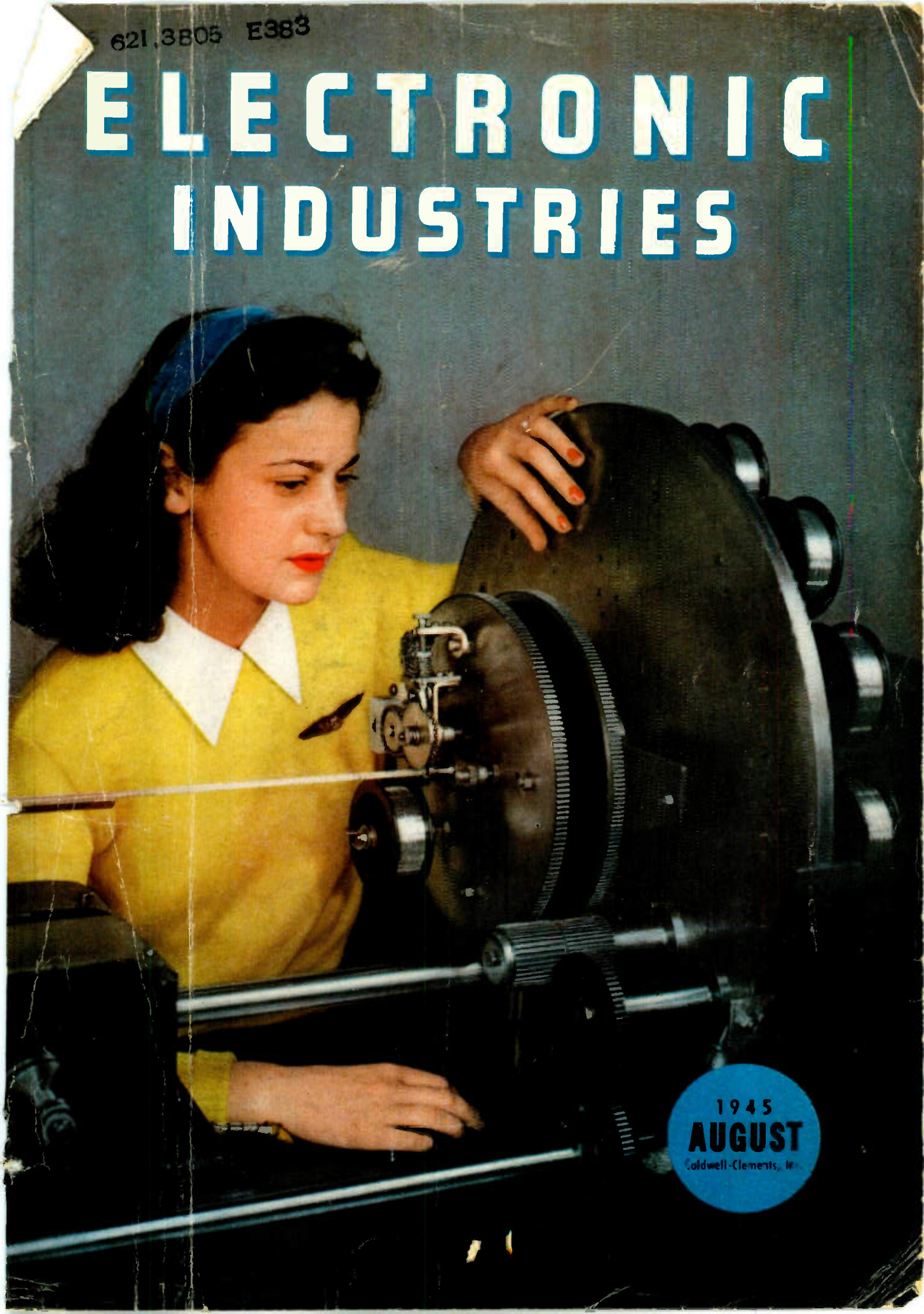
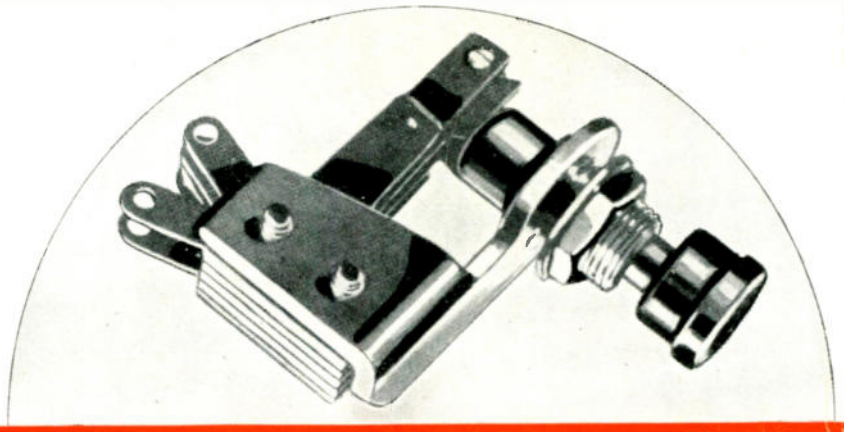
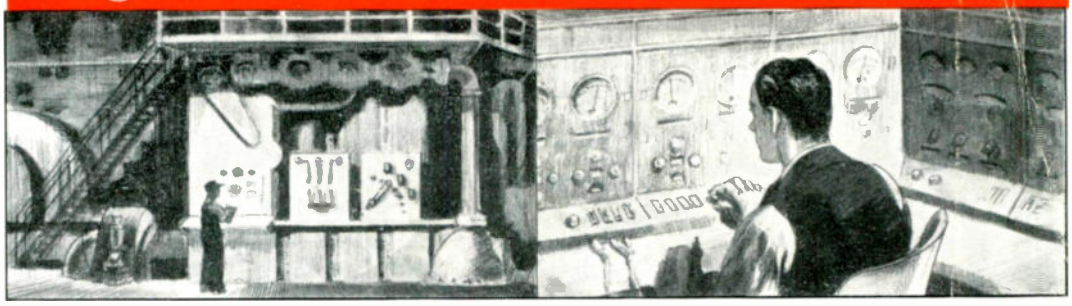
ELECTRONIC INDUSTRIES



1945
AUGUST
Caldwell-Clements, Inc.



Mallory Push Button Switch Provides Sure Control for Big Machines or Little Instruments

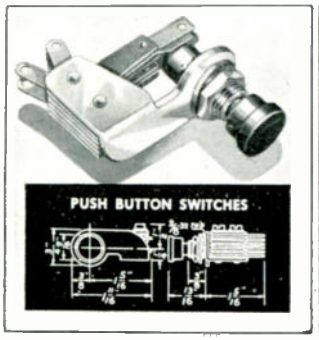


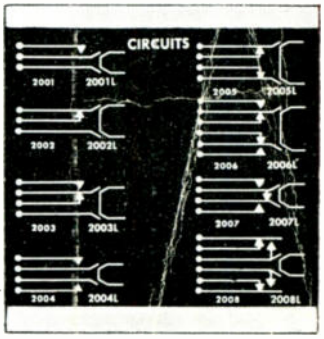
EIGHT different circuit combinations permit a wide variety of applications for this Standard Mallory Push Button Switch—from remote controls for huge industrial machines to operation of small laboratory test instruments.

Each circuit combination of this Mallory switch is available in either a locking or a non-locking type. Locking types keep the circuit closed until the button is pulled out. Non-locking types maintain contact only while the button is held depressed.

Special construction features provide improved electrical characteristics and assure long operating life. The switch frame and bushing are nickel-plated brass. Low-resistance contacts are silver. Contact springs are nickel-plated phosphor bronze.

Select the push button or circuit selector switches you need from the Mallory catalog. Your nearest Mallory Distributor—who has a stock of standard switches—will gladly furnish you with a copy of this useful catalog, which lists 1616 precision items. Or write us today.

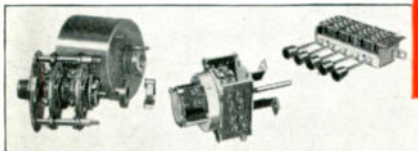


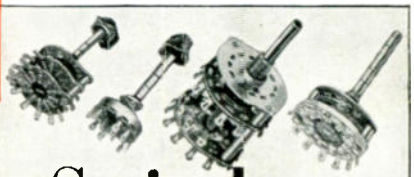


P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

P. R. MALLORY & CO. Inc

MALLORY





Industrial and Electronic Switches

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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

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Printed in U. S. A.

THE AMPEREXTRA FACTOR in INDUCTION HEATING

The **Amperextra** Factor is the longer operating life and lower maintenance cost of **Amperex** air and water cooled transmitting and rectifying tubes. In induction heating, a field in which our engineers have pioneered, this Factor adds considerably to the general efficiency of equipment using **Amperex** tubes.

LONGER LIFE . . .

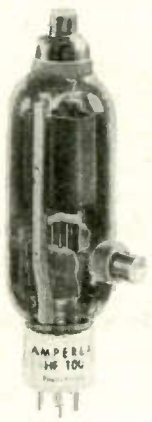
. . . since the life of a tube is influenced by the equipment in which it is used, as well as by the inherent characteristics of the tube itself, we maintain a Special Engineering Application Department which constantly applies our tubes in actual circuits, and determines which conditions are conducive to prolonged life. Their findings are freely available to you.

FIGURED . . .

. . . on the basis of the hours of maximum tube life, *Amperex* tubes are by far your best and most economical "buy."

LOWER MAINTENANCE COST . . .

. . . *Amperex* tubes offer more value per dollar invested. Down time is noticeably decreased, number of replacements minimized, overall costs reduced.

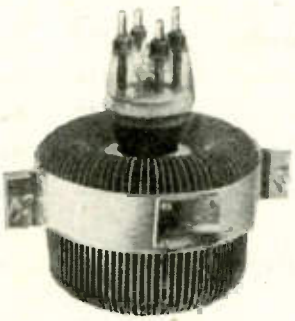


Amperex Type HF-100 Transmitting Tube. Filament Voltage, 10-10.5 volts. Filament current, 2.5 amperes. Amplification factor, 23. Grid to plate transconductance at 100 ma., 4200. Direct interelectrode capacitance: Grid to plate, 4.5 μμf: grid to filament, 3.5 μμf: plate to filament, 1.4 μμf. $12.50, list price.

AMPEREX

. . . the high performance tube

The Amperex Special Application Engineering Department, another "Amperextra," will be glad to work with you on present or postwar problems.



Amperex Type 889-R Transmitting Tube. Filament voltage, 11 volts. Filament current, 125 amperes. Amplification factor, 21. Direct interelectrode capacitance: Grid to plate, 20.7 μμf: Grid to filament, 19.5 μμf: Plate to filament, 2.5 μμf. $260.00, list price.

Amperex Type 575-A Mercury Vapor Rectifier. Filament AC voltage, 5.0 volts. Filament current, 10.0 amperes. Preheating period, before plate voltage is applied, 30 seconds. $30.00, list price.

AMPEREX TUBES . . .

. . . for induction heating applications range from small 50 watt types to "big boys" of 100,000 watts. Many of these tube types are now available through leading radio equipment distributors.

AMPEREX ELECTRONIC CORPORATION

25 Washington St., Brooklyn 1, N. Y., Export Division: 13 E. 40th St., New York 16, N. Y., Cables: "Arlab"

Canadian Distributor: Rogers Electronic Tubes, Limited • 622 Fleet Street West, Toronto

Capacity

Modern, large capacity equipment, skillfully operated and carefully supervised, assures quantity with quality.

. . . to deliver molded oil-paper capacitors . . . in quantities more than ample for your needs . . . and in exact agreement with American War Standard C75/221 . . . is afforded by batteries of these dual-77-cavity monsters. Fed with oil-impregnated, aluminum-foil-wound, non-inductive sections and pre-forms of mica-filled phenolic, these huge presses are continually pouring forth capacitors of uniformly high quality with the consistency of characteristics for which Tobe products are famous.

So, however great may be your consumption of molded oil-paper capacitors, Tobe can deliver them in volume. Capacitance ranging from 1000 to 50,000 mmfd: working voltages from 120 to 800 volts d-c: shunt resistance as high as 40,000 megohms at 25°C: power factor as low as 0.004 at 1000 cycles: and moisture seal that meets all thermal cycle, immersion, and humidity requirements.

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

FIELD OFFICES IN NEW YORK CITY • CHICAGO • DETROIT • GLENDALE, CALIFORNIA

THE COVER

● The Kodachrome photograph on the cover was made especially for Electronic Industries by the photographers in the plant of Eitel-McCullough, San Bruno, California, and shows a recently developed machine that is used for the precision winding of grids used in transmitting tubes. Heretofore such grids have had to be fabricated by hand, a slow, laborious process requiring keen eyesight, great patience and hard-to-find manual dexterity. The machine permits mass production of large quantities of grids to very close tolerances. See page 104.

* * *

Allocations Chart Sent You With This Issue

As a special supplement to this issue of Electronic Industries there is enclosed a four-color Chart showing all the final frequency allocations between 25 and 30 million kilocycles, as well as the allocations which have been proposed by Federal Communications Commission for the region below 25 kilocycles. The Chart has been prepared by the Editorial Art Department of Electronic Industries as a service to readers and is one of a series of such color charts on other subjects intimately related with electronic applications that have long been a prominent and valuable feature of this publication.

This Frequency Allocations Chart represents the first general picture of the entire radio spectrum to appear and because of the intense interest of all industries in various particular frequencies, many never before definitely allotted for specific purposes, it has been made minutely complete and is so arranged as to be easily understandable. It is felt that the Chart will be of great value for reference purposes.

Although that portion of the spectrum lying below 25 kc is at present only a proposal of FCC it is believed that there may be no great change in that region. In any case it likely will be several months before this region below 25 kc is allocated in final form.

$1,000 Editorial Award

There is still plenty of time for engineering authors to submit papers or articles for consideration under the terms of the Editorial Award announced several months ago. The plan, briefly, is this: All articles published in Electronic Industries between now and December 31 will be judged by an impartial panel of engineers who will select the best three articles. To the

(*Continued on page* 202)

G-E high-frequency tubes for electronic heating are SERVICE PROVED!

Type GL-889-A (water-cooled) is shown at left; price $160
Type GL-889R-A (forced-air-cooled) at right; price $280

Your tube requirements for electronic heating are best served by G-E power triodes, which have demonstrated their efficiency over years of both radio transmitting and industrial use. Combining modern design and proved trustworthiness which feature the entire line of G-E tubes for electronic heating, Types GL-889-A and GL-889R-A, shown above, contain numerous advancements reflected in superior performance.

o Their compact, low-inductance design makes for stable operation under varying circuit conditions, while individual features of construction add efficiency and contribute strength.

• Cathode distortion is minimized by multiple-strand design and rigid construction of this electrode. The self-supporting grid cage structure further increases internal stability.

• In all respects Types GL-889-A and GL-889R-A are engineered for top-grade service in busy plants where dependability is a first essential. Consult your nearest G-E office or distributor for further information about G-E high-frequency tubes for electronic heating. Or write direct to *Electronics Department, General Electric, Schenectady 5, N. Y.*

Characteristics of the GL-889-A

Three-electrode vacuum oscillator tube for producing the high-frequency alternating current required in electronic heating. Its water-cooled anode suits Type GL-889-A for induction heating, where water-cooling generally is employed. Cathode voltage and current are 11 v and 125 amp. Maximum plate ratings are: voltage 8,500 v, current 2 amp; input 16 kw, dissipation 5 kw.

For dielectric heating, Type GL-889R-A is available with cooling by copper-fin radiator and forced air. Ratings are the same as those given above for Type GL-889-A.

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

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

GENERAL ELECTRIC

162-D9-8650

Global shrinking

PART of our business is making the world smaller—by telescoping time and space with *speed*. We contribute to the process in two ways. First, electronically. With radio communication equipment that shrinks thousands of miles into an instant. Such as the **Aireon** Type 508 Transmitter for ground-to-plane and point-to-point conversation. It's used by the Army Air Transport Command and commercial airlines to monitor global air traffic, keep planes hopping. Second, hydraulically. With fast-acting power actuators and controls. Precision designed for war-planes, cargo carriers and commercial aircraft that make ponds out of oceans, islands out of continents. Electronic or hydraulic, it's our stuff; designed and built from the ground up by **Aireon** engineers with real technical savvy and produced in plants equipped to handle precision work on a quantity basis. The same combination is available to handle your problems whenever you say.

Aireon MANUFACTURING CORPORATION

Radio and Electronics Engineered Power Controls

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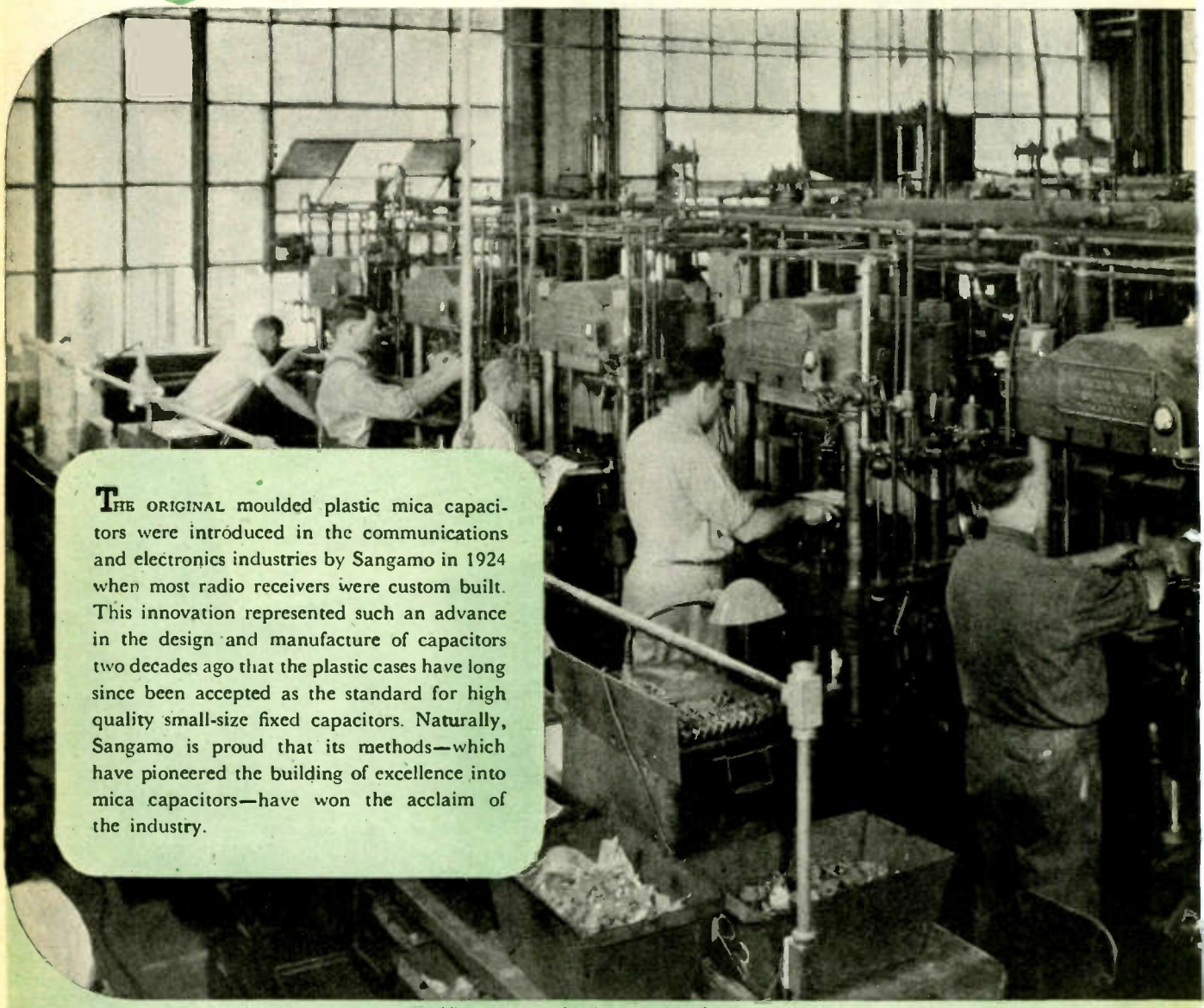
HOW EXCELLENCE IS BUILT INTO

Sangamo MICA CAPACITORS



THE ORIGINAL moulded plastic mica capacitors were introduced in the communications and electronics industries by Sangamo in 1924 when most radio receivers were custom built. This innovation represented such an advance in the design and manufacture of capacitors two decades ago that the plastic cases have long since been accepted as the standard for high quality small-size fixed capacitors. Naturally, Sangamo is proud that its methods—which have pioneered the building of excellence into mica capacitors—have won the acclaim of the industry.

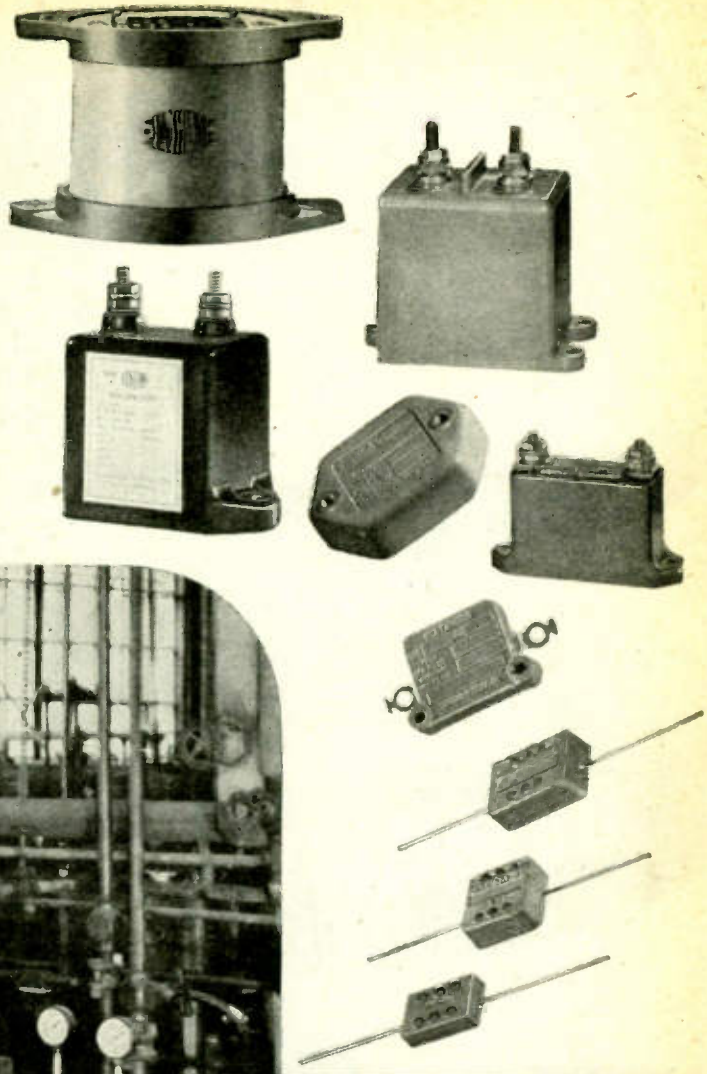
Moulding presses used in the production of Sangamo capacitors.

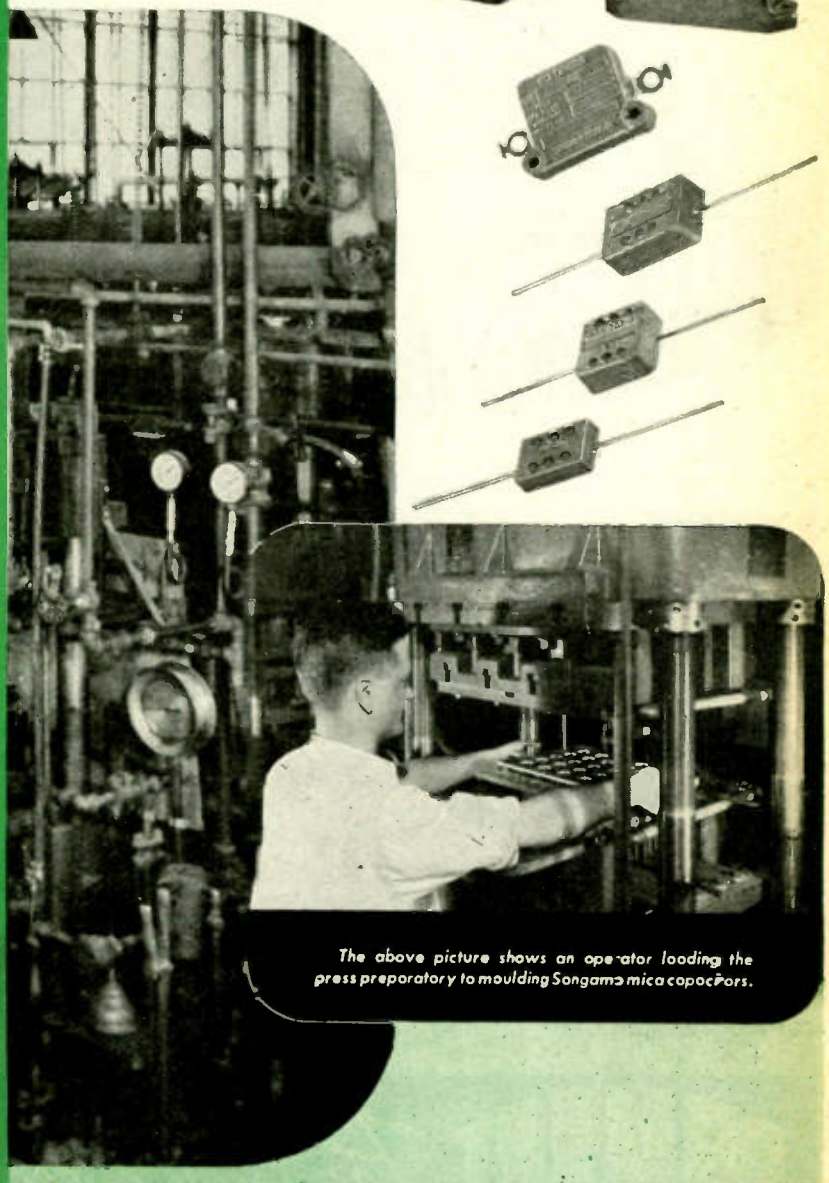
SANGAMO ELECTRIC

ESTABLISHED 1898 • • • MICA CAPACITORS • • •

Capacitor MOULDING

IN ORDER to insure the continued satisfactory operation of a mica capacitor, it is essential that the capacitor element be provided with a shell or housing of some sort. This housing not only serves to give the capacitor increased mechanical strength and, consequently, durability, but also serves to help prevent the absorption of moisture and to retain the desired characteristics built into the capacitor unit. Prior to about 1924, most mica capacitors were mechanically held by using two outside plates of fiber or other insulating material, which were riveted together to form a housing or protective case for the unit. This did not prevent the absorption of moisture. In 1924, Sangamo conceived the idea of moulding mica capacitor elements in plastic or bakelite cases, and this proved so satisfactory that this method of housing capacitors has been employed ever since. Mica capacitors are moulded in presses, where the proper operating temperatures and pressures insure uniform, thoroughly cured plastic enclosures. Highly polished dies result in a capacitor with a smooth, glossy finish which is moisture resistant. Various moulding compounds can be used in the production of mica capacitors, but those most commonly used are of the low loss mica filled types, which contribute to high insulation resistance and high "Q" values in the finished capacitor. The use of plastic housings contributes greatly to the excellence of the quality in Sangamo mica capacitors.





The above picture shows an operator loading the press preparatory to moulding Sangamo mica capacitors.

Another "First"!

25,000 volts accelerating potential on a cathode-ray tube...

DuMONT MULTI-BAND

TYPE 5RP CATHODE-RAY TUBE

We repeat: 25,000 volts accelerating potential on a cathode-ray tube! That's front-page electronic news. Likewise cathode-ray history in the making.

The DuMont Multi-Band Tube (Type 5RP) permits recording at writing rates in excess of 2500 km/sec (using a 35 mm camera with f:1.9 lens) corresponding to sine wave transients at 10,000 megacycles!

This is a hot-cathode, permanently-sealed, high-vacuum tube. Subdivision of the intensifier element provides a controlled gradient allowing a total accelerating potential of 25,000 volts to be employed, with only slightly reduced deflection sensitivity. Greatly increased brightness with small spot size results in a writing rate far exceeding that heretofore obtainable.

Yes, DuMont pioneering continues.

Literature on request.

Cylindrical flat-face tube. Approximately the size of conventional 5-inch tubes. Deflection-plate leads brought out through neck instead of base. Shunt input capacities and cross-coupling effects reduced to minimum. Second anode and intensifier leads brought out through envelope to facilitate high-voltage operation.

DuMONT Precision Electronics & Television

ALLEN B. DuMONT LABORATORIES, INC., PASSAIC, NEW JERSEY

you can't *put the squeeze* on SEALDTITE CAPACITORS

Just try it . . . Take a genuine "Sealdtite" capacitor and try to *squeeze* it. No results. You'll find it has no soft spots, which in ordinary tubulars provide room for moisture, the capacitor's worst enemy, because the Solar capacitor has an internal winding of high quality paper and foil, skillfully *molded* into *solid* plastic.

No moisture can penetrate this protective case and its substantial construction permits rough handling, assures long and *reliable* service.

Use "Sealdtite" capacitors. Send for your copy of Catalog V-4. Any Climate—Any Atmosphere—Any Service.

SOLAR

BAYONNE PLANT
WEST N.Y. PLANT
A TOTAL OF EIGHT ARMY-NAVY EXCELLENCE AWARDS

SOLAR CAPACITOR SALES CORP.
285 MADISON AVENUE, NEW YORK CITY

7567

Telephone Type Plugs

Signal Corps • Navy Specifications

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

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

OTHER DESIGNS TO ORDER

Simple things—these humble plugs, but Remler found a way to make them better, faster. Production has been doubled while man hours were reduced fifty per cent. This precision efficiency has been made possible by ingenious machines designed by Remler engineers to combine several operations.

The facilities of this organization, backed by 27 years of experience in radio, electronics and plastics will soon be available to sub-contract the manufacture of your peace time parts and components in metal and plastics.

Inquiries invited, write—

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

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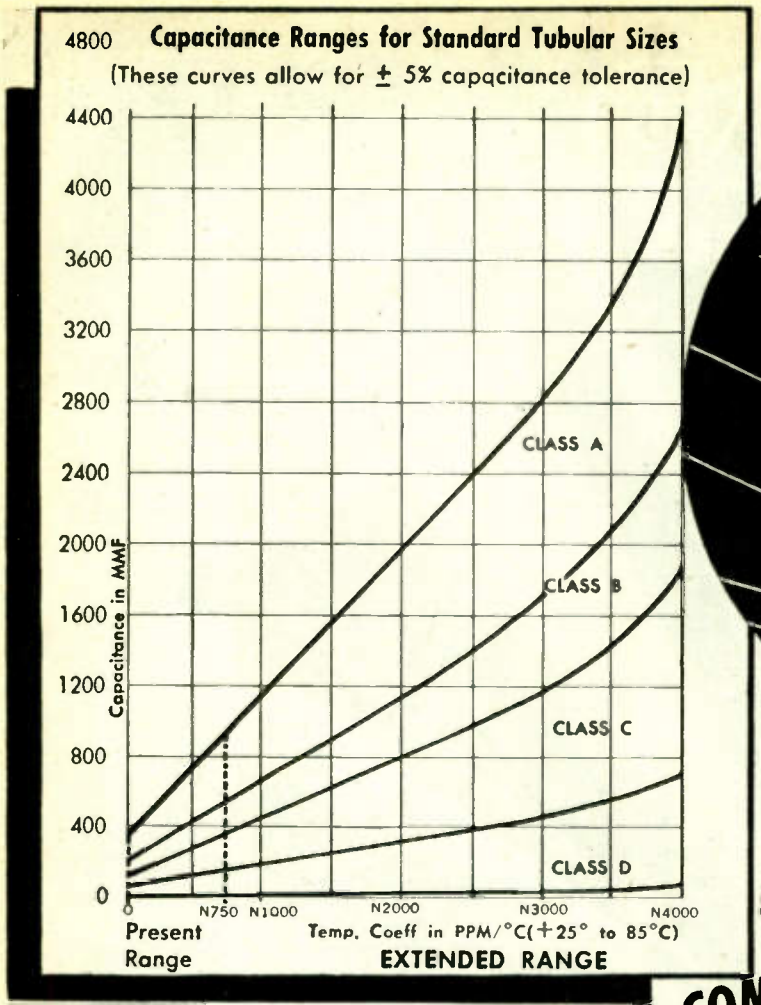
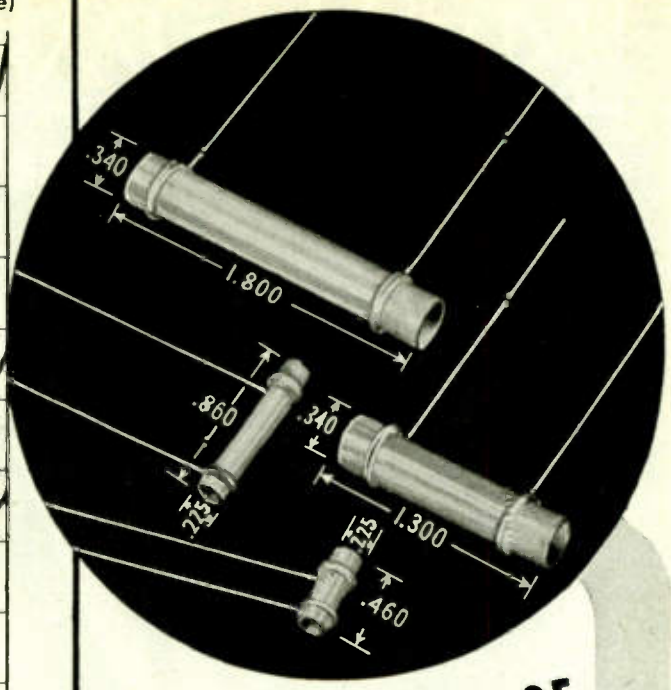
SINCE 1918

Announcing & Communication Equipment





A *New* RANGE OF CONTROLLED TEMPERATURE COMPENSATING CAPACITORS *by* Centralab

Centralab Tubular Ceramic Capacitors can now be supplied in any desired temperature coefficient from P120 to N4000 parts per million per degree Centigrade.

The range from N750 to N4000 P.P.M. is *new*, with the same accuracy of temperature compensation curve and uniform electrical characteristics as the present standard ranges.

The new ceramic bodies have somewhat higher dielectric constants and thus provide higher values of capacitance on the same size tube. They are not to be confused, however, with the so called Hi-K or high dielectric bodies that have still higher dielectric constants but less uniform characteristics.

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

Centralab
CRL
Division of GLOBE-UNION INC., Milwaukee

"Electrolytic Corrosion" is his name.

He works slowly . . . quietly . . . continuously . . . and unobserved.

His prey is sub-surface cables, pipe lines and other metallic structures.

Unchecked, he can markedly shorten the life of buried equipment.

Yet, there *is* a way to protect your underground installations . . . *use Federal Cathodic Protection Rectifiers.*

These equipments, incorporating Federal Selenium Rectifiers to convert alternating current to direct current, send a steady current through the earth surrounding underground metal structures, counteracting the natural forces of corrosive galvanic action.

Federal Cathodic Protection Rectifiers are now at work in all parts of the country . . . mounting silent, motionless guard over buried investments.

Stop deterioration of your equipment now. Put Federal Cathodic Protection Rectifiers to work for you . . . cost of operation is low . . . attention required is negligible.

Write us today for the FTR Technical Information Series booklet "Cathodic Protection and Applications of Selenium Rectifiers"...get the full story on this effective means of protection.

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Federal Telephone and Radio Corporation

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Newark 1, N. J.

"JUST TELL HIM ALBION CAN SHIP ALL THE COILS HE NEEDS... THAT'LL QUIET HIM."

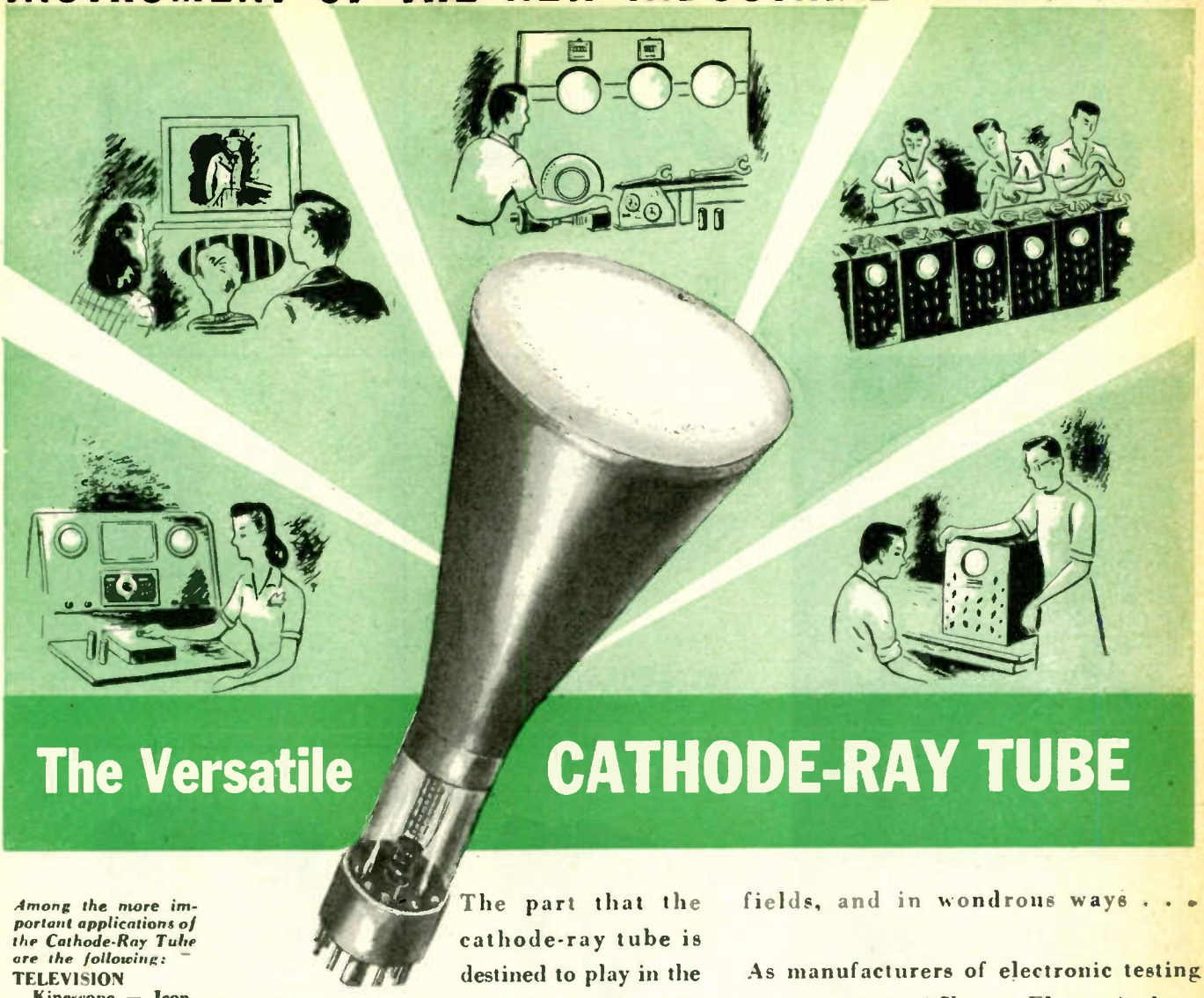
SUPER-QUALITY COILS AT REASONABLE PRICES

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

ALBION
COIL COMPANY
ALBION, ILLINOIS

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

INSTRUMENT OF THE NEW INDUSTRIAL REVOLUTION



The Versatile CATHODE-RAY TUBE

Among the more important applications of the Cathode-Ray Tube are the following:

TELEVISION
- Kinescope — Iconoscopes
- Monitors for television signals

ELECTRICAL LABORATORY PRECISION MEASUREMENTS
- Oscilloscopes
- Comparison of Wave Shapes
- Frequency Response
- Power Distortions

MEDICAL
- Electrocardiograph
- Reaction of nerve stimuli

MECHANICAL
- Measurement and visual indication of Tension
- Stress analysis
- Compression of engines
- Vibrations
- Uniformity of gear cuts, cams, etc.
- Regulation of spring movements

GENERAL
- Musical tones study
- Measuring efficiency of operations
- Speed measurements

The part that the cathode-ray tube is destined to play in the industrial picture of tomorrow is dramatically suggested in its wartime applications.

The term "picture" is used advisedly. For the performance of the cathode-ray tube is pictorial. Thanks to its magical powers, hidden secrets are made to materialize . . . elusive phenomena are captured and crystallized so that they may be viewed and studied.

Today, the cathode-ray tube is a weapon of war. In the tomorrow of peacetime progress, it will demonstrate its versatility in industry, in medicine, in countless fields, and in wondrous ways . . .

As manufacturers of electronic testing equipment, we of Sherron Electronics have a first-hand familiarity with cathode-ray tubes.

In our research and development departments, we have produced equipment for the inspection of the cathode-ray tube, as well as equipment in which the cathode-ray tube has served as a measuring device.

Already, the cathode-ray tube figures importantly in the postwar projects of many manufacturers. For information regarding the adaptability of the cathode-ray tube to your own manufacturing processes, write to:

Sherron Electronics

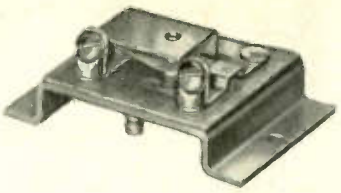
SHERRON ELECTRONICS CO.

Division of Sherron Metallic Corporation

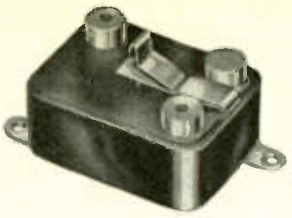
1201 FLUSHING AVENUE, BROOKLYN 6, N. Y.

"Where The Ideal Is The Standard, Sherron Units Are Standard Equipment"

Type RT Thermostat. Adjustable Temperature Control.

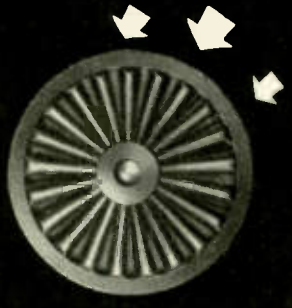


Type C–4351 Thermostat. Used for Tube Warming, Tube Cooling, High Limit Controls, etc.

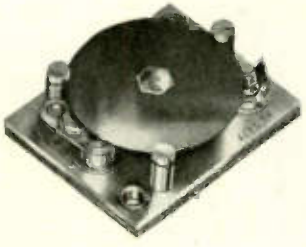


Type C–7220 Precision Snap Switch 12 amps. 30 Volts D. C, 125 Volts A C

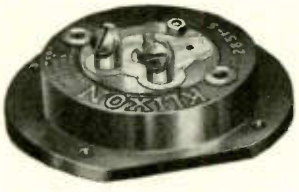
This "Business End"



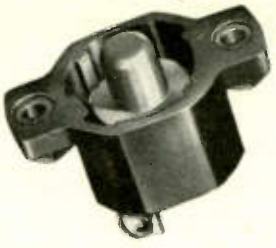
in KLIXON Disc-Operated Controls



Type B–3120 Thermostat and Heater, Crystal Dew Point Control



Type C–2851 Thermostat For such use as Roughing Controls on Outer Crystal Ovens.



Type PM (NAF–1131) Circuit Breaker

Type ER Series. Ambient Compensated Time Delayed Relays.

ASSURES TROUBLE-FREE CONTROL or PROTECTION

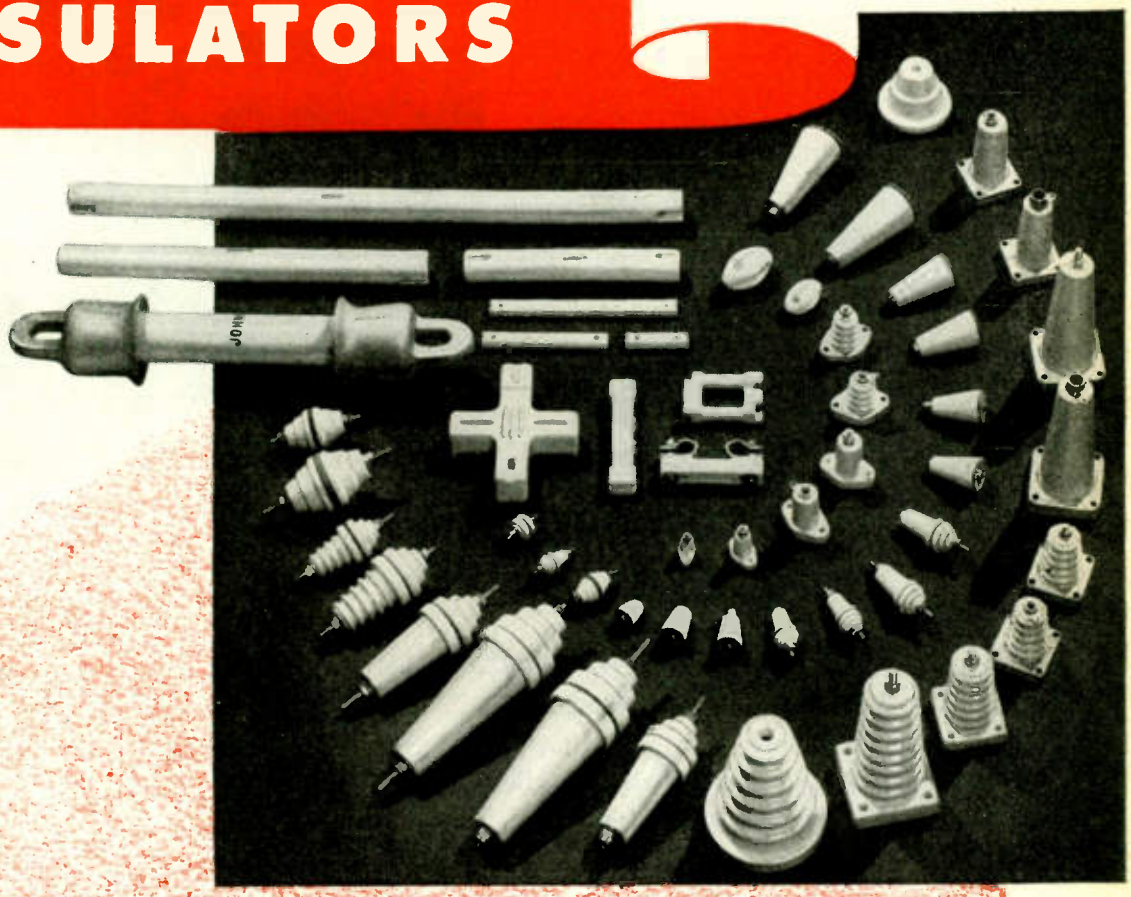
The reason for the reliability of operation of Klixon Controls lies in the simple Spencer thermostatic disc. This foolproof actuating element snaps to a quick, clean "break" or solid "make". Its accurate operation is unaffected by shock, motion, vibration or altitude . . . no matter how often the disc operates.

Klixon Controls are small, compact and light in weight. They are available in many standard types and ratings to meet practically every control or protection requirement such as motor or transformer overheat protection, electrical circuit overload protection, thermal time delays or temperature control for radio equipment. Write for complete information today.

KLIXON

SPENCER THERMOSTAT CO., ATTLEBORO, MASS.

ENGINEERED INSULATORS



Johnson Radio Engineers have been specialists in insulator design for radio frequencies for almost a quarter of a century. Shapes to provide strength for strains and stresses — reinforced mounting holes and carefully designed mountings — high internal resistance to radio frequency voltage — long leakage path — careful treatment to present a surface that will not collect dirt and foreign matter — quality hardware, not punched nuts and poorly formed parts — materials selected for their radio frequency characteristics, not the ordinary variety of ceramics. To Johnson Engineers an insulator is a piece of radio apparatus and given the same careful attention in design and production. As a result you can't buy a better insulator than Johnson. Your radio-electronics parts jobber stocks Johnson insulators.

Ask for catalog **968-O**

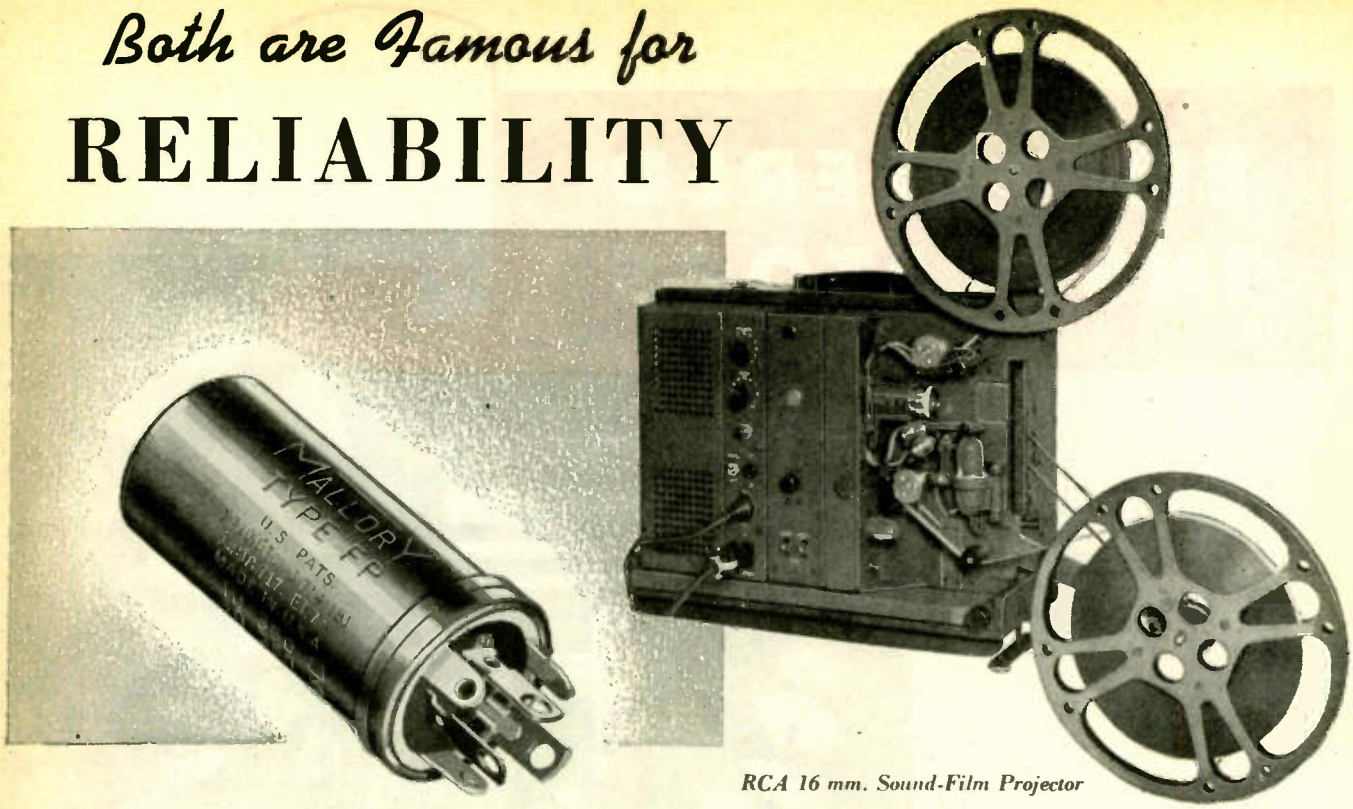
JOHNSON

a famous name in Radio

E. F. JOHNSON COMPANY • WASECA • MINNESOTA

Both are Famous for

RELIABILITY



RCA 16 mm. Sound-Film Projector

MALLORY "FP" or RCA "Projector"—each in its field is the accepted standard. No wonder that the famous capacitor is a factory-installed part of the famous projector. Reliability of performance distinguishes *both*.

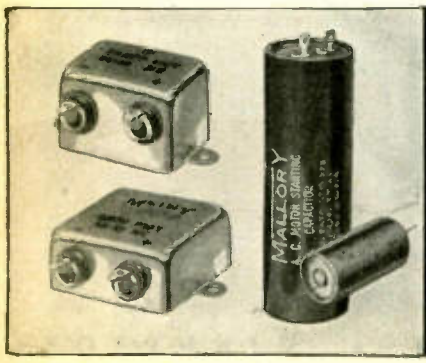
Workmanship on Mallory "FP's" is the finest in the industry. Quality is consistently uniform. Operating life is so long that, in the case of the RCA Projector, five, six or even more years of service are typical.

Moreover, Mallory "FP's" are the smallest capacitors known for a given rating. They are low in cost, save chassis space, make designing easier. Their "twisted ear" feature makes extra hardware unnecessary.

The fact is that no other capacitors today are so ideally suited for top-chassis mounting. Standard equipment in hundreds of products, they offer everything you need for *your* product too. Write for full information—or see your Mallory Distributor.

Complete information on Mallory capacitors. Pictures, drawings, electrical characteristics. Write for it today.

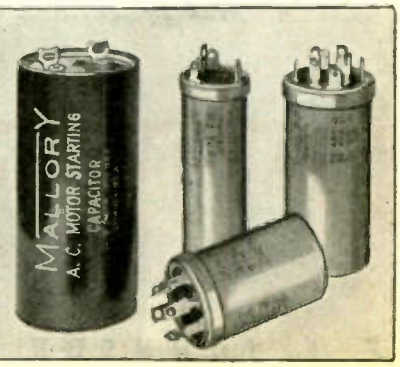
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



P.R. MALLORY & CO. Inc.

MALLORY

Electrolytic, Film and Paper CAPACITORS



LUMARITH* "walls out"

THE BLACK HAND OF CORROSION

•ELECTRICAL COILS, from the smallest size to the largest, can be effectively protected against electro-chemical corrosion by the use of Lumarith CA (cellulose acetate) insulation. The advantages of this synthetic material in the electrical field are outstanding. Lumarith is resistant to organic decomposition even in the presence of moisture, one of the inherent hazards of many insulation materials.

Lumarith CA films and foils have high dielectric strength (2800-3300 volts/mil.) and high softening point. Films and foils are furnished plain or with a special mat finish that aids visibility and prevents slippage. Lumarith is also available in sheets, rods, tubes and molding materials. We will be glad to send you the new reference booklet, "Celanese Synthetics for the Electrical Industry." Write Celanese Plastics Corporation, a division of Celanese Corporation of America, 180 Madison Ave., New York 16, N.Y.

A Celanese® Plastic

®Reg. U. S. Pat. Off.

The POWER behind

TRANSMITTER-RECEIVER OF THE SCR-694

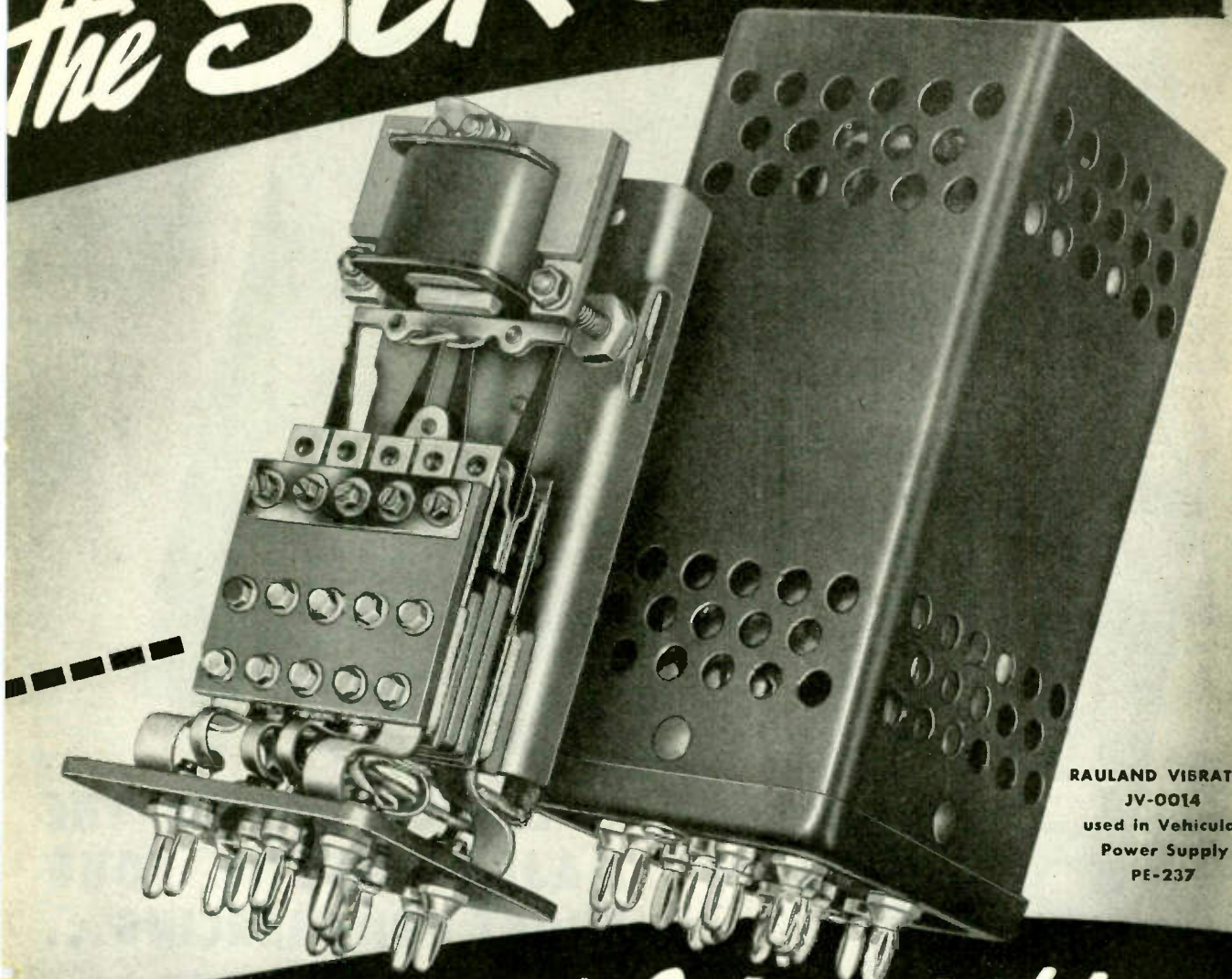
Working with the Signal Corps in the creation of the now famous SCR-694, RAULAND Engineers had to solve many a knotty problem. None, however, proved as tough as producing the heart of the Vehicular Power Supply . . . the *Vibrator.* That power supply had to operate from a vehicular battery at 5.4 to 8 volts, 10.8 to 16 volts or 21.6 to 32 volts while maintaining filament voltage within the limits of ±5% from nominal value. In addition it had to be fully immersion proof! The full story of how they licked a job that "couldn't be done" packs as dramatic a punch as anything in this man's war, but RAULAND *Engineers did it!* They designed and built the *highest frequency heavy-duty vibrator ever made* . . . to operate on *200 cycles ±1%.*

The development of the PE-237 Vehicular Power Supply Unit, and especially the Rauland Vibrator JV-0014, is a typical example of RAULAND engineering thoroughness . . . the kind of electronic planning and craftsmanship that will be available for full cooperation with industry after this war.

VIBRATOR POWER SUPPLY FOR THE SCR-694

RADIO • • RADAR • • COMMUNICATIONS •

the SCR-694...



RAULAND VIBRATOR
JV-0014
used in Vehicular
Power Supply
PE-237

...the "HEART" that made it tick!

RAULAND VIBRATOR

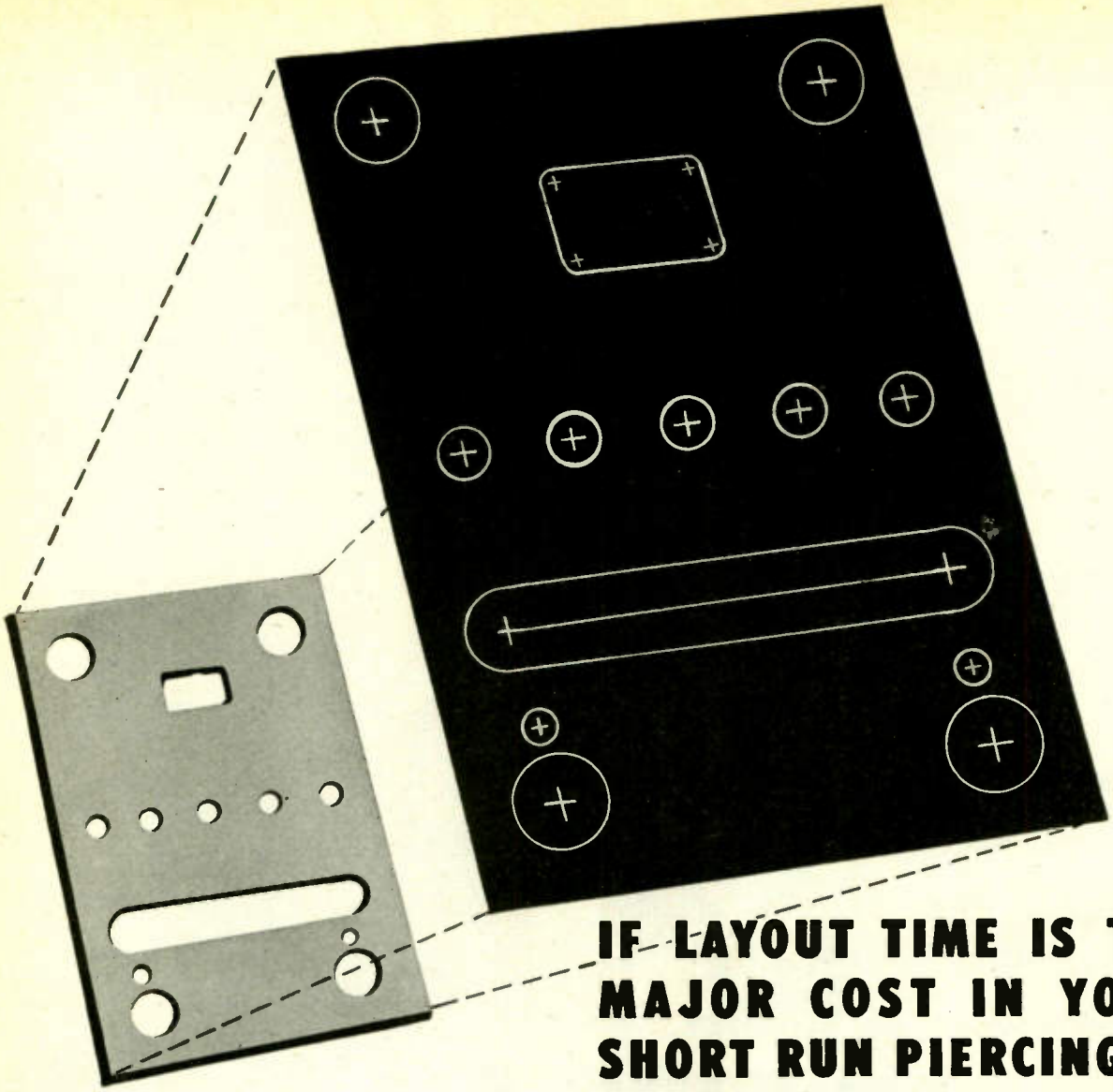
A POWER VIBRATOR IN WHICH ARE COMBINED THESE DESIRABLE FEATURES:

- **HIGH CURRENT CAPACITY** — *35 amperes continuous duty*
- **MULTIPLE VOLTAGE**—*6, 12, or 24 volt input to same vibrator*
- **HIGH FREQUENCY** — *200 cycles*
- **WIDE TEMPERATURE RANGE** — *minus 40 to plus 70° C*
- **MULTIPLE CONTACT** — *20 power contacts*
- **MAXIMUM UNIFORMITY OF LOAD DIVISION** — *each contact brought out to a separate base pin*
- **MINIMUM TRANSMISSION OF VIBRATION** — *heavy wall extruded case*

Electroneering is our business

• SOUND **Rauland** TELEVISION

THE RAULAND CORPORATION • CHICAGO 41, ILLINOIS



IF LAYOUT TIME IS THE MAJOR COST IN YOUR SHORT RUN PIERCING...

. . . talk to the man who has a WIEDEMANN

PIN TYPE GAUGE

The Pin Type gauge consists of a back gauge bar operating in and out parallel to the punch and die in the working position and controlled by a handwheel conveniently located for the operator. A series of holes are drilled in the gauge bar on ⅛" centers . . . four rows across and each spaced ⅛" beyond the preceding hole. By dropping pins of various diameters into these holes, any dimension down to increments of 1/32" can be obtained. The standard length for the Pin Type Gauge is 30" but the gauge can be supplied in lengths of 48"

RACK TYPE GAUGE

An accurate rapid gauging arrangement for longer runs from 25 to 1000 pieces of a kind. The handwheel and dial control the in and out movement of the rear gauge bar, which moves parallel to the punch and die by means of two lead screws on either side of the press. Cross dimension is obtained by two ⅛" circular pitch racks mounted face to face and extending to the right or left of the machine, whichever is more desirable to the user. Stops are provided to drop into the racks. By rotating the entire stop 180 degrees, dimensional increments of 1/16" and ⅛" are obtained. Other stops provide for 1/32" increments.

A Wiedemann Turret Punch Press completely eliminates or greatly reduces layout time. For example: on a Wiedemann equipped with a gauge table, all layout readings are taken from the blueprint or chart and then immediately positioned on the gauge table where the work is pierced.

Get the facts . . . the complete story of short run piercing economy. See for yourself how a Wiedemann Turret Punch Press can save you up to 2000% in labor alone. Then if you want to see a Wiedemann in operation, write us and we'll tell you of a shop near you that's using a Wiedemann for short run piercing.

WIEDEMANN MACHINE COMPANY

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ERIE CERAMICONS*

Leaders in the WORLD of COMMUNICATIONS

as General Purpose Condensers

*Ceramicon is the registered trade name of silvered ceramic condensers made by Erie Resistor Corporation.

CHOICE OF TEN STANDARD TEMPERATURE COEFFICIENTS

CHARACTERISTICS

CAPACITY RANGE IN MMF	JAN-C-20 STYLE	ERIE STYLE	MAXIMUM OVERALL DIMENSIONS
1 to 51	CC20 CC21	A K	.200 x .400 .250 x .562
52 to 110	CC25 CC26	B L	.200 x .656 .250 x .812
111 to 360	CC35 CC36	C M	.265 x 1.125 .340 x 1.328
361 to 510	CC40	D	.375 x 1.110
511 to 820	CC45	E	.375 x 1.560
821 to 1100	CC45	F	.375 x 2.00

THE superior stability and performance of Erie Ceramicons have steadily increased the popularity of these silvered ceramic condensers since their introduction, now almost ten years ago. Today, they are literally leaders in the world of communications.

Strenuous war conditions have emphasized the necessity for equipment of unfailing reliability, and Erie Resistor has been called upon to furnish millions of Ceramicons, particularly as general purpose condensers, where a moderate degree of capacity change with temperature is permissible.

The superiority of Erie Ceramicons as general purpose condensers for home receivers and civilian communications equipment, has been proved in numerous applications. They are ideal coupling condensers, as in plate-to-grid installations, where high insulation resistance is imperative.

Ceramicons may be selected from any one of 10 standard temperature coefficients, ranging from P120 to N750.

The capacity range for equivalent physical size is given in table above. We will gladly send you samples of Erie Ceramicons for your general purpose applications.

Electronics Division

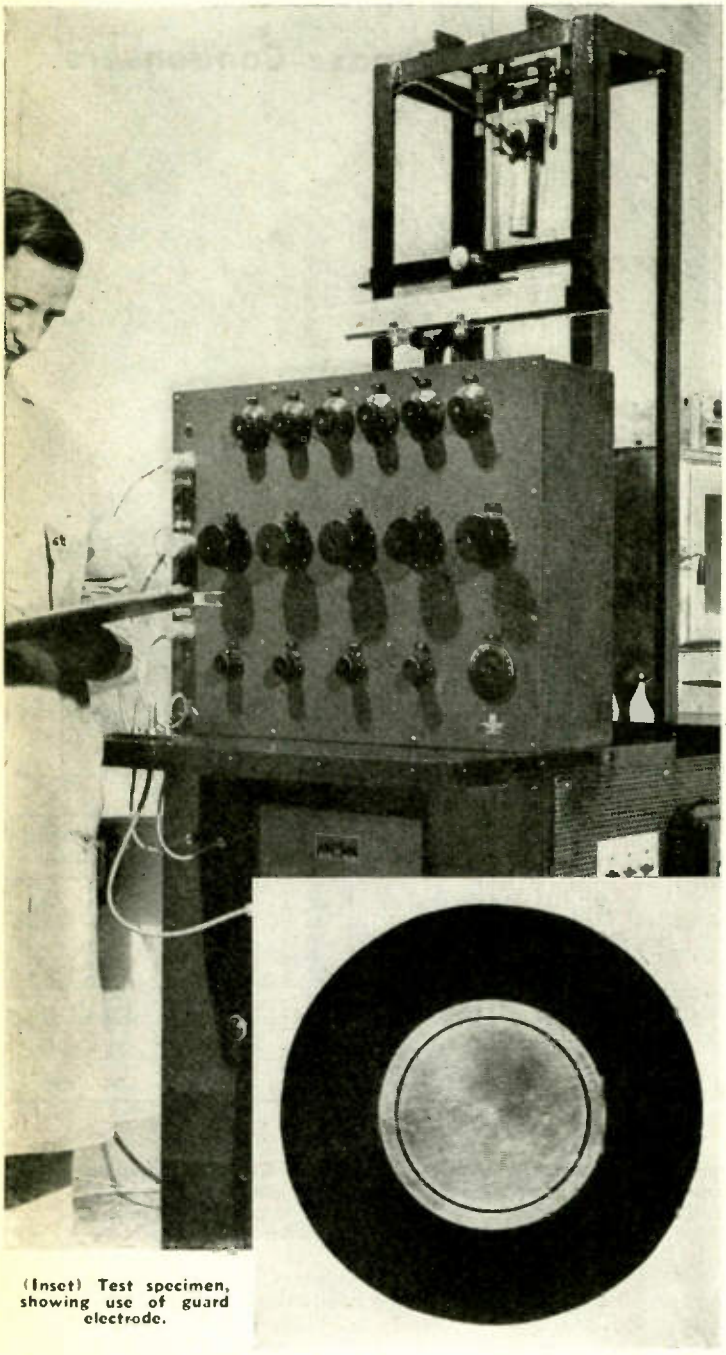
ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

FOR HIGH ACHIEVEMENT IN WAR PRODUCTION

BUY MORE WAR BONDS

SERVICE!



(Inset) Test specimen, showing use of guard electrode.

DOLPH Research and Testing Facilities Include Equipment to Determine Power Factor and Dielectric Constant of Insulating Varnish.

Data on dielectric constant and power factor of insulating varnish and insulating materials has long been of importance in the electrical field. Realizing this, the JOHN C. DOLPH COMPANY installed a Leeds and Northrup high voltage modified Schering Bridge. This measuring equipment is noted for its high degree of precision and is designed primarily for use on frequency of sixty cycles. The power factor of the specimen is read directly at this frequency on most materials. Operation can be effected up to a maximum voltage of 10 K.V.

Determination of dielectric constant and power factor is obtained while the specimen is under a voltage stress, thereby simulating actual operating conditions. This data is obtained with the highest possible degree of accuracy by the use of guard electrodes. (See Illustration.)

TWO PURPOSES SERVED

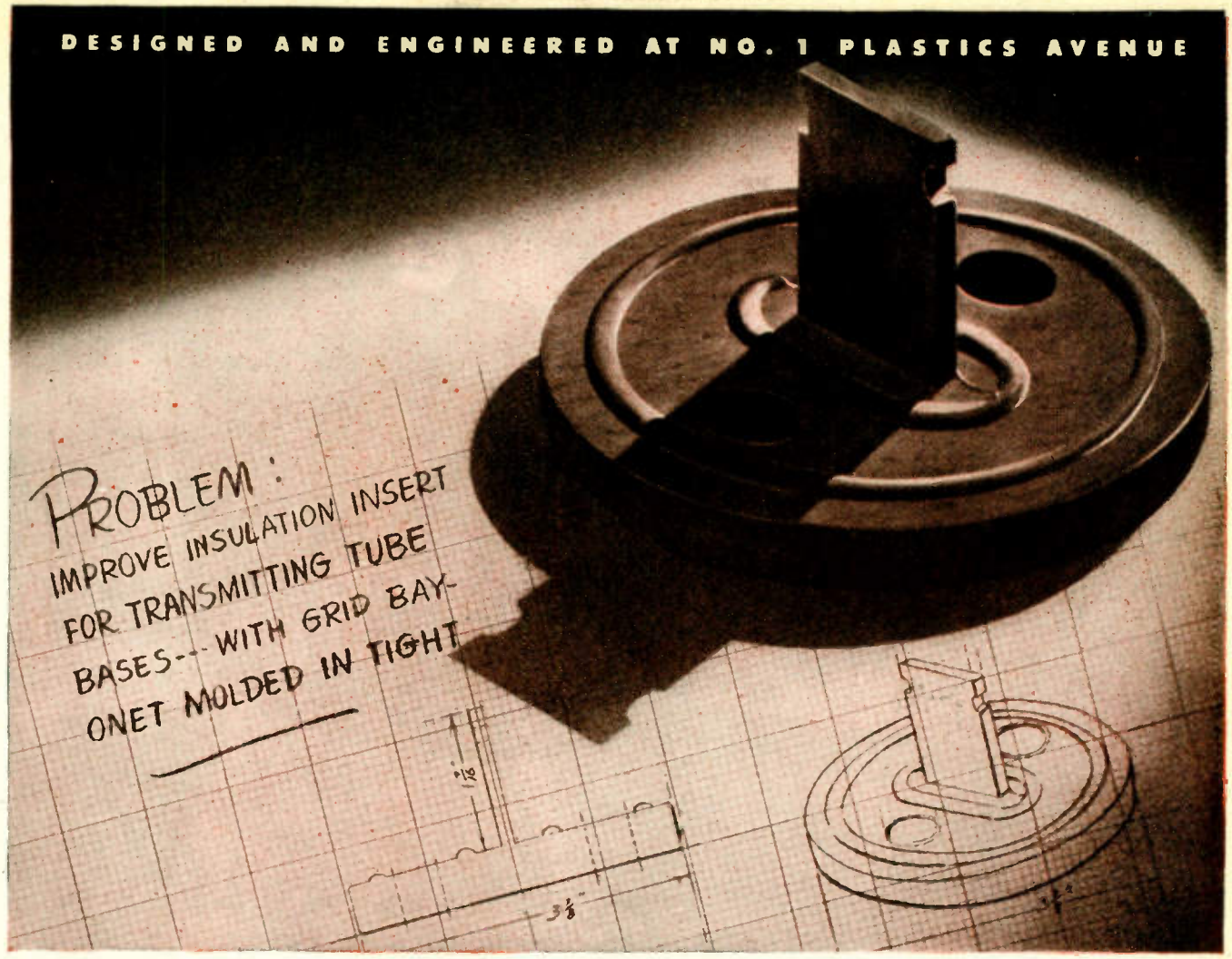
Production Check Any variations in quality due to improper processing of the varnish or variations in the raw materials used in formulations, can usually be detected through dielectric measurements.

Further Research Today, electrical manufacturers are seeking pertinent information on the electrical characteristics of insulating varnish films. We, of the JOHN C. DOLPH COMPANY, are now in a position to handle requests of this nature and we make this service available to you without any obligation on your part. Send us your inquiries and we will be glad to furnish you with the desired information.

Insulating **Dolph's** *Varnish Specialists*

JOHN C. DOLPH COMPANY

168 EMMETT STREET • NEWARK 5, N. J.



G-E MYCALEX—BASIC FOR HIGH FREQUENCY INSULATION

● This is an insulation insert for bases of high frequency radio transmitting tubes.

It is molded by G.E.'s complete plastics service from G-E mycalex . . . compound of glass and powdered mica with a unique combination of properties.

G-E mycalex was specified for its excellent mechanical strength, high frequency insulation characteristics, and because the grid bayonet could be molded in tight.

To improve *your* electrical components, thoroughly investigate the possibility of utilizing G-E mycalex.

G-E mycalex . . . in standard sheets and rods or molded to your design . . . is available to all manufacturers. For information, write to Section T-91, Plastics Division, General Electric Co., 1 Plastics Avenue, Pittsfield, Mass.

G-E MYCALEX

A Unique Combination of Properties

1. High dielectric strength
2. Low power factor
3. Prolonged resistance to electrical arcs
4. Chemical stability—no deterioration with age
5. Dimensional stability—freedom from warpage and shrinkage
6. Imperviousness to water, oil, and gas
7. Resistance to sudden temperature changes
8. Low coefficient of thermal expansion
9. High heat resistance

Samples Supplied on Request

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

GE MYCALEX

GENERAL ELECTRIC

CD45-M1

BUY WAR BONDS


For once, we were
More than 1000 tubes like the one above, duplicates of an unknown German tube, were produced by Bell Labs and Western Electric in 17 days. They helped put an important enemy communications system back to work for our Army.

copy-cats!

. . . by special request

Somewhere on the Western front, the retreating Germans left behind their strategic telephone communications system — all intact — *except that every vacuum tube had been removed from the repeaters.*

The Signal Corps went to work speedily to restore this valuable system for our own use. An engineer who had worked under the Germans supplied some general notes on the system and its operation. One tube believed to be of the missing type was found. Notes and tube were rushed to the U. S. by air.

At Bell Labs, tests and X-rays revealed the tube's inner construction and electrical characteristics and proved that no similar tube was available in this country. The German tube differed also in dimensions of the bulb and base and in the arrangement of the pins. Hurried consultations and calculations indicated that a suitable tube could be built from existing parts of American tubes — except for a grid and the base.

At Western Electric, the tube shop went to work — modified machines to wind the grid, and in three days produced eight tubes with hand-made bases, which were flown to Europe for trial in the system. Meanwhile, production went ahead at top speed and just 17 days after the lone German tube was received at Bell Labs, 1,015 duplicates of it had been completed. Result: the Signal Corps soon had the German telephone system in operation again.

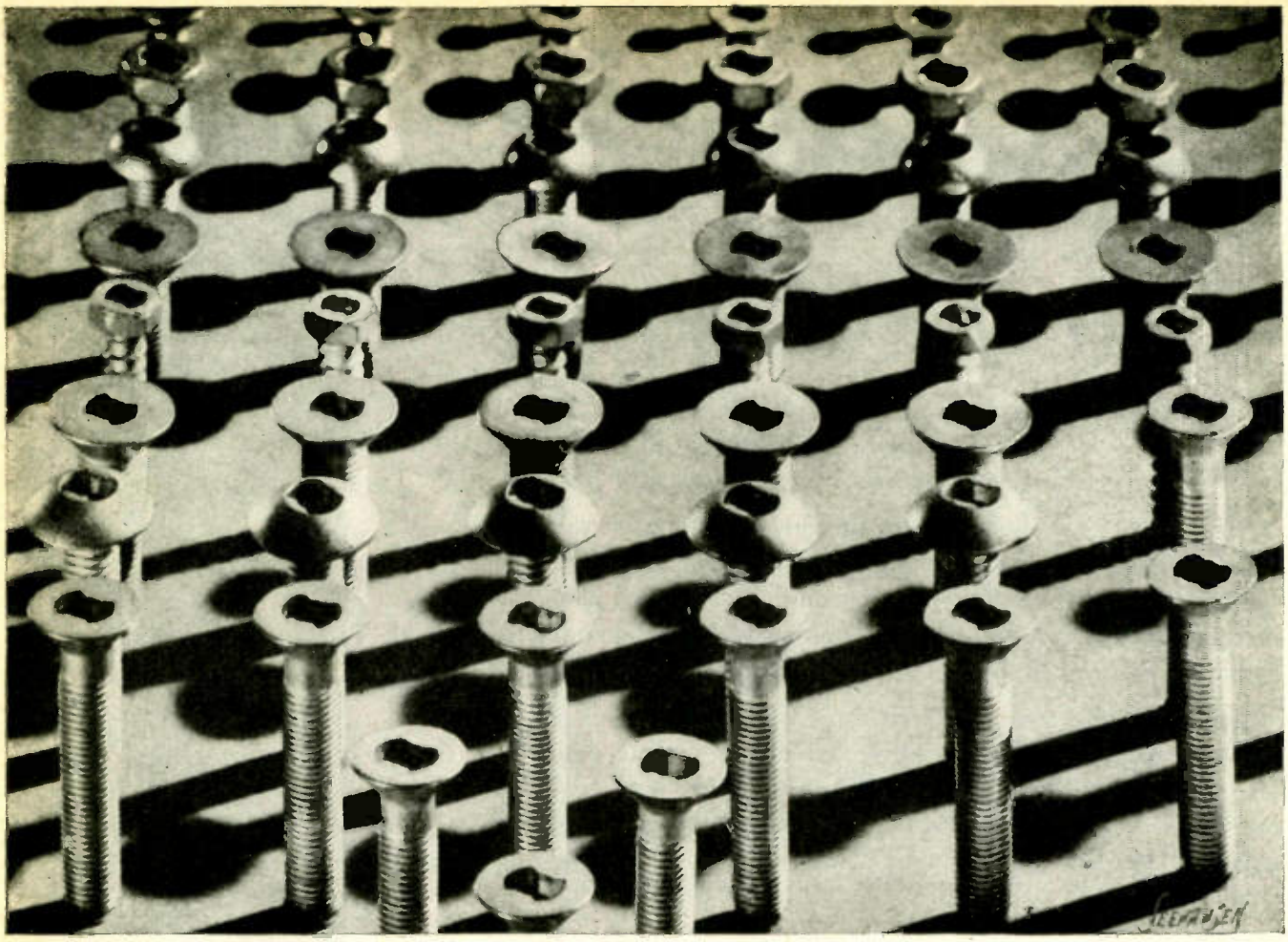
Bell Labs and Western ordinarily wouldn't be happy about copying *anybody's* products. We developed the first repeater tubes — which later led to trans-Atlantic telephony and radio broadcasting. It has long been our tradition to create our own superior designs. Working together, Bell Labs and Western have solved many of the war's toughest electronic problems. After the war, count on this team for continued leadership in communications equipment.

BELL TELEPHONE LABORATORIES

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

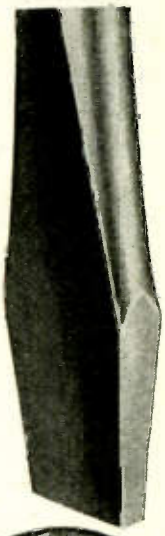
Western Electric

Manufacturing team-mate of Bell Labs, and the country's largest producer of communications and electronic equipment for war.



TYPE "A" ASSEMBLY BIT

COMMON SCREWDRIVER



Why Your Assembly Parade

MOVES FASTER, SAFER, SMOOTHER

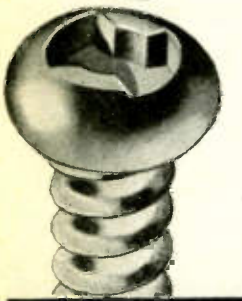
With Clutch Head Screws

AN EASY-TO-HIT BULLS-EYE TARGET
DRIVER ENTRY IS ON DEAD-CENTER
STRAIGHT DRIVING IS AUTOMATIC
NO DRIVER CANTING FOR SLIPPAGE
NO "BREAK-IN" OF GREEN OPERATORS
SMOOTHS OUT SLOW-DOWN HESITATION
NO CHEWED-UP HEADS TO STOP OR SLOW DOWN THE LINE

DRIVING IS NON-TAPERED
ENGAGEMENT IS ALL-SQUARE
NO RIDE-OUT TO COMBAT AND NO END PRESSURE
EASY, SMOOTH DRIVING
NO FATIGUE FACTOR
PROTECTS MANPOWER AGAINST INJURY
PROTECTS MATERIAL AGAINST DAMAGE

SIMPLE BIT RECONDITIONING IN 60 SECONDS
DRIVE EXTRA THOUSANDS OF SCREWS PER BIT
THERE IS NO BACK-TO-THE-FACTORY SHIPMENT
SETTING A NEW STANDARD OF TOOL ECONOMY
CLUTCH HEAD LOCK-ON SOLVES MANY PROBLEMS
ONE-HANDED REACHING BREAKS "BOTTLENECKS"

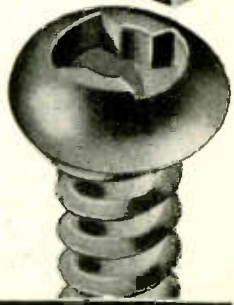
TYPE "A" HAND DRIVER FOR FIELD SERVICE TOO
REMOVES SCREWS UNDAMAGED AND SAVED FOR RE-USE



THE ONLY MODERN SCREW BASICALLY DESIGNED

CLUTCH HEAD - SCREWS -

TO OPERATE WITH AN ORDINARY TYPE SCREWDRIVER



SAMPLE BIT AND SCREWS SENT ON REQUEST

UNITED SCREW AND BOLT CORPORATION

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You'll find WHITAKER is a dependable source for Cables, Wiring Harnesses and Assemblies

Speed up your production, avoid unnecessary grief, and enjoy a lower cost of manufacturing by letting Whitaker supply your wiring assemblies, flexible leads and other cable products.

As specialists having a lot of experience and ample production facilities we are well prepared to supply engineered wiring service. Every step of our work is rigidly tested and checked. (Illustration above shows inspection for color code and length of break-out on a harness being produced for a radio manufacturer). In this instance, or in your case, the delivered harness will be right for electrical continuity, for quality of workmanship, and ease of assembly.

Whitaker Can Wire It

In addition to an engineered wiring service, Whitaker also offers a quality line of standard cable products.

●

WRITE FOR DETAILS.

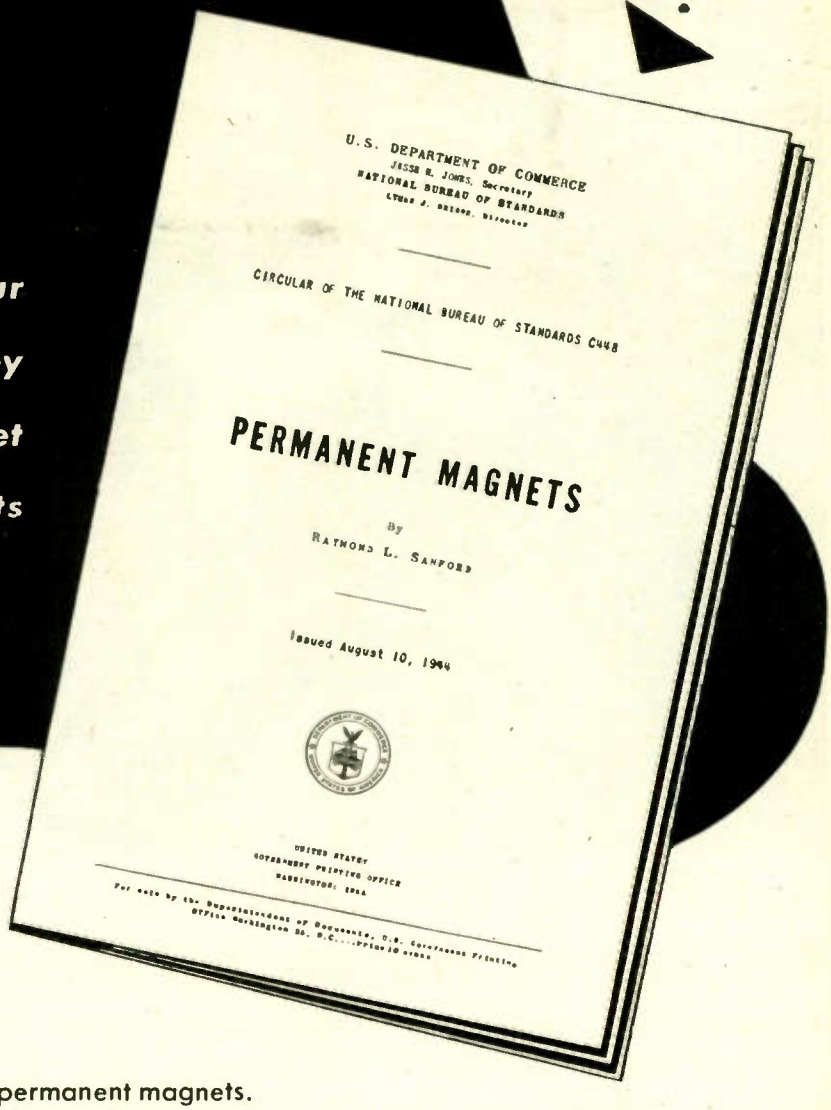
WHITAKER CABLE CORPORATION

General Offices: 1311 Burlington Avenue, Kansas City 16, Missouri
Factories: Kansas City, Mo. • St. Joseph, Mo. • Philadelphia • Oakland

1920--Silver Anniversary--1945

YOURS!

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


U.S. DEPARTMENT OF COMMERCE
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NATIONAL BUREAU OF STANDARDS
LYMAN J. BRIGGS, Director

CIRCULAR OF THE NATIONAL BUREAU OF STANDARDS C448

PERMANENT MAGNETS

By
RAYMOND L. SANFORD

Issued August 10, 1944

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON: 1944

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

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

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

THE ARNOLD ENGINEERING COMPANY

147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS

Specialists in the Manufacture of ALNICO PERMANENT MAGNETS

But we can tell you about ALUMINUM...

Words cannot express our great admiration for the amazing accomplishments and the future possibilities of electronics. Electronics leaves us breathless.

So, we're content to leave the designing of electronic equipment in the capable hands of those who know how.

But when it comes to using aluminum in electronic equipment, that is where we may be of real service. Alcoa Engineers have a wealth of data and years of experience in using aluminum successfully and economically in other industries.

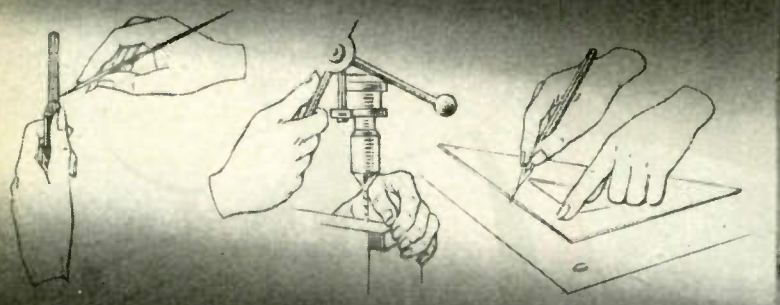
Whether it's a problem of light weight, strength, corrosion resistance or a question of the most economical method of fabricating parts, let us give you the benefit of our experience.

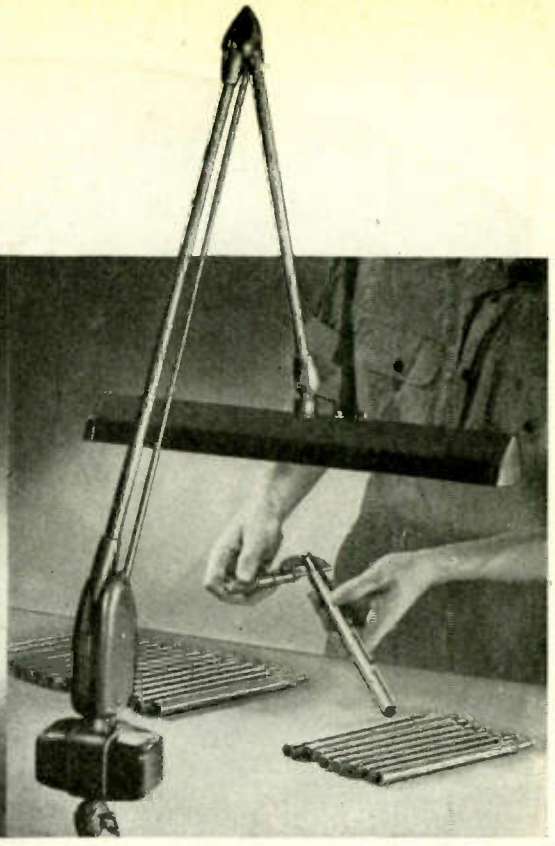
ALUMINUM COMPANY OF AMERICA, 1921 Gulf Building, Pittsburgh 19, Pa.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

UNERRING hands





need this *Floating* lamp

Precision engineering and manufacture call for unerring hands. But hands, unfortunately, can do well only what the eyes see clearly.

Aided by the *flexible,* intense *localized* lighting provided by Dazor *Floating* Lamps—instantly adaptable to the needs of each worker, each job—your employees will see the fine details of work easily, comfortably, accurately. Their hands will work faster with fewer mistakes and minimum fatigue.

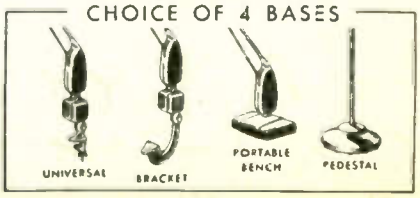
And a touch of the hand does it—*floats* the Dazor Lamp to any desired position, where, without adjustment or locking, it *stays put* until moved to a new position. This exclusive feature results from a patented enclosed balancing mechanism.

