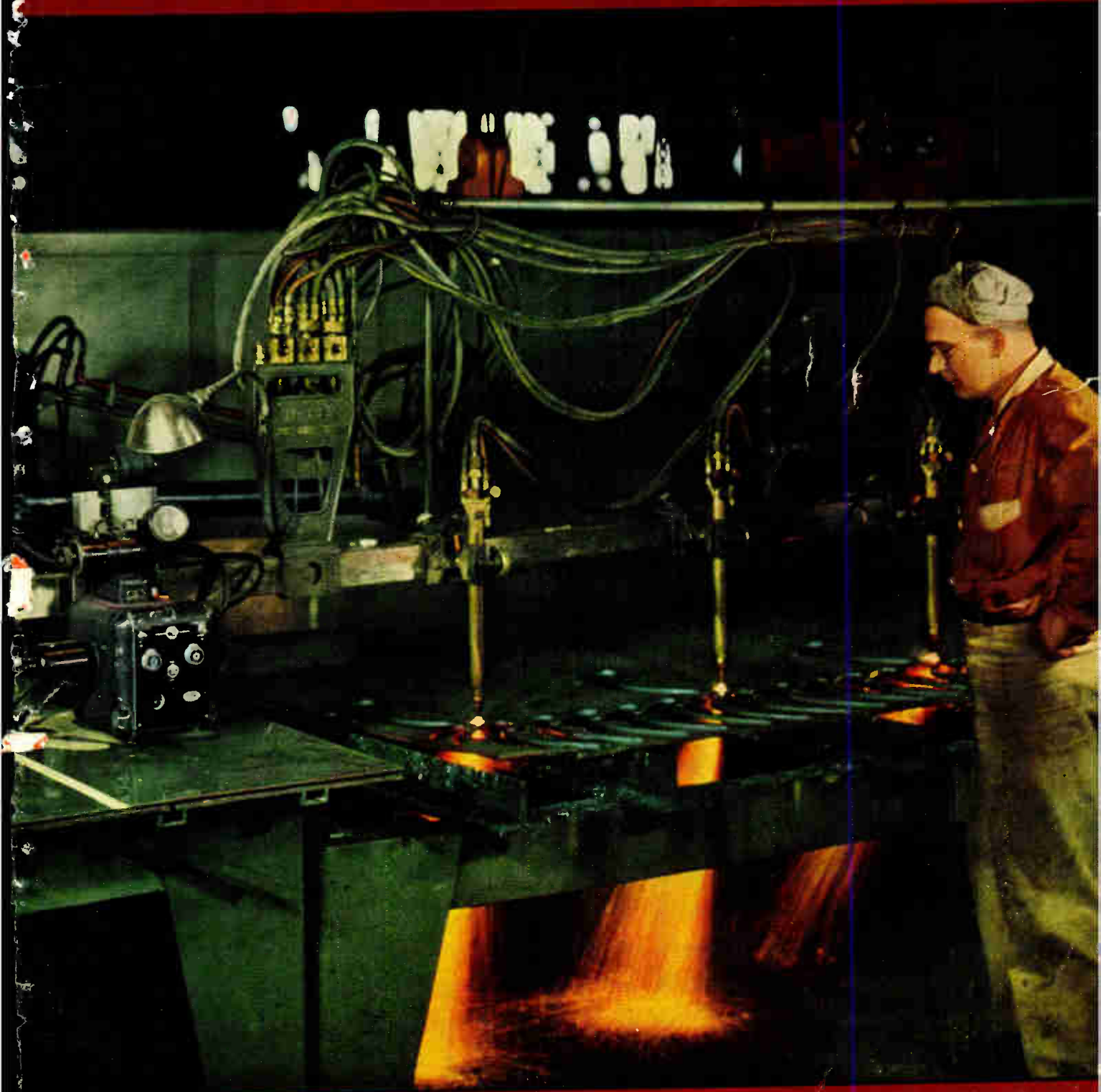


DECEMBER - 1948

# electronics

A MCGRAW-HILL PUBLICATION



PHOTOELECTRIC CUTTING MACHINE

World Radio History

# For Perfected Large-Size Home Projection-PROTELGRAM



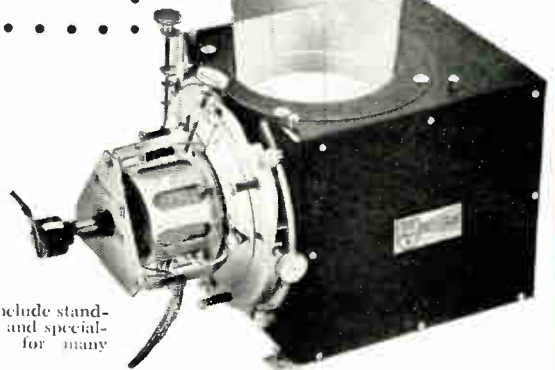
The 2½" magnetic projection triode 3NP4 has a face as small as a compact and is only 10½" long.

**HERE'S THE OPPORTUNITY THAT MANUFACTURERS OF TELEVISION RECEIVERS HAVE BEEN AWAITING!**

• • • • • **10 SIGNIFICANT FEATURES** • • • • •

- 1 Flat 16" x 12" non-reflecting picture provides fatigueless viewing from less than 5 feet and upward!
- 2 Wide-angle visibility — *square corners*.
- 3 True photographic black and white picture quality—no discoloration.
- 4 Compact unit—suitable for table model cabinets.
- 5 Long-life, low-cost picture tube.
- 6 Manufacturers can most economically extend their product range into projection television by adapting their 10" EM chassis for use with PROTELGRAM.
- 7 Easy to service.
- 8 High contrast ratio and broad gray tone range.
- 9 Simple optical adjustment system.
- 10 *Quality built* after more than 10 years of development.

NORELCO PROTELGRAM consists of a projection tube, an optical box with focus and deflection coils, and a 25 kv regulated high-voltage supply unit, making possible large-size home projection. More than ten years of exhaustive research resulted in this ideal system for reproducing a projected picture. The optical components are designed to produce perfected projection for a 16" x 12" image, the optimum picture size for steady, distant observation and also for proper viewing at less than 5 feet.



Other NORELCO products include stand- and 10" direct-viewing tubes and special-purpose cathode-ray tubes for many applications.



**PROTELGRAM**

**IS PICTURE PERFECTION IN PROJECTION**

**NORTH AMERICAN PHILIPS COMPANY, INC.**  
DEPT. TE-12, 100 EAST 42nd STREET, NEW YORK 17, N. Y.

IN CANADA: PHILIPS INDUSTRIES LTD., 1203 PHILIPS SQUARE, MONTREAL \* EXPORT REPRESENTATIVE: PHILIPS EXPORT CORPORATION, 100 EAST 42ND STREET, NEW YORK 17, N. Y.

# electronics

A MCGRAW-HILL  
PUBLICATION



DECEMBER • 1948

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# MARION . . . helps WEBSTER-CHICAGO



record sound on a wire

In designing their superb wire recorder for office and studio recording, Webster-Chicago needed a special meter-type, volume-level indicator for accurate input control. Ruggedness and accuracy were basic requirements. Because Marion has long been noted for fool-proof, trouble-free electrical meters and instruments, it was natural for Webster-Chicago to turn to Marion for this important component.

Marion soon developed a small, specially designed, panel-mounting type of meter for the amazing Webster-Chicago Wire Recorder. In doing so Marion played a vital part in helping Webster-Chicago record the human voice and other sounds on a wire.

When you have a problem that concerns electrical measuring or indicating, we invite you to turn to Marion. We have a long record of success in helping others. And, because we know the name "Marion" means the "most" in meters, we believe we can help you too.

THE NAME "MARION" MEANS THE MOST IN METERS



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*Slide Rules      Measuring Tapes*



# the voice that

## STEPPING-STONES TO PROGRESS IN MARINE RADIOTELEPHONY



The first ship-to-shore radiotelephone communications were established almost 30 years ago between land stations at Green Harbor, Mass., and Deal Beach, N. J., and the steamers "Ontario" and "Gloucester," operating between Boston and Baltimore.



The "Leviathan" was the first ship to handle radiotelephone messages as a public service to and from land telephones.



This selector set made it possible to dial ships at sea, and eliminated the need for constant monitoring by loudspeaker or headphones.

IT'S COMMONPLACE TODAY to pick up a telephone on shipboard and talk to a business associate on land. But little more than 30 years ago, this was just a dream.

Back in 1915, the spoken voice could travel to far places only by wire. Then telephone scientists developed the radiotelephone, and soon the spoken word was winging its way across the ocean. A further use of this new magic was soon proposed: could not the human voice be sent from shore to ships at sea?

Soon sub-chasers and other small Navy craft were talking to each other over equipment designed by Bell engineers. And in experiments starting in 1919, the men on two coastwise steamers talked through land stations to land telephones of the Bell System.

These early experiments covered fairly short distances. But in the meantime, telephone calls across the Atlantic by radio had become an ordinary occurrence. So . . . why not 'phone calls to ships way out in *mid-Atlantic*?

Of course, long-distance ship-to-shore radiotelephony brought up problems of varying distances and directions—problems not encountered in point-to-point transmission. Bell Telephone Laboratories solved these problems with the design of the "Leviathan's" equipment. For the first time, long-range marine radiotelephony became a reality.

Later, Bell Laboratories scientists developed selective ringing, which made it possible to *dial* particular ships at sea. The basic elements of practical marine radiotelephony had now been developed.



## BELL TELEPHONE LABORATORIES

*World's largest organization devoted exclusively to research and development in all phases of electrical communications.*

# links the ship and the shore

IN ADDITION TO producing radiotelephone equipment for the largest ocean liners, Western Electric for many years manufactured the 224, 226 and 227 type sets, which brought the benefits of radiotelephone facilities to coastwise vessels and small craft.

These sets provided power capacities ranging up to 100 watts. As the Bell System had tremendously expanded its chain of harbor stations, coastal craft were normally near a shore station. Hence these capacities were ample to maintain contact with land.

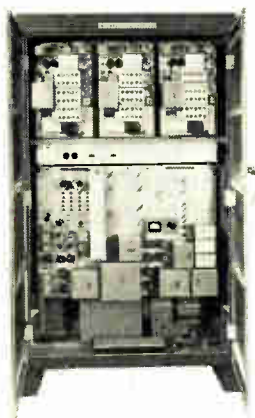
There still existed, however, no equipment specifically designed for tankers, freighters and smaller passenger ships plying the *ocean* lanes. This need has been filled by the introduction of the Western Electric 248A.

This new equipment provides 250 watts of transmitted radio frequency carrier power, resulting in greatly increased range. Provision is made for transmission and reception on the frequencies of the high-seas shore stations (as well as on the coastal harbor and ship-to-ship channels). Because of these two features, a ship equipped with the 248A, at practically any point on world trade routes, can establish contact with a land station.

The 248A combines this advantage with the compactness and simplicity of operation essential on smaller ships.

—QUALITY COUNTS—

## THE NEWEST IN MARINE RADIOTELEPHONE EQUIPMENT



Left: Main cabinet of 248A mounting transmitter and three receivers.

Above: Remote control unit.

The long experience of Bell Laboratories and Western Electric in design and manufacture of marine radiotelephone equipment has culminated in the 248A—compact, powerful, simple to operate.

A single cabinet houses the transmitter and three receivers. Each of the three receivers can be tuned to any one of 10 pre-set frequencies; the transmitter to any one of 30. Transfer from one frequency to another is accomplished simply by turning knobs on the remote control panel.

Because three receivers are used, it is possible for the ship to monitor simultaneously on three different channels. The set is designed to permit easy installation of selective equipment to allow dialing the ship from shore stations.

# Western Electric

Manufacturing unit of the Bell System and the nation's largest producer of communications equipment.



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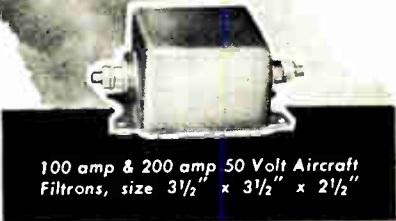
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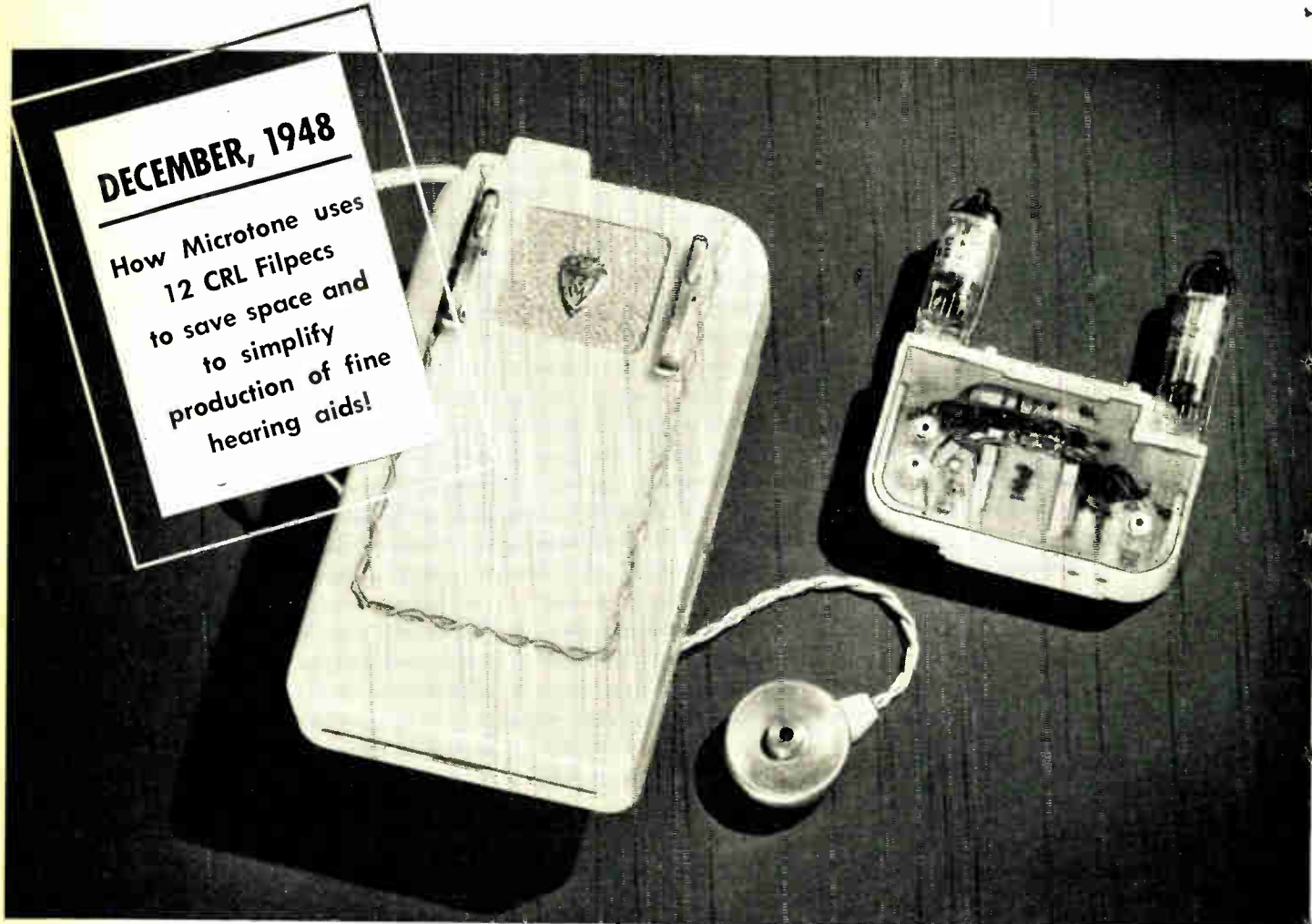
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**DECEMBER, 1948**

How Microtone uses  
12 CRL Filpecs  
to save space and  
to simplify  
production of fine  
hearing aids!



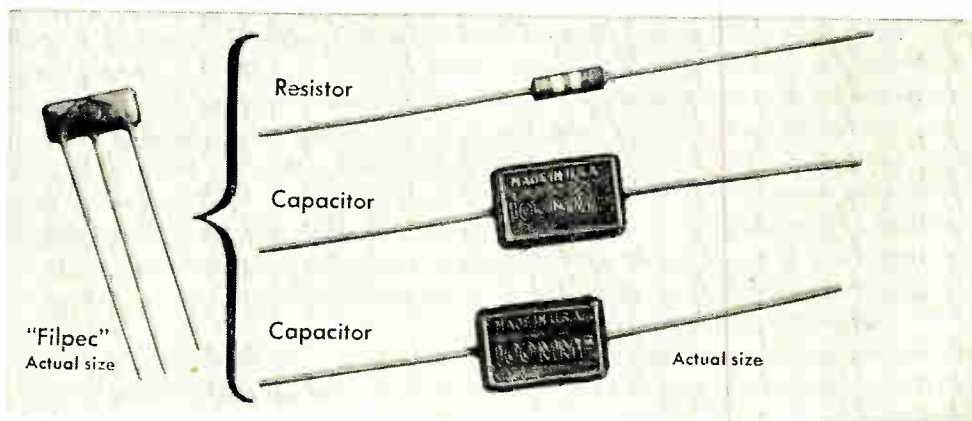
*Models courtesy of the Microtone Co.*

**1** Hearing aids are smaller and lighter. Hearing aid performance is better . . . absolutely unaffected by moisture and humidity. Centralab's amazing *Printed Electronic Circuit* is an important reason and the Microtone hearing aid is important proof. When

Microtone engineers switched to *Filpec*, here's what they found. *Filpec* cuts down size and weight by reducing the number of components needed . . . increases production by eliminating many assembling operations. For all the facts, write for Bulletin 976.

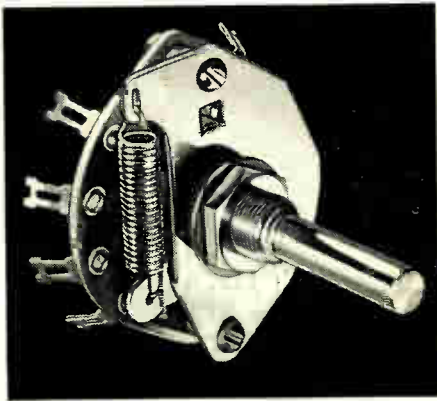


**2** Model 1 *Radiobm* (left), and ten *Filpecs* molded into a single amplifying unit (right) help Microtone build smaller, more efficient hearing aids.

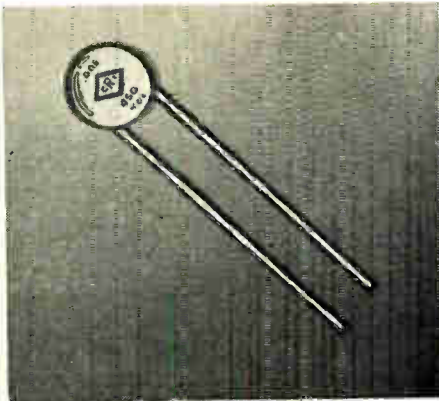


**3** Centralab's *Filpec* is designed for use as a balanced diode lead filter, combines up to three major components into one tiny unit, lighter and smaller than one ordinary capacitor. Capacitor values available from 50 to 200 mmf. Resistor values from 5 ohms to 5 megohms. For complete information, write for Bulletin 976.

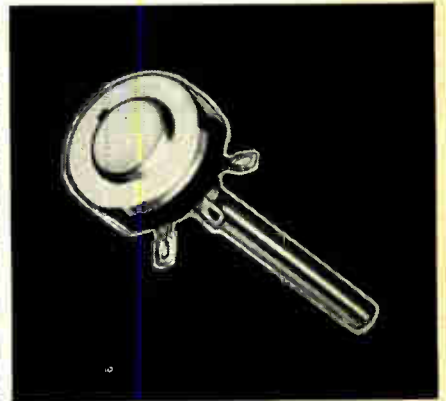
# Electronic Industry



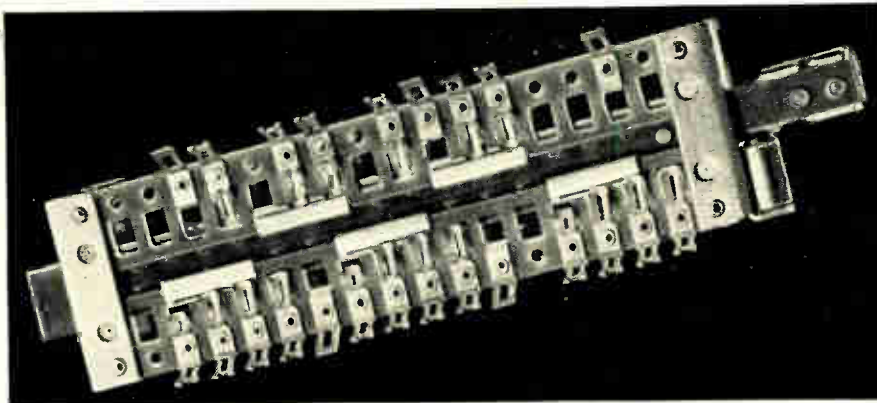
**4** Great step forward in switching is CRL's New Rotary Coil and Cam Index Switch. Its coil spring gives you smoother action, positive indexing, longer life.



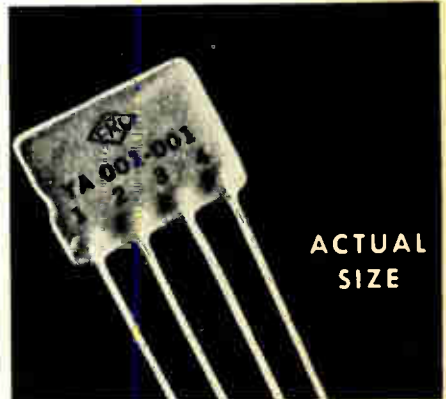
**5** To CRL's line of high quality ceramic capacitors, these miniature disc Hi-Kaps have been added. Combine reliability, capacity. Order Bulletin 933.



**6** Wide range of variations in CRL's Model "M" Radiohm simplifies production and inventory. Bulletin 697-A illustrates convenience, versatility!



**7** Centralab's development of a revolutionary, new Slide Switch promises improved AM and FM performance! Flat, horizontal design saves valuable space, allows short leads, convenient location to coils, reduced lead inductances for increased efficiency in low and high frequencies. Rugged, efficient. Write for Bulletin 953.



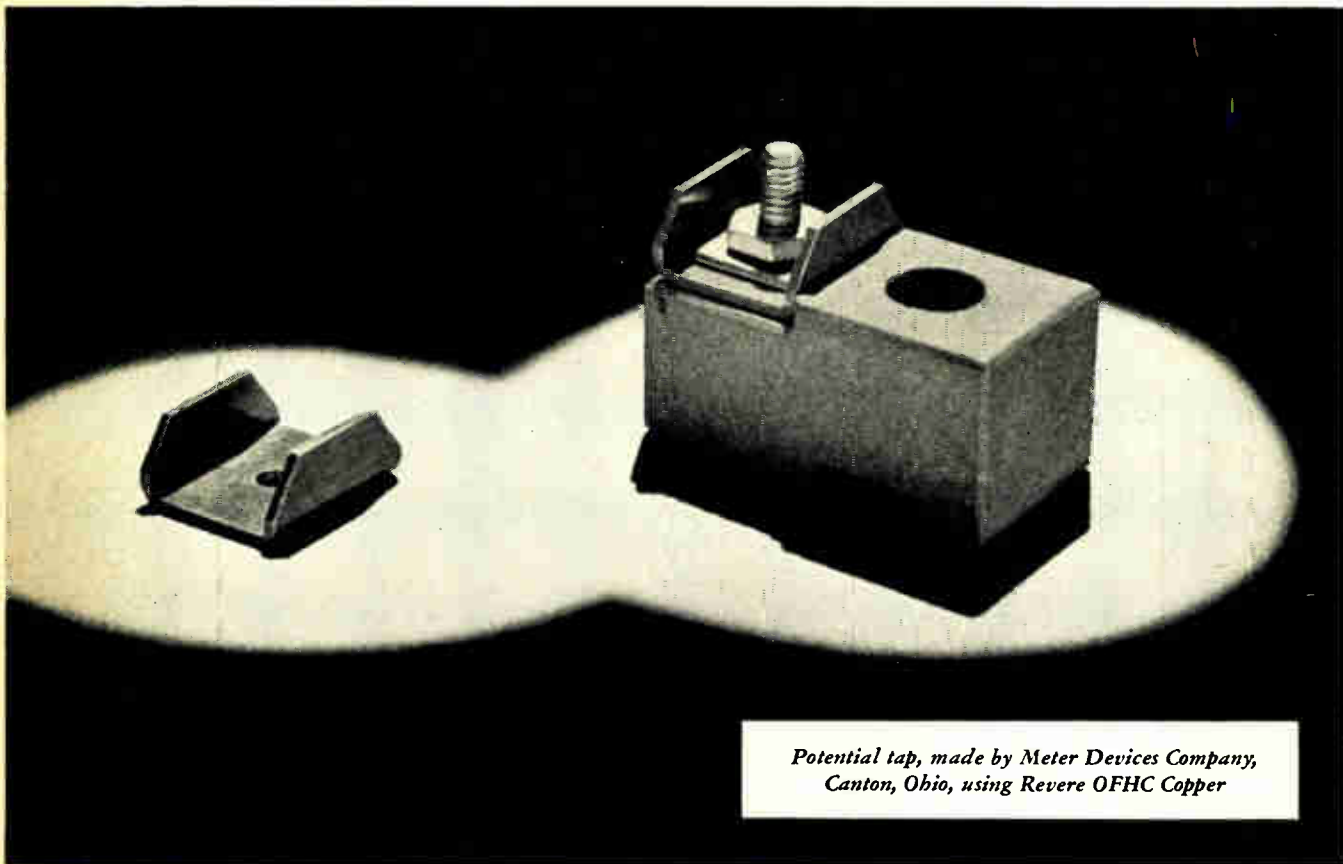
**8** CRL's Couplate consists of a plate lead resistor, grid resistor, plate by pass capacitor and coupling capacitor. Write for Bulletin 943.

**LOOK TO CENTRALAB IN 1949!** First in component research that means lower costs for the electronic industry. If you're planning new equipment, let Centralab's sales and engineering service work with you. Get in touch with Centralab!

# Centralab

DIVISION OF GLOBE-UNION INC., MILWAUKEE, WIS.

# IT PAYS TO LOOK AT COST PER PART NOT PRICE PER POUND!



*Potential tap, made by Meter Devices Company,  
Canton, Ohio, using Revere OFHC Copper*

**T**HERE'S certainly nothing complicated-looking about the small stamped channel section of .042" gauge copper shown in the accompanying illustration. And that's what makes this story all the more interesting.

It is told by Mr. T. J. Newman, Manager of the Meter Devices Company, Canton, Ohio.

"Even a relatively simple application can cause trouble," says Mr. Newman, "a lot of trouble—if you are not using exactly the right metal for the particular job.

"In our case the problem centered around this small stamped channel, originally made of electrolytic copper with a Rockwell B 35/45. The part is bolted to a porcelain base and mounted on the test panel in a standard electric meter box. Used on the service box for test purposes, it allows the connection of a small feed-in wire off the main lines to supply the potential coils in the meter.

"Sounds simple enough. Yet complicated trouble came quickly. It started with cracks in the bends. And that resulted in a high percentage of rejections, along with expensively close inspection.

"It was then that we called in the Revere Technical Advisory Service. Acting on their recommendation, we exactly tested potential taps made of OFHC Copper with Rockwell B 49/50. Results were so satisfactory that we placed a considerable production order.

"In doing so we frankly paid a premium for OFHC.

But that premium is much more than offset by our saving in scrap and the all-around reduction in costs. Our potential taps now have no more cracks in the bends—there are no rejections whatever—and expensive inspection has been eliminated."

Thus the Meter Devices Company has learned, by its own exacting tests, that the premium purchase of OFHC Copper is a real economy. Once again it is proved that the real guide to economy is the cost of the finished part, not the price per pound of the metal of which it is made.

This progressive company is only one of the many modern industrial organizations that have profited by calling in the Revere Technical Advisory Service. Perhaps you would profit too. We suggest that you ask the nearest Revere Sales Office for more information.

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*Founded by Paul Revere in 1801*

230 Park Avenue, New York 17, New York

*Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.;  
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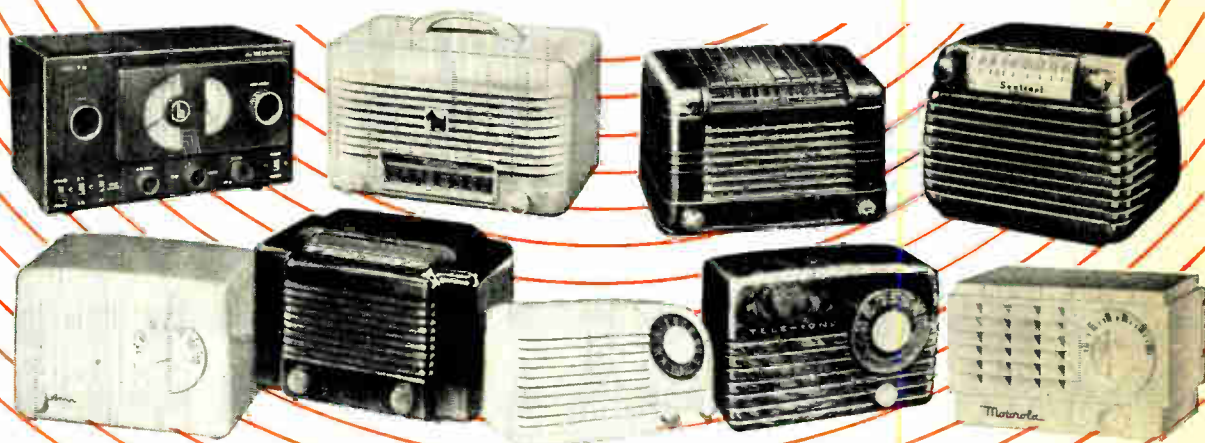
The ALL-AMERICAN FIVE

and HYTRON go together



Build a better mouse trap and the word gets around—but fast. Same with Hytron a-c/d-c tubes. Many years of experience. Many millions of tubes. Constant engineering cooperation with dozens of prominent radio set manufacturers. All help make Hytron a-c/d-c tubes better. Make it natural to think of Hytron when you think of the All-American Five.

The lowly a-c/d-c tubes must pack a heck of a lot of performance—at a price. Hytron tubes do. They offer the special advantage of being built to the strictest requirements of leaders in the small set field. GT or miniature—you, too, will find Hytron a-c/d-c tubes your best choice.



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**HYTRON**

**RADIO AND ELECTRONICS CORP.**

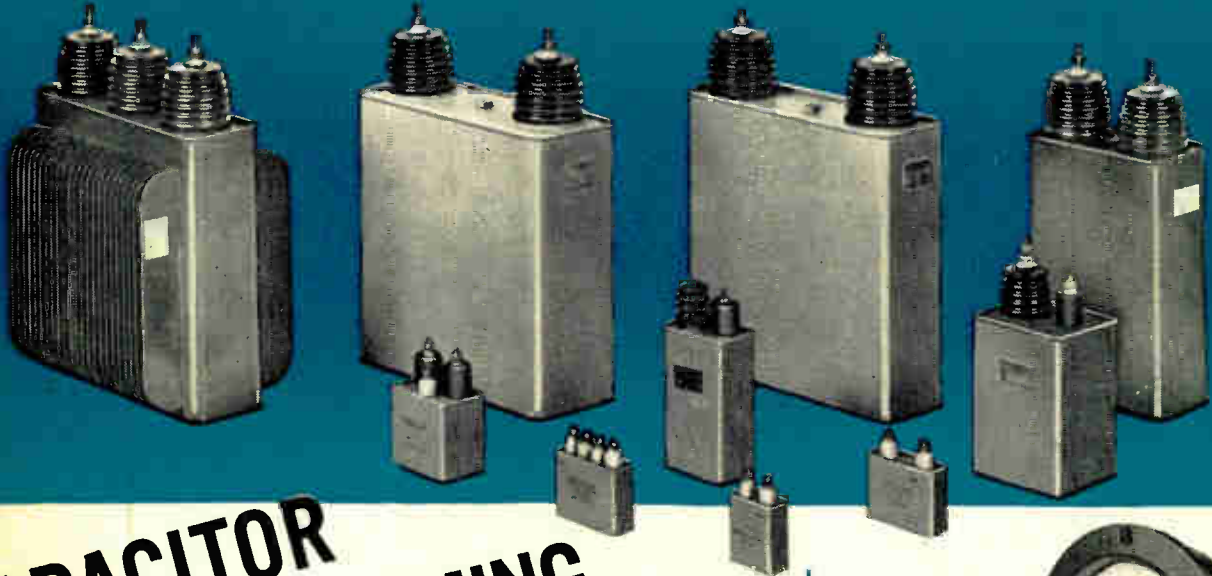
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DESIGNED  
FOR BETTER  
READABILITY



General Electric's new line of 3 1/2-inch thin panel instruments will save space and add to the appearance of your panels. They're dust-proof, moisture resistant, and vibrations normally encountered in aircraft and moving vehicles have no adverse effects. Especially designed for better readability, the scale divisions stand out by themselves. Lance-type pointers and new-style numbers mean faster reading. Available in square and round shapes, depth behind the panel is only 0.99 inches. Construction is of the internal-pivot type, with alnico magnets for high torque, good damping, and quick response. Check bulletin GEA-5102.

GENERAL  ELECTRIC

# Digest

## TIMELY HIGHLIGHTS ON G-E COMPONENTS



### SIMPLIFY CONTROL WIRING WITH THESE TERMINAL BOARDS

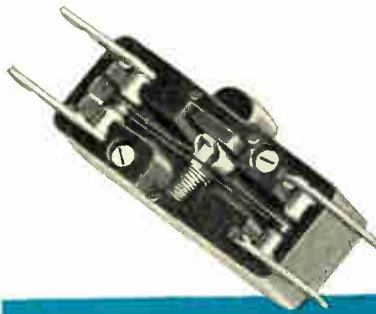
Easy-action hinged covers protect control wiring, help give your product a neat appearance. Hook-ups are easy with the hard-gripping connectors. Simply strip the wire end, screw down the connector on the bare wire. Blocks are durable, too, constructed of strong Textolite with reinforced barriers between poles to insure against breakage. Marking strips are reversible—white on one side, black on the other. These terminal boards are available with 4 to 12 poles, 2 inches wide, 1 1/4 inches high. Send for bulletin GEA-1497C.



### HOLDS OUTPUT VOLTAGE CONSTANT

This latest addition to G.E.'s line of automatic voltage stabilizers comes in 15-, 25-, and 50-va ratings. Output is 115 volts, 60 cycles. The small size of the unit makes it particularly applicable

to shallow-depth installations in many types of equipment. You may have a job for this unit which will give you automatically stabilized output voltage at a low cost. There are no moving parts, no adjustments to make; long service is assured. Check bulletin GEA-3634B for more information about this and other G-E voltage stabilizers.



### LOOKING FOR LIGHTWEIGHT SWITCHES?

Switchettes\* are designed for applications which require a manually operated electric switch in a limited space. Though small, these switchettes are lightning fast in action and are built to withstand severe service. A wide variety of forms and terminal arrangements makes them particularly useful where special circuit arrangements are necessary. Switchette shown above has one normally open and one normally closed

circuit, transferable when button is depressed. Check bulletin GEA-4888. \*Switchette is General Electric's trade name for these small snap switches.



### FOR YOUR COOLING FANS

Here's a fractional-horsepower fan motor suitable for many uses because of its compact design, low servicing requirements, and extreme quietness. Long, dependable operation is assured by sturdy, totally enclosed construction. These Type KSP unit-bearing motors are of shaded pole type design with low starting torque characteristics especially applicable to fans. A continuous oil circulation system furnishes good lubrication. You can use simple, hubless, low-cost blades with the special mounting arrangement. Write for bulletin GEC-219.

General Electric Company, Section B642-19  
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

- |  |  |
|--|--|
| <input type="checkbox"/> GEA-4996 Capacitor Pulse-forming Networks | <input type="checkbox"/> GEA-3634B Automatic Voltage Stabilizers |
| <input type="checkbox"/> GEA-5102 Panel Instruments                | <input type="checkbox"/> GEA-4888 Switchettes                    |
| <input type="checkbox"/> GEA-1497C Terminal Boards                 | <input type="checkbox"/> GEC-219 Unit-bearing Fan Motor          |

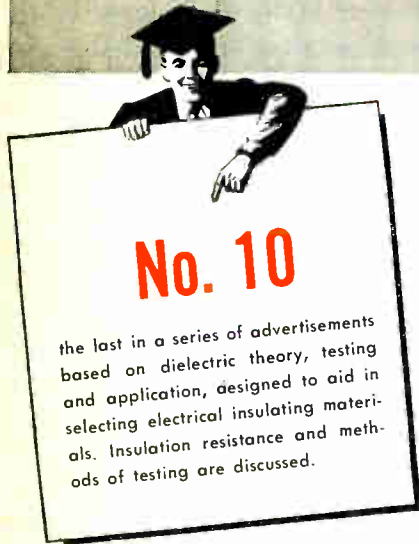
NAME .....

COMPANY .....

ADDRESS .....

CITY.....STATE.....

# Insulation Resistance Another Factor in



ditioning, factors that must, therefore, be closely controlled in testing. Wide allowances on measured values should be set in using insulation resistance as a basis for specification.

## TEST FOR INSULATION RESISTANCE

For separating insulation resistance to approximate surface and volume resistance, guarded mercury electrodes of the type shown in Figure 1 are used. Additional apparatus consists of a source of d-c potential, a galvanometer, suitable shunts, a calibrating resistance, reversing switches and keys.

The resistances are determined by the deflection method. Galvanometer deflections across the unknown resistance and the standard resistance are noted successively. The unknown resistance is then equal to the value of the standard resistance multiplied by the ratio of the deflection for the calibrating resistance to the deflection for the unknown resistance, also by the shunt ratio.

By this method, we measure (1) the over-all insulation resistance with the guard electrode attached to the unguarded electrode, and (2) the volume resistance, which is the resistance between the guarded and unguarded electrodes when the guard electrode is maintained at about the same potential as the guarded electrode. This circuit arrangement (see Figure 2) insures that only the current flow through the guarded electrode registers on the galvanometer. Surface resistance is calculated from these measurements.

With volume and surface resistance known, we can calculate the respective resistivities from the following formulae:

$$\text{volume resistivity} = \frac{RA}{t}$$

when R = volume resistance  
 A = area of guarded electrode  
 t = average thickness of sample

$$\text{surface resistivity} = \frac{R'c}{L}$$

when R' = surface resistance  
 c = average circumference of the guarded electrode and of the inner edge of the guard electrode  
 L = distance between the electrodes

The report includes: a) over-all insulation resistance in ohms, b) volume resistivity in ohm-cm. units, c) surface resistivity in ohms, d) Centigrade temperature, e) percentage relative humidity, f) time of exposure to that humidity, g) voltage used, and h) type of electrodes.

Electrical insulation is, by definition, a material of such low conductivity that current flow through it is negligible for practical purposes. Whether a material is suited for insulation depends (among other things) upon the amount of leakage current allowable in a specific application.

Measurements of leakage currents are usually expressed as "insulation resistance": the ratio of d-c voltage across two electrodes, in contact with or embedded in the specimen, to the total current between them.

Resistance measurements are useful in comparing different materials as electrical insulation. Also, in testing specimens of the same material, they often show the presence of impurities, moisture or imperfections that are difficult to measure directly.

Two leakage current paths are usually considered: one through the body of the material, the other through a thin film of moisture or other semi-conducting substance deposited on the surface.

Insulation resistance is thus dependent upon both the volume and surface resistivities of the material as well as electrode configuration. Volume resistivity is the ratio of potential gradient in volts per centimeter, parallel to the current flow in the material, to current density in amperes per square centimeter; surface resistivity is the ratio of potential gradient in volts per unit distance parallel to current flow along its surface to current in amperes per unit of surface. Resistance measurements vary widely with temperature, humidity, voltage and time of con-

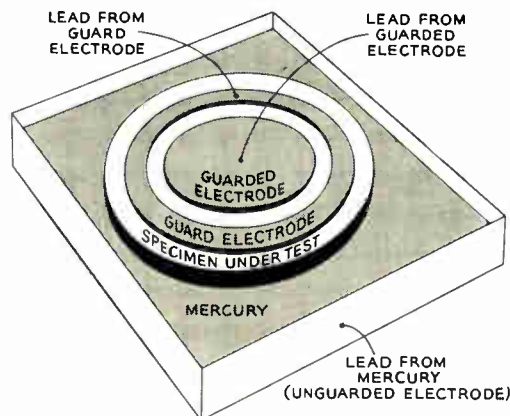


Figure 1—Arrangement of mercury electrodes used in testing insulation resistance of flat, solid materials.

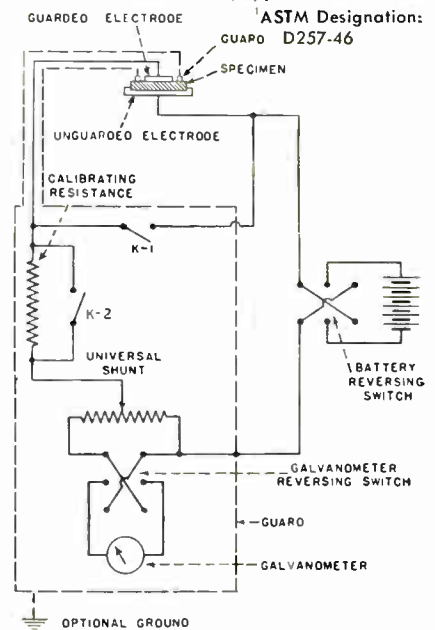


Figure 2—Diagram of connections for determination of insulation resistance.

**MICA**



# Selecting Electrical Insulation Materials

## A COMPLETE LINE OF INSULATION, BACKED BY YEARS OF RESEARCH AND PRACTICAL EXPERIENCE

In concluding this series—which has touched only the more important aspects of dielectric theory and application—we invite your inquiries for technical service on insulating problems and in the selection of insulation materials.

Mica Insulator Company has, for 55 years, specialized in

the development and manufacture of electrical insulating materials. Our complete line offers a wide selection to meet specific requirements for increased efficiency of electrical equipment performance. Our Technical Service Department will gladly bring their experience to bear on your problems.

*For your reference file...*



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This convenient folder, in regular desk-file size, has been prepared in response to many requests. It contains reprints of all ten of the technical advertisements on dielectric theory, testing and application.

Designed to help you in the selection and application of electrical insulating materials, this series contains basic information you will want to keep handy. It treats the following subjects:

1. Short-Time Dielectric Strength Test
2. Step-by-Step Dielectric Strength Test
3. Three Theories of Dielectric Breakdown
4. Effects of Temperature and Moisture on Dielectric Breakdown
5. Effects of Frequency and Time on Dielectric Breakdown
6. Effects of Geometry of Electrodes and Ambient Medium on Dielectric Breakdown
7. Physical Testing: Impact Tests
8. Tensile Strength Test
9. Compressive and Flexural Strength Tests
10. Testing for Insulation Resistance

Write today for your copy of this useful reference folder. Simply ask for Folder E.

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# RIGHT . . . . FOR MODERN CIRCUIT DESIGNS

## The Chicago Transformer New Equipment Line

Chicago Transformer's *New Equipment Line* fills an urgent need in the electronics fields for transformers designed exclusively to fit up-to-date circuit requirements. Here's why . . .

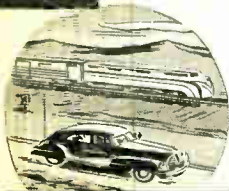
1. *Voltage and Current Ratings* of C.T. *New Equipment* Power Transformers have been selected to conform closely to the plate and filament loads of the tubes most widely used today. These units are conservatively rated . . . will deliver their full output with temperature rise well within RMA-recommended standards.
2. *Line and Voice Coil Impedances* of C.T. *New Equipment* Audio Transformers fit the accepted industry practice of standardized 600 and 150-ohm line impedances; 16, 8, and 4-ohm speakers.
3. *High Fidelity at Full Rated Output.* Frequency response within  $\pm 1/2$  db for virtually all output and input transformers, within  $\pm 1$  db for all driver and modulation transformers, is guaranteed. Recommended frequency ranges fit three fields of general use—30 to 15,000 cycles, 50 to 10,000 cycles, and 200 to 3,500 cycles.

Add to these features the sleek, modern appearance and compactness of C.T.'s outstanding drawn steel case constructions—in two alternate base styles as illustrated—and you have the reasons why this is *the only transformer line of its kind!*

WRITE FOR CATALOG TODAY



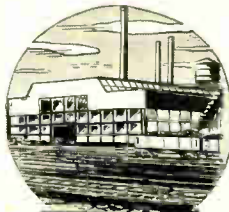
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# CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

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**OHMITE Resistance "Know-How"**

*Let Ohmite  
Help Solve  
Your  
Resistance  
Problems*



**O**hmite Resistance "Know-How" represents the combined thinking of our entire staff of resistance specialists. Remember . . . it's available to you for the asking . . . to help solve your rheostat and resistor problems . . . to analyze your requirements and suggest the correct units to fit your specific application.

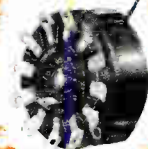
Years of experience in building dependable rheostats and resistors, in helping others solve specialized resistance problems, is your assurance that Ohmite "Know-How" can help you. We invite you to submit your problems to us.



**Rheostats**



**Resistors**



**Tap Switches**

*Be Right with* **OHMITE**

World Radio History

# OHMITE

## Close Control

# RHEOSTATS



... Available with many additional features

On this page are shown some of the many forms in which standard Ohmite rheostats can be furnished. All models have the distinctive, time-proved features of Ohmite design. They are all-ceramic in construction—ceramic parts insulate the shaft and mounting, and the resistance winding is permanently locked in place by vitreous enamel. Smoothly-gliding, metal-graphite brush provides contact with every turn of the resistance winding. Ohmite rheostats are known for their smooth, gradual, close control and their long, trouble-free life.

Write for Catalog and Engineering Manual No. 40, on your letterhead. It contains information on the complete Ohmite line, plus a wealth of helpful engineering information.



*Be Right with...*

# OHMITE

RHEOSTATS • RESISTORS  
TAP SWITCHES

*Industry's First Choice*

OHMITE MANUFACTURING COMPANY

4818 Flournoy Street — Chicago 44, Illinois

### in TABLE MOUNTING CAGES

Used to prevent mechanical injury to the rheostat or human contact with electrically "live" parts. Tabletop mounting, ventilated enclosures.



### with TOGGLE SWITCH and EXTRA LUG

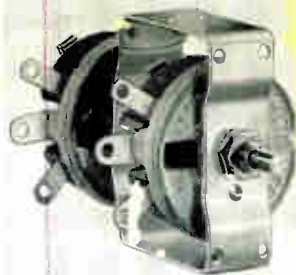
Permits dual switching of rheostat and independent circuits. Rheostat winding is terminated at an extra lug located where the switch opens.



World Radio History

### TANDEM ASSEMBLIES

Ohmite rheostats can be mounted with two, three, or more in tandem, for simultaneous operation of several circuits by one knob.



### with BUSHINGS for special panel thickness

Rheostats can be furnished with extra-long bushings and shafts for panels over 1/4" and up to 2" in thickness. Five bushing lengths.



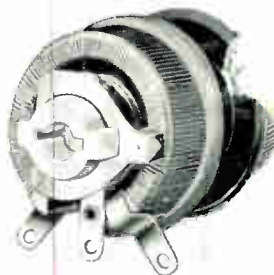
### with SCREW DRIVER SLOT SHAFT

Shaft ends can be slotted for operation with a screwdriver, where few adjustments are needed. Minimizes tampering with setting.



### with DEAD LUG OFF-POSITION

Opens the circuit at the high resistance position as the contact passes on to the lug, which is disconnected from the winding.



### with SNAP-ACTION OFF POSITION

Opens the circuit at the high or low resistance position. The contact brush snaps into an insulated notch next to the lug, providing indexing.



### with DEAD-SECTION OFF POSITION

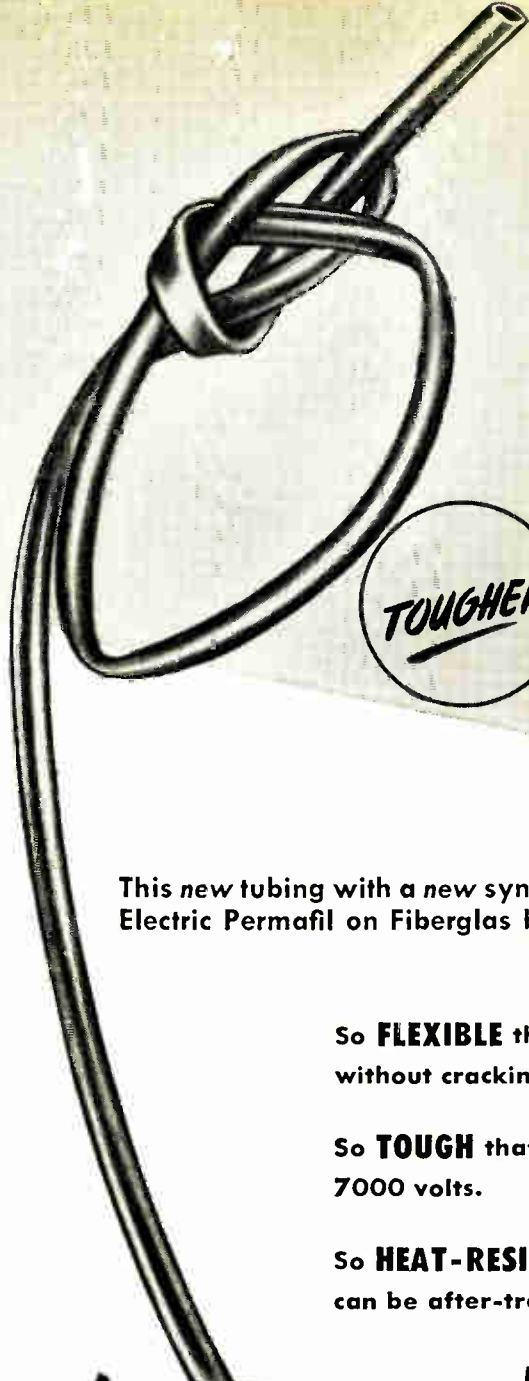
Opens the circuit at the high or low resistance position as the brush passes off the lug onto an insulated section. Medium duty.



### with TOGGLE SWITCH

Toggle switch is operated with a positive snap by the rheostat arm at either end position. Used for heavy duty applications.





# NEW!

## VARGLAS TUBING

Impregnated with  PERMAFIL

**TOUGHER**

...more  
**FLEXIBLE**

...more  
**HEAT-RESISTANT**

This new tubing with a new synthetic coating of General Electric Permafil on Fiberglas braid is . . .

Send for  
**FREE**  
Sample!

So **FLEXIBLE** that it can be twisted, bent, wrapped, tied in knots . . . without cracking or peeling.

So **TOUGH** that severe use will not destroy its dielectric property — 7000 volts.

So **HEAT-RESISTANT** that it will withstand high temperatures and can be after-treated in baking and varnishing operations.

Made in standard colors, in a wide range of sizes. It is available in coils—so that you can cut the exact lengths you need, without waste.

And . . . this is a premium tubing at a reasonable price. Send coupon for free sample and full information.

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Makers of  
Electrical Insulating  
Tubing and Sleeving

**VARFLEX Corporation, 308 Jay St., Rome, N. Y.**

Please send me full information as well as a free sample of your new Varglas Tubing impregnated with G. E. Permafil. I am particularly interested in samples suitable for.....

Name.....

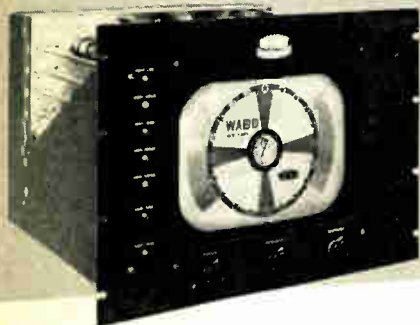
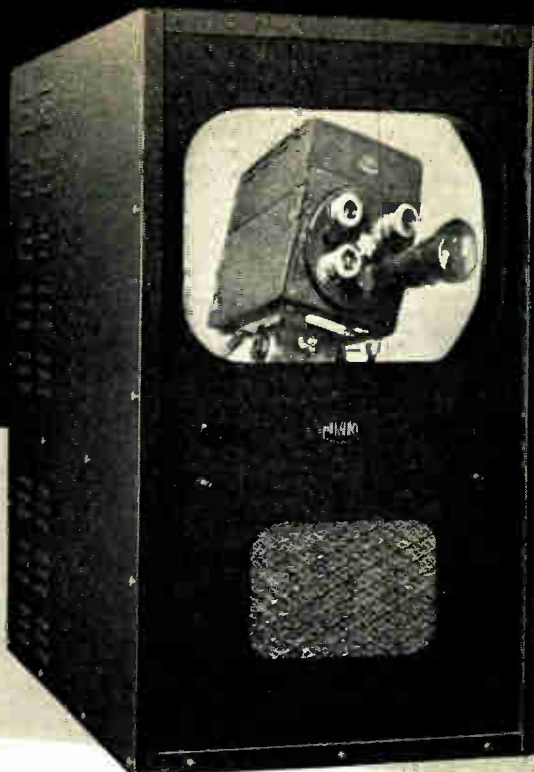
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Street.....

City.....Zone.....State.....

For the best "look-in" on television programming and transmission . . . they are installing

# DU MONT LARGE-SCREEN Picture Monitors



START AS SMALL AS YOU WISH, WITH THE DU MONT

*Acorn Package*

## TYPE 5108 12" PICTURE MONITOR

- ✓ Used in combination with companion unit, Type 5112-B Low Voltage Power Supply.
- ✓ Produces a comfortable-sized image on 12" picture tube for program monitoring of picture content.
- ✓ Operates from standard black negative composite picture signal with level in the range of 0.5 to 2.5 volts peak-to-peak. 1000-ohm input impedance.
- ✓ A 75-ohm input terminal is provided and is inserted across input terminal by means of toggle switch at rear.
- ✓ Type 5108-C fitted with 13<sup>3</sup>/<sub>8</sub>" x 17<sup>1</sup>/<sub>8</sub>" panel fitting into control consoles.
- ✓ Type 5108-D fitted with standard 14" x 19" relay rack panel.
- ✓ Overall dimensions, less panel: 12-11<sup>1</sup>/<sub>16</sub>" h. x 16<sup>1</sup>/<sub>4</sub>" w. x 18<sup>3</sup>/<sub>4</sub>" d. Weight, 50 lbs. Resolution exceeds that of usual commercial equipment.

## TYPE 2116 20" PICTURE MONITOR

- ✓ Du Mont deflection system for better-than-usual focus.
- ✓ Full light output from 20" picture tube operated from 15KV supply. An excellent image thoroughly enjoyed even in lighted room.
- ✓ 215 square inches of picture. Excellent resolution — 450 lines.
- ✓ High voltage automatically removed should horizontal sweep fail, in order to protect picture tube.
- ✓ Monitor operates from a composite signal on a 75-ohm line with a level between .5 and 2.5 peak-to-peak voltage.
- ✓ Foolproof. Front panel carries brightness and contrast controls. At rear are the linearity, focus and other occasionally-adjusted controls.
- ✓ Type 2116-A includes a 10-inch high-fidelity speaker installed with baffle and grille assembly.
- ✓ Overall dimensions: 38" h. x 22" w. x 30" d. Weight, 300 lbs.

◆ Superlative rendition — that accounts for the growing popularity of Du Mont large-screen picture monitors.

Two models: Type 5108, 12-inch tube, 72-square-inch screen. Type 2116, 20-inch tube, 215-square-inch screen. The direct-view images are brilliant, sharp, and pleasingly contrasty yet retain the full range of all the half-tone values so

necessary for pictorial beauty.

The 12-inch model in combination with Type 5112-B Low Voltage Power Supply unit, is intended primarily for control functions. The 20-inch giant-image monitor is ideal for use on a dolly in the studio, for visual cueing of actors and studio personnel during a performance. It may also be placed in

the lobby, in the studio manager's office, in other executive offices, and in clients' rooms.

For superlative monitoring, as in every other TV function from camera to transmitter and again to receiver, make it DU MONT for "The First with the Finest in Television."

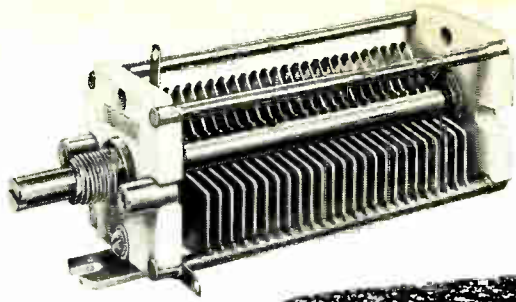
◆ Details on request. Submit your telecasting plans for that Du Mont "know-how" guidance.

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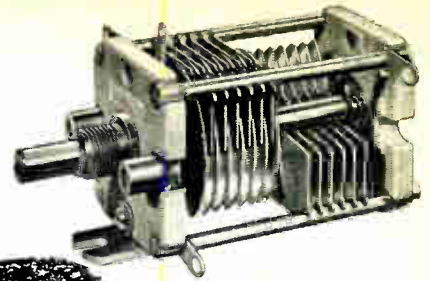
# DU MONT

*First with the Finest in Television*

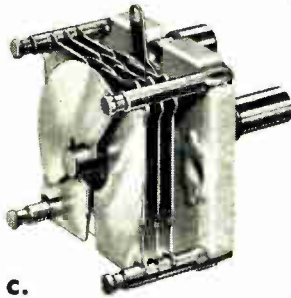
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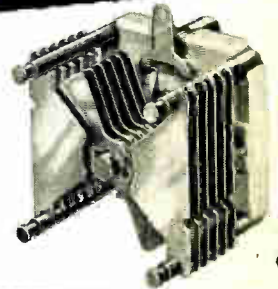
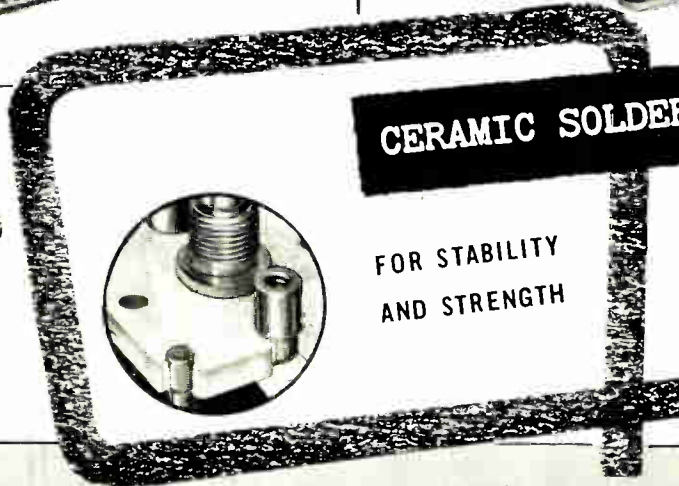
a.



b.



c.



d.

# Announcing the new JOHNSON 167 VARIABLES

BETTER FOR UHF - VHF - LF

With the introduction of this new line of air variables, JOHNSON brings you many important design advantages never before available.

Outstanding of these is the use of perfected ceramic soldering which assures absolute — and permanent — rigidity and strength, absolute — and permanent — maintenance of capacities!

There are no eyelets, nuts or screws to work loose, causing stator wobble and fluctuations in capacity. JOHNSON ceramic soldering leaves a bond which is stronger than the rugged steatite end plates themselves. There's nothing to come loose, because the stator terminals, mounting posts and rotor bearings are ceramic soldered!

Silent operation on the highest frequencies is assured with a split sleeve tension bearing that also prevents fluctuations in capacity.

These new variables are ideal for peak efficiency even under the severest conditions, such as portable — mobile operation. They are available in .030" and .080" spacings.

Two sets of stator contacts are provided for connecting components to either side of condenser without appreciably increasing inductance of the circuit. New bright alloy plating is used. It has high corrosion resistance, is easily soldered and possesses lower electrical resistance than other common platings.

These variables are available for all types of communications equipment having tuned circuits operating as high as 500 mc.

## Features

1. Ceramic soldered for stability and strength
2. Soldered plate construction, heavy .020" plates, new bright alloy plating
3. Beryllium copper contact spring, silver plated
4. Split sleeve rotor bearings — no wobble to shaft
5. Steatite end plates
6. Long creepage paths
7. Low minimum capacity — maximum tuning range
8. Small size — end plate only 1 3/4" square

Other capacities and spacings available on special order.



**JOHNSON** . . . a famous name in Radio!  
**E. F. JOHNSON CO., WASECA, MINNESOTA**

### a. SINGLE SECTION VARIABLES

Cat. No.	.030" Spacing		Length Behind Panel
	Max.	Min.	
167-101	11	2.8	15/16
167-102	27	3.5	1-9/64
167-103	51	4.6	1-7/16
167-104	75	5.7	1-3/4
167-151	99	6.8	2-7/32
167-152	202	11.6	3-33/64

Also Available In .080" Spacing

### b. DUAL SECTION VARIABLES

Cat. No.	.030" Spacing		Length Behind Panel
	Max.	Min.	
167-501	27	3.5	1-13/16
167-502	51	4.6	2-27/64
167-503	99	6.8	3 3/8

Also Available In .080" Spacing

### c. DIFFERENTIAL VARIABLES

Cat. No.	.030" Spacing		Length Behind Panel
	Max.	Min.	
167-301	11	2.8	15/16
167-302	27	3.5	1-9/64
167-303	51	4.6	1-7/16

Also Available In .080" Spacing

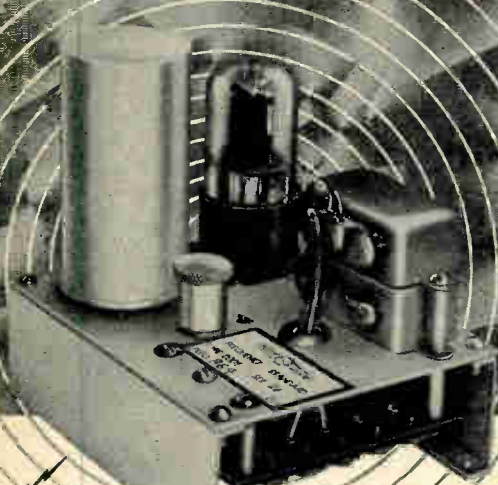
### d. BUTTERFLY VARIABLES

Cat. No.	.030" Spacing		Length Behind Panel
	Max.	Min.	
167-201	10.5	2.8	1-3/64
167-202	26	4.3	1-7/16
167-203	51	6.5	1-15/16

Also Available In .080" Spacing

Write For NEW JOHNSON 167 VARIABLE CATALOG

PICK A NUMBER  
ANY FREQUENCY FROM 10 TO 1,000



Pictured here is a tuning-fork frequency standard with accuracy guaranteed to one part per million per degree Centigrade. The fork is temperature-compensated and hermetically sealed against variations of barometric pressure. This standard, when combined with basic equipment, facilitates accurate speed and time control by mechanical, electrical, acoustical or optical means.

The unit is available separately or in conjunction with complete timing instruments. Our engineers are ready to cooperate on any problem.

MOTORS • FACSIMILE • AIRCRAFT • LABORATORIES

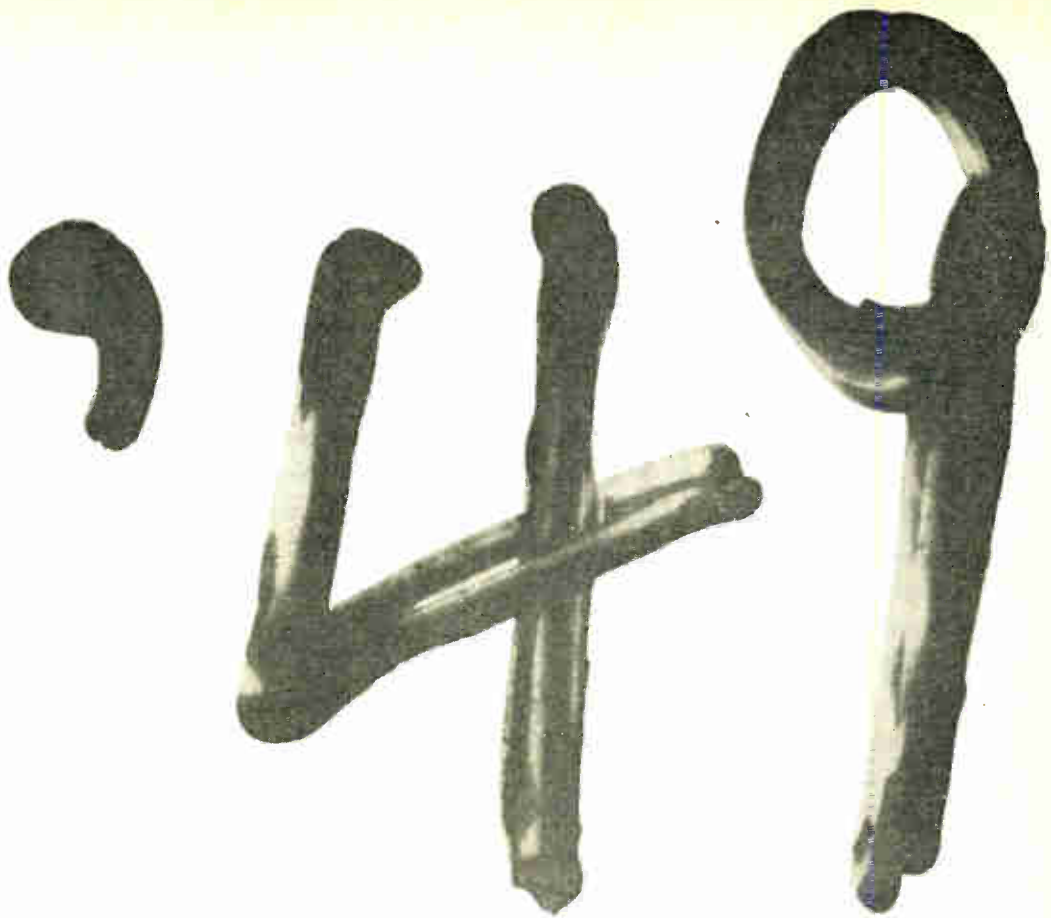
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580 Fifth Avenue

New York 19, N. Y.

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY



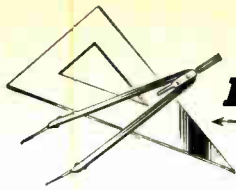


... looks like a Carbonyl Iron Powder year. Estimates show that practically all Television sets, *and most of the Radio sets* made in 1949 will contain cores made of Carbonyl Iron Powders. There must be a reason. Ask your coil winder. Ask your core maker. Ask any good designer ...

## **G. A. & F. CARBONYL IRON POWDERS**

*An Antara® Product of General Aniline & Film Corporation*

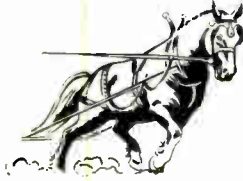
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**Designed** for modern applications...



**Streamlined** for compactness...



**Built** for dependable performance...

# I-T-E wire-wound Oval Power Resistors—

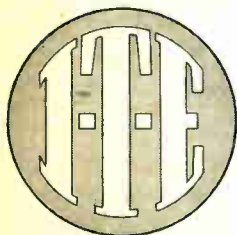
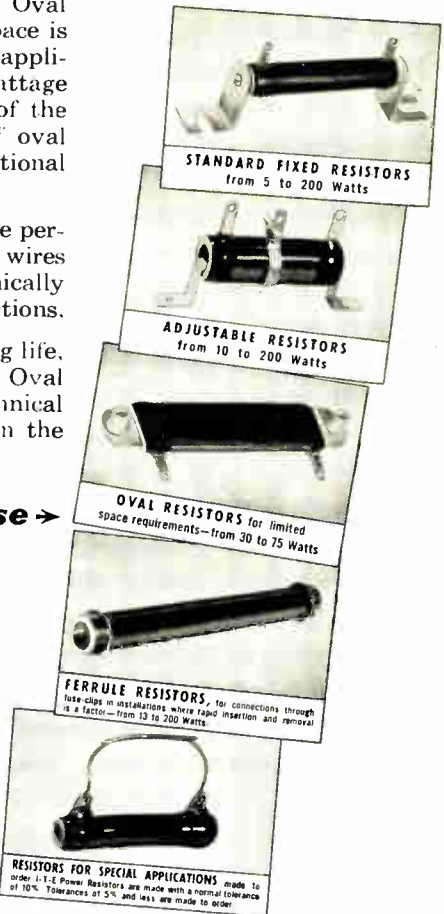
Modern resistors designed for modern applications... I-T-E Oval Resistor Assemblies... specially suited for installations where space is limited, such as in aviation, sound, radio, and other electronics applications. I-T-E "Ovals" are distinguished by their high unit-area wattage ratios, which are due in part to the heat dissipation qualities of the mounting brackets. An I-T-E Oval Resistor—or an assembly of oval units—has a much higher wattage rating than that of a conventional round resistor of comparable size.

And I-T-E Resistors are better-built for a longer life of dependable performance. Bases are best non-hygroscopic ceramics... resistance wires are purest obtainable... resistances are uniformly wound, mechanically tied, and silver-soldered at high heat for permanent, solid connections.

No matter what your resistor problem calls for—compactness, long life, dependability, or exact tolerances—be sure to investigate I-T-E Oval Resistors, the *modern* wire-wound Power Resistors. Complete technical information, as well as valuable application data, is contained in the new I-T-E Resistor catalog. Send for it today.

**There's an I-T-E Resistor for Every Purpose** →

I-T-E OVAL RESISTORS				
Type	Watts	Length	Maximum Recommended Resistance	Mounting Centers
108 Oval	30	1¼"	10000	2"
200 Oval	40	2"	15000	2¾"
316 Oval	55	3½"	25000	4¼"
424 Oval	65	4¾"	35000	5½"
600 Oval	75	6"	50000	6¾"

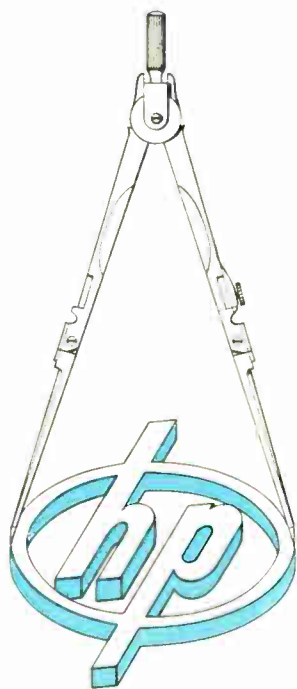


## POWER RESISTORS

*The Leader In Technical Excellence*

I-T-E CIRCUIT BREAKER CO., RESISTOR DIVISION, 19TH & HAMILTON STREETS, PHILADELPHIA 30, PA.

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • AUTOMATIC RECLOSING CIRCUIT BREAKERS • RESISTORS • SPECIAL PRODUCTS



Accurate measurements are fundamental to the electronic industry.

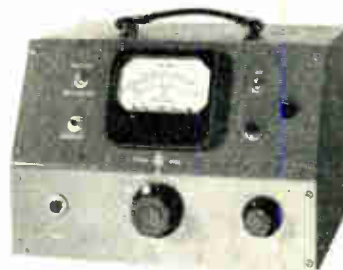
*-hp-* precision instruments are basic tools for obtaining these measurements swiftly, surely and easily.

3 NEW *-hp-* INSTRUMENTS TO MAKE YOUR MEASURING JOBS EASIER



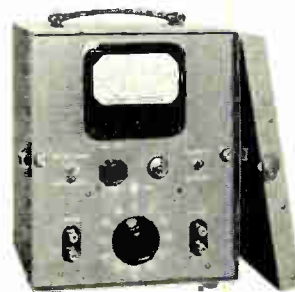
*-hp-* 400C Vacuum Tube Voltmeter

Wide range, 20 cps to 2 mc, 12 ranges, 0.001 v to 300 v, flat response, 10 megohms input impedance.



*-hp-* 415A Standing Wave Indicator

300 cps to 2000 cps. For use with bolometer or crystal rectifier. Previewed here for the first time.



*-hp-* 404A Battery-Operated Voltmeter

Light, compact, portable vacuum tube voltmeter. No ac power needed. 2 to 50,000 cps. 11 ranges, 0.003 to 300 v.

For brief details of these and other *-hp-* precision instruments, see following pages. For complete specifications, write direct to factory.

HEWLETT-PACKARD COMPANY

1782-A PAGE MILL ROAD • PALO ALTO, CALIFORNIA

Power Supplies

Audio Signal Generators

Amplifiers

FM Monitors

Frequency Meters

UHF Signal Generators

Square Wave Generators

Audio Frequency Oscillators

Attenuators

Frequency Standards

Noise and Distortion Analyzers

Wave Analyzers

Vacuum Tube Voltmeters

World Radio History



# MEASURING SPEED AND ACCURACY



-hp- Model 200C  
Resistance Tuned Oscillator



-hp- Model 216A  
Audio Signal Generator



-hp- Model 300A  
Wave Analyzer



-hp- Model 330B  
Distortion Analyzer



-hp- Model 615A  
UHF Signal Generator

FUNCTION	MODEL	FREQUENCY	CHARACTERISTICS
HARDWARE	10		Binding Post
	14		Flexible coupler, ceramic insulated; permits misalignment of 1/32" and/or 5°
LOW FREQUENCY STANDARDS	100A	100 kc, 10 kc, 1 kc, 100 cps	Accuracy 3 cps per mc per degree Centigrade
	100B	100 kc, 10 kc, 1 kc, 100 cps	Temperature controlled; accuracy 0.001%
FREQUENCY DIVIDER	110	100 to 10 cps	Controlled by 100A or 100B. Multipliers also available up to 1 mc
RESISTANCE-TUNED OSCILLATORS	200A	35 to 35,000 cps	Output 1 watt into 500 ohms; 1% distortion
	200B	20 to 20,000 cps	Output 1 watt into 500 ohms; 1% distortion
	200C	20 to 200,000 cps	Output 10 volts into 1,000 ohms; 1% distortion
	200D	7 to 70,000 cps	Output 10 volts into 1,000 ohms; 1% distortion
	200H	60 to 600,000 cps	Output 10 mw into a 100 ohm load; 3% total distortion
	200 I	6 to 6,000 cps	Frequency setting closer than 1%; output 10 volts into 1,000 ohms; 1% distortion
	201B	20 to 20,000 cps	Output 3 watts at 1% and 1 watt at 1/2% distortion into 600 ohms
	202B	1/2 to 50,000 cps	For low frequency studies. Output 10 volts into 1,000 ohms; 1% distortion
	202D	2 to 70,000 cps	Output 10 volts into 1,000 ohms; 2% distortion
	204A	2 to 20,000 cps	Portable, battery-operated; output 5.0 volts to 10,000 ohm load; 1% distortion
AUDIO SIGNAL GENERATORS	205A	20 to 20,000 cps	Output 5 watts, 1% distortion into impedances of 50, 200, 600, 5,000 ohms. Output VTVM and 110 db attenuator, 1 db steps
	205AG	20 to 20,000 cps	Same as 205A, plus separate VTVM for complete gain measurements
	205AH	1 to 100 kc	Output 5 watts, 3% distortion into 50, 200, 500, 5,000 ohm impedances. Output VTVM and 110 db attenuator, 1 db steps
SQUARE WAVE GENERATOR	206A	20 to 20,000 cps	Output +15 dbm with less than 0.1% distortion into 50, 150, 600 ohm impedances. Output VTVM and 111 db attenuator in 0.1 db steps
WAVE ANALYZER	210A	20 to 10,000 cps	Output 50 volts peak to peak; 1,000 ohm internal impedance; 70 db attenuator, 5 db steps
	300A	30 to 16,000 cps	Variable selectivity; measurement range 1 mv to 500 volts; 5% accuracy

## HEWLETT-PACKARD

1782A PAGE MILL ROAD - PALO ALTO, CALIFORNIA

# THROUGHOUT THE ELECTRONIC FIELD

FUNCTION	MODEL	FREQUENCY	CHARACTERISTICS
DISTORTION ANALYZERS	320A	400 cps and 5 kc	Measures total distortion as low as 0.1%. 70 db attenuator, 1 db steps for comparison
	320B	50, 100, 400 cps and 1, 5 and 7.5 kc	Some as 320A
	325B	30, 50, 100, 400, 1,000 cps; 5, 7.5, 10 and 15 kc	Measures total distortion as low as 0.1%. Input amplifier and complete VTVM each usable separately
	330B	Any frequency 20 to 20,000 cps	Similar to 325B but measures at any frequency and includes AM detector
FM BROADCAST MONITOR	330C	Any frequency 20 to 20,000 cps	Similar to 330B, no AM detector. Meter has VU characteristics to meet FCC requirements for FM broadcasting
	335B	88 to 108 mc	FCC approved. Monitors carrier frequency and modulation. High fidelity output for aural monitoring
ATTENUATORS	350A	Max 100 kc	110 db, 1 db steps; 5 watts, 500 ohm level. Bridged T type. Accuracy 1 db in 50 db at 100 kc
	350B	Max 100 kc	Same as 350B but 600 ohm level
	400A	10 cps to 1 mc	Nine ranges 0.03 to 300 volts full scale. Accuracy $\pm 3\%$ to 100 kc, $\pm 5\%$ to 1 mc. Average reading. Calibrated in rms.
VACUUM TUBE VOLTMETERS AND ACCESSORIES	400B	2 cps to 100 kc	Some as 400A with response flat to 2 cps. 10 megohm input impedance
	400C	20 cps to 2 mc	Twelve ranges 0.001 to 300.0 volts full scale; accuracy $\pm 3\%$ to 100 kc, $\pm 5\%$ to 2 mc; 10 megohm input impedance; average reading; calibrated in rms volts; may be used as 54 db amplifier
	404A	2 to 50,000 cps	Portable, battery-operated; eleven ranges; 0.003 to 300 volts full scale; accuracy $\pm 3\%$ to 20 kc; 10 megohm input impedance
	410A	20 cps to 700 mc	AC: six ranges 1 to 300 volts. DC: seven ranges 1 to 1,000 volts. Resistance: seven ranges 0.2 ohm to 500 megohms
	415A	300 to 2,000 cps	Standing Wave Indicator for use with a bolometer or crystal rectifier; standard frequency 1000 cps, others on special order
	455A	to 1,000 mc	Connects probe of 410A across 50 ohm transmission line. Type N fittings
	458A	to 1,000 mc	Connects probe of 410A to open end of 50 ohm transmission line. Type N fittings
	AMPLIFIERS	450A	10 to 1,000,000 cps
ELECTRONIC FREQUENCY METER	500A	5 cps to 50 kc	Ten ranges, $\pm 2\%$ accuracy. Input 0.5 to 200 volts
ELECTRONIC TACHOMETER	505A	300 to 3,000,000 rpm	Ten ranges, $\pm 2\%$ accuracy
	505B	5 to 50,000 rps	Some as 505A except calibrated in rps
SIGNAL GENERATORS	610A	500 to 1,350 mc	Calibrated output 0.1 microvolt to 0.1 volt. Internal pulse modulation. Direct calibration
	616A	1,800 to 4,000 mc	Direct reading. Pulse modulation, CW and FM. Calibrated output 0.1 microvolt to 0.2 volts
	650A	10 cps to 10 mc	Direct reading. Six bands. Output 3 volts to 600 ohm load. VTVM and output attenuator
POWER SUPPLY	710A		Any dc voltage 180 to 360 for 0 to 75 mo load; approximately 1% regulation. Also 6.3 volts, 5 amps ac.



-hp- Model 400A  
Vacuum Tube Voltmeter



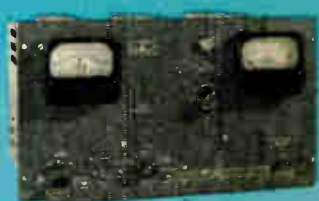
-hp- Model 410A  
Vacuum Tube Voltmeter



-hp- Model 610A  
UHF Signal Generator



-hp- Model 650A  
Audio Signal Generator

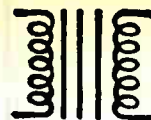


-hp- Model 325B  
FM Monitor

# COMPANY

Export: FRAZER & HANSEN, 301 Clay Street, San Francisco 11, California

# Wherever There's a CORE and COIL

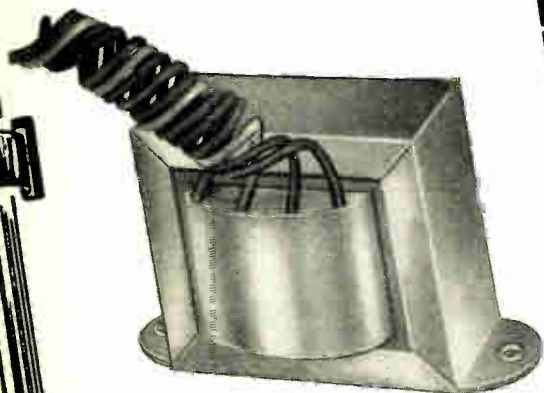


## Choose

# FERRANTI

## Power and Audio Transformers Chokes • Filters

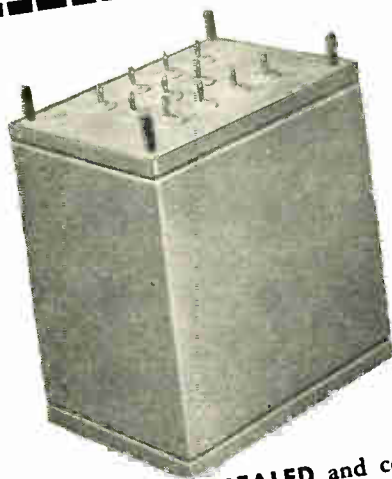
3 EXAMPLES OF OUR WIDE RANGE:



**OPEN FRAME TYPE** for mass production, minimum cost and weight for enclosed equipment.



**ENCLOSED CASE**, compound filled, for high moisture resistance. Standard cases up to 500 VA. Wide range of standard audio transformer units.



**HERMETICALLY SEALED** and compound filled cases. Glass or ceramic sealed terminals. Designed to meet JAN salt water immersion tests.

We offer ample modern facilities and intensive experience in up-to-date practice, including the latest core material developments, and components for 400 cycle power supplies. Our large accumulation of patterns, tools and dies often makes it possible to supply your specific requirements from standard parts, thus cutting your costs without sacrifice of quality. Whatever the type of unit, our bid will meet your needs. Submit your inquiries.

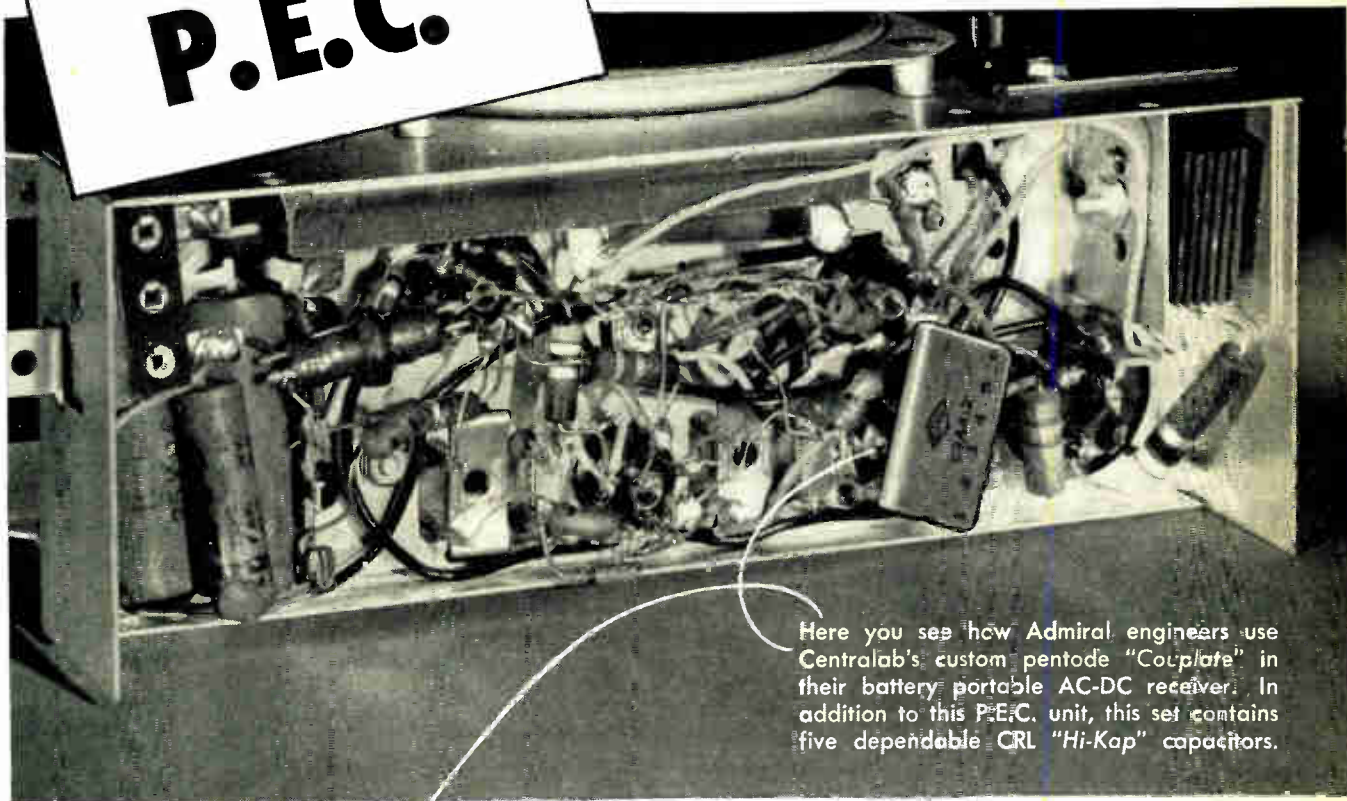
**POWER SUPPLY UNITS AND ELECTRONIC ASSEMBLIES TO SPECIFICATIONS**

# • Ferranti Electric, Inc. •

30-A Rockefeller Plaza • New York 20, N. Y.

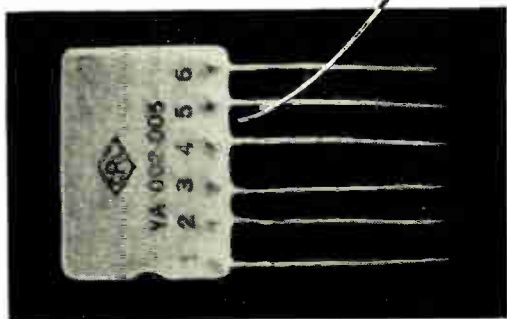
# PROGRESS REPORT ON P.E.C.\*

How Admiral Radio uses  
Centralab's Printed Electronic Circuit  
to build finer radios . . .  
to cut assembling time!

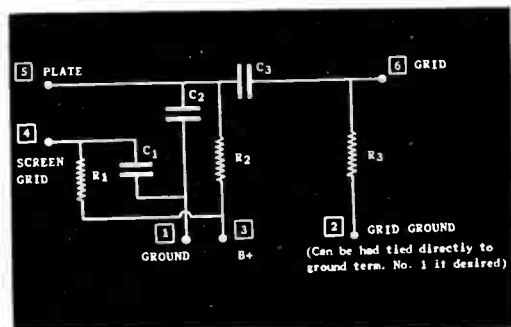


Here you see how Admiral engineers use Centralab's custom pentode "Couplate" in their battery portable AC-DC receiver. In addition to this P.E.C. unit, this set contains five dependable CRL "Hi-Kap" capacitors.

*Chassis courtesy of Admiral Radio Corp.*



"COUPLATE" is made of high dielectric Ceramic-X to give long life, low internal inductance, positive resistance to humidity and vibration. A circuit diagram of CRL's Couplate is shown below.



**\*Centralab's "Printed Electronic Circuit"**  
— Industry's newest method for  
improving design and manufacturing efficiency!

IMAGINE the time, the space, the material you save by using one unit instead of six. That's just what Centralab's amazing pentode "Couplate" is doing for Admiral Radio Corporation, Chicago. This complete interstage coupling circuit combines three resistors and three capacitors into one tiny, dependable P.E.C. unit. "Couplate" saves time for Admiral by eliminating many assembling operations. It saves space and material by reducing the number of components needed. What's more it improves performance by minimizing the chance of broken or loose connections.

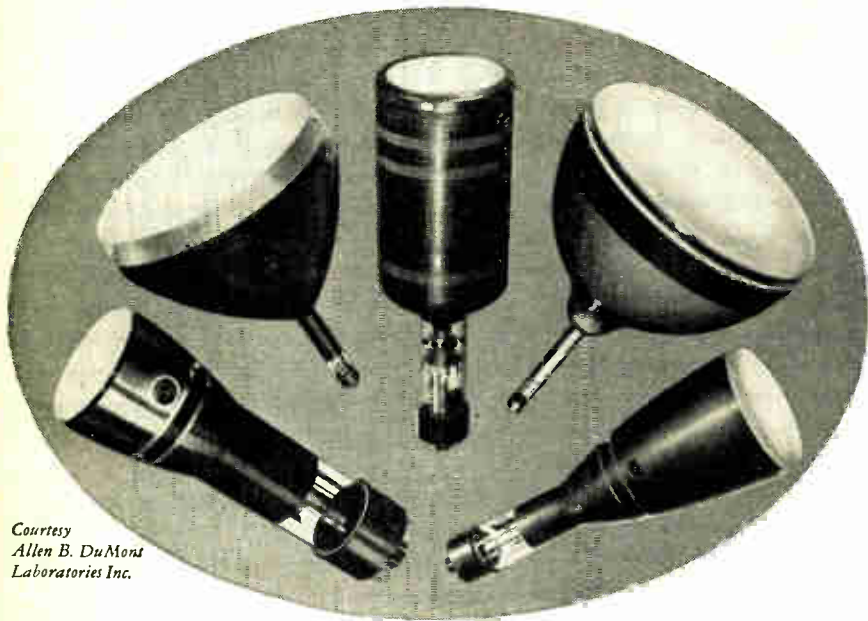
*Integral Ceramic Construction:* Each Printed Electronic Circuit is an integral assembly of "Hi-Kap" capacitors and resistors closely bonded to a steatite ceramic plate and mutually connected by means of metallic silver paths "printed" on the base plate.

You'll want to see and test this exciting new electronic development. For complete information about Couplate, as well as other CRL Printed Electronic Circuits, see your nearest Centralab Representative, or write for Bulletin 999.

LOOK TO **Centralab** IN 1949!  
CRL

Division of GLOBE-UNION INC., Milwaukee

# The NEW "dag" CRT Wall Coating . . .



Courtesy  
Allen B. DuMont  
Laboratories Inc.

for all  
CRT  
glass  
envelopes

Here's an entirely new CRT Wall Coating, developed by Acheson Colloids specifically and solely for use on CRT glass envelopes.

"dag" CRT Wall Coating is very easily applied . . . adheres tenaciously to all types of glass . . . does not yield objectionable by-products on heating.

Prominent cathode-ray tube manufacturers have already found this opaque, electrically conductive "dag" CRT Wall Coating eminently satisfactory, especially in tubes intended for television reception.

Let Acheson Colloids help you with your CRT wall coating problem. Mail the coupon today for information on this or other electronic applications of "dag" colloidal graphite dispersions.

Give me information on "dag" colloidal graphite dispersions for:

- Wall coating of CRT's
- Electrostatic shielding
- Corona prevention
- Dry-film lubrication
- Copper oxide rectifier disc coating
- Electrical resistances
- Filament cement

MM-5

40th Anniversary Year

## Acheson Colloids Corporation

Port Huron



Michigan



Specify  
for

**HI-Q**

**COMPONENTS**

**UNIFORMITY...**

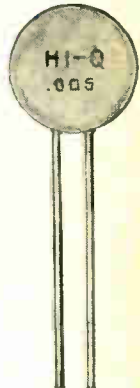


**HI-Q** components are uniformly superior because of rigid quality control throughout all stages of manufacture. Final individual inspection insures their conformance to electrical and physical specifications. When you specify **HI-Q** components, you can be sure they meet your most stringent requirements for precision, dependability, compactness and uniformity. Write for complete information and engineering data.

#### HI-Q DISK CAPACITORS

**BPD** Where space is a factor and the physical shape is more adaptable than tubular unit try these **HI-Q** Disk Capacitors. Another example of accurate dependable miniaturization, this high dielectric by-pass, blocking or coupling **HI-Q** Disk Capacitor has many applications. Available in three standard capacities. Type BPD-5: .005 mfd. guar. min. Type BPD-10: .01 mfd. guar. min. Type BPD-1.5: .0015 mfd. guar. min.

Illustration at right is actual size.



#### HI-Q MINIATURE G. P. TUBULARS



**G.P.** By the use of our new Body 41, 5 mmf to 33,000 mmf capacity ranges are now available which will cover the majority of your by-passing problems. These **HI-Q** Miniature G. P. Tubulars also provide closer coupling of leads thus insuring minimum inductance and highest self resonant frequencies.

Illustration at left is actual size.

**HI-Q COMPONENTS**

**BETTER 4 WAYS**

**PRECISION** Tested step by step from raw material to finished product. Accuracy guaranteed to your specified tolerance.

**UNIFORMITY** Constancy of quality is maintained over entire production through continuous manufacturing controls.

**DEPENDABILITY** Interpret this factor in terms of your customers' satisfaction . . . Year after year of trouble-free performance. Our **HI-Q** makes your product better.

**MINIATURIZATION** The smallest **BIG VALUE** components in the business make possible space saving factors which reduce your production costs . . . increase your profits.

**HI-Q**

*Electrical Reactance Corp.*

FRANKLINVILLE, N. Y.

Plants: FRANKLINVILLE, N. Y. — JESSUP, PA.

Sales Offices: NEW YORK, PHILADELPHIA, DETROIT, CHICAGO, LOS ANGELES

## MACHLETT TUBE USERS GET MORE LIFE, BETTER VALUE

BECAUSE OF MACHLETT EXPERIENCE, SKILL AND "SINCERITY OF SERVICE"

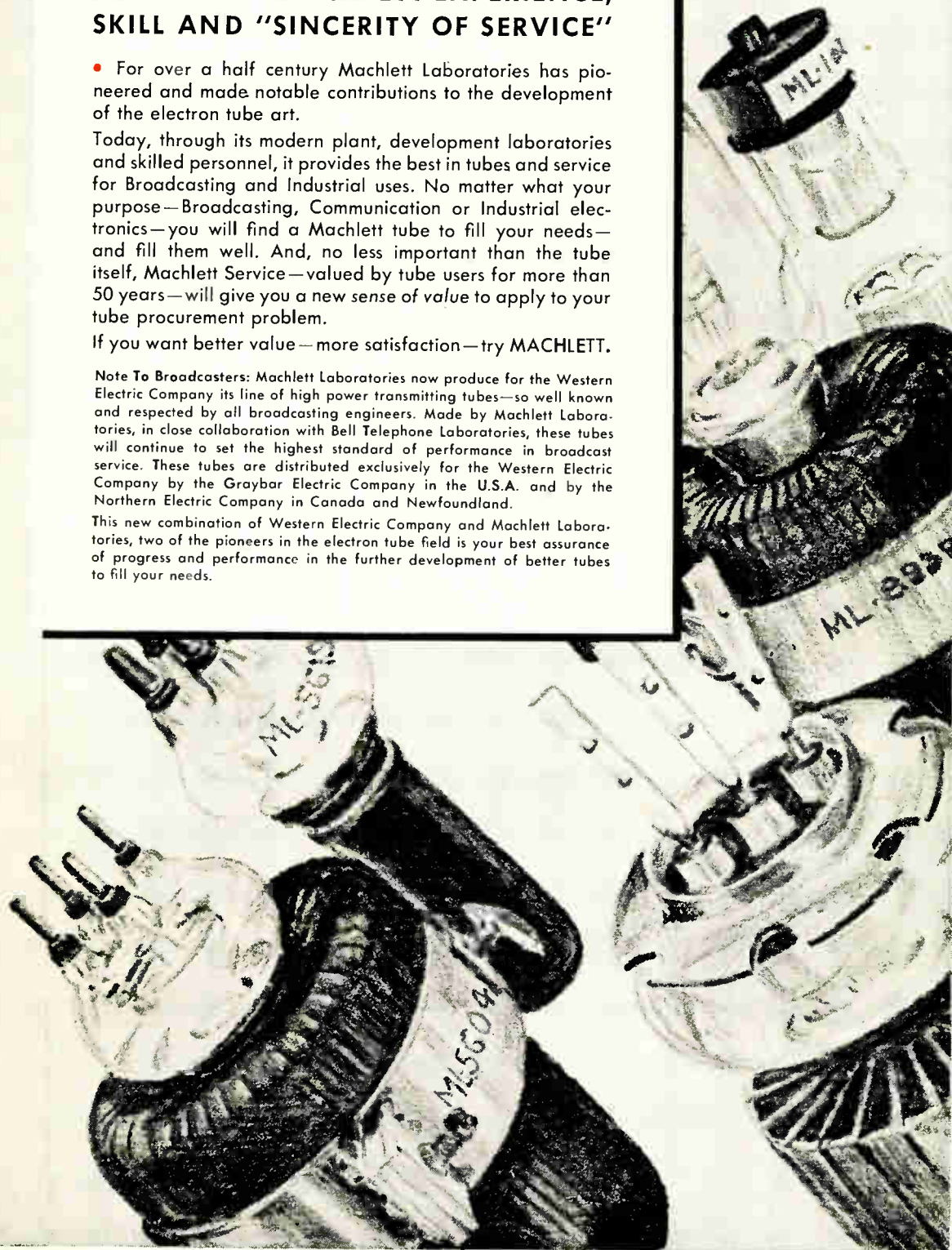
- For over a half century Machlett Laboratories has pioneered and made notable contributions to the development of the electron tube art.

Today, through its modern plant, development laboratories and skilled personnel, it provides the best in tubes and service for Broadcasting and Industrial uses. No matter what your purpose—Broadcasting, Communication or Industrial electronics—you will find a Machlett tube to fill your needs—and fill them well. And, no less important than the tube itself, Machlett Service—valued by tube users for more than 50 years—will give you a new sense of value to apply to your tube procurement problem.

If you want better value—more satisfaction—try MACHLETT.

**Note To Broadcasters:** Machlett Laboratories now produce for the Western Electric Company its line of high power transmitting tubes—so well known and respected by all broadcasting engineers. Made by Machlett Laboratories, in close collaboration with Bell Telephone Laboratories, these tubes will continue to set the highest standard of performance in broadcast service. These tubes are distributed exclusively for the Western Electric Company by the Graybar Electric Company in the U.S.A. and by the Northern Electric Company in Canada and Newfoundland.

This new combination of Western Electric Company and Machlett Laboratories, two of the pioneers in the electron tube field is your best assurance of progress and performance in the further development of better tubes to fill your needs.





Equipment designers, broadcasters, operators of point-to-point services, and industrial users of power tubes are invited to write for complete information. The Machlett Electron Tube Data Book will be sent on request.

**MACHLETT**

Over 50 years  
of Electron Tube Experience

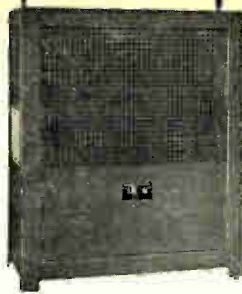
**MACHLETT LABORATORIES, INC.**  
Springdale, Connecticut



### 3-Phase Regulation

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
3P15,000	1500-15,000	0.5%
3P30,000	3000-30,000	0.5%
3P45,000	4500-45,000	0.5%

• Harmonic Distortion on above models 3%.  
Lower capacities also available.



### Extra Heavy Loads

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
5,000*	500 - 5,000	0.5%
10,000*	1000-10,000	0.5%
15,000*	1500-15,000	0.5%



### General Application

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
150	25 - 150	0.5%
250	25 - 250	0.2%
500	50 - 500	0.5%
1000	100-1000	0.2%
2000	200-2000	0.2%

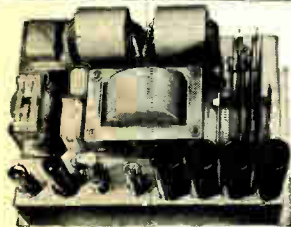


### 400-800 Cycle Line INVERTER AND GENERATOR REGULATORS FOR AIRCRAFT.

Single Phase and Three Phase

MODEL	LOAD RANGE VOLT-AMPERES	*REGULATION ACCURACY
D500	50 - 500	0.5%
D1200	120-1200	0.5%
3PD250	25 - 250	0.5%
3PD750	75 - 750	0.5%

Other capacities also available



### The NOBATRON Line

Output Voltage DC	Load Range Amps.
6 volts	15-40-100
12 "	15
28 "	10-30
48 "	15
125 "	5-10

• Regulation Accuracy 0.25% from 1/4  
to full load.

# SORENSEN

## The First Line of standard electronic AC Voltage Regulators and Nobatrons

### GENERAL SPECIFICATIONS:

- Harmonic distortion max. 5% basic, 2% "S" models
- Input voltage range 95-125: 220-240 volts (-2 models)
- Output adjustable bet. 110-120: 220-240 (-2 models)
- Recovery time: 6 cycles: + (9 cycles)
- Input frequency range: 50 to 65 cycles
- Power factor range: down to 0.7 P.F.
- Ambient temperature range: -50°C to +50°C

All AC Regulators & Nobatrons may be used with no load.

\*Models available with increased regulation accuracy.

Special Models designed to meet your unusual applications.

Write for the new Sorensen catalog. It contains complete specifications on standard Voltage Regulators, Nobatrons, Increvolts, Transformers, DC Power Supplies, Saturable Core Reactors and Meter Calibrators.

SORENSEN & CO., INC.  
STAMFORD CONNECTICUT

Represented in all principal cities.

**“Give us the tools...”**

# TO SURVIVE

## America Must Have Better Tools

**I**N THE past twenty years the United States has failed to provide its workers with enough new tools and equipment.

To most Americans this statement will come as a shock — or will be doubted. We are quite complacent about our industrial equipment, for easily understood reasons.

Throughout the '30s we heard continuously the propaganda line that the United States had become a “mature economy.” The job of equipping America with industrial plants and tools was said to be largely done.

Now, knowing that industry is spending billions to expand and rebuild its plants, many people assume that the result must be a first-class industrial system.

A further powerful inducement to complacency is the vastly worse industrial condition of most of the rest of the world. When Americans look abroad in almost any direction they see shattered plants and equipment. A natural reaction is that we are sitting pretty.

That is a dangerous reaction. Between depression and war, we have failed to build the tools and equipment we need. This condition is dangerous for three reasons:

1. *From bitter experience we know that national security depends first and foremost on the capacity and readiness of our industrial equipment.*

All of our plans for stabilizing prosperity assume a world at peace. The greatest menace to peace would be an unarmed America, unable or unwilling to keep herself strong and ready for defense — strong in spirit, in resources and in the all-important industrial plant and equipment.

2. *Whether Americans live well — or badly — depends directly on the kind and quality of tools used by American workmen.*

This is true for all workers, and for every worker — from a garage mechanic and his wrenches to a steel mill gang and its rolling equipment. In a monumental study of “America’s Needs and Resources” the Twentieth Century Fund found this fact: The improvement in the real income of the American people has more consistently followed the amount of power used in industry than anything else. What the workman worked *with* determined, more than any other factor, the size of his pay envelope, and what it would buy.

3. *Our success in stabilizing prosperity will depend largely on what we do about building new tools and equipment.*

About 30% of our industrial workers are employed in producing tools and equipment. Steady employment for them is essential to our over-all prosperity.

**How far have we fallen behind in providing new plants and equipment?**

Estimates vary. Here is one rough estimate: If we had built new industrial facilities during 1930-48 at the rate we did in the prosperous '20s, we would have spent at least \$100 billion more than actually we did.

To get a better and more complete measure of this deficit, McGraw-Hill is undertaking a survey of American Business’ Needs for New Plant and Equipment.

Businessmen all over the nation are being asked to answer questions like this: How much

money would you need to put your plant in first class condition? How much are you planning to spend for new plant and equipment? Where do you expect to raise the money? The results will be reported later in this editorial series. Already the survey shows we have fallen many billions of dollars behind.

Some shortcomings are apparent to everyone. They are revealed in a lot of rickety transportation facilities and in rundown buildings.

Many other deficiencies do not come into general view. They are, for example, the antiquated machines in our plants. Of the privately-owned machine tools in use in 1945 — when the last census of metalworking equipment was made by AMERICAN MACHINIST — 54% were more than 10 years old. Their average age is higher today.

It is true that in recent years we have hit new highs in total national production. But we have done so by putting far more people to work than ever worked before . . . and by driving equipment to the limit of its waning endurance, sometimes beyond. It has not been done *primarily* in what is by all odds the best way to increase production—to use more and better and more modern tools and equipment.

**Haven't we overcome much of this twenty-year deficit by rushing to build new plants since the end of the war?**

No. For two clear-cut reasons:

1. The accumulated shortage is tremendous. The total of about \$40 billion, which has been spent for industrial plant and equipment since VJ-Day, has not wiped it out.

2. Some key industries have had difficulty in getting the facilities they need. Take steel, for example — the industry that turns out our most basic industrial material. Its needs for new equipment are measured in billions of dollars. To pay for that equipment, it should have *risk capital* — money which people are willing to invest with a risk of losing for the sake of gain. For steel is an up-and-down industry. Earnings on its common stocks inevitably share both ways in those ups-and-downs.

Since the war, steel, in common with most of industry, has been unable to market new common stock successfully. Its outstanding stock is now selling for only about one-half the current net worth of the industry's present assets. With investors willing to pay only 50 cents on the dollar for its facilities, the industry can not readily sell stock to pay for *new* plant and equipment — at higher prices even than the old.

*Why can't steel — and other industries — attract people who are willing to risk their money retooling America?*

The full answer to that serious question must be left to future editorials in this series, for it involves many things . . . tax reform . . . mobilization of small savings . . . a new respect for corporate profits.

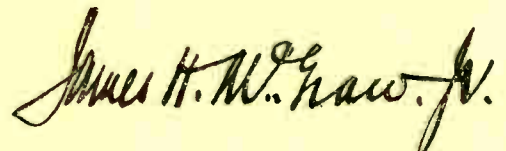
This first editorial seeks simply to emphasize two fundamentals:

First, our standard of living improves with the *quality* of our industrial equipment.

Second, American industry and American workmen badly need billions of dollars worth of better equipment *now*.

The American people must understand that *not only our continued prosperity but also our security as a nation depends upon giving American industry more and better equipment.*

"Give us the tools." This was Winston Churchill's cry for help to win the war. Only if we give American industry new and better tools will we have a chance to win abiding prosperity at home and good order abroad.



President, McGraw-Hill Publishing Company, Inc.

★ THIS EDITORIAL, and a series to follow, will be devoted to a single problem — how to provide American industry with the equipment needed to improve that envy of the world, the American standard of living. No more important problem confronts us today. Upon our wisdom in handling it depends not only the degree of our prosperity, but also our security as a nation.

# "Clocked" in Record Time



**No. 102's at Five Star Company increase production by synchronizing output on basis of time required for manual operations**

Experience of the Five Star Company, West Cheshire, Conn., shows how one manufacturer can profit from use of Universal Coil Winding Machines.

This company, manufacturing a variety of coils, uses the No. 102 Winders shown below to produce coils for electric clocks, winding six coils at a time from unrolling spools of No. 38 enameled wire.

Relay coils, ringer coils and switch coils are other bobbin-type coils wound on this machine which permits synchronization of winding time on the various heads with handling time per coil.

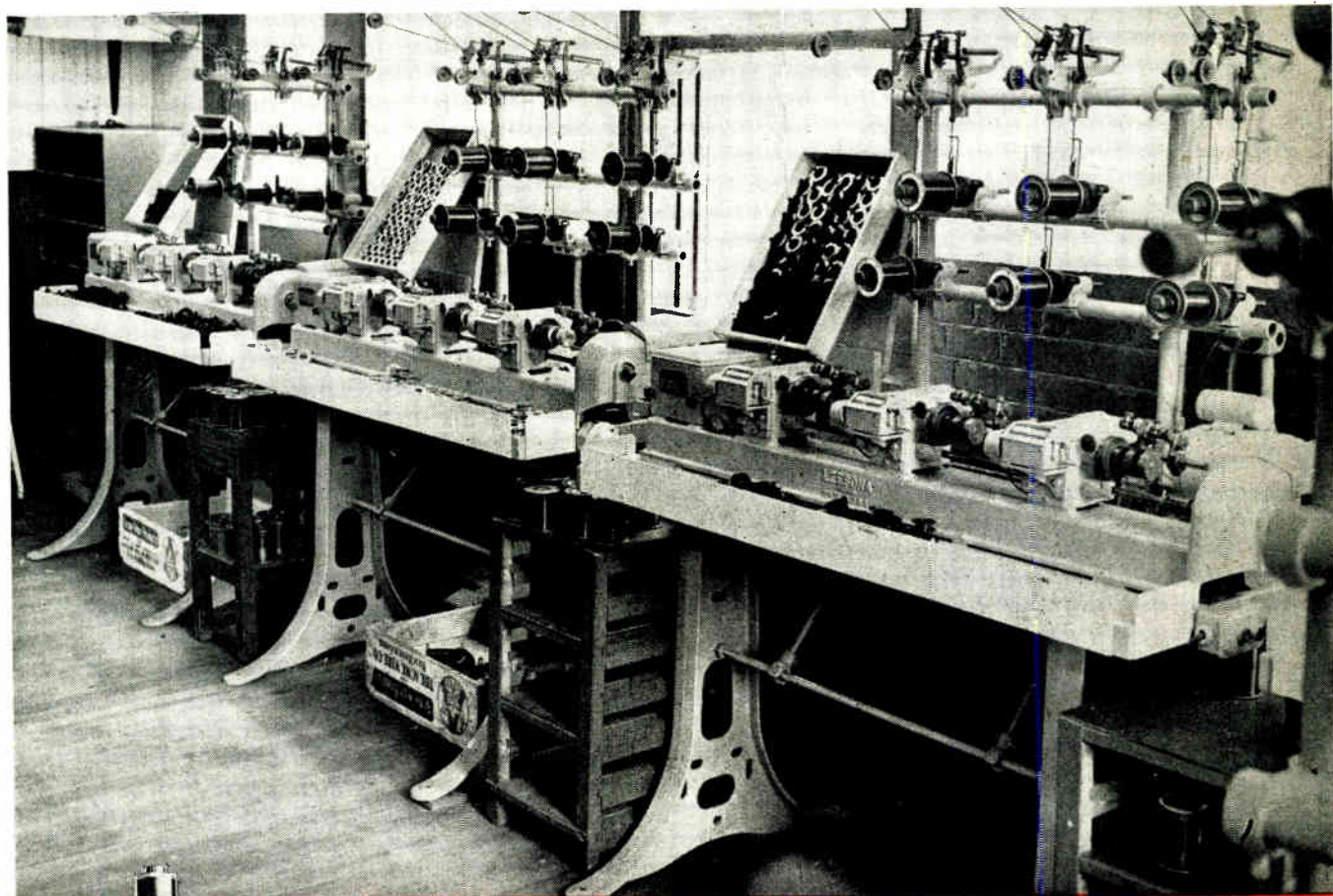
Coil size is accurately controlled by an elec-

trically-operated counter which automatically stops each head upon completion of the coil. Steel-strap control of tension makes it possible to handle even the finest wires.

Other Universal Coil Winders in this plant are the No. 104 which winds paper-insulated coils and the No. 96 which winds cotton-interwoven coils for business machines.

Write for bulletins on Universal Coil Winders — No. 84, lattice-type; No. 96, layer-wound; No. 98, gutter-wound; No. 102, spool-wound, non-insulated; Nos. 104 and 105 paper-insulated, in stick form.

**UNIVERSAL WINDING COMPANY, Dept. L, P. O. Box 1605, Providence 1, R. I.**



**LEESONA**  
REG. U.S. PAT. OFF.

**FOR WINDING COILS IN QUANTITY  
ACCURATELY . . . AUTOMATICALLY  
USE UNIVERSAL WINDING MACHINES**



**EXPERIENCE  
PLUS  
COOPERATION  
*DOES IT!***

There's a lot of satisfaction in working with radio engineers who know exactly what they need to get top efficiency from the transmitter. To their specifications Blaw-Knox applies an experience in antenna tower building that dates back to the days of "wireless" . . . Together we get results that reflect credit on our structural designers and the station's technical experts . . . If your plans call for more effective coverage or directional changes we would welcome an engineering interview at your convenience.

**BLAW-KNOX DIVISION**  
OF BLAW-KNOX COMPANY  
FARMERS BANK BUILDING  
PITTSBURGH 22, PA.

◀ Blaw-Knox 550' Heavy Duty Type H40 Tower supporting a Federal 8 square loop FM antenna 74' high. Station WTMJ-FM, Richfield, Wisconsin.

**BLAW-KNOX ANTENNA TOWERS**



Most prominent position in any parade is

# UP FRONT

featuring  
**"Built-In"  
 CONSTANT  
 VOLTAGE**  
 For the Protection of Our Customers



PHOTO ENGRAVING

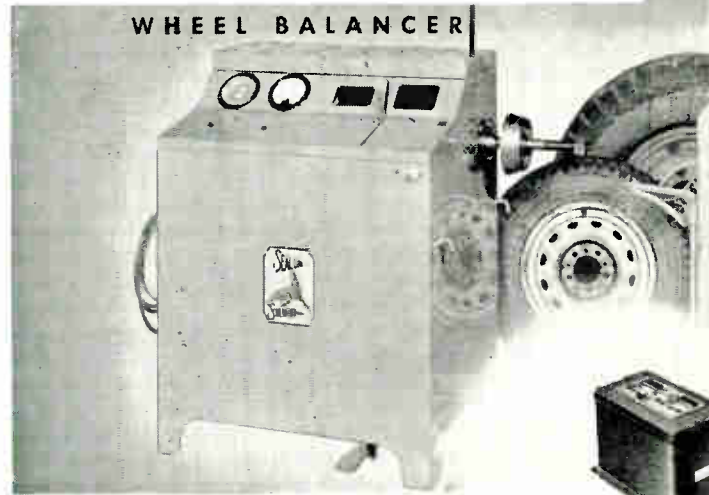
With power shortages playing hob with line voltages all over the country—isn't it about time that you too joined the parade of manufacturers who are featuring constant voltage as a built-in component in their products.

↑ This preamplifier phasing control section of a medium power, low distortion restricted band audio-amplifier employed in a new printing plate engraving system couldn't operate satisfactorily on available line voltages. Robert H. Rigby Corp., solved the problem with a "built-in" SOLA CONSTANT VOLTAGE TRANSFORMER.

→ Unstable voltages varied the light output essential for satisfactory operation of this precision instrument. High voltages burned out the light source. "Built-in" SOLA CONSTANT VOLTAGE TRANSFORMERS now provide a constant source of light and enable R. S. Wilder Company to guarantee the life of the lamps.



MICRO-PROJECTOR



WHEEL BALANCER

← The H. C. Schildmeier Co. says, "We have found the SOLA CONSTANT VOLTAGE TRANSFORMER to be the solution to many of our troubles, by maintaining a constant output voltage to actuate a unit that is direct meter reading" . . . a SOLA CV transformer is a built-in component of every Seal Line Balancer produced by this company.

**SOLA HANDBOOK  
 BULLETIN DCV-102**

A complete, and authoritative treatise on voltage regulation. Write for your copy.



# SOLA *Constant Voltage* TRANSFORMERS

Transformers for: Constant Voltage • Cold Cathode Lighting • Airport Lighting • Series Lighting • Fluorescent Lighting • Luminous Tube Signs • Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • SOLA ELECTRIC COMPANY, 4633 W. 16th Street, Chicago 50, Illinois

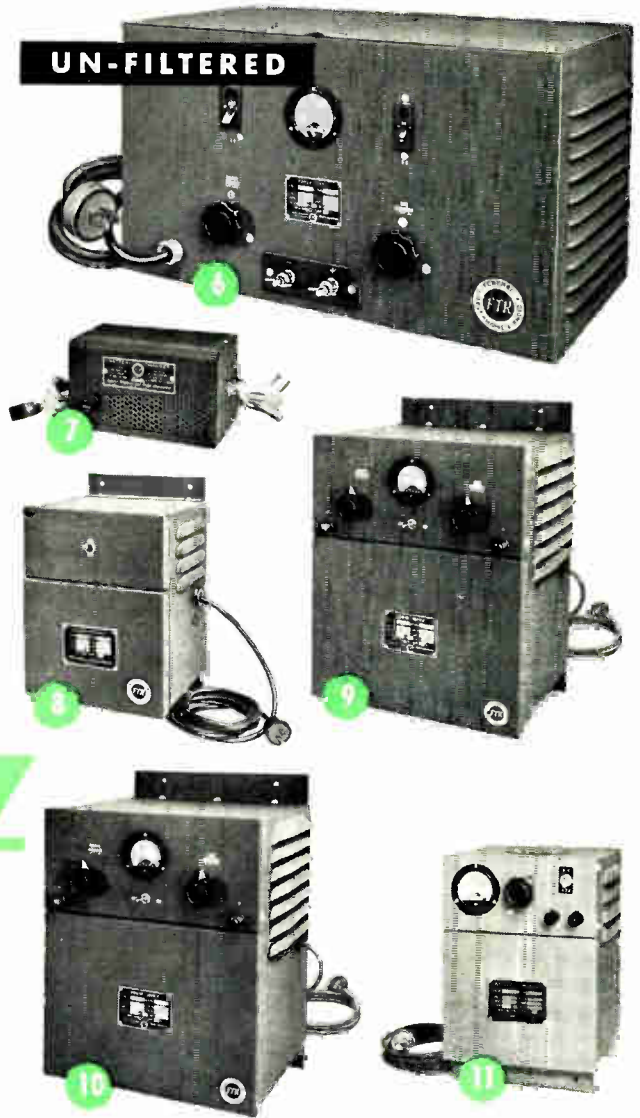
Manufactured under license by: ENDURANCE ELECTRIC CO., Concord West, N. S. W., Australia • ADVANCE COMPONENTS LTD., Walthamstow, E., England • UCOA RADIO S.A., Buenos Aires, Argentina • M. C. B. & VERITABLE ALTER, Courbevoic (Seine), France

# FEDERAL STANDARD **D-C** POWER SUPPLIES...

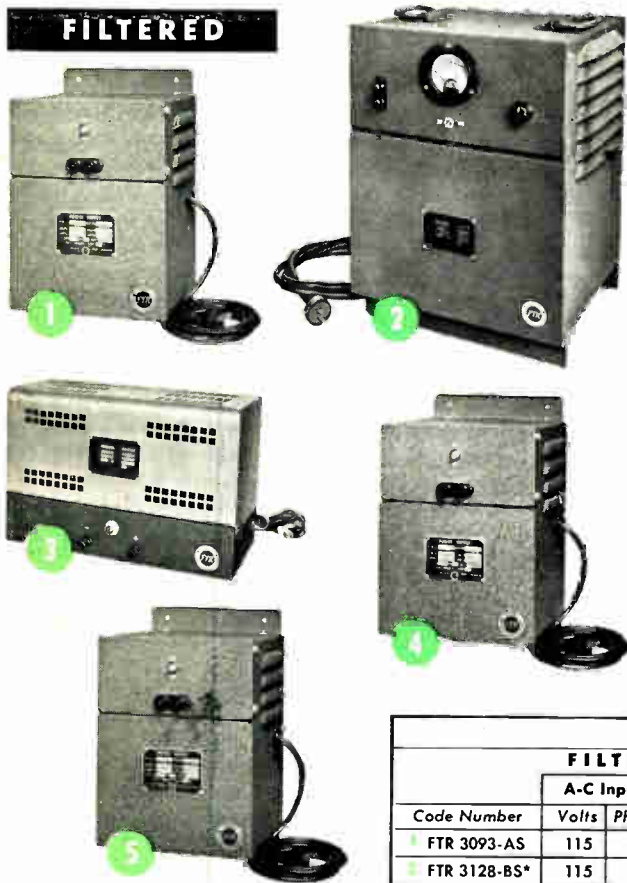
**now in stock and ready for quick delivery**

These Federal standard D-C Power Supplies are now available to meet a wide range of industrial and laboratory requirements for both filtered and unfiltered D-C power. All Federal D-C Power Supplies are powered by Federal long-life Selenium Rectifiers with no expendable parts that demand frequent replacement. Operation is dependable and economical. Federal D-C Power Supplies are conservatively rated. Heavy duty Selenium Rectifiers are able to withstand momentary overloads . . . provide D-C power immediately without heat-up period . . . operate quietly and efficiently with practically no maintenance. For prices and information on other Federal standard D-C Power Supplies, write Department E-313.

## UN-FILTERED

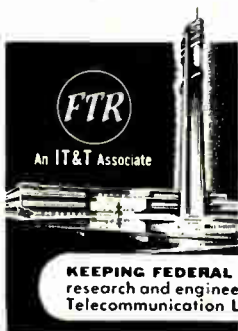


## FILTERED



### RATINGS

Code Number	A-C Input		D-C Output			Code Number	A-C Input		D-C Output		
	Volts	Phase	Cycles	Volts	Amps.		Volts	Phase	Cycles	Volts	Amps.
FTR 3093-AS	115	1	60	12	3	FTR 3300-DS	115	1	60	2-32	50
FTR 3128-BS*	115	1	60	22-30	10	FTR 1342-AS	115	1	50/60	6	4
FTR 3246-BS	115	1	60	6	10	FTR 3341-AS	115	1	50/60	28	5
FTR 3138-BS	115	1	60	12	5	FTR 3339-BS	115/230	1	50/60	6-24	18
FTR 3185-AS	115	1	60	12	7.5	FTR 3340-BS	115	1	50/60	5-70	12
*Filtered and regulated						FTR 3352-BS	115	1	50/60	5/10	20/10



KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

*Federal Telephone and Radio Corporation*

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.  
Export Distributors: International Standard Electric Corp. 67 Broad St., N. Y.



Your customers will  
never think of this wire

**... AND THAT'S GOOD!**

When your product is internally wired with Rockbestos wire, cable or cord, your customers will probably never see the wire at all. Most likely, they'll never even give it a thought. There's no reason why they should. For Rockbestos' impregnated asbestos insulation is *permanent*. It *won't* bake brittle, crack or flow under high temperatures or conductor-heating overloads. It *won't* carry or support flame. It *won't* rot or swell from exposure to grease, oil or fumes. And, because of all of these things that it *won't* do, Rockbestos wire *will* make your product's name synonymous with dependable performance — *will* help bring new customers in and old customers back. Write for your copy of Catalog No. 10-F . . . *today*.

**ROCKBESTOS PRODUCTS CORP., NEW HAVEN 4, CONN.**

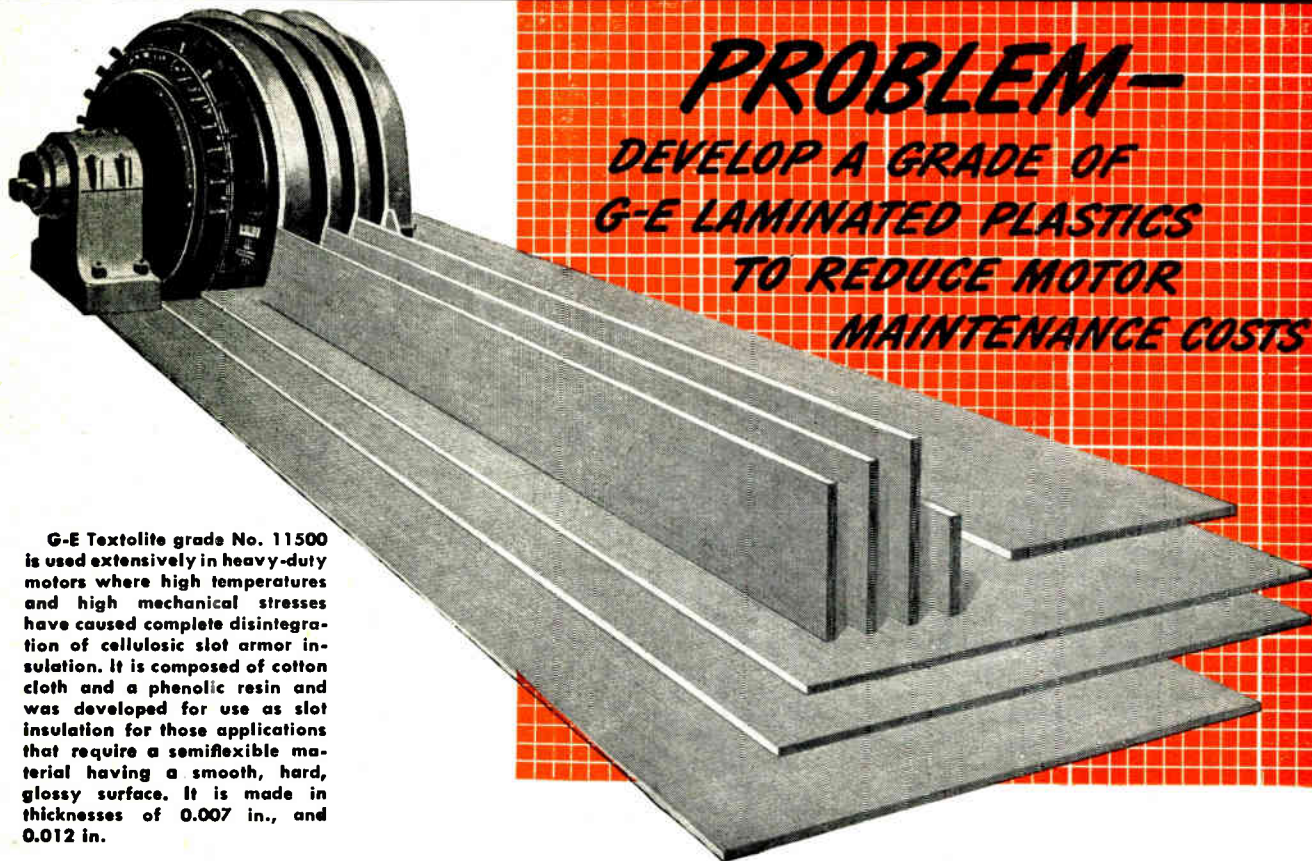
NEW YORK      CLEVELAND      DETROIT      CHICAGO  
PITTSBURGH      ST. LOUIS      LOS ANGELES  
OAKLAND, CALIF.



**ROCKBESTOS**



THE WIRE WITH PERMANENT INSULATION



**PROBLEM—  
DEVELOP A GRADE OF  
G-E LAMINATED PLASTICS  
TO REDUCE MOTOR  
MAINTENANCE COSTS**

G-E Textolite grade No. 11500 is used extensively in heavy-duty motors where high temperatures and high mechanical stresses have caused complete disintegration of cellulosic slot armor insulation. It is composed of cotton cloth and a phenolic resin and was developed for use as slot insulation for those applications that require a semiflexible material having a smooth, hard, glossy surface. It is made in thicknesses of 0.007 in., and 0.012 in.

**TAKE YOUR PICK**

G-E Textolite grade No. 11500 was developed to reduce insulation maintenance costs on heavy-duty motors. However, it isn't the only grade of Textolite manufactured. There are more than fifty grades available, and EACH has an **INDIVIDUAL COMBINATION** of properties.

Some grades excell in heat resistance, some in dielectric strength, others in loss factor. And you need this large assortment to select from if you want to produce your products in the most economical and satisfactory way.

Then, too, these many grades of Textolite are supplied in five different forms. Again you get a choice which can pay you dividends in many ways. Plastics Division, Chemical Department, General Electric Co., Pittsfield, Mass.

**GET THE COMPLETE STORY!**

Send for the new bulletin G-E TEXTOLITE LAMINATED PLASTICS which lists grades,

properties, fabricating instructions and detailed information about the five forms of Textolite. Fill in and mail the coupon below for your free copy.

**PLASTICS DIVISION, CHEMICAL DEPARTMENT  
GENERAL ELECTRIC COMPANY (BA-12)  
ONE PLASTICS AVE., PITTSFIELD, MASS.**

Please send me the new G-E Textolite laminated plastics bulletin.

Name .....

Firm .....

Address .....

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

**GENERAL  ELECTRIC**

CD48-M1

**TEXTOLITE LAMINATED IS SUPPLIED  
IN FIVE FORMS**



**SHEETS, TUBES, AND RODS**  
—These standard shapes are available in thousands of sizes. Up-to-date manufacturing methods facilitate quick deliveries.

**FABRICATED PARTS**—G.E. has modern fabricating equipment to machine Textolite laminated plastics parts to your own specifications.



**MOLDED-LAMINATED PARTS**—Textolite is custom molded directly to shape. Molded laminated products are among the strongest plastics parts produced.

**LOW-PRESSURE MOLDED PARTS**—Extremely large and irregular Textolite shapes are custom molded by the low-pressure laminating process.



**POST-FORMED LAMINATES**  
—Sheets of Textolite laminated plastics are custom formed into simple shapes by this very inexpensive method.

AS TELEVISION VOLTAGES

# CLIMB *and* CLIMB

... these New Aerovox Electrolytics,  
Aerovox Oil-filled Capacitors and  
Aerovox Duranite Capacitors  
show the way

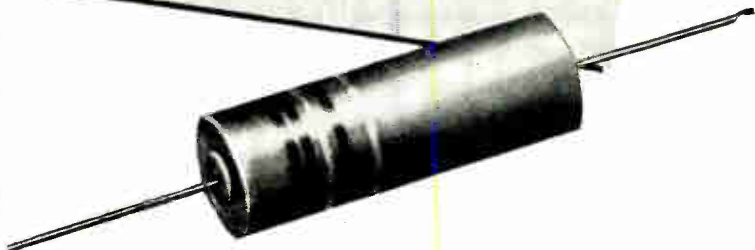
## HIGHER-VOLTAGE ELECTROLYTICS

Many types of Aerovox electrolytics are available to meet the severe-service conditions encountered in television equipment. Especially where temperatures of 85° C may be reached in hour-after-hour use. The Type AF twist-prong base electrolytic here shown is typical of the Aerovox trend towards higher voltages.



## DURANITE— THE SUPERIOR CAPACITOR

Brand new—designed from scratch. Utilizing the new Aerolene impregnant; the new Duranite casing material; and entirely new processing methods. Not to be confused with usual plastic tubulars. Duranite casing is unaffected by wide range of temperatures. Nothing to melt or burn. Moistureproof. No shelf deterioration. Pig-tails won't pull out. 200 to 1600 v. D.C.W. Popular capacitance values.



## HIGHER-VOLTAGE OIL TUBULARS

Popular Type -89 midget-can oil tubulars. Ratings increased from 2500 to 6000 v. D.C.W. Capacitances to .1\*. Higher voltage units with special terminals to provide necessary creepage distance without increasing diameter or length. Oil-impregnated paper section. Hermetically-sealed can. Insulated jacket. Center radial mounting strap.

\*Write for descriptive listings.



● Component performance can make or break this new television industry. Greater capacitor safety factors become imperative. And that is where these new Aerovox capacitors blaze the trail.

Now standard types, they are typical of how Aerovox application engineering anticipates circuit and operational requirements. Yes, regardless of your voltage, temperature and other severe-service conditions, Aerovox can deliver capacitors that will stand the gaff.

● Send us your capacitance problems for engineering collaboration. Let us quote on your capacitance requirements.



## FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AERVOX CORPORATION, NEW BEDFORD, MASS., U. S. A.

SALES OFFICES IN ALL PRINCIPAL CITIES • Export: 13 E. 40th St., NEW YORK 16, N. Y.

Cable: 'ARLAB' • In Canada: AERVOX CANADA LTD., HAMILTON, ONT.

# AMERICAN PHILLIPS SCREWS

Break Driving-Time  
Records on Trailers  
...Stop Driver-Accidents...  
Help Keep Sales Rolling in High



**FASTEN FASTER** with American Phillips Screws . . . the way plywood panels are fastened to trailer frames . . . with power drivers. *One man takes only 32 minutes to drive 522 screws!* That's 50% faster than slotted screws, with half the labor. And there are no corners too close . . . no angles too awkward. No costly accidents to workers or their work.

**SELL FASTER** . . . Buyers of *all* types of products are learning to recognize this "high sign" of quality construction . . . the American Phillips Screw with the universal cross-recess. Just tell them the whole story of American Phillips strength and vibration-resistance . . . and watch sales pick up speed! Write.

4-WINGED DRIVER CAN'T SLIP OUT  
OF PHILLIPS TAPERED RECESS

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois St.

Detroit 2: 502 Stephenson Building

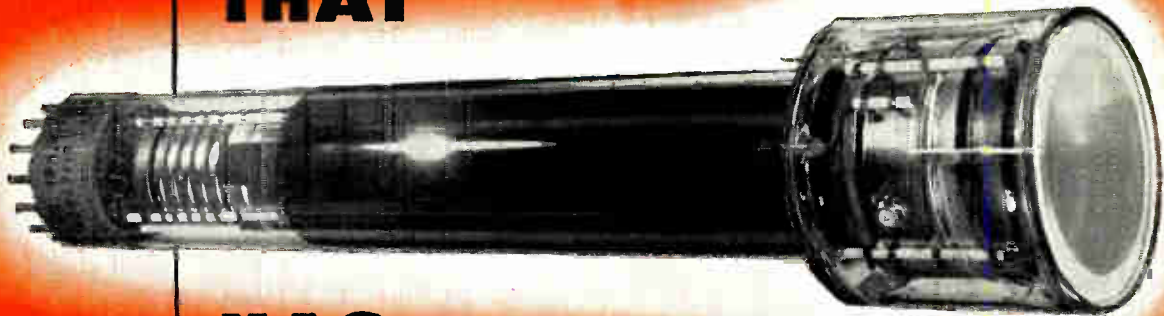
# AMERICAN PHILLIPS Screws



ALL TYPES

ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

# THE TUBE THAT



# HAS DONE MOST FOR TELEVISION HAS 95%

# NICHROME\* V

## METAL PARTS

The 5655 has three sections: (1) Image, (2) Scanning, (3) Multiplier. The image section contains a semi-transparent photocathode on the inside of the face plate, and on this the scene televised is focused by an optical lens system. This causes the photocathode to emit a stream of electrons from each illuminated area (proportional to the light striking the area), and these are focused on one side of the "target" where they produce a charge pattern. The opposite side of the target is scanned by a low-velocity electron beam from an electron gun in the scanning section. Electrons from the gun are turned back at the target forming a return beam which has been amplitude modulated by deposition of the electrons at the target, in accord with the charge pattern whose more positive areas correspond to highlights of the televised scene. In the multiplier section, the return beam is directed to a 5-stage amplifier (using secondary emission to amplify electron beam signals), and here the modulated beam is amplified at least 300 times—to drive the first stage of the video amplifier.

This is the RCA Image Orthicon 5655—super sensitive eye of the television camera. Developed primarily for studio use and applications employing artificial illumination, it is several times more sensitive to light at low levels than the fastest motion picture film.

Only 1 1/4" long, it has over 150 precision-made parts, many assembled under microscopes.

These parts must remain unmagnetized by the strong magnetic fields of the focusing and deflection coils that surround the tube. Magnetized, they would produce fields of their own, and prevent proper operation.

When the parts are assembled, the glass housing of the tube is sealed. Temperature of the glass during sealing operations is raised to over 1600°F., temperature of the parts to as much as 900° F.

Under these conditions of manufacture, the alloy used must not only be entirely non-magnetic but possess high resistance to heat and oxidation. The only alloy that most satisfactorily meets these specifications is Nichrome V. That is why 95% of the metal parts in the RCA Image Orthicon 5655 are made of Nichrome V.

Driver-Harris manufactures over 85 alloys for the Electronic and Electrical fields. These are distinguished for giving exceptionally efficient, long and economical service—most particularly where requirements are unusually tough. So send us your specifications. As with the Image Orthicon, it is most probable a D-H alloy will best solve your manufacturing problems.

\*Nichrome is manufactured only by

## Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle  
Manufactured and sold in Canada by  
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada



\*T.M. Reg. U. S. Pat. Off.



