small eyelets on both ends of the protruding shaft of the seal allow for wire attachments to transformers, condensers, relays and miscellaneous radio components. These seals make it possible for electrical equipment such as transformers, condensers, relays, etc., to operate efficiently at high altitudes, in humid climate, or under other extreme conditions, and the hermetic sealing protects valuable equipment against harmful clogging by insects, dust, or fungus growth. The maker is Sperti, Inc., Beech and Kenilworth, Cincinnati, O.

Vacuum Tube Voltmeter

Model 400A vacuum tube voltmeter, one of a number of laboratory instruments developed by Hewlett-Packard Co., Palo Alto, Calif., is a wide band feedback amplifier which operates a diode voltmeter of the average reading type. The circuit is independent of line voltage variations and tube characteristics to a high degree. A special input amplifier circuit is used to provide

a high input impedance and also to allow the use of an accurate voltage divider to select the voltage range. The power supply is self-contained, thoroughly filtered and electrostatically shielded from the primary voltage source. The voltage range is from .003 to 300 volts in nine steps, all having full scale sensitivity. The meter is calibrated to read the rms value of a sinusoidal wave. The voltage scale is linear and a decibel calibration based on one milliwatt at 600 ohms is provided. Frequency response is within 3 per cent from 10 cps to 100 kc and within 5 per cent to 1 mc. The meter is mounted in a grey wrinkle finished steel cabinet.

Relay-Contactor

Developed for heavy-duty circuit control under conditions requiring compactness, ease of mounting, and reliability, the new G-R relay-contactor is suited to many circuit control applications. A vertical solenoid, actuated by a coil rigidly mounted on the relay core frame, operates a molded bridge carrying heavy-duty spring-loaded contact bars on which large-diameter silver alloy contacts are mounted. Matching silver-alloy contacts are mounted on a double-break "wiping" action that keeps contact surfaces clean and smooth. The contact-carrying bridges are so designed that additional "decks" may be incorporated, permitting a wide range of contact arrangement. Units for normally closed, normally open or double-throw operation with single, double, triple or more poles are thus quickly available from standard mass-produced parts. Single or dual-voltage operating coils for all standard voltages are available; seal current, pickup and drop-out voltage is low. Standard units are conservatively rated at 30 amperes at 110 volts, 20 amperes at 220 volts, or 10 amperes at 440 volts. The manufacturer is Glenn-Roberts Co., 1009 Fruitvale Ave., Oakland 1, Calif.

Meter Rectifier

Selenium Corp. of America, 1719 West Pico Blvd., Los Angeles, has developed a new meter rectifier styled type N-6, consisting of six selenium rectifying elements enclosed in a tubular plastic case. Rating of the rectifier is 1.5 ma, and the maximum voltage to which it may be subjected is 150 volts ac. Frequency response is flat to 6000 cycles and at 20,000 cycles efficiency is 35 per cent of rated value. The rectifier may be used within a temperature range of —40 to —70 degrees C.

Improved Attenuator

An improved line of attenuators, featuring a new detent gear, new materials and new type steel cover, has been developed by The Daven Co., 191 Central Ave., Newark 4, N. J. The new detent gear provides more positive action, greater degree of accuracy, more uniformity in operation, longer life and a stronger stop

mechanism. Contacts and switches of the attenuators are tarnish-proof silver alloy. Cleaning and lubricating of the contact points has been eliminated. The new type steel cover provides improved magnetic shielding. The body of the cover forms an integral part of the attenuator assembly, protecting the resistors. A snap-on cap gives access to switch blades and contacts.

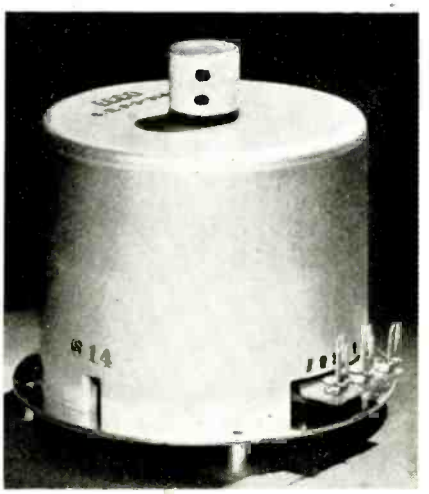
"Magic Moisture Meter"

A "Magic Moisture Meter", developed by engineers of the Friez Instrument Division of Bendix Aviation Corporation, is revealing the secrets of the stratosphere more accurately than was ever before possible. The new element, known as an electric hygrometer strip, replaces human hair in the Ray Sonde, an instrument which is attached to a free balloon and radios weather information to an automatic recorder on the ground, from heights up to ten miles above the earth. Human hair, the best previous conductor, is still relatively slow in reaction to moisture changes. The electric hygrometer, immediately sensitive to such variations, gives a more accurate picture of weather conditions high in the sky when the Ray Sonde passes rapidly through different strata of clouds. The electric hygrometer strip was developed by Friez engineers and engineers of the Bureau of Standards under the sponsorship of the Navy. It is now being used by the Navy, Army and Weather Bureau.

