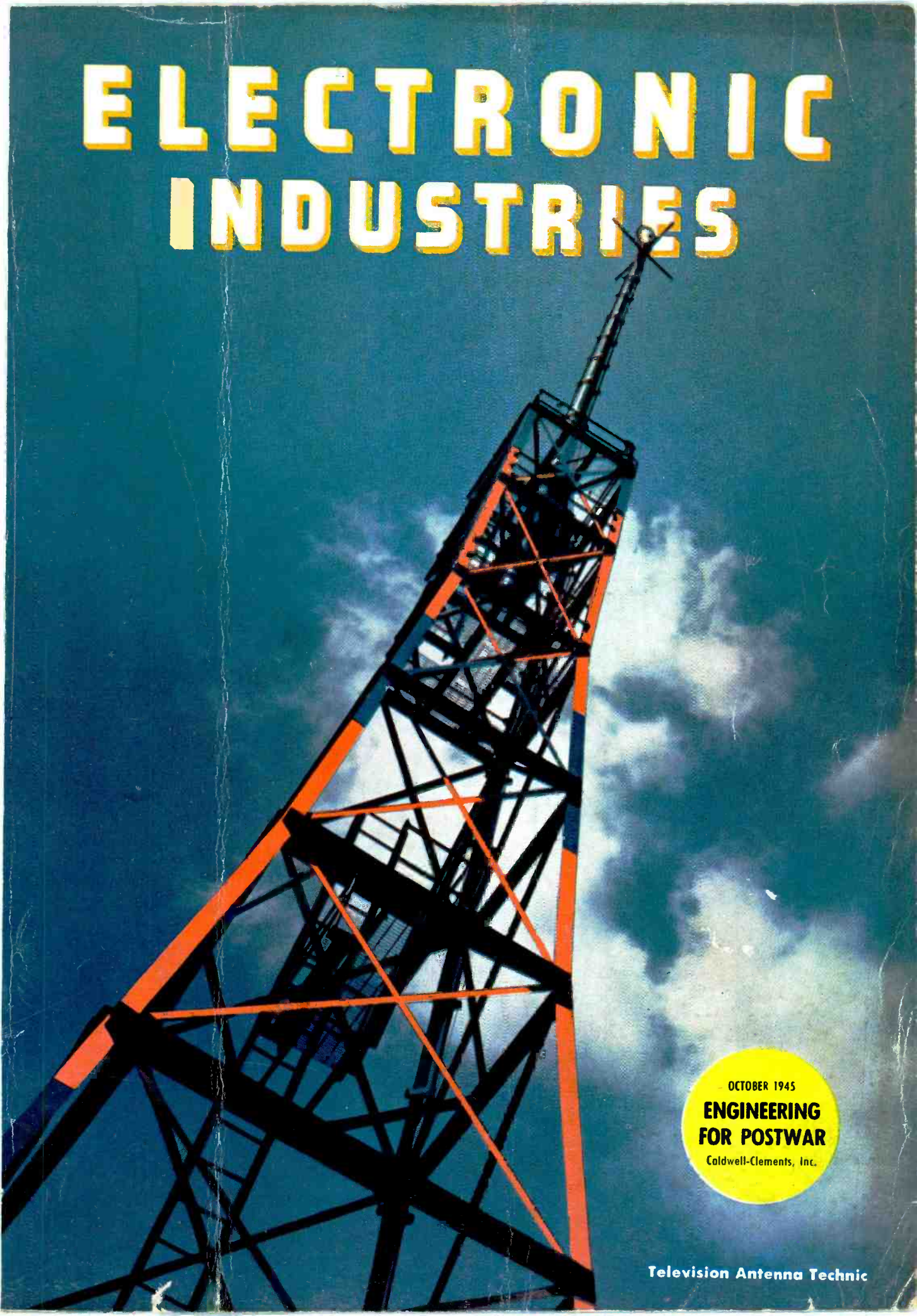
ELECTRONIC INDUSTRIES



OCTOBER 1945

ENGINEERING FOR POSTWAR

Caldwell-Clements, Inc.

Television Antenna Technic

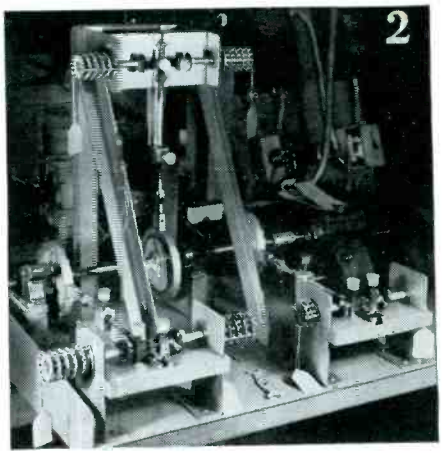
Pre-Testing of MALLORY SWITCHES Assures Precision Performance

MALLORY has pioneered in developing new designs for both rotary and push-button switches, and in manufacturing them from improved materials. To make sure of the electrical performance and long life of these switches, Mallory puts them through punishing tests.

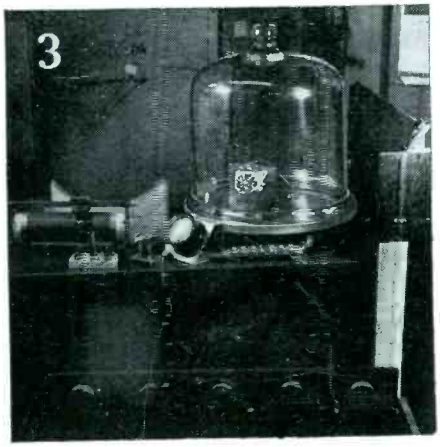
The complete line of Mallory *standard, pre-tested* precision switches and other electronic components is available from your nearest Mallory Distributor. See him today, and ask for your free copy of the Mallory catalog—containing specifications for switches, jacks, plugs, capacitors, resistors, rectifiers and other parts. Or write us today.

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

1 SALT SPRAY TEST: In a few short hours, switches are subjected in this salt spray chamber to conditions that equal years of marine service.

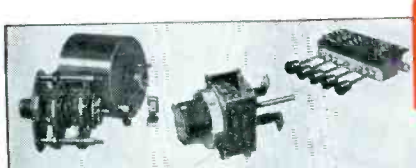


2 SWITCH LIFE TEST: Hour after hour, this machine continues to operate the switch until it is destroyed. Results enable Mallory to develop switches with operating life exceeding normal requirements.

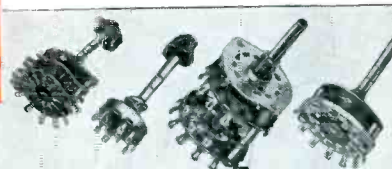


3 LOW ATMOSPHERIC PRESSURE TEST: The rarified air of the substratosphere is reproduced inside this large bell jar. Data from this test has aided Mallory in developing better switch construction for aircraft application.

4 FUNGUS CONTROL: In this laboratory, fungus cultures from the tropics are used in testing the fungicidal properties of new impregnating materials for the insulation in Mallory Switches.



P. R. MALLORY & CO. Inc.
MALLORY



Industrial and Electronic Switches

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

★ IN THIS ISSUE OCTOBER, 1945 ★

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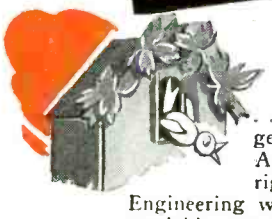
Printed in U. S. A.

THE AMPEREXTRA FACTOR IN DIELECTRIC HEATING

Dielectric heating has revolutionized the processing of plastics, textiles, rubber, drugs, foods, wood, paper and many other products. For dielectric heating equipment Amperex has originated a number of electronic tube types especially suited for use as oscillators at high frequencies. Dependable operation and reserve capacity are the **Amperextra Factor** in this group of tubes — a Factor which will increase in importance in the highly competitive postwar years when goods must be delivered better, cheaper—and on time.



"WON'T GO CUCKOO"

. . . that is how one electronic heat generator manufacturer describes Amperex tubes. If your equipment is right, Amperex Special Application Engineering will help you make it better. Dependable operation is assured, replacements minimized, and greater value per dollar expended may be anticipated.

THE AMPEREX SPECIAL APPLICATION ENGINEERING DEPARTMENT

. . . Amperex Special Application Engineers have nothing to sell. Their job is to work with you on the development of new equipment or the improvement of present products. Their time and knowledge is yours for the asking, without charge or obligation.

RESERVE CAPACITY

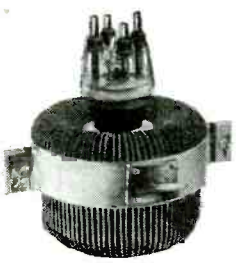
. . . the measure of tube life is in the reserve capacity of the tube. Because of novel design, Amperex high frequency tubes may be used at plate voltages and plate power inputs sufficiently high to allow power outputs at maximum rated watts per tube.

Amperex Type 235-R Transmitting Tube. Filament voltage, 14.5-15.0 volts. Filament current, 39.0 amperes. Amplification factor, 14.0. Grid to plate transconductance at 500 ma., 6500 micromhos. Direct interelectrode capacitance: grid to plate, 9.0 μμf; grid to filament, 10.0 μμf; plate to filament, 1.5 μμf. List price, $125.00.

AMPEREX TUBES . . .

. . . for dielectric heating applications are available in 25 different types, operating with remarkable efficiencies at frequencies ranging from 20 to 120 megacycles. Write for the Amperex catalog.

Amperex Type 889 Transmitting Tube. Filament voltage, 11 volts. Filament current, 125 amperes. Amplification factor, 21. Direct interelectrode capacitance: grid to plate, 17.8 μμf; grid to filament, 19.5 μμf; plate to filament, 2.5 μμf. List price, $175.00.



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. List price, $325.00.

AMPEREX

. . . the high performance tube

Many standard types of Amperex tubes 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 Majestic Ltd. • 622 Fleet Street West, Toronto

HOLD ON TO THE WAR BONDS YOU HAVE — AND KEEP BUYING MORE

THE COVER

The color photograph on the cover of this month's issue of Electronic Industries is a shot of the video-sound antenna of television station WABD in New York City, owned by Allen B. DuMont Laboratories Inc.

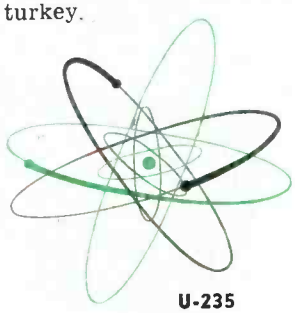
The diagonal dipole crossarms, which radiate the high frequency video signal, are connected by two coaxial cables that are fed by push-pull type amplifiers just below the tower on the top floor of the building. The circular loop at the tip of the mast is for sound radiation.

Equipped with built in electric heating coils to guard against the formation of ice during winter telecasting, the mast of the tower can be telescoped by turning a hand winch for servicing.

That Boring Bohr Atom

Now that the public is beginning to learn about nuclear physics and other phenomena associated with atomic power, it is to be hoped that the much-abused Bohr atom diagram, herewith, will no longer be misrepresented as being something somehow related to our own electronic arts—(which it ain't!)

While this electronic picture of the atom is generally accepted by students of nuclear physics, it has of course no more relation to our kind of electronic action in vacuum tubes than your Aunt Mary's Christmas turkey.



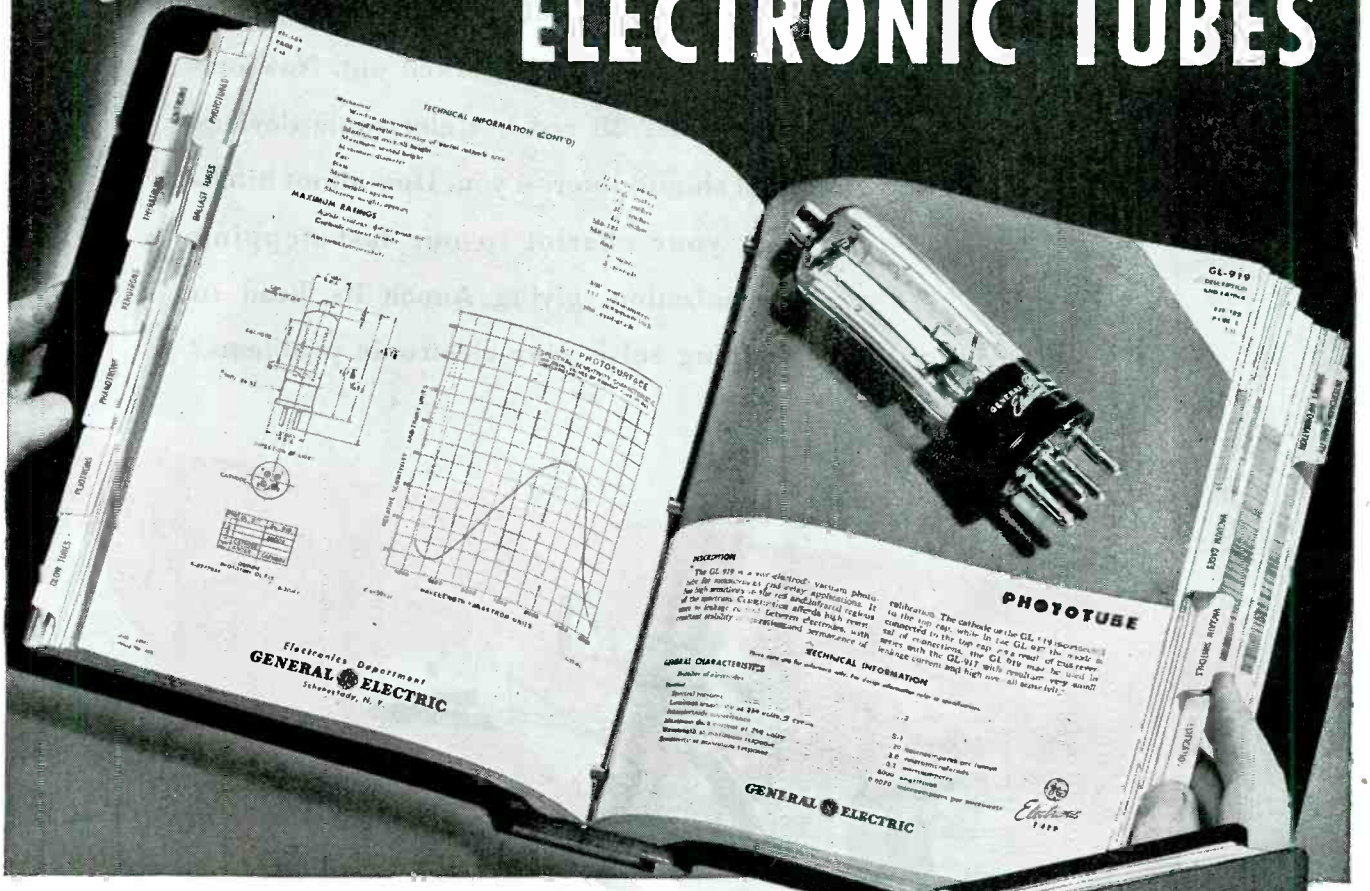
U-235

Electronic Industries used the sketch correctly last month in its comments on uranium 235 and atom splitting. The sketch applies properly to atom structure. But we hope that from now on it will be forever excluded from further electronic-tube exploitation, for which it is, of course, meaningless.

Hope He Didn't Mean Us

A New York newspaper recently interviewed fifty citizens to find out how they induced slumber on sleepless nights. Some counted sheep, some drank warm milk, but a radio engineer among the number was brutally frank. "When I can't drop off normally," said he, "I pick up a radio-engineering magazine and read it for a few minutes. That always put me soundly asleep."

it's here MANUAL OF INDUSTRIAL ELECTRONIC TUBES



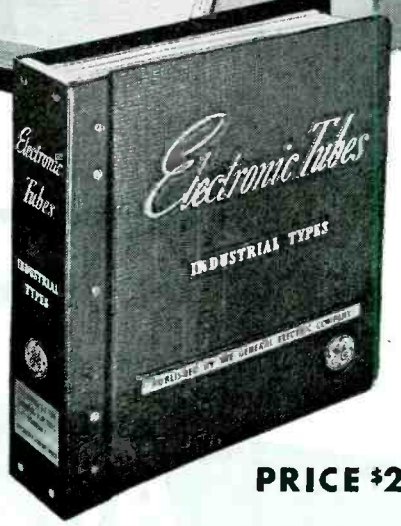
Newest, most comprehensive book in its field!

OVER 400 LARGE PAGES, filled with photographs, outline drawings, and performance curves, make G.E.'s new, *complete* manual on electronic tubes for industry a "must" for engineers and management.

EVERY TYPE OF INDUSTRIAL TUBE has its section — ignitrons, thyratrons, kenotrons, pliotrons, phanotrons, phototubes, glow tubes, ballast tubes, vacuum gages and switches. Applications are explained, typical circuits given, and 93 tubes are pictured, described, and rated. New tubes, such as the midget thyratron, are included.

DESIGNERS OF ELECTRONIC EQUIPMENT will find this manual a working ally they cannot do without. To users of industrial tubes, the book is a time-saving reference work of great value—easy to consult because of the tabbed dividers and indexed page corners, always up-to-date by reason of its loose-leaf format with new sheets sent when changes occur.

HANDSOMELY AND DURABLY BOUND, G.E.'s new tube manual is indispensable for your desk, file, or engineering library. Order direct from *Electronics Dept. (Section 4C), General Electric, Schenectady 5, N.Y.*



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"Electronic Tubes, Industrial Types" comes to you for $2. Also, for an annual service charge of $1 new and revised pages will be sent to you regularly as issued . . . ORDER TODAY, enclosing payment, or giving authority on your company letterhead to invoice you.

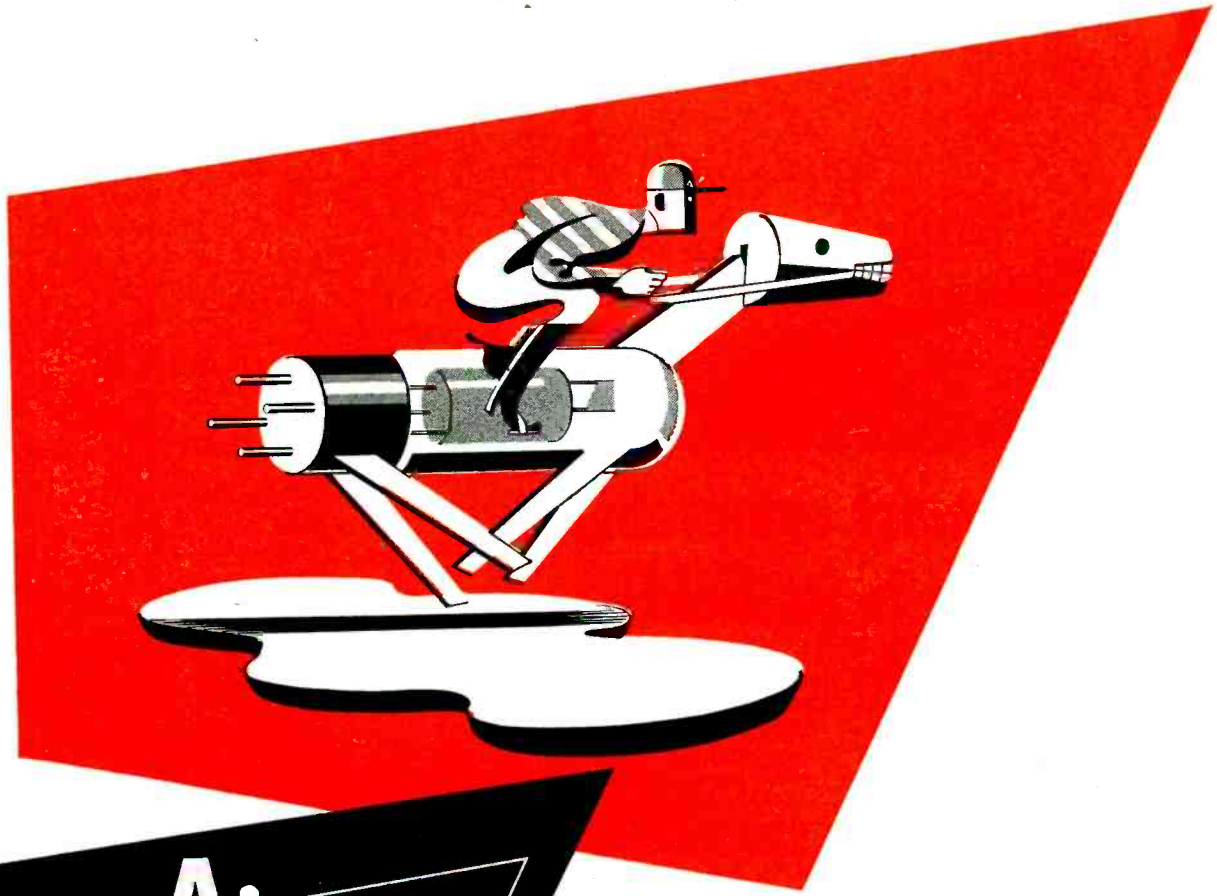
GENERAL ELECTRIC

162-D15-885C

TRANSMITTING, RECEIVING, INDUSTRIAL, SPECIAL PURPOSE TUBES • VACUUM SWITCHES AND CAPACITORS

Aireon rides again

OUR spirited steed is not only fast but well-gaited. We curled our lasso around the neck of "Electronics" a long time ago and with our strong personality, and kind treatment, turned it into our pet horse. It took a lot of skull work, a lot of smart engineering, but it worked out. Now our stable has 28 red hot electronic devices that should interest you. How about hitching your chariot to our fast-stepping organization, giving Aireon its head in helping solve your electronic problems?



Aireon

MANUFACTURING CORPORATION

Radio and Electronics • Engineer Power Controls

NEW YORK • CHICAGO

KANSAS CITY • BURBANK

INTO CARTONS.. NOT CANS..

WHERE do radio tubes go after inspection? Shipping cartons, or waste cans!

Imperfect tubes can't be fixed up. They have to be smashed up. So the manufacturer's problem is to keep down the number smashed up. And that calls for Nickel.

Consider the problems involved: Millions of intricate parts to be made to close dimensions... safeguarded against rust and corrosion while in storage, and through repeated handling . . . held to close dimensions in assembly . . . thoroughly degassed during bombardment.

No wonder manufacturers for over thirty years have stuck to Nickel. Nickel helps manufacturers produce tubes that are right in every respect . . . tubes that pass the inspector. And that means fewer rejections, increased yields, lower cost per finished tube . . . *saving where it counts the most.*

Pure Nickel and Nickel alloys serve many electrical applications. And among *your* metal problems, too, are some they'd doubtless solve.

Study Nickel's advantages, listed at right, and you'll see why.

Then write us for more information. Ask for your copy of "Nickel in the Radio Industry."

IMPORTANT ADVANTAGES

combined *exclusively* in NICKEL

1. Nickel's excellent forming quality simplifies production of precision parts.
2. Spot welds on Nickel make strong joints that are practically free of oxidation.
3. Nickel has strength to maintain precision during frequent handling in mounting parts.
4. Nickel is proof against rust during handling or storage, and it resists corrosion by solvents used for cleaning parts.
5. Nickel contains much less gas than other commercial metals and is degassed more readily. Higher temperatures can be used to speed up evacuation.
6. Nickel is stronger at the high evacuating temperatures and there is no crystal change on heating—both of which keep down dimensional changes, and preserve tube constants.
7. Better electron emission is obtained from coated Nickel cathodes.
8. Better, more adherent carbon coatings can be deposited on Nickel and the carbonizing process does not produce a brittle strip.
9. Nickel conducts heat better at elevated temperatures.

NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK 5, N. Y.

STANDARD CRYSTALS

Announcing

STANDARD'S MIDGET crystal unit, now on a production basis.

STANDARD brings you, as an answer to your frequency control problem, the MIDGET. A precision crystal to your specifications in a holder that's radically different* — designed to fit *minimum* space requirements. Furthermore, the cost is attractive.

The MIDGET is a real triumph of that skill and knowledge gained through our years of research, development and production experience. We have furnished the armed forces millions of crystal units—NOW we welcome the opportunity to supply *your* requirements.

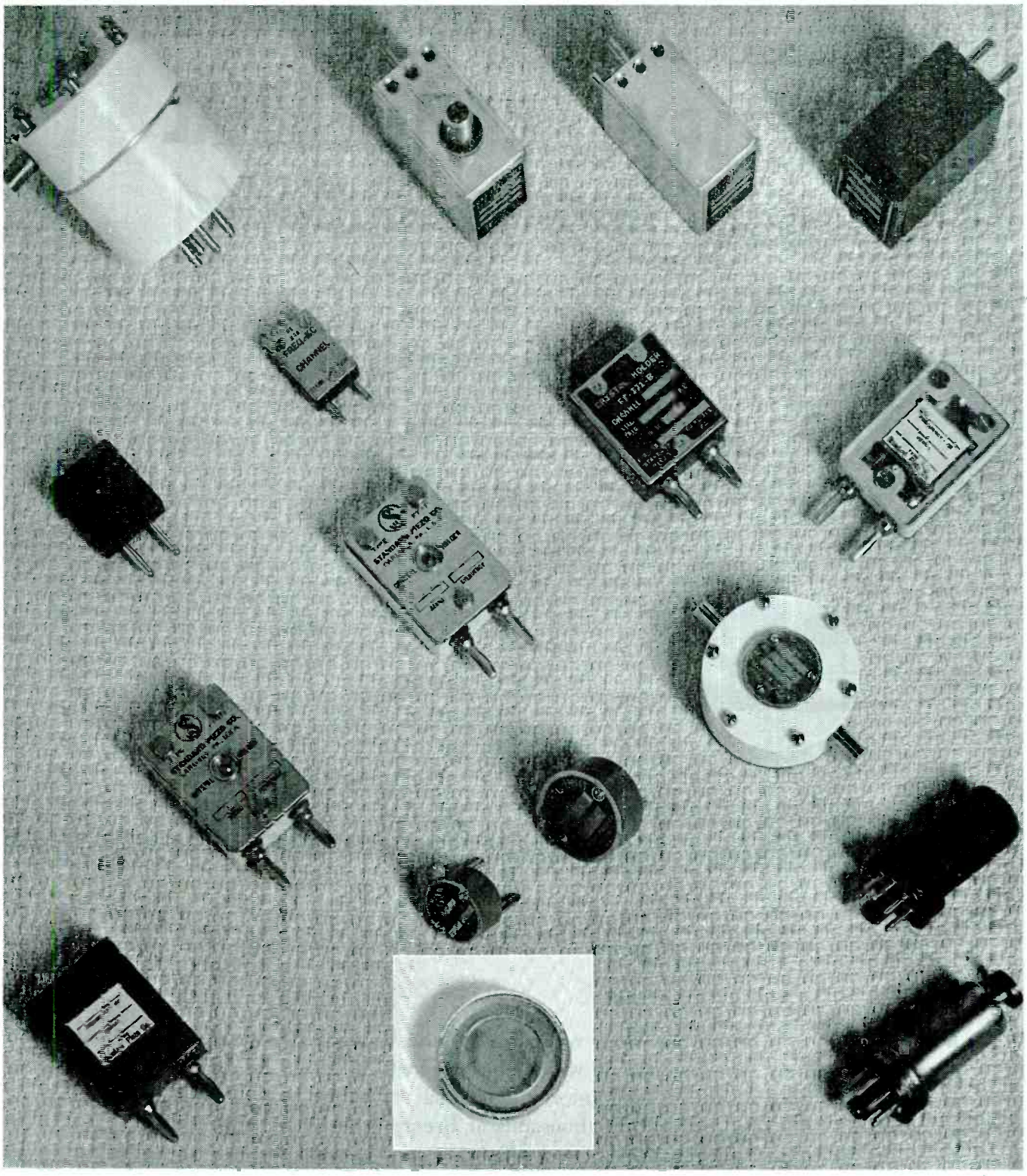
STANDARD'S engineering staff is at your command. *Write, wire* or *phone* us your frequency control problems.

For general AIRLINE, POLICE, BROADCAST, AIRCRAFT, AMATEUR and COMMERCIAL uses we make a complete line of crystals in standard or special holders. *Send for new catalog just coming off the press.* We take this opportunity to greet our old customers in these fields and to solicit their continued business.

* Refers to designs of holders.

→

In the inset (opposite page) the new STANDARD MIDGET is reproduced in actual size. The background pictures popular types in the STANDARD line.



STANDARD PIEZO COMPANY

Established 1936

Quartz Crystals and Frequency Control Equipment

Office and Development Laboratory

CARLISLE, PA., P. O. BOX 164

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CARLISLE, PA.

MILITARY or COMMERCIAL

—they're BOTH Breeze Shielded

Four Breeze-Shielded Wright Cyclone 18's rated at 2200 HP power the Boeing B-29 Superfortress in its smashing attacks against the Japanese homeland.

The 55-passenger Lockheed Constellation, whose trans-continental record of 6 hours, 58 minutes was powered by four Breeze-Shielded Wright Cyclone 18's.

• For many years Breeze has been recognized as the General Headquarters for Radio Ignition Shielding. The reputation which the products bearing the Breeze Mark of Quality built up on national and international airlines before the war has now been augmented by the service record of thousands of Breeze Shielding Assemblies for America's famous fighting aircraft, tank, marine and commercial engines. When final victory has been won, Breeze will once again be able to return to production of Shielding for commercial applications without delay for reconversion. And the reservoir of Breeze Shielding experience so materially increased in maintaining dependable communication in war, will be available to help pace progress in peace.

BREEZE

Corporations Inc.

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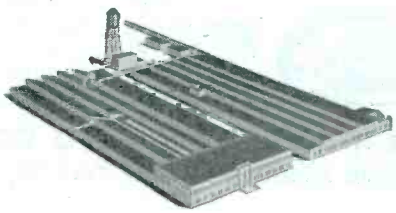
Other Breeze Products • SHIELDING FOR AIRCRAFT • MARINE • ELECTRONIC APPLICATIONS OF ALL TYPES

FOR 34 years, Magnavox has specialized in speakers and speaker satisfaction.

★★ *Magnavox designers and engineers have achieved a breadth of experience and knowledge that enables them to meet your specifications exactly. And Magnavox production men have the know-how to build your speakers at the right price, to a high standard of quality—on time.*

★★ Hard-to-satisfy research engineers constantly seek better speaker designs and better production methods. They stand ready to apply their developments to any of your component problems.

★★ *When you think of speakers, think of Magnavox.* ***There is no substitute for experience.*** *The Magnavox Company, Components Division, Fort Wayne 4, Indiana.*

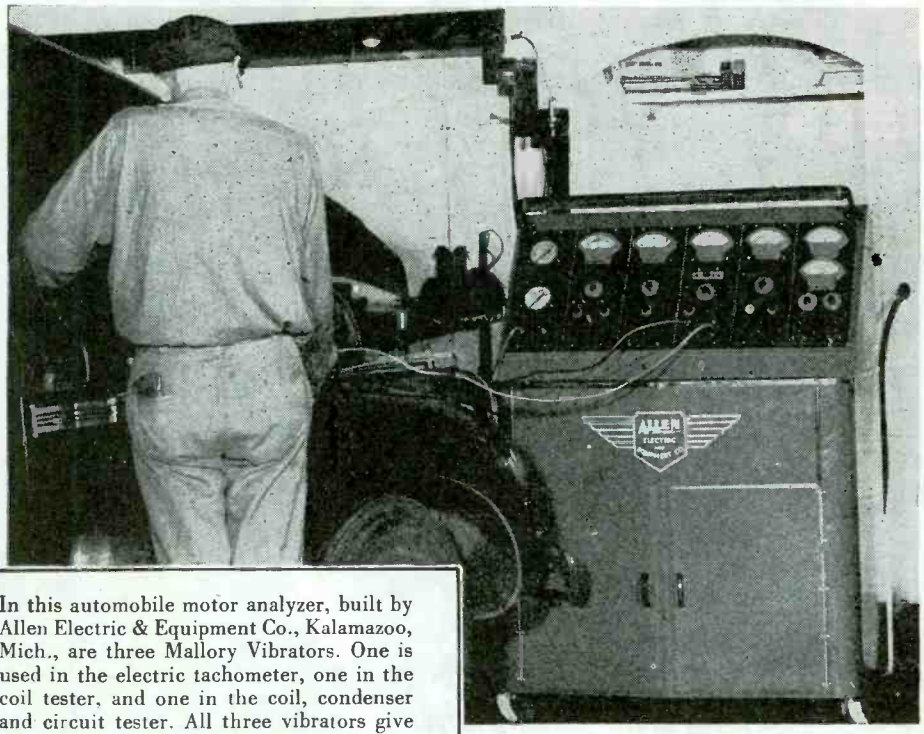


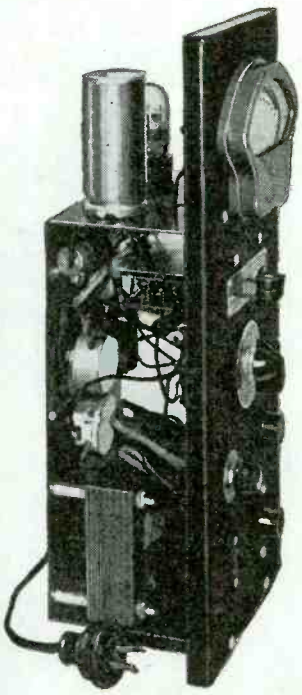
Magnavox

has served the radio industry 34 years

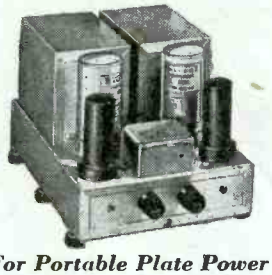
SPEAKERS · CAPACITORS · SOLENOIDS · ELECTRONIC EQUIPMENT

MALLORY Precision VIBRATORS
Help Test Automobile Engines





In this automobile motor analyzer, built by Allen Electric & Equipment Co., Kalamazoo, Mich., are three Mallory Vibrators. One is used in the electric tachometer, one in the coil tester, and one in the coil, condenser and circuit tester. All three vibrators give precision performance and help assure accurate motor testing.



For Portable Plate Power Mallory Vibrapacks

Mallory Vibrapacks deliver voltages from 125 to 400 from any low voltage source . . . with high efficiency; low battery drain; ease of installation; long life.

PRECISION test equipment, such as this motor analyzer, is always built with precision parts like Mallory Vibrators. Serving in similar industrial electronic applications, in automotive, aircraft and marine radios, and on farms are millions of Mallory Vibrators . . . wherever dependable conversion of battery DC voltages to high voltages is required.

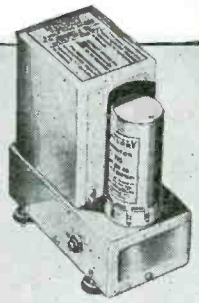
Mallory engineers have pioneered in improving vibrator designs, materials and workmanship. An example is the hermetic sealing of every Mallory Vibrator . . . preventing damage from moisture or fumes, or ionization at low atmospheric pressures.

There's a complete line of Mallory standard Vibrators and Vibrapacks* available from your nearest Mallory Distributor. Ask him for a free copy of the Mallory catalog. Or write us today.

Inquiries are invited from manufacturers for Vibrators and Vibrapacks for use in original equipment

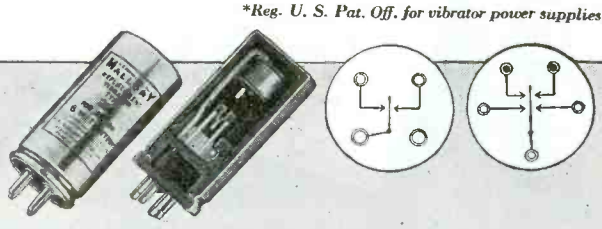
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

**Reg. U. S. Pat. Off. for vibrator power supplies.*



P.R. MALLORY & CO. Inc.

MALLORY



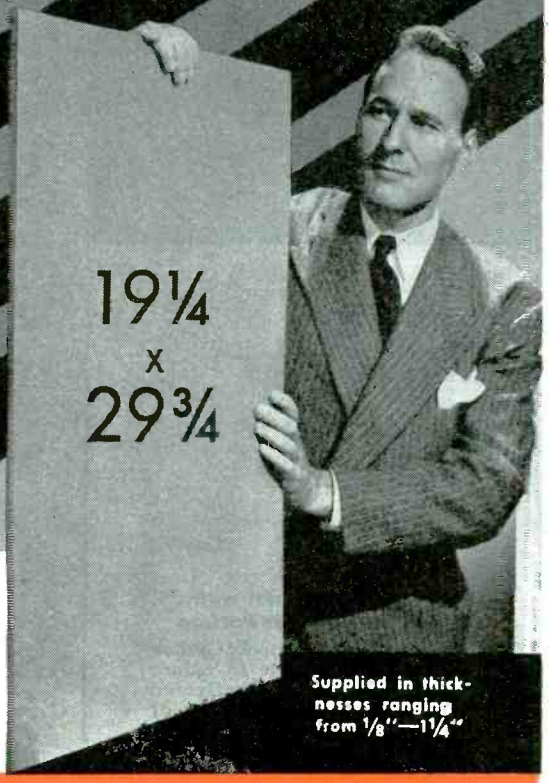
VIBRATORS and VIBRATOR POWER SUPPLIES

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

MYKROY

PERFECTED MICA CERAMIC INSULATION

Make Possible Many Additional Uses for this Superior Insulation



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

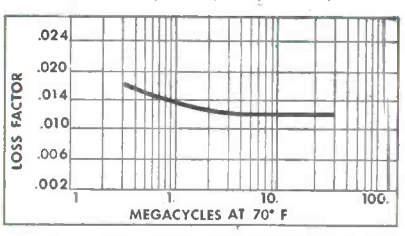
ELECTRICAL PROPERTIES*

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 Boonton 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

Microphones Engineered by Electro-Voice

Answer Everyday Sound Problems

Maximum Intelligibility Under Extreme Noise

Hand-Held, close-talking single button carbon *DIFFERENTIAL microphone for all speech transmission in any noisy, windy, wet or extremely hot or cold locations. Cancels out background noise. Articulation is at least 97% under quiet conditions, and 88% under a 115 db noise field.

Model 205-S. List Price.....$25

Patent No. 2,350,010

Higher Articulation with Less Fatigue

Moving coil, hand-held Dynamic microphone for high fidelity speech transmission. Uniform response, free from peaks, in the useful frequencies gives higher articulation, provides more usable power level, and is less fatiguing to the listener. For outdoor or indoor use.

Model 600-D. Dynamic. List. $27.50
Model 210-S. Carbon. List. . $17.50

Poly-Directional with Adjustable Polar Pattern

The versatile high fidelity Cardak is readily adjustable to reduce any combination of reflected sound. Cuts reverberation or random noise pick-up . . . minimizes acoustic feedback. For broadcasting, recording, public address, communications.

Model 725—Cardak I. List....$55
Model 730—Cardak II. List....$75

General-Purpose Dynamic for Voice and Music

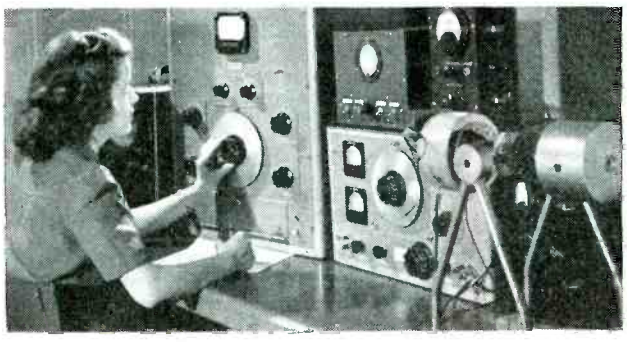
Widely used because of its dependable all-around performance. Excellent frequency response for both indoor and outdoor speech and music pick-up. Rugged, small size, light weight. High output. Suitable for public address, dispatching, paging, recording and remote broadcast.

Model 630-C. List Price..... $30

Velocity High Fidelity Bi-Directional Sound Pick-Up

Wide, flat frequency response, bi-directional polar pattern, high fidelity characteristics, wide-angle front pick-up, and pick-up range make it ideal for solo, orchestra, or chorus, for single speaker or groups. For indoor P.A., broadcasting, recording.

Model V-1-C. List Price.....$30
Model V-2. List Price.....$37.50
Model V-3. List Price.....$50



Corner of E-V "Lab"

One of our Quality-Control units used in testing close-talking microphones. Harmonic distortion, frequency response, positional response (for carbons) level, etc., are carefully analyzed. Calibration is effected by Bell Laboratory standards and our own reciprocity checks.

SEND FOR COMPLETE CATALOG

Gives valuable data on Electro-Voice Microphones for communications, public address, broadcasting and recording. Includes helpful Reference Level Conversion Chart.

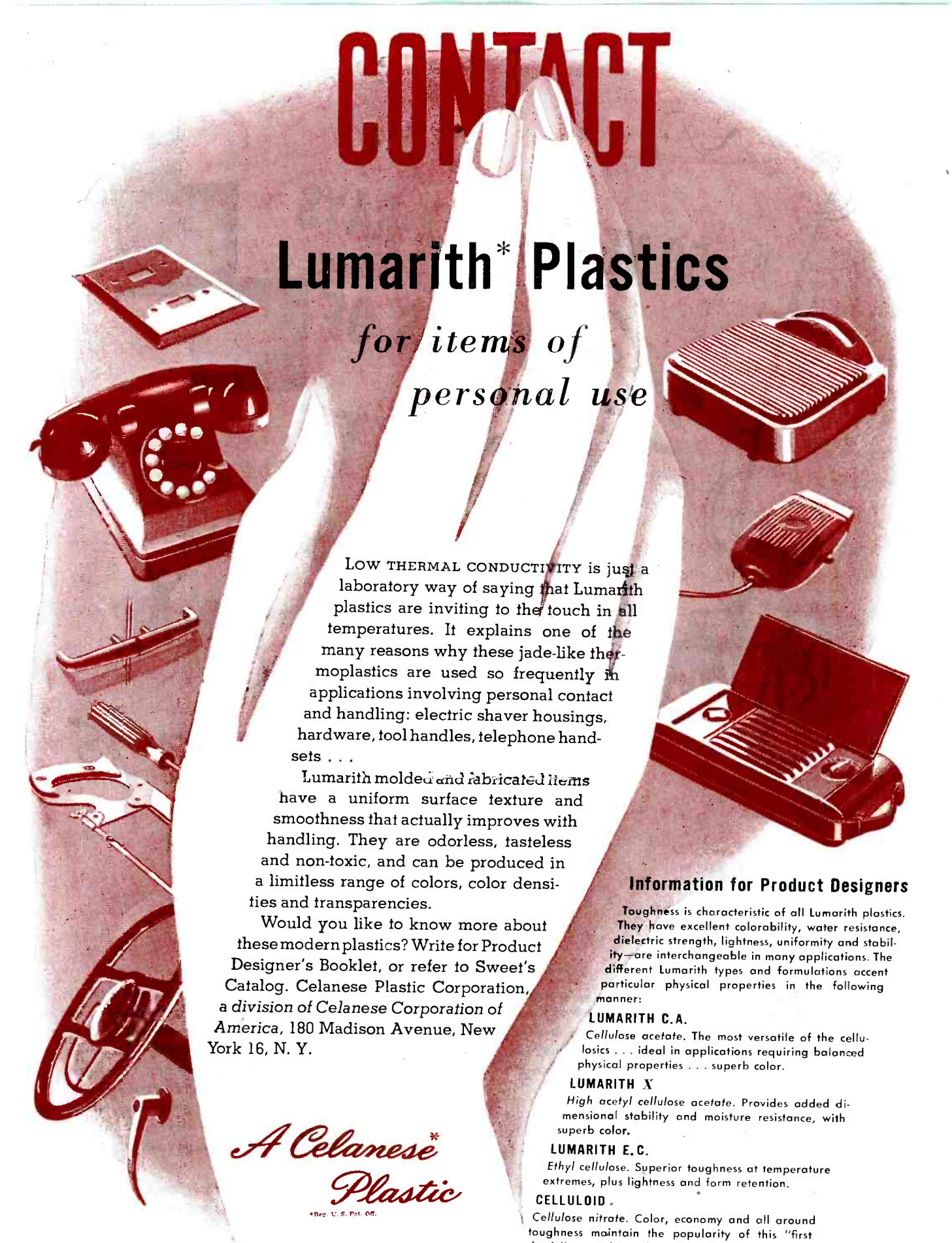
Authorized Distributors Everywhere

No finer choice than **Electro-Voice MICROPHONES**

GUARANTEE

The E-V models shown here are guaranteed forever against defects in workmanship and material.

ELECTRO-VOICE, INC., 1239 South Bend Ave., South Bend 24, Indiana ★ *Export Division:* 13 East 40th St., New York 16, N. Y., U. S. A.— Cables: Arlab



CONTACT

Lumarith* Plastics

for items of personal use

LOW THERMAL CONDUCTIVITY is just a laboratory way of saying that Lumarith plastics are inviting to the touch in all temperatures. It explains one of the many reasons why these jade-like thermoplastics are used so frequently in applications involving personal contact and handling: electric shaver housings, hardware, tool handles, telephone handsets . . .

Lumarith molded and fabricated items have a uniform surface texture and smoothness that actually improves with handling. They are odorless, tasteless and non-toxic, and can be produced in a limitless range of colors, color densities and transparencies.

Would you like to know more about these modern plastics? Write for Product Designer's Booklet, or refer to Sweet's Catalog. Celanese Plastic Corporation, a *division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

A Celanese Plastic*

*Reg. U. S. Pat. Off.

Information for Product Designers

Toughness is characteristic of all Lumarith plastics. They have excellent colorability, water resistance, dielectric strength, lightness, uniformity and stability—are interchangeable in many applications. The different Lumarith types and formulations accent particular physical properties in the following manner:

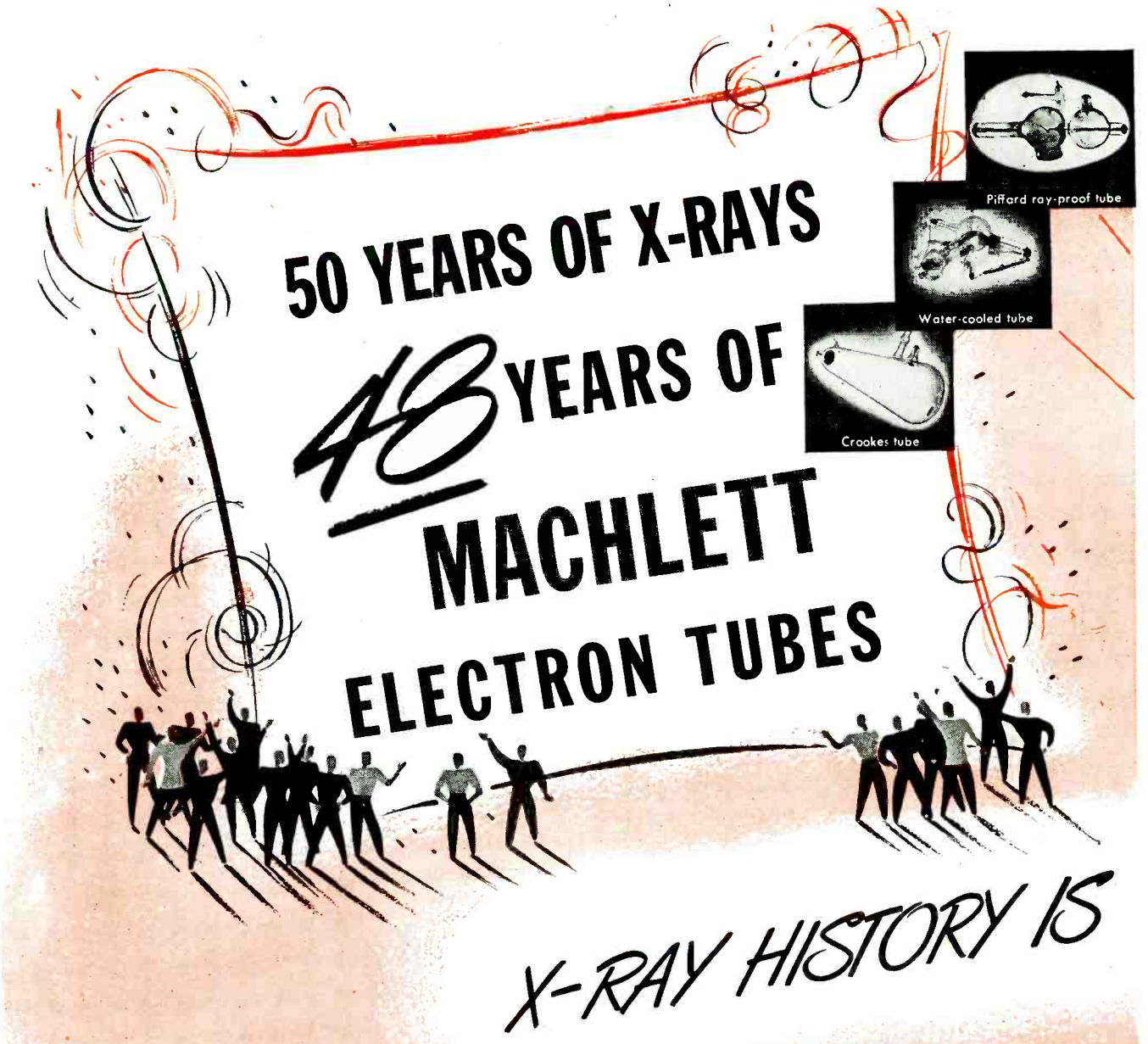
LUMARITH C.A.
Cellulose acetate. The most versatile of the cellulosics . . . ideal in applications requiring balanced physical properties . . . superb color.

LUMARITH X
High acetyl cellulose acetate. Provides added dimensional stability and moisture resistance, with superb color.

LUMARITH E.C.
Ethyl cellulose. Superior toughness at temperature extremes, plus lightness and form retention.

CELLULOID
Cellulose nitrate. Color, economy and all around toughness maintain the popularity of this "first plastic". . . used in volume for fabricated items.

Success with plastics depends on the proper selection of plastic type and formulation. Our technical staff is at your service.



50 YEARS OF X-RAYS

48 YEARS OF MACHLETT ELECTRON TUBES

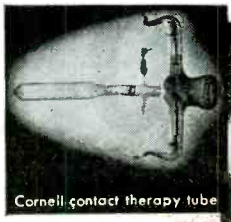
X-RAY HISTORY IS

IT WAS 50 YEARS AGO, on November 8, 1895, that scientific investigation led Roentgen to the discovery of X-rays. In this semi-centennial year we honor his work, and the work of the pioneers who, sometimes at the sacrifice of their own lives, developed the theory and practice of a science that today means so much to all mankind.

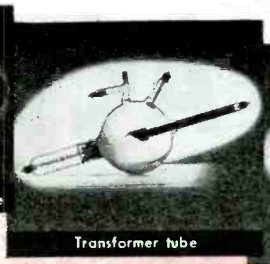
Very soon after Roentgen publicly announced his discovery in 1896, Robert H. Machlett made the first practical American X-ray tube. Quickly he improved his techniques, creating a whole series of "firsts" such as the first ray-proof tube, the first cooled by water, the first for contact therapy. The organization he founded carries on his principle of constant research, improvement and initiative, and has many other firsts to its credit, culminating in the amazing and unique 2,000,000-volt, direct current, sealed-off, precision X-ray tube.

To a large extent, X-ray history is Machlett history, a history of service to mankind. Today, Machlett tubes are in use by doctors, hospitals, laboratories and factories in many parts of the world, saving lives, inspecting products, performing delicate analyses, expanding man's knowledge, serving with unmatched exactitude and economy. For the future, Machlett's talents will create other and still more valuable applications, for Machlett never stands still, is always creative, improving its tubes, developing new ones for old and new services.

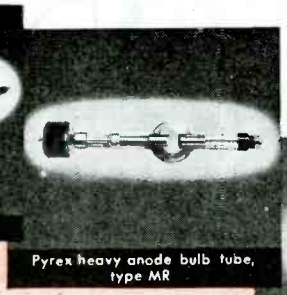
In addition to X-ray tubes for all purposes, we also make oscillators, amplifiers and rectifiers for radio and industrial uses, all to the same high (and unmatched) standards to which our X-ray tubes are held. It will pay you to buy Machlett tubes. For information as to the available types, write Machlett Laboratories, Inc., Springdale, Connecticut.



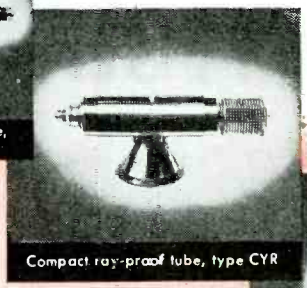
Cornell contact therapy tube



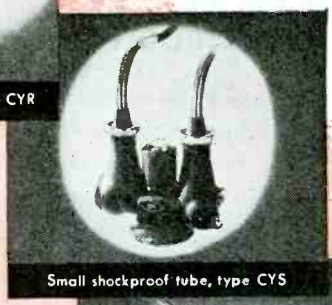
Transformer tube



Pyrex heavy anode bulb tube, type MR



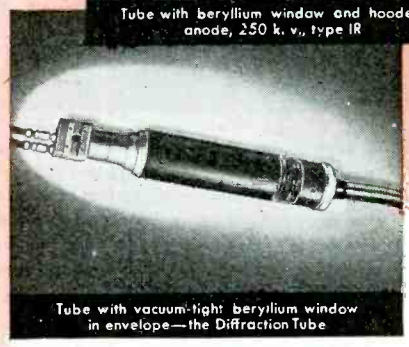
Compact ray-proof tube, type CYR



Small shockproof tube, type CYS

Silver bearing long-life rotating target tube, type DX

Tube with beryllium window and hooded anode, 250 k. v., type IR



Tube with vacuum-tight beryllium window in envelope—the Diffraction Tube

first MACHLETT HISTORY!

From the Beginning

"When in 1895 Professor Roentgen announced his discovery, Machlett was immediately interested and began experiments to reproduce the results of Roentgen. He was ideally equipped for such work, for just at that time he had perfected a mercury pump capable of producing a very high vacuum. He attacked the difficult task and before many days had passed, succeeded in producing the first X-ray tube in this country."—I. S. Hirsch, *Radiology* 8:254, 1927.

2,000,000 volt direct current precision radiographic tube, type VM

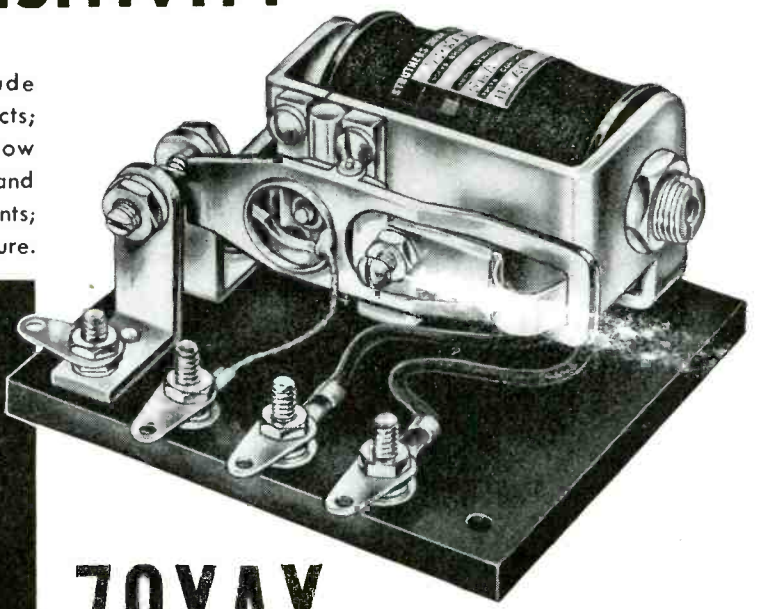
MACHLETT

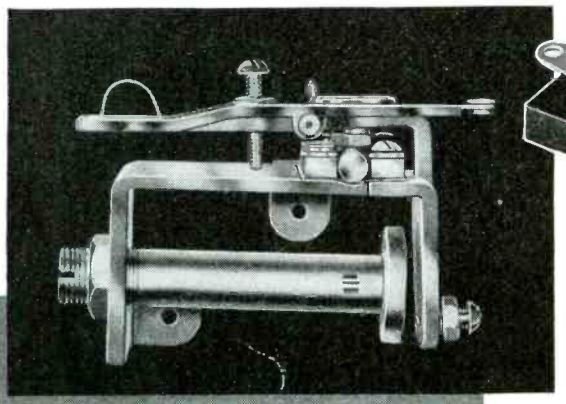
APPLIES TO RADIO AND INDUSTRIAL USES ITS 43 YEARS OF ELECTRON-TUBE EXPERIENCE

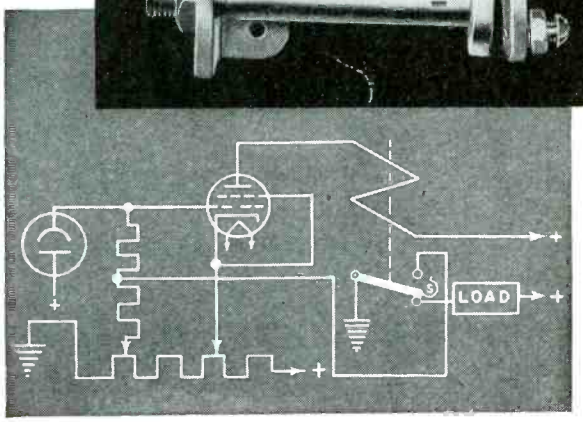
POSITIVE SNAP ACTION

0.02 WATT SENSITIVITY

SIMPLIFIED CONSTRUCTION . . . Features include snap action contacts; high sensitivity; low operating power; statically balanced armature and contact assembly; six easily accessible adjustments; good contact wipe and stable contact pressure.







A typical vacuum tube application. A slight increase in plate current closes the relay, thus increasing negative bias on the amplifier tube so that plate current through the relay coil immediately decreases to a point close to the release value for the relay. Thus, any slight decrease in light falling on the photo cell will reduce plate current sufficiently to return relay contacts to normal position.

79XAX

Struthers-Dunn Type 79XAX snap action d-c operated relay is a positive acting sensitive unit that finds a wide variety of applications in circuits with slowly changing control currents. Erratic operation and varying contact resistance encountered with ordinary sensitive relays are eliminated. Applications for this popular relay cover a broad range of use from vacuum tube circuits, to overcurrent protection, pulsing circuits, and uses where extremely close differential or sensitivity of operation is required.

WRITE for Data Bulletin 79XAX giving full construction details and outlining a variety of suggested uses.

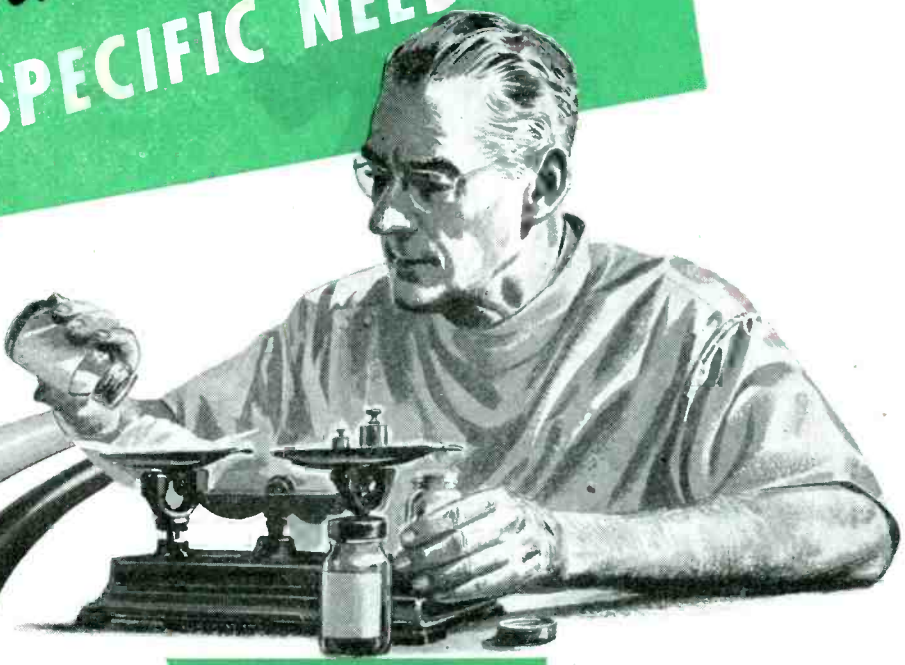
STRUTHERS-DUNN, Inc., 1321 Arch Street, Phila. 7, Pa.

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

Special formulations FOR SPECIFIC NEEDS!



Fibron

PLASTIC TUBINGS AND TAPE

Users of flexible plastic tubings and tape secure a large increment of efficiency and economy when they specify "Fibron by Irvington." For the product they receive has been especially formulated for their own specific need. Should the *major* requirement be operation at elevated temperatures, a Fibron formulation for exactly that job can be supplied. Likewise for temperatures as low as −70° F; or for services requiring resistance to acids, alkalis, corrosive fumes, and abrasion. In each case the correct Fibron formulation is supplied. Each formulation of course, furnishes the high electrical and mechanical properties essential for efficient, long lasting insulation.

It is this Irvington policy of "*engineering* and *formulating* for specific applications," that accounts for the long service which Fibron plastic products provide . . . as well as for Irvington's continuing leadership in electrical insulation!

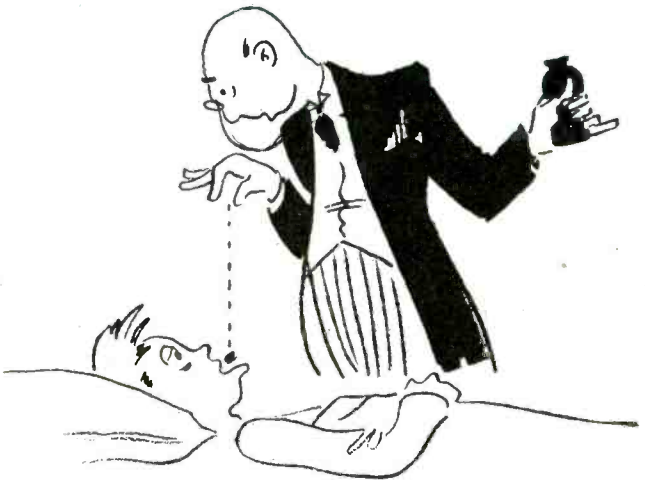
Fibron plastic tubings are produced in all standard opaque colors as well as transparent — diameters from .034" to 2" — in coils or cut lengths. Fibron tapes are obtainable in black and clear, in widths ½" to 3", thicknesses .004" to .030" and in convenient length rolls for hand application. Fibron wire markers are available plain or stamped, in inside diameters from .053" to ½".

An outline of *your* special requirements will receive immediate attention. Write Dept. 50.

STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE REG. U.S. PAT. OFF. MARK

IRVINGTON
VARNISH & INSULATOR CO.
Irvington 11, New Jersey, U. S. A.

"LOOK TO IRVINGTON FOR CONTINUED LEADERSHIP IN INSULATION"



GOOD MEDICINE

for your control or protection problems

KLIXON Snap-Acting CONTROLS

A quick, clean "break" or a solid "make" . . . that's what you get when you use Klixon Snap-Acting Controls in such applications as motor and transformer overheat protection, electrical circuit overload protection, thermal time delays or temperature control for radio equipment. These small, compact, lightweight controls operate surely and accurately no matter how often they operate. Because they have no toggles, or other complicated parts, they give foolproof control or protection even under vibration, shock, motion or altitude. They are available in a wide range of standard types with ratings to meet practically all requirements . . . and in sizes that can easily be incorporated into most mechanical design plans.

Our engineers will gladly help you with your control or protection problems. Write for their services today.

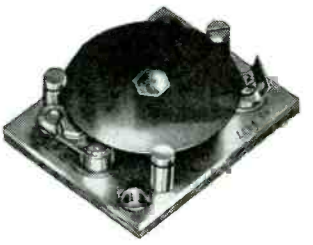
SPENCER THERMOSTAT COMPANY • ATTLEBORO, MASSACHUSETTS

KLIXON

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

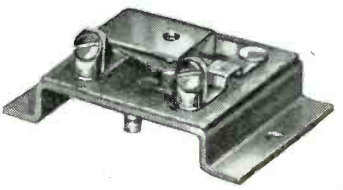
Type C-2851 Thermostat. For such use as Roughing Controls on Outer Crystal Ovens.

Type ER Series. Ambient Compensated Time Delay Relays.



Type B-3120 Thermostat and Heater, Crystal Dew Point Control.

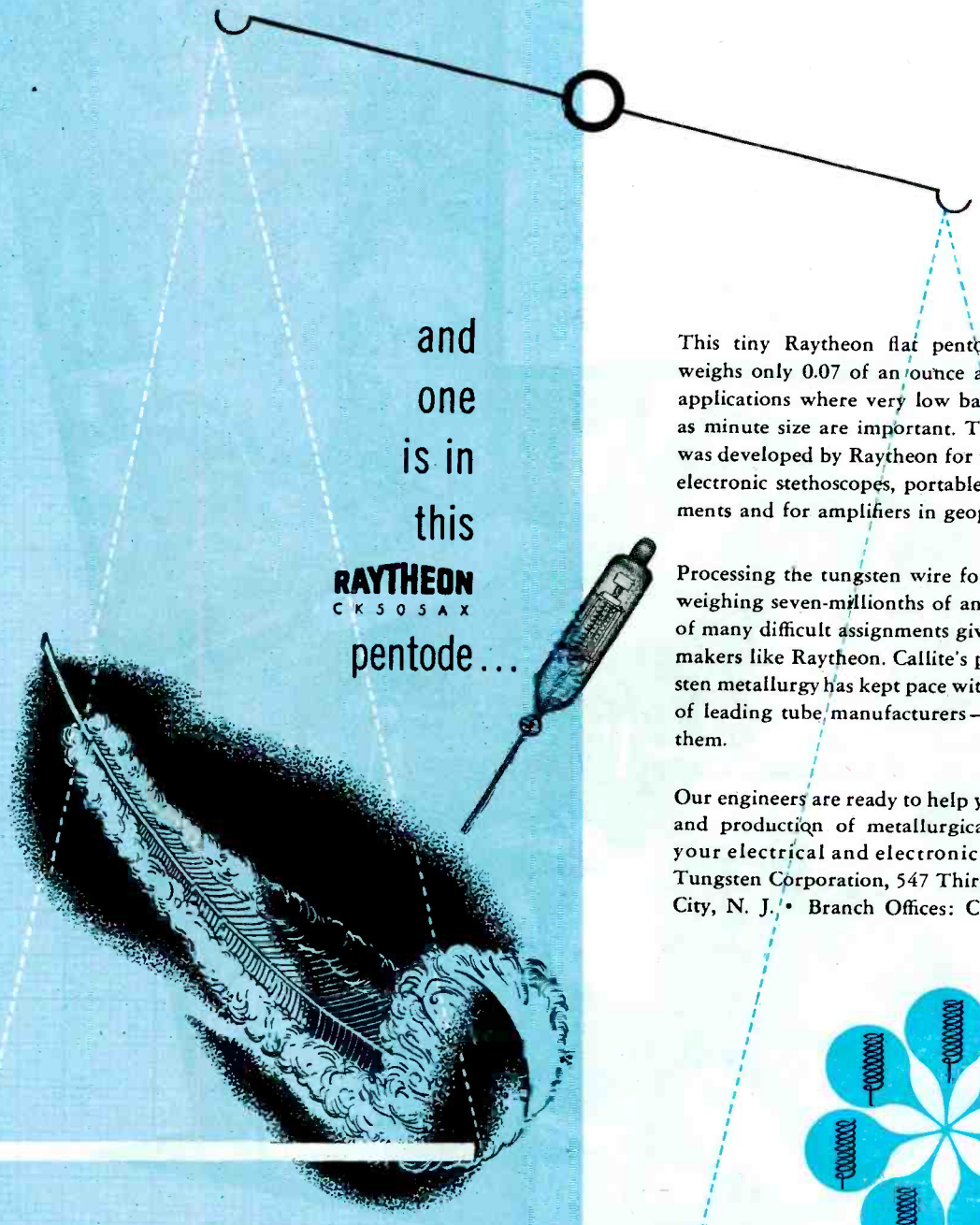
Type C-6363
Switch Circuit Breaker



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

Type RT Thermostat. Adjustable Temperature Control.

7,000,000 of these Callite filament springs weigh one ounce!



and one is in this RAYTHEON CK505AX pentode...

This tiny Raytheon flat pentode in its entirety weighs only 0.07 of an ounce and is designed for applications where very low battery drain as well as minute size are important. The CK505AX tube was developed by Raytheon for use in hearing aids, electronic stethoscopes, portable measuring instruments and for amplifiers in geophysical apparatus.

Processing the tungsten wire for a filament spring weighing seven-millionths of an ounce is only one of many difficult assignments given Callite by tube-makers like Raytheon. Callite's pioneering in tungsten metallurgy has kept pace with the requirements of leading tube manufacturers—often anticipating them.

Our engineers are ready to help you with the design and production of metallurgical components for your electrical and electronic products. Callite Tungsten Corporation, 547 Thirty-ninth St., Union City, N. J. • Branch Offices: Chicago, Cleveland.

Callite tube components

CALLITE TUNGSTEN CT

Hard glass leads, welds, tungsten and molybdenum wire, rod and sheet, formed parts and other components for electron tubes and incandescent lamps.

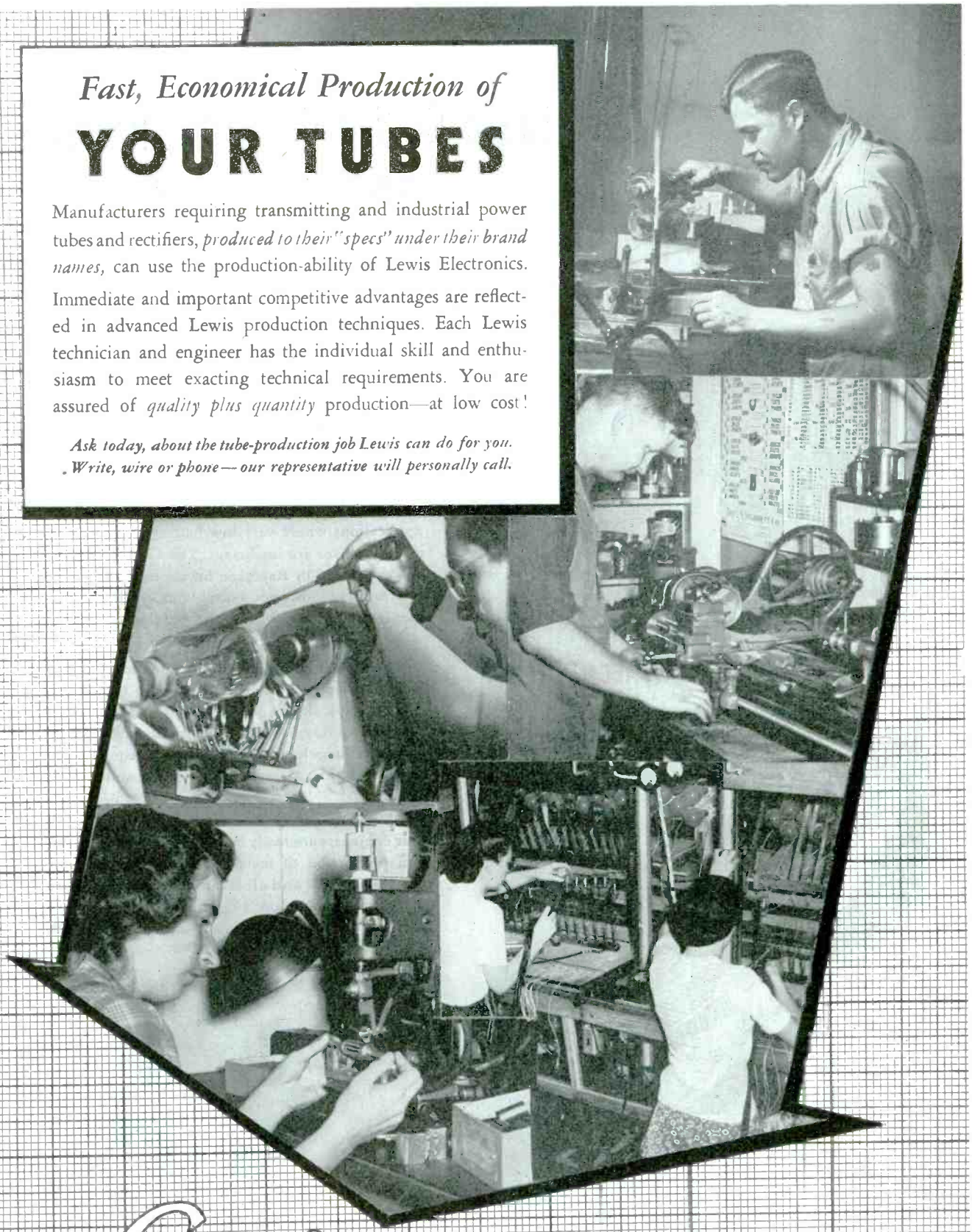
Fast, Economical Production of

YOUR TUBES

Manufacturers requiring transmitting and industrial power tubes and rectifiers, *produced to their "specs" under their brand names,* can use the production-ability of Lewis Electronics.

Immediate and important competitive advantages are reflected in advanced Lewis production techniques. Each Lewis technician and engineer has the individual skill and enthusiasm to meet exacting technical requirements. You are assured of *quality plus quantity* production—at low cost!

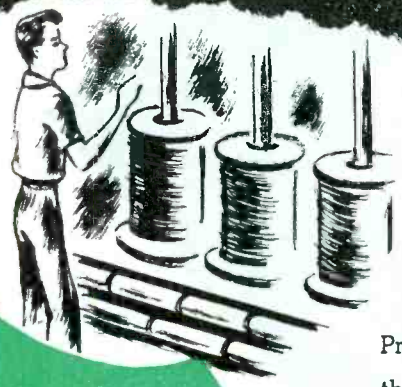
Ask today, about the tube-production job Lewis can do for you. Write, wire or phone—our representative will personally call.



Lewis ★ ELECTRONICS

LOS GATOS · CALIFORNIA

From Annealing to Flaw Detection
ELECTRONICS Does it better



-for the WIRE INDUSTRY

Problems in wire-making that have long challenged the industry are on their way out, thanks to the solutions which electronics offers. Costly operations will be replaced by economical short cuts. Laborious checking methods will yield to automatic controls. In industry after industry, electronics is showing how to do the job better, how to make a better product — for less! We of Sherron Electronics offer a worthwhile service to manufacturers in the wire industry. Our experience and skills in the production of custom-built electronic equipment cover all factors involved in . . . design, engineering, development and manufacturing. Write to learn how Sherron Electronics can help you.

How Electronics Serves the Wire Industry

ELECTRONIC HEATING for annealing and finish drying.

ELECTRONIC CONTROLS for level, shut-off, spray, temperature and time.

ELECTRONIC REGULATION for slack and tension.

ELECTRONIC counters for coil counting, flaw detection, weld detection and fault detection and location.

ELECTRONIC and automatic measurement of thickness, etc.

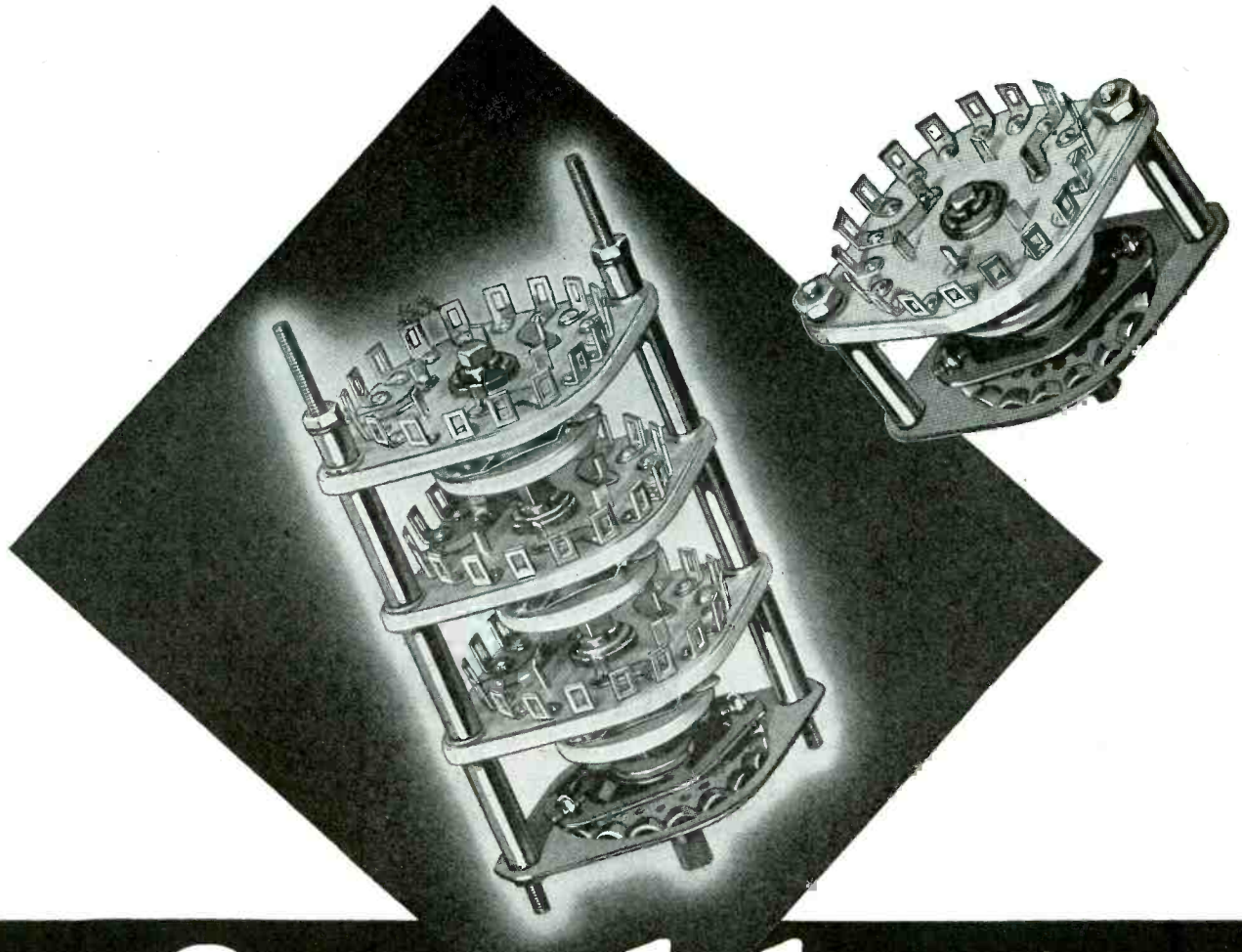
Sherron Electronics

SHERRON ELECTRONICS COMPANY

Division of Sherron Metallic Corporation

1201 Flushing Avenue — Brooklyn 6, N. Y.

"WHERE THE IDEAL IS THE STANDARD, SHERRON UNITS ARE STANDARD EQUIPMENT"



Centralab

MEDIUM DUTY POWER SWITCHES

. . . available for transmitters, power supply converters and many special industrial and electronic uses.

The units are assembled in multiple gangs with a choice of shorting or non-shorting contacts.

The switching combinations manufactured for stock delivery are in single or multiple sections . . . 3 pole, 5 positions and 1 pole, 17 positions. (17 positions can be furnished with 18 positions continuous rotation.) Special combinations available.

Rated at 7½ amperes at 60 cycles, 115 volts, voltage breakdown 2500 volts D.C. to ground.

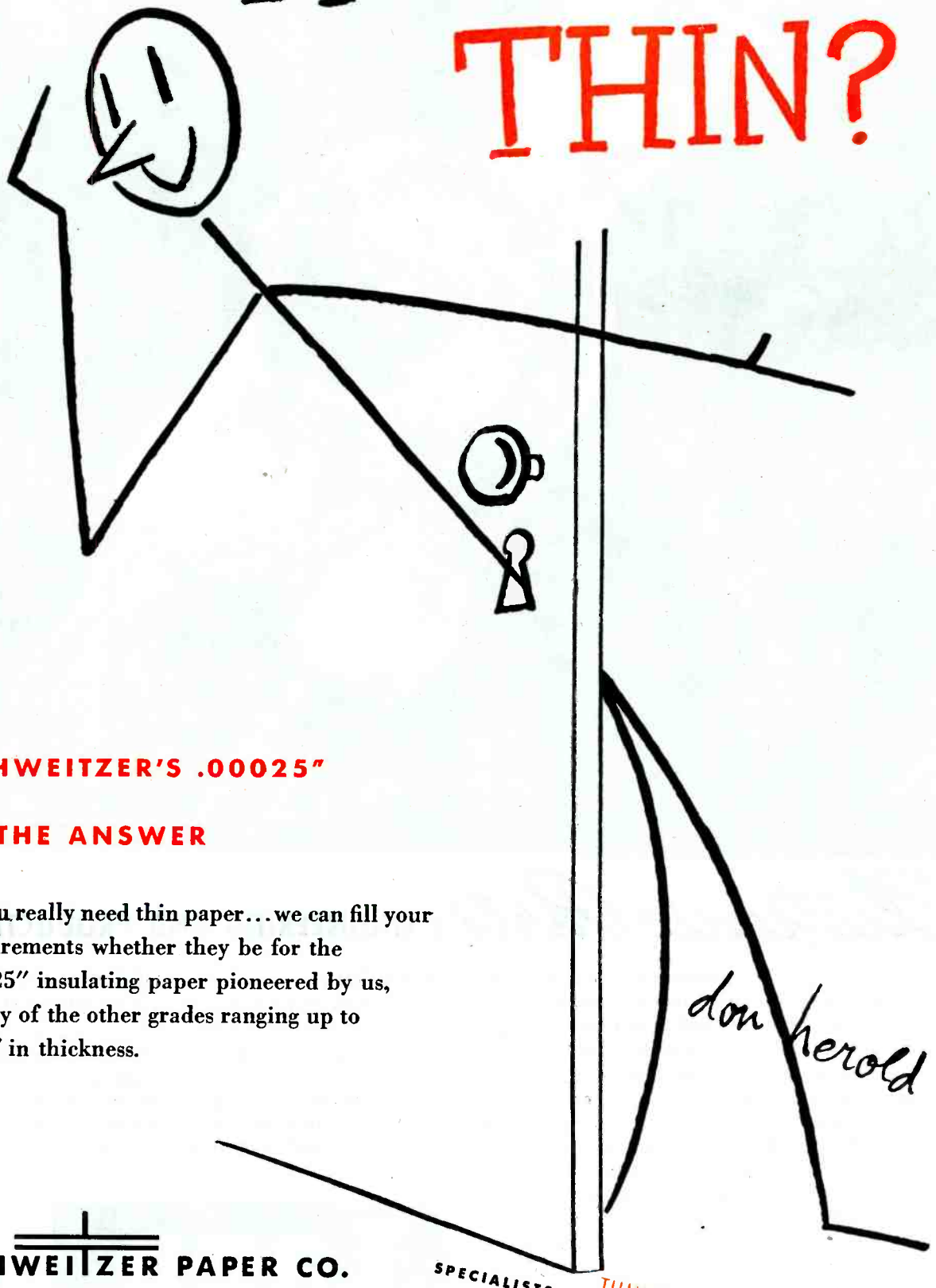
Write for Bulletin 815.

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

Centralab

Division of GLOBE-UNION INC., Milwaukee

How thin is THIN?



SCHWEITZER'S .00025"

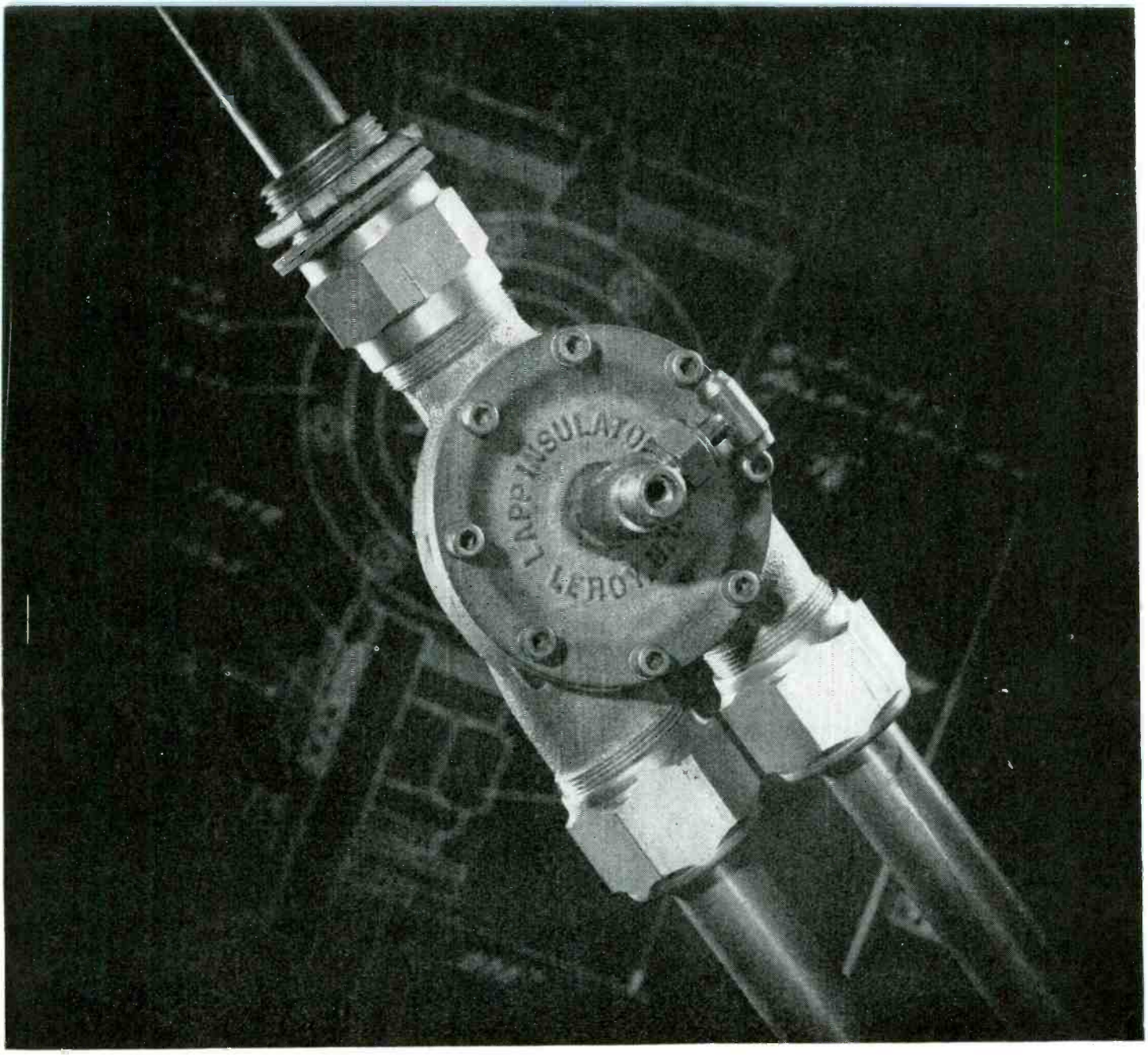
IS THE ANSWER

If you really need thin paper... we can fill your requirements whether they be for the 00025" insulating paper pioneered by us, or any of the other grades ranging up to .004" in thickness.

SCHWEITZER PAPER CO.

142 MILLER STREET, NEWARK, N. J.
Plants: Newark, Jersey City, N. J., Mt. Holly Springs, Pa.
Research Laboratories: Chrysler Bldg, New York, N. Y.

SPECIALISTS IN THIN GAUGE INSULATING PAPERS



Electronic Parts: ENGINEERING AND PRODUCTION

The gadget above is a junction box for a co-axial gas-filled transmission line. It is one of a series of coupling units, end seals and other fittings for high-frequency transmission—designed and built by Lapp.

To this type of construction, Lapp brings several innovations and improvements. For example, such a line from Lapp parts is genuinely leak-proof. Every gasket is under spring loading, so there's no leakage created by vibration or thermal change.

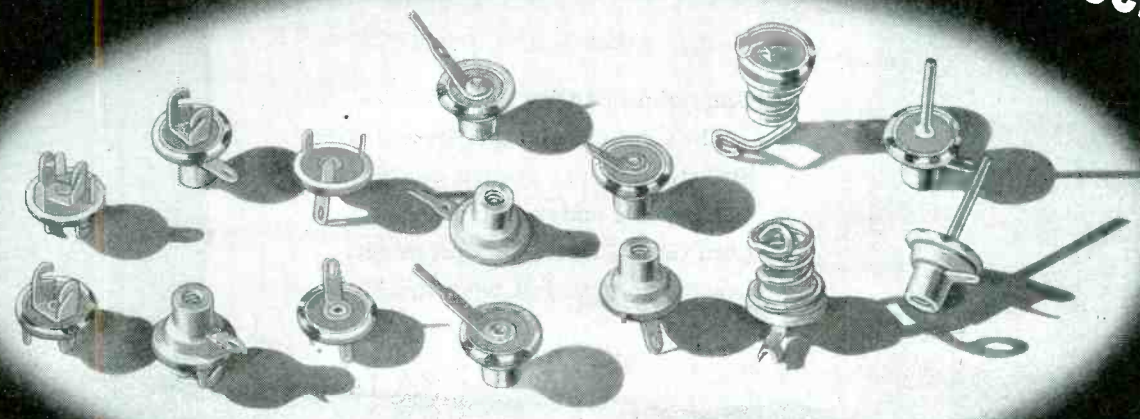
Whether or not you're interested in gas-filled transmission lines, you ought to know about Lapp. Here is an organization of engineers and manufacturers with broad basic knowledge of ceramics and their application. With experience in hundreds upon hundreds of special-purpose electronic parts, we have been able countless times to improve performance, or reduce costs, or cut production time through the application of our specialized skills to design and manufacture of parts involving porcelain or steatite and associated metal parts.

For quick and efficient assistance on a war production subcontract—or for the competitive advantage Lapp-designed and Lapp-built parts will give to you in the postwar battle—an inquiry to Lapp now may pay you dividends. *Lapp Insulator Co., Inc., LeRoy, N. Y.*

Lapp

ERIE

Button Silver Mica Condensers



Now available up to 1000 MMF

THE compact Erie Type 370 Button Silver Mica Condensers are now available with uniform nominal diameter of .447" in all capacities up to and including 1,000MMF. This higher capacity range greatly broadens the field of application for these popular units.

These condensers have proven to be ideal components for V.H.F. and U.H.F. applications where short ribbon-type leads, low series inductance, and compactness are requisite factors. Their efficiency and quality have been thoroughly established through practical service, in large quantities since 1941.

Illustrated above are several special and standard styles of type 370 Button Micas. In the interest of economical production 18 styles have been selected as standard units. The chart at the right gives the corresponding letter designations for the case and terminal styles of these standard units.

When ordering, case style should be specified first, by its corresponding letter, followed by terminal letter.

Complete technical information on Erie Type 370 Button Micas will be sent to interested engineers on request.

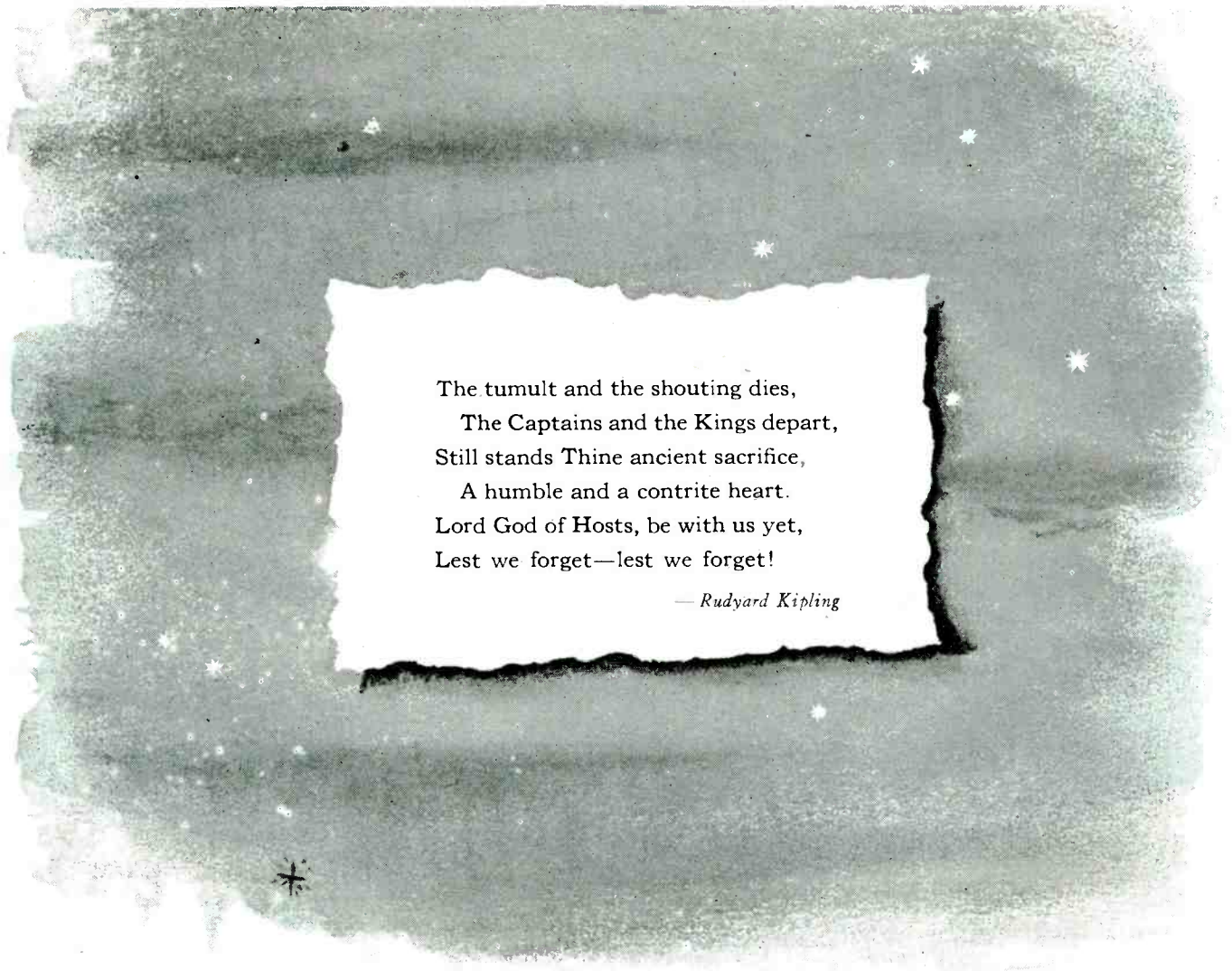
CASE STYLE → / TERMINAL STYLE ↓	B	C	D	E	F	G
A SINGLE	370BA	370CA		370EA	370FA	
B FEED-THRU	370BB	370CB				
C SINGLE U	370BC	370CC	370DC		370FC	
D FEED-THRU U	370BD	370CD				
E PILLAR				370EE	370FE	
F LONG				370EF	370FF	
G WIRE LEAD						370GG
H EYELET		370CH				

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

ARMY-NAVY E — FOR HIGH ACHIEVEMENT IN WAR PRODUCTION



To Our Customers and Friends—

You and we have worked together through four of the world's most tragic years. Our common interest in a common cause has strengthened old business friendships and has made many new ones. For this we are grateful.

This experience of mutual respect and confidence is *one* result of the war that will be carried over to the problems of peace. It is the very stuff that will assure profitable business at home and better relations with our neighbors abroad.

We of the Biddle Company fortunately have no factory problem of reconversion. For the most part, we make the same testing instruments for industry at peace as were required for war. And as more of our products become available for industrial and rehabilitation purposes, we will continue to serve you—in good faith always—and to the best of our ability.