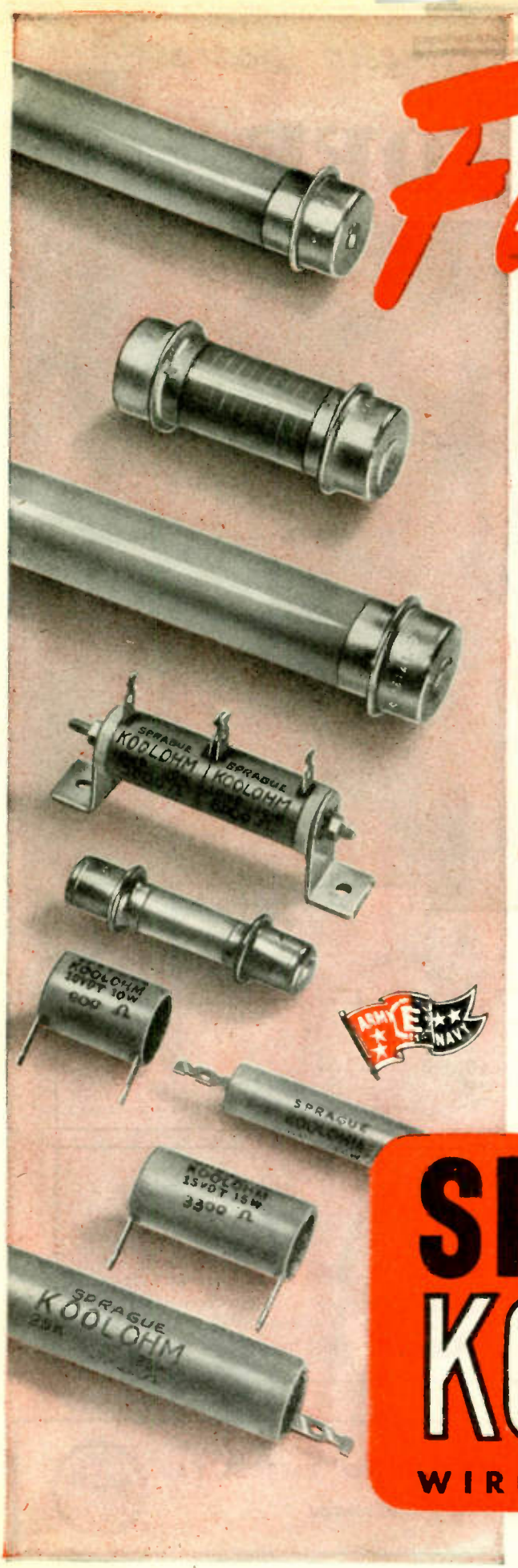
Near you is a Dazor-appointed distributor who is qualified to give sound, practical advice and application assistance. Phone him for detailed information and a demonstration of the Dazor *Floating* Lamp under actual working conditions. His name, if unknown to you, can be secured by writing to the Dazor Manufacturing Co., 4483 Duncan Ave., St. Louis 10, Mo. *In Canada* address all inquiries to the Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

PHONE THE DAZOR-APPOINTED DISTRIBUTOR NEAR YOU *TODAY*

DAZOR *Floating* LAMPS

FLUORESCENT and INCANDESCENT





First with GRADE 1, CLASS 1 RESISTORS

(First produced Dec. 1941—Millions made to date)

First with RESISTORS WOUND with CERAMIC INSULATED WIRE
(Pioneered and perfected by Sprague many years ago)

First with GLASS-TO-METAL SEALED RESISTORS (Pioneered by Sprague in 1941, now produced commercially at the rate of thousands of seals per day)

First with GLAZED CERAMIC SHELLS and New Style End Seals for 5-, 10-, 25-, 50- and 120-watt resistors. (One type of Koolohm—the *standard* type—does the job under any climatic condition, anywhere in the world)

First and STILL EXCLUSIVE with MEGOMAX
(The high-resistance, high-voltage resistors. Megohms of resistance operated at thousands of volts!)

One after another, Sprague Koolohm Resistors have established new performance records as proved indisputably by the record. One after another Koolohm Resistors have revolutionized traditional limitations to wire wound resistor usage—because radically different Koolohm construction permits a higher degree of physical protection, better electrical characteristics, smaller sizes, and easier mounting arrangements than are possible with conventional resistor types. Write for catalog.

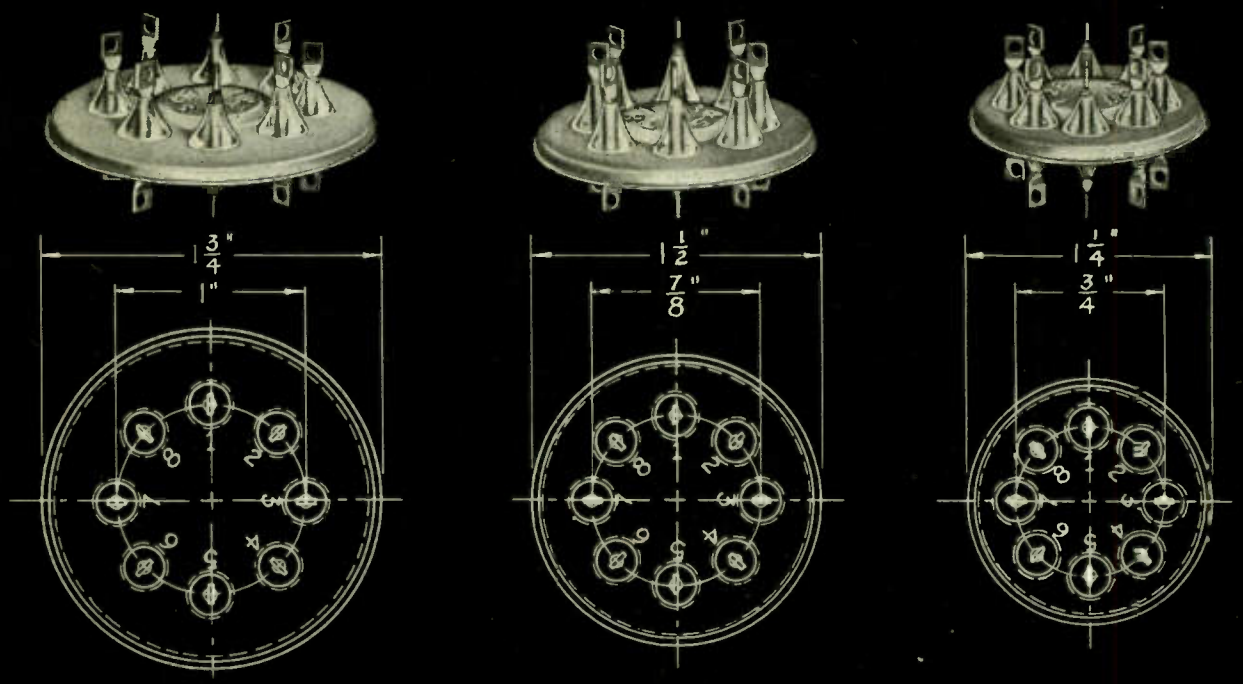
SPRAGUE KOOLOHM

(Trademark Reg. U. S. Patent Office)

WIRE WOUND RESISTORS

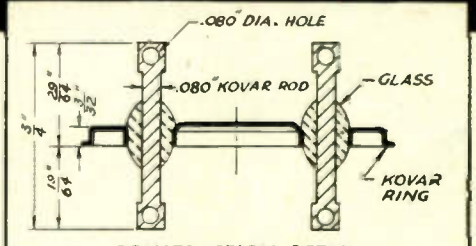
SPRAGUE ELECTRIC COMPANY
(Resistor Division) **North Adams, Mass.**

Multi-Terminal Hermetic Seals
BY
STUPAKOFF



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

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



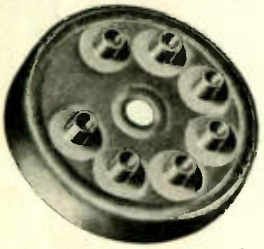
CONSTRUCTION DETAIL
VERTICAL DIMENSIONS SHOWN COMMON TO ALL PARTS

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

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

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

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



ONE PIECE HEADER

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

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

ARMY NAVY "FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

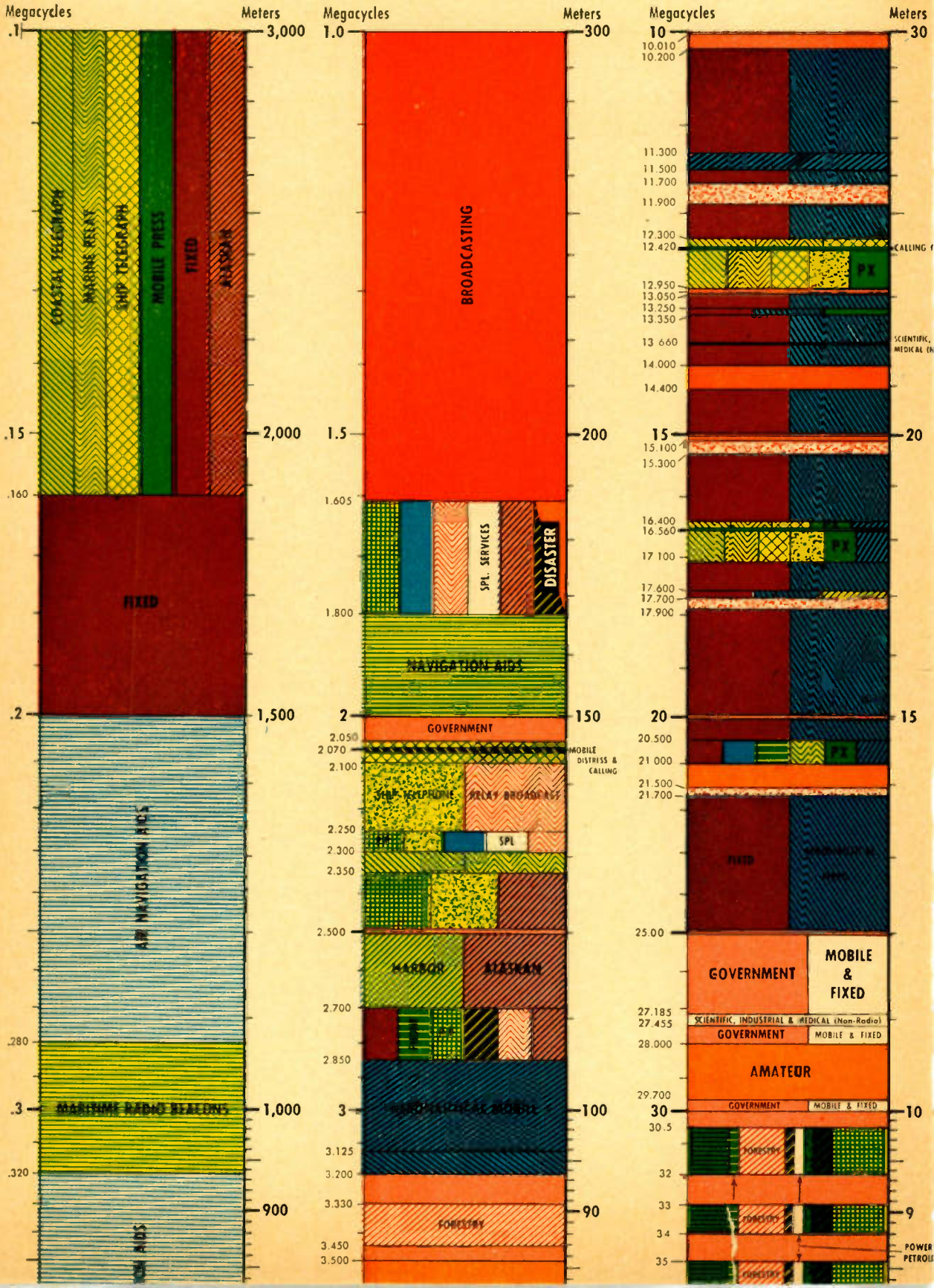
Products for the World of Electronics

RMA RADIO MANUFACTURERS ASSOCIATION MEMBER

THE NEW FCC FRE

As Proposed and Approved by Federal Communications Commission, July 1945. (Note: That portion of the s

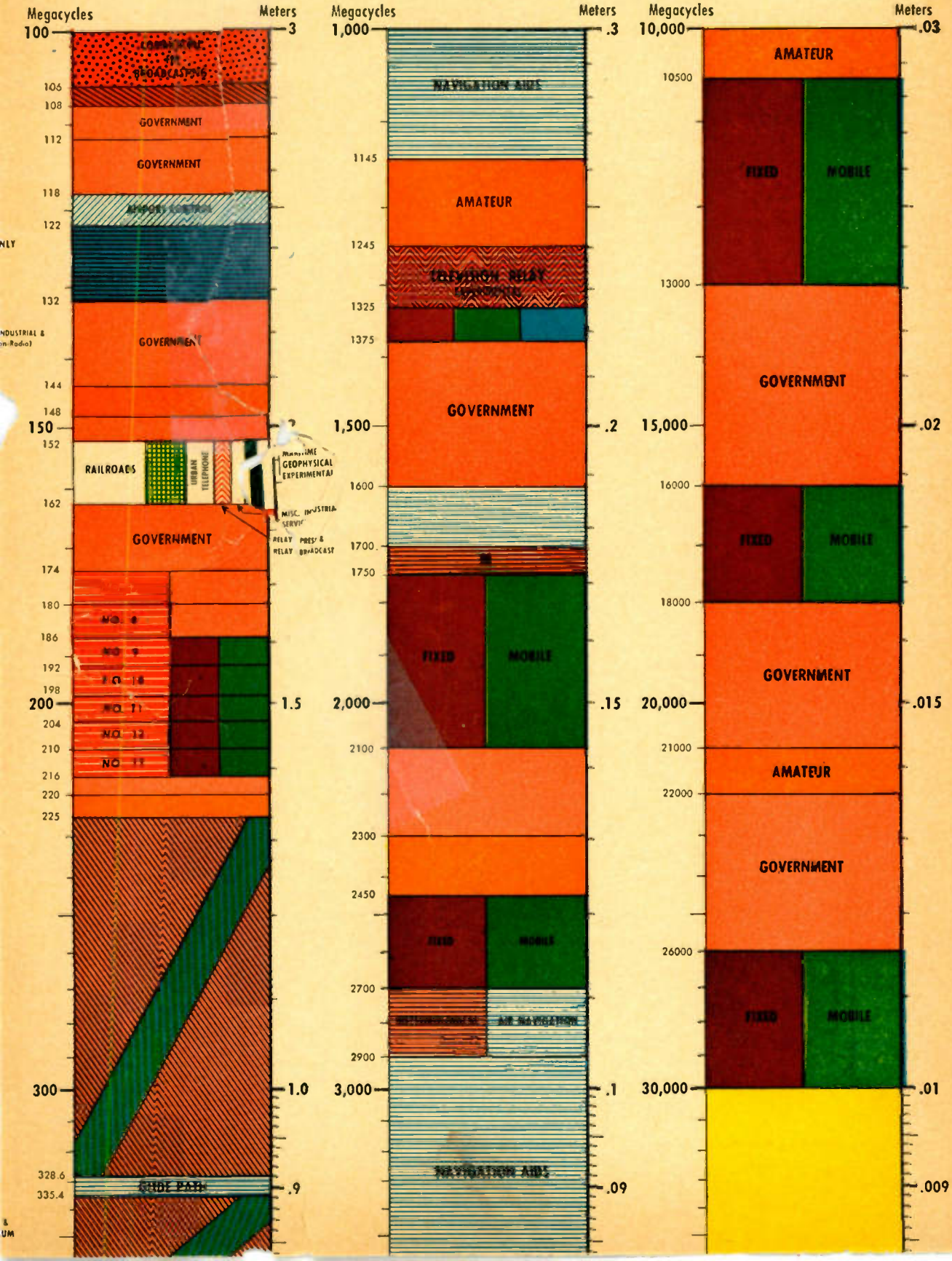
ALL FREQUENCIES ARE SHOWN IN MEGACYCLES — ONE MEGACY

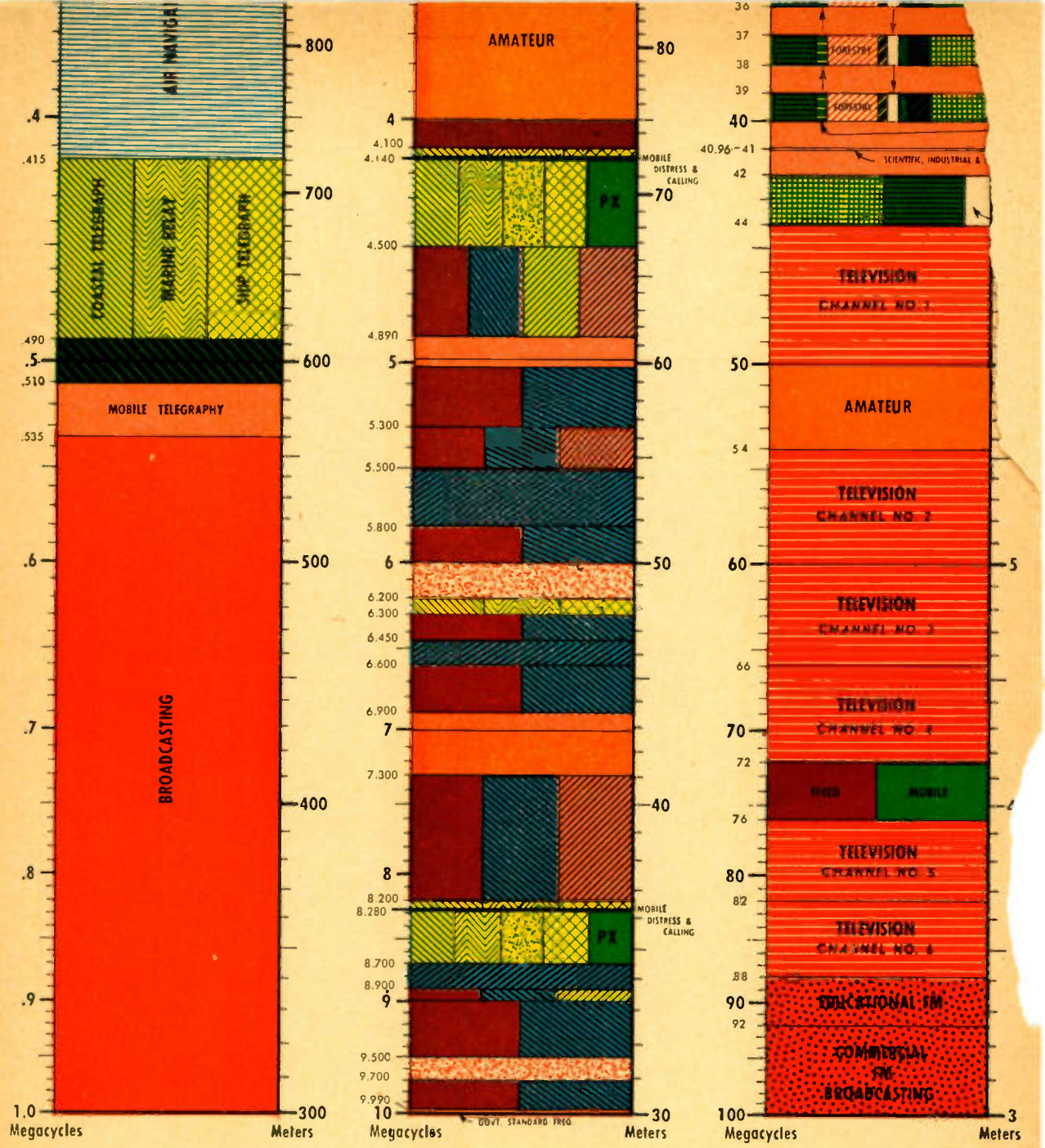


QUENCY ALLOCATIONS

pectrum below 25 mc [25,000 kc] represents FCC's proposal for allocations in this region and is not yet final.)

CLE = 1000 KILOCYCLES — ALL WAVELENGTHS ARE SHOWN IN METERS



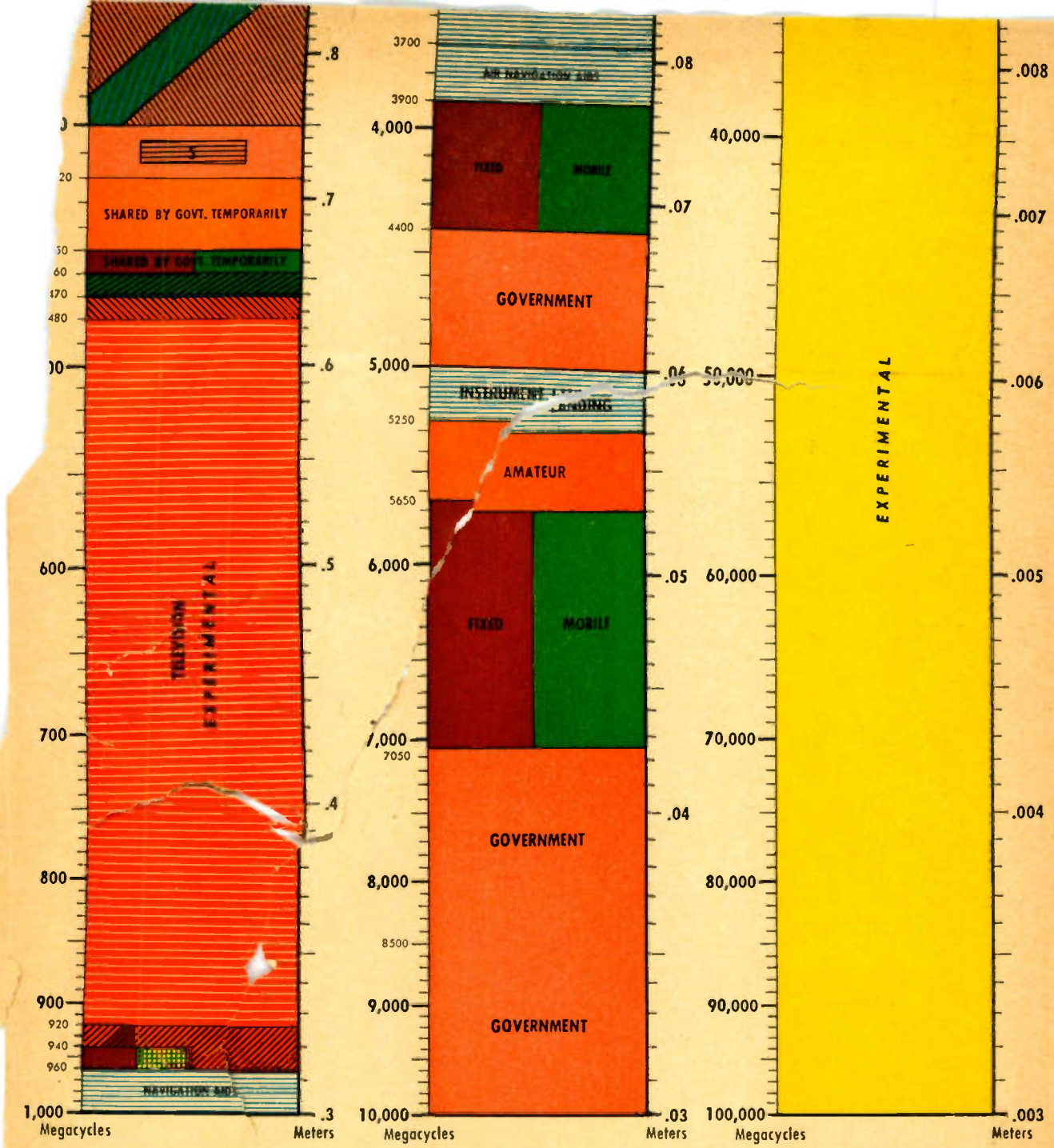


FIXED
MOBILE
COASTAL TELEPHONE MOBILE
MARINE RELAY
SHIP TELEPHONE
SPECIAL EMERGENCY
BROA
DISTRESS & CALLING
FIRE
GENERAL HIGHWAY MOBILE
COASTAL TELEGRAPH MOBILE
NAVIGATION AIDS
CITIZENS RADIO
A
PX
MOBILE PRESS
URBAN TRANSIT
MARITIME MOBILE
SHIP TELEGRAPH
EXPERIMENTAL
AMATEUR
RELAY

Supplement to
ELECTRONIC INDUSTRIES
for August 1945

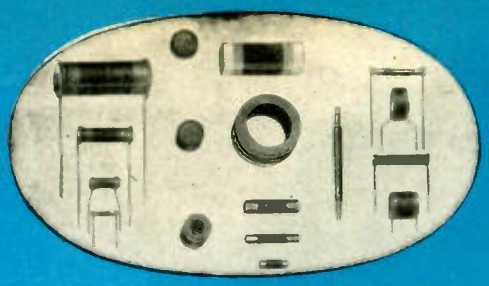
Compiled by the Editors of Electronic I

480 Lexington Av



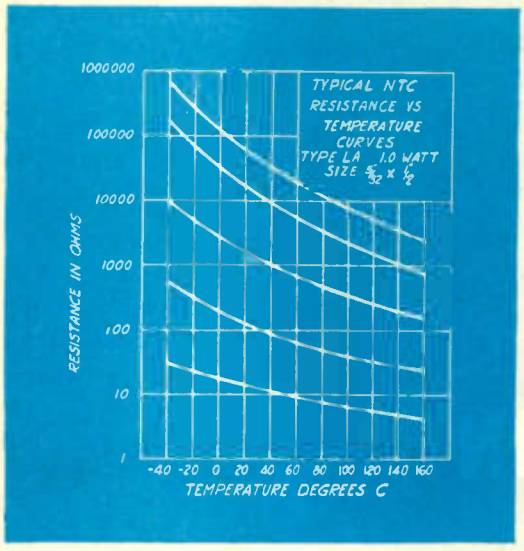
ndustries and Radio & Television Retailing.
LDWELL-CLEMENTS, INC.
New York 17, N. Y.

ELECTRONIC INDUSTRIES



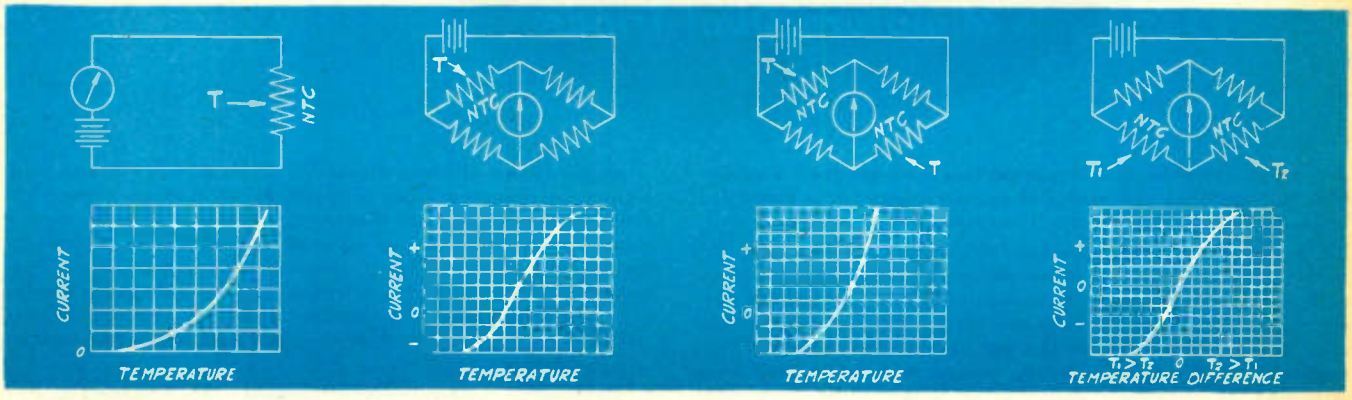
Do you have a

TEMPERATURE MEASUREMENT OR CONTROL PROBLEM?



CHECK THESE ADVANTAGES OF KEYSTONE NTC UNITS FOR YOUR APPLICATION

Keystone NTC units are electrical resistors especially developed to have an unusually high negative temperature coefficient of resistivity. The slopes are much greater than those observed with pure metals or their alloys. The result is an element with very high thermal sensitivity, useful on AC or DC, inherently suitable for remote indication, which has gained wide acceptance for temperature measurement and control purposes. NTC units are made in wide range of shapes, resistance values, temperature coefficients and wattage ratings, of which the characteristics at the left are typical. The circuits below suggest basic means for translating resistance changes into current or voltage variations. Modifications and extensions of these principles are many, especially in conjunction with electronic apparatus.



This simple series circuit of voltage source, instrument and NTC unit has been utilized to indicate engine coolant temperature, etc. It provides sufficient accuracy for many applications despite scale crowding at the bottom.

Basic bridge circuit straightens and steepens the characteristic. Zero-center meter may be used or balance point may be placed near the lowest temperature. Electronic balance indication provides enhanced sensitivity.

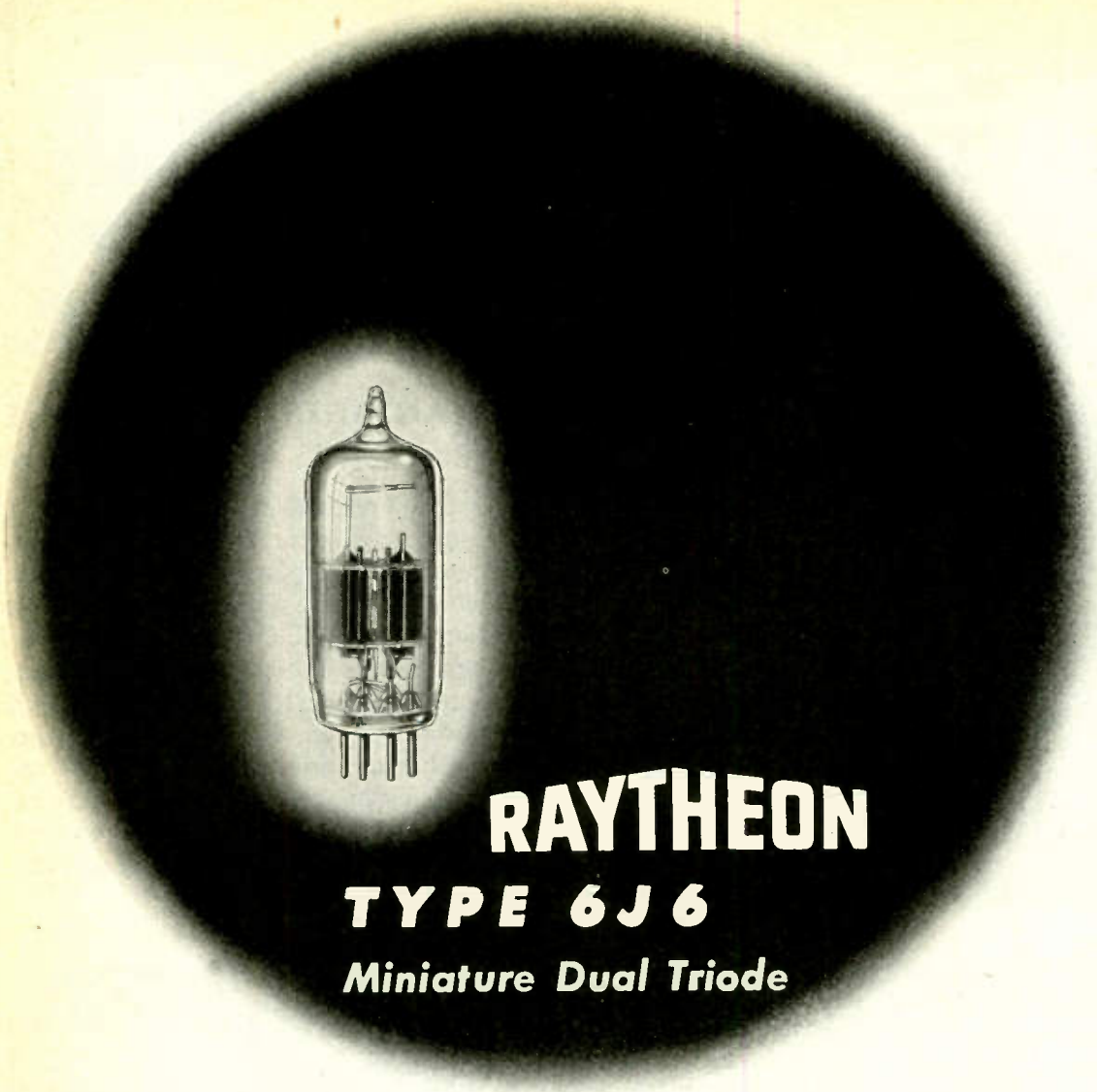
Adding a second NTC unit, and exposing both to the temperature to be indicated, gives a double unbalancing effect and increases sensitivity under certain conditions over part of the temperature range.

Two NTC units in adjacent arms is a method of indicating equality of two temperatures, or temperature difference or rise. Temperature of either source can be obtained by substitution of standard resistance for other NTC unit.

Keystone NTC resistors are also valuable for neutralizing the change in resistance with temperature of electrical indicating instruments and control devices, for introducing time delays and many other applications. Write and tell us about your problem—we'll be glad to analyze it for the applicability of NTC units.

KEYSTONE CARBON COMPANY, INC.

SAINT MARYS . . . . PENNA.



RAYTHEON

TYPE 6J6

Miniature Dual Triode

For a considerable time Raytheon has been assigned a major role in supplying the essential requirements for a versatile, miniature, dual triode tube, type 6J6.

The precise manufacturing techniques which must be maintained are obvious when the physical structure of this tube is considered. Two high transconductance triodes are obtained from a single relatively large flat cathode, which also acts as a shield to prevent interaction between two separate half-grids. These are wound with extremely fine wire and are accurately spaced a few thousandths of an inch on either side of the cathode. Two individual half-plates complete the tube.

Applications utilizing Raytheon Type 6J6 are varied and numerous, ranging from a diode detector to an ultra high frequency push-pull oscillator capable of producing useful energy at frequencies of several hundred megacycles. Its unique construction lends itself to connection as a high permeance diode, a single very high transconductance triode, or a dual triode with a common cathode. The 6J6 is also used in cathode follower service and high frequency mixer applications.

Raytheon's continuing development work and long manufacturing experience means *better* tubes. Use Raytheon High-Fidelity Tubes in *your* postwar products!

SPECIFICATIONS OF 6J6

DIMENSIONS:		
Maximum Over-all Length	2⅛	inches
Maximum Seated Height	1⅞	inches
Maximum Diameter	¾	inches
RATINGS:		
Heater Voltage	6.3	volts
Heater Current	0.45	amperes
Maximum Plate Voltage	300	volts
Maximum Plate Dissipation (per unit)	1.5	watts
DIRECT INTERELECTRODE CAPACITANCES (Approx. for each unit) — Unshielded:		
Grid to Plate	1.6	μμf
Input	2.2	μμf
Output	0.4	μμf
CLASS A_1 CHARACTERISTICS (Each triode):		
Plate Voltage	100	volts
Cathode Bias Resistor — Both units operating	50	ohms
Plate Current	8.5	ma
Transconductance	5300	μmhos
Amplification Factor	38	
Plate Resistance (Approx.)	7100	ohms

Listen to
"MEET YOUR NAVY"
AMERICAN BROADCASTING CO.
Every Monday Night
Coast to Coast
181 Stations

All Four Divisions Have Been Awarded Army-Navy "E" with Stars

RAYTHEON

MANUFACTURING COMPANY
RADIO RECEIVING TUBE DIVISION
NEWTON, MASSACHUSETTS — LOS ANGELES
NEW YORK — CHICAGO — ATLANTA

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

New! L-A-R-G-E-R Size Sheets of

MYKROY

PERFECTED MICA CERAMIC INSULATION

Make Possible Many Additional Uses for this Superior Insulation

Supplied in thicknesses ranging from 1/8"—1¼"

Now You Can Use MYKROY For:

- Large Terminal Boards
- Switch Board Panels
- Large Inductance Bars and Strain Insulators up to 29 inches long
- Switch Connecting Rods
- Transformer Covers
- Large Meter Panels
- Bases for Radio Frequency and Electrical Equipment assemblies requiring large one-piece sheets

HERETOFORE the largest sheet of glass-bonded mica insulation available measured 14½" x 19¼". By doubling the size, Electronic Mechanics, exclusive manufacturers of Mykroy, now afford Design and Production Engineers many important, new application and fabricating advantages.

Lower Cost per square inch affects savings as high as 33% depending upon work piece size, greatly reducing the cost per fabricated part. Better Cutting efficiency lowers cost still further extending the use of Mykroy to a longer list of electronic applications where formerly cost prohibited its use.

Get the full facts about this versatile dielectric now. Ask for a copy of the new MYKROY BULLETIN 102 which describes the new, larger 19¼" x 29¾" sheets.

MECHANICAL PROPERTIES*

MODULUS OF RUPTURE	18000-21000psi
HARDNESS	Mohs Scale 3-4 BHN. BHN 500 K9 Load. 63-74
IMPACT STRENGTH	ASTM Charpy .34-.41 ft. lbs.
COMPRESSION STRENGTH	42000 psi
SPECIFIC GRAVITY	2.75-3.8
THERMAL EXPANSION	.000006 per Degree Fahr.
APPEARANCE	Brownish Grey to Light Tan

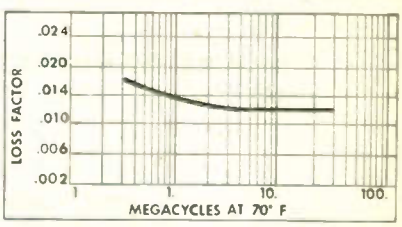
ELECTRICAL PROPERTIES*

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

*THESE VALUES COVER THE VARIOUS GRADES OF MYKROY

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

Special formulas compounded for special requirements.



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

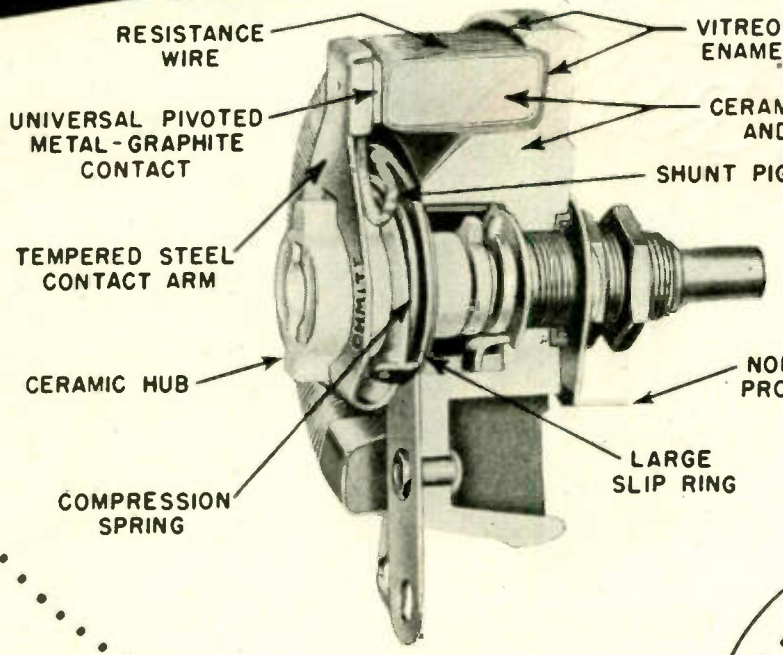
MADE EXCLUSIVELY BY

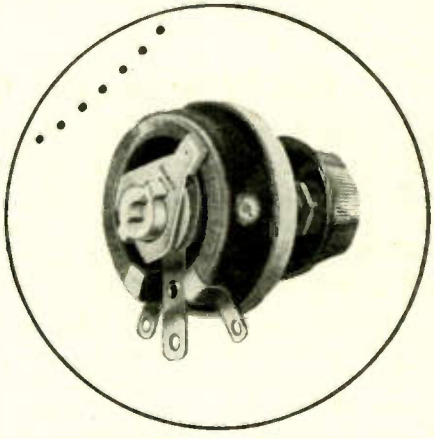
ELECTRONIC MECHANICS INC.

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

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

Why OHMITE Rheostats GIVE SMOOTHER, CLOSER CONTROL





DESIGNED AND BUILT TO WITHSTAND
SHOCK • VIBRATION • HEAT • COLD • HUMIDITY

In critical applications, engineers know they can rely on Ohmite design. Construction is compact . . . all ceramic and metal. The wire is wound on a solid ceramic core, locked in place and insulated by special Ohmite vitreous enamel. Each turn of wire is a separate resistance step. Self-lubricating metal-graphite contact brush rides on a large, flat surface . . . insures perfect contact, prevents wear on the wire. Tempered steel contact arm assures uniform pressure at all times. High strength ceramic hub insulates shaft and bushing. These are just some of the Ohmite rheostat features that provide permanently smoother, closer control.

OHMITE MANUFACTURING COMPANY
4984 Flournoy Street • Chicago 44, U. S. A.

Ohmite Rheostats are extensively used in all types of applications . . . military and industrial. Widest range of types and sizes, in stock and special units, for every need . . . 10 models ranging from 25 to 1000 watts, from 1-9/16" to 12" diameter. Ohmite engineers are glad to assist you.

• • •

Write on company letterhead for helpful Catalog and Engineering Manual No. 40.

BUY MORE WAR BONDS

Be Right with OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES

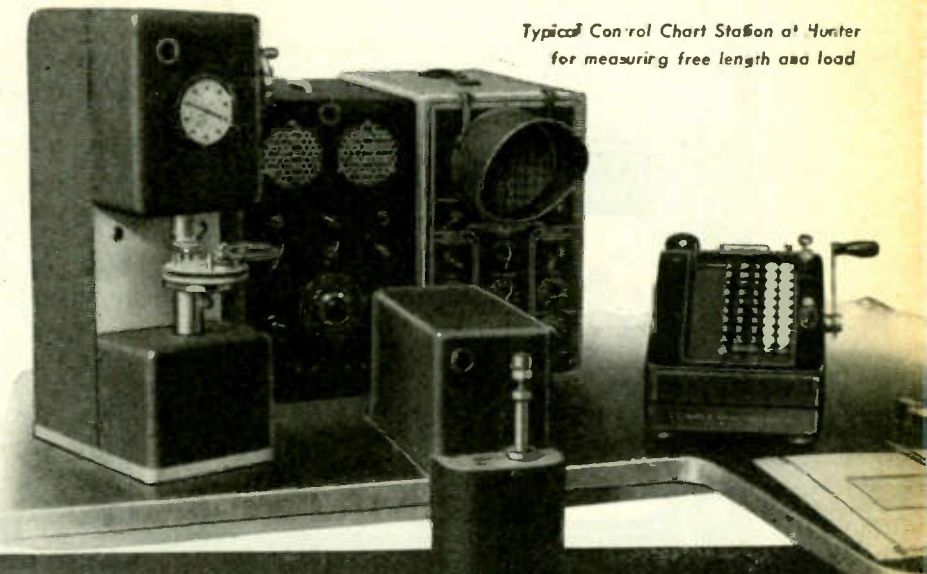
Flow Chart for Quality Control

Efficient control over the quality of precision springs requires active and intelligent application of statistical methods, using testing and measuring devices possessing accuracy and speed standards unheard of less than three years ago.

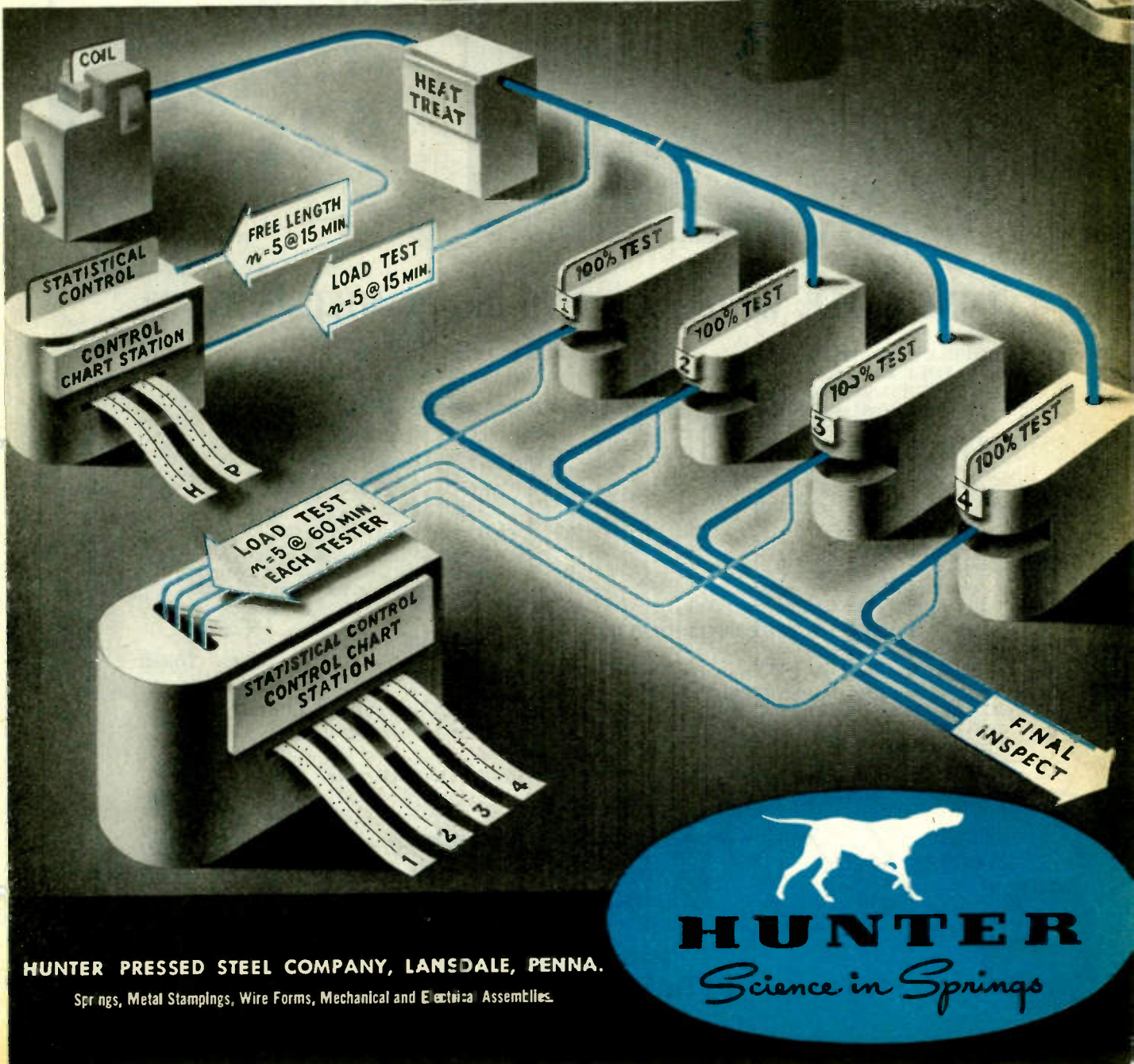
These new inspection techniques have been in full use at Hunter for some time.

The development and manufacture of our own new electronically-operated devices reached such proportions that we had to create a new "Special Apparatus" department to handle the work.

Below, you see how the quality function ties into the manufacturing cycle. The artist's drawing is based on an actual flow chart for close tolerance compression springs.



Typical Control Chart Station at Hunter for measuring free length and load

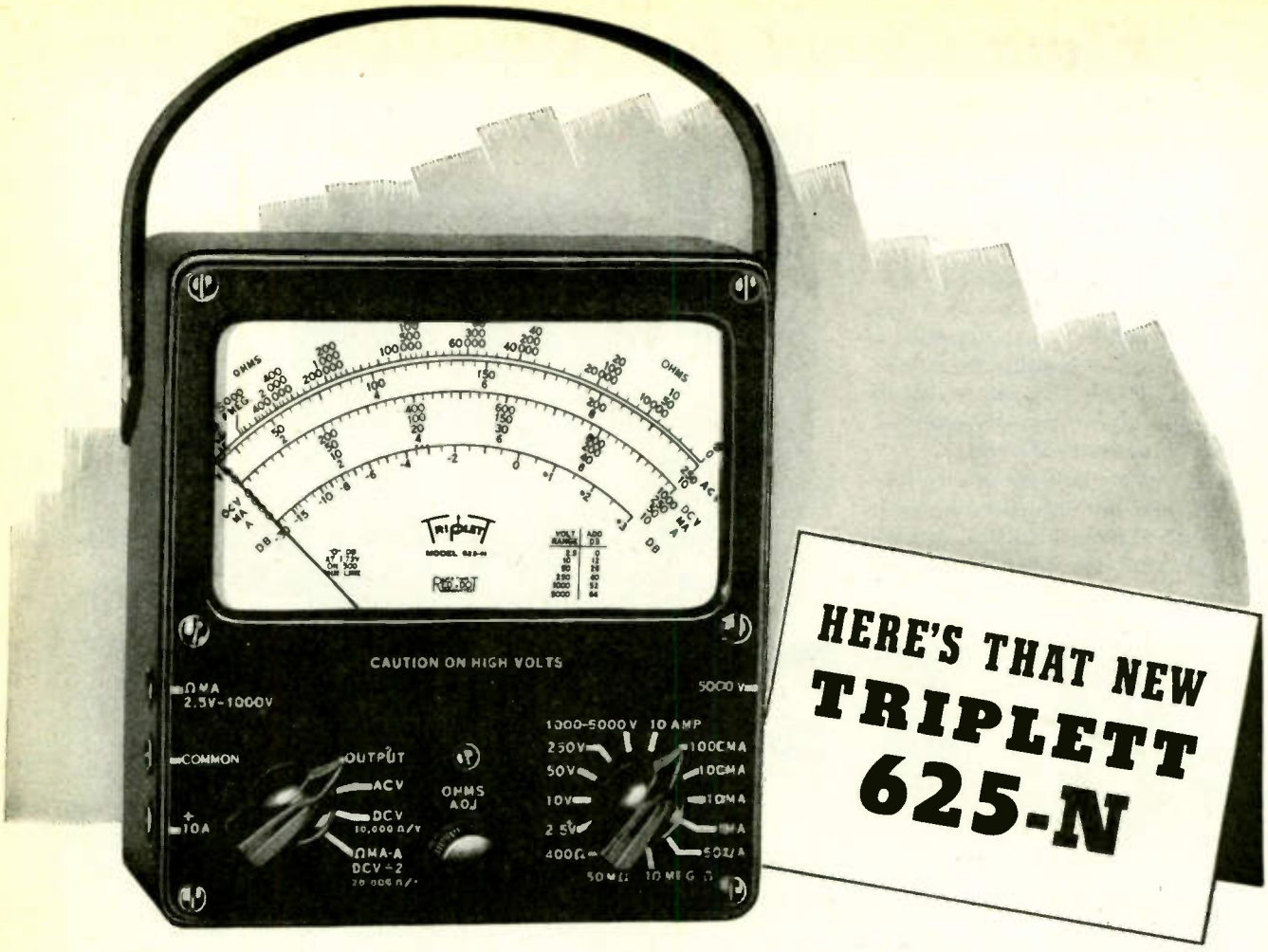


HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNA.

Springs, Metal Stampings, Wire Forms, Mechanical and Electrical Assemblies

HUNTER

Science in Springs



HERE'S THAT NEW
TRIPLETT
625-N

LONG SCALE, WIDE RANGE VOLT-OHM-MILLIAMMETER

DOUBLE SENSITIVITY
D. C. VOLT RANGES
0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.
0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

A. C. VOLT RANGES
0-2.5-10-50-250-1000-5000 Volts, at 10,000 ohms per volt.

OHM-MEGOHMS
0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)
0-10 megohms (60,000 ohms center scale)

DIRECT READING OUTPUT LEVEL DECIBEL RANGES
−30 to +3, +15, +29, +43, +55, +69 DB

TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES
0-50 Microamperes, at 250 M.V.

D. C. MILLIAMPERES
0-1-10-100-1000 Milliamperes, at 250 M.V.

D. C. AMPERES
0-10 Amperes, at 250 M.V.

OUTPUT READINGS
Condenser in series with A.C. Volts for output readings.

ATTRACTIVE COMPACT CASE
Size: 2½" x 5½" x 6". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

LONG 5" SCALE ARC
For greater reading accuracy on the Triplett RED • DOT Lifetime Guaranteed meter.

SIMPLIFIED SWITCHING CIRCUIT
Greater ease in changing ranges.

Write for descriptive folder giving full technical details

STANDARDS ARE SET BY TRIPLETT

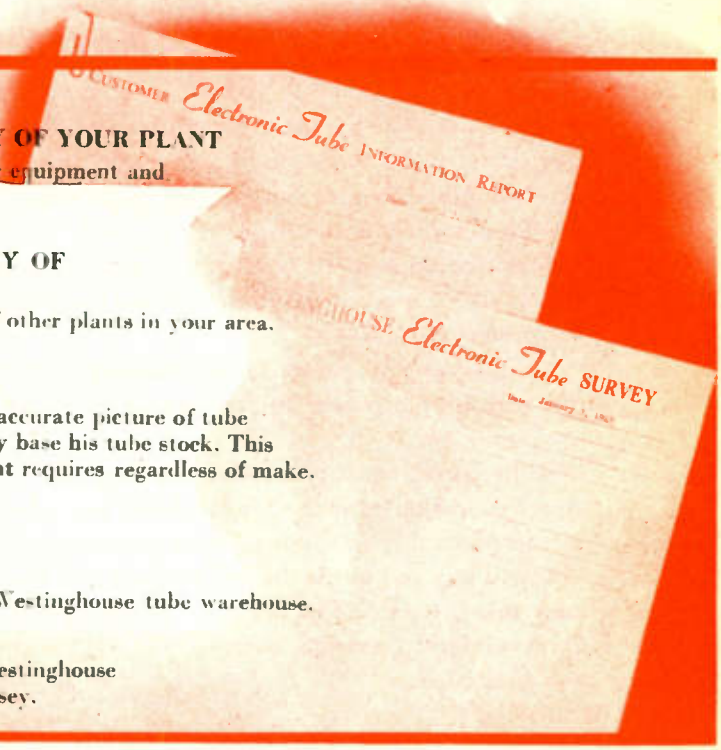
Precision first ...to last

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

No matter what electronic tube you need Westinghouse can provide it with this new

SURVEY AND SUPPLY PLAN!



WESTINGHOUSE MAKES A TUBE SURVEY OF YOUR PLANT

A tube representative will inspect your electronic equipment and determine the number of each tube and its estimated life, regardless of make.

WESTINGHOUSE MAKES A TUBE SURVEY OF OTHER PLANTS IN YOUR AREA

A tube representative will make a tube survey of other plants in your area.

WESTINGHOUSE BASES ITS LOCAL TUBE STOCKS ON THESE SURVEYS

Your Westinghouse tube distributor then has an accurate picture of tube requirements of your entire area on which he may base his tube stock. This stock will include the tubes which your equipment requires regardless of make.

HERE'S WHAT YOU GET!

A copy of the survey of your equipment.

A report on the tubes used in your plant.

Prompt delivery on these tubes from your local Westinghouse tube warehouse.

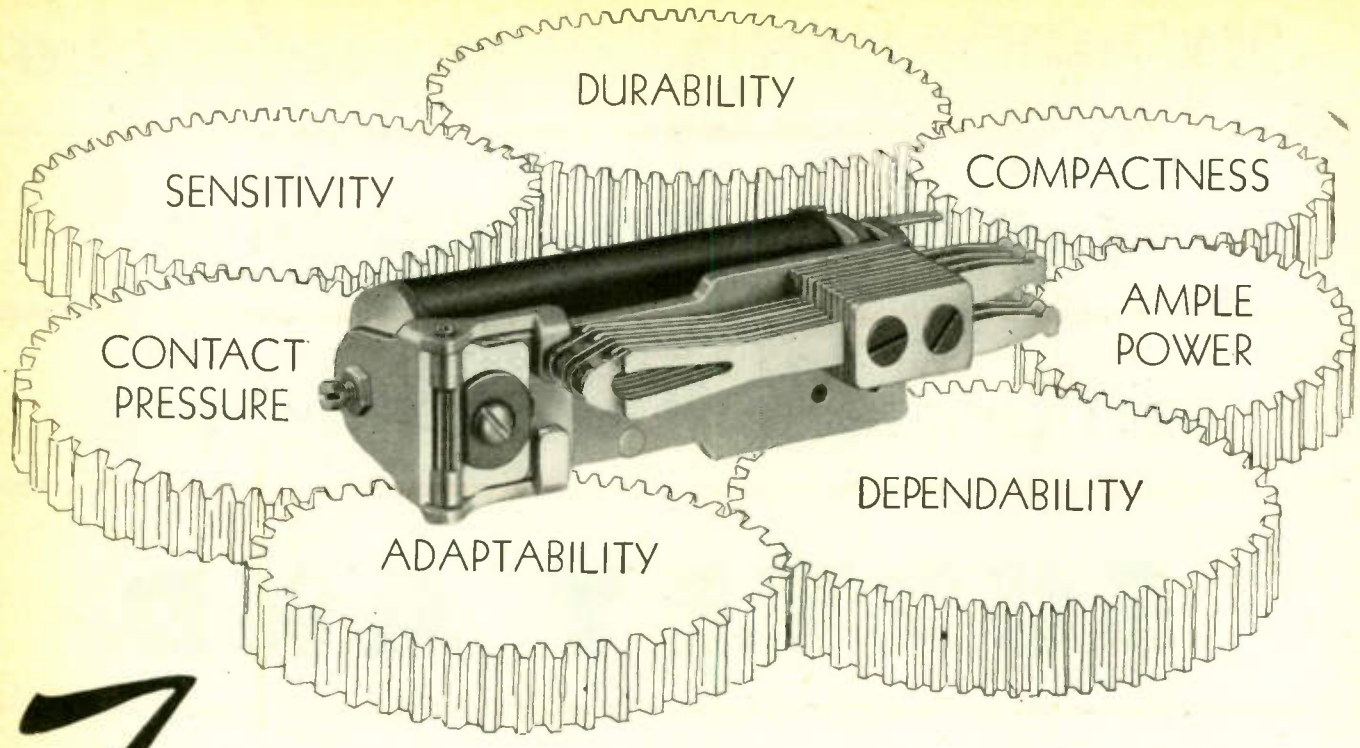
FOR A SURVEY OF YOUR PLANT

. . . call your local Westinghouse representative or write Westinghouse Electric Corporation, Lamp Division, Bloomfield, New Jersey.

Westinghouse

Electronic Tubes at Work

ONE CALL DOES IT ALL



7 *vital qualities* GEARED TOGETHER

IN THE NEW AUTOMATIC ELECTRIC CLASS "B" RELAY

• Check over one by one the qualities you want most in any relay. Here, in this new relay, you will find them all—combined to give outstanding performance in any electrical control application.

Sensitive enough to operate on minute current, the Class "B" has also the high contact pressure needed for perfect closure—

Compact enough for multiple mounting in small space, yet with ample power for operating up to 28 contact springs—

With inbuilt quality needed for long service under tough conditions, and the dependability provided by dual circuit paths through independent twin contacts—

It will pay you to get the full story on this remarkable new relay. It is one of the forty basic types described in Automatic Electric's catalog 4071-D. Write today for your copy.

ONLY THE CLASS "B" RELAY HAS ALL THESE DESIGN FEATURES:

Twin Contacts—providing dual circuit paths for maximum reliability.

Efficient Magnetic Circuit—for sensitivity and high contact pressure.

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

Compact Design—for important savings in space and weight.

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

Relays AND OTHER CONTROL DEVICES *by* AUTOMATIC ELECTRIC

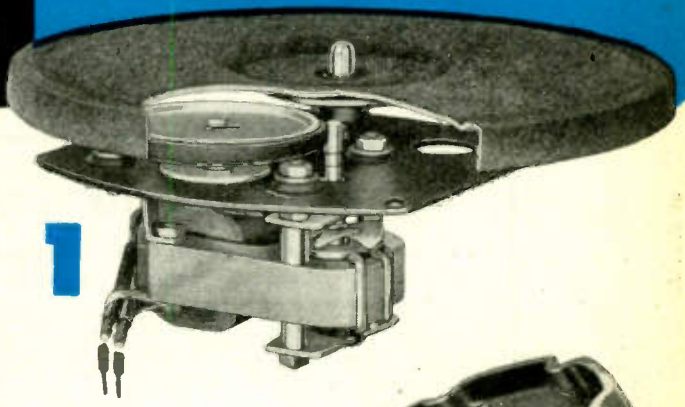
AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Illinois

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS • AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

DOUBLE FEATURE

for postwar showing



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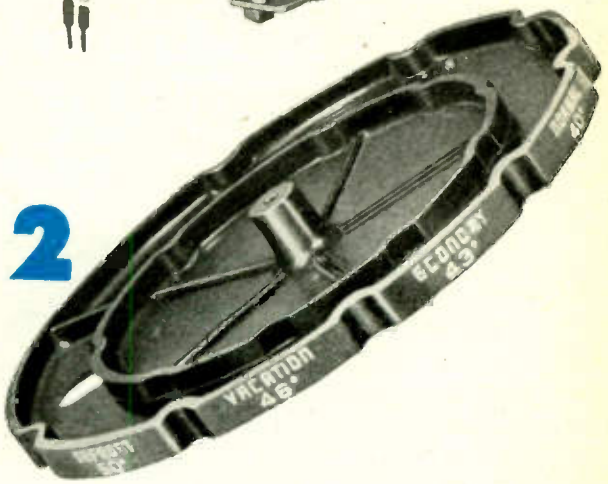


2

● We wish we could ring the curtain up now, on what we are going to have for your peacetime products, in the way of small motors and molded plastics.

About small motors, and electric drive assemblies, we do know this. They'll be the same sturdy, dependable units that have proved so satisfactory for military operation, and many years before that, for all manner of civilian products requiring low torque drives. *Smooth Power*, we've always called these units, and *Smooth Power* they'll continue to be, whether our own standard line, or especially designed to meet your specific conditions.

Molded Plastics? We've gained a lot of broadening experience during the past five years. We think we'll be better able than ever before to furnish molded plastic parts, in any size or quantity, for almost any industry or product. Our engineers, moldmakers and machine operators have learned wartime lessons that they're waiting to apply in peacetime production.

Right now we're still engaged 100% with Uncle Sam's business or on priority orders. We hope the time is not too far distant when this condition will be relieved. When that day comes, we'd like to be considered a prime source for your needs in *small electric assemblies and motors* . . . and *molded plastics*.

ARMY E NAVY

THE GENERAL INDUSTRIES COMPANY
Elyria, Ohio

THE GENERAL INDUSTRIES COMPANY

MOTORS PLASTICS

HOW WE SAVE 45 MINUTES OUT OF AN HOUR

When Connecticut Telephone & Electric Division began to make aircraft ignition terminals for a famous engine manufacturer, we knew that standard testing procedure could not keep pace with our mass production methods. Even a score of trained inspectors, each equipped with high-voltage testing equipment, would soon fall hopelessly behind.

Again Great American Industries engineers overcame a stubborn wartime bottleneck. They designed an electro-mechanical tester which accurately checks four parts faster than former methods could check one. Five such testers, operated by unskilled persons, have a capacity of 12,500 tests an hour... with a degree of error almost too small to measure.

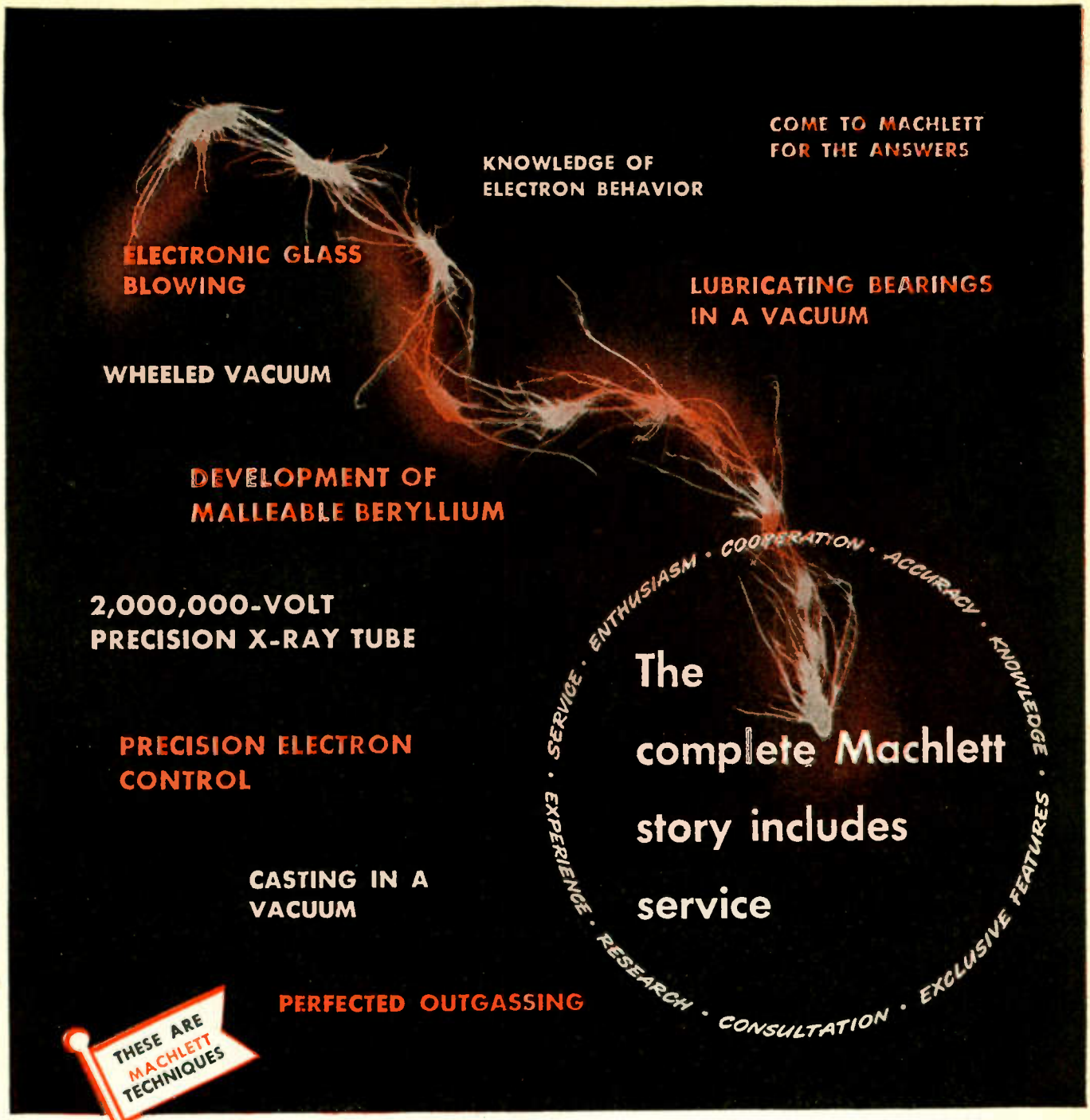
This is but one of many new methods, contributed by G.A.I. engineering to speed the war effort. It will be equally important to efficient electrical manufacturing in time of peace.

HERE'S HOW IT'S DONE

Operator places terminals to be tested in slots at edge of turntable. As each part reaches test point, one electrode of a 10,500 v. circuit contacts the conductor element of the terminal . . . while another encircles its insulating shell. Current leakage through minute cracks or porous sections of the insulation operates a relay which ejects the faulty piece. If the terminal meets specifications, it automatically falls into a chute and is conveyed to the packing bench. This swift, foolproof tester lends itself to many production tests of insulation.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES INC. • MERIDEN, CONNECTICUT



The above ten Machlett techniques reflect only a part of one side of this organization — that of technical capability.

It takes much more than even the highest techniques to make a business great. There is also required a thorough knowledge of customers' requirements, and that conscientious, painstaking, continuing meeting of them called "service."

Just as there is the most intimate relationship between an electron tube and the equipment with which it is connected, so there is a close and constant contact with our customers. With them we are never in competition, and thus we may be, and often are, called upon to do design and development work, to live with tube and equipment problems, and cooperate in solving them. We often follow through all the way to the ultimate users, to make certain of their satisfaction and see that conditions of use are such as to assure optimum results and economy. It is a long-established Machlett practice not merely to accept but to seek out every opportunity to serve. Thus, Machlett customers obtain much more than the best possible tubes.

When you need a medical or industrial X-ray tube, or a radio or industrial oscillator, amplifier or rectifier, it will pay you to choose a Machlett. Write for information as to available types, identifying the associated equipment and nature of use. Machlett Laboratories, Inc., Springdale, Connecticut.

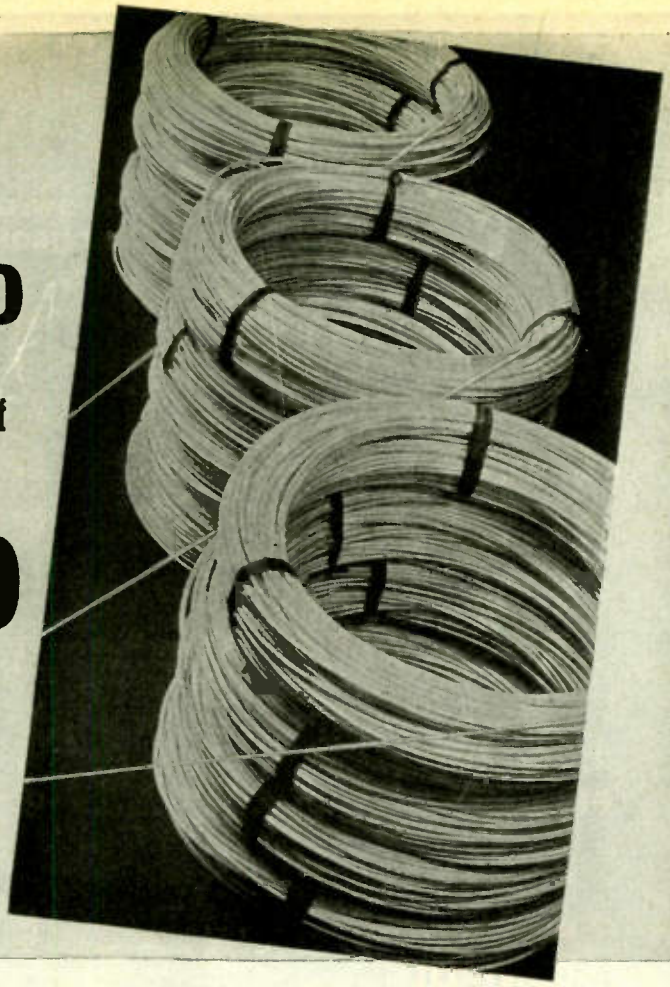
MACHLETT

APPLIES TO RADIO AND INDUSTRIAL USES ITS 40 YEARS OF ELECTRON-TUBE EXPERIENCE

WILCO
NOW EQUIPPED

for large scale production of

JACKETED WIRE



WILCO wire, tubing and other products are used in various electronic applications for the Army and Navy. In response to the wartime demand for these various products, the H. A. Wilson Company has enlarged its plant, increased its manufacturing facilities, added essential new equipment and developed new products and techniques. Both present and future customers will find these new WILCO developments of great advantage.

The H. A. Wilson Company manufactures and is interested in receiving inquiries regarding the following typical products—

WILCO JACKETED WIRE

Silver (Fine, Sterling or Coin)
Silver Jacketed Copper
Silver Jacketed Invar
Silver Jacketed Brass
Silver Jacketed Steel
Gold Jacketed Silver (Fine, Sterling, Coin)
Gold Jacketed Brass or Bronze
Copper Jacketed Monel
Nickel Jacketed Copper

WILCO JACKETED TUBING

Silver Tubing (Fine, Sterling or Coin)
Gold Tubing (any Color or Karat)
Silver Jacketed Brass or Bronze (one or both sides)
Gold Jacketed Silver (one or both sides)
Gold Jacketed Brass or Bronze (one or both sides)

WILCO STRIP MATERIAL

Silver (Fine, Sterling or Coin) on Brass or Bronze (Inlay or Overlay)
Gold on Silver (any Karat on Fine, Sterling or Coin)
Gold on Brass or Bronze

Other WILCO products include Electrical *Contacts*—

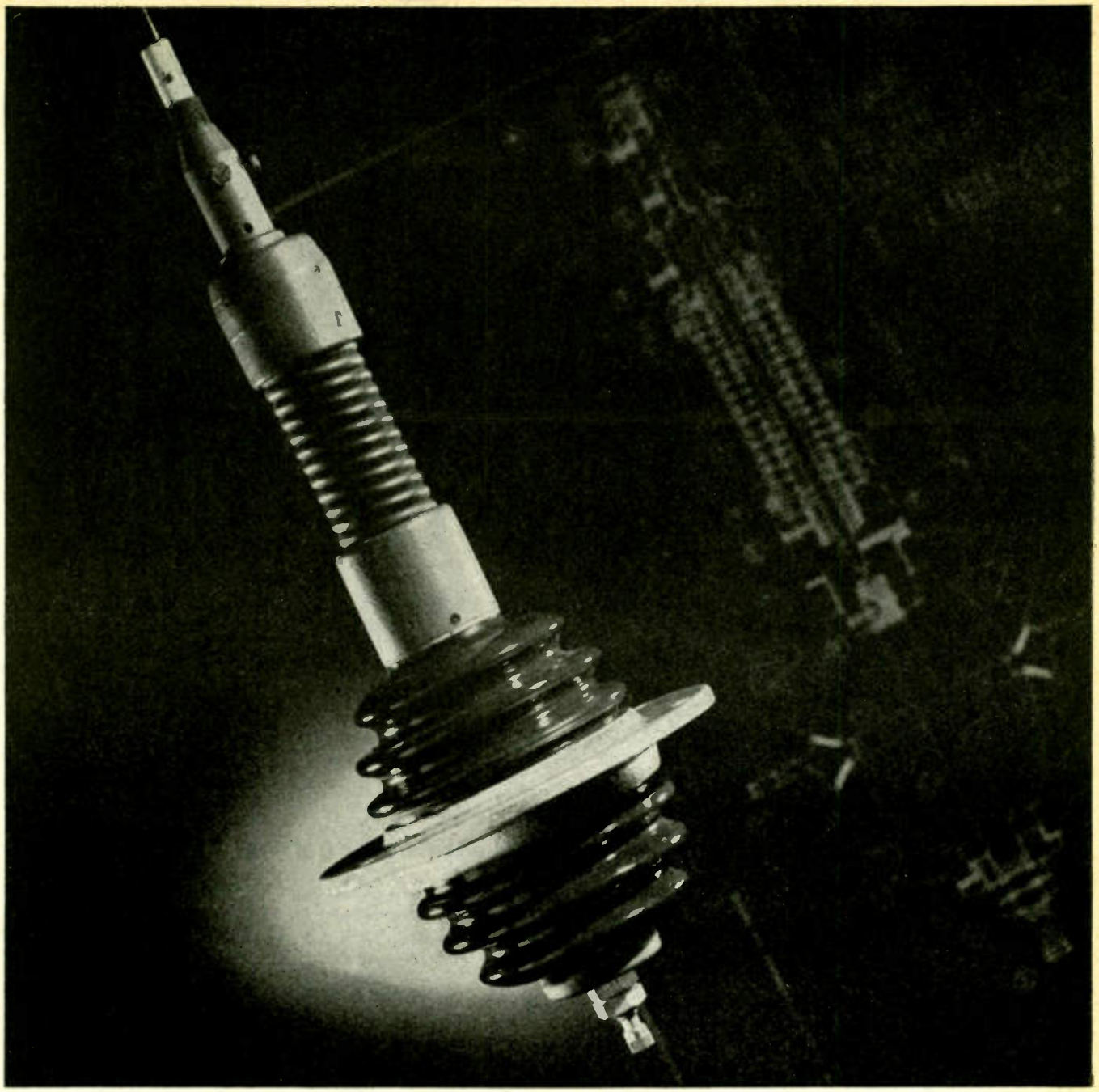
Silver. Platinum, Tungsten, Alloys, Powder Metal. *Thermostatic Bimetal* (High and Low Temperature with new high temperature deflection rates.) *Precious Metal Collector Rings*—For Rotating controls. *Silver Clad Steel. Rolled Gold Plate. Special Materials.*

Let us analyze your problems.

THE H. A. WILSON COMPANY

105 Chestnut Street, Newark 5, N. J.

Branches: Detroit · Chicago



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

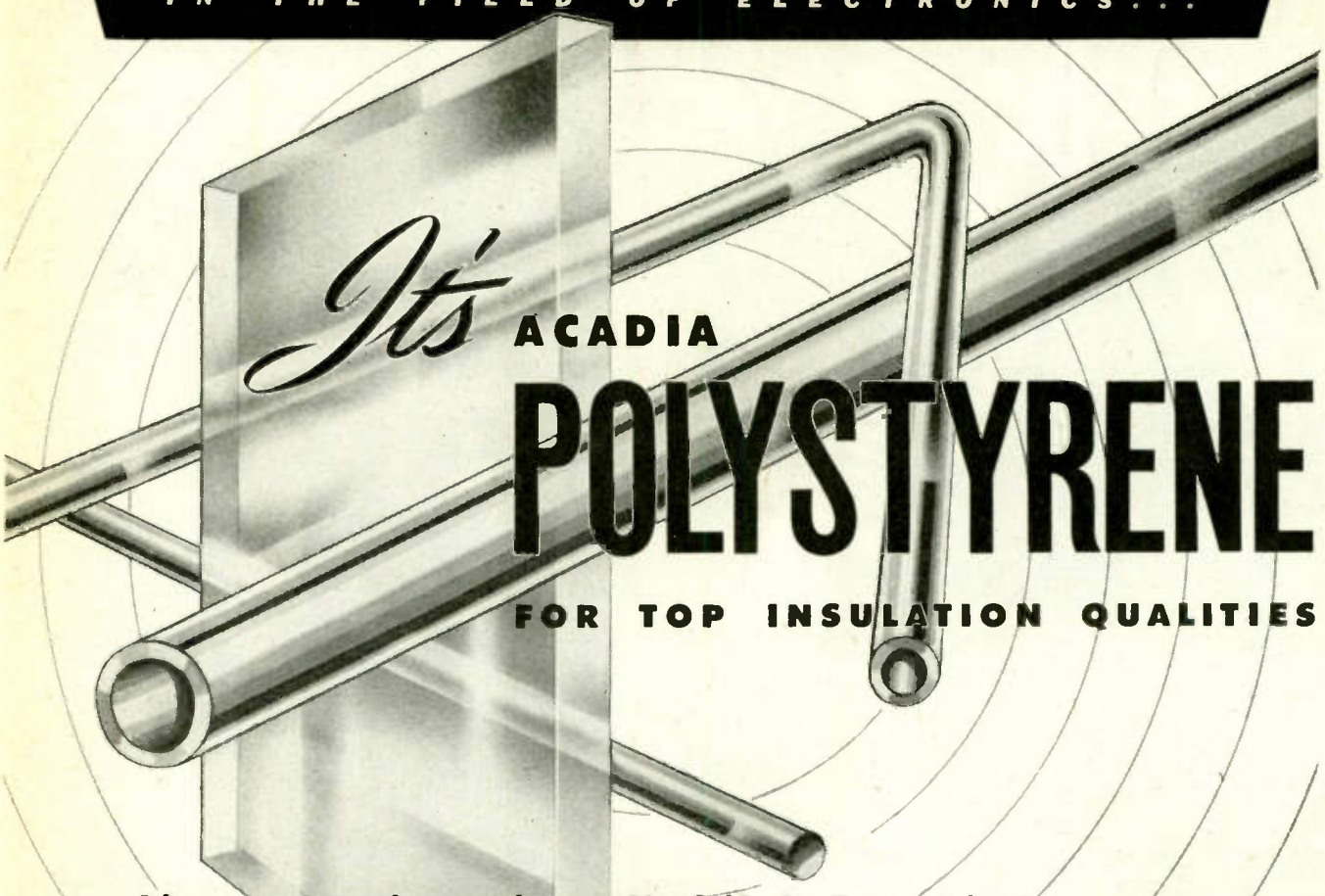
This is an antenna base insulator for use on a communications center transmitter. It is one of several Lapp designs for transmitter and receiver mast bases for military vehicular radio—on jeeps, halftracks, tanks and other rolling equipment.

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

IN THE FIELD OF ELECTRONICS . . .



It's ACADIA POLYSTYRENE

FOR TOP INSULATION QUALITIES

Sheets • Rods • Tubes • Molded • Extruded

In dielectric strength and power factor Acadia Polystyrene is equal to ceramics and mica, *and superior to most other commercial plastics.* Its many outstanding characteristics measure up to the most severe specifications for electronics applications—in terms of highest insulation efficiency.

Acadia Polystyrene is practically unaffected by acids, alkalies, alcohol, weather, stack gases and many other corrosive elements . . . Its strength increases as temperature decreases.

High tensile and impact strength and zero moisture absorption are matched by these other essential qualities of Acadia Polystyrene—low specific gravity, freedom from shrinkage and improved heat resistance.

To this impressive list of superior properties must be added the important fact that Acadia Polystrene is easily shaped for the many purposes it serves—molded, as desired, or machined to close tolerances . . . *It avoids waste in fabrication.*

Write today for complete data on the physical properties of Polystrene—of which the most outstanding values are summarized here for quick reference:

Dielectric constant	2.5 to 2.6 at frequencies 106
Power Factor, 60 cycles	.0001 to .0003
10^3 cycles	.0001 to .0003
10^6 cycles	.0001 to .0008
Dielectric strength, Volts /Mil ⅛" thickness	
Short time	500 to 700
Step by Step	450 to 600
Volume Resistivity, ohms-cms	10^{17} to 10^{19}
Heat Resistance	150°F to 250°F.
Softening Point	190°F to 250°F.
Specific Gravity	1.05

ACADIA "B"

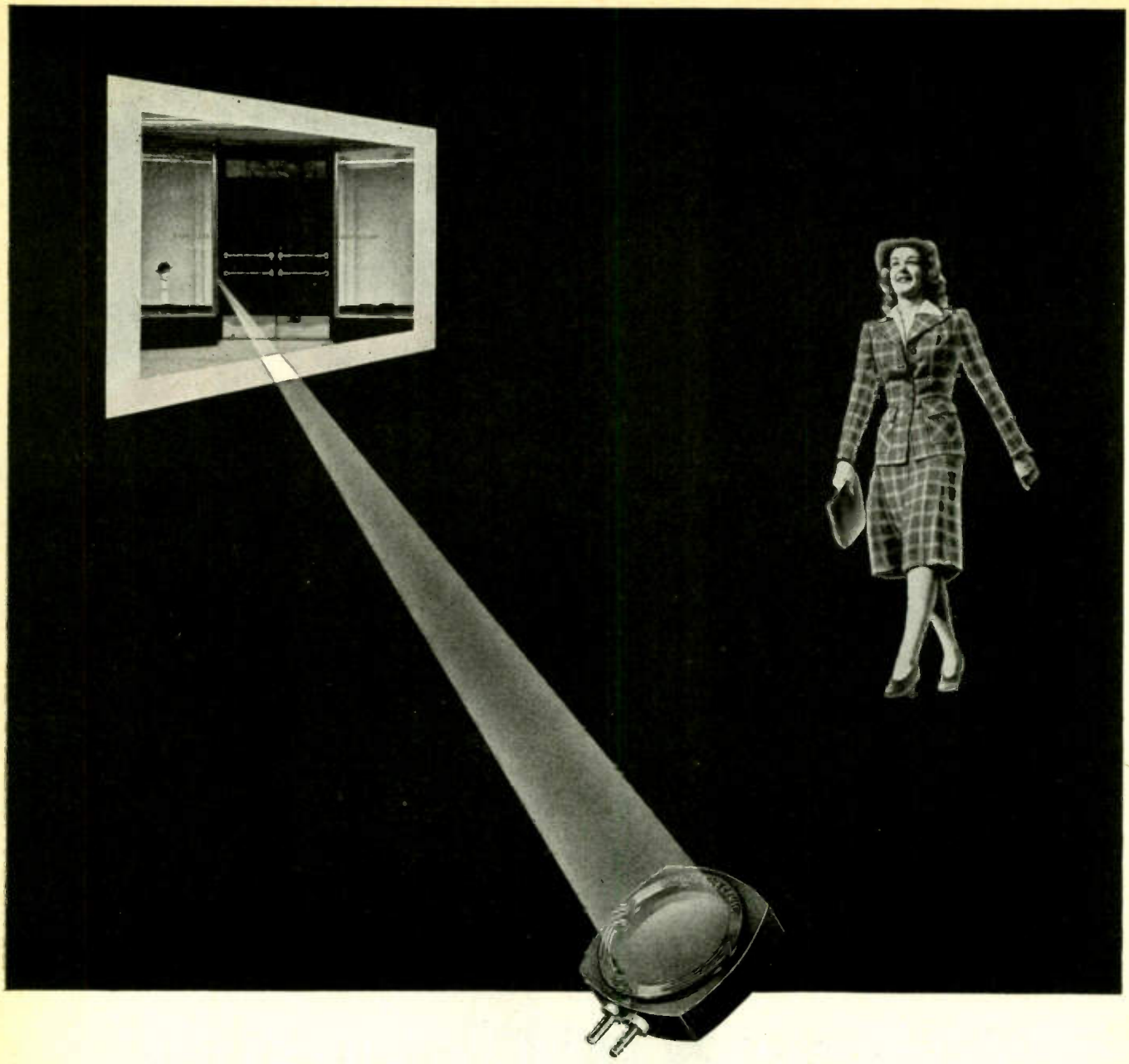
Flexible at—100°F and has many of the same electrical properties of Polystyrene. Ideal for many electrical applications. Write for information on forms now available and ask for data on physical and electrical properties.

ACADIA Synthetic **PRODUCTS**

Largest Independent Manufacturers and Cutters of Felt

DIVISION WESTERN FELT WORKS

4035-4117 Ogden Avenue, Chicago 23, Illinois • Offices in All Principal Cities



How to beat a woman—TO A DOOR

One way to startle the lay public into awed pleasure is to show them a door opened by means of a photo*cell*.

The practical beauty of this stunt is that you can do it over and over again without failure, even where shattering vibrations exist as part of normal operating conditions. For the Luxtron* photo*cell* is really rugged.

Another advantage is that Luxtron photo*cells* convert light into electric energy for the direct operation of meters and meter relays without amplification. They are lightweight, too. They are a good way to beat competition to a customer.

If you have any control problem that has defied solution with a simple, durable piece of apparatus, perhaps Bradley can throw some light on it—and make that light do the work for you. Write for literature and samples.

*T. M. REG. U. S. PAT. OFF

Another "Coprox" Rectifier

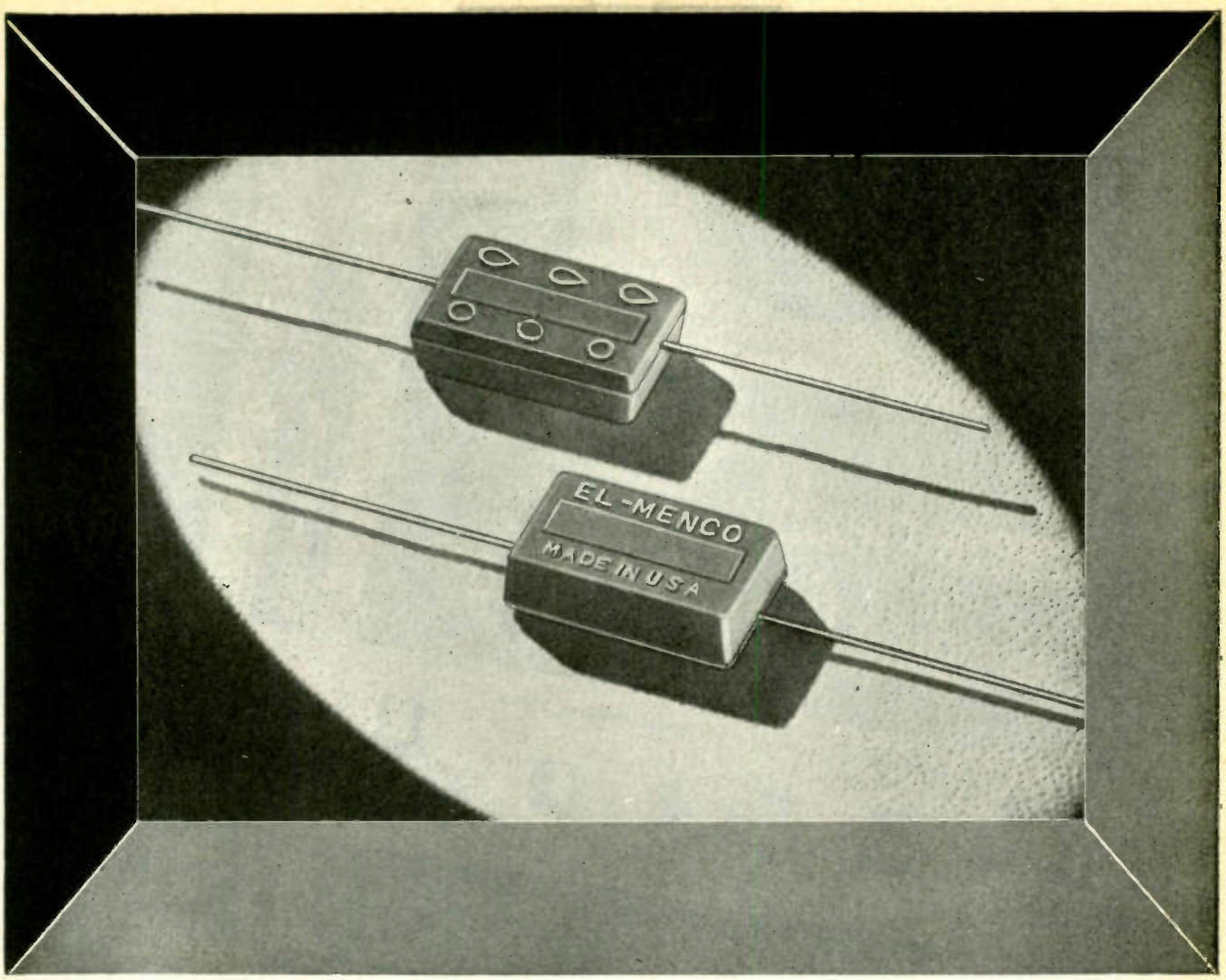
This center tap, full wave rectifier for high frequency current is one of a useful group of copper oxide rectifiers developed by Bradley. Illustrated "Coprox" bulletin mailed on request.

PHOTOCELLS—MASTERS OF LIGHT

BRADLEY

MASTER OF PHOTOCELLS

BRADLEY LABORATORIES, INC., 82 MEADOW STREET, NEW HAVEN 10, CONNECTICUT



PORTRAIT OF *Precision*

Precision marks every step in the manufacture of El-Menco Capacitors, for well we know the vital role our products must play, and how much depends upon their unfailing performance. That this precision is appreciated is best evidenced by the Army-Navy award we so proudly display.

Postwar products in which El-Menco Capacitors will be used will undoubtedly be *fine* products — products of quality in *every* detail.

Manufacturers of
Electronic Equipment:

ARMY E NAVY

Send, on firm letterhead
for new Capacitor Catalog.

THE ELECTRO
MOTIVE MFG. CO.
Willimantic, Conn.

El-Menco
MOLDED MICA–
MICA TRIMMER
Capacitors

● Breeze Flexible Metal Tubing solves many a design and modification problem by providing easily installed ducts and vents for air conditioning, exhaust or dust collection. Produced in a variety of metals from a continuous strip, Breeze Tubing resists heat and corrosion and is available in a variety of shapes to fit structural considerations.

Breeze Flexible Shielding Conduit is made from similarly constructed tubing with the addition of a braided wire covering which acts as a shield preventing radiation or absorption of electrical interference. Double layers of braid are sometimes specified to provide complete isolation from ultra-high-frequency interference. A variety of specially designed fittings meet every installation need.

If you are confronted with difficult tubing or shielding problems, call in a Breeze engineer for a complete analysis and recommendation.

