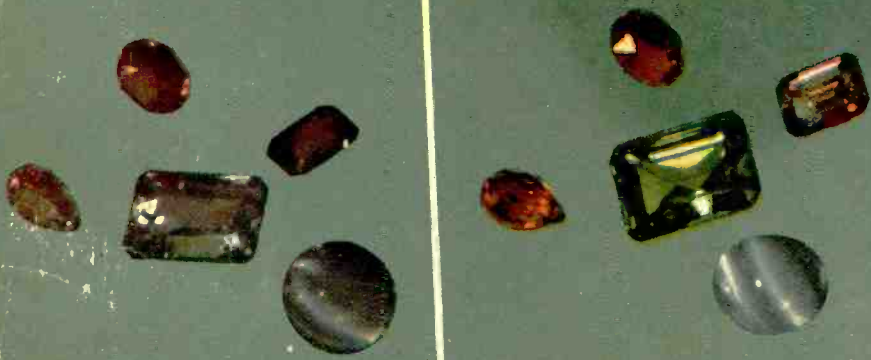


AUGUST • 1947

electronics

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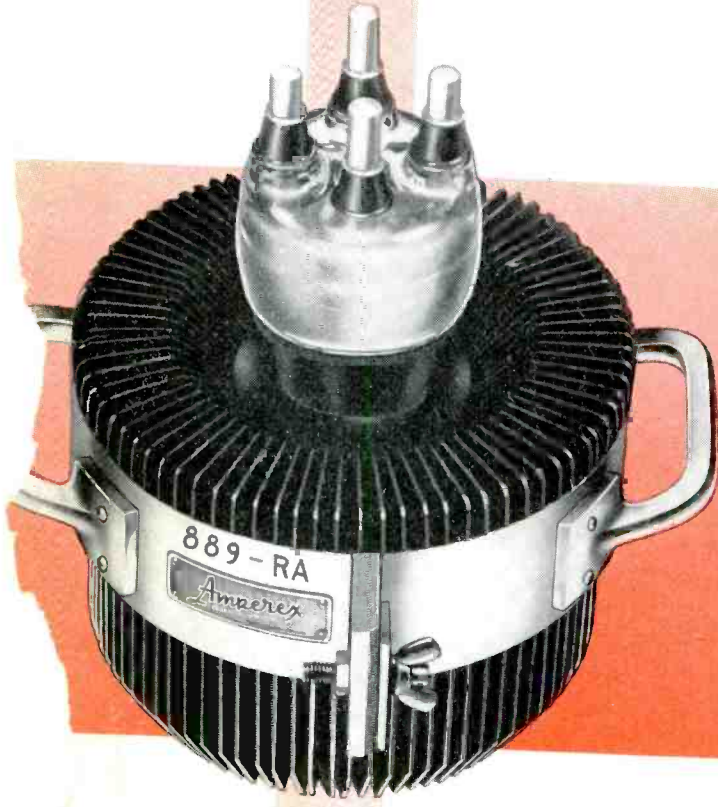
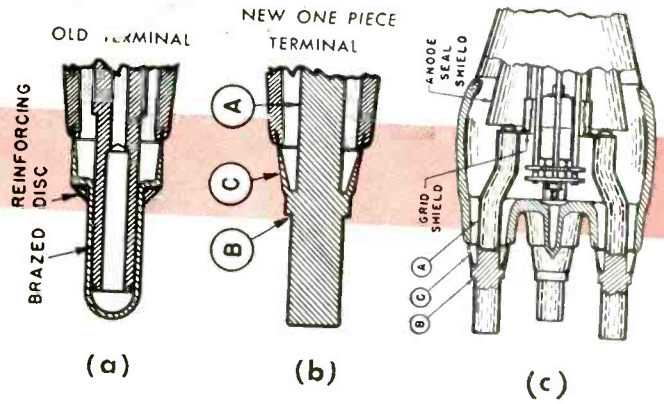
Coloring Gems by X-Ray

(See Page 138)

BEFORE

AFTER

the **LITTLE**
differences



There may be little visible physical difference between a good violin and a great violin. But, in their respective performances, these almost invisible differences may make all the difference. Similarly, while all transmitting tubes may look alike and be designed to serve the same purpose, the little "extras" are the things that give outstanding distinction to Amperex tubes.

For example, one of these "differences" is the one-piece contact pin, grid and filament support used in the Amperex 889R-A. Heretofore, the pin support and seal were a brazed assembly (a). Now, they are one unit, made of pure, oxygen-free copper which is non-magnetic, and has a very low RF resistance and high conductivity. A strong conical form replaces the less desirable cylindrical form at the seal, and the lack of brazing eliminates not only the weaker mechanical area but also its detrimental effects on the copper and the glass seal (b).

This new Amperex structure is stronger... much stronger! Where the old pins could be distorted by side pressure, the new ones resist that pressure up to the breaking point of the glass. Not only have we added strength where it is needed but the one-piece design has enabled us to relocate and redesign the anode and grid shields (c). This has reduced glass heating and resultant punctures. Laboratory tests also indicate a remarkable freedom from grid-filament shorts caused by thermal fatigue. Little differences, yes!—but they make the Amperex 889R-A the tube to use when you re-tube.

make the
BIG
difference

re-tube with Amperex

**AMPEREX
ELECTRONIC
CORPORATION**



25 WASHINGTON STREET, BROOKLYN 1, N. Y.
In Canada and Newfoundland, Rogers Radio Electric Limited
11-19 Brentcliffe Road, Leaside, Toronto, Ontario, Canada

electronics

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PUBLICATION

AUGUST • 1947

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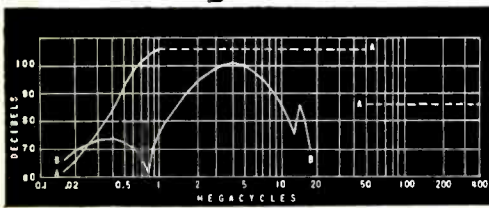
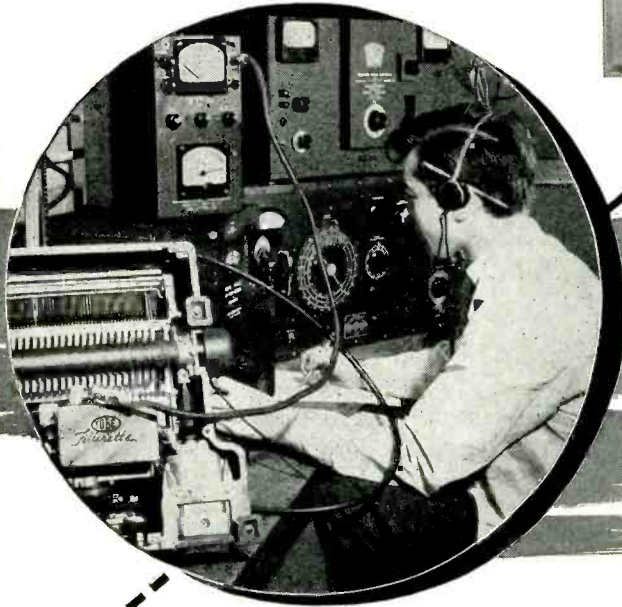
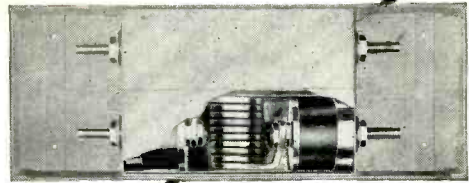
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ISOLATION

...from extraneous radio interference...
for test rooms in laboratory or factory



Curve A — Heavy-duty filters; dotted line indicates attenuation beyond range of available measuring equipment.

Curve B — Medium-duty filters.

Installed where the electric power service passes through the screen, these Filterettes provide high attenuation from 150 kc to 400 mc, thus permitting operation of sensitive high-frequency test apparatus in close proximity to electric production equipment, welding generators, repulsion motors, and high-frequency induction heating equipment.

SPECIFICATIONS

Mechanical design and assembly conform to practical electrical installation requirements. Outer housings are of welded steel; knockouts at each end accommodate electrical conduits; heavy, threaded studs facilitate attachment of cable lugs.



Screen Booth Filters

These units employ non-inductive, mineral-oil impregnated capacitors; the inductors, of large cross-section, have low series resistance, hence voltage drop is negligible. Overload ratings are: 150% of ampere rating for one hour; 200% of voltage rating for one minute. Since the filters have no saturable characteristics, performance is uniform for all loads up to maximum ratings.

HEAVY DUTY FILTERS					
Type	Amperes	Volts	Volt. Drop	Freq. Range	Weight
No. 1179-A Two Wire	100	500 a-c/d-c	.2 volts per circuit	0.15 to 400 megacycles	40 lbs.
No. 1182-A Three Wire	100	500 a-c/d-c	.2 volts per circuit	0.15 to 400 megacycles	65 lbs.
MEDIUM DUTY FILTERS (Two Wire)					
No. 1137	20	110/220 a-c 500 d-c	.5 volts per circuit	0.15 to 20 megacycles	17 lbs.
No. 1116	50	110/220 a-c 500 d-c	.5 volts per circuit	0.15 to 20 megacycles	17 lbs.



TOBE DEUTSCHMANN Corporation CANTON, MASSACHUSETTS



...the world's greatest
radio networks



...most efficient
office buildings

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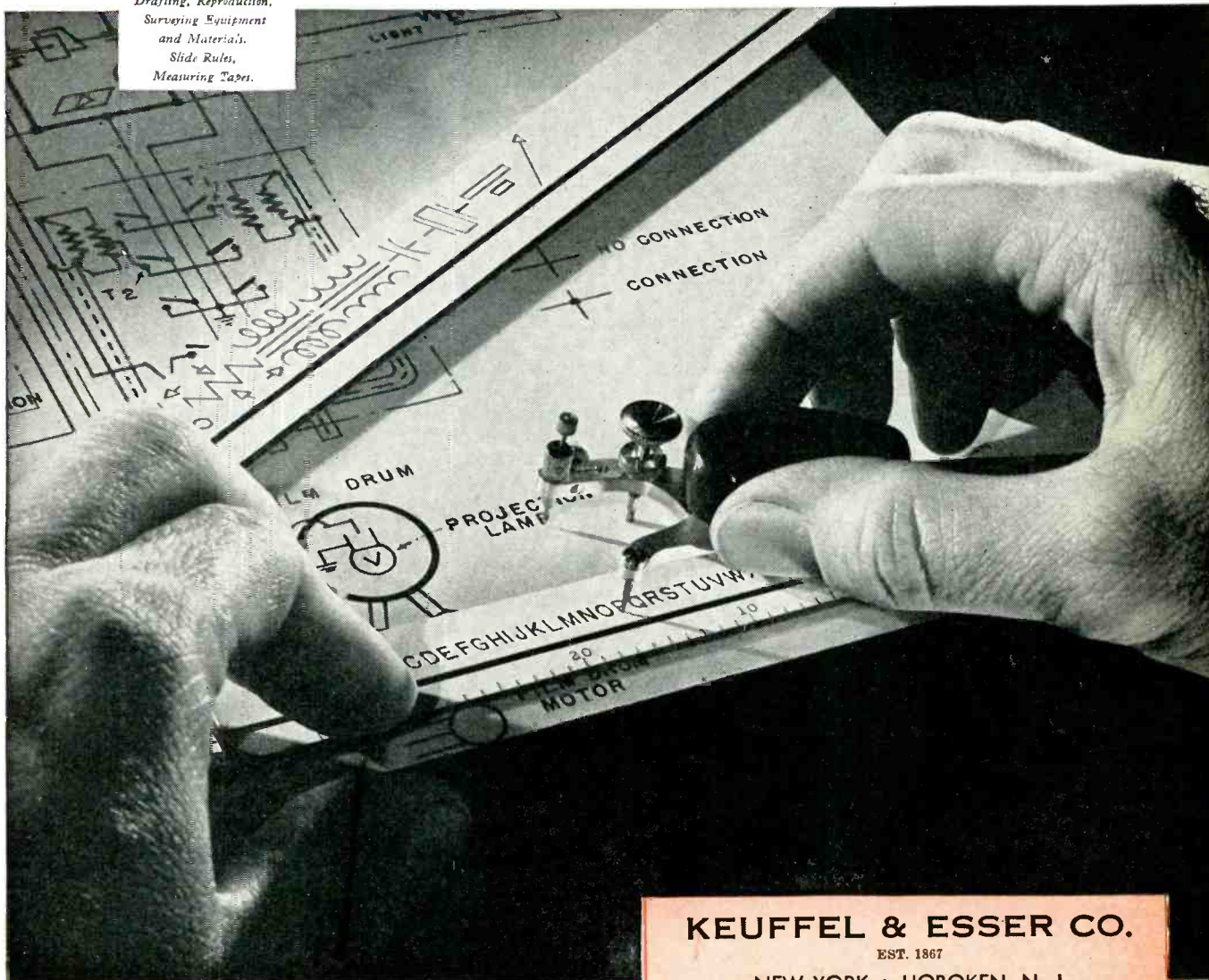
For faster, better lettering you will find a LEROY† Lettering Set a tremendous help. With it you can produce a wide range of lettering styles and symbols with complete uniformity. Precision lettering need no longer be tedious. For full information write to your nearest K & E Distributor or to Keuffel & Esser Co., Hoboken, N. J.

†Reg. U. S. Pat. Off.

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and Materials.
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EST. 1867

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CHICAGO • ST. LOUIS • DETROIT • SAN FRANCISCO
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Why this team can bring

ACTIVE DEVELOPMENT of loudspeakers moved forward after World War I, when Western Electric produced the 196W, employing a non-magnetic diaphragm driven by an armature. First used in the Victory Loan campaign of 1919, the 196W took part in the national political conventions of 1920, the presidential inauguration of 1921, and the burial of the Unknown Soldier later the same year. Success of these pioneer public address systems rested not only on loudspeakers but also on high quality microphones and amplifiers—all Western Electric developments.

Continual progress in the intervening years has kept pace with the development in Bell Telephone Laboratories of telephone transmitters and receivers for the Bell System. Fundamental to both loudspeakers and telephones have been the Laboratories' pioneering studies in sound, speech, hearing and the theory of vibrating systems.

Sound distribution systems, sound motion pictures and radio broadcasting—all have benefited from the teamwork which has done so much to make possible today's efficient, powerful, wide-range loudspeakers.



1919. New York's Victory Loan celebration pioneered the art of reaching tremendous audiences. 113 Western Electric speakers made possible this mass demonstration of the new art.



1924. Non-directional, small in size, yet extremely wide-range for its day, the 540 cone speaker designed for broadcasting was so popular for home receivers that it became a symbol of early radio.



1926. The 555 Receiver, with its large wooden horn, contributed to the success of sound motion pictures. From this single-unit loudspeaker grew the high quality wide-range theatre speaker systems of today.

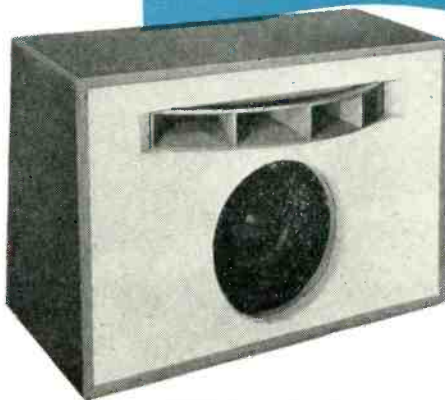


1937. The introduction of the 750 series of loudspeakers provided the first really wide-range direct radiator. With the proper mounting, this speaker covers a frequency band from 80 to 10,000 cycles. Still a popular speaker.

you loudspeakers like these



728B 12" direct radiator, 30 watts continuous capacity. Frequency response 60 to 10,000 cps.



757A two unit system, using 728B plus separate high frequency speaker. Frequency response 60 to 15,000 cps.



756A 10" direct radiator, power handling capacity 20 watts, response 65 to 10,000 cps.

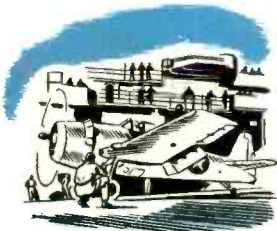
755A 8" direct radiator, 8 watts capacity. Response 70 to 13,000 cps.



TODAY Western Electric offers a complete line of wide-range direct radiators, high frequency speakers, horns and multi-unit systems all designed by Bell Telephone Laboratories. There's one to meet your requirements for highest quality sound whether you want an eight inch, eight watt speaker, or a giant theatre-type system with 120 watts capacity.

No matter which you select, you get the benefit of a broad experience which long antedates the public address art.

— QUALITY COUNTS —



1943. Battle announce speaker designed for the United States Navy hit a new high in intelligibility and power. Used on all types of Navy ships, they passed commands to fighting men over the noise of battle.



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

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

H
IGH SCORER

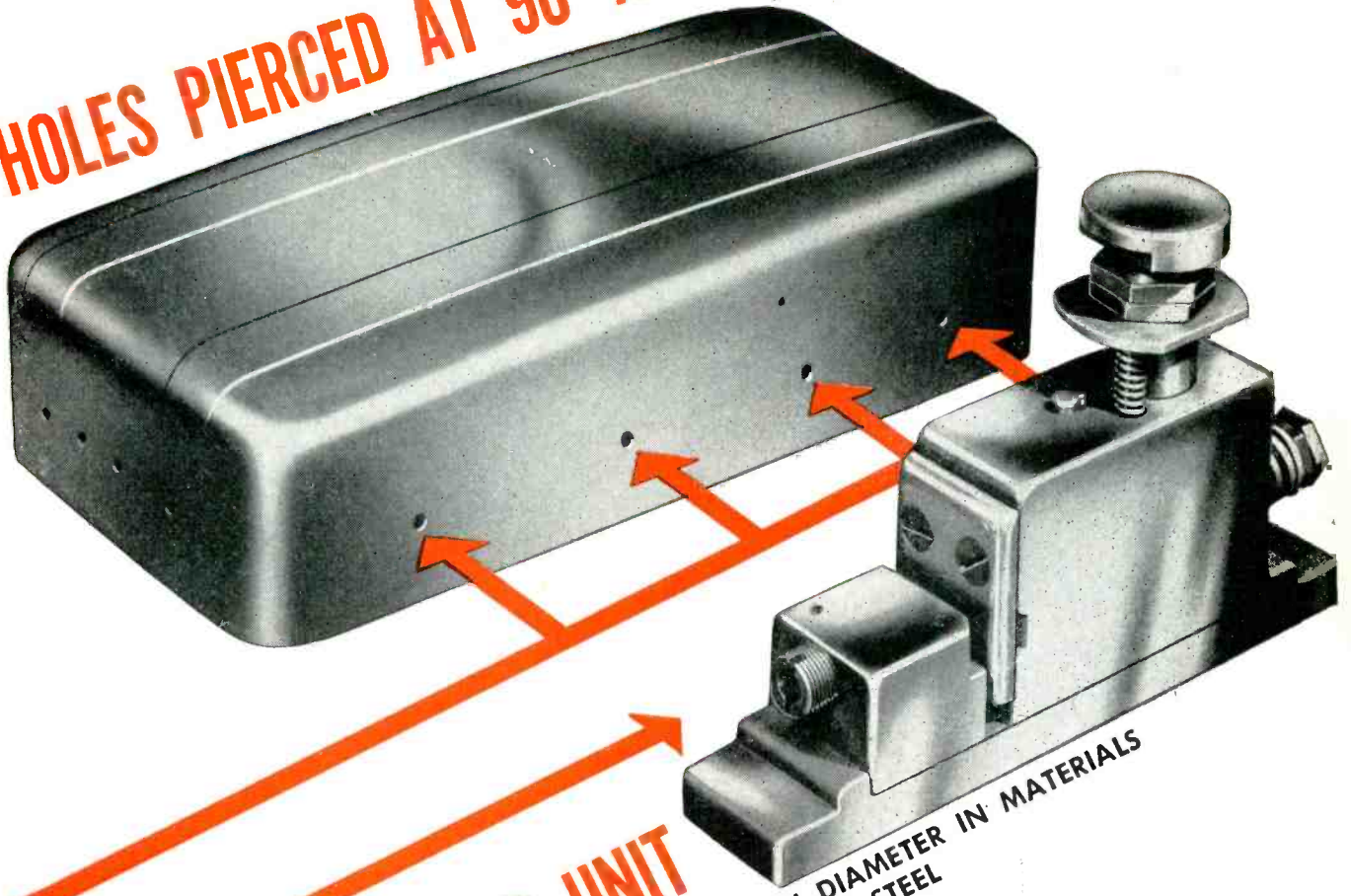
HQ-129-X

In any contest, Sweepstakes or DX, you will find HQ owners way up among the High Scorers. Why? Because the HQ-129-X has what it takes—plenty of selectivity to dig out those "down under" stations that you have to work if you want to be **HIGH SCORER**.



HAMMARLUND
THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

HOLES PIERCED AT 90° ANGLE . . .

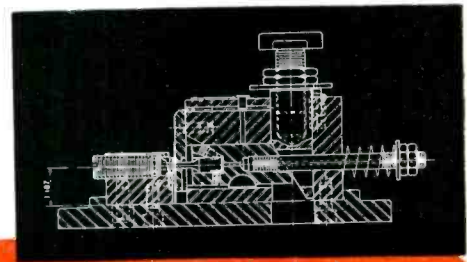


With

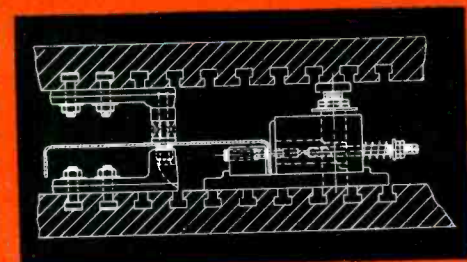
NEW

WHISTLER UNIT

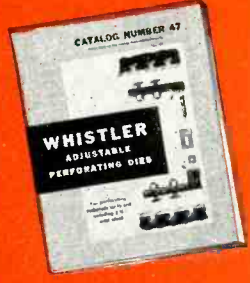
PERFORATES HOLES UP TO 1/2" IN DIAMETER IN MATERIALS TO 1/16" THICK MILD STEEL



Detailed drawing showing operation of HU-50 90° Perforating Unit.



Typical set-up shows 90° perforating unit operated in conjunction with standard perforating equipment.



DETAILS EXPLAINED IN CATALOG NO. 47

Get the facts about this 90° perforating unit in a hurry. Your copy of this catalog will be sent at once upon request.

Extruded shapes, ells, angles and other molded, shaped or fabricated pieces are easily pierced from the side at 90° with HU-50 Perforating Units. Quickly set up and adjustable, these units may be used separately or with standard perforating equipment. The advantages provided by other Whistler Adjustable Dies are retained. Absolute accuracy is assured. Quick change-over of hole arrangements can be made . . . in many cases, on the press. Production economies and speeded up operating schedules are effected. Continued re-use of units in different groupings spreads initial cost.

It makes sense to look into the use of Whistler Adjustable Dies for all perforating, notching, slitting or rounding operations.

S. B. WHISTLER & SONS, INC.
 746 MILITARY ROAD
 BUFFALO 17, NEW YORK



a revolutionary new studio camera

Produces sharp, realistic television pictures
without hot lights

THIS IS IT! RCA's new studio camera which does for indoor productions what RCA's super-sensitive field camera equipment did for outside events! Television pictures produced with this camera are sharp and clear, contain half-tone shadings needed for natural-appearing images, show detail in the highlights and shadows—all without the glare and heat formerly required in television studios.

Gone is the need for expensive, intense studio lighting. No need for oversized air-conditioning plants. You get brilliant, sharply defined pick-ups at light levels of from 100 to 200 foot candles . . . functions down to 25 foot candles.

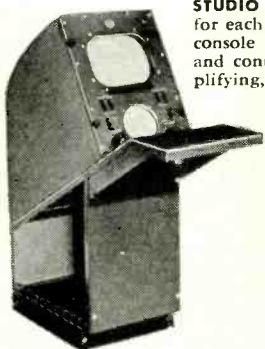
This studio camera opens new fields of studio production. Is simple to use and requires no fussy shading adjustments. Offers higher resolution and lower noise level than the field-type, image-orthicon camera with somewhat less sensitivity which is not required in the studio. You see exactly what you are picking up on an electronic view finder at the back of the camera.

The turret-mounted lenses can be switched in a matter of seconds. Lens ranges from 35mm f/2.8 to 135mm f/3.8 cover all studio requirements. Depth of focus is such that refocusing is seldom required.

The "eye" of this camera is a new studio-type, image-orthicon tube. Circuits and components used with it are similar to those in RCA's field camera. Therefore, anyone familiar with the field camera can operate or service the studio camera without special training.

The only camera connection needed for operation is a flexible, lightweight cable less than an inch in diameter. Intercommunication facilities for the operator and built-in tally lights are provided to co-ordinate all programming directions.

Here, we believe, is a real aid to versatile, low-cost studio programming . . . brighter, clearer, steadier telecasting. An early order from you will help us meet your delivery requirements. Write Dept. 30-H.



STUDIO CAMERA CONTROL—one required for each camera . . . becomes part of video console . . . permits operator to monitor and control quality of picture signal (amplifying, mixing, blanking, synchronizing, etc.).

VIDEO CONSOLE—composed of studio and film camera controls, a master monitor, and switching, lap-dissolve, and fading facilities for selecting the camera pick-up desired. "Building-block" design assures a compact, unified appearance . . . permits adding extra units at any time.



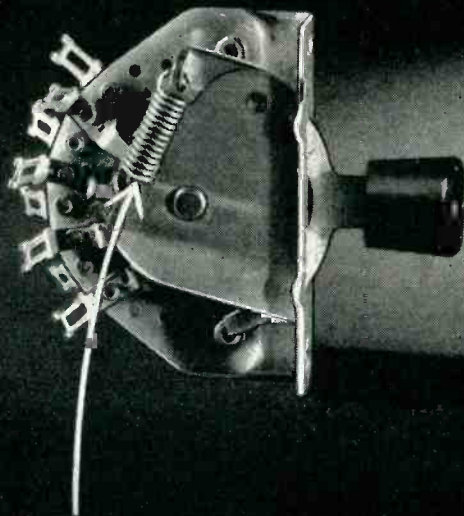
TELEVISION BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

Centralab reports to

AUGUST 1947

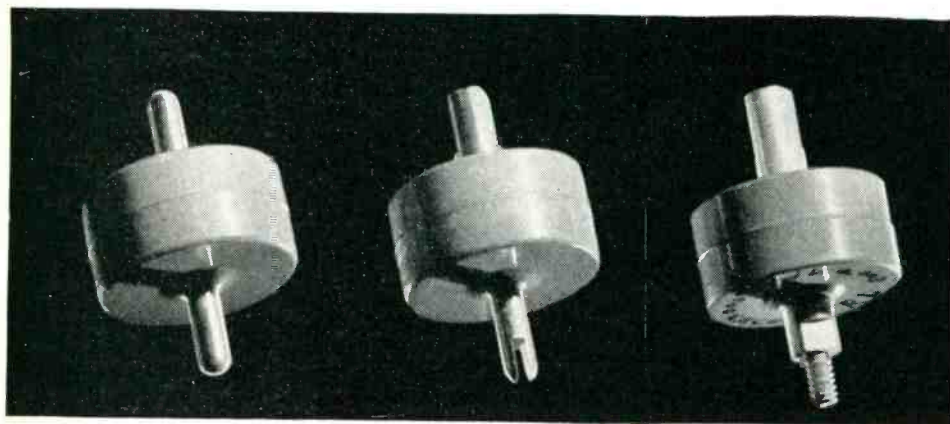
New lever switch
features coil spring
design, guaranteed
minimum life test
of 25,000 cycles!



New coil spring design provides smooth action, more positive indexing! Note how easily spring can be replaced without removing switch from chassis. Simplicity of engineering and rugged construction assure long life and dependability.

I Centralab's revolutionary, new *Lever Switch* features exclusive coil spring design with cam and roller, offers you new dependability, long life and resistance to hard service for inter-com and test equipment use. Guaranteed minimum life of 25,000 cycles.

Available with shorting or non-shorting contacts, or combination of both. Low capacity. 30 degree indexing. Rated at 6 watts. Brass silver-plated clips and contacts. All other metal parts cadmium-plated steel. Send for bulletin number 970.



2 New Centralab *Hi-Vo-Kaps* made with Ceramic-X, combine high voltage and small size for television applications. For use as filter and by-pass capacitors in video amplifiers — for high DC voltages with small component AC voltages (not for use in temperature compensation or resonant circuits".) Send for bulletin 946.

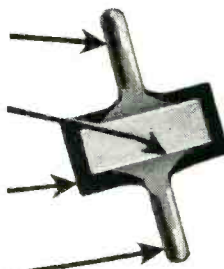
Cutaway view shows integral ceramic construction

Solid brass terminals, soldered directly to electrodes.

Metallic silver electrodes fired directly to high dielectric constant Ceramic-X.

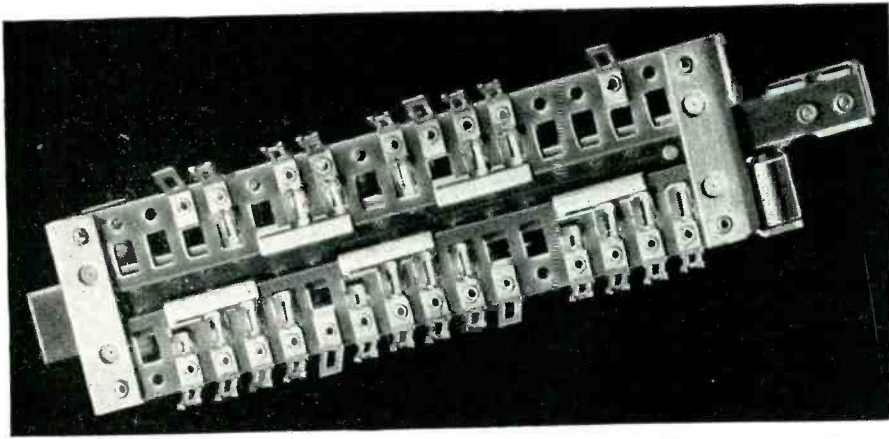
Low loss, mineral filled phenolic resin.

Three terminal types for strong, fast connections.

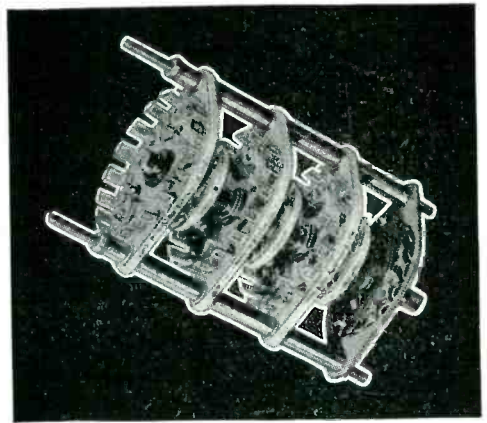


3 *Ratings:* 10,000 WVDC, 15,000 VDC flash test, 500 and 1000 mmf. + 50% - 20% at 1 megacycle (2½% higher at 1 kilocycle). Dia. - 1.000", length - .510".

Electronic Industry



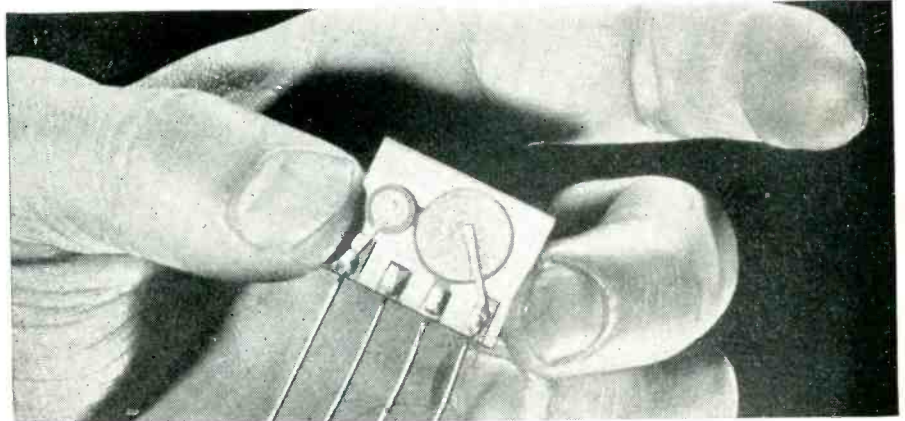
4 Centralab's new *Slide Switch* promises improved AM and FM performance! Flat, horizontal design saves valuable space, allows short leads, convenient location to coils, reduced lead inductances for increased efficiency in low and high frequencies. Designed for maximum reliability and long service life. Send for bulletin 953.



5 For transmitters, power supply converters, X-ray equipment, etc., CRL's medium-duty *Power Switches* are now available. Efficient performance up to 20 megacycles.



6 CRL's continuing program of research has produced the "printed circuit" *Complate* which promises a host of new cost-cutting uses for the industry.

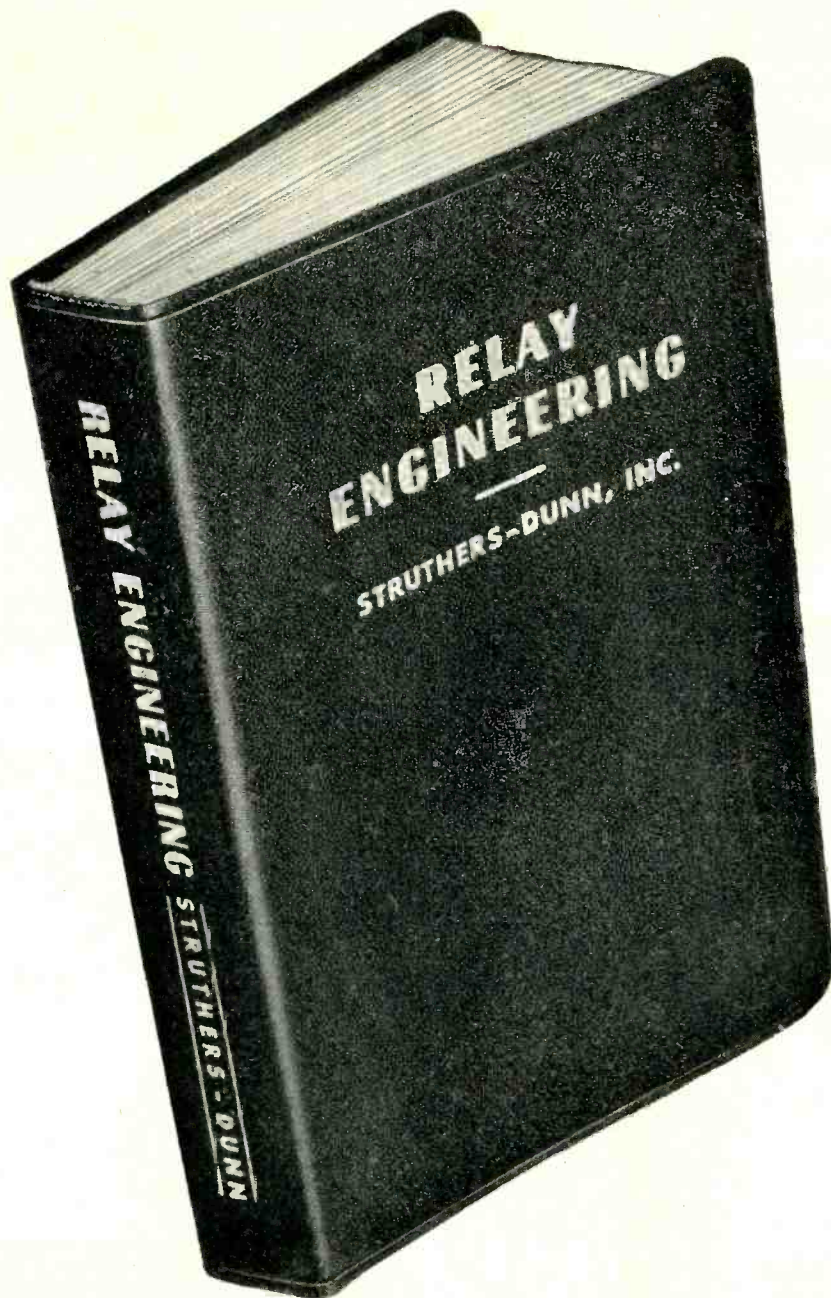


7 First commercial application of the "printed circuit", the *Complate* is a complete interstage coupling circuit which combines into one unit the plate load resistor, the grid resistor, the plate by-pass capacitor and the coupling capacitor. Send for complete facts and bulletin 943.

Look to Centralab in 1947! First in component research that means lower costs for 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.



HERE IS RELAY EXPERIENCE

... During the past 25 years, Struthers-Dunn has produced millions of relays in thousands of types for hundreds of uses.

... This 640-page RELAY ENGINEERING HANDBOOK brings you full benefit of this experience — in terms of helping you select the right relay for a job, then install and maintain it properly.

... Over 15,000 engineers already use the Handbook.

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STRUTHERS-DUNN

~ 5,348 RELAY TYPES ~

STRUTHERS-DUNN, INC., 150 N. 13TH ST., PHILADELPHIA 7, PA.

Shorter and shorter wavelengths require better and better dielectrics —

**GENERAL CERAMICS
STEATITE***



— low loss insulators
for low, high, ultra-high
and very high frequencies!

If you require low loss insulators with demonstrated ability to function efficiently in any frequency range, and with mechanical characteristics capable of meeting practically any conditions of exposure, shock or vibration, GENERAL CERAMICS steatite products merit first consideration. In many cases, a standard GENERAL CERAMICS insulator will be found available to exactly meet your needs. The specification of these stock items, which are mass-produced to standards that represent the highest attainments in ceramic fabrication, can effect economies of vital importance. Where

unusual electrical or mechanical requirements demand an insulator of special design, our engineers will gladly assist in its development. Also, GENERAL CERAMICS production facilities are geared to produce it promptly, accurately and at moderate cost. Your inquiries are invited — write today, no obligation.

* Steatite has a low loss factor — 0.7% at 1000 KC; no moisture absorption; high surface and volume resistivity; high tensile strength. Compressive strength is comparable to cast iron. Practically any size or shape is feasible in Steatite.