JAMES G. BIDDLE CO.

1211-13 Arch Street, Philadelphia 7, Pa.

"MEGGER" INSULATION TESTERS, GROUND TESTERS AND OHMMETERS • "FRAHM" FREQUENCY METERS AND TACHOMETERS • "JAGABI" RHEOSTATS • INDICATING HAND TACHOMETERS • SCIENTIFIC APPARATUS

This Kind of WAVE GUIDE Is Not Our Business . . .

DE MORNAY BUDD INC.

EQUIPMENT FOR 97% OF ALL RADAR SETS

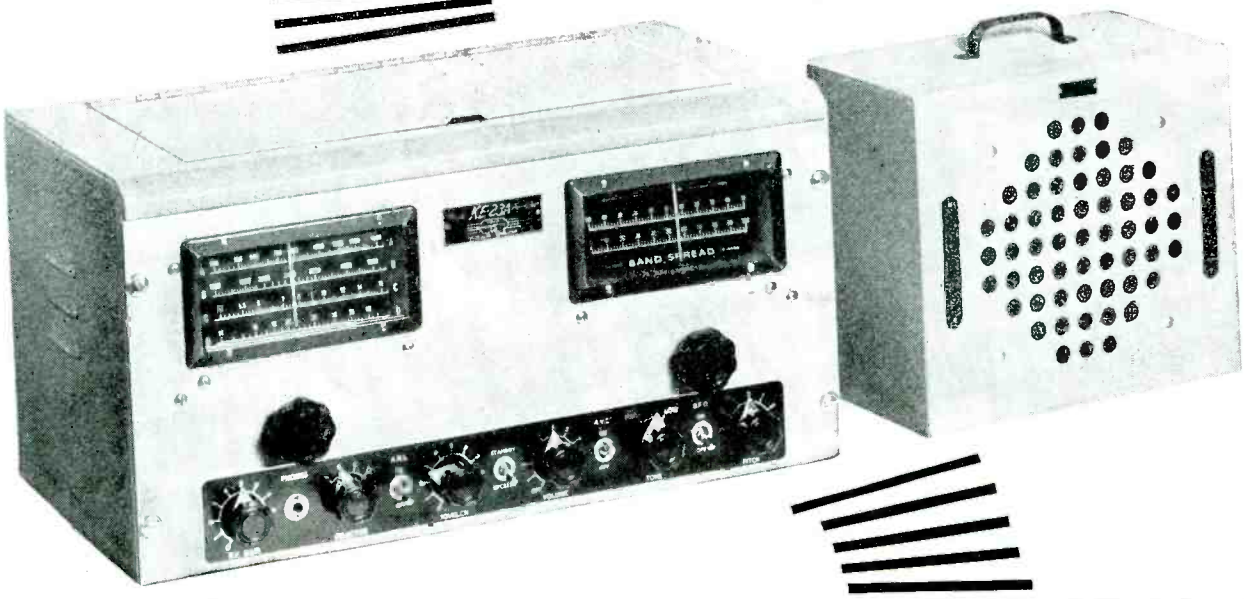
but we are recognized as experts on wave guides and all micro-wave equipment.

Our specialized skills in research, development, design and production offer advantages to the radio and television industries, and to the electronic field in general, which are worth exploring.

DE MORNAY-BUDD, INC., 475 GRAND CONCOURSE, NEW YORK, N. Y.

WAVE GUIDES • DIRECTIONAL COUPLERS • MIXERS
CO-AXIAL STUB SUPPORTED LINES • ROTATING JOINTS
R. F. BENCH AND FIELD TESTING EQUIPMENT • AMPLIFIERS
MODULATORS • I. F. STRIPS • ANTENNAE

UP TO 42 Mc



DOWN TO 500 Kc

No-signal squelch circuit makes this general purpose KAAR RECEIVER IDEAL FOR STANDBY!

The KAAR KE-23A general purpose receiver has a wider than customary range, covering all of the radio communication bands from 500 Kc to 42 Mc. Unsurpassed for most types of emergency, commercial, and amateur operation, it is especially favored as a standby receiver.

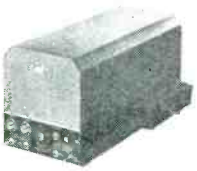
A *no-signal squelch circuit*—normally not available in a general purpose receiver—automatically silences the speaker except when a call or message is being received, thus eliminating background noise during standby periods. A threshold control on the panel determines the amount of carrier required to operate the receiver, or cuts out the squelch circuit when desired.

This nine tube receiver has a high degree of stability and its selectivity and sensitivity insure reception under the most difficult conditions.

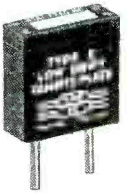
The KE-23A, designed for 117 volt 60 cycle AC operation, is instantly converted to 6 volt DC by plugging in a KAAR 647X power pack at the back. Write today for additional information about this versatile KAAR receiver.

KAAR ENGINEERING CO.
PALO ALTO, CALIFORNIA
Export Agents: FRAZAR & HANSEN
301 Clay Street • San Francisco, California

FM TRANSMITTERS—50 and 100 watt mobile FM transmitters with instant-heating tubes for lower battery drain.



CRYSTALS—Low-drift quartz plates. Fundamental and harmonic types available in various holders.



AM TRANSMITTERS—Mobile, marine, and central station transmitters for medium and high frequencies. Instant heating, quickly serviced.

MICROPHONES—Type 4-C single button carbon. Superb voice quality, high output, moisture proof.

CONDENSERS—Many types of small variable air condensers available for tank circuit and antenna tuning.

20,000 VOLTS IN A 2 3/8" BULB!

ANOTHER "FIRST" BY NATIONAL UNION RESEARCH LABORATORIES

AN example of how war-time research by National Union engineers is helping to lay the foundation for vastly improved post-war Television, FM and radio reception, is this new half wave high vacuum rectifier—the NU 1Z2.

Here is a miniature with the voltage handling capabilities heretofore possible only in full size tubes. For a high voltage rectified supply in the operation of radar and television equipment, the NU 1Z2 saves space—operates with increased efficiency—is exceptionally rugged. Its low filament power consumption suggests many new fields in circuit design and application.

The NU 1Z2 joins a notable group of original electron tube developments by National Union Research Laboratories. For progress through research —count on National Union.

National Union 1Z2
High Voltage Rectifier

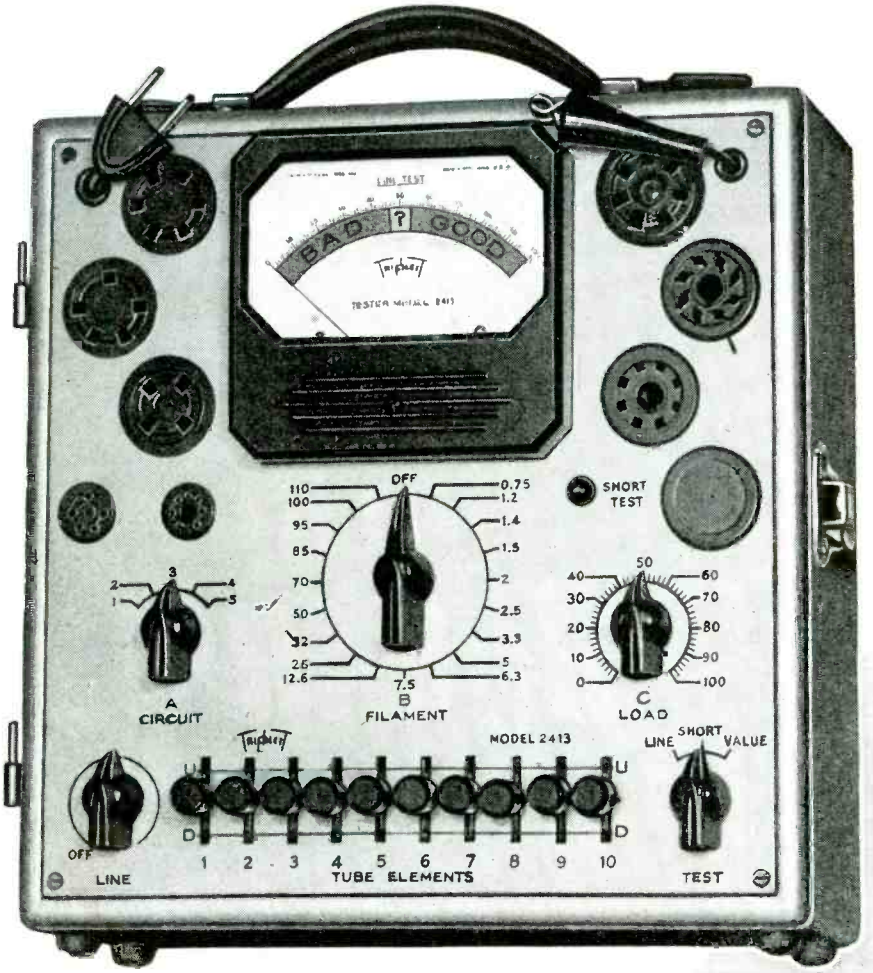
Inverse peak anode voltage-max.	20,000 volts
Peak anode Current	10 ma.
DC Output Current	2 ma.
Filament Voltage	1.5 volts
Filament Current	300 ma.

The NU 1Z2 is designed to withstand shocks in excess of 500 G's.

Maximum overall length	2.70"
Maximum seated height	2.37"
Maximum diameter	.75"
Bulb	T5½
Base Miniature Button	7 pin
Mounting position	Any

NATIONAL UNION
RADIO AND ELECTRON TUBES

NATIONAL UNION RADIO CORPORATION • NEWARK 2, N. J.



MODEL
2413
T
is another member of the NEW TRIPLETT Square Line
T

The New Speed-Chek Tube Tester

MORE FLEXIBLE • FAR FASTER • MORE ACCURATE

Three-position lever switching makes this sensational new model one of the most flexible and speediest of all tube testers. Its multi-purpose test circuit provides for standardized VALUE test; SHORT AND OPEN element test and TRANSCONDUCTANCE comparison test. Large 4" square RED•DOT life-time guaranteed meter.

Simplicity of operation provides for the fastest settings ever developed for practical tube testing. Gives individual control of each tube element.

New SQUARE LINE series metal case 10" x 10" x 5½", striking two-tone hammered baked-on enamel finish. Detachable cover. Tube chart 8" x 9" with the simple settings marked in large easy to read type. Attractively priced. Write for details.

Additional Features

- Authoritative tests for tube value; shorts, open elements, and transconductance (mutual conductance) comparison for matching tubes.
- Flexible lever-switching gives individual control for each tube element; provides for roaming elements, dual cathode structures, multi-purpose tubes, etc.
- Line voltage adjustment control.
- Filament Voltages, 0.75 to 110 volts, through 19 steps.
- Sockets: One only each kind required socket plus one spare.
- Distinctive appearance with 4" meter makes impressive counter tester — also suitable for portable use.

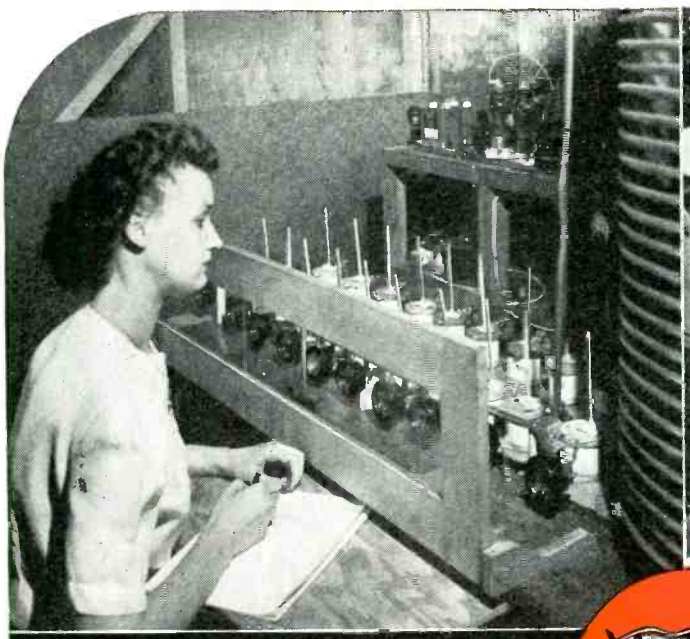
STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

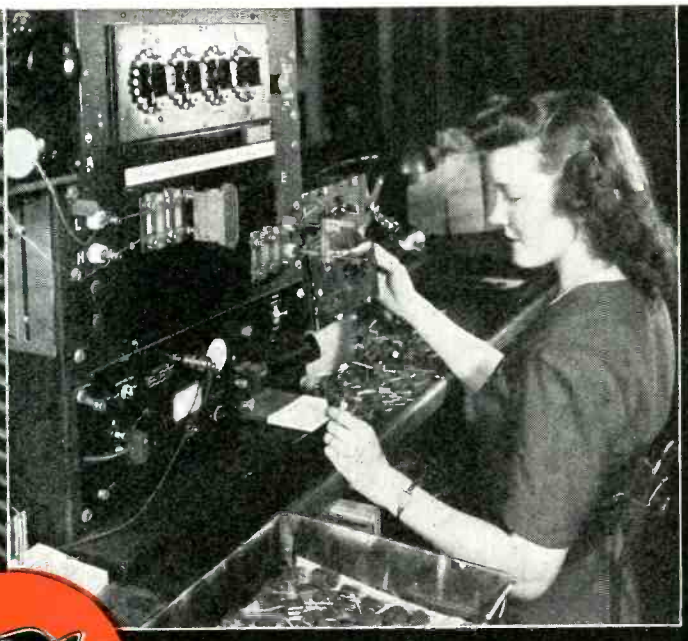
Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

HOW EXCELLENCE IS BUILT INTO



Checking mica capacitors for current carrying ability on high frequency.



The above operator is shown checking a capacitor on a precision bridge.

A view of the "merry-go-round" automatic checking equipment used for dielectric strength test.

The above picture shows an operator color coding capacitors on special equipment used for this purpose.

SANGAMO ELECTRIC

ESTABLISHED 1898 • • • MICA CAPACITORS • • •

Sangamo

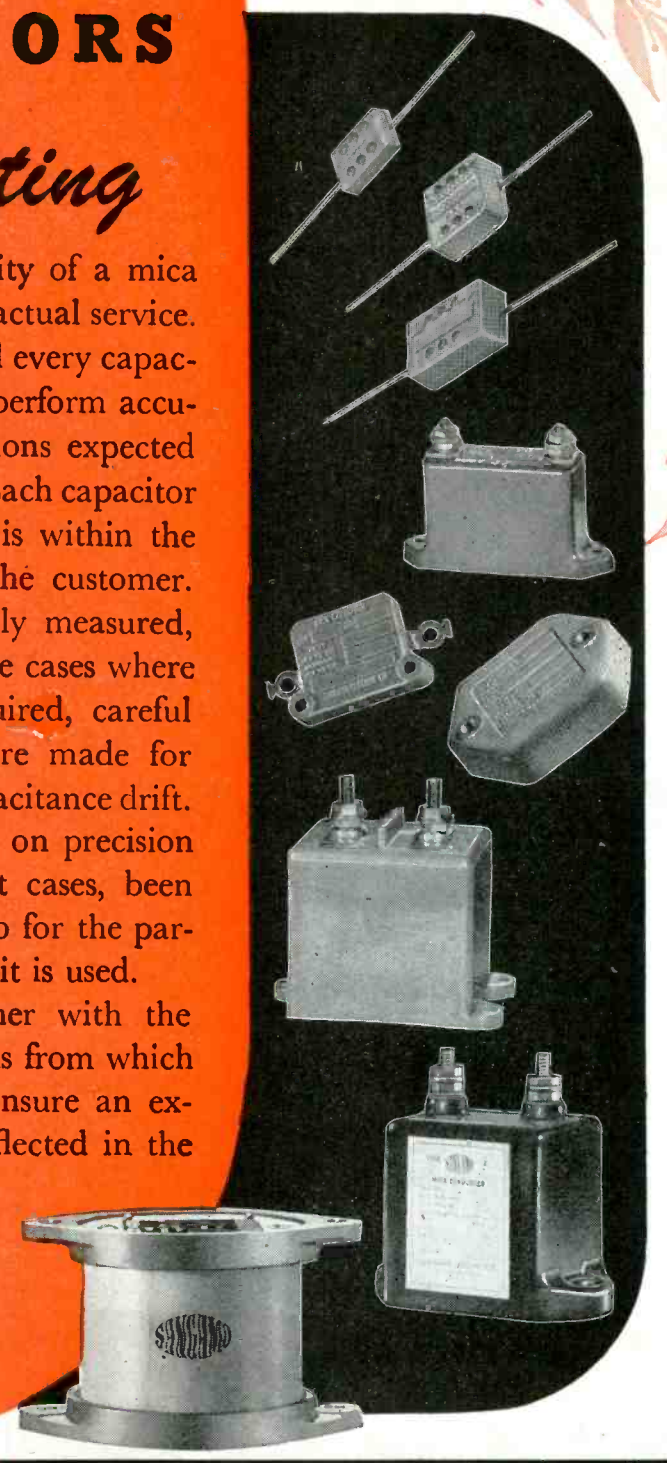
MICA CAPACITORS

Final Testing

The final measure of the quality of a mica capacitor is its performance in actual service. In order to insure that each and every capacitor shipped by Sangamo will perform accurately and faithfully the functions expected of it, numerous tests are made. Each capacitor is tested to make sure that it is within the capacity limits requested by the customer. Insulation resistance is carefully measured, as is dielectric strength. In those cases where special characteristics are required, careful and accurate measurements are made for temperature coefficient and capacitance drift. These measurements are made on precision equipment which has, in most cases, been designed and built by Sangamo for the particular measurement for which it is used.

These measurements, together with the careful selection of the materials from which capacitors are manufactured, insure an excellence of quality which is reflected in the performance of the capacitors under the most severe operating conditions.

☆



COMPANY SPRINGFIELD ILLINOIS

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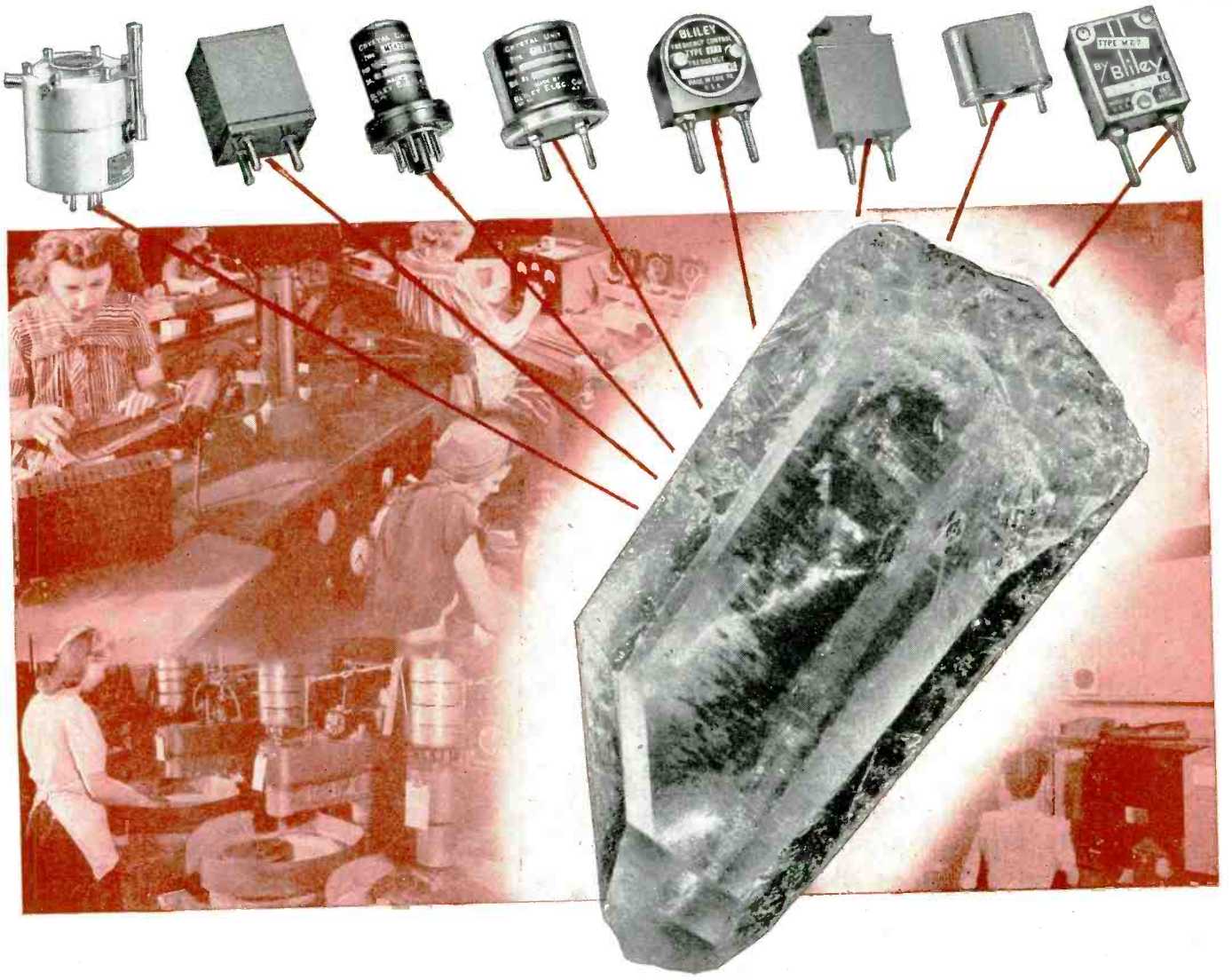


You name the application . . .

BLILEY has the crystals

Post VJ Day production of Bliley acid etched* crystals for FM receivers, Aircraft and Marine radios, Railroad communications equipment and many other applications is proceeding with the same skill and efficiency that marked our wartime operations.

Substantial quantities of these crystals are in the hands of foresighted manufacturers who planned in advance with Bliley engineers for frequency stabilization in their postwar models.

Now, more than ever before, you need the versatile experience of Bliley engineers and craftsmen gained through more than 15 years of quartz crystal engineering exclusively. Whether your requirements are one crystal or a million, you can be sure of top quality—top design—and top performance—in Bliley crystals.

Another star has been added. Our 5th citation for outstanding achievement in producing materials essential to the war effort.

* * *

**Acid etching quartz crystals to frequency is a patented Bliley process.*

Bliley CRYSTALS

Radio Engineers—write for temporary Bulletin E1-26

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

AEROVOX "Know-How"

Aerovox "Know-How" in action: Chief Engineer Stanley Green (center) with Joseph L. Collins (Electrolytics), Louis Kahn (Assistant Chief Engineer) and Samuel Heyman (Production Manager) working out the capacitance problem of a customer from the application blueprints.

...can save you untold time, expense, trouble

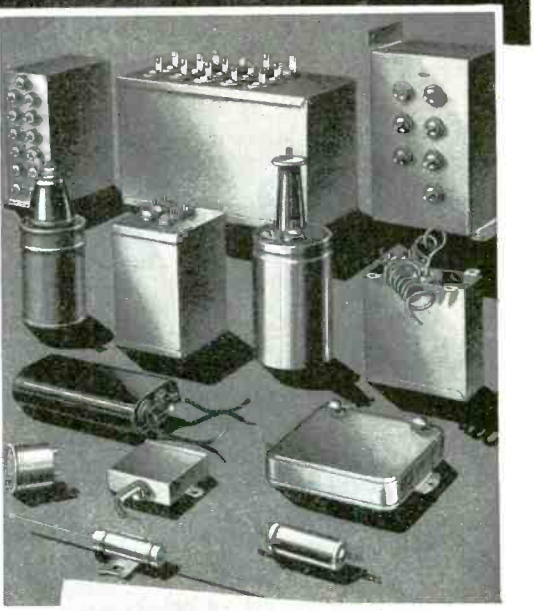
● Ingenuity, imagination, versatility, adaptability, coupled with sound engineering practice, add up to Aerovox "Know-How."

Of course Aerovox has an outstanding line of *standard* capacitors—paper, oil, electrolytic, mica and low-loss ultra-high-frequency types. A wide range of requirements are met with such a variety of listings. But Aerovox can also meet most extraordinary needs with *special* types that do not have to be billed at usual special prices. Here's why:

A tremendous variety of cans, terminals, insulators, mountings and production processes at the disposal of Aerovox engineers enables Aerovox to make up special types quickly, readily, inexpensively. So:

Bear in mind Aerovox "Know-How"—and save untold time, expense, trouble.

● *Try us on that capacitance problem.*



Typical "special" capacitors assembled from standard Aerovox parts, indicating the wide variety of cans, terminals, insulators and mountings.

AEROVOX Capacitors

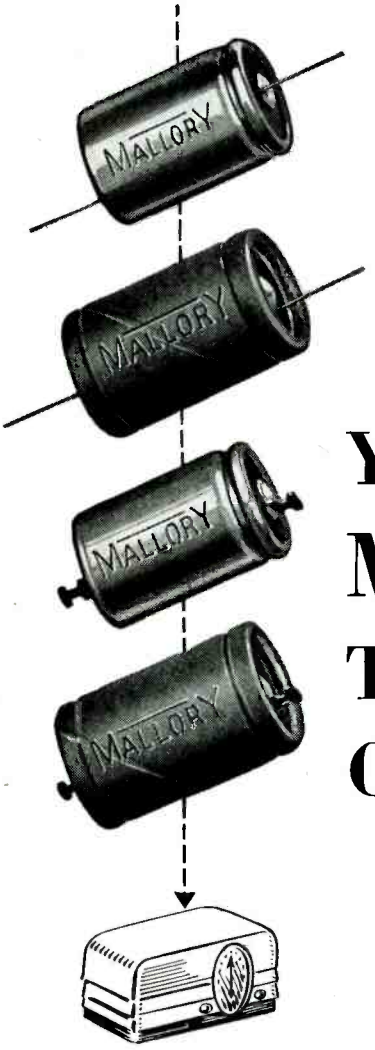
INDIVIDUALLY TESTED

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.

You want them small...

You want them to last...



You Want MALLORY Tubular Capacitors

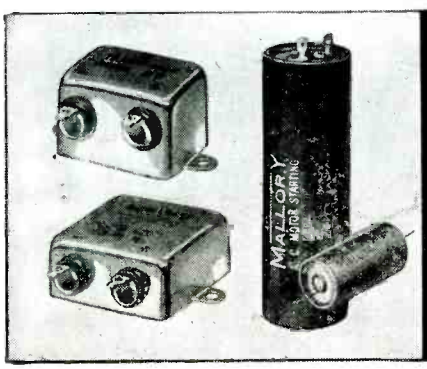
THEY'RE more dependable than cardboard tubulars. They're aluminum-contained, hermetically sealed! Yet, unit for unit, they're *smaller* in size—ideal for under chassis mounting where space is at a premium.

They come in single OR dual units. Single units available with lugs or leads. With insulating covering, or without. In ratings up to 600 volts—surge volt limits up to 750 volts.

Fine workmanship makes them tops in quality. Special mounting hardware makes them easy to install. Get ALL the facts.

Everything you want to know about Mallory Capacitors. Pictures, drawings, electrical characteristics. Available from us, or your nearest Mallory distributor.

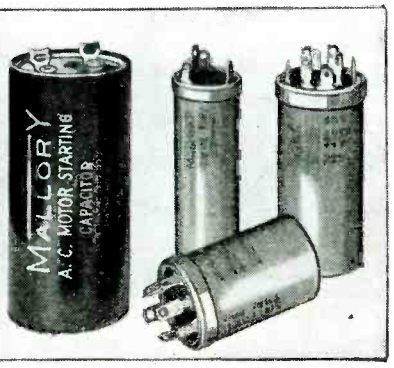
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



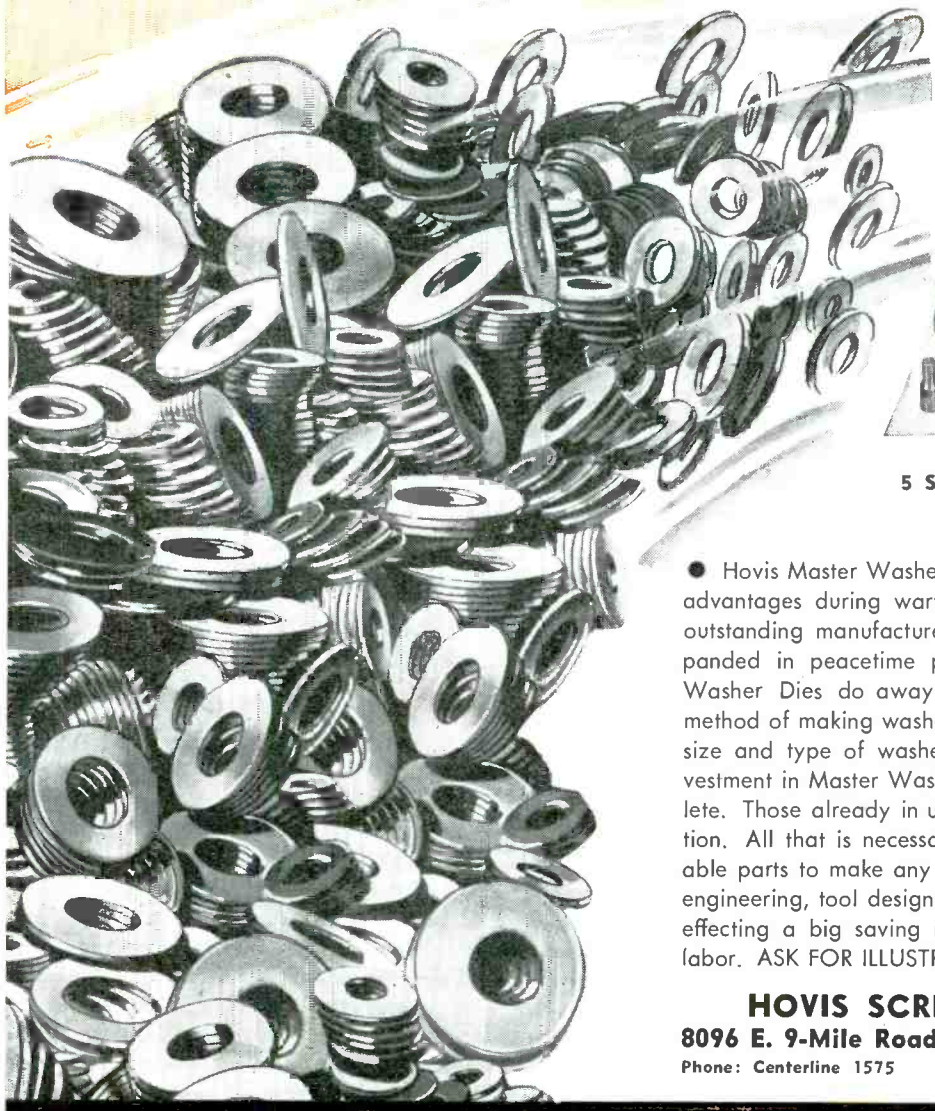
P.R. MALLORY & CO. Inc.

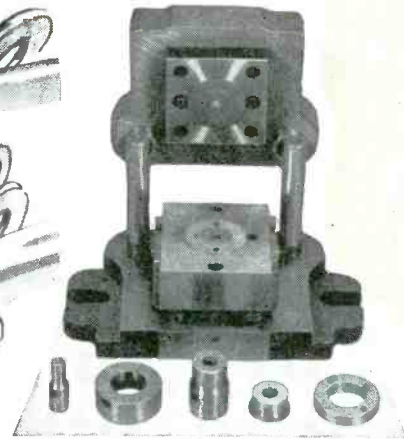
MALLORY

Electrolytic, Film and Paper CAPACITORS



Geared to POST-WAR PRODUCTION





5 Sizes: 3/4"—1 1/2"—2 1/2"—4"—6"

● Hovis Master Washer Dies demonstrated their tremendous advantages during wartime. They were widely adopted by outstanding manufacturers and their use will be greatly expanded in peacetime production. Hovis Universal Master Washer Dies do away with the old, slow and expensive method of making washers, requiring a new die for each new size and type of washer. Instead, you make a nominal investment in Master Washer Dies, which do not become obsolete. Those already in use can be utilized in civilian production. All that is necessary is to change 5 small interchangeable parts to make any size washer, thus eliminating process engineering, tool designing, tool making and tool tryout, and effecting a big saving in time, storage space, material and labor. ASK FOR ILLUSTRATED LITERATURE.

HOVIS SCREWLOCK COMPANY
8096 E. 9-Mile Road **Van Dyke, Mich.**
Phone: Centerline 1575 **(Suburb of Detroit)**

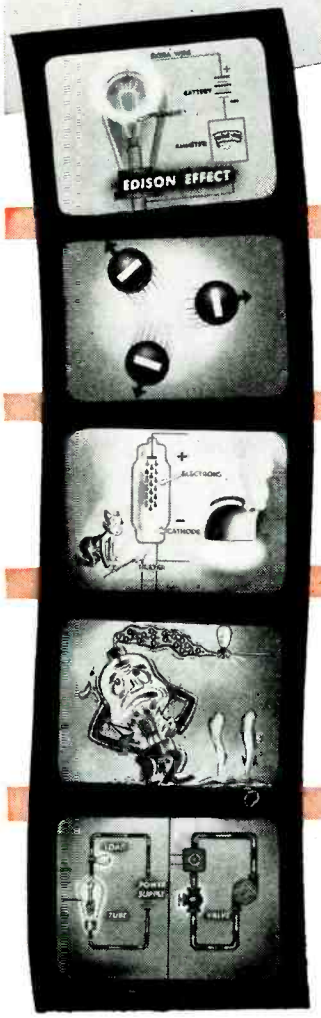
HOVIS UNIVERSAL MASTER WASHER DIES

GENERAL ELECTRIC

Announces

A 12-PART TALKING SLIDEFILM COURSE in INDUSTRIAL ELECTRONICS

THESE 5 ILLUSTRATIONS AND (RECORDED) CAPTIONS are typical of the simple, interest-arousing sequences. 100 in each slidefilm.



When the lamp is lighted and the filament glows, current flows through the extra wire, even though it is not connected with the filament itself. This phenomenon (Edison Effect) demonstrates the underlying principle of electronic tubes.

Electrons, being negatively charged particles, repel each other and hinder the flow of other electrons from cathode to anode. This repelling action is called "space-charge"—a factor of very great importance in electronic-tube design.

In some types of electronic tubes, we "boil" the electrons out of the cathode with heat, much as boiling water produces steam.

A gas-filled tube (phanotron) can be damaged if forced to operate before its cathode has been heated sufficiently to emit the required amount of electrons. To prevent such abuses, most electronic equipments have automatic timers built in to protect rectifier tubes.

In our electric circuit, we use a second voltage supply called the control, or grid, voltage. It performs much the same function as the control handle on the valve in a hydraulic circuit.

. . visualized for easy understanding, even by non-technical people

. . packaged for easy instruction, using your own "home-talent" leaders

. . practical up-to-the-minute subject matter, technically authentic

Now, an understanding of electronics as applied in industry can be built up, right within your organization, using the ingenious techniques of *visual instruction* that have proved so successful for wartime training. Every sequence of this 12-part course has been put to test on groups of widely different education levels. Educators have joined practical plant executives in praising its combination of *easy understanding* and *technical accuracy*.

As you follow the instruction manual, the sessions almost "conduct themselves," so that no great experience in organizing or instructing people is necessary. Everything essential is furnished except a sound slidefilm projector (35 mm, 33½ rpm), screen, and a meeting place. Upon completion of the course, your people will have a well-rounded acquaintance with electronic devices, tubes, circuits, and applications.

ALL THESE WILL BENEFIT

As electronic apparatus is applied more and more widely to industrial plants and processes, more and more of your people—from managers to maintenance men—will find their work depending upon electronics in a very practical way. Some of them must learn to service this equipment. Others will be better equipped to get the most out of electronic equipment when it is no longer "all a mystery" to them.

PLANT ELECTRICIANS and maintenance men will find the course understandable, even if their knowledge of electrical theory is limited. In learning about electronics and its application, they'll get a background of fundamentals of electricity, too.

PLANT AND DESIGNING ENGINEERS will find the course stimulating in suggesting practical electronic applications to improve processes or products.

PRODUCTION MANAGERS and foremen will get a clearer concept of the workings of equipment for which they are responsible. New process control ideas may also be suggested.

EXECUTIVE MANAGEMENT and purchasing agents can get a clearer concept of practical electronic possibilities. They will be in a better position to consider and approve recommendations.

SALESMEN selling electronic products will be better equipped to talk to their customers.

Note: *ELECTRICAL UTILITY COMPANIES* and electrical associations in many communities are organizing inter-company groups for this course of instruction. You may want to check with your local utility on this point.

THESE ARE THE 12 SUBJECTS OF INDIVIDUAL FILMS AND LESSON BOOKS

1. Harnessing the Electron
2. Electronic Tubes as Rectifiers
3. Grid Control of Electronic Tubes
4. Fundamentals of Electricity, Part I
5. Fundamentals of Electricity, Part II
6. Electronic Relay Systems
7. Electronic Rectifier Equipment
8. Thy-mo-trol (Thyratron Motor Control)
9. Electronic Control of A-c Power
10. Electronic Frequency Changing
11. Photoelectric Systems
12. Electronics, Today and Tomorrow

Here's what you get

12 SLIDEFILMS AND RECORDED TALKS—each about ½ hour long

300 REVIEW BOOKLETS—25 sets of 12 individual lessons, keyed to the slidefilms

1 INSTRUCTOR'S MANUAL—a 140-page book with hundreds of illustrations and detailed steps for conducting the course

1 CARRYING CASE—attractive and strongly built, it holds records, films, and manuals

THE PRICE—for the complete "package" as above, $100; *extra* manuals, $3; *extra* sets of 12 *review booklets*, $2

ORDERS—can be placed through any local G-E office, or use the coupon below.

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Apparatus Dept., Section H685-13
Schenectady 5, N. Y.

—Enclosed is our order for ..... complete INDUSTRIAL ELECTRONICS courses at $100 each (May be returned without charge if you are not fully satisfied.)

—When could someone in our organization see a showing of one of these lessons and examine the complete kit?

Name.....

Company.....

Address.....

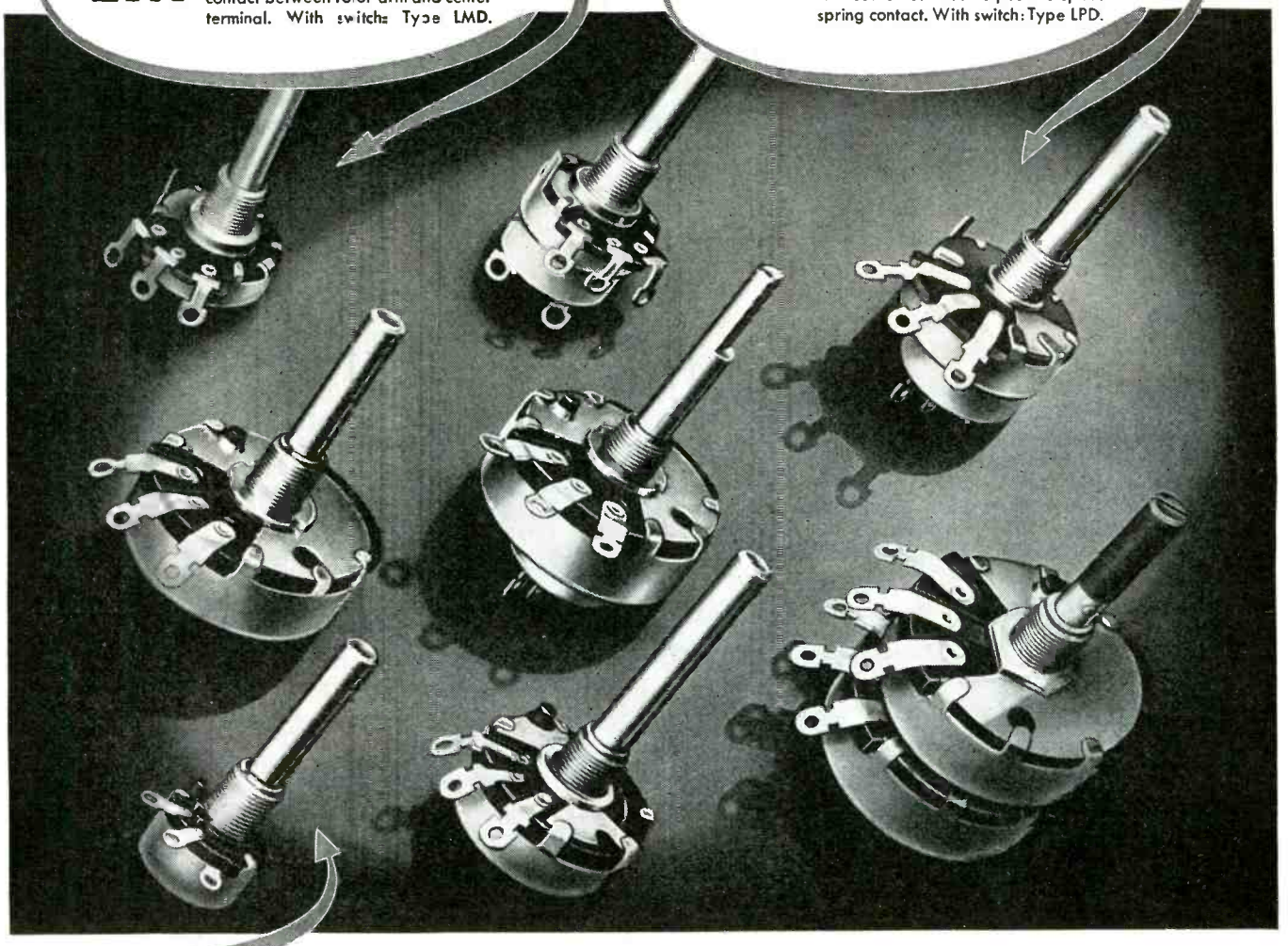
8980

GENERAL ELECTRIC

BUY ALL THE BONDS YOU CAN—*AND KEEP ALL YOU BUY*

LM An exceptionally sturdy type only 57/64" in diameter for low-wattage requirements. Has positive-contact spiral spring to eliminate sliding contact between rotor arm and center terminal. With switch: Type LMD.

LP A larger type, 1-3/32" in diameter for use where voltages do not exceed 350V, and where wattages are .4-watt or less. Can be supplied with sealed cover. Has positive spiral spring contact. With switch: Type LPD.



PSM MIDGET Only 23/32" in diameter—unexcelled for low-wattage uses where size and weight are important factors. Widely used in hearing-aid devices and similar equipment.

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VARIABLE RESISTORS

(Volume, Tone Controls, etc.)

Tested, tried, and proved in all types of equipment calling for units of this sort, Stackpole Variable Resistors offer maximum dependability under all conditions of use. The line is sufficiently broad to meet all requirements up to ratings of 2 watts. Large, medium and midget sizes—with or without switches—high insulation types—standard, sealed, or insulated shafts—standard and water- and dust-proof covers—friction rotor types, and various others.

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BRUSHES — CONTACTS
(All carbon, graphite, metal and compositoin types)
IRON CORES RARE METAL CONTACTS
WELDING CARBON PRODUCTS
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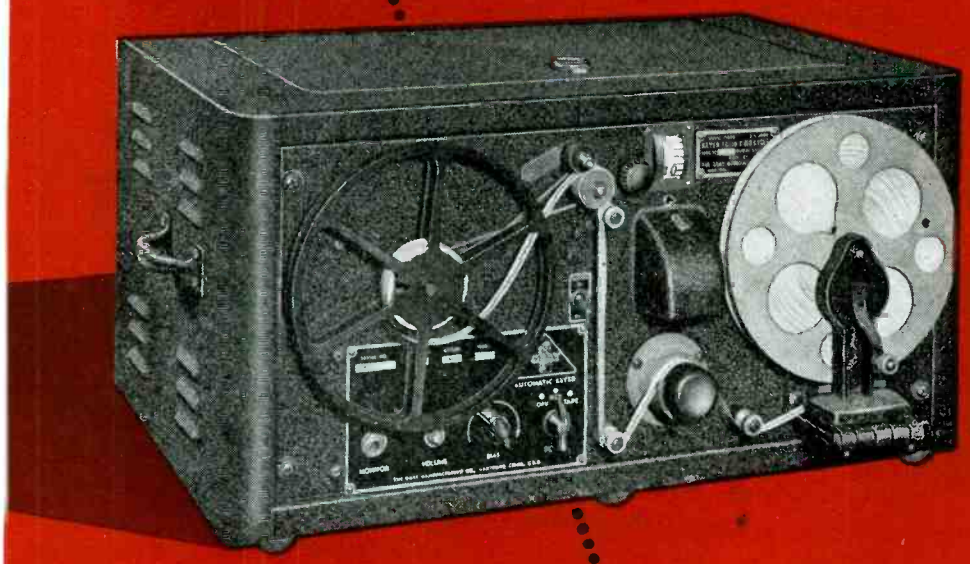
SPECTROGRAPHITE No. 1, etc., etc.

Write for ELECTRONIC COMPONENTS CATALOG—RC6

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

JUST ONE



JUST ONE of numerous government radio and electronic items now available through the Hallicrafters Co., Chicago, agent for Reconstruction Finance Corporation.

This is a Keyer TG-10-F, an automatic unit for providing code practice signals from inked tape recordings. Excellent for group instruction, sufficient power to operate up to 300 pairs of head phones. Can be adapted as amplifier of 10 to 15 watts output for use with crystal mike or phono pick up. Completely checked and reconditioned by Hallicrafters engineers. Send coupon for further details and lists of other available items.

THESE VALUABLE ITEMS *Available Now*

Or Very Soon. Write, wire or phone for further information

• head phones • test equipment • component parts • marine transmitters and receivers • code practice equipment • sound detecting equipment • vehicular operation police and command sets • radio beacons and airborne landing equipment

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THE HALLICRAFTERS CO., AGENT OF RFC UNDER CONTRACT SIA-3-24
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SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

CLIP THIS COUPON NOW

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☐ Send further details and price on Keyer TG-10-F
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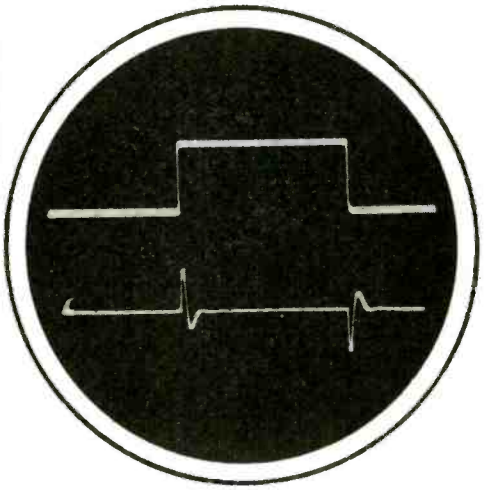
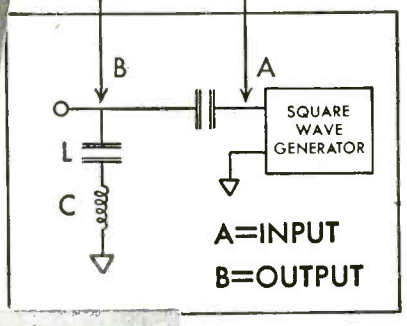
Now it can be told...

The Type 5SP double-beam tube may be used to examine both the input signal to a circuit and the circuit response at the output. A square wave is here applied to an LC circuit. Both input and output signals can be studied simultaneously. Either signal may be expanded for detailed study.

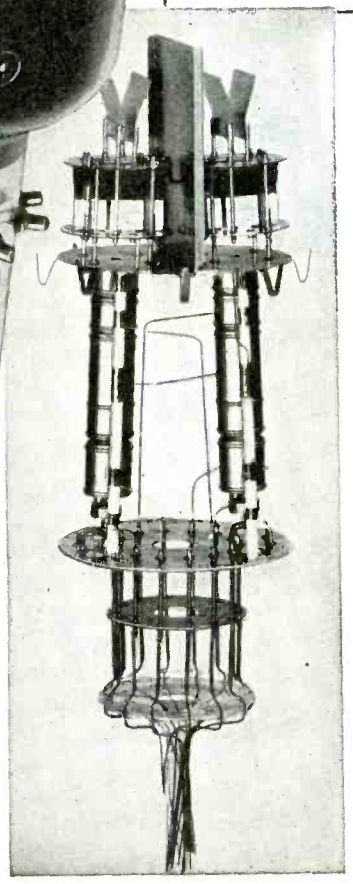




by means of the new DuMONT

DOUBLE-BEAM

TYPE 5SP CATHODE-RAY TUBE



Further details on request

New and startling applications are ushered in by this latest DuMont development.

Two complete "guns" in a single 5" envelope converge on one screen for *simultaneous* and *superimposed* traces. Heretofore such simultaneous comparison of two phenomena could be accomplished either by (1) using two separate tubes or oscillographs placed side by side, or (2) using the electronic switch. Both methods presented limitations either in observation convenience, or in frequency response and inability to use independent time bases.

With the new DuMont Type 5SP double-beam tube there is *complete and independent control* of the X, Y and Z axis functions for each beam. Adequate shielding between "guns" and "plates" minimizes "cross-talk" particularly at high frequencies. Side-wall connections to the deflection plates minimize shunt-input capacitance and lead inductance; also provide better insulation and longer leakage paths. Army-Navy diheptal 12-pin base. Electrode rating similar to Army-Navy preferred Type 5CP1.

DUMONT *Precision Electronics & Television*

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

All of the well known Utah qualities of workmanship and design go into Utah vibrators, yet they cost no more than ordinary vibrators.

- ★ 70 vibrator replacement types.
- ★ 39 different hook-up diagrams.
- ★ Servicing 3651 different auto and farm radio models.
- ★ More than a million radio sets are equipped with Utah vibrators.

There is a Utah vibrator for every replacement requirement!

utah

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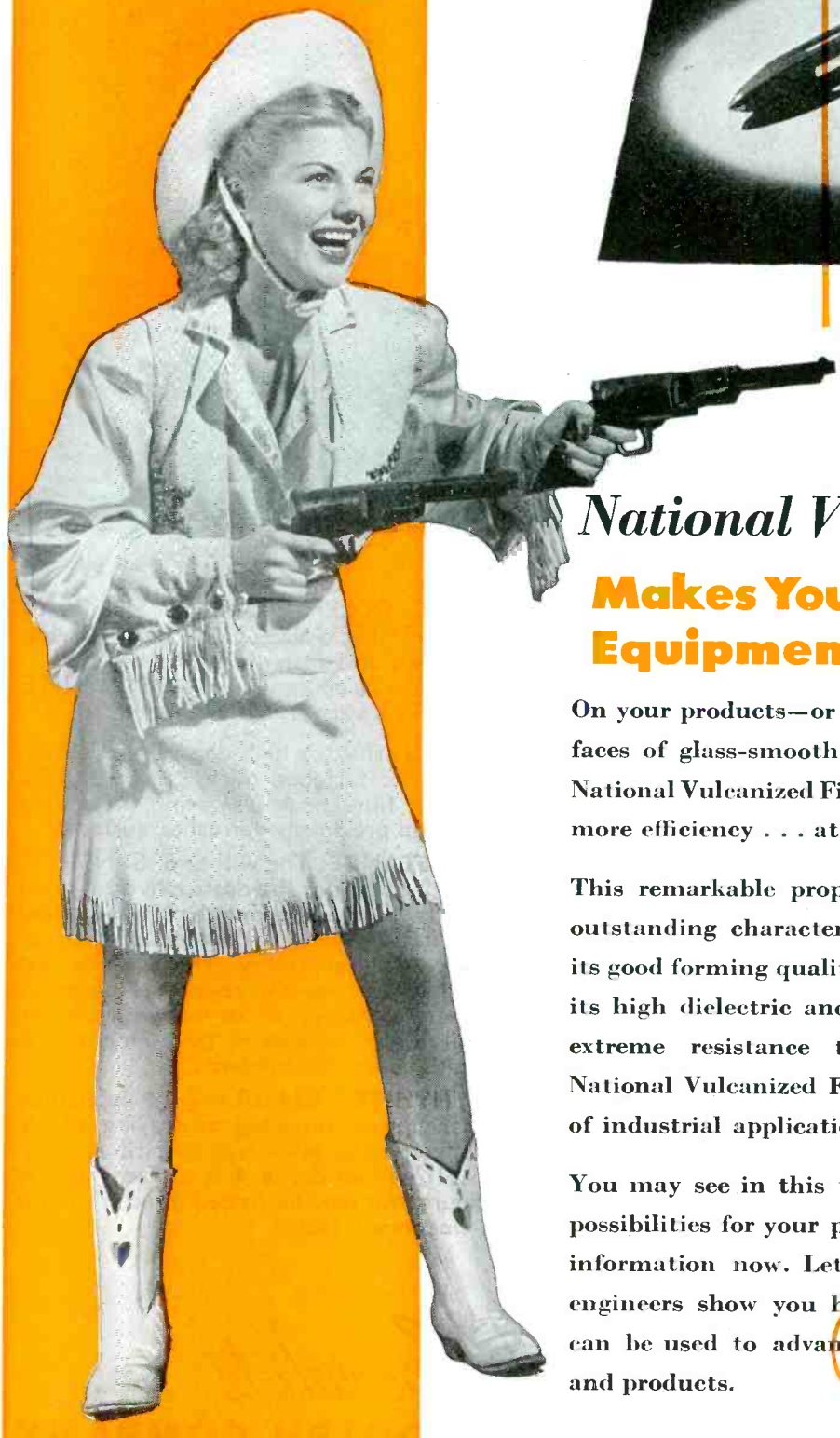
TOUGH

Shuttles slamming back and forth at high rates of speed in textile looms must be able to "take" it. The *toughness* and *resiliency* of National Vulcanized Fibre provide long service.



National Vulcanized Fibre

Makes Your Products and Equipment Last Longer

On your products—or on your plant equipment—surfaces of glass-smooth, naturally tough and resilient National Vulcanized Fibre give longer performance and more efficiency . . . at greater economy to you.

This remarkable property, combined with its other outstanding characteristics—its lightness in weight, its good forming qualities, its excellent machinability, its high dielectric and mechanical strength, and its extreme resistance to wear and abrasion—make National Vulcanized Fibre adaptable to a wide range of industrial applications.

You may see in this tough, versatile material many possibilities for your post-war projects. Write for full information now. Let one of our trained technical engineers show you how National Vulcanized Fibre can be used to advantage in your plant equipment and products.

NATIONAL VULCANIZED FIBRE CO. WILMINGTON, DELAWARE
Offices in Principal Cities

Synthite*

#924-20

Clear Air Drying Varnish

*FLEXIBILITY *ADHESION *RESISTANCE

FORMULATED strictly in keeping with the JOHN C. DOLPH COMPANY'S policy of high quality insulating varnishes and compounds, SYNTHITE # 924-20 Clear Air-Drying Varnish has added "new Laurels" to the already proven and tested DOLPH Line. . . . The following features, each one of a high degree, have been combined in SYNTHITE # 924-20 to give you the best performance possible in a varnish of this type.

* **FLEXIBILITY:** A prime factor contributing to the effectiveness of # 924-20 is the flexibility life. The following thermal shock test conducted according to government specifications conclusively proved this feature.

A copper strip, dipped in # 924-20 and then air dried, was heated at a temperature of 85° C. for three hours. Next, the same strip was subjected to a temperature of minus 40° C. for three hours more. Allowing 1 hour recovery time, which made a complete cycle of 7 hours, the strip was then bent around a metal bar of a specified diameter. After the completion of five of these cycles, the film of # 924-20 had not lifted, and showed no signs of cracking.

* **ADHESION:** In addition to possessing excellent bonding properties, SYNTHITE # 924-20 affords a high degree of adhesion to phenolic surfaces, mica, cambric, glass, asbestos, fibre board, sleeving, insulating paper and previously varnished surfaces.

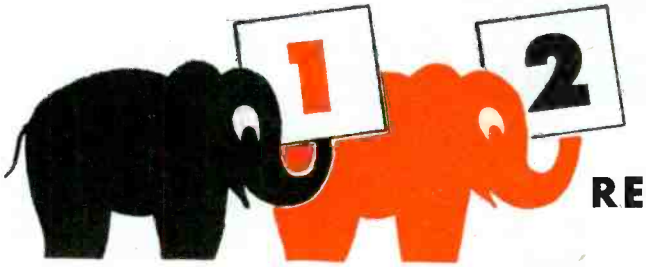
* **RESISTANCE:** The ability of SYNTHITE # 924-20 to resist the destructive action of oil and water was shown by the excellent results obtained in tests conducted by an independent laboratory. This varnish was found to successfully resist the corrosive action of salt spray, and actually surpass the requirements of various government specifications for oil resistance.

* **SYNTHITE # 924-20** may be applied by either dipping, brushing or spraying, this to be governed by your own specific application. It will air dry on flat surfaces in 2 to 3 hours, but may be forced dried if time is an important factor.

Insulating Dolph's *Varnish Specialists*

JOHN C. DOLPH COMPANY

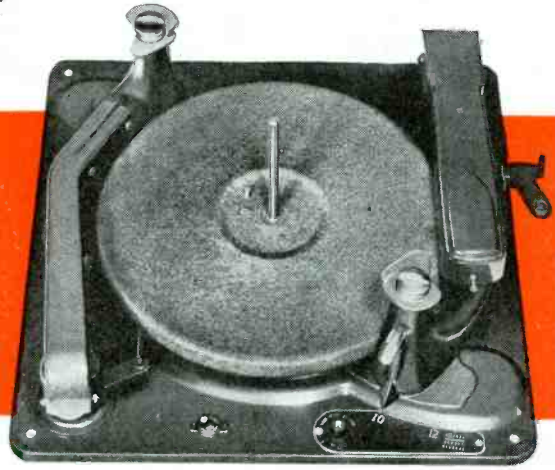
168 EMMETT STREET • NEWARK 5, N. J.



REMEMBER OUR 2 SERVICES

when you're planning ahead

1



2

First-time visitors at our plant are usually amazed at our facilities for making such widely different products as (1) small motors or electric assemblies; and (2) molded plastic parts. But they always agree we know these two jobs.

For instance, our *Smooth Power* motors drive mechanisms that record and play everything from grand opera to news broadcasts. They're equally smooth, quiet and efficient in industrial, commercial and domestic applications. That's because they're engineered, fabricated and assembled to the most critical requirements.

In our molded plastics division, our people know plastics, and what they will or won't do. Engineers, mold makers and machine operators are continually alert for ideas or methods that will improve or speed production, or reduce costs. Simple or complicated, large or small, in any quantity, we work to close tolerances and fine finish.

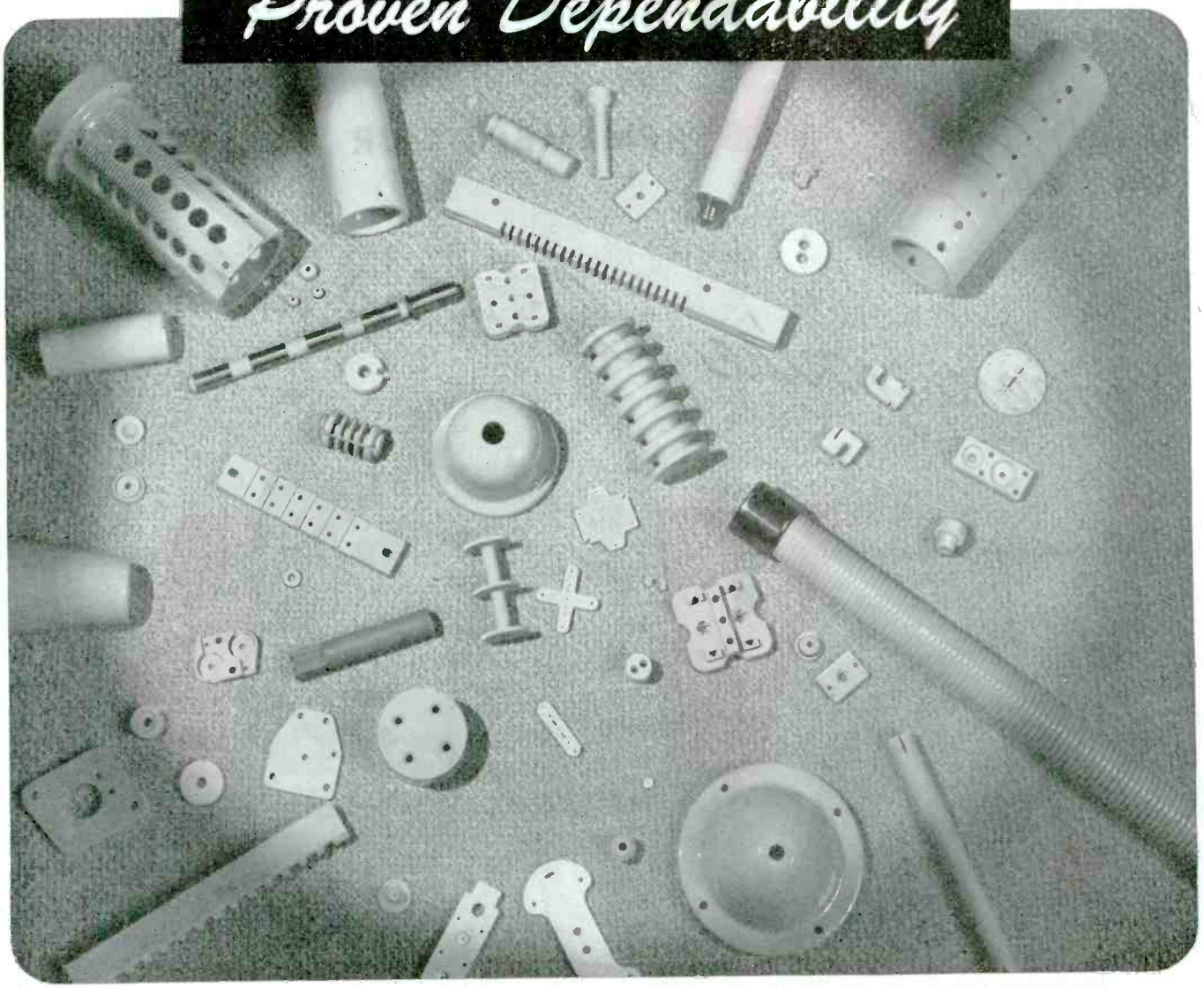
So, it will profit you to remember these two services for your future production. Right now, we can't divert either engineering or machine time from high priority work. But we hope the day is not too distant when we can help you on your requirements in *small motors* and *molded plastics*.

THE GENERAL INDUSTRIES COMPANY
ELYRIA • OHIO

THE GENERAL INDUSTRIES COMPANY

MOTORS PLASTICS

Proven Dependability



PRECISION CERAMICS by STUPAKOFF

DURING two generations of research and experience, Stupakoff solved many unprecedented insulation problems and thus added much to its rich store of knowledge of ceramic insulation.

While the United States and her allies were at war, Stupakoff devoted its whole energy to the production of engineered ceramic insulators for military applications—insulators built to withstand the severe and infinitely varied conditions found in scattered fields of operation.

Now that the war is over, STUPAKOFF again offers its PRODUCTS unhesitatingly to the manufacturer of electronic equipment, electrical apparatus and appliances, as THE VERY FINEST CERAMIC INSULATORS OBTAINABLE—insulators that materially contribute to the perfection of any finished product and satisfaction of its users.

Qualities incorporated in Stupakoff insulators represent the applied knowledge of two generations of experience plus additional skill acquired during intensified wartime activity. The result—mass production of ceramic insulators with a new high in electrical and mechanical values.

With production and development facilities unsurpassed in the industry, Stupakoff is anxious to work with you on your insulation problems. Write, wire or phone your requirements. DELIVERY—NOW.

BUY VICTORY BONDS

ARMY E NAVY "FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Products for the World of Electronics

In center: Type GC-25 with new one piece center terminal and collector ring.

One way to assure TOP PERFORMANCE

Chicago Telephone Supply Company's test and research laboratory is continually making performance tests on every electrical and mechanical characteristic of CTS variable resistors.

In addition, production resistors are carefully checked, not only against customers' specifications, but against the recognized CTS standards of quality.

This control of quality and thorough inspection assures the fine performance to which CTS customers all over the world have always been accustomed.

CTS engineers are ready to help solve your variable resistor problems.

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VARIABLE RESISTORS
PLUGS AND JACKS

SWITCHES • RINGERS
TELEPHONE GENERATORS

CTS

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Manufacturers of Quality Electro-Mechanical Components Since 1896

WHEN WE SAY QUICK WE MEAN QUICK!

SHORT RUN FOR QUICK PIERCING OF SHEET METAL USE A WIEDEMANN

Here's a typical example of how piercing time was reduced 90% by using a Wiedemann Turret Punch Press.

THE JOB: An order of 10 pieces 12⅝ x 8½ x .078 mild steel (50 openings pierced requiring 7 different shapes and diameters)

TOTAL TIME FOR 10 PIECES:

OLD METHOD: 9 hours, 16 minutes

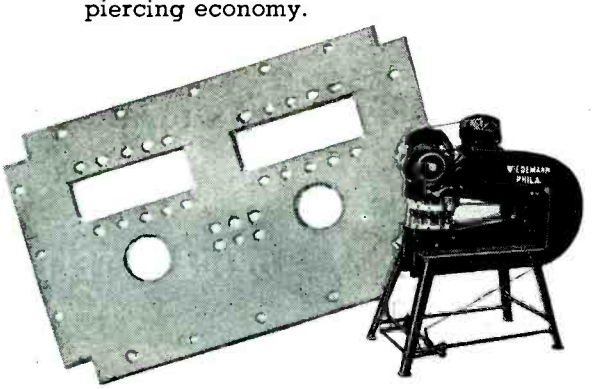
WIEDEMANN METHOD: 1 hour, 16 minutes (Time includes loading and unloading material in the machine)

TIME FOR 1st PIECE . . . 19 minutes, 18 seconds

TIME FOR EACH OF NEXT 9 PIECES . . 6 minutes, 39 seconds

The job was produced on a Wiedemann R-4P 11 Station Turret Punch Press with Drop-latch gauge. *Layout work was done directly in the machine and is included in the above time.*

You can see for yourself . . . when we say QUICK we mean QUICK. See a Wiedemann Turret Punch Press in operation. Write us for address of a shop in your vicinity that uses a Wiedemann for short run piercing at long run low cost . . . and send for Bulletin 92 for the complete story of short run piercing economy.



WIEDEMANN MACHINE COMPANY
1833 SEDGLEY AVENUE, PHILADELPHIA 32, PA.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES

Only Cornell-Dubilier could build this Giant Tank Capacitor

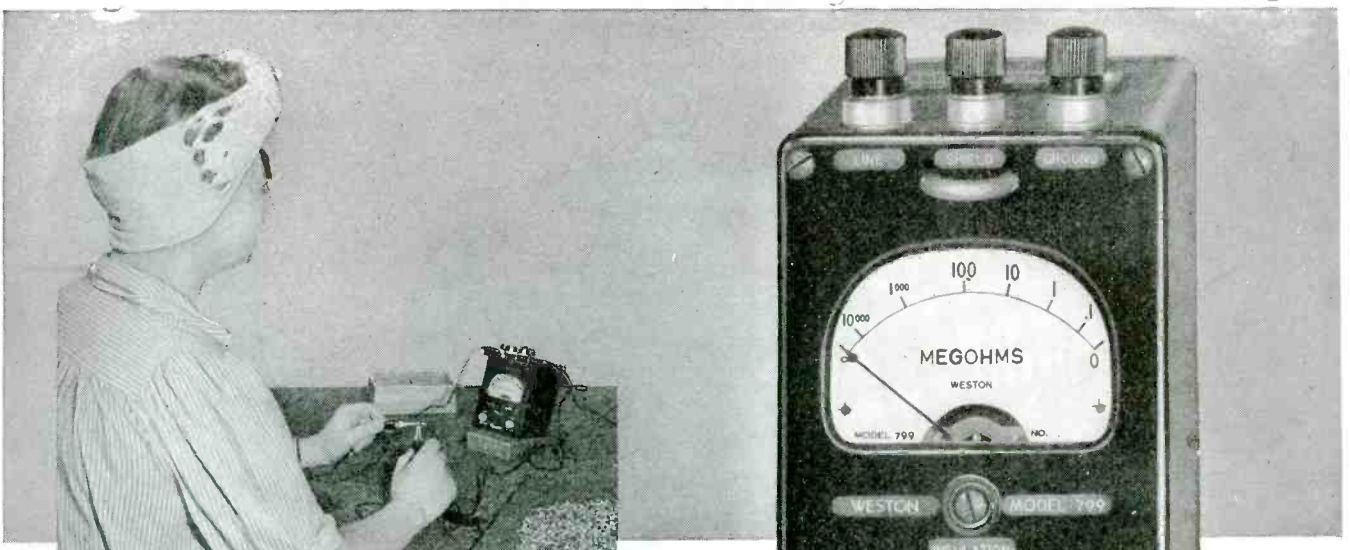
When an unusual problem in capacitors arises, engineers think first of C-D. A case in point is this giant mica tank capacitor for a transoceanic transmitter. It is now in use and combines space-saving design with the capacity of much larger units.

No matter what kind of capacitor you require, C-D can design and build it for you. Discuss your capacitor requirements with our engineers. They will welcome the opportunity to help. Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

FROM THE LARGEST TO THE SMALLEST — WE MAKE THEM ALL

Other plants at:
New Bedford, Brookline, Worcester, Mass. and Providence, R. I.

CORNELL-DUBILIER
First in Quality **CAPACITORS**
MICA · DYKANOL · PAPER · ELECTROLYTICS



Now . . . **Leakage Resistance Measurements at Low Potentials!**

Weston

MODEL 799 INSULATION TESTER

• 10 BILLION Ohms •

will measure:

- Insulation Properties
- Resistance Leakage
- Conductivity of Insulating Materials
- Leakage due to Moisture Absorption
- Readings — .1 to 10,000 megohms

Because of its compactness and extreme high sensitivity, this direct reading instrument fills an important measurement gap in the production and servicing of a wide variety of components and electrical devices. Minute faults can be detected *in advance* . . . tests can be made without destructive breakdown. Test potential less than 50 Volts.

Here's what a few typical users say about Model 799:

"We use it for testing the leakage between windings in transformers, or from windings to core or case."

"We can test the leakage of low voltage paper and mica condensers with the 799, and without danger of damaging the dielectric."

"We test leakage resistance between individual wires in cable harnesses."

"Model 799 is also ideal for checking leakage due to moisture in fiber terminal strip."

For complete data on Model 799 Insulation Tester, communicate with the WESTON representative in your locality, or write...Weston Electrical Instrument Corporation, 666 Frelinghuysen Ave., Newark 5, N.J.

Weston *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN
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In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

Now, as before, expect quality leadership in Collins broadcast equipment

THE NEW COLLINS AM transmitters and remote amplifiers, now ready, reflect characteristically advanced Collins engineering.

Notable transmitter refinements include extremely high fidelity, and increased safety factors through the use of oversize components throughout.

The Collins 21A is a superb 5,000 watt transmitter, with reduced power operation at 1,000 watts also available. Its response curve is flat, within ±½ db, from 30 to 10,000 cycles.

The Collins 20T is a 1,000 watt transmitter, of similar characteristics, equipped for reduced power operation at 500 watts if desired.

The Collins 300G is a 250 watter of equal fidelity, with reduced power operation at 100 watts available.

The Collins 12Y one channel remote amplifier is light, handy, simple and efficient. It is for unattended operation from a 115 volt a.c. power source.

The Collins 12Z four channel remote amplifier is a.c.-d.c. powered, the d.c. source being self-contained batteries which take the load automatically in case of a.c. line failure.

A complete line of Collins high-quality studio equipment is available for either AM or FM application.

An outstanding broadcasting station begins with outstanding equipment. We will be glad to know about your plans and submit complete recommendations. For additional detailed information, write the Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y. Collins equipment is sold in Canada by Collins-Fisher, Ltd., Montreal.

FOR BROADCAST QUALITY, IT'S . . .

"Singers always have a favorite critic ...mine is a PRESTO RECORDING!"

"I know of no better check on my work than hearing it with my own ears," says Morton Downey of the famed Irish tenor voice. "That's why I have each of my Coca-Cola programs transcribed. I feel that a Presto Recording—with its fine, clear reproduction and fidelity to musical tones—gives me a reliable basis for improvement."

Presto sound recording and transcription equipment is used by major broadcasting stations from coast to coast. Schools, colleges and business organizations, too, depend on Presto to help train students and personnel. A Presto Recorder is easy to operate. It stands up under hard usage. In short, it's a precision instrument designed to produce consistently superior results. Write for complete information.

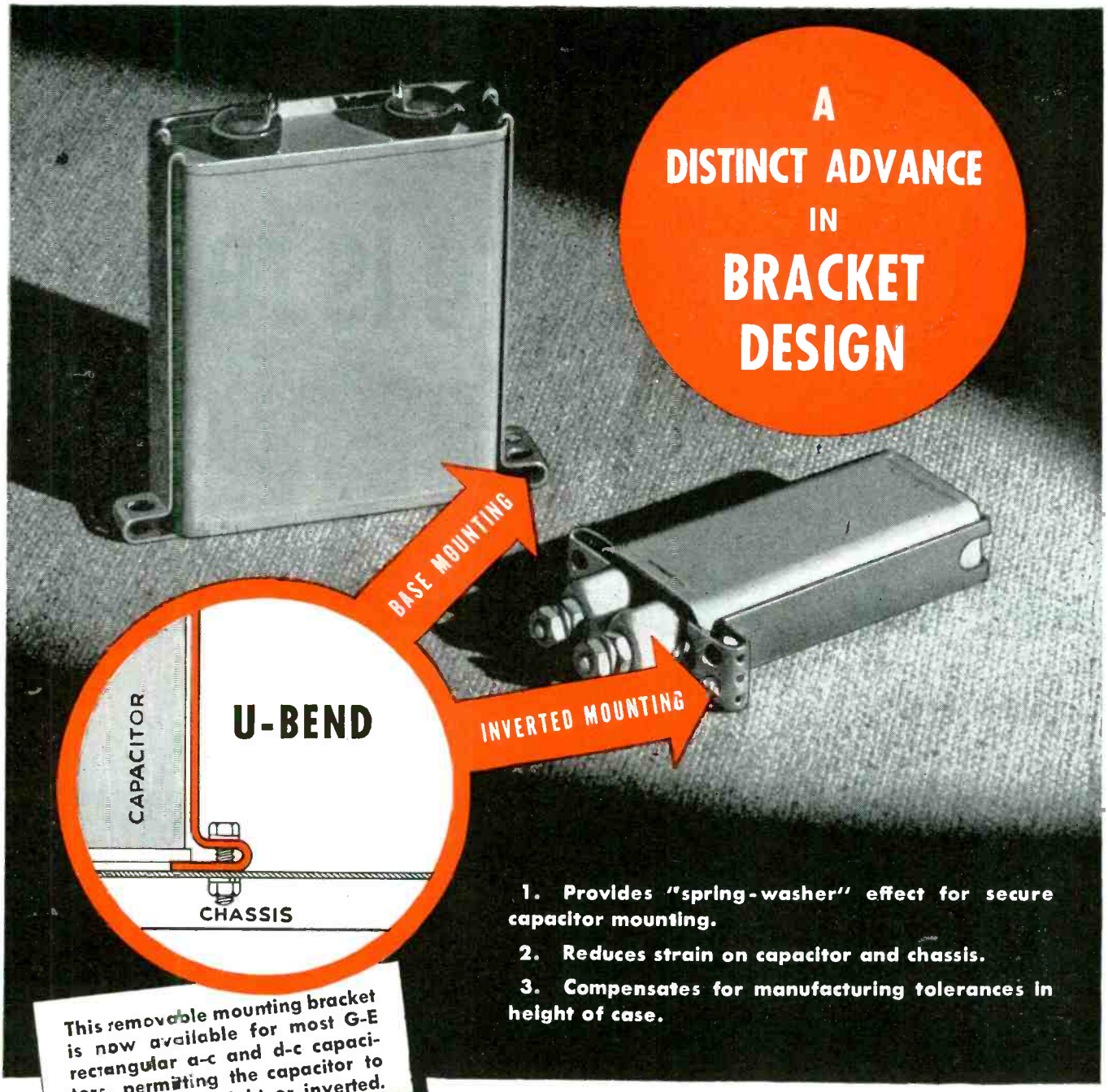
PRESTO

RECORDING CORPORATION

242 West 55th Street, New York 19, N.Y.

Walter P. Downs, Ltd., in Canada

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT AND DISCS



In contrast with the conventional L-shaped bracket, this U-bend construction minimizes the stress on the metal chassis and prevents distortion when mounting bolts are tightened. The mounting foot is sufficiently flexible to compensate for normal tolerances in height of case, and for variations in dimensions of the bracket itself.

The brackets are sufficiently thick to provide strong, rigid support. A corrosion-resistant finish of lacquered zinc plate assures a good ground from capacitor to chassis. The brackets have either one or two mounting holes depending upon the width of the capacitor.

These brackets are an exclusive feature on G-E capacitors. Spade-type and L-shaped brackets can still be obtained when desired. Ask for Bulletin GEA-4357 for information on the G-E capacitors that can now be furnished with this improved feature. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

CAPACITORS

Buy all the BONDS you can
—and keep all you buy

GENERAL ELECTRIC

407-96-5700

Again, Revere is ready

Revere metals are impartial. They don't care whether they are used for battleships or baby carriages, for rockets or refrigerators, for primers or piping. That is why there are no difficult reconversion problems at Revere to slow down production of copper, brass, bronze, aluminum, magnesium, steel.

We are ready *now* to fill industry's peacetime needs.

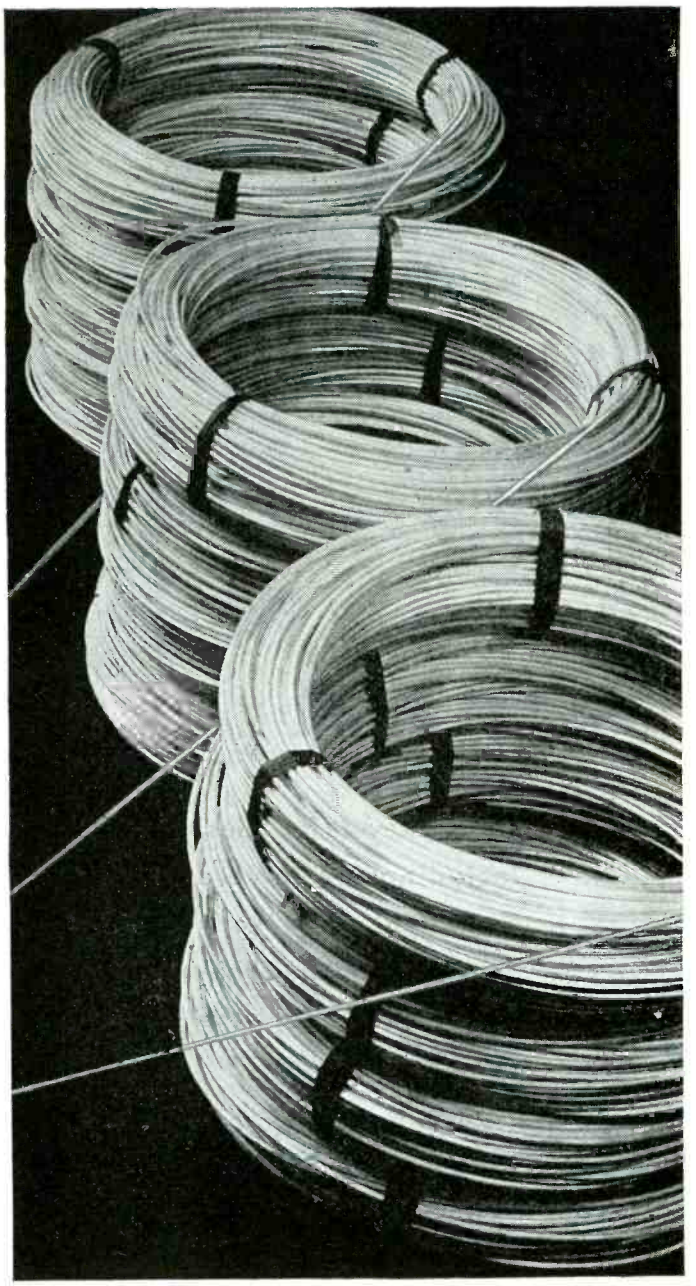
Revere hopes that, in the conflict just ended, what we won was the gigantic opening battle for better living. To fight *this* war our nation needs materials and the products of industry on a scale even greater than that which won military victory.

One inevitable result of Revere's war effort is that not only our ability to produce, but our ability to give service, have been expanded many times. Revere research has probed further and further. Revere Technical Advisors are armed with greater knowledge and experience. New methods and new machines may save precious time or cut all-important cost.

With all these enhanced resources we are ready now to serve man's creative spirit and, by supplying industry in abundance, to help make of life the rich, joyous thing it can be.

ANOTHER WILCO DEVELOPMENT

SILVER JACKETED WIRE



WILCO Silver Jacketed Copper Wire now widely used for coils in Short Wave Radio Communications Systems.

PROPERTIES AND CHARACTERISTICS—WILCO Silver Jacketed Copper Wire—an economical non-corrosive wire with solid-silver characteristics—is used successfully in many *electronic* applications, where high frequency currents are a problem. Another WILCO jacketed type combines great physical strength with high conductivity. A third unites stamina with highly desirable electrical characteristics. In fact there is almost no limit to WILCO facilities for combining metals of widely differing physical and electrical properties to meet individual engineering needs.

Gold, silver, copper, brass, bronze, iron, steel, nickel, monel and invar, are all utilized in producing WILCO'S uniform, non-porous, securely bonded jacketed wire and rolled strip.

CONSULT OUR ENGINEERING DEPARTMENT—Write our Engineering Department for help in developing the proper application of WILCO materials to your products.

SEND FOR WILCO BLUE BOOK—The Blue Book contains charts, formulae and full descriptions of *all* Jacketed Materials and other WILCO products. Send for FREE copy today.

WILCO PRODUCTS INCLUDE:

Contacts—
Silver
Platinum
Tungsten
Alloys
Sintered Powder Metal

Thermostatic Bimetal—
High and Low Temperature with new high temperature deflection rates

Precious Metal Collector Rings—
For rotating controls

Silver Clad Steel Jacketed Wire—
Silver on Steel, Copper, Invar or other combinations requested

Rolled Gold Plate

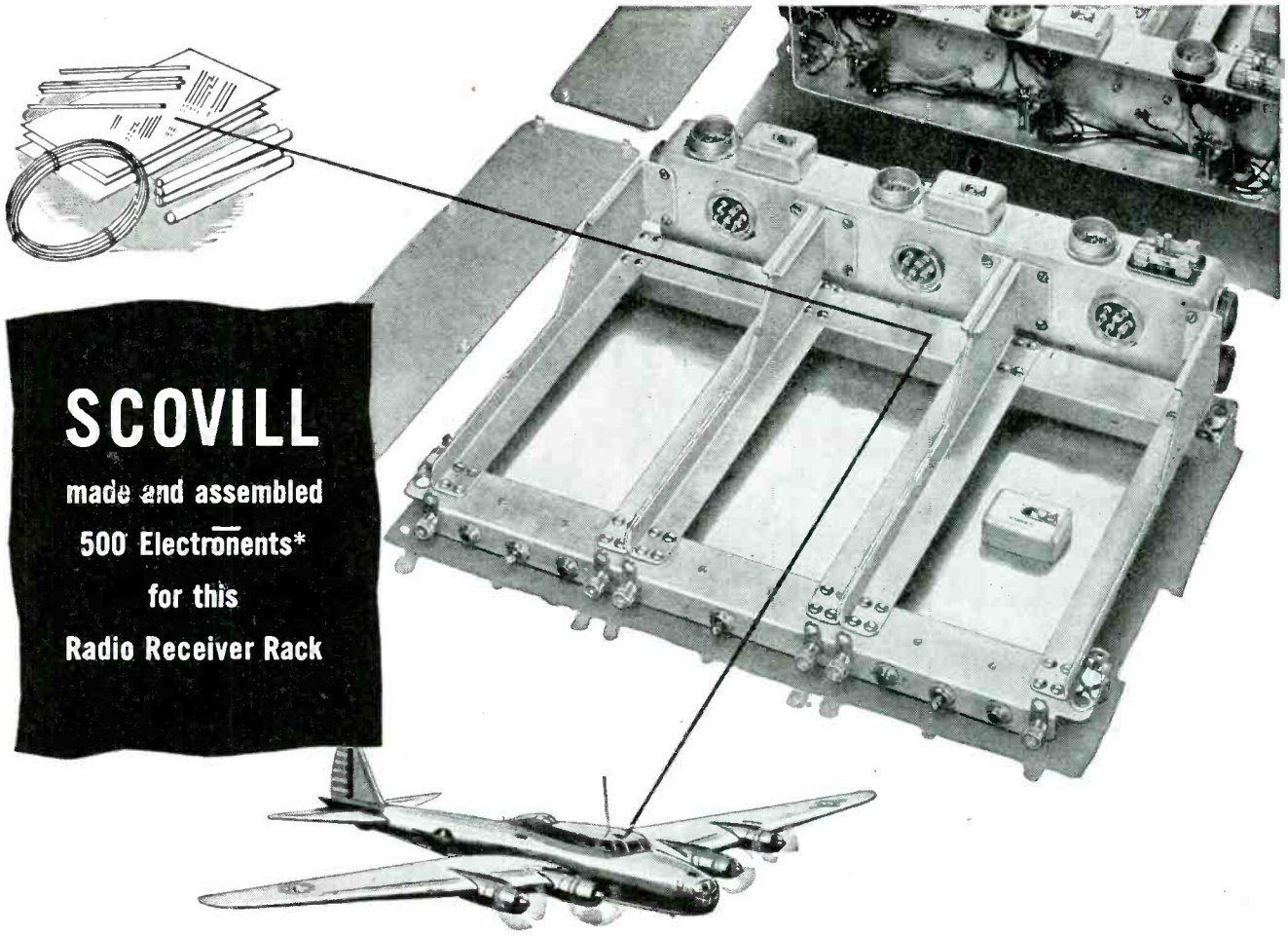
Special Materials

WILCO

THE H. A. WILSON COMPANY

105 Chestnut Street, Newark 5, N. J.
Branch Offices: Chicago • Detroit • Los Angeles

SPECIALISTS FOR 30 YEARS IN THE MANUFACTURE OF • THERMOMETALS ELECTRICAL CONTACTS • PRECIOUS METAL BIMETALLIC PRODUCTS



Demonstrating how Scovill can reduce your overhead on small parts or complete assemblies

Put yourself in the shoes of the prime contractor who needed this three-position, high-frequency radio receiver rack for big bombers in a hurry. He could have undertaken to make in his own plant the more than 500 individual parts required, or . . . made some and purchased the remainder, then assembled the complete unit himself. Instead he turned the complete responsibility over to Scovill . . . and saved time, space, trouble and money.

Here's what Scovill did: made all the metal parts of sheet, rod, wire and tube stock using such metal-working methods as forging, stamping, drawing, heading, machining and wire forming . . . cut all wires to length, stripped and soldered them into position . . . manufactured, tested and adjusted relays . . . assembled the entire rack as illustrated.

Investigate how Scovill's versatile production setup, as exemplified above, can improve the quality or lower the cost of your small electronic components or complete assemblies. Learn how Scovill's designing and metal-working experience and facilities will make you sure of getting the one *right* solution to your metal-parts problems. For proof of Scovill's ability to help you, write for literature. Fill in the coupon below and mail it today.

*Electronents = Electronic Components

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

Please send me a free copy of "Masters of Metal" booklet describing your facilities. I am interested in the ELECTRONENT* applications checked.

- ☐ Batteries
- ☐ Dials
- ☐ Panels
- ☐ Record Changers
- ☐ Escutcheons
- ☐ Sockets
- ☐ Clips
- ☐ Jacks
- ☐ Stampings (misc.)
- ☐ Condensers
- ☐ Lugs
- ☐ Tubes

Other applications .....

SCOVILL MANUFACTURING COMPANY

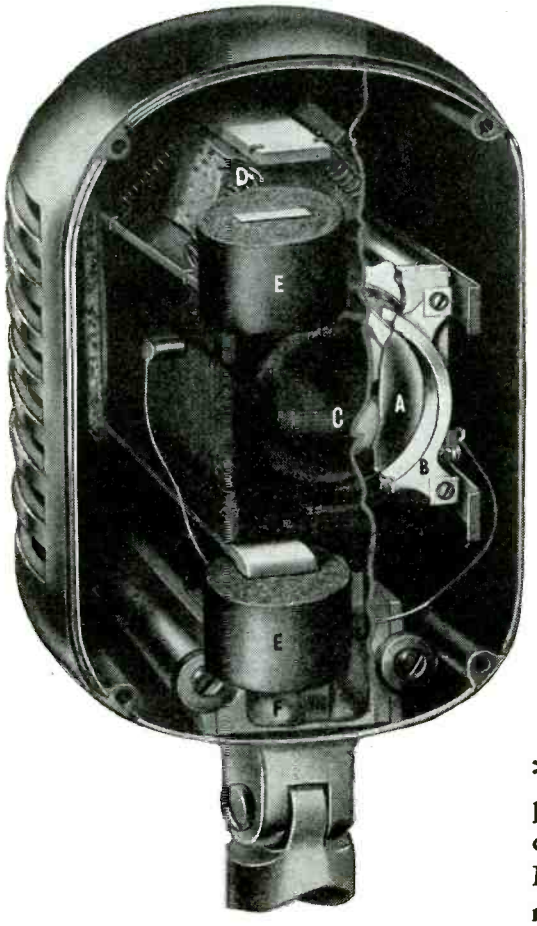
Electronic Division
23 Mill Street, Waterbury 91, Connecticut

Name .....

Company .....

Address .....

. . . this is the single unit* construction of SHURE Super-Cardioid Dynamic Microphones



(A) Single moving coil diaphragm.

(B) Rugged 4 point moving coil suspension.

(C) First wind and dust screen.

(D) Spring mounted mechanism.

(E) Shock absorbers.

(F) High fidelity transformer.

* Using the "Uniphase" principle, an exclusive patented Shure development, this single unit construction is possible in a unidirectional Microphone. This eliminates the problems of matching two dissimilar units and results in compactness and ruggedness. Because only one unit is employed, all these advantages are available at less cost to you.

SHURE MICROPHONES

List Prices . . . Shure Super-Cardioid Dynamic Microphones

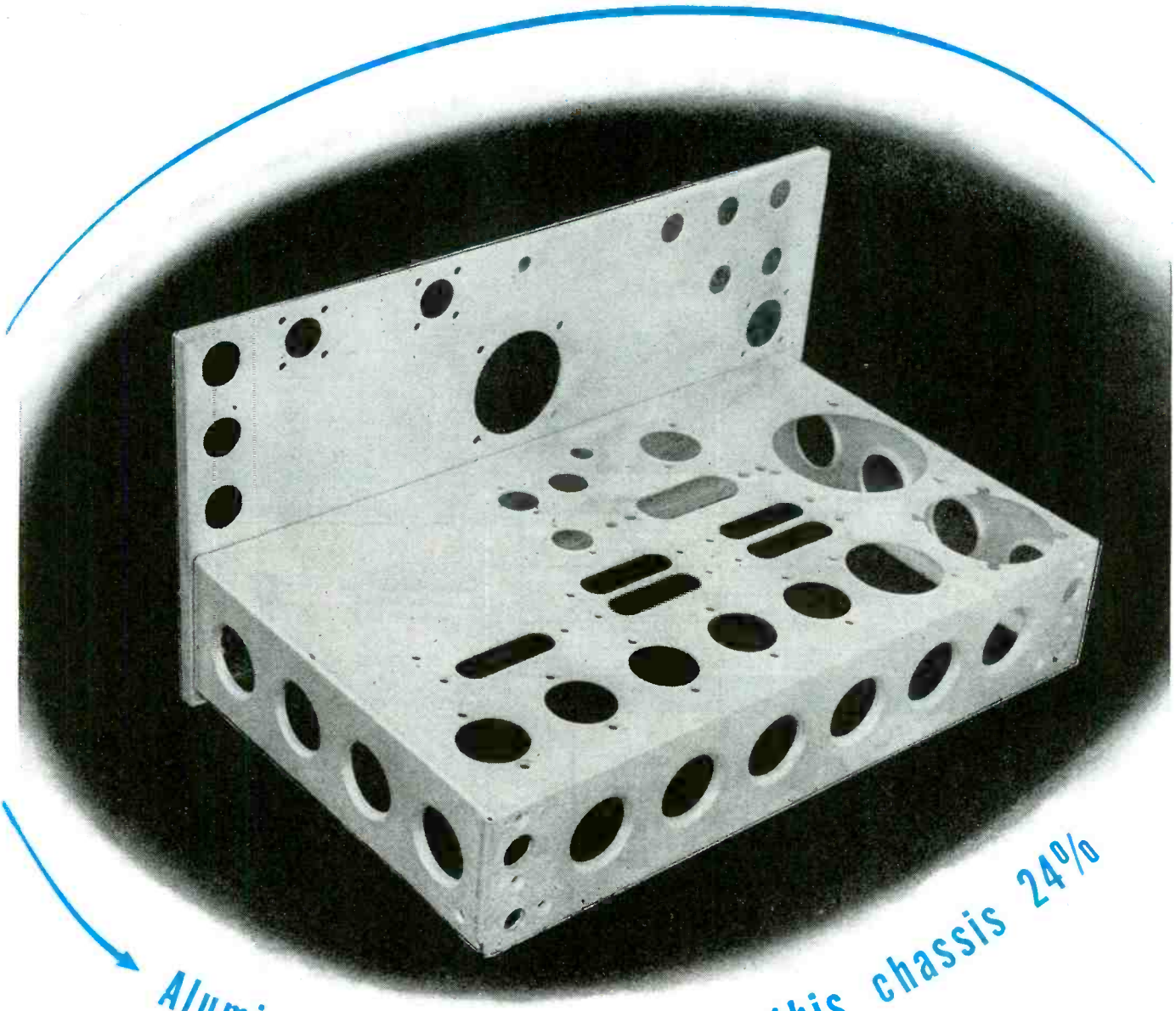
Models "556" Broadcast $75

Models "55" Unidyne . . . . . $47 to $49.50

SHURE BROTHERS

Designers and Manufacturers of Microphones and Acoustic Devices

225 West Huron Street, Chicago 10, Illinois • Cable Address: SHUREMICRO



Aluminum reduces weight of this chassis 24%

Photo, courtesy of Airodio, Incorporated, designers ond manufacturers of rodor ond electronic test and communication equipment.

Before it was redesigned by Airadio, Incorporated, Stamford, Conn., this chassis for radar equipment weighed 17½ pounds. Made with Alcoa Aluminum the weight was reduced to 13 pounds and 5 ounces.

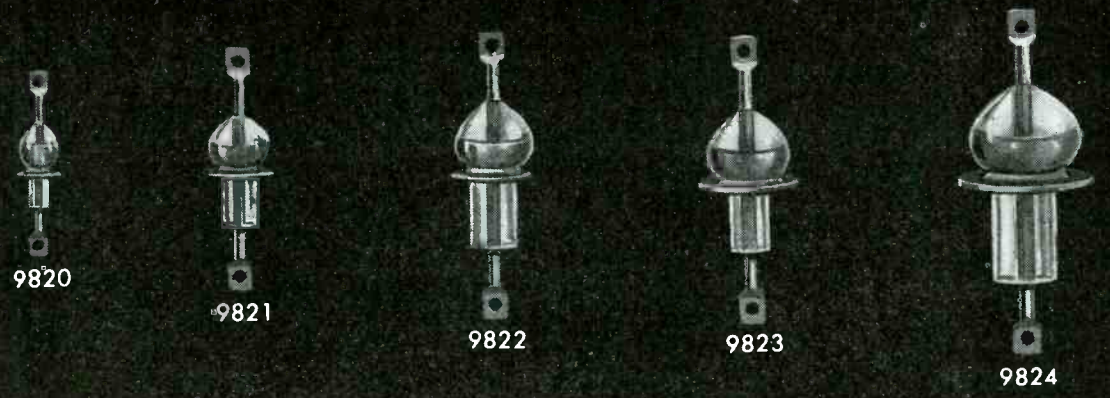
Reduction of weight is only one of many advantages provided by aluminum. It is easily workable, gives excellent thermal conductivity, superior electrical conductivity and furnishes a bright surface for stenciling markings.