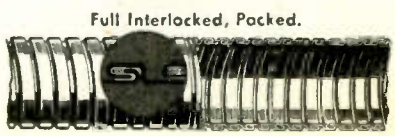
BREEZE

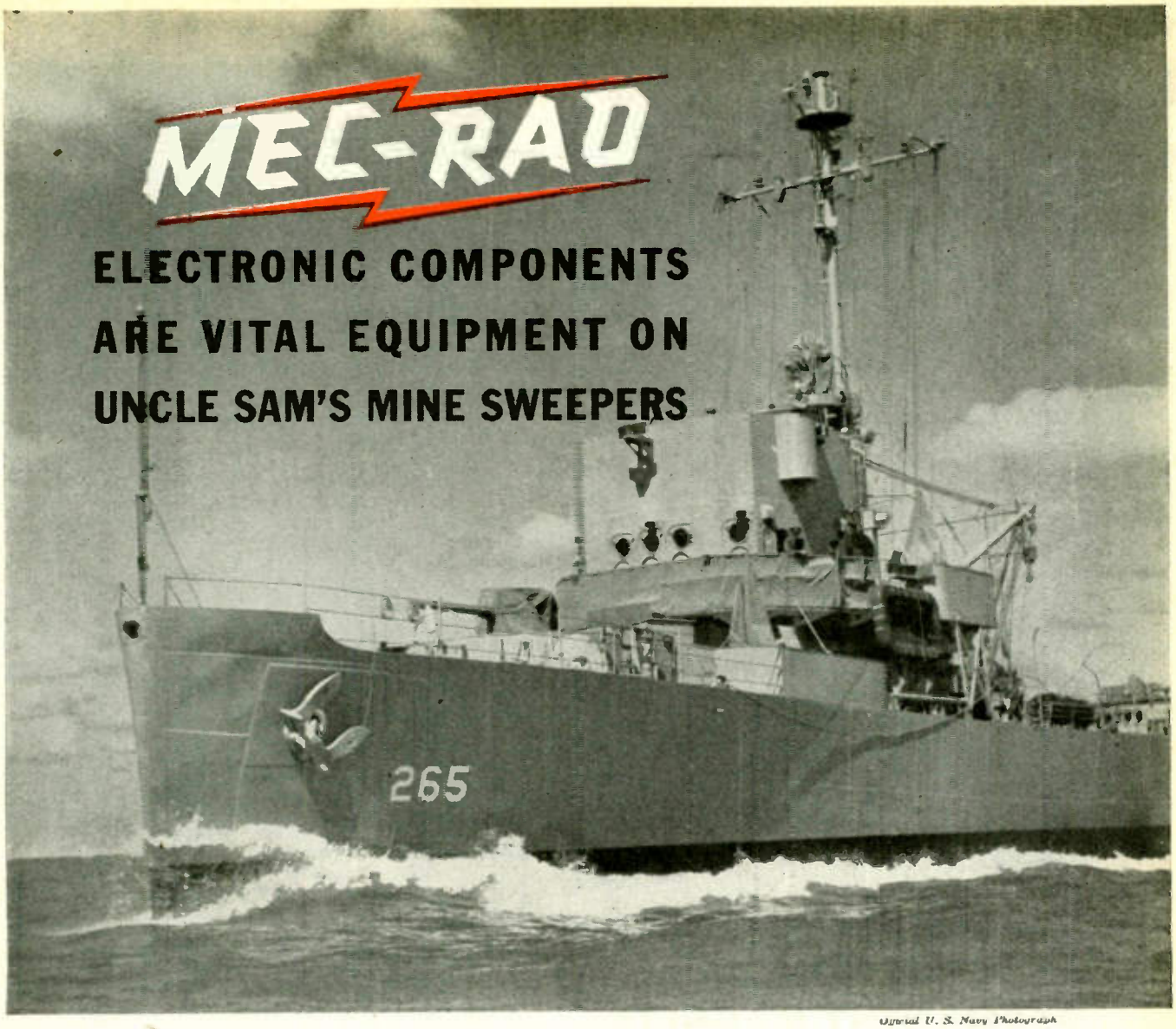
Corporations Inc.

NEWARK BREEZE MARK NEW JERSEY


Square Locked, Packed.


Full Interlocked, Unpacked.

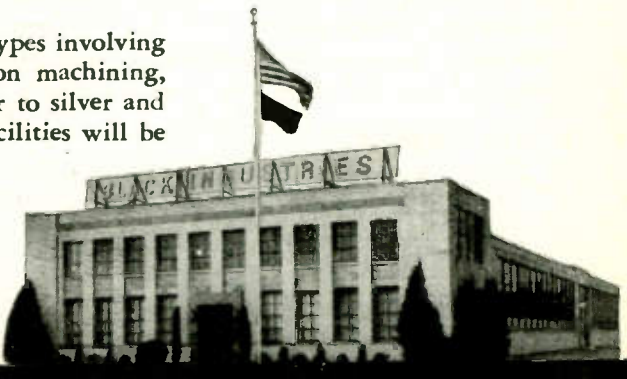

Full Interlocked, Packed.



Official U. S. Navy Photograph

SHIPS like these have performed a heroic service in U. S. Naval warfare. Their effectiveness has been due in large part to the ingenious electronic devices with which they are equipped. Mec-Rad makes certain vital, highly precise mechanical and electronic components for these devices—and until the Jap war is over, this will be our all-consuming task.

Our work includes "fancy brass plumbing" of all types involving soft and hard soldering, close tolerances, precision machining, careful assembly and finishes ranging from lacquer to silver and rhodium plating. After the war our specialized facilities will be available to the electronic industry for peacetime needs. Our engineering "know-how" is at your disposal now to help you with your post-war plans.

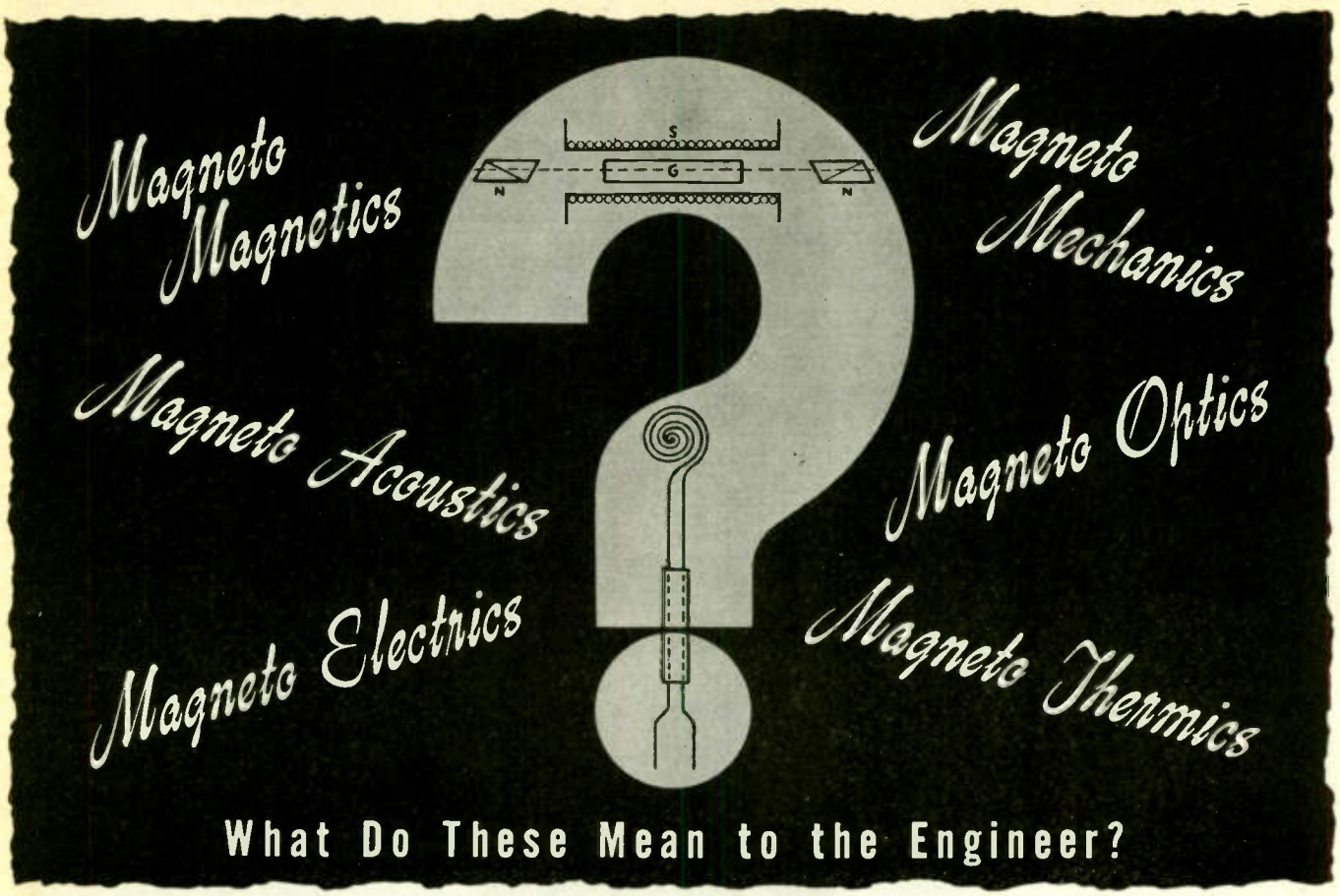


MEC-RAD

DIVISION-BLACK INDUSTRIES

1400 EAST 222ND STREET ☆ CLEVELAND 17, OHIO

PERMANENT MAGNETS MAY DO IT BETTER



(This is the fourth of four advertisements discussing the major functions of permanent magnets.)

THE LEAST KNOWN FUNCTION OF PERMANENT MAGNETS

To Change Apparent Characteristics of Materials

What are the commercial and scientific possibilities in the application of magnetism which changes the characteristics of certain materials whether gas, liquid or solid?

We know, for example, that the application of a magnetic field will cause the following changes:

IT WILL CHANGE

- *the apparent a.c. permeability of soft magnetic substances*
- *the normal hysteresis curve of magnetic materials*
- *the dimensions of nickel and some other metals*
- *the frequency of a tuning-fork*
- *the electrical resistance of bismuth*
- *the boiling point of some materials*
- *the rotation of polarized light through many materials*

These and kindred effects, which are known and are being investigated by physicists, may well lead to new fields for the application of permanent magnets. The potential uses of this little known property of magnetism have been scarcely touched industrially, although it has been employed in magneto stricture oscillators, in remote control indicators and, by the use of bismuth to determine field densities.

Our own research, based upon 35 years of specialization in the manufacture of permanent magnets, may help you to find some new means of achieving desired results. Write for consultation. Without obligation, send for copy of technical handbook: "Permanent Magnets Have Four Major Jobs."

THE INDIANA STEEL PRODUCTS COMPANY★

6 NORTH MICHIGAN AVENUE, CHICAGO 2, ILLINOIS

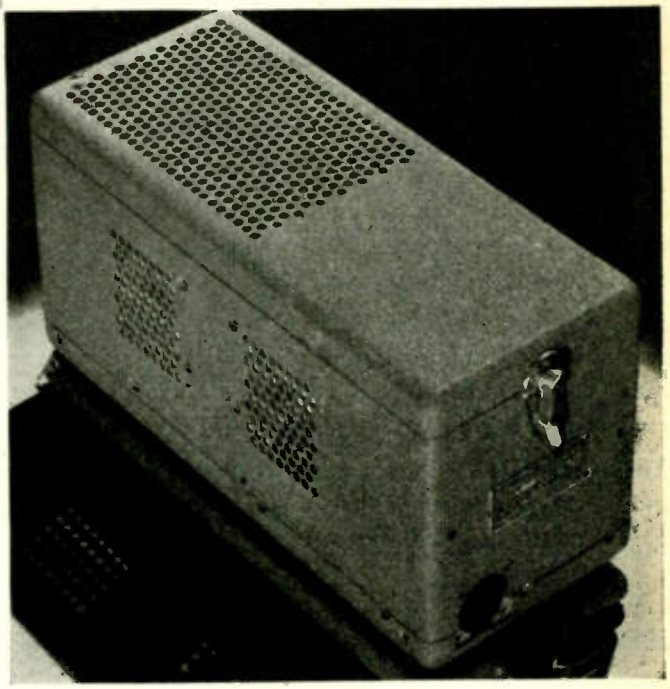
SPECIALISTS IN PERMANENT MAGNETS SINCE 1910

an open and shut case of finer craftsmanship

When you bring us your sheet metal fabrication problems, you hire 20 years of *specialized* experience in serving the highly individual needs of manufacturers of electrical, radio, electronic and mechanical apparatus. Our long history in this exacting specialty is one of intimate knowledge, and assures post-war permanence.

At your service are our 65,000 square feet of floor space . . . hundreds of skilled craftsmen . . . large stores of stock dies to save you money. Try us for chassis, panels, cabinets, racks, housings.

ANY SIZE . . . ANY METAL . . .
ANY GAUGE . . . ANY FINISH



KARP

METAL PRODUCTS CO., INC.

Custom Craftsmen in Sheet Metal

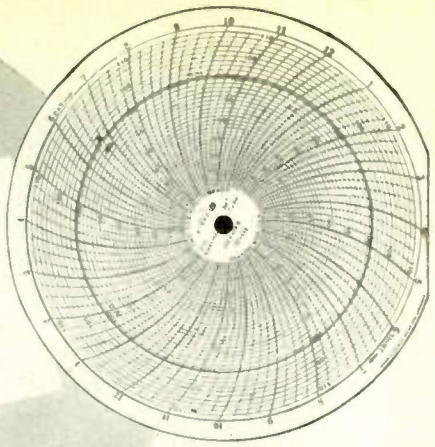
126-30th Street, Brooklyn 32, N. Y.

ARMY E NAVY

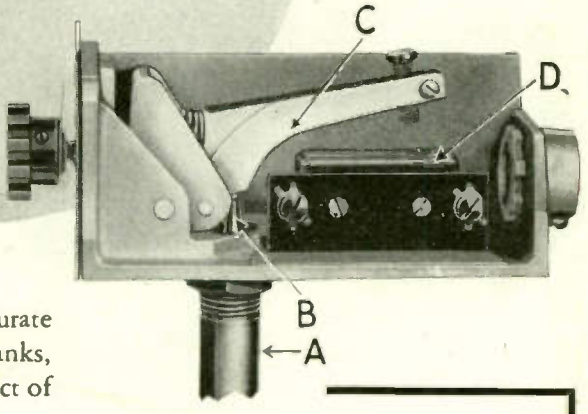
Is Control of Temperature to ± .10° Close Enough?

MICRO SWITCH

SNAP-ACTION HELPS BURLING INSTRUMENTS TO GIVE ALMOST PERFECT CONTROL



Recorded temperature of low temperature test oven controlled by Micro Switch equipped Burling Temperature Control which shows almost perfect control. The "hump" in the line is where the switch was changed from normally open to normally closed.



Burling Temperature Controls are designed to give the most accurate control of temperatures of cold boxes, low temperature cabinets, tanks, ovens, incubators and high temperature furnaces. They are a product of the Burling Instrument Company of Newark, N. J.

The basic operating principle of these precise controls is the differential expansions of solids. The difference in expansion of the two members is multiplied by a lever which operates a Micro Switch snap-action switch. This switch, in turn, electrically controls the heat supply.

The almost perfect control indicated in the test illustrated was made in a low temperature test oven with an aluminum alloy tube 30″ long. The small variation would indicate a control as fine as plus or minus .10°.

Such control is possible because the precise, sensitive Micro Switch action permits a snap from one position to another with extremely small motion. The operating force required is so small that the slight expansion of tube is ample.

This application of Micro Switch products is typical of the many uses industry has found for these tiny, sensitive switches in thermostats, gages, and fine instruments of many types.

HERE IS HOW IT WORKS

Difference in expansion between outside tube "A" and inside tube "B" causes lever "C" to contact switch "D." This contact electrically controls the operation of the heating element.

Micro Switch engineers, experienced in the applications of millions of these precise, snap-action switches to products for both war and peace, will be glad to show you how they can add long life and reliability to your product at lower cost. Send for the Micro Switch Handbook - Catalog No. 60 today.

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

MICRO MS SWITCH
TRADE MARK
A DIVISION OF FIRST INDUSTRIAL CORPORATION
Freeport, Illinois, U. S. A., Sales Offices in Principal Cities

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

Avoid Moisture Damage in Over-Seas Packages

Simply put a few small bags of Jay Cee Silica Gel, like the ones above, inside your container . . . wrap or seal tightly . . . and ship over-seas without fear of damage from "in-the-package" moisture. Jay Cee Silica Gel is an ideal drying agent . . . has amazing power to absorb atmospheric moisture. Thus the air inside of containers is kept absolutely dry and delicate metal parts are protected from rust and corrosion.

Jay Cee Silica Gel is also used in packages of foods, fabrics, chemicals, and other products. Moreover, it has wide application in the air conditioning, refrigeration, and chemical industries. Jay Cee Silica Gel is clear white; passes a rigid section test; meets exacting Government specifications; is strictly a quality product.

JOBBERS WANTED — There are excellent opportunities for jobbers to build profitable business on Jay Cee Silica Gel in a few territories. Write for details.

JOLIET CHEMICALS, LTD., INDUSTRY AVENUE, JOLIET, ILLINOIS

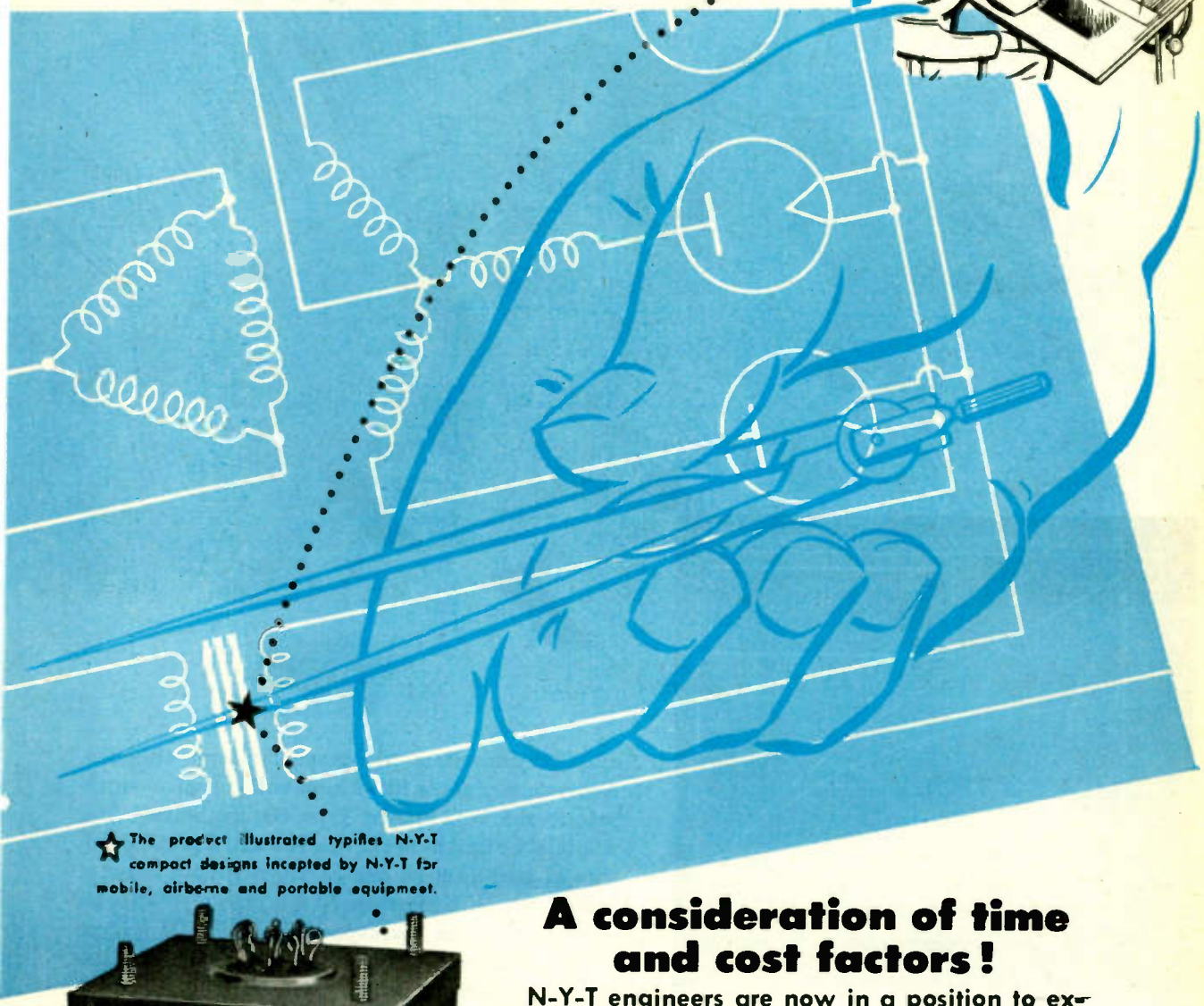
JAY EE

SILICA GEL

A superior dehydrant

Down to fundamentals...

IN TRANSFORMER DESIGN FOR POST-WAR



☆ The product illustrated typifies N-Y-T compact designs incepted by N-Y-T for mobile, airborne and portable equipment.

A consideration of time and cost factors!

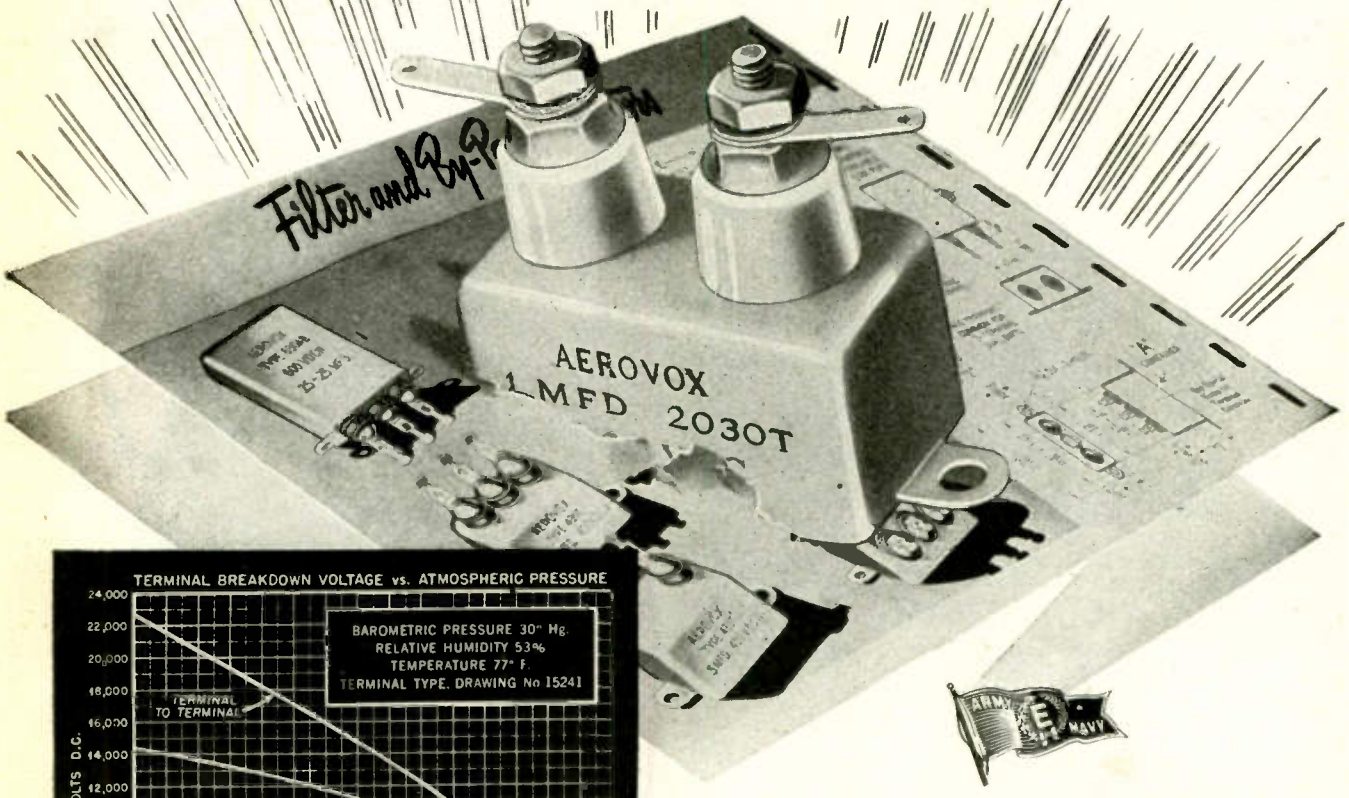
N-Y-T engineers are now in a position to extend close collaboration in the solution of transformer, choke and filter problems—from blueprint to finished product. They are prepared to design special components for specific applications and produce them promptly at low unit cost. This unique service is made possible by the specialized engineering and production facilities of N-Y-T. Our engineers are available for consultation.

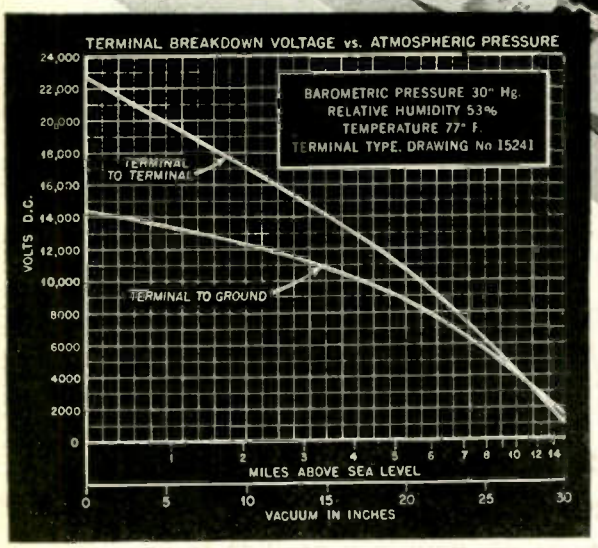
Address inquiries to Dept. N.

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

Aerovox Standard Types *Plus* Aerovox Engineering Ingenuity Meet High-Altitude Operation Requirements

PILLAR-TERMINAL "Bathtubs"





• Aerovox "know-how" is multiplying the outstanding choice of standard Aerovox capacitors countless fold in meeting extraordinary needs. For instance:

To meet certain aircraft requirements for compact oil-filled capacitors to operate at high altitudes, Aerovox engineers fitted high-voltage pillar terminals to the well-known Type 30 "bathtubs". The result is the unit here shown. The small pillar terminals of feed-through design are normally rated at 3500 V. D.C.W. maximum. At this rating they can be used at altitudes corresponding to 35,000 feet or almost 7 miles. At 50,000 these terminals could be used on capacitors rated at 2000 V. or less. The accompanying chart tells the story.

Just another example of that outstanding Aerovox "know-how" that is saving time, money, headaches, for more and more critical capacitor buyers.

• Submit your problem.

AEROVOX Capacitors

INDIVIDUALLY TESTED

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

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

INSIDE AREA HARDENING

Overall view and detail of the work in fixture. A solenoid releases the work to a water quench-bath below.

● ● ● RIGHT ON THE PRODUCTION LINE—WITH *MEGATHERM**

In just six seconds Megatherm electronic heat hardens the inside surface of this sheave hub, controlling the hardened depth to vary from .125" at the rims, to .030" at the center.

Moreover, this hardening is accomplished without affecting the toughness of the surrounding metal.

To enable the Kimberly-Clark Corporation to successfully harden this hard to reach part, FTR engineers assisted in solving the problem through the use of megacycle energy.

Megatherm delivers the heat... when you want it... where you want it... *FAST.*

And Megatherm is versatile... will heat treat a wide range of irregular shapes and surfaces... shafts, bearings, cams, gear teeth, lever ends... and in hard-to-reach places.

Write to Dept. M for help on *your* heating problem.

Black area illustrates controlled variation in depth of hardening from .030" to .125", 40-45 Rockwell-C.

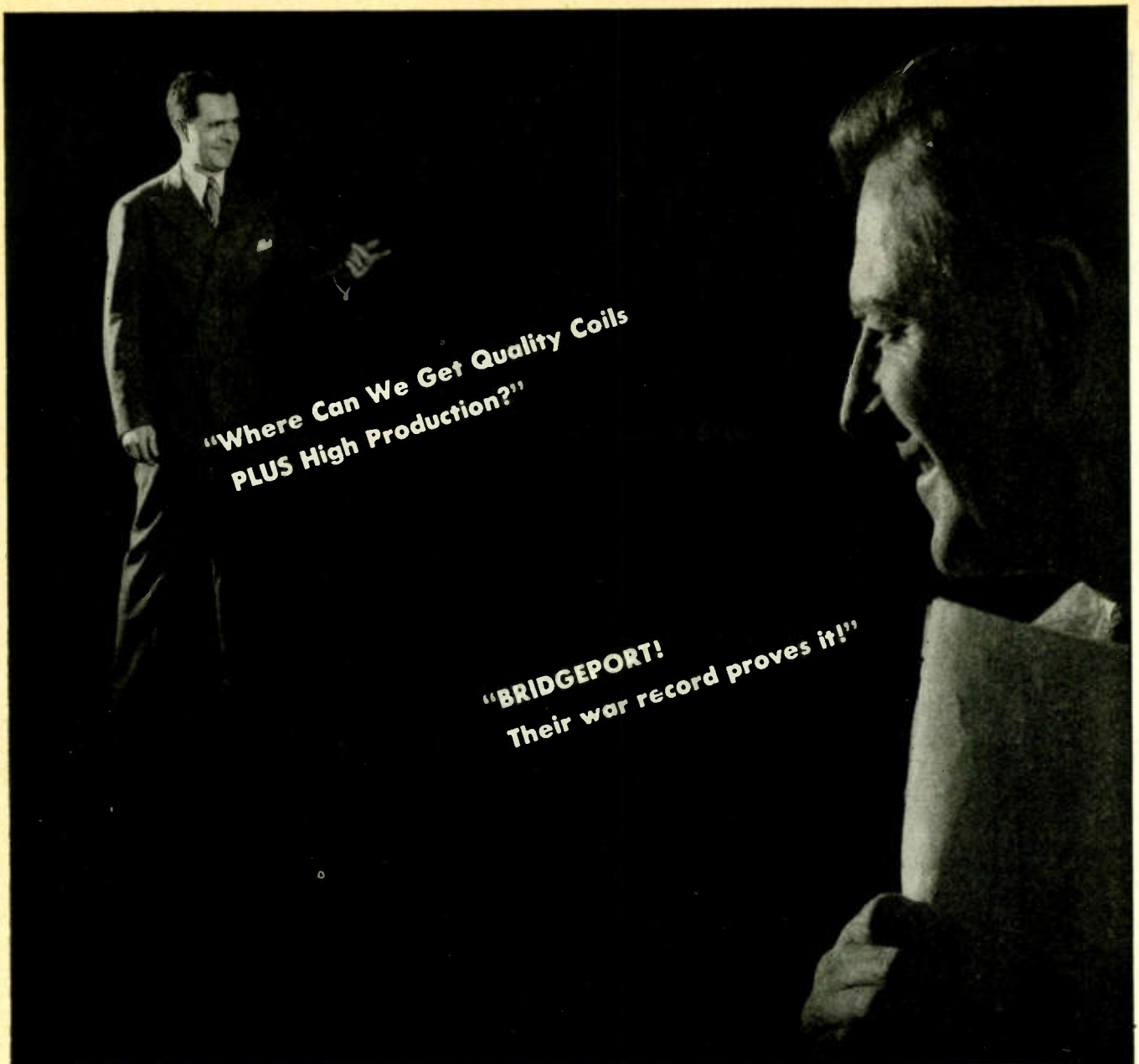
FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

*Reg. U. S. Pat. Off.



Look at Bridgeport's Service Record

Right now, search coils and variometers, built to meet and surpass the most exacting military specifications are leaving Bridgeport by the carload. To do this big war job, Bridgeport has develcped the facilities and the personnel to combine quality with high production.

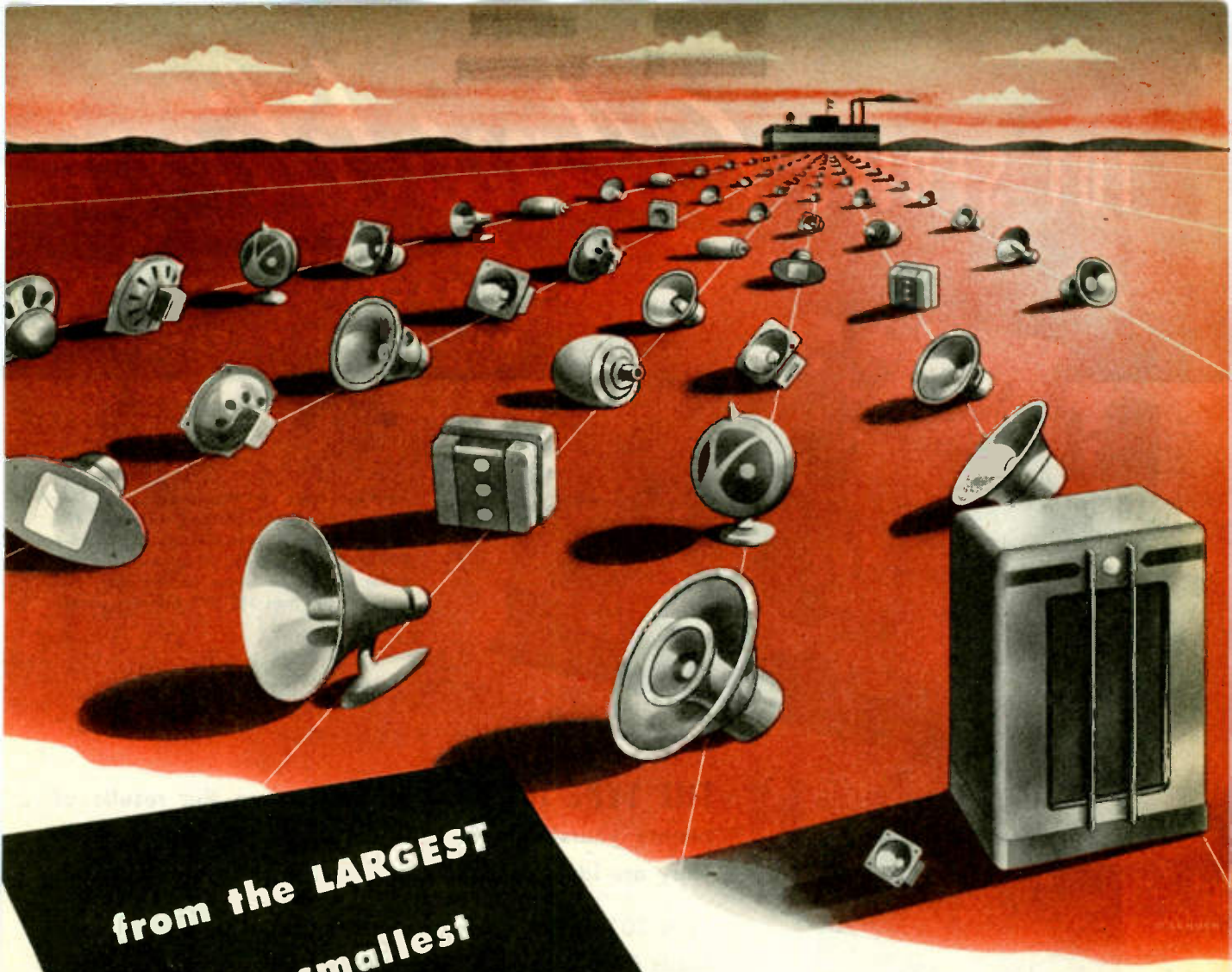
After the war, that combination will be valuable, you will also get the advantage of Bridgeport's location that assures fast, trunk line service to any point in America. Place your order NOW to establish a priority on Bridgeport's postwar production schedule.

BRIDGEPORT

MANUFACTURING COMPANY

Bridgeport, Illinois

R. F. Coils • R. F. Chokes • I. F. Transformers
Transmitting Coils • Transmitting Chokes



Utah's post-war line of quality speakers . . . the most complete ever available . . . will include standard and high fidelity PM's, *all using* ALNICO 5.

Ever since radio speakers have been made, Utah has been a leader. Electro dynamic and P.M. speakers, (based on the new industry standards) . . . wide range (ideal for FM reception)...dual speakers...cabinet speakers...trumpets... whatever your speaker requirements might be, Utah can meet your needs. That's why the Utah Franchise is the most valuable franchise a radio parts distributor can own.

utah

UTAH RADIO PRODUCTS COMPANY • 820 ORLEANS STREET • CHICAGO 10, ILL.

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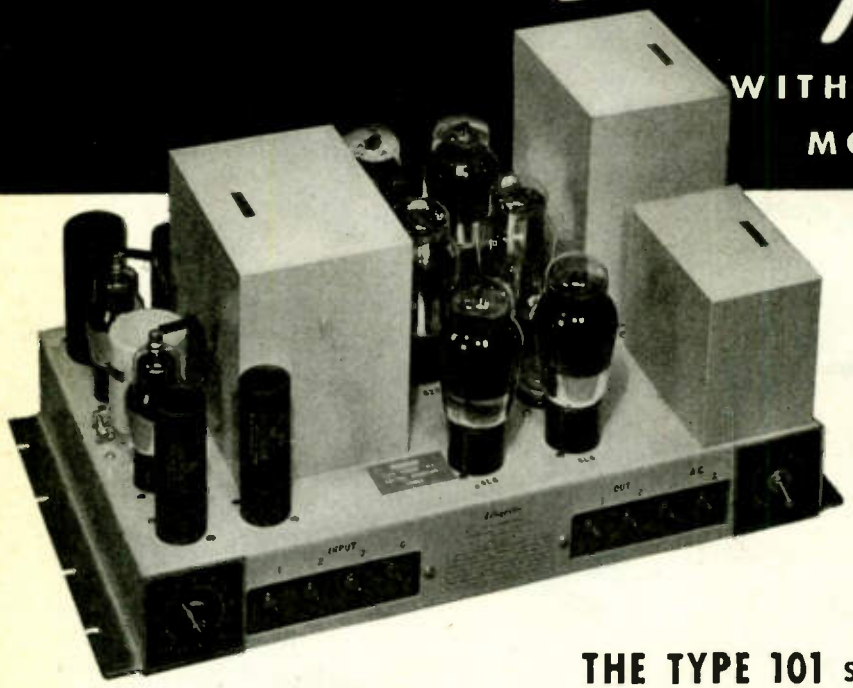
101 SERIES *Amplifiers*

WITH RACK PANEL OR WALL MOUNTING ACCESSORIES



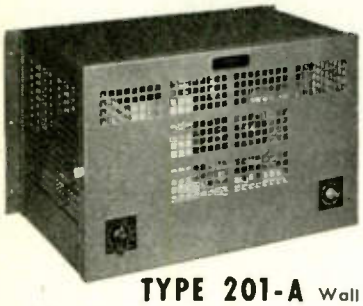
Input impedance 600 ohms and bridging. Gain 600 ohm input 61 db., bridging input 46 db. Frequency response 30 to 16,000 c.p.s. either input—600 ohm output ±.5 db., 30 ohm output ±1 db. Power output—production run average: +47 V.U. with less than 3% RMS harmonic content.

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.

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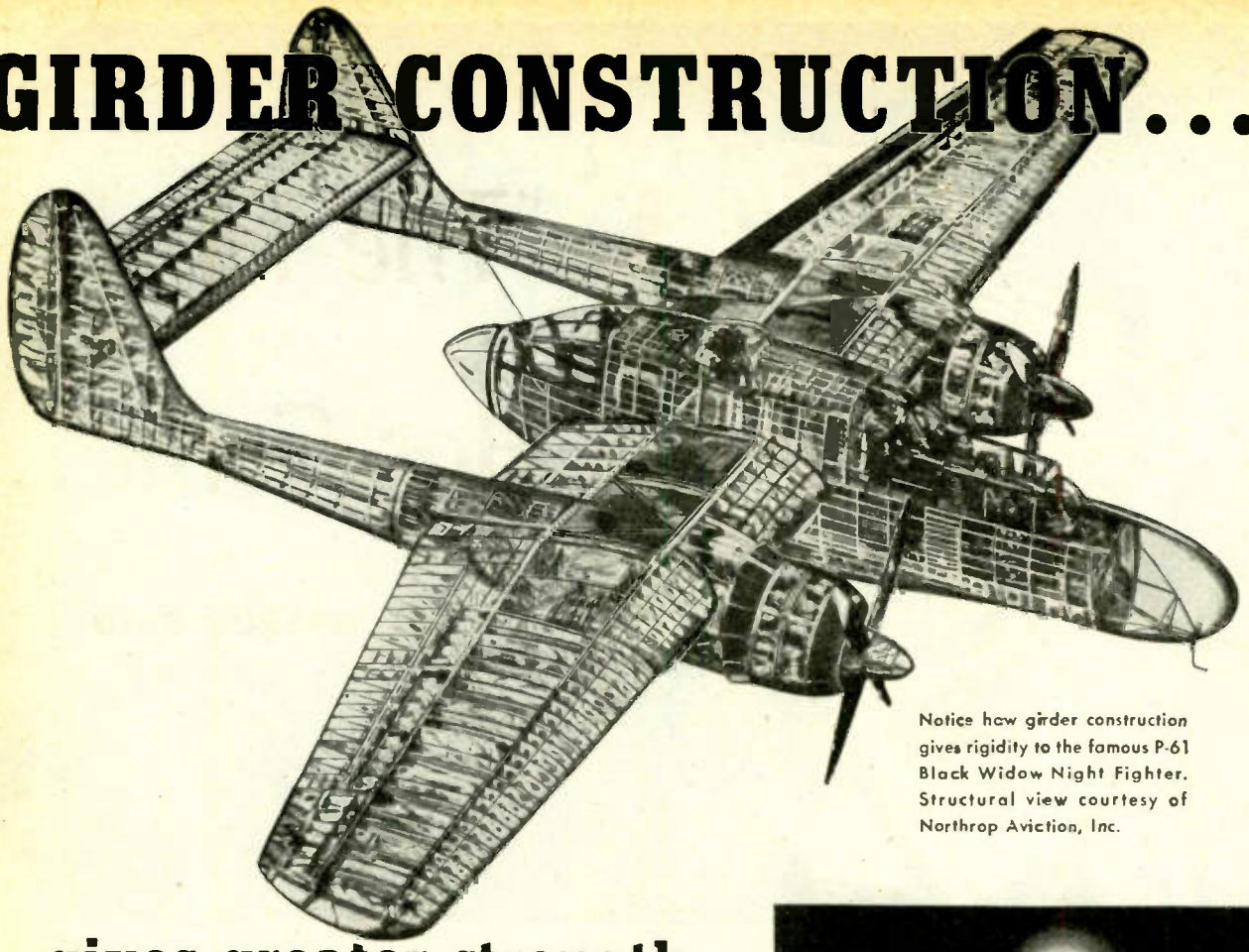

Notice how girder construction gives rigidity to the famous P-61 Black Widow Night Fighter. Structural view courtesy of Northrop Aviction, Inc.

gives greater strength to *Gammatron Tubes*

The same type of construction which gives strength and rigidity to a modern airplane, skyscraper, or bridge has been successfully incorporated into the design of the HK-854 and HK-1054 triodes. Compare the girder construction of the P-61 with the plate and grid supports of the HK-1054—the structural principles are identical! Note particularly how the heavy tripod plate support is welded to large diameter tubing, which in turn is firmly secured to the copper plate cup.

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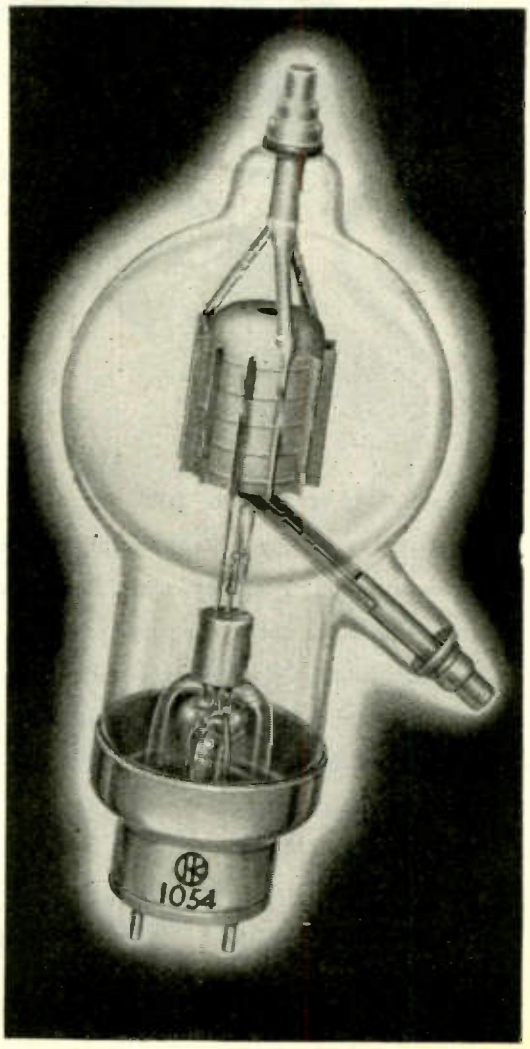

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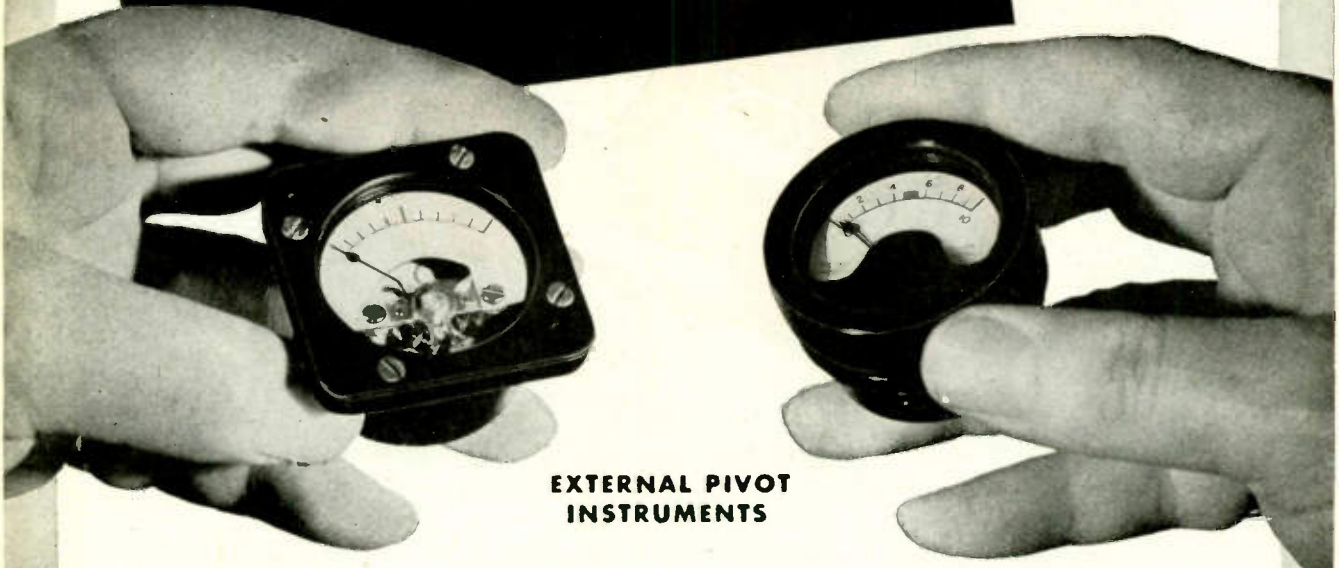

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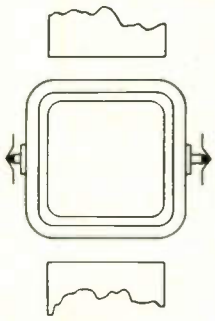

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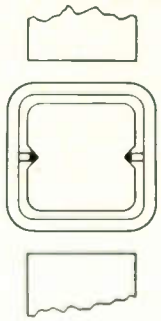

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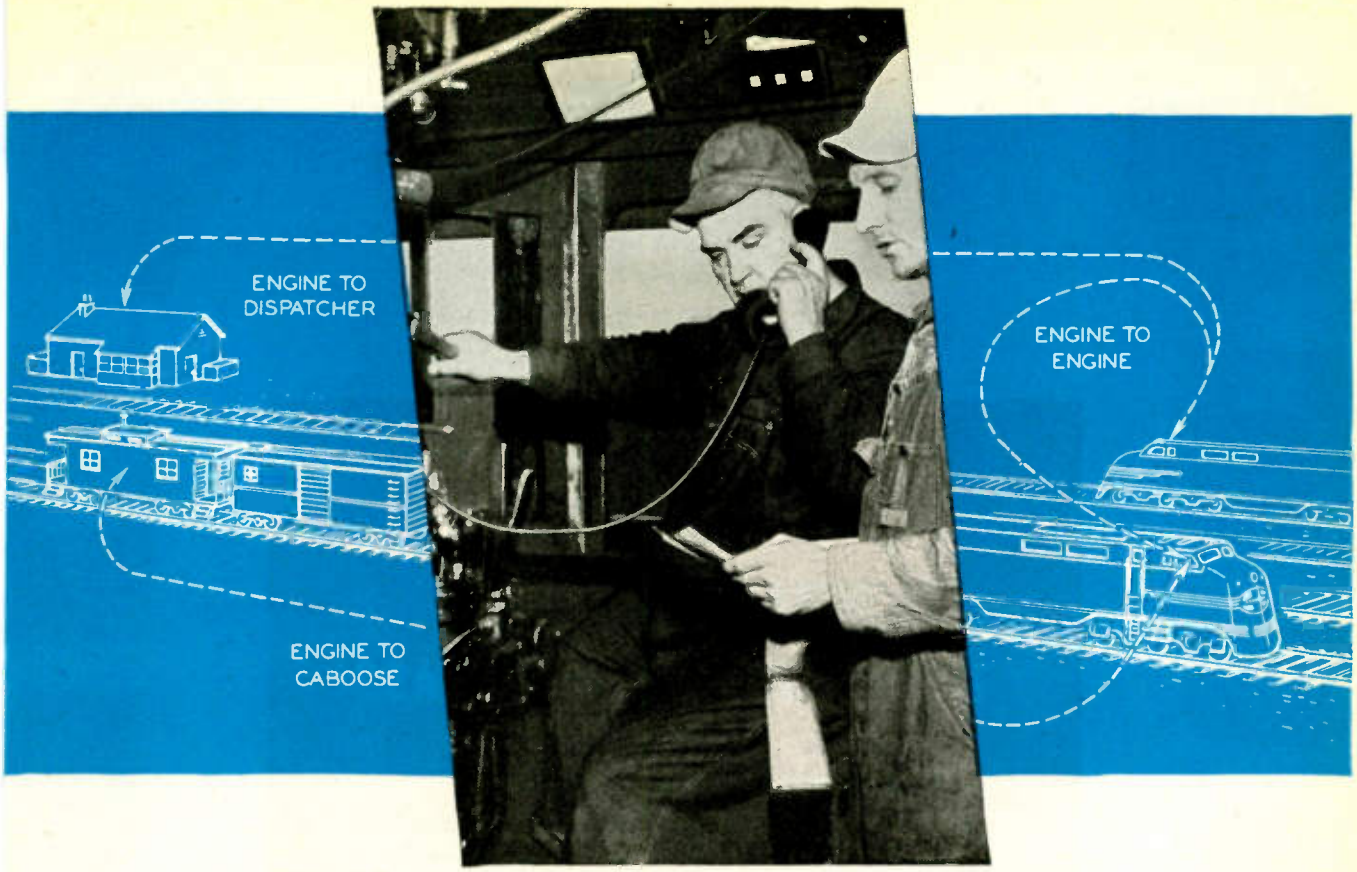

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With a calculated operating voltage, communications equipment can be designed to operate superbly in the laboratory.

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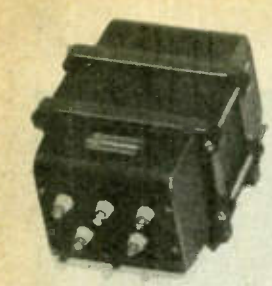
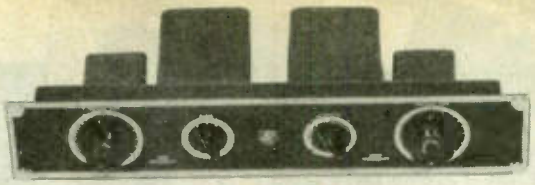


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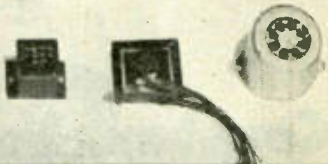

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O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17), N. Y.

Engineering for Post-War

Recent releases from restricted classification have disclosed that most of the mystery devices now playing so important a part in military tactics, have an electronic background. The know-how that went into their development came largely from the experience obtained by a few companies who pioneered in television research. In return, many circuit and equipment component improvements developed as a part of the war effort will bring about improved television service, expanding video's post-war promise.

FM's Travail—and Future!

FM's position in the spectrum is now settled. FCC acted promptly—though a good many FM adherents still feel that the evidence was pretty slim on which the tearing-out-by-the-roots process was based.

But now that the worst is known, designers are going earnestly to work to provide FM sets that will bring in both the old 42-50 mc FM range, and the new 88-106 mc FM assignments. Engineers in receiver design groups are meeting this requirement in various ways—separate tuners, separate bands, special converters, etc. But the hope of all is that FM will go forward to new excellence as the ideal broadcast service!

Electronic Desk-Library

An outstanding example of the creative thinker, Dr. Vannevar Bush proposes an original electronic solution to the modern engineer's great problem of absorbing, classifying and indexing the massive amount of information which is today's inheritance. Pointing out that the human mind does not index its knowledge but calls it up by association of ideas, Dr. Bush imagines a combination of microfilm and electronic sorting techniques advanced beyond present grain size and other limitations, to permit storing whole libraries of information in an ordinary desk.

Christening this imaginary device the Memex, Dr. Bush visions trails formed through this mass of knowledge by associative ideas. Using a ground-glass viewing screen, the owner could follow the trail by pressing sequence buttons and even go on to some branch path of particular interest. Development of such a device would undoubtedly be a long forward step in human history.

12-volt Auto Radios Are "Out"

Nothing much will come of talk about the possibility or probability of automobile radio sets "going 12-volt" in the immediate postwar period. Automobile engineers and lighting experts see some advantages in adopting the higher voltage as a measure to lighten battery loads, but point out that increased battery costs, to say nothing about the premium on space, more than offset the advantages. Besides, the Society of Automotive Engineers is on record favoring a continuance of the 6-8-volt standard that has served so well so long. Set designers won't have to worry about 12-volt tubes for quite a while at least.

Foliage vs. Video

There is little in the records about the effect of summer foliage in blocking home television reception in suburban areas. Yet we find that already a number of set owners have experienced difficulty from this cause. The industry and public will have to be forewarned to expect this seasonal reduction in signal which comes with the outbreak of leaves. Pictures which were solid and "creamy" all winter, may after blossom-time become weak, "snowy," and easy prey to interference.

Higher antennas and tuned dipoles at the receiving end, more power and height at transmitters, will solve the problem of good television reception all year 'round.

WITH THIS ISSUE—COLOR CHART OF THE NEW FCC FREQUENCY ALLOCATIONS

Now that the FCC has definitely fixed television, FM and other services above 25 megacycles, and has presented its recommendations for assignments below 25 megacycles, the editors of Electronic Industries have carefully charted the complete radio spectrum as allocated, and include this large 14½ x 21-inch chart of the new FCC frequencies as a supplement to this issue. The chart illustrates the explanatory article on page 84. Prices of reprints of the chart will later also be obtainable from the publishers, Caldwell-Clements, Inc., 480 Lexington Avenue, New York 17, N. Y.

*ENGINEERING FOR POSTWAR

THERMISTOR TECHNICS

By J. C. JOHNSON
Western Electric Co., N. Y.

Application of new forms of negative temperature coefficient resistors in automatically maintaining levels

• Part I of this article treated mainly of the history and general characteristics of a new group of electrical circuit elements, called thermistors. These elements, which are characterized by their relatively large negative temperature coefficient of resistance were developed by Bell Telephone Laboratories and are now being manufactured by the Western Electric Co.

As was stated in Part I,* thermistors offer a wide variety of electronic circuit applications, particularly in the important fields of regulation, measurement and control. Here again the vastly increased demand for electronic devices for the prosecution of the war has stimulated the development of a device which was utilized only to a somewhat limited extent before the war. Thus, when peace comes, the wealth of knowledge and the scientific achievements of wartime will release for private enterprise a flood of electronic devices, many of which can advantageously utilize the specific characteristics of thermistors.

Although it is the purpose of Part II to describe in some detail a variety of applications of thermistors, security reasons forbid for the present reference to some of the more interesting of these applications. In view of these restrictions, the content of this discussion will be confined to a study of how the three basic types of thermistors, namely, externally-heated or ambient temperature type, the directly-heated type, and also the indirectly-heated type, are used in simple feedback amplifiers as regulation and control devices to effect the economies inherent in an entirely electrical system by eliminating such mechanical devices as motor-driven condensers, sliding contacts and rotary switches.

In Fig. 1 we have illustrated the schematic for a simple feedback amplifier of the type used in telephone carrier systems in which a directly-heated type of thermistor is used to accomplish automatic gain regulation. The thermistor used in this amplifier has a change in resistance of the order of 2.5 per cent per degree Fahrenheit, so that the resistance is approximately halved for every 20 degree increase in temperature. This unit under normal operating conditions offers a resistance of about 20,000 ohms for a current of 0.10 milliampere and approximately 1100 ohms for a current of 1.0 milliampere. Fig. 2 shows the resistance vs current characteristic of this thermistor and its temperature compensating network.

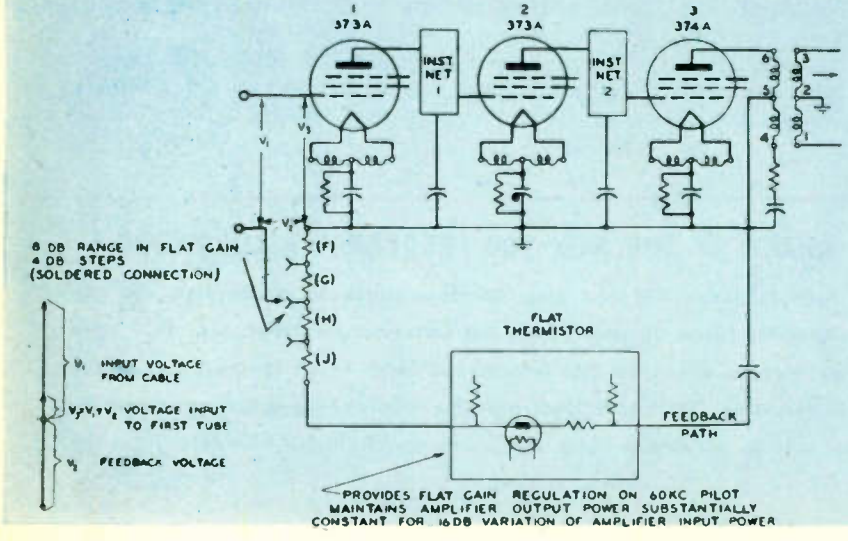
The directly-heated type of thermistor used in the simple feedback type amplifier shown in Fig. 1 is one in which the temperature changes needed to bring about the desired resistance changes are obtained from the heating effect of the current flowing through the variable resistance element which is in the form of a tiny semi-conducting bead.

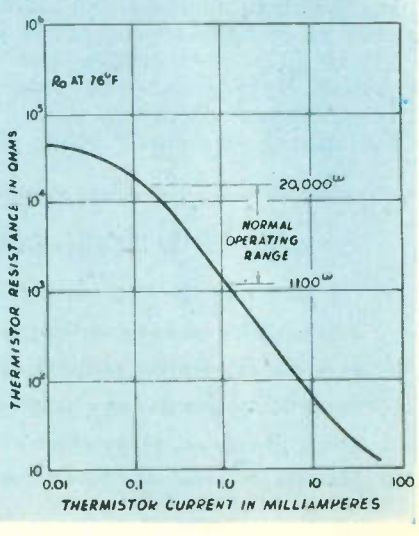
However, for this particular unit it is necessary to take ambient temperature into consideration and, therefore, a special heater wire is embedded in the glass surrounding the bead. Heat, in this instance, is transferred to the bead by conduction and serves only to maintain a reference temperature for the bead itself.

In order to regulate the current for this special heater so as to compensate for variations in ambient temperature surrounding the bead, another thermistor of the disc or externally-heated type, whose resistance varies with ambient temperature, is introduced into the heater circuit between the ac supply and the heater. Fig. 3 shows the thermistor and its temperature compensating circuit and Fig. 4

*"Thermistors in Electronic Circuits," by Ralph R. Batcher, Electronic Industries, January, 1945, p. 76

Fig. 1—Schematic for simple feedback type amplifier with thermistor applied. Fig. 2—Showing operation in linear part of range





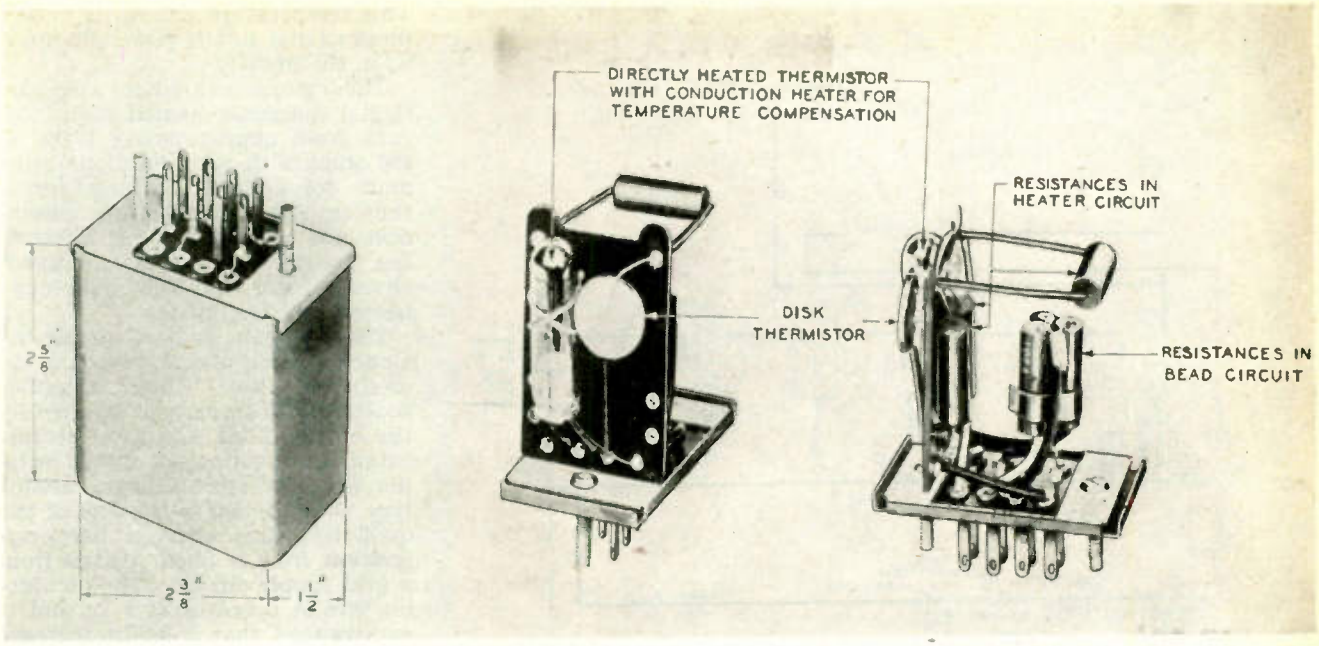


Fig. 4. The two views at the right show a directly-heated type thermistor of the disk type. This unit is mounted with its associated network balancing resistor in a metal container, as shown at the left, making a complete self-contained unit which can be applied where needed

illustrates the final assembly of the unit and two views of the physical arrangement of its component parts.

It will be noted in these illustrations that various known resistances also are built into the network. The purpose of these resistors is to match the thermistor units, which are made under economical manufacturing procedures, into a network which will fit the close electrical tolerances required by the amplifier. This custom building results in maintenance of a fixed operating temperature within 1.0 degree Fahrenheit over the ambient range of 32 degrees to 120 degrees Fahrenheit.

The amplifier itself is a three-tube, one-way type amplifier with negative feedback to stabilize the amplifier and provide a means for adjusting and automatically regulating the gain and boosts currents of all frequencies in the range from 12 kc to 60 kc by the same amount. As shown in Fig. 1, it is in this feedback circuit that the thermistor unit is placed to accomplish automatic regulation. If there is an increase in output due to changes in line losses, the increased feedback current heats the thermistor.

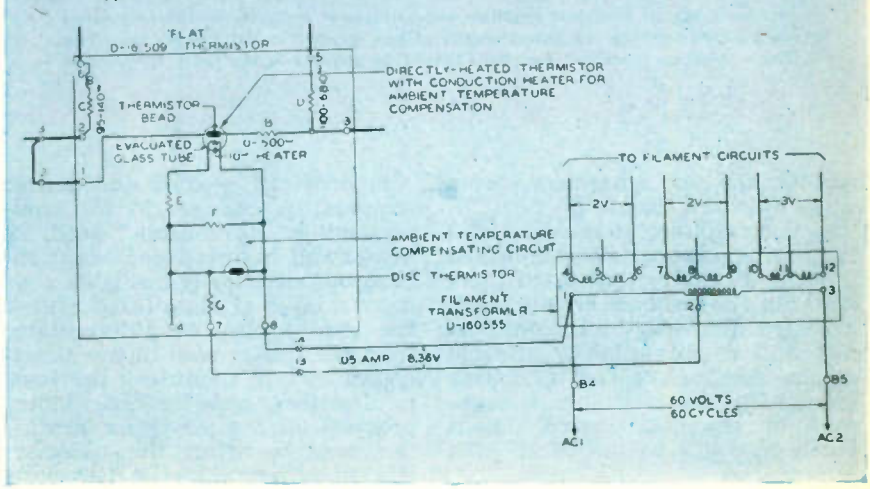
Because of its special characteristics, a small change in the current through the thermistor bead produces a large change in its resistance. Therefore, the resistance drops and the feedback current presents a larger opposition to the input current and a smaller portion of the input signal reaches the grid of the first tube. Thus, the output of the amplifier is restored to its correct level. If the output is decreased, there is a corresponding decrease in the feedback current and the output level is again restored to the level of the transmitter.

Briefly, by means of a thermistor unit, it is possible automatically to control the gain in the amplifier so that the output will be held constant with the output of the transmitting terminal irrespective of the variations in losses in the cable or wires.

In Fig. 5 we have illustrated the schematic of another type of simple feedback amplifier which utilizes several indirectly-heated type thermistors in the feedback path to control the characteristics of the amplifier at two or more frequencies. Whereas, the gain regulation for the previously described amplifier is "flat" or the same for all frequencies, this amplifier takes into account and corrects for the slight errors caused by variations in cable temperature.

The gain in this type of amplifier is under the control of the various pilot currents, namely, the 12, 28, and 56 kc currents, which are introduced into the system at the transmitting terminal. These currents are introduced on the cable at a level of —11 dbm (where "m" means the number of dbs above one milliwatt in a 135-ohm circuit) and at the output of the amplifier each pilot is again returned to a level of —11 dbm so that any distortion in the attenuation-frequency characteristic developed along the proceeding cable is removed. A comparison of the schematics of the two amplifiers in Figs. 1 and 5 shows that the principal difference

Fig. 3 shows a simplified schematic of the compensating circuit used with a directly-heated type of thermistor for taking care of variations in ambient temperature



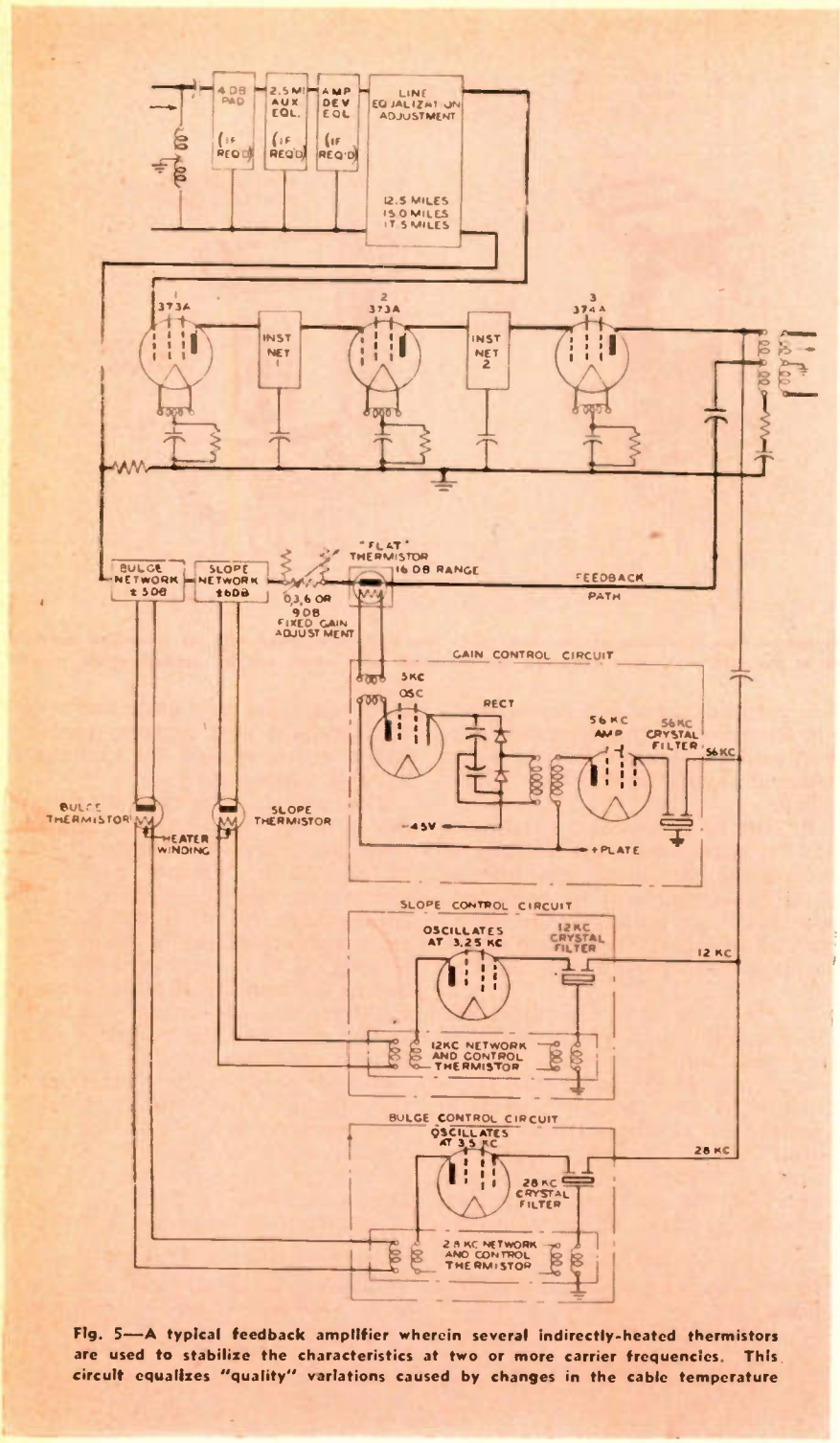


Fig. 5—A typical feedback amplifier wherein several indirectly-heated thermistors are used to stabilize the characteristics at two or more carrier frequencies. This circuit equalizes "quality" variations caused by changes in the cable temperature

between the two amplifiers occurs in the feedback circuit.

In the amplifier shown in Fig. 5 flat gain regulation is accomplished by using an indirectly-heated thermistor in the feedback circuit which is heated indirectly by control current and is only slightly affected by the feedback currents flowing through it. Its resistance is regulated by the gain control circuit which responds to the 56 kc pilot current.

In order to produce the desired temperature changes in the semiconducting thermistor bead, a heater coil is introduced about the bead but electrically insulated from it by a layer of glass fused around the bead itself. As differentiated from the heater used in the directly-heated type thermistor previously described, this heater winding provides all the power for heating the bead to affect the necessary rise in temperature of the bead. This temperature change is closely proportional to the power dissipated in the heater.

The operating range for this particular indirectly-heated thermistor runs from approximately 17,000 to 300 ohms with no corrections being made for ambient temperature as the amplifier's regulating circuit does not require it. Fig. 6 shows the resistance vs. heater current characteristic for the indirectly-heated type thermistor.

The flat gain control circuit includes an amplifying tube and an oscillating tube. The amplifier boosts the 56 kc current selected by the crystal filter and after rectification by a voltage-doubling rectifier, of the Western Electric varistor type, it is applied to the grid of the oscillating tube where it meets opposition from a fixed voltage from a grid supply circuit. The oscillating circuit operates at 5 kc and is so arranged that a slight increase in rectified voltage causes a large increase in oscillation.

The 5 kc current heats the flat gain thermistor, so an increase in current causes a large decrease in its resistance. The decrease in thermistor resistance allows an increased flow of feedback current through the thermistor which, since it opposes the input current to the amplifier, reduces net input to the amplifier and, thereby, restores the increased output of the 56 kc current to its normal level.

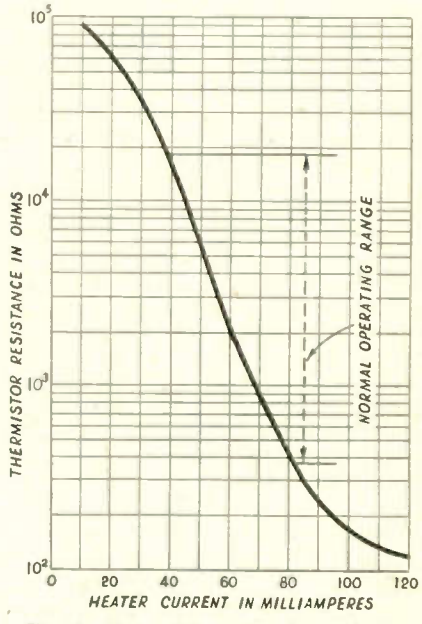


Fig. 6—Many circuits can be controlled most readily with the indirectly-heated thermistor, with its heater in an independent circuit. Typical characteristics shown above

Since the flat gain regulator of this amplifier, like the amplifier shown in Fig. 1, makes the same

gain correction for all other frequencies as it does for the 56 kc current, an accumulated error in transmission occurs because the amount of cable attenuation at the other frequencies varies differently with temperature. The degree of error is greatest at those frequencies which are farthest from the 56 kc pilot. This accumulated error, commonly referred to as slope, is proportional to the difference between the frequency in question and the 56 kc pilot and is corrected by a slope network in the amplifier circuit. The network is regulated by the 12 kc through a slope control circuit.

As in the flat gain control circuit, a crystal filter is used to select the pilot, namely, the 12 kc current, from the output of the amplifier and directs it to a tube that serves both to amplify and to oscillate at 3.25 kc. It will be noted from the schematic that a directly-heated thermistor is used in the slope control circuit to control the amplitude of oscillation. This directly-heated thermistor and its ambient temperature compensating network is somewhat similar to the one used in the first amplifier described for flat gain regulation, the principal difference being that a heater coil is used instead of just a heater wire and heat transfer in this instance is accomplished by radiation instead of conduction.

The effect of the slope network on the overall characteristic of the amplifier is determined by an indirectly-heated thermistor connected in the output of the tube circuit and which receives part of the 12 kc and part of the 3.25 kc currents. By means of this thermistor the output is held substantially constant because, as the amount of the 12 kc current fed into the tube decreases, the thermistor allows the strength of the 3.25 kc oscillation to increase so that nearly constant output power is obtained.

It will be noted that a transformer in the plate circuit is designed to reduce oscillations of the 3.25 kc current which are routed to the heater of the thermistor in the slope network. The resulting changes in the thermistor's resistance causes the slope network to make the necessary changes to restore the 12 kc pilot to its normal level. The circuit constants of the network are such that a small change in the level of the 12 kc pilot current causes a large change in the amount of 3.25 kc current fed to the slope thermistor.

As pointed out above, the 12 kc and 56 kc regulators take care of corrections at both ends of the transmission band. However, further correction is necessary as there may still be some error in the middle of the band not controlled by either the 12 kc or 56 kc regulators. The method used to remedy this type of error is called bulge correction and is accomplished by the introduction of a bulge network in the feedback circuit under the control of the 28 kc pilot current.

The characteristic of the bulge network is controlled by a bulge control circuit which is essentially the same as that for the slope network except that the control circuit oscillates at 3.5 kc instead of 3.25 kc as for the slope circuit. A directly-heated type thermistor is used in the control circuit and an indirectly-heated type thermistor serves as the bulge thermistor. Both of these thermistors are similar to the units used for slope regulation.

Briefly, by means of thermistors the objective of this simple feedback type amplifier, which is to have as small a change as possible in the amplifier's output for a large change in input, is accomplished.

It is obvious from this discussion that the development of the inexpensive Western Electric thermistor and its introduction to simple feedback type amplifiers which are used in such vast numbers for so many purposes in long distance communication have substantially increased the efficiency of automatic gain regulation and substantially reduced their maintenance factor.

A view of a typical test position where thermistors are indivdually checked as to a complete series of operating characteristics. These tests are made on complete units consisting of the thermistor, the heater, and compensating networks

Selenium Rectifiers for Aircraft

● Progress in the development of selenium power rectifiers for converting alternating to direct current on large aircraft is reported in a paper by A. L. Embry, design engineer of tungar and metallic rectifiers at General Electric's Lynn River Works, on the AIEE Spring Program.

Indicating that many of the large planes of the future will have auxiliary power generated as ac but that considerable amounts of dc power will still be required, Embry predicts that the selenium rectifier will have a wide field of application. He states that it has several advantages as a means of conversion: It does not have the high voltage drop of an electron tube nor the moving parts and brushes of a rotating machine; it is simple, reliable, and easy to maintain; for three-phase power input it can be designed for 85 per cent efficiency; weight of a complete unit, including transformer and voltage regulating equipment, compares favorably with that of a motor-generator of the same rating.

According to Embry, selenium rectifiers can be used with transformers to obtain any desired output voltage. Input may be single phase or polyphase. The widest present application is for 28.5-volt dc units with three-phase input. He says that for some applications where the dc load is substantially constant it may be practical to use selenium rectifiers without voltage regulation.

NOMOGRAPH FOR COILS

A chart for determining the length of wire to fill a given spool. Example calculations on wire wound resistors

• For certain applications, such as precision wire wound resistors, a multi-layer solenoid construction is used. The winding form may be ceramic, bakelite or other material and the resistor usually is constructed in sections or pies. These sections are wound to a given radial depth usually as near the outer rim of the form as possible.

In winding special sizes of resistors and making other calculations on different size winding forms, it is useful to use the accompanying nomograph which will give a number of factors relating to this problem.

For example, if the width and depth of the bobbin section, as shown at the bottom of the chart are known, then the number of feet of wire of a particular size that will fill that section can be determined. Another possibility is that the number of feet of a given wire size is known, and it is required to learn the width and depth of the winding. These problems can be solved by following the instructions given below for the specific examples.

Chart basis

The nomograph is based on the theory that the wire is wound in even layers perfectly stacked, and the formula for the feet in each winding section is the value given by the formula at the bottom of the chart. The nomograph is based on this formula. In actual practice the winding on wire wound resistors is not a perfect layer winding, but is a more or less scramble winding in which case the number of feet of wire in the section is somewhat less than that given by the formula and the nomograph. The answer determined by the nomograph usually is about ten to fifteen per cent higher than the winding will permit.

The chart is more accurate for smaller wire sizes than for larger ones since the stacking factor of the wires becomes better. The larger wire sizes tend to overlap and waste more space and therefore do not produce the same results as the chart would indicate.

Wire sizes on the nomograph are diameters in inches. Since the amount of wire that can be put into a given section on the form depends upon the overall diameter including the insulation, scale No. 4 is the overall diameter of the wire. This figure usually is not given by the manufacturer and the actual sample of wire should be checked with a micrometer to give this value. Scale No. 5 is the nominal wire size as listed by the wire suppliers. It will be noted that the relationship between scales No. 4 and No. 5 is approximately ½ to 1 mil. This is an average relationship of enameled wire to bare wire. For insulations other than enamel, another scale may be added parallel to No. 4 and properly offset to it to give easy reference to the nominal wire size and its actual overall diameter.

Typical example

As an example, consider the problem of calculating the length of a given wire size to fill a given section. The width W times the depth D of the section of the spool is given as 20,000 square mils. This value is located on scale No. 1. The maximum mean winding radius for the given spool is 400 mils. This value is located on scale No. 3. A line joining the point on scale No. 1 and the 400 value on scale No. 3 is drawn and this intersects scale No. 2 at point marked 0. This point 0 need not be redetermined every time this particular spool is used and various points for commonly used spools may be so identified by marks on scale No. 2.

The enameled wire to be used in this particular example is 0.0040 in. diameter. The average diameter of this nominal wire size (which is the bare wire size) when enameled is 0.0047 in. The example line (numbered 2) is drawn horizontally from scale No. 5 to scale No. 4, this giving the 0.0047 in. diameter of the wire including the enamel insulation. To find the footage of wire that can be wound into the given section, a line (3) is drawn from point 0 on scale No. 2 through the insulated wire size determined on scale No. 4 until it intersects scale No. 6. The particular example is an answer of 183 ft. which can be wound on this given section size. The resistance of the winding can be determined for the particular wire alloy and size that may be used.

As previously mentioned, the winding radius R is a function of the depth of the section on the bobbin. This relationship, which is given at the bottom of the chart, shows that the winding radius R is equal to half the depth D plus the distance from the center line of the winding form to the bottom of the winding section. The winding radius generally used is the maximum value since it is most economical to wind the wire approximately to the full depth of the section. Where a different winding radius is used below this maximum possible value, the dimension D must also be reduced since this is a function of R.

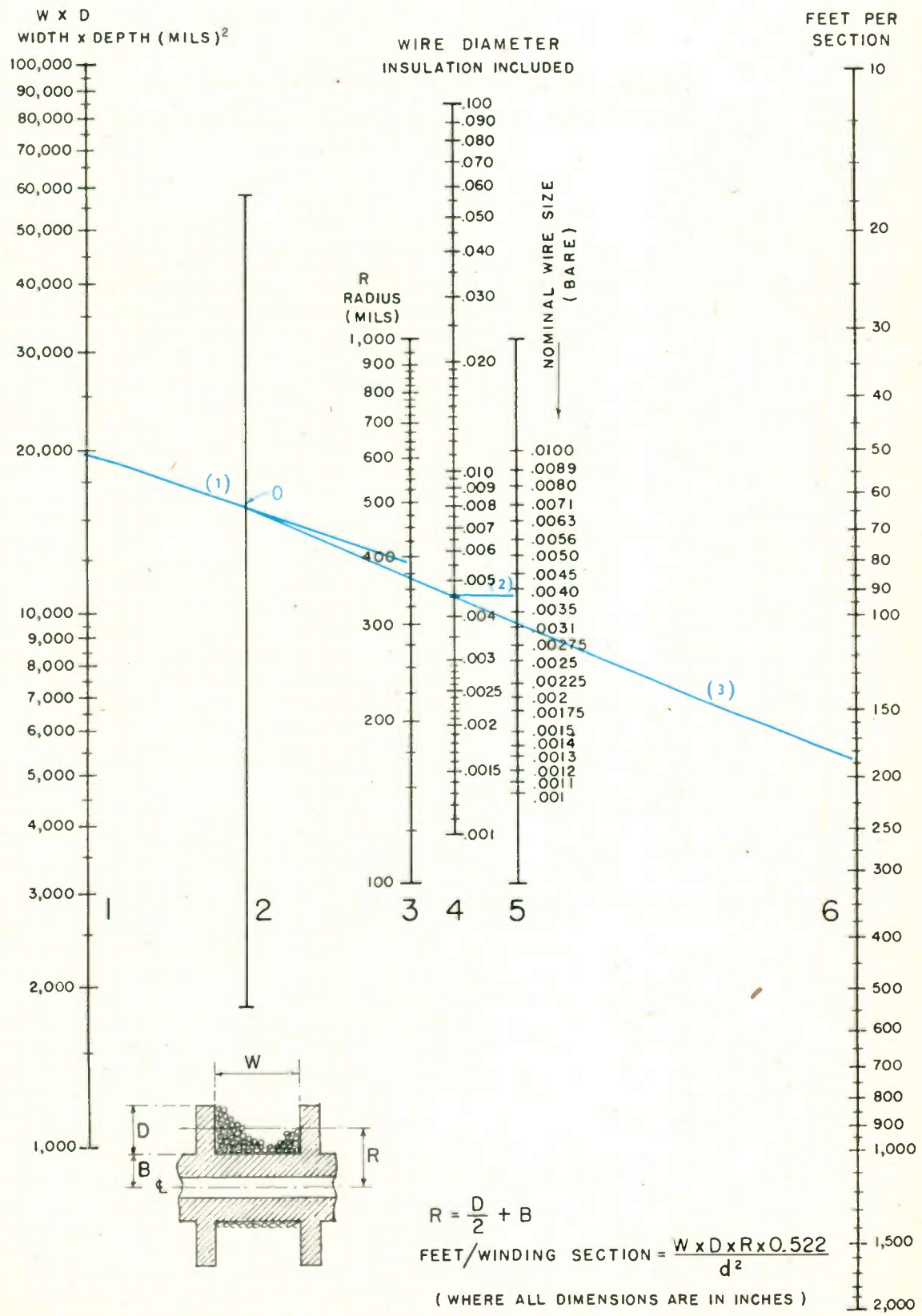
When the total footage of wire and the given wire size are known, the chart may be worked backwards in order to determine the dimension of the winding section required. That is, a line similar to the example line No. 3 can be drawn from scale No. 6 through the proper point on scale No. 4 until it intersects scale No. 2. The intersection on scale No. 2 is then the product of W x D x R. By pivoting a straight edge through this point combinations of W, D, and R may be selected.

Other uses

The mathematical combination of width and depth and winding radius for a given form is identified as a point on scale No. 2. This point is usually too high on the scale for practical winding answers. That is, the point identified as 0 in the example, will give a footage answer which is slightly greater than can actually be obtained. The amount by which the footage answer is high depends upon the wire size and other factors. It averages about fifteen per cent. In order to compensate for this and make the chart more useful, after a given form has been wound several times and examined, the actual footage which is obtained on the form, can be compared to the value given by the chart and a new point located on scale No. 2 by projecting a line from scale No. 6 back through the wire diameter on scale No. 4 to the scale No. 2.

This chart was prepared by the Richardson-Allen Corp., New York, for use in preparing special size wire wound precision resistors.

WIRE FOOTAGE CALCULATOR



TELEVISION OPTICS

By DR. K. PESTRECOV
Scientific Bureau
Bausch & Lomb Optical Co.

Comparison of optical characteristics of refractive and reflective (Schmidt) projection systems for home television receivers

• The projection of a television image from the fluorescent screen of a cathode-ray tube has intrigued many designers of optical equipment, and has taxed their ingenuity to the utmost. In this case they are confronted with an extremely difficult problem because the fluorescent screen of the receiving tube is a relatively dark source of light as compared with incandescent-filament or arc sources which are utilized for conventional motion picture and slide projection.

Two important methods present themselves as possible solutions to the problem. One is the use of refractive optics, i.e. of lenses similar to those used in motion picture projectors, but of a special design based on the specific requirements of the television projection. The second method is the so-called Schmidt reflective optics system where a spherical mirror is used with a refractive component known as a Schmidt corrector plate or a correcting lens.

There are three basic factors which should determine the choice between the two possible systems.

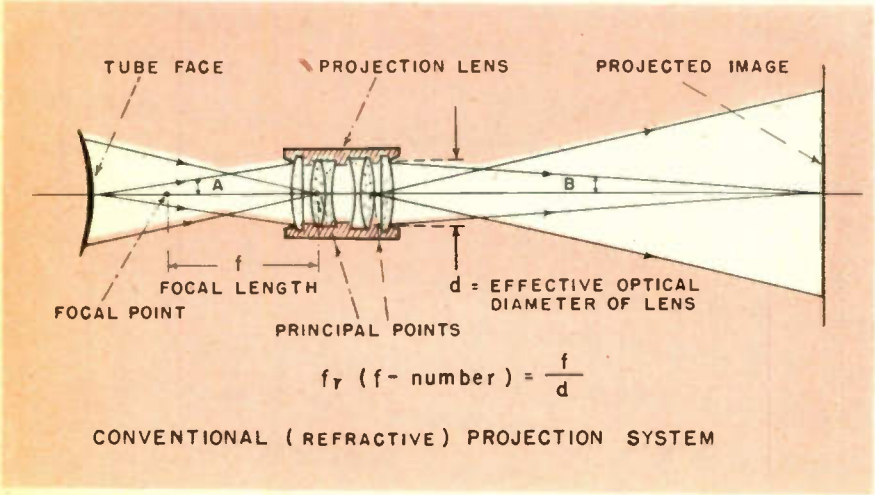
1—The desired brightness of the viewing screen. This depends on the light-gathering efficiency of the system, the image magnification, and the efficiency of the screen itself. Basically, of course, it depends also on the brightness of the cathode-ray tube. With the present status of lens design it is impossible to expect the same high efficiencies with refractive optics as are obtainable with the Schmidt system. Some people are, however, satisfied with the brightness now obtainable with the available refractive optics.

2—Convenience of mounting. If the brightness produced with refractive optics may be accepted as satisfactory, a real advantage may be found in the fact that the lens dimensions are many times smaller than the dimensions of mirrors and corrector plates in Schmidt systems. Another advantage is that a given lens usually is capable of accommodating a somewhat larger range of magnifications.

3—Another important factor is that of economics. No accurate estimates are possible now because they would be significantly affected by quantities of optics required and the desired rate of delivery.

The work of optical manufacturers would be greatly facilitated and more reasonable prices could be expected if some kind of standardization pertaining to tube diameters and to the image magnifications were made effective in the near future.

Basic dimensions for conventional projection lens system applied to problem of enlarging cathode ray tube television image. Angle A determines light gathering efficiency of lens; angle B determines screen illuminating efficency. Lens design would be simplified by using flat face cathode ray tubes. Lens diameter should be approximately tube diameter divded by f. number. Focal length should be about equal to tube diameter



CONVENTIONAL (REFRACTIVE) PROJECTION SYSTEM

Refractive optics

While it is possible to produce a satisfactory optical system with only two parts for projection television (the sperical mirror and corrector plate of the Schmidt system), it is theoretically impossible to produce a single-element or a two-element lens sufficiently free from all the aberrations affecting the image quality of the television projection. Hence it is reasonable to expect that only multiple-element lenses will be found satisfactory in this application.

To obtain a satisfactory image quality all the aberrations should be reduced to a minimum; namely, chromatic aberrations, spherical aberration, coma, astigmatism, curvature of field, and distortion. The problem is essentially the same as with any other projection system. It is, however, more difficult in the case of the projection television system because of the relatively wide angular coverage, the short projection distances, and the requirement for high efficiency.

Theory and experience indicate that at least three elements are necessary to produce anastigmats, i. e. lenses with reasonably well corrected aberrations. When, however, higher efficiencies, wider angular coverage and critical definition are required (as is the case with television projection), more elements are needed for a satisfactory design.

One of the aberrations, curvature of field, may be corrected by a proper shaping of the viewing screen. However, the needed special screen construction may in itself represent a technically and economically very difficult problem.

Inherent to a multiple-element lens is a considerable loss of light in the lens itself caused by the reflections from the various components and, to a considerably smaller degree, by the absorption of light in glass. In recent years significant progress has been made toward the elimination of reflection losses by applying anti-reflection coating to lens surfaces. Thus, using a most efficient experimental anti-reflection coating, the light loss in a single lens element of a high index of refraction may be reduced from about 8 per cent to less than 1 per cent.

Lens losses

In a multiple component lens the light loss is primarily dependent not on the number of components but on the number of air-to-glass surfaces utilized in the lens construction and upon the refractive indices of the components. Using the most efficient commercial anti-reflection coating, the light loss in a lens consisting of four separated elements would amount to about 15 per cent. Another important advantage of anti-reflection coating is that, by practically eliminating the multiple internal reflections and the general "spilling" of light connected with them, it considerably increases the image contrast.

The tube face is an essential part of the optical projection system. It is important, therefore, that the outer and inner surfaces of the tube face be free from surface irregularities. A good fit to a gage may be used as a measure of the required surface accuracy. It is, of course, not important whether this accuracy is attained by grinding and polishing, or by some precision molding process. It would simplify the lens design if the tube face were flat, or, still better, concave toward the lens.

There is no direct relationship between the lens diameter and the tube diameter. However, the lens diameter is a function of the efficiency or of the corresponding f-number desired and the focal length required to produce a given magnification at a given projection distance. The optical diameter of the lens is usually equal to the focal length of the lens divided by its f-number. It is possible, for a given efficiency, to design a lens of any focal length, and hence, of any diameter.

There are, however, practical considerations which limit the choice of focal length and projection distance. For a given tube diameter and magnification, a shorter focal length would require a lens capable of covering a wider angular field. This would further complicate the lens design. On the other hand, if the chosen focal length is too long, the projection distance for a given magnification may become longer than is practicable for home use.

For orientation purposes the following rule of thumb may be used. The focal length of the lens should preferably be somewhat longer than the tube-face diameter. Therefore, as a first approximation, the lens diameter is equal to the tube diameter divided by the f-number of the lens.

The mounting precision of the refractive or lens system with respect to the tube and viewing screen is substantially the same order as for an equivalent Schmidt or reflective optics system.

For evaluating the suitability of a lens for projection television, it is of primary importance to know its theoretical efficiency if, as is customary, only its f-number is given. Here, in absence of standardization it is necessary first of all to define what is meant by "efficiency" of a projection lens.

Efficiency ratings

Fundamental optical considerations indicate that two quantities may be used as a basis for efficiency rating of the lens in a given projection system. One is the relative amount of light which a lens is capable of collecting from an axial element of the source. The second is the relative illumination produced by a lens on an axial element of the screen. Both these quantities are functions of the f-number of the lens and the image magnification.

When two systems working at the same magnification are compared, either of the two quantities will yield the same relative rating if the lens f-number is the same in both systems. If, however, the systems are working at different magnifications their relative rating would depend upon which one of the two quantities is used as a basis for rating, and the comparison may be misleading unless it is definitely indicated what basis is used for the comparison.

Although a rating based on the relative illumination gives a more direct answer as to the merits of a given system, the relative amount of light collected by a lens is of such a fundamental importance that it may be undesirable entirely to disregard this quantity as a basis for efficiency rating.

For lack of better terms, the two efficiencies of a system may be called the "light-gathering efficiency" (e) and the "illuminating efficiency" (e') or the "relative illumination."

The following relationships exist between quantities e and e' and the half-angles subtended by the effective lens diameters at the source and at the screen respectively. See illustration at left.