General CERAMICS and STEATITE CORP.
GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, ALUMINA, LIGHT-DUTY REFRACTORIES, CHEMICAL STONEWARE



**QUADRUPLED CAPACITY
FOR BETTER SERVICE WITH
A BETTER PRODUCT!**



CAPACITY for sheets, tubes and rods at the Formica factory has been multiplied by four since the war began. New types of equipment, more efficiently arranged, have prepared the plant for production on a scale never attempted in the laminated industry. At the same time new types of resinoids and new types of bases have made possible the production of better and more efficient materials better adapted to specific jobs they are expected to perform. Machining and finishing equipment for electrical parts has been expanded in proportion. So you can send your blueprints here with confidence that when your order is placed you will get promptly, uniform materials of high quality, produced in the most efficient way by the finest manufacturing equipment, manned by the most competent staff in the industry.

THE FORMICA INSULATION CO., 4661 SPRING GROVE AVE., CINCINNATI 32, OHIO

Now Available! HEINTZ AND KAUFMAN FREQUENCY SHIFT TERMINAL EQUIPMENT

FS offers vastly improved signal-to-noise ratio... faster keying—greater selectivity

The rapid trend toward Heintz and Kaufman frequency shift transmission for communication circuits has been prompted by the superior signal-to-noise ratio obtained as compared with "make-break" keying systems.

Properly designed FS terminal equipment improves the signal-to-noise ratio by 11 DB by virtue of frequency shift alone. Further gains are obtained under circuit conditions where noise and atmospherics are high. The gain of the Heintz and Kaufman dual diversity carrier shift system over a single channel "make-break" system approximates 22 DB.

The selectivity obtained with this equipment cannot be approached in constant frequency systems except at very slow keying speeds. Key clicks, transients, and keying sidebands are either eliminated by frequency shift or effectively kept within the pass band of the system. High speed keying with no loss of selectivity is a marked advantage of this new equipment.

General Description:

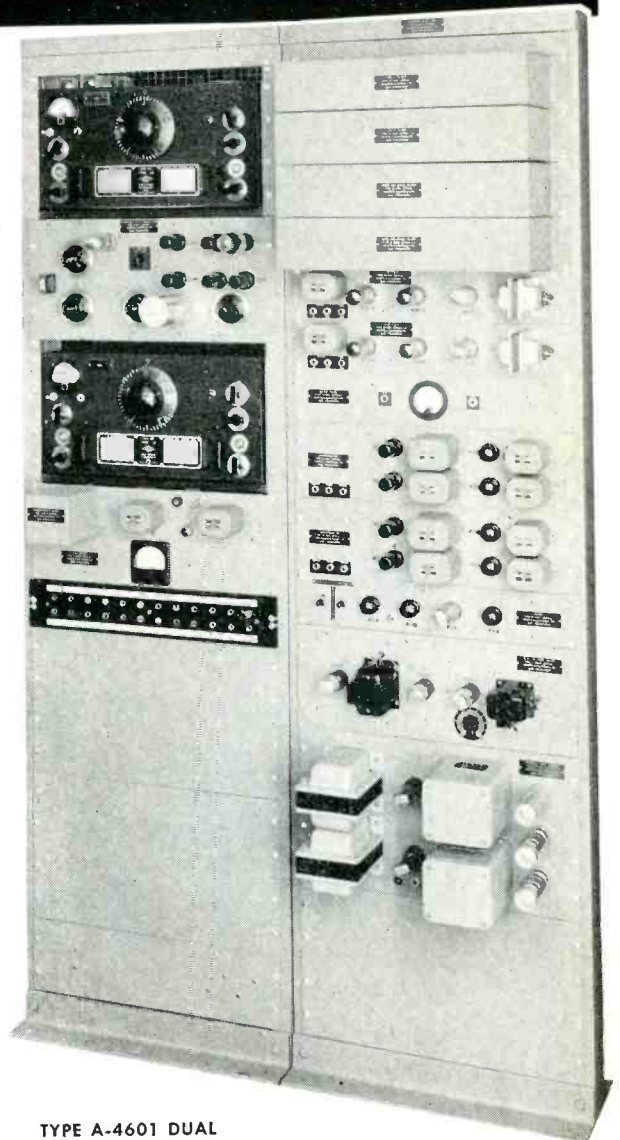
The H&K A-4601 dual diversity frequency shift terminal is the heart of the FS system. This unit accepts a frequency shifted signal from two communication receivers, and converts it either to tone, neutral, or polar d.c., keyed in accordance with telegraphic intelligence. The recording device may be Radiotype, teletype, or hi-speed telegraph tape recorder.

The terminal consists of a crystal oscillator and BFO, input filters, three stage limiter amplifiers, discriminator filters, discriminator amplifier-rectifier, mixer, and tone keyer or d.c. keyer.

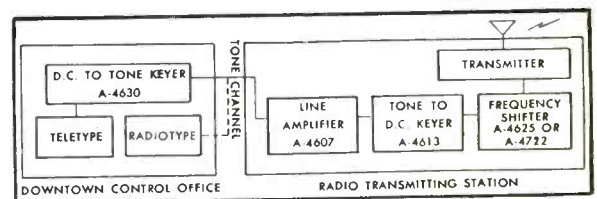
Power Requirements: 110-125 volts, 60 cycle, approximately 150 watts.

Write for detailed information

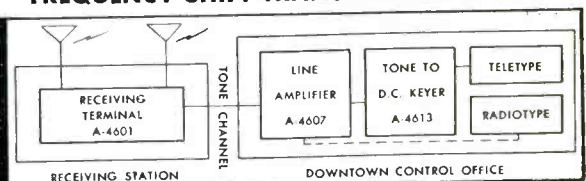
Descriptive literature describing operation of sub-units is now available. Our engineering department will be glad to correspond with you about your requirements.



TYPE A-4601 DUAL DIVERSITY RECEIVER TERMINAL, including receivers, is mounted on two 6' x 19" racks. Cabinet mounting can also be provided.



FREQUENCY SHIFT TRANSMITTING SYSTEM



FREQUENCY SHIFT RECEIVING SYSTEM

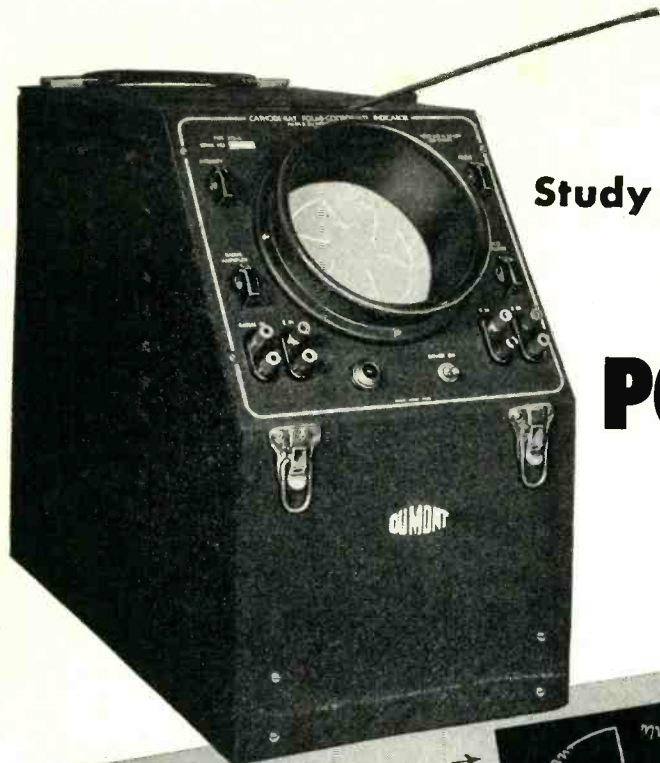


HEINTZ AND KAUFMAN LTD.

Communications Equipment Division

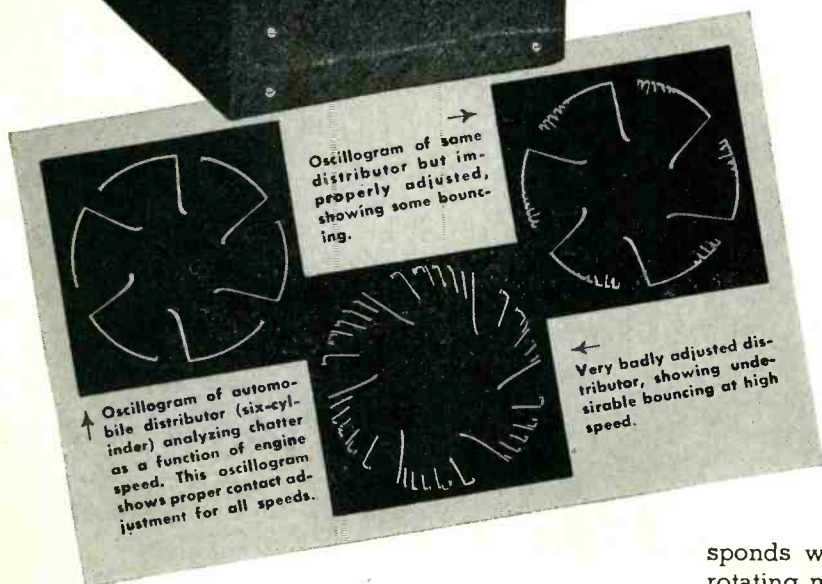
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Gammatron Tube Division • South San Francisco • Calif.



Study All Types of Rotating Machinery
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POLAR-COORDINATE INDICATOR



- ✓ Fully portable; self-contained
- ✓ Type 5CP-A Cathode-ray Tube
- ✓ 3000 v. accelerating potential
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- ✓ Automatic synchronization
- ✓ Frequency response of radial amplifier less than 10% down at 2 cps. and 30 kc.
- ✓ 0.4 v. R.M.S. sufficient to apply deflection to center

► All types of rotating machinery can be studied with the new Du Mont Type 275-A Polar-Coordinate Cathode-ray Indicator. Likewise the plotting of phenomena on a circular time base.

This circular time base provides a *continuous time base* since no time is lost on retraces. Furthermore, a given spot position along this time base always corresponds with the same phase or rotation angle, regardless of speed of rotation.

Presentation on a circular or angular time base corre-

sponds with methods customarily used in studying rotating machinery. The signal under examination is always synchronized with the circular sweep of the cathode-ray tube since the sweep is controlled directly by means of a two-phase generator coupled to the apparatus from which the signal is taken. This generator is supplied with the Type 275-A.

The Polar-Coordinate Indicator is designed for use in the laboratory or in the field. Major controls conveniently located on front panel; those for occasional adjustment, in recessed space accessible through top of unit. Cathode-ray tube set at 55° angle for ease of observation.

► Write for further details . . .

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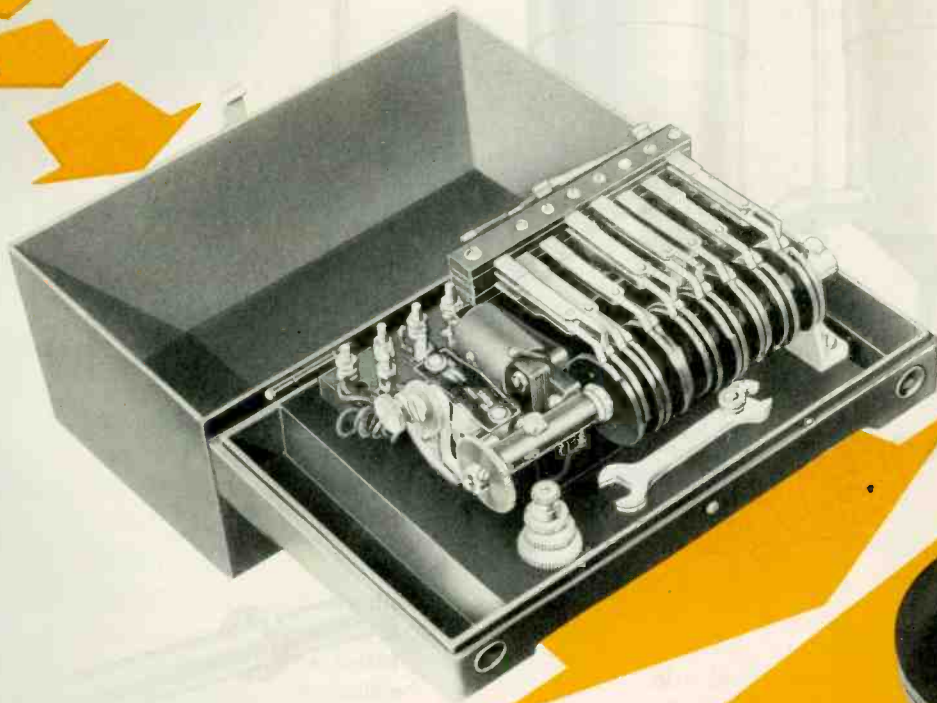
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An example of the use of technical plastics is this timing device which uses Synthane for its cams.



The Cam Timer (above) is the heart of an automatic system designed to control the flow of exhaust gases through a stack in a lampblack plant.

The timing cams are made of Synthane because Synthane is, first of all, an effective electric insulator. Synthane cams operate noiselessly, virtually without friction, and calibrations are easily printed on them by the Synthographic process.

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Dielectric? Synthane is an excellent electrical insulator. Dielectric strength is high, power factor and dielectric constant low. What makes Synthane the useful dielectric it is, is its strength and the comparative ease with which it can be punched or machined into the variety of parts needed on radio and electrical equipment.



Strength? Synthane seldom is asked to compete with metals and alloys in strength. It is exceptionally strong for its weight and will compare favorably with metals for strength on a weight basis. Synthane is a member of that family of plastics highest in tensile, compressive, flexural and impact strengths.



Light Weight? One of the most important properties of Synthane is its light weight. Although Synthane weighs only 1/2 as much as aluminum its strength is ample for electrical applications and sufficient for most mechanical uses. Light weight plus other virtues accounts for its wide use in aviation.



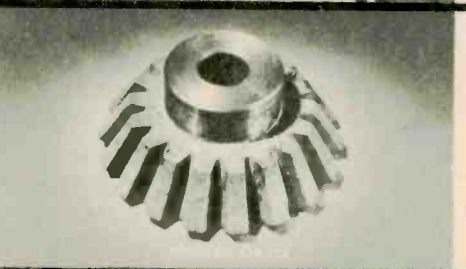
Anti-friction? Two grades of Synthane laminated have anti-friction and anti-wear characteristics built in, due to the incorporation of a special graphite. Available in sheets, rods, tubes and in special shapes and fabricated parts. Possibilities for this material are worth investigating.



Corrosion Resistance? Perhaps you can take advantage of Synthane's immunity to most oils and solvents, Synthane's resistance to various concentrations of acids and salts. Often used because it has longer life per dollar than other materials, including cost of replacement.



Combination? Are you looking for two, three, four or even more properties combined in one material? Synthane may do the trick. It has all of the advantages above plus hardness, abrasion resistance, stability under temperature or moisture conditions, ease of machining, and many others.



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SYNTHANE
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CHECK THESE OUTSTANDING FEATURES

Frequency response of Tuners is flat within ± 2 db from 30 to 15,000 cycles! Bass control provides 10 db boost at 40 cycles; treble control varies response from +12 db to -14 db at 10,000 cycles. Volume control has automatic bass compensation circuit to match the bass characteristic of the human ear.

Sensitivity of the Tuners is less than 10 microvolts. Selectivity for AM signals may be made either "broad" or "sharp". Output of the Tuners is 8 volts at the high-impedance terminals and .75 volts at the 500 ohm terminals. Hum level is 60 db below output. Phonograph input terminals are provided so that Tuner and its amplifier may be used with a record player. Any antenna with single lead-in wire can be used for AM signals. FM section designed for an antenna having a balanced 300 ohm transmission line.

AM-FM Tuner Tube complement; 9003 R. F. Amplifier; 6BE6 oscillator converter; 2-9003 I. F. Amplifiers; (456 kc); 6AL5 detector for AM section. For the FM section; 6AG5 R. F. Amplifier; 6C4 oscillator; 6AG5 converter; 3-6AG5 I. F. Amplifiers (10.7 mc.) 2-9001 limiters and 6AL5 detector. Two 6C4's are used for audio amplifiers, a 6U5/6G5 for tuning indicator and 5Y3GT/G for rectifier.

AM Tuner Tube complement; 6BA6; 6BE6; 2-6BA6; 6AL5; 2-6C4; 5Y3GT/G and 6U5/6G5.

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*For
Superlative Reception*

Designed for use wherever exceptionally high fidelity reception is desired, the new postwar Meissner AM and AM-FM Tuners are now available for your most exacting requirements. Both of these new precision designed components cover the broadcast band from 527 to 1620 kc. and the AM-FM Tuner also covers the FM band from 88 to 108 mc. At 105-125 volts, 50-60 cycles, power consumption is 80 watts for the AM-FM Tuner and 60 watts for the AM Tuner. See these quality units at your jobbers today or write for complete specifications to the address below;

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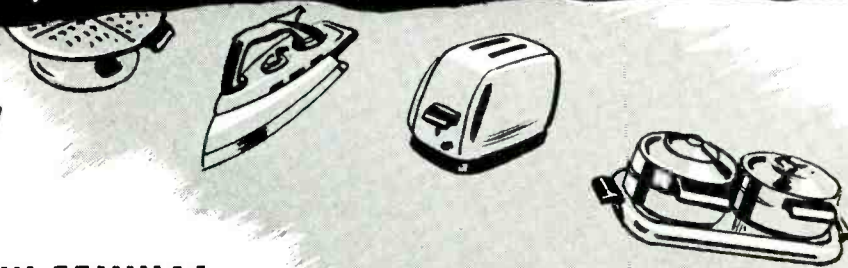
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If your product uses **HEAT**

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CONTROL**

**Safe • Accurate • Long-Lasting
Temperature Control For All
Types of Electrical Appliances**

The unique and rugged design of the new Fenwal Appliance THERMOSWITCH Control provides a heat control unit that will withstand shock, vibration, tampering and other operational hazards that lower product life... and influence buying attitudes.

Note these outstanding features:

- Torque applied to terminal binding posts will not shift contact support members.
- Adjusting screw will not drift under normal vibration.
- The mounting bracket provides for side or bottom mounting, or a cross-mounting bracket is available for special applications.
- One-piece, welded case and cover assures rugged, tamper-proof unit... stable temperature settings.

TWO DISTINCTLY DIFFERENT MODELS FOR HIGH AND LOW TEMPERATURE RANGES

The Appliance THERMOSWITCH Control is available in models especially designed for both high and low temperature ranges. The high temperature model provides control over the wide range of 175° F.-600° F. The low temperature model provides extremely critical control for low temperature applications throughout its range of 50° F.-250° F. Each model assures the highest degree of efficiency and dependability; both incorporate the outstanding Fenwal characteristics.

SPECIFICATIONS

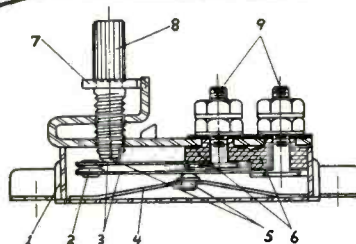
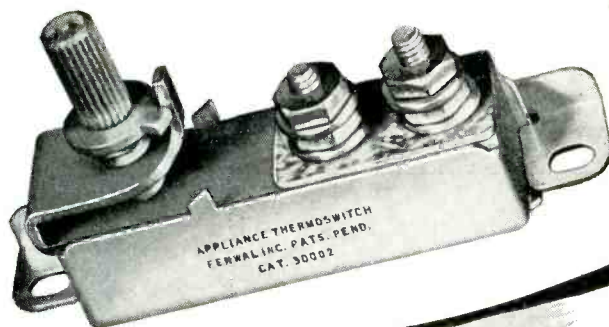
Overall case dimension: 1/2" high x 5/8" wide 2 1/8" long.

Maximum Load Rating: 1200 watts on 110 volt 60 cycles.

TEMPERATURE RANGE:

50° F. to 250° F. (Series 30003)

175° F. to 600° F. (Series 30002)



- | | |
|------------------------------------|--------------------------------|
| 1. Expanding stainless steel case. | 5. Ceramic Insulating Buttons. |
| 2. Fine silver contacts. | 6. Precision Ceramic Locator. |
| 3. Contact Supporting Members. | 7. Stop Collar. |
| 4. Low expansion metal bridge. | 8. Adjusting Screw. |
| | 9. Terminal Binding Posts. |

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FOR FOOL-PROOF PERFORMANCE

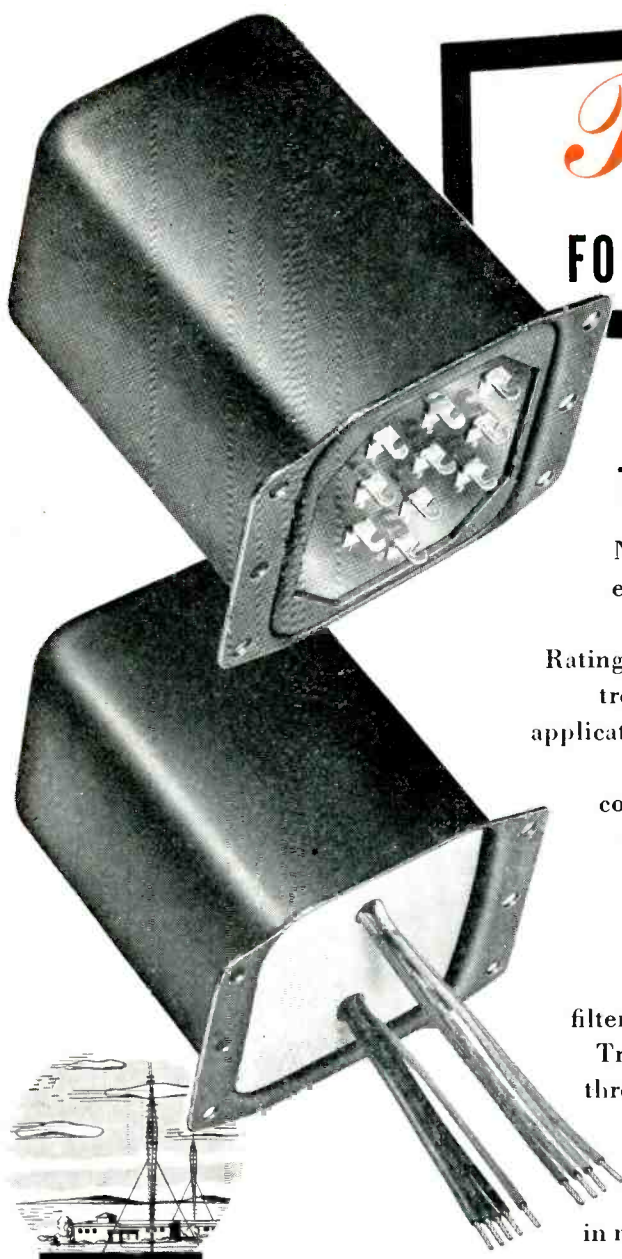
There is a Fenwal THERMOSWITCH Control to meet the requirements of most temperature control applications. Write for complete information.



FENWAL INCORPORATED

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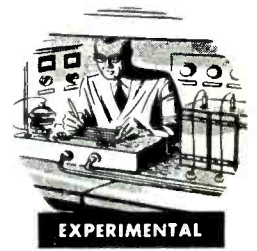
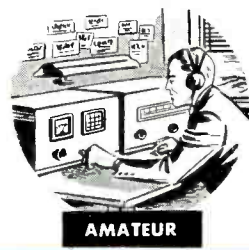
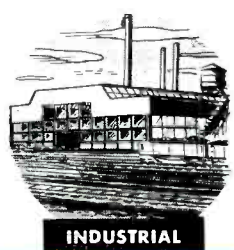
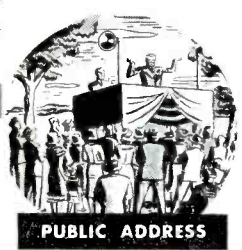
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New and up-to-date, yet embodying all the quality, precision engineering and outstanding construction features for which Chicago Transformers have long been recognized. Ratings have been skillfully selected by men who know the latest trends in circuit design. They provide maximum flexibility in application and close matching with today's most widely used tubes.

Audio transformers have 600/150-ohm impedances and contribute to product performance which not only meets but surpasses RMA and FCC standards for high quality reproduction, uniform frequency response over the required ranges, and freedom from distortion. Power transformers meet or surpass RMA standards for temperature rise and insulation test voltages. Combined in the power series are filter reactors with conveniently matched D.C. current ratings. Transformers and reactors are mounted in drawn steel cases in three variations of CT's famous "Sealed In Steel" construction.

This provides protection against atmospheric moisture, efficient magnetic and electro-static shielding, strength and rigidity to withstand shock and vibration, convenience in mounting, compactness, and clean, streamlined appearance.



Write for Catalog



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DIVISION OF ESSEX WIRE CORPORATION

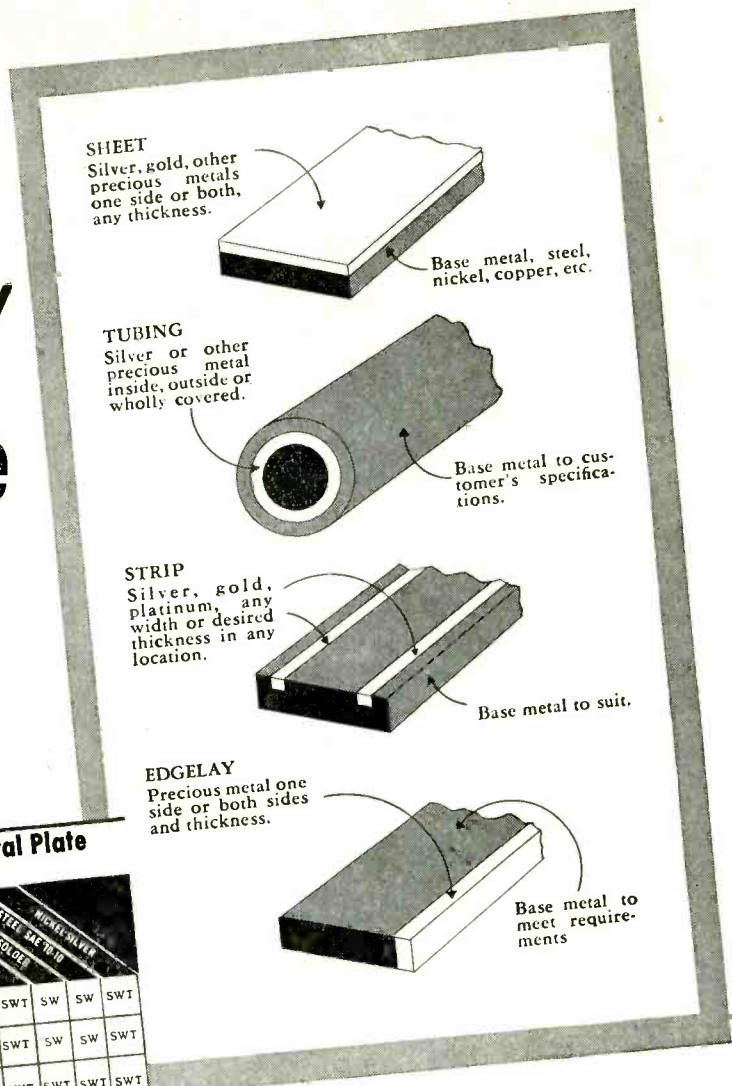
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Laminated Metals

Save You Money



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PLATINUM															
PROSILVER															
GOLD															
SILVER															
ALUMINUM															
BRASS															
COPPER															
BERYLLIUM COPPER															
IRON															
INVAR															
STAINLESS STEEL															
MONEL															
NICKEL															
SILVER SOLDER															
STEEL SAE 10-10															
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Because General Plate Laminated Metals give you silver or other precious metal only where you need it . . . at the point where precious metal performance is required . . . they save you money — especially with today's high cost of precious metals.

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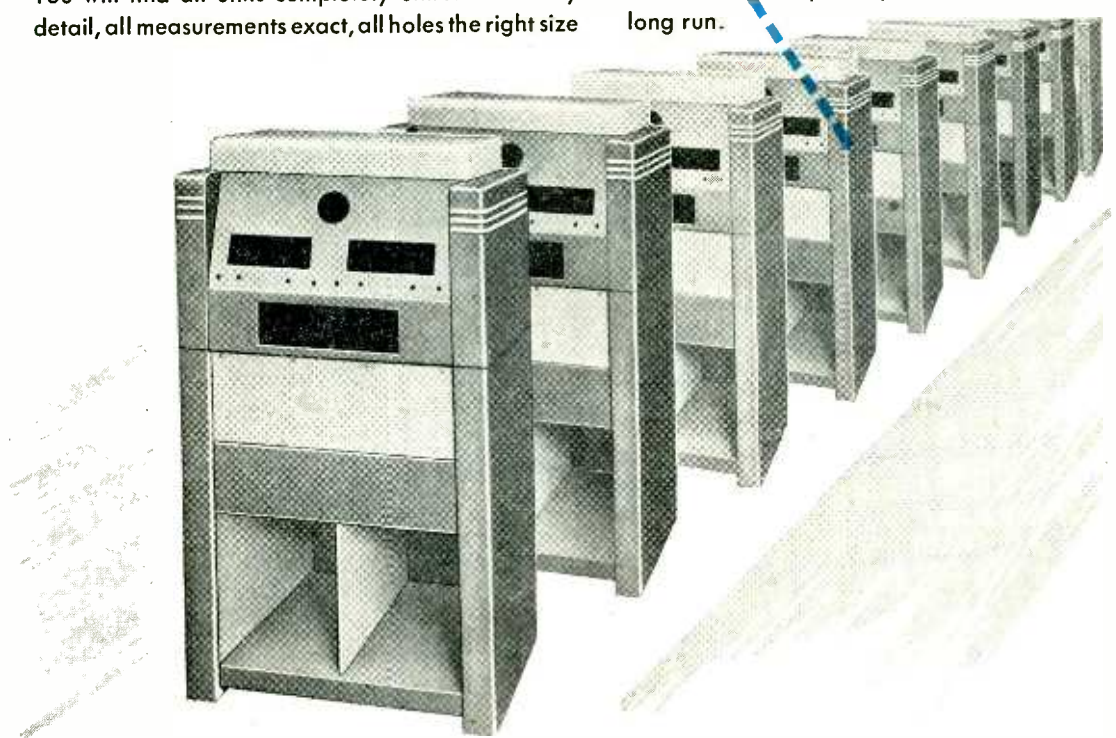
When we build cabinets, housings or enclosures for you, we plan and work with the objective of saving you time, labor and extra operations on your production line.

Karp-constructed units are handsome and streamlined, but their beauty is more than skin deep. The extra value our work affords is a degree of quality, accuracy and precision that will speed up your assembling operations.

You will find all units completely uniform in every detail, all measurements exact, all holes the right size

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As a result, in your assembling, all functional parts, instruments and controls will fit correctly and easily into place. Installation operations will be smooth and speedy. You will encounter no delays for any completion details. This saving of time and labor will cut your costs. Your completed assemblies will have added market value, too. In short, Karp custom craftsmanship will prove less expensive in the long run.

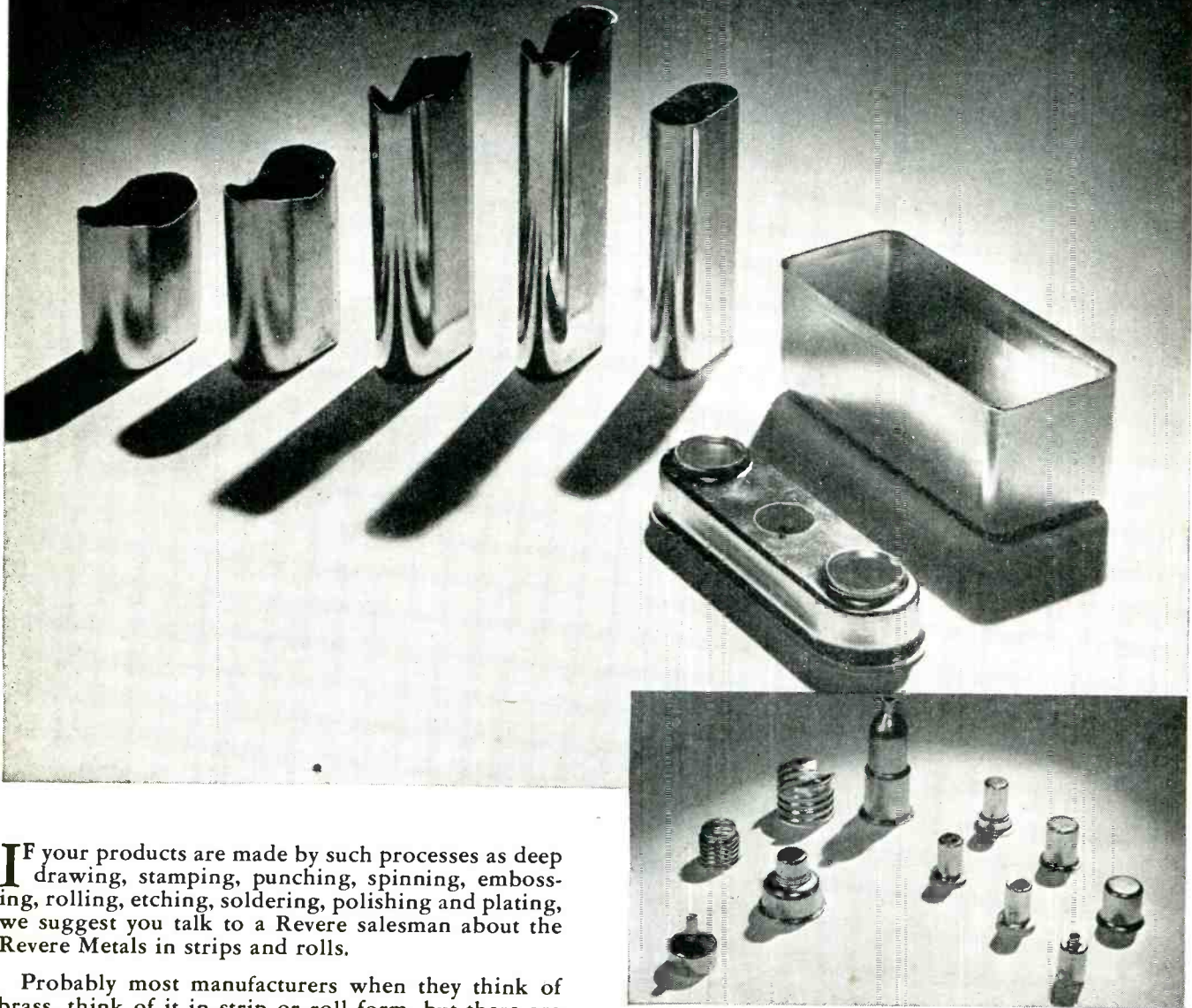


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Custom Craftsmen in Sheet Metal

REVERE STRIP AND ROLL FOR ECONOMICAL MANUFACTURING



If your products are made by such processes as deep drawing, stamping, punching, spinning, embossing, rolling, etching, soldering, polishing and plating, we suggest you talk to a Revere salesman about the Revere Metals in strips and rolls.

Probably most manufacturers when they think of brass, think of it in strip or roll form, but there are other things to be considered, such as alloy, temper and finish. Revere produces strips and rolls in brass, also copper, bronze, nickel silver and cupro-nickel, and each is available in a range of physical characteristics.

Specification may seem obvious to you, or it may not. In any case, it is suggested that you permit a Revere salesman, and if necessary a Revere Technical Advisor, as well, to study your production methods and end products. Revere customers in numerous cases have been able to effect important economies by following our recommendations for changes in such things as alloy, gauge, temper, and dimensions of strips and rolls. For example, a change in temper may reduce the number of anneals, and a reduction in width may cut

material costs and lessen the amount of scrap. Strips and rolls are exceptionally useful forms of the Revere metals, and Revere will gladly cooperate with you in studying the important subject of specification.

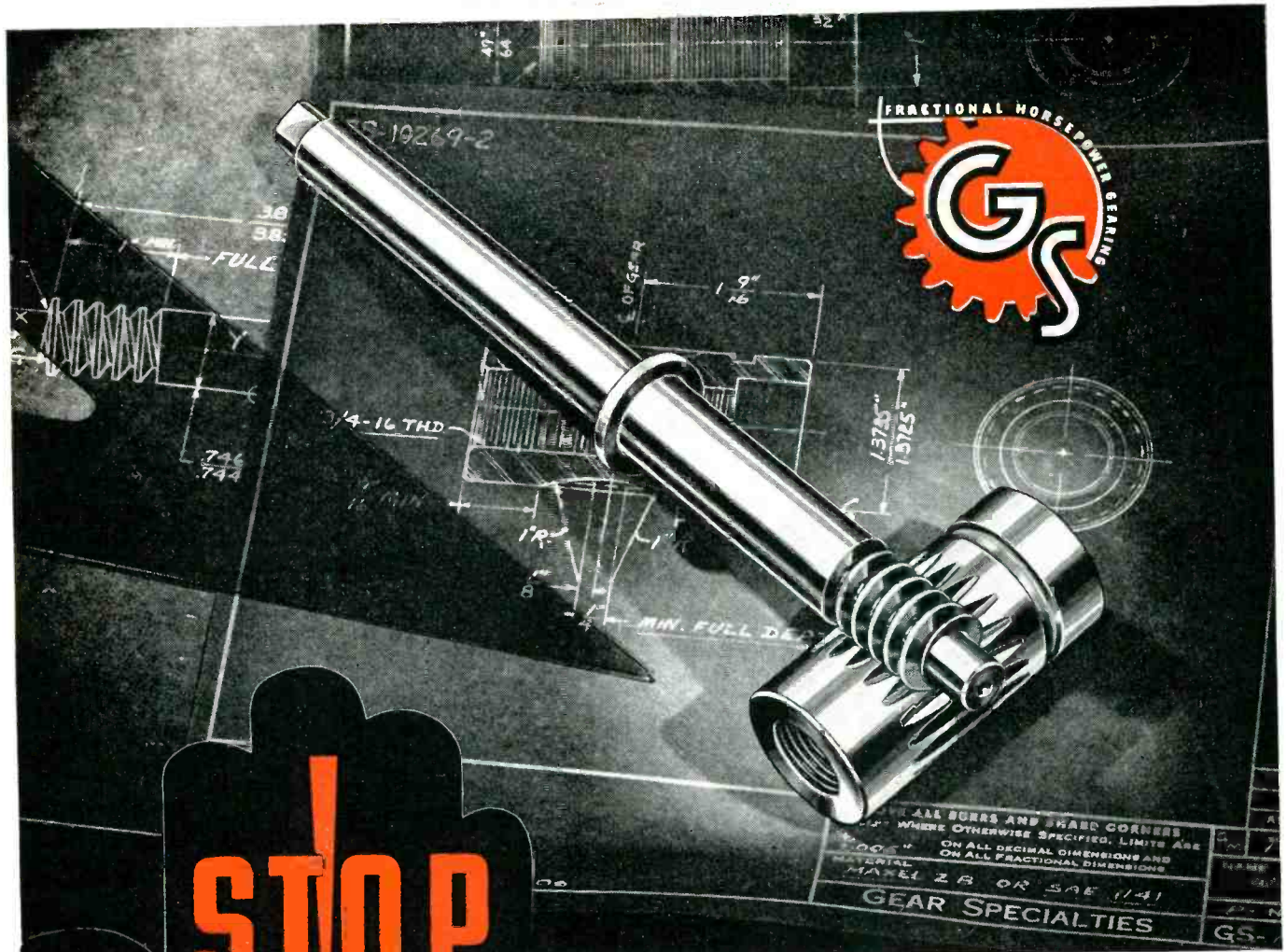
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MANY of America's most particular buyers specify "G.S." when they want better Small Gears. They have learned that we can be relied upon to deliver correctly designed gears in any quantity, manufactured to the highest standards of uniform accuracy. Here, the most elaborate methods of inspection are employed... methods requiring painstaking care and the use of every modern measuring device. Small wonder G.S. Fractional Horsepower Gears give smoother, more dependable performance. Over a quarter century of specializing in making better Small Gears exclusively has resulted in the development of a high degree of efficiency in our engineering and manufacturing techniques. Let our highly skilled engineers lend you valuable aid on the Small Gears you need. Tell us now, just how we can best serve you.