Basically, the difference between the new strip and human hair is that the latter varies in length with changes in humidity while the former varies in electrical characteristics. It is made of a plastic and is, roughly, about five inches long, an inch and a half wide, and about an eighth of an inch thick. The edges are specially treated so as to provide electrical conducting surfaces and the surface is so treated that the electrical resistance between the edges varies with the amount of moisture in the air.

Continuous Ring Pot

A continuous ring potentiometer having a total resistance in the active winding of 50,000 ohms, has been developed by Electronic Components Co., 423 North Western Ave., Los Angeles. The pot is a precision device having dual wiper arms spaced 180 degrees apart and equipped with building out resistors on each 120 degree tap. Similar units can be produced having taps at 60 or 90 degrees and these various sections can be connected through Y-type resistor arrangements.



McIntosh Leaves WPB; Will Become Consultant

Frank H. McIntosh, Assistant to the Director of the WPB's Radio and Radar Division, who has had charge of civilian radio requirements, both broadcasting and communications since the creation of the Division, has submitted his resignation to become effective June 1 or June 15, so that he can establish a consulting engineering practice in electronics and radio. In his engineering practice, Mr. McIntosh will engage in broadcasting. radio, both studio design, acoustics and frequency allocations. He also is going to enter the electronic induction heating field.

Mr. McIntosh plans to establish his radio engineering practice in Washington during the Summer, after he has engaged in conducting some private affairs during a period of 30 or 45 days following his retirement from the WPB. His assistant, John Creutz, is expected to serve as acting chief of the civilian radio section of the Division until a successor is named.

Mr. McIntosh joined the WPB in April, 1942, as Chief of the Radio Section then under the Communications Branch, which is headed by Leighton H. Peebles. In March, 1943, his Section was shifted to the Radio and Radar Division under Director Ray C. Ellis. Mr. McIntosh is credited with having kept broadcasting operations on an even keel through careful allocations of critical materials and in his blueprint of wartime broadcasting which enables stations to obtain maximum use of component parts. Before coming with the WPB, he had been technical adviser to the Fort Industry broadcasting stations for two years.

Surplus More Available

There is available from the Army Air Force close to 700,000 feet of flexible lead wire of the following sizes: 41-34; 20-34; 63-40; 6-38-resistance.

Further information of these and other sizes can be obtained from the Area Property Disposal Office of the Army Air Force, 1 Park Ave., New York.

CORRECTION

The curves shown on page 112 listing the number of bands available between certain limits are based on the relation

$$n \log (1 + 0.02X) = R,$$

where X indicates the band width, or tolerance, in percentage as shown, and R the range assumed. However, in the curves shown a misplaced decimal point places the number of bands available at only 10 percent of the actual total. The number of bands should be multiplied by ten.

Precedence Unaffected By ANEPA Dissolution

That the dissolution of the Army-Navy Electronics Production Agency by May 15, with its functions being absorbed and carried on by the Army, Navy and WPB, do not alter the rules of Limitation Order L-183-a (Electronic Equipment) nor weaken the force and importance of the Precedence List as the basic schedule for the military electronics program was emphasized in a letter to all prime contractors and component suppliers in the electronics-radio field by L. R. Boulware, Operations Vice-Chairman of the War Production Board. The letter stressed the importance of keeping the expanded military electronics program at its highest production level throughout 1944.

The L-183-a Order and the Precedence List had been two major functions in which ANEPA took part in expediting electronic-radio production. The Precedence List is defined in L-183-a as the schedule, issued and amended from time to time by the Joint Army-Navy Communications Board which sets forth the relative urgency for deliveries of equipment. Manufacturers were advised by Mr. Boulware to guard against any impressions that the discontinuance of ANEPA means the Precedence List schedules and the L-183-a requirements may be disregarded. They were advised to observe particularly the L-183-a requirement of purchase order being identified with Precedence List designations and schedules applicable to them. This identification information on purchase orders for the purposes of expediting and scheduling is increasingly important.