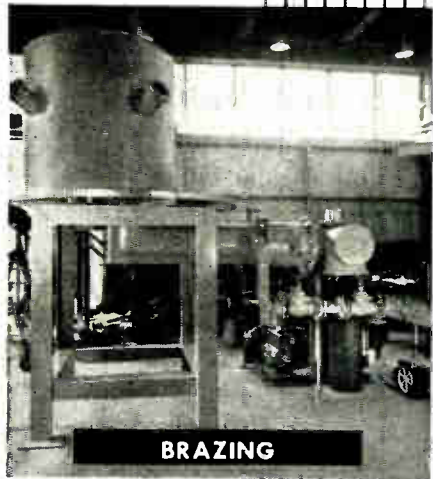
# SPECIAL HIGH VACUUM EQUIPMENT

## BUILT TO MEET YOUR PROCESS REQUIREMENTS

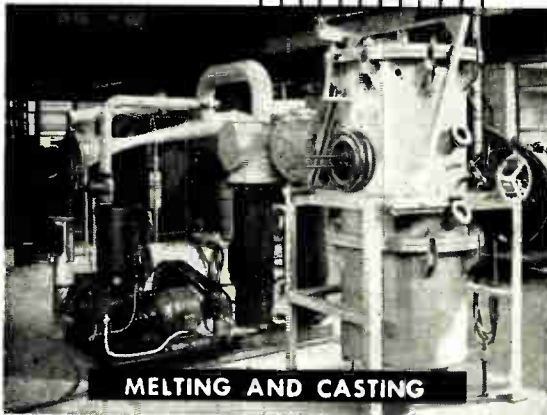
We design, engineer, fabricate and install special High Vacuum process equipment.

In the High Vacuum field National Research Corporation offers you unified, under-one-roof control and responsibility. We not only build equipment, but also undertake development work for others in fields where the unique experience and ability of our own Research Division can be used to your advantage.

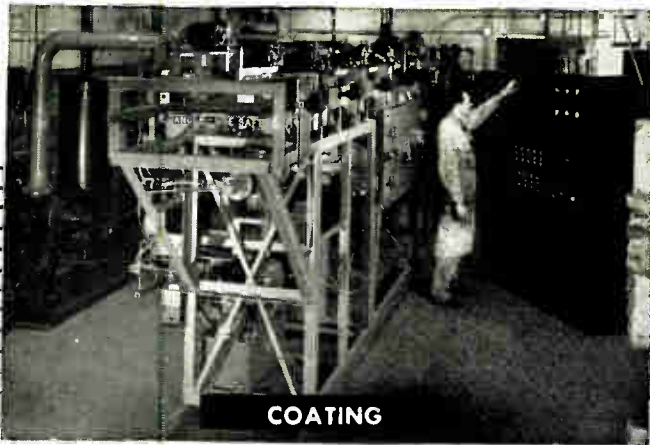
If you plan to profit from your own High Vacuum process developments—if you require assistance in developing your processes—you should become acquainted with the National Research Corporation, 70 Memorial Drive, Cambridge 42, Massachusetts.



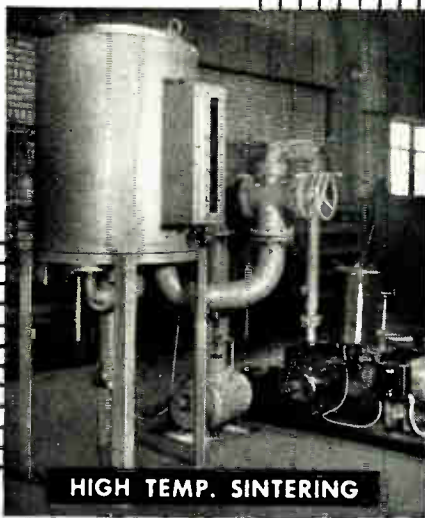
BRAZING



MELTING AND CASTING



COATING



HIGH TEMP. SINTERING

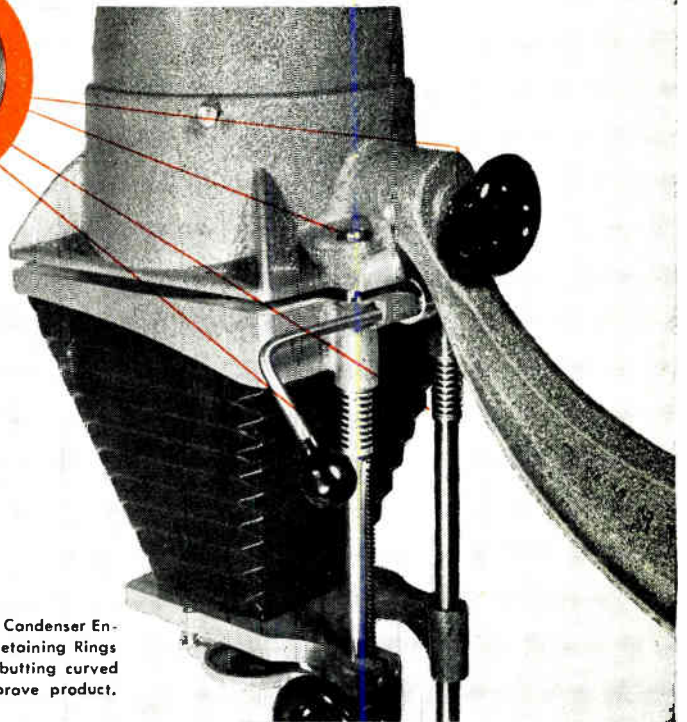
HIGH VACUUM FOR INDUSTRY  
**NATIONAL RESEARCH CORPORATION**  
Vacuum ENGINEERING DIVISION



# Truarc inverted rings align shafts, save 20 minutes . . . \$10.00 per unit

Production savings and sales advantages result from redesign with four Truarc rings

- Eliminate two drilling, two tapping operations, and the fabrication of two collars and four pins.
- Eliminate two set screws.
- Cut dis-assembly, re-assembly time 75%.
- Make for closer tolerances.
- Make drive shaft self-aligning: operation by user greatly simplified.
- Make more delicate adjustments easier for user.
- Streamline entire unit.
- **TOTAL OVERALL SAVINGS, per unit . . . \$1.00**



Elevator-rod detail of Skyview Condenser Enlarger, where Truarc Inverted Retaining Rings provide uniform shoulder for abutting curved surface of helical spring, improve product.



Like the Skyview Camera Company of Olmsted Falls, Ohio, re-design with Truarc and you will cut costs and improve your product too. Wherever you use machined collars, nuts, bolts, snap rings, cotter pins

See us at the Power Show, Grand Central Palace, N. Y.  
November 29-December 4, Booths 522-523

—there's a Truarc ring that does a better job of holding parts together. All Waldes Truarc retaining rings are precision engineered, easy to assemble and dis-assemble, retain circularity always to give you a never-failing grip. They can be used over and over again. Send us your problem. Waldes Truarc engineers will be glad to show how Truarc can help you.



**WALDES**  
**TRUARC**

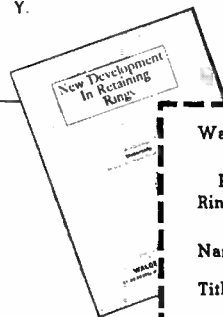
REG. U. S. PAT. OFF.

**RETAINING RINGS**

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS ARE PROTECTED BY U. S. PATS. 2,302,948; 2,026,454; 2,416,852 AND OTHER PATS. PEND.

ELECTRONICS — December, 1948



● Send for new Truarc booklet,  
"New Development In Retaining Rings"

Waldes Kohinoor, Inc., 47-10 Austel Place E-12  
Long Island City 1, N. Y.

Please send booklet, "New Development In Retaining Rings" to:

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Business Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**THERE'S PROFIT FOR YOU IN  
THE TIME AND MONEY-SAVING QUALITIES OF**

# ARNOLD

## PERMANENT MAGNETS



Several avenues of profit are open to you in Arnold Permanent Magnets. You can improve the performance and overall efficiency of equipment. You can increase production speed, and in many cases reduce both weight and size. And most important, you can maintain these advantages over any length of production run or period of time, because Arnold Permanent Magnets are completely quality-controlled through *every* step of manufacture—from the design board to final test and assembly. You'll find them unvaryingly uniform and reliable in every magnetic and physical sense.

It's our job to help you discover and then fully attain these benefits. Arnold Products are available in all Alnico grades and other types of magnetic materials—in cast or sintered forms, and in any size or shape required. Our engineers are at your command—check with our Chicago headquarters, or with any Allegheny Ludlum branch office.

W&D 1298



### **THE ARNOLD ENGINEERING CO.**

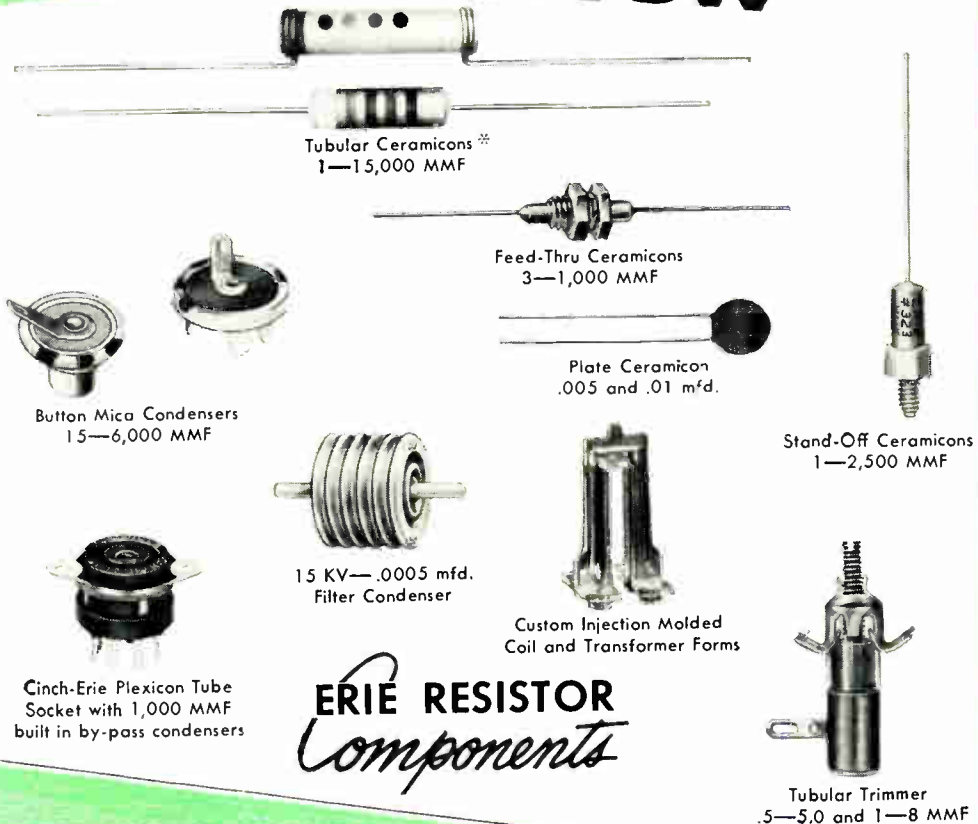
Subsidiary of **ALLEGHENY LUDLUM STEEL CORPORATION**

147 East Ontario Street, Chicago 11, Illinois

*Specialists and Leaders in the Design, Engineering and Manufacture of PERMANENT MAGNETS*

*Definitely in the Picture*

# FOR TELEVISION



**T**HE special problems inherent in television receivers have been given careful attention by Erie Resistor engineers in designing condensers for these applications.

The components illustrated above have been correctly designed for efficient operation at high frequencies. The condensers have low series inductance and incorporate specially designed terminals and mounting arrangements. Of special interest is the high voltage Erie Double Cup condenser for power supply

filtering circuits. Rated at 15 KV and having a capacity of .0005 mfd. these units are unusually compact and economical. Plastic coil and transformer forms are custom injection molded to customer's specifications.

We will be glad to send you technical data and samples on any of the condensers shown above. Our engineers are at your service to develop special ceramic or mica condensers for television applications.

<sup>®</sup>"Ceramicon" is a registered trade name and refers to ceramic dielectric condensers manufactured by Erie Resistor Corp.



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

# RAYTHEON AM-FM & TV TRANSMITTERS

are equipped with  
**Adlake Relays**

RAYTHEON Manufacturing Company's AM, FM and TV transmitters, including the famous "RF-3" 3-KW FM, "RA-5" 5-KW AM and the new "RTV-500" 500 watt TV and "RTV-5" 5000 watt TV equipment, employ Adlake Relays for CONTROL.

*Silent and chatterless*, Adlake Mercury Plunger Type Relays are an integral part of these streamlined transmitters which produce high fidelity modulation with a low noise level.

Besides silent operation, Adlake Relays bring these advantages to *any* job where relays are used:

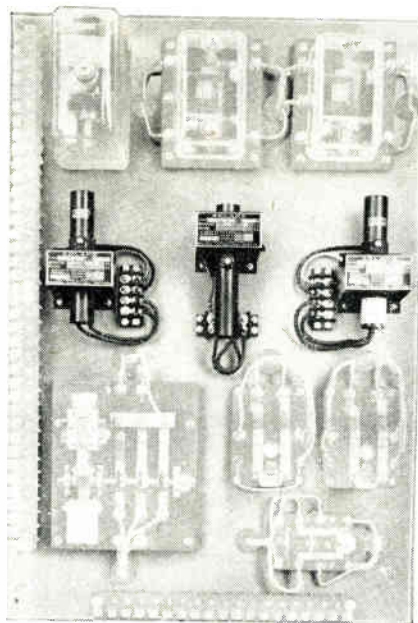
- Hermetically sealed contact mechanism is impervious to dust, dirt and moisture.
- Liquid mercury-to-mercury contact prevents burning, pitting and sticking.
- Adlake design armors relays against outside vibration or impact; they are usable on either stationary or fixed equipment.

Whatever your relay needs are, there's an Adlake Relay to do the job. You'll like our free, illustrated folder giving full details. Write for it today to: The Adams & Westlake Company, 1107 N. Michigan, ELKHART, Indiana.

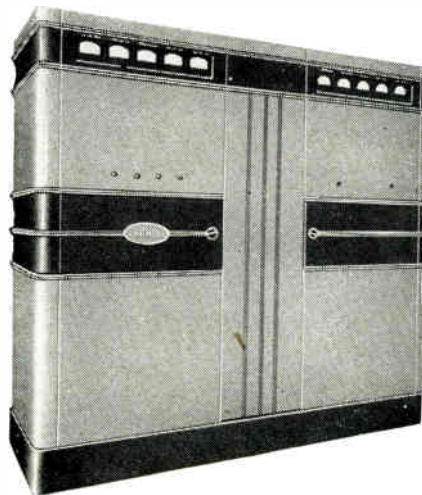
## THE Adams & Westlake COMPANY

Est. 1857 • ELKHART, INDIANA • New York • Chicago

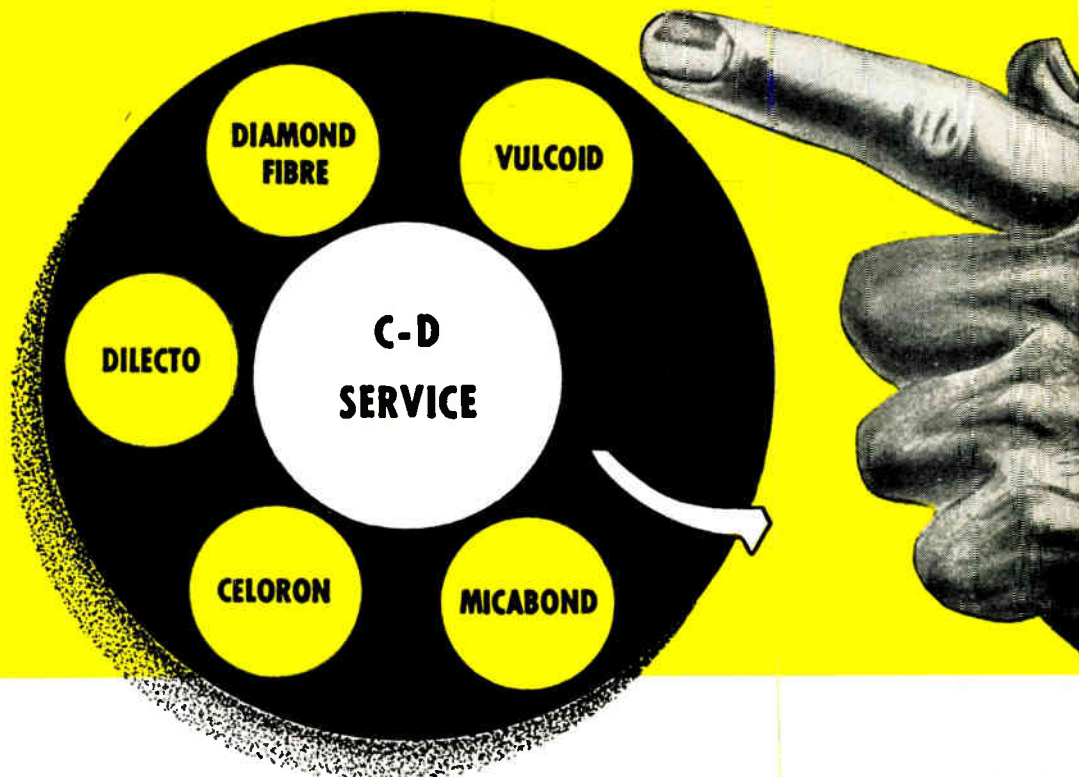
Manufacturers of Adlake Hermetically Sealed Mercury Relays for Timing, Load and Control Circuits



(Above) Relay panel in Raytheon's RF-3A 3-KW FM AMPLIFIER (shown below)



The right material for your job  
 . . . right at your fingertips!



## How to Save Production Hours and Dollars on Your Electrical Insulating Jobs . . .

One of the surest ways to reduce unit costs on any job is to be right the first time when selecting materials. Continental-Diamond's complete line of high strength electrical insulating materials makes proper product engineering easy.

There are trained C-D technicians on hand at all times to give you personal help in getting bet-



ter, lower-cost applications. To be sure of being right the first time in the selection of materials, call your nearest C-D office whenever the need arises.

### C-D HIGH-STRENGTH PLASTICS

- DIAMOND FIBRE**—Vulcanized Fibre.
- VULCOID**—Resin Impregnated Fibre.
- DILECTO**—Laminated Thermosetting Plastic.
- CELORON**—Molded High-Strength Plastic.
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*Continental - Diamond* FIBRE COMPANY

Established 1895. Manufacturers of Laminated Plastics since 1911—NEWARK, 16 • DELAWARE

# FOR ELECTRONIC APPLICATION

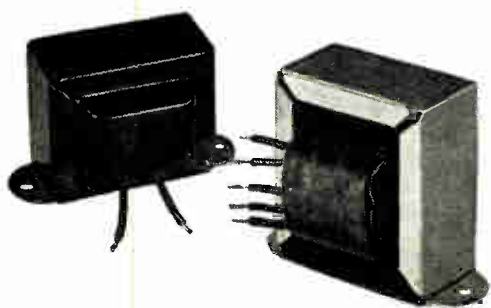
use

# AMERTRAN

all the way

**I**N manufacturing, specialization is as important as it is in medicine or any of the other professions. Since the founding of this organization, we have specialized in the development and manufacture of transformers and allied components. Whether your requirements are for large liquid-immersed units or small dry-type transformers, special designs made in our job shop or conventional designs manufactured on our mass production lines, Amertran engineering, experience, and adequate production facilities are at your disposal.

For electronic transformers, Amertran all the way!

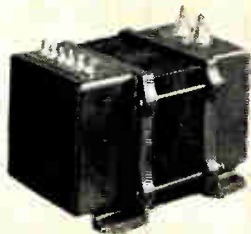


**AMERTRAN "K" LINE** — A line of audio and power transformers and reactors available for mass production requirements. Amertran has the production facility to maintain production schedules.

**THE AMERICAN TRANSFORMER CO.**  
178 EMMET STREET • NEWARK 5, N. J.



**MODULATION TRANSFORMERS AND REACTORS** — Supplied in matched units for every size of transmitter.



**"W" DRY TYPE TRANS-MITTER COMPONENTS**—

Economical self-cooled transformers and reactors — for better rectifier construction and operation.

**HERMETICALLY SEALED TRANSFORMERS** —

Highly resistant to moisture, shock, pressure and temperature variation.

Either liquid-immersed or compound filled. Liquid-immersed type for high voltages reduces size and weight, with lower corona effect.

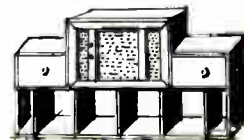
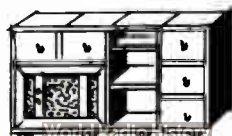
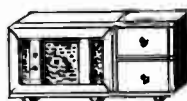
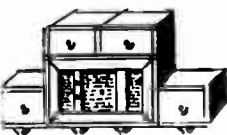
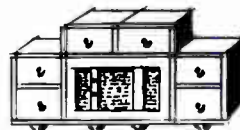
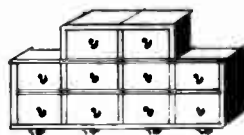
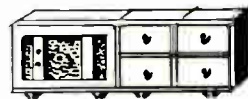
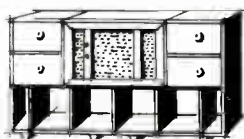
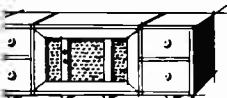
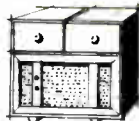
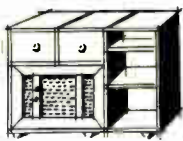


# AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

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





# Jensen Customode

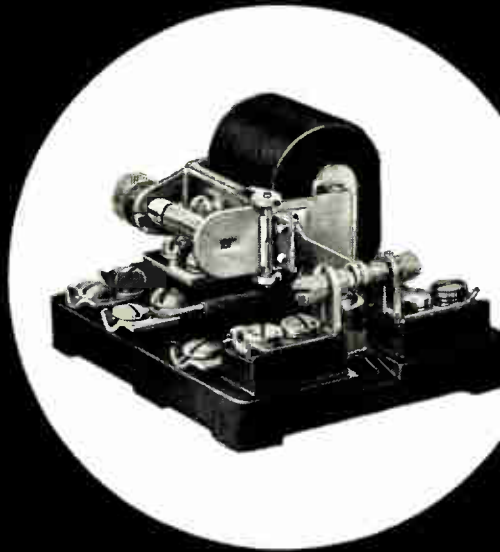
*It's your move!* You are assembling a Home Entertainment Center or a Ham Shack and need fine loud speaker performance and cabinets for the ever expanding requirements of audio-video equipment. Designed by leading furniture stylists and electronics engineers, Customode's "building block" versatility enables you to create thousands of cabinet variations as you wish—when you wish. *It's your move!* Write today for literature and scale cut-up illustrations. Jensen Manufacturing Co., 6607 S. Laramie, Chicago 38, Ill.

# 3 sensitive **ALLIED RELAYS**

FOR A LIMITED POWER SUPPLY  
OR PRECISE OPERATING  
CHARACTERISTICS

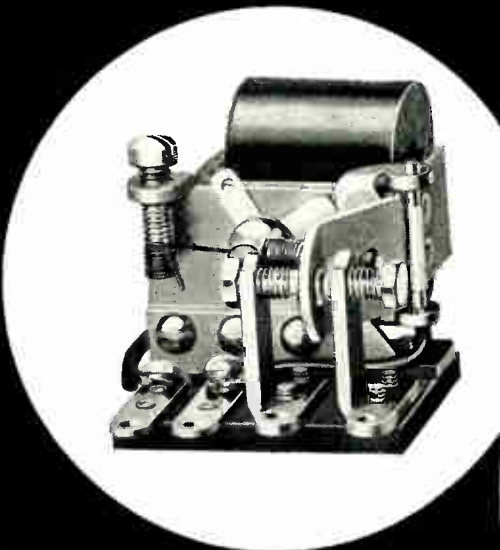


This new folder shows 24 small, compact Allied Relays with a carefully detailed table of characteristics and specifications. Write for YOUR free copy today.



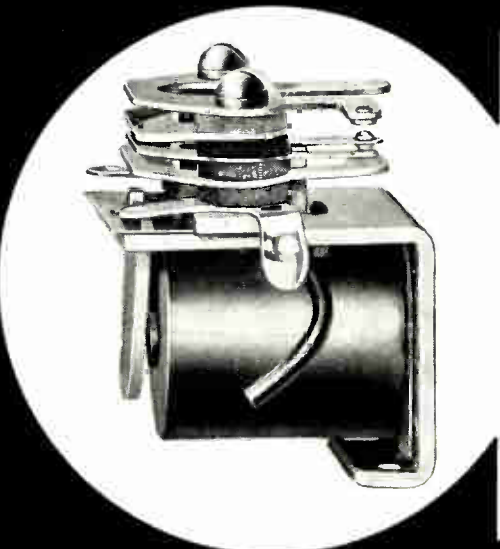
TYPE **B**  
ALLIED RELAY  
**SENSITIVITY:**  
**9 MILLIWATTS**

Supplied with contact arrangements up to 2-pole double-throw. Standard silver contacts rated at 1 ampere at 24 volts DC or 110 volts AC non-inductive. Coil rating 9 milliwatts up to 38 volts DC and 0.12 volt-amperes up to 110 volts AC. Dimensions:  $1\frac{3}{4}$ " x  $2\frac{3}{8}$ " x  $2\frac{3}{4}$ ".



TYPE **BG**  
ALLIED RELAY  
**SENSITIVITY:**  
**11 MILLIWATTS**

Contact arrangements, single-pole double-throw. Standard silver contacts rated at 2 amperes at 24 volts DC or 110 volts AC non-inductive. Coil rating 11 milliwatts up to 25 volts DC. Coils available for DC operation only. Dimensions:  $1\frac{1}{4}$ " x  $1\frac{3}{4}$ " x  $1\frac{3}{8}$ ".



TYPE **F**  
ALLIED RELAY  
**SENSITIVITY:**  
**80 MILLIWATTS**

Supplied with contact arrangements up to 2-pole double-throw. Standard silver contacts rated at 2 amperes at 24 volts DC or 110 volts AC non-inductive. Coil rating 80 milliwatts up to 31 volts DC. Coils available for DC operation only. Dimensions:  $1\frac{3}{8}$ " x  $1\frac{1}{10}$ " x  $1\frac{3}{8}$ ".

AL-128



**ALLIED CONTROL COMPANY, INC.**

2 EAST END AVENUE, NEW YORK 21, NEW YORK





# your product

IS MORE SALEABLE WITH



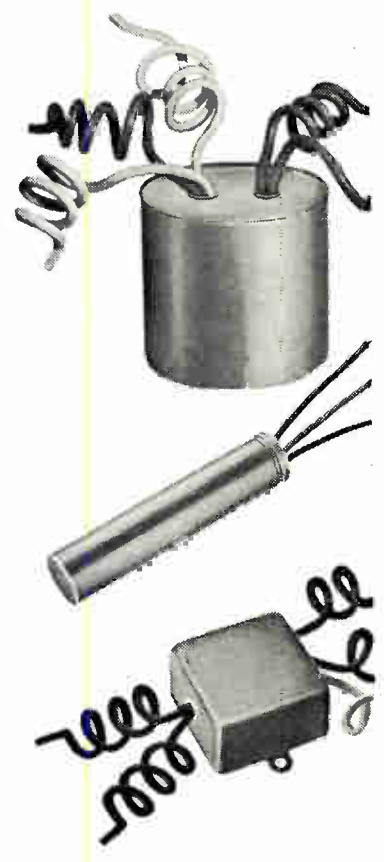
*Quietones*  
Reg. U.S. Pat. Off.

You may build the best appliance of its kind on the market — but if it sets up local radio interference—you'll have tough sledding against today's keen competition. Your customers are *demanding* radio noise-free performance in the electrical equipment they buy.

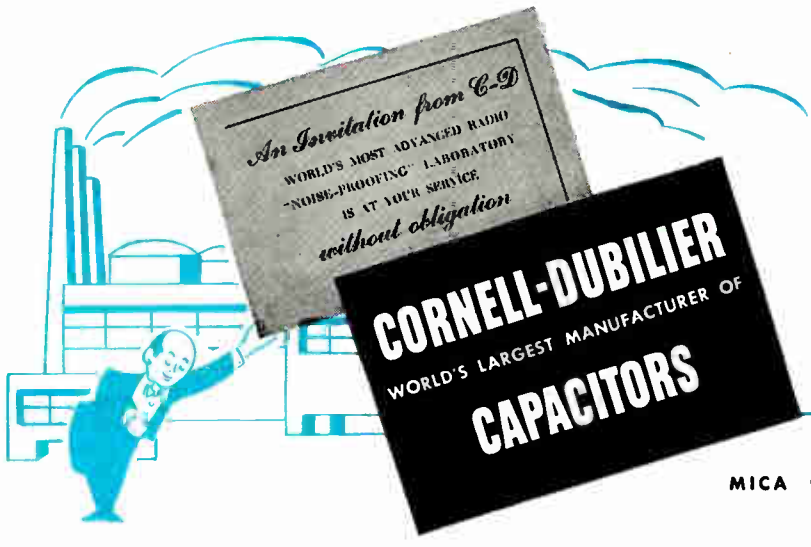
The answer, of course, is to equip *your* products with C-D Quietones. Why Quietones? First, because they're the best-engineered noise filters — second, because they guard your product's reputation by

giving long trouble-free service — third, because they're designed and built to meet manufacturers' specific needs — efficiently and economically.

Speed up sales — build prestige — boost profits with C-D Quietones. Your inquiries are invited. Cornell-Dubilier Electric Corporation, Dept. K-12, South Plainfield, New Jersey. Other large plants in New Bedford, Brookline and Worcester, Mass., and Providence, Rhode Island.



Make Your Product More Saleable with C-D Quietone Radio Noise Filters and Spark Suppressors



MICA • DYKANOL • PAPER • ELECTROLYTIC

**PROBLEM:**

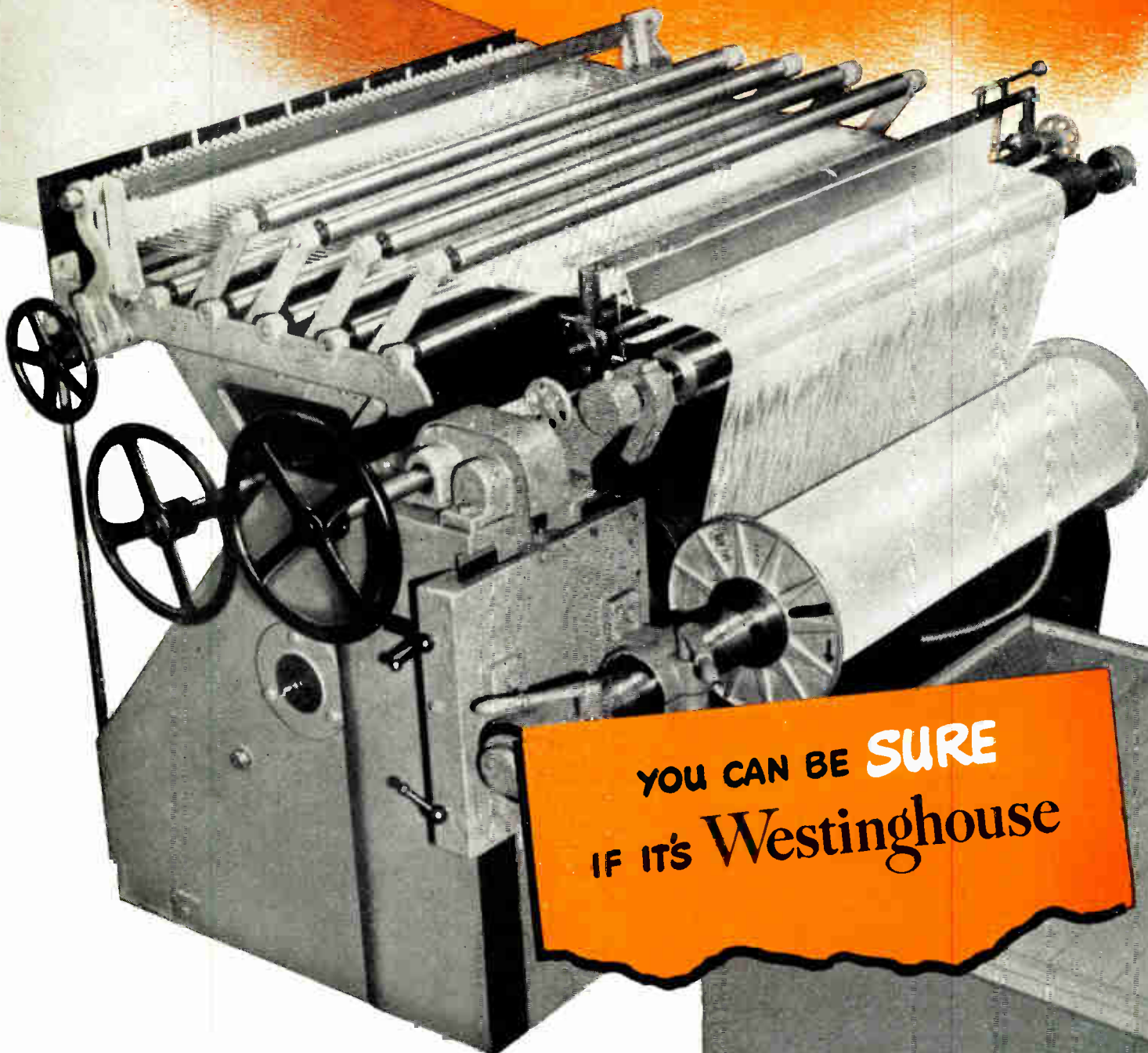
How to produce Better,

**ANSWER:**

Westinghouse Electronic

*FOR  
EXAMPLE:*

**MOT-O-TROL**



**YOU CAN BE SURE**  
**IF IT'S Westinghouse**

# Faster, Cheaper Control

## FOR THE JOB THAT DEMANDS PRECISE CONTROL OF DRIVE SPEEDS

The textile industry supplies an excellent example of how Westinghouse Electronic Controls are helping to speed production of better products at lower cost.

The industry's trend toward high-speed, high-quality production runs developed a need for closer control of warper drives. The answer was found in Westinghouse Electronic Warper Drive—an adaptation of Mot-O-Trol—which applied the precision of electronics to maintain the rigid but necessarily gentle control over yarn tension and speed.

Many of Mot-O-Trol's unique features contributed to its ability to handle this tough control job. Its ability to provide a wide, stepless range of speed control for d-c motors from alternating-current sources; its ability to start motors, to bring them up to a preset speed smoothly and rapidly, to permit wide changes of speed at any time, to regulate speed under varying loads, to apply dynamic braking for timed stopping, to reverse the motor when necessary.

All of these remarkable Mot-O-Trol functions, plus many others, are the products of electronics. In which of them do you spot an opportunity to boost the efficiency of your men and machines . . . to produce faster, better and cheaper? For complete details ask for booklet B-3256. Call your Westinghouse representative or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-60682



Mot-O-Trol provides precise control in a packaged drive that needs no additional equipment. It can be mounted on or built into machines.



**Westinghouse**  
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

**ELECTRONIC CONTROL**

LAMINATED or MOLDED

# INSUROK

A DEPENDABLE NAME IN PLASTICS

INSUROK is a registered trade-mark of The Richardson Company.

When it comes to serving industry through plastics, the names of Richardson and INSUROK command respect and attention in high places.

To our old friends, we offer assurance that past high standards of quality and materials and skilled workmanship will be zealously protected.

To new prospects, we offer an invitation—let us prove our claim that Richardson experience, talents and facilities can mean worthwhile benefits for you in meeting your plastics requirements.

*The* **RICHARDSON COMPANY**

LOCKLAND, OHIO • FOUNDED IN 1858

Sales Headquarters: MELROSE PARK, ILLINOIS

CLEVELAND • DETROIT • INDIANAPOLIS • MILWAUKEE • NEW  
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**WE CAN HELP YOU WITH**

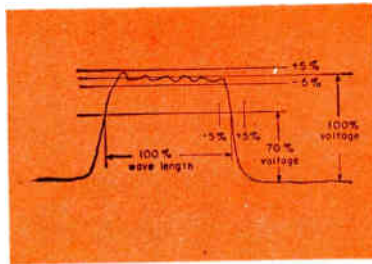
# Energy-Storage Capacitors!

Our experience—in engineering, designing, and building performance into energy-storage and discharge capacitors—may provide just the help you are looking for.

Do you make discharge welding or photographic flash-tube equipment? Radar equipment? Flash beams, aircraft signalling, or similar devices? Or research tools, from spectrosopes to cyclotrons? We have furnished a large proportion of the capacitors used for all of these applications.

Unusual applications, too—like those listed below—are a specialty with us. Whatever your problem, let our engineers give you a hand. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

**NEED SQUARE WAVES?** Pulse-forming networks can provide them. Networks are used where the normal capacitor discharge wave shape is not suitable and where an impulse must have definite energy content and duration. The Type E network, produced by General Electric, consists of capacitor and coil sections, adjusted to close tolerances, and hermetically sealed in single metal containers. Built by the thousands for radar, they are now available for commercial use.



**NEED ARTIFICIAL LIGHTNING?** Potent artificial lightning bolts—at voltages up to 10,000,000—are not a usual need. But when required—for universities, laboratory testing, or exhibition—General Electric can build the capacitors. A typical example is the 100-kv d-c unit, about 3 feet in diameter and 2 feet high. Units can be stacked, as shown, for ease of installation and minimum space. In some instances as many as 100 separate units have been placed in series to produce 10,000,000 volt discharges.



**OR DO YOU WANT TO TAKE A PICTURE?** A maker of flash-tube photographic equipment wanted a lighter capacitor for his portable sets. Our designers went to work and came up with just what he desired—and one which he could use, also, for his studio equipment at a considerable saving in price. (In case you're interested, this capacitor is rated 14 muf, weighs 2½ lb, and delivers 43.8 watt-seconds with 1000 hour service life or 58 watt-seconds at 400 hours. Used in pairs, they replace a 28 muf-studio capacitor, save in cost too.)

## GENERAL ELECTRIC

407-176

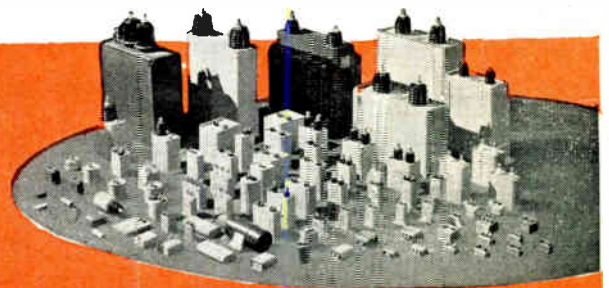
*Specialty Capacitors*  
FOR

Motors  
Luminous-tube transformers  
Fluorescent lamp ballasts

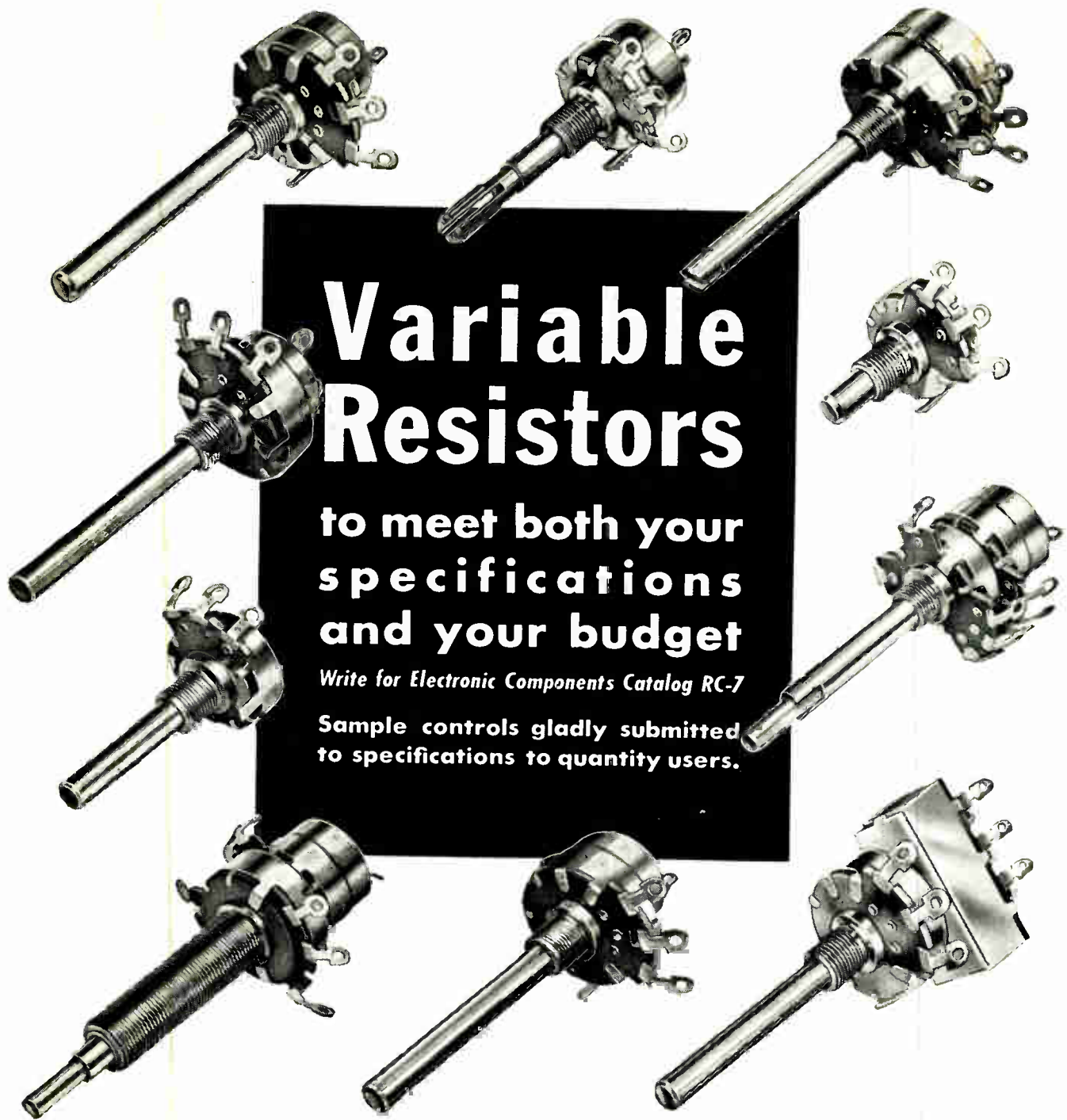
Industrial control  
Radio filters  
Radar  
Electronic equipment  
Communication systems  
Capacitor discharge welding

Flash photography  
Stroboscopic equipment  
Television  
Dust precipitators  
Radio interference suppression  
Impulse generators

AND MANY OTHER APPLICATIONS



**RADIO • TELEVISION • INDUSTRIAL**



# Variable Resistors

**to meet both your specifications and your budget**

*Write for Electronic Components Catalog RC-7*

**Sample controls gladly submitted to specifications to quantity users.**

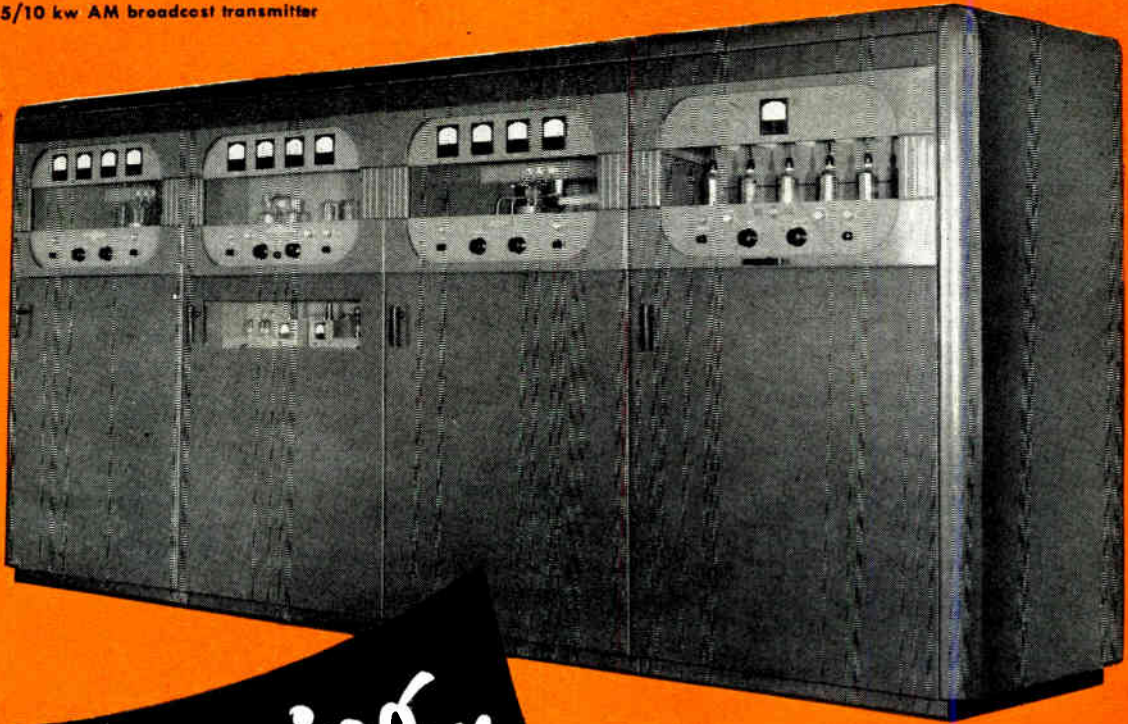
# STACKPOLE

Fixed and Variable Resistors • Iron Cores (All standard and special types) • Switches (inexpensive line, slide and rotary-action types) • Sintered Alnico II Permanent Magnets . . . and hundreds of molded iron powder, metal, carbon and graphite products.

*Electronic Components Division*

**STACKPOLE CARBON COMPANY • ST. MARYS, PA.**

The magnificent new Collins 21B/21L  
5/10 kw AM broadcast transmitter



**Announcing...**

*the latest great contribution to modern AM broadcasting*

The 21B/21L is the finest 5/10 kilowatt AM broadcast transmitter of which Collins engineering and manufacturing skills are capable. No compromise has been made for reasons of economy. Without deviation, our purpose has been to achieve the highest possible quality regardless of cost.

*Yet the 21B/21L is competitively priced.*

When furnished as the Collins 21B, this is a five kilowatt transmitter with provision for instantaneous reduction of power to 1,000 watts. It is designed to permit full 100% modulation of the carrier at frequencies between 30 and 10,000 cycles per second. The audio frequency response is constant, plus or minus 1.5 db, within this range.

Featured are utmost reliability, with fine components, conservatively rated; vertical chassis construction, and easy accessibility of components and wiring; precise motor tuning with eye-level metering throughout; adequate air cooling; dependable personnel and circuit protection.

The 21B may be converted to become the ten kilowatt 21L by inserting an additional power tube in

a socket already installed, and making a few simple additions in the exciter and power amplifier cabinets. The 10 kw 21L (pictured above) may be purchased initially.

If you are contemplating the replacement of obsolescent 5 or 10 kw transmitter equipment, or the building of a new station of either of these powers, the very efficient, completely modern Collins 21B/21L should be your first consideration. We will welcome your inquiry for further information.

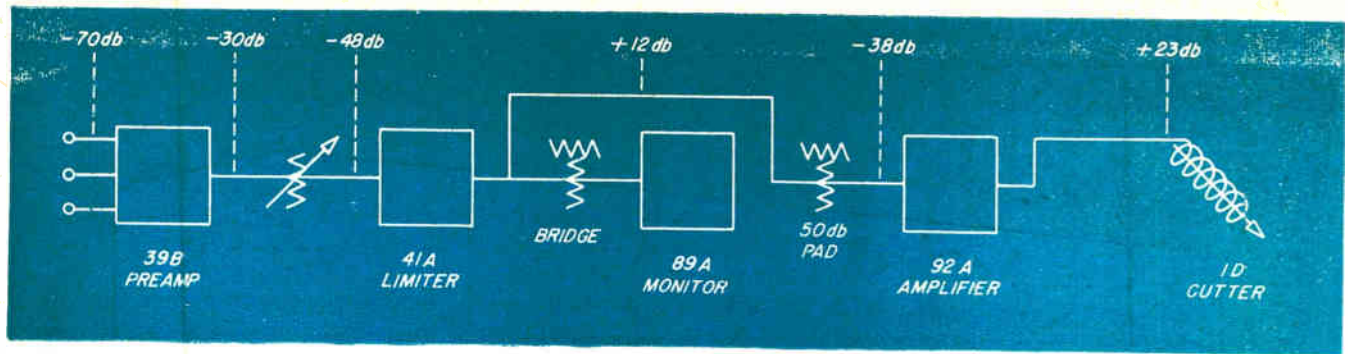
FOR BROADCAST QUALITY, IT'S . . .



**COLLINS RADIO COMPANY, Cedar Rapids, Iowa**

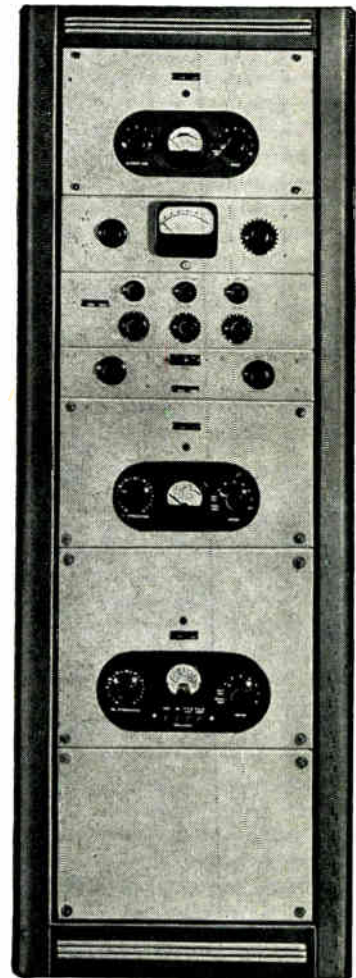
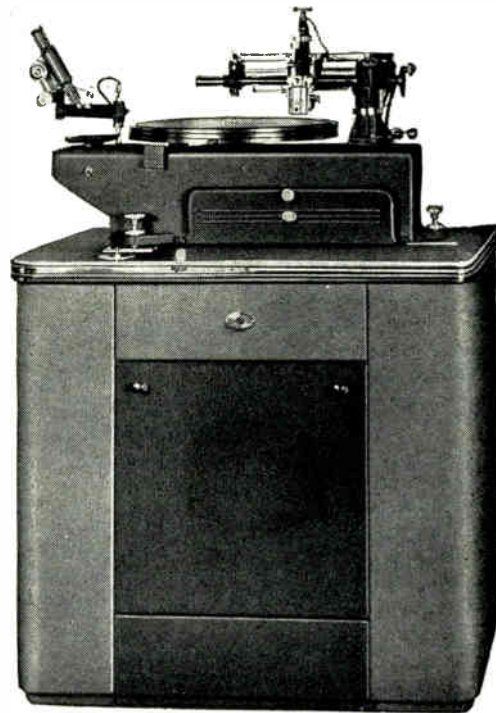
11 West 42nd Street, New York 18, N. Y.

458 South Spring Street, Los Angeles 13, California



# *You're sure*

## WHEN IT'S 100% PRESTO




Pictured here is an all-Presto single channel recording system. Above is the block diagram, worked out for this equipment by Presto engineers.

**W**HEN YOU NEED recording or transcription equipment you can't go wrong if you make the complete system 100% Presto.

For Presto is the world's foremost manufacturer of recording and transcription equipment and discs. And Presto's experience with countless installations, including all the big ones, will aid you in achieving greater efficiency and trouble-free operation.

The recorder is the 8DG with direct gear drive. The amplifiers are the 39-B three channel preamp, the 41-A limiter, the 92-A 60 watt recording amplifier, and the 89-A monitor.

Multiple channel installations consist of as many duplications of the basic channel as are needed with the addition of switch or patching facilities. When you think of recording, think of PRESTO.



**PRESTO**  
**RECORDING CORPORATION**  
 Paramus, New Jersey

Mailing Address: P.O. Box 500, Hackensack, N. J.  
 In Canada: WALTER P. DOWNS, Ltd., Dominion Sq. Bldg., Montreal

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



**WHEN THIS NEW  
INDIANA PERMANENT MAGNET**



**REPLACED THIS OLD ONE**



**A BETTER SPEEDOMETER  
WAS BORN**



New  
King-Seeley  
speedometer

**Indiana's experience brings  
Better Designs, Lower Costs**

Recently our engineers, working with those of King-Seeley Corp., helped design an entirely new permanent magnet for a greatly improved speedometer. This *Indiana* magnet, made of Cunife, weighs *one third less* than the previous magnet, yet has *30% more energy*. It reduces bearing load by 50%, and is *750% more stable*—is *far* more resistant to shock, temperature change, stray magnetic fields. And it *costs less*.

**WE MAY HAVE YOUR ANSWER, TOO**

For four decades, the pace-setting design techniques at *Indiana* have made possible new and better permanent magnets. This "packaged energy" improves performance, adds new functions, *saves money* in countless different products . . . as mechanical force in holding and separating devices . . . for changing electrical energy to mechanical motion and vice versa . . . for changing the apparent characteristics of materials. *Indiana* offers you the experience and know-how of more than 30,000 different applications. Let's get our engineers together on *your* problem. Write *today*.



*Indiana*—world's largest exclusive producer of permanent magnets—is the *only* manufacturer furnishing all commercial grades of permanent magnet alloys. Most commonly used are:

**CAST:**

Alnico I, II, III, IV, V, VI, and XII;  
Indalloy; Cunico; Cobalt.

**SINTERED:**

Alnico II, IV, V; Indalloy; Vectolite.

**DUCTILE:**

Cunico; Cunife I and II; Silmanal.

**FORMED:**

Chrome; Cobalt; Tungsten.

Ask for free Book No. 4-E12—our new permanent magnet engineering manual. A note on your company letterhead will bring a copy to your desk.

**40 YEARS OF BETTER  
PERMANENT MAGNETS**



**THE INDIANA STEEL PRODUCTS COMPANY**

PRODUCERS OF "PACKAGED ENERGY"  
6 NORTH MICHIGAN AVENUE • CHICAGO 2, ILL.

SPECIALISTS IN PERMANENT MAGNETS SINCE 1908  
PLANTS: VALPARAISO, INDIANA • CHAUNCEY, N. Y.

# BUSINESS BRIEFS

By W. W. MacDONALD



## FM TRANSLATOR General Electric Model XFM-1



Post-war version of the old G.E. J.F.M.-90 Translator which was used and enjoyed by tens of thousands of discriminating radio listeners.

Covers 88-108 mc range, diol 12 inches long, uses guillotine tuning for highest efficiency, high stability. Designed for export, has power inputs for 110 to 250 volts, 50/60 cy. Used in conjunction with good audio section or separate amplifier will provide best FM listening you ever heard. In attractive natural walnut cabinet — 10 3/4" high x 15 3/4" wide x 11 3/8" deep, complete with 8 tubes. Tropic-proof construction. Quantity limited.

Special Price . . . . . \$49.50

## TECHMASTER TV KIT



Exactly The Same as the RCA 630TS TV Chassis Complete kit of parts, including pre-wired and aligned RCA front end, condensers, resistors, punched chassis, all tubes including kine, complete manual with service notes, all RCA. . . . . \$198.50

## MICROGROOVE

Harvey has everything in microgroove equipment: motors; pickups; GE and Pickering cartridges, both sapphire and diamond; Coltron sapphire; Astotic duol 33 1/2. 78 crystal arm; Livingston universal arm, etc. Write to Harvey for all your wants in LP-microgroove.

All prices Net, F.O.B., N.Y.C. Subject to Change Without Notice

Telephone: Luxemburg 2-1500



**More About Mobilization:** Since last month (Nov., p 64) we have learned that no less than four plans for further mobilizing the electronics industry in preparation for a possible war are being studied in Washington. Two of them, one apparently favored by the military and the other by a majority within the industry, appear to clash in basic principles.

The first envisions placement of contingent contracts involving performance of all the paper-work connected with planning but stopping short of actual additional production. It places the major planning responsibility upon industry but retains the power for direction and policing of the job within government circles. It visualizes use of a great many manufacturers as prime contractors rather than subcontractors.

The second plan revolves around the placement of leader-operation contracts for pilot quantities of needed military equipment. It places the major planning responsibility upon government but suggests that contracts be distributed by a civilian member of the industry. It favors initial use of some 40 or 50 companies as prime contractors, with other manufacturers serving as subcontractors.

From where we sit it looks like the answer is somewhere between two imperfect plans, both of which have their good and bad points.

It appears unlikely that any plan calling upon manufacturers to do a lot of paper work in peacetime for peanuts will be conducive to action. Some more effective method of sharing the planning load should be possible without appointing either an industry or a government czar. And any proposed limitation of the number of manufacturers who would work directly for government could not be expected to meet with enthusiasm on the banks of the Potomac.

Our leg-men down in the nation's capitol think there will be two and possibly three committees

at work on a compromise before long and so . . . still more on the subject later.

**Major Users** of industrial electronic indicating, recording and automatic control devices are the petroleum, chemical and public utility industries, in about this order. These three are so receptive, in fact, that we suspect our field is to some extent neglecting others ultimately destined to be as important, or more important, from the standpoint of potential business.

**Automatic Electronic Control** of batching operations is a job at which electronics shines in many industries. Next major trend, we think, may be automatic control of continuous operations, to which industry must lean more and more in the interest of lowered production costs.

**Speaking Of Industrial Gear,** Brown Instrument's George Muschamp uses a neat adjective to distinguish highly precise electronic indicating, recording and automatic control apparatus from the simpler mechanical and electrical variety. He calls it "sophisticated" apparatus.

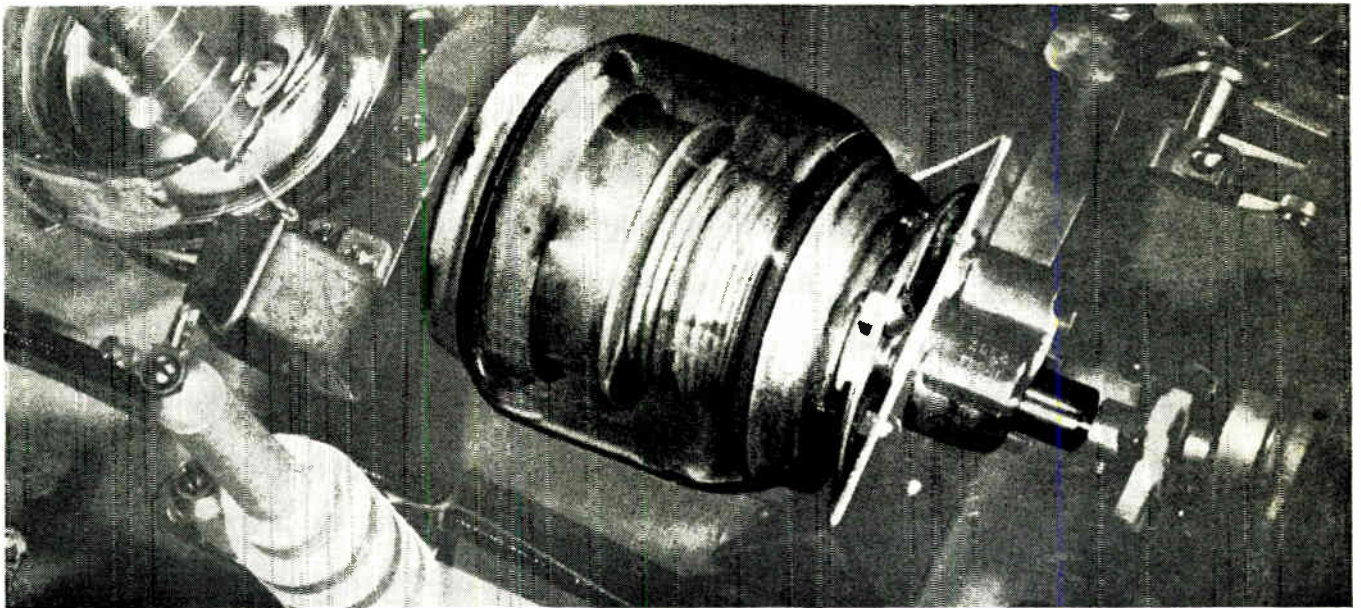
**Temporary Tough Sledding** for f-m broadcast interests hinted at last month in this column (p 65) has led the FM Association to suggest to the FCC that when holders of construction permits surrender them for one reason or another they should not be permitted to reapply within two years. The Association, realizing that a snowball increases in size only when it continues to roll, wants people to push or get out of the way for those who will.

**Speaking Of F-M,** Dean Wisleder of Westinghouse has written us an interesting letter in which he says: "So far as f-m is concerned, I would warn anyone who tries to sound a death knell that

Follow the Leaders to

**Eimac**  
TUBES  
The Power for R-F

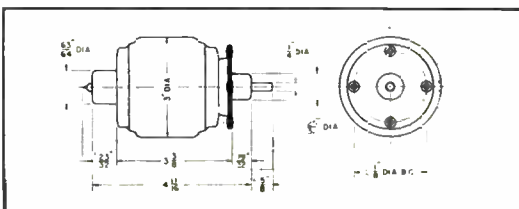
# ESSENTIAL IN MODERN CIRCUITRY



EIMAC VVC 60-20 in an ultra-compact 4-250A 1 KW Amplifier.

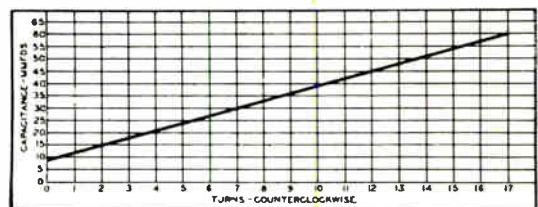
Consider the advantages . . . and Eimac Variable Vacuum Capacitors become the essential component in modern circuitry.

- Extremely compact size reduces equipment bulk. Type VVC 60-20 is less than one-sixth the size of air-dielectric capacitors with similar ratings.



- Structural rigidity eliminates electro-mechanical vibration.
- Low-torque tuning mechanism.
- Unaffected by dusty or humid atmospheres. Ideal for industrial application.

- Capacitance variation is linear with shaft rotation.



- Low temperature coefficient. Negligible change in capacitance due to temperature variance. (.004 mmfd. per degree cent.)

Eimac variable vacuum capacitors are immediately available. In addition to the type VVC 60-20 illustrated here, there are types VVC2 60-20 and VVC4 60-20.

#### GENERAL CHARACTERISTICS

	Capacity	R-F Peak Voltage	Maximum RMS Current
VVC 60-20	10-60 mmf.	20-KV	40 amp.
VVC2-60-20	Parallel	20-KV	80 amp.
	Split-stator	40-KV	40 amp.
VVC4-60-20	Parallel	20-KV	160 amp.
	Split-stator	40-KV	80 amp.

## EITEL - McCULLOUGH, INC.

206 San Mateo Ave., San Bruno, California

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

# OSCILLOGRAPHS

By **HATHAWAY**  
for **EVERY** purpose

**S8-B** General Purpose, 12 to 24 elements, for laboratory or field use, quick-change transmission for wide range of record speeds, automatic titling and numbering, automatic record-length control, tuning fork time marker, galvanometer attenuators, governor motor.

(Bulletin SP165)

**S8-C** General Purpose, 24 to 36 elements, otherwise same as type S8-B.

(Bulletin SP165)

**S8-D** General Purpose, 12 to 24 elements, similar to type S8-B except without automatic controls.

(Bulletin SP175)

**S12-A** Small Portable, General Purpose, the smallest complete 12-element oscillograph.

(Bulletin SP167)

**S6-A** Geophysical, 12 elements.

**S6-B** Geophysical, 24 elements.

**S14-A** Student's Oscillograph, 6 to 12 elements, ultra-simple, low in cost.

(Bulletin SP183)

**S15-A** Portable Self-Powered, 6 elements, for use where very small size is essential and power is not available.

(Bulletin SP193)

**SC16-A** Cathode Ray, 6 elements, very high frequency response and writing speed, record speed to 6000 inches per second.

(Bulletin SP194)

**RS9-A** Automatic Oscillograph, 12 elements, for switchboard or portable use, for automatic recording of faults or staged system testing, high-speed starting.

(Bulletin SP196)

WHATEVER YOUR REQUIREMENTS MAY  
BE THERE IS A  
HATHAWAY OSCILLOGRAPH FOR YOU

WRITE FOR  
TECHNICAL BULLETIN

*Hathaway*  
INSTRUMENT COMPANY  
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

it is merely overexpanded for the moment. There are several reasons why it will come through with flying colors.

"People will buy f-m and a-m receivers because of vanity if nothing else. In summer daytime, f-m actually renders service at 100 to 150 miles from transmitters where a-m stations are ineffective. Most a-m broadcasters must offer their client f-m too in order to keep up with their competition."

Down in Birmingham an electroencephalograph, or brain-wave recorder, is reported to be picking up programs from local radio stations. Retaliation, no doubt, for the strain placed upon the machine by patients seeking relief from the effects of quiz programs.

C-R Tube Bottleneck may still be present in the television picture next spring but glassmakers are now keenly aware of the market waiting just around the corner and are husting a gut to serve tubemakers. Kimble Glass division of Owens-Illinois tells us, for example, that two years of progress have been telescoped into six months. Machine methods are taking the place of hand work, and 90 percent of the firm's 600 employees have had special training in such methods for the production of 10 and 12½-inch envelopes.

We've Commented several times on the television installation and servicing problem, and stuck our neck out to the extent of saying that there will come a day in the not-too-distant future when dealers and servicemen will have to do most of it if sales are to keep up with demand. Now we are reminded by a reader that if and when this day comes the flat annual charge idea will probably go out the window.

At This Writing there are 70 brands of television receivers on the market. Statistics concerning the types of sets offered by manufacturers do not necessarily indicate what types the public will buy, and this fact should be carefully noted, but they are of some market significance so we offer

them here for what they're worth.

Models offered by the 70 companies total 185, broken down as follows:

44%	table
35	console
10	commercial
9	kit
2	custom

List prices average \$673, ranging from \$59.50 (kit) to \$2,495.

A check on optical systems indicates that of the 185 models 88 percent employ direct-view, 10 percent projection and 2 percent mirror-reflected image systems. With respect to c-r tube sizes:

41% have	10-inch tubes
22	12
16	15
9	5
7	7
2	20
2	3
1	16

Total number of tubes in the average model offered is 29, with 11 the smallest and 48 the largest.

Some 51 percent contain no a-m, f-m or s-w broadcast radio tuners. Of the 185 models:

19% provide	a-m and f-m radio
15	f-m
10	a-m, f-m and s-w
3	a-m
1	a-m and s-w
1	f-m and s-w

Record players are included in 72 percent.

Of the available models:

62% tune	13 channels
24	12
6	8
2	11
2	7
2	6
2	5

**Two Straws In The Wind** within this issue of *ELECTRONICS* indicate that we may be entering an era in which research is made to pay for itself more rapidly than in the past. The first is Waldo Kliever's significant suggestion for selling research ideas to management, sales and production (p 68). The second is the knowledge that Sonotone paid much of the freight on further research in connection with piezoelectric barium titanate by quickly going into production on phonograph pickups (p 94) made of the new ceramic.

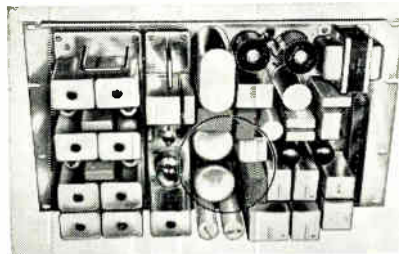
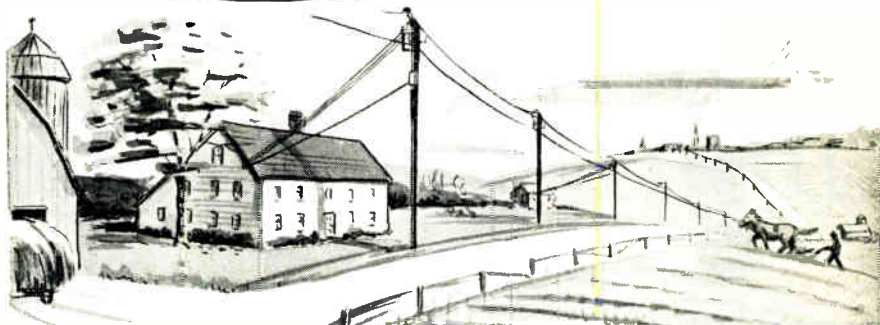
**Story Of The Month:** The trouble with salesmen, says an engineer who has evidently tried without success to put over a technical point, is that when you tell them something it goes in one head and out the other.

# Sigma RELAYS

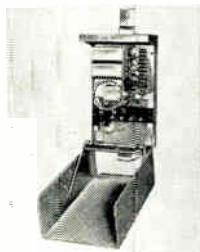
ARE USED IN

## Western Electric

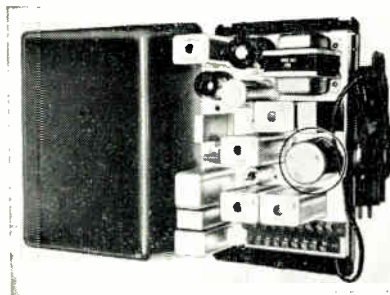
POWER LINE  
CARRIER TELEPHONE SYSTEM



Common Carrier Terminal Chassis



Subscriber Coupling Unit



Subscriber Terminal Equipment

The Western Electric M1 Power Line Carrier Telephone System permits telephone service in thousands of farm houses having electric power service but no telephone wire line connections. It will help raise living standards in many rural areas.

Sigma Relays are used for three functions in this equipment, two of which are unusually exacting. By careful cooperative study of each application Sigma was able to work out solutions using highly refined but none the less conventional sensitive relays of standard Sigma design — available at comparatively low cost.

From vending machines to V-Bombs specialized relay design plus facility at solving problems involving circuit, relay and function enable Sigma to render valuable service.

### SIGMA RELAY TYPES

A.C. - D.C. - POLAR  
SENSITIVE - PRECISION - KEYING  
SINGLE OR MULTIPLE CIRCUIT  
From 68¢ to \$25.00 each!

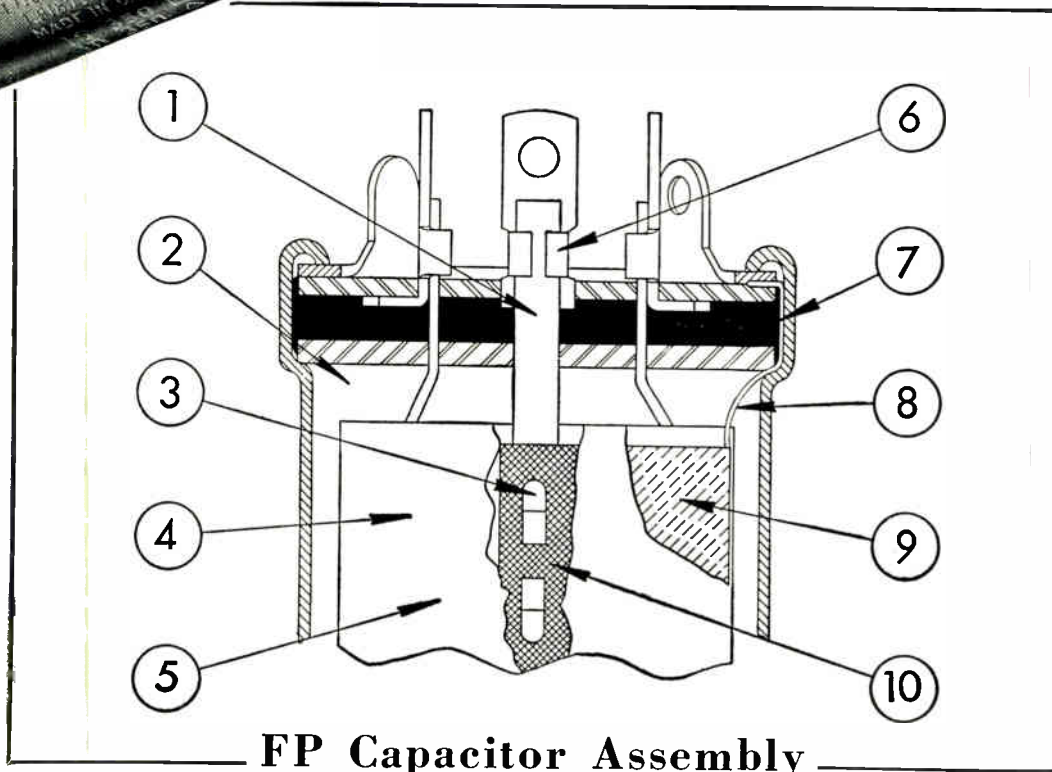
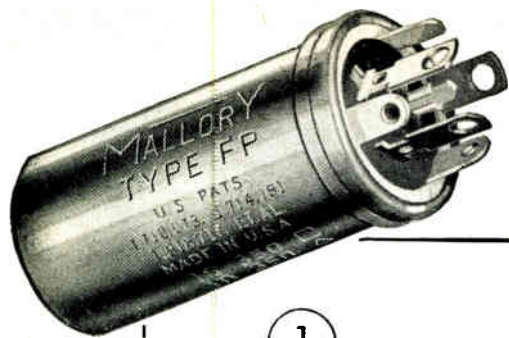


## Sigma Instruments, Inc.

*Sensitive* RELAYS

62 CEYLON ST., BOSTON 21, MASS.

# NEW!



## FP Capacitor Assembly

For the past ten years Mallory FP Capacitors have set new standards of dependability. Now new improvements make them more reliable than ever.

- ① New design anode tabs cannot break from vibration.
- ② Ample air space retained for gas expansion at elevated temperatures.
- ③ New staking method between anode and tab permits higher discharge currents.
- ④ Improved high surge separator material better at high temperatures.
- ⑤ Unique processing improvements provide still better performance at 85°C. No voltage derating required by Mallory FP capacitors at this temperature. (Including the 450V rating.)
- ⑥ Lower tab to terminal contact resistance for sensitive circuits.
- ⑦ Extra heavy rubber seal for high temperature and ripple conditions with venting feature preserved.
- ⑧ Heavier cathode tab for better tab to ring weld, lower resistance and more rugged mechanical construction.
- ⑨ Special etched cathode (all voltages) reduces loss of capacity under high ripple conditions, lowers RF impedance and remarkably reduces intersection coupling.
- ⑩ Increased FP anode ratio of 12 to 1 at 450V and 15 to 1 at 150V provides better design factors.

**Still cost no more.** Mallory FP capacitors have given exceptional performance at prices comparable to ordinary capacitors. These new improvements have all been accomplished without extra cost to the user.



**Yours for the asking!**

Send for the Mallory Capacitor Catalog, which contains useful data on all types of Mallory Capacitors—sizes, electrical characteristics, test measurements, mounting hardware.

**P. R. MALLORY & CO. Inc.**  
**MALLORY CAPACITORS**  
**(ELECTROLYTIC, OIL and WAX)**

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



# CROSS TALK

► **TELAUTO** . . . The question of the bandwidth required to transmit intelligence at a given rate is, to judge by its many appearances in this column, a subject on which we're hipped. At any event we were much taken by Bill Tuller's discourse on the weather map and the telautograph, given at a recent communication symposium in Washington. It is customary to transmit weather maps by facsimile, using the familiar line-at-a-time scanning process. But this system ignores the evident fact that the map of the United States stays reasonably constant from day to day. What changes is the position of the isobar contours and associated symbols. Recognizing this fact, we might send the basic map through the mails and employ a telautograph (the gadget commonly seen in stores, banks and railroad stations which transmits handwriting by an electrically-actuated pen) to transmit, handwriting-fashion, the contours and symbols. The facsimile scanning system needs a bandwidth of several hundred cycles. The telautograph, freed from the necessity of transmitting anything but the essential information superimposed on the map, needs a bandwidth of only 15 cycles to do the job at the same speed. Tuller's point is that a transmission system set up to take account of the special characteristics of the information to be transmitted may be much more efficient than one which ignores said characteristics.

A logical extension of this philosophy applies to television. The background of many television scenes remains unchanged for considerable periods, and need not be changed in less time than, say, a quarter of a second. Suppose then that the background could be transmitted separately from the central subject matter. If a storage screen were available to retain the background it could be transmitted at a slow rate, that is, in a narrow band. The major part of the video band might then be reserved for depicting the smaller area comprising the central subject of the scene and the detail of this subject would be correspondingly enhanced. The detail of

the background, being sent at a slow rate, could readily be made to match the high value possessed by the central subject. This proposal is easily stated, much more difficult to achieve in practice, and its application is limited to scenes having separately delineated subjects and backgrounds. But in the long run it may prove to be a practical method of enhancing the detail of television images.

► **BROAD** . . . Progress in the design of broadband amplifiers for television, radar and pulse communication is so rapid that, for a change, the engineers are ahead of the demand. When electronic television came along in the early thirties, the tubes of the day permitted amplifying a band no wider than a few megacycles. Then came radar; in 1945 it was news that an amplifier having a bandwidth of 20 megacycles had been achieved. Now comes a new technique, called "distributed amplification" or "wave amplification". Several tubes are used in each stage, the capacitance of each tube being isolated in a separate section of a filter. In this way the output currents of the tubes are added while their capacitances are separated, and a wholly new order of bandwidth becomes possible. In one such amplifier, a bandwidth of 200 mc. with 9-db gain, is achieved in an amplifier using seven 6AK5 tubes in a single stage. Further progress must, in all likelihood, wait until someone finds a use for what is now available.

It is indeed encouraging when the techniques thus outstrip the applications. It gives the system engineers something to think about: a 200-mc amplifier can transmit at one crack all the signals in the pre-war frequency spectrum, all point-to-point, marine, mobile services, all standard broadcast, f-m, facsimile, all television, navigation, and amateur signals. Looked at another way, a 200-mc bandwidth can transmit messages at the rate of over a billion words per hour, or a ten word telegram once a day to every man, woman and child on earth. The amplifier exists. Any takers?

Here is an article that is definitely not technical. **ELECTRONICS**, a technical magazine, is nevertheless proud to present it.

The subject is important to everyone in every manufacturing industry. In a new and fast-changing industry like electronics, a continuing supply of new products is particularly essential. Here, however, as in so many other fields, the lifeline of idea-flow from research through production is being throttled at dozens of points.

The author tells what you can do about it in your own plant.

—THE EDITORS

# Selling Research Ideas

An idea born of research is useless unless pushed and passed on by those who come after, right through production of the resulting new or better product. Idea promotion requires convincing facts, good research reports, working models, repeated follow-ups and frequent research-design-sales meetings

By **WALDO H. KLIEVER**

*Director of Research  
Minneapolis-Honeywell Regulator Co.  
Minneapolis, Minn.*

**T**HERE ARE THOSE who would say that after research people have done their work it is up to management or someone else to see that its results are used. That would be lovely if it would work. I well remember thinking, when starting out in the business of research, that when something good was developed there would be no doubt about anyone being interested in it. How innocent!

After working on a number of problems I found that while I could develop what appeared to be good workable devices to satisfy the problems that had been assigned to me, everything seemed to end at that point. I would show the working models and everyone would say "How nice" or "That's wonderful," but that was all.

Even the people who had asked for the developments had in the interim become interested in other things and were not inclined to do anything about it.

There I was as helpless as the distinguished visitor trying to make a phone call from the insane

asylum. After failing sadly to get results, he said in desperation to the operator, "Do you know who I am?" and she sweetly replied, "No, but I know where you are."

Something had to be done. In talking with others and doing considerable reading on the subject, it became obvious that the problem was not unique with me. One man confirms this as follows: "The research director's job, therefore, is not done when the product has been invented, designed, and proven in theory. He has to sell it, just as much as if he were a private inventor."

## The Basic Problem

It is here that we bump into the thing called human nature. People are inclined to be interested in their own ideas; accepting someone else's ideas requires considerable effort, and there is also perhaps a little strain on individual pride. They have inertia; they don't want to be bothered. Whether it is for these or other reasons, it is generally conceded that one of the most

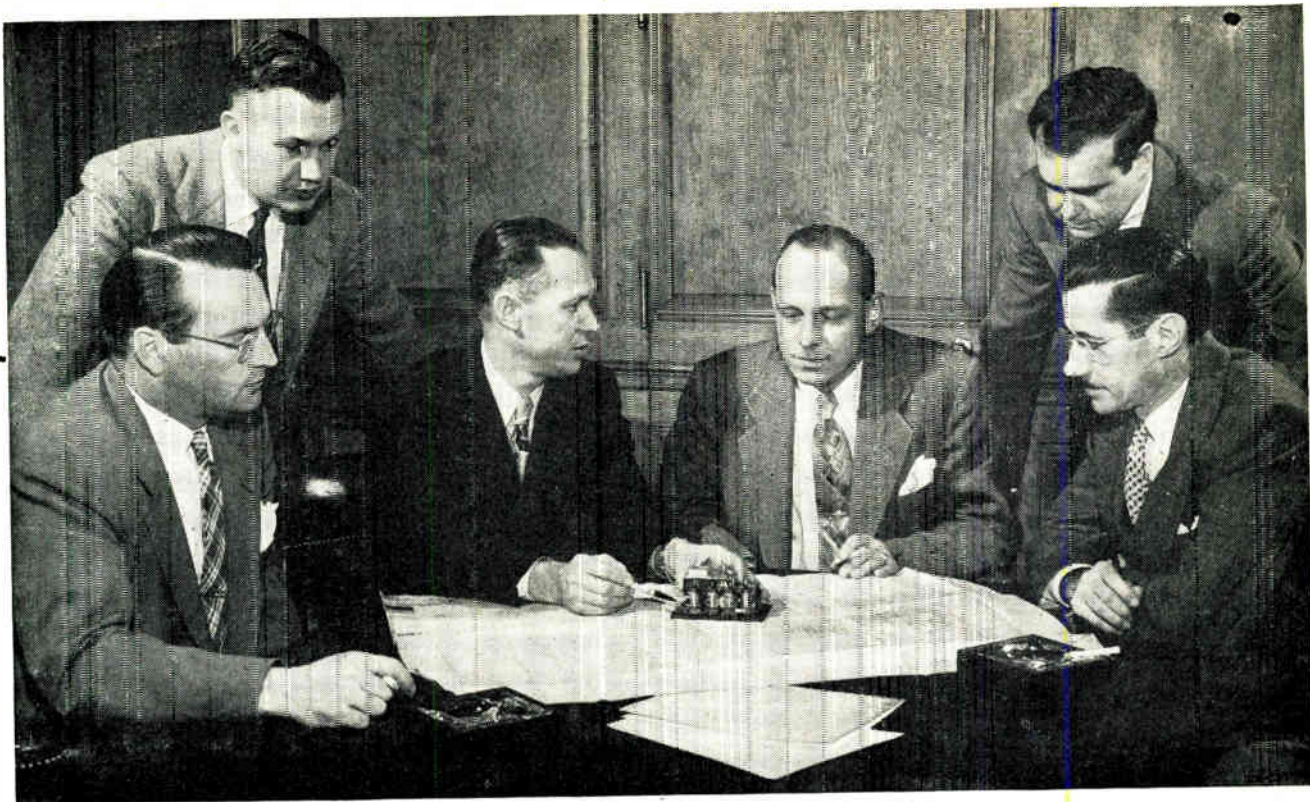
difficult things in the world to sell is an idea.

And so we come face to face with the sales problem in research. Some people say this should be the function of top management. For this reason those who direct research are often included in top management or in meetings with management when decisions about new products are made. However, the director of research, the vice-president in charge of engineering, or someone in a similar position who is very close to the research work must still present the new ideas in such a way that they will appear sufficiently attractive financially and otherwise to promote the necessary interest. He must close the gap between the technical facts and their business significance.

The fact that any management maintains a research organization is evidence that it is interested in new ideas, but it is the right and duty of management to question

This paper was presented at the 1948 National Electronics Conference in Chicago.





Regular idea-evaluation meetings are one requirement for acceptance of good new ideas. In this typical Minneapolis-Honeywell research department meeting are, left to right: Glen Seidel, administrative engineer; Raymond O. Anderson,

coordinator of research; Waldo H. Kliever, director of research; John E. Haines, vice-president; John W. Magoffin, market research department; George Muschamp, vice-president in charge of engineering of Brown Instrument Division

these ideas and to require proof that they are economically sound.

In looking for solutions to this research-sales problem, one must go all the way back to the origin of the ideas. An idea originally suggested by those who will have to carry on with its future—an idea that fills a real need that is appreciated by everyone—will be accepted much more readily than an idea which enters a completely new field or replaces devices that have not been a source of extensive troubles.

New ideas may come from the customer, the sales department, management, the design engineering department, the research department, as by-products of work on other problems in research, and from inventors outside of the engineering and research departments.

It is helpful later, when the results of a project are considered for production, if those concerned with passing on it at that time are in at the early stages, provided not too much is promised at that time. However, the research department

should have the right to carry on some investigations, especially those of a preliminary survey nature, without requiring extensive outside approval. Then, as the idea progresses, it should be reviewed more carefully in the light of technical feasibility, cost and marketability. Ideas that prove unpromising should be eliminated as early as a reliable decision can be made.

The complete path of a good idea may be as follows: (1) Basic research; (2) applied research or development; (3) design engineering; (4) engineering test; (5) methods engineering; (6) production; (7) sales. That is a long and devious route involving many different people, and it is not surprising that it involves transfer problems.

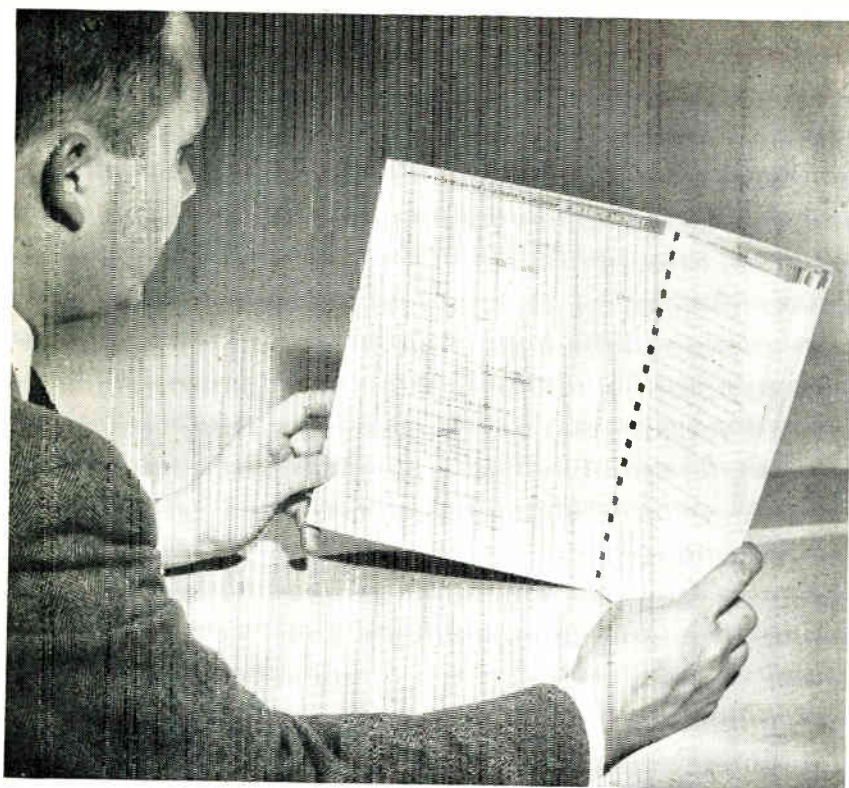
#### Attitudes to be Recognized

Even the basic attitudes of various groups toward problems will differ. For example, in basic research the objective is information, while in applied research the objective is new products. Companies

differ widely in the amount of basic research they do. Ideas often originate from basic research done in other organizations, including universities. Many companies sponsor basic research in universities or research foundations.

Basic research is very important, but this present study will be more concerned with selling the products of applied research. Applied research has been described<sup>2</sup> as follows: *"The pursuit of a planned program toward a definite practical objective—a preconceived end-result. It takes the results of fundamental or exploratory research and tries to apply them to a specific process, material, or device."*

In the design engineering group the objective is still new products, but with more thought to how the new product can be manufactured and made to work reliably under field conditions. The research man is an optimist who takes ideas that everyone says are impossible of execution and shows how they can be made to work. The design engineer is a pessimist who takes ideas



Research reports should be attractive and styled for easy reading. This means double-spaced typing, liberal use of subheads and a convenient table of contents as in this annual report. Note use of special printed stationery and spiral binding

that everyone feels are ready for production and finds the bugs which might cause later serious difficulties. This division of responsibilities has been defined<sup>3</sup> as follows: "The research man, if he is to be worth anything, must be able to find the grain of gold in the pan of gravel; the development engineer must be able to see the fly in the ointment. These attitudes—the one trained to look for what's wrong, the other to see the valuable features of a complete failure—make engineering and research complementary to each other, but also miles apart."

What about the attitude of the sales people toward new developments? They will want to know what the device does for the customer and how it compares with competition in performance and price. Don't bother them with telling how it works or how it is made.

For convincing management of the worth of the idea, dollar signs must be used, along with other pertinent information.

This diversity of methods of approach is necessary in the selling of research ideas. Know your people.

Quoting again,<sup>4</sup> "There is no part of research more important than sales, and this means, in order of increasing importance, a good article, proper preparation of sales presentation, full knowledge of the financial situation of your customer, knowledge of the peculiarities of the personality of those to whom you sell, and most of all, personal contacts."

#### Transferring Ideas

Having reviewed a research project after preliminary survey, with due regard for marketability of the end products, the project people in applied research proceed with the serious business of producing the best solutions to the problem. Here we must be careful, in our zeal for results, not to restrict the necessary freedom of the people in research.

In general, the research departments will not come up with the kind of device expected; if they do, it is probably a sign that the research was not very thorough. Also, if the research department is alert there may be several possible by-products from the investigation

which often are more important than the original objective. The freedom in applied research, however, is always tempered by the feeling that research is a serious responsibility and that there are general objectives to be kept in mind.

Another characteristic of good research people must be considered. A good research man will always see additional ways to make improvements on ideas and he will insist that he should have a little more time to study this or that, until the development goes on and on without end. When to transfer an idea from research into production design probably constitutes one of the most important problems in research management. Expressed another way, it is the problem of determining the state of perfection which should be required before transfer to the development team.

One procedure is to let the research man continue in his endless quest, with the director of research or the company management reviewing the work periodically. When any development has progressed to a point where it offers sufficient improvement over equipment in current use or in a new field to justify it, and when the device developed appears to be workable and saleable, the available information is extracted from research for conversion into production. We do not wait for the final perfect design, but often allow the research to continue on the same problem so that in one or two years we can obtain from it further improvements in products. It is much easier to justify spending money on further work on a project after it is bringing returns.

#### Requirements for Selling

When the director of research has selected an item to be considered for production he faces the two-fold problem of convincing management and sales that the new product should be manufactured and informing and convincing the production design engineering people that the work done in research is a good basis for the design of a product.

In the sale of research products,

as with other sales work, certain aids are essential:

(1) *Basic facts.* This is the most important requirement on the list. It includes not only information about what the device is and what it can do, including test results, but in the final form will also have to include a market analysis, along with cost estimates for manufacture and for design and tooling. The research department may or may not be responsible for the latter, but must certainly be interested to see that such information is available.

(2) *Research reports.* These should include illustrations, diagrams and complete well-organized information and technical data. Reports are also a useful adjunct to laboratory records, especially in connection with projects not contemplated for immediate production, and they help to clarify the thinking of the research people who write them. It is worth while to make these reports attractive and styled for easy reading. We have a business manager in the research department who makes it his business to see that the reports are written and are complete and comprehensible.

(3) *Models.* We strongly believe in making up working models because they help to convince skeptical people, especially the design engineers, that something usable is being presented, and make the idea more interesting and understandable. Models also help the research people, in that they give the concrete objective of producing a working model.

(4) *Meetings.* Most people are overburdened these days with conferences and meetings, but there still is a useful place for them. We believe that in getting together the interested parties and discussing a new product when it leaves research much can be gained. Many questions will be answered and mutual interest stimulated. The meeting may also point up channels for further research which are required or worthwhile.

(5) *Field applications.* The research department will usually be called upon to try out the idea on various problems in the field. Some of this type of work is good for the

education of research people, for better knowledge of the product and for promoting confidence in the research work. In general, much of this application work in research should be avoided because it can easily grow to demand a considerable part of research time. Besides, it provides a good means of acquainting the production design engineering department with the problem if the application work can be done there.

One thought which must permeate all of the above sales methods is "Be specific". If possible, do not propose three ways for solving a problem and leave it to someone else to make the choice. The research department can generally inform themselves sufficiently well to be in the best position for recommending a definite solution. If research has not progressed to this point, it is better to study the matter further before making the sales presentation. This principle is probably not much different here than it is in any sales work.

#### Follow-Up

Having presented a new idea and obtained approval for production design, along with work priority assignments by the sales department and the design department where necessary, one could easily feel that now the research department can forget the matter. Such is far from being true. In most cases the matter would die quickly if so neglected, or in any case would take routes which have been shown in research to be blind alleys.

#### Nobody Likes a Change

"The greatest durability contest in the world is getting a new idea into any factory. It is well if the management understands this and will constitute itself the sales department for the research organization. Otherwise, the hard-boiled men in the factory will put research men out of business in a fortnight.

"When we present a new idea to people, their first instinctive reaction is against it. Nobody likes a change. That is the one great thing you must understand in the psychology of research."—Charles F. Kettering

It is never possible to put all the information learned in research on paper. Experience has shown that a close collaboration and follow-up is needed for a long time after the transfer of an item from research to design. However, during this period the research department will have to be tolerant of changes in the ideas and in the device. Designers are creative workers also and will contribute ideas of their own. If this is not permitted, life becomes uninteresting and unpleasant for them and you wouldn't want that to happen. Unless research people have good reasons to argue with designers that one of the design proposals will lead to trouble, such modifications should be allowed. In general, the changes will be for the better. Incorporating many people's ideas into a product seems to lead to the best end result.

This brings us to some general considerations in the relationship of research with other departments in the company. The marketing of product ideas becomes much easier if the research department is well acquainted with the problems of salesmen, the problems of designers, the problems of field sales people and the problems of management. This might be called personnel relations work by research. It involves a helpful attitude toward other people's problems, rather than competition with these people. It involves instilling in contacts with others a feeling of confidence, rather than a spirit of jealousy or excessive pride.

If these interdepartmental contacts are properly handled, the research department and the director of research will find that others in the company are regularly coming to them with problems. Such contact is not only a helpful condition in guiding research work, but the spirit of it is a necessity for bringing research to that successful goal which includes actual products going out to benefit humanity.

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- (2) C. C. Furnas, *Research in Industry*, The Macmillan Co., New York, N. Y., p 7.
- (3) J. R. Bichowsky, *Industrial Research*, Chemical Publishing Co., New York, N. Y., p 28.

# TELEVISION STATION COSTS

Plans are suggested for a small station to which additional plant and facilities can be added in normal process of growth. Building costs are estimated and figures are given for equipment, beginning with bare essentials. Details show how to realize a maximum return for the investment

By **WILLIAM FOSS**

*Consulting Engineer,  
Washington, D. C.*

**T**HE installation and operation of a well-equipped television station today runs into astronomical figures when compared with the cost of construction and operation of standard broadcasting stations. In the early twenties there were many stations actually put on the

air for sums so ridiculously low as to seem unbelievable. The writer actually constructed several such stations at costs under \$10,000, this expenditure being the maximum sum that the owners invested. These same stations and many others like them are now operating

successfully, are affiliated with national networks, and have in many instances brought returns to their owners in sums of seven figures.

The television story is entirely different. Construction costs can not be met for less than \$100,000 and this sum represents a station such as a small town community could support. This size station would be limited by its incomplete equipment to very few hours of service per week and would probably have no studio. It would depend on mobile pickup equipment to televise sports and civic events, with possible additional programs from networks that are now fast growing, and from the projection of films.

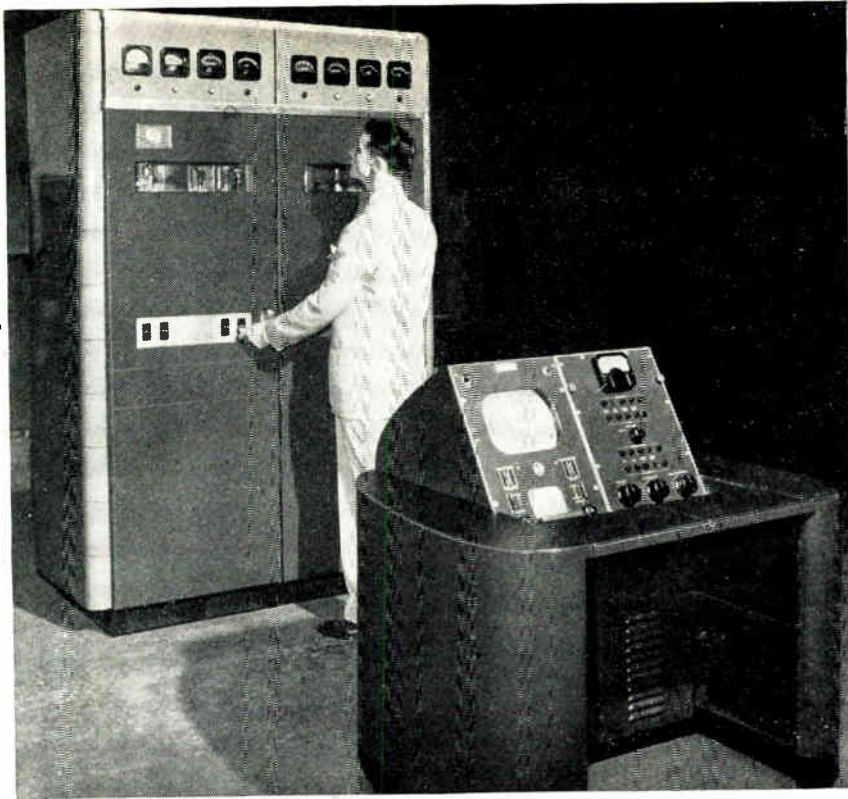
In the design of suitable studio and projection facilities for television stations we face problems far more complicated and considerably more costly than those at standard broadcast stations. It is not unusual for a broadcast station to be able to find any number of buildings in average cities that can be made to accommodate the working force and supply studio space without the removal of a single partition. In television broadcasting, however, it is usually necessary either to build a new structure from the ground up or to perform a major operation in

**Table I—Initial Studio Equipment Costs**

Remote Equipment		
2 Camera chains complete.....	\$32,750	
1 Standard pickup truck.....	11,000	
1 Auxiliary power supply.....	2,000	
Audio equipment and spares.....	4,000	
		\$19,750
Studio lighting equipment.....	3,500	
		3,500
Projection room, consisting of 2 film camera channels with controls complete, 2—16 mm projectors, 1 slide projector, and 1 special picture projector		
Equipment.....	29,303	
Installation.....	2,500	
		31,803
Total.....		\$85,053

**Table II—Costs Including Control Equipment**

Remote equipment.....	\$49,750	
Projection room.....	31,803	
Studio lighting.....	3,500	
Control room—1 program console, 1 master monitor, 1 line monitor, synchronizing, pulse and blanking equipment, power supplies and miscellaneous		
Equipment.....	\$32,000	
Installation.....	5,000	
		37,000
Total.....		\$122,053



Complete 500-watt television transmitter and control console

the remodeling of an existing building at a cost which is comparatively high.

#### High Ceiling Necessary

The reason that remodeling a building for studio facilities is usually necessary lies in the fact that the ceiling must be high enough to provide room for a special lighting system which, of course, is not necessary in standard broadcast work. Since a television station consists of two complete and separate transmitters, namely, one for the transmission of the picture (the so-called video plant) and the other a conventional f-m plant, it is also necessary to treat the studio to obtain the proper acoustic effects.

The trend at present seems to indicate that television studios will not be built to accommodate large crowds of spectators since the emphasis is on the pictures being transmitted and these can be seen on adequate monitors or on outside television receivers. The arrangement is advantageous from the financial standpoint because it eliminates the necessity of supplying a finished show place to the public. This article will not attempt to supply in accurate detail either the fin-

ished plans of studios or the exact costs to be met. It is, rather, the intention of the writer to present such plans and costs in general that will stimulate in the mind of the reader ideas necessary to develop concrete plans that fit each individual case.

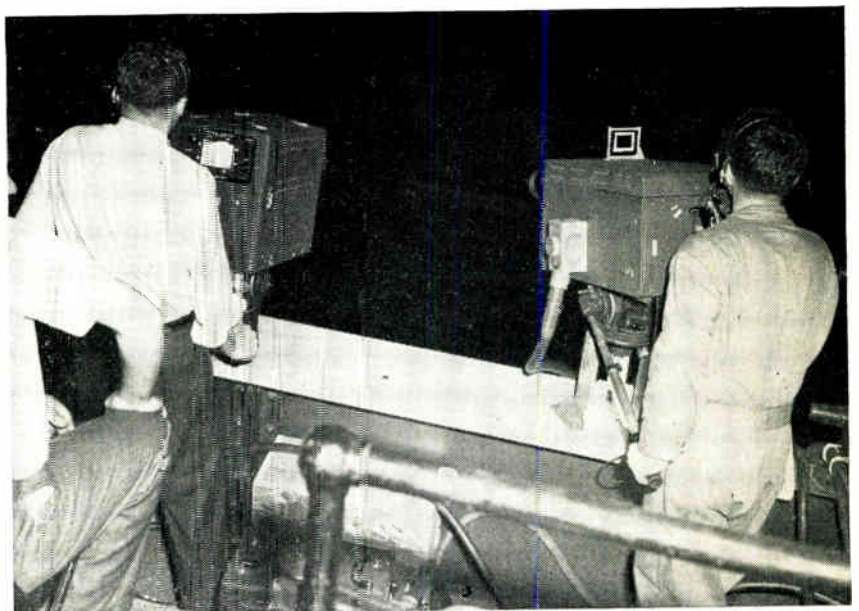
Tables of costs for equipment alone which will be supplied here-

after indicate the importance of designing in order to make every possible piece of equipment carry its share of the financial load. From these tables it will be noted that a properly equipped pickup truck will cost in excess of \$49,000. If, for instance, a station is able initially to use the equipment in the truck both for the televising of remote events and for live programs at the studio location, a considerable saving can be made by designing a building so that the truck can be backed up to the studio and the equipment used in the studio with the truck functioning as the control room.

#### Truck Studio Control

Figure 1 shows such a plan. This plan represents a building so arranged that the shop on the first floor (A) can be used as a garage for the truck, in addition to functioning as a scene dock for props and scenery and a repair shop for general repair and maintenance work. It will also accommodate the truck when used as a control room, the truck being backed up to a large window in the studio when so used. The minimum investment necessary to give continuous service will be that necessary to equip a truck for handling remote programs and for equipping a projection room where films, slides, and other pictures can be televised.

The investment just mentioned



Typical night baseball pickup. Note that remote cameras are semi-permanently mounted on parapet

**Table III—Equipment Costs with Studio and Control**

Remote equipment.....	\$19,750
Projection room.....	31,803
Control room.....	37,000
Studio	
Video and audio equipment.....	\$32,895
Lighting.....	3,500
Treatment.....	5,000
Installation.....	4,000
Total.....	45,395
Total.....	\$163,948

does not include the transmitter, antenna, and their associated apparatus nor does it include a master control room where the dispatching, distribution, and main control of the program can be centralized. The transmitters and antennas will be discussed later. In lieu of this control room, simple switching devices may be designed and operated at the transmitter location, or they may be installed at the projection room location.

Table I indicates the equipment costs for the plan shown in Fig. 1, showing the projection room and truck but not including the control room and not including the transmitter and its related equipment.

Figure 1B shows the second floor plan of the same building. The film projection room is so designed that when the studio is to be equipped with its own apparatus a control room then can be built in. In case the whole operation is a consolidated one, the transmitter may also be installed in this presently available space.

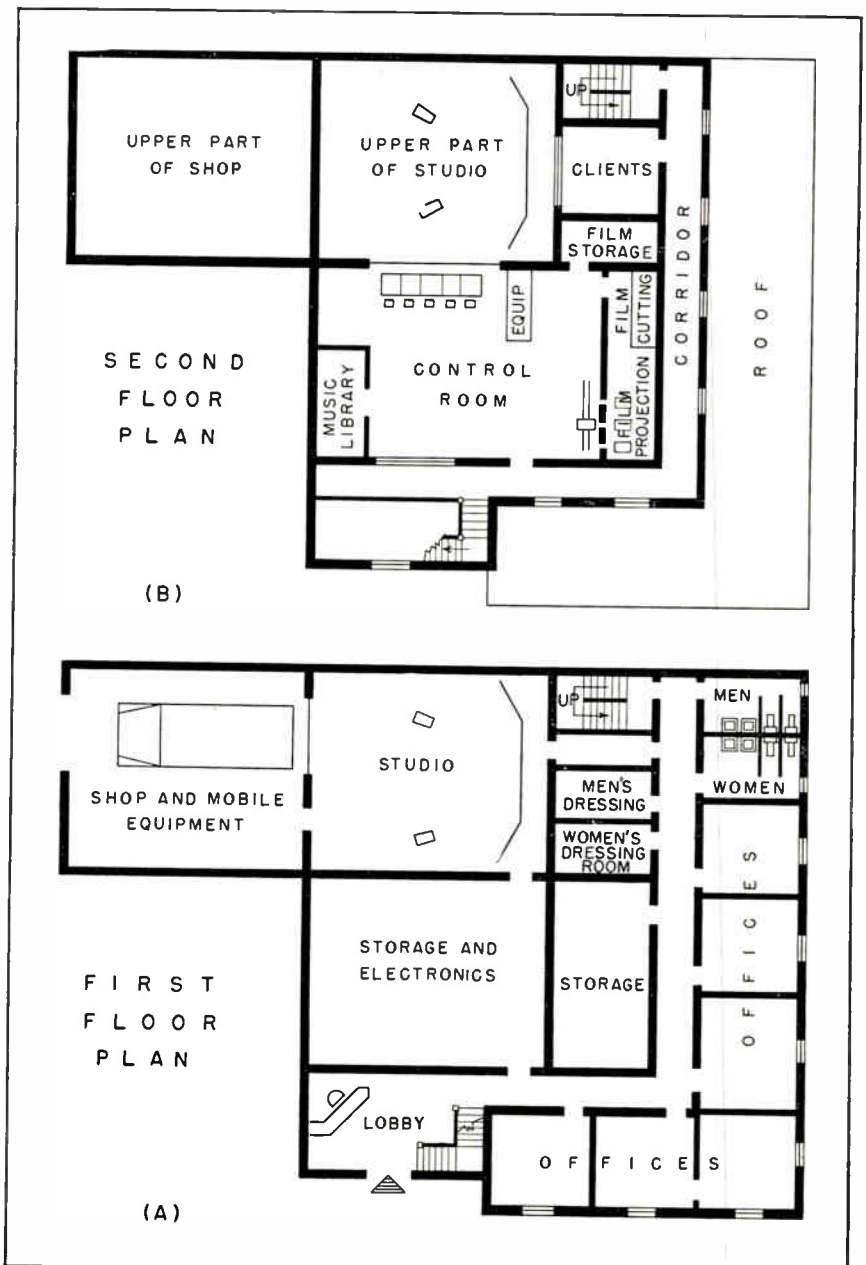
Table II also indicates equipment costs for the plan shown in Fig. 1. In this instance the control room is equipped to dispatch and coordinate the operation of the remote equipment, the projection room, and network terminal facilities. However, the cost of equipping the studio is not shown in this table. Studio lighting will be necessary provided a room such as shown in Fig. 1 is used in conjunction with the equipment from a truck. A rough estimate of lighting costs may be obtained by using the cost figures \$4.00 to \$4.50 per square foot of studio floor space. A pipe-work grid should be installed on the ceiling for the purpose of hanging the overhead fixtures. This grid should be made up in squares, each

grid not larger than seven feet.

Table III indicates equipment costs for the plan shown in Fig. 1 when the studio is so equipped as to operate from the control room,

permitting the use of the remote equipment purely for pickup.

The main drawback with the first plan above described lies in the fact that when the station first goes into operation, the mobile equipment is tied up whenever a live program from the studio is necessary. A further drawback becomes immediately evident when the first studio is equipped. While the building of control equipment into the studio does free the mobile equipment to pick up programs for which it was primarily designed, station operators are still faced with a further serious drawback. This lies in the fact that adjacent or contiguous live



**FIG. 1—First (A) and second floor plans (B) for initial construction of a small station**

programs cannot be put on from the studio and it will therefore be necessary either to broadcast programs from the projection room or from the mobile equipment while studio scenery is being changed. If the studio is large enough to accommodate more than one scene at a time, the scene may be set up before the series of broadcasts starts and the cameras and associated apparatus may be moved to pick up each scene in succession. However, no scenes can be changed while the studio is on the air because of the noise caused in making such changes.

Figure 2A shows a first floor plan

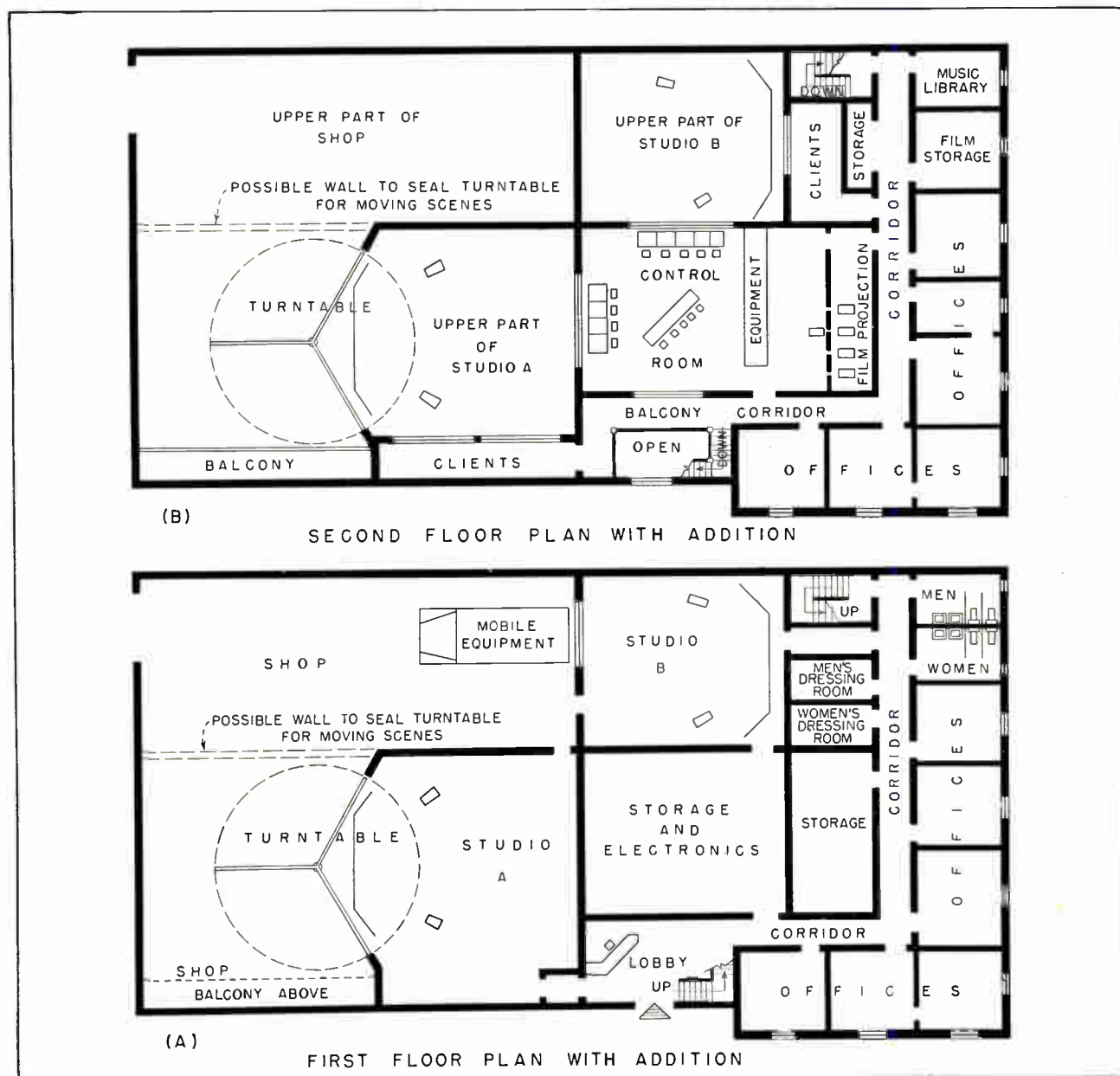
for the expansion of the same building to accommodate two studios and Fig. 2B shows the second floor plan of this enlarged building. In this plan two completely equipped studios with a master control have been provided in addition to the projection room which is necessary for the station operation from the start. In addition, the shop has been increased in size to accommodate props and scenery to be used in the two studios. The turntable shown installed in Studio A will be discussed separately.

Table IV indicates equipment costs for the plan shown in Fig. 2. Referring to the total cost as

shown in Table III, it is seen that the cost of equipping a second studio will be an additional \$45,395 or a total of \$209,343. This additional investment will furnish a second studio and give the station the necessary flexibility which will

**Table IV—Equipment Costs for Plan in Fig. 2**

Remote equipment.....	\$49,750
Projection room.....	31,803
Control room.....	37,000
Studio A.....	45,395
Studio B.....	45,395
Total.....	\$209,343



**FIG. 2—The minimum station shown in Fig. 1, to which has been added additional studio space and more elaborate master control equipment**

finally be needed to carry on continuous live programs.

The turntable mentioned above and indicated in Fig. 2 is important to this discussion for two reasons,—first, to create a substantial saving when one studio alone is used; and second, to add additional flexibility resulting in increased facility in the station operation.

The cost of such a table when electrically driven varies from approximately \$8,000 for a table 25 feet in diameter to approximately \$11,000 for a 40-foot table. The wings or partitions segregating the table into three parts may be swung to vary the size of the settings or may be completely removed from the table when a rotating set is desired. The table is planned to be mounted flush with the floor of the studio and so designed that it can be loaded unevenly with a maximum loading of about 50 pounds per square foot.

This plan calls for a shop and scene dock behind the studio in which the main body of the table is located so that work can be done on the sets on the shop side of the table while televising is proceeding in the studio. If the table is to be installed in the studio before the second studio is built, a certain amount of flexibility can be expected with a construction saving of from \$30,000 to \$40,000, depending upon the size of the table.

Most manufacturers currently design and construct transmitters of only two sizes, namely the 500-w

**Table V—Transmitting Station Costs**

	500-W Transmitter		5,000-W Transmitter	
	Channels	Channels	Channels	Channels
Transmitter	2-6	7-13	2-6	7-13
Spare tubes and parts	26,500	31,000	82,165	88,200
Aural monitor	3,000	4,000	8,015	9,288
Visual frequency monitor	1,600	2,000	1,980	2,000
Picture demodulator	675	675	675	675
Waveform demodulator	650	650	650	650
Power supply	900	900	900	900
Adapter kits	365	365	365	365
Rack cabinet	20	20	20	20
	390	390	390	390
Antenna	12,000	13,000	12,000	13,000
Tower, 100 ft.	2,000	2,000	2,000	2,000
Transmission line, 2 lines 150 ft.	500	500	2,000	2,000
Transmitter house	3,500	3,500	7,500	7,500
Tower lighting	800	800	800	800
Labor	8,000	8,000	12,000	12,000
Total	60,900	70,800	131,490	139,788
Contingencies 10%	6,090	7,080	13,149	13,979
Grand total	66,990	77,880	144,639	153,767

**Table VI—Test Equipment List and Costs**

Equipment	Remote	Studio	Transmitter
5-in. oscilloscope	\$195.00	\$195.00	\$195.00
3-in. oscilloscope		550.00	550.00
Square-wave generator		225.00	225.00
Capacitance—resistance bridge	59.50	59.50	59.50
Voltmeter	39.50	39.50	39.50
H-v multiplier	18.75	18.75	18.75
Audio oscillator		500.00	500.00
Distortion and noise analyzer		575.00	575.00
Video sweep generator		1,000.00	
Wavemeter			38.00
V-t voltmeter	150.00	150.00	150.00
Tube tester		59.50	59.50
5-in. oscilloscope (Tektronix type)		795.00	795.00
Total	\$462.75	\$4,167.25	\$3,205.25

or so-called community transmitter and the 5-kw or metropolitan type. The transmitter may be installed either at the site of the studios or at a remote location which affords the

radiation system a more favorable location for the purposes of propagating the wave.

Since television channels are located in the very-high-frequency band, the radiated signal is subject to shadowing by obstacles between transmitter and receiver. It is usually necessary, therefore, to take into consideration the possibility of shadows and reflections when selecting a site for the transmitter proper. Simply stated, if you can see it, you can hear it, although service may be rendered beyond the line of sight under some conditions.

#### Transmitter Costs

In Table V the costs of the transmitters and associated equipment have been set up. This table is approximately correct except that no consideration for the cost of land has been given.

It will be noted that both types of transmitters designed for channels



Typical small-studio control room with audio controls at left, video at right. The program director sits at the desk





Mobile field unit that can double as initial control room for the small station. One camera and 7,000-mc relay equipment are mounted on the roof

2 to 6 are less expensive than those designed for channels 7 to 13. Since the band including channels 2 and 6 represents frequencies from 54 to 88 mc and the band including channels 7 to 13 includes frequencies from 174 to 216 mc it is evident that tube design as well as transmitter design and construction is more expensive at the higher frequencies.

#### Relay Links

Where the transmitter and studio are situated at remote locations and also in cases where the remote equipment is functioning at sites away from the studio, it is present general practice to connect these units with relay circuits. Equipment has been developed and is operating successfully on several microwave channels. Notable in this category are circuits on approximately 2,000, 4,000, and 7,000 mc.

Since the equipment constructed for the higher frequencies can be manufactured in more compact fashion its high degree of portability renders it best for remote pick-up work. The 7,000-mc equipment is therefore most popular to serve as a truck-to-studio link while in many instances the lower frequencies have been used between studio and transmitter. For the purposes of this paper, an approximate price

of \$10,000 for each complete link, consisting of a transmitter at the originating point and a receiver at the incoming terminal, has been used.

#### Testing Equipment

A certain amount of test equipment with every television installation is an actual must. Operating crews cannot be expected to maintain the apparatus nor can they do the necessary trouble shooting without an adequate complement of this equipment. As stated above, the transmitter is often located at a different site from the studio and the remote equipment needs maintenance and repairs when in the operating location. Table VI lists equipment of this type.

The foregoing indicates the approximate equipment costs that a prospective television station builder may expect to meet but does not include the price of real property either at the studio or that necessary on which to construct the transmitter. It has been estimated, however, that the cost of constructing a building such as that shown in the plans illustrated above will be in the neighborhood of \$66,000 for the first stage of construction and an additional \$59,000 for the finished building.

The approximate costs have been

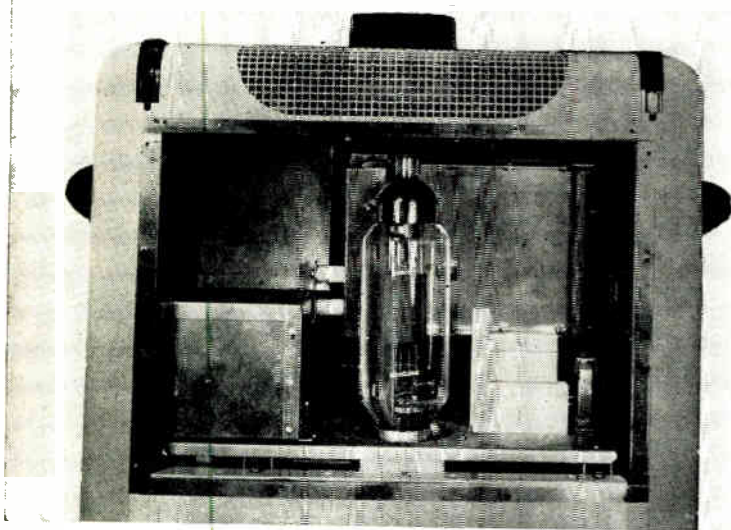
so tabulated, however, that any combination of equipments can be correlated and the resulting costs obtained from the tables. For instance, it is evident that the type of station which can be most inexpensively constructed is one which is equipped to receive network programs only. Thus, by referring to Table II, the control-room item shows an equipment cost of \$32,000 with an installation cost of \$5,000, bringing the total to \$37,000 and from Table V a 500-w transmitter operating on channels 2, 3, 4, 5; or 6 will cost approximately \$66,900. If the transmitter and control room are located in the same building, the owner should then be able to construct a station for approximately \$103,990 and with the additional test equipment shown in Table VI, an additional \$3,205 will complete the station.

If, however, the prospective owner is considering a well-equipped station with two studios, projection room and remote equipment, Table IV furnishes figures showing a total cost of \$209,343. Table V for a 5-kw transmitter operating on channels 7, 8, 9, 10, 11, 12, or 13 shows a total of \$153,767. Such a station will probably be so constructed that the transmitter and studios at different locations and the remote equipment will be supplied with radio relay links, two such circuits costing approximately \$20,000.

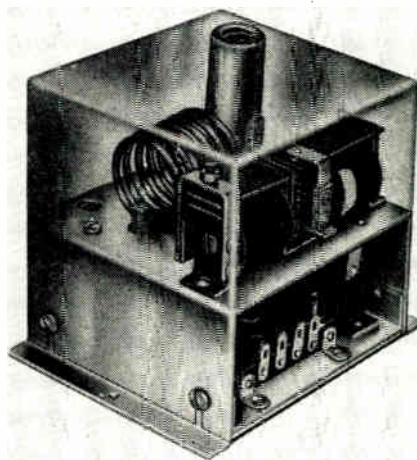
In addition to the items stated above, test equipment in the amount of approximately \$7,500 will be needed, bringing the total expenditure for equipment installed to approximately \$390,610. Some few organizations have already gone well beyond this amount in constructing stations but in this paper it has been the intention of the writer to point the way for the beginning of such an operation in a comparatively modest way rather than to describe the more elaborate procedures of the larger companies.

The writer wishes to thank the personnel of the following organizations for their assistance in compiling the data herein: Radio Corp. of America, General Electric Co. Allen B. DuMont Labs., Inc., Television Associates and Lester V. Johnson Associates.

# Frequency Stabilization



Rear view of Liebel-Flarsheim model SW-227 short-wave diathermy unit having FCC type approval. Single tube minimizes maintenance problems. At lower left of tube is plug-in monitor unit



Phantom view of Wavemaster monitor unit, showing differential relay and coil of resonant circuit

**P**RIOR to the establishment of frequency allocations for short-wave diathermy units, frequencies anywhere in the range from about 10 to 60 mc were used by various manufacturers, depending on the type of applicator furnished. Since the therapeutic benefit is due to heat alone, all frequencies are equally effective in the treatment of tissue.

To suppress wasteful use of the frequency spectrum, three bands were assigned by the FCC for medical apparatus, in conformance with those adopted by the International Radiocommunications Conference, as follows:

Band	Center Freq.	Tolerance
13.5532-13.5667 mc	13.56 mc	6.75 kc
26.9573-27.2827 mc	27.12 mc	162.7 kc
40.6597-40.7003 mc	40.68 mc	20.3 kc

Although there is no limit to the amount of radiation permitted within these bands, harmonic radiation must not exceed 25 microvolts per meter at 1,000 feet.

The 13.56-mc band serves adequately for pads and inductive applicators, but is generally unsatisfactory for air-spaced plate applicators because the associated high reactance requires excessive patient-circuit voltages. The 27.12-

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mc band effectively operates all known types of applicators. The 40.68-mc band is usually unsatisfactory for inductive applicators because of excessive turn-to-turn voltages and resulting high dielectric loss, but is satisfactory for pads and spaced plates.

The wider frequency tolerance of the 27.12-mc band permits the design of simple self-excited oscillator circuits, obviating the complications and maintenance problems involved in crystal-controlled circuits.

### Frequency-Shift Problems

The frequency stability of a self-excited diathermy oscillator circuit is affected by five major factors: (1) mechanical vibration or displacement of frequency-determining parts and components; (2) replacement of tubes; (3) replacement of parts; (4) frequency drift due to heating of oscillator circuit components; (5) frequency shifts due to patient-circuit loading and tuning.

Mechanical factors can be elimi-

nated by building strong and sturdy circuit components and fastening them rigidly.

Changes due to tube replacement can be minimized by using a high tank capacitance so that variations in tube interelectrode capacitance will produce only small frequency changes. Here a limit is quickly reached due to the inefficiency of high-Q tank circuits, hence under the best practical conditions it is reasonable to expect up to a 50-kc shift in either direction due to interchange of tubes of identical make. When tubes of different manufacturers are interchanged, at least three times this shift is sometimes experienced.

Frequency shifts due to circuit heating can run as high as 150 kc, but by proper design this can be limited to 20 kc.

Patient-circuit loading is the bugaboo of all short-wave diathermy design. Applicator and patient-circuit impedances may range from 5 ohms to 150 ohms of resistance and from  $+j2,000$  ohms to  $-j2,000$  ohms of reactance. Variable coupling is therefore necessary to couple a patient circuit efficiently to an oscillator. A coupling for a



to compensate for frequency variations due to change of tubes or other components and mechanical instability.

### Frequency Monitor

A monitor circuit insures that the unit will always operate within the band. It consists essentially of a thermally and mechanically stable high-Q resonant circuit which operates a sensitive relay through a rectifier tube. When the circuit is excited the relay completes the cathode circuit of the oscillator.

When the oscillator frequency deviates more than a predetermined amount from 27.12 mc, the voltage across the monitor circuit decreases to the point where the relay opens, interrupting the cathode circuit of the oscillator. At the same time a low-voltage buzzer is energized, notifying the operator immediately of the condition. The monitor circuit (covered in U. S. patent application) is set to allow operation in a band of  $\pm 100$  kc; this is well within the FCC type approval limit of 70 percent of allocated channel width.

The uppermost curve in Fig. 2 illustrates the response of a simple resonant circuit energizing a relay through a rectifier to monitor a frequency band for various values of deviation from the frequency to which the circuit is tuned, expressed in effective resonant-circuit

Q values. When the frequency deviates so that resonant-circuit response falls below the control level the relay will become deenergized. Such a method of control requires that the relay contacts be bridged by an auxiliary switch momentarily in order to start oscillations.

The lower solid curve in Fig. 2 shows that a 15-percent reduction in r-f excitation results in a 17-percent reduction in the pass band. This weakness of the simple system can be overcome by the use of a differential relay. One winding is connected to the resonant circuit, and the other winding is connected through a rectifier to a voltage proportional to the high-frequency exciting voltage of the resonant circuit, as in the monitor circuit of Fig. 1. These two windings are connected so their electromagnetic fluxes are adding in the magnetic circuit operating the relay armature.

The dotted curves in Fig. 2 illustrate the characteristics of such a differential circuit. A 15-percent reduction in excitation voltage here results in only a 7-percent change in frequency band width at the differential relay control level.

### Operation of Circuit

When the main power switch in Fig. 1 is turned from OFF to HOLD, the oscillator tube and the rectifier

in the monitor circuit warm up. Plate power is not, however, applied to the oscillator tube. During the brief period that the power switch is turned from the HOLD position to the ON position an auxiliary switch momentarily applies plate power to the oscillator tube. Oscillations start immediately, and if the frequency is within the operating band the monitor differential relay contacts close and hold the plate power on. If the oscillator frequency is outside the limits, the monitor relay will not hold the plate power on and a buzzer will operate.

Trimmer  $C_2$  is adjusted by determining the low and high-frequency limits of the monitor and setting the trimmer at a point midway between these two limits. This is normally done after allowing the unit to warm up for two minutes, thus automatically compensating for the frequency shift due to initial heating.

### Harmonic Radiation

The reduction of harmonic radiation of short-wave diathermy machines to limits prescribed by FCC allocations requires application of standard methods of shielding and filtering. In actual test it was found that a 40-millivolt 135-mc signal applied to the plate applicators would produce a field intensity equal to 25 microvolts per meter at 1,000 feet. This illustrates the degree of suppression required. Even though the actual signal voltage received by the field intensity meter decreases with the higher harmonics, the field intensity, as computed by the induced signal voltage and divided by effective length of the antenna, tends to stay high because the effective length of the antenna decreases directly with wavelength.

Harmonic tests are conducted preferably on open terrain. Field intensity meter readings are taken either 100 or 500 feet distant from the diathermy unit. The diathermy unit is mounted on a rotatable platform which is turned 360 degrees during a given reading. Maximum signals are recorded. The unit is connected to a gasoline-powered a-c generator and is tested with applicators under all conditions. Figure 3 shows typical results of tests performed on production units.

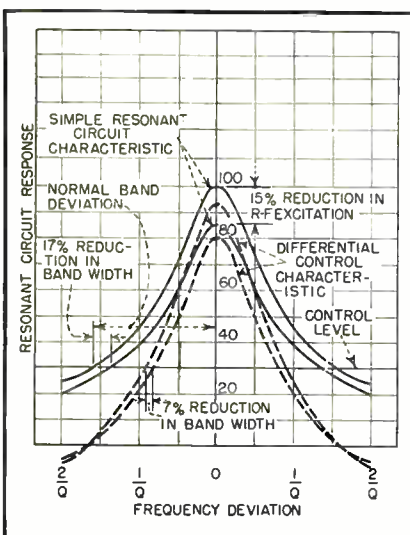


FIG. 2—Solid-line curves give characteristics of simple frequency monitor circuit, while dotted-line curves show how effect of reduction in r-f excitation of diathermy unit is minimized by using differential control in monitor circuit

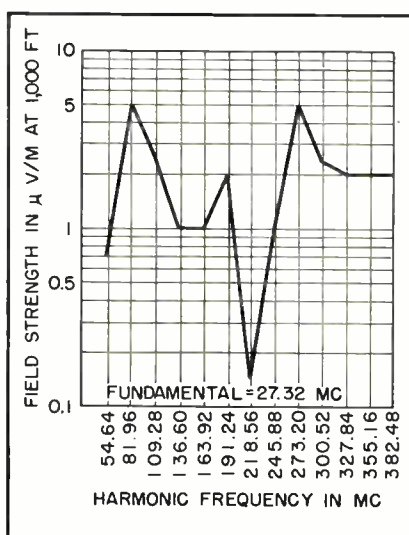


FIG. 3—Intensity of radiation of short-wave diathermy on various harmonics when center frequency is 27.32 mc. Unit represented here is well within legal maximum of 25 microvolts per meter at 1,000 feet

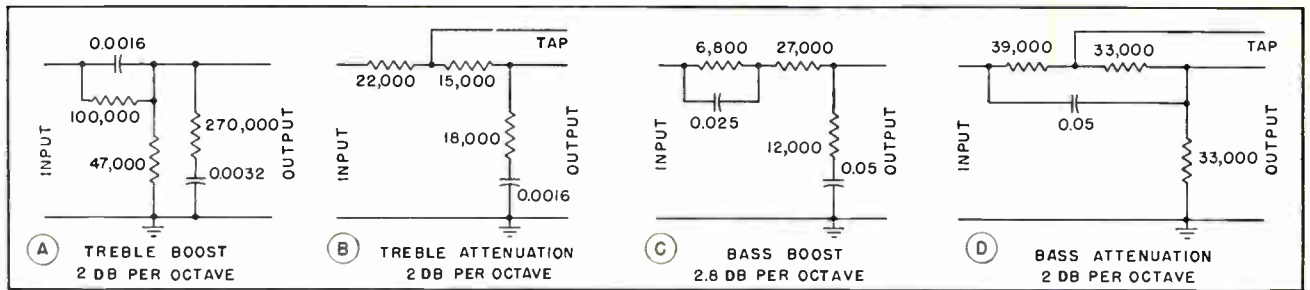


FIG. 1—Typical R-C networks used in tone control for boosting and attenuating audio signals. Taps on attenuation network provide half the indicated effect

# Versatile Tone Control

Treble and bass frequencies are independently boosted or attenuated in steps to provide 121 different response curve combinations for reproduction of speech or music. Gain at 500-cycle crossover is automatically held constant by switching in cathode followers

**T**HE TONE CONTROL described here originated largely with a desire to compensate for the limitations of recording techniques. With it, treble frequencies can be boosted or suppressed, and bass frequencies can be similarly treated independently, all in small steps.

The bass and treble controls each provide sharp rise or fall starting at 500 cycles or any other crossover frequency chosen. Bass control produces no substantial effect above crossover, and treble control produces no substantial effect below. The rising or falling slope is adjustable in steps of one db per octave up to a maximum of 5 to 7 db per octave. The overall volume level at the crossover frequency is unchanged by applying any bass or treble compensation, or by applying both simultaneously. All frequency-determining components are resistances or capacitances. All curves flatten off above 10 kc and below 25 cycles.

## R-C Networks

Selective frequency boost is achieved by attenuating one group of frequencies and readjusting the overall level with flat amplifiers. The basic R-C networks used for this

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purpose are shown in Fig. 1, along with the networks used primarily for attenuation.

Treble boost (Fig. 1A) is obtained with a bass attenuation network having a gradual drop near the crossover and a sharp flattening off at the lower frequencies. When this curve is slid up the frequency axis until the sharp bend reaches the crossover frequency, it becomes treble boost.

Treble attenuation (Fig. 1B) gives an abrupt drop near the crossover frequency and a smooth flattening off at higher frequencies.

Bass boost (Fig. 1C) is obtained with a treble attenuation network having a gradual drop near the crossover and a sharp flattening off at the higher frequencies. When this curve is in effect slid along the frequency axis until the sharp bend occurs at the crossover frequency, it becomes bass boost.

Bass attenuation (Fig. 1D) gives an abrupt drop near the crossover frequency and a smooth flattening off at lower frequencies.

Any desired crossover frequency may be achieved by selection of resistance and capacitance values for the R-C networks. For example, doubling all indicated resistance values without changing the capacitances will shift the entire curve toward lower frequencies by a factor of two. Doubling all capacitances produces the same effect, while decreasing resistances or capacitances or both shifts the curve bodily toward higher frequencies.

The impedance any network presents may be altered by a factor  $N$ , without altering the frequency response curve, by multiplying all resistance values by  $N$  and at the same time dividing all capacitances by  $N$ .

## Complete Circuit

The final tone control circuit is shown in Fig. 2, along with the response curve combinations obtainable and the control switch settings for each. Since all the required compensation cannot satisfactorily be provided in variable form in one network section, composite networks consisting of three such sections in tandem or cascade are used for bass and treble attenuation,

with provisions for tapping the composite network at the desired points.

The succeeding sections in any one network increase in impedance by a factor of four or five each time, so that succeeding sections do not furnish loading which would alter the frequency response characteristics of preceding sections.

Because of the nature of the basic bass boost section, the building up of a network from several such sections would add many bulky components. Instead, therefore, a switching arrangement was developed wherein three sections of 1.4, 2.8, and 2.8-db boost per octave were combined successively to give in turn 1.4, 2.8, 4.2, 5.6, and 7-db boost per octave. The same system is employed for treble boost, and the network sections again increase in impedance as they are added.

Two six-pole eleven-position

switches are required. The five positions of boost and the five positions of attenuation are wired to one switch for each frequency range, along with a neutral position in which no bass or treble alteration occurs. Continuous control is not provided, but small enough steps make the action gradual as the switches are rotated.

The overall result, then, is to have one switch for bass, giving from 7 db of boost per octave to 5 db of suppression per octave in ten steps, and one switch for treble, giving from 5-db boost per octave to 6-db reduction per octave in ten steps, with no interaction between controls. The words per octave here refer to the number of octaves displacement from 500 cycles.