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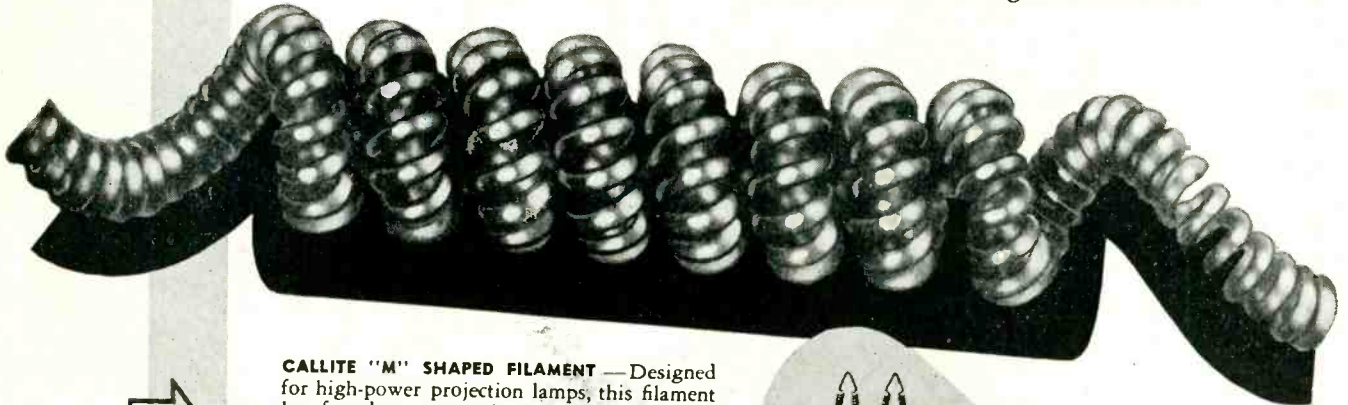


WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS



"We didn't know you could do that with **Callite** tube & lamp components"

CALLITE TUBE AND LAMP COMPONENTS have two basic qualities—uniformity and dependability. Other than that, the sky's the limit. No matter how unusual the shape—or size—of the required contact, we can design *and* manufacture them quickly and economically. For 27 years we have specialized in the field of metallurgical research. May we translate this rich experience for you into substantial savings on your assembly line? Callite Tungsten Corporation, 544 Thirty-ninth Street, Union City, New Jersey. Branches in Chicago and Cleveland.



CALLITE "M" SHAPED FILAMENT — Designed for high-power projection lamps, this filament has found many uses in other types of lamps where high wattage requires excellent heat dissipation. It employs a tungsten wire of .010" diameter wound on a .035" molybdenum mandrel at 55 turns per inch.



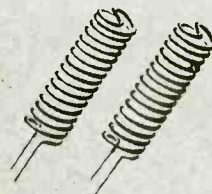
CALLITE COILED-COIL HEATER — A highly efficient heater for miniature tubes with emission properties equal in performance to filaments normally used in larger-envelope tubes. It employs a .375-mg tu wire heater wound on a .004" molybdenum mandrel at 800 tpi. It is then re-wound on a .030" steel mandrel and skip-turned every 68 tpi.



CALLITE CONE-SHAPED TUNGSTEN FILAMENT — Because of the limited distortion of its coils—even at elevated ambient temperatures—C-T's cone-shaped tungsten filaments are widely used in high vacuum metal evaporators and special lamp types where a high level of luminosity is required.

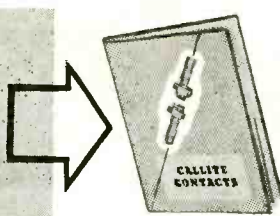


CALLITE MINIATURE DOUBLE HELICAL HEATER — Uniformly wound, of high tensile strength, good ductility and uniform resistance, this filament is well-adapted to high and ultra-high frequency applications, such as radar and microwave transmitting tubes. The molybdenum-tungsten-alloy wire is .0048" in diameter and 133 mm. in length, coated with alumina.



Callite

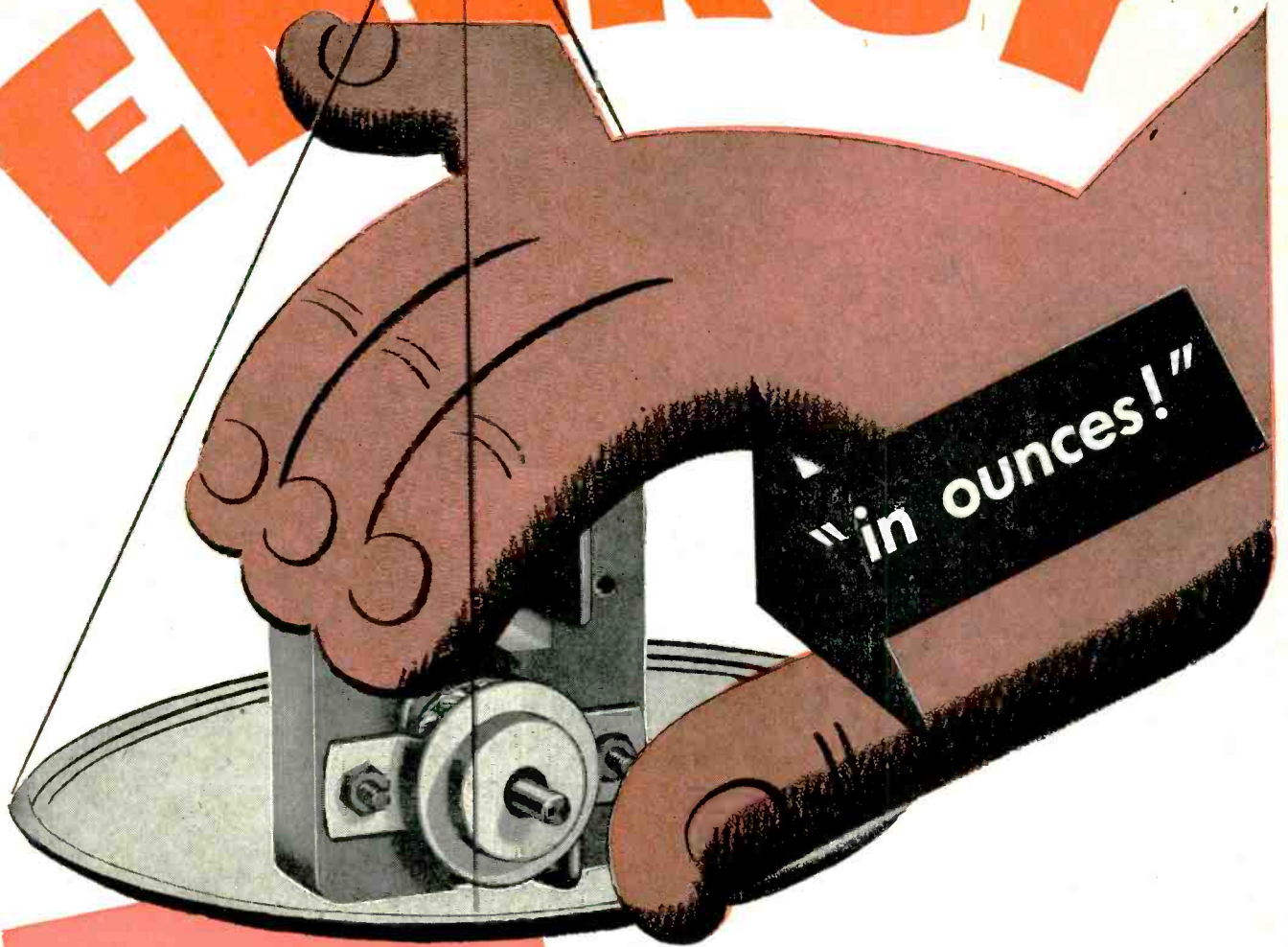
TUBE & LAMP COMPONENTS



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

WRITE FOR CATALOG No. 156

EMERGENCY



The Alliance Powr-Pakt Model MS Motor is for 110 volts, 60 cycle operation. Here is a truly miniature power plant so compact and light in weight that it can be used for many designs calling for more "tailored power."

The Model MS fills the growing need for small compact motors to increase the motion and utility features in thousands of new products!

Alliance Powr-Pakt motors are mass produced. They can be built with design variations to meet special load and operating conditions . . . where motors rated from less than 1/400th h.p. on up to 1/20th h.p. are required.

**MINIATURE MOTORS THAT
MAKE 'EM MOVE!**

- Light weight, compact, interchangeable power sources . . . small motors that can be mass produced at low cost are in rapidly growing demand! And Alliance has a "Head Start" in making millions of small electric motors.
- Alliance phonomotors drive most of the turntables, record changers and recorders for the radio-phonograph industry. And Alliance Powr-Pakt Motors rated from less than 1-400th h. p. up to 1-20th h. p. will drive fan blades, motion displays, projectors and actuate switches and controls!
- Write today . . . find out how Alliance Motors can help to drive your products to market!

WHEN YOU DESIGN—KEEP

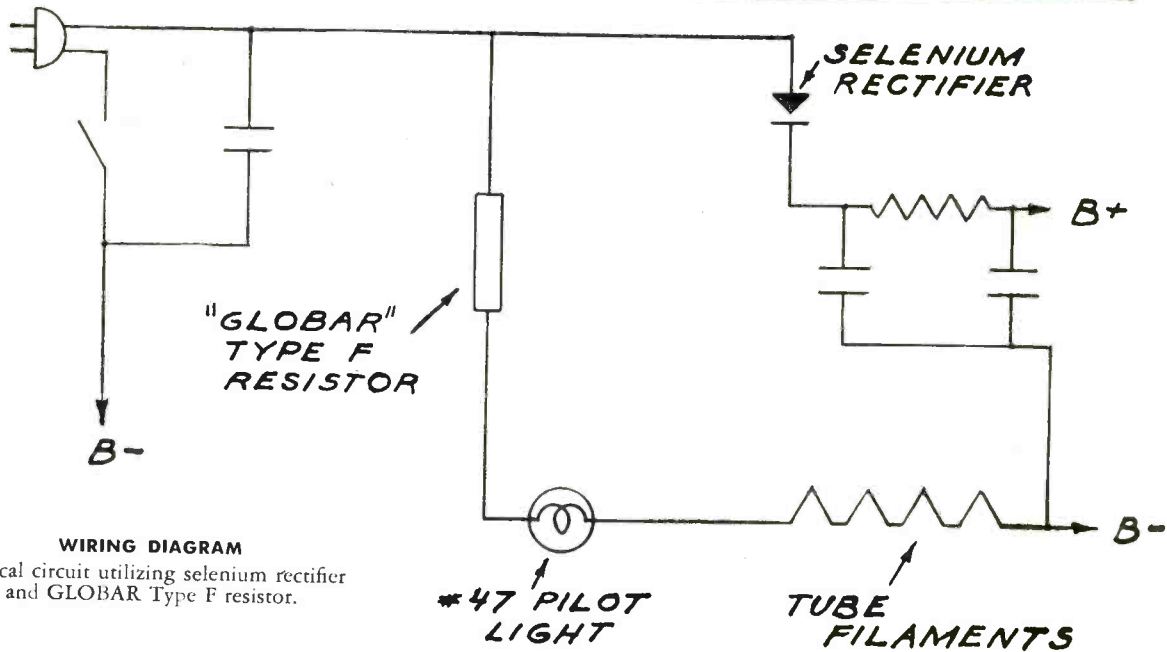
alliance

MOTORS IN MIND

ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO

EXPORT DEPARTMENT, 401 BROADWAY, NEW YORK 13, NEW YORK, U. S. A.

Boosting Performance of AC-DC Radio Receivers

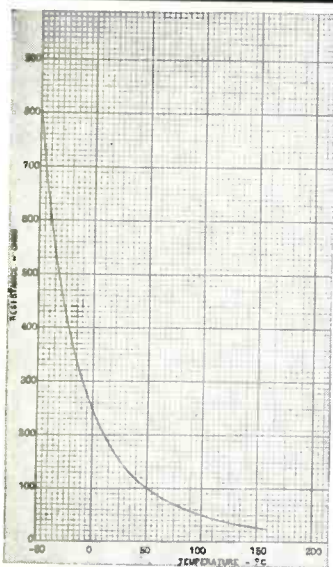


THIS wiring diagram illustrates a simple and practical method of building big set performance into conventional AC-DC receivers. The accompanying charts help explain how this is accomplished with selenium rectifiers and GLOBAR Type F Resistors. Selenium rectifiers provide a source of low loss DC power and GLOBAR temperature sensitive resistors compensate for the positive resistance-temperature characteristic of radio tubes and pilot light filaments. The high initial resistance of GLOBAR Type F resistors prevents sudden inrush of high currents which shorten tube life and burn out pilot lights, thus insuring continuous maximum tube performance.

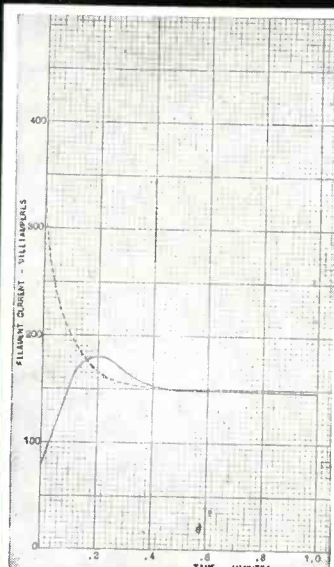
Of many benefits reported, five are particularly significant.

- 1 Protection against premature failure of pilot lights and radio tubes.
- 2 Undistorted audio output multiplied.
- 3 Manufacturing and service costs reduced.
- 4 Wiring circuits simplified.
- 5 Quality and efficiency of receiver increased.

A good way to check these claims is to run tests in your own plant. We will be glad to supply sample resistors. Merely send us a diagram of your test circuit so we may send you resistors of correct specifications. There is no obligation, of course. We want you to prove to your own satisfaction that the use of GLOBAR resistors and selenium rectifiers will improve receiver performance at lower cost. The Carborundum Company, Globar Division, Niagara Falls, New York.



TEMPERATURE CHART (above left)—Note the extreme temperature sensitivity of the GLOBAR Type F resistors pointed up in the steepness of this typical curve.



FILAMENT CHART (above right)—This chart, illustrating the shock absorbing quality of GLOBAR Type F Resistor, shows how both pilot lights and tubes are protected from the sudden inrush of current when the set is turned on. This protection insures longer life from the tubes; moreover, the tubes retain their original performance characteristics.

GLOBAR Ceramic Resistors

BY CARBORUNDUM

TRADE MARK



"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company

Where there is Horsepower...

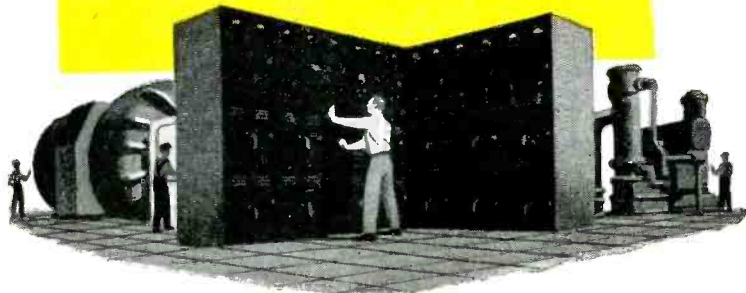
There is Wire



Belden



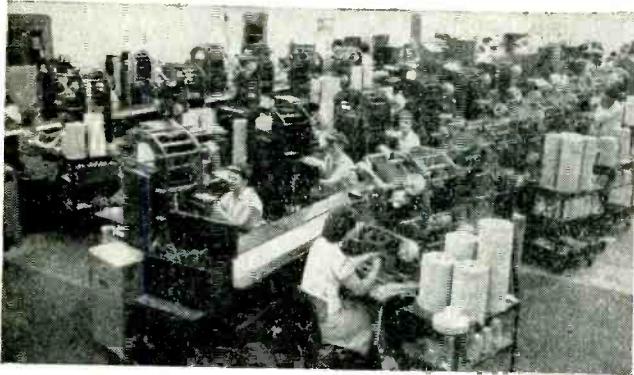
WIREMAKER FOR INDUSTRY



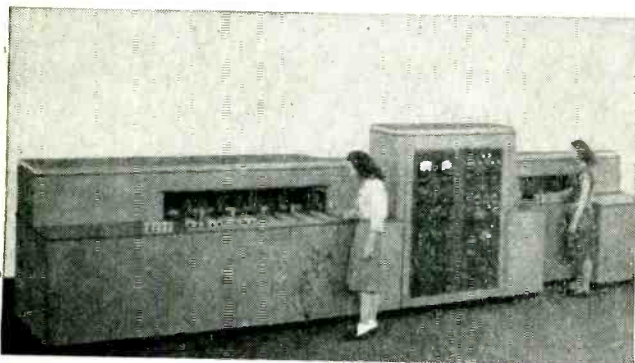
There are ten thousand hurdles that horsepower has mastered. Harnessed horsepower counts shipping cases or molecules; it integrates complicated mathematical problems; it assists in healing the sick; it even stoops to pick up and magnify the song of the goldfish.

Only during the last half century has man mastered horsepower and come of age electrically. Such strides have only been made possible through the collaboration of the wiremakers in making available the wide variety of products—from fine filaments to heavy cables. Belden Manufacturing Company has grown through this same period—and has been foremost in pioneering specialized wires that harness horsepower.

WHEN IT'S *Specialty Capacitors* YOU WANT



Clean—is your first impression of the winding room. Air conditioning, including removal of dust and control of humidity, is important to quality.



Testing—testing—and testing again—every capacitor is production-tested to assure a positive seal. Terminal-to-terminal, terminal-to-case, and capacitance tests performed by the above equipment assure detection of possible open or short circuits, grounds, and high or low capacitance. This testing equipment also segregates the units into four capacitance tolerance groups. This is in addition to exhaustive engineering and laboratory tests on materials, and life tests on capacitors under operating conditions.

407-148

Remember that General Electric puts quality into volume production by using the most modern equipment and methods.

... We know it's there by testing, testing, and testing again each individual capacitor.

A visit to our Ft. Edward, N. Y., plant would show, far better than words and pictures, why G-E specialty capacitors for fluorescent lamp ballasts are known for quality.

This modern factory of 77,000 square feet is devoted to the manufacture of just one type of capacitor—for use with fluorescent ballasts. Year-round air conditioning of the winding and assembly areas assures cleanliness, humidity control, and freedom from conducting particles in the air—resulting in the best possible winding and assembly conditions. Other outstanding features include: a continuous case-cleaning system; the most modern treating methods and equipment; and a continuous degreasing process—all contributing to high-quality volume production.

Above all is the testing equipment. Improved seal-testing facilities make it possible to check every single capacitor for possible leaks. Automatic electrical testing equipments, developed and built by General Electric expressly for this application, pass on the characteristics of each capacitor.

There are more than ten million G-E ballast capacitors in use. Every one—as with all G-E Specialty Capacitors—has been manufactured under rigid, quality-controlling methods.

Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

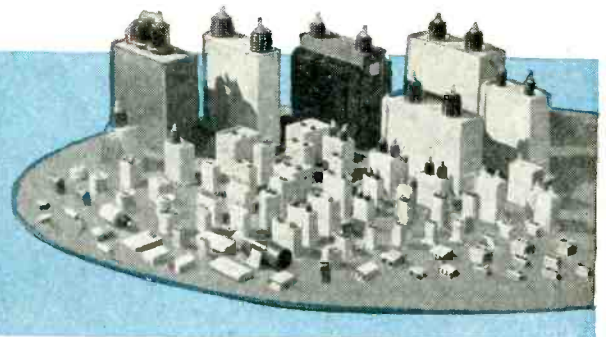
Specialty Capacitors
FOR

Motors
Luminous-tube transformers
Fluorescent lamp ballasts

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

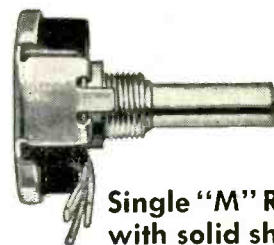
Flash photography
Stroboscopic equipment
Television
Dust precipitators
Radio interference suppression
Impulse generators

AND MANY OTHER APPLICATIONS

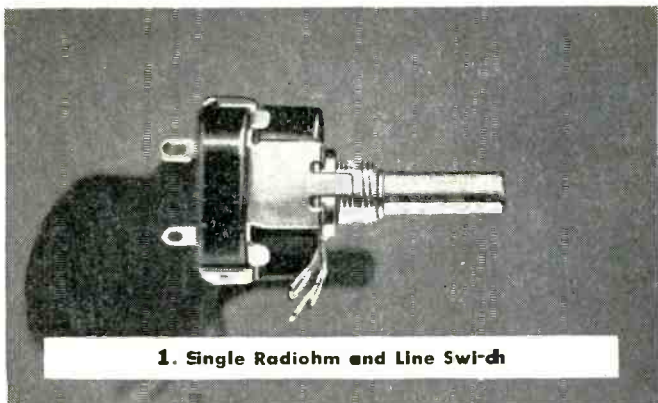


Want to simplify production?

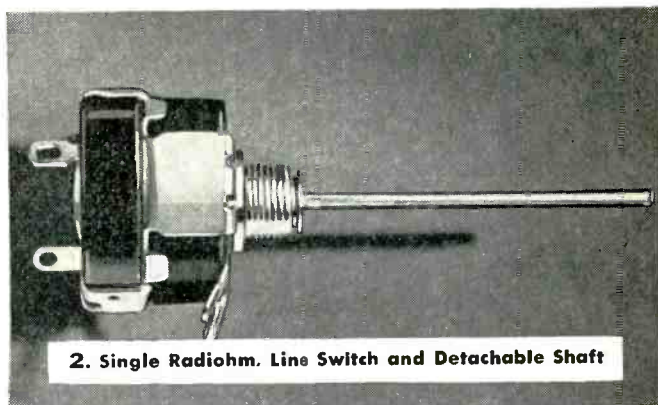
See how Centralab's model "M" Radiohm gives you wide range of possible mechanical variations . . . helps keep down your inventory, step up your production of electronic equipment.



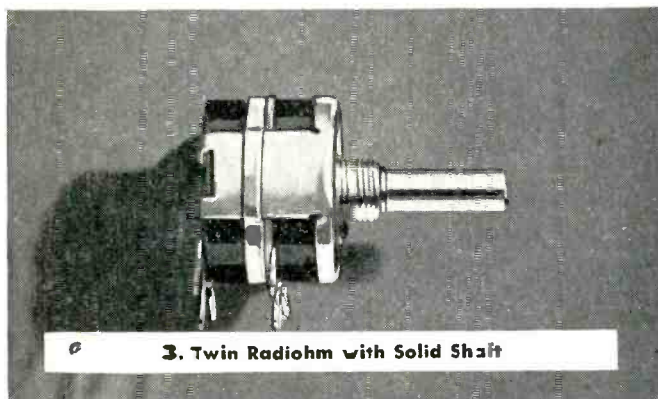
Single "M" Radiohm with solid shaft



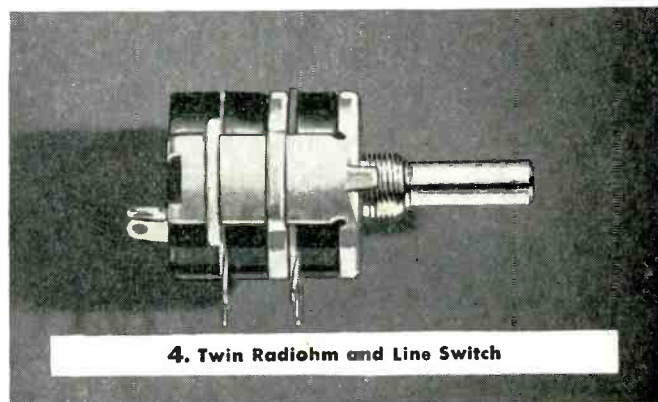
1. Single Radiohm and Line Switch



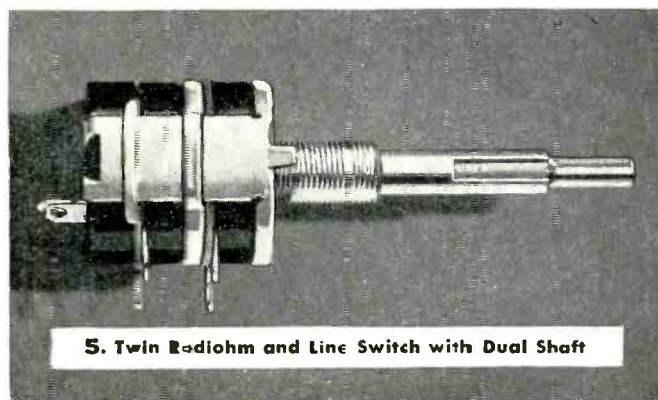
2. Single Radiohm. Line Switch and Detachable Shaft



3. Twin Radiohm with Solid Shaft



4. Twin Radiohm and Line Switch



5. Twin Radiohm and Line Switch with Dual Shaft

Your choice of detachable and dual shafts gives you new versatility, maximum convenience!

ONE LOOK at the many variations you can have from Centralab's single model "M" Radiohm, and you'll see why it's one of the most popular controls on the market today for cost-conscious manufacturers! Added to this: fine CRL engineering and research have given it a guaranteed minimum life test of 10,000 cycles (control resistance that is) . . . an average life expectancy of 20,000-25,000 cycles. Available with shaft and bushing lengths to meet your needs. For complete facts, send for Bulletin E697-A.

LOOK TO CENTRALAB IN 1947! First in component research that means lower costs for the electronic industry . . . pioneer manufacturer of Radiohms, switches, capacitors and ceramics.

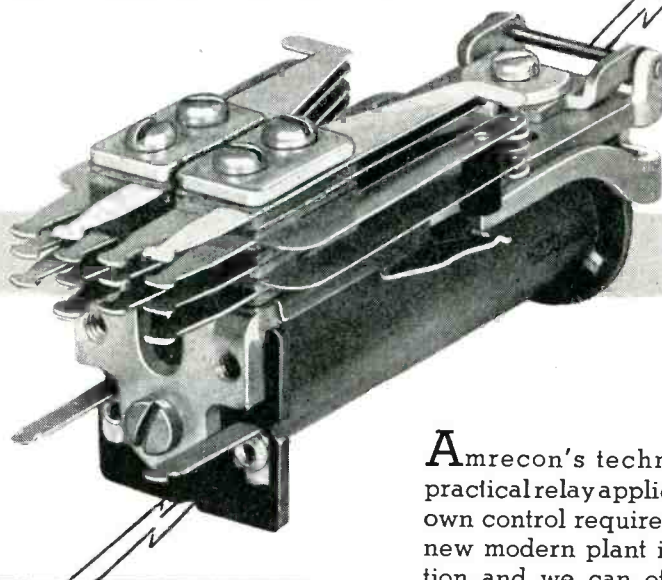
Centralab
CRL
Division of GLOBE-UNION INC., Milwaukee

**AMERICA'S LEADING
MANUFACTURERS SPECIFY**

AMRECON

Telephone Type

RELAYS



ENGINEERING "KNOW-HOW"

Amrecon's technical knowledge of practical relay application simplifies your own control requirement problems. Our new modern plant is now in full operation and we can offer you prompt delivery and even greater service.

Write for our informative illustrated Bulletin listing our many products, describing the scope of our manufacturing facilities, and the wide extent of our services. Your inquiry will receive prompt attention.

American Relay & Controls, Inc. manufactures acetate coils under license arrangements with Western Electric Company, Inc.



Offices in principal cities

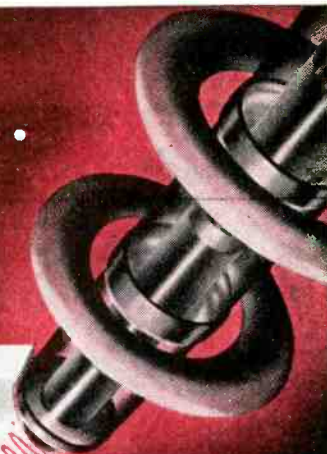
American Relay & Controls, Inc.

2555 DIVERSEY AVE.

CHICAGO 47, ILLINOIS

From Elemental Fluorine...

SULFUR HEXAFLUORIDE



A General Chemical Research Development +

SULFUR HEXAFLUORIDE

Formula: SF₆
 Molecular Weight: 146.06
 Melting Point: -50.8°C
 Sublimation Temperature: -63.8°C
 Critical Temperature: 45.6°C
 Critical Pressure: 540 p.s.i.a.
 Vapor Pressure:

Temp. (°C)	Pressure (p.s.i.a.)
-80	5
-50	34
-20	102
+10	240
+40	481

In Sulfur Hexafluoride, General Chemical Research makes another important contribution to fluorine chemistry. This stable dielectric gas is the first commercial chemical produced from elemental fluorine to be offered Industry . . . and fore-runner of many similarly-made fluorine compounds awaiting introduction.

Sulfur Hexafluoride was discovered by Moissan and Lebeau in 1900 as the product of combustion of sulfur in fluorine. It has been found to be remarkably inert and to possess exceptional thermal stability. These characteristics,

together with its splendid electrical properties, have led to its present use as a gaseous dielectric in high-voltage equipment.

The physical data presented here may suggest other applications worthy of prompt investigation for your products and processes. For commercial quantities, experimental samples, or more detailed technical information, contact General Chemical Company, Research & Development Division, 40 Rector Street, New York 6, N. Y. Please use business letterhead when writing.

BASIC CHEMICALS



FOR AMERICAN INDUSTRY

GENERAL CHEMICAL COMPANY

40 Rector Street, New York 6, N. Y.

Sales and Technical Service Offices Serving Industry from Coast to Coast

In Canada: The Nichols Chemical Company, Limited, Sun Life Building, Montreal, Quebec

METAL PLATES that serve a steady diet of sound



The FATHOMETER†—the first practical application of "Sonar"—utilizes the magnetostriction of Nickel

One of the most practical uses of sonar is the Fathometer, manufactured by the Submarine Signal Co., Boston, Mass.

The Fathometer generates sonic vibrations, throws them at the bottom, and then listens for their echoes. With a Fathometer you can map the ocean floor . . . locate fish . . . safeguard navigation.

Like many other adaptations of sonar, the Fathometer depends upon Nickel to send and receive the sonic vibrations. Heart of each oscillator is a stack of thin Nickel plates, laced together with a winding of wire.

HOW THE FATHOMETER WORKS

When current is passed through these windings, a magnetic field is created. *That's when the magnetostrictive property of Nickel goes to work!*

For under the influence of magnetic force, Nickel contracts, returning to its original length when the field goes dead. In a fluctuating field, the resulting vibrations are powerful enough to produce an echo from the ocean floor.

When the sonic waves bounce back to the Fathometer, a second oscillator (acting as a receiver) goes through the same cycle in reverse to convert sound into electrical impulses. Other components then time the lag between transmission and echo, registering the depth on an indicator.

WHY NICKEL WAS CHOSEN

Nickel is used in sonar because it contracts more than other magnetostrictive metal, contracting 32 units of length for every 1,000,000.

Magnetostriction is just one of the specialized properties obtainable with Nickel. When specifying metals for electronic or electrical use always consider Nickel and the INCO Nickel Alloys. They are strong, tough, rustless, corrosion-resistant and thermally durable.

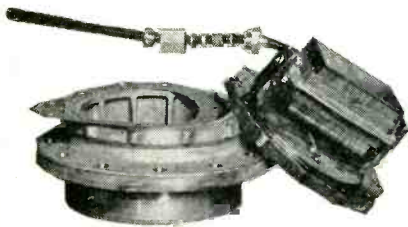
†Trademark registered by Submarine Signal Company

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

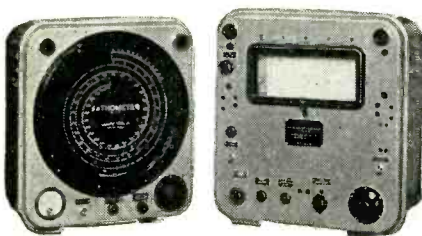
Nickel

NICKEL  ALLOYS

MONEL • "K"•MONEL • "S"•MONEL • "R"•MONEL • "KR"•MONEL • INCONEL • NICKEL • "L"•NICKEL • "Z"•NICKEL
Reg. U. S. Pat. Off.



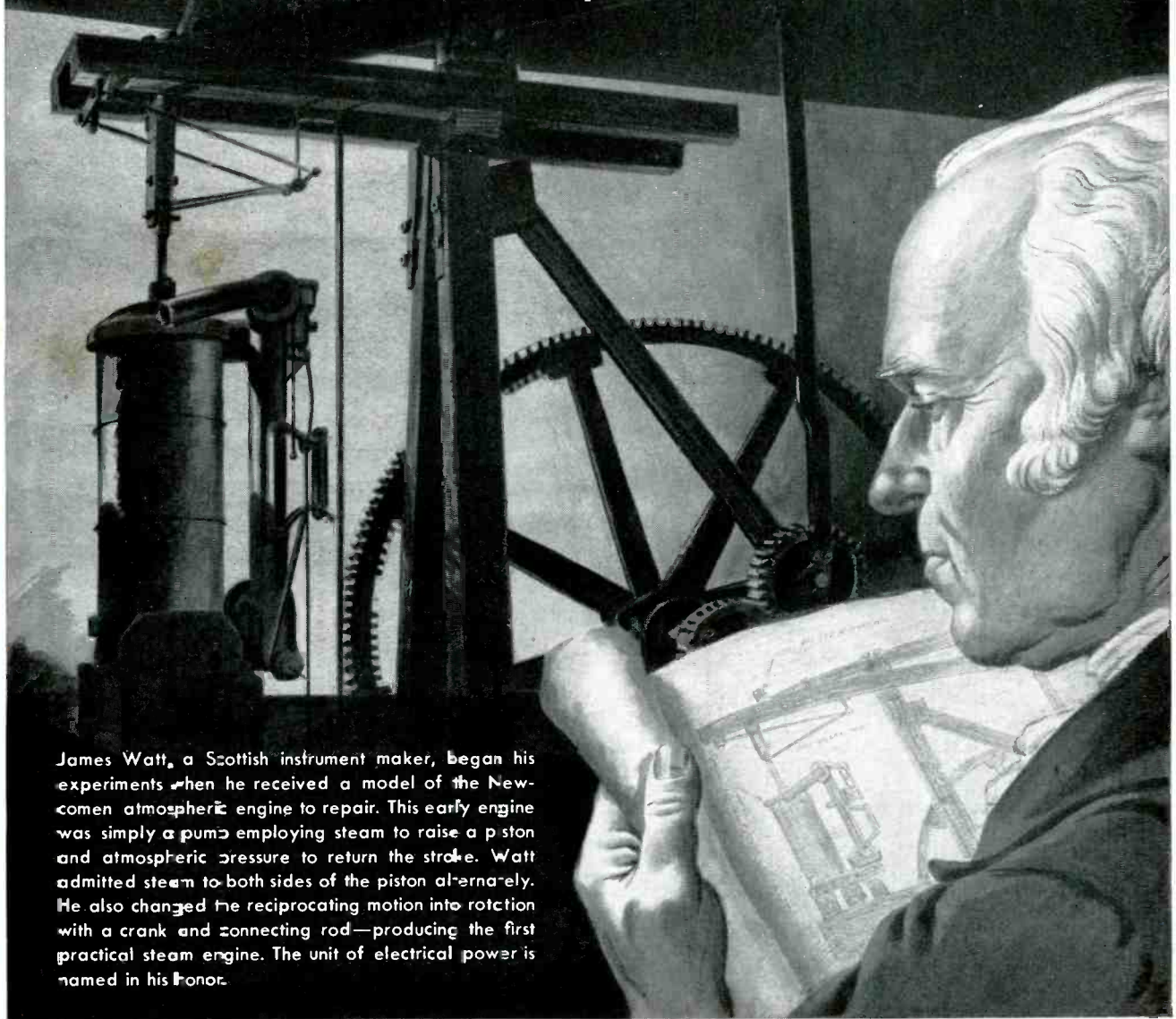
One of the two oscillators that are the key parts of every Fathometer. Here, the oscillating unit has been tipped back out of its casing to show where the stack of Nickel lamination plates is mounted.



Both an indicating dial and recorder can be used with the Fathometer. Other components include an amplifier and a driver.

James Watt—(1736-1819)

FIRST to build a practical steam engine



James Watt, a Scottish instrument maker, began his experiments when he received a model of the Newcomen atmospheric engine to repair. This early engine was simply a pump employing steam to raise a piston and atmospheric pressure to return the stroke. Watt admitted steam to both sides of the piston alternately. He also changed the reciprocating motion into rotation with a crank and connecting rod—producing the first practical steam engine. The unit of electrical power is named in his honor.