Further, Aluminum is nonmagnetic . . . it can be silver-plated to meet high frequency requirements and to allow for soldered assemblies. Alcoa engineers will be glad to help you find the best way to use aluminum in your electronic equipment. ALUMINUM COMPANY OF AMERICA, 1921 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

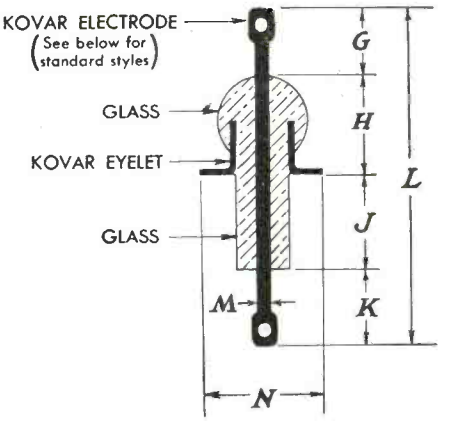
ALCOA ALUMINUM

for POSITIVE HERMETIC SEALING



PART No.	Average of Actual Test Flash Over or Breakdown Voltage R.M.S.	Recommended Maximum Use Voltage at Sea Level R.M.S.
9820	4,750	2,500
9821	6,900	5,000
9822	9,624	7,500
9823	9,300	7,500
9824	12,725	9,000
INSULATION RESISTANCE OVER 1,000,000 MEGOHMS		

Actual Size Photograph



STANDARD SIZES (other sizes to your specifications)							
PART	G	H	J	K	L	M	N
9820	3/16	5/16	3/16	3/16	7/8	.040	.212
9821	1/4	3/8	1/4	1/4	1 1/8	.060	.340
9822	1/4	13/32	13/32	1/4	1 1/4	.080	.380
9823	1/4	11/32	13/32	1/4	1 1/4	.080	.500
9824	1/4	1/2	1/2	1/4	1 1/2	.080	.672

STANDARD ELECTRODE STYLES AVAILABLE IN COMBINATION (EXCEPT B)

METAL-GLASS SEALS by STUPAKOFF

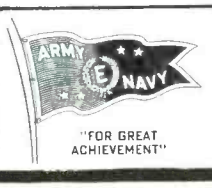
The series of Stupakoff metal-glass seals illustrated offers maximum electrical qualities consistent with space limitations and simplicity of design permitting mass production. They are suitable for operation at temperatures from —55° C to +200° C, and are tested to meet thermal shock specifications of the services. The construction provides a hermetic seal with a long electrical leakage path, resistance to thermal shock and mechanical strength.

Such seals are made possible by the metal, Kovar, a cobalt, nickel, iron alloy which matches the expansion of certain hard glasses from —80° C to the annealing point of the glass (approx. +450° C). Kovar forms a seal through a heating process in which the oxide of Kovar is dissolved into the glass to form a perfect bond — pressure and vacuum tight under extreme climatic conditions.

Stupakoff furnishes Kovar-glass seals with single or multiple electrodes in various styles. For those equipped for glass working, Stupakoff supplies Kovar as rod, sheet, wire, tubing or fabricated into cups, eyelets or special shapes.

Write Stupakoff today for assistance in developing hermetically sealed components for war applications. Samples and reprints of this advertisement may be obtained by writing department K-56.

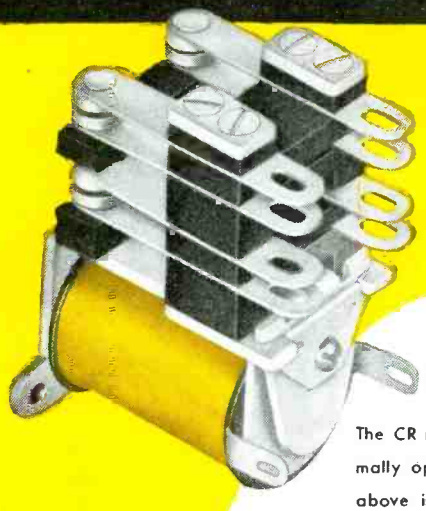
Do More Than Before—Buy EXTRA War Bonds



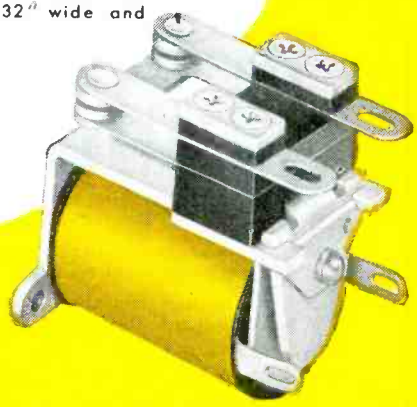
STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Products for the World of Electronics

Reduce YOUR CONTROL SIZE WITH ALLIED'S "CR" RELAY



The CR relay shown below is a single pole normally open double break arrangement. Shown above is the four pole single throw, normally open combination. The CR uses molded bakelite throughout. Standard contacts are silver; alloy contacts can be supplied. Contact rating with ¼" silver contacts is 15 amperes at 24 volts DC or 110 volts AC non-inductive. The single pole weighs 3 ounces and is 1 33/64" high; 1 3/32" wide and 1 25/32" long. The four pole weighs 3¼ ounces and is 1 29/32" high, 1 3/32" wide and 1 25/32" long.



The CR type relay is amazingly small compared to previous power relays. It was developed by Allied to allow greater compactness and less weight in your electronic controls.

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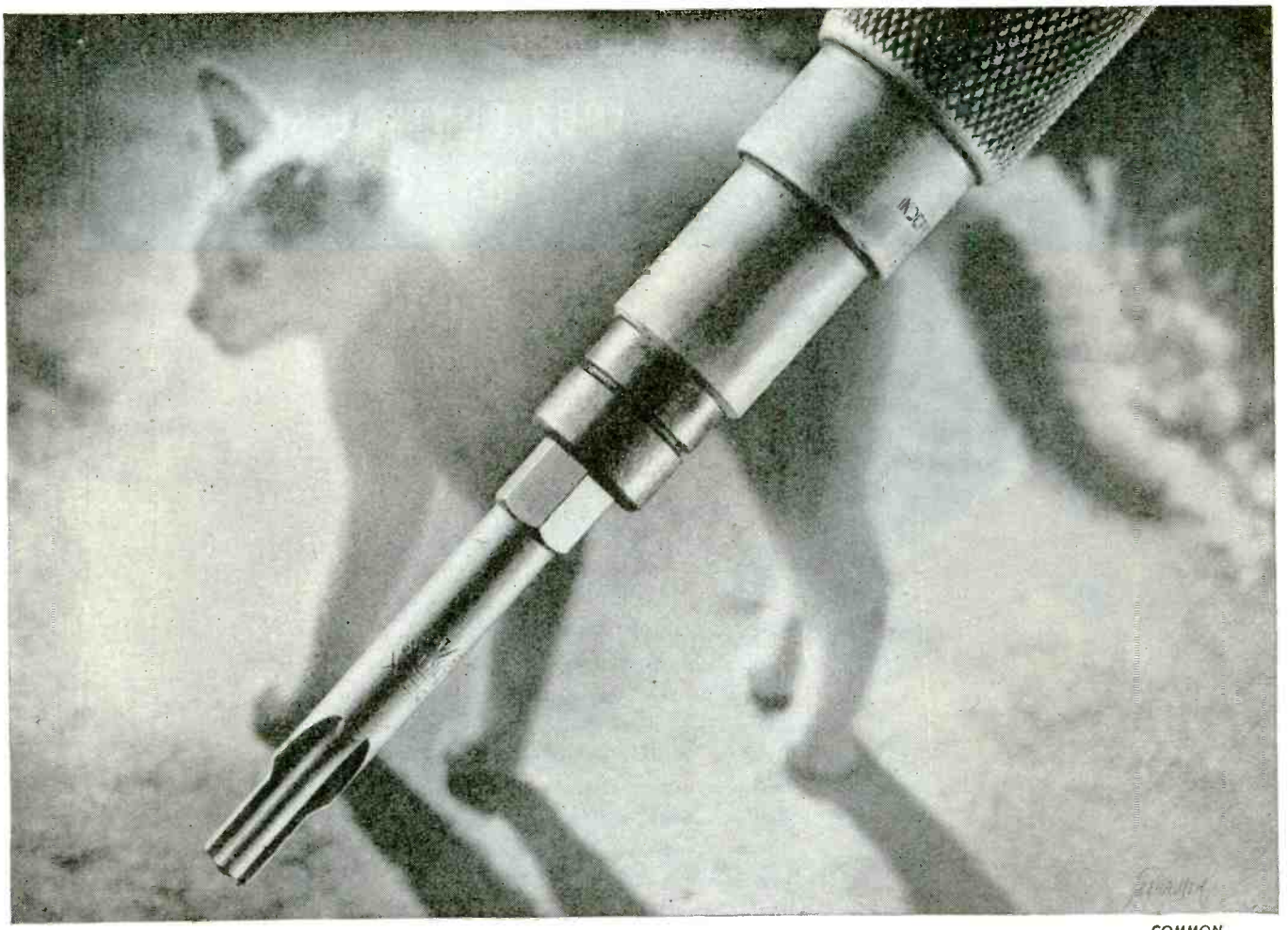

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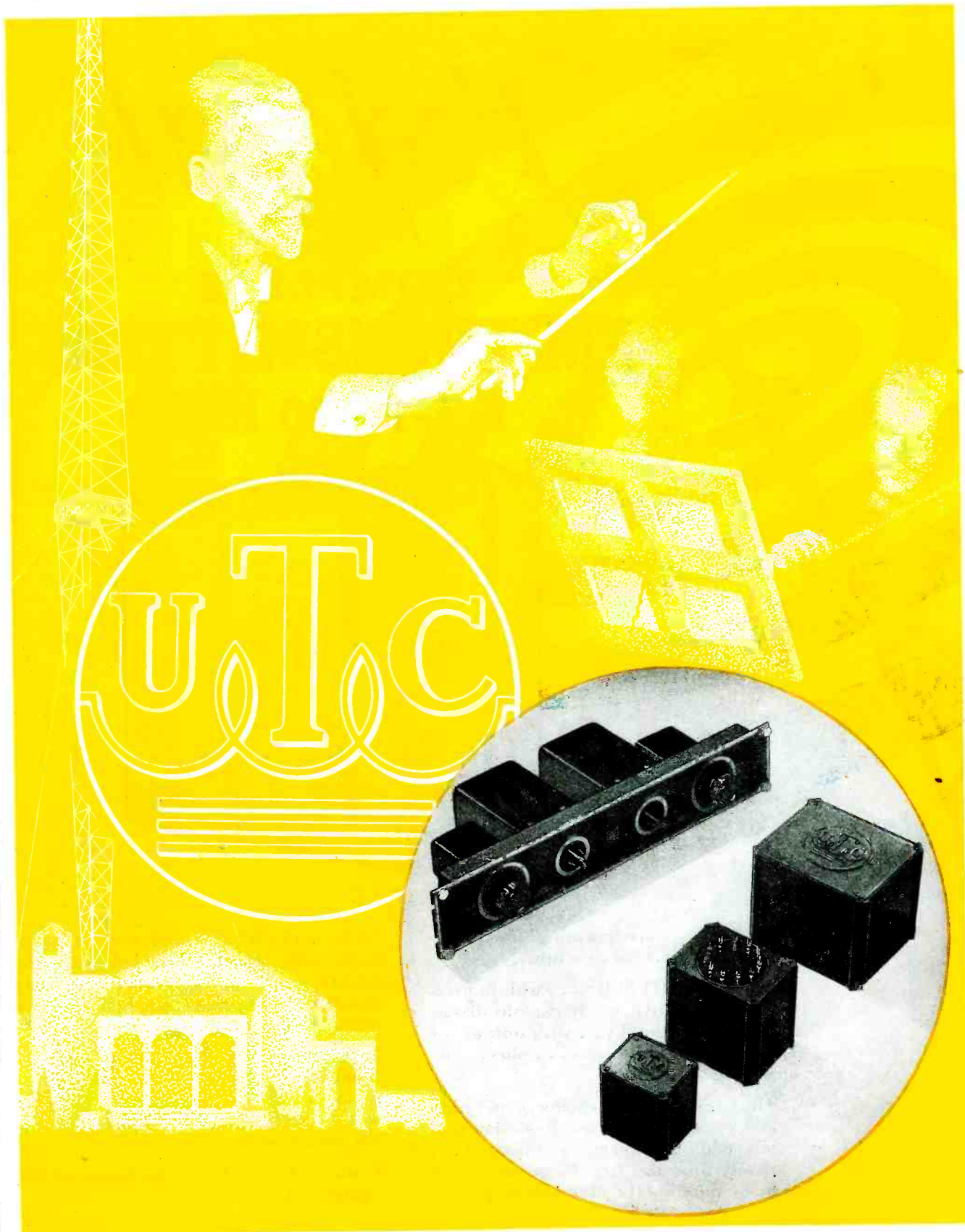

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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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

The Underpaid Engineer

That radio and electronic engineers need a new yardstick for computing their own compensations, in comparison with salesmen, lawyers, and other executives in their organizations, is pretty evident to most readers of Electronic Industries. The following survey of a Cornell University class, made ten years after graduation, reveals average incomes which certainly are not representative of the relative services to the employing company or to the community and public. Surely something ought to be done to bring engineers' compensation up to levels corresponding to the true value of engineers' contributions of ideas and services.

Bankers and Brokers	$11,040	Newspapermen	$5,180
Manufacturers	8,524	Accountants and Statisticians	5,004
Physicians	7,944	Insurance men	4,533
Architects	7,230	Farmers	4,461
Merchants	7,136	Contractors	4,287
Lawyers	5,905	Engineers	3,724
Salesmen	5,690	Teachers	3,137
Purchasing Agents	5,600		

Incentive Compensation Plans

To give proper rewards to electronic engineers who make important contributions to the earnings of their corporations, Dr. J. A. Stobbe presents some interesting proposals in an article in this issue. For, not only should the radio and electronic technician benefit in a real way from the inventions and ideas which he originates, but he should also share proportionately in the general prosperity of his company, as it earns substantial sums for other executives and for the stockholders. In too few instances, so far, has the electronic engineer received his fair share of the peaches-and-cream.

Be Wise: Standardize

Everyone agrees that tube, component and equipment standardization has served a great purpose in insuring adequate production of the electronic material of war.

The future of peacetime electron-tube applications to industrial processes may very well depend on this availability of "packaged goods." The manufacturer who intends to make motor control equipment, weld-timers, photoelectric units, or almost any other type of industrial electronic device, designed for flexibility of application, should standardize, then let production roll. Only in this way can costs be cut and reliability and ease of maintenance be upped to the point where prospects generally can't afford NOT to employ electronic processing devices.

Sauce for the Gander

The shoemakers' children go barefoot, and M.D.'s die young from neglecting their health, but you'd think that the cold light of costs and profits would induce manufacturers of electronic equipment to use electronic equipment on their own production lines. We've been quite surprised to see how many tube structures are welded without benefit of tube-controlled welding time, or how much gas and I^2R electricity go up in smoke and wasted heat, brazing and soldering electronic components that could be put through in a tenth the time with electronic induction heating. How come? Aren't outsiders going to be suspicious of the golden claims for tubes in industry if they get wind of this preposterous situation? Let's be our own best customers now, thus modernizing our production facilities for that hoped for post-war business.

ENGINEERING DIRECTORY NUMBER in December

At the moment when manufacturers are announcing their new peace-time products and completing 1946 design and marketing plans, the publishers of Electronic Industries announce the Engineering Directory to be published in December as an integral part of the regular magazine. This Directory—an editorial service for the benefit of our engineering readers—will include complete listings of all manufacturers of finished products, raw materials, parts and components, equipment and accessories, laboratory apparatus and production equipment.

Be sure to return your questionnaire to editors of Electronic Industries, 480 Lexington Ave., New York 17, N. Y.

STRAIN ANALYZING AND

By CLAUDE M. HATHAWAY,
Hathaway Instrument Co., Denver, Col.

Practical schemes developed include inductance and resistance type gages with results recorded on moving film

• Engineers today are faced with the problems of designing for higher speeds and lighter weight, requiring a closer knowledge of actual strains and much more careful attention to vibration. In many modern structures, the strain introduced by vibration may be many times the static strain, and the only practical way to determine this predominant vibratory motion is to measure it under operating conditions in an actual machine. Instruments to measure strain in this manner have been of inestimable value to aeronautical engineers during the rapid aircraft development of the last five years, and these methods will, no doubt, prove to be of almost equal value in the post-war development era.

Dynamic strain recording and analysis as an aid and adjunct to engineering development and design was probably first applied on a major scale jointly by the Pennsylvania Railroad, the General Electric Co. and the Westinghouse Electric Corp. in 1935. This was in connection with development of electric locomotives, and their application to the electrified Pennsylvania system. Electric strain gages connected to remote oscillographs recorded pressures on rails, rail joint bars, and locomotive parts at various speeds, up to 100 miles per hour and over.

The dynamic strains and impacts determined by this analysis led to rapid advances in electric locomotive design, and provided valuable information on stresses encountered in rails and joint bars. The valuable results obtained led to the application of strain recording to aircraft propellers and engine mounts, and then to all other stressed parts in airplanes, so that at the present time dynamic strain recording is one of the necessities of the aircraft designer.

Part of the modern concept of industrial design is to know accurately the stresses applied to each part and where on the part the greatest strains occur. In very many cases mathematical or graphical analysis of strains is difficult or impossible. This formerly necessitated the inclusion of large safety factors to cover ignorance. Even then safety was doubtful, parts became bulky and costs rose. An exact knowledge of strains has produced notable improvements in military equipment designs, and will do the same for many more peace time products where economy and efficiency are both to be considered.—The Editors.

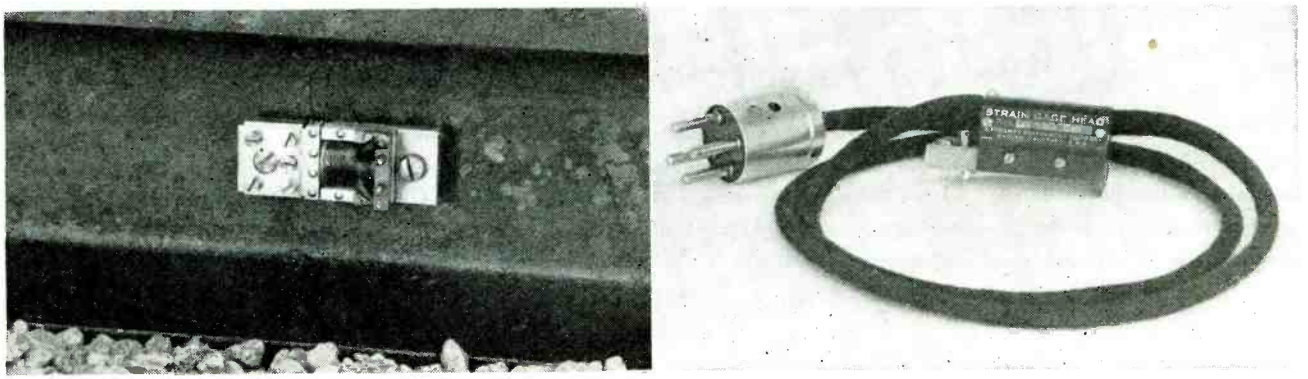
The methods of strain recording proved particularly important in this field because of the greatly increased necessity of weight reduction and the economic use of materials, as well as of the fact that failures must be held to an absolute minimum. Vibratory strains are also of particular importance in this field because of high speeds and accelerations, and all of these factors together make accurate strain measurement a prime necessity.

The many applications of electric strain gages that have been made, and the many more applications that can and will be made, will not be discussed here, except to say that almost without exception, strain gages can be applied to any stressed member regardless of size, regardless of the material, regardless of the value of the strain, and regardless of the frequency range of the strain if it is not steady. This fact, together with the obvious fact that strain is everywhere and is an underlying factor affecting the design of every machine part or device, is enough to convince everyone of the basic importance and absolute necessity of dynamic strain measurement. With this introduction to the subject and evaluation of its importance to modern engineering, we will proceed to a discussion of the instruments and equipment involved.

Apparatus needed

Electric strain-recording equipment consists of the strain gages which are attached to the member in which strain is to be measured, amplifiers for amplifying the strain gage outputs, and a recording instrument, usually a multi-element oscillograph, for recording the amplifier outputs. In some instances,

Fig. 1. Inductance type strain gage applied to a rail. As this must be screwed in place it is most used on large pieces. This gage measures strain at a point slightly off the surface thus permitting errors due to bending. This fault is not present in the type shown in Fig. 2, right



RECORDING INSTRUMENTS

the strain gage output is sufficiently high and the recording instrument sufficiently sensitive so that the amplifier is not required.

Supplementary to this fundamental equipment are the sources of electrical energy for operation of the equipment. Frequently, the primary source of electric power does not supply the right kind of power so that a special power-supply unit is required which operates from the primary source of power and supplies electric power suitable for the strain recording equipment in regard to voltage, frequency, regulation, etc.

Strain gages

An electric strain gage is an electrical device that is attached to the member at the point to be studied. Variations in electrical properties of the strain gage, as a result of strain in the member to which it is attached, are translated in deflections of the measuring instrument or oscillograph galvanometer.

Strain gages have been built involving capacitance change, inductance change, and resistance change. Gages involving capacitance change are seldom used because of the relatively greater difficulties in measuring the change, and this discussion will, therefore, be limited to gages involving inductance and resistance change.

Inductance-type strain gages

Strain gages involving inductance change have been used over a considerable period of time with very satisfactory results, and are still in considerable use, particularly on large members such as bridge members and railroad rails.

This type of strain gage has a laminated magnetic circuit in which a small air gap is introduced, and the gage is attached to the member in such a way that the air gap varies with strain. Variations in the air gap cause variations in the inductance of a coil wound around some portion of the laminated structure, and the deflection of the measuring or recording equipment is made to depend upon the inductance of the coil.

A typical inductance-type strain gage is shown in Fig. 1. The laminated magnetic circuit is made up of two parts, an E-shaped assembly and a straight bar which completes the circuit. The coil is wound around the center leg of the E, and the entire E assembly and coil is mounted on a rigid base and attached to the member under test by means of a single screw. The bar assembly or armature is likewise attached to a rigid base and to the member under test by means of a screw. Strain in the member between the two screws will produce a variation in the air gap between the two assemblies and hence variations in the inductance of the coil.

Dimensions

The strain gage shown in Fig. 1 has a gage length of two inches, which is the distance between the two mounting screws, and a weight of 4½ oz. This gage can be used satisfactorily on large members, but cannot, of course, be used on small members where the gage weight is of significance or where it would not be practical to attach the gage by means of screws. On large members where the gage shown in Fig. 1 can be used, it has certain advantages over other types, however, and these are extreme ruggedness and simplicity and the fact that the strain gage output is high enough to drive recording equipment without the use of amplifiers.

Another disadvantage to the use of the large inductance strain gage shown in Fig. 1 on small members arises from the fact that the air-gap change is not measured on the surface of the member but approximately 5/16 above the surface. Because of this fact, errors may be introduced if the strain is due to bending and if the distance from the air gap to the surface of the member is appreciable, as compared to the distance from the surface to the neutral axis. This disadvantage is eliminated in the inductance strain gage shown in Fig. 2.

The strain gage shown in Fig. 1 has three knife-edge feet that rest in tiny indentations in the surface of the member. Two feet are rigidly attached to the frame of the strain gage, and the third is attached to a rocking lever supported by knife edges, as shown in Fig. 3. The rocking lever is terminated with a small armature which is movable between a pair of coils.

Fig. 6. Coil type galvanometer. Characteristics are high sensitivity at low frequencies

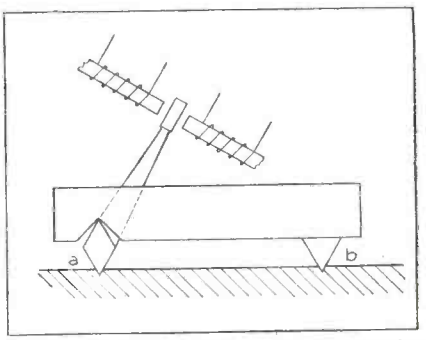


Fig. 3. Schematic view of the construction of the gage of Fig. 1. Movement of the material under the knife edges alters inductance

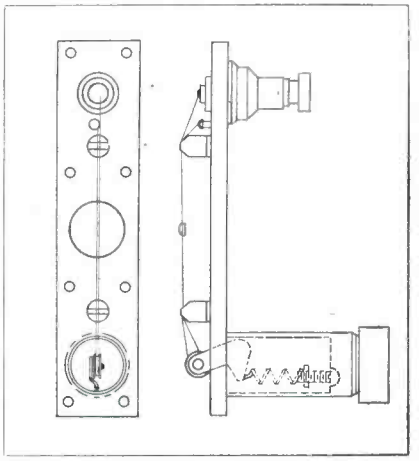


Fig. 4. Constructional drawing of bifilar galvanometer. A mirror bearing loop of metallic ribbon is stretched over a magnet

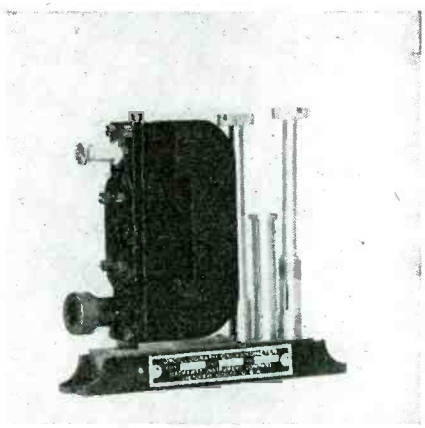


Fig. 5. A bifilar galvanometer. Sensitivity of 50 mm/ma scale deflection at 1 meter can be obtained with low frequency stringing

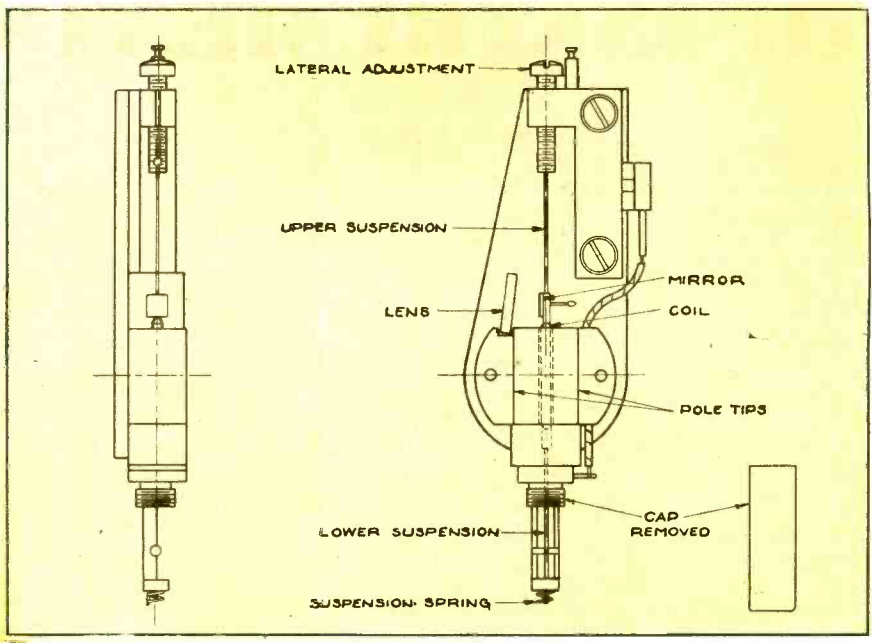


Fig. 7. Construction of coil type galvanometer. Due to the much greater mass and inertia of the moving coil as compared with the bifilar type, frequency response limit is low

The diagram shows that a change in the distance ab between the knife-edge feet will result in a change in the location of the armature between the two coils.

Resistance strain gages

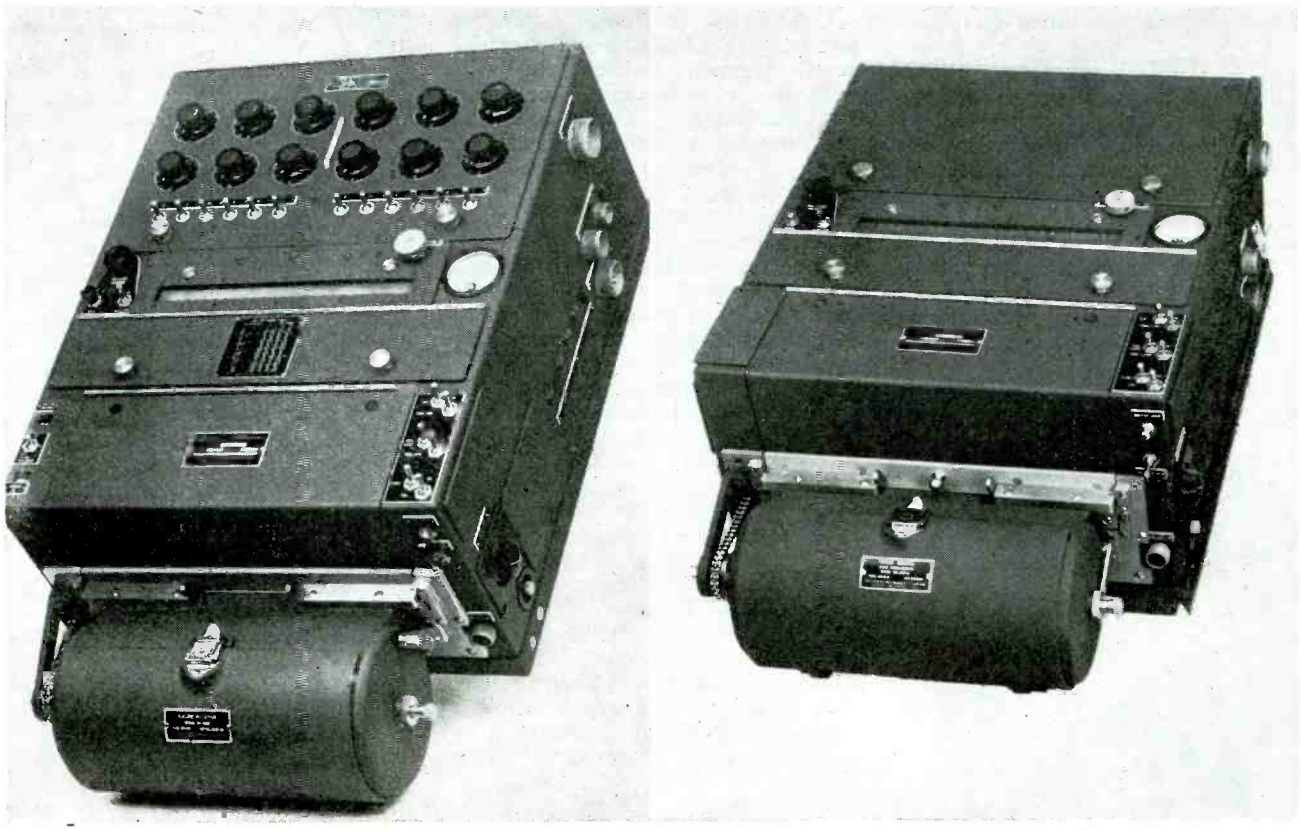
A resistance strain gage utilizes a change of resistance with elongation. This type of gage consists of a resistance element attached so that strain in the member will result in a small dimensional change in the resistance element, producing an actual change in the resistance of the element.

A resistance strain gage is usually a very simple device. The Baldwin - Southwark type SR - 4 strain gage, which is the most successful and generally adaptable resistance strain gage with which the author is familiar, consists of a grid of fine wires about .001 diameter, cemented between two small pieces of thin paper. To measure static or dynamic strain at any point in a member, it is only necessary to attach the strain gage to the member at that point with cement, with the axis of the gage in the direction of the strain component that it is desired to measure.

The resistance change with strain in a wire strain gage, such as the Baldwin-Southwark type SR-4, is partly due to an actual dimensional change of the wire, and partly due to the fact that the specific resistance of the wire changes with strain, a phenomenon discovered by P. W. Bridgeman in his experimental work on the physical properties of materials at high pressures.

Several years before the development of the Baldwin-Southwark type SR-4 strain gage, considerable use was made of another type of resistance gage in which the resistance element consisted of some form of graphite or carbon. A simple construction used by Hull of the General Electric Co. was a strip of paper coated with India ink. Another construction was a thin strip of phenolic material on one

Fig. 8. Semi-portable type of multi-element oscillograph arranged to accommodate 12 to 24 bifilar or 14 to 36 coil type elements. Light for recording is furnished by one or two standard auto headlight lamps. The instrument of Fig. 9, right, is similar, but smaller and lighter



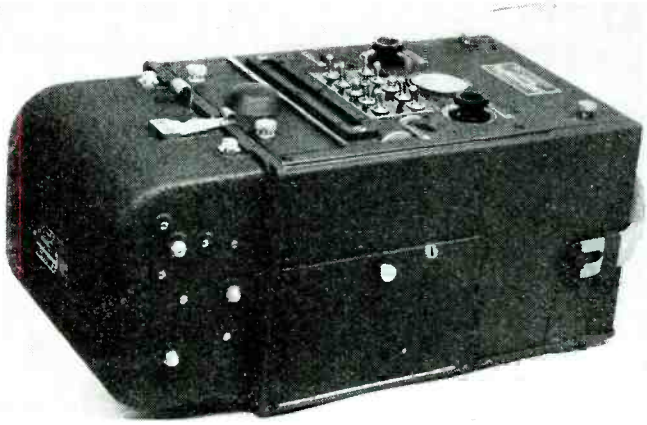


Fig. 10. Portable oscillograph designed for field use such as strain recording in fighter aircraft and other general uses

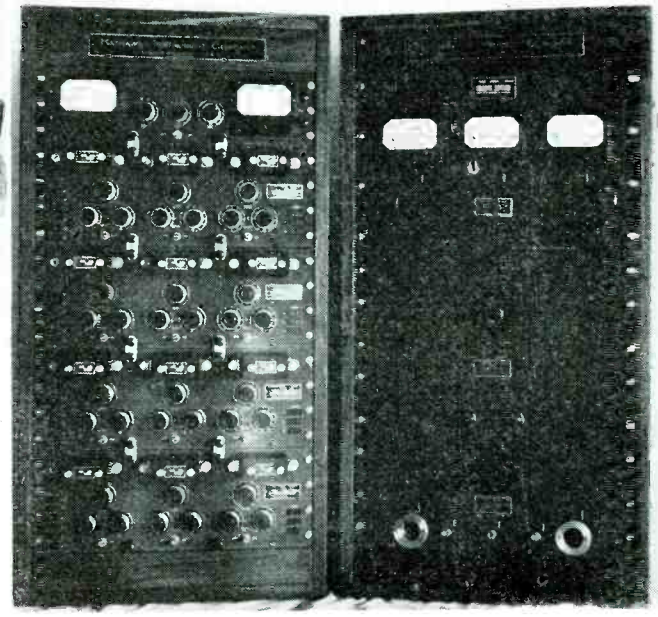


Fig. 12. Strain gage control unit used to apply the gage current to an oscillograph

side of which a thin layer of graphite was deposited electrolytically.

Resistance strain gages employing graphite or carbon have an advantage over those using metallic wire, in that the voltage output is very much greater, but they have a disadvantage in that the resistance is also a function of humidity. Because of the greater stability of the wire-type gage, and because satisfactory amplifier equipment has been developed to handle its low output, this wire-type gage is used almost exclusively at the present time.

Gage factor

The output of a resistance strain gage, in terms of strain, is a function of the "gage factor," which is defined as follows:

$$\text{Gage Factor} = \frac{\dfrac{\text{resistance change}}{\text{total resistance}}}{\dfrac{\text{length change}}{\text{total length}}}$$

A typical wire strain gage has a gage factor of approximately 2, and a resistance of 120 ohms. This means that a strain of .001 inch per inch, or a stress of 30,000 lb. per sq. in. in steel, will result in a resistance change of .24 ohm.

Oscillographs

The oscillograph must be designed for recording quantities that are subject to rapid variation. Oscillographs are usually electrical, in that they are designed to record electric currents, and recording is usually accomplished on a moving chart or sensitized paper or film by small spots of light reflected from galvanometer mirrors.

The galvanometer is the measuring element of an oscillograph. Its moving element, consisting of the mirror and its driving means, must have a high natural frequency, in order to follow rapid variations in the strength of the electric current, and it must be properly damped according to the well-known laws of vibrating systems.

Several types are in common use. The bifilar type, generally used for oscillograph work, consists of a single loop of fine metallic ribbon tightly stretched between the pole-tips of a permanent magnet with a small mirror cemented to the loop at its center. This construction is shown by the diagram in Fig. 4, and a typical bifilar galvanometer is shown in Fig. 5.

The performance characteristics of an oscillograph galvanometer can be expressed by sensitivity, natural frequency, mirror area and degree of damping, and these characteristics can be varied between wide limits in the case of the bifilar galvanometer by varying the cross-section of the suspension strip, the tension in the strip, the length of strip between supports, and the size of the mirror. With the bifilar galvanometer illustrated, sensitivities up to 50 mm/ma at 1 meter can be obtained for low-frequency stringing, and an undamped natural frequency of 10,000 cps can be obtained with a high-frequency stringing with a corresponding sensitivity of 0.1 mm/ma at 1 meter.

The coil-type galvanometer, as as shown in Figs. 6 and 7, is occasionally used where a high frequency response is not required. The moving element in this galvanometer consists of a small coil held in place between the poles of

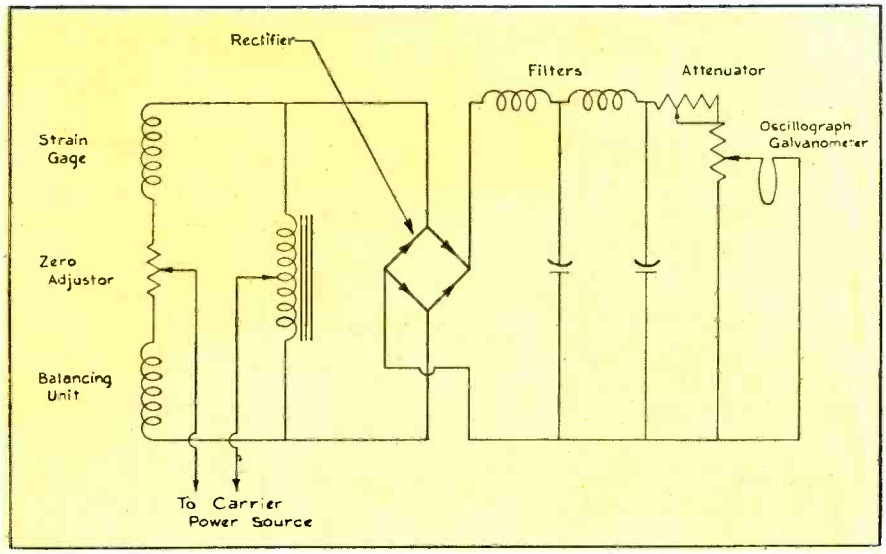


Fig. 11. Circuit of the strain gage unit. This operation from a 2000 cycle carrier source and is accurate for strains up to a frequency of 600 cycles per second

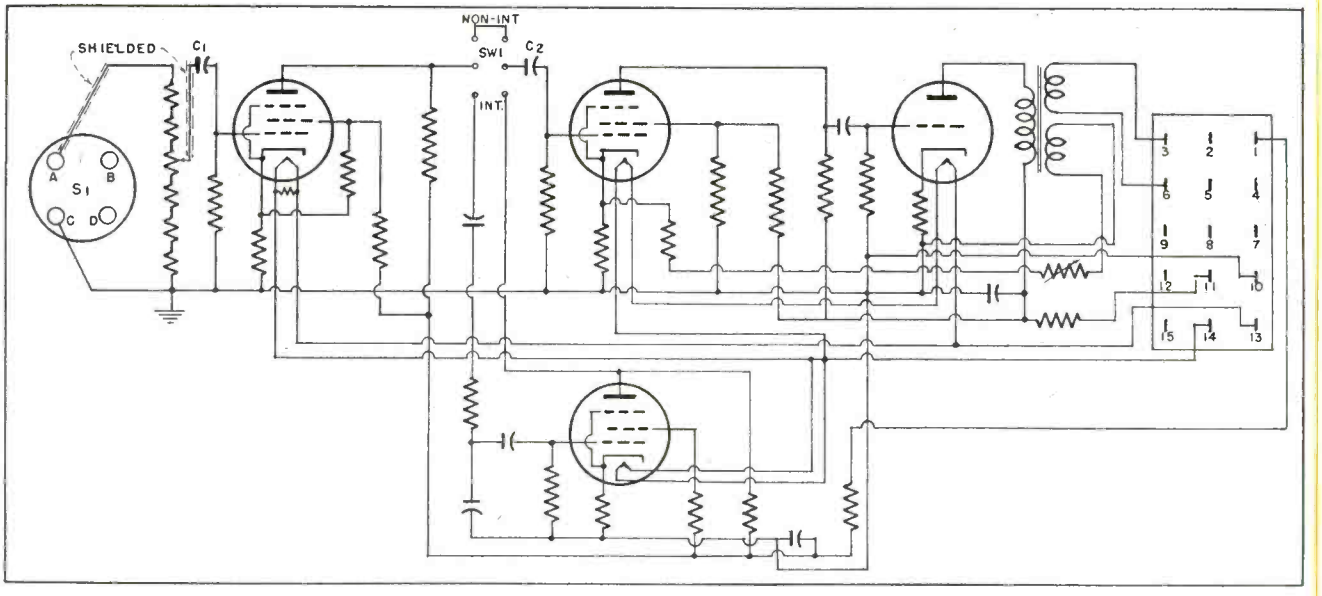


Fig. 13. A typical amplifier circuit for direct current in the strain gage circuit and a wide band low-frequency ac amplifier. This diagram shows the strain gage bridge, the oscillograph galvanometers and the intermediate amplifier equipment. Its response is from 3 to 3000 cps

a permanent magnet by two taut suspensions, in a construction similar to a conventional but miniature D'Arsonval galvanometer. This type of galvanometer is generally useful only in those applications where the maximum frequency response is not greater than several hundred cycles per second.

For low-frequency work where the coil-type galvanometer can be used, it has several distinct advantages over the bifilar type, as a result of its larger mirror. The large mirror of the coil-type galvanometer permits the use of a simpler optical system and a less-sensitive recording paper. The record traces obtained with a coil-type galvanometer are usually somewhat sharper than those obtained with a bifilar galvanometer, because a small amount of diffraction is produced by the small bifilar galvanometer mirror, whereas mirrors used on coil-type galvanometers can be large enough to eliminate diffraction almost entirely.

Multi-element oscillographs

Three multi-element oscillographs widely used for strain recording are shown in Figs. 8, 9 and 10.

This oscillograph, in Fig. 8, is arranged to accommodate 12 to 24 bifilar type OA-2 galvanometers or 12 to 36 coil-type galvanometer elements. Light for recording is supplied from one or two standard automobile headlight lamps. For charts, either sensitized paper or film can be used in widths of 6 or 10 in., and in lengths of 100 or 200 ft. The chart is driven by an internal governor-controlled motor at any one of 16 speeds between 1/3 and 40 in. per sec., and the speed desired is selected by means of a quick-change transmission.

Time-coordinate lines are photographed on the record as it is taken, by means of an internal tuning-fork controlled synchronous motor-driven shutter with a time-line spacing of 1/100-second or 1/10-second as desired. Consecutive record numbers are automatically photographed on the end of each record, and an automatic record length control device can be set to run off any length of record desired after the oscillograph is started. A calibrated viewing screen on the top panel of the oscillograph provides for visual observation of spot positions and deflections even when records are being taken.

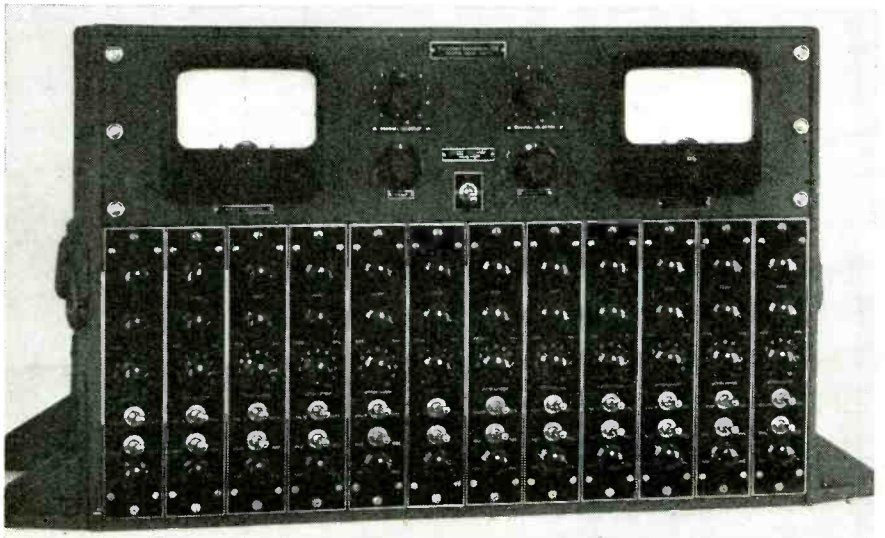


Fig. 15. A 12 channel strain gage control unit, for which three types of amplifier elements are available. These can be inserted in unit to make any desired combination

The oscillograph shown in Fig. 8 is classed as semi-portable. Its external dimensions are 18 x 10¾ x 28¼ inches, and its weight complete with 12 galvanometers is 125 lb.

The type S8-D oscillograph, shown in Fig. 9, is similar to the above but omits several convenient features, such as automatic numbering and automatic record-length control. It is, basically, a complete oscillograph for general-purpose requirements, however.

The type S12-A oscillograph, Fig. 10, is a portable instrument designed for field use, such as for strain recording in fighter aircraft, as well as for general or laboratory use. It is a 12-element instrument with a number of convenient features such as a time-coordinate device, record-numbering device, automatic record-length control, viewing screen, and magazine load-

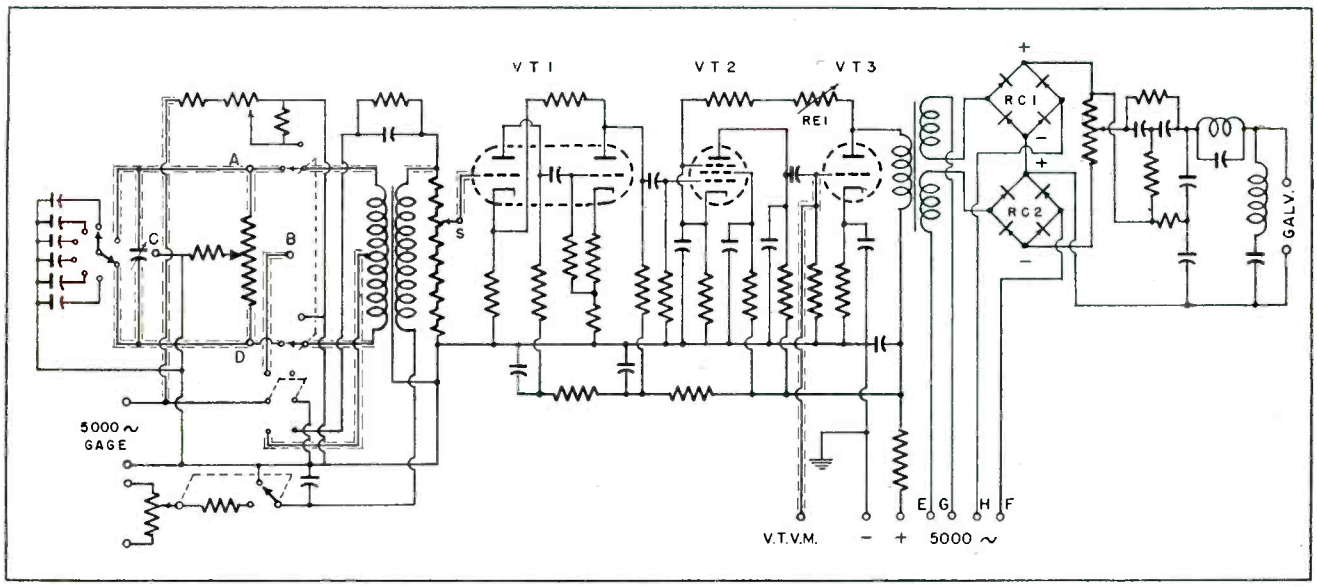


Fig. 14. A typical amplifier using a carrier in the strain gage circuit, and an amplifier with flat frequency response over a range wide enough to cover the carrier and both side bands. This circuit has a phase selective demodulator in the output circuit to remove the carrier

ing, all included in a case 18 x 9 x 8 in., and with a weight of only 40 lb.

It can be equipped with 12 bifilar type OA-2 galvanometers or with one 12-element type OD-12 coil-type unit. Six-inch recording chart is loaded into the record magazine in 100 ft. lengths, and any record speed desired between ½ and 48 inches per second can be selected by inserting the proper change gears into the gear train, accessible through the hinged cover on the side. All controls, adjustments, and indications are mounted on a single control panel on the top.

The term "strain-gage control unit" has been assigned to all the auxiliary electrical equipment between the strain gages and the oscillograph. This unit is usually of multi-element design and may or may not contain amplifiers. Several variations of strain-gage control units will be described and illustrated.

Amplifier equipment

Large inductance-type strain gages, such as the type shown in Fig. 1, may drive their oscillograph galvanometers directly without the use of amplifiers. A typical circuit for this type of operation is shown in Fig. 11, and a complete 12-channel strain-gage control unit which houses the balancing gages, adjustments, rectifiers, filters, etc. for 12 separate channels is shown in Fig. 12.

The equipment illustrated in Figs. 11 and 12 operates from a 2000-cycle carrier and provides a strain record that is accurate for static strain and for dynamic strain, up to a frequency of 600 cycles per second. No amplifiers are required. The strain gage is connected in a bridge circuit consisting of the strain gage, a balancing unit similar to the strain gage, and a center-tapped inductance unit. Carrier power is supplied to two corners of the bridge and the carrier voltage across the other two corners is a function of strain. The voltage output from the bridge is demodulated to remove the carrier by means of a full-wave rectifier and proper filters, and then applied to the oscillograph galvanometer terminals through an attenuator, as shown in Figure 11.

In general, resistance strain gages and small inductance gages require the use of an amplifier be-

(*Continued on page* 182)

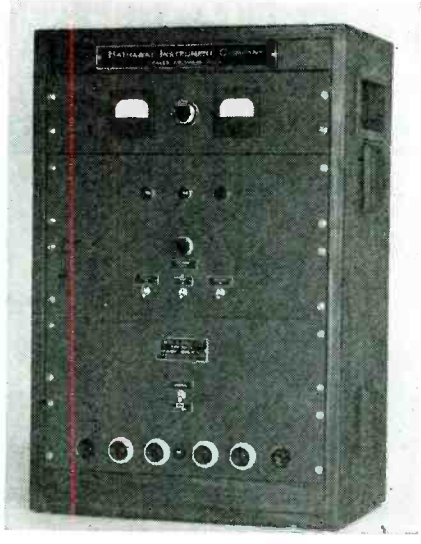
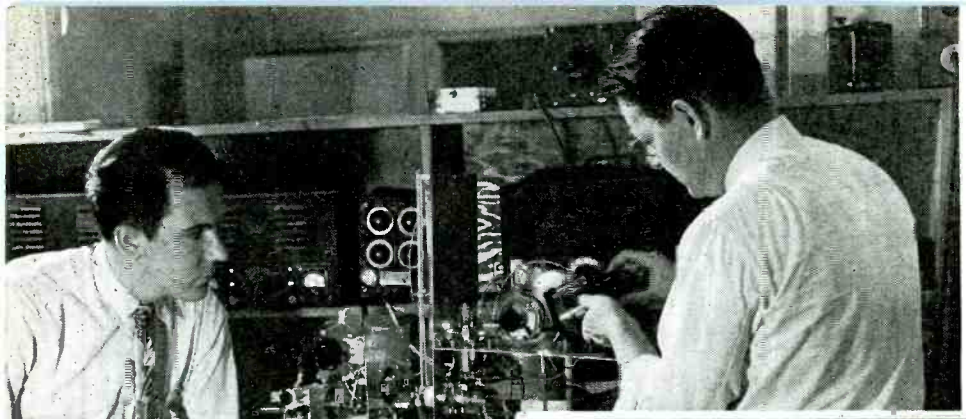
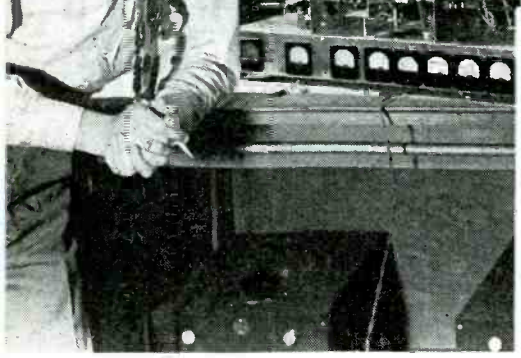


Fig. 16A, left. An electronic power supply unit to supply power for 24 large 2000 cycle inductance strain gages. Fig. 16, right. A power supply unit designed for use with type MRC-10 control unit to supply 5000 cycle power for carrier circuits and also all dc for amplifier elements

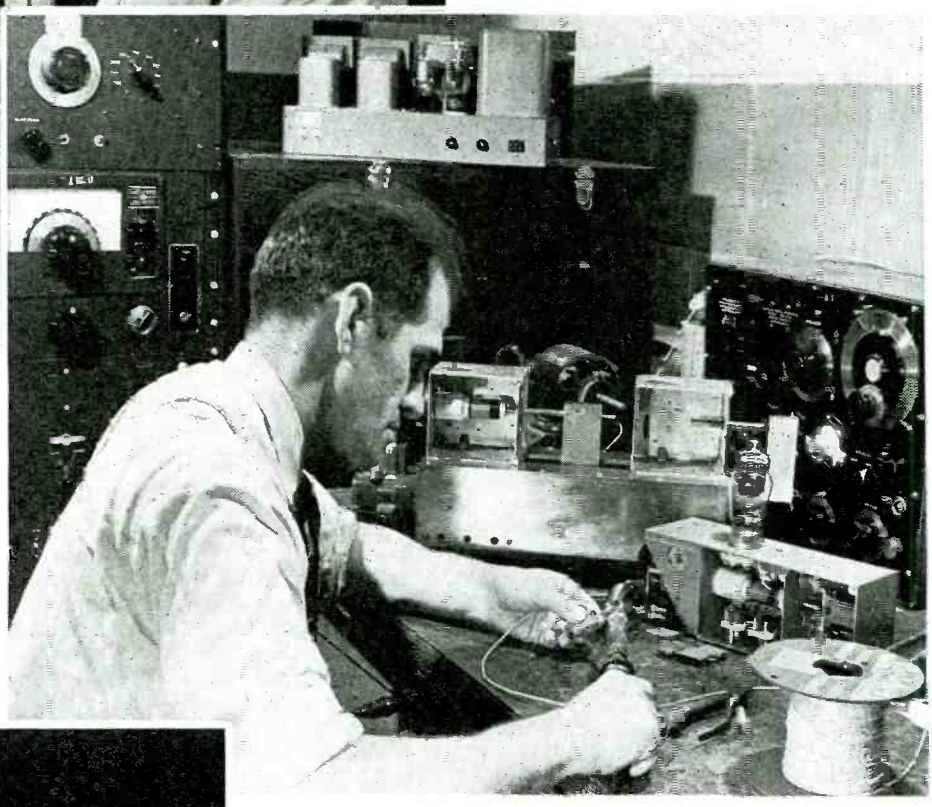
MODERN

Viewing some of the laboratories in the Cedar Rapids plant

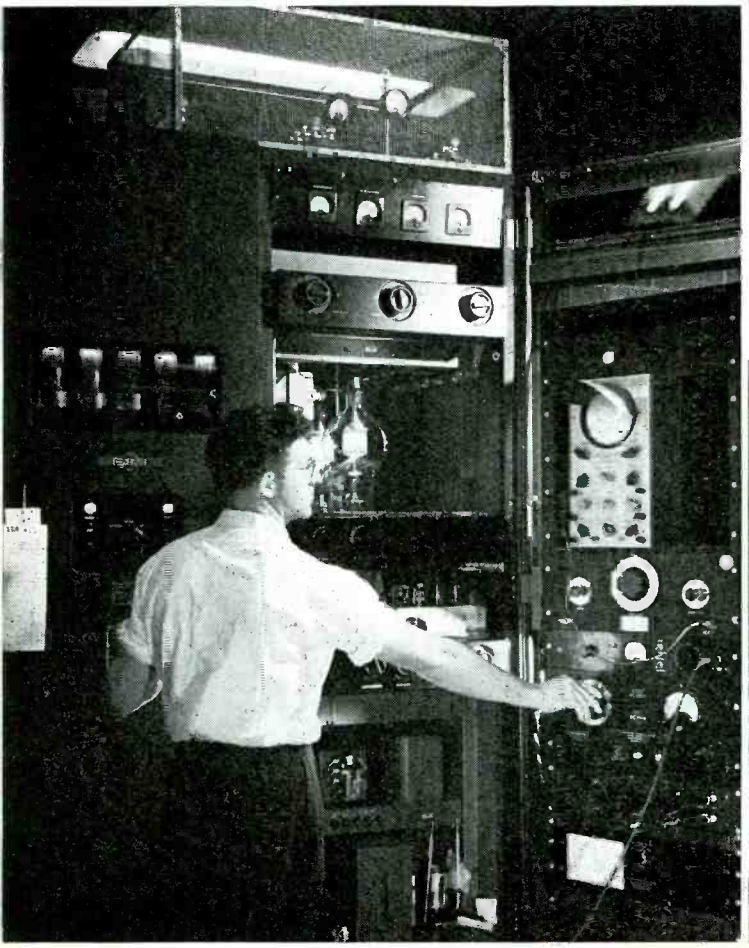




▲ Position of circuit elements, shields and leads is critical factor in design of higher frequency equipment. At this stage, months are spent in these specialized laboratories arranging and proving circuit for its intended purpose

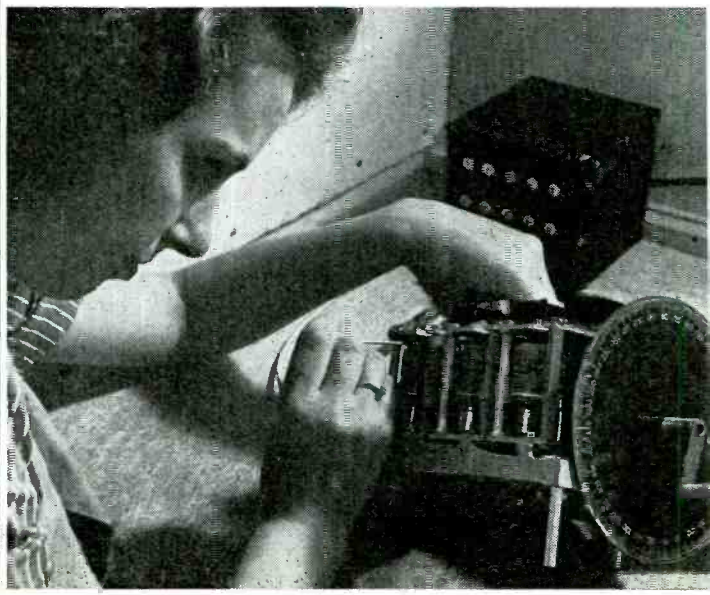


▼ Although components, sub-assemblies, wiring and soldered joints have been inspected and tested, each finished transmitter is completely operated into a simulated antenna load. Here measurements of all characteristics are recorded



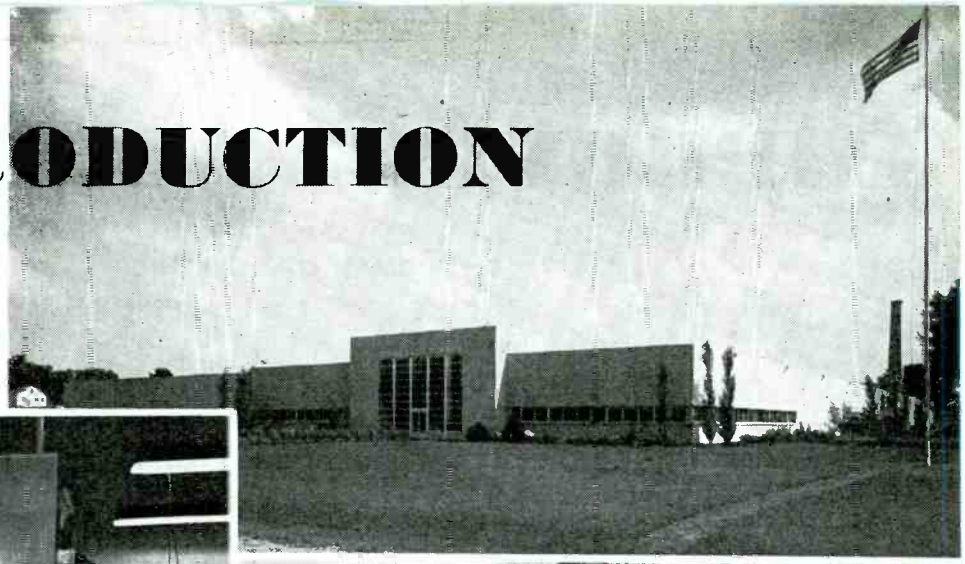
▲ The communication equipment produced often departs from current conventional design. Therefore much of the needed test and control equipment not being commercially available, is designed and built in the Test Equipment Department of the Collins Radio Company

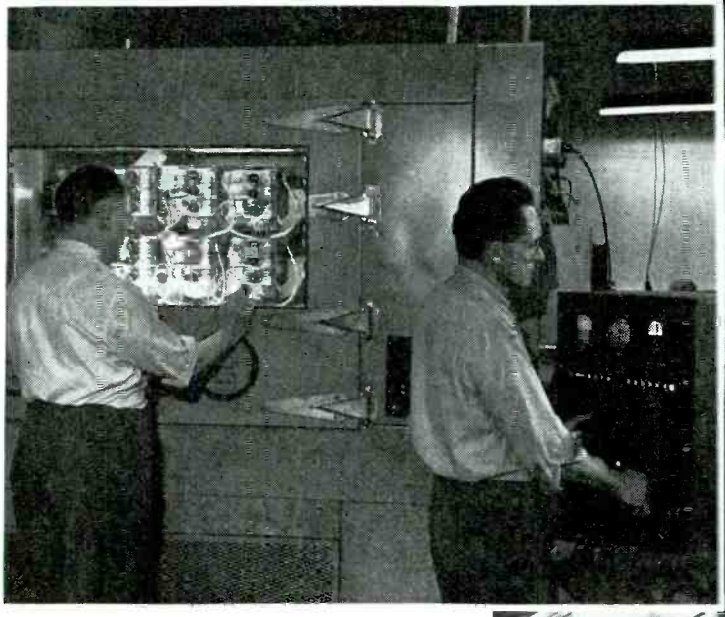
▼ Collins Autotune heads are synchronized in a sound-proof booth so that the pawls are heard when they drop. Indicator lights show which channel is electrically selected. Large dial gives precise electro-mechanical synchronization simplifying test of complete assembly



Radio PRODUCTION

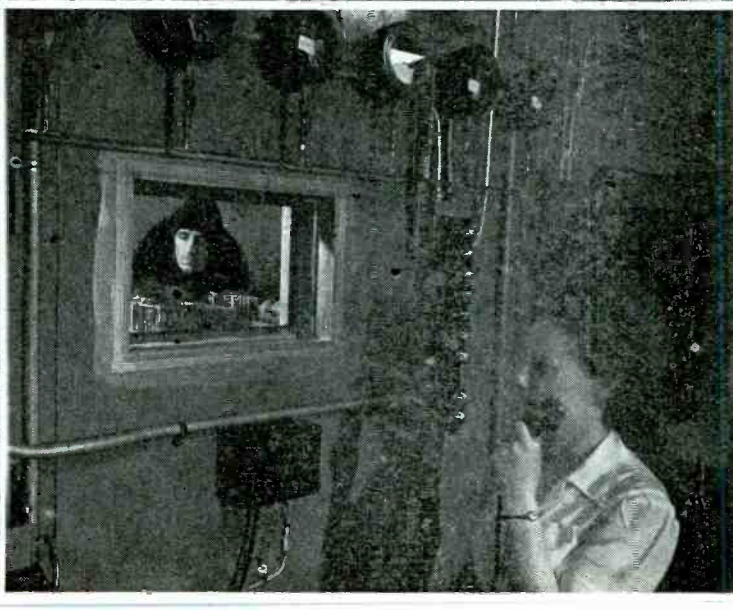
tory and factory methods of the Collins Radio Co.





▲ (Top right) Main plant of the Collins Radio Co., containing 150,000 square feet, houses administration, engineering and manufacturing. Above Test of Autotune assemblies with torque meter at "forty below." (Right) Tubes are checked under actual operating conditions. Rotary tube checker in foreground preheats filament before a tube reaches the high-voltage rectifier tester or the high power tube tester at rear

▼ (Below) Each laboratory includes well equipped machine shop and assistants. (Below right) Each aircraft transmitter is tested in climate chamber, which simulates the complete gamut of service temperatures



IMPROVING RECORDINGS

By NORMAN C. PICKERING
Control Instrument Company, Inc., Brooklyn, N. Y.

How to get the most out of phonograph records including a new design for a volume expander to increase 'presence'

• It has long been realized that reproducing phonograph records in the home in such a manner as to invoke all the psychological responses experienced in the concert hall is a formidable problem. At the outset we are faced with the realization that the atmosphere of excitement and expectancy which gives glamour to all performances in a concert hall will be entirely missing in the familiar and prosaic living-room. And, unless the room is very large, the feeling of acoustic spaciousness which contributes so much to the grandeur of the sound in a good auditorium just isn't there, unless some clever auditory faking is done.

It is the purpose of this article to explain some of the more easily applicable methods by which reproduction of phonograph records can be enhanced to the point where, instead of being merely a reminder of an actual performance, the playing of a recording can be a thrilling musical experience in itself.

All musical performances can be analyzed into the simple elements of rhythm, dynamics, pitch and tone-color. If these elements are present in the proper quantities at the proper times the result is a satisfying musical performance. Rhythm, of course, being a time-sequence function, is dependent on turntable speed and stability. It is important that the absolute time-sequence of successive tones in a musical performance be maintained accurately, because "tempo" is the most important single factor affecting the emotional response to a musical performance. Inasmuch as "pitch," or fundamental frequency, is also affected by turntable speed, it is most important to rotate the record under the pickup at a steady speed of exactly 78.26 revolutions per minute. The word "steady" in this statement has great significance inasmuch as the "wow" caused by non-uniform turntable rotation is the most irritating distortion possible. Unfortunately, many commercial pressings are released with the "center" hole any place but in the center. With a disc like this, the "wow" will be bad even on a perfect turntable, and since the eccentricity is contant it will be more noticeable toward the center of the record. This is shown in the following derivation:

Let R = radius of a given groove, inches

ω = Angular speed of turntable, radians per second

λ = Wavelength of modulation, inches

f = Frequency of output voltage from pickup

For a record with no eccentricity:

$$f = \frac{\omega R}{\lambda}$$

The wavelength of a constant frequency tone is directly proportional to the distance from the center of the record.

Frequency varies

Let us assume a constant frequency record, where the center of rotation is not at the true center of the grooves. (The groove on a record is a continuous spiral, of course, but for this discussion no error is involved in assuming a given groove to be a circle.)

Let d = distance in inches from true center to center of rotation. Then the frequency will vary from

$$f_1 = \frac{\omega(R+d)}{\lambda} \text{ to } f_2 = \frac{\omega(R-d)}{\lambda}$$

$$f_1 - f_2 = \frac{2\omega d}{\lambda}$$

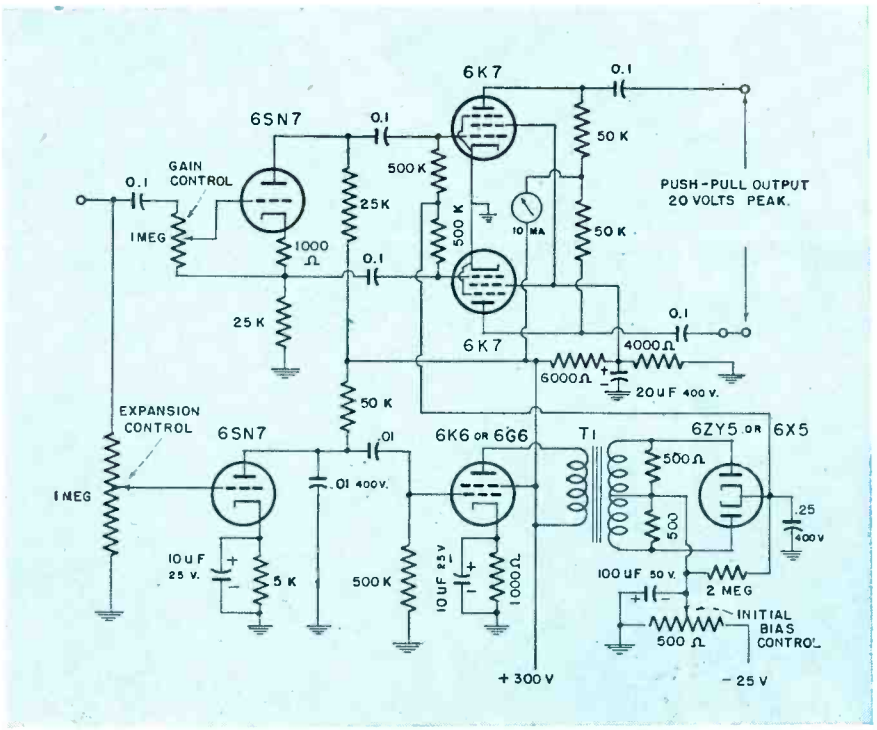


Fig. 1. Schematic diagram of the volume expander. The signal is amplified through one single and one push-pull stage. In the bottom circuit the same signal is amplified and rectified to bias the push-pull grids

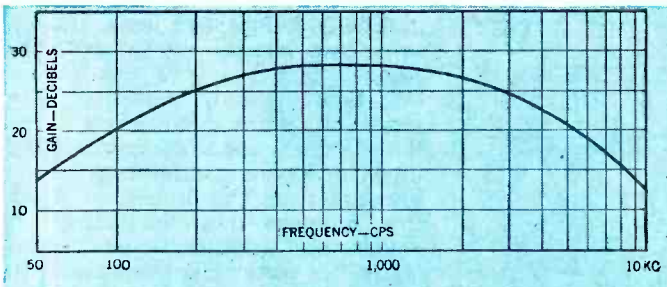


Fig. 2. Gain in db versus frequency curve for the amplifier of Fig. 1

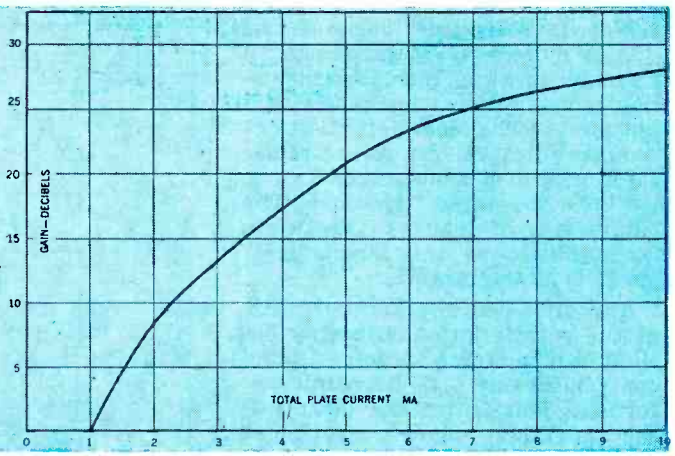


Fig. 3. Calibration of the 10 ma meter shown in the plate feed circuit in Fig. 1. The range of volume expansion available depends on the initial plate current. The 500 ohm potentiometer shown in Fig. 1 adjusts the fixed bias on the grids of the control stage of the amplifier. The relaxation time of the expander is made much slower than the response

The relative frequency change is

$$\Delta f = \frac{f_1 - f_2}{f} = \frac{2\omega d/\lambda}{\omega R/\lambda} = \frac{2d}{R} \quad (1)$$

From the Bell System Technical Monograph No. B-621 it is found that the minimum perceptible increment of pitch for frequencies from 500 cycles to 2,000, which is the band in which most of the energy of music appears, is less than 0.005 at normal levels. Since these measurements were made under laboratory conditions with pure tones, we will double the amount for complex waves in music under usual listening conditions. This gives us a limit of 0.01 for Δf.

Substituting in equation (1)

$$0.01 = \frac{2d}{R} \quad (2)$$

A common minimum value for R is 1.7 in. (There are records with even lower minimum groove radius.)

Substituting in equation (2) and solving for d

$d = .0085$

This represents the eccentricity at which pitch variations become noticeable, hence objectionable. In this light it is astonishing to realize that many commercial pressings have been purchased where the eccentricity is 0.020 inches or more!

A partial remedy for these records is to have a centerpin on the turntable which is about 0.040 inches smaller in diameter than the standard 0.281 inches. A tubular sleeve with the standard outside diameter would be normally placed on the centerpin. When an eccentric record is encountered the sleeve would be removed and the record moved about on the turntable until the grooves run true. A mark on the record label would simplify future location of the true center. With a light-weight pickup the weight of the record will be enough to hold it in position on the turntable. With some pickups extra weight at the center of the record will be necessary.

If the music on the record is of such a nature that there are no notes sustained for more than one rotation of the turntable, quite a large amount of eccentricity can be tolerated. However, if the recording contains music having sustained tones played by instruments not normally employing vibrato, such as the clarinet, horn or piano, the limit of eccentricity given here may be even too much.

Tone-color

Tone-color is the name given to the character of the sound. It is well known that the quality which enables us to distinguish between two instruments playing the same fundamental sustained tone is the number and relative intensities of the "overtones" or harmonics which are multiples of the fundamental frequency.

High frequency response is the controlling factor in the reproduction of the distinguishing harmonics of musical instruments. This has been the most discussed characteristic of reproducing systems ever since electronic amplification became popular. It should be clearly pointed out that a high upper limit of frequency response is not in itself a desirable characteristic. In fact, for phonograph record reproduction it is a decided disadvantage, as will be discussed below. What is important is that throughout the transmission band of the system there be no serious discrimination between adjacent frequencies. This dictates smooth frequency response.

The effect of jagged high frequency response is to accentuate some harmonics of certain tones, and attenuate others. The order of the harmonics which are altered changes for different tones in a given system. This produces the curious and displeasing effect of changing the tone color of an instrument in a manner which varies with the tone being played. As an example, a clarinet playing a chromatic scale with uniform tone quality would be reproduced so that adjacent tones differed seriously in timbre and even in loudness. In extreme cases adjacent semitones could assume the character of clarinet, flute and oboe respectively.

Smooth frequency response also results in much less unpleasant "surface noise." The ear apparently responds to the peak noise, rather than the average noise, in this case. This phenomenon gives the effect of an increased signal-to-noise ratio on a given record when played on a system having smooth frequency response over that when played on a system having jagged response over the same transmission band.

Smooth response is difficult to obtain with an ordinary single cone loudspeaker. Paper cone "tweeters" are particularly non-uniform in frequency response, even though they do contribute a lot of high frequency energy. However, there are available loudspeakers of conventional design which have fairly smooth response. A good horn-type loudspeaker of the metal diaphragm type is the best obtainable for smooth response and low distortion.

Harmonic distortion

Another important factor in natural rendition of tone-color is the elimination of harmonic distortion. The addition of harmonics to the fundamental tone, other than those present in the original sound, is not easily tolerated by the musical ear. The "raw" sound of a distorted wave is most unpleasant, and is the primary cause of the habitual over-

use of the so-called "tone control."

It is quite easy to construct an amplifier in which harmonic distortion is negligible at low power output levels. The most important design specification for an amplifier working into a loudspeaker load is low effective output impedance. The elimination of transient distortion accomplished by this means is of paramount importance.

Any good loudspeaker operating at the volume levels ordinarily desired in home reproduction of sound contributes very little harmonic distortion. This leaves the pickup as the most likely source of trouble of this kind. A good magnetic pickup gives the "cleanest" reproduction of any kind available today. Unfortunately good magnetic pickups are not inexpensive and inexpensive magnetic pickups are, as yet, not good. There should be developments in this field in the near future, however.

It should be pointed out here that some record distortion cannot be eliminated by any means. Records which have high level passages close to the center can never be reproduced with entire lack of distortion. Good equipment will, however, reduce it to the point where it is hardly objectionable.

A decided improvement in the sound of phonograph records can be obtained by sharply limiting the high frequency response of the system to 7500 cycles. This represents about the highest useful frequency which appears on most pressings commercially produced. Nothing appears in the region above 7500 cycles, therefore, but products of harmonic distortion, and surface noise. The improvement in quality realized on most records by eliminating these very high frequencies is considerable.

Filter

The low pass effect can be obtained by restricting the upper frequency limit of either the pickup, the amplifier or the loudspeaker. Since it would be desirable to have a wider frequency band available for very noise-free records cleanly recorded, a filter in the amplifier which can be switched in and out is convenient.

The dynamic range, or volume range, is the final characteristic of a reproducing system to be discussed. Although an orchestra in a concert hall may have a volume range of 50 db or so, it is impossible to maintain the correct relative volume levels on phonograph recordings. The amplitude of the modulation in the phonograph groove is severely limited by the groove spacing, by the overload

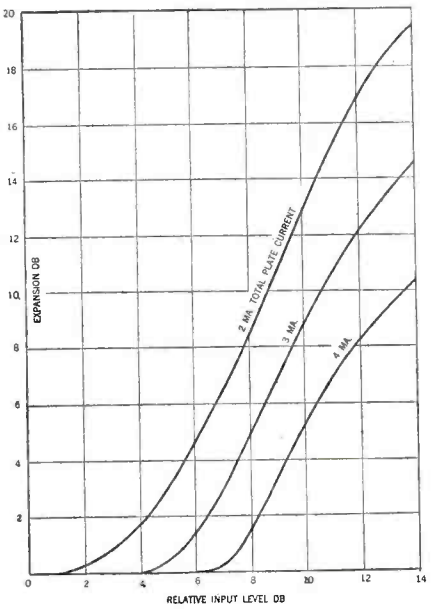


Fig. 4. Expansion in db plotted against relative input level. Higher plate currents reduce the expansion which is obtainable

limit of the recording head, and by the ability of the reproducing stylus to follow the groove.

Results of measurements on many commercial phonograph records show a maximum modulation level of 30 db above surface noise, with an average value of 25 db. Many records show a maximum level of only 20 db above surface noise. All measurements were made on records having the same absolute level of surface noise, and were of similar types of music, so that the high level passages would represent about the same sound pressures in the concert hall.

A 30 db volume range might be considered by some listeners to be too great. If the music is being used as background for conversation this is usually the case. Many others, however, consider a range of as much as 40 db to be desirable in the home. If the room noise is low, so that the quiet passages can be reproduced really pianissimo, a fortissimo of 40 db above this level is very impressive. If all the foregoing factors such as frequency response, distortion, etc. are well taken care of the performance begins to become excitingly real.

Some form of volume expansion is indicated to produce the dynamic range mentioned above. If the volume compression used in recording were automatic and of known constant characteristics it would be a simple matter to build a volume expander with inverse characteristics. Unfortunately, the compression actually used follows no pattern, being entirely manual. Usually the man who is "riding gain" attempts to anticipate peaks and reduce gain gradually before the peak arrives, so as not completely to spoil the climax. Sometimes the gain reduction is not steady, resulting in a series of "steps" of volume level. Not always is the same gain setting used for the same level of sound pressure from the orchestra. When this happens one "fortissimo" is louder than another, or one "pianissimo" is softer than another. In some cases "piano" may be louder than "forte" or "pianissimo" louder than "piano." When this happens no volume expander can remedy the situation.

Circuits

There have been many different volume expanding circuits described in the literature at various times. Some of the simpler ones involve such schemes as short-circuiting the output stage with a lamp bulb which increases its resistance at high volume levels. The long time lag is the most obvious disadvantage of this system. Furthermore, if the output amplifier is a good one, having low output impedance, a large change of load resistance will have little effect on anything but harmonic distortion!

The usual expander has a single control tube, such as a 6L7 or 6K7, rectifies the audio signal, filters it, and applies it as a variable bias to the control grid. The gain changes with bias, hence with audio level. A system of this type can never be made with a time lag of less than 0.1 second, and can never be entirely free from harmonic distortion. If these two objections are overcome this system of volume expansion can be very effective. The expander to be described does eliminate these objections, while retaining the desirable features of the electronic volume control.

Because of the manner in which the volume compression is accomplished the characteristics of the volume expender should be as follows:

(1)—Expansion should not start until the volume level reaches a certain minimum value.

(2)—Expansion should be fairly linear with input level once it does take effect.

(3)—The distortion introduced by the expander should be virtually zero.

(4)—The amount of expansion should be limited to a specified maximum.

The latter provision is important. These "steps" in volume, referred to above, which almost always occur at rather high levels, are magnified by the expansion. Consequently, too much expansion will

(*Continued on page* 206)

INCENTIVE PAY FOR ELECTRONIC ENGINEERS

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Compensation Plans Based upon Individual Achievements and Inventions as Well as Company Prosperity. Rewards for Technical Men Comparable to Earnings of Sales and Other Executives

Is there a yardstick by means of which the value of an electronic engineer to his organization can be gaged? The matter of the compensation of engineer-executives is a complicated one and a subject of grave importance not alone to the engineers involved but to the industry itself. Generally, engineers are underpaid by other-industry standards. Some sensible, equitable plan must soon be evolved.—Editors.

• How can an individual's contribution to the general good be measured? It is true that outstanding artistic or scientific achievement usually does get "delayed" recognition—but often so much delayed that its recipient is not around to receive it.

On the other hand, commercial, military and political success usually has had wide acclaim, with timely and substantial benefits to the man of merit.

Since the popularization of the corporate form of business and the far-reaching tendency to specialization in our manufacturing plants and research laboratories, the engineer in his own right has become more and more a mere cog in the wheel: A cog to be oiled when it squeaks, but merely praised when its expected silent, but efficient, operation goes on, year in and year out!

Labor, because of past evils, was forced to seek methods of enforcing its rights. Sheer weight of numbers and organization has produced such a far-reaching political result that today an untrained eighteen-year-old girl starts her factory job at a 20 per cent higher rate than was paid to college-graduate engineers starting in with electrical manufacturing companies at the peak of the 1929 boom. In those same years great communications research laboratories paid college trained engineers $27 and $30 per week to start, with an increase of 10 per cent to $33 within six months if performance warranted.

The trained engineer of above-average ability started right in to specialize, and, unless he departed from his chosen profession, found himself ten years later to be one of a handful of scientists who, of all the people in the world, knew most about that special subject. The trouble is that he was supposed to be so completely overjoyed by the possession of this special knowledge—and his patents which are not his—that he would be completely unaffected by his wife's oft-repeated comments that they can't afford to live with or up to his contemporaries who became lawyers, doctors, investment bankers, industrial executives, or went into business for themselves.

Rented for life

True, the corporation provided comfortably heated, lighted and well-equipped office and laboratory facilities. True, it provided a budget and a promise of life-long security; these latter had a, by then, almost-forgotten, embarrassing unreality about twelve years ago. The engineer who behaved himself and became top-notch man in his field, today in most cases, has as much future and "cross commercial" recognition as the heating plant in the laboratory where he dwells. He is a machine, rented for life and expected to function—regularly and well.

Some forward-looking companies have seen this engineering cul-de-sac clearly, and whether by sound policy or by expedient, under today's competition for technical men, have set about to provide substantial recognition for engineering achievement. These companies, however, are few and far between so that our engineer today is by and large little better off than was the skilled Greek scholar during the early Christian era in relation to his Roman master-owner.

Unless better methods are devised quickly and are made effective, the coming years will see the best engineering minds seeking more lucrative fields and the less able men banding together in union organization to force the issue. Timely action by employers can avoid this, but what action?

Some employers have tried a lazy yardstick like $100 per patent application. Others have made promises that rivaled the traditional "blue sky" promoter. In a few instances engineers by retaining competent and understanding counsel have been protected by controlling their contributions. By and large the fear of "going overboard" in wholehearted recognition has retarded any satisfactory solution to this problem.

We believe that a general pattern with special deviations to suit each individual case is a "must" for forward-minded companies, during this period of applying war-born developments to peacetime uses.

In the first place, good engineering means so much to industrial progress that any reasonably conceived incentive plan must perforce pay dividends. If it only eradicates

this practice of a company's engineers' saving their best ideas for a "special deal" with someone else or really doing their best work "on the side" for pay, it will make plenty of sense. After all, venture capital expects large rewards if results are produced. Labor in general works for an incentive based on increased production. Salesmen operate on commission. Many executives have bonus or stock option arrangements. Why should engineers be unique?

Engineering in order to call and hold good minds and to inspire the profession to its maximum effectiveness, should be provided with attractive and adequate incentives. In such a fast moving branch of engineering as our electronic industry only the best mentalities can keep up. Those who have the ability should be compensated in keeping with their achievements. To do so poses a personnel and administrative problem.

We present here certain suggestions in the hope of stimulating thought and provoking comment. The following are in a sense alternates, but can be combined in whatever way seems best for any particular group or company:

Compensation plans

1. Straight periodic salary on a term contract basis with provision for reexamination and adjustment of the rate within classification limits at stated intervals by the department head.
2. A straight periodic salary with a quarterly, semi-annual or annual lump sum bonus determined by the department head with the bonus amount set after examination and evaluation of one or more of the following:
   - A. Company profits
   - B. Inventions conceived
   - C. Patents applied for (value and number)
   - D. Patents issued (value and number)
   - E. Original ideas of value to production for all the range of cost saving, work simplification, etc. items
   - F. Independent thinking
   - G. General cooperation
   - H. Saneness of behavior
3. A base periodic salary plus a regular additional percentage determined on a calculable basis such as this: Of the entire company or division earnings, actual or estimated, before taxes, a predetermined fraction is set aside as an "Engineering Incentive Fund." This fund then is administered by the department head on a periodically revised basis and distributed as additional compensation to all engineering group people with each individual's share set much as in the manner outlined in paragraph 2 above.
4. A straight salary plus a periodic royalty calculated somewhat as follows:

Evaluating results

Each substantial contribution and/or patent introduced is to be assigned an arbitrary original value. This value will be revised each year. Each engineer's individual part in that invention will be determined on a percentage basis (all-50 per cent-25 per cent, etc.). A "ledger account" to be opened where all such values are entered to the credit of each individual engineer. This capitalized basis would handle much in the manner done by patent holding companies with cross-licensing agreements. Periodic distribution of "royalties" would be made to each "owner." These would continue only during his term of employment. A fair percentage, say 5 per cent, of the assigned value would be allowed for each element. The total calculated sum of all royalties would be paid by the company to this fund periodically. Depreciation of the patents over their life would be unnecessary as the royalty payments would cease on expiration or prior obsolescence. To avoid confusion this type of account would be completely independent from company books and have no relation thereto. In other words, the engineering group would have their own patent pool—company supported—

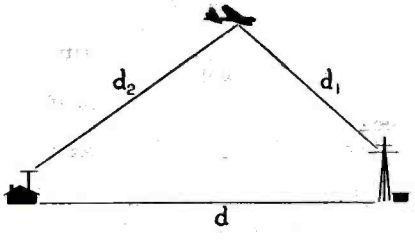
(*Continued on page* 214)

TELEVISION REFLECTIONS FROM AIRPLANES

A question frequently asked is: Why can an airplane flying overhead at a speed low compared with a television signal (say 250 mph against some 650 million mph) produce such a violent signal fluctuation in a television receiver. This phenomenon is a direct visual illustration of the same basic principle used by radar: the remarkable degree to which ultra-high-frequency waves are reflected. Referring to the diagram, the condition is as follows:

A plane is flying at a height h, which is usually a small part of the direct separation distance d, between the transmitter and receiver. Here two signals can reach the receiver—the second signal being reflected by the plane. If these signals arrive in phase the total received signal is augmented. However, since the plane is moving, the second path is continually changing in length—one instant the reflected signal adds to the normal value and the next instant it subtracts. At say 240 miles per hour a plane may move through about 21 wavelengths of the signal per second if plane and signal directions are parallel. This fluctuation would certainly be too fast to be noted by eye, if the radio equivalent of the Doppler effect were effective.

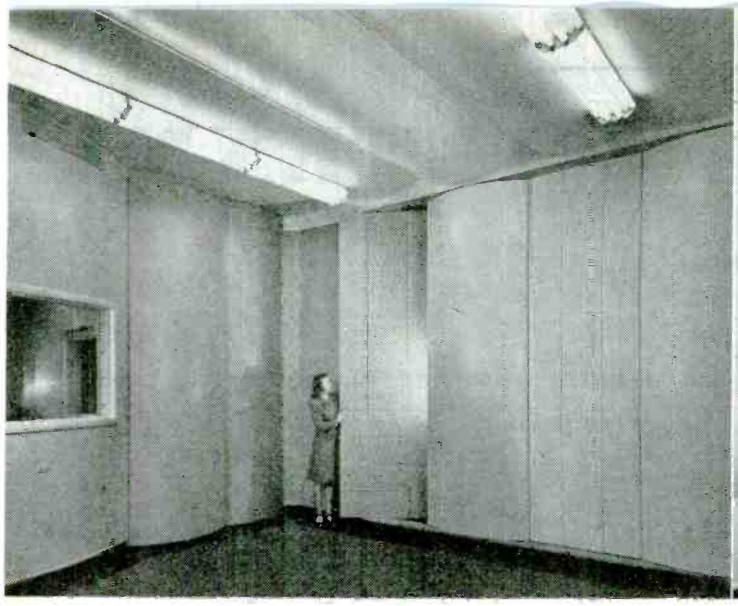
How airplanes may cause video signals to fluctuate

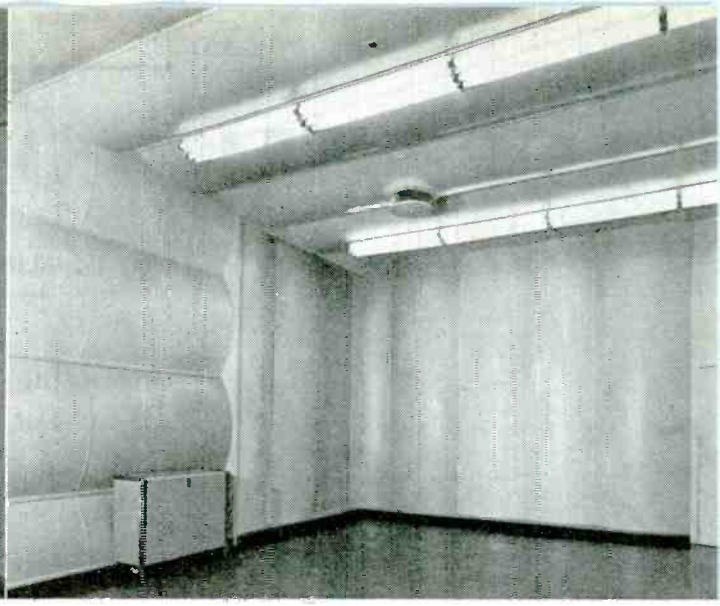


However, the actual path length over the reflected path is equal to the sum of that from the transmitter to the plane (d_1) plus that from the plane to the receiver (d_2). If the plane is over a point between these locations, d_2 is increased at approximately the same rate that d_1 decreases (or vice-versa if the plane is moving toward the receiver). If the sum of d_1 and d_2 remained exactly a constant, a ghost image and not a fluctuating picture would result.

When the plane is over territory between the stations, but not necessarily moving in the same line as the television signals, the common effect is that the total combined path d_1 and d_2 creeps up one or loses out one wavelength at definite intervals along its path. A varying signal strength is received therefore which causes more or less violent fluctuation of picture intensity.

The signal fluctuation rate may change over wide limits depending on the speed, height and direction of the plane. If it is flying outside of the territory between the transmitter and receiver and in a path roughly the same as that taken by the television signal, it produces a signal change twice as rapid as the Doppler rate (twice the 21 wavelengths figured in the example above). However, if it happens to be flying at a larger angle with the signal direction, such as at right angles to it, it can still produce a fluctuating effect.





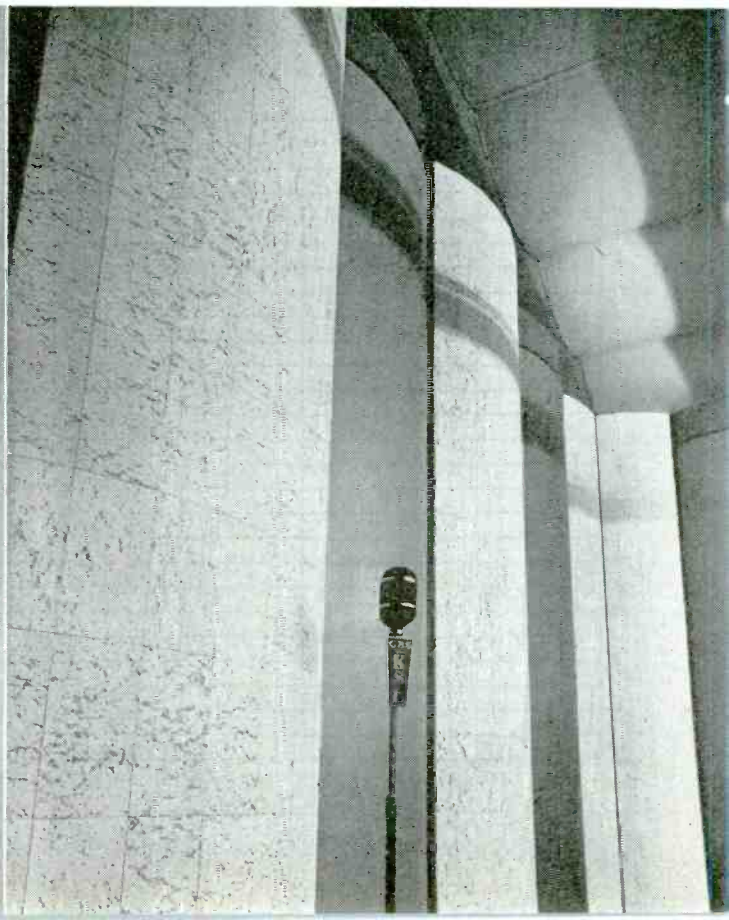
Broadcasting studio with polycylindrical surfaces having random resonance characteristics at low frequencies. Reversible sections on one end wall provide a two-to-one range in reverberation time. Highest time is 1.4 seconds. The cylinders are vertical as well as horizontal

SOUND STUDIO DESIGN

• To obtain uniform acoustic reinforcement with all frequencies of speech and music without having any unwanted resonance points, engineers of KSL broadcasting studios, Salt Lake City, have redesigned the walls of the studio. The effect from the broadcaster's point of view is that he can hear himself and others more clearly, and he applies less effort to achieve a given acoustic level. In addition, placement of microphones and instruments seems far less critical and the number of microphones is reduced to the point where in most cases one alone gets good results with orchestra.