In order to achieve a constant volume level at the crossover frequency, a stepping gain control was added, ganged to the bass and treble

switches, in the cathode circuits of two cathode followers. In this way, the proper amount of input signal is chosen for each position of the selector switch in order that the gain at 500 cycles may remain constant. In practice, this is easily achievable within one db if care is taken in selecting components.

### Cathode Followers

The cathode followers serve the main purpose of transforming a high-impedance input signal down to a low impedance so that the networks may begin at low impedance and build up as described. It has been found that stray coupling between high-impedance networks can seriously alter the ideal frequency response curves. With capacitance values all larger than 400 micro-microfarads, a small unintended coupling capacitance (on a switch wafer, for example) will not pro-

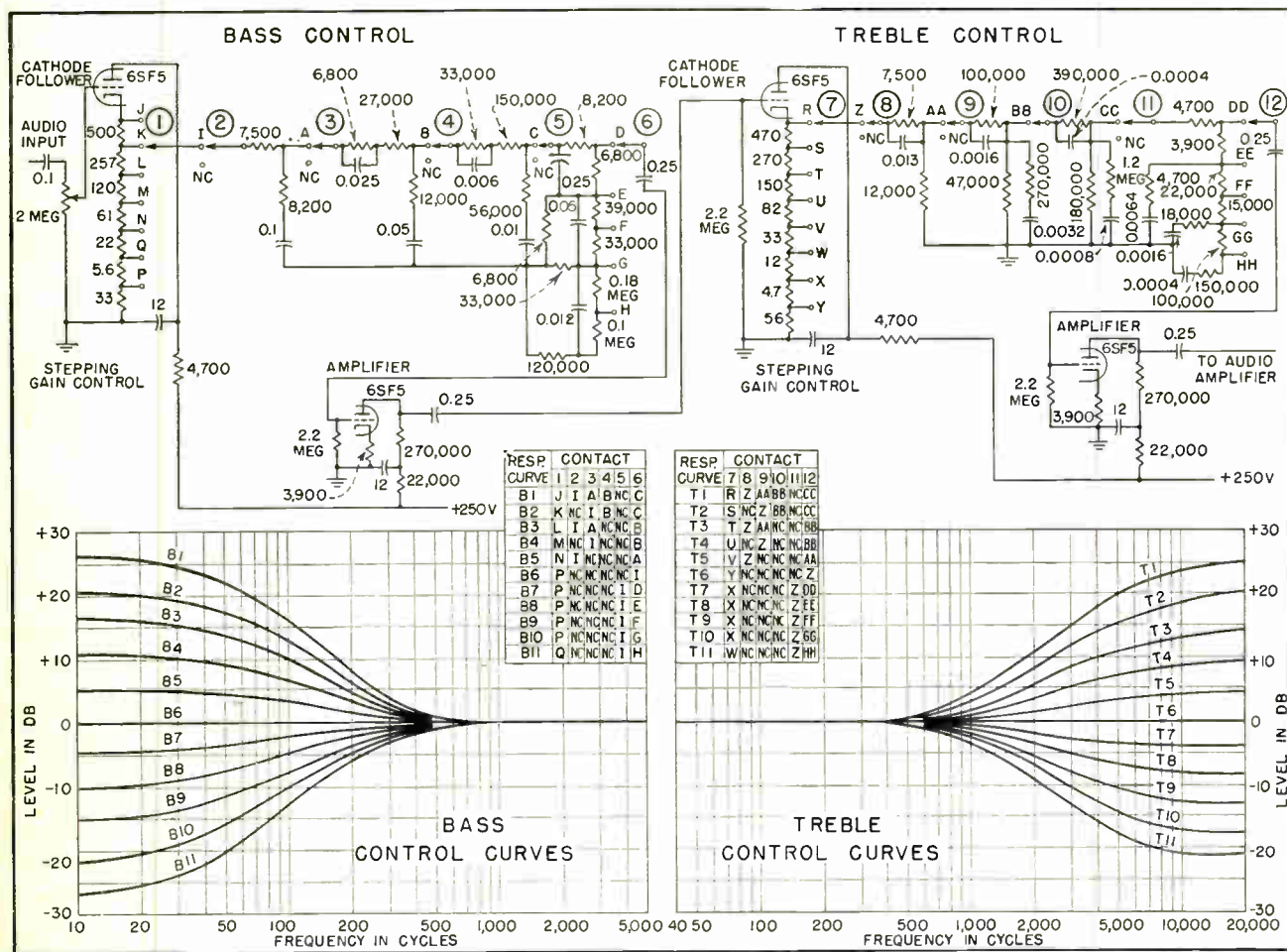


FIG. 2—Complete tone control system. When inserted in an audio amplifier, its overall gain is zero at the 500-cycle crossover frequency. The inset tables give the positions of the contact arms of the two six-pole eleven-position control switches to provide the indicated bass and treble control curves. Treble curves were taken with bass control at B6 (neutral), and bass curves with treble control at T6

duce a noticeable effect on the tone.

Amplification must be provided (not necessarily within the tone control) in order to re-establish the original volume level. At the same time, it is advisable to amplify and then again transform down to low impedance between the bass and treble controls. This serves the added purposes of isolating the bass and treble components electrically and keeping either from operating at too low a voltage level. All these networks are bound to have insertion loss at any frequency, and a total of 40 db of attenuation at 60 or 120 cycles (as provided by bass suppression and treble boost, before re-establishment of the 500-cycle level) could push the signal into the heater-to-cathode hum voltage level.

#### Amplifier Design

Choice of tubes for this tone control proved somewhat vexing. The 6SL7 twin high-mu triode would have been most convenient, but even a 6SL7W proved to be usually too microphonic, and always too rich in hum introduced through the heater circuit. The 6SN7 does not have enough gain; the 6SC7 has only one external cathode lead. The 6SF5 high-mu triode was found to be available and free from hum in a sufficient number, and so this type was decided upon.

In the amplifier stages, cathode resistors were left unbypassed to make the neutral amplification curve as flat as possible, at the sacrifice of some gain. A total of 12 db more of gain may be obtained by suitable bypassing of these two resistors. All plate supply circuits must be decoupled as shown, and all blocking capacitors must be large enough so that low frequencies are not attenuated.

The input signal level must be low enough so that, after boosting, neither the bass nor the treble signal will overload either level-restoring amplifier. A gain control is therefore provided directly at the input to the tone control. This is not intended as a main gain control for the entire control and program amplifier combination, but as an auxiliary which may be set according to the maximum level of the incoming signal.

In commercial recording, com-

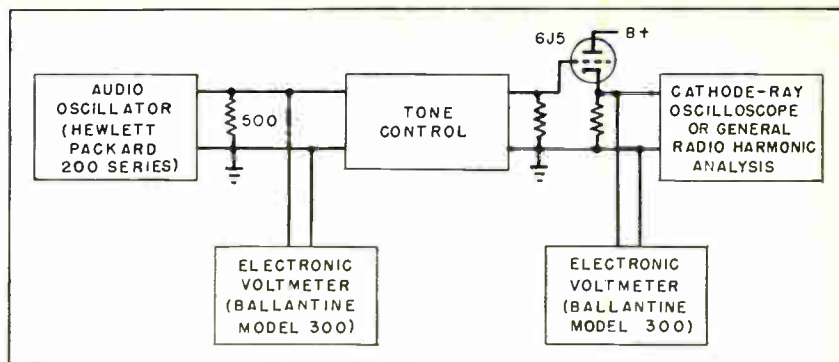


FIG. 3—Method used for testing individual R-C networks and complete tone control system

pression takes place before the mechanical limitations of recording techniques produce their tone-modifying effects. Therefore, the tone control should be used before a volume expander. This also lessens the danger of overloading the amplifiers in the tone control.

#### Construction and Testing

All parts were selected, using a resistance bridge and a capacitance bridge, from stock 1-watt resistors in RMA sizes and stock capacitors. In many cases resistance values were changed slightly from nominal values shown in order to achieve a smooth consistent family of curves.

Assembly may be along lines conventional for low-level audio circuits. Compactness was achieved by wiring virtually all the resistors and capacitors on the two switches before installing the switches on the chassis. The tone control with its two switches, four tubes, a spare selected 6SF5 tube and a 3-tube a-m tuner were assembled on a 9x11-inch chassis, the audio amplifier and power supply being remote.

#### Checking Response Curves

A testing method was evolved for this type of work, which eliminated disturbing effects due to such factors as voltmeter frequency response, loading, signal generator variations, and distortion. As shown in Fig. 3, an audio oscillator with load resistor was fed to the input of the tone control, across which an electronic voltmeter was placed. The linear db scale on the Ballantine voltmeters simplified measurements since all data could be obtained directly in decibels and plotted immediately; any odd points

could be immediately investigated.

Each network was tested individually, after which the entire tone control was tested as a unit.

The output from the last 6SF5 was transformed down to low impedance in an auxiliary cathode follower (6J5) and another voltmeter was placed across the cathode follower cathode resistor. The oscillator was set for 500 cycles, its output set for midscale (10 db) on the input monitor meter, and the input gain control adjusted for midscale (10 db) on the output meter, on the 1 volt scale.

#### Precautions

Any change in oscillator output as frequency was changed was eliminated by always adjusting the oscillator output control so that the input meter read 10 db. A series of measurements was taken by setting the frequency, setting the oscillator output, and recording the output reading in db as the treble or bass control was varied throughout its range. The tone control net effect is the output reading in db minus 10.

Great care must be taken in planning this type of measurement since it is easy to overlook a cable lumped capacitance, which will change beyond recognition an otherwise desirable curve. It is also advisable to monitor, on a good oscilloscope or harmonic analyzer, the audio output from the tone control, to avoid recording false readings due to overloading and consequent waveform distortion.

The author wishes to express appreciation to Dr. Hugh F. Gingerich, to whom credit for the basic network design is due.

# Power Amplifier for the Citizens Transmitter

Construction details and circuitry of a two-stage power amplifier for use in conjunction with the transmitter described in November 1947 *ELECTRONICS*. Simplified design of cavity resonators and mounts permits duplication of the unit with the use of hand tools only.

No machining is necessary

By **WALTER C. HOLLIS**

*Project Engineer  
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## Part V

**T**HE UNIT illustrated is designed to be added to the *ELECTRONICS* Citizens transmitter to provide the higher power needed for covering greater distance and more reliable communication. With it, the quarter-watt output of the mobile transmitter is increased to 10 watts, a

total gain of 16 db. Although intended primarily for fixed station operation, where a conventional 115-volt power line is available, the input requirements are sufficiently low as to permit mobile operation from a vibrator or dynamotor power supply.

The power amplifier consists of two stages of class-C grounded-grid amplification employing type 2C43 tubes. The complete circuit diagram is shown in Fig. 1.

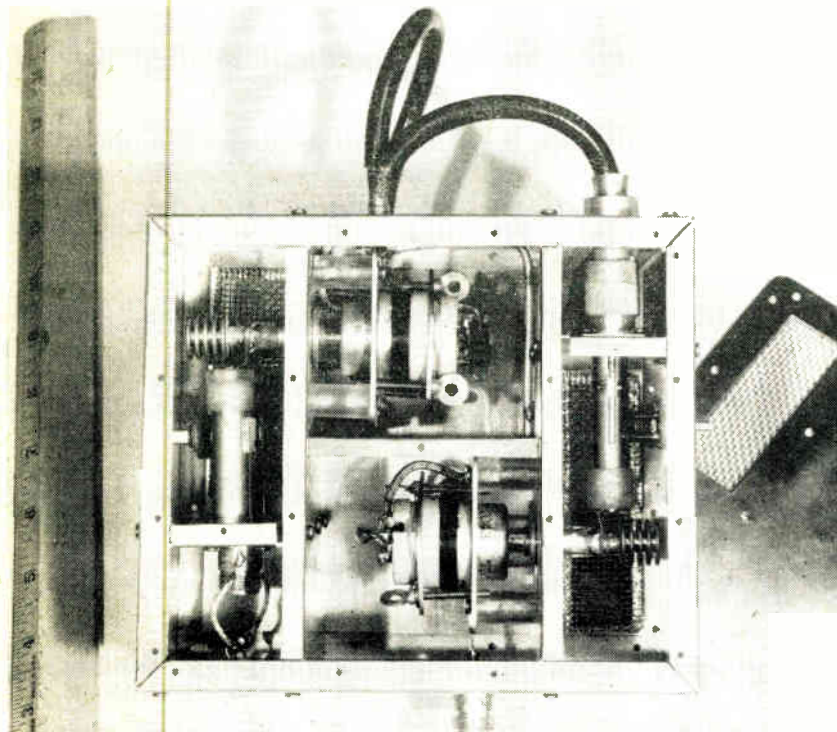
The first stage is operated single ended and is driven through a

type-N panel jack,  $J_1$ . Loop  $L_1$  is a short length of tubing which approximately resonates out the grid-to-cathode capacitance of  $V_1$ . A wire shielded within the tubing provides one connection for the heater voltage and the other is returned to ground through an internal connection in  $V_1$ . Capacitors  $C_1$  and  $C_2$  are button mica types that maintain both filament connections and the three cathode d-c connections at the same r-f potential. The cathode r-f connection is provided through a built-in capacitor between the shell and cathode of the 2C43. Cathode resistor  $R_1$  develops the required grid bias and serves as overload protection for the tube in case of drive failure.

### Coupling

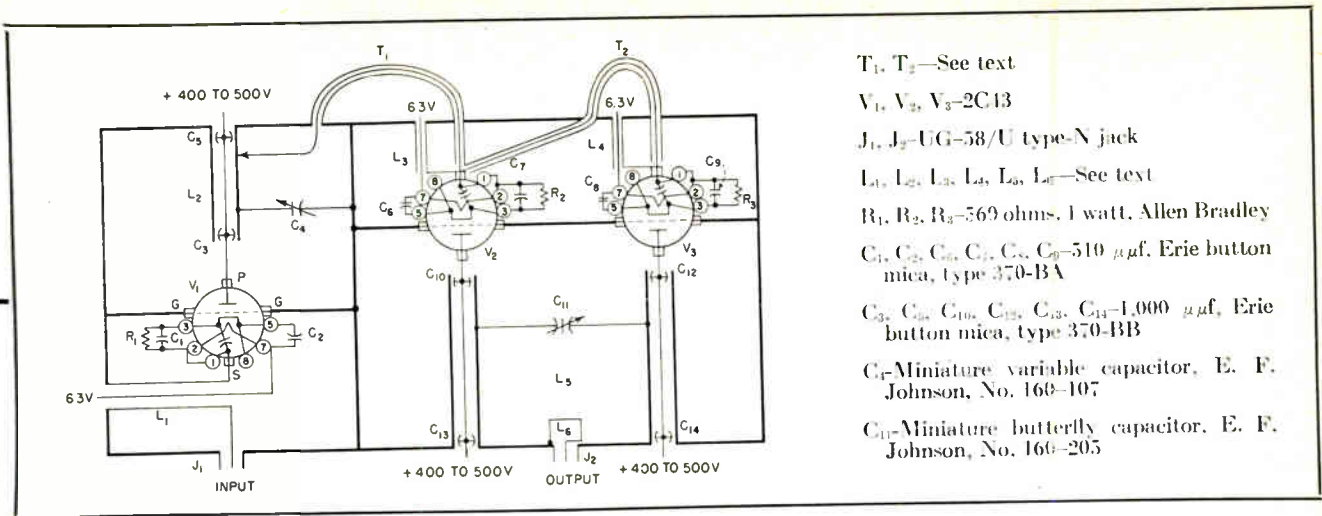
The output tank circuit is of the transmission-line type and consists of a length of short-circuited transmission line,  $L_2$ , resonating with the grid-to-plate capacitance of  $V_1$ , and a variable capacitor,  $C_4$ , located part way up the line. The resonant circuit thus formed is shunt fed through a pi filter consisting of  $C_5$ ,  $C_6$  and the inductance of the length of wire connecting these capacitors. Output from the first stage is fed to the second stage by means of an adjustable tap on  $L_2$  through a length of transmission line,  $T_1$ .

The second stage consists of two 2C43 tubes,  $V_2$  and  $V_3$ , operated in push-pull. Tubing  $L_3$  and  $L_4$  are similar to and serve the same purpose as  $L_1$ . Capacitors  $C_7$ ,  $C_8$  and  $C_9$  have the same function as  $C_1$  and



Complete amplifier with one cover removed. Resonant cavities are formed by the metal case and the partitions





- $T_1, T_2$ —See text
- $V_1, V_2, V_3$ —2C13
- $J_1, J_2$ —UG-58/U type-N jack
- $L_1, L_2, L_3, L_4, L_5, L_6$ —See text
- $R_1, R_2, R_3$ —569 ohms, 1 watt, Allen Bradley
- $C_1, C_2, C_6, C_7, C_8, C_9$ —510  $\mu\text{f}$ , Erie button mica, type 370-BA
- $C_3, C_4, C_{10}, C_{12}, C_{13}, C_{14}$ —1,000  $\mu\text{f}$ , Erie button mica, type 370-BB
- $C_5$ —Miniature variable capacitor, E. F. Johnson, No. 160-107
- $C_{11}$ —Miniature butterfly capacitor, E. F. Johnson, No. 160-205

FIG. 1—Complete circuit of the two stages of the power amplifier

$C_2$ . Resistors  $R_2$  and  $R_3$  provide grid bias and overload protection. The cathodes of  $V_2$  and  $V_3$  are driven by the output of  $V_1$  through transmission line  $T_1$ . Amplifier  $V_2$  is driven directly and  $V_3$  is driven through an additional half-wave line,  $T_2$ , which serves as a phase inverter. This is one form of the balance-to-unbalance transformer (balun).

The output tank circuit consists of a length of short-circuited parallel transmission line,  $L_5$ , resonated by the grid-to-plate capacitance of  $V_2$  and  $V_3$  and a butterfly capacitor located part way up the line. The resonant circuit thus formed is shunt fed through pi filters consisting of  $C_{10}, C_{12}, C_{13}, C_{14}$  and their respective connecting leads. The output of this stage is coupled out through  $J_2$  by means of coupling loop  $L_6$ .

### Construction Details

As shown in the accompanying photographs, the two stages of amplification are assembled within a sheet-metal shield box  $7\frac{1}{8} \times 6\frac{1}{8} \times 4\frac{1}{8}$  inches, consisting of two L-shaped flanged parts and two covers.

The shield box is divided into four compartments by three partitions. One compartment each is used for the input cathode circuit of  $V_1$ , output resonant circuit of  $V_1$ , input cathode circuits of  $V_2$  and  $V_3$ , and output resonant circuit of  $V_2$  and  $V_3$ . All parts for the shield box are made of 1/32-inch sheet brass and held together by 4-40 binding-head screws.

The layouts for the two L-shaped flanged parts are shown in detail

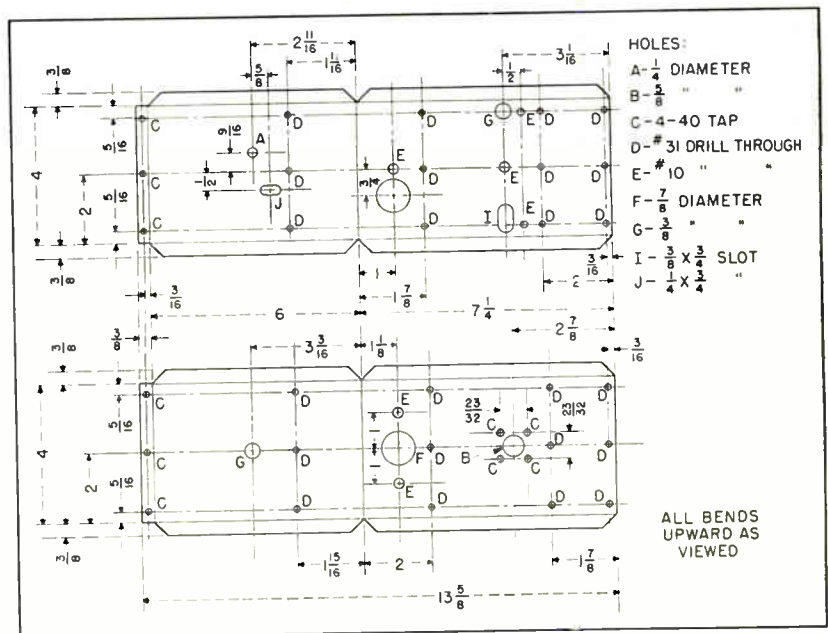


FIG. 2—Layout of two L-shaped shields that form the metal cabinet. All dimensions are given in inches

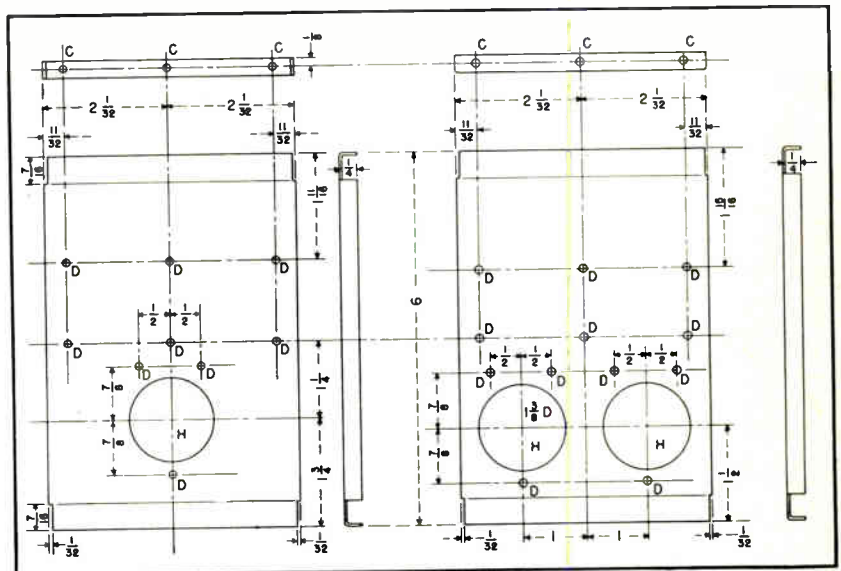
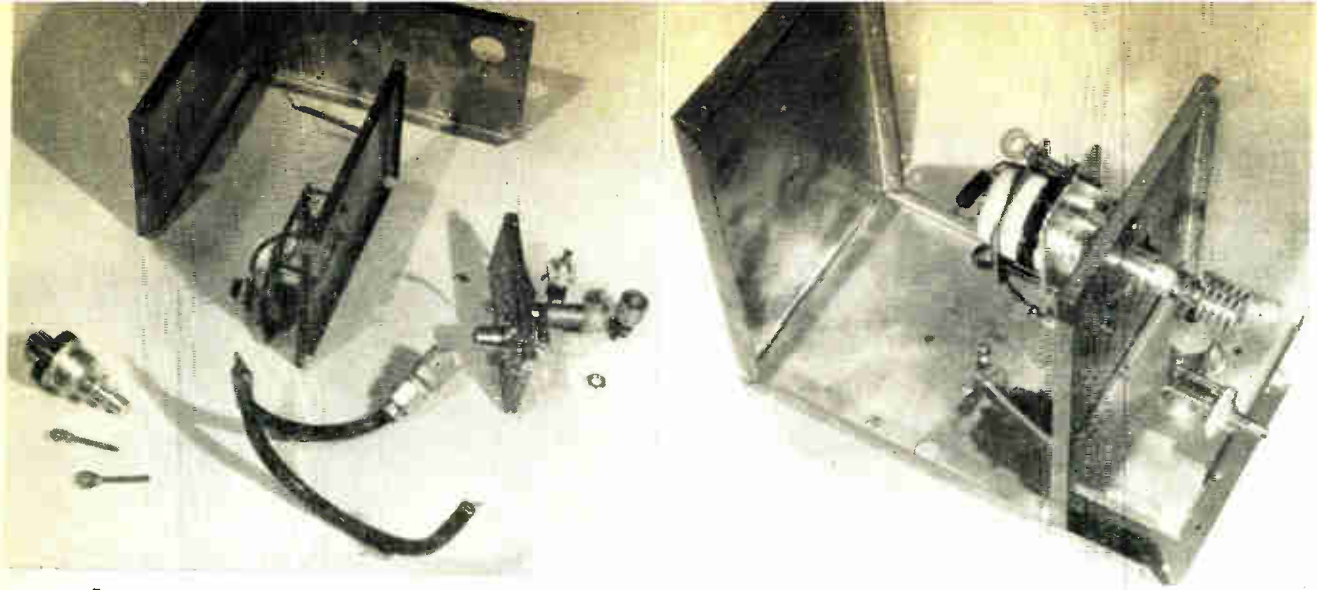


FIG. 3—Ground-plane partitions



Single-ended input stage at right uses components at left and mounts with output stage to form the metal cabinet

in Fig. 2. Two partitions, which serve as ground planes, are shown in Fig. 3. The smaller partition, which shields the input of the first stage from the input of the second stage, is shown in Fig. 4. The two line assemblies are detailed in Fig. 5 and 6. Figure 5 shows assembly details of the input amplifier line

assembly. Figure 6 omits these details as they were identical. Assembly is done exclusively with soft solder. Details of the covers are shown in Fig. 7. Two are required and screening is soldered over each opening on the inside surface. After all parts for the box are made, tapped holes on the flanges are spotted from the covers. Figure 8 shows all other details.

33446. Only the middle size is used. After all metal parts are made, they may be silver plated for improved conductivity, as was done with the model.

#### Assembly

All metal parts are held together by 4-40 screws and lock-washers. In addition to the parts called for in Figures 1 to 8, the following are required: four feed-through terminals, such as Vitro Seal Corp. Terminal No. 1901-9LHT; about 18 inches of shielded wire, such as Precision Tubing's No. 20 (10/30) wire in silver-plated copper shields; 0.1495 O.D. x 0.011 wall thickness; three Millen type 33008 steatite

The grid fingers shown in Fig. 8 are centered and soft soldered over the holes in the ground planes (Fig. 3). They should be soldered on the side opposite the flange with the fingers protruding. Fingers similar to these may be purchased from James Millen Mfg. Co. as part No.

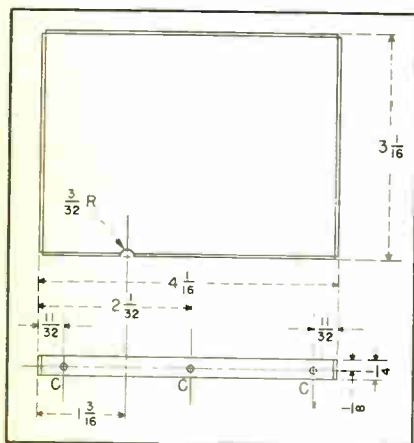


FIG. 4—Small partition to separate the stages

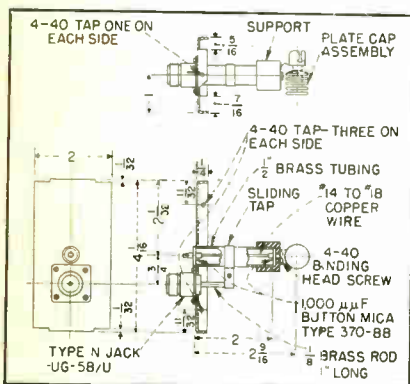


FIG. 5—Resonant-line assembly of input amplifier

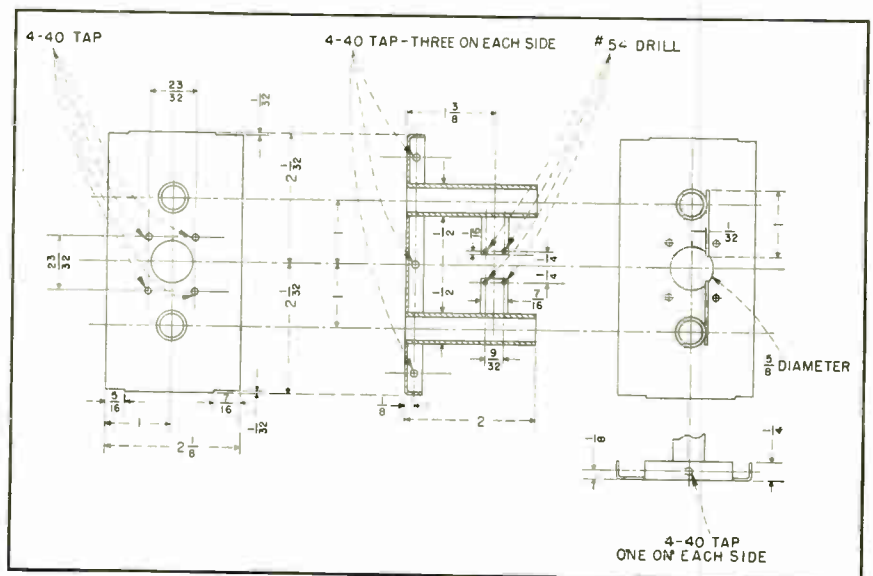
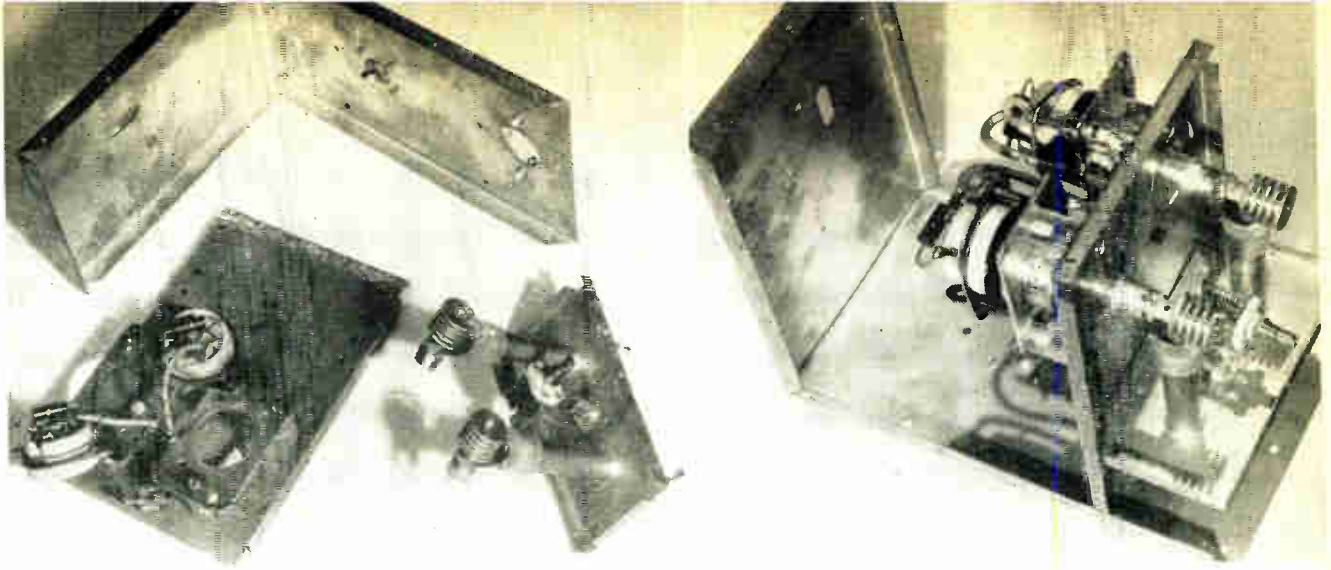


FIG. 6—Output amplifier resonant-line assembly as shown pictorially at top of following page



Components and shields of the push-pull output stage, left, form the assembled unit at right, half of the cabinet

octal sockets; six 6-32 fillister head screws, 1 1/4 inches long; about 18 inches RG-5/U cable; and one UG-18/U plug.

The shielded wire is soldered to the chassis and cathode mount as shown in the photographs to form  $L_1$ ,  $L_2$  and  $L_3$ , respectively. The inner wire supplies the filaments of  $V_1$ ,  $V_2$  and  $V_3$ . Filament and cathode connections are made through an octal socket.

The cathode bypass capacitors and bias resistor are mounted on the socket as shown in the photographs. The outer rim of each button mica capacitor is soldered to terminals 3, 5, and 8 of the socket and one is stacked above the other. The lug of the lower capacitor is soldered to terminal 2, which is connected to terminal 1, providing a ground return to the shell of the 2C43. The lug of the upper capacitor solders to terminal 7 which connects to the filament lead. The bias

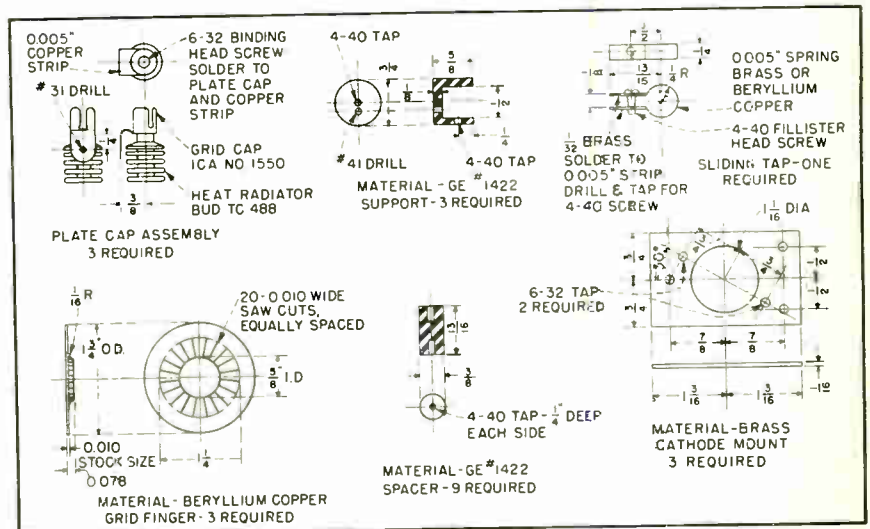


FIG. 6—Small parts required are plate caps, grid fingers, supports, spacers, tuning clips and cathode mounts

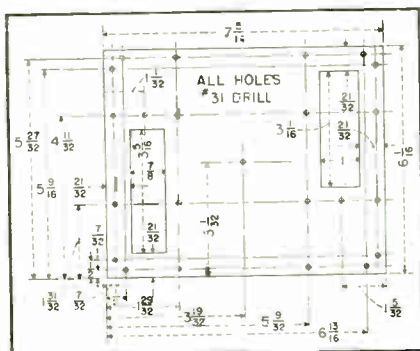


FIG. 7—Copper screening is soldered over the openings of the covers

resistors span terminals 1 and 5.

The resonant lines are assembled as shown in Fig. 5. The GE 1422 supports are secured to the brass tubing by means of 4-40 set screws. The purpose of the support is to take all stress off the fragile button mica capacitors. The rest of the assembly is readily completed by referring to the photographs.

The balun,  $T_2$ , is an 8 1/4-inch length of RG-5/U cable with the inner conductors soldered to the cathode mounts of  $V_2$  and  $V_3$ . One side of the outer shield is connected to the shield of transmission line  $T_1$ . The inner conductor of  $T_1$  also terminates on the cathode mount of  $V_2$ . Line  $T_1$  is a 6-inch length of RG-5/U cable terminated in a UG-18/U plug.

The first stage showed a power gain of 10 db with a driving power of 1 watt, and an output of 2.5 watts. The plate input was 22 ma at 500 volts. The second stage showed a gain of 6 db with an output of 10 watts. The input was 30 watts, yielding a plate efficiency of 33 percent. If lower power is desired, the first stage may be used alone.

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# Precision Interval Timer



Complete timer chassis. The relay is mounted underneath

By **SIDNEY WALD**

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RCA Victor Division  
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**A** WIDE variety of modern industrial jobs require accurate timing. Control of current duration in welding and timing of exposure in high-frequency heating and photographic enlargement are but a few possible applications.

Electronically operated timing circuits almost universally employ a combination of resistance and capacitance, wherein the measured interval is the time required for the capacitor to reach some predetermined voltage. While the relationship between the charge or discharge time and  $RC$  product is predictable and accurate the practical embodiment of this statement usually results in the introduction of other circuit variables such as tube electrode potentials, aging and loss of calibration through tube replacement.

The electronic timer to be described eliminates these sources of error while retaining simplicity.

The formula which governs the discharge of a capacitance through a resistance is

$$v = V_0 e^{-t/RC} \quad (1)$$

where  $v$  = voltage across the capacitor after time  $t$  seconds

$V_0$  = initial voltage across the capacitor

$C$  = capacitance in  $\mu f$

$R$  = resistance in megohms

$e = 2.718$

If we permit the capacitor to dis-

High accuracy of timing intervals from 0.01 to 100 seconds for industrial control applications is provided by permitting a capacitor to discharge through a voltage source of reversed polarity

charge to the point where  $v = (1/n)V_0$  we have

$$\frac{1}{n} V_0 = V_0 e^{-t/RC}$$

$$\text{or } e^{-t/RC} = 1/n$$

Thus for a given  $R$  and  $C$  it always takes the same time to discharge the capacitor to a given fraction of the initial voltage. Note that this time is independent of the value of  $V_0$ .

#### Modified Circuit

By the simple expedient of discharging the capacitor through a voltage source of reversed polarity, it is possible to make  $v = 0$  when the ratio  $1/n = 1/2$ . This type of discharge is shown in Fig. 1. Making use of these facts in Eq. 1 results in the following

$$e^{-t/RC} = 1/2 \quad (2)$$

$$\log_e 1/2 = -t/RC$$

$$\text{from which } t = 0.693 RC \quad (3)$$

Thus, after  $0.693 RC$  second, the voltage across the capacitor will be zero regardless of the initial voltage  $V_0$ .

In the circuit of Fig. 2, a miniature thyatron fires when its grid voltage passes through zero. A relay in the plate circuit pulls in and either energizes or interrupts a load circuit, depending on the contact arrangement. To repeat the cycle, the thyatron plate current is momentarily interrupted. This action permits the negative grid to regain control, holding off conduction until the capacitor discharge curve again passes through zero.

When the device is first connected

to the a-c line, the  $4\text{-}\mu f$  timing capacitor,  $C_t$ , is in a discharged state and consequently the thyatron fires as soon as the plate voltage derived from the 6AL5 power supply builds up. This action causes the plate circuit relay to pull in and  $C_t$  charges to 200 volts negative, with respect to the cathode of the 2D21. The grid of the latter, being permanently connected to  $C_t$ , likewise goes 200 volts negative. The thyatron remains in a conducting state, since one property of gas-filled tubes is the loss of control by the grid once the gas ionizes.

The circuit is now ready for the initiation of a timing cycle. It is accomplished by momentarily interrupting the continuity of the plate circuit. When the toggle switch marked RECYCLE is thrown to either position, the plate circuit is interrupted for a period equal to the transit time of the switch element. For the ordinary toggle switch, this may amount to a few milliseconds.

The tube is thus extinguished, the relay is de-energized and the highly negative grid regains control. At the same time, the normally closed contacts on the relay change the circuit so that the timing capacitor starts to discharge through the decade resistor (marked  $\times 1$  and  $\times 10$ ) and through the power supply. The action of the discharge circuit is clearly shown in Fig. 1.

When the potential across the capacitor reaches about 2 volts, the thyatron fires and the relay pulls in and remains that way until the

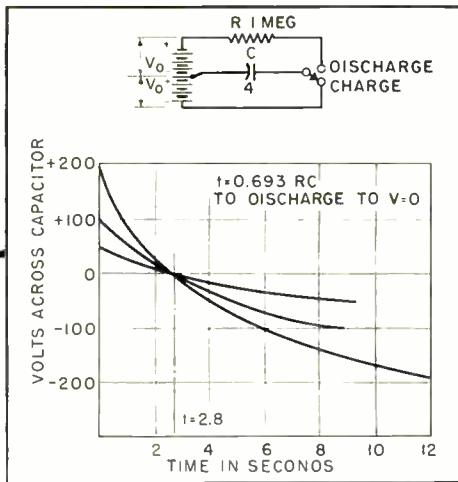


FIG. 1—Discharge of RC circuit

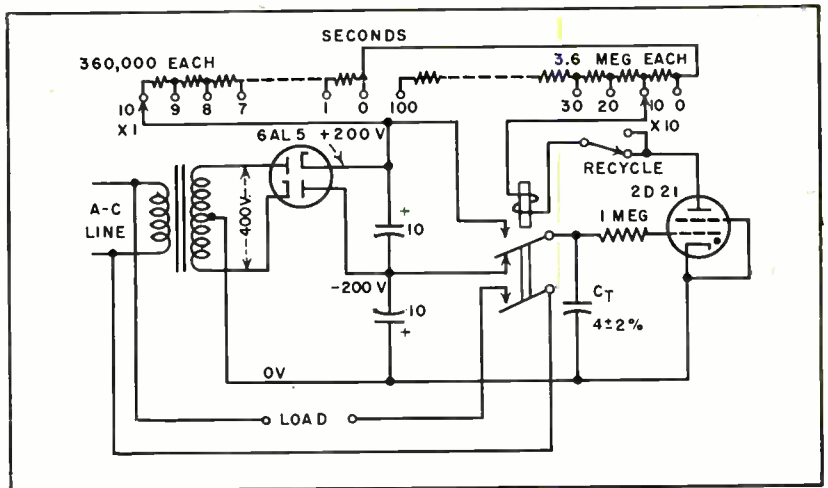


FIG. 2—Stable timer circuit provides intervals repetitive to 0.75-percent accuracy

circuit is again recycled. If a load, such as photographic enlarging lamp is connected in series with the a-c line and another pair of normally closed contacts on the relay, the light will go on for the precise period of time determined by the setting of the resistor decade switches.

#### Accuracy

The accuracy of the timing interval which may be obtained with this circuit depends on two principal factors, slope of the discharge curve near the firing potential of the thyratron and tolerance of the timing resistors and capacitor. Both of these are not only controllable but highly stable.

The value of the slope of the discharge curve at the firing point can be shown to be  $V_0/RC$  volts per second where  $V_0$  is initial voltage across the capacitor,  $R$  is given in megohms and  $C$  in microfarads.

To ascertain the timing error due to variation in firing potential of the tube, assume a maximum grid voltage drift of plus or minus 1 volt.

For a timing interval of 1 second,  $RC = 1/0.693$  or 1.44;  $V_0/RC = 200/1.44 = 139$  volts per second.

A more useful concept is the number of seconds per volt. Thus,  $1/139 = 0.0072$  second per volt. For the assumed variation in firing potential, we have a timing error of  $\pm 0.0072$  second. Since we were considering an interval of one second, this is equivalent to an error of  $\pm 0.72$  percent.

For a timing interval of 100 sec-

onds, we have an inverse rate of 0.72 second per volt and again the error is  $\frac{0.72 \times 100}{100} = \pm 0.72$  percent.

This shows that regardless of the timing interval, the percent error due to small variations in critical grid potential is fixed and, for most purposes, insignificant.

Resistance and capacitance tolerances affect the accuracy of timing directly since the measured interval is directly proportional to  $RC$ . If we consider equal tolerances on the capacitance and resistance, then the timed interval  $t = kRC(1 \pm p)$  where  $p =$  percent tolerance and  $k = 0.693$ . This leads to the relationship,  $t = k[RC \pm RC(2p) + RCp^2]$ .

For tolerances up to 10 percent, the second order term may be disregarded with the result that the resulting interval is in error by double the percent tolerance on either  $R$  or  $C$ . Thus, to insure one-percent accuracy, one must use half-percent resistors and capacitor.

An interesting case of cancellation occurs when the tolerance of one component is on the high side and that of the other component is equally on the low side. Then  $t = kRC(1 - p^2) = k[RC - RCp^2]$ .

For example, if the resistance is 10 percent high and the capacitance 10 percent low, the product error is 1 percent low. For 20-percent components, the timing error would be on the low side by only 4 percent.

The present design will give elec-

tronically timed intervals which are repetitive to an accuracy of at least 0.75 percent and absolute within about 5 percent, from 1 second to 110 seconds in 1-second increments. By making use of the relationship,  $t = 0.693RC$  and using suitable values of  $R$  and  $C$ , it is possible to extend the timing range considerably below and somewhat above that given. The plate circuit relay operate time limits the shortest possible timing operation. With ordinary relays, it is possible to go down to 0.01 second. There are two limiting conditions for measuring long intervals. One is the necessity for extremely large  $RC$  values and the other the need for a steep discharge curve at the firing point.

#### Maximum Time Interval

With 400 volts on the plate of the 2D21, a 10- $\mu$ f timing capacitor and a discharge resistance of 43.3 megohms, a maximum of 5 minutes might be successfully attained. It is believed, however, that a mechanical timer of some type would be inherently more suitable for such comparatively long intervals. The difficulties involved in procuring and maintaining extremely high stable  $RC$  are well known and in spite of recent advances in insulation and hermetic sealing techniques, it is well to avoid such circuitry wherever possible.

Credit is due J. S. Russo, also of Aviation Equipment Engineering, who was instrumental in the development of this electronic timer.

# Television REMOTE VIEWERS

By VIN ZELUFF

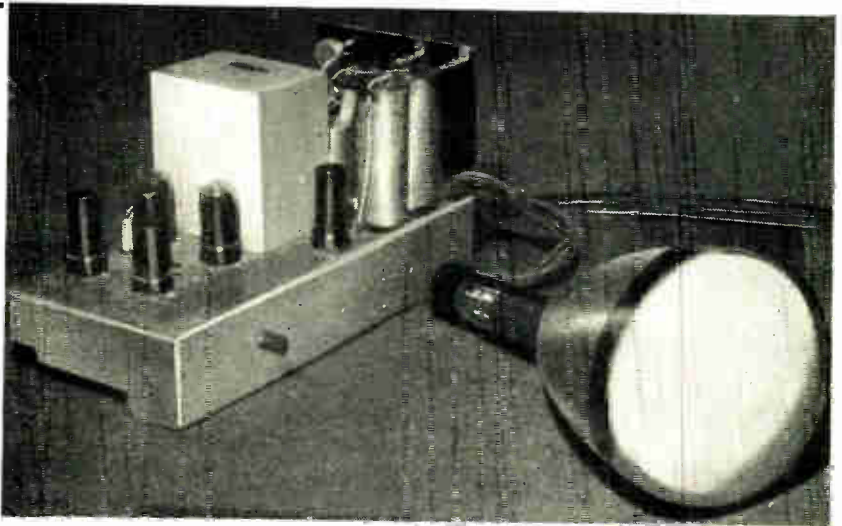
Associate Editor  
ELECTRONICS

**T**HE ADVENT of television has brought unusual desires to many set owners like the author. One of these, the desire for a larger screen, has not been found too important after the first year of operation. More confining have been the limitations imposed by having only one picture tube in the home. This tends to involve constant attendance in the living room when duty, homework, mealtime and other activities require presence in other rooms away from the picture tube.

In answer to this second desire, three different remote viewers have been devised to provide video programs in other rooms. These viewers permit occasional monitoring of the evening programs while engaged in other tasks and also permit a large number of people to be entertained in several groups of convenient size. Having two or more screens for larger groups eliminates the confusion of assembling all available chairs in one room.

## Independent Seven-Inch Viewer

The television receiver itself contains a seven-inch tube requiring electrostatic focus and deflection. For the first remote viewer, similar video and deflection circuits were assembled to form the unit shown in the block diagram of Fig. 1. This unit is an independent viewer that requires only a video signal of about two volts for picture operation. It contains cathode-coupled multivibrators for both vertical and horizontal oscillators, deflection amplifiers, a sync separator and, in the interests of economy, a single-stage video amplifier. For the same reason, d-c restoration is accom-



Independent viewer for attachment to video amplifier of any receiver. A second chassis, not shown, contains the low-voltage power supply, audio amplifier and loudspeaker

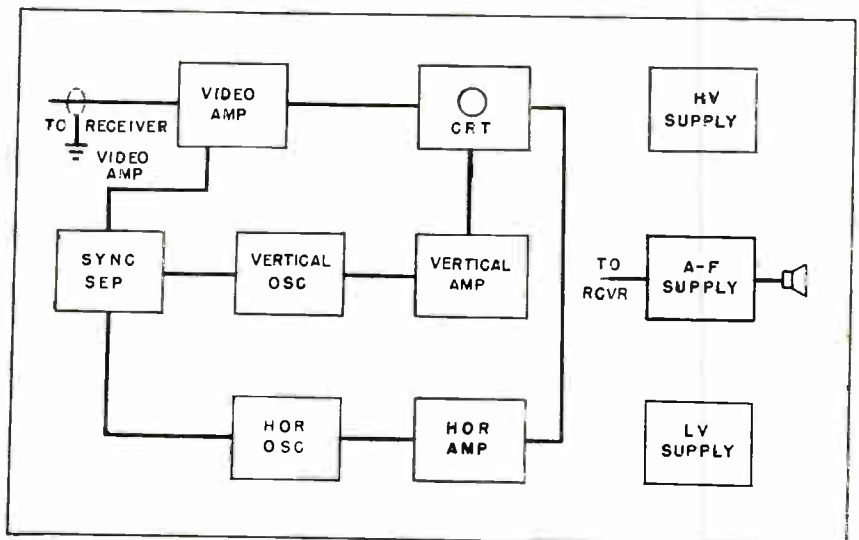


FIG. 1—Independent remote viewer contains its own sync-separation and deflection oscillators and is fed from the cathode of the video amplifier stage of any receiver

plished by utilizing the current through the grid resistor of the video amplifier tube.

An unterminated coaxial cable is used to carry the video signal to the remote viewers. A cathode follower was installed at the receiver for feeding the video signal at low output impedance to the cable.

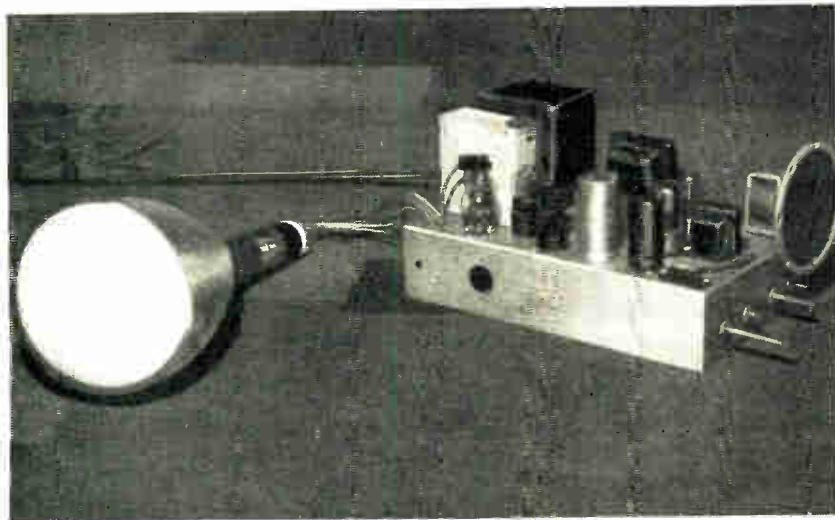
It was considered desirable to investigate the possible design of simpler remote viewers. Here sim-

plification of circuit connections and minimizing of changes in the receiver were indicated.

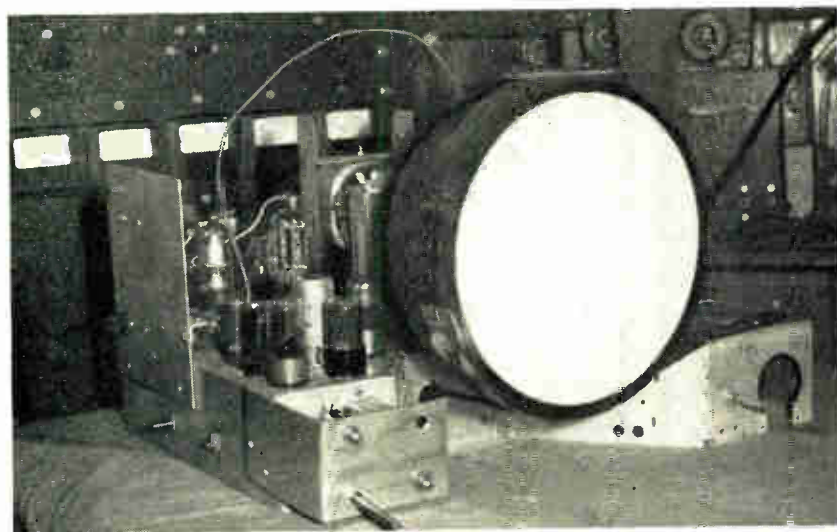
## Design Simplification

Elimination of the extra tube for the cathode follower was desirable and found feasible. This was accomplished by inserting a 500-ohm resistor in the cathode circuit of the receiver's video amplifier and feeding the voltage developed

Cathode loading of a video amplifier stage in a receiver permits feeding two different types of picture-tube repeaters. By the same method, a third type, a simple slave repeater, can be fed from one of the viewers or from a receiver having electrostatic deflection



Complete slave viewer and audio channel. The electrostatic independent viewer or the receiver is used as a master unit



Ten-inch independent viewer constructed on a prepunched chassis. Only the video cable and audio line are needed for operation of this unit

across it to the remote viewers. The normal plate load circuit of the video amplifier was left unchanged. The final circuit is shown in Fig. 2. Only slight loss of video voltage to the receiver picture tube resulted from the dual output loading, and this was readily compensated by adjustment of the i-f gain control used as a contrast control.

The video signal has been fed through various types of cable, in-

cluding RG8U, RG59U, microphone cable and even 300-ohm flat transmission line. All of the shielded types proved satisfactory in lengths up to 100 feet. Distances greater than this would not usually be encountered in the average home and would probably require a terminated line to eliminate standing waves at the highest frequency.

The independent viewer can be connected to any receiver at a point

where a positive video signal of the proper voltage is available. If it is necessary to use a negative signal, the input can be made to the cathode of the remote's video stage.

The circuits of several receiver models available show an unby-passed cathode resistor in one of the video amplifier stages. From this point, these sets can be connected to remotes with only a possible addition of a signal divider if the video level is too high.

The first remote viewer included its own sound channel, using the simple intercarrier system, for demodulating the f-m signal produced at 4.5 megacycles by the transmitter. This required four tubes and was found to be an unnecessary luxury. A single audio stage is used in the viewers illustrated. Each of these is fed by an audio line from the receiver.

An alternative would be to eliminate the audio tube and connect loudspeaker voice coils to the audio line with low-impedance pads for individual control of audio level at each viewer. The system shown was adopted because of simplicity in circuit arrangement, as well as because it allows any remote viewer to be operated at a higher sound level than the receiver.

The picture controls of the independent viewer are essentially the same as those in a conventional receiver. Width, height, brightness, focus, vertical and horizontal frequency and centering controls are provided. Sufficient variation of contrast is provided by a 100-ohm rheostat in the cathode circuit of the video amplifier.

#### Simplified Seven-Inch Viewer

Cathode loading suggested a means of designing a slave remote unit in which there would be no

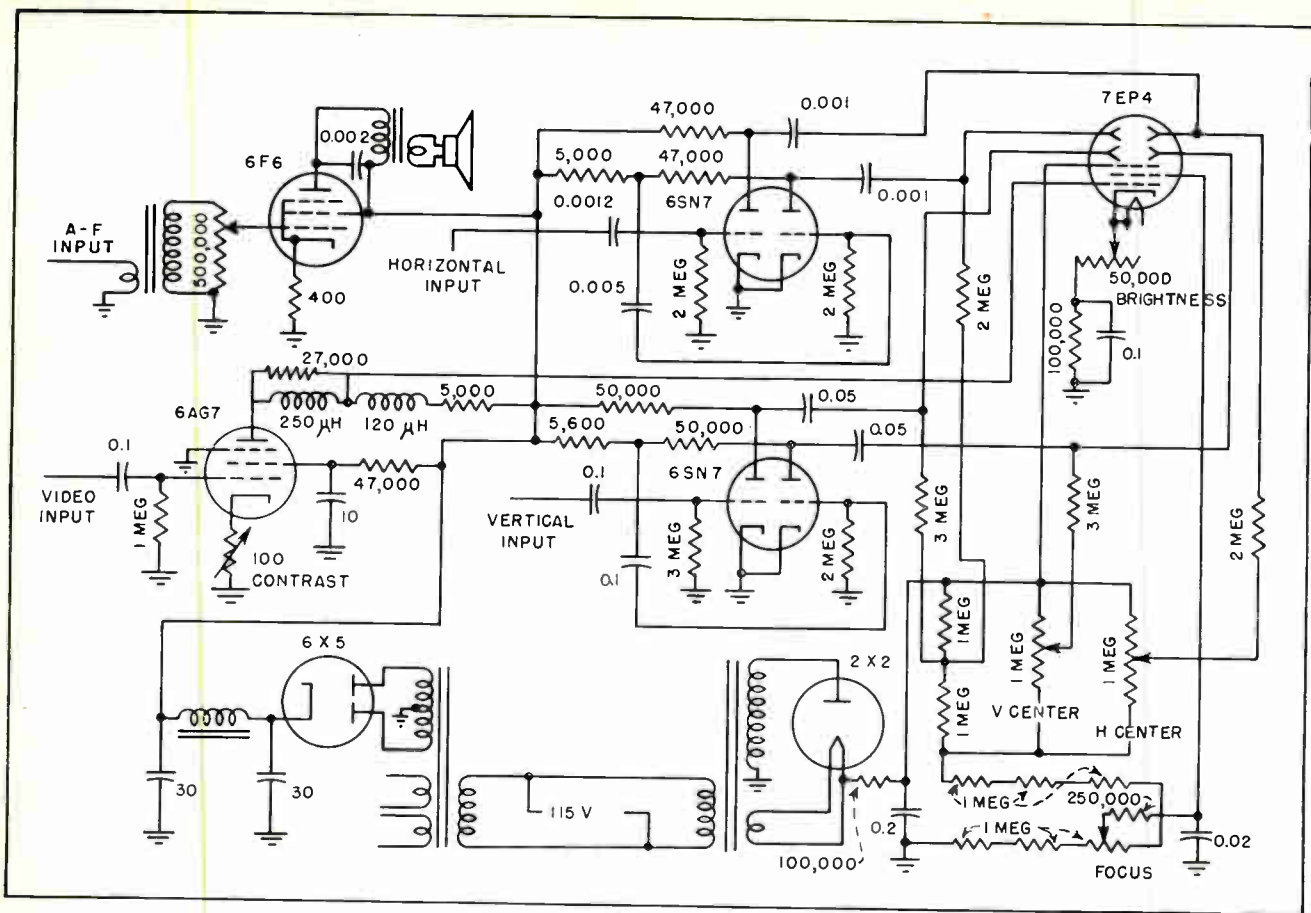


FIG. 3—Complete circuit of slave viewer. Three 35-foot sections of RG59U carry the video signal and vertical and horizontal deflection voltages. A separate line carries the audio signal

need for a sync separator, vertical oscillator or horizontal oscillator. The complete circuit of a slave remote is shown in Fig. 3.

The two 6SN7 tubes are operated as two-tube paraphrase vertical and horizontal deflection amplifiers feeding the appropriate plates of the cathode-ray tube. Sawtooth pulses for the two amplifiers are supplied from the cathode circuits of the deflection amplifiers

in the receiver (or from the independent master remote).

The values shown in the schematic provide a raster whose corners just touch the periphery of the cathode-ray tube screen in the slave remote when the width and height controls of the master unit are adjusted for that condition. Different types of picture tubes that operate at higher or lower voltage would require slightly different sweep voltages to fill the screen. To minimize changes in the original receiver, it is best to vary only the values of components in the slave unit. In operation, the size of the slave picture varies directly with change in size of the master unit.

Four controls are provided on the front panel of the slave viewer. These are focus, contrast, brightness and audio gain. The vertical and horizontal centering controls are mounted at the rear of the chassis.

Figure 4 shows the connections of the cables to the deflection amplifiers in the receiver. Most com-

mercial receivers have similar circuit arrangements of the deflection amplifiers. The cathode circuit of the first vertical amplifier usually contains a resistor that can be utilized as the load feed to the remote amplifier.

Usually the horizontal amplifier has the tube cathodes grounded, and a resistor is inserted as the cathode load. The values shown were found optimum for the par-

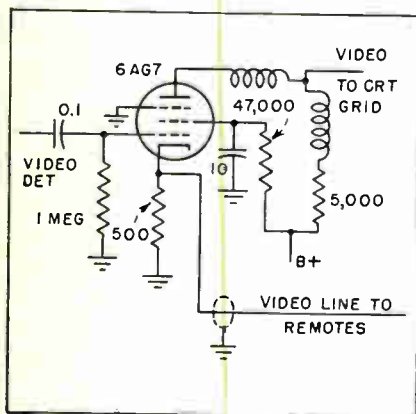


FIG. 2—Low-impedance output for remote viewers is obtained from the cathode load resistor of the video amplifier

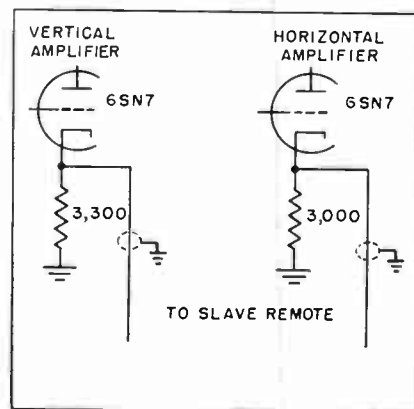


FIG. 4—Changes in receiver circuits to provide sawtooth output for the deflection circuits in the slave viewer



ticular receiver; others that use 6SL7 tubes will probably require a different value.

In some receiver designs, the second tube of the paraphase may have a cathode resistor which can be used without change. Since this tube is handling the opposite phase of the first, the slave viewer would then produce a mirror image of the picture. Reversing the deflection plate connections to the coupling capacitors of the slave unit will then give the proper image at the remote.

### Deluxe Ten-Inch Viewer

It was felt that a larger and perhaps brighter picture unit was the next step. This need was quite adequately met by the General Electric 10FP4 picture tube, and an inde-

pendent electromagnetic remote viewer using it was constructed. The circuit of this unit is shown in Fig. 5.

The blocking oscillator transformers and focus and deflection coils are RCA components and their circuits are the ones recommended for these parts, although the tube line-up is different from that employed in the RCA receivers.

Like the independent seven-inch viewer, the ten-inch remote contains a single-stage combined video amplifier and d-c restorer. Sync pulses are taken from the video cable by the 6SK7 sync separator at the left in the schematic diagram. Some misgiving was felt initially at the use of this simple grid-leak biased pentode circuit, but it has proven quite satisfactory.

The focus coil is arranged in the positive low-voltage line for convenience in mounting the filter capacitors. The plate current requirement of all tubes in the viewer is 150 milliamperes.

If the audio stage (not shown) is omitted, the values of the resistors shunting the focus coil may need to be changed and a bleeder resistor may be necessary in the power supply to keep the current through the coil sufficient for focusing.

Damping resistor *R* can be composed of a fixed resistor of 5,000 ohms and a rheostat of 3,000 ohms. Less than 5,000 ohms causes the picture to fold back on itself at the left side. A value upward from 5,000 ohms controls trace linearity of the left side of the picture.

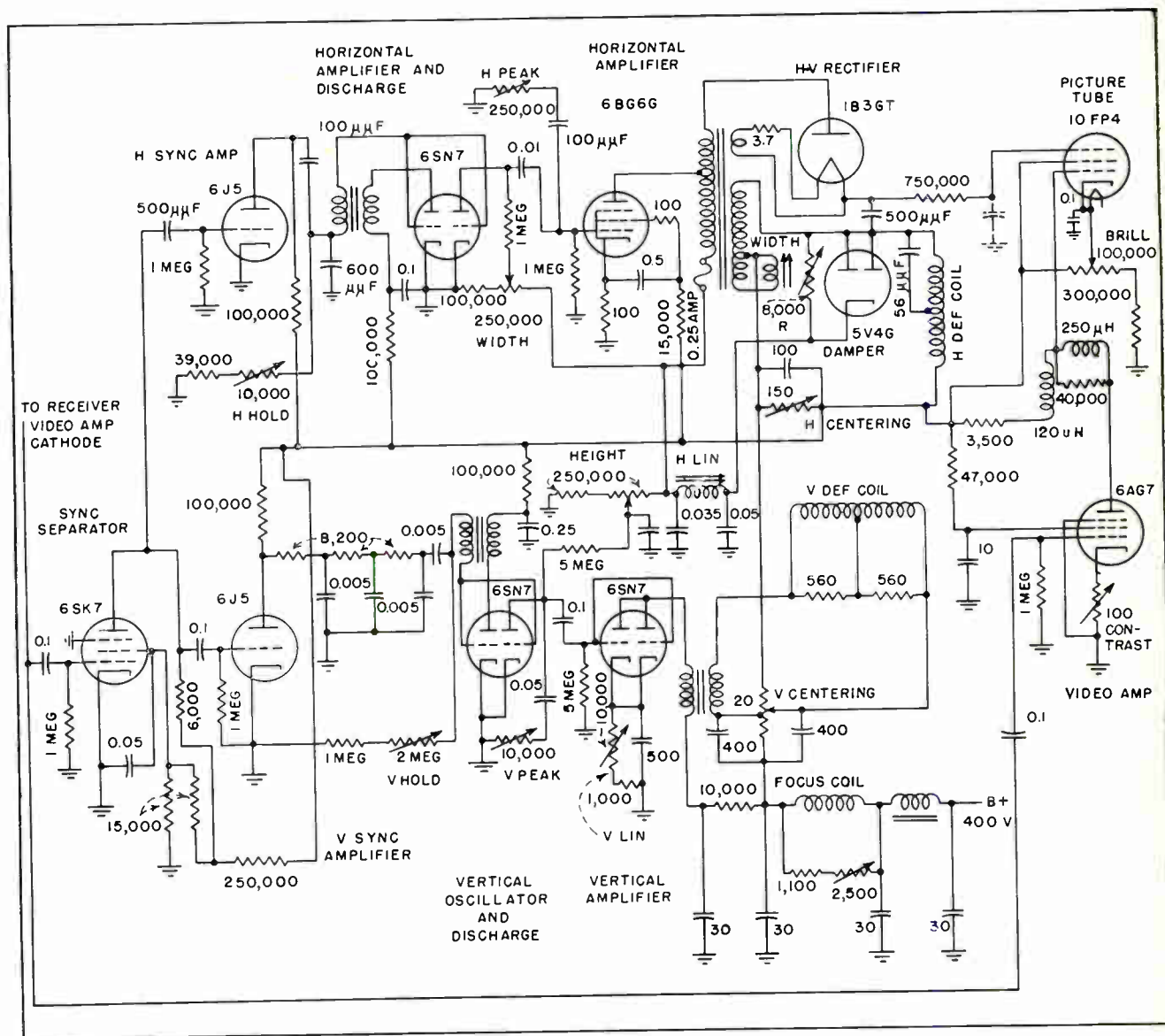


FIG. 5—Complete circuit of ten-inch independent remote viewer with electromagnetic deflection and focus

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**S**EVERAL YEARS AGO, an investigation was begun in these laboratories of newly developed high dielectric materials. Potential use in capacitors for hearing aids was envisioned. As a result of this study it was predicted that some of the materials might show piezoelectric properties while under the influence of a direct-current polarizing field. The junior author, with the assistance of Joseph Crownover, then with this company, made an experimental study of the prediction. This work disclosed that such piezoelectric properties did exist and, furthermore, that permanent polarization remained, giving some of these materials permanent piezoelectric properties.

The application of such materials to numerous types of transducers such as microphones, vibration and pressure detectors, frequency-control units, modulation units and phonograph pickups was at once indicated. A project covering these and other related items of development was started. To make this project self-supporting it was decided to exploit the use of the material in a phonograph pickup cartridge at the start. A part of the general research was concerned with an investigation of various materials which showed the piezoelectric property from the point of view of picking out a material that represented the best combination of sensitivity, freedom from temperature variation and ease of handling. The material finally chosen was barium titanate in the form of a ceramic.

#### Properties of Barium Titanate

The property of permanent piezoelectricity for the materials studied occurs at temperatures below the Curie point. The Curie point corresponds to a maximum point in the dielectric properties of the material.



To test each cartridge, it is placed on a vibrating platform which is driven in frequency across the audio spectrum. Oscilloscope and meter show pickup response

## Ceramic

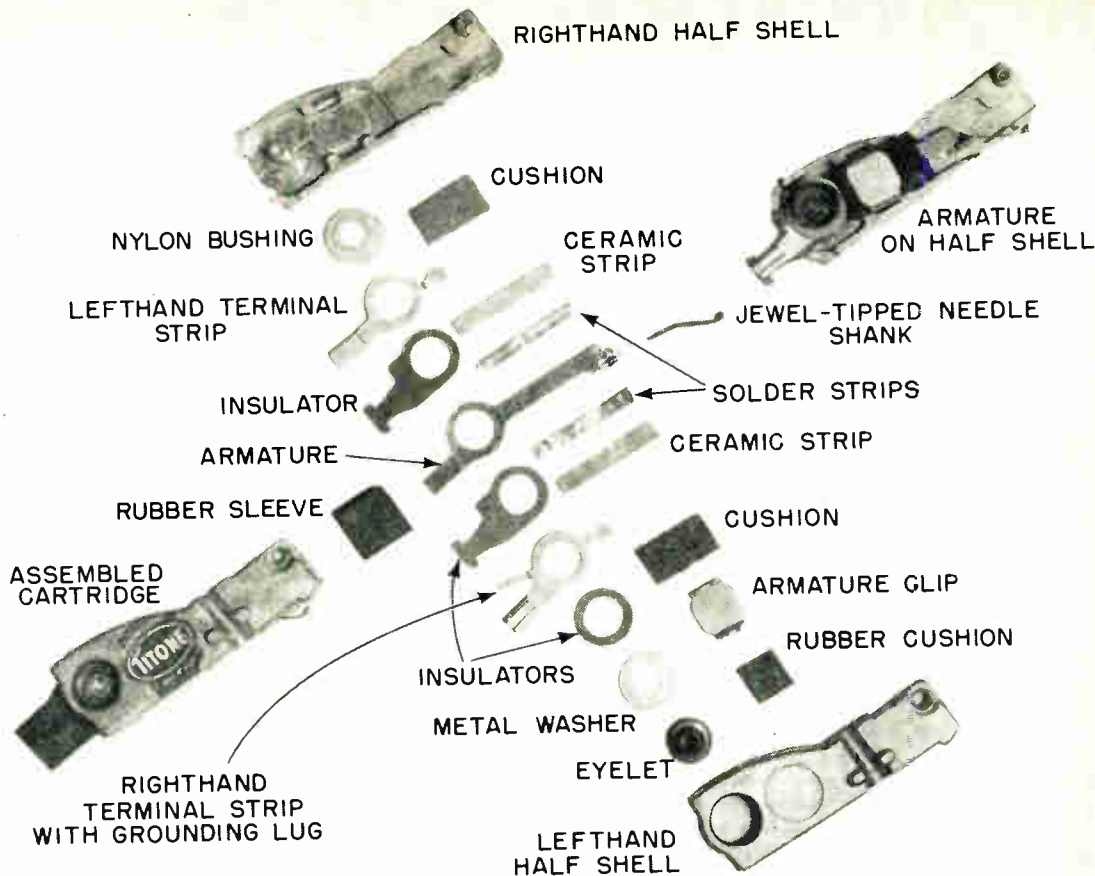
For the case of pure barium titanate this temperature is approximately 120 C. Sensitivity of the material shows negligible change between  $-70$  and  $+70$  C. The material is also independent of humidity effects. In addition to these properties of permanence, the material also lends itself to a symmetrical construction which contributes to the flatness of frequency response of a transducer. This property, in combination with permanence under varying conditions of temperature and moisture, makes it an ideal material for use in phonograph pickups.

#### Pickup Characteristics

A phonograph pickup cartridge was developed which gives a nominal output of 0.75 volt at 1,000

cycles per second on a standard test record. The construction is such as to permit this pickup to be made for the low-cost market in spite of its excellence in performance and durability. The standard cartridge originally produced carries a permanent sapphire needle with a tip of 0.0027-inch radius. The compliance of the device is sufficiently high to permit a tracking weight of only 22 grams for use on 78-rpm records. (This cartridge has been used in large quantities in phonographs marketed by Sears Roebuck & Company for considerably more than a year under the trade name Syntronic. Pickups are marketed directly by the Sonotone Corporation under the trade name Titone.)

The ceramic material is cut in narrow strips, the sides of which



Parts of the ceramic pickup for 78-rpm records are shown in their order of assembly. The sensitive element of the pickup is formed by the two ceramic strips that are soldered to the armature. Terminal strips and cushions hold it in shell

# Phonograph Pickup

Two synthetic barium titanate slabs are mounted between three electrodes and then made piezoelectric by applying high voltage to form a pickup that is unaffected by humidity or normal temperatures. The artificial piezoelectric is generally applicable as a transducer

are covered with a silver frit. Two such pieces are fastened by soldering to the opposite sides of a thin metal armature. One end of the armature is clamped in the case, forming a hinge. To the other end is soldered a small metal arm carrying the sapphire needle. Plastic pads on either side of the assembly act as lateral dampers and control the compliance. Practically, there is an optimum thickness of the barium titanate ceramic which is a compromise between a thin strip for high capacitance, high compliance

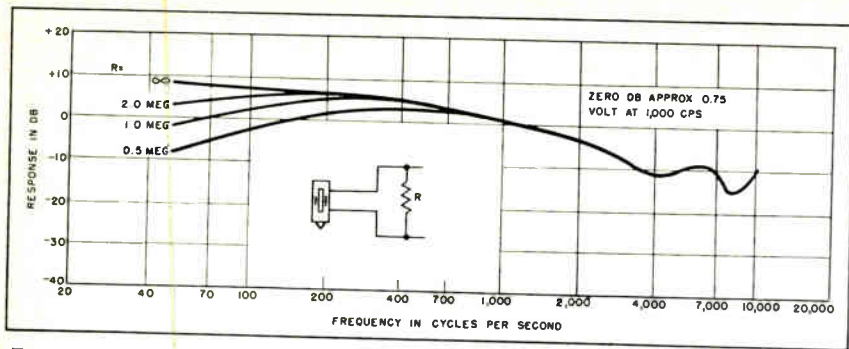
and low mass on the one hand and a thick strip for ease in handling and freedom from dielectric breakdown because of effects of surface roughness during polarizing on the other hand. Theoretically, thin strips would be best as there would then be more strain energy stored in them to produce the piezoelectric voltage.

### Compliance, Inertia and Damping

At low frequencies, compliance (the reciprocal of stiffness and the mechanical analog of capacitance)

is of primary importance. The ratio of the distance from the center of effective force of the plastic dampers to the hinge and from the needle tip to the hinge forms a step-down lever so that large motions at small force (high compliance) on the needle produce less motion but large force (low compliance) on the ceramic element. This arrangement is necessary, the compliance of the titanate structure being too low to drive directly.

In designing a pickup, one wants a high needlepoint compliance for



Frequency response of pickup for 78-rpm records is substantially flat at low frequencies despite small size of sensitive element because of its high dielectric constant

tracking at low frequencies, but in general the higher the compliance, the lower the sensitivity. The needle is therefore mounted on a short extension to give a reasonably high compliance. This extension is also used to give very high vertical compliance to provide freedom from surface noise and to lessen vertical shock. The proportioning of inertia (inductance), compliance (capacitance) and damping (resistance) is such as to give good transient response, which is required for clear reproduction of speech and music.

High-frequency response is provided by coupling the 7,000-cps needle-arm mode with that of the lowest mode of the system, which occurs at 2,000 cps. The provision of sufficient damping in the plastic pads smooths the resonances due to these modes to provide the response shown in the diagram.

Of great importance for proper tracking at high frequencies is the value of the effective mass of the pickup at the needle point. This mass is measured rather than calculated because of the many uncertainties and assumptions required in a system of distributed parameters. The measurement is made by observing the deviation in frequency, produced by the loading introduced by the pickup needle, of a reed driven electromagnetically. An inertia of four milligrams was measured at 10,000 cps.

The production pickup for 78-rpm records, tested on the 1,000-cps band of a standard test record, gives an open circuit output of 0.75 volt; it has a lateral compliance of  $0.5 \times 10^{-6}$  cm per dyne or better. The active material in the pickup has an effective dielectric constant

of 1,200, giving a total internal electrical capacitance of about 900  $\mu\text{f}$ . The internal generator voltage is directly proportional to the needle excursion amplitude plus a lift above 5,000 cps due to the effect described above. For nominal performance the pickup should work into a load resistance of one megohm.

A pickup for microgroove records, with a 0.001-inch radius needle tip and a tracking weight of 6 grams using the same materials, develops 0.25 volt at 1,000 cps on a standard test record. This 33 $\frac{1}{3}$  rpm pickup has a compliance of  $0.75 \times 10^{-6}$  cm per dyne. Models have also been made of a dual cartridge for playing both 78 and 33 $\frac{1}{3}$ -rpm records.

#### Manufacture of the Pickup

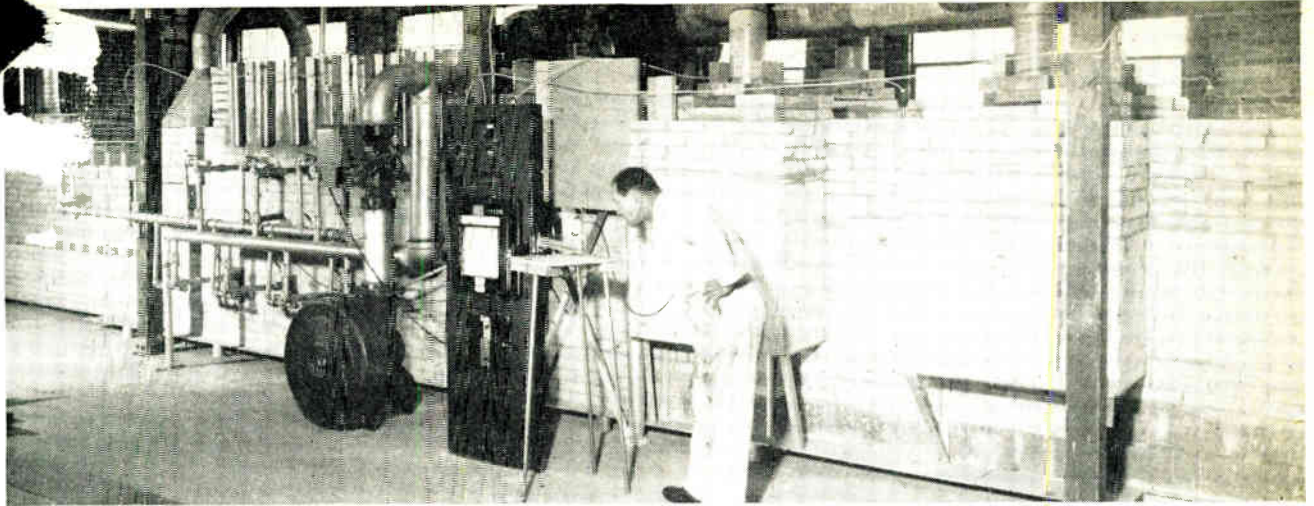
In describing the design and response of the pickup, its general construction was outlined. The accompanying labeled parts-view photograph indicates the construction of the pickup for 78-rpm records. The barium titanate used in the sensitive element is in the same class as that used commercially in ceramic capacitors, although the purer it is the better. Strips for the cartridge are cut from silver-frit coated sheets and solder-sweated onto the metal support. The metal wets the ceramic at high temperature and, in cooling, contracts more than it, thus putting the ceramic strips under longitudinal compression. The titanate is brittle, but by thus placing it under precompression, the assembled element can be handled safely during production and is negligibly subject to damage from rough handling in use.

The ceramic is then polarized by applying high voltages to the electrodes. Polarization takes an action of an hour, the exact time depending on the voltage used. However, some combinations of materials are very sluggish, even taking days to polarize.) Inasmuch as the barium titanate breaks down above approximately 100 volts per mil the charging voltage is limited by breakdown, although for rapid production the highest safe voltage is desirable.

After the units are polarized, they are tested for sensitivity. The pickup is then assembled and finally tested for response. In some production items a sampling technique can be used to test for quality, especially if a limited number of variables affect the final performance. However, in such production items as pickups where overall response is a function of every variable in the unit, sampling is inadequate; quality control must be maintained by checking each unit for its response. Efficient operation of the production line depends, in part, on a practically automatic means of testing each assembled pickup.

Barium titanate ceramic is a polycrystalline aggregate with a high dielectric constant. Other well known materials with comparable piezoelectric properties are Rochelle salt and ammonium dihydrogen phosphate. These latter materials are used in the form of single crystals. It would not ordinarily be expected that strong piezoelectric properties would be observed in polycrystalline aggregates of random orientation. The fact that a strong effect is observed in barium titanate ceramic may be explained on the assumption that the material exists in the form of transitional-type crystals intermediate between the ionic and valence types. It appears to be possible in this type of structure to orient the domains by means of an applied polarizing field.

The project in which the above work was accomplished is now being expanded to include a study of piezoelectric properties of single crystals of barium titanate and in their potential applications to other transducer problems.



To obtain dense, nonporous slabs of barium titanate from which highly sensitive synthetic piezoelectrics can be made, the temperature of this special kiln in which the material is fired is held constant to one part in a thousand

# New Synthetic Piezoelectric Material

Pure barium titanate, fired into a ceramic, can have piezoelectric properties induced into it permanently by applying a direct-current polarizing field. The design considerations for transducer elements made with the synthetic material, its properties and production are described

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**B**ARIUM TITANATE has been studied extensively recently because of its high dielectric constant and piezoelectric properties.<sup>1</sup> It is a heterogeneous, randomly oriented polycrystalline, dense ceramic.

While this material has been used for several years as a high constant dielectric, in recent months it has attracted considerable attention for use in such piezoelectric transducers as microphones and phonograph pickups. In both these applications, a double-slabbed element is strained in bend fashion so that a mechanical lever advantage is gained. This article describes the bases of these appli-

cations and the method for making the material piezoelectric<sup>2</sup>.

#### Size of Transducer

In fabricating transducer elements of the size used in micro-

phones and phonograph pickups, two ceramic sheets of the desired size are bonded together, such as by soldering, after which leads are attached. These barium titanate ceramic elements, after being sub-

#### APPLICATION AND MATERIAL

The preceding article described the application of a new material to phonograph pickups. This article describes the material itself in greater detail. Together, they tell an interesting story.

Barium titanate, studied during the war, was found to have a remarkably high dielectric constant so it was produced as a substitute for mica in capacitors. Later a way was found to make it piezoelectric.

With the resumption of peace-time research, the properties of this material were further studied, and ultimate use in transducers of many kinds seems likely.

jected to high electric fields, exhibit induced piezoelectric properties.

The thickness to which the ceramic is extruded is determined by the practical optimum thickness of the transducer element, which has been found to be 0.010 inch, a compromise of low compliance on the one hand and voltage breakdown strength due to corona on the other hand. That such elements can have good frequency response is illustrated in Fig. 1A. Here the calculated midband and low-frequency responses are given for several microphone elements feeding through a 400- $\mu$ f cable to a 5-megohm load. The curves, calculated on the basis of the equivalent circuit included in Fig. 1A, are given for elements of five different widths, indicated by their capacitances.

Changing the width of the element has two effects upon the response. First, an increase in width decreases the longitudinal stresses in the material and hence the midband response is decreased. Secondly, increasing the width of the element has the effect of increasing the series capacitance and thus increasing the flatness of response at the low frequencies. To illustrate this point, note that the 1,600- $\mu$ f unit has the smoothest overall response, going down to half power (0.7 volt) at 17 cps. But this flatness is gained at the sacrifice of the midband level.

If the width of the unit is too small, not only is the low-frequency response sacrificed, but the midband response drops as well. This is illustrated by the curve of the 200- $\mu$ f unit in Fig. 1A. In Fig. 2 the midband response of an element is plotted as a function of its capacitance (width) for several cable loadings. From these graphs, we can expect the 400- $\mu$ f element to give the best results.

While the curves of Fig. 1A and Fig. 2 are calculated, actual tests of the frequency-response characteristics on microphone and Glenite pickup elements in Astatic housings have been made and the results, as indicated in Fig. 1B and 1C, are comparable.

#### Induced Piezoelectricity

The ceramic is made piezoelectric, after it is fabricated into the

transducer element, by applying a polarizing potential.

The limiting factor on the usable charging potential is the dielectric strength of the titanate material. The breakdown voltage was found to be approximately 100 volts per mil, but when corona is completely eliminated, breakdown strengths approximating 200 volts per mil are obtained. A much smaller charging potential is capable of producing almost the same degree of polarization when exerted over a longer period.

The time delay for polarization to take place and the saturation can be understood from the nature of the polarizing action. Initially, individual cubic crystals are twinned within themselves (optical axes of different domains of a crystal are at 90 degrees to each other). When the polarizing potential is applied, the domains of one orientation grow gradually at the expense of the others so that, finally, the crystal approaches a single domain. This growth of one domain and shrinkage of the other can be seen with a microscope, using polarized light. Because in polycrystalline ceramic materials the orientation of some crystals may not favor the growth of one domain at the expense of the other, not all the crystals will contribute to the overall piezoelectric effect. It is interesting to observe that a single crystal of barium titanate that has been polarized has a sensitivity one order higher than does Rochelle salt.

Figure 3A shows the dielectric constant and  $\tan \delta$  of the material versus temperature. It will be noted that the dielectric constant is quite uniform through the normal temperature range. Figure 3B shows the piezoelectric modulus (sensitivity) over the temperature range from  $-60$  to  $+140$  C. There is a drop in sensitivity at low temperature (not shown) due to the lowering of the dielectric constant. The piezoelectric effect is lost if the material is heated above the Curie point, represented by the peak in the dielectric constant shown in Fig. 3A. The peak occurs at about 248 F, (120 C), therefore the maximum practical operating temperature has been found to be

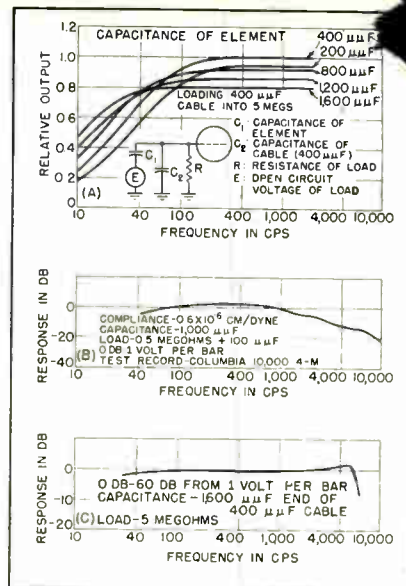


FIG. 1—(A) Capacitance of ceramic element affects theoretical frequency response, but if the optimum thickness and area of ceramic are used, the measured responses of pickups (B) and microphones (C) made from it are uniform

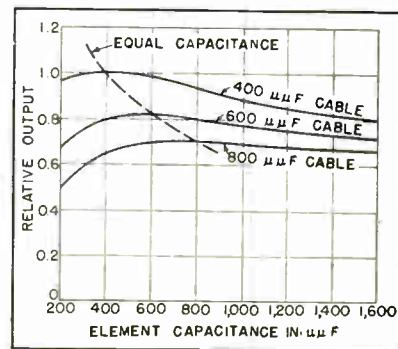


FIG. 2—For maximum midband response, the capacitance of the piezoelectric ceramic element should be made equal to that of its connecting cable

212 F, which leaves some margin.

The manner in which the relative piezoelectric sensitivity is affected by charging time is shown in Fig. 4 for a bender-type element at various charging potential gradients. The sensitivity of elements is easily determined by observing its hysteresis loop on an oscilloscope.<sup>3</sup>

#### Physics of the Phenomena

No complete theory has been advanced to explain the phenomenon of an induced piezoelectric effect. However, there does appear to be a close resemblance between the ability to produce the magnetic effects in ferromagnetic substances and these phenomena; that is, there exists small regions in which dipoles can be oriented in the same direc-

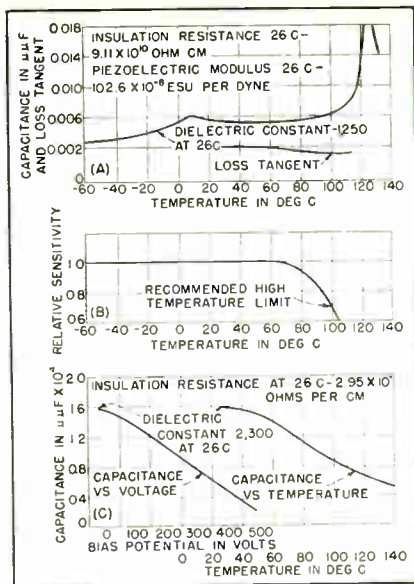


FIG. 3—Characteristics of piezoelectric ceramic are (A) dielectric constant, loss tangent and (B) sensitivity. Another type of ceramic shows nonlinear capacitance effects (C) illustrating the versatility of these new materials

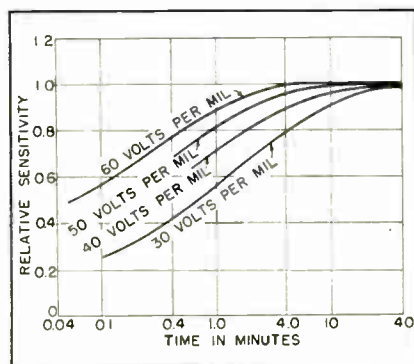


FIG. 4—Saturated polarization is reached sooner with higher potential gradients, but even small voltages polarize the material ultimately

tion under the influence of strong electric fields and these regions retain an electric moment after the externally applied field is removed.

Like all piezoelectrics, electrical charges can be generated in the sensitized barium titanate on the application of mechanical stress. However, the features which distinguish the piezoelectric ceramic material from the natural piezoelectrics are: (1) the piezoelectric effect is induced, (2) oriented cuts of the piezoelectric ceramic are not required because the material is polycrystalline and random in distribution, while in the normally accepted material, oriented cuts of single crystals are used, (3) the induced piezoelectric effect can be removed and reinduced

repeatedly with no discernible deterioration of the material, (4) oppositely sensitized adjoining regions may lie within a single strip of ceramic, and (5) it does not absorb moisture.

The piezoelectric effect, due to hydrostatic pressure, has been measured and found to be on the order of  $100 \times 10^{-8}$  esu per dyne.

If this general phenomenon exhibited by the material can be considered as conforming to properties of certain piezoelectric materials, it means that the piezoelectric ceramic material will exhibit primary pyroelectric effects. This would place a limitation on the use of barium titanate in high power mechano-electric transducers, because application of high alternating potentials would heat the ceramic, possibly above its Curie temperature, in which event the induced piezoelectric effect would be lost. However, it can be used for low-powered devices, such as tweeters.

#### Producing the Ceramic

As in all ceramics, control of the composition of the raw material is highly important. However, for piezoelectric purposes this alone is insufficient. Several steps must be taken to remedy slight variations of impurities in the raw material. The necessity of processing barium titanate into thin sheets has called for a new ceramic method.

The raw materials are intimately blended by severe agitation and grinding with the vehicles and binders. The mixed suspension is then placed under vacuum to eliminate entrapped gases, which tend to lower the density and dielectric strength of materials made by typical methods.

The treated suspension is next spread evenly on a moving belt where it is dried and then removed in sheet form resembling paper. The sheets are then punched to a convenient size and are placed on highly pure ceramic tile for firing.

Firing of the ware is a step where extreme control must be maintained to obtain high-quality ceramics of uniform characteristics economically. It has been found necessary to design and build a special tunnel kiln where tempera-

tures between 2,400 and 2,500 F can be maintained within  $\pm 3$  F.

The fired ware is then silver coated using ceramic fired-on silver. Control at this point must be maintained to apply the correct electrode thickness properly. Ceramic sheets are then cut by an abrasive wheel into the sizes required for piezoelectric applications.

It is well to note that this process can be adapted to the fabrication of capacitors and other dielectrics. Sheets from 0.003 to 0.020 inch thick can be processed up to 16 square inches in area.

An additional ceramic of considerable interest, which is not piezoelectric at room temperature, is one having a high voltage coefficient of capacitance: Fig. 3C gives its capacitance versus voltage as well as its capacitance versus temperature. This ceramic material could facilitate the construction of a sweep-frequency generator. The frequency of an oscillator can be changed by applying biasing voltages to the ceramic capacitor. It has been found that a varying biasing potential can be conveniently used to modulate an oscillator. An inexpensive sweep-frequency generator for television testing purposes could be easily made with it. Thus it can be anticipated that ceramics will play an increasingly important part in the electronic industry.<sup>15</sup>

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# High-Voltage Supplies

Discusses several types and their adaptability to portable applications. Describes system found to be best suited for such applications and gives curves showing typical operation under normal operating conditions

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**D**URING the past decade, a number of battery-operated light-weight power supplies for use with Geiger-Muller counters operating between 800 and 1,500 volts have been described, and data on their performance characteristics have been recorded. Where light weight has been the prime consideration, as for example, in cosmic-ray measuring equipment sent aloft in balloons, specially designed batteries are often required. These are of such small size that they are usually exhausted in the few hours required for a test.

For applications involving field service work, it is desirable that standard batteries be used. They must be light in weight but capable of supplying the equipment for several hours per day with intermittent use over a period of several months.

## Metering

For all work with power supplies for G-M tubes, it is usually desirable to have a direct and fairly accurate indication of the voltage. In this way, the voltage may be checked with the data supplied by the manufacturer to insure that the operating point of the tube is on the Geiger plateau or level portion of the counter characteristic.

One of the simplest ways to obtain accurate voltage indication is to insert a sensitive meter in series with an accurately known bleeder resistance across the high-voltage output. With a high-voltage source of low internal resistance, such as a battery, the resistance and the meter may be switched out of the circuit

except when the voltage is measured. With sources of high internal resistance, such as in portable electronic h-v supplies, the load regulation is poor and the bleeder should be in the circuit at all times during operation. The meter, however, when not being used as a voltage indicator, may be switched for use elsewhere in the apparatus, as, for example, for indicating the integrated counting rate in an amplifier circuit from the G-M tube.

For the sake of ruggedness, a meter drawing 50  $\mu$ a at full scale appears to be desirable. With high-voltage sources of high internal resistance, the use of a 50- $\mu$ a meter is also preferable to a 20- $\mu$ a meter because of the improvement in regulation with variable G-M tube loads.

The need for metering the high voltage and its consequent ramifications, particularly when used in circuits of high internal resistance, presents a further problem, the efficiency of power transformation. In the sense that the bleeder power is useful, in that it makes possible

a necessary voltage indication, the output power may now be considered the sum of the power dissipated in the bleeder, meter, and G-M tube circuit. The power expended in the meter and G-M tube circuit is negligible compared with the power dissipated in the bleeder. A bleeder current of 50  $\mu$ a at 1,500 volts represents a power output of 75 milliwatts, a requirement which has a direct bearing on the battery size for the desired life. It also points to the need for good power transformation efficiency.

For example, suppose that four midget 67½-volt batteries, each weighing 12 oz., are arranged in series-parallel to deliver 135 volts at 2.5 ma for a desired useful life of 325 hours. Suppose that at this battery input a voltage-multiplying circuit has been found that will deliver 50  $\mu$ a at 1,500 volts. The efficiency or ratio of power output to power input is 22.2 percent. If the efficiency were 44.4 percent, the battery weight could be reduced from 3 lb to 1½ lb.

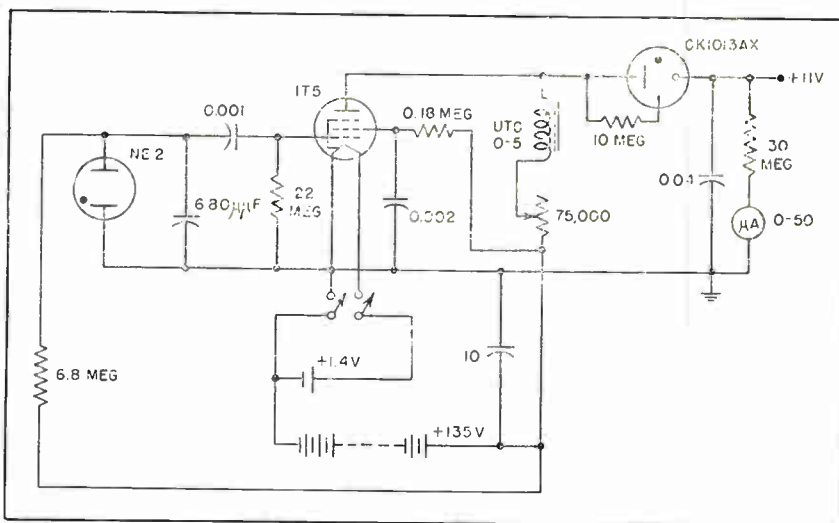


FIG. 1—Circuit of portable 900-volt power supply with adjustable output voltage



# For G-M Counters

Midget batteries are now available up to 300 volts (Eveready No. 433). A high-voltage supply consisting of a multiple of 300-volt units has much in its favor. The units are fairly compact and extremely simple to install. The life is essentially the shelf life when used with normal G-M counter currents of less than 1  $\mu$ a. Even when counting at a rate of 250,000 counts per minute, the current drawn by a small G-M tube is seldom more than 3  $\mu$ a, which is still a negligible drain. Because of the low internal resistance, the metering may be done intermittently; hence there is no metering drain during operation. Disadvantages include lack of voltage variability, changes in voltage with battery age, and higher weight and replacement cost than that of some electronic circuit substitutes.

## Charged Capacitors

Instead of using batteries, the possibility of storing a charge in a capacitor might be considered. Prior to taking the equipment into the field, a capacitor is charged to the desired operating voltage. Suppose that the total load and leakage current is 1  $\mu$ a and the permissible voltage drop over 3 hours anticipated field use is 100 volts, and the G-M tube has a useful plateau 100 volts wide. The required capacitance is the ratio of change in charge to change in voltage  $\Delta V$ . Then  $C = it/\Delta V$  where  $i$  is the current and  $t$  is the time. Substituting the values from the above example, a capacity of approximately 108  $\mu$ f is required.

A single voltage unit might be arranged to charge a number of capacitors in parallel and discharge them in series, thus building up the voltage to the desired value. The best method proposed has been to connect the capacitors in series, and charge each one successively by switching the battery voltage with a pair of commutators mounted on a rotating shaft. The shaft may be spring driven or motor driven. Because of the inevitable losses in

switching, the resulting voltage is not an integral multiple of the battery voltage and will, of course, vary as the battery ages. This calls for voltage metering. By suitable choice of shaft speed, number of commutator sections, and capacitor values, the percent ripple and the internal resistance can be made low and the metering circuit may be removed except when a voltage reading is required.

If a battery-powered electric motor is used to drive the commutator shaft, the problem of the weight of this battery in relation to its useful life enters in. The smallest electric motor is rated at 1/2,000 h-p or 373 milliwatts. The battery supplying this motor for 325 hours intermittent service weighs almost 3 lb.

For sake of comparison with other systems, the efficiency is computed when the voltage is being metered (when there is appreciable output power). Assuming a power transformation factor for the voltage-multiplying circuit of 75 percent, and as before, that the device is supplying 50  $\mu$ a at 1,500 volts, the efficiency will be 15.85 percent.

At 900-volt operation, the efficiency is only 6.6 percent. The difficulty of adjusting the voltage and the relatively high power requirements of the motor make this system a doubtful solution to the problem.

## Vibrators

Considerable interest is being shown among commercial and governmental agencies in the development of small high-voltage low-power devices employing mechanically vibrating reeds. These vibrators normally operate from a battery supplying 1½ to 6 volts. The high voltage is obtained by the rapid collapse of the magnetic field produced in a transformer supplied by the same battery. The voltage is readily controlled by a series variable resistor in the low impedance side of the transformer.

One type of vibrator supply is reported to deliver 50  $\mu$ a at 1,100 volts with an input drain of 250 ma at 3 volts. A battery delivering this input intermittently for 325 hours weighs 5 lb 10 oz. The power transformation efficiency is 7.34 percent.

Vibrator-type power supplies for

TABLE I—Comparison of Portable High-Voltage Power Supplies

Type	Limitations for Portable Use
Straight Battery Operation (Using Eveready 300-volt midget batteries)	No voltage variability. Voltage changes with battery age. Heavy. Replacement cost high
Charged Capacitor (Large capacitor charged to desired voltage prior to taking equipment into field)	Leakage current causes voltage to drop between time charged and time when unit is used. Large capacitor needed (over 100 $\mu$ f). Bulky, expensive, and annoying to charge before use
Capacitors in Series (Charging capacitors in parallel with low voltages and discharging them in series for desired high voltage)	A motor-driven switching system is required, with accompanying motor power requirements. Low efficiency at desired voltage. Discharge voltage depends on condition of charging battery. Switching losses
Vibrators (Vibrating reed causes periodic collapse of magnetic field in transformer)	Heavy low-voltage battery. Low power transformation efficiency for high-voltage low-power applications. Bulky
R-F Power Supply (High frequency feeding into step-up transformer)	Transformer losses. Low overall efficiency

automobiles have an efficiency between 60 and 75 percent. Unless the efficiency of the high-voltage low-power types can be made 15 percent or more, metered power supplies of light weight and relatively long battery life are not very practical by this method.

#### R-F Power Supplies

High-voltage r-f power supplies for cathode-ray tubes have been in use for some years and it is natural to consider the applicability of this type for portable G-M counters. Again the efficiency is the prime consideration.

In the r-f type of power supply, a feedback oscillator drives the primary plate coil closely coupled to a larger secondary coil.

A commercial coil unit was tried in a circuit employing a 1U4 oscillator and a CK1013AX cold-cathode rectifier. It became apparent that the rectifier did not perform properly in the frequency ranges tested, 80 to 400 kc. A filamentary type rectifier, a type 1654, performed satisfactorily, but the best B-battery efficiency secured was only 13.4 percent. A coil combination made from commercially available chokes gave approximately the same efficiency.

The chief source of loss occurs in the secondary winding. In order to keep the losses in the secondary small, the equivalent parallel resist-

ance of the secondary at resonance must be large compared with the load resistance. As the output load is to be 30 megohms, the secondary must have at least this resistance. Quoting from an article by O. H. Schade (see bibliography), "... secondary circuits of such high impedance are too expensive and large for practical use."

If a sawtooth voltage is applied to the grid of a vacuum tube in the plate circuit of which there is a high inductance choke, the rapid changes in plate current induce large voltages across the winding in the choke. This induced fluctuating voltage may be rectified and smoothed to provide high d-c voltages.

As an alternative, a cold-cathode grid-controlled thyratron is arranged so that the RC-derived voltage periodically gains control and cuts off the plate current. This would have the great advantage of requiring no filament battery supply. Unfortunately, experiments with a CK1089 tube indicated that stable oscillations could not be secured with less than about 500 milliwatts input.

A blocking type of audio oscillator was also tried, using the secondary of the transformer in the plate circuit and the primary as tickler feedback in the grid circuit. The efficiency of this system was relatively low.

Another way to generate a suitable sawtooth voltage is by means of a multivibrator. A pair of vacuum tubes, resistance and capacitance intercoupled, operate in a free-running flip-flop arrangement and the voltage developed in the output circuit of one tube drives the amplifier. Subminiature tubes of low power drain are excellent.

#### Neon-Controlled Oscillator

A very simple method which provides slightly better overall efficiency than the multivibrator is to use a neon bulb supplied through a resistor from the B-battery supply and shunted by a suitable capacitor. The sawtooth is generated by the voltage rise across the capacitor and sudden drop when this voltage reaches the ionization potential of the gas.

The proper choice of iron-core choke in the plate circuit is usually found by trial and error. Commercially available interstage audio transformers are often used with primary and secondary connected in series aiding. There is a marked difference in the performance of units supplied by different manufacturers, even among units whose design characteristics for their originally intended purpose are the same.

A rectifier capable of withstanding at least 2,000 inverse peak volts is desirable. In the unit to be described, the CK1013AX cold-cathode gas rectifier is efficient and has the advantage that no filament battery is needed. Voltage is supplied to the starter electrode through a 10-megohm resistor.

Where voltages over a wide range are required, a convenient control is to use a series variable resistor in the screen grid circuit of the output tube. In this way, variable voltages can be obtained at maximum efficiency.

A number of experimental circuits employing a neon-controlled oscillator operating at audio frequencies and driving a 1U4 or 1T5 were tried. For obtaining 1,500 volts or more, about 200 volts plate supply is required in addition to the 50 ma at 1.4 volts drawn by the filament. At 1,500 volts, an overall power transformation efficiency of 22 to 23 percent is normal. At

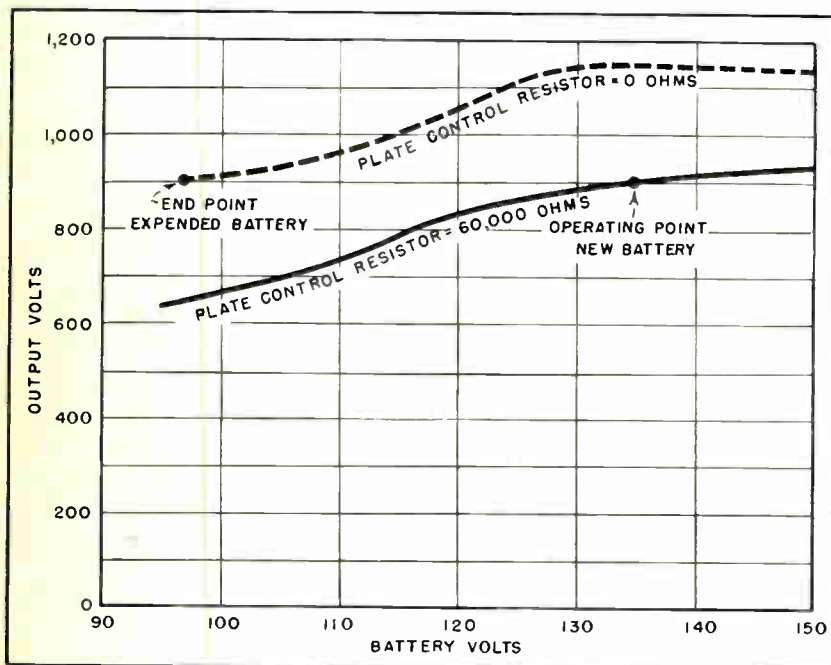


FIG. 2—Effect of battery aging on output voltage for two settings of output adjustment

lower output voltages, the filament power drain is a larger factor and consequently the overall efficiency is less.

### 900-Volt Power Supply

Figure 1 is the circuit used for a 900-volt supply and on which the performance curves of Fig. 2 and 3 are plotted. In this case, the objective was a single-control constant-voltage supply that could be compared for cost and weight with three 300-volt batteries. The control is necessary in order to adjust for the slow drop in voltage over the useful life of the two midget 67½-volt plate and neon supply batteries.

The frequency is determined by the time constant of the RC combination in the neon supply circuit, by the particular characteristics of the plate-circuit choke, and to a lesser extent by the supply voltage. The choke is a UTC 0-5 hearing-aid transformer with primary and secondary connected in series. The NE-2 neon bulb may be replaced by a NE-51, which is a based type of identical characteristics. In operation, the neon bulb glows sufficiently to act as a pilot light. Its characteristics do not appear to change with use. A half dozen NE-2 and a couple of NE-51 bulbs have been tried in the circuit with inappreciable differences in response.

In order to keep the battery drain over its useful life at about 1.1 ma or less, the output voltage control was placed in the plate circuit and the values of the screen dropping resistor and by-pass capacitor were adjusted until satisfactory operation was secured. The effect of battery aging on the output voltage at two settings of the variable resistor is plotted in Fig. 2. The introduction of resistance in the plate circuit decreases the efficiency of the circuit when a new battery is inserted. As the batteries age, the setting is advanced and the efficiency increases, permitting operation at 900 volts output over a fairly wide range in battery voltage. The overall power transformation efficiency at the 900-volt operating point when the batteries are new is 13.2 percent. For expended batteries (decreased to 97

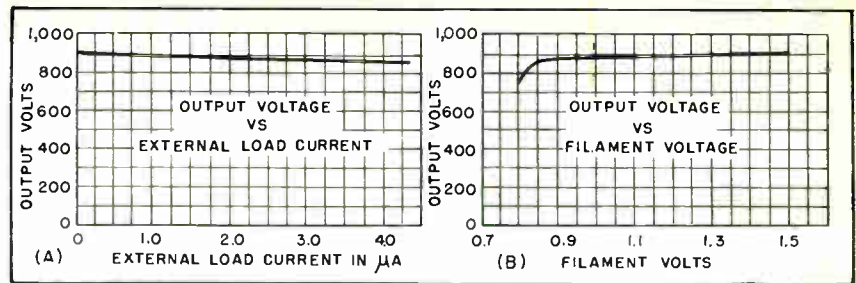


FIG. 3—Curves showing effect of load current and filament voltage on voltage output

volts), the overall efficiency is 17.0 percent.

Fig. 3A shows the output voltage regulation as a function of the external load, as would be produced by a G-M tube operating at high counting rates. This would be considered adequate for a G-M tube having a normal flat-plateau characteristic. If the G-M tube does not have a flat plateau, the voltage is returned to the proper operating potential by adjusting the resistance in the plate circuit. Such readjustment would be necessary only at counting rates of several hundred thousand counts per minute.

### Battery-Aging Effects

The effect of changing filament voltage on output voltage is given in Fig. 3B. The data recorded was taken at 135 volts battery supply. At 105 volts battery supply, the curve is similar with very little change in output voltage as the filament battery decays from 1.5 to 0.8 volt.

A 0.04- $\mu$ f capacitor was selected for convenient physical size and low cost as output smoothing capacitor. With the circuit delivering 900 volts the ripple is 0.3 volt.

The weight of all the components of Fig. 1 including batteries is 2.1 lb. Three 300-volt batteries weigh 2.8 lb. The two 67½-volt batteries in the circuit may be used as low-current plate supply in associated amplifier circuits fed from the G-M tube. With a 900-volt battery pack, an additional low-voltage battery is required for the pulse-amplifying and recording circuits, adding another 0.7 lb to the weight of the battery pack system. The total cost of components is very nearly the same as the cost of a 900-volt battery pack. On the other hand, the battery replacement cost for the neon-oscillator circuit is

about one quarter of the total replacement cost for the battery pack system.

Available literature on 67½-volt midget battery characteristics indicates that the circuit of Fig. 1 should operate 300 hours at 6 hours per day intermittent use before the batteries must be replaced. The unit was tested continuously for 126 hours at 900 volts output without failure.

The high peak voltage which appears across the plate of the output tube suggests the possibility of early tube breakdown. A circuit similar to Fig. 1, but using the miniature type 1U4 tube and higher plate and screen voltage, delivered 1,900 volts output for several hours without evidence of voltage breakdown. Nevertheless, with a d-c voltage source, three type 1U4, with plate and screen connected together and tested at grid bias sufficient to limit the current to 1.0 ma, broke down between 1,500 and 1,700 volts. Apparently, the tubes withstand higher instantaneous voltages than would be indicated by tests made under static conditions.

In conclusion, the author wishes to extend his grateful acknowledgment to R. P. Ghelardi for his helpful counsel and encouragement during the course of this investigation.

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# Carrier-Frequency VOLTMETER

Strength of signals received over power lines, telephone lines and cables in the range between 20 and 500 kc is directly indicated in db, using a fixed-gain double-superheterodyne receiver. A built-in calibration oscillator is provided

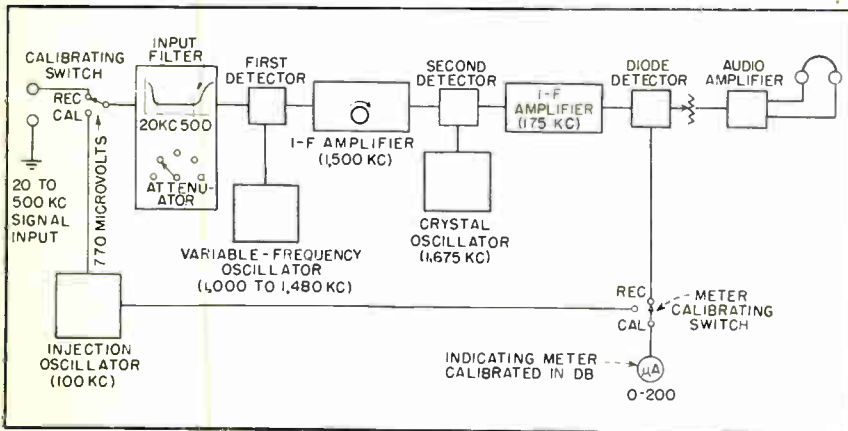


FIG. 1—Functional block diagram

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**T**HE carrier-frequency voltmeter to be described was developed primarily for making measurements on power lines, telephone lines and cables in the region between 20 and 500 kc. The specifications to which the instrument performs are based on the requirements of the Pacific Gas and

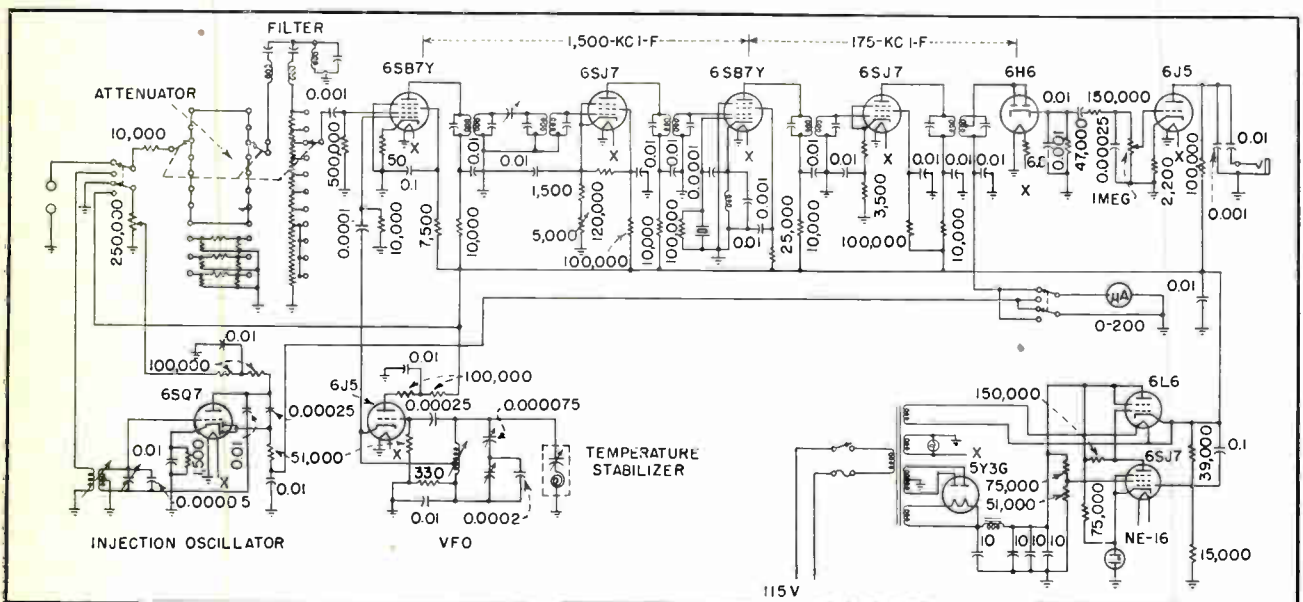
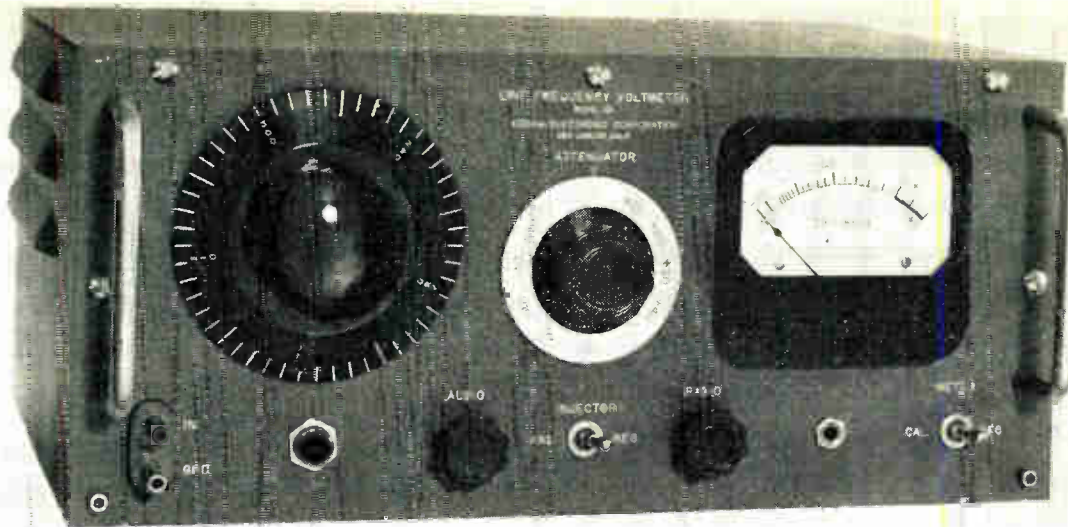


FIG. 2—Complete circuit diagram of the instrument



The carrier-frequency voltmeter

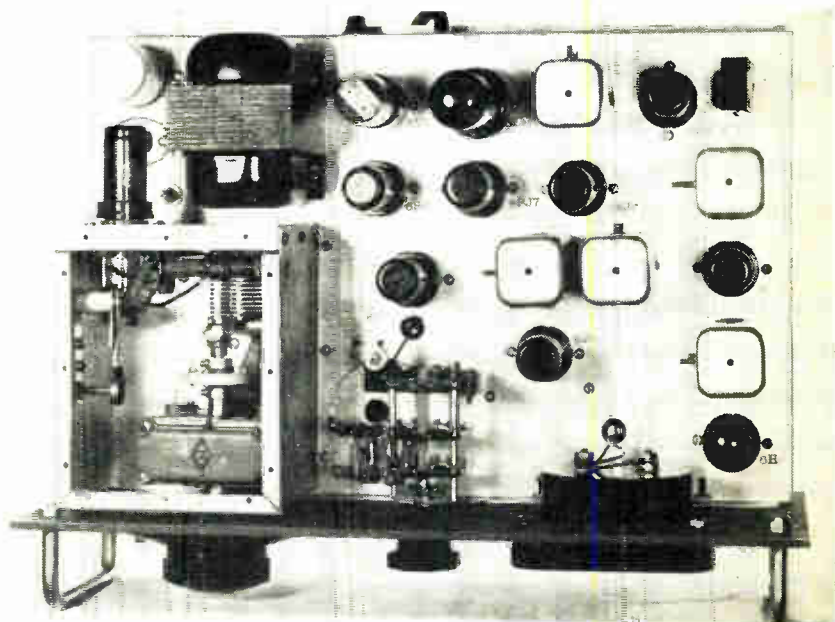
Electric Company. Special features were suggested by engineers of the Bell Telephone System.

The instrument is essentially a fixed-gain double-superheterodyne radio receiver covering the required frequency range. The d-c output of the final detector operates a microammeter calibrated in db. A variable attenuator, connected between the input terminals and the first grid, provides a wide range of measurable voltages. An injection oscillator, in effect a signal generator, is included to facilitate calibration.

#### Circuit Details

Referring to the block diagram of Fig. 1 and the complete schematic of Fig. 2, the input filter is of the bandpass variety. The attenuator consists of a wire-wound section and a carbon-resistor section, and operates in 10-db steps.

The variable-frequency oscillator beats with incoming signals in the carrier-frequency range and produces a 1,500-kc signal at the input of an adjustable-gain i-f amplifier. Temperature stabilization of the vfo is accomplished by means of a variable capacitor consisting of two fixed plates about  $\frac{1}{4}$  inch by  $1\frac{1}{2}$  inches in size and an intermediate movable plate operated by a 2 $\frac{1}{2}$ -turn spiral of thermostatic bimetal. The output of the 1,500-kc amplifier combines in a second detector with



Internal construction of the instrument

that of a 1,675-kc crystal oscillator to produce a 175-kc signal which is fed to a fixed-gain i-f amplifier. Output of the 175-kc amplifier goes to a third detector. The audio output of this detector drives an a-f amplifier operating a headset used for monitoring. The d-c output of the third detector operates the indicating meter, which is a 0-200 microammeter.

The injection oscillator delivers 0.77 volt (0 db) to the input circuit of the instrument, operating at 100 kc. A switch permits the output of the injection-oscillator monitoring diode to be read on the indicating meter for calibration purposes. Adequate signal input is provided

so frequency calibration of harmonic points above 100 kc on the dial can be checked from the injection oscillator.

#### Performance Characteristics

The carrier-frequency voltmeter will handle from 77 microvolts to 77 volts at the input, or 80 db below to 40 db above zero level (1 milliwatt into 600 ohms). Selectivity characteristics are approximately 6 db down at 1 kc off resonance, 18 db down at 3 kc off resonance and 40 db down at 7 kc off resonance.

Input impedance is 10,000 ohms in the rejection band, and approximately 20,000 ohms in the pass band.

# Multichannel Radio

Developed to transmit cosmic ray and other high-altitude data, the Aerobee telemetering system combines a high degree of flexibility and package design with light weight and small volume. Uses special circuits for transmitting voltage and pressure data

RECENTLY publicized work in high-altitude research has been highlighted by the development of the 3,000-mile-per-hour Aerobee sounding rocket. In order to collect data for high-altitude studies, a telemetering system with a high degree of flexibility, light weight, and small volume was needed.

One purpose of the Aerobee program is to measure cosmic rays at high altitudes, using Geiger tubes as the primary end instruments. These tubes feed scaling-down and thyatron circuits, the outputs of which consists of negative pulses of short duration and random timing. The telemetering system must then transmit these pulses as faithfully as possible and record them as a function of the cosmic rays.

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Additional requirements imposed upon the system include measurements of several different pressures in the missile, and a variety of d-c voltages, both positive and negative.

## The Telemetering System

The basic telemetering system now being used is of the frequency-division type, utilizing six audio subcarrier bands whose oscillators are frequency-modulated by end instruments actuated by the intelligence to be transmitted. Frequency response for the bands is approximately 60 cps and is presently limited by the response time of the recording galvanometers used.

A method of measuring higher frequency components lies in the use of a multivibrator oscillating at 50 kc, which is frequency-modulated by the signal voltage. Response of this unit is good to 10 kc. The output of this oscillator modulates the radio transmitter directly and, for recording, a 50-kc discriminator is employed, the output driving a recording-camera-type oscilloscope. Frequency and amplitude may be read from the film obtained from this method.

The subcarrier oscillators are designed to be used in any band and give a varying frequency output as a function of the input intelligence. The simplest type of oscillator, for measuring pressures, utilizes an iron-core coil whose inductance is varied by a mu-metal slug attached

to a flexible diaphragm to which the varying pressure is applied. Other types of oscillators are more complex in order to measure such variables as temperature, voltage and strains, but all perform in the same manner to give a frequency-modulated audio signal.

The outputs of the oscillators are adjusted to proper level, mixed together through an isolating network, and the complex voltage is applied to the grid of a reactance tube in an f-m transmitter, giving direct frequency modulation.

The ground station equipment for recording the transmitted signal consists of an f-m receiver, a set of audio discriminators, and a multichannel recording oscillograph. The receiver detects and demodulates the transmitted signal in normal f-m fashion, and the complex audio output is applied to a set of filters in the audio discriminators. These filters are of the band-pass type tuned to cover the respective subcarrier bands and have substantially flat-topped response inside the band, with steep skirts at each end. Each filter output is then passed through limiter and clipper stages and is fed to a tuned audio discriminator whose output is linear with frequency. A cathode-coupled push-pull power output stage drives a string in the oscillograph for the actual photographic record. A block diagram of the ground station equipment is shown in Fig. 1. Auxiliary equipment in the ground station includes a large disc-recorder for simultaneous recording and interpolation oscillators for calibrating the audio discriminators.

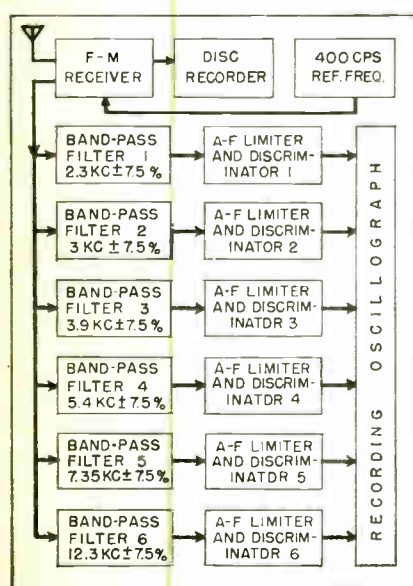


FIG. 1—Block diagram of ground-station equipment which receives and records telemetered information

# Telemetry for Rockets

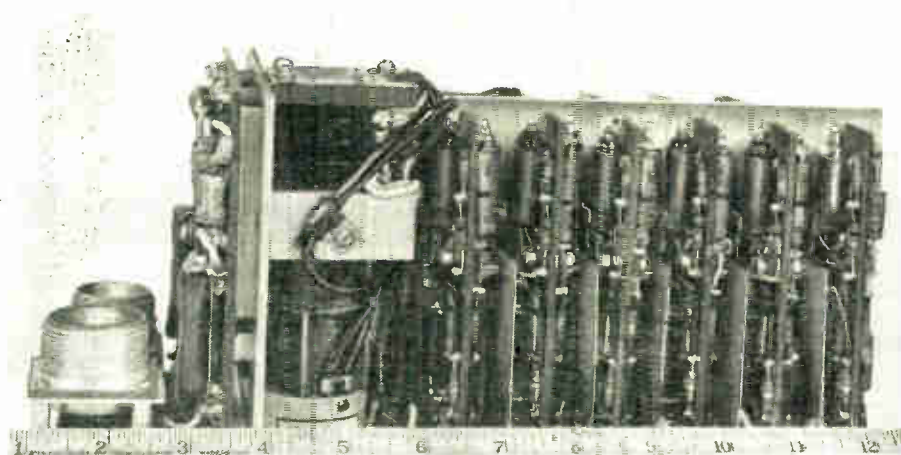


FIG. 2—Back view of audio case showing commutating switch and voltage-controlled oscillator. This unit weighs about 5 pounds

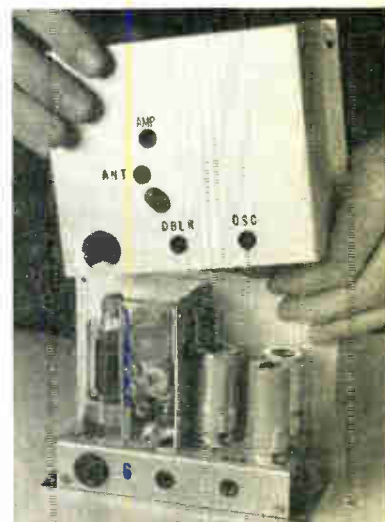


FIG. 3—Front view of r-f portion of the telemetering transmitter

The Aerobee telemetering system, as supplied to the user group, is broken down into two parts: the audio case and the r-f transmitter. These units are mounted separately in the missile and are connected by a cable.

The audio case is of aluminum construction, occupies a volume of 281 cubic inches and has a maximum weight of five pounds. The use of commutation and switching of oscillators increases the amount of data which may be transmitted and a maximum of fourteen oscillators is provided for in the unit. A complete audio unit is shown in Fig. 2.

The transmitter is also of aluminum construction, has a volume of 60 cubic inches and weighs 1½ lb including cover and mounting plate. Figure 3 shows a front view of the transmitter. Excitation of the missile is employed to radiate the r-f signal and is accomplished by means of an insulated spike mounted in the nose. A slug-tuned loading coil couples the spike to the transmitter through a coax cable.

Power for telemetering is supplied from the missile power supply system, consisting of 28 volts of

storage battery driving a bank of dynamotors, with three allotted to telemetering. These dynamotors furnish approximately 220 volts at 60 ma, although one may give as high as 400 volts to supply the transmitter final stage. Filament supply is taken from an 8-volt tap on the main battery and is adjusted to 6 volts by a resistor.

## Audio Chassis

Three types of audio systems have been produced to date, with different electrical requirements for

each one. Figure 4 shows the block diagram of the unit used in recent tests. Provision for the separation relay and commutating switch is included in all types and may be left out if not needed for the particular application at hand.

Two basic types of subcarrier oscillators are used: the TOL-1A inductance oscillator for pressure measurements, and the TOE-1A voltage-controlled oscillator for voltage measurements, including cosmic pulses. These units are dimensioned in a multiple system of

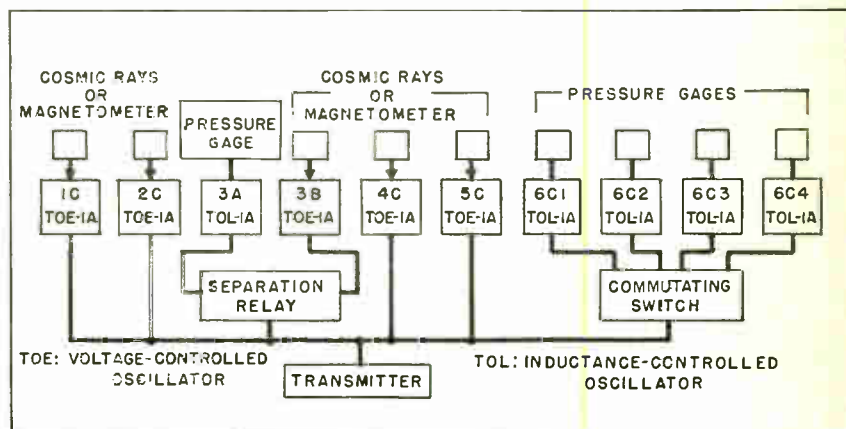


FIG. 4—Block diagram of audio case used in recent Aerobee flights

lengths, the TOE-1A being twice as long as the TOL-1A. Since both oscillators are the same width, two TOL-1A oscillators occupy the same space as one TOE-1A and these units may be interchanged in this fashion. A total of 10 TOE-1A oscillators may be used or 8 type TOL-1A oscillators in combination with 6 TOE-1A oscillators to give 14 channels of information. The vertical mounting panel in the case is drilled and tapped in universal fashion in order to take a variety of the two oscillators. Replacement or addition of oscillators on either side of the panel is readily accomplished in a short time.

The inductance-oscillator circuit for pressure measurements utilizes a single tube, the subminiature type 6K4. The pressure gauge forms the inductance of the tank circuit of the oscillator, a change in pressure

varying the spacing of a mu-metal pad with respect to the iron-core coil. The gauge is mounted remotely from the oscillator unit and the two are connected together by a three-wire cable. Band selection is accomplished by tuning to the desired frequency by means of mica capacitors connected across the gauge coil and mounted in the oscillator unit. Current drain for the oscillator is approximately 3 ma at 108 volts while filament drain is 150 ma at 6 volts. The circuit is shown in Fig. 5.

The TOE-1A voltage-controlled oscillator is a four-section phase-shift oscillator using three tubes. The resistance of one leg of the phase-shift network is supplied by a modulator tube, which has its plate resistance varied by the voltage under measurement applied to the modulator grid. A miniature triode, the 6C4, is used for the modulator; a subminiature 828A pentode is used for the oscillator stage, and a 6K4 functions as a cathode follower.

Since the cosmic-ray instrumentation output is in the form of negative pulses, the TOE-1A oscillator operates over the range from zero to -10 volts. With zero input to the modulator, the oscillator frequency is at the top end of the band. For the -10 volt condition, the frequency shifts downward to the low end of the band, giving a total change of 15 percent in frequency. Pulsing of the oscillator is straightforward and has given very good results.

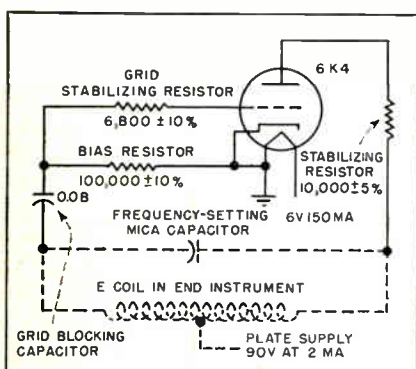


FIG. 5—Schematic diagram of sub-carrier oscillator with variable inductance end instrument

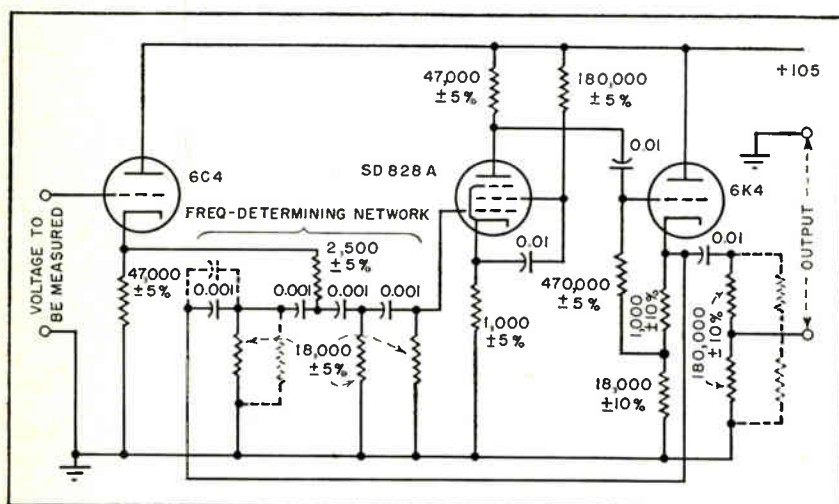


FIG. 6—Circuit diagram for voltage-controlled oscillator

In addition to the cosmic-ray pulse service, the TOE-1A has also been used to telemeter the operation of the emergency fuel cut-off receiver in the missile by measuring the limiter-grid voltage and the output thyatron grid and cathode voltages.

Modulation sensitivity is a constant percentage function for all bands, the zero to -10 range giving full bandwidth in each case. Sensitivity in cycles per volt varies from 35 cycles per volt on band 1 to 200 cycles per volt on band 6. The circuit diagram is given in Fig. 6. B+ current drain for the oscillator is 3.5 to 4 ma at 108 volts and A+ drain is 450 ma at 6 volts. Band selection is carried out by installing four mica capacitors in the phase-shift network and tuning to exact frequency with a small mica capacitor in parallel with the input capacitor of the network.

Two separate regulated B voltage supplies, with OB-2 miniature regulator tubes, are used in the audio case. These tubes are fed from separate dynamotors whose output voltage may vary over a wide range, due to load conditions or drop in primary battery voltage. All oscillators operate at a common value of 108 volts and may be interchanged from one supply to the other, with no change in calibration, and with good stability.

Provision for extra data beyond the normal six channels is accomplished in two ways: commutation, and channel switching by means of a relay. For commutation, a motor-driven cam-type switch using a maximum of four Acro snap-action switches is used to switch outputs of the oscillators at a rate of approximately four samples per second. A long cam-section gives an identifying mark for the record.

The relay switching system serves to substitute oscillators during flight and is applied in regard to booster action. Booster pressure is measured until separation, at which time the relay coil, normally energized, is de-energized by a pull-out plug on the booster. The booster pressure oscillators are turned off while another set is turned on. By



grouping outputs and switching with the 3-pole, double-throw relay normally used, any desired oscillator-time sequence may be obtained.

Output voltages from all oscillators are fed to a terminal board where each voltage is adjusted to proper level by means of individual voltage dividers. Provision is made for commutating at the same board as well as grouping of outputs for the separation relay.

Connections to the audio case are accommodated by three plugs mounted on one end of the case. The largest, a 19-pin AN connector, connects all end instruments to their oscillators. The second plug, a 10-pin AN connector, supplies all power and control circuits, while the third, a 5-pin connector, connects the r-f transmitter to the case and furnishes power and audio input to the transmitter.

#### The Transmitter

The f-m transmitter (Fig. 3) is a multistage unit with a reactance-modulated oscillator, a frequency-doubler stage, and a 2E26 tetrode final amplifier. Miniature tubes are used in the low-power stages, and are readily replaced in case of failure.

The low-power stages are supplied with 200 volts with a current drain of approximately 40 ma, while the B voltage for the final amplifier may be 250 to 400 volts supplied from a separate dynamotor. Current drain varies between 50 and 85 ma between the above limits. Total filament drain is 1.4 amp at 6 volts.

Deviation of the transmitter is set at  $\pm 65$  kc for 1 volt rms input to the reactance tube grid and harmonic distortion is less than 2 percent for this condition.