OHMITE...

FIRST in rheostats... today



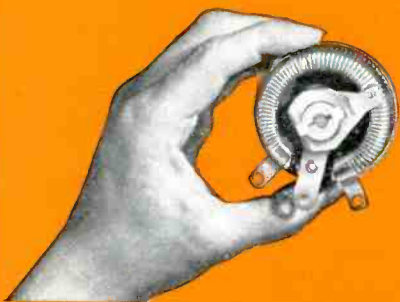
More manufacturers have standardized on Ohmite rheostats for their products . . . more companies are buying these rheostats for their own use . . . than any other make on the market today. One of the important reasons for this preference is that Ohmite rheostats have established a reputation for dependability under frequent service and adverse operating conditions. It will pay you to standardize on Ohmite rheostats for your product.

Be right with **OHMITE** • Rheostats • Resistors • Tap Switches

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

4816 Flournoy Street — Chicago 44, Illinois

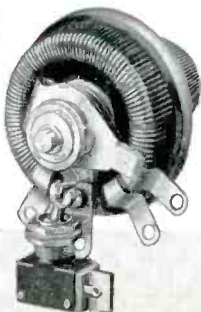
in TABLE MOUNTING CAGES

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.



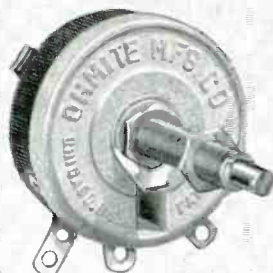
TANDEM ASSEMBLIES

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.



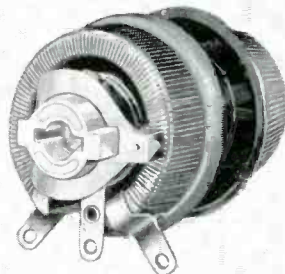
with SCREW DRIVER SLOT SHAFT

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.



ARNOLD

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



Arnold's business is permanent magnets, *exclusively*—a field to which we have contributed much of the pioneering and development, and in which we have set peak standards for quality and uniformity of product.

Our service to users of permanent magnets starts at the design level and carries on to finish-ground and tested units, ready for your installation. It embraces all Alnico grades and other types of permanent magnet materials—any size or shape—and any magnetic or mechanical requirement, no matter how exacting.

Let us show you the latest developments in permanent magnets, and how Arnold products can step up efficiency and reduce costs in your magnet applications. Call for an Arnold engineer, or check with any Allegheny Ludlum representative.

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

W&D 1100

On
the
job



**THE
CONSOLETTÉ...**



At **WFBL-FM**—another General Electric Consolette is on the job.

Outstanding performance and unmatched styling help **WFBL-FM** and scores of other broadcasters decide on General Electric broadcast equipment.

Operators like this simplified switching—visitors are impressed by its smart modern appearance.

COMPLETE studio facilities are provided by General Electric's two-studio Consolette—monitoring, cueing, simultaneous broadcasting and rehearsing, and over-ride talk-back that operates without need for order wires—all at a price every station can afford.

Here is an outstanding control unit that contains all the amplifiers and controls needed for split-second control of two studios, an announce booth, two turntables, and eight remote lines. Two program amplifiers give maximum operat-

ing flexibility and program protection.

A reliable push-button system and simplified switching, careful arrangement of controls, and a correctly sloped panel combine new operating ease and operator comfort unmatched by other consolettes. A hinged top and a hinged-type chassis mounting provide complete accessibility.

Ask your nearest General Electric broadcast sales office for complete information, or write: *General Electric Company, Electronics Department, Syracuse 1, New York.*

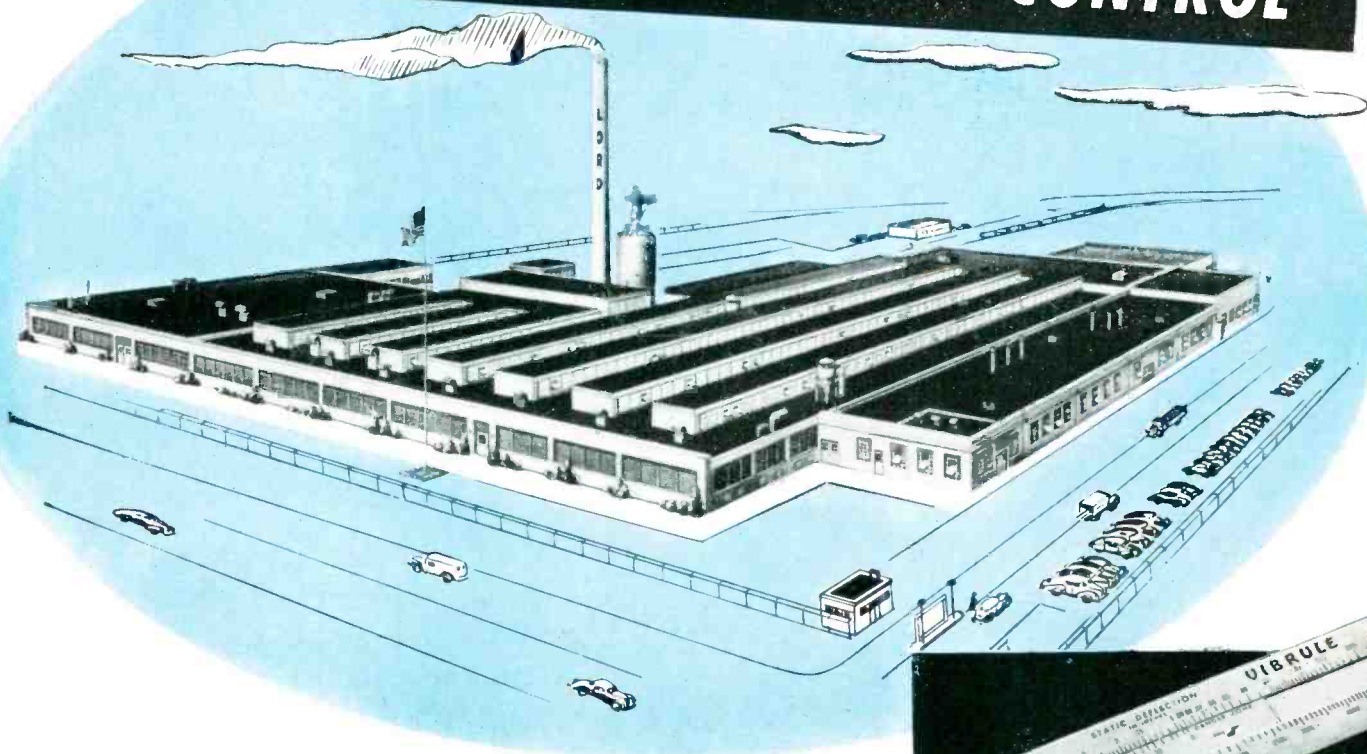
LEADER IN RADIO, TELEVISION AND ELECTRONICS

GENERAL  **ELECTRIC**

160-F5-6914

MAKE LORD YOUR HEADQUARTERS

FOR VIBRATION CONTROL



USE LORD ENGINEERING SERVICE TO SOLVE YOUR PROBLEMS IN ELIMINATING COSTLY VIBRATION AND NOISE

Do you plan to make more, sell more, and profit more . . . in the face of the strongest competitive market ever known? First—better take another look at your product. Does it have *minus* sales appeal caused by destructive, costly, nerve wracking vibration and noise?

Vibration can be eliminated and the solution is simple and free . . . add LORD to your engineering staff. Use Lord's specialized know-how in Vibration Control—without obligation. Send us your problem . . . trained Lord engineers plus the finest of research facilities plus long, practical experience are at your disposal.

If you intend to design the kind of smooth, quiet product that outsells competition, then here's a valuable, helpful service worth investigating. Write or phone us today.

LORD MANUFACTURING COMPANY • ERIE, PA.

FIELD OFFICES } New York, N. Y. Providence, R. I. Washington, D. C. Detroit, Mich.
Chicago, Ill. Burbank, Cal.
Canadian Representative: Railway & Power Engineering Corp., Ltd., Toronto, Canada.

LORD *Engineered*

VIBRATION CONTROL and BONDED RUBBER



FREE!

SEND FOR YOUR LORD VIBRULE ANOTHER LORD SERVICE IN VIBRATION CONTROL

- Use the Lord Vibrule to solve difficult vibration problems . . . measures vibration quickly, easily.
- Does the work of expensive, complex instruments . . . simple to use, gives approximate, practical readings.
- Helps you select the most effective mountings for every job . . . conveniently, accurately.

LORD MANUFACTURING COMPANY ERIE, PENNSYLVANIA

Please send me without cost LORD VIBRULE

Please send me literature on LORD VIBRATION CONTROL

NAME _____

TITLE _____

CITY _____ STATE _____



**RIGHT ON
"MAIN STREET"**

WHEN the most desirable FM location happens to lie in a congested area, tower design is of prime importance.

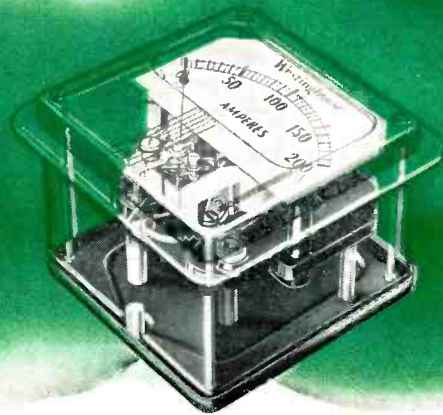
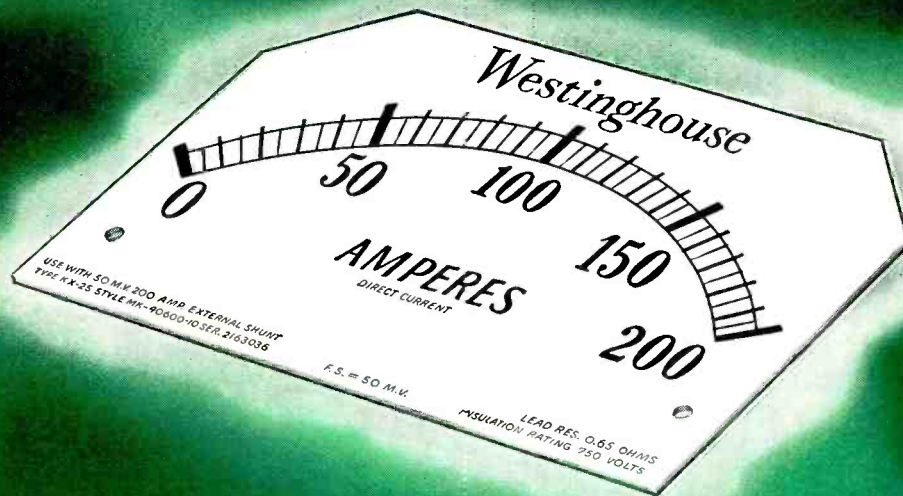
It is therefore necessary that such a structure be designed to have an adequate margin of safety, and be of pleasing appearance.

This installation has back of it the experience and engineering ability acquired in building thousands of Towers and Vertical Radiators, both here and abroad . . . This obvious advantage adds nothing to the cost of a Blaw-Knox job.

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
207 Farmers Bank Building, Pittsburgh 22, Pa.

BLAW-KNOX ANTENNA TOWERS

What is one of the basic requirements of a "good" instrument?



DIALS that stay white under all conditions
...one of the reasons why Westinghouse instruments are good!

A good instrument dial must be accurate and remain clearly legible under all operating conditions. Heat, humidity and corrosive fumes do not deteriorate the whiteness of Westinghouse instrument dials. The finish does not check or crack. Carefully designed characters assure maximum readability permanently.

It is this specialization...continued research for better instruments...and 58 years of skill and "know-how" that make Westinghouse the standard of reliability.

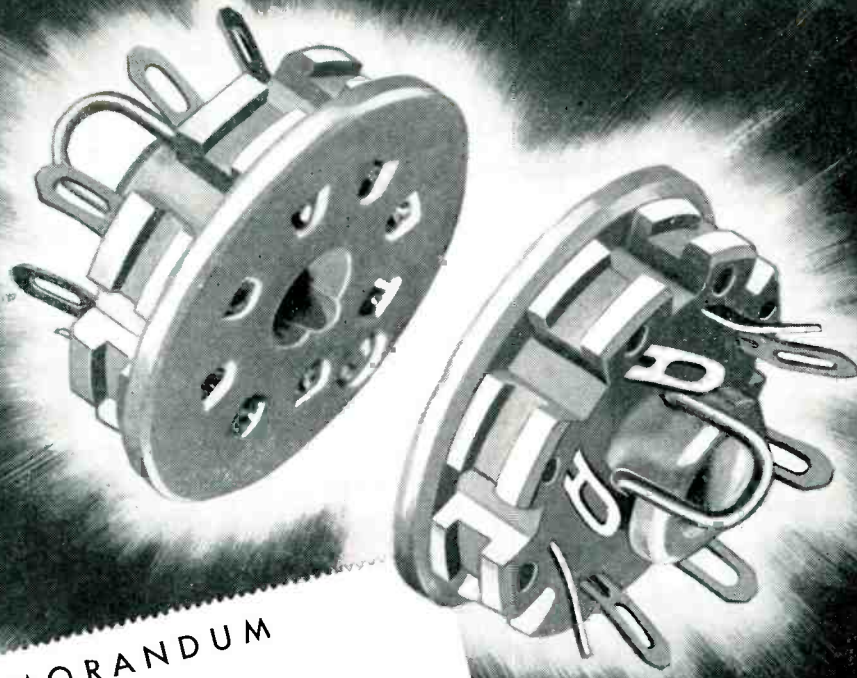
For the right electrical measuring instrument for every job . . . consult a Westinghouse instrument specialist. Call your nearest Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40350

★ ★ ★
IMMEDIATE DELIVERIES on some instruments . . . others up to 90 days.



Westinghouse INSTRUMENTS
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Built for Unfailing Performance



MEMORANDUM
 TO: *Engineering*
 FROM: *Purchasing*
Here is the New Ceramic Socket
for those Lock-in Tubes.
TFC

The main holding pressures are contributed by the 8 FLOATING contact springs. The locking spring action is merely sufficient to prevent the tube from starting to work out.

The socket mounts in the standard 1 1/4" diameter hole having one or two keys, using a specially designed spring retainer-ring. The 8 keyways on the socket permit choice of 8 mounting positions.

✓ **FORGET HUMIDITY!**

Steatite Insulation with Baked Silicone Varnish Coating

✓ **NO FUMBLING!
NO DAMAGED TUBES!**

Tubes Are Easily Removable Yet Effectively Locked In Sockets

✓ Write on your letterhead for Catalog describing our other component parts, such as Snap-slide Fasteners, Steatite-Insulated Connectors, Steatite-Insulated Miniature Relays, Miniature Pin-Plugs, and "Music-Box"-Type Selector Switches.

Aircraft Radio Corporation

DEPENDABLE ELECTRONIC EQUIPMENT SINCE 1928

Boonton, N. J.

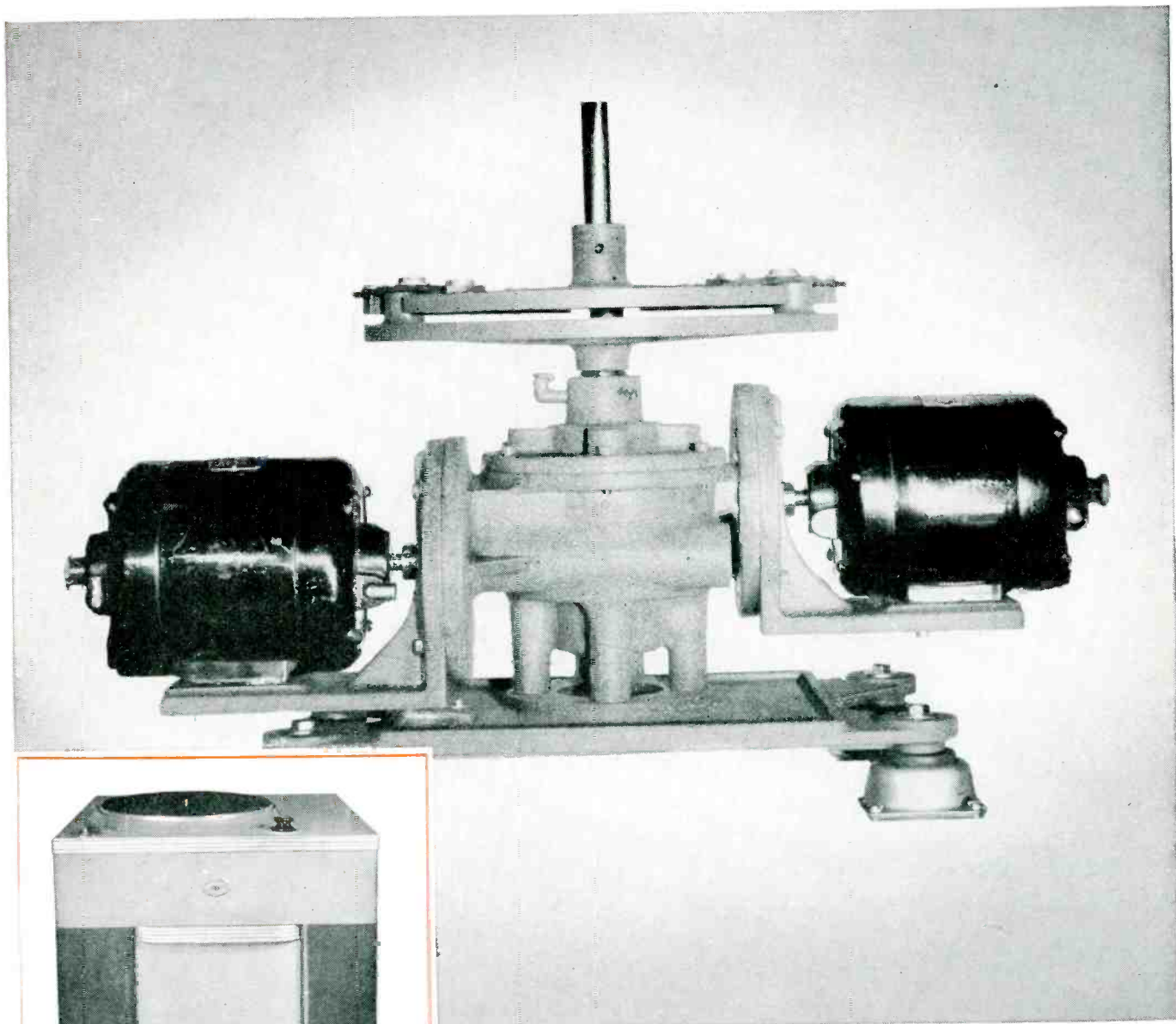


NEW!
Presto's
Dual-Motor,
Direct Drive!

▶The new Presto 64-A transcription unit combines a number of radical improvements which are of first importance to broadcast stations, recording studios, and industrial and wired music operators.

▶The turntable is directly gear-driven at both 33 $\frac{1}{3}$ and 78.26 rpm and two separate motors are employed — one for each speed. Speed may be changed instantly at any time by turning a mercury switch, without damage to the mechanism. *No frictional, planetary, or belt operated elements are used in this new drive mechanism.*

▶The following points are of interest: *Motors*—Two 1800 rpm synchronous. *Speed*—Total speed error is zero. *Noise*—At least 50 db below program. *Starting*—Table on speed in less than one-eighth revolution at 33 $\frac{1}{3}$ rpm. *Adjustment*—Construction is very rugged and no attention whatsoever is required—except lubrication.



Brand of reproducer is at the customer's discretion

 **PRESTO** RECORDING CORPORATION

242 West 55th Street, New York 19, N. Y. • Walter P. Downs, Ltd., in Canada

WORLD'S LARGEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT & DISCS
 ELECTRONICS — August, 1947



... Sent
to the Junkyard
by
Wire Failure...

A few of the 125 permanently insulated wires, cables and cords developed by Rockbestos to protect product performance and give lasting service.

ROCKBESTOS HIGH TEMPERATURE WIRE

The original glass and felted asbestos insulated High Temperature Wire — silicone impregnated and heat-cured to take a maximum operating temperature of 400° F. — was designed for jet-propelled plane applications, circuits to hot-wing de-icers, fire detectors and extinguishers and air heating units where baking temperatures destroy ordinary insulation. Under *continuous* operation at rated temperature it retains its original dielectric strength and resistance to flame and *progressively improves* in its resistance to moisture and abrasion. Sizes 18 AWG to 2/0.



ROCKBESTOS ALL-ASBESTOS APPLIANCE LEAD WIRE

Available in several types to fit the electrical and mechanical requirements of your product. Solid or stranded copper, nickel or monel conductors insulated with .031" or .040" of impregnated felted asbestos in black, white or colors.



TYPE AVA ROCKBESTOS A.V.C. MOTOR LEAD CABLE

A 600 volt cable for coil connections, motor and transformer leads exposed to overloads and high ambient temperatures. Insulated with felted asbestos and varnished cambric and covered with asbestos braid like Power Cable. Sizes 18 AWG to 1,000 MCM.

Protect Performance with Permanently Insulated **ROCKBESTOS** WIRES, CABLES AND CORDS

Every time a customer flicks a switch on one of your products your reputation as a manufacturer *is on trial*. If it operates — fine. If it doesn't you're in for everything from repairs, servicing or replacement to sales-killing comments — and the failure of a little wire could be the cause of all the grief.

To avoid such trouble and keep customers satisfied, check operating temperatures that may be running close to the danger point. How about the possibility of equally destructive high ambients — heating and cooling cycles — or conductor-heating overloads? And don't overlook the job that rotting fumes, grease and oil can do in ruining wire.

The conditions listed above are a few of the reasons why manufacturers of appliances, electrical equipment and electronic devices standardize on Rockbestos wires, cables and cords. They want wire that will give them a *safety margin* in performance protection by standing up under all possible service conditions. And they know that Rockbestos will go to work on a special if a standard won't do.

For information, recommendations or engineering assistance write to the address below or your nearest district office.

ROCKBESTOS PRODUCTS CORPORATION

450 Nicoll St., New Haven 4, Conn.



ROCKBESTOS RESEARCH

Solves Difficult Wiring Problems

NEW YORK BUFFALO CLEVELAND PITTSBURGH DETROIT CHICAGO ST. LOUIS LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

These PROBLEMS are push-overs...

... for "dag" colloidal graphite. These, and many others!

Have you a lubricating problem which graphite can solve if you can get graphite to the spot and keep it there? Or a problem which requires a dry film both lubricating and electrically conductive?

Remember then that "dag" colloidal graphite adsorbs readily to bearing surfaces—that it is dry, slippery, heat-defying. Remember that "dag" colloidal graphite is densely opaque, electrically conductive, and has many other characteristics which in combination are unique.

18 different dispersions of "dag" colloidal graphite give it application over a wide range of industry. New dispersions are constantly under study in Acheson Colloids Corporation laboratories. Your unsolved problem will be welcome to our engineers.



colloidal products

ACHESON COLLOIDS CORPORATION, Port Huron, Michigan

This new literature on "dag" colloidal graphite is yours for the asking:

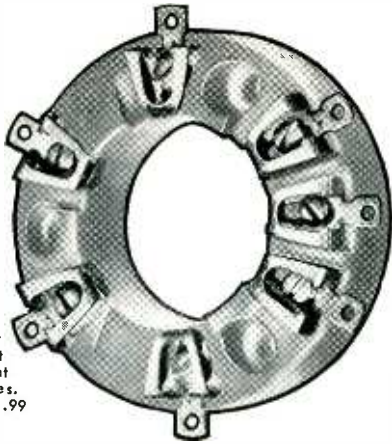
- 460** A data and reference booklet regarding "dag" colloidal graphite dispersions and their applications. 16 pages profusely illustrated.
- 421** Facts about "dag" colloidal graphite for ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY.
- 422** Facts about "dag" colloidal graphite as a PARTING COMPOUND.
- 423** Facts about "dag" colloidal graphite as a HIGH TEMPERATURE LUBRICANT.
- 431** Facts about "dag" colloidal graphite for IMPREGNATION AND SURFACE COATINGS.
- 432** Facts about "dag" colloidal graphite in the FIELD OF ELECTRONICS.



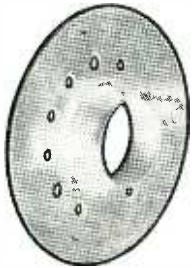
ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN, DEPT. H-5

Please send me without obligation, a copy of each of the bulletins checked:

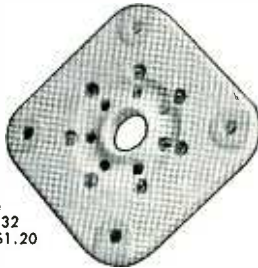
- 460** NAME _____
- 421** POSITION _____
- 422** FIRM _____
- 423** STREET _____
- 431** CITY _____ ZONE _____
- 432** STATE _____



XLA
A low-loss socket for the 6F4 and 950 series acorn tubes for frequencies as high as 600 mc. By-pass condensers may be compactly mounted between contact terminals and chassis. Low contact resistance, short and direct leads, and low and constant inductance are features. Net Price.....\$.99



XLA-S
An internal shield fitting the XLA socket and suitable for tubes such as the 956. Net Price.....\$.36

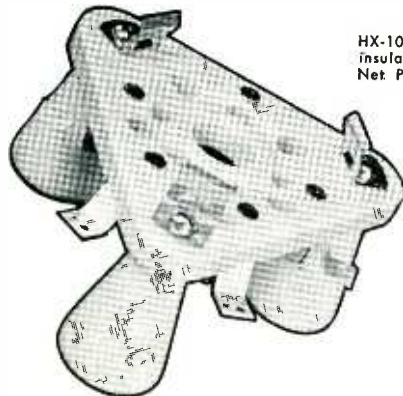


HX-29
A low-loss wafer socket with steatite insulation for the popular 829 and 832 tubes. Net Price.....\$1.20



JX-51
A low-loss wafer socket for the 813 and other tubes having the Giant 7-pin base. Net Price.....\$.81

HX-100S
A low-loss wafer socket suitable for the type 4-125-A, 4-250-A and other tubes using the Giant 5-pin base. Shield grounding clips are supplied. Air holes are provided for forced air cooling.



HX-100S (with standoff insulators).
Net Price.....\$2.55

HX-100 (without standoff insulators).
Net Price \$1.98



A TUBE IS NO BETTER THAN THE SOCKET IT FITS IN

The most expensive tube available will fail to function properly if the socket it fits in is not made correctly.

That's why National sockets have come to be so widely used by hams, engineers and manufacturers in constructing new equipment.

When you use a National socket, you know from experience that it will grip the tube perfectly and will stand up under heavy duty.

Send today for your copy of the 1947 National catalog, containing over 600 parts.

**National
Company, Inc.**
Dept. No. 10
Malden, Mass.

Type AR-16 (Air-Spaced) Exciter Coils and Forms

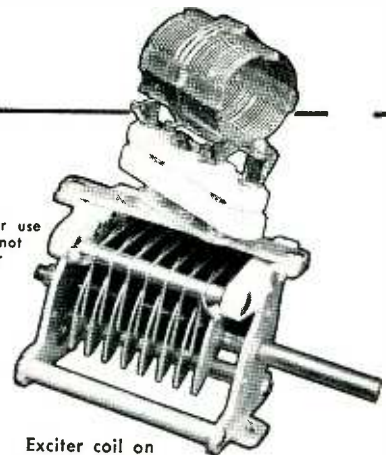
These air-spaced coils are suitable for use in stages where the plate input does not exceed 50 watts and are available for the 6, 10, 20, 40 and 80 meter bands. All have separate link coupling coils and all include the PB-16 Plug, which fits the XB-16 Socket.

AR-16, Coils, End Link, Center Link or Swinging Link. Net Price...\$1.15 (Include PB-16 Plug)

PB-16, Plug-in Base Only.
Net Price.....\$.27

XB-16, Plug-in Socket Only.
Net Price.....\$.33

Type TMK Transmitting Condenser
—An ideal condenser for exciters and low power transmitters. Available in single and double stator models. For panels or stand-off mounting. Steatite insulation. Net Price.....From \$2.30 to \$5.11



Exciter coil on
TMK condenser

MAKERS OF LIFETIME RADIO EQUIPMENT

NOW! 10 cps to 10 mc

...with the New -hp- 650A RESISTANCE-TUNED OSCILLATOR



HERE IT IS . . . another -hp- "first" . . . a new resistance-tuned oscillator that not only covers a frequency range of 10 cps to 10 mc, but brings to the r-f and video field all the speed, accuracy and ease of measurement traditional to famous -hp- audio oscillators. And, this important addition to the -hp- line incorporates all the family characteristics of other -hp- oscillators . . . no zero setting, minimum adjustment during operation, virtual in-

dependence of line and tube characteristics, accurate calibration, and streamlined circuits for long, trouble-free performance.

The result is a highly stable, wide-band precision instrument which provides output flat within 1 db from 10 cps to 10 mc, and a voltage range of .00003 to 3 volts. Output impedance is 600 ohms or 6 ohms with output voltage divider.

LIKE OTHER -hp- resistance-tuned oscillators, the new 650A gives you the advantage of decade frequency ranges, a 94" scale length, and a 6 to 1 micro-controlled vernier drive. A complete vacuum tube voltmeter, included in the 650A circuit, monitors output in volts or db at the 600 ohm level. A continuously variable output voltage is obtained by means of an output attenuator of 50 db, variable in 10 db steps and an amplitude control which adjusts the level to the monitor vacuum tube voltmeter.

Where it is desirable that the measurements be made with a low source impedance, an output voltage divider unit is supplied. This attachment consists of a cable, which may be extended to the point of measurement and provides an internal impedance of 6 ohms. It also reduces the output voltage 100 to 1.

THE COMPACT, efficient -hp- 650A is available now for making a wide number of measurements . . . testing television amplifiers, wide-band systems, filter transmission characteristics, tuned circuits, receiver alignments. And . . . it serves admirably as a power source for bridge measurements or as a signal generator modulator.

For full information...write today

Hewlett-Packard Company • 1495A Page Mill Road • Palo Alto, Calif.

1495

SPECIFICATIONS

FREQUENCY RANGE: 10 cps to 10 mc

FREQUENCY CALIBRATION: 0.9 to 10.

Multiplying factors are:

MF	Freq. Range
X10 cps	9 to 100 cps
X100 cps	90 to 1000 cps
X1kc	900 to 10,000 cps
X10kc	9 to 100 kc
X100kc	90 to 1000 kc
X1mc	0.9 to 10 mc

STABILITY: $\pm 2\%$, 10 cps to 100 kc; $\pm 3\%$, 100 kc to 10 mc including warmup, line voltage, and tube changes.

OUTPUT: 10 milliwatts or 3 volts into 600 ohm resistive load. Open circuit voltage is at least 6 volts. 600 ohm reflected impedance. Output impedance of 6 ohms also available.

FREQUENCY RESPONSE: Flat within ± 1 db, 10 cps to 10 mc.

DISTORTION: Less than 1% from 100 cps to 100 kc. Approx. 5% from 100 kc to 10 mc.

OUTPUT MONITOR: Vacuum tube voltmeter monitors output level in volts or db at 600 ohm level. Output response beyond monitor is accurate within $\pm 5\%$ all levels and frequencies.

OUTPUT ATTENUATOR: Output level attenuated 50 db in 10 db steps, providing continuously variable output voltage from +10 dbm to -50 dbm, 3 volts to 3 millivolts, or down to 30 microvolts with voltage divider.

HUM VOLTAGE: Less than 0.5% below maximum attenuated signal level.

POWER SUPPLY: 115 volts 50/60 cps. Consumption 135 watts. Plate supply electronically regulated.

MOUNTING: Cabinet or relay rack. Panel size 19" x 10 1/2". Depth 13".

DON'T MISS OUR EXHIBIT
at the

3rd Annual Electronics Trade Show
San Francisco - Sept. 26, 27, 28

hp laboratory instruments
FOR SPEED AND ACCURACY



WHERE DIAMOND VULCANIZED FIBRE FITS INTO PRODUCT DESIGN

C-D NON-METALLIC PRODUCTS

DIAMOND VULCANIZED FIBRE

VULCOID—Resin Impregnated Vulcanized Fibre.

DILECTO—Thermosetting Laminated Plastics.

CELORON—A Molded Phenolic Plastic.

MICABOND—Built-up Mica Electrical Insulation.

HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

STANDARD & SPECIAL FORMS

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

DESCRIPTIVE LITERATURE

Bulletin GF gives Comprehensive Data on all C-D Products. Catalogs are also available.

There is no end of profitable applications for this versatile material. It is used in a multitude of mechanical, structural and electrical applications because of its unique combination of lightweight, strength, toughness, resistance to wear and abrasion, excellent arc-resistance and good dielectric properties.

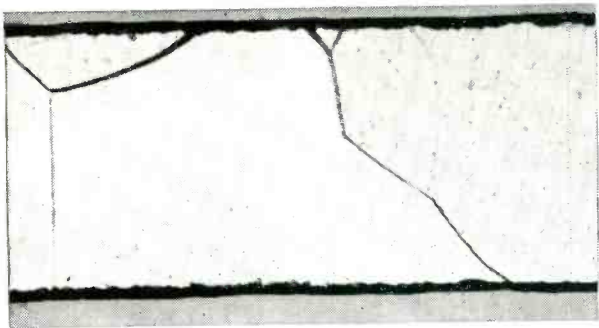
Diamond Vulcanized Fibre is available in sheets, rods and tubes which are easily and cleanly fabricated on woodworking or metalworking machinery. It can be formed and punched; cut and sawed; drilled and tapped; turned, threaded and reamed . . . or, if you wish, we can supply the parts you need fabricated to your specifications.

Long experience in fibre application engineering, in connection with our complete line of laminated (Dilecto) and molded (Celoron) plastics, enables us to render unbiased recommendations for the best application of fibre to the solution of your mechanical and electrical problems. Just call in a Continental-Diamond Technician—or write for your Continental-Diamond Fibre catalog.

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Continental - Diamond FIBRE COMPANY
Established 1895.. Manufacturers of Laminated Plastics since 1911—NEWARK 16 • DELAWARE



Micrographs at 800 magnification show grain structure and the thickness of insulation on ARMCO Thin-Gage, .002 inches (top left) and ARMCO Tran-Cor 52, .014 inches (right).

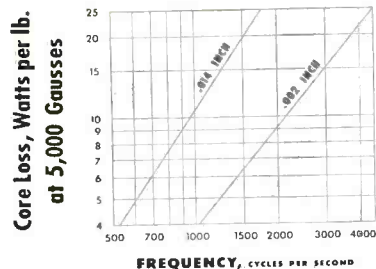
How to insure low energy loss at high frequencies

For applications involving changes in magnetic flux equivalent to frequencies as high as 1,000,000 cycles a second, ARMCO Thin-Gage Electrical Steel, CARLITE Insulated, has five definite advantages:

1. It is supplied in coils suitable for high-speed punching operations or for winding into cores.
2. Skin-effect will not become appreciable up to quite high frequencies because it is obtainable in thicknesses as light as 1 or 2 mils.
3. The stacking factor is high considering the gage and the insulation on both sides. Four hundred sheets of .002-inch insulated steel make a stack only 1 inch high.
4. The hysteresis is unusually low for such thin steel—an important factor in keeping the total loss to the reasonable values shown in the chart.

5. CARLITE Insulation, formed by a new surface treatment developed by Armco, effectively insulates each lamination and assures minimum interlamination loss.

Write us for further information pertaining to your specific equipment. Just address The American Rolling Mill Company, 290 Curtis Street, Middletown, Ohio.



Core loss at high frequencies of ARMCO Thin-Gage, .002" and ARMCO Tran-Cor 52 Steel, .014".

THE AMERICAN ROLLING MILL COMPANY

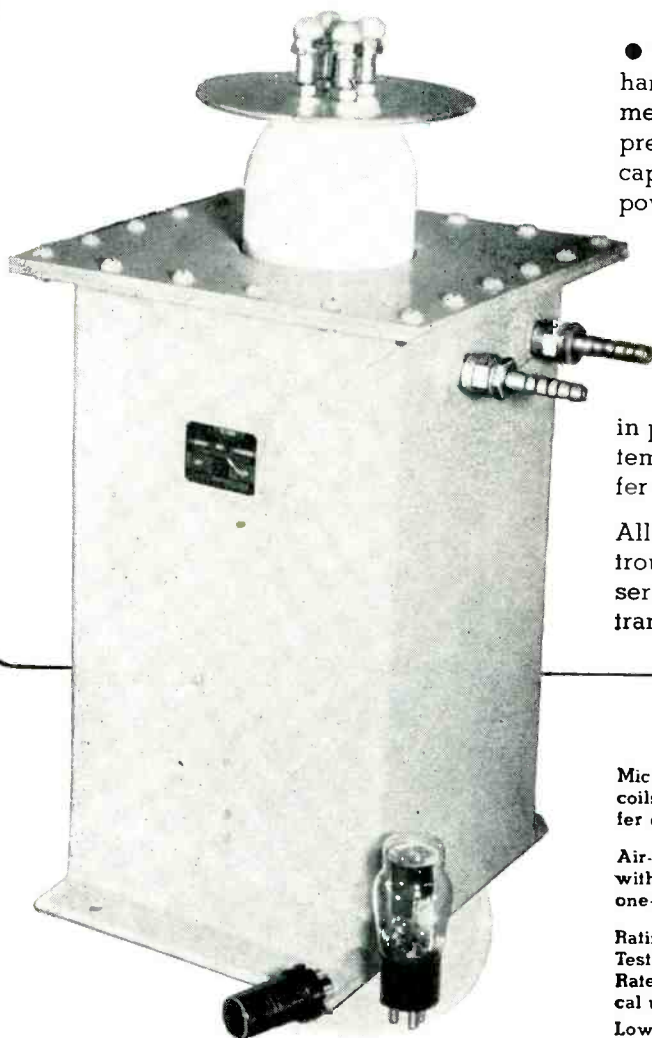


BOOST KVA RATING BY FIVE OR MORE . . .

CUT PRESENT SIZES OF POWER CAPACITORS . . .