The object of adding the polycylindrical surfaces, shown in the photographs is to increase the diffusion of the sounds, particularly those of lower frequencies. Random resonance of the cylinders through the low frequency range offers considerable absorption by diaphramic action. It also increases diffusion. This means that the reverberation time can be fairly long without spoilage of articulation.

Fixed absorbant is located in corner. The cylinder surfaces are ⅛ in. tempered masonite of standard 4-ft. stock. The radius of curvature is 4 ft. Designed for drama, this studio was built for bright sound effect. Absorption was then added until drama requirements were satisfied



TECHNIC OF ANTENNA

By G. GLINSKI
Electronic Division, Northern Electric Co., Montreal, P. Q.

Standing wave ratio obtained by means of slotted line used to correct power input to antenna under test

● The main purpose of the VHF directional antenna is to increase the field strength at the receiving point, without the necessity of increasing the power of the transmitter. Since the half-wave dipole is the simplest type of VHF antenna, it is customarily chosen as a "reference" antenna and the effectiveness of any other antenna is evaluated in terms of the increase of the field strength at the receiving point in comparison with the field strength which would be produced by the reference dipole, when fed with the same power. In other words, if "reference" antenna, when fed with power P, produces the field strength E_R at the receiving point and if directional antenna, when located at the same point as reference antenna, and fed with the same power, produces the field strength E_D at the same receiving point, then the antenna field gain (in db) is defined as:

$$(AFG)_1 = 20 \log \frac{E_D}{E_R} \qquad (1)$$

An antenna gain of 10 db means therefore that the directional antenna produces a field strength about three times as high as the reference one. To produce the same field strength with the reference antenna would require ten times as much power.

Given $\frac{E_D}{E_R}$, $(AFG)_1$ can be found from Fig. 1.

From the above definition it follows that the gain measurement reduces to the field strength measurement: a) when reference antenna is used; b) when directional antenna is used, under the proviso that both antennas are fed with the same power. Hence, for antenna gain measurements, and in addition to the directional antenna under consideration, the following items are required:

1) Reference Antenna
2) Receiving Field Strength Measuring Equipment
3) Transmitting Power Measuring Equipment

If the directional antenna under consideration is of such a type that it has some form of half-wave dipole as a driving (active) element, this element, after the removal of all other elements, can be used as a reference antenna. Otherwise a specially built half-wave dipole, located at the point where the directional antenna is placed afterwards, can be used as a reference antenna.

Relative measurements

Since in the antenna field gain formula (1) only the ratio of the field strength is involved, only relative values of the field strengths need to be measured. If the proper field strength measuring equipment is not available, any calibrated receiver (without avc) can be used for the same purpose.

Any appropriate equipment can be used for the measurement of power input, but a measuring section of the feeder line is convenient and can be used with particular advantage in the way described below.

If, as is customary, a coaxial

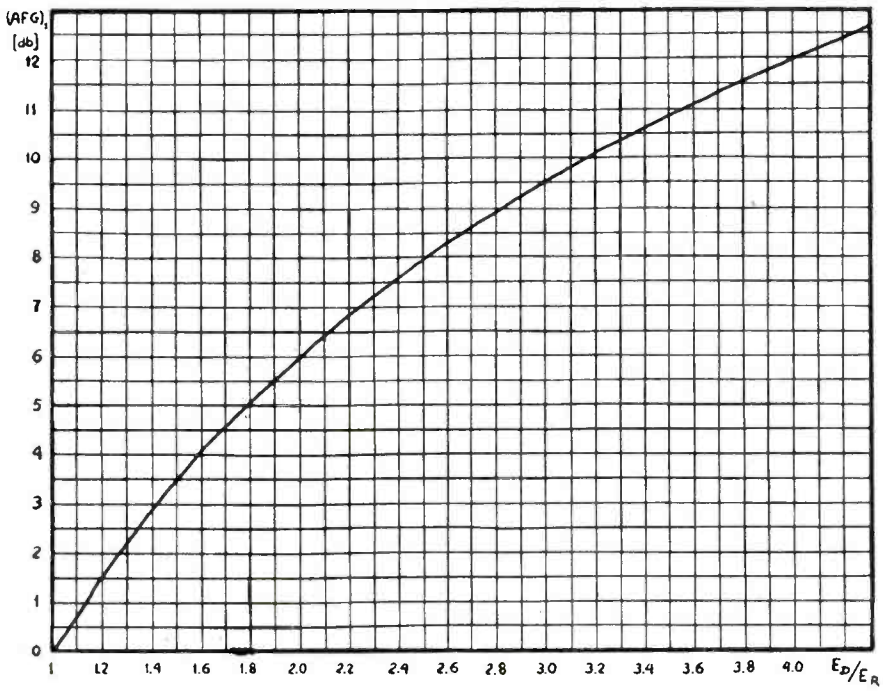
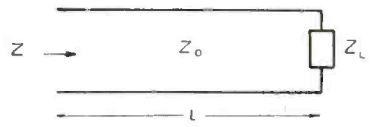
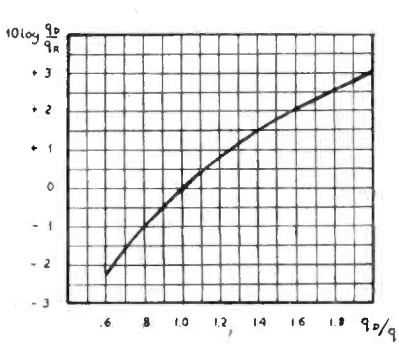


Fig. 1—Curve showing the antenna field gain in db when the ratio of field strength of directional and reference antenna is known. Fig. 3—Input impedance Z of line is resistive at point of voltage minimum. Fig. 4—Correction for different power input





GAIN MEASUREMENTS

feeder is used, the measuring section of the feeder line takes the form of, approximately, a wavelength section with equidistant holes in the outer conductor to permit the measurement of the voltage distribution. These holes are conveniently numbered 0, 1, 2 . . . . n starting from the near end. An example of such a measuring section is shown in Fig. 2.

As far as the choice of the location of the measuring section is concerned, it is desirable to place it as near to the antenna as possible. Since this usually requires a serious alteration of the existing installation, however, the simplest solution is to place the measuring section between the transmitter and the antenna feeder proper.

Power measurement

If the input admittance of the feeder (with the directional antenna connected at its far end) is $G + jB$ and if the input voltage is V (rms) then the average (active) power delivered to the feeder is

$$P = GV^2 \qquad (2)$$

If the feeder is lossless, this power is also equal to the power delivered to the antenna.

If the feeder introduces some losses, there will be a continuous loss of power along the feeder and the power delivered to the antenna will be smaller by the amount lost in the feeder itself.

Hence the power measurement by means of the measuring section is based on the simultaneous measurement of the conductance and voltage at any point of the feeder. Moreover, if between the antenna and the feeder input there is an appreciable length of the feeder, the power loss due to the attenuation should be taken into consideration in the way explained below.

To measure the power the following procedure seems to be the simplest:

The voltage maximum, V max, and minimum, V min, are measured on the measuring section. The ratio $\frac{V\,max}{V\,min}$ gives the standing wave ratio q:

Fig. 2—Measuring section of co-axial feeder line consists of a wave length section with equidistant holes in the outer conductor to permit the measurement of voltage distribution. These holes are conveniently numbered 0, 1, 2, etc., starting at near end

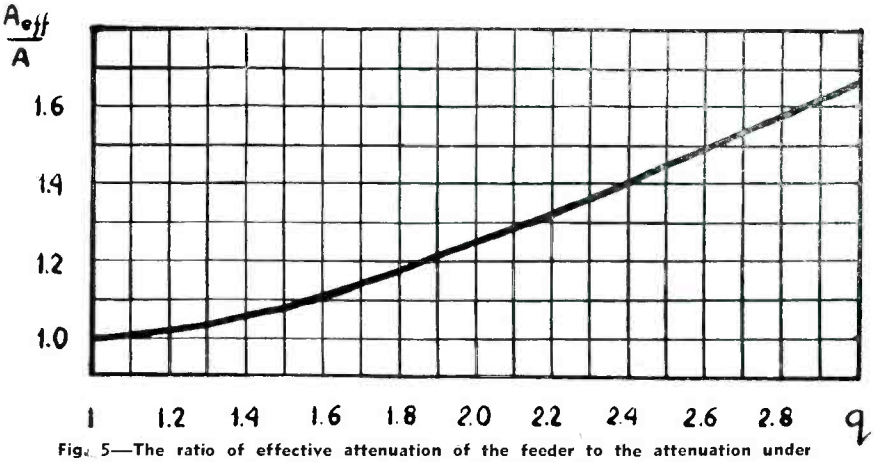


Fig. 5—The ratio of effective attenuation of the feeder to the attenuation under matched conditions is plotted against the measured voltage standing wave ratio

$$q = \frac{V\,max}{V\,min} \qquad (3)$$

As is known from transmission line theory, the input impedance of the feeder at the point of minimum voltage is purely resistive and has the value:

$$Z = \frac{Z_0}{q} \qquad (4)$$

where Z_0—characteristic impedance of the line.

Therefore, the input admittance at the same point is

$$Y = \frac{1}{Z} = \frac{q}{Z_0} \qquad (5)$$

and the power

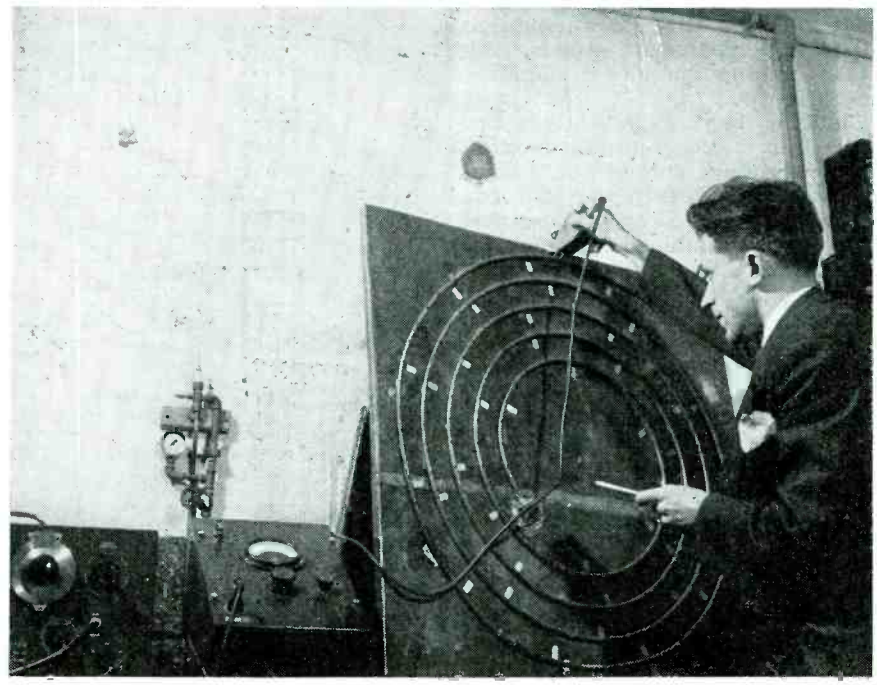
$$P = YV^2min = \frac{qV^2min}{Z_0} \qquad (6)$$

If, with the directional antenna connected, the measured power is P_D whereas with the reference dipole connected the measured power is P_R, then the antenna field gain $(AFG)_2$ corrected for the constant power input to the feeder is:

$$(AFG)_2 = 20 \log [(E_D/\sqrt{P_D})/(E_R/\sqrt{P_R})]$$
$$= 20 \log \frac{E_D}{E_R} + 10 \log \frac{P_D}{P_R}$$
$$= (AFG)_1 + 10 \log \frac{P_D}{P_R} \qquad (7)$$

where $(AFG)_1$ is given by the formula (1).

(*Continued on page 222*)



GENERATION OF ATOMIC

By H. GREGORY SHEA,
Associate Editor, Electronic Industries

Electronic principles familiar to tube engineers are of vital importance in the development of nuclear energy

• Night and day at Hanford, Wash., next to the Columbia River, a number of self-generating chain reaction piles are producing large quantities of heat in connection with the transmutation of uranium into plutonium. For every gram of plutonium up to 1,500 kw hours of heat energy are produced and removed by the cooling action of the river.

This heat energy has been wasted and there were no attempts to harness it because effort was concentrated toward the single goal of producing an atomic bomb.

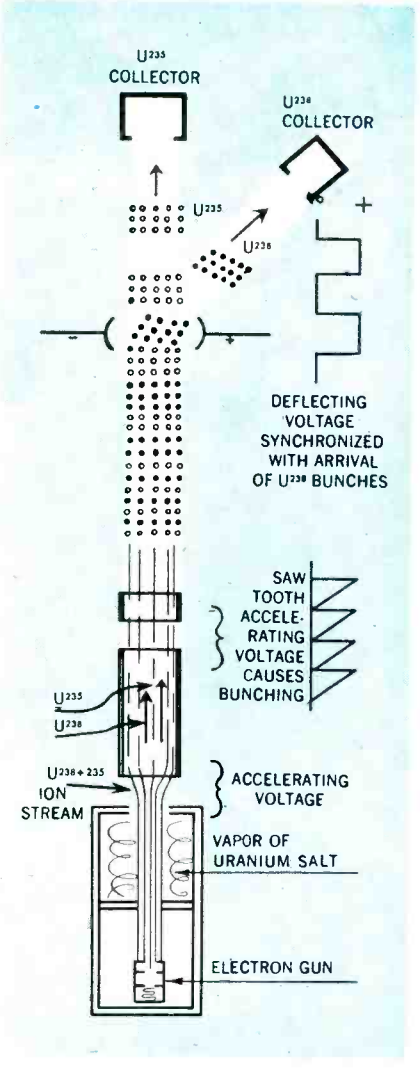
However, in the light of such production of energy from small amounts of material who can say that atomic power is not here!

Of course, there are engineering difficulties connected with using it. One obvious way of extracting the energy would be to reduce the flow of cooling water so that the temperature would rise to the steaming point. Possibly troubles would be encountered in this scheme. Doubtless, there is no demand for much power in that region of the United States so that an attempt to use it would prove uneconomic. The fact remains that here ready at hand is a means for utilizing nuclear binding energies to produce useful heat.

Judging by the presently available information, initial development of atomic energy would be as a primary source of power, like coal. There is no reason to suppose that shortly this binding energy can be applied directly to industrial and domestic processes without going through a series of complicated power plants any more than that coal could be so used. However, that need not worry us, since atomic power is undoubtedly here and may soon be ready to furnish electricity for our radios, our homes and our factories.

Modern nuclear physics postulates the atom to be made up of a nucleus bearing a positive electric charge surrounded by a system of electrons at various distances each bearing a negative electric charge of 1.60×10^{-19} coulombs. When the positive and negative charges are equal the atom is electrically neutral. The nucleus is supposed to be made up of one or more positively charged particles of matter called protons together with particles bearing no charge called neutrons. Since the proton has a mass of 1.6729×10^{-24} grams and the mass of the neutron is 1.6751, while the mass of the electron is 9.1067×10^{-28} grams it can readily be seen that as it takes about 1836 electrons to equal one proton, the protons and neutrons account for most of the mass of the atom. The mass unit used in physics is slightly different from any of these being equal to 1.6603×10^{-24} grams, or 1/16 the mass of an atom of oxygen in its most common form.

The Isotron, a promising but undeveloped scheme for separating U^{235} from U^{238}. It utilizes the klystron bunching principle



Hydrogen is the simplest atom known, having a nucleus consisting of only one proton with one electron surrounding it, while uranium until recently has been the most complex known atom having a nucleus consisting of 92 protons and 146 neutrons with 92 electrons surrounding the entire mass.

Atomic number

In writing nuclear equations the number of protons in a nucleus or, what is the same thing, the number of positive charges on a nucleus, is called the atomic number and is designated by the letter Z. The entire mass of the nucleus consisting of protons and neutrons designated by the letter A is called the mass number. The atomic number and mass number are written respectively as a subscript before and a superscript after the chemical symbol of the atom thus: ${}_{92}U^{238}$.

Since the diameter of a nucleus is about 10^{-12} centimeters while that of an atom is 10^{-8} centimeters, it can be seen that most space is empty.

Atoms having the same charge but different masses are called isotopes and in the last twenty years a very great number of these has been found. As they have identical numbers of electrons (equal to the number of protons) and as these appear to control the chemical behavior of matter, isotopes have the same chemical reactions. On the other hand, two different chemical elements having different charges may have the same mass and in such cases are called isobars.

Other particles mentioned in the literature are alpha particles which are helium nuclei containing two protons and two neutrons having

POWER FROM ELEMENTS

a charge of 2 and a mass of 4, beta rays consisting of a stream of electrons, gamma rays consisting of very short electromagnetic radiation similar to radio waves or x-rays, positrons which are positive electrons emitted by some artificial radioactive nuclei and deuterons which are nuclei of heavy hydrogen consisting of one proton and one neutron. Photon is the name used for a certain quantity of radiant energy.

Radioactive materials, or those bombarded by some kind of radiation, may give up various kinds of particles or radiation such as those listed above. The particles which have been found of such extraordinary use in the development of atomic energy have been the neutrons. As stated before, these are characterized by their lack of any charge. This permits them to proceed through matter unaffected by the intense electric fields surrounding the nuclei.

One of the important discoveries of physics has been that the sum of the masses of the protons and neutrons making up the nucleus of an atom is not equal to the mass of the atom nucleus. For example the total mass (in mass units of 1.6603×10^{-24} grams) of the components of the helium nucleus is

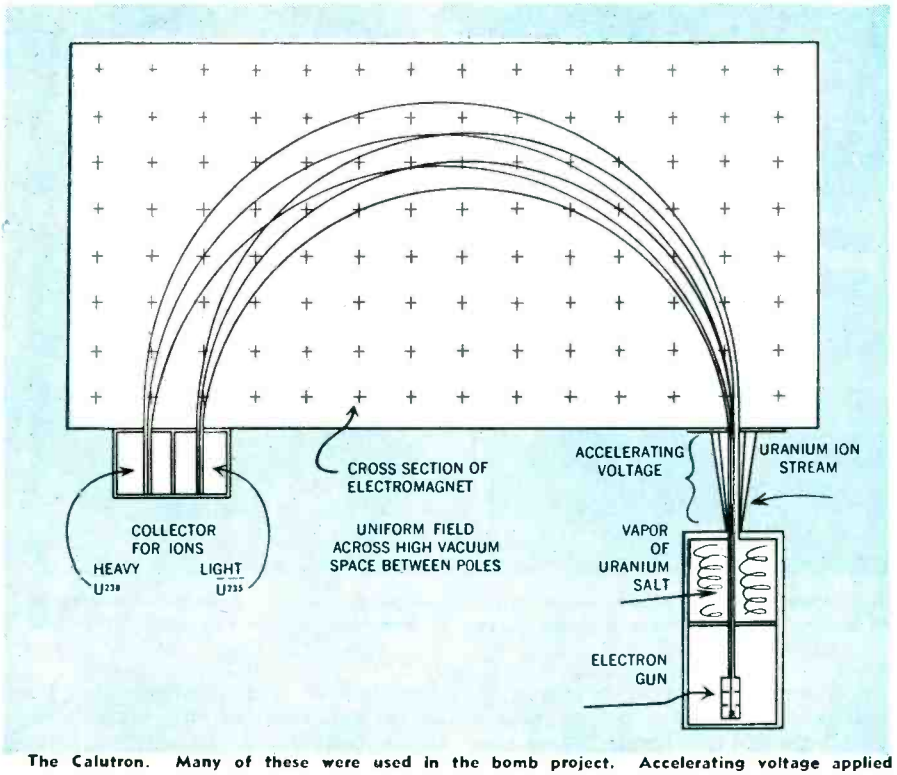
Protons Neutrons

$$2 \times 1.00758 + 2 \times 1.00893 = 4.03302$$

whereas the mass of the helium nucleus itself is 4.00280. As can be seen the difference is equal to about .030 mass units.

A number of years ago through the work of Einstein and others it was discovered that the mass of a moving electron depended upon its velocity, and consequently classical force, mass, acceleration relationships must be modified when dealing with electrons or other atomic particles whenever their velocities begin to reach 1/10 or more of the velocity of light. For an electron such a velocity would be reached if it were subjected to an accelerating voltage of about 6,000 volts.

This discovery obviously indicated an equivalence between mass and energy. This Dr. Albert Einstein formulated in his equation $E = mc^2$ where E and m are energy and mass and c is the velocity of light. Thus multiplying .030 mass units (1.6603×10^{-24} grams) by 9×10^{20}, the square of the velocity of light one obtains 4.5×10^{-5} ergs per nucleus. Since there are 6.07×10^{23} molecules in a gram molecular weight this equals 2.7×10^{19} ergs per gram molecule of helium.



The Calutron. Many of these were used in the bomb project. Accelerating voltage applied to particles of equal charge but different mass produces velocities differing by ratio $v/v_1 = (m_1/m)^{1/2}$. In the magnetic field the radii of motion depend on charge and velocity so that as a result they are in the ratio of $R/R_1 = \frac{mV/eH}{m_1V_1/eH} = mm_1^{1/2} / m_1m^{1/2} = (m/m_1)^{1/2}$

In other words we have reached the startling conclusion that a gram of helium has 188,750 kilowatt hours less energy than its individual protons and neutrons due to their association in helium nuclei. Since energy cannot be destroyed it must have been liberated during the combination. Hence, if we could find a way of combining protons and neutrons in free space into helium nuclei, we would presumably be able to generate such an amount of power for each gram of helium we made.

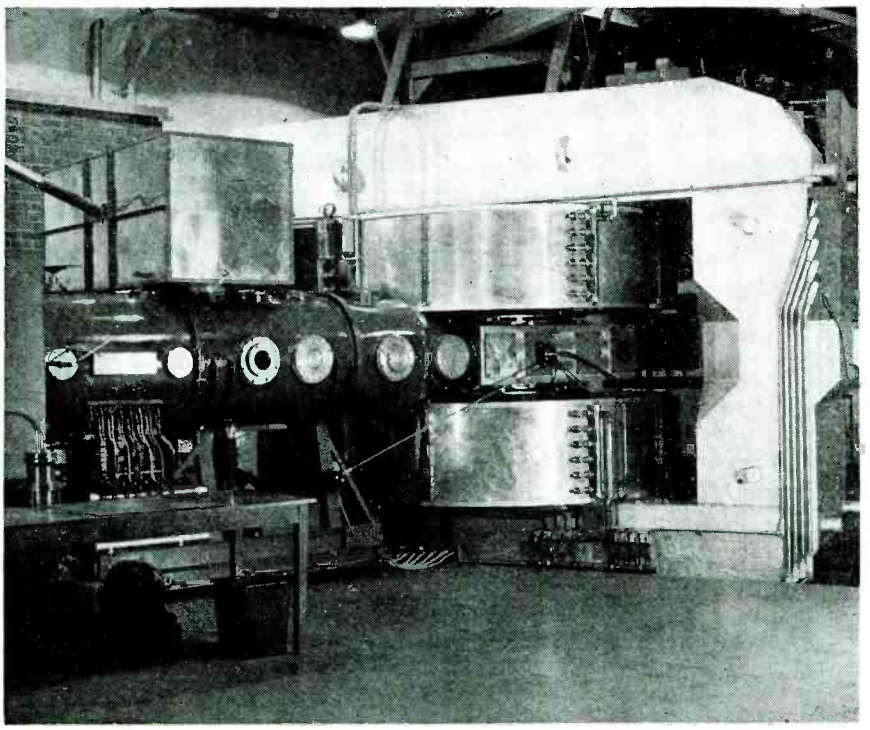
Binding energy

This energy is called the binding energy of the nucleus. As the binding energy per particle is calculated for various elements it is found that the elements in the middle of the periodic table having mass numbers ranging from 40 to 100 are most strongly bound, the energy decreasing toward the lower as well as toward the higher ends of the table. This suggests to the mind the possibility of obtaining energy either by breaking down heavy atoms or combining light ones.

Now both of these things actually have been done—at the lower end of the scale by bombarding a lithium target with protons to produce two helium nuclei each with an energy of 8.5 million electron volts, equal to 65,000 kilowatt hours per gram of lithium, and at the upper end by the breakdown or fission of U^{235} atoms into atoms of two groups of a number of other elements which shoot off at enormous velocities corresponding to an energy level of 200 million electron volts (Mev). It is the latter type of reaction, of course, that made possible the atomic bomb.

In 1940, A. V. Grosse of Columbia published a fission equation showing identification of the following elements in the fission products; molybdenum, iodine, xenon (4 isotopes), cesium (2 isotopes), lanthanum and cerium. Masses ranged from 127 to 140 in the iodine-cerium group and around 92 for the light group.

The variety of products is apparently due to the fact that the ratio of neutrons to protons is greater in the very heavy atoms than in the middle range ones. Therefore two lighter atoms result-



The cyclotron at the department of terrestrial magnetism of the Carnegie Institution of Washington. It weighs over 225 tons, is over 12 feet high, 30 feet long and 20 feet wide

ing from fission have an excess of neutrons to dispose of before reaching stable isotopic forms. These excess neutrons can be either emitted or can become protons if an electron is emitted. In the breakdown of uranium there is a considerable number of excess neutrons available. The products of breakdown are the results of the various possible combinations obtained by neutron or electron emission.

The neutrons which are used to initiate the breakdown of uranium can be obtained by the bombardment of certain elements such as beryllium or boron by natural alpha particles. A common means of doing this is to use a mixture of radium and beryllium, the alpha particles of the radium penetrating the Be^9 nuclei. These then give off neutrons and become stable carbon (C^{12}) nuclei. There are a number of other reactions that could be used for the same purpose.

Capture probability

We have seen above how small the nuclei are in comparison to the space occupied by atoms so that it becomes important to consider what chance a stream of neutrons has of hitting atomic nuclei in its passage through target material. This is a statistical question which can be resolved by well-known methods of geometrical probabilities and depends on the number of atomic centers in an area of a plane perpendicular to the direction of the neutron stream. As an extension of this plane idea it is convenient to express the probability that a particle will hit such a target in terms of a cross-section. This cross-section in square centimeters is defined as the ratio of the number of processes occurring to the product of the number of incident particles and the number of target nuclei per square centimeter. Such cross-sections vary enormously depending on the materials and on the impinging particles, as much as from $1{,}000 \times 10^{-24}$

$$\text{cm}^2 \text{ down to } \frac{1}{1{,}000} \times 10^{-24} \text{ cm}^2.$$

Ordinarily uranium is predominantly the $_{92}U^{238}$ isotope containing about one part in 140 of $_{92}U^{235}$. As previously stated $_{92}U^{235}$ can be broken down with the release of tremendous energy. However, when U^{238} is bombarded with neutrons it does not break down but produces $_{92}U^{239}$ plus gamma rays. $_{92}U^{239}$ transmutes into neptunium $_{93}Np^{239}$ with the emission of one electron, the half life of this process being 23 minutes. In turn $_{93}Np^{239}$ transmutes into plutonium, $_{94}Pu^{239}$ with the emission of one electron and gamma rays in a half life period of 2.3 days. Like U^{235}, Pu^{239} is subject to fission when bombarded by neutrons. Also like U^{235} it releases about the same amount of energy.

With this background of information it can easily be seen that if a substantial amount of either U^{235} or Pu^{239} could be obtained and could be caused to break down rapidly, an explosive action would result and that the energy release of 200 Mev would be equal to 23,000 kwh per gram of substance exploded, or about, 3.57×10^{10} Btu/lb. Even if only 1/10 of 1 per cent of the energy were released before the bomb flew apart and the reaction stopped this would amount to 36 million Btu per pound of substance. Assuming that the specific heat of the exploding material were 1/30 that of water the temperature rise due to the transformation of that amount of energy into heating a pound of material would be one billion degrees F, an almost inconceivable temperature.

Chain reaction

The question that immediately arises in an engineer's mind is that if all these figures are true, how can there be any uranium left in the world. In other words, why hasn't all of it disintegrated long ago? This immediately brings up the question of chain reaction. If an ordinary combustible substance such as a piece of paper is ignited with a match, heat generated by the burning of the paper at any one spot is sufficient to ignite the paper all around that spot and so the process of combustion goes on until all of the paper has been burned. All of us, however, have had the experience of trying to light a fire in the fireplace using heavily coated magazine paper and have found that often after being started it would go out due to the large amount of non-combustible material present.

It is the same way with uranium occurring in nature. The amount of fissionable material is so small a proportion of the entire quantity of uranium that a chain reaction cannot proceed and the neutrons produced by fission do not produce enough secondary fissions to keep the process going. In order to have a chain reaction it is necessary that the ratio of fissions produced secondarily to those produced primarily be greater than 1. If this ratio is less than 1 fission will die out. Now neutrons may be dissipated in four different ways:

(1) They may escape out of the material entirely.
(2) They may be captured by the uranium in a manner not producing fission.
(3) They may be captured by impurities.
(4) They may cause fission.

Naturally, whether a ratio or multiplication factor greater than

1, as mentioned above, can be maintained depends on the frequency of occurrence of these various means of dissipation of neutrons. The escape ratio naturally depends on the relation between the surface of the active material and its volume and hence there is a critical size which will permit a chain reaction to exist and below which none can take place.

Non-fission or so-called resonance capture of neutrons by uranium atoms generally occurs when neutrons have a speed higher than that for which fission capture occurs. Since fission itself produces high speed neutrons which are ineffective in causing further breakdowns, they must be slowed down, but in slowing down they must pass through the middle speed range. In order to slow down the neutrons efficiently it is desirable to make them pass through a retarding or moderating material. This should have a low atomic weight because in elastic collisions the ratio of energy carried off by light and heavy particles is inversely proportional to the masses involved. For this purpose carbon in the form of graphite has been used.

Graphite pile

It can be shown by calculation that the number of medium speed neutron collisions can be reduced more by having lumps of uranium separated by the graphite rather than by having an intimate homogeneous mixture of uranium and graphite. Furthermore, since U^{238} has a large capture cross-section for medium speed neutrons, producing U^{239} but not fission, it wastes neutrons, and it seems obvious that by separating U^{235} from U^{238} and discarding the latter, a chain reaction might be set in motion.

In producing the atomic bomb both U^{235} and Pu^{239} were made so that no possibility of success might be overlooked.

The Pu^{239} manufacturing process at the Hanford Plant in Washington near the Columbia River embodies the principle of a controlled chain reaction occurring in a pile consisting of graphite interspersed with uranium. The first model of such a chain reaction pile was built in a rough spherical form somewhat like a door knob. It consisted of graphite bricks built up in layers, alternate ones of which contained lumps of uranium at the corners of squares. It had about 12,400 lb. of metal altogether and for control purposes had ten slots passing completely through it. One row of bricks was arranged so that it could be pushed completely out of the pile. Control was obtained by rods of boron steel having a high neutron absorbing capacity placed so that they could be pushed in and out of the control slots. A multiplication factor of 1.0006 was obtained with this pile and while at first it was operated at a power of ½ watt this was later increased to 200 watts, a limit caused by the danger of radiation of the radioactive substances to the street. (The pile was in the West stands of the University of Chicago stadium.)

Since the production of one gram of plutonium per day results in the liberation of energy at the rate of 500 to 1,500 kilowatts it is apparent that very expensive cooling facilities would be required for large scale production.

Pilot plant

To facilitate study of problems in connection with handling of substantial quantities at Hanford, a pilot plant was built at Clinton, Tennessee. Instead of having the uranium formed in lumps, in this case the pile consisted of a cube of graphite containing horizontal channels. Uranium in the form of metal cylinders protected by gas-tight casings of aluminum were placed in these channels and cooling air was forced through the channels.

After the reaction has been going on for a certain time the cans containing uranium are pushed out of the pile and chemical separation of the plutonium proceeds. The means used to separate out the Pu involved the phenomenon of coprecipitation, i.e., the precipitation of small concentrations of one element along with a carrier precipitate of some other element.

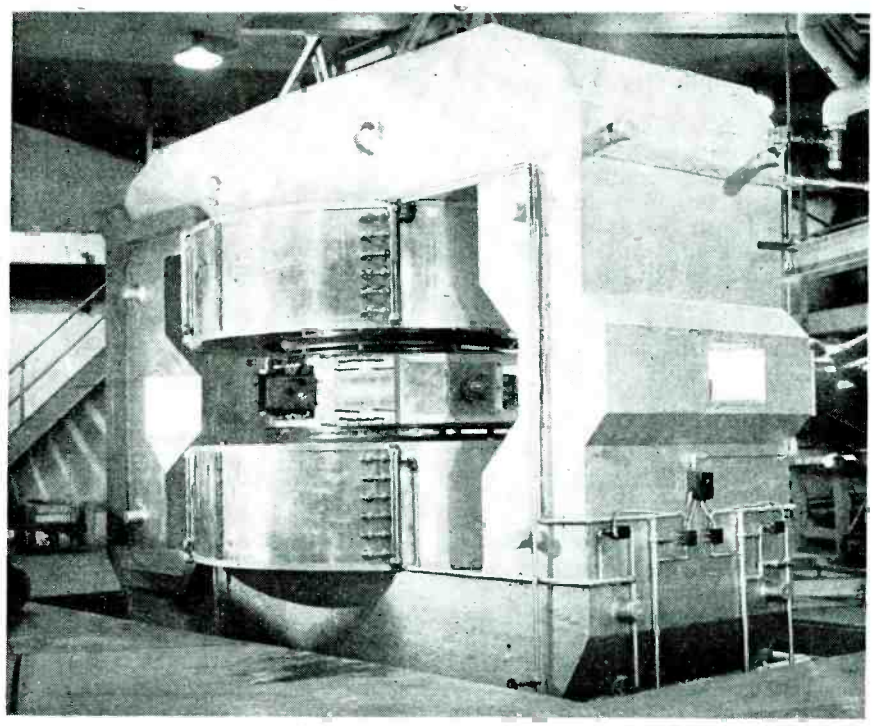
U^{235} separation

The success of the separation process at Hanford has exceeded all expectations and it is interesting to note that the process was developed from a knowledge of plutonium chemistry gleaned from less than a milligram of the material.

As stated above, at the same time that work on plutonium was progressing, investigations were carried on to determine a method of separating U^{235} from U^{238}. Two general methods of separation have been used, the electromagnetic method and the diffusion method. The electromagnetic method made use principally of what came to be called a "calutron" which name is a contraction of California University's cyclotron. Briefly the principle of the calutron consisted of producing positive uranium ions, accelerating them into the field of a very powerful electromagnet which causes them to move in a circular path and collecting them after they have traversed a semicircle. The separation between U^{235} and U^{238} depended on the fact that one of them having a slightly greater mass would move in a semi-circle of greater radius than the other.

By placing suitable collectors at the termination points of these

General view of a cyclotron. The cast steel pole structure, field coils and magnetic gap may be seen. Applied to "Calutron" use, the gap is evacuated to permit movement of ions



semi-circles of different diameters, the separate isotopes could be caught. The ions were produced by shooting a beam of electrons through the vapor of a uranium salt and permitting the resulting ionized uranium particles to go through a slit and through an electric field which accelerated them. It can readily be seen that ions coming out of the slit would initially be moving in slightly different directions, the total dispersion angles depending on the width of the slit. All ions of equal mass, however, would move in semicircles of the same diameter and therefore after completing a semicircle they would re-converge so that the logical place to put the collector was at the re-conversion point.

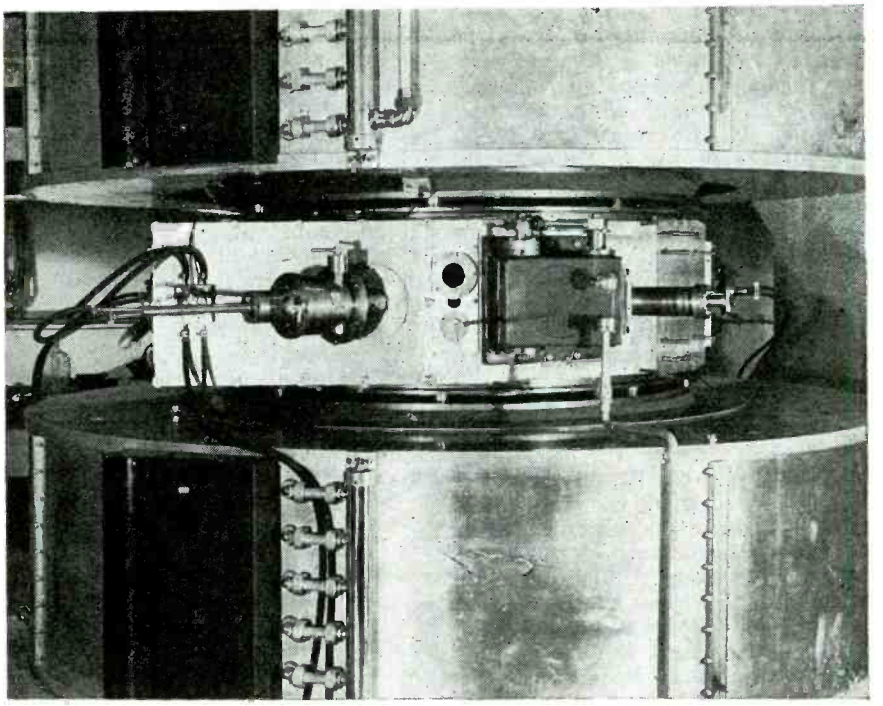
Cyclotron magnet

This electromagnetic separation method immediately produced greater concentration than gaseous diffusion methods and work progressed on it energetically. There was available at Berkeley a giant cyclotron magnet with a pole diameter of 184 in. and a gap of 72 in. which was to be the largest in existence. Its completion had been interruped because of the war and therefore it was available for dismantling and use in this electromagnetic separation scheme. Much work resulted in a great increase in the beam strength of the ion. The width of the slit was increased to permit more ions to go through and magnetic focusing methods were used so that the dispersion would not be too great.

On the basis of the Berkeley work a plant was built at the Clinton, Tennessee, site consisting of a number of units for this type of separation.

Another interesting scheme of separation is based on introducing a low intensity radio frequency electric field which would cause the ions to bunch in their progress down a tube in a manner similar to that used for klystron high frequency oscillators. By applying a transverse focusing electric field with a radio frequency component synchronized with the arrival of the bunches, isotopes can be separated inasmuch as the bunches of ions of different mass travel with different velocities and therefore became separated. By this means U^{238} ions can be deflected from the stream whereas the U^{235} ion bunches can come through and be selected. Although this scheme held great promise, work on it was discontinued to permit more attention to be given to the calutron method.

Of course, in the electromagnetic method of separation of the isotopes, a balance had to be struck between the yield per stage and the purity obtained per stage. If the purity were run up, the yield of course went down, so that finally a large number of stages were built.



Close up of target and accelerating chamber of the Carnegie cyclotron. In using these for uranium isotope separation, a number of modifications had to be made. Main magnets were kept

Gaseous diffusion

It was recognized early that if the raw materials could be enriched even by a slight amount, an enormous benefit would result. In order to do this a thermal diffusion plant for the separation of isotopes was constructed and its product was used as a feeder for the electromagnetic separation plant. Thermal diffusion depends on the fact that if there were a temperature gradient in a mixed gas there would be a tendency for one type of molecule to concentrate in the cold region and the other in the hot region.

In addition to the above a plant was built for gaseous diffusion at Charlotte, North Carolina. This was based on the principle that the rate of diffusion of a gas through an ideal porous barrier is inversely proportional to the square root of its molecular weight. Thus if a gas consisting of two isotopes starts to diffuse through a barrier into an evacuated vessel the light isotope diffuses more rapidly than the heavier.

In conclusion, a word should be said about the production of the bomb itself. From what has gone before it is obvious that a certain minimum size was required for the reaction to proceed. This suggests a means of keeping the bomb inactive until the correct moment by keeping pieces of the reactive material separated from each other and bringing them together with great rapidity at the time of detonation. This could be accomplished by firing one of the portions of the bomb against the other portion to detonate the bomb. In addition the bomb would have to be enclosed in an envelope which reflected many neutrons back into the reactive material and which would have a high inertia, thereby delaying the expansion of the reactive material inasmuch as fission takes place in 10^{-12} seconds.

Air-borne Radio Station

Army communication units established radio contact with Manila only 45 minutes after American troops landed on Japanese soil. The contact was established by a high power station which had been built into twelve transport planes and flown to the Atsugi airfield with advance units.

The station was constructed on 42 hours' notice and was comprised of four three kw transmitters, five 800-watt transmitters, and four jeep-mounted control towers. Besides being used for Manila contact, the station was also set up as a navigational direction aid for approaching aircraft.

Thru the LABORATORY KEYHOLE

Current Research that Forecasts Future Electronic Developments

3000 MC OSCILLATOR—Certain financial interests are said to be negotiating with an inventor who has developed a means of producing 3000 mc oscillation with an ordinary receiving tube. The scheme is supposed not to depend on the ordinarily limiting tube constants such as inter-electrode capacitance.

CANDLELIGHT TELEVISION was actually demonstrated as a possibility of the new supersensitive video pickup —indicating that postwar television will no longer require studio intensities of hundreds of foot-candles. A visiting group saw a television scene illuminated only by one candle! And the pickup was excellent.

RETINA SENSITIVE TO UV—At Harvard biological lab, Dr. George Wald in experiments with persons whose eye lenses have been removed in cataract operations, finds that the human retina, freed of its lens filter, is highly sensitive to ultra violet or 'black light." At 365 millimicrons, this average sensitivity of lensless eyes is 1000 times normal. In fact, under black light which made the room Stygean-dark for normal eyes, 60-70 year old patients read a test chart top to bottom.

BRITISH STUDY FOLIAGE SHIELDING—Regarding recent articles on the subject of foliage shielding at television and FM frequencies, the British have recently completed some very thorough engineering measurements on the effect of leaves on UHF, continuing these studies up to centimeter waves. This information should be released for publication within six months.

KRYPTON ONE-TENTH-WATT LAMPS, which have been developed in Westinghouse laboratories at Bloomfield, N. J., offer many new applications for pilot lamps, instrument boards, clock and dial illumination. These little KR-110 volt fluorescent lamps, containing double spiral electrodes, glow with yellow-green light at the maximum sensitivity of the human eye. They are rated at 3000 to 5000 hours' life, so that for many uses they will be burned continuously.

SOUND AT 30,000 FT.—The jet plane which flew from Dayton to New York in an hour, was announced to have a speed of 550 miles per hour, nearly the "speed of sound". At 30,000 ft., the plane's usual height, sound has a speed of 680 miles per hour, compared with 750 miles per hour at sea level.

PISCATORIAL ELECTRONICS—Laboratory tests underway indicate that elimination of bad odors from fish reduction plants by drying the fish meal with heat from infra-red lamps may enable the plants to be more conveniently located for reception of raw material and shipment of finished product. Furthermore, schools of fish can be located by means of under-water sound detectors instead of depending upon the sheen they cause in the water. Finally, Pacific Coast canneries are also experimenting with high-frequency cooking in glass jars.

RED POINTS FOR LAB WORKERS—Dr. Irving Langmuir, who has just returned from a visit to Russian laboratories and research institutes, reports that Soviet scientists and laboratory workers are, as a matter of governmental policy, regularly rewarded with extra ration allowances as well as money. Since such rationed goods, including food, furniture and clothing are sold at pre-war prices, while unrationed goods carry a surtax as high as 99 per cent, money is of little importance in the present economy of the Muscovites.

OLD CHINESE CUSTOM AIDS RADAR—In China for ages, prisoners have been restrained by simple woven sleeves placed on their arms. If they try to pull away, the woven sleeves are drawn tight and grip more firmly than ever. Later this idea was imported to America and used as a cable-grip for drawing cables into conduits. And now the Signal Corps has applied the pull-grip to removing radio and radar tubes from their sockets, when the pulling is hard. Several thousand Kellems grips have already been purchased for this purpose.

SIMPLICITY IN CHANGERS—New Erwood record-changer reported from Milwaukee to have only four moving parts. Finished laboratory models are now being advanced to be made ready for production schedules running several thousand per day.

NOTE: *Please don't ask us for more details about any of the foregoing. We present here all the information we have. As soon as we get more about any of these situations, full details will be printed in Electronic Industries. Our editors run across many interesting tips, leads, and rumors, both well-founded and baseless. We thought you would be interested in hearing about them, even if we can't give all the details or vouch for their authenticity. Editors.*

CENTRALIZED LABORATORIES FOR BASIC RESEARCH

Formerly it was the practice of large corporations to have research for their various departments and subsidiaries done in scattered local laboratories under the direction of each division. Now a change is taking place in the direction of having all basic scientific research concentrated in a principal research laboratory, while subsidiaries tackle only immediate product research. This newer policy is evident in GE's retention of basic electronic research at Schenectady, despite its plans for a great electronic center at Syracuse. Also, RCA's Princeton, N. J. laboratory layout, follows this principle, as will General Motor's new $20,000,000 research center near Detroit.

More and more, parent corporations will insist on keeping in their own hands all basic research of their fields.

PRACTICAL PROBLEMS OF

By C. W. FRANKLIN,
Cambridge Thermionic Corp., Cambridge, Mass.

A systematic approach to methods that will result in reducing differences under conditions otherwise standard

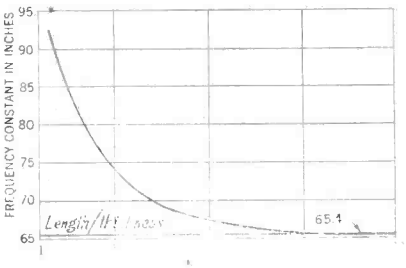


Fig. 1—Length/thickness vs. frequency constant for AT cut crystals

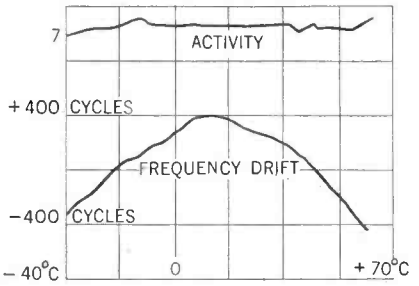


Fig. 2—Activity-temperature and frequency-temperature for well-mounted, well-dimensioned BT crystal

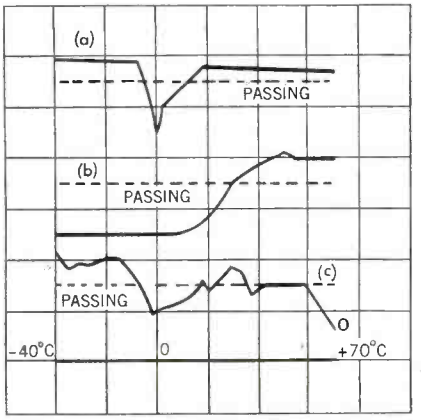
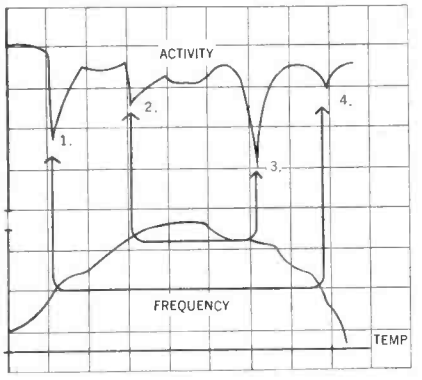


Fig. 3—(Above) Activity curves showing three types of failure not due to dimensions

Fig. 4—Badly dimensioned crystal, exhibiting sawtooth at critical frequencies



In the manufacture of quartz crystal units as in all other branches of the electronic industry the impatient and exaggerated demands of the war years have forced development. Problems which defied theoretical solution have had to be tackled practically and have somehow been solved. Furthermore a vast amount of material has passed through critical fingers and yielded up new knowledge. Thus we are now in a position to do many things that we could not have attempted before, and to advance even further in others.

• What remains to be done in the crystal field lies in the direction of the standardization of electrical and mechanical characteristics. Crystals of a given cut and frequency should not vary as much with respect to resistance, inductance, capacity, activity and frequency drift, as is commonly the case. Since tolerances and technics in the matter of cutting, lapping, finishing and mounting are accurately prescribed, this divergence must proceed from some other source.

It has been observed that in "thickness" crystals certain face dimensions are extremely favorable to desirable behavior and certain others extremely adverse. Some sort of dimension control is, therefore, called for. Unfortunately, there is as yet no complete body of information on the vital question of dimensioning. It is the purpose of this paper to offer a systematic approach to the subject.

Let me specify what is meant by dimensioning. Every crystal when finished has one dimension which is thought of as governing its frequency, which is determined as the ratio of a certain constant K (the frequency constant) and this dimension, i.e. $f = \frac{K}{t}$. If this were literally the case then problems of dimensioning would not exist. It would merely be necessary to assign the determining dimension in such a way as to obtain the desired ratio, and the desired frequency would result.

But it must be always kept in mind that, despite its usefulness in electric circuits, a piezo-crystal is primarily a vibrating solid. As such it is subject to the mathematical laws of elasticity in which boundary conditions are vital. Hence, a change in any one of its dimensions may well affect all its modes of vibration. Thus when we are concerned with the frequency of a plate in its thickness mode of vibration, we may not a priori assume that thickness alone is the determining factor: all of its dimensions affect it.

That this last statement is so may be readily verified: A thickness vibrating crystal (AT or BT) is systematically altered by progressive reduction of its length (or width). Its frequency as read with a deviator is recorded with successive values of the dimension under consideration. It is then seen that the frequency is seldom twice the same: That changes of .002 in. may be accompanied by changes of ±300 cycles or more and that the overall trend for substantial reduction in surface area is always a substantial increase in frequency. Thus the thickness which has been left unchanged throughout is not the unique determining factor.

Mathematics is corroborated by practice in finding this phenomenon to exist. Unfortunately mathematics fails us at this point: It states the difficulty but does not offer the cure. The problem of the finite vibrating plate is incompletely solved, and if our knowledge of its behavior is to be made more precise we must rely on experimental methods. From cumulative experimental data we must seek to discover what choice of crystal dimensions for a given cut leaves the mode of vibration in which we are interested at any time most immune to changes in the

CRYSTAL DIMENSIONING

other modes. This is the problem of dimensioning.

Theoretical approach

As indicated, because of coupling with other modes the so-called frequency-constant is not constant but varies inversely with length/thickness ratio. Bechmann* has developed a curve relating the thickness frequency-constant given in mm. for circular AT crystals to the diameter/thickness ratio. The accompaning curve (Fig. 1) gives such data for measurements in inches. The straight line in this diagram represents the thickness/frequency constant, K = 65.4, for the same cut calculated mathematically on the assumption of no coupling (infinite plate) from the elastic constants of quartz.

On the assumption of uncoupled vibration, it is possible to calculate ideal frequency constants for the various other vibratory modes. A whole school of dimensioning is based on the frequency constants for these uncoupled modes. These constants determine a set of secondary frequencies and their overtones. If any one of these frequencies (or of its overtones) coincides with the frequency of the desired mode of crystal vibration, it is likely to cause bad or uncertain performance. If, therefore, dimensions for which this can occur are calculated and avoided by as wide a margin as possible, it is not unreasonable to expect that good performance will result.

In fact, if crystal modes of vibration occurred simultaneously in their uncoupled form, this would be an infallible method of dimensioning. But, as we have stated, the finiteness of the plate introduces unpredictable interaction between the various modes. The uncoupled modes with their predicted frequencies do not necessarily occur. And even if a predicted frequency is present, we may not, without elaborate interferometric study, presume that it is due to a specified mode. Thus, although the theoretical approach to crystal dimensioning is valuable as a first approximation, it must still be subjected to experimental verification.

Nevertheless we may not decide that because it is difficult to pin down the laws of crystal behavior in terms of mathematical formulas and physical nomenclature, such laws do not exist. Crystal phenomena are consistent and recurrent and may be studied accordingly.

It is important to emphasize at this point that no analysis of crystal behavior can be fruitful unless the crystals under scrutiny and those to which we hope to apply our conclusions are kept within close tolerances of the same cutting angles. It is only under these circumstances that we may state that crystals cut to the same dimensions, mounted in the same way and finished to the same frequency at room temperature give closely similar results.

Frequency and activity

Under government specification all crystals are called upon to pass certain continuous temperature change tests. Frequency and amplitude of vibration, or "activity," (measured in terms of rectified grid current) are recorded over a range from —40 deg. C. to +70 deg. C. or greater. Under these tests crystals are acceptable if their activity stays in excess of a preassigned minimum and their frequency drift lies within a preassigned maximum.

A satisfactory pair of activity and frequency curves for a BT crystal is given in Fig. 2.

Frequency has it peak value at the mid-point of the temperature range and falls away parabolically on either side in a rather shallow curve; activity is high and smooth.

Often, however, the recorded crystal makes no such showing but produces simultaneous irregularities in both curves. These irregularities are capable of diagnostic interpretation.

As it is, in particular, the correlation between curve irregularity and bad dimensioning that interests us, other sources of curve irregularity must be carefully eliminated. A crystal will give eccentric performance if it is chipped, flawed, dirty or wet, if it is subjected to unfavorable pressure, or if its air-gap is of the critical height given by integral multiples of

$$h \text{ (in inches)} = \frac{792 \times \sqrt{\text{absolute temperature}}}{2 \times \text{frequency in cycles}}$$

This is the height for which the air gap resonates at crystal frequency and may beat heavily against it and damp it. Since the numerator of the fraction increases steadily with temperature while the denominator changes negligibly, we may expect this phenomeon to

(*Continued on page* 146)

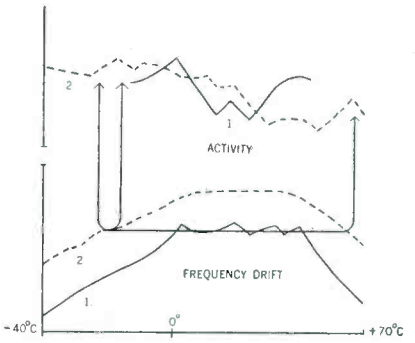


Fig. 5—Air gap unchanged, crystal unchanged. Note recurrance of instability near same frequency

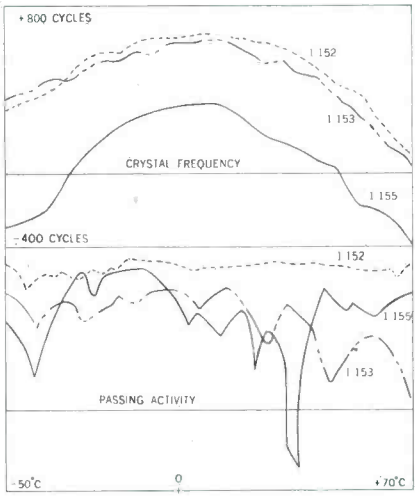


Fig. 6—(Above) Result obtained when electrodes and mounting are unchanged but one dimension is changed progressively

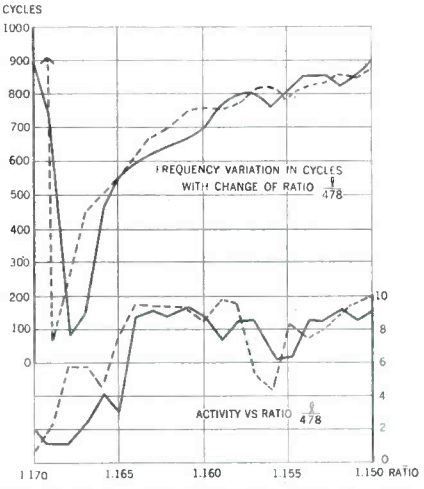
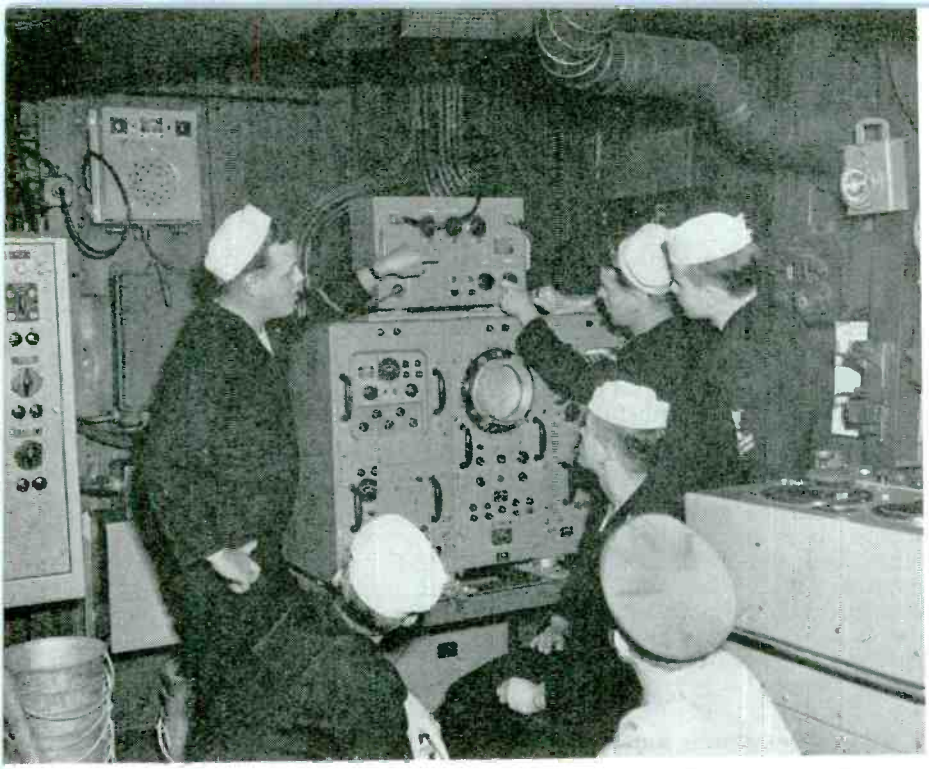


Fig. 7—Temperature/frequency and temperature/activity curves in the neighborhood of desirable dimensions for BT cut crystals

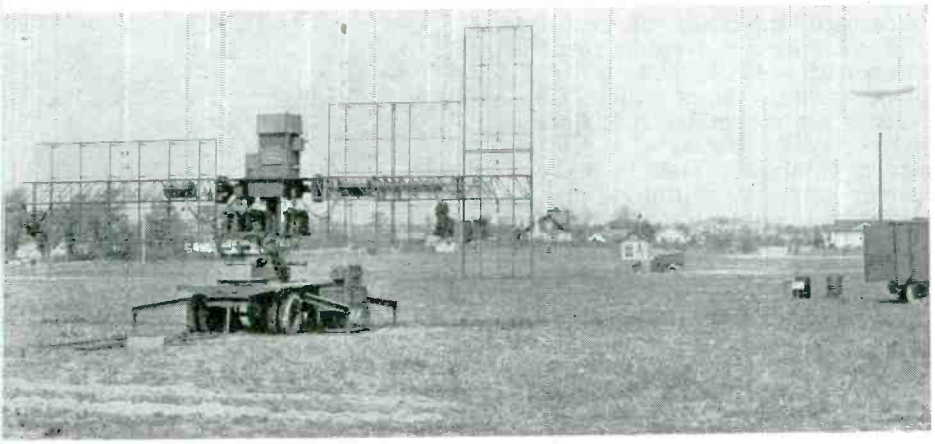
*R. Bechman, Hochfrequenztechnik und Electroakustik, Band 59, Heft 4.

ARMY and

Electrical echoes can be in either horizontal and



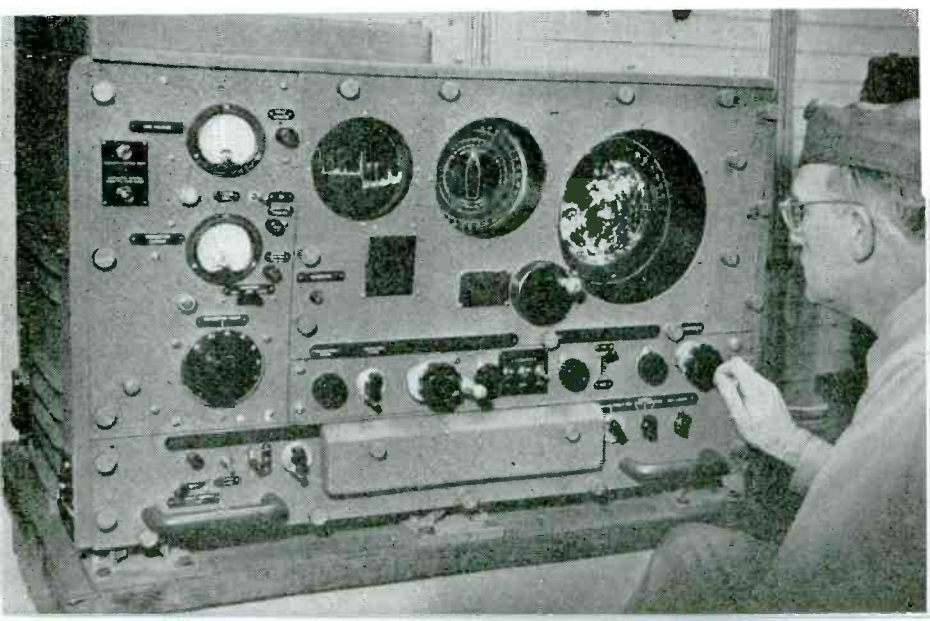
▲ Modern radar set installed on shipboard. Plan position indicator tube is at center. This gives a radial picture of the surroundings of the set location. The sweep starts at the center of the CRO tube face and goes to the outer edge. As the antenna is turned in azimuth the sweep rotates synchronously. Echoes intensify the beam of the CRO tube. This creates a bright spot



▲ Western Electric early warning radar set which made the sound locator obsolete. This model was built of light magnesium and was mounted on a wheel truck for mobility and erection ease

Many types of radar sets have been used by the Army and Navy during the war and doubtless several types will find application in peace time. The word radar refers, not to a particular instrument, but to the general system of sending out hf pulses and measuring the direction from which an echo is received as well as the time interval between sending the pulse and receiving the echo. Not only is it possible to reproduce the information obtained in a number of different ways, but also various operating frequencies can be used for different purposes. For example, if the whole sky is to be searched for planes it would be foolish to use an extremely sharp and narrow beam possibly ½ deg. wide and enclosing a solid angle of only 6.28×10^{-5} steradians since such a long period of sweeping would be needed to cover an appreciable area of the whole outdoors. Therefore, so-called early warning sets are made to operate at the reasonably low radar frequencies of 200 mc and are supplied with large bedspring type antennas as shown on this page. These not only send out a beam of respectable width but also present a substantial collecting surface for the echo energy. On the other hand, when it is desired to pin-point a known target for gun-

▼ Type SG radar displaying echoes on horizontal line (type A) (left) and radially (PPI) (right). Vertical lines in type A presentation are echoes while distance from left edge indicates distance from ship. Dial in center shows ship's heading, true compass points and direction of antenna

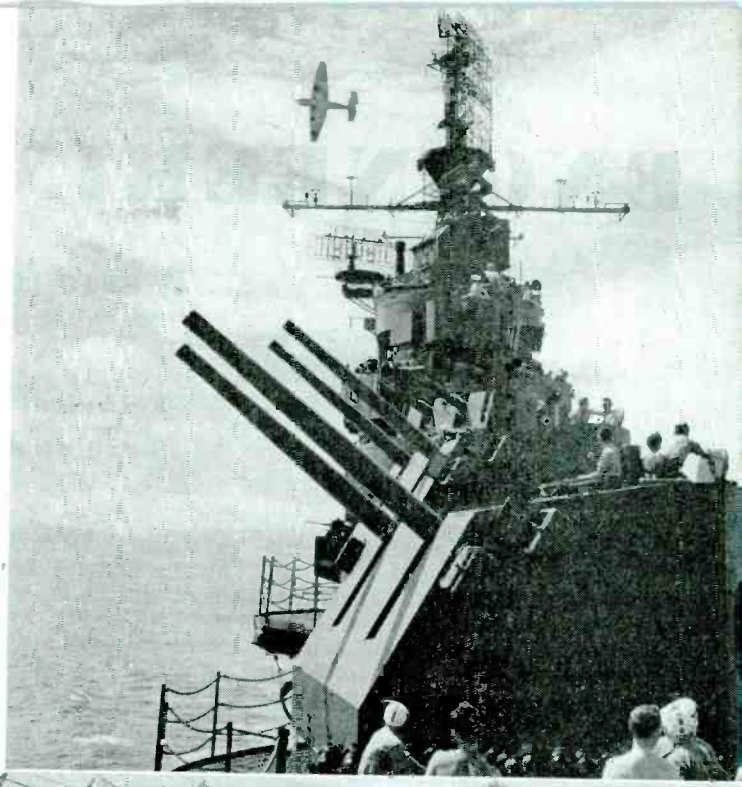


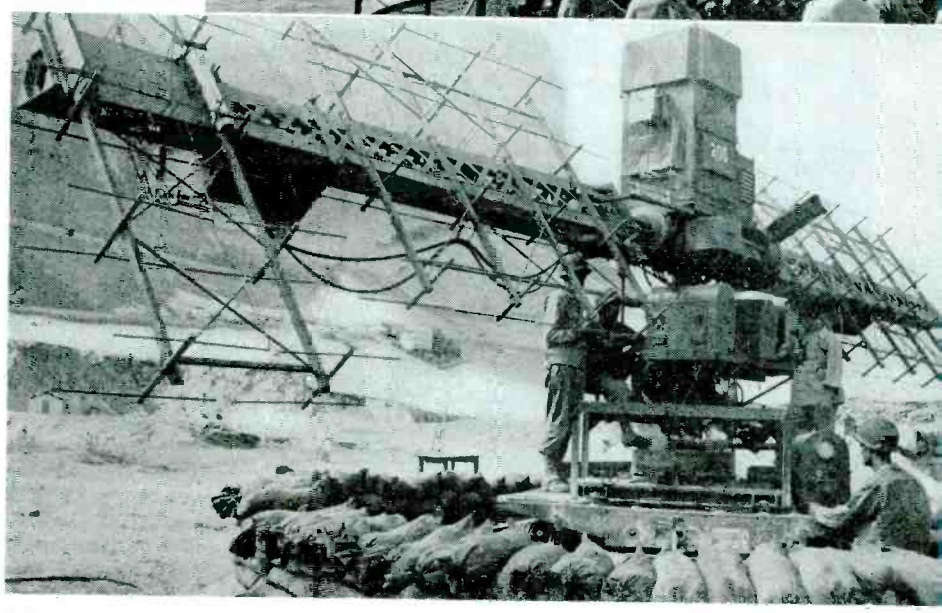
▼ Repeater for type SG radar. This can be located anywhere on the ship to give a PPI indication of objects surrounding the ship. The circles in the larger 'scope indicate distances. The smaller tube at the right presents an expanded view of a portion of the area scanned. Any portion can be chosen by turning one knob

NAVY RADAR

shown on oscillograph tubes
vertical or circular patterns

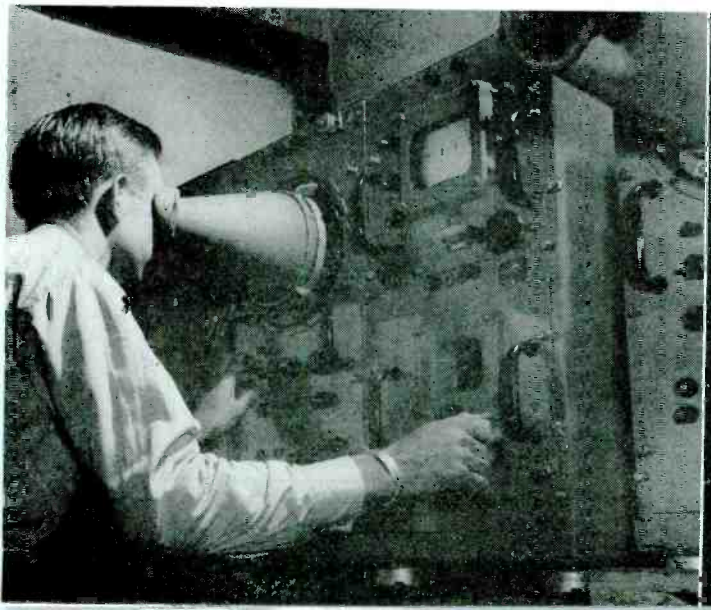
fire ranging purposes a sharp accurate beam is highly desirable, giving accuracy greater than that of the dispersion of the shells themselves. Aside from the PPI presentation, CRO tubes can be used to show range only along a horizontal axis, or azimuth angle horizontally and elevation angle vertically. In some types of radar sets, notably the earlier ones showing only the range along the horizontal axis, the distance was marked right on the face of the tube by means of a calibrated scale. Later models contain a step or notch, part of the trace being displaced vertically by means of a dc voltage impressed on the deflector plates at the proper instant of time in the transmission-echo reception cycle. The beginning of this step can be moved left or right by a hand knob until it corresponds to the echo pip of interest at the moment. Previous calibration permits the knob to actuate geared dials reading distance accurately. Such a step is shown on the 'scope face on the opposite page. Other schemes used are the inclusion of markers along the trace. These are pips formed by the discharge of condensers at accurately known time intervals in so called counter circuits. Usually several sets of markers are available by turning a switch. These correspond to several sweep speeds permitting one instrument to be used for either long or short range work.

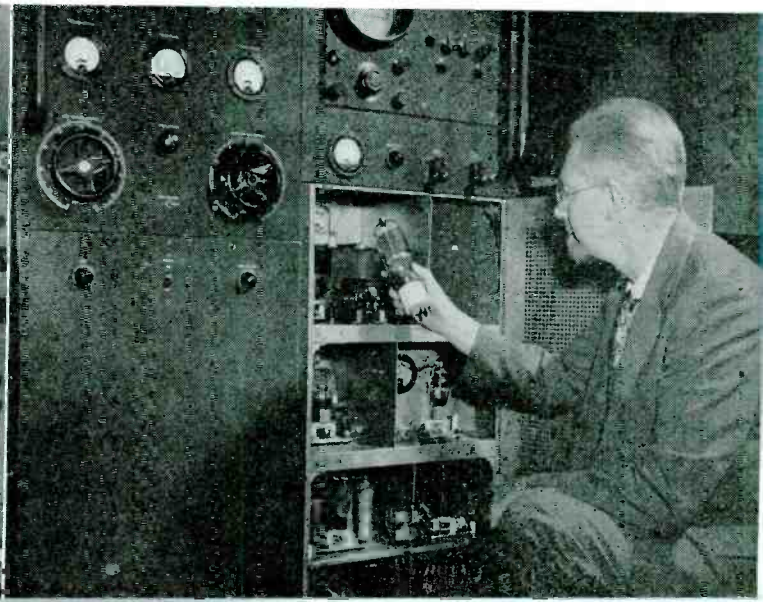




▲ Numerous antennas on this fighting mast testify to the importance of radar. Two bedspring types can be seen as well as a semicylindrical reflector. Below, early warning set used in Italy

▼ Range in yards can be read on dials below the type A 'scope face at the right while true and relative bearings show on an indicator above the right hand. Dr. R. M. Page at the right is holding a rectifier tube from an early XAF radar now honorably retired from the fleet





ENGINEERING DETAILS

By **HUGO ROMANDER**
Federal Radio and Telephone Corp., Newark, N. J.

Technical data and constructional features of fully modulated inverted amplifier operating at 6-22 mc

● Two of the most powerful short-wave broadcast stations in the world, strategically situated near the West Coast where coverage of the western Pacific area can be made more effective than from any other region of the continental United States, are now in operation, carrying both morale broadcasts by the Armed Forces Radio Service to our troops in that theater, as well as an intensive OWI campaign of psychological warfare to Japan. Designed and equipped by the Federal Telephone and Radio Corp. to meet specifications of the Office of War Information, these stations are part of the OWI program.

The recently completed stations are located at Delano, near Bakersfield, and at Dixon, near Sacramento, California. Construction of the building and installation of primary power supply and audio equipment at Delano has been supervised by the Columbia Broadcasting System,* while the National Broadcasting Company has similarly participated in the construction of the Dixon station. Federal Telephone and Radio Corp., associate of the International Telephone and Telegraph Corp., has supplied and installed, in addition to the 200 kilowatt amplifiers, the 150 kilowatt modulators, and all associated rectifier and power supply equipment, including the cooling-water circulation system.

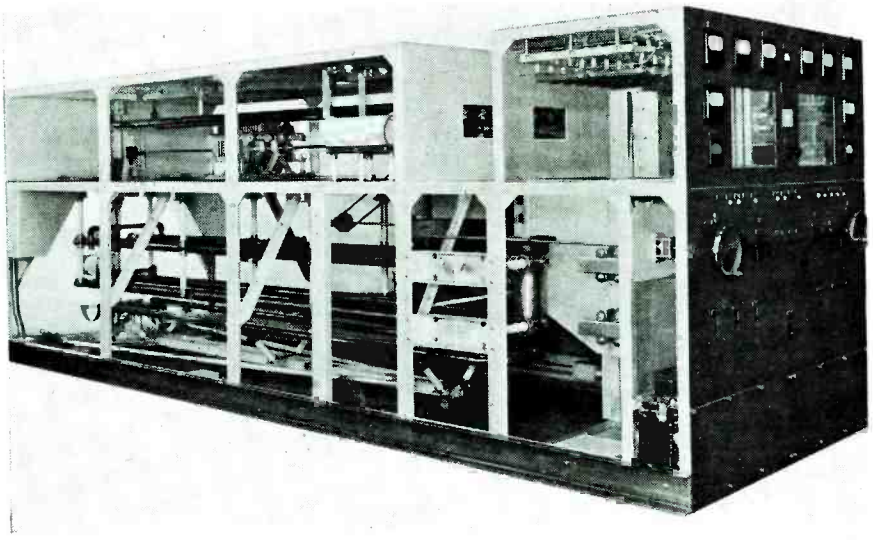


Fig. 2—General view of the left side of the 200 kw OWI international broadcast transmitter power amplifier showing arrangement of the copper pipes feeding excitation to the filaments

The design of the station transmitters presented many problems because of the fully-modulated 200-kilowatt carrier power specified for the allocated frequency range of from 6 to 22 megacycles. Though many of the components, including the power supplies, rectifiers and modulators, are somewhat conventional in design, the final radio-frequency power amplifier stage is rather unorthodox in that it utilizes a grounded-grid, push-pull amplifier with tuned input and output circuits. (Fig. 1)

This circuit, which is sometimes referred to as an inverted amplifier, was selected because of the many advantages it offers in high power operation at these frequencies. With the use of power tubes capable of providing the required power output in the conventional bal-

*"OWI-CBS 200 Kw West Coast Transmitter," Robert N. De Hart, CBS, E I, April, 1945.

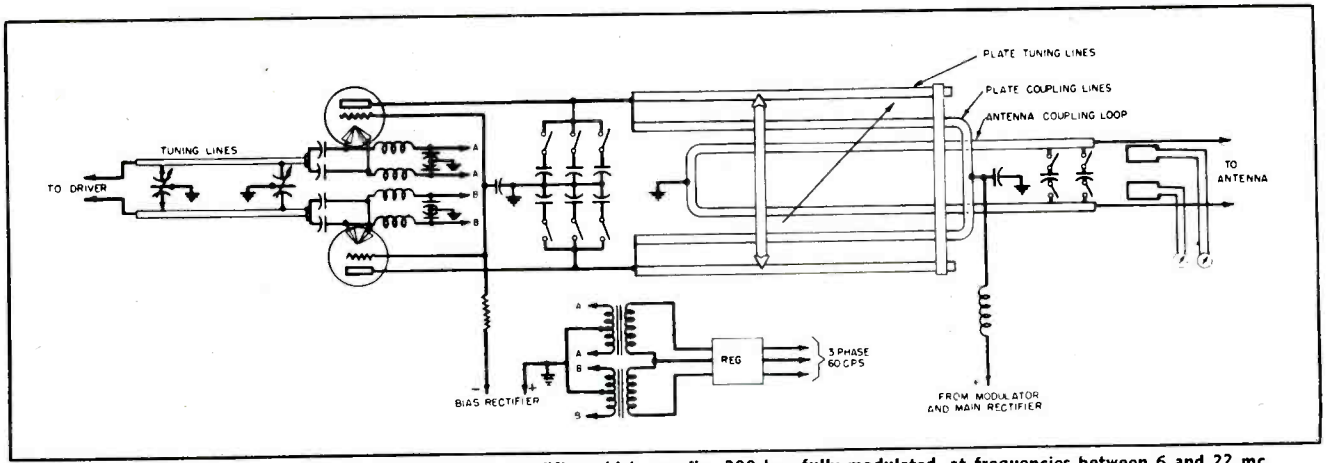


Fig. 1—Schematic diagram of the inverted power amplifier which supplies 200 kw, fully modulated, at frequencies between 6 and 22 mc

OF OWI 200 KW UNITS

anced amplifier and their unavoidably larger interelectrode capacitances, it becomes difficult to resonate the circuits to which the tubes are connected. Moreover, the grid-plate neutralizing capacitances would add to the tube capacitances and seriously limit the design of the output circuit inductance and considerably reduce the overall efficiency of the amplifier.

These problems are more easily solved by the inverted amplifier through the screening effect of the grounded grids and the reduction of output circuit capacitances, as compared with those of the equivalent balanced amplifier. Neutralizing condensers are entirely eliminated and it becomes practical to use very large tubes at relatively high radio frequencies.

In the inverted type of amplifier the excitation power is applied to the cathodes, instead of to the grids, which are held at ground potential. Therefore, the power developed in the amplifier plate circuit is in phase with the power developed in the driver, and as a result, in order to obtain full modulation in radio telephone operation, it is necessary to modulate the driver as well as the amplifier.

Since the driver is effectively in series with the amplifier plate by means of the cathode-to-plate electron stream, the power developed in the output tank circuit consists of the power delivered by the driver (except for any portion lost in the amplifier grid circuit) plus the power developed by the amplifier. Greater excitation energy is required, but there is no sacrifice in overall efficiency.

Driving power for the 200 kilowatt amplifier is provided by a 50 kilowatt transmitter which was supplied from OWI stock. Since this unit was originally designed for operation into an antenna, provision was made for adjusting the input circuit impedance of the larger amplifier to the normal load impedance for the 50 kilowatt unit, so that the output coupling facilities of the latter could be employed without alteration. As the driver must be modulated simultaneously and to the same degree as the power amplifier, its plate supply is obtained from the same modulated source as for the 200 kilowatt power amplifier.

The power amplifier is mounted in a frame 22½ ft. long, 6 ft. wide, and 6½ ft. high. Fig. 3 shows a view of the front panel from which all circuit adjustments are made with the exception of plate tank circuit capacitor switching. The two controls for the variable capacitors in the input circuit are operated directly by means of handwheels, all other controls be-

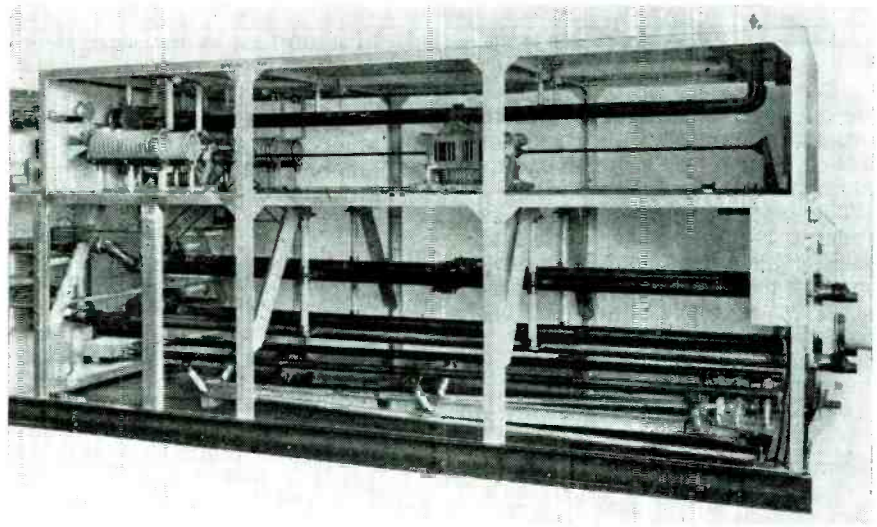
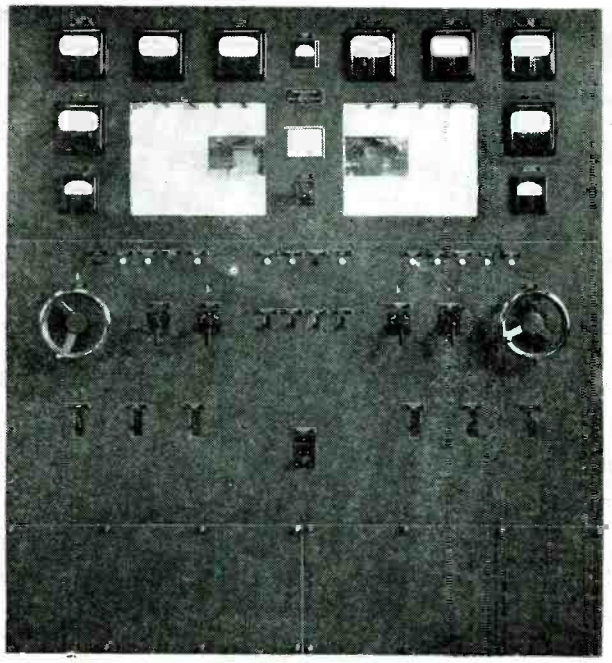
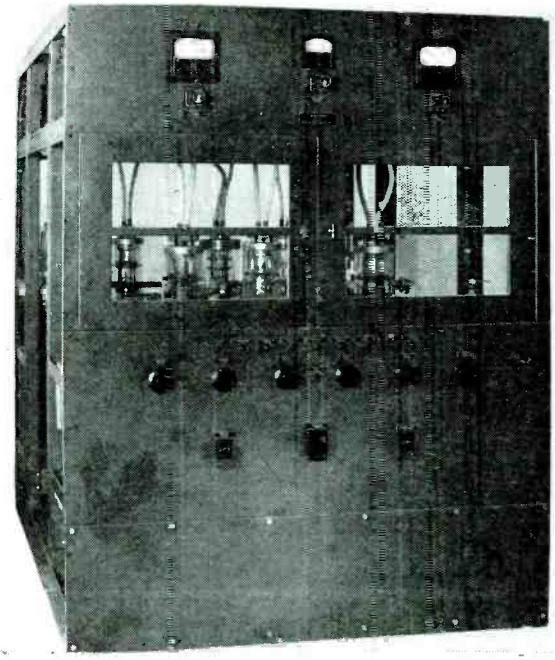


Fig. 4—(Above) Right side of rear section of power amplifier. Filament chokes, input circuit transmission lines and tuning capacitors are in upper section; plate inductance and antenna pick-up loop in lower section. Fig. 3—(Left) Front view. Fig. 6—The 150 kw modulator





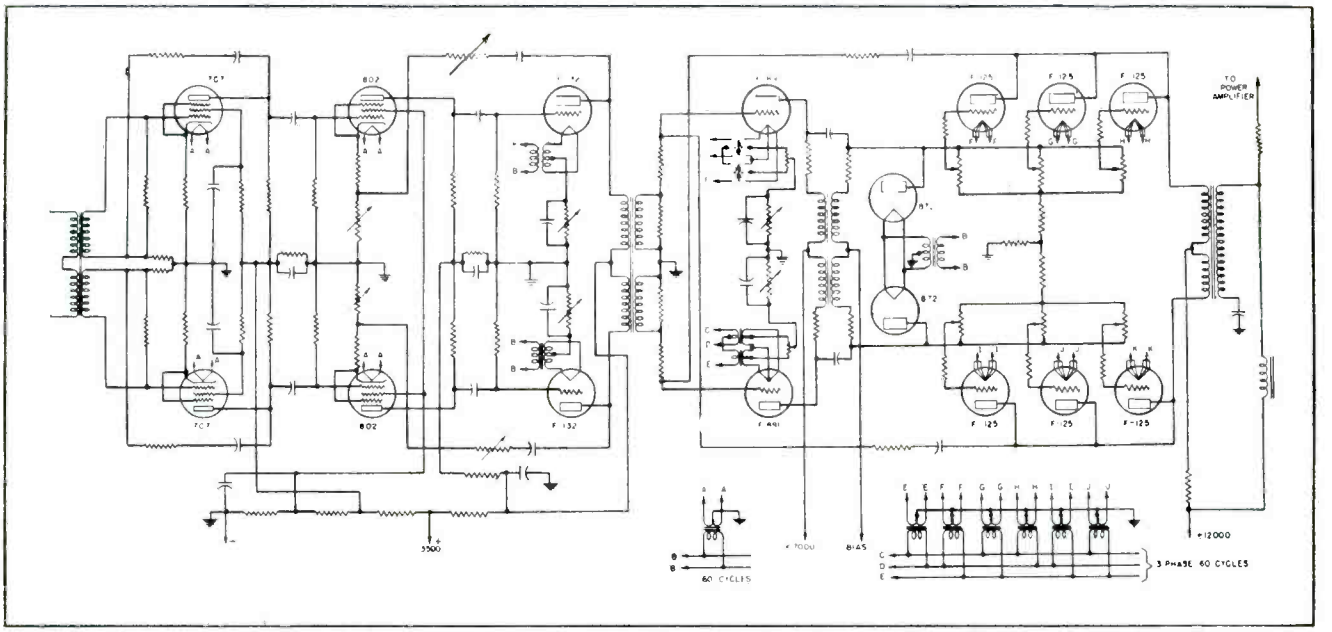


Fig. 5—Simplified schematic diagram of the modulator for the OWI 200 kw transmitter, which supplies 150 watts to completely modulate carrier

ing operated by means of reversible two-speed motors, which are controlled, in turn, by switches mounted on the front panel.

The power amplifier utilizes two Federal F-135-A water-cooled triodes. This tube is a recent development incorporating a thoriated-tungsten filament, and has been designed to minimize grid-lead inductance as well as plate-to-filament capacitance. Principal characteristics of the F-135-A are as follows:

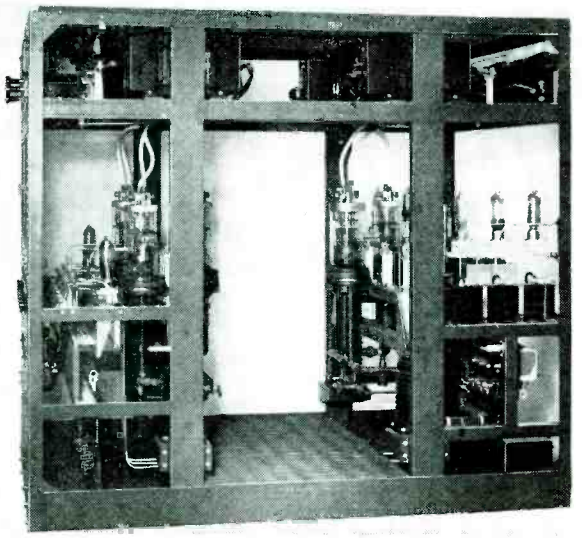
Filament: Single phase
Plate Dissipation ..... 100 kw.
Direct Interelectrode Capacitances:
Grid-to-Plate ..... 125 mmf.
Grid-to-Filament ..... 125 mmf.
Plate-to-Filament ..... 4 mmf.
Overall Dimensions:
Length ..... 30 in.
Diameter of Anode ..... 6 in.
Diameter of Glass Envelope ..... 6½ in.

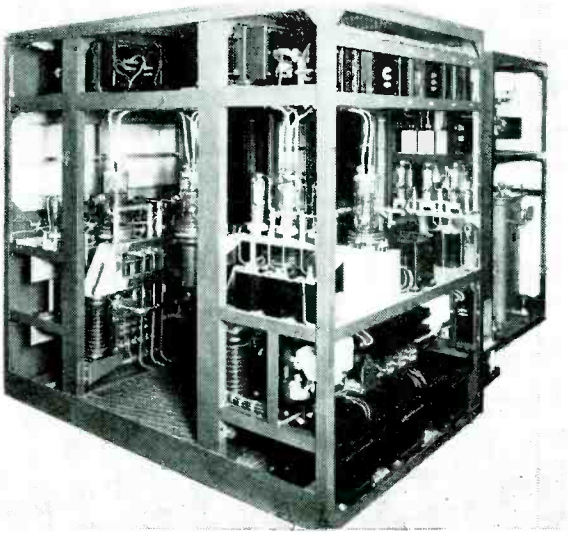
A pair of transformers, connected in open delta to the 230-volt, three-phase supply, feed the filaments of the F-135-A tubes. Motor-operated, air-cooled induction regulators control the voltage at the transformer primaries and permit remote-control adjustment of the filament voltage. Resistors in the primary power supply circuits limit the initial current-surge to less than 1.5 times normal current when power is first applied to the cold filaments.

Since the rf excitation is applied directly to the filaments in the inverted amplifier, it was necessary to design special rf chokes capable of carrying the 385 amperes of filament heating current. Sections of copper tubing, about 20 in. long and with an outside diameter of approximately eight inches, were spiral-cut on a lathe to form a very rigid coil of copper bus 1 in. wide and ½ in. thick. Because of the low impedance of the input circuit, the few hundred ohms reactance provided by these chokes is sufficient to prevent any appreciable power losses.

Excitation energy is fed to the power amplifier filaments from the transmission lines leading from the 50 kw driver by means of two parallel copper pipes 18 in. apart and about 12 ft. long. Two variable capacitors, controlled by the handwheels on the front panel, are used

Fig. 7—(Left) Right side view of the complete 150 kw modulator showing physical arrangement of various components. Fig. 8—(Right) Rear view





to tune the input circuit. One of these capacitors is fixed in position at the filament end, the other being mounted on a four-wheeled dolly and supporting contacts which permit connection to any point on the input circuit pipes mounted above. This entire assembly may be moved along the length of the pipes by a motor-driven stainless-steel belt, controlled by a switch on the front panel.

Parallel copper pipes are also used for the plate-circuit inductance, which consists of two parallel pairs, each approximately 18 ft. in length. The inductance of one of these pairs is varied by means of a carriage-mounted shorting-bar which can be moved to any position along the length of the pipes by a stainless-steel belt, driven by a reversible motor, controlled from the front panel. The inductance of the other pair remains fixed, and provides for coupling to the antenna pick-up loop. The ends of this loop are pivoted so that it may be raised or lowered by a motor-driven worm which runs through a bracket supporting the loop. Thus the antenna coupling may be adjusted by means of front panel switches which control the action of the motor-driven worm. The pipes forming the plate circuit inductance also serve to carry the cooling water to and from the tubes.

Plate circuit capacitance is provided by fixed 100 mmf vacuum capacitors, specially designed and manufactured by Federal, which are switched in and out of the output tank circuit as required. These capacitors incorporate a small filament which may be heated occasionally to assure a high degree of vacuum.

The position of the variable capacitor along the input line, the position of the plate tuning carriage, and that of the antenna pick-up loop, are indicated by counters on the front panel, coupled by means of selsyn motors to their respective driving mechanisms. These motor-driven tuning facilities permit adjustment of the power amplifier in less than five minutes to any frequency in the transmitters' range of 6 to 22 megacycles.

A special carrier cut-off device protects against damage due to flash-over in the radio frequency circuits and antenna system by causing a momentary interruption of the carrier if the average level rises or falls more than a few per cent from a predetermined value. Breakdown in any rf circuit thus will momentarily disable a low power stage, and if the ensuing interruption of excitation to higher power stages fails to clear up the fault, the cut-off apparatus will continue to re-cycle until the operator shuts down the equipment.

The audio frequency equipment is divided into a low power unit, an intermediate amplifier unit, and the modulator unit. Push-pull circuits are used throughout, satisfactory harmonic suppression and good stability being obtained with three separate negative feedback

(*Continued on page* 158)

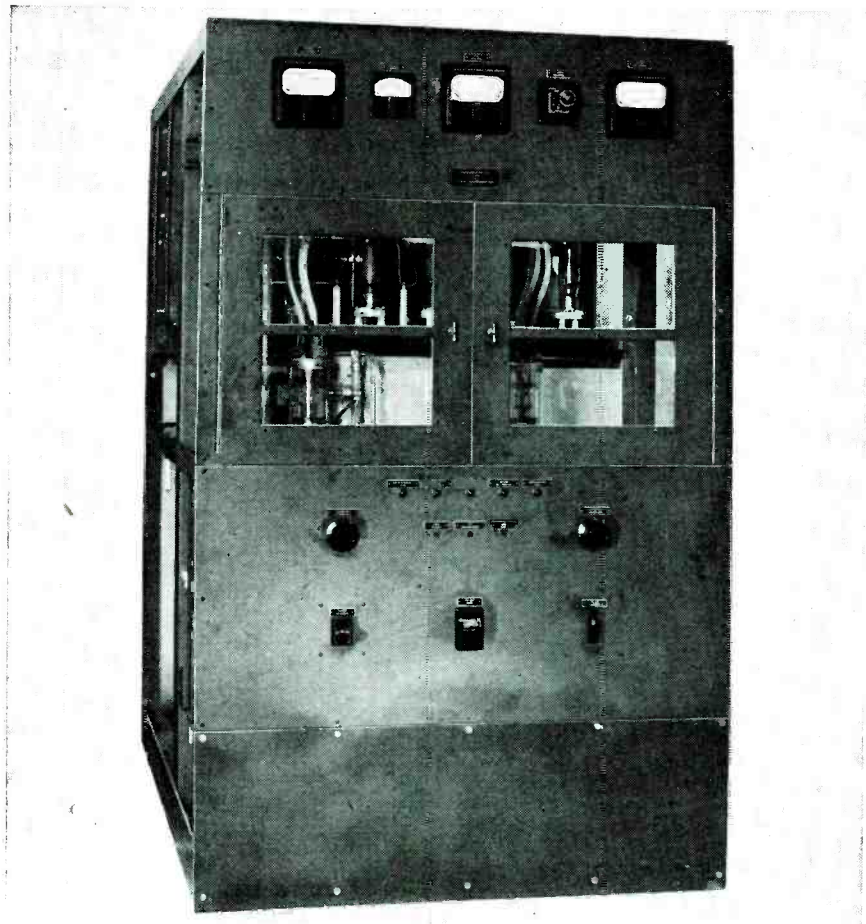


Fig. 9—Front view and control panel arrangement of the audio amplifier for the transmitter

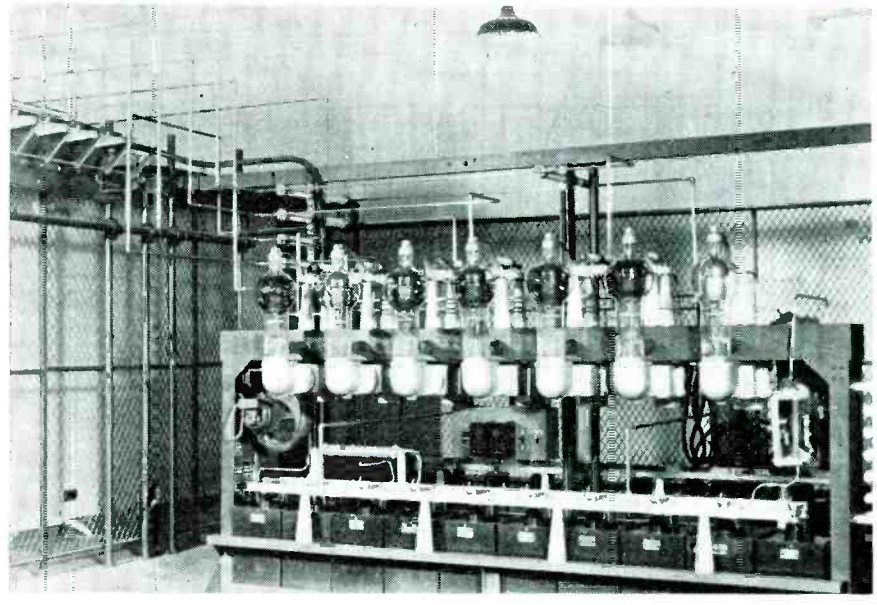
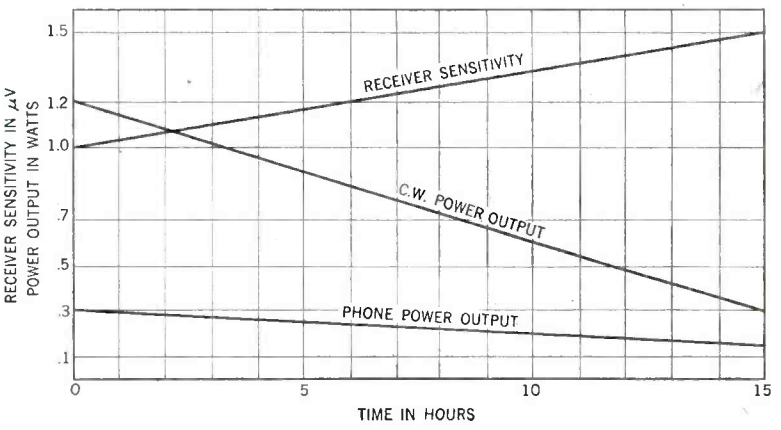


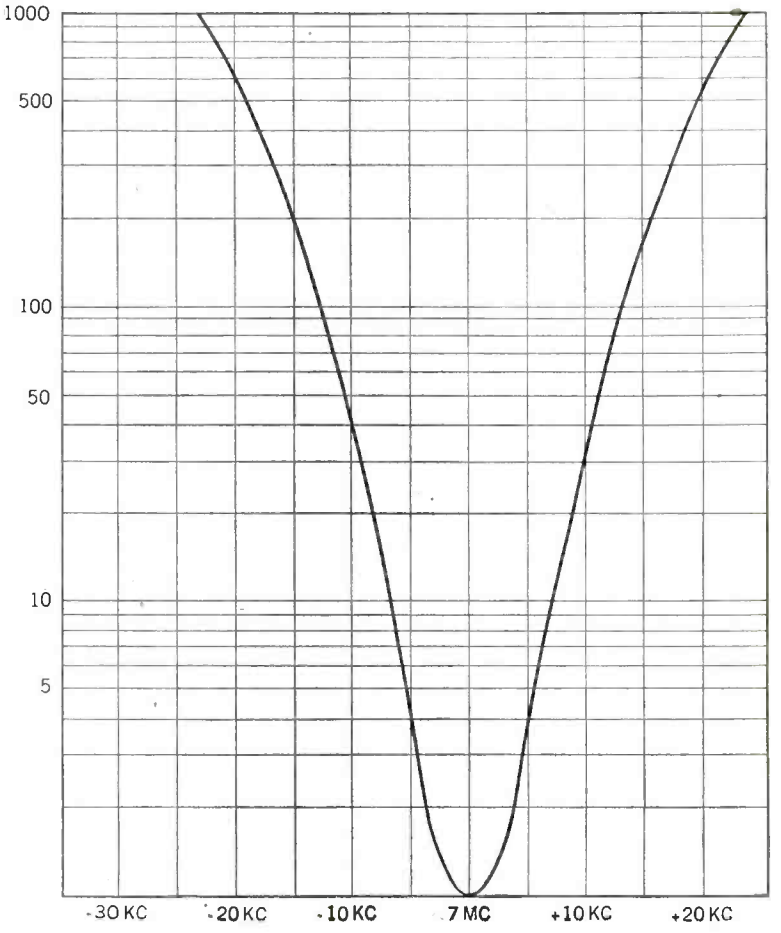
Fig. 10—View inside the rectifier rack capable of supplying 300 kw of power, showing one bank of seven Federal F-857A mercury-vapor rectifying tubes, one kept hot for emergency substitution

ENGINEERING BRITISH

Technical features of Americanized design for combined mobile transmitter-receiver developed for military liaison

● The very nature of modern warfare necessitates the use of large quantities of portable communication equipment. Of all such equipment probably the most important was a medium range battery-operated radio communication set, light and simple enough to be carried and operated by one man. This was one of hundreds of items which American industry produced and supplied to our British ally.