Tuning is accomplished by means of silver-plated slugs in all coils except the final amplifier, eliminating the need for variable capacitors. Tuning of the transmitter is conventional and straightforward. A low impedance link and coax cable couple the output to the missile nose-spike.

To facilitate rapid production of complete systems for future use,

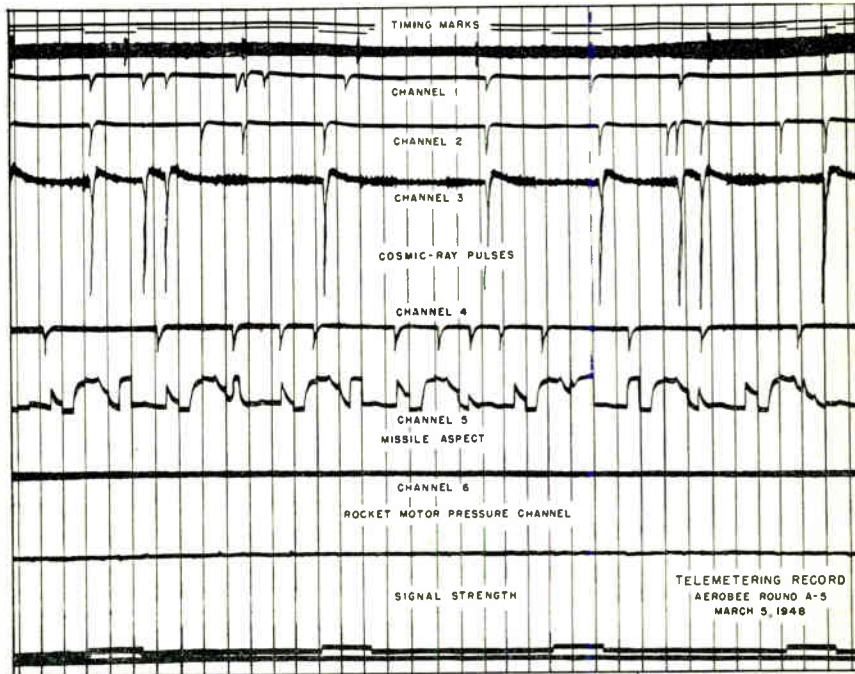


FIG. 7.—Telemetering record from recent firing at Almagordo. Missile near peak of trajectory

emphasis was placed on simplicity of design. The units are produced in two definite phases. In the first, the units are assembled in large numbers and held in stock for future use. Separate calibration curves are supplied with each audio unit and they are used in the final phase, the calibration of the basic units.

#### Results of Firings

The first round, fired in November, 1947, reached an altitude of approximately 200,000 feet. It was found necessary to cut off the rocket motor during flight since the missile drifted out of the prescribed trajectory limits. An emergency cutoff receiver in the missile, triggered from the ground, was telemetered and the record proved of value in determining the point of cutoff, as well as operation of the receiver during the critical part of flight.

The second round, fired March 5, 1948, proved even more successful. This missile attained an altitude of 78 miles and a wealth of useful cosmic-ray data was obtained from the telemetering records. Four channels of intelligence were devoted to cosmic rays, one to missile aspect, and the sixth was commutated to

telemeter four rocket motor pressure functions. All channels functioned without failure and signal strength from the missile held up well during the flight despite the fact that the r-f transmitter had low voltage applied to the final amplifier stage and was giving less than 5 watts output. A portion of the record of this flight, recorded at Almagordo station some 43 miles from the firing tower, is shown in Fig. 7.

The third round, fired in April, 1948, was designed to measure the magnetic field of the earth and reached the same altitude as round number 2. Data channels were similar to those in round number 2, with magnetometer output voltages substituted for cosmic-rays. Telemetering was successful for some 326 seconds of flight.

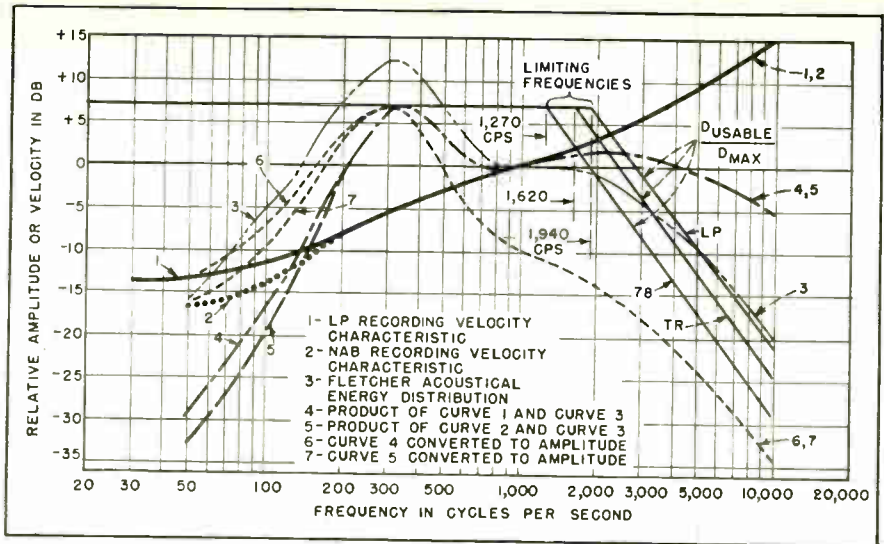
The telemetering unit described in this article was designed by the writer using the basic Applied Physics Laboratory subminiature f-m/f-m system developed by the Telemetering Group at The Johns Hopkins University. At present, the production of the Aerobee telemetering equipment is being done by the Pacific Division of Bendix Aviation Corporation.

**T**HE EARLY orthoacoustic phonographs depended on the driving power of the turntable motor to produce the sound. The motor turned the record, the groove of which vibrated the needle, and the needle in turn drove the diaphragm in the throat of the horn. The grooves had to be rugged and the pickup stylus large in order to produce a loud acoustic output. Under these conditions the record had to be turned at high speed to provide sufficient frequency range.

Because the industry has developed high-gain electronic amplifiers, dynamic loudspeakers and sensitive phonograph pickups to the point where they are reliable consumer goods, it is no longer necessary to use a record designed to produce sound directly. Groove deviation need be only great enough to maintain the signal sufficiently above the surface noise; the stylus tip need only be large enough to provide tracking for low-compliance low-inertia electrical pickup cartridges. The analyses of these considerations, on which the long-playing record (*ELECTRONICS*, p 86, Sept. 1948) was designed, were presented in a paper by Peter C. Goldmark and René Sneyvangers of Columbia Broadcasting System and William S. Bachman of Columbia Records before the New York Section of the IRE in September. Here is a discussion of the highlights of the paper; it will be published in its entirety in the *Proc. IRE*.

#### Design Factors Evaluated

The public's familiarity with phonograph records makes it desirable to solve the problem of providing uninterrupted music reproduction by using records as the basic medium. A study of the playing time for classical compositions shows the average to be about 40 minutes. Thus, if a record were to accommodate 20 minutes of playing time on a side, it would accommodate most compositions. One record would then replace an album of several and therefore save the consumer money and storage space, as well as 90 percent in total weight. For these reasons, the possibility of producing a long-playing record seemed desirable.



To evaluate the various types of records, their inherent properties are compared to the frequency-amplitude spectrum they have to accommodate

# Design of L-P RECORDS

From geometric considerations, the maximum playing time was found to be obtained if the inside recording diameter was half the outside diameter. To use a smaller inside diameter would require a higher rate of revolution (to maintain the same minimum linear velocity at the innermost groove), thus decreasing the playing time. A larger inside diameter, reducing the number of grooves, would decrease the playing time more than the permissible decrease in record speed would increase it.

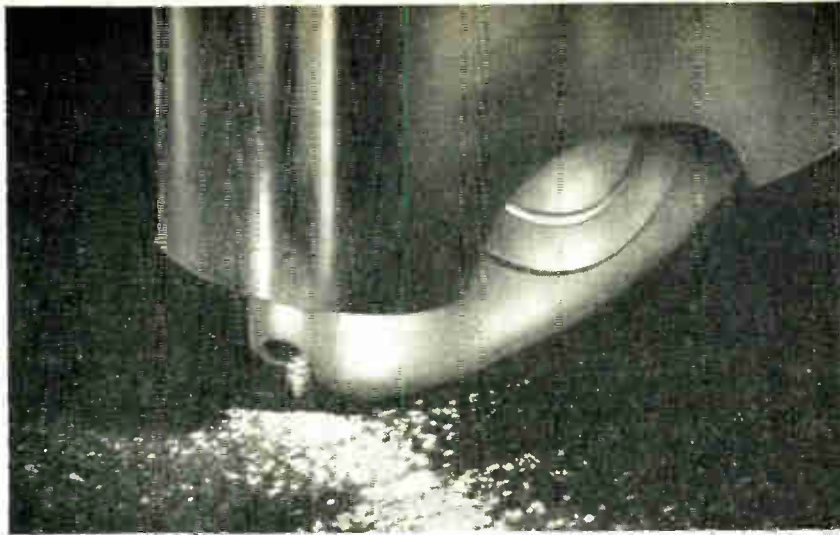
With a 12-inch record, the outside recording diameter of which is 11.5 inches, the inside diameter would thus be 5.5 inches. Although at this point the design of the record might be achieved by finding the linear velocity and the tip radius of the stylus necessary to reproduce the required high frequency, it is simpler to arbitrarily decide on a turntable speed (linear velocity). As low a speed as possible is desirable, but too low a speed would create serious problems of rumble. Because so much experience has been gained with transcription equipment operating

at 33 $\frac{1}{3}$  rpm, this speed was chosen. At this speed, 230 grooves per inch are necessary to provide 20 minutes of playing time; the nearest practical value is 224 grooves per inch. The peak groove displacement for 224 grooves per inch is thus 0.0009 inch and the linear velocity of the innermost groove is about 9.6 inches per second.

The wide frequency response of frequency-modulated broadcasting and of professional wire recorders suggests that improvements in the frequency range of records are also in order. To meet this requirement, a frequency range from 30 to above 10,000 cps is desirable.

#### Relative Performance

By way of evaluating the long-playing record having these characteristics, its performance was compared to that of conventional 78-rpm records and transcriptions. To establish an analytical basis for comparison, the condition where the radius of the reproducing stylus and the minimum radius of curvature of the recorded wave are equal was arbitrarily chosen as the limiting condition, and the corre-



A needle tip of one-mil radius, a tracking weight of about 6 grams and 224 grooves per inch characterize pressings that can contain from 30 to above 10,000 cps

## Choice of groove width and spacing of long-playing records is based on considerations of playing time of classical compositions, minimum linear velocity, tracking, maximum deviation, and cost

sponding frequency termed the limiting frequency. This condition is reached when  $f_L = V/2\pi(R_{EFF}D)^{1/2}$  where  $f_L$  is the limiting frequency,  $V$  is the linear velocity,  $R_{EFF}$  is the effective radius of the reproducing stylus, and  $D$  is the groove deviation. This equation shows that, if the deviation is very small, the limiting frequency can be very high.

The limiting frequencies for the three types of records are tabulated on the accompanying diagram. If the frequency is greater than the limiting value, the deviation for equal radius of needle tip and groove modulation must be made less than maximum. This consideration establishes a usable deviation as a function of frequency.

The percent usable deviation for the inside groove of the three types of records is also shown in the diagram as a function of frequency. Full deviation is 0.002 inch for 78-rpm records, 0.0011 inch for transcriptions and 0.0009 inch for L-P records; inside groove diameters are respectively 4, 8 and 9.6 inches.

Another way to evaluate the records is on the basis of the harmonic

distortion produced in tracing the grooves. Because of the symmetry of this tracing error, there will be no second harmonic distortion. However, there will be third harmonic distortion. In this way it is found that, for the inside groove and at any given frequency, the relative tracing distortions at maximum deviation of the systems are  $T_{78}/T_{LP} = 5.35$  and  $T_{TR}/T_{LP} = 1.91$ . Thus the tracing distortion of L-P records is about a fifth that of 78-rpm records and about half that of transcriptions. Were it not that the maximum displacement of the groove was rarely required at high frequencies (above the limiting frequency), the tracing distortion from all three recording systems would be excessive.

These inherent limitations of the recording systems, to be indicative of their practical abilities to accommodate actual program material, need to be evaluated in terms of the amplitude-frequency content of the recorded material. The diagram shows the most probable energy distribution curve for a 75-piece orchestra as determined by Fletcher. The recording characteristic of the

L-P record is also shown, together with the NAB recording characteristic for comparison. (The L-P characteristic has a slight bass lift to reduce rumble and hum level.) The most probable recording velocity distributions can be obtained by adding ordinates (in db) of the two curves. The resultant curve shows that the most probable amplitudes lie below the maximum limits determined by the limiting frequency and usable deviation for all three types of recording. However, L-P records lie further from the required curve than the others and can be expected to have less distortion.

### Phonograph Pickups

As indicated earlier, the possibility of using the L-P recording system depends on technological development of pickups that require very low driving force at their styli and have high sensitivity. The use of Vinylite as the record base reduces the surface noise so that even with the small recorded groove deviations the signal-noise ratio is acceptable. The use of lightweight pickups further improves this ratio so that a dynamic range of 45 db with an acceptable background noise level is obtained.

The development of suitable pickups was a part of the overall program. The needle radius should be 0.001 inch plus or minus 10 percent. A downward tracking force not exceeding 6 grams is desirable. The theoretical compliance, measured at the point of the stylus, for low-frequency tracking of 78-rpm records with this low tracking force is  $0.87 \times 10^{-6}$  cm per dyne and, for L-P records, it is  $0.39 \times 10^{-6}$  cm per dyne.

Crystal cartridges producing about 0.5 volt rms at reference frequency and level can be built within these limitations. It was also found that r-f modulation pickups (like Cobra) and variable-reluctance type pickups (like GE) are also suitable for design as L-P pickups. The rapidity with which suitable pickups have been developed commercially verifies the basic assumption that the art has progressed to the point that this new approach to recording is justified.—F.H.R.

# HUM REDUCTION

Intensive investigation of problem results in useful circuit design data for minimizing hum from alternating magnetic fields, electrical leakage, input circuit wiring and heater-cathode leakage current

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**S**OURCES of hum fall into two broad classifications: hum arising from causes external to the tube which act either upon the tube or upon the components of the circuit, and hum arising within the tube as a result of its characteristics. The first classification covers hum from alternating magnetic and electrostatic fields and from leakage and stray capacitances in the circuit wiring, while the second includes heater-to-cathode leakage and the action of the heater field within the tube.

The most common sources of alternating magnetic fields are transformers and chokes. There are also fields surrounding the wires carrying the heater current and the a-c primary supply, but these fields are extremely small by

comparison. The intensity of the field in air at a distance of one inch from a single wire carrying one ampere is in the order of 0.08 gauss, while the stray flux from transformers may be more than a hundred times greater than this value.

The amount of stray flux for a specific transformer is determined by the design of the core and is practically constant over the normal load range. It is difficult to assign a general value to the magnitude of stray flux since it is dependent largely upon the quality of the transformer. However, the order of magnitude for average-quality transformers is 5 to 10 gauss at a distance of two inches from the core in the active portion of the flux pattern.

Figure 1 shows the flux pattern for a transformer with E-type core laminations. This pattern is quite similar to that of an air-core coil, except for modification due to the iron core of the transformer. The pattern is represented as if the transformer were suspended in air. The presence of a chassis of magnetic material will have little effect upon the portion of the field which is two inches or more above the chassis, but the field in the region of the chassis will be extended due to the lower reluctance path. Some advantage may be gained in this respect by the use of vertical-mounting transformers in preference to the half-shell types of construction.

The flux concentration point at which the major portion of the flux leaves and enters the core is located at the ends of the core segment on which the winding is made. This point is further from the chassis in the vertical-mounting transformers, thus reducing the extension of the field. The directional properties of the stray flux are also more favorable in transformers of the vertical-mounting type than in transformers of the half-shell type regardless of the material used in the chassis.

## Hum In Receivers

An alternating magnetic field was applied to each tube of three different receivers, which ranged from communications types to commercial five-tube table models and

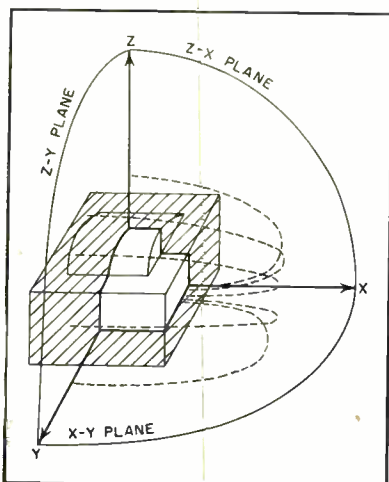


FIG. 1—Stray flux pattern for transformer with E-type core laminations

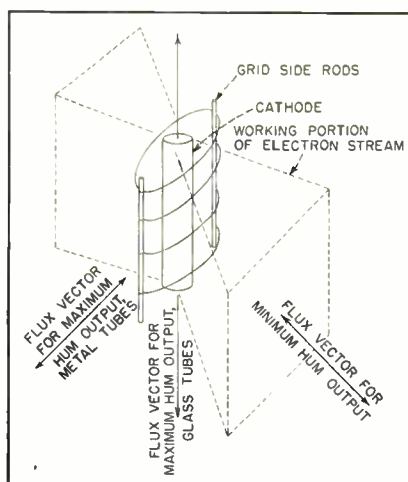


FIG. 2—Tube with concentric type construction

## Common Sources of Hum and Their Solutions

Cause of Hum	Maximum Hum Level at Grid	Solutions
Modulation of plate current by stray flux from power transformer		Proper orientation of tube with respect to power transformer
Glass pentode	2.00 mv	Selection of proper size plate load resistance. (See text)
Glass triode	0.30 mv	
Metal pentode	0.10 mv	
Metal triode	0.02 mv	
Heater-to-grid leakage across socket	10 to 15 $\mu$ v for each megohm of grid resistance and each volt rms of heater above ground	Use of double-ended tubes. Adjustable ground position on secondary of filament transformer
Leakage or induced voltages in closed loops of the input circuit	Up to 75 $\mu$ v	Use of double-conductor input cable as shown in Fig. 5
Heater-cathode leakage	Currents of 0.04 to 1.0 microampere	Adequate bypassing of cathode for power frequency. Use of low cathode impedances

included both f-m and a-m reception. The antenna was disconnected and the gain control advanced all the way. The field intensity was then increased until the hum level became audible above the noise. This was repeated individually for each tube in the set.

It was found that in most cases a field of 50 gauss rms would produce audible hum when applied to the r-f amplifier, converter, i-f amplifiers, or the first audio stage. The power-output stage, and the detector or discriminator stage in circuits employing separate tubes for detector and first audio were not affected by fields as high as 150 gauss rms.

Since it has been shown that a representative figure for escape flux from a power transformer is 5 to 10 gauss, it would seem that the tube itself offers no particular problem as to hum. In many cases this may be true. However, the value of 5 to 10 gauss was given for a distance of two inches from the core of the transformer, and the field intensity increases inversely as the square of the distance from the transformer. The fields in the immediate vicinity of the transformer are therefore quite high, and placement of critical tubes in this region should be avoided.

In addition, the final measurements in the test outlined were made aurally, and the hum components, both 60 and 120 cycles, were less audible than the higher-frequency noise which was used as

a reference. In the fields of audio work this is a legitimate criterion, but in measurement and control equipment the hum must be considered on the basis of its rms value.

A considerable amount of data has been taken on several different tube types under varying field intensities and circuit conditions. A few representative figures may be quoted for general guidance. An arbitrary unit (microvolts-per-gauss referred to the grid) has been selected since it takes into account the gain of the tube under test as well as the strength of the field, and in addition is more easily referred to the signal level at which the tube is expected to operate.

The hum level of the pentode-type amplifier does not increase linearly with an increase of field intensity, but varies at a rate somewhere between the first and second power of the field intensity, depending upon the reference level of the magnetic field. Thus, for glass-type pentodes, a hum level of about 250 microvolts-per-gauss (referred to the grid) may be expected at field intensities of around 45 gauss, while at 5 gauss the figure drops to around 20 microvolts-per-gauss. Values for comparable metal-type pentodes are in the order of 5 microvolts-per-gauss and increase only slightly between 5 and 45 gauss due to shielding effect of the metal envelope. Triode types show hum levels of around 30 microvolts-per-gauss at 45 gauss,

and 7 microvolts-per-gauss at 5 gauss.

The orientation of the tube elements in a magnetic field determines largely the influence that the field will have upon the output of the tube. A tube of concentric-type construction is shown in a cutaway view in Fig. 2. A major portion of the electron stream can be considered bidirectional along a line which is perpendicular to the plane of the grid side rod supports at the cathode. The magnetic field will deflect the electron stream a maximum when the flux is perpendicular to the path of the electrons. These maximums occur when the flux vector is coaxial to the tube, or when perpendicular to the tube axis and in the plane of the grid side rods. As a general rule, metal tubes and glass tubes which have nonmagnetic side rods show a maximum in the direction normal to the tube axis, while those with magnetic side rods have a maximum in the axial direction, the difference between the two conditions being in the order of 6 to 10 decibels in voltage. Example:

	Axial Flux Hum Voltage at Plate of Tube	Normal Flux Hum Voltage at Plate of Tube
6SJ7GT.	1.5	0.5
6SJ7 ...	0.02	0.04

The minimum hum condition for all types occurs when the flux vector is perpendicular to the tube axis and normal to the plane of the grid side rods. The minimum is down 30 to 40 decibels from the maximum in glass types and 10 to 20 decibels in metal types, the difference arising from the distortion of the field in the metal type which prevents a sharp minimum.

Since the minimum occurs only

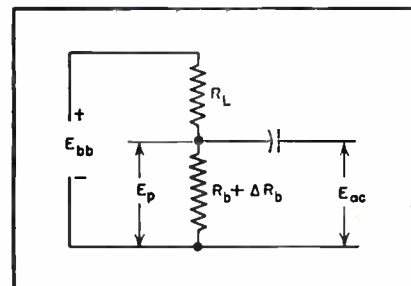


FIG. 3—Equivalent circuit for a tube operating in a magnetic field with no signal on the grid

when the flux is directed perpendicular to the tube axis, rotation of the tube socket is not effective in removing hum when the flux vector is parallel to the tube axis. It is possible to rate a transformer on the basis of the direction of stray flux vectors in the area adjacent to the transformer, normally occupied by tubes. In this respect the vertical-mounting transformer is superior to the half-shell type, since more of its flux is perpendicular to the usual tube mounting axis in the space occupied by the tube elements.

If a tube is operated in an alternating magnetic field, the hum output is a function of the strength of the field, the constants and voltages of the circuit, and the characteristics of the tube. Consider a tube operating in a magnetic field without a signal on the grid. The equivalent circuit is shown in Fig. 3. The effect of the field

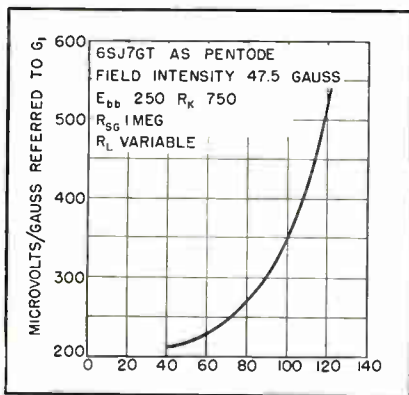


FIG. 4—Variation of hum with gain in a typical pentode amplifier

upon the tube may be considered as a change in the static plate resistance of the tube. The sign is shown as positive since only in comparatively rare tube designs is the static plate resistance decreased by application of the magnetic field. In this circuit:  $R_L$  = load resistance,  $R_b$  = static plate resistance,  $\Delta R_b$  = change in static plate resistance at peak flux,  $E_{bb}$  = d-c plate supply voltage,  $E_b$  = static plate voltage,  $E_{ac}$  = peak-to-peak hum output voltage and  $I_b$  = static plate current.

Let the subscript 1 refer to

normal operation (that is, operation in the absence of a magnetic field) and subscript 2 refer to operation at peak flux value. Then:

$$E_{ac} = (I_{b1} - I_{b2})R_L \quad (1)$$

$$I_{b1} = \frac{E_{bb}}{R_L + R_b} \quad (2)$$

$$I_{b2} = \frac{E_{bb}}{R_L + R_b + \Delta R_b} \quad (3)$$

Substituting Eq. 2 and 3 in Eq. 1

$$E_{ac} = \left( \frac{E_{bb}}{R_L + R_b} - \frac{E_{bb}}{R_L + R_b + \Delta R_b} \right) R_L \quad (4)$$

$$= \frac{E_{bb} R_L \Delta R_b}{(R_L + R_b)(R_L + R_b + \Delta R_b)} \quad (5)$$

$$E_{b1} = \frac{E_{bb} R_b}{R_b + R_L} \quad (6)$$

$$\Delta R_b = K R_b \quad (7)$$

where  $K$  is a function of static plate voltage and flux density.

Substituting Eq. 6 and 7 in Eq. 5

$$E_{ac} = \frac{K E_{b1} R_L}{R_b + R_L + K R_b} \quad (8)$$

$$K R_b \ll (R_b + R_L) \quad (9)$$

Eq. 8 may be written

$$E_{ac} = K \frac{(E_{b1} R_L)}{(R_b + R_L)} \quad (10)$$

Experiment has indicated that  $K$  is a function of  $1/E_b$  within the normal limits of  $E_b$  encountered in a resistance-coupled amplifier. If the peak value of flux remains constant, for a specific tube:

$$K E_b = \text{a constant} \quad (11)$$

Then

$$E_{ac} = \frac{R_L}{(R_L + R_b)} \times \text{a constant} \quad (12)$$

If the tube is a triode, the static

plate resistance  $R_b$  is fairly constant for different values of  $R_L$ , and in addition  $R_L$  is usually much larger than  $R_b$ . Equation 12 indicates that if this is the case,  $E_{ac}$  is reasonably independent of the circuit values.

In the case of a pentode,  $R_b$  decreases with an increase of  $R_L$  and since  $R_b$  and  $R_L$  are of the same order of magnitude:

$E_{ac}$  is a function of

$$\frac{R_L}{(R_L + R_b)} \times \text{a constant} \quad (13)$$

It will be noted that this expression for hum output voltage is quite similar to the familiar formula for output signal voltage:

$$E_o = \frac{\mu E_g R_L}{R_L + R_p} \quad (14)$$

in which case  $\mu E_g$  represents the constant. The major difference is that  $R_b$  in the hum formula is static plate resistance,  $E_b/I_b$ , while  $R_p$  in the signal-voltage formula is dynamic plate resistance.

It has been shown that in the usual application for triodes ( $R_L \gg R_b$  or  $R_p$ ) the output hum level is relatively independent of the plate load resistance, as is also the gain. Hence, for triodes, the hum level referred to the grid is constant for a given value of flux.

In pentodes,  $R_b$  varies inversely with  $R_L$ , and  $R_b$  remains practically constant over the flat portion of the plate characteristics. Thus, if  $R_L$  is increased, assuming  $R_L$  and  $R_p$  of like magnitude, the gain in-

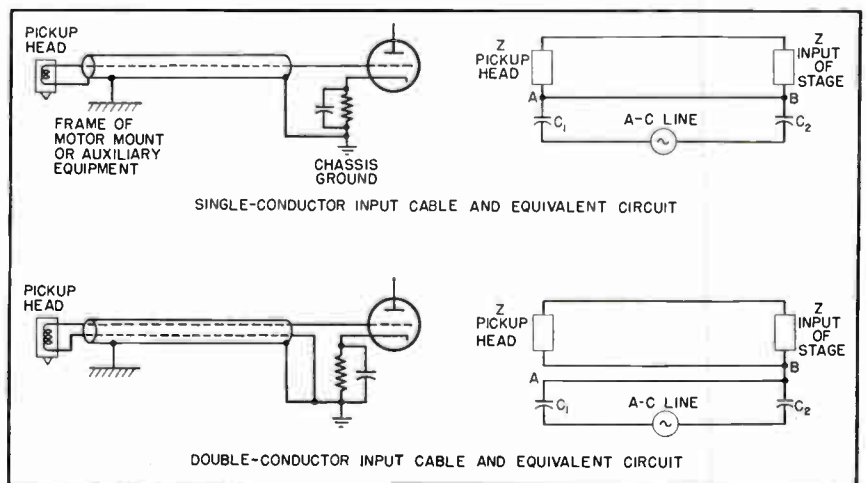


FIG. 5—Actual and equivalent input circuits for single and double-conductor shielded input cable. Reduced hum is achieved with double-conductor cable

creases by an amount less than the increase in  $R_p$ , but the hum output increases directly as  $R_p$ . The hum level referred to the grid of a pentode increases, therefore, with an increase of the plate load resistance as demonstrated in Fig. 4.

The output from metal types was approximately 40 decibels down in voltage from that of glass types. The placement of a close-fitting iron shield over the glass tube reduces its hum to within 2 or 3 decibels of the metal type.

The wave form of hum output for the metal type is for the most part fundamental, with a small amount of second harmonic, while for the glass type it is second harmonic with varying amounts of higher-order even harmonics. This represents an advantage for the metal type when viewed from an audibility standpoint, since a 120-cycle note is much more readily heard than a 60-cycle note. A 60-cycle note, to sound as loud as a 120-cycle note, must be about 3 decibels greater in power.

#### Electrical Leakage

The leakage impedance between socket pins contributes hum to stages with a-c heaters to a degree dependent upon grid-circuit impedance, pin placement, socket material and heater-to-grid capacitance. Consider a voltage divider made up of the leakage impedance from heater to grid pin ( $Z_{leakgr}$ ) and the impedance from the grid to ground ( $Z_{grid}$ ). The voltage which appears across this divider is determined by the wiring of the heaters, and the portion of this voltage which appears at the grid is determined by the ratio of grid-circuit impedance to leakage impedance. Since normal  $Z_{grid}$  is much smaller

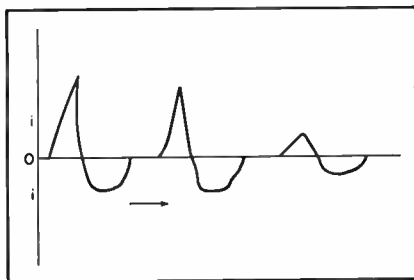


FIG. 6—Typical waveforms of heater-cathode current

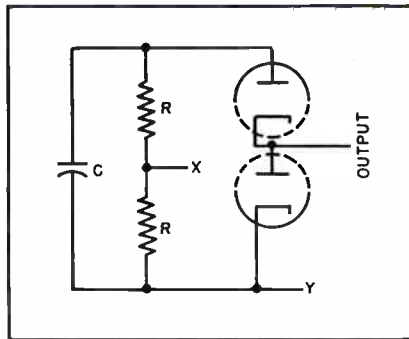


FIG. 7—Basic ratio-detector circuit

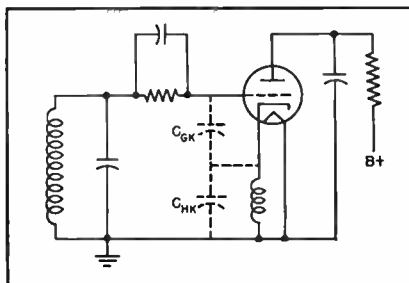


FIG. 8—Variations of  $C_{gk}$  may cause hum through frequency modulation of local oscillator

than  $Z_{leakgr}$ , the voltage at the grid is almost directly a function of the grid-circuit impedance and inversely a function of the leakage impedance.

Insolantite-type sockets have the highest leakage impedance, which is almost entirely capacitive reactance. Next best are polystyrene, mica-filled Bakelite and black Bakelite, in that order, with varying amounts of resistive components. Since the leakage impedance is predominantly capacitive even in the worst sockets, the elimination of harmonics in the heater supply is of great importance. The leakage impedance decreases for the higher-order harmonics. In addition, the gain of the stage is usually greater. Thus a sine-wave heater voltage appears as a sine-wave output at the plate, but a complex wave at the heater is reproduced with greater harmonic content at the plate. Representative values of hum to be expected from this source are 10 to 15 microvolts at the grid for each volt of heater potential above ground with a 1-megohm grid impedance.

When one pin of the heater is grounded there is a single source of leakage voltage, which arrives at

the grid leading the heater voltage by 90 degrees. When the heater is above ground in a series string, the leakage from both pins arrives in-phase at the grid. However, if the heater is operated from the secondary of a power transformer with the center-tap grounded, the leakage from the two pins arrives at the grid out-of-phase, but with different magnitudes. This partial bucking effect may be utilized completely by grounding the heaters through the center tap of a potentiometer with the outside arms connected to the heater supply, and then adjusting the ground tap for cancellation of the two leakage voltages.

Double-ended tubes such as the 6J7 offer a distinct advantage in the problems of hum from leakage since their grid connections are well removed from the heaters. As an example, the 6J7 has one-tenth the hum of the 6SJ7 in this respect.

#### Input-Circuit Wiring

Careful attention to the wiring of input circuits will frequently reduce the hum of low-level amplifiers. Figure 5 shows the equivalent circuits for single and double-conductor shielded input cable. Units  $C_1$  and  $C_2$  are leakage capacitances to the a-c line in the amplifier and in the auxiliary equipment. For the single-conductor cable a closed circuit is made which has a portion of the grid-return lead in the loop. This closed circuit may act either as an electrical-leakage path or as a magnetic loop, depending largely upon the line connections and the size of the leakage capacitances.

The resistivity of ordinary shield braid over a single conductor is roughly 0.003 ohm per foot. Capacitors  $C_1$  and  $C_2$  then must be rather large to produce an appreciable voltage drop along the shield. However, in the case of a grounded line,  $C_2$  becomes a direct connection and  $C_1$  may be as high as 0.1 microfarad due to the line-isolation capacitors in certain types of equipment. With a grounded 115-volt line, 0.1-microfarad leakage will produce 50 microvolts across three feet of shield.

Frequently the leakage path of

$C_1$  and  $C_2$  is shorted out by a ground strap between the two chassis or some other direct connection. In this case the closed circuit acts as a magnetic loop subject to the stray flux of the equipment. Hum levels as high as 75 microvolts at the grid have been encountered in tests from this source.

The use of two-conductor shielded cable as shown isolates the input circuit from any closed loop which the shield may make with auxiliary equipment, and thereby prevents a voltage drop which may appear along the shield from being reflected through the pickup impedance to the grid. This principle can also be applied to the use of ground straps.

The careful elimination of all closed loops in the grounding connections will frequently reduce the hum level of the equipment. Ground connections inside the chassis follow the same pattern, so that the cathode-grounding point and the ground end of the grid circuit should always be connected at the same point on the chassis and should be independent of other circuits, except at the chassis point.

#### Sources Within the Tube

The heater is the only tube element intentionally carrying alternating current at the power frequency. The heater for indirectly-heated-cathode types is coated with a ceramic-like material to insulate it from the cathode sleeve which encloses it. Of several possible ways for alternating current exciting the heater to act upon the other elements and cause hum, the most important and probably the only one that causes noticeable hum in receiving tubes is leakage current between heater and cathode. Modulation of the plate current by the alternating field of the heater is negligible in modern receiving tubes.

Extensive work is being done to establish the nature of heater-cathode leakage current but the information is not yet complete. It may be stated that the current is due mainly to a combination of three phenomena: capacitive coupling between heater and cathode, direct (more or less resistive) leakage between them and emission

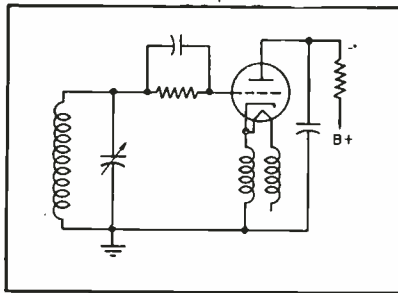


FIG. 9—Heater and cathode arranged to be at same r-f potential, thus reducing hum due to variations of  $C_{HK}$

from the cathode and the heater. Three frequently occurring waveforms of heater-cathode leakage current are shown in Fig. 6 and these indicate that this current is rich in harmonic content.

If the cathode is grounded, current will not affect operation. The same holds for an adequately bypassed-cathode-resistance condition. However, there are numerous cases such as cathode followers, phase inverters, and detectors where the heater-cathode leakage current will cause a voltage drop across the cathode resistance if the heater is returned to ground. To present satisfactory design data it is necessary to consider this current.

The heater-cathode impedance is so large when compared with the normally used cathode resistance that the current source may be considered as a constant-current generator. In tubes which are manufactured with an aim to minimizing heater-cathode leakage, current of 0.04 microampere is common where the heater voltage is 6.3 volts rms and where the cathode is returned to one end of the heater through a resistance. In some types such as output tubes, where hum requirements are less severe, this current may be as high as 1.0 microampere. Fortunately the degenerative action of an unbypassed cathode resistance tends to lessen the effect of the leakage current.

A frequently used circuit in f-m sets is the ratio detector. The schematic circuit is given in Fig. 7. The ground is connected either at point X or at point Y. The former is called a balanced ratio detector. The hum due to heater-cathode leakage current is 3 or 4 times greater with a balanced circuit than with the unbalanced circuit ob-

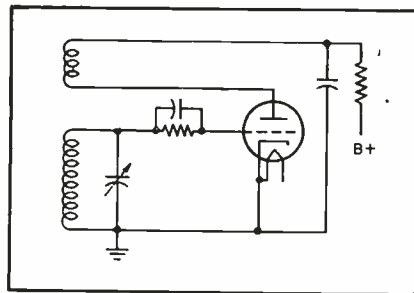


FIG. 10—Tuned-grid tuned-plate oscillator with grounded cathode to minimize effect of variations in  $C_{HK}$

tained when point Y is grounded. The hum increases, of course, with increased resistance values. Also, the larger the resistances, the greater the difference between the balanced and the unbalanced circuit. This is due to the loading effect of the diodes.

The increased use of the higher-frequency television and f-m bands has presented an unusual problem of hum arising in the local oscillator. Figure 8 shows a circuit diagram of a typical high-frequency local oscillator. The a-c heater supply causes the heater-to-cathode capacitance,  $C_{HK}$ , to vary at the power frequency. This arises from either thermal variations of the heater insulation or from mechanical vibration of the heater, possibly from a combination of the two.

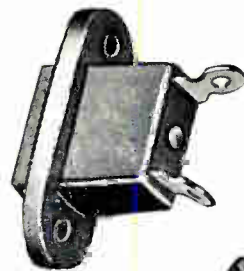
Since the heater-to-cathode capacitance appears in series with the grid-to-cathode capacitance,  $C_{GK}$ , across a portion of the grid tank, any repeating variation of  $C_{HK}$  will cause the oscillator frequency to vary. At the higher frequencies the capacitance in the grid tank is extremely small so that a small change of  $C_{HK}$  will vary the oscillator frequency enough to produce an f-m signal in the i-f strip. It has been estimated that a heater-cathode capacitance change of one part in two million in television channel 13 will produce audible hum at the loudspeaker.

Figures 9 and 10 show two methods for minimizing hum from this source. In Fig. 9 the heater and cathode of the oscillator tube are operated at the same r-f potential. This method has proved satisfactory up to 200 mc. The tuned-grid tuned-plate circuit of Fig. 10 enables the cathode to be operated at ground potential.

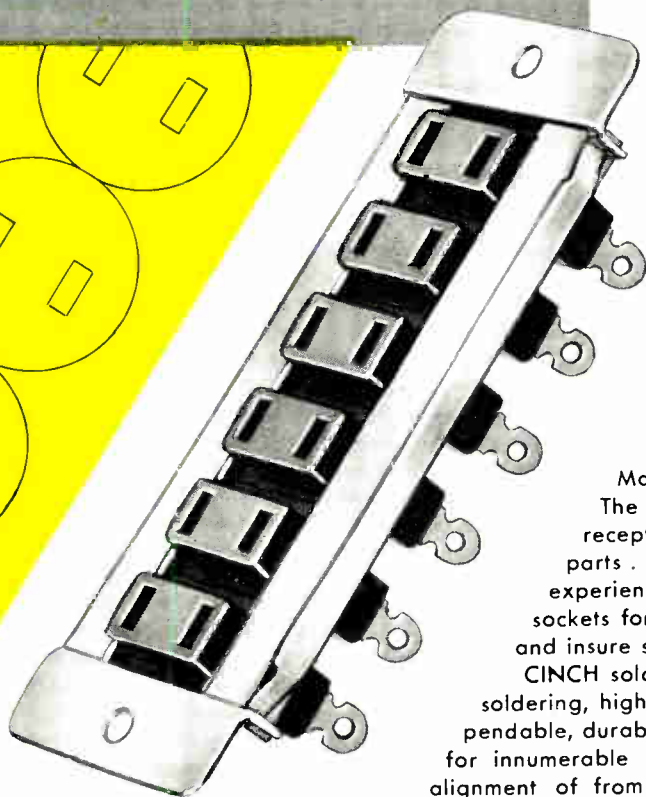
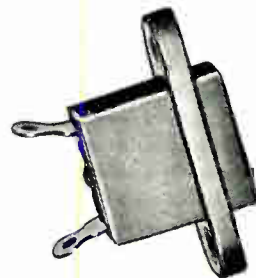


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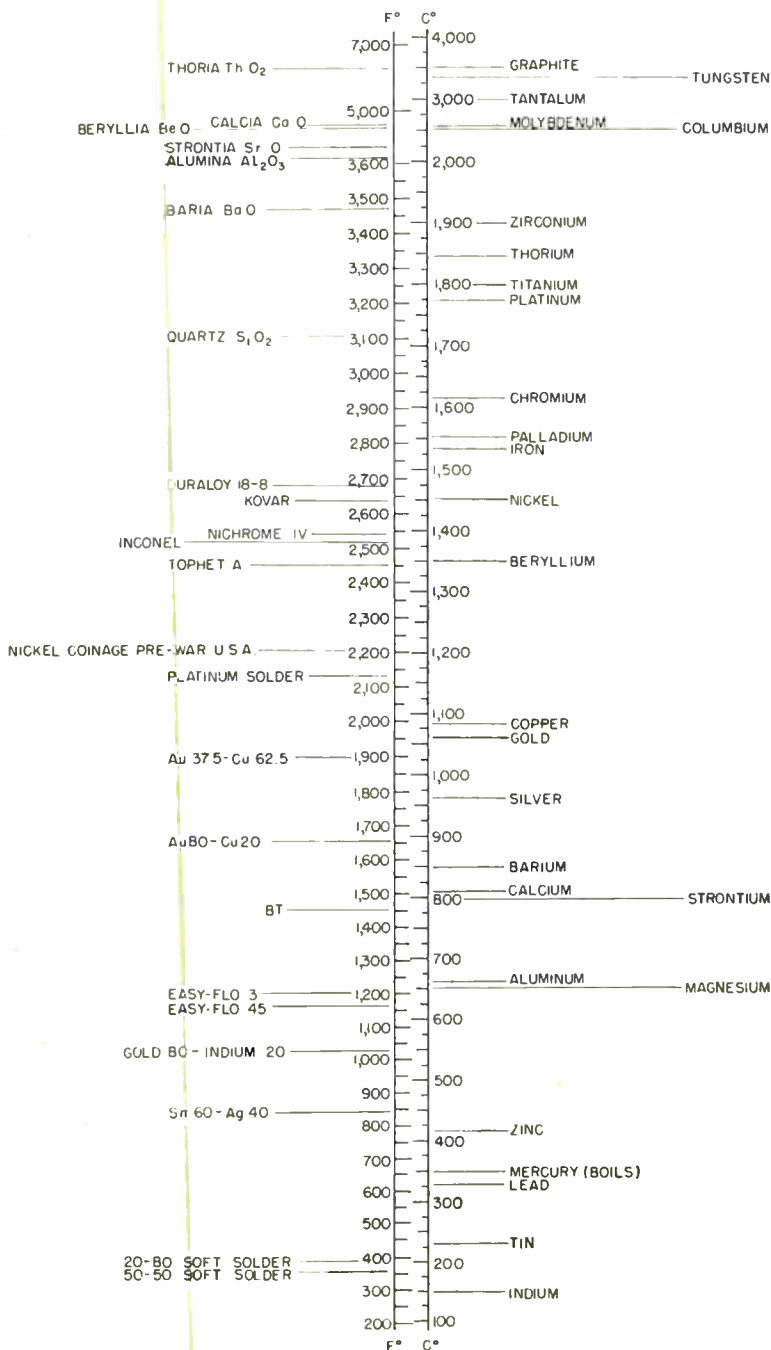
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# Melting-Point Chart

Metals, alloys and ceramics commonly used in electron tubes are covered. Critical temperatures are given in degrees Fahrenheit and centigrade

By **K. H. McPHEE** *Research Division, Vacuum Tube Laboratory  
Collins Radio Company, Cedar Rapids, Iowa*



**T**HE MELTING POINT CHART is a thermometer-type graph upon which are placed the melting points of metals, alloys and ceramics most commonly used in electron tubes.

A linear scale representing degrees F is located on the left side of the central thermometer. A linear scale representing degrees C is located on the right side of the thermometer. Any line drawn through the thermometer, normal to its length, designates a C reading and the F equivalent. Above 2,000 C, the scale is condensed.

Pure metals are shown opposite their respective melting points on the right side of the thermometer. Ceramic materials and metal alloys are similarly shown on the left.

The melting temperature shown for ceramic bodies is that temperature above which no crystalline phase normally exists. No attempt has been made to indicate their progressive softening characteristic.

### Uses

When a specific material is being considered for use because of desirable electrical, chemical or other properties, the melting point is easily obtained. Conversely, where the temperature range within which materials must work is known suitable ones can be quickly selected.

Fabrication techniques may employ soldering, brazing, or welding, and the most suitable method for a particular material is frequently determined from the chart. Similarly, where sequential heating operations are planned it is useful.

The chart also facilitates rapid conversion between F and C scales.

# Hold That "Line"!



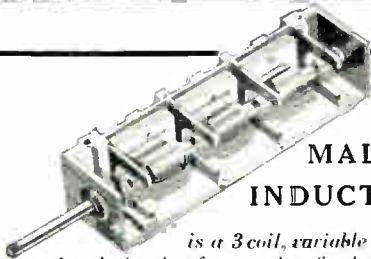
## *The Mallory Inductuner\* tunes in the telecast clearly and keeps it in line*

Frequency drift—which in television means a gradual blur and weakening of the picture, and results in irritated calls for the service man—is one of the problems that Mallory recognized in the early days of television.

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*is a 3 coil, variable inductance tuning device that features low final cost, contact reliability, simplicity of operation and uniform reception. Currently it is being incorporated in television receiving equipment as a practical, efficient means of tuning the entire TV and FM range of 44 through 216 Mc. In addition, the Inductuner offers unusual possibilities in the test equipment, amateur and experimental fields.*

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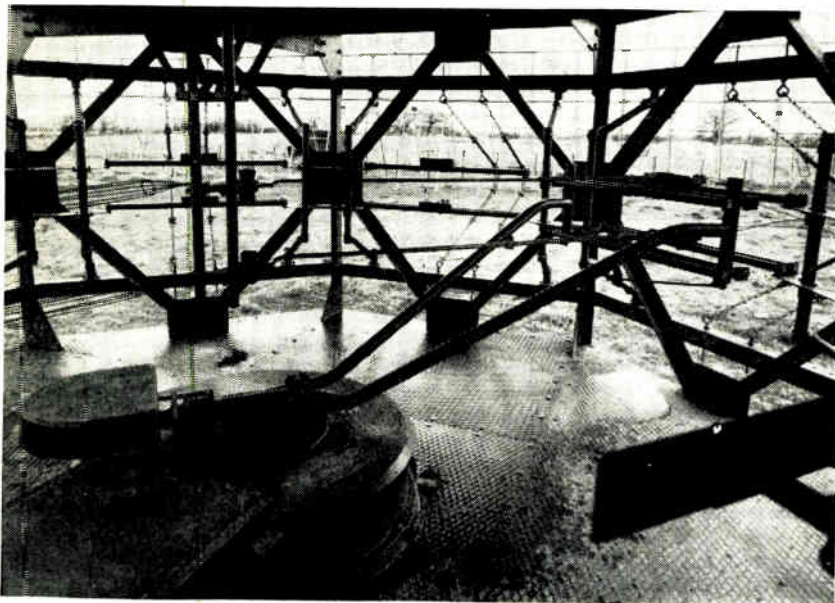
**P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA**

# TUBES AT WORK

Including INDUSTRIAL CONTROL

Edited by VIN ZELUFF

British Valves at Work.....	120
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Inside base of an antenna switching tower showing one of six stacked switching arms. The remotely controlled motor is mounted in the large box in the center

## British Valves at Work

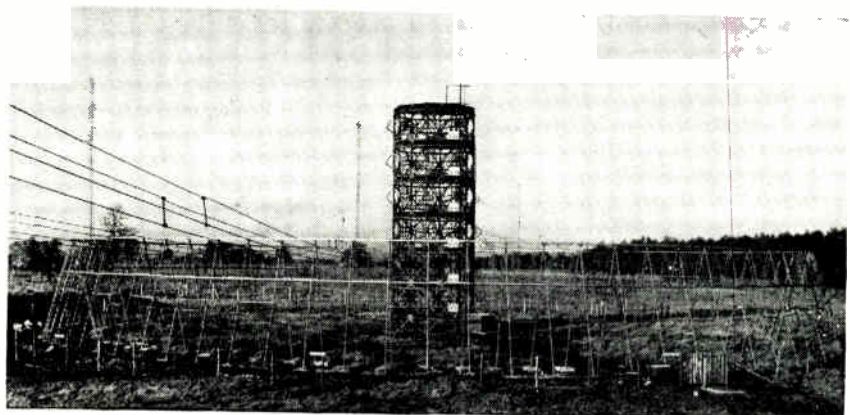
*McGraw-Hill World News*

WITH a frequency accuracy of one part in a million and occasional effective radiated power output of 1,500 kw from six transmitters, the BBC transmitting station at Skelton, England, incorporates many ingenious and effective methods for band and antenna switching. The station operates on the short-wave bands and it was constructed specifically for the purpose of transmitting to European countries, Latin America and certain parts of the Pacific.

These transmissions are radiated in some thirty-six languages, and the service continues through day and night, changing frequencies and directions as demanded by conditions of propagation and location of areas to be served. The station was built during the war and de-

signed to ensure reliable transmissions despite enemy jamming efforts.

In all, there are 51 antenna arrays strung between 31 masts



One of the forty-foot rotary switches used in the BBC's Skelton station for antenna switching. Each of the six decks contains a switch

ranging in height from 200 to 350 feet. The remote antenna switching system is perhaps the most interesting feature of the station. Any one of the six transmitters may be connected between a certain number of arrays, thus enabling the output of a transmitter to be beamed to any part of the world.

A picture of one of the giant multipole switches is shown. These towers are forty feet high and built in six levels, each being connected to a certain transmitter. The switching arm is controlled by an electric motor. The antenna arrays are in the form of stacked horizontal arrays.

The master oscillators are not crystal controlled, but excellent stability is possible through the use of double temperature control where the temperature inside the frequency determining unit is controlled and the temperature of the room housing the unit is also constant. The oscillators operate at comparatively low frequencies and the frequency is multiplied in harmonic generators with a switching arrangement for optimum flexibility.

Another ingenious design feature is the mounting of tuned circuits on trucks. These units are wheeled into the rear of the transmitter cabinet, and contact is made by spring-loaded copper blades of generous area.

The audio driver delivers 1,200 watts to the class B modulators and each of the latter can dissipate up to 75 kilowatts on its anode. Each tube takes 2.5 amperes of grid current on drive peaks. The modulation transformer carries up to 20



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## THE FRONT COVER

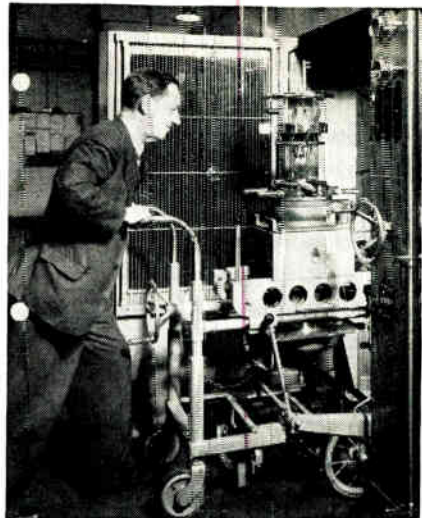
**D**ESIGNS as intricately curved as that at the right can be produced in a single operation with the Air Reduction Sales Co. photoelectric cutting machine shown below and on the front cover.

A silhouette or outline drawing of the desired shape is placed on the table at the left in the photo, under the photoelectric tracing head. An optical unit in the head projects a small spot of light downward on the pattern, and phototubes responding to the reflected light drive a steering motor that keeps the spot positioned half on the black line and half on the white paper while traveling around the pattern at the desired cutting speed. The oxyacetylene cutting torches on the other end of the pantagraph bar cut the desired pattern from the sheet of boiler plate or other material under the torches.

The number of torches used can be varied at will. Three are shown in use, cutting out large washers, while four are in operation on the front-cover setup for cutting paper-mill pulp beaters from  $\frac{3}{4}$ -inch low-carbon plate 4 ft wide and 8 ft long.

There are no limitations to the variety of designs that may be cut with electronically controlled tracing equipment. Cutting accuracy is greater than with manually guided or automatic mechanical tracing spindles, and the low cost of paper patterns permits economical operation even on orders for single pieces. Paper patterns are easily stored, in contrast to storage problems for the carefully machined metal templates otherwise needed.

The electronic tracing device contains two phototubes, an amplifier tube, a lamp, associated circuit components and optical lenses, and three motors that control movement of the head—the steering motor, the tracer driving motor and a motor that raises or lowers the head in response to a manually operated switch. The tracing wheel controls the direction of movement of the head but does not track over the outline of the template except where it may intersect the outline.



Changing tubes is a touchy proposition when those involved cost about \$5,000. Tubes are wheeled into position and lowered slowly into their sockets by truck mechanism

amperes peak current in the primary at a peak voltage of over 7,000. The modulation choke has an inductance of about 13 henrys at 14 amperes.

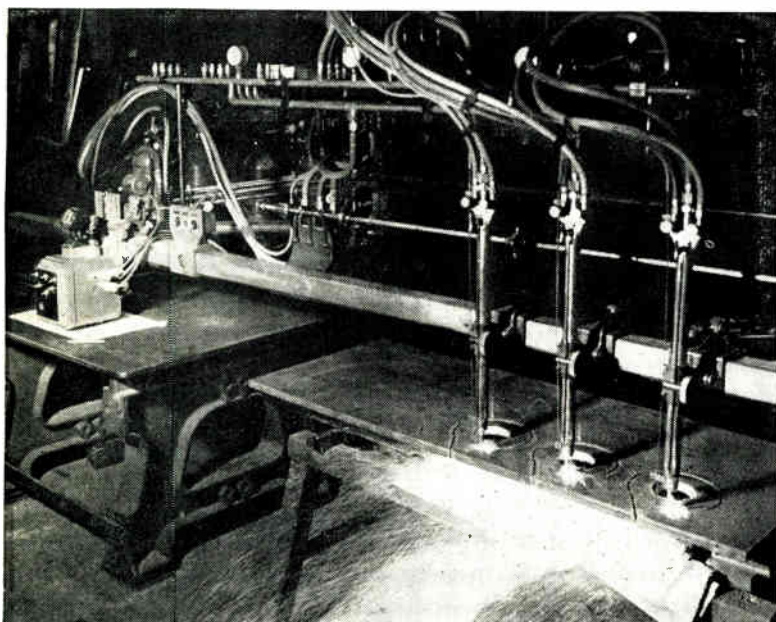
The final stage is a class C push-pull stage using two water-cooled tubes in a balanced bridge circuit. The filaments of these tubes carry 460 amperes at 32 volts, and their anodes are capable of dissipating 150 kw with voltages around 20,000. The tubes are 3 ft 6 in. high and they are wheeled in and out of the transmitter on special trolleys for safety in handling and ease of replacement.

Each transmitter is controlled from a small metal desk where the engineer may fire up his transmitter from a cold start and keep constant check on its efficient operation. Complete monitoring equipment is, of course, provided.

Power for the station is obtained from the Electricity Authority at 11 kv, 3-phase, 50 cps. Also, three 500-kw diesel-engine-driven alternators are available for emergency operation.

For some 22 hours a day, a radiated power of 1,500 kw is sent out to Europe and Asia, while from other beam networks services are transmitted to North America, Central and South America at night, and to the Fleet in the Pacific. The longest circuit on which direct transmission is achieved with ex-

(continued on p 136)



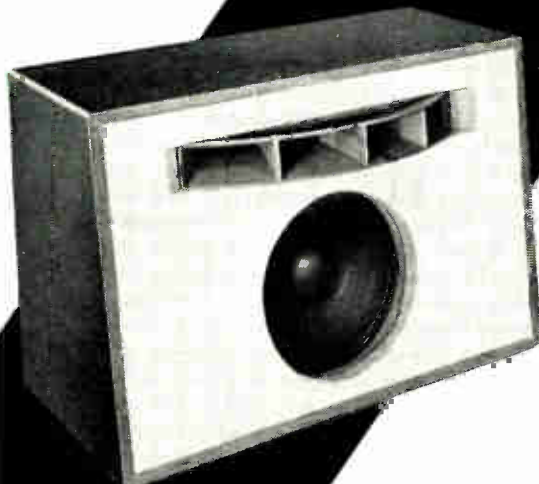
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755A—8" direct radiator,  
8 watts, 70-13,000 cycles.



756A—10" direct radiator,  
20 watts, 65-10,000 cycles.



757A—dual unit system,  
30 watts, 60-15,000 cycles.



728B—12" direct radiator,  
30 watts, 60-10,000 cycles.



754A—12" direct radiator, extra high  
efficiency, 15 watts, 60-10,000 cycles.  
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# THE ELECTRON ART

Edited by FRANK ROCKETT

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## Tube Maps Magnetic Fields

PATHS OF MAGNETIC LINES of flux can be traced with a mercury vapor diode having a perforated tantalum (or other nonmagnetic) anode and a coaxial cathode. With an anode potential of 10 to 15 volts (approximately the ionization potential of the mercury) and a cathode current of about 10 ma (although operation is satisfactory over a wide current

range), the electrons are focused into tight helical beams whose axes follow the magnetic flux paths even in fields as weak as 0.01 weber per square meter. Ionization of the vapor along the paths makes them visible.

The action of the tube, which is being studied by S. J. Tetenbaum under the direction of Prof. S. G. Lutz at New York University, can be seen from Fig. 1. Electrons from the cathode are accelerated toward the anode. Because of the magnetic field, only those electrons whose initial trajectories are nearly tangential to the magnetic flux continue undeflected through the perforations in the anode. The low radial velocities of these electrons enables the magnetic field to confine them to tight helical beams whose axes follow the magnetic flux paths quite accurately. The only cumulative distortion is a slight drift in the direction of the curvature axis of the field; it is minimized by the low electron velocity.

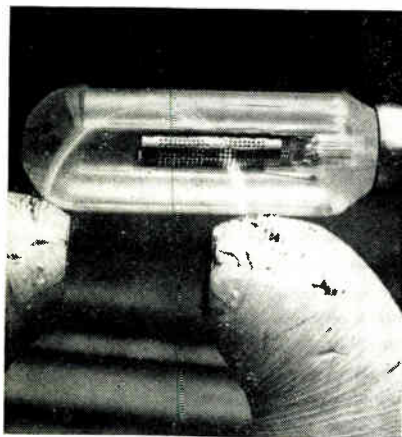


FIG. 1—Gas diode shows magnetic lines in flux; diameters of electron beams are least in regions of highest flux

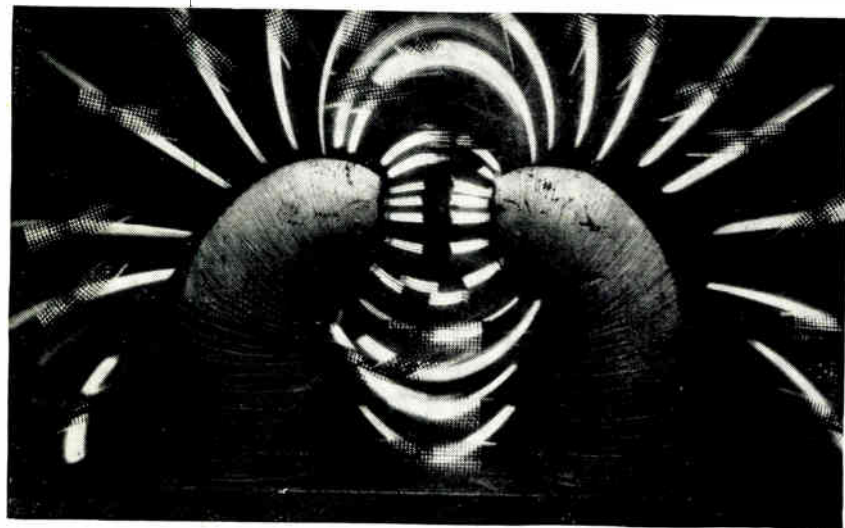


FIG. 2—Successive exposures with tube in various positions about a magnetron magnet (pole faces and shunt removed) show its field configuration; room lights, off during exposures, were turned on later to photograph magnet

The tube can be used to delineate leakages about magnetic structures or as a means of visually demonstrating the patterns of magnetic fields. By successively exposing a photographic film in a darkened room as the tube is moved about a magnet, the field can be mapped, as in Fig. 2. A paper describing this tube in greater detail was presented at the National Electronics Conference, Nov. 1948.

## Radome Design Limitations

HOUSINGS for aircraft radar and radio antennas are often made of low-pressure molded plastic. The two conflicting requirements for the contours of these laminated structures, that they do not interfere (1) with the airfoil design of the airplane or (2) with the focusing of the radar beam, make their design and fabrication difficult. As pointed out by F. H. Behrens of the Air Materiel Command before a seminar of The Society of The Plastics Industry in June at Washington, D. C., the services and industries working on these problems have developed means for reconciling them to some extent.

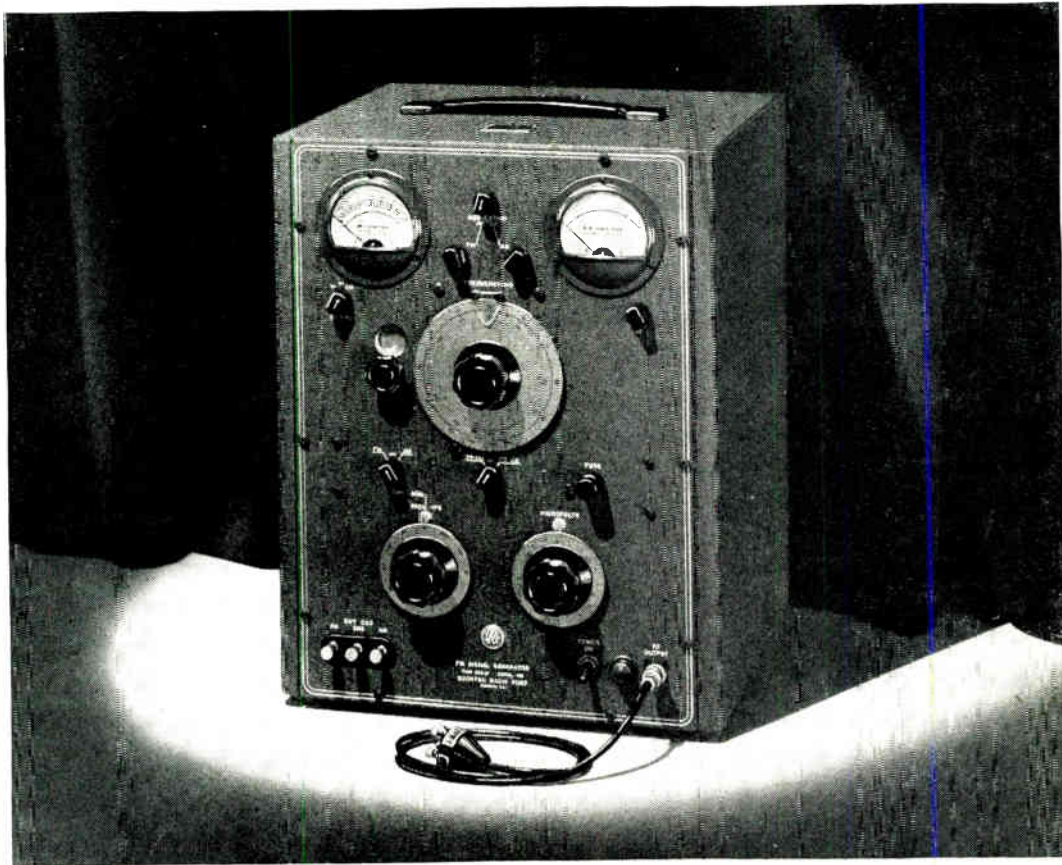
### Classification of Radomes

Radomes can be classified into types according to the constructional means used to minimize distortion of the radar beam. The radome absorbs appreciable power from the radiated field and also distorts it by reflection, refraction and diffraction. The radome may reflect sufficient energy back into the antenna to cause signal instability. At most radio frequencies the antenna housing is sufficiently thin compared to a wavelength to cause no distortion. However, at microwaves the thickness of the radome is comparable to a wavelength so that reflected and refracted energy from the inner and outer surfaces are not in a phase relation to produce cancellation.

There are four principal wall constructions in use: (1) thin wall, (2) thick wall, (3) double wall, and (4) sandwich. The sandwich construction is the most extensively used.

Thin walled construction is used





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Utilizing this valuable information, Boonton Radio Corporation's engineers worked another full year before they were ready to place their approval on the final design—the type 202-B FM-AM Signal Generator.

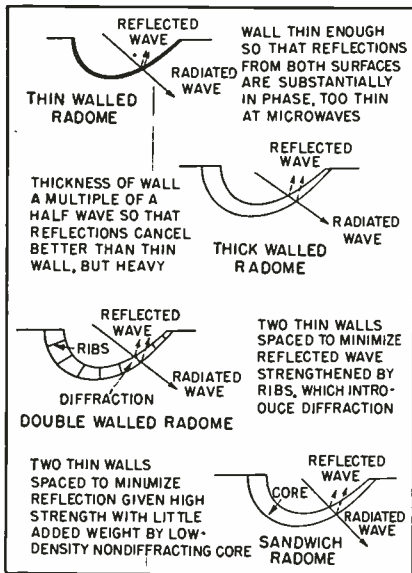
The advantages of this essential instrument were recognized

immediately. Since its enthusiastic reception, the 202-B has increased in popularity and today it is generally accepted as the acknowledged standard of FM-AM signal generator performance. Practically every well known radio manufacturing concern is now placing increasing numbers of this versatile instrument in full time use, assisting their engineers and research staffs to design and produce better, lower cost radio and television receiving equipment.

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Utility of airborne radar depends on the equipment having a suitable window through which to transmit its beam. Four types of radomes are commonly used to provide this window, but making them transparent and streamlined is difficult

at radio and longer microwave frequencies at which the wall thickness can be made small compared to a wavelength in the radome material. Such walls made thin enough for use at microwaves are structurally too weak for use in high-speed aircraft. At lower frequencies, where they can be made sufficiently thick for strength, thin walled housings are very satisfactory.

Structurally, the thick walled housings are similar to the thin walled types, but the thickness is made at multiples of a half wavelength in the dielectric so the reflections are neutralized. Because of the shape of the radome, the waves do not pass through all portions of the material at the same angle, so the thickness is a compromise or must be made variable. This type of wall is usually used at shorter microwaves; at longer wavelengths this construction gives an excessively heavy housing.

The double walled radome consists of two thin walls, one within the other, and accurately spaced to neutralize reflections by ribs that also increase its strength. Because of the poor strength and diffraction around the ribs, this type is little used.

The sandwich construction consists of two thin walls, one within

the other as in the double walled type, but spaced and fully stabilized by a low density core material bonded between the thin skins. This arrangement neutralizes reflections and provides tremendous strength with low weight.

#### Streamlining and Transmission

Unless the radome is sufficiently streamlined it produces intolerable drag on a modern aircraft. Unless it presents sufficient undistorted transmission to the radar beam, the radome limits the accuracy of the radar equipment. Thus streamlining is limited by the critical angle of incidence at which the radar waves will pass through the wall. The relative orientation of the rays and the sloping surface of the radome establish this angle. The upper limiting angle of incidence is a function of the dielectric properties of the material used for the radome and of the wall configuration to which it is designed. In general, the lower the dielectric constant and the loss factor, the greater the freedom in streamlining.

A detailed study can be conducted to good accuracy to determine the angles of incidence and polarizing directions throughout the radome, thereby providing design data for grading the wall thickness. By this means an efficient, streamlined radome can be designed, but its final performance depends on the tolerance to which it can be molded.

#### Fabrication Limitations

Fabrication of radomes is beset by many problems and several improvements are necessary such as: (1) harder finishes that are less subject to erosion by rain, (2) close control of outline, thickness and uniformity of material, (3) elimination of lap joints in window areas of critical types of radomes, (4) fabrication of controlled graded thicknesses, and (5) elimination of hand tailoring of the core in various types of sandwich radomes.

The properties of laminated resins used for radomes need improvement also so that they will bond more strongly to glass fiber, withstand elevated temperature,

have greater mechanical strength, lower dielectric constant and loss factor, and be sufficiently viscous so that voids will not form between laminations. Most current development is directed to improving sandwich domes. Voids are avoided by premolding skins which are then accurately supported during sandwich fabrication by molds. The core is introduced by heating a prepared foaming batter.

In conclusion, the speaker stated that the future of airborne radar depends to a great extent on satisfactory solution of these problems. (Ed. Note: see also Part II of "Radar Scanners and Radomes" by W. M. Cady, M. B. Karelitz, and L. A. Turner, vol 26, MIT Radiation Lab. Series, McGraw-Hill, 1948.)

#### Series Overmodulation

By ROBERT E. BAIRD  
Chief Engineer, KWSC  
Pullman, Wash.

Amplitude modulation in excess of 100 percent can be produced with a series modulator without creating sideband splatter. Several methods have been described for accomplishing such overmodulation (for example: Overmodulation Without Sideband Splatter, O. G. Villard, Jr., ELECTRONICS, p 90, Jan. 1947) and for exceeding 100 percent modulation on positive peaks without exceeding it on negative peaks. Broadcast stations in some localities overmodulate within the five-percent differential allowed by the FCC by slightly unbalancing their class-B linear amplifier. The simple method that is to be described here rounds the negative peaks so that overmodulation cannot occur on them even though over 200 percent modulation may be produced on positive peaks. In this way the break in the carrier that would cause sideband splatter is avoided.

#### Modulator Tube is Variable Resistor

Series modulation has considerable merit in itself because there are no reactances in the modulator. All that is needed is the proper tube and a power supply giving a little more than twice the rated voltage of the r-f amplifier. Figure 1A

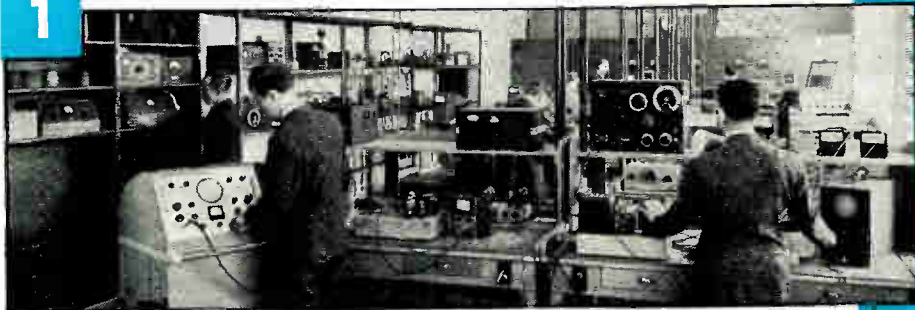
(Continued on p 160)

What we mean by...

# RIGID QUALITY CONTROL

## A DEFINITION OF SHERRON METHODS IN THE BUILDING OF CUSTOM MADE ELECTRONICS PROJECTS

1



HERE IN THE SHERRON electronics laboratory we initiate our design and development procedures. Every detail of a project's embryonic phase is explored by thoroughly seasoned physicists, engineers and technicians. Here the pattern for the finished product is accurately defined to assure trouble-free performance.

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THE SHERRON electro-mechanical laboratory serves in the fabrication of mechanical components for . . . computers, vacuum tube structures, mechanical equipment for electronoptics, special precision wave guides, precision tuning units, precision drive mechanisms, servo mechanisms. Staffed by graduate mechanical engineers, equipped with the newest precision machines and tools, this laboratory is invaluable in closing up the margin for error in the electronic equipment we manufacture.

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- Television Signal Synthesizer Sync Generators
- Monoscope
- Shapers — Timers
- Wide band oscilloscopes
- Air monitors
- Field intensity equipment
- Television test equipment



## SHERRON ELECTRONICS COMPANY

Division of Sherron Metallic Corporation

1201 FLUSHING AVENUE • BROOKLYN 6, NEW YORK

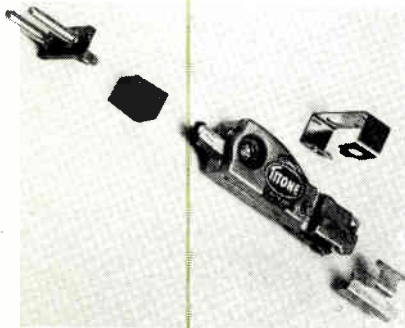
# NEW PRODUCTS

Edited by A. A. McKENZIE

**New equipment, components, tubes, testing apparatus and products closely allied to the electronics field. A review of catalogs, handbooks, technical bulletins and other manufacturers' literature**

## Ceramic Pickup

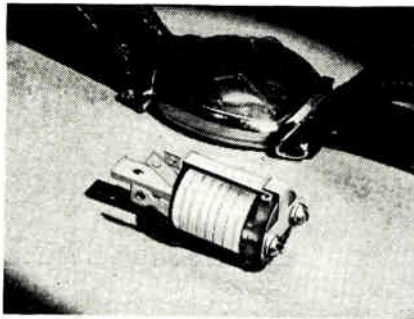
SONOTONE CORP., Elmsford, N. Y. Titone ceramic pickups for 78 and long-playing records use synthetic barium titanate piezoelectric elements. The pickup for 78-rpm records has a 0.0027-inch radius needle tip, requires a tracking weight of 22 grams, has a lateral compliance of  $0.5 \times 10^{-6}$  cm per dyne or better, and delivers an open-circuit output of 0.75 volt at 1,000 cps. The pickup for L-P records has a 0.001-inch radius needle tip, requires a tracking weight of



only 6 grams, has a lateral compliance of  $0.75 \times 10^{-6}$  cm per dyne, and delivers 0.25 volt at 1,000 cps on a test record. Both pickups have permanent sapphire needles and wide frequency responses. Mounting and electrical adapters are available so that the cartridge can be used in standard tone arms.

## Supermidjet Relay

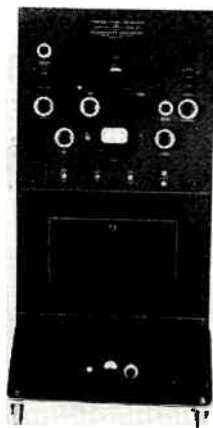
POTTER AND BRUMFIELD MFG. CO., 549 W. Washington Blvd., Chicago, Ill. A new type of miniature relay weighing only 0.33 ounce eliminates all nonfunctional parts. The core parts are formed to act as current-carrying elements and contacts, one part providing the armature and movable-contact arm while another



part is extended to provide a stationary contact arm and mounting. Another stationary contact can be mounted on the insulating bakelite front of the coil form with two screws. Contacts are heavy silver plating applied directly to the iron magnetic parts. They are rated for 100 milliamperes d-c at 50 volts for maximum life. Coils are wound to any desired resistance up to a maximum of 1,600 ohms.

## Television Signal Standard

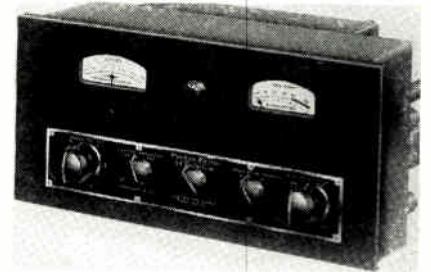
MEASUREMENTS CORP., Boonton, N. J. Model 90 television standard signal generator has a master oscillator, buffer, and modulated power amplifier. Output circuits are overcoupled to permit modulation frequencies up to 5 megacycles. Carrier range is continuously vari-



able from 20 to 250 megacycles. Video modulation operating from a standard RMA composite signal has a bandwidth of 4 mc at 3 db. A mutual-inductance balanced attenuator is provided.

## F-M Monitor

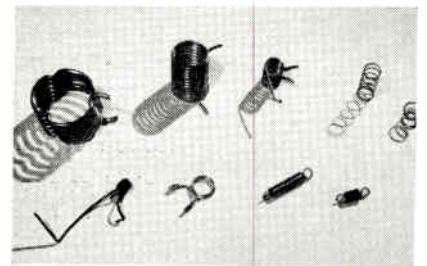
GRAYBAR ELECTRIC Co., 420 Lexington Ave., New York 17, N. Y. The Western Electric model 5A f-m frequency and modulation monitor provides continuous indication of center-frequency error, percentage of modulation, a visible alarm for



overmodulation, program monitor, and noise detector for measurement of transmitter a-m noise. Extension meters can be added. Write for brochure WECO-T2437.

## Coils and Springs

WEBSTER SPRING CORP., 97 South 5th St., Brooklyn 11, N. Y. The coils and springs illustrated indicate the scope of the company's



manufacturing possibilities. In addition, solenoids and i-f transformers can be furnished on order in small or large quantities.

## Submidjet Switches

GENERAL CONTROL Co., 1200 Soldiers Field Road, Boston 34, Mass. New lever switches have shielding between switch assemblies and single-hole mounting or two sets of four holes on standard

# WHY IT'S TO YOUR ADVANTAGE TO STANDARDIZE ON RAYTHEON SUBMINIATURE TUBES

For Special Purpose Applications

Raytheon Filamentary Subminiatures increase the solubility of your product by decreasing its size. They are flat. Batteries can be little instead of big because of extremely low filament drain.

Raytheon Subminiatures plug into standard sockets, (over one and a half million in use), or can be soldered or welded into the circuit.

Raytheon Tubes are readily available from stock. Over half a million of the tubes described on this page are available at all times. They are standard throughout the world — more are in use

today than all other makes combined!

Raytheon offers you unsurpassed application engineering service, backed by nine years of production and application experience.



→ NEW TYPES

This chart gives you at a glance the characteristics of representative Raytheon Subminiature Tubes

Type No.	Remarks	Maximum Diameter Inches	Maximum Length Inches	Filament Or Heater		Mutual Conductance Umhos	Power Output MW	TYPICAL OPERATING CONDITIONS				
				Volts	Ma.			Plate Volts	Ma.	Screen Volts	Ma.	Grid Volts
<b>HEATER CATHODE TYPES</b>												
CK5702/CK605CX	Characteristics of 6AK5	0.400	1.5	6.3	200	5000	120	7.5	120	2.5	-2.0	
CK5703/CK608CX	Triode, UHF Oscillator, 3/4 watts at 500 Mc	0.400	1.5	6.3	200	5000	120	9.0	150ac	9.0	-2.0	
CK5704/CK606BX	Diode, equivalent to one-half 6AL5	0.315	1.5	6.3	150		250	4.0			-2.0	
CK5744/CK619CX	Triode, High mu.	0.400	1.5	6.3	200	4000	120	5.2	120	3.5	-2.0	
→ CK5784	Characteristics of 6AS6	0.400	1.5	6.3	200	3200	120	5.2	120	3.5	-2.0	
<b>FILAMENT TYPES</b>												
2E31-32	RF Pentode for pocket radio	0.300x0.400	1.56	1.25	50	500	22.5	0.4	22.5	0.3	0	
2E35-36	Output Pentode for pocket radio	0.290x0.390	1.56	1.25	30	385	1.2	22.5	0.27	22.5	0.07	0
2E41-42	Diode Pentode for pocket radio	0.290x0.390	1.56	1.25	30	375		22.5	0.35	22.5	0.12	0
2G21-22	Triode Heptode for pocket radio	0.300x0.400	1.56	1.25	50	75	conv. cond.	22.5	0.20	22.5	0.30	
RK61	Gas Triode, Exp. Radio Control	0.550	1.81	1.4	50		45.0	1.5	Special Circuit			
CK502AX	Output Pentode	0.285x0.385	1.5	1.25	30	550	6.0	45.0	0.6	45.0	0.15	-1.25
CK503AX	Output Pentode	0.285x0.385	1.5	1.25	30	550	9.5	45.0	0.8	45.0	0.25	-2.0
CK505AX	Voltage Amp. Pent.	0.285x0.385	1.5	0.625	30	38†		22.5	0.125	22.5	0.04	-0.625
CK506AX	Output Pentode	0.285x0.385	1.5	1.25	50		25.0	45.0	1.25	45.0	0.40	-4.5
CK510AX	Double Space Charge Tetrode Amplifier	0.285x0.400	1.25	0.625	50	150†	both units	45.0	0.06		0	
CK512AX	low microphonic voltage amplifier	0.285x0.385	1.25	0.625	20	37†		22.5	0.125	22.5	0.04	-0.625
CK522AX	Output Pentode	0.285x0.385	1.5	1.25	20	450	1.2	22.5	0.30	22.5	0.08	0
CK523AX	Output Pentode	0.285x0.385	1.5	1.25	30	360	2.5	22.5	0.30	22.5	0.075	-1.2
CK524AX	Output Pentode	0.285x0.385	1.5	1.25	30	300	2.2	15.0	0.45	15.0	0.125	-1.75
CK525AX	Output Pentode	0.285x0.385	1.5	1.25	20	325	2.2	22.5	0.25	22.5	0.06	-1.2
CK526AX	Output Pentode	0.285x0.385	1.5	1.25	20	400	3.75	22.5	0.45	22.5	0.12	-1.5
CK527AX	Output Pentode 1.5 ma. filament	0.285x0.385	1.5	1.25	15	225	0.75	22.5	0.10	22.5	0.025	0
CK529AX	Shielded Output Pentode	0.290x0.390	1.5	1.25	20	275	1.2	15.0	0.20	15.0	0.05	-1.5
→ CK533AX	Output Pentode	0.285x0.385	1.5	1.25	15	425	2.0	22.5	0.4	22.5	0.1	0
→ CK535AX	Output Pentode	0.285x0.385	1.5	1.25	20	275	1.2	15.0	0.20	15.0	0.05	-1.5
CK551AXA	Diode Pentode	0.300x0.400	1.56	1.25	30	235		22.5	0.17	22.5	0.043	0
CK553AXA	RF Pentode	0.300x0.400	1.56	1.25	50	550		22.5	0.42	22.5	0.13	0
CK571AX	10 ma. Filament electrometer tube, Ig = 2x10 <sup>-13</sup> amps.	0.285x0.400	1.5	1.25	10	1.6†		10.5	0.20			-3.0
→ CK573AX	Triode, high frequency output	0.300x0.400	1.5	1.25	200	2000		135	14.0			-7.5
→ CK574AX	Shielded Pentode RF Amplifier	0.290x0.390	1.25	0.625	20	37†		22.5	0.125	22.5	0.04	-0.625
CK5672	Output Pentode	0.285x0.385	1.5	1.25	50	625	60.0	67.5	2.75	67.5	1.1	-6.25
CK5676/CK556AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	120	1600		135.0	4.0			-5.0
CK5677/CK568AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	60	650		135.0	1.9			-6.0
CK5678/CK569AX	RF Pentode	0.300x0.400	1.5	1.25	50	1100		67.5	1.8	67.5	0.48	0
CK5697/CK570AX	Electrometer Triode Max. grid current 5x10 <sup>-13</sup> amps.	0.285x0.400	1.25	0.625	20	1.5†		12	0.22			-3.0
→ CK5785	High voltage rectifier	0.285x0.400	1.5	1.25	15			0.1	Inverse peak 3500 volts			
<b>VOLTAGE REGULATORS</b>												
→ CK5783	Voltage reference tube — like 5651	0.400	1.63	Operating voltage 85.		Operating current range 1.5 to 3.5 ma.						
→ CK5787	Voltage regulator	0.400	2.06	Operating voltage 100.		Operating current range 5 to 25 ma.						
CK ⊗	RK ⊗											

(Voltage Gain (lines))

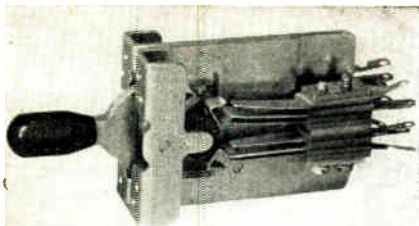
NEW — Write for Socket and Mounting Notes for Flat Press Subminiature Tubes.

**RAYTHEON MANUFACTURING COMPANY**  
SPECIAL TUBE SECTION  
Newton 58, Massachusetts

**RAYTHEON**

RADIO RECEIVING TUBES • SUBMINIATURE TUBES • SPECIAL PURPOSE TUBES • MICROWAVE TUBES

Excellence in Electronics



centers. Total depth of the frame behind the panel is  $2\frac{1}{2}$  inches to  $2\frac{21}{32}$  inches depending upon the contact arrangement.

### Bus Receiver

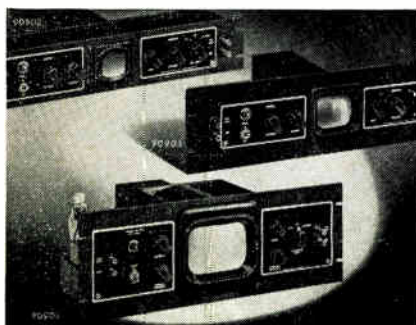
GENERAL ELECTRIC Co., Syracuse, N. Y. The f-m fixed-tuned receiver shown is used in buses or other vehicles that are a part of the programming-advertising combination sometimes known as "car-card radio". Crystal controlled at the fre-



quency of the desired station, the receiver operates from the bus battery, is connected to four or eight speakers, and is used with a dipole mounted externally over the driver's seat.

### Basic Oscilloscopes

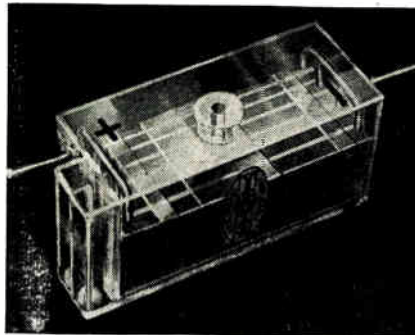
JAMES MILLEN MFG. Co., INC., Malden, Mass. The three models of rack panel oscilloscopes have been designed as basic units to which



other units, such as sweep circuits, pulse generators, and amplifiers can be added for any laboratory or industrial use. Models 90902, 90903, and 90905 use two-, three-, and five-inch tubes, respectively.

### Small Wet Cell

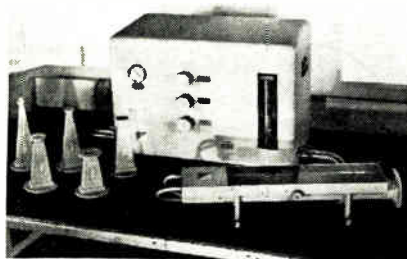
THE VITAMITE Co., 227 West 64th St., New York 23, N. Y. A new rechargeable nonspill wet-cell battery model 2A-3.00 weighs six ounces. It has a four-ampere capacity and



has been designed to operate under low-temperature and low-pressure conditions.

### Microwave Calorimeter

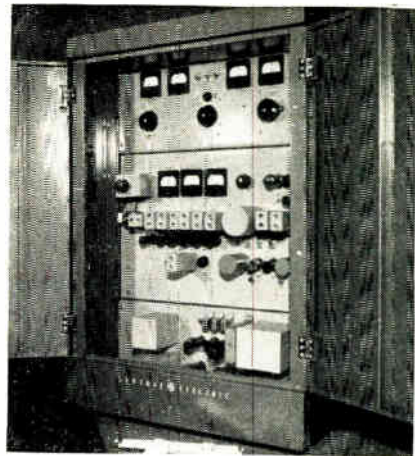
DE MORNAY BUDD INC., 475 Grand Concourse, New York 51, N. Y. Measurement of absolute r-f power in a series of frequency bands between 2,600 and 26,500 megacycles



is now possible. Accuracy of 2 watts at average power readings of 100 to 500 watts is attained by the calorimetric principle.

### Educational F-M

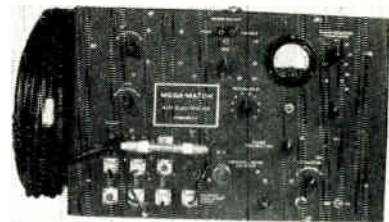
GENERAL ELECTRIC Co., Syracuse, N. Y. A new f-m broadcast transmitter type BT-11-B operates in the 88-to-108-megacycle range, but is designed for a power output of ten watts or less for noncommercial



educational work. Coverage ranges from 5 to 10 miles depending upon the installation. The unit employs a Phasitron modulator, has 21 tubes, and weighs 280 pounds.

### Standing-Wave Meter

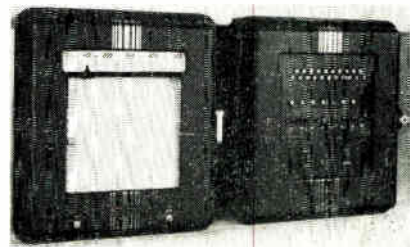
KAY ELECTRIC Co., Pine Brook, N. J. The modified Megamatch displays reflected energy in bandwidths of 30 mc anywhere between



10 and 500 mc, and can be used for most work up to 1,000 mc. Price of the modified unit, which uses a special coaxial detector and delay line, is \$895 f.o.b.

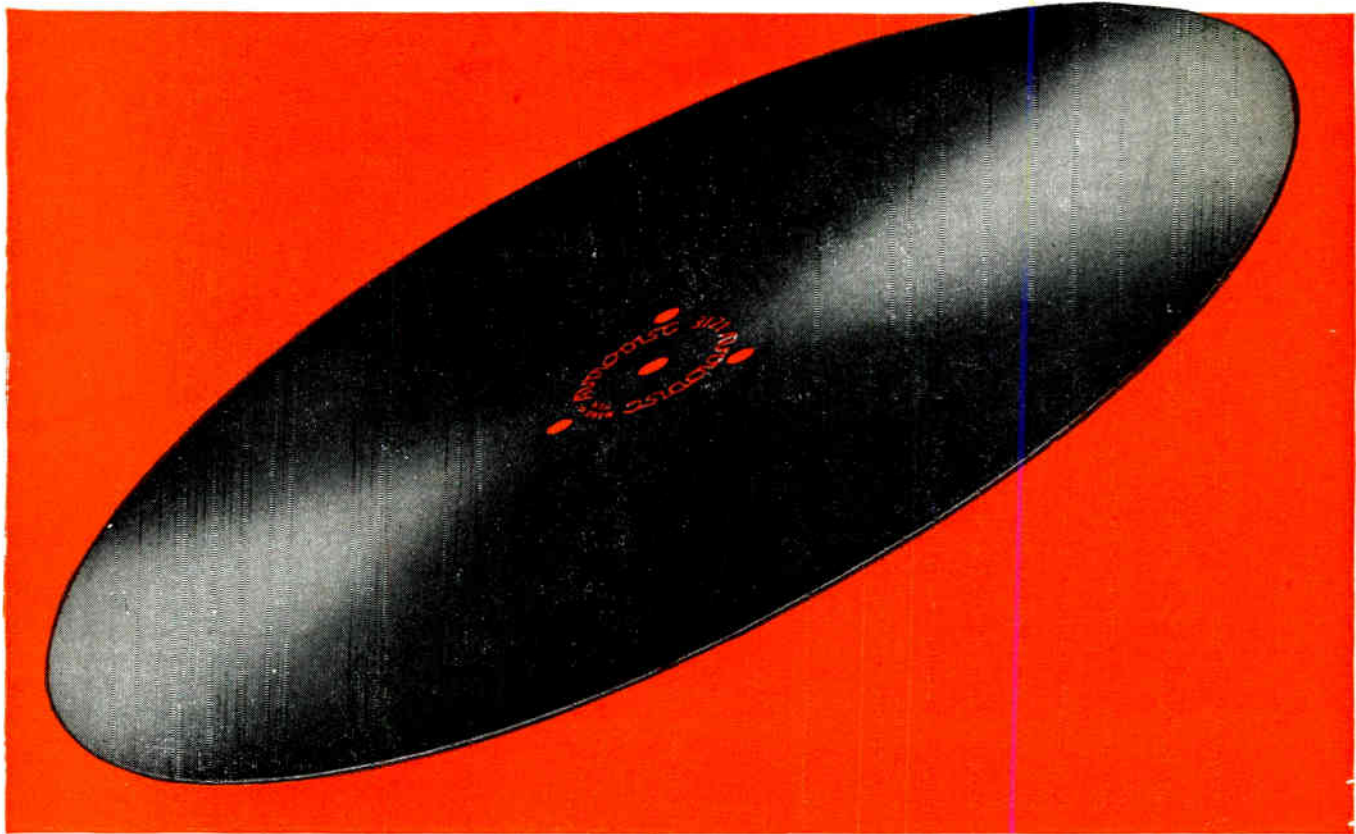
### Multiple Recorder

LEEDS AND NORTHRUP Co., 4934 Stenton Ave., Philadelphia 44, Pa. A new Speedomax recorder automatically logs as many as 160 separate thermocouple temperatures in succession at a rate of 4



(continued on p 178)

# FOR FINER ALL-WEATHER RECORDING



## Now **audiogram**\* lacquer provides permanent resistance to humidity

Excessive humidity has long been one of the industry's major problems—both to the manufacturer and to the recordist. Humid conditions in factories have frequently held up production and caused excessive spoilage. Also, discs which have absorbed too much moisture make poor recordings. The noise level increases progressively while recording and the cut gets greyer and greyer.

Air conditioning has been tried by several producers, but this does not prevent moisture absorption during transportation and storage. The real solution lies in the formulation of a lacquer which will provide permanent resistance to humidity. This has now been successfully accomplished by our research laboratory. Here are the facts:

1. THE IMPROVED AUDIODISC FORMULATION has eliminated all production difficulties due to excessive humidity. During the past summer no trouble was encountered, even with humidity as high as 90%.

2. COUNTLESS TESTS in our "weather room" have proved the new AUDIODISCS to be remarkably resistant to moisture absorption. Discs subjected to a temperature of 90° at 80% to 90% humidity for many weeks show no increase in noise level while recording. Ordinary discs, under the same conditions, show a noise level increase of from 15 to 25 db. The most conclusive proof of all, however, has come from the field—for during the past summer, one of the most humid on record, our customers have reported no difficulties in recording or reproduction due to humid conditions.

3. THIS "WEATHER-PROOF" FEATURE has been achieved without any basic change in our lacquer formulation. Recordists will therefore continue to note the outstanding qualities in recording, playback and processing which have made for AUDIODISC leadership.

This improved humidity-resistant lacquer is now used on all AUDIODISCS. It is your assurance of finer, all-weather recording—with the same consistent, uniform quality which has characterized AUDIODISCS for a decade.

\*Reg. U. S. Pat. Off.

*Audiograms are manufactured in the U.S.A. under exclusive license from PYRAL, S.A.R.L., Paris.*

**Audio Devices, Inc., 444 Madison Ave., N.Y.C.**

EXPORT DEPT: ROCKE INTERNATIONAL, 13 EAST 40TH STREET, NEW YORK 16, N. Y.



*they speak for themselves* **audiograms**

# NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

**Magnetic recording standards; train television demonstrated; FCC abandons operator license changes**

**Park Strollers View World Series**



Baseball fans unable to get into the ball park view opening game of World Series over RCA television sets installed by that company on Boston Common. Telecast was from WBZ-TV, Brighton, Mass., with microwave relay and coaxial cable providing feed from the master receiver atop the Ritz Carlton Hotel

ONE of the largest group installations of television sets ever made brought the recent World Series to an estimated 100,000 viewers on Boston Common. Over one hundred RCA Victor 721TS receivers with 52-sq-in. screens were set up by RCA Service Company technicians.

For this mass installation of sets, a special receiver was installed atop the Ritz Carlton Hotel to pick up the telecast from WBZ-TV and feed a microwave transmitter that beamed the program directly to the control tent on the Common. A five-foot-diameter parabolic reflector on the hotel roof was aimed at a similar dishpan atop the control tent to provide ghost-free and interference-free transmission to the sets at the tent. The signal was con-

verted back to a standard television signal and fed through a total of three miles of coaxial cable to the 100 individual sets.

Each set was mounted on a 7½-ft stand with a special shadow box to cut down sunlight, so that as many as a hundred people at a time were able to sit and stand in front of each set and view the game satisfactorily despite full daylight.

## Ultrafax Progress Report

THE PRESENT status of a new technique for transmitting enormous quantities of written, printed, or drawn material in an extremely short time was demonstrated by Radio Corporation of America at

the Library of Congress, Washington, D. C., on October 21, 1948. The system shown consists of a somewhat unconventional scanning device employing a flying-spot cathode-ray tube and a photomultiplier tube, a 7,000-megacycle relay link, and a projection kinescope at the receiving end to expose a 16-mm moving film. The experimental transmitter uses a 35-mm film on which is recorded the desired intelligence. An important feature of the system is the rapid development of the film at the receiver. For demonstration purposes a small unit built by Eastman Kodak was used that moved the exposed film through a hot developing bath, delivering a dry positive film, suitable for viewing, in 40 seconds. Already developed but not demonstrated is a three-channel machine for printing up enlarged paper copies of the received messages.

To date, the photographic aspect of the system lags somewhat behind the electronic equipment which is essentially simpler and represents the refinements of known techniques. However, certain developments, such as a flying-spot scanner with a narrow beam have been essential. The radio transmission speed was pointed up by the transmission of the whole of the book, "Gone with the Wind" page by page, in two minutes and twenty-one seconds. Photographing the pages and reprinting them at the receiver would take substantially longer.

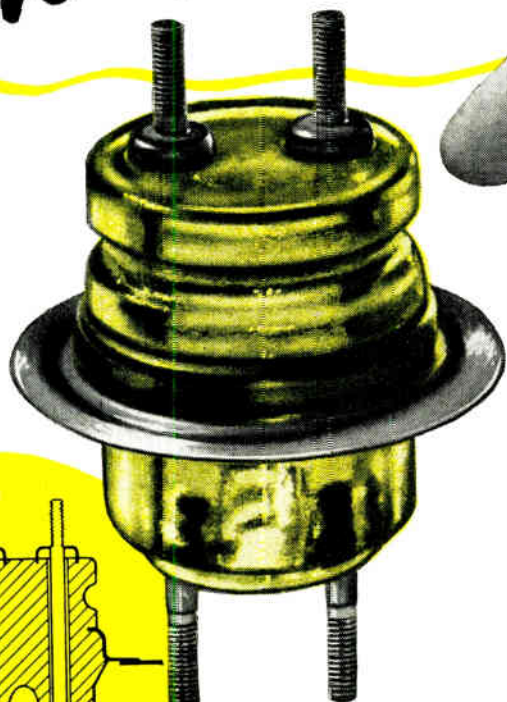
The functioning of the system on



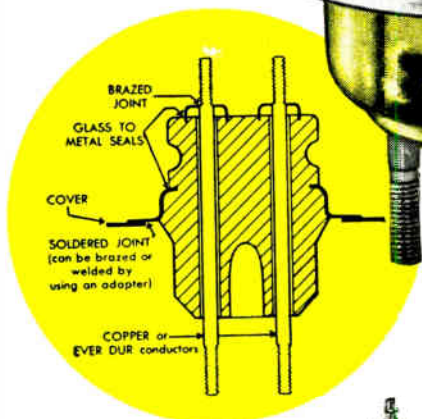
Donald S. Bond, RCA Laboratories, Ultrafax project engineer threads film to be transmitted between the flying-spot scanner (left) and the photomultiplier tube (in light box beneath his left hand)



# Glass bushings Now Available



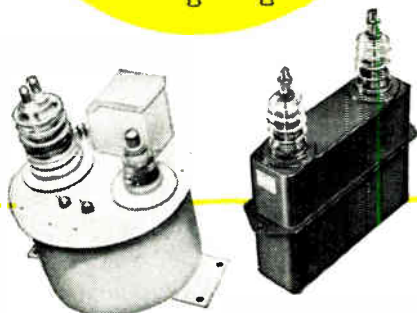
to manufacturers of  
electronic equipment



Can be welded, brazed, or soldered to case, forming a strong, permanent, hermetic seal that eliminates moisture problems and often permits more compact, light-weight design.

General Electric is now offering to other manufacturers the glass bushings that it has used so successfully on capacitors, rectifiers, modulator and instrument transformers, and other electrical equipment. These bushings are cast of an exceptionally stable, low-expansion glass. Metal hardware is a special nickel-alloy steel, fused to the glass in casting. Bushings are attached directly to the apparatus without gaskets—by soldering, welding or brazing the metal bushing flange to the metal case.

The resulting joint between bushing and equipment is permanent, vacuum-tight, and of high mechanical strength. It is especially desirable for equipment subject to vibration, shock, fungus growth or severe changes in temperature. These glass bushings are currently available to meet dry, 60-cycle, flashover values of from 10 to 50 kv, and in current ratings of 25 and 50 amperes (large sizes up to 800 amperes). They may be single or multi-conductor and can be provided with a top flange to permit mounting tube sockets directly on the bushings. Diameters range from  $1\frac{5}{8}$  to  $3\frac{3}{8}$  inches and weights from  $2\frac{1}{2}$  oz. to 4 lb.



The best way to evaluate these glass bushings for capacitors, modulator transformers, and other electronic equipment, is to see them. If you will send us a sketch and ratings of bushings you are now using, we will furnish you with samples of one or more of our standard glass bushings. Or write for Bulletin GEA-5093 which contains complete listings of our standard designs, allowing you to select the particular bushing you require. Power Transformer Sales Division, General Electric Co., 16-215 Pittsfield, Mass.

GENERAL  ELECTRIC

401-63

an economic basis is predicated upon the establishment of nationwide microwave relay links also necessary for television. It was suggested that transatlantic service might begin soon if government services could maintain a chain of relay airplanes, spaced about every 200 miles between North America and Europe.

Although the reproductions obtained at the receiver were reasonably good, it has been pointed out that greater clarity and a goal of "a million words a minute" will only be possible using bandwidths of 10 megacycles as compared with the five-megacycle width employed for demonstration purposes.

### Magnetic Recording Standards

ANNOUNCEMENT OF a proposal of three recording speeds for magnetic tape was recently made by the National Association of Broadcasters' Recording and Reproducing Standards Committee. The group's proposal involves adoption of a primary-standard magnetic tape speed of 15 inches per second for a frequency response of 50 to 15,000 cycles, a secondary standard of 7.5

inches per second, for a frequency response of 50 to 7,500 cycles and a supplemental standard of 30 inches per second for all wide-range standards. The latter essentially corresponds to the European standard 77 mm (30.318 inches) established by the German magnetophone.

The committee also agreed that the minimum playing time per reel should be 33 minutes. Maximum permissible noise level was set at 40 db below peak signal level. Zero db level was set at 2-percent distortion.

It is expected that the standards will be ready for submission to the

NAB board of directors for final adoption at the regularly scheduled November meeting.

### Industry to Present Views to FCC

THE RMA has appointed a committee to confer with FCC Chairman Coy, and to offer the RMA's assistance in expediting an FCC decision in the matter of the recent temporary freeze on television station applications.

The committee consists of president Max Balcom; W. R. G. Baker, director of the RMA Engineering Department and vice-president of GE; H. C. Bonfig, vice-president of Zenith Radio Corp.; Allen B. Dumont, president of Allen B. Dumont Laboratories, Inc.; Frank W. Folsom, executive vice-president of RCA Victor; Paul V. Galvin, president of Motorola Inc.; and L. F. Hardy, vice-president of Philco Corp.

### Radio Network for Farmers

AN F-M network with no wires whatsoever, known as the Rural Radio Network Inc., has been established by ten farm organizations to serve about 118,000 farms in New York State. Stations are linked together only by direct radio pickup of each other's programs. Stations now on the air, with frequency assignments and distance to the adjacent station they feed or

(Continued on p 217)

### MEETINGS

Nov. 29-DEC. 1: Conference on electronic instrumentation in nucleonics and medicine, sponsored by IRE and AIEE, Engineering Societies Building, New York City.

Nov. 29-DEC. 4: 18th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

DEC. 10-11: Southwestern IRE Conference, Baker Hotel, Dallas, Texas.

JAN. 10-12: Symposium on high-frequency measurements, held by Instruments and

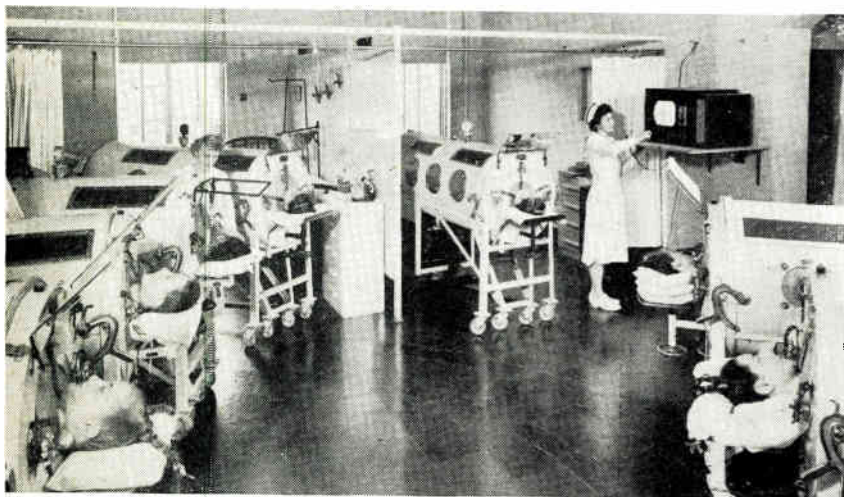
Measurements Committee jointly with the IRE and National Bureau of Standards, at Washington, D. C.

MARCH 7-10: IRE annual convention, Hotel Commodore and Grand Central Palace, New York City.

APRIL 11-15: Sixth Western Metal Congress and Exposition, Shrine Auditorium, Los Angeles, Calif.

MAY 16-20: Radio Parts Industry Trade Show and RMA Silver Anniversary Convention, Hotel Stevens, Chicago.

### Hospital Television

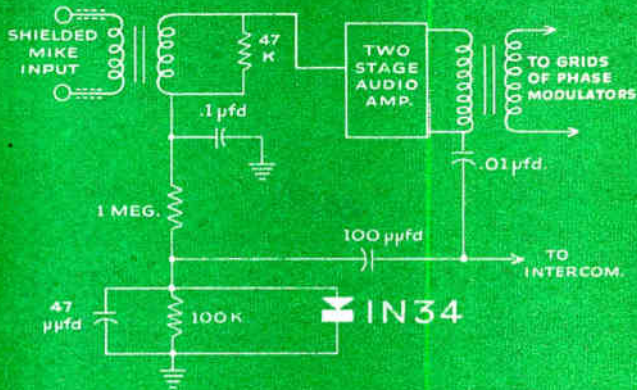


Nurse tunes in television receiver, a gift of the Baltimore Rotary Club, while iron lung patients watch their individual mirrors

POLIO victims in an iron lung ward at the Baltimore Children's Hospital School recently had installed for them a Stromberg-Carlson 12-inch

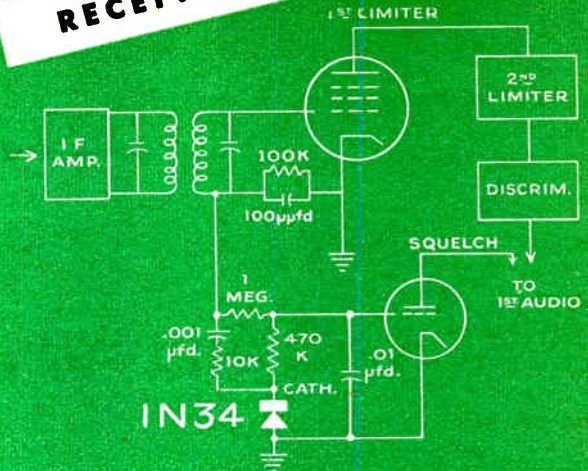
screen television receiver. Special mirrors were erected above the patients' heads so that all could see the screen.

## TRANSMITTER



IN THE TRANSMITTER, a Type 1N34 SYLVANIA GERMANIUM DIODE rectifies the audio modulating voltage, to provide a variable d-c bias for automatic gain control. Use of such a circuit helps prevent over-modulation while maintaining a high average audio level. The result — voices of the train crews are transmitted clearly, evenly.

## RECEIVER



IN THE RECEIVER, another SYLVANIA GERMANIUM DIODE, Type 1N34, provides a delayed noise-gate action which suppresses undesired noise interference in the receiver output. Hence, only signals of usable amplitude will actuate the squelch circuits and the receiver is kept essentially silent in the absence of a carrier.



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# Shallcross

Type	Sections	Size	Watts	Maximum Resistance per section Ohms	Minimum Resistance per section Ohms
136	1	13/32" x 1/4"	0.25	150,000	1.
137	2	45/64" x 1/4"	0.25	150,000	1.
133	3	1-5/32" x 3/8"	0.25	550,000	1.
134	4	1-1/4" x 3/8"	0.25	375,000	1.

ACTUAL SIZE ILLUSTRATION

## AKRA-OHM PRECISION RESISTORS for "miniaturization" programs

These new Shallcross Akra-Ohm Wire-Wound Precision Resistors have been designed to meet the needs of modern, miniature equipment. Standard tolerance is 1% and closer tolerances can be furnished on special order.

The units offer unusually high and accurate resistance values in small space and are light enough to be suspended by their

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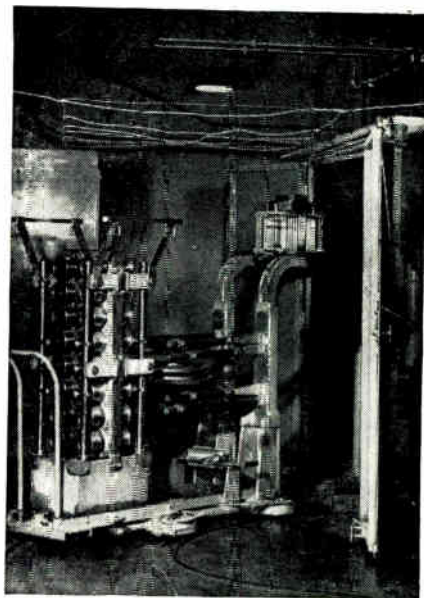
Other Shallcross Akra-Ohm Precision Resistors include types, shapes, mounting arrangements and ratings for every close-tolerance requirement and are designed to meet JAN specifications. Write for Bulletin RG, giving complete precision resistor data in convenient chart form.

### Complete Service measurement facilities IN A SINGLE INSTRUMENT

The improved Shallcross 614-A Service meter covers a wide range of measurements. These include d-c and a-c voltage, capacitance, and d-c resistance. Also it can be used for approximating an artificial load. Auxiliary scales provide an inductance range of 1 to 100; 1,000, 10,000 henries, and an a-c resistance range of 25 ohms to 3 megohms. Only two switches are used for 25 ranges. The instrument is self-contained, housed in a metal case with handle and weighs only 12½ lbs. Write for details.

**SHALLCROSS MANUFACTURING COMPANY**  
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## TUBES AT WORK (continued from p 122)



Band and frequency changing is expedited by the use of mobile tank circuits. A rail system guides trucks accurately to their contacts in the transmitter cabinet

cellent results at the receiving end is 14,000 miles using a 100-kw channel, the full output of one transmitter. The average shut-down time since the station was commissioned in 1913 has been less than 0.04 percent.

## Graphical Iron Core Reactor Design

BY MORTON R. WHITMAN

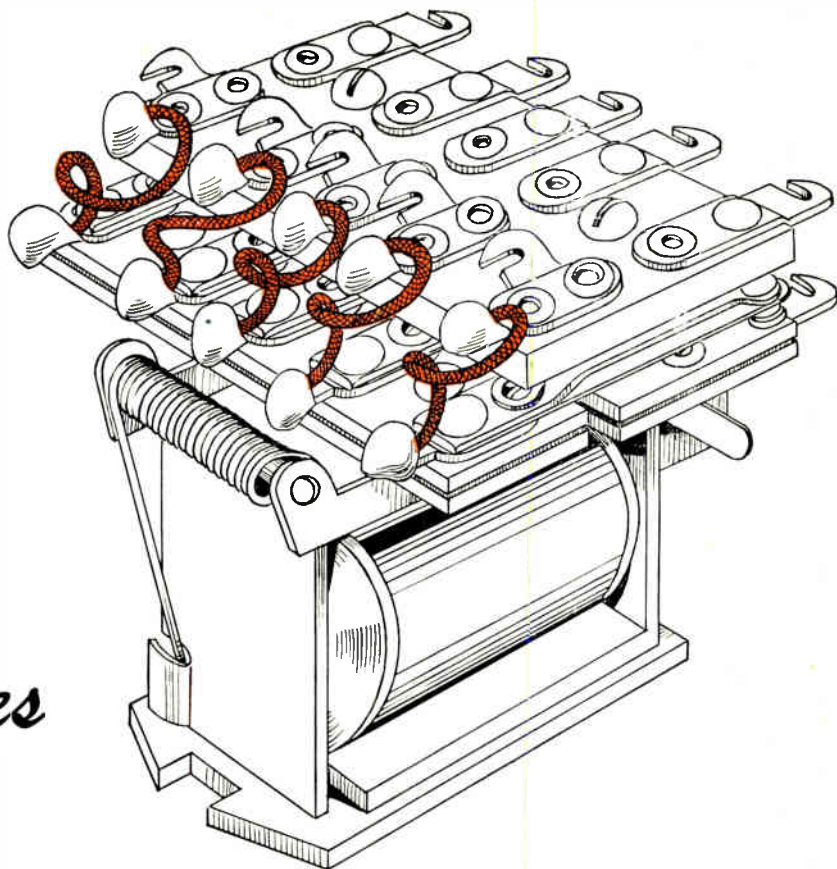
Engineering Department  
Thordarson Electric Manufacturing  
Division  
Chicago, Illinois

REACTOR DESIGNERS are usually plagued by the mutually hostile requirements of speed and an optimum balance of the parameters involved in the design of reactors which carry both direct and alternating currents.

An optimum balance means the use of readily available parts and standard production techniques, a minimum of material in construction, low operating noise level and good thermal and insulation characteristics.

The principal difficulty in this problem arises from the nonlinearity of the magnetic material used in core structures. This makes impossible the derivation of an explicit formula which could give accurately say, the size and weight of a specified reactor. The purpose

# Aircraft Relay Requires this Sleeving



Aircraft receiving and transmitting sets must operate constantly and without interruption in varying climatic temperatures, and must be able to withstand engine vibration. Burden of this performance falls upon the relay units within the sets.

BH Extra Flexible Fiberglas Sleeving is used on Automatic Electric Manufacturing Company's R-30 relay unit because it meets a specific insulation requirement fully and completely.

Here is what the Automatic Electric engineers found:

"In the R-30 relay, BH Extra Flexible Fiberglas Sleeving—fungicide treated—insulates the jump wires which are soldered to a stationary terminal

strip on one end and the moveable armature-mounted terminal strip on the other end. Flexibility is essential. Stiffening of the sleeving would tend to put a drag on the armature and thus vary the pull-in and drop-out. BH Sleeving is not only flexible, but also *stays* flexible when subject to climatic changes in temperature."

BH Extra Flexible Fiberglas Sleeving remains flexible as string because no hardening varnish or lacquer is used in its manufacture. It is heat resistant to 1200°F. if required. Cuts without fraying and won't deteriorate. Use it in your plant, in your product.

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\*BH Non-Fraying Fiberglas Sleeveings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2395530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp

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# COMPLETE MONITORING EQUIPMENT

By 

for TV  
and FM  
TRANSMITTERS



WITH our recent announcement of the Type 1182-T Video Frequency Monitor, complete transmitter monitoring equipment by General Radio Company for TV as well as FM stations is now available. The FM Monitor has FCC approval; the TV equipment meets all of the tentative proposed specifications of the FCC.

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## TYPE 1170-A FM MONITOR

For both FM and audio channel monitoring of TV stations, features: **TRANSMITTER RANGES** of either 30 to 162 Mc or 160 to 220 Mc. **CONTINUOUS MONITORING:** center frequency indication continuous; requires restandardization only once a day. **REMOTE MONITORING:** equipped with circuits and terminals for remote indicators of Center-Frequency Indication, Percentage-Modulation Meters, Over-Modulation Lamp, 600-Ohm Unbalanced Aural Monitor, Recorder and with the Type 1932-A Distortion and Noise Meter will measure distortion. **HIGH STABILITY:** 200 cycles (2 parts per million) or better with daily check of electrical zero of meter. **LOW INPUT POWER:** 1 volt at high impedance, amplified to several hundred volts for high-level operation. **LOW RESIDUAL DISTORTION:** less than 0.2% at 100 k. c. swing; accurate for measurements to as low as 1/2 per cent. **75-25 KC DEVIATION** provided with a single internal adjustment for either TV or FM monitoring. **TYPE 1170-A FM MONITOR . . . \$1625**

## TYPE 1182-T VIDEO MONITOR

For video channels of TV transmitters, features include: **TRANSMITTER RANGE:** 54 to 220 Mc. **DEVIATION RANGE:** 3-0-3 and 6-0-6 kc for all present TV channels. **DEVIATION** from assigned channel is shown continuously on large-scale meter, unaffected by TV video modulation. **HIGH STABILITY:**  $\pm 0.001\%$ . **HIGH ACCURACY:** crystal frequency when monitor is delivered is within  $\pm 0.001\%$  (10 parts per million). Adjustment provided to set monitor in agreement with frequency measuring service. **HIGH IMPEDANCE INPUT CIRCUIT** for channels 2 to 6; coaxial line for channels 7 to 13. **REMOTE FREQUENCY DEVIATION METER** terminals provided. **THREE SPARE CRYSTAL POSITIONS** selected by panel switch. **TYPE 1182-T VIDEO FREQUENCY MONITOR . . . \$675**

WRITE FOR COMPLETE ENGINEERING DATA

**GENERAL RADIO COMPANY** Cambridge 39  
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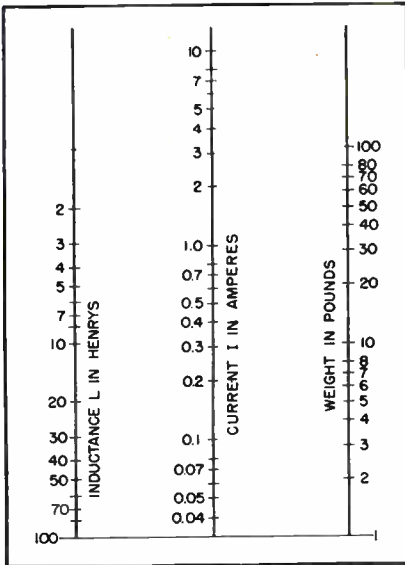


FIG. 1—Alignment chart which may be altered to give actual design figures by reference to data on an arbitrarily selected prototype unit and appropriate vertical displacement of vertical axes

here is to suggest empirical techniques for doing these things.

Model theory offers a useful approach to this problem. It generalizes the results obtained on a sample and makes possible, in effect, the extrapolation of the data so obtained. The precision of data obtained in this way depends on how accurately a unit holds to scale with this sample, or prototype. Nevertheless, even if the scale factor is omitted from consideration, the results are significant from a design point of view.

An important result of the kind discussed is the relation: weight equals  $kLI^2$  where weight is that of either core iron or total core and coil weight (adjustment of the constant  $k$  can be performed to suit one requirement or the other since in a line of geometrically similar reactors the winding weight will be a relatively fixed percentage of total core and coil weight);  $L$  is the inductance, and  $I$  is the direct current in the winding. An alignment chart is presented in Fig. 1 to expedite use of this relationship. The chart is not intended to give actual design figures but can be made to do so by reference to the data on an arbitrarily selected prototype unit and appropriate vertical displacement of the axes. Greatest accuracy can be secured by choosing as prototype



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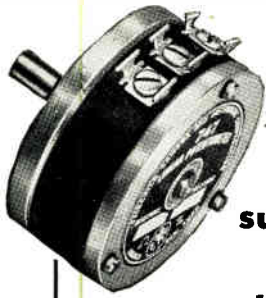
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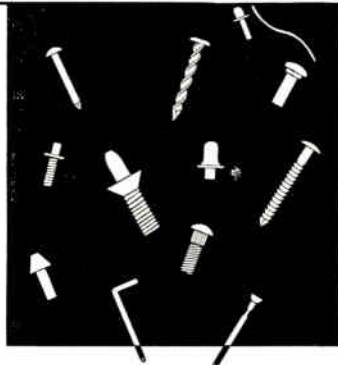
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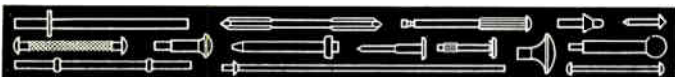


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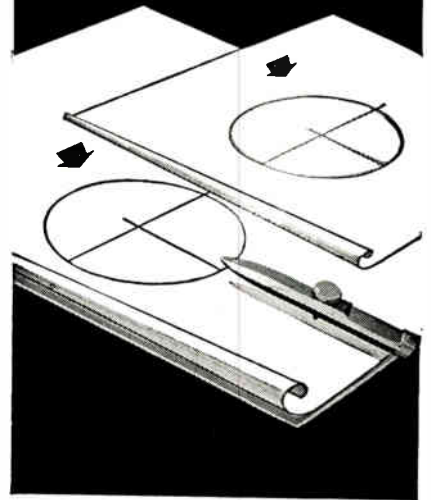
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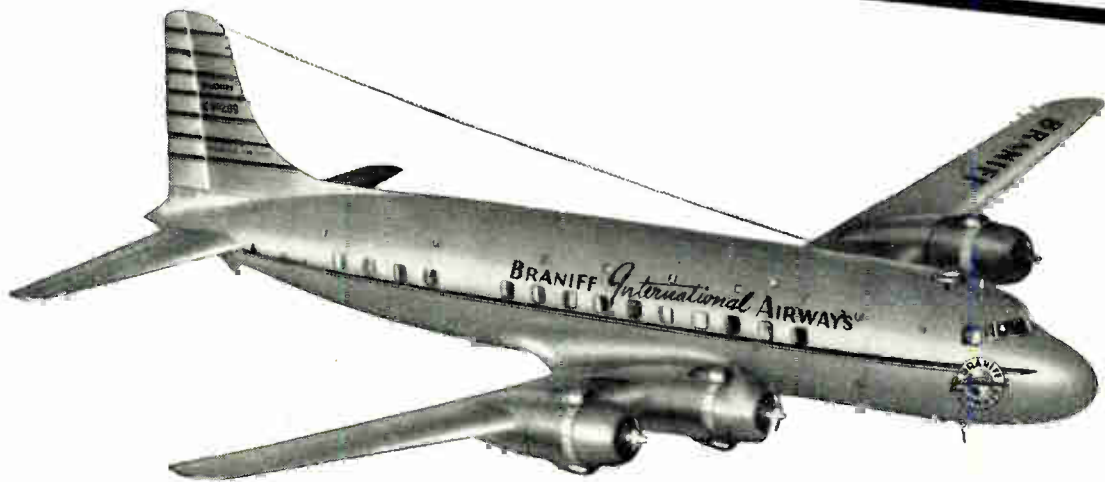
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#### DESIGN SIMPLIFIES SERVICE

Conventional circuit design, fewer numbers and types of tubes, plus open mechanical construction simplify tube stocking problems and speed maintenance. The entire transmitter portion of the Type 364A is built on a drawer-type chassis, instantly withdrawable from the front of the panel.

#### RELAY RACK MOUNTING SAVES SPACE

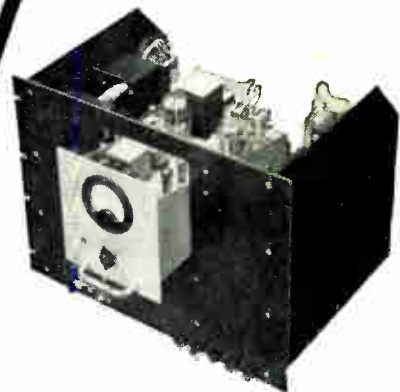
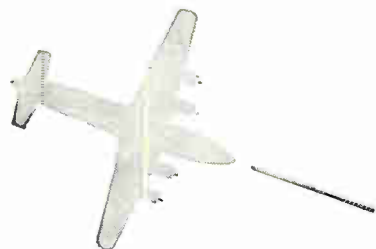
Compact design requires only 15 inches of rack space for installation, frequently utilizing space already available.

#### .005% FREQUENCY STABILITY WITHOUT TEMPERATURE CONTROL

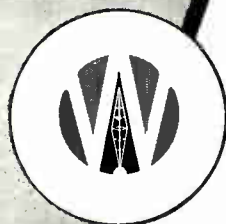
Through the use of a newly developed crystal, troublesome thermostatic temperature controls and crystal ovens are no longer necessary to provide adequate frequency stability.

#### SIMPLIFIED CONTROL FOR REMOTE LOCATION

Modulation over a single telephone pair and carrier control by means of a simplex circuit allow the transmitter to be readily located at a remote point.



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 118-136 MC. Band

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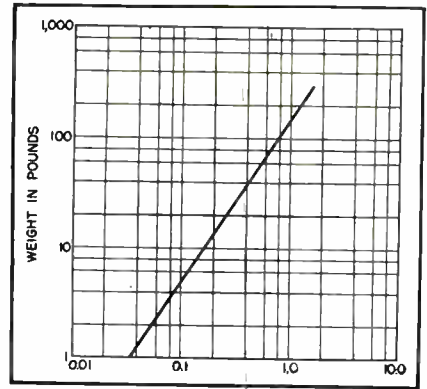


FIG. 2—Design curve for finding weight of a single reactor unit from the reactor time constant,  $L/R$

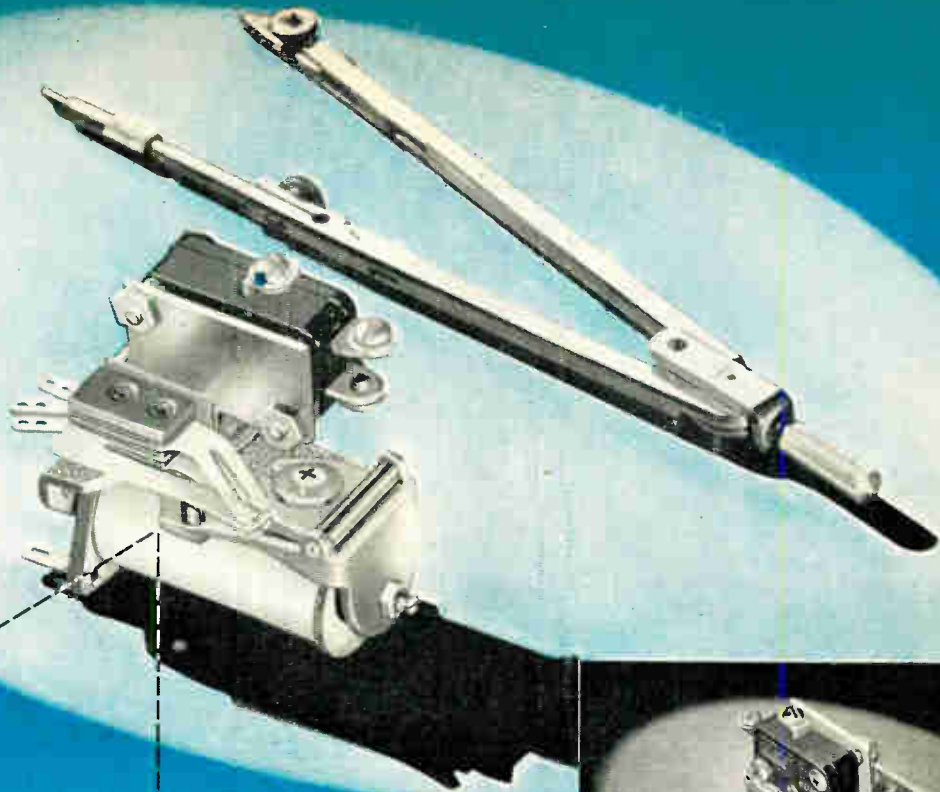
a unit somewhere in the desired range of size and weight.

A second relation gives the weight in terms of the time constant,  $L/R$ , of the reactor. Here,  $R$  is the simple ohmic resistance of the winding— $L/R$  equals  $KW^2/3$ . The form of this equation makes graphical representation very simple. Measurements of the time constant and the weight on a single unit are used as the co-ordinates of a point on log-log paper. A straight line drawn through this point with a slope equal to  $\frac{2}{3}$  completes the graph. A typical curve is shown in Fig. 2.

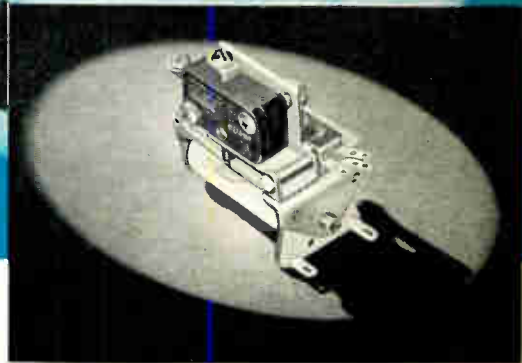
The curves must be used with caution since generally they are valid only when conditions of similarity to the prototype are maintained. Varying insulation requirements, cooling considerations and other considerations introduce error. Nevertheless, the curves are useful for estimating purposes and for reducing the number of steps in the preliminaries to actual design.

Filter reactors for use with polyphase rectifier systems operate at considerably lower excitation levels than corresponding single-phase systems for the same output voltage. Since permeability is an increasing function of the excitation up to some maximum characteristic of the material used, the polyphase filter reactor will in general be different from the single-phase unit. The difference will not be so large, however, that the charts will not be of some use for both.

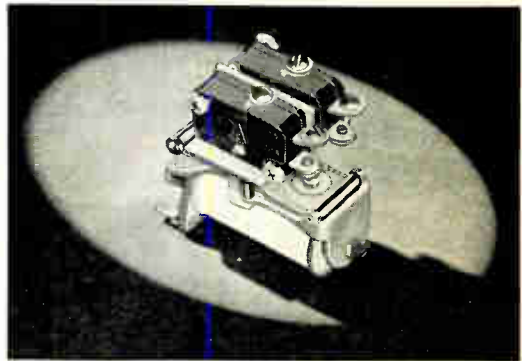
An illustration of the use of the curves will be given here. Assume we wish to design a reactor of 5 henrys at 1 amp d-c. The insula-



CLARE Type "JMS" Relay with single armature, equipped with one snap-action switch.



Showing mounting of snap-action switch on CLARE Type "JMS" Relay with single armature.



CLARE Type "JMS" Relay provided with double armature and two snap-action switches.

## THIS SMALL, COMPACT **CLARE RELAY**

**WILL SWITCH 1250 WATTS WITH AN INPUT OF 1 WATT!**

This new CLARE Type "JMS" Relay is a sensitive relay for switching heavy a-c loads with small d-c controlling currents . . . as high as 1250 watts can be switched with a 1-watt input.

It combines the outstanding features of the larger CLARE Type "CMS" Relay with the small size and light weight of the CLARE Type "J" Relay and employs a new-type Micro precision switch of unusual efficiency and compact design.

The CLARE Type "JMS" Relay is especially suitable to locations subject to sudden jolts, constant vibration or tilting. It may be provided with either one or two Micro snap-action switches, or with one switch and a pileup of twin-contact springs. For installations where quick removal or replacement may be desirable, it may be fitted and wired to a standard radio type plug.

This new relay is a development of CLARE's unceasing effort to keep pace with every industrial relay requirement. Our engineers and sales representatives are constantly at your service to provide just the relay to meet your specific need.

For full information on the CLARE Type "JMS" Relay, look up the CLARE office in your classified telephone directory . . . or write for Bulletin 102 to C. P. Clare, 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address CLARELAY.

### STANDARD SPECIFICATIONS

**Contacts:** Snap-action, enclosed. Varying capacity: 10 amperes at 125 volts; 5 amperes at 250 volts.

**Residual:** Lock Screw (Adjustable).

**Mounting:** May be mounted on relay bases or strips as well as mounting bars or individual mounting brackets.

**Dimensions:** Overall length: 2 1/4"; width: 1 1/8"; height: 2".

**Weight:** Net: 4 oz. (approx.); Shipping: 1/2 lb. (approx.)

Write for Clare BULLETIN 102

# CLARE RELAYS

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The Model 53 Breaker-type D.C. Amplifier was developed for the measurement of d. c. and low frequency a. c. voltage in the microvolt and fractional microvolt region. It is compact, portable, and makes an excellent replacement for the suspension galvanometer. The output of the amplifier is sufficient to operate standard meters and recording devices directly.

It has been employed for the amplification of infra-red detectors, thermocouples, voltaic photocells, and the like, both in research and industrial applications.

Among the advantages of this amplifier are the following:

1. Noise level that approaches the theoretical limit imposed by Johnson noise.
2. Extremely low zero drift (less than .005  $\mu$  V after warmup).
3. Freedom from the effects of vibration such as found in moving vehicles.
4. Response characteristics permitting overall amplification flat from 0 to 10 cycles per second.
5. Reliability, as demonstrated by units which have been in continuous operation for several years.

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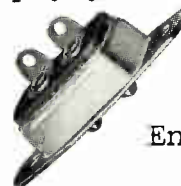
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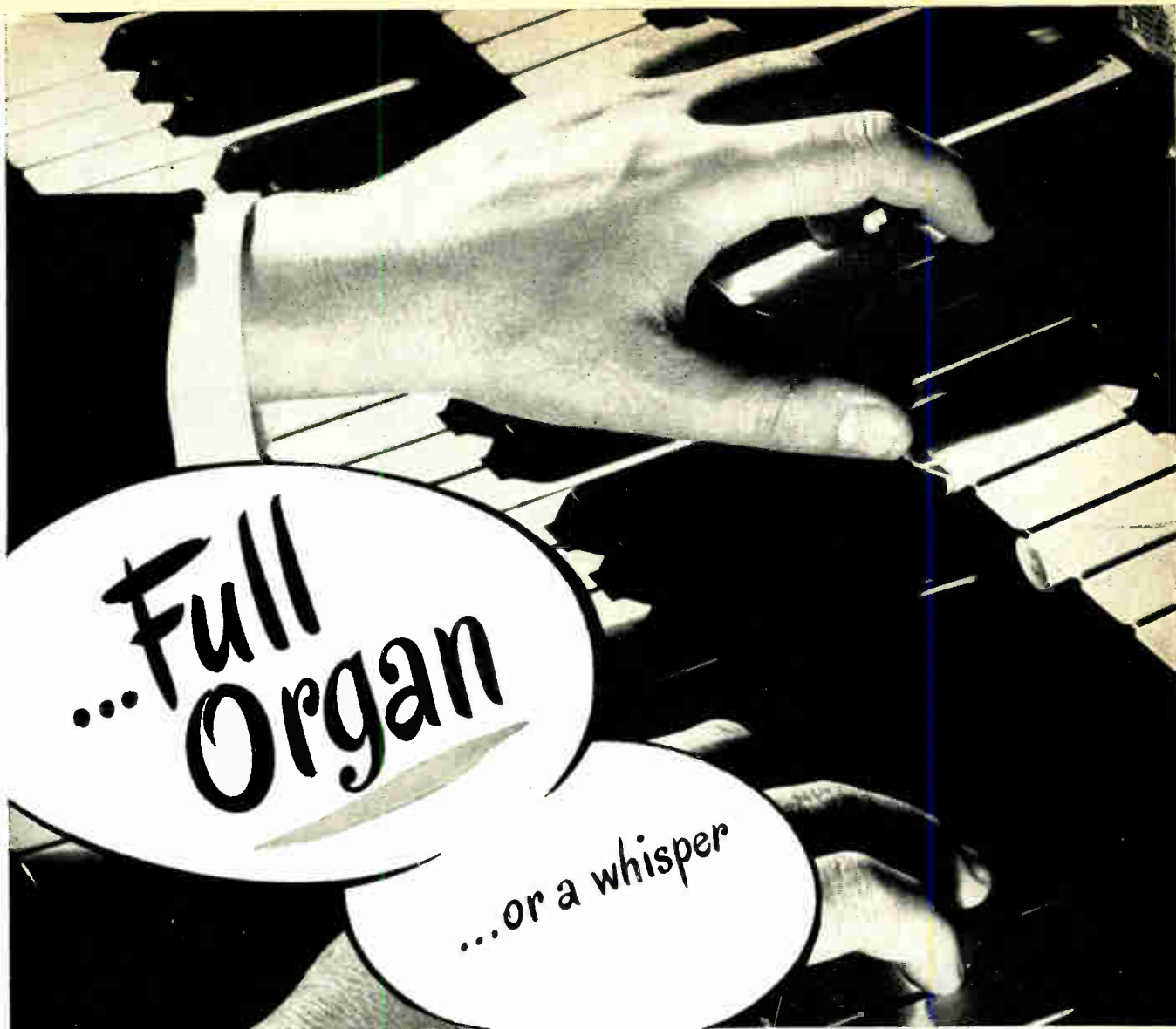
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Trained hands expect a pipe organ to respond immediately to any demand — from complete silence to a powerful crescendo. To meet these demands, hundreds of magnets and solenoids must have controlled d-c voltage on tap at all times.