AEROVOX SERIES 1780

Water-cooled
MICA CAPACITORS



● This new water-cooled oil-filled mica capacitor handles exceptional KVA loads for its size. This means that more power can be handled than with previous capacitors of similar size or, conversely, capacitor size can be greatly reduced for given power ratings.

Series 1780 capacitors attain their higher KVA ratings in two ways: (1) By exceptional design such as critical arrangement and location of sections; choice of materials; specially-plated parts; large cross-section of conductors; careful attention to details and true craftsmanship in production. (2) By the use of a water-cooling system so designed as to provide maximum heat transfer from capacitor section to cooling coils.

All in all, here is a sturdy, compact, hard-working, trouble-free mica capacitor for extra-heavy-duty service, such as induction furnaces and high-power transmitters.

Featuring...

Mica stacks in oil bath. Cooling coils in oil bath for efficient transfer of heat.

Air-cooled operation, 200 KVA; with water-cooling, 1000 KVA—a one-to-five ratio.

Ratings up to 25,000 volts A.C. Test. Capacitances up to .01 mfd. Rated loads up to 1000 KVA. Typical unit: 20,000 V. at .01 mfd.

Lower power factor (.01%). Long life and large factor of safety.

Provisions for making connections with high-current-capacity conduc-

tors. Four-stud terminal. Grounded case.

Heavy welded metal case, hermetically sealed. Exceptionally sturdy construction.

Series-parallel mica stack designed for uniform current distribution throughout.

Silver-plated hardware for minimum skin resistance. To minimize or eliminate corona, terminals are finished with large radii of curvature. Steatite insulator shaped to hold gradients below corona limits.

TECHNICAL DATA ON REQUEST



FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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TRADE MARK

CUSTOM MADE TECHNICAL CERAMICS

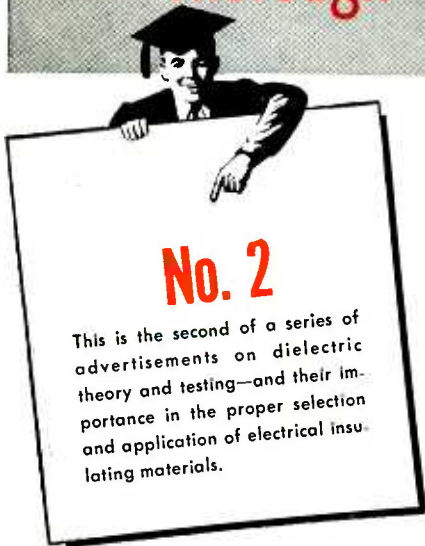
• ACCURATE IN DIMENSION TO SPEED YOUR ASSEMBLY. PROMPT DELIVERY
TO MEET YOUR REQUIREMENTS. ECONOMICAL IN FIRST COST.

AMERICAN LAVA CORPORATION

46TH YEAR OF CERAMIC LEADERSHIP
CHATTANOOGA 5, TENNESSEE

SALES OFFICES: CAMBRIDGE, NEWARK, PHILADELPHIA, CHICAGO, ST. LOUIS, SAN FRANCISCO, LOS ANGELES

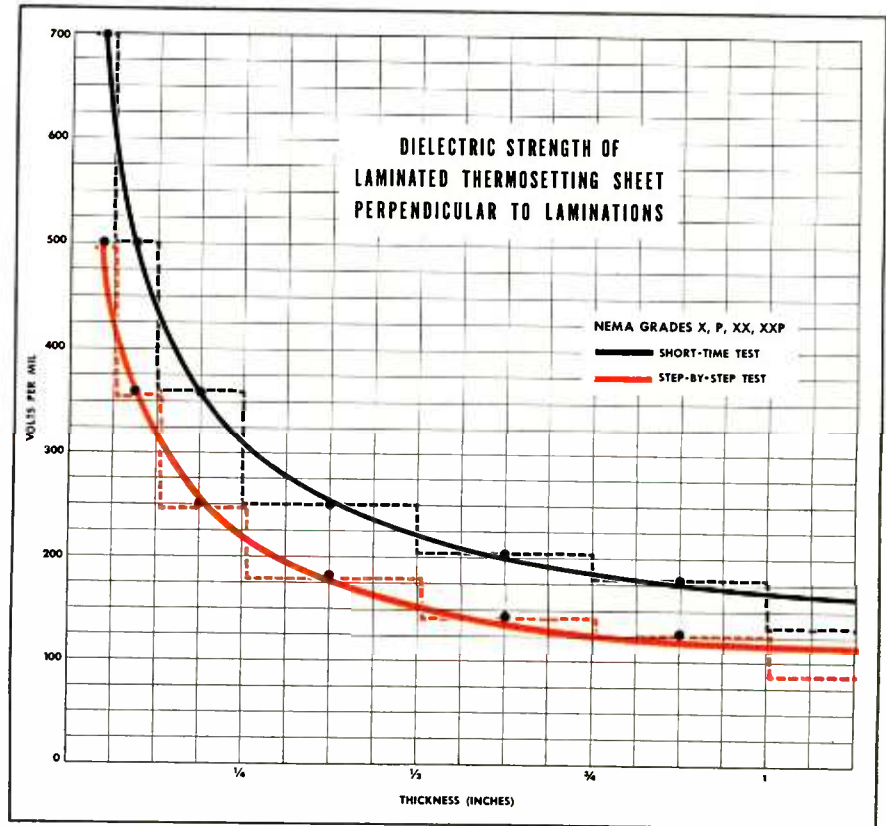
Thorough Knowledge of Dielectric Strength



Dielectric strength values of insulation, determined by means of laboratory tests, are seldom exactly like those obtained in actual service. To be the same, all factors that affect dielectric breakdown would have to be identical.

For instance, the chart (Fig. 1) illustrates the values of Short-Time Tests¹ as compared with the values of Step-by-Step Tests² for the same material. Here the test specimens have been conditioned alike, tested in the same atmosphere, at the same temperature and with the same electrodes. The only variation was the rate at which the voltage was applied. Since all the variables mentioned above have an effect on dielectric breakdown, it can easily be seen that test values are but an indication of dielectric quality.

For this reason, the American Society for Testing Materials has set up detailed standard test procedures for each type of insulating material. Thus, a common basis is established for comparing the dielectric quality of one material with another. And it is possible to compute, fairly accurately, what



the dielectric strength will be for the same insulation under other conditions, by starting with a value that has been determined by a standard test.

STEP-BY-STEP DIELECTRIC STRENGTH TEST

The first advertisement of this series dealt with the Short-Time Dielectric Strength Test, devised for quick determination. Here the Step-by-Step Method is outlined. This means of determining dielectric breakdown, where the voltage is applied for longer periods of time, simulates to a certain extent operating conditions of many applications where the electrical insulation is under extended stress. The Step-by-Step values should therefore be used when considering such applications.

The electrical equipment needed to perform the Step-by-Step Test is the same

as that needed for the Short-Time Method (step-up transformer, automatic circuit breaker, device for controlling rate of voltage rise, voltmeter and electrodes of proper size and shape). In this procedure, however, the initial voltage applied (50% of the breakdown in the Short-Time Test) is held for a specified time, then increased by equal increments to higher voltages, but held at each step for a definite period of time as stated in the ASTM specifications.

¹ASTM Designation D149-44-10(a)

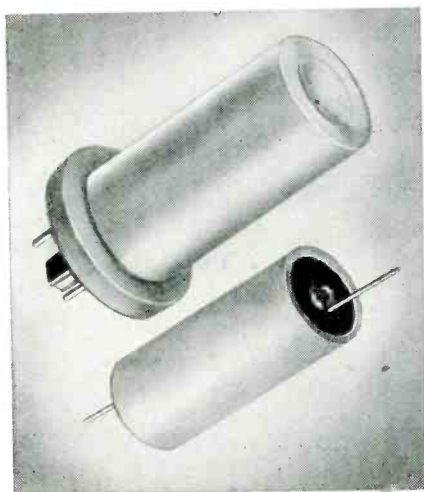
²ASTM Designation D149-44-10(b)



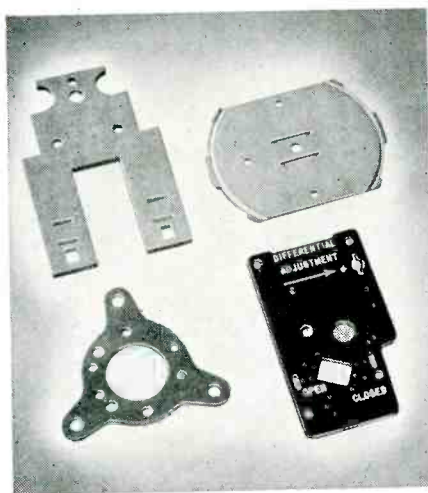
Lengthens Life of Many Electrical Products

APPLICATIONS OF ELECTRICAL INSULATING MATERIALS

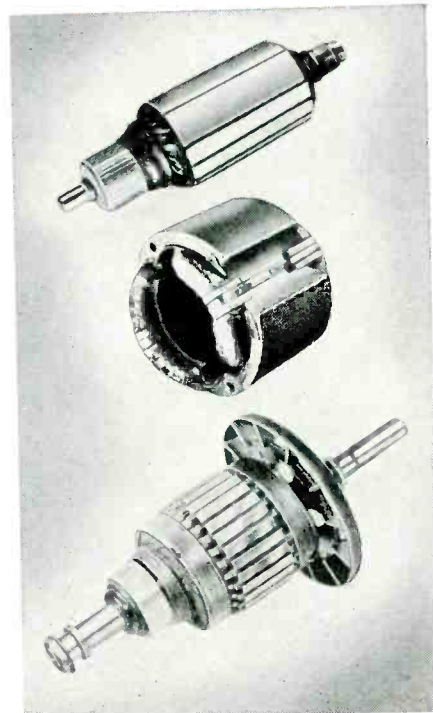
Mica Insulator Company makes a wide variety of insulating materials, thus giving the designer and manufacturer a free hand in specifying a dielectric to meet the exact conditions of use. Products include, for example, fabricated *Munsell Mica* (machined to specifications); *Micanite* and *Super-Micanite* (built-up mica); *Lamicoid* (laminated plastic); *Empire* (varnished fabrics and papers); and *Miscellaneous Insulations* (tubing, untreated tapes, fiberglass products and varnishes).



EMPIRE YELLOW-VARNISHED CONDENSER PAPER is free from impurities that may impair insulation qualities. Furnished in thicknesses of 1.5, 2 and 3 mils, its extreme thinness makes it suitable for magneto, induction and ignition coils, condensers, etc.



LAMICOID SHEETS NEMA Grade XXX are made with paper base and high quality synthetic resins. They are particularly well suited for radio parts and similar applications where at high frequency, low-loss characteristics must be maintained under severe conditions.



MICANITE SEGMENT PLATES are made with both amber (phlogopite) and India (Muscovite) mica. They have proved exceptionally valuable for most flat-insulation applications, punched segments, undercut and flush-type commutator segments, washers and discs.

Experience accumulated by Mica Insulator Company as electrical insulation specialists for over 50 years, plus knowledge gained from extensive research, can help solve your insulation problems. Call on our Technical Service Department—there is no obligation.

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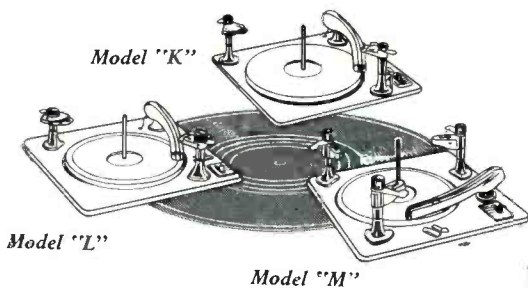


Trade-mark



Changer Performance

**TO MATCH THE PERFECTION
OF THE INSTRUMENT**



Model "K"

Model "L"

Model "M"

Fine combination instruments are judged—and sold—by their over-all excellence of performance. It's important, then, that you select record changers to match the precision and beauty of your radio-phonograph combinations.

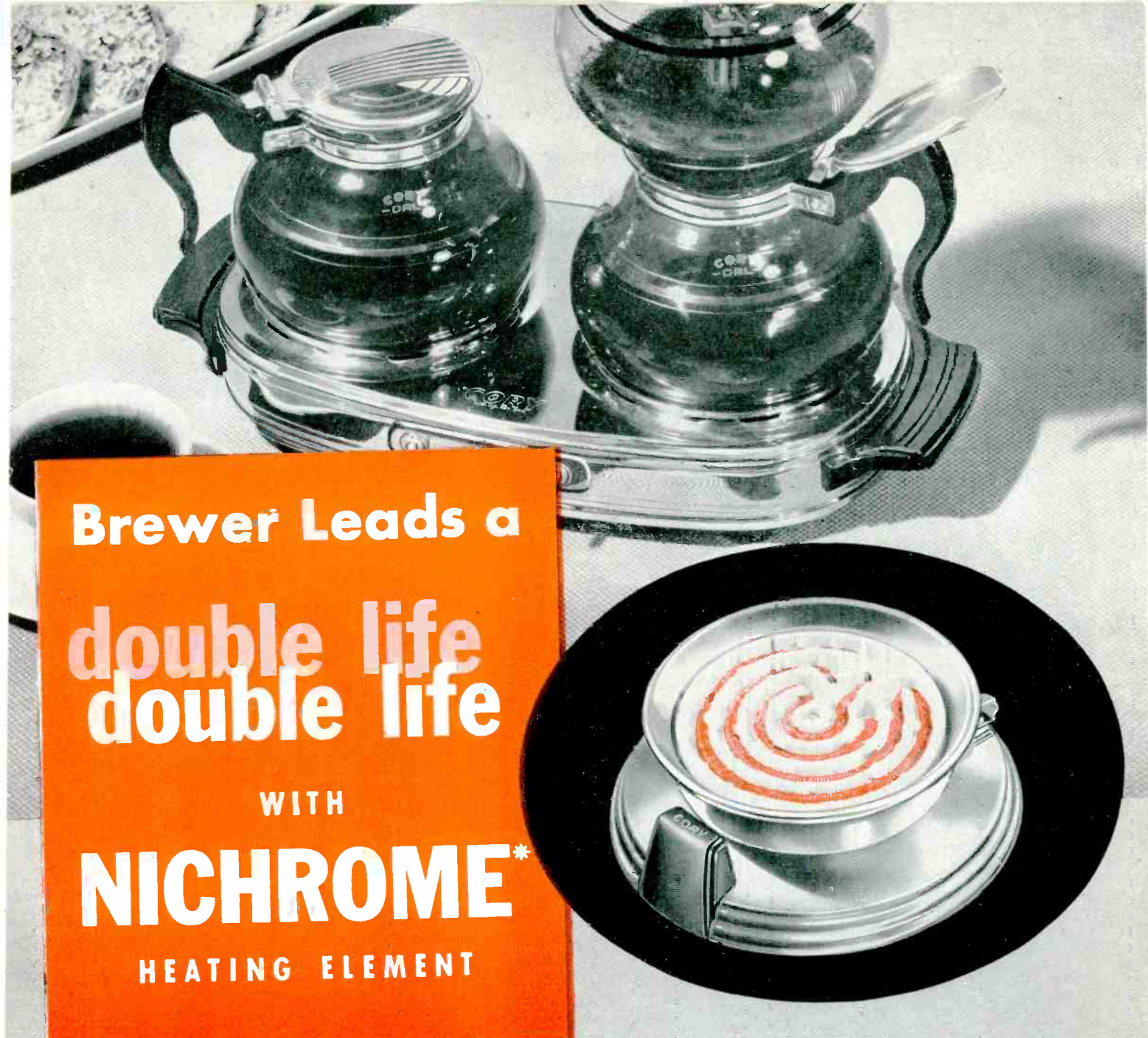
Seeburg builds three such changers. While each is designed for use in sets of varying price ranges, all are engineered to give simple, trouble-free operation.

Back of every Seeburg changer is a broad, successful experience in the development and manufacture of all types of changing mechanisms—this is your assurance of dependable, gratifying performance.

Seeburg

RECORD CHANGERS ★ MUSIC SYSTEMS

J. P. SEEBURG CORPORATION
1500 N. Dayton St., Chicago 22



Brewer Leads a
double life
double life

WITH
NICHROME*
HEATING ELEMENT

a single heating element which provides a choice of two heats — one high for quick coffee brewing — one low for keeping it piping hot — is the heart of a new coffee brewer manufactured by the Cory Corporation of Chicago.

Like hundreds of other quality electrical appliances, the Cory coffee brewer is equipped with a Nichrome heating element — for Nichrome

can be depended upon to deliver the desired heat throughout a life-time of trouble-free, economical operation.

Because of its excellent electrical properties, strength and thermal durability, Nichrome has been the standard of quality in electrical heat and corrosion-resistant alloys for more than 38 years — and Nichrome is made only by . . .



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**THE ONE
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FOR EVERYTHING IN
ELECTRICAL
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SLEEVINGS, CORDS
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**COTTON TAPES & SLEEVINGS
FIBERGLAS-MICA COMBINATIONS
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FOR 58 YEARS.**



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Presenting the **NEW MODEL SX-43**

...to give amateurs:

**MORE
VALUE**

Never before all these features at this price

**GREATER
PERFORMANCE**

AM-FM-CW . . . all essential amateur frequencies from 540 kc. to 108 Mc.

LOWER PRICE

\$169⁵⁰

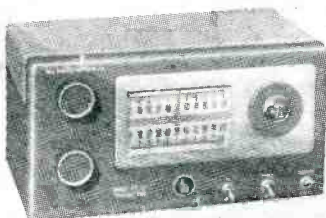
Sets available after August 1947

**Built in the
Hallicrafters
Classic
Tradition**



The new SX-43 is built in the Hallicrafters classic tradition: providing custom quality, precision engineering, excellent performance and wide frequency range at a medium price. The SX-43 offers continuous coverage from 540 kc. to 55 Mc. and has an additional band from 88 to 108 Mc. AM reception all bands. CW on four lower bands and FM on frequencies above 44 Mc.

New **LOW PRICE** Transmitter



\$69⁵⁰

**MODEL
HT-17**

- Ham bands from 3.5 to 30 Mc.
- 15 watts power output on low frequency bands.

Here's real Hallicrafters transmitter performance with maximum convenience and economy. A pi-section matching network, as well as a link, provides coupling to any type of antenna or permits the HT-17 to be used as an exciter for a high power final amplifier. Coil sets extra.

Added technical details on all these models in Hallicrafters New Catalog, No. 38. Ask your local distributor for a copy.

NEW BETTER QUALITY AM WITH NARROW BAND FM

Exclusively designed — **VARIABLE
MASTER OSCILLATOR \$110.00**
(amateur net)

Here is the hottest transmitter item available today. Packed with outstanding features never before available in one low-priced unit. Add to the HT-18 one or two amplifier stages and you have a complete, high quality transmitter permitting operation on phone or CW up to 1 KW.

MODEL HT-18



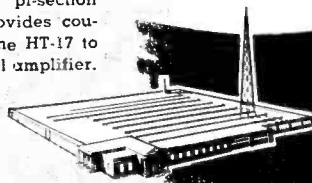
Narrow band FM . . . direct frequency calibration . . . finger-tip control of entire station . . . full frequency deviation on all ham bands to 29.7 Mc. . . only 1/10 the distortion of comparable units . . . excellent stability . . . clean keying . . .

BUILDERS OF *Skyphone* AVIATION RADIOTELEPHONE

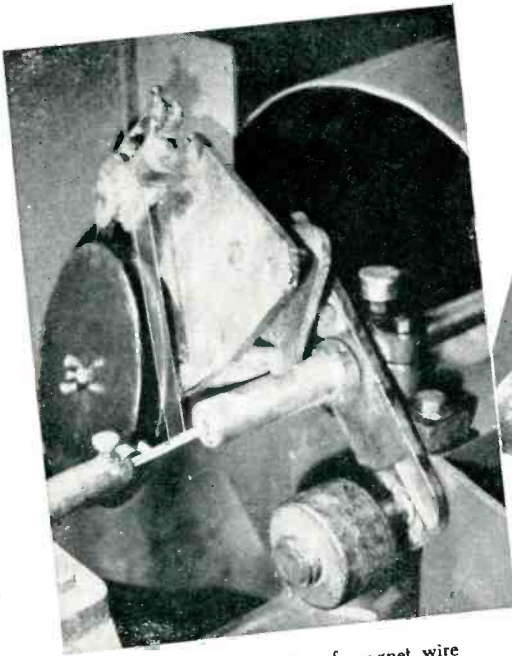
hallicrafters RADIO

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

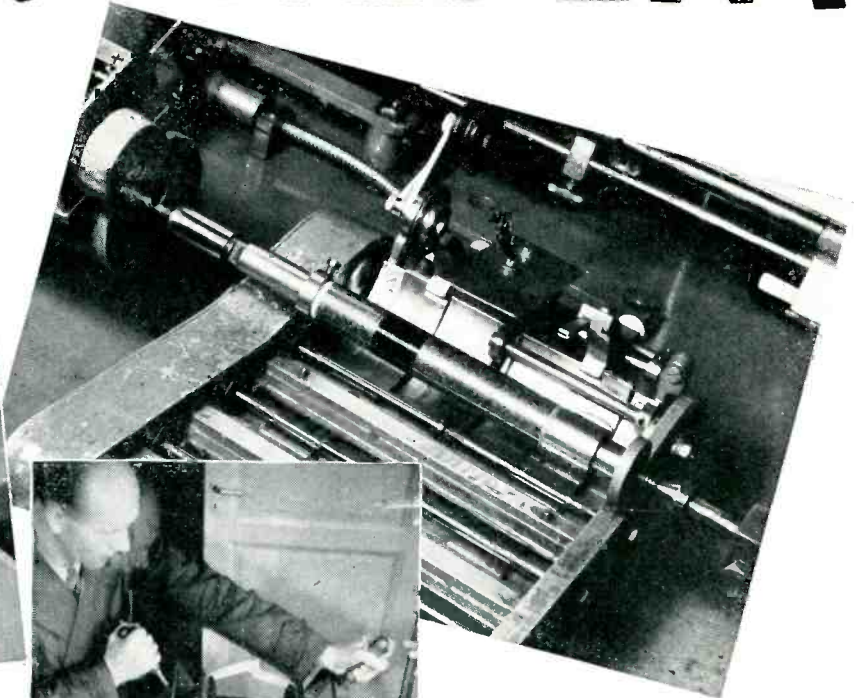
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NATVAR *in* SWEDEN!



Taping a flat copper strip of magnet wire with Natvar Varnished Fibreglas Tape—a continuous operation.



Winding an ignition coil, Natvar Varnished Paper is used between soft iron core and Bakelite tube.



Rectangular copper conductors, insulated with Natvar Varnished Fibreglas Tape, are wound into coils. They are then formed for installation in locomotive motors.

These pictures were all taken in Swedish shops. Natvar sole representative for Sweden East and North—Hjalmar Andren & Soner, Telegramaddress "PRESSPAN," Kaptensgatan 6, Stockholm. Natvar sole representative for Sweden West and South—Handels-och Fabriksbolaget Hjalmar Andren, Telegramaddress "HJALMANO," Magasinsgatan 3, Gothenburg.

For important jobs, large or small, Natvar insulating materials are used because in actual service they consistently equal or exceed specifications.

If your requirements call for insulating materials with good physical and electrical performance characteristics and exceptional uniformity—it will pay you to use Natvar. Get in touch with your Natvar distributor, or with us direct.



Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fibreglas cloth
- Silicone coated Fibreglas
- Varnished papers
- Varnished tubings and sleeveings
- Varnished identification markers
- Lacquered tubings and sleeveings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Ask for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS

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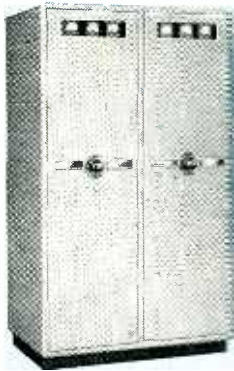
CABLE ADDRESS
NATVAR: RAHWAY, N. J.

Corporation

201 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

8-NVP-2

THREE GREAT AIR LINES

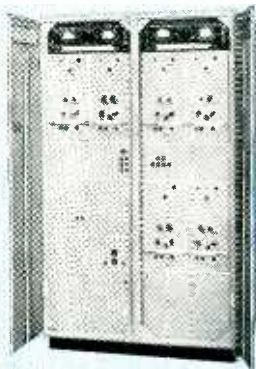


RADIO TRANSMITTER 184-A. Provides maximum operation on 2 phone channels and 2 CW channels simultaneously, or 4 CW channels simultaneously, with choice of up to 4 different frequencies.



USE FEDERAL'S MULTI-CHANNEL TRANSMITTERS

Interchangeable-unit Construction gives a new high in versatility for ground-to-air and point-to-point communication



RADIO TRANSMITTER 185-A. Provides maximum operation on 1 phone channel and 1 CW channel simultaneously, or 2 CW channels simultaneously with choice of up to 6 different frequencies.



RADIO TRANSMITTER 186-A. Provides maximum operation on 1 phone channel and 1 CW channel simultaneously, or 2 CW channels simultaneously, with choice of 2 frequencies.

THE BIG AIRLINES, like TWA, United and American, know how important it is to meet the fast-changing needs of modern airport communication service, without obsolescence of costly equipment. And they've solved this problem with Federal's multi-channel ground station transmitters, 184A, 185A and 186A. For interchangeable RF units, power supplies and modulators make them adaptable to an almost unlimited combination of operating characteristics — for present needs and those of the future!

In one transmitter, you can now combine single or multi-channel CW and phone service in all three bands—HF,

VHF, and LF. Unit-type construction simplifies maintenance and inspection, minimizes service interruptions and holds down operating costs. And, as always, Federal offers you the last word in modern engineering, top quality and precise workmanship—backed by 38 years of research and experience.



THIS NEW BOOKLET GIVES YOU ALL THE FACTS

A request on your company letterhead will bring your copy by return mail, without obligation. Write Dept. A-513.

INTERCHANGEABLE COMPONENTS permit wide selection of ratings and characteristics

Transmitter	RF Units	Power Supplies	Audio Amplifiers
184-A	1 to 4	1 or 2	1 or 2
185-A	1 to 6	1	1
186-A	1 or 2	1	1
RF Units*	HF, 2-20 Mc.—500 Watts, CW or Phone VHF, 108-140 Mc.—200 Watts, Phone LF, 200-540 Kc.—400 Watts, CW or Phone		
Power Supply 125-A	Provides power for simultaneous operation of 2 RF units on CW or 1 RF Unit on CW and 1 RF Unit on Phone		
Audio Amplifier 136-A	Provides voice modulation of any one RF unit at full rated output		

*Each RF unit is independent of all others—HF, VHF, and LF can be used in the same transmitter if desired.

Federal Telephone and Radio Corporation

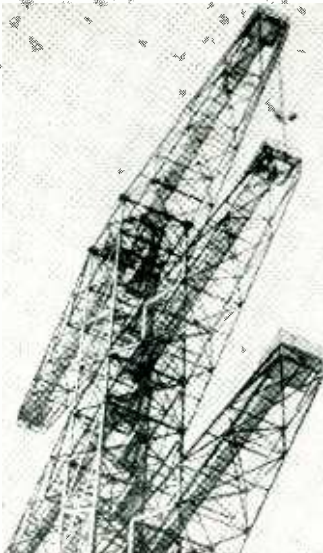
100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

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



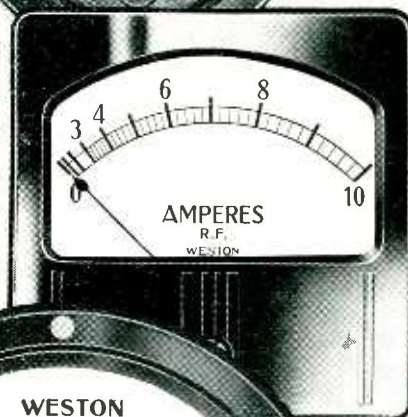
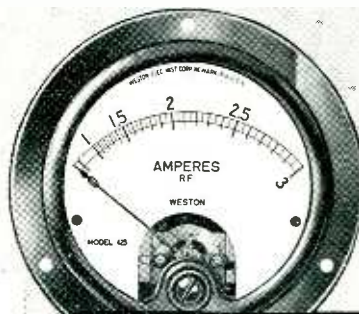
KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

**For Antenna Current Measurements
at Television and FM frequencies!**



WESTON

*High Frequency
Thermo Ammeters*



WESTON thermo ammeters are particularly designed for more accurate measurements of *very high frequency* antenna current in present FM and Television installations.

The thin-walled tubular heater*, an exclusive WESTON development, substantially reduces skin effect, thus providing vastly improved accuracy at the higher frequencies. Meeting FCC requirements, these instruments are available in sizes and ranges for all needs. Also vacuum-type thermocouple instruments for milliampere ranges. Ask your local WESTON representative, or write Weston Electrical Instrument Corporation, 618 Frelinghuysen Avenue, Newark 5, New Jersey.

*Patent 2,100,260

WESTON
Instruments

ALBANY · ATLANTA · BOSTON · BUFFALO · CHARLOTTE · CHICAGO · CINCINNATI · CLEVELAND · DALLAS · DENVER · DETROIT · JACKSONVILLE · KNOXVILLE · LITTLE ROCK · LOS ANGELES · MERIDEN · MINNEAPOLIS · NEWARK
NEW ORLEANS · NEW YORK · PHILADELPHIA · PHOENIX · PITTSBURGH · ROCHESTER · SAN FRANCISCO · SEATTLE · ST. LOUIS · SYRACUSE · IN CANADA, NORTHERN ELECTRIC CO., LTD., POWERLITE DEVICES, LTD.

for UNVARYING SPEED!



NOTE—RECORDER APPLICATIONS

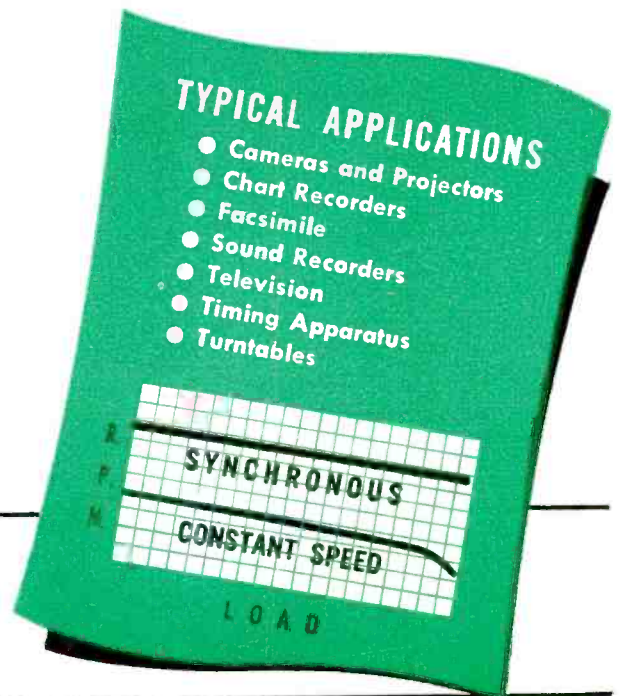
Certain types of these Synchronous Motors are specifically designed for use in disc and recorder applications where extremely low noise level is essential. May we demonstrate?

115 VOLTS—60 CYCLES—CONTINUOUS DUTY			
CLASSIFICATION	H.P.	SPEED	REMARKS
SYNCHRONOUS (Capacitor start and run)	1/30, 1/50,	1800 RPM and 3600 RPM	Totally enclosed. Sleeve or ball bearings.
	1/100, 1/200		
OTHER EAD MOTORS			
INDUCTION (Capacitor start and run)	1/12, 1/15,	1600 RPM and 3200 RPM	Totally enclosed. Sleeve or ball bearings.
	1/20, 1/30,		
	1/50		
SHADED POLE	1/15, 1/30,	1500 RPM	Totally enclosed. Sleeve or ball bearings.
	1/50, 1/100		



EASTERN AIR DEVICES, INC.

585 DEAN STREET • BROOKLYN 17, N. Y.



Check first with **ERIE RESISTOR**

- ✓ **YOU CAN SAVE SPACE**
- ✓ **YOU CAN CUT COSTS**
- ✓ **YOU CAN INCREASE EFFICIENCY**



- ✓ **by using ERIE "GP" CERAMICONS*
for general purpose applications**

THE low price of ERIE "GP" Ceramicons is not attained by sacrifice of quality, but by mass production methods; and mass production methods are possible because of the wide field of application—wherever the condenser is not directly frequency determining.

But the economy of ERIE "GP" Ceramicons is not due alone to their low price. They save space because high capacities are available in extremely compact sizes, and because the tubular shape is in itself space-saving

compared to condensers of rectangular shape in equal capacity. ERIE "GP" Ceramicons also speed up production, because they are easy to handle in the assembly line.

These Ceramicons have excellent electrical properties, with higher resonant frequencies, a factor of increasing importance with the trend to FM and Television.

ERIE "GP" Ceramicons are made in insulated styles in popular capacity values up to 5000 MMF., and in non-insulated styles up to 10,000 MMF. Write for details and samples.

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

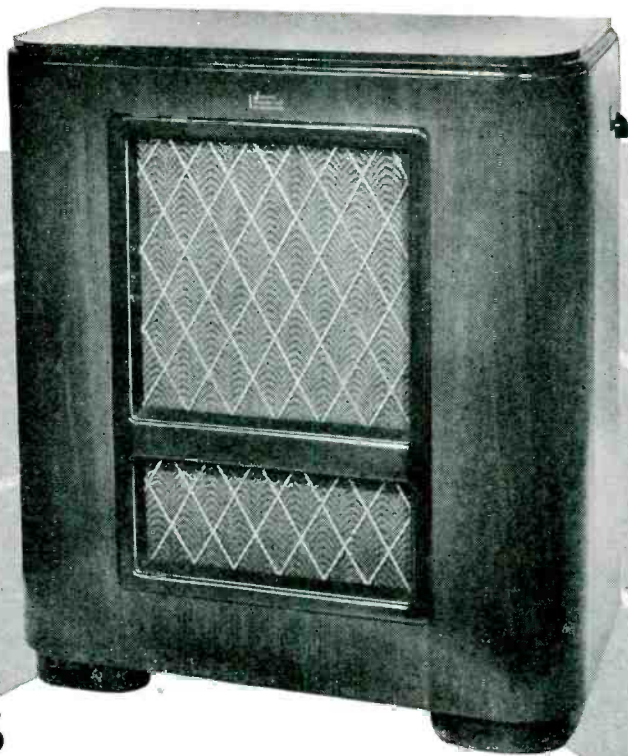


Electronics Division
ERIE RESISTOR CORP., ERIE, PA.
LONDON, ENGLAND • • TORONTO, CANADA

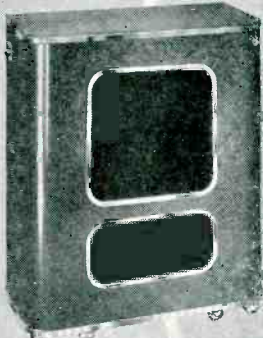
Jensen

Bass Reflex

CABINETS

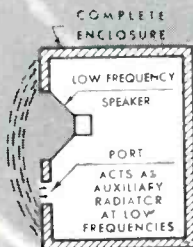


Three types—six models to accommodate 6", 8", 12" and 15" speakers



TYPE 3 Bass Reflex Cabinets are manufactured in sizes for 8", 12" and 15" speakers. A superior new wood composition in outer walls and panels assures distinguished appearance at a modest price. Finish is an attractive, baked-on hammerloid, trim is of chromium and aluminum.

BASS REFLEX PRINCIPLE: Through exact acoustical proportioning of the completely enclosed cabinet, and the use of an auxiliary port, the port is made an auxiliary radiator at low frequencies. This controlled use of what otherwise would be waste energy increases efficiency.



*TYPE J PERI-DYNAMIC (Model J-61) CABINET is a wall-mounting style which takes any standard six inch speaker. Handsomely styled of a textured composition material, it is complete with mounting bracket. A five-lug terminal board facilitates installation.

Meeting the high engineering and appearance standards which for years have been a Jensen hallmark, these new Bass Reflex cabinets provide acoustically correct enclosures for Jensen speakers. They are particularly suitable for Jensen Coaxials.

All of them (except the J-61) employ the widely heralded Jensen Bass Reflex principle. This, together with special acoustical treatment, assures maximum extension of low frequency response, and freedom from objectionable "boom" or resonance.

See these new cabinets today at your dealers—or write for full information and prices.

ABOVE RIGHT: New Type D Deluxe Bass Reflex Cabinets are available for either 12" or 15" speakers. Exterior styling is by a noted designer; construction by one of the nation's foremost furniture manufacturers. All hard woods are of selected striped walnut. Finish is natural walnut rubbed to a satiny smoothness.