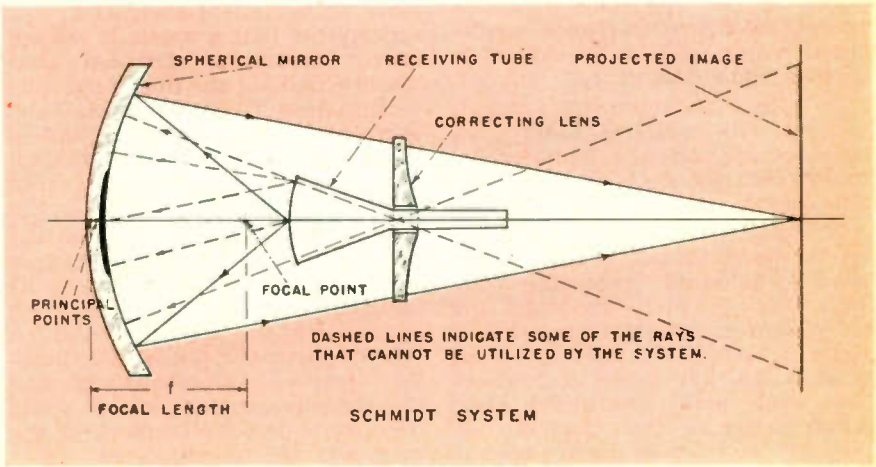
$$e = \sin^2 A \qquad e' = \sin^2 B$$

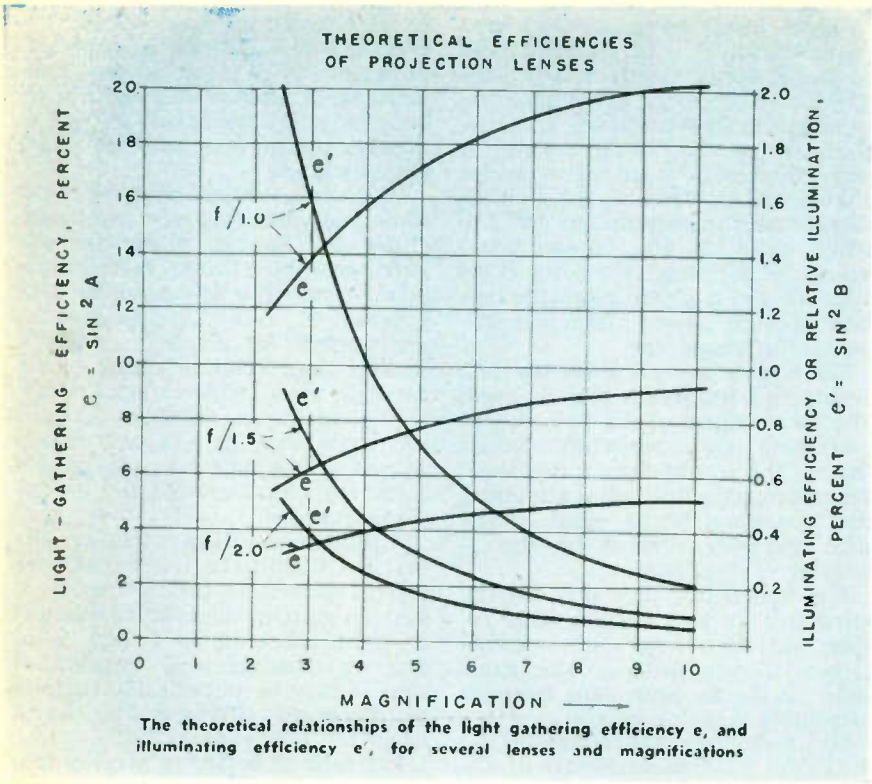
The following simple relationship connects these two quantities:

$$e = m^2 e'$$

where m is the image magnification.

Principal parts and physical arrangement of the reflective, or Schmidt, projection system for television receivers. Basic parts are a front surfaced spherical mirror, an aspherical correction lens, and a curved face cathode ray tube. The central part of the mirror, which is represented by the heavy arc, is about equal to tube face area and is blacked out to improve the image contrast by reducing the light reflected back onto the tube face. Dashed lines toward viewing screen represent light lost by tube's blocking of path





The theoretical relationships of the light gathering efficiency e, and illuminating efficiency e', for several lenses and magnifications

The exact equations connecting e and e' with the f-number (f_n) of a lens are rather complicated. For most practical purposes the following approximations may, however, be used for lenses in projection systems:

$$e = m^2/4f^2_n(m+1)^2$$
$$e' = \tfrac{1}{4}f^2_n(m+1)^2$$

It should be noted here that these formulas require that m be treated as a positive quantity, although generally in optical design the magnification is considered negative if the image is inverted with respect to the object, as is usually the case in projection systems. Furthermore, it should be noted that all these relationships disregard light losses in the lens because such losses depend on lens construction and cannot be introduced in the efficiency equations except as a transmittance coefficient, which should be evaluated in each individual case.

In the accompanying graph (above) efficiencies e and e' of lenses of the various f-numbers are represented as functions of magnification.

In connection with general interest in plastics, a few words should be said regarding the suitability of such materials for the design of well corrected multi-element lenses. Generally speaking, plastics are not magic substances that would make lens design easy. As a matter of fact, they do not possess any exceptional optical properties of especial value to a lens designer, and their mechanical properties are not the most favorable for maintaining the optical precision of surfaces.

It still should not be excluded that plastic lenses or plastic and glass combinations may be designed for use in projection television receivers. It is doubtful, however, that such lenses could be produced at a significantly lower cost than all-glass lenses. Nevertheless, the fact that Schmidt corrector plates are successfully made of plastics may serve as indication that the situation is far from being hopeless.

Reflective optics

While a correcting lens is necessary in the Schmidt system to remove the spherical aberration, it is conceivable that a specially shaped mirror could be designed that would eliminate the need for a correcting lens. It is doubtful, however, that the problem could be satisfactorily solved and that such mirrors could be produced on a commercial basis.

An all plastic mirror is possible. The basic question here is whether such a mirror would maintain its accuracy as the plastic may exhibit a characteristic cold flow and an "elastic memory," and would therefore tend to produce distortions of the reflective surface which would necessitate the replacement of the mirror in the television set.

The reflection losses of light from a silvered mirror surface would be less than 4 per cent. There are, however, no good commercial methods available as yet for protecting silvered surfaces from tarnishing. Hence, the best choice at the present time is the aluminized surface. Reflection losses from such surfaces amount to between 10 and 15 per cent. These surfaces are delicate and great care must be taken to avoid damage to them when cleaning. In addition to the reflection losses on the mirror, the light loss in the correcting lens would amount to nearly 8 per cent.

Mirror corrections

While all the aberrations affecting image quality should be corrected, in the design of a Schmidt system advantage is taken of the following:

1—Mirrors are not afflicted with chromatic aberrations.

2—A system consisting of a spherical mirror and a stop or aperture at its center of curvature practically eliminates all of the monochromatic aberrations except spherical aberration and the curvature of field.

To eliminate spherical aberration without introducing disturbing amounts of other aberrations, a correcting lens with a properly shaped surface is placed at the center of curvature of the mirror. To compensate for the curvature of field, the tube face should be concave to the mirror. Because of the high efficiencies utilized in the Schmidt systems, the optical accuracy of the tube face is even of a greater importance than in the case of refractive optics. Therefore, it should be not only free from surface irregularities, but its thickness and the curvatures of the outer and inner surfaces must be precisely related to the radius of curvature of the spherical mirror and to the projection distance (throw) of the system.

Although there is no direct relationship between the mirror diameter and the tube diameter, the basic condition is that the mirror diameter should be larger than the tube, otherwise all the reflected light will be blocked by the tube. How much larger it should be depends upon the efficiency desired, on the focal length required to produce a given magnification at a given projection distance, and on the tube diameter. No simple equations relating these parameters and the mirror diameter are available. A good guess for home television receivers is that the mirror diam-

(*Continued on page* 146)

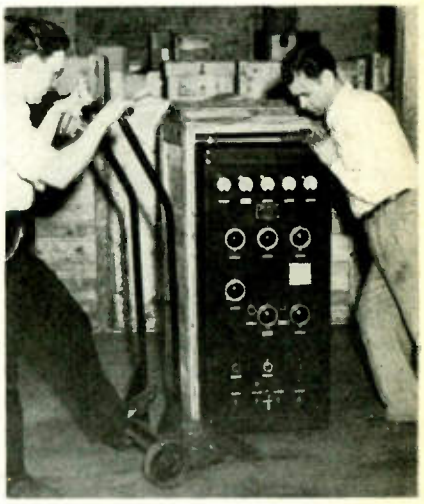
SURPLUS DISPOSAL

Government bodies, linked with industry, seek to make effective an orderly program to prevent market chaos

• An estimate that from three to five billion dollars worth of surplus radio and electronic material will have to be disposed of following the end of the war and at the time when sizable reduction in the Army and Navy and Marines will take place. With this in mind the federal government officials of the Surplus Property Board (SPB) and the Defense Supplies Corporation (branch of the Reconstruction Finance Corporation) revealed that there is a definite possibility that the surplus "may take a large bite out of the post war market" unless a smooth running disposal program can be effected immediately.

Under the present surplus program, all radio and electronic material is to be sold through the 31 offices of the RFC's surplus division with each manufacturer acting as an individual selling agency. The business is handled much like any other enterprise with the manufacturer receiving a ten per cent commission on his sales.

Matters pertaining to the disposal of surplus units and components are of grave concern to the whole electronics industry. As set up now by the government, the plan provides for a straightforward attack at the problem and anticipates a solution that will work to everyone's advantage. If the plan fails—well, it is anyone's guess what may happen.—Editor.



Uncrating a surplus airport transmitter at Belmont-operated DSC disposal plant, Chicago

Tubes biggest item

Tubes will be the biggest item on the surplus list after the final inventory is taken. These tubes will represent a variety of types from the high power transmitting tubes, to radar tubes, etc. A large percentage will represent ordinary receiver type tubes that are on the civilian market today.

The general expectation in Washington is that components will be the item that may hit the peace time market. This is believed to be true to a very great extent by surplus officials due to the fact that the complete units that will be declared surplus in most cases are located overseas and SPB rulings have declared that "no surplus war property will be re-imported back to the United States but instead will be sold in the foreign country located." The sale of this material will be handled by the United States Liquidation Commissioner who will follow the rules and regulations set up by SPB for the sale of surplus war material."

Other components that will likely be available in huge quantities include capacitors, resistors, transformers and sockets. These items will number into the millions and will be available in this country for the open market.

In order to insure an orderly disposal of this material, and to prevent as much as possible a "flooding of the market" condition, SPB and DSC agencies have acquired the services of noted radio engineers including Robert Battle, Philco engineer, who has been loaned to the government by Philco for the disposal program.

Floor on pricing

The way in which the surplus property impact will be felt by the radio and electronic industry will depend entirely on the way the industry helps handle the disposing of the goods. If the program falls by the wayside the government will be forced to take more drastic steps in disposing of it.

The floor on the pricing of the material has been laid, officials point out, but if the disposal program is not carried out in an orderly fashion, the surplus material will have to be thrown on the market on a "get what we can basis," and with little regard for the economic market at that time.

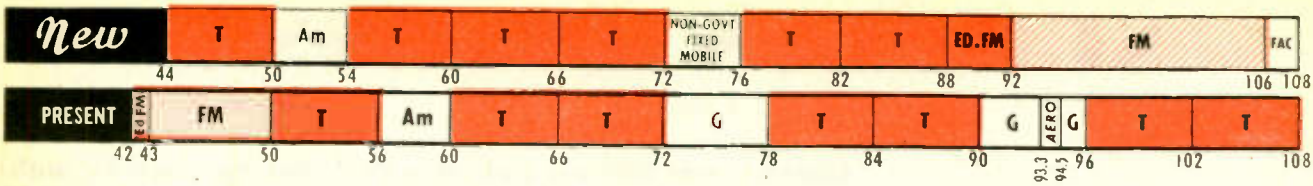
From a percentage standpoint, the surplus radio and electronic material disposal is likely to follow the following course, according to SPB officials:

40 per cent—competitive market
30 per cent—sold at a low price to "non-profit" organizations and educational institutions
30 per cent—unusable and will be sold as junk or scrap material

"Wildcat" dangers

Defense Supplies Corporation officials agreed with the SPB officials in these percentages and they also point out that the forty per cent estimate was taken in view of the fact that about seventy-five per cent of all military equipment is made from standard civilian type components. Both the War Production Board and Army, Navy and Marine official sources agreed to this percentage regarding civilian standard components. (In an oral discussion during RMA's reconversion committee meeting held two months ago in Chicago, it was agreed that only about three per cent of the material would be usable after the war in civilian markets.)

Keeping the forty per cent figure in mind, the government officials said, if the situation got out of hand, and the material did flood the market, it would encourage "every loft operator in the country" to wildcat the radio home receiving business. New makes of radios, of an inferior type would appear on the market and if this was allowed to happen it would put a definite black eye on the entire industry.



Relationship between present utilization of radio spectrum between 42 and 108 mc and newly adopted allocation (representing a modification of the original Alternative No. 3 proposed by FCC) are charted for comparison: T—Television; Am—Amateur; G—Government; Fac—Facsimile

*ENGINEERING FOR POSTWAR

44-108 MC ALLOCATIONS

Engineers generally approve final adoption of revised Alternative No. 3 putting FM upstairs and television down

• FM goes "upstairs" after all—a bit further "upstairs" than the original FCC proposal (82-104 mc) and higher, even than the controversial "Alternative No. 3" proposed for that part of the spectrum between 44 and 108 mc in frequency allocations from 10 kc to 30 million kc made final by FCC last month. And the general feeling is one of relief—relief that radio's two fastest growing services, FM and Television, at long last have found a permanent home.

The decision to put FM up and Television down, states FCC, was made strictly for engineering reasons, and specifically in order that FM may be capable of rendering the kind of interference-free service for which it is justly famous. Interference-free service, it is believed on the weight of technical data, could not have been possible either at the present FM spot in the spectrum, or at the place represented by Alternative No. 2 which has been the much publicized first choice of all but a very tiny segment of the entire industry.

Simultaneous transmissions

Major Armstrong, father of FM, has been one of the most outspoken critics of any proposed shift away from the current spot between 42 and 50 mc, but suggested that if a move appeared inevitable something around 60 mc would be best. He still feels that preponderance of evidence based on five years successful operation in the present band outweighs all other evidence. He says, however, that FM undoubtedly will work, and well, in the new band, pointing out that his original experiments were carried on at frequencies between 110 and 117 mc. He has even gone so far as to make known the fact that he has developed a method of transmission which will permit broadcasters to transmit simultaneously on both the old and the new frequencies, thus eliminating the bug-a-boo of obsolescence feared by the industry and the present 375,000 FM set owners.

Television channels

The Television people have not publicly expressed any apprehension over dropping down to the lower slots in the spectrum. They feel some slight elation over the fact that the new allocation makes immediately available all 13 channels below 300 mc. At the lower frequencies at which Television will function, it is pointed out, there is little likehood of co-channel interference because of the considerably lower sensitivity of Television receivers and the much wider geographical location of transmitters. Temporarily, at least, the first five Television channels must be shared with other services. In this respect FCC engineers point out that they plan to move with extreme care to make sure that nothing interferes with Television development or services.

So far nothing very definite has been made known by FCC as to when actual services may begin on the new allocations. Their use will be authorized, FCC engineers state, as soon as the various services indicate that they are ready to go ahead. This goes for FM, Television and all the other multitudinous services provided for in the complete allocation table.

Those services are many and varied, representing as they do developments that have come about since last the spectrum was divided up. Many services that never before have had definite spots now have specific allocations; there are a great number of shared channels allocated for the first time as a result of experience which made plain such possibilities. Experience is still lacking regarding the higher frequencies and for this reason all non-government allocations above 450 mc are classified as "experimental."

The really important part of the whole allocations matter, of course, is that manufacturers are now in a position to go ahead with engineering design with all the guesswork taken out. They can't manufacture—yet—because the "freeze" order of last January is still in effect. However, WPB has let it be known that "spot" authorizations will be made at the earliest possible moment, and all restriction wiped away practically coincident with VJ day, and maybe sooner.

420 FM applications

Manufacturers of transmitting equipment—FCC has "tabled" applications for some 420 FM and 119 Television stations—are in a somewhat different position, for the new allocations call for new engineering standards and nothing can be done until such matters are cleared up. FCC Chairman Paul Porter states that "the Commission expects to confer at an early date with representatives of industry groups with the view of scheduling a meeting sometime this month (July) of all interested parties to formulate the industry's proposals for rules and standards." Meantime he has advised manufacturers to design their receivers to cover the entire band from 88 to 108 mc with the thought that Facsimile may ultimately go into the 400 mc region, in which case FM would get another 2 mc above the new 106 mc top.

Decision to adopt the "Alternative No. 3" plan came immediately

after additional hearings held by FCC during June 22-23 and before tests to determine the best plan, scheduled for all summer, could be fairly started. They are to be continued, however. The Commission's decision in making these allocations final was based on propagation data largely accumulated by the military, unquestionably as a result of radar experience, and never made public for security reasons, though some industry engineers were permitted some knowledge of the facts in a closed hearing immediately following the public hearings that preceded the original allocations proposals.

Justifying the position it has taken in the final adoption of what amounts to the "Alternative No. 3" with minor adjustments, the Commission has issued a "Report of Allocations Between 44 and 108 mc," which states in part:

"Various objections to assigning the higher frequencies to FM have been raised. . . . For example, it has been alleged that tropospheric interference may be worse in the vicinity of 100 mc than in the 50 mc region. The Commission in its report of May 25, 1945, specifically pointed out that there would be some difference in tropospheric propagation; but this difference would be only slight and that tropospheric interference at the higher frequencies could be eliminated by slightly increasing the geographical separation between stations. This evidence was not controverted at the oral argument on June 22 and 23, 1945, and Dr. Beverage, one of the propagation experts chiefly relied upon by persons favoring Alternative No. 1, testified that tropospheric effects change slowly and that they would not be greatly different throughout the range of frequencies under consideration.

No long delay

"The point has also been made that equipment for use in the vicinity of 100 mc will cost more than equipment for use in the vicinity of 50 mc. This will no doubt be true at least temporarily, but it seems equally clear that competition will reduce the differential substantially, and that the benefit to the public resulting from an interference-free service will more than outweigh the slight increase in initial cost for service in the 100 mc region.

"At the earlier hearings, some contended that FM might be delayed for two years or even longer if FM were assigned to the higher frequencies. At the time of the oral agreement, June 22-23, 1945, the estimates of delay were reduced to four months. It may well be that competition will markedly reduce even this four-month estimate. Moreover, this report makes it possible for manufacturers to begin at once their planning and design for the higher frequencies. The WPB has not yet authorized construction of AM, FM, or television equipment for civilian use; and some months may still elapse before manpower or materials become available in sufficient quantities for such production to begin. If so, the planning and design of equipment for the higher frequencies can be completed before civilian production of any AM, FM, and television equipment is authorized.

Public protection

"Manufacturers, of course, are desirous of marketing FM receivers at the earliest possible moment; and the Commission, too, is concerned that FM receivers shall be freely available to the public early enough to supply the immediate post-war demand. However, the Commission has a duty to consider the long range effects of its action as well as the effects during the months immediately ahead, and it does not propose to provide an inferior FM service during the decades to come merely because of the transitory advantages which may be urged for an inferior type of service.

"Earlier in these proceedings, much emphasis was placed on the presumed hardship which would result to the approximately 400,000 persons who had purchased FM receivers before the war. Most of these receivers are combination AM-FM and the AM part of the receiver will continue to be used. There is now substantial agreement that the band (42-50 mc) for which these receivers were made is wholly inadequate and unsuited to FM reception.

"Accordingly, no one today argues that postwar FM should be degraded to the point necessary to accommodate these receivers. However, interim operation in the present band from 42 to 44 mc is being provided until such time as equipment for the higher frequencies is freely available to the public and until owners of existing receivers have had equal opportunity to adapt or convert them to the new band. In this connection, a converter was demonstrated to the Commission which would make existing FM receivers capable of tuning to the higher frequencies and which should retail for approximately $10."

SEE FREQUENCY ALLOCATION CHART SUPPLEMENT

With this issue of Electronic Industries there is included as a Special Supplement a frequency allocation chart showing the division of the complete radio spectrum as adopted by the Federal Communications Commission. However, not all allocations have as yet been made final. The region below 25,000 kc likely will not be finally approved for several months though it is not anticipated that there will be any great change from the allocations that have been proposed by FCC and that are shown on the chart. The region above 25,000 kc and extending to 30,000,000 kc has been definitely allotted and the data included on the Chart represents the final choice of FCC in this respect. The Chart is one of a series covering various aspects of electronic applications to communications and industry which appear at regular intervals and long have been an editorial feature of Electronic Industries

Approximate hours per year of interference from sporadic E layer transmissions at the 100 microvolt per meter contour from 50 kw FM stations with an antenna gain of six representing 300 kw effective radiated power as compiled by FCC for transmission at various frequencies

mc	2:1 ratio, one co-channel station hours	2:1 ratio, full channel occupancy hours	10:1 ratio, one co-channel station hours	10:1 ratio, full channel occupancy hours
43	95-173	475-865	157-429	785-2145
58	16-32	80-160	27-81	135-405
48	54-100	270-500	90-247	450-1235
66	6.4-13	32-65	10-33	50-165
84	0.75-1.7	3.75-8.5	1.2-4.5	6.0-22.5
104	0.07-0.18	0.35-0.9	0.12-0.46	0.6-2.3

*ENGINEERING FOR POSTWAR

MAGNETIC POWDERS

By H. GREGORY SHEA
Associate Editor, Electronic Industries

Many physical and chemical characteristics bear on the usefulness of metallic and compound iron powders

● While the use of iron powder has increased greatly in the last 15 years, the principal tonnage has gone into industrial parts which can be made inexpensively and substituted for costly shapes machined out of solid stock. Much research work has been done toward developing the process in large industrial laboratories. One objective has been to obtain a powder at five cents a pound or less. In addition, purity and physical characteristics have been sought which would permit compression and sintering with relative ease, and would result in a high strength product. When such a low cost powder is developed, use can be further increased to the point warranted by the ease of its application.

Aside from relatively impure crushed iron, none of the powders on the market is currently within this low price range as may be seen from the following table of iron powder prices:

	Per lb.
Iron, crushed, 200 mesh and finer 90 per cent	$ .04
Iron, commercial 100 and 200 mesh 96 per cent	.12½— .15
Iron, electrolytic	.40 — .65
Iron, hydrogen reduced	.60 — .70
Iron, carbonyl	.90 — 1.75
Magnetite	.12 — .20

Manufacturers of radio cores and coils, on the other hand, have been obliged to direct their attention first to such factors as the Q of a given coil and core combination, the frequency range over which it is usuable, and the ratio of minimum to maximum inductance obtainable. Naturally, however, here also cost is important and will become increasingly so as usage is extended.

Of course, the Q of any given combination is fairly easy to measure, but so many factors affect it that its predetermination has been an empirical art, and while a substantial amount of work has been done on the problem of reducing it to an exact science, this goal has not yet been achieved.

A consequence of this lack of knowledge has been that much secrecy and mystery have enveloped the products of radio core manufacturers as each has sought to guard his painfully acquired tables of practice from the knowledge of competitors. Such a tendency has undoubtedly retarded the growth of this highly useful art.

Iron cores are introduced into electronic coils to increase the ratio of inductance to size. They are also put in as a means of varying the inductance to permit tuning circuits inductively, and for other purposes.*

Why powdered iron?

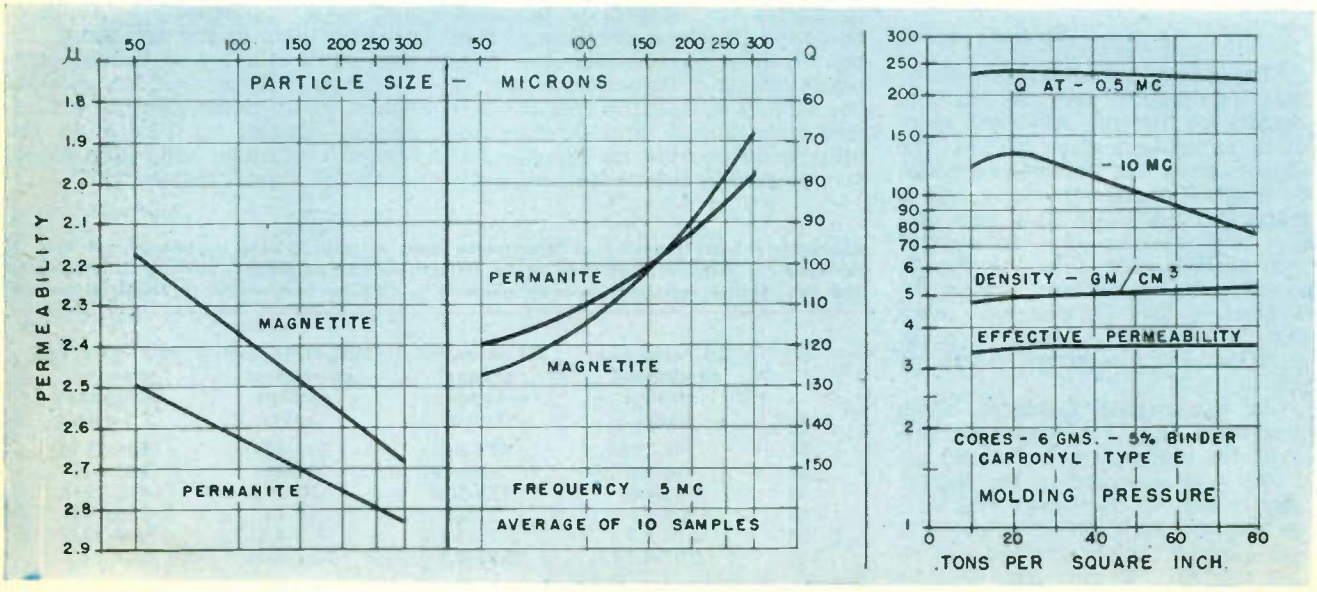
In low frequency power work, iron used in motors and transformers is divided into laminations insulated from each other. This is done to increase the resistance of the electrical circuit which must be traversed by the eddy currents.

When a changing magnetic flux passes through an iron core, or any object for that matter, a voltage is induced which causes a current to circulate around the axis of the flux. This current heats the material and thereby causes a loss of power. If the resistance of the path which the current must follow is high, the loss of power which varies inversely with the resistance, is low.

To accomplish this result in low frequency power work, iron cores are divided into laminations insulated from each other. The influence of this construction in increasing the resistance of the current paths may be seen in Fig. 1 (see page 89). If the flux is distrib-

*"Powdered Iron Cores"—C. T. Martowicz—Electronic Industries — June, 1945 — pp. 108.

Fig. 2, Left. Variations of permeability with particle size for samples of magnetite, an iron oxide and permanite, a purified oxide. Fig. 3, Center. Q values for same materials at 5 mc. These are purely illustrative. Fig. 5, Right. Effect of molding pressures on core characteristics



uted uniformly through the core, the voltage induced in each lamination is proportional to its cross section, and since the width of the lamination is unchanged for different thickness, the voltage per lamination will vary as the thickness. The conductance varies directly as the area and inversely as the current path length. Since the latter changes only slowly, the conductance can be said to vary roughly with the thickness. The total power loss which is $P=V^2Gn$ where V is the voltage, G, the conductance and n the number of laminations, will then vary as

$$P \sim f(t^2, t, \frac{1}{t}) = f(t^2)$$

In other words, halving the thickness will roughly decrease the power loss to one quarter its previous value.

As the frequency is raised this eddy current loss increases very rapidly and is given by $P = \lambda v f^2 B^2$ ergs per second where

- λ = eddy current coefficient, about $.0035 \times 10^{-6}$ for ordinary iron
- v = volume of core material in cm^3
- f = frequency in cycles per second
- B = flux density, maximum, in gausses

At higher frequencies magnetic skin effect becomes important and modifies the applicability of the above formula so that P varies more nearly as $B^{1.5}$. It is obvious that to make it possible to use iron cores at all in high frequency work a means must be resorted to which will further increase the electrical resistance of the current paths.

Powdered iron is used to obtain the desired result. From the above discussion it is easily seen why the size of the particles, their shape and electrical resistance are of great importance.

It should be borne in mind that a mixture of powdered iron grains and a binder, no matter how solidly compressed is not likely to have permeability of as high an order as solid iron in the form of laminations. In fact the permeability of a radio core often runs about 3 or 4 and would be high at 25 or 30, while in low frequency transformer practice much higher permeabilities are common.

Another source of loss in iron cores is the hysteresis effect. This loss depends to a great extent on the shape of the hysteresis curve of the core material. Since the hysteresis loss is proportional to the area enclosed by the hysteresis curve, it is of course desirable to use a core material having a narrow hysteresis loop. This is as true

TABLE I

Physical Characteristics of Carbonyl Powders

Grade	Chemical Analysis % Carbon	% Oxygen	% Nitrogen	Wt. ave. diameter microns	Tap Density g/cm^3	Apparent Density g/cm^3
L	0.005-0.03	0.1 -0.2	0.005-0.05	20	3.5-4.0	1.8-3.0
C	0.03 -0.12	0.1 -0.3	0.01 -0.1	10	4.4-4.7	2.5-3.0
E	0.65 -0.80	0.45-0.60	0.6 -0.7	8	4.4-4.7	2.5-3.5
TH	0.5 -0.6	0.5 -0.7	0.5 -0.6	5	4.4-4.7	2.5-3.5
SF	0.5 -0.6	0.7 -0.8	0.5 -0.6	3	4.7-4.8	2.5-3.5

TABLE II

Q of Carbonyl Powders Measured with RMA Coils

Carbonyl Iron Grade	Effective Permeability at 1 kc	10 kc	Relative Quality Factor at 150 kc	200 kc	1 Mc	100 mc
L	4.16	78	75	70	34	1
C	3.65	102	109	107	78	3
E	3.09	101	107	125	121	37
TH	2.97	213	244	258	263	142
SF	2.17	100	115	126	136	162

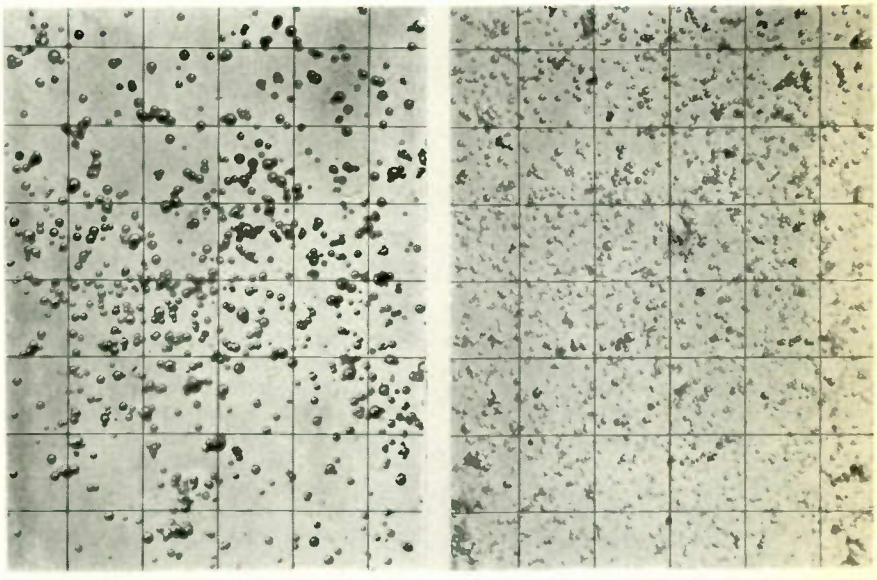


Fig. 7—Above. Photomicrographs of carbonyl E powder, left and TH, right. About 350x

Fig. 4—Below. Samples of various types of radio cores made from magnetic iron powders

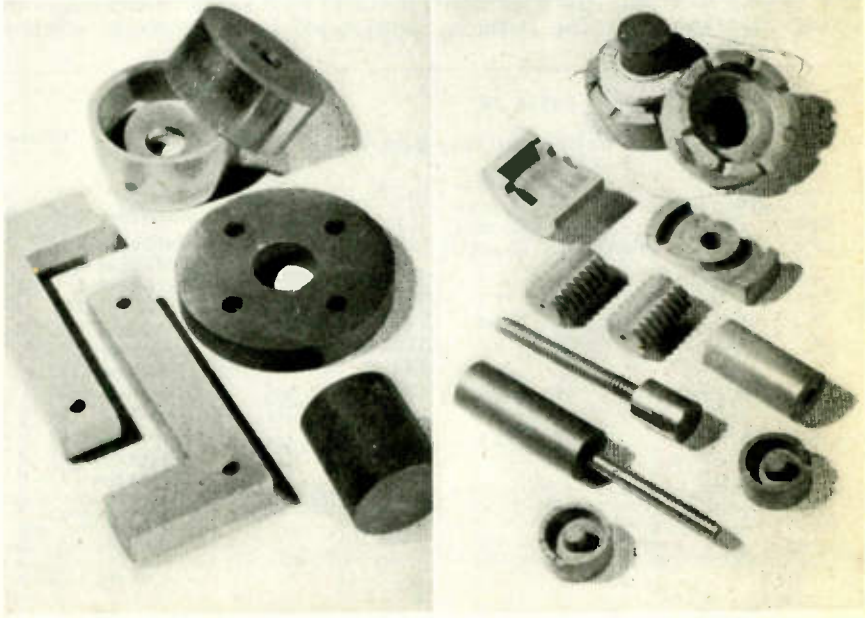


TABLE III

Characteristics of One Make of Hydrogen Reduced Powders

Material	Apparent Density Gms/cc	Tapping Density Gms/cc	Initial Permeability	Particle Size-Range of Bulk of Material in Microns	Q Values Measured with R.M.A. Coils 1 MC	25 MC	50 MC	100 MC	130 MC	Density of Core gms cc
IRN-2	2.75	4.05	25	10-25	170	—	—	—	—	5.5
IRN-6	2.45	3.90	20	5-15	190	—	—	—	—	5.5
IRN-8	1.40	2.30	5	5-15	—	170	180	200	175	3.5
IRN-9	1.45	2.50	3	5-15	—	165	190	226	220	3.3
IRN-16	1.80	3.75	12	3-10	246	152	110	—	—	4.5

TABLE V

Influence of Binder on Q and μ

Type of binder	Q	μ
A	233	3.42
B	223	3.44
C	217	3.44
D	186	3.50

Measurements made at 2 mc.
μ = Effective permeability.

at high frequencies as at low, and makes it desirable to use a soft annealed iron.

This loss also varies with the frequency and its value can be found from the following equation.

$P = \eta v f B^x$ ergs per second where

η = Hysteresis coefficient
v = Volume in cm^3
f = frequency in cycles per second
B = flux density in gausses
^{x} = Hysteresis exponent, usually about 1.6

Since the eddy current loss varies as the square of the frequency and the hysteresis loss as its first power, the former becomes very much more important at the higher frequencies. For this reason soft annealed powders of low retentivity are preferred at the lower frequencies and higher resistance powders at the higher frequencies even though their hysteresis loop may be larger.

While these loss equations are important, they are not used as much in practice as a different form wherein the various losses are expressed as equivalent resistances in a unified coil and core design. Such design will be discussed in a future article.

It follows naturally from all the above, that the finer the powder, the higher the frequency at which it can be used. Also it seems natural that the range of size of the grains used in any one batch should not vary too much, as otherwise uniform production of cores would be difficult to achieve. Two other simple deductions are that the more tightly the grains can be packed without making electrical contact, the greater will be the effective permeability of the resulting core, and in order to pack the grains closely it is necessary to have some variation in size so that the small grains can fill the spaces between the big ones.

As mentioned before, it is necessary to insulate the separate grains of iron from each other in utilizing powdered iron as a core material, and therefore the cores are held together in a matrix of some synthetic resin. Also the grains are sometimes treated in a chemical bath prior to mixing with the binder to create a high resistance contact surface. Here again the shape of the particles is important as those with sharp points may have a tendency to pierce the insulating binder.

The introduction of a dielectric material into the core, however, introduces new losses as the material is stressed in the circular electric field which is associated with the magnetic field and is at right angles thereto. While much work is being done at present on the fundamentals of dielectric losses, it is difficult to give an exact relationship between dielectric losses and ordinary circuit parameters. Suffice it to say the losses vary both with materials and frequencies. The loss in any particular range must be determined experimentally but it is usually small compared with other losses.

Another source of loss of a rather obscure nature is the so-called residual loss, sometimes referred to as secondary magnetic effect. This loss may form a considerable proportion of the total core losses, but as its nature is not quite clearly understood, it is merely stated here to depend on the frequency but not the flux density.

With this theoretical background it is interesting to compare the various powdered core materials which have been developed for electronic work and which are on the market today. These fall into four principal categories, namely magnetite, carbonyl, hydrogen reduced and electrolytic irons.

Magnetite is a magnetic natural iron oxide, Fe_3O_4 which is mined

TABLE IV

Characteristics of Test Coils*

Coil No.	Frequency range in mc	Micro-henrys inductance	Micro-micro-farads capacity	Q of coreless coil
1	.5— 1.5	225	2.5	150 @ 1 mc
2	1 — 3	67.5	2.3	150 @ 1.5 mc
3	2 — 6	14.0	3.0	145 @ 3.5 mc
4	4 —12	3.6	2.0	130 @ 6 mc
				155 12 mc
5	10 —25	.8	2.2	170 @ 15 mc
				200 25 mc
6	25 —40	.3	2.0	160 @ 25 mc
				190 40 mc

Wound on 3/8 in. I.D. x 11/16 in. long x .015 in. wall bakelite tube. Mounted in bakelite container with holes at top and bottom and rigid lugs for insertion in Q meter terminals.

*Proposed as standards by Radio Manufacturers Association but not adopted.

TABLE VI

Electromagnetic Characteristics of Various Iron Powders

Material	Dens.	Permeability	Hyst.	Eddy	Stab.
Carbonyl L	5.7	24.8	3.1	0.13	+1.4
Carbonyl C	5.7	16.7	1.1	0.14	+0.6
Carbonyl E	4.9	10.4	0.3	0.11	+0.6
Carbonyl TH	4.9	9.6	0.3	0.10	+0.18
Carbonyl SF	4.8	8.1	0.3	0.10	+0.15
Electrolytic	5.6	23.4	2.4	0.33	—0.17
Hyd.-Red. (1)	5.6	18.4	2.6	0.12	+1.3
Hyd.-Red. (2)	5.5	16.9	1.0	0.12	+1.6
Hyd.-Red. (3)	5.2	12.5	3.1	0.11	+1.5
Magnetite (1)	4.1	7.9	9.1	11.5	—2.1
Magnetite (2)	4.0	5.7	6.8	0.21	—1.6
Magnetite (3)	3.5	3.1	0.3	0.085	+0.10

Density: g/cm^3
Permeability: gauss/gilbert-per-cm
Hysteresis Loss Coefficient: 10^{-3} ohms/henry, gauss cycle
Eddy Current Loss Coefficient: 10^{-6} ohms/henry, $cycle^2$
Magnetic Stability: Percentage change of permeability after 4 amps passage through winding.

and brought to a processing plant where it is ground to specified mesh sizes. Some of the standard granulations supplied are 40 x 70 mesh (powder passes through a 40 but not through a 70 mesh per inch screen), 60 x 140, 100 x 200, 200 mesh and fines, and airfloated-90 per cent through 325 mesh. Two sets of sample curves (Figs. 2 and 3) indicate the range of values to be obtained with one given test coil at 5 mc.

The raw magnetite usually contains some impurities, and after grinding it is possible to remove these by magnetic separation. Some magnetites contain impuri-

(*Continued on page* 186)

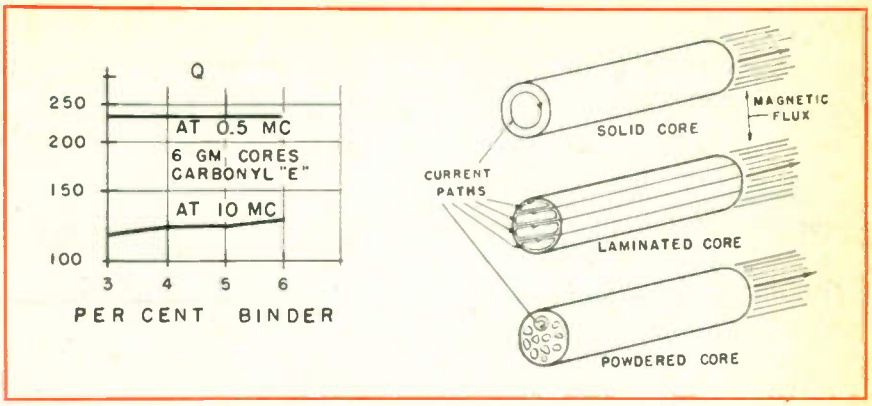


Fig. 1, Right—Distribution of eddy currents in circular paths around the flux lines in a magnetic core. Subdividing the iron reduces eddy currents. Fig. 6, Left—Change of Q with changes in percent of binder in core. Only slight effect can be noticed

Strain-Gage Phono Pickup

● The principle of the strain gage, now being applied in a wide variety of ways in industry, has been put to a new purpose by the General Electric Co., Schenectady, which has developed an entirely new type of phonograph record pickup that has certain unusual features. General Electric engineers have long investigated problems having to do with record reproduction* and this latest development represents the culmination of much intensive work along these lines.

The strain gage, as most everyone knows, depends for operation upon the changing resistance of a fine wire as it is minutely elongated under stretch or strain. Such gages are currently being used in measuring strain in mechanical members such as bridge girders, aircraft parts, engine connecting rods and a host of other applications. It is the principle of such gages that has been put to work in the new phonograph pickup.

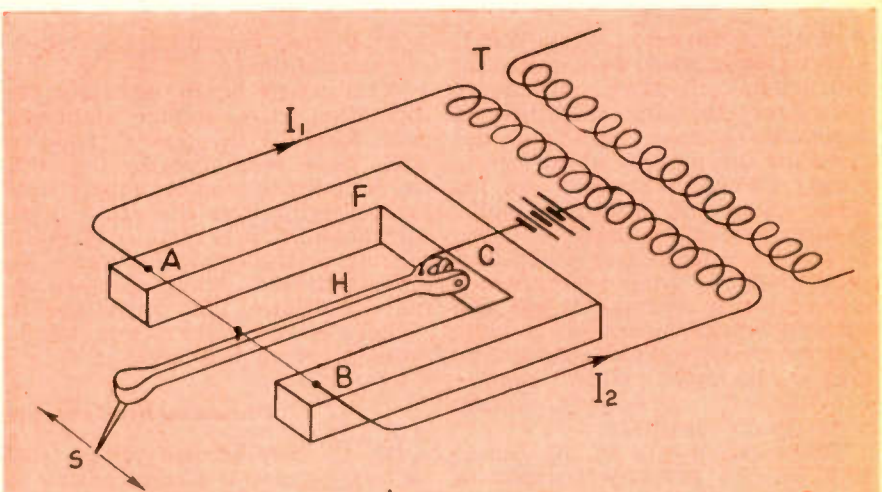
The accompanying sketch, which is purely diagrammatic in form and does not closely resemble the actual construction of the pickup, illustrates the manner in which the device operates. A yoke or frame F supports the strain element, which is a short length of fine resistance wire AB fastened at each end and under slight tension. A small cantilever beam H, carrying the stylus S is pivoted to the yoke at C and attached to the resistance element at its midpoint.

In operation, lateral movement of the cantilever, as the stylus follows the record groove, alternately stretches and relaxes each half of the resistance element, thereby slightly altering its resistance. The change in resistance is directly proportional to the movement of the stylus. The electrical circuits include a transformer, since the strain gage element is a low impedance device, and a source of direct current.

It may be seen from the diagram that when the stylus is at rest and the cantilever in a central position, both sides of the resistance element are under the same tension and the currents I_1 and I_2 will be equal. As the resistance of sections A and B is changed as they are stretched or relaxed under movement of the cantilever, the currents become unbalanced and the net magnetizing force in the transformer produces an alternating current which is directly proportional to the movement of the stylus. The frequency response is said to be better than can be obtained by other means.

A principle advantage of the new pickup is that because of its small mass, the stylus can be made to follow the record grooves accurately with pressures in the order of 10 to 15 grams, thus materially reducing record wear. Like other pickups, this new recorder effectively discriminates between horizontal and vertical movement of the stylus. In lateral type recordings, only lateral movement of the stylus is desired. Vertical movement of the usual stylus is due to pinch effect and to roughness of the record groove, dirt scratches, and produces undesired record noise.

In the strain gage pickup as made for lateral recordings, vertical movement of the stylus does not cause any movement of the cantilever and thus does not cause any unbalance in the circuits and hence no output.



Diagrammatic sketch of the principle on which the new General Electric strain-gage pickup operates to cause current variations only through lateral movement

*"Phonograph Dynamics," W. S. Bachman, Electronic Industries, July 1945.

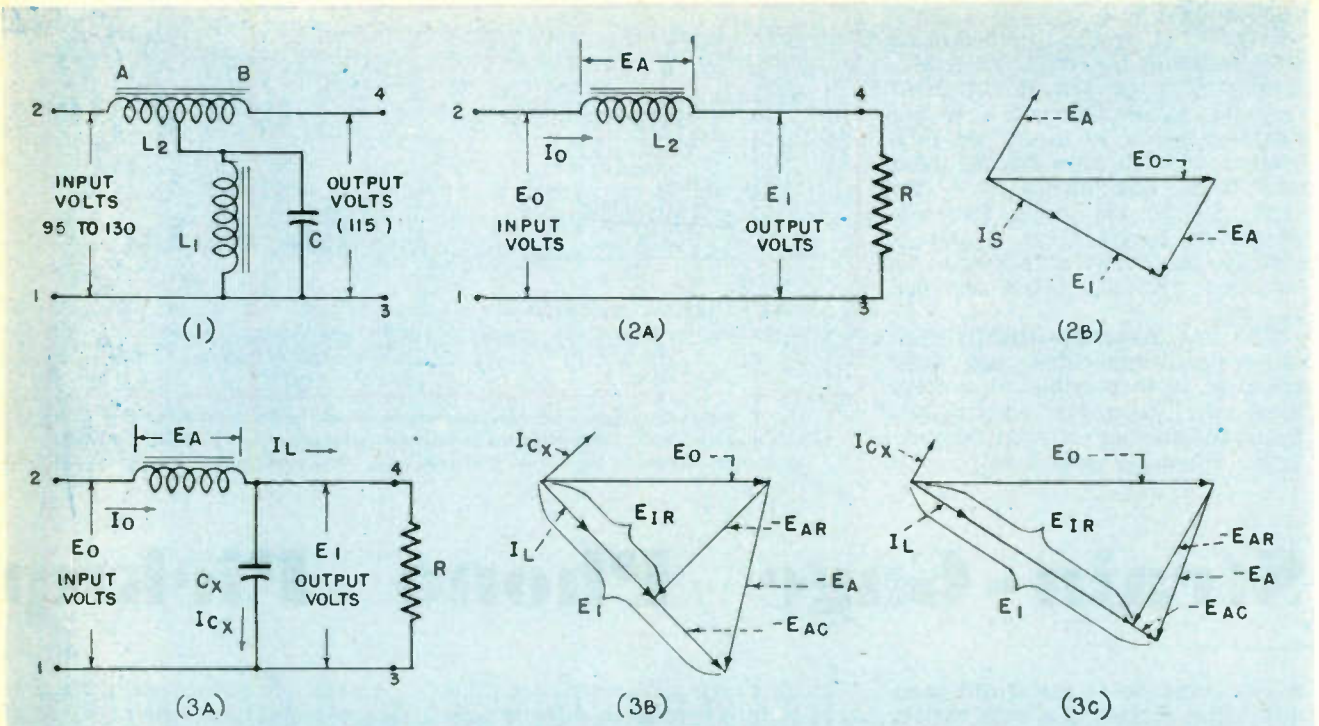


Fig. 1—Schematic of fundamental circuit containing two reactors and a capacitor. Fig. 2A and 2B—Schematic and vector diagram explaining the operation of the fundamental stabilizer circuit. Fig. 3A and 3B—Circuit revised by the addition of capacitor C_x in parallel with load resistor R, and associated vector diagram. Fig. 3C—In order to maintain an output voltage of 115 it is necessary to decrease the capacitance of C_x as shown in this vector diagram, the effect being to create a leading current Ic_x which compensates for the load current I_L.

*ENGINEERING FOR POSTWAR

VOLTAGE STABILIZERS

By J. A. UTTAL,
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Engineering developments in the design and construction of automatic equipment to compensate for voltage fluctuations

• With the advent of World War II and its associated acceleration of production schedules, an urgent need arose for large quantities of automatic voltage stabilizing devices for the purpose of correcting supply voltage variations. In industry, they were needed for maintaining constant voltage on control and miscellaneous equipment being supplied from overburdened electric power sources. It was also determined that operation of radio and electronic equipment would be greatly improved under combat conditions if the supply voltage were always constant.

The requirements of the armed services and industry resulted in the further development of static-type automatic voltage stabilizers. Circuit variations were also developed to meet unusual, specific operating conditions.

This article briefly describes the operation of a voltage stabilizer, and some of the special features that have been incorporated with it, designed to regulate supply voltages varying over the range of 95 to 130 volts for a nominal 115-volt circuit, or the equivalent range for other voltages. Application experience indicates that variations in voltage on nominal 115-volt circuits seldom exceed this range.

Fundamental circuit

Most widely applied voltage stabilizers consist of a combination of capacitive and inductive reactances requiring no moving elements. The necessary reactance values can be obtained by using individual reactors or high reactance transformers with conventional liquid filled capacitors. A circuit, containing two reactors and a capacitor that has proven highly satisfactory is shown schematically in Fig. 1.

Reactor L_1 has a non-linear volt-ampere characteristic and capacitor C has a linear volt-ampere characteristic. Reactor L_2 has a linear volt-ampere characteristic and the current drawn by the load and the parallel combination of L_1 and C flows through section A of this reactor. The voltage induced in section B of reactor L_2 is added vectorially to the voltage impressed on reactor L_1.

In order to explain the operation of this circuit, let us first consider what occurs in an elementary cir-

cuit consisting of a series reactor L_2 and a load resistor R connected to a voltage supply as shown in Fig. 2A. In order to be consistent with stabilizer terminology, the supply voltage will be designated as input volts and the voltage across the load will be designated as output volts.

Basic vector diagram

The vector diagram for this circuit is illustrated in Fig. 2B. The output voltage E_1 is obtained by subtracting vectorially the voltage E_A from the input voltage E_0. Obviously, if E_1 is to equal 115 volts, the input voltage must be greater than this value. The load current is equal to the input current and is in phase with the output voltage E_1. In addition, it can be seen that the voltage E_1 and current I_0 both lag the input voltage E_0.

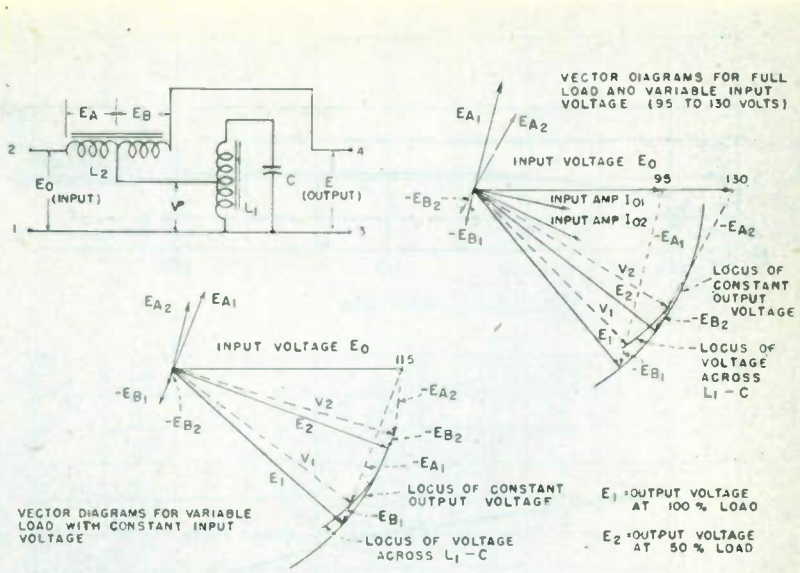
If the input voltage of the circuit in Fig. 2A is lowered to 95 volts, obviously the output voltage will be reduced to a value considerably below 115 volts. However, by adding capacitor, C_x, to the circuit in parallel with the load resistor R, the output voltage can be raised to the required 115 volts. The new circuit and its associated vector diagram are shown in Figs. 3A and 3B respectively.

The vector diagram shows that the load current I_L flowing through reactor L_2 produces a voltage drop E_{AR} across this reactor, which then subtracted vectorially from the input voltage E_0 (95 volts) lowers the output voltage to a value, E_{1R}, less than 95 volts. However, the voltage drop E_{AC}, produced by the capacitor current, I_{C_X}, flowing through reactor L_2, when subtracted vectorially from the voltage E_{1R} actually increases this voltage to the required output voltage, E_1, or 115 volts.

Thus, the addition of capacitor C_X in parallel with the output has provided a leading current I_{C_X} which when flowing through reactor L_2 not only compensates for the decrease in voltage caused by the load current I_L, but, in addition, raises the output voltage, E_1, to the desired value.

Let us now consider the circuit of Fig. 3A when the input voltage E_0 is 130 volts. To maintain an output voltage equal to 115 volts, it is necessary, as shown in the vector diagrams of Fig. 3C, to decrease the capacitance of C_X, thus lowering the value of the current I_{C_X} flowing through reactor L_2.

With an input voltage of 130 volts, less capacitance current is required than with 95 volts input because the E_{1R} voltage component, obtained by subtracting vectorially the voltage E_{AR} from E_0, is almost equal to the required 115 volts.



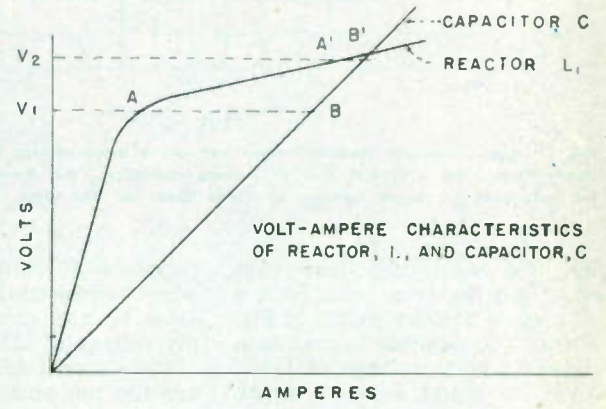
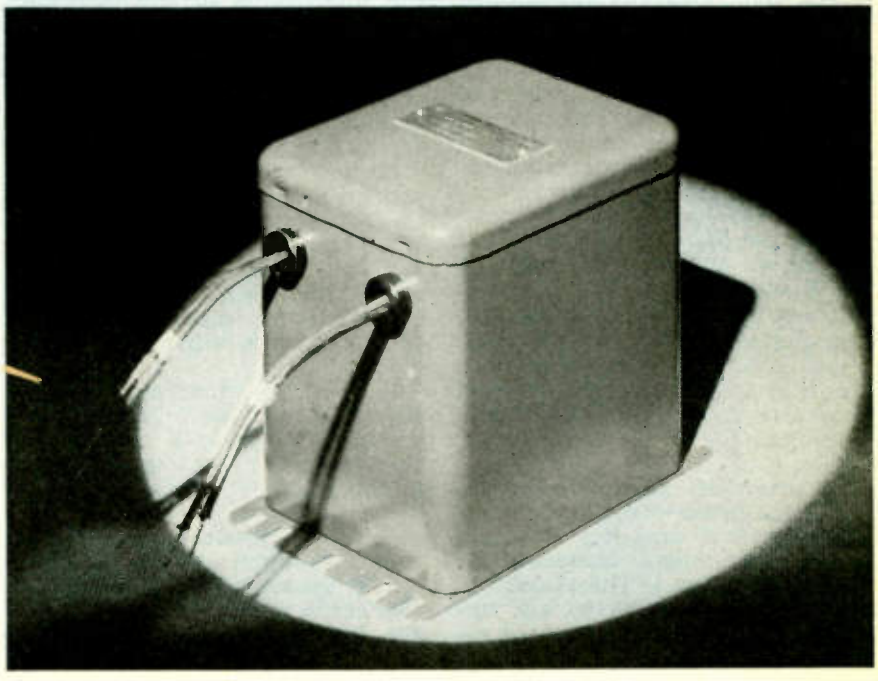


Fig. 5 (Above)—Correlation of nonlinear Reactor L_1 with capacitor C is practically equivalent to hypothetical capacitor C_x. Fig. 4—Voltage impressed on reactor L_1 and capacitor C at supply of 95 and 130

Fig. 6—Construction of a typical 50 va voltage stabilizer unit, which is merely a housing in which all the elements are completely immersed in an asphalt compound to anchor them and help in conducting heat away from the elements. Weight of this particular unit is 16 lb.



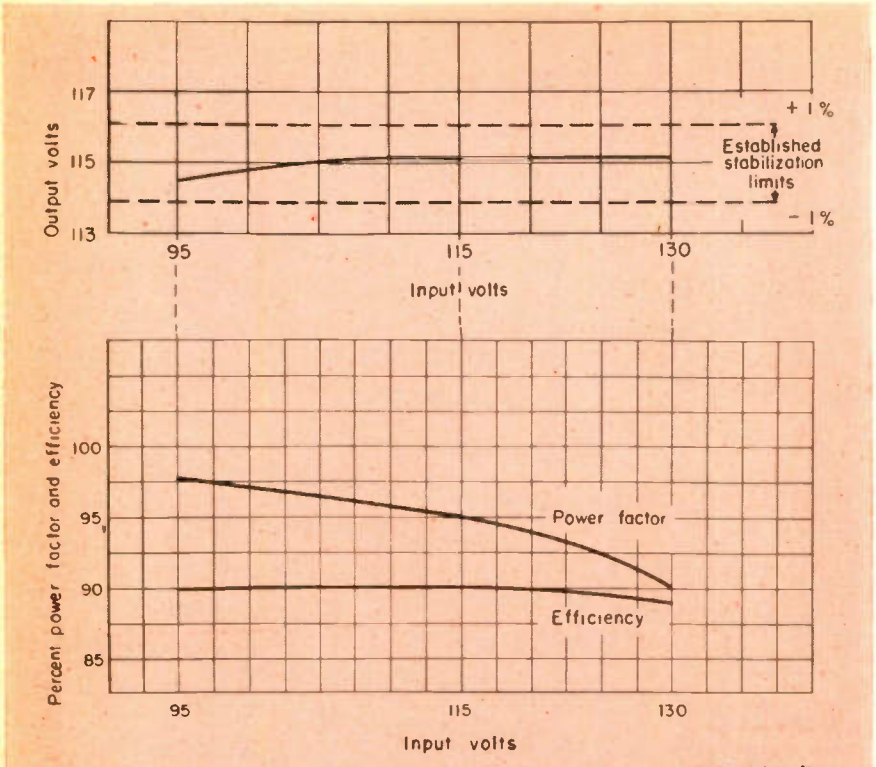


Fig. 7 (Above)—Graph showing output voltage vs input voltage at rated load unity power factor, for a typical 500 va voltage stabilizer. Fig. 8—Input power factor for efficiency vs input voltage at rated load for the same 500 va equipment

From the examples just presented, it can be seen that, with a circuit similar to that shown in Fig. 3A, it would be possible to maintain a constant output voltage of 115 if C_x could be made to vary as an inverse function of input voltage which varies between the limits of 95 and 130 volts.

Since we have determined that a variable capacitor C_x in the circuit of Fig. 3A will provide an output voltage that is independent of input voltage variations, let us now consider the possibility of obtaining a combination of circuit elements that will be equivalent to such a hypothetical capacitor. It should be kept in mind that in order to accomplish automatic output voltage regulation, this equivalent impedance combination must possess the property of a capacitor varying as an inverse function of the input voltage.

It will be shown in the following explanation that the careful correlation of non-linear reactor L_1 with capacitor C of the stabilizer circuit, illustrated in Fig. 1, is practically equivalent to the hypothetical capacitor C_x.

As previously stated, reactor L_1 has a non-linear volt-ampere characteristic and capacitor C has a linear volt-ampere characteristic, as plotted in Fig. 4. The V_1 point in Fig. 4 represents the voltage impressed on the combination of reactor L_1 and capacitor C at a supply voltage of 95 volts. Similarly, the V_2 point represents the voltage on reactor L_1 and capacitor C at a supply voltage of 130 volts.

The current AB and A'B' in Fig. 4 are the net currents flowing to the combination of L_1 and C at voltages V_1 and V_2 respectively. These currents are capacitive because the current in capacitor C is always greater than that in reactor L_1 when the voltage points are below the intersection of the two volt-ampere curves. Obviously, the current A'B' is less than current AB. Therefore, we have an impedance combination that draws decreasing capacitive current with increasing supply voltage.

Since a change in voltage impressed on reactor L_1 is necessary to change its impedance, there is some voltage variation, corresponding to the difference between V_1 and V_2 lines in Fig. 4, at this point in the circuit. Actually, this voltage variation is only approximately 6 volts.

In order to minimize the variation of the output voltage, a compensating winding B is added to the reactor L_2. The voltage induced in this winding is added vectorially to the voltage across the L_1-C combination to produce practically a constant output voltage.

The actual vector diagrams of this entire circuit are illustrated in Fig. 5. In order to simplify these vector diagrams, the net capacitive current flowing to L_1-C is added vectorially to the load current to give the input current, I_0. The voltage drop E_A across the reactor L_2 is now illustrated as being produced by the input current.

The effect of decreasing load upon the operation of this circuit is similar to that of increasing the input voltage. This can be seen by referring to the vector diagrams for variable load in Fig. 5. Actually, at extremely lights loads and input voltages near 130 volts, the L_1-C combination operates above the intersection of the volt-ampere characteristics illustrated in Fig. 4. Thus the L_1-C combination operates as an inductance rather than a capacitance under these conditions.

Because the L_1-C combination is effectively a variable capacitance, this stabilizer is classified as a variable impedance device. All static voltage stabilizers can be grouped in this general classification.

In any automatic voltage stabilizer of the static type, the harmonic content of the output voltage may be in the order of 25 per cent at full load. It may be thought that because of this harmonic content, vector diagrams would not predict the operation of an automatic voltage stabilizer. However, it has been found, experimentally, that equivalent sine waves (defined as a wave with the same frequency and the same RMS value as the actual wave, the frequency of the sine wave being equal to the fundamental frequency of the non-sinusoidal wave), can be represented vectorially with accurate results.

The nature of the harmonics present in the output voltage of the automatic voltage stabilizer and methods for eliminating them will be discussed briefly later in this article.

Design problems

One of the most interesting design problems offered by an automatic voltage stabilizer of the static type is that of obtaining the volt-ampere characteristic required for the non-linear reactance (reactor L_1 in this particular circuit) without exceeding the heating limits of conventional insulations used in the windings of the reactor. At present, either Class A insulation (maximum average operating temperature 95 deg. C.) or Class B insulation (maximum average operating temperature 120 deg. C.), whichever affords the most economical design, is used.

One method of obtaining the desired volt-ampere characteristic in the non-linear reactor would be to operate the core steel at flux densities well above the normal values.

This practice would unquestionably cause excessive heating. However, a reactor has been developed that gives a volt-ampere characteristic equivalent to that of a completely saturated core without exceeding safe operating temperatures for Class A or Class B insulation. Small core sections of the reactor operate at the required high flux densities while the remainder of the core operates at flux densities slightly below normal.

The design of the reactor having the linear volt-ampere characteristic is strictly conventional and the capacitor employed is of the Pyranol* type. It should be noted at this point that actually, although not shown in Fig. 1, reactor L_1 has an extended winding for connection to the capacitor. This is done merely to increase the voltage on the capacitor so that an economical capacitor can be employed without adding any appreciable size to reactor L_1.

Various types of enclosures can be used to house the elements of a voltage stabilizer. Obviously, it is necessary that a housing be used that will allow adequate removal of the heat generated by the elements. An example of a construction that has proven very satisfactory is shown in Fig. 6.

Fig. 6 illustrates one construction of a typical 50 va unit (total weight 16 lb.). This is merely a housing in which all the elements are completely immersed in asphalt compound. The asphalt compound serves the dual purpose of conducting the heat away from the elements and anchoring them in their proper position.

*Reg. U.S. Patent Office.

Operating characteristics

The output voltage of the automatic voltage stabilizer versus input voltage for a typical 500 va unit is plotted in Fig. 7. It can be seen that the output voltage regulation is excellent. Manufacturing tolerances, however, forbid warranting less than ± 1 per cent output voltage regulation with a varying input voltage of 95 to 130 volts. The horizontal dotted lines on Fig. 7 correspond to a maximum regulation of ± 1 per cent.

It is also possible by adjustment of the voltage on the B section of reactor L_2 to obtain output voltage patterns that can have either negative or positive regulation with respect to varying input voltage.

The input power factor and efficiency versus input volts of a typical 500 va rating is plotted in Fig. 8. It can be seen from these curves that the input power factor is approximately 90 per cent or higher, and that efficiency is essentially independent of input voltage. Obviously, high input power factor, which limits the increase in volt-ampere load on the generating supply to approximately only the amount of the stabilizer's low inherent losses, is a desirable feature.

The curve of rated load efficiency versus various typical stabilizer ratings is shown in Fig. 9. It is to be noted that the efficiency curve follows somewhat the pattern of transformer efficiencies in that the efficiency improves with increase in rating.

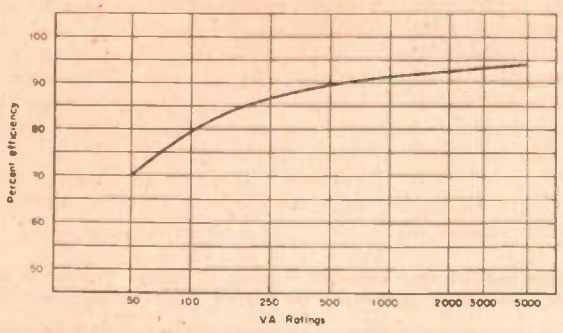
Most automatic voltage stabilizers of the static type possess the inherent characteristic of limiting the output short circuit current to a relatively low value. The magnitude of the short circuit current is limited primarily by the series reactance of the stabilizer.

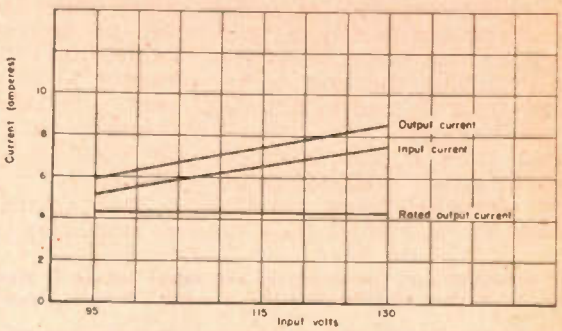
The actual short-circuit currents, both input and output, versus input voltage of a typical 500 va stabilizer are plotted in Fig. 10. It can be seen from this figure that the input short circuit current is less than the output short circuit current. In order to show why this occurs, the fundamental circuit under short-circuit conditions is schematically illustrated in Fig. 11.

I_o is the input current to the voltage stabilizer and I_L is the output current of the stabilizer under short-circuit conditions. I_c is the resultant small capacitive current flowing through the combination of reactor L_1 and capacitor C. Since the current I_c is capacitive, it subtracts directly from the inductive output current, I_L. Thus the input current, I_o, which is equal to the difference of the currents I_L and I_c, is less than I_L—the output current under short circuit conditions.

Another characteristic of this particular stabilizer circuit is its ability to respond very rapidly to changes in operating conditions. Referring to oscillograms in Fig. 12, it is apparent that complete response to sudden changes in either input voltage or output load is accomplished in approximately two cycles.

This rapid speed of response enables the voltage stabilizer to main-





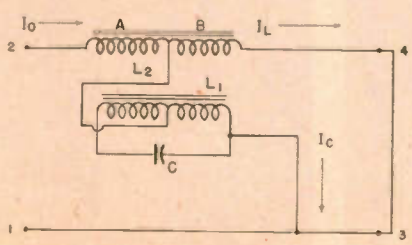
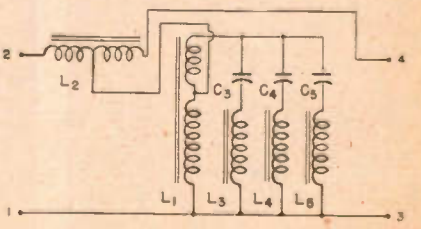
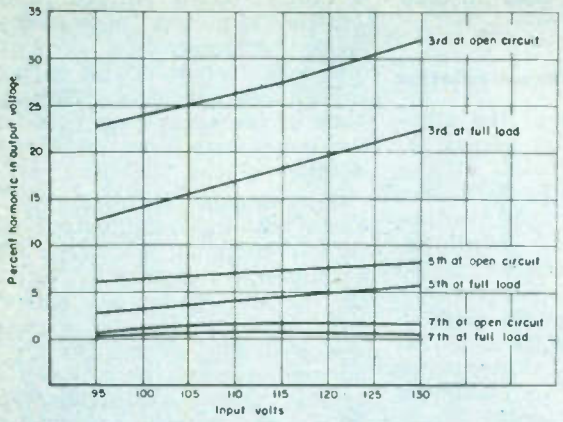


Fig. 9—Top left. Efficiency vs volt ampere rating. Note improvement with larger units. Fig. 10—Top right. Short circuit characteristics of 500 va unit. Fig. 11—Lower left. Stabilizer circuit when shorted. Fig. 14—Lower right. Suppression circuit for 3rd, 5th, 7th harmonics.





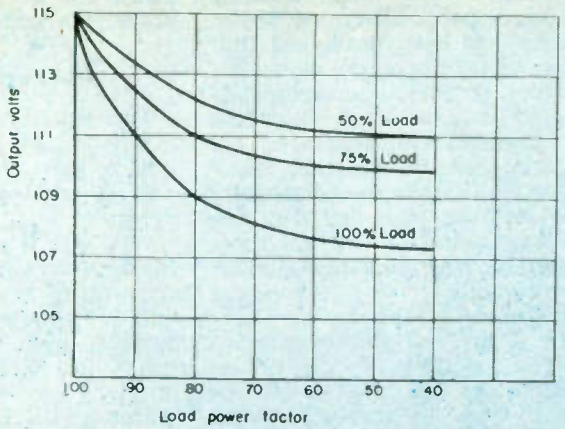


Fig. 13—Left. Per cent harmonic in output voltage vs input volts. The pronounced harmonics at light loads can be corrected by filters. Fig. 15—Right. Output volts vs load power factor. The drop in voltage with decreasing power factor can be corrected by capacitors at the load

tain a constant steady output voltage with supply voltage variations and load fluctuations that are too rapid for satisfactory performance of other types of regulating equipment. In fact, this one feature alone makes the stabilizer the only suitable means of regulating the voltage of many applications, whose supply voltage or load varies frequently and widely. However, there are some applications where fluctuations in supply voltage or load conditions may be too rapid for even a static type stabilizer to perform satisfactorily. For example, voltage fluctuations on circuits connected to seam welders may be as rapid as one cycle. If the stabilizer were connected to such a circuit, it might be unable to reach a steady operating state.

Similarly, half-wave rectifiers are an example of a load that fluctuates too rapidly for the static type stabilizer. A half-wave rectifier draws current during only one-half cycle, and draws no current during the remaining one-half cycle. Thus, this type of load would be equivalent to changing the load on the stabilizer from no load to full load every one-half cycle.

Special circuits have been developed to satisfy applications requiring somewhat more exacting operating characteristics than are afforded by standard stabilizers. The three special circuits that have found most widespread application will be briefly discussed.

Harmonic suppression

It has been previously stated that the harmonic content of the output voltage wave of any fundamental static type voltage stabilizer circuit may be in the order of 25 per cent total at full load. The output voltage wave shapes of the stabilizer, previously described, are shown in the oscillograms of Fig. 12. The three prevalent harmonics of this wave, both at no load and full load, versus input voltage are plotted in Fig. 13.

The harmonics present in the output voltage wave are generated by the non-linear reactor, L_1, which is, in effect, connected parallel with the load. The harmonic content of the output voltage increases with increasing voltage on reactor L_1. Since either increasing input voltage or decreasing load, or both, cause the voltage to increase on reactor L_1, it is reasonable to expect, with these variations, an increase in the harmonic content of the output voltage wave, as shown in Fig. 13.

There are many applications, such as stabilizing the voltage supply on filaments of electronic tubes or on various types of heater elements, where only the heating value or RMS value of the supply voltage is important. For such applications, a standard voltage stabilizer circuit will give satisfactory operating results. However, there are many applications that require output voltage wave shapes practically free from harmonics.

A special circuit, shown in Fig. 14, will furnish a stabilized voltage supply having negligible harmonic content. Results have been obtained that show the third harmonic content of this type of circuit will not exceed 5 per cent of the fundamental and any individual higher harmonic will not exceed 3 per cent.

The circuit, shown in Fig. 14, minimizes the total harmonic content by using filtering circuits L_3 C_3, L_4 C_4, and L_5 C_5, which suppress the third, fifth and seventh harmonics, respectively, of the output voltage wave, resulting in a wave shape closely approximating a sine wave.

An interesting operating result of this special circuit is that distortion of the input voltage wave will not appreciably distort the sine wave characteristics of the output voltage. Thus, it is possible to obtain an output voltage wave con-

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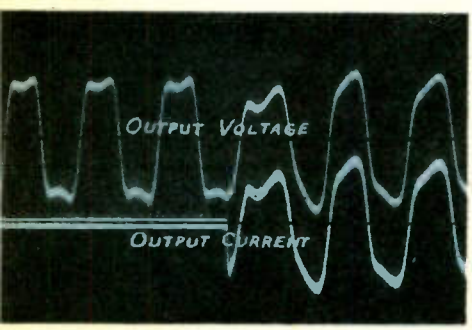
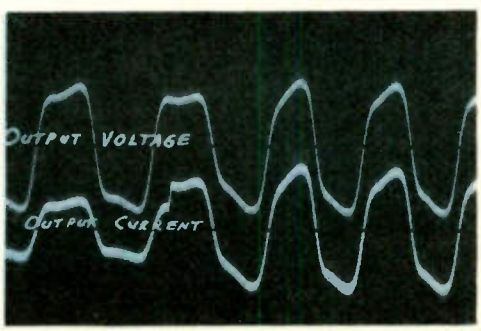
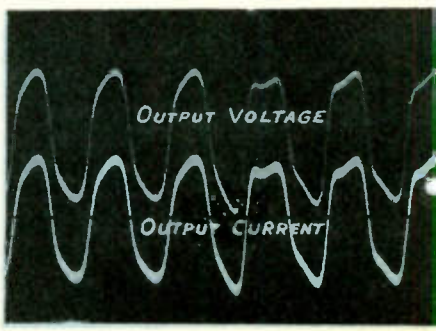
Fig. 12—Oscillograms of output current and output voltage of typical stabilizer indicate that complete response to sudden changes in current or voltage is obtained in approximately two cycles. However, even this rapid response is unsuitable for certain types of electronic circuits







COAX CABLE PROTECTION

By L. S. INSKIP
Bell Telephone Laboratories

Ground currents from lightning discharges can crush or puncture underground cables in cross-country networks

● Contrary to popular belief, electric cables buried in the ground are not thereby automatically shielded from lightning discharges.

Lightning investigations, including both theoretical studies and field tests, have shown that when lightning strikes, the current spreads in all directions from the point where it enters the ground. If there is a buried cable nearby, the cable provides a low-resistance path, so that much of the stroke current will flow to the cable and thence along the cable in both directions, decreasing with distance because of leakage from the sheath to earth.

As a result of this flow of current, a voltage is produced between the sheath and the core conductors that varies in magnitude, depending on the resistance drop in the sheath between the stroke point and a remote point where the current has substantially all leaked off the sheath. The magnitude of the stroke, which determines the total current involved, the earth resistivity, which determines the rate at which the current leaves the sheath, and the size of the cable, which determines the resistance of the sheath—these are the controlling factors in determining whether voltage likely to cause insulation breakdown will occur. There is no evidence to indicate that because a cable contains coaxial conductors, it is more likely to fail.

If the insulation from core conductors to sheath breaks down, the conductors to which arcing occurs will then take the same potential as the sheath at that point. Arcing will quite likely occur between these conductors and others in the cable near the stroke point. Other breakdowns will occur some distance away, where the potential between conductors and sheath has been increased as the result of voltage redistribution caused by the breakdown at the stroke point. Arcing may cause pair troubles by fusing conductors to the sheath or to each other, or by fusing open one or more conductors. In addition, arcing from conductors to sheath may pit the inner surface of the sheath, and if the arcing is sufficiently severe, holes may be burned in the sheath.

Figure 1 illustrates a severe case of crushing on a short piece of one of the four coaxials in the cable between Stevens Point and Minneapolis. The coaxial was flattened from pressure, probably due to gas generated by the lightning arc in passing through the outer wrapping of the cable. All four coaxials in the cable were similarly crushed.

The tremendous electromagnetic forces created by the large current along the coaxial tube resulted in the complete collapsing of the coaxial shown in Figure 2. This coaxial is of somewhat different construction than the telephone coaxials and was the transmission line to a radio antenna at a broadcasting station. There was no outer sheath to carry the current in this case, and it all passed along the one coaxial. Buried telephone cables containing coaxials have a conducting cable sheath and in addition contain several coaxials, so that the likelihood of such complete collapsing of telephone coaxials is remote.

Most of the large toll cables installed before cable carrier systems were developed were designed

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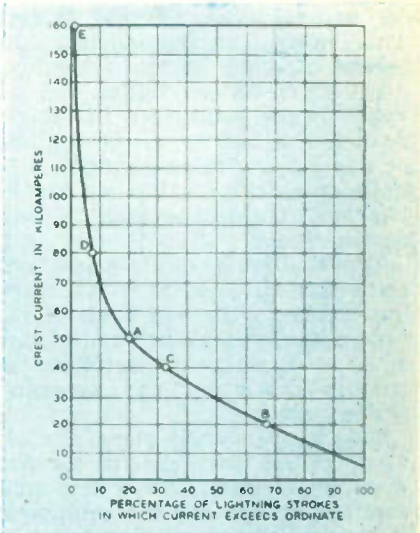
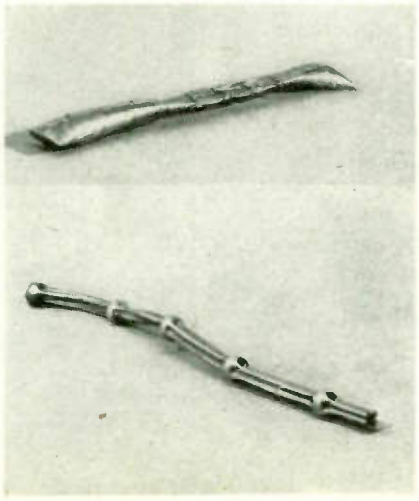


Fig. 3—Above. Crest lightning current in kiloamperes vs. percentage of lightning strokes which exceed value shown by curve. Fig. 4—Below. Construction of coaxial cable

Fig. 1—Above. A severe case of crushing on a coaxial cable probably due to gas generated by lightning arc in passing through outer wrapping of cable. Fig. 2—Below. Complete collapsing of a bead coaxial due to electromagnetic forces produced by passage of large lightning current in cable antenna transmission line



SHIPBOARD ANNOUNCERS

By L. B. COOKE,
Apparatus Development
Western Electric Company, New York

Three independent high volume loud speaker systems and controls permitting cross-ties provide battle safety

● The shrill scream of the bosn's pipe startles a sailor from well-deserved slumber. A few seconds later, wide awake, he hears a "Bong! Bong! Bong!"—the repeated bell-tone of General Alarm. This means an emergency. He listens carefully to the announcement which follows, telling him the cause of the emergency. It might be a fire, a call to battle stations, or any other serious condition, and he goes quickly to the station he has been trained to man in such an emergency.

These alarms and instructions come through the Battle Announcing System, with which all of the two or three thousand men aboard a large warship are informed of trouble and given any necessary special instructions.

This is one of the more spectacular but less usual uses of the Announcing System. Every few minutes during the day the equipment is used for the more prosaic job of calling together a group for a work detail, paging an officer, or calling the men to mess. It is the means by which all general commands are transmitted to the crew, members of which may be in any of the hundreds of separate compartments on the vessel.

Western Electric Announcing Systems on Naval vessels go back more than 25 years. The earlier uses were entirely as paging systems, and most of the equipment was based on standard telephone designs. About ten years ago the Navy, seeing the possibilities of announcing systems for handling certain battle functions, laid down basic requirements, and the Bell Telephone Laboratories was requested to design experimental equipment to test out these ideas.

Surveys were made of the noise conditions on all types of naval vessels. Intelligibility tests under shipboard conditions were made to determine optimum frequency characteristics for speech. Tone signal characteristics were analyzed to determine the most attention-arresting signals consistent with limitations of amplifiers and loud speakers.

In this work the Laboratories' basic studies of hearing and intelligibility of speech provided the background for the study of the specialized conditions on board ship. The results of these tests, and the success of the experimental equipment led to a change of name from General Announcing Systems to Battle Announcing Systems, and to the issuance of new Navy specifications covering the new requirements.

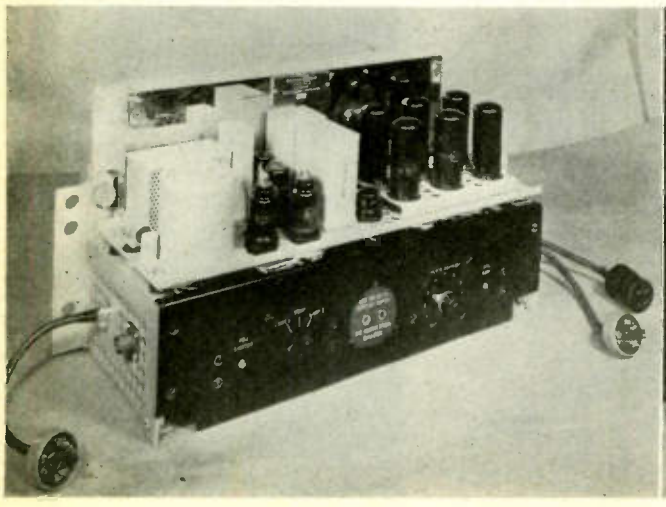
The first systems built to the new requirements were in service on large ships such as battleships and aircraft carriers before Pearl Harbor, and the application of this type of system has been extended rapidly by the Navy to smaller vessels such as destroyers, submarines, and landing craft. Designs have been changed to increase ruggedness and to eliminate faults disclosed under battle conditions, but even the earlier designs met the needs of Naval service with considerable success.

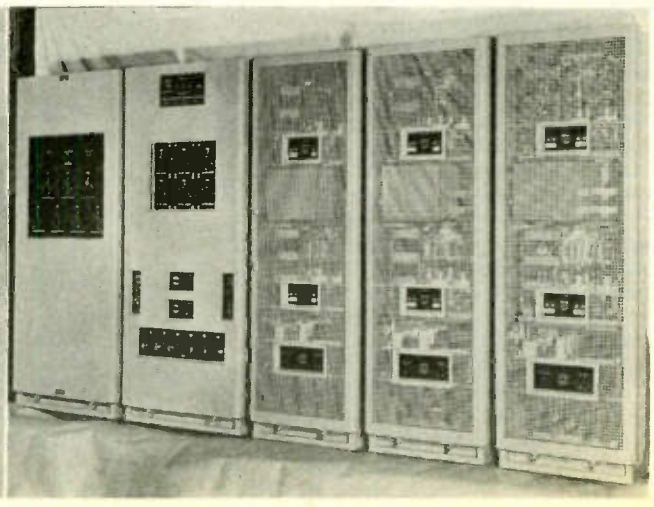
Multiple systems

Announcing equipment on shipboard is divided into several separate but inter-related systems. The General System might well be termed the Commanding Officer's system. Announcements on this system are usually made from the point of ship control: the bridge while under way; the quarter deck while at anchor; or the central station, deep in the most protected part of the ship, during special conditions.

As many as two hundred or more loud speakers are distributed

Fig. 1. Amplifier used on small announcing systems such as the turret or anti-aircraft system. It has a 40 watt output and 120 db gain
Fig. 2. Right. Amplifier and control equipment for the combined general, engineer's and aviator's battle announcing systems on carrier





throughout the ship. These may be selected in groups, so that it is unnecessary to disturb most of the crew when an announcement is of interest only to men in a particular section, such as the engine rooms. Alarm signals, such as the bell tone for General Alarm and the special signal for gas attack, are generated by electronic means, and sent out over the loud speakers. This system is often used during battle to keep the officers and crew below decks informed of the progress of the fighting.

Engineer's system

The Engineer's System is primarily intended for use by the Chief Engineer in giving instructions to machinery spaces. On Aircraft Carriers, the Aviator's System provides for instructions to Hangar and Flight Deck. These systems are tied in with the General System, however, so that alarms and general orders can be sent to all spaces.

Each turret on cruisers and battleships, incorporating a maze of compartments and intricate machinery, has a special two-way Announcing System over which the Turret officer gives orders for the operation of the turret and the loading, aiming, and firing of the guns.

The larger anti-aircraft guns are under the control of an officer at an Anti-Aircraft Director Station, located high up in the ship's superstructure. Loud speakers at the guns transmit verbal orders from this officer, and also special tone signals to begin and cease firing.

One of the more interesting uses of announcing systems is on the flight deck of Aircraft Carriers. Several super-power loud speakers are located in the island structure, and pointed so that the entire flight deck is covered. Each of these loud speakers is driven by an audio amplifier of 500 watts output capacity. These loud speakers form part of the system over which the Air Officer, located at the Fly Control Station above the flight deck, can give orders to pilots and deck crews during fight operations and while the airplane engines are being warmed up. This system is also used for transmitting warning signals in flight deck emergencies.

The frequency band transmitted by these systems, including microphone, amplifier, and loud speaker, is approximately 500 to 6,000 cycles. The low end is cut off at about 500 cycles, partly because these lower frequencies do not add materially to the intelligibility, and in fact often serve to reduce intelligibility in noisy, reverberant spaces, and partly because this low-end cut-off permits loud speakers and amplifiers to be smaller and lighter than would otherwise be required.

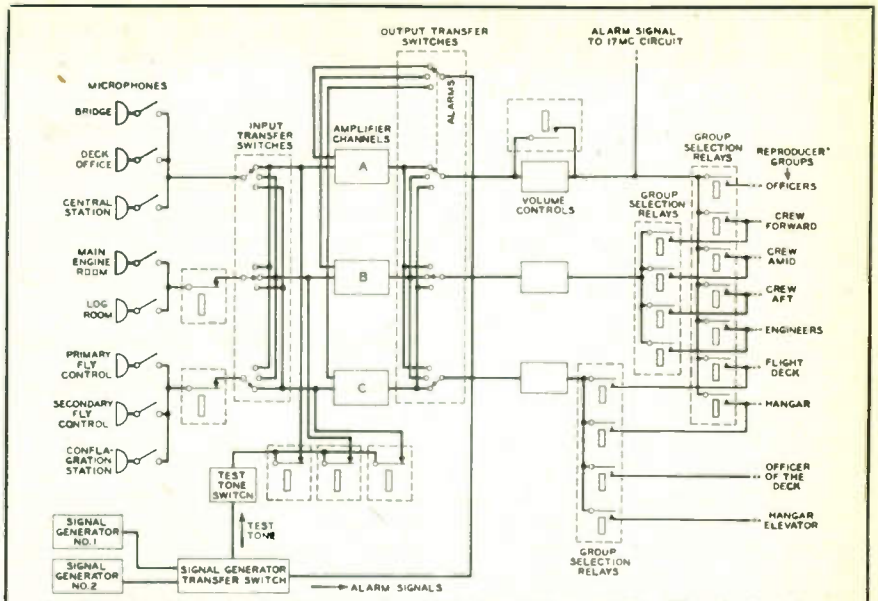


Fig. 3. Simplified circuit diagram of a triple announcing system. The three systems may be used simultaneously to transmit announcements to three separate parts of the ship. Each amplifier channel is capable of handling the load of the three combined

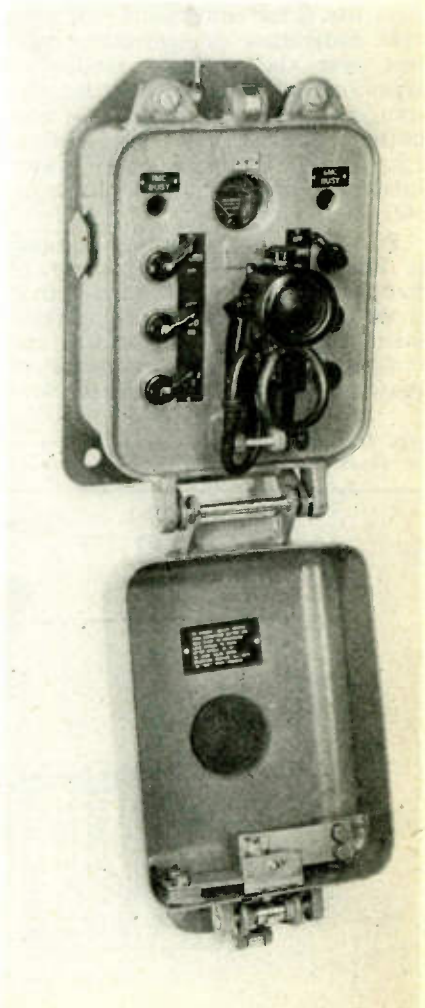
The higher frequencies have been accentuated to give better intelligibility in noisy spaces. Volume compression which averages 2:1, and thereby compresses a 40 db volume range into a 20 db volume range, is used to bring up the volume of the weaker syllables, and thus to improve intelligibility in noisy locations. As full amplifier output is approached, the compression ratio increases until at rated output the compression is about 10:1, helping to prevent overload and blasting of the loud speakers.

Amplifiers

Two types of amplifiers have been standardized for this equipment. One is the 40-watt, 120 db gain amplifier shown in Fig. 1. In small systems such as the turret or anti-aircraft systems, this is the only amplifier used. In larger systems, this amplifier is used to drive one or two 500-watt amplifiers. Fig. 2 shows the amplifier and control equipment for the combined General, Engineer's, and Aviator's Battle Announcing Systems on a large Aircraft Carrier. The two racks at the left contain switching equipment and signal generators for the production of alarm signals. Each of the three racks at the right is a high-gain, 1,000-watt audio amplifier channel which uses the 40-watt amplifier and two of the 500-watt amplifiers mentioned above. At full audio output, this system draws 100 amperes from the 115-volt, 3-phase power supply.

(*Continued on page* 130)

Fig. 4. A transmitter control station with cover down. This is the type of station used by the "talker" to transmit to selected parts of the ship the orders of the officer in charge. A db meter with a designated operating point indicates the proper volume for speech



STREET LIGHT CONTROL

By JESSE L. HALEY,
Supt. Electric Meter Dept.,
Memphis Light, Gas and Water Division, Memphis, Tenn.

Largest such system, operated by carrier, permits remote control of lighting through 1300 pole receivers

● Wired radio is a remote control system particularly applicable to electric distribution systems for the control of loads that would otherwise require special metallic control circuits or might be economically out of the question by other methods.

The value of such a control system is demonstrated by its ability to utilize existing power lines for means of transmission and to provide effective control at any point on those power lines. Its usefulness is greatly enhanced by the fact that the same equipment can provide individual or collective control over six or more groups or types of load, any of which may be composed of hundreds of load units scattered over the system, e.g., street lights, electric water heaters (off-peak load control), etc.

For the more economy-minded, it has the attractive feature of comparing favorably with other types of control in capital investment, maintenance costs and operating results when systems of reasonable size are considered. Several such systems are in operation throughout the country, the one under discussion being one of the largest.

Such a system functions on the carrier principle, where a control frequency higher than the power frequency is supplied by a transmitter and is superimposed on the power frequency through suitable coupling equipment and thereby delivered to the entire system or to selected portions through the power lines. Our system is used entirely for the control of multiple street lights, one group being used for all night street lights and another for half night lights.

The system has been in operation for approximately five years and now controls approximately 65 per cent of all lights in Memphis and county, the remainder being the residue of the old series street lighting circuits which have not yet been converted to multiple.

We have six low frequency transmitters installed in widely separated substations throughout the city, and approximately 1300 receivers connected to an equal number of light circuits over the city and county.

The six transmitters are remotely controlled from the system dispatcher's office through a master controller which enables the system dispatcher to operate the transmitters individually or simultaneously.

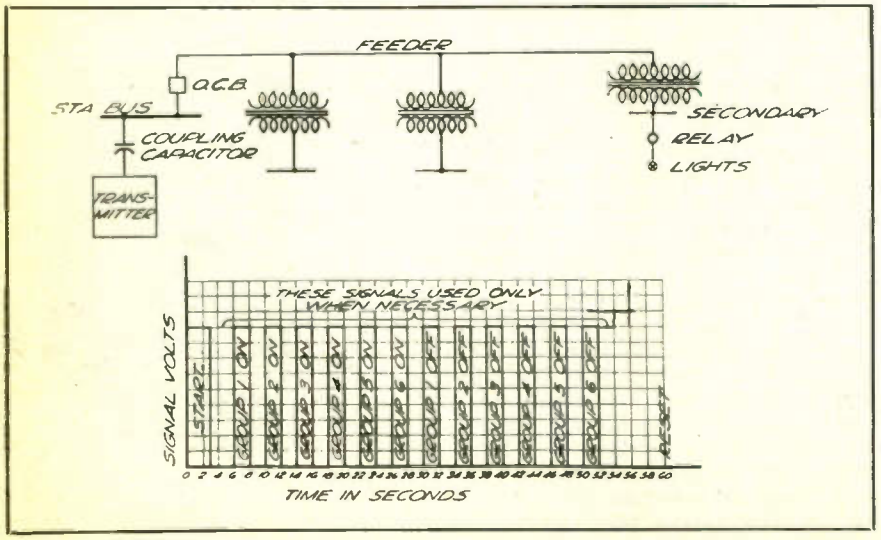
Transmitter

The fundamental scheme is shown in Fig. 1. At the substation, the transmitter is coupled to the station bus which supplies power to the distribution feeders and the receivers are connected to the secondaries of the usual distribution transformers. When the control signal, at approximately 3000 cycles, is applied to the substation bus, it travels over the distribution system exactly as the power frequency does and operates the receiver which in turn controls the lights.