In 1940 the British had designed and made such a set known as Wireless Set No. 18 or, for short, B18. So great was the pressure on the electronic industry in Britain at that time that insufficient quantities were forthcoming, and it was decided to supplement British production by having a similar set manufactured here. Several of these B18 sets were sent to this country to serve as a background for developing the American counterpart.

Frequency varies

The requirement for the new set was that it should conform both in physical dimensions and weight to the B18 and that its electrical performance should be the best obtainable, but in any case not worse than the B18.

Extensive tests and measurements, part of which were made by the Emerson Radio and Phonograph Corp. Laboratories, served as the nucleus for the final specification of the British Wireless Set No. 48 or, for short, B48, now in use by the British Armies.

The B48 set consists of a transmitter and receiver complete with all accessories required for both phone or cw operation. It is intended primarily for short-range communication between infantry units. It may be used as a fixed ground station working in the open, or from cover or as a man-carried pack set for working on the move. It also works from either stationary or moving vehicles. For mobile operation the set is fed from a compact self-contained "battle battery." For fixed station work, it can be operated from its heavy duty battery pack or from a special light-weight, hand-cranked generator, which was developed by Emerson. This generator complete,

Fig. 3—(Upper) Graph of receiver sensitivity, and power output of transmitter when battery operated

Fig. 4—Chart of the overall selectivity of receiver

B48 WALKIE TALKIES

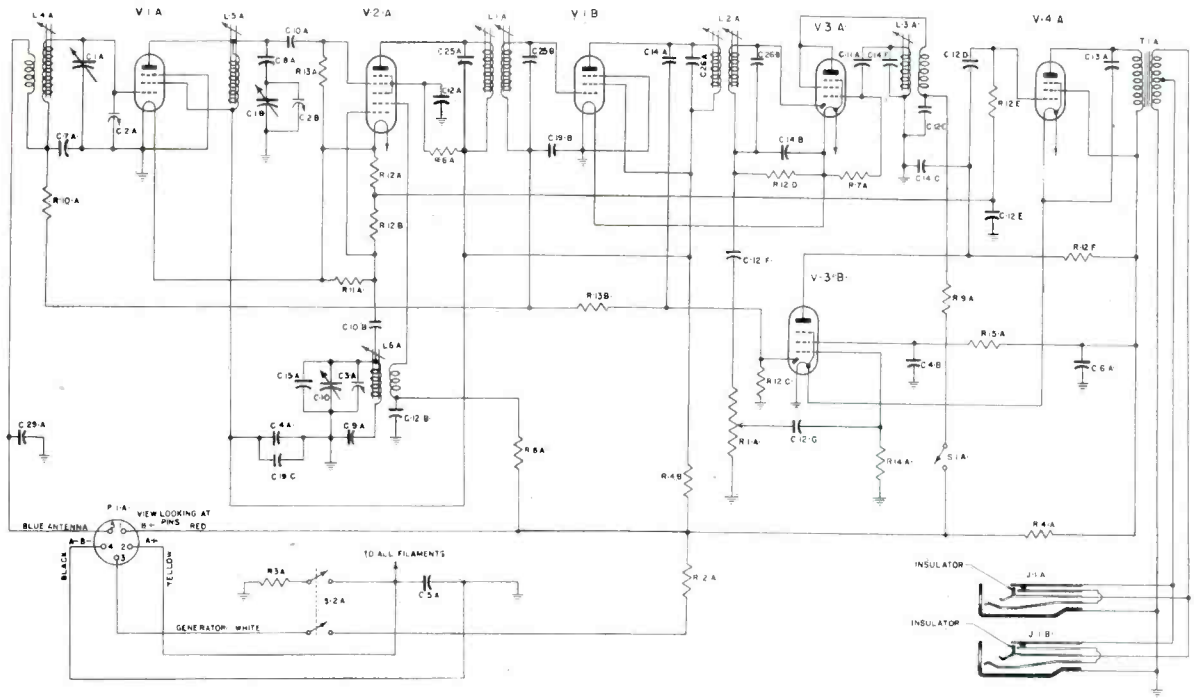


Fig. 2—Schematic wiring diagram of the receiver portion of the British model B48 Walkie Talkie set, either battery or generator operated

including legs, seat, filter enclosed in the generator housing, and voltage regulator weighs approximately 19 lb.

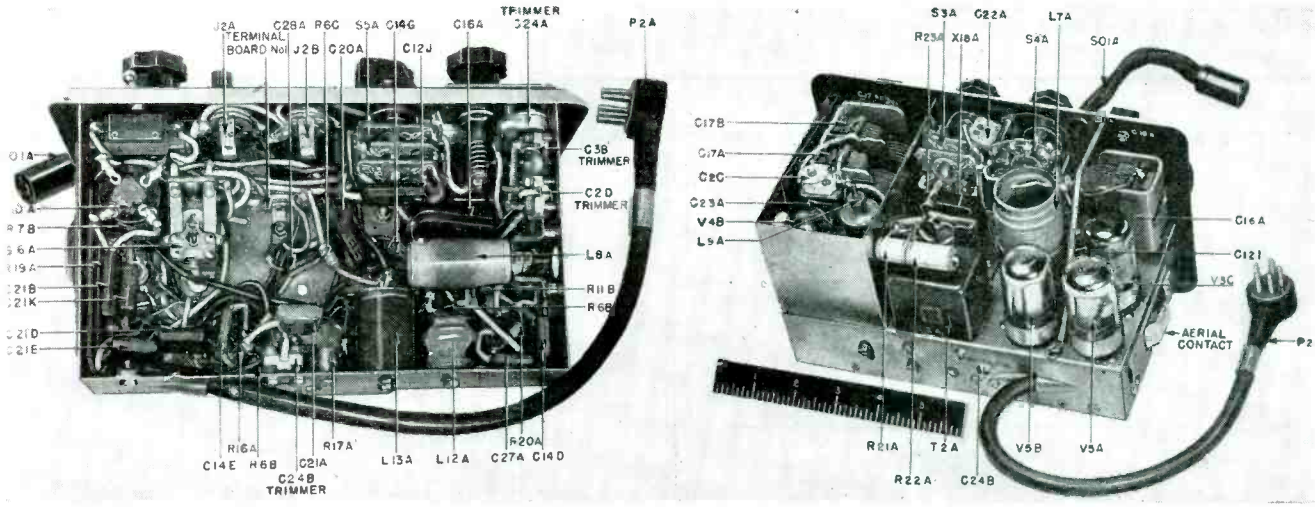
Antenna equipment

The transmitter-receiver, sectional rod antenna and battle battery pack are all contained in one case, fitted with straps so it can be carried on a man's back. When used with batteries, the set may be operated by one man, and by two men when used with the hand generator.

Function	Tube Type	Ef	If	Eb	Ecz	Ec1	Ib	Ic2	Gm	Rp	u
RF Amp. & IF Amp. . .	1LN5	1.4	.050	120	60	0	.95	.18	650	2 Meg.	—
Converter.	1LA6	1.4	.050	90	45	0	.55	.6	250	.75 Meg.	—
Detector Audio Amp..	1LD5	1.4	.050	120	—	—2.0	2.6	—	945	17,800	17
Audio Amp. Master Osc.	1A5GT	1.4	.050	90	90	—4.5	4.0	.8	850	.3 Meg.	—
Modulator Crystal Osc..	1LD5	1.4	.050	150	90	—4.5	3.0	.9	—	—	—
Power Amp.	1299	2.8	.110	150	150	—8.0	19.0	3.2	3000	—	—

Fig. 1—Line-up and characteristics of tubes used in the B48 transmitter and receiver

Top and bottom views of the receiver chassis showing location and arrangement of components



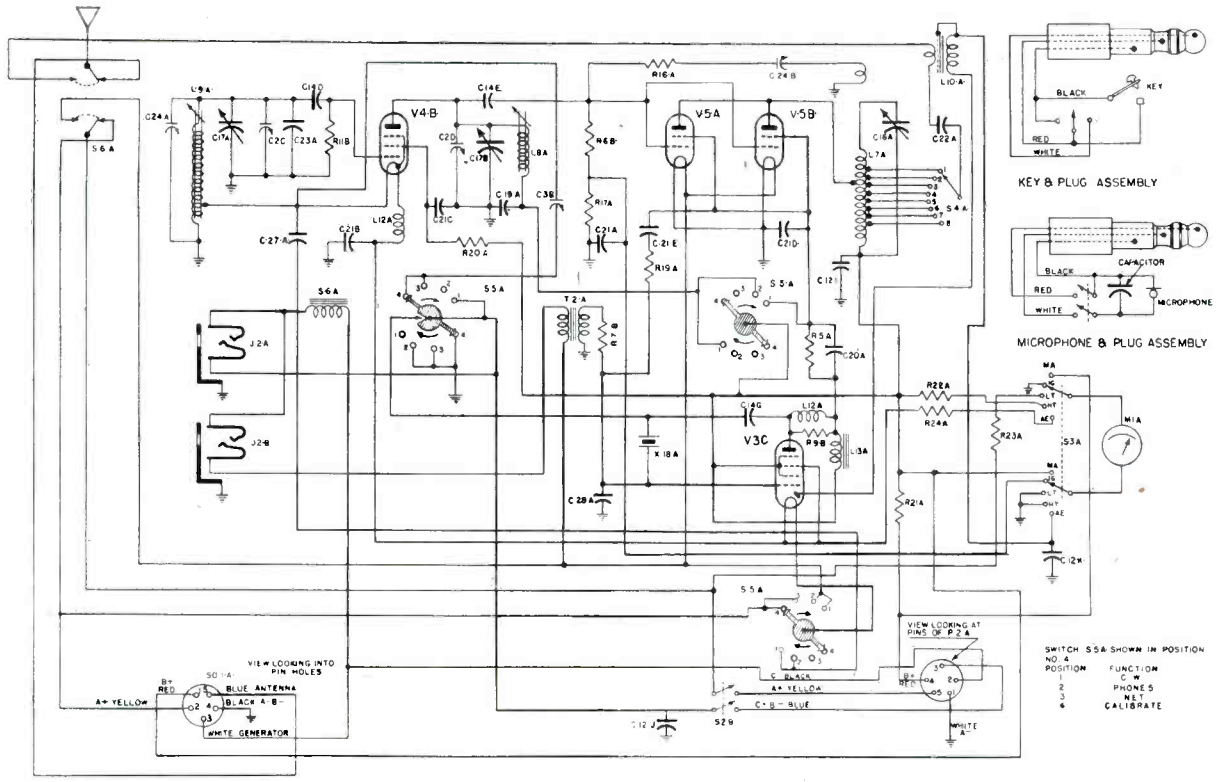


Fig. 6—Schematic wiring diagram of the transmitter of the British B48 Walkie Talkie, officially designated as the "Sender"

The sectional antenna is made up of eleven sections of painted steel tubing. For short-range work, as few as one or two sections can be used. For long-range work, all eleven sections may be used. When not in use, the sections are stowed in a rack on each side of the case.

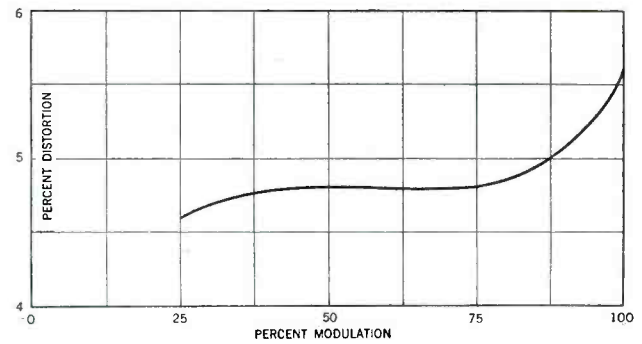
The antenna is erected on the side of the case in a pivoted spring loaded socket which allows it to be vertical regardless of the operator's position. Provision is made for locking the antenna's position at any desired point in the arc of rotation by means of a screw and a captive knurled knob. This spring loaded Emerson originated antenna is also used by the Navy on one of their man-borne communication sets.

The British Royal Corps of Signals also requires that its equipment operate with a ground antenna—a 25-ft. length of wire. This antenna can be laid out on the ground or can be thrown over a bush or low tree to increase the range of the set. Exceptional improvements in signal-to-noise ratio are sometimes obtained with this arrangement. Typical service ranges are:

Antenna Type	Phone Range Miles	CW Range Miles
10 ft. rod	5	10
6 ft. rod	2-5	4-10
Ground Aerial	1-3	2-6

The front of the ribbed steel case in which the set is housed is closed by hinged metal flaps and a canvas hood. This hood provides protection against bad weather conditions. The battle battery is housed in the hinged bottom pan of the case. The transmitter slides into the lower section of the case proper, and the receiver into the upper, each being held in position by captive thumb screws. The chassis may be removed for inspection or maintenance. The microphone, head phones, key and 25-ft. wire are carried in a bag slung over the operator's shoulder.

One of the first problems which arose during the designing of the



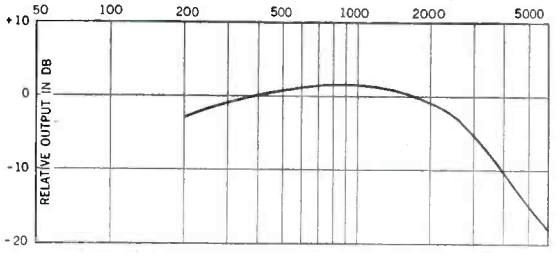


Fig. 7—(Left) Graph of percentage of distortion vs. modulation percentage of B48 transmitter. Fig. 5—Overall receiver fidelity

B48 was the selection of tubes equivalent to those used by the British. Because the B48 equipment must be operated from the same battery supply as the B18, this selection was not easy. After a careful survey of all the battery operated tubes, the complement shown in Figure 1 was selected.

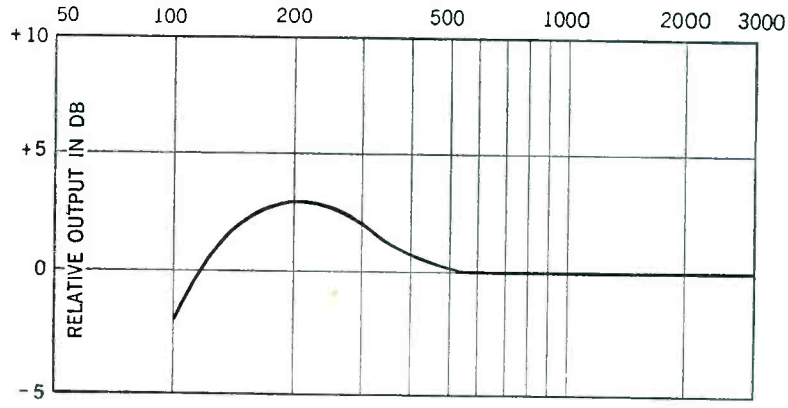
The B18 set used a common antenna coil for both the receiver input and transmitter power amplifier tank circuit. The coil and tuning condenser were mounted in the transmitter. While this method was economical, eliminating the need for a receiver antenna coil, it resulted in a serious reduction in performance. There was considerable loss of transmitter power output in the long lead which connected the receiver rf amplifier grid to the antenna coil. In certain circumstances when using the receiver, two tuning controls had to be manipulated, the main tuning control in the receiver panel, and the antenna tuning control on the transmitter panel. These disadvantages are eliminated in the B48.

Single tuning control receiver operation was achieved by using a separate receiver antenna coil in a conventional three-gang superheterodyne arrangement. Power losses were reduced by means of a newly-designed antenna switching relay located in the transmitter, which disconnected the lead to the receiver when the transmitter was operated.

Relay specs

The relay specifications presented many problems. It would have to use very little current to energize the field coil of the relay. It was necessary to be sure that the contacts would not be intermittent when the set was bounced or shaken. Since the rf output power of the transmitter is so limited, and the antenna is in the relay circuit, the relay had to be of a low loss, low capacity type. Special Mycalex insulation was worked out and found to be very satisfactory.

The B18 employed grid modulation which had one advantage in that no additional tubes were necessary. The microphone voltage was stepped up in an audio transformer and applied directly to the power amplifier grid. In the B48 screen grid modulation was employed, a form of modulation for which the 1299 tube is admirably suited. The modulator tube selected with a 1LD5 operating as an audio power amplifier with 150 volts on both screen and plate, and with the control grid biased at —3 volts. Laboratory tests showed that life of tube would be satisfactory as operated.



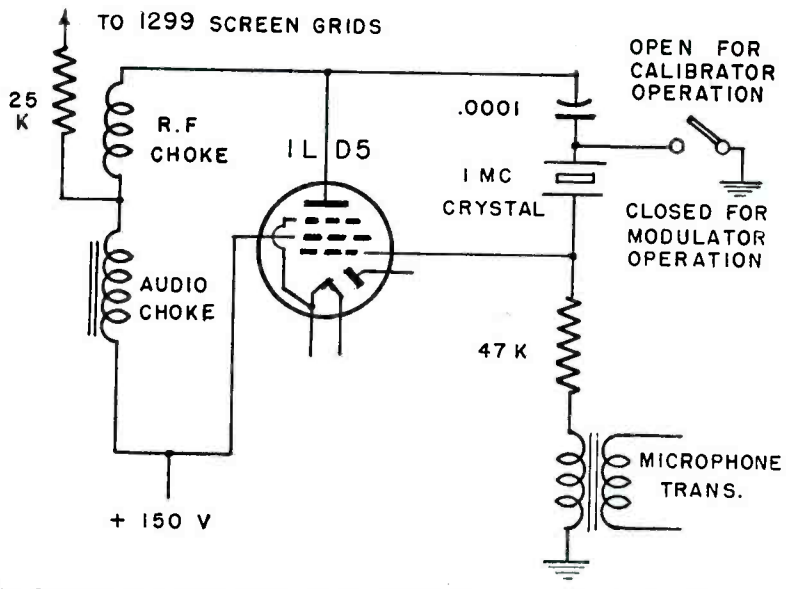
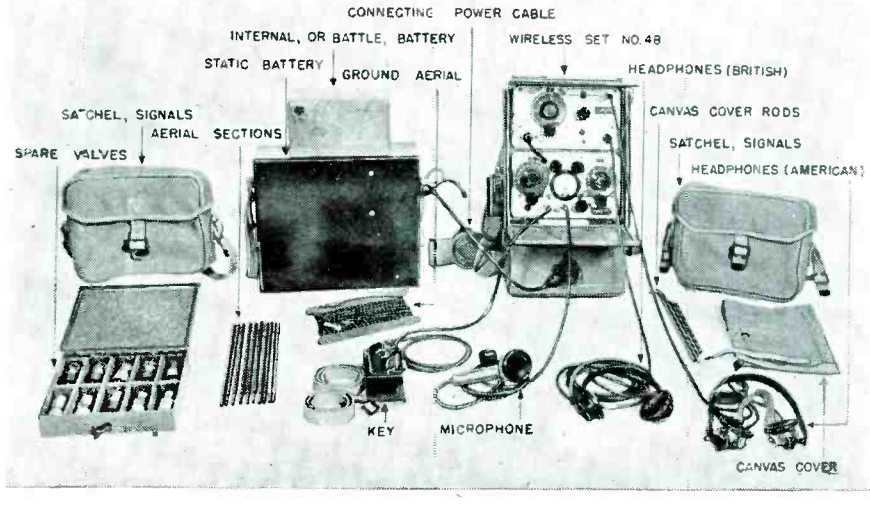
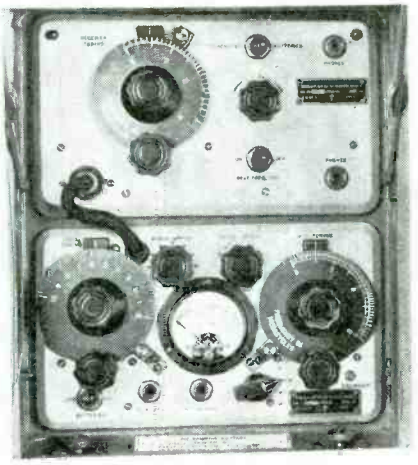


Fig. 8—(Above) Relative fidelity of the modulation system. Fig. 9—Simplified wiring diagram of the crystal controlled calibrator used in checking frequency of the transmitter

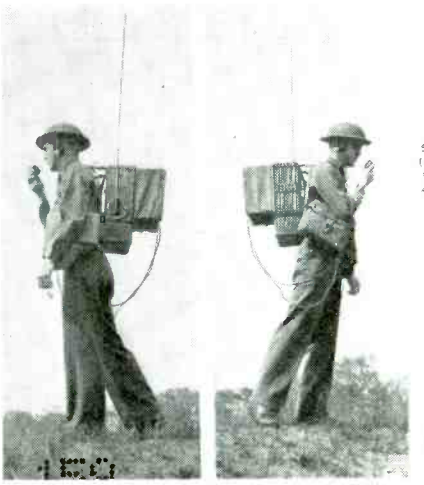
Using negative feedback, almost 0.1 watt of audio power was obtained. This is more than enough to modulate the transmitter 100 per cent. No increase in filament current was necessary because the

Here are shown all the various components in the B48 transmitter-receiver, as supplied to the British Army for operation on batteries. Equipment may also be hand-generator operated

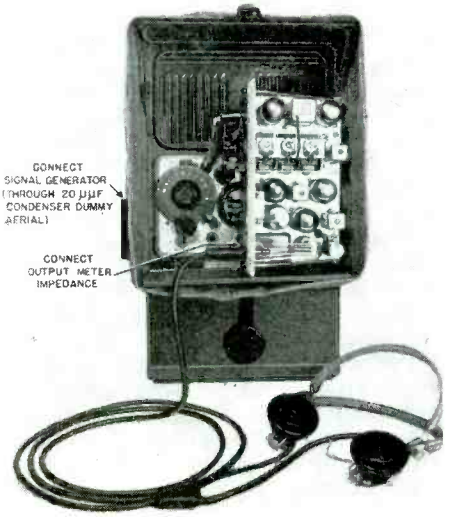




View of the control panel of the B48 receiver-transmitter radio



The equipment from both sides showing battery pack and antenna mounting



Top view of receiver unit as arranged for alignment procedure

1LD5 filament was merely substituted for the series resistor required for the 1.5-volt master oscillator filament operating from the 3-volt filament supply. The 3 ma of B current needed for the modulator was more than made up for by the reduction in total current resulting from the increased efficiency of the rf power amplifier.

The selection of the 1LD5 as modulator was dictated for reasons other than its power output, for if this were the only requirement the 1A5GT already used as master oscillator may have been much more suitable. The 1LD5 was selected because it was the only tube which delivered the necessary power output, and also contained a diode. The diode was needed for the antenna current indicator. A feature of the B18 set which permitted the operator to select the best tap on the power amplifier tank coil, for maximum power transfer into the antenna, was a dry disc rectifier connected to the transmitter output in series with a microammeter. In the B48 the diode is connected to a special transformer to the transmitter output in series with a microammeter. It was necessary to use a diode because American manufacturers of dry disk rectifiers would not furnish a disk rectifier to operate at radio frequency.

Superheterodyne receiver

The receiver is a superheterodyne tuning the range of 6 to 9 megacycles (Fig. 2). A stage of trf amplification insures good image rejection and high sensitivity with low noise. This is followed by a conventional pentagrid converter. The oscillator section is temperature stabilized by a small negative coefficient ceramic condenser. A single high gain stage of 455 kc if amplification is used. The two double tuned if transformers provide sufficient selectivity easily to meet the specifications.

A conventional diode, second detector is used. A 454 kc oscillator for cw reception is also provided. Since the cw oscillator tube is contained in the same tube envelope as the diode second detector, no external injection is required. Opening or closing a switch in series with the cw oscillator plate supply gives phone or cw operation as desired.

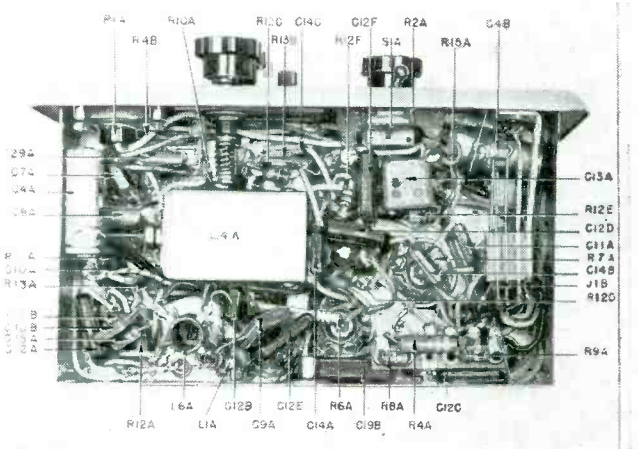
AVC voltage is developed from a separate diode coupled to the primary side of the second if transformer. This gives much better AVC than obtained from the secondary because the AVC action takes control over a broader band and is of greater intensity.

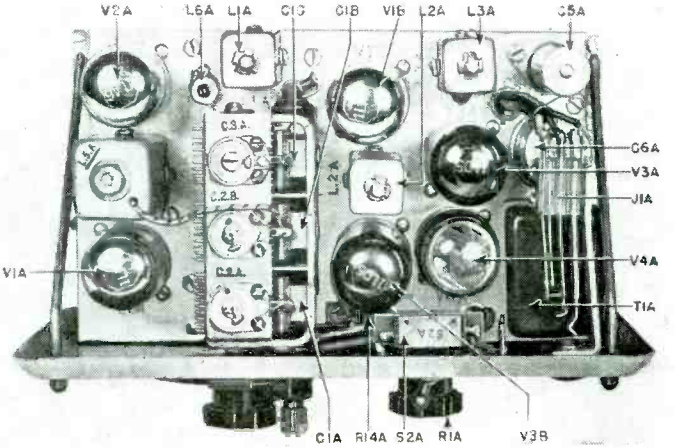
Two stages of audio amplification are used, to insure adequate audio volume, even at low percentages of modulation. Two output impedances are provided for either the high impedance American 'phones, or the low impedance British type. Automatic impedance selection is accomplished in the phone jack by taking advantage of the difference in phone plug lengths used with American and British phones.

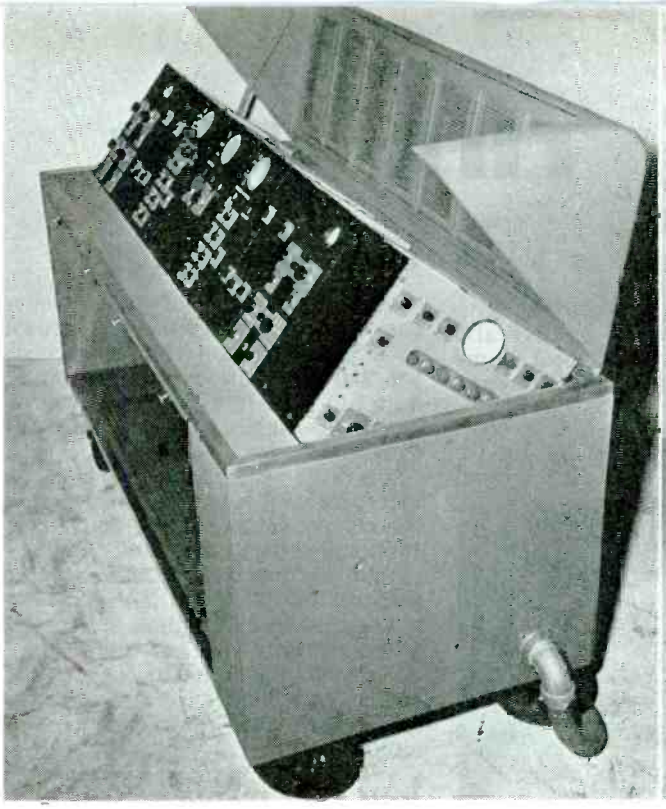
A group of measurements made

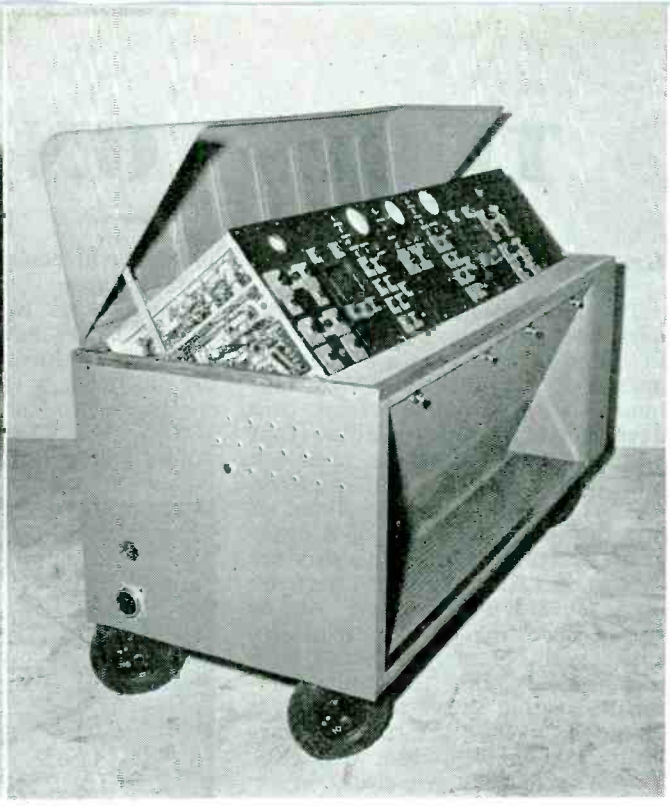
(*Continued on page* 130)

Top and bottom views of the transmitter chassis of the B48 Walkie-Talkie showing the general lay-out and identifying the various components in this portion of the equipment

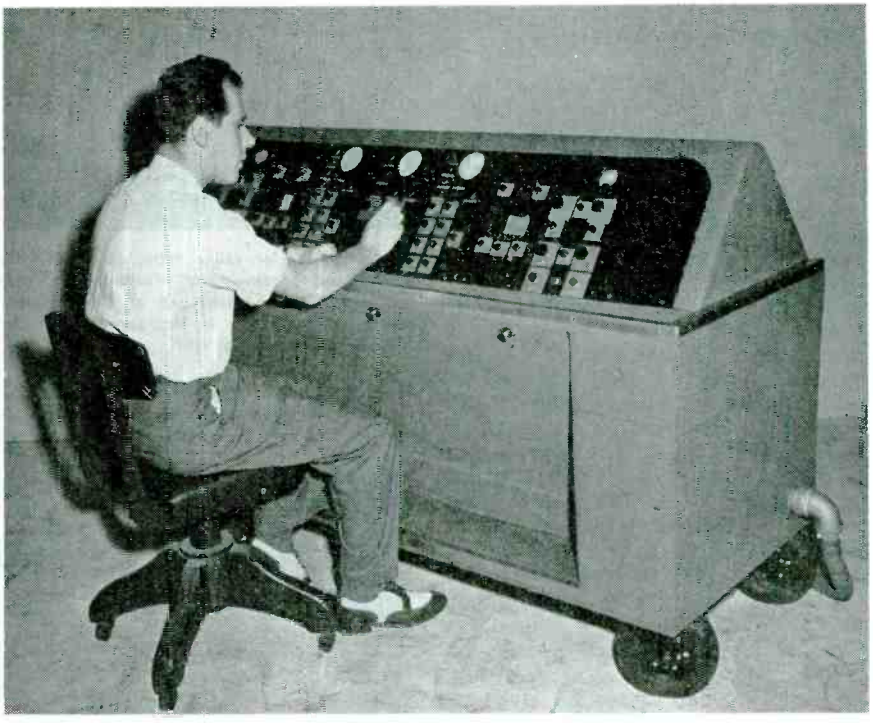






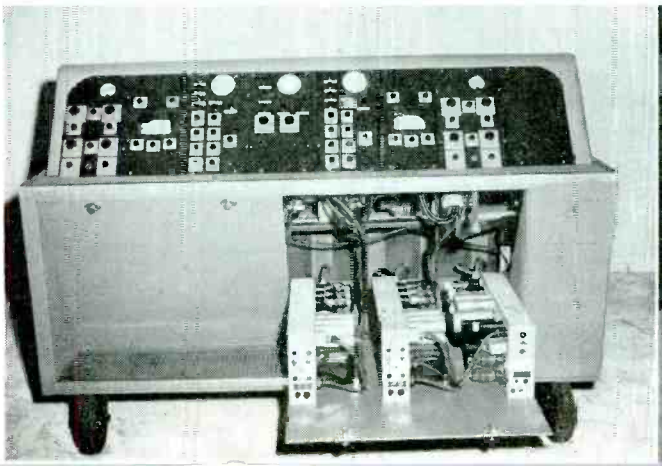


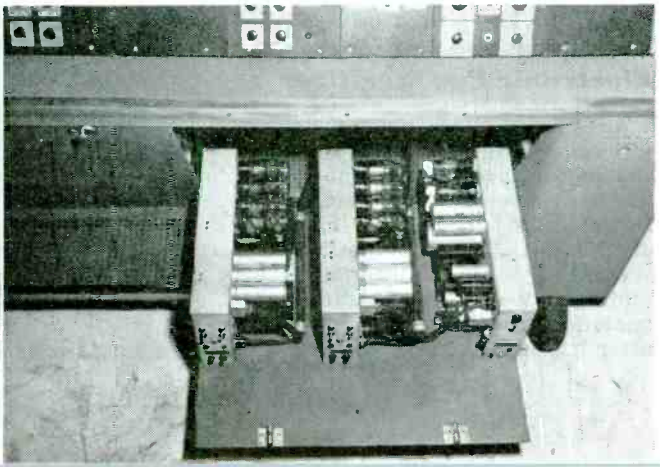
Mobile TELE Control



Something new in the realm of portable television control and monitoring equipment is Klaus Landsburg's "Telemobile." Landsburg is director of Paramount's television station W6XYZ, Hollywood, California.

The Telemobile combines all the control equipment necessary to operate two cameras, including synchronizing pulse generator, sweep signal generator, and monitoring units.





TUBES ON THE JOB

Grain Size Grading

To grade speedily metallic powders used by numerous industries in making pressed and molded parts Dr. P. F. Kalischer, Westinghouse research metallurgist, has developed a sorting machine that employs a glass tube, a photocell and light bulb and a milliammeter.

One gram of the specimen is mixed with 1/10th litre of acetone and a wetting agent. This mixture in a glass tube is mounted between photocell and light source. As the particles settle, more light passes through the glass tube to the photocell. By reading the milliammeter at regular intervals a plot is obtained showing the rate of clearing. This is compared with calibrations from known sizes.

Navy Electronic Applications Multiply

As an index of the growth in importance of electronic applications in our fleet, an interesting comparison recently came to light of the personnel engaged in planning the design, procurement, production, distribution, installation and maintenance of electronic equipment in the current war and in World War I.

At the time of the World War I armistice, the total staff of the then Radio Division which was established in 1910 numbered 75 officers and 25 civilians. As of April 1, 1945, the staff of the Electronics Division now under the direction of Captain J. B. Dow USN, has grown to 1160, composed of 459 officers, 487 civilians and 214 Waves. Just prior to December 7, 1941, the total division personnel number was 107. In other words, the present personnel is sixteen times as large as the World War I group, and over eleven times as large as the personnel in the period just before our entry into the war in 1941.

Electronic Egg Sterilizer

An electronic method of sterilizing eggs is under development at the Agriculture Experiment station of the University of California at Davis, Calif. University scientists claim that the new method will successfully kill all interior germs and foreign egg growth along with bacteria growth on the egg shell after but ten seconds exposure. The process will cook the egg hard in nine minutees.

The process is expected to give eggs a better keeping quality and a higher texture quality for home use in that a stronger albumen coating is produced.

SUPER RADAR TUBE

It was a special radar tube, like this, designed and produced by Westinghouse, that was used in the radar set at Pearl Harbor which gave warning of the approach of the Japs in December of '41

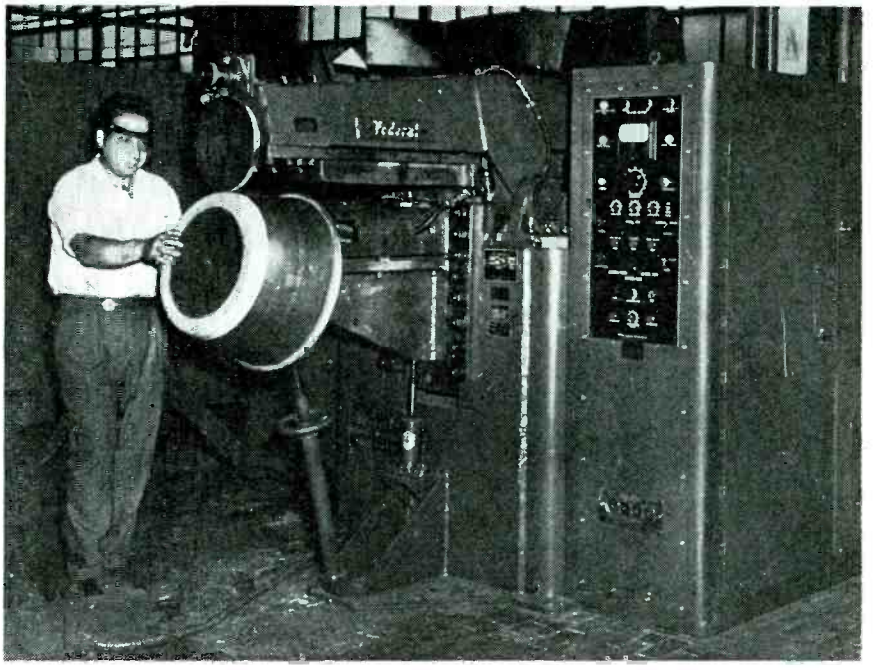
Speeds as high as 300 welds a second on .32 in. aluminum sheet are being made in production on this new type roll welding equipment

Electronic Output

Within a space of three years the electronic industry has grown to a point where it now exceeds pre-war production of automobiles and automobile equipment, points out the Business and Industry Committee for Bretton Woods, a nationwide committee formed to interpret and advance the Bretton Woods Agreements. From 1939 to 1941, the report continues, the electronic output was valued at approximately $300 million. By 1942, a volume of $1.5 billion had been reached, only to be more than doubled in the following years. The output just before recent military cut-backs was more than $4.6 billion.

Roll Spot Welder

Speeds as high as 300 welds per minute on .32 in. aluminum sheets are being obtained at the New Kensington plant of Aluminum Co. of America on this Federal welder. The Westinghouse electronic controls charge as many as 84-120 mfd capacitors (10080 mfd) from 1500 to 3000 volts with a peak demand of 100 kva on a three phase system. Each time this charge is "dumped" into the welder transformer, a weld is formed. The electronic controls for the capacitor discharge system assure the right amount of current for consistent welding results whether .032 in. sheet or .187 in. sheet is being put through the welder.



No Bubble—No Trouble!

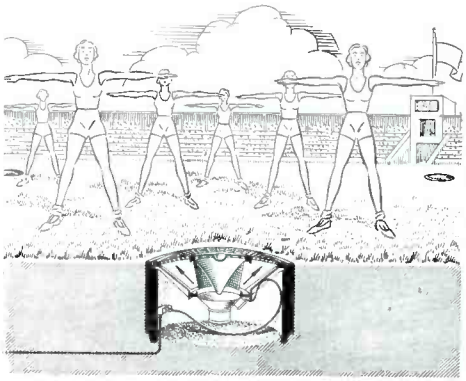
Marion Electrical Instrument Co., Manchester, N. H., has developed a new production vacuum checking apparatus — used to ascertain the perfect sealing of glass-to-metal 2½ and 3½ in. hermetically sealed indicating instruments. After the instruments have been sealed they are submerged in glass jars which are partially filled with alcohol. A vacuum of 25 in. is drawn and checkers watch for air bubbles which would indicate imperfect sealing. Spot checks for a period of four hours are made in a 29 in. vacuum.

Detectors Into Friskers

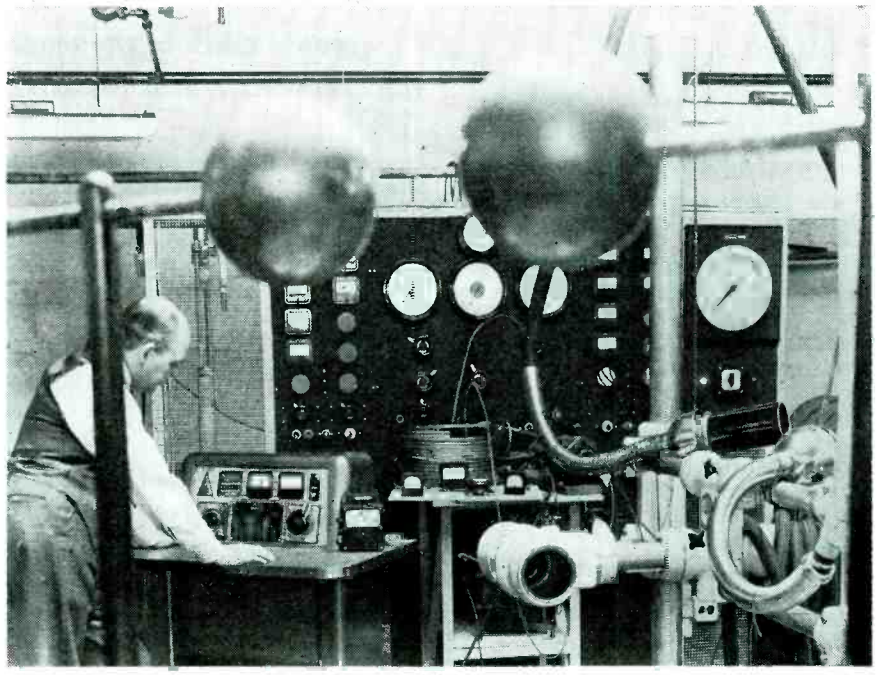
Returning GI Joes insist on bringing back in their luggage amazing relics in the form of live grenades and bombs, pistols and swords. As an aid to detection of such metal contraband before embarkation, all GI packs are now gone over with electronic "friskers," readapted from the electronic mine-locaters which played such a part at the front. And the mine locaters themselves were originally adapted from friskers used by FBI and police departments.

Underground Speakers

To obtain better sound distribution in large areas such as a stadium, loud speakers are being installed in concrete sub-surface mountings by German engineers. Advantages claimed by this scheme are infinite baffle area and more uniform sound distribution as well as lower costs than other types of installation.



HIGH VOLTAGE SPHERES OF INFLUENCE



This "sphere-gap view" shows a part of the new pilot-lab test panel in the Mount Vernon plant of North American Philips Co., where medical and industrial X-ray units are put through their paces. The sphere gap serves as a means of gaging the extremely high voltages used in part of the test routine

WIRED MUSIC INVADES THE GROCETERIA

Mrs. Joe Shopper walks into a food market, undecided whether to buy a can of salmon or a can of spamola for Joe's dinner. A dulcet voice in the offing warbles "The Fisherman's Song" and winds up with a commercial extolling the vitamins and calories lurking in the gizzards of the denizens of the deep. So Mrs. Joe buys a can of salmon.

This and other economic possibilities are latent in the surge of telephoned music which is exciting the moguls of mechanical melody in these parts. The idea is to pipe musical entertainment, judiciously mixed with commercial plugs, into markets, department stores, factories and other places where potential customers are wont to gather. Entertainment service, accompanied by plugs, is furnished free of charge, with the advertising sponsors footing the bills, as in radio.

Survey is under way in the Los Angeles area to feel out local merchants and manufacturers. As an example, the surveyors point with pride to the results in the Oakland, Calif., district, where approximately 50 chow markets are wired for entertainment combined with economic suggestions to housewives who are wavering between pickles and salad dressing.

Riveters' rhapsody

Several mechanical music units have been set up in defense plants, where the workers are given injections of melody every couple of hours to avert factory fatigue. Swank dress shops in Beverly Hills have adopted tuneful suasion, via platters, to attune the buyer to a $250 symphony in blue or mauve. Doctors' offices are being probed with the idea of installing wired music to fortify the patient against the rigors of the medico's drill or bill. Home installations are impracticable at present and will be for some time to come, with the telephone company controlling the wires.

Top company at the moment in this field is Muzak, with others breaking in. World Broadcasting and Transcriptions, parent company for Decca, and several other outfits are reported contemplating commercial as well as entertainment accounts, via wire, reports the publication "Variety."

SURVEY of WIDE READING

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

Tester for Plastic Windows

J. McG. Sowerby and W. H. Walton (Journal of Scientific Instruments, London, April, 1945)

The instrument was designed for use in the factory or industrial test room for the "pass-reject" testing of the optical distortion of small, transparent, domed windows molded from thin plastic sheets. The optical system (see figure) is so designed that the small central light stop cemented to the upper surface of the collecting lens intercepts all the light when the rays are sharply focussed.

The insertion of a perfect plastic window causes no appreciable deflection of the light beam as the rays are everywhere nearly normal to the surface. Thus the focus of the light on the stop is not impaired. A faulty window, whether the fault consists of non-uniform thickness or slight scratching, deflects the rays and the light beam is no longer completely intercepted by the stop. The deflected or scattered light is collected by the collector lens and is brought to a focus on the cathode of the photocell. The amount of light reaching the photocell is therefore a measure of the optical distortion of the window; faults which merely reduce the visual brightness can not be detected.

Constructional details of the optical arrangement are given. Particular care must be taken to maintain correct alignment of all optical elements.

Trigger and amplifier

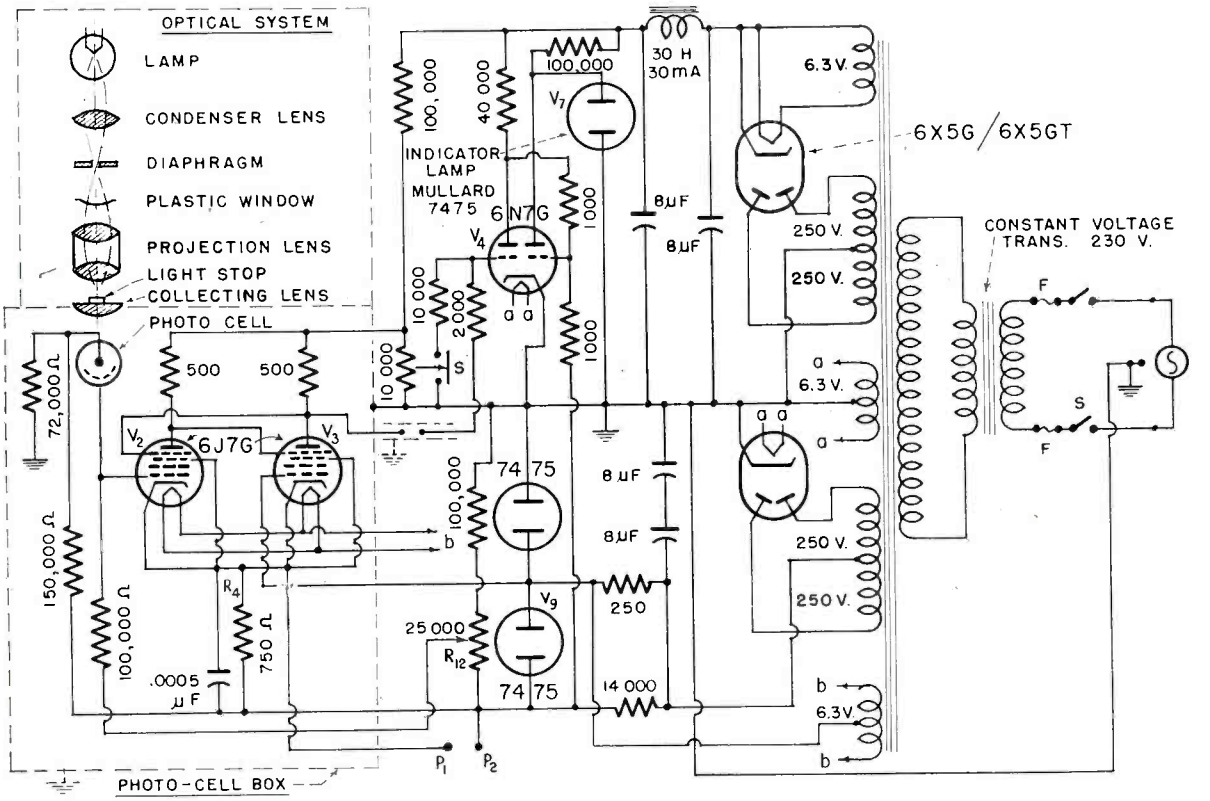
The two pentodes V_2 and V_3 form a trigger circuit having two stable states; they are controlled by the photocell current. Assume no photocell current and the slider of R_{12} at the potential of the negative voltage supply. Then the grid of V_3 is positive with respect to the grid of V_2 by the voltage drop across tube V_9 (about 100 volts) and this voltage appears across R_4 since the common cathode potential rises just above that of the more positive control grid. V_2 is therefore cut off and its control grid current is very low.

As the photcell is illuminated increasingly, the grid potential of V_2 approaches that of V_3, as soon as V_2 passes appreciable current V_3's screen voltage falls and V_2's rises. This is clearly a cumulative action so that V_3 cuts off and the current through R_4 is suddenly switched from V_3 to V_2 with consequent large voltage changes across the plate resistors. V_2 is left working approximately as a cathode follower so that a high grid leak is permissable and control is retained. When the illumination on the cell decreases and the potential of V_2's grid again approaches and falls below that the V_3, the trigger action is reversed.

The circuit is designed for comparatively low power input and is therefore especially suitable for direct operation from a photocell. The sensitivity can be adjusted by varying the slider of R_{12} which controls the photocell current required to operate the trigger.

When the trigger operates, the large voltage change at the plate of V_3 is amplified in the first sec-

Pass-reject tester for small plastic windows consisting of optical system, photocell, trigger circuit, amplifier and indicator lamp



tion of V_4 and applied to the grid of the second section of V_4 biasing it beyond cut-off. Previously this tube section was carrying current and the voltage across its cathode-plate space was considerably below the running voltage of the neon tube V_7 which was therefore extinguished. With the current through the second section of V_4 cut off, the voltage across V_7 is increased and its light indicates a failed window.

Spurious indications of bad windows due to operation of the trigger by the flanges of the windows while they are being placed in position on the instrument are prevented by the switch S. It grounds the grid of the first section of V_4, V_7 is lighted. Upon depression of switch S when the window has been correctly positioned, V_7 extinguishes if the window is acceptable and remains alight when it should be rejected.

Plug terminals P_1 and P_2 were taken out across R_4 so that on removal of V_3's heater supply, V_2 behaves as a linear current amplifier allowing the changes in photocell current to be indicated indirectly on a high resistance voltmeter applied across P_1 and P_2.

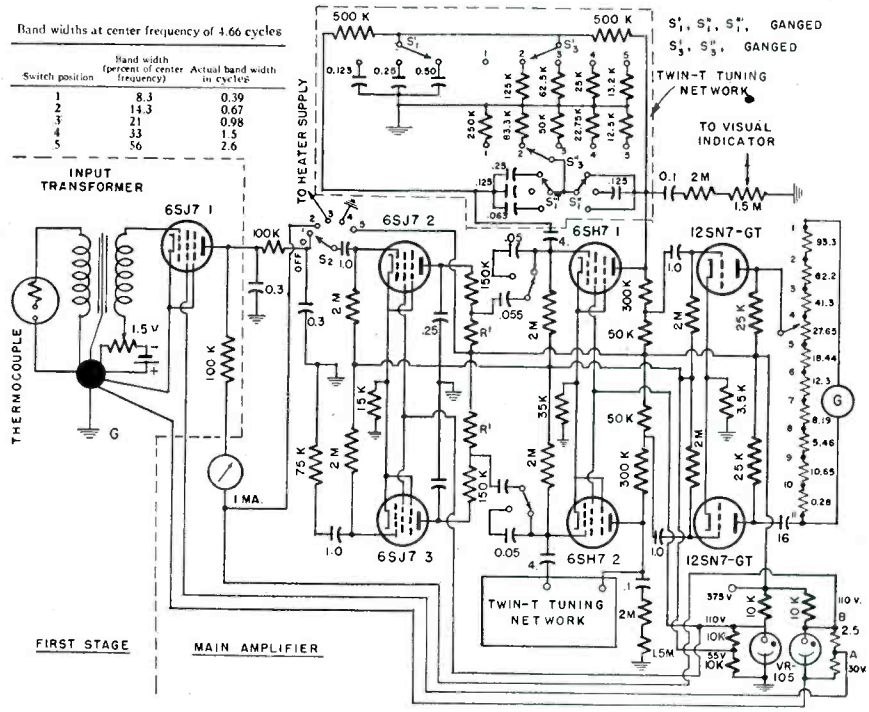


Fig. 1.—Circuit for measuring thermocouple output. Second push-pull stage incorporates two twin-T resistance-capacitance networks providing negative feedback to effect sharp tuning

Electron Trajectories in a Plane Diode

Leon Brillouin (Electrical Communication, Vol. 22, No. 3)

The following theorem regarding electron trajectories is proved: In a plane diode with hot cathode and space charge operated under arbitrary voltage variation as a function of time, electron trajectories never cross each other provided electronic emission on the cathode is continuous and the current does not become negative. Conditions for negative current are also considered. This theorem was based on some of the equations derived in a previous article "Transit Time and Space-Charge in a Plane Diode" (Electrical Communication, Vol. 22, No. 2) by the same author.

AC Amplifier and Voltmeter

L. C. Roess (Review of Scientific Instruments, July, 1945)

It is intended to measure the output of a rapid-response thermocouple in an infra-red spectrograph the incident radiation being interrupted at frequencies between 1 and 5 cycles. The low frequency amplifier and voltmeter designed for this purpose and capable of detecting 5.10^{-10} volt is described. The amplifier is sharply tuned to the interruption frequency and is required to have a very low inherent noise level below the thermal noise of the thermocouple resistance.

Amplifier

Careful selection from a large number of tubes will yield a few having an inherent noise level of 5.10^{-8} volt referred to the grid; such a tube was used in the first amplifier stage. The thermal noise voltages of low resistance thermocouples are of the order of 2.10^{-10} to 2.10^{-9} volt which is much less than the noise of the first tube, indicating the use of a carefully designed input transformer if maximum sensitivity is to be attained.

In order to balance out any effects of fluctuations in the plate and screen supply potentials, the main amplifier following the first stage is connected in push-pull. This connection also permits the use of an unbypassed common cathode resistor in each stage introducing an appreciable amount of negative feedback. No loss of gain of the out-of-phase signal voltage results from its use, but a considerable loss of gain does occur for all voltages, such as plate supply voltage fluctuations, which reach both grids of a given stage in phase. The presence of the cathode resistor tends to equalize any unbalance in signal voltages at the grids of the individual tubes of each push-pull stage. This behavior makes it possible to feed the output of the first stage, which is single-ended, to the push-pull main amplifier without introducing a special phase inverter stage.

The two twin-T resistance-capacity networks connected to provide negative feedback from the plates to the grids of the second stage of the main amplifier, produce an effect equivalent to the introduction of sharply tuned resonant circuits. The amount of negative feedback increases rapidly from zero to a large value as the frequency is changed from the center or resonant frequency so that the grid to plate gain is reduced from about 350 at this frequency to about unity for frequencies somewhat larger or smaller. The sharpness of tuning depends upon the gain available between the points across which the feedback network is connected. Various experimental results for different positions of switch S_3 are given in the table at the top left-hand corner of figure 1.

By means of switch S_1 it is possible to tune the amplifier to 1.2,2.4, or 4.8 cycles. Amplification at higher frequencies, particularly at 60 cycles, is reduced by the resistance-capacitance networks shunted across the plate circuits of the first two amplifier stages.

The 12SN7-GT output tubes were chosen because they have the high mutual conductance necessary to couple the output of a voltage amplifier to a low impedance galvanometer. The entire swing of the

(Continued on page 166)

AIRLOOP ANTENNA

A new development in loop antennas for broadcast receiving sets combines high performance with low cost mass production and good physical appearance. This loop, a photo of which is shown in Fig. 1 is made of sheet copper on a punch press machine at rates far exceeding anything possible through wire-winding technic. The manufacturer* claims that thirty complete units can be made per minute, not only formed with terminals but attached to the back which forms a complete part of the radio receiver.

Sheet copper is fed into the press along with the material which is to be used as the back for the receiver or to hold the loop. The die on the press shears the copper sheet into a pattern which forms a continuous spiral from the outer edge around to the innermost end. The die having a "V" shape forces the copper ribbon which is sheared from the sheet into an inverted "V" cross-section as shown in Fig. 2.

At the same time the copper is sheared into this "V" cross-section it produces the necessary spacing between adjacent turns in the loop and acts to lock the loop to the backing material. In the locking of the sheared copper strip to the backing material, no additional cement or binding is necessary.

The loop illustrated in Fig. 1, has 34 turns and an inductance of 166 microhenries. The quality or Q of this loop over the broadcast band is given by the curve in Fig. 3.

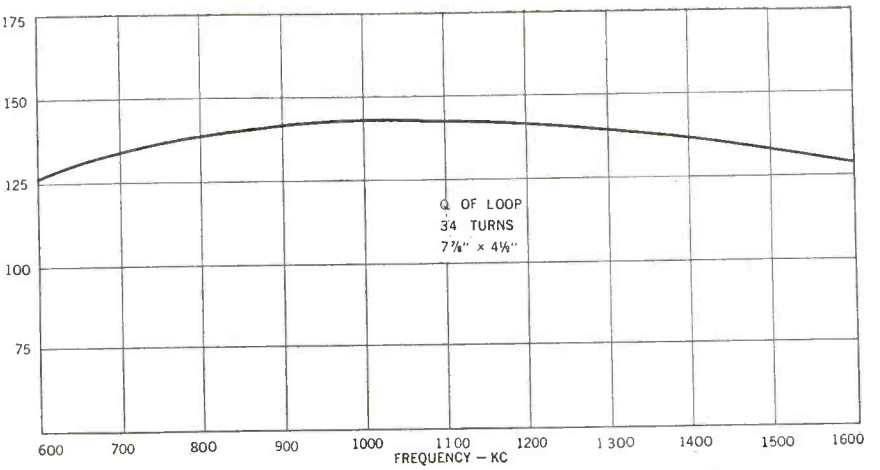


Fig. 3—Q characteristic for isolated loop in Fig. 1 over broadcast band range

The maximum area of the square "Airloop" is more than 27 per cent greater than old type oval flat wound loops. Since loop pick-up is proportional to turns x Q x area, this means that for a given space the air loop will have 27 per cent better pick-up than a flat oval loop, assuming the winding space for each loop to be the same. Effective areas are in the same ratio for the same width of winding.

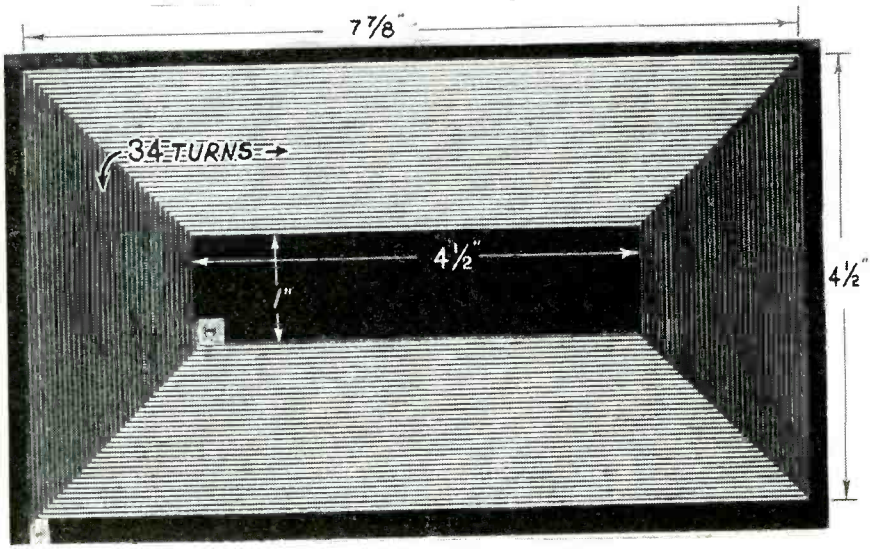
In the formation of the loop by a press method, the insulation between adjacent turns is primarily air. This is caused by the forcing of the copper sheet into the "V" formation which brings the adjacent surfaces of the turns up above the back sheet. Thus the backing sheet does not behave so much as a dielectric material as if it were between adjacent turns. The losses in the loop and the resulting Q are only slightly different for high grade insulating material than for common material such as press-boards, etc. Where the electric field is greater between adjacent turns, the only insulation is air, thus producing relatively high Q.

The large effective area of the conductor and the close spacing along with the minimum of insulation gives this loop its Q characteristics. Its mechanical rigidity makes is possible to have a greater permanence in the alignment of small broadcast sets using this type of antenna. The stiffness of the conductors and freedom from the use of cement means that a higher degree of stability in tracking in the tuned circuits is possible. Only 5 per cent reduction in Q after subjecting to 100 per cent humidity for 24 hours is claimed by the manufacturer.

For a Q of 75, the "Airloop" permits a saving in cabinet depth of ⅜ in. permitting lower cabinet cost, with no sacrifice in performance under that of a good quality solenoid loop. Conversely, for a given cabinet depth, better performance (Q) results from replacing the solenoid loop with the "Airloop." This is shown in Fig. 4.

*A. W. Franklin Company, New York City.

Fig. 1—Photograph of typical loop antenna, die formed from sheet copper, for small broadcast receivers



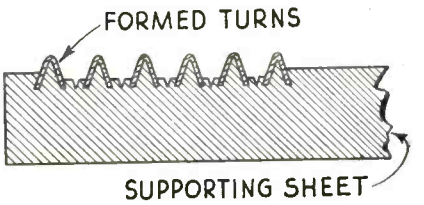
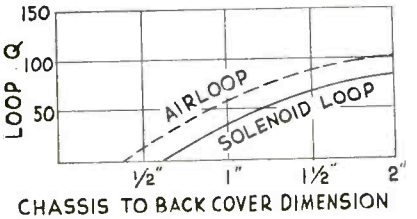


Fig. 2—Cross section of turns formed by die

Fig. 4—Comparison of Q for distances to chassis and loop types



NEW INSTANT-HEATING BEAM TETRODE

Ruggedized 2E25

FOR MOBILE OPERATION

Developed for Signal Corps portable, mobile, or emergency communications equipment, the 2E25 r.f. beam tetrode is easy on the battery. The thoriated tungsten filament permits simultaneous application of filament and plate potentials. Precious battery power is conserved during standby periods.

Completely shielded for r.f., the 2E25 requires no neutralization even at its maximum frequency of 100 megacycles. Other features are: low-loss octal base, plate connection to top cap, filament potential centered at 6.0 volts, and extremely rugged construction.

Consider the advantages of the 2E25 as an instant-heating replacement for the 6V6GT or 6L6G in older equipment, or for use in modern equipment such as the new Kaar mobile FM set illustrated. Remember, the versatility of the 2E25 beam tetrode simplifies the spares problem; this one type can power a whole transmitter—R.F. and A.F. Order your engineering samples today.

HYTRON 2E25

Instant-Heating 15-Watt R.F. Beam Tetrode

TENTATIVE ELECTRICAL DATA

Filament Potential	6.0 ± 5% ac or dc volts
Filament Current	0.80 amp.
Plate Potential	450 max. dc volts
Screen Potential	250 max. dc volts
Grid Potential	−125 max. dc volts
Plate Current	75 max. dc ma.
Plate Dissipation	15 max. watts
Screen Dissipation	4 max. watts
Grid Driving Power (Class C)	0.5 watt approx.
Power Output (Class C)	20 watts

AVERAGE DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate (with external shielding)	0.18 max. mmfd
Input	8.5 mmfd
Output	6.0 mmfd

MECHANICAL DATA

Maximum Overall Length	4 3/16 inches
Maximum Diameter	1 7/16 inches
Bulb	T-11
Cap	Small metal
Base	7-pin med. short shell low-loss octal

The New 2E25 Supersedes and Replaces the HY65

New instant-heating mobile FM transmitter developed by Kaar Engineering Co. uses 7 Hytron 2E25 and 2 Hytron HY69 or HY1269.

ARMY NAVY

WRITE TODAY to Dept. 10 for these: New Hytron transmitting and special purpose tube catalog; 21 x 17 inch sheet illustrating Step-by-Step Assembly of Typical Hytron Tube.

OLDEST MANUFACTURER SPECIALIZING IN RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

NEWS OF THE INDUSTRY

Airline to Spend $10,000,000 for Radio

Indicating potential markets for airline communications and electronic equipment, United Airlines, Chicago, has let it be known that this organization plans to invest about $10,000,000 for voice and telegraph signalling apparatus and meteorological aids. Among other equipment, United plans on:

1. Airway traffic monitors, operating on the radar principle, which would enable airway and airport traffic control centers to maintain a visual watch on planes in flight.
2. Automatic position recorders giving pilots exact location information.
3. A radio-impulse device warning pilots of the presence of other planes in the immediate vicinity.
4. Automatic landing devices.
5. A radio means of making automatic written recordings, aboard planes in flight, of information transmitted from ground stations.

Aireon Adds Two

Aireon Mfg. Corp. has expanded still further in the radio electronic field through the purchase of two Chicago companies manufacturing speakers, microphones and other accessories. These are the Oxford-Tartak Co. and the Cinaudagraph Corp.

VHF for B & O

Marking one of the first railroad uses of very high frequency communication equipment, the Baltimore and Ohio railroad has placed an order with the radio division of the Bendix Aviation Corp. Most of the equipment will be installed in the railroad's New Castle (Pa.) yards.

Radio-Radar Museum

There ought to be a Federal national war museum of radio and radar, suggests the advertising committee of Radio Manufacturers Association. Chairman John S. Garceau of the advertising committee plans to present the matter at the next RMA board of directors meeting. Such a museum would include a complete display of radio and radar military equipment of historical character. Plan would be to include discarded and battle-scarred equipment used in historic battles.

Conventions and Meetings Ahead

Society of Motion Picture Engineers (J. Haber, Hotel Pennsylvania, New York City), 58th Semi-Annual Fall Conference, October 15, 16, 17, Hotel Pennsylvania, New York City.

The Instrument Society of America and the Carnegie Institute of Technology (Chairman Dr. B. R. Teare, Jr., Department of Electrical Engineering, Carnegie Institute of Technology, Pittsburgh 13, Pa.), Educational Conference on Instrumentation, October 16, 17, 18, Pittsburgh, Pa.

Electrochemical Society (Colin G. Fink, Columbia University, New York City), Electronics Division, October 17, Philadelphia.

Optical Society of America (A. C. Hardy, Massachusetts Institute of Technology), October 18, 19, 20, Hotel Pennsylvania, New York City.

Institute of Radio Engineers (330 West 42nd Street, New York City), Old Timers Night, November 8, Hotel Commodore, New York City.

Rochester Engineering Society (O. L. Angevine, Hotel Sheraton, Rochester, N. Y.), Rochester Fall Meeting, November 12-13.

Institute of Radio Engineers, Annual Winter Technical Meeting, Hotel Astor, New York, January 23-26.

Emerson Acquires Radio Speakers

Emerson Radio & Phonograph Corp., New York, has acquired Radio Speakers, Inc., Chicago. The company has for many years been one of the large producers of radio speakers. For the past four years, the company has been engaged in war production.

Heating Lab

A laboratory specializing on rf heating problems is soon to be opened for the benefit of west coast Westinghouse clients, at Los Angeles. The equipment includes a 20 kw generator for induction heating and a 5 kw generator for capacitive heating. Dr. R. A. Neilson is in charge.

DuMont Exec. Sees High Video Payroll

Television broadcasting stations will have a total national payroll of more than ten million dollars in the next three years, Paul E. Carlson, merchandising manager of Allen B. DuMont Laboratories Inc., told the graduating class of War Industries Training Program at commencement exercises held in New York City recently.

His prediction was based on existing payroll figures taken from presently operating stations, and multiplied by the number of applications for new video stations now being processed by FCC.

Three Video Applications

Three applications to set up commercial television stations at Pittsburgh and Lancaster, Pa., and Dallas, Texas, were filed with the Federal Communications Commission this month.

The Pittsburgh application was filed by Allen B. DuMont Laboratories Inc. of New York City. DuMont's application asks that the Pittsburgh station be allowed to operate on Channel No. 2. The New York firm has applications pending before FCC for stations at Boston and Washington, D. C.

The Dallas application was filed by the Times-Herald Publishing Co., Dallas, Texas, and asks for Channel No. 2. WGAL Inc., Lancaster, Pa., asked for television Channel No. 4 in Lancaster.

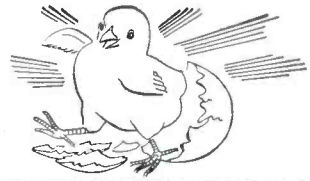
Echophone Receivers

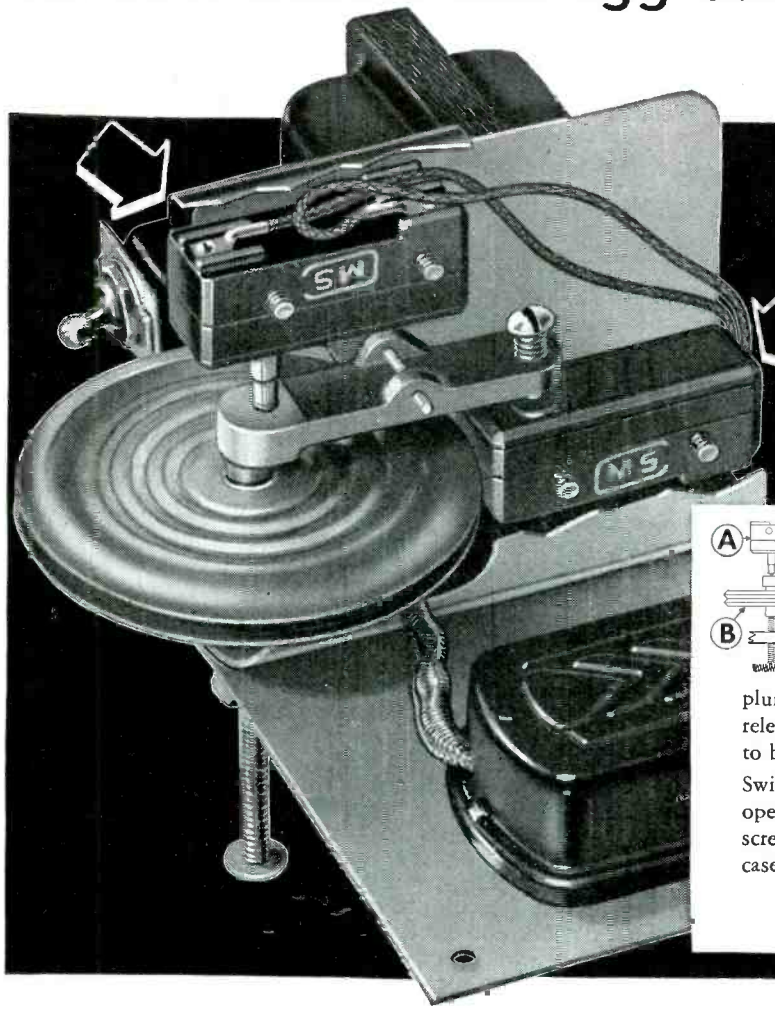
The Echophone division of the Hallicrafters Co., Chicago, is going into the home receiver market with a line of console combination models, featuring AM, FM and short-wave reception. These will be built to receive on the new 88 to 106 megacycle FM band, and will carry the Echophone brand name.

Universal's Nite Lite

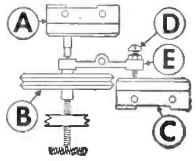
Universal Microphone Co., Inglewood, Cal., has formed a new division for the manufacture of a tiny neon night light. The lamp, of 1/25th watt capacity, is of the plug-in type, plastic encased in an attractive transparent housing and may be used on either ac or dc. Trade name of the product is Robolite.

Here's where the egg came first





MICRO SWITCH
SNAP-ACTION
Helps bring the chick



Here is how it works

Switch "A" is held in an open position by the pressure of liquid filled bellows "B" against the spring plunger. If temperature falls, the bellows contracts and releases the pressure on switch "A" which causes current to be switched on.

Switch "C" is an auxiliary pin plunger type switch, also operated by bellows "B". It is actuated by adjusting screw "D" on lever arm "E" and is operated only in case expansion of the bellows fails to operate switch "A".

Incubators for hatching poultry eggs depend on constant, precise regulation of temperature. Deviation of as little as half a degree, if long sustained, means loss of an entire setting.

That is the reason the Reliable Incubator and Brooder Company of Quincy, Illinois, selected Micro Switch snap-action switches as the monitors to insure the even temperature on which the success of their products depends.

Reliable Incubator and Brooder Company provides two switches as an additional safety check. Should lightning strike the line and cause the switch points to fuse together, a second standby switch will take over. The overtravel plunger on the main switch permits further expansion of the bellows to operate the standby switch and at the same time operate an alarm bell.

This application makes excellent use of the small, compact size of Micro Switch products and their ability to handle up to 10 amperes of current at line voltage without the use of relays.

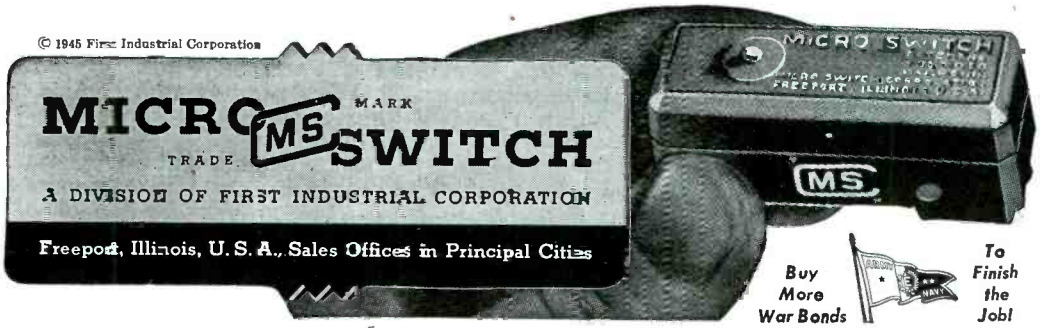
Because of their long life and rugged dependability, designers and engineers in almost every branch of industry are using Micro Switch snap-action switches for limits, safeties and interlocks. A full line of housings and actuators make them applicable under all conditions where a tiny, precise, completely accurate switch is required to handle substantial amounts of power at line voltage.

Your engineers should know all about Micro Switch controls. Send for as many copies of Handbook-Catalog No. 60 as you need. If you are designing for aircraft, send for Handbook-Catalog No. 71 also. Write today.

MICRO MS TRADE MARK SWITCH

A DIVISION OF FIRST INDUSTRIAL CORPORATION

Freeport, Illinois, U.S.A., Sales Offices in Principal Cities



Buy More War Bonds

To Finish the Job!

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.

WASHINGTON

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

OCTOBER TO BE STARTING POINT—Wrangling over postwar price levels for receivers (end-equipment) and tubes and parts with the OPA economists and attorneys occupied the radio-electronic manufacturing industry leadership during much of September. But the time was not seriously wasted, although there was some delay in set production due to the price controversy. However, actually, the industry had to occupy itself largely with the tasks of redesigning of the civilian home receivers, components and tubes and the difficult and huge assignment of settling the military contracts, inventorying, determination of armed forces' surplus and other "cleaning-up" duties resulting from the end of war.

CIVILIAN PRODUCTION STILL DRIBLETS—Because the parts manufacturers were dissatisfied with the OPA price levels, only 5 to 10 per cent of the orders of end-equipment manufacturers were filled in September and tube manufacturers with a similar unsatisfactory price determination generally confined their output to limited quantities mainly for design, except that maintenance-repair tubes with the quotas and M-R markings removed flowed into retailers in larger quantities. During the latter part of October and November and December, provided the price ceilings were acceptable, the industry promised to place by the end of the year on the civilian market anywhere from 2 to 4 million receivers.

TRANSMITTER PRODUCTION—In the case of broadcasting station transmitters, the FCC's assignment of FM frequencies in the new bands to the new stations created a temporary confused situation, but during October when most of the new station applications are to be processed through the Commission, FCC officials anticipated production of FM transmitters will get under way. However, except for one big company's pledge of earlier production, it will take about 6 months for the delivery of the higher-power FM transmitters.

FOREIGN TRADE PROSPECTS BRIGHT—Radio-electronic equipment bulks big among major items of foreign nations sought from the United States, according to a canvass by Electronic Industries' Washington bureau of embassies and legations of leading foreign nations. Much of the apparatus to be purchased in the United States will be financed through loans by Uncle Sam's Treasury through the Export-Import Bank and other American governmental agencies. Russia (which will pay its own cash) has a substantial radio expansion program in its new 5-Year Plan; China has a most ambitious plan for covering its vast areas with radio-communications and broadcasting stations, the cost to run into hundreds of millions of dollars; France and Turkey likewise contemplate substantial purchase of radio equipment; and several Latin American countries have announced similar plans. The Army and Navy radio stations throughout the world gradually will be declared as surplus and sold generally to the foreign nations where they are located; UNRRA will also consume much of this military surplus, planning to use radio apparatus in such communications-sparse countries like Jugoslavia.

MILITARY SURPLUS FLOOD IN U.S. SOON—Disposal of the Army and Navy surpluses is becoming more and more of a thankless task; and some of the original RFC officials realizing this have returned to former assignments out of the Surplus Property Board. However, the plan of President Truman for the single Surplus Administrator (Symington, Lincoln Electric President who knows something of radio equipment problems), instead of the three-man board, has led to the creation of some order out of the previous chaos. Radio-electronic surpluses also were placed under a single top SPB official, Deputy Administrator Schwartz. The alignment of the industry's end-equipment, parts and tube manufacturers as authorized disposal agents for the surpluses has laid the firmest possible foundation for the handling of the excess Army-Navy equipment and components which during the last months of the year are expected to flow in greatly increased quantities.

AVIATION INDUSTRY PLANS HUGE ELECTRONIC PROGRAM—The blueprint for the U. S. Aviation industry and the Civil Aeronautics Administration transition of radio and electronic communications-navigation systems to VHF was plotted in final shape during the last week of September by the Radio Technical Commission for Aeronautics, headed by Bureau of Standards' able radio chief Dr. J. H. Dellinger. Aeronautical Radio, Inc., the cooperative radio organization of the airlines, coordinated the planning for the latter and the FCC aided in freeing the aviation frequencies, held by the military services during the war, for civilian usage. Manufacturers can anticipate an aviation program of many millions of dollars. Example: United Air Lines alone plans a $10 million expenditure in next few years.

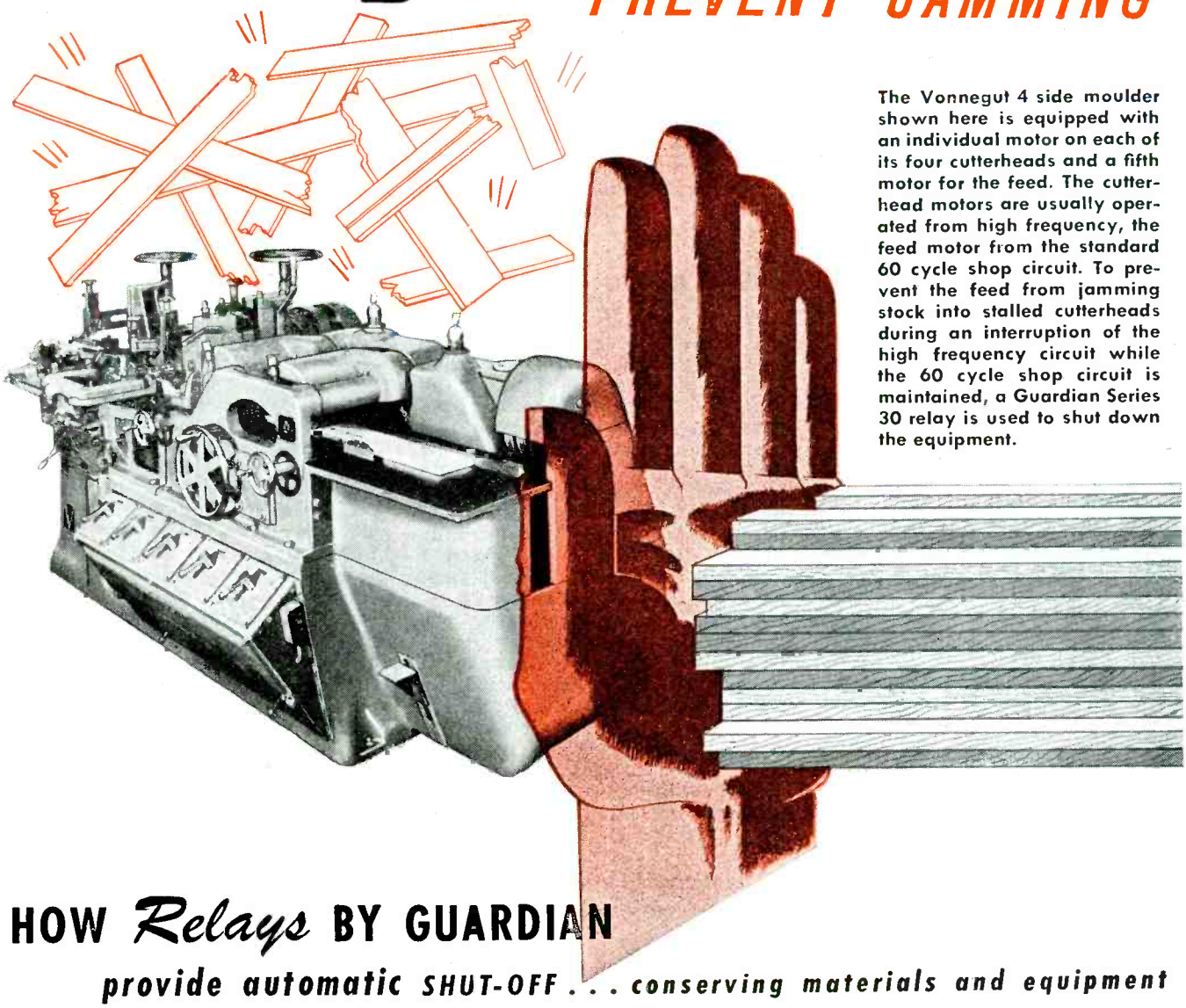
CONGRESSIONAL TRENDS—"Reconversion" session of Congress presents two most significant issues for our industry—wages and full employment legislation and proposal for a National Research Foundation. Too much of a swing to a greatly-shortened work week with maintenance of high wartime wages will kill chances of nation's reconversion and, even though left-wing government officials and labor union leaders advocate this, Congress is felt certain to keep an even balance of economics. The National Research Foundation which President Truman assures will not compete with private enterprise research does offer threat that the comparatively small Federal sums proposed in this venture would mushroom to huge amounts if pressure groups in the scientific world launched drives for allotments.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

relays IN MACHINE CONTROL

PREVENT JAMMING



The Vonnegut 4 side moulder shown here is equipped with an individual motor on each of its four cutterheads and a fifth motor for the feed. The cutterhead motors are usually operated from high frequency, the feed motor from the standard 60 cycle shop circuit. To prevent the feed from jamming stock into stalled cutterheads during an interruption of the high frequency circuit while the 60 cycle shop circuit is maintained, a Guardian Series 30 relay is used to shut down the equipment.

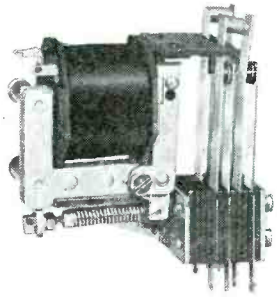
HOW *Relays* BY GUARDIAN

provide automatic SHUT-OFF . . . conserving materials and equipment

Wherever two or more independent sources of power are utilized to perform one operation, the failure of one power source presents a hazard to safety, materials and equipment. In such places Relays by Guardian are often employed to interrupt all other circuits when one circuit fails.

The Vonnegut 4 sided moulder, built by the Vonnegut Moulder Corporation of Indianapolis, uses a Guardian Series 30 relay in this application. This is a quiet, dependable relay with a laminated field piece and armature, a large contact switch capacity, and a wide operating range. It is available for operation on any frequency between 20 and 150 cycles.

But whatever your relay application may be, it will pay you to write. If you describe your application when writing, Guardian engineers will make recommendations.



Series 30 A.C. Relay

Also, iron clad and laminated solenoids, stepping relays, magnetic contactors, electric counters, snap and blade switches.

GUARDIAN ELECTRIC

1622-L W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

DEVELOPMENTS IN THE FM FIELD

FCC's FM Rules

The most important issue among the rules and regulations formulated for FCC for governing FM broadcasting was the assignment of additional channels to the northeastern section of the United States. The number of available channels for the heavily populated New England area was raised from 170 to 180 by taking over the 2 mc from the 106 to 108 mc band heretofore reserved for facsimile broadcasting which now moves up to 470 to 480 mc.

This action gives the New England section as many rural and metropolitan FM stations as there are AM metropolitan stations at the present time (either high or low power). In addition, there will be spectrum space for 30 per cent more community FM stations than there are existing AM stations in that category. Generally speaking, sixty channels have been allocated for metropolitan and rural stations having a power of 20 kw and a 500-foot antenna. Twenty channels have been assigned to the small community stations which will have 250 watts of power and 250-foot antenna. The remainder of the nation will have 70 channels for metropolitan and rural stations, and 60 channels for community stations.

Other rules promulgated are:

1. FM stations will be licensed for an unlimited time and during the initial period of existence the new station will be required to operate a minimum of six hours per day.

2. No rule was set up concerning the time element for program duplication.

3. No. person may own more than one FM station in the same community, and no person may own more than one FM station in separate communities except on proper showing and in no event may one person own more than six FM stations.

4. No rule has been made regarding the ownership of an FM station by an AM station owner.

5. AM chain rules will apply to FM.

6. Sharing of antenna sites will be required when no comparable antenna site is available. The FCC feels that this rule will prevent any station operator from sewing up a market area by the control of an antenna site.

7. No rules regarding booster stations. The FCC points out that applications for booster stations will be considered on their individual merit.

8. The Commission is not reserving any future channels for FM at the present time.

9. FM stations will be permitted to transmit facsimile during the hours they are not on commercial broadcasting.

HF FM By '46

FCC's recent notice to the six FM license holders to be ready to go into operation in the new 92 to 108 mc strip by the first of the year, and to start field tests on the new assignments by December 1, is interpreted as an attempt to speed up the change over from the old to new spectrum positions. The holders of the seven construction permits so far issued must be ready to start field testing by January 1 and to enter operation by February 1 under new assignments.

Of the 500 FM applicants, the FCC pointed out that licenses will be granted, along with permission to operate at a lower power than the license stipulates, until equipment is more easily obtainable. However, applicants are requested by the commission to submit a complete statement on transmitter location and antenna site within 30 days.

FM Communication for Bus Services

Permission of the Federal Communications Commission to equip up to 100 intercity buses with FM two-way radio communication and to operate a central control transmitter is being sought by Intercity Bus Radio, Inc., a division of the National Association of Motor Bus Operators, Chicago. The experiment is being undertaken by the Greyhound Corporation in cooperation with several other intercity bus lines running into Chicago. Unless delays are encountered in the granting of licenses, the complete system will be in operation within 90 days.

The tentative plans, which are expected to lead to the development of a nationwide system of two-way radio communication on highway buses, provide for the operation of a 250-watt central transmitter in the Chicago Loop. The buses will be equipped with 50-watt transmitters, combined with receivers. Greyhound plans to install the radio sets on buses of four of its lines—Pennsylvania, Central, Northland and Illinois—running into Chicago. Similar equipment is expected to be placed on the coaches of several other operating companies. In addition, there will be three relay receiving stations located in outlying sections of Chicago.

Jett Advises AM-FM Radio Sets

Radio listeners were advised by Federal Communications Commissioner E. K. Jett, in a recent radio speech, to buy combination AM-FM sets when the new models appear on the market.

Declaring that the speed with which FM broadcasting develops will depend on "how rapidly you, the listeners, accept this new method of program transmissions," Commissioner Jett said:

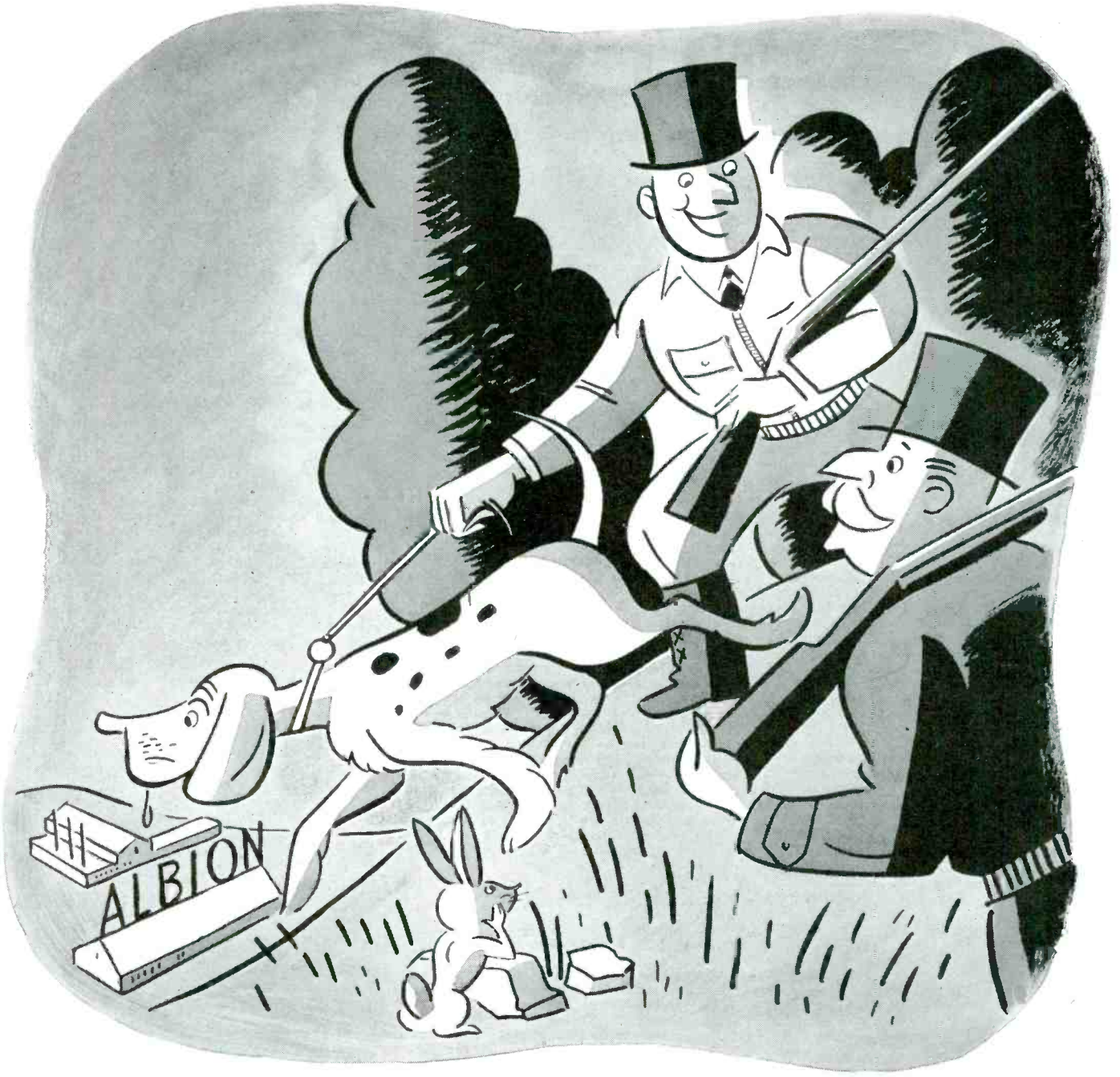
"During the transition period from AM to FM most of the receivers offered for sale to the public will incorporate both systems of broadcasting. The added cost for the FM feature will not be great—perhaps no more than you have been accustomed to pay for the short-wave international broadcasting range in your existing pre-war receiver. It is, therefore, to your advantage to obtain a combination set which will receive both AM and FM when the new models appear on the market. If your present receiver is in good condition you may wish to consider purchasing an FM adapter, or a receiver capable of FM reception only."