JENSEN MANUFACTURING COMPANY

6607 SOUTH LARAMIE AVENUE • CHICAGO 38, ILLINOIS

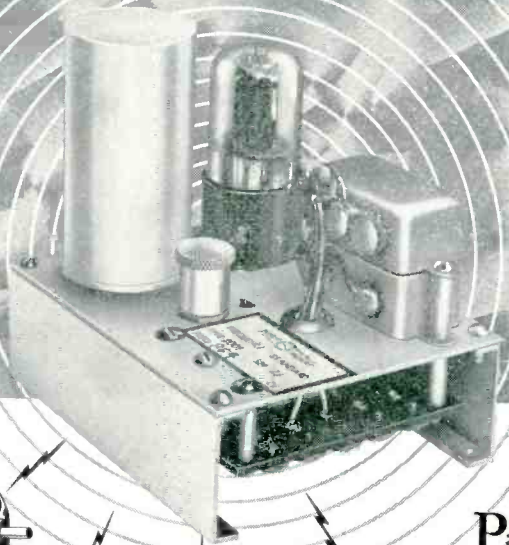
In Canada: Copper Wire Products, Ltd.,
137 Oxford St., Guelph, Ontario



Jensen

Designers and Manufacturers of Fine Acoustic Equipment

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

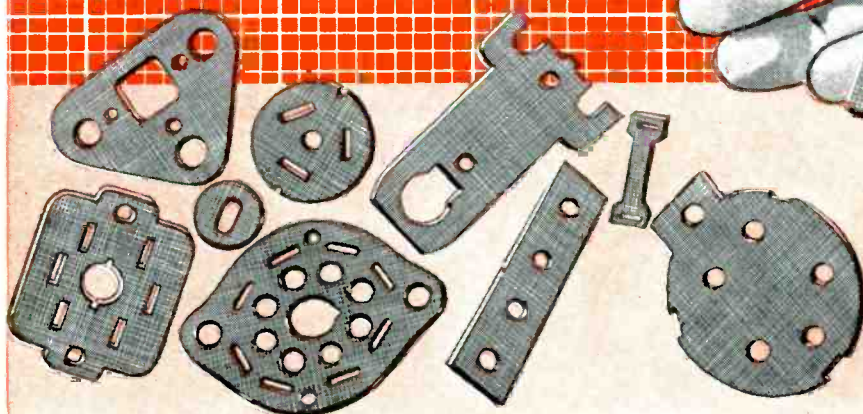
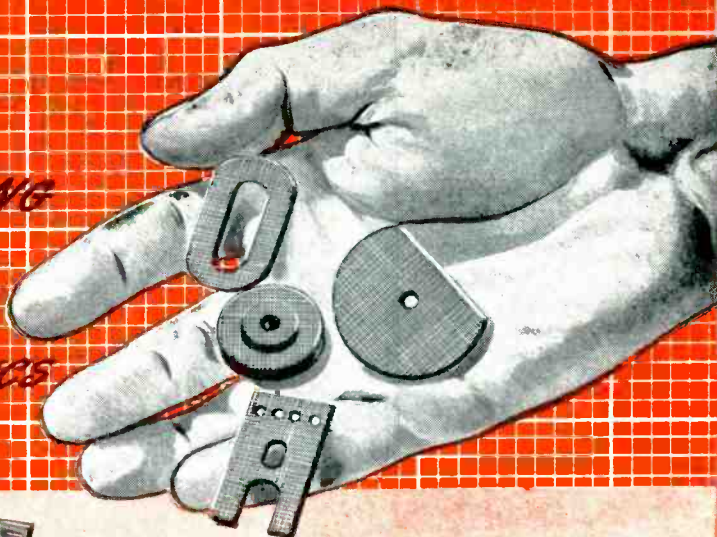
American Time Products, Inc.

580 Fifth Avenue

New York 19, N. Y.

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

PROBLEM—
 DEVELOP A LAMINATED
 PLASTICS MATERIAL HAVING
 EXCELLENT ELECTRICAL
 PROPERTIES—EXCEPTIONAL
 MACHINING CHARACTERISTICS



G-E Textolite grade No. 1841 punches and machines exceptionally well. It is used for critical circuits where intricate punchings with slots close together and holes near the edge are necessary. No. 1841 has low moisture absorption, and the decrease in electrical properties in the presence of water or high humidity is very small for a fabric-base grade of laminated plastics.

**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.

YOU GET A CHOICE

The laminated plastics parts shown above were punched from G-E Textolite grade 1841. But grade 1841 is just one of the many grades of G-E Textolite available. There are more than fifty, and each has a special combination of properties. This variety of grades assures you that the one specified for your particular application will do the job. For to be successful in any application a laminated plastics must have the correct properties . . . with Textolite you get a choice.

Yes! G-E Textolite is supplied in many grades, however, these grades are also supplied in many forms—sheets, tubes, and rods; fabricated parts; molded-laminated parts; low-pressure laminated parts; post-formed laminates. Again you get a choice. Plastics Division, Chemical Department, General Electric Company, Pittsfield, Mass.

GET THE COMPLETE STORY!

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

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

**PLASTICS DIVISION (AC-8), CHEMICAL DEPARTMENT
 GENERAL ELECTRIC COMPANY
 ONE PLASTICS AVE., PITTSFIELD, MASS.**

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

Name

Firm

Address

City State

GENERAL  ELECTRIC
CD47-E3

MAKING TUBES IS

Easy

IF YOU KNOW HOW!

Life racks (sides) and voltage distribution panels (rear) at Hytron's Newburyport plant. Up to 2980 tubes can be life-tested simultaneously.

TO GIVE YOU TUBES THAT LIVE LONGER

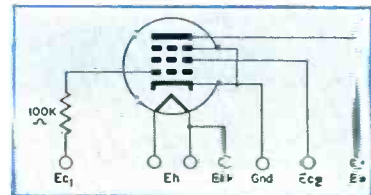
Tubes are like folks. Some live longer than others. That is why you are protected by your Hytron service guarantee. More important to you, statistical information amassed by continual life testing provides Hytron engineers with the means to control and extend the life of the average tube.

Of necessity, life tests are limited samplings. An adequate number of tubes from each day's production are plugged into life racks. Positive potentials are patched in from distribution panels. The life racks themselves supply other potentials. Time meters count the hours of operation. Cycling controls permit adjustable intermittent tests. Repetitive, paralleled circuits, such as those diagrammed, simulate worst-possible maximum operating conditions.

Tubes run to predetermined life test end points — adequate to control deterioration of characteristics during normal life. At frequent intervals, engineers check important characteristics like transconductance, gas current, and power output. Special dynamic life tests help determine ratings and overload capabilities of newly developed tubes. For example, the 5516 was life-tested intermittently and continuously at 160 mc.

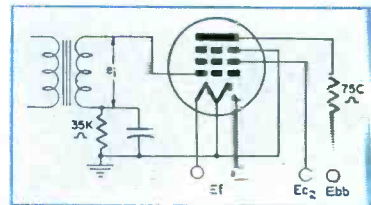
Life will vary from tube to tube. But such careful, persistent checking makes it much easier to assure you of uniform Hytron tubes which live longer.

STATIC LIFE TEST — 6SK7GT



Static class A amplifier with fixed bias, maximum operating potentials, and heater-cathode potential to test breakdown of h/k insulation.

DYNAMIC LIFE TEST — 2E30



Dynamic class C amplifier with grid leak bias and maximum operating potentials. Note rms voltage in series with rectified d-c grid potential.

SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS





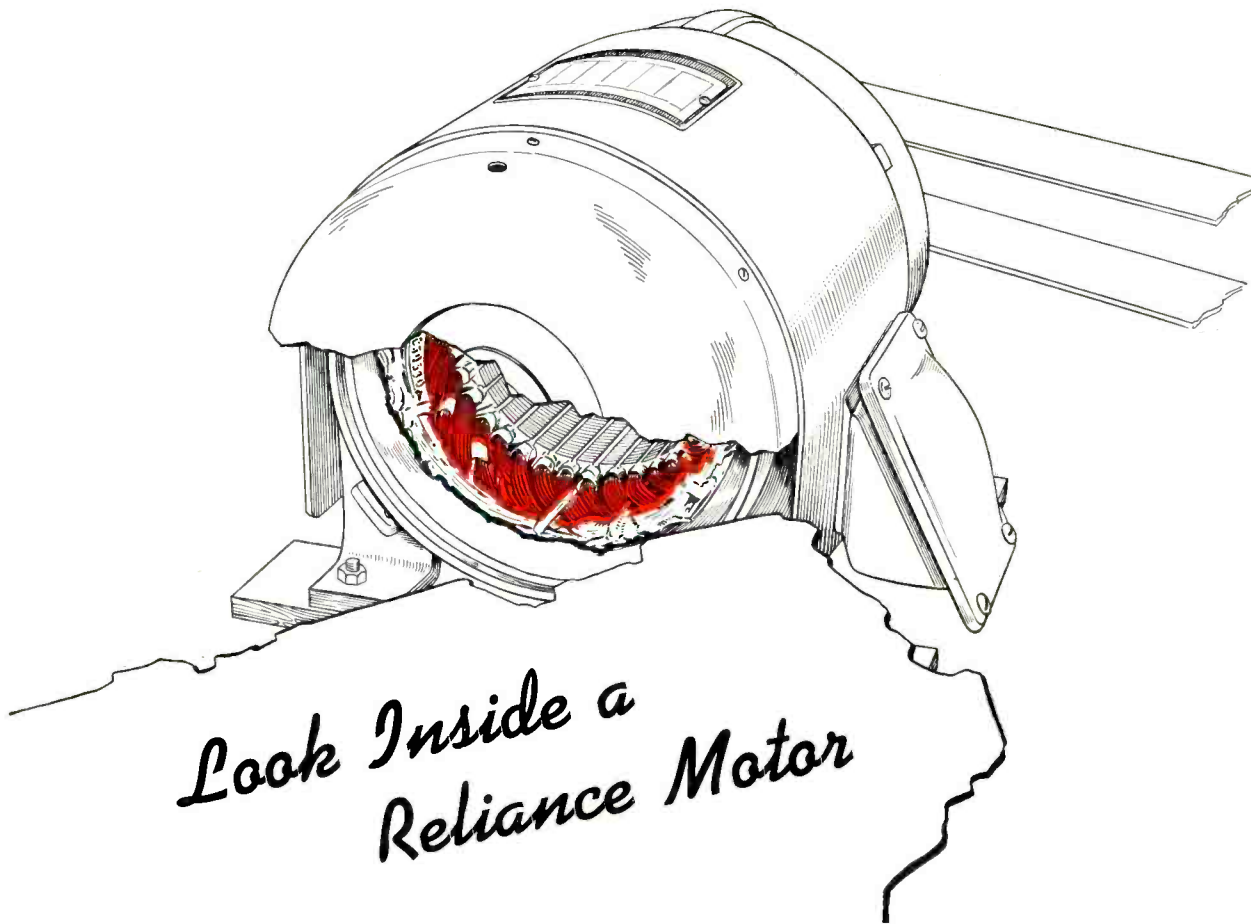
Continuously **VARIABLE**

CAPACITANCE "ON-THE-NOSE" FOR HIGH CURRENT, HIGH POWER ELECTRONIC CIRCUITS

The variable capacitance feature of Lapp Gas-Filled Condensers permits you to "tune-to-a-whisker," with power on, to get the most out of any high current, high power circuit. And once set, this gas-dielectric unit delivers uniformly—no "warm up," no change of capacitance with change in temperature. Non-deteriorating, too, the Lapp unit is truly puncture-proof and will outlast almost any other components of any circuit of which it is a part. In addition to the variable unit, there are adjustable units, continuously adjustable within their range but not designed for frequent "tuning dial" adjustment, and fixed capacitance units. Current ratings range up to 500 amperes R.M.S.; power ratings to 60 Kv peak load. Capacitance to 60,000 mmf. (for fixed units); to 16,000 mmf. (variable and adjustable units). Higher ratings on special design order.

Lapp

LAPP INSULATOR COMPANY, INC., LE ROY, NEW YORK



Motors that run 24 hours a day require rugged insulation — especially when subjected to high temperatures.

The makers of Reliance Precision-Built Motors use Ben-Har Special Treated Fiberglas Tubing for tough insulation jobs.

Ben-Har is used for motors carrying a heavy current load or for motors operating in high ambient temperatures. It's essential that the insulation in motors have high dielectric strength and heat resistance that will not break down under

constant use or heat. The flexibility and uniformity of Ben-Har are great production advantages.

Try Ben-Har in your plant, in your own product—under actual service conditions. See for yourself how Ben-Har remains flexible . . . will not split, crack or fray at the ends. Notice that it will not support combustion. The value of Ben-Har is proved by daily use in a wide variety of applications—from hearing aids to movie projectors, from watt-hour meters to television receivers.

BENTLEY, HARRIS MFG. CO., CONSHOHOCKEN, PA.

BH *Fiberglas** SLEEVINGS

*BH Non-Fraying Fiberglas Sleeveings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

USE COUPON NOW

Bentley, Harris Mfg. Co., Dept. E-13, Conshohocken, Pa.

I am interested in Ben-Har Special Treated Fiberglas Tubing _____ for _____
 (size) (product)
 operating at temperatures of _____°F. at _____volts. Send samples so I can see for myself
 how Ben-Har will not crack in a bend, will not support combustion.

NAME _____ COMPANY _____

ADDRESS _____

Send samples, pamphlet and prices on other BH Products as follows:

- Cotton-base Sleeveing and Tubing
- Non-fraying Fiberglas Sleeveing

TWO POPULAR RECTIFIER TUBES

for broadcast,
communications,
and other work

... better built for
more hours of
topgrade performance!



GL-8008

GL-673

RATINGS

	GL-8008	GL-673
Cathode voltage	5 v	5 v
current	7.5 amp	10 amp
Typical heating time	30 sec	30 sec
Anode peak inverse voltage	10,000 v	15,000 v
peak current	5 amp	6 amp
avg current	1.25 amp	1.5 amp



Heavy-duty bases, with large pin-contact area, are one of many features that give these mercury-vapor phanotrons the dependability needed for 24-hour broadcast-station use—extra reliability for police-radio, aviation, and other exacting communications work—the steady efficiency required to convert power for small d-c industrial equipment operating on full schedule.

Minimum temperature rise is an especially valuable characteristic of Types GL-8008 and GL-673. Installation of these tubes reduces the cooling problem for broadcast-station and factory engineers.

Less mounting space needed... this is an important result of the straight-side envelope design in contrast to the bulb shape of older types. Maintenance men, too, report that the

straight-side contour makes Types GL-8008 and GL-673 easier to handle, and helps ward off accidental tube breakage.

Sturdy, shock-resistant... these qualities stem from the modern structural design of the GL-8008 and GL-673—their strongly braced cathodes, and their nickel anodes which, lighter in weight than others, put less strain on the seal above them, enabling the latter to withstand shocks and vibration better.

General Electric builds a complete line of phanotron rectifier tubes—15 types in all, matching every broadcasting, communications, or industrial need. Your nearby G-E tube distributor or dealer will be glad to give you prices and full details. Phone him today! *Electronics Department, General Electric Company, Schenectady 5, N. Y.*

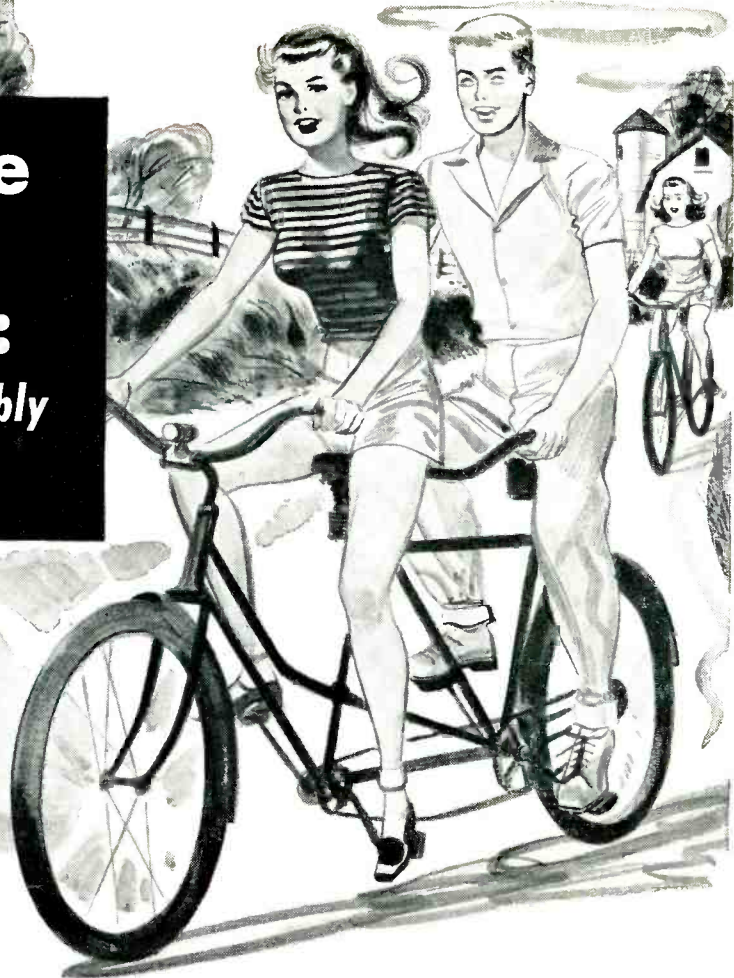
G.E.'s new Transmitting Tube Manual is the most complete book in its field! Profusely illustrated; packed with application data. Over 600 large pages. Price \$2, with an annual service charge of \$1 for new and revised pages to keep the manual up-to-date. Order direct from General Electric Company.

GENERAL ELECTRIC

1G1-F3-8850

FIRST AND GREATEST NAME IN ELECTRONICS

**It's a Bicycle
built for
2 Purposes:
Faster, Low Cost Assembly
— Easier Selling**



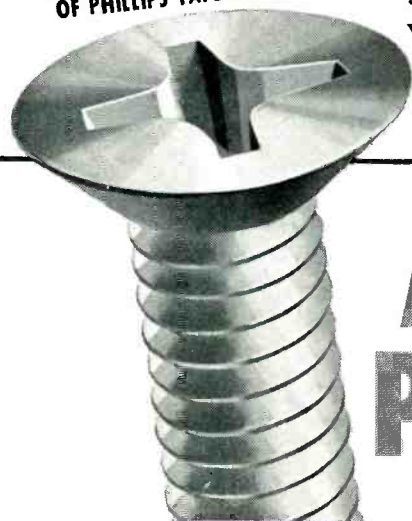
when you use AMERICAN PHILLIPS SCREWS

IN PRODUCTION — Here's the modern way to get the lower costs everyone wants — thru automatic, high-speed screw driving. Screw heads can't burr. Drivers can't slip. Work cannot be spoiled. Fingers can't fumble. And whether you're "buttoning up" bicycles or radios, appliances or airplanes, you cash in on time-savings up to 50%!

IN PROMOTION — Showmanship and salesmanship *go up* when American Phillips Screws *go in!* They look modern, *are* as modern as this minute. Buyers right down the line — jobbers, dealers, consumers — like their smart looks and the story they clearly tell of long service and solid construction. Write, wire, or phone for these production-promotion advantages today.

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND
Chicago 11: 589 E. Illinois St. Detroit 2: 502 Stephenson Building

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



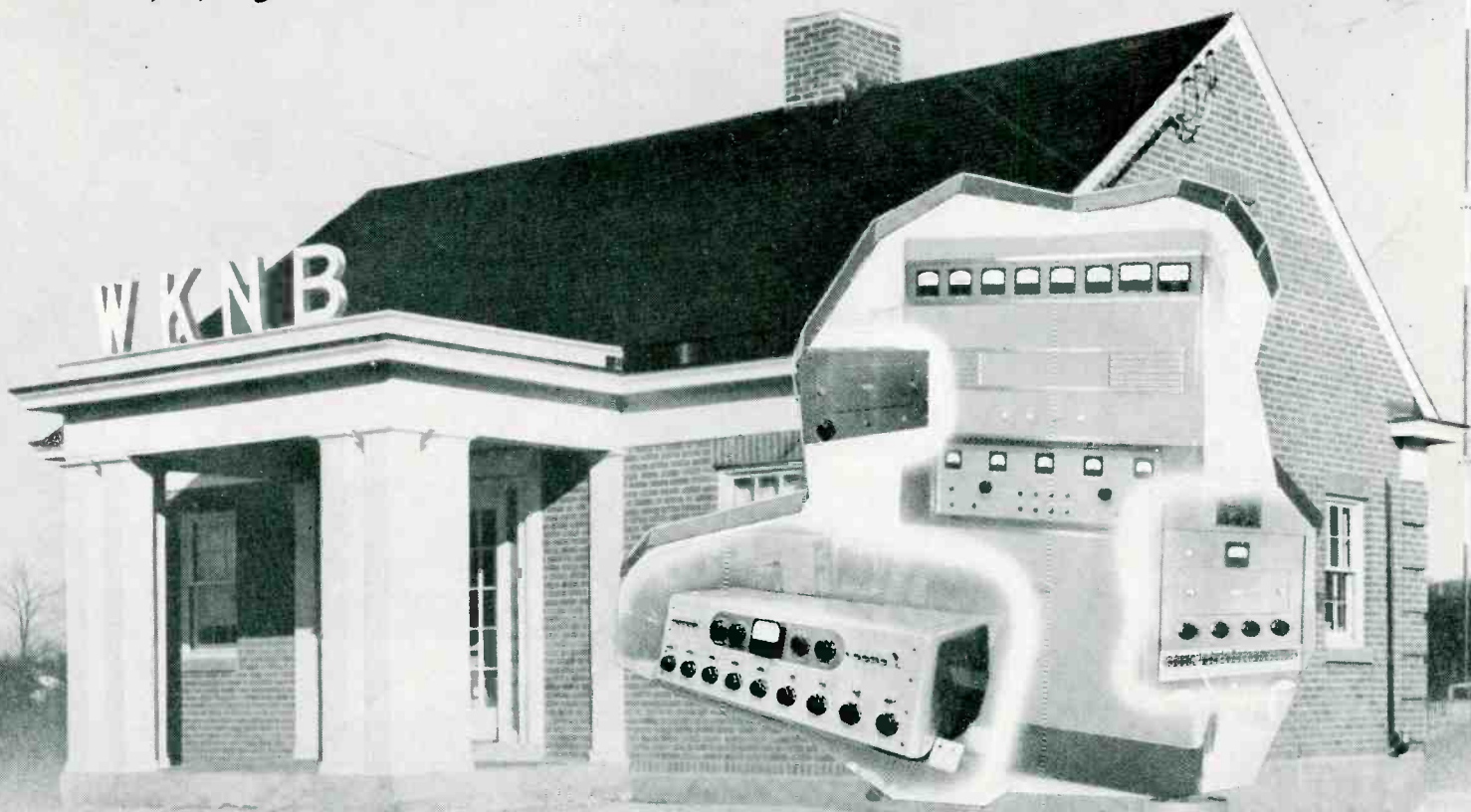
**AMERICAN
PHILLIPS**

Screws



ALL TYPES
ALL METALS: Steel,
Brass, Bronze, Stain-
less Steel, Aluminum,
Monel, Everdur (sili-
con bronze)

Happy Anniversary, WKNB...



Raytheon equipment installed includes: RM-10 Monitoring Amplifier; RL-10 Limiting Amplifier; RC-10 Studio Console; R9 1000 Watt AM Transmitter.

AND *More Power* * TO YOU!

Every day for twelve consecutive months New Britain's WKNB has been operating on the Raytheon equipment shown. Owner and engineers now *know from experience* that Raytheon is truly "the finest in broadcast equipment." Result: When WKNB is

Meet Chris Brauneck...

Here's the chap who helped select and procure the Raytheon equipment and associated items for WKNB... and, incidentally for many other New England stations. He is typical of the high type Raytheon representatives who are ready to work with you:



CHRISTIAN BRAUNECK
1020 Commonwealth Ave.
Boston, Massachusetts
Tel. Aspinwall 6734

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60 East Forty-Second Street
New York 17, New York
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W. B. TAYLOR
Signal Mountain
Chattanooga, Tennessee
Tel. 8-2487

ADRIAN VAN SANTEN
Fifth and Spring Streets
Seattle, Washington
Tel. Eliot 6175

COZZENS & FARMER
7475 North Rogers Avenue
Chicago 26, Illinois
Tel. Ambassador 0712

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414 West Tenth Street
Dallas 8, Texas
Tel. Yale 2-1904

EMILE J. ROME
215 West Seventh Street
Los Angeles, California
Tel. Tucker 7114

ready to use *more power, they will buy their equipment from Raytheon!

Users the country over are enthusiastic about the high fidelity, servicing accessibility and low-cost maintenance of Raytheon AM and FM broadcast equipment. They find it greatly facilitates setting up programs, with operation so simple and logical that errors are cut to a minimum.

Get the facts before you buy. Write for illustrated bulletins and technical data on the complete line of Raytheon Speech Input Equipment and AM and FM Transmitters ranging from 250 to 10,000 watts.

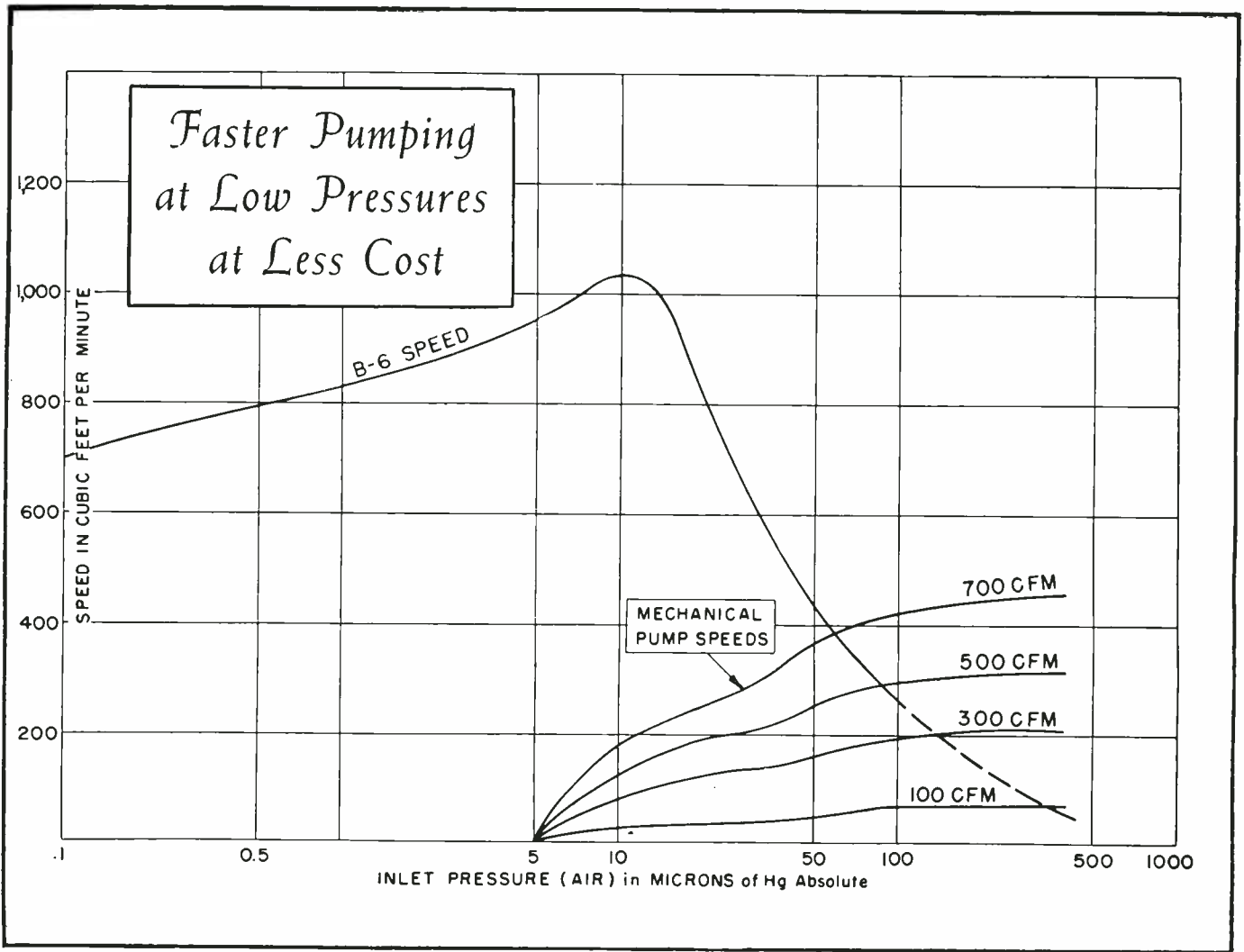
RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY
COMMERCIAL PRODUCTS DIVISION
WALTHAM 54, MASSACHUSETTS

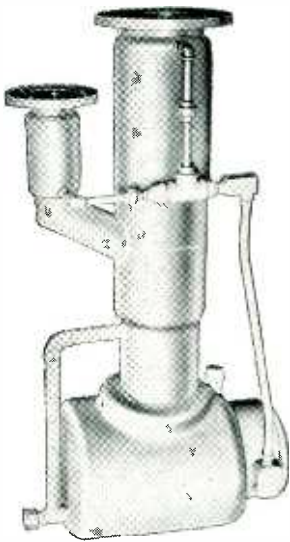
Industrial and Commercial Electronic Equipment, Broadcast Equipment,
Tubes and Accessories

Sales offices: Boston, Chattanooga, Chicago,
Dallas, Los Angeles, New York, Seattle



The B-6 BOOSTER TYPE DIFFUSION PUMP is worth investigating for Vacuum

*Evaporation, Sputtering, Dehydrating, Impreg-
nating, Distilling, or Degassing.*

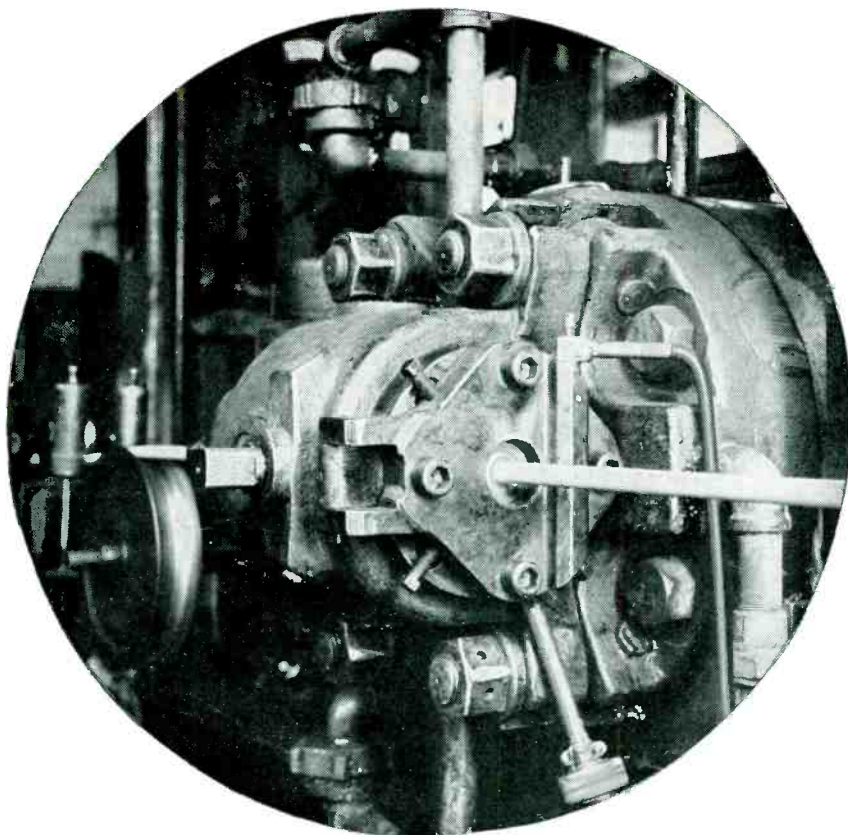


A mechanical pump can be made more effective in the micron pressure range by supplementing it with a B-6 Booster Type Diffusion Pump, or a large mechanical pump may be replaced entirely by the more efficient and less expensive combination of the B-6 and a small forepump.

The savings in capital investment, operating cost and installation space may surprise you. Write to National Research Corporation, Cambridge 42, Mass.

HIGH VACUUM FOR INDUSTRY
NATIONAL RESEARCH CORPORATION
Vacuum ENGINEERING DIVISION

Picture
of **YOUR**
cable
requirements
being
protected
by



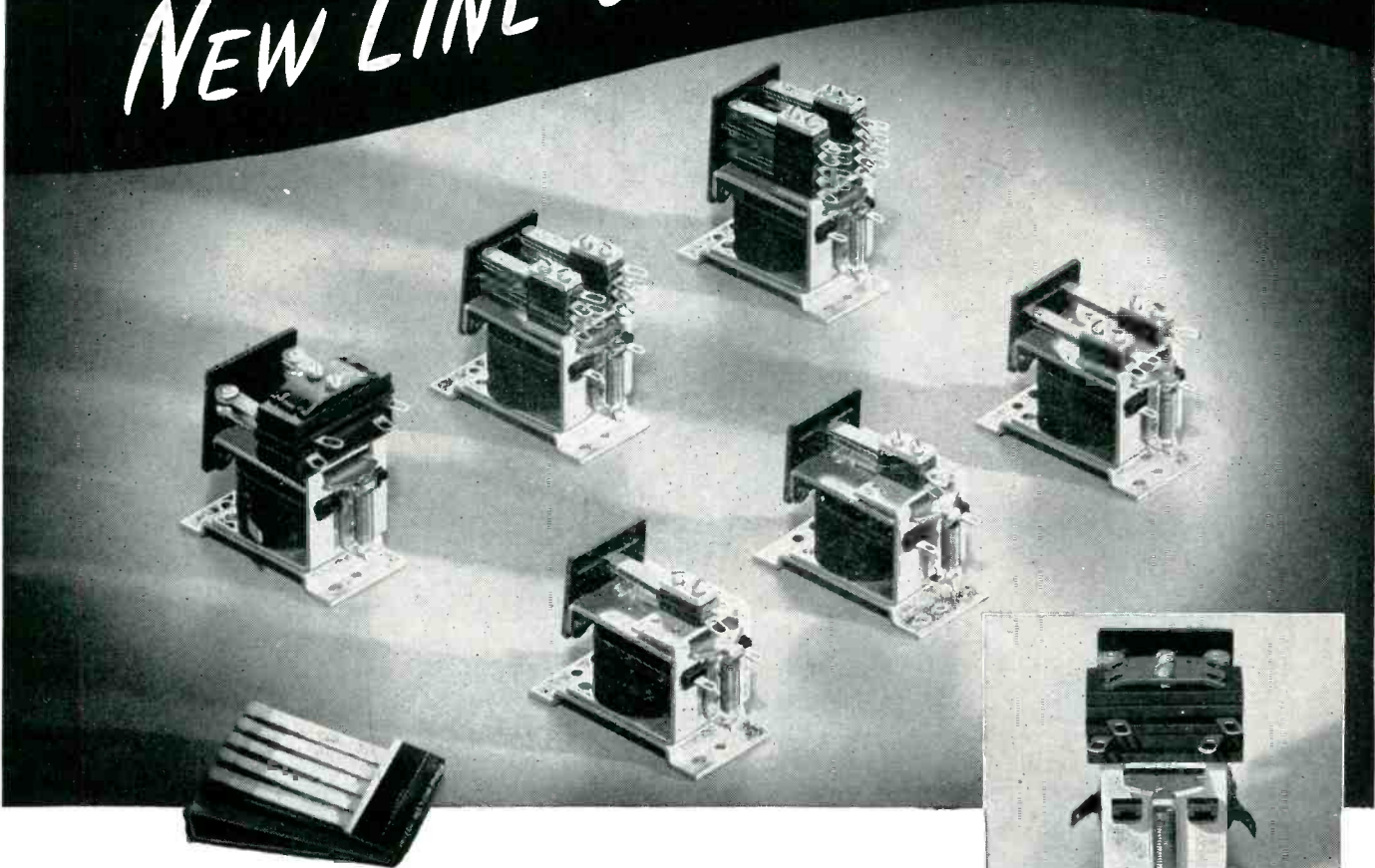
★ **ANSONIA** ★
Ankoseal



Complicated control cables or relatively simple communications wiring, your cables will last longer and give better service when coated with Ankoseal. Equally as important, you will secure a cable that is precisely engineered for your job.

THE ANSONIA ELECTRICAL DIVISION
ANSONIA, CONNECTICUT *of*
NOMA ELECTRIC CORPORATION

VERSATILE NEW LINE OF... A·C AND D·C RELAYS



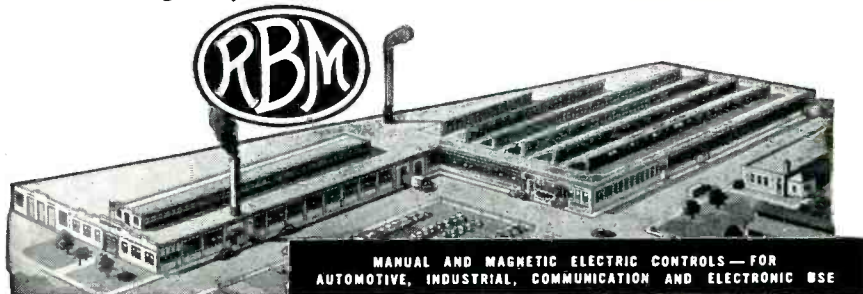
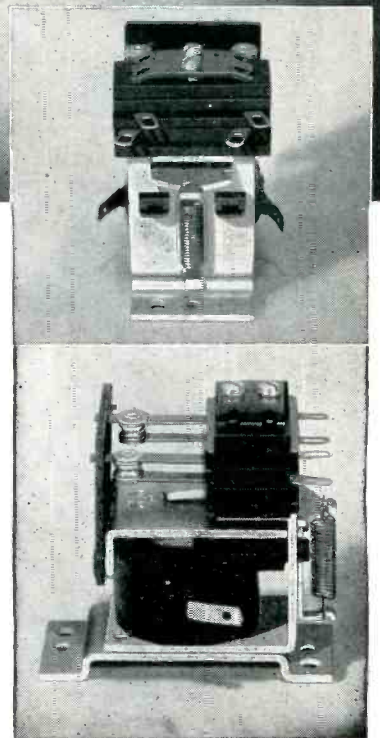
**EXCEPTIONALLY SMALL AND COMPACT
YET EXTREMELY RUGGED!**

● R-B-M announces a new line of general purpose magnetic relays, with either A.C. or D.C. shunt coils or series coils, for electronic applications.

Relays are available in standard contact arrangement of single and two pole normally open, normally closed; or double throw with light and heavy contacts. Four and six pole double throw relays are available with 3 ampere contacts at 32 volts or less.

Insert shows double pole, normally open contactor rated 12 amperes, 115 volts, A.C., and 6 amperes at 230 volts, A.C. This relay is designed in accordance with Underwriters' specifications and will ultimately carry Underwriters' Approval for Small Devices classification. For further information write for Bulletin 570. Address Department A-8

R-B-M DIVISION
ESSEX WIRE CORPORATION
Logansport, Indiana



CORNELL-DUBILIER RADIO-NOISE LABORATORY



An Invitation from C-D
 WORLD'S MOST ADVANCED RADIO
 "NOISE-PROOFING" LABORATORY
 IS AT YOUR SERVICE
without obligation

**Make Your Product More Sale-
 able With C-D Quietone Inter-
 ference and Spark Suppressors**



CORNELL-DUBILIER
 WORLD'S LARGEST MANUFACTURER OF
CAPACITORS

The finest noise elimination laboratory, under the supervision of the pioneer in the field of capacitor noise-filtering, is at your service.