The transmitter may be coupled to more than one distribution bus —for example, a 4 kv bus and a 12 kv bus, thus simultaneously supplying both. By coding or timing the control signals, group control is obtained. By referring to the graph in Fig. 1, it can be seen that the interval between the "start" signal and the subsequent group signal determines which group operation is to be effected.

A transmitter is made up of a 3000 cycle motor generator set, a control cabinet and coupling units, (Fig 2). The motor generator set is composed of a 3-phase, 60-cycle motor coupled mechanically to three single-phase, 3000-cycle inductor type generator units. These units are so arranged that they supply voltages 120 degrees out of phase and are usually connected in wye, constituting a 3-phase, 3000-cycle power source. On a 6 kva transmitter unit, each of the single phase generators is rated 2 kw, at a voltage of approximately 125. The control cabinet houses the auxiliary control relays, the check

Fig. 1. Fundamental scheme of controlling remote operations such as lights by means of timed impulses sent out over power feeder lines. Coupling capacitor isolates set



receiver and part of the tuning and impedance matching inductors.

The coupling units usually consist of capacitors which perform the dual purposes of blocking the 60-cycle power from the transmitter equipment and providing negative reactance for resonating purposes. In some cases it is necessary to use series inductors in conjunction with coupling capacitors.

Impedance match

By referring to the fundamental single line diagram of the transmitter circuit, Fig. 3, it will be seen that the series and shunt variable inductors are roughly the equivalent circuit of a transformer with the series inductance on the generator side omitted. The series inductor on the line side, along with the coupling capacitors, are used to approach a resonant condition for these reactances and the bus impedance, and the shunt inductor is used to match the impedance of this circuit to the impedance of the generator. With a good matching and resonating condition, the line current, I_l, will be approximately twice the generator current, I_g.

Referring to the schematic diagram of the transmitter, Fig. 3, an operation begins when one or more of the selector push button switches is depressed momentarily. This action energizes the associated selector relay and the motor starting relay which seal in through their own contacts. The selector relay sets up a circuit between the timer relay and the keying relay to determine the group operation, and the motor starting relay energizes the motor generator set and the time delay relay motor. The time delay motor seals itself in through its contact TD-1 which opens 60 seconds later.

After an interval of approximately 40 seconds, the time delay relay closes its contact TD-3 which applies the dc field to the generator through relay F which seals in. After an additional three seconds the time delay relay contact TD-4 closes and energizes relay S for three seconds. One contact of relay S energizes the keying relay for that interval, three seconds, and the start signal as shown on the graph, Fig. 1, is applied to the bus. The other contact of relay S energizes the timer relay motor which seals itself in through its own contact TRM-2. This contact will open 60 seconds later corresponding to one revolution of the motor driven shaft.

The timer relay then makes contact 1N, 6 seconds from the time the timer relay motor was energized and for an interval of 2 seconds. After an interval of 2 seconds, contact 2N is made for 2 seconds. The remainder of the contacts of the timer relay are made in that sequence and if the circuit to the keying relay has been completed through the selector relay contacts, the keying relay will be energized during those intervals of contact closing.

After all the group control con-

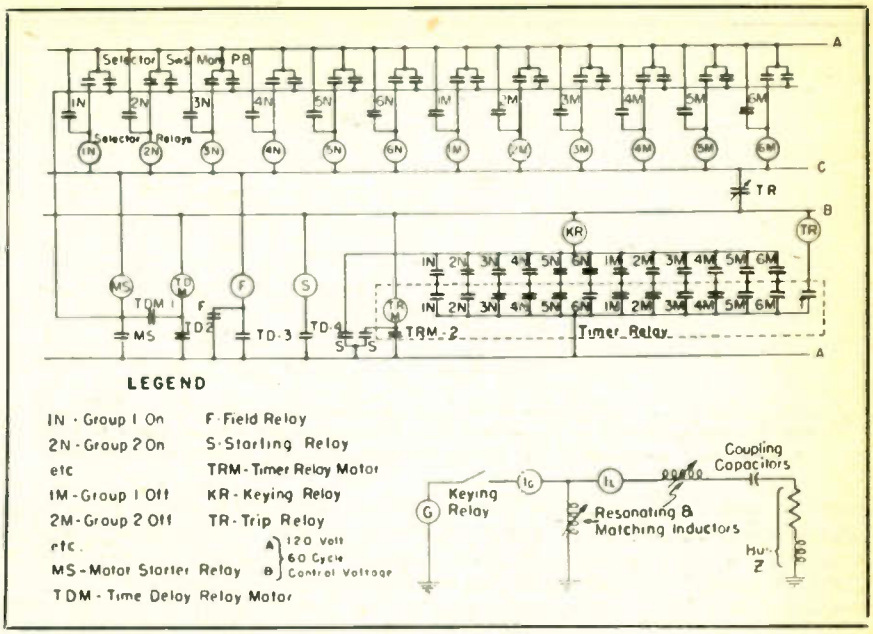


Fig. 3. Coupling capacitor and series inductor are used to resonate the bus impedance. Above is shown the layout of timing and selector relays determining group operation

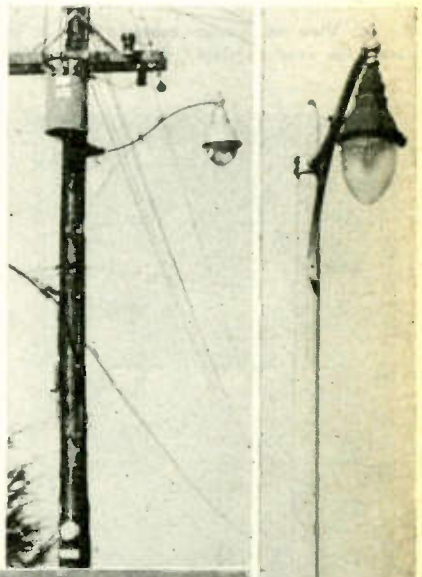
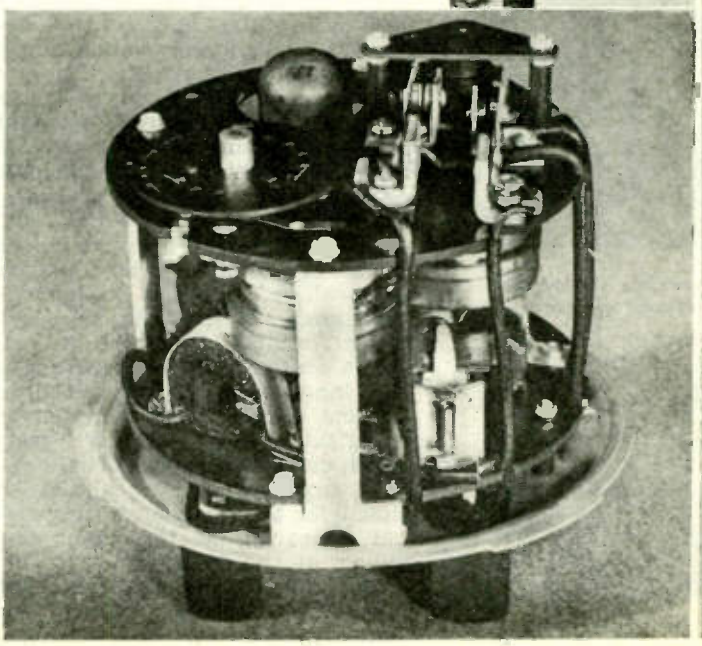


Fig. 4, Below—Receiver housed in socket type meter parts for installation at the controlled location. It is similar in appearance to residential watthour meters. Fig. 7, Right — Receivers installed on street lighting circuits showing ease of use



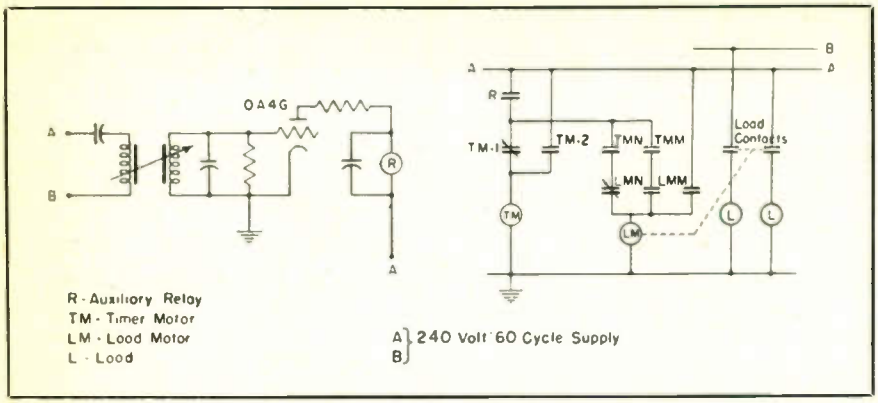


Fig. 5. Circuit diagram of receiver using a 3000-cycle filter to feed signal to grid of tube. Time delay relays and motors complete operation to the load contactors

tacts of the timer relay are closed and opened in sequence, the trip contact "T" is made, energizing the trip relay TR to deenergize the seal-in bus, C, to the control relays and the transmitter resets and is ready for an another operation.

Fig. 6. View of master control. This is located in the system dispatcher's office

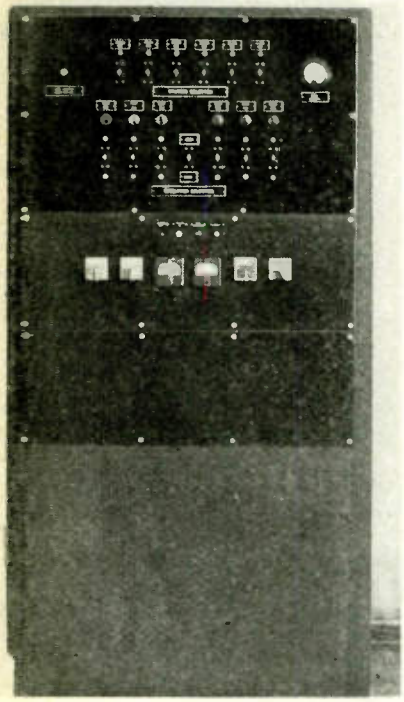


Fig. 2. Motor generator set showing three single phase generators and driving motor

Contact TRM-1 in the time delay relay motor circuit is a normally closed contact operated by the timer relay which opens 3 seconds after the timer relay is energized and closes after the time relay sets. This is provided in order that the time delay relay motor will not continue to run when it reaches the end of its cycle during the operation of the timer relay.

In order to provide sufficient signal strength at the relay locations, it is necessary to apply approximately 125 volts to a 4 kv bus and 300 volts to a 12 kv bus.

Receiver

The receiver is a unit that compares in size with a standard residential watthour meter and is usually very similar in appearance. The receivers used on our system are housed in socket type meter parts and are installed in meter sockets provided at the control location. Fig. 4 is a view of the receiver with the glass cover removed.

The receiver is made up of a 3000-cycle filter and control devices, a timer motor section and a load motor section. The filter is connected across the power source and is made up of a series resonant input circuit coupled to a parallel resonant output stage which is connected between the grid and cathode of a type OA4G cold cathode gaseous tube. In the anode circuit of the tube is an auxiliary relay whose contact is in the control circuits of the timer and load motor circuits.

The control voltage appearing at the input terminal of the filter triggers the gaseous tube, thereby energizing the auxiliary relay which closes the contact. Therefore, the auxiliary relay contact is closed for the duration of any signal appearing at the input terminals of the filter.

Referring to Fig. 5, the receiver schematic diagram, when the auxiliary relay contact R closes, it energizes the timer motor which seals itself in through contact TM-2. Contact TM-1 opens 2 seconds after the motor is energized and remains open for 57 seconds and contact TM-2 closes after 2 seconds and opens after 58 seconds thus energizing the timer motor for 60 seconds or 1 revolution of the motor-driven shaft.

Relay operation

The timer motor "on" contact TMN, is made for 2 seconds after a time delay determined by the group setting of the relay and the timer motor "off" contact is made for 2 seconds beginning 24 seconds after the "on" contact TMM is made. If the auxillary relay contact R is made by a signal during those 2 second intervals, 60-cycle energy is fed through that particular contact to the load motor "on" and "off" contacts LMN and LMM and this energy will be fed to the load motor if the signal coincides with the load motor contact setup.

When the load motor is in the off position its "on" contact is made and if the motor receives energy to start from the proper signal, it seals itself in within 2 seconds through contact LM-1 and contact LMN opens. Contact LM-1 remains closed for 28 seconds so that the motor will run for 30 seconds, or one half revolution of the motor-driven shaft. At the end of this period the load motor "off" contact, LMN, is made, thus setting up the load motor to receive an "off" signal. The load motor operates a cam which in turn operates the main load contacts as shown in the schematic diagram. From the above description it can be seen that repeated signals will not cause the relay to operate after the first operation.

The receiver can be made to operate on a signal as low as .1 volt. However, as in communication, signal-to-noise ratio is important. To realize proper operation on signal strength as low as .1 volt, there must be practically no interference signals. We have found by experience that .5 volt is a better operating minimum for this particular system and we attempt to maintain a signal level of 1.5 volts or better.

The master control is shown in Fig. 6. This equipment is in our system dispatcher's office. The carrier principle is not utilized here since we had available telephone cables from our system dispatcher's office to our various substations. With this exception, however, the principle of control is very similar to that of the transmitter and one pair of

(*Continued on page* 130)

MEASURING THICKNESS

Gamma rays from radium source are used to measure wall sizes by detecting the reflections from molecules

In many industries, particularly those using pipes or closed vessels it is necessary to make routine checks to determine the thickness of the pipes or of the walls of the vessels, as an indication of their strength or ability to resist pressures. In other cases it is necessary to determine the level of a fluid inside a tank without having access to it. All of these problems can now be solved easily and quickly by means of a new radium and electronic measuring instrument called the Penetron. This instrument was developed by Dr. Gerhard Herzog of The Texas Company.

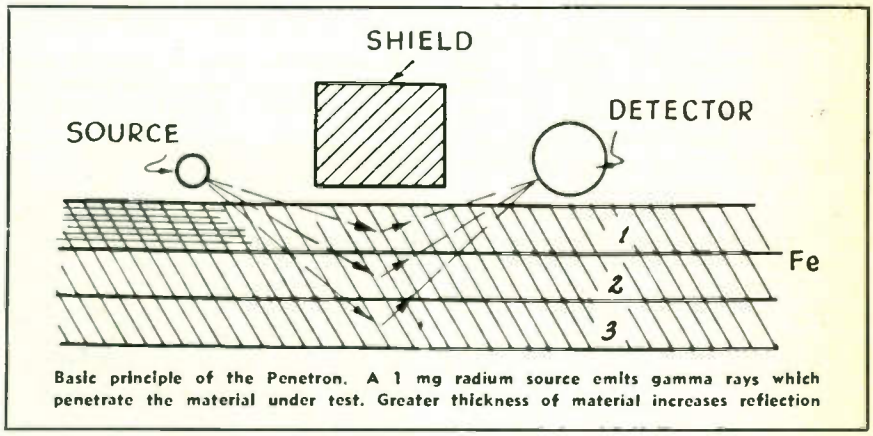
Basically, the instrument consists of a source of gamma radiation in the form of a commercially available 1 mg. needle of radium, a collector of this gamma radiation and an amplifying and metering system.

The radiation is utilized by measuring either the amount transmitted through a thickness of metal or other material, or the amount reflected from the molecules in the material. The latter is the method used in the measurement of the wall thickness of closed vessels. The radiation is permitted to enter the wall to be measured through a window in a shielded compartment surrounding the radium. Due to the shortness of the gamma electromagnetic waves, they penetrate into the intermolecular space of the material under test.

A portion of these rays strikes the molecules and is reflected back in all directions. By means of a detector placed against the surface some inches from the radium, a fraction of this back scattered radiation is collected and used to trigger a pulse generating circuit. The pulses are amplified and put through an integrating circuit to produce a direct current, the magnitude of which is proportional to the number of pulses created per unit time in the detector. The current is measured by a microammeter in the control box.

By proper calibration against specimens of the same material and of known thickness, the readings obtained on the meter are readily converted to the wall thickness of the object being measured.

Since the presence of a liquid behind the wall being measured would cause some rays to be reflected from the liquid molecules as well as from those in the wall, the meter readings will increase as the instrument is moved down a wall past the surface of a liquid. Thus the liquid level is easily located. For the same reasons, the density of a liquid flowing behind a wall can be measured, as the denser liquid causes more reflections.



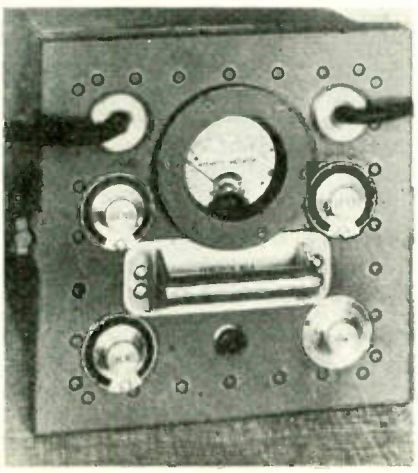
Basic principle of the Penetron. A 1 mg radium source emits gamma rays which penetrate the material under test. Greater thickness of material increases reflection

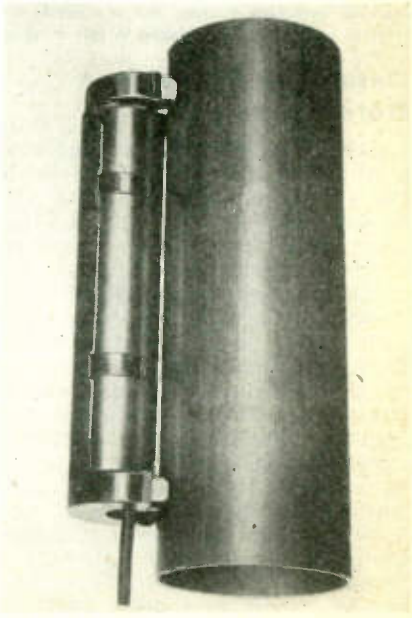
Steel walls up to about .75 in. can be measured. For other materials, the limiting thickness is different, due to different densities. The accuracy of measurement is about plus or minus three per cent.

In making measurements by the method of transmission instead of reflection, the readings decrease instead of increasing with increasing thickness of material. This is because more rays are absorbed in going through the greater thickness.

The measuring head is housed in a steel tube 2.5 in. in diameter and 13 in. long. It can be inserted in various holders. One holder for use on outside walls is equipped with two permanent magnets which serve as supporting points to locate the head accurately at a certain distance from the surface measured and also hold it firmly in place. Another holder for use inside tubes has pneumatic pistons which press the head against the inner wall of a tube. This head contains the radium, the detector, a shield between the two and a preamplifier.

Right—The head in a magnetic holder used to fasten it to the pipe under test. Head contains radium source, shield and detector as well as a preamplifier. Below—Control box containing amplifier and meter





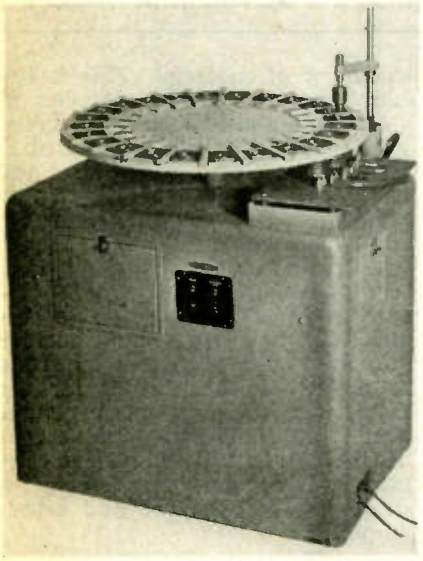
TUBES ON THE JOB

Production Brazing

The rotating work table illustrated successively brings metal assemblies over three electronic induction heating coils. The coils are followed by a vertically operating ejecting mechanism.

By having an operator loading the stations as they come around empty, this twenty-four position indexing carrier delivers a completed assembly every twelve seconds. Only a small motor is needed to drive the turn-table.

The unit shown, manufactured by the "S"" Corrugated Quenched Cap Company of 107-119 Monroe Street, Garfield, N.J., delivers 18 kw at 200 to 600 kc. Water cooling hoses may be seen leading to the coils.



Multiple induction heating and completely automatic operation are achieved in this machine

Balancing Submarine Motor Armatures

Balancing the armatures of submarine driving motors is a delicate operation that used to take two men a full eight to ten hours. Principal difficulties were connected with the inability to accelerate the armature quickly to a desired speed or bring it to rest. Time for stopping used to be about four minutes. These problems have been solved by the installation of a General Electric Co. Thy-mo-trol electronic regulator. This regulator operates a direct current motor on ac power by rectifying the ac, and then automatically regulates the voltages applied to the field and armature windings of the dc motor. Any speed within the range of the machines can be preset and held. Furthermore, the circuits are arranged so that when it is desirable to slow down or stop the armature under test, electromagnetic braking takes place in the driving motor. By this means stopping time has been reduced to 37 seconds. Total test time is now only five hours for one man.

Time required for balancing submarine motor armatures has been reduced from 10 hrs. for 2 men to less than 5 through electronic drive

Streetcar Emergency Trucks Speeded by FM

Multiplying effectiveness of crash truck and other emergency equipment, the Los Angeles Transit Lines have inaugurated station KTIF, a new 250-watt transmitter, as the heart of a two-way frequency-modulation radio network.

The system affords direct contact among the dispatcher, supervisors and emergency equipment crews at all times. Cruising repair and other trucks may be rushed to the scene of a streetcar breakdown or other emergency with a minimum of delay. Thus:

"Derailment at Pico and Broadway. Get a crew there at once . . ."

Immediately, L. J. Turley, L.A.T.L. electrical engineer, explains, trucks suitable for righting the situation are speeding to the scene. Result: Elimination of the tie-up within minutes instead of hours.

An 85-foot transmission tower atop the Transit Lines Building at 11th St. and Broadway has a 35-mile range. In event of failure of this installation, any one of the mobile trucks may be turned into a temporary broadcasting station.

"Bottle Detective"

A decided benefit to food processors and consumers alike was seen in an announcement by General Electric of the development of a photoelectric crack detector that inspects glass jars and bottles as they pass on a rotary turntable, automatically singling out and rejecting those that contain minute cracks or surface irregularities. Such flaws, if they were to pass unnoticed, might prevent airtight sealing and result in spoilage of the contents.

More accurate than a human inspector in uncovering defects in glass containers, this crack detector is also much faster. It inspects bottles as fast as they are made on a bottle making machine, which may be one or more every second, and it detects even those flaws which are barely visible to the naked eye. General Electric, in collaboration with the Hartford-Empire Company, developed it especially for use in food packaging plants. In one such plant it was previously found that, on the average, 2 out of every 100 glass containers with flaws escaped detection by human inspectors.

In operation the detector rejects faulty containers without interrupting the continuous bottle making process. As the containers automatically move in front of a sensitive photoelectric tube, they are whirled rapidly while a strong light is directed on the part to be inspected. Since the phototube is not affected by a steady light, the light reflected by a perfect glass produces no effect. A rapidly spinning bottle with even the slightest imperfection on the sealing edge, however, causes the light beam to flicker, and this quick change in

This monster inductance, built by Andrew Co. for Augusta radio station WRDW is made of coaxial cable, and used for rf energy monitoring

the intensity of the beam is sufficient to eject the imperfect container while the perfect ones are allowed to continue on their way.

Recording Depthometer

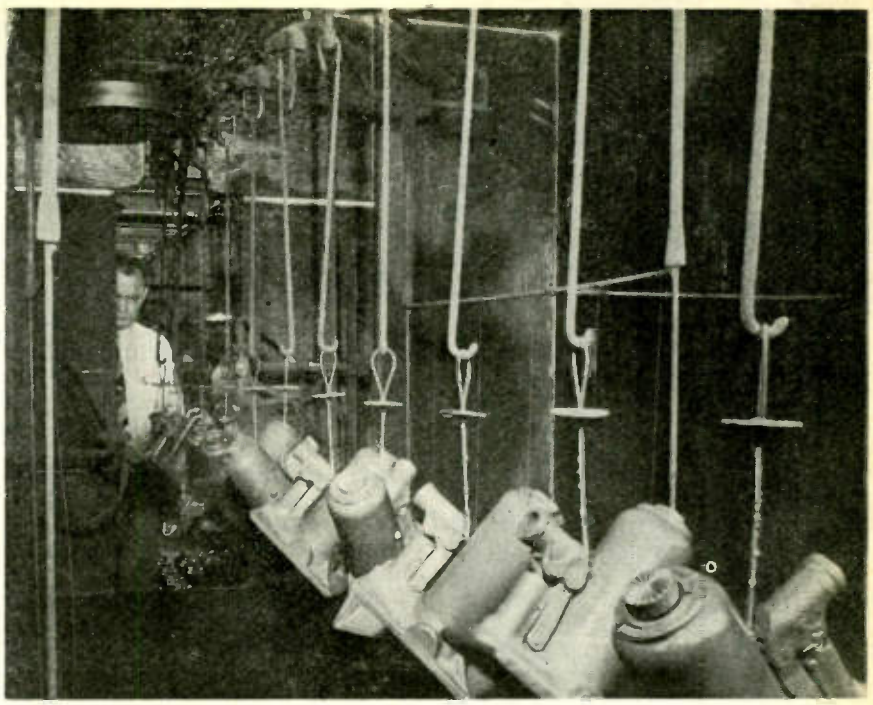
One of the most ingenious and intricate uses to which instruments have been put is that of recording how deeply a submarine cable is buried in the ocean bottom. In laying a cable it is "ploughed in," that is, actually buried in the sand or soil of the ocean bottom. After the cable has been laid, the next problem is to inspect the work by measuring the depth to which the cable is buried below the ocean floor.

A paper by Mr. D. H. Nelson, Electronic Engineer of the Western Union Telegraph Co., before the American Institute of Electrical Engineers, describes the "Depthometer" which was designed and built for this purpose. When we consider that these measurements were made at depths up to 3,000 ft. at which the water pressure is 1,200 lbs. per sq. in., over the often rough floor of the ocean bed, some idea of the complexity of the task can be imagined. Esterline-Angus graphic instruments were used to record the measurements, and a pair of special chart drives were used to indicate whether the sled carrying the measuring equipment was right side up on the ocean bottom at all times.

Electronic Vulcanizing

Use of electronic preheating and also complete curing of rubber goods on a production basis has been adopted by the Firestone Tire and Rubber Co. Such production is scheduled for Army tank tracks at the Noblesville, Indiana, plant, and for industrial rubber wheels as well as foamed sponge rubber mattresses, seat cushions and parachute pads at the Fall River, Mass., plant. These installations are expected to save thousands of man hours and to increase output 50 to 80 per cent.

Standard steam curing of Army tank tracks takes 60 minutes. By preheating electronically for two minutes subsequent steam curing time is reduced to 28 minutes. Similarly, two minutes of electronic preheating reduces steam curing time of large rubber wheels from five hours to 18 minutes. Foamed sponge rubber, previously requiring 30 minutes steam curing and 16 hours of subsequent hot air drying, can be cured in four minutes, and after 30 seconds of electronic preheating, can be air dried in one hour. Heating is accomplished by the usual method of placing the rubber product in a high frequency electric field.



Electrostatic painting, relatively new, speeds up and greatly improves finishing operations on odd-shaped parts by taking advantage of attraction between oppositely charged paint and part

Electrostatic Painting

A neat solution of the problem of obtaining an overall coating of paint on an odd shaped product such as an automobile jack is presented by electrostatic spraying. Obviously, the piece can not be dipped as the paint would get in the works. Hand painting is too slow, and ordinary spraying does not cover the whole surface. By establishing a potential of about 85,000 volts between the jacks to be painted and the surrounding structures, paint particles are charged electrically and are attracted to every portion of the surface of the jacks. In addition the jacks are made to rotate slowly by the conveyor system. High production, even coating and reduced paint waste are achieved by this scheme.

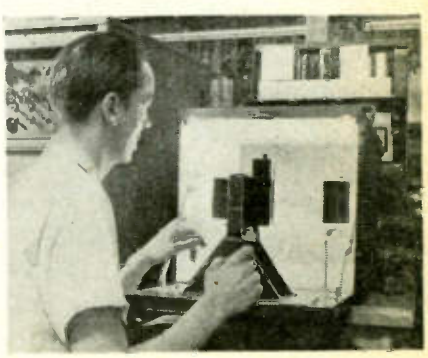
A ¾ kw oil immersed high voltage transformer is used to supply the 2 to 10 milliamps required by the electric field. This is rectified with usual types of half wave rectifiers and applied directly to the job. Of course, paint consistency and quantity of solvent are carefully regulated. Lower air pressures are used than in ordinary paint spraying both to force the paint through the hose and to atomize it.

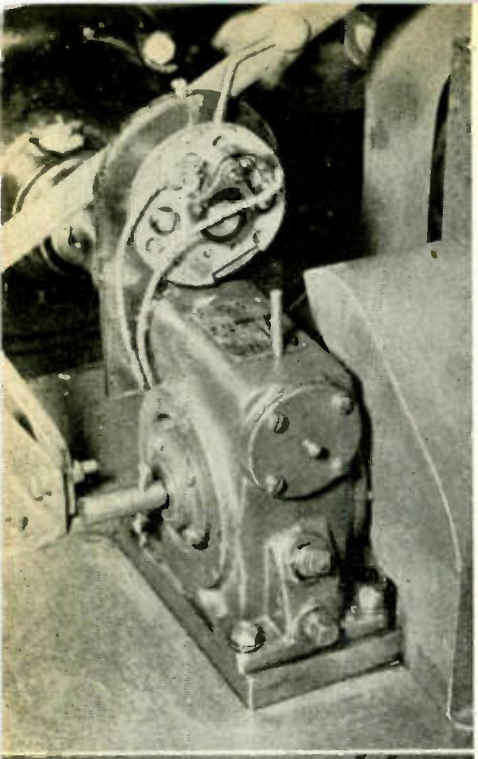
Movies Check Gun Director

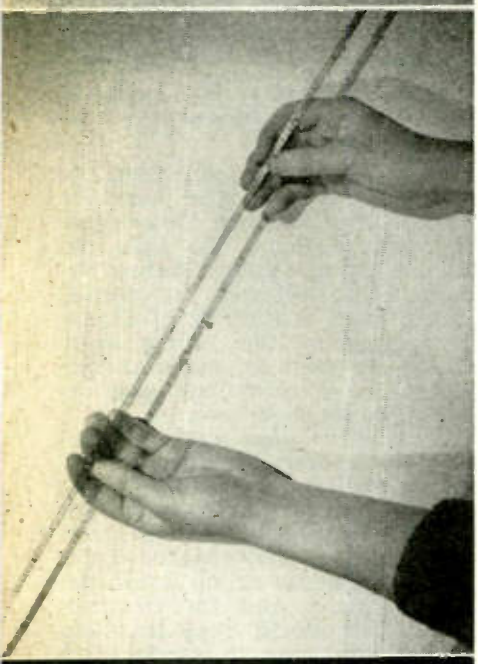
One of the most remarkable series of devices used in the war are the gun aiming computers for 90 mm AA guns, B29 power operated turrets and others. Voltages are obtained from the sighting mechanisms which are proportional to the deflection of the sight in azimuth and elevation. These cause the gun to follow the sight. By using electronic differentiating circuits, other voltages are derived proportional to the rate of change of angular rotation of the sight. These are used for speed corrections. The directors are also arranged to set shell fuses.

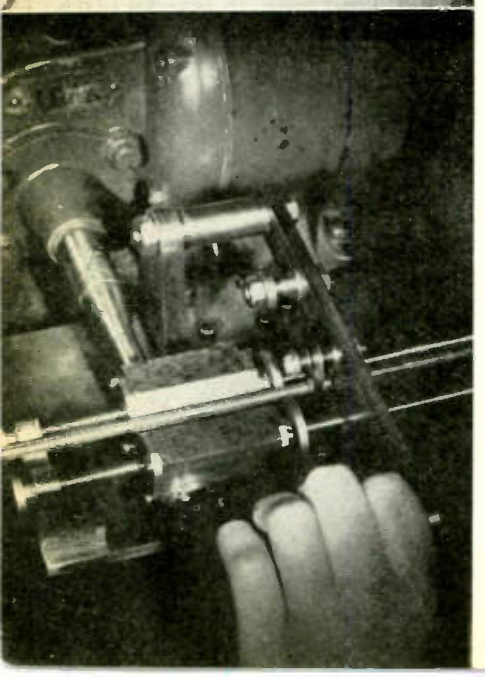
All these complex functions must be given an overall operating check. To do this and to read revolving dials at spaced time intervals, the motion picture camera is used. Four dials are photographed. Three of these indicate azimuth and elevation angles and fuse settings, while the fourth registers time. Quick developing in special dark rooms provides a visual record of the test only a few minutes after completion. Viewing is done with a Recordak reader, giving a 13 in. x 13 in. image.

Electronically coltrolled gun aiming computers are monitored and checked through photographic records which picture four dials simultaneously









MECHANICAL

● An urgent military request late in 1942 for mass quantities of the 304TL, a high frequency transmitting tube type which up to that time had been made largely by hand, posed a series of technical problems for the Eitel-McCullough organization at San Bruno, California, and Salt Lake City, Utah, designers and then sole producers of the required tube.

Among the most formidable of these problems was the production of more than 4,000 cage-type, vertical-bar grids a day, grids of a type which had always defied mechanical fabrication. The 304TL, a multiple triode with four grids, four plates and four filaments internally connected in parallel, required absolute uniformity in grid structure to attain electrical balance. This requirement greatly aggravated the mass production difficulty.

Highly-skilled girl operators, employing hand mandrels and precision spot-welders, were able to make uniform grids, but not in sufficient numbers, and the need for individual welding devices, great numbers of precision-grooved mandrels, electrodes, timers and other equipment became extremely onerous.

Because the San Bruno plant was already overburdened with production of other types of military tubes, the 304TL (and 304TH) contracts had to be assigned to the new Salt Lake plant, which was then (1942) just going into production. The company was, accordingly, hiring every available qualified person in the Salt Lake area to fill the many other necessary jobs.

It was found that only a small percentage of the available personnel was qualified to perform the exacting operations of grid making, with its demands for superior eyesight, hand - and - eye coordination and digital dexterity. A training period of several months was in store for those who could qualify. A critical shortage of materials made training a drain on production, since the actual materials had to be used in the training. Waste and shrinkage were minimized by close supervision, but the loss of materials soon became a considerable item.

THE COVER

The Kodachrome photograph which adorns the cover of this issue was specially made for Electronic Industries by Eimac photographers and shows the newly developed machine for mass producing transmitting tube grids in operation.

The answer was obviously a machine to do the job, though the industry had long accepted the "impossibility" of winding and welding vertical-bar grids by machine, especially to the close dimensions of the 304T type. Each grid (304TL) was wound of .007 in. tantalum wire, with 12 bars and a spiral wrapping. It was 1 9/32 in. in length, and 0.208 in. in diameter. Bars and wrapping were formed of the same kind of wire. There was no internal "hardware" or insulation, hence the grids had to be self-supporting and able to operate at high temperatures without distortion.

Summed up, the machine had to wind and weld simultaneously the grid bars and the spiral wrapping to turn out one cage-type grid after another to exact specifications as to dimension, spacing, spiral pitch and wire diameter, and to do it very rapidly. No grid winding machine then in use in the vacuum tube industry could begin to meet these requirements.

The experimental laboratory at the Eimac San Bruno plant advanced several possible solutions in the next several months of research on the problem. Some of the designs discarded had desirable features, but considerations of a practical nature led to the adoption of the fundamental construction shown in the illustrations.

The continuous-feed operation of the machine required some method of accurately controlling the advance of the mandrels on which the grids were made to ensure absolute similarity of each succeeding grid in the chain. This was accomplished by an accurate gear-driven roller feeding mechanism.

Top—Timing apparatus for grid winding machine, which triggers the welding current power supply to produce one complete cycle for each weld. Center—A "string" of grids as removed from the mandrel, before cutting. Bottom—Motor driven cutter for separating individual grids

PRODUCTION OF GRIDS

Development of high speed machine equipment for turning out 4000 vertical bar grids daily for transmitting tubes

The wires which formed the vertical grid bars were pulled forward by the mandrel, unwinding each wire from an individual spool, the tension of which was correctly maintained by means of a friction brake. The uniform spacing of the vertical bars was accomplished by guiding the mandrel and wires through an accurate indexing nozzle.

To produce a variable spiral winding, some means of controlling the motion of the wrapping wire was necessary. Cam control lent itself to this type of movement and was adopted, the cam contour being carefully designed to produce the desired pitch variation. The winder head which carried the wrapping wire and welding wheel was oscillated by means of the cam and return springs.

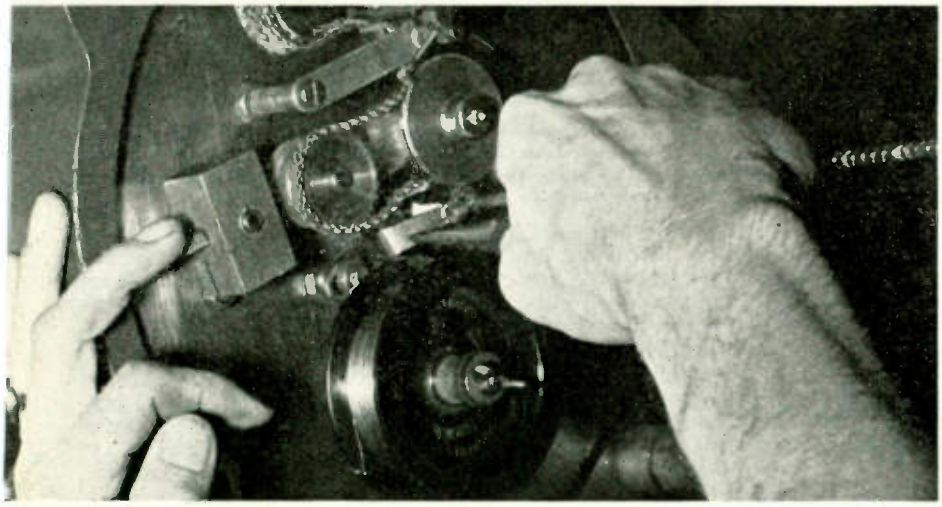
To weld the spiral wire to the vertical bars, a positive-drive welding wheel was used. The linkage controlling the welding wheel movements was carefully balanced and the desired welding pressure was maintained by spring loading.

The welding current passed from the welding wheel to the copper mandrel. Brushes as shown in the illustration completed the electrical circuit.

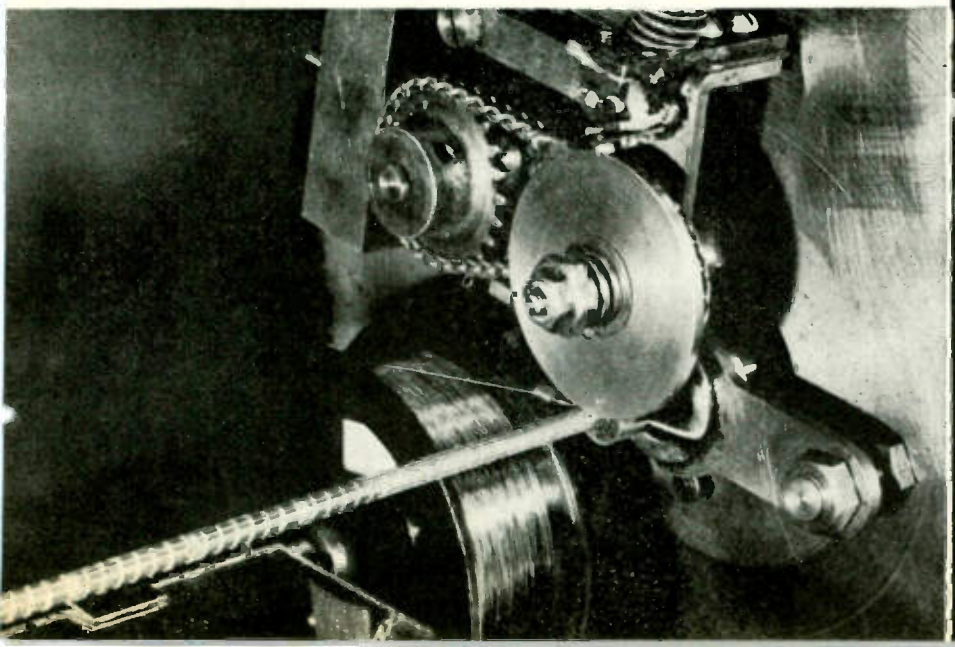
Welding trigger

The welding current power supply was designed to produce one complete cycle of current for each weld. The circuit was "triggered" by means of timer points geared to the machine. In order to have an identical electrical cycle for each weld, the machine was driven by a synchronous motor enabling the timer to be "in step" with the alternating current supply.

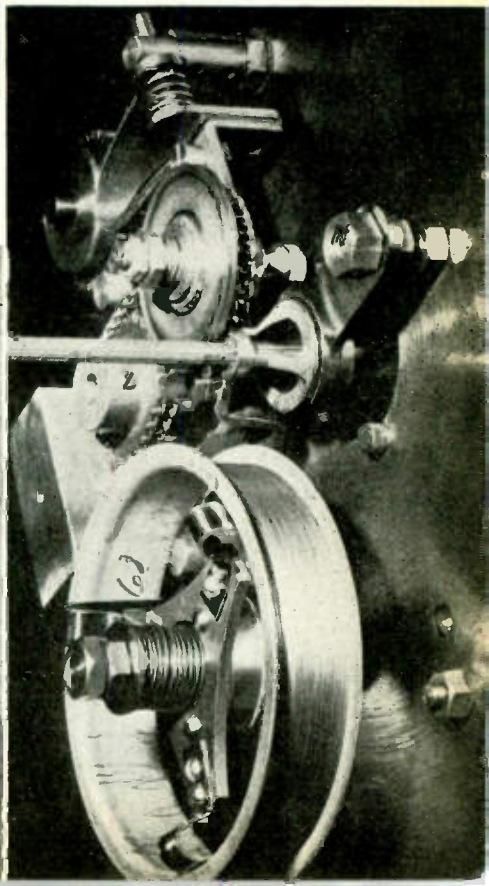
The Eimac drafting department's machine designers produced the specifications and the drawings, and the machine was constructed in the machine tool and die shop in the San Bruno plant. The first machine was completed and put into operation August, 1943, after a troublesome period of adjusting,



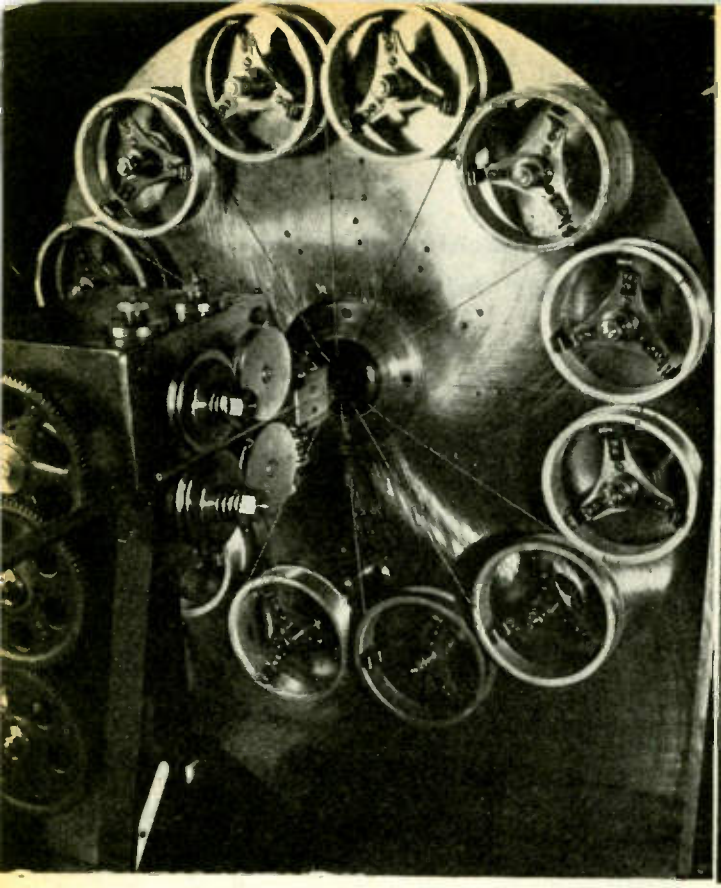
Operator feeds wire to nozzle in the welding head, at the same time releasing pressure on welding wheel by finger tip control on the counter-balance. Spool supplies wire for spiral wrapping



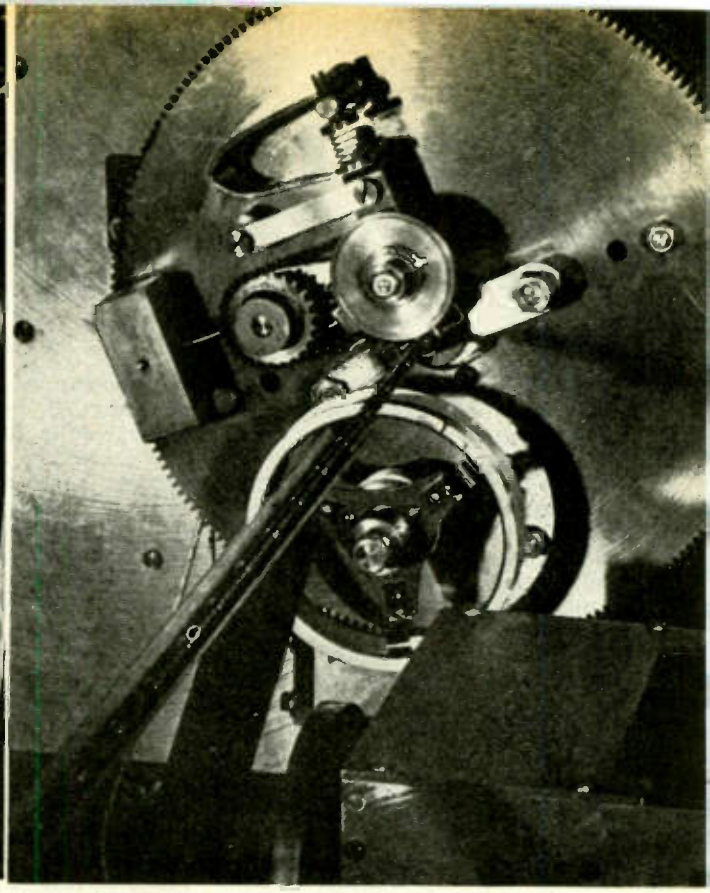
The rotating winder head which carries the spiral wrapping wire and welding wheel is rotated by means of a cam which produces the desired pitch variations in the spiral wrapping as it is put on



Rotating winding head, showing nozzle with mandrel, welding wheel just completing close wound turns, spiral wire spool in foreground



Back view of grid machine showing wire spools feeding into nozzle; gear train (left) controls progress of mandrel through feed rolls and welding current brushes. Number of spools varies in accordance with the number of vertical bars that are required in type of grid being wound



Rear view of rotating head, showing continuous "string" of grids emerging from the nozzle on a copper mandrel supported by a trough. Note the balancing weight (left) which adjusts the critical pressure of the welding wheel on the wire, insuring production of perfect welds

"bug" removing and last-minute changing.

At first the machine produced only 15 welds a second, but this speed was eventually increased to 30 welds a second, and an output of 2,400 grids per shift, per machine, was attained in a remarkably short time.

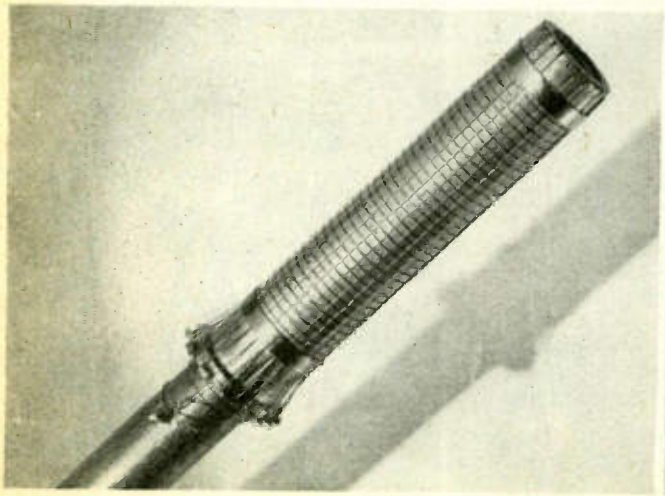
Since some changes in grid design were necessary, such as the substitution of close-wound turns for the traditional end-rings, an open instead of a closed top, it was not possible to make a fair comparison between machine and hand grid methods on a purely numerical basis.

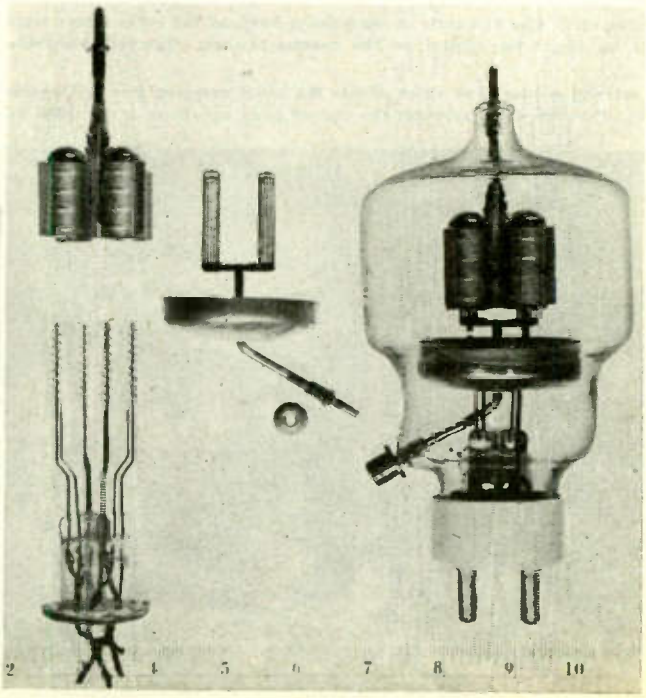
The machine grids, rolled out in a continuous chain, had to be cut apart with a specially-devised cutting machine, the ends clipped and finished, each grid welded to an ear before it could be mounted on the 4-way 304T grid support structure.

The fact that one machine, however, could turn out in two shifts more than enough wound-and-welded grids to supply the need for three shifts in production of the tube, gave the answer to the question of whether this machine was doing its job. Absolute uniformity was attained, the problems of personnel and materials were dimin-

(*Continued on page* 134)

Left—Large type grid requiring more than 800 welds. Right—Exploded view of Eimac 304TH, showing internal structure and complete tube





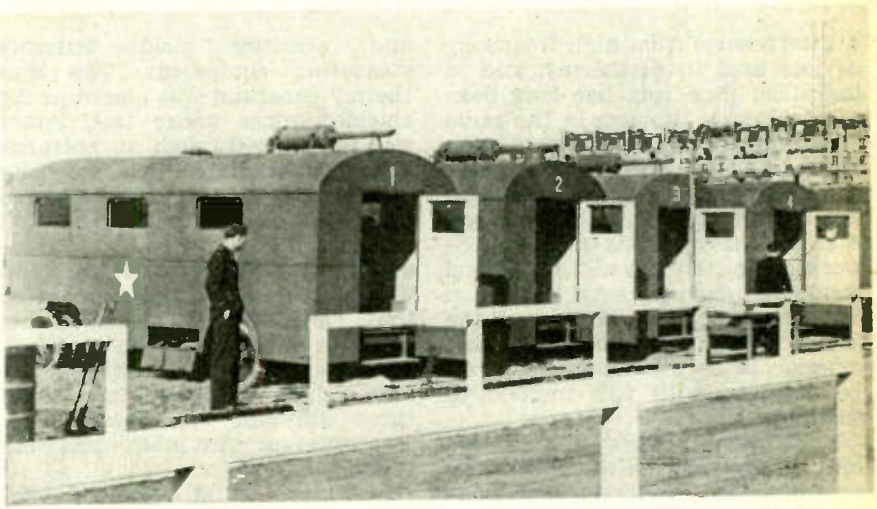
SIGCIRCUS—P-563

Largest mobile station ever built is rated 60 kw and capable of transmitting and receiving 200,000 words per day

● The largest mobile radio equipment ever constructed, Mobile Radio Station, P-563, developing a power of 60 kilowatts, is now being operated in Europe by the U. S. Army Signal Corps following its completion by Le Materiel Telephonique, French associate of International Telephone and Telegraph Corporation, New York.

The new station, which is known as SigCircus, occupies 17 large trailers and has all the facilities of a modern fixed radio station of comparable power. Containing its own power plant and signal center, the complete unit can be set up for operation in little more than 24 hours, and can be dismantled and moved with equal speed. Ordered by Brigadier General Carroll C. Bickelhaupt, Director of Communication Division of the U. S. Army on October 26, 1944, it was delivered as per schedule within three months.

The station is capable of transmitting and receiving a total of 200,000 words daily. In addition to the normal message handling radio-teletype channels, which provide for simultaneous transmission and reception between Europe and the United States, SigCircus is equipped with complete broadcast facilities. These include a portable



All equipment is housed in 17 trailers. These are divided into three general groups: Transmitter, Signal Center and Power and Pictorial. Included are 3-50 kw generators

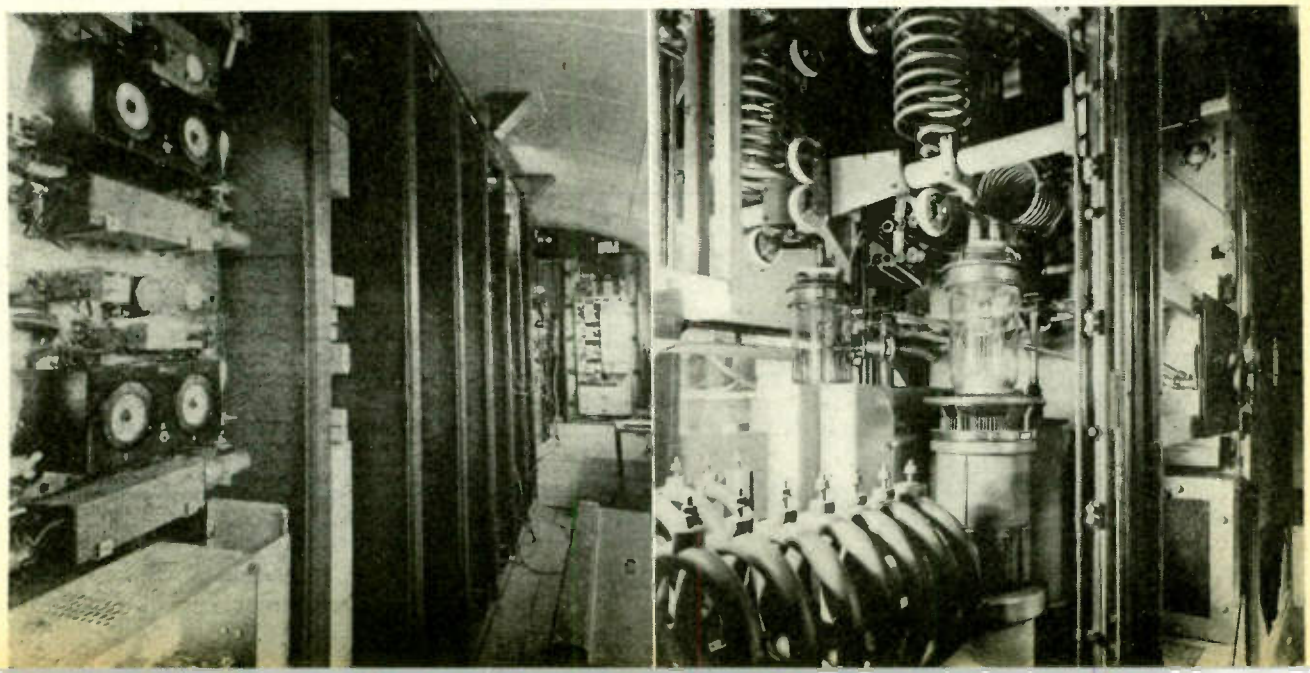
American Forces Network studio, a modern broadcast studio and control booth, as well as complete equipment for facsimile transmission and reception of photographs, and wire, film and disc recording.

Designed for broadcast service to the United States, the station is also capable of providing local programs for the entertainment of Allied troops within a radius of 25 to 30 miles of the station. All these services — radio-teletype operation, local broadcast, as well as photograph facsimile and broadcasts beamed to the United States, can be carried on simultaneously without interference.

One of the many innovations incorporated in this mobile station consists of a special VHF inter-unit communications system for use between the radio transmitting and receiving groups, which are placed a considerable distance apart to prevent mutual interference. This system includes suitable voice fre-

(Continued on page 138)

Left. Channel teletype carrier equipment and radio control positions inside one of the trailers. The racks can be rolled in and out on tracks. Right. Intermediate power amplifier, 60 kw amplifier which is contained in trailer No. 7. This is fed from a transmitter located in trailer 6



SHIELDING HF INTERFERENCE

By ALBERT F. MURRAY*

Attenuation ratios as high as 10,000,000 to 1 can be obtained with shielded rooms

● Interference from high frequency devices used in diathermy, and in industrial processes, has long been a troublesome problem in the radio communications field. Investigation indicates that single or double shielded rooms, or "cells," can best eliminate this type of disturbance. A unit consists of a six-sided framework completely covered by a good conductor, such as metal screening. Suppression of interference at the source, as well as protection against exterior fields of interference, can be obtained with this method of shielding.

Experimental work was carried out under controlled laboratory conditions at Rensselaer Polytechnic Institute, Troy, N. Y., using high power diathermy equipment and sensitive field intensity measuring equipment. The diathermy generator was placed in the shielded room under test. Power was fed to it through an entrance filter. The radiated field intensity at distance of 50 ft. was measured when the frequency of operation was varied from 10 to 50 mc. Frequency runs were made with and without this surrounding room so that attenuation measurements could be made to show its effect. This was done on fourteen different shielded rooms. Materials of three different types were used. Two different wire mesh sizes were tested, 5/8 in. and 1/16 in.

Fig. 1 shows the effects of mesh fineness on attenuation. Fig. 2 shows the comparative attenuation for 5/8 in. and 16-mesh galvanized iron shields, at various frequencies from 10 to 50 mc. The curves are fairly flat, slowing rising at the higher frequencies (with some unexplained wiggles at about 50 mc).

The "figure of merit," indicating the effect of suppression of unwanted interference, is taken as the "attenuation" of the radio field, i.e.

$$db = 20 \log_{10} \frac{\text{field intensity with cage}}{\text{field intensity without cage}}$$

To secure the ratio of field strength with and without a certain shield, the field from the generator is measured by a sensitive meter both with and without the shield. The resulting ratios, as high as 10,000,000 to 1, are expressed, for convenience, in decibels which are 10 log of the ratio of the power levels considered.

For a single shielded room, an electrically complete cage of single layer conductor is built over the wooden framework. On such a structure, tests comparing the effectiveness of copper and galvanized iron screening wire were made, with the following results:

Comparison of Copper vs. Galvanized Iron Screening, (1/16 in. mesh):

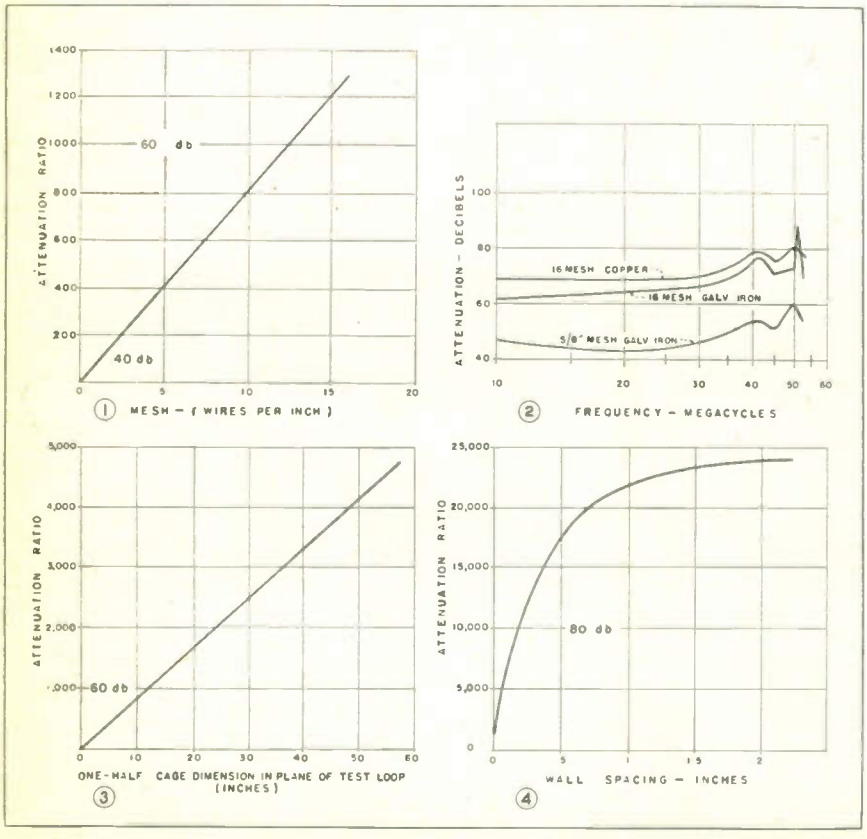
Frequency mc	Attenuation in db Copper	Galv. Iron
10	68	62
50	79 (av.)	74 (av.)

Comparison of 5/8 in. vs. 1/16 in. Mesh (Galv. Iron Screening):

Frequency mc	Attenuation in db 5/8 in. Mesh	1/16 in. Mesh
10	46	62
50	56 (av.)	77 (av.)

An interesting experiment in high resistance screening was carried out as follows: Paper, coated with two coats of powdered graphite in suspension (dag dispersion No. 38) produced a surface

Fig. 1. Effect of the mesh size on attenuation with iron wire mesh shielding. Fig. 2. Attenuation in decibels obtainable at various frequencies for 16 mesh and 5/8 in. mesh galvanized iron wire shielding, with a comparison of 16 mesh copper wire shield. In Fig. 3 the effect of room size on attenuation for the 16 mesh copper screen shielding is shown. Fig. 4 indicates the change in shielding effect obtained with different wall separations for the cell type rooms. This data was obtained in the frequency range of 10 to 16 megacycles



*Formerly Chief Technical Aide, Division 13, Electrical Communications, National Defense Research Committee. Condensation of a Report by Warren C. Stoker, Assistant Professor of Electrical Engineering and William A. Seifert, Instructor in Electrical Engineering, Rensselaer Polytechnic Institute, for Division 13 of NDRC of the Office of Scientific Research and Development, and used as Exhibit 462 at FCC Frequency Allocations hearings.

having a resistivity of 500 ohms/sq. cm. This produced no attenuation at all.

The dimensions of the shielded room should be as large as conveniently possible. Tests showed that the gain in attenuation ratio, (field strengths, shielded to unshielded) for a cube of twice the linear dimensions is roughly 2 to 1, or 6 db. (See Fig. 3). However, the larger room in this case, having four times the surface, would cost four times as much. Therefore, the extra cost would be justified only if increased floor space is usable and necessary.

Double shields

Doubly shielded rooms are many times better than singly-shielded rooms, when properly built and used with a proper entrance filter. Inner and outer shields may be allowed to touch at many points. Such interconnections, however, should not extend beyond the outer shield. Spacing of ½ in. between inner and outer shields is satisfactory. One inch spacing gives 30 per cent more attenuation; however, spacings greater than two inches effect little further improvement.

The theory of the double shield is that the radio generator inside the room induces eddy currents in the inner shielding. These are not allowed to produce disturbing radiation because of the outer shield. The great effectiveness of such shielding was shown by measurement, using a generator at 14 mc. The interference field at 10 ft. from the doubly shielded room was only 1μv (barely detectable), whereas the field with no shield was 10 v—an intensity ratio of 10,000,000 to 1 (or 140 db)! A singly shielded room gave an attenuation of 73 db, corresponding to a field intensity ratio of 4,500 to 1.

A cell type of doubly shielded room is recommended because it gives fairly high attenuation, at low cost. Other advantages are: no soldering of the joints is required; doors and windows can be more easily arranged to make good electrical contact; tears in the screening produce smaller effect; portability (if desired) is increased and construction is easier.

The cell type of shielded room is made up of a number of individual wooden frames measuring, say, 38 in. x 33 in., covered on both sides with metallic screening. These "cells" are firmly bolted together and arranged so that good electrical conductivity is maintained without soldering. Incidentally, it has been found that after about two years the effectiveness of soldered joints in metallic screens deteriorates. This does not happen in the cell type of construction. After five months no change was noted. If the joints do increase in resistance, the cells can be removed and the edges buffed to secure better contact.

The effectiveness of the cell type of shielded room can be judged from the measured attenuation of 117 db, field intensity ratio 700,000 to 1, compared with 140 db for the doubly shielded and 73 db for the singly shielded room. The graph in Fig. 4 shows how the amount of wall spacing in cell type rooms affects attenuation in the 10-16 mc range.

REDUCING INTERFERENCE AT ITS SOURCE

(a) Design for operation in only one of the three frequencies suggested by the Federal Communications Commission, 13.66, 27.32, 40.98 mc with the frequency tolerance recommended, namely, .5%.

(b) Utilize rectified and smoothed plate power, not raw ac.

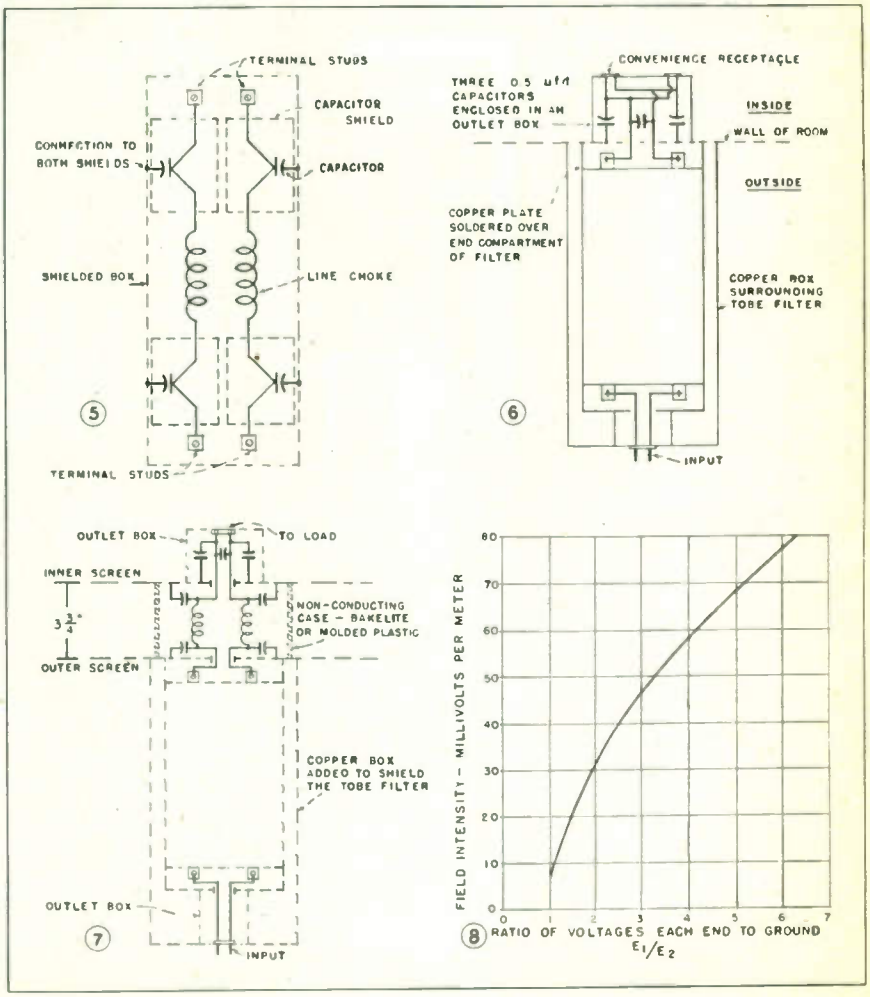
(c) Reduce the generation of higher harmonic frequencies to a minimum.

(d) Keep the maximum power to a value no higher than needed for the job at hand.

(e) Provide means (usually low pass filter) to remove unwanted radio energy from the power leads.

(f) Completely shield the generator itself, and provide for grounding this shield.

Fig 5 is the circuit for a Tobe-Deutschman power line filter. Fig 6 is a later modification for a single shielded room. When a push-pull balanced oscillator is used it is necessary that the tank voltage balance be maintained with any loading to reduce radiation to lowest value and to increase the efficiency. The equipment for the doubly-shielded wall is shown in Fig. 7. Fig. 8 illustrates the point showing increase in radiation intensity produced by an unbalance of the point voltages with respect to ground



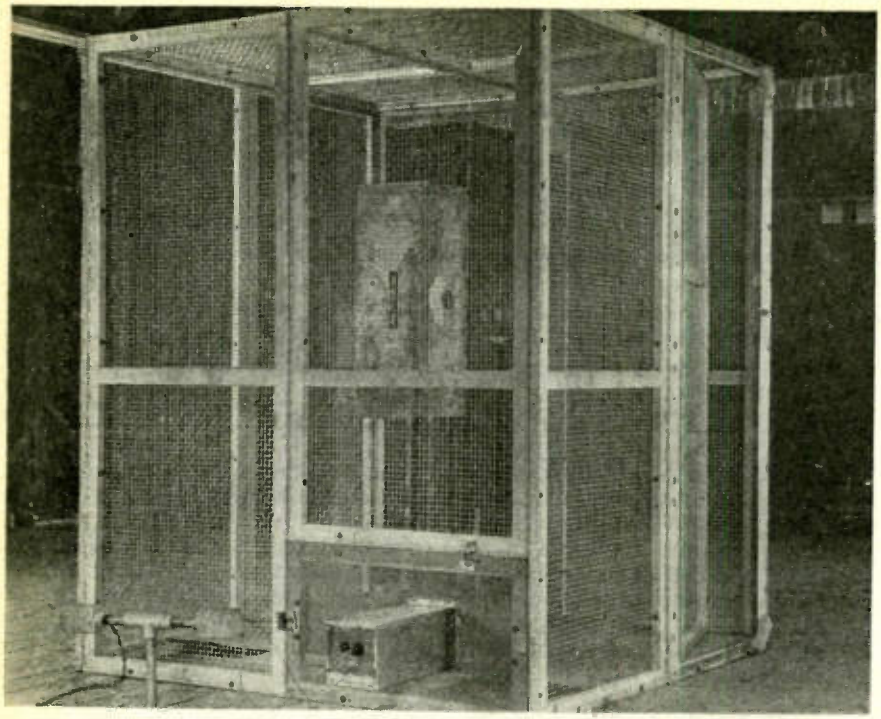
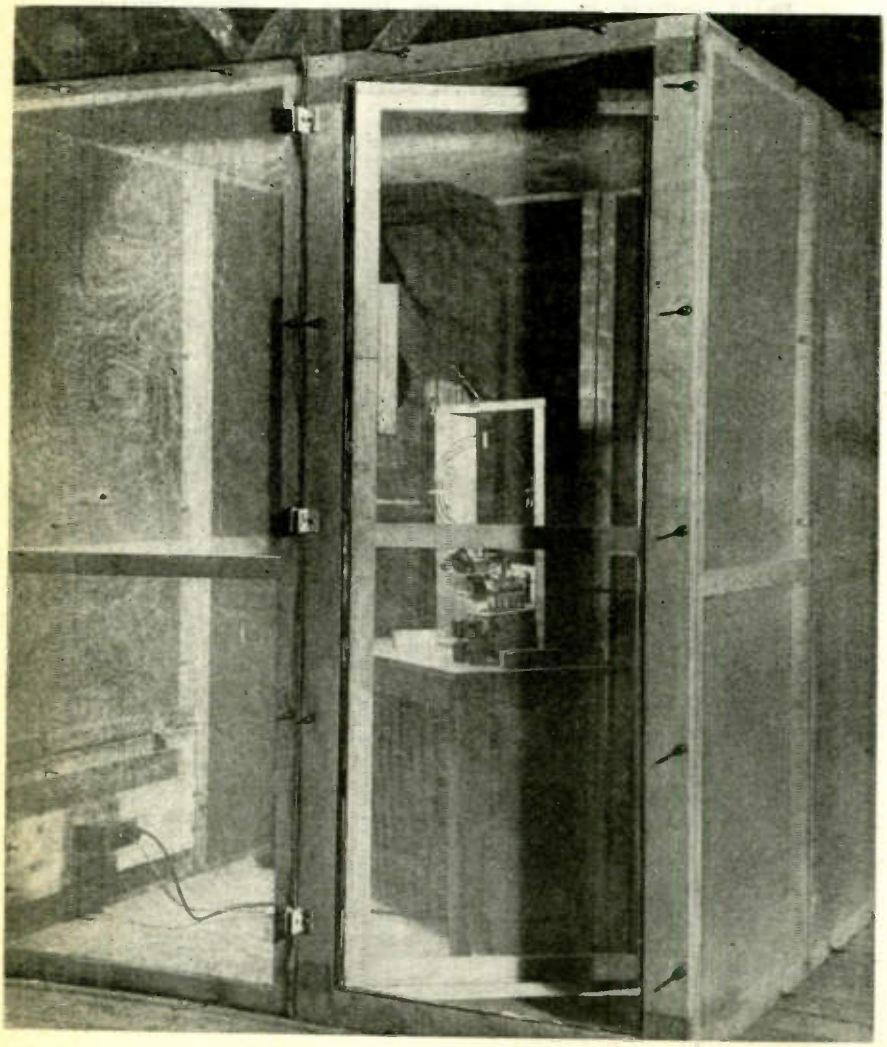


Fig. 9 illustrates the cell type shielded room. The screen units are bolted together to insure good conductivity. Here metal screen is applied to both sides of the wooden frame. Fig. 10 (Below) shows one of the test rooms used during the Rensselaer experiment. The diathermy equipment is on the bench



Some type of filter must be installed at the point where the electric power line enters the cage, to prevent radio frequency disturbances within the room being carried over the power line, and producing interference at considerable distances. Therefore, a low pass filter, to pass 60 cycles and impede radio frequencies, is required. In our experiments, an entrance filter made by the Tobe Deutschman Co., Canton, Mass., Model No. 1116*, was used (see Fig. 5, 6).

Input filters

To be entirely satisfactory for a singly shielded room such a filter should be completely enclosed in a metal shield. The effectivenss of this arrangement is shown by the measured attenuation of 86 db for the screened room to which it was connected. This indicates that the filter did an excellent job of preventing radiation by the power line.

Connecting filters for doubly shielded rooms constitutes a more difficult problem, because the power lines must pass through both shields. The filter circuit for this purpose is shown in Fig. 7. By using this circuit, an overall attenuation as high as 120 db results. The additional capacitors connected directly from the receptacle to the terminals on the shield are not always necessary. By-passing a greater part of the rf current at this point, however, reduces the amount of current flowing in the filter unit.

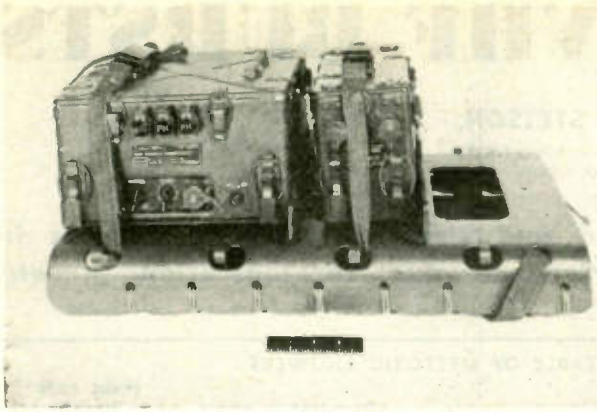
Considerable care should be taken to eliminate any possible rf paths of energy from the screened room to the power line because small, often-overlooked features considerably decrease the effectiveness of a good screened room.

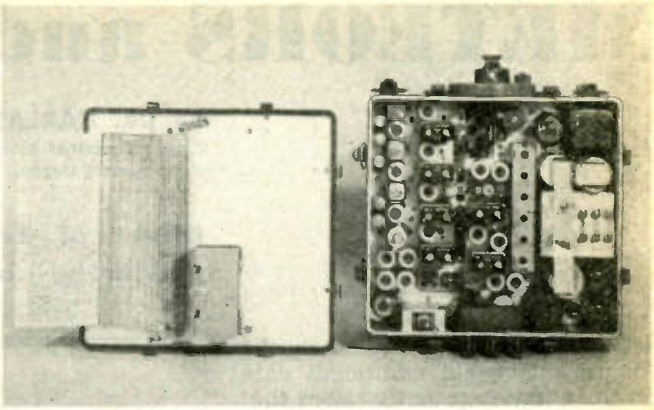
A method sometimes used, but not recommended, to prevent an undesired flow of rf energy over the supply lines, involves the use of a shielded transformer. Normally, such transformers are constructed by covering the primary or secondary with copper foil, so placed that a short circuited turn does not surround the magentic core. The copper shield must be directly connected to the wall of the shielded room by a path having zero impedance. This is more difficult to secure than in the case of a filter, due to the larger dimensions of the shielded windings. The additional length of the ground path is troublesome.

Two different commercially available shielded power transformers were tested and were found to give

(*Continued on page* 142)

*A newer type is available now.





Radio transmitter, receiver and battery box mounted on a standard quartermaster plywood pack board. Right, top view showing alignment equipment, instructions, spare tubes and crystal storage space. It operates at very high frequencies on any of 120 crystal controlled channels

ARMY FM MOBILE UNIT

• Another communications weapon for U. S. Army ground troops—the Signal Corps radio set SCR-619, designed for the use of field artillery and tank destroyer units—is being produced in quantity and soon will be in use on the Pacific fronts.

Announcement of this new set, which recently was displayed for the first time at a special exhibit of war materiel at Fort Myer, Virginia, focusses attention on the fact that against Japan the Army now fights a "radio war," as contrasted to the European war which was predominantly a "wire war," except in cases where rapid movement made wire communications impracticable.

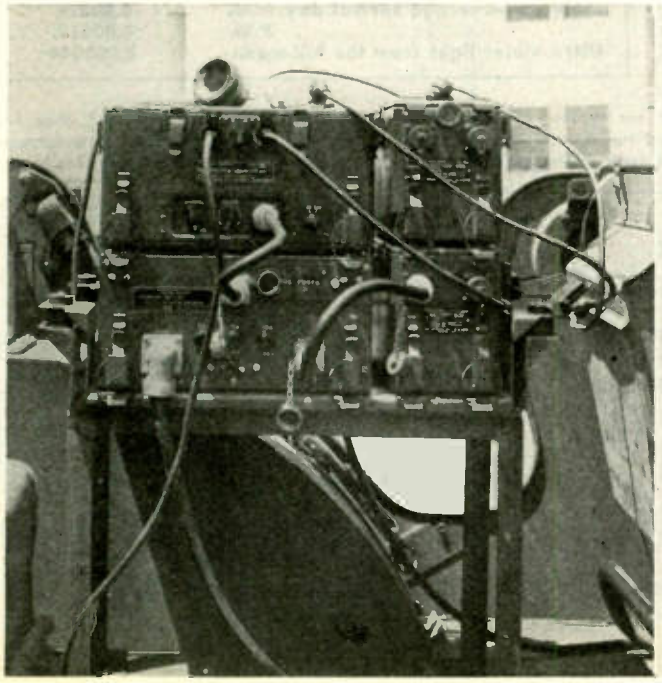
One reason is that while radio communications are much simpler than wire to establish and maintain, they are subject to enemy jamming. The Germans were far more proficient at this than the Japanese and besides, the distances separating opposing forces are substantially greater in the Pacific. This makes jamming more difficult.

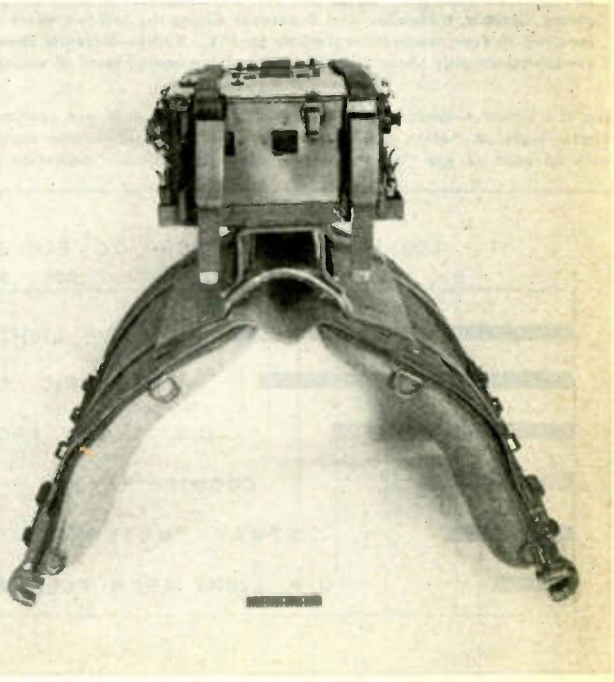
Operating range

The new SCR-619 is an FM voice communication set with a normal range of operations of about five miles over average terrain. Weighing around 50 pounds, the set may be carried by one man on foot or by pack animal, and with added accessories, may be mounted in a vehicle. It operates in the very high frequency band on any one of 120 crystal-controlled channels, with a choice of two preset channels instantly available.

This new set is designed as replacement for the radio sets SCR-609 and SCR-610. It is smaller, lighter in weight (by 5 and 40 pounds, respectively) and has a simpler arrangement for changing the channels of operation. The set is powered by 6-volt or 12-volt batteries, depending upon whether it is carried by man, pack or in a vehicle.

Installation in Command and Reconnaissance truck. The transmitter and receiver, vibrator power pack for 6, 12 or 24 volt operation (bottom) and two battery boxes are mounted on an angle iron frame. Right, receiver and transmitter and battery box installed on a Phillips pack saddle





METEORS and VHF BURSTS

By DR. HARLAN T. STETSON,
Cosmic Terrestrial Research
Massachusetts Institute of Technology

Effect of Leonid and Perseid meteoric showers in producing interference due to ionization streaks

● Observations of FM bursts during August may yield additional data on the question recently raised that VHF interferences are due to ionization streaks in the E layer produced by meteors or shooting-stars.

In January 1945[1] attempts to relate sporadic reception from WGTR's FM station at Paxton, Mass. (44.3 mc) with the Leonid meteor shower of November 1943 were made. The inferences were based on records received at Laurel, Maryland, 337 miles from Paxton, and on data from Exhibit 4 of the frequency allocation hearings before the Federal Communication Commission.

Since FM bursts generally are attributed to E layer reflection it is interesting to compare the total minutes of occurrences of sporadic E with field strengths exceeding 25 microvolts from WGTR for the entire three months period, October, November and December, during the last two years as received at the four observing stations of the Federal Communication Commission, and furnished by and published with the consent of its Engineering Department. These may be tabulated as shown:

It will be observed that in 1944 October yielded less than one min-

TABLE OF METEORIC SHOWERS

Meteoric Showers	Duration, days	Date of maximum	Hour rate of all meteors on this date
Quandrantids	3	Jan. 2	28
Lyrids	4	Apr. 20	7+
Eta Aquarids	8	May 2-4	7
Delta Aquarids	3	July 28	27
Perseids	35	Aug. 11-12	69
Orionids	14	Oct. 19-23	21
Leonids	3—	Nov. 14	21
Andromedes	2	Nov. 24	16
Geminids	14	Dec. 11-13	23

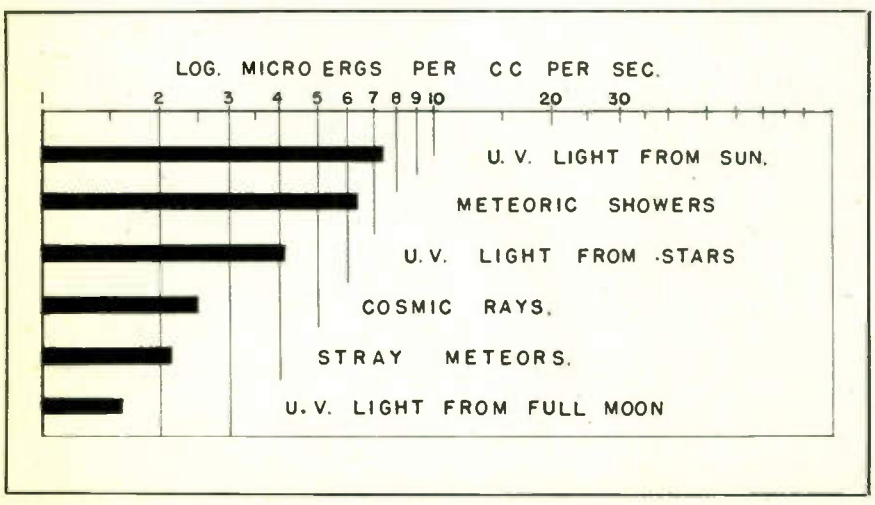
This list of the principal meteoric showers gives their time of duration in days, date of maximum intensity and hourly rate for comparison with data on interference

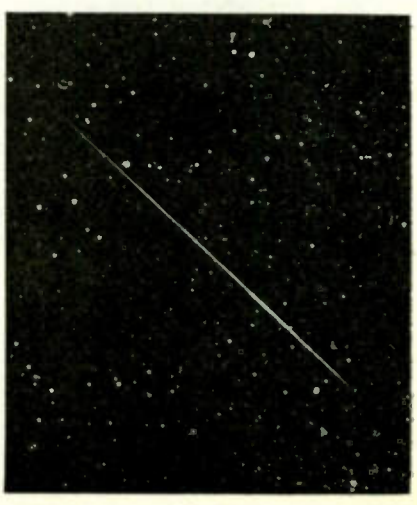
	Laurel 337 Mi.		Allegan 720 Mi.		Atlanta 900 Mi.		Grand Island 1370 Mi.	
	1943	1944	1943	1944	1943	1944	1943	1944
Oct.	0	0	0	14	16	—	2	9
Nov.	0	3	0	6	0	—	0	0
Dec.	0	—	58	89	166	—	0	23

Above—Total minutes of occurrences of sporadic E with field strengths exceeding 25 microvolts from WGTR for the three-month period, October, November and December during the last two years as received at four observation stations by FCC. Right—Meteoric showers contribute only about 7 per cent of ionizing energy from all sources

Sources of Ionization	Energy Received by the Earth, Ergs per Square Centimeter per Second
Ultra-violet light from the sun	28.35
Meteors during meteoric shower (A.M.) up to	2.4
Ultra-violet light from the stars (approximate)	0.014
Cosmic rays	0.00031
Meteors—average normal day: A.M.	0.00024
P.M.	0.00012
Ultra-violet light from the full moon	0.000044

Fig. 2 (Below)—Ionization energies in log - micro ergs per centimeter per second, as included in the table "Sources of Ionization." Fig. 1—Photo made at Yerkes Observatory showing a typical meteor train and the manner in which ionization of the atmosphere causes incandescence with advance of gas "cap." Meteors cause considerable ionization at E layer levels but contribute only a small percentage of total ionizing energy





ute of sporadic E field strength in excess of 25 mv. per meter, while November yielded three minutes of sporadic E occurrences at Laurel, Maryland, 337 miles from Paxton. It is unfortunate that similar data for December 1944 is not yet available. However, in 1943 none of the months, October, November, or December, exhibited a whole minute of sporadic E interference.

Analyzing interference

Reference to the other stations shows that at Allegan, 720 miles from Paxton, December was the most disturbed month both in 1943 and 1944, and that November 1944 yielded only six minutes of sporadic E as compared with 14 in October and 89 in December of that year. At Atlanta, 900 miles from Paxton, November 1943 yielded less than one minute of sporadic E field in excess of 25 mv. per meter, whereas there were 16 minutes in October and 166 minutes in December of that year. Data for Atlanta in 1944 was not available. At Grand Island, 1,370 miles distant from Paxton, November 1944 showed less than one minute of occurrences of sporadic E, whereas there were 9 minutes of such occurrences in October, and 23 minutes in December.

If the Leonid meteors which occur from the 14th to the 16th of November were to be held chiefly responsible for FM bursts, through reflection from sporadic E ionization, it would be expected that there would be indication of maximum sporadic E during the month of November. The figures for 1944 based on Laurel give the only possible evidence of this in the table—an argument which seems to be weakened by the other data.

To experience interfering VHF stations at remote distances with sufficient field strength to cause serious interferences, one must suppose fairly complete reflection from an ionization area at E layer levels. It is somewhat difficult to see how a cylinder of ionized gas produced by a single meteor would be so positioned in space and orientation to give such clear interference bursts as have been observed, except on the remotest chance.

However, J. A. Pierce has attributed 10 megacycle bursts at a distance of 30 kilometers to energy reflected from an ionized cylinder produced by a single meteor, and in an elaborate treatment of the problem based on a number of assumptions[2] arrives at the conclusion that the random distribution of meteor paths is such that the "number of meteors which pass more or less overhead in such a way that a per-

(*Continued on page* 166)

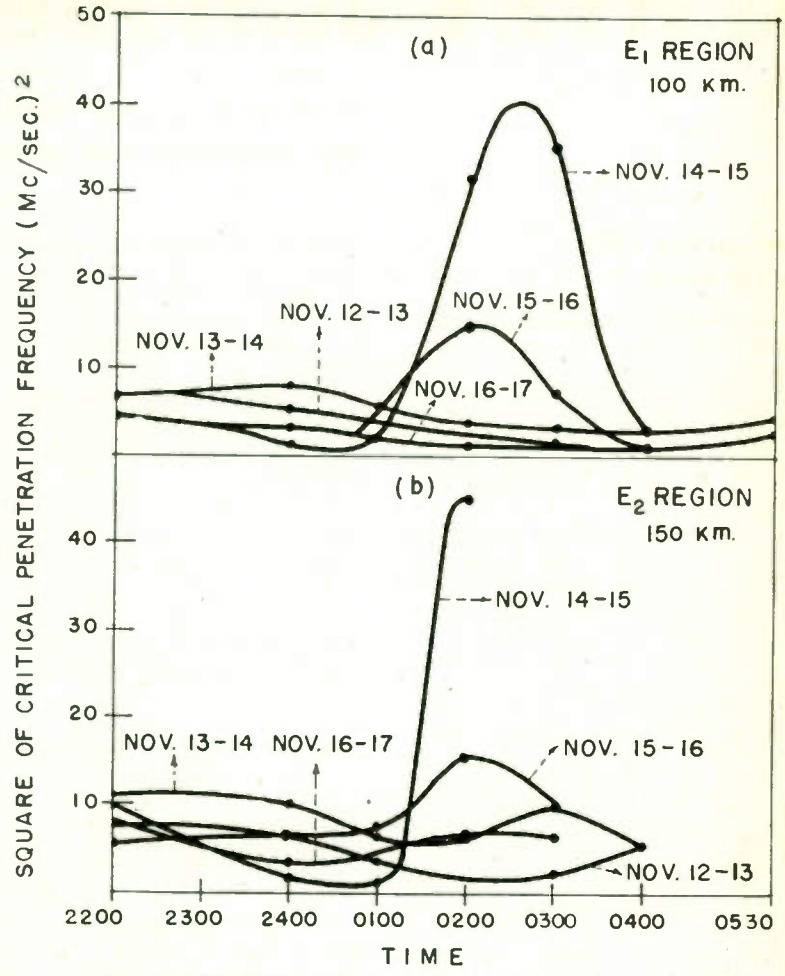
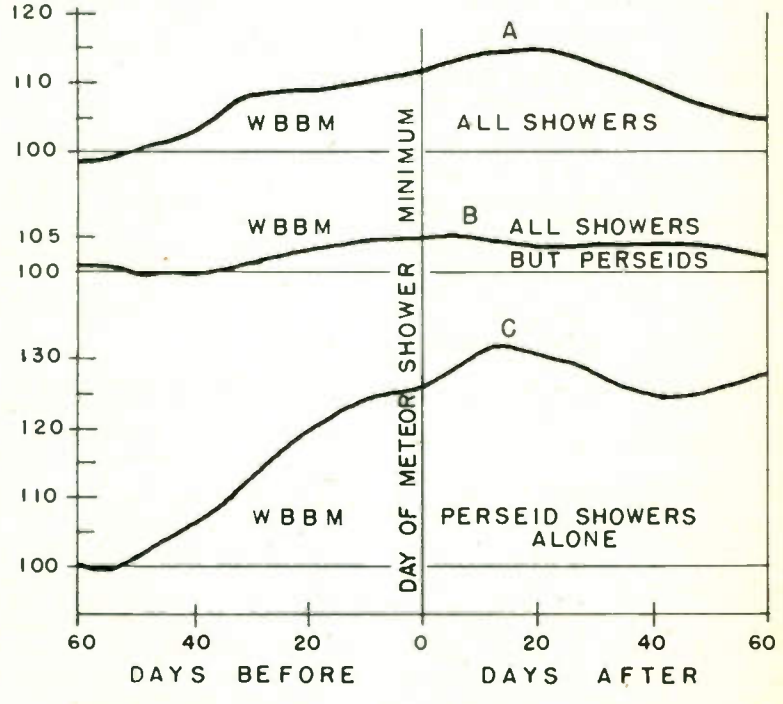


Fig. 3—Graph showing the sharp increase in E critical frequencies observed by Bhar during meteoric showers of Nov. 14-16, 1936

Fig. 4—Relative field intensities of WBBM in Boston for two months before and two months after two major meteoric showers



SURVEY of WIDE READING

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

Measuring UHF Resistance

By F. Borgnis (Naturwissenschaften, Berlin, Jan. 1, 1943)

An experimental method is proposed for the determination of the equivalent parallel resistance of a cavity resonator or other uhf device, the method is explained by an example.