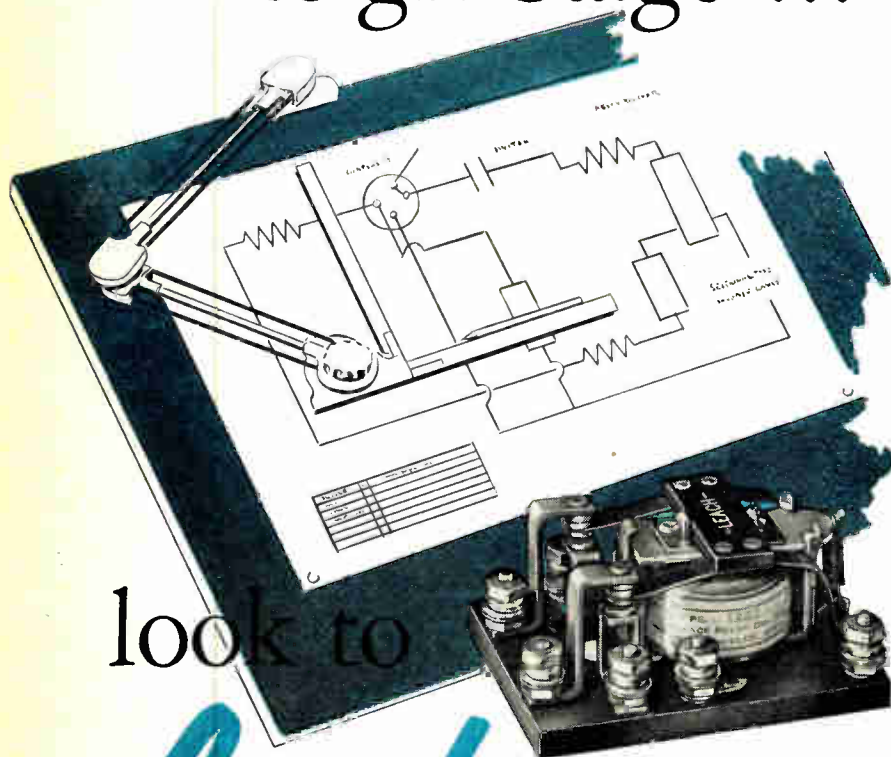
In a growing number of installations, General Electric selenium rectifiers — specially designed and built for pipe organs — are supplying the smooth, constant voltage this application calls for. Over the full load range, these rectifier units give instant response — operate silently — at low cost.

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The time to select relays is at the start of circuit design. Frequently, manufacturers save time and money—develop a better product, by consulting Leach during the first stages of their designing. Here's how—

Leach manufactures thousands of types of relays, for thousands of applications. Many are production items which may offer you savings in delivery time and unit cost. Through a slight change in circuit design you may gain the advantages of a standard type, at considerable savings *and* do a better job.

For your specific requirements, consult the competent staff of Leach electrical engineers. Custom designs are their stock in trade. Remember, for Better Controls through Better Relays, *look to Leach*. Write today.



## LEACH RELAY CO.

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TUBES AT WORK

(continued)

tion level, excitation and thermal characteristics will be neglected to illustrate the technique.

From Fig. 1, the weight will be 47 pounds. From Fig. 2 the time constant will be 0.46. Hence, the nominal resistance will be  $5/0.46$  or approximately 11 ohms. On the basis of the information now available the required lamination size is readily determined.

A square center leg cross-section will give minimum leg length of turn for the winding for a given cross-section area so that using minimum copper weight as a criterion the lamination size may be picked out from a table of lamination sizes and weights per square stack. Since the resistance is known, the number of turns in the winding may be readily determined in terms of the mean length of turn for the core size chosen. The design may then be refined by consideration of the factors which have been omitted up to this point. In most instances only relatively slight changes will be required.

### Remote Control for Radio Tuning

BY S. WALD

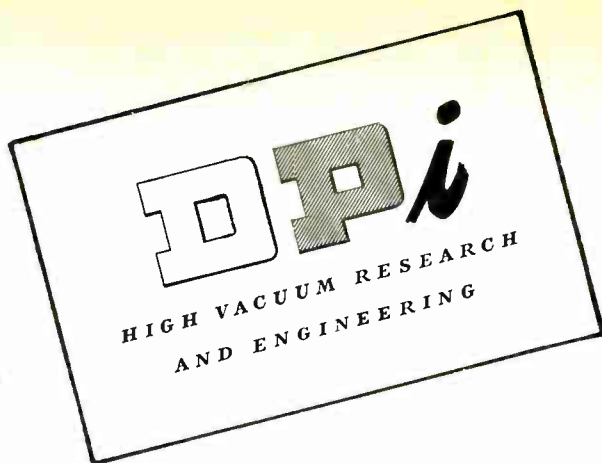
*Aviation Equipment Engineering  
Engineering Products Department  
Radio Corporation of America  
Camden, New Jersey*

A noticeable trend in architecture and planning for modern homes is the increased use of built-in broadcast receivers. Their popularity has encouraged the author to investigate the possibilities of remote tuning devices and their application to standard broadcast receivers. The unit discussed in subsequent text and illustrated in the accompanying diagrams has been found to be highly effective, providing for both push-button and continuous remote tuning.

The schematic of the system is shown in Fig. 1. Alternating plate and grid voltages are applied to two miniature thyratrons in a push-pull circuit. The voltage between grid and cathode of each tube lags the corresponding plate voltage by approximately 115 degrees. Thus, each tube fires during a little less than one-half of the positive plate voltage excursion.

The induction motor working





## Better Tubes—Longer Life—Increased Production through **DPI HIGH-VACUUM ENGINEERING**



**Y**OUR present rotary exhaust machines can be completely automatic in operation, yielding increased production for any size tube.

Converted to DPI vacuum equipment, your machines will have a *fractionating* oil diffusion pump and a small mechanical pump *under each separate port*. Tubes are rough pumped through automatic solenoid valves.

Protective devices with automatic controls will seal off the pumps and isolate the trouble in case of faulty tubes. Seal-off pressure will reach  $5 \times 10^{-6}$  mm of mercury *before* getter is flashed.

DPI-engineered rotary exhaust machines produce *cleaner* tubes *faster*, by continuous pumping throughout the cycle—eliminate large backing pumps and rotary slide valve.

For full information, write—

*Vacuum Equipment Division*

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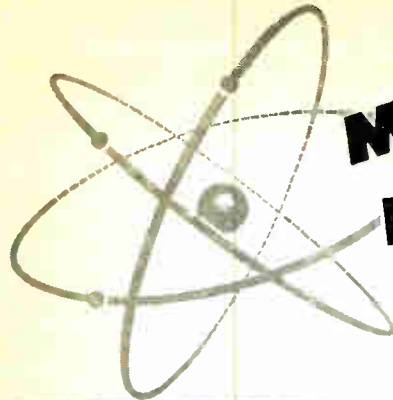
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*Manufacturers of Molecular Stills and High-Vacuum Equipment; Distillers of Oil-Soluble Vitamins and Other Concentrates for Science and Industry*



**MIRACLES  
DO HAPPEN!  
WITH**

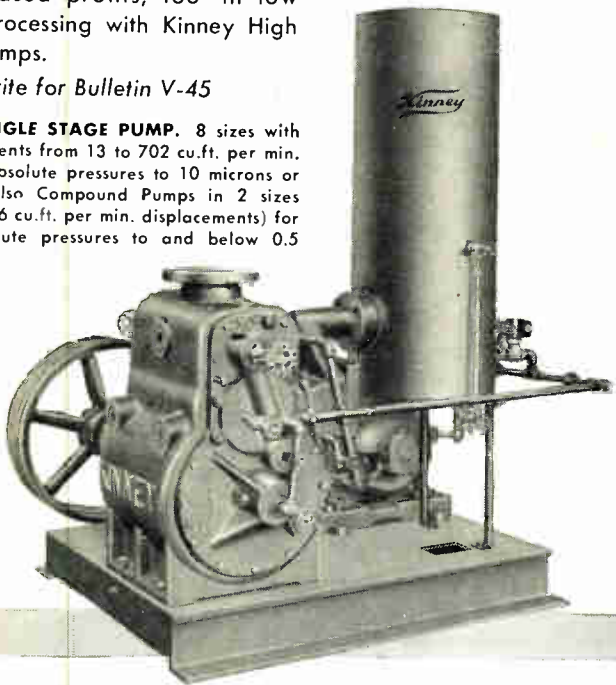
# KINNEY

## HIGH VACUUM PUMPS

Kinney High Vacuum Pumps are performing modern-day miracles in industrial production. Already they have greatly improved countless products and have made possible many spectacular new developments. Further miracles continue to unfold almost daily. Kinney Pumps are playing a vital part in producing pharmaceuticals, dehydrating foods, coating lenses, sintering metals, exhausting lamps and tubes, and performing many other low pressure operations. The high pumping speed, long life, and dependability of Kinney High Vacuum Pumps have indeed put vacuum processing on a full production basis. Investigate the new possibilities—and increased profits, too—in low pressure processing with Kinney High Vacuum Pumps.

Write for Bulletin V-45

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TUBES AT WORK

(continued)

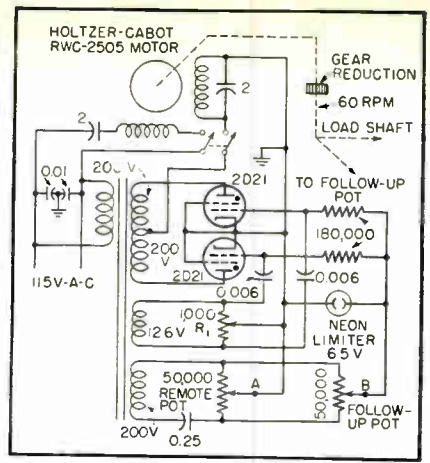


FIG. 1—Schematic diagram for remote tuning device using miniature thyratrons. Resistor  $R_1$  is adjusted for no motor rotation with points A and B shorted

winding being connected in the mid-tap of the transformer secondary receives two 65-degree duration pulses for each cycle of a-c power. This is equivalent to a direct-current with a superimposed 120-cycle voltage. Since the other motor winding is excited from the line at 60 cycles, no rotation results.

If we now consider an unbalanced condition of the input bridge consisting of the two 50,000-ohm potentiometers, an error voltage in phase with the plate voltage will be impressed equally and in phase on both grids. The resulting grid voltage will cause one tube to increase its angle of plate current flow while the other will decrease.

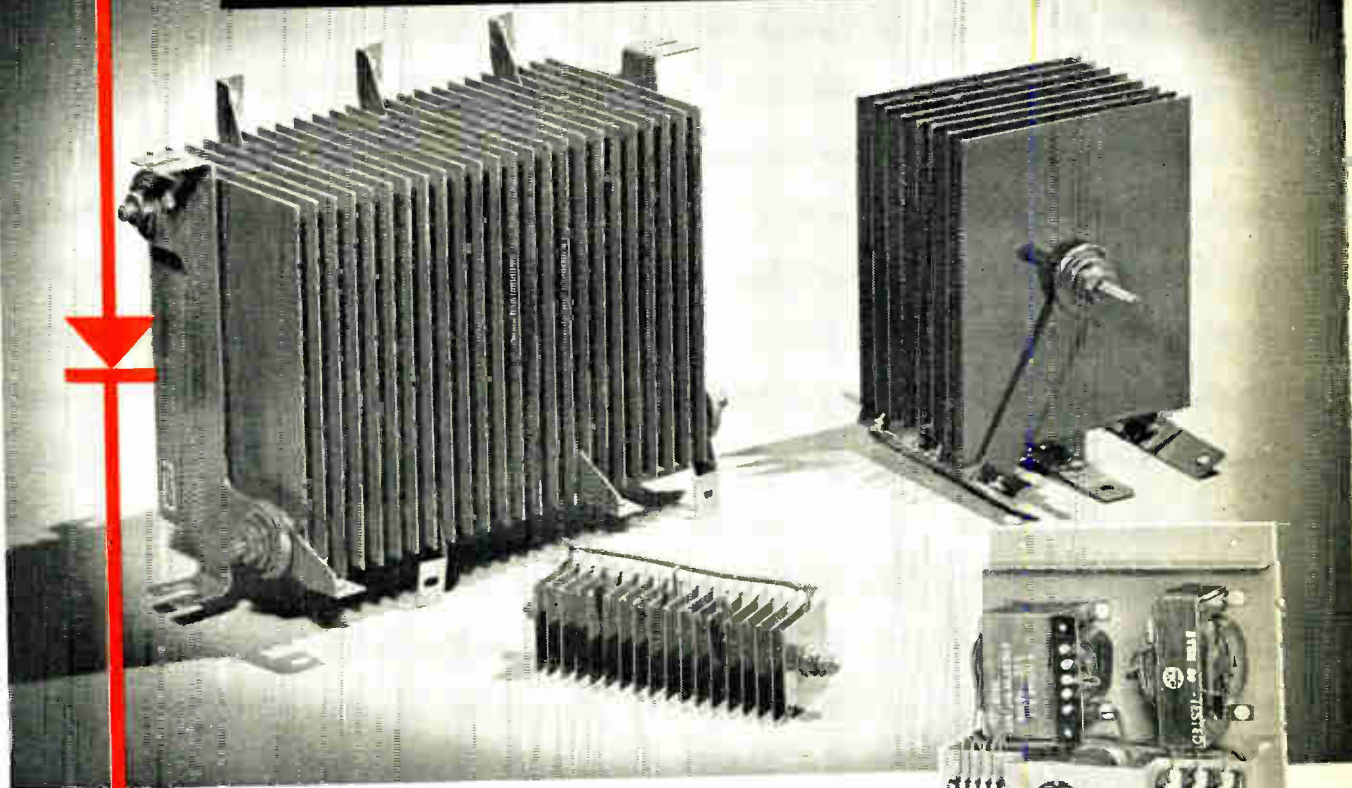
The current passing through the motor winding now has a strong 60-cycle component and, depending on the phase relation of this component with respect to the fixed line excitation, the rotor will turn in one direction or the other. If the potentiometer bridge connected to the input is sufficiently unbalanced, it is possible for one tube to be completely cut off while the other is conducting over 180 degrees.

The function of the 2- $\mu$ f capacitor connected in parallel with one of the motor windings is to improve the 60-cycle power factor of the motor so that the output torque for moderate error voltages is increased while the volt-ampere load on the transformer is reduced. The 2- $\mu$ f capacitor connected in series with the a-c line and the exciting winding produces 90-degree phase-shift for induction motor action.

While the d-c in one of the motor

**Federal**

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More watts per cubic inch in your cabinet space... made possible by Federal's 26-volt RMS square and rectangular Selenium Rectifier plates. By materially reducing the number of plates required for a given output, this important advance in the art of Selenium Rectifier design and manufacture offers engineers and designers new opportunities for savings in space and weight. Now greater power—with the efficiency and dependability inherent in Federal Selenium Rectifiers—may be had with-

out sacrificing compactness.

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# C.T.C. Custom-Engineers

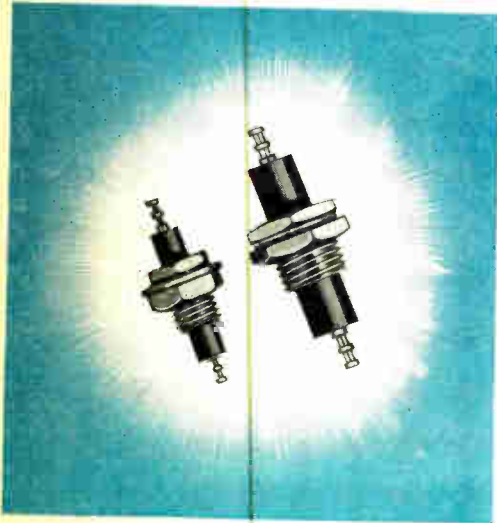
## The Solution To

*a tricky  
feed-thru problem*

Feeding an R. F. potential through the wall of a cavity oscillator presented many difficulties. Not only was space at a premium, but extreme changes in humidity, temperature and other service conditions had to be met.

### THE ANSWER

C.T.C. 1795B Insulated Feed-Thru Terminals fulfilled every requirement. Design-features like these show you why: *Rugged construction that withstands loosening under vibration or shock . . . approved phenolic insulating material, JAN type LTS-E-4 . . . brass bushings, cadmium plated . . . brass thru-terminals, silver plated for easy soldering.*



### SPECIFICATIONS

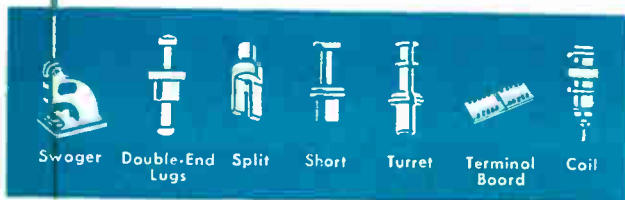
The 1795B mounts in a  $\frac{1}{4}$ " hole, and has an over-all length of approximately  $\frac{7}{8}$ ". C.T.C. Feed-Thru Terminals are available in additional sizes. The 1795A is similar to the 1795B, but with an over-all length of 1". Also similar in design and function are X1771A and X1771B, but larger in size and mounting in a  $\frac{3}{8}$ " hole. Breakdown voltages, at 60 cycles R.M.S., are:

1795A . . . 3800V    X1771A . . . 8200V

1795B . . . 3200V    X1771B . . . 6000V

Catalog No. 200 contains details of C.T.C. standard electric and electronic components, together with full information on our custom-engineering service. Write for it today.

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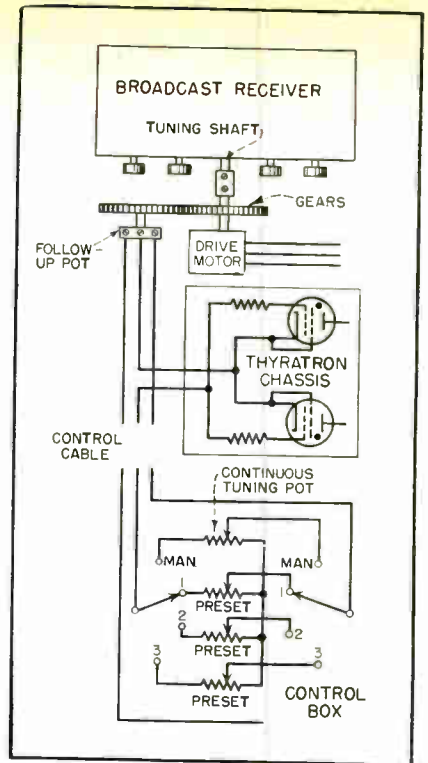


FIG. 2—The continuous tuning potentiometer is calibrated in frequency. The switching may be accomplished by a multi-position rotary switch or a bank of push-buttons

windings causes increased heating, it is nevertheless beneficial. The superposition of a continuous current converts the shape of the induction motor speed-torque curves so that the rotor speed is easily controllable by the stator voltage, and it provides a damping or anti-hunt torque proportional to the angular velocity of the rotor, thus preventing overshooting and the resulting continuous mechanical oscillation known as hunting.

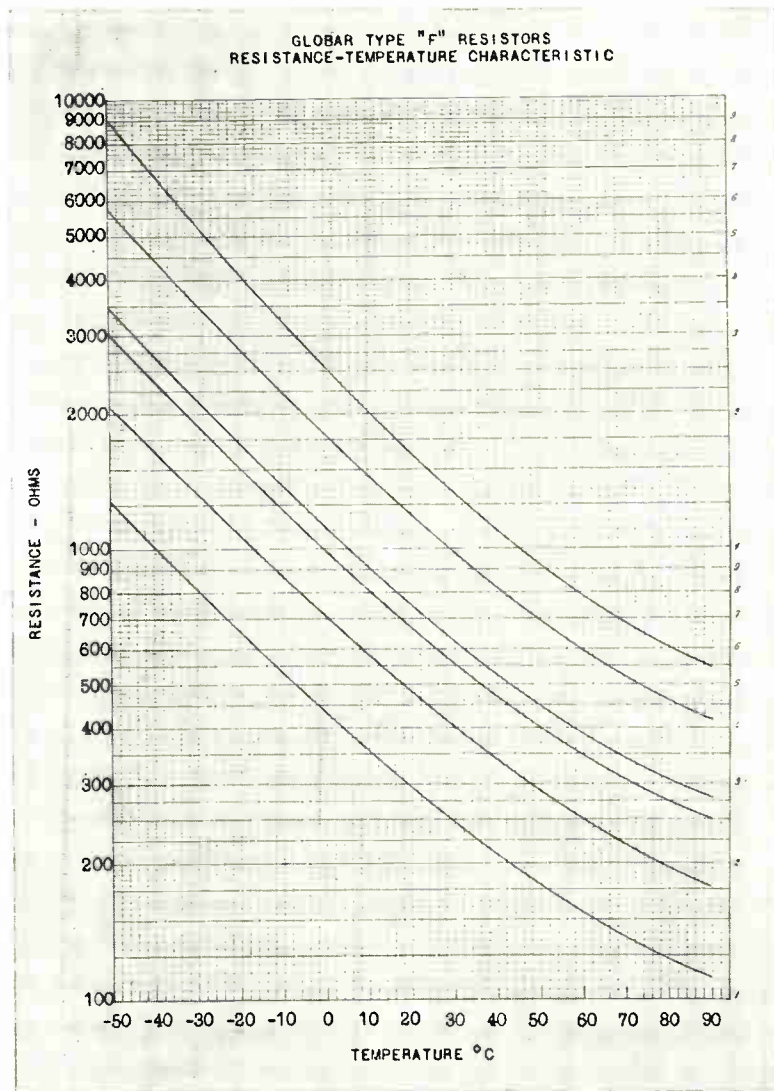
The fixed a-c grid bias is made as low as possible without causing the grid to lose control, and the phase angle is made to approach 90 degrees. A single R-C network is used to supply this grid bias at a phase angle close to optimum value from the heater winding on the transformer.

Using a radio receiver with the servo-device incorporating a 15-watt Holtzer-Cabot gear head induction motor to drive the 4-gang tuning capacitor, the unit was capable of resetting to within 1,000 cycles at 1,000 kc.

The physical and electrical requirements for potentiometers suitable for use in the control and follow-up circuits are not severe. The

## GLOBAL TEMPERATURE SENSITIVE RESISTORS

# Operate accurately over wide Temperature Range



The steep negative curve of Global Type F Resistors points up their sensitivity over a range from  $-50^{\circ}\text{C}$ . to  $100^{\circ}\text{C}$ . Actually this range can be extended beyond  $150^{\circ}\text{C}$ . This pronounced and important characteristic of Global Type F Resistors makes them particularly useful for stabilizing circuits possessing a positive temperature coefficient of resistance.

Functioning electrically, Global Resistors have no mechanical parts to get out of adjustment. They retain their inherent characteristics over long periods of time. They may be used on A.C. or D.C. circuits. Typical applications are:

**RADIO CIRCUITS**—Type F Resistors eliminate the high initial inrush of current, preventing pilot light burnouts and insuring long tube life performance characteristics.

**RESISTANCE THERMOMETER**—Type F Resistors are ideal for Remote Control and Indication of Temperatures.

**MOTOR GENERATORS**—Global Type F Resistors serve as voltage regulators by compensating for the positive temperature—resistance of copper field coils.

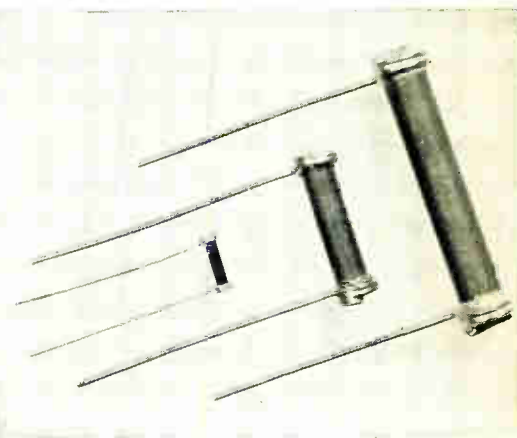
**ELECTRIC METERS**—Global Type F Resistors provide automatic temperature corrections. To do the job most efficiently for which they are intended, Global Resistors are designed to meet the specific needs of each application. This means that complete information on your circuit must be supplied. Global Resistors can be made to specifications in a hurry. Samples sent on request. Dept. V-128, The Carborundum Company, Global Division, Niagara Falls, N. Y.

# GLOBAL Ceramic Resistors



BY **CARBORUNDUM**

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## SPECIFICATIONS

### BALLANTINE MODEL 300 ELECTRONIC VOLTMETER

**RANGE:** .001 to 100 Volts, r.m.s.  
(.00001 to 10,000 Volts, with accessories)

**ACCURACY:**  $\pm 2\%$  at any point on the scale.

**FREQUENCY:** 10 cycles to 150,000 cycles.

**STABILITY:** Permanent calibration—unaffected by variation in line voltage, tubes, etc.

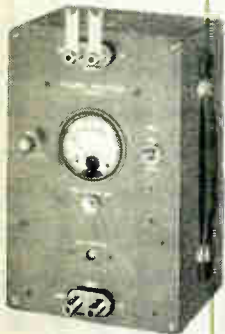
**METER:** Logarithmic Voltage scale and uniform decibel scale.

**AC OPERATION:** Will operate on 105-125 Volts, 50-60 cycles. (Battery operated models also available)



MODEL 300  
ELECTRONIC  
VOLTMETER

since 1935  
the only VOLTMETER  
featuring a simplified  
**LOGARITHMIC  
SCALE**



MODEL 220 DECADE AMPLIFIER



MODEL 402 MULTIPLIER

The Model 300 Voltmeter is a valuable tool for measurements in communication and "weak current" engineering. Its unusual sensitivity, accuracy and stability make it ideal for work in the audio, carrier, and supersonic ranges. Logarithmic meter indication assures uniform accuracy of reading over the whole scale while permitting range switching in decade steps. There is but one scale to read for all ranges. Output jack and output control are provided so that the voltmeter can be used as a high-gain stable amplifier.

Accessories include Model 220 Decade Amplifier, which supplies standardized gains of 10x and 100x, and the Model 402 Multipliers which supply additional ranges of 1,000 and 10,000 Volts.

*Descriptive Bulletin No. 12 Available*

## BALLANTINE LABORATORIES, INC.

BOONTON, NEW JERSEY, U. S. A.

TUBES AT WORK

(continued)

unit used for the continuous tuning function should be a wire-wound, high resolution potentiometer having at least 5 to 7 turns of wire per degree of rotation. Preset potentiometers are employed for rapid channel selection. In the circuit shown, one potentiometer per station is required.

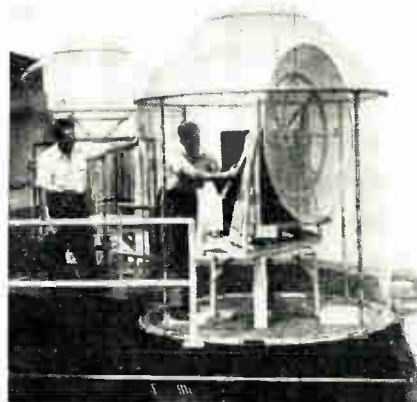
The components contained in the control box consist of a number of preset potentiometers, a rotary switch or bank of push-buttons and a continuous tuning potentiometer which is calibrated in frequency. The circuit is shown in Fig. 2. In operation, one adjusts each potentiometer for each station. Thereafter, whenever the switch connects a particular potentiometer in the circuit, the gang capacitor in the radio receiver chassis is rotated to its correct position for station selection.

### Protection For TV Antennas

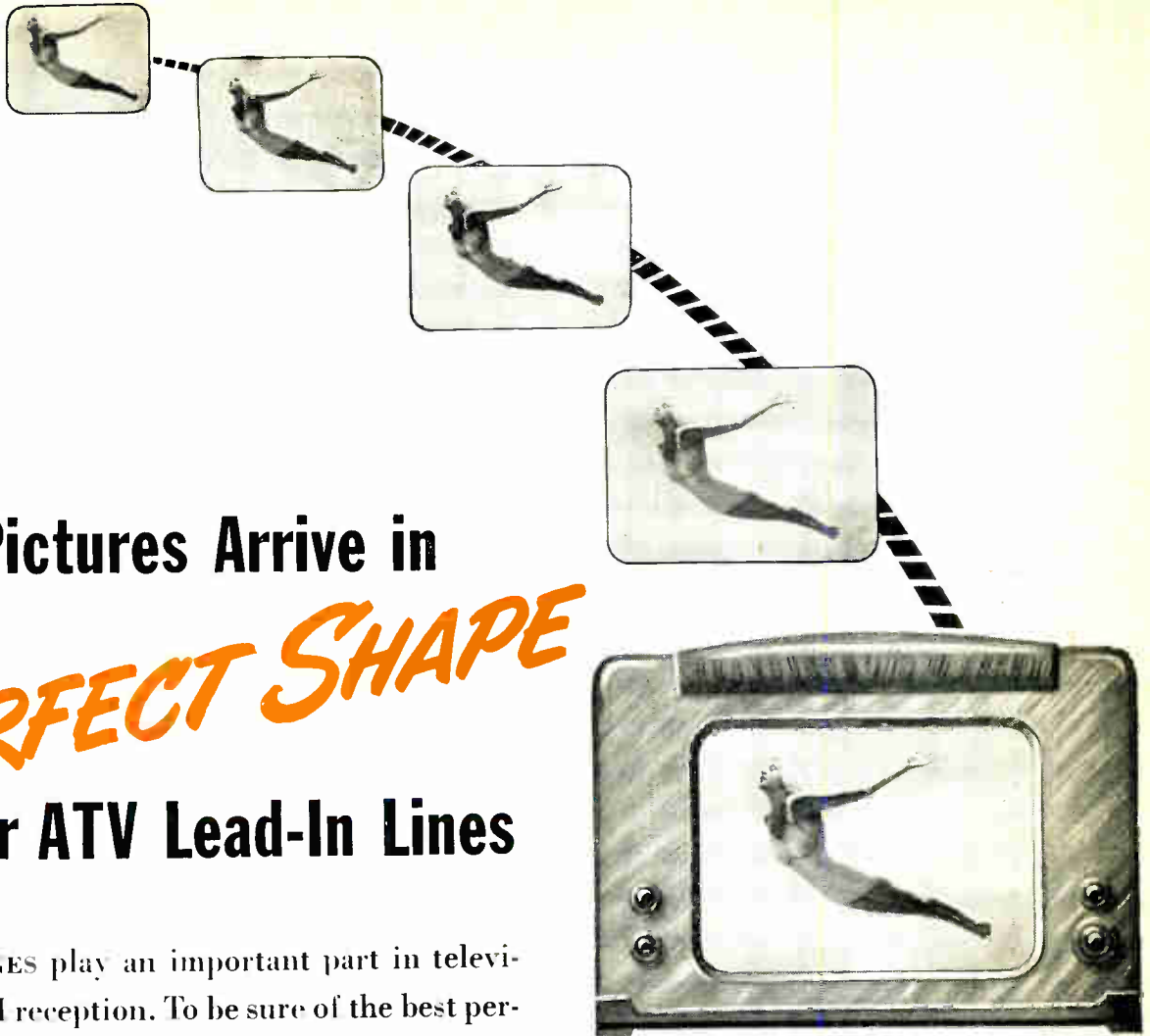
NBC ENGINEERS have enclosed in Plexiglas housings the microwave antennas mounted high on the Empire State and RCA Buildings in New York. These plexiglas igloos house five-foot parabolas which pick up television signals from baseball parks and arenas, or from mobile units elsewhere in the metropolitan area. Video cables then carry the signals to transmitters of television stations.

Primary purpose of the new housings is to shield the parabolic antennas from high winds and the destructive cascades of ice which plunge down in winter from the 300-foot tower above.

For strength, the dome-shaped



Plexiglas igloos protect NBC's microwave television antennas



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LEAD-IN LINES play an important part in television and FM reception. To be sure of the best performance of your set, specify ATV\* lines for your set.

The effects of attenuation and impedance mismatch on FM and Television reception are minimized by Anaconda Type ATV lead-in lines.

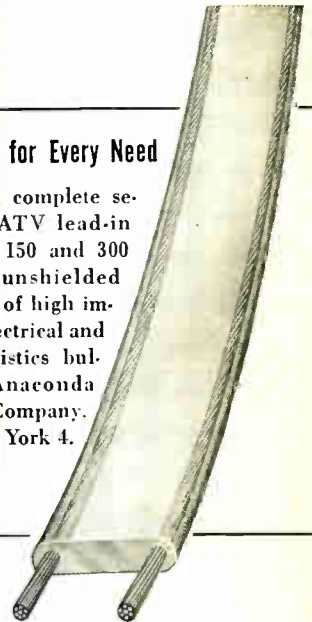
The satin-smooth polyethylene insulation of Type ATV line sheds water readily, thus avoiding subsequent impedance discontinuities. This material also has exceptionally high resistance to corrosion. Count on Anaconda to solve your high-frequency transmission problems—with anything from a new-type lead-in line to the latest development in coaxial cables.

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### A Type ATV Lead-In for Every Need

Anaconda offers a complete selection of Type ATV lead-in lines for 75, 125, 150 and 300 ohms impedance unshielded and shielded lines of high impedance. For an electrical and physical characteristics bulletin, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y.

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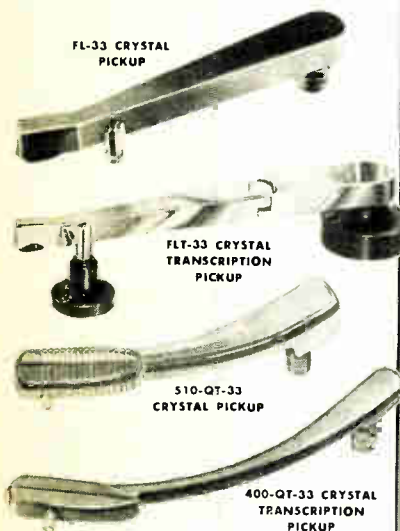
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**400-QT-33 CRYSTAL TRANSCRIPTION PICKUP**—Graceful, slender beauty of professional pickups. Employs QT Cartridge with replaceable precious metal or sapphire needle. Flawless reproduction at lower cost.

**400-MI-2M-33 MAGNETO-INDUCTION TRANSCRIPTION PICKUP**—Identical to 400-QT-33, except for Magneto-Induction Cartridge.

TUBES AT WORK

(continued)

tops are reinforced with an extra thickness of the acrylic at their crowns, where the ice might strike a direct blow. Except for this limited area, the curved shape of the structures guarantees that they will receive at worst a glancing blow.

First of their kind to be tested in actual use, these housings are made of shatter-resistant Plexiglas  $\frac{1}{4}$ -inch thick. Plexiglas was chosen because it passed microwaves without perceptible distortion; it was easily formed to exact curvature and dimensions; although light in weight, it combined great shatter-resistance with inherent resiliency; it was virtually impervious to extremes of weather and continued exposure to sunlight; and finally, its transparency allowed quick inspection of the apparatus within, and simplified visual aiming of the antennas. Components are rubber-gasketed and assembled with stainless steel bolts.

A door in each structure gives access to the microwave equipment, which may be rotated and swiveled to permit accurate aiming at the point of program origin. To prevent development of excessive heat in the summer, or freezing condensation in cold weather, each housing has its own "air-conditioning" treatment. Forced air, which may be heated electrically in winter, enters through a floor register and is exhausted through hinged louvers in the side of the platform on which each antenna is mounted.

### Servo Physical Tester

BASED ON PRINCIPLES used in wartime gun computers and rate setters, a servo-mechanical physical tester for plastics has been developed at MIT. It has a steel arm which pulls plastic test specimens with a force equal to that of an elevator car. This tremendous force is controlled automatically by mechanisms of featherweight sensitivity.

The tester, a product of the Society of The Plastics Industry's research program, was designed primarily for the observation of mechanical properties of plastics



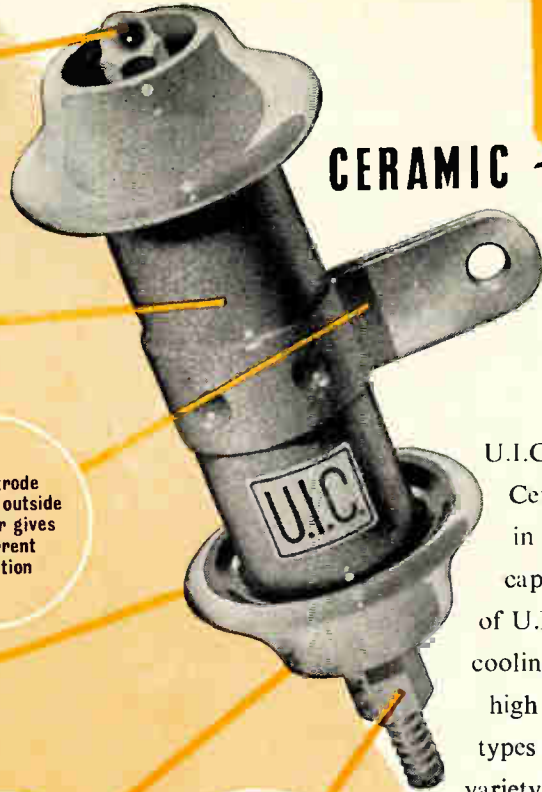
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Designs registered U.S.A., U.K. and other territories.

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Special silver layer gives low-loss high conductivity electrode surfaces

Special ceramic body gives low losses under R.F. load

Tag electrode soldered to outside silver layer gives even current distribution

Glazed sheds give ample flash-over path in all conditions of humidity

Aero-dynamic shape gives improved cooling, particularly with forced draught

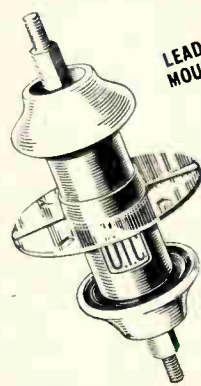
Heavy rod with double spider mounting gives reliable heavy current connection to inside silver layer

TAG MOUNTING TYPE

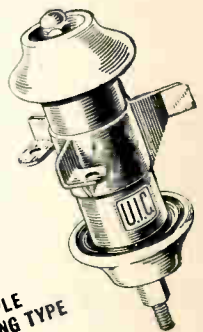
U.I.C. of England, pioneers in the manufacture of Ceramic Transmitter Capacitors, are foremost in the application of aerodynamic principles to capacitor design. The new aerodynamic shape of U.I.C. "Hi-Load" Capacitors gives optimum cooling in still air. With forced draught their high R.F. ratings can be multiplied. All three types of mounting assist cooling and cater for a variety of applications, such as single stand-off tag fitting, parallel and series banking for very large powers, and lead-through types for anode by-pass.

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Type	HLS203I	HLT202I	HLT202I	HLC201I	HLC2014★
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Max. R.F. Load	70KVA	50KVA	50KVA	25KVA	40KVA
Peak Voltage	7.5KV	7.5KV	7.5KV	7.5KV	7.5KV
Max. R. F. Current	30 Amps	30 Amps	30 Amps	30 Amps	30 Amps
Body Dimensions	1 3/4" x 3 1/2"	1 1/8" x 3 1/2"	1 3/4" x 3 1/2"	1 3/4" x 3 1/2"	1 1/8" x 3 1/2"



LEAD-THROUGH MOUNTING TYPE



TRIPLE MOUNTING TYPE

★ Lead-through type, all other examples tag type.

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ELECTRONICS — December, 1948

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Sizes of Precision Tubing cover a range of outside diameters from 0.500" to 0.010", with wall thicknesses down to 0.0015". Available in aluminum alloys, brass, copper, nickel, monel, or other non-ferrous alloys—each length of Precision Tubing can be preformed to the shape you specify . . . ready on good delivery.

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### THE ELECTRON ART (continued from p 126)

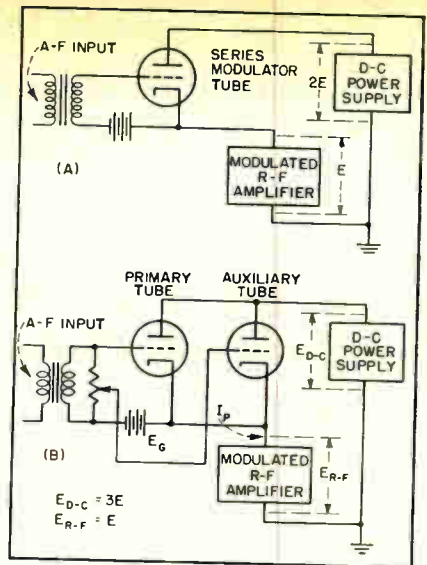


FIG. 1-(A) Conventional series modulator and (B) series modulator with auxiliary tube to suppress negative peaks

shows the basic circuit. The modulator operates like a class-A audio amplifier in that the grid never swings positive. In action, the modulator tube behaves as a variable resistance (with half the supply voltage across it when no audio signal is applied) in series with the modulated r-f amplifier. The variation in resistance acts at audio frequency, approaching zero resistance on positive peaks so that the full power supply voltage (twice the rated voltage of the r-f amplifier) appears across the modulated stage. On negative peaks, cutoff is approached (or reached) so that the tube impedance approaches (or reaches) infinite resistance.

#### Modified Power Supplies

In practice it is found that, because the tube is not absolutely linear, it needs considerably more than half the power supply voltage across it in order to stay in the linear portion of its characteristic and still achieve 100-percent modulation on positive peaks without distortion. As much as 20 percent of the power supply voltage may still be across the modulator tube when 100-percent undistorted positive peaks are being handled by the modulated tube. (This remaining voltage could be considerably reduced by designing a tube for the purpose. The 6AS7G might prove very good in a low power modulator.)

By using several tubes in parallel,

# 4 PROBLEMS 4 ANSWERS

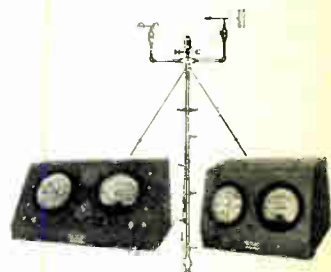
You, as a Communications Engineer, will be interested in the four *Aerocom* products illustrated below. They are designed and built to solve your communications problem. They are the result of engineering knowledge and experience gained during 18 years of manufacturing communications equipment for more than 200 installations throughout the world.

**WEATHERPROOF LOW FREQUENCY ANTENNA TUNER.** Sturdily constructed; using heavy aluminum sheet and rustless hardware. Ample ventilation provided, yet insect and vermin proof. Suitable for 1-2 kw carrier, 200-415 kcs; coupling coil matches either coaxial or 2 wire line. Illustration shows cabinet with protective and weatherproof (no gaskets) covers removed. Locking facility provided.



**AUTOMATIC KEYER** provides continuous or interrupted identification signals for beacon or aerophare service. Small, compact ( $6\frac{3}{8}'' \times 9'' \times 7''$ ) and fully enclosed, this keyer will give long trouble-free service. Two synchronized cams, which can be milled to your specifications, provide several keyer combinations. Motor -- 105/115 v-50/60 cy.

**METEOROLOGICAL INSTRUMENTS** -- Aerocom's group assemblies; anemometer and wind direction indicator on mast for outside installation, and reading instruments in cabinet or standard rack panel, give constant and reliable weather information. Instruments available: wind direction, wind speed, Kollsman station barometer (altimeter), 24 hour clock, or any combination thereof. Mast assembly may be remotely located from instruments.



**LINE MATCH INDICATOR:** Made in two models (a) LMI-72 for coaxial lines and frequencies from 0.2 to 10 mcs; (b) LMI-500 for balanced pair lines and frequencies from 0.2 to 2 mcs., or 2 to 20 mcs. These instruments permit adjustment of load for optimum line match. Sturdy and rugged, engineered for field use.

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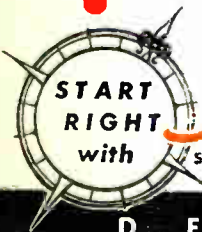
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it is possible to make a slight change in the circuit that, with proper adjustment, will enable it to accentuate positive peaks and suppress negative peaks. In the circuit of Fig. 1B the grid of the auxiliary tube is shown connected to a tap across the audio input. Although there may be sufficient signal to cut off the primary tube on negative peaks, the auxiliary tube will still be conductive and hence the resistance of the modulator will not reach infinity and 100-percent modulation on the negative peaks is not attained. If in addition the static voltage drop across the modulator is increased from  $E$  to  $2E$ , it will be possible to furnish  $3E$  to the modulated stage on positive peaks, or 200-percent modulation. Under this condition the tap for the auxiliary tube is adjusted so that its grid does not quite reach cutoff on negative peaks, thus 100-percent negative modulation will not be exceeded. Proper adjustment of the tap can be determined with an oscilloscope as shown in Fig. 2.

As is expected, the foregoing procedure introduces some distortion. However, for speech it is not objectionable at 150 percent modulation and does not interfere with the intelligibility at even 200-percent peak positive modulation.

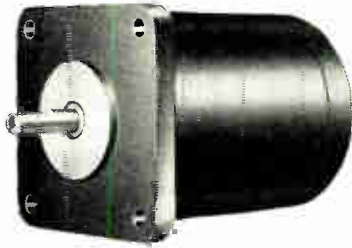
### *Experimental Equipment*

To demonstrate the feasibility of the method, a transmitter using type 10 tubes and having series modulation was modified for the purpose. With conventional 100-percent modulation, 400 volts appeared across the r-f stage and about 600 across the modulator. On 200-percent modulation with suppressed negative peak, about 250 volts appeared across the r-f stage and 750 across the modulator. The ideal values for these respective conditions would be 500-500 and 333-667.

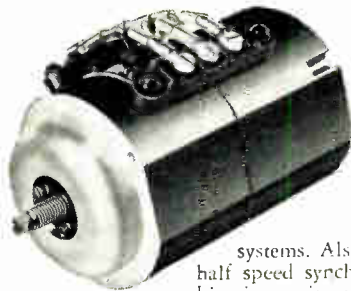
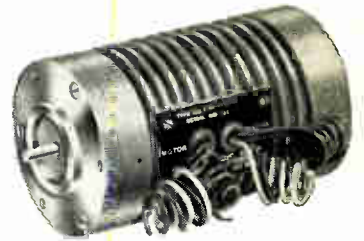
More detailed data were obtained from a transmitter having a single-ended 304TL r-f stage and 304TL's in the modulator. Transformer coupling into the modulator tubes was found necessary to provide a low-impedance d-c grid return. Although a power supply capable of providing nine times the unmodulated carrier power on positive

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**SYNCHRONOUS DIFFERENTIAL UNITS**—electromechanical error detector with mechanical output for use in position or speed control servo systems. Also a torque-producing half speed selsyn scope. Small combination unit with two variable frequency synchronous motors and differential gearing.

Output: Speed =  $\frac{N_1 - N_2}{2}$ ; torque up to 1.0 oz/in.

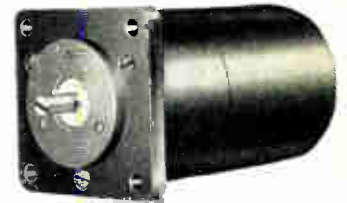


**TELETORQUE UNITS**—precision built selsyn type units for remote indication. Accurate to  $\pm 1$  degree. Actuated by units producing as little as 4 gr/cm of torque.

**DRAG CUP MOTORS**—miniature 2-phase motors with high torque/inertia ratio and extremely fast stopping, starting and reversal characteristics. Suitable for many special applications requiring torque of 0.4 oz/in. or less.



**GEARED INDUCTION MOTORS**—miniature 2-phase servo motors with gear reducer. Desirable motor features: Maximum torque at stall with low wattage input and high torque/inertia ratio. Gear reducer conservatively rated at 25 oz/in. Maximum torque with gear ratios from 5:1 to 75,000:1 available.



**B**ecause of their high responsiveness and precision, Kollsman Special Purpose Motors are particularly suited to systems requiring extremely accurate remote indication or positive electronic control. The units shown above are only representative of a complete line which includes many similar units in various voltages and frequencies. Among them, the instrumentation or control engineer will find, in many instances, the device that fills his specifications exactly.

Reliable performance, light weight and compact size are characteristics of the entire line. In each unit is to be found the same ingenuity of design and care in manufacture that has for twenty years made Kollsman the outstanding leader in the field of aircraft instrumentation.

For full information on any or all of these Special Purpose Motors, write to: Kollsman Instrument Division, Square D Company, 80-64 45th Avenue, Elmhurst, N. Y.

## KOLLSMAN INSTRUMENT DIVISION

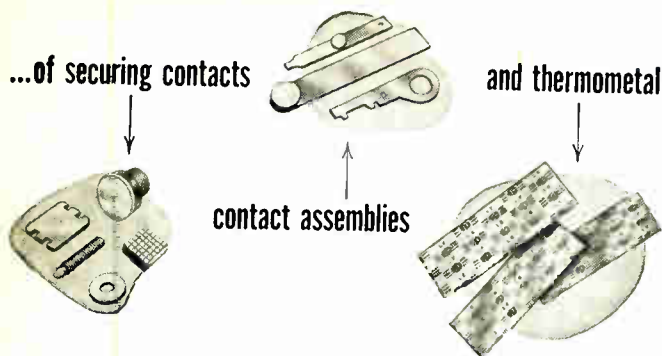


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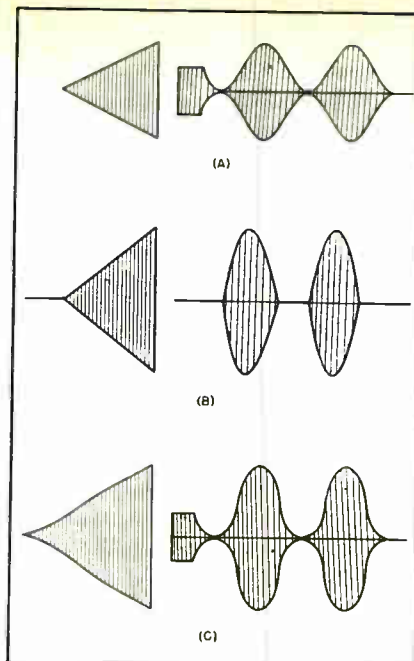


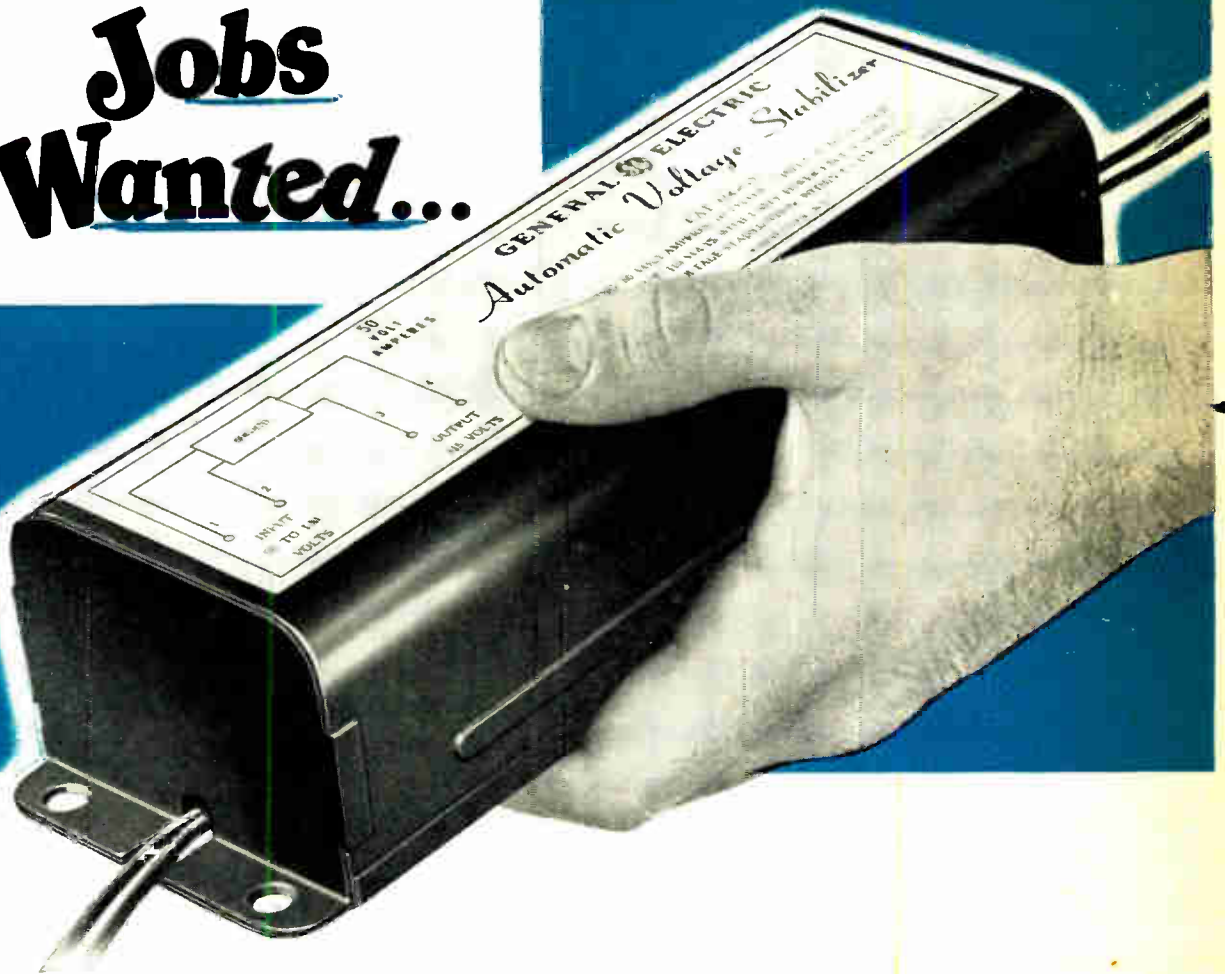
FIG. 2-(A) Conventional 100-percent modulation, (B) unsuppressed 200-percent modulation, and (C) 200-percent modulation with auxiliary tube adjusted to limit negative peaks

peaks may seem excessive, the fact that this power need be provided only on such peaks means that, in practice, the filter capacitors can be relied upon to supply the peaks; the power transformer and filter chokes need be but little larger than for a conventional modulator. The heavier the modulation, the smaller the power dissipated in the modulator tubes. Thus considerable increase in peak power is made possible with negligible increase in power supply. In addition, because series modulation is used, a heavy modulation transformer and speech amplifiers are omitted; a voltage amplifier is

### MODULATOR CHARACTERISTICS

Percent Positive Peaks	$E_{R-F}$ Volts	$E_{D-C}$ Volts	$I_P$ Ma	$E_G$ Volts
TWO TUBES				
100	1,050	2,700	370	-120
125	850	2,750	300	-130
150	750	2,750	270	-145
200	650	2,800	240	-165
THREE TUBES				
100	1,100	2,600	380	-117
125	900	2,700	330	-130
150	800	2,800	270	-150
200	700	2,750	240	-165
Percent negative peak modulation: 100				

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These units will operate continuously at no load

or short circuit without damage to themselves. They will limit the short circuit current to approximately twice normal full load current. Dimensions are  $9\frac{1}{2} \times 3\frac{1}{8} \times 2\frac{11}{32}$ " high—making possible shallow depth installations. Other standard G-E stabilizers are available in ratings from 100 to 5000 va.

Drop us a line if you see a possibility for these new automatic voltage stabilizers in your product. Please give us all the information you can—and if possible, a circuit diagram or description of the load, so that we can help you in evaluating the application. Simply address your nearest G-E Apparatus Sales Office or Apparatus Department, General Electric Company, Schenectady 5, N. Y.

GENERAL  ELECTRIC

MEASUREMENTS CORPORATION

# TELEVISION STANDARD SIGNAL GENERATOR

## MODEL 90

### SPECIFICATIONS:

#### ● CARRIER FREQUENCY

**RANGE:** Continuously variable from 20 to 250 megacycles, in eight ranges.

**ACCURACY:** Crystal frequency standard permits setting to .01%. Dial scale may be set to 0.1%.

**STABILITY:** Warm-up drift less than .05%.

**LEAKAGE:** Less than 10 microvolts.

#### ● MODULATION

Continuously variable from zero to 100%.

**ENVELOPE:** Sinusoidal, or composite television. Bandwidth to 3 db is 4 Mc. Rise time from 10% to 90% modulation 0.15 microsecond. Overshoot less than 5%. Slope less than 5% on 60 cycle square wave.

**INPUT IMPEDANCE:** 75 ohms  $\pm$  10% (RMA Standard).

**INPUT LEVEL:** 1.5 volts peak to peak minimum level for 100% modulation. Black negative polarity.

**MODULATION PERCENTAGE:** Zero to 110%; plate modulation.

#### ● OUTPUT

**LEVEL:** Continuously variable from 0.3 microvolt to 0.1 volt balanced to ground (measured at 100% modulation level).

**IMPEDANCE:** (a) 107 ohms line to line (balanced).

(b) 53.5 ohms line to ground (unbalanced).

(c) Suitable pads may be employed to alter these impedances.

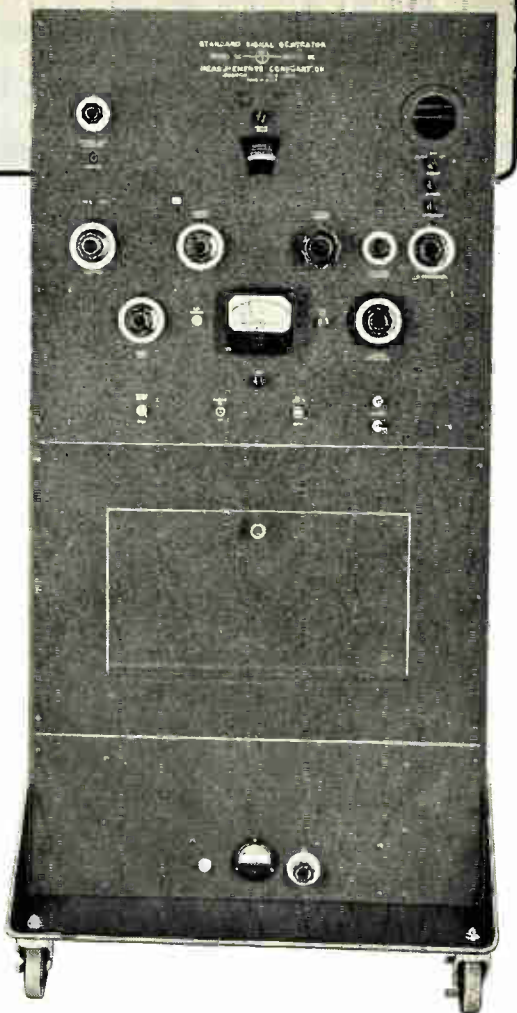
#### ● DIMENSIONS

**OVERALL:** Height—58 $\frac{3}{4}$ "; Width—28 $\frac{1}{4}$ "; Depth—25 $\frac{1}{2}$ ".

**WEIGHT:** Model 90—302 pounds.

External Voltage Regulator 92 pounds.

**POWER SUPPLY:** 117 volts, 60 cycles.



### THE FIRST COMMERCIAL WIDE-BAND, WIDE-RANGE SIGNAL GENERATOR EVER TO BE DEVELOPED

The Model 90 employs a master oscillator, buffer amplifier and modulated power amplifier. The push-pull buffer eliminates incidental frequency modulation.

**Features:** A self-contained crystal calibrator and individually calibrated dial scales permit frequency settings to a high degree of accuracy. A built-in video modulator with manual or automatic dc inserter, designed to operate from a standard RMA composite signal. Continuous monitoring is provided by built-in oscilloscope.

This signal generator meets the most exacting standards required for high definition television use.

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Television and FM Test  
Equipment

MEASUREMENTS CORPORATION  
BOONTON NEW JERSEY

THE ELECTRON ART

(continued)

sufficient to drive the modulator. The modulator is as shown in Fig. 2A. The accompanying tabulation gives data taken with it for two conditions: (1) two 304TL's in parallel, one having reduced audio excitation, and (2) three 304TL's in parallel, again with one having reduced excitation.

Although this method of suppressing the negative peak so that amplitude modulation in excess of 100 percent can be obtained without sideband splatter may not be desirable for high-power transmitters, it is economical for some uses of low-power transmitters. For example, using this method, the watt-hours at the increased voltage, with appropriate batteries, obtainable from such portable equipment as that used by the forestry fire wardens can be increased without increasing the weight of the equipment.

### Transitron Oscillator Tube

A SPECIALLY-DESIGNED TETRODE or a standard pentode can be operated with the second grid acting as the anode of an oscillator and the plate acting as an electron reflector; the potential of the reflector controls the transit time and hence the frequency of oscillation, as described by Jerome Kurshan in a paper entitled *The Transitron, An Experimental A.F.C. Tube*, presented before the National Electronics Conference in November and published in the *RCA Review* for December.

Used as the local oscillator in an f-m receiver (88-108 mc) with automatic-frequency control, an experimental tube showed a sensitivity of 100 kc per volt, thus counteracting warmup drift at the high-frequency end of the band by a factor of 4.5. Tests of commercial miniature tubes in the accompanying circuit showed that the 6BE6 with its third (r-f signal) grid as reflector and biased to at least 20 volts negative was one of the strongest oscillators. The 9001 gave the greatest control sensitivity, but oscillated very weakly; the 6AK5 performed most reliably but had low control sensitivity. A special Transitron tube was built





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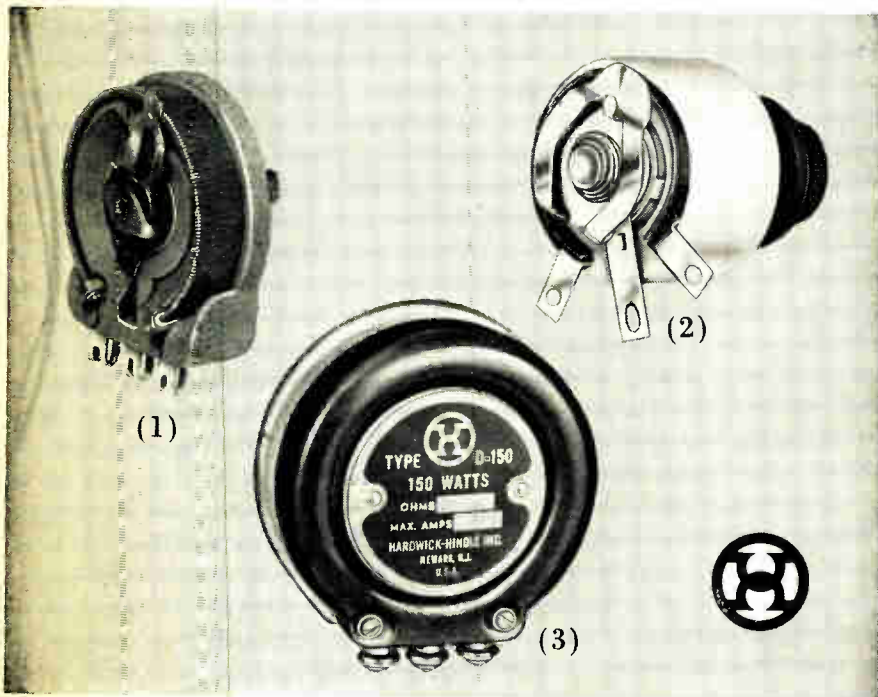
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Celenamel\* magnet wire—a copper wire insulated with a film of cellulose acetate combined under heat with other resinous materials. The film so produced is tough, flexible, continuous, and of high dielectric strength. The insulation additions produced with Celenamel\* have close and uniform tolerances.

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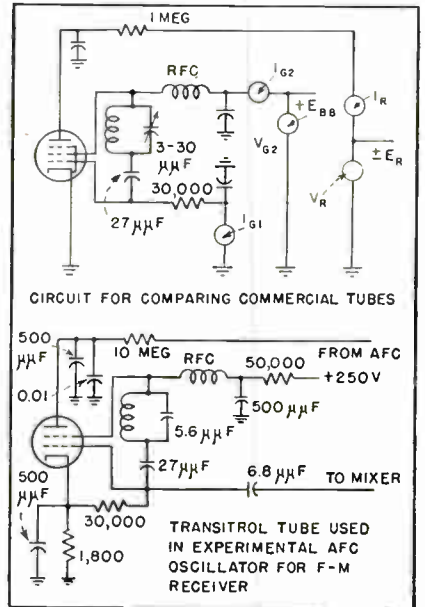
NEWARK 5, N. J.      Established 1886      U. S. A.

THE ELECTRON ART (continued)

and tested in the circuit shown in the diagram; its performance correlated well with theoretical expectations.

### Transit-Time Frequency Control

Because of the greater need for afc in the vhf region (30-300 mc) than in the lower-frequency bands, a simple means of controlling the frequency of a local oscillator is

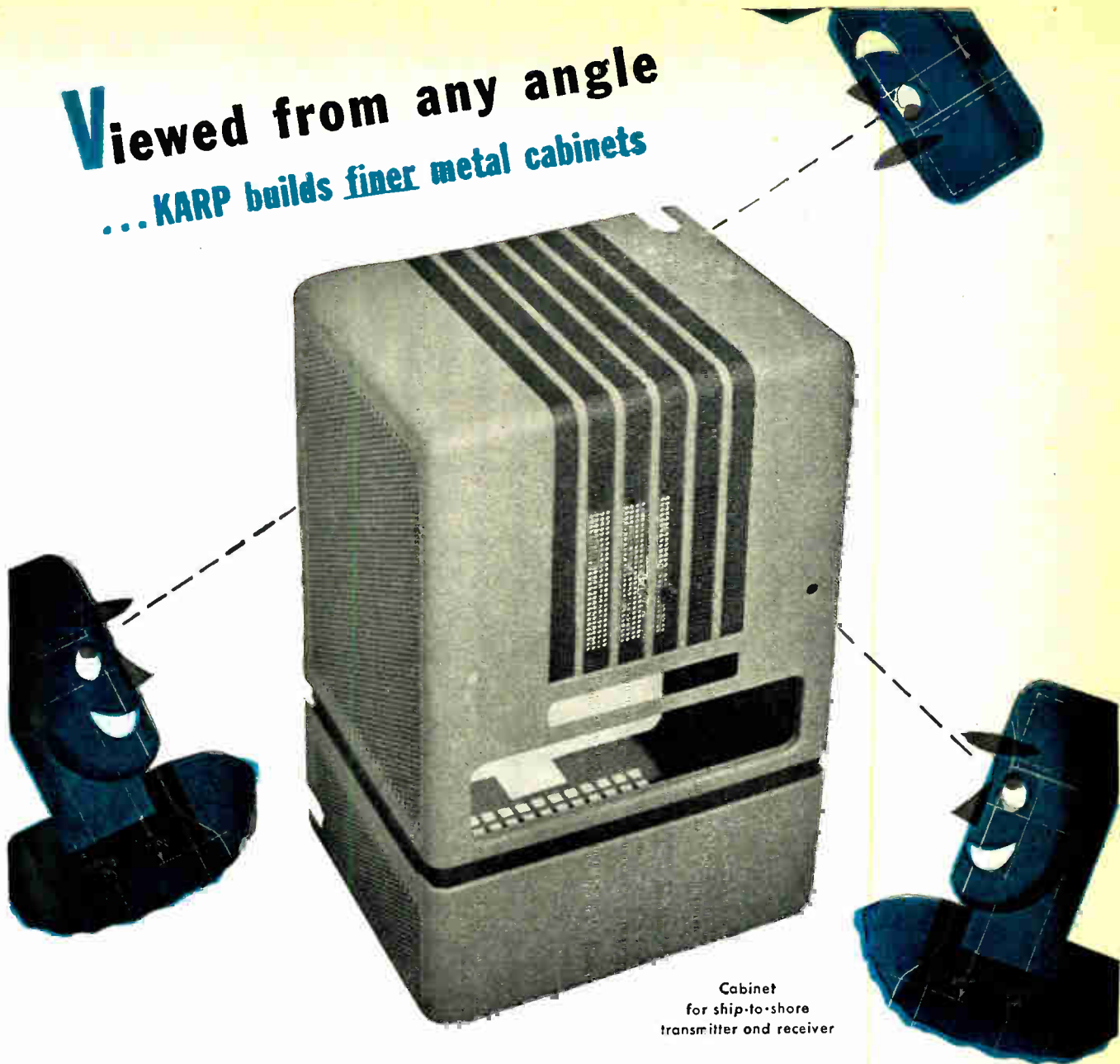


To determine the suitability of commercial tubes for Transitrol operation they are tested in the top circuit. The voltage applied to the second grid should be large enough to produce stable oscillation but not so large as to exceed the grid dissipation. The reflector voltage is adjusted for zero reflector current. The bottom circuit shows the oscillator using a modified 6BE6 which reduced warmup drift by a factor of 4.5 from that without afc

needed. Although a reactance modulator can be used, it entails an additional tube in the receiver.

The pulling of the local oscillator frequency by changes in the bias on the r-f signal grid, an effect sometimes observed in converters, can be used as the basis for afc. The frequency pulling arises because, as the bias changes, electrons are variously reflected back to the oscillator section where they interact with the electrodes and space charge to produce a changing susceptance across the oscillator circuit. To make use of the effect, the tube is so operated that electrons leave the cathode, pass through the control grid, are accelerated by the screen, are possibly

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reflected by the reflector, and finally reach the anode. By changing the potential on the reflector, the transit time of the electrons between grid and anode can be altered. By deriving a direct voltage from the discriminator of an f-m receiver and using it to control the reflector, afc is obtained without an additional tube.

### Operation

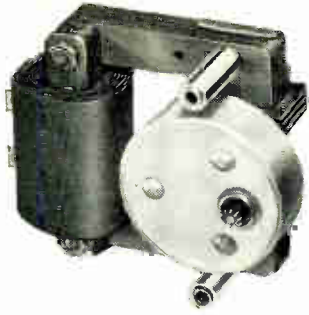
An analysis of the oscillator shows that a small capacitance in its resonant circuit is desirable for control sensitivity, although then there will be considerable warmup drift because interelectrode capacitance is a large fraction of the resonant-circuit capacitance.

In practice, it is desirable to keep the voltages on the anode and the control potentials small for large control sensitivity. The reflector spacing in the experimental tube was adjusted to obtain the optimum response with these conditions, but some commercial tubes have such spacings that, by suitable choice of their electrodes and potentials, they can be used with reasonable sensitivities, such as the 6BE6 previously mentioned.

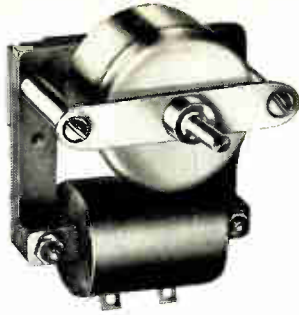
### Circuit for Testing Tubes

The Colpitts oscillator circuit shown in the diagram was used to test commercial tubes in this afc circuit. For f-m receivers with a standard i-f of 10.7 mc, the local oscillator normally ranges from 99 to 119 mc. Miniature tubes are most suitable for this range. Also, the Colpitts circuit, using the interelectrode capacitances for feedback and with the cathode grounded, is the simplest to use at these frequencies. For transit-time control, it is important that the cathode be at ground potential.

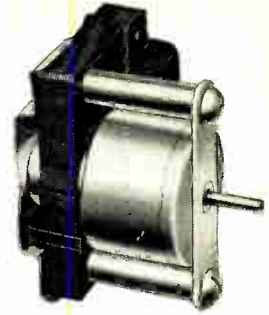
Unfortunately, neither end of the tuned circuit is at ground. It is necessary for this application that there be an r-f field between the second grid and the reflector, otherwise the transit of the electrons would effectively terminate when they passed the second grid (anode), because thenceforth they could not induce voltage in the resonant circuit. Practically, it is simplest to have the reflector at r-f



**Light-duty motor, type H3.** Torque rating .018 pound-inch at 3.6 rpm. at 60 cycles.

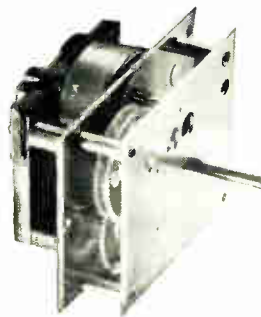


**Medium-duty motor, type H5.** Torque rating from .20 pound-inch at 6 rph. to .50 pound-inch at 1 or 2 rph. at 60 cycles.



**Medium-duty motor, type B.** Torque rating of various models from .015 pound-inch at 60 rpm. at 60 cycles to .375 pound-inch at 1 rpm.

**For accurate  
long-life  
instruments  
PICK  
TELECHRON  
MOTORS**



**Type 1M8 synchronous movement.** Small, compact movement for light-duty applications. Terminal shaft speeds from 12 rph. to one revolution in 24 hours. Terminal shaft rotation clockwise.



**Type 1M9 instrument movement.** Designed especially for chart drives but adaptable to most instruments. Terminal shaft speeds from one revolution in 15 minutes to 1 in 30 days. Terminal shaft rotation counterclockwise.

Count on a Telechron synchronous electric motor for the absolute accuracy and dependability so vital in automatic timing, switching, control and recording instruments. These self-starting motors are engineered and precision-built for long, continuous service in an almost limitless range of industrial applications.

Because they operate in perfect synchronism with any commercial frequency, they have to be accurate . . . can't run faster or slower. The replaceable, high-speed rotor unit is sealed in to keep out dust, and lubricated by Telechron's exclusive oiling system for long life. Fields are mounted externally for easy service and lower operating temperatures.

Telechron motors are available in many different types, torque ratings and terminal-shaft speeds. Torque ratings are conservative. Motors are available for all standard commercial frequencies.

These motors give you the advantages of the longest engineering and manufacturing experience in the field. They're built by the largest producer of synchronous electric timing motors for over 25 years. Every one is Underwriters Laboratories approved. Telechron application engineers are always glad to discuss your special requirements. Address Motor Advisory Service, Dept. M, Telechron Inc., Ashland, Massachusetts.



Telechron motors are meeting the need for greater accuracy and dependability in many industrial applications. They include:

- |                           |                                  |
|---------------------------|----------------------------------|
| <b>Timing</b>             | <b>Signaling</b>                 |
| <b>Controlling</b>        | <b>Fixed Process Controlling</b> |
| <b>Metering</b>           | <b>Measuring</b>                 |
| <b>Recording</b>          | <b>Gaging</b>                    |
| <b>Switching</b>          | <b>Regulation</b>                |
| <b>Cycling Operations</b> | <b>Communications</b>            |

**THE FIRST AND FAVORITE SYNCHRONOUS ELECTRIC TIMING MOTOR**





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In the field of electronics and the electrical goods industry, MOSINEE stands for paper-base processing materials with scientifically controlled chemical and physical properties, high quality standards and dependable uniformity... with good dielectric strength, high tensile or tear strength; proper softness or stiffness; creped with controlled stretch or flexibility; specified pH for maximum-minimum acidity or alkalinity; accurate caliper, density, liquid repellency or absorbency... or other technical characteristics vital to your quality standards and production requirements.

**MOSINEE PAPER MILLS COMPANY • MOSINEE, WIS.**

*"Essential Paper Manufacturers"*

ground, which requires that the cathode also be at r-f ground to avoid reflector current due to electrons that would be emitted at the negative peaks of cathode voltage.

## SURVEY OF NEW TECHNIQUES

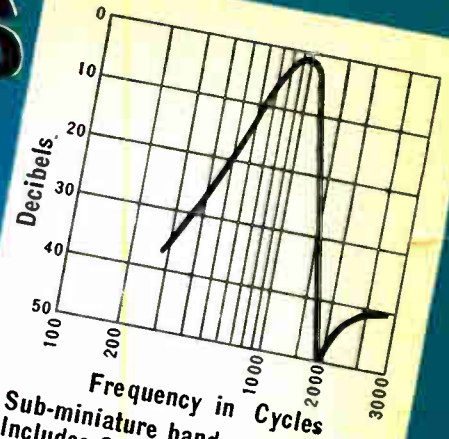
MINIATURIZATION of airborne equipment is now being carried on by the Air Materiel Command at Wright Field, Patterson, Ohio with the objective of reducing electronic gear to 20 percent of its present size, but without impairing performance. By redesigning tubes to subminiature size, the same characteristics are being obtained in 80-percent less space for amplifiers, 90-percent less space for rectifiers. The size and weight of transformers has been reduced to a third their present values.

In addition to these and other reductions in sizes of components, the compactness of the assembled equipment contributes to the reduction in overall bulk.

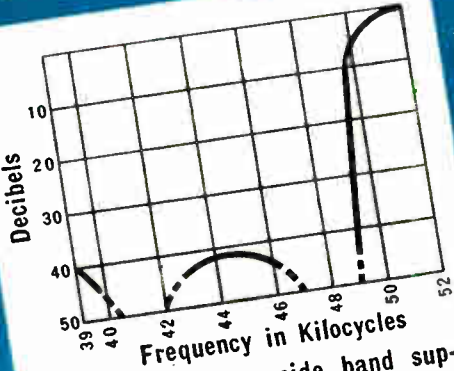
Printed radio circuit techniques are used to minimize the sizes of low-level circuits; cooling, using liquid Freon, enables parts in high-level circuits to be grouped more compactly and at the same time protects the equipment from atmospheric effects (fungus and oxidation) and reduces the possibility of burnouts so that the equipment will outlast conventional gear. The need for more electronic equipment in modern high-speed aircraft and the reduced space for such equipment makes this miniaturization necessary for expanded applications of electronics in aviation.

A NEW HEARING AID A-BATTERY extends the life of such subminiature batteries to 80 hours (4.25 ampere-hours under ASA test). Hearing aid A-batteries using two pen-sized flashlight cells gave 8 hours service and have been improved so that they give 24 hours service. Although the new National Carbon Co. unit is the size of these dual pen-cell batteries (A on accompanying graph) used in single-unit hearing aids, it has the life of the larger cell (see B on graph) which are used in old-style hearing aids having

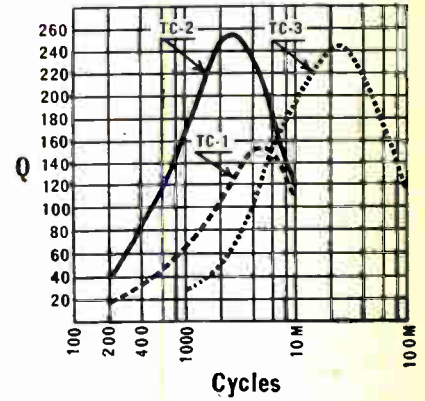
# TOROIDAL COIL FILTERS AND TOROIDAL COILS DESIGNED FOR CRITICAL APPLICATIONS



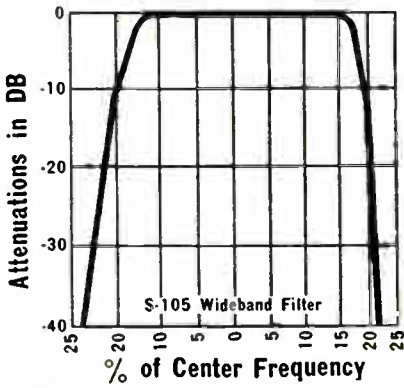
Sub-miniature band pass. Includes 3 coils and 4 condensers. Volume—4½ cubic inches.



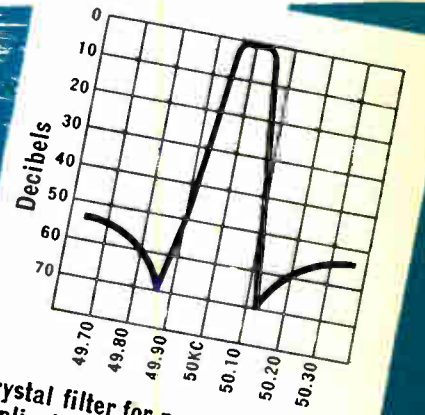
Extremely sharp side band suppression filter. Available in either low or high pass. Size: 2½ x 4 x 2½.



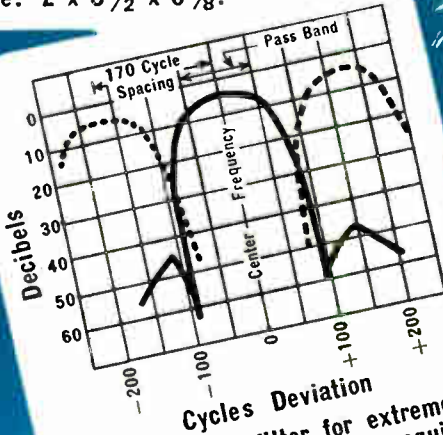
The big three out of 30 types of toroidal coils we are supplying. TC-1 any ind. up to 10 hys. TC-2 any ind. up to 30 hys. TC-3 any ind. up to .750 hys.



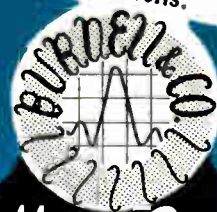
Wide band sharp cutoff band pass. Size: 2 x 3½ x 6⅝.



Crystal filter for narrow band pass applications too critical even for toroidal coils.



Tone channel filter for extremely high crossover attenuation requirement. Size: 2½ x 2½ x 5.



**Burnell & Company**  
YONKERS 2, NEW YORK  
CABLE ADDRESS "BURNELL"

for **POWER, SIGNAL and  
CONTROL CIRCUITS**  
in **AIRCRAFT and  
ELECTRONIC EQUIPMENT**

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### Ruggedness for AIRCRAFT SECURITY . . .

Stronger shells, stronger insulation, lowest resistance contacts with wiring solder pockets aligned for quick, convenient connections.

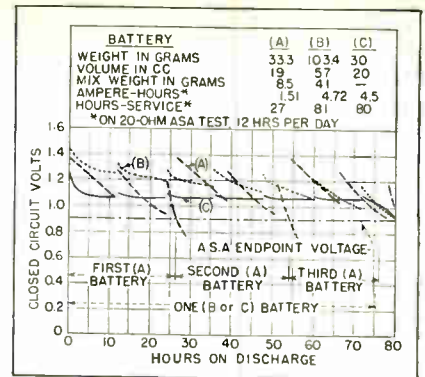
Built to quality standards beyond the already rigid specifications for AN Connectors. Amphenol pioneered in the engineering of this rugged and efficient line of connectors for use in military aircraft. To be sure of top performance, specify Amphenol AN Connectors and Fittings.

*Write for the new AN Catalog A-1. It's abundant with the latest connector information and contains timesaving listings and indexes for the engineer and buyer. Mail your request on company letterhead to Department 13-B.*



## AMERICAN PHENOLIC CORPORATION

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COAXIAL CABLES AND CONNECTORS · INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT · ANTENNAS · RADIO COMPONENTS · PLASTIC FOR ELECTRONICS



Comparison of two batteries commonly used in hearing aids (A) and (B) with new cell (C)

separate battery packs. The new cell (C) uses oxygen from the air as its depolarizer, thus enabling the chemical content to be devoted to electrolyte, giving larger power output per weight and volume than do other batteries. It consists of (1) two oxygen-absorbing carbon strips (positive electrode) bonded to (2) a perforated metal strip and molded into (3) a plastic case having air vents and into which is poured (4) a gel-paste that immobilizes (5) the alkaline electrolyte in the center of which is inserted (6) a sheet of zinc (negative electrode) that will be completely consumed at the end of the cell's life. The action of these six parts of the battery is effectively the burning of the zinc electrode in the oxygen of the air. The vents in the plastic case are sealed with a vinyl tape until the battery is placed in operation so that the shelf life of the sealed cell is very long. It is rated for use at 20 to 80 ma (ampere-hour capacity is little affected by the rate of drain within these limits.) Terminal voltage into a 20-ohm load is practically constant (75 percent of life) at about 1.06 volts.

A PLASTIC BASE for printed circuits is being used by Telex, Inc., Minneapolis, manufacturer of hearing aids. The chief advantages in using plastic bases are lightness, flexibility, durability, and moisture resistance. Conductors and resistors are etched into the surface of the plastic by the silk-screen process and then the circuit is hermetically sealed. The new printed circuit used a 0.025 inch thick piece of polystyrene (Styron) which



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Send for booklet B-2209-A, Communication Instrument Booklet B-3283, or Switchboard Instrument Booklet B-3363.

The *Coordinated Design and Styling* of Westinghouse instruments contribute greatly to the space-saving arrangement and excellent appearance of this installation.

For such complex and exacting instrument applications, *reliability* is a "must". Every part of Westinghouse instruments is completely designed and manufactured by Westinghouse to insure proper relation with all other parts. This undivided responsibility and attention to all details assures you of unfailing performance.

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Would they include—reliable performance . . . styling . . . size . . . readability . . . or different types of service . . . portable . . . switchboard . . . panel . . . recording?

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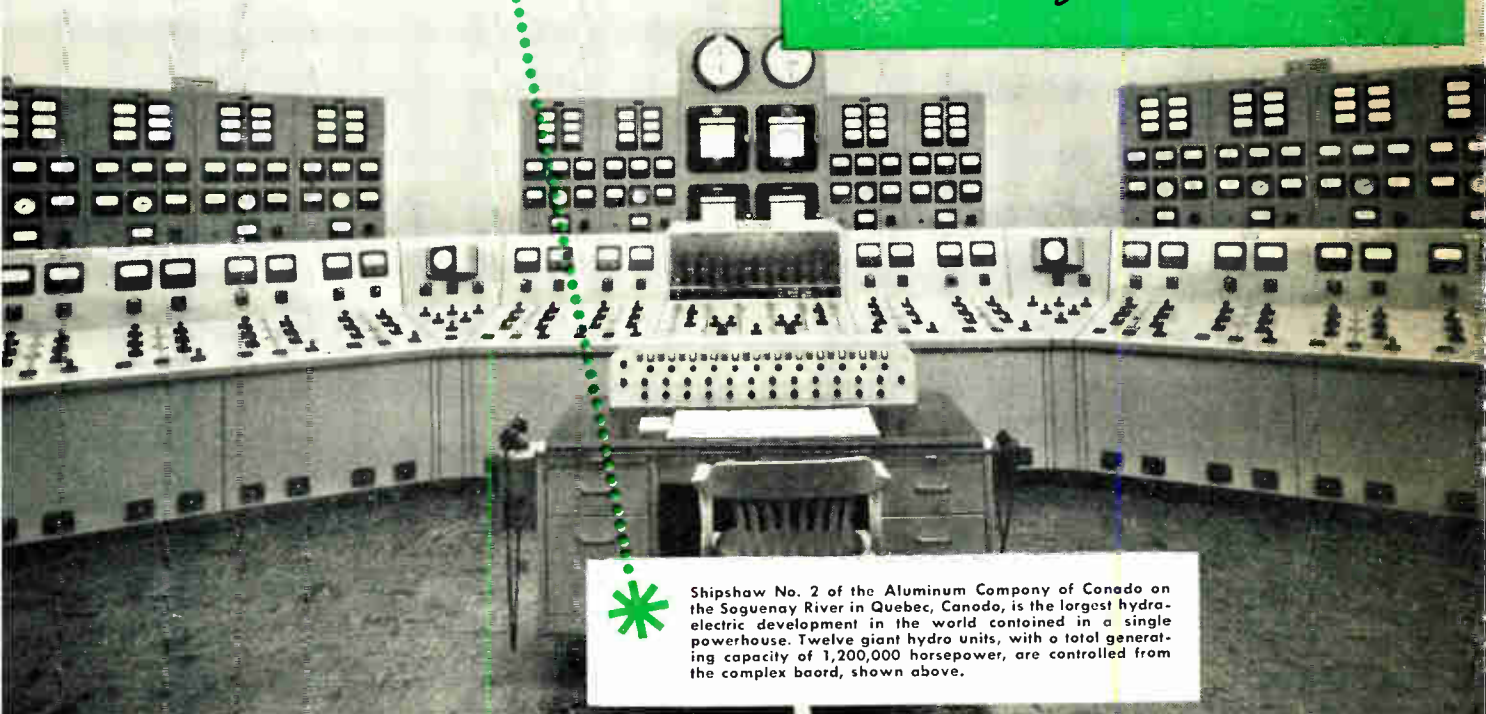
J-40363

**YOU CAN BE SURE... IF IT'S**

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*Electrical Measuring Instruments for ANY Job*



Shipshaw No. 2 of the Aluminum Company of Canada on the Saguenay River in Quebec, Canada, is the largest hydroelectric development in the world contained in a single powerhouse. Twelve giant hydro units, with a total generating capacity of 1,200,000 horsepower, are controlled from the complex board, shown above.

# PAMARCO WIRE DE-REELING TENSIONS

## PROOF OF PERFORMANCE!



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WINDING DEPT., PAMARCO DE-REELING TENSIONS  
REDUCE WINDING COSTS AND REJECTS\*

PAMARCO tensions are the low-cost answer to lower coil winding costs. The free-running action of the PAMARCO tension practically eliminates wire breakage, shorted turns; allows higher winding speeds. Their compact size permits many more simultaneous coil winds on any machine. Simple thumb screw adjustment makes it possible for the operator to rapidly adjust for any gauge wire ... no tools or special skill are required.

\*The economies effected with PAMARCO tensions are a proven fact in hundreds of installations. For detailed information call or write today without obligation.



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measures  $1\frac{1}{8}$  inches in length by  $1\frac{1}{2}$  inches wide. The one-piece Telex "99" hearing aid circuit using this polystyrene base weighs 5 ounces including batteries, while the plastic base itself weighs only  $\frac{3}{8}$  of an ounce.

RADIATIONS similar to cosmic rays will be generated by the 1,000,000,-000 electron-volt accelerator to be completed in 1951 at Stanford University, Calif. The prototype electron accelerator (ELECTRONICS, p 144, Nov. 1947) was 12 feet long and produced 6 mev. The full-scale wave guide accelerator, being developed under direction of Dr. W. W. Hansen, will be 160 feet long.

SENSITIVITY of the zeus ionization chamber circuit can be increased by using a new subminiature tube having a maximum grid current rating of  $2 \times 10^{-13}$  amperes. The tube's filament, rated at 1.25 volts and 10 ma, is designed for operation directly from a dry cell. The new CK571AX tube has a slightly higher mutual conductance and gain than the CK5697/CK570AX, which was originally designed for the zeus circuit (see ELECTRONICS, p 182, Nov. 1947 and p 196, Jan. 1948), and can therefore be used in this circuit. This new Raytheon tube can be employed in various portable instruments for measuring radioactivity.

MAGNETIC POLE FACE SHIMS for the synchrocyclotron now being built by the Carnegie Institute of Technology are radically different from conventional design. In addition to the series of steps usually machined into the profiles of pole tips, deep concentric grooves are being milled near their edges. As a result, the new design extends the useful radius of the magnet to 96.5 percent of the actual shim radius (compared to 85 to 90 percent heretofore possible). In this way the 150-ton cyclotron will be able to produce 400-mev particles with only 160-ton pole pieces having 141.65-inch, 30-ton shims. (Existing machines in the same energy class require from 2,000 to 4,000 tons of steel.) The design constituted the thesis of M. H. Foss, for which he was awarded his doctorate last June.

**NEW ELECTROLYTICS**  
*fully dependable*  
**TO 450 VOLTS AT 85°C**



ILLUSTRATIONS  
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**for TELEVISION'S exacting applications**

Designed for dependable operation up to 450 volts at 85°C. these new Sprague electrolytics are a good match for television's severest capacitor assignments. An extremely high stability characteristic is assured, even after extended shelf life, thanks to a special Sprague processing technique. Greatly increased manufacturing facilities are now available.

*Your inquiries concerning these new units are invited.*

**DEPENDABILITY  
 TO MATCH THESE  
 NEW ELECTROLYTICS!  
 SPRAGUE PHENOLIC  
 MOLDED TUBULARS...**

Highly heat- and moisture-resistant—  
 Non-inflammable—Moderately priced—  
 Conservatively rated for —40°C.  
 to +85°C. operation—Small in size  
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 cally rugged—Thoroughly field-tested  
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*with*  
**COTO-COIL**  
*windings*

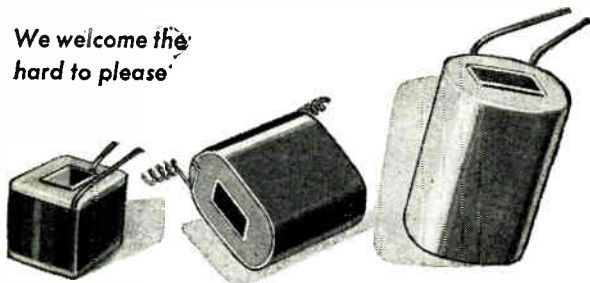
You can stand pat with windings by COTO-COIL. There is no gamble because there's nothing that can beat them.

We place our 31 years of experience at your service, plus unexcelled facilities for producing the coils you're looking for.

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**BOBBINS • PAPER INTERLEAVE  
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TAPED FORM WOUND  
UNIVERSAL SINGLE OR MULTI-PIE CROSS WOUND**

*We welcome the  
hard to please*



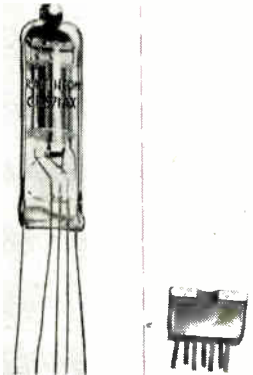
**COTO-COIL CO., INC.**  
COIL SPECIALISTS SINCE 1917  
65 Pavilion Ave., Providence 5, R. I.

## NEW PRODUCTS (continued from p 130)

seconds per point. In case of trouble thermocouples can be cut out in banks of 20 at a time. When a temperature reaches a preset limit an alarm sounds.

### Subminiature Tube

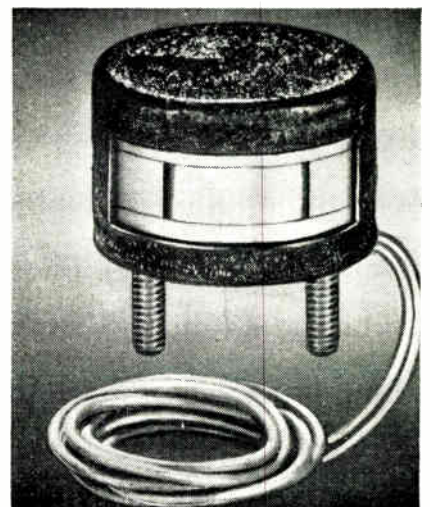
RAYTHEON MFG. Co., Newton, Mass., has added type CK571AX electrometer tube to its subminiature line. The filament is designed to be operated directly from an ordinary battery cell and draws 10 ma at nominal rating of 1.25 volts.



Besides its applications in the 2-tube zeus circuit it may be used in single tube circuits, and is particularly useful in radioactivity measuring instruments.

### Tape Recording Head

THE INDIANA STEEL PRODUCTS Co., 6 N. Michigan Ave., Chicago 2, Ill. Model TD-704 magnetic tape recording head, used for both recording and playback, is designed for high-impedance circuits and gives best results with a track 0.2 inch



# TSM

## TIME MULTIPLEX SHARING

# 24

## CHANNEL SINGLE CARRIER RADIO LINK

**STORM PROOF**  
**STATIC PROOF**  
**SECRET**  
**SEMI-AUTOMATIC**



Complete terminal equipment occupies a double cabinet 7' wide x 2' 4" deep x 6' 6" high, and aerials may be up to 100' from the main equipment.

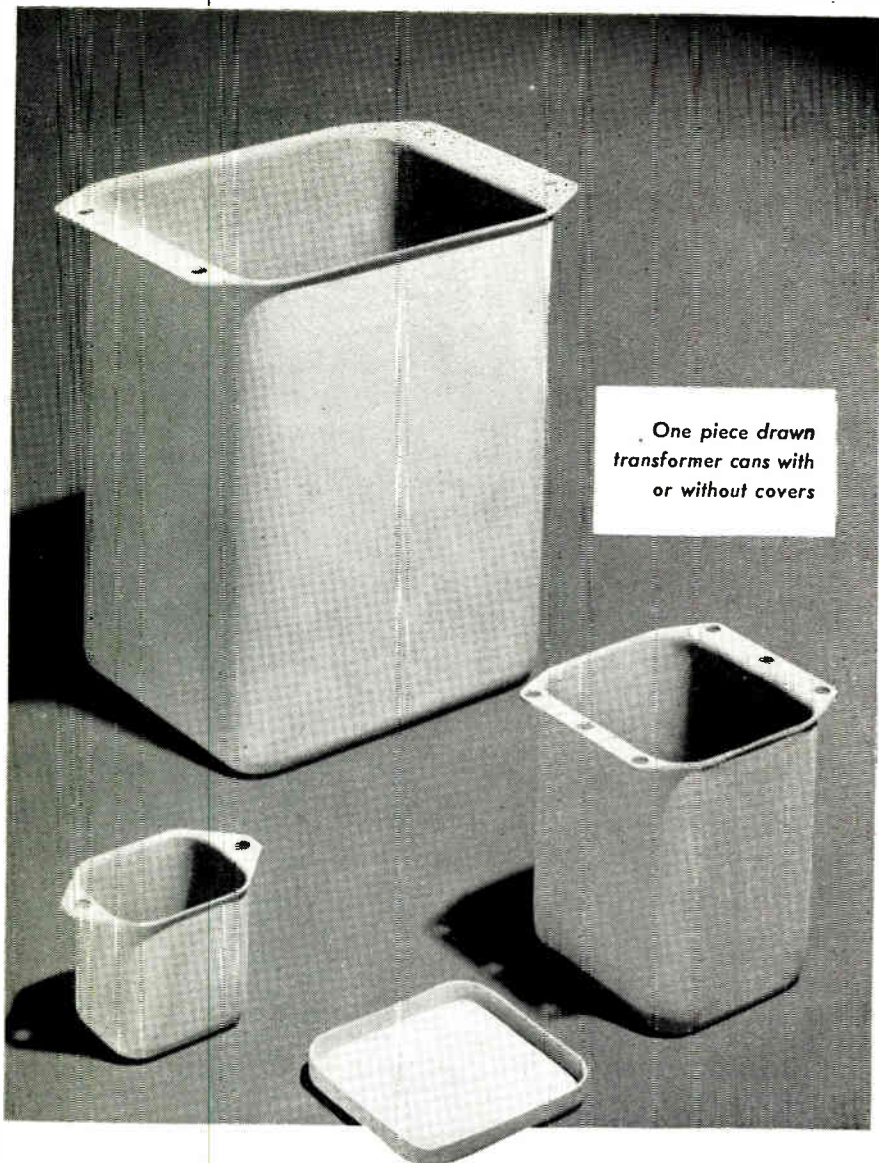
Write for our Bulletin No. 511 which gives further facts and figures.

Where the installation of wires or cables is hazardous or uneconomical, Standard Time-sharing Multiplex provides a thoroughly reliable telephone trunk system, easy to install and maintain. Each equipment deals with up to 24 channels, handling any kind of A.F. traffic in the 300-3400 c/s range, including teleprinter and automatic telephone signals. Time-sharing Multiplex ensures low crosstalk and noise levels, and fading does not affect speech levels. An UHF carrier is used and the normal line-of-sight range (approx. 35 miles) may be extended by automatic repeaters.

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*Radio Division*

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One piece drawn transformer cans with or without covers

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Let us save you die costs on all stock size transformer cans, and make IMMEDIATE DELIVERY. We carry a full range of sizes and can supply with or without covers. List of stock sizes and prints will be furnished upon request.

We are also equipped to fabricate special sizes and shapes (round, square and rectangular) of transformer cans to your own specifications. Tell us your requirements and we will be glad to submit estimates.

*Important:* All Craft Transformer Cans are drawn in one piece.

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3949 W. Schubert Ave., Chicago.  
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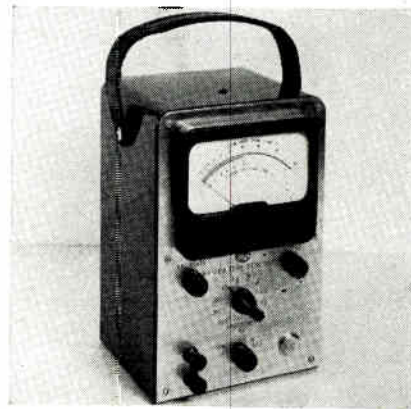
### NEW PRODUCTS

(continued)

wide. Using tape with a coercive force of 300 oersteds at a speed of  $7\frac{1}{2}$  inches per second, operating bias level at 40 kc is 1.7 ma and the audio signal current for standard recording level is 0.15 ma.

### Tone Generator

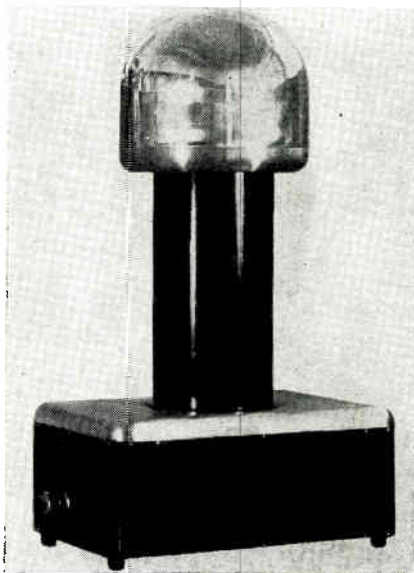
RADIO CORP. OF AMERICA, Camden, N. J. Type WA-26A portable tone generator is designed for use in broadcasting studios in equalizing



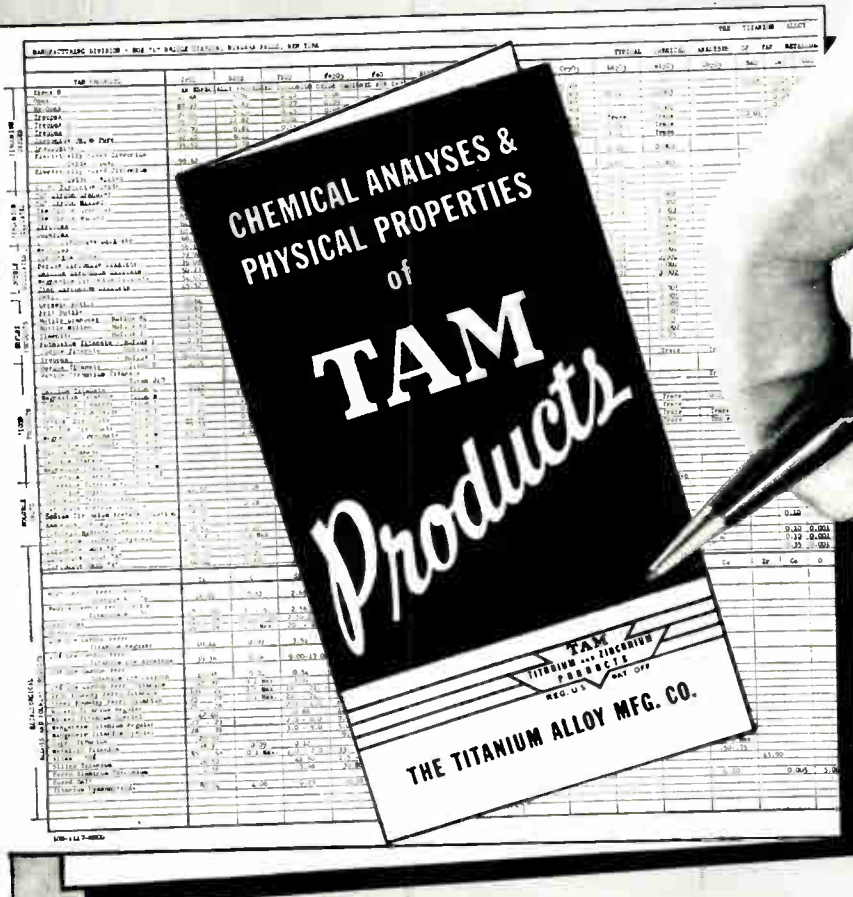
remote telephone lines. The circuit is an R-C type allowing selection of ten frequencies from 50 to 15,000 cps. Output is metered and calibrated in dbm.

### High-Voltage Generator

HIGH VOLTAGE ENGINEERING CORP., 7 University Road, Cambridge, Mass., announces the model L Van de Graaff high-voltage generator which provides adjustable constant potential up to 250,000 volts. A voltmeter reads terminal



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With this compact folder, you can obtain information on TAMCO products readily. When you want approximate physical properties, a chemical analysis, or commercial applications of specific products—clear concise charts provide them at a glance. That's why you will want this helpful booklet whether you are interested in TAM ceramic, chemical or metallurgical products. Address your request to our New York City office.

More detailed information on Titanium or Zirconium products is available also upon request. These data have been compiled to meet the demand for authentic information on these products from the source most closely identified with their development. It may prove advantageous to discuss certain problems and applications with our sales engineers.

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Executive and Sales Offices: 111 BROADWAY, NEW YORK, N. Y. General Offices and Works: NIAGARA FALLS, N. Y.



Western Union's new Telefax Receiver, the Desk-Fax model, is a compact facsimile telegraph sending and receiving system for desk use. Accurate timing is one of the fundamentals of its ingenious operation and the new device is wired for dependable Haydon timing. A #1600 series motor is used to drive the scanning stylus from left to right by means of a drum and cord. The synchronous motor operation permits constant speed stylus movement and both sending and receiving units run at the same speed.

Western Union pioneers in communications, Haydon in the science of timing . . . developing devices and motors which make possible progress in all fields of industry. In addition to producing timing motors and a wide range of standard timers, Haydon also specializes in design engineering and production of custom-built timing devices for specific volume applications. Wherever timing is important, Haydon is ready to assist.

Wire or write for a Haydon representative to call. If it's time for timing, it's time for Haydon. An Engineering Data Catalog is available. For quick reference, see Haydon Catalog, Sweet's File.

WRITE 2412 ELM STREET, TORRINGTON, CONNECTICUT

# HAYDON

MANUFACTURING COMPANY, INC.

TORRINGTON

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HARNESS TIME TO

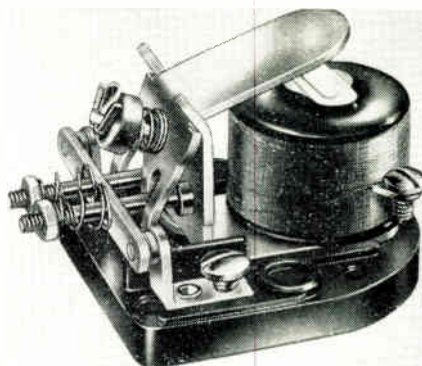
YOUR PRODUCTS

SUBSIDIARY OF GENERAL TIME INSTRUMENTS CORPORATION

voltage directly and a polarity reversing switch permits selection of either positive or negative voltage. The unit will operate from any 115-volt, 60-cycle, single-phase circuit fused for 20 amperes.

### Motor-Starting Relay

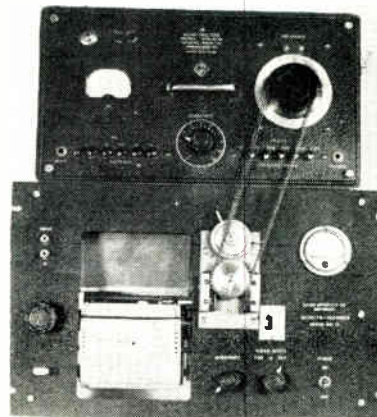
POTTER & BRUMFIELD SALES CO., 549 W. Washington Blvd., Chicago 6, Ill. The MS4A, a 3 h-p motor-starting relay, is fitted with large silver cadmium oxide contacts for



high current loads. It is available with 800-ohm winding for 115-volt 50 to 60-cycle motors or with 2,100 ohm coil for 230-volt 50 to 60-cycle motors.

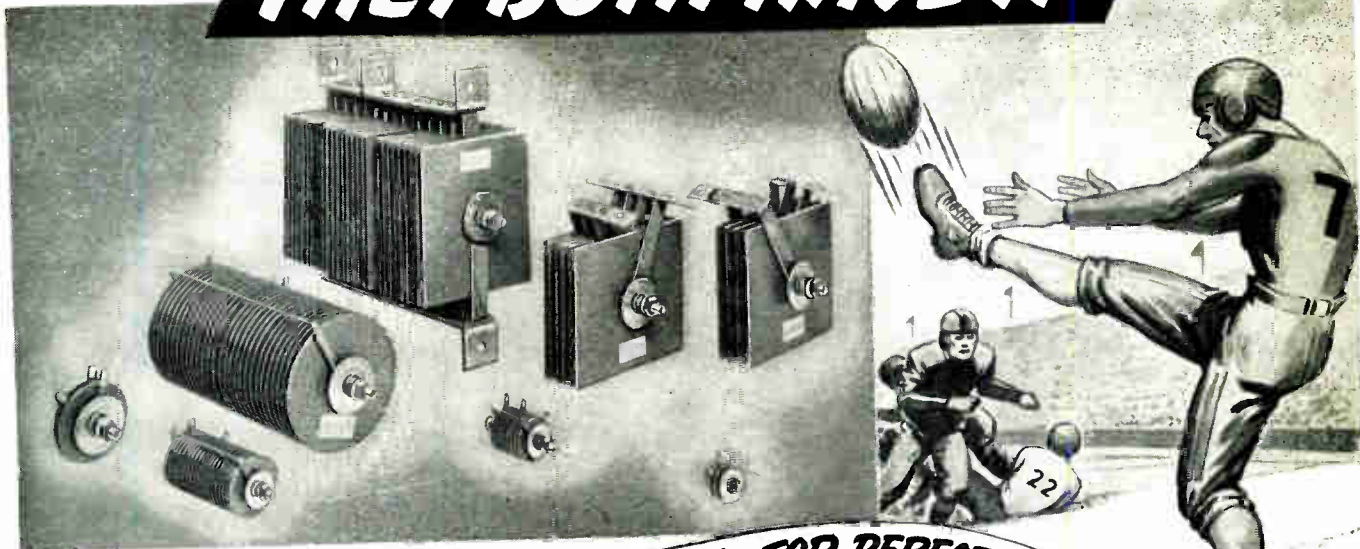
### Recording Sound Analyzer

SOUND APPARATUS CO., 233 Broadway, New York 7, N. Y. Frequency analysis of a complex wave from 25 to 750 cps is recorded on a 4-inch wide calibrated scale by the FR and FR-1 recorders in conjunction with the General Radio 760-A sound analyzer. Full scale





# THEY BOTH HAVE IT



*The EXTRA SOMETHING that spells TOP PERFORMANCE*



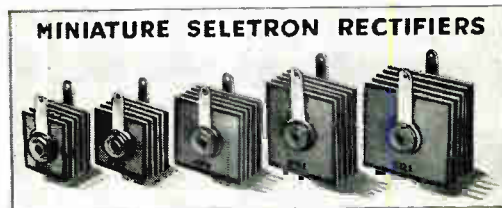
**Built on Aluminum**

THE football star who eludes the players of the rival team and sends the pigskin hurtling down the field to a goal has "the extra something that spells top performance."

For outstanding service in every rectifier application specify Seletron Selenium Rectifiers. They have the "extra something" that spells top performance.

From the large power stacks to the miniature units for radio and television, Seletron uniformity and precision methods of manufacture insures user satisfaction. Efficient—dependable, durable under the severest service conditions.

Furnished in a wide variety of voltages and currents to meet the individual requirements.



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MINIATURE SELENIUM RECTIFIERS  
FOR RADIO AND TELEVISION APPLICATIONS**

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Current Rating	75 ma.	100 ma.	150 ma.	200 ma.	250 ma.
Plate Height	1"	1"	1 3/8"	1 1/2"	1 1/2"
Plate Width	7/8"	1"	1 3/8"	1 1/4"	1 1/2"

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DIVISION OF THE SPERRY CORPORATION

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BRIDGEPORT 4, CONNECTICUT

MAGNET WIRE • BALLASTS • COILS • COMMUNICATIONS EQUIPMENT

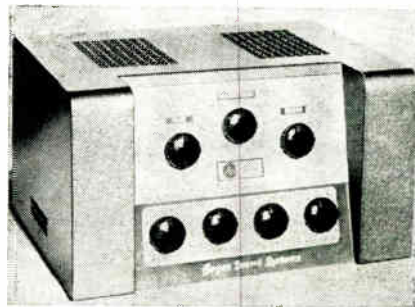
### NEW PRODUCTS

(continued)

width is calibrated linearly in equal 20, 40, 60 or 80-db divisions. The recorder is separately usable as a sound, power, or voltage level recorder.

### Anti-Feedback Amplifier

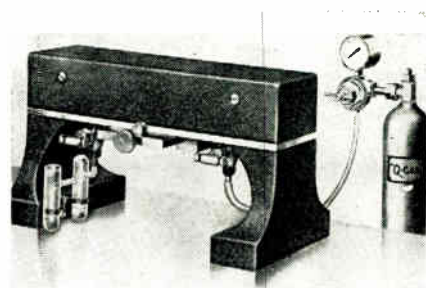
DAVID BOGEN CO., INC., 663 Broadway, New York City. The HX50 amplifier incorporates the new anti-feedback control, making microphone placement less critical. A dual tone corrector controls bass and treble ranges. Bass control is



from  $-20$  to  $+20$  db at 60 cycles. Treble control of  $+20$  to  $-20$  db at 10,000 cycles is also provided. The unit has three microphone channels and one phone input.

### Geiger Counter

NUCLEAR INSTRUMENT & CHEMICAL CORP. (formerly Instrument Development Labs., Inc.) 223 West Erie St., Chicago 10, Ill. Model D-46 Q-gas Geiger counter uses a formulated gas for detection of soft ioniz-



ing radiation like that from  $C^{14}$  or  $S^{35}$ . Anode potential used is 1,450 volts. The pulse output will operate a scaling unit with an input sensitivity of 0.25 volt.

### Voltage Regulators

SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. The new type 5 and 10-kva voltage regulators are available in either 115 or 230-volt models. Regulation ac-

# KAY ELECTRIC COMPANY

## TO SERVICE PRESENT AND FUTURE T-V SETS . . .

### THE MEGA-LINE OF INSTRUMENTS COVERS ALL CHANNELS

Think that statement over before you spend even a few dollars for any sweeping oscillator . . .

With any Mega-Sweep you can cover any proposed frequency . . . When any future channel, even above 500 megacycles, is added you will not have to fuss around with special adjustments or added equipment . . . or buy new equipment . . . The MEGA-SWEEP covers it with ease and accuracy . . .



### THE MEGA-SWEEP

Wide Range Sweeping Oscillator . . . **DISPLAYS PASS BAND** . . . Features: Frequency Range—50 kilocycles to 500 megacycles and up to 1000 mc . . . Frequency Sweep Adjustable from 30 megacycles to 30 kilocycles throughout the complete spectrum . . . Continuously variable attenuator . . . Low amplitude Modulation while sweeping—less than 0.1 DB per megacycle . . . Precision wavemeter. High and Low level output. Sweep voltage output for driving oscilloscope.

Price \$395.00 f. o. b. factory



### THE MEGA-MARKER SR

For Rapid and Accurate Alignment of Television Receivers. The MEGA-MARKER SR, provides a precise source of frequencies (accuracy .01%) one at the sound carrier in each of the twelve television channels.

MEGA-MARKER SR. can also be used alone for the alignment of the local oscillator for all twelve channels.

The single-dial control gives a rapid and efficient means of frequency selection.

The MEGA-MARKER SR. facilitates the alignment of the r. f. channels in the same manner that the MEGA-PIPPER and MEGA-MARKER facilitate the i. f. alignment.

MISC. 117 volt 60 cycle Size 8 x 16 x 8 Weight 15 pounds

Price \$195.00 f. o. b. factory



### THE MEGA-MARKER

Precision variable marker oscillator having a range of either 19 to 29 or 29 to 39 megacycles for the television i. f. band.

Crystal oscillator for the alignment of intercarrier i. f. and discriminator (4.5 mc).

A large easily read dial provides over 12 inches of calibrated scale length. Thus it may be read to accuracies of 0.02 megacycles.

Included in the MEGA-MARKER is a crystal oscillator which provides accurate check points.

The MEGA-MARKER is a valuable accessory for television applications of the MEGA-SWEEP and MEGA-MATCH.

For a high order of stability the regulated power supply of the MEGA-SWEEP or the MEGA-MATCH is used.

Weight 5 lbs. size 7 x 10 x 6

Price \$60.00 f. o. b. factory



### THE MEGA-PIPPER

The MEGA-PIPPER is a new production and service alignment instrument. By the use of this unit in conjunction with the MEGA-SWEEP or MEGA-MATCH it is possible to quickly and accurately align television i. f. amplifiers.

The MEGA-PIPPER gives four precise crystal positioned pips. These pips establish the picture and sound i. f. carrier points, and also the adjacent channel carrier points. Thus the MEGA-PIPPER is an instrument which will save many hours of time spent in alignment.

Inasmuch as the pips are fed directly into an oscilloscope, the pips are visible at all times, even in the traps where the highest precision is desired.

Self contained power supply.

Weight 15 lbs.

Price \$150 f. o. b. factory

Size 6 x 16 x 8

WRITE FOR FULL SPECIFICATIONS

**KAY ELECTRIC CO., 25 MAPLE AVENUE, PINE BROOK, N. J.**

Also Manufacturers of the Megalyzer, Mega-Match and Mega-Pulser.

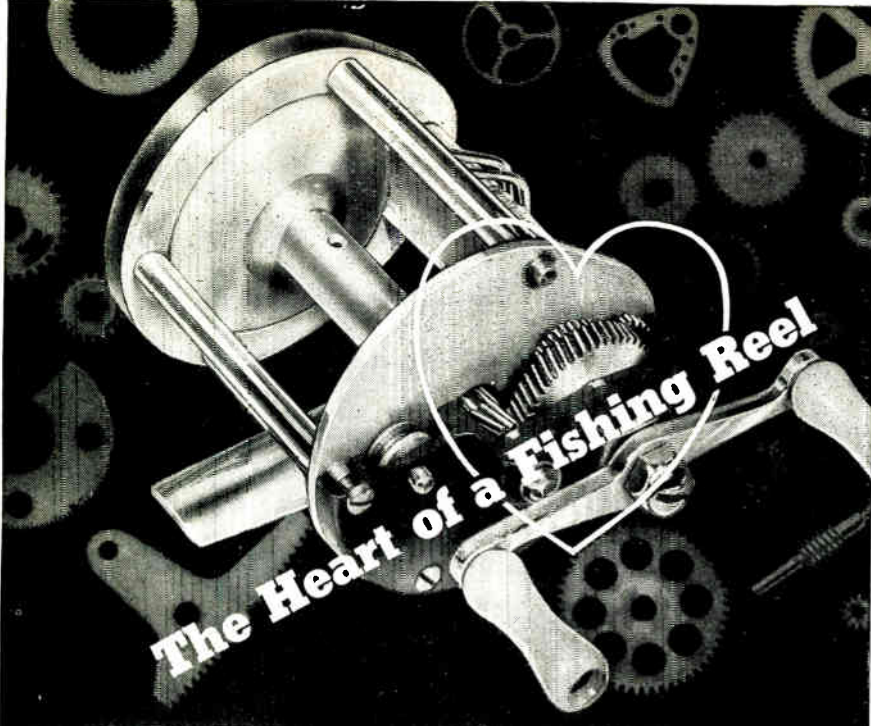
### The News of Radio

#### RCA Will Study Ultra-High Frequencies in Search for Television Channels

Plans for the study of ultra-high frequencies to determine whether they can accommodate the expansion of television broadcasting were announced yesterday by Dr. C. B. Julliffe, executive vice president in charge of RCA Laboratories. At the same time the Radio Corporation of America applied to the Federal Communications Commission for a license to install an experimental station in Washington over which to conduct the tests, expected to start about Sept. 1. The radio frequencies to be explored are above 500 megacycles, Dr. Julliffe said. He explained that the spread between 475 and 800 megacycles, already set aside by the FCC for future television development, is the only part of the spectrum where television can look for more channels in view of the search for additional frequencies by other services.

*New York Times*  
5-28-48

INSTRUMENTS



## The Heart of a Fishing Reel

Fishing reel gears must operate smoothly at a speed of 3000 revolutions per minute or more, when a cast is executed. These gears must also withstand the strain of hauling in a fighting fish of unpredictable size and strength, thus rendering a dual purpose: speed and velvety smoothness in one direction—strength and durability in the other.

Instruments and machines have individual gear problems. For over a quarter of a century, Quaker City Gear Works has solved thousands of them and produced millions of gears of every description up to 60" in diameter for manufacturers in many diversified industries.

Aircraft controls, dental drills, electric clocks, gauges, indicators, heat controls, machine tools, radar, radios, washing machines and motion picture projectors are but a few of the many conveniences of modern progress which depend upon the heartbeat of Quaker City Gears. Your gear problem is our business, our large productive capacity is at your service.

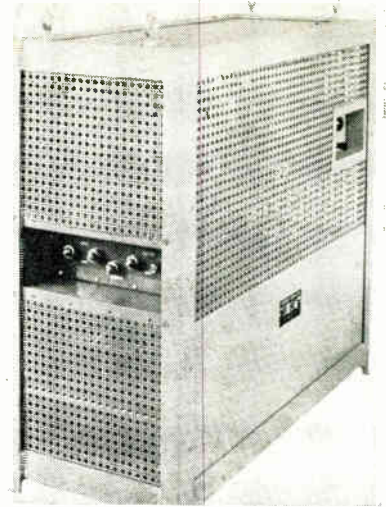
**YOUR INQUIRIES WILL RECEIVE PROMPT ATTENTION**

*The heart of the Outdoorsman Castomatic reel illustrated above is but one of many gear trains developed by our engineers and produced in our fully equipped plant.*

# Quaker City Gear Works

INCORPORATED

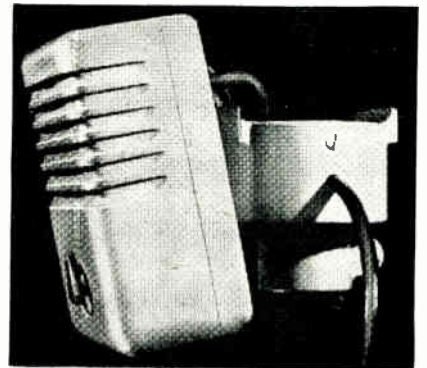
1910 N. Front Street, Philadelphia 22, Pa.



curacy is 0.5 percent. Line frequency changes between 50 and 60 cycles do not affect output voltage or performance of either regulator. For further information ask for catalog S-348.

### Loudspeaker Unit

TARRYTOWN METALCRAFT CORP., 82 Chestnut St., Tarrytown, N. Y. The Han-D-Vox speaker unit is available in both indoor and outdoor models for theatre installations. Enclosed in a cast-aluminum case,



it contains a 4-inch permanent-magnet speaker and a constant-impedance sound control or L-pad whereby line impedance is matched and maintained.

### Code Machine

ULTRADYNE ELECTRONICS, Oswego, Oregon. Designed for radio telegraph instruction, the radio code machine RCM-1 sends at speeds between 4 and 80 words per minute. The many available types of tape serve particular functions of instruction, and although the overall

For wider frequency range...top writing rates...

increased brightness...it's

**DU MONT**

# High-voltage Oscillography

▶ The basis is the Type 5RP-A Cathode-ray Tube operating at an accelerating potential up to 29,000 volts maximum. This achieves: (1) Greatly increased brightness; (2) Observation or recording of traces hitherto invisible; (3) Vastly increased writing rates even better than 400 inches per microsecond;

(4) Optical magnification by projection lenses such as Du Mont Type 2542. Although deflection sensitivities are slightly less than those of low-voltage cathode-ray tubes, high-voltage oscillographs produce smaller spot size and higher brightness, thereby presenting a finer, better resolved trace.

And here's the Du Mont selection of high-voltage oscillographs:



**10 CPS to 10 MC**

**Type 280:** A precision time-measuring oscillograph with range of 10 cps to 10 mc. Sweep speeds as high as 0.25 microsecond/in. are available. Duration of any portion of signal measured on 0.25 microsecond/in. sweep to an accuracy of  $\pm 0.01$  microsecond. Intervals greater than 5 microseconds read on calibrated dial to accuracy of  $\pm 0.1$  microsecond. Ready application to precise measurement of duration of waveform of various components in the composite television signal. Accelerating potential adjustable from 7,000 to 12,000 volts. Recordable writing rates up to 63 inches per microsecond, with commercially available equipment.



**WRITING RATES TO ABOVE 400 IN./MSEC.**

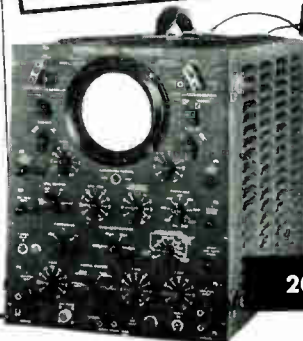
**Type 281-A:** Devoid of internal deflection amplifiers, there are no frequency response limitations within the ratings of its Type 5RP-A tube. Phenomena have been recorded photographically at writing speeds of 85 inches per microsecond. With external power supply (such as Du Mont Type 286-A), photographic writing speeds of over 400 inches per microsecond may be examined. Recommended when oscillographic needs are extremely specialized or too advanced for standard commercial equipment. An accelerating potential as high as 29,000 volts is available with the Types 281-A and 286-A in combination.

**Type 250-H:** Covers range from d-c to 200 kc. Potentials containing both d-c and a-c components may be examined. Many special features for general usage include: linear time-base of unusual flexibility; automatic beam control on driven sweeps; internal calibrator of signal amplitude. This is a high-voltage oscillograph with maximum accelerating potential of 13,000 volts. Recordable writing rate of approximately 40 inches per microsecond.



**D-C to 200 KC**

**Type 248-A:** Frequency range of 20 cps to 5 mc. Specifically intended for investigation of pulses containing high-frequency components of recurrent or transient nature. For this purpose it provides these necessary characteristics: High-frequency recurrent sweeps; short-duration driven sweeps; timing markers; signal delay network. Accelerating potentials up to 14,000 volts at recordable writing rate of approximately 69 inches per microsecond.



**20 CPS-5 MC**

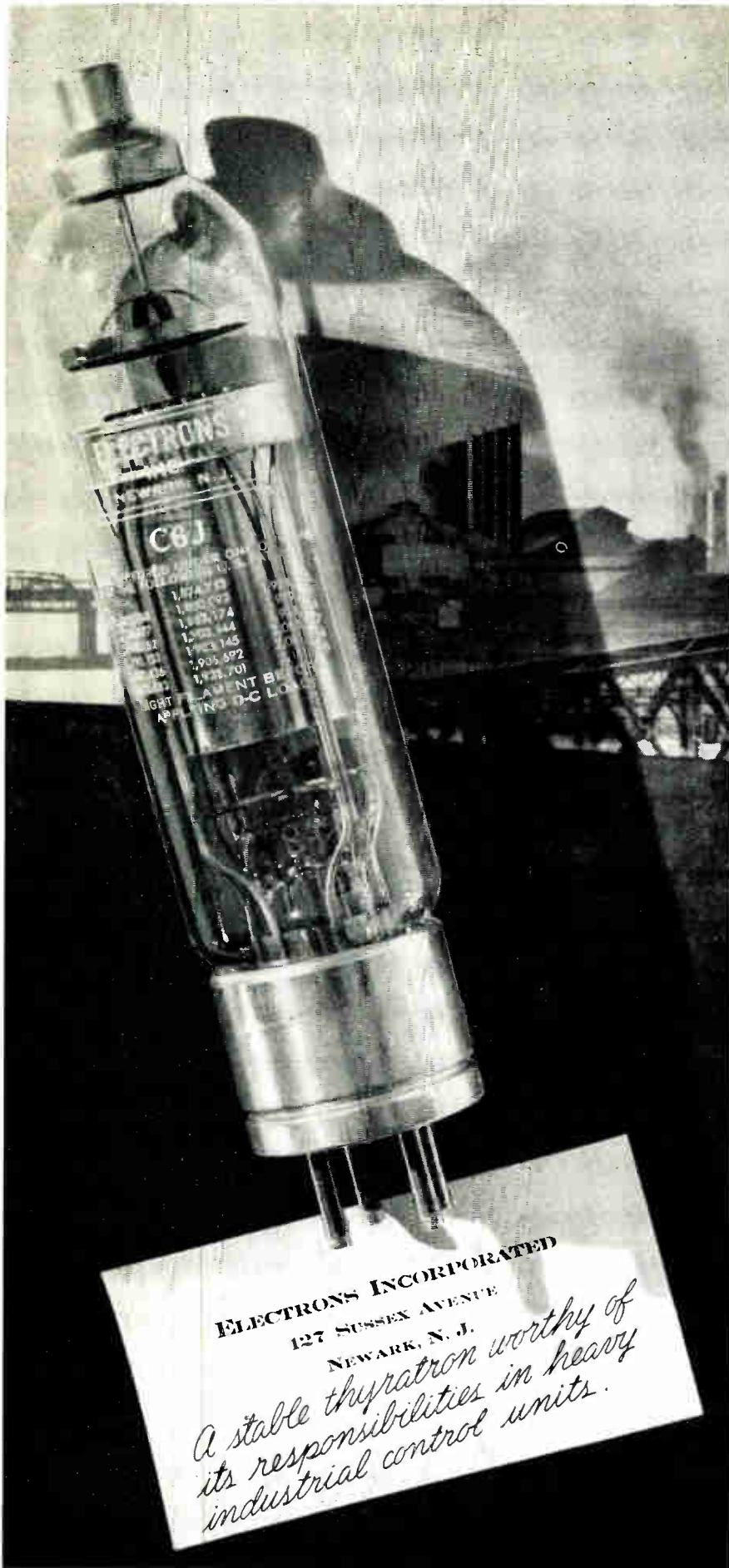
▶ LITERATURE ON REQUEST

© ALLEN B. DU MONT LABORATORIES, INC.

# DU MONT

## for Oscillography

ALLEN B. DU MONT LABORATORIES, INC., PASSAIC, N. J.  
CABLE ADDRESS: ALBEEDU, NEW YORK, N. Y., U. S. A.



**ELECTRONS INCORPORATED**  
 127 SUSSEX AVENUE  
 NEWARK, N. J.

*A stable thyatron worthy of  
 its responsibilities in heavy  
 industrial control units.*



speed of a tape may be 5 wpm, the characters are keyed individually at between 15 and 20 wpm. Brochures are available.

**Tele and F-M Antenna**

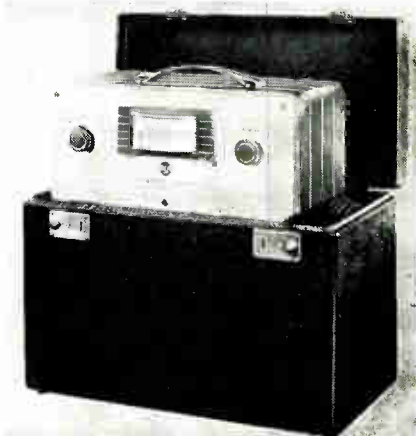
TRICRAFT PRODUCTS Co., 1535 N. Ashland Ave., Chicago, Ill. Model 500 f-m and television antenna



shown weighs only 2½ pounds and is provided with 300-ohm line to the receiver.

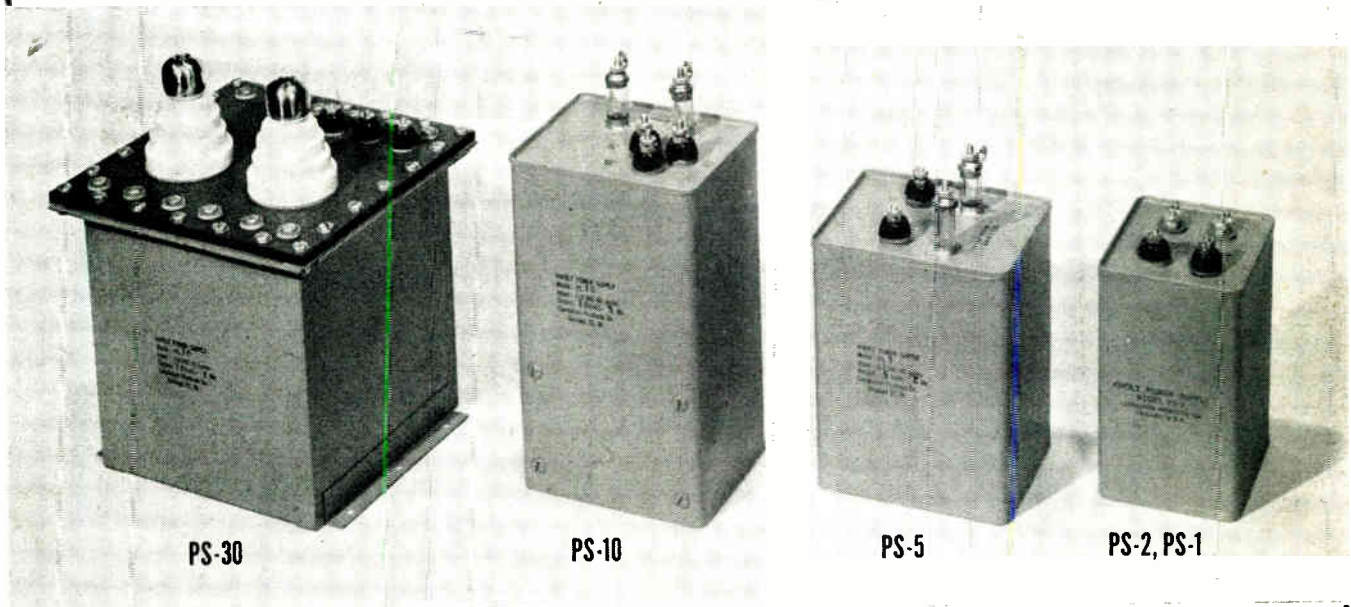
**Carrying Case**

RADIO CORP. OF AMERICA, Harrison, N. J. Especially designed for transporting test and measuring equipment, the new carrying case



# Introducing— Another Plasticon Development

## HIVOLT POWER SUPPLIES



HiVolt Supplies are self-contained in hermetically sealed metal containers. They are designed to transform low voltage AC to high voltage—low current DC.

PS-30-30,000 VDC; 1 Ma.; dimen. 7" x 7" x 7"

PS-10-10,000 VDC; 2 Ma.; dimen. 3 $\frac{3}{4}$ " x 4  $\frac{9}{16}$ " x 8"

PS-5-5,000 VDC; 5 Ma.; dimen. 3 $\frac{3}{4}$ " x 4  $\frac{9}{16}$ " x 6"

PS-2-2400 VDC; 5 Ma.; dimen. 3 $\frac{3}{4}$ " x 3  $\frac{3}{16}$ " x 5 $\frac{1}{2}$ "

PS-1-2400 VDC—Capacitor load; dimen. 3 $\frac{3}{4}$ " x 3  $\frac{3}{16}$ " x 5 $\frac{1}{2}$ "

### High Voltage-Low Current DC Power Supplies for

Television—Radiation Counters—Photo-flash Devices—Electrostatic Precipitators—Spectrographic Analysers—Oscilloscopes, etc.

*Write for descriptive literature*

Plasticon Capacitors, Pulse Forming Networks and HiVolt Power Supplies are available at all leading jobbers.