If all electronic equipment manufacturerers conform to the basic principles of these regulations, schedules will be met to keep production at its highest level in conformity with the requirements of all Claimant Agencies. These organizational changes, Mr. Boulware stated, in no way indicate production needs have leveled off and, in fact, this program demands still greater production than in the past. Electronic equipment manufacturers and component part suppliers were urged by Mr. Boulware to note Interpretation 1 to Order L-183-a, setting forth the relation of the Precedence List to Scheduling and the rules of Priorities Regulation 18 relating to frozen schedules.

WCEMA Meets

The Los Angeles Council of the West Coast Electronics Manufacturers Association held its monthly meeting May 10 at the Chapman Park Hotel with Robert Young, acting deputy director of the Los An-

PUNCH IN HOLES INDICATED FILE IN YOUR NOTEBOOK

TECHNICAL NOTES

Excerpts from New Home Study Lessons Being Prepared under the Direction of the CREI Director of Engineering Texts

The Iconoscope

In this month's issue of THE CREI NEWS, appears Part II of the article on Iconoscopes. This section deals with the construction of the Iconoscope and a preliminary discussion of its action when scanned in the dark. In the next issue, the action of the Iconoscope when a scene is imaged on its mosaic will be analyzed.

We believe that this material will be of interest and value to the radio engineer, whether or not he is at present engaged in television, because television promises to be one of the major post-war activities.

Once again, permit us to remind you that THE CREI NEWS, the house organ of the Capitol Radio Engineering Institute, publishes each month a technical article of interest to the radio engineer.

***Write today for the June issue of THE CREI NEWS and the second interesting technical article on "The Iconoscope."* You may secure your copy free and without any obligation merely by writing to the Capitol Radio Engineering Institute. We shall be pleased to mail you all future copies thereafter without cost or obligation.**

★ ★ ★

The subject of "The Iconoscope" 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. Rietzke. 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.*

CAPITOL RADIO ENGINEERING INSTITUTE

E. H. RIETZKE, President

Home Study Courses in Practical Radio-Electronics Engineering for Professional Self-Improvement

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Contractors to the U. S. Navy—U. S. Coast Guard — Canadian Broadcasting Corp.—Producers of Well-trained Technical Radiomen for Industry.

geles War Manpower Commission, as principal speaker.

Other speakers included Capt J. T. Asbury, head of the new office in Los Angeles for the Army Signal Corps labor, procurement and production, and his assistant, Lieut. E. C. Williams; and Navy Senior Lieutenant Ben Swartz, of the industrial incentive division. Dick Leesman, marine corporal who was decorated with the silver star, the purple heart and other honors for action at Tarawa, gave a stirring account of the battle.

Following the speakers and a general round table discussion, films were shown by the Citizens Manpower Commission. H. L. Hoffman, president of the Association and of the Hoffman Radio Corp., presided. Bill Goody, new statewide secretary for the Association, was presented to the group.

Replogle in New York

D. E. Replogle & Co. has opened a New York office for consulting engineering in electronics in the transmitting and radio fields. Location is 1819 Broadway in the Manufacturers Trust Building.

Two to Great American

Great American Industries, Inc., 247 Park Ave., New York, has made two additions to its staff. Langdon H. Roper, recently released by the War Department after serving two and one-half years as principal production engineer, first with the U. S. Signal Corps and later with ANEPA, has been made assistant to the president; Ovid Riso has been appointed advertising director and will be responsible for public relations of all divisions of the company, including Connecticut Telephone & Electric Co., Meriden, Conn., Rutland Electric Products Division, Rutland, Vt., and Ward La France Truck Division, Elmira, N. Y.

Hoffman Adds Engineers

Hoffman Radio Corp., Los Angeles, has appointed William W. Wells a senior engineer. He went west several years ago from the Colonial Radio Corp. and became a department supervisor with the Universal Microphone Co. and, more recently, with Marine Radio at Wilmington. He has been assigned to engineering duties on war contracts. William J. Green is another new senior engineer. He was an engineer with the Radiobar Co. for six years. When Radiobar was merged with Philco he was with their Philadelphia plant for six years before going west to Los Angeles. Roy Deane has also joined the Hoffman staff as a production supervisor.