A circular cylindrical cavity (see figure) is excited in the fundamental electric mode. There will be only an axial component of the electric field strength, its dependency on the radius will be given by a Bessel function. The problem is to evaluate the equivalent parallel resistance of the cavity between points A and B which must be specified at very high frequencies. To measure this resistance, a thin dielectric rod is mounted in the axis of the cylinder; the field distribution will not be affected by the insertion of the rod, but its dielectric losses will simulate a resistance in parallel to the unknown cavity resistance (see equivalent circuit).

The excitation is maintained constant while two rods with different dielectric losses, and consequently with different equivalent parallel resistances R′ and R″, are alternately inserted within the cavity. Two readings α' and α'', corresponding to the two dielectric rods, respectively, are taken on a square-law instrument.

Diameters, ρ' and ρ'', and dielectric constants, ϵ' and ϵ'', of the two rods are so chosen that the resonance wavelengths, $\lambda + \Delta\lambda'$ and $\lambda + \Delta\lambda''$, at which the measurements are made, are identical for both arrangements. As the relative changes in wavelength $\Delta\lambda'/\lambda$ and $\Delta\lambda''/\lambda$ are given, respectively, by:

$$\Delta\lambda'/\lambda = 1.86\,(\epsilon' - 1)\rho'^2/R^2$$

and

$$\Delta\lambda''/\lambda = 1.86\,(\epsilon'' - 1)\rho''^2/R^2,$$

it is required that

$$(\epsilon' - 1)\rho'^2 = (\epsilon'' - 1)\rho''^2.$$

The value R of the equivalent cavity resistance is being determined at a resonant wavelength, $\lambda + \Delta\lambda' = \lambda + \Delta\lambda''$, instead of at a resonance wavelength λ. This is, however, of minor importance, because the change in wavelength $\Delta\lambda'$ introduced by the dielectric rod does not exceed one per cent of the resonant wavelength λ without the rod.

The equivalent cavity resistance R between the points A and B can be computed by means of the expression:

$$R = \frac{1 - \sqrt{\frac{\alpha'}{\alpha''}}}{\sqrt{\frac{\alpha'}{\alpha''}}\,\frac{1}{R''} - \frac{1}{R'}}$$

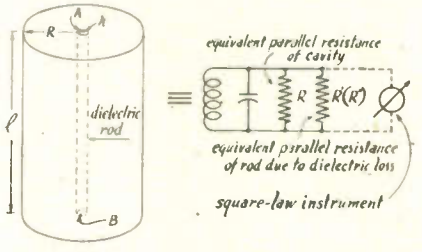
The equivalent rod resistances R′ and R″ are found from the relations:

$$1/R' = \frac{0.886 \times 10^{-13}\,\rho'^2\,\pi}{l}\,\omega\epsilon' \tan\delta',$$

and

$$1/R'' = \frac{0.886 \times 10^{-13}\,\rho''^2\,\pi}{l}\,\omega\epsilon'' \tan\delta'',$$

The dielectric loss factors $\epsilon' \tan\delta'$ and $\epsilon'' \tan\delta''$, where δ' and δ'' are the dielectric loss angles of the material from which the rods are made, can be determined with a similar arrangement from the resonance curves of the empty cavity and of the cavity with the respective rod inserted. (See Borgnis, Physikalische Zeitschrift, 43, 284, 1942.)



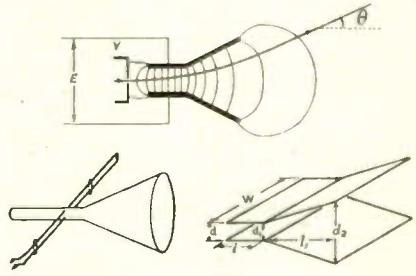
The equivalent resistance at resonance of a circular cylindrical cavity at its fundamental frequency was measured between points A and B for a wavelength of 14 cm. The radius R of the cavity was 107 mm, its axial length 1 was 100 mm. The computed value of the resonance resistance R was evaluated to 8.4×10^6 ohms. Three experimental values of 6.0, 6.0 and 6.3×10^6 ohms were found for three pairs of rods made of different materials.

The method may be applied to various other devices. For instance, the resistance at resonance of a concentric cable between inner and outer conductor can be determined with the aid of thin circular discs made of dielectric material.

Cathode-Ray Oscillograph Sensitivity

H. G. Rudenberg (Journal of Applied Physics, May 1945).

An expression for the sensitivity of a cathode-ray oscillograph is derived by applying Gauss's theorem to the space between the deflected beam and one deflecting plate. By this method of derivation edge effects at the entrance and exit of the electrons from the deflection space are taken into account.



Transit-time effects are neglected, the longitudinal velocity of the electrons is assumed to remain constant during their passage through the deflection system, and the field strength is supposed to be uniform across the central part of the plates where the beam passes.

Under these assumptions the expression for the sensitivity is equal to:

$$\theta = Ec/2\,V\epsilon_0. \qquad (1)$$

Where θ is the angle in radians through which the beam is deflected, E is the deflecting voltage in volts, c the deflecting-plate capacitance per unit width in farads per cm, V the accelerating voltage, and $\epsilon_0 = 1/(36\pi \times 10^9)$ farad per cm is the dielectric constant of free space.

The capacitance c refers to the central section of the deflection plates directly opposite the beam; it does not include any stray capacitance of either deflection plate to the leads, to other electrodes, etc. This capacitance per unit width, c, determines the voltage-deflection sensitivity θ/E of any arbitrarily

shaped deflection system; it can easily be obtained from capacitance measurements if appropriate shielding precautions are observed. Alternatively, it may be determined by computation.

For a parallel plate system of axial length l and separation d, both in cm, $c = \epsilon_0 l/d$ and there results

$$\theta = \frac{E}{2V}\frac{l}{d}, \qquad (2)$$

the well-known formula for the deflection angle.*

Design considerations

Considering the first equation, the deflection angle θ is proportional to the product cE which is the charge per unit width on the plates in Coulomb per cm. Consequently, for a given total charge available, the deflection angle θ can be made larger by making the plate capacitance per unit width c as large compared to the total circuit capacitance as possible. This applies particularly when the oscillograph is connected to a circuit which already has some capacitance and which is supplied by a limited amount of total charge, as may be the case with ordinary vacuum tube amplifiers at high frequencies.

When considering the output amplifier stage feeding the cathode-ray oscillograph it would appear advisable to reduce the deflection-plate capacitance which is in shunt with the output resistor and consequently decreases the available voltage. However, the increased oscillograph sensitivity resulting from an increased deflection-plate capacitance may provide a better compromise between the amplifier output-circuit capacitance and the deflection system.

It is shown that deflection systems of the same relative dimensions and shapes but of different sizes will have the same deflection sensitivity.

Parallel-wire deflection system

At frequencies ranging far above several megacycles, measurements are frequently made by direct connection of the oscillograph deflection system to the voltages to be observed. The transit time and the deflection-system capacity can both be substantially reduced by using a closely spaced parallel-wire line instead of deflection plates (see figure). Substituting the expression for the capacitance per unit length of a parallel wire system in the formula for the deflection angle one obtains:

$$c = \pi\epsilon_0/\cosh^{-1}(d/2r),$$

$$\theta = \frac{E}{2V}\frac{\pi}{\cosh^{-1}(d/2r)} \simeq \frac{E}{2V}\frac{\pi}{\ln(d/r)}, \qquad (3)$$

The last expression becomes valid for large values of d/r; d being the wire spacing and r the wire radius.

Parallel wires of 3mm diameter, separated by 3mm will result in a sensitivity of 0.3mm kv/volt dc at a screen distance of 250 mm.

In a parallel wire system, the ratio of the stray capacitances to the effective capacitance c may be kept small. Further, at fixed frequencies, the parallel wire system may be tuned like a Lecher line and a voltage maximum made to occur at the place where the electron beam travels between the wires. Owing to the high Q of such a line, very high maxima of charge and voltage may be obtained, thus ensuring maximum deflection. If wide band operation is contemplated, the deflection system may be terminated by its characteristic resistance. Naturally, a much greater input power will be required. The deflection in terms of the input current I is given by:

$$\theta = 60\pi I/V, \qquad (4)$$

independent of the relative spacing d/r of the two wires.

Particularly for the study of transients, the absence of reflections accomplised by proper termination of a deflection line will be of advantage, since conventional deflection plates and their leads may introduce undesirable resonances into such transients.

Another advantage of parallel-wire deflection systems is the small coefficient of coupling to the second pair of deflection plates or wires in the oscillograph owing to the small spacing of the two wires of the line. This reduces undesired interaction.

*For a flaring plate system, $c = \epsilon_0 l_1/(d_2 - d_1) \times \ln(d_2/d_1)$, where d_1, d_2 and l_1 are the distances indicated in the figure.

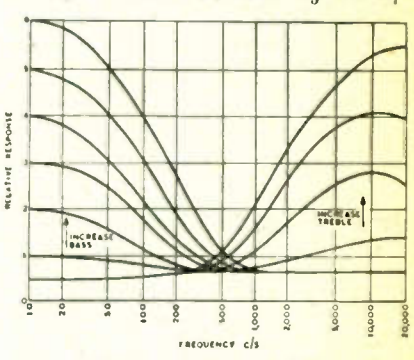
Tone Control Circuit

G. N. Patchett (Wireless World, London, April, 1945)

If fed between A and E the phase-splitting tube V_1 acts as a cathode follower. This has the advantage that the loading of the two tone-control filters across the cathode resistor does not produce any distortion in the phase-splitting tube. It is the purpose of the isolating resistors R_{18}, R_{19} in the plate leads of the twin tube V_2 to prevent the low impedance of one section of V_2 loading the other section; the two sections provide amplification for the output of the two tone control filters, respectively. A voltage independent of frequency is obtained from the plate of the phase-splitting tube V_1.

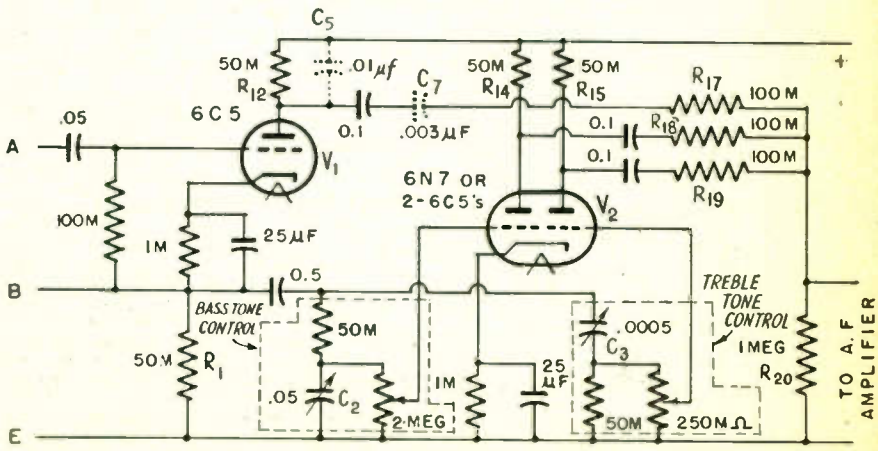
Only approximately one-third of the output from the tubes V_1 and V_2 is obtained across R_{20} because, for instance for the output of V_1, R_{20} is in parallel with R_{14} in series with R_{18} and R_{15} in series with R_{19}. This means that if R_{12} is equal to R_1 and terminals A and E are used, the output at the middle frequencies is only about one-third of the input; greater gain can be obtained by decreasing R_1. For R_1 one-third of R_{12} the overall gain at the middle frequencies will be unity.

Fig. 2—Performance of tone control circuit of Fig. 1 without capacitors C_5 and C_7



(Continued on page 174)

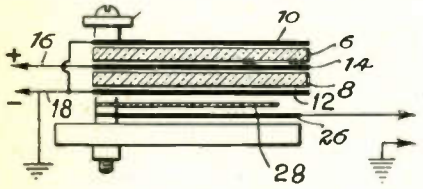
Fig. 1—Tone control circuit with separate regulation for bass and treble ranges



NEW PATENTS ISSUED

Voltage-Responsive Capacitance

A piezoelectric bending or twisting effect is used to move one plate of a capacitor and thereby to control its capacitance; the bending is produced by a voltage applied to a piezoelectric crystal unit so that a change in voltage will result in a change in capacitance. The device may replace a reactance tube in a frequency-stabilizing or a frequency-modulating circuit; it has the advantages of requiring little power and of comparatively high sensitivity at ultra-high frequencies.



The piezoelectric unit consists of crystals 6 and 8 cemented together and associated with plates 10, 12 and 14. The crystal axes are so oriented that when voltage is applied between terminals 16 and 18 one of the crystals is compressed in its lengthwise dimension while the other is elongated. This causes the unit to operate like a bimetallic thermal element; it will bend an amount dependent on the applied voltage.

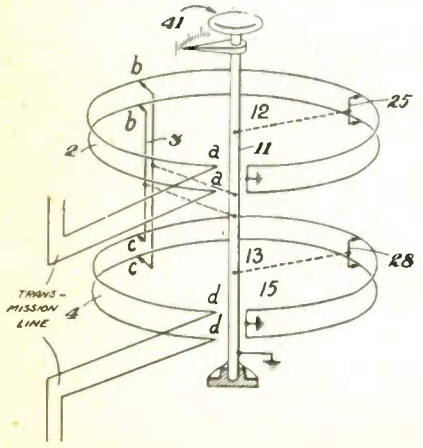
Plate 12 constitutes one plate of the variable capacitor, 28 is a dielectric, and 26 the other capacitor plate. Bending of the crystal unit will result in a variation of the distance between the capacitor plates and, consequently, in a change of capacitance.

Frequency-modulation circuits incorporating this voltage-responsive capacitance instead of a reactance tube are described and claimed.

M. G. Crosby, RCA, (F) December 31, 1941, (I) February 6, 1945, No. 2,368,643.

Impedance Adjuster

The electrical length of a transmission line may be made variable by the insertion of the impedance adjuster shown. The transmission line is broken and section a, a to b,b of transmission line 2, transmission line 3 extending between points b,b and c,c, and section c.c to d.d of transmission line 4 are connected between the four terminals a,a,d,d of the broken transmission line. Lines 2,3 and 4 are identical; shielding for these lines may be provided and so spaced that the surge impedances of all three lines equals that of the transmission line the electric length of which it is intended to make adjustable.

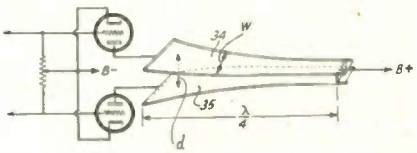


Shorting contacts 25 and 28, spaced one-quarter wavelength from line 3, cause the portion of line 2 to the right of b,b and the portion of line 4 to the right of c,c to present a very high impedance. The distance between contacts 25 and point b,b and contact 28 and points d,d along the lines 2 and 3, respectively, can be adjusted to be one-quarter wavelength by turning sleeves fastened to shaft 15 by clamping screws 12 and 13. Rotation of knob 41 will result in a lengthening or shortening of the electric length of the portions of lines 2 and 4 inserted into the transmission line the length of which is to be made continuously variable. Contacts 25 and 28 will be rotated simultaneously. The mechanical mounting of the various parts incorporated in the impedance adjuster are described in detail.

C. A. Segerstrom, Federal Telephone and Radio Corp., (F) February 27, 1943, (I) January 23, 1945, No. 2,367,693.

HF Tank Circuit

The tank circuit for a push-pull amplifier is designed for a high-frequency, high-power system and, consequently, a high capacitance must be provided to store the energy and at the same time the two parts forming the capacitor must be spaced a safe distance apart to avoid sparking.



According to the invention the tank circuit consists of a pair of elongated flat conductors, 34,35 separated by a distance sufficient to prevent flash over and of such width w as to provide the desired capacitance when the length is equal to one-quarter of the operating wavelength. The distance d between the plates is varied along their length in accordance with the potential distribution to maintain the potential gradient between the plates constant along their length. Further, the plate width may be varied to keep the characteristic impedance constant along their length. Assuming the voltage to be a sine function of the electrical length measured from the shorted end, the separation between the conductors d as well as their width w varies as a sine function. In many instances it will be sufficient to taper the strips linearly and set them at a small angle with respect to one another.

W. van B. Roberts, RCA, (F) February 27, 1945, (I) October 31, 1941, No. 2,370,423.

Mass Spectrometry

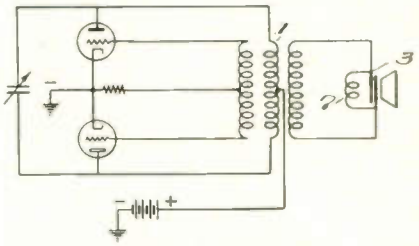
A mass spectrometer is an apparatus for sorting ions according to the ratio of the mass of the ion to the charge that it carries. It consists of an ionization chamber in which molecules of the mixture to be analyzed are converted into ions, an analyzer tube in which a heterogeneous beam of the ions is separated by electric and magnetic fields into a plurality of diverging homogenous beams of ions, an ion collector, a beam sweeper for bringing the several beams successively into contact with the collector, and a recorder for indicating separately the currents collected from the several beams.

The invention is concerned with an additional circuit which simultaneously with the current recording draws a ratio-of-mass-to-charge scale on the record. As the ratio of the mass to the charge of the ions recorded at any instant is a function of the beam sweeper voltage, the additional circuit provides an indication for this voltage calibrated in the desired mass/charge ratio units. A specific circuit including a voltage comparison unit, a vibrator, an oscillator, an amplifier, several control relays and lamp circuits is claimed.

C. E. Berry, Consolidated Engineering Corp., (F) August 19, 1943, (I) March 6, 1945, No. 2,370,631.

Frequency Modulator

It is intended to secure a wide-band frequency modulation by a microphone capacitor. Variation in the capacitance of microphone 3 causes variation in the effective inductive reactance of winding 1 and therefore varies the oscillator frequency.

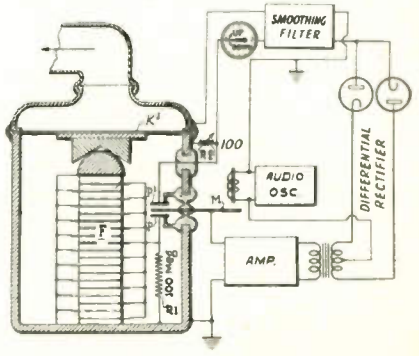


According to the invention, the frequency deviation produced by the reflected reactance is greatly increased by reducing the static capacitance of the condenser microphone 3; for this purpose inductance 7 is provided and the combination 3, 7 is made parallel resonant near the operating frequency.

E. J. O'Brien (F) December 4, 1942, (I) January 23, 1945, No. 2,368,036.

Vertical Velocity Meter

The invention covers a method and an apparatus for ascertaining the vertical velocity of an aircraft. The charge developed on the faces of the piezoelectric crystal pile F in response to the atmospheric pressure against diaphragm K' is converted into a current through R_1. This current is directly proportional to the vertical velocity of the aircraft; the resulting voltage across the resistor R_1 is measured by a self-balancing system.



(*Continued on page* 182)

ASSOCIATION NEWS

Happenings of the month concerning industry organizations

Instrument Exhibit Postponed

As a result of travel restrictions, it will be impossible to hold the Instrumentation-for-Tomorrow Exhibit at Pittsburgh, Pa., on the date originally scheduled, Sept. 17-21, 1945. The Exhibit Committee has therefore changed the date for this show to September 16-20, 1946, and the same space has been reserved at the William Penn Hotel, Pittsburgh, for the 1946 period, reports Paul G. Exline, exhibit chairman.

On April 28, 1945, the Instrument Society of America was formed by the joint action of seventeen local socleties. The American Society for Measurement and Control, which will later become the Pittsburgh Section of the Instrument Society of America, was requested to continue handling the arrangements for the Exhibit which is now sponsored by the national Society. It is expected that this will substantially widen the interest in and attendance at the Exhibit.

The president of A.S.M.C. is R. J. S. Pigott, Gulf Research and Development Corp., and the secretary is L. M. Susany, Carnegie Institute, both of Pittsburgh.

ASA Broadens Scope

American Standards Association is broadening its scope. Changes in the organization's constitution have been made to enable the body to turn its attention to any standardization project in the field of engineering or consumer goods. Previously ASA had restricted its work "to those fields in which engineering methods apply." The board of directors of the organization will be enlarged to include three members-at-large making it possible to enlist the services of outstanding persons from groups not otherwise represented.

GE Training Course

A new industrial electronics talking slide film training course which offers a thoroughly practical and quickly grasped understanding of the subject of industrial electronics, has been developed by the General Electric Co. Carefully organized for presentation in twelve sessions, the new course is expected to have wide use throughout industry wherever electronic equipment is applied or a knowledge of it is required.

The course consists of twelve talking slide films (35-mm film strips and 16-inch, 33 1/3 rpm records), each approximately thirty minutes in length; twenty-five copies each of twelve lecture review booklets keyed to the slidefilms; an instructor's manual covering the presentation of all twelve lectures; and an attractive, sturdily constructed carrying case designed to accommodate the complete course.

RMA Reelects Most

Only change in the officers of Radio Manufacturers Association which emerged as a result of the annual meeting (June) involves M. F. Balcom (Emporium, Pa) who replaces David T. Schultz (Newton, Mass.) as vice-president and chairman of the tube division; and George Lewis (Federal T&R), vice-president who replaces Walter Evans (Westinghouse).

RMA Adds Ten

With the addition of ten new members at its annual meeting last month, RMA's roster reached another new high, 256. New members elected were: Argus, Inc., Ann Arbor, Mich.; Astatic Corp., Conneaut, O.; Call-A-Phone Mfg. Co., Chicago; Gates Radio Co., Quincy, Ill.; Littelfuse, Inc.; Chicago; Madison Electrical Products Corp., Madison, N. J.; Standard Coil Products Co., Chicago; Teletone Radio Co., New York; Thomas and Skinner Steel Products, Indianapolis, Thordarson Electric Mfg. Co., Chicago.

NEDA Reelects

The Chicago chapter of the National Electronic Distributors Assn. reelected President Sam Poncher, (Newark Electric Co.), and Secretary-Treasurer Ralph E. Walker, (Walker-Jimieson, Inc.).

Galvin Appoints Overseas

Overseas Industries Inc. has been appointed by the Galvin Mfg. Corp., to act as export sales department for Motorola radio. Overseas Industries will handle Motorola sales in all parts of the world outside the United States and will cooperate with Galvin in taking their expanding merchandising campaign to foreign countries. Overseas Industries is headed by C. M. Wynne, who is director of export sales. The firm is located at 431 S. Dearborn St., Chicago 5, Illinois, Cable address—Motol, Chicago.

Electrical Engineers Elect

Dr. William E. Wickenden, president, Case School of Applied Science, Cleveland, was elected president of the American Institute of Electrical Engineers for the year beginning August 1, 1945. Other officers elected were: vice-presidents E. S. Fields, Cincinnati; H. B. Wolf, Charlotte, N. C.; L. M. Robertson, Denver; F. F. Evenson, San Diego; F. L. Lawton, Montreal; Directors, J. M. Flanigen, Atlanta; J. R. North, Jackson, Mich; Walter C. Smith, San Francicso;—National Treasurer W. I. Slichter, New York, N. Y.

These officers, together with the following hold-over officers will constitute the Board of Directors for the next administrative year: Charles A. Powel, East Pittsburgh (retiring president); Nevin E. Funk, Philadelphia (junior past president); P. L. Alger, Schenectady; C. B. Carpenter, Portland; M. S. Coover, Ames, Iowa; J. F. Fairman, New York; K. L. Hansen, Milwaukee; R. T. Henry, Buffalo; C. M. Laffoon, East Pittsburgh; M. J. McHenry, Toronto; C. W. Mier, Dallas; S. H. Mortensen, Milwaukee; W. B. Morton, Philadelphia; D. A. Quarles, New York; W. R. Smith, Newark, N. J.; R. W. Warner, Austin.

IRE Nominates

List of nominations for 1946 officers and directors of the Institute of Radio Engineers is headed by F. B. Llewellyn (Bell Labs) for president; other officers nominated are: for vice-president E. M. Deloraine (Federal); for directors, Dr. W. R. G. Baker (GE); W. C. Evans (Westinghouse); R. A. Hackbusch (Stromberg-Carlson); F. R. Lack (GE); D. B. Sinclair (General Radio); W. O. Swinyard (Hazletine).

Designers' Roster

The American Designers Institute, 115 E. 40th Street, New York, has released its roster of members for the guidance of manufacturers, governmental and private advisory agencies, and other sources. The roster, which includes the names of designers in every phase of industrial endeavor in America, is presented in alphabetical form, outlining fields of operation of each designer. Included is the Standards of Practice demanded of the men and women members of the Association concerned with product design. Copies are available at $2.

NEWS OF THE INDUSTRY

RCA to Continue Philips Licensing

Consummation of a new agreement granting the Radio Corporation of America the right to continue licensing other manufacturers under United States patents of the N. V. Philips' Gloeilampenfabrieken (Philips Incandescent Lamp Works Co.) formerly of Eindhoven, Holland, has been made public in a joint statement by Dr. Charles B. Jolliffe, vice-president in charge of RCA Laboratories, and Maynard T. Hazen, vice-president and a director of the Hartford National Bank and Trust Co., Hartford, Conn. The agreement, signed by RCA and the Hartford Bank, as Trustee under Indenture with Philips, became effective on July 1 and remains in force until December 31, 1954. The rights acquired by RCA are non-exclusive.

RCA is also granted similar rights to license the United States Government directly for the duration of hostilities and six months thereafter. RCA's right to license manufacturers for the sale of apparatus to the United States Government continues until December 31, 1954. RCA has informed its licensees that it is extending to them rights under the Philips' patents at no extra charge.

Crosley to Avco

The Crosley Corp., Cincinnati, has been sold, though the change in ownership, which passes to Aviation Corp., will have little or no effect on the company's products or on its personnel or management. The sale includes radio station WLW, subject to FCC approval. Aviation Corp. is a holding company with investments in a considerable number of industries including Consolidated Vultee Corp., maker of the Liberator bomber.

Raytheon Proposes HF Coastal Service

Along with its excursions into the high frequency communications field, Raytheon Mfg. Co., plans installation and operation of coastal harbor radio telephone stations at five points on the New England coastline. Applications have been filed with FCC for stations to operate in the new allocated 152-160mc band to serve the fishing industry centering in the area from Eastport, Me., to New Bedford, Mass. In addition application has been made for the assignment of 2, 4, 6 and 8 mc to reach vessels outside the range of the proposed 50-watt 160mc transmitters which is expected to be in the neighborhood of 45 miles. The lower frequencies, at 2,000 watts, would provide service facilities estimated at up to 800 miles. Plan is to provide a link to the regular Bell system land lines.

Another permit authorizes Raytheon to erect two developmental frequency modulation stations in New York city on top of the 700-ft. Lincoln building, using frequencies of 105 and 107 mc. The call letters of these stations are W2XRA and W2XRY. Transmissions from these stations are scheduled to commence in the near future, and will be co-ordinated with the FCC's extensive summer tests designed to determine propagation data on high frequency transmissions.

Gothard Enlarges

Gothard Mfg. Co., Springfield, Ill., is shortly to occupy a new plant which will considerably expand its production facilities. Provision will be made for the enlargement of the company's engineering and research departments.

New RCA Tube Division

Radio Corp. of America is consolidating all its tube engineering and manufacturing activities in a new RCA Tube Division with headquarters in Harrison, N. J. Dr. G. R. Shaw has been appointed chief engineer of the division.

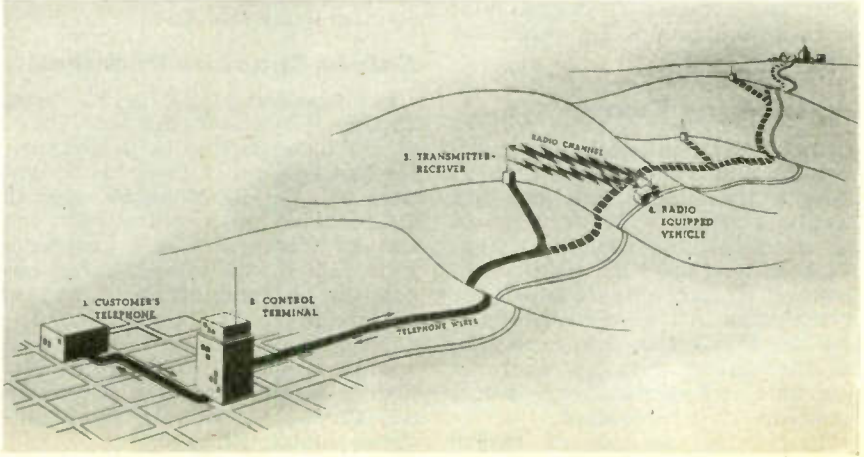
AT&T Plans Mobile Subscriber Service

American Telephone and Telegraph Co, has pushed along its plans for providing a general two-way voice communication system for the drivers of motor vehicles to the point where application has been made to FCC for authority to install radiotelephone stations for the purpose in Baltimore, Chicago, Cincinnati, Columbus, Denver, Houston, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, Salt Lake City and Washington. Other cities are being studied. Plan is that mobile transmitters will be supplied so that subscribers may make calls to be routed through regular telephone facilities and land lines. Incoming calls to boats, cars, etc., would be indicated by a visual and audible signal; each mobile unit would have its own "telephone" number. Frequencies to be used will come in the 152-162 mc range. Station transmitters would be powered at 250 watts, mobile units at 15 watts.

Wire Recorder Moves

The Wire Recorder Development Corp., which handles all business and licensing activities for the Armour magnetic wire sound recorder, moved into larger offices in the Field Building, 135 South LaSalle street, Chicago. The corporation has maintained offices at 8 South Michigan avenue since its activation. The new quarters will contain a modern studio for demonstration work in addition to the executive offices.

Schematic to show the manner in which AT&T mobile subscriber service will operate with transmitters in cars and boats, strategically located receiving stations and hook-up with land lines



TWO NEW GASEOUS VOLTAGE REGULATORS *In Miniature*

The list of Hytron's customers for the standard OC3/VR105 and OD3/VR150 reads like the social register of electronics. Proved quality products, these Hytron tubes are found literally by the millions in military radar, communications, and electronic equipment.

Now in space-saving miniature bulbs, the new Hytron OA2 and OB2 offer the same careful engineering design, rigid control of processing and assembly, and adherence to tight factory specifications which have made the standard Hytron regulators famous. Life and performance of the miniature OA2 and OB2 equal those of the standard tubes, except that maximum operating current is 30 ma. for the miniatures. Construction is both simple and rugged. Note, for example, use of both top and bottom mica supports and the heavy stem leads. Compare the characteristic data given. Consider the possible space economies. Order your engineering samples today.

COMPARATIVE DATA

HYTRON MINIATURE AND STANDARD GASEOUS VOLTAGE REGULATOR TUBES

TYPE	PHYSICAL CHARACTERISTICS				AVERAGE OPERATING CONDITIONS			
	Max. Length (inches)	Max. Diam. (inches)	Bulb	Base	Supply Voltage† (min.)	Operating Voltage (approx.)	Regulation $E_{30}-E_{5}$‡ (volts)	Operating Current* (ma.)
OA2	2 5/8	3/4	T-5 1/2	7-pin Min.	185	150	2	5–30
OD3/VR150	4 1/8	1 3/16	ST-12	6-pin Octal				5–40
OB2	2 5/8	3/4	T-5 1/2	7-pin Min.	133	108	1	5–30
OC3/VR105	4 1/8	1 3/16	ST-12	6-pin Octal				5–40

†Sufficient resistance must always be used in series with the tube to limit current through it as follows: OA2 and OB2, 30 ma.; OD3/VR150 and OC3/VR105, 40 ma.
‡Regulation (either positive or negative polarity) is defined as the difference in voltage when the current is varied from 5 ma. to 30 ma.
*Operation for extended periods of time at low current will temporarily increase regulation of tube.

OLDEST MANUFACTURER SPECIALIZING IN RADIO RECEIVING TUBES

HYTRON

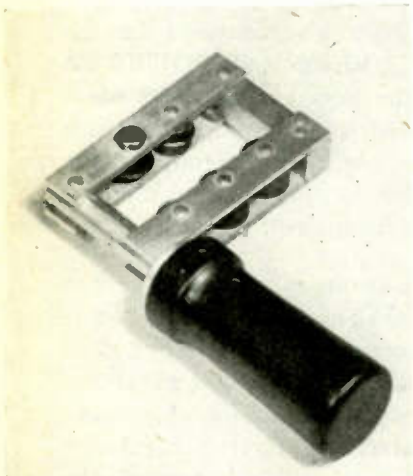
RADIO AND ELECTRONICS CORP.

BUY ANOTHER WAR BOND

MAIN OFFICE: SALEM, MASSACHUSETTS
PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE

WHAT'S NEW

Devices, products and materials the manufacturers offer



Grooving Tool

A new coaxial cable grooving tool has been developed by the Andrew Co., 363 E. 75th Street., Chicago 19, Ill., for making soldered splices on ⅞ in. coaxial cable. It can also be used to make soldered joints on ⅞ in. diameter tubes used in plumbing, heating and refrigeration. The tool makes spun-in grooves in the splicing sleeve that grip the outer conductor firmly. The unit is also equipped with replaceable cutting wheels for cutting outer conductors.

Vacuum Tube Voltmeter

A Series 200 A vt voltmeter, with a range of 7 cps to 500 megacycles, is being manufactured by Televiso Products, Inc., 7466 Irving Park Road, Chicago 34, Ill. Lowest readable voltage is .05 volts on a maximum scale range of .5 volt. There are five voltage ranges—.5, 2, 15, 50, 150—spread full scale on a 4½ in. meter dial. Accuracy of readings is 2 per cent at full scale; middle scale accuracy is 5 per cent or better. Flat ½ in. wide brass terminals connect to input to make easy soldering to test or work piece. For low frequency work up to 100 mc, removable banana plugs are spaced ¾ in. center to center for use with standard jacks. Input tube is of plate circuit rectifier type. Dimensions of unit are 14 in. x 9½ in. x 7½ in. Unit operates on 95 to 135 v, ac.

Volume Indicator

The Daven Co., 191 Central avenue, Newark, N. J., has a new volume level indicator (Type 920) for low-level indication. Designed primarily for use across balanced lines, it also permits either side of bridged lines to be grounded. The unit is mounted on a panel for use in standard relay rack, and comprises a copper-oxide type indicating meter adjusted for deliberate pointer action, a meter zero adjusting control and heavy-duty meter range control variable in steps of 2 VU, 100 to 130 volt, 60 cycle ac power supply with voltage regulator to adjust for normal supply variations. Specications are: Range: — 20 to + 20 VU at 0 VU meter reading; Extreme Range: — 40 to + 23 VU, including full meter scale; Standard Reference Level: 1 mw into 600 ohms; Variation with frequency: less than 0.2 DB between 30 and 15,000 cycles.

Cathode Ray Tube

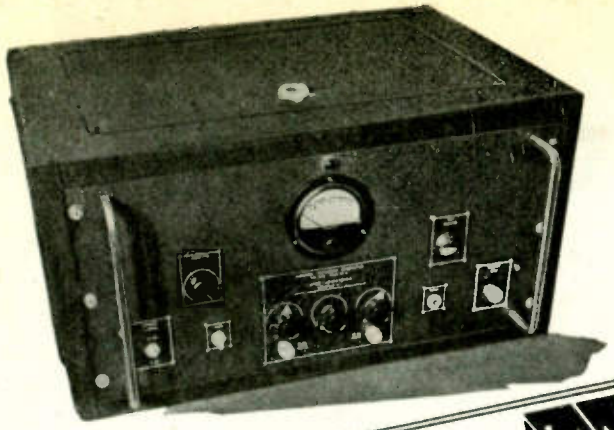
A multi-band cathode ray tube has been developed by Allen B. DuMont Laboratories, Inc., Passaic, N. J., that permits recording at writing rates in excess of 2500 km/sec (using a 35 mm camera with an f:1.9 lens) corresponding to sine wave transients at 40 mc. The tube is of the hot cathode, permanently sealed, high vacuum type. A cylindrical flat face tube of the same approximate size as other 5 In. cathode ray tubes, Type 5RP, is constructed with deflection plate leads brought out through the glass neck instead of the base.

High Vacuum Recording Gage

The F. J. Stokes Machine Co., Philadelphia 20, Pa., has developed a McLeod type recording gage for producing a continuous, visible record of pressure conditions within a vacuum system, between the limits of 1 and 5,000 microns absolute pressure. The unit consists of a modified high vacuum gage, calibrated in microns, combined with a galvanometer type recording unit. The gage is mechanically tilted from the horizontal (normal) position to the vertical (reading) position by an electric motor. The height of the measuring capillary and hence the vacuum in the system is electrically determined, this reading being automatically transmitted to the recorder. The recording unit may be located at any distant point, but the instrument proper is installed, preferably, close to the sampling point. A similar instrument, with one recording unit and as many as four indicating instruments is available, to record pressure in sequence on a strip chart. A built-in chemical trap excludes gases and all condensable vapors, including water, oils and alcohol.

Resistor Series

Non-inductive resistors, designated as Types RL and SL, and designed for use where light weight and compact size are important, are being manufactured by the Instrument Resistors Co., 25 Amity street, Little Falls, N. J. Spools are non-hygroscopic. Type RL is rated at ½ watt, maximum resistance 500,000 ohms. Size ½ in. diam. x ½ in. long. Tinned copper leads are 1½ in. long. Type SL is similar to RL. Maximum resistance is 1 meg. and size is ½ in. diam. x 15/16 in. long. Both resistors are furnished with standard tolerance of ½ per cent. Resistors with tolerances to 1/10 per cent are available.



UHF HARMONIC FREQUENCY GENERATOR

PROVIDES output voltages which are multiples of 10 or 40 megacycles with CRYSTAL-CONTROLLED accuracy.

RECOMMENDED FOR: the calibration of receivers, wavemeters, or using internal beat detector for calibration of oscillators and signal generators.

WRITE FOR FULL DETAILS

U H F

Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

An Open Letter on your War or Post-War UHF Problems . . .

This letter is your invitation to consult with us on your present or reconversion problems in the UHF field.

Your immediate plans may consist simply of ideas on which you require technical advice — or you may need help in re-design or ways and means to lower production costs.

Regardless of your particular requirements, our specialized knowledge of UHF, plus a plant especially equipped for UHF production, should be invaluable in accomplishing your objective quickly, accurately and economically.

There is no cost or obligation involved in talking it over. Your inquiries will have our prompt and careful attention.

Very truly yours,

LAVOIE LABROATORIES

UHF PRECISION FREQUENCY METER

Completely portable Accuracy 0.1%
Battery or AC-Operated

Models available from 100 to 1500 megacycles with 2 to 1 frequency coverage on each model. Available only on high priority

WASHINGTON

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

RECONVERSION "BUDS"—As has been predicted in this column and in recent issues of ELECTRONIC INDUSTRIES, the Army radio-electronic requirements for the one-front war are being revised downwards as the estimates of needs become clarified. Result has been that the stage has been set for the first act of Reconversion—"spot authorization" to allow limited civilian production for the manufacturers who have suffered substantial cutbacks and promise of revocation of the Limitation Order L-265, barring civilian radio-electronic manufacturing. With the changing military requirements, the outlook is in a state of flux and changes fast. But the predictions are—as was stated in June "E.I."—that a limited quantity of new radio receivers, probably of the smaller types and definitely not deluxe models, will be on the market by Christmas and in the first quarter of 1946 the volume will be increased in a substantial amount.

SPOT AUTHORIZATION PROGRAM—Although many of the larger companies still piled up with war production feel it is a poor reconversion springboard and constitutes a "hunting license" for certain types of fly-by-night manufacturers, the WPB is putting into effect the "spot authorization" machinery for our industry. At first, there will only be a comparatively small number of manufacturers to qualify for this program but by September and October a large number of companies will have this authority for civilian production.

COMPONENTS THE KEY—Because re-entrance into civilian production is predicated on a supply of components, Assistant Director Karns of the WPB Radio and Radar Division (and one of the ablest officials in the WPB), told ELECTRONIC INDUSTRIES that the "spot authorization" application form will require more data for the radio-electronic manufacturers than in other industrial fields. The radio "spot" form will require considerable detailed information on the supply of components available to the manufacturer-applicant and whether military component surpluses can be obtained and utilized. The new form was approved during the second week in July by the top WPB legal officials. But government and industry experts do not see any great volume of civilian production—military requirements for the next 4 or 5 months call for $195,000,000 a month compared to $207,000,000 monthly during the first part of this year or a difference of $12,000,000 a month for civilian products.

FCC GREASES RUNWAY FOR FM AND TELEVISION—Following up speedily its final allocation for FM and Television, the Commission held informal engineering conferences July 12 for FM and Facsimile and July 13 for Television to start the determination of the Rules and Regulations and Standards of Good Engineering Practice for these three services which promise to be the vanguard of "big" radio services in the postwar period. Discussions at these two engineering conferences, attended by many of the leading radio engineers of the country, was confined to the technical phases.

WILL MOVE FAST—The economic and service (public interest) policies are to come later before the Commission. FCC Chairman Paul Porter pledged that the Commission will move with all possible speed and that his agency will give the industry immediate notice when the Freeze Policy is modified or terminated so the FCC can move to act upon the 420 FM station and 119 television station applications now in its pending files for the war's duration.

GOVERNMENT OFFICIALS FEAR BIG SURPLUS—Components are viewed by the government surplus authorities as dangerous for the postwar civilian market unless handled by orderly and proper methods. Tubes constitute the major surplus bogey, as huge quantities of tubes of different types have been stored up by the Army and Navy, according to SPB sources. Other "large volume" surplus items are resistors, capacitors, condensers.

DISPOSAL PROBABILITIES — Manufacturing industry sources disagree and assert that most of the military components will not be useful commercially. Surplus Property Board officials estimate that the surplus radio-electronic disposal will follow this course—40 per cent to commercial competitive market; 30 per cent sold at low price to non-profit organizations and institutions (such as 800-station education program and police services); and 30 per cent unusable and to be sold as junk or scrap material.

FEAR "FLY-BY-NIGHT" OPERATORS—Danger of surplus is that components can be obtained by "fly-by-night" manufacturers and distributors and the latter (some government authorities estimate there will be up to 2,000) will enter receiver market under "spot autnorization" plan. These manufacturers will skim the cream of the early market with about 500,000 cheap, no-guarantee sets and will give the legitimate radio-electronic manufacturing industry a black eye.

MISCELLANY—FM manufacturers must build receivers to cover the band from 88 to 108 mc so that FM can expand into area now earmarked for Facsimile; sets, FCC Chairman Porter warns, should reject undesired signals and noise up to one-half the strength of the desired program. . . WPB Chairman Krug in annual report credited radio and radar with "leading and dramatic parts in the widening theatres of war." . . . Radio and radar end-equipment program for 1944 exceeded 1943 production by 25 per cent and actual 1944 output came within 1 per cent of meeting requirements. Military demand last year saw shift from radio to radar with uneven distribution of plant load to larger companies with engineering "know-how" and tube program became tremendous. . . Radar units of older type were declared surplus by Army and Navy in July; are to be processed and defaced so there can be no revelation to enemies.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

relays

IN SAFETY CONTROLS FOR GAS PILOTED HEATERS

Series 150 A. C. Relay

Designed by Guardian engineers to be used in a half wave rectified circuit with a shading ring, thus eliminating the use of a filter condenser commonly required in similar electronic circuits.

HOW *16 Relays* BY GUARDIAN help prevent explosions...

In their multiple burner Safety Control, Drying Systems, inc. of Chicago has given industry a device that saves millions of dollars yearly in losses from fire and explosion resulting from leaky valves, vapor accumulations and unburned gases in heaters and ovens.

This control, pictured above, uses the electrical conductive qualities of the pilot flame to complete a circuit through the rod inserted in the flame. A momentary absence of any flame in the multiple circuit is detected by the associated thyratron tube. This in turn activates the corresponding Guardian Relay to shut off the entire system.

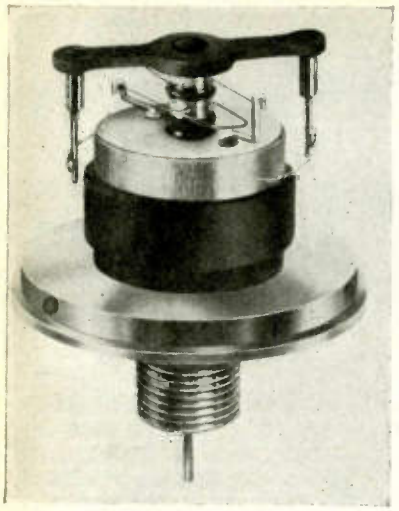
The multiple burner Safety Control supervises up to 16 flames and uses a tube and a Relay for each flame. With so much at stake, the Relay used so plentifully in this application must be dependable. Among other Guardian Relays it is described in the new 56-page Guardian catalog. Write on your business letterhead for your copy today.

NEW CATALOG NOW READY

GUARDIAN ELECTRIC

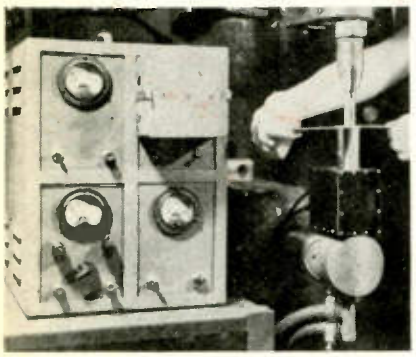
1622-J W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY



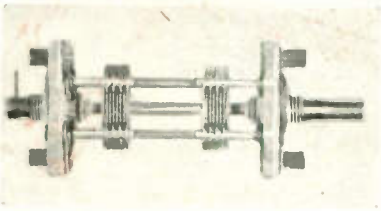
High Sensitivity Resistors

High sensitivity resistors have been developed by G. M. Giannini & Co., Inc., Pasadena, Calif. Overall dimensions are 1¼ in. by 1 1/16 in. diameter. These small size resistors produce from a low torque rotational movement a variable electric resistance. They can be connected directly to sensitive low torque apparatus such as aircraft flight test recording instruments, and will operate relays or recording systems without the use of amplifiers, and from a simple dc source. Obtainable in various types from 100 to 1500 ohms, and from 4 to 15 watts, these resistors require but 2 gram millimeters input torque to overcome friction. This low value is secured by use of a jewel supported shaft, the contact mechanism being made with the accuracy of a watch.



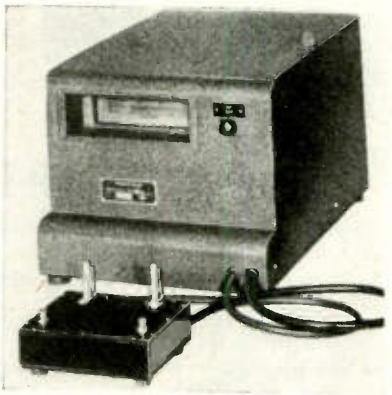
Current-Force Recorder

A new current-force recorder for recording current and force in resistance welding machine electrodes has been developed by the special products division of the General Electric Co., Schenectady, N. Y. The new recorder is specially designed to be helpful to users of energy-storage type welding machines for determining when forge pressure is applied to the work with respect to the discharge of welding current. In addition, the recorder permits resistance welding machine users to comply with Navy Specifications, Navaer PW-6A, Bureau of Aeronautics, Specifications for the Spot Welding of Aluminum Alloy, for Class A Spot Welding. The recorder consists of an amplifier-oscillograph unit and a special electrode holder. The amplifier-oscillograph unit, which operates from a 115-volt, single-phase, 60-cycle power source, is composed of a single-channel amplifier, an oscillator, a power unit, and a small magnetic oscillograph, all housed in a sturdy metal case. This unit simultaneously records a timing wave, the rapidly changing electrode force, and the electrode current of the welding machine while a weld is being made. The record produced by the recorder also indicates squeeze time, the duration and magnitude of the welding current, the rate of rise of forge pressure, and the hold time. The special electrode holder is equipped with strain gages for measuring compressive strain, which is a measure of the force in the electrode, and a built-in shunt for diverting from the electrode a proportional amount of current, which is used to operate an oscillograph galvanometer. In operation, a 5,000-cycle voltage from the oscillator is applied to two points on the strain gage bridge circuit, and the output from the two opposite points is a measure of the force on the electrode. The output of the bridge is fed into the amplifier, which amplifies the modulated carrier and rectifies and filters the amplified output. The output is then fed to the oscillograph, where the record is made. The welding current and a 60-cycle timing wave are recorded simultaneously on the 3½-in. paper record.



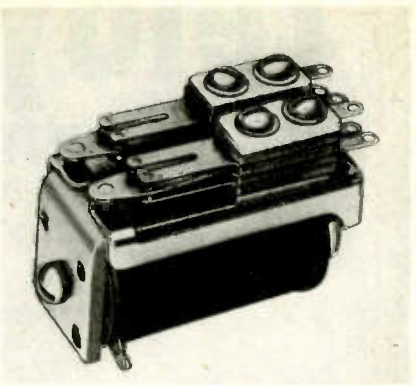
Air Trimmer Capacitor

The Comar Electric Co., 2701 Belmont Ave., Chicago 18, Ill., is producing a new air trimmer capacitor. Available either single or dual, it has ceramic mounting base, with brass plates and mounting studs. carmium, silver or nickel plate as required. Capacitances range from 5 to 140 mmf., with the following standard air gaps, .012, .015, .019, .030, .045.



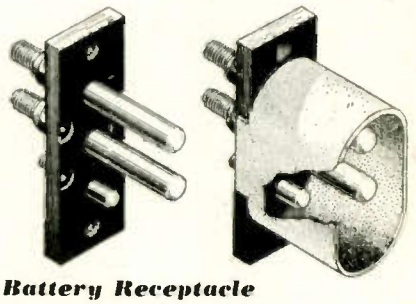
Resistance Tester

Model 238 Vibrotest is a crankless insulation resistance tester made by Associated Research, Inc., 231 South Green St., Chicago. The indicating instrument is a spotlight galvanometer having a 100 millimeter scale calibrated 0-20,000 megohms direct reading, at a potential of 500 volts dc self-contained. Power is supplied from two No. 6 dry cells mounted in instrument, and providing 500 volts dc for operation through a synchronous vibrator system. The indicating instrument is permanently mounted within the new unit—readings being taken through a shielded opening for clarity and ease of reading.



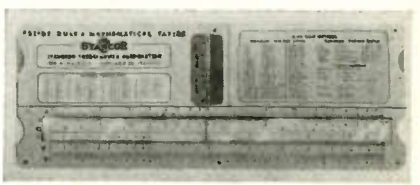
Telephone Relay

Miniature telephone type relays weighing 1¾ oz., and known as the "MT" Series, are being manufactured by Potter & Brumfield Mfg. Co., 212 Linden Ave., Princeton, Ind. The relay is sensitive enonugh to operate on minute current. Twin contacts exert the high contact pressure needed for perfect closure. The relay is resistant to vibration. Overall dimensions with two type C contact assemblies are: length 1½ in., height 1 7/32 in., width 11/16 in. Operating voltage up to 60 v dc.



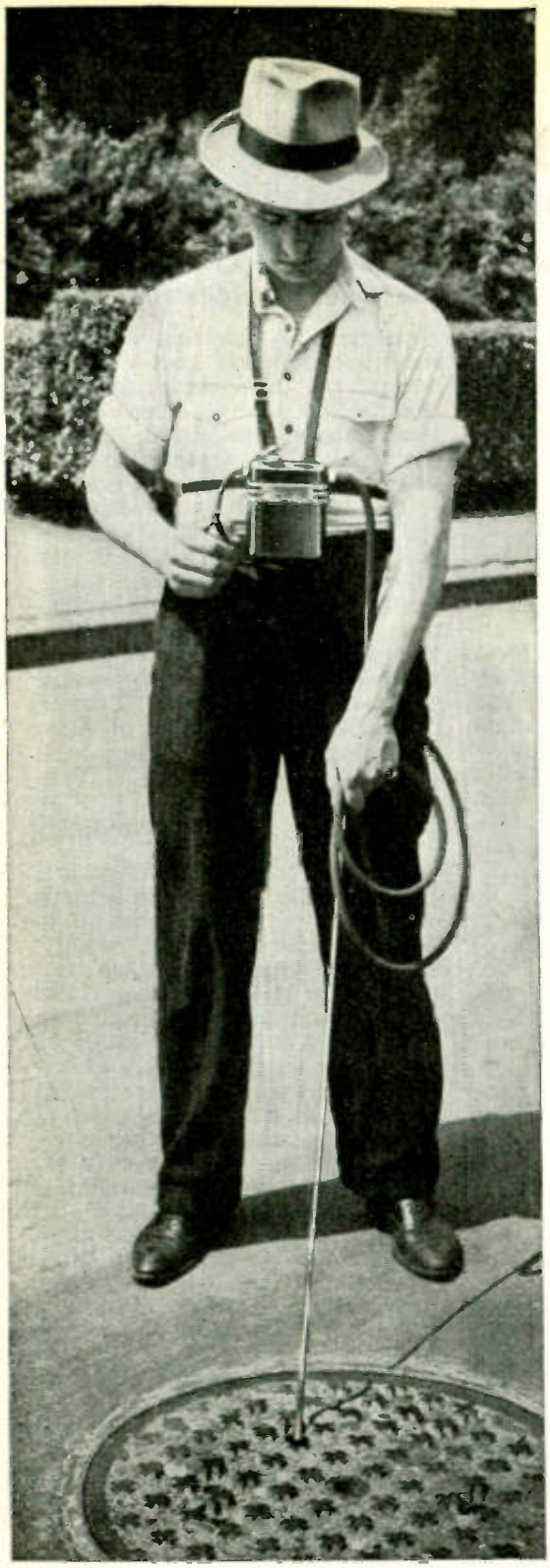
Battery Receptacle

A new three-contact battery receptacle conforming to Army-Navy specification AN2552 has been released by Cannon Electric Development Co., Los Angeles. The fitting mates with any standard AN2551 plug. Four combinations are available: AN2552-1, complete fitting with shield and three pin contacts; AN2552-2, shield less small pin contact; AN2552-A1, panel without shield but having small pin contact, and AN2552-A2, panel without small pin contact. Contacts are brass with silver plate finish. Receptacle panel is phenolic, drilled for two mounting holes. Shield is die-cast aluminum alloy with sand blast and clear lacquer finish.



Slide Rule

The Standard Transformer Corp., 1500 N. Halsted St., Chicago 22, Ill., is producing a regular slide rule with 8 mathematical tables added. The tables are: 1) Four-place logarithm table; 2) Signs and limits of value assumed by trigonometric functions; 3) Table of natural trigonometric functions; 4) Table of trigonometric formulae; 5) Table of slide rule settings; 6) Table of general equations; 7) List of common mathematical formulae; 8) Decimal equivalents of a fraction. The Multi-Slide Rule is made of durable stock, clear-print, and has a transparent plastic indicator. Price of $1 includes carrying case.



You Can't See Them

. . . But You Almost *Know* They're There

This operator is demonstrating the EXPLOSIMETER, an ingenious instrument made by the Mine Safety Appliance Company of Pittsburgh, for testing the presence of combustible gas.

You can't see it in the photograph, but the EXPLOSIMETER is equipped with a Mallory variable resistor. That almost follows as a matter of course. Mallory resistors are *standard components* in all manner of precision devices, electrical and electronic.

What makes Mallory resistors popular? Sturdy construction, for one thing. Dependability. Efficiency. Intelligent design. Not least of all, a complete and varied line, including:

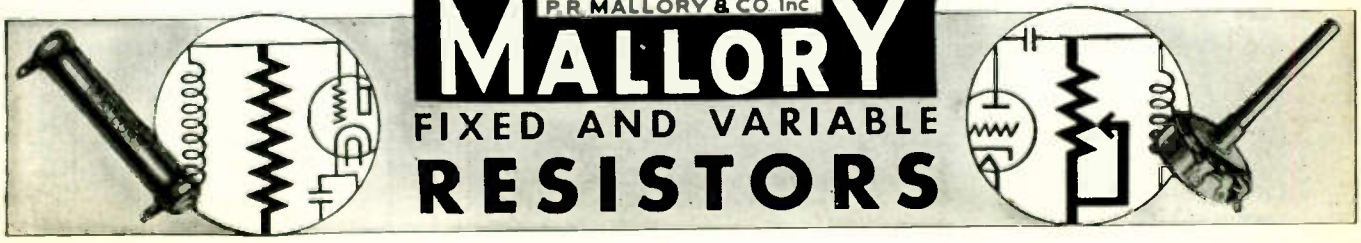
Variable Carbon Resistors — In standard and midget types, from 5000 ohms to 9 megohms.

Variable Wire-Wound Resistors — In three standard types, from 0.5 to 150,000 ohms resistance, 2 to 9 watts.

Fixed and Adjustable Wire-Wound Resistors—Available from 1 to 100,000 ohms and from 10 to 200 watts.

For standard values and types see your Mallory Distributor. For engineering assistance on resistor problems call on Mallory direct.

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



★ TELEVISION TODAY* ★

New Developments in the Video Field

GE Big Screen Tele Receiver

General Electric, readying post-war plans and production, late in June publicly revealed its first large screen home television receiver. Basically, the receiver is built around the Schmidt projection system in which the image on a vertically mounted five-inch cathode ray tube is reflected from a curved mirror at the bottom, through a plastic correcting lens and then to a 16 x 22 in. viewing screen by means of a 45-degree flat mirror. Certain engineering details, as yet under wraps, have been incorporated by which brilliance and contrast of pictures is improved. At the same time, first public showing of a new radio-phonograph combination was made, feature of which, to be incorporated in all GE combinations, is a newly designed reproducing system intended to improve tone quality, subdue needle chatter and scratch, reduce record wear, and increase frequency range.

W2XDK for Sherron

An experimental television station is to be established by Sherron Electronics Co., Brooklyn, N. Y. A construction permit has been guaranteed by FCC, and the station will operate under the call letters W2XDK.

Television Helps Peace

Television will be a great force for peace during the coming years, believes John F. Royal, NBC vice-president in charge of video operations. "Through television," he told the opening session of NBC-Northwestern University's summer radio course, "we will better understand the thinking of other peoples, thereby enhancing the cause of international peace and solidarity."

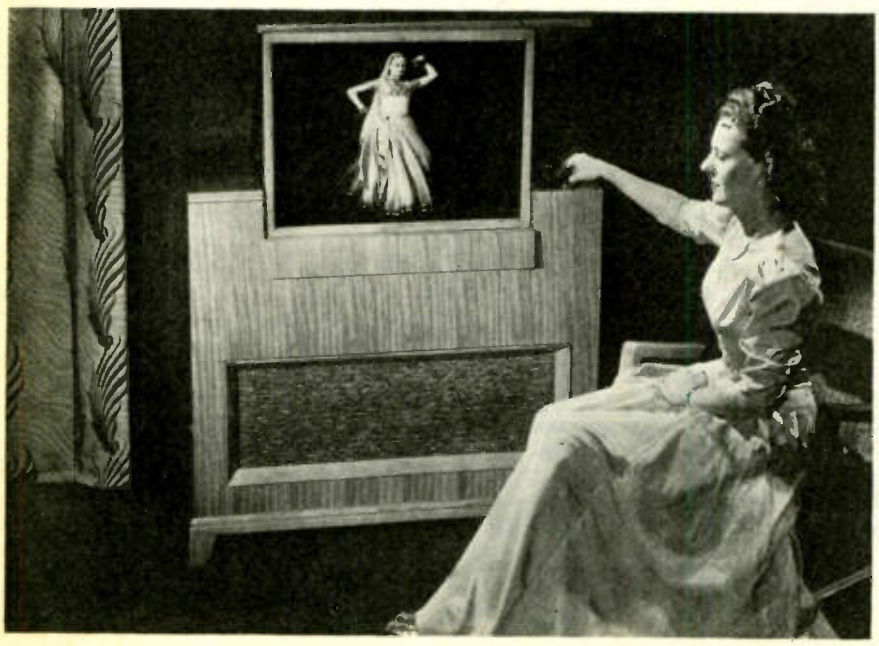
More Video Aps.

With an application on file for a television station to be erected in Baltimore, Hearst Radio, Inc., has also filed for Milwaukee, where channel No. 4 is sought. Earle C. Anthony, pioneer automobile dealer and radio operator on the West Coast, has asked for another channel in Los Angeles, No. 2. He has an application pending for channel No. 6.

Billion Dollar Tele

Within five years after full production starts, television will be a billion dollar industry in the belief of Brig-General David Sarnoff, head of RCA. When WPB gives the industry the green light, television equipment will be rolling off the production lines in from nine months to a year, he says.

General Electric's large screen home television receiver, utilizing the Schmidt projection principle, has a screen 16 x 22 in. Controls are conveniently located at the top



DuMont Tele Transmitter For Buenos Aires

American engineering and science had its first post-V-E Day triumph in the consummation of negotiations between Allen B. DuMont Laboratories and an influential syndicate of Argentinian businessmen for the sale and erection of the first television transmitter for South America. The syndicate, headed by Martin Tow, holds the only franchise for television transmitters so far granted in Argentina. Negotiations were begun in 1944 and final arrangements have just been made over Trans-Oceanic Telephone by Leonard F. Cramer, Executive Vice President of Allen B. DuMont Laboratories, Inc.

25 kw video

Though this will be the first sale of a television transmitter actually concluded for the continent of South America, several priority applications have been filled with DuMont for stations both in South America and Australia. Leaders of the television industry point to these instances as evidence of the future importance of this new instrument in the development of better international understanding.

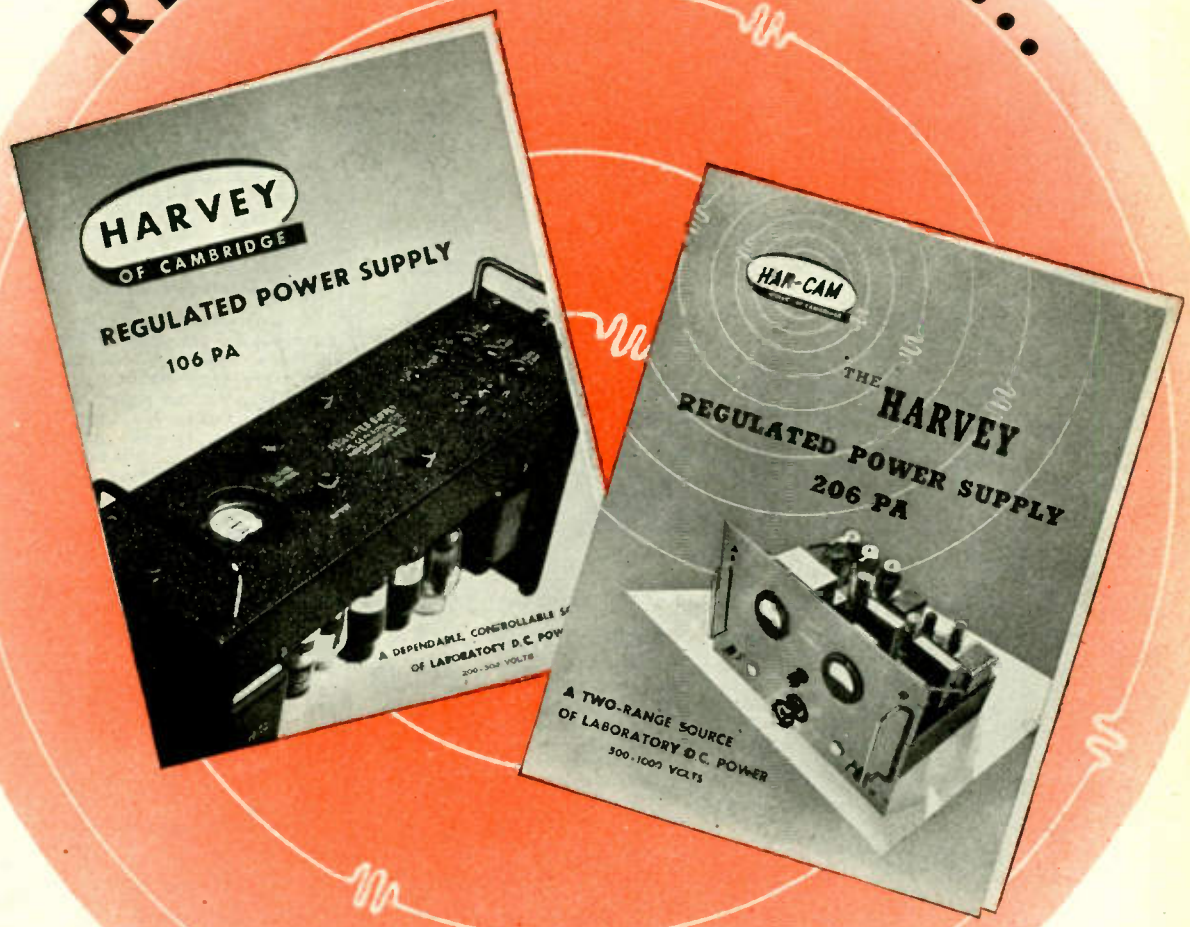
Exact details of the installation contemplated by the purchasing syndicate were not revealed, but the original proposal provided for a DuMont 25-kw peak video and a 12.5-kw peak audio transmitter, full field pick-up and relay equipment, together with cameras and control equipment for three studios. It is assumed that the transmitter will be located in or near Buenos Aires, which has a population of nearly 2,500,000.

Five Year Estimate

Another guesstimate of the probable magnitude of the television industry within five years after the war puts video service within the reach of more than half the population of the United States. The prediction is contained in a 400-page report of testimony given the sub-committee on war mobilization of the Senate Military Affairs Committee. The report covers war time technological developments, is signed by Senator Harley M. Kilgore of West Virginia.

*Title registered U. S. Patent Office

REQUIRED READING...



For Anyone Whose Equipment Includes Amplifiers, Pulse Generators, Measurement Equipment, Constant Frequency Oscillators and Other Apparatus Requiring a Constant Source of Laboratory D. C. Power

Reading time only ten minutes, but these bulletins will bring you up to the minute on Regulated Power Supply facts and figures.

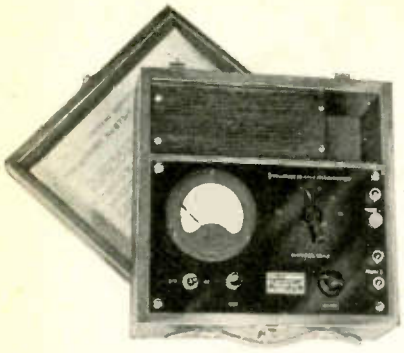
They contain complete performance and operating information on the Harvey Regulated Power Supply 106 PA and the Harvey 206 PA that are setting new standards of performance and dependability. And they'll show you the design refinements, operating conveniences and precision construction that makes this performance possible.

Whether or not you have an immediate need for a Regulated Power Supply you should have these bulletins in your files. We'll be pleased to forward them to you on request.

HAR-CAM
HARVEY OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

441 CONCORD AVENUE · CAMBRIDGE 38, MASSACHUSETTS



Medium Range Milliohmmeter

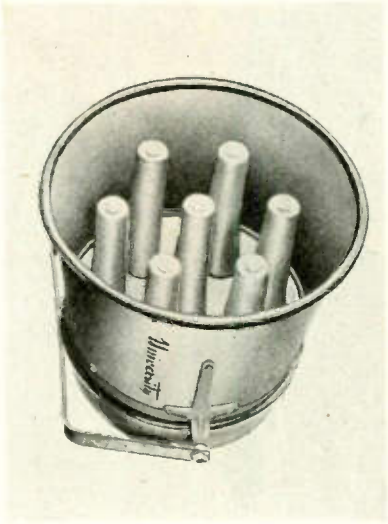
The Shallcross Mfg. Co., Collingdale, Pa., is manufacturing a medium range milliohmmeter, with linear scales which eliminate crowding of the higher values of resistance at one end of the scale. The six scales have ranges as follows: 0-0.5-1-5-10-50 and 100 ohms full scale. Separate connections for current and potential are provided to minimize the effect of lead and contact resistance when measuring low values. The instrument uses a single built-in No. 6 dry cell.

Precision Resistors

A line of precision wire wound resistors are available from the Grove Corp., Cape Girardeau, Mo., in a variety of resistance values from 0.5 ohms to one megohm. Resistors are wound on ceramic forms with reversed pie sections for minimum inductance and have thin soldering lugs with a central hole through the core for mounting. Resistors are treated with fungusproof lacquer. Normal tolerance is 1 per cent, with other tolerances available on special order.

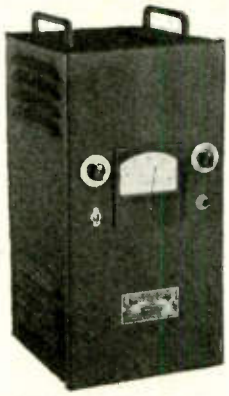
Frequency Meter

A Model 39-VTF vacuum tube frequency meter, designed to provide the maximum degree of accuracy in measuring frequencies in the 400, 800, 1200, 1600, 2400, and 3600 cycle bands, is being manufactured by J-B-T Instruments Inc., 441 Chapel Street, New Haven 8, Conn. A special multivibrator circuit in the electronic unit divides the incoming frequency by 2, 3, 4, 6 or 9. The resulting frequency is measured by a standard vibrating reed frequency meter, with an accuracy of 0.25 per cent or better, independent of line voltage. Input sensitivity of unit is 500,000 ohms. Voltage range is 100-350 v. Power consumption is approximately 25 watts at 115 v, 60 cycles.



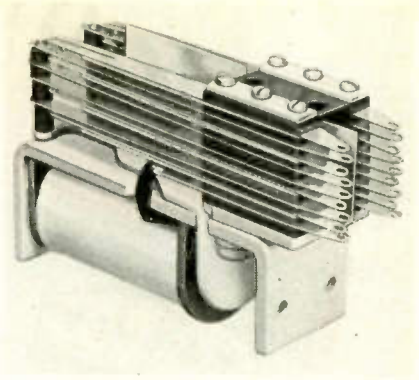
Power Speaker

This super power multi-reflex speaker was specifically designed for extreme long range sound projection over wooded or built up areas, rough terrain or water and has an audio capacity of 200 watts, designed with 250 cycle low frequency cutoff. The projection range of this speaker is over 1½ miles. Projector is reflexed for compactness and mounts a battery of 7 Model PAH hermetically sealed, shock and blast proof driver units. Rubber damped rim construction effectively eliminates mechanical or acoustic resonance and rattle even at full power. Construction is rugged, though relatively light-weight, with swivel mounting bracket for easy handling and rapid orientation. Projector may be subjected to continuous severe atmospheric exposure; waterproof protective coating and hermetic sealing assure unaffected performance. Maker is University Labs., 225 Varick Street, New York.



Automatic Voltage Regulator

The Superior Electric Co., Bristol, Conn., is producing automatic voltage regulators for 1 and 2 kva applications. These new 4101 and 4102 models are small and lightweight. Consisting of a thyratron tube circuit controlling a variable transformer, they will maintain constant output voltage regardless of variations in input voltage or output load current. They are not affected by changes in the power factor of the load, nor is there any distortion in the wave-form of the output.



Multi-Contact Relay

A long coil (type 20000) relay is being produced by the R-B-M Mfg. Co., division of Essex Wire Corp., Logansport, Ind., for use where minimum operating currents are important. Contact spring assemblies can be furnished in one, two, or three stacks, with various combinations up to 16 springs. Coils, treated to withstand humidity and prevent fungus growth, are available in voltage ranges from 1½ to 28 v dc. This type of relay is also available in two-pole double-throw contact arrangement, with current sensitive coil operating at 3.2 ma pickup and 1 to 1.5 ma dropout. These relays are available with quick acting, slow dropout and slow pickup armatures. There are two sizes; standard—4¾ in. long, 1 in. wide, and approximately 1¾ in. to 2½ in. high, depending upon contact spring assembly; intermediate—3⅝ in. long, 1 in. wide, and 1¾ in. to 2½ in. high, depending upon contact spring assembly.

Reproducer

The Jensen Radio Mfg. Co. of Chicago, Ill., has developed a reproducer, Type NJ-300, for use in locomotives, cabooses, signal towers, and in railroad yards. Enclosed in a cast aluminum case, it is capable of withstanding shock and vibration, as well as prolonged exposure to smoke, dust and the elements. Provision is made for installation within the case of a hermetically sealed impedance matching transformer. Heavy duty, railroad type binding posts are readily accessible by removal of the special screw-type dome condulet cover. Voice coil impedance is 12 ohms nominal value; power handling capacity for speech is 10 w.

HIGH VACUUM NOW CONTROLLED TO ONE-BILLIONTH OF AN ATMOSPHERE

HIGH on the list of important recent electron tube developments in the National Union Research Laboratories is this ultra sensitive N. U. Ionization Gauge.

Used as a control device in the evacuation of other electron tubes, this gauge reads pressures of .00001 of a micron! High vacuum is assured with resulting uniform high performance characteristics of all N. U. Tubes it helps to manufacture.

Having no grid element, this gauge is completely free from Barkhausen oscillations. Construction is simple, rugged, dependable—and, of course, economical to manufacture.

Here again is an example of the many contributions National Union engineers are making to the advance of electronics. For progress through research—count on National Union. *National Union Radio Corporation,* Newark 2, New Jersey.

N. U. IONIZATION GAUGE

Typical Operation

- Filament voltage—3.0 volts
- Filament current—1.8 A.
- Electron collector voltage—13 volts
- Electron current—20 Ma.
- Ion collector voltage—200 volts
- Sensitivity—Ten times the ion current in amperes equals the pressure in mms. of mercury.

It is possible to expose the hot filament of this gauge to air at atmospheric pressure and later have it function efficiently under vacuum conditions.

NATIONAL UNION RADIO AND ELECTRON TUBES

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

SHIPBOARD ANNOUNCERS

(*Continued from page* 97)

The three systems combined in this setup may be used simultaneously to transmit announcements to three separate parts of the ship. Each amplifier channel, however, is capable of handling the loud speaker load of the three systems combined. In case of amplifier trouble, the facilities normally associated with the disabled channel may be combined with those of another channel until repairs can be made. Even if two of the three channels are disabled, messages can still be transmitted throughout the whole ship. Fig. 3 shows a simplified circuit of this system.

The more interesting design problems arise because of special requirements for service on naval vessels. Short circuits on loud speakers must not interfere with operation over other loud speakers. Short circuits or trouble grounds on microphone circuits or control wiring at microphone locations must not prevent the system being used from any other microphone location.

Mechanically the design problems become even more interesting. Great strength is required, and protection against shock, because equipment must not be rendered inoperative by the ship's own gunfire or the shock of torpedoes or near misses by aerial bombs. Vibration over long periods, caused by the ship's engines, must cause no damage. Loud-speaker and microphone diaphragms must be designed to withstand blasts from nearby gun muzzles.

All equipment located on weather decks must be protected from corrosion by salt water. This includes microphone, control boxes, and loud speakers. In some cases equipment is made watertight so that no water can enter the enclosure. In others, equipment is designed with the expectation that water will enter, and drain holes are provided. Under these latter conditions, all internal parts must be made immune to the corrosive effect of sea water.

STREET LIGHT CONTROL

(*Continued from page* 100)

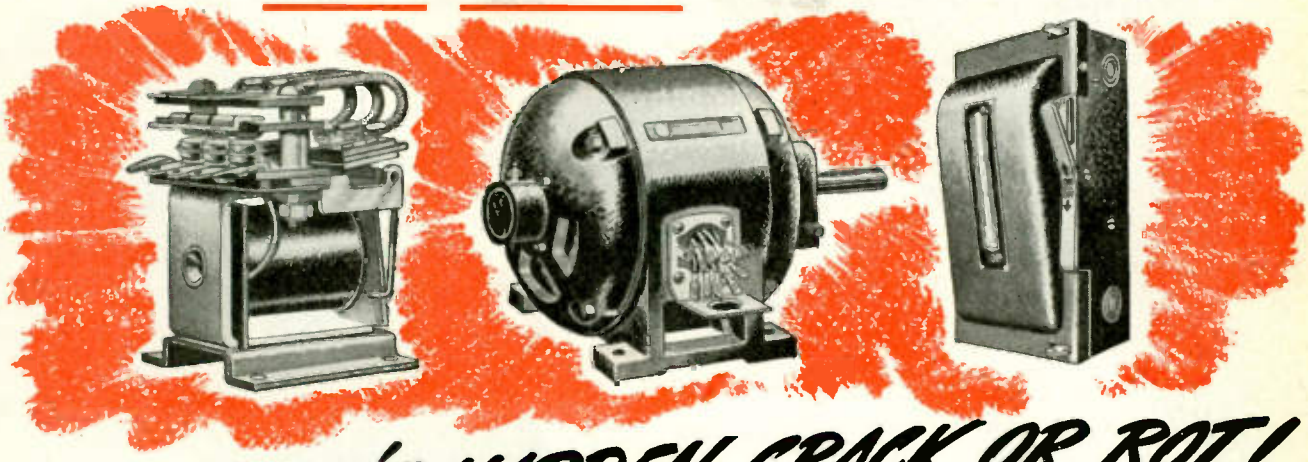
telephone wires from the transmitter is utilized for the control, 60-cycle voltage being used as the control voltage. Another pair of wires from the substation is utilized for check-back to assure the dispatcher that his selected operation has been carried out.

In order to inform the dispatcher correctly as to when the lights should be turned on or off, a photoelectric relay is utilized. This relay sounds an alarm when light intensity is low enough to require

(*Continued on page* 134)

FOR ALL ELECTRICAL APPLICATIONS --

BH EXTRA FLEXIBLE FIBERGLAS SLEEVING



WON'T HARDEN, CRACK OR ROT!

SNUB TEST

Proves BH Non-Fray Feature

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

THE RESULT

BH *EXTRA FLEXIBLE* FIBERGLAS SLEEVING

2 WAYS BETTER

NON-FRAYING • NON-STIFFENING

WHY give a few cents worth of electrical insulation a chance to be the weak link in *your* product? Use BH *Extra Flexible* Fiberglas Sleeving—the *one* insulation with *all* these advantages:

It is *permanently* non-fraying, non-stiffening and non-burning, by virtue of the exclusive BH process. It will not dry out, crack or rot, retaining its original unusual resistance to high and low temperatures, moisture, oil, grease and chemicals *indefinitely*.

If you want an all-purpose sleeving that simplifies assembly and maintenance and gives longer maximum protection, standardize on BH *Extra Flexible* Fiberglas Sleeving. Available in all standard colors and sizes from 5/8" to No. 20, inclusive. Write for free samples today and compare by actual test!

HOW TO KEEP CUSTOMERS COOL AT 1200°F!

Direct contact with heat up to 1200°F does not harm BH Special Treated Fiberglas Sleeving, the non-burning, unsaturated, flexible-as-string sleeving that stays supple and won't fray when cut. Made in natural color only—all standard sizes. Get this *extra* protection now and keep customers' temper cool, too!

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

BH PRODUCTS

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

BENTLEY, HARRIS MANUFACTURING CO.

Dept. I, Conshohocken, Penna.

Jennings RADIO

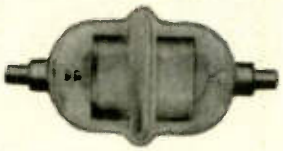
VACUUM ELECTRONIC COMPONENTS

* Y—PINENUT SERIES OF CAPACITORS

PATENT APPLIED FOR

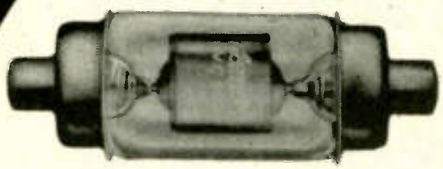
* X—PEANUT SERIES OF CAPACITORS

PATENT APPLIED FOR

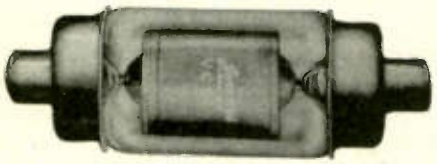


* W—WALNUT SERIES OF CAPACITORS

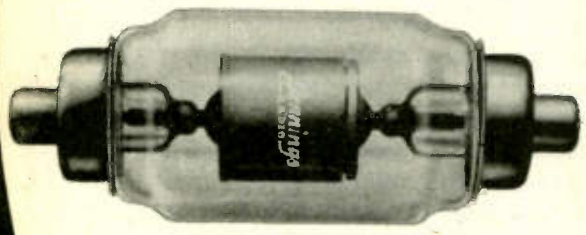
PATENT APPLIED FOR



VC 50—SERIES OF CAPACITORS



VC 250—SERIES OF CAPACITORS



* C—COCONUT CAPACITOR

Above sizes relatively in proportion

Jennings RADIO

VACUUM ELECTRONIC COMPONENTS

ANNOUNCES

4*

NEW VACUUM CAPACITORS

THE CAPACITY RANGE AND SIZE OF

JENNINGS HIGH VOLTAGE VACUUM CAPACITORS

COVER MANY NEEDS IN ADVANCED ELECTRONICS

FOR THE FIRST TIME VACUUM HIGH VOLTAGE CAPACITORS ARE AVAILABLE OVER A WIDE RANGE OF SIZES AND CAPACITIES.

* **Y—PINENUT,** 1-5 mmfd., 3500 Peak Volts, 7½ Amps.
* **X—PEANUT,** 5-25 mmfd., 7500 Peak Volts, 20 Amps.
* **W—WALNUT,** 6-50 mmfd., 20,000 Peak Volts, (Available up to 32,000 Peak Volts), 20 Amps.
* **C—COCONUT,** 50 mmfd. 50,000 Peak Volts, 60 Amps.

VC 50, 6-50 mmfd. 20,000 Peak Volts, (Available up to 32,000 Peak Volts), 20 Amps.

VC 250, 50-250 mmfd. 20,000 Peak Volts, 60 Amps.

* Four new units added to the wide range of sizes and capacities in Jennings Vacuum Capacitors.

We welcome your inquiry and the opportunity to serve you.

WATCH JENNINGS FOR NEW DEVELOPMENTS IN THE FIELD OF SPECIALIZED VACUUM ELECTRONIC COMPONENTS.

WRITE FOR BULLETIN E1

JENNINGS RADIO MANUFACTURING COMPANY • 1098 E. WILLIAM ST. • SAN JOSE 12, CALIFORNIA

STREET LIGHT CONTROL

(*Continued from page* 130)

street lights and when the light intensity is high enough to dispense with street lights.

We have been able to operate receivers on any circuit fed from a bus to which a transmitter is coupled. In some cases receivers are located as much as twenty-five miles from the station. Also in most cases, we have been able to operate receivers on feeders from stations which do not have transmitters and must receive their signal from a remote station over the substation tie lines.

This type of system offers great flexibility in remote control since it affords control upon demand over a great many individual control units over a wide area. This flexibility is increased greatly by its ability to control more than one type of load with the same equipment.

The advantages of such a control are many. Primarily, it is at least one answer to the question of multiple street light control which utilities have faced for many years. By using such a system, the good load characteristics inherent in street lights can be realized by applying them to distribution transformers rather than using a low power factor series circuit. By reducing street lighting to the low voltage multiple system, hazardous maintenance work is eliminated.

Older types of street light control systems are not adaptable to other loads as is the type of control under discussion. Other types of control circuits are limited in application to areas adjacent to the station whereas the carrier type of control can be applied as far as distribution feeders can be run.

This type of control is relatively new in the utility field and its future seems to be very bright. There has been and still is a need for control systems that can be easily applied and adapted and the carrier principle has been well developed to answer that need.

PRODUCTION OF GRIDS

(*Continued from page* 106)

ished (or transferred to another tube type) and the harassing need for hundreds of mandrels was removed at once.

The machine has since been adapted to several other types of grids, and more machines have been constructed with considerable improvement incorporated in their design. The original model is still in operation, however, and in its essential characteristics remains the standard for the mass fabrication of transmitting vacuum tube grids.

Following are some recent figures on the production of machine grids

(*Continued on page* 138)

ANSCO Gets Better Color Prints with G-E Voltage Stabilizer

● *Illumination of unvarying brightness* is essential for processing color prints and transparencies. A slight change in the voltage supplied to the lamp, used in exposing and printing, changes its color temperature and content, and makes accurate, uniform printing of color values difficult.

Ansco's San Francisco Laboratories, as part of their research to simplify color printing for amateur photographers, have found that the G-E voltage stabilizer is a substantial aid in assuring correct illumination.

This small, compact, automatic device, which can be connected to any 115-volt plug outlet, provides a constant power supply regardless of line-voltage fluctuations up to ±15 per cent.

CONSTANT VOLTAGE

may add new accuracy to your precision jobs, too

● On almost every precision job where electricity is used, a closely held voltage supply adds speed or accuracy, or decreases rejects. In addition, it protects delicate instruments, tools and electronic tubes from sudden overvoltages, and increases the reliability and life of such equipment.

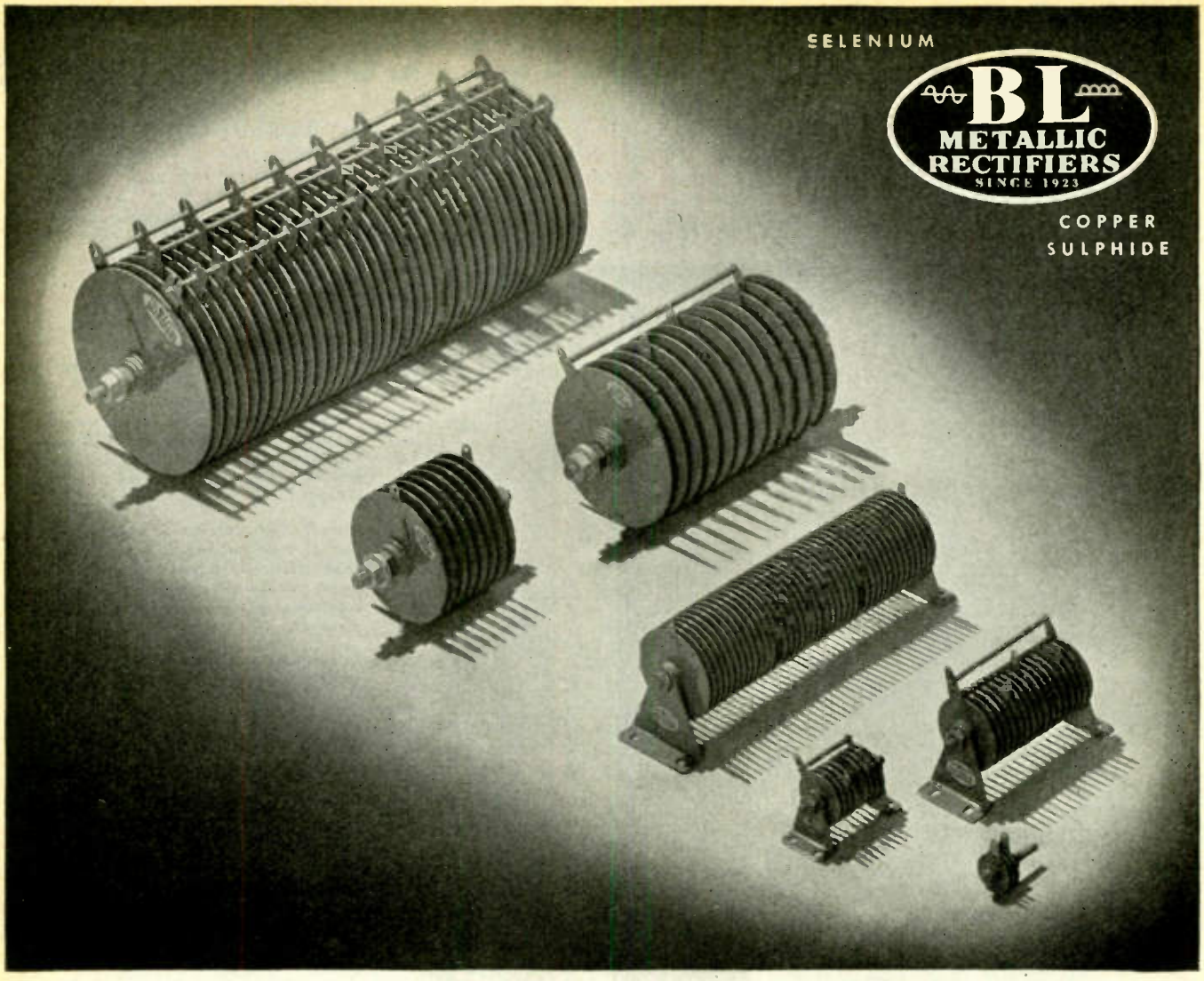
If you are a user or manufacturer of such apparatus as radio transmitters, testing equipment, X-ray machines, other electronic devices, motion-picture projectors, and precision photographic equipment, it will pay you to investigate the benefits of G-E voltage stabilizers. They can be used as an accessory to present equipment or built into new, redesigned products to add salability.

These small, compact units are available in ratings from 50 to 5000 va. On circuits where the voltage may vary from 95 to 130 or 190 to 260 volts, they automatically provide a constant 115- or 230-volt output. Because they have no moving parts, the need for maintenance is practically nonexistent. Ask for Bulletin GEA-3634A for complete information. *General Electric Company, Schenectady 5, N. Y.*

Buy all the BONDS you can — *and keep all you buy*

GENERAL ELECTRIC

403-81-5206



B-L METALLIC RECTIFIERS

from Milliwatts to Kilowatts

If you have an A. C.-D. C. conversion problem, let B-L engineers help you. We have successfully produced many appliances formerly thought impractical.

B-L Metallic Rectifiers have been favorably known to the electrical industry for many years. They are reliable, efficient, designed to get *your* job done right!

No matter what rectifier applications you are considering, B-L will be glad to work with you. Selenium and Copper Sulphide Rectifiers for all needs are available.

Write today for Bulletin R-41-b.

SELENIUM BL METALLIC RECTIFIERS COPPER SULPHIDE

THE BENWOOD LINZE COMPANY

1815 Locust Street . . . . . St. Louis 3, Mo.

Long Distance Telephone CEntral 5830

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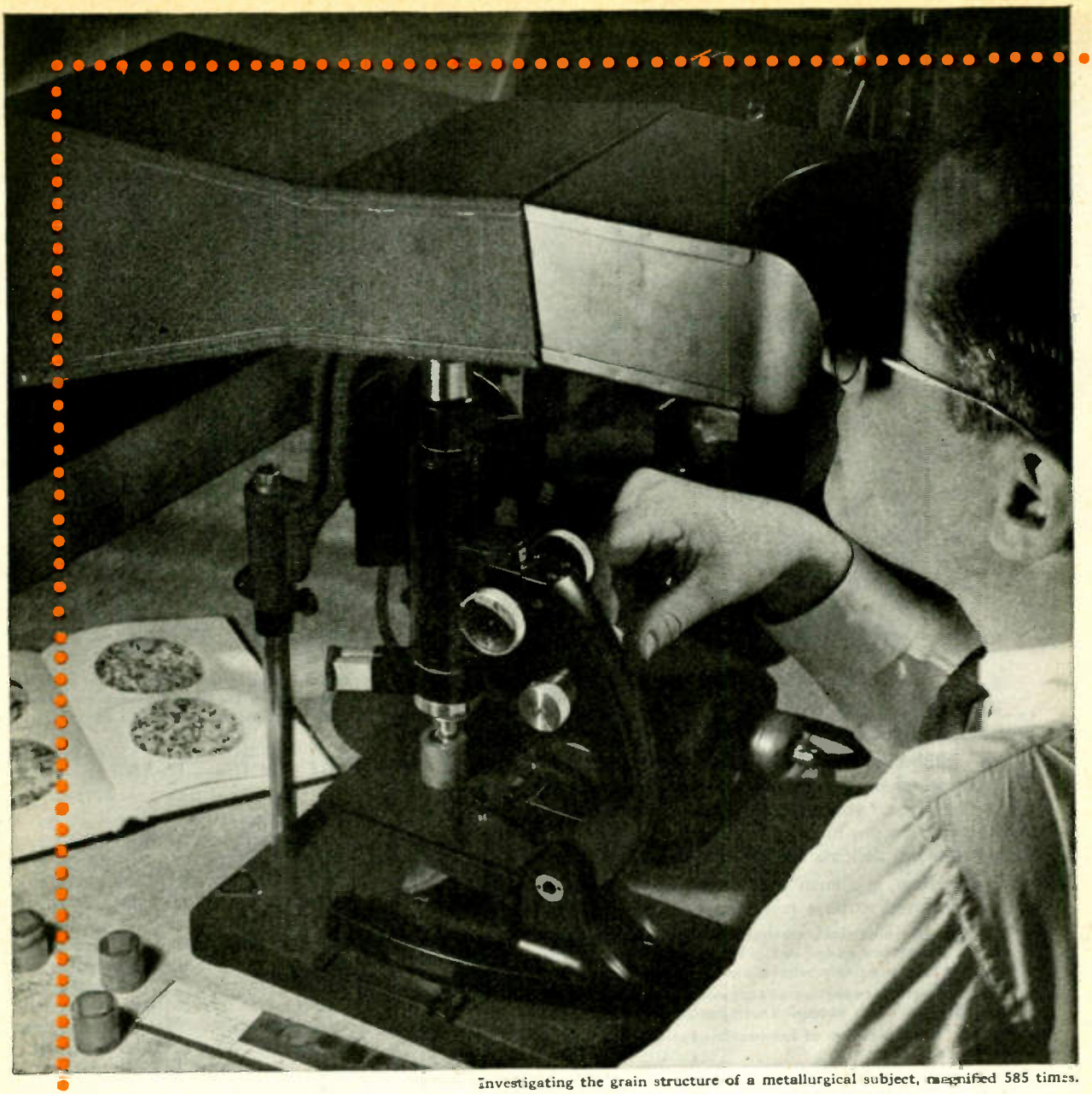
Designers and Manufacturers of Selenium and Copper Sulphide Rectifiers, Battery Chargers, and DC Power Supplies for practically every requirement.