## Condenser Products Company

1375 NORTH BRANCH STREET • CHICAGO 22, ILLINOIS

See why Leaders in

# TELEVISION

choose

# MYCALEX 410 insulation



**PHILCO**  
uses these  
MYCALEX 410  
molded parts  
in its  
TELEVISION  
TUNER

In television seeing is believing . . . and big name makers of television sets are demonstrating by superior performance that MYCALEX 410 molded insulation contributes importantly to faithful television reception.

Stability in a television circuit is an absolute essential. In the station selector switch used in receivers of a leading manufacturer, the MYCALEX 410 molded parts (shown here) are used instead of inferior insulation in order to avoid drift in the natural frequency of the tuned circuits. The extremely low losses of MYCALEX at television frequencies and the stability of its properties over extremes in temperature and humidity result in dependability of performance which would otherwise be unattainable.

Whether in television, FM or other high frequency circuits, the most difficult insulating problems are being solved by MYCALEX 410 molded insulation . . . exclusive formulation and product of MYCALEX CORPORATION OF AMERICA. Our engineering staff is at your service.

#### Specify MYCALEX 410 for:

1. Low dielectric loss
2. High dielectric strength
3. High arc resistance
4. Stability over wide humidity and temperature changes
5. Resistance to high temperatures
6. Mechanical precision
7. Mechanical strength
8. Metal inserts molded in place
9. Minimum service expense
10. Cooperation of MYCALEX engineering staff

**MYCALEX CORP. OF AMERICA**

"Owners of 'MYCALEX' Patents"

Plant and General Offices, CLIFTON, N. J.

Executive Offices, 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

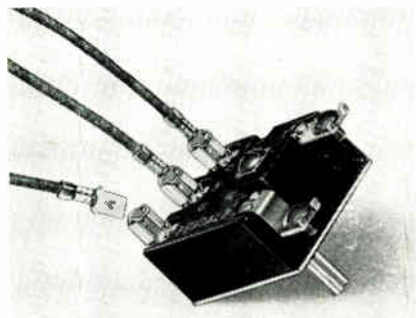




WG-274 is an aid to a-m, f-m and television servicing. Extra storage compartment at right provides space for test leads, adaptors, probes and other accessories. List price is \$16.95.

### Wiring Connector

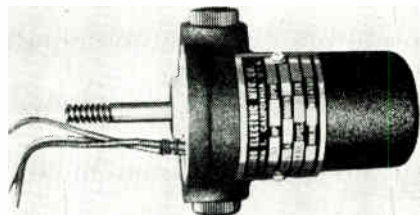
ARK-LES SWITCH CORP., 55 Water St., Watertown 72, Mass., has developed a new disconnect terminal designed to speed the wiring of electrical equipment. A flat blade staked to the connecting wire snaps



into a rigid receptacle in which it is retained by spring pressure. The unit features low contact resistance. The terminal assembly illustrated lists at a rating of 20 amperes, 125-250 volts a-c.

### Electric Motor

MISSION ELECTRIC MFG. Co., 132 West Colorado Blvd., Pasadena, Calif. The new electric motor with 0.005-horsepower rating has an



rpm rating of 5,000 to 20,000 under load and 10,000 to 40,000 free speed. The unit weighs less than 11 ounces.

### Photocounter

POTTER INSTRUMENT Co., INC., 136-56 Roosevelt Ave., Flushing, N. Y. Model 310 photoelectric counter can be used at rates up to 6,000 per minute. Last digit of the number is registered on neon glow lamps and the rest of the digits are indi-

## An Important Statement

by

# MYCALEX CORPORATION OF AMERICA

As illustrated on the opposite page, PHILCO uses Mycalex 410 (glass bonded mica) molded parts in its television receiver tuner — to avoid frequency drift of tuned circuits.

Your attention is also called to the Mycalex 410 advertisement which appeared on pages 54 and 55 of the October 1948 issue of Electronics.

Constant research, improved technics, advances in the art, new, modern plant expansion, improved engineering, more efficient manufacturing equipment—now permit us to make available in increased quantities—Mycalex 410—molded—at prices comparable to other less efficient molded insulations.

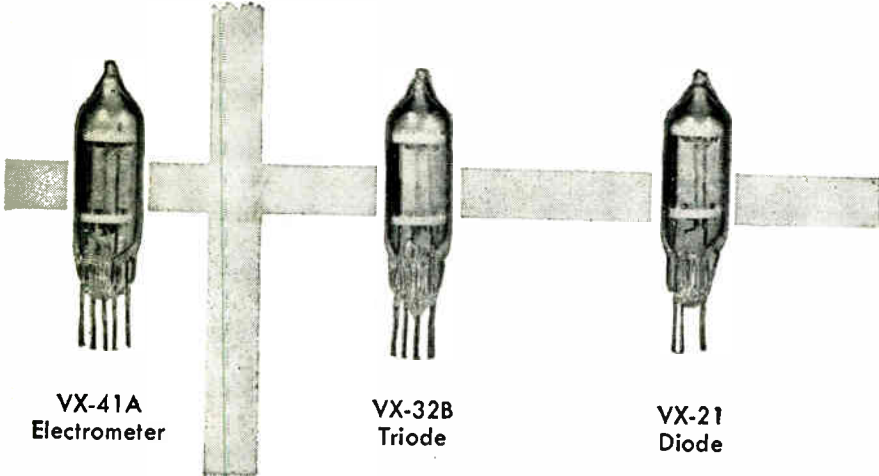
## MYCALEX 410 is now priced to meet rigid economy requirements

Any interest evidenced on your part in Mycalex products and services—will receive the prompt, courteous and intelligent attention of a competent Mycalex sales engineer. He will receive the fullest backing and cooperation from other factory executives—to serve you promptly — with a quality product and at an economical and fair price.



*Components which are contributing an essential service in the progress of radiation instrumentation.*

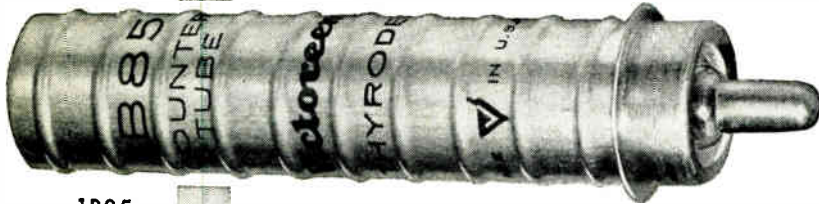
10 mil-filament subminiature tubes



VX-41A  
Electrometer

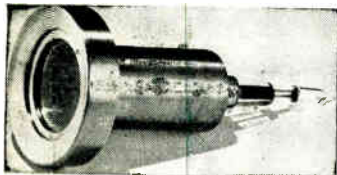
VX-32B  
Triode

VX-21  
Diode



1B85

The new 1B85 Thyrode is a thin rib re-enforced aluminum self-quenched, beta-gamma counter tube operating at 900 volts. Wall thickness 30 mg/sq. cm.



1B67/VG-10A

RMA TYPE 1B67 has been assigned to the standard laboratory mica window self-quenched, beta thyrode which operates at 1200 volts. Window thickness 2.0 to 2.6 mg/sq. cm. Other thicknesses on request.



1B87

The new 1B87 sub-miniature Thyrode is designed to operate at 900 volts with a plateau greater than 100 volts and a nominal background counting rate of 12 counts per minute.



Hi-Meg

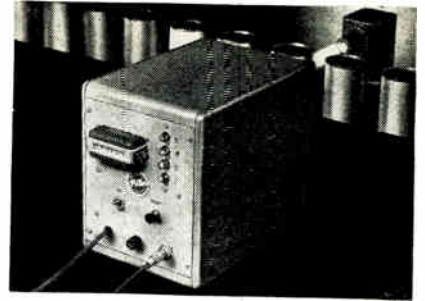
Hi-Meg resistors

Hi-meg resistors vacuum sealed, from  $10^8$  ohms to  $10^{13}$  ohms measured to within 1% accuracy are a symbol of reliability in all ion chamber radiation measuring instrument and electrometer circuits.

**Victoreen**

5806 HOUGH AVENUE

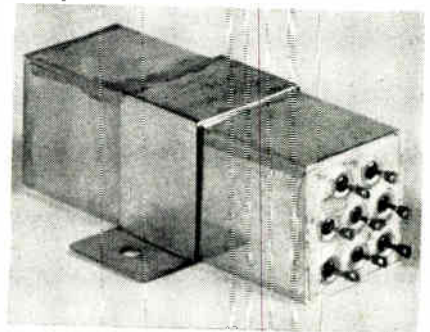
CLEVELAND 3, OHIO



cated on the mechanical register that accommodates up to seven digits. The complete system is priced at \$185.

Ultra-High-Speed Relay

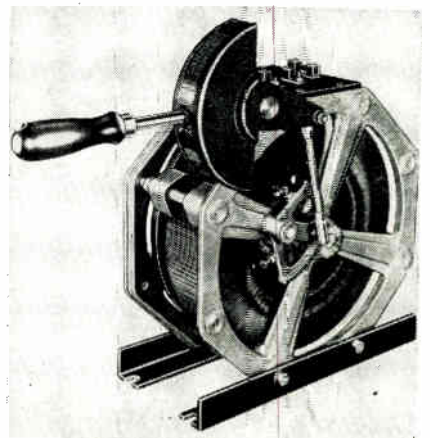
STEVENS-ARNOLD INC., 22 Elkins St., South Boston 27, Mass. The Millisec relay, formerly spdt, is now made 4 pole, double throw, hermetically sealed. It will operate as



fast as  $\frac{1}{3}$  millisecond and has a life expectancy of 22 to 100 million operations. Contact rating is 110 volts d-c, 0.5 ampere.

Dimmers

SUPERIOR ELECTRIC Co., Bristol, Conn. Switchboard dimmers for use in theaters and television studios are available in the form of continuously variable autotransformers. Two types are provided



for Results



McGraw-Hill  
DIRECT MAIL LIST SERVICE

## MAILING LISTS THAT WORK...

McGraw-Hill Industrial Mailing Lists are a direct route to today's purchase-controlling executives and technicians in practically every major industry.

These names are of particular value now when most manufacturers are experiencing constantly increasing difficulty in maintaining their own lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled changes in industrial personnel. These lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nation-wide field staff, and are maintained on a twenty-four hour basis.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.

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Publishing Co., Inc.**

DIRECT  
MAIL  
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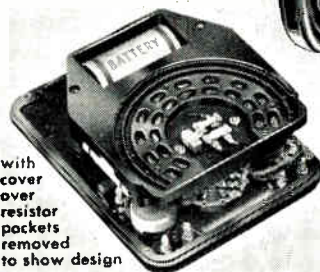
830 WEST 42nd STREET  
NEW YORK, 18, N. Y.

# No value equal to it...

## Model 260 Volt-Ohm- Milliammeter

There's good reason why this is the world's most popular high sensitivity volt-ohm-milliammeter. In every part, from smallest component to overall design, no competing instrument can show superiority. It outsells because it outranks every similar instrument. And in the Simpson patented Roll Top safety case, shown here, it brings you important and exclusive protection and convenience.

### Sub-Panel Assembly —Strong, Simple, Accessible



with cover over resistor pockets removed to show design

The ruggedness, the simplicity of design, and the consequent accessibility of components are shown here. Molded of sturdiest bakelite, the sub-panel provides separate pockets for resistors. This separation makes for orderly assembly, highest possible accessibility, and added insulation for preventing shorts. All connections are short and direct. Cable wiring is eliminated. Each battery has its own compartment, again increasing accessibility.

High voltage probe (25,000 volts) for TV, radar, x-ray and other high voltage tests, also available.



- in staying accuracy
- in functional design
- in useful ranges
- in sensitivity
- in ruggedness
- in precision

A flick of the finger opens or closes the Roll Top front.

**The New Simpson Switch Mechanism.** You will find no other switch mechanism on the market like this Simpson switch. It is built of molded bakelite discs. Unusually sturdy contacts, of heavy stamped brass, silver-plated for superior conductivity are molded permanently into each disc. They can never come loose, never get out of position. When the discs are assembled into the complete switch, these contacts are self-enclosed against dust. Danger of shorts is automatically eliminated. As the switch is rotated from range to range, the contact is always positive and unvarying.

A ball-and-spring mechanism positions the switch at the selected range by a 3-point pressure. Switch is thus held securely in place, yet smoothly re-positions to each new range. This mechanism is also self-enclosed against dust in a bakelite housing.

### RANGES

20,000 Ohms per Volt D.C., 1,000 Ohms per Volt A.C.  
Volts: A.C. and D.C.: 2.5, 10, 50, 250, 1000, 5000  
Output: 2.5, 10, 50, 250, 1000  
Milliamperes, D.C.: 10, 100, 500  
Microamperes, D.C.: 100  
Amperes, D.C.: 10  
Decibels (5 ranges): -10 to +52 D.B.  
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center),  
0-20 megohms (120,000 ohms center).  
Model 260, Size: 5 1/4" x 7" x 3 1/8" ..... \$38.95  
Model 260 in Roll Top Safety Case, as shown. .... \$45.95  
Size: 5 3/8" x 7" x 4 3/4"  
Both complete with test leads and 32-page Operator's Manual

Ask your jobber or write for complete descriptive literature.

**Simpson**  
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY  
5200-5218 W. Kinzie St., Chicago 44, Ill.  
In Canada: Bach-Simpson, Ltd., London, Ont.

# VIBRATIONLESS



*Cyclohm*

## Capacitor Type Induction Motors

Here is a capacitor type motor that is precision built for quiet, smooth performance — accurate bearing alignment... perfect rigidity. The Cyclohm 29 Size is the outstanding value in motors for recording, tape pulling, facsimile work and many other jobs. Available in non-synchronous, and two types of synchronous — reluctance torque and hysteresis torque. Capacitor can be used either on or alongside motor. Ball bearings or sleeve bearings. 1/100 to 1/10 horsepower; various speeds, voltages and frequencies available. Write today for complete information.

**CYCLOHM MOTOR CORPORATION**  
**DIVISION HOWARD INDUSTRIES, INC.**  
 5-17 46th Road, Long Island City 1, N. Y.

**NEW... IMPROVED**

**PRECISION ATTENUATORS**

**by TECH LABS**



TYPE  
 850-A 850-B

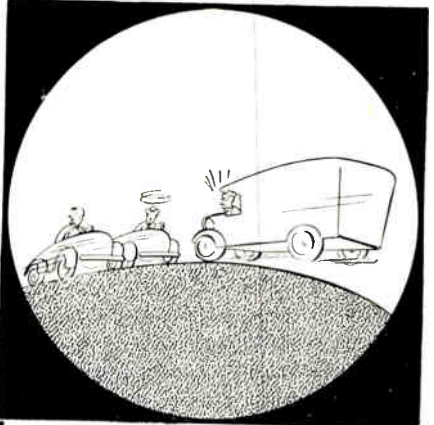
The units illustrated represent a complete redesign of our older precision attenuators for laboratory standards. Flat for all frequencies in the audio range. Reasonably flat to 200 k.c. up to 70 db.

Bulletin sent on request.



Manufacturers of Precision Electrical Resistance Instruments

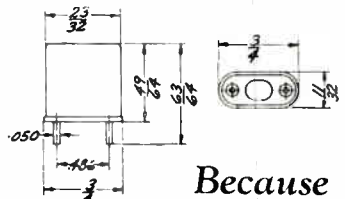
BERGEN BLVD., PALISADES PARK, N. J.  
 Tel: LEonia 4-3106



WHEN **SPACE**  
 IS A FACTOR ....



STANDARD'S  
 CRYSTAL Type 20  
 is the answer



Because

... it meets  $\pm .005\%$  stability over  $-55^{\circ}$  to  $+90^{\circ}$  C. range. ... it is hermetically sealed in dry nitrogen. ... of its proven consistent superiority in stability and activity. ... of its low price.

Let us send you our **FREE** catalog showing the **STANDARD** line of frequency control units. For your super-sonic and ultra-sonic crystals, you can rely on **STANDARD**.

**STANDARD PIEZO CO.**

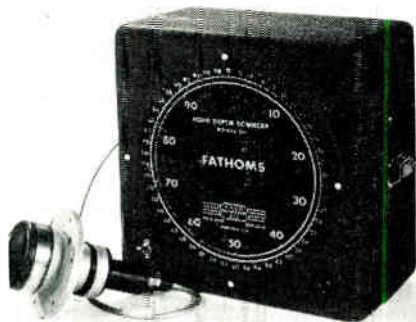
Office & Development Laboratories

CARLISLE, PENNA.

with output range from 0 to 1,700 watts and also 0 to 4,600 watts. Group control is conventionally arranged with coupling to a common shaft.

### Echo Depth Sounder

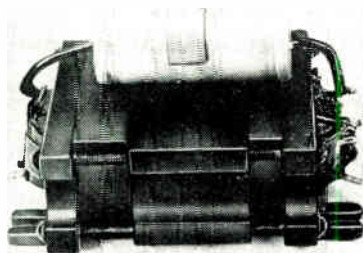
KAAR ENGINEERING Co., Middlefield Road, Palo Alto, Calif. The ES-29 electronic echo depth sounder has



an indicator scale calibrated to 100 fathoms plus, and a power drain of about 30 watts. It is available for input voltages of 6, 12, 32 and 110 volts d-c. The unit uses an ultrasonic transducer of the inboard crystal type which both transmits and receives ultrasonic waves.

### Voltage Stabilizer

RAYTHEON MFG. Co., Waltham, Mass. The VR-6000 miniature 5-watt stabilizer operates at an input



voltage of 95 to 130 volts a-c, 60 cycles, single phase. Output is 120 volts stabilized to  $\pm 0.5$  percent.

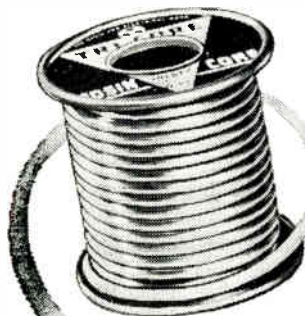
### Transformer Assembly

SPELLMAN TELEVISION Co., INC., 130 W. 24th St., New York 11, N. Y., has developed a high-voltage corona shielded, tuned transformer assembly which includes an octal socket

**FOUND! A WAY TO CUT PRODUCTION COSTS 25% AND STILL IMPROVE QUALITY**



SOLDER SPECIALISTS  
FOR OVER 58 YEARS



# ALPHA TRI-CORE *Rosin-filled* SOLDER

Three cores for the price of one! Speedier action! More operations per pound of solder! Test after test in radio plants has proved that Alpha Tri-Core is more efficient and more economical than conventional solders. Our engineers will be glad to demonstrate these dollar-saving features in your plant. There is no obligation; just call on us.

### CHECK THESE FEATURES

#### Alpha TRI-CORE ROSIN-FILLED Solder

- ★ 99.9% pure, water-white rosin used exclusively!
- ★ Non-activated! No rejects due to corrosion!
- ★ Adapted to your production needs: an American solder designed for American production; manufactured and stored here ready for delivery!
- ★ No toxic, obnoxious fumes!
- ★ 25% more joints per hour per pound of solder!
- ★ Cut your solder cost with Tri-Core's — 5 to 15% less tin and still get better results than possible with other solders using more tin.
- ★ Tri-Core available in diameters as large as  $\frac{1}{4}$ ", and heavier—down to .020" and finer.

# Alpha

other ALPHA PRODUCTS include:  
TRI-CORE "ENERGIZED" ROSIN-FILLED SOLDER;  
TRI-CORE "LEAK-PRUF" ACID-FILLED SOLDER;  
SOLID SOLDER WIRE; PREFORMS (rosin and acid-filled); BAR SOLDER, ANODES AND FOIL.

ALPHA METALS, INC., 371 HUDSON AVENUE, BROOKLYN 1, NEW YORK

## QUANTITATIVE MEASUREMENTS ON HIGH IMPEDANCE CIRCUITS



MODEL 102

# PHANTOM REPEATER

AN INSTRUMENT AMPLIFIER WITH  
200 MEGS.—6.0 MMF INPUT IMPEDANCE

The Phantom Repeater bridges voltmeters and cathode ray oscilloscopes, which have inputs of 1 megohm and 30 mmf, onto signal circuits of 50,000 ohms and higher—such as a pentode amplifier stage with its high resistance plate load—without the loss of voltage and high frequency response which would result if the measur-

ing instruments were connected directly. Input Impedance: 200 megohms shunted by 6 mmf. Output Impedance: 300 ohms. Gains of 1.00, 10.0, and 100. Frequency Range from 5 cps to 150,000 cps within 2%. Background noise equivalent to 40 to 70 microvolts at the input.

*Descriptive Bulletin Sent Upon Request*

## KEITHLEY INSTRUMENTS

7960 LORAIN AVENUE

CLEVELAND 2, OHIO

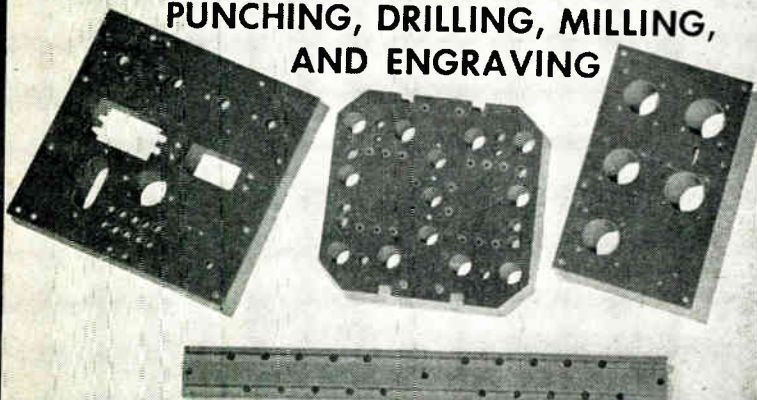
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Acme Electric can produce transformers of special characteristics from standard parts which means that our enormous manufacturing facilities and quality controlled production results in buying economies for you.

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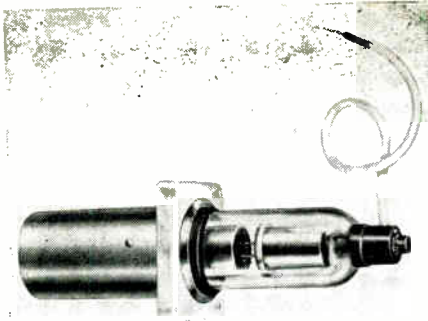
**ACME ELECTRIC CORP.**

3112 WATER ST.

CUBA, N. Y.

**Acme Electric**  
TRANSFORMERS

December, 1948 — ELECTRONICS



for use with 1B3-8016 type tube. Adjustable filament voltage allows the tube to be used for voltages from 1 kv to 20 kv. The unit is designed to operate in conjunction with r-f step-up coils of approximately 200-kc frequency.

**Voltage Stabilizer**

RAYTHEON MANUFACTURING Co., Waltham, Mass. A new model in the VR-6000 line of voltage stabilizers is hermetically sealed and oil-filled. Power rating is 15 watts.



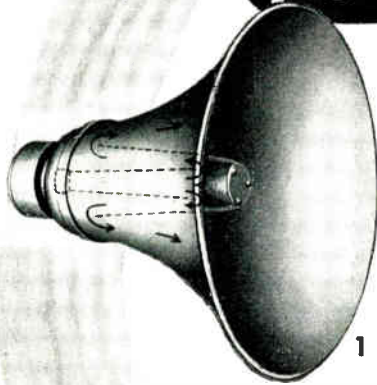
The unit provides 115 volts stabilized to plus or minus 1 percent for inputs of 95 to 125 volts in the frequency range 57 to 63 cycles.

**Oscillator Improvement**

KAY ELECTRIC Co., Maple Ave., Pine Brook, N. J., has added tone

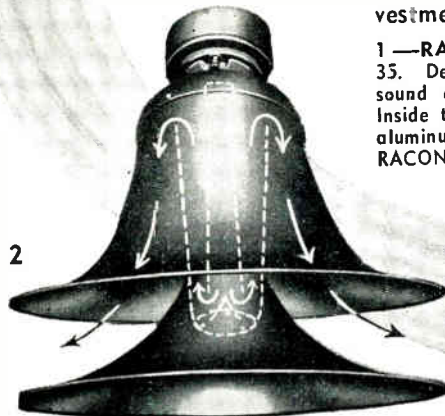


**RACON**  
**ADVANCED ENGINEERING**  
*Gives you* **RACON**  
**SUPERIOR**  
**PERFORMANCE**



A horn or speaker of conventional type may resemble a Racon horn or speaker in outward appearance. But close examination of a Racon unit reveals internal differences—refinement of design, better mechanical construction, sturdier materials and other special features that represent **ADVANCED ENGINEERING**. It is these exclusive features that give you superior performance in any Racon unit. Higher efficiency over wider ranges. Freedom from distortion. Uninterrupted service. The long life that protects your investment.

1—**RACON-RE-ENTRANT TRUMPET RE-35**. Designed to deliver highly concentrated sound over long distances. Air column 3½'. Inside tone arm aluminum castings; bell, heavy aluminum spinnings; center reflecting section, **RACON PATENTED ACOUSTIC MATERIAL** to prevent resonant effects. Ruggedly built. Length 16", bell diam. 18". Swivel ratchet or U bracket mounting.



2—**RACON RE-ENTRANT RADIAL TRUMPET SR-35R**. Has all of the construction features of RE-35 such as non-vibratory center section, heavy aluminum castings, etc. All reflecting surfaces of **RACON PATENTED ACOUSTIC MATERIAL** to prevent resonant effects prevalent in all large reflecting surfaces. Delivers sound with even intensity over a 360° circumference. Length 16"; width 17". Type SR-60R length 34½"; width 36".

3—**PERMANENT MAGNET HORN UNITS**. Highly popular in all types of service. Many improvements. Two groups with Alnico V Magnets and Alnico Blue Dot Magnets. Steel parts plated to prevent corrosion. Also fitted with corrosion proof metal or plastic diaphragms. Voice coil impedance on all units: 15 ohms. Special ohmages on request.



**NOW FURNISHED WITH WATERPROOF CASING**

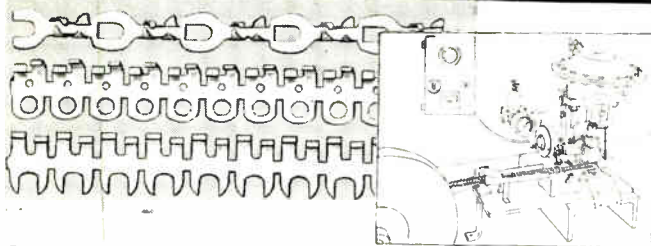
All units may now be had with heavy spun aluminum cases, forming a hermetically sealed, watertight housing for outdoor use, at slight extra cost.

Write for Catalog of complete Racon Line

**RACON ELECTRIC CO., INC.**  
 52 E. 19th Street New York, N. Y.

**RACON** *Speakers  
Horn Units  
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For ordinary runs in moderate quantity we continue to produce **SEPARATE TERMINALS** for **ELECTRIC WIRES**

We also make **SMALL METAL STAMPINGS** Exact to Customer's Prints. Modern Plant and Equipment. Moderate Die Charges. Precision Work. Prompt Service.

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WIRE WOUND  
RESISTORS**  
by  
**WILKOR**

Actual  
Size  
1/2 Watt



ENGINEERED  
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THEIR WATTAGE RATING  
*with Safety!*

• WILKOR WC-type wire-wound resistors are fully ceramic insulated and engineered to withstand tremendous overloads, as well as either high or low temperatures. In use by manufacturers of radio, television and other electronic instruments.



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**DURABILITY**  
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Write for specification sheet.  
Samples available for quantity users.

**WILKOR PRODUCTS, INC.**  
3835 WEST 150TH STREET  
CLEVELAND 11, OHIO

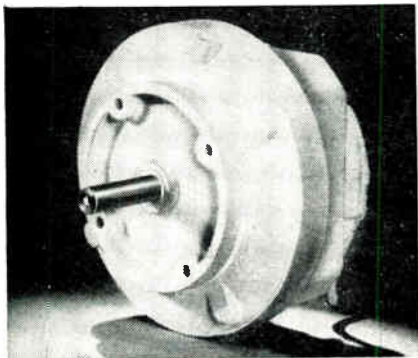
Manufacturers of  
*Carbofilm* RESISTORS



modulation to the Mega-Marker Sr. oscillator for television testing. The modulation may be switched on or off. By its use, the local oscillator may be aligned by using only the Mega-Marker Sr. and the television sound channel and loud-speaker.

### Single-Bearing Motor

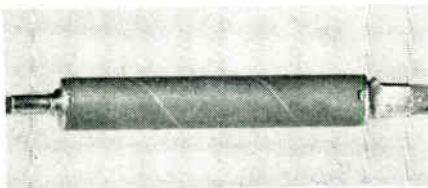
ELECTRO-ENGINEERING PRODUCTS Co., INC., 4824 W. Kinzie St., Chicago 44, Ill., has developed a single bearing motor to provide accurate lineup in air gap. It is



of the four-pole type with a no-load speed of 1700 rpm and a full-load speed of 1550 rpm. The unit is designed for such applications as wire recorders, turntables and fans.

### Fuse Protection

THE CLEVELAND CONTAINER Co., 6201 Barberton Ave., Cleveland 2, Ohio. The Cosmalite enclosing tube for the indicating secondary fuse



illustrated protects the fuse chamber, fuse link, and all operating parts.

### Binary Scaler

GENERAL ELECTRIC Co., Syracuse, N. Y. Model 4SN1A1 binary scaler, designed for use in nucleonic and computer applications, counts electrical impulses at speeds up to 200 kc in either binary or decade operation. A 5 to 20-volt negative input pulse of 1 microsecond dura-

# AN ENTIRELY NEW

## *Dependable*

# AUTOMATIC DEHYDRATOR

BY

## *Andrew*

For pressurizing  
coaxial systems  
with dry air

WRITE FOR  
BULLETIN  
85



Now, for the first time, here is an automatic dehydrator that operates at line pressure! This means, (1) longer life, and (2) less maintenance and replacement cost than any other automatic dehydrator.

Longer life because the compressor diaphragm operates at only 1/3 the pressure used in comparable units, vastly increasing the life of this vulnerable key part.

Reduced maintenance and replacement costs because new low pressure design eliminates many components.

Operation is completely automatic. Dehydrator delivers dry air to line when pressure drops to 10 PSI and stops when pressure reaches 15 PSI. After a total of 4 hours' running time on intermittent operation, the dry air supply is turned off and reactivation begins, continuing for 2 consecutive hours. Absorbed moisture is driven off as steam. Indicators show at a glance which operation the dehydrator is currently performing.

Output is 1/4 cubic feet per minute, enough to serve 700 feet of 6/8" line; 2500 feet of 3/8" line; 10,000 feet of 1/8" line or 40,000 feet of 1/16" line. Installation is simple, requiring only a few moments.

*Important! Not only is this new differently designed Andrew Automatic Dehydrator completely reliable, but it is available at a surprisingly low price.*

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TRANSMISSION LINES FOR AM, FM,  
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Please send me Bulletin 85 describing the new Type 1900  
Andrew Automatic Dehydrator.

Name \_\_\_\_\_

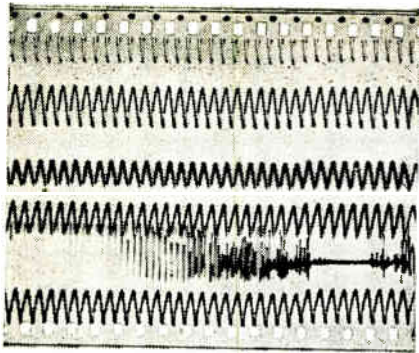
Title \_\_\_\_\_

Company \_\_\_\_\_

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EL-12-48



## TRANSIENT EVENTS ARRESTED

The first Avimo Oscillograph Recorder was a specially built Camera designed to provide Records of Cathode Ray Traces to a scale which permitted accurate measurement, side by side on continuous film, so that precise relationships could be determined.

Success in this specialised field led to demands for Cameras to record other kinds of transient events, so that within the Avimo range listed below there are, to-day, Instruments to meet nearly any requirement of the Research or Laboratory worker.

The wide experience gained in the course of this development is at your disposal and Avimo engineers will be glad to submit suggestions if you will state your problem.

GROUP	FUNCTION
A. Continuous Recording.	For recording oscillograph traces on 35 mm. or 70 mm film.
B. Single Shot.	For use where phenomena are constant.
C. Combined Continuous and Single Shot.	Provides the functions of Groups A or B as desired.
D. Drum.	For high-speed drum recording of high-frequency phenomena on 35mm. film.
E. Multi-Channel Recorders.	With built-in Cathode Ray Tubes for continuous recording of up to 15 traces.
F. Instrumentation Cine.	Provides a pictorial record of several variants over a period of time.

There is no reasonable limit to the film speeds which may be provided and recorders of Groups A, B, C & D may be used in conjunction with any standard oscillograph.



AVIMO LIMITED  
TAUNTON (SOM.), ENG.

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Only \$975

Never before a value like this 3½ KW bombarder or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations. Is

Portable . . . mounted on four rubber coasters. Width 14½"; depth 27"; height 42½"; weight 300#.

Operates from 220 volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only \$975. Immediate delivery.

Scientific Electric Electronic Heaters are made in the following ranges of power: 1-2-3-5-7½-10-12½-15-18-25-40-60-80-100-250. KW.

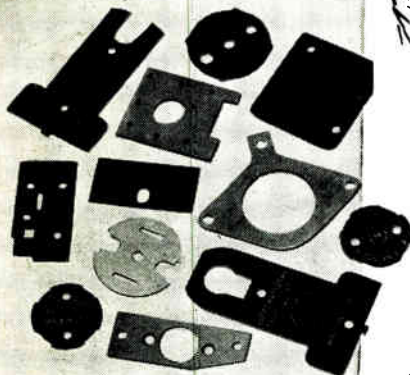
*Scientific  
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Division of

"S" CORRUGATED QUENCHED GAP CO.

105 - 119 Monroe St., Garfield, N. J.

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offers accurate fabrication of  
phenol and vulcanized fibre!



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Check BAER FIBRE for accurate dimensioning, uniform surface, mechanical and electrical qualities, and *low cost per piece*. See how efficiently a BAER FIBRE terminal board, bushing, gasket, washer or other shape can simultaneously solve your electrical or mechanical problem...improve your product...and save you money! BAER FIBRE is precision fabricated to your specifications.

LITERATURE ON REQUEST

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tion and 0.1 minimum rise time will produce an output pulse of 50 volts, peak to peak. Resolution time is 5 microseconds and output impedance is 27,000 ohms.

**Tube Tester**

HICKOK ELECTRICAL INSTRUMENT Co., 10527 Dupont Ave., Cleveland 8, Ohio. Model 533 DM display



tube tester is a dynamic mutual conductance type. Flexibility is provided by a system of selector switches.

**Small Blower**

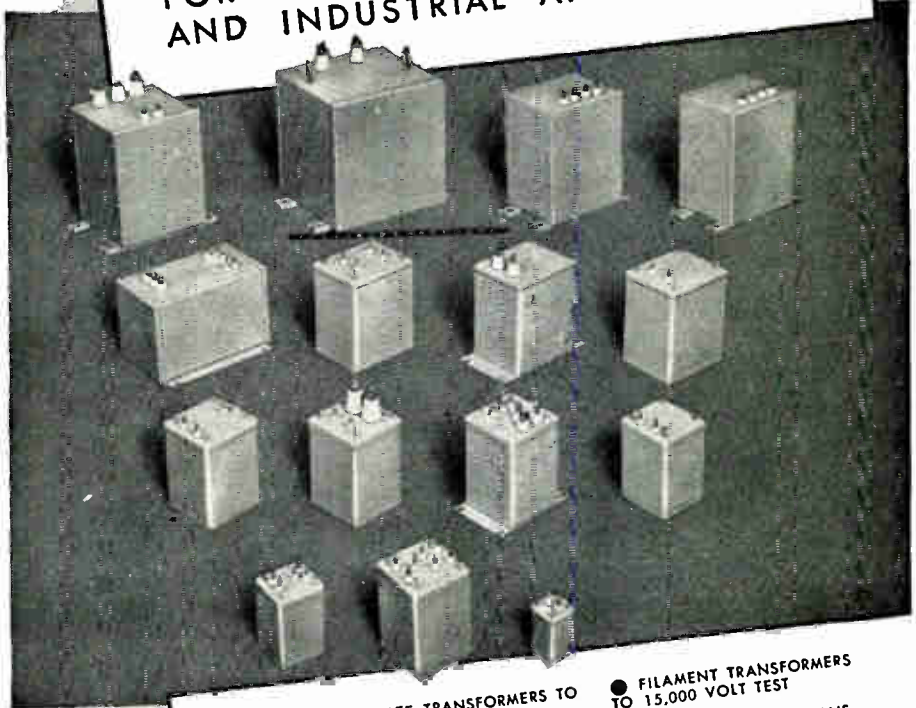
GLOBE INDUSTRIES, INC., 125 Sunrise Place, Dayton 7, Ohio. The MB-1 blower unit comprises a 0.01-hp aircraft-type d-c motor with centrifugal impeller. At rated voltage, the unit will produce 20 cubic feet per minute. The unit operates at 11,000 rpm with an in-

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**STANDARD LINE OF TRANSMITTER COMPONENTS**

FOR AM, FM AND TV—LABORATORY AND INDUSTRIAL APPLICATIONS



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**NEW YORK TRANSFORMER CO., INC.**  
ALPHA, NEW JERSEY

## SLICE Rising Time Costs with Solder Pre-Forms

Eliminate time-consuming manual solder operations in your assembly processes. Pre-formed rings, washers, discs, pellets, squares, etc., complete with flux, save time, trim labor costs, insure cleaner, more uniform, sturdier bonds. We meet your specifications in the widest variety of solder alloys. Consult with us on any solder or brazing problem.

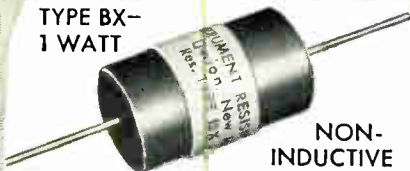
(Literature on Request).

## Soldering Specialties

Dept. C, Summit, N. J.

## —high accuracy plus!

TYPE BX—  
1 WATT



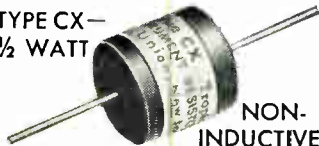
NON-INDUCTIVE

MAX. RES: 1.5 Megohm (331 Alloy)  
1.0 Megohm (Nichrome)  
30,000 Ohms (Manganin)

BODY SIZE: 1" lg. by 9/16" diam.

TOLERANCE: STANDARD 1%  
(TO 1/10% at Slight Extra Cast)

TYPE CX—  
½ WATT



NON-INDUCTIVE

MAX. RES: 750,000 ohm (331 Alloy)  
500,000 ohm (Nichrome)  
15,000 ohm (Manganin)

BODY SIZE: 5/8" lg. by 9/16" diam.

TOLERANCE: STANDARD 1%  
(TO 1/10% at Slight Extra Cast)



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applications

IN-RES-CO wire wound resistors are engineered for the manufacturer maintaining a reputation of top quality and performance in his equipment. They cover a full range from 1 watt to 10' watts and .01 ohm to 1.5 megohm. Conservative ratings assure maximum long life; trouble free service. Write for catalog today on company letterhead.

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APPLICATION-DESIGNED  
**RESISTORS**



INSTRUMENT RESISTORS CO., 1056 COMMERCE AVE., UNION, N. J.

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- MATERIALS
- MAN-HOURS
- MONEY

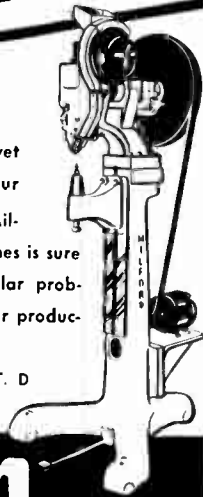
with the . . .

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Select exactly the right semi-tubular, split rivet, or cold-headed fastener from Milford's complete line. You'll find it pays in every way!

## RIGHT MACHINE

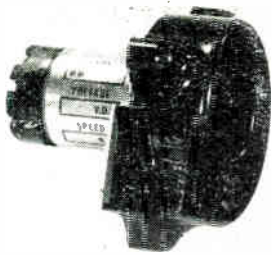


Then use the right rivet setting machine for your application. One of Milford's 15 basic machines is sure to solve your particular problem . . . and slash your production costs!

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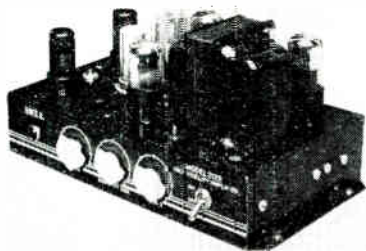
254 Huntingdon Street  
PHILADELPHIA 33, PENN.



put of 14.5 watts. A fan unit is also available separately. Motor can be used as part of a vibrator unit in a stall warning system for planes.

### Phono Amplifier

BELL SOUND SYSTEMS, INC., Columbus 7, Ohio. Model 2122 high-fidelity radio-phono amplifier has four input circuits, built-in preamplifier for each of two magnetic pickup



inputs, as well as bass and treble boost. Peak power output is 15 watts. Response is essentially flat from 30 to 15,000 cycles. Send for sheet Lit 4849-2A.

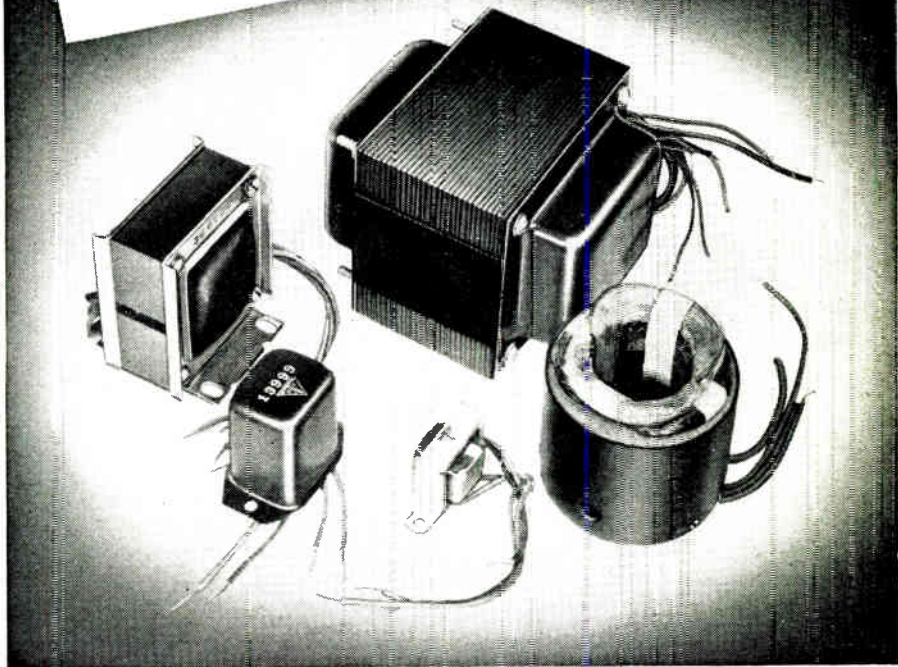
### Precision Switch

UNIMAX SWITCH DIVISION OF THE W. L. MAXSON CORP., 460 W. 34th St., New York 1, N. Y. Type DMX universal precision switch has spst silver contacts capable of handling



\*Here's your supply of N.Y.T

# TELEVISION COMPONENTS



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- ★ TELEVISION POWER TRANSFORMERS
- ★ DEFLECTION COILS
- ★ VERTICAL OUTPUT TRANSFORMERS
- ★ HORIZONTAL BLOCKING OSCILLATOR TRANSFORMERS
- ★ VERTICAL BLOCKING OSCILLATOR TRANSFORMERS

N.Y.T. facilities are now expanded to supply all types of inductive television components in quantity. Estimates will be supplied promptly on standard units or types wound to your exact specification. In addition to television components, N.Y.T. offers complete manufacturing service on power transformers, chokes, and audio transformers. Modern plant and winding equipment assures finest quality at low cost. Call or write today for information.

\* IN ANY QUANTITY!



## NEW YORK TRANSFORMER CO.

ALPHA • NEW JERSEY

it's **in** the groove...  
...and out!



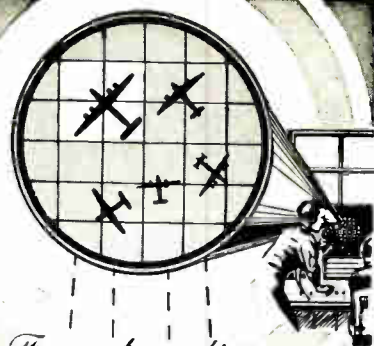
High speed machine-winding of electric motor armatures necessarily exposes magnet wire to some rugged treatment.

The all-around (in the groove and out) "windability" of ESSEX EXTRA TEST MAGNET WIRE in this and other exacting applications cannot be excelled.

**ESSEX WIRE CORP.**  
FORT WAYNE 6, INDIANA



Plants: Anaheim, Calif.; Detroit, Mich.; Fort Wayne, Ind. Warehouses\* and Sales Offices: Atlanta, Ga.; Boston, Mass.; Chicago, Illinois; Cleveland, Ohio; Dallas, Texas; Dayton, Ohio; Detroit, Mich.; Kansas City, Mo.; Los Angeles, Calif.; Milwaukee, Wis.; Newark, N.J.; Philadelphia, Pa.; Portland, Oreg.; St. Louis, Missouri; San Diego, Calif.; San Francisco, California



*For extraordinary electrical performance*

**Use SILVER GRAPHALLOY\***



THE SUPREME CONTACT MATERIAL

BRUSHES



CONTACTS

in BRUSHES for high current density ◯ minimum wear ◯ low contact drop low electrical noise ◯ self-lubrication

in CONTACTS for low resistance ◯ non-welding character

GRAPHALLOY works where others won't! Specify GRAPHALLOY with confidence.

\*A special silver-impregnated graphite

**GRAPHITE METALLIZING CORPORATION**

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**KOTRON STRIP-TYPE SELENIUM RECTIFIERS**

PATS. PEND.

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- Max. A. C. line input 130 volts rms
- Max. inst. peak current 1000 Ma.
- Max. inverse peak voltage 360
- Average operating temp. 105°F
- Dimensions: 4-1/16" x 1-1/16" x 5/32"
- Other Sizes: 75 Ma. and 200 Ma.

Kotron's metallic rectifying elements are mounted in one plane. Plates cannot contribute heat to each other. Result—Cooler Operation . . . longer life . . . increased circuit efficiency. Wafer-thin Kotron saves space, mounts easier.

Write for Complete Technical Data, Prices and Delivery

**ARCTURUS**  
"KNOWN THE WORLD OVER"

**STANDARD ARCTURUS CORPORATION**

54 CLARK STREET • NEWARK 4, NEW JERSEY

HUmboldt 2-2400

10 amperes at 125 volts, either a-c or d-c. It features a focused-flux alnico magnet, a ceramic baffle chamber and an arc-resistant molding on base and cover.

**Precision Pot**

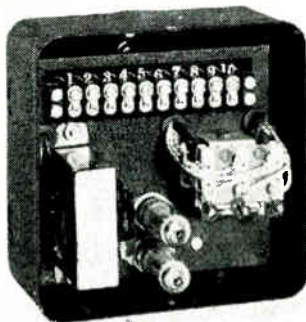
TECHNOLOGY INSTRUMENT CORP., 1058 Main St., Waltham, Mass. The new 2-in. potentiometer illustrated



has a linearity of 0.2 percent and has a maximum electrical rotation of 320 degrees. Designed particularly for computer and similar applications, the units are available only on special order.

**Welding Water Control**

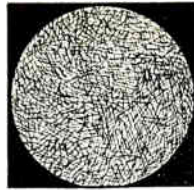
ROBOTRON CORP., 56 Manchester, Highland Park (Detroit) 3, Michigan. The Robotector model 22B01A



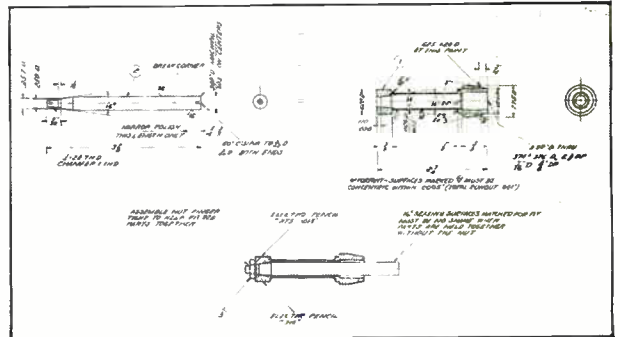
protects an idle welding transformer from excessive condensation and acts as a simple fail-safe electronic circuit. Further details are given in a catalog sheet.

**Metal Locator**

FISHER RESEARCH LABORATORY, INC., Palo Alto, Calif. The new M-Scope conveyor belt locator detects metal objects as small as a dime on conveyor belts and automatically interrupts the power circuit to stop the line. The unit pictured will accommodate a belt 2 ft



with **STEEL** — the small extra first cost of test samples pays off in assurance of efficiency and durability of the finished product.



with **TRACING CLOTH . .**

The small extra first cost of Arkwright Tracing Cloth, over that of tracing paper, repays many times over in the efficiency and durability of valuable drawings.

Your investment in Arkwright Tracing Cloth is a trifling sum, compared to its returns in drawings kept permanently sharp and repeatedly useful!

Foresighted drafting departments regularly specify fine-woven, expertly bonded Arkwright, rather than perishable tracing paper, for every drawing worth keeping for possible future use.

Read the *Big Six Reasons* why Arkwright Tracing Cloth eases work, improves jobs, resists wear and time. Then send for generous samples and prove this superiority on your drawing board. Sold by leading drawing material dealers everywhere. Arkwright Finishing Company, Providence, R. I.

**The Big Six Reasons Why Arkwright Tracing Cloths Excel**

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6. Mechanical processing creates permanent transparency.



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**TRACING CLOTHS**  
 AMERICA'S STANDARD FOR OVER 25 YEARS

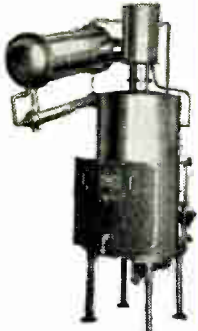
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Can Offer You **"GRADED WATER"**  
for Parts Rinsing and Screen Processing

With Barnstead Water Still or Demineralizers (or a combination of both) you can be assured of a constant unvarying supply of high resistance water exactly fitted to your needs. Where the use requires only the removal of mineral content, Barnstead 2-Bed, 4-Bed or Type "R" Upflo Models provide rinse water that leaves no harmful salt residue.

If the requirements demand elimination of organic impurities as well as inorganic, Barnstead Water Still provide the surest and most economical answer. For such exacting uses as on screens of cathode ray tubes it may be necessary to de-ionize the water first and then distill it — as many leading tube manufacturers do.

TYPE "SS" WATER STILL



In any event, Barnstead Equipment is your safest solution. And remember, only Barnstead offers you both distilling and demineralizing equipment — and are thus able to handle all situations. Put your pure water problems in the hands of a Barnstead Engineer and have a single responsible authority for their solution.

*We will be glad to supply recommendations for your particular problem without obligation.*

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STILL & STERILIZER CO.

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for your special need

If you are looking for hard-to-get or special dry batteries, write us. We design, create and manufacture to your requirements.

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MADISON 4, WISCONSIN



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1F TRANSFORMERS



SOCKETS



COUPLINGS



DIALS



**FREE** catalog of famous National precision components, parts, and communication receivers.

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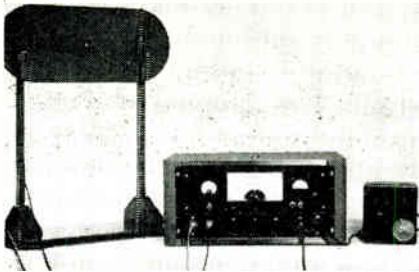
**National**



**NATIONAL COMPANY, Inc.**

61 Sherman St. Malden, Mass.

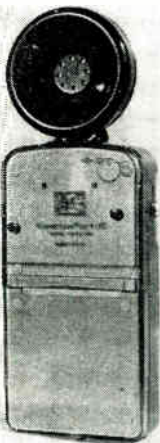




wide with a load 2 ft. high. Loop antennas can be adjusted for different heights and widths.

**Hand Hearing Aid**

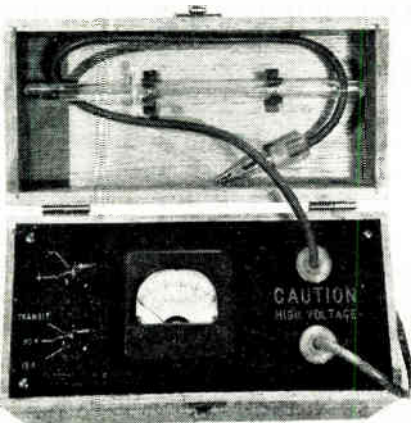
DICTOGRAPH PRODUCTS, 580 Fifth Ave., New York, N. Y. The Hear-ette is a hand-held type of hearing aid that is intended both for people



with slight hearing loss and those with normal hearing who may wish to use a selective system in auditoriums or other places where noise level is high.

**Kilovoltmeter**

BETA ELECTRONICS Co., 1762 Third Ave., New York 29, N. Y. Series 121 multirange kilovoltmeters have full-scale range of 15 and 30, and



# CURRENT CONVERSION

## ATR STANDARD AND HEAVY DUTY INVERTERS



**For Inverting D. C. to A. C. . . .**

Specially Designed for operating A. C. Radios, Television Sets, Amplifiers, Address Systems, and Radio Test Equipment from D. C. Voltages in Vehicles, Ships, Trains, Planes and in D.C. Districts.

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**AUTO RADIO VIBRATORS**



*A Complete Line of Vibrators . . .*  
 Designed for Use in Standard Vibrator-Operated Auto Radio Receivers. Built with Precision Construction, featuring Ceramic Stack Spacers for Longer Lasting Life.

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**"A" BATTERY ELIMINATORS**



*For DEMONSTRATING AND TESTING AUTO RADIOS*  
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NEW MODELS  
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*See your jobber or write factory*

New 36 page VIBRATOR GUIDE FREE



VIBRATOR GUIDE  
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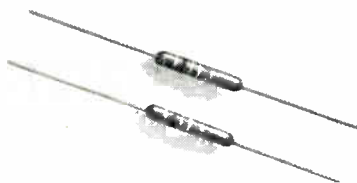
**AMERICAN TELEVISION & RADIO Co.**  
*Quality Products Since 1931*  
 SAINT PAUL 1, MINNESOTA-U.S.A.



25 and 50 kilovolts at 50,000 and 25,000 ohms per volt. Applications include nuclear research, electrostatic precipitation measurements, flocking or abrasive techniques and television.

**Molded Capacitors**

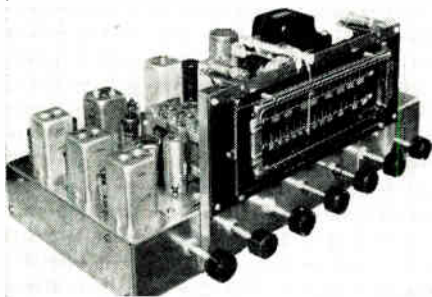
SPRAGUE ELECTRIC Co., North Adams, Mass. Prokar capacitors operate continuously at high temp-



eratures without deterioration owing to a new plastic impregnant. Rated for service between minus 50 and plus 125 C, the new units are described in bulletin 211.

**F-M and A-M Tuner**

BROWNING LABORATORIES, INC., 742 Main St., Winchester, Mass. The instrument type f-m and a-m tuner model RJ-20 comprises two independent tuners with a common audio amplifier. The f-m section has 32 db of quieting with a 10



microvolt signal. The a-m section has a variable-width i-f from 8 to 18 kilocycles adjustable from the front panel. Audio output is at 20,000 ohms.

**Audio Transformers**

STANDARD TRANSFORMERS CORP., Elston, Kedzie & Addison Streets, Chicago 18, Ill. The HF and WF series of high-fidelity audio transformers have frequency responses plus or minus 1 db from 20 to 20,-

**FOR LOW COST**  
**MICROPHONE** *Performance*



**Model BX—BD**  
**Crystal or Dynamic**

**BX Crystal**—Attractive brown enamel finish. 7 ft. attached cable. Level: 52 db below 1 volt/dyne/sq. cm. Response: 50-6000 c.p.s. List . . . . . **\$10.85**

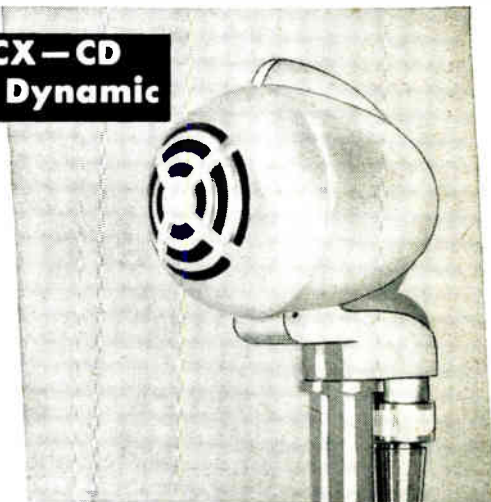
**BD Dynamic**—Same appearance as BX. Equipped with high level dynamic circuit. Level: 52db below 1 volt/dyne/sq. cm. at high impedance. Response: 50-6000 c.p.s. Available in 50, 200, 500 ohms, or high impedance. 7 ft. attached cable. List **\$15.75**

**TURNER** *Challengers*

**Model CX—CD**  
**Crystal or Dynamic**

**CX Crystal**—Satin chrome finish with 7 ft. quick-change removable cable set. Level: 52 db below 1 volt/dyne/sq. cm. Response: 50-7000 c.p.s. List . . . **\$16.25**

**CD Dynamic**—Same style and finish as CX. High quality magnets in dynamic circuit. Level: 52 db below 1 volt/dyne/sq. cm. at high impedance. Response: 50-7000 c.p.s. Available in 50, 200, 500 ohms, or high impedance. With 7 ft. removable cable set. List . . . . . **\$19.50**



Popularly priced TURNER Challengers offer style, quality, and performance features usually found in microphones selling at twice their low cost. They are Turner Engineered with substantially flat response and give clear cut results on both voice and music pickups.

Crystal models are designed with shock-proof mounting, barometric compensator, moisture sealed crystal, and wind-gag to prevent blasting. Dynamic models are built to give dependable service indoors or out. You can rely on TURNER Challengers for satisfactory performance in recording, public address, sound system, and amateur work — they are fully guaranteed. Write for complete microphone literature.



**THE TURNER COMPANY**  
905 17th Street N. E., Cedar Rapids, Iowa

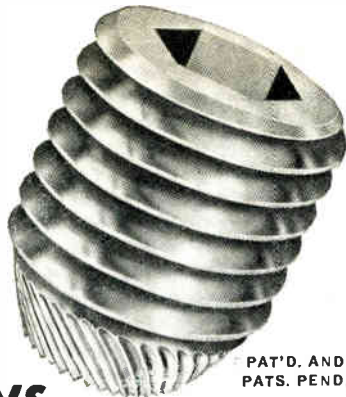
*Microphones* **BY TURNER**

Licensed under U. S. patents of the American Telephone and Telegraph Company, and Western Electric Company, Incorporated. Crystals licensed under patents of the Brush Development Company.

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PAT'D. AND PATS. PEND.

## SOCKET SET SCREWS WITH THE KNURLED CUP POINT

The KNURLED cup point of this popular "Unbrako" Socket Set Screw makes it a Self-Locker . . . because the keen edges of the counter-clock-wise KNURLS positively prevent creep, regardless of the most chattering vibration. A real fastener, if ever there was one . . . it positively won't shake loose! Sizes from #4 to 1-1/2" diameter, in a full range of lengths.

Knurling of Socket Screws originated with "Unbrako" in 1934.

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### "HALLOWELL" KEY KIT



KITS: PATS. PEND.

You can't tighten or loosen socket screws without a hex socket wrench, so why not get our No. 25 or No. 50 "Hallowell" Hollow Handle Key Kit which contains most all hex-socket bits.

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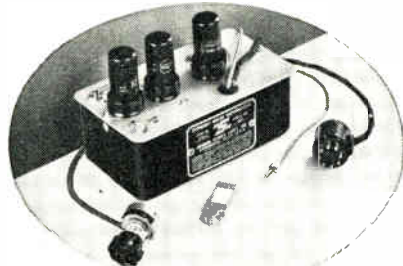
Now you can have

## \*DYNAMIC NOISE SUPPRESSION

with Your Present Radio-phonograph or Amplifier

These 3 simple steps add realism to your music reproduction.

1. Plug in the "Little Wonder" \*Dynamic Noise Suppressor between your pick-up and amplifier.
2. Plug in the socket adapter to the power-tube socket.
3. Insert the matched low-needle-talk pick-up in your pick-up arm.



- Remote control mounts anywhere
- Separate gates . . . for high- and low-frequency noise suppression
- Two-inductor type high-frequency gate circuit
- Two separate control rectifiers
- Compact . . . 7 x 3 3/4 x 4 3/4 inches

The "Little Wonder" realizes the full capabilities of your present equipment; can be used, with suitable pick-up, on the new, long-playing records, too. For full specifications, write Dept. EL. Or, even better, hear a demonstration at your distributor's.

That's all that is necessary to reduce background noise with negligible loss of depth and brilliance . . . giving you a gratifying sense of "presence" in your music reproduction.

**COMPLETE SUPPRESSOR . . . including tubes, matched pick-up, remote control, cables, adapters, instructions . . . \$82.50 list.**

\*Licensed under U.S. and foreign patents pending and issued.

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FOR **ECONOMY** IN  
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ENGINEERING . . .  
SPACE . . .



ACTUAL SIZE

## GERMANIUM DIODES

**E**ASILY INSTALLED, General Electric Diodes are space-saving . . . provide outstanding advantages over other rectifiers in many applications.

These advantages can be quickly translated into dollars saved in production and improved equipment operation. The features listed below are only a few of the reasons for the rapid increase in the use of G-E Germanium Diodes.

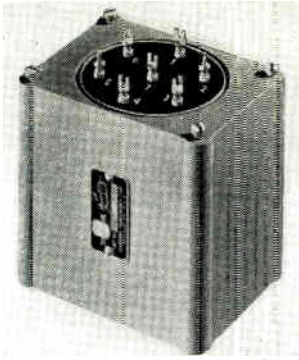
- **Welded Contact**—The welding of the platinum whisker to the germanium peller improves electrical stability. Neither mechanical shock nor vibration affect it. Operation may be conducted at higher than ordinary temperatures since no filler, such as wax, is required to hold the point in place.
- **Plastic Shell**—More economical than previous metal type and yet it retains mechanical ruggedness. Use of plastic gives a lower lead-to-lead capacitance, permitting its use in circuits of very high frequency.
- **Small Size**—Requires no more space in circuit than an ordinary 1/4 watt resistor.
- **No Heater Connections**—Eliminates hum sometimes associated with vacuum type rectifiers.
- **Easy Installation**—Insulated shell and only two leads to connect.
- **Quick Recovery**—Returns to normal quickly after sudden applications of excessive voltage when not accompanied by excessive current, providing the source of high voltage is removed at once.
- **Low Shunt Capacitance**

Five types of G-E Germanium Diodes are available to meet practically all requirements. For complete information write: General Electric Company, Electronics Park, Syracuse, New York.

GENERAL ELECTRIC

185-133

December, 1948 — ELECTRONICS



000 cycles, and plus or minus 2 db from 30 to 20,000 cycles respectively. Hum pickup, leakage reactance, as well as harmonic and intermodulation distortion have been reduced to a minimum.

### Electromanometer

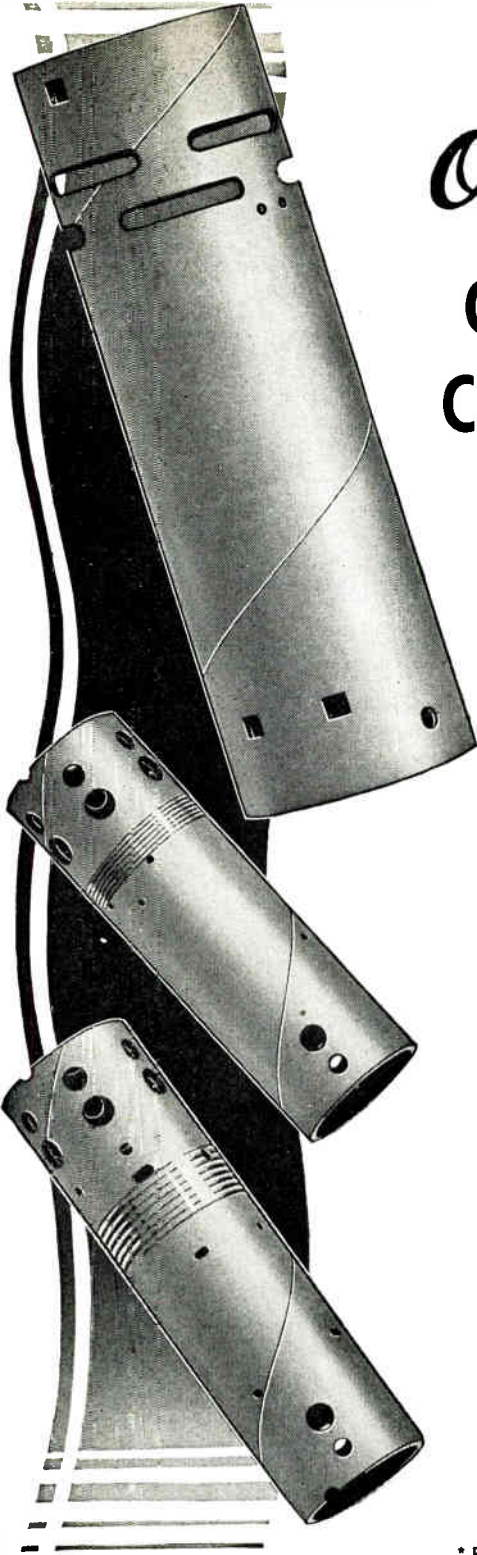
SANBORN Co., 39 Osborn St., Cambridge, Mass. The electric manometer illustrated is used for graphic registration of rapidly



fluctuating pressures as well as steady pressures. Standard ranges are 0-to-1 mm of mercury to 0-to-400 mm. Negative and mean pressures can also be measured.

### Carbon Resistors

INTERNATIONAL RESISTANCE Co., 401 N. Broad St., Philadelphia, Pa. The new type deposited carbon resistors, DCF for applications up to 1 watt, and DCH for applications up to 2 watts, are made by depositing pure crystalline carbon film on specially compounded ceramic rods. They are available in 1, 2 and 5-percent tolerances. Resistance ranges are: type DCF, 200 ohms to 5 megohms; type DCH, 500 ohms



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Your specifications as to punching, threading, notching and grooving are followed with the most exacting care. Ask about our many stock punching dies available to you.

Are you familiar with our #96 COSMALITE for coil forms in all standard broadcast receiving sets; SLF COSMALITE for permeability tuners; COSMALITE deflection yoke shells, cores and rings?

Spirally wound kraft and fish paper Coil Forms and Condenser Tubes.

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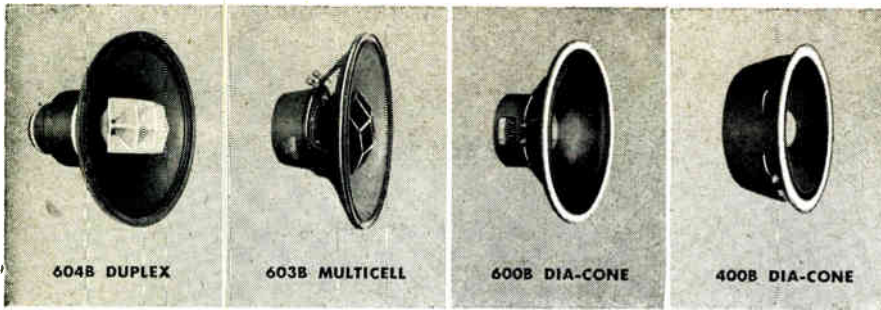
*The* **CLEVELAND CONTAINER Co.**

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- All-Fibre Cans • Combination Metal and Paper Cans
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CANADIAN PLANT: The Cleveland Container Canada, Ltd., Prescott, Ontario





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Quality-conscious engineers in every field have now found out, in actual use, the remarkable efficiency, the amazing smoothness of frequency response, and the clearly superior performance of the new, improved 1948 Altec Lansing speakers.

This complete, all-purpose line, fundamentally re-engineered and incorporating new scientific discoveries result-

ing from original Altec Lansing research, offers the highest obtainable quality now available in the electronic industry.

The clear superiority of Altec Lansing speakers is substantiated by frequency response curves, made on measurement equipment that has earned the approval of conservative, unbiased audio scientists.

*An illustrated brochure, fully describing the 1948 Altec Lansing line, containing frequency response curves for each speaker, will be sent on request. Write to address nearest you.*

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1161 N. Vine St.  
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## MODEL 204A REGULATED POWER SUPPLY

0-500 VOLTS D.C. AT  
300 MA. WITH POSITIVE  
OR NEGATIVE GROUND

The Model 204A Regulated Power Supply will provide from 0-500 volts of well regulated and well filtered D.C. The output voltage is continuously variable without switching and either positive or negative side may be grounded.



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High Voltage: 0-500 Volts D.C. continuously variable (Without switching).  
Current: 300 Ma.  
Low A.C. Voltage: 6.3 Volts A.C. at 6 amps. center-tapped, unregulated

#### REGULATION

Within 1% for voltage between 30-500 volts, from no load to full load.  
Within 1% for line voltage variations from 105 to 125 volts at full load current for any voltage between 30-500 volts and within 2% at 10 volts.

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Within 10 Millivolts at any voltage or load within ratings.

#### LINE INPUT

105-125 Volts A.C. 50-60 cycles.

#### OUTPUT TERMINATIONS

High and low voltage outputs available from front and rear of unit. Positive or negative terminal of high voltage output may be grounded as desired.

Detailed specifications will be forwarded upon request without obligation.



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**TINYMITE**

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P 5

600V

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SMALLEST PAPER  
CAPACITOR  
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to 20 megohms. See technical bulletin B-4 for further data.

## Literature

**Carrier Systems.** Lenkurt Electric Co., 1113 County Road, San Carlos, Calif. Form CX42 is a 12-page booklet providing a comprehensive illustrated listing of carrier telephone and telegraph systems. Also included is a description of signaling equipment and test apparatus for system maintenance.

**Sound Services.** Reeves Sound Studios, Inc., 304 E. 44th St., New York 17, N. Y. A recent brochure describes and illustrates the wide variety of sound recording facilities, experience and technical knowledge available for turning out films or disc production.

**Nuclear Charts.** Westinghouse Electric Corp., Box 1017, Pittsburgh 30, Pa., has prepared six lithographed wall charts in two colors illustrating the important areas of nuclear physics. Measuring 25 by 36 inches and made of heavy stock, the charts are accompanied by a 32-page book of supplementary information. Complete set may be purchased at the above address for \$1.00.

**Classroom Radio.** Radio Manufacturers Association, 1317 F St., N. W., Washington 4, D. C. The present thinking of radio manufacturers and educators specializing in audio education is summarized in a recent booklet. Contents cover utilization, teaching with radio, considerations for purchase and technical considerations.

**Electronic Controls.** Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill. Bulletin Z6500 contains an illustrated and de-

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*1st in Your Industry*



## For Peak Soldering Efficiency It's Kester

In these days of high labor costs, it is of the utmost importance to maintain peak efficiency in your production and maintenance operations. Kester Cored Solders will speed up all soldering jobs.

### A Complete Technical Service

If you have a specific problem in your soldering operations, take advantage of the facilities of Kester's Technical Department. It costs you nothing.

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SOLDER COMPANY

4204 Wrightwood Ave., Chicago 39, Ill.

Factories Also At  
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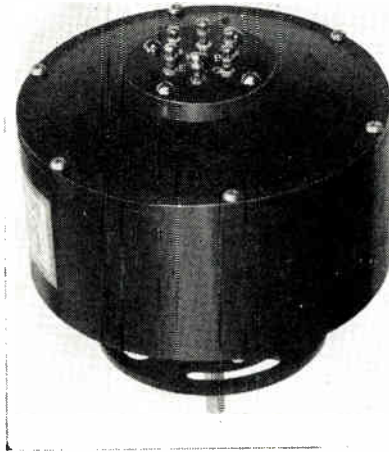
**KESTER**  
**SOLDER**

# PRECISION POTENTIOMETERS

Toroidal and Sinusoidal

For use in computing and analyzing devices; generation of low frequency saw tooth and sine waves; controls for radio and radar equipment; position indicators; servo-mechanisms; electro medical instruments, measuring devices—telemetering; gun fire control where 360° rotation, high precision and low noise levels are essential.

The type RL14MS sinusoidal potentiometer is illustrated. It is wound to a total resistance of 35,400 ohms and provides two voltages proportional to the sine and cosine of the shaft angle. It will generate a sine wave true within  $\pm .6\%$ . Overall dimensions are  $4\frac{3}{8}$ " diameter x  $4\frac{11}{32}$ " long plus shaft extension  $\frac{1}{4}$ " diameter x  $1\frac{1}{4}$ " long.



Write for Bulletin F-68

## THE GAMEWELL COMPANY

Newton Upper Falls 64, Massachusetts

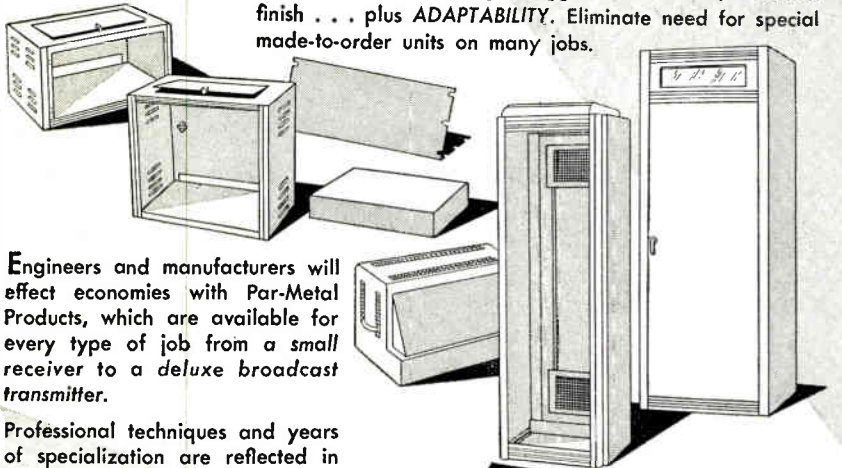


## STANDARDIZED METAL EQUIPMENT

READY-TO-USE

ADAPTABLE FOR EVERY REQUIREMENT

Par-Metal Equipment offers many features, including functional streamlined design, rugged construction, beautiful finish . . . plus ADAPTABILITY. Eliminate need for special made-to-order units on many jobs.



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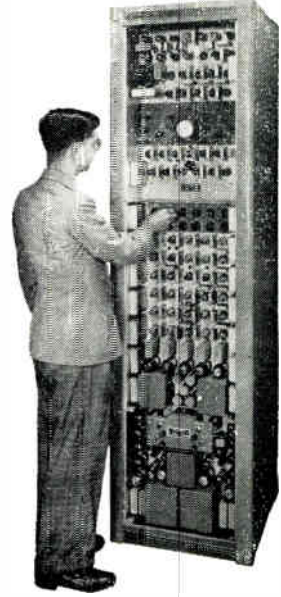
**PAR-METAL**  
PRODUCTS CORPORATION  
32-62 - 49th STREET  
LONG ISLAND CITY 3, NEW YORK  
Export Dept.: Rocke International Corp.  
13 East 40 Street, New York 16

# POLARAD TELEVISION Equipment

for studio • laboratory • manufacturer

## SYNCHRONIZING GENERATOR

Model PT 101—Television



### FEATURES

- Built-in 3" oscilloscope with synchronized sweeps for viewing Timing and Video Output pulse wave forms.
- Synchronized marker system for checking pulse width and rise time.
- Extreme stability, insured by deriving all pulses from leading edge of master oscillator pulse.
- Means for checking synchronizing pulses in odd and even fields.

### SPECIFICATIONS

525 line, interlock, 80 fields, 30 frames, RMA Synchronizing pulses held to tolerance specified in the NRPFB report of 1945. Output Pulses; Synchronizing, Video Blanking, Camera Blanking, Horizontal Driving, Vertical Driving Pulses. 5 volts across 100 ohm termination. Dual output jacks. 115 volts 50/60 cps. Complete with tubes.

## TELEVISION MONOSCOPE SIGNAL SOURCE

Model PT 102

- Composite Video Signal
- Wide Band Video Amplifier, 6 DB down at 10MC
- Dual outputs for feeding two 75 or 100 lines
- Black positive or Black negative output.
- Resolution greater than 600 lines

INPUT: Vertical and Horizontal Driving pulses, Camera and Kinescope Blanking Pulses.

OUTPUT: Composite Video Signal, 3 volts, 100 ohm line 115 volts 50/60 cps. Complete with tubes and including high and low voltage power units.

9 FERRY STREET  
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**Polarad**  
Electronics Company

Television engineers and consultants to the nation's great television stations.



scriptive listing of standard instrument models including indicators, controllers, recorders, and combustion safeguards. A separate price list is also available.

**Precision Switches.** Unimax Switch Division of the W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y. A 20-page booklet on precision switches provides engineering data on force and movement specifications, dimensions and electrical ratings.

**High-Voltage Supply.** Instrument Development Laboratories, 223-233 West Erie St., Chicago 10, Ill. A single sheet illustrates and gives technical data on the model 1090 high-voltage supply which delivers 0 to  $\pm 5,000$  volts continuously variable, for ionization measurements and other low drain applications. Output voltage variation is less than 0.1 percent for a line voltage change of 95 to 130 volts.

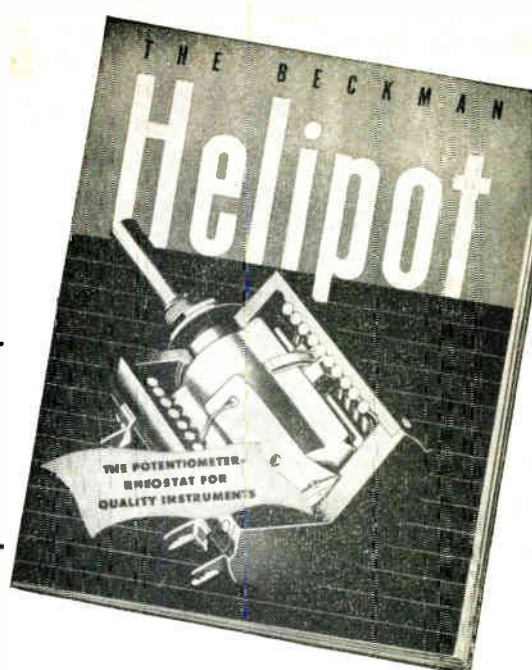
**Instrumentation System.** Automatic Temperature Control Co., Inc., 5212 Pulaski Ave., Philadelphia 44, Pa. Detailed engineering and application data on the Atcotran instrument system for electrically measuring mechanical motions or displacements may be found in the 8-page catalog R-10.

**Shipboard Radar.** Radiomarine Corp. of America, 75 Varick St., New York 13, N. Y. Booklet MS-15 completely describes and illustrates the CR-101 radar designed for commercial shipping. Dimensional digrams and specifications are given.

**Ham Inductors.** E. F. Johnson Co., Waseca, Minn. Now available is a new catalog dealing with air-wound ham inductors and plug-in swinging link assemblies. Instructions are provided which enable the amateur to select the correct coil and link for individual application.

**Dry-Type Transformers.** Lindberg Engineering Co., 2444 West Hubbard St., Chicago 12, Ill., recently released bulletin 1110 which gives applications, design and construction of a standard line of dry-type transformers, and also covers types for special applications.

# Do you have This Helpful Helipot and Duodial Catalog?



Do you have complete data on the revolutionary new HELIPOT—the helical potentiometer-rheostat that provides many times greater control accuracy at no increase in panel space? . . . or on the equally unique DUODIAL that greatly simplifies turns-indicating applications? If you are designing or manufacturing any type of precision electronic equipment, you should have this helpful catalog in your reference files . . .



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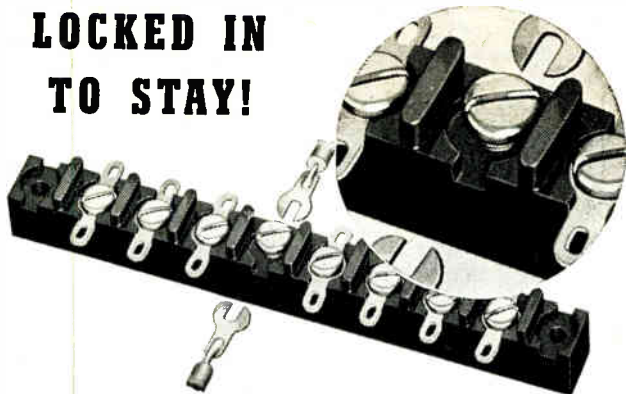
**It Describes**—and illustrates the various special HELIPOT designs available—double shaft extensions, multiple assemblies, integral dual units, etc.

**It Gives**—full details on the DUODIAL—the new type turns-indicating dial that is ideal for use with the HELIPOT as well as with many other multiple-turn devices, both electrical and mechanical.

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Terminal Block Sales  
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When you hear the Newcomb "Red Knob" record condition compensator for the first time, we are sure you'll agree it's really a "Dream Come True." These two great Newcomb Amplifiers with the "Magic Red Knob" do wonders in eliminating needle scratch and record distortion while retaining the maximum natural brilliance.

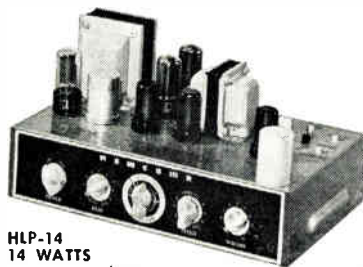
Of course, it's not only this remarkably effective scratch control that gives you the extreme quality achieved by these two amplifiers. Their measured performance is superb. In every respect, they represent the ultimate in technical perfection, and in addition, there's a listening quality that even performance curves do not tell. That's why we ask you to be sure and hear these two Red Knob Amplifiers before you buy. Both have built in Pre-Amplification for G.E. or similar variable reluctance type pickups, plus inputs for AM-FM radio and crystal pickups, and the finest of tone controls.

Both are individually, and completely, custom tested to insure each unit will be "Laboratory Perfect." A "Certificate of Performance" accompanies each amplifier. Look for it. It is your assurance of individual perfection.

See your Newcomb Distributor or write for detailed specifications.



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**THEORY OF  
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Vol. 25. Edited by H. M. JAMES, Purdue Univ.; N. B. NICHOLS, Taylor Instrument Co.; and R. S. PHILLIPS, Univ. of Southern Calif. 375 pages, illus., \$5.00

Here is a coherent description of the theory and mathematics involved in standard methods of servomechanism design, showing application of current techniques, and providing an introduction to a new technique. It covers frequency response design considerations—transfer loci, attenuation vs. log-frequency plots, phase-angle vs. log-frequency plots—and explains the later method which depends upon minimization of rms error with which the mechanism produces a desired result in the presence of electrical noise and other disturbances.

**TECHNIQUE OF  
MICROWAVE MEASUREMENTS**

Vol. 11. Edited by C. G. MONTGOMERY, Associate Professor of Physics, Yale University. 937 pages, illus., \$10.00

The four sections of this book provide a thorough analysis of the methods and apparatus deemed most useful in measuring the properties of microwaves and designing circuits in which they are to be used. A full description of the measurable quantities of microwaves provides sound groundwork for chapters which deal with sources of power suitable for measuring purposes and the means for detecting energy at microwave frequencies. Methods for measuring wave lengths, impedance, frequency, and attenuation are fully described.

**PULSE GENERATORS**

Vol. 5. G. N. GLASOE, Rensselaer Polytechnic Institute; and J. V. LEVACQZ, Johns Hopkins Univ., 737 pages, \$9.00

This detailed discussion of the techniques of pulse generation presents a comprehensive survey of the rapid advancements made in this field. It covers the theoretical and practical aspects of the generation of power pulses, the practical methods of pulse-generator design, including hard-tube pulsers, line-type pulsers, and pulse transformers. Pulse powers in the range of 100 watts to 20 megawatts and pulse durations from .03 to 10 microseconds are considered, covering pulse formation, pulse power, circuit efficiency, etc.

**MICROWAVE RECEIVERS**

Vol. 23. Edited by S. N. VAN VOORHIS, Assoc. Professor of Physics, Univ. of Rochester. 617 pages, illus., \$8.00

This analysis of wide-band receivers provides a thorough description of the various component circuits and equipment—individual circuit types, duplexers, microwave mixers, local oscillators, automatic frequency control systems, i-f input circuits, amplifiers, and detectors. With this comprehensive groundwork, the book takes up the assembly, testing, and maintenance of receivers, offering analyses of actual receivers which contain examples of important circuit combinations.

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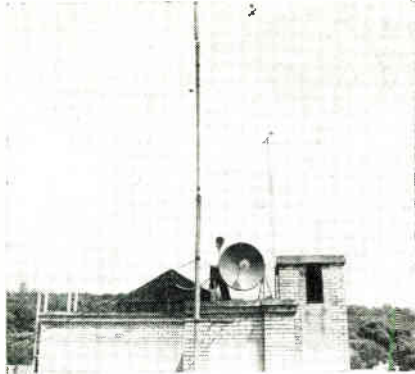
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Studio-to-transmitter microwave antenna which beams programs from Ithaca studio to Connecticut Hill transmitter site for re-broadcast over Rural Radio Network

receive from, are: WSLB, Ogdensburg on 106.1 mc, and 75 miles from WVBN, Turin, on 107.7 mc and 72 miles from WVCV, Cherry Valley on 101.9 mc and 56 miles from WVCN, De Ruyter on 105.1 mc.

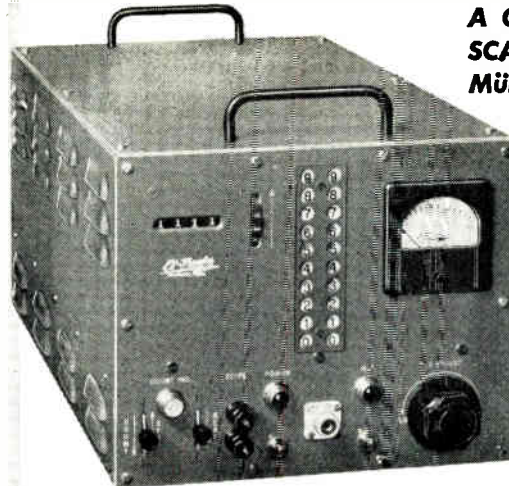
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Headquarters for the statewide chain are at Ithaca, N. Y. From this point a GE studio-to-transmitter link operating on 940.5 mc beams programs to a transmitter



Engineers adjust antennas of Nemo trailer used by Rural Radio Network for remote pickups. The program is broadcast from here on 152.75 mc to the nearest RRN station

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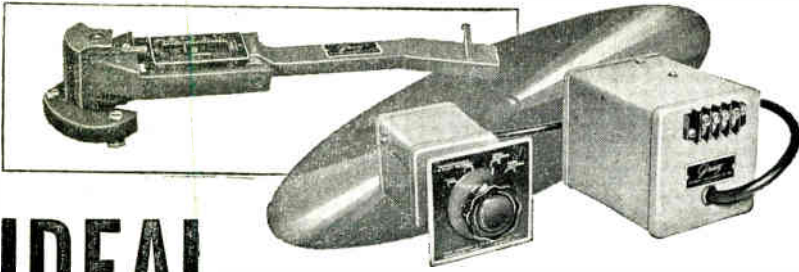


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The GRAY #601 4-position EQUALIZER for GE Cartridge, finest performance and workmanship, ideal response curves. Adopted by radio networks. Matches pickup to microphone channel. Complete, \$49.50.

*Inquiries invited for development and manufacturing.*

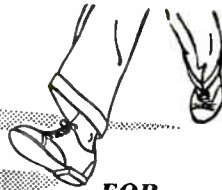
**GRAY RESEARCH & DEVELOPMENT COMPANY, Inc.**

16 ARBOR STREET

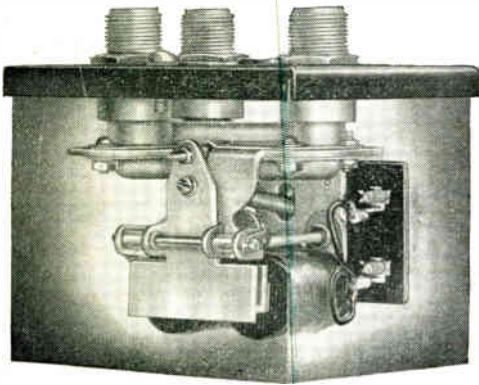
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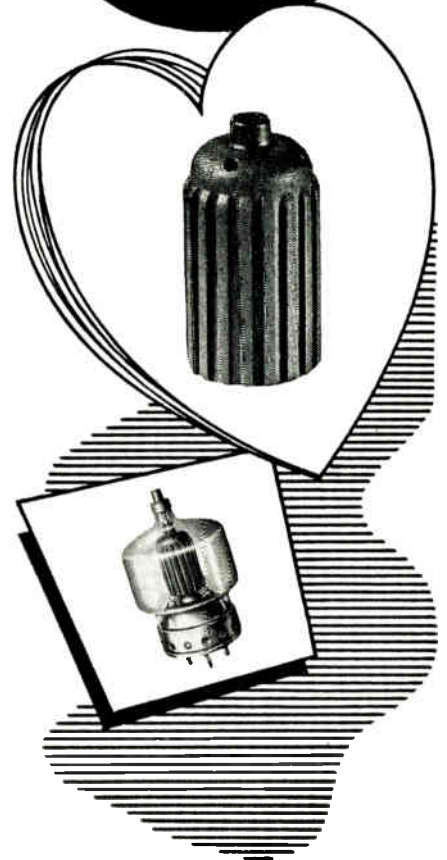
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site at Connecticut Hill, 9½ miles southwest. There the programs are put on the air and picked up simultaneously by master receivers at other stations, for immediate re-broadcast on their own channels. Each station can also originate programs for pickup by others in the network.

### Certificates of Merit

AT CEREMONIES held in several regions recently, presidential certificates of merit were awarded as testimonials for outstanding service in technological research and development during World War II.

The following were the recipients:

Henry B. Abajian of L. H. Terpening Co.; George W. Bailey of the IRE; Wilmer L. Barrow of Sperry Gyroscope Co.; H. H. Benning of Aircraft Radio Corp.; Harold H. Beverage of RCA; K. C. Black of Aircraft Radio Corp.; Hendrik W. Bode and Ralph Bown of Bell Labs.; Herbert E. Bragg of NDRC; Henri Busignies of Federal Telecommunication Laboratories; John F. Byrne and F. C. Cahill of AIL; Howard A. Chinn of CBS; F. S. Cooper of Haskins Laboratories; Inc.; W. F. Davidson of Consolidated Edison Co.; H. D. Doolittle of Machlett Laboratories; O. S. Duffendack of Philips Laboratories, Inc.; John N. Dyer of AIL; Donald G. Fink, editor-in-chief, ELECTRONICS, E. G. Fubini of AIL; Raymond L. Garman of General Precision Equipment Corp.; B. L. Havens of Watson Scientific Computing Laboratory; L. Grant Hector of Sonotone Corp.; William H. Martin of Bell Labs.; James H. Moore of AT&T; Haraden Pratt of American Cable and Radio Corp.; J. C. Schelleng of Bell Labs.; William P. Short of Federal Telecommunication Laboratories; Hector R. Skifter of AIL; Ernst Weber of Polytechnic Institute of Brooklyn; Browder J. Thompson (posthumously), Vladimir K. Zworykin, Loren F. Jones and Hugh H. Spencer of RCA.

### Australian Mobile F-M

FIRST INSTALLATIONS of mobile f-m equipment for public works and police authorities in Australia were recently completed by Amalgamated Wireless (Australasia) Ltd. and Philips' Australian branch plant. Regular f-m entertainment programs, however, are at least a year away.

### Train Television

A SUCCESSFUL demonstration of television reception aboard a moving train was made during the recent World Series by Bendix Radio Division of Bendix Aviation and the Baltimore and Ohio Railroad, along the Washington-New York route. Only when the train

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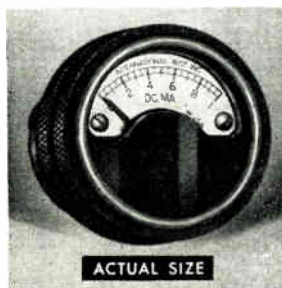
**INCORPORATED**

The fine quality midget meters formerly manufactured by the MB Manufacturing Company are now being produced by International Instruments, Inc., — a new name for the established line of midget meters of unexcelled accuracy.

Improvements in design have been effected under International Instruments' modern engineering methods. Production has been increased without loss of precision. Now International Instruments can provide prompt delivery of a complete line of improved midget electrical panel meters, ranging from 1" to 1½" in diameter, combining with small size the same ruggedness and accuracy of the larger panel meters.

Production quantities or sample orders are available for practically every use where small size and minimum weight are prime factors. Our engineers will gladly work on adapting International midget electrical instruments to your requirements.

Write now for our new midget meter folder complete with specifications.



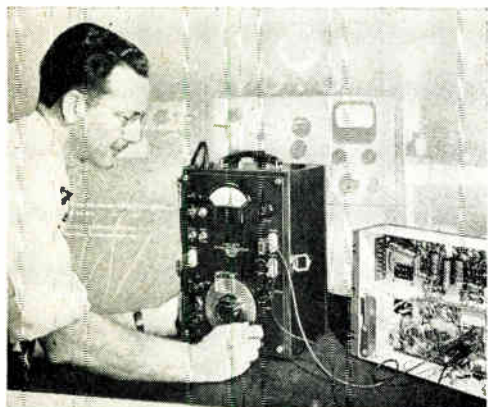
ACTUAL SIZE

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# Z-ANGLE METER'S Accuracy — Speed — Simplicity PLEASES LANGEVIN ENGINEERS



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## AUDIO ENGINEERS:

Note This Report From Langevin

"The Langevin Manufacturing Corporation Development Laboratories finds the Z-Angle Meter extremely useful in the determination of transformer impedances. In the manufacture of amplifiers it is often necessary to determine the impedances existing within amplifier stages. Heretofore, these determinations have involved a long drawn out test procedure. The Z-Angle Meter, however, allows readings to be made accurately and quickly."

Their engineers say, "... the plate impedance of a resistance coupled triode tube can be determined by taking a reading with the Z-Angle Meter at the output terminals and then extracting the unknown from the mathematical formula for the impedances in parallel. This is only one of the many uses we have found for this instrument."

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These green-colored power resistors handle heavy overloads without flinching. The exclusive cold-setting inorganic cement coatings means that the wire winding remains unimpaired in manufacture. Coating withstands the heat shock of frequent on-off operation without cracking, flaking, peeling. Yes, TOUGH!

Fixed and adjustable. 5 to 200 watt ratings. Widest choice of terminals and mountings.

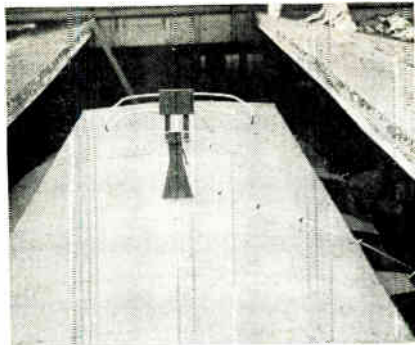


Bulletin 113 sent on request. Let us quote on your requirements

# Controls and Resistors

CLAROSTAT MFG. CO., Inc., Dover, N. H.

In Canada: CANADIAN MARCONI CO., Ltd. Montreal, P.Q., and branches



Special antenna mounted atop roof of train for television reception must not extend more than 15 1/4 inches because of railroad's clearance pattern. Larger portion is used for the 54 to 88-mc band; smaller antenna is for 174 to 216 mc

passed under bridges or steel structures or was out of range of transmitters was there any indication that the receiver was operating under unusual circumstances.

A special antenna known as a ram's horn doublet was mounted atop the car. The a-c power necessary for the set's operation was obtained by using a standard Bendix train radio inverter.

### RMA Mobilization Plan

To SPREAD the military preparedness production load broadly throughout the radio industry, the RMA industry mobilization policy committee has presented a plan to the Munitions Board. Aim of the plan is to create as many prime contractors as possible and get the industry as a whole back into government business. The new committee has as its chairman Fred R. Lack of Western Electric Co.

Included in the detailed recommendations is the proposal that the government appoint a four-man committee consisting of three military officers and a representative of industry to properly coordinate and channel current procurement. It was also recommended that the government appoint an industry advisory committee to act as consultants and technical advisors to the four-man procurement committee.

### Radiation Detection Display

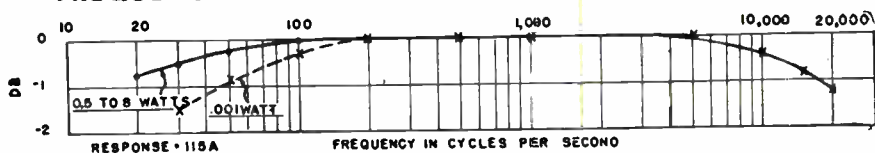
INSTRUMENTS FOR radiation detection in the industrial, medical and biological applications of nuclear

# 1st LINE PERFORMANCE *Proved in* ADC 2nd Line Transformer

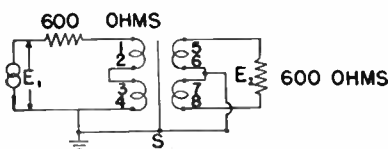
An ADC 115A (Industrial Series) impedance matching transformer, picked at random from stock, was submitted to tests to compare its performance with that of other makes of 1st line transformers. Here are the results. Compare performance of the ADC transformer with that of other makes.



### FREQUENCY RESPONSE

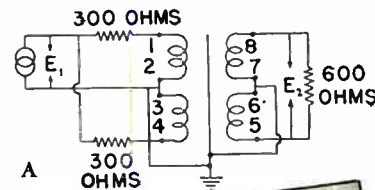


It may be noted that altho the permeability of magnetic materials drops at low flux densities, the ADC transformer has sufficient reserve inductance to allow for this even at low power levels. At 40 db below maximum power level it exceeds the response guarantee. Insertion loss at 1,000 cps was 0.75 db



### LONGITUDINAL BALANCE

The most common interference voltages encountered in telephone line transmission are longitudinal; that is, the induced voltages in both wires are in phase with respect to ground. These can be removed from the signal voltage only by means of a well balanced line transformer. Illustration "A" shows the test circuit used to measure the degree of removal of these interference voltages. Level reduction on the ADC 115A transformer was 67 db at 100 cps and 56 db at 10,000 cps.



CONSULT ADC for your engineered transformer where exacting specifications require positive results. ADC's policy assures you the finest available materials and workmanship to give you the very best electronic components.

ADC QUALITY PLUS TRANSFORMERS  
Finest transformer made. For AM and FM broadcast stations and recording studios. ± 1/2 db 30-15,000 cps.

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- EXTREME RUGGEDNESS
- VERY LOW CURRENT

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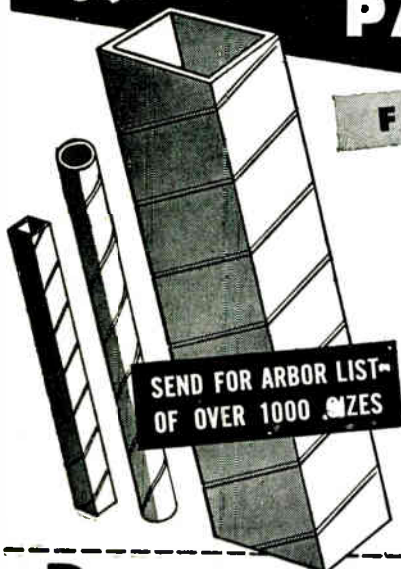
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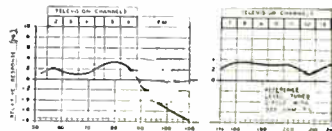
## Paramount PAPER TUBE CORP.

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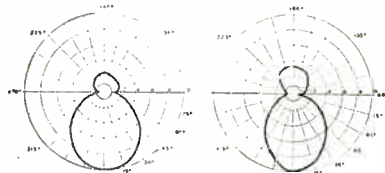
Manufacturers of Paper Tubing for the Electrical Industry



## All-Channel Antenna



MEGACYCLES



Horizontal Directivity 60 mc.

Horizontal Directivity 190 mc.

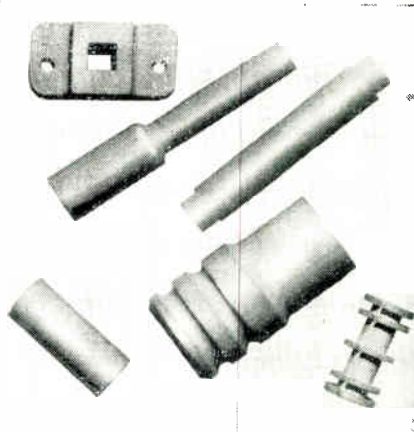
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New York • Philadelphia



energy are being given a comprehensive display at a conference on electronic instrumentation in nuclear physics and medicine in New York, November 29 through December 1. The Atomic Energy Commission's exhibit will include 22 types of basic instruments manufactured by 20 commercial companies.

The purpose of the conference is to show the problems facing utilization of atomic energy and the need for cooperation among electronic engineers, physical scientists and medical doctors. Over twenty papers are being presented by various authorities in the atomic energy research and development field.

### South American Television

TRANSMITTING EQUIPMENT for South America's first television station was recently sold by General Electric Co. to Cesar Ladeira, one of the founders of Radio Televisao do Brazil. Television service, expected to be functioning within a year, will be operated in collaboration with Radio Mayrink Veiga, PRA-9, of Rio de Janeiro.

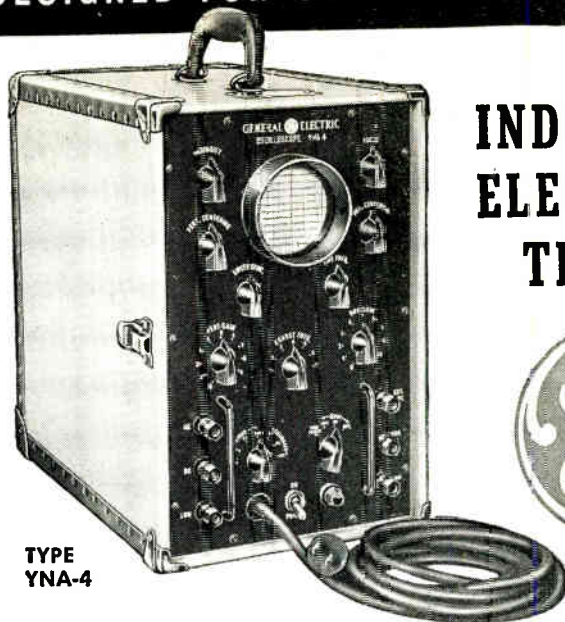
The transmitter will have 5-kw power rating, which will make it comparable in strength to stations operating now in the U. S. The system will operate on American standards of 525 lines, 30 frames and 60 fields in black and white.

The laboratory includes a high-voltage section, a pilot plant, a chemical and metallurgical area, and a photo-technical department.

### Technical Information Committee

A SPECIAL COMMITTEE on Technical Information has been formed by Vannevar Bush, chairman of the Research and Development Board, to promote effective exchange of research and development information among the departments of the National Military Establishment. Detlev W. Bronk, president of Johns Hopkins University, is chairman of the new group. Other members include: John E. Burchard, Dean of Humanities, MIT; Herman Henkle, director of the

DESIGNED FOR ONE SPECIFIC PURPOSE—



TYPE  
YNA-4

## INDUSTRIAL ELECTRONIC TESTING



## INDUSTRIAL OSCILLOSCOPE

Check—Measure—Test—with the G-E Industrial Oscilloscope.

The following partial list of uses will indicate its importance where ever electrical apparatus is employed.

For checking welding equipment, testing photo-electric circuits, checking performance of relay contacts, performance of high power rectifier tubes, measuring voltage and current relationship in motors, performance of commutators, checking audio oscillators—the YNA-4 Industrial Oscilloscope performs all these important checking and testing functions most efficiently.

**D-C Amplifiers for Horizontal and Vertical Deflection**—Give a true trace combining both the AC and DC components important for industrial purposes which is not possible with the ordinary oscilloscope used in radio work.

**Completely Insulated Case**—Since the entire unit is insulated, it may be operated as high as 550 volts above ground. Instrument may be placed on metal working surfaces, machinery, and other advantageous working spots even when connected to ungrounded circuits.

**Internal Calibrating Voltages**—The YNA-4 provides internal calibrating voltages of known value to enable the operator to set the deflection sensitivity of the oscilloscope. Functions as a vacuum tube voltmeter permitting AC and DC voltage measurements without a voltmeter.

**Flexible Input Circuits**—Vertical Amplifier—varied inputs are available to accommodate a wide range of voltages and circuit requirements. This oscilloscope may be used to

examine voltages from 1.0 volt to 500 volts and its input impedance may be switched from 1 megohm to 10 megohms or to open grid.

**Horizontal Amplifier**—direct coupled input terminals are provided or the built-in sweep generator may be used for horizontal deflection. This generator may be synchronized with the power line, the vertical amplifier or with an external source.

**Wide Sweep Frequency Range**—The YNA-4 has been designed so that the operator can observe separate cycles over a wide band of frequencies. A minimum sweep rate of 10 cycles has been established as desirable for industrial operations—this has been incorporated in YNA-4.

For complete information on the YNA-4 Industrial Oscilloscope and other precision measuring equipments write today to: General Electric Company, Electronics Park, Syracuse, New York.

165-66

GENERAL  ELECTRIC

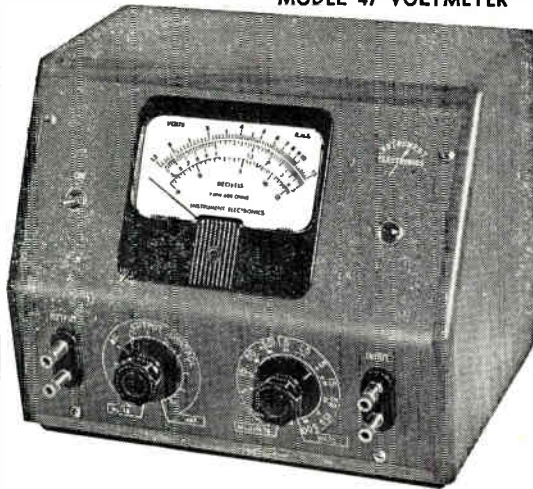
# High Sensitivity . . . Logarithmic AC VOLTMETER

50 MICROVOLTS TO 500 VOLTS  
MODEL 47 VOLTMETER

SELF-CONTAINED  
ALL AC OPERATED UNIT

An extremely sensitive amplifier type instrument that serves simultaneously as a voltmeter and high gain amplifier.

- Accuracy  $\pm 2\%$  from 15 cycles to 30 kc.
- $\pm 5\%$  from 30 kc. to 100 kc.
- Input Impedance 1 meg-ohm plus 15 uuf. shunt capacity.
- Amplifier Gain 40000



Also MODEL 45  
WIDE BAND  
VOLTMETER  
.0005 to 500 Volts!  
5 Cycles 1600 kc.

A few of the many uses:

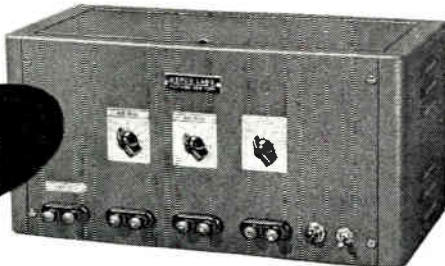
- Output indicator for microphones of all types.
- Low level phonograph pickups.
- Acceleration and other vibration measuring pickups.
- Sound level measurements.
- Gain and frequency measurements for all types of audio equipment.
- Densitometric measurements in photography and film production.
- Light flux measurements in conjunction with photocells.

Write for Complete Information

## Instrument Electronics

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DOUGLASTON, L. I., N. Y.

*Separate  
voltage  
supplies  
eliminated*



### CHECK THESE FEATURES

- Two continuously variable B supplies, from 0 to 300 volts at currents up to 120 ma.
- One continuously variable C supply, from minus 50 to plus 50 volts at 5 ma.
- One heater supply, 6.3 volts A. C. at 5 amperes.
- Power requirements: 105 to 125 volts, 50 to 60 cycles.
- Two 5Y3 rectifiers, two 6Y6 control tubes.
- Length 16", height 8", depth 8 3/4".  
Wgt. 28 lbs.

## Kepeco MULTIPLE POWER SUPPLY

### ADVANTAGES

- Four commonly used voltages from a single compact unit.
- B supplies cannot be burned out even if terminals are shorted.
- Control circuit eliminates the use of heavy duty power potential dividers.
- Complete voltage control from the front panel.
- All connections made to sturdy front panel binding posts.
- Voltages are isolated from the chassis.

The Kepco Multiple Power Supply is now widely used in schools and industrial laboratories.

# Kepeco

ELECTRONIC INSTRUMENTS

For complete details  
Address Dept. K-E

Kepeco Laboratories,  
Inc.

149-14 41st Avenue  
Flushing, N. Y.

## EISLER ELECTRICAL & ELECTRONIC EQUIPMENT ELECTRONIC TUBE EQUIPMENT



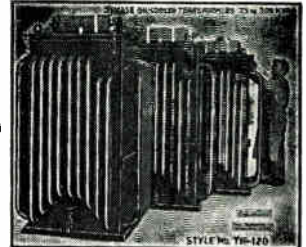
36 HEAD  
RADIO TUBE  
EXHAUSTING  
MACHINE

We Make  
Complete  
Equipment  
For The  
Manufacture  
Of Incandes-  
cent Lamps  
and Elec-  
tronic Tubes.

### TRANSFORMERS OF ALL TYPES

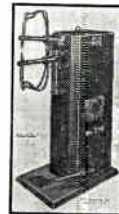
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LIGHTING  
POWER  
FURNACES  
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ETC.

Air, Oil,  
or Water  
Cooled



SIZES 1/4 to 250 KVA  
SPOT WELDERS

OF ALL TYPES  
FOR ALL PURPOSES  
SIZES 1/4 to 250 KVA  
Butt Welders - Gun Welders  
Arc Welders  
Neon Sign Units  
Fluorescent Tube  
Manufacturing Equipment



CHAS. EISLER

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### No Change in Operator License Rules

LAST YEAR'S PROPOSAL to provide for three classes of radio operator licenses has been abandoned by the FCC. The Commission finds no justification for the proposed rules or for any substantial changes in present rules, provided that qualifying examinations are kept up to date in relation to developments in the broadcast radio art through appropriate periodic revisions.

### British TV System to Stay

TO PREVENT THE SETS now in use from becoming obsolete, the British Broadcasting Corporation's television advisory committee has advised the Postmaster General to make no technical changes which would involve a change in the present television system.

The London television station will continue to operate for a number of years on the present 405-line system. The same system is being adopted for the Midlands station and is proposed for other British stations. Frequencies for vision and sound will be in the neighborhood of 60 mc. Alternative radio and cable links are being provided to make television available to more of the population.

### BUSINESS NEWS

RADIO CORP. OF AMERICA and its subsidiaries have been granted a license under the radar development patents owned by Raytheon Mfg. Co., Waltham, Mass.

NUCLEAR INSTRUMENT CHEMICAL CORP. is the new name of Instrument Development Laboratories, Inc., Chicago, Ill. Products include instruments for nuclear and radioactivity measurement.

RANSBURG ELECTRO-COATING CORP., Indianapolis, Ind., has available a

*Standardize on One*

Now, one crystal unit will accommodate all aircraft communications equipment applications. The RH-7B-68 crystal unit is available for commercial airline radio over a frequency range of 1 to 75 mc. This unit, too, can be made to Army-Navy specifications or to fit your particular application. Why not standardize now, on one!

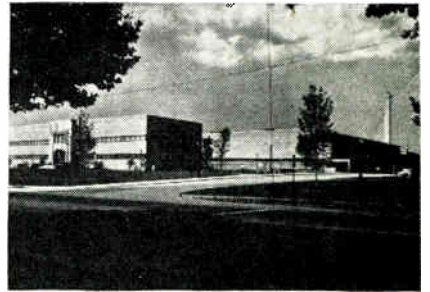
For complete information write for Bulletin RHC-X

**REEVES  HOFFMAN**  
**C O R P O R A T I O N**  
 CHERRY AND NORTH STREETS • CARLISLE, PA.

16-mm film covering their electrostatic detearing and spray finishing processes.

CLAROSTAT MFG. Co., INC., has moved from Brooklyn, N. Y., to a block-long plant in Dover, N. H., providing over 250,000 sq ft of floor space to expand operations and add various radio-electronic specialties to its line.

WESTERN ELECTRIC Co., INC., recently opened a new plant on a 50-acre tract two miles east of Allentown, Pa., for the manufacture of tubes and other precision electronic



Administration building (left) and manufacturing building of Western Electric's Allentown plant

equipment. Cost of the plant, which will employ about 2,500 people, is estimated at over \$10,000,000.

MEKELEK, INC., Highland Mills, N. Y., was recently organized for the production of electronic devices, particularly sound apparatus.

WORLD INDUSTRIES, INC., Dayton, Ohio, has been incorporated to manufacture electronic and other products and to operate research and development laboratories.

LENNOX INDUSTRIES, INC., Cleveland, Ohio, has been incorporated for the manufacture of electronic devices.

FAIRCHILD RECORDING EQUIPMENT CORP., New York, N. Y., was recently formed to combine the manufacture and sale of a new magnetic tape recorder with Fairchild Camera and Instrument Corporation's line of recording and sound equipment.

STROMBERG-CARLSON Co. recently broke ground atop Pinnacle Hill, Rochester, N. Y., for television station WHTM. The tower will also be able to support two f-m antennas

# Uniformity

The days of "file and fit" went out when volume methods came in. The modern assembly line in large production plants is in itself so dramatically arresting a spectacle that the "feeder lines", of which there are hundreds in every volume industry, are lost sight of. Just as mighty rivers exist only because of the less majestic tributaries, so the production line is dependent upon sources of supply so unvarying in flow and quality, that every part is ready and right to "fall into place" with mechanical precision and constant supply. Our production line has been standardized to a degree of uniformity attainable only through long-time development of machines, controls and skilled workmen.

## MACALLEN MICA

*A product developed for big business through serving the needs and keeping the pace of big business. Obviously best to help small business grow bigger.*

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These active patents apply to SYNCHRON Motors, printed on every motor which leaves our factory:

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2,128,141	2,237,960	2,295,786
2,128,142	2,237,961	2,304,688
2,143,653	2,237,962	2,305,963
2,155,266	2,256,711	2,323,035
2,202,693	2,274,957	2,332,634
2,219,388	2,289,495	2,349,620
2,237,958	2,298,373	

May we suggest that if you need timing motors, let us build them for you. We make them in large quantities—at prices difficult to duplicate—and you can avoid costly patent litigation and development expense. Catalog and engineering data on SYNCHRON Timing Motors, Time Machines, and Clock Movements will be mailed promptly on request.

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STAINLESS STEEL - LOCKING TYPE

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Where vibration is a problem, Birtcher Locking TUBE CLAMPS offer a foolproof, practical solution. Recommended for all types of tubes and similar plug-in components.

More than three million of these clamps in use.

**FREE CATALOG**

Send for samples of Birtcher stainless steel tube clamps and our standard catalog listing tube base types, recommended clamp designs, and price list.

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**COUNT TEN  
TIMES FASTER**

...and accurately!



MODEL 310  
ILLUSTRATED  
PRICE \$185.00

## NEW POTTER PHOTO-ELECTRONIC COUNTER

- ★ High speed—counts at rates up to 6000 per minute
- ★ Long life—mechanical register operates at only 1/10 normal rate
- ★ Direct reading—units digit is read from electronic counter, other digits from mechanical counter
- ★ Accurate—mechanical register not affected by detector "on-off" time
- ★ Compact—completely self-contained, no wiring required, easy to install
- ★ Flexible—self-contained "eye", separate "eye" or electromagnetic pick-up coil may be used for actuation

**POTTER INSTRUMENT COMPANY**

INCORPORATED  
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Designed for



Application



90711

The No. 90711

**Variable Frequency Oscillator**

The No. 90711 is a complete transmitter control unit with 6SK7 temperature-compensated, electron coupled oscillator of exceptional stability and low drift, a 6SK7 broad-band buffer or frequency doubler, a 6A67 tuned amplifier which tracks with the oscillator tuning, and a regulated power supply. Output sufficient to drive an 807 is available on 160, 80 and 40 meters and reduced output is available on 20 meters. Close frequency setting is obtained by means of the vernier control arm at the right of the dial. Since the output is isolated from the oscillator by two stages, zero frequency shift occurs when the output load is varied from open circuit to short circuit. The entire unit is unusually solidly built so that no frequency shift occurs due to vibration. The keying is clean and free from all annoying chirp, quick drift, jump, and similar difficulties often encountered in keying variable frequency oscillators.

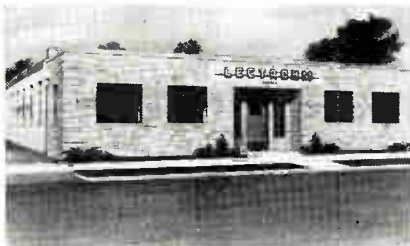
**JAMES MILLEN  
MFG. CO., INC.**

MAIN OFFICE AND FACTORY  
**MALDEN  
MASSACHUSETTS**



and two more television antennas. Since Rochester is allotted three channels it is expected that future licensees will take advantage of Stromberg-Carlson's offer to share the tower, so that residents may angle their receiver antennas at one location for a choice of three programs.

LECTROHM, INC., Chicago, Ill., has moved to larger quarters at 5939 Archer Ave. in that city, to increase



New Lectrohm plant

production of vitreous enamel resistors and electric solder pots.

GENERAL ELECTRIC RESEARCH LABORATORY has built its fourth betatron, a 50-million volt device for producing high-energy x-rays for use in cancer treatment.

**PERSONNEL**

LELAND J. HAWORTH, associated with the Brookhaven National Laboratory since August 1947, has been promoted from acting director to director of this atomic research center. During the war he served with the MIT Radiation Laboratory in radar development.

NEWBERN SMITH, a member of the National Bureau of Standards staff since 1935, has been appointed chief of the NBS Central Radio Propagation Laboratory.

HAROLD P. KNAUSS has resigned as director of research and development at the Mound Laboratory, Miamisburg, Ohio, to become head of the department of physics at the University of Connecticut. During the war he worked on submarine detection at Harvard Underwater Sound Lab and at Submarine Signal Co.

TIMOTHY E. SHEA, after 28 years with Western Electric's engineer-

**Speedy  
Accurate  
Testing**

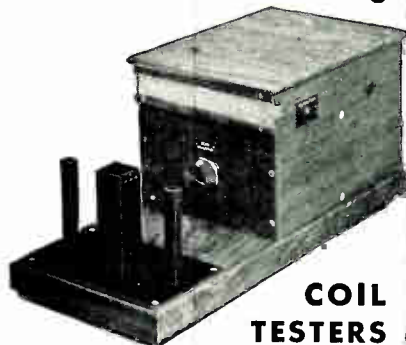
**1. Resistance Testing**



**LIMIT BRIDGES**

For high speed testing of resistors, coils, heater elements and similar products in production quantities where costs must be minimized. Designed for use by non-skilled operators, they are capable of checking as many as 2000 items per hour. Ranges from 1 ohm to 10 megohms. Simple and sturdy, these instruments will withstand hard usage for many years. Described in Bulletin 100.

**2. Shorted-Turn Testing**



**COIL  
TESTERS**

For detecting shorted turns or opens in coil windings of nearly every variety. Speeds of 2000 items per hour easily attained with non-skilled personnel. Will readily detect a single shorted turn of No. 44 copper wire. Operation at 60 cycles assures substantial freedom from capacity effects. Simple and sturdy for long service under hard usage. By detecting defective windings at negligible cost before assembly into completed units, these instruments greatly increase production efficiency and contribute to product quality. Described in Bulletin 109.

**★Other Rubicon Products:**

Wheatstone, Kelvin and Mueller Bridges; Potentiometers for precise measurement of DC voltages; Galvanometers; Photo-electric Colorimeters; Sanford-Bennett High H Permeameters; Magnetometers for intercomparing permanent magnets. Literature on request.

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**and COMPONENTS**

Over 200,000 Hillburn Video and Sound Transformers are now in use in more than 35,000 sets throughout the country.

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**BETA HIGH VOLTAGE**  
**POWER SUPPLIES**



**PROBLEM:** A group of research physicists associated with a major photographic equipment supply manufacturing company required a 0-40 KV DC reversible polarity power supply. Low ripple was essential.

**BETA Built it!**

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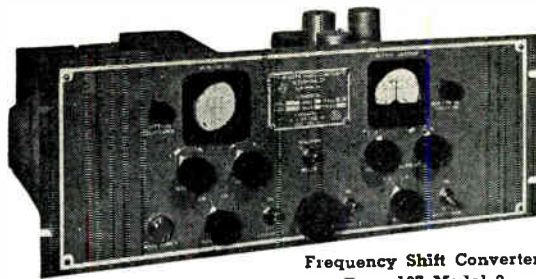
Input: 115 volts, 50/60 cycles; 200 volt-amperes.  
 Output: 0-40 KV DC; Variac controlled. Either positive or negative polarity as desired.  
 Output Current: More than 200  $\mu$ A at 40 KV.  
 Less than 1% ripple.  
 Size: 21" x 16" x 48"  
 Insulation: Air insulation throughout.

Power Supplies up to 200,000 volts DC. regulated or unregulated, built to specifications. Compactness, low cost and rapid delivery featured. Submit your high voltage power supply requirements to us for a prompt bid on price and delivery.

Other BETA products include:  
 KILOVOLT METERS up to 50 KV.  
 PORTABLE 0-30 KV DC POWER SUPPLIES.  
 ELECTRONIC MICROAMMETERS — 0.01  $\mu$ A full-scale.

Send for descriptive literature  
 Field engineers throughout the country are at your service to discuss our products more thoroughly with you.

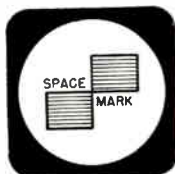
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Frequency Shift Converter  
 Type 107 Model 2

**FOR TELETYPE RECEPTION**

Converts any receiver with B. F. O. into teletype operation. Has dual input and combining feature for diversity reception. Audio frequency type. Dual channel ganged discriminator. Provided with demodulator facilities for CW-ICW. Over 60 DB limiting and special discrimination for maximum signal to noise ratio. Tolerates receiver or transmitter frequency drifts of  $\pm$  400 cycles in 850 cycle FS operation. Also available with linear output for facsimile.



**NEW and novel tuning and monitoring feature on 2" scope allows tuning of signal either in standby or while keying, which makes tune up a matter of seconds.**

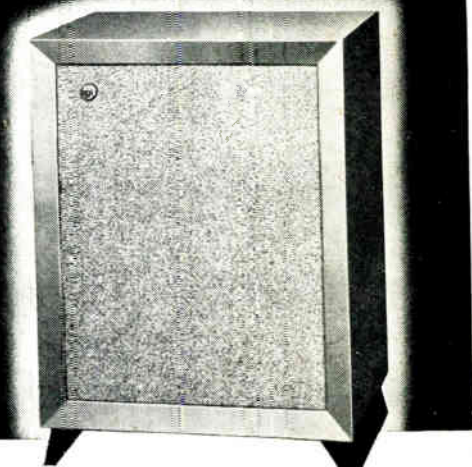
FOR OTHER FREQUENCY SHIFT TERMINAL EQUIPMENT SEE OUR  
 ADVERTISEMENT PAGE #190-191 ELECTRONICS BUYERS GUIDE.

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 Incorporated

143-145 WEST 22nd ST. NEW YORK 11, N. Y.

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 presents the  
**LC-4B**

Acoustically engineered to give the finest in listening pleasure at the lowest cost.



● From the laboratories and factory of RCA which have produced the speaker equipment now used in some of the world's largest and finest theatres, auditoriums, and studios comes a NEW Console Reproducer—the LC-4B. This unit combines the exceptional frequency characteristics of a unique, low distortion, low frequency speaker and a brilliant, high efficiency, horn type tweeter in a functionally designed cabinet with natural or walnut finish. You can now realize the full tonal range, richness, and color of FM Radio and wide range recordings at a new low price.

**SPECIFICATIONS LC-4B**

Frequency range 60 to 13,000 cycles  
 Sensitivity 94 db (Measured with IMV signal at 4 ft.) Impedance 7.5 ohms  
 Power Handling Capacity 10 watts.  
 Weight 44 lbs.  
 Suggested list LC-4B, Complete \$163.50

**SPECIFICATIONS LC-4A**

Frequency range 75 to 13,000 cycles  
 Sensitivity 97 db (Measured with IMV signal at 4 ft.) Impedance 7.5 ohms  
 Power Handling Capacity 20 watts.  
 Weight 44 lbs.  
 Suggested list LC-4A, Complete \$161.00

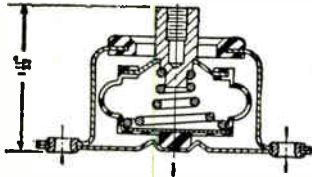
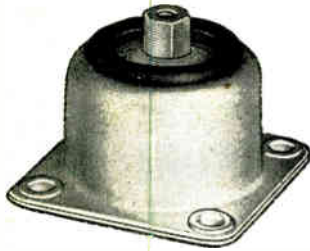
Make the RCA Sound Products Distributors in your territory YOUR SOUND HEADQUARTERS.



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**RADIO CORPORATION of AMERICA**  
 ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N. J.

In Canada: P.C.A. VICTOR Company Limited, Montreal

## New Design Vibration Isolator with Air Damping



### BARRYMOUNT TYPE 770 INSTRUMENT VIBRATION ISOLATOR

Revolutionary new design utilizing air damping to limit excursion at resonance. Metallic non-linear springs give constant resonant frequencies throughout a two to one load range. Unaffected by high or low temperatures. For all types of light weight instruments and other applications where a high degree of isolation is required.

Catalog Number	Load Range in Pounds
770-2	1 to 2
770-3	1 1/2 to 3
770-4	2 1/4 to 4 1/2
770-6	3 to 6

Similar type available in larger sizes

### BARRYMOUNTS Control VIBRATION and IMPACT

Standard Barrymounts are available for all sizes of mechanical, electrical, and electronic instruments in commercial industrial, and military applications—also an engineering consulting service on special problems.

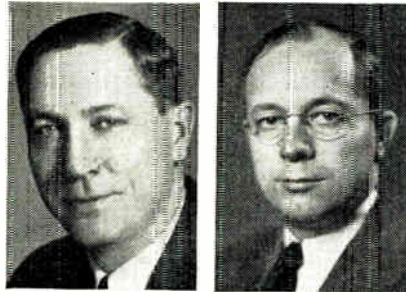
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ing department and Bell Telephone Laboratories, and most recently assistant engineer of manufacture for Western Electric Co., has been elected president and a director of the Teletype Corp. Early in his career he developed filters and networks used for transatlantic radio, carrier telephony and television. He holds the Medal for Merit and is author of "Transmission Networks and Wave Filters."



T. E. Shea

T. M. Liimatainen

TOIVO M. LIIMATAINEN, formerly associated with Sylvania Electric Products Co., has been appointed to the staff of the Electron Tube Laboratory, National Bureau of Standards, to work on the engineering and development of microwave tubes.

SYDNEY CRAMER, formerly television development engineer with GE, has joined Paramount Pictures television group in the same capacity.

RODNEY D. CHIPP, previously with NBC, has been promoted from assistant chief engineer to director of engineering for the DuMont television network.

H. U. HJERMSTAD, former vice-president in charge of manufacturing and engineering at Federal Enterprises, Inc., has been appointed assistant to the president of Sola Electric Co., Chicago, Ill.

G. LESTER JONES, formerly associated with automatic pilot development at Sperry Gyroscope Co. and prior to that, chief engineer of Sperry Products Co., was recently appointed chief engineer of Lear, Inc., Grand Rapids, Michigan.

HOWARD R. BOYLE, formerly affiliated with Sylvania Electric Products and Sperry Gyroscope Co., has been appointed chief engineer of the key station of the Far East

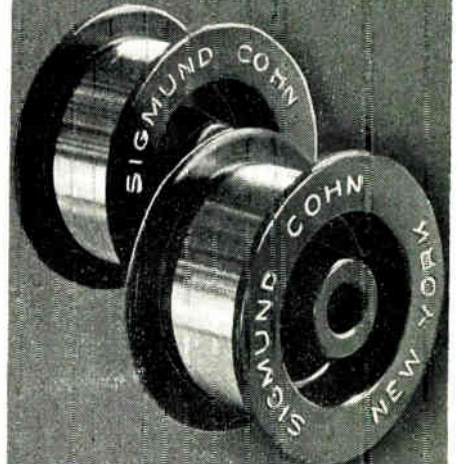
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Alloys for Special requirements.



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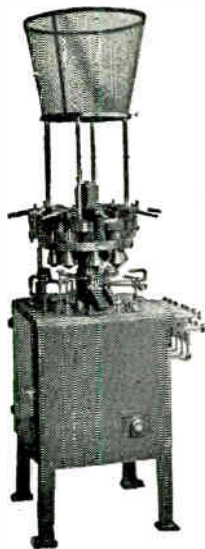
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Cuts off and flares in one operation.  
Production 1250 flares per hour. For miniature flares, fluorescent starters, standard size lamps, fluorescent and radio tubes.

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Glass tubing 27 to 45 gauge  
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Forms flares up to 47 mm. diam.  
Net weight, 960 lbs.  
Gross weight 1450 lbs.

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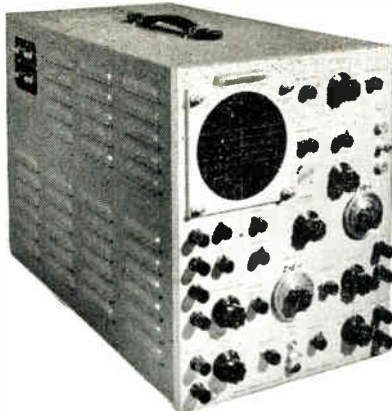
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Please send me FREE the Newark 1949 Catalog  
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**THE TYPE 512  
DIRECT COUPLED OSCILLOSCOPE**  
Sensitivity 7.5 Millivolts per Cm. AC or DC • Accurate Time and Amplitude Calibration • Wide Band Video Amplifiers. • Delayed Trigger Output



The Tektronix Type 512 Oscilloscope is a truly NEW quantitative measuring instrument.  
The combination of DC amplifiers and single, recurrent or triggered sweeps ranging from 3 seconds to 30 microseconds is of particular interest to geo-physical, mechanical and biological research groups.

A continuously variable vertical sensitivity range of 10,000 to 1 (7.5 millivolts to 75 volts per cm.) is provided by a single switch plus fill-in potentiometer.

**Tektronix Type 512 Cathode Ray Oscilloscope**

## Outstanding Type 512 Features

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- Revolutionary carrier type blanking circuit,

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- Any 20% of sweep may be expanded 5 times for detailed signal study.
- All DC voltages, including accelerating potential, electronically regulated against line voltage changes.

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Your inquiry will bring more detailed information and name of the nearest Field Engineering Representative.



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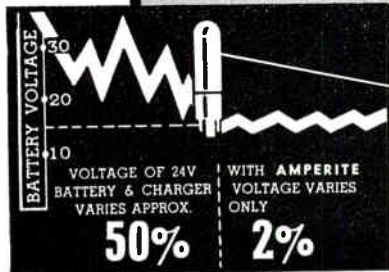
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**HEXACON ELECTRIC CO.**

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NEWS OF THE INDUSTRY (continued)

Network of the Armed Forces Radio Service in Tokyo, Japan.

WILLIAM L. EVERITT, head of the University of Illinois department of electrical engineering since 1944, will become dean of the University's college of engineering and director of its engineering experiment station in September, 1949.

JOSHUA SIEGER, engineering chief of Great Britain's wartime radar program, has been appointed director of research and development of Freed Radio Corp., New York City.



J. Sieger



W. H. Bennett

WILLARD H. BENNETT, former director of physical and applied research at the Institute of Textile Technology, was recently named head of the Physical Electronics Section of the Atomic and Molecular Physics Division, National Bureau of Standards. He will engage in basic research on cathode emission processes and the physical properties of negative atomic ions.

RANDALL MCGAVOCK ROBERTSON, formerly research associate of the Norton Co., and associated during the war with the MIT Radiation Laboratory airborne radar group, has been appointed acting director of the Physical Sciences Division of the Office of Naval Research.

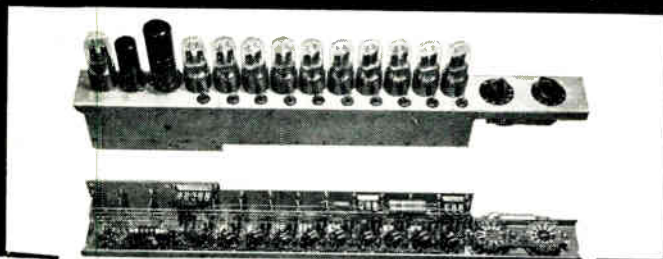
CHARLES S. RICH, formerly secretary of the AIEE technical program committee, has been named editor of the Institute's official publications, *Electrical Engineering and Transactions*, to succeed G. Ross Henninger who recently resigned.

A. K. WRIGHT, chief radio engineer of the Tungsol Lamp Works, Inc., Bloomfield, N. J., was recently appointed a member of the Joint Electron Tube Engineering Council.

ROBERT FINLAY, wartime procurement engineering counsel for the

## ELECTRONIC COUNTERS

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### BASIC DECADE COUNTER

To meet your specifications, basic decade counters are combined with electronic switching circuits by us to provide counters and timers for factory and laboratory.

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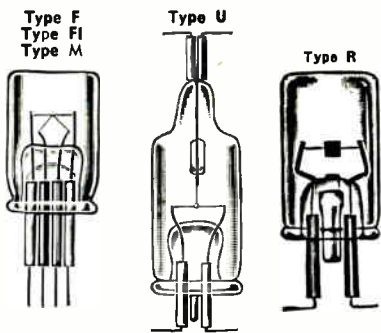
Over 150,000 counts per second.  
Elapsed time measured to less than 7 Micro Seconds.  
Decimal indication of count.  
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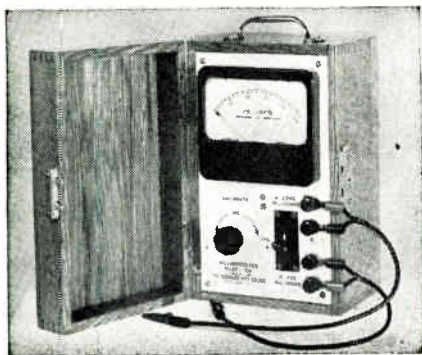
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ENGINEERED TO MEET THE MOST EXACTING REQUIREMENTS

Resistances can be read as low as 1/1000 of an ohm and as high as 2 ohms on a linear scale calibrated directly in milliohms. Readings simplified by evenly divided scale of 100 equal divisions and two overlapping ranges 0-200 and 0-2000 milliohms full scale deflection.

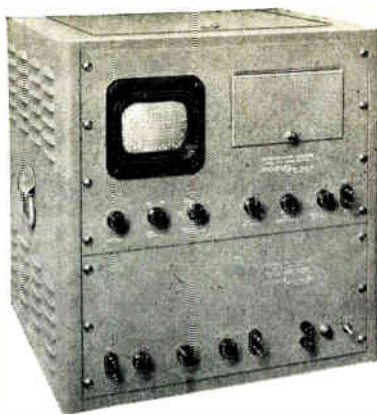
The lead resistance problem is eliminated. A breaker relay protects meter from damage. Housed in a portable, rugged, hardwood case, 9 3/4" x 6" x 4 1/2".