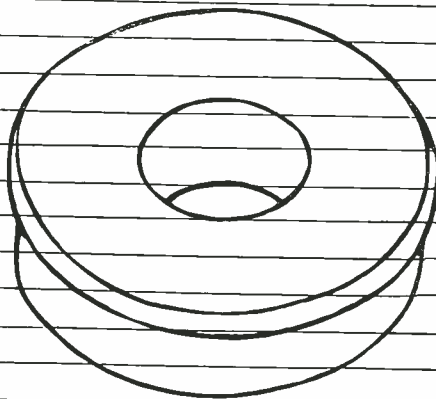
A simple way to accept this invitation from Cornell-Dubilier: — send a sample of the equipment or appliance you want noise-proofed to *our* laboratory — make full use of its facilities — consult with our engineers as though they were on your own payroll. *That's the way to solve your noise and spark suppression problems quickly and efficiently.* There is absolutely no charge for this service.

No other capacitor manufacturer can equal C-D's thirty-seven years of experience in the design and manufacture of noise filters and spark suppression devices for every conceivable type of electronic and electrical equipment. Cornell-Dubilier Electric Corporation, Dept. K-8, South Plainfield, N. J. Other large plants in New Bedford, Brookline and Worcester, Mass., and Providence, R. I.

MICA ★ DYKANOL ★ PAPER ★ ELECTROLYTIC

Problems solved by Richardson...in Plastics

#1--Non-Corrosive, Abrasion Resisting, Conveyor Wheel.



Problem: To produce a conveyor wheel for a bottle vending machine which would be not only non-corrosive but resistant to the abrasive action of the conveyor chain moving around its periphery and still serve as its own self-lubricating bearing.


Solution: Laminated INSUROK graphitized fabric was recommended and approved for machining to size. After field tests had proved this material selection, quantity production was required and the economies of molding became evident. As Richardson facilities include both operations, INSUROK graphitized molding materials of desirable properties were produced and no lost time was expended in the change-over.

INSUROK Precision Plastics—INSUROK is the family name of a great variety of laminated and molded plastic products produced by Richardson. Laminated INSUROK is available in sheets, rods, tubes, punched and machined parts, made from paper, fabric, melamine, etc. Molded INSUROK products are made from Beetle, Bakelite, Plaskon, Tenite, Styron, Durez, Lucite, etc., by compression, injection and transfer molding.

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Sales Headquarters: MELROSE PARK, ILL. FOUNDED 1858 LOCKLAND, CINCINNATI 15, OHIO
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PHILADELPHIA 40, PA., 3728 NO. BROAD STREET Sales Offices MILWAUKEE 3, WIS., 743 NO. FOURTH STREET
CLEVELAND 15, OHIO, 326-7 PLYMOUTH BLDG. • DETROIT 2, MICH., 6-252 G. M. BLDG. • ST. LOUIS 12, MO., 5379 PERSHING AVENUE
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RICHARDSON MEANS *Versatility* IN PLASTICS



Why the *Lock-In* Tube is at home **IN THE AIR!**

COMPACT . . . MADE TO FIT SMALL SPACES

This famous Sylvania product is ideal for use in air-borne radio equipment—it's so compact . . . has reduced overall height and weight. Further, it has no top cap connection . . . overhead wires are eliminated.

STAYS PUT IN SOCKET...THROUGH LOCK-IN FEATURE

No matter how rough the air, the tubes in an aircraft's radio will stay in their sockets—if those tubes are *Lock-Ins*. Specially designed "lock-in" locating lug on each tube keeps them in place—assuring firm socket contact.

ULTRA-HIGH FREQUENCIES...HANDLED WITH EASE

Lock-In is the tube specifically engineered to more than satisfy the requirements of today's sets, as well as handle ultra-high frequencies with ease! Electrical features include: short, direct connections . . . fewer welded joints—less loss; getter located on top . . . shorts eliminated by separation of getter material from leads. See *Sylvania Distributors or write Radio Division, Emporium, Pa.*

SYLVANIA ELECTRIC



SYLVANIA'S LOCK-IN TUBE...

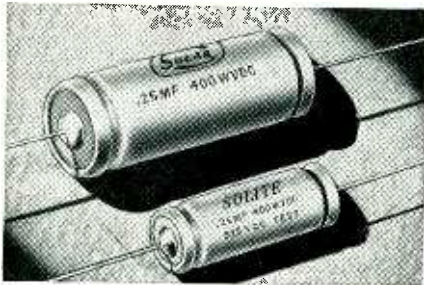
... the radio tube whose electrical and mechanical superiority makes it the ideal choice for equipment in the air, on the road, marine radar, FM and television.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS



electronics edition • August 1947

SOLITE* CAPACITORS IN HERMETICALLY SEALED METAL TUBES



THESE hermetically sealed small-size full-performance units fill a long-voiced demand on the part of designers of compact electronic devices. In addition, their self-healing characteristics are a noteworthy improvement in the capacitor art.

The photograph shows the space saving possible through the use of a .25 mf, 400 wvdc SOLITE aluminized paper capacitor instead of a conventional foil-paper unit. Mineral-wax filled and impregnated, SOLITE capacitors are designed for operation at ambient temperatures up to 85C.

These metal-encased tubular units are furnished with both insulated and uninsulated sections as Solar Types XTILWO and XTGLWO, respectively.

For cardboard or plastic outer sleeving, change the letter "O" in the type designation to "P" or "V" respectively.

Preferred ratings are as follows:

Catalog Number†	Mf	WVDC	Dimensions in inches‡	
			Diam.	Length
XTILWO2-.05	.05	200	3/8	2 9/32
XTILWO2-.1	.1	200	7/16	2 9/32
XTILWO2-.25	.25	200	1/2	2 9/32
XTILWO2-.5	.5	200	1/2	1 13/32
XTILWO2-1	1.0	200	.670	1 13/32
XTILWO2-2	2.0	200	.670	1 13/32
XTILWO2-4	4.0	200	1.0	1 13/32
XTILWO2-6	6.0	200	1.0	1 13/32
XTILWO4-.05	.05	400	1/2	2 9/32
XTILWO4-.1	.1	400	1/2	1 13/32
XTILWO4-.25	.25	400	.670	1 13/32
XTILWO4-.5	.5	400	.670	1 13/32
XTILWO4-1	1.0	400	3/4	2 13/32

Capacitance Tolerance: -20, +30 Percent, unless otherwise specified.

‡For grounded section XTGLWO units, deduct 1/8" from length.

†Add 1/16" to diameter and 1/8" to length for units with cardboard or plastic outer sleeving.

*Trade Mark



BUSINESS BRIEFS

By W. W. MacDONALD

Normal Is The Word most freely bandied about at RMA's recent Chicago convention to describe the state of the radio receiver business. Set manufacturers now fully realize that the honeymoon is over, with all that this implies regarding the dangers of overproduction, excessive inventories, and the need for aggressive selling.

Retiring president Cosgrove said the industry would produce 18,000,000 home and auto radios in 1947, including 2,000,000 sets capable of receiving f-m programs. Television receiver production, he thinks, might reach 250,000. Radio receiver exports are at present 5 percent of the total, should reach 10 percent by the end of the year.

Banquet keynoter Sarnoff struck an "all this and heaven too" note when he said that the industry had an extremely bright future selling f-m receivers, home, theatre and industrial television, and industrial electronic devices, while at the same time continuing to do a good business in conventional radios and, particularly, record-playing combinations.

Anti-Excise Tax Efforts on the part of radio receiver manufacturers, with RMA leading the parade, continue in high gear. Our Washington expert on matters pertaining to feeling up on the Hill says it will be strictly no dice this session. Continued repetition of the fact that radio is a necessity, not a luxury, will nevertheless someday pay off, however, and we're all for it.

Television Receivers are so popular in the taverns of Philadelphia that it is not unusual for people who have just purchased a set to find a barkeep offering a premium for it on their doorstep the day after the set is installed. Philco's Jim McLean tells us that an unofficial survey around town indicates that pubs frequently increase their business threefold on the nights good sports programs are telecast.

Our own unofficial surveying

among the taverns of New York, Chicago and cities in between indicates that the condition is widespread.

Electronic Equipment Prices concern just about everybody in the business. The other evening Bev Dudley, at one time Managing Editor of ELECTRONICS and now getting out MIT's *Technology Review*, engaged in some armchair research on the subject. He thumbed through the 1942 and 1947 catalogs of a well-known mail-order house, checking the prices of comparable items, and came up with the following tabulation:

Item	1942	1947	Ratio (%)
Five-tube three-way portable.....	\$15.95	\$37.95	238
Six-tube ac-dc table model.....	14.25	34.95	245
Communications receiver.....	259.60	553.85	136
Communications receiver.....	279.00	323.25	116
6V6 beam tube.....	.54	.75	139
80 rectifier.....	.32	.56	175
2A3 triode.....	1.13	1.33	118
6SK7 pentode.....	.54	.68	126
801A.....	3.45	3.00	87
807.....	3.60	2.30	66
Test oscillator.....	29.35	48.02	164
Audio oscillator.....	63.10	114.66	182
Signal generator.....	35.10	62.87	179
Capacitance analyzer.....	21.40	34.08	139
VU meter.....	23.52	25.87	110
Microphone.....	24.99	30.25	121
Microphone.....	14.70	16.08	109
12-inch electrodynamic speaker.....	10.14	19.40	191
A-B battery pack.....	3.55	5.62	158
Tuning capacitor.....	2.40	3.75	156
4-mfd 1,000 v. filter capacitor.....	3.67	5.58	152
4-mfd 1,000 v filter capacitor.....	2.79	4.23	152
Bell-ringing transformer.....	.46	.80	174
Universal driver transformer.....	2.21	5.10	231
Vernier dial.....	1.65	1.80	109
Crystal.....	7.75	8.75	113
Steel cabinet.....	3.80	5.59	147
Channel racks.....	10.70	16.17	151

Our Industry is well aware of the fact that it must sell itself to other industries; that it cannot expect the others to beat a path to its door. Conversation with an engineer employed by one of the largest automotive outfits in the country enroute to Chicago last month leads us to believe, however, that this consciousness of the need for selling does not go deep enough.

Several electronic engineers are employed by the automotive firm referred to above. They are good men. When mechanical and combustion engineers approach them for help in connection with a research or design problem, and tubes can solve the problem, the

NOW - A SIXTY-FIVE WATT

EIMAC TETRODE

TYPE

4-65A



- Hard Glass
- Non-Emitting Grids
- Instant Heating Filament
- Low Drive
- Low Voltage
- Low Feed-Thru Capacitance
- Low Cost

\$14.50

THE ANSWER TO THE TRANSMITTER-MAN'S PRAYER

Available now, type 4-65A is a small radiation cooled, instant heating tetrode. Devoid of internal insulating hardware, the 4-65A was designed as a transmitting tube . . . not a blown-up receiving tube. This rugged new Eimac tetrode really performs at low voltage, and its instant heating thoriated tungsten filament makes it ideally suited for mobile installations. The 4-65A operates well into the VHF, beyond the 160-Mc. band, and is capable of delivering relatively high-power with a plate voltage range from 400 to 3000 volts. As do other Eimac tetrodes, type 4-65A embodies the inherent characteristics of low grid drive, low feed-thru capacitance, and general stability of operation.

Type 4-65A's versatility of operation is demonstrated in the adjacent data showing typical operation at 400, 1000, and 2000 volts. Additional data on the 4-65A are now available, write direct.

EITEL-McCULLOUGH, Inc.
 1771 San Mateo Ave., San Bruno, California

TYPE 4-65A	
ELECTRICAL CHARACTERISTICS	
Filament: Thoriated tungsten	
Voltage	6.0 v
Current	3.5 amp
Grid-Screen Amp. Factor (Av.)	5
Direct Inter-Electrode Capacitances (average)	
Grid-Plate	0.08 μf
Input	8.0 μf
Output	2.1 μf
TYPICAL OPERATION	
Class C Telegraphy or FM Telephony (Key Down Conditions, 1 Tube)	
D-C Plate voltage	400 1000 2000 v
D-C Screen voltage	250 250 250 v
D-C Grid voltage	-40 -50 -70 v
D-C Plate current	100 125 125 ma
D-C Screen current	40 37 35 ma
D-C Grid current	13 16 16 ma
Peak R-F grid input voltage	135 155 180 v
Driving power (approx)	1.8 2.5 2.9 w
Screen dissipation	10.0 9.2 8.8 w
Plate power input	40 125 250 w
Plate dissipation	12 30 50 w
Plate power output	28 95 200 w

Follow the Leaders to **Eimac** REG. U. S. PAT. OFF. **TUBES** The Power of R-F

EXPORT AGENTS: FRAZAR AND HANSEN, 301 CLAY STREET
 SAN FRANCISCO 11, CALIFORNIA, U.S.A.

**36
TYPES
OF...**



**... INDUSTRIAL ELECTRON
TUBE SOCKETS**

by

AMPHENOL

To insure top performance and long uninterrupted tube life, leading manufacturers of electron tubes cooperated with Amphenol engineers in designing these new Industrial Sockets. With 36 types currently available, and more to come, Amphenol Sockets today are available for practically all electron tubes now in use.

Amphenol Industrial Electron Tube Sockets combine the best of design in terminals, contacts and insulation. Quick-connect screw type terminals simplify testing in original equipment and the replacement of sockets in older equipment. Cloverleaf contacts, an exclusive Amphenol feature, provide four full lines of contact to the tube pins and assure against loss of conductivity under the heavy current loads of industrial applications. Insulation materials have been chosen to provide maximum physical strength, high arc-resistance and reduced carbon tracking. Barriers provide extra safety factors.

These Amphenol Features Spell Top Efficiency

- ★ First to comply with N.E.M.A. and Underwriters' specifications for industrial equipment.
- ★ Rugged insulating barriers prevent flashover and arcing in humid and dusty industrial applications.
- ★ Reversible binding screw terminals simplify wiring and maintenance.
- ★ Cloverleaf contacts . . . four full length lines of contact with each tube pin.

See your parts jobber, or write today, for full technical and cost data on Amphenol Industrial Electron Tube Sockets.

AMERICAN PHENOLIC CORPORATION

1830 South 54th Avenue, Chicago 50, Illinois

COAXIAL CABLES AND CONNECTORS • INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT • ANTENNAS • RADIO COMPONENTS • PLASTICS FOR ELECTRONICS

help is forthcoming. That, says our informant, is good but not good enough. He believes the electronic engineers should familiarize themselves with the work being done by other engineers in the plant so that they can voluntarily suggest possible solutions, clinches his argument by insisting that the firm's electronics department is a service department, just as the safety department is a service department. . . . and who ever heard of research and development people asking safety people for help?

Taxicab Radio System construction permits issued up to July 1 by the FCC totalled 1,400 (10,000 mobile units). As near as we can find out, 217 systems (2,377 mobile units) have been installed by one manufacturer, and another 50 systems have been installed by other companies. Many more have been sold but not delivered.

Figures we've seen on the cost of taxicab radio vary from 67¢ to \$1.40 per day, per cab, for a 50-cab fleet. This covers amortization of the cost of the equipment, installation, and maintenance. Dispatcher's time is not included.

Mobile Radio is not without its hazards. A friend of ours who wanted to contact an experimentally-equipped car the other day picked up his telephone and asked for the mobile operator. After considerable delay a feminine voice said, in a conventional manner that made him suspicious: "Number please." So he repeated: "Is this the mobile operator?" Back came the voice: "Yassuh, this is Mobile. . . . Alabama."

Common Carrier Service on 152 mc for motoring doctors, salesmen and others who must remain in close contact with their offices is about to break out of the experimental into the commercial stage in several cities. Equipment will probably be rented.

Howard Hughes' Radar for commercial airplanes is coming off production lines at the rate of 50 per week, with initial production of 2,000 of the low-cost 16-lb devices planned. First shipments went largely to TWA for use in obstacle-

warning service aboard 128 transports. Several other airlines have ordered samples for experimental installation, after witnessing demonstrations. Use of two sets per plane, one for obstacle-warning service and the other for navigational use, is a possibility.

Technical Problems the Army, Navy and Coast Guard would like to lick include the following:

Development of 8,000-40,000 volt rectifier tubes having lower filament drain.

Storage batteries having more satisfactory performance at low temperatures.

More accurate gages to show the draft and trim of vessels at sea.

Simpler roll indicator for vessels.

Effective naval fog detector.

Electronic device for instantly, positively and effectively igniting oil burners.

Miniature radio transmitter for use in lifeboats, rafts and floats.

Continuous-sampling combustible gas indicator.

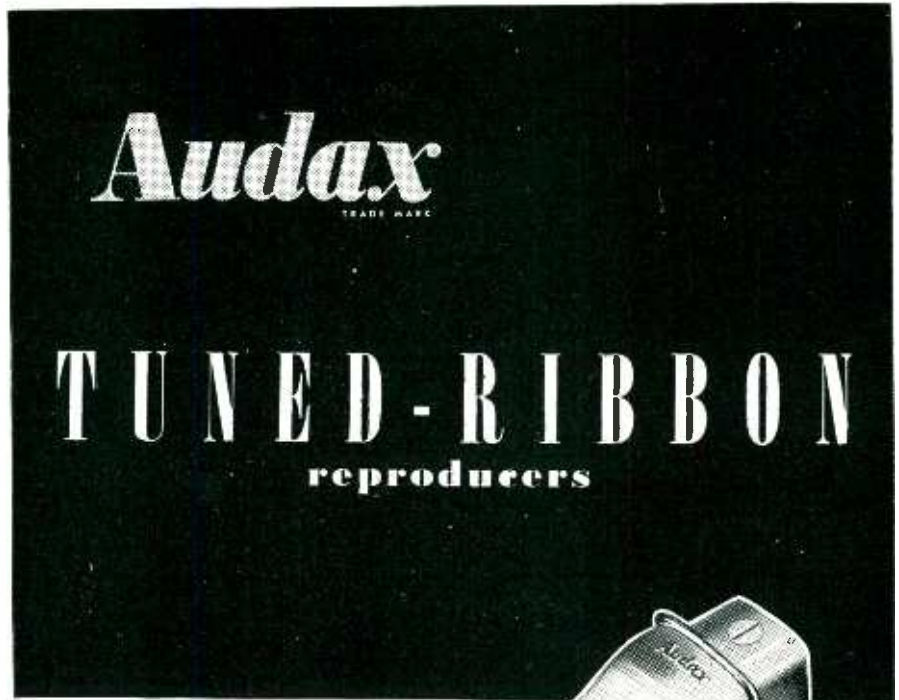
National Inventors Council (Washington 25) can supply more details.

Rotating Machines may soon encounter stiffer competition from tubes in low-frequency (10 kc and below) induction heating service. Hydrogen thyratrons used as frequency converters appear to have distinct possibilities.

One Reason Why business will not fall as far, or stay down as long, as it did after the first world war is the placing of large government contracts with our industry. They won't avoid the blow. But they will soften it.

Editorial Correspondence runs heavily to letters asking who makes this and that. Reference to the *Buyers' Guide*, published by ELECTRONICS in mid-June, will save us all a lot of time and trouble.

Possibility Of Error in this column keeps us awake nights. Should one occur we will probably fall back on the phrase overheard in a McGraw-Hill elevator the other day. A company researcher who shall be nameless was heard to remark that he had been "misinformed by a reliable source."



TUNED-RIBBON Pickup
model *STUDIO - 81*
(actual size — special
arm not shown)

- A model for every purpose



ADMIRABLY this revolutionary **NEW** line by Audax bears out the **business maxim**:—

“LOOK TO THE LEADER FOR LEADERSHIP”

Technicians, listening to the incomparable reproduction of **TUNED-RIBBON**, have been startled at the realism!

The technical side is eye-opening . . . Near-zero mass; linear response to 15 kc.; practical output; point pressure of but 14 grams; jewel point; torsional action eliminated.

Translated into performance . . . clearcut, faithful *fac simile* reproduction that takes you to the very studio where the program originated. Ear-pleasing (there ought to be a word in our language for it) . . . proving anew Audax right to the slogan:—

“The Standard by Which Others Are Judged and Valued”

Yes, Audax **TUNED-RIBBON** has put something into reproduced music that was not there before . . . let **YOUR** ears be the final judge.

Send for literature

AUDAX COMPANY

500 Fifth Avenue

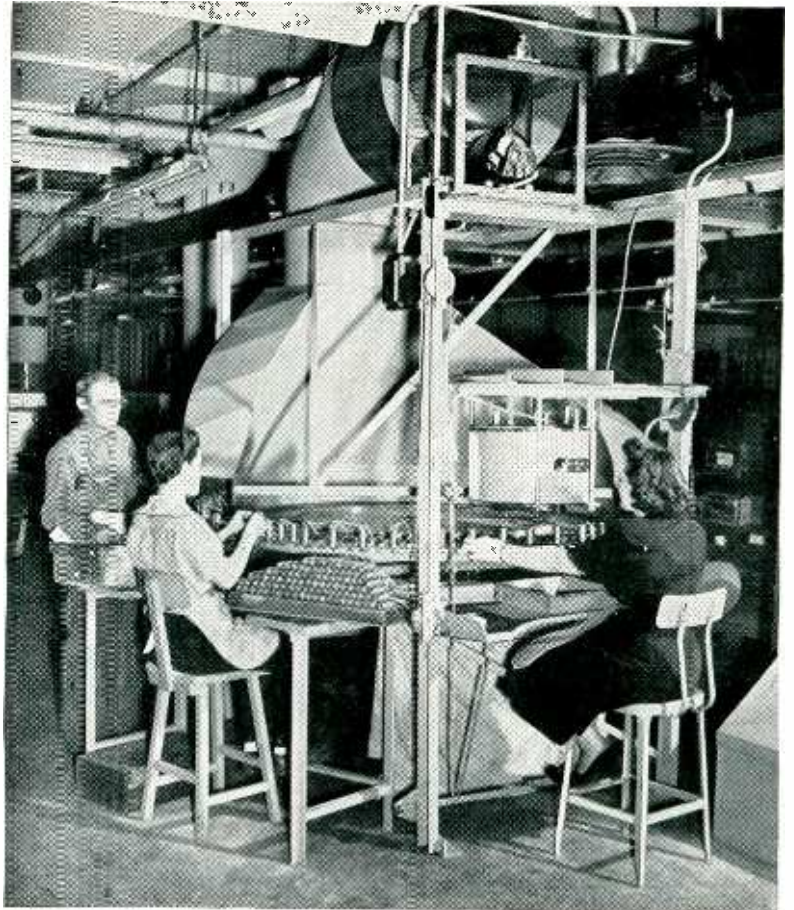
New York 18

CREATORS OF FINE ELECTRO-ACOUSTICAL APPARATUS SINCE 1915

MALLORY

*Cardboard
Tubular Electrolytic*

CAPACITORS

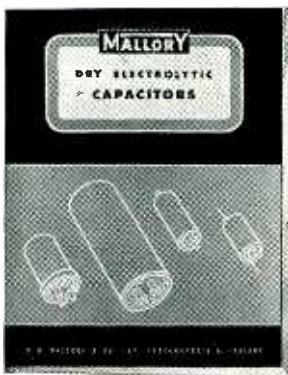


Round table method of pouring end seals at Mallory Plant

We put more into them . . . You get more out of them

DEPENDABLE PERFORMANCE at low cost has won widespread popularity for cardboard tubular electrolytic Capacitors in low priced equipment where operating conditions are not severe. Mallory tubulars are made under the same rigid processing and inspection methods that have earned for Mallory Capacitors a world wide reputation for highest quality.

The extra inner seal, generous end seals and controlled freedom from contamination in handling provide the extreme reliability for which they are noted. Their long life, their ability to survive high temperatures and heavy ripple currents are due to unique processing operations developed in nearly twenty years of research experience.



Send for Mallory Capacitor Catalog which contains useful data on tubulars and on other Mallory electrolytic Capacitors.

P. R. MALLORY & CO. Inc.

MALLORY CAPACITORS

(ELECTROLYTIC, OIL and WAX)

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



CROSS TALK

► **HARTLEY . . .** Hartley's law, that the amount of information that can be transmitted in a given time is proportional to the bandwidth of the circuit, has always seemed an unchallengeable fact of nature. But now comes word that the law is up for revision. We have it from W. G. Tuller, of MIT's Research Laboratory of Electronics, now completing a doctor's thesis on this subject. He, among others including Professor Wiener of MIT and C. R. Shannon of the Bell Labs, has proved that the Hartley rule must take into account noise as well as signal. The old law said that the product of bandwidth and time was a constant for a given amount of information. The revised law says that the bandwidth-time product should be multiplied by $\ln(1 + S/N)$ where S/N is the signal-to-noise ratio. In a noise-free circuit, this multiplier becomes infinite, so a finite amount of information can be sent in zero time on any old bandwidth. The practical man knows this just ain't so. The rejoinder is that all circuits do in fact transmit noise, so the multiplier is not infinite. But it's not necessarily unity either, as Hartley implied. One important result of the analysis is that all modulation schemes (a-m, f-m, ptm, and so on) are essentially identical in their ability to transmit information in a given bandwidth with a given signal-to-noise ratio, a fact long suspected. Only apparatus limitations (real though they are) give f-m any noise advantage over that possible from new a-m techniques when both use the same bandwidth. Moreover the theory indicates that none of the modulation methods now used is as effective in combating noise as it might be. There is as yet no published reference on this subject, but several papers are expected in the forthcoming months. Our guess is that the new theory, like many another in the history of physical science, will open new doors in practical technology. As soon as we find a presentation of the theory in engineer's language, we'll print it.

► **FIDELITY . . .** We commend the article by Harry Olson which appears on page 80 of this issue. Taking

a new slant on the question of audience desires, Dr. Olson set up a system for changing fidelity acoustically, thus eliminating many questions rooted in the electrical performance of the system. He concludes that audiences prefer music as played, not doctored, but hastens to add these conclusions are not necessarily at variance with the findings of other investigators, since the methods of measurement are radically different. We take great heart, nonetheless, from this evidence that listeners do prefer truly natural reproduction, even though we have as yet, apparently, no electrical system faithful enough to demonstrate the fact.

► **ULTRAFAX . . .** On this page last January we considered the future possibility of facsimile transmission on television channels, pointing out that the television bandwidth is wide enough to handle 108,000 complete facsimile pages per hour. Such is the speed of our industry that we now read, some seven months later, of the Ultrafax system, described by Niles Trammel of NBC testifying before the Senate Commerce committee. Developed by RCA and billed as "television used for communications", the new system is to operate at 1,000,000 words a minute. Each transmitted page is handled as a single frame of a television image and is separately photographed at the receiving end. Mr. Trammel cited this device as evidence that radio broadcasting was fast getting into the printing business, and deserves freedom of expression under the law equal to that enjoyed by the newspapers. Being in the publishing business ourselves, we extend the hand of brotherhood to the broadcasters. But we pale before the cavernous maw of Ultrafax, busily ingesting 60 million words an hour. We have enough trouble getting together 100,000 words, more or less, each month. A big newspaper publishes less than 200,000 words a day. So beware, broadcasters, and get those typewriters oiled. There's big doings ahead.

Frequency

By HARRY F. OLSON

*RCA Laboratories
Princeton, N. J.*



Movable panels between audience and talent permitted response to be cut off at 5,000 cycles. Panels were concealed by a curtain during actual tests

SUBJECTIVE TESTS of frequency range preference of reproduced sound have been made by various organizations from time to time. These tests appear to indicate that the average listener prefers a restricted frequency range in monaural reproduced speech and music.

There are three possible reasons for the results of these tests, as follows: (A) That the average listener after years of listening to the radio and phonograph has become conditioned to a restricted frequency range and feels that this is the natural state of affairs. (B) That musical instruments are not properly designed and would be more pleasing and acceptable if the production of fundamentals and overtones in the high-frequency range were suppressed. (C) That the distortions and deviations from true reproduction of the original sound are less objectionable with a restricted frequency range.

Distortions

The distortions and deviations from true reproduction of the original sound are as follows:

- (1) Amplitude distortion
- (2) Nonlinear distortion
- (3) Spatial distribution
 - (a) Relatively small source
 - (b) Separated sources in two-way loudspeaker system

- (c) Nonuniform directional pattern with respect to frequency
- (4) Single channel system
- (5) Phase distortion
- (6) Transient distortion
- (7) Microphone placement and balance
- (8) Acoustics of two rooms, the pickup studio and the listening room
- (9) Limited dynamic range
- (10) Difference in level of the original and reproduced sound
- (11) Noise

To obtain a better understanding of the reason for the preference of a restricted frequency range in reproduced sound, a fundamental all-acoustic test of frequency range preference was made. A small orchestra was used for the source of sound in this test. An acoustical filter was placed between the orchestra and the listeners and arranged so that the filter could be turned in or out.

Room and Filter

The floor plan of the room and the general arrangement of the test is shown in Fig. 1. The room was designed to be the acoustical equivalent of an average living room and is 24 feet long, 20 feet wide and 9½ feet high. It is partially finished in acoustical plaster backed by two inches of Rockwool. A wainscoat extends up four feet from the floor. Drapes are also used to cover a part of the wall surface.

The reverberation - time frequency characteristic approximates

that of a typical living room of this size in a home or apartment. The average ambient noise level in the room without the orchestra or listeners is 30 decibels.

The acoustical filter used in the tests consisted of two sections. A sectional view of the acoustical network, the electrical equivalent, and response characteristics are shown.

The filter was made in the form of elements one foot wide by eight feet in length. These elements were pivoted at the top and bottom so that the filter could be placed in or out of operation by turning the entire group of elements by means of a lever. Overlapping strips backed with felt gaskets, together with weights, insured a soundproof joint with the filter in the operating position.

The response-frequency characteristic of the filter approximates very good commercial radio or phonograph reproduction in the high-frequency range. A cloth curtain was used to cover the filters so that listeners could not see what transpired behind the curtain. The loss in response introduced by the cloth curtain is negligible. The particular condition, that is, the full frequency range or the 5,000-cycle low-pass transmission, was depicted on a frequency indicator.

Test Procedure

The orchestra used in the tests was composed of six semi-professional musicians. The following instruments were used: piano, trumpet, violin, clarinet, contra-

Range Preference FOR SPEECH AND MUSIC

Live talent played popular music, and people familiar and unfamiliar to an audience talked. An acoustical filter consisting of movable panels was introduced to cut off response at 5,000 cycles. Results are presented here

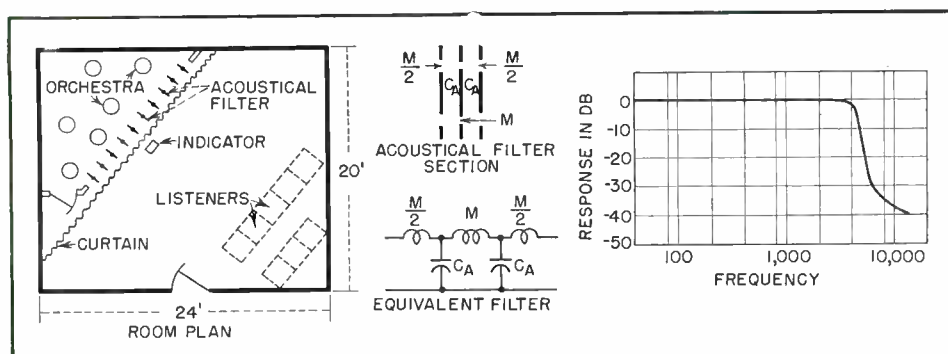


FIG. 1—Plan view of the room in which the tests were conducted, and a sectional view of the acoustical filter. Electrical equivalent of the filter, and a graph showing response-frequency characteristic, are also shown (Above)

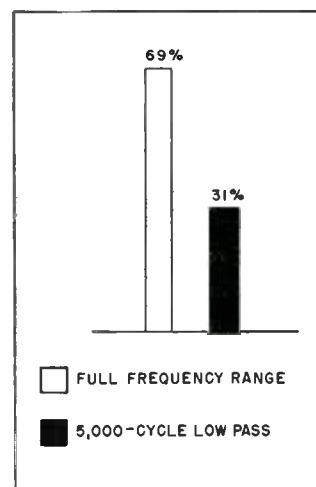


FIG. 2—Frequency-range preference of 1,000 listeners on popular music (Right)

bass, drums and traps. Popular music was used for a major portion of the tests. The orchestra was balanced for the most pleasing condition. The balance was checked by competent musical directors.

The listeners were selected from random visitors to the Laboratories. They were brought into the room and told that there was a source of music behind the curtain which would be rendered under two conditions, namely, *A* and *B* as depicted on the indicator, and that the two conditions would change every 15 seconds. The listeners were asked to vote for the condition which they preferred on a ballot provided for this purpose.

Results

Over 1,000 listeners participated in the tests. The aggregate results of all the musical tests are shown in Fig. 2. It will be seen that there

is a preponderant preference for the full frequency range.

Tests were made on speech, where the listeners were familiar with the speaker's voice. Under these conditions, the listeners felt that there was a detrimental change in the voice when the frequency range was restricted to the 5,000-cycle low-pass transmission.

In tests in which the listeners were not familiar with the speaker's voice, the majority voted for the full range. The comments on the restricted range were as follows: "muffled", "muddy", "mushy", "lacking in intimacy", "pushed back", "not as intelligible".

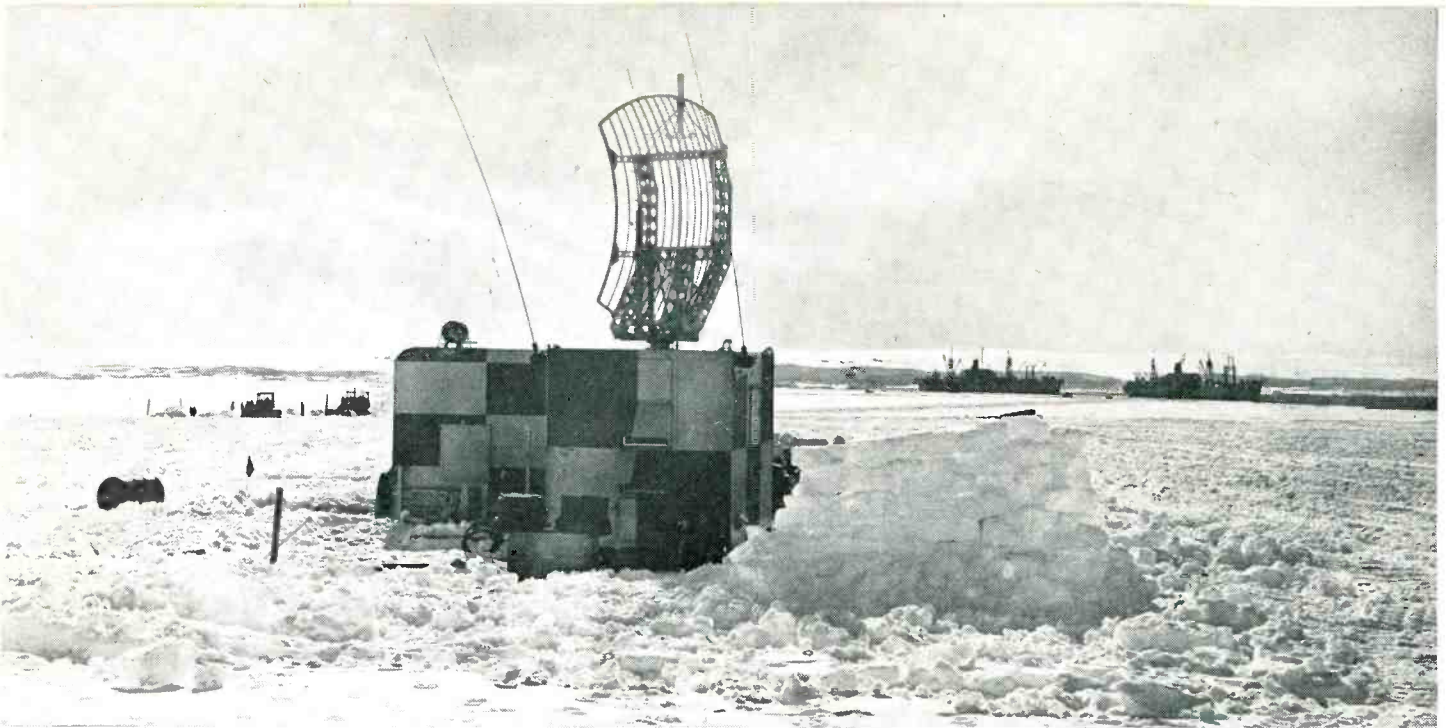
Conclusion

The results of the test do not coincide with most of the results obtained on monaural reproduced sound. In the case of reproduced sound, there appears to be a pre-

ponderant preference for a restricted frequency range.

The results of the test reported here appear to rule out the first two reasons for the preference of a restricted frequency range in reproduced sound outlined in the introduction, namely: (A) That the average listener after years of listening to the radio and phonograph has become conditioned to a restricted frequency range and feels that this is the natural state of affairs. (B) That musical instruments are not properly designed and would be more pleasing and acceptable if the production of fundamentals and overtones in the high-frequency range were suppressed.

There remains one other reason for a preference of a restricted frequency range in reproduced sound, namely, the distortions (C) outlined in the introduction.



Type GPN (Ground Pulse Navigation) airport area surveillance unit on air strip at Little America, with ships moored in Bay of Whales in background. This radar unit was used exclusively for keeping track of all aircraft within a 30-mile range

Electronics in the Antarctic

By HENRY C. BAILEY

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Sixty-Eight*

ELECTRONICS as used during the latest U. S. Navy Antarctic Expedition served three good purposes: it substantially reduced the magnitude and number of hazards commonly associated with the venturing of numbers of ships, aircraft, and personnel into such wild, bitter, unexplored territory; it permitted certain operations hitherto impossible; and the use of standard and experimental electronic equipment under the conditions of the expedition gave information of considerable value in future design and operation of that and other equipment.

The purpose of this article is to describe as completely as possible some of the operational and experimental uses to which electronic equipment was put, while still remaining within the restrictions imposed by governmental security regulations.

Radar in Ice

Radar did not find a new use during this operation, but old uses

were put to critical trial. It was used very successfully in detecting icebergs and growlers, in finding openings in the ice pack through which columns of thin-skinned vessels had to break their way, and in conning vessels through concentrations of huge icebergs that almost defy imagination of bulk, fearful aspect, and number.