Investigating the grain structure of a metallurgical subject, magnified 585 times.

Arming radio for war

MODERN GLOBAL WARFARE has subjected radio communication equipment to hitherto unheard-of forms of punishment. Not the least of these are extremes of shock and vibration, the enormous acceleration of high-powered aircraft take-offs and the abrupt deceleration of carrier landings.

Such service requires not only a high degree of excellence in design and fabrication, but also an infinite amount of research in the field of available materials and their behavior under varying conditions.

Collins chemical and metallurgical research has played a very important part in developing the Collins communication transmitters and receivers which have proved so trustworthy in Military service. The result of continuing research will be reflected in the Collins equipment available to commercial users after the war. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

ARMY E NAVY

. IN RADIO COMMUNICATIONS, IT'S . . .

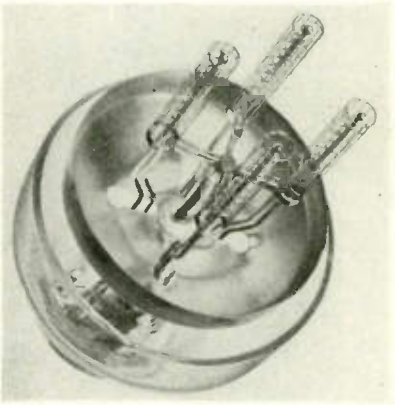
COLLINS

PRODUCTION OF GRIDS

(*Continued from page* 134)

for several mass-production tube types:

Grid Type	Machine Output Grids Per Minute
304TH	5.63
304TL	5.00
3C24	5.15
15E	7.35
35T	5.15
35TG	5.15
527	1.28



Internal construction of the Eimac 304TH tube showing the four filaments and four grids internally connected in parallel

SIGCIRCUS—P-563

(*Continued from page* 107)

quency carrier equipment to provide the required number of keying controls and channels and is expected to prove more efficient than the telephone lines ordinarily used for this purpose.

All the equipment for the completely independent operation of Station SigCircus is ingeniously disposed in the 17 trailers (manufactured by Millionguiet and Societe Parisienne de Materiel Coder), which are nominally divided into three general groups: Transmitter, Signal Center, and Power & Pictorial.

In the first, or Transmitter group, Trailers 1, 2, and 3 each contain a 50 kilowatt Diesel power generator and a 275 gallon fuel tank. A master power switch is provided for converting from Diesel power to commercial power when the latter is available. Trailer 4 contains a low-tension power supply and voltage regulator, with a 12 kilovolt filter condenser. Trailer 5 holds a high-voltage dc rectifier (12 kilovolts).

A Western Electric two-kilowatt driver unit is contained in Trailer 6, together with VHF transmitters, receivers and associated carrier equipment. This trailer also contains the Transmitter Operating Position. Trailer 7 carries the 60 kilowatt power amplifier which is fed from the transmitter contained in Trailer 6, while Trailer 8 has an Army Forces network transmitter, an air blower for its high power

(*Continued on page* 142)

AS the draftsman's pencil makes its mark, he issues orders, through a remarkable kind of shorthand, to the men who must act on his drawings. But only with special assistance can human hands shape such precise, complex orders as these. No wonder the draftsman chooses his instruments with care . . . he is, in effect, taking them into partnership!

In this sense, Keuffel & Esser Co. drafting equipment and materials have been the draftsman's partners for 78 years in creating the peaceful culture and wartime might of America, in making possible our concrete dams, steel bridges, aluminum bombers.

...the world's highest dams

....longest bridges

....fastest airplanes

partners in creating

So universally is this equipment used, it is self-evident that every engineering project of any magnitude has been built with the help of K & E. Could you wish surer guidance than this in the selection of your "drafting partners"?

Especially in these hurried days, you will find a PARAGON* Drafting Machine a boon to your work ...and your nerves! With the finger tips of your left hand on its control ring, the lightest pressure enables you to set the scales at any angle, anywhere on the board. Your right hand is always free. For the full PARAGON* story, write on your letterhead to Keuffel & Esser Co., Hoboken, N. J. **Reg. U. S. Pat. Off.*

KEUFFEL & ESSER CO.
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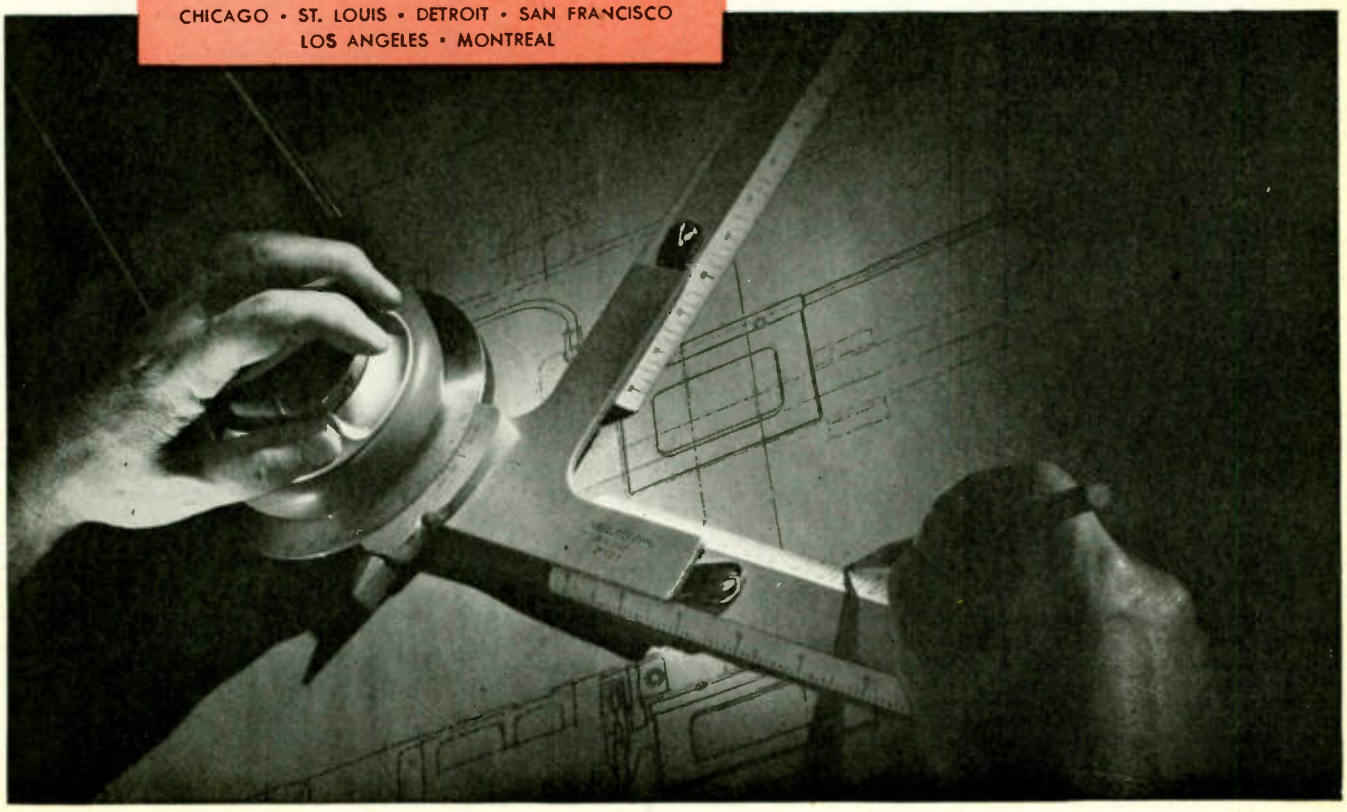
LOS ANGELES • MONTREAL

K+E

Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules, Measuring Tapes.



POWERSTATS

IN THE AIR OR ON THE GROUND

400 cycles

POWERSTAT TYPE 1140

Pictured above is the new 400 cycle POWERSTAT Variable Transformer designed especially for aircraft use. This lightweight, rugged, dependable POWERSTAT type 1140 is an aircraft component where ounces count and failure cannot be tolerated. Having the features of advanced design, carefully selected improved materials and conservative ratings, the POWERSTAT type 1140 is the air-borne variable transformer. The new POWERSTAT type 1140 retains the features of the 60 cycle POWERSTATS — essential components of many types of ground and shipboard war equipment. Type 1140 is readily available for similar use on 400 cycle equipments.

RATINGS OF UNITS ILLUSTRATED

POWERSTAT Variable Transformer Type 1140:
Input: 115 volts, 400 cycles, 1 phase.
Output: 0-135 volts, 6.5 amperes, .880 KVA.
Mounting Radius 2½ inches; Overall height 4¾ inches.

POWERSTAT Variable Transformer Type 116:
Input: 115 volts, 50/60 cycles, 1 phase.
Output: 0-135 volts, 7.5 amperes, 1.0 KVA.
Mounting Radius 2½ inches; Overall height 6⅜ inches.

A special POWERSTAT is incorporated in the M-9 Gun Director shown on this page.

POWERSTAT TYPE 116

PHOTO COURTESY WESTERN ELECTRIC CO.

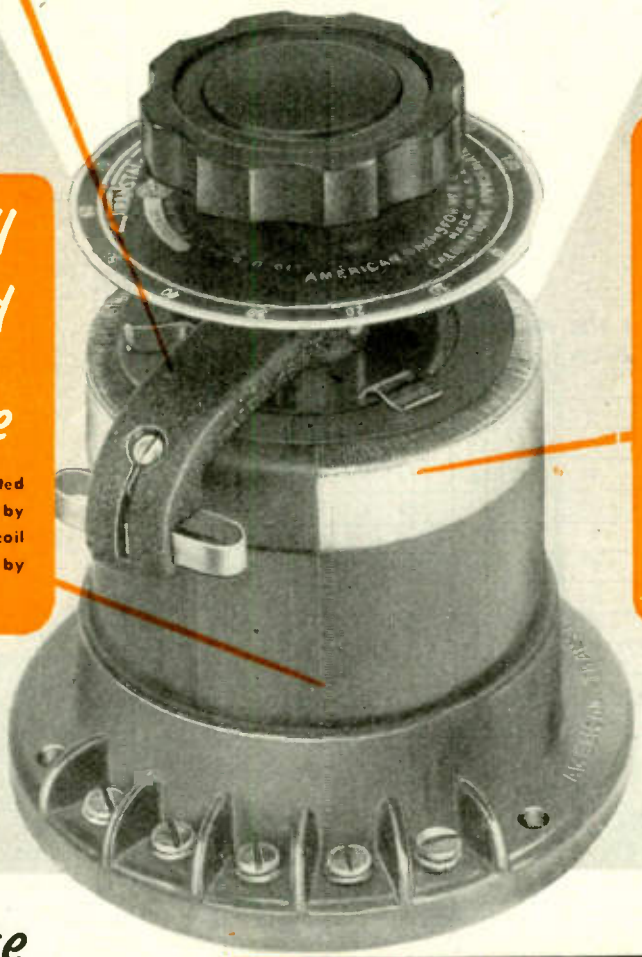
SUPERIOR ELECTRIC CO., SEND FOR BULLETINS 1E
466 Laurel St., Bristol, Conn.

SMOOTH COMMUTATION!

A.C. VOLTAGE CONTROL with TH 2½A TRANSTAT

Brush Arm Assembly

One piece die casting permits good heat dissipation, provides a simple means of replacing the brush and protects the commutator against contact with brush holder if brush should break or loosen.



Core and Coil Impregnated FOR Long Service

Each turn of vinyl acetal insulated wire is PERMANENTLY anchored by impregnation of whole core and coil with phenolic resin, followed by baking.

Broad Commutating Surface

Ground from parallel wires on outer periphery of coil, forms long even segments with solid insulation necessary to avoid shorted turns. Greater contact area results in a lower operating temperature. Smooth, mirror-like finish provides a practically frictionless brush track.

Write FOR THIS NEW FOLDER!

Complete description, including construction details, performance curves, wiring diagrams, ratings, electrical data and applications covered. Ask for Bulletin No. 171-01.

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

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

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

AMERTRAN

SIGCIRCUS—P-563

(*Continued from page* 138)

air-cooled tubes, a workshop and storage space.

The Signal Center group is composed of five trailers numbered from 9 to 13 inclusive. Trailer 9 holds supplies and two VHF transmitter and receiver systems, while Trailer 10 contains special carrier equipment. Trailers 11 and 12 have six high-speed teletype machines and associated facilities for handling traffic. Trailer 13 contains the facsimile transceiver units, the broadcast studio, and a control booth in which space has been set aside for the wire, disc and film recorders. This trailer is also the home of the portable American Forces network studio.

The receiving station, consisting of one W.E. receiver, VHF transmitters and associated carrier equipment, is fitted into Trailer 14.

The Power & Pictorial group is composed of trailers 15, 16 and 17. Trailers 15 and 16 each contain a 25 kilowatt gasoline power unit, while trailer 17 carries the army pictorial division hut.

The complete station is manned by a team composed of carefully chosen personnel selected for their technical proficiency and operating skill. Administrative and guard personnel have been provided to make the operating team completely independent and self-sustaining.

The project was executed by the U. S. Army Signal Corps, headed by Major General W. S. Rumbough, of Lynchburg, Va., Chief Signal Officer, European Theater of Operation. Its excellent performance was made the subject of special commendation by General Bickelhaupt.

HF INTERFERENCE

(*Continued from page* 110)

poor attenuation, 20 db or more below that for the filter. When the shielded transformer was installed in the cell type of cage, the measured attenuation was no greater than that for a single cage, yet when the filter was used, the cell type of cage was 24 db better than the single cage. This point emphasizes the attenuation that must be paid to the entrance device for the power line. The performance of the shielded transformer in connection with a doubly shielded room was good, but not equal to the filter arrangement. From the power standpoint, the transformers tested were unsatisfactory, giving very poor voltage regulation. Shielded transformers, therefore, are not recommended except for special cases.

It is of interest to note that the effect of grounding a shielded cage, especially where line filtering

(*Continued on page* 146)

NOW. . . SEALING–WELDING–BONDING

The **THERMATRON** *"Weldmaster" with demonstration heat-weld equipment.*

MORE PROVED USES FOR THE Thermatron

ELECTRONIC DIELECTRIC HEAT GENERATOR

Electronic welding of thermoplastic sheeting such as Koroseal, Vinylite and Saran, which has been proved practical and time-saving by months of production on **THERMATRON** units in a war industry, opens a new field for postwar activities.

The list of everyday products which lend themselves to the **THERMATRON** method is endless. It includes such items as shower curtains, bathing caps, aprons, cosmetic bags, tobacco pouches, tennis racket covers, etc.—in fact, almost any product fabricated of thermoplastic sheeting which has hitherto been stitched or sealed by resistance heating. **THERMATRON** can handle the assignment—and make faster and cheaper "seals" or "welds."

Almost any seamed product of thermoplastic sheeting can be fabricated better and quicker with **THERMATRON** equipment.

Thermatron electronic dielectric welders are available in 1 KW, 2½ KW and 5 KW sizes. Send for folder, "Heat Sealing of Plastics by Electronics."

THE Thermatron LINE

. . . of electronic dielectric heat generators, 500 watts to 30 kilowatts, for all purposes, including the popular 5 KW "Heatmaster" especially designed for heating preforms, is described in our **THERMATRON** folder. Free on request.

No **THERMATRON** *has ever become an orphan.*
THERMATRON *application service insures against it.*

Thermatron *ratings based on output.*

RADIO RECEPTOR COMPANY, Inc.
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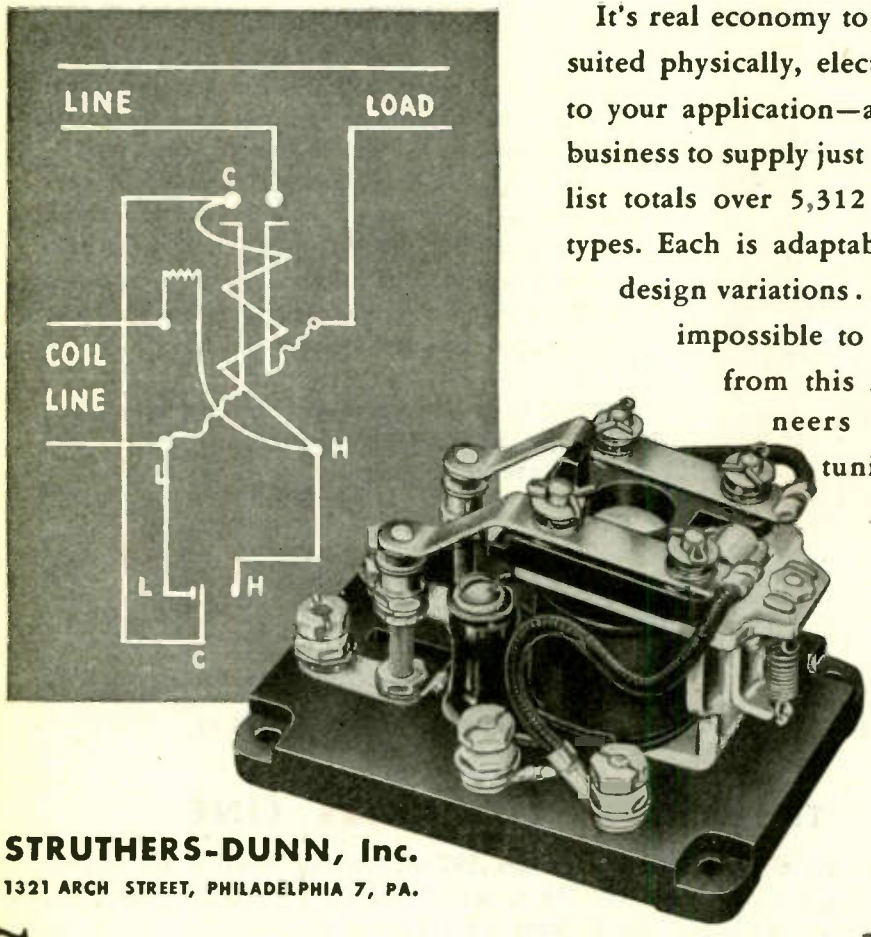
Engineers and Manufacturers of Airway and Airport Radio Equipment
SINCE 1922 IN RADIO AND ELECTRONICS

FIT THE RELAY TO THE JOB....

NOT THE JOB TO THE RELAY



It's real economy to use relays that are *exactly* suited physically, electrically, and mechanically to your application—and it is Struthers-Dunn's business to supply just the unit you need. Today's list totals over 5,312 standard Struthers-Dunn types. Each is adaptable to numerous coil and design variations . . . but, should it still prove impossible to match your specification from this list, Struthers-Dunn engineers welcome the opportunity to "tailor" a new relay type to your exact measure.

A typical application of the Struthers-Dunn Type 88XX50 electrical lock-in relay used with a 3-wire "high-low" temperature control thermostat.

STRUTHERS-DUNN, Inc.
1321 ARCH STREET, PHILADELPHIA 7, PA.

STRUTHERS-DUNN

5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

3 OUTSTANDING FEATURES OF THE NEW EIMAC 4-125A TETRODE

1 LOW DRIVING POWER

With but 2.5 watts driving power, the 4-125A will deliver 375 watts output at frequencies as high as 120 Mc. The low driving power requirement has been achieved without the use of excessive secondary emission. The control grid is specially processed to reduce both primary and secondary emission.

2 HIGH FREQUENCY PERFORMANCE

The Eimac 4-125A will deliver 200 watts output at 250 Mc. The performance curves below show the relationship between driving power and power output at frequencies up to 250 Mc.

3 LOW GRID-PLATE CAPACITANCE

The grid-plate capacitance of the 4-125A is only *0.03 uufd.* This low value allows operation up to 100 Mc. without neutralization. Stability is further assured by the special grid processing which reduces secondary emission.

A technical bulletin on Eimac 4-125A Power Tetrode contains full specifications and detailed discussion of the tube's characteristics, circuit diagrams and constant current curves. Write for your copy today.

The Eimac 4-125A is the first of many new Eimac tubes that are on the way. Watch for future announcements.

ELECTRICAL CHARACTERISTICS

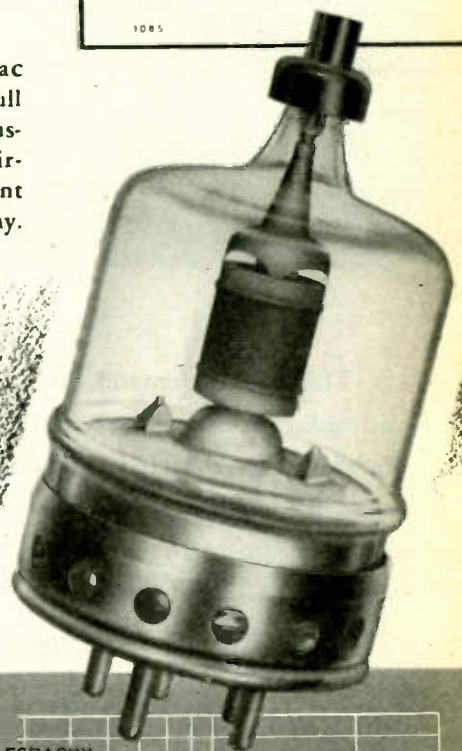
Filament: Thoriated Tungsten
- Voltage . . . . . 5.0 volts
- Current . . . . . 6.2 amperes

Plate Dissipation (Maximum) 125 watts

Direct Interelectrode Capacitances (Average)
- Grid-Plate (Without shielding, base grounded) . . . . 0.03 *uufd.*
- Input . . . . . 10.3 *uufd.*
- Output . . . . . 3.0 *uufd.*

Transconductance (i_B = 50 ma., E_B = 2500 v., E_{C2} = 400 v.) . 2450 *umhos*

1085



FOLLOW THE LEADERS TO

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

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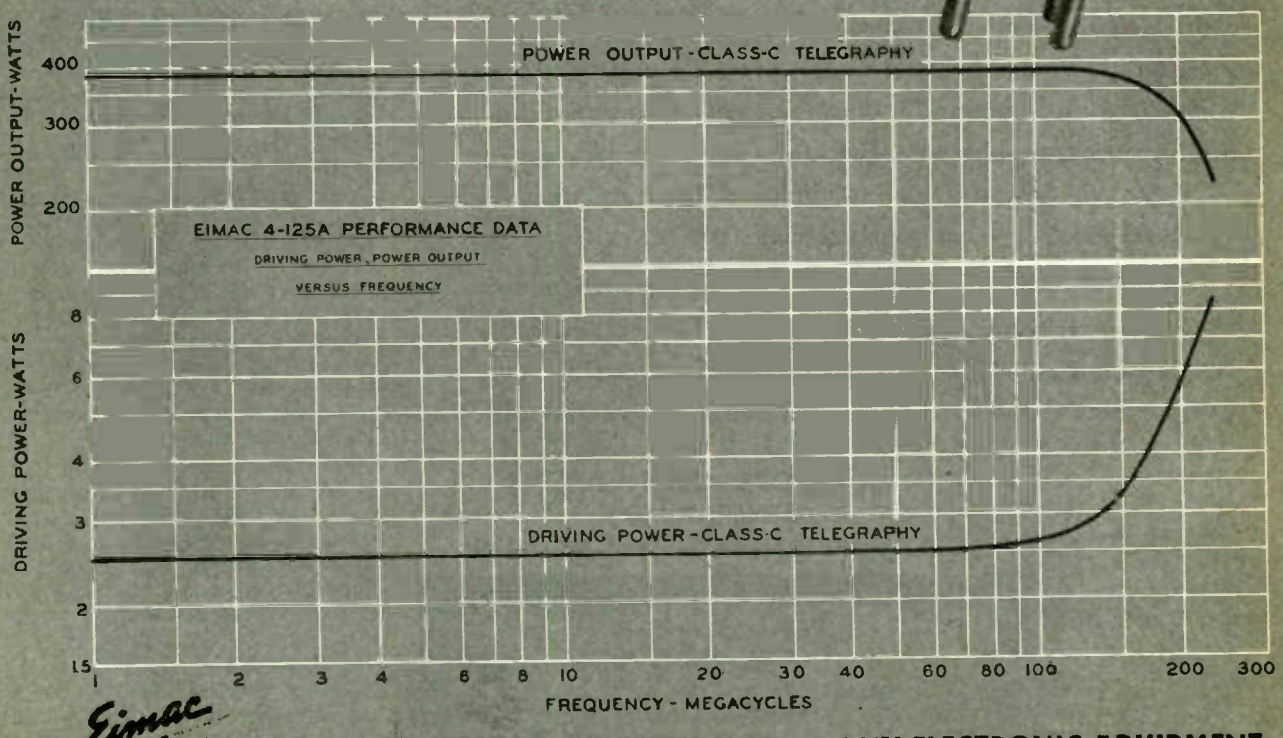
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco 11, Calif., U. S. A.



Eimac TUBES **THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT**

HF INTERFERENCE

(*Continued from page* 142)

is not correct, can vary considerably. Under some conditions a ground will decrease the field intensity from a shielded room; under other conditions, it will increase it. However, when correct shielding, with a proper entrance filter, is used, there is no difference between the grounded and ungrounded conditions. In fact, one way of testing the cage is to ground it. If the field intensity changes, it is a sign that the filter is not right, or that there is a poor joint in the cage, such as the door not being tightly closed.

The cell type of shield construction described in these pages may ultimately make electromagnetic shielding of a room as simple as acoustic treatment is today. The major obstacle—that of cost—should be overcome by mass production of cells.

TELEVISION OPTICS

(*Continued from page* 82)

eter should be about three times the tube diameter.

A central area of the mirror of a diameter about equal to the tube diameter cannot be utilized by the Schmidt system. If this area were not eliminated, practically all the light reflected by it would fall directly on the tube face, thus tending to reduce appreciably the image contrast. A significant amount of light reflected from an area up to a diameter about twice the tube diameter falls back on the tube face. Theoretically, in order to eliminate all back reflections, the central part of the mirror up to about twice the tube diameter should be cut out or blackened.

This ideal condition cannot be realized in practice because it would entail also a loss of a greater part of the useful reflective area. If the efficiency of the system were to be maintained, it would be necessary to compensate for this loss by increasing the mirror diameter beyond practical limits. A more practical compromise, therefore is, to eliminate the central area of about the same diameter as the tube face.

A schematic diagram of a Schmidt system is given on page 81. Some of the rays that are not utilized are indicated there by dashed lines. A central portion of the mirror which is usually eliminated is represented by a heavy arc.

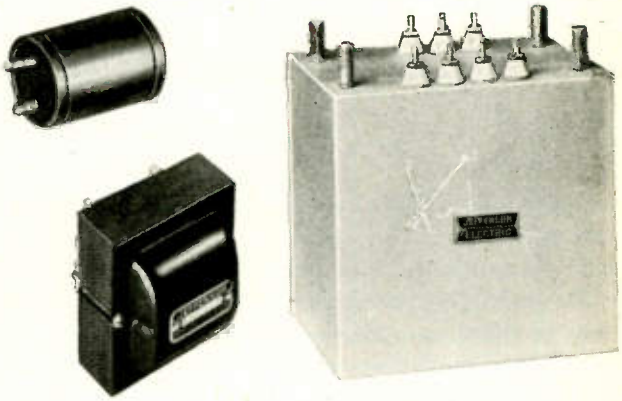
Theoretically, any particular Schmidt system can be corrected for only one value of image magnification. The range of permissible adjustments in the magnification

(*Continued on page* 150)

AIDING THE WAR TODAY . . . . . .

. . . . SERVING THE PEACE TOMORROW

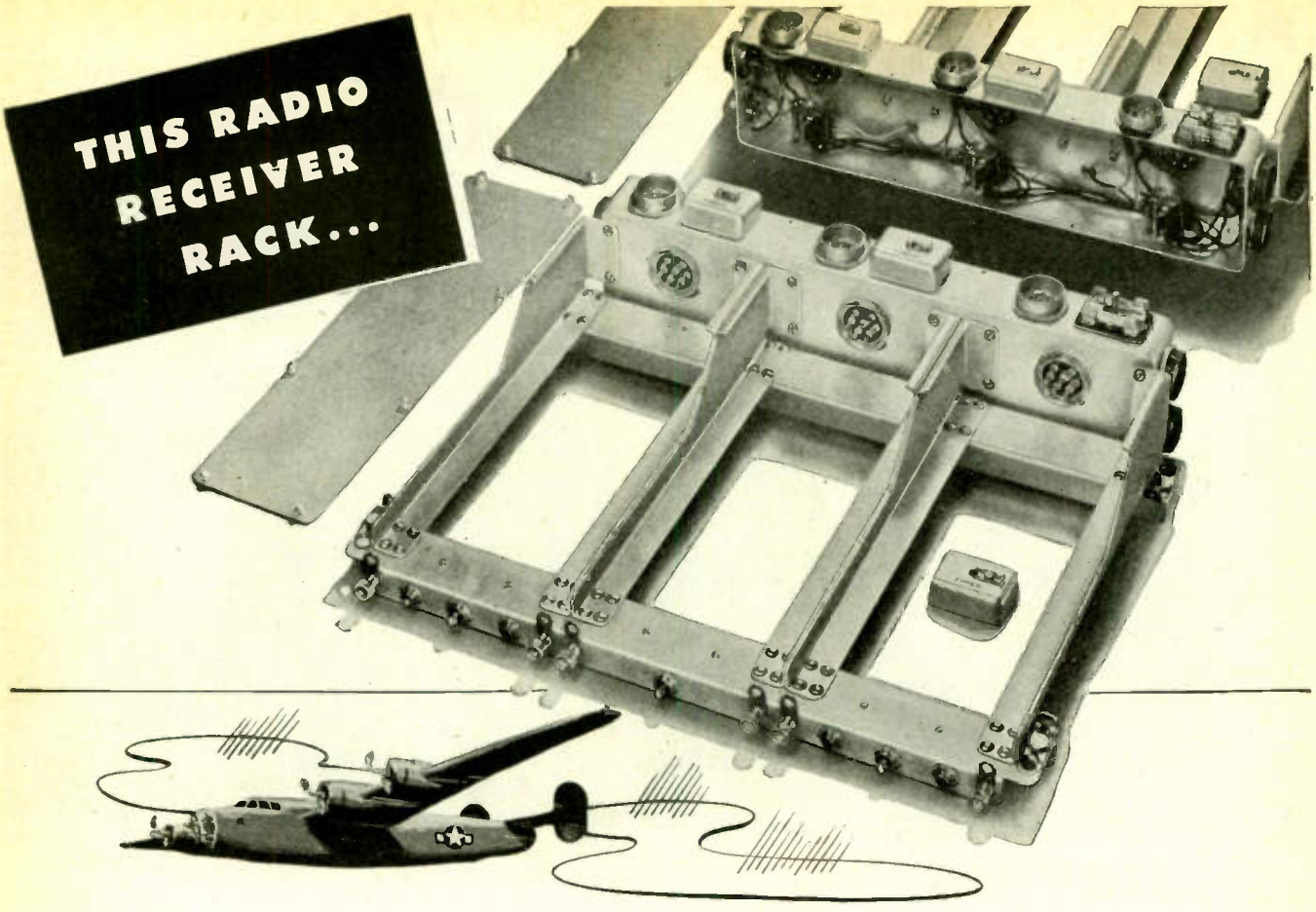
Tomorrow, when the tools of strife are turned to the ways of peace, Jefferson Transformers will serve with the same fidelity. Improved manufacturing techniques established under the stress of war will be turned to producing still better transformers for your post war needs. Let Jefferson engineers examine your particular requirements now and make suggestions that will save you time later . . . JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. *In Canada:* Canadian Jefferson Electric Co. Ltd., 384 Pape Avenue, Toronto, Ont.



In all theatres of war, on the invasion beaches, wherever allied forces march against aggression, Jefferson Electric Transformers establish records of dependable performance. Today—on radio, radar, "walkie-talkies," television communications systems, electronic and control applications,—Jefferson Transformers aid our war effort with a long-life reliability based on engineering skill and Jefferson's basic principle of "quality—with quantity" production.

JEFFERSON ELECTRIC

TRANSFORMERS



contains more than 500 Electrōnents . . . all made and assembled by Scovill*

This three-position, high-frequency radio receiver rack for big bombers . . . one of the most intricate manufacturing and assembling problems ever entrusted to Scovill . . . shows how Scovill's versatile production facilities can meet requirements for electronic components or complete assemblies.

More than 500 individual parts are assembled in this rack. Materials used range from plastics to metal alloys in the form of sheet, rod, wire and tubing. Scovill makes all except glass and plastics components. Methods include forging, stamping, drawing, heading, machining, and wire forming.

Even complicated wiring does not stump Scovill's production engineers. Every wire is cut to length, stripped and soldered into correct position. Relays are manufactured, tested and adjusted by Scovill technicians.

In other words, Scovill engineered the whole job for assembly-line production . . . a service that can help you, too, save time, trouble and money on the production of small electronic components as well as large assemblies. For further details about the scope of Scovill's ingenuity and facilities, send for literature. Fill in coupon below and mail today.

*Electrōnents = Electronic Components

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Please send me a free copy of *"Masters of Metal"* booklet describing your facilities. I am interested in the ELECTRŌNENT* applications checked.

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- ☐ Lugs
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An improved product *demands* an improved wire!

from .001 to .050 *SPECIFY SPENCER*
Beryllium, Phosphor Bronze and Stainless Steel wire for . . .
1. EXACT SIZES 2. SPECIAL USES 3. EXACT PHYSICAL CHARACTERISTICS

Manufacturers of today's and tomorrow's products can now demand — and get — controlled specification fine wire in Beryllium, Phosphor Bronze and Stainless Steel. Spencer — originators of "Control Crimp" and "Spencerized" wire — invite your wire product problems.

SPENCER Precision WIRE

"SPECIFY SPENCER"
for *exact* specifications

SPENCER WIRE COMPANY
WEST BROOKFIELD PLANT
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TELEVISION OPTICS

(*Continued from page* 146)

depends upon the criteria to be used in judging the image quality. If the criteria are strict, even a 10 per cent change of magnification results in deterioration of image quality.

The mirror size alone does not determine the optical efficiency of a Schmidt system. Additional data are necessary for its evaluation. The correcting lens diameter must be known, also the magnification and the focal length or the projection distance of the system. The situation is further complicated by the fact that the central portion of the mirror is not utilized, and that the correcting lens must have a central hole to accommodate the tube. In addition to that, a considerable blocking of useful rays is caused by the tube and by mechanical parts supporting the tube and the correcting lens, and by the wiring adjacent to the tube. Unless all these factors are taken into consideration, efficiency values based on purely optical considerations may result in too optimistic ratings which could not be relied upon in actual practice.

Despite all these reservations a good use still can be made of approximate equations as, for example, those given by Maloff and Epstein.* These equations yield the "light-gathering" efficiency of the Schmidt system. They may be converted into the "illuminating efficiency" through the same relationship as was established for projection lenses.

With all the losses inherent in the Schmidt systems, their efficiencies are considerably higher than those of projection lenses now available or that may be available in the near future. For example, a reasonable estimate for the "light-gathering" efficiency of home-television Schmidt systems currently under consideration should be perhaps higher than 25 per cent for a magnification of 8, while the theoretical "light-gathering" efficiency of a f/1.5 lens is 8.8 per cent at the same magnification.

*Electronics, December 1944.

Note: Second sentence in second paragraph under "Mirror corrections" p. 82, word "concave" should be convex.

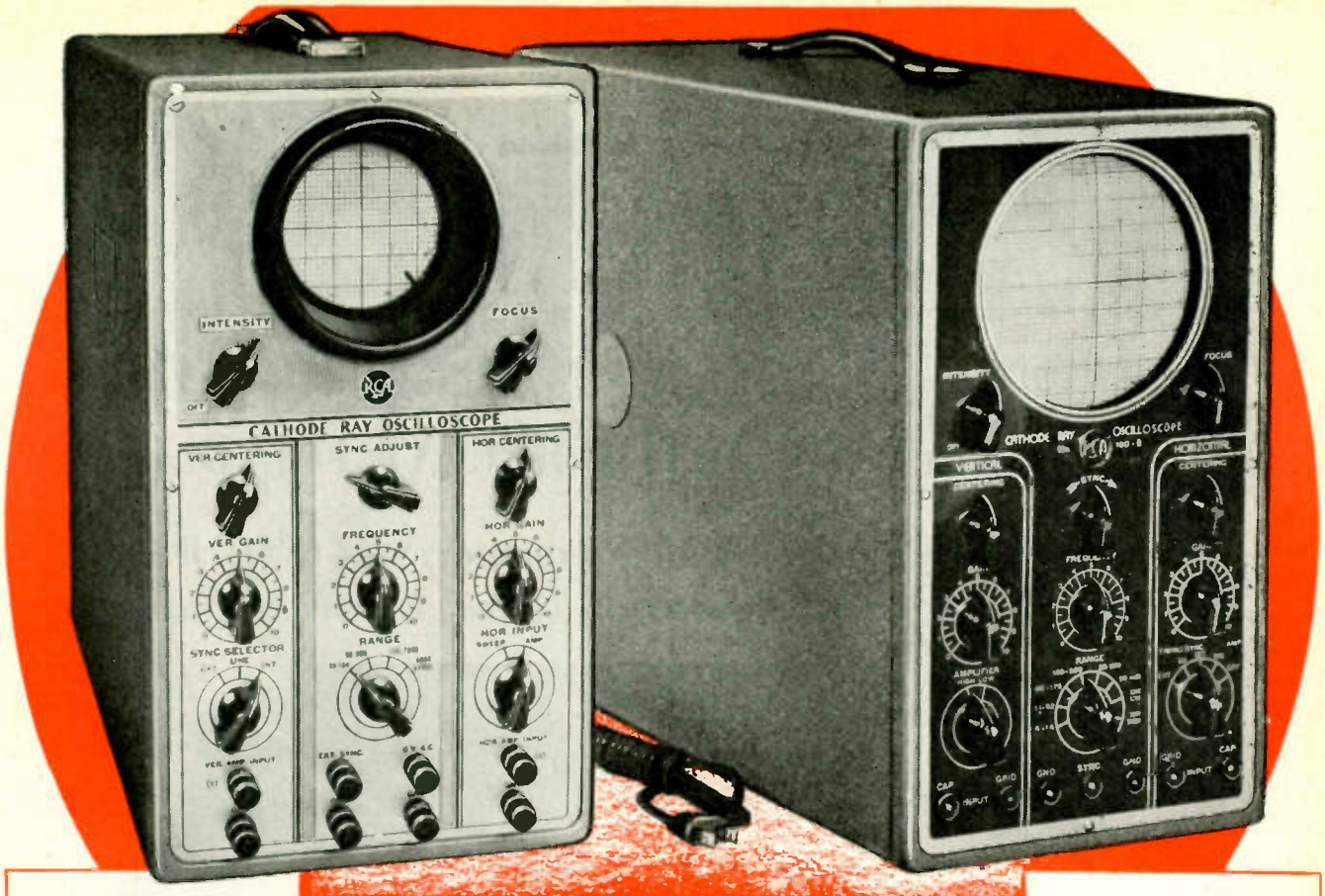
VOLTAGE STABILIZERS

(*Continued from page* 94)

siderably less distorted than the input voltage wave when the input voltage contains third, fifth, and seventh harmonics of sizable magnitudes.

The voltage regulation obtainable from this special circuit at rated frequency is essentially the

(*Continued on page* 154)



RCA 155-C 3-INCH OSCILLOSCOPE

Easily portable. Adequate and convenient for field work, industrial testing, and most laboratory work. Special light-shield aids accurate observation at low intensity. High-fidelity amplifiers; improved, wide-range timing oscillator.

Not just your laboratory— your shop, too, needs Oscilloscopes!

RCA 160-B 5-INCH OSCILLOSCOPE

Entirely portable. Produces large, clear image on graduated viewing screen. Wide-range deflection amplifiers and low-frequency timing-axis oscillator provide unusual accuracy in measurements. Integral power-supply unit. All controls at front of cabinet.

• Too many people imagine that cathode-ray oscilloscopes are purely laboratory instruments—not suitable for the shop, or for use by anyone except highly trained technicians. That is a mistake. A mistake that is costing many industrial companies money that could be saved. The RCA oscilloscopes shown above are especially made for practical men who want an instrument of this type, which can be used and maintained with minimum difficulty and maximum satisfying results. Bear in mind that by using an oscilloscope many jobs can be easily and quickly handled that otherwise would be difficult, time-consuming, or impossible.

BUY BONDS

RCA

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SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

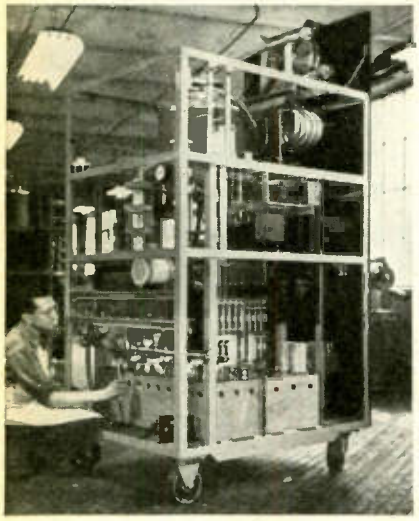
AUGUST *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

HIGH FREQUENCY INDUCTION FURNACE USED IN TUBE PLANT

The bombarder or high frequency induction furnace pictured below is another example of high-precision, modern equipment manufactured at Sylvania Electric's plant in Williamsport, Pa.

Flexible in Application

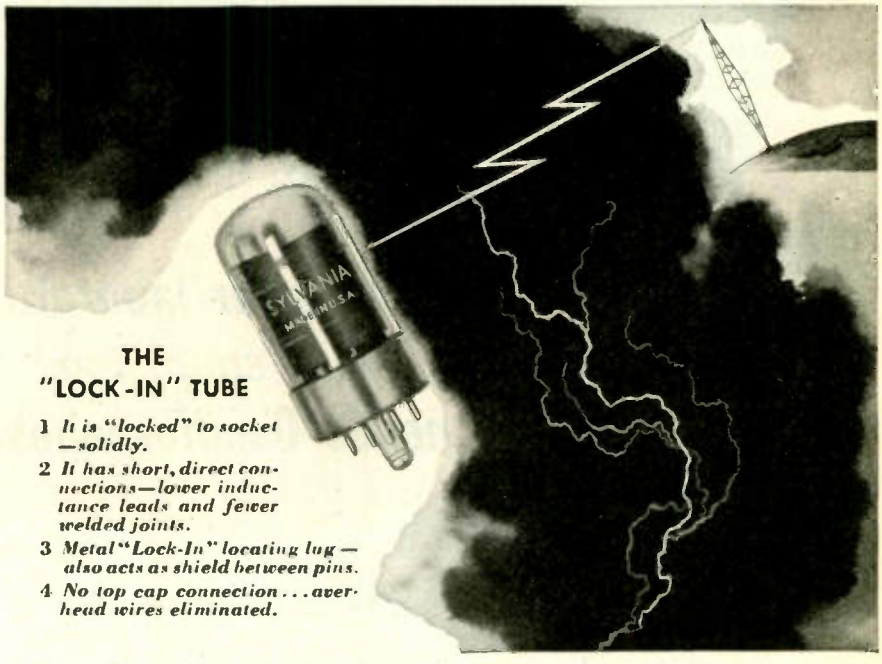
Used in all radio tube plants where exhaust machines operate, this essential apparatus may also be adapted for use in practically any application that requires high frequency induction heating by the connection of the proper heating coils. Its rated input is 25KVA, uses Type 207 tube as oscillator, frequency about 300KC.



High frequency induction furnace used in all radio tube plants where exhaust machines operate. Made by Sylvania Electric at Williamsport, Pa.

LOCK-IN TUBES PERFECTLY IN LINE WITH RECENT FCC DECISION

High Frequency Sets (FM) Will Get Benefit of Tubes' Electrical Superiority

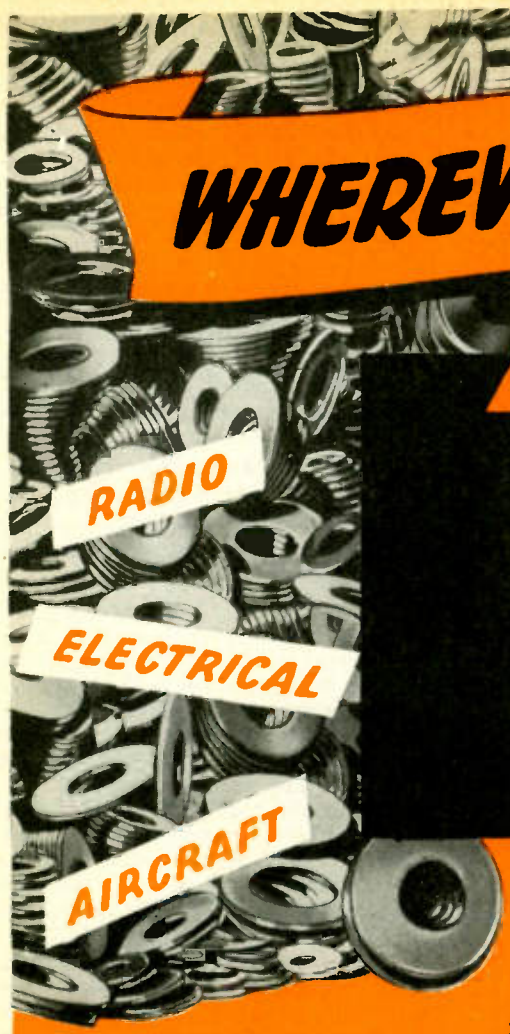


Sylvania Electric's revolutionary type of radio tube — the Lock-In — is so mechanically stronger and electrically more efficient that it takes in its stride the recent FCC decision assigning to frequency modulation the band between 88 and 106 megacycles. The basic electrical advantages of the Lock-In construction are ideally suited to the adoption of higher frequencies.

Mechanically it is more rugged because support rods are stronger and thicker—there are fewer welded joints and no soldered joints—the lock-in lug is metal not molded plastic—the elements are prevented from warping and weaving.

Electrically, it is more efficient because the element leads are brought directly down through the low loss glass header to become sturdy socket pins—reducing lead inductance—and interelement capacity.

Today, the many special features of the Sylvania Lock-In Tube are even more up-to-date than when they were introduced in 1938—a fact of increasing importance when considering the numerous postwar developments in the field of communications.

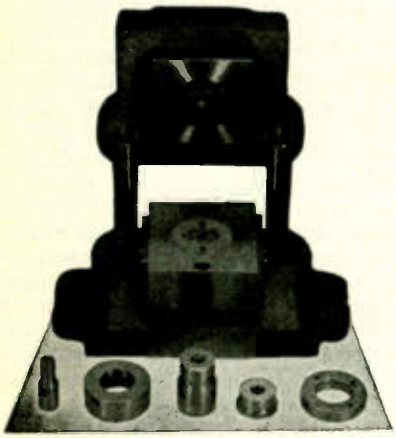


WHEREVER WASHERS ARE MADE

HOVIS

UNIVERSAL MASTER WASHER DIES

offer advantages you can't afford to overlook



Mode in Five Sizes: ¾" — 1½" — 2½" — 4" — 6"

OUTSTANDING MANUFACTURERS know from experience the saving of time, storage space, material and labor made possible by the Hovis method of making washers. No longer is it necessary to make a complete new die for each new size and type of washer. Instead you make a nominal investment in MASTER WASHER DIES, then 5 small interchangeable parts are the only items necessary to purchase to make any size washer. And the Hovis MASTER WASHER DIES themselves do not become obsolete; they can be used for both present and postwar production.

ASK TODAY FOR LITERATURE

HOVIS SCREWLOCK COMPANY

8096 E. NINE-MILE ROAD — Suburb of Detroit, Phone: Centerline 1575 — **VAN DYKE, MICHIGAN**

VOLTAGE STABILIZERS

(*Continued from page* 150)

same as that obtainable from the standard circuit shown in Fig. 1. This special circuit adds only approximately 35 per cent to the weight and volume of a standard circuit.

Power factor compensation

The fundamental voltage stabilizer circuit is designed for applications having small changes in load power factor. Since most loads encountered are of this type, the fundamental stabilizer circuit can be used without any modification. However, those loads whose power factor varies widely require a special stabilizer circuit.

Fig. 15 shows that the output voltage of a typical standard stabilizer decreases as the load power factor decreases. For the purpose of determining the effect of varying load power factor, the circuit of the standard stabilizer can be resolved into one impedance, equivalent to the combined effect of all the stabilizer impedances, in series with the load. As previously shown, it is possible to obtain constant output voltage with wide variations in load at unity power factor.

Therefore, in effect, the circuit has negligible internal resistance and it is practical to consider the stabilizer circuit, insofar as changes in load power factor act upon it, as a series inductance. Actually, under variable power factor conditions, it has been determined that this reactance is inductive and, quite surprisingly, it is practically equivalent to a reactor possessing a linear volt-ampere characteristic, even though the stabilizer includes reactor L_1, having a non-linear volt-ampere characteristic.

Since the stabilizer circuit can be resolved into a series linear inductance, it is theoretically possible to neutralize completely the effect of the series linear inductance by adding a series capacitor whose reactance equals the inductive reactance of the stabilizer. Thus, the output voltage of the stabilizer can be made independent of the load power factor by the addition of a suitable capacitor in series with the load on the stabilizer.

At present, even with tolerances in the manufacture of capacitors and reactors, it is possible to obtain an output voltage regulation of only $\pm$ ½ per cent with changes in power factor between the limits of approximately 25 per cent lagging and unity.

The weight and size of a voltage stabilizer incorporating power factor correction is approximately 10

(*Continued on page* 158)

KEEP that designation in mind—FF-55. You will need it when you redesign a lot of your electrical apparatus for genuine postwar efficiency.

It represents the newest and best in laminated electrical insulation—a new product produced with a new fibre base—Glass Cloth—and a recently perfected synthetic resin—Melamine.

While retaining the easy machinability and workability that makes rapid production possible, it offers in combination many qualities that previously could be had separately only in much less adaptable insulating materials.

It has very high strength—tensile, compressive and flexural. It stands up to 440 degrees Fahrenheit for short periods, more heat than any previous laminated grade. It also stands arcing for longer periods.

As there is no cellulose in its composition, it resists fungus growth in the tropics. And moisture absorption is so low, and has so little effect on it, that its stability of dimensions and electrical characteristics is equally unusual.

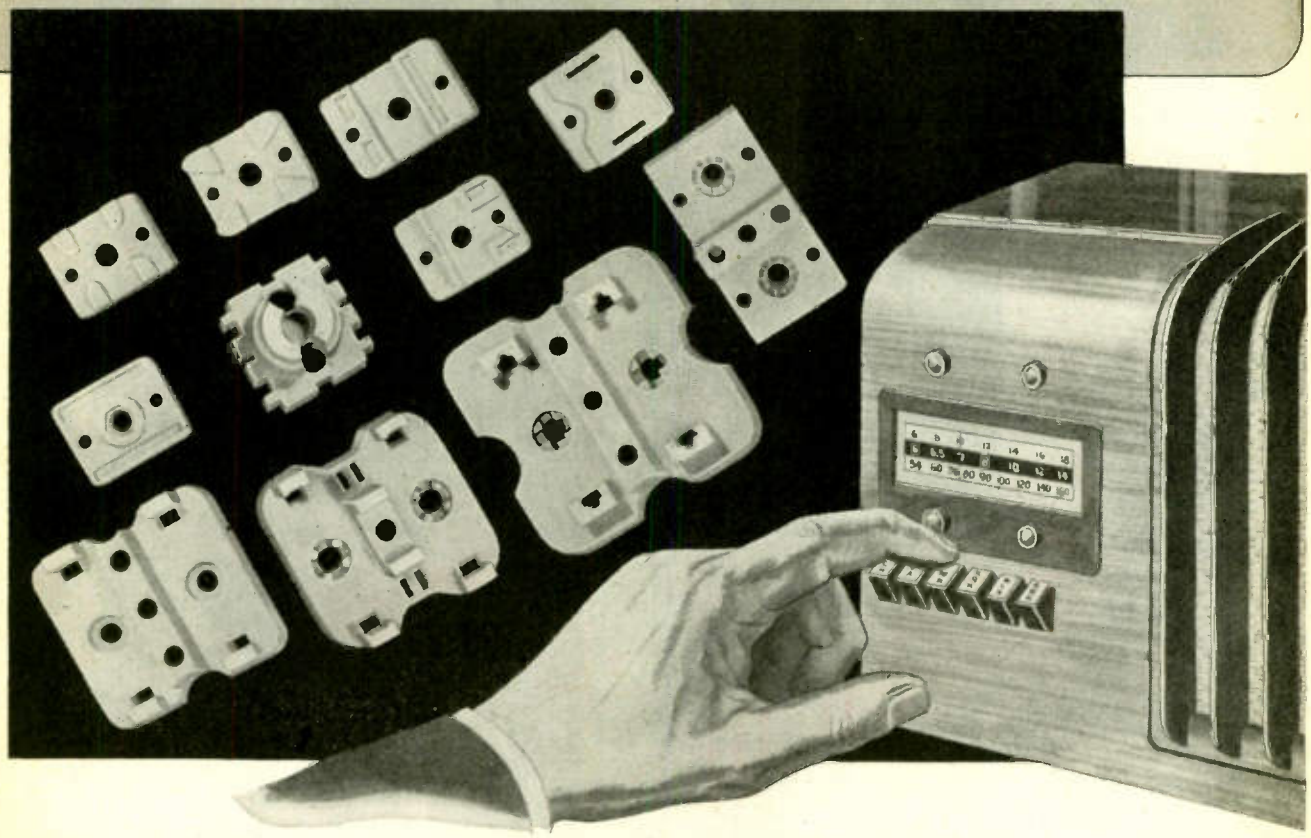
Other materials with glass fibre bases, and new and useful characteristics are also now available.

You will certainly find use for it. Remember the name, Formica FF-55!

Engineering test data is yours for the asking.

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

Behind Push Button Tuning . . .



STEATITE CONDENSER BASES
. . . strong—accurate—stable
by STUPAKOFF

STUPAKOFF steatite bases for padder and trimmer condensers provide stable insulation within the circuit—are precision built and withstand rapid assembly operations. They are made of fully vitrified, dense, hard and non-hygroscopic inorganic materials, resulting in low electrical losses and accurate tuning in complete assemblies. They go through riveting operations with little cracking or breaking, and once assembled, "stay put" because of their rigidity and permanence under changing conditions of atmosphere and temperature.

Dimensional accuracy—vitally important to rapid assembly lines—is obtained by absolute control over every factor in the Stupakoff method of manufacture. Precision is the watchword with Stupakoff—and precision on a mass production scale.

During the past twenty years Stupakoff has supplied hundreds of millions of ceramic parts to the radio industry. It is suggested that you bring your insulation problems to Stupakoff—specialists in developing insulators to satisfy the most exacting standards and requirements.

BUY MORE WAR BONDS

ARMY E NAVY "FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Products for the World of Electronics

MODERNIZE YOUR PRODUCT *at Low Cost*

WITH THESE INEXPENSIVE, HIGHLY ADAPTABLE SWITCHES

Up-to-the-minute switches add efficiency to the electrical product, that means greater sales appeal to the ultimate consumer. Stackpole line, slide, and rotary-action switches are highly adaptable to the individual needs of a wide variety of electrical equipment and cost but little. Eighteen standard units include 3-position types and 1-, 2-, 3-, and 4-pole switches with or without spring return, detent, covers and other optional features. Each can be adapted mechanically or electrically to meet a wide variety of specific requirements.

OTHER STACKPOLE PRODUCTS

Brushes and Contacts
Carbon Regulator Discs
Bearings—Pipe
Anodes and Electrodes
Packing, Piston and Seal Rings
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WRITE FOR ELECTRONIC COMPONENTS CATALOG
. . . for complete details on Stackpole Switches, also Fixed and Variable Resistors, and molded iron cores.

STACKPOLE CARBON COMPANY, St. Marys, Pa.

STACKPOLE

VOLTAGE STABILIZERS

(*Continued from page* 154)

per cent greater than the weight and volume of a standard unit.

Frequency compensation

The output voltage of most static voltage stabilizers varies as a function of the supply frequency unless special compensators are incorporated in the circuit. In the fundamental circuit being discussed, the output voltage percentage variation is approximately 1½ times the frequency percentage deviation and in the same direction. For example, a 5 per cent supply frequency increase results in an increase of 7½ per cent in the output voltage.

The application of standard automatic voltage stabilizers is continually expanding. In addition, it is hoped that the special circuits which have been developed may furnish solutions to application problems formerly considered impractical. Although the automatic voltage stabilizer cannot be considered a remedy for all stabilization problems, new and broadening applications are continually arising offering this type of device greater opportunities for useful service.

COAX CABLE PROTECTION

(*Continued from page* 95)

to withstand a factory test of 1000 volts ac between core conductors and sheath. The insulation of most of the smaller cables has now been approximately doubled, and is tested at 2000 volts.

In addition to the increased insulation, bare copper wires have sometimes been plowed in just above the cable by the cable laying plow. The shield wires are so spaced from the cable that a substantial portion of the current flows in them. It is expected that a stroke nearby will cause arcing between the shield wires and the cable. In all cases, however, the proportion of the stroke current carried on the cable sheath will be lower than without shield wires, and the likelihood of extensive cable damage will be less.

In Figure 3 is plotted a curve showing the approximate relationship between the maximum current in the stroke and the percentage of all strokes equal to, or exceeding, a given maximum current. Five points, A to E inclusive, at which lightning may cause breakdown on various types of cable are indicated on the curve. A soil of moderate resistivity is assumed. A full-size cable (2⅝ inches in diameter) with ordinary core insulation is represented at A. Breakdown of such cables will not

(*Continued on page* 162)

DO YOU NEED A CRYSTAL BALL ?

THERE are times in the lives of all good engineers when a crystal ball would come in mighty handy. We know because we've had many a problem where it looked like aid from the occult was the only solution. Instead, we found that sound engineering plus the outstanding physical properties of Corning's electrical glasses usually supplied the answers.

These same glass qualities are ready to help *you* produce better postwar electronic products. Which do you need?

1. High dielectric strength—high resistivity—low power factor—wide range of dielectric constants—low losses at all frequencies.

2. Permanent hermetic seals against gas, oil and water between glass and metal or glass and glass.

3. Commercial fabrication to the fine tolerances of precision metal working.

4. Corning's metallizing process produces metal areas of fixed and exact specification permanently bonded to glass.

* * *

Write us about your problems. We'd be interested in seeing if glass can help you. Address Electronic Sales Dept., 1-8, Bulb and Tubing Division, Corning Glass Works, Corning, N. Y.

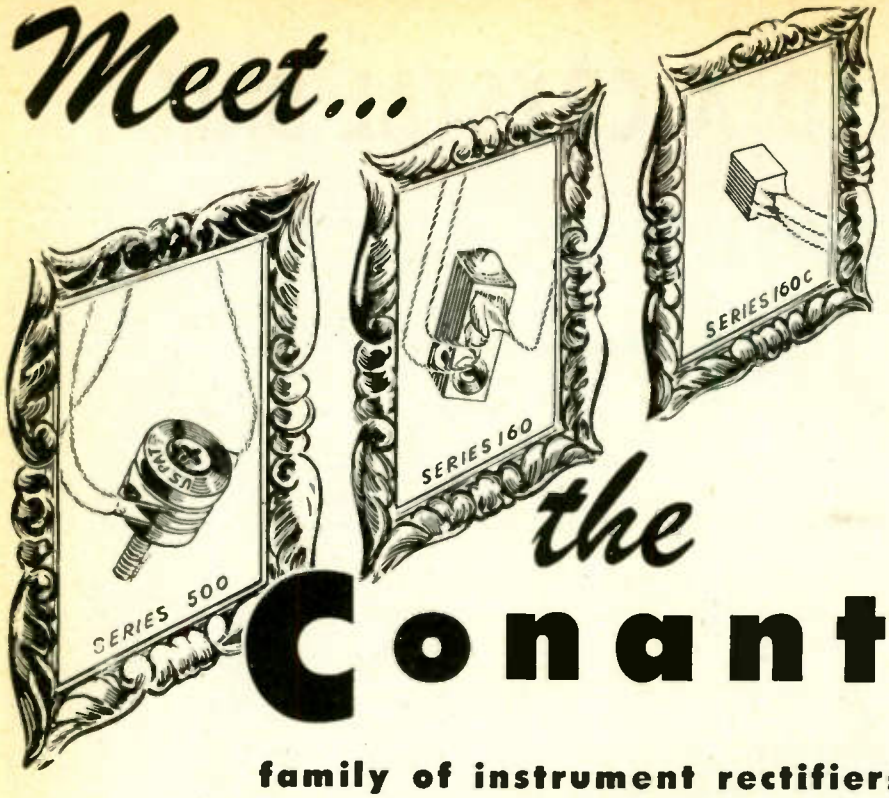
CORNING *means* Research in Glass

Electronic Glassware

REG. U.S. PAT. OFF. VYCOR CORNING PYREX

"PYREX", "VYCOR" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

Meet... the Conant



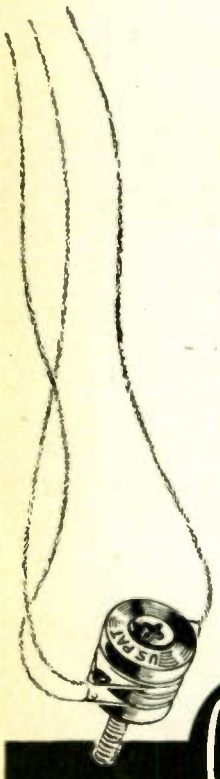
family of instrument rectifiers

It's a *distinguished* family, this Conant clan of instrument rectifiers. They have taken all the mystery out of the rectifier business.

Over ninety per cent of all rectifier requirements are served by 12 types—4 basic assemblies in 3 series. These 3 series are the three members of the Conant family shown above. Special types, however, can be developed as needed, and you'll find Conant ready to cooperate.

Conant rectifiers are available from stock for immediate delivery on priorities of AA5 or higher. MRO, CMP, V3 or MILITARY END USE classifications are recognized.

If you have no priority: File form WPB 547 for your stock requirements. You'll be glad to know this Conant family of rectifiers. They're doing a great wartime job.



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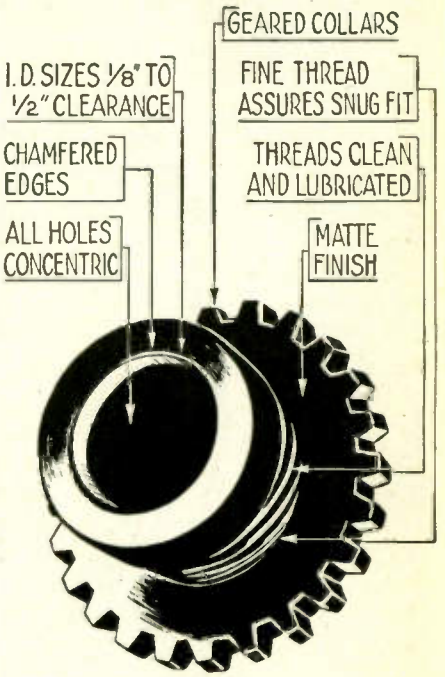

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Creative PLASTICS CORP.
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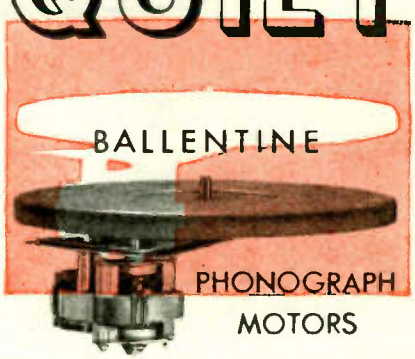
QUIET



In one expressive word you have the reason why so many phonographs will be powered by a BALLENTINE motor drive.

To the user, *quiet* means low background noise.

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BALLENTINE PHONOGRAPH MOTOR DRIVE

RUSSELL ELECTRIC CO., 306 W. HURON STREET, CHICAGO, ILLINOIS • MANUFACTURERS OF

COAX CABLE PROTECTION

(*Continued from page* 158)

occur with strokes of less than 50,000 amperes, and only about 20 per cent of all strokes are as large as this.

B is a 1½ inch cable with ordinary insulation. Strokes of 20,000 amperes or more will insure conductor-to-sheath breakdown in such cables, and currents of this magnitude occur in about 67 per cent of the strokes.

C is the same size cable as B, but with doubled core-sheath insulation. Breakdown in C will be caused only by strokes of 40,000 amperes or more, which occur only about 30 per cent of the time.

D is the same as C, but with two copper shield wires buried above the cable. Under these conditions, 80,000 amperes in the stroke are required to cause breakdown, and this current occurs only 7 per cent of the time. The shield wires carry about 50 per cent of the current of the stroke.

If it were practicable to increase sufficiently the insulation strength between the core and the sheath, taking into account both the insulation of the cable itself and that of various connections which must be made to it, failure of insulation from lightning strokes could be entirely prevented. The same result could be obtained by sufficiently increasing the conductance of the sheath.

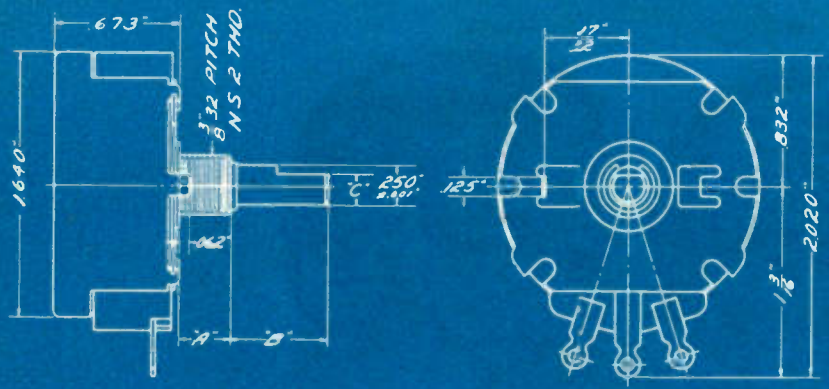
There are difficulties in increasing the strength of the insulation beyond a certain point, due mainly to the necessity of bringing conductors out of the sheath at intervals along the cable. By surrounding the sheath itself with a high-breakdown dielectric, however, and placing outside of this a copper jacket of moderately low resistance, it is feasible to exploit both means of approaching immunity from lightning damage. This method has the further advantage, as compared to shield-wires, of incorporating the protection in the cable structure itself.

A six-tube coaxial cable incorporating these features has recently been developed and is now being installed in the first section of the transcontinental coaxial system.* The copper jacket forms a low-resistance path over which the large lightning currents can flow, and the insulation—tested to 10,000 volts dc at the factory—prevents breakdown between jacket and sheath, and thus damage to the cable, even when the currents are large enough to develop very high potential difference between them.

The construction of this cable is evident from Figure 4. It carries six coaxial units with service pairs within the coaxial group and in the

(*Continued on page* 166)

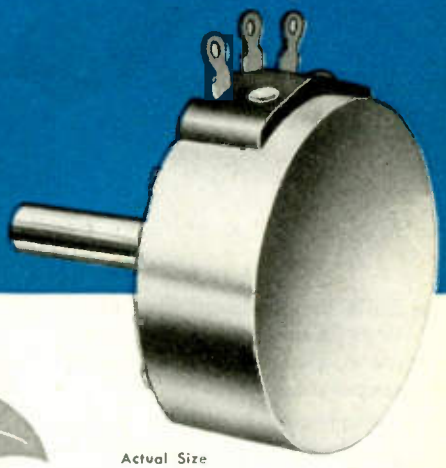
352 SERIES



GC-352 SERIES

SPACE REQUIREMENTS FOR 352 SERIES AND GC-352 SERIES

3 watt wire wound variable resistor



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☆ Throughout the world, experienced electronic engineers know that they can safely leave all worries and headaches about variable resistors to Chicago Telephone Supply Company.

They know from experience that an order placed with CTS means: –

- A variable resistor engineered for the application.
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VARIABLE RESISTORS • PLUGS AND JACKS
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"We heard voices over our shoulders!"

As we built up the family of INCO Nickel Alloys, it was as though voices of future users were telling us which properties to incorporate.

Almost *everybody*, it seemed, wanted strength, toughness, and hardness, combined with corrosion resistance. (*And, with Nickel as the base, this was easy.*)

Then, individual voices were heard asking for *specialized* properties, in addition to these *group* properties.

Different users wanted: . . . a metal with longer life at high heat . . . a corrosion-resistant metal, heat treatable to the strength and hardness of heat-treated steel . . . a high-strength, non-magnetic metal . . . a rustless, fatigue-resisting, spring metal . . . and, *even*, the paradoxical combination of hardness and toughness with high-speed machinability.

Today, all — *and more* — of these demands are being met with the INCO Nickel Alloys.

When selecting metals for "tough" jobs, do *you* get *all* the properties you need? Or is your choice usually a compromise? There's less need for compromises with the INCO Nickel Alloys available. *Just refer to the 8 different "property-combinations" they offer!*

PROPERTY	MONEL	"R" MONEL	"K" MONEL	"KR" MONEL	"S" MONEL	NICKEL	"Z" NICKEL	INCONEL
CORROSION RESISTANCE	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
STRENGTH	GOOD	GOOD	HIGH	HIGH	GOOD	GOOD	HIGH	GOOD
TOUGHNESS	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH	HIGH	HIGH
HARDNESS	GOOD	GOOD	GOOD	GOOD	HIGH	FAIR	HIGH	GOOD
MACHINABILITY	GOOD	HIGH	GOOD	HIGH	GOOD	GOOD	GOOD	GOOD
NON-GALLING	NO	NO	NO	NO	HIGH	NO	NO	NO
SPRING PROPERTIES	GOOD	NO	HIGH	NO	NO	GOOD	HIGH	HIGH
ELEC. CONDUCTIVITY	POOR	POOR	POOR	POOR	POOR	GOOD	GOOD	POOR
HEAT RESISTANCE	GOOD	GOOD	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH
HEAT TREATABLE	NO	NO	YES	YES	YES	NO	YES	NO
NON MAGNETIC	NO	NO	YES	YES	YES	NO	NO	YES

THE INTERNATIONAL NICKEL COMPANY, INC.
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MORE INFORMATION? — Tell us the alloy that interests you, and we'll mail more information. Or, send for "List B-100", listing over 100 bulletins which explain the properties and applications of the INCO Nickel Alloys.

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings . . . Welding Rods (Gas & Electric)

Here's the very heart of your post-war product!

When your new product gets into the consumer's hands, the battery that powers it can spell the difference between consumer satisfaction and disappointment. Ray-O-Vac Batteries are designed and built to deliver plus performance—extra capacity and dependability at lowest possible cost to the user. You take no chances when you specify Ray-O-Vac Batteries. Our engineers are at your service now.

For Dependable Power, Use

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OTHER FACTORIES AT CLINTON, MASS., LANCASTER, OHIO, SIOUX CITY, IOWA, FOND DU LAC, WIS., MILWAUKEE, WIS.

COAX CABLE PROTECTION

(*Continued from page* 162)

interstitial spaces immediately around them. Over this assembly is a wrapping of paper, and then a group of paper-insulated quads with another layer of paper surrounding it. The lead sheath is placed directly over this latter wrapping. Over the lead are two wrappings of thermoplastic material and a layer of tough cloth known as gray sheeting. Over this insulation is placed the copper jacket, which is 10 mils thick and is corrugated transversely to the length of the cable to give flexibility. An open cloth tape is wrapped over the copper. Each layer over the lead is flooded with a thermoplastic cement that remains soft after cooling. The outer cloth tape protects the copper in handling, and also reduces corrosion of the copper. It offers comparatively little resistance to the entrance of lightning current or to its leaking off along the length of the cable.

During early trials of cable buried directly in the ground, it was found necessary to protect the lead from damage both from handling and from gophers. One or two wrappings of steel tape have been used for this purpose. Tests indicate that the corrugated copper jacket of the new cable will give essentially as good protection in the steel cable.

There has not been time as yet to determine from experience and field tests the position of the new lightning-protected cable on the curve, of Fig. 3, but theoretical studies and limited tests indicate that it would in practically all cases be above the range of strokes thus far observed—E on Figure 3. Only an exceptionally heavy stroke to a cable in soil of very high resistivity would cause damage. This added security for coaxial cables is particularly interesting at this time because of their probable uses for television networks after the war.

*Bell Telephone Laboratories Record, December 1944, page 619.

METEORS & VHF BURSTS

(*Continued from page* 113)

pendicular may be dropped from a point on the surface of the earth to some point on the meteor's trail is of the order of one-third to one-half of the total number of meteors passing through the same region." From this, and from a limited number of observations he appears to favor the theory that a single meteoric train may be the cause of an FM burst.

However debatable the matter of tracing FM bursts to single meteors may appear, there seems to be little question that meteors in general

(*Continued on page* 170)

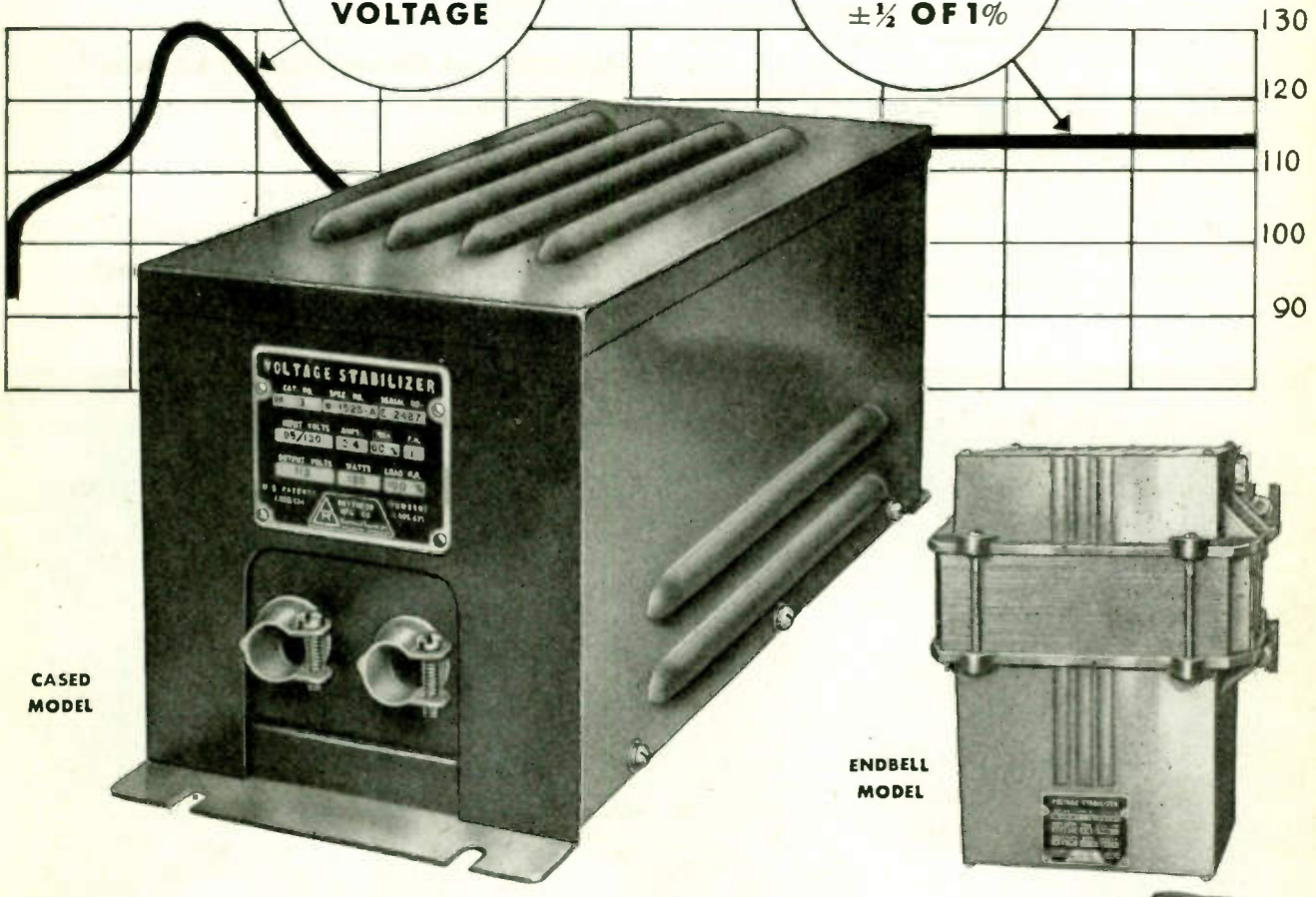
RAYTHEON VOLTAGE STABILIZERS

REGULATE

VARYING INPUT VOLTAGE

TO

CONSTANT OUTPUT VOLTAGE ±½ OF 1%

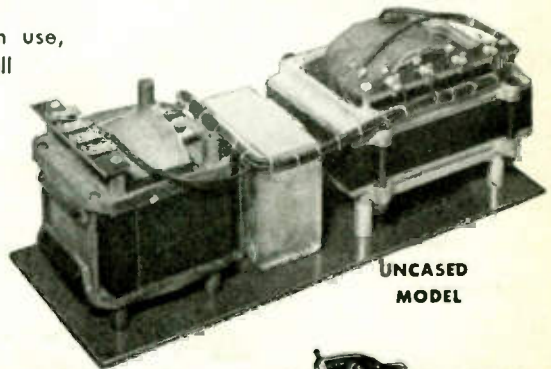


CASED MODEL

ENDBELL MODEL

Built into new products or installed into equipment already in use, Raytheon Voltage Stabilizers assure more accurate operation of all types of electrical equipment. Note these Raytheon performance features—stabilizes output voltage to ±½ of 1% . . . stabilizes the varying input voltage within 2 cycles... stabilizes input voltages from 95 to 130 volts or 190 to 260 volts.

Raytheon Voltage Stabilizers are entirely automatic in operation. They have no moving parts . . . nothing to wear out. Available in three styles, cased, uncased and endbell, to meet most application requirements. Write for bulletin DL 48-537. It gives performance curves, technical data and complete information.



UNCASED MODEL

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

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190 WILLOW STREET, WALTHAM, MASS.

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

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

2608 OPPORTUNITIES to mak

● There are 2608 G-E capacitor ratings now being applied in all fields where capacitors are used. We believe you will find that the long life and dependability of these components will add extra reliability to *your* equipment—giving you, over a period of years, substantial savings in replacement costs and servicing. In addition, many equipment manufacturers have found that use of G-E capacitors often appreciably reduces the size, cost, and weight of their product.

The high quality of these units has been made possible by new processing techniques, together with improvements in hermetic sealing, bushing construction, and G-E developments in dielectric materials such as Pyranol, lectronol, lectrofilm, and extra-thin kraft paper.

Here are some of the more important items in this ever-widening line that it will pay you to investigate.

CAPACITORS FOR D-C APPLICATIONS

Fixed paper-dielectric capacitors, hermetically sealed in metallic containers, built in accordance with the Proposed Joint Army-Navy Spec. JAN-C-25. All units can be obtained in either Pyranol (Characteristic F) or mineral-oil (Characteristic E) types. CP-50 to 55 in single-, dual-, or triple-section units; CP-60 to 65 in single- or dual-section units with conventional or glass terminal seals; CP-70, all listed ratings, with or without removable mounting brackets.

Ask for Bulletins GEA-4357 and GEA-4424

CAPACITORS FOR NORMAL-FREQUENCY A-C CIRCUITS

Motor capacitors in rectangular or cylindrical cases

Ballast capacitors for use in high-power-factor ballasts for fluorescent lamps

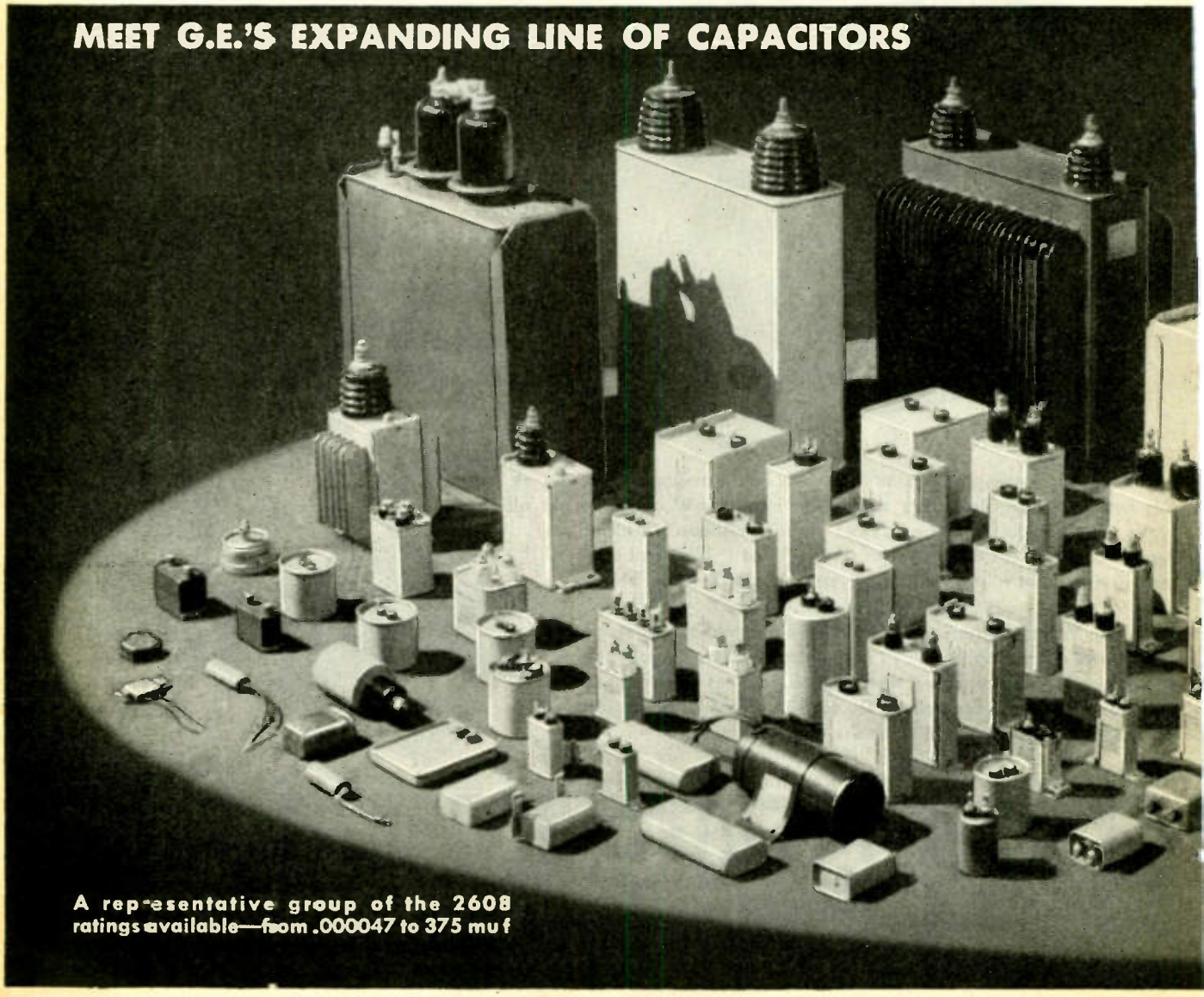
Capacitors for ignition transformers or other specialty transformer applications

Ask for Bulletin GEA-2027

CAPACITORS FOR HIGH-FREQUENCY APPLICATIONS

Lectrofilm capacitors for radio-frequency blocking

MEET G.E.'S EXPANDING LINE OF CAPACITORS



A representative group of the 2608 ratings available—from .000047 to 375 muf

long-range savings

and by-pass applications, in Case-60, -65, and -70 types

Ask for Bulletin GEA-4295

Parallel-plate capacitors for resonant circuits of high-frequency induction heaters or other electronic oscillators

Ask for Bulletin GEA-4365

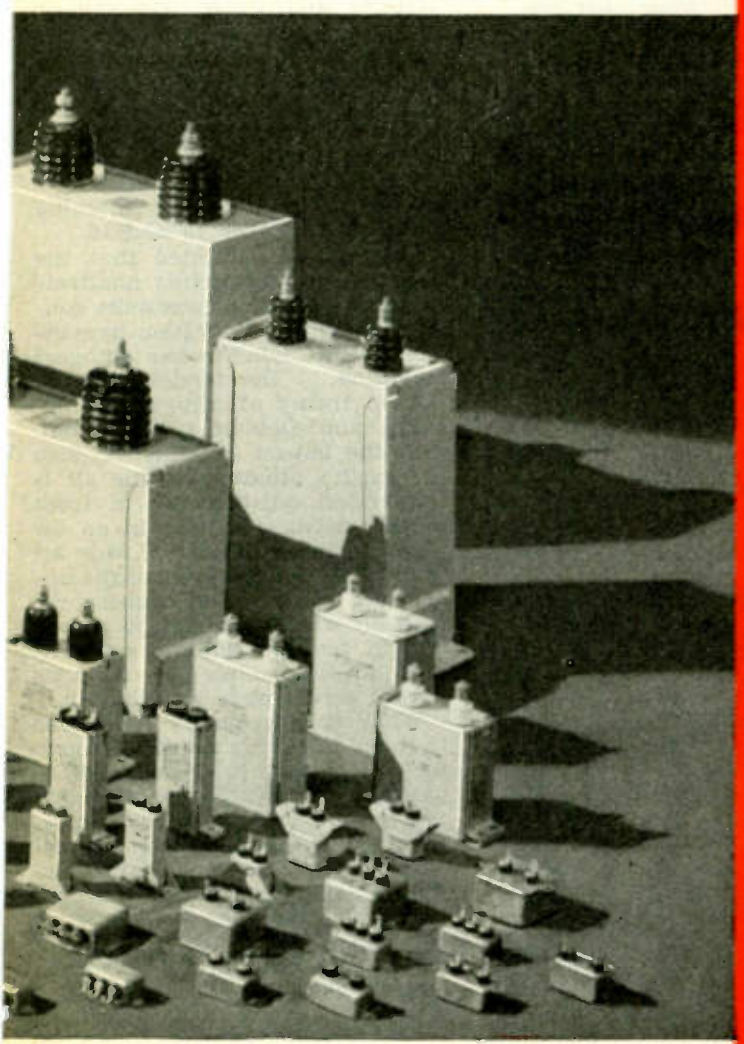
Paper-dielectric capacitors for grid and plate blocking and by-pass service in electronic oscillators

Ask for Bulletin GEA-4388

Capacitors for high-voltage networks, flash photography, discharge welding, impulse generators, and other energy-storage applications.

Data on request

For complete descriptive and application information, ask for the bulletins indicated. Where a bulletin is not listed, if you will let us know of your problem or requirements, we shall be glad to supply the data you need. *General Electric Co., Schenectady 5, N. Y.*

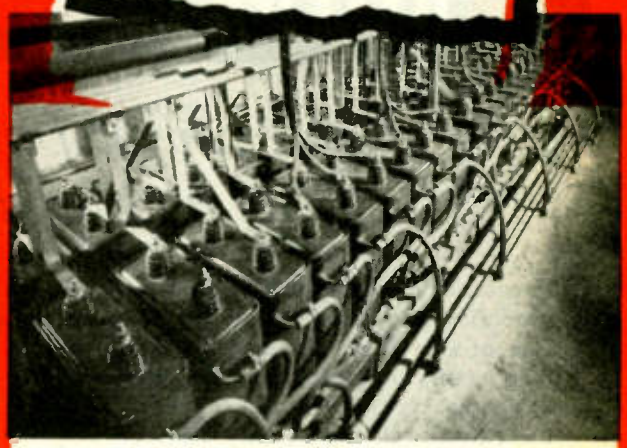


Here's the kind of help we can give you on your new circuits

Extracted from "Induction Heating—A History of Its Development," by Frank T. Chesnut, Ajax Electrothermic Corp., *Iron Age*, March 22, 1945.

The first capacitors were hand made, with sheets of brass and photographic glass plates alternately stacked and immersed in an oil bath. The capacity of the units necessarily was low, and the dielectric so poor that breakdown was the rule. A furnace would operate for a period of from seconds to half an hour, when the capacitors would fail.

Dr. Northrup finally appealed to the General Electric Co. to make him a high frequency power capacitor. The early co-operation of General Electric Co., especially in respect to these capacitors, made induction heating possible from a practical standpoint. Although good capacitors are now being made by others, it can be said fairly that the General Electric Co. has consistently led the world. Capacitor units of 300 kva. are now no larger than 1/3 cu. ft. volume.



"Made induction heating practical"—This bank of G-E water-cooled capacitors is used with two Ajax-Northrup induction-type steel furnaces in a Western metals plant.

GENERAL ELECTRIC

CAPACITORS

for built-in applications

METEORS & VHF BURSTS

(*Continued from page* 166)

are responsible for a considerable portion of the ionization at E layer levels; and that this meteor effect may be accentuated in the early morning hours when radio transmission paths are located on the front side of the moving earth, and therefore the incoming meteors meet the atmosphere head on with the added velocity of the earth's orbital motion of 30 kilometers per second.

An examination of the various sources of ionization of the upper atmosphere shows that meteoric showers contribute approximately 7 per cent of the ionizing energy received by the earth from all known sources. These, according to various authorities, have been listed by Skellet and are shown on page 112. These ionization energies in log-micro-ergs per centimeter per second, are exhibited in the accompanying graph (Fig. 2).

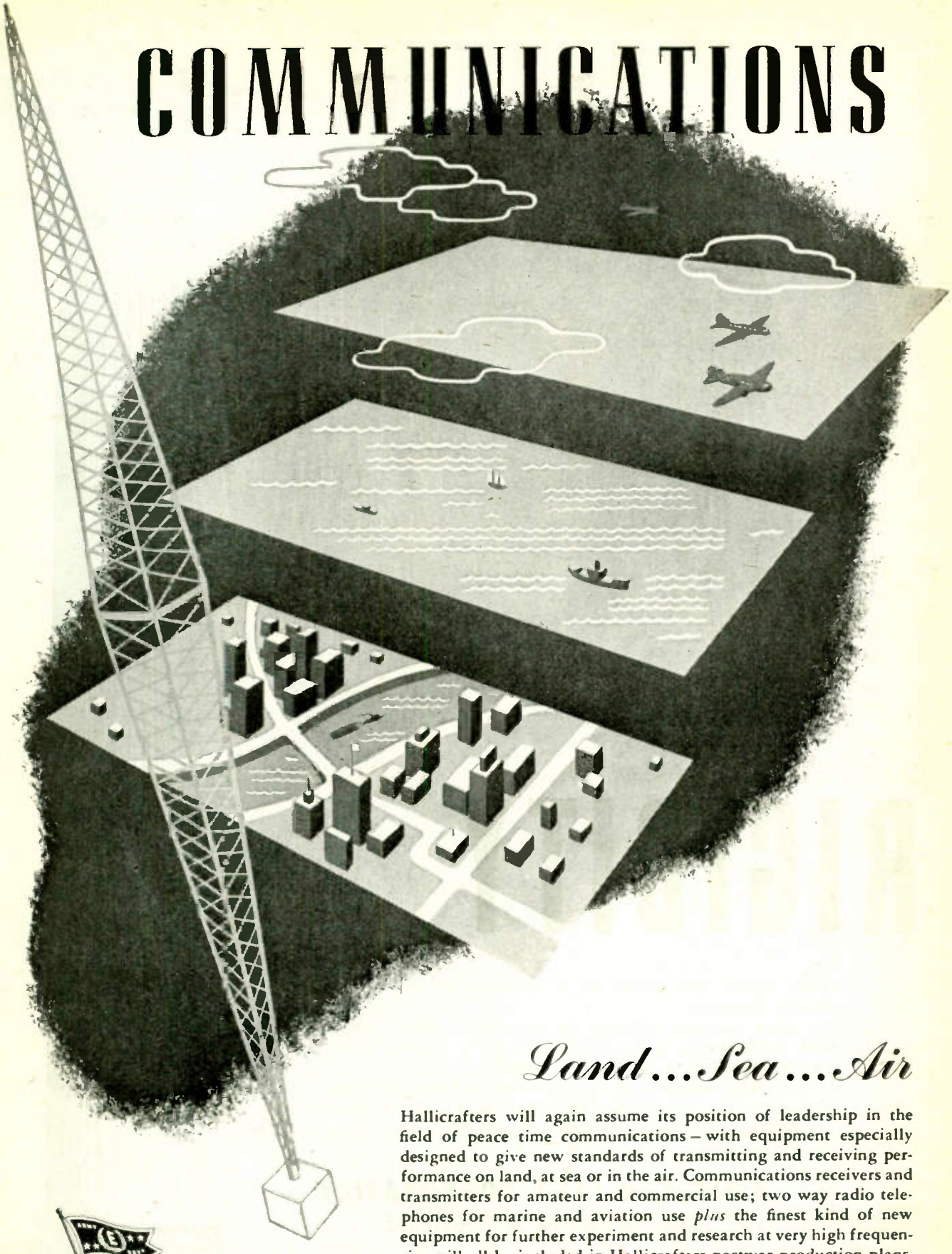
A few years ago J. N. Bhar of Calcutta University in a paper on "Meteors and Upper Atmospheric Ionization"[3] showed from some special ionospheric measurements that the ionization effect of meteors was confined chiefly to the E layer region, and he found that the ionization increased enormously during the Leonid meteoric shower of 1936, especially in the early morning hours of November 15 and 16.