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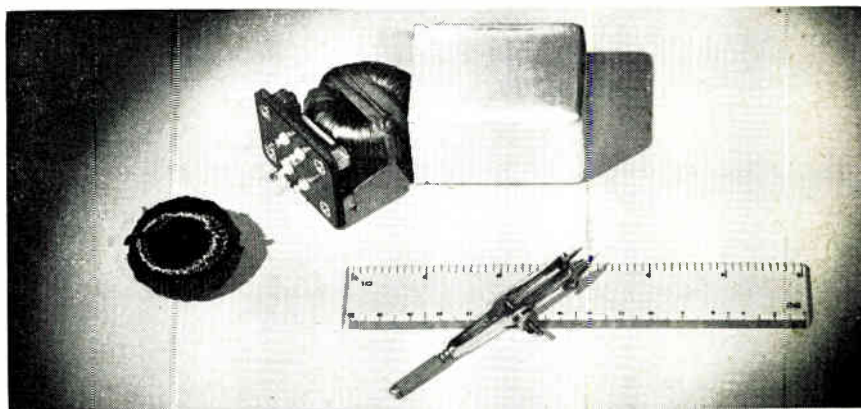
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Model AP-1 assures faster, simpler audio analysis by *automatically* separating the components of complex audio waves and *simultaneously* measuring their frequency and amplitude.

Whether your problem is investigation of harmonics, intermodulation, transmission characteristics, high frequency vibration, noise or acoustics, it will pay to look into the unusual advantages offered by the Panoramic Sonic Analyzer.

- Indications are spectrographic-frequency versus voltage
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Close-tolerance toroids from 3/4 in. o-d up. Wound to the rigid requirements of Lenkurt Carrier Systems, they can be made accurate within 0.1 per cent. Available to specifications with emphasis on magnetic and temperature stability.

Made with two balanced windings, tapped or untapped, impregnated or not, as required. Also available with close-coupled secondaries for impedance-matching applications. Write for further data:

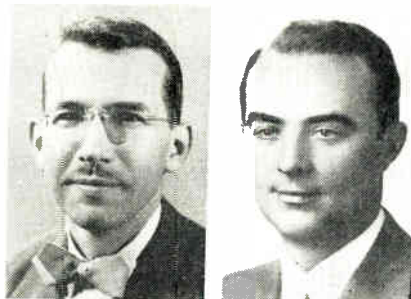
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**LENKURT ELECTRIC CO.**  
SAN CARLOS • CALIFORNIA

Hallicrafters Co. in Washington, has opened a consultant's office in Ridgewood, N. J., to serve as liaison between electronics manufacturers and government agencies.

EDWIN F. DILLABY, formerly with Hytron Radio & Electronics Corp., was recently appointed chief engineer in charge of the newly formed Tube Division of Tracerlab, Inc., Boston, Mass.



E. F. Dillaby

F. W. Walker

FRANK W. WALKER, formerly national president of the Associated Police Communications Officers and vice-chairman of Panel 13 of the RTPB, was appointed radio communication engineer in the state of Michigan by Motorola, Inc.

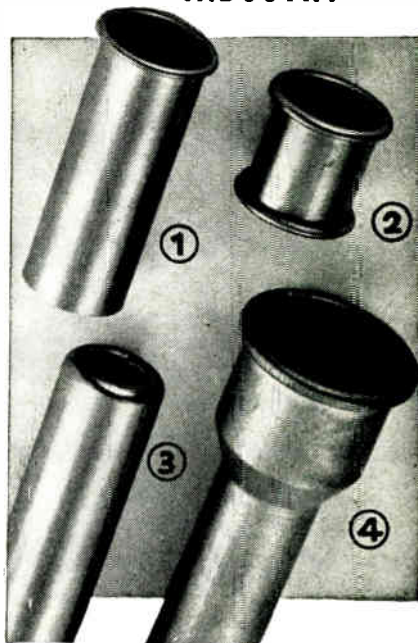
RALEIGH J. WISE, Telefax research engineer for Western Union Telegraph Co., has been awarded the 1948 Longstreth Medal from the Franklin Institute for his development of a dry electrosensitive recording blank.

RALPH A. KRAUSE, senior engineer consultant to Brookhaven National Laboratory, N. Y. and formerly assistant to the president of Raytheon Mfg. Co., has been named director of research at Stanford Research Institute, Stanford University, Calif.

JAY C. FONDA, former engineering consultant, has joined the Morris F. Taylor Co., manufacturers' representatives, as sales engineer.

D. GORDON CLIFFORD, one of the development engineers who worked on the klystron and formerly chief engineer of Industrial & Commerce Electronics, is now field engineer at Lenkurt Electric Co., San Carlos, Calif., manufacturers of carrier telephone and telegraph equipment.

## TUBULAR PARTS FOR THE ELECTRONICS INDUSTRY



Anodes and Grid Cylinders for television and cathode ray tube gun structures, are a Superior specialty that is now a standard for the electronics industry.

Parts illustrated are:

1. Tube rolled on one end—.520" O.D. x .500" I.D. x 1.378" long, rolled to .600" diameter used as an anode in television tube gun structure. Superior Print ET-28, Part 3.

2. Tube rolled on both ends—.500" I.D. x .010" wall x .590" long, rolled on both ends to .590" diameter—used in rectifier tubes. Superior Print ET-10, Part 1.

3. Tube with inverted roll on one end—.520" O.D. x .500" I.D. x 1.850" long . . . cylinder for use in television tube gun structures. Superior Print ET-36, Part 1.

4. Expanded and rolled end tube—.500" I.D. x .012" wall x 2.600" long, after expanding one end to .760" diameter, and rolling same end to .915"—used as focusing electrode in television tube gun structure. Superior Print ET-9, Part 1.

Tubular parts, also available in straight and angle cuts, can be produced to your specification or to standard Superior design.

We invite your inquiry for further information.

**Superior**  
THE BIG NAME IN SMALL TUBING .101" TO 5/8" O.D. MAX.

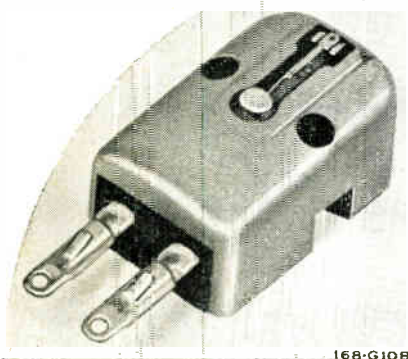
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- Specifically designed for the new long playing records... high compliance... low mass stylus assembly
  - Equipped with 1 mil tip radius sapphire stylus
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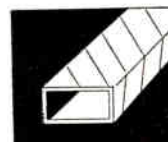
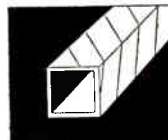
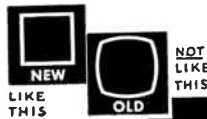
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Precision DI-FORMED Paper Tubes have made a most important improvement throughout coil industry. Now ALL coil manufacturers and users can take advantage of the opportunity to obtain Precision DI-FORMED square and rectangular paper tubes for coil bases, at no extra cost!

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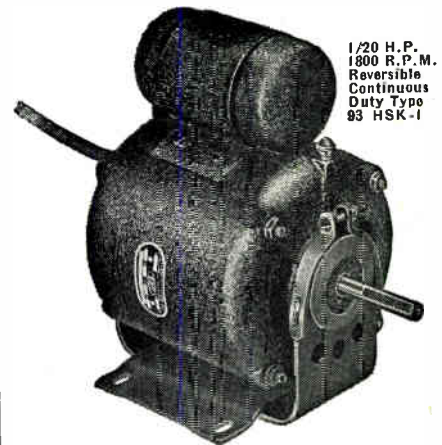
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1/20 H.P.  
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Continuous  
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- NO NOISE
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Disc, wire and film recorders  
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600 R.P.M.  
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Instantly reversible with D.P.D.T. switch! H.P. ratings 1/150 to 1/30 depending on speed combination selected. Round Frame, Resilient Mount, Rigid Base.

The hysteresis design of these new Synchronous Motors lowers noise and vibration level to a fraction of that normally present in conventional salient pole construction. Unaffected by load inertia.

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## NEW BOOKS

### Frequency Analysis, Modulation, and Noise

By STANFORD GOLDMAN. McGraw-Hill Book Co., New York, 1948, 434 pages, \$6.00.

THIS BOOK is unique in that three virtually unrelated fields are under study. The first, frequency analysis, is obviously stimulated by the author's dissatisfaction with the brevity it usually receives in texts designed to present a variety of mathematical methods at the engineer's level. A total of 140 pages is devoted to the subject; the basic Fourier transforms, in series and integral form, are developed in swift, palatable form, and much attention is given to simplifications which result from various types of symmetry. In addition, a variety of problems is treated to illustrate applications of the Fourier technique, most noteworthy perhaps being those that deal with detail and bandpass requirements in television and pulse receivers.

The portion on modulation is much shorter than the other two, and accordingly not as comprehensive. Instead of attempting a swift course through the entire present status of the art, the author has chosen to organize and expand special items which so far have been treated only in periodical literature. For example, the technique of resolving an arbitrary sideband distribution into symmetrical and antisymmetrical components is treated in some detail, while on the other hand little is said about the means for generating or detecting various modulation types, or about such topics as single sideband, suppressed carrier, and pulsed code.

The final section on noise constitutes the greatest portion of the book, and meets a need long felt by communications engineers who, concerned with noise problems, must refer to the scattered publications of Nyquist, North, Ferris, Schottky and many others. In this book the fundamental contributions of these workers are integrated into a broad, coherent presentation. In an introductory chapter, the author chooses to outline the several types of noise, state the formulas which

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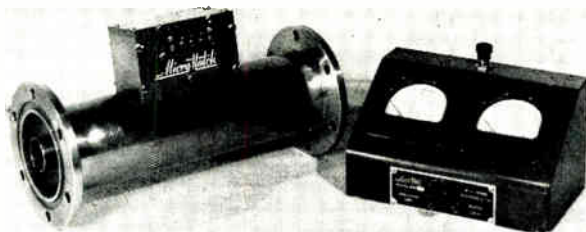
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Our engineers will select or develop rectifiers or photo cells to meet your needs exactly. Write for BRADLEY LINE showing basic models.

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Measures SWR  
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MM 205 series Specifications  
Frequency range 40 to 220 MCS  
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Impedance (205) 51.5 Ohms (206) 72 Ohms  
Connectors Standard flanges for 3/8" line  
Wattmeter scale 0 to 1.2, 4, 12, or 40 KW  
Accuracy  $\pm 4\%$



Micro-Match gives you direct reading of SWR and power—providing at-a-glance assurance of the proper functioning of the complete RF portion of your transmitter and of your antenna system and transmission lines. Price complete \$200. Micro-Match models available for operation at 500 KC to 400 MCS, and power levels of 2 to 50,000 watts.

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Distributed outside continental U.S.A. by RCA International Division Radio Corporation of America.

## rpc HIGH VOLTAGE RESISTORS



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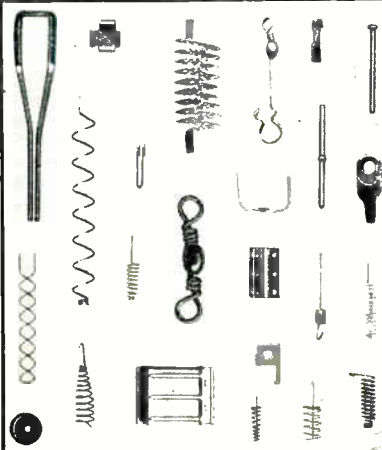
These stable resistors are made in many sizes from one inch to 18½ inches long, for voltage as high as 125 KV. Power ratings range from one watt up to 90 watts. Resistances can be furnished up to one million megohms. RPC High Voltage Resistors are used by leading manufacturers, instrument makers, universities and laboratories.

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Filaments, anodes, supports, springs, etc. for electronic tubes. Small wire and flat metal formed parts to your prints for your assemblies. Double pointed pins. Wire straightened and cut diameter up to 1/8-inch. Any length up to 12 feet.

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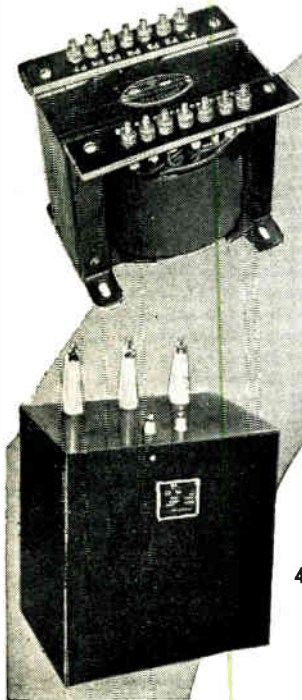
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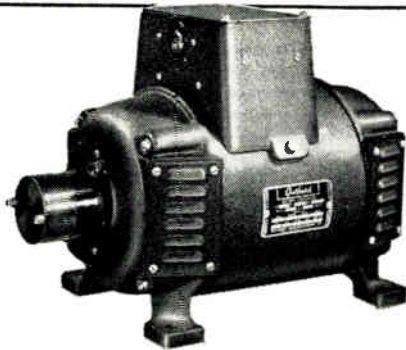


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NEW BOOKS

(continued)

apply, and show via many examples and circuits how to calculate such things as total noise, noise figure and sensitivity. In the remaining three chapters the noise formulas are derived in a unified and straightforward manner; the necessary fundamentals of probability and statistics are first established, and from these the well-known noise formulas are developed.

In addition to the many problems which are used to illustrate techniques and applications, the book contains extensive reference to pertinent literature and publications.—**JOHN F. MCALLISTER, JR.**, Specialty Division, General Electric Co., Syracuse, N. Y.

## **Electronic Musical Instruments**

By **S. K. LEWER**, Published by *Electronic Engineering*, 28 Essex St., London, W. C. 2, England, 1948, 101 pages paper bound, 3/6 net.

THIS is one of the series of Technical Monographs published in England. Like others of this series, it comprehensively covers its subject. Following a general introduction discussing the factors influencing musical reproduction and the distinction between synthetic and natural sources of music, the author discusses in order: acoustics of music, classification of instruments, electrostatic, electromagnetic and photoelectric tone generators, and finally amplifiers and tone control circuits.

Although the basic principles of most of the more successful instruments in the field are described, no detailed circuits with values are given. For the true electronic experimenter, the lack of values is no drawback and the focus of attention on principles is a decided advantage. However, for the home experimenter and musician with only a passing acquaintance with electronics, the lack of complete circuits with values is a decided disadvantage. The copious list of literature mitigates this shortcoming somewhat.

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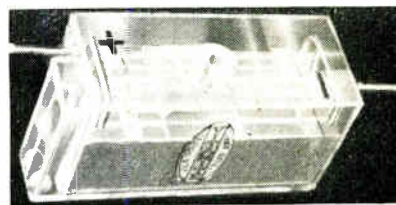
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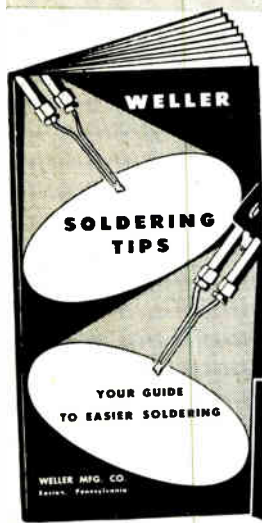
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NEW BOOKS

(continued)

musical instruments (Proc. IRE, p 1427, Nov. 1936) has there been a survey of this specialized field. In coordinating the principles on which the modern instruments operate, the author has epitomized the experience of the past decade and placed in the hands of the qualified designer the basic knowledge he needs to be able to build on the shoulders of others.—F. H. R.

• • •

### Books Received for Review

**MATHEMATICS—OUR GREAT HERITAGE.** Edited by W. L. Schaaf. Harper & Brothers, New York, 1948. 291 pages. \$3.50. Essays by various authors, largely nontechnical, chosen to emphasize man's esteem for mathematics and mathematicians through the ages.

**FUNDAMENTALS OF ELECTRICAL ENGINEERING.** By V. P. Hessler and John J. Carey. McGraw-Hill Book Co., New York, 1948. 241 pages. \$3.50. Written to bridge the transition for college students from science courses in the physics department to design courses in the engineering department, this book on circuits, machines and electronics emphasizes the nature of basic relations; that is, whether they are observed facts, definitions, derivations or generalizations.

**A.S.T.M. STANDARDS ON NONMETALLIC MATERIALS.** 1947 supplement to part III-B. Published by American Society for Testing Materials, 1916 Race St., Phila. 3, Pa. 305 pages, paper cover, \$4.00. New and revised standards on electrical insulation, plastics, rubber, paper, shipping containers and adhesives, accepted since appearance of the 1946 Book of Standards. Includes revised tentative specifications for natural block mica and mica films suitable for capacitor and revised tentative tests for power factor and dielectric constant of electrical insulating materials.

**POWDER METALLURGY.** By Paul Schwarzkopf. The Macmillan Co., New York, N. Y., 1947. 356 pages. \$8.00. Five chapters on powder processing methods, seven on products (including one on electric contact materials and one on magnetic materials), three chapters on theoretical principles, and a 47-page supplement reviewing recent developments. Includes literature and patent indices, technical diary material, and unrestricted presentation of experience resulting from author's thirty years in the field of powder metallurgy.

**BASIC MATHEMATICS FOR RADIO.** By George F. Maedel. Prentice-Hall, Inc., New York, 1948. 339 pages. \$4.75. Arithmetic, algebra, geometry and radio mathematics. A revision of "Mathematics for Radio and Communication," with new title.

**FUNDAMENTAL PRINCIPLES OF IONOSPHERIC TRANSMISSION.** Produced by The Inter-Service Ionosphere Bureau at the Great Baddow Research Laboratories of the Marconi Wireless Telegraph Co., Ltd. Published by His Majesty's Stationery Office, London, York House, Kingsway, W. C. 2, 1948. 82 pages, paper bound, 1s. 6d. Originally written 1943, mostly by G. Millington of the Marconi Co., to acquaint engineers with radio propagation problems, this monograph has been brought up to date and made generally available as a comprehensive qualitative summary of the subject.

**RADIO INDUSTRY RED BOOK.** Compiled and published by Howard W. Sams & Co., Inc., Indianapolis, Ind., 1948. 448 pages, paper cover, \$3.95. Reference book giving replacement parts data for 1938 to 1948 radio receivers. Specific model numbers of correct replacement parts available from various manufacturers are

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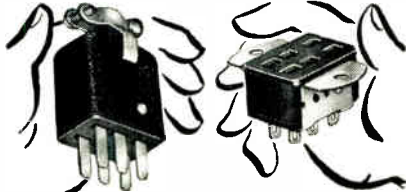
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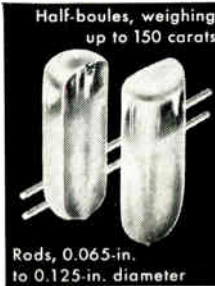
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(Temperature at which resistance becomes 1 megohm)	
Melting Point . . . . .	2,030 deg. C.
Thermal Conductivity . . . . .	0.015
(cal. sec. <sup>-1</sup> cm. <sup>-1</sup> deg. C. <sup>-1</sup> at 500 deg. C.)	
Thermal Expansion Coefficient . . . . .	8.3 to 9.0
(per deg. C. x 10 <sup>6</sup> at 1,000 deg. C.)	

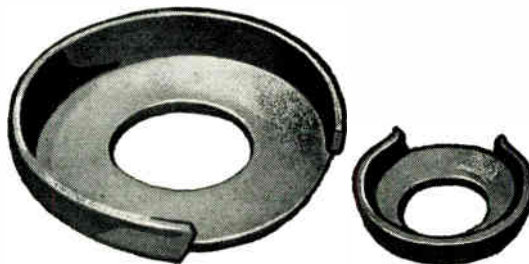


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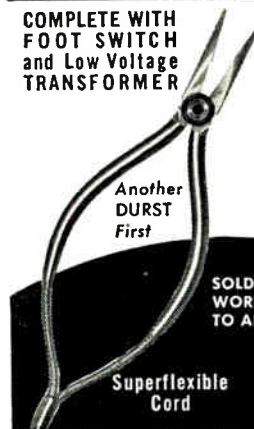
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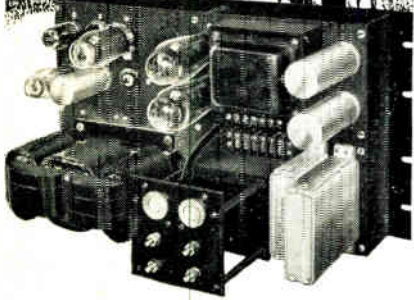


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**PRACTICAL DISC RECORDING.** By Richard H. Dorf. Radcraft Publications, Inc., New York, N. Y., 1948, Gernsback Library No. 39, 96 pages, paper cover, \$.75. Composition of blanks, design features of motor, turntable, feed, cutter, stylus, and amplifier, equalization problems, recording procedures, playback, duplication, possible troubles, and glossary.

**RADIO AT ULTRA-HIGH FREQUENCIES, Volume II (1940-1947).** Published by RCA Review, Princeton, N. J., 1948, 485 pages, \$2.50. Eighth volume in RCA Technical Book Series and second on radio at higher frequencies. Presents papers by RCA authors on antennas and transmission lines, propagation, reception, radio relays, microwaves, measurements and components, and navigational aids, along with a bibliography and summaries of all papers in the predecessor Volume I now out of print.

**ELECTRIC EYE CIRCUITS AND RELAYS.** By A. Edelman, chief engineer, Photobell Co. Published by Eby Specialty Sales Co., New York, N. Y., 36 pages, 1948, paper-bound, \$1.00. Principles of photoelectric detectors, optical systems, amplifiers, power supplies and relays are presented for technicians. Typical circuits are shown, along with suggestions for maintenance.

**ELECTRON-OPTICS.** By Dr. Paul Hatcheschek, American Photographic Pub. Co., Boston, Mass., 1948, 2nd ed., 183 pages, \$3.50. This translation from the German (originally published in 1937) has had two additional chapters added, one on electron microscopes at the time of translation (1944) and another on nuclear accelerators and radar with the publication of this second edition. Primarily for laymen and electrical engineers who have not specialized in electronics, this book describes electron lenses, television tubes and how electron optics is used in amplifiers.

**UNDERSTANDING TELEVISION.** By Orrin E. Dunlap, Jr. Greenberg: Publisher, New York, 1948, 128 pages, \$2.50. History, process of seeing by television, what television performers should know, questions and answers, glossary, bibliography and list of stations on the air, written for the layman. Liberally illustrated.

**RADIO AND TELEVISION LAW.** By Harry P. Warner. Matthew Bender & Co., 149 Broadway, New York, N. Y., 1948, 1,095 pages, in looseleaf binder, \$30.00. Reference book on radio broadcasting industry's legal and regulatory structure, explaining the law in plain language and tracing the legal, financial and technical history of an a-m, f-m and television station in turn from first filing of the application with the FCC on through going on the air and receiving a regular license. Covers what can and can't be broadcast, transfer and assignment of licenses, network regulations, probable amendments to Communications Act, control of radio advertising, and many related topics.

**NATIONAL ELECTRICAL SAFETY CODE.** National Bureau of Standards Handbook H30, issued March 1948, 408 pages, \$1.25 from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Contains first five parts of fifth edition of code, as approved by ASA; part 6 is now being revised. The five parts cover mandatory (shall), advisory (should) and desirable (recommended) practices for electrical supply stations, electric supply and communication lines, electric utilization equipment, electric equipment and lines, and radio installations.

**RADIO COMPONENTS HANDBOOK.** Written and published by the staff of Technical Advertising Associates, Cheltenham, Pa., 211 pages, \$1.50. Intended to bridge gap between formal textbook and general handbook. Covers design, application and specification of each type of component in turn, plus an opening chapter on general design problems. Sponsorship by The Foster Transformer Co., The Magnavox Co. and Ward Leonard Electric Co. makes the low price on this book possible.

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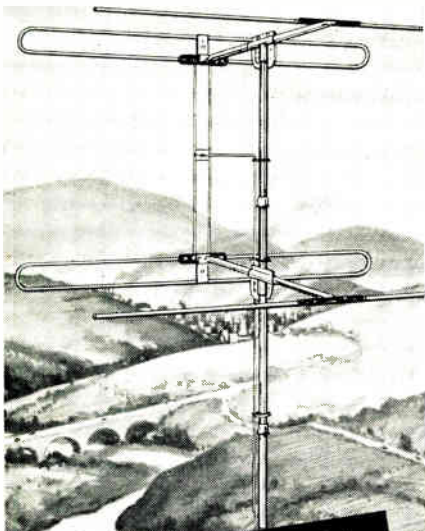
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# Backtalk

This department is operated as an open forum in which our readers may discuss problems of the electronics industry or comment upon articles that ELECTRONICS has published.

## Half-Wit

DEAR SIRs:

WE HAVE read with interest in Crosstalk of September 1948 ELECTRONICS your suggestion on Semicons as a name for devices employing a semiconducting material in the solid state, through which flows a current capable of being varied by external physical influences.

But please, we beg you, do not launch that word Semicon. We in Europe have to rely on U. S.-made words for new principles and appliances in the field of radio and electronics. Generally, we have no choice but to take over the new words.

If you know that the word "con" in French means a half-wit, you will probably understand our pains and troubles.

P. H. BRANS  
*De Radio Revue  
 Antwerp, Belgium*

## Transductors

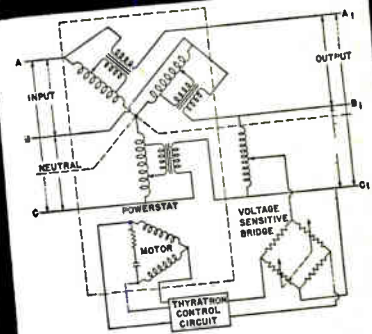
DEAR SIRs:

BECAUSE OF communication difficulties, the galley proof corrections for our paper Transductor Fundamentals (p 88, Sept. 1948) apparently arrived too late to be made.

One error concerns the simplified transductor symbols. The symbol is intended to replace the whole transductor in all its elements. In redrawing the diagram of the elementary current-controlled rectifier, two such symbols have been used where one is sufficient. The arrow indicating self-excitation should be used both when a self-excitation winding and simplified self-excitation are used. Arrows on control windings indicate the direction of the self-excitation, the winding direction being the same.

The diagram of the avostat recti-

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**GENERAL ELECTRIC**

BACKTALK

(continued)

fier circuit is drawn with symbols understood in another way, and the result is rather confusing. If the symbols are understood as described above, the diagrams will be simpler.

Equation 3 should read

$$i = (E/R) \cos \phi [\sin (\alpha - \phi) - \sin (\alpha_0 - \phi) \exp - \cot \phi (\alpha - \alpha_0)]$$

In the middle of the third column on p 92 is the statement: "and flows in branches 1A and 2A of the rectifier..." A glance at Fig. 5A shows that it is actually branches 1B and 2A.

Equation 11 should read

$$\tau = \frac{2L_S}{R_S} = N_S \frac{\phi_2 - \phi_1}{R_S \Delta I_S} = \dots$$

S. E. HEDSTROEM  
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## Insert One Zero

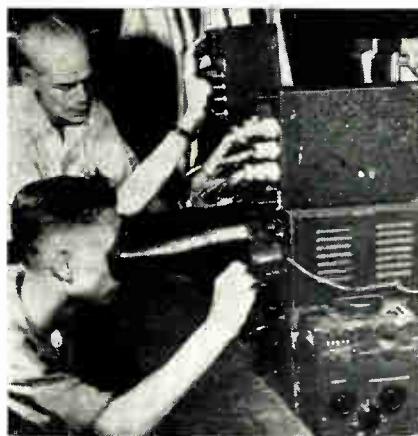
DEAR SIRs:

IN MY wide-band phase shifter article in the May, 1948 ELECTRONICS, the lower of the two capacitors immediately adjacent to the input transformer in Fig. 3 on p 84 should be labelled 0.000892 instead of 0.00892. The mistake, I am sorry to say, is mine.

The circuit is the example given by Dome in his December, 1946 ELECTRONICS article, referenced in mine, and it is hoped that anyone undertaking serious work with these networks will refer to the Dome article.

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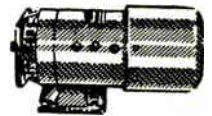
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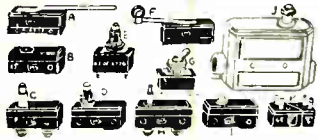
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- E) ARROW HI & H PLUNGER SPNO/8A @... .39
- F) MICROSWITCH ROLLER SPNC 10A @... 1.09
- G) AH & H Toggle 6A/DPST 30c @ 4 for... 1.09
- H) MICROSWITCH PLUNGER SPNO NC @... .59
- I) MU & MICROSWITCH SPDT w/reset... .65
- J) MICROSWITCH PLUNGER Button SPDT @ .69
- K) MICROSWITCH SPNO/30 Amp/Cased @...1.25
- L) SWITCHETTE DPNO&NC 30c; SPNO @... .25

**2 1/2" MTR BUTTERFLY**  
COM DSR 30mm/10 R.F. Tank & choke "TAB" SPECIAL 45 @ \$1.25  
**PHASING COND SR. 90°**  
Quadrants/4 taps, 360° SINE-WAVE GENERATOR Variable \$2.39

**COMPLETE TELEVISION POWER SUPPLY Kit III Voltage 5000VDC/5ma**  
LO Voltage 300VDC/175ma output, fl 6.4V/10.3A, fl 5.4V/8A, 5.1V/3A & 5V/3.5A Inpt 105, 115, 125V/50 to 425ers & choke & diagram oil filled USN Transf W.E. D303184 "TAB" SPECIAL... 24.95  
SAME TELEVISION POWER SUPPLY KIT & added parts for providing III VOLTAGE DOUBLER circuit—with 10000 Volts dc output... 32.95

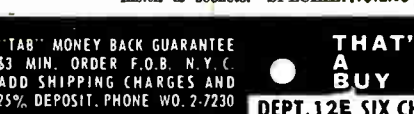
**TRANSFORMERS 115 V/60 Cy. Input**  
7500V or 15000V DOUBLER/35ma \$15.95  
10800VCT or 21000V DOUBLER/35ma 19.95  
500VCT/60ma, 6.3V/4A Hittelly Cased 1.29  
1100VCT/212ma \$5.95; 10V/8A/19KV 6.95  
5V/115Amp \$10.95; 2.5V/10A/10KV 3.95  
250 to 440V or -110 to 220V 250watt 4.95  
880VCT/125ma 6.3V/2A, 6.3V 3A & 5V/3A de-IRTS 250ma on hls 4.45  
5V/60Amp KENYON HV Instn 6.95  
840VCT/110ma, 540VCT 11ma, 5V/3A, 5V/3A & 6.3V/1A, 6.3V/1A USN Csd 2X safety factor 4.95  
2.5V 40Amp GE Insln 93KV 7.95  
6800V or 6000V Amp/17KV Insln, 208 to 251V \$59.50  
340V or VCT/10Amp/2KV Insln 107 to 126V \$59.50  
115 or 230V/10Amp/2KV TRANSFORMER 18.95  
115 or 230V 8Amp/1.8KV AUTOTRANSF. 16.95  
5V/6.5Amp/36KV Insln & socket UX 6.95  
7.5VCT 6.5A, 6.3VCT/3A 3.75  
700VCT/150ma, 10V/3.25A, 2.5V/10A & 3VCT/2A, 5V/3A, 6V Insln Cased 5.95  
1100VCT/150ma, 6.3V/3A, 11V Ins. 4.50  
10V 8A/12KV or 2c5V/8A/12KV Ins. 6.95  
1000VCT/150ma, 300Vblns, 6.3V/5A, 5V/2A & 2c6.3V/6.5A, 6.3V/1.25A CSD50-800ers & prt fans 0-80 115VAC Hmt sealed 4.50  
7.5V/12A HV \$4.95; 4.5V/2V 4A & 3.5V/1A 4.50  
10VCT/10A/220V or 5VCT/10A/110V 4.95  
5VCT/20A/220V or 2.5VCT/20A/110V 4.95  
10VCT/10A, 12VCT/7A, 8cV/1A, 2cV/2A 7.95  
3c5V/3A, 2.5V 1.75A, 6.4V/12A, 6.4V/10A 4.95  
1200VCT/300ma & 780VCT, 12VCT/5A 12.95  
320VCT/120ma, 115V/100ma, 6.3V/2A & 6.3V 2A, 5V/2A CASED HV Insln 3.25  
Universal Vibrator Transf 6.12.24, 115DC & 115V & 230VAC 50-60c, 420VCT/5ma, 6.3V/3A 500V/3A \$10 @ 2 for \$19; 7.5V/24A/2200.S. 3.95  
223VCT/500ma, 7-1105 to 250V/50-60c hmt & 2.5V/10A, 12V/4.5A, 19V/2.5A \$24.95 @ 2 for 47.00  
250VCT/60ma, 6.3V1.5A Small 1.49

**AUDIO LINE XFORMER**  
Super File & UTC can be used 600 ohm line input or 600 ohm line out. 2-300 Input: OPT to grid or Mike or 500 ohm line or 100V Imped or HIGH Imped headst: 3 wdg 600 C.T. & 4000 ohms tapped 250 & 150 ohms. Fully shielded hmtly sealed. BARGAIN 59c. 2 for \$1.00 BARGAIN—Dynamic Mike 85c/mr. 98c

**CHOKES**  
13.5H/1Amp/42ohm/17KV Insln \$48.00  
15-20H/150ma Swinging Cased 2.95  
12H/300ma \$3.95; 3H/40ma 3 for 1.00  
12H/100ma or 20H/100ma/12KV Ins. 7.95  
8H/150ma new UTC ckdlt Blite TBd. 2 for 2.25  
50H/125ma Csd 1.95  
8H/100ma/\$1.10; 12H/275ma 3.29

**RF CHOKES**  
A) HAMMARLUND CH500/2.5MH/50ohms/600ma .98c  
A) 20 MH/500 ma/14.75ohmsDCR/8mmf dist Cap w/mtr ft & 4 1/2" nite crts, lug term, ceramic core. 98c  
B) SICKLES 85MH/250ohms/ceramic form. 69c  
C) NATIONAL R152/80 & 160rns/20ma 28c @ 4.98  
C) 20 2.5MH/125ma & 01. & 002c dcr & R resist. 45c  
D) 5MH/300ma, pl. wound. 29c  
E) MILLER 2 1/2 & 5mtr/2.5MH/1A 25c @ 5/98c  
F) NATIONAL R152/80 & 160rns/3MH/600ma. 98c  
G) SICKLES HP 20MH/200ma/75ohms. 49c  
H) Hack Chokes for Mercury Vapor Tct @ 25c. 5/98c  
I) SICKLES 1.5MH/200ma ea. 25c @ 5 for 98c

**KIT 866A's & XFORMER**  
Input 115 VAC/50-60 cys, output 2.5 VDC/10 Amps 10 KV Insulation and JOHNSON sockets & TUBES. SPECIAL \$5.95  
KIT GE872A's & XFMR. 12.5 KV. Insln & sockets. SPECIAL...\$12.95



TAB MONEY BACK GUARANTEE \$3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO. 2-7230

THAT'S "TAB" THAT'S A BUY

TAB MONEY BACK GUARANTEE \$3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO. 2-7230



FREE! Get on the "TAB" Bargain Sheet Mailing List. Write Now.

PRECISION RESISTORS Specialists in Precision Resistors Write for Quantity Prices

"NO MFGRS CHOICE, We ship types in stock"

116	182	689	2750	14440
42	199	677	2800	14400
425	200	700	14500	14500
607	209.4	733	2900	15000
7	216	750	3000	15500
1.3	220	800	3100	16500
1.75	220.4	806	3290	17000
2.5	225	854	3384	17500
2	230	900	3500	18000
3.83	235	910	3509	18380
4	240	917	3700	18500
4.35	245.4	946	3730	18800
5	250	978	3760	19000
5.025	260	1000	4000	19500
6	271	1030	4280	20000
6.25	275	1056	4280	20200
7	280	1060	4300	20200
7.5	286	1100	4314	21500
7.8	289	1110	4440	22000
7.9	299	1150	4444	22500
8	300	1185	4500	22900
10	310	1162	4720	23000
10.38	311.5	1175	4750	23150
10.48	320	1200	4850	23325
11.25	325	1225	4885	23400
12	340	1250	4900	24000
13.2	350	1300	5000	24600
14.2	366.6	1322	5100	25000
14.5	370	1350	5210	25200
15	375	1355	5235	25400
16	380	1400	5200	26600
16.37	390	1495	5500	27500
17	410	1500	5600	28000
20	410	1510	5700	28000
21	414.3	1518	5910	28900
25	418.8	1600	6000	30000
26	425	1640	6140	31000
30	428.9	1646	6200	31000
37	427	1650	6300	35000
38	440	1662	6400	35000
50	450	1680	6500	38400
51.78	452	1710	6840	39500
55	470	1740	6990	39500
60	475	1770	7000	40000
63	478	1800	7500	43000
68	480	1816	7700	47000
71.4	487	1830	7900	48000
74	490	1865	8000	48600
75	520	1900	8250	49000
80	525	1910	8500	50000
81.4	540	1960	8700	52000
89.8	550	1960	8890	54000
90	575	2000	8900	56000
95	580	2045	9445	60000
100	600	2080	9500	61430
101	607	2095	9710	62000
105	612	2145	10000	64000
105.7	625	2160	10430	65000
107	633	2195	10500	68000
113.1	640	2200	10600	70000
120	641	2250	11000	72000
121.2	649	2300	11400	75000
125	650	2400	11500	80000
141.5	657	2450	11600	84000
160	665	2463	12000	60000
160	669	2485	12600	91000
165	670	2490	13200	95000
170	675	2500	13500	

ABOVE SIZES EACH 30c @ .10 TEN FOR \$2.50  
100000 to 950000 ohms, over 100 times. Specify size desired... 1.00  
1 Meg 2.25 \$ 3.5 Meg 4.23 \$ 10 Meg 11.5 \$  
1.2 2.855 \$ 3.73 4.5 \$ 11.5 \$  
1.6 3 3.9 \$ 5 \$ 12.83 \$  
1.8 3.673 4 \$ 9.05 20

ABOVE SIZES EACH 75c @ .10 TEN FOR \$6.50  
**Vacuum Precision Hi-Volt Resistors (C)**  
1. 1.5, 2, 3, 3.75 megohms 0.5% accuracy SPECIAL \$1.00 @ .10 TEN FOR \$7.50  
SEALRD. 10 or 12 Meg/10KV/0W. \$1.35 @ 10 for \$10.00  
NVC/820Watt/30Mc/ohms/25KV \$1.98 @ 6 for \$10.00  
MFB100 1Meg/5c accv/Jan. R-29 1.98 @ 6 for \$10.00  
20Meg/1ANR29/20KV/0.5% accv. \$29.95  
200R/175Watt/0-135V GR 10.95  
200C/80Watt/0-135V GR 16.50  
100R/0-2500r/270/2KV/1150r/220V In 39.95

**VARIABLE CONDENSERS**  
A) 150mm/3000V gap HF \$1.00  
B) DUAL 15mmf per Sect/3000V gap. .79  
C) DUAL 75mmf per Sect/1000V gap/HF 1.49  
D) 70H30/4mmf/3000V gap 1.29  
E) Neut 27/12mmf/5000 gap & locknut. 98c  
VACUUM CONDENSERS 50 mmf/7500V 2.95  
VACUUM CONDENSERS 100mmf/7500V 4.95  
VACUUM CONDENSERS 50mmf/20KV. 6.95

**Test Instrument Specials!**  
Pocket VOM-18 ranges Volts AC DC Ohms leads 13.90  
New Tube Tester, tests all modern types w/chart 20.90  
Write for info on above instruments.



**SPECIALS! Popular Items**  
A) 5Mfd 600VDC oil cond & brackets 69c @ 2for 98c  
B) JACK telephone W.E. type 630 @ 4for... 1.00  
C) 2Mfd 330VAC/1000W VDC 49c @ 3for... 1.00

**MICA CONDENSERS**

Fig.	Mfd	WVDC	Each	Fig.	Mfd	WVDC	Each
D .0002	500	\$0.20	D .006	600	\$0.25		
D .0003	600	.20	E .006	2500	.98		
E .0004	2500	.35	E .0062	1200	.40		
E .00047	2500	.35	D .008	600	.25		
E .00055	600	.30	D .0082	2500	1.00		
D .00089	1200	.25	E .01	500	.25		
D .001	500	.20	D .01	600	.30		
D .001	750	.20	D .01	1200	.60		
E .0012	600	.20	E .01	1200	.60		
D .002	1200	.30	D .01	2500	1.25		
E .002	2500	.75	E .01	2500	1.25		
D .003	600	.25	E .013	2500	1.00		
E .003	600	.25	E .015	2500	1.30		
E .0035	2500	.75	E .02	600	.45		
D .0039	2500	.85	D .026	500	.65		
E .0043	2500	.95	D .03	600	.98		
D .005	600	.30	E .03	600	.98		
E .005	600	.30	E .03	1200	1.45		
D .005	1200	.40	E .033	1200	1.00		
E .005	2500	.95	E .033	1200	1.90		
E .005	3000	1.25	D .043	600	1.65		
E .0051	1200	.35	E .05	600	1.90		

F) G.E. Interlock Safety Switch 650 @ 2for... 98c  
G) BARRIER STRIP—Jones, Amphelon, etc. All types & sizes—Specify. Write for prices.  
H) TUBE CLAMP Birtcher 50r... 1.00  
I) COUNTDOWN Counter Reset 650 @ 2for... 1.49  
J) JACK Phone Plug 1L68 618 @ 7for... 1.00  
K) JACK Phone Plug 1L55 618 @ 7for... 1.00  
L) JACK Phone Plug 1L55 620 @ 6for... 1.00

**HIPOWER VARIABLE ANT. Matching Netw/k 100A/1KV W.E. 35V 1.5-500c convertible Hi-Freq. PI Net add IN&OUT CSD 15x15x23" Rack/Mtg Ribbon Coil & 250mmf/700V Cndsr. 10Pmtr. Inslns & Manual. Matches most ANTS. BRAND NEW \$12.95**  
NEW, rec. recent coil turns... \$9.95  
NEW, broken coil... 8.95

**HEINEMAN MAGNETIC BKRS.**  
10 ma, 220 ma 3, 5, 10, 15, 20, 30, 40, 80 & 180 amps New, each 1.95... 10 for \$8.00  
SQ.D. KLIXON & CH 5, 10, 20, 25, 33, 50 & 60 70 Amps, 98c each... 10 for \$8.00  
THERMOSTAT 35°F/20A adjustable. 49c

**NAVY LINE FILTERS**  
NAVY LINE FILTERS 10 amp/130V AC DC Cased filters 0.1 to 1000 mc/150V. \$1.29  
TOBE 30 amp/250V AC DC filter 0.15 to 1000 mc/USN Cased Cont. \$4.50 @ 2for... \$8.00  
GE 100 amp filter & 2x5 mtd/50V pyranol Condns works 110 V AC DC SPECIAL 98c @ 2 for \$1.75

**Collins Art-13 Speech Amplifier**  
Dynamic or Carbon Mike or line Inpt. Audio Driver to PPG & Monitor tube. Less Tubes \$3.98  
SAME & CLIPPER KIT & TUBES & Data. NEW \$8.25

**DUPLEXER USN CTZ50ACW**  
IDEAL for TELEVISION, RECEIVING or XMITTING; permits use ONE Antenna for Two RECEIVERS or REPEATER XMITTER or for isolating ONE INPUT signal to TWO SOURCES; without loss in output or signal interference. Consists of COAXIAL INPUT feeding TWO coaxial outputs each having an adjustable TUNABLE LINE for phase shifting; Vornier calibrated dials & locking device. Designed for 115v ac silver plated thruout. Complete with SIX COAXIAL PLUGS & detailed installation instructions. Ruggedly constructed & shielded. \$9.95

**RELAYS—FAMOUS MAKES**  
AUTOMATIC R474 Remote Control Reset Stepping Twin Coil 240V/DP10 Circuit... \$8.95  
W.E. 263A Telephone 275ohm dual coil 2 section each 25 pole DTNO palladium cts... \$10.95  
CLARE A12280/115V 60Hz SPDT & 3SPNC. \$2.98  
CLARE Octal based 115VAC/DPNC & SPNO. \$2.98  
CH/B operates 700VDC/200V AC/200V AC. \$2.98  
W.E. U682 Telephone coil 500ohm 121°NO palladium contacts adjustable tension... \$2.98  
S'DUNN 32AXX10 Reset & load 10ma & 115VAC \$4.98  
S'DUNN 17AXX109/115VAC/SPNO 610:30A cts. \$1.98  
KURMAN 4maSens 650ohm/DP1NO&INC/5A. \$2.25  
LEACH 115VAC/DPDT/10Amp contacts... \$1.98  
A Bradley 702/110VAC/3SPDT/DPDT/10Amp. \$4.49  
ADVANCE 4001B Antenna DPDT/SPNO 15Amp Ceramic HF ins 750110V52.75 @ & Rec115VAC \$3.25  
A Bradley Overload ad118/15/2/12/9 & 6.3A... \$3.98  
Potter & B 115VAC/DPNO 8A contacts... \$1.79  
CLARE VAC Nitrogen shd SK5010/DPDT/18-25 3Amp Cts octal base @ \$1.49 w/115VAC rec. \$1.98  
GE Inst V Col Ref 10. 85, 110, 160V/0r115VAC \$9.95  
A'Chairms Prec. Comp 194 Thermo/Load... \$7.95  
G'DIAN 750ohm/50DC120sec delay/31ST... \$1.79  
GE CT2792B 117A3/28V/50A/SPNO Dbl Bk... \$1.98



BATTERIES Storage and Dry Types

- A) RHIS B152 5oz/36v minISlaty \$1.49
B) 8 for \$10.00
C) BURGESS 3V F21P/dated/67 Special 5 for \$1.00
D) B154 2V 27 amp WILLARD S' Baty \$1.98
E) WILLARD 4V 40AH/TBY S' Baty \$5.95
F) B1206U 2V 11AH WILLARD S' Baty \$1.89



BLOWERS Cool That Tube!

- A) 100 CFM/28VACD \$5.95
B) 100 CFM/28VACD \$4.95
C) XFORMER 12 or 28V to 115VAC for above \$1.69
D) 250 CFM/28VACD \$8.95
E) 250 CFM above plus 28/115VAC XFORMER \$10.95
F) 40 CFM/28VACD \$2.98

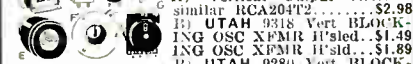


CONSTANT VOLTAGE REGULATORS

- RAYTHEON Const VR in 95-130V60cy; Out 115V 60 cyc CSD. NEW \$10.95
RAYTHEON in 198 to 242 Vlnp/50-60 cyc; Output 220V/500 Watta/0.5% Rltm Rctg etc; \$36.00
SOLA Constant Voltage Regulator USN Cased in 95 to 190V/50-60 cyc; Output 125 to 220V 2KW/17.4 Amp/Constant Duty. 1% Reg. \$130.00
SAME UNIT NEW. USN Cost \$369. SPECIAL \$162.00

MICROWAVE TS-12AP TEST SET—Brand New!

1 Write for complete SPECS and Special Price.



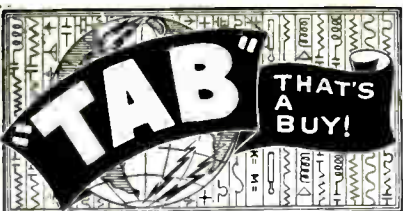
- A) Vertical Output Xformer similar RCA204T \$2.98
B) UTAH 9318 Volt BLOCK-ING OSC XPMR H'sld. \$1.49
C) UTAH 9280 Volt BLOCK-ING OSC XPMR H'sld. \$1.89
D) UTAH 9280 Volt BLOCK-ING OSC XPMR H'sld. \$1.29
E) ERIC HiVolts Capacitor 500 mfd/10KV \$3.40
F) JEFFERS HiVolts Capacitor 500mfd/20KV \$7.75
G) YOKE Magnetic Deflection similar RCA201D \$4.59
H) FOCUS COIL for Mag FocusKinescopes. \$3.95
I) HiVolts FlybackHORIZoutXFMRSimilarCA 211T1 \$5.49

XTAL DIODES & THERMISTORS

- 1N34 \$1.08; 2 \$2.10; 10 \$9.85
1N21B, 21A, 22, 23, 23A ea. \$1; 12 \$10
1N21B, 1N26 \$2; 10 for \$17.50
1N35 Full Pwr. \$2.35
1N183B1, Thermistor \$2.35
D170386 HP pur meas. \$90; 3 for \$2.50
1C Bulb Time Delay. \$90; 3 for \$2.50

SOCKETS—All Types!

- A) RCA 5-pin GIANT for 803, RK28 USN. \$90c
B) Johnson 4-pin bayonet for 866, etc. \$49c
C) Johnson Type 124-213 for 304TL, 152TL. \$90c
D) Johnson 7-pin Steatite 829B/829C, 826, 306; 4/51
E) Small Shell DUODECAL for 2BP1, 5TP1, 5UP1, 59C
F) Med Shell DIHEPTAL Cinch. \$69c
G) 5-pin ACORN 1 9/16" dia Hammerlund 25C
H) Johnson 122-234, 5D21, 715 w/tube lock 81c
I) 4-prong STEATITE Johnson for 866 etc. 2/49c
J) 5-prong STEATITE Johnson for 807 etc. 2/49c
K) 7-prong STEATITE Johnson for 309S etc. 2/49c
L) 7-pin NATIONAL CIRTL Steatite. 24c; 5 for \$1
M) MIN 7-pinMica less shield&mtg. 21c; 5 for \$1
N) MIN 7 pin Amph 78-7P. \$11c; 10/98c
O) MIN 7-pinMica less shield&mtg. 21c; 5 for \$1
P) Amphenol Fen78FP c/nector in 4, 5, 6, 7, 8 ea \$89c
Q) 4-pin Amphenol 40R854& mtg Ceramic. 24c; 5/51
R) OCTAL spin&mtg plate&lug CINCH. 9c; 12 for \$1
S) OCTAL 8 pin & mtg plate Steatite \$18c; 7/51
T) LOKTAL 8pin&lock mtg plate CINCH. 11c; 10/51
U) LOKTAL SOCKET CINCH. 25c; 4 for \$1
V) OCTAL Amphenol 40R854 steatite. 24c; 5 for \$1
W) OCTAL Amphenol 40R854 Rktg. 8c; 25 \$1.49
X) OCTAL Amphenol 40R854 steatite. 18c; 10 \$1.49
Y) HiVolts 4pinAmph77A4micaB. 36c; 4/51.18



TUBE SPECIALS—JAN & STANDARD

- SNOOPERSCOPE INFRARED Image-Converter Tube HiSensitivity simplified design 2" dia. Willemitte screen—Resolution up to 350 lines/in. Complete data in Tube.
'TAB' SPECIAL \$10.98
G.E. GL434A similar TC29/1KW. Hi RF \$7.95
REL36 ACORN similar 6J4 gnd \$98c

Grid SPECIAL WRITE FOR COMPLETE LIST & Send us All Tube Inquiries & ORDERS—Quantity Prices. We Buy Surplus Tubes.

Table of tube specifications including model numbers (e.g., 6AK5, 6AR5, 6BD6) and prices.

Table of tube specifications including model numbers (e.g., 6X4, 6X5, 6X6) and prices.

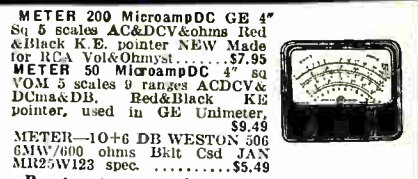


Table with columns: Range, Description, Each. Lists various meters and their specifications.

RECTIFIERS, Bridge (C)

Table with columns: In, Out, Amps, Each. Lists bridge rectifier specifications.

PHOTO-FLASH & 2 KRYPTON LAMPS

Text describing photo flash and krypton lamps, including models like FEDERAL 100 ma 81c.

PHOTOFASH CONDENSERS

Table listing photoflash condenser models and prices.

INSULATORS

Text describing various types of insulators (A, B, C, D) and their uses.

STAND-OFF, PILLAR

Table listing stand-off and pillar components with columns for Type, Size, and Each.



## MICROWAVE PLUMBING 10 CENTIMETER

**MAGNETRON TO WAVEGUIDE** coupler with 721-A duplexer cavity, gold plated.....\$45.00  
**10 CM WAVEGUIDE SWITCHING UNIT**, switches 1 input to any of 3 outputs. Standard 1 1/2" x 3" guide with square flanges. Complete with 115 vac or dc arranged switching motor. Mfg. Raytheon. New and complete.....\$150.00  
**721-A TR CAVITY WITH TUBE**, Complete.....\$12.50  
 tuning plunger.....\$2.00  
**10 CM McNALLY CAVITY Type SG**.....\$3.50  
**WAVEGUIDE SECTION, MC 445A**, rt. angle bend, 5/8" dia. OA 8" slotted section.....\$21.00  
**10 CM OSC. PICKUP LOOP**, with male Homedell output.....\$2.00  
**TS11/APS-2F 10 CM ANTENNA** in lucite ball, with type "N" fitting.....\$4.50  
**OAJ NAVY TYPE CTT66ADL ANTENNA** in lucite ball, with Sperry fitting.....\$4.50  
**10 CM FEEDBACK DIPOLE ANTENNA**, in lucite ball, for use with parabola.....\$6.00  
**10 CM END FIRE POLYRODS**.....\$1.75 ea.  
 "S" BAND Mixer Assembly, with crystal mount, pickup loop, tunable output.....\$3.00  
 7/8" RIGID COAX—3/4" I.C.  
**RIGHT ANGLE BEND**, with flexible coax output pickup loop.....\$8.00  
**SHORT RIGHT ANGLE bend**, with pressurizing nipple.....\$4.00  
**RIGID COAX** to flex coax connector.....\$3.50  
**STUB-SUPPORTED RIGID COAX**, gold plated 5' lengths. Per length.....\$7.00  
 RT. ANGLES for above.....\$3.75  
 7/8" COAX, ROTARY JOINT.....\$8.00  
 RT. ANGLE BEND 15" L.O.A.....\$4.25  
**FLEXIBLE SECTION, 15" L.** Male to female.....\$4.25  
**MAGNETRON COUPLING** to 7/8" rigid coax, with TR pickup loop, gold plated.....\$7.50  
 7/8" RIGID COAX, Bend Supported.....\$1.20 per ft.  
 Short right angle bend.....\$3.00  
 Rotating joint, with deck mounting.....\$6.00  
 Rigid coax slotted section CU-60/Al.....\$5.00

## 3 CM. PLUMBING

(STD. 1" x 1/2" GUIDE UNLESS OTHERWISE SPECIFIED)

**THERMISTOR: D-104699**—for mtg. in "X" Band Guide.....\$2.50  
 45 DEG. TWIST, 6" Long.....\$8.50  
 12" SECTION, 45 deg. twist, 90 deg. bend.....\$6.00  
 11" STRAIGHT WAVEGUIDE section choke to cover. Special heavy construction, silver plated.....\$4.50  
 15 DEG. BEND, 10" choke to cover.....\$4.50  
 5 FT. SECTIONS, choke to cover, silver plated.....\$14.50  
 18" FLEXIBLE SECTION.....\$17.50  
 "E" or "H" PLANE BEND.....\$12.50  
**BULKHEAD FEED THRU**.....\$15.00  
**WAVEGUIDE SECTION CG 251/APS-15A** 20" long choke to cover, with 180 deg. bend of 2 1/2" rad. at one end.....\$6.00  
**ROTARY JOINT** with slotted section and type "N" output pickup.....\$8.50  
**WAVEGUIDE SECTION, 12"** long choke to cover, 45 deg. twist & 2 1/2" radius, 90 deg. bend.....\$5.00  
**SLUG, TUNER/ATTENUATOR** W.F. guide, gold plated.....\$6.50  
**TR/TR DUPLEXER** section with iris flange.....\$8.00  
 WAVEGUIDE SECTIONS 2 1/2" ft. long, silver plated, with choke flange.....\$5.75  
**WAVEGUIDE, 90 deg. bend** E plane 18" long.....\$5.00  
**ROTARY JOINT**, choke to choke.....\$6.00  
**ROTARY JOINT**, choke to choke, with deck mounting.....\$6.00  
**S-CURVE WAVEGUIDE, 8"** long cover to choke.....\$3.50  
**3" FLEX SECTION**, Sq. flange to circ. flange adapter.....\$7.50  
 "X" BAND WAVEGUIDE, 1 1/2" x 5/8" OD, 1/16" wall, aluminum.....per ft. \$ .75  
**TR CAVITY** for 721-A TR tube.....\$3.50  
 721-A TR tube (41 TR).....\$2.50  
**APS-15 DUPLEXER SECTION** using 11324.....\$10.00  
**3 CM WAVEGUIDE, 1"** x 1/2" I.D., per ft.....\$4.50  
**CIRCULAR CHOKE FLANGES**, solid brass.....\$ .55  
 SQ. FLANGES, flat brass.....\$ .55 ea.  
 "T" SECTION (TR-ATR) choke to choke, supplied with iris or sq. flanges.....\$4.50  
 "X" BAND PRESS. WAVE SECTIONS, with 15 lbs gauge and press. nipple.....\$18.50

**APS-10 MIXER 2K25/723AB**, X band local oscillator mount with (1) choke coupling to beacon reference cavity; (2) choke coupling to TR and receiver; (3) iris coupling with AFC attenuator to antenna waveguide; (4) Radar AFC crystal mount; (5) Receiver crystal mount; (6) Attenuator slugs. Mfg. Raytheon. Buidl.....\$22.50  
 TR/TR Duplexer section for above.....\$8.00

**TRANSMISSION LINE PRESS. GAUGE**.....\$3.50  
**2" FLEXIBLE SECTION**, cover to cover.....\$5.00  
**MOUNTING SECTION** for Absorp. Wavemeter and Thermistor Mount, Silver Plated, Sq. Flanges.....\$6.50

## 1.25 CENTIMETER

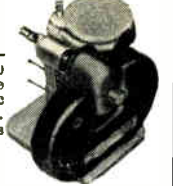
**MITRED ELBOW** cover to cover.....\$4.00  
**TR/TR SECTION** choke to cover.....\$4.00  
**FLEXIBLE SECTION** choke to choke.....\$5.00  
**KBAND Rotary joint**.....\$5.00  
**ADAPTER**, rd. cover to sq. cover.....\$5.00  
**MITRED ELBOW** and S sections choke to cover.....\$4.50

## RADAR SETS

**RC 145 IFF SET**. Consists of RC 1267 xmtr-revr, remote antenna controller and indicator I-221, power supply RA 105-A. 1 kw. pulse oscillator operates on 154-186 mc. Operates from 117 v., 60 cy. New.....\$190.00  
**SN RADAR-GE**, low power, 5 and 25 miles ranges. Uses GL446 as pulsed oscillator, 5" "A" scope, "S" band. Extremely compact, ideal for demonstration and laboratory work. 115V 60C operation. Used. Excellent condition.....\$600.00  
**SE 10 CM. SURFACE SEARCH RADAR**, W.F. 20,000 to 80,000 yds. range. 250 KW. pk. power input to 706 magnetron. Thyatron modulator, variable pulse rate. Complete set including spare parts, tubes, waveguide and fittings. Send for price and additional information.....\$85.00  
**R85TPL-1 RADAR RCVR**, Sperry.....\$85.00

## MAGNETRONS

**2J41 magnetron-magnet-stabilizer** pkg. 9290-9330 mc. 1.25 KW Pk Pulse Output Power. 100 mc tuning range possible. Refer Rad. Lab. Series Vol. 6, pg. 766  
**\$75.00 (As shown)**



TUBE	FREQ. RANGE PK.	PWR. OUT	PRICE
2J31	2820-2860 mc.	265 KW.	\$25.00
2J21-A	9345-9405 mc.	50 KW.	\$25.00
2J22	3267-3333 mc.	265 KW.	\$25.00
2J26	2992-3019 mc.	275 KW.	\$25.00
2J27	2965-2992 mc.	275 kW.	\$25.00
2J32	2780-2820 mc.	285 kW.	\$25.00
2J38 Pkg.	3249-3263 mc.	87 KW.	\$25.00
2J39 Pkg.	3267-3333 mc.	5 KW.	\$25.00
2J55 Pkg.	9345-9405 mc.	50 KW.	\$25.00
2J61	3000-3100 mc.	35 KW.	\$65.00
2J62	2914-3010 mc.	35 KW.	\$65.00
3J31	24,000 mc.	50 KW.	\$55.00
5J30			\$39.50
714AY			\$25.00
720BY	2800 mc.	1000 KW.	\$25.00
720CY			\$50.00
725-A	9345-9405 mc.	50 KW.	\$25.00
730-A	9345-9405 mc.	50 KW.	\$25.00

**MAGNETS**  
 For 2J21, 725-A, 2J22, 2J26, 2J27, 2J31, 2J32, and 3J31.....\$3.00  
 4850 Gauss, 5/8" bet. pole faces, 3/4" pole diam., Each \$8.00  
 1500 Gauss, 1 1/2" bet. pole faces, 1 1/2" pole diam., Each \$8.00  
**TUNABLE PKG'D "CW" MAGNETRONS**  
 QK69 2675-2900 Mcs. QK61 2975-3200 Mcs.  
 QK60 2800-3025 Mcs. QK62 3150-3375 Mcs.  
 New, Guaranteed.....\$65.00 each

## VARISTORS—W.E.

D-171121	.....\$ .95	D-10854E	.....\$ .95
D-171131	.....\$ .95	D-102482	.....\$3.00
D-107125	.....\$ .95	D-99139	.....\$1.65
D-17127A	.....\$ .95	D-106271	.....\$2.30
D-106887	.....\$ .95	D-102556	.....\$1.25
D-171212	.....\$ .95	D-101871A	.....\$1.20
D-171528	.....\$ .95	D-99934	.....\$2.00
D-103298	.....\$ .95		

## THERMISTORS—W.E.

D-107322 (bead)	.....\$ .95	D-104699 FOR MTG. in	
D-170346 (bead)	.....\$ .95	"X" Band Guide.....	\$2.50
D-107613 (button)	.....\$ .95	D-107018 (tube)	.....\$ .95
D-106228 (button)	.....\$ .95		

## COAX CABLE

RG 18/U, 52 ohm lin. armored.....\$51/ft.  
 RG 23/U, twin coax, 125 ohm imp. armored.....\$50/ft.  
 RG 28/U, 50 ohm imp. pulse cable, Corona min. starting voltage 17 KV.....\$50/ft.  
 RG 35/C, 70 ohm imp. armored.....\$50/ft.

## COAX CONNECTORS

831SP	.....\$ .35	UG 254/U	.....\$ .75
831AP	.....\$ .35	UG 255/U	.....\$1.25
831HP	.....\$ .15	UG 146/U	.....\$1.25
UG 21/U	.....\$ .85	UG 85/U	.....\$1.25
UG 86 U	.....\$ .95		
D-86366 "BABY N"	.....\$ .85		
ADAPTER CABLE ASSY: Type "N" Male to Type "N" Female	.....\$2.25		
ADAPTER CABLE ASSY: Sperry Male to Type "N" Male	.....\$2.25		
Homedell male to type "N" male adapter.....	\$1.25		

## MISCELLANEOUS

"IPL" ROTATING YUKE TYPE. Complete with all necessary oscillator circuits, CR tube 5M17, complete with tubes. Used with SO radar.....\$100.00  
**SPERRY KLYSTRON TUNER** Mod. 12.....\$2.00  
**SINE POTENTIOMETER**, GE#251x96 or W.E. #K5 15138 L01.....\$5.00  
**PH-SHIFTING CAP**, 180 deg. W.E. #D-15073A.....\$2.50  
**KLYSTRON SOCKETS** for 723 A,B, and similar types 2 for.....\$1.00  
**LINE INSERTION ATTENUATOR**, type OAX-1, 20 db. attenuation, with 3-contact plug and socket (amphenol 6S).....\$2.25

## MICROWAVE ANTENNAS

**AN MPG-1 Antenna**, Rotary feed type high speed scanner antenna assembly including horn parabolic reflector. Less internal mechanisms, 10 deg. sector scan. Approx. 12" L x 4" W x 3" H. Unused. (Gov't Cost—\$4500.00).....\$250.00  
**APS-4 3 cm. antenna**, Complete. 1 1/2" dish. Cutler feed dipole directional coupler, all standard 1" x 1/2" horizontal and vertical scan. New, complete.....\$65.00  
**AN/TPS-3**, Parabolic dish type reflector approx. 10" diam. Extremely lightweight construction. New, in 3 carrying cases.....\$69.50  
**RELAY SYSTEM PARABOLIC REFLECTORS**: approx. range: 2000 to 6000 mc. Dimensions: 4 1/2" x 3", rectangle, new.....\$85.00  
**TOD "JAM" RADAR ROTATING ANTENNA**, 10 cm, 30 deg. beam, 115 v.a.c. drive. New.....\$100.00  
**SO-13 ANTENNA**, 2 1/2" dish with feedback dipole 360 deg. rotation, complete with drive motor and selsyn. New.....\$120.00  
**DBM ANTENNA**, Dual back-to-back parabolas with dipoles. Freq. coverage 1,000-4,500 mc. No drive mechanism.....\$65.00  
**AN/128A ANTENNA**, Two Vertical dipoles working against a square reflector approx. 3' x 4'. Range: 140-200 mc.....NEW \$40.00  
**AS 125/APR** Cone type receiving antenna, 1000 to 3200 megacycles. New.....\$4.50  
**140-600 MC. CONE TYPE ANTENNA** complete with 25' sectional steel mast, guys, cables, carrying case etc. New.....\$49.50  
**ASD 3 cm. antenna**, used, ex. cond.....\$49.50

## MICROWAVE GENERATORS

**AN/APS-15A "X"** Band compl. RF head and modulator, incl. 725-A magnetron and magnet, two 723A/B klystrons (local osc. & beacon), 1B24 TR, revr-amp, duplexer, 11V supply, blower, pulse start. Peak Pwr. Out: 45 KW. Input: 115, 400 cy. Modulator pulse duration 5 to 2 micro-sec. apx. 13 KW Pk Pulse. Compl. with all tubes incl. 715-B, 829B, RK17 73, two 72's. Compl. pkg. new.....\$210.00  
**APS-15B**, Complete pkg. as above, less modulator.....\$150.00

**"S" BAND AN/APS-2**, Complete RF head and modulator, including magnetron and magnet, 417-A mixer, TR, receiver, duplexer, blower, etc., and complete pulser. With tubes, used, fair condition.....\$75.00  
**10 CM. RF Package**. Consists of: SO Xmtr-receiver using 2J27 magnetron oscillator, 250 KW peak input, 707-B receiver-mixer.....\$150.00  
 Modulator-motor-attenuator unit for above.....\$75.00  
 Receiver-rectifier power unit for above.....\$25.00  
 Rotating antenna with parabolic reflector for above.....NEW \$75.00

## PULSE EQUIPMENT

**APS-10 MODULATOR DECK**, Complete, less tubes.....\$75.00  
**APS-13 LOW voltage power supply**, less tubes.....\$18.50  
**APQ-13 PULSE MODULATOR**, Pulse Width 5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. pwr. out 35 KW. Energy 0.018 Joules.....\$49.00  
**TPS-3 PULSE MODULATOR**, Pk. power 50 amp, 24 KV (1200 KW pk); pulse rate 200 PPS, 1.5 micro-sec; pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New.....\$49.50  
**MIT MODEL 3 HARD TUBE PULSER**, Output Pulse Power: 144 KW (12 KV at 12 amp). Duty Ratio: .001 max. Pulse duration: .5, 1.0, 2.0 microsec. Input voltage: 115 v. 400 to 2400 cps. Use 1-715-B, 1-829-B, 3-72's, 1-73. New.....\$110.00  
**MODULATOR UNIT BG 1203-B**, Provides 200-4,000 PPS. Sweep time 100 to 2500 microsec. in 4 steps, fixed mod. pulse, suppression pulse, sliding modulating pulse, blanking voltage, marker pulse, sweep voltages, calibration voltages, fil. voltages. Operates 115 vac, 60-60 cy. Sliding pulse variable in phase up to 2500 microsec. Amplitude of suppression pulse adjustable between 10 and 35 v. and width variable between the limits of 10 microsec. or less to 1800 microsec. or more at a recurrence rate between 200 and 300 cps. Provides various types of voltage pulse outputs for modulation of a signal generator such as GR #804B or 804C. New.....\$125.00

## PULSE NETWORKS

**G.E. #25E5-1-350-50P2T**, 25 KV, 5 sections, "E" circuit, 1 microsecond pulse length, 350 PPS, 50 ohms impedance.....\$45.00  
**G.E. #6E3-5-2000-501P2T**, 6 KV, "E" circuit, 3 sections, .5 microsecond, 2000 PPS, 50 ohms impedance.....\$6.50

## PULSE TRANSFORMERS

**W.E. #D166173 III-Volt input transformer**, W.E. Impedance ratio 50 ohms to 900 ohms. Freq. range: 10 kc to 2 mc. 2 sections parallel connected, potted in oil.....\$12.00  
**W.E. KS 9800** input transformer. Winding ratio between terminals 1-3 and 1-2 is 1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 cps. Permalloy core.....\$2.00  
**G.E. #K2731** Repetition Rate: 635 PPS, Pri. Imp: 50 Ohms, Sec. Imp: 450 Ohms, Pulse W: 1 Microsec. Pri. Input: 9.5 KV PK. Sec. Output: 28 KV PK. Peak Output: 800 KW. Bifilar 2.75 Amp.....\$19.50  
**W.E. #D169271 III Volt input pulse Transformer**, \$9.95  
**G.E. K2450A**, Will receive 13 KV, 4 microsecond pulse on pri., secondary delivers 14 KV. Peak power out 100 KW GP.....\$15.00  
**G.E. #K2748A** Pulse input, line to magnetron.....\$12.00  
 Utah Pulse or Blocking Oscillator Transformer. Freq. limits 790-810 cy—3 windings turns ratio 1:1:1. Dimensions 1 13/16 x 1 1/2 x 1 1/2. Pulse Cable, with UG-34/U connections, approx. 30' L.....\$6.50

## MICROWAVE TEST EQUIPMENT

**TS-238 GP**, 10 cm. Echo box with resonance indicator and micrometer adjust cavity, 2700 to 2900 Mcs calibrated.....\$85.00  
**TS 108-AP** dummy load \$65.00  
 Center freq. 30 plus or minus 5 mc. Band calibrated attenuator.....\$75.00  
**Directional Coupler CG 176/AP**, 20 db.....\$18.00  
 Shielded klystron tube mounts with rough attenuator outputs.....\$90.00  
**W. E. I 138**, Signal generator, 2700 to 2900 Mc range. Lighthouse tube oscillator with attenuator & output meter. 115 VAC input, reg. Pwr. supply. With circuit diagram.....\$50.00  
**3 cm. wavemeter**: 9200 to 11,000 mc transmission type with square flanges.....\$15.00  
**3 cm. stabilizer** cavity, transmission type.....\$20.00  
**3 cm. Wavemeter**, Micrometer head mounted on X-Band guide. Freq. range approx. 7900 to 10,000 Mc.....\$75.00

## 30 MC I.F. STRIP

Overall gain: 25 db or more  
 Bandwidth: 4 plus or minus 4 mc @ 3 db down.  
 Center freq: 30 plus or minus 5 mc.  
 Current drain: 30 plus or minus 5 ma.  
 New, less tubes.....\$17.50

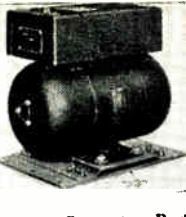
ALL MERCHANDISE GUARANTEED. MAIL ORDERS PROMPTLY FILLED. ALL PRICES, F.O.B. NEW YORK CITY. SEND MONEY ORDER OR CHECK ONLY. SHIPPING CHARGES SENT C.O.D. RATED CONCERNS SEND P. O.

Prices Subject to Change Without Notice

# COMMUNICATIONS EQUIPMENT CO.

131-E Liberty St., New York, N. Y. Cable "Comsupo" Ph. Digby 9-4124, Mr. Chas. Rosen

## DYNAMOTORS



Type	Input Volts	Output Amps	Radio Set	Price*
BD 77KM	14 40	1000 .350	BC 191	\$20.00LN
PE 73	28 19	1000 .350	BC 375	24.00LN
DM 21CX	14 3.3	2355 .090	BC 312	3.45LN
DM 25	12 2.3	250 .050	BC 367	2.49LN
DM 28R	28 1.25	275 .070	BC 348	8.95LN
DM 33	28 7	540 .250	BC 456	5.50LN
DM 42	14 46	515 .110	SCR 506	6.50LN
		1030 .050		
PE 55	12 25	500 .400	SCR 245	5.25LN
PE 86	12 1.25	250 .000	RC 36	3.95
PE 101 C	13/28	12.6/4.0	135 SCR 515	5.25LN
		6.3	800 .020	
		9	AC 1.12	
BD*AR 93	28 3.25	285 .075	APN-1	4.95LN
23350	27 1.75	285 .075	APN-1	3.50LN
35X045B	28 1.2	250 .060		3.50LN
ZA .0515 12 24	4/2	500 .050		3.95LN
B-19 pack	12 9.4	275 .110	Mark H	9.95LN
		500 .050		

\*N—New. LN—Like New.

## INVERTER PE 218

Input: 27.5 V DC, 90 AMPS  
Output: 115V, AC, 400 CY, 13 AMPS  
1500 Volt—Amperes .9 PF  
New. Original Packing . . . . \$49.95

## POWER EQUIPMENT

**STEP DOWN TRANSFORMER:** Pri: 440/220/110 volts  
e. c. 60 cycles. 3 KVA. Sec. 115 v. 2500 volt insulation.  
Size 12" x 12" x 7". \$40.00

**PLATE TRANSFORMER:** Pri: 117 v. 60 cy. Sec.  
17,000 v. @ 144 ma. with choke. Oil immersed. Size:  
26" x 29" x 13". Amertran. \$120.00

**FIL. TRANS. 1XK689:** Pri: 115 v. 60 cy. Sec: Two  
5 v. 5.5 amp wdg. 20 KV. test. \$24.50

**LINE VOLTAGE REG. PR:** 92-138 v. 57/63 cy. lph15A  
Sec. 115 v. 7.15 A. 82 Kw 96% PF. \$89.50

**VOLTAGE REG. Transtat:** Amertran type RII 2 KVA  
load. input: 90/130 v. 50-60 cy. output 115 v. \$40.00

**ITE CIRCUIT BREAKER, 115 A, 600 v.**  
2750/2470/2240 v. on sec. at 750 ma. no CT. 7,000  
v. ins. \$34.50

**UX 6801 (Raytheon):** Pri: 110 v. 60 cy. 1 ph. Sec:  
22,000 v. 234 ma. 5.35 KVA. Dim: 25"x24"x10 3/4".  
\$31.91 (Amertran): pri: 115 v. 60 cy. 3 ph. 4 KVA. Sec:  
105/125 v. Dim. 25"x14 1/2"x12 1/2". \$37.50

**Plate Xfmr:** Pri: 198, 220, 240 v. 60 cy. 1 ph. 16.7  
KVA. Sec: 3650 v. 30 KV test. \$15.00

**Fil Xfmr: Kenyon:** Pri: 210/215/220/225/230/235/240  
vac. 60 cy. Sec: 11 v. 35 amp; 10 v. 35 amp; 7.5 v.  
35 amp; 5 v. 35 amp. #S-10768. \$37.50

**Fil Trans. K88767:** Pri: 115 v. 60 cy. Sec: 2 wdg. 5 v.  
@ 5 amps. \$15.00

## OIL CONDENSER

.1 mfd. 10 KVDC #14F191. . . . . \$15.00  
.06 mfd. 15 KVDC, 25F585-G2. . . . . \$ 8.70  
1.5 mfd. 6000 vdc. . . . . \$12.50  
2.5 mfd. 20,000 vdc. . . . . \$17.50  
10 mfd. 1000 vdc. . . . . \$ 1.79  
3x10 mfd. delta connected synchro-capacitor, 90  
v. 60 cycles. . . . . \$ 4.95  
.1 mfd. 6000 vdc. 25F509G2. . . . . \$ 3.85

## 400 CYCLE XFARS

352-7070: Pri: 118 v. 440 cy. Sec: 2.5 v. 2.5 amp; 2.5  
v. 2.5 amp; (2000 v ins.) 6.3 v. 2.25 amp; 1200 v.  
tapped at 1000 and 750 v. p/o AN/AP-8. \$4.95  
#7469105: Pri: 115 v. 400 cy. Sec: Tapped to give  
742.5 v. 50 ma; 709 v. .0477 ma; 671 v. .045 ma. \$2.95  
M-7474319: Pri: 115 v. 400 cy. Sec: 6.3 v. 2.7 amp;  
6.3 v. .66 amp; 6.3 v. 2.1 amp. \$2.95  
32332: Pri: 115 v. 400-2400 cy. Sec: 400 vct, 35 ma;  
6.4 v. 2.5 amp; 6.4 v. 15 amp. \$2.25  
352-7179: Pri: 115 v. 400-2400 cy. Sec: 6.5 v. 12 amp  
ct. 250 v. 100 ma; 5 v. 2 amp. \$3.50  
#9069: Pri: 115/80 v. 400-2600 cy. Sec: 650 vct. 50  
ma; 6.3 vct. 2 amp; 5 vct. 2 amp. \$2.15  
1.75 amp. 3 KV ins; 5 v. 3 amp; 6.5 v. 6.5 amp;  
6.5 v. 1.2 amp. \$3.95  
352-7096: Pri: 115/80 v. 400-2400 cy. Sec: 2.5 v.  
1.75 amp. 3 KV ins; 5 v. 3 amp; 6.5 v. 6.5 amp.  
\$3.95  
KS 9607: Pri: 115 v. 400-2400 cy. Sec: 734 vct.  
177 ma. 1710 vct. 177 ma. \$5.95  
D-166333: Pri: 115 v. 400-2400 cy. Sec: 6.3 v. 0.9  
amp. 7.7 v. 0.865 amp. \$2.79  
GE #7471957: Pri: 100/110/120/130 v. 400-2400 cy.  
Sec: 2.5 v. 20 amp. HV ins. \$4.85  
D-163254: Pri: 115 v. 400 cy. Sec: 6.3 v. 12 amp; 6.3  
v. 2 amp; 6.3 v. 1 amp. P/O AN/AP-5. \$5.85  
KS-9685: Pri: 115 v. 400-2400 cy. Sec: 6.4 vct. 7.5  
amp; 6.4 v. 3.8 amp; 6.4 v. 2.5 amp. \$4.35  
or  
PLATE XFMR: Pri: 115 v. 400 cy. Sec: 9800 v. \$2.79  
8600 v. @ 32 ma dc. \$12.50  
#12033. Plate Xfmr: Pri: 115 v. 800 cy. Sec: 4550 vct.  
250 ma. \$7.95  
KS 9445. Pwr Xfmr: Pri: 115 v. 400-2400 cy. Sec:  
502 vct. 120 ma. 6.3 v. 8 amp; 5 v. 2 amp. \$3.50  
PLATE XFMR: Pri: 115 v. 400-2400 cy. Sec: 4500 v.  
9 ma. \$6.50  
#7443. Plate Xfmr: Pri: 115 v. 400 cy. Sec: 6.3 v. 7 amp.  
8.3 v. 8.8 amp. 6.3 v. 1.3 amp. \$2.50  
FIL XFMR: Pri: 115 v. 400 cy. Sec: 6.3 v. 9 amp.  
6.3 vct. 6.5 amp. 2.5 v. 3.5 amp. 2.5 v. 3.5 amp. \$3.25  
KS 9584. Pri: 115 v. 400 cy. Sec: 5,000 v. 290 ma.  
5 v. 10 amp. size: 7" x 10" x 6". \$15.00

## INSTRUCTION MANUALS

BC 312, BC 342. . . . . \$1.52  
SCR 281. . . . . \$1.25  
Z Eght. . . . . \$1.00  
SCR 508. . . . . \$1.00  
BC 642. . . . . \$1.00  
SX-32. . . . . \$1.00

## VIBRATORS

TR 1210, 12 vdc, 5 pin  
OAK V-6875, 24-32 vdc, 7 pin  
Mal. Type G534C, 12 vdc, 4 pin  
Mal. Type G629-C, 12 vdc, 4 pin  
Radiatac VR2, 6 v. DC. 6-pin special  
\$1.00 each.

## HEADSETS

Dynamic Mike and Headset Combination. A high quality, efficient unit, used in B-19 tank Xmters. Mike and phones complete, new. \$2.75  
R-15 Headsets: 8000 ohms impedance, rubber cushions. Comes with 8' cord and plug PL 55. New. \$2.95

## R.F. COILS

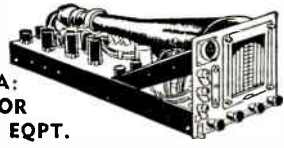
3C4016-7, RF coil Ass'y. 30-40 mc. for revr FMR-13V \$59  
2C5395-1306/C3, Antenna Coil, 3.8 to 6.5 mc, iron core for IC 1306 revr. \$45  
2C300-457, 22.5 to 25 mc. for Adcock antenna ckt of phasing box. For radio beacon equipment IC 163 \$1.25  
3C302D, RF Antenna coil, 3750 to 5850 kc. p/o BC 654A \$3.35  
3C351, M.O. coil, 1800 to 2250 kc. plug-in p/o Collins Xmt'r 32-BA \$1.85  
3C350, M.O. coil, 1480 to 1840 kc. p/o Collins Xmt'r 32 RA \$1.85  
2C5003A/C8, HIF osc. coil, bands A, B, C, Revr BC 1003 \$45  
2C6632 RA-1/7, RF amp. coil, 9-12 mc, Collins 32 1A Xmt'r \$1.75  
2C690-4/C9, RF amp. coil, 1KW, 14, 850-18,000 kc. 3.4 Microhy. \$2.95  
2C4528/9, LFO coil for Super Pro Receiver. \$65  
#9901, 455 kc. I.F. coils, sicksles, Air Trimmers. \$75

## MISCELLANEOUS

A-10 and A-20 OXYGEN MASKS. . . . . \$1.50  
HEADBANDS, III-1, III-4, III-30. . . . . \$2.5 ea  
Inserts, M-300, for III-30 HEADSETS. \$4.00/M  
RADIOSENO TRANSMITTERS, T-49/AMT-1. \$3.75 ea  
TRANSFORMERS for Collins ART13 Transmitters, GE #7472068, GE #7472065 \$7.95 ea  
HEADSET, WE #716A, with dual plug patch cord \$1.50  
BC 733-D LOCALIZER RECEIVER, with 6 crystals. New. \$14.50

GN 35 HAND GENERATORS: 350 v, 60 ma; 8 v, 2.5 amp. New with 2 hand cranks. \$12.50  
GN 45 HAND GENERATORS: 500 v, 100 ma; 6 v, 3 amp. slightly used, excellent cond. with 2 crank handles. \$12.50

PULSE TRANSFORMER, GE #7760489  
1.5 MC. I.F. TRANSFORMERS  
RECEIVER PANEL, #226955  
CONTROL BOX BC 321 (22656)  
6-SECTION CERAMIC CAPACITOR, 10-460 mmf (Collins AIT-13) \$6.9 ea  
BC 306-A, ANTENNA LOADING UNIT for BC 375 \$2.75 ea  
VOLTAGE REGULATOR: Carbon, GE #50979366 \$1.00  
ANTENNA, AN/100-A, for RC 103. \$3.00  
ANTENNA, AN/104-A, for SCR 522. \$1.00  
POWER SWITCH, 4 pos. 60 amps, 600 vac. Arrow 1K \$4.25  
ROTARY SPARK GAP, 24 vdc motor, 4 spark gap electrodes, p/ Xmt'r BC 1081-7G. \$5.50  
CODE TAPE, paper 11/16 wide, 8" diam. rolls. \$5.50  
CABLE ASSEMBLY, 45 pr. 102' L. Telephone type WE #D166039. \$20.00 per length  
SONAR SOUND DETECTOR: Underwater detector with 7 microphone units encased in rubber sheath Model JR \$12.50  
MN52H Azimuth control box for aircraft radio compass \$1.25  
ARC-3 Airborne radio series replacement relays. Types 55526, 55251, 55342, 55528, 55531, 55585. \$6.00 ea.  
FUSE HOLDER (GE type EP-1) \$1.00  
AMERTYPE RECORDING FILM, 50 ft. lengths indit-vertually boxed \$3.5 ea.



**BC 704-A: INDICATOR FOR ASE EQPT.**  
"L" Scope, with all tubes. \$17.50

**BC 701-A RADAR RECEIVER**  
Part of SCR521 and ASE Eght. 176 MC. operation, receives bi-lobed search and homing patterns. Complete with tubes and antenna switching motor \$37.00

**HEINEMANN CIRCUIT BREAKERS**  
AM 1614-50. . . . . 50 amps, 28 vdc \$1.65  
AM 1614-100. . . . . 100 amps, 28 vdc \$1.65  
AM 1614-150. . . . . 150 amps, 28 vdc \$1.65

**MICROPHONE ELEMENTS**  
Carbon transmitter element for TS11-J, TS11-L, TS13-E, TS15-A. \$7.75 ea.  
Element for microphone T-24, 30 ohm resistance. \$9.95 ea.  
SELENIUM RECTIFIERS. Input: 115 vac, 60 cy. Out: 120 vdc. 1.65 amps. Full Wave. F. T. & R. #DE11 \$9.95

**AUDIO TRANSFORMERS**  
Mod. Xfmr: 1r 807's to 807's in parallel. \$1.65  
Audio Output: 7500 ohms to 3 1/2 ohms. \$ .95  
Plate-to-line: 5000 ohms pri. to 2500, 1500, 1000, 150 ohms secondary. \$1.25  
Audio Output: 1r 1450 ohms. Sec: 8000 ohms. \$1.00  
Line-to-grid: Pri: 600 ohms. Sec: 50,000 ohms. \$1.35  
Line-to-voice coil: Pri: 250 ohms. Sec: 15 ohms 5 watt level. 250-5000 cy. UTC 32838. \$ .95

## 30' SIGNAL CORPS RADIO MASTS

Complete set for the erection of a full flat top antenna. Of rugged plywood construction telescoping into 3 ten-foot sections for easy storage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate, Shipping wt. approx. 300 lbs. Sig. Corps #A289, 223-A. New. \$39.50 per set

**WIRE WOUND POTENTIOMETERS**  
20,000 ohms, 10%, 8 watt. . . . . \$ .95  
5,000 ohms, 10%, 8 watt. . . . . \$ .95  
15,000 ohms, 10%, 4 watt. . . . . \$ .69  
Dual 250 ohms, 25 watt. . . . . \$ .98  
50 ohms, 25 watt. . . . . \$ .69  
1000 ohms, 50 watt, mod J. . . . . \$ .98  
800 ohms, 50 watt mod J. . . . . \$ .98  
5 ohms, 250 watt mod J. . . . . \$3.25

## GRATE TUBE VALUES

O1-A. . . . . \$4.45	7C4. . . . . 1.00	836. . . . . 1.15
1B24. . . . . 4.85	7E5. . . . . 1.00	837. . . . . 1.95
1H5. . . . . .55	7E6. . . . . .72	843. . . . . .59
1N5. . . . . .69	10Y. . . . . .60	860. . . . . 15.00
1T4. . . . . .69	12A6. . . . . .35	861. . . . . 40.00
2C21. . . . . .69	12GP7. . . . . 14.95	874. . . . . 1.95
2C22. . . . . 25.00	12K8Y. . . . . .65	876. . . . . 4.95
2J21-A. . . . . 25.00	12SR7. . . . . .49	889R. . . . . 78.50
2J22. . . . . 25.00	12SR7. . . . . .72	1005. . . . .
2J26. . . . . 25.00	15R. . . . . 1.10	1613. . . . . .95
2J27. . . . . 25.00	28D7. . . . . .75	1619. . . . . .21
2J31. . . . . 25.00	30 (Spec). . . . . .30	1624. . . . . .85
2J32. . . . . 25.00	45 (Spec). . . . . .59	1629. . . . . .35
2J38. . . . . 25.00	39/4A. . . . . .49	1961. . . . . 5.00
2J39. . . . . 25.00	35/51. . . . . .72	8012. . . . . 3.95
2J55. . . . . 25.00	211. . . . . .75	9002. . . . . .65
3J31. . . . . 55.00	227A. . . . . 3.85	9004. . . . . .47
2X2 879. . . . . .65	225. . . . . 8.80	9006. . . . . .47
3A4. . . . . .65	268-A. . . . . 20.00	CQ672. . . . . 1.95
3BP1. . . . . 2.25	255-A. . . . . 19.50	EF 50. . . . . .79
3C24. . . . . .70	417A. . . . . 2.50	GE-1148. . . . . .75
3C30. . . . . .70	530. . . . . 90.00	F-127. . . . . 20.00
3D6. . . . . .79	531. . . . . 45.00	FC258A. . . . . 165.00
3CP1/S1. . . . . 3.50	532. . . . . 3.95	FC 271. . . . . 40.00
3D21-A. . . . . 1.50	559. . . . . 4.00	GL 562. . . . . 75.00
3E1. . . . . 2.25	562. . . . . 90.00	GL 623. . . . . 75.00
3EP1. . . . . 1.95	615. . . . . 6.00	GL 697. . . . . 75.00
3FP7. . . . . 1.20	703-A. . . . . 7.00	ML 100. . . . . 60.00
3GP1. . . . . 3.50	704-A. . . . . .75	OK 59. . . . . 65.00
3Q5. . . . . 1.20	705-A. . . . . 2.85	OK 60. . . . . 65.00
5B1. . . . . 1.70	707-B. . . . . 120.00	OK 61. . . . . 65.00
5BP4. . . . . 4.95	714AY. . . . . 15.00	OK 62. . . . . 65.00
5CP1. . . . . 3.75	715-B. . . . . .39	OK 63. . . . . 65.00
5FP7. . . . . 3.50	720BY. . . . . 50.00	PR 91. . . . . 1.00
5J2. . . . . 8.00	721-A. . . . . 3.60	VR 130. . . . . 1.25
5J30. . . . . 39.50	723-A/B. . . . . 12.50	VR 135. . . . . 1.25
6AC7. . . . . 1.00	724B. . . . . 1.75	VR 137. . . . . 1.25
6C4. . . . . .68	725-A. . . . . 25.00	VU 120. . . . . 1.00
6C7. . . . . 2.80	726-A. . . . . 15.00	VU 134. . . . . 1.00
6J6. . . . . 1.80	800. . . . . 2.25	WL53. . . . . 4.75
6K7. . . . . .55	800. . . . . 2.25	WN 150. . . . . 3.00
6L6GA. . . . . 1.80	801-A. . . . . 1.10	WT 260. . . . . 5.00
6SC7. . . . . 1.70	804. . . . . 9.85	1 W/th Cavity. . . . .
6SL7. . . . . 1.00	815. . . . . 2.50	* Photocell.

## TYPE 1619 POWER PENTODES

TYPICAL OPERATING CHARACTERISTICS

PLATE VOLTS	Class "C"	
	400	400
SCREEN VOLTAGE	300	300
PLATE CURRENT	75 ma	75/150 ma
SCREEN CURRENT	10.5 ma	6.5/11.5 ma
GRID VOLTAGE	-5	-932
GRID CURRENT	5 ma	.....
GRID DRIVE	36 W	4 W
POWER OUTPUT	19.5 W	36 W

\$21 ea. or 5 for \$100.  
MFRS. PRICES ON REQUEST

## PRECISION CAPACITORS

D-160270: 1 mfd @ 200 vdc. —40 to plus 65 deg C \$2.00  
D-161858: 4 mfd @ 400 vdc. —50 to plus 85 deg C \$2.00  
D-163707: 0.4 mfd @ 1500 vdc. —50 to plus 85 deg C \$2.00  
D-163035: 0.1 mfd @ 600 vdc, 0 to plus 65 deg C \$2.00  
D-170908: 0.152 mfd, 300 v, 400 cy. —50 to plus 85 deg C \$2.50  
69p C. \$1.50  
D-164960: 2.04 mfd @ 200 vdc, 0 to plus 55 deg C \$2.50  
D-168344: 2.16 mfd @ 200 vdc, 0 to plus 55 deg C \$3.00  
D-161555: .5 mfd @ 400 vdc, —50 to plus 85 deg C \$3.00  
D-166620: 16 mfd @ 400 vdc, temp comp 50 to plus 85 deg C \$12.50  
D-161270: 1 mfd @ 200 vdc, temp comp —40 to plus 65 deg C \$2.00

## CROSS POINTER INDICATOR

Dual 6-20U microamp. movement in 3" case. Each movement brought out to 6-term. Receptacle at rear. Originally used in IIS equipment. New. \$5.50

## SCR 610 11-10 METER PORTABLE/MOBILE XMT-R CVR.

SCR 610 portable transmitter-receiver, 27 to 88.9 mc. crystal controlled, using FM for efficient operation. Unit consists of Xmt-r cvr BC 659 and power supply PE 97. . . . . operating from 6 or 12 vdc. Slightly used, excellent condition. Less xtals. \$25.00

**HEADSET PLUGS and JACKS**  
PL-68 PL-54 JK-26  
AVAILABLE IN MFR'S. QUANTITIES

## 6-VOLT RELAY PANELS

Comes complete with relays mounted on bakelite panel with 25 terminals:  
1—SPST (NO) 1—DPST (NO)  
1—SPST (NO) 2—DPST (Make 1, break 1)  
Board Dim: 10" L x 6" W x 2 1/2" D. \$9.95

**COMMUNICATIONS EQUIPMENT CO.**  
131-"LIBERTY ST., NEW YORK, N. Y. DIGBY 9-4125

# Build YOUR OWN TEST EQUIPMENT

## Heathkit ELECTRONIC SWITCH KIT DOUBLES THE UTILITY OF ANY SCOPE



**\$34.50**

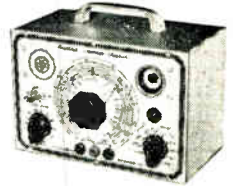
Gives two separately controllable traces with individual inputs on any scope. See both the input and output traces, locate distortion, phase shift, etc., immediately. Individual gain controls and positioning control. Coarse and fine sweeping rate controls. Complete Heathkit matches others, with 5 tubes. All metal parts are punched, formed and cadmium plated. Complete with tubes, all parts, detailed blueprints and instructions. Shipping Wt. 13 lbs.

**Nothing ELSE TO BUY**

## HEATHKIT CONDENSER CHECKER KIT

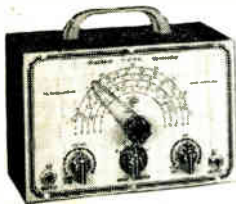
**\$19.50**

**Nothing ELSE TO BUY**



A condenser checker anyone can afford to own. Measures capacity and leakage from .00001 to 1000 MFD on calibrated scales with test voltage up to 500 volts. No need for tables or multipliers. Reads resistance 500 ohms to 2 megohms. 110V 60 cycle transformer operated complete with rectifier and magic eye indicator tubes. Easy quick assembly with clear detailed blueprints and instructions. Small convenient size 9" x 6" x 4 3/4". Wt. 4 lbs.

## HEATHKIT SIGNAL GENERATOR KIT

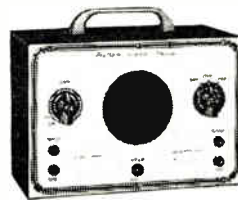


**\$19.50**

**NOTHING ELSE TO BUY**

Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150 Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110V 60 cycle transformer operated power supply. 400 cycle audio available for 30% modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4 3/4". Wt. 4 1/2 lbs.

## HEATHKIT SIGNAL TRACER KIT



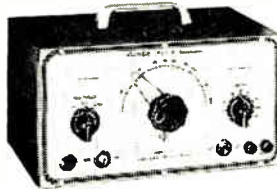
**\$19.50**

**Nothing ELSE TO BUY**

Reduces service time and greatly increases profits of any service shop. Uses crystal diode to follow signal from antenna to speaker. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection for VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, PA systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions. Small portable 9" x 6" x 4 3/4". Wt. 6 pounds. Ideal for taking an service calls. Complete your service shop with this instrument.

## HEATHKIT SINE AND SQUARE WAVE AUDIO GENERATOR KIT

The ideal instrument for checking audio amplifiers, television response, distortion, etc. Supplies excellent sine wave 20 cycles to 20,000 cycles and in addition supplies square wave over same range. Extremely low distortion, less than 1%, large calibrated dial, beautiful 2 color panel, 1% precision calibrating resistors, 110 V 60 cycle power transformer, 5 tubes, detailed blueprints and instructions. R.C. type circuit with excellent stability. Shipping weight 15 pounds.



**\$34.50**

**Nothing ELSE TO BUY**

## THE NEW HEATHKIT VACUUM TUBE VOLT METER KIT

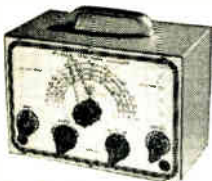
The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for \$75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6 X 5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC and DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Complete with detailed instructions. Add postage for 8 lbs.



**\$24.50**

**Nothing ELSE TO BUY**

## HEATHKIT FM AND TELEVISION SWEEP GENERATOR KIT



**\$24.50**

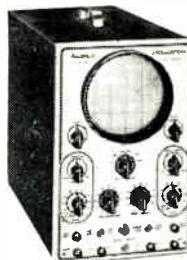
**NOTHING ELSE TO BUY**

### THE BASIC FM AND TELEVISION SERVICE INSTRUMENT

At the lowest cost possible, anyone can now service FM and television receivers. The Heathkit sweep generator kit operates with oscilloscope and covers all necessary frequencies. A few pleasant hours assembling this kit puts any organization in position to share the profits of the FM and TV boom.

Every part supplied - grey crackle cabinet, two color calibrated panel, all metal parts punched, formed and plated. 5 tubes, complete detailed instructions for assembly and use. Shipping weight 6 lbs.

## The NEW 1948 HEATHKIT 5 INCH OSCILLOSCOPE KIT



**\$39.50**

**NOTHING ELSE TO BUY**

New improved model of the famous Heathkit Oscilloscope. Building an oscilloscope is the finest training for television and newer servicing technique and you save two-thirds the cost. All the features and quality of instruments selling for \$100.00 or more. Supplied complete with cabinet, two color panel, 5B1 tube, 2 5Y3 tubes, 2 6SJ7 tubes and 884 sweep generator tube. Power transformer supplies 1000V negative and 350 volt positive. Sweep generator 15 cycles to 30 M. cycles. Has vertical and horizontal amplifiers. Oil filled filter condensers for long life. Complete blueprints and instructions included.



**The HEATH COMPANY**

**... BENTON HARBOR 14, MICHIGAN**





## SURPLUS NEW EQUIPMENT

### TOGGLE SWITCHES

Quantity	45,000	SPDT with center off position.
		5 amp 125 Volt A.C., 35 Amp 24 Volt
		Cutler Hammer type B-9A
		Bat handle, luminous tip, 2 hole mtg.
10,000	DPDT with center off position.	
		30 Amp 125 Volt A.C.
		Cutler Hammer type C-2
		Bat handle, luminous tip, 2 hole mtg.
3700	DPDT with center off position	
		Cutler Hammer type 882-1KI
		Bat handle, luminous tip single hole mtg.

### MICROSWITCHES

Quantity	3200	SPNO 10 Amp 125 volt, 5 amp 250 volt
		Microswitch Corp. type Z, WZRQ1-023A38
		1/2" single hole mounting
2500	SPNO 10 Amp 125 volt, 5 amp 250 volt	
		Microswitch Corp. type Z, YZ RQ1-023A38
		1/2" single hole mounting
1000	SPNO 10 Amp 125 volt, 5 amp 250 volt	
		Microswitch Corp. type WZ-RQ1-023A38
		1/2" single hole mounting
2500	SPNO 10 Amp 125 volt 5 Amp 250 volt	
		Microswitch Corp. type YZE/RQT in explosion proof case
1000	SPNO 10 amp 125 volt 5 amp 250 volt	
		Microswitch Corp. type YZE-TRQ2TN in explosion proof case with roller arm (limit switch)

### CIRCUIT BREAKERS

Quantity	5000	5 Amp Single Pole
		"Clixon" Spencer Thermostat type
		C6363-C-5-J
100	10 Amp Single Pole	
		"Clixon" Spencer Thermostat type
		C6363-M-5-K
1000	15 Amp Single Pole	
		"Clixon" Spencer Thermostat type
		C6363-L-5-Z
400	15 Amp 120 Volt Double Pole	
		Heinemann Cat. #0322, Curve D
600	9 Amp 125 Volt Single Pole	
		Heinemann Cat. #FO 4117S curve inst.

### SPECIAL METERS

		FREQUENCY METER JBT 30-F Dual Range covers frequency ranges from 48-52 cycles & 58-62 cycles: Dual element, vibrating reed type, 115 volt, 3/4" dia. Bush metal case. @ \$5.95
		FREQUENCY METER Range 530 to 470 cycles, 115 volt A.C. iron core dynamometer type movement, 5 cycles per scale division. Black scale luminous markings Weston model 637, 3/4" Aircraft style. @ \$4.95
		FREQUENCY METER 50 to 70 cycles, Westinghouse HY 5 1/2" Square Proj. mtd case. Accuracy within 1% electric dynamometer type movement; Comp with ext. reactor. @ \$8.50
		FREQUENCY METER 58 to 62 cycles, Westinghouse HY 5 1/2" square proj. mtd case accuracy within 1% Electric Dynamometer type movement; Comp. with ext reactor. @ \$39.50
		HOURLY METER, Totals to 99,999.9 hours and repeats. WH NII-35, 3/4" Rd. fl. b. bake case. Operates on 230 volt 60 cycle. @ \$8.50
		D. C. MILLIAMMETER, Weston 271 fan type, 1-0-1 MA (60-0-60 M.V.) movement Sc. cal 600-0-600 R.P.M. @ \$12.50
		DECIBEL METER, Weston 506 minus 10 to plus 6, 0 MW in 600 ohms 2 1/2" Rd. fl. bake case. @ \$5.50
		DECIBEL METER, -10 to plus 6 Weston 301-21 3/4" Rd fl. bake case 6 MW 600 ohms. @ \$8.50
		DECIBEL METER, -10 to plus 6 Westinghouse NC-35 3/4" rd fl. bake case 6 M.W. 600 ohms zero DB = 1.89 V. @ \$5.95
		RECTIFIER TYPE MILLIAMMETER, Weston Model 545, type 81, 4" Aircraft type, full sc. = 1.1 MA AC, 940 UA D.C. mvt., 70 ohms resistance of moving coil, bl. sc. calib 0-270" @ \$6.50
		SIGNAL STRENGTH "S" 6 ohms, 5 MA Simpson 25 3/4" Rd. fl. bake case. @ \$4.50
		RECTIFIER TYPE MICROAMMETER, Hickok 2" Ring mtd. met case 700 UA D.C. 1 MAAC @ \$2.50
		RECTIFIER TYPE MICROAMMETER, 500 G.E. DP-55 3" Sq. fl. bake case sc cal Plate/Bias 2000 ohm per V. @ \$4.95
		RECTIFIER TYPE MICROAMMETER, 1.2 VAC Weston 301 3/4" Rd fl met case 625 microa sc cal. Power Level Ind. @ \$6.50

		TACHOMETER 0-20,000 R.P.M. Port. Chron. type, Jaeger #43A6. @ \$24.50
		TACHOMETER 300-1200, 1000-4000, 3000-12000 R.P.M. Mult. Range, Cont. Indicating, Jones Motrola @ \$24.50
		INSULATION TESTER 0-20, & 0-200 Megohms, Weston 790 port., 500 volt int. wire, power supply @ \$39.50
		GASOLINE HEATER 15,000 B.T.U. Approx. 75-100 Watt power consumption, operates 24-28 Volt with inst. for use on 110 volt A.C. Galvin (Motorola) Mfr. Co. @ \$22.50
		CURRENT TRANSFORMER, portable, Weston 461-4, 5 Amp, 100, 200, 500 @ \$35.00
		1000 Amp. pr. 1/2% Acc. 15 V.A. @ \$35.00
		PORT. A.C. AMMETER 0-2.5, 0-5, 0-10 Amp. Mult. range, Weston 433 use with 461-4 C.T. @ \$55.00

### CODE TRAINING SET for visual & audible group code practice McElroy Mfg. Co., AN/GSC-T1

		@ \$24.50
		115 V.A.C., 14 tubes, dia. etc. @ \$34.50
		HI. FREQ. TRANS. BC-1160-A, 157-157 MC., 115 V.A.C. with blower, variac, 5 KV meter, 10 tubes, etc. @ \$29.50
		MOTOR GENERATOR 1.250 KVA 60 cycle output, 230 Volt 6.8 Amp D.C. input 3600 RPM, Allis-Chalmers @ \$100.00
		D.C. VOLT. REGULATOR, carbon pile, 20 Amps, 110 volt. load max. Safety Car Heat & Light Cat. #29540 type 8700L. @ \$65.00
		AIR CIR. BREAKER 125 Amp 500 Volt 3 Pole AC. G.E.-AF-1 #6275122-XG-22. @ \$35.00
		BOWL INSULATOR, clear glass, Corning #07076 Type C, overall dia 3/4" Pin 3/8" x 1 1/2", All brass fittings S.C. stock # 3G-1830-07076.1 @ \$6.00
		TACH. GENERATOR, three phase, G.E. Model 2CM5A1A @ \$9.50
		ACROSS THE LINE STARTER man. oper. Cutler Hammer type 6922 H1A @ \$4.50
		AUTOMOTIVE GENER. 6 V., 12 Amps, Antoinette #GA4901 @ \$15.00
		MICROSWITCH S.P.N.C. 10 Amp 125 Volt, 10 for \$3.00
		THER. CIR. BREAKER D.P.S.T. 15 Amp 120 V.A.C. Curve D Heinemann #0322. @ \$1.50
		REV. CURR. RELAY 12-15 Volt 200 Amp L.N. #2550 @ \$2.50
		TERM. BOARD 4 Conn. 3/4" L x 2" W x 1 1/2" H 6 Conn. 4 1/2" L x 2" W x 1 1/2" H @ 40c @ 60c @ 80c
		DUAL RANGE VOLTMETER 0-15, 0-150 Volt A.C., Weston 528 w. case & leads. @ \$9.50
		DUAL RANGE AMMETER 0-3, 0-15 Amp. A.C. Weston 528 w. case & leads. @ \$12.50
		SPEC. COMBINATION above voltmeter & ammeter, both for @ \$21.00
		COMBINATION O.M.E.R. 0-150 Volt A.C. & 0-30 Amp A.C. Triplett 3/4" Rd. meters. @ \$7.95 Both for. \$7.95
		A.C. VOLTMETER, portable, 0-300 V., R.S. Steel 6 @ \$27.50
		A.C. AMMETER, port 0-200 A. Weston 150, self cont. @ \$32.00
		D.C. VOLTMETER, port. 0-3, 0-150 V., Dual range, W.H. PX-4 @ \$17.50
		D.C. VOLTMETER, port. 0-15, 0-150 V. dual range, R.S. steel 6. @ \$21.00
		D.C. AMMETER, port. 0-25 A, G.E. DP-9, self contained @ \$19.00
		D.C. AMMETER, port. 0-10 M.V. mvt., W.H. PX-4, se. cal 1000, 2000, 4000 Amp, less shunts @ \$17.50
		VOLT OHM MILLIAMMETER, port. Weston 665 @ \$45.00

### PANEL METERS

		0-8 AC V WESTON 476 3/4" RD. @ \$3.50
		0-15 AC V GE 2 1/2" RD BL SK 300 CY. @ \$2.50
		0-15 AC V GE 2 1/2" RD BL BLANK SC IS-122 @ \$2.50
		0-15 AC V GE 2 1/2" RD BL SC. @ \$3.00
		0-15 AC V WH 3 1/2" RD @ \$3.95
		0-75 AC V WESTON 517 2 1/2" RD MET CS RING MTD @ \$2.95
		0-130 AC V WH 3 1/2" RD BLANK SC. @ \$2.95
		0-150 AC V BURL 2 1/2" RD @ \$2.95
		0-150 AC V BURL 2 1/2" RD MET CS. @ \$2.95
		0-150 AC V HIICK 2 1/2" RD MET CS. @ \$2.95
		0-150 AC V WESTON 517 2 1/2" RD MET CS BL SC 400 CY @ \$2.50
		0-130 AC V WESTON 517 2 1/2" RD MET CS. \$2.95
		0-130 AC V GE 3 1/2" RD BL SC @ \$4.50
		0-150 AC V GE 3 1/2" RD 400 CY @ \$4.00
		0-150 AC V GE 3 1/2" RD BL SC 400 CY. @ \$4.00
		0-150 AC V GE 3 1/2" RD @ \$5.50
		0-130 AC V TRIP 3 1/2" RD @ \$4.50
		0-150/300 AC V TRIP 3 1/2" RD W RES POH @ \$5.50
		300 V @ \$7.00
		0-150 AC V WH 3 1/2" RD 400 CY. @ \$5.50
		0-150 AC V WH 3 1/2" RD @ \$5.50
		0-150 AC V WH 3 1/2" RD SURF MTD MET CS @ \$3.00
		0-300 AC V BURL 3 1/2" RD @ \$8.00
		0-300/600 AC V BURL 3 1/2" RD W RES POH @ \$7.00
		0-500 AC V GE 3 1/2" RD @ \$12.00
		0-5 AC A WH 3 1/2" RD @ \$4.95
		0-15 AC A STERL 2" SQ POLARIZED VANE MVT @ \$1.50
		0-30 AC A TRIP 3 1/2" RD @ \$4.00
		0-60/120 AC A BURL 3 1/2" W EXT CURRENT TRANSFORMER @ \$7.50
		0-60/120 AC A BURL 3 1/2" LESS CURRENT TRANSFORMER @ \$4.50
		0-75 AC A TRIP 3 1/2" RD @ \$3.50
		0-3 DC V SIMP 2 1/2" RD MET CS RING MTD @ \$2.00
		0-3 DC V TRIP 2 1/2" RD BL SC MET CS @ \$2.00
		0-3 DC V WESTON 506 2 1/2" RD BL SC. @ \$2.50
		0-3-0-3 DC V WH 2 1/2" RD SURF MTD 200 R/V @ \$1.25
		0-5 DC V WH 2 1/2" RD 200 R/V P. S. 5 MA @ \$3.50
		0-10 DC V SUN 2 1/2" RD 100 R/V @ \$2.50
		0-15 DC V GE 2 1/2" RD BL SC @ \$2.50
		0-15 DC V GRUEN 2 1/2" RD @ \$3.50
		0-15 DC V MC CLINTOCK 2 1/2" RD BL SC 1000 R/V @ \$3.00
		0-15 DC V MC CLINTOCK 2 1/2" RD @ \$2.00

		0-20 DC V WESTON 506 2 1/2" RD 1000 R/V @ \$3.50
		0-30 DC V GE 2 1/2" RD 250 R/V @ \$2.95
		0-30 DC V DE JUR AMSCO 2 1/2" RD @ \$2.50
		0-50 DC V READRITE 2 1/2" RD STAMPED MET @ \$1.00
		0-50 DC V WH 3 1/2" RD 200 R/V @ \$1.00
		0-200 DC V WH 3 1/2" RD 1000 R/V @ \$3.95
		0-300 DC V WH 3 1/2" 1000 R/V @ \$7.00
		0-600 DC V SIMP 2 1/2" RD W EXT RES @ \$4.00
		0-75 DC V WESTON 301 3 1/2" RD MET CS 1000 R/V @ \$11.00
		0-1.5 KV DC WH 3 1/2" RD 1000 R/V @ \$7.25

		0-20 DC MICRO WESTON 301 3 1/2" RD SPECIAL SC @ \$4.95
		0-150 DC MICRO GE 2 1/2" RD BL SC @ \$6.50
		0-100-0-100 DC MICRO WE 3 1/2" RD CONC STYLE 950 OHMS @ \$6.50
		0-200 D C MICRO GE 3 1/2" RD SPECIAL SC @ \$4.95
		0-200 DC MICRO SUPER 4" RECT 500 OHMS SPECIAL SC @ \$7.50
		0-400 DC MICRO TRIUMPHI 4" RECT 500 OHMS SC @ \$7.50
		0-500 DC MICRO DE JUR AMSCO 2 1/2" RD \$3.00
		0-300 DC MICRO SIMPSON 2 1/2" RD \$1.95
		0-500 DC MICRO SIMP 2 1/2" RD @ \$3.50
		0-500 DC MICRO TRIP 2 1/2" RD @ \$3.50
		0-500 DC MICRO WH 3" SQ SPEC SC @ \$4.95
		0-550 DC MICRO GE 3" SQ SPEC SC @ \$4.50
		0-2-2 DC MA RS TYPE J-1 1 1/2" SQ @ \$4.50
		0-1 DC MA GE 2 1/2" RD @ \$3.95
		0-1 DC MA GE 2 1/2" RD MET CS SPEC SC @ \$3.00
		0-1 DC MA GE 2 1/2" RD BL SC SPEC SC @ \$3.00
		0-1 DC MA GE 3 1/2" RD BL SC SPEC SC @ \$4.50
		0-1 DC MA MC CLINTOCK 3" SQ 65 OHMS SPEC SC @ \$3.50
		0-1 DC MA SUN 3 1/2" RD @ \$3.00
		0-1 DC MA WE 3 1/2" RD CONC STYLE SPEC SC @ \$4.00
		0-1.4 DC MA HICK 3 1/2" RD 70 OHMS W M1 CROMIOS CS @ \$2.00
		0-1.5 DC MA HICK 2 1/2" RD MET CS @ \$2.00
		0-2 DC MA RS 50 MV MVT SPEC SC @ \$2.50
		0-3 DC MA GRUEN 2 1/2" RD @ \$2.00
		0-3 DC MA GRUEN 2 1/2" RD SPEC SC @ \$2.00
		0-3 DC MA SIMP 2 1/2" RD @ \$2.25
		0-3 DC MA WESTON 506 2 1/2" RD MET CS @ \$2.50

		0-10 DC MA HICK 2 1/2" RD MET CS SPEC SC @ \$2.50
		0-15 DC MA SIMP 3 1/4" RD @ \$4.50
		0-20 DC MA GE 2 1/2" RD BL SC @ \$3.00
		0-20 DC GE 3" SQ @ \$3.75
		0-25 DC MA WESTON 301 3 1/2" RD @ \$3.95
		0-30 DC MA GE 3 1/2" RD @ \$3.50
		0-30 DC MA GE 3" SQ @ \$3.25
		0-30/300 DC MA WH 3 1/2" RD @ \$3.50
		0-30/300 DC MA WH 3" SQ @ \$3.95
		0-50 DC MA GE 3 1/2" RD @ \$3.95
		0-50 DC MA GE 3" SQ BL SC @ \$3.25
		0-80 DC MA GE 3 1/2" RD @ \$3.75
		0-100 DC MA WESTON 506 2 1/2" RD @ \$3.95
		0-150 DC MA GRUEN 2 1/2" RD @ \$3.00
		0-200 DC MA GRUEN 2 1/2" RD @ \$3.00
		0-200 DC MA TRIP 2 1/2" RD @ \$3.00
		0-200 DC MA WESTON 506 2 1/2" RD BL SC @ \$3.00

		0-200 DC MA MARION 3 1/4" RD @ \$4.00
		0-200 DC MA SIMP 3 1/4" RD @ \$4.50
		0-200 DC MA WE 3 1/2" RD @ \$4.50
		0-300 DC MA WE 3" RD @ \$3.50
		0-500 DC MA WH 2 1/2" RD @ \$3.95
		0-5 DC A GRUEN 2 1/2" RD @ \$3.95
		0-15 DC A STERLING 2" SQ STAMPED MET CS @ \$1.25
		0-15 DC A SUN 3 1/4" RD @ \$4.00
		0-15 DC A TRIP 3 1/4" RD @ \$4.00
		0-15 DC A WH 2 1/2" RD SURF MTD @ \$3.50
		0-30 DC A HOYT 2 1/4" RD MET CS @ \$2.50
		0-30-0-30 DC A REEDE 2 1/2" RD MET CS @ \$3.95
		0-50-0-30 DC A GE 2 1/2" RD MET CS @ \$3.50
		0-30-0-30 DC A U. S. GAUGE 2" MET CS BL SC @ \$1.50
		0-200 DC A WESTON 506 2 1/2" RD W 50 MV SHUNT @ \$7.50
		0-300 DC A GE 2 1/2" RD W 50 MV SHUNT @ \$5.50
		0-250 MA RF GE 2 1/2" RD BL SC CAL 0-75 \$3.50
		0-250 MA RF WH 2 1/2" RD BL SPEC SC @ \$3.50
		0-1 RF A GE 2 1/2" RD BL SC @ \$2.95
		0-1 RF A GE 2 1/2" RD @ \$3.50
		0-1 RF A GE 2 1/2" RD MET CS @ \$3.50
		0-1 RF A WH 2 1/2" RD BL SC @ \$2.95
		0-1.5 RF A GE 2 1/2" RD MET CS BL SC @ \$2.95
		0-1.5 RF A WESTON 507 2 1/2" RD MET CS BL SC @ \$2.50
		0-2 RF A SIMP 2 1/2" RD @ \$3.50
		0-2.5 RF A WESTON 507 2 1/2" RD @ \$3.95
		0-2.5 RF A SIMP 3 1/2" RD @ \$4.95
		0-2.5 RF A WH 3 1/2" RD @ \$5.50
		0-2.5 RF A MC CLINTOCK 3 1/2" RI @ \$1.50
		0-3 RF A SIMP 2 1/2" RD @ \$3.50
		0-3 RF A WH 3 1/2" RD @ \$5.50
		0-4 RF A GE 2 1/2" RD BL SC @ \$2.95
		0-6 RF A GE 2 1/2" RD BL SC @ \$2.50
		0-1 RF A WESTON 125 3 1/2" RD @ \$5.50
		0-20 RI A WESTON 507 2 1/2" RD @ \$3.50
		0-20 RI A GE 3 1/2" RD @ \$4.95
		0-30 RI A TRIP 3" SQ W E/T LEADS & COUPLE @ \$8.00

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 NO. 255. An ideal oil filled power supply filter used in army 16 tube unit, has 2.5, 2.5 and 5 MFD all at 600V D.C. rating. Shipping Wgt. 3 lbs. Each. **\$1.50**

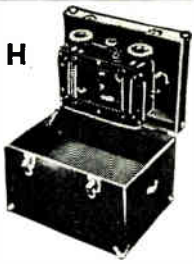
**STANDARD BRAND TELEVISION CONDENSER**  
 No. 256. .05 MFD at 7500v. rating. Excellent Television Coupling Condenser with mounting bracket. Shipping Wgt. 3 lbs. each. **\$3.50**

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 NO. 257. Plug in transmitter tuning unit from army Walkie Talkie. Contains antenna and tank coils, tuning condenser, transmitting and receiving crystals. Ideal transmitter foundation. Shipping Wgt. 1 lb. Each. **\$1.00**  
 (Same as above except transmitter crystal in 80 meter amateur band.....\$2.50 each)

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 NO. 258. Makes excellent contact microphone for musical instrument or vibration pick-up. Shipping Wgt. 1 lb. \$1.00 each Extension cord with switch for above .50 each

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NO. 259. The case of this unit makes the finest tool and service kit ever designed. Plywood construction, 14 x 11 x 10" high, with 8 covered compartments in the bottom for repair parts, leather handle, steel reinforced covers, hinged lid. Also excellent as case for radio phonograph, movie projector, camera, shell case, fishing kit, picnic kit, etc. The astrograph itself, (which cost the government \$125.00) makes an excellent contact printer, and can be used for a foundation for enlarger, strip map holder, etc. The case alone worth twice the give-away price of **\$3.95**



**AN27/ARNS ANTENNA**  
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**AT38A/APT RADAR ANTENNA**  
 NO. 263. New radar dome type antenna with mounting base and connections, in original carton. Ship. Wgt. 11 lbs. **\$14.50**

**AN104A BLADE ANTENNA**  
 NO. 264. Standard blade antenna used on many military fighting planes with coaxial connection at base. Shipping Wgt. 3 lbs. **\$1.50**

**BENDIX MTS1C TRANSMITTER CONTROL BOX**  
 NO. 235. Contains channel switch, emission switch, send receive switch, power switch and indicators for Bendix aircraft transmitters. Ship. Wgt. 3 lbs. **\$5.50**

**BC 670B REMOTE CONTROL BOX**  
 NO. 265. Motor starting control box has starting and stopping switch, indicator, cable and plug. Wooden case. Ship. Wgt. 6 lbs. Each. **\$1.95**

**BK 22 RELAY ASSEMBLY**  
 NO. 266. Used on SCR 269 Radio Compasses. Contains stepping and control relays — junction box of aluminum. Brand new. Ship. Wgt. 7 lbs. Each. **\$3.95**

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**B & W 11 to 14 MC TANK COIL**  
 NO. 281. Plug in type used on BC 610 Transmitter. New, original cartons. Shipping Wgt. 2 lbs. Each. **\$1.50**

**DM 64A 12 VOLT DYNAMOTOR**  
 NO. 269. Input 12V at 5 Amps. Output 275 Volt 150 MA. New. Shipping Wgt. 7 lbs. Each. **\$5.50**

**DM 32A COMMAND SET DYNAMOTOR**  
 NO. 270. Part of 274N Command Receivers. Input 28 Volts, output 250V at 60 MA. Shipping Wgt. 4 lbs. Each. **\$5.50**

**DM 21 12 VOLT DYNAMOTOR**  
 NO. 271. Used in Army BC 312 Communication Receiver. Input 12 Volts at 3.3 Amps. Output 235 Volts at 90 MA. New, original cartons. Shipping Wgt. 8 lbs. Each. **\$5.50**

**PE94C SCR 522 POWER SUPPLY**  
 NO. 272. Complete dynamotor power supply for the SCR522, operates from 28 Volts. Complete with controls, filters, etc. Original carton. Shipping Wgt. 34 lbs. Each. **\$8.75**

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 NO. 273. Complete power supply for BC 645. Operates from 12 or 24 Volts. Supplies both AC and DC required. Shipping Wgt. 13 lbs. Each. **\$3.95**

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 NO. 274. New input 12 Volt at 18.7 Amperes. Supplies 675V at 275 MA or 1/2 above voltage from 6 volts. Excellent for auto use. Shipping Wgt. 11 lbs. Each. **\$7.50**

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 NO. 214. A popular 28 Volt receiver dynamotor used on present military equipment. Supplies 250V at 60 MA. Shipping Wgt. 4 lbs. Each. **\$5.50**

**GN 58 HAND GENERATOR**  
 NO. 275. Makes excellent home lighting plant, operated by wind propeller, waterfall, gas engine, or hand crank. Reduction gear allows full output at slow speed; supplies 6 volts at 2.45 amp., 425 volts at .115 amp. New. Add postage for 28 lbs. Each **\$7.95**  
 Handles for GN 58 \$ .50 each  
 Connecting cord for GN 58 with plugs CD1086. \$1.50 each

**COLLINS AUTOTUNE CONTROL HEAD**  
 NO. 278. Brand new controls used on the ART/13, 100 Watt, Transmitter. Types 7, 8, 10, and 11 available. Get a spare while available as new cost is over \$22.00 each. Shipping Wgt. 3 lbs. Price any type (mention when ordering). Each **\$4.50**

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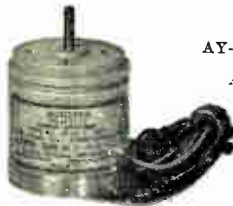
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QUANTITY PRICES ON REQUEST

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
11B23	\$49.50	211	\$ 98	851	\$75.00	HY31Z	\$5.50	154	\$ .96	606G/6T7G	\$1.06	12SK7	\$ .66
11B24	4.95	215	3.00	852	14.95	HY65	2.49	155	.72	607	.80	12SK7GT	.88
11B27	4.95	218	7.50	860	3.00	HY69	2.49	174	.80	607GT	.72	12SL7GT	.88
11B56	8.00	217C	4.95	861	45.95	HY75	1.25	175GT	1.06	6R7	1.06	12SN7GT	.80
1N21	.59	221A	2.95	864	.69	HY14B	1.25	1U4	.80	6R7GT	1.06	12S07	.60
1N23	.59	222A	120.00	865	2.98	HY115	1.25	1U5	.72	6S7	1.28	12S07GT	.60
1P22	11.50	227A	3.95	866	2.98	HY615	1.25	1V	.88	6S7G	1.28	12SR7GT	.39
1P24	2.00	241B	90.00	866JR	1.25	HYE1148	4.48	2A3	1.28	6S8GT	1.06	12X3	.98
1S21	1.95	242C	3.95	868	1.95	HY1231Z	5.50	2A4G	1.28	6SA7	.66	12X3	.98
2B22	5.35	249C	3.49	869B	75.00	KY1269	2.95	2A5	1.88	6SA7GT	.66	12Z3	.88
2B22	5.35	250R	7.95	872A	2.95	KU76	105.00	2A7	1.06	6SF7	.72	12Z3	.88
2B120	6.95	250TH	19.50	874	.98	ML100	105.00	2E5	.88	6SD7GT	.49	14A7/12B7	.88
2C22	.39	250TL	19.50	876	2.49	ML101	150.00	2V3G	1.98	6SF5	.66	14AF7/XXD	.88
2C26A	.75	252A	4.95	878	.98	ML502	300.00	2X2A	1.25	6SF5GT	.66	14B6	.88
2C34	.75	258A	4.95	879	.89	MR4	90.00	3A4	1.39	6SG	.80	14C7	.88
2C40	1.98	274A	1.25	884	1.49	OK59	90.00	3A5	1.39	6SH7	.39	14E6	.72
2C43	7.50	274B	1.25	885	.98	OK60	39.50	3A8GT	1.98	6SJ7	.66	14F7	.88
2C44	1.75	282A	9.95	902P1	7.95	OK61	39.50	3B7	.36	6SJ7GT	.66	14F7	.88
2C46	7.50	301A	4.95	904	11.95	OK62	39.50	3D6	.36	6SK7	.66	14F7	.88
2D21	1.69	304TH	6.95	905	2.95	REL21	4.25	3O4	.88	6SK7GT	.96	14H7	1.06
2E22	1.50	304TL	12.95	923	.98	RK12	1.95	3O8GT	.96	6SL7GT	.88	14N7	1.06
2E24	4.95	307A	4.95	931A	4.95	RK21	3.95	3V4	.80	6SN7GT	.88	14O7	.88
2E25	4.25	307A	4.95	950	1.06	RK22	4.25	5A24	.50	6SO7	.60	14R7	.88
2E26	3.95	310	4.95	950	1.06	RK25	2.95	5A24	.50	6SO7GT	.60	14R7	.88
2E30	2.49	311A	1.98	953B	4.95	RK33	.98	5R4GY	1.15	6SR7	.72	14W7	1.06
2J21A	14.95	316A	.69	955	.75	RK34	.59	5T4	1.28	6SR7GT	.66	14X7	1.06
2J26	14.95	322A	120.00	956	.75	RK59	3.95	5U4G	.60	6SV7	.88	14X4	.88
2J31	24.95	327A	4.95	956	.75	RK60	24.95	5V4G	.96	6SV7GT	.66	14Y4	.88
2J32	24.95	331A	4.95	957	.75	RK69	7.99	5W4	1.06	6U5/6G5	.72	19T8	1.06
2J33	24.95	338A	4.95	958A	.75	RK72	1.95	5W4GT	.66	6V6	1.28	22	1.28
2J34	24.95	350 A B	2.95	959	.75	RK73	3.95	5X4G	.72	6V6GT	.88	24A	.88
2J37	24.95	353A	4.95	954	24.95	1000 SPEC.	24.95	5Y3GT	.42	6V7G	.66	25AC5GT	1.16
2J38	37.50	354C/D	19.95	1000T	75.00	1000T	75.00	5Y4G	.60	7A4	.72	25A7GT	1.16
2JBS1	4.95	368AS	4.95	1608	4.95	RX120	10.00	5Z3	.72	7A4	.72	25B5GT	.66
2Y54	25.00	371A	2.95	1611	.99	SD809	4.95	6A3	1.28	6Y6G	.96	25C5	1.16
3AP1	4.95	388A	7.95	1613	.75	TZ40	1.98	6A6	1.06	6Z55G	.88	25D5	1.16
3B22	4.95	393A	7.95	1614	1.75	V70D	3.95	6A7	.80	7A4/XXI	.72	25E7	.60
3B23	4.95	394A	4.50	1616	1.49	VR75	6.95	6A8	.80	7A5	.72	25F7GT	.66
3B24	1.95	417A	24.95	1619	.75	VR75	.98	6ARGT	.80	7A6	.72	26	.72
3B25	1.95	434A	1.95	1621	1.98	VR78	.75	6B1853	1.16	7A7	.72	27	.60
3B26	5.95	446A	1.95	1622	1.75	VR90	.75	6B1853GT	1.16	7A8	.72	28D7	.39
3B31	3.95	450TH	24.95	1624	1.75	VR91	1.49	6AC7 1852	1.16	7AD7	1.06	30	.39
3C21	5.95	503	195.00	1625	.49	VR92	.75	6AD7G	1.28	7AF7	.72	31	1.28
3C22	12.95	527	12.95	1626	7.95	VR105	.75	6AG5	1.06	7AG7	.88	32	1.28
3C23	4.95	531	24.50	1627	4.95	VR150	.98	6AG7	1.28	7AH7	.88	32L7GT	1.28
3C24	1.69	575A	14.95	1628	4.95	VT127A	3.00	6AH6	1.06	7B3	.72	33	.39
3C30	1.50	632A	3.95	1629	.69	U111	1.19	6AK5	1.56	7B5	.72	34	.39
3CP1	3.00	702A	3.95	1630	7.50	WL460	14.95	6AK5	.96	7B7	.72	35 51	.80
3BP1	3.95	703A	4.95	1631	1.98	WL468	14.95	6AK6	.80	7B8	.72	35A5	.80
3EP1	3.95	704A	1.98	1634	1.10	WL542A	4.95	6AL5	1.06	7C4 1203A	.72	35B5GT	.66
3EP2	4.95	704A	1.98	1635	5.95	WL562	150.00	6AL7GT	.80	7C6	.72	35W4	.46
3EP7	3.95	705A	2.95	1636	1.98	WL616	105.00	6AO5	.80	7C6	.72	35Y4	.72
4-65A	14.50	706BY	24.95	1638	.98	WL619	49.50	6AO7GT	.66	7C7	.72	35Z3	.72
4-125A	27.50	706CY	24.95	1641	.79	Z225	1.95	6A08	.88	7E5/1201	1.06	35Z4GT	.60
4-250A	37.50	707A B	24.95	1642	.98	OA3 VR75	1.98	6A55	.80	7F6	.72	35Z5GT	.60
4A1	1.98	708A	7.95	1644	1.49	OA4G	1.06	6AT6	.60	7E7	.88	36	.39
4AP10	6.95	709A	9.95	1645	1.98	OB2	2.05	6AU6	.80	7E7GT	.88	37	.39
4B24	4.95	710A	2.95	1646	1.25	OB3 VR90	.75	6AV6	.80	7F7 1232	1.06	38	.39
4C35	19.95	713A	1.65	1851	1.06	OC3 VR105	.95	6AY6	1.28	7H7	.88	39 44	.39
4J26	14.00	714A	14.95	1852	1.06	OD3 VR150	.88	6B15	1.56	7H7	.88	41	.66
4J33	4.95	715A B	9.95	1853	.95	OY4	1.19	6B16G	.88	7I7	1.06	43	.66
5AP1	4.95	715C	24.95	1963	1.19	OZ4	.88	6B17	1.28	7K7	1.06	43	.66
5AP4	5.95	717A	.99	2050	.58	OZ4	.88	6B18	1.28	7K7GT	.88	45	.66
5BP1	2.95	720CY	34.95	2051	20.00	OZ46	.88	6B18G	.80	7L7	.88	45Z5GT	.72
5BP4	4.95	721A B	4.35	2140	4.95	O1A	.50	6B18GT	.80	7M7	.72	46	1.06
5CP1	4.95	723A B	7.95	5514	4.95	I A3	1.28	6B18	.80	7N7	.88	47	.96
5CP7	13.95	724A B	4.95	5516	1.10	I A4	1.56	6B18G	1.92	7O7	.72	48	.66
5D21	29.95	725A	24.95	5562	10.00	I A5	.39	6B18GT	1.92	7R7	.72	49	.66
5EP7	3.95	726A	23.50	7193	.39	I ADP	.72	6B18G	.80	7S7	1.06	50	.88
5GP1	9.95	750TL	49.50	8003	8005	5.99	6C4	.39	7V7	1.06	50A5	.88	
5HP4	9.95	800	2.25	8008	3.75	I A7GT	.80	6C5	.66	7X7/XXFM	1.06	50B5	.66
5LP1	11.95	801A	2.95	8011	2.95	I B3GT	1.49	6C6GT	.80	7Y4	.72	50C5GT	.72
6AF6G	.88	802	8.95	8012	4.95	I B4	1.28	6C8G	1.28	7Z4	.66	50D5GT	1.06
6C21	24.95	804	12.95	8013	2.95	I B5 2S5	1.28	6C8G	1.28	7Z4	.66	50E5GT	.80
6J4	3.95	804	12.95	8014A	24.95	I C6	.88	6D6	.66	12A	.60	50F5GT	.80
6O5G	1.25	805	5.95	8016	1.49	I C7G	1.28	6DRG	1.28	12A6	.60	50G5	.80
7B27	4.95	806	17.50	8016	3.95	I D5GT	1.55	6E5	.66	12A6GT	.39	50H5	.88
7EP4	17.95	807	1.25	8020	7.95	I D7G	1.28	6F5	.66	12A7	1.28	71A	.80
7GP4	19.40	808	2.95	8027	12.95	I D8GT	1.50	6F5GT	.66	12A7GT	.88	75	.66
9CP7	15.00	809	2.95	C5B	9.95	I D8GT	1.50	6F6	.80	12A7GT	.88	76	.66
9IP7	4.95	810	7.95	C6A	12.95	I E7G	1.56	6F6GT	.66	12A15	.88	77	.66
9MP7	14.95	811	2.45	C6I	1.95	I F4	1.06	6F7	1.06	12A15GT	.88	78	.66
10BP4	34.95	812	2.95	CF Q72	1.39	I F5G	1.06	6F8G	1.28	12A16	1.06	79	.88
10HP4	49.50	812H	6.90	CF 1005	4.95	I F6	1.56	6G6G	1.06	12A16GT	.88	80	.46
10Y	.69	813	8.95	CK 1006	.69	I F7G	1.56	6G6GT	.60	12A17	.88	81	1.56
10SP6C	.69	815	3.95	CK 1090	4.95	IC4GT	1.06	6H6	1.06	12A17GT	.88	82	1.06
12DP7	14.95	816	2.95	FF50	.79	IC4GT	1.06	6					

# NEW GUARANTEED SURPLUS

## AUTOSYNS



**Pioneer**  
AY-1, AY-14, AY-20,  
AY-30, AY-54,  
AY-101D,  
etc.

Prices on Request

## SYNCHROS

Navy Types

1G, 1F, 1CT, 5G, 5F, 5CT,  
5DG, 5HCT, 5SF, 5HSF,  
etc.



Prices on request

## SELSYN SPECIAL



W.E. KS-5950-1.2.  
Size 5. 115 v. 400  
cycles. Use on re-  
duced 60 cycles.  
Stock #SA-182.  
Price \$3.75 each



**Kollman**  
775-01 Selsyn

Ideal for Ham use as transmitter or re-  
ceiver. 6-12 volts 60 cycles. 26 volts 400  
cycles. Stock #SA-57.  
Price \$3.75 each

Phase Shift Capacitor — 4 stators single  
rotor 0-360° phase shift. (Use in complex  
wave synthesis.) Stock #SA-114.  
Price \$4.75 each



## DYNAMOTOR

D-101. 27 v. DC in @ 1.5  
amps. DC output 285 v.  
@ .060 amps. Stock  
#SA-187. Price \$1.50 each.