ELECTRONIC INDUSTRIES

Advertisers—June, 1944

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Allen-Bradley Moves New York Headquarters

Allen-Bradley Co., Milwaukee, Wis., manufacturers of electrical controlling apparatus, has moved their New York offices to 155 East 44th St., New York 17, N. Y. The new telephone number is Murray Hill 2-7142. C. N. Calkins remains in charge.

"E" to Price

Price Brothers Co., manufacturers of relays and magnetic controls at Frederick, Md., was awarded the Army-Navy "E" on April 28th. The company is engaged exclusively in the manufacture of relays and sensitive controls for the communications branches of our military services.

Thermex in New York

The Thermex Division of the Girdler Corp., Louisville, Ky., has opened a New York office at 150 Broadway with Hugh Cameron as eastern representative. Cameron has had extensive experience as an engineer and as a consultant, and was formerly with General Electric in Fort Wayne, Ind.

Schott Expands

Walter L. Schott Co., 9306 Santa Monica, Beverly Hills, Calif., has taken over another factory in W. Hollywood of 2,000 sq. ft., for the manufacture of radio and radar equipment for the government.

Muniz Heads Espey Engineering

Harold Shevers, president, Espey Manufacturing Co., of New York, announces that Ricardo Muniz has joined the company's engineering staff as director. Mr. Muniz was until recently chief engineer and plant manager, Radio Navigational Instrument Corp., and before that electronic consultant, Telector division of International Business Machines Corp.

Graduate of Brooklyn Polytechnic Institute, 1930, he taught radar at Brooklyn Tech, and at Hunter College directed classes in design, development and production.

Craven Leaves FCC

Winding up some 30 years of government service, FCC Commissioner T. A. M. Craven has resigned, effective end of this month, and will return to private enterprise. He joined FCC in 1935 as chief engineer; two years later he became a commissioner. He will join the Cowles interests which operate broadcasting stations in Des Moines and Minneapolis and own "Look" magazine.

FOR ACCURATE MEASUREMENT OF AUDIO FREQUENCY VOLTAGE

RANGE: indicating meter is calibrated at 2 volts full scale. Multiplier extends this range by 1, 2, 5, 10, 20, 50 and 100 times full scale

INPUT IMPEDANCE — on constant impedance scale — 20,000 ohms. ohms per volt scale — on constant 40,000, 100,000, 400,000 ohms, 1 megohm and 2 megohm.

ACCURACY: plus or minus 5% of full scale over the range of 30 to 5000 cycles. A correction of approximately 3% per kc. may be applied above 5000 cycles.

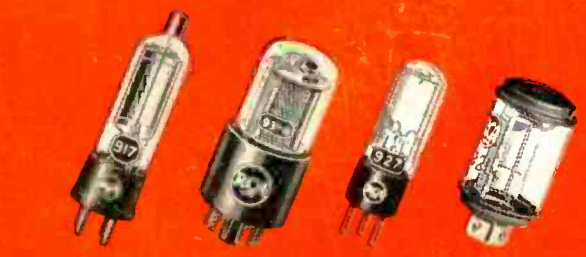
The **DAVEN** D-180 Output Meter is a combination of a high impedance voltmeter and a constant impedance output meter. The high impedance voltmeter range is particularly convenient when measuring transformer secondary voltages and as a bridging indicator where a high impedance is required. The constant impedance range serves as a null detector and as a beat indicator in the comparison of two frequencies.

The indicating element of the **DAVEN** D-180 Output Meter is a copper oxide rectifying voltmeter calibrated to read directly in volts. Multiplier network provides a meter range of 1, 2, 5, 10, 20, 50, and 100 times meter scale reading. On the left of the vertical center line, the multiplier changes the input impedance to keep resistance equal to 10,000 ohms per volt. On the right of the vertical center line, the impedance remains constant at 20,000 ohms. When measuring between 50 and 200 volts, the ability to increase the input impedance is particularly desirable.

Regular Purchases of War Bonds Aid the Fight Against Inflation

THE DAVEN COMPANY
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

HOW TO SELECT PHOTOTUBES



PHOTOTUBES have found such a wide variety of applications that many types have been developed to meet special needs. The complete RCA line includes both gas-filled and high-vacuum phototubes, with various spectral responses and a variety of sizes and shapes. And for applications requiring extreme sensitivity, RCA supplies multiplier phototubes.

A phototube acts as a light-actuated electric valve. (It does *not* convert light energy to electrical energy, but acts only as a control device.) The current passed is in proportion to incident light. Some phototubes are "high-vacuum" types; some are filled with an inert gas (such as argon) to increase current-carrying capacity.