Commissioner Jett predicted that within four or five years after civilian production is resumed "at least half of the homes of America will be equipped to receive FM broadcasts." In metropolitan areas, he said, "FM eventually will replace local and regional AM reception." However, he added, the high-power clear-channel AM stations "must be retained throughout the years to serve rural audiences which cannot get good reception from FM stations."

Tubes in 1946 Sets

Tube complements to be required in the new 1946 radio sets with FM bands and television reception, as compared to pre-war sets, are estimated by Raytheon's L. K. Marshall as:

	Number of Tubes
Pre-war radio set in $50 retail price range	6- 8
Comparable new set with FM band	8- 9
Low-cost television set	18-20
High-quality television set with FM band and record changer	25-30



"CONFIDENTLY, SMITHERS, BOSCO IS A COIL HOUND. HE SHOWS US WHERE WE CAN GET ALL THE COILS WE NEED"

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

WHAT'S NEW

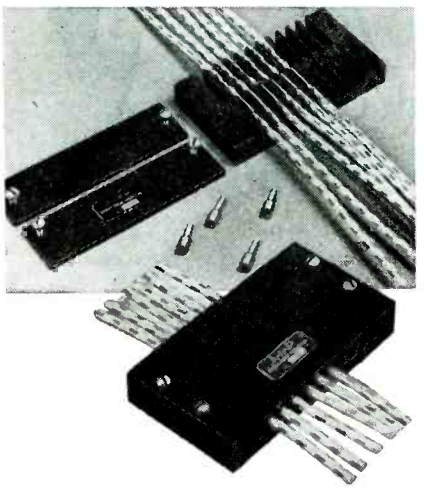
Devices, products and materials the manufacturers offer

Circuit Breaker

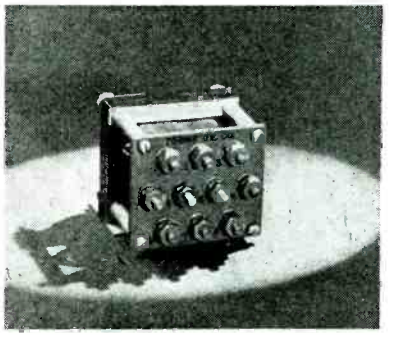
A new double pole circuit breaker, designed for service on 230 v ac or 250 v dc, 50 amps maximum, is being manufactured by the Heinemann Circuit Breaker Company, 137 Plum Street, Trenton, N. J. Unit may be connected either front or rear, will carry full load continuously, and has instantaneous trip at eight to ten times full load. It also has a selection of three time delays, any one of which may be specified. Overall dimensions are: 5¼ in. long by 2 1/16 in. high and 2 in. wide.

Solderless Connector Strips

Connector strips using knife switch disconnect terminals, are being manufactured by Aircraft-Marine Products, Inc., 1591 D No. 4th St., Harrisburg, Pa. Two types are available: (1) Illustrated. The single-width strip adapted for use with the AMP preinsulated splicing terminal which requires no insulation sleeving. The knife switch part



of the permanent member extends outside the strip and connection and disconnection are made without removing the cover of the assembly. (2) The double-width strip in which the disconnect ends are enclosed, locked and insulated by the cover, one-half of which is independent of the other half. Disconnection is made by unscrewing only one half of the cover to expose the connections. Special stacking screws with threaded heads make it possible to permanently stack a series of AMP strips with the cover screwed on top. The strips can accommodate any desired number of connections. Any combination of adjacent members may be electrically connected.



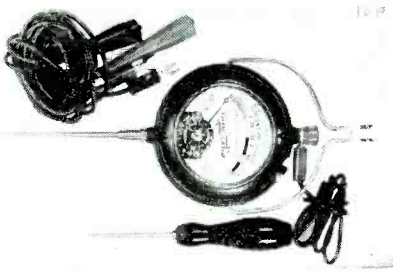
Aircraft Transformers

Two new 115-volt, 400-cycle, single-phase transformers, designed to operate 6-volt aircraft-instrument lights, are being manufactured by General Electric's Specialty Transformer Division, Schenectady 5, N. Y. With an output capacity of 30 volt-amperes, either of these units permits simultaneous operation of 25 lamps at full brilliancy. One of the transformers is provided with taps which facilitate the preselection of any desired light level within the unit's range of 6 to 1.74 volts. The taps are so arranged that each successive voltage reduction approximately halves the previous candlepower output of the lamps. Taps are not provided on the other unit, but any desired light level can be maintained by using a potentiometer. Both transformers are light in weight—the tapped unit weighing 1 lb. and the other 0.8 lb.—and were designed for convenient mounting and connecting. The mounting clamps are protected against corrosion and the terminal boards are constructed of vibration and shock-resistant material.

One-Piece Fastener

A new one-piece fastener assembly, which does not require nuts or receptacles, has been developed by the Simmons Fastener Corp., Albany, N. Y. Self-adjusting to compensate for various material thicknesses within the range of the fastener, the fastener locks and unlocks with a quarter-turn in a 90 degree clockwise rotation, or can be

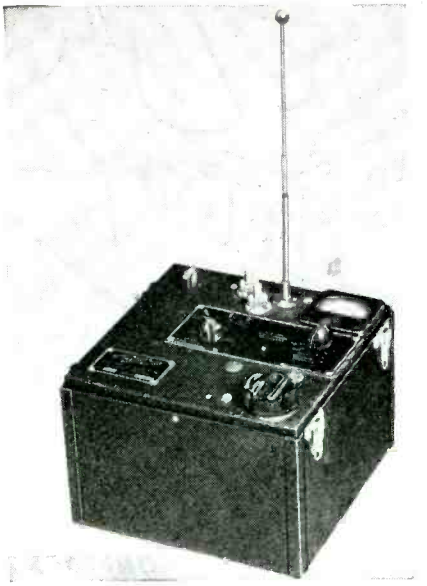
permanently installed for use as a blind rivet. Standard size fasteners are ⅛ in., 5/32 in., 3/16 in., ¼ in. and 5/16 in. The range of material thicknesses go from nothing to 3/16. in. total on the largest fastener.



Hydrometer Substitute

The Hickok Electrical Instrument Co., 10528 Dupont Ave., Cleveland 8, Ohio, has developed a unit that indicates electrically the equivalent gravity of lead-acid storage batteries. The Chargicator unit gives instantaneous measurement of battery condition, and shows what charging rate to use, either for trickle charging or for a safe, high rate charge. Also indicated are the percentage of charge, and over-charging danger. Weak or defective cells are readily spotted. A large 4-color scale is used. All models are sealed within molded acid-proof bakelite cases and are not affected by weather or temperature.

Checking Oscillator



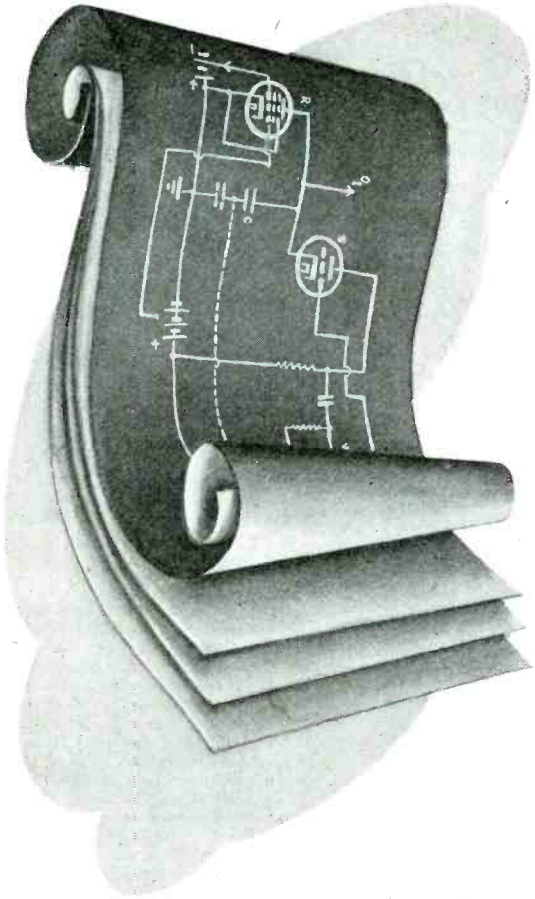
Type 291 is a portable, battery operated oscillator especially and primarily designed for checking HF aircraft radio receivers. As such, all features and equipment not relating to checking aircraft receivers have been omitted, resulting in a specalized, good quality checking oscillator at low cost. This new instrument has a frequency range from 49 to 154 megacycles with modulation frequencies of 70, 90, 400, 1300, and 3000 cycles. It contains an easily extended, collapsible antenna and two coaxial terminals for low and high level output. Maker is Andrew Co., Chicago 19, Ill.

Dynamic Mike

Universal Microphone Co., Inglewood, Cal., has reissued its prewar KD dynamic microphone for home recording, industrial call systems and public address systems. Frequency response is 50-7500 cycles per second; output level 63 db below one volt per bar; impedance 40,000 ohms. The KD is finished in deep bronze plating; includes 10 ft. rubber covered cable.

Specialized Knowledge and Equipment for

UHF DESIGN



● The phenomena encountered in the UHF field are in many cases so decidedly different from those true of lower frequencies that many manufacturers find themselves in urgent need of specialized UHF knowledge, in order to develop equipment that will handle certain specific conditions.

● Since we are specialists in UHF engineering, we are equipped not only to render technical advice, but also to follow through in the actual production of equipment in our shops.

● Of necessity, during the war period, our efforts have been concentrated largely on Army and Navy work. Now that peace is with us, we have adequate time to devote to civilian requirements. We invite discussion of any problems you may have in the UHF field.

U H F

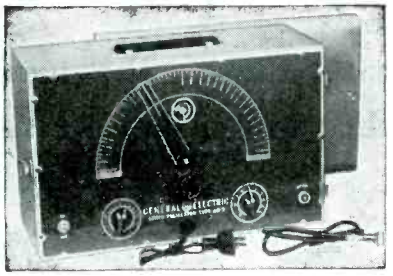
Lavoie Laboratories

RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

Specialists in **The Development of UHF Equipment**
and in **The Manufacture of UHF Antennas**

Resistance Limit Bridge

A resistance limit bridge (LB-3) working to plus/minus .1 per cent is being manufactured by Industrial Instruments, Inc., 17 Pollock Ave., Jersey City 5, N. J. The bridge has high and low limit dials covering a range of plus/minus 11 per cent in .1 per cent steps, and uses a sensitive built-in galvanometer to provide for the high and low indication, respectively.



Audio Oscillator

A new beat frequency audio oscillator, Type AO-2, has been developed by the Specialty Division of the General Electric Company's Electronics Department, Schenectady, N. Y. The unit has been designed to simplify the measurements of audio amplifiers and radio receiver fidelity. Using full vision and making possible direct calibration, the unit provides a stable sine wave, continuous variable frequency from 25 to 15,000 cycles per second. The panel control knob regulates the output level from zero to full power output. A Type 6E5 Electron-ray Tube is used to indicate zero beat while adjusting the panel control knob to obtain the proper relationship between the two high frequency oscillators. The maximum output is 120 milliwatts on the cathode follower type output impedance coupling circuit.

Regulated Power Supplies

A new series of saturable reactor regulated power supplies has been developed by the Amplifier Co. of America, 398 Broadway, New York 13, N. Y., for all applications requiring dc voltages regulated to better than 5 per cent from full load to no load, and having less than 1 per cent ripple under full load conditions. Included in this new series are the following standard power packs, which may be supplied with built-in automatic voltage regulators: 24 v ½ amp; 24 v 2 amp; 48 v 1¾ amp; 48 v 5 amp; combination 24 and 48 v 750 mil; 36 v 1 amp; 110 v 8 amp; 120 v 200 mils; 135 v ½ amp; 250 v .4 amp; 500 v 200 mils. Power packs employing heavy-duty rectifier tubes are provided with built-in thermal time delay relays which apply plate supply voltage approximately 30 seconds after rectifier filaments are heated. All power packs are equipped with recessed male receptacles, female outlets, power line switch, pilot indicator and fuse.

Thermoset Plastic

A new non-flammable thermoset plastic with high optical and electrical properties, good resistance to abrasion and high resistance to oils and greases and most chemicals, including acids and alkalies, has been developed by the B. F. Goodrich Chemical Co., Cleveland. The new material has been named Kriston. Kriston monomer is a somewhat viscous, water-clear, anhydrous liquid having a specific gravity of 1.25 and can be cast in simple molds. It sets to a hard, heat-resistant plastic. No water or other volatile products are released during the polymerization, making easy the preparation of dense, non-porous articles. Shrinkage during polymerization is substantially lower than that of any other known material of the type.

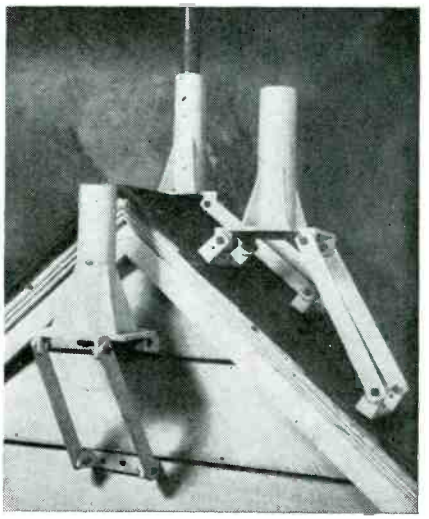
Kriston polymer has a refractive index of about 1.57. This is higher than most optical glass. The material can be made into a water-clear plastic or made in a wide range of colors which can be transparent, translucent or opaque. In its cast state, Kriston is odorless, tasteless, nontoxic, and dimensionally stable. After molding it can be worked on standard machining and polishing equipment.

Colortone Mikes

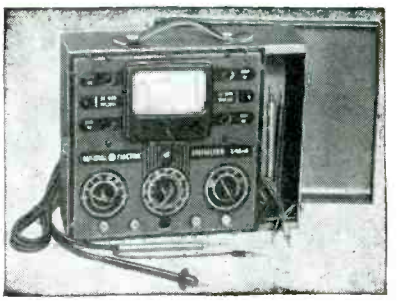
Inspired by the growing demand for color harmony in modern living, business and entertainment, the Turner Co., Cedar Rapids, Iowa, is introducing a new line of crystal and dynamic microphones in color, styled by Arthur C. Haggstrom, noted industrial designer. The material selected for the "Colortone" cases is a tough, resilient cellulose acetate. These plastic castings can be produced in a wide variety of rich, gem-like colors, including solid colors and pastels, mottles and striated effects.

Antenna Mount

A mount for FM and television antennae is being manufactured by Shur-Antenna-



Mount, Inc., 272 Sea Cliff Ave., Sea Cliff, N. Y. The unit will fit any roof top, and is suited for all types of surfaces. It will sustain the weight of any fixed standard FM or television antenna array.



Multirange Instrument

A new multirange instrument, Type UM-4 Unimeter, has been developed by the Specialty Division of the General Electric Company's Electronics Department, Schenectady, N. Y. The new device is equipped with special jumbo test prods and has a wide coverage of ranges. On dc it operates from 0 to 10,000 volts at 20,000 ohms per volt. On ac it ranges from 0 to 10,000 volts at approximately 5,000 ohms per volt. Direct-current ranges extend from 100 microamperes to 10 amperes in six steps and resistance measurements are provided from 3,000 ohms to ten megohms in five steps.

Cooling Cabinet

A cold cabinet has been developed by the Precision Scientific Co., 1750 N. Springfield Ave., Chicago 47, Ill., for use from —90 deg. F. to + 220 deg. F. The unit uses dry ice. A 7-pane sealed window unit prevents condensation and frosting, and makes the apparatus under test readily visible at all times. A shielded fluorescent light prevents direct and indirect glare. Thermal losses are kept at a minimum by completely insulating the inner wall from the outer wall. An air stirrer, in the specimen chamber holds the temperature constant ± 1 deg. F. A blower circulates the air to and from the chamber. Metal plates 4 in. wide, the height of the chamber, are centered on each side, in the rear, and on the top, to provide facilities for mounting the test apparatus from any of these positions. Cabinet is available in 2 sizes: 1 cu. ft. capacity and 8 cu. ft. capacity. The 1 cu. ft. box is 53 in. high, 26 in. wide, 26 in. deep. The capacity of the dry ice trays is 15 lbs. The 8 cu. ft. box is 73 in. high, 39 in. wide, 39 in. deep. The center of the test chamber, which is 24 in. x 24 in. x 24 in. is located at an operating height of 48 in.

SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

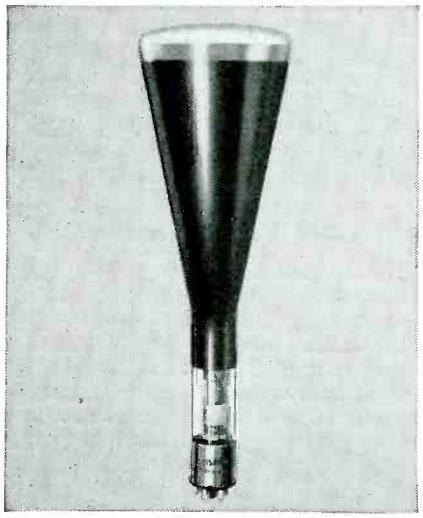
OCT. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945

SYLVANIA CATHODE RAY TUBES NOW AVAILABLE

Ready for New Television Sets To Be Produced

Sylvania Electric announces the welcome news that cathode ray tubes are once more available for the manufacturers of television sets.

Constant research in this field, combined with wide experience in large-scale production to meet war requirements, has placed Sylvania in a position to manufacture these tubes to a much higher standard than ever before.



Sylvania Electric precision-built cathode ray tube now available to television set manufacturers.

This is an important factor to manufacturers of television receivers whose "plans" are rapidly becoming realities.

Check today with Sylvania Electric Products Inc., Emporium, Pa.

MANY MANUFACTURERS TO USE ELECTRICALLY SUPERIOR TUBE

Sylvania Lock-In Radio Tube Ideal For FM, Television, Radar

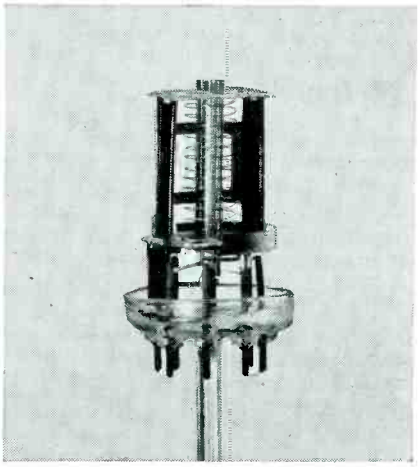
With the increasing trend toward higher frequencies—as shown by recent FCC decision assigning FM the band between 88 and 106 megacycles—set manufacturers will tend, more than ever, to use a tube ideally suited to the adoption of these very high frequencies.

The Sylvania Lock-In is *known* to be electrically and mechanically superior to any tube made.

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.

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.

Today, set manufacturers considering the many developments in the field of communications, are looking to the Sylvania Lock-In Tube as a perfect electronic unit—the tube built to handle ultra-high frequencies.



The Sylvania Lock-In Tube showing construction—electrical and mechanical—that makes it superior to any tube made.

SYLVANIA ELECTRIC

Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

★ TELEVISION TODAY* ★

New Developments in the Video Field

CBS Color Plans

Some additional light has been let in upon Columbia Broadcasting Company's shortly-to-be-inaugurated television experiments at high frequencies. Some time ago it was announced that CBS had authorized Federal Telephone and Radio Corp. to produce a new transmitter to operate between 480 and 500 mc that it is now expected will be installed in New York's Chrysler building and ready for operation some time in December. Meantime, General Electric has authorization for another transmitter which it is stated may be installed either in Chicago or Hollywood, both locations having been applied for to FCC.

According to present CBS plans, experimental transmissions of both color and high definition black and white pictures will be started in New York as soon as the transmitter installation is completed. For the present no change is contemplated in the CBS fundamental method of transmitting color through the medium of a rotating disk. The disk itself has been considerably improved, is understood to be somewhat smaller and to operate silently. At the same time, work is progressing on the design and construction of several types of receivers which will be suitable for the reception of both color and black and white.

"Television City"

Three television studios, to be operated in conjunction with Dumont's New York station, will be installed in the John Wanamaker department store in New York City. Plans call for taking over of 500,000 cubic feet of store space to build a virtual "Television City." The installation will include one giant studio measuring 50 x 60 ft. with a 50 ft. ceiling and two smaller studios, a teletheater, and art and property rooms.

The large studio will be equipped with four cameras while the two smaller studios will handle three and two cameras respectively. The three studios will be separated by soundproof walls and doors to permit simultaneous use of the three, even though one may be on the air.

The department store television production center will offer larger accommodation facilities for live audiences than any other television station in the country. A balcony above the studio floor will seat 400 visitors and a platform around the balcony will handle 200 standees. A glass wall at the rear of the studio will permit shoppers to watch daytime and evening rehearsals and broadcasts.

50 Kw for W6XAO

Don Lee television system, Los Angeles, will replace its present 2 kw W6XAO on Mt. Lee with a 50 kw station on Mt. Wilson, elevation 5800 ft. The present site will be used for relay and studio purposes. The new equipment was ordered from General Electric Co., before the surrender of Japan. W6XAO (KTSL) has been on the air since December 1931 under the engineering direction of Harry R. Lubcke. In addition to fulfilling war contracts there have been fortnightly broadcasts of live and film shows during the past 3 years. Mt. Wilson has also been selected as the site for at least five other television stations to be erected in the Los Angeles area.

DuMont HF Tele

Allen B. DuMont Labs., Inc., is preparing to invade the 480-920 mc band recently assigned by FCC for experimental video work. The company has been granted permission to construct a portable-mobile station with a peak power of one kw, visual and aural.

Educational Video

Television as a medium of education will have its first tryout this fall in a series of experiments to be conducted by three institutions of learning—the New York Board of Education, Chicago Board of Education and Syracuse University.

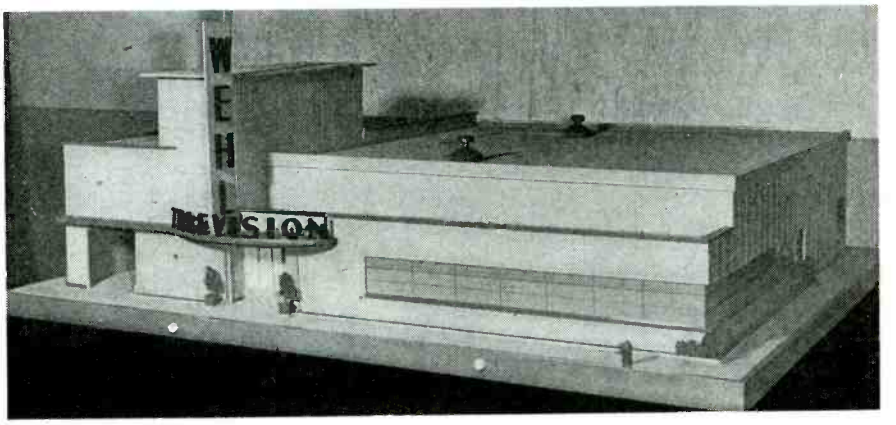
The New York test was scheduled to start as soon as school resumed and be conducted in conjunction with the National Broadcasting Co. The experiments were to originate at NBC's television outlet WNBT and be received by specially installed large screen receivers in classrooms in various schools throughout the city.

The Chicago tests are scheduled to start in sixty days and will originate at television station WBKB in Chicago. The tests scheduled for Syracuse University students are to be conducted in conjunction with General Electric. The University's plan calls for lecturing on laboratory experiments by television.

Futuristic Video Station

The television station of the future may be a structure of streamlined beauty following the latest architectural trends. At least that is the vision of Allen B. DuMont Laboratories, whose engineers have constructed a six foot model of the coming video station as part of Toledo, Ohio's "Toledo Tomorrow" exposition.

The model has a removable top which allows views to look inside. The interior of the miniature is complete to the smallest detail, including studios, control rooms, transmitter rooms. Studios have accommodations for forty guests.



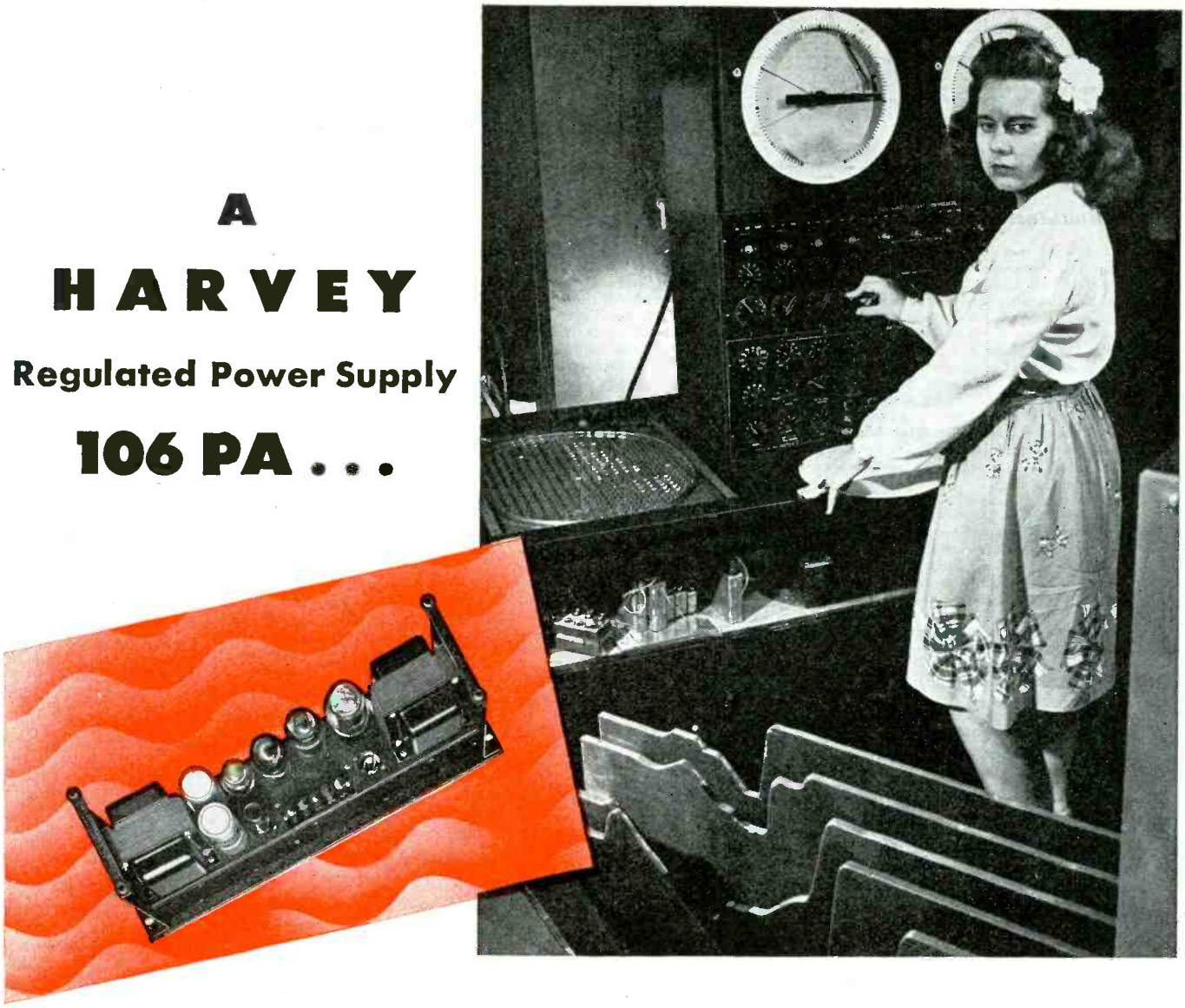
DuMont Laboratories drew the plans and specifications for this streamlined, futuristic video station. It represents the last word in the efficient arrangement of studios and equipment

*Title registered U. S. Patent Office.

A HARVEY

Regulated Power Supply

106 PA . . .



Helps RECORD A SUBTERRANEAN RESERVOIR'S REACTIONS

This Petroleum Reservoir Behavior Analyzer, developed by a major oil company, is used to analyze the behavior of petroleum reservoirs and predict the future performance of these reservoirs under arbitrarily assumed conditions of reservoir control. It makes automatic computations in a matter of minutes that would take a dozen mathematicians several months.

A *HARVEY Regulated Power Supply 106 PA* like the one pictured plays an important role in the operation of this amazing device. To perform efficiently, the Analyzer must have a constant source of static-free regulated power. The HARVEY 106 PA has proven a dependable, controllable source of this power.

The *HARVEY Regulated Power Supply 106 PA* provides laboratory D.C. power between 200-300 volts. Operates from 115 volts A.C. . . . output remains constant even though line voltage varies between 95 and 115 volts. Ripple content is better than 10 MV . . . two separate filament voltages available, 6.3 volts, 5 amps. each . . . parallel operation possible making 6.3 volts at 10 amps. available.

If you operate equipment requiring a constant source of laboratory D.C. power — pulse generators, amplifiers, measurement equipment, constant frequency oscillators and the like — you should have complete information on the HARVEY 106 PA on hand. Write for HARVEY Regulated Power Supply Bulletin H-25 today.

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NEW PATENTS ISSUED

Pulse Modulation

It is proposed to transmit short pulses separated by comparatively large spaces, and to modify the relative timing of successive pulses in accordance with the modulation voltage. Thus, if successive pulses are numbered 1, 2, 3, 4, 5, etc., one polarity of modulation potential moves pulses 1 and 2, 3 and 4, 5 and 6, etc., closer together but moves pulses 2 and 3, 4 and 5, 6 and 7, etc., further apart by an equal amount (see diagram at lower right-hand corner). Reversing the modulation potential will reverse the time displacements of successive pulses. There is no change in average pulse rate.

By operating the communication system of the invention so as to transmit short pulses separated by relatively long spaces, the following desirable results are achieved: (1) Higher peak power and much higher frequencies than would otherwise be possible because of limitations due to heating of the transmitter tubes, (2) an improvement of signal-to-noise ratio in view of the fact that the receiver is responsive only during time periods which may be occupied by the transmitted pulse, and (3) a degree of secrecy in signaling.

When the pulsing tubes in the transmitter circuit become non-conductive simultaneously, the power source potential is applied to the transmitter. With no modulation applied, one or the other of the pulsing tubes passes current at all times except when the input from the constant frequency source is near the zero value. For near zero values both tubes are simultaneously cut off and a short current pulse at relatively high potential is passed into the transmitter. These pulses are uniformly spaced.

Modulation produces a variation in the bias potential of both grids in opposite directions, drawing alternate pulses together; reversal of modulation potential polarity will cause the pulses to be pushed apart, as illustrated in the figure.

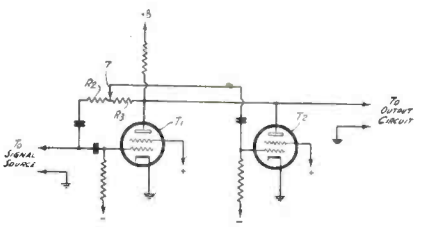
The receiver incorporates two pulsing oscillators similar to those used to produce sawtooth potentials in television receivers, each adjusted to 7,500 cycles. They are provided with a common plate resistor for the purpose of making them tend to operate substantially 180 deg. out of phase. The received pulses are utilized to synchronize the operation of the pulse oscillators and, obviously, alternate received pulses are automatically effective in controlling the timing of each oscillator. When a received pulse advances the time of tripping of one oscillator, it retards the time of tripping of the other. In effect, the received pulses modulate the phase or timing of oscillations of each pulse oscillator but not the oscillation frequency; they vary the average current through the tubes. Once the oscillations have dropped into synchronism with the received pulses, the average plate current will be modulated by the pulse modulation. This current provides the useful output for the headphone or a recorder.

C. W. Hansell, RCA, (F) November 29, 1940, (I) July 10, 1945, Nos. 2,379,899 and 2,379,900.

Amplifier Circuit

It is the object of the invention to eliminate harmonic distortion in an amplifier output without reducing its gain. For this purpose, the grid of tube T_2 is coupled to point 7 which is at zero signal potential with respect to the signal voltage but which is at an appreciable potential with respect to the distortion voltage so that tube T_2 amplifies the distortion voltage exclusively. Its output is combined with the output of amplifier tube T_1, the combined output containing no distortion voltage; the signal voltage amplitude is not affected by the addition of tube T_2.

The value of R_2 plus R_3 is made sufficiently large so that no appreciable negative feedback occurs between the grid and plate of T_1. The relative magnitudes of resistors



R_2 and R_3 are so dimensioned that at the junction point 7 the signal voltages from the plate and the grid compensate one another, or R_3 is equal to R_2 times the amplification factor of tube T_1; no signal voltage will then be applied to tube T_2.

Assume an amplifier with a gain of 10 and 10 per cent distortion. If approximately 1 per cent distortion is desired, conventional feedback calls for a 10 to 1 reduction in amplifier gain. However, by inserting tube T_2, the lower level of distortion may be attained without materially reducing the original gain.

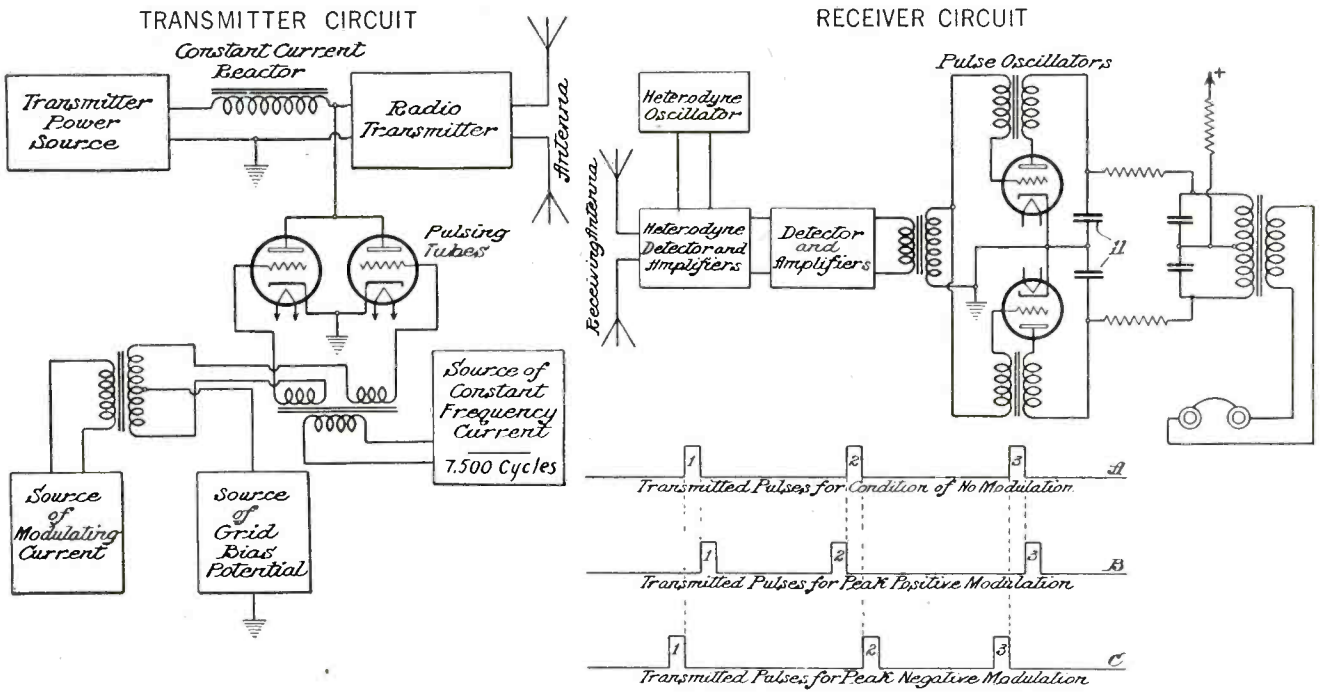
J. R. Ford, RCA, (F) October 13, 1943, (I) July 3, 1945, No. 2,379,699.

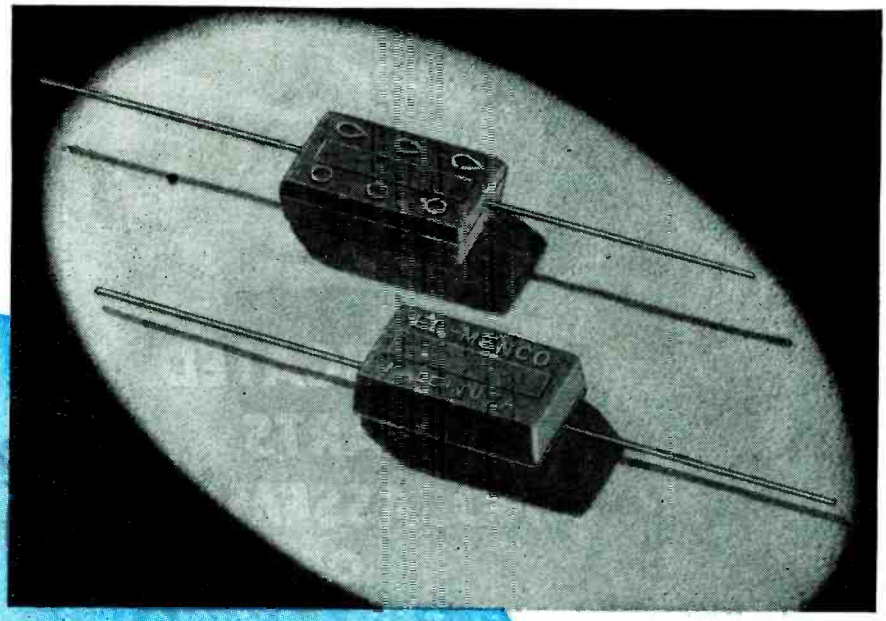
Mine Detector

The circuit was designed to indicate the presence of metallic objects buried underground. Tube L_1 is connected as a generator feeding 1,000 kc oscillations to the primary of transformer M and to the search coil circuit. The secondary of transformer M and the search coil circuit provide voltages across the two diagonals of a Wheatstone bridge formed by the secondary of transformer M, resistors R_2 and R_3, and dry rectifiers D_1 and D_2; this part of the circuit acts as a phase discriminator.

If the search coil circuit is at resonance, the two voltages in the phase discriminator

(*Continued on page* 194)





Trifles

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BRITISH WALKIE-TALKIE

(*Continued from page* 108)

on a typical receiver are given in Fig. 3. Curves of receiver rf selectivity and audio fidelity are shown in Figs. 4 and 5.

The transmitter is a master oscillator, power amplifier type, tuning the same range as the receiver. The circuit is shown in Fig. 6. The master oscillator utilizes both electron coupling and frequency doubling. The control grid and screen grid section of a 1A5GT operate as an oscillator at 3 to 4.5 megacycles, and the plate circuit tunes from 6 to 9 megacycles, selecting the second harmonic of the oscillator. This type of oscillator was found to be extremely stable because of the buffer action of the plate circuit. Single tuning control is achieved by ganging both the oscillator and plate tuning condensers.

Power amplifier

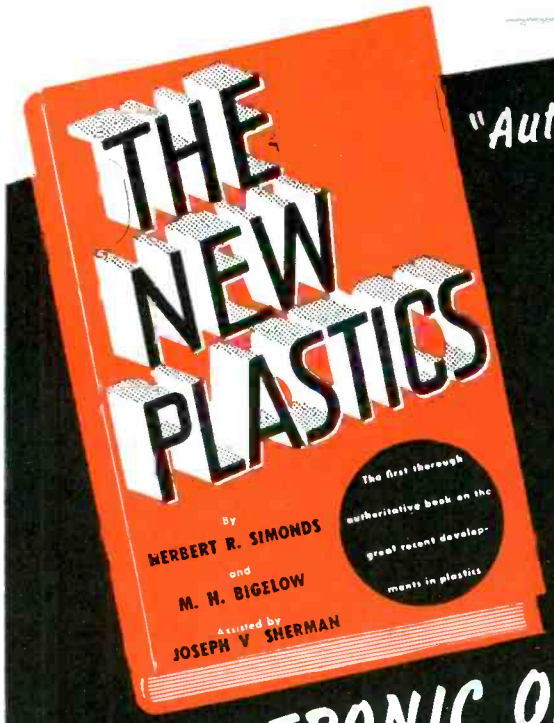
The power amplifier consists of two 1299 tubes connected in parallel. Two tubes are needed to meet the power output specifications. Parallel operation rather than push-pull was used to simplify the buffer and tank coil construction. While neutralization of plate to grid capacity is normally unnecessary in a screen grid type amplifier, it was found necessary in order completely to eliminate interaction between the power amplifier and master oscillator. When neutralized, the change in oscillator frequency due to any variation in amplifier load or tuning, never exceeds 500 cycles per second. The frequency of oscillation is almost completely independent of power amplifier load and tuning variations.

For cw transmission, the 1299 tubes deliver maximum power output, operating with 150 volts on both plate and screens. For phone operation, the screen voltage is reduced to 60 volts by the insertion of a series resistor between B+ and screen grid.

The modulator system consists of a carbon microphone coupled through the step-up transformer to the grid of a 1LD5 operating as an audio power amplifier. A negative voltage feedback loop from the 1299 screen grids to the modulator grid, serves to reduce distortion and improve the frequency response of the modulator. A curve of distortion versus percentage modulation is shown in Fig. 7, while Fig. 8 is a fidelity curve.

The power amplifier tank coil is equipped with a series of taps available through a selector switch. These permit proper matching of any one of a wide variety of antennas with which the set must

(*Continued on page* 134)



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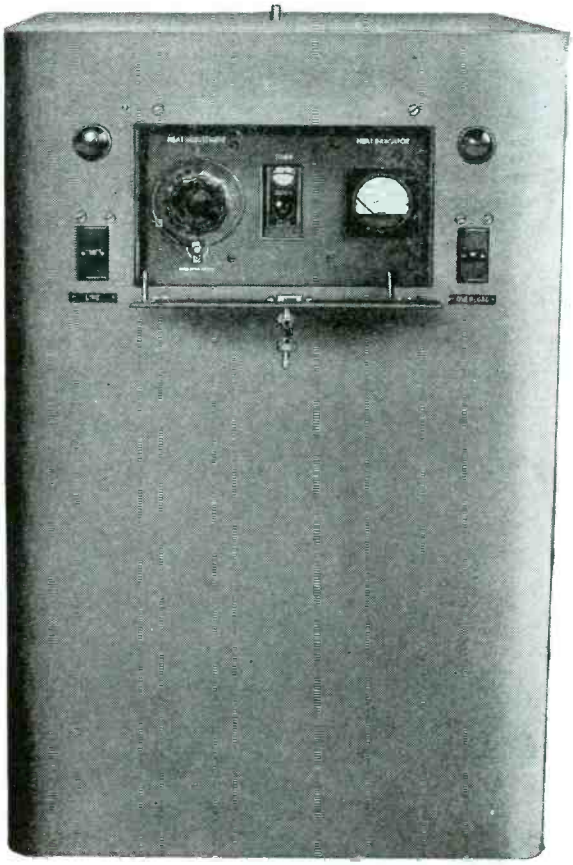
"High frequency or electronic heating is a method of converting electricity into a form that will cause the molecules in a substance to distort and rub together, thus setting up friction that results in internal heat."

From THE NEW PLASTICS by Herbert R. Simonds and M. H. Bigelow, published 1945 by D Van Nostrand Company, Inc.



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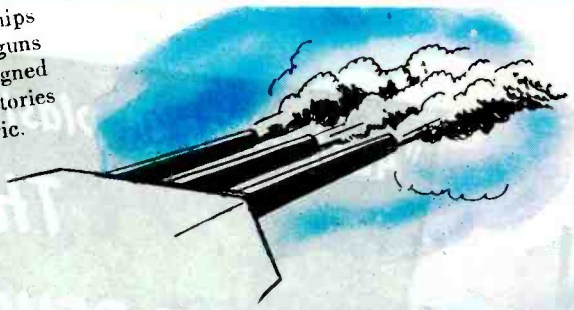
SINCE 1922 IN RADIO AND ELECTRONICS

All of the big guns on Navy ships and a majority of their smaller guns are directed by radars designed by Bell Telephone Laboratories and made by Western Electric.



What TEAMWORK

Bomb-directing radars used on B-29s were designed by the Laboratories and made by Western Electric.

This team developed and produced low altitude radar bombsights widely used against the enemy's merchant shipping.

Bell Telephone Laboratories and Western Electric were "naturals" for the leading part they played in the radar program. For years they've worked as a team in developing and producing complex electronic equipment.

Here are some unadorned facts about what their teamwork made possible.

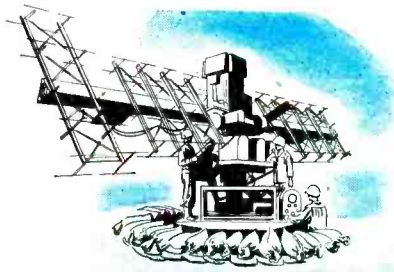
Up to the end of the war, Western Electric had furnished the Army, Navy and Air Forces with more than 56,000 radars of 64 different types, valued at almost $900,000,000.

In 1944 alone, Bell Laboratories worked on 81 different types of radar systems and Western Electric produced 22,000 radars of 44 different types — of which 20 were new in production that year.

Western Electric was the largest producer of the cavity magnetron and other essential vacuum tubes for radar. Number of tubes required for Western Electric radar systems varied from less than 100 to nearly 400 per system.

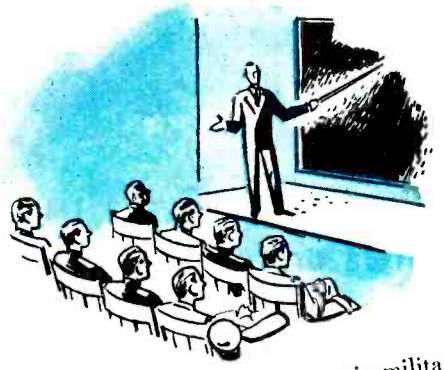
Complexity of radar manufacture is indicated by the fact that even a simple type may require 4,000 labor hours to manufacture and the larger types as much as 40,000 labor hours.

From the very beginning, ground radars made by Western Electric played an important role in all theatres of war.



did for RADAR

Bell Laboratories developed more than 100 different radar test sets. In 1944, Western produced over 40,000 test sets of 68 types.



A school to train military personnel to operate and maintain radar was established by the Laboratories. Over 100 courses were given to some 4,000 officers and men.

The same team is working for YOU!

The unique combination of brain power and manufacturing facilities that made Bell Laboratories and Western Electric the nation's largest source of radar, is now devoted to bringing you the best in communications equipment for a world at peace. In peacetime off-shoots of radar—and in FM, AM and television broadcasting—in radio telephone equipment for every type of mobile service—this team can be counted on to lead the way.

Western Electric built up a Field Engineering Force of more than 500 specialists. They served with all branches of the Armed Forces on all fighting fronts.

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World's largest organization devoted exclusively to research and development in all phases of electrical communication.

Western Electric

Manufacturing unit of the Bell System and nation's largest producer of communications and electronic equipment.

BRITISH WALKIE-TALKIE

(*Continued from page* 130)

operate. To insure proper tap selection, an antenna current indicator is provided. This consists of an rf current transformer whose low impedance primary is connected in series with the antenna. The secondary, electrostatically shielded from the primary to prevent capacitative coupling, is connected to a diode rectifier whose output operates a microammeter. Maximum meter deflection occurs at the tap setting which permits maximum power transfer into a given antenna. The meter reading is a measure of antenna current and provides a very effective means of determining quickly the best tap to use for a given antenna.

A unique circuit was created for the transmitter, to provide a 1 mc crystal oscillator for calibration check of both receiver and transmitter tuning dials. A simplified circuit is shown in Fig. 9. The 1LD5 tube already used as a modulator and antenna current rectifier is alternately used, this time as a crystal oscillator, by connecting a 1 mc crystal betwen plate and control grid through a .0001 blocking condenser. Using an rf choke from plate to the audio choke needed for the modulator, the tube functions as a Pierce oscillator. When the switch shown in Fig. 9 is closed, oscillations cease and the tube performs as an audio amplifier. The introduction of the crystal and rf choke has no undesirable effect upon modulator performance.

Crystal calibrator

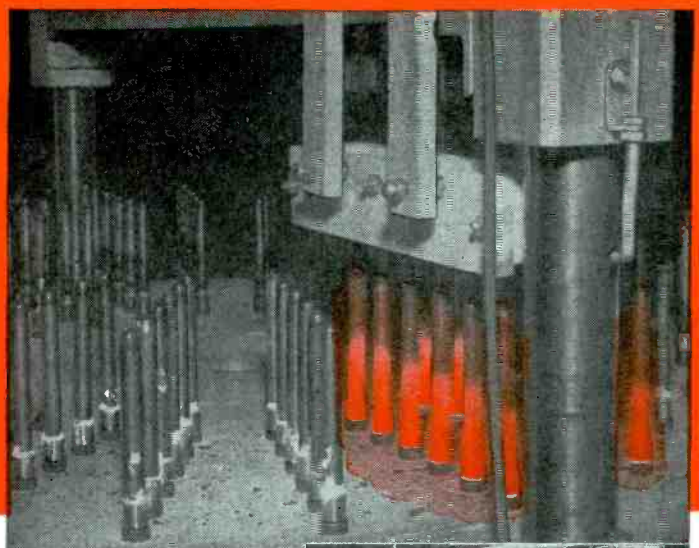
In operation, the crystal oscillator, being very rich in harmonics, radiates sufficient energy to be picked up on the receiver. Using the cw oscillator of the receiver, the dial calibration is easily checked against the 6th, 7th and 9th harmonics of the crystal. For the transmitter calibration, the master oscillator and calibrator are turned on. Using the receiver as detector (cw switch off), the two oscillators are heterodyned at 6, 7, 8 and 9 mc. The "aerial switch" connects to taps on the tuned tank circuit inductance of the power amplifier tubes. The "Systems" switch marked "CW Phone-Net-Cal" permits the selection of the desired condition of the transmitter. The meter switch, in conjunction with the test meter, provides for rapid checking of the high and low battery voltages, and the emission current of the tubes in the receiver and transmitter.

It also indicates grid current of the power amplifier tubes. With the switch in the position marked

(*Continued on page* 138)

INSIST ON PROOF BY TRIAL

before you buy an Electronic Heater

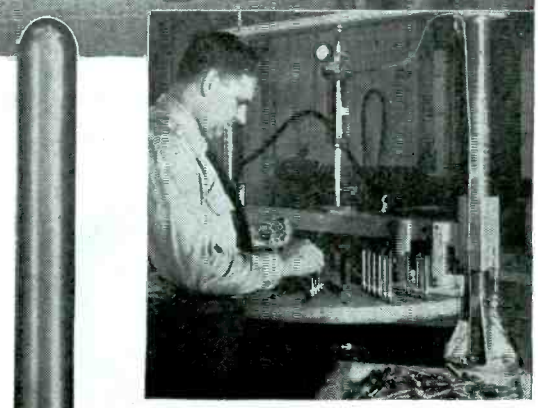


This is how Scientific Electric proved the value of electronic heating to the Progressive Welding Company of Norwalk, Connecticut . . .

GREAT improvements in product quality and remarkable savings in time and money are being achieved by means of electronic heating. Industrialists everywhere are now acclaiming its many advantages. But don't let your enthusiasm lead you to invest in an electronic heater before you have seen it perform the work you expect of it.

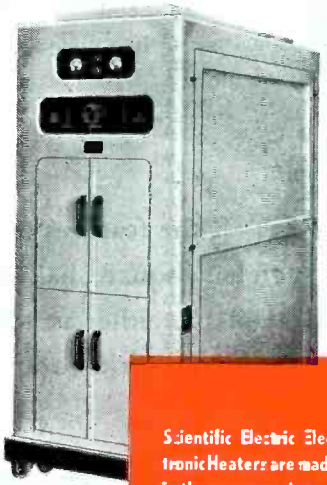
Another important point is this . . . in order to work at maximum efficiency and live up to its reputation for doing things better, faster and cheaper . . . electronic heating must be "tailored" to the job. That is why we never sell a Scientific Electric unit until it has been satisfactorily demonstrated. Regardless of the amount of time and effort required, our engineers will not release a single machine for sale until it has fulfilled every claim we make for it.

So here is a word of counsel . . . get plenty of advice before you buy. Consult with our recognized engineers who have pioneered in electronic heating since 1921 and, without obligation, they will demonstrate what electronic heating can do for you.



Above: This practical, automatic brazing turntable powered by a 40 KW. Scientific Electric heater speeded up production 700%—cut costs 87% and reduced rejects by 90%.

Left: Close-up of the finished two-piece tube assembly after being brazed by induction heating. Three complete brazing installations have been built for Progressive.



40 KW INDUCTION HEATER

Write for a free copy of our handbook . . . *The ABC of Electronic Heating* which contains an easily understood explanation of this new heating method.

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3 KW	18 KW
5 KW	25 KW
7½ KW	40 KW
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Scientific Electric Electronic Heaters are made in these power sizes . . . and a range of frequencies up to 300 Megacycles depending upon power requirements.

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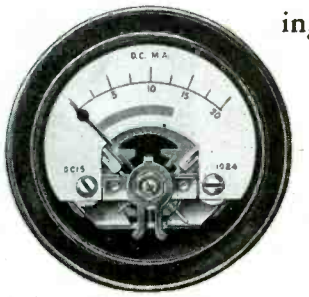
THEY'RE GREAT LITTLE METERS!

Side View

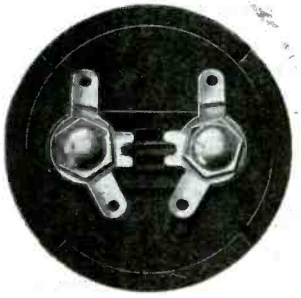
Front, side or back – inside and out – the 1½" Round Model 120 can do a whale of a job for you on a wide variety of applications.

External pivots provide maximum accuracy in mounting the moving element between the jewel bearings ... prevent rocking of pointer ... reduce side friction between jewels and pivots ... increase the life of bearing surfaces. Movements are designed to meet forthcoming JAN-I-6 specifications for 1½ inch instruments.



Front View

Built with fine precision, entirely self-contained ...with built-in resistors and shunts, this great little meter is also completely immersion-proof throughout. It has a special locking device for exerting pressure against rubber gaskets on either side of the glass. Watertight sealing includes terminal studs and a gasket back of the flange waterproofs the juncture between the meter and the panel. Installation is easy – a ring mounting eliminates mounting screws. The case is Black Anodized Aluminum.



Back View

Model 112 has all the features of the Model 120 except that it has a square, bakelite case. Like the 120 it is available either as a D.C. or A.C. (rectifier) instrument. Write for latest catalog.

"Inside" View

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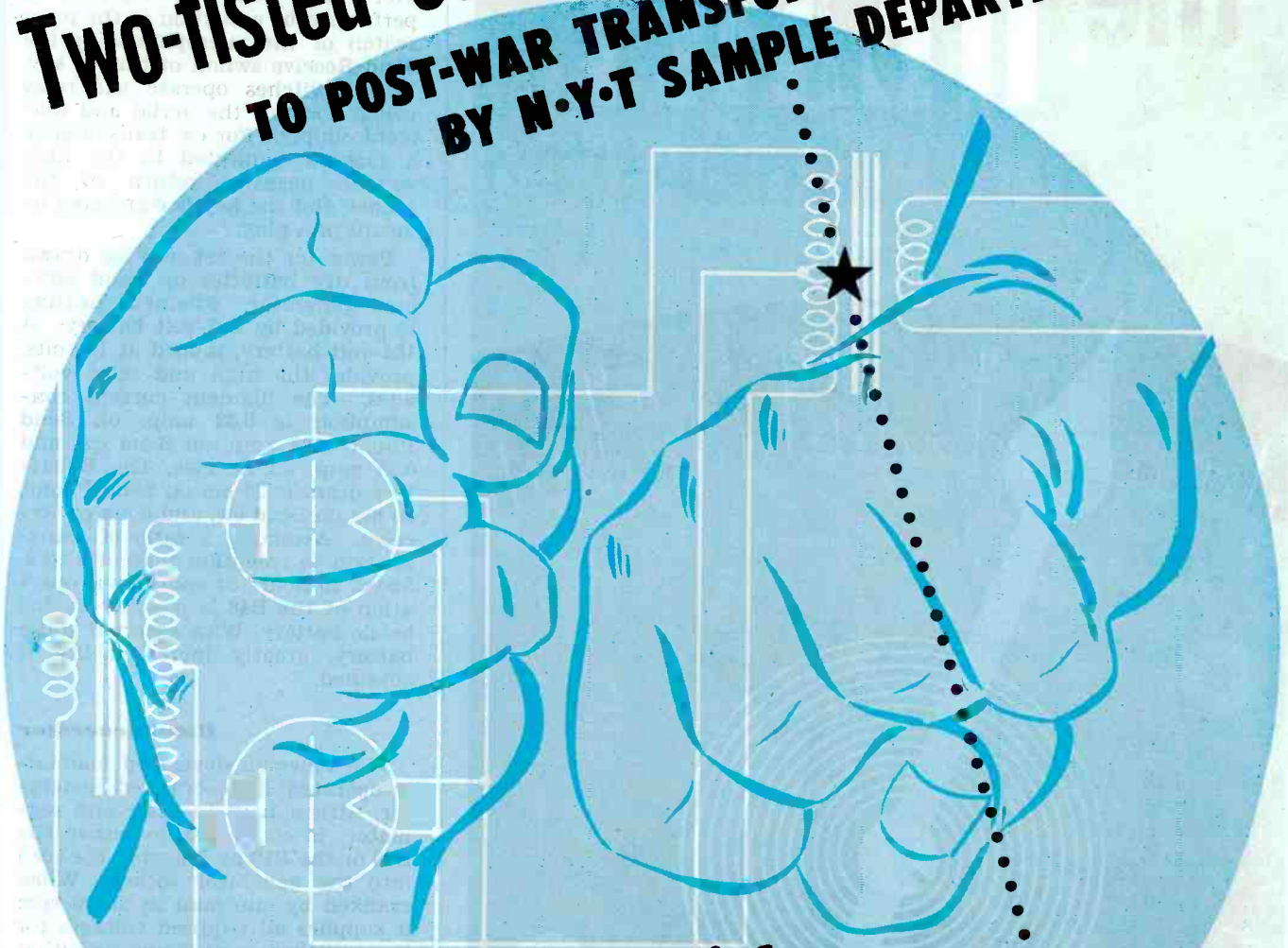

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NEW YORK 3, N. Y.

BRITISH WALKIE-TALKIE

(*Continued from page* 134)

"AE" the meter indicates a measure of aerial current. The changeover from "Send" to "Receive" is performed by actuation of the press switch of the microphones or the Send-Receive switch of the cw key. These switches operate the relay which controls the aerial and filament supply. For cw transmission, a jack is connected in the high voltage negative return of the sender and the key is connected by means of a plug.

Power for the set may be drawn from dry batteries or hand powered generator. Filament heating is provided by a 3-volt battery. A 162-volt battery, tapped at 12 volts, provides the high and relay voltages. The filament current consumption is 0.32 amp. on Send Phone, 0.25 amp. on Send cw, and 0.15 amp, on Receive. The B battery drain is 20 ma on Send Phone, 50 ma on Send cw, and 8 ma on Receive. Assuming a ratio of transmission to reception time of 1 to 3, about 15 hours of continuous operation of the B48 is possible on one battle battery. With external static battery, greatly increased life is obtained.

Hand generator

The Emerson developed manually-operated hand-cranked generator, with a built-in filter and regulator, is connected to either the B48 or the B18 by plugging the cord into the generator socket. When cranked by one man at 50-70 rpm it supplies all required voltages for transmitting or receiving on either B18 or B48. A toggle switch changes the connections for either unit. The dimensions of the generator are 5½ x 5⅞ x 6¾ in.

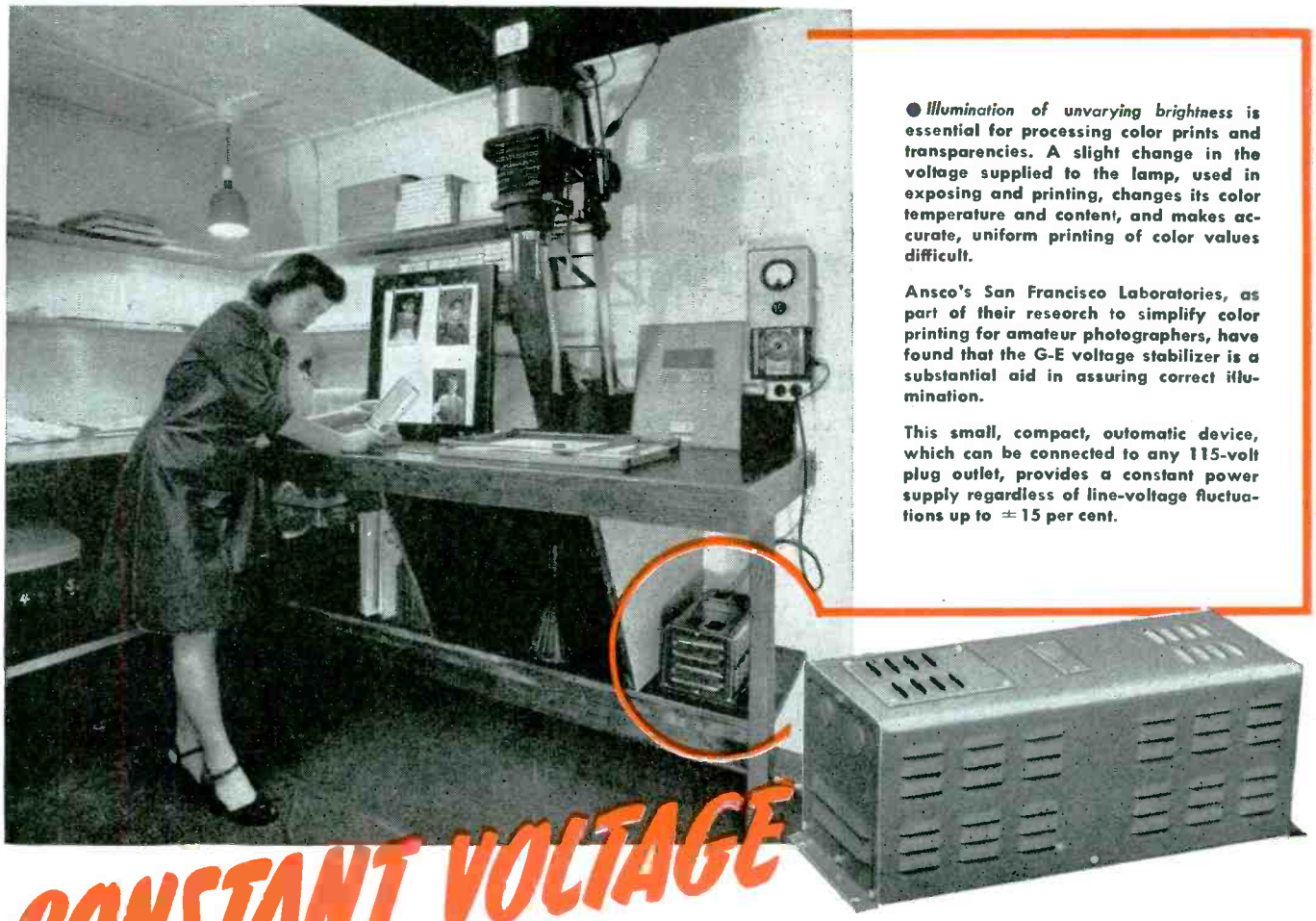
If the toggle switch is on B48 position, the high voltage is 160 volts for B at .106A and the low voltages 3.1 volts at .3A. When the toggle switch is in the B18 position, the high voltage on receiver is 180 volts and on sender 150 volts. The low voltage is 3.1V and the current .3A with bias voltage of 12V. All of these voltages are measured at filter output. The regulator, a vibrating Terrell type, and a very important part of this unit, operates at a frequency of 5 to 7 vibrations per second.

The generator armature is a two commutator type whose shaft is supported on two bearings and is turned through a train of gears (75.4 to 1 ratio). When hand cranked at 60 rpm, the armature rotates at 4,524 rpm.

Because of the heat, humidity and great shipping distances from either England or America to the Burma theatre of operations, bat-

(*Continued on page* 142)

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.

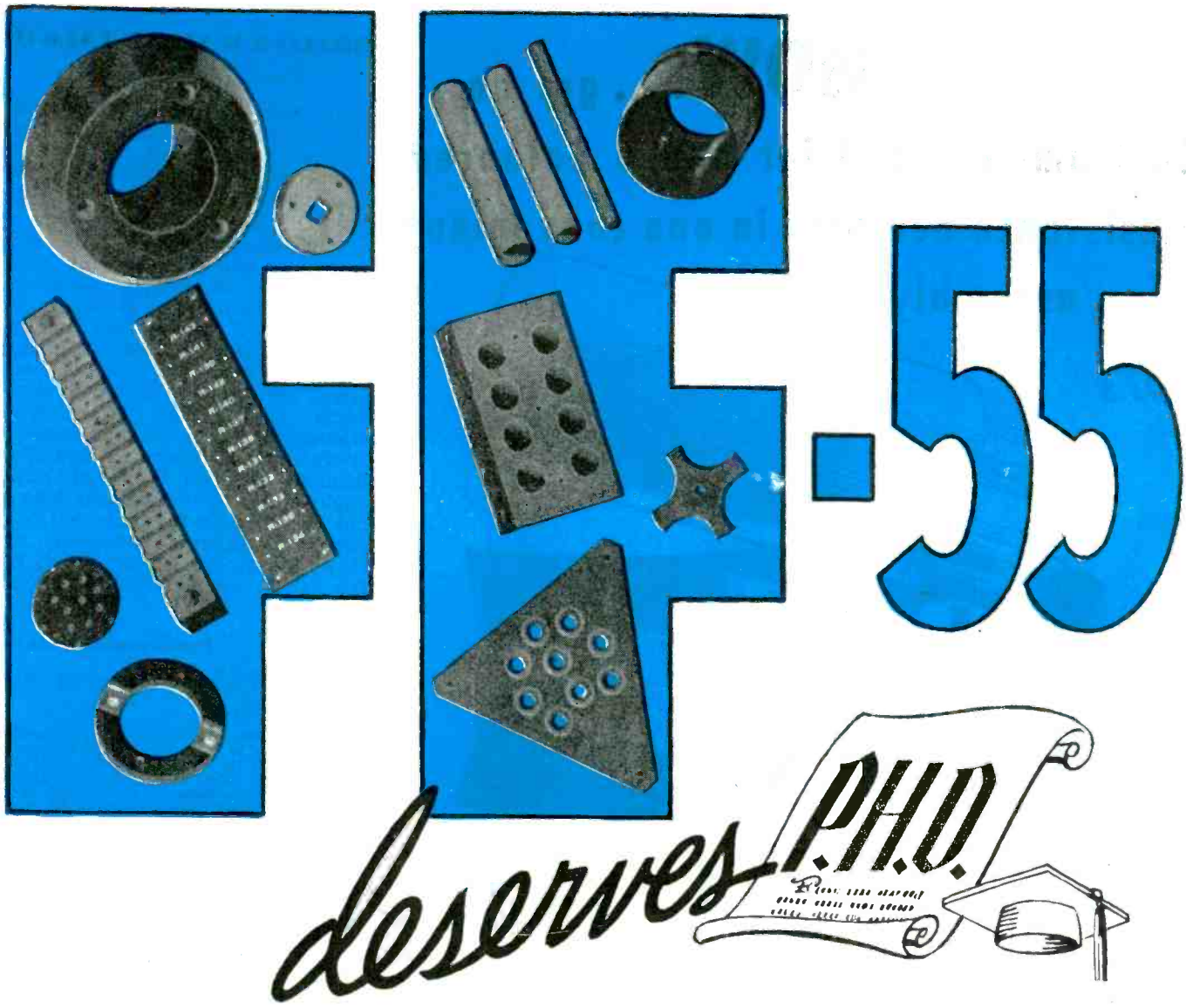
If you are a user or manufacturer of such apparatus as radio transmitters, testing equipment, X-ray machines, other electronic devices, motion-picture projectors, and precision photographic equipment, it will pay you to investigate the benefits of G-E voltage stabilizers. They can be used as an accessory 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

408-81-6205



FOR THESE MARKS IN CHEMISTRY AND PHYSICS

This recent graduate of the Formica war-expanded laboratories has passed the following tests and is qualified for employment in many old and new applications.

It is made with melamine resins and glass fibre base and conforms to Navy Grade GMG.

It withstands 440 degrees F for a short period, and 390 degrees continuously.

Its arc resistance reaches a new level—by ASTM test D 495-42 it is rated at 185 seconds.

It is so strong it can take structural stresses when desirable. Test figures: Tensile strength 25,000 P.S.I.; Compressive strength (flatwise) 90,000 P.S.I.; Modulus of Elasticity in bending 3,000,000 P.S.I.; Izod impact, 12 ft. lbs. per inch of notch.

FORMICA

Here is a new combination of desirable properties not previously available in one material. Unlike various materials which possess some of these characteristics, FF-55 can be easily punched and machined. It is superior for rapid fabrication by production methods.

THE FORMICA INSULATION COMPANY, 4647 SPRING GROVE AVENUE, CINCINNATI 32, OHIO

BRITISH WALKIE-TALKIE

(*Continued from page* 138)

teries were of little use there until the British were able to manufacture batteries nearer to the field of operation. They, therefore, had to depend almost entirely on the hand operated generator.

Many of the Emerson Radio engineering and Procurement staff have made substantial contributions to this project. Messrs. A. G. Rogers and J. W. Jennings directed the engineering. Messrs. Murray Goldstein, Henry Fogel and Walter Lukas were responsible for the electrical engineering on receiver, transmitter and generator, respectively. Edward Buechner and Abe Skolnick handled the mechanical engineering. In addition, the splendid and resourceful material procurement program conducted by H. J. Dostal contributed much to the all-around success of this project.

Performance data

Measured performance of the B48 follows:

*Sensitivity Phone	5 microvolts
*Sensitivity C.W.	3 microvolts
Selectivity X 10	17 Kc
Selectivity X 1000	55 Kc
Image Rejection Ratio	250 to 1
AVC	Output change of 10 db for input change of 40 db
Frequency Stability	.02% for 1 hour warm up period
Signal to Noise	10 to 1
Dial Calibration	100 Kc intervals
*Power Output	25 milliwatts at 10% distortion
Output Impedance	200 and 4000 ohms
Fidelity	—3 db from 300 to 2500 cps.
**Power Output Phone	0.25 watts
**Power Output C.W.	1.15 watts
Modulation	To 100%
Capability	30% distortion at 95% modulation
Fidelity	—3 db from 300 to 2500 cps.
Calibrator	Built in crystal oscillator at 1 megacycle to check dial calibration.
Frequency Stability	.02% for 5 minute warm up period.
Dial Calibration	50 Kc Intervals

*Input carrier modulated 30% at 400 cps. Output of 1 milliwatt into resistance load of 200 ohms.

**Into dummy load of series 50 mmfd condenser and 7 ohm resistor.

Resin Plasticizer

One of the most closely held secrets of the war has been lifted in part by consent of the Navy with the news that a new type resinous plasticizer is used to prevent premature failure and loss in signal strength of high frequency cables for Navy equipment. Known as Paraplex G-25 and developed by the Resinous Products & Chemical Co., Philadelphia, this product might be described as a "polymeric" plasticizer, the first resinous type plasticizer compatible with polyvinyl chloride, the preferred cable jacketing material, and which combines the desirable features of ester type plasticizers with the permanence and non-migrating quality of a synthetic resin.

Quiet

Efficient—reliable—above all, *QUIET*—
that's the Ballentine Phonograph Drive.
Basic refinements in design, *precision dynamic balance*, the most advanced manufacturing technique and equipment make the Ballentine Phonograph Motor unequalled for low background noise or rumble.
Send for descriptive bulletin.

RUSSELL ELECTRIC COMPANY

366 WEST HURON ST., CHICAGO 10, ILL.

Manufacturers of

BALLENTINE PHONOGRAPH DRIVE

JAY CEE

SILICA GEL

PROTECTS TELETYPE* EQUIPMENT FROM MOISTURE DAMAGE • • •

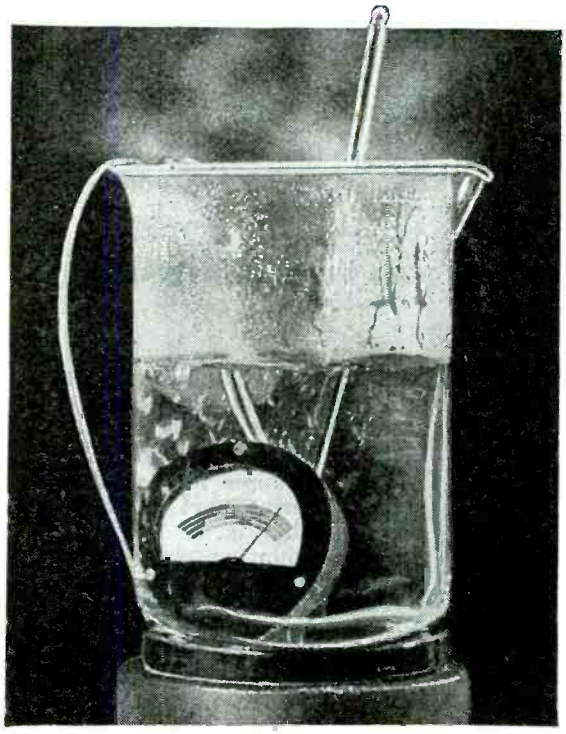
Yes . . . this Teletype printer arrived "perfectly dry" . . . thanks to Jay Cee Silica Gel —which is protecting innumerable over-seas shipments of delicate machines, instruments and weapons from moisture damage.

A few small cotton bags containing this ideal drying agent are enclosed in the box or carton with the equipment. The phenomenal power of Jay Cee Silica Gel to absorb the atmospheric moisture within the container prevents rust or corrosion in transit. 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—A few excellent Jay Cee Silica Gel sales territories are still open to jobbers. Write for details.

* Registered trade-mark

JOLIET CHEMICALS, LTD.
INDUSTRY AVENUE
JOLIET, ILLINOIS



We weren't satisfied to test our hermetically sealed instruments for temperature, humidity and salt spray individually — we went whole hog and combined the three conditions in a beaker of boiling brine. This test, which really exacts more from an instrument than is normally necessary, was conducted for two weeks without failure or permanent error in excess of 1%. The maximum zero shift was .75%, the current sensitivity plus .5% — and the instrument showed no moisture penetration and no leaks as was evidenced by further production vacuum checking.

What may be "unfair" in a test of Marion hermetically sealed instruments is only fair to their users. Whether you're a manufacturer or a consumer, our tests serve to prove the quality and dependability of our instruments. They are an assurance that when these "hermetics" are installed in any equipment, and used in any part of the world, their trouble-free performance will be sustained. Remember — Marion glass — to — metal hermetically sealed instruments are positively interchangeable, and cost no more than standard conventional types. Write for our 12-page brochure.

Marion Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

WHAT CAN MARION "HERMETICS" DO FOR ME? WRITE—WE'LL SUPPLY THE ANSWER

Thermoplastic Insulator

Plastiform, a new thermoplastic material which can be used in making electrical and other equipment that does not have to withstand high operating temperatures, has been developed by L. C. Wilson, chief engineer for Duorite Plastic Industries at Culver City, Cal. A dielectric, it is 100 per cent reclaimable without additives and impervious to both acids and alkalies. It can be formed by casting in molds or by working with an ordinary soldering iron.

High-frequency heating has been found to be the most economical and efficient process for mass-producing Conolon airplane parts, according to a recent report by Dr. G. G. Havens of the National Research and Mfg. Co. at National City, Cal. Conolon is a new low-pressure plastic laminate, which is lighter than aluminum yet as strong as many types of steel.

CRYSTAL DIMENSIONING

(*Continued from page* 97)

occur at most once during a temperature run, giving, in the absence of other disturbing phenomena, an activity curve such as (a) in Fig. 3.

Wetness causes the crystal to be inactive during part or all of the curve, cf (b) Fig. 3. Uneven pressure in mounting may damp the curve erratically, cf (c) Fig. 3.

Frequently, even when all of these causes of failure have been eliminated, curve irregularity still persists. The accompanying diagram, Fig. 4, is typical. Let us consider the activity disturbances in the order in which they occur from left to right. The activity disturbance (1) has its counterpart in the frequency disturbance approximately under it. When this frequency is repeated we note that once again there is a marked irregularity in the upper curve: 4. A similar relation exists between disturbances 2 and 3. The result is a saw-tooth effect in the activity curve with irregularities paired about the peak of frequency. Certain frequencies thus reveal themselves as unfavorable to the activity of the crystal. At these frequencies conflicting modes contend for control of the crystal and it is unable to give full response to either.

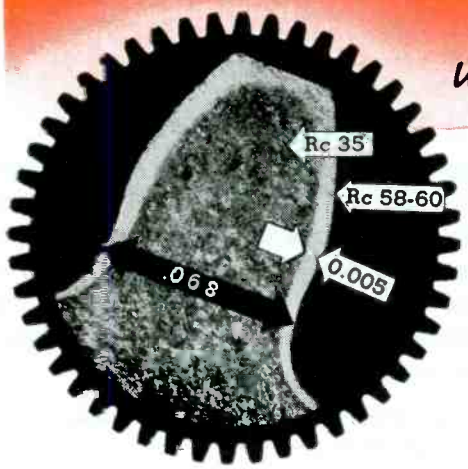
A few instructive crystal records will serve to emphasize the relevance of the crystal dimensions to all this: (1) In Fig. 5 nothing has been changed between the runs which produced curves 1 and 2, except the height of the air-gap which in neither case was such as to produce air-gap resonance. The

(*Continued on page* 150)

They're All Talking About It!

A New Thin Case Contour Hardening Job . . .

with MEGATHERM*



Thin case contour harcening of gear teeth with controlled depth of hardness has been made possible by the use of MEGATHERM induction heat.

The hardened surface completely follows the tooth and root contour of the gear with the core still in its original state, as shown plainly by this microphotcgraph. This 0.005 case was applied to gears of 24 D.P. —51 teeth—2.125 P.D.—2.208 O.D. and S.A.E. 4140 steel in 1/4 of 1 second with a 25 KW MEGATHERM—5 megacycle energy doing the job.

These long wearing contour hardened gears become an automatic production item with MEGATHERM.

Write *today* on your company letterhead for data on MEGATHERM.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

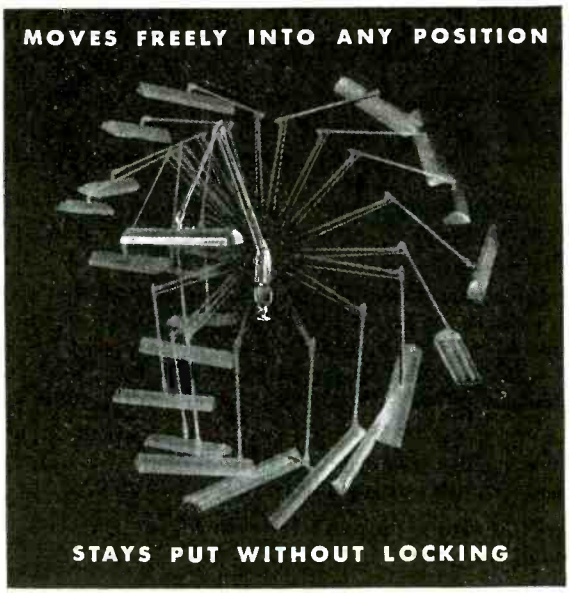
*REG. U. S. PAT. OFF.

EYES *work better*

with the personally-fitted lighting of

DAZOR *Floating* LAMPS

Many of your workers are handicapped by defective vision. You *can't* give them better eyes but you *can* help balance sight inequalities with Dazor *Floating* Lamps: flexible, *localized,* high intensity lighting which provides an *individual fit* for each operator. And easy does it! Fingertip pressure *floats* the Dazor to any desired position, where it *stays put*—without locking or tightening—until moved elsewhere. This is due to a patented enclosed spring force which balances the arm automatically.

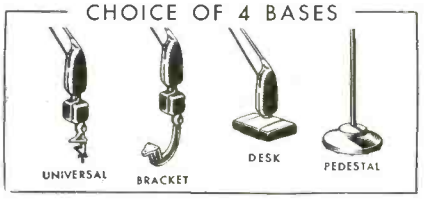


Whether for eyes old or young, sound or defective, Dazor *Floating* Lamps make seeing easier on all jobs requiring concentrated and prolonged vision: precision machine work, inspection, fine assembly, and drafting. They help increase output, reduce spoilage, minimize fatigue, promote safety and increase profits.

Call Your Dazor Distributor

For complete information, experienced application assistance and a practical on-the-job demonstration, phone one of the Dazor-appointed distributors in your locality. Their names, 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 Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

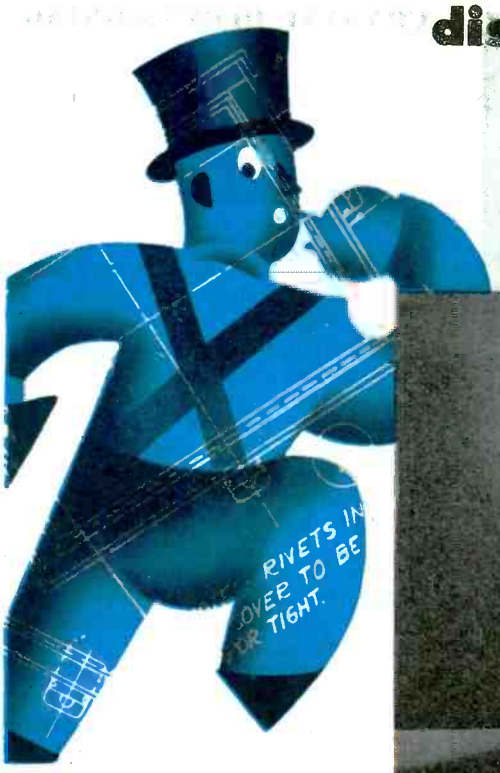


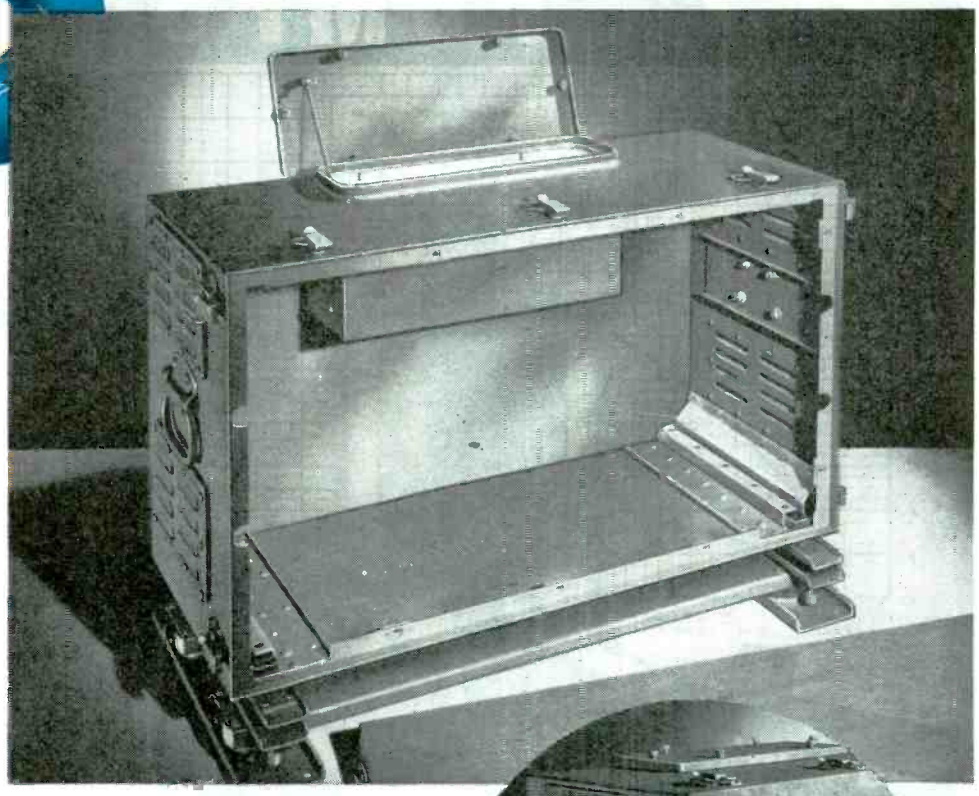
DAZOR *Floating* LAMPS

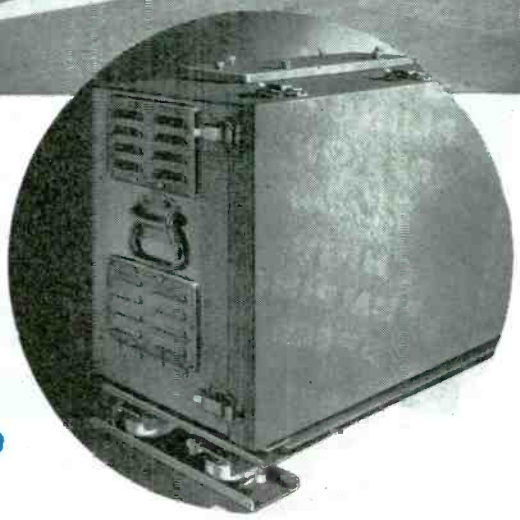
FLUORESCENT *and* INCANDESCENT

distinguished cabinet member

on a secret mission . . .







The actual use of this Karp-constructed cabinet assembly for electronic apparatus is a military secret.

We can, however, reveal the superior details of the all-welded aluminum construction. It is splash-proof, insect-proof—and at the same time ventilated. The assembly also includes a shock mount. Suspension slides permit the electronic apparatus to move in and out like a drawer.

If you require special-built housings, racks, panels, chassis or enclosures for electrical equipment, get the benefit of our 20 years of specialized experience in this field. Our hundreds of skilled craftsmen will save your time. Our complete facilities and numerous stock dies will save you money.

ANY METAL • ANY GAUGE • ANY SIZE • ANY FINISH

KARP METAL PRODUCTS CO., INC.

Custom Craftsmen in Sheet Metal

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

ARMY E NAVY

CRYSTAL DIMENSIONING

(*Continued from page* 146)

effect of the change in air-gap is to change the frequency by a small amount without altering the crystal physically. We note that the frequency disturbance at the peak of curve 1 has its counterpart in an activity disturbance above, and that similar disturbances take place in curves 2 when the same frequency is passed.

We conclude that bad behaviour at this frequency is a characteristic of the crystal and its unchanged dimensions. (2) cf Fig. 6. This time electrodes and mounting are unchanged and one dimension is altered progressively. Here the activity disturbances change frequency with each dimension—change and vanish or become negligible for certain dimensions. We conclude that saw-tooth activity irregularity may be corrected by dimension shift.

Importance of stability

It will be noted in each instance that it is the presence of irregularity rather than the magnitude of the irregularity to which I give importance. This is because, being symptomatic of instability, these irregularities, though they appear at the same frequencies, will not necessarily reproduce themselves as to magnitude, even for the same crystal under temperature runs which as far as can be verified are identical. On the other hand, stability does reproduce itself and a relatively smooth activity curve can be expected to repeat itself very closely.

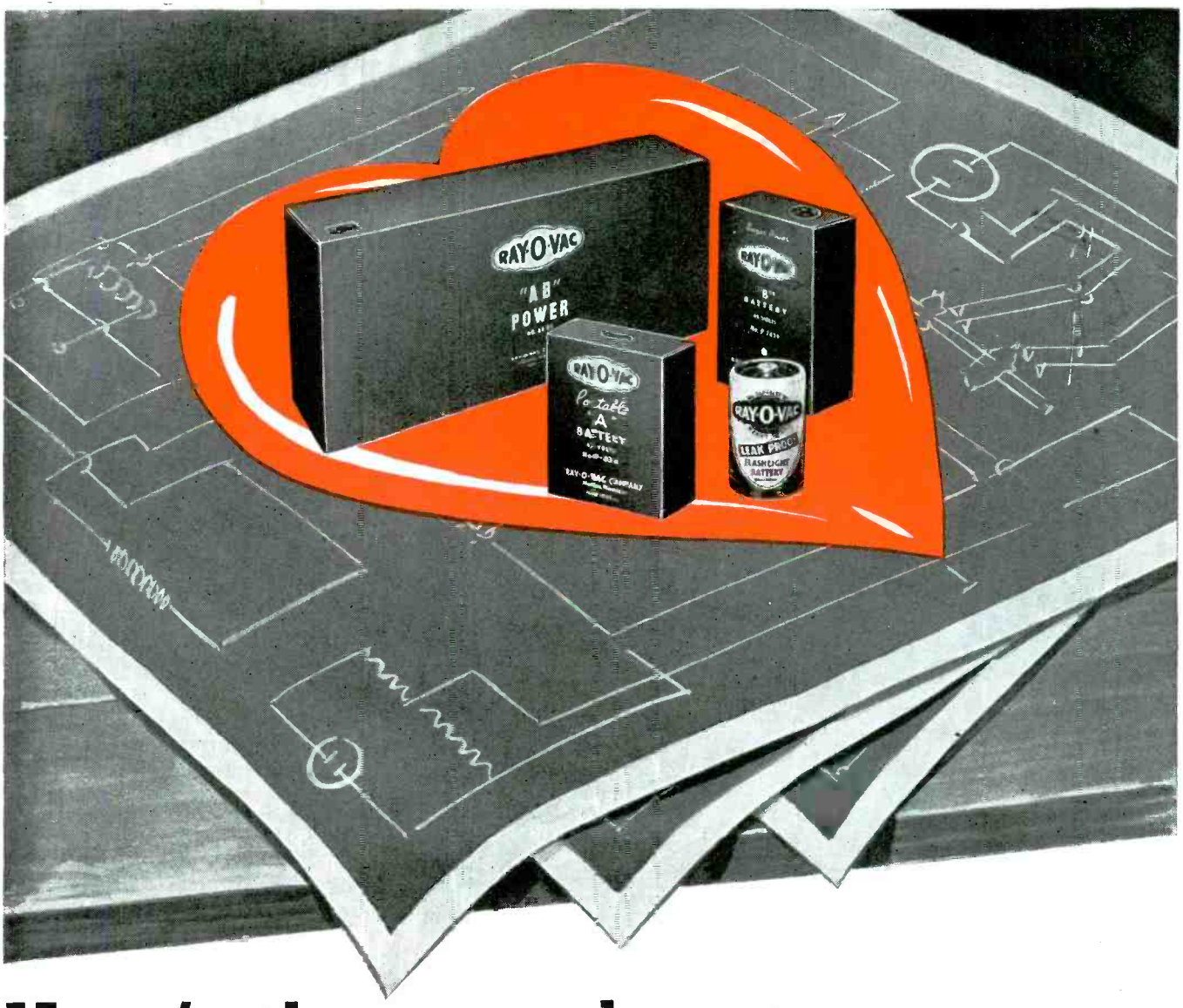
Furthermore, if we simultaneously examine crystals cut within close tolerances as to angle and dimensions, mounted alike, and brought to within close tolerance of the same frequency at room temperature, we note that all their instabilities occur within close tolerance of the same temperatures, or that they are all stable throughout the temperature run for certain dimensions.

Thus we may use the data obtained from relatively few crystals to ascertain safe dimensions for other crystals of the same frequency.

Temperature exploration

Since temperature-runs take time, and since available time is finite, it is obviously desirable to cut down the number of temperature runs involved in discovering favorable dimensions. If in any way we can ascertain that a pair of initial dimensions is near to those which are favorable to a given frequency, then by "pushing" the dimensions

(*Continued on page* 154)



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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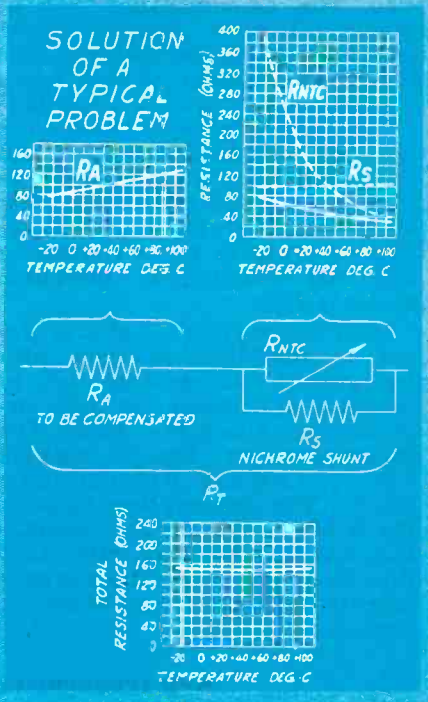
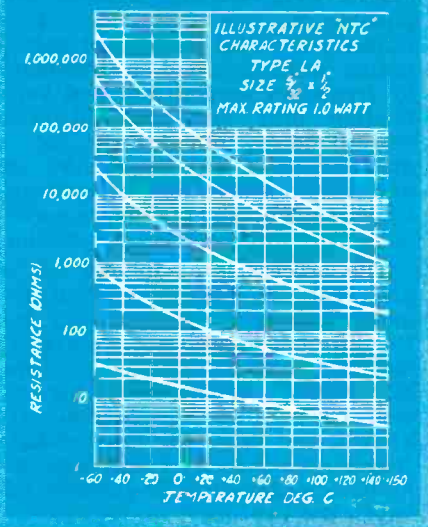
OTHER FACTORIES AT CLINTON, MASS., LANCASTER, OHIO, SIOUX CITY, IOWA, FOND DU LAC, WIS., MILWAUKEE, WIS.

Here's How to CANCEL-OUT RESISTANCE CHANGES DUE TO TEMPERATURE WITH KEYSTONE "NTC" UNITS

- ✔ Purely Electrical Method
- ✔ Efficient—less added resistance
- ✔ For AC or DC
- ✔ Lightweight, compact
- ✔ Close compensation over range as wide as −55°C to +150°C





A wide range of temperature coefficients, resistance values, sizes, shapes and wattage ratings are available.

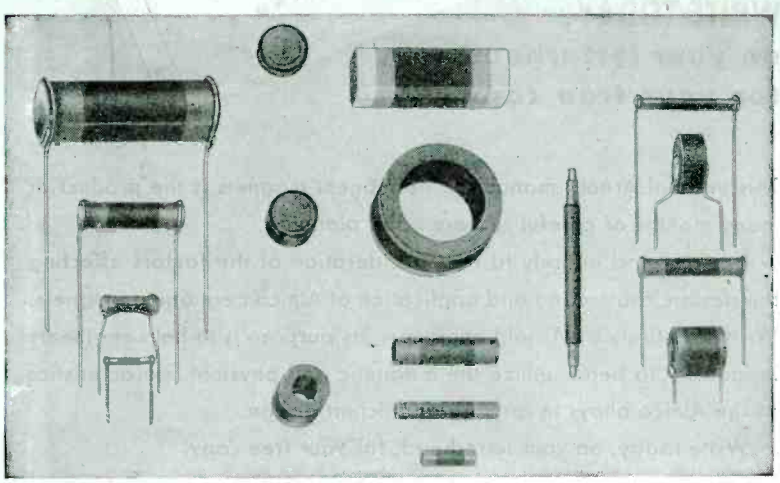
NOW . . . EFFICIENT, SIMPLE COMPENSATION FOR WIDE VARIETY OF ELECTRICAL DEVICES

MODERN war has demonstrated that the extremes of world climate are only hours away . . . has clearly indicated the expanded temperature range over which many precision electrical devices must operate if they are to meet the demands of the future.