## RATE GENERATORS

Elineo PM-2

2.0 v. DC per 100 rpm.  
Use to 2000 rpm. Stock  
#SA-53. Price \$7.50 ea.

ELINCO F-16. 2 Phase AC. 1.3 v. AC per  
100 rpm. 60 cy. output at 1800 rpm. Stock  
#SA-193. Price \$12.50 each.

## SWEEP GENERATOR CAPACITOR



Hi-speed bearings. Split  
stator. Silver plated co-  
axial type. 6-10 mmf.

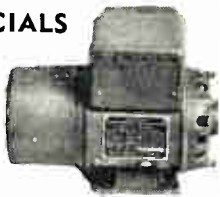
Stock #SA-167. Price \$2.75 each.

## INVERTER

### SPECIALS

400 Cycles

Three Phase



Holtzer Cabot MG-153—Input 28 volts DC  
at 52 amps. Output three phase 115 volts  
400 cycles at 750 V.A. 0.90 P.P. Also sec-  
ond output of 26 volts 400 cycles at 250  
V.A. Voltage and frequency regulated.  
Stock #SA-134.

Price \$99.50 each

Leland SD-93—(10258)—Input 28 volts DC  
at 60 amps. Output 115 volts three phase  
400 cycles at 750 V.A. 0.90 P.P. Second  
output voltage of 26 volts 400 cycles at  
50 V.A. Voltage and frequency regulated.  
Designed for use with various autopilots.  
Stock #SA-209.

Price \$79.50 each

SPERRY PHASE ADAPTOR — 661102  
115 volts 400 cy. Used for operating 3  
phase equipment from single phase source.  
Stock #SA-194. Price \$6.75 each.

### Quotations on request for the following inverters.

General Electric 5AS131JJ11A—(PE-218)  
Navy Type CRV-21AAR G.E. 5AS121LJ2  
General Electric 5D2INJ3A  
Holtzer Cabot MG-149H  
Holtzer Cabot MG-149F  
Wincharger PU7/AP  
Wincharger MG-750  
Pioneer 12125-1A  
Pioneer 12117-2  
Pioneer 12117-3

### ALSO IN STOCK

SINUSOIDAL POTENTIOMETERS  
SINE COSINE GENERATORS  
(Diehl Types FJE-43-9 and FPE-43-1)  
PIONEER TORQUE UNITS  
KOLLSMAN COMPASS SYSTEMS  
AIRCRAFT TACHOMETER SYSTEMS  
AMPLIDYNES - MAGNESYNS  
DC SERVO MOTORS  
SERVO AMPLIFIERS  
GYROS - AUTOPILOTS

### LP-21-LM Compass Loops



New

Original  
Cartons

Stock #SA-99.

Price \$9.50 each.

### G.E. 10 RPM DC Motor 5BA 10FJ12



Output 40 lb. in  
at 10 rpm. 24 V.  
@ 1.1 amps.  
Series-wound. 2  
wire reversible.

(Frame is common wire.)  
Ideal for relay servo-systems. Stock #SA-  
17. Price \$8.75 each.

### Delco PM Motor—5068571



Alnico field. 27 v. DC.  
10,000 rpm. 1" x 1" x 2".  
0.120 diam. shaft. 31/64"  
lg. Stock #SA-151. Price  
\$3.75 each.



### 12V D.C. Motor John Oster B-9-2

1.4 amps.  
5600 rpm.

1 3/4" Diam. x 3 3/4" Lg. Spline shaft. C. W.  
rotation. Stock #SA-46. Price \$3.75 each.



### Blower Assembly MX-215/APG

John Oster C-2P-1L

28 V. DC. 7000 RPM.  
1/100 H.P. #2 L-R  
Blower.

Stock #SA-203. Price \$4.00 each



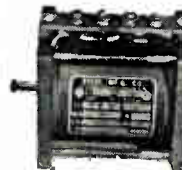
### BEAM ROTATOR

1 rpm. 12 v. DC or 40 v  
60 cy. operation. Re-  
versible. 3 1/2" diam. 5"

lg. 1/2" diam. spline shaft. Ideal for Ham  
or television antennas. Stock #SA-185.  
Price \$9.50 each.

Synchron 10 RPM Timing Motor—24 V.  
DC. Stock #SA-110. Price \$3.75 each.

### AC SERVO MOTORS



Pioneer—CK-2 and 10047-2A for 400 cy.  
Kollman—775-01 for 400 cycles.  
Diehl—FP-25-3, FPE-25-11 (CDA-211052)  
and ZP-105-14 for 60 cycles.

Prices on Request

### 110 RPM MOTOR

G.E. 5BA10J18D, 27 V. @ 0.7 amps. 1 oz./ft.  
torque. 1 3/4" diam. x 3 1/2" lg. Operates on  
AC or DC. Stock #SA-98.



Include 15¢  
for P.P.  
and  
handling  
Price  
\$2.95 ea. net

TWX Pat-199.

Write for complete listing,  
or call ARmory 4-3366

4 Godwin Ave.

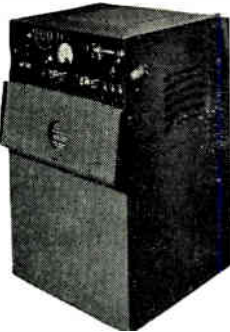
**SERVO-TEK**  
PRODUCTS CO.  
Incorporated  
Surplus Division

Open account shipments  
to rated concerns.  
All prices F.O.B. Paterson, N. J.

Paterson, N. J.



## Raytheon RECTICHARGERS

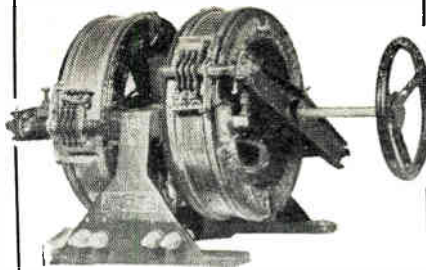


Input: 115 volts AC, 60 cy., 1 Ph. . . . .  
Output: 48 v. DC at 3 amperes regulated and adjustable.  
Charges 23 to 24 cell battery or may be used direct as battery eliminator.

The Raytheon Recticharger is designed to supply current at constant voltage to any load within its rating, and in addition to supply current to a storage battery connected across its load, of sufficient amount to maintain full charge. The function of the battery is to supply surge current due to sudden changes in load and to supply current above the rating of the Recticharger for temporary overload, and to act as a "stand-by" source of power in event of commercial power failure.

**BRAND NEW . . . \$69.50**

## TRANSTAT VOLTAGE REGULATOR



Max KVA Output. . . . . 11.5  
Single Phase. . . . . 50-60 Cycles  
Fixed Winding. . . . . 115 Volts  
Commutator Range. . . . . 0-115 Volts  
Max. Amperage. . . . . 100  
With reconnection for 220 V. Operation: Max Amperage. . . . . 50

This Transtat has wide application to control temperature, motor speed, illumination, rectifier output, filament supply, voltage compensation, instrument calibration, and general testing and laboratory use.  
Net weight 134 Lbs. Dim. 25" W x 16" D x 17 1/2" H (Exclusive 8" shaft extension)  
Brand New . . . . . \$75.00

## GE BATTERY CHARGER



Input: 115 V, 60 cy., 1 Ph. . . . .  
Output. Charges 54 cell battery at from 1 to 10 ampere rate.

Complete with spare fan and fuses. Brand new in original packing cases. Shipping wt. approx. 305 lbs.

The model 6 RC 89F16 Copper Oxide Battery Charger consists of a transformer, a secondary reactor, a copper oxide rectifying element, a ventilating fan, control circuits and auxiliary equipment necessary for proper operation. Transformer tapped for various supply voltage. Eight secondary taps for adjusting charging rate.

ment, a ventilating fan, control circuits and auxiliary equipment necessary for proper operation. Transformer tapped for various supply voltage. Eight secondary taps for adjusting charging rate.

**BRAND NEW . . . \$149.50**

## SHOCK MOUNTS



- |  |     |
|--|-----|
| A. Lord #20, 3" x 3" x 1 1/4" . . . . .                    | .40 |
| B. U. S. Rubber #5150 C 2 3/8" x 2 3/8" x 1 1/4" . . . . . | .30 |
| C. Lord #15 2 3/8" x 2 3/8" x 1 1/4" . . . . .             | .25 |
| D. Lord #10 1 1/2" x 1 1/2" x 3/8" . . . . .               | .10 |
| E. Lord #3 1 1/2" x 1 1/2" x 3/8" . . . . .                | .10 |
- BRAND NEW**

## LINEAR SAWTOOTH POTENTIOMETER

W.E. No. KS 15138



The d-c potentiometer consists of a closed type die-cast aluminum alloy frame consisting of a continuous resistance winding to which electric power is supplied through two fixed taps 180 degrees apart. Two rotating brushes (180 degrees apart and bearing on the resistance winding) and two take-off brushes are provided for the output voltage. Varying the position of the brushes varies the output voltage in accordance with a linear sawtooth wave. The potentiometer is excited with 24-volt direct current, is arranged for panel or bracket mounting, is approximately 3-11/16 inches in diameter, 3 inches deep, 4 1/2 inches long, and has an approximate weight of one pound. External connections are made through a standard AN type connector.

**Brand New \$5.75**

## STEPDOWN TRANSFORMERS

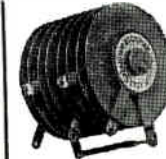
Input: 115V.-60 cycles.  
Output: 20 V., at 10 amps.  
Also tapped at 6V., for pilot light. Ideal for Selenium Rectifier Applications, etc.



**Brand New \$2.45**

## SELENIUM RECTIFIER

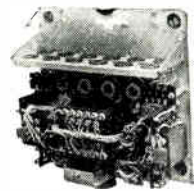
Bridge Type  
Input: 36 V. AC.  
Output: 28 V. DC., 1.1 Amps.



**Brand New \$2.75**

## 400 CYCLE SERVO AMPLIFIER

G. E. Type 2CVIC1



**Brand New . . . . . \$29.50**

## METER SHUNTS



10 Amp. 50 Mv.  
**BRAND NEW \$ .50**

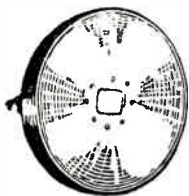
## SOUND POWERED TELEPHONE HANDSETS

W. E. Type TS-10M.  
Complete with 7 ft. cord.



**Brand New . . . \$16.95**

## PARABOLOIDS



Ideal for microwave experimental work.  
Spun Magnesium dishes  
Reinforced Perimeter  
17 1/2" Diameter x 4" Deep  
Two sets mounting brackets on rear.  
Open center hole 1 1/2" x 1 5/8"

**Per Pair, Brand New . . . \$8.75**

## MERCURY CONTACT RELAY

Western Electric D-168479

For applications in all types of high speed switching devices. Long service life, high operating speeds. Large current and voltage handling capacity, uniform and constant operating characteristics under adverse atmospheric conditions. Hermetically sealed mercury-wetted contacts in gas-filled glass envelope. Free from moisture, dirt, corrosion and atmospheric pressure. Single pot. double throw contacts.  
1000 hours life at 60 operations per second. Two coils of 700 ohms. and 3300 ohms. Operating current, coils series aiding—6.6 mils. Release current, coils series aiding—5.2 mils. Four page Technical Data on request.



**Brand New in Original Cartons, \$4.75**

## DYNAMOTORS—500 Watt Navy Type CAJO-211444

Input: 105-130 Volts D.C., 6 amps. Output 13 or 26 Volts D.C. (26 V. at 20 amps. in series of 13 V. at 40 amps. in parallel). Designed for radio use, fully R.F. filtered, complete with separate Square D line switch box.

**BRAND NEW \$59.50**

## RADAR ANTENNAS

SO-1 (10 cm.) . . . . . \$149.50  
SO-13 (10 cm.) . . . . . \$129.00  
TDY (10 cm.) . . . . . \$95.00  
Radar Repeater Adapters, Antenna Control units with P P I units, Transmitter-Receiver units, etc. for SO Radar.  
All Brand New Equipment.

## ACME HI-VOLT TRANSFORMERS

Primary: 115 V., 60 cycles.  
Secondary: 8000 V., C.T., 800 V.A.  
Brand new in sealed cans . . . . . \$27.50

## MOTOR GENERATORS

Brand New War Surplus Machines Built by Allis Chalmers Co. to U. S. Navy Specifications.  
Input: 115V. D.C. at 14 amps., 3600 rpm.  
Output: 120V A.C., 60 CY. 1 ph. at 10.4 amps. 1000 Watts continuous duty. Ball bearings.  
Splashproof. Fully enclosed. Centrifugal starter.  
Frequency adjustable to load.  
Length 26"; Width 12 7/8"; Height 13".  
**Price \$97.50**  
Same machine but for 230V. D. C. input.  
**Price . . . . . \$125.00**

Prices FOB, Tuckahoe, N. Y.  
Subject to Change Without Notice. 20% With Order on C.O.D. Shipments.

# ELECTRONICRAFT

INC.

All merchandise guaranteed. Immediate delivery, subject to prior sale.

**5 WAVERLY PLACE**

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**TUCKAHOE 7, NEW YORK**

# RELIANCE Wishes its many friends a VERY MERRY CHRISTMAS

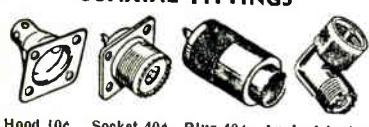
## RG 8/U NEW-UNUSED 52 OHM COAXIAL CABLE

4¢ A FOOT

500-2,500 feet	\$40.00 per M
3,000-5,000 feet	35.00 per M
5,500-10,000 feet	30.00 per M
10,500-20,000 feet	27.50 per M
over 20,000 feet	25.00 per M

No charge for reels.

### COAXIAL FITTINGS




Hood 10¢	Socket 40¢	Plug 40¢	Angle Adaptor 20¢
	SO-239	PL-259	M-359
	83-1R	83-ISP	83-1AP

PL259A, 83-ISP, 83-1J, UG21U, UG22U, UG13U, UG27U, UG281 U assembled with short piece of RG 8/U . . . . .40¢ each  
UG85U Baby "N" Plug . . . . .40¢ each  
UG87U Baby "N" Socket, Gold Plated with Hood Attached . . . . .50¢ each

## FILAMENT TRANSFORMER

### WESTINGHOUSE #6D4298

Tested at 34,000 volts  
Pri. 115 V. A.C., Sec. 5V @ 6.5 Amp.  
**ONLY \$8.50**



### CHOKES

400 MA. 12 Henry 90 Ohms, 6,000 V.D.C. Test. Hermetically Sealed. 4 1/2" x 5 3/4" x 4 1/4". 12 lb. . . . . \$3.85

## PRECISION RESISTORS

Any Order For

100 pieces . . . . .10% Off  
1000 pieces . . . . .20% Off

### 1/4 WATT—25c

6.68	12.32	16.37	123.8	414.3
10.48	13.02	20.	147.5	705
10.84	13.52	62.54	220.4	2193
11.25	13.89	79.81	301.8	10,000
11.74	14.98	105.8	368.6	59,148

### 1/2 WATT—25c

.250	11.1	235	4,451	15,000
.334	13.15	260	5,000	15,750
.502	46	270	5,900	17,000
.557	52	298.3	6,500	20,000
.627	55.1	400	7,000	25,000
1.01	75	723.1	7,500	30,000
1.53	97.8	2,500	8,000	100,000
2.04	125	2,850	8,500	150,000
2.04	180	3,427	10,000	
2.25	210	4,000	14,825	


### 1 WATT—30c

1.01	5.21	1,250	9,000	55,000
2.58	10.1	3,300	18,000	65,000
3.39	10.9	5,000	20,000	70,000
5.05	270	7,000	50,000	75,000

### 1 WATT—40c

100,000	128,000	180,000	470,000	525,000
120,000	130,000	250,000	500,000	500,000
125,000	160,000	320,000	522,000	700,000

1 Megohm, 1W, 1%, 65c, 5%, 40c



### CAPACITORS

#### OIL FILLED

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.375 @ 16,000			.2 750	V.A.C.	.49
and			(2,200	V.D.C.)	1.75
.75 @ 8,000		\$14.95	8	1,000	1.50
.1	7,500	12.50	4	1,000	1.00
.1-1	7,500	1.95	3	1,000	.80
.1	7,000	1.85	2	1,000	.65
.02-.02	7,000	1.65	.05	1,000	.29
.1	6,000	1.75	10	800	1.35
.03-.03	6,000	1.65	4	600	.69
.1	6,000	8.50	2	600	.39
.01	5,000	1.35	1	500	.29
.25	3,000	1.75	5	500	.24

### POSTAGE STAMP MICAS

5mmf	66*mmf	220mmf	525*mmf	.0015mf
8.2	68	300	560	.002*
10	90	360	650	.0022*
22	100	390	690*	.0027*
33	110*	400	750*	.003*
39	120*	430*	800	.0033*
47	150*	470	820*	.0039*
50	180	488*	.001mf	.0068*
56	180*	500*	.0012	.01
60	200	510*	.0013*	

\* Silver Mica

#### Price schedule

5MMF to .001MFD	5¢	Silver Mica	10¢
.0012MFD to .0027MFD	7¢	Silver Mica	20¢
.0029MFD to .0068MFD	12¢	Silver Mica	50¢
.0082MFD	16¢	.01MFD	18¢

### CERAMIC CONDENSERS—6c ea.

3.44 mmf	12 mmf	27 mmf	62 mmf	91 mmf
4.7	13	33	65	150
6.8	15	50	75	220
10.	22	56	82	1000

\$4.50 per 100 of one value.

### ELECTROLYTIC

20-20 mfd	450 VDC self mtg. can.	95¢
125	self mtg. can. <td>95¢</td>	95¢
20	can. <td>20¢</td>	20¢
10	can. <td>15¢</td>	15¢
1000	25 self mtg. can. <td>85¢</td>	85¢
75	25 threaded can. <td>30¢</td>	30¢
40	25 can. <td>20¢</td>	20¢
50	25 tubular. <td>15¢</td>	15¢
1000	15 self mtg. can. <td>35¢</td>	35¢
225	15 self mtg. can. <td>25¢</td>	25¢

### SMALL VARIABLE AIR

5-25 mmf 7 plates 15¢	3-30 double spaced 30¢
3-50 14 plates 20¢	7-80 21 25¢
5-30 9 plates 20¢	7-1000 27 30¢

### CERAMIC VARIABLE

3-12 Eric NPO 25¢	4-30 Eric N500 25¢
20-120 Centralab 30¢	

### PULSE TRANSFORMERS

X 143T 2, UTAH, core—% x % x 1/4", 3 windings, open frame, capable of shortest pulses **\$1.50**

X 124 T2, UTAH, marked 9262 or 9280, small gray case 1 1/2" high x 1 1/2" x %" with two 6-32 mtg. studs. Ratio 1:1:1, hypersil core **\$1.50**

Spec.—10, 111, Chicago Transformer equivalent of 9262 . . . . .**\$1.50**

134-BW, Westinghouse, core—1 1/2" x %" x %" 4 windings open frame . . . . .**\$1.50**

7472407, GE, core % x 1 1/2" x 3/16", 2 windings (0.6 ohm and 0.03 ohm DC) . . . . .**\$1.25**

80G16, GE . . . . .**\$1.25**

D161310 Western Electric, cased 1 1/2" dia. x 1 1/2" high, impedance ratio 120 to 2350 ohms, molybdenum Permalloy tape core. Frequency response 50 Kc to 4 Mc. . . . .**\$2.00**

D166438, Western Electric, cased 1 1/2" x 1 1/2" x 2 1/4", 2 semitoroidal windings, 150 turns ea. of two windings, used in portable oscilloscope . . . . .**\$1.25**

352-7250-2A, cased 5/16" dia. x 1 1/2" high, DC 10 ohm, 3 1/2 ohm sine wave response 140 kc. to 175 Kc. . . . .**\$1.25**

352-7251-2A, similar to above but for shorter pulses . . . . .**\$1.25**

300 KVA GE 7557296, 50 ohm pulse cable connection; 3,850 V. in 17,300 V. out. (250 KVA @ 1/4 micro second) . . . . .**\$15.00**

800 KVA GE 7710417, 50 ohms pulse cable connection, 450 ohm output, 9500 volt input, 28000 volt pk. output, bifilar . . . . .**\$19.50**

### SWITCHES

GE switchette CR 1070C 123, SPST, N.C. . . . . \$2.00

Micro switch, BZ 2R5, SPDT, small pin . . . . . 45¢, 10 for \$4

Micro switch, YZ RQ1, SPST N.O., push button . . . . . 45¢, 10 for \$4

H&H Toggle, 6A, 125V, SPDT. . . . . 35¢, 10 for \$3

U. S. Instrument Corp., 2 pole 16 position, exceptional quality, dual wiping heavy silver contacts, 2 1/2" x 2 1/2" x 1 1/2" deep. Single hole mount. Not to be confused with ordinary wafer switch . . . . . \$1.05

Altitude limit switch SA 1A/ARN-1 completely enclosed 2 pole 11 position. . . . . \$1.00

Oak wafer switch, bakelite, 4 pole 5 position non-shorting . . . . . \$6.00

H&H, 6 pole double throw, 10 ampere 125 V.A.C. . . . . \$1.50

### UNIVERSAL JOINT ALUMINUM

1 1/2" long x 1/2" O.D. 1/4" ID

**35¢**



### HARDWARE

Glyptal-cement, 1 quart cans GE #1286 **\$7.75**

#### ALLEN SET SCREWS

4-40x1/8	8-32x1/8	10-32x1/4
4-40x3/16	8-32x3/16	1/4-20x1/2
6-32x1/8	8-32x5/16	1/2-16x3/8

All sizes . . . . . \$1.50 per C

%—32 nuts for potentiometers. 100 for \$1.00

15/32—32 nuts for toggle switches **100 for \$1.00**

Screw, Nut & Washer Asst. . . . . 3 lbs \$1.00

Vernier dials, 2% dia. 0-100 in 360°, black with silver marks, thumblock. For BC221 **\$8.50**

Hose clamps, Aero seal, QS 100M4—1/2" nom. dia. or QS 100M8—% nom. dia. **50 for \$2.50**

SLIP RING ASSEMBLY—5 silver plated rings on molded bakelite rotor. Stator hold, 2 silver carbon brushes for each ring. Rotor 3 3/4" O.D., fits 1 1/2" shaft. Complete with brushes. . . . . \$2.95

Split lock washers. #2, 4, 6, 8, 10, 12 **95¢ per 1000**

#### Wrapped—BALL BEARINGS—New

Mfg.	ID	OD	Width	Price
Fafnir 33K5E	3/16"	1/2"	5/32"	25¢
Fafnir 38K	5/16"	7/8"	9/32"	45¢
Timken	1/2"	1 3/8"	7/16"	85¢
ND5202G13M	1/2"	1 3/8"	1 3/8" (dual)	1.25
ND 38503	13/64"	1 37/64"	21/32"	1.00
MRC 2065F	1 5/32"	2 7/16"	5/8"	1.25
Fafnir 545	2 1/6"	2 5/8"	15/32"	1.00
ND-R 4A	1 1/4"	3/4"	7/32"	.35¢

#### NEEDLE BEARINGS

B88 1 1/2" wide	1 1/2"	11/16"	25¢
B108 1 1/2" wide	5/8"	13/16"	30¢
GB34X 1 1/4" wide	3/16"	11/32"	25¢

Mounting Brackets—(Bakelite) for selsyns and differentials shown below . . . . . 25¢ pair

### SELSYNS

**ONLY \$7.25 pair**

#C78248

115 V., 60 Cyc., 3 3/4" dia. x 4 1/2" body. Used in Pairs for Remote Control. Also 50 V., 50 Cyc., \$4.75 pair.

### SELSYN DIFFERENTIAL

#C78249

**ONLY \$2.25 ea.**

115 V., 60 Cyc. Used between two #C78248's as dampener. Can be converted to a 3600 RPM Motor in 10 Minutes. Conversion sheet supplied. Also 50 V., 50 Cyc., \$1.50 ea.



# RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey, Philadelphia 3, Pa. Telephone RIttenhouse 6-4927

MINIMUM ORDER \$3 All Orders f.o.b. PHILA., Pa.

## FREE CATALOG

Write today for your copy of our listings of thousands of surplus bargains.

**ANNOUNCING!**

Larger Values Than Ever Before In Our New  
Larger Store At 189 Greenwich St., N. Y. 7  
(Come In And Browse Around)



**ANNOUNCING!**

THE OPENING OF OUR NEW LARGER  
QUARTERS AT 189 GREENWICH ST., N. Y. 7  
(STREET LEVEL STORE)

**1 K.W. POWER SUPPLY KIT**  
2500-0-2500 Volts @ 500 MA

2000-0-2000 Volts @ 500 MA  
(oil-filled Xformer from BC610) \$39.95

- 1—Swinging choke . . . . . 14.95
  - 1—Smoothing choke . . . . . 7.95
  - 1—Filament Xformer . . . . . 9.95
  - 2—2 Mfd., 3000 v. Condensers, ea 3.45
  - 2—872A Tubes . . . . . each 1.95
  - 2—Plate Caps for 872A . . . . . each .20
  - 2—Sockets for 872A . . . . . each 1.19
  - 2—Hash Filter Chokes . . . . . pr. .79
- \$79.50**
- All parts New! Reduced to

**SELENIUM RECTIFIERS**  
Full Wave Bridge Type

INPUT	OUTPUT	1/2 Amp.	1 Amp.	5 Amp.	10 Amp.	15 Amp.	30 Amp.
up to 18v AC	up to 12v DC	1/2 Amp.	\$0.98				
up to 18v AC	up to 12v DC	1 Amp.	1.95				
up to 18v AC	up to 12v DC	5 Amp.	4.45				
up to 18v AC	up to 12v DC	10 Amp.	7.45				
up to 18v AC	up to 12v DC	15 Amp.	9.95				
up to 18v AC	up to 12v DC	30 Amp.	14.95				
up to 36v AC	up to 28v DC	1 Amp.	3.45				
up to 36v AC	up to 28v DC	5 Amp.	7.45				
up to 36v AC	up to 28v DC	10 Amp.	12.45				
up to 36v AC	up to 28v DC	15 Amp.	18.95				
up to 115v AC	up to 100v DC	.25 Amp.	2.95				
up to 115v AC	up to 100v DC	.6 Amp.	6.95				
up to 115v AC	up to 100v DC	5 Amp.	19.95				
up to 115v AC	up to 100v DC	3 Amp.	12.95				

**OIL CONDENSERS**  
NATIONALLY ADVERTISED BRANDS  
All Ratings D. C.

2x.1mfd. 600v	\$0.35	1mfd. 2000v	\$0.95
.25mfd. 600v	.35	2mfd. 2000v	1.75
.5mfd. 600v	.35	4mfd. 2000v	3.75
1mfd. 600v	.35	15mfd. 2000v	4.95
2mfd. 600v	.35	4mfd. 2500v	3.98
4mfd. 600v	.60	2mfd. 2500v	2.49
8mfd. 600v	1.10	1mfd. 2500v	1.25
10mfd. 600v	1.15	25mfd. 2500v	1.45
3x.1mfd. 1000v	.45	.5mfd. 2500v	1.75
.25mfd. 1000v	.45	05mfd. 3000v	1.95
1mfd. 1000v	.60	1mfd. 3000v	2.25
2mfd. 1000v	.70	.25mfd. 3000v	2.65
4mfd. 1000v	.90	1mfd. 3000v	3.50
8mfd. 1000v	1.95	12mfd. 3000v	6.95
10mfd. 1000v	2.10	2mfd. 4000v	5.95
15mfd. 1000v	2.25	1mfd. 5000v	4.95
20mfd. 1000v	2.95	1mfd. 7000v	2.95
24mfd. 1500v	6.95	3mfd. 4000v	6.95
.1mfd. 1750v	.89	2mfd. 3000v	3.45
.1mfd. 2000v	.95	2x.1mfd. 7000v	3.25
.25mfd. 2000v	1.05	.02mfd. 12000v	9.95
.5mfd. 2000v	1.15	.02mfd. 20000v	11.95

**HIGH CAPACITY CONDENSERS**

10,000 mfd.—25 WVDC	\$6.95
2x3500 mfd.—25 WVDC	3.45
2500 mfd.—3 VDC	.39
3000 mfd.—25 WV DC	2.49
2x1250 mfd.—10 VDC	1.25
1000 mfd.—15 WVDC	.99
200 mfd.—35 VDC	.59
100 mfd.—50 WVDC	.49
4x10 mfd.—400 VDC	.89
4000 mfd.—18 WVDC	1.95
4000 mfd.—25 WVDC	2.95
4000 mfd.—30 WVDC	3.25

**FILTER CHOKES**  
HI-VOLTAGE INSULATION

8 hy @ 550 ma.	\$7.95	325 hy @ 3 ma.	\$3.45
8 hy @ 300 ma.	3.95	1 hy @ 800 ma.	14.99
25 hy @ 160 ma.	3.49	10 hy @ 250 ma.	2.45
12 hy @ 150 ma.	2.25	10 hy @ 200 ma.	1.98
30 hy @ 70 ma.	1.39	10/20 @ 85 ma.	1.59
.05 hy @ 15 amps.	7.95	15 hy @ 125 ma.	1.49
1 hy @ 5 amps.	6.95	15 hy @ 100 ma.	1.39
4 hy @ 600 ma.	5.95	3 hy @ 50 ma.	.29
200 hy @ 10 ma.	3.49	30 hy Dual @ 20 ma.	1.49
600 hy @ 3 ma.	3.49	8/30 hy @ 250 ma.	3.50
085 hy @ 2.5A.	2.49	10 hy @ 100 ma.	1.29

**RADIO TUBES**  
NEW! STANDARD BRANDS!

1B24	\$22.95	726A	\$4.50	1LN5	\$7.79
1B26	4.95	800	1.69	1Q5GT	.95
1B29	.89	801A	.49	1R5	.79
1N21	.59	802	2.95	1R4	.69
1N23	.59	803	5.95	1R5	.59
1N34	1.69	805	5.25	1T4	.59
1P24	.89	807	1.19	3Q4	.59
2AP1	2.39	808	1.95	3Q5	.69
2C22	.19	809	1.98	3S4	.59
2C26	.29	810	6.25	5Y4GT	.49
2C40	1.74	811	1.49	6A7	.59
2C44	1.29	812	1.39	6ARGT	.59
2C46	3.75	813	5.25	6A G5	.79
2D21	1.59	814	2.75	6AG7	.98
2J21	12.95	815	1.45	6B4G	.95
2J22	12.95	816	1.10	6B6G6	1.49
2J26	9.95	826	.49	6C6	.49
2J31	14.95	829B	4.85	6D6	.49
2J32	14.75	832A	2.95	6E5GT	.49
2J36	24.95	833A	29.50	6P6GT	.49
2J37	18.95	836	.79	6F6	.59
2J38	14.75	837	1.49	6H6GT	.39
2J39	18.95	838	2.95	6J5GT	.42
2J40	18.95	841	.50	6J5	.55
2J48	18.95	843	.39	6J7GT	.55
2J49	26.95	845B	3.29	6K6GT	.49
2J51	69.50	851	17.95	6K7GT	.49
2J54B	18.95	860	1.98	6L6G	.95
2J55	18.95	861	11.95	6L6	1.23
2K25	24.95	865	.79	6L7	.79
2K28	8.95	866A	.85	6Q7GT	.55
2V3G	2.39	866B	1.10	6R7GT	.49
2X	2.39	869B	28.75	6C7	.55
3AP1	2.79	874	.69	6F5GT	.59
3BP1	1.39	876	.39	6H7	.49
3B22	.59	878	1.89	6J7GT	.49
3B24	.69	884	.79	6K7GT	.49
3B26	1.95	885	.79	6S17GT	.59
3CP1	2.95	902P1	5.95	6S7GT	.59
3C22	19.95	905	4.95	6Q7GT	.49
3C23	2.49	923	.69	6V6GT	.59
3C24	.29	954	.35	6X5GT	.59
3C30	.59	955	.35	7A8	.69
3C31	1.49	956	.45	7B7	.55
3D21A	2.25	957	.75	7C5	.59
3E29	1.59	958	.35	7C6	.59
3E29	3.39	1611	.98	7F7	.49
4B24	2.25	1613	.58	7Y4	.49
4E27	12.95	1616	.75	12A8GT	.63
5AP4	4.75	1619	.21	12AT6	.49
5BP1	1.10	1622	1.59	12AT6	.75
5BP4	4.95	1624	.85	12BA6	.55
5CP1	2.95	1625	.19	12BF6	.59
5D21	18.95	1626	.25	12J5GT	.49
5FP7	.85	1629	.19	12J7GT	.49
5J21	11.95	1630	3.95	12K7GT	.59
5J29	18.95	1638	.69	12Q7GT	.49
5J30	18.95	1654	1.98	12R7GT	.49
5L21	11.95	1851	.89	12SF5GT	.49
5R4GY	.89	2050	.75	12SF7GT	.59
5T4	.69	2051	.45	12SJ7GT	.49
5T4G	.45	8005	2.29	12SK7GT	.49
5V4	.72	8011	.65	12SQ7GT	.49
5X4	.59	8012	1.98	12SR7GT	.49
5Y3	.35	8013	.89	14A7	.69
5Z3	.35	8014	6.95	14B8	.69
5Z4	.79	8016	1.39	14Q7	.69
6AR7	.95	8020	.80	24A	.49
6AC7	.59	8025	4.89	25L6GT	.49
6AK5	.89	901	.39	25V5	.47
6AL5	.59	9002	.35	25Z6GT	.45
6C4	.25	9003	.35	26	.26
6D4	1.29	9004	.29	27	.49
6J4	3.95	9005	.39	30 Spec	.39
6J6	.89	9006	.29	32L7GT	1.19
6Q5G	1.25	CK1005	.29	35V51	.59
7BP4	17.95	CK1006	.49	35A5	.49
10V	.39	CK1090	1.49	35L6GT	.49
12A6	.75	EF50	.50	35W4	.38
12DP7	13.95	F123A	12.95	3F4	.69
12GP7	13.95	F127A	17.50	3KZ3	.87
15E	.89	F128A	69.50	35Z5GT	.39
15R	.89	F660	39.50	36	.79
75TL	3.49	FC81A	4.75	41	.52
100TH	9.45	FG105	7.95	42	.89
211	.35	FG238B	39.50	43	.52
227A	3.75	GT146	10.95	45	.82
231D	1.49	GL605	39.50	45 Spec	.35
249C	1.75	GL697	29.50	47	.74
250TH	19.49	HY75	1.25	50A5	.50
304TL	.99	HY815	.49	50B5	.80
304TH	3.95	ML100	29.50	50L6GT	.49
316A	.35	ML101	39.50	50Y6GT	.80
327A	4.95	ML502	99.50	56	.54
350B	1.95	VR75	.80	57	.95
368AS	2.95	VR90	.65	70L7GT	1.29
371B	.99	VR105	.65	71A	.59
450TH	29.45	VR150	.65	75	.52
527	8.95	VT127A	2.49	76	.49
531	2.50	VI111	.49	77	.49
550	.75	OZ4	.59	78	.49
703A	2.95	1A5GT	.49	80	1.35
706A	1.85	1A7GT	.50	81	.85
708CV	18.95	1F5GT	.54	82	.89
714AY	6.05	1N5GT	.59	83	.89
715B	8.05	1L4A	.95	84	.90
715C	18.95	1L6A	.59	84	.60
717A	.50	1L8A	.05	89	.60
721A	.50	1L9A	.05	117L7GT	1.15
732A/R	5.05	1L7D5	.05	117P7GT	1.15
734A/B	1.75	1L7E3	.05	117Z3	.49
725A	7.45	1L7E4	.79	117Z6GT	.69

**500 WATT POWER SUPPLY KIT**  
(Ideal for BC-191 & BC-375E)

- 1—Transformer—Pri: 105/250v
  - 60 cyc in 5v Steps
  - Sec: 1120-0-1120v @ 500 MA
  - 2 1/2 v CT @ 10 AMPS
  - 12v @ 14 AMPS
  - 17v @ 2 1/2 AMPS
  - 32v @ .025 AMPS... \$32.50
  - 2—Filter Chokes @ \$7.95 ea. . 15.90
  - 2—Condensers 3 Mfd @ 2000v DC @ \$4.45 ea . . . . . 8.90
  - 2—866 Tubes @ \$.89 ea . . . . . 1.78
  - 2—Plate Caps Ceramic @ \$.20 ea . . . . . .40
  - 2—Sockets @ \$.20 ea . . . . . .40
  - 1 Pair Hash Filter Chokes . . . . . .79
- Extra Special Buy \$49.50**

**TRANSFORMER—115 V. 60 Cy. HI-VOLTAGE INSULATION**

3710v @ 10 ma.; 2x2 1/2 v @ 3A	\$9.95
2500v @ 15 ma.	6.50
2500v @ 4 ma.; 2 1/2 v @ 2A; 6.3v @ 1 amp.	7.95
2150v @ 15 ma.	5.50
1750v @ 4 ma.; 6.3	

# SAVE — Brand New and Fully Guaranteed

## SYNCHROS

- If Special Repeater, 115 volts, 400 cycle. Will operate on 60 cycle at reduced voltage.—**Price \$15.00 each net.**
- 1CT Control Transformer, 90/55 volts, 60 cycle.—**Price \$22.50 each net.**
- 2J1G1 Control Transformer, 57.5/57.5 volts, 400 cycle.—**Price \$2.00 each net.**
- 2J1H1 Selsyn Differential Generator, 57.5/57.5 volts, 400 cycle.—**Price \$3.25 each net.**
- 5G Generator, 115 volts, 60 cycle.—**Price \$25.00 each net.**
- W. E. KS-5950-L2, Size 5 Generator, 115 volts, 400 cycle.—**Price \$3.50 each net.**
- Size 5 Generator, Army Ordnance Drawing No. C-78414, 115 volts, 60 cycle.—**Price \$14.00 each net.**

## PIONEER AUTOSYNS

- AY1, 26 volts, 400 cycle.—**Price \$4.00 each net.**
- AY20, 26 volts, 400 cycle.—**Price \$5.50 each net.**
- AY30, 26 volts, 400 cycle.—**Price \$10.00 each net.**
- AY31, 26 volts, 400 cycle. Shaft extends from both ends.—**Price \$10.00 each net.**
- AY38, 26 volts, 400 cycle. Shaft extends from both ends.—**Price \$10.00 each net.**

## PIONEER PRECISION AUTOSYNS

- AY101D, new with calibration curve. **PRICE—WRITE OR CALL FOR SPECIAL QUANTITY PRICES**
- AY131D, new with calibration curve. —**Price \$35.00 each net.**

## GENERAL ELECTRIC D. C. SELSYNS

- 8TJ9-PDN Transmitter, 24 volts.—**Price \$3.00 each net.**
- 8DJ11-PCY Indicator, 24 volts. Dial marked  $-10^{\circ}$  to  $+65^{\circ}$ .—**Price \$4.00 each net.**
- 8DJ11-PCY Indicator, 24 volts. Dial marked 0 to  $360^{\circ}$ .—**Price \$6.50 each net.**

## PIONEER TORQUE UNITS

- Type 12602-1-A.—**Price \$30.00 each net.**
- Type 12606-1-A.—**Price \$35.00 each net.**
- Type 12627-1-A.—**Price \$70.00 each net.**

## PIONEER TORQUE UNIT AMPLIFIER

- Type 12073-1-A.—**Price \$17.50 each net.**

## RATE GENERATORS

- PM2, Electric Indicator Company, .0175 V. per R. P. M.—**Price \$7.25 each net.**
- F16, Electric Indicator Company, two-phase, 22 V. per phase at 1800 R. P. M.—**Price \$12.00 each net.**
- B-68, Electric Indicator Company, Drag Cup, 110 volts, 60 cycle, one phase.—**Price \$14.00 each net.**

## INVERTERS

- 12117-4, Pioneer. Input 24 volts D. C. Output 26 volts, 400 cycle.—**Price \$15.00 each net.**
- 12117, Pioneer. Input 12 volts D. C. Output 26 volts, 400 cycle.—**Price \$15.00 each net.**
- 12123-1-A, Pioneer. Input 24 volts D. C. Output 115 volts, 400 cycle, 3 phase. Voltage and frequency regulated. 100 V. A.—**Price \$75.00 each net.**
- 153F, Holtzer Cabot. Input 24 volts D. C. Output 26 volts, 400 cycle, 250 V. A., and 115 volts, 400 cycle, 3 phase, 750 V. A. Voltage and frequency regulated.—**Price \$150.00 each net.**
- WG750, Wincharger, PU16. Input 24 volts D. C. Output 115 volts, 400 cycle, 1 phase, 6.5 amps. Voltage and frequency regulated.—**Price \$35.00 each net.**
- 149H, Holtzer Cabot. Input 28 volts at 44 amps. Output 26 volts at 250 V. A. 400 cycle and 115 volts at 500 V. A. 400 cycle.—**Price \$39.00 each net.**
- 149F, Holtzer Cabot. Input 28 volts at 36 amps. Output 26 volts at 250 V. A. 400 cycle and 115 volts at 500 V. A. 400 cycle.—**Price \$29.00 each net.**

## SPERRY PHASE ADAPTER

- Type 661102, 115 volts, 400 cycle. Used for operating 3 phase equipment from a single phase source.—**Price \$6.50 each net.**

## SINE-COSINE GENERATORS (Resolvers)

- FJE 43-9, Diehl, 115 volts, 400 cycle.—**Price \$20.00 each net.**

## D. C. ALNICO FIELD MOTORS

- 5067127, Delco, 27 V., 250 R. P. M.—**Price \$2.90 each net.**
- 5069600, Delco, 27 V., 250 R. P. M.—**Price \$4.00 each net.**
- 5069466, Delco, 27 V., 10,000 R. P. M.—**Price \$3.00 each net.**

WRITE FOR COMPLETE LISTINGS

## D. C. MOTORS

- 5069625, Delco Constant Speed, 27 volts, 120 R. P. M. Built-in reduction gears and governor.—**Price \$4.25 each net.**
- A-7155, Delco Constant Speed Shunt Motor, 27 volts, 2.4 amps., 3600 R. P. M., 1/30 H. P. Built-in governor.—**Price \$6.25 each net.**
- 5BA10J18D, General Electric, 27 volts, 0.7 amps., 110 R. P. M.—**Price \$2.90 each net.**
- 5066665, Delco Shunt Motor 27 volts, 4000 R. P. M. Reversible, flange mounted.—**Price \$4.50 each net.**
- C-28P-1A, John Oster Shunt Motor, 27 volts, 0.7 amps., 7000 R. P. M., 1/100 H. P.—**Price \$3.75 each net.**

## A. C. MOTORS

- 5071930 Delco, 115 volts, 60 cycle, 7000 R. P. M.—**Price \$4.50 each net.**
- 36228, Hayden Timing Motor, 115 volts, 60 cycle, 1 R. P. M.—**Price \$2.85 each net.**

## SERVO MOTORS

- CK1, Pioneer, 2 phase, 400 cycle.—**Price \$10.00 each net.**
- CK2, Pioneer, 2 phase, 400 cycle.—**Price \$4.50 each net.**
- FPE-25-11, Diehl, Low-Inertia, 75 to 115 V., 60 cycle, 2 phase.—**Price \$16.00 each net.**
- FP-25-2, Diehl, Low-Inertia 20 volts, 60 cycle, 2 phase.—**Price \$9.00 each net.**
- FP-25-3, Diehl, Low-Inertia 20 volts, 60 cycle, 2 phase.—**Price \$9.00 each net.**

## GYROS

- Schwein Free & Rate Gyro type 45600. Consists of two 28 volt D. C. constant speed gyros. Size  $8'' \times 4.25'' \times 4.25''$ .—**Price \$10.00 each net.**
- Schwein Free & Rate Gyro, type 46800. Same as above except later design.—**Price \$11.00 each net.**
- Sperry A5 Directional Gyro Part No. 656029, 115 volts 400 cycle, 3 phase.—**Price \$17.50 each net.**
- Sperry A5 Vertical Gyro. Part No. 644841, 115 volts 400 cycle 3 phase.—**Price \$20.00 each net.**
- Sperry A5 Amplifier Rack Part No. 644890. Contains Weston Frequency Meter. 350 to 450 cycle and 400 cycle, 0 to 130 voltmeter.—**Price \$10.00 each net.**
- Sperry A5 Control Unit Part No. 644836.—**Price \$7.50 each net.**
- Sperry A5 Azimuth Follow-Up Amplifier Part No. 656030. With tube.—**Price \$5.50 each net.**
- Pioneer Type 12800-1-D Gyro Servo Unit. 115 volts 400 cycle, 3 phase.—**Price \$15.00 each net.**
- Norden Type M7 Vertical Gyro. 26 volts D. C.—**Price \$20.00 each net.**
- Norden Type M7 Servo Motor. 26 volts D. C. **Price \$20.00 each net.**

# INSTRUMENT ASSOCIATES

147-57 41st AVENUE Telephone INdependence 3-1919 FLUSHING, N. Y.



## STANDARD D. C. POTENTIOMETER TYPE—MICROMAX

# L & N INDICATORS — CONTROLLERS — RECORDERS

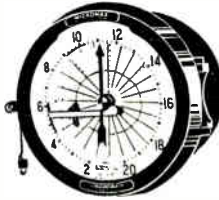
Rebuilt . . . Thoroughly re-conditioned . . . Mechanically, electrically checked and adjusted . . . Instruments shipped ready to put into actual use.

### Model S INDICATING & RECORDING CONTROLLER



Single Point - Curve Drawing, Continuous Line One set adjustable High & Low contacts 115 V AC Motor-Flush mounted metal case Gasketed door. RANGES: 0-1000° F C/A, 0-1500° F C/A, 0-1800° F C/A, 200-2000° F C/A. 1000-2000° F C/A. **\$210.00**

### Model R INDICATING & RECORDING CONTROLLER



2000° C/A . . . . . **\$175.00**

Single Point-Curve Drawing, Continuous Line Chart speed—one revolution in 24 hours One set Adjustable High & Low Contacts 115 V AC Motor-Flush mounted metal case Gasketed door. RANGES: 0-800° F C/A, 700-1400° F C/A, 200-2000° C/A . . . . . **\$175.00**

### Model C SINGLE POINT CONTROLLER



F C/A, 800-2000° F C/A . . . . . **\$135.00**

Non Indicating, Non Recording, Open type contacts for use with External relay, High-Common-Low Contacts for controlling, 115 V AC motor, Metal case, gasketed door, flush mount. RANGES: 0-1500° F I/C, 0-1600° F C/A, 0-1800° F C/A, 0-2000° F C/A, 200-2000° F C/A . . . . . **\$135.00**

### MODEL S—RECORDER

with alarm feature using relay & cam operated contacts. Can be used as on-off controller without temperature setting device. 115 V, AC motor, Range 0-1800° F C/A . . . . . **\$210.00**

### Model S—RECORDER—CONTROLLER

Single Pen—2 Thermocouples—2 sets H.C.L. Contacts—115 V. AC motor. Ranges 0-1200° F C/A, 0-1800° F C/A . . . . . **\$210.00**

### Model S—RECORDER—CONTROLLER

H.C.L. Contacts—115 V. AC motor Extra set on-off contacts. Range 0-1500° F C/A **\$210.00**

# SURPLUS BARGAINS — — NOW!!

### SELENIUM RECTIFIERS

New—Fresh Stock—Not over 6 mos. old. Full wave bridge . . . single phase . . . resistive inductive load . . . continuously rated . . . conservative design.

Type	Max. Input	Max. D.C. Output at 35° C	Price
5B-1	24	18 V @ 3.1 A	\$5.03
5B-1	24	18 V @ 5.2 A	6.73
10B-1	24	18 V @ 10 A	8.71
1B-1	24	19 V @ 1.6 A	4.04
16B-1	24	19 V @ 16 A	16.40
24B-1	24	19 V @ 24 A	23.76
1B-2	48	37 V @ 1.2 A	7.21
3B-2	48	37 V @ 3.1 A	9.60
5B-2	48	37 V @ 5.2 A	13.37
10B-2	48	37 V @ 10 A	17.18
16B-2	48	37 V @ 16 A	30.89
24B-2	48	37 V @ 24 A	44.67
5B-6	144	110 V @ 5.2 A	35.70
2B-6	144	112 V @ 2.4 A	21.86
1B-6	144	114 V @ 1.2 A	17.34
2B-7	168	131 V @ 2.4 A	25.51
1B-7	168	133 V @ 1.2 A	19.68
5B-7	168	133 V @ 5.2 A	41.10

### RECTIFIER TRANSFORMERS

**PRI—105/110/115/120 V.—50/60 Cycles—Open Frame Construction**

SEC—18 V @ 2.5 Amps	4 lbs.	\$3.35
18 V @ 5 Amps	5.5 lbs.	5.25
18 V @ 10 Amps	10 lbs.	6.75
18 V @ 25 Amps	25 lbs.	14.95
18 V @ 50 Amps	30 lbs.	24.75
36 V @ 2.5 Amps	7.5 lbs.	5.25
36 V @ 5 Amps	10 lbs.	6.50
36 V @ 10 Amps	20 lbs.	10.95
36 V @ 25 Amps	30 lbs.	22.50

### PRI—115 Volts—50/60 Cycles

**Open Frame Construction**

SEC—135/145/155/165 V @ .5 Amps	5 lbs.	\$5.25
135/145/155/165 V @ 1.5 Amps	15 lbs.	7.95
135/145/155/165 V @ 2.5 Amps	25 lbs.	13.50
135/145/155/165 V @ 5 Amps	35 lbs.	24.50

### HIGH VOLTAGE CAPACITORS

1 MFD 20 KV DC 18"x13 1/4"x5"	\$25.00
1 MFD 25 KV DC 13"x7"x4"	9.85
.001 MFD 50 KV DC 5 1/2"x7 1/2"x4" Insulators 4" dia. x 7" high.	12.50

Cap. Mfd.	Volts D.C.	Height	Width	Length	Price
10	1000	5-7/8 x 1-3/4	3-4	3-7/8"	\$1.85
4	1000	5-7/8 x 2-3/4	1-1/4"		.85
1	1000	3-5/7 x 2	1-1/16"		.50
1	500	2"	1-1/4" x 1-1/16"		.25
.25	1000	1-1/2 x 1"	3/4"		.25

### HEINEMAN CIRCUIT BREAKER

For use with low voltage, D.C., 100 Amps Dimensions: 3 1/4" H x 4" D x 1" W . . . . . **\$1.75**  
 15 Amp, 115 V AC, Curve 3, CAT. AM 2511-16 **\$1.75**  
 35 Amp, 120 V AC, Curve 2, CAT. AM 1510R-35 **\$1.75**  
 1.5 Amp, 117.5 V AC, Instant Trip. . . . . **\$1.75**

### WESTON Model 622—New!

D.C. Portables . . . 1/2 of 1% accuracy . . . High sensitivity . . . Moulded bakelite case . . . A famous instrument at a real low price.

Range	List Price	Your Price
0-20 Microamps—280 ohms	\$232.50	\$139.50
0-30 Microamps—1800 ohms	202.50	121.50
0-50 Microamps—150 ohms	217.50	130.50
0-20 Microamps—45 ohms	210.00	126.00
0-100 Microamps—10 ohms	210.00	126.00
0-.5 Mills Thermal	300.00	180.00
0-2 Mills Thermal	300.00	180.00
1.5 3/7.5/15/30/75 150/300/750 Volts	294.75	237.00

### QUANTITIES LIMITED! ACT NOW!

### WHSE PORTABLE GALVANOMETER



Type PX-12-7 M.A. movement, special scale, solid connecting terminals, contains a 1 volt internal cell which can be easily removed for conversion to DC AMMETERS & VOLTMETERS, with leather case & canvas carrying strap.

**A buy at \$4.95**

### GE TYPE DO 50 DC AMMETER

50 MV FULL SCALE, RECTANGULAR 3 1/4" x 3", Barrel 2 3/4" DIAM, x 1 1/4" DEEP, MOUNTING HOLES 2 3/4" x 2 3/4" c. to c. SPECIAL SCALE, CAN BE USED WITH EXT. SHUNT FOR ANY RANGE, BAKELITE CASE

Price . . . . . **10 for \$27.50**

### GE TYPE DO 50 DC VOLTMETER

3 VOLTS FULL SCALE, 100 OHMS 1V, SPECIAL SCALE, SAME DIMENSIONS AS ABOVE, BAKELITE CASE

Price . . . . . **10 for \$27.50**

### MICROVOLTER—FERRIS Model 20B

.2 to 100,000 microvolts output, continuously variable . . . operates on 115 V, 60 cycle AC . . . push button selector for 18 frequencies from 455 K.C. to 22 M.C. . . with or without 400 cycle 30% modulation . . . frequency may be varied ±2% by screwdriver adjustment. **Your Price . . . . . \$100.00**

### GE STEPDOWN TRANSFORMER

PRI 115/230 V 60 cycles, SEC 32 V, Rating .5 KVA Isolation type cat 61G60 enclosed, bell end, cont. duty.

Your Price . . . . . **\$7.50**

### STEPDOWN TRANSFORMER—SPECIAL

Made by GE . . . heavy duty . . . considerable over-design . . . open frame . . . ideal for rectifier application . . . size 3 1/2" x 3 1/2" x 4", Primary—115 V 60 cycles. SEC—15 V. @ 12 amps . . . a buy at . . . **\$3.75**  
 SEC—10 V. @ 18 amps . . . a buy at . . . **3.75**

### POWER TRANSFORMER

Pri.—440/220 V 60 Cy Sec—125/115/105 V. Rating .8 KVA RCA Open construction. Bracket mounted, pri & sec terminal board. Overall dimensions: 5 1/2" H, x 7 1/4" W, x 8" D. Mounting Dimensions 6 1/2" x 5 7/8".

Price . . . . . **\$12.50**

### TRANSTAT—3 K.V.A.



Type RH Input: 115 V, 10%. Output: 115 V. Max. Amps: 26 A. Made as a line voltage corrector 10% of input voltage, or can be connected to give plus 20% or minus 20% of input. Can also be reconnected to be

used as an isolated type stepdown with variable secondary. Input: 115 V. Output: 0-30 Volts at 30 Amps. No Knob.

**A Real Buy at . . . . . \$18.00**

(Same type but .25 KVA. Input: 103-126 V. Output: 115 V.-2.17 A.)

Price . . . . . **\$6.50**

### RHEOSTAT

Ohms	Amps	Size-Diam.	Price
.87	2 1/3	3 1/2"	\$2.50
6	2	1 1/2"	1.75
10	9.2	1 1/2"	5.95
22	4.5-3.1	6"	6.50
30	1.7-.9	2 1/2"	1.50
32	2.4	3 1/2"	4.95
40	1.12	2"	2.50
75	1.11	2"	2.50
100	3.5	6"	7.50
100	1	3"	2.95
200	.25	1 1/2"	.75
250	2.5-.51	6"	7.50

### STRUTHERS-DUNN RELAYS

D.P.S.T., Normally open, 115 V, 60 Cycle, AC coil, 30 Amp. contacts, fibre base with 4 holes for mounting. Dimensions, 4 1/2" L x 3" W x 3 3/4" H. **A Real Buy At . . . . . \$2.50**

ALL PRICES INDICATED ARE FOB OUR WAREHOUSE NYC. SHIPMENTS WILL BE MADE VIA RAILWAY EXPRESS UNLESS SUFFICIENT POSTAGE IS INCLUDED OR OTHER INSTRUCTIONS ISSUED. WE WILL REFUND EXCESS POSTAGE IN STAMPS.

# POWERTRON Electrical Equipment Co.

117 LAFAYETTE STREET Phone: WOrth 4-8610 NEW YORK 13, N. Y.

# BIG VALUES IN SURPLUS

## Inter-Communication Sets Manufactured by Dictograph



Designed to bring to homes and offices the convenience of two-way conversation without the use of telephone, household electric current, or radio.

It can be set up in any two rooms you wish . . . being limited only by the length of the wire you use. Inter-Communication Sets will operate efficiently up to 800 feet using 14-gauge wire. Operates off three 1½ volt flashlight batteries per unit.

**BRAND NEW, Pair \$9.95**

## Heavy Duty TRANSFORMERS



Primary: 55 V. Secondary: 10 V @ 238 Amps., 2.38 KVA. Dimensions: 5½" x 7½" x 8½".

Two transformers can be put in series to operate on 110 V Input, giving secondary of 20 V, 238 Amps.

**BRAND NEW INDIVIDUALLY CASSED \$12.50 each**  
2 units for \$22.50

## Cotrell System PRECIPITATOR

Unit consists of very large screen for roof mounting and General Electric Transformer de-ignated as "Substation Transformer" 13,200 Volts, 3 phase, 60 cy. Sec. 110/220V, 75 KVA, original cost \$7,000.

**Like New PRICE \$775.**

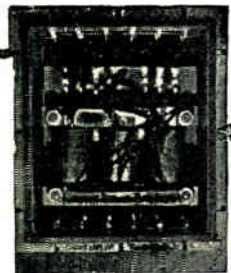
## MOTORS

General Electric Motors: Type B288; 6½ HP; no base; flange mounting; 230 Volts, D.C.; Field; separately excited at 110 Volts, 1100 Speed; Ball Bearings. Brand New in original factory cases. Price \$64.50

Electric Specialty Motors: Type HF311; Marine Duty; Double Shaft, Ball Bearings; 2½ HP—5 Min. 440-3-60. Brand New in original factory cases. Price \$23.50

General Electric Motors, 1/61HP, Type BC, 115 VDC, 1725 RPM Compound Wound. Reconditioned, guaranteed perfect. Price \$9.50

## G. E. Motor Starting Reactors



Type 11K2840G2

Rated at 440 Volts, 3 Phase, 60 Cycles, 16.8 Amperes, 15-20 HP. Waterproof Steel case. 17" x 15" x 10". Brand New in original factory cases.

**\$9.90**

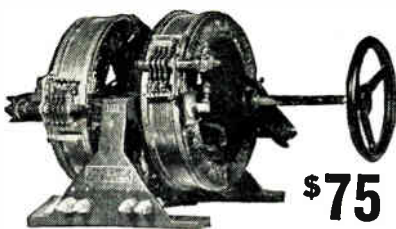
## General Electric

## Automatic COMPENSATOR

Type CR7051-111A; Cat. 4386997G8, 2200 Volts, 3 Phase, 60 Cycles; 75 H.P.; Control Voltage: 220.

**Condition Like New PRICE \$365.**

## "TRANSTATS" Amertran Voltage Regulator



**\$75**

11.5 KVA; 50/60 cy. Commutator Range 0-115 V. Max. Amp. 100. Can be reconnected for 230 volts @ 50 Amps. **BRAND NEW**

## General Electric, Oil Filled OUTDOOR TRANSFORMERS

**BRAND NEW**

3 KVA; TYPE HS: 3000 5200Y-115/230 STYLE 3266596-G1; IN ORIGINAL FACTORY CASES

**\$36.**



## MOTOR GENERATORS

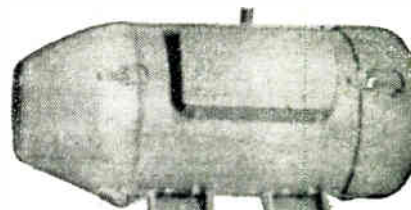
Built by Allis Chalmers to U. S. Navy Specifications

Input: 115 Volts, DC at 14 amperes. 3600 speed, ball bearings. Output: 1.25 KVA; 80% P.F.; 120 Volts, 10.4 Amperes. With resistive control of voltage output and frequency built-in and with Centrifugal automatic controller built-in, permitting line-start operation. Fully enclosed. Splashproof. Brand New in Original Factory Cases.

**\$100**

Same machine for 230 Volts, DC operation. **\$120**

Spare parts kit of brushes, brushholders, ball bearings, field coils, etc. in steel case, Price \$10.



## DUST COLLECTORS

These machines, manufactured by the Torit Mfg. Co. of St. Paul, Minn., are used for extraction of any dust from the air. They consist of a suction blower driven by a GE 1½ HP Motor; Type K; 220/440-3-60, 3475 RPM, and the entire unit is housed in a heavy steel case with louvers for dust intake.

**PRICE \$100.**

## General Electric Type IRT 3 PHASE INDUCTION VOLTAGE REGULATOR

1.64 KVA. Outdoor service, filled with 9 gallons oil. Primary Volts; 208; Load Amperes—10.5. Brand New and in original manufacturer's cases.

**PRICE \$83.50**

## INVERTERS

Electronic Laboratories Inverters; Type 262; 250 watts, maximum; 110 Volts, DC, input to deliver 110 Volts, AC, 60 cycles. Brand New but shop-worn—re-painted. Guaranteed perfect. Price \$26.50

ART Inverters; 6 Volts DC to deliver 110 Volts, AC; 85 watts, maximum. Brand new. Price \$14.50

ATR Inverters; 6 Volts DC to deliver 110 Volts, AC; 85 watts maximum. Brand New. Price \$17.00

## Westinghouse Watthour Meters

Type CS, 240V/60cy/1ph 15 Amp., 3 Wire, new \$12.50

Type CS, 120V/60cy/1ph 15 Amp., 2 Wire, new \$9.50

Type CA, 120V/60cy/1ph 15 Amp., 2 Wire, new \$9.50

Ford Instrument Synchro Generator, 7G, MK111 Mod. 3 115/90 Volts 60 Cycles. Price \$16.50

Arma Corp. Synchro Differential Generator, Type 51D; MR4 Mod. 1 90/90 Volts 60 Cycles. Price \$7.95

Diehl Synchro Transmitter, Type CT8414 115 Volts 60 Cycles. Price \$4.35

Western Electric Motor, KS8624, 20 VAC, 200 Cps, 2 ph, 9000 RPM. Price \$4.95

Oster Shunt Motor, Type E-7-5, 27½ Volts DC, 1/20 HP, 3650 RPM. Price \$7.50

Oster Series Motor, Type C-2BP-1A, 27.5 Volts DC, 1/100 HP 7000 RPM. Price \$2.50

Universal Electric Shunt Motor, KS5603L02, 28 Volts, 6 Amps, 5000 RPM. Price \$2.00

Elinco AC Generator, Type F-16 2 phase, 1.5 Volts per 100 RPM. Price \$7.95

Elinco DC Generator, Type PM-2, 1.75 Volts per 100 RPM. Price \$5.75

Universal Electric Co., 115 VDC, 500 RPM, 1.2A. Price \$4.50

Emerson Electric Motor, Style 1610212, 24 Volts 160 cy/1 27 Amps, 100 RPM. Price \$8.95

G. E. Permanent Magnet Generator, 5HY928, 140 Volts DC, 0.25 Amps, 1800 RPM. Price \$5.50

G. E. Amplidyne, Mod. 5AM45DB20, input 115 Volts, single phase, 60 Cycle 5.0 Amps, output 250 Volts, 0.6 Amps, 150 watt, 3450 RPM, continuous duty. Price \$53.50

## CONTINENTAL MOTOR GENERATOR SETS

7½ KVA; 1800 Speed, Ball Bearings. Input: 220 Volts, DC. Output: 115 Volts, AC, single phase, 60 cycles. Complete with automatic controller, field rheostat and push button station.

**Rebuilt—some as new PRICE \$490**

Bendix Autosyn, Type AY-101-D; Input: 26 Volts, single ph. 400 eye. 65 mills, 36 watts. Can be used on 6.3 volts, AC, 60 cycles, with current drain of 75 mills and 3 watts. Price \$21.50

Ford Instrument Synchro Generators, Type 5G; MK 1 Mod. 3 115/90 Volts, 60 eye. Price \$37.50

Step-by-step Motors; 65 volts, complete with gear train. Price \$65.00

Pioneer Autosyn Indicators, Type AY-1; 26 Volts, 400 eye. Price \$4.50

GE Selsyn 2J1G1; 57.5 Volts, 400 eye. Two or more connected together work perfectly on 60 eye. Connecting data included. SPECIAL PRICE \$2.50

PER PAIR GE Selsyn 2J1F1; same as above but operates on 115/57.5 v. 400 cycles. PRICE \$3.00 PER PAIR

DIEHL FP-25-3, 2 Phase, 60 cycles, low inertia motor, 20 volts per phase, 2.5 watts; 2 pole. Stall torque 2.5 oz./in., .35 amps, per phase; 1 oz./in. at 2700 RPM. SPECIAL PRICE \$8.75

DIEHL FPE25-11 (Navy type CDA 211052) Low inertia Motor, 5 watts output; 75/115 Volts, 60 cycles. .11-.16 amps; 4.25 oz per inch, stall torque. Develops 65% of stall torque at 2000 RPM. SPECIAL PRICE \$15.00

IMPOSSIBLE TO LIST ALL OF OUR ITEMS AND COMPONENTS. TELL US YOUR NEEDS. All prices F.O.B. Boston. Orders accepted from rated concerns on open accounts. Net 30 days.



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Industrials  
Schools - Labs

### HIGH VOLTAGE MICA CAPACITORS\*\*

XR .0001 MMF 5 KV.....	.75
F2L .0005 MMF 5 KV.....	.85
F2L .001 MMF 5 KV.....	1.39
F2L .0015 MMF 5 KV.....	1.69
F2L .003 MMF 5 KV.....	1.90
XS .005 MMF 6 KV.....	2.50
F3L .007 MMF 5 KV.....	2.75
*G1 .00024 MMF 6 KV.....	4.50
*G1 .001 MMF 6 KV.....	4.75
F3L .002 MMF 6 KV.....	3.50
F3L .0025 MMF 6 KV.....	3.60
F3L .003 MMF 6 KV.....	3.75
*MX .004 MMF 6 KV.....	4.95
F3L .0005 MMF 8 KV.....	2.90
F3L .0006 MMF 8 KV.....	3.00
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F3L .0015 MMF 8 KV.....	3.50
F3L .002 MMF 8 KV.....	4.00
F3L .0025 MMF 8 KV.....	4.50
F3L .003 MMF 8 KV.....	5.00
F3L .004 MMF 8 KV.....	5.50
F3L .005 MMF 8 KV.....	6.00
F3L .01 MMF 8 KV.....	6.50
*G2 .005 MMF 10 KV.....	5.95
*G2 .001 10 KV.....	5.95
*G2 .002 MMF 10 KV.....	6.95
XA .0005 MMF 12 KV.....	2.50
*G4 .008 MMF 12 KV.....	26.50
*G4 .0033 MMF 20 KV.....	22.90
*G4 .004 MMF 20 KV.....	24.50
G4 .001 MMF 25 KV.....	32.50
*G4 .015 MMF 25 KV.....	32.50

\*\* All ratings "working-voltage."  
\*Tolerance +5%. Ceramic case. High current.

### MEG OHM METER


Industrial Instruments Model L2AU 110/220 volts 60 cycle input. Direct reading from 0-100000 megohms on 4" meter. Can be extended to 500000 megohms with external supply. Stopping hardware Cabinet 15"x8"x10". Brand new with tubes plus running spare parts including extra tubes. Great value only \$69.95.



### SPIRTI RF

#### VACUUM SWITCH

9200 volts peak, 8 amps. Used as antenna switch in Collins AR713. BRAND new.....\$1.75



### U. H. F. COAX. CONNECTORS

UG12U-831R-UG21U-831AP-8315P .39 ea.


Precision 15 Meg. 1% Accuracy Resistor. Non-inductive, 1 watt, hermetically sealed in glass .39c each; 10 for \$3.50.

### OIL CONDENSERS

11 mfd 250 vac.....	.85	.1/.1 mfd 7000 vdc.....	2.25
5 mfd 150 vac.....	.49	.1 mfd 7500 vdc.....	1.95
1 mfd 600 vdc.....	.29	1 mfd 7500 vdc.....	9.25
2 mfd 800 vdc.....	.39	4 mfd 8 kv dc.....	19.95
4 mfd 600 vdc.....	.59	.01/.01 mfd 12 kv dc.....	5.75
3/3 mfd 600 vdc.....	.79	.005/.01 mfd 12 kv dc.....	5.50
10 mfd 600 vdc.....	.95	.03 mfd 16 kv dc.....	5.75
14 mfd 600 vdc.....	1.35	.05 mfd 12,500 vdc.....	12.95
4 mfd 1000 vdc.....	.95	.75/.35 mfd 8/16 kv.....	12.95
2 mfd 1000 vdc.....	.95	.02 mfd 20 kv dc.....	7.95
15 mfd 1000 vdc.....	2.95		
2 mfd 1500 vdc.....	.29		
1 mfd 2000 vdc.....	1.45		
2 mfd 4000 vdc.....	5.50		
3 mfd 3000 vdc.....	3.95		
1 mfd 5000 vdc.....	4.50		

### 1 KW TRANSTAT or Stepdown Transformer

110/220 volts 60 cycle input. Output variable plus or minus 10% of 115 volts at 8.5 amps. Also can be connected to give different voltage combinations. Brand new.....Special 9.95



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Hammerlund MC 250S 250 mmf.....	\$ .69
Hammerlund MC 320S 320 mmf.....	.79
Hammerlund APC 100 100 mmf.....	.39
Bud MC 913 35 mmf. Per Section.....	1.25
Hammerlund HLF 15 mmf.....	.39
National TMS 150 mmf.....	.79
Bud 902 35 mmf.....	.59

### H. V. VARIABLES

150 MMF .5 Spacing.....	\$17.50
250 MMF .5 Spacing.....	19.50
75 MMF .3 Spacing.....	9.50
250 per section .051.....	3.95
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Tremendous stocks on hand. Please send requests for quotas. Special quantity discounts. Price f.o.b. N. Y. 20% with order less rated, balance C. O. D. Minimum order \$3.00.

WE BC 1091A-Radar RF unit—with magnetron, etc., in pressurized tank..... 59.50

### 50 MICROAMP METER



This is the exact meter utilized in the General Electric model YMW-1A Lab-Type Unimeter.

- 50 Microamps Movement  $\pm 2\%$
  - 2500 Ohms Resistance  $\pm 2\%$
  - Knife-Edge Pointer
  - Uncrowded Multi-Range Scale
  - 4 x 4 1/2" Black Bakelite Case
  - 50 Microamp scale available at 25c additional
- BRAND NEW only \$9.75 ea.

### METER SPECIALS

2" GE 0-30 amps, D. C.....	2.95
2" GE 0-1 amp RF (internal thermo).....	2.95
2" GE 0-5 ma (amp scale).....	1.95
2" GE 0-1.2 ma (0-100 scale).....	2.49
2" GE 0-1 ma (volt scale).....	2.95
2" Gruen 0-3V DC (1000 ohms-volt).....	2.45
2" GE 0-30V DC (1000 ohms-volt).....	2.95
2" Westinghouse 0-250 Volts DC.....	2.95
2" Weston 150-0-150 Microamp.....	3.49
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3" GE 200-0-200 volts DC.....	2.95
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**WESTINGHOUSE RUNNING TIME METER**  
0-99,999.9 hours, 3 1/2" Square Bakelite Case, 110V 60 Cycle. Brand New .795

Voltage Regulated Power Supply—Input 110 v. 60 cy. Delivers 150 v. DC—Well filtered (3 chokes), uses VR 150 and 6x5. Has extra 6.3 v. winding. Swell for coils, freq. meters, etc.. 16x3"x5" with tubes. Used but good.....6.95

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25 Ohms 25 Watt.....	.69
300 Ohms 50 Watt.....	.69
50 Ohms 50 Watt.....	.69
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Dual 200 Ohms 50 Watt.....	.89

### AN/APT-2 AIRCRAFT RADAR JAMMER



425-750 mcs. Contains 10 tubes:  
(1)—807 (2)—703A (2)—6AC7 (2)—6AG7—(2)—5R3GY (1)—2x2 (1) 931A  
Unit has blower motor and 400 cycle pwr supply complete with all tubes etc.  
BRAND NEW.....\$19.95 each

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4 Stator Single Rotor. 0-360 Degrees Rotation.....Only 2.95 each

1-196-B SIGNAL GENERATOR 175-220 Mcs. With Tube and Carrying CASE, \$5.95.

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220-110 volts, 110 watts. Fully encased, 5/8 x 3/4 x 5/8. 110V. 60 cycle.....\$2.49 each

### WIRE WOUND RESISTORS

5 Watt type AA, 20-25-50-200-470-2500-4000 ohms.....	.09 ea.
10 watt type AB, 25-40-81-400-470-1325 1900-2000-4000 ohms.....	.15 ea.
20 watt type DG, 50-70-100-150-300-750 1000-1500-2500-2700-5000-7500-10000-18000-20000-30000 ohms.....	.20 ea.
30 watt type DI, 100-150-2500-3000-4500-5300-7500-18000-30000 ohms.....	.24 ea.

### 1% PRECISION RESISTORS

200-2500-5000-8500-10000 ohms.....	\$3.99 ea.
50000-95000 ohms.....	.49 ea.
100000-750000-1 meg.....	.89 ea.

### HIGH VOLTAGE—HIGH CURRENT PLATE

1500-0-1500 volts at 1.5 amps. Tapped at 1350 and 1250. Pri. 110/220 volts 50/60 cycles in 2 Separate windings. Built to rigid Navy specs by Amertran. Suitable for broadcast transmitters, induction heating, etc. Size 10" x 10" x 7" s.w.t. 125 lbs. \$67.50 each



### MEDIUM CURRENT PLATE

As illustrated above, 1500-0-1500 volts at 600 ma. Pri. 110/220 v. 50/60 cycles. 8 x 8 1/2 x 7 s.w.t. 78 lbs.....\$32.50

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Direct readings from 0-30 KC in 4 separate ranges on 6" Weston Model 271 Fan Meter. Built-in voltage regulated power supply operates from 115 volts 60 cycles, has high input impedance. With pick-up can be used to determine frequency in vibration tester. With suitable mixer can check deviation of R.F. carrier from standard. Mounts on 8 1/2"x19" rack panel. Complete with tubes. Slightly used but perfect. Only \$59.50

CWI 60 AAG range calibrator and power supply, book, cables, etc.....29.50

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1.5 to 7 MMF.....	.24	1 to 30 MMF.....	.24
3 to 13 MMF.....	.24	7 to 45 MMF.....	.24
5 to 20 MMF.....	.24		

### AMERTRAN 500 VOLT PLATE

1000 volt et at 300 ma. Pri. 110 v. 60 cy. 6" x 5 1/4" x 4 1/2" cased.....\$9.95

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6.3 v 21 amps. Hermetically sealed, 110 v 60 cy Pri.....4.75

### AMERTRAN FILAMENT TRANS.

5.25 volts at 21 amps. plus 2 x 7.75 v at 6 amps. Pri. 110 v 60 cy. H.V. Ins. 6" x 5 1/2" x 4 1/2". \$7.75

### SOLA CONSTANT VOLTAGE

Transformer, Input 95 to 130 output 115 v. 350 VA. 9 amps.....29.95

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Trans. 2.5 V 10 A Pri. 110 v. 60 cy. H.V. Insulation. Cased.....4.95

### "A POWERFUL BABY"

This plate transformer built to rigid Signal Corps spec. Input 118 volts, 25 to 60 cycles. Has 2 separate 118 volt primaries and can be used on 110 or 220 volts. Secondary 800 volts center tapped at 775 mills. Exceptional regulation even when loaded to 900 mills! Fully cased—4 mtg holes. 37 lbs. net wt. 6 1/2 x 6 1/2 x 7 1/2. Peak value at 7.95. 10 for \$70.00

### CHOKE BARGAINS

6 Henry 45 MA 300 ohms.....	.39
8 Henry 75 MA 230 ohms.....	.59
8 Henry 160 MA 140 ohms.....	1.39
10 Henry 200 MA 150 ohms.....	1.95
1.5 Henry 250 MA 72 ohms.....	.60
10 Henry 350 MA 60 ohms.....	3.75
6 Henry 550 MA 30 ohms.....	4.95
4.3 Henry 620 MA 42 ohms.....	4.95
10 Henry 750 MA 95 ohms.....	11.50

### FILAMENT TRANSFORMER

Two separate 118 volt, 25 to 60 cycle primaries. Can be used on 110 or 220 volts. Secondary 5 volts at 15 amps. Built to Signal Corps specs. Fully encased. 5 x 4 1/4 x 5 1/8. Net wt. 10 lbs. \$3.75 each, 10 for \$30.00.

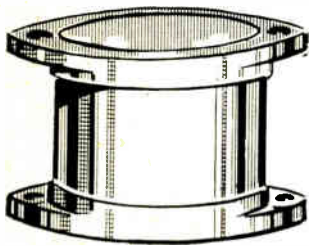
### VERSATILE POWER

These transformers have many uses—filament, isolation, stepdown, bias, etc. All have 2 separate primaries for 110/220 volt 25-60 cycle operation. Primaries. Can be used in series or parallel.  
3 Choices of Secondaries:  
Type 501—115 volts 900 mills and 6.3 volts 5 amps.  
Type 505—115 volts 900 mills and 6.3 volts 2 amps.  
Type 502—0.70-75 volts at 2.5 amps. (35-37 v. in series).  
Fully encased—4 mtg. holes, 5/8 x 3/4 x 5/8.  
Your cost any type.....\$1.95 each  
10 for \$17.00

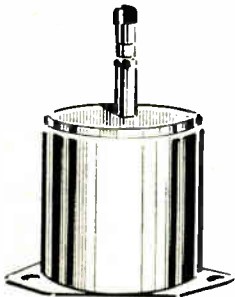
**PEAK ELECTRONICS CO.**  
188 Washington St., New York 7, N. Y.

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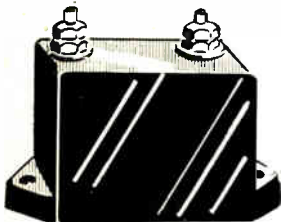
# TRANSMITTING Mica CONDENSERS



STYLE "AA"



STYLE "A"



STYLE "B"



STYLE "C"



STYLE "D"

## SPECIAL LOW PRICES FOR IMMEDIATE SALE AND DELIVERY

We have literally hundreds of thousands of these top quality standard type transmitting mica condensers in stock for immediate delivery at a fraction of their original cost. Every condenser is brand new and carries the name of a fine nationally known manufacturer.

Despite the unusually low prices, these mica condensers, like all Wells Components, are fully guaranteed. Be sure to order sufficient quantities for your requirements.

Cap Mfd	Wrkg. Volt.	Price Each	Cap Mfd	Wrkg. Volt.	Price Each	Cap Mfd	Wrkg. Volt.	Price Each	Cap Mfd	Wrkg. Volt.	Price Each
<b>STYLE "AA" CONDENSERS</b>			<b>STYLE "C" CONDENSERS</b>			<b>STYLE "D" CONDENSERS</b>					
.04	1000	\$3.50	.01	2500	1.60	.00004	600	\$0.20	.00004	600	.25
.02	3000	4.50	.01	5000	1.95	.0001	1250	.25	.0001	1250	.30
.002	35000	15.00	.0125	6000	2.00	.0005	2500	.45	.0005	2500	.45
			.02	3000	1.70	.001	600	.35	.001	600	.35
			.025	2500	1.60	.0015	2500	.45	.0015	2500	.45
			.047	2500	1.75	.00175	2500	.40	.00175	2500	.40
						.015	600	.40	.015	600	.40
						.0175	1200	.55	.0175	1200	.55
						.02	2500	.65	.02	2500	.65
						.02	1250	.45	.02	1250	.45
						.025	600	.35	.025	600	.35
						.03	1200	.50	.03	1200	.50
						.04	1200	.55	.04	1200	.55
						.04	1000	.45	.04	1000	.45
						.04	600	.35	.04	600	.35
						.047	1200	.50	.047	1200	.50
						.047	600	.40	.047	600	.40
						.056	1000	.55	.056	1000	.55
						.06	1000	.50	.06	1000	.50
						.073	500	.40	.073	500	.40
						.09	1000	.55	.09	1000	.55
						.09	600	.45	.09	600	.45
						.1	1000	.60	.1	1000	.60
						.1	600	.45	.1	600	.45
									.0068	1200	.35
									.007	600	.30
									.008	1200	.35
									.008	600	.30
									.009	600	.30
									.01	1250	.40
									.01	600	.30
									.01	2500	.50
									.015	1250	.40
									.015	600	.30
									.015	600	.30
									.014	600	.35
									.0175	600	.40
									.02	2500	.50
									.02	1200	.35
									.02	1200	.35
									.022	1200	.35
									.022	600	.25
									.022	1200	.35
									.025	1200	.35
									.025	600	.25
									.03	1200	.35
									.033	1200	.35
									.033	1200	.35
									.04	1000	.35
									.04	600	.30
									.047	1200	.40
									.047	600	.30
									.056	1000	.35
									.06	1000	.40
									.073	500	.30
									.09	1000	.45
									.09	600	.35
									.1	1000	.50
									.1	600	.35

This is only a partial listing. Write or wire for information on types not shown and for receiving set micas and silver micas.

We advise distributors to order immediately from this ad. Our standard jobber arrangement applies.

Manufacturers and Distributors: Write for our complete Mica Condenser Listing No. 103A.



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Hundreds of major radar components, mostly for navy types, includes power transformers, wave-guides, plumbing of all sorts, magnetrons, cavity chambers, echo boxes, connectors, antennas. Complete SF and SF-1 spares in original factory cases. Inspection invited, or write us your requirements.



#### FREQUENCY METER TS-69/AP

Frequency range 400 mc to 1,000 mc, continuous. Ideal for labs, schools, or for hams experimenting with eqpt. for civilian phone band. Black-crackle finished metal case, dim: 6"x6"x22". Contains variable length coax resonating cavity with crystal rectifiers and 0-200 microammeter, Veeeder - Root counter and calibration charts insure extreme precision. Telescopic antenna, and coax line probe, with metal carrying case for entire equipment. New equipment.

**COMPLETE, EACH \$42.50**

#### REGULAR STACK SPECIALS!

##### 5-Meter Walkie-Talkie

Model BC-322 Transceiver; simple, popular communications unit. Freq. range 52-65 mc. Uses only two tubes, types 33 and 30. Includes a 5 mc. crystal in a crystal calibrator circuit. Range 5 to 50 miles, depending upon location and altitude. Operates from single battery block (not supplied) available from mfr., or other sources. Supplied with handset, less antenna, battery. Excellent condition.

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##### Telescoping

Antenna for above ..... **\$2.00**

#### DECK ENTRANCE INSULATORS

##### Bowl and Flange Type

Manufactured by OHIO BRASS CO. for Army and Navy use. Has heavy galvanized metal flange 8 7/8" diameter, porcelain bowl set in rubber gaskets, top bell is 6 1/4" in diameter. Brass feed-thru rod 1 1/2" long. Insulation distance between top bell and flange is 4 1/4". Individually packed in cartons. Quantities available.

**NEW, price each \$2.75**

Spare porcelain bowl, only, each **\$ .75**

#### 32 VDC 110 AC CONVERTER

Mfd. by Kato Engineering, for marine or farm installation. Rotary type, compact and ruggedly built for continuous duty. Rubber shock mounting on filter case, with complete input and output filtering. Output 110 volts, 60 cycles AC, .225 KVA, but will operate efficiently on loads up to 300 watts. New units only.

**PRICE, EACH \$39.95**

Quantities, 10 or more, each... **\$32.00**

#### AMPLIDYNE MG SET MOTOR 110/220, 60 C.A.C.

For Automatic or Remote Control of heavy equipment. Mfd. by General Electric. Generator is Type V-5875677, motor 78AB-58; Navy type CG-21ABU. Generator delivers 250 volts DC, 375 watts. Motor—115 or 230 volts, 1-phase, 60 cycles AC, rated at 3/4 HP RPM-1725. Includes capacitor for starting, and instructions for 115 or 230 volt connections. Generator section can be removed, and entire assembly shortened to make valuable 3/4 H.P. AC motor. Quantity sufficient to warrant this conversion.

**PRICE, EACH \$60.00**

All Prices F.O.B. N.Y.C.

All Material Offered Subject to Prior Sale

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## TELEMARINE COMMUNICATIONS COMPANY

280 Ninth Ave.,  
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#### DAK—DIRECTION FINDERS, with AUTOMATIC BEARING INDICATORS.

The DAK is a highly engineered shift DF receiver, and this particular model includes an automatic bearing indicator, with stand and operator's seat pedestal, that produces a sharp figure 8 pattern on a large scope tube which is calibrated in degrees. An immediate indication of the direction of the received signal is thereby obtained; eliminating calculation, loop rotation and the possibility of human error in determining exact aural null point. The following, sufficient for 5 complete DAK installations plus major component spares, are available: 7-DAK Radio Receivers, 7-Crossed Loop Assemblies, 5-Sense Antenna Assemblies, (minus Bases), 5-Automatic Bearing Indicators complete with mounting tables and goniometers, 5-Metal chairs (operator) for mounting table, 6-Junction Boxes, 9-Boxes of spares, 20 Reels (250 feet each) of Coaxial cable for Loop to Receiver connection.

**PRICE, For COMPLETE LOT ..... \$3,000.00**

## RADIO TRANSMITTERS, RECEIVERS

Immediate Delivery from Stock

**RADIO TRANSMITTER T-4/FRC, 400 Watts** Output, Freq. Range 2 to 18 Mc. Operates from Power Supply PP-1/FRC described below. 12 available, 3 New, balance almost new. **PRICE, EACH ..... \$500.00**

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**POWER RECTIFIER PP-1/FRC, Operates** from 220 v.a.c. 50-60 cycles, current 50 amps max. Supplies all necessary power to above described units, as well as to a 300 watt audio modulator (not available). Four Available, all New. **PRICE, EACH ..... \$1,000.00**

**BG-325 Transmitter, 400W.-A1, 100 W.-A2** and A3. 1.5 to 18.0 mc. M.O. or X'tal control on 6 frequencies. Operates from 110/220/1/60c. AC. With tubes in excellent condition. **PRICE, EACH \$400.00**

**TCR—Radiomarine Transmitter, 125** watts (conservative) A1, A2, & A3 For ship or shore station radio telephony. 6 channels in 2 to 3 mc band controlled by remote control box supplied. Complete RF, modulator and power supply (for 110 or 220 V. 50/60 cycles AC) in one cabinet. Excellent condition, with tubes and remote control box. **PRICE, EACH \$500.00**

**BC-319-A Transmitter, CW only 300 watts** output, Freq. range 4.0 to 13.4 mc. Operates from 110/220 volts, 60 cycles AC. Excellent condition. Less tubes. **PRICE, EACH \$300.00**

**Wilcox, 96-200A 2-KW RF section.** Large cabinet with complete RF end containing the VFO, intermediate sections and PA stage. Almost new, but lacks PA inductance only. Power supply separate unit not available, but can be built. Less tubes **PRICE ..... \$500.00**

**RCA 8023/IF Ship Transmitter, 200 watts** output, A1 and A2. Freq. range 4.0 to 20 mc. Operates from mc set (not supplied) in IF main transmitter (RMCA type 8024). With tubes, but no audio receiver. Excellent cond. **PRICE, EACH... \$350.00**

**MACKAY SHIP TRANSMITTERS.** The following Mackay ship-radio types are available: 150-AY, 151-A1, 149-A, 136-A, 104-M, 147-M. Some new, most in excellent condition. Write for prices.

**LINK FM Transmitter Receiver, 70-100** MC. Model 1498 DC. 50 watts output, wall style cabinet containing transmitter, re-

ceiver and 14 V. D.C. power supply, handset. Dim: 34"x21"x11". **NEW CONDITION.** Complete with tubes, crystals, special telescopic antenna, instruction book. **PRICE EACH ..... \$600.00**

**NOTICE: Price quoted above does not include crating or packing. Price for packing will be quoted upon specification as to whether export or domestic packing is desired.**

**BC-620 FM Transmitter-Receiver.** Mobile or portable unit main part of SCR-510. **NEW,** with tubes and complete crystals but less accessories or power supply (operates from batteries or vibrator power supply). Export packed. **PRICE EACH ..... \$50.00**

**BC-603, 604, 683, 684, Transmitters, Receivers.** Main components of SCR-508, 528, and 608, 628 FM mobile installations. Dynamotor and tubes supplied. **PRICE, New BC-603 Receiver, w/dynamotor, tubes ..... \$40.00**  
**PRICE, Used but excellent condition \$30.00**

**PRICE, New BC-604 Transmitter, w/dynamotor, tubes, crystals ..... \$50.00**  
**BC-683 Receiver, New w/dynamotor and tubes, EACH ..... \$40.00**

**BC-684 Transmitter, New w/dynamotor, tubes and crystals, EACH ..... \$50.00**  
**BD-72 Switchboards: 12-position** field switchboards. New and complete, packed two to case. **EACH ..... \$60.00**

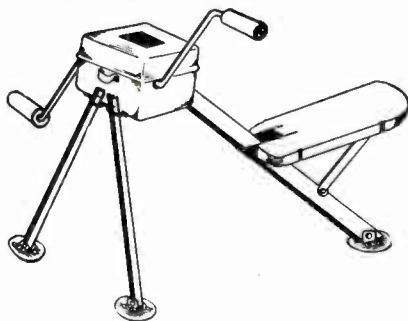
**SB-23/6TA-2, Large Airport Switchboard.** With separate power supply (SB-14/6T) operates from 110V. AC, 50-60 cycles, to charge telephone batteries and operate switchboard. Both in handsome metal cabinets, approx. 50" high, 30" wide and 22" deep. New eqpt. **PRICE, per Switchboard and Power Supply ..... \$300.00**

#### MISCELLANEOUS SPECIALS

**APQ2 Transmitter, only, with tubes, Al** most New. **Each ..... \$37.50**  
**SN-APQ5 Synchronizer, with tubes, Al** most New. **EACH ..... \$37.50**  
**TA-12B 4-Channel Aircraft Transmitters,** less dynamotor and accessories, but with tubes. Excellent condition. **EACH... \$40.00**

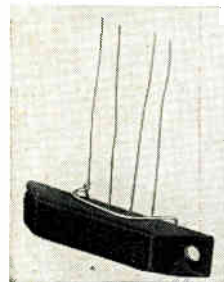
**NOTICE: Price quoted above does not include crating or packing. Price for packing will be quoted upon specification as to whether export or domestic-packing is desired.**

## NEW, COMPLETE 10 W. HAND GENERATORS



**FOR MARK II. Delivers 162.0 volts at .06 amps, and 3.1 volts at .3 amps, completely voltage-regulated and filtered. NEW units, export packed four to the case, with seat pedestals, cranks, carrying bags, cords. Complete, in 1-case. FOUR, for ..... \$30.00**

# PARTS FOR EVERY LABORATORY AND FOR THE SMALL MFR.

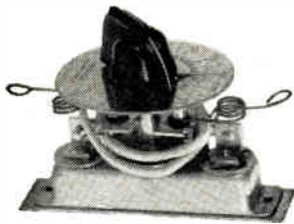


### FREE RECTIFIER OFFER

#1—This is a full wave bridged selenium rectifier. Input 115 to 130 A.C. Continuous duty. Output 15 milliamperes at 25 volts drop. Less than 25 volt drop if less current is drawn. For instruments, relays, etc. One of leaving 2400 to sell at 39c each.

these will be sent free with each \$10. ordered leaving 2400 to sell at 39c each.

### #2—THERMOSTAT G. E. 10 AMP.



Adjustable to within 1°F. in range 135°F. to 185°F. with scale and knob. Contacts 110 volt. Good for heating wax, compound, in tanks also oven control, etc.—Quantity in stock: 1147. Priced at 59c. ea.

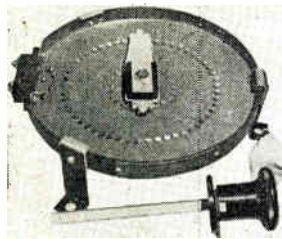
### TERMINAL STRIP, 6 TERMINAL



5 x 1" by 1" high overall, hard black bakelite moulded, 8 x 32 brass studs, 12 heavy brass hex nuts, 6 lockwashers. Heavy or light wiring. Mounts flat, insulated for 5000 v. 14 bakelite finger separate wires to each terminal allowing wires to enter either side without danger of shorting. Suitable for transmitters, induct. equip.; may be put shorter cheaply.—Price 11c each.



#99A—1600 Mfd. 12 volt; Quantity: 1032; Very Special at 49c. each.



### BRAND NEW NAVY SURPLUS 14 INCH RHEOSTATS

Any voltage up to 600 volts—9.2 amperes continuous duty — 10 OHMS — EXTRA LONG SHAFT. Can be banked in series or parallel.

#92A—Extra cost feature is linear ampere rating. Every section down to one ohm is wound for same current as the whole Rheostat—9.2 ampere to 9.2 ampere, no drop. Price—\$5.45 ea.



### #79A—HEATER VULCAN D5

Ring 2" O.D., 1" I.D. 3/4" thick, fully armored, with upstanding porcelain bushing insulators 3/4" high for two terminal leads, 35W, 55V; designed for two in series on 110V. Excellent for small compound heaters, wax heaters, small enough to hold and pour from. Liquid-proof design, easily installed in any pot or ladle, small tank, stamping die. Quantity in stock; 2,332. Priced at 10c. each.

### STOCK UP ON AIRCRAFT LAMPS AT THESE EXCEPTIONAL BARGAIN PRICES

Quantity	Mfr. Number	Base	List Price	Our Price
3,072	West.hse. 1747	Single Contact 50CP	12-16 V	\$1.05 \$ .21
	Silvered Bowl			
3,940	West.hse. 1745	Single Contact 32CP	12-16 V.	.90 .18
	Silvered Bowl			
1,800	West.hse. 308	Red Double Contact 21CP	28 V.	.55 .11
1,920	West.hse. 311	Single Contact 50CP	28 V.	.55 .11
1,320	West.hse. 986	Double Contact 2.5 Amp.	28 V.	1.05 .21
4,000	G. E. 77	Single Contact 3CP	12-16 V.	.30 .06
22,400	G. E. 78	Double Contact 3CP	12-16 V.	.30 .06
4,000	G. E. M306	Double Contact 15CP	28 V.	.45 .09
8,800	G. E. 307	Red Single Contact 21CP	28 V.	.55 .11
8,400	G. E. M310	Double Contact 32CP	28 V.	.55 .11
5,200	G. E. RP11	Flasher 5 Filament GE #1039		
	Single Contact 6.6 Amp.	13 V.	.50 .10	
27,200	Tung-Sol 302	Double Contact 3CP	28 V.	.30 .06
1,280	Tung-Sol 304	Double Contact 6CP	28 V.	.35 .07
293	Tung-Sol 311	Single Contact 50CP	28 V.	.55 .11

All packed in original package of ten; fifty packages to a carton. Minimum order: 10 of any one number (one package).

Extra 10% discount on any assortment of 1,000  
Extra 15% discount on any assortment of 5,000  
Extra 20% discount on any assortment of 10,000

### #89—CANNON SOLENOID



This item just must be seen and tested to be appreciated. At 6 volts, draws 1 1/3 ampere, has 1/2 pound pull at 3/8 in. stroke; 2 pound pull at 3/4 in. stroke. At 12 volts, draws 2-2/3 amperes, has 1 1/2 pound pull at 3/8 in. stroke; 4 pound pull at 3/4 in. stroke. At 24 volts (rated voltage), draws 5 amperes, has 2 pound pull at 3/8 inch stroke; 8 pound pull at 3/4 inch stroke. Very compact, easily mounted. Tapered shaft that goes clear through the back of the case when energized protruding 3/8 of an inch which would be sufficient to close a micro switch in addition to the mechanical functions above described. Quantity: 1760—69c each

### NON-INDUCTIVE RESISTORS

Quan.	GLASS FERRULE		Length	Price
	Value	Wattage		
157	2 Ohms	15	2 3/8"	\$.15
170	10 Ohms	15	2 3/8"	.15
42	10 Ohms	120	9 5/8"	.45
34	15 Ohms	120	9 5/8"	.45
360	25 Ohms	15	2 3/8"	.15
624	40 Ohms	20	3"	.20
58	150 Ohms	120	9 5/8"	.45
16	500 Ohms	15	2 3/8"	.15
112	500 Ohms	90	7 3/8"	.40
204	800 Ohms	120	9 5/8"	.45
132	1000 Ohms	15	2 3/8"	.15
60	2000 Ohms	15	2 3/8"	.15
112	4000 Ohms	20	3"	.20
256	9000 Ohms	35	4 3/8"	.25

PORCELAIN ENAMEL FERRULE			
Quan.	Value	Wattage	Price
139	10 Ohms	100	9 5/8" .45
115	15 Ohms	100	9 5/8" .45
165	150 Ohms	100	9 5/8" .45

FERRULE			
Quan.	Value	Type	Price
880	1.3 Ohms	Type CX	8" .45
656	18 Ohms	Type A	2 3/8" .15

### #85—G. E. THYRISTE K-522332 (M)

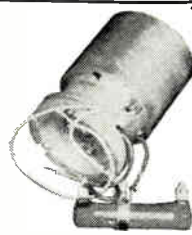
Diameter 3 in. Thickness 1/2 in. Hole 1/2 in.  
Good voltage regulator, 3rd harmonic generator.  
Current: 5 ma. at 18 volts; 10 ma. at 23 volts. 20 ma. at 29 volts; 40 ma. at 36 volts.  
Rating: 3 watts maximum in air.  
Quantity: 2,348—Priced at 25c each.  
We have sold these at \$1. right along.

### #82—G. E. THYRISTE K-8396832-1.

Diameter 1 1/2". Thickness 1/2". Hole 1/2".  
Good voltage regulator, 3rd harmonic generator.  
Current: 5 ma. at 21 volts  
10 ma. at 23 volts  
20 ma. at 28 volts  
40 ma. at 33 volts  
Rating 1 1/2 watt maximum in air. .15c ea.

### #80—EDISON FIXED THERMOSTAT

Hermetically sealed. Explosion proof. 135 degrees Fahrenheit, normally closed. Opens above 135 degrees. Sealed in glass. One ampere contacts. Fine for fire alarm system. Another 29c. bargain. Lists for over \$3.00. Quantity in stock: 364.



### #12—CARBON PILE VOLTAGE REGULATOR

supplied with 30 watt, 50 ohm slide wire adjustable resistor; the voltage regulator has an even 18 1/2 volt output with a variable input of from 21 to 30 volts D.C. The coil and upper bed make a very EFFICIENT magnetizer if supplied 80 to 100 volt D.C. and an efficient DEMAGNETIZER on 110 A.C. The regulator can be disassembled for the above purpose in less than 1 minute. Can also be used as a small magnetic chuck. Quantity in stock: 8400  
Special price for both regulator and resistor: 89c.

### #4—300 OHM WIRE WOUND POTENTIOMETER

5 watts, 1 3/8" diameter x 5/8" deep. 1/2" shaft above threads. Linear.  
Quantity in stock: 1,352  
Price 22c.  
We also have 351 of the 200 ohms—same price.

### SELENIUM RECTIFIER, FULL-WAVE BRIDGE

Up to 90 volt A.C. input, 20 plate, output, 150 m.a. continuous duty.  
Special \$1.35 each.  
Only 280 available

### #76—60 DEGREE FAHRENHEIT THERMOSTAT

Fixed thermostat. Closes at 60 degrees and opens at 65 degrees. 10 ampere contacts. Snap action. Made by Kilxon. Excellent for auto heater control. Quantity in stock: 2,000.  
—We are closing these out at 22c. each, less quantity discounts.

### DONGAN Navy Type Ignition TRANSFORMER

Catalogue No. 2705T  
This is a 115 watt enclosed job with a 460 volt primary and a secondary of 5000 volt at 20 ma.  
Can you adapt it?  
Special \$2.45 each

### FAMOUS ROBSON-BURGESS CONDENSER TESTER AND CIRCUIT CHECKER

Attractively cased item for use on 110 A.C. or D.C., consisting of 125 volt full-wave bridged rectifier, resistor switch and neon light with six foot line-cord and plug and test leads. This is one of the best inexpensive condenser testers, because it actually puts D.C. current into the condenser.  
Regularly \$7.95, our price, while 276 last, \$2.95 each. Original cartons.

**TERMS** Net 30 days to rated mfrs and to schools. All shipments F.O.B. New York. 20% deposit on C.O.D. orders.

# EXCESS INVENTORY CORP.

ELECTRONICS DEPT.

56 LISPENARD ST.

Tel. Walker 5-9135—9136

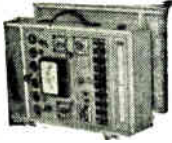
NEW YORK 13, N. Y.



## RADIOMEN'S HEADQUARTERS ✨ WORLD WIDE MAIL ORDER SERVICE !!

BUFFALO RADIO SUPPLY, ONE OF AMERICA'S LARGEST ELECTRONIC DISTRIBUTORS, IS IN A POSITION TO SUPPLY MOST OF THE REQUIREMENTS OF FOREIGN PURCHASES, DIRECTLY FROM ITS GIGANTIC STOCKS OR THOSE OF ITS AFFILIATES. EXPORT INQUIRIES ARE SOLICITED BOTH FROM EXPORT HOUSES AND FROM FOREIGN GOVT. PURCHASING COMMISSIONS HERE AND ABROAD. EXPENSE CAN BE REDUCED AND REQUIREMENTS FILLED WITH A MINIMUM OF DELAY BY CONTACTING BUFFALO RADIO SUPPLY INITIALLY.

### 1949 MODEL MUTUAL CONDUCTANCE TUBE TESTER with new 9 pin socket to handle all future tube developments **\$49.95**

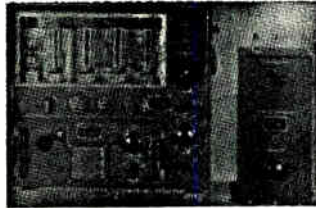


No possibility of good tubes reading "Bad" or bad tubes reading "Good" as on dynamic conductance testers or other ordinary emission testers. Attractive panel and case equal to any on the market in appearance. . . . Large 4 1/2" meter. . . . Calibrated micromho scale as well as a Bad-Good scale. . . . Front panel fuse. . . . Individual sockets for all tube base types—voltages from .75 volts to 117 volts and complete switching flexibility allow all present and future tubes to be tested regardless of location of elements on tube base. . . . Indicates gas content and detects shorts or opens on each individual section of all local, octal and miniature tubes including cold cathode, magic eye and voltage regulator tubes as well as all ballast resistors. Name of the nationally known reading "Good" as on dynamic conductance testers or other.

Model "C"—Sloping front counter case. . . . **\$49.95**  
 Model "P"—Handsome hand-rubbed portable case. . . . **\$4.95**  
 Built-in roll chart with either of above **\$5.00** extra.

### GENERAL ELECTRIC 150 WATT TRANSMITTER

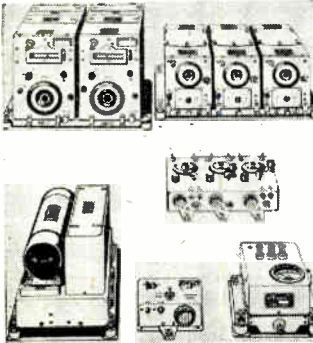
Cost the Government \$1800 • Cost to You—**BRAND NEW—100.00**



This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, with the millimeter, volt-meter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter bands with slight modification for which diagrams are furnished). OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA, from either 12 or 24 volts. Complete instructions are furnished to operate set from complete air tube, dynamotor, 300 lbs., 110V AC. SIZE 21 1/2 x 23 x 9 1/4". Total shipping wgt. 300 lbs. NOTE: Price increases to \$100.00 effective Oct. 1, 1948.

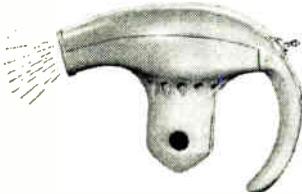
### SCR-274N COMMAND SET

The greatest radio equipment value in history



A mountain of valuable equipment that includes 3 receivers that use plug-in coils, and that consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28V. Dynamotors (easily converted to 110V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at **\$34.95**, including crank type tuning knobs for receivers.

### HEAT GUN



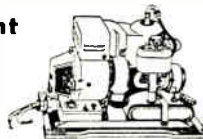
Streamlined pistol grip heat gun in vivid red housing, that delivers a powerful 20 Cubic Ft. per minute blast of hot air at 160 Fahrenheit. Ordinary blowers have small fan motors, but this has a life-time-lubricated AC-DC motor of the rugged vacuum cleaner type, that produces a hurricane of either hot or cold air. Perfect for blowing out dirt or dust from radio chassis, drying out ignition systems, warming up carburetors, quick-drying paint, thawing out radiators or water pipes, etc. Warning:—Keep this away from your wife, or she will be using it to dry her hair because it will do it in half the time of her ordinary hair dryer, to say nothing of her using it to dry stockings or clothing, or defrost the refrigerator instantly. Only **\$12.95**. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

### GENERAL ELECTRIC 15-TUBE TRANSMITTER-RECEIVER SET

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3-7H7's as IF's with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E5's and 7E7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any experimenter to connect this unit for 110 AC, using any supply capable of 400 DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, on 80 to 110 Mc, as an FM broadcast receiver, as a Facsimile transmitter or receiver, as an Amateur Television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. Order our RT 1048 for only **\$29.95**, or two for **\$53.90**. If desired for marine or mobile use the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only **\$15.00** additional.

### Our PE 109 32-Volt Direct Current Power Plant

This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 Volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32 volts DC for their operation. The price of our PE-109 power plant tested and in good condition is only **\$79.95 F. O. B. Buffalo**, or we can supply in strictly "as is" condition for **\$58.95 F. O. B. New York City**. These latter are exactly as received, in heavy steel-strapped gov't. cases, and we are unable to determine if the individual units are new or used or what the condition is, if used, while the **\$79.95** units are some of the same that we have brought to Buffalo for repair if necessary, and testing. We do not recommend gambling on the "as is" condition except for quantity purchasers. We can also supply a converter that will supply 110v AC from the above unit or from any 32V DC source for **\$12.95**.



All sales final and no returns unless otherwise specified in ad or item. Right reserved to change prices and specifications at any time.

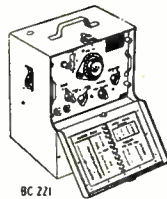
### COMPRESSED AIR INSTANTLY, Anywhere!!



Portable Air Compressor and storage tank. Ruggedly built of best materials using lifetime lubricated ball-bearing on connecting rod and oil impregnated main bearing on shaft. Unusual design forever eliminates valve trouble, the most common fault in air compressors. PATENTED unique air intake system increases efficiency tremendously over other compressors so that air output is increased more than that from larger compressors powered by heavier motors. Will deliver approximately 3500 cu. inches of air per minute at maintained pressure of 30 lbs., or will inflate a 90 lb. truck tire in less than one minute. Comes complete with 100 lb. gauge, although finger-tip adjustment allows setting of output pressure at any value, automatically be maintained. Works from any 1/2 H.P. motor. Useful for spraying paints or lacquers, disinfectants, insecticides, annealing or brazing with natural gas, inflating tires, etc. Price **\$14.50** postage prepaid anywhere in the U. S. Efficient, completely adjustable syphon type spray gun complete with 12 ft. of 100 lb. tested hose available for only **\$7.75** with pint container, also prepared 25% discount on all C. G. orders. Send for free catalogs of radio parts and surplus items.

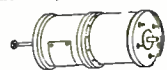
### BRAND NEW

BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **\$75.00**.



### \$10.95 Takes All Three BIG BARGAINS

1. ALUMINUM GEAR BOX 1 1/2x3x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from 1/2 to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar use. . . . **\$3.00**
2. SENSATIONAL FASCINATING AMAZING SELSYNS. Brand new selsyns made by G. E. Co. Two or more connected together work perfectly on 110 VAC. Any rotation of the shaft of one selsyn and all others connected to it will rotate exactly as many degrees in the same direction, following unerringly as if the units were connected together by shafting instead of wires. This is true whether you twist the shaft of the master unit a fraction of a revolution or many revolutions. Useful for indicating the direction of weather vanes, rotating directional antennas, or controlling innumerable operations from a distance. Complete with diagram and instructions. Per matched pair . . . . **\$4.95**
3. HOME WORKSHOP AT BARGAIN PRICE. Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 5/8" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a 1/2" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost **\$6.00**. Sole export agent. Distributor inquiries invited.






## SELENIUM RECTIFIERS

### AND SPECIALIZED ELECTRONIC COMPONENTS

## THIS MONTH'S SPECIALS !!

**VACUUM CAPACITOR**

50 MMFD.  
20 KV. **\$4.95**



**TRANSFORMER**

HIGH CURRENT  
AMERTRAN



5.1 Volts at 190 Amps.  
Primary 105/125 Volts

**OIL CAPACITOR**

.125 MFD.  
27 KV.DC. **\$17.50**

With mounting brackets

Can easily deliver 250 Amps. Insulation 35 Kv. Test. Approx. Shipping weight 75 lbs. **\$17.50**

**Full Wave Bridge Types**

Input Type#	Output Current	Price
B1-250	250 MA.	\$ .98
B1-500	500 MA.	1.95
B1-1	1 AMP.	2.49
B1-1X5	5 AMP.	2.95
B1-3	3 AMP.	3.49
B1-5	5 AMP.	3.95
B1-7X5	7.5 AMP.	7.95
B1-10	10 AMP.	9.95
B1-15	15 AMP.	13.95
B1-20	20 AMP.	15.95
B1-25	25 AMP.	20.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95
B1-60	60 AMP.	36.95

**Full Wave Bridge Types**

Input Type#	Output Current	Price
B2-150	150 MA.	\$1.25
B2-220	220 MA.	1.25
B2-300	300 MA.	1.50
B2-450	450 MA.	2.25
B2-600	600 MA.	2.95
B2-1	1 AMP.	3.95
B2-2	2 AMP.	4.95
B2-3	3 AMP.	6.95
B2-5	5 AMP.	9.95
B2-6	6 AMP.	10.95
B2-7X5	7.5 AMP.	13.95
B2-10	10 AMP.	15.95
B2-15	15 AMP.	24.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95

**Full Wave Bridge Types**

Input Type#	Output Current	Price
B2-150	150 MA.	\$ .98
B2-220	220 MA.	1.25
B2-300	300 MA.	1.50
B2-450	450 MA.	2.25
B2-600	600 MA.	2.95
B2-1	1 AMP.	3.95
B2-2	2 AMP.	4.95
B2-3	3 AMP.	6.95
B2-5	5 AMP.	9.95
B2-6	6 AMP.	10.95
B2-7X5	7.5 AMP.	13.95
B2-10	10 AMP.	15.95
B2-15	15 AMP.	24.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95

**Three Phase Bridge Types**

Input Type#	Output Current	Price
3B7-4	4 AMP.	\$32.95
3B7-6	6 AMP.	48.90
3B7-11	11 AMP.	65.00

**Full Wave Bridge Types**

Input Type#	Output Current	Price
B6-150	150 MA.	\$1.95
B6-250	250 MA.	2.95
B6-1X2	1.2 AMP.	9.95
B6-2	2 AMP.	12.95
B6-3X5	3.5 AMP.	21.95
B6-5	5 AMP.	24.95
B6-7X5	7.5 AMP.	32.95
B6-10	10 AMP.	36.95

**CENTER TAPPED TYPES**

Input Type#	Output Current	Price
C1-10	10 AMP.	\$7.95
C1-20	20 AMP.	12.95
C1-30	30 AMP.	17.95
C1-40	40 AMP.	21.95
C1-50	50 AMP.	25.95
C1-80	80 AMP.	34.95
C1-120	120 AMP.	46.95

**Rectifier Transformers**

Input Type#	Output Current	Price
3B13-4	4 AMP.	\$56.00
3B13-6	6 AMP.	81.50
3B13-11	11 AMP.	110.00

**Rectifier Transformers**

Input Type#	Output Current	Price
B13-4	4 AMP.	\$54.95
B13-7X5	7.5 AMP.	63.95
B13-10	10 AMP.	69.95

\* Select Proper Capacitor From List Shown Below, to Obtain Higher D.C. Voltages Than Indicated

### RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... \$ .35 per set  
 For Types B13 ..... .80 per set  
 For Types 3B ..... 1.20 per set

### RECTIFIER CAPACITORS

CF-13	6000 MFD	10VDC	\$2.49
CF-14	3000 MFD	12VDC	1.69
CF-15	6000 MFD	12VDC	2.95
CF-1	1000 MFD	15VDC	.98
CF-2	2000 MFD	15VDC	1.69
CF-3	1000 MFD	25VDC	1.69
CF-4	2X3500 MFD	25VDC	3.45
CF-18	10000 MFD	25VDC	4.95
CF-5	1500 MFD	30VDC	2.49
CF-6	4000 MFD	30VDC	3.25
CF-7	3000 MFD	35VDC	3.25
CF-8	100 MFD	50VDC	1.95
CF-19	500 MFD	500VDC	1.95
CF-16	2000 MFD	50VDC	3.25
CF-17	50 MFD	150VDC	.59
CF-9	200 MFD	150VDC	1.69
CF-10	500 MFD	150VDC	3.25
CF-11	100 MFD	350VDC	2.25
CF-12	125 MFD	350VDC	2.49

### Rectifier Transformers

All Primaries 115VAC 50/60 Cycles

Type#	Volts	Amps.	Price
TXF15-12	15	12	\$3.95
TXF36-2	36	2	3.95
TXF36-5	36	5	4.95
TXF36-10	36	10	7.95
TXF36-15	36	15	11.95
TXF36-20	36	20	17.95

### RECTIFIER CHOKES

Type	Amps.	Price
HY2	.03 Hy	2 \$2.25
HY3	.03 Hy	3 2.95
HY5	.02 Hy	5 3.25
HY8X5	.02 Hy	8.5 7.95
HY10	.02 Hy	10 9.95
HY12	.125Hy	12 12.95
HY15	.015Hy	15 13.95

### ELECTROLYTIC CAPACITORS

	Lots of 10	Lots of 100
100 MFD	50 VDC	\$2.20 \$19.00
40 MFD	150 VDC	1.80 17.50
50 MFD	150 VDC	2.00 18.50
8-20 MFD	350,150 VDC	4.70 43.00
*20-20 MFD	400,250 VDC	4.50 38.00
10 MFD	450 VDC	2.50 20.00
15 MFD	450 VDC	2.50 20.00
15-15 MFD	450 VDC	3.00 22.00
40 MFD	450 V C	4.20 36.00

\* 4 prong plug-in type.

### METERS

O-15 MA.D.C. Weston #506 2" Rd.	\$2.95
O-30 A.D.C. Weston W shunt 2 1/2" Rd., aircraft type.	2.95
O-50 A.D.C. Weston #301 3 1/2" Rd., Enclosed shunt type.	5.50
O-60 A.D.C. West.. w. shunt, 2 1/2" Rd., aircraft type.	3.25
O-120 A.D.C. West. w. shunt, 2 1/2" Rd., aircraft type.	4.95
O-8 V.A.C. G.E. 3 1/2" Round	2.95
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EE-108 Sound powered field telephone sets in leather carrying cases with ringer. Equivalent in size and shape to EE-8 but is sound powered instead of battery operated. Brand new in original packing. Can be used on ships, oil fields, farms, schools, sugar and rubber plantations & etc. **Price \$19.45 each**

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TRC-109B Western Electric small craft Transceiver 2000Kc to 3500Kc 10 watt output 12 Volt operation New in original packing with spares. **Price \$195.00 each**

128AZ MacKay Marine receiver 15Kc to 650Kc 110 V AC-DC 6 Volt Battery operation New with spares. **\$160.00 each**

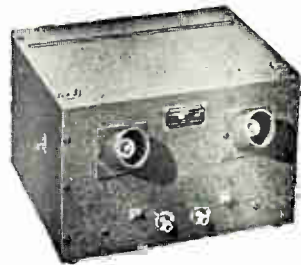
TDE Navy Transmitters 300 kc to 18000 kc complete with tubes and M. G. with output of 125 Watts A-1, A-2, 35 Watts 'phone 230 Volt DC operation. Original packing new with spares. **Price \$795.00 each**

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1—ELECTRA VOICE AUDIO AMPLIFIER 7 tubes with P.P. 807 output.

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TEST SET IE-19-A, for SCR-522..\$175.00

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PULSE TRANSFORMER, Utah 9280..\$15.00

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# COAXIAL CABLES AND CONNECTORS

## "UHF" COAXIAL CABLE CONNECTORS



### 83 SERIES

No.	An. No.	Description	Price
83-1SP	(PL259)	Plug	ea. 22¢
83-1SPN	(PL259A)	Plug	ea. 22¢
83-168	(UG176U)	Reducing adapter for RG 29, 55 and 58U. Use with 83-1SP or 83-1SPN.	ea. 12¢
83-1R	(S0239)	Receptacle	ea. 28¢
83-1AP	(M359)	Angle Plug adapter	ea. 22¢
83-1T	(M358)	Connector	ea. \$1.12
83-22R	(UG103U)	Receptacle	ea. 35¢
83-22SP	(UG102U)	Plug	ea. 35¢
83-1J	(PL-258)	Junction	ea. 70¢

Minimum Quantity — 100 of a type

## COAXIAL CABLES



RG5U	per 1000 ft.	\$70.00
RG6U	per 1000 ft.	70.00
RG7U	per 1000 ft.	120.00
RG8U	per 1000 ft.	40.00
RG9U	per 1000 ft.	135.00
RG10U	per 1000 ft.	90.00
RG11U	per 1000 ft.	100.00
RG12U	per 1000 ft.	175.00
RG13U	per 1000 ft.	125.00
RG18U	per 1000 ft.	320.00
RG22U	per 1000 ft.	120.00
RG29U	per 1000 ft.	37.50
RG34U	per 1000 ft.	175.00
RG39U	per 1000 ft.	55.00
RG54A/U	per 1000 ft.	60.00
RG54U	per 1000 ft.	65.00
RG57U	per 1000 ft.	75.00
RG58U	per 1000 ft.	59.00
RG59U	per 1000 ft.	45.00
RG62U	per 1000 ft.	50.00
RG71U	per 1000 ft.	120.00

Prices based on a minimum quantity of 500 ft.

## UG TYPE CONNECTORS

Deduct 10% from prices shown on quantities of 100 or more of any type

AN #	Price ea.	AN #	Price ea.
UG-9/U	1.14	UG-97/U	3.50
UG-10/U	1.56	UG-98/U	1.55
UG-11/U	1.45	UG-100/U	2.34
UG-12/U	1.14	UG-101/U	2.95
UG-13/U	1.56	UG-106/U	.45
UG-14/U	1.45	UG-107/U	2.25
UG-15/U	1.14	UG-108/U	1.75
UG-16/U	1.56	UG-109/U	1.75
UG-17/U	1.45	UG-114/U	1.50
UG-18/U	1.25	UG-115/U	1.35
UG-18A/U	1.05	CW-123/U	.45
UG-18B/U	.99	UG-155/U	.40
UG-19/U	1.28	UG-154/U	3.75
UG-19A/U	1.38	UG-155/U	3.75
UG-19B/U	1.45	UG-156/U	2.25
UG-20/U	1.17	UG-160/U	1.90
UG-20A/U	1.26	UG-160A/U	1.55
UG-20B/U	1.41	UG-167/U	2.25
UG-21/U	.99	UG-173/U	.30
UG-21A/U	1.05	UG-175/U	1.30
UG-21/U	.99	UG-176/U	.15
UG-22/U	1.08	UG-188/U	1.10
UG-22A/U	1.38	UG-201/U	1.22
UG-22B/U	1.34	UG-202/U	2.75
UG-23/U	.99	UG-205/U	1.02
UG-23A/U	1.26	UG-208/U	28.50
UG-23B/U	1.29	UG-222/U	4.50
UG-27A/U	2.25	UG-213/U	4.50
UG-28/U	2.34	UG-215/U	3.35
UG-29/U	1.22	UG-216/U	8.70
UG-30/U	1.75	UG-213/U	3.10
UG-33/U	30.00	UG-218/U	6.50
UG-34/U	35.00	UG-222/U	35.00
UG-35A/U	28.00	UG-231/U	2.00
UG-36/U	35.00	UG-236/U	11.75
UG-37/U	28.00	UG-241/U	2.20
UG-37A/U	30.00	UG-242/U	2.50
UG-57/U	.99	UG-243/U	2.75
UG-58/U	.63	UG-244/U	2.50
UG-59/U	2.75	UG-245/U	1.25
UG-59A/U	1.70	UG-246/U	1.45
UG-60/U	1.90	UG-252/U	4.50
UG-60A/U	1.30	UG-254/U	1.82
UG-61/U	2.85	UG-255/U	1.85
UG-61A/U	1.80	UG-260/U	1.12
UG-62/U	28.00	UG-261/U	1.95
UG-63/U	1.50	UG-262/U	1.05
UG-65/U	1.65	UG-269/U	2.60
UG-66/U	1.69	UG-273/U	1.50
UG-67/U	1.40	UG-274/U	1.98
UG-68/U	1.47	PL-274	1.12
UG-69/U	.95	UG-290/U	.85
UG-80/U	1.05	UG-291/U	1.95
UG-91/U	1.25	UG-306/U	2.03
UG-91A/U	1.05	UG-333/U	4.70
UG-92/U	1.10	UG-334/U	5.75
UG-92A/U	1.35	UG-352/U	6.00
UG-93/U	1.25	UG-387/U	5.25
UG-93A/U	1.45	UG-270/U	6.50
UG-94/U	1.25	UG-259/U	4.10
UG-94A/U	1.05	UG-279/U	2.40
UG-95/U	1.10	UG-157/U	4.25
UG-95A/U	1.35	MX-195/U	.55
UG-96/U	1.25	UG-197/U	5.25
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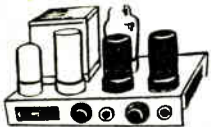
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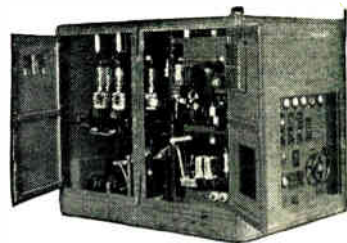
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# INDUSTRIAL POWER SUPPLY EQUIPMENT

for immediate shipment at worthwhile savings

## NEW RA38 POWER SUPPLIES

115V., 60 cyc. input adjustable output 0.15-000V. A.C. or D.C. @ 500 Mils. Complete with extra set of new tubes and remote control.  
Shipping weight 2100 lbs. **\$250.00**



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Dry Disc Type—Continuous  
Duty Ratings

- 3.5V. A.C. 1.8V. D.C. 1.0 Amps Full Wave Bridge.....90c
- 6.5V. A.C.—2.2 V. D.C. @ 3.0 Amps Full Wave Center Tap.....\$1.20
- 36V. A.C. 200 Mil D.C. H.W.....75c
- 54V. A.C.—1.6 Amps. D.C. G.E. Full Wave Bridge. \$4.40
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- 2 Mfd 600 V Tubular Oil...39c
- 2 Mfd 3000 Oil.....\$2.75
- 1.0 Mfd 25-KV.....\$36.00

### HEATERS

H-149—Chromolox strip heaters, 300 W., 115 V. 1/4x1 1/2" 12".....\$1.00



### 2000 ELECTROLYTIC CAPACITORS

500 MFD 200 DCWV:  
2 Insulated Terminals:  
2" dia. x 4 1/2" can:  
mounting bracket; new,  
orig. factory packing.  
Per unit... **\$ .95**

Write for quantity discount

1000 .25/.25 Mfd @  
6000 VDC ov .125  
MFO @ 12,000 VDC.  
5" x 3 1/2" x 9 1/2"  
H.O.A. Mfg. by John  
D. Fast—Oil filled w/  
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new, orig. factory  
packing. **\$3.75**

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115 V. 50/60 cycle input 103-126 V. output @ 2.17 amps. **\$9.50**  
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Fenwall—50° +400° F. 110-220 V. 2500 watt contacts, adjustable.....\$1.60  
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T-103 — Voltage regulator Transstat, American Transformer Co. Spec. 29145 Max KVA output 11.5 56/60 cyc. 0.115 V. 100 amps. or 230 V. 50 amps. **\$75.00**

Net Wt. 134 lbs. Dim. 25" W x 16" D x 17 1/2" H (Incl. 3" shaft ext.)

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G.E. Type CO-21991 Input 115 volts D.C. @ 5.7 amps. Output 115 V. A.C. 60 cycle, single phase 350 V.A. @ 85%. \$58.00  
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2 1/2" dia. x 6 1/2" O.A. Clip mounting. New orig. **\$4.95**  
factory packing  
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### 100 001 MFD. 25,000 V.D.C. MICA CAPACITOR

25 A. @ 3,000 KC. 18A @ 1,000 KC. 11 A.C. 300 KC. CD type 1 1/2" x 2 1/2" x 4 1/2" Diam. 10 1/2" x 4" x 9" H.O.A. Original factory packing. \$25.00  
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  - 931A Photo-Mult. 2.75
  - All Tubes New, Boxed

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  - 531..... 18.00
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*Partial Listing*

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**136A**—Mackay ship transmitter, 40 watts cw, 5.5-22 mcs. Supplied complete w/110 V dc motor generator and spares for both m/g and XMTR. NEW, export packed, \$115 per set.

**ET-4332B**—RCA 250 watts radio telephone, 350 watts cw, 2.0-20.0 mcs. Operates from 110 AC. Condition: EXCELLENT. One only at \$825.00.

**INSULATORS**—Standoffs, Feedthru's and Strains. We have tens of thousands in stock. Please advise size and quantity desired.

**TBK**—500 watts cw Navy transmitter, 2.0-20.0 mcs

**TAJ**—500 watts cw Navy transmitter, 150-550 kcs

**TBL**—350 watts cw, 50 watts phone, 175-600 kcs and 2.0-18.1 mcs. Each of the above supplied with 115 or 230 vdc motor generator and magnetic controller. TBL has speech input eqpt. Condition: EXCELLENT.

**Underwater Sound Beacons**—Model NAA. Consists of a buoy-shaped water-tight, welded container fitted with omnidirectional electrosonic transducer. Inside are batteries, oscillator-amplifier, vibrator power supply, timer and self-destroying device, which can be removed if desired. Beacon emits 5 watts audio at 10 to 20 kcs at chosen code for 48 hours. NEW, original packing.

**SPECIAL INTRODUCTORY OFFER.** Standoffs insul., 12 in. w/brass or bronze base and cap at \$1.00 each.

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*Partial Listing*

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**Z A**—Blind Landing Eqpt. 90-100 Mcs., complete, new with test oscillators and spares for same.

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**ET-270-D**—Federal 300 Watt cw transmitter; 110 Volts A.C. operation 3.0-20.0 MCS. Price, \$275.00.

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**Westinghouse Ammeters**—100-0-100 amps. Circular, type EX, style WG 42719-1, with about 10 ft. of lead wire less 50 mv shunt. NEW. \$9.50 ea.

**TDY Radar jammer**—Power Oscillator only; 110 V AC, 60 c. Brand new, less tubes at \$95.00 ea.

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**Transformers**—Modulation Reactors—2500 W—12000/7500 SEC.....\$72.50

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**Complete line supersonic components.** QBD our speciality.

**Meters**—0-300V DC—1 mil movement—Sun—2 1/2".....

Lots of 100—ea. \$1.80  
Lots of 10—ea. \$2.20

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This analyzer, featuring a sensitive repulsion type meter housed in a bakelite case, represents the culmination of 15 years achievement in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model Volt-Ohm-Milliammeter:

AC Volts — 0-25,50,125,250  
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Milliamperes AC—0 to 50 DC  
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Total Price, prepaid anywhere in the USA—\$7.00  
Similar DC Meter, lacking the AC operated ranges of above, \$5.50 prepaid.



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(Sold at less than established factory price so we cannot mention brand name.) Only \$20.95 equipped with 1/2" Jacobs Geared Chuck and Key.

Not an intermittent duty drill, but a full size rugged tool.

Most convenient type switch, natural grip handle, and balance like a six-shooter.

Precision cut gears—turbine type cooling blower—extra long brushes.

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Other bearings self-aligning lifetime-lubricating Chrysler Oilite type.

Made for toughest year-in and year-out service in Plant or on construction jobs.

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## GENERAL ELECTRIC FG-172 THYRATRONS

Brand new in original cartons  
This tube is used in many industrial controls and is specially priced at \$14.80 each  
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ASB 5 element Yagi (500 MC).....\$7.00  
ASA dual 6 element Yagi (400 MC) with hydraulic servo trans. and recvr. for remote control.....\$48.75  
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Pri 115V 60 cy 3/4 KVA—Sec #1 240V @ 1.56A, Sec #2 240V @ 1.56 A, Wt. 30 lbs. ....ea. \$11.50  
\$10.00 each in lots of 10

Pri 115V 60cy tapped, Sec 5V @ 30A.....\$3.32  
ELINCO PM-2 Rate Generator.....\$6.00  
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TUBES AT SENSATIONALLY LOW PRICES  
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3—AN/APR-4 RECEIVERS; 3—TN-17, 3—TN-54; 2—TN-16; 2—TN-18; 2—TN-19; TUNING UNITS.

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Vibrating Reed Type. Range 48-62 cycles. **PRICE \$6.95**

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**Magnet Wire** on small spools 1/8-1/4 lb. in sizes #22 through # 44. **Price \$.25 per spool**

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**C1015**—AIRCRAFT-TYPE STARTER RELAY Leach type #7220-

## RELAYS (Con't)

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12	6.75/M		
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Size	Price	Size	Price
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20	15.00/M	28	2.25/M
22	12.00/M		

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22	.85 lb.
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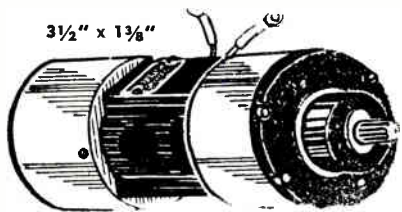
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**HAYDON or TELECHRON SYNCHRONOUS MOTOR**  
to operate switches, etc., 1 Rev. per minute at this **SPECIAL PRICE \$3.85**  
Many other speeds available at \$5.25 up

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Transformer, 115V.A.C. 60 cycle, output 5 volts at 190 amps., ideal for welding etc. Good condition ..... \$12.95

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EXTENSION CORD, CD307 with PL-55 and JK-26 ..... New \$0.49

Headset, HS30 complete with matching transformer, 6 ft. cord and PL-55..... New \$1.95  
SOUND POWERED CHEST SETS..... New \$5.95  
SOUND POWERED HEADSETS, TS10 New \$15.00, pair \$25.00

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IDEAL MOBILE POWER SUPPLY  
PE237—Heavy duty vibrator power supply, 6, 12, or 24 volt input, 525v, 95 ma.; 105v, 42ma.; 6.5v, 2 amp.; 6v, 500ma.; 1.3v, 450ma.; small supply—100v, 17ma., 1.35v, 450ma. with tubes, shock mounted, Brand New..... \$29.50

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SCR522—TRANSMITTER AND RECEIVER, Good condition, tubes..... \$35.00  
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TERMS: F. O. B. Pasadena, 25% deposit required on C. O. D.

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**A-PL-55 Lock Type Phone Plug** (SC#B180207) 2-Circ. For JK-34A Jacks .....25¢

**B Headset Extension Cord** 65' equipped with rubber jacketed SC PL-55 Plug and JK-26 Jack—moisture and fungus proofed, 2-cond neoprene cord. Navy type CW49534 .....39¢

**ANTENNA REEL**  
50-ft. Antenna, flexible braided wire. Winds up into compact bakelite case only 2 3/4" x 2 1/4" x 3/8". Perfect for portable or fixed use.....98¢

**REPRODUCER**  
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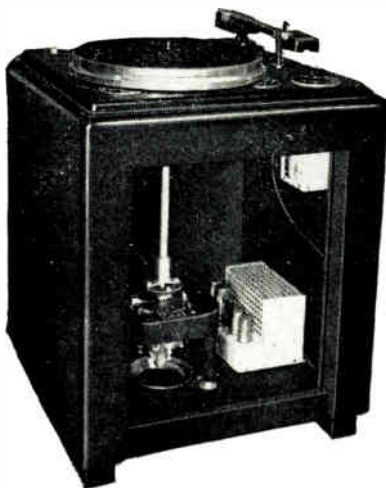
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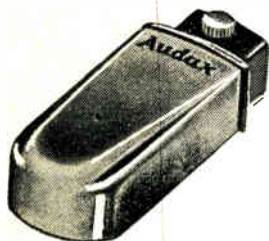
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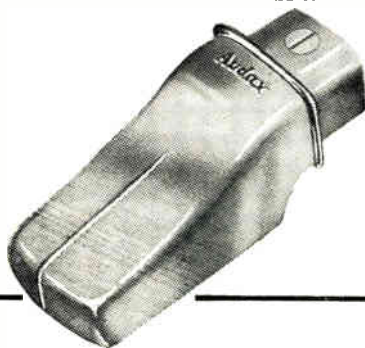
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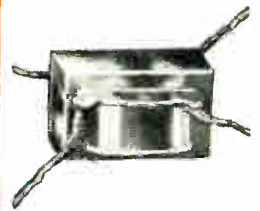
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**POWER COMPONENTS**  
Rugged . . . Dependable



**VARITRAN**  
Voltage Adjustors



**MODULATION UNITS**  
One watt to 100KW



**VARIABLE INDUCTOR**  
Adjust like a Trimmer



**TOROID HIGH Q COILS**  
Accuracy . . . Stability



**TOROID FILTERS**  
Any type to 300KC



**MU-CORE FILTERS**  
Any type 1/2 - 10,000 cyc.



**EQUALIZERS**  
Broadcast & Sound



**PULSE TRANSFORMERS**  
For all Services



**HERMETIC COMPONENTS**  
Ceramic Terminals



**HERMETIC COMPONENTS**  
Glass Terminals



**GRADE 3 JAN**  
Components



**CABLE TYPE**  
For mike cable line



**VERTICAL SHELLS**  
Husky . . . Inexpensive



**REPLACEMENT**  
Universal Mounting



**STEP-DOWN**  
Up to 2500W . . . Stock



**LINE ADJUSTORS**  
Match any line voltage



**CHANNEL FRAME**  
Simple . . . Low cost

*United Transformer Co.*  
150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

World Radio History



Representative RCA types standardized for future equipment designs

# Tubes for today and tomorrow

HERE ARE power tubes, phototubes, and c-r tubes to serve the major requirements of equipment manufacturers for a long time to come. The tubes listed are those you can depend on now, and for your future designs.

These RCA types are especially recommended because their wide-spread application permits production to be concentrated on fewer types. Such longer manufacturing runs reduce costs—lead to improved quality and greater uniformity. Resultant benefits are shared alike by the equipment manufacturer and his customers.

RCA Application Engineers are ready to suggest suitable tube types for your design requirements. For further information write RCA, Commercial Engineering, Section LR-40, Harrison, N. J.

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

Preferred List of RCA Non-Receiving Types					
<b>CATHODE-RAY TUBES AND CAMERA TUBES</b>					
Kinescopes (Projection)	Camera Types	Oscillograph Types	Monoscope		
5TP4	5527	2BP1	2F21		
(Directly Viewed)	2P23	3KP1			
7DP4	5655	5UP1			
7JP4	1850-A				
10BP4					
<b>PHOTOTUBES</b>					
Gas Types	1P41	921	927	930	
Vacuum Types	922	929			
Multiplier	931-A				
<b>GAS TUBES</b>					
Thyratrons	2D21	3D22	884	2050	5563
Ignitrons	5550	5551	5552	5553	
Rectifiers	3B25	673	816	857-B	866-A 869-B
	8008				
Voltage Regulators	0A2	0C3/VR105		0D3/VR150	
<b>POWER AMPLIFIERS AND OSCILLATORS</b>					
<b>(Air-Cooled)</b>		<b>TRIODES (Forced-Air-Cooled)</b>		<b>(Water-Cooled)</b>	
811		6C24		9C21	
812-A		7C24		9C27	
826		9C22		889-A	
833-A		9C25		892	
8000		889R-A			
8005		892-R			
8025-A		5588			
		5592			
<b>TETRODES (Air-Cooled)</b>		<b>BEAM TUBES (Air-Cooled)</b>		<b>PENTODES (Air-Cooled)</b>	
4-125A/4D21		8D21		802	
		2E24			
		2E26			
		807			
		813			
		815			
		828			
		829-B			
		832-A			

The world's most modern tube plant . . .  
RCA, Lancaster, Pa.



**TUBE DEPARTMENT**

**RADIO CORPORATION of AMERICA**

**HARRISON, N. J.**