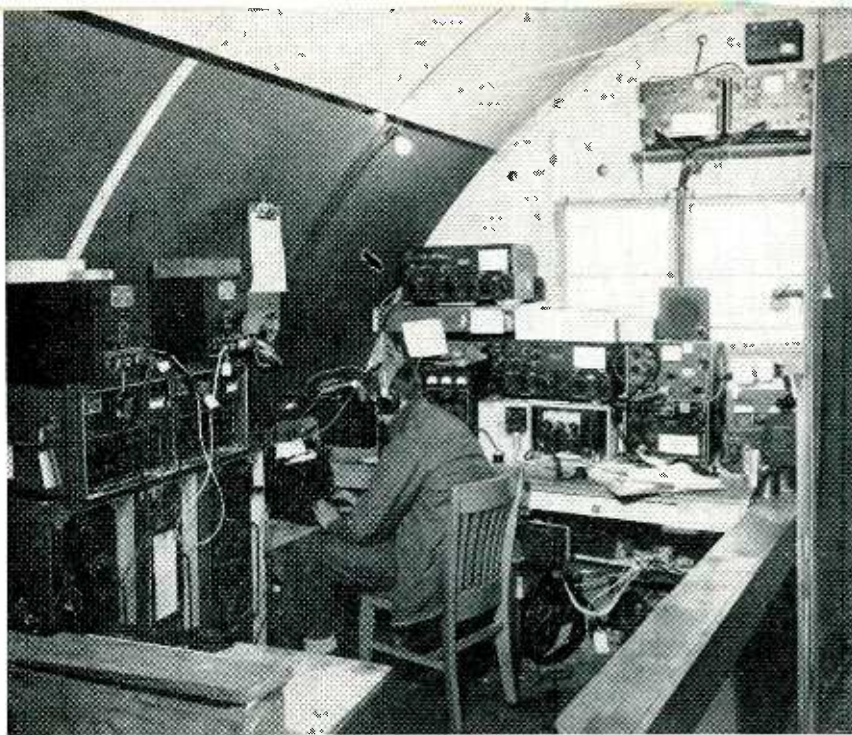
Surface search equipment was used successfully as ground-controlled approach equipment on certain vessels. At close ranges planes could be vectored into an ice-free area for landing. One vessel in a dense fog successfully vectored a plane, taxiing on the surface, four miles through ice-flecked water. Solid indications were obtained from the plane as well as from all pieces of ice large enough to damage the plane's very thin hull. The sea at that time was quiet and the smallest pieces of ice showed up clearly on the indicator.

Air search equipments proved invaluable to seaplane tenders in enabling patrol planes to return to

their vessels after long flights, and added to the utility of small vessels used as emergency seadromes. Usually planes on completing long flights had to let down through overcast, for which positions had to be furnished. Radar fixes were provided by the air search equipments. Aircraft were usually picked up on return flights at about 80 miles and vectored in.

Under conditions where the sun could not be used for compass check after outgoing planes were airborne, radar provided the navigators with fixes for checking course and ground speed. In all cases, air search equipment definitely reduced hazards attending air operations in areas where navigation was difficult.

Fire control radar equipment on two vessels was used in observing wind speed and direction at high altitudes. Corner reflectors borne aloft by aerological balloons were tracked with these equipments out to ranges near 55,000 yards, with an average range of about 40,000



Standard Navy shipboard and aircraft communications equipment installed at temporary base camp on Antarctic ice

Effectiveness of electronic equipment on recent U. S. Navy expedition, including radar and sonar for ships among icebergs, radar and GCA for air navigation, radio for communication, broadcasting, teletype, and radiophoto, and an airborne magnetometer for aerial surveying

yards to signal fadeout. Valuable wind information was obtained in this manner, which substantially reinforced the framework of weather information so vital to operations of this nature. Because of weather conditions there would have been no other way to obtain this information.

A relatively new, very high definition radar proved of great value to the icebreaker carrying it in working in the ice, in detecting small targets that other equipments missed, and in gaining greater detail in targets of all sorts. During one phase of the operation photographs made of the plan-position indicator of this equipment enabled hydrographers to complete a useful and accurate coastal survey of a group of islands which at that time were shrouded in fog such that aerial photography was impossible.

Three- and ten-centimeter radars proved very dependable in reducing navigational hazards associated with icebergs and other dangerous masses. With such radars, ice-

bergs over 200 feet high were reliably detected at more than 40,000 yards, smaller icebergs at an average of 35,000 to 40,000 yards, growlers of various sizes at an average of 7,000 to 8,000 yards, and pack ice, floating loose pack, and brash at up to 13,000 yards. Antenna height was about 100 feet, and equipment was in design-standard operation.

In most cases a sizable portion of the top of the berg was projecting into the line of sight before the tilted or rounded peak returned a signal sweeping low enough to intercept the radar antenna. On very clear days the peaks of the largest icebergs, reflecting much light from all angles, frequently were visible through glasses before the returning radar signal swept low enough to be detected.

Air search equipment proved inferior to microwave surface search equipments for detecting ice. Ice was detected, but at generally shorter ranges. The relatively poor definition inherent in air

search was a marked disadvantage in its use against dangerous ice masses, although the prime function of the equipment, that of detecting and determining range and azimuth of aircraft, remained just as important and just as effective in high latitudes as anywhere else.

Sea return, the radar indicator clutter caused by return signals from the surface of the sea, proved to be a limiting factor in the detection of small icebergs and growlers. Following an inverse fourth-power relationship with range, in rough seas it extended out sometimes to the maximum range at which small ice masses, still large enough to damage the vessel, could be detected. In this way a hazard was introduced, for growlers not detected before they came within the radius of sea return conceivably could not be detected by radar at all. Actually, however, all ice masses dangerous to navigation were detected in time to be avoided. Reduction of the gain of the receiver, and judicious use of such controls as fast time constant and time-varied gain proved of some value in circumventing these difficulties.

Meteorological conditions such as fog, rain, snow, and weather fronts were factors worth considering. It is known that these effects attenuate the radiated and reflected energy, the degree varying in individual cases. No serious handicap was apparent, but the lack of finite evidence of such handicap should not deter from normal, common-sense precautions. On occasions, icebergs were detected at twenty or more miles through very dense snowstorms; but those same snowstorms completely obscured all targets in the immediate vicinity of the vessel.

No equipment failed utterly because of weather conditions. Difficulties were had with high winds blowing on rotating antennas and placing unusual loads on their drive motors. One case was reported where the high winds forced water into a drive motor and drowned it. These difficulties were met by alert maintenance personnel. For the most part the materiel held up well under the conditions encountered by the task force and is a

credit to the painstaking effort of designers and manufacturers throughout the country.

Sonar in Ice

Sonar found use as a substantial aid in navigation of icewater. Water temperatures in the ice regions consistently lay near 32 degrees Fahrenheit, dropping as low as 29 degrees in some areas. Great uniformity of water temperatures and linear temperature distribution patterns made conditions for sound propagation in Antarctic waters excellent beyond expectations. There were exceptions to this, but in a characteristic area the predominant pattern showed an isothermal surface layer between 60 and 80 feet in depth, a slight negative gradient between 80 and 300 feet, and a slight positive gradient extending below 300 feet. Deviation from strictly isothermal conditions was seldom in excess of a few degrees.

The only abnormality in operation of the equipment was associated with changes in water temperature affecting the resonant frequencies of magnetostriction sound projectors, necessitating minor adjustments of driver frequencies by maintenance personnel. This in no way constituted a difficulty, for the tuning range of the drivers is invariably broad enough to include any conceivable change in resonance characteristics of the projectors.

Sonar became of great value in detecting ice targets during conditions of reduced visibility. Vessels carrying horizontal echo-ranging equipment used it in conjunction with radar with excellent results. Sonar detected ice masses too small to be detected by radar through sea return, even when swells as high as six and eight feet were encountered.

Sonar was not so trustworthy when storms and heavy seas were encountered. Under these sea conditions the effectiveness of the equipment was reduced because of water noises and rolling of the ships. One destroyer rolled 50 degrees under these conditions, and an ice-breaker topped that.

During moderately calm periods, and when water conditions were at their best, sonar could be de-

pendent on to detect icebergs at 3,000 to 4,000 yards, growlers at 1,500 to 2,000 yards, and pack ice or brash at up to 2,000 yards.

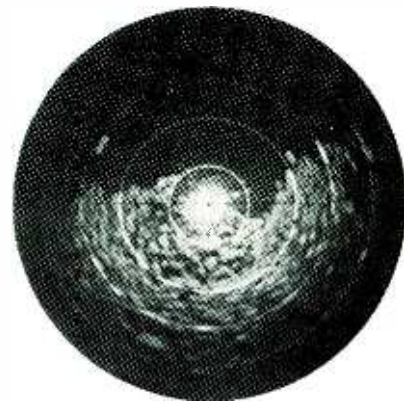
Ranges checked within 20 to 30 yards of radar ranges taken simultaneously, with a percentage rather than fixed error. The velocity of sound through salt water varying with temperature possibly accounts for the discrepancy. Bearings obtained checked usually within two degrees of the radar bearings. It must be remembered, however, that the target definition of sonar is not to be compared with that of surface search radar, so greater errors in azimuth determination may be expected with the sonar equipment.

One vessel conducted a few experiments to determine the utility of echo depth-sounding equipment for studying the temperature and other refractive layers commonly responsible for reverberations. This study bears relationship to the study of marine life and is also of military value to the Navy. Refractive layers were found at varying depths even in areas where the temperature distribution pattern is substantially vertical or linear. This tends to indicate, especially in the light of oceanographic studies of planktonic forms of animal life in these regions, that it was layers of concentrations of these microscopic organisms that comprised the refractive media which gave return signals. Knowledge of the behaviour of any such refractive area is of great interest to designers of Navy echo-ranging equipment, especially that used in submarine warfare.

Sonar also found a use in the study of marine life. The ability of underwater sound equipment to detect whales was noted, and future operations of this nature may provide much information on habits of whales.

Radio Teletype

The radio teletype system established between the USS Mount Olympus, at or near the Bay of Whales, and Washington, D. C. was used extensively in passing high-priority radio traffic to Washington. Approximately half a million words of press copy were transmitted in this manner from Antarc-



Antarctic ice pack as seen on ppi screen of 10-cm radar using 4-mile scale. Though ice rose only few feet out of water at this point, it was detected at 10,000 yards

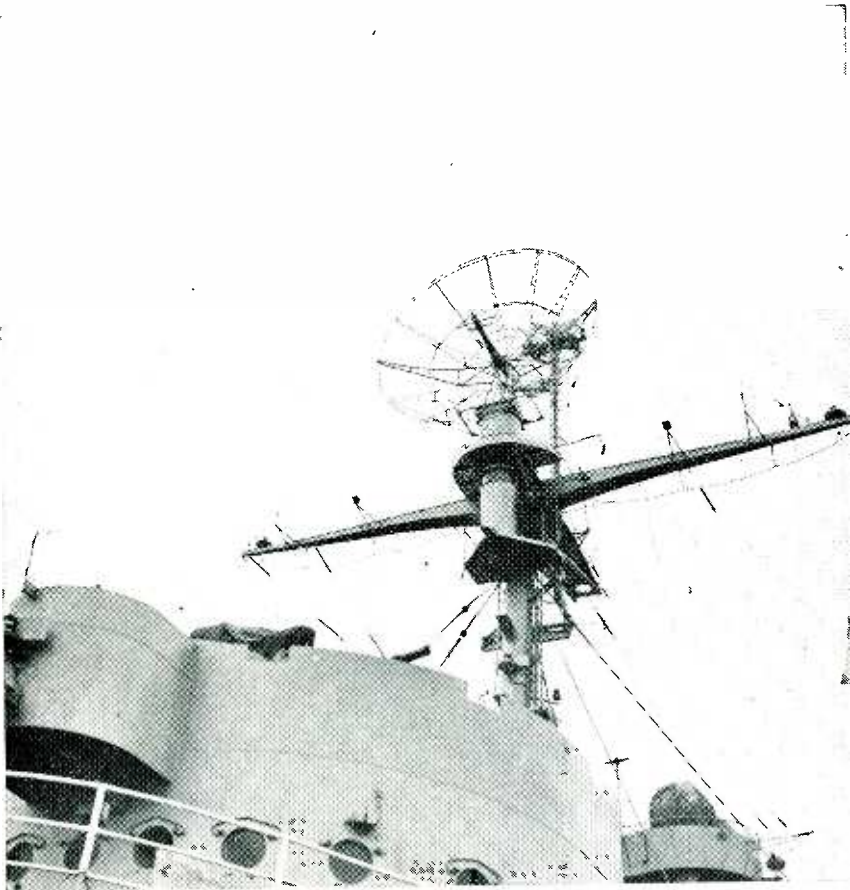


Icebergs and growlers (dense icebergs floating mostly under water) as seen with 10-cm radar using 20-mile scale. Some of the bergs are up to 300 feet high and 1,000 feet long. Sea return is moderate

tica to Washington during the course of the operation.

Radio Washington had little difficulty in obtaining perfect copy for an average of over thirteen hours per day. Rhombic antennas and an elaborate diversity receiving system were used at the Washington end, the antennas trained exactly on Little America. The flagship was using standard type 19 teletypewriter tables operating through Navy type FSA Western Electric frequency shift keyers into one-kilowatt transmitters connected to vertical single-wire antennas in a characteristic Navy installation. Frequencies in the 12, 17, and 21 mc bands were found the most effective.

In spite of the fact that Radio Washington had rhombic transmitting antennas beamed on Antarctica, reception by the Mount Olympus was severely limited by high interference level. Local transmit-



Radar and radio antennas on USS Pine Island, one of the ships taking part in recent U. S. Navy Antarctic Expedition. Despite large size of parabolic reflector, the P-band air search radar on this ship did not give very good definition on ice targets

ters, being used on high power to reach the remotely-located Eastern and Western Task Group commanders, interfered badly with reception from Washington. Standard shipboard receiving equipment was used, operated through model FRA RCA-manufactured frequency shift converters; receiving antennas were the usual shipboard single-wire verticals.

Directional antennas were erected at the camp at Little America but time limitations prevented their being used operationally; they were used for tests only, a few messages being transmitted manually. There is little doubt that had the same radio teletype equipment been used with these antennas both transmission and reception would have been vastly improved.

Radio Photographs

The Mount Olympus maintained radiophoto circuits with Radio Washington and Radio San Francisco throughout the operation. A daily schedule was maintained com-

mencing at 0600 GCT and lasting usually three to four hours, that time found the most dependable.

Frequencies in the 9 and 13 mc bands were used for transmitting and the 13 mc band for receiving. Other frequencies were available, but these were found to provide the best circuit conditions during the times chosen for schedules.

An Acme type CNP telephoto transceiver was used with a model FSD Press Wireless frequency-shift keyer. One kilowatt of r-f power and a single-wire vertical radiator were used in the transmissions. This equipment was monitored with a standard Navy shipboard receiver, an oscilloscope, and audio signal generator.

The urgency of other communications and the volume of outgoing picture traffic prevented much experimenting on reception by the ship, and only a few pictures were received. Two pictures of very good quality were received by the ship while moored at Little America.

At best the results in general could be considered fair. The majority of pictures transmitted were fair to good, with a few of excellent quality. About 190 7-inch by 9-inch pictures were transmitted to the Office of Public Information. To provide these, many pictures were transmitted more than once, either on the same schedule or on following schedules. Altogether about 390 transmissions were involved.

The long distance separating Antarctica and continental United States and the need for directional antennas were the chief reasons why the results were not better. Radiophoto requires somewhat better signal-to-noise ratios than manual telegraphy or radio teletype, and increased transmitter power or the benefit of directional antennas would have been the only means of increasing the volume or bettering the quality of pictures transmitted.

Radio Broadcasting From the Mount Olympus

About two weeks before the Task Force sailed from U. S. ports the operation was declassified and it was learned that radio networks would provide representatives to participate in broadcast work.

The Mount Olympus was chosen to do the transmitting. At that time the only transmitters installed on board suitable for broadcast work were two Westinghouse 350-watt Navy model TBM-7 equipments. Obviously these transmitters would not serve the desired purpose because of their low power and the 9,000 statute miles separating Long Island from Antarctica. Accordingly a Collins, Navy model TDH-4, 2,500-watt phone transmitter was provided for installation.

The TDH-4 equipment was designed for shore use where 230-volt, 3-phase power and an abundance of space are provided. Special transformers were provided initially to make available the necessary voltage, but getting the bulky units of the equipment in place on board and erecting suitable antennas proved difficult. One model TBM-7 transmitter was removed and set aside in the transmitter

room to make more space available. Doors were burned out where they interfered with passage of the larger units. Because the pi-network output of the power amplifier was designed to work into a moderately low impedance, special transmission lines were run topside through antenna trunks to a home-made antenna change switch and from there to either of two doublet antennas cut to operate in the 17 and 19 mc bands, respectively. Since the new transmitter was received when the ship arrived at Panama, this installation work was done at sea.

While the TDH-4 was being installed, the TBM-7 remaining in operation was being used successfully. As the ship neared the halfway point between Panama and the Antarctic Circle, installation was completed on the TDH-4 and it was placed on the air.

Frequencies in the 9, 12, 15, 17 and 19 mc bands were allotted. Of these, only the latter two were used extensively. It is believed that had higher frequencies been available they should have proved still more satisfactory.

The War Command room was used as a studio. At best it was

not too good, as an expansion joint in the superstructure traversed this space and squeaked as the ship rolled. A ventilation blower in an adjacent space contributed to the noise. Acoustics were somewhat improved by hanging curtains around the studio room. It was in this room that control and monitoring equipment, RCA broadcast microphones, an RCA 4-position mixer and line amplifier with a volume unit meter, General Electric wire recorders, and standard Navy shipboard receivers were installed. All programs were recorded on the wire recorders as they were transmitted.

Schedules were held with RCA Communications and Press Wireless, Inc., twice daily at 1230 and 2330 GCT, one-half hour earlier than the morning and evening news roundups on the networks. On these schedules broadcast times were established and cues were arranged.

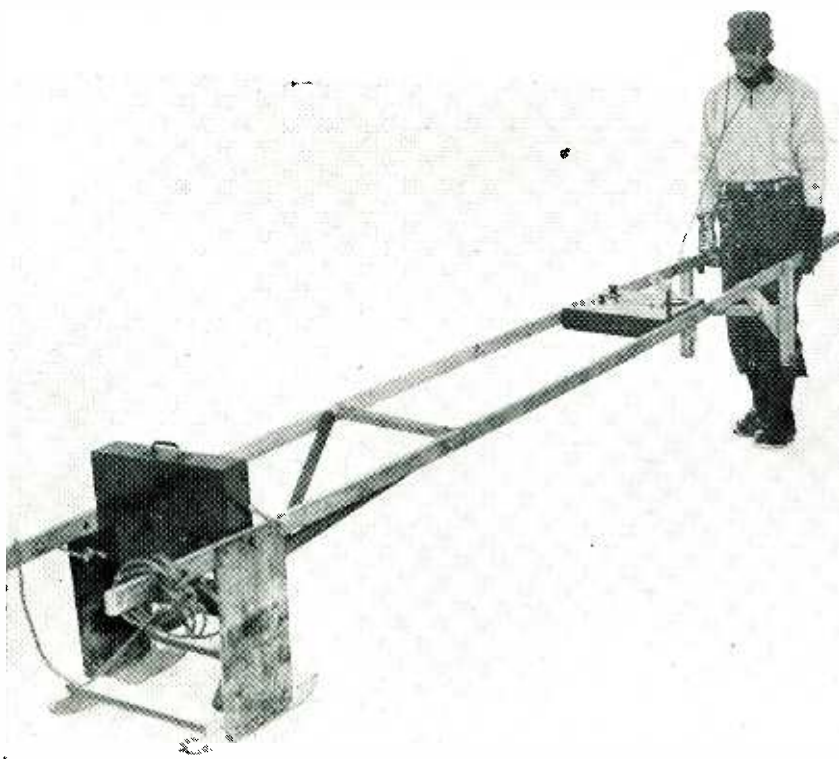
Four major networks were represented. Most of the programs were live news bulletins, with an occasional interview of some personality on board. There was one long program at Christmas when personnel on board the ship talked

with their families in the U. S. Altogether about seventy seven successful programs were transmitted and used by the networks mentioned. Sixteen others were unsuccessful due to radio wave propagation conditions.

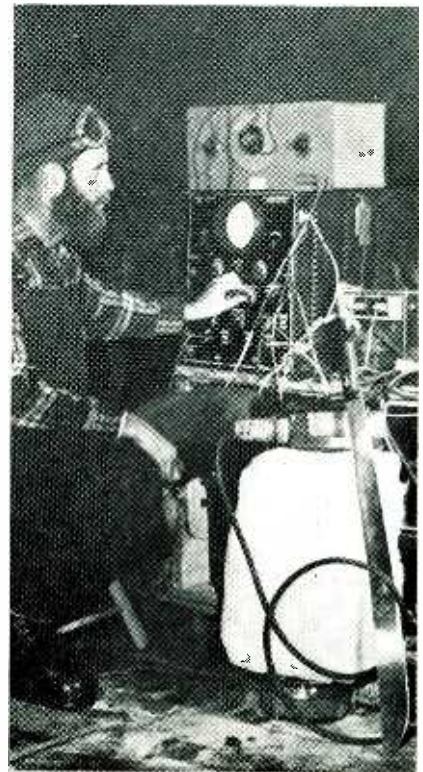
Communication Facilities at Little America

The original plan for air operations with the two-engine patrol planes called for landings, take-offs, and local flights of limited radius being controlled from the air strip. Longer flights were to be controlled by the Mount Olympus, moored to the ice within view of the landing area. Ice conditions forced a change in those plans, however, as the ship was forced to retire to the vicinity of Scott Island, leaving the base camp to hold its own.

To serve as a control tower at the air strip and to house the equipment and operators, a Quonset hut was erected. This building also served as an airborne electronics and general plane maintenance shop in which were installed battery-powered, dynamotor-operated aircraft type transmitters and receivers for communication with the planes, the ships moored to the ice,



This modification of a commercial electronic metal locator located metallic objects in ice at depths as great as 25 feet



Equipment for measuring velocity of sound through ice

and the Emergency Base. All transmitting and receiving antennas were erected in the necessarily congested area, but the equipment operated satisfactorily nevertheless.

Later, as time allowed, a Navy model YR radio beacon, a 400-watt intermediate-frequency transmitter, and better intra-camp communication equipment were installed and the aircraft type radio receivers replaced by a-c operated receivers. Other improvements were made, most notably in power supply facilities, which improved operations by reducing radio interference. The camp being located as it was on dry snow and ice, with no physical earth ground, local interference such as ignition and commutator noise became a factor of grave concern. There being no way to shield equipment from the sources of interference, it was mandatory that the sources themselves be eliminated. This was done by re-shuffling the power equipment. A two-kilowatt d-c motor-generator set was replaced by a bank of storage batteries floated across an a-c rectifier charger, and most dynamo-powered equipment was replaced with a-c equipment.

The ice and snow underfoot was several hundred feet deep and no means were available to drill clear through to the seawater below. Even had a hole been drilled and a suitable low-resistance ground cable lowered, it is doubtful that interference conditions would have been noticeably improved. Due note has been made of this situation. Any future operations in this area will be provided with means for drilling many holes through the ice in an effort to raise the ground plane.

Before the flagship was forced to depart, the USS Philippine Sea, then 650 miles to the north, discharged the six planes that were to operate in the area. Good communications were had between the Mount Olympus and the planes on their flight to the airstrip; voice communication in the 4 mc band was excellent throughout; the automatic direction finders on the planes operated nicely in the 400 kc band with signals from a two-kilowatt transmitter.

Communications with planes on long flights were vested in the

Emergency Base radio station. This camp was intended to be of a more permanent nature since there were possibilities that it would be occupied all winter. It comprised a double Quonset hut located about two miles from the temporary base camp at the airstrip and equipped with voice and c-w transmitters necessary to enable it to perform its function. Power was supplied by a diesel-driven a-c motor-generator set. This Quonset was well insulated from the weather and sealed against sifting snow.

Rhombic antennas for transmitting and receiving were erected at this site and directed toward Washington, D. C. In addition, Marconi L and T transmitting antennas and miscellaneous receiving Marconi and doublet antennas were installed.

Telegraph c-w communications with planes on extended flights out 700 to 800 miles to the South Pole and beyond were good at all times. Tests with Radio Washington, using the rhombics, proved highly successful on the 8, 12 and 16 mc bands.

The absence of a physical earth ground presented difficulties here as at the temporary camp. A wire counterpoise, connections to the power plant and connections through a tunnel to the old Little America buildings, and the provisions for use of only a-c operated equipment eliminated these difficulties. The 96-foot length of the Quonset hut provided adequate counterpoise for high-frequency transmissions.

Ice and snow in Antarctica is so dry that an antenna stretched out on the ice works beautifully. The snow is fine and grainy in texture and perfectly dry, unlike that found in the Arctic.

This snow does not pack down very well, and hauling of heavy equipment was seriously complicated by that fact. Equipment was loaded on steel go-devil sleds weighing about two and a half tons and fitted with runners, and drawn by D-6 Caterpillar tractors. On the bay ice these tractors worked nicely in the snow without any modification. Up on the barrier the tracks had to be fitted with oak extensions which provided additional traction and prevented the tractor from dig-

ging down into the deep snow. To draw the sleds up the steep slope between the bay ice and the barrier, a cable railway system was used whereby the tractor or tractors in use ran down the slope or on level ice to draw the sled upward.

Ground-Controlled Approach

The objectives in transporting bulky MPN-1A and GPN-2 GCA equipment to Antarctica and setting it up at Little America were threefold: (a) to provide facilities for planes to land at Little America under conditions of reduced visibility; (b) to augment communication facilities and act as auxiliary to airstrip control; (c) to determine the practicability of GCA under the difficult conditions for movement, installation, and operation of the equipment.

The completed installation of the GPN equipment accomplished the first two objectives. Although the MPN was not used operationally, still it was installed and tested successfully, satisfying the third objective.

Temperatures varied constantly between 26 degrees below and 29 degrees above zero Fahrenheit. One blizzard struck, bringing temperatures around 14 degrees and winds up to 45 knots.

Problems in installation arose by the dozens. Initially it was discovered that the 26,500-pound prime mover for the MPN equipment, when removed from the ship at the edge of the bay ice, not only could not move under its own power in the 15-foot thick snow and ice, but required two D-6 tractors to tow it. The prime mover for the GPN equipment was similarly immobilized. These problems were circumvented by lifting the radar shelter of the GPN off the six-by-six truck bed, and by placing skids under the MPN trailer and towing it by tractor. In each case the associated prime mover was useless. The GPN shelter was towed on its own skids.

The heavy diesel generators presented similar problems. The GPN generator was equipped with heavy metal skids before leaving the ship. The MPN generator truck, being useless as a prime mover, had to be left on board, so the truck bed with generators attached was lifted off

and placed on a go-devil sled which could be towed by a tractor.

Both spare parts trucks, one for each major unit, were left on board ship. Only those parts necessary for operation were brought ashore.

The MPN being so heavy and difficult to move, and in light of the fact that weather conditions made unnecessary the precision features of the MPN, it was decided to install the GPN first and place it in operation. Accordingly, the GPN was placed on 3-inch by 8-inch wood timbers laid on level snow and work of assembly and preparation was begun. Spare parts were brought up by sled from the ship. The generator was hauled to a convenient position about nine feet from the door end of the shelter and a tarpaulin was secured between the two so the door to the shelter would open on a place protected from the wind. A 16-foot-square tent was pitched in the immediate vicinity for housing the GPN spare parts and auxiliary radio equipment. It was also used for living quarters.

Throughout the flight operations, the performance of the GPN equipment was satisfactory. Whenever possible, planes in local flights were controlled by this equipment. With its associated communication equipment it was often called on to act as control tower, which it did nicely.

After the GPN installation was well under way, installation of the heavier MPN was begun. Erection of the MPN search and elevation antenna housings was completed in cold, windy weather. Because of the time element and the prospective brevity of operational usage the heavy radome for the search antenna was not installed. No technical or mechanical difficulties were experienced in the installation, but the wind and weather reduced the efficiency of maintenance personnel to a low point. Many of the operations had to be performed without gloves, and work could be continued for only a few minutes at a time.

All components worked perfectly when the equipment was placed in operation and power applied. Tests made to determine its efficiency under adverse weather conditions proved quite satisfactory.

The time factor entered into the

proceedings again, however, and made it necessary that the equipment be dismantled and transferred back to the ship. The GPN was still operating nicely and could perform all the vital functions. Accordingly, work was started—and halted three hours later by the blizzard.

Altogether a great deal of information was gained through the installation, test, and operation of this equipment at Little America. Although the main unit of the GCA system, the MPN, was not used op-



Airborne magnetometer used in surveying portions of Antarctic continent

erationally, the main objectives of the operation were accomplished.

The Magnetometer

The initial purpose behind the provisions for use of the airborne magnetometer during this operation was to obtain magnetic profiles along the tracks flown by the photo-reconnaissance planes operating from Little America. Properly interpreted, these profiles would give information on the geological formations in the earth's crust, and in favorable locations disclose topographic features buried under ice and snow and trace major geologic trends and structures. Used in this way a valuable supplement to the aerial photography of significant parts of the Antarctic continent would be provided.

To accomplish this the U. S. Geological Survey and the Naval Ordnance Laboratory cooperated to pro-

vide personnel and equipment to participate in the operation.

The equipment used was the Magnetic Airborne Detector developed by the Naval Ordnance Laboratory and used by the Navy in antisubmarine warfare, modified by the Naval Ordnance Laboratory, the U. S. Geological Survey and the Office of Petroleum Reserves to allow its use as a geophysical surveying instrument.

As modified, the magnetometer measures electronically the fluctuations in the terrestrial magnetic field intensity caused by the variations in magnetic properties of different materials in the earth's crust, and continuously records them on a paper chart as the plane moves on.

Two of the planes brought to Scott Island by the Philippine Sea were equipped with the necessary frames and supports to carry the magnetometer. Unfortunately, because of operational difficulties and weight limitations the racks had to be removed before the planes could take the air; because of curtailment of flight operations at Little America it was not until the last five days of the ice reconnaissance that makeshift racks could be installed.

Considering the prospective brevity of the operations, the objective in the use of the magnetometer became one of investigation of the usefulness of the equipment in the Antarctic area. To accomplish that, magnetic profiles were made of well-known terrain so that their utility could be evaluated.

Four flights were started. The first was a test hop; the fourth was unsuccessful due to engine failure. The two remaining flights, of 4½ hours duration each, were highly successful.

As a result of the flights, previously-made suppositions as to the material content and the topographic aspects of the areas traversed were in some cases confirmed and in others disproved; whether or not previously suggested, the material composition of the crust along the plane's tracks was determined. The coastline, if you can designate as such the place where eternally ice-covered land meets eternally ice-covered sea, was delineated in the path of the plane.

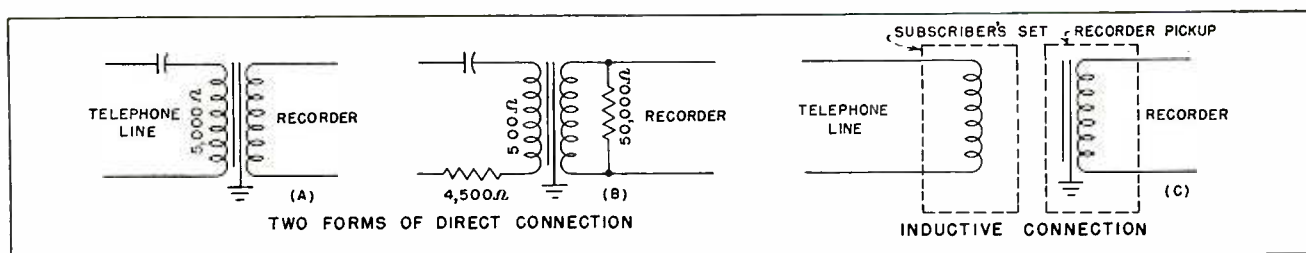


FIG. 1—Recorder can be either connected directly or by induction to telephone

Telephone Recording

Electronic dictating machines can be used to record important telephone conversations. Either direct or induction connection to the line is suitable. Design considerations are given

LEGALITIES

Use of telephone recorders is now permitted by FCC for legitimate activities as described in Docket No. 6787. This change in regulations governing recording or monitoring telephone conversations has been made because of the utility of permanent documentation of telephone conversation.

Personal privacy of telephone conversations will be protected by the use of a distinctive tone (exact nature of which had not been decided upon at press time) when a recorder on the line is operating. Telephone companies will provide and maintain the tone generator.

APPLICATIONS

Monitoring message telephoned by contract officers, lawyers, public relations executives, doctors, others whose conversations warrant exact transcription.

Automatic recording of messages in absence of person called.

Transacting business by telephone such as recording accumulated orders at night over long-distance toll circuits from branch offices, permanently recording telephone orders and thus eliminating need for written confirming orders, telephone dictation from field to home office.

Recording fire alarms, calls to police, dispatching instructions of public utilities including railroads and power companies, military commands.

By **K. L. MacILVAIN**

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New York, N. Y.*

appreciably load the telephone line.

A typical direct connection is shown in Fig. 1A. The capacitor provides d-c isolation; the transformer blocks longitudinal current (produced by voltage between the telephone pair and ground). Transformer input impedance should be sufficiently high not to appreciably load the line. If the transformer input impedance is low, for example 500 ohms, a series resistor added in the primary circuit, 4,500 ohms in Fig. 1B, prevents loading.

Although speech levels to be expected from a telephone line vary widely, signals available with the direct connection range from +10 db (where 0 db equals 6 milliwatts) for peak levels to -40 db, with good local voice levels averaging around 0 db but with many between -10 and -15 db. Regardless of the high standards at which telephone lines are maintained, wide ranges in speech levels are to be expected because of conditions beyond control of telephone engineers. The recording equipment must, therefore, be designed to record satisfactorily a 40-db range, although the extreme range might be as great as 60 db. To keep the recording level within the range of

the recording medium, automatic control circuits should be incorporated in the recorder.

Inductive Pickup

With the inductive connection, shown in Fig. 1C, the telephone terminal equipment forms one winding of a transformer and the recorder pickup is the other. The pickup is formed into a flat unit that can be placed under the subscriber's set. The transformer so formed has low coupling between primary and secondary because of the relatively large spacing. The inductive pickup should be electrostatically shielded to eliminate effects of undesirable fields in the vicinity. From 40 to 60 db are lost in this form of coupling, so the recorder amplifier must have greater gain than for the direct connection. Hum-bucking arrangements can be added to neutralize fields from local motors and transformers, but because such fields are neither constant in magnitude nor direction, complete cancellation is difficult.

Either method of connection is satisfactory, and now that recording telephone conversations has been made legal many applications for this technique will be realized.

TELEPHONE lines carry not only speech signals, but also interfering noise, ringing and other operating voltages. Any connection to a recording circuit should eliminate interference between the telephone pair and ground, provide isolation for direct current, and should not affect or be affected by the operating voltages nor should

Measuring Speed With WWV

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A variable reluctance tachometer is used to generate a frequency proportional to the speed of revolution of a shaft. This frequency is compared to that of a variable frequency oscillator. Means of obtaining harmonics of WWV's 440-cps signal for calibrating the oscillator are described

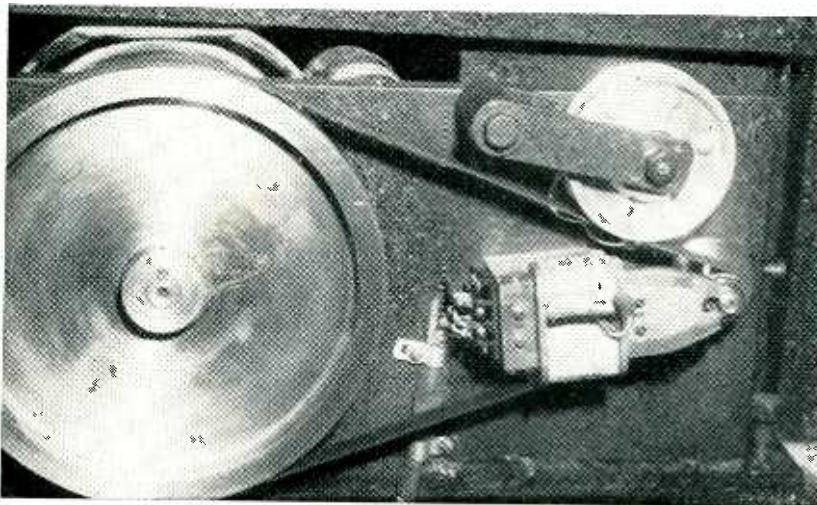


FIG. 1—The variable reluctance tachometer is at the extreme right

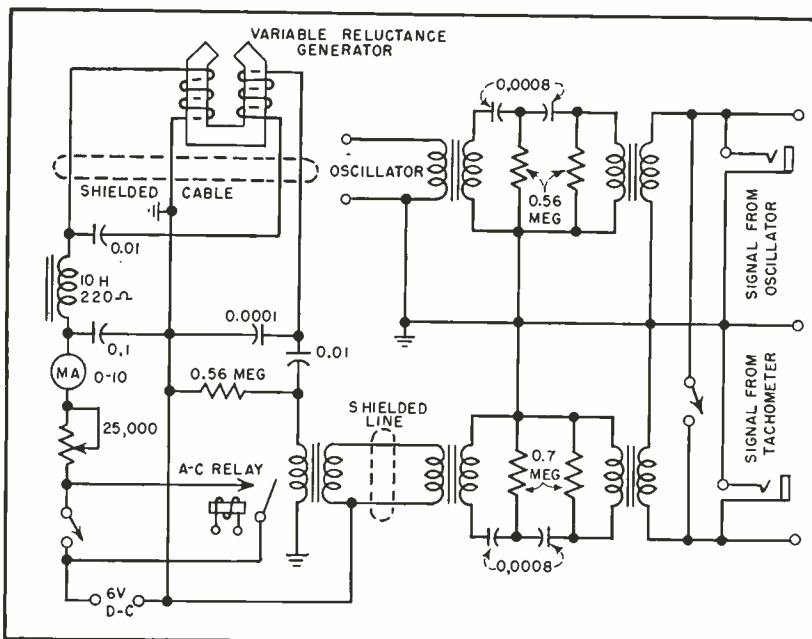


FIG. 2—At the left is the excitation and takeoff circuit for the variable reluctance tachometer; at the right is the mixer output