The inherent positive temperature coefficient of copper (and many other pure metals) results in large variations in current flow and voltage drop in windings and conductors when the temperature range is great. If uncompensated, wide-tolerance performance is probable. If the percentage resistance change is minimized by adding large amounts of low-coefficient resistance, low efficiency and drastic limitation of available power are inevitable.

Because they have a large *negative* temperature coefficient, there need be only a moderate increase in circuit resistance when Keystone "NTC" units are used. The remarkable effectiveness and simplicity of this method are evident from the typical problem and its solution illustrated at the left.

The experience of our customers indicates that Keystone "NTC" compensation can help make better-performing, more-salesworthy indicating and recording devices, meters, relays, control systems and many other electrical devices and components . . . economically. Why not let us tell you more about them—and put us to work on *your* problem? Write now—no obligation.



Keystone "NTC" units are thermal resistors of special composition (not carbon), developed and manufactured by Keystone, and extensively used for temperature compensation, temperature measurement and control, time delay and other applications.

A NEW DEVELOPMENT — KEYSTONE NTC RESISTANCE MATERIAL — DECREASES IN RESISTANCE WITH INCREASE IN TEMPERATURE

KEYSTONE CARBON COMPANY, INC.
ST. MARYS . . . . . PENNSYLVANIA

CRYSTAL DIMENSIONING

(*Continued from page* 150)

about these as a mean we may locate correct dimensions in relatively few runs. One method of obtaining such a point of departure is by the calculation of uncoupled frequencies indicated above. Another, which is purely empirical, follows.

We take a group of crystals of the same arbitrary face dimensions, cut within close angle tolerance and finished to the same frequency at room temperature. Then we progressively alter the same dimensions on these crystals, maintaining fixed temperature, and record frequency change and activity at each step. The accompanying pair of graphs (Fig. 7) is typical of those obtained. It will be observed that in those dimension regions where the frequency curve is smoothest and most nearly approximates the horizontal, activity is highest and most unvarying. From this we tentatively conclude that the crystal in this range of dimensions is relatively insensitive to its contours—i.e., that coupling to unwanted modes is slight.

If this is the case, then it is also not improbable that even with temperature change this lack of coupling will persist for some intermediate dimension - ratio. The explorations of Fig. 7 indicate 1.555 . . . 1.150 as a likely dimension region. The temperature runs of Fig. 6 were made on this assumption and the excellent ratio 1.152 thus arrived at. This ratio was consistently verified for a set of similar crystals.

Key frequencies

This is a technic that is applicable to any frequency. Fortunately the vast amount of painstaking work involved in frequency by frequency exploration and verification may be shortened once corresponding dimensions for a distribution of key frequencies are known. Considerations of continuity make it possible to derive curves on which interpolation is possible.

The process is as follows: If a given ratio is valid for a given frequency, then for a frequency too far different a ratio not too greatly differing may be expected to work. Furthermore, if the ratios for two well - separated frequencies are known, the ratio for intermediate frequencies may, as a first approximation, be taken to lie linearly between the two.

This will not prove to be accurately the case, but if crystals are made up near this ratio, and their ratio varied, the correct ratio may then be verified in terms of activity and frequency performance. As

(*Continued on page* 158)

You can use the NEW VOLTOHMYST for checking FM Discriminator Alignment

(A ZERO-CENTER-INDICATOR IS INCORPORATED FOR THIS PURPOSE)

—and you can also use the 195-A Voltohmyst

As an ELECTRONIC D-C VOLTMETER

Measures d-c Voltage to 1000 volts in six ranges—has high resistance input of 10 megohms constant on all ranges—plus isolation resistor in probe for dynamic socket voltage readings—polarity turnover switch eliminates confusion in reversing test leads—positive and negative indications are individually calibrated.

As an ELECTRONIC OHMMETER

Measures Resistance up to 1000 megohms with internal source of only 3 volts—six resistance ranges indicating from .1 ohm with shielded cable—zero resetting unnecessary with change of range—all ranges are indicated on "OHMS" scale.

As an ELECTRONIC A-C VOLTMETER

Measures a-c Voltage to 1000 volts r.m.s. in six ranges—with clear linear scale—Binding Jack with locking pin plug prevents accidental ground lead disconnection—meter protected against accidental burn-out.

As an ELECTRONIC A-F VOLTMETER

Measures a-f and Supersonic Voltage up to 100 volts with a range of 20 to 100,000 cycles—internal self-balancing diode—produces linear reading at any frequency.

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Measures Decibels based on a-f voltage—calibrated in Volume Units for direct reading across 600 ohm audio circuits with standard zero level of 1 milliwatt.

The New Model Of The Famous RCA Junior Voltohmyst Incorporates Several New Features Including:

A diode for a-c measurements (flat 20 cycles to 100 kilocycles); linear a-c scale for all ranges; new plastic meter case with one-piece crystal-clear transparent front (no glass to break or loosen); and a shielded a-c cable and probe.

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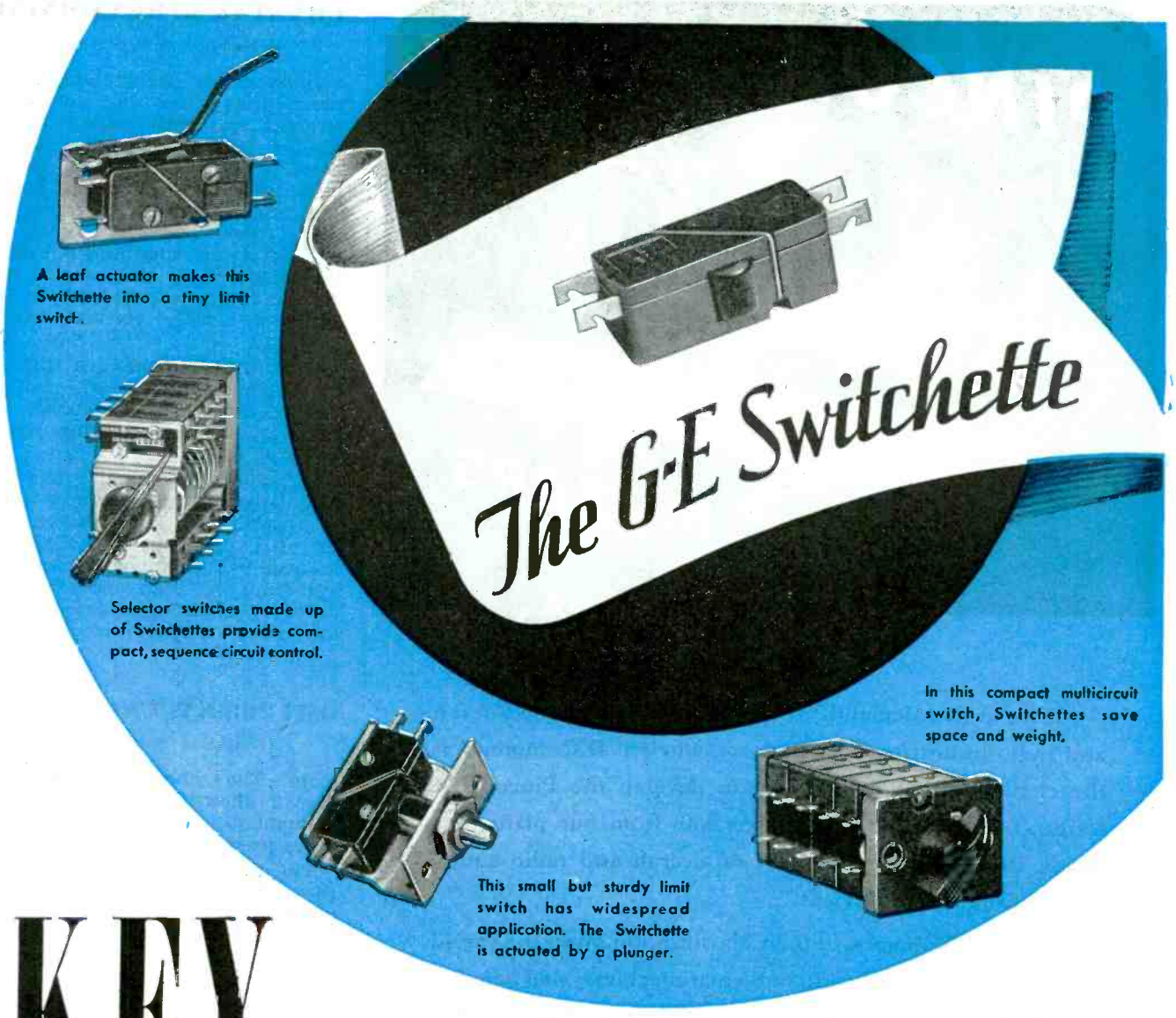
RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY LIMITED, Montreal



KEY TO COMPACT DESIGN

YOU can use Switchettes to control several circuits from a single location. They can be actuated by cams in selector switches, or by a bellows or lever in limit switches. Whichever way you use them, G-E Switchettes help you save space and make your equipment more compact.

Note the dimensions: 1¼ by ½ by ½ inch. Yet the Switchette handles up to 10 amperes at 24 volts d-c (230 volts a-c), and is sturdy enough to withstand millions of mechanical operations.

Its small size, its lightning-fast snap action, and its ability to resist high physical shock and vibration make it ideal for built-in applications on electric control equipment that has to "take it." Best of all, because of its unusual double-break contact structure, it simplifies the solution of many tricky circuit-control problems.

Don't handicap your important designs

Your plans for a smaller, lighter, or more compact equipment need not be stymied by the lack of a suitable make-and-break contact mechanism. More than 200 modifications of the Switchette are ready to meet your needs. In addition, we have a variety of limit switches, transfer and selector switches, push-button stations, thermostats and timers built around the Switchette. Perhaps you can use some of these ready-made devices to advantage.

Send for a catalog

If you don't already have a copy of our Switchette catalog, mail the coupon below. If none of the forms listed in the catalog meet your needs, our engineers will be glad to work with you to adapt them. *General Electric Co., Schenectady 5, New York.*

General Electric Company, Section B676-142
Schenectady 5, New York

Please send me Bulletin GEA-3818, which gives detailed information on Switchettes.

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COMPANY .....

ADDRESS .....

.....

8946

GENERAL ELECTRIC

BUY WAR BONDS

CRYSTAL DIMENSIONING

(*Continued from page* 154)

verified ratios accumulate, it appears that they lie not on a straight line with respect to frequency but may be very closely fitted with an hyperbola, or inverse ratio curve. With this knowledge and three well-separated, verified frequency-ratio points, we may derive an equation from which the ratio for all other points may be accurately ascertained—a fact which is easily verified experimentally.

It is to be remembered that the curve thus derived will not be unique. Further exploration will discover other curves lying, roughly, parallel to it.

But when this charting has been completed the manufacturer will be in a position to know that a crystal of a given cut and frequency, accurately cut, lapped, dimensioned and finished, and mounted, will differ by a minimum amount from any other similarly processed.

OWI 200 KW UNITS

(*Continued from page* 103)

loops. The schematic diagram of Fig. 5 shows the details of the equipment and indicates the tube types used.

The line amplifier equipment in the control room feeds audio frequency energy to the low power unit at a level of about 10 vu. From there it is passed to the intermediate amplifier, and thence to the modulator stage, which is designed to use either four or six Federal F-125A tubes operating Class AB, that is, without grid current. The four-tube complement is used when modulating two 50 kw power amplifiers, instead of the 200 kw amplifier. As will be noted in the circuit diagram, two Federal F-872 mercury-vapor rectifier tubes are connected across the grid circuit of the F-125A modulator stage for protection again current surges due to possible grid-plate flash-over.

Overall audio frequency response of the audio amplifier-modulator equipment is within 0.5 db of the 1,000-cycle level from 30 cycles to 10,000 cycles. Harmonic distortion is less than 5 per cent from 50 to 7,500 cycles at 95 per cent modulation.

The main rectifier has twelve Federal F-857A mercury-vapor rectifier tubes, arranged in banks of six, in a three-phase, full-wave rectifier circuit to supply 12,000 volts for the 200 kilowatt power amplifier. A seventh F-857A tube is included in a stand-by position with each group of six rectifier

(*Continued on page* 162)

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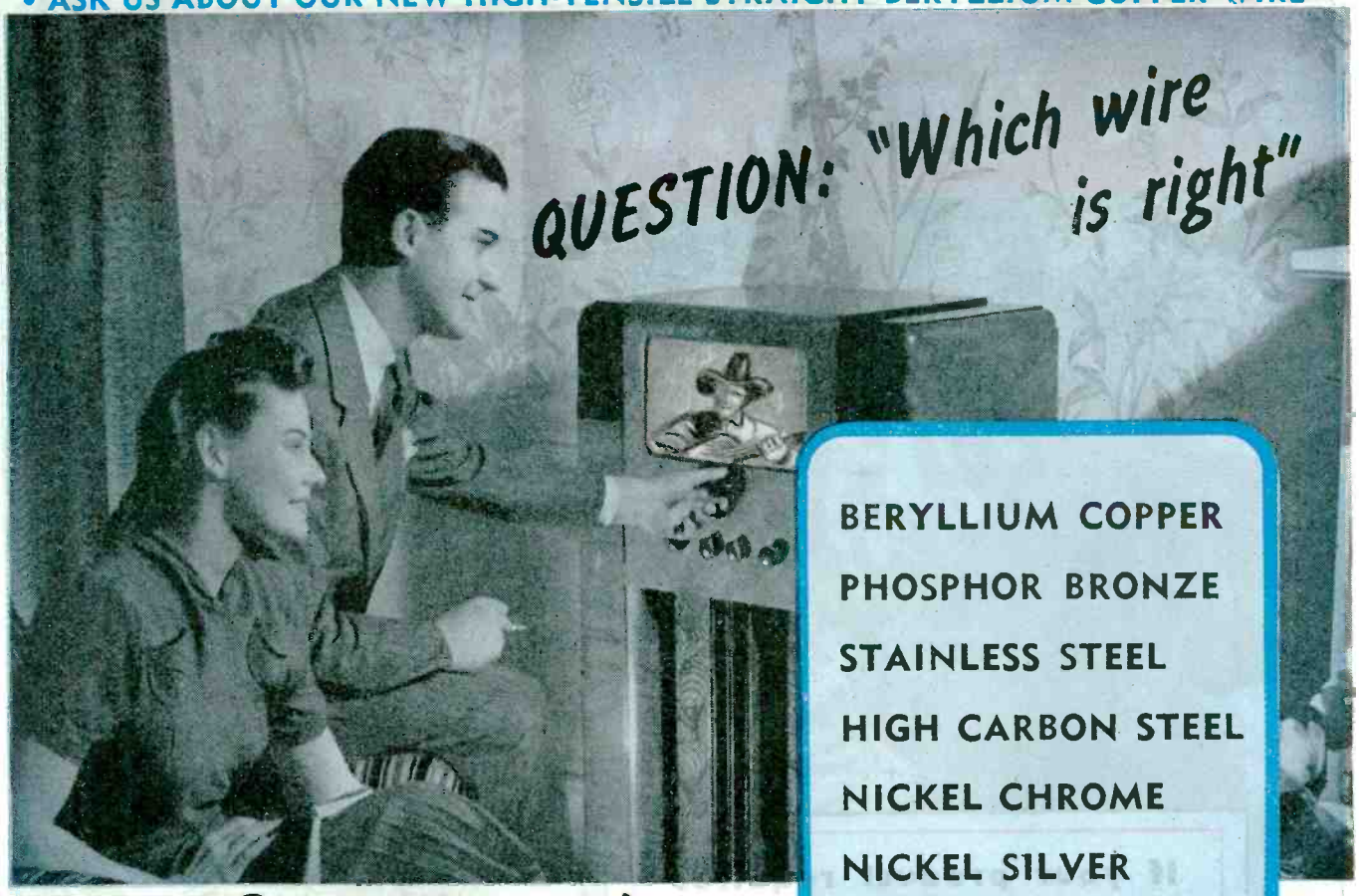

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829 NEWARK AVENUE, ELIZABETH 3, N. J.

OWI 200-KW UNITS

(Continued from page 158)

tubes, to be switched into service in the event of failure of one of the active tubes.

The transformer bank is connected in delta-delta to permit operation at reduced power if one of the transformers must be removed for servicing. Output voltage of the rectifier is controlled by the motor-operated induction regulator in the 2,300 volt primary supply. Controlled either automatically or manually, this regulator holds the rectifier output to any selected voltage between 8.0 and 12.5 kilovolts. In automatic operation of the regulator, opening of the primary circuit breaker instantaneously sets the regulator at its lowest operating position, so that when the circuit breaker is closed the rectifier will start at a reduced voltage and slowly reach any predetermined value.

The international broadcast transmitters at both the Dixon and the Delano stations are now in operation about 20 hours per day. In the design of the equipment for these stations ample margin of safety has been stressed to assure uniformly high performance free from interruptions due to breakdown of components. At the same time, this has been accomplished without any sacrifice in flexibility, the motor-operated tuning controls in the 200 kw power amplifier being particularly useful in making rapid changes of frequency. Though departing in several important respects from the design of more conventional lower powered amplifiers, the basic design of the 200 kw power amplifier has proved completely dependable, entirely practical and highly efficient.

Automatic Ball Sorter

Sorting commercial grade steel balls already accurate to .0005 in. into ten sizes accurate to .00001 by letting them roll down a pair of fine knife edges set at taper may be an old story, but Jack & Heintz, Inc., Cleveland, have given it an electronic twist by incorporating a self feeding and gating mechanism. In this automatic ball gage, the operator need only fill the plexiglass hopper. Four machines sort more balls than 32 hand operators and don't make mistakes.

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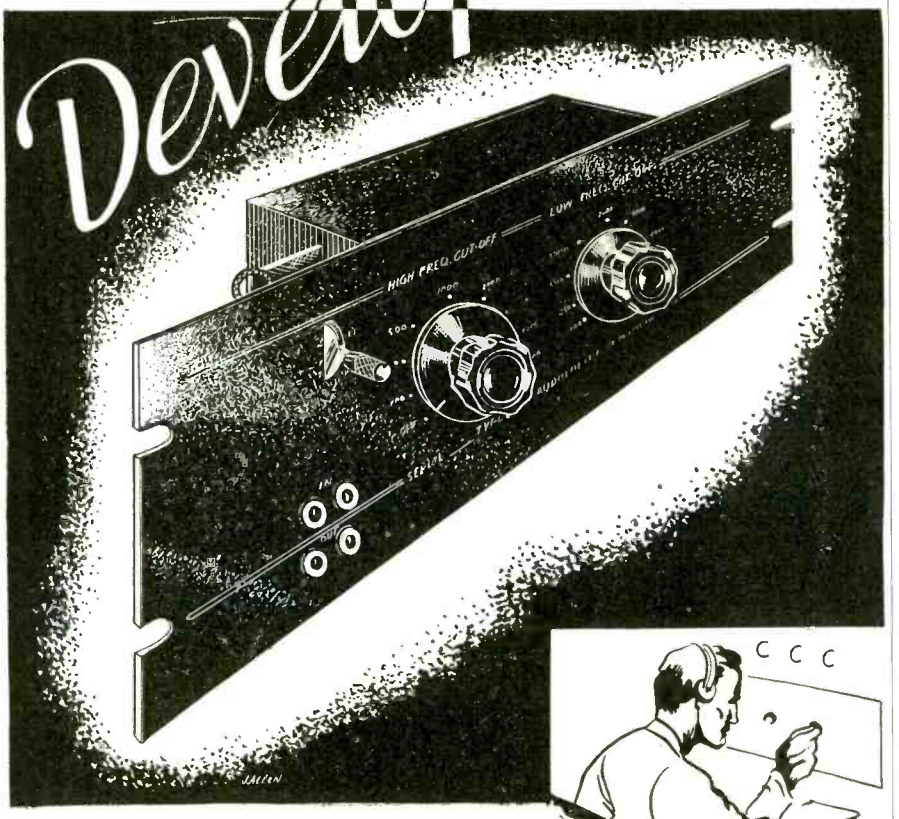

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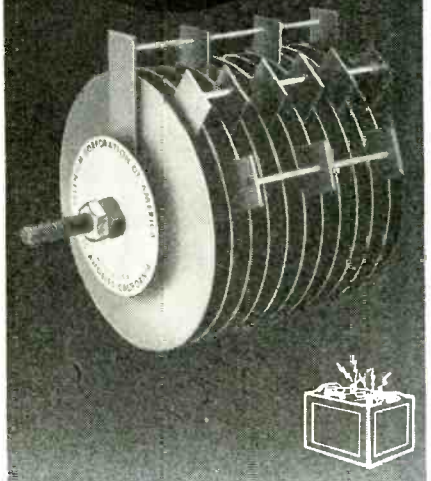

DC means SC . . . Selenium Conversion in battery charging. Fully automatic . . . absolute dependability over wide temperature range . . . elimination of maintenance costs . . . no harmonics in DC wave . . . power failure protection . . . small . . . compact . . . moisture and fungi proof . . . immunity to corrosive fumes . . . these features prove that DC means SC . . . Selenium Conversion in battery charging. If you use DC . . . get the facts on SC!

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Westinghouse

Electronic Tubes at Work

WIDE READING

(*Continued from page* 113)

galvanometer is recorded photographically, and the resulting records have the appearance of a modulated carrier wave.

Accessory equipment

Two similar electronically regulated power supplies are provided; the heater supply is diagrammatically illustrated in figure 2. Upon an increase in heater voltage, the grid potential of tube 6SF5 2 increases, that of the right-hand section of the tube 6SC7 2 decreases, while that of the left-hand section increases, causing the plate potential of the left-hand section to decrease cutting off current through the 5 6L6 tubes connected in parallel.

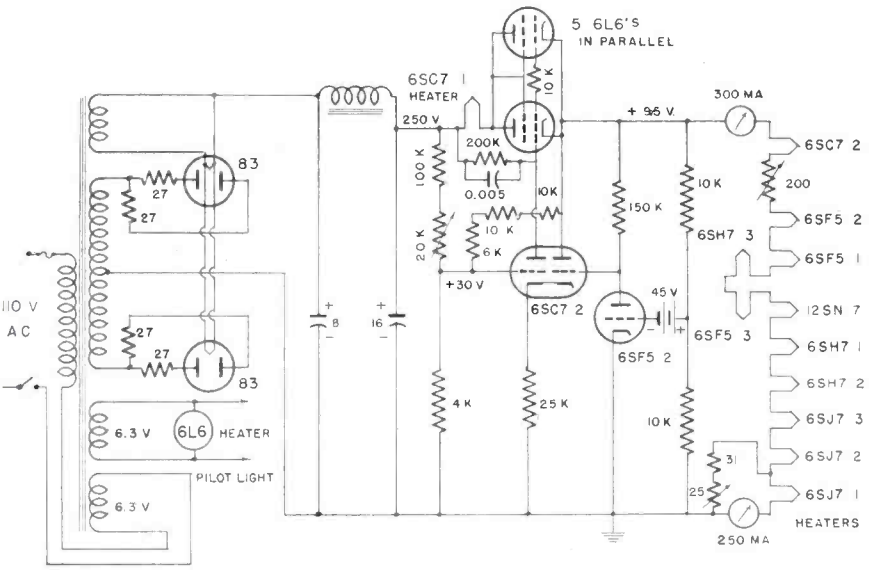

Fig. 2. Electronically regulated power supply for stabilizing the heater voltages

It is important that the operator be able to observe the output of the thermocouple amplifier while obtaining a spectrum. Provision of a portable output meter satisfies this requirement. A two tube amplifier and vacuum tube voltmeter combination connected to the plate of the 6SJ7 1 tube is used for the visual indicator.

Test methods are described and details of the operation and performance of the circuit given; the noise behavior is illustrated by oscillograms taken with different inputs.

Degassing of Metal Alloys

W. Esmarcht, T. Rommel and K. Benther (W. V. Siemens Werke, Werkstoff Sonderhefte, Berlin, 1940, pp. 78-87; reported in Electronic Engineering, London, July, 1945).

The passage of an ultrasonic wave through a liquid is accompanied by the liberation of gas bubbles, and therefore these waves can be used for degassing metallic melts. The method described proposes the generation of waves directly inside the molten metal.

In the electric furnace discussed (operating frequency of the order of 10 kc), the heat production is caused by the formation of eddy currents in the charge. These eddy currents, in addition, cause a rotary motion of the molten metal, which favors the absorption of air by the molten material and counteracts to some extent the degassing effect of the rise in temperature.

By superimposing a constant magnetic field on the high-frequency field of the furnace, mechanical vibrations are induced in the melt, the force at each point being proportional to the product of the local current density and the field strength and acting radially to the coil axis. By a suitable choice of bath dimensions, resonance effects can be produced which increase the intensity of the vibrations. We thus have a method of generating high-frequency waves within the melt.

In the experiments a 10,000 cycle generator delivered a current of the order of 100 amperes to the furnace coil. The total energy consumption amounted to about 15 kw, of which 10 kw were supplied by the high frequency generator. With a specially designed heating coil, the energy consumption for the steady magnetic field could have been reduced very considerably. The experiments were carried out with 8 to 10 kilograms of melts of pure aluminum and aluminum-magnesium alloys, the temperature was kept constant at 700 deg. C. Samples were drawn off every 10

(*Continued on page* 170)

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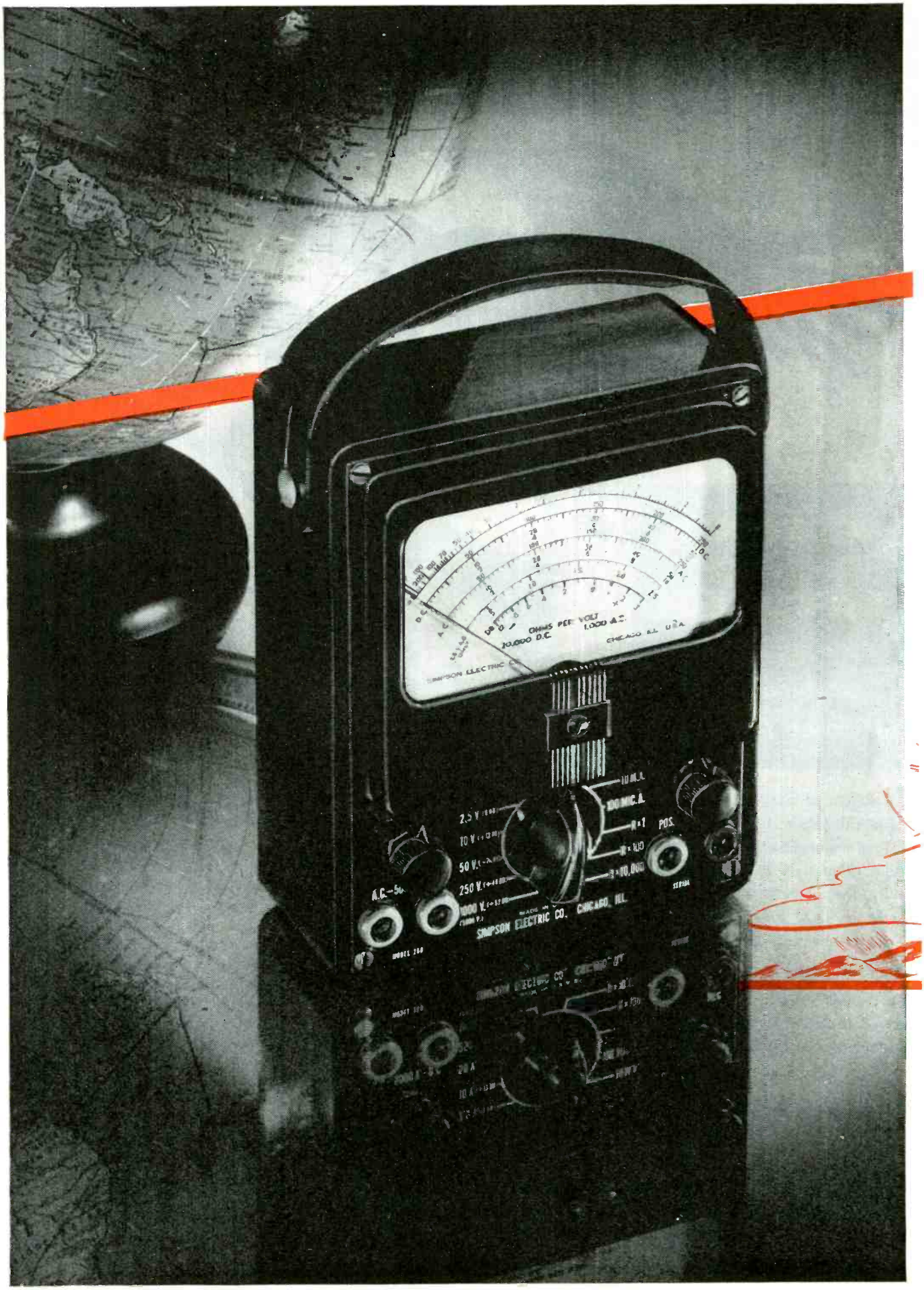
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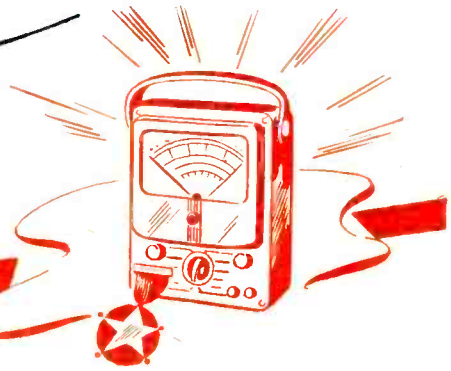

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Originally designed as a radio serviceman's test unit, the Simpson 260, because of its sensitivity and wide range was found adaptable to general service duties in the entire electronics and electrical fields. Not a warborn instrument, the 260 was given thousands of essential war jobs in the production and servicing of communications equipment. It made a vital contribution to the success of tactical operations.

Over 300 government agencies and university laboratories of the United States and Canada procured every one of these test instruments Simpson could deliver on an expanded war production schedule. They were turned out by the thousands. Every branch of the armed services—Army, Navy, Marines, Coast Guard—carried them to the far ends of the earth. They were compelled to perform under conditions often so arduous that testimonials of amazement at their ability to function at all became commonplace as the record grew.

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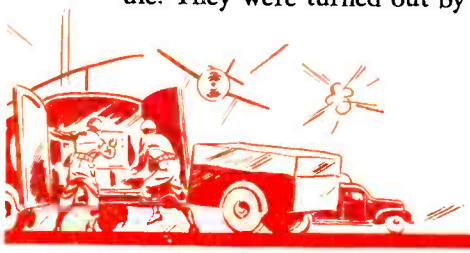

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10	10	10 V.	100		0-100,000	(1200 ohms center)
50	50	50 V.	500		0-10 Megohms	(120,000 ohms center)
250	250	250 V.				
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5000	5000	5000 V.				

(5 Decibel ranges: —10 to +52 DB)

WATCH FOR NEW SIMPSON DEVELOPMENTS. THEY WILL BE WORTH WAITING FOR!

WIDE READING

(*Continued from page* 166)

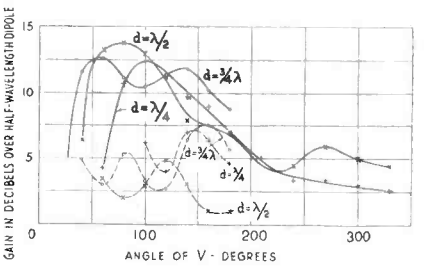
minutes and the gas content determined by the vacuum method.

It appears that alloys containing even relatively large percentages of Mg can be completely degassed by this method in 30 to 60 minutes, provided the surface of the melt is protected by a fused salt layer and that dry air or nitrogen is directed onto the surface during the treatment. The salt used had the following composition: KCl 40 per cent, NaCl 30 per cent, NaCi 30 per cent, $CaCO_3$ 15 per cent, NaF 15 per cent.

Polar Diagrams for Antennas

J. S. McPetrie, L. H. Ford and J. A. Saxton (Wireless Engineer, London, June, 1945)

Experiments are reported on the directional properties of a half-wavelength receiving antenna associated with a V-shaped wire-netting reflector. Polar diagrams were measured with 50 cm waves for various angles of the V between 80 deg. and 330 deg. and distances of the antenna of quarter, half and three-quarter wavelengths from the apex of the reflector. The antenna was placed either parallel or pendicular to the apex of the reflector; measurements with the antenna in the plane of a sheet reflector are also discussed. A great number of polar diagrams obtained are reproduced in the text. The figure shows the variation of gain in the direction of maximum received signal with angle of V for three distances d between antenna and apex of V. The full-lines were obtained with the antenna parallel to the apex of the V, the dotted lines with the antenna at right angle to the apex of the V.



Directional characteristics of half-wave antenna associated with V-shaped reflector

The following results are stated: The backward radiation decreases as the angle of the V is decreased. The backward radiation increases with increase in antenna-reflector distance. If the antenna is parallel to the apex and for angles of V in the neighborhood of 80 deg. to 100 deg., there is no appreciable change in the polar diagram or gain with

(*Continued on page* 174)

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WIDE READING

(*Continued from page* 170)

change in antenna reflector distance over the range of one quarter to three-quarter wavelengths. By using an antenna in the plane of a flat sheet reflector it is possible to obtain a polar diagram showing an almost uniform sensitivity for a signal received from any direction over an arc of 180 deg., combined with a reasonably sharp minimum when the sheet is in the plane connecting the transmitter and receiver. This property might be of use for direction finding purposes.

Dielectric Heating for Gluing of Wood

D. I. Lawson (Electronic Engineering, London, August, 1945)

An investigation is made into the relative efficiencies of longitudinal and transverse heating applied to the gluing of wood. In longitudinal heating the electric field is applied along the lines of glue, in transverse heating it is applied at right angles to the lines of glue.

Equivalent circuits for the two arrangements, assuming the load to be tuned to resonance, are considered and the following formulae are derived:

$$a_L = \frac{1}{1 + \frac{N\epsilon_w c \tan.\beta_w}{(N-1)\epsilon_g d \tan.\beta_g}},$$

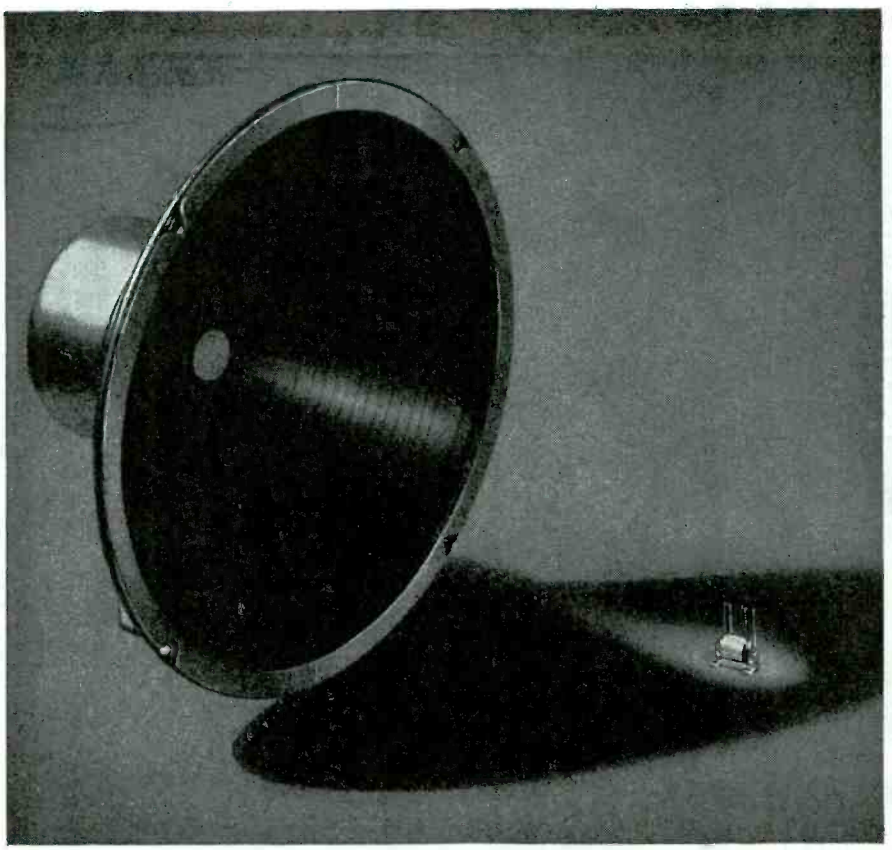
$$a_T = \frac{1}{1 + \frac{N}{(N-1)}\frac{\epsilon_g c \tan.\beta_w}{\epsilon_w d \tan.\beta_g}}.$$

a_L is the fraction of the total radio frequency power dissipated in the glue line with longitudinal heating and a_T the same fraction for transverse heating; N is the number of wooden sections, N-1, consequently, the number of glue lines; ϵ_w and ϵ_g are the dielectric constants of wood and glue, respectively, while tan β_w and tan β_g are the power factors of wood and glue; c and d are the width of the wood and the glue sections, respectively.

The two formulae differ in that the dielectric constants of wood and glue are interchanged. To obtain maximum efficiency, longitudinal heating is to be preferred if the dielectric constant of the glue exceeds that of the wood and transverse heating if the dielectric constant of the wood exceeds that of the glue.

An advantage of longitudinal heating is that in dealing with thick wooden blocks it is possible in effect to reduce c by using a series of platens covering the glue lines only and missing the bulk of wood in between.

(*Continued on page* 178)



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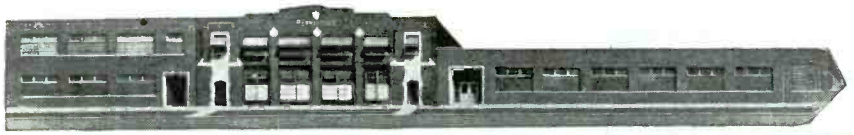
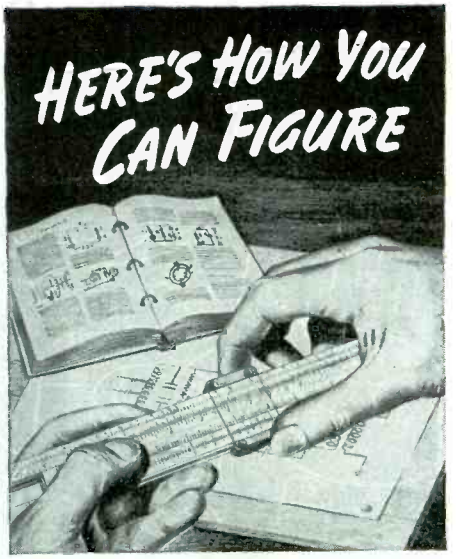


PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS



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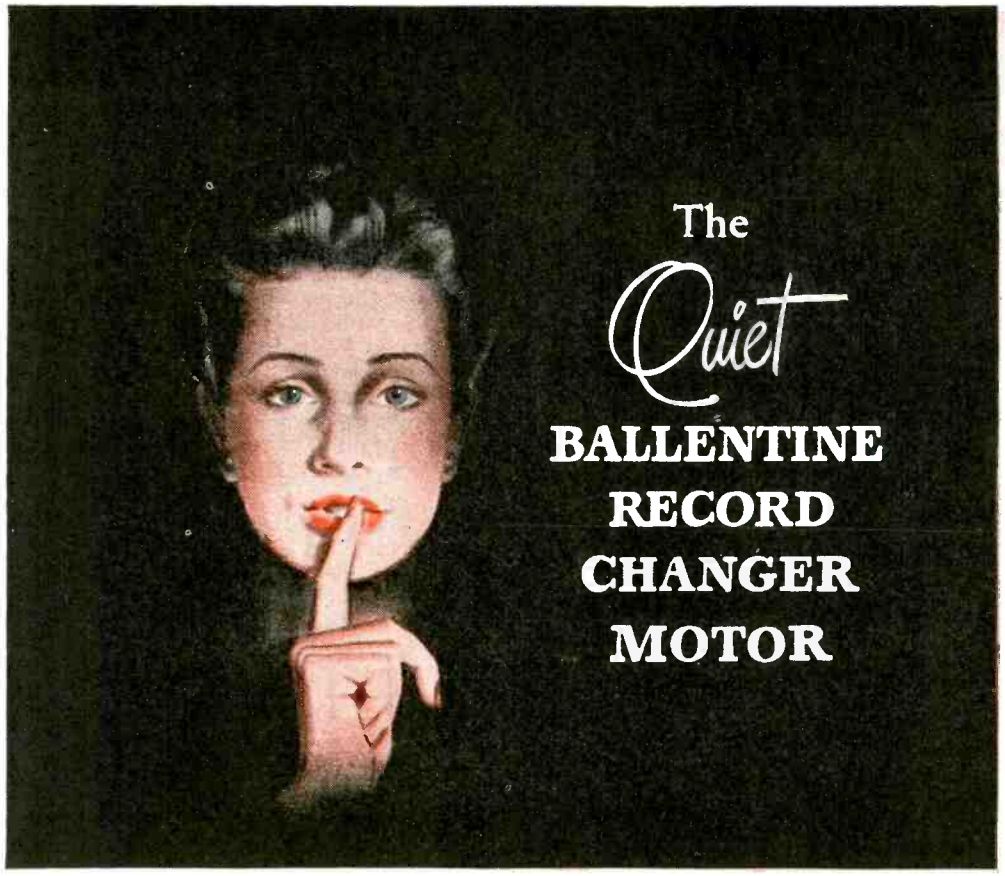

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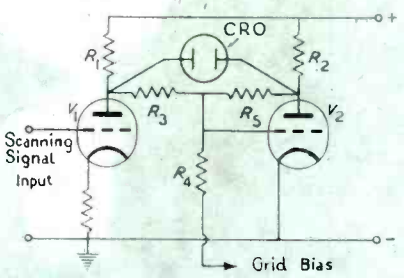
WIDE READING

(*Continued from page* 174)

Balanced Amplifier

E. M. I. Laboratories (Electronic Engineering, London, July, 1945)

It is frequently required to feed unbalanced signals to an amplifier feeding a balanced output circuit. A typical sawtooth wave amplifier for the sweep circuit of a cathode ray tube is shown in the drawing. Tube V_2 is driven by a fraction of the output voltage derived from the plate of tube V_1 and its output voltage developed across resistor R_2 is applied to one plate of the cathode ray oscillograph.



Balanced saw-tooth wave amplifier circuit

A resistor R_5 introducing negative feedback is inserted in this conventional circuit. It tends to prevent any deviation of the amplitude of the plate voltage of V_2 from the amplitude of the plate voltage of V_1 maintaining a balanced output. By suitable choice of the values of R_3, R_4 and R_5, the swings on the plates of V_1 and V_2 are made equal in magnitude and of opposite sign.

As the feedback path passes both ac and dc, the mean potential of the plates will also be stabilized. If ac balancing is not required, series capacitor may be inserted in the feedback path. On the other hand, should the dc stabilization be desired without ac stabilization, the feedback circuit must be designed to pass dc and no ac, as for example by including series inductance.

Bendix Establishes International Division

The formation of a new division, Bendix International, to handle the comprehensive foreign trade program of Bendix Aviation Corp., has been completed and will be under the direction of Charles T. Zaoral. The new division will handle throughout the world, with the exception of the United States and Canada, the products of the seventeen divisions of the corporation. It has established headquarters at the corporation's New York office, 30 Rockefeller Plaza.

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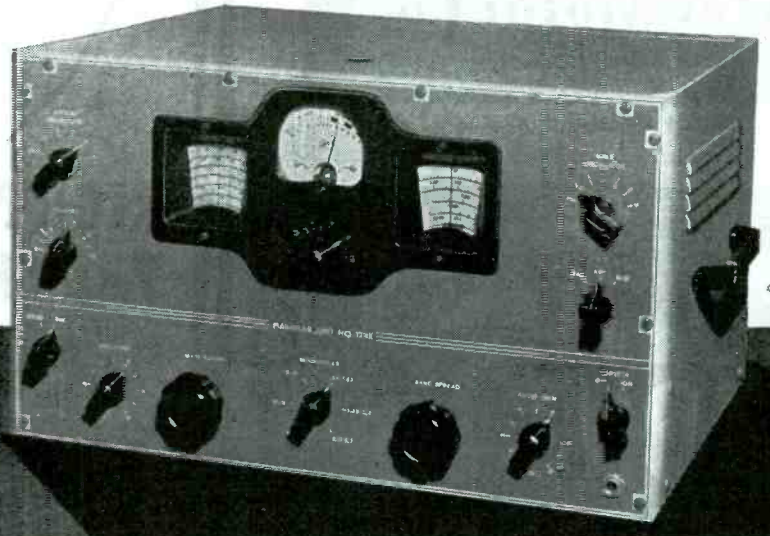

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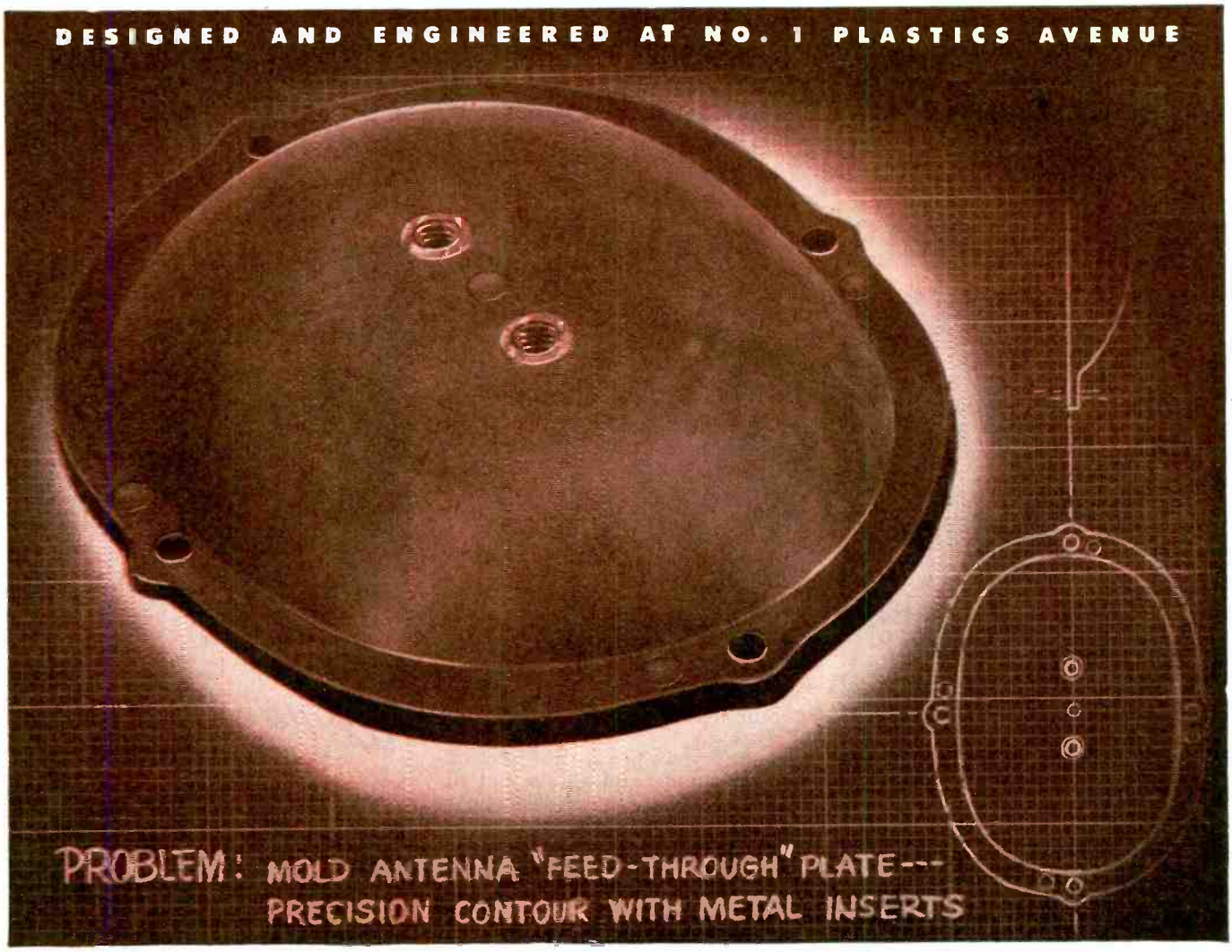

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Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "G-E House Party" every weekday 4:00 P.M. EWT, CBS.

GE MYCALEX

GENERAL ELECTRIC

CD-45-M3

BUY VICTORY BONDS AND HOLD THEM

STRAIN GAGE

(*Continued from page* 79)

tween the strain gage circuit and the oscillograph galvanometer, inasmuch as the available power output of the strain gage bridge circuit is insufficient to drive the galvanometer directly.

If a source of direct current power is applied to the strain gage bridge, the output of the bridge during the measurement of dynamic strain will be a varying or an alternating current of the same wave shape as the strain itself, and the amplifier must be designed to handle all of the frequency components contained in the strain pattern. If the strain is maintained at a steady value for any appreciable time and it is necessary to measure this steady value, the amplifier must be direct-coupled so that its response will go down to zero frequency. The upper limit of uniform frequency response must be high enough to handle the highest strain frequency component that will be encountered or that it is desired to measure.

Amplifiers to cover a wide range of dynamic response, such as from 5 to 1500 cycles per second, are reasonably simple and stable, but direct-coupled amplifiers designed to go down to zero frequency are unwieldy and usually unstable, hence it is usually unsatisfactory to measure static strain by means of circuits utilizing a direct current in the strain gage bridge circuit.

When it is desired to measure static as well as dynamic strain, the usual procedure is to supply the strain gage bridge circuit with an alternating carrier voltage three or four times higher in frequency than the highest strain frequency component to be measured. The output of the strain-gage bridge will then be an alternating current of carrier frequency amplitude modulated by strain. The amplifier can then be designed to handle the carrier with side bands which constitute a relatively narrow frequency band that does not approach zero as a lower limit.

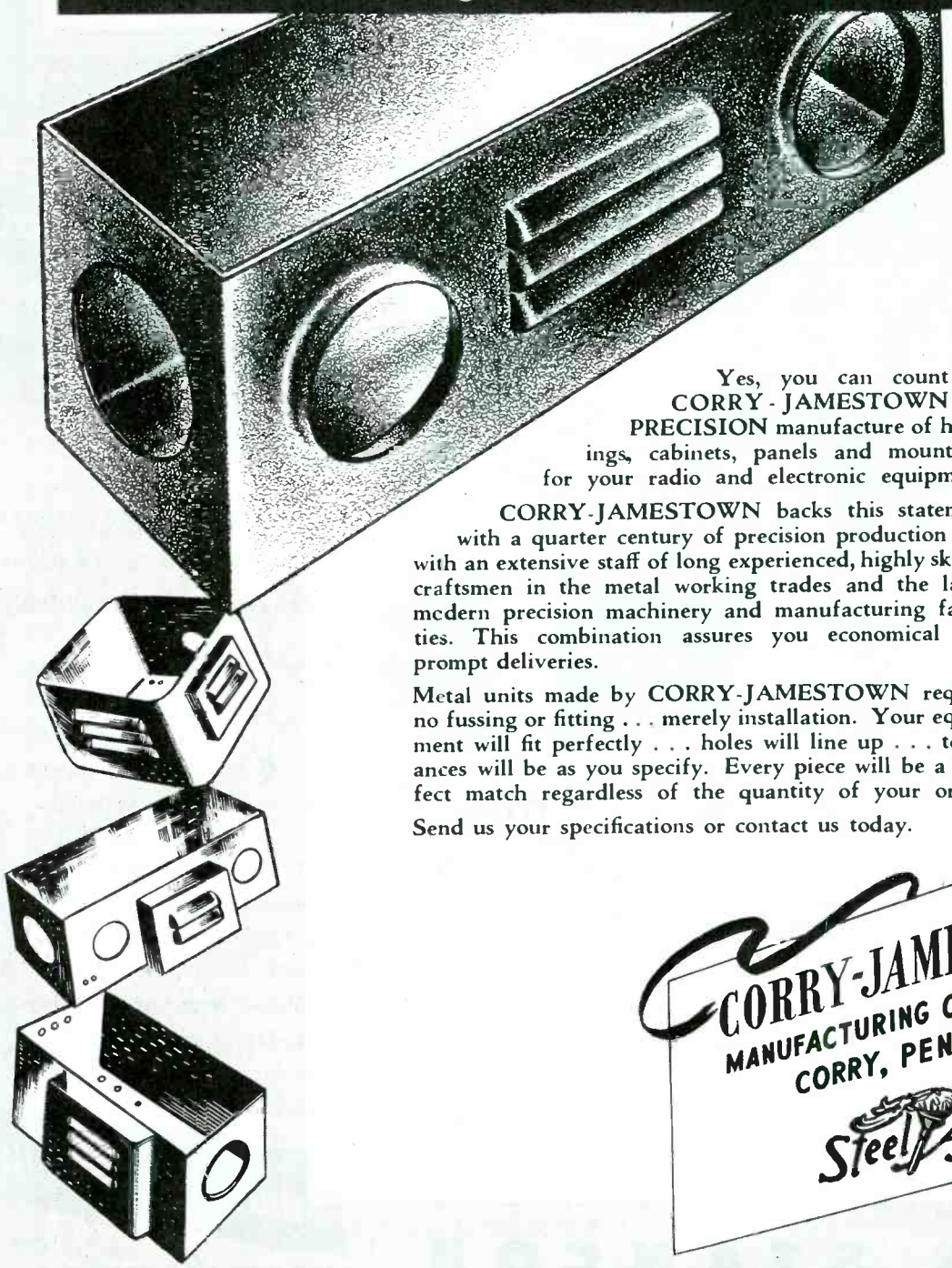
The use of a carrier supply to the strain gage bridge makes possible a very simple and stable amplifier, capable of measuring static as well as dynamic strain.

Circuits

Circuits. Fig. 13 shows a typical amplifier circuit for direct current in the strain gage circuit and a wide-band low-frequency ac amplifier. This diagram shows the strain gage bridge, the oscillograph galvanometers and the intermediate amplifier equipment. This is the circuit used in the type MRC-10AC amplifier element, and is capable

(*Continued on page* 186)

Count on CORRY-JAMESTOWN *for* PRECISION



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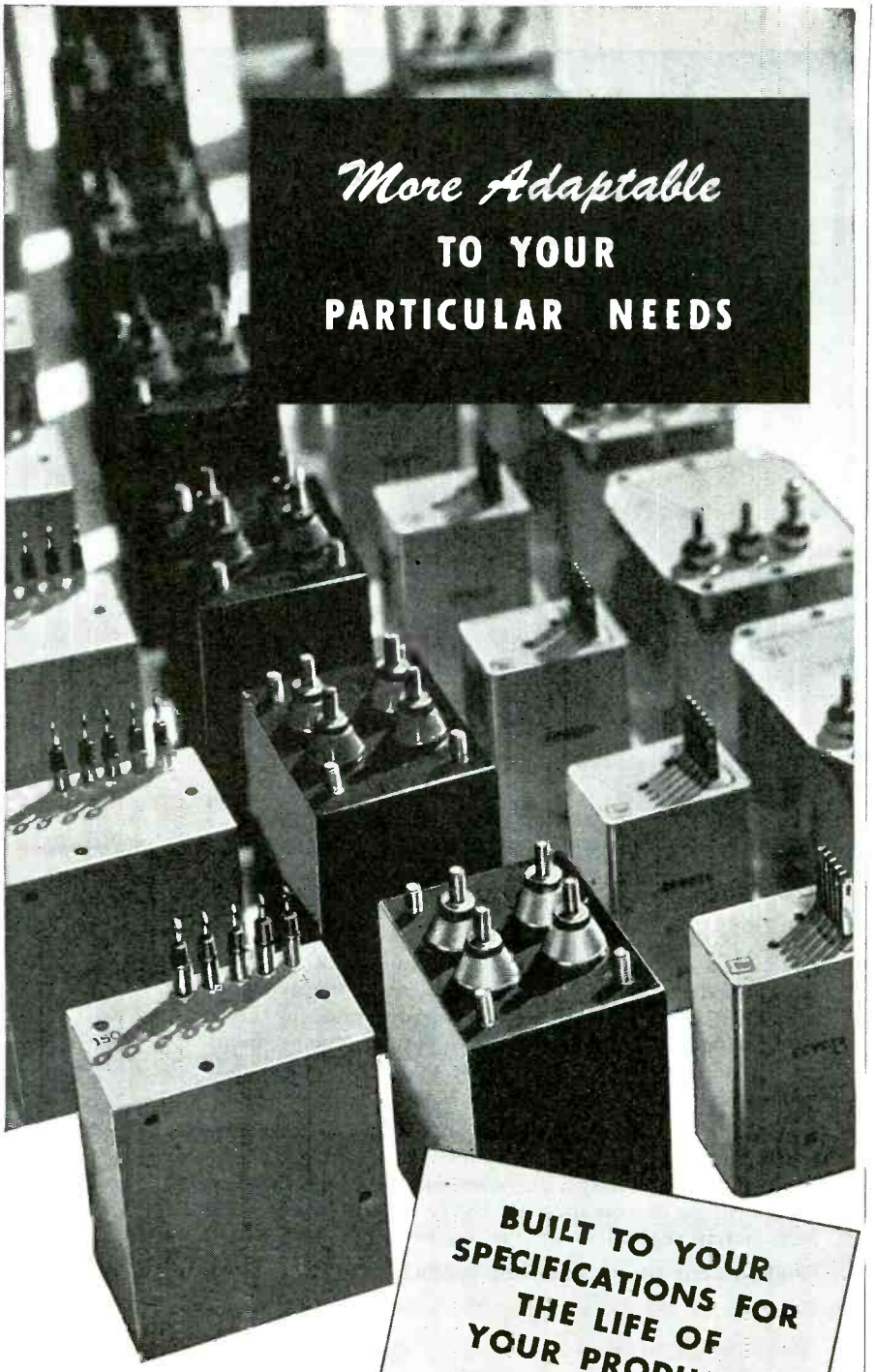

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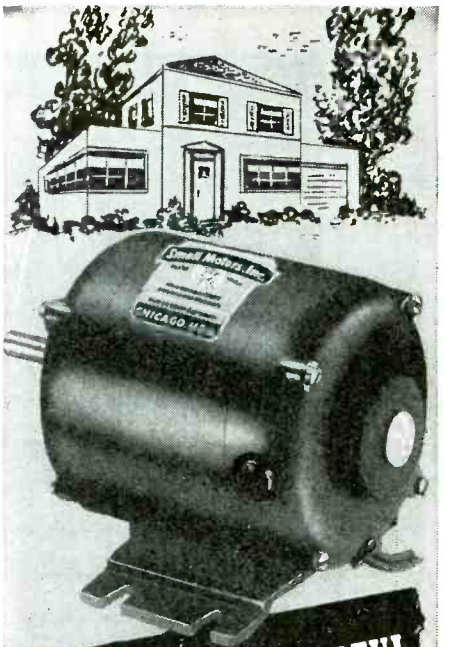

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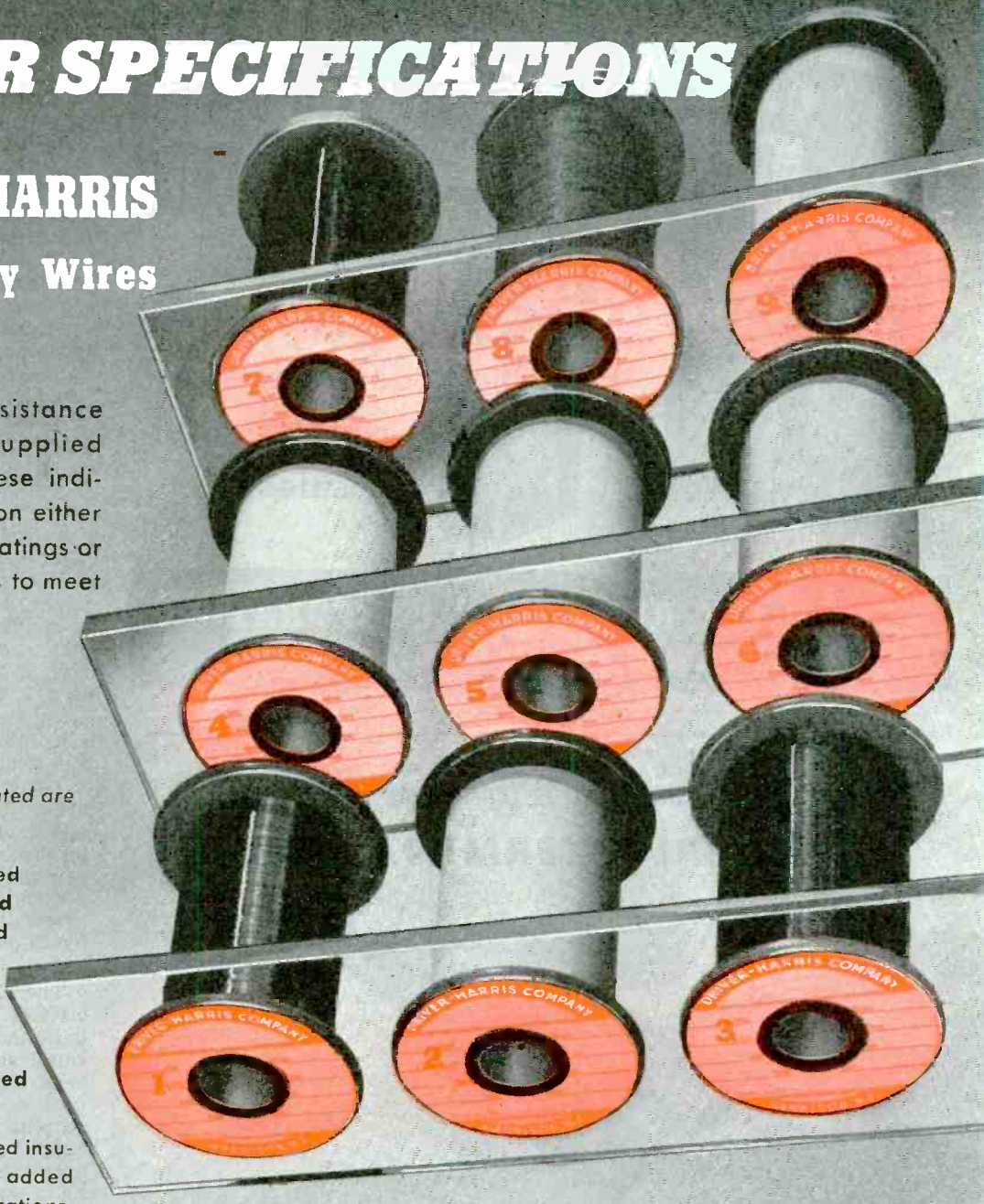

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STRAIN GAGE

(*Continued from page* 182)

of providing a flat strain frequency response on the record from 3 to 3000 cycles per second.

Fig. 14 shows a typical amplifier circuit using a carrier in the strain gage circuit, and an amplifier with flat frequency-response over a range wide enough to cover the carrier and both side bands. This circuit has a phase-selective demodulator in the output circuit that removes the carrier and that provides for galvanometer deflection in one direction for strains of compression and in the other direction for strains of extension. The galvanometer receives a varying current for varying strain, the strength of which is instantaneously proportional to strain. This circuit uses a 5000-cycle carrier and provides a flat strain frequency response from 0 to 1500 cycles per second.

Multi-channel unit

Typical Apparatus. The type MRC-10 strain gage control unit is shown in Fig. 15. This is a 12-channel unit, for which three types of amplifier elements are available which can be inserted in the control unit in any desired combination. The MRC-10AC amplifier element, circuit diagram shown in Fig. 13, uses direct current in the strain gage circuit and provides a frequency response of 0 to 1500 cycles per second. A third element is a double-integrator unit that can be used in connection with an accelerometer unit to provide displacement records. The unit has external dimensions of 14 in. long by 23 in. wide by 15 in. high, and weighs 123 lb.

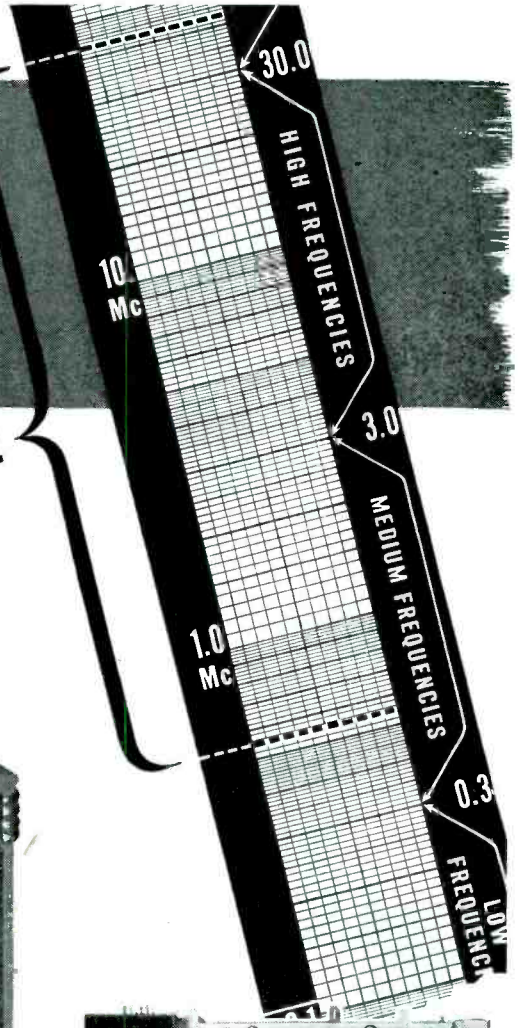
The type MRC-12 strain-gage control unit is a six-element unit designed for application where small size and extreme portability is of paramount importance. This unit contains six separate carrier amplifier elements, a carrier power supply oscillator, and all necessary batteries for its operation mounted in a case only 12 x 8 x 7 in. external dimensions. The total weight of this unit, including batteries, is less than 25 lb. A carrier frequency of 2000 cycles is used, and a flat strain frequency response of 0 to 500 cycles per second can be obtained.

Power supply equipment

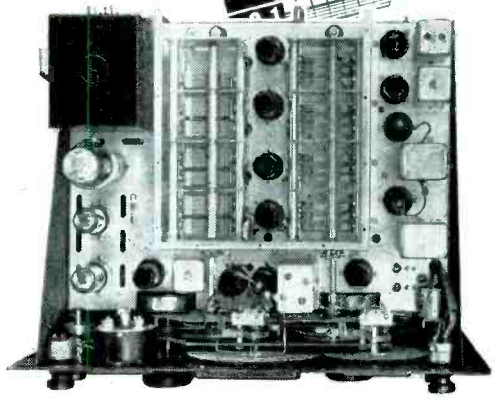
Power requirements for strain-analysis equipment depend on the type of strain gage employed, and on the type of circuit. Large inductance gages used to drive the oscillograph galvanometer directly re-

(*Continued on page* 190)

HOW hallicrafters EQUIPMENT COVERS THE SPECTRUM



MODEL SX-28A — from 550 kc to 42 Mc



HALLICRAFTERS Super Skyrider, Model SX-28A, covers the busiest part of the radio spectrum – standard broadcast band, international short wave broadcast bands, long distance radio telegraph frequencies, and all the other vital services operating between 550 kilocycles and 42 megacycles. Designed primarily as a top flight communications receiver the SX-28A incorporates every feature which long experience has shown to be desirable in equipment of this type.

The traditional sensitivity and selectivity of the pre-war SX-28, ranking favorite with both amateur and professional operators, have been further improved in this new Super Skyrider by the use of "micro-set" permeability-tuned inductances in the RF section. The inductances, trimmer capacitors and associated components for each RF stage are mounted on small individual sub-chassis, easily removable for servicing.

Full temperature compensation and positive gear drive on both main and band-spread tuning dials make possible the accurate and permanent logging of stations. Circuit features include two RF stages, two IF stages, BFO, three stage Lamb-type noise limiter, etc. Six degrees of selectivity from BROAD IF (approximately 12 KC wide) for maximum fidelity to SHARP CRYSTAL for CW telegraphy are instantly available. Speaker terminals to match 500 or 5000 ohms are provided and the undistorted power output is 8 watts.

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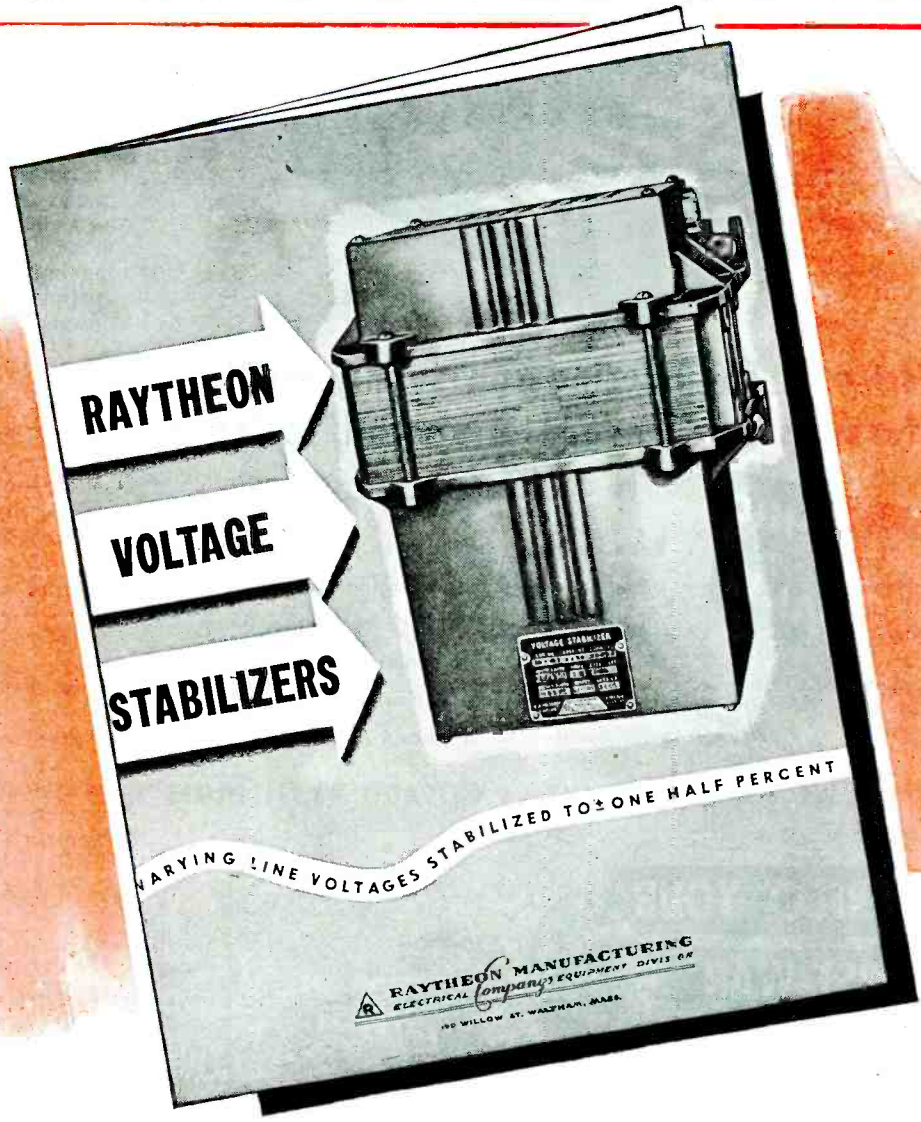

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ELECTRICAL EQUIPMENT DIVISION

Excellence in Electronics

STRAIN GAGE

(*Continued from page* 186)

quire only a source of carrier power accurately controlled in regard to voltage and frequency. A frequency of 2000 cycles is usual for gages of this type, and this can be supplied by a rotating attenuator or by a vacuum-tube oscillator, followed by a power amplifier. The latter type of supply has been found superior to the former because of better voltage regulation and because it has been found more difficult in the case of rotating equipment to keep the carrier output free from 60-cycle superimposed voltages.

Power supply

Small inductance gages and resistance gages operating in an attenuating-current bridge require an accurately regulated carrier source for the strain gage circuit as well as regulated direct current for the anode circuits on the amplifier and oscillator equipment.

Fig. 16 shows an electronic power supply unit to supply power for 24 large 2000-cycle inductance strain gages at the left. At the right is a power-supply unit designed for use with the type MRC-10 control unit, to supply 5000-cycle power for carrier circuits, as well as all direct-current power required by the MRC-10 amplifier elements.

Hammarlund's Death Reveals Inventions

Oscar Hammarlund, founder of the Hammarlund Mfg. Co. Inc., New York, died August 25, 1945, at his home in Brooklyn at the age of eighty-three. In 1886 he joined the Western Electric Co. as superintendent at Chicago. Six years later he went to the Gray National Telautograph Co., now Telautograph Corp., where he assisted Elisha Gray, co-inventor of the telephone, in the development of the technique of transmitting actual writing over wires. One of his outstanding contributions was the automatic stylus used in the telautograph machine. That automatic stylus was the forerunner of the present day propelling and repelling pencil. During his association with Professor Gray, Mr. Hammarlund developed a keen interest in radio communication. In 1910 he left Professor Gray's organization to found his own company for the purpose of developing his own inventions. He leaves a son, Lloyd A. Hammarlund, and three grandsons, Lt. L. A. Hammarlund, Jr., Sgt. Frazier S. Hammarlund, and Roger Hammarlund.

Eimac TUBES

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Tests Prove Eimac Vacuum Condensers Far Superior in Operating Efficiency

Ability to handle high current at high frequencies is the true measure of the performance of a capacitor. A high peak voltage rating based on low frequency measurements does not tell the whole story.

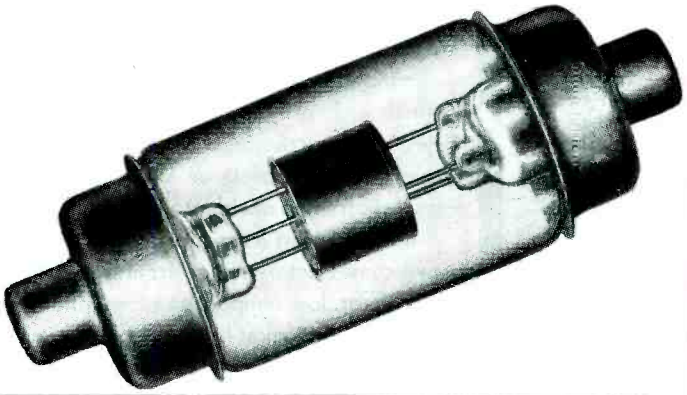
The chart on this page shows the results of tests at 50 Mc. conducted on a standard Eimac VC50-32 Vacuum Capacitor and three other 50 mmfd. vacuum capacitors, designated on the chart by "A," "B" and "C." At just over 17 amps. (approximately 1525 peak volts across the capacitor) Unit "A" (rated at many times the applied voltage) became sufficiently heated to melt the solder on the end caps. Under this same test, the Eimac VC50-32 operates at less than 70°.

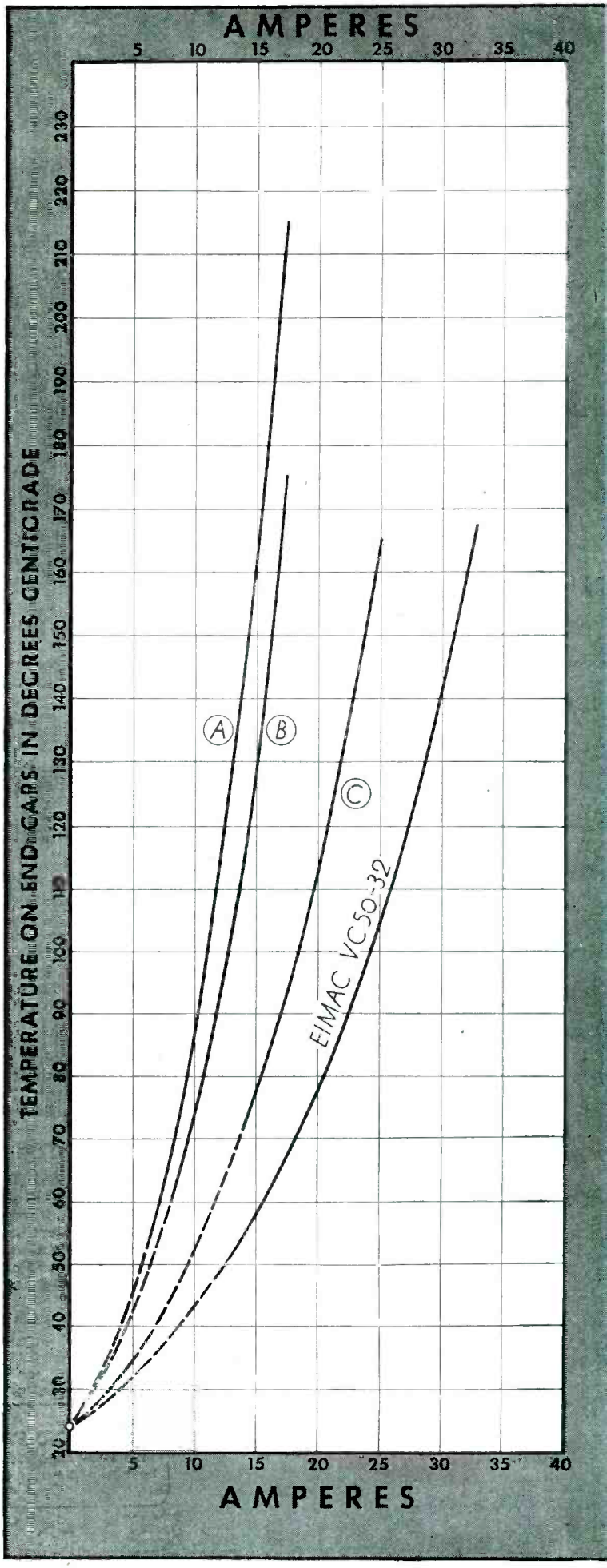
Eimac introduced the vacuum capacitor in 1938. It is interesting to note that the original Eimac capacitor design is still outperforming all comers. Such outstanding performance is typical of all Eimac products, which is one of the reasons why they are first choice of leading electronic engineers throughout the world.

Follow the leaders to

Eimac TUBES

1113





EIMAC VACUUM CAPACITOR TYPE VC50-32

General Characteristics

Mechanical:

Maximum Overall Dimensions

Length	6.531 inches
Diameter	2.281 inches

Electrical:

Maximum Peak Voltage	32,000 volts
Maximum RMS Current	28 amps.

EITEL-McCULLOUGH, INC., 1113 San Mateo Avenue, San Bruno, Calif.

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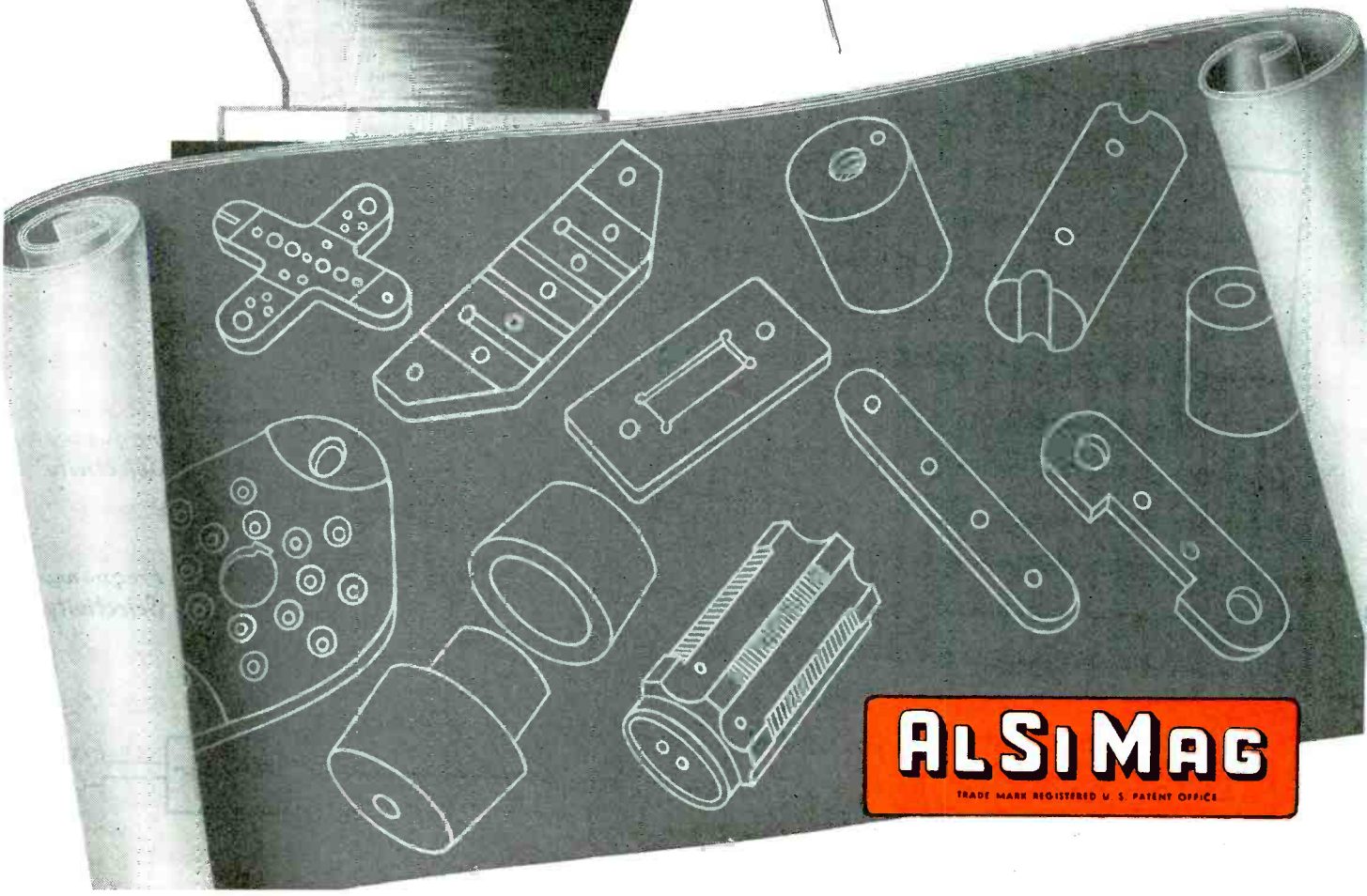
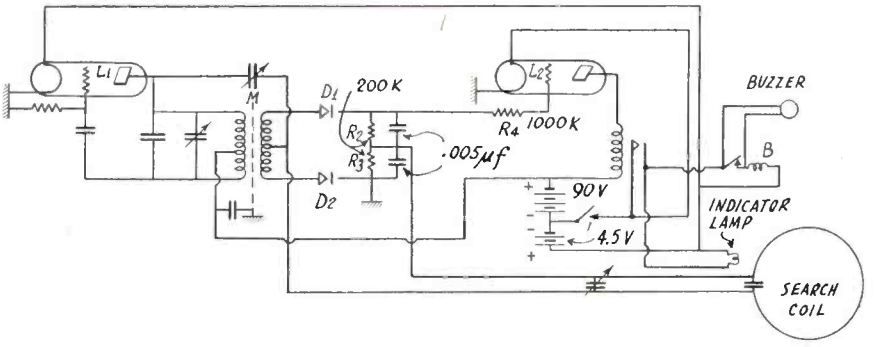


NEW PATENTS

(Continued from page 128)



are in phase quadrature, no output is obtained and R_4 is at ground potential. As soon as a metallic object reduces the apparent self-inductance of the search coil, the two voltages are no longer in phase quadrature, an output is obtained across R_4, causing the grid of L_2 to cut off current through the tube; this will actuate the control relay Q and the buzzer and indicator lamp will respond.

H. Chireix, Alien Property Custodian, (F) November 18, 1941, (I) May 22, 1945, No. 2,376,659.

FM Detector

The invention relates to an FM detector for extremely short waves below one meter which avoids the need for conventional resonant circuits. A metallic baffle 1 provided with many parallel slits 2 of the order of one wavelength wide constitutes a diffraction grating for the incoming waves. The component waves behind the baffle combine to form an interference pattern with maxima and minima of intensity. Energy collectors, for instance, dipole antennas or probes, are located at the points where the interfering waves add for maximum reception. Curves 3 represent the instantaneous wave fronts at a given instant. Zones of minimum field strength, zones of maximum field strength with frequency selectivity (i.e., the zones shift with frequency), and zones with maximum field strength with no frequency selectivity (i.e., the zones are locii of maximum field strength for all frequencies) are indicated on the drawing.

Obviously, the energy collectors 4 for frequency discrimination should be located in the latter region, as shown. The equivalent electric length of the dipole collector should be approximately one-half wavelength; a probe may be used instead of the dipole. A plurality of probes or dipoles are preferably located at different maxima and their output combined. A concave grating can be used instead of the planar baffle, in order to produce focusing in the manner of optical gratings and thus avoid most of the multiple probes.

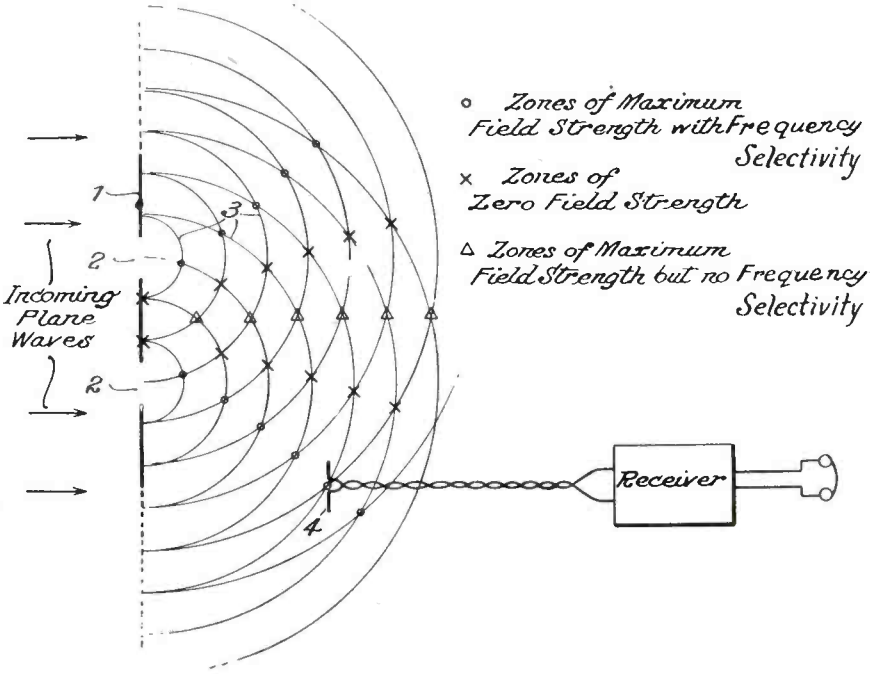
For discriminator action, the energy collectors are placed at maximum reception for the maximum frequency deviation to either side of the carrier. Less energy will be picked up at the unmodulated carrier frequency, and still less energy for the maximum frequency deviation to the other side of the carrier. Consequently, the received energy will be a function of frequency, as desired.

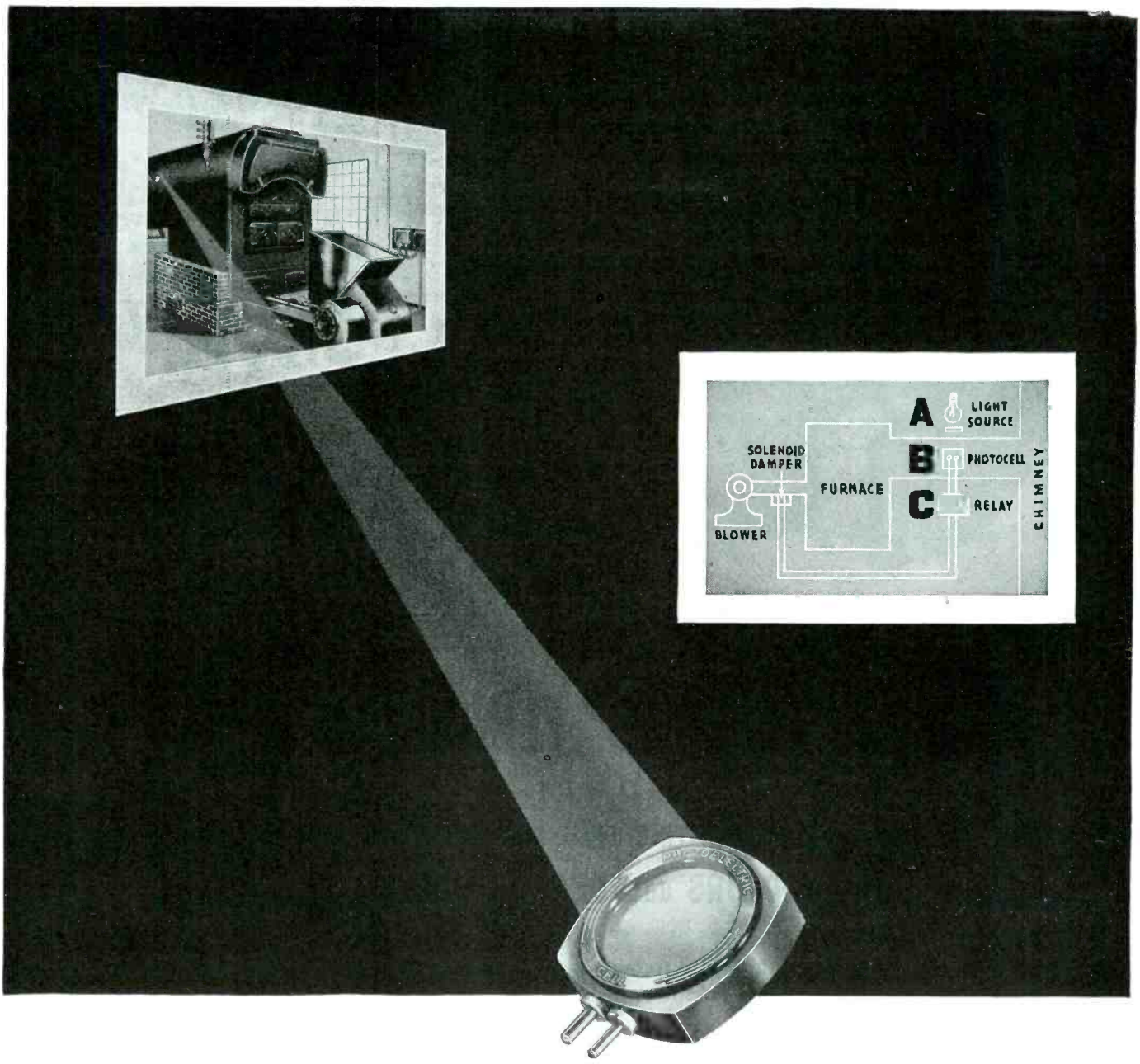
W. R. Ferris, RCA, (F) January 30, 1942, (I) January 23, 1945, No. 2,367,764.

PH Meter

The circuit is intended for measurement of small dc voltages across a source of very high internal impedance, for instance, as a pH meter indicating the hydrogen ion concentration of a solution. For this purpose the unknown voltage E_{pH} is compared to the known, adjustable voltage E, the voltage difference is converted into an ac voltage by variation of the capacitance of capacitor 3. Upon amplification in tubes 6, 7 and 8, the ac voltage is applied to the second section of tube 8 which acts as a cathode ray indicator. For zero input, the fluorescent surface of the indicator is a minimum and is of constant size; for dif-

(Continued on page 198)





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Typical of the applications possible with a Bradley Luxtron* photo*cell* is this suggested means of smoke control in a stoker-fired furnace.

Light source "A", beamed through the smoke stack to photo*cell* "B", will cause the cell to generate power sufficient to close relay "C" until smoke diminishes the light. Or the system could be arranged to close the relay when light is reflected by smoke particles.

In any event, resistance to vibration and temperature changes make the photo*cell* ideal for such an application. As in any photo*cell* application, it is as simple as A, B, C—and the "B" stands for Bradley.

Write Bradley for literature and complete engineering assistance on any photo*cell* application you may have in mind.

Write for Rectifier Data

Bradley also has available a complete line of unique copper oxide rectifiers, featuring mounting flexibility, pre-soldered terminals for ease and safety in assembly, low forward resistance with high leakage resistance, and gold coating of pellets to provide long life.

Data on five basic models are included in an illustrated Bradley "Coprox" Rectifier bulletin sent on request. Please write for it.

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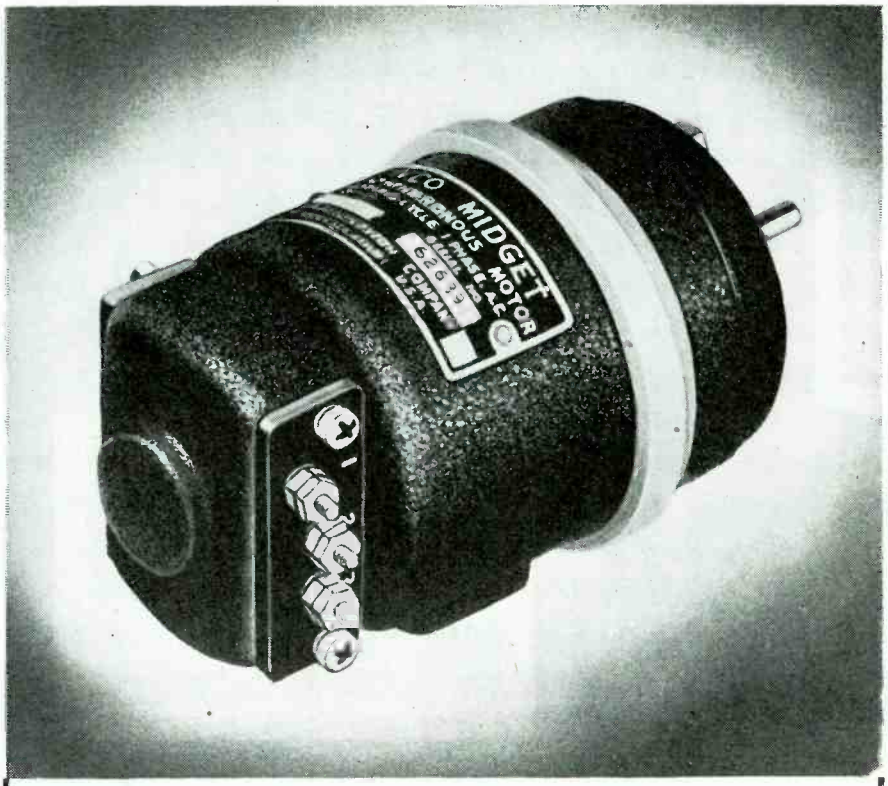

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Stainless steel shafts, aluminum die-cast housing finished in baked enamel. Overall dimensions 4" long (exclusive of shaft) by 2½" over flange. Designed for either base or flange mounting. Weight from 26 to 32 oz. according to type.