Observations indicated that the F_2 region was apparently unaffected. This latter fact was quite consistent with the ionization hypothesis accompanying meteoric impact according to the Lindemann and Dobson theory of meteors. Lindemann and Dobson suppose that, with the impact of a meteor with the earth's atmosphere, the air is compressed adiabatically in front of the meteor resulting in an air "cap." The encounter of this air "cap" with the molecules of the upper air ionizes the atmosphere through which the meteor passes, and in the end imparts sufficient heat to the meteor to cause its partial or complete vaporization.

While it is generally considered that the meteor is rushing through un-ionized air, it should not be overlooked that a degree of ionization already exists in the atmospheric layer through which the meteor passes. In Lindemann and Dobson's theory significant ionization of gas molecules would not occur until the meteor reaches E layer levels, the height at which meteor trails in general have been observed to start. The sharp increase in E critical frequencies observed by Bhar during the meteoric showers of November 14 to 16 in 1936 is shown in Fig. 3.

(*Continued on page* 174)

COMMUNICATIONS



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Hallicrafters will again assume its position of leadership in the field of peace time communications – with equipment especially designed to give new standards of transmitting and receiving performance on land, at sea or in the air. Communications receivers and transmitters for amateur and commercial use; two way radio telephones for marine and aviation use *plus* the finest kind of new equipment for further experiment and research at very high frequencies will all be included in Hallicrafters postwar production plans.

BUY A WAR BOND TODAY!

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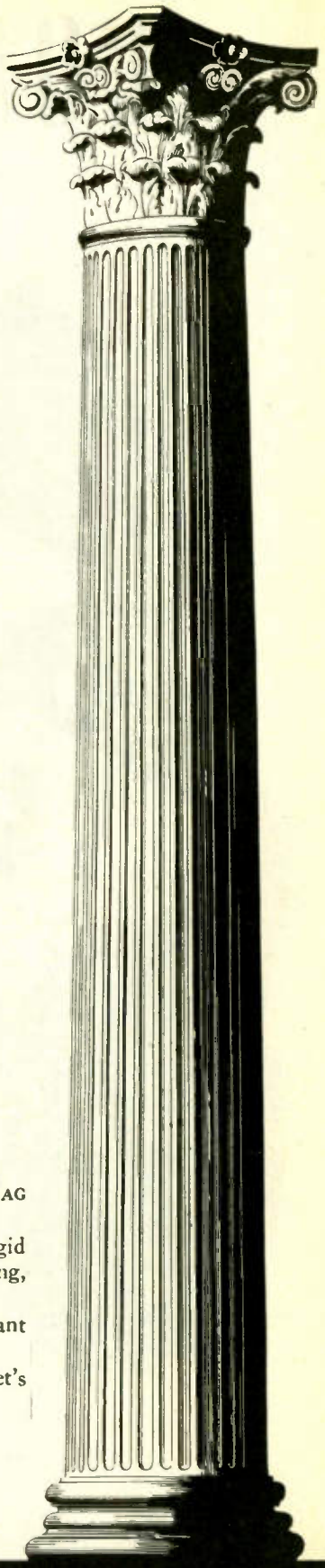
THE HALLICRAFTERS CO., WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT, CHICAGO 16, U. S. A.



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Rigid support and permanence of alignment are provided by ALSIMAG Steatite Ceramics.

These inorganic materials are mechanically strong, permanently rigid and are electrically stable at high frequencies. Do not distort by loading, nor do they shrink or coldflow with time.

ALSIMAG Ceramics are highly resistant to thermal shock and to constant temperatures up to 1000°C. Non-corrodible. Do not absorb moisture.

ALSIMAG Ceramics are a dependable foundation for your design. Let's work together.

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STEATITE CERAMICS

High Mechanical Strength • Permanent Rigidity
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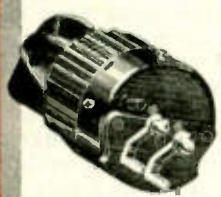
Resistant to High Temperatures
Will Not Absorb Moisture
Precision Made of Purest Raw Materials

43RD YEAR OF CERAMIC LEADERSHIP

YOUR CHECK LIST OF NEW IRC PRODUCTS

To a line of resistors already broader than that of any other manufacturer in the entire resistor industry, IRC has, in the last few months, announced several new and important contributions. Among the newer developments having wide-spread application in the electronics field are the components here briefly reviewed. All of these products are available in reasonable quantities except the Type BTR Resistor, which is still wholly allocated to a special war project. However, samples of this unit are available and will be gladly sent for test or experimental purposes. Your inquiries will receive prompt and welcome attention.

TYPE PRT POWER RHEOSTAT



Rugged yet light in weight and of neat appearance the PRT conforms fully with AN3155 specs. Has heavy screw type terminals at rear of enclosed all-metal housing. Available in 25 and 50 watt models.

TYPE BTA 1 WATT METALLIZED INSULATED RESISTOR

Pencil-thin, less than ¾" in length and conservatively rated at one watt the BTA is a quality resistor throughout and meets RC30 specs. Low in operating temperature it has proportionately high wattage dissipation.

TYPE BTR ⅓ WATT METALLIZED INSULATED RESISTOR

Scarcely bigger than a bump on a wire (L. 13/32"-Dia. 3/32") the BTR ⅓-watt resistor has all the quality characteristics and features that have long made IRC's BT line "Preferred for Performance." Suitable for Army-Navy RC 10 applications. *Available postwar.*

TYPE FRW FLAT WIRE WOUND RESISTOR

Efficient as a tubular wire wound, the type FRW has many features that recommend it for limited space use. In 5 standard sizes to comply with JAN-R-26, specs for RW 20, RW 21, RW 22, RW 24 requirements.

TYPE GRW GRADE 1-CLASS 1 RESISTOR

Thoroughly dependable and of sound construction these completely sealed units meet or surpass every requirement of JAN-R-26 specs. Made in 7 standard sizes with power ratings of 15 to 140 watts and resistance ranges of 0.1 to 63,000 ohms.

FINGERTIP CONTROL

No bigger round than a nickel and wafer-thin, this control will find many useful applications in the smaller electronic devices. All-inclusive design eliminates the usual knob, shaft and bushing without impairing functional operation.

For more complete, technical information on any of the above IRC products write to Dept. 2-H

INTERNATIONAL RESISTANCE CO.

401 N. BROAD STREET · PHILADELPHIA 8, PA.

* PREFERRED FOR PERFORMANCE * IRC FIXED & VARIABLE RESISTORS

IRC makes more types of resistance units, in more shapes, for more applications, than any other manufacturer in the world.

METEORS & VHF BURSTS

(*Continued from page* 170)

The effect of meteoric showers on the reception of broadcasting frequencies was studied by G. W. Pickard during the years 1926 to 1930. A statistical investigation of the relative field intensities of WBBM (770 kc.) as received in Boston for two months before to two months after two major meteoric showers—the Leonids in November, and the Perseids in August—revealed the results exhibited in Fig. 4.

Mr. Pickard also relates that on one occasion, August 9, 1921, while listening to the French station LY, at Bordeaux, he noted an exceptionally bright meteor, presumably of the Perseids shower, coincident with a sharp hiss in the earphones of a duration which coincided as nearly as could be judged with the beginning and the end of the meteor trail.

In conclusion, it would appear that there is little doubt of meteors, particularly meteoric showers, contributing to the ionization of the E region. It would seem more probable that such radio effects as may be produced would be more of the nature of static than of such a nature as to produce clear interferences of distant stations at high frequencies, though this possibility should not be ruled out. The accumulation of irregular patches of ions at E layer level diffused over a considerable area may be a cause of sporadic E. Meteors may well play their part in the production of these conditions. The shower of Perseids which Pickard found of significance in augmenting E layer reception in the broadcasting band may offer another opportunity this year for a careful analysis of the high frequency records which are now rapidly accumulating.

A list of the principal meteoric showers, their duration, and dates of occurrencies is appended for the convenience of those who may be interested.

1—Electronics, January 1945.
2—Proceedings, IRE, July, 1938.
3—Indian Journal of Physics, May, 1937.

WIDE READING

(*Continued from page* 115)

The experimentally determined curves in Figure 2 illustrate the performance of the circuit without capacitors C_3 and C_7 when input terminals A and E are used. Similar results are obtained for terminals A and B. By varying capacitors C_2 and C_3, the frequency at which the increase starts may be selected.

A reduction of the bass or treble frequencies may be obtained by the addition of capacitors C_5 and C_7.

(*Continued on page* 178)

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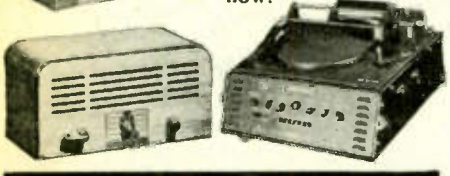

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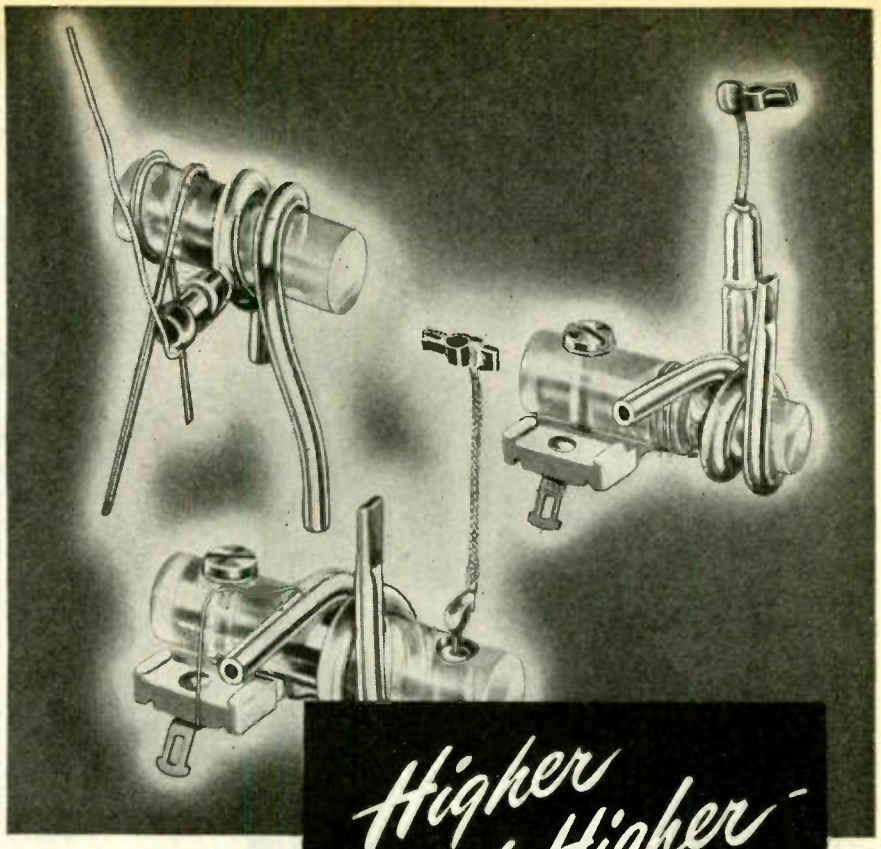

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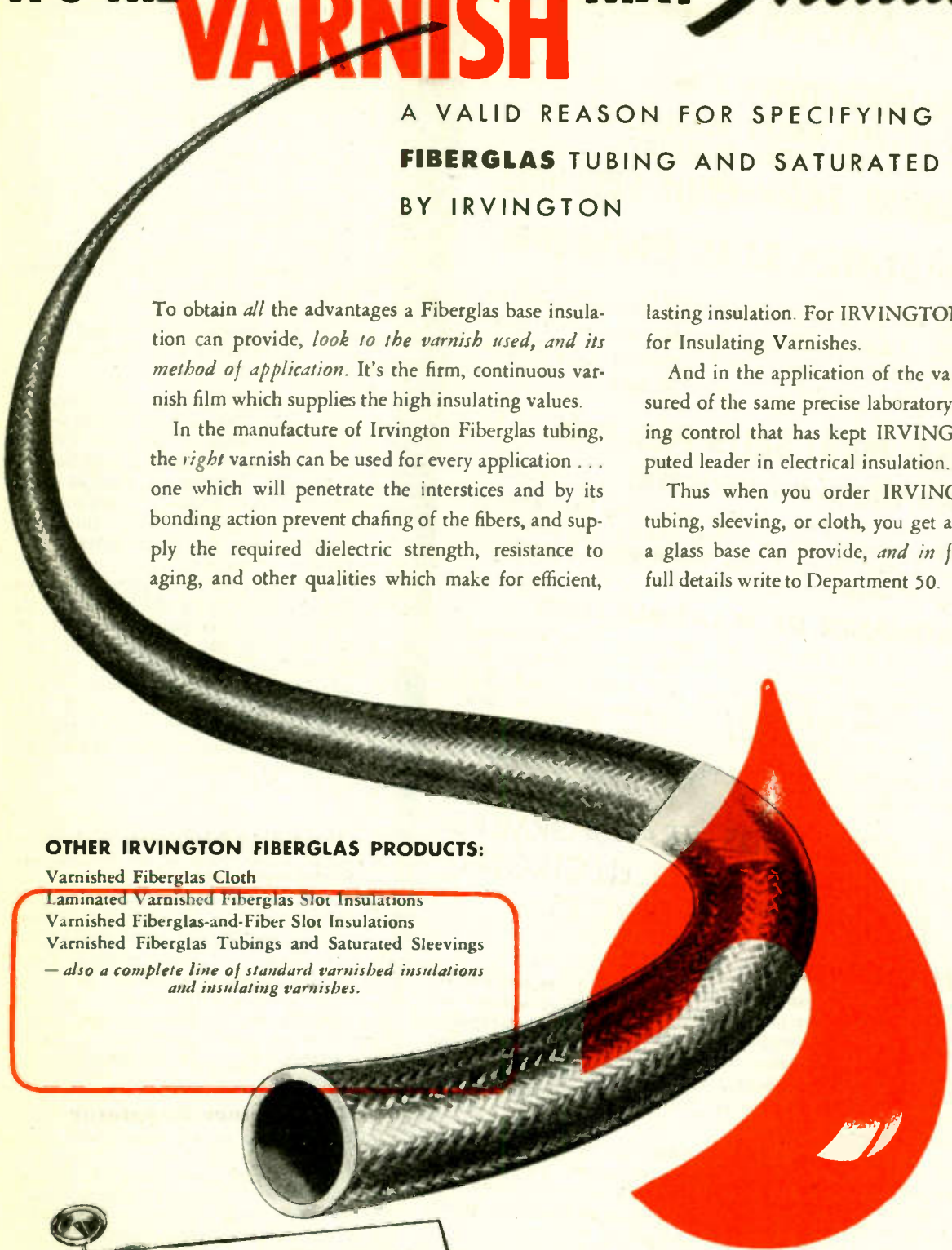

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WIDE READING

(*Continued from page* 174)

C_5 acts as a partial bypass at the high frequencies and C_7 as a partial block to the low frequencies. The new frequency-response characteristics are shown in Figure 3.

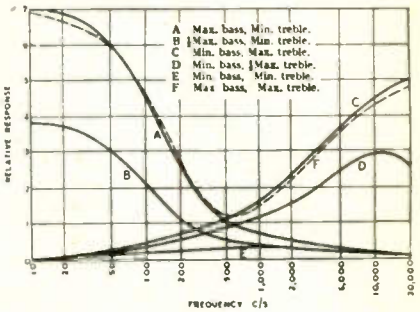


Fig. 3—Performance of tone control circuit of Fig. 1 including capacitors C_5 and C_7

The tone control unit can be modified to be used as a tone-compensated volume control as well as for tone control by the addition of a variable resistor in parallel with R_1. Variation of this resistance will not affect the input to the tone control unit but will control the voltage across R_{12}.

It is suggested to substitute two heptodes (such as 6L7's) for the V_2 tube and to control the tone by varying the dc potential on the third grids. This circuit is readily adaptable to remote control. Another alternative is to feed the three outputs from tubes V_1 and V_2 into three separate audio frequency amplifiers connected to three loud speakers.

Glass For Electron Tubes

M. C. Steiner (Bulletin of the American Ceramic Society, February 15, 1945).

The most important properties of glass used for electron tubes are its sealing properties to metal, its expansion with heat, and its electric resistance. A survey of glass types particularly suitable for this purpose and of their special properties are given; particularly, glass-to-metal seals are discussed.

Arc Furnace Regulator

R. A. Geiselman and J. E. Reilley (Steel, March 19, 1945)

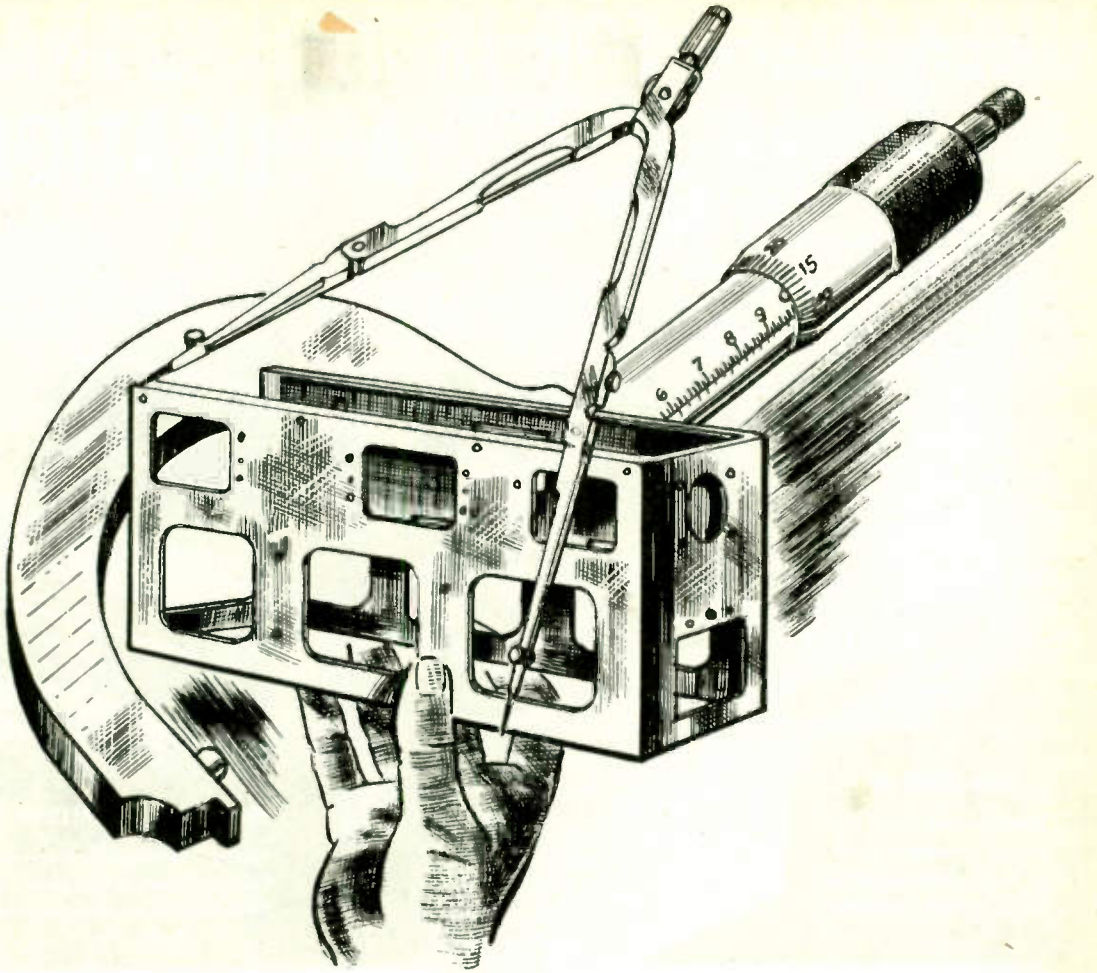
A tube circuit is used to control the movement of the electrode motors. Electrode current and voltage are made to both influence the lowering and raising, respectively, of the furnace electrodes.

Solids in HF Rotating Fields

A. Hartmann and W. Stuermer (Naturwissenschaften, Berlin, 1943, p. 206)

According to computations by Debye, a moment of force is exert-

(*Continued on page* 182)



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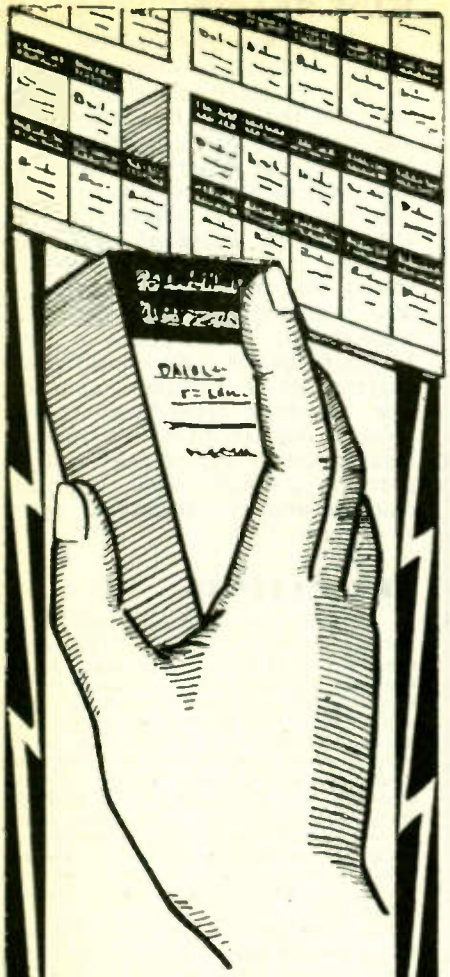

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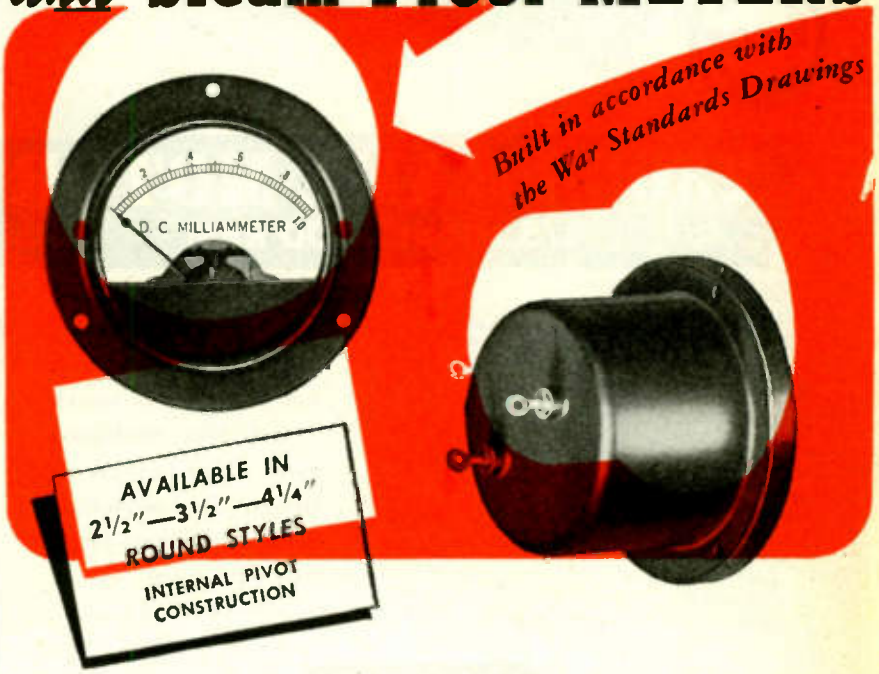

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WIDE READING

(*Continued from page* 178)

ed on a material in a rotating high-frequency electromagnetic field, provided the field frequency is of the order of the dispersion frequency of the material. The effect has been established for liquids.

In the course of investigations on the dielectric losses of solids, the rotating force predicted by the theory was proved experimentally. The measurements were made at wavelengths in the range of from 1.2 to 5 meters. By continuously varying the transmitter frequency, the frequency dependence of the rotating force could be investigated. Measurements were carried out on paraffin, p - nitrophenol, p - nitrochlor-benzene, and several other substances.

NEW PATENTS

(*Continued from page* 116)

The self-balancing system comprises the metallic reed M driven mechanically by an audio oscillator. If the potential of the balancing plate P′ is adjusted to equal that of the plate P, vibration of the reed will not affect the reed potential, if the two capacitor plates P and P′ are at different potentials, the potential of the vibrating reed M will fluctuate. Thus the vibrating reed acts as a converter, giving an alternating voltage output which can easily be amplified and which is proportional to the difference of the direct current potentials of the two capacitor plates P and P′.

To obtain automatic operation, the output of the amplifier and the output of the audio oscillator are combined in a differential rectifier circuit and a smoothing filter which will provide a direct current depending on the amplifier output and, consequently, on the potential difference between plates P and P′. It will fall to zero as the variable balancing voltage across R_2 is made equal to that produced by the flow of the crystal-generated current through resistor R_1. A suitably calibrated current meter X as well as the resistor R_2 are traversed by this direct current.

As a vertical velocity of 10 feet per minute is to be indicated and the crystal pile F is designed to develop a charge at a rate of one micromicrocoulomb per second under that condition, a voltage of 100 microvolts on the plate P must be indicated; to balance this, a current of one microampere must flow in the balancing plate resistor R_2. For sufficient accuracy of balance at this rate of climb, the amplifier must have sufficient gain to give considerable output for a potential difference between the plates P and P′ of less than 100 microvolts. This is best achieved by tuning the amplifier to the vibrating frequency of the reed M. A differential detector output of one milliampere, resulting from a converter difference of 100 microvolts, would permit a reading of 5,000 feet per minute to be exact to 5 feet per minute.

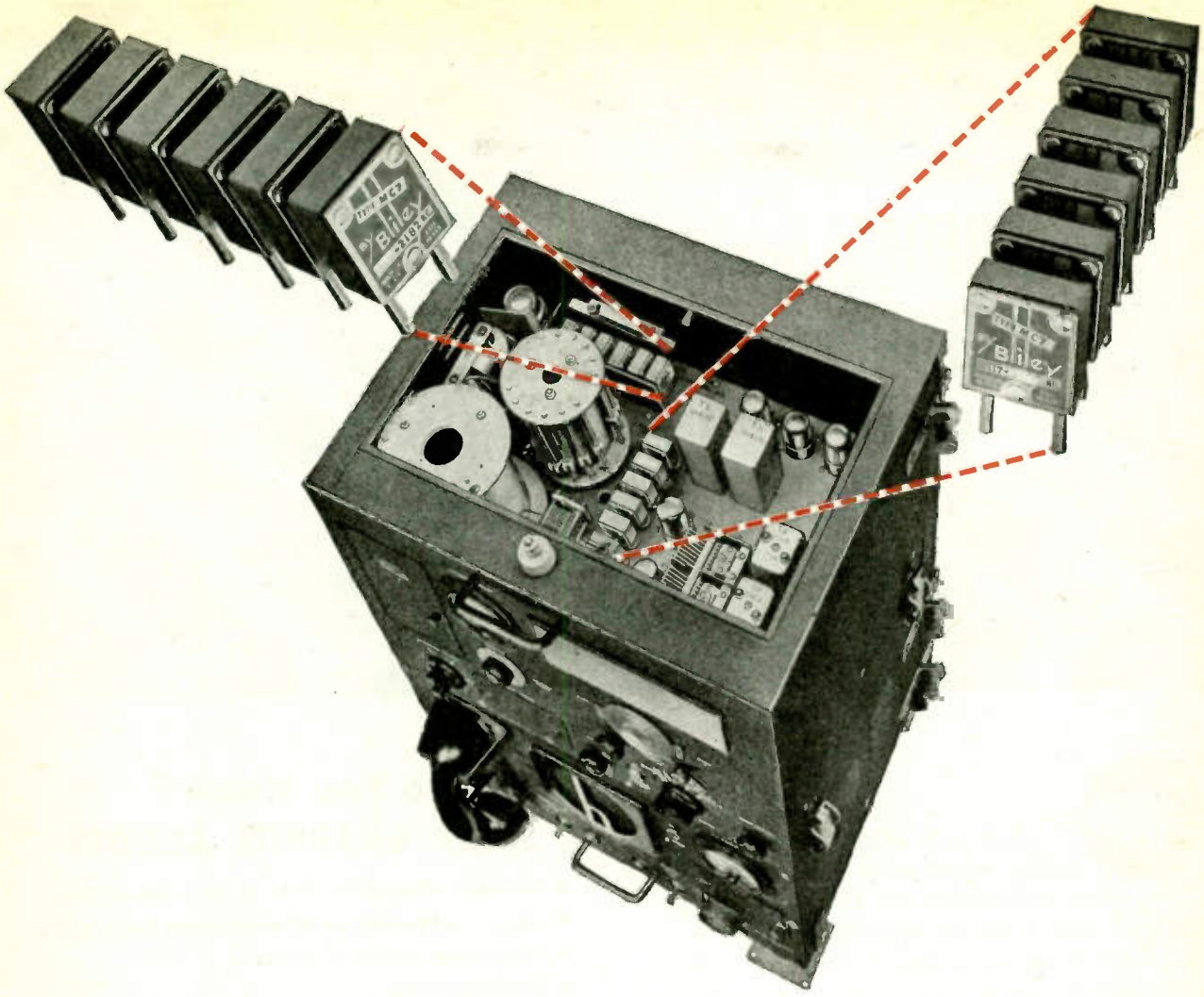
This being a self-balancing circuit, the gain of the amplifier-rectifier-filter system and the vibration amplitude of the reed have negligible effect on the accuracy of the indication.

D. G. C. Luck, RCA, (F) May 30, 1942, (I) February 20, 1945, No. 2,369,788.

Mass Spectrometry

In a mass spectrometer the relative concentrations of ions derived from a sample are recorded. According to the invention high recording speeds are attainable by making possible the use of an alternating current amplifier instead of a direct current amplifier for the ion current output. For this purpose it is necessary to produce

(*Continued on page* 186)



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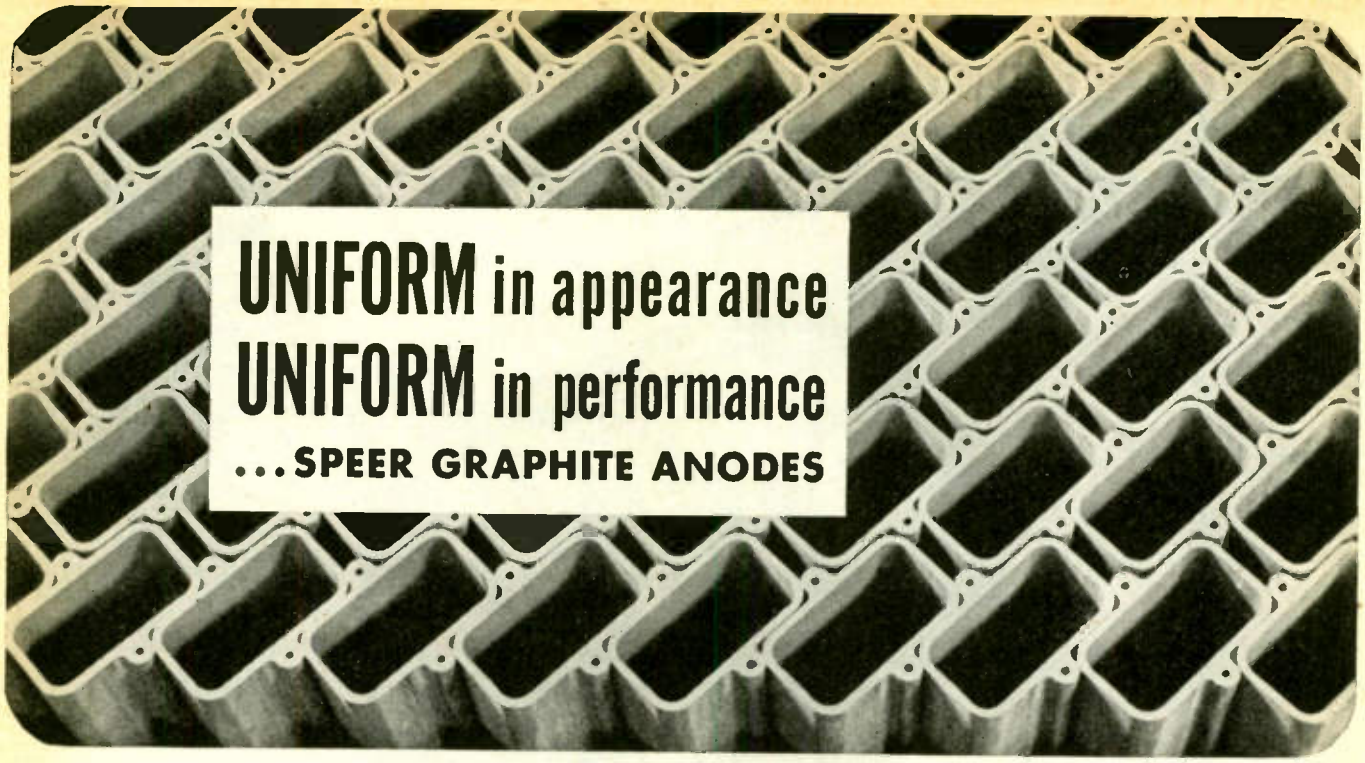

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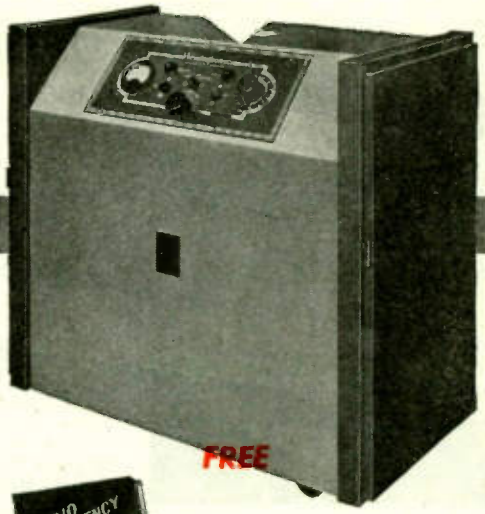

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Westinghouse

Electronic Tubes

NEW PATENTS

(*Continued from page* 182)

a varying-intensity ion beam for each charge-to-mass component. This is accomplished by varying the intensity of the bombarding electron beam which then causes a varying-intensity ion beam to be generated. The varying-intensity ion beam is split into its equal charge-to-mass ratio components by conventional apparatus and variable-intensity ion beams of constant charge-to-mass ratio are obtained as was intended.

R. V. Langmuir, Consolidated Engineering Corp., (F) September 11, 1939, (I) March 6, 1945, No. 2,370,673.

MAGNETIC POWDERS

(*Continued from page* 89)

ties in chemical forms which make such separation difficult. As a consequence they are not suitable for electrical work.

The effective permeability of cores made with these granulations varies from 2.8 for the 40 x 70 down to approximately 2.4 for the air-floated variety. The Q value for a particular test coil varied from 70 to 130 over the same range of particle sizes. By virtue of the simplicity of its manufacture, purified magnetite powder has definite possession of the low cost field. This renders it particularly important for the larger cores.

Electrolytic powders are made by the deposition of iron on a cathode consisting of a stainless steel plate. The plated coating is stripped off when it has attained a thickness of 1/32nd to 1/16th in. The resulting sheet, containing a good deal of hydrogen, is quite brittle and can readily be crushed and milled to obtain the desired sizes of powder particles. As is well known, the effect of this added hydrogen, called hydrogen embrittlement in plating technic, can be removed by heating to drive off the hydrogen.

As might be expected, the iron particles produced by this process are of an exceedingly high purity, containing not over .002 per cent carbon and 99.95 + per cent Fe, although after grinding and exposure the purity is reduced to 98-99 per cent. The particles tend to be flat like graphite particles. When mixed with a binder, of course, the flat side of these particles is disposed in a random manner. If some means could be found for lining them up properly with respect to the direction of the flux through the finished core, some interesting low loss results should be obtainable. After grinding, the powder is annealed to make it more compactable. Its resistivity is possibly low.

Electrolytic iron can be obtained ground to any desired mesh size. However, since 325-400 mesh screens are about the smallest commercially obtainable and even these tend to clog badly with soft pow-

(*Continued on page* 190)

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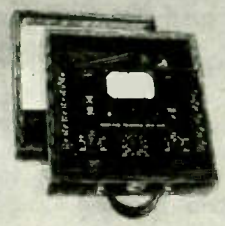

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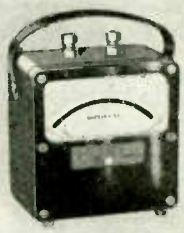

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PORTABLE POWER PROBLEMS

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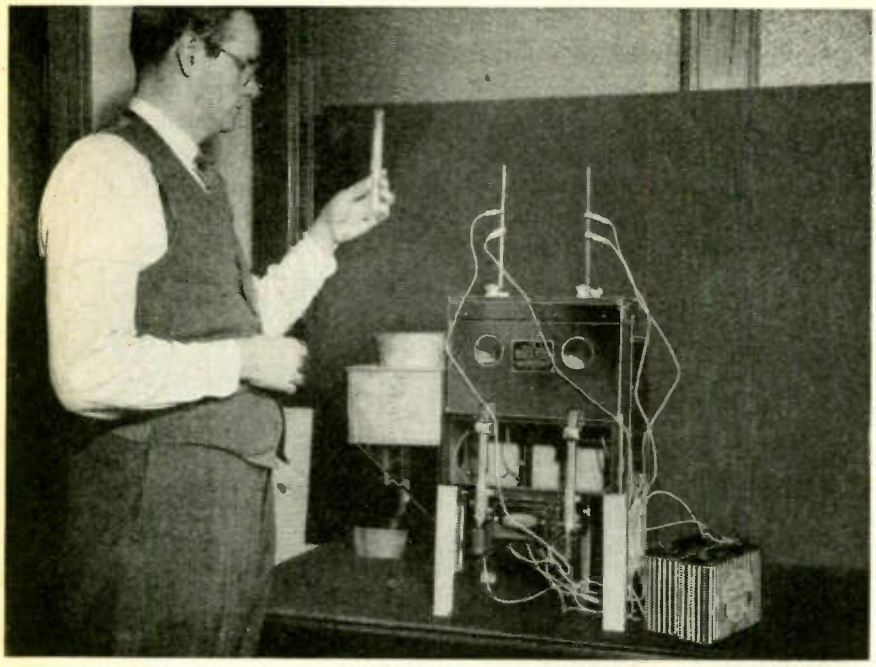

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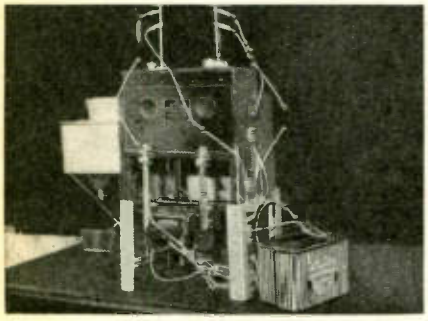

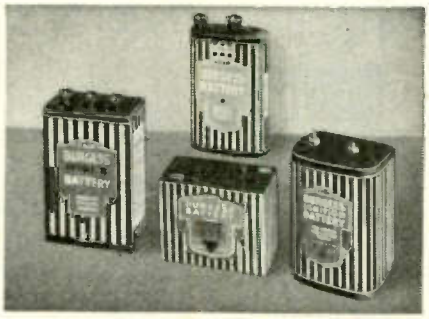

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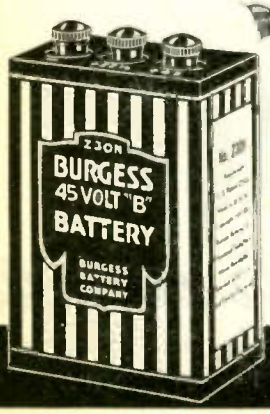

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MAGNETIC POWDERS

(*Continued from page* 186)

ders, finer particles are graded by air flotation. In this scheme the iron powder is blown in a horizontal direction by means of an air jet. The larger particles are not carried along by the air as far as the smaller ones. By placing a series of bins underneath the air jet the powder can be graded roughly according to the distance various portions have traveled. Particle sizes of 5 to 25 microns are obtainable.

A number of different sources of iron can be used to make the iron anode used in the electrolytic process. Care must of course be taken that the plating bath will not plate out any other metals that might be present in the anode as impurities.

In one process the iron is obtained by the continuous electrolysis of ferrous chloride to ferric chloride, iron being returned to the ferric liquor by reaction with ore which has been roasted and ground and which runs 20 to 40 per cent iron. Other manufacturers prefer a sulphate bath.

Powdered iron, due to its finely divided state, burns easily and in some forms may be subject to spontaneous fires. As a consequence, it is necessary to mill it in a non-oxidizing atmosphere, such as pure nitrogen.

The finest particles of uniform grain size are made by the carbonyl process and can give relatively excellent results in the ultra-high-frequency region as well as in the lower region of the radio spectrum.

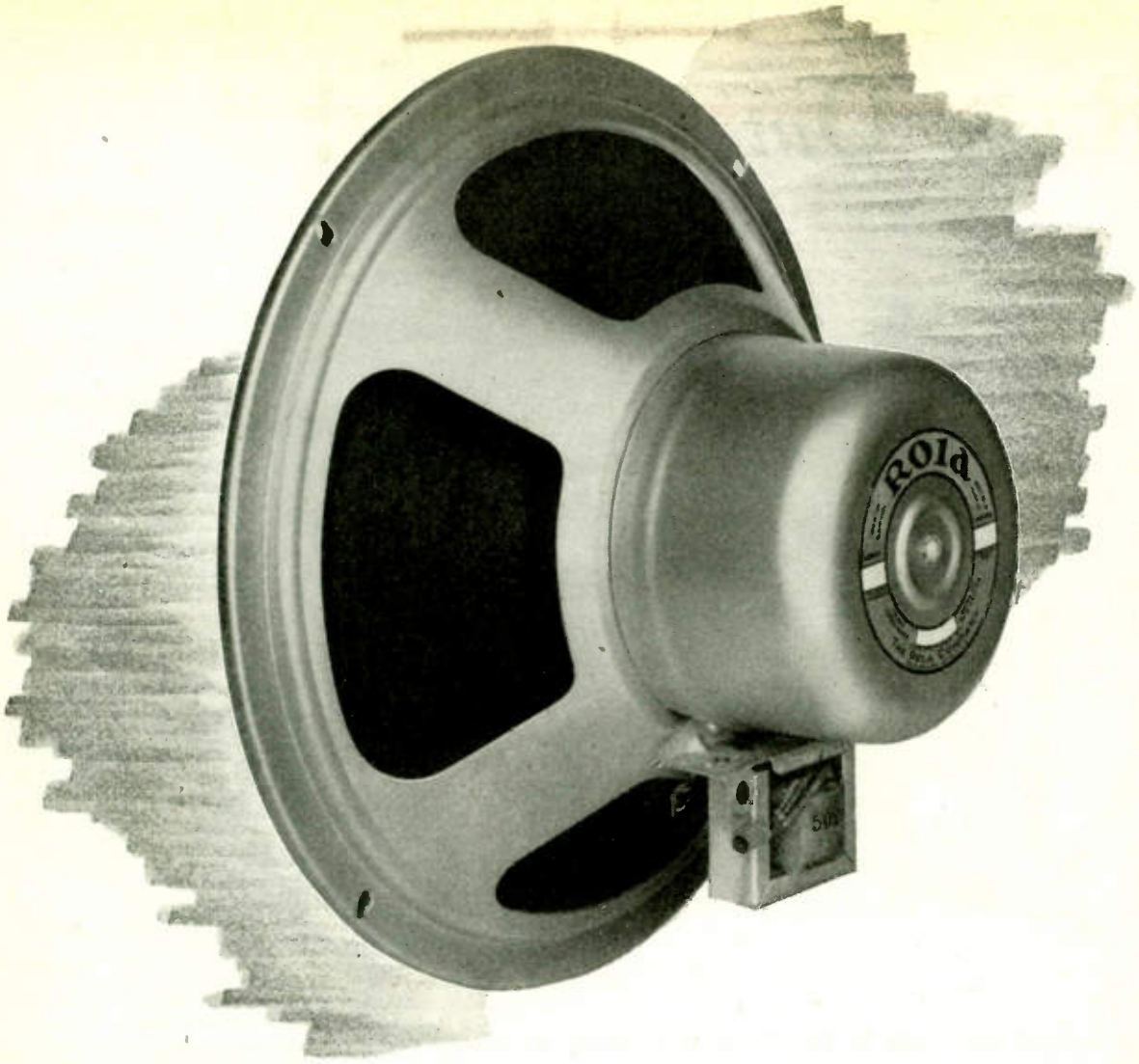
In the carbonyl process, iron formed into 1 in. diameter pills is subjected to an atmosphere of carbon monoxide at high temperatures and pressures (100-200 deg. C. and 50-200 atmospheres). The result is iron pentacarbonyl $Fe(CO)_5$. This brownish liquid is then decomposed in vapor phase with a catalyst at about 200 deg. C. in high towers, the pure powdered iron being collected at the bottom and the carbon monoxide being recovered for further use. The chemical reaction taking place is simply

$$Fe + 5CO \rightleftarrows Fe(CO)_5$$

Different grades are obtained by variations in the process and by milling and hydrogen reduction. Since during the reduction of $Fe(CO)_5$ carbon is absorbed by the iron, a hard material similar to steel results. For some applications, particularly the lower frequency uses, a softer purer iron gives better results, and hence certain grades are produced by further reduction in a hydrogen atmosphere.

As the size of the particles produced depends on the temperatures, pressures and rate of gas flow, careful chemical control is essential in

(*Continued from page* 194)



It May Look the Same... *But...*

New Rola speakers may look similar to prewar models. But in performance, fidelity and craftsmanship there will be no comparison! Rola research, intensified by war needs, has paced the swiftly advancing stride of electronic development.

Improvements, exclusive with Rola, will be incorporated in the broadened line of speakers. And the developments and processes that have resulted from exacting wartime tasks will further guarantee the quality and dependability which, for a quarter of a century, have made Rola a leader.

Rola's greatly expanded production facilities still are absorbed in supplying communication needs of our military forces—but it is possible, now, to provide experimental models and demonstrate to interested manufacturers Rola's improved engineering and performance.

The Rola Company, Inc., 2530 Superior Ave., Cleveland 14, O.

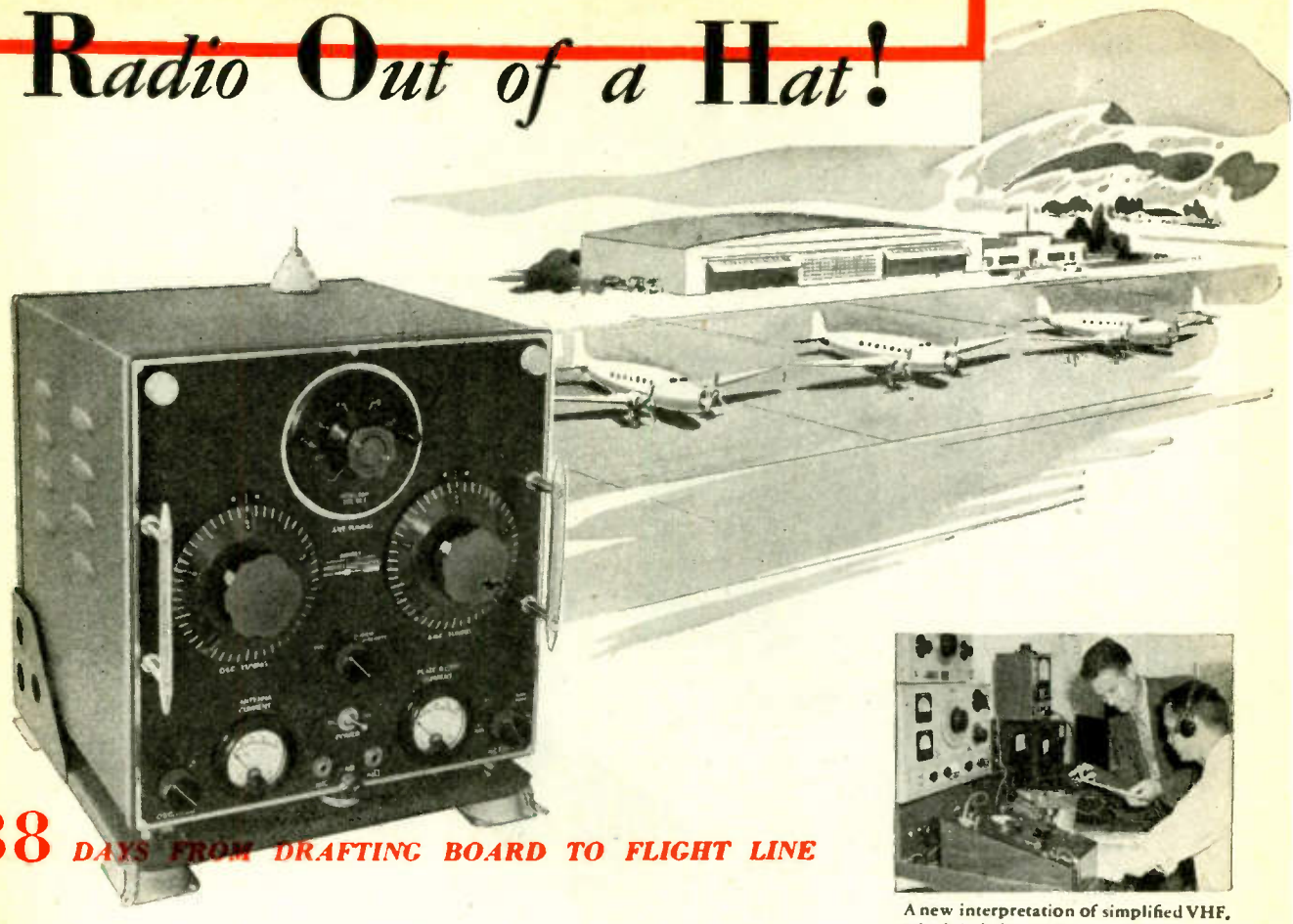
MAKERS OF THE FINEST IN SOUND REPRODUCING AND ELECTRONIC EQUIPMENT

ROLA SPEAKERS NOW AVAILABLE FOR RATED ORDERS

A few weeks ago Rola resumed the manufacture of Speakers in moderate quantities and for rated orders. Inquiries are invited from manufacturers who need quality speakers for priority contracts.

ROLA

Radio Out of a Hat!



88 DAYS FROM DRAFTING BOARD TO FLIGHT LINE

Germany stunned the world in '39 with their *blitzkrieg*. At exactly the same time another *blitzkrieg* was quietly being made by the Canadians in this country. They needed airplanes and radio communication equipment—fast.

The airplanes they got...and the radios. There were less than 90 days left when Pacific Division got the go ahead for transmitters and interphone equipment that had not even been designed.

In 88 days Pacific Division designed—developed—and delivered a quantity of 100-watt master oscillator transmitters for low and high frequency...amplifiers for the interphone...and engineered and installed these and all other radio equipment in the Canadian airplanes.

We at Pacific Division would rather not accept any more orders that we have to pull out of a hat. But we are open for business, especially VHF Communication Systems in which we specialize, that demands experience, ability and resourcefulness. Your inquiries are invited.

Pacific Division
Bendix Aviation Corporation
VHF COMMUNICATION SYSTEMS
NORTH HOLLYWOOD 7, CALIF.
LINCOLN BLDG. NEW YORK 17
CONTINENTAL BLDG. ST LOUIS 6

A new interpretation of simplified VHF, scheduled for early announcement, is the latest development of the company's radio engineering laboratory.

Quality in quantity is the keynote of all Pacific Division manufacturing processes.

Pacific Division's engineering ability is matched by its outstanding production facilities. Here future VHF equipment will be manufactured in volume.

PRODUCT OF Bendix AVIATION CORPORATION

OPERATING SIX VHF EXPERIMENTAL STATIONS

MAGNETIC POWDERS

(*Continued from page* 190)

all steps. This high degree of control is also of advantage to the core maker, as the manufacturer can deliver powder whose variations in Q under identical test conditions can be held to 2 per cent. The corresponding permeability variations are 1 per cent.

Carbonyl iron has a growth structure very much like that of an onion. This is formed as successive layers adhere to the particle in their travel through the reaction tower. The presence of these non-homogeneous layers seem to cause the carbonyl iron grains to have a high resistivity tending to reduce eddy currents and their losses.

Carbonyl powders are available in a graded range as shown in Table 1, the larger sizes being suitable for the lower frequencies. Types L and C being reduced in hydrogen, do not have the shell like structure but consist of homogeneous spheres and agglomerates.

Due to softness of these reduced powders, they are highly compressible, can be used in cores to obtain higher densities and permeabilities than harder carbonyl powders.

Hydrogen reduced powders are produced by a number of varying processes. One manufacturer dissolves iron scrap in sulphuric acid. The resulting iron sulphate is crystallized out as copperas, $FeSO_4 . 7H_2O$ which is then calcined to ferric oxide Fe_2O_3. The ferric oxide is reduced in a shaft type furnace in a blue gas atmosphere $(H + CO)$. This results in spongy iron which is disintegrated by attrition. A hammer mill, ball mill or disk pulverizer may be used in some processes. Iron produced in this way is very finely divided and of great purity. By grading processes such as have been described before, powders are obtainable with size ranges as low as 3 to 10 microns.

The grains of hydrogen reduced powders are homogeneous, somewhat porous due to their method of production and of irregular shape. As may be seen from table III, excellent results are obtained in cores made from this material.

Core manufacture

For some cores, manufacturers of iron cores first pickle the powder in a salt or an acid to insure high surface resistivity of the individual particles. A typical process would be to mix the powder with 1 per cent of its own weight of zinc phosphate, $ZN_3(PO_4)_2$ dissolved in a 2—normal ammonia solution and evaporating to dryness.

The iron powder is then mixed with a plastic such as Bakelite or Durez dissolved in acetone or

(*Continued on page* 198)

Model 645 A.C.-D.C. Electronic Multimeter

(Vacuum Tube Voltmeter)

Both A.C. and D.C. volt ranges are electronic. This provides the maximum of sensitivity and overload protection for all A.C. ranges as well as D.C. and ohms ranges.

Measures resistance up to one thousand megohms and as low as 2/10 ohm.

Constant input resistance 12 megohms on all D.C. volts ranges.

Input resistance 4.4 megohms on all A.C. ranges. Flat frequency response between 50 cycles and 10,000 cycles.

Meter cannot be damaged by accidental overload on any electronic range. Electronic overload protection on all A.C. and D.C. volts, and ohms ranges.

Variations in line voltage do not affect accuracy within the range of 100 to 125 volts. The instrument is equipped with ballast control tube and self-compensating circuits.

Meter Ranges—

A.C. Volts: 0-1/4/10/40/100/400/1000

D.C. Volts: 0-4/10/40/100/400/1000

Ohms: 0-1000/10,000/100,000/1 meg/10 meg/100 meg/1000 meg

M.A.: 0-1/4/10/40/100/400/1000

Decibels: Minus 30 to minus 5/minus 10 to plus 15/10 to 35/30 to 35

Either positive or negative D.C. voltmeter indications instantly by means of reversal switch. Signal tracing type test lead with isolation resistor in probe. Model 645 is an ultra-modern high sensitivity instrument, with all of the famous Jackson features, including exceptional accuracy and simplicity of use.

MODEL 645 **Net Price** **$56.50**

Available *now* on *rated orders* . . . after war a new regular in the Jackson line . . . a line that shall always live up to a long reputation for INTEGRITY OF DESIGN.

BUY WAR BONDS AND STAMPS TODAY

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Fine Electrical Testing Instruments

JACKSON ELECTRICAL INSTRUMENT COMPANY, DAYTON, OHIO

PRECISION PARTS

SMALL PARTS WITH A BIG FUTURE

Smooth working communications, straight shooting that hits the target, bombing that wipes out an objective—all these and many other operations vital to victory are dependent upon small, highly accurate instrument parts.

Maintaining such exacting tolerances, and doing it on a mass production basis is a war-time development that has important post-war significance. Modern Ace equipment and proved Ace ability will be able to meet manufacturers' requirements for accuracy, and do it at a price that would have been impossible not so many years back.

Now is the time to reserve your production capacity. Let us quote you on small parts or assemblies involving stamping, machining, heat-treating, or grinding. Send blueprint, sketch or sample.

CURRENT CAPACITY AVAILABLE

CYLINDRICAL GRINDING—Multiple banks of widely varying internal and external cylindrical grinders are available for outside diameters up to 12" by 24" between centers . . . and inside diameters as small as 1/16" or as large as 4" by 2¼" long.

THREAD GRINDING—Our battery of Ex-Cell-O and J & L Thread Grinders equips us to give you tolerances of .0001" on all Standard V Threads, Acme and Square Threads, and on single or multiple leads. All sizes up to 5" diameter with threads 8" long, on parts up to 20" between centers.

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MAGNETIC POWDERS

(Continued from page 194)

ethanol and dried slowly. Since this forms agglomerate lumps, it is necessary to grind the mixture to about 20 mesh size to permit uniform filling of the mold. Wax is then mixed with the ground powder to lubricate the mixture, and floating dies of the requisite shape are then filled with powder and placed under varying pressures up to 100 tons per sq. in. Mechanical strength of the finished cores is improved by heating to a temperature where the resin sets or near where it softens, and allowing to cool.

Standardization is seriously needed in the manufacture of iron powder and cores. Some attempts have been made along this line by the Radio Manufacturers Association, but the program has not been completed. Such questions as these arise, namely, in comparing two cores having different pressures applied to them, should the cores be made to the same physical dimensions or the same iron content? Or again, should a given core be judged by its performance in a coil in which it performs best or in a standard coil?

Some investigations have been carried on by various manufacturers using coils proposed by W. J. Polydoroff and whose characteristics are indicated in table IV. However, these have not been adopted as standard by the R.M.A. committee.

The influence of variations in molding pressures, percentage of binder and type of binder are illustrated by curves in Figs. 5, 6 and in Table V based on original measurements made by Dr. Hans Beller and G. O. Altmann. The data for Fig. 5 were obtained for cores of 6 grams weight and 5 per cent binder made with carbonyl powder type E. They were ⅜ in. in diameter and were tested in the R.M.A. proposed coils with a Boonton Radio type 160A Q meter.

Fig. 6 data were obtained with the same type of cores, with varying amounts of binder, at a constant pressure of 35 tons per sq. in. The data demonstrate that there are only small differences of Q over a wide range of dilution, provided the same amount of iron powder is used.

In Table V the effect of using four different commercially available formaldehyde type resins is shown. All cores weighed 6 grams, had 4 per cent binder, approximately the same density of 5 grams per cm^3 (obtained with widely different molding pressures), and the same true or toroidal permeability of 10.5.

Table III shows a range of Q values obtained by various grades of hydrogen reduced powders. It

(Continued on page 202)

MAGNETIC POWDERS

(*Continued from page* 198)

is based on measurements made by R. H. Rodrian. The apparent density was obtained with a Scott volumeter; the tapping density was obtained by tapping the iron powder to a certain volume for five minutes. Initial permeability was obtained with toroidal cores measured at 1 kc. Cores used in the Q measurements were ⅜ in. in diameter and ⅜ in. long. The iron powders were insulated, then mixed with bakelite powder, 4 per cent for grades 2, 6 and 16 and 5 per cent for grades 8 and 9. All cores were compressed with about 65,000 pounds per sq. in. and cured at about 250 deg. F.

Table VI shows a comparison of various types of magnetic powders. Toroids were used for the measurements in each case and were made with 4 per cent bakelite, 2 per cent Sterotex for lubrication, 50 tons per sq. in. pressure and 50 grams weight. O. D. was 2.25 in., I. D. 1.50 in and they were wound with a single layer of 200 turns of No 25 magnet wire.

Tables I and II give data on carbonyl powders. Tap density shown here was measured by filling a 100 cm^3 graduate cylinder, closing with a stopper and tapping 100 times from a height of 8 in. on a wooden surface. The weight in grams divided by the resulting volume in cc is the tap density.

Emphasis must be laid on the fact that comparisons of various materials cannot be made except under identical conditions, and sometimes identical conditions are quite difficult to obtain. For this reason no attempt has been made to present direct comparisons leading to exact conclusions under any given conditions. It is still a fact that the coil and the core should be designed together to achieve best results in a certain application.

$1000 EDITORIAL AWARD

(*Continued from page* 4)

author of the article judged best Caldwell-Clements, Inc., publisher of Electronic Industries will make a First Award of $600; second best will receive $300; third best will receive $100. These amounts are in addition to regular payment for the article. The editors desire technical articles describing new or advanced applications of electronic principles in all fields, communications, industry, science, instrumentation, laboratory, etc. Articles should preferably be about 2,500 words in length and should be well illustrated with photographs, charts and drawings. The editors will be glad to correspond with prospective authors regarding the suitability of material intended for publication.

NEW BULLETINS

Resistor Selection

A guide to fixed wire-wound resistor selection and use in all types of modern equipment has been incorporated in a 28-page engineering bulletin (R) issued by the Shallcross Mfg. Co., Collingdale, Pa. In addition to complete listings of all Shallcross Akra-Ohm resistor types the bulletin includes data on resistance alloys, maximum resistance and temperature coefficient charts, dimensional specifications, mountings and terminal designs, power dissipation, moisture and fungus-proofing data, hermetic sealing information and full data as to Shallcross types designed to meet JAN-R 93 specifications.

Rectifier Data

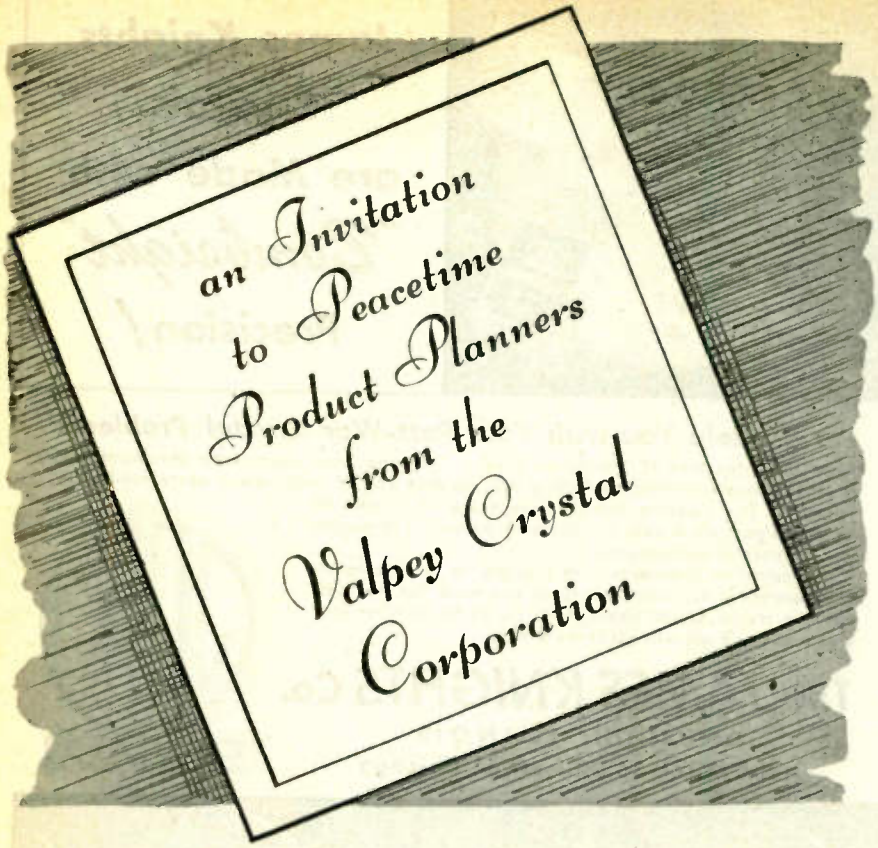
"Selenium vs. Tube Rectifiers" is the title of a four-page study by Chief Engineer L. W. Reinken of Green Electric Co., 130 Cedar street, New York, relating to technical considerations in the selection of rectifiers. Relative advantages of selenium in the low voltage high current field and of tubes for high voltage low current needs are pointed out.

Equipment Catalog

Walker-Jimieson, 309 South Western Avenue, Chicago, has published a new catalog of radio and electronic equipment. Included are descriptions of industrial X-ray machines, electronic comparators, test equipment including signal generators, tube testers, and multitesters, photo-electric devices, dieless duplicating tools, plastic sectional wiring systems, that have never been been cataloged before.

Brakes and Shears

A combined catalogue and illustrated technical manual on Di-Acro benders, brakes and shears has been published by the O'Neil-Irwin Mfg. Co., Minneapolis, Minn. The Di-Acro system of die-less duplicating is explained, and numerous examples are shown of the finished pieces and of the manner in which they can be turned out. The benders feature a central mandrel around which metal parts can be rolled by means of a lever. Maximum capacity is $\frac{5}{8}$ in. round steel bar. Numerous locating holes and adjustments are provided. Ability to make a centered eye in one operation is notable. Shears of 6, 9 and 12 in. capacity and brakes from 6 to 18 in. are listed.



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CM-1

A design for normal frequency control applications.

VP-3

Developed for use in limited space . . . in mobile equipment.

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Experienced in volume production of vital crystals for wartime communications needs, Valpey engineers and craftsmen are well equipped to solve any commercial crystal problem. *Insure* the success of your future products by planning to use Valpey Crystals in every "Vital Spot." Valpey's never vary.

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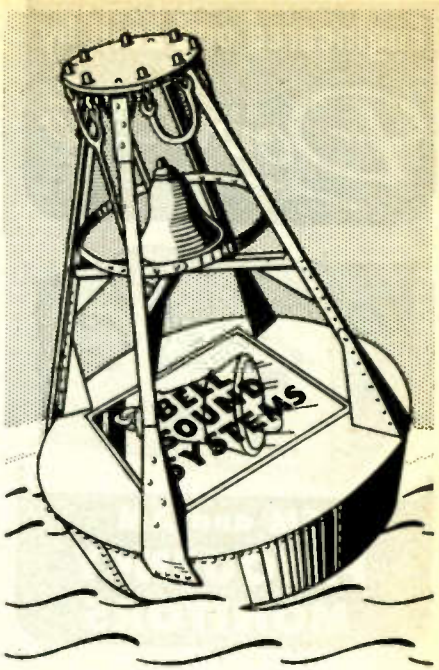

BUOY UP your post-war production with BELL electronic controls or assemblies!

A BELL solution to your electronic control or assembly needs may bring you smoother sailing in the post-war picture. Our complete facilities and wide experience warrant your inquiry — and we'll welcome the chance to discuss our capabilities in terms of your specific needs.

BELL PRODUCTS INCLUDE: Electronic Sound Devices . . . Intercommunicating Systems . . . Industrial Voice-Paging and Broadcasting Equipment . . . Permanent and Portable Amplifying Systems . . . Recording and Disc Playing Units . . . Electronic Controls . . . Operating Sequence Recorders . . . Other Special Devices.

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NEW BOOKS

Principles of Radio

By Keith Henney, Fifth Edition, 534 Pages, Price $3.50. Published by John Wiley & Sons, New York.

This revised fifth edition of an elementary text book on radio is divided into twenty-two chapters starting with the fundamentals of electrons, electrical charges, electric current and related information. The book continues through direct current circuits covering resistance, voltage drop, power and energy, Kirchhoff's laws. The characteristics of inductance, capacitance, magnetism and the production of electric current are also covered in the early chapters of the book.

Chapter 11 covers the fundamentals of vacuum tubes while the next few chapters treat a tube as an amplifier, as a rectifier, and as a detector. Chapter 16 deals with the characteristics of receiver systems, and Chapter 18 covers transmitters. A chapter on antennas and electromagnetic radiation is included, as is a chapter on frequency modulation and another on ultra-high-frequency phenomena. The chapter on ultra-high-frequency phenomena includes details of transmission lines, antennas, the magnetron, the klystron, wave guides and cavity resonators. The last chapter covers some of the fundamentals of electronic measuring instruments such as the vacuum tube voltmeter, cathode-ray oscillograph, etc.

As in the other editions of this book, a number of problems are included in the text. These problems are related to the subject matter covered.

NEW BULLETINS

Sealed Meters

The Marion Electrical Instrument Co., Manchester, N. H., has published an illustrated 12-page brochure, explaining the history, uses and advantages of hermetically sealed 2½ in. and 3½ in. electrical indicating instruments. The booklet describes the construction of the instruments and shows the induction heating process used to seal glass to metal. It illustrates the various stringent tests to which these instruments have been subjected and gives all "specs."

Universal Resistors

Wire wound power and precision resistors are described in the new catalog issued by the Groves Corp., Cape Girardeau, Mo., Monel ferrule, radial tab, and axial lead GA series resistors are included.

Expanding Organization with Post-War Future

Wants Junior and Senior

RADIO ENGINEERS

for Research and Development Work in UHF Field

TOP SALARIES . . . EXCELLENT CONDITIONS!

Capable men will find initiative and ability appreciated and rewarded in this medium-size, progressive organization. Management-within-plant provides opportunity not only to work projects from start to finish . . . but a future just as big as you can make it. *These are no "cog-in-the-wheels" jobs, but highly-desirable opportunities for immediate and post-war careers.*

Applications are invited from key men, research and production engineers experienced in UHF test equipment, industrial electronics or similar work.

Working conditions are ideal in a modern, fully-equipped plant, and with every facility for carrying out projects under your direction. Plant is located in attractive, east-central New Jersey within an hour's ride from New York City and near the New Jersey shore.

Write us in detail concerning yourself — your experience and your accomplishments. *If possible, telephone us for an immediate* appointment. Engagements must, of course, be in accordance with War Manpower Commission and wage and salary regulations. Needless to say, your application will be held in the strictest confidence.

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RADIO ENGINEERS AND MANUFACTURERS

MORGANVILLE, N. J.

Specialists in the Development of UHF Equipment and in the Manufacture of UHF Antennas

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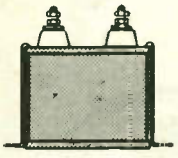
C-D never relaxes in its determination to improve capacitor design and to develop new and better materials and processes of manufacture. The C-D Type TJ series is typical of improved capacitor engineering.

Where a lot of capacitance must be packed into little space, there is no better capacitor for high voltage filter applications than the C-D Type TJ containing the Dykanol impregnant.

Dykanol "G", due to its chemical stability, allows operation at higher temperatures. It also permits the use of maximum paper thickness for a given size container, with a high factor of safety due to low voltage stress. Insulation resistance is five or more times as high as in capacitors using organic oil impregnants. On the larger sizes of the Type TJ series, the sturdy porcelain terminals withstand extremes of heat and cold and are practically unbreakable.

Look to Cornell-Dubilier for the extra quality and dependability that is engineered into every capacitor — the result of C-D's 35 years of capacitor specialization. Cornell-Dubilier Electric Corporation, South Plainfield, N. J. Other plants at New Bedford, Brookline, Worcester, Mass. and Providence, R. I.

Comparative size of capacitors for some voltage stress using two types of impregnants.



MINERAL OIL

C-D DYKANOL

Testing paper for number of conducting particles. Other tests determine thickness, porosity, voltage breakdown.

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PERSONNEL

Garrard Mountjoy, who has been in charge of research and development work in the Radio Division of Lear, Inc., has been advanced to take charge of all research and development work in the New York laboratories. He will supervise research in radio, television, wire recording, aircraft radio, navigational instruments, and many mechanical products.

Howard E. Kingdon has been appointed chief engineer and manager of the transformer department of the Eisler Engineering Co. Newark, N. J. He has had long experience in transformer designing, dating back to 1923 when he joined the transformer engineering department of General Electric in Pittsfield, Mass.

Howard E. Kingdon

C. Frank Miller

C. Frank Miller has been appointed chief engineer of Price Bros. Co., Frederick, Md. He was formerly a member of the faculty on the electrical engineering staff at Johns Hopkins University.

Dr. Nelson W. Taylor has been appointed technical assistant to the director of research of the Minnesota Mining & Mfg. Co. In addition, he will also continue as head of the ceramics section. Before coming to 3-M company in November 1943, Dr. Taylor was head of the ceramics section in Pennsylvania State college.

Conway P. Coe, has been elected vice-president of RCA Laboratories, and will have charge of the patent department. Until June 15, he was United States Commissioner of Patents.

Frank H. McIntosh has opened his own office at 710 14th St., N.W., Washington, and will conduct an electronic consulting business. He will specialize in all phases of broadcasting, including allocation studies, antenna design, studio construction and special electronic applications.

Measuring Attenuation of Coaxial Cable

Chandler Stewart, Jr., Dayton, Ohio.

A method, known as the "S Function" method, for measuring attenuation of coaxial cables in the frequency range of from one to 100 megacycles is proposed. It is stated that this method is simpler, faster and more convenient than any other in general use; also it requires samples which are shorter and whose lengths are less critical than do other methods. Further, an error in the value of the characteristic impedance will generally not adversely affect the atennuation results.

To measure the attenuation constant a sample is used having a length approximately equal to $d_o = 144V/f_{mc}$ feet, where V is the relative velocity of propagation in the cable, and f_{mc} the test frequency in megacycles. Preparation of the sample to make connections is described in detail. The sample is then connected to a conventional Q-meter and f, Q and C_o recorded. From these measurements and the solid curve shown in the figure the value of S is obtained, which is inserted in the following formula for attenuation: $N = S/Qd$ decibels per 100 feet. As a guide in subsequent sample cutting, the dashed line of the figure gives the ratio of preferred sample length d_o to the actual sample length d.

The formula used in plotting the curves in the figure are derived and the expression for the attenuation given above is proved. Results obtained with the described method are reported.

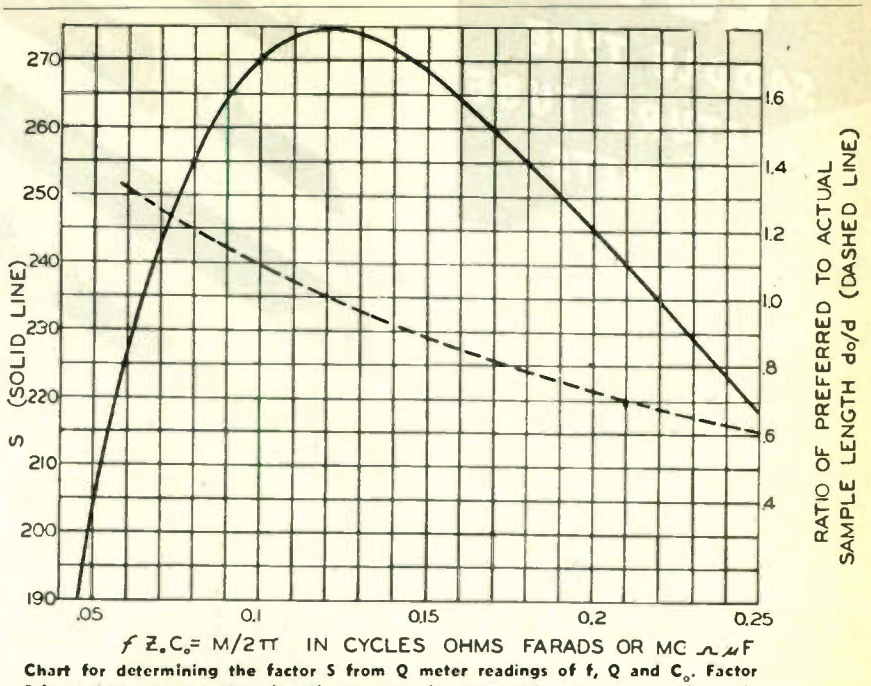
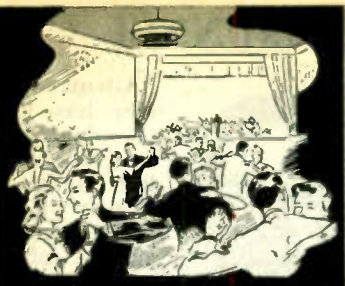


Chart for determining the factor S from Q meter readings of f, Q and C_o. Factor S is used in equation given in adjacent story for determining attenuation of sample of transmission line. While sample cable length d is not critical in this method, subsequent sample cuttings can be corrected by use of dashed line relationship of preferred cable length. This method is summarized here from a paper prepared for the 1945 summer program of the American Institute of Electrical Engineers



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UNIVERSITY radial cone projectors are pleasing in appearance, compact and completely "water-shedding". Continuous outdoor exposure is permissible. RBP 12 and RBP 8 are ideal for all indoor and outdoor installations where the advantages of a centralized sound source are desired.

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12 Types will *CORRECTLY SERVICE* well over 1200 of the most popular Auto Radio Receivers . . . . . .

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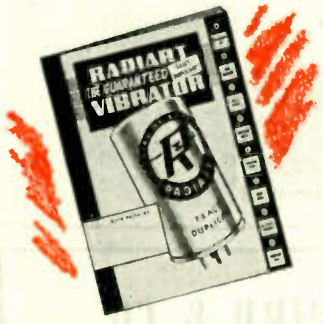
The following 12 types are a "must" for your service stock. If you keep at least one of each on hand you will be able to service over 7/8 of the vibrator replacements in popular demand. Yet each is individually engineered to correctly replace the original vibrator.

3320	5303	5326	5400
*4613	5314	5335	5406
5300	5320	**5342M	5426

*4613 may be used as replacement for 3461 if the smaller diameter can is acceptable.
**5342M is now recommended in all instances where 5340M was previously used.

Outside of those exceptions these 12 exactly duplicate the original units not only as to voltage and plug arrangement but in every respect including *physical size, frequency and current carrying capacity.* (Essential features for long life and best service.)

To be sure, the less popular models will still need servicing and you can get the correct RADIART VIBRATORS for every one of them.



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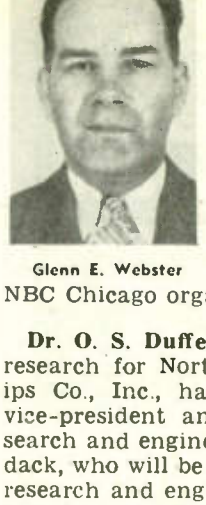
PERSONNEL



Glenn E. Webster

Glenn E. Webster has joined the engineering staff of the Collins Radio Co. Cedar Rapids Ia. He will have charge of the development of broadcast speech input and associated equipment; was formerly in the NBC Chicago organization.

Dr. O. S. Duffendack, director of research for North American Philips Co., Inc., has been appointed vice-president and director of research and engineering. Dr. Duffendack, who will be responsible for all research and engineering activities was formerly Professor of Physics at the University of Michigan. During the war he has been a director of research with the National Defense Research Committee and serves as chief of one of its sections.

Robert W. Clark has been made television operations supervisor of the National Broadcasting Co. He has been station engineer at WEAF New York.

Ralph E. Middelton, until now chief engineer of Aireon Mfg. Co. Kansas City, has been elected vice-president of the company. He will have charge of engineering at the company's Burbank, Calif., plant.

Dr. Robert C. McMaster, formerly associated with the electrical engineering staff at the California Institute of Technology, has been appointed to the staff of Battelle Institute, Columbus, Ohio, and assigned to its division of industrial physics.

Albert F. Polk, vice president in charge of engineering, The Sheffield Corp., Dayton, Ohio, has been selected by the War Department for a mission in the occupied territory on the Western Front. It is understood his appointment carries the rating of a lieutenant colonel, although he is classified as a civilian.

Jean M. Roberts has been appointed chief engineer of Electronics Corp., 132 Nassau St., New York. He was formerly senior research and development engineer at Lear, Inc.

William A. Acton has been appointed staff engineer of the engineering department of RCA International Division. He has been connected with the Royal Canadian Air Force and joined the RCA Victor Co., Ltd., Montreal, last October.

1,001 USES

Condensed Power for Years of Service

VERSATILITY and dependability were paramount when *Alliance* designed these efficient motors—*Multum in Parvo!* . . . They are ideal for operating fans, movie projectors, light home appliances, toys, switches, motion displays, control systems and many other applications . . . providing economical condensed power for years of service.

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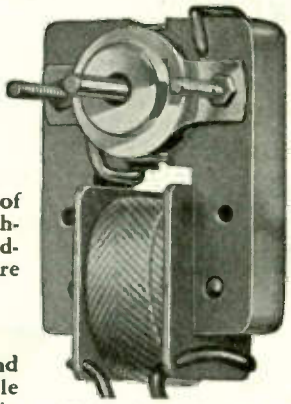

Model "MS"—Full Size Motor Measures 1¾" x 2 x 3⅛"

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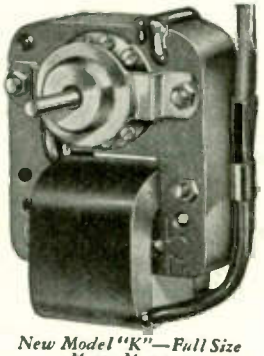
Both the new Model "K" Motor and the Model "MS" are the shaded pole induction type—the last word in efficient small motor design. They can be produced in all standard voltages and frequencies with actual measured power outputs ranging upwards to 1/100 H. P. . . Alliance motors also can be furnished, in quantity, with variations to adapt them to specific applications.



New Model "K"—Full Size Motor Measures 2⅛" x 2⅝" x 3 1/16"

DEPENDABLE

Both these models uphold the *Alliance* reputation for all 'round dependability. In the busy post-war period, there will be many "spots" where these Miniature Power Plants will fit requirements . . Write now for further information.

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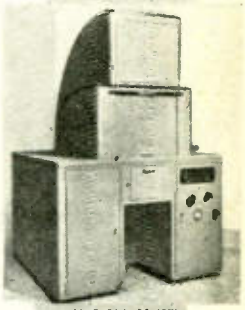

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RCA Scholarship Plan

Brigadier General David Sarnoff, President of RCA, has announced the adoption of a scholarship plan for the encouragement of promising young scientific students by the Radio Corporation of America. The plan provides for as many as ten students to receive RCA scholarships during the academic year 1945-1946, thirty during 1946-1947, fifty during 1947-1948, and sixty each academic year thereafter. Each scholarship consists of a cash award of $600. Those eligible will include all students enrolled at universities to be selected by the RCA Education Committee. Selection of students will be made upon recommendation of the dean of the specific university and approval by the committee.

Comprising the RCA Education Committee are Dr. James Rowland Angell, President Emeritus of Yale University and Public Service Counselor of the National Broadcasting Company, who is Chairman; Gano Dunn, President of the J. G. White Engineering Company, President of Cooper Union and a Director of RCA; Dr. C. B. Jolliffe, Vice President in Charge of RCA Laboratories, and F. H. Kirkpatrick, Director of Education and Training, RCA Victor Division.

Meck Develops All Frequency FM Receiver

An FM receiver with which it would be possible to tune both the old (42-50mc) and the new (88-108mc) FM broadcast bands, has been developed by John Meck Industry, Inc., in its Plymouth, Ind., laboratories. According to Chief Engineeer Charles Wexler, the circuit is not a two-band set, and does not call for remodeling of an original set at the factory, or by local service men. The wavelength bands are not changed by means of switches. The circuit will not cover the unusued band between 50 and 88 megacycles. Wexler says, however, that if the Commission should change its mind and use the wavelength between 50 and 88 megacycles, that a set could be built to cover the entire band.

Two-Band FM Receivers Promised

According to Pioneer FM Radio Manufacturers, new receivers definitely will be designed with two FM bands to provide reception in both the present and the new FM channels. The group, headed by Major Edwin H. Armstrong, met in New York early in July to discuss engineering problems created by the new allocation, and it was at this meeting that the prediction concerning double band sets was made. There is still some uncertainty, though, as to what may, can or must be done with FM receivers at present in public hands.

McGuire Buys Meissner

Supplementing its acquisition last March of the Thordarson Electric Mfg. Co., Chicago, now to become a division of the parent company, McGuire Industries, Inc., has now purchased all the stock of the Meissner Mfg. Co., Mt. Carmel, Ill. Meissner, founded in 1922, will be continued as an independent division of McGuire with no change in policies or products except for some expansion in volume.

French Patents to CBS

Columbia Broadcasting system, long a color television proponent, is reported to have acquired American rights under French and other foreign patents covering certain aspects of color transmission and 1,000 line scanning. It is planned to reveal the nature of the acquisition some time this month.

Dreyer's Own Office

John F. Dreyer, Jr., has opened a New York office at 29-28—41st Ave., Long Island City, as a consulting engineer. He will specialize in the fields of communications, vibration and industrial electronics.

ELECTRONIC INDUSTRIES

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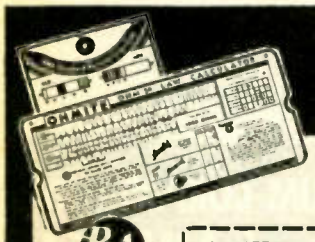

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Manufacturing corporation, international in scope, with a sales volume of approximately 40 million dollars a year, in radio, electrical business, can use the services of a top ranking executive officer, preferably a man under 40 with manufacturing and general executive experience. This is a fast growing young organization and can offer unparalleled opportunity to the right man, with a salary commensurate with his ability.

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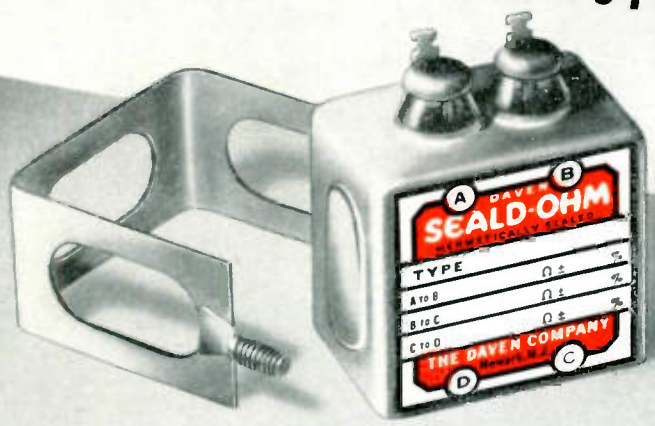

Totally unaffected by extremes of humidity and temperature, highly resistant to vibration and shock, with provision for rigid mounting . . . these were "specs" that could not be met by any resistor on the market. In response to a direct request, DAVEN, applying the know-how of over two decades of precision resistor engineering, carefully designed and built a new, completely hermetically-sealed resistor. DAVEN SEALD-OHMS squarely meet these specifications. This was proven by exhaustive tests conducted by a famous research laboratory.

SEALD-OHMS are ruggedly constructed throughout, with special attention given to combining vibration and shock resistance. Their physical design enables the combining of several circuits within a single unit. A unique mounting bracket arrangement adds to the brood adaptability of these resistors. SEALD-OHMS are intended for use in any equipment subjected to humidity and temperature extremes. They fully meet both Army and Navy Specifications. Typical applications include as secondary standards, resistor elements in bridge networks, in voltage divider circuits, in attenuation boxes, etc.

ELECTRICAL DATA

RESISTOR WINDINGS: Either spool or mica-card type, depending upon engineering requirements. Non-inductively wound and carefully aged to remove strain before final calibration.

RESISTANCE RANGE: Any desired value may be had; maximum 1,600,000 ohms depending upon type of resistance wire employed.

TEMPERATURE CHARACTERISTICS: Four types of resistance wire of different characteristics are available.

ACCURACY: May be had to tolerance as close as $\pm 0.1\%$.

FREQUENCY CHARACTERISTICS: No appreciable effect over the audio range. This range may be exceeded to meet many other applications.

CIRCUIT COMBINATIONS: Resistors available with 2 terminals at one end or 2 terminals at two ends. A single four terminal unit is designed to take up to four separate spool-type resistors of different values and accuracies.

MECHANICAL DATA

SHIELDING: Drawn brass, completely hermetically-sealed. Thermal-shock tested for faulty seals before shipment. Treated to withstand 200 hours salt spray test (f-13 AWS Spec C75.16-1944).

TERMINALS: Electrical connections are brought out through fused glass seals which are soldered in the resistor shield.

MOUNTING: A speciolly designed steel bracket with spade lugs welded to the sides is supplied with each unit. Cut-outs on this bracket engage with embossings on the side of the brass shielding to enable firm mounting of the unit in a vertical, inverted or horizontal position.

DIMENSIONS: 1-9/16" wide, 1½" high, ⅞" deep. Add terminal height, 9/16" Studs on mounting bracket, 1-11/16" between centers.

***For additional information, write to* THE DAVEN CO.,**
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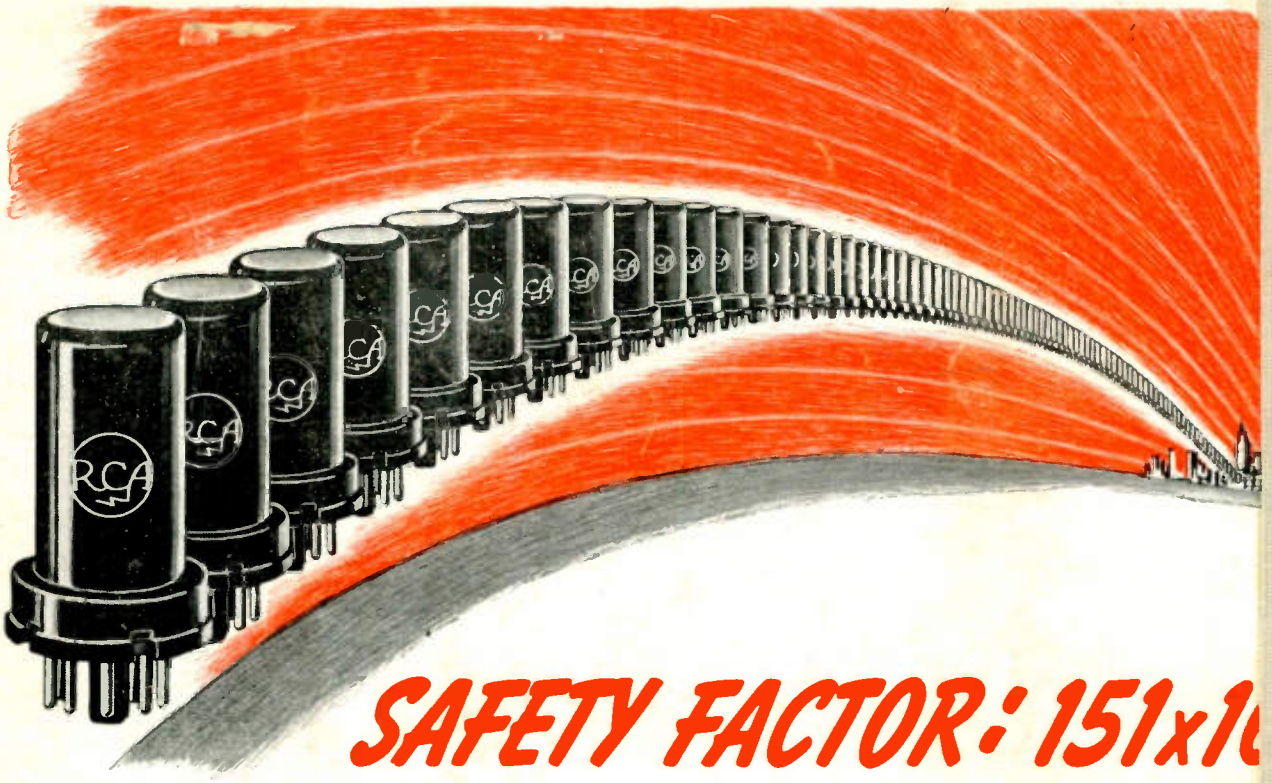

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WHEN you specify RCA metal tubes in your equipment designs, you are specifying more than tubes—you are specifying ten years of engineering and manufacturing experience.

Each of the millions of metal receiving tubes we have built has contributed to the experience of our engineers, and to the skill of our workers and production technicians.

An example of RCA's untiring effort to build better tubes at lower prices is the famous RCA Preferred-Type Program (applied to metal, glass, and miniature receiving tubes), which, in a single year, brought about an average reduction of 13% in the cost of receiving-tube types included in the program.

The idea behind the Preferred-Type Program was to concentrate production on fewer types, making possible longer manufacturing runs, which, in turn, would increase production efficiency and reduce costs.

The preferences of RCA customers determined which tubes were to be included in the Preferred-Type Program.

In 1940, 80% of all metal tubes manufactured RCA were *preferred* types. Of the 151-million me tubes manufactured by RCA since 1935, nearly 4(have been *preferred* types.

Look to RCA, postwar, for your metal-tube requi ments. If you already have specific tube complemer in mind for your postwar equipment, why not ch with RCA *now* to make sure that the tubes you int using shall be included in the postwar RCA Preferr Type Program. Remember, it is *you*, not RCA, v decides which types are to be *preferred* types. Wr listing your tube types, to RCA, Commercial E neering Department, Section 62-40J, Harrison, N

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