A multiplier phototube contains additional electrodes (dynodes) which emit secondary electrons and thus greatly increase sensitivity and output current as compared to 2-electrode phototubes.

Color Sensitivity: The cathode coating material and the envelope glass determine color sensitivity. RCA phototubes fall into five "color groups":

Use	Tube Types	Maximum Color Sensitivity
With incandescent lamps	High vacuum: 925, Gas-filled: 868, 920, 924, 927*, 928	Red and infra-red
With incandescent lamps—and for infra-red application	High vacuum: 917, 919, 922*. Gas-filled: 918, 921*, 923, 930*	Similar to above, but sensitivity extended further into infra-red
With light source for colorimetry application	High-vacuum: 926	Blue light. Approximates the human eye
With daylight, carbon-arc, or mercury-vapor light source	High-vacuum: 929*, 934. Multipliers: 931-A*, 1P21	Blue light. Very sensitive to incandescent light at a color temperature above 2700°K.
For ultra-violet measurement	High-vacuum: 935, 1P28	Same as above, but special glass envelope permits high ultra-violet sensitivity

*An RCA Preferred Type Tube

Color response curves are available on all RCA phototubes.

Vacuum- or Gas- or Multiplier-Type? Several important factors to be considered in selecting the general type of phototube for a service are given in the following table. Specific values should be considered in selecting the actual tube type.

Characteristic	High-Vacuum type	Gas-filled type	Multiplier type
Sensitivity	Low	Medium	Very high
Current Output	Low	Medium	Very high
Amplification factor	1	Up to 10	Up to 1,000,000
Relative signal-to-noise ratio (including amplifier stage)	Low	Intermediate	High
Anode Volts	Up to 500	Not over 90	Up to 1250
Distortion (audio)	Negligible	Appreciable in some cases	Negligible
Frequency Range	Limited largely by circuit	Limited by tube performance	Limited largely by circuit

Gas-filled phototubes are, at present, extensively used for sound-on-film reproduction and for relay work. Vacuum-types are widely used where high sensitivity is needed; for precision measurement where stability of calibration is essential; and for high-speed work.

Sensitivity: The sensitivity of a phototube may vary according to whether the light change is abrupt or continuous. *Static sensitivity* is the ratio of anode direct current to constant light flux. *Dynamic sensitivity* is the ratio of the variation of anode current to the variation of light input. The sensitivity of gas-filled phototubes drops off as light-source frequency increases.

Optical Systems: The use of phototubes usually involves some sort of optical system. The fundamentals of optics must be carefully considered in the successful application of phototubes.

Mechanical Features: As illustrated at left, several types of tubes are available. Size, vibration, directional requirements, etc., all may influence the choice of one of the many RCA phototubes.

Phototube Life: Phototubes are inherently sturdy, long-lived tubes and when operated under recommended conditions, give extended reliable service.

Application Hints: Here are a few general suggestions on applying phototubes:

1. In relay and measurement circuits where tubes must respond to very small amounts of light, avoid leakage currents outside tube. Keep tube terminals and sockets clean. Erratic leakage currents will affect results.
2. In amplifiers where low leakage is important, select top cap types such 917, 919, or 935.
3. Shield phototube and leads to amplifier or relay tubes when amplifier gain or phototube load resistance is high.
4. Where high-frequency response is important keep phototube leads short to minimize capacitance shunting of output.
5. For constant calibration of high-precision vacuum phototube devices, keep anode voltage at or below 20 volts. Keep incident light spread over wide cathode area.
6. Design or circuit constants should be based on tests with the equipment operating over the expected range of line-voltage variation.
7. RCA voltage-regulator tubes can improve phototube circuit performance.
8. Anode characteristic curves on phototubes can be used to predict performance under given operating conditions.

What Phototube Do You Need?

Due to space limitations, the suggestions presented here are brief and in a condensed, summary form. If you have a specific application problem or wish to discuss your phototube requirements with us, write to RCA, Commercial Engineering Section, 714 S. Fifth Street, Harrison, N. J. For further published information on RCA Phototubes and how to use them, send the coupon at left.

Send for this valuable data

Free to electronics engineers: "RCA Phototube Booklet," complete with 11 typical circuit diagrams, curves, tables, and clearly written text. Address:

RCA, 714 South Fifth Street, Harrison, N. J.

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RCA VICTOR DIVISION · CAMDEN, N. J.

The Magic Brain of all electronic equipment is a Tube and the fountain-head of modern Tube development is RCA.