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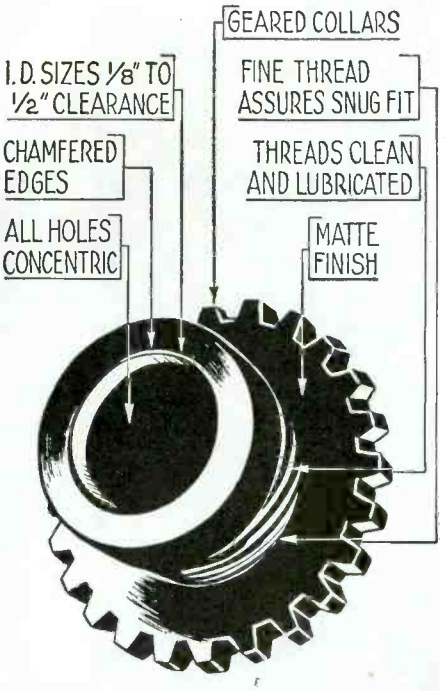

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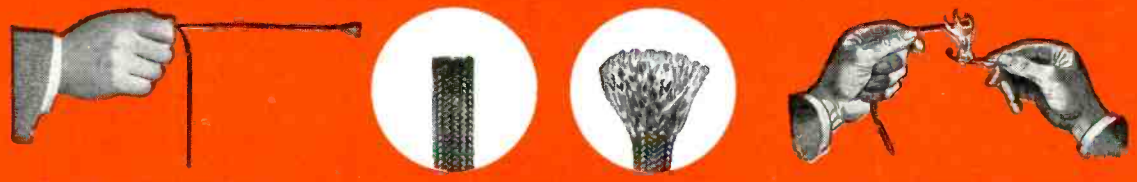

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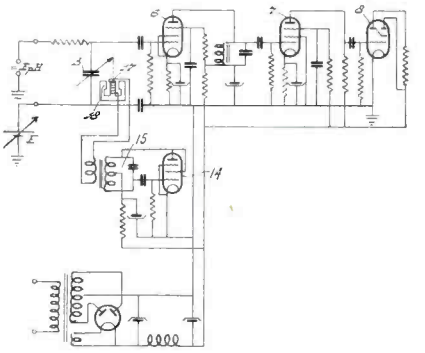
Dept. I, Conshohocken, Penna.

NEW PATENTS

(*Continued from page* 194)

ferent voltages E and E_{plt} and consequent ac voltage at the amplifier output, the fluorescent surface is larger and varies in the rhythm of the ac voltage.

The accuracy of the results of this method may be impaired if the supply voltage or a harmonic of the supply voltage has the same frequency as the ac voltage furnished by the capacitor. Undesired coupling may be responsible for erroneous results. It is the purpose of the invention to avoid this difficulty by the use of generator 14 which supplies an ac voltage the frequency of which depends only on the circuit constants of tank circuit 15 and which



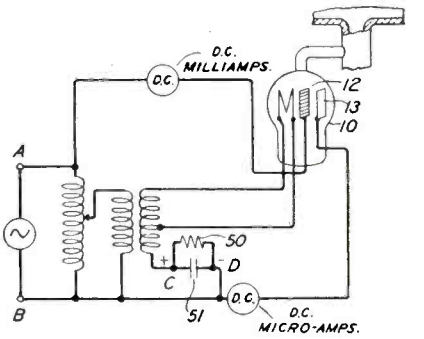
is chosen to be different from any frequency likely to be present in the supply voltage. The capacitor 3 is rigidly connected to the movable coil 17 arranged in the field of magnet 18; the current through the coil is supplied by generator 14 and it moves at the frequency of the generated oscillations different from the supply frequency and its harmonics.

C. Dorsman, Alien Property Custodian, (F) December 24, 1942. (I) March 20, 1945, No. 2,372,062.

Manometer Circuit

As is well known, the ratio of the electron current to the positive grid 12 to the ion current to the negative plate 13 is proportional to the gas pressure in the manometer tube 10. It is a disadvantage of this method that the leakage current between grid and plate makes the result inaccurate.

The invention has for its object to eliminate or reduce the effect of the leakage current. An alternating voltage is applied between grid and plate, and a capacitor-resistor combination 50,51, providing less



voltage than the alternating voltage employed is used to bias the plate negative with respect to the cathode. Direct current meters are used in the plate and grid circuits and as the leakage current between grid and plate is alternating, the meters do not indicate it.

C. J. Calbick, Bell Telephone Laboratories, Inc., (F) March 2, 1943, (I) May 8, 1945, No. 2,375,280.

(*Continued on page* 202)

½ ACTUAL SIZE

RAYTHEON

TYPE CK1012

A High Current, Medium Voltage Gas Rectifier

The Raytheon type CK1012 full wave gas rectifier was developed to supply the requirements at high rectification efficiency for those applications which require more power than is obtainable with conventional receiving tubes and yet cannot justify the size and expense of transmitting type tubes. In this category are the larger fm and television receivers and small fixed or mobile transmitters.

The CK1012 is contained in an ST-14 bulb, which is the size of a type 80. The emitter can be directly heated — or, under the proper conditions noted below, ionically heated for greater efficiency and elimination of heater windings.

The very rugged construction is ideal for mobile equipment, and the use of an inert gas allows it to operate over a wide range of ambient temperature. No preheating time is required, and consequently full output is obtainable almost instantly. Any tendency to generate noise in radio frequency applications can be minimized by proper filtering and shielding of the tube and associated wiring.

Whether or not CK1012 fits your requirements, it is an example of the advanced engineering and painstaking manufacture found in the entire Raytheon tube line. For best results, specify Raytheon High-Fidelity Tubes for your postwar products.

TYPE CK1012 RATINGS — FULL WAVE RECTIFIER SERVICE

	IONICALLY HEATED*	DIRECTLY HEATED	
Filament Voltage	0	1.75	volts
Filament Current	0	2.00	amp
Maximum Peak Inverse Voltage	1200	1200	volts
Average D.C. Voltage Drop	25	20	volts
Maximum D.C. Output Current	300	300	ma
Minimum D.C. Output Current	70	0	ma
Minimum Starting Peak Voltage	400	300	volts
Maximum Steady State Peak Anode current per anode	900	900	ma

**This condition is not recommended for rapid intermittent operation*

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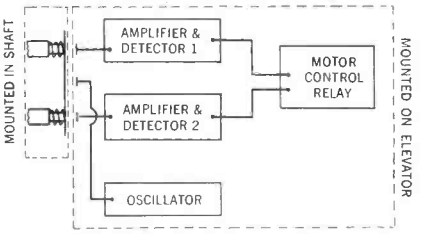
IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.

NEW PATENTS

(*Continued from page* 198)

Floor Leveler for Elevators

It is intended to provide a mechanism to stop an elevator automatically at the exact level of one of the landings. The operation of the apparatus will be clear from the accompanying diagram. As soon as the elevator approaches the region of the landing, the oscillations generated by the oscillator



will be capacitively coupled to amplifier and detector I or II, depending on whether the elevator is too low or too high in the shaft. Corresponding operation of the motor control relay will cause the elevator to be raised or lowered as required.

W. Muller, Brujac Electronic Corp., (F) September 29, 1944, (I) May 8, 1945, No. 2,375,435.

Shear Modes in Piezo-electric Crystals

The following report by S. Bhagavantam and D. Suryanarayana appeared in the February 10, 1945, issue of Nature, London:

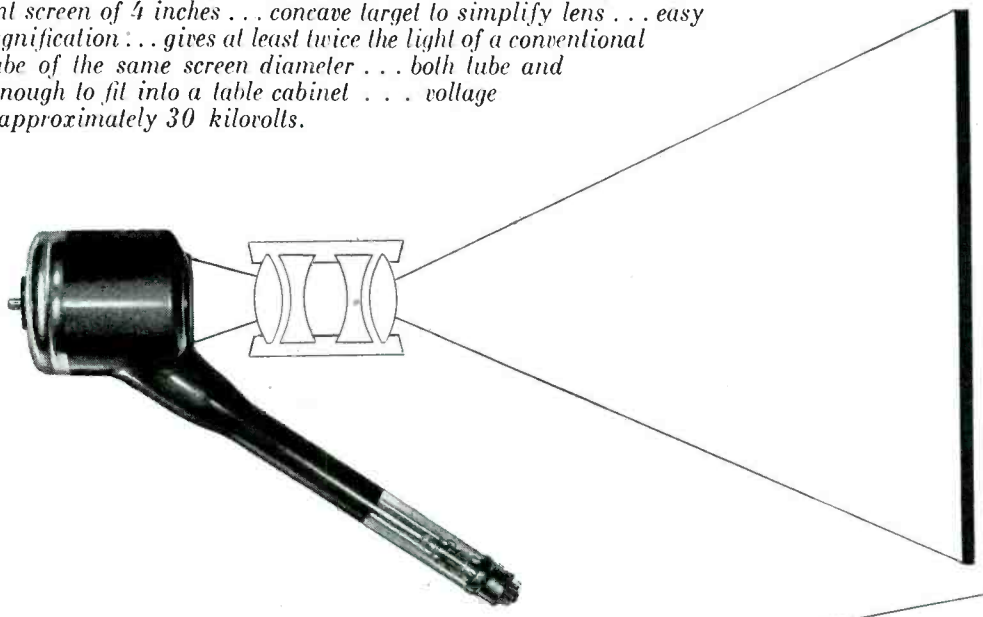
"While investigating the diffraction patterns produced by ultrasonic waves set up in a liquid medium by piezo-electric crystal plates, we made the following observations. Besides the usual thickness longitudinal mode, diffraction patterns corresponding to thickness transverse or shear modes have been observed occasionally. We find that the appearance of such patterns is facilitated when the crystal plates are either silvered in patches only, or so prepared that there is a deviation from the normal cut. When irregular silvering is adopted, not only do the odd harmonics of the shear modes make their appearance, but also the even harmonics of all the modes begin to show up. Such results have been observed by us in differently oriented plates of quartz and tourmaline and used for determining the elastic constants corresponding to the shear modes of these crystals. Details of these investigations are being published elsewhere.

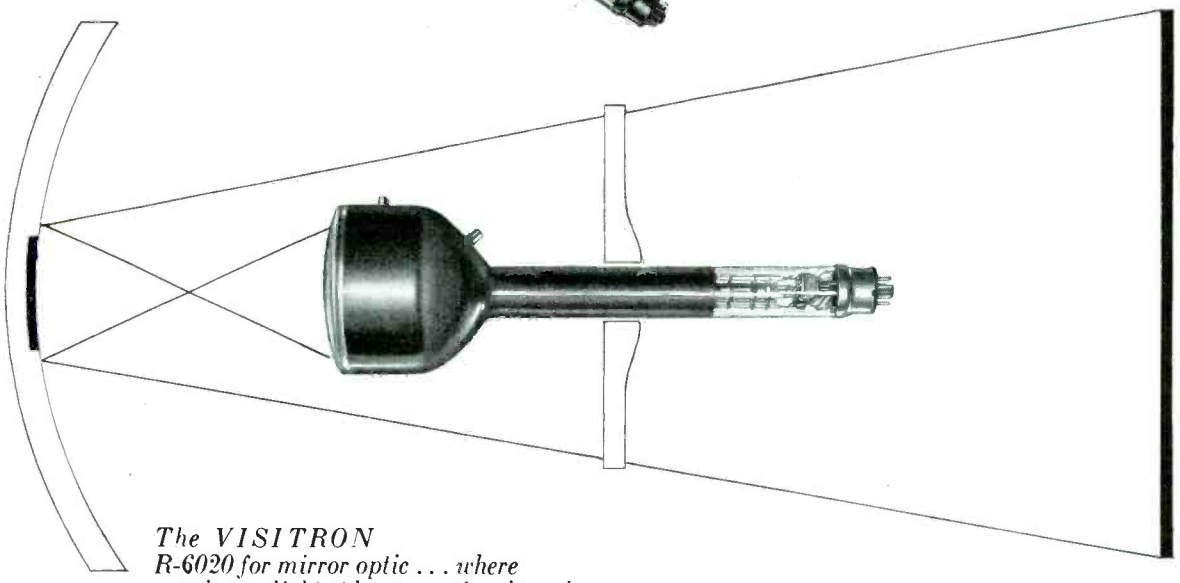
"These observations mean that particular shear modes cause longitudinal strains in the crystal plates resulting in corresponding longitudinal ultrasonic waves in the liquid. The phenomenon is presumably connected with the coupling between the longitudinal and shear modes produced either by the finite size of the plate or the cut of the plate, being such that the modes themselves are inherently coupled."

Projection Tubes for Home Television

Pioneering experience in the development of large screen television projection has given *Rauland* physicists and engineers the "know-how" necessary to produce projection tubes for home television receivers.

The VISITRON R-6016 Front Surface Projection Tube with refractive optic . . . fluorescent screen of 4 inches . . . concave target to simplify lens . . . easy change of magnification . . . gives at least twice the light of a conventional projection tube of the same screen diameter . . . both tube and optic small enough to fit into a table cabinet . . . voltage requirement approximately 30 kilovolts.





The VISITRON R-6020 for mirror optic . . . where maximum light at lower anode voltage is desired . . . 5 inch diameter fluorescent screen.

Consult with *Rauland* about your television tube problems. We have the facilities to build projection tubes to special requirements.

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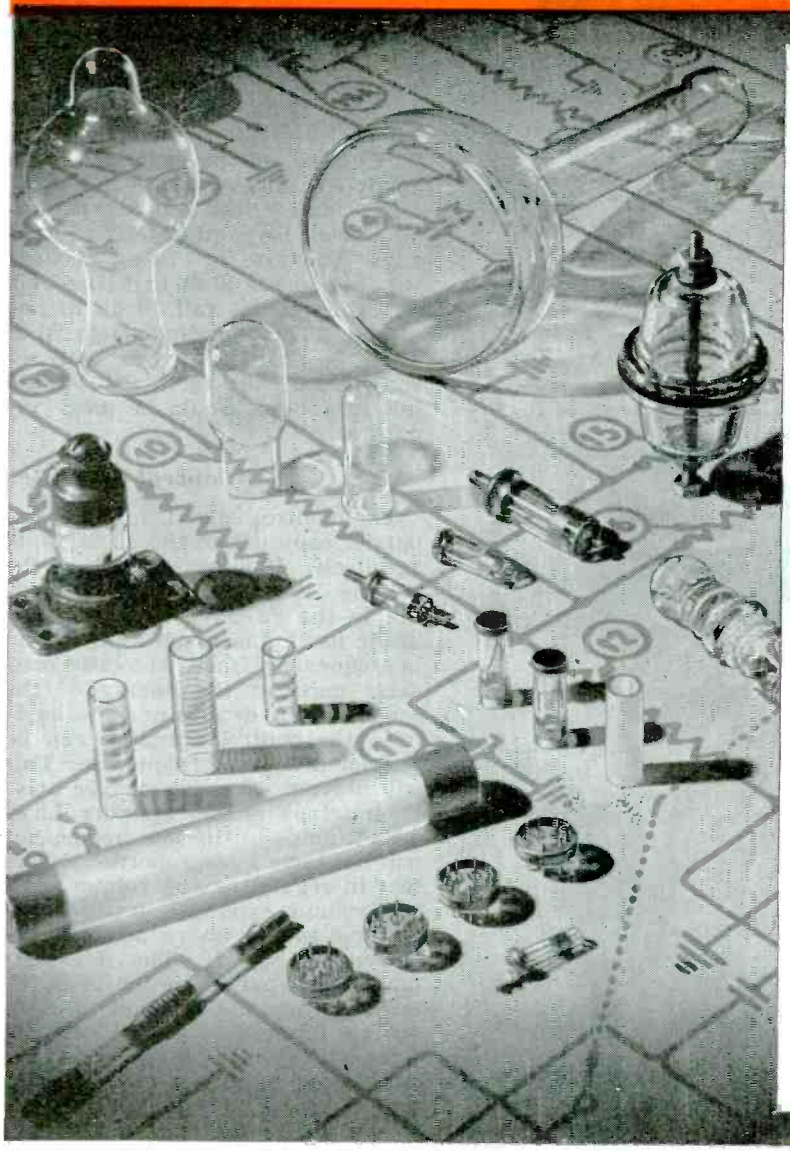

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IMPROVING RECORDINGS

(*Continued from page 84*)

produce unpleasant "jumps" in the volume of the music. It has been found that for most music 10 db is a maximum safe value.

The manner in which the expansion takes effect is also important. When a sudden loud chord is played the expansion must be so rapid that no time lag in the rise of gain of the amplifier can be noticed. A rise time of one millisecond will be so small as to be unnoticeable. However, if the decay time is as rapid as the rise time, individual cycles of all frequencies below 1000 cycles will be expanded, with horrible results.

Fortunately, the solution is simple electrically, and effective musically. The rate of rise of the expander is made 10 db in .001 second, and the rate of fall 10 db in one second. This corresponds to what would be heard in a room with reverberation. In fact, a too-rapid fall in volume would be most unnatural.

Control amplifier

The control signal for the expander comes from the signal voltage itself. It is necessary that the volume level be regulated according to the effective volume of the music itself. Inasmuch as the band of frequencies from 200 to 3000 contains most of the energy of the sound which determines the loudness, the control amplifier can be restricted to these frequencies. This will prevent excessive surface noise from actuating the expander. Likewise thumps in the low frequencies will not have a disproportionate effect in regulating the volume.

A volume expander designed according to the above principles is shown in Fig. 1. The device is made push-pull in order to minimize harmonic distortion, and to obviate filtering of the grid control signal. Any filter in the grid circuit would introduce objectionable time delay. If this controlled stage is used in a push-pull amplifier an output transformer is unnecessary. However, if it is desired to insert the amplifier in a single-ended amplifier it will be necessary to use a transformer output. For this purpose a good single plate to push-pull grids transformer can be used. The grid windings are used to supply the plates of the 6K7 tubes, and the primary, (10,000 ohms or so) suitably terminated with a load resistor, will give single-ended output.

The frequency response of this expander can be made as good as any other resistance-coupled amplifier. The frequency response of the control amplifier is shown in Fig. 2.

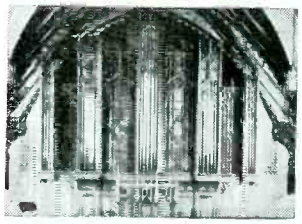
(*Continued on page 210*)

B-L METALLIC RECTIFIERS SINCE 1923

SELENIUM COPPER SULPHIDE

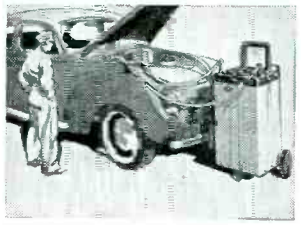
A few B-L Rectifier applications are illustrated below:

AUTO RADIOS

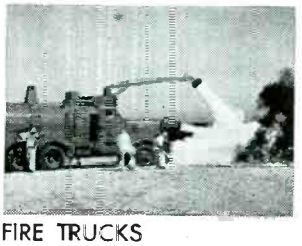


PIPE ORGANS

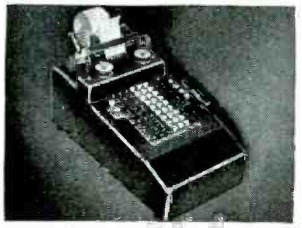
CLOCKS



BATTERY CHARGERS



FIRE TRUCKS



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Dependability is assured by their simple and rugged construction, in which no glass bulbs, filaments, or other fragile parts are employed.

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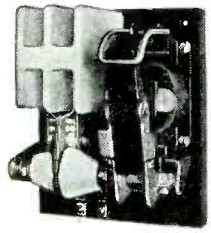
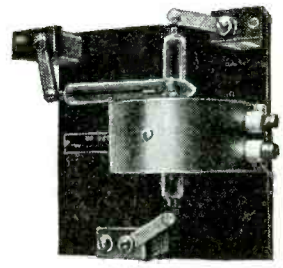
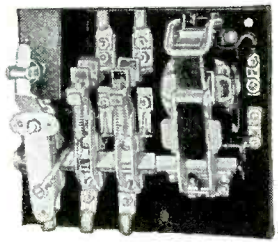
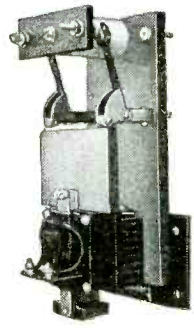




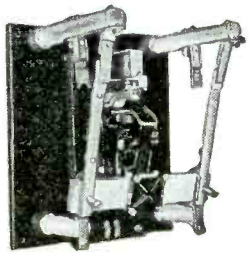
HIGH VOLTAGE D. C. HOT BREAK CONTACTORS for energizing high voltage vacuum tube circuits. Contactor, *above left*, breaks circuit carrying 1 ampere at 3,000 volts D. C. Contactor, *above right*, successfully breaks circuit carrying 2 amperes at 5,000 volts because contacts operate in a vacuum. This contactor incorporates principles of Eimac VS2 vacuum switch which eliminates external moving parts. Operating coil completely shielded. Can be completely tropicalized.



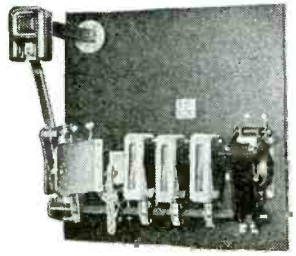
CONTACTOR-TIMERS used as main power or filament contactors with auxiliary delayed time circuit or circuits. Contactor and timer joined together physically, as well as electrically, saving space, assuring certain operation.



HIGH VOLTAGE-HIGH FREQUENCY CONTACTORS designed primarily for high frequency switching from a remote control point. Can be used with any high voltage cold break application—A. C. or D. C. All insulation of low loss type, either steatite or glass bonded mica. Held either mechanically or magnetically. Furnished either normally open, normally closed or both. Our complete line of contactors range from 15 amps at 3,000 volt minimum to 35 amps at 25,000 volt maximum.



HIGH FREQUENCY-HIGH VOLTAGE TRANSFER SWITCHES for either radio or industrial load transfer. Magnetically operated from remote point but mechanically held in either position. Can accommodate currents up to 75 amps high frequency. Insulation of low loss type, either steatite or glass bonded mica. Cold break only.



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Due to its war effort, its facilities, experience and personnel have been increased. It will continue to develop, design and manufacture—to better than FM standards—sound and broadcast speech input equipment.

Its products will continue to include quality transformers and quality amplifiers, ranging from the smallest unit to especially-engineered speech input systems for the large broadcast stations. Much of this equipment is now in production; some in development—some between development and production.

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IMPROVING RECORDINGS

(*Continued from page* 206)

The meter which is in the plate supply lead to the controlled stage gives an indication of the expansion at any instant. This meter should be of the volume-indicator type of movement, because an ordinary milliammeter would overshoot sudden changes in gain. If dynamic readings are not to be taken this special meter need not be used. Fig. 3 is the calibration of this meter in terms of amplifier gain. It can be seen that the range of volume expansion available depends on the initial plate current. The 500 ohm potentiometer shown in Fig. 1 adjusts the fixed bias on the grids of the control stage.

Fig. 4 shows the expansion characteristics for several values of initial bias. The absolute level at which expansion begins depends on the gain of the control amplifier channel. Obviously, at high settings of the expansion control the input level required to actuate the expander will be lower than at lower settings of the expansion control.

The use of full-wave rectification for the signal is important for smoothest operation of the device. Many complex waves have positive and negative peaks of considerably different values. With a half-wave rectifier the phasing of the input signal would make a great difference in the amount of control voltage developed.

The 2 Meg. resistor and .25 μfd capacitor at the rectifier output determine the release time of the expander. The values given produce good results with most types of music. For very slow music it might be desired to increase the time constant. This can be done by increasing the value of the resistor. This resistor can, of course, be made variable. If variable time delay is desired a resistance variable from one to 10 megohms will give all the values desired.

Volume expander

The operation of the volume expander to produce satisfying results requires some care. Music in which the contrast between loud and soft is a very important factor benefits most by volume expansion. Such music is any of the Rossini overtures (especially as recorded by Arturo Toscanini), Tschaikowsky Symphonies and Fantasias, orchestral music of Wagner and Strauss, and other music of a dramatic nature.

The expander should not be used with any vocal music, string quartets or other music where the volume range would be less than 20 db in the actual performance. In fact in any record of any type

(*Continued on page* 214)

FARNSWORTH

EXTENDS COMMUNICATION ACTIVITIES

BY ACQUIRING

THE HALSTEAD

TRAFFIC COMMUNICATIONS CORPORATION

WILLIAM S. HALSTEAD, president of the Halstead Company, joins the Farnsworth organization as consultant on radio communications equipment and traffic control, as well as on other phases of Farnsworth's broad electronic developments.

JOHN A. CURTIS, vice president of the Halstead Company and chairman of its management committee, joins the Farnsworth organization as manager of the mobile communications division.

To EXTEND its broad communications activities into the rapidly expanding field of mobile railway and highway communications and control, Farnsworth has acquired the assets of the Halstead Traffic Communications Corporation, including its developments, designs and patents. Key personnel, including William S. Halstead, president, and John A. Curtis, vice president, have joined the Farnsworth staff.

The Halstead organization is a recognized pioneer in this relatively new field of radio communications. It has invented, developed and produced field-tested equipment to provide railroads with modern, unfailing radio communications. It gave the world its first successful highway radio service, including the centralized control of busses, trucks and passenger vehicles.

The Halstead technical staff will establish new headquarters at the Fort Wayne Farnsworth laboratories. The organization will be merged and coordinated with more than two hundred Farnsworth research and development engineering personnel—a staff of scientists and technicians recognized as one of the country's leading technical organizations in the development of television; broadcast transmitters and receivers; radio-phonographs, and the most complicated types of radio and radar equipment for the Armed Forces.

Farnsworth resources, plus its seventeen years of electronic pioneering, its extensive engineering staff, and specialized manufacturing facilities, will strongly augment the outstanding position of the Halstead developments in this field.

FARNSWORTH TELEVISION & RADIO CORPORATION

FORT WAYNE 1, INDIANA

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Halstead Mobile Communications and Control Systems for Rail and Highway • the Farnsworth Phonograph-Radio • the Capehart • the Capehart-Panamuse

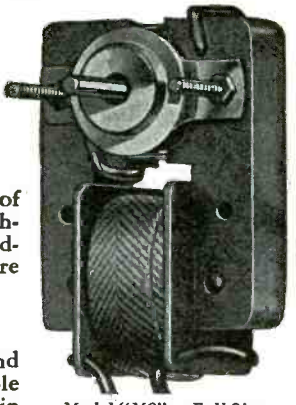
1,001 USES

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.

Alliance Precision

Our long established standards of precision manufacturing from highest grade materials are strictly adhered to in these models to insure long life without breakdowns.



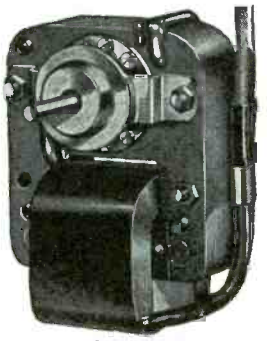
Model "MS"—Full Size Motor Measures 1¾" x 2 x 3⅛"

EFFICIENT

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.

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.

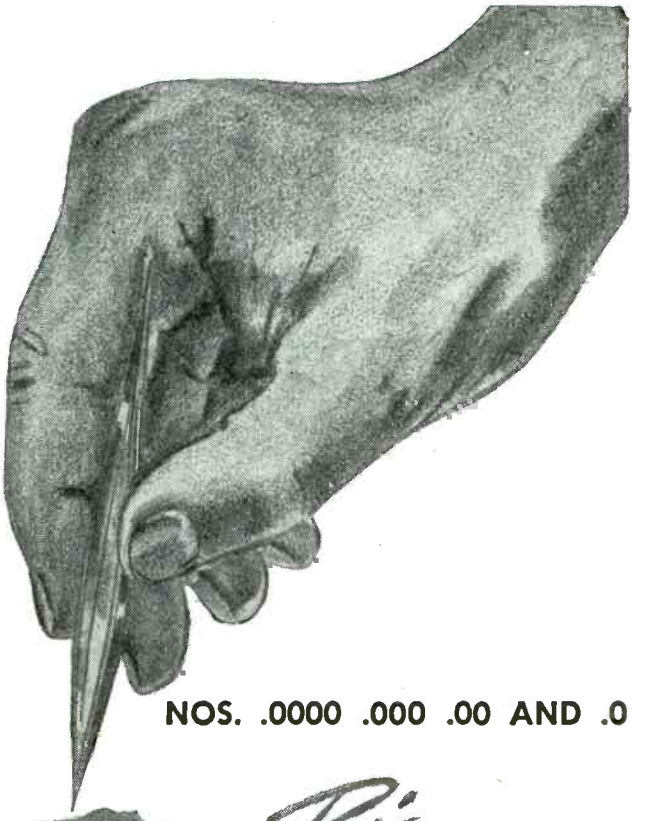


New Model "K"—Full Size Motor Measures 2⅛" x 2⅜" x 3 1/16"

Remember Alliance!
—YOUR ALLY IN WAR AS IN PEACE

ALLIANCE MANUFACTURING CO.

ALLIANCE . OHIO



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ARE *Big* PRODUCTS

— big in their importance to the manufacture of precision instruments, for they are the *almost infinitesimal* screws that are used in the assemblies of many of the world's finest mechanical masterpieces.

For more than half a century Waltham has specialized in the production of *precision* screws. Its plant and equipment have steadily modernized and expanded to meet the demands of every period of business development and the exacting needs of three wars.

Waltham is tooled to produce fine screw machine products *for a million uses*—any thread, material or finish — any type head, from 1/64" to 1½" diameter.

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Send for catalogue for complete data

WALTHAM SCREW COMPANY

77 Rumford Ave.
Waltham, Mass.

New Pilotless Plane?

BACK IN 1939 PACIFIC DIVISION HAD ALREADY FLOWN THIS RADIO CONTROLLED AIRPLANE

Six years ago we did it the hard way. Month after month at an isolated camp in the Mojave Desert Pacific Division radio engineers collaborated with Lockheed engineers to perfect electronic controls and the aerodynamic characteristics of one of the first airplanes to fly by radio direction alone.

The operations were part of a special Army project and, in all, six airplanes of Lockheed design were successfully flown. In light of the tremendous strides Pacific Division radio engineers have made since those early days, it is interesting to know that this first radio control receiver had to provide simultaneous operations of *thirteen* controls—for the elevator, rudder, 5-position throttle, altitude, airspeed, counter, camera and parachute release.

The success of these early, complicated experiments have given Pacific Division a six-year lead in the development of numerous types of VHF control and communication equipment. We would like the opportunity to demonstrate how these modern controls may solve your problems, too.

This portable 100 watt transmitter was used to control the plane. "Ground Pilot" sat in the truck body.

Taken from movie film, this shows an actual take off. Note perfect flight attitude for this critical operation.

Trailing smoke made observation easier. The 80 h.p. plane, comparable to a single-seater, had speed of 105 m.p.h.

OPERATING SIX VHF EXPERIMENTAL STATIONS

IMPROVING RECORDINGS

(*Continued from page 210*)

whatever, if the volume expansion produces unnatural effects as judged by the ear, too much expansion is being used. However, on a well-monitored recording of music with a normally high dynamic range the restoration of some of that range enhances the musical effect beyond description. It is with records of this type that the volume expander is worth its weight in gold. Some recordings found to be excellent in this respect are: Bizet—"Carmen" Suite—Columbia X144; Rossini—"Semiramide Overture"—Victor M408; Stravinsky—"Firebird Suite"—Victor M291; Wagner-Stokowski—"Tristan and Isolde"—Victor M508.

A few suggestions on the overall system will give some other ideas for improving realism. If possible, more than one loudspeaker should be used, especially if the room is quite large. Both speakers should be within an included angle of 90 deg. from any listener. If the sound arriving at the ear of a listener is very obviously from two separate sources, the mind refuses to blend them into a satisfying "wave front" of sound. Extremely effective results can be obtained in a good sized room of rectangular shape. In this case the loudspeakers should be placed in adjacent corners at one end of the room. The listeners should be placed as far from the loudspeakers as possible, and approximately equidistant from both speakers.

If one of the speakers is supplied with frequencies from about 500 cycles down and the other with frequencies from about 500 cycles up, the utmost in realism is accomplished. A close approach to the stereophonic sound system is produced in this way. Listeners will feel that the orchestra is spread out across the end of the room and the feeling of "presence" will be uncanny.

Successful reproduction of music resolves itself into the careful adjustment of all components in the system, with an eye to the effect each has on each element of the musical performance.

INCENTIVE PAY

(*Continued from page 86*)

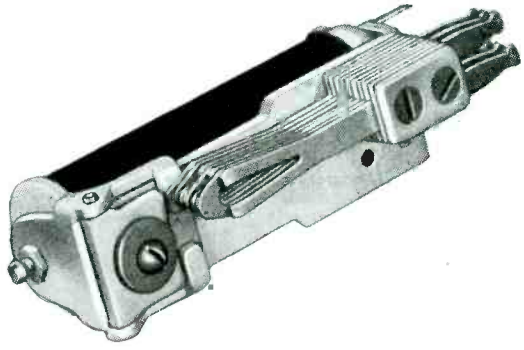
and the company would pay royalties through this pool to its own employees during their continued employment with the company.

5. No straight salary would be provided. Instead, a total percentage of sales would be fixedly allocated to "engineering compen-

(*Continued on page 218*)

- SENSITIVITY
- CONTACT PRESSURE
- DEPENDABILITY
- COMPACTNESS
- VERSATILITY
- LONG LIFE

ALL THESE *in* THIS ONE RELAY



AUTOMATIC ELECTRIC'S CLASS "B" RELAY

Check Automatic Electric's Class "B" relay against *all* your requirements. It's one relay that gives you all six of the features you want—and gives you the *most* of each of them. Don't compromise with the requirements of the job; simply standardize on the Class "B" relay and get *all* the features you need!

Independent twin contacts for dependable contact closure... efficient magnetic circuit for sensitivity and high contact pressure . . . unique armature bearing for long wear under severe conditions . . . compact design for important savings in space and weight. Now available for coil voltages to 300 volts DC and 230 volts AC, with capacities up to 28 springs; also with magnetic shielding cover, when specified.

The Class "B" relay, and many others, are shown in Catalog 4071. Write today for your copy.

Relays by

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PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

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BUT CAN YOU PITCH LIKE A CHAMP?

There is more to throwing curves than holding a ball a certain way—

And there is more to producing top-performance transformers than assembling coils, cores, etc. in an enclosing case.

Correct use of engineering—years of experience—control of quality and manufacture in everyday large scale production—and the selection of the appropriate type and design for each particular requirement—are all essential to successful operation.

The hundreds of thousands of transformers regularly produced—are ample proof that leading manufacturers of equipment in electronic, lighting, radio and similar fields prefer Jefferson Electric Transformers. Recommendations concerning transformers made by the Jefferson Electric engineering staff can save time for you—and insure the performance you desire. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. In Canada: Canadian Jefferson Electric Co. Ltd., 384 Pape St., Toronto, Ont.

JEFFERSON ELECTRIC

ELECTRONIC • RADIO • TELEVISION

TRANSFORMERS

INCENTIVE PAY

(Continued from page 214)

sation." This percentage could be subdivided into research, development and production segments. The share of each man could be predetermined much in the way law and investment securities partnerships operate. In other words, the engineering department would function as a partnership whose income fluctuated with the business of the company. This idea could be modified by a guarantee of salary, drawing account, sliding scale or "power" increment tied into company profits. After all, manufacturers' representatives have waxed fat on these kinds of deals during recent years—at the expense of engineers who do most of their selling for them.

6. One or more of the above ideas, except that the overriding compensation would be paid in company stock. This gives a double-barrelled incentive and while more adaptable to the medium-sized company is an extremely effective approach.

Engineer's requirements

The above six suggestions are a few out of many that could be proposed. Basically, I feel three things should be done:

A. The engineer should have security and a stable income.

B. He must then prosper as the company grows; and

C. He must have special recognition for signal achievements.

The sooner our electronic companies realize the power behind plans such as these and the extremely interesting results that can come from new thinking, the sooner the engineer can emerge and be proud of his profession.

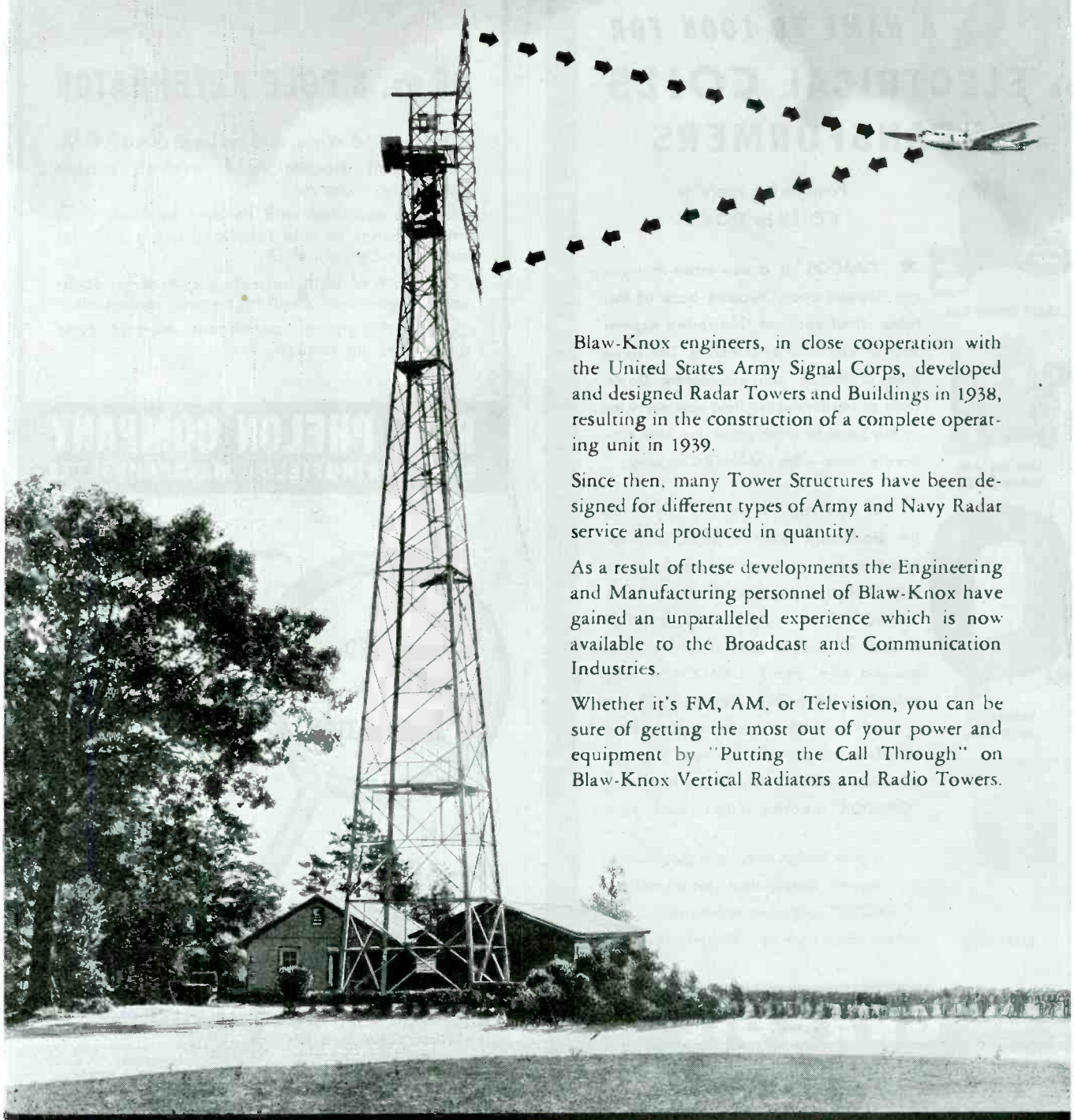
Has a salesman or a movie director more "on the ball" than an engineer? I don't believe it—but right now the income tax man does.

Maybe the amusement industry grease-paint idols deserve what sound pictures have given them. I wonder what proportion the **total** engineering **payroll cost** of "sound on film" bears to **annual** salary costs of directors and "stars." Or how broadcast engineering cost is related to annual "talent" and program outlay. Just think it over! I contend that our engineers made possible sound pictures and radio, just as they will television and a host of other things.

Can't we pick out one of the proposals in the foregoing—change it around some, if we must—and get started recognizing that the fundamentals of electronic development are in the laboratory design room and factory, and not in exploitation? There's no time like NOW.

RADAR

is not new to the Blaw-Knox Company



Blaw-Knox engineers, in close cooperation with the United States Army Signal Corps, developed and designed Radar Towers and Buildings in 1938, resulting in the construction of a complete operating unit in 1939.

Since then, many Tower Structures have been designed for different types of Army and Navy Radar service and produced in quantity.

As a result of these developments the Engineering and Manufacturing personnel of Blaw-Knox have gained an unparalleled experience which is now available to the Broadcast and Communication Industries.

Whether it's FM, AM, or Television, you can be sure of getting the most out of your power and equipment by "Putting the Call Through" on Blaw-Knox Vertical Radiators and Radio Towers.

BLAW-KNOX

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY
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TYPES OF SUPERIOR TUBING IN MANY METALS—MAX. OD—5/8"

MECHANICAL—Analyses generally handled are SAE 1010, 1015, 1020, 1025, and 1035. They are used wherever tubes are machined, formed, bent, etc.

AIRCRAFT—Requirements of this industry cover every analysis. Major production is in SAE 4130X, SAE 1025, SAE 1010, Stainless Types 304, 321, and 347, Inconel and Aluminum. Government specifications in constant use are AN-WW-T-846, AN-WW-T-850A, AN-WW-T-855, AN-WW-T-858, AN-WW-T-861, and AN-T-43. Also certain AMS specifications, with reservations because of size range or availability of redraw stock. As substitutes become available, Superior will advise customers as far in advance as possible. Practically all of these changes will be forced by war conditions, but we are confident that the substitutes will be every bit as effective for the application as the material being supplanted.

INSTRUMENT TUBING—In this field, Superior furnishes hypodermic needle tubing, metal tubing for surgical instruments and parts, pointer tubing for electrical instruments, flattened tubing for Bourdon Springs. The hypodermic needle tubing is available in all standard sizes in the temper developed over a period of years, as most suitable for the application. The pointer tubing is generally aluminum where you get the combination of extreme lightness and maximum strength. For Bourdon Springs, Superior uses SAE 4130 X and Beryllium Copper.

CORROSION RESISTANT TUBING—In this category, Superior places the Stainless Steels, Nickel, Monel, Inconel, Copper and Aluminum. All of these are handled more or less regularly. The use of these alloys is indicated wherever you would find the problem of corrosion, whether because of acids, atmosphere, etc.

TUBING FOR ELECTRONIC APPLICATIONS—At the present time, Superior is furnishing Seamless Nickel, Monel, Inconel and Stainless. The tubes are used as anodes and cathodes in practically all types of Electronic tubes. In addition, we produce Lockseam Sleeves** made from Nickel strip and also some Lapsleeves made in somewhat the same way. Also tubing with special magnetic and glass sealing properties can be obtained. We urge you to get in touch with us when you are developing a design.

** U. S. Patented

SUPERIOR

THE BIG NAME IN SMALL TUBING

SUPERIOR TUBE COMPANY, NORRISTOWN, PENNSYLVANIA

NAVY

FOR EVERY SMALL TUBING APPLICATION FROM 5/8" OD DOWN

SUPERIOR Seamless in various analyses. WELDRAWN Welded and drawn Stainless, "Monel" and "Inconel"

SEAMLESS and Patented LOCKSEAM Cathode Sleeves

ANTENNA GAIN

(*Continued from page 89*)

Suppose that we can adjust the transmitter power so that the minimum voltage on the measuring section with either the directional antenna or reference antenna connected has the same value, then:

$$\frac{P_D}{P_R} = \frac{q_D}{q_R} \tag{8}$$

where q_D and q_R are respectively the standing wave ratios when directive antenna and reference dipole are connected.

And the corrected antenna field gain is

$$(AFG)_2 = (AFG)_1 + 10 \log \frac{q_D}{q_R} \tag{9}$$

$10 \log \frac{q_D}{q_R}$ versus $\frac{q_D}{q_R}$ is plotted in Fig. 4.

Feeder attenuation

The total attenuation of the feeder with standing wave ratio q is larger than the total attenuation of the same feeder when matched to the load. This follows from the fact that the lack of matching introduces the reflected waves which produce the additional losses. Averaging the losses occurring in the feeder element over its total length, it can be shown* that the effective attenuation A_{eff} is approximately:

$$A_{eff} = .5A\left(q + \frac{1}{q}\right) \tag{10}$$

where

$$A = \alpha L \tag{11}$$

and

α—attenuation constant (in db per 1000 feet)

L—length of feeder (in thousands of feet)

A_{eff}/A versus q is shown in Fig. 5.

Antenna gain

If $(A_{eff})_D$ and $(A_{eff})_R$ are respectively the effective attenuations when directional antenna and reference dipole are connected, then the gain $(AFG)_3$, corrected for the constant power input to the antenna is:

$$(AFG)_3 = (AFG)_2 + A\left[\frac{(A_{eff})_D}{A} - \frac{(A_{eff})_R}{A}\right] \tag{12}$$

To show the importance of the

*Proc. I.R.E.

corrections discussed let us calculate the following example: If $\frac{E_D}{E_R} = 2.5$, $q_D = 1.8$, $q_R = 1.2$, $A = 4$db., then $(AFG)_1 = 8$ db.

$$(AFG)_2 = 8 \text{ db.} + 10 \log \frac{1.8}{1.2}$$

$$= 9.8 \text{ db.}$$

$$(AFG)_3 = 9.8 \text{ db.} + 4(1.19 - 1.02) = 9.8 \text{ db.} + .68 \text{ db.} = 10.48 \text{ db.}$$

This shows how simple the application of the transmission line measuring technique is for the accurate measurement of the directive antenna field gain.

RCA'S ANTENNALYZER

An electronic "brain," called the Antennalyzer, which in the space of a few minutes solves with complete accuracy the complicated problems of directional antenna design that heretofore have required weeks of laborious computation, was described in Washington, on September 10 by Dr. George H. Brown, of RCA Laboratories, Princeton, N. J., speaking before a section meeting of the Institute of Radio Engineers.

Radiation patterns

Directional antennas for broadcast stations must be designed and erected to protect the service areas of existing stations on the same or adjacent channels, Dr. Brown said. But although the proper design formulas are known, he explained, their solutions have been based on the use of trial values which in the final analysis often resulted in no more than close approximations. The Antennalyzer eliminates these inaccuracies.

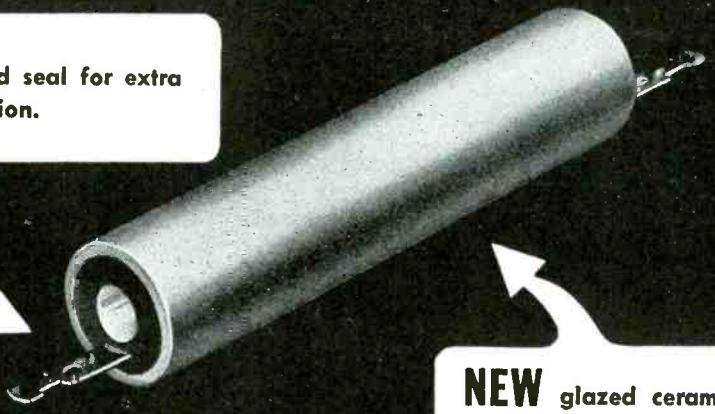
(*Continued on page 226*)

RCA's Antennalyzer is an electronic computing device which automatically solves the problems of locating and arranging new antennas. Readings taken from dial settings indicate proper tower location to direct maximum power where wanted

ONE STANDARD TYPE

does the job...

NEW type end seal for extra humidity protection.



WOUND WITH CERAMIC INSULATED WIRE 1000°C. HEAT-PROOF!

NEW glazed ceramic shell to withstand thermal shock, humidity and corrosive conditions.

..in ANY climate!

No more "special orders" to obtain suitable resistors to withstand the extreme thermal and humidity conditions to which your product may be subjected in many parts of the world! STANDARD Sprague Koolohm Wire-Wound Resistors now incorporate these extra protection features — and this means that you can count on STANDARD Sprague Koolohms for maximum dependability in ANY climate, ANYwhere on the face of the globe. Write for new catalog of Sprague Koolohm wire-wound types for every requirement.

ARMY E NAVY

SPRAGUE KOOLOHM

TRADEMARK REGISTERED U.S. PAT. OFF.

WIRE-WOUND RESISTORS

SPRAGUE ELECTRIC COMPANY, Resistor Division, North Adams, Mass.

RCA'S ANTENNALYZER

(*Continued from page 223*)

The RCA Antennalyzer, Dr. Brown said, consists of a number of interrelated circuits whose electrical values may be adjusted by dials. Knowing the desired directional pattern of the projected broadcast station, the operator twiddles the 16 dials and observes the results on a cathode ray oscillograph. When the curve of the graph corresponds to the required directional pattern, the dial settings are recorded. These figures tell where to locate the antenna towers, and give the current ratios and phase angles to use in designing the system as a whole.

Analyzer operation

In operation the Antennalyzer utilizes a radio frequency signal obtained from a crystal controlled oscillator. This signal is then divided into five distinct channels, each channel representing one antenna element of the directional array. By manipulating the dials, an operator can vary the amplitude and phase of each channel as desired.

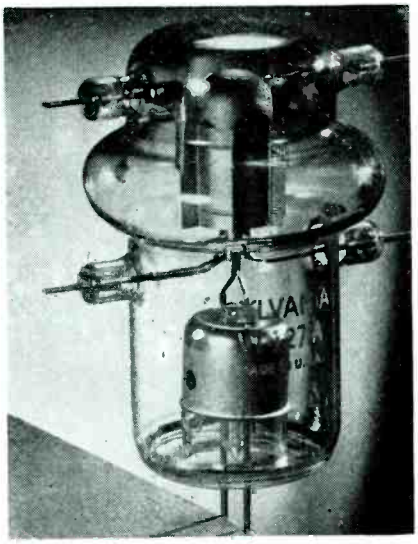
General principles of the Antennalyzer, Dr. Brown pointed out, were worked out on paper several years ago but construction of the first unit was delayed while a search was made for a superior phase modulator. A crystal-controlled phase modulation system developed by R. D. Kell of the RCA Laboratories, for another purpose, was found to be ideal for the Antennalyzer.

The Kell circuit makes it possible to phase-modulate each channel with a total swing of 720° plus and minus. The Antennalyzer uses 52 vacuum tubes in addition to the 26 tubes comprising the special cathode ray oscillograph and its attendant amplifiers.

Five tower arrays

In performing its computations electronically, "the Antennalyzer," Dr. Brown said, "adds and subtracts angles, multiplies, looks up trigonometric functions, adds numbers together, squares them and finally takes the square root of the whole." Because individual values represented by the dial settings are highly accurate, the final result is equally accurate and there are no compromises involved as in former slide-rule-design procedure.

The Antennalyzer, Dr. Brown said, is limited to the design of directional arrays up to five towers. This, he asserted, will take care of almost any directional antenna problem that will arise for years. When needed, however, additional circuits to compute data for a larger number of towers could be added, practically without limit.



Power Measurement

Simple, direct measurement of the power output of electronic and radio communication equipments at frequencies up to 900 mc. are provided by six types of power measurement lamps developed by Sylvania Electric Products Inc., Emporium, Pa. Built with two identical small filaments and mounted in lock-in type bases, these lamps measure power outputs ranging between 0.05 and 25 watts with accuracies within 5 per cent or less, depending on the type of reading taken. Power output measurements are made by connecting one filament to the high frequency output and the other to an ac or dc source. Voltage of the second filament is regulated until both filaments are equally bright. Power is determined by meter readings in the ac or dc circut with equal power dissipated by the filament in the high frequency circuit.

New Oscillating Crystals

The Department of Commerce reports that an electrical equipment manufacturer in Switzerland is using potassium - hydrophosphate as a substitute for natural quartz crystals in radio transmission sets. The process for making the artificial crystals is said to be relatively simple as they can be cut into any required sizes.

Another substitute is suggested by C. P. Fagan, A.R.I.C., of Marconi's Wireless Telegraph Co., Ltd., in an article published in the August 1945 issue of Electronic Engineering, London. The following is taken from this paper:

"During an investigation of the tartrates, the writer found that lithium potassium tartrate was a crystalline compound with good electrical characteristics which could be obtained in large-sized crystals which had good mechanical strength, and which were not affected by atmospheric moisture. Such crystals are easily prepared by neutralizing a solution of potassium hydrogen tartrate with lithium hydroxide, and crystallizing the resultant solution. Small seed crystals may be obtained by allowing a portion of the solution to evaporate spontaneously. A seed crystal of suitable size, suspended by a hair or a very fine nickel wire in the saturated mother liquor, will grow quickly."

Physical features

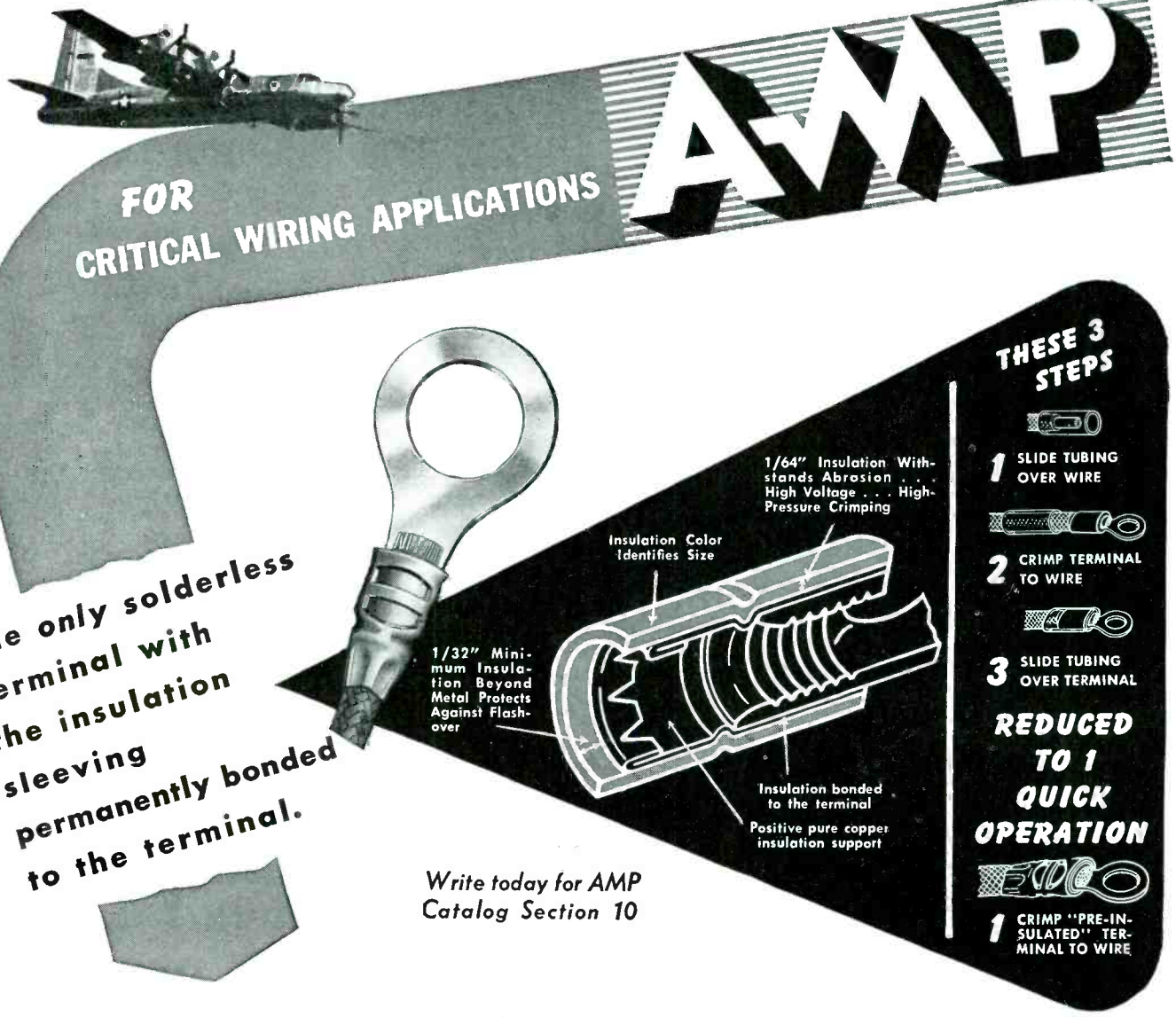
"With regard to mechanical properties it may be said that the crystal is slightly less hard than Mycalex. Cutting and filing the crystal shows a tendency to cleaving in several directions, one normal to the principal axis. The crystal was not affected by atmospheric moisture over a period of twelve months. It was found that the piezo-electric axis coincided with the principal axis and no piezo-electric effects were observable in directions normal to this. One resonance was observed at 279 kc/s. Rough measurements showed that the 'Q' value was of the order of 2,000 in a circuit composing a heptode oscillator, requiring a series resonant impedance not greater than 0.1 megohm with the crystal standing vertically on one electrode with a top air gap of about .01 in. The fact that a crystal of such low 'Q' would oscillate in the above circuit indicates that the substance is of the order of ten times the piezo-electric activity of quartz. The frequency of resonance

$$f = 1{,}760/\sqrt{A},$$

where f is the frequency in kc/s, and A is the cross-sectional area in sq. mm. This would seem to indicate that the vibration is a simple expansion and contraction about the axis.

Temperature coefficient

"The indicated temperature - coefficient is — 426 parts in one million per + 1° C. As this value is more than 200 times the value usually permitted in medium precision quartz, it will be seen that the crystal is quite unsuitable as a frequency stabilizing element. While it is possible that a slant-cut crystal might have a zero coefficient, the angle of cutting would need to be very precise in order to obtain a good balance. Further experiments on lithium potassium tartrate crystals indicated that ageing effects are likely to be small, and that the substance is stable at all temperatures likely to be met with in normal apparatus in any part of the world. Breathing upon the crystal damps the oscillations, as with quartz, and it recovers as soon as the moisture has evaporated. While these crystals appear to be useless as frequency stabilizing elements the ease with which they can be prepared will be of interest to amateurs. Such crystals might be used as thermometers in a suitable holder, and might also be useful as a stable substitute for Rochelle salt."



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The AMP PRE-INSULATED TERMINAL

Providing Revolutionary speed and accuracy in mass production wiring with superlative electrical properties.

PERFORMANCE CHARACTERISTICS

1. Terminals withstand a temperature of 350 degrees for 10 hours without physical damage to insulation or any deleterious effects on insulation.

2. Minimum breakdown voltage is 2500 volts D.C. in air at sea level; 800 volts D.C. at altitude of 30,000 feet.

3. Insulation does not support combustion when tested in accordance with ASTM D350-40T.

4. Insulating qualities are unaffected by long immersion of terminals in 10 per cent salt solution.

5. Water absorption of insulation is less than 1½ per cent.

6. The pre-insulation takes the exact contour of the crimp without distortion or cracking. It will not dry out or come loose.

7. Maximum electrical and mechanical properties of the AMP "Diamond Grip" Insulation Support Crimp assure vibration-proof connections. All three crimps made in one operation by AMP hand tools or press dies.

PRODUCTION ECONOMIES

THE INSULATION IS PERMANENTLY BONDED TO THE BARREL OF THE TERMINAL. The AMP Pre-Insulated Terminal is delivered to you ready to install with AMP precision hand, foot or power installation tools — thereby eliminating all stocking and handling of separate sleeving, and eliminating costly human errors in its application. The cost of applying separate tubing to the terminal is approximately the same as the cost of applying the terminal itself to the wire.

Color identification of wire sizes clearly marked on terminals and tools.

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BOOK REVIEW

Electronic Laboratory Manual

By RALPH R. WRIGHT

Published by McGraw-Hill Book Company, New York 18, N. Y.
First Edition, 77 Pages, 82 Illustrations
Price $1.00

This is a laboratory text book and manual for a first course in electronics for electrical engineering students. Twelve basic experiments are included concerned with the characteristics, with principles of operation and the application of electron tubes. Sufficient theory is included to provide the student with the background of each experiment to enable him to interpret and understand the results without additional guidance.

National UHF Receiver

Development of a radio receiver which in mechanical design is a revolutionary departure from existing types of construction has been completed by the National Radio Co. which has a $15,000,000 contract to supply the receivers to the Navy.

The receiver, which reaches into the ultra-high frequencies, is mounted on a drawer-slide, which does away with the necessity of removing the receiver from the cabinet. With the receiver pulled

out on this drawer-slide, the set can be tilted into three different positions so that all components can be reached easily.

Wilmotte's N. Y. Lab

Raymond M. Wilmotte, director of Wilmotte Laboratory, Inc., Washington, D. C., has opened a branch laboratory in New York City. The new laboratory is under the supervision of Paul H. Crago, former design engineer for the Union Switch and Signal Co., manufacturers of railroad signaling devices. He will be assisted by Hugh J. Cameron, formerly of the radio and radar division of the War Production Board, who will specialize in electronic heating, and G. Curtis Engel, formerly of General Electronics, Inc., who will specialize in electronic control and testing methods.

Ellis Joins Raytheon

Ray C. Ellis, former director of the WPB radio-radar division, has been appointed a vice-president of Raytheon Mfg. Co. From 1930 to 1941 he was with General Motors Corp. in various activities including engineering, sales, service, personnel and public relations, being associated with electronic work through most of this period. When General Motors entered the auto radio manufacturing business in 1936, Mr. Ellis was made general manager of the Delco Radio Division. In the spring of 1941, at the request of General Knudson, he joined O.P.M., later W.P.B., to start the mobilization of radio and radar production facilities

In 1942 he became director of the WPB radio and radar division. In addition to correlating the electronic production facilities in the United States, he made extensive trips to England and Russia, assisting those countries in the scheduling and production of their electronic equipment.

More recently, Mr. Ellis was chairman of an FEA Committee to suggest plans for the demobilization of the German electronic manufacturers and also was associated with Johns Hopkins University in the development and production of highly classified military apparatus.

PERSONNEL

Harry A. Winne, vice president in charge of engineering for the General Electric Co.'s apparatus department, has been appointed vice president in charge of engineering policy for the entire company. **Ernest E. Johnson,** assistant engineer of the aeronautics and marine engineering division, has been named to succeed Mr. Winne. In assuming his new duties, Mr. Winne becomes a member of the president's staff. His headquarters will be in Schenectady. As chairman of the engineering council, Mr. Winne will co-ordinate the engineering, scientific, and research projects of all departments and all laboratories of the company. He will also be responsible for company policy and activities in connection with standards and the co-ordination of matters relating to recruiting, education, and transferring between company units of all engineering personnel.

Hugh S. Knowles, vice-president and chief engineer of the Jensen Radio Mfg. Co., Chicago, has been elected president of the Acoustical Society of America. He has been further recognized by the Fellowship Award of the Institute of Radio Engineers and the chairmanship of Committee on National Defense, Electroacoustics Standards of the IRE and Sound Equipment Standards of the RMA. He has also represented the IRE and RMA on various electroacoustical committees of the American Standards Association, and served as chairman of the Chicago Section of the IRE.

Mr. Knowles began his service with the Jensen company in 1931 as chief engineer and was elected in 1940 to the position of vice-president in charge of product research and development. He is inventor of many of the Jensen engineering innovations and heads a department of capable development and design engineers with that firm. Mr. Knowles is also an independent consultant in the electronic and acoustic fields.

Colonel George P. Dixon, who was chief of air communications for all United States air forces in the European theater of operations, has been elected a vice president of the International Telephone and Telegraph Corp.

Raymond C. Fancy, formerly with the radio engineering section of the Army Service Forces Headquarters, 6th Service Command, Chicago, has been appointed to head a new division of Barnes & Reinecke, industrial designers and engineers, Chicago. A member of the Institute of Radio Engineers, Mr. Fancy will be in charge of instruction manual and visual service aids production for Barnes & Reinecke.

Maxwell S. Symon has been appointed engineer-in-charge-of-sales for De Mornay-Budd, New York. He will handle all rf transmission equipment for radar, which the firm has been engaged in designing and manufacturing, as well as special navigational equipment for land, sea and air, the designing and engineering of which the firm has now entered.

Dominick Albanese has joined the staff of DeMornay-Budd, Inc., 475 Grand Concourse, New York, as a research engineer. He has just been released from the military services where he was a research engineer, is credited with the development of some 29 major developments for aircraft use.

Carl P. Sorenson has been appointed consulting standards engineer for the Cherry Rivet Co., Los Angeles. He was formerly with the Glenn L. Martin Co., Baltimore.

William R. Hough, now product development engineer of the Reliance Electric and Engineering Co., Cleveland, has been appointed chief engineer of the company. He succeeds Fred E. Harrell who has been advanced to general works manager.

J. Harold Blair has been appointed sound communications engineer of Walker-Jimieson, Inc., Chicago. He goes to W-J from Operadio where he held the position of sales engineer.

F. F. Sylvester has been appointed technical director in charge of research and engineering for Reeves-Ely Laboratories, Inc., New York. Latterly with Lewyt Corp., Mr. Sylvester has had wide electronic experience, having been connected with Federal Telephone and Radio Corp., RCA, Hytron and other companies.

Arthur Slepian has been elected president of Universal Wire and Cable Co., Montreal. Until now he has been vice-president and general manager of Wheeler Insulated Wire Co., Bridgeport, Conn.

NEW BULLETINS

Duplex Speakers

How 15 in., 25 watt duplex multicellular speakers increase area of horizontal and vertical sound distribution is explained and illustrated in a new booklet issued by Altec Lansing Corp., 250 West 57th St., New York 19, N. Y. Performance curves on and off axis are given. These show an extended useful range. Amplifiers of 15 to 18 watts output are also listed.

Resistors

A new resistor catalog of 32 pages has been issued by Ward Leonard Electric Co., Mt. Vernon, N. Y. The booklet describes and illustrates various types of units including vitreous, fixed or adjustable, plain ceramic, pressed steel cased and throughbolt styles. A line of ring type rheostats is also listed.

Engineering Training

A complete engineering graduate training course permitting exploration by the graduate engineer of production, sales, research, design, field work, administration and many other elements of industrial operation is outlined in a new training brochure, "Where Do We Go From Here," published by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Based on the theory that an engineer finds the right job by working at several, the two-year training course coordinates shop and office work in a program designed to fit individual aims and abilities.

Recently inaugurated, an Allis-Chalmers program of graduate study in cooperation with the Illinois Institute of Technology is also discussed. This program involves professional and technical education on the graduate school level, leading to a master's degree.

Locknuts and Fasteners

Stamped sheet metal locknuts are described and illustrated in a folder from the Palnut Co., 39 Cordier St., Irvington, N. J. Regular, inverted, acorn and washer types are available. Security against vibration as well as low cost are the object of the product.

X-ray Spectrometer

A new 12-page booklet, titled "Engineering - Design Development of X-ray Spectrometer," has been issued by North American Philips Co., Inc., 100 East 42nd St., New York. The text material covers in detail the basic design principles involved in the Geiger-Counter X-ray spectrometer — recently developed industrial control tool. Specifically, the author discusses: X-ray diffraction principles, new instrument requirements, X - ray source, pulse conditioning, frequency meter circuit, counting meter circuit, meters and controls, and applications.

Laminated Plastics

All the essential factual data and engineering information about Taylor phenol fibre, vulcanized fibre, and the new phenolastic fibre, as well as Taylor insulation (fish paper), Taylor silent gear material, special laminates, moldings, and assemblies are included in a new catalog of Taylor Fibre Co., Norristown, Pa. A section devoted to fabricating data contains the latest shop practices for machining laminated plastics and for servicing the tools and machines used in the many machining processes possible with laminated plastics.

Vacuum Capacitors

Specifications of vacuum capacitors from 6 to 100 mmfd. are included in a folder from Industrial and Commercial Electronics, Belmont, Calif. A patented method of external adjustment to precise values is featured, making possible accuracies to plus or minus 0.2 mmfd.

Drive-In Theaters

A detailed study of the construction and equipment of drive-in motion picture theaters has been issued by the Radio Corp. of America, RCA Victor division, Camden, N. J. Layout of ramps, type and location of projecting equipment, building construction required and reproducing equipment such as in-car speakers are all discussed. Also mentioned are methods of wiring the area for best control, drainage and surfacing problems and required illumination. There is a table showing the average temperatures for each month of the year throughout the United States, with the higher temperatures emphasized to indicate the length of the available operating seasons.

Train Communication

Inductive type and space radio train communications systems and equipment are described and illustrated in a new brochure issued by the Aireon Mfg. Corp., 60 East 42nd St., New York. Numerous colored plates and simple explanations of the methods used and the advantages of each system are included. More detailed engineering explana-

(*Continued on page* 233)

1945 ELECTRONIC ENGINEERING DIRECTORY

INDEX TO PRODUCTS, EQUIPMENT, INSTRUMENTS AND MATERIALS

ALPHABETICAL FINDING LIST of Electronic Manufacturers

Use this list if you know the name of a company and want to learn one of its products. Most of the following companies manufacture more than one product

Antennas & Accessories

Airplane antenna	AA
All-wave (home)	AW
Antenna reeling equipment	AR
Auto	A
Dummy antenna	DA
Feeder spreaders	FS
Ground clamps	G
Grounding springs	GS
HF assemblies	HF
Insulators	I
Kits	K
Lightning arresters	L
Loop antennas	LA
Master systems	MS
Outlets	O
Rotary beam	RB
Television & FM	TL
Towers & Supports (home)	T

ABC Radio Laboratories, 3334 N. New Jersey St., Indianapolis, Indiana—AW
Acme Welding Co., Louisville, Ohio—AW, F, LA,T
Aeronautical Radio Mfg. Co., Roosevelt Field, Mineola, L. I., N. Y.—AA, I, LA, AR
Aircraft Accessories Corp., Fairfax & Funsten Rd., Kansas City 15, Kan.—AA,LA
Airplane & Marine Instruments, Inc., Box 92, Clearfield, Pa.—TL, LA
The Akron Porcelain Co., Corey Ave., Akron 14, Ohio—I
Alpha Wire Corp., 50 Howard St., New York 13, N. Y.—G, I, K, L, MS, TL
American Lava Corp., Cherokee Blvd., & Manufacturers Rd., Chattanooga 5, Tenn.—FS, I
American Radio Hardware Co., Inc., 478 Broadway, New York, N. Y.—G, O
Amplex Engineering, Inc., 1620 Grand Ave., New Castle, Ind.—RB, T
Amy, Aceves & King, Inc., 11 W. 42nd St., New York 18, N. Y.—MS, O
Andrew Co., 363 E. 75th St., Chicago, Ill.—AA, AW, A, IIF, K, LA, MS, RB, TL
Astatic Corp., 830 Market St., Youngstown 1, Ohio—AA
Atlas Products Corp., 30 Rockefeller Plaza, New York
Middletown, Conn.—
Centralab, D
Keefe Ave.
Clampipe—M
Collins Radi
Iowa—T,
Colonial Rad
—A
Communicat
Coral Gal
Communicat
Blvd., I
Consolidate
Chicago,
Cook Cera
N. J.—
Cook Elec
L
Corning
Cornish
7, N.
L, TL
Corwico
Coto-Co
R. I.
Creativ
N. Y
Doolitt
36,
DX Cr
RB
Eagle
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Keasbey, N. J.—FS, I
General Communications Co., 681 Beacon St., Boston
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Bridge, Mass.
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Broad
Ill.—T
Bells-
Chicago,
Ave. &
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Ave., Co-
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, Freeport,
on Pkwy.,
Palo Alto
St., Chicag
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31st St., C
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14, Ohio. "Univer
The Muter Co., 1255 S. Michigan Ave., Chicag
LA

HOW'S YOUR { husband's / wife's } I.Q.?

This little quiz lets you decide if you're doiug your part to help Uncle Sam hold prices down. No thinking person wants a price inflation like the cruel one we had during and after the last war. That's why we have rationing, ceiling prices and wage controls this timc.

		HE	SHE
Does { he / she } buy rationed goods without points?	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐
Does { he / she } pay Black Market prices, forget about ceilings?	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐
Does { he / she } buy a lot of things you don't really need?	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐
Does { he / she } want to cash in a War Bond now and then?	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐
Does { he / she } grab the first things back on the market— *when you could do without them a little longer?*	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐
Does { he / she } believe in spending while the money's coming in easy, *laugh at you for trying to save up for a rainy day?*	*Never*	☐	☐
	Occasionally	☐	☐
	Often	☐	☐

HOW TO SCORE

Never counts 10, *Occasionally* 5, *Often* 0

If your husband's score is:

50 or Over—He's a wonder—hang on to him!

10-30—He's pretty good—steer him a little!

0-10—Get busy, lady—take him in hand!

If your wife's score is:

50 or Over—She's an angel. KISS her!

10-30—A word from you might be in order!

0-10—Only *one* thing to do SPANK her!

ONE PERSON CAN START IT!

You give inflation a boost

—when you buy anything you can do without

—when you buy above ceiling or without giving up stamps (Black Market!)

—when you ask more money for your services or the goods you sell.

SAVE YOUR MONEY. Buy and hold all the War Bonds you can afford—to pay for the war and protect your own future. Keep up your insurance.

HELP US KEEP PRICES DOWN

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

NEW BULLETINS

(*Continued from page* 230)

tions are contained in a supplemental booklet in a pocket insert. For reasons of economy the use of space radio is advocated only for yard and head to rear communications and inductive equipment is recommended for main line and wayside station use.

Service Accessories

General Cement Mfg. Co., Rockford, Ill., has issued a catalog (No. 146) containing complete listings of the line of radio cements, chemicals, hardware, cabinet repair kits, repair parts, tools and other service accessories.

Cerium Alloys

Two lists of references to the uses of cerium as an alloying agent in conjunction with aluminum and magnesium have been compiled by the Cerium Metals Corp., 522 Fifth Avenue, New York. These annotated bibliographies have been selected from English, French and German material of the past twenty years. Patents are listed. Important articles are briefly summarized.

Generator Units

A line of electric generators up to 25 kw is described in a new catalogue of the Kato Engineering Co., Mankato, Minn. Gasoline-driven, hand-starting plants of 500 watts through 5,000 watts are listed in air cooled styles, and from 10 kw to 25 kw water cooled. Automatic controls are available. Independent generators, single and three phase, motor generator sets and high frequency generators are also featured. A group of high efficiency rotary converters and a dual voltage set are included.

Vitreous Resistors

Details of a line of vitreous resistors are given in a folder newly issued by Presto Electric Co. Inc., Union City, N. J. Sizes up to 215 w are available.

Porcelain Enamel

A new booklet, describing many of the characteristics and applications for procelain enamel, white and colored, has been issued by the Porcelain Enamel Institute, 1010 Vermont Ave., N. W., Washington 5, D. C. It includes a pictorial description of how procelain enamel is made and applied to metal parts. The information given is of interest to engineers, designers and manufacturing and sales executives.

(*Continued on page* 234)

NEW BULLETINS

(Continued from page 233)

Commutator Stones

A new booklet on motor-generator maintenance and repair equipment has been issued by Ideal Commutator Dresser Co., Sycamore, Ill. A great deal of information is given about surfacing commutators and undercutting mica. The booklet also catalogs coil winding and armature winding machinery, growlers, insulation testers, blowers and vacuum cleaners and miscellaneous tools of interest to the electrical industry.

Research Index

A 72-page catalogue of the publications and patents which have resulted from fifteen years of fundamental and applied Battelle research has just been published by Battelle Memorial Institute, Columbus, Ohio.

Founded to advance education, science, and industry, through research and through the dissemination of technlogical information, Battelle has published widely in the nation's technical and scientific journals. The new catalogue lists more than eight-hundred such journal contributions, books, and patents between the years 1929-1944,, inclusive.

The catalogue includes subjects in the fields of organic chemistry, electrochemistry, chemical engineering, graphic arts, welding mineral dressing, industrial physics, technology, applied mechanics, ceramics, fuels, and metallurgy.

Contact Data

A new 36-page electrical contact catalog and data book (No. 12) issued by the Stackpole Carbon Co., St. Marys, Pa., contains information and data for manufacturers of products utilizing contacts. In addition to describing all of the many types of Stackpole contact materials with extensive notes on the applications of each type, the catalog gives data on such factors as variables in contact selection; factors in the choice of materials; contact types, shapes, and sizes; methods of attaching contacts; contact metal compositions; welding and brazing tips, and various others.

Die Casting

A valuable treatise on high-pressure die casting has been published by the H. L. Harvill Mfg. Co., Los Angeles, Calif., in cooperation with Paul R. Jordan, consultant of the same city. The book, of 100 pages,

(Continued on page 236)

NEW BULLETINS

(*Continued from page 234*)

with many photographs and drawings, covers the following subjects: Processes, materials, construction of dies, design of dies and parts for die casting, pressure castings, machining, finishing and inspection. It is written for engineers who wish to use die casting.

Glass Bonded Mica

Properties of Turx (formerly PemQue) glass bonded mica as manufactured by the International Products Corp., Baltimore 18, Md., are described in an illustrated booklet newly issued. Useful curves are included showing low water absorption.

Diathermy Tubes

A printed substitution list of tubes for diathermy apparatus has been published by Taylor Tubes, Inc., 2312 Wabansia Ave., Chicago, Ill. The leaflet lists the equipment by manufacturer, such as Fischer, Lindquist, Bristow, Birtsher, Burdick, deForest, McIntosh, Majestic, Rose., etc., showing which type tubes are furnished with the unit and the Taylor tube substitute. With the extreme scarcity of tubes of original specification, the leaflet should prove an invaluable adjunct to many of whose diathermy units are standing idle for want of the proper vacuum tube, and who do not know of substitutes.

Multi-meters

Metropolitan Electronics & Instruments Co., 258 Broadway, New York 7, N. Y., has issued a folder offering multi-meters, signal tracers and resistance capacity bridges. Modern design and simplicity of operation are featured.

Plastic Molding

Kurz-Kasch, Inc., 1415 So. Broadway, Dayton 1, Ohio, have issued "A Businessman's Guide to the Molding of Plastics." Methods used at the factory to insure satisfactory products are explained.

MEASURING RADIOACTIVE EMANATIONS

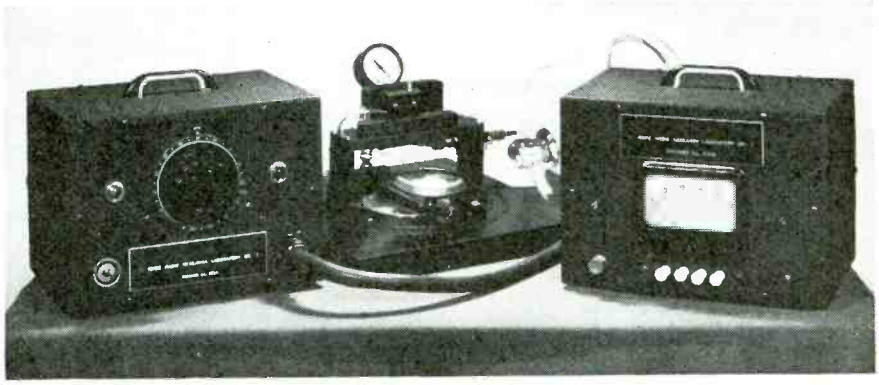
The Rowe radio type RM82 radioactivity "R" meter is a sensitive electronic apparatus for measuring directly very weak radiations from small quantities of radioactive materials. It will indicate values from 0.000001 to 20.0 "R" units. In spite of its very high sensitivity it is a fully stable instrument and is simple to operate.

The "R" meter is calibrated directly in fractions of "R" units on a linear scale of a four inch meter. It has five "R" ranges which are selected by push buttons. Full scales on these ranges at maximum voltage are: 0.0001, 0.001, 0.01, 0.1, and 1.0 "R" units. By using minimum voltage the least sensitive range can be extended to 20 "R" Units for full scale.

The meter proper is an electronic device which measures very small currents as low as 0.001 microampere. A high voltage power supply with adjustable output from 100 to 2000 volts dc is part of the apparatus Safety switches are provided so that there is no possibility of the operator being exposed to the high voltages.

Various types of units are provided for holding chemicals to be measured. The illustration shows one of several arrangements. In this case the material holder and electrodes are enclosed in a bell jar for evacuation. This is not necessary but often desirable.

The radioactivity "R" meter is enclosed in two steel cases, each approximately 11 in. wide, by 8 in. high, by 8 in. deep. The finish is a baked black enamel wrinkle. The apparatus is arranged for operation from 115 volts 60 cycle ac. Manufacturer is the Rowe Radio Research Laboratory Co., 2422 North Pulaski Road, Chicago 39, Ill.



WESTINGHOUSE ELECTRIC CORPORATION

has a position open for Acoustical Engineer with experience in loudspeaker and phonograph record changer development or laboratory measurement. An attractive position for the man with experience. Wire or write for application:

Manager, Technical Employment

306 Fourth Avenue **Pittsburgh 30, Pa.**

PHYSICIST—ELECTRICAL ENGINEER

Desires position in charge of research and development. B.S. in E.E. and Ph.D. (electronic physics), age 39, married, 10 years in charge of research laboratory concerned with design and development of electronic devices; experience in telephone, power and electrical control development. Permanent position only, where initiative, ability and supervising talent required. Nature of undertaking, locale, etc. outweigh remuneration.

BOX 1099
ELECTRONIC INDUSTRIES
480 Lexington Ave., New York 17, N. Y.

SALES MANAGER WANTED

An old established progressive radio parts manufacturer situated in southern California having national distribution requires a sales manager. Must have real executive ability. Several years experience in sales department of a radio parts manufacturing company or equivalent background essential. This is a splendid opportunity for a man capable of handling all contacts and correspondence with jobbers and manufacturers, supervising the activities of agents and salesmen and assisting in the design of new products, etc. Reply

Box 1053
ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE **NEW YORK 17, N. Y.**

Norman D. Morris, C. P. A.
Formerly Senior Administrative Officer, Signal Corps Cost Analysis Agency

Irving Rosen, C. P. A.
Formerly Field Supervisor, Signal Corps Cost Analysis Agency

Announce the formation of the firm of

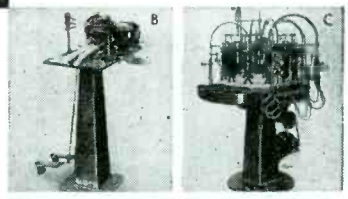
MORRIS & ROSEN

FOR THE GENERAL PRACTICE OF ACCOUNTANCY

100 East 42nd Street, New York 17, N. Y.
MUrray Hill 6-8923

EISLER EQUIPMENT
. . . the plus factor in tube manufacture

CHAS. EISLER specialized facilities are supplying high-efficiency manual, automatic and semi-automatic machinery for vacuum tube and electronic component production. Hundreds of devices are included — glass tube slicers, stem and sealing machines, flaring units, laboratory apparatus, etc.



(A) No. 161-WH Glass Tube Constriction Forming Machine draws, rapidly, automatically.

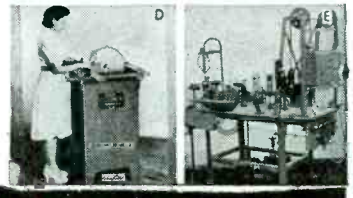
(B) No. 16 - 2S Two - Head Bench Type Flare Machine. Capable of rapid, efficient production. Simple operation.

(C) No. 23-12LD, new type 12 head giant Tipless Stem Machine.

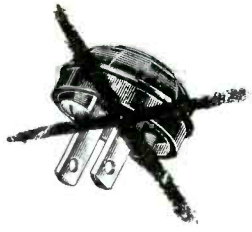
(D) No. 11-TU Glass Tube Slicer, makes clean, sharp cuts—does not require skill.

(E) No. 57-X Laboratory Unit for glass cutting, flaring, stem making, sealing-in, exhausting, basing.

Chas. Eisler



CHAS. EISLER
EISLER ENGINEERING CO.
778 SO. 13th STREET (Near Avon Ave.) NEWARK, NEW JERSEY



YES **NO**

MR. APPLIANCE MANUFACTURER

Why continue to equip the appliances you make and sell to the export market with American type plug caps which are useless in the country in which your devices are going to be used?

We make a complete line of Attachment Plug Caps and Adaptors that are used in foreign countries.

Modernize your export line. It's simple, inexpensive. Send for Bulletin number 420 and samples.

Manufactured by

C. D. WOOD ELECTRIC CO.

826 Broadway **New York 3, N. Y.**
GRamercy 7-0100

FM FREQUENCY ALLOCATIONS

Federal Communications Commission on Sept. 12 issued its list of frequencies which have been assigned to FM stations for operation in the new high frequency band. Following is the complete list:

METROPOLITAN STATIONS

City and Call Letters	Radiated Power kw	Antenna Height	Frequency
Baton Rouge, La. WBRL	20	500	96.1
Binghampton .... WNBF-FM	10.5	657	96.7
Boston ..... WBZ-FM	20	455	95.7
Chicago ..... WBBM-FM	10*	668	99.3
Chicago ..... WDLM	20*	479	99.7
Chicago ..... WEHS	12*	616	100.1
Chicago ..... WGNB	20*	472	98.9
Chicago ..... WWZR	12*	611	98.5
Columbus ..... WELD	20	341	94.5
Detroit ..... WENA	10.5	663	96.9
Detroit ..... WLOU	20	362	96.5
Evansville ..... WMLL	20	281	94.7
Fort Wayne ..... WOWO-FM	20	300	95.9
Hartford ..... WDRC-FM	7.0	758	94.3
Hartford ..... WTIC-FM	9.5	673	93.5
Indianapolis ..... WABW	20	290	94.9
Kansas City ..... KOZY	20	500	99.9
Kansas City ..... KMBC-FM	20	500	97.9
Milwaukee ..... WMFM	20*	310	92.3
Nashville ..... WSM-FM	8.5*	720	100.1
Philadelphia ..... KYW-FM	20	382	93.1
Philadelphia ..... WCAU-FM	20	366	95.5
Philadelphia ..... WFIL-FM	20	464	94.3
Philadelphia ..... WIP-FM	18	520	93.9
Philadelphia ..... WIBG-FM	20	358	95.1
Philadelphia ..... WPEN-FM	20	455	95.9
Pittsburgh ..... KDKA-FM	6.5	783	94.1
Pittsburgh ..... WTNT	20	500	94.5
Rochester ..... WHEF	20	387	98.5
Rochester ..... WHFM	20	261	98.9
Salt Lake City.... KSL-FM	8.5	720	100.1
Schenectady ..... WGFM	6	805	95.3
Schenectady ..... WBCA	6	805	95.7
South Bend ..... WSBF	20	312	101.3
Springfield, Mass. WBZA-FM	20	500	99.1
Superior, Wisc... WDUL	20	500	92.3
Worcester, Mass. WTAG-FM	20	477	102.1
Worcester, Mass. WGTR	9.5	680	101.7
Alpine, N. J. .... WFMN	6.0	795	100.9
New York ..... WQXQ	11.5	632	100.5
New York ..... WABF	15	567	98.5
New York ..... WGYN	4.0	905	100.1
New York ..... WFGG	7.2	747	99.7
New York ..... WHNF	20	455	99.3
New York ..... WNYC-FM	15	560	98.1
New York ..... WBAM	15	559	96.9
New York ..... WABC-FM	5	850	97.3
New York ..... WEAF-FM	1.6	1258	97.7
Jersey City ..... WAAW	13.5	590	96.1

RURAL STATIONS

Mt. Washington, N. H. ..... WMTW	10		97.9
Winston-Salem, N. C. ..... WMIT	200		97.3

The following metropolitan stations may operate from their present sites with the power indicated below until such time as the Commission considers all of the applications in the Los Angeles area.

Los Angeles ..... KHJ-FM	4.8	870	99.7
Los Angeles ..... KTLO	4.8	870	100.1

**This antenna height is based upon previously authorized antenna construction, and a minimum antenna height of 500 feet above average elevation will be required in the future unless a showing is made to the contrary that such an antenna height is not feasible.*

Some Television Dollars and Cents

Several members of the staff of Electronic Industries have television sets which they are operating nightly to become thoroughly familiar with the technical and program problems of the new art.

One man has just completed a year's use of television in his own home, and now sums up his experiences. Similar reports could be made by other staff members as the result of their own experiences as members of the video audience. The year's report follows:

"Last evening being Saturday, with no television programs on the air, I went to a movie. For 75 cents I sat in a 'loge' seat, so far back that the entire screen could be totally hidden by a postage stamp held at normal reading distance, 12 inches from my eye (as determined by actual measurement there on the spot).

Video 16 times movie screen

"In other words, the movie picture, from where I sat, appeared to be no larger than one of Uncle Sam's gummed steel engravings pasted on a newspaper at ordinary reading distance for fine type. (In contrast, as I normally sit before my 9 x 12 in. home television screen, its size on by retina is just 16 times as large as was that movie screen from my 75-cent seat!)

"This movie experience—my first full cinema visit in many months—started me to figuring just how much it would have cost for movie tickets for all those evenings our home television set has been pouring forth its studio plays, news events, sports, westerns, educational films and variety acts.

$950 for shows!

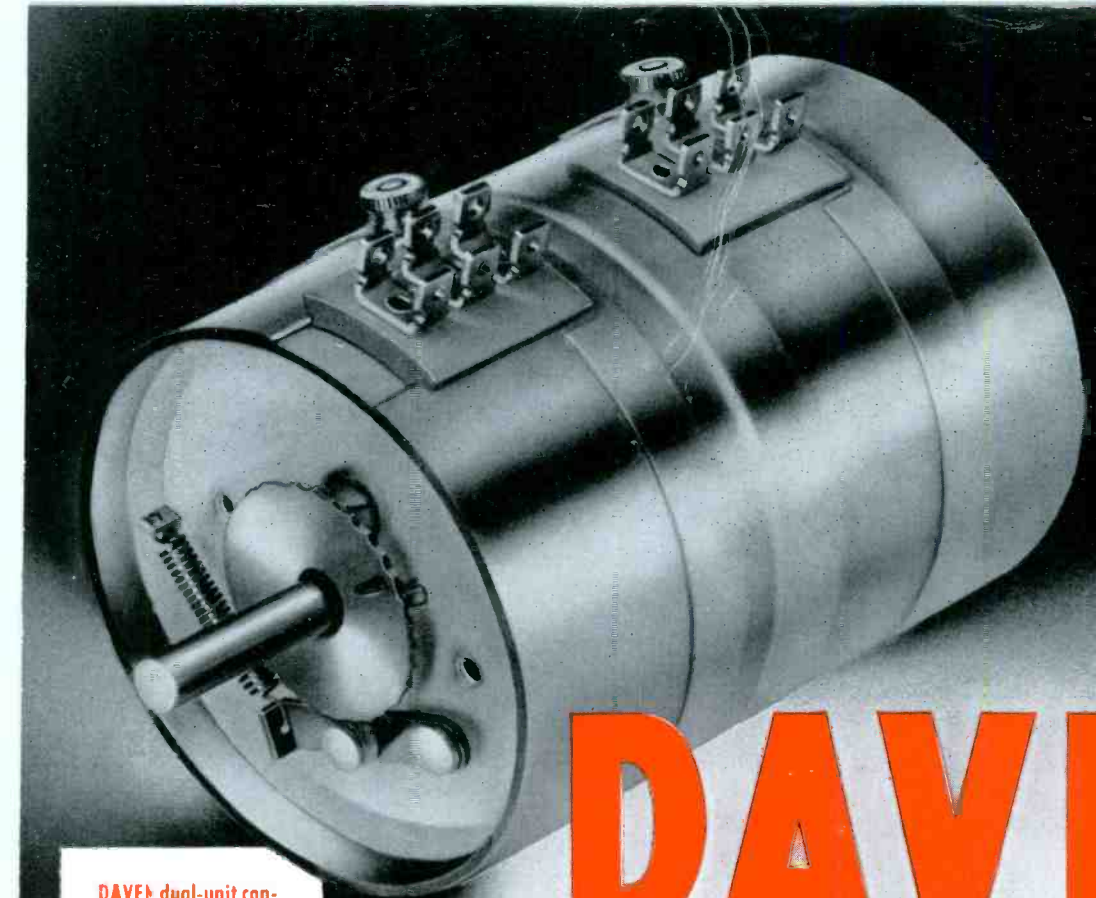
"During the past year we have operated the television set at least 300 evenings or afternoons, with an average of two to three hours per day. The average audience has been five viewers. Had we bought that number of tickets (1,500) at, say 50 cents each, the year's outlay would have been $750.

"Our nearest cinemas are 4 miles away—8 miles, the round trip. To go by car would have entailed 2,400 miles of automobile travel, costing at least $200 more for gas and tires.

"So we have had television entertainment during the year that would have cost us $750 to $950 had we gone to the nearest movie. Also we saved three-quarters hour of travel time coming and going (225 hours per year) as well as inconvenience, and exposure to rain, snow and cold. Instead, with television we were able to enjoy ourselves relaxed in our own living room to the accompaniment of smokes, cool drinks, shoes off and minimum dress. And this is the kind of television enjoyment that is awaiting everyone in all of the 30,000,000 American homes that now have radios, and who eventually will be seeing as well as listening."

ELECTRONIC INDUSTRIES

Advertisers—October, 1945



DAVEN dual-unit construction finds most important application in Balanced "H" attenuators, as well as in special multiple-circuit controls of the Potentiometer, "T", Ladder, "L" and Rheostat types.

DAVEN

ANNOUNCES A NEWLY-IMPROVED MODEL for DUAL-UNIT* ATTENUATORS

DAVEN engineers have incorporated into the improved dual-unit all the important new features recently announced for DAVEN standard single-unit attenuators. A noteworthy addition in the dual-unit is the improved method of coupling front and rear attenuators. The respective shafts of each meet in a lap joint within a long, snug collar, providing quick and complete access to either unit. By loosening a knurled nut and releasing a snap-on fitting, the front or rear switch may be reached without dismounting the front unit from the instrument panel.

*Patent Pending

Features of DAVEN Dual-Unit Attenuators

SEPARABLE COUPLING—Front and rear units now easily separated: gives quick access to either unit. Simple, durable, foolproof construction illustrated at left.

IMPROVED SHIELDING—Sturdy, snug fitting, 3 piece steel cover affords superb electrical and dust shielding, as well as greater all around ruggedness.

NEW DETENT DEVICE—Large gear and roller mounted in recessed front end of front unit, separate from resistive network, gives accurate indexing. (Illustrated.)

GREATER COMPACTNESS — Rear-of-panel depth only 3⅞"; 9/16" less than former models.

CERTAIN STOP—Extrusion of detent gear and steel attenuator cover form sturdy stop to rotation, eliminating rotor-hub strain of previous method.

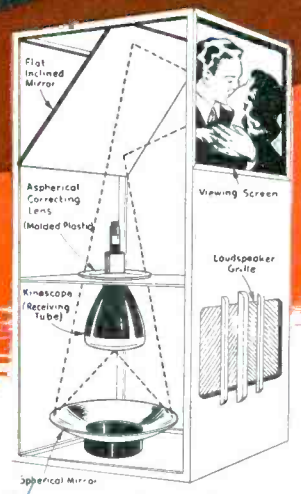
CAPTIVE TERMINAL BOARD—Solder-lugs eyeletted to bakelite boards, which are grooved to fit securely into slots in their respective can sectors.

ANTI-FUNGUS TREATED—Bakelite parts and resistive windings treated to resist fungus and mildew.

SILVER ALLOY—Contacts, switch arms and returns of tarnish-resisting silver alloy lower internal resistance. Other metals optional.

THE DAVEN COMPANY
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

HERE'S WHAT YOU'LL GET FROM RCA IN PROJECTION-TELEVISION TUBES--



LOWER COST OF TUBES: Simple bulb design in soft glass lends itself to low-cost quantity production.

LOW-COST POWER SUPPLY: New electrostatic-focus electron gun avoids cost of a magnetic-focus coil and, at the same time, permits use of a low-cost power supply not requiring good regulation.

HIGH CONTRAST: New "settling" method of applying screen reduces degree of optical contact between fluorescent particles and face of tube, resulting in higher contrast.

TAILORED TO PROJECTION OPTICS: Spherical face of RCA projection kinescopes matches RCA reflection-type optical system.

* * *

Already, RCA has demonstrated to hundreds of engineers and radio experts television of tomorrow as made possible by these new tubes. Screens as large as a newspaper page, with clear, bright images, enable dozens of persons to see the program . . . and this is but one example of RCA electron tube development, engineering and leadership.

Postwar, why not consult RCA for better tubes for better television? RCA tube-application engineers are always ready to serve you. Address: RCA, Equipment Sales Department, Section 62-34J, Harrison, N. J.

The Fountainhead of Modern Tube Development Is RCA

62-6126-34

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION - CAMDEN, N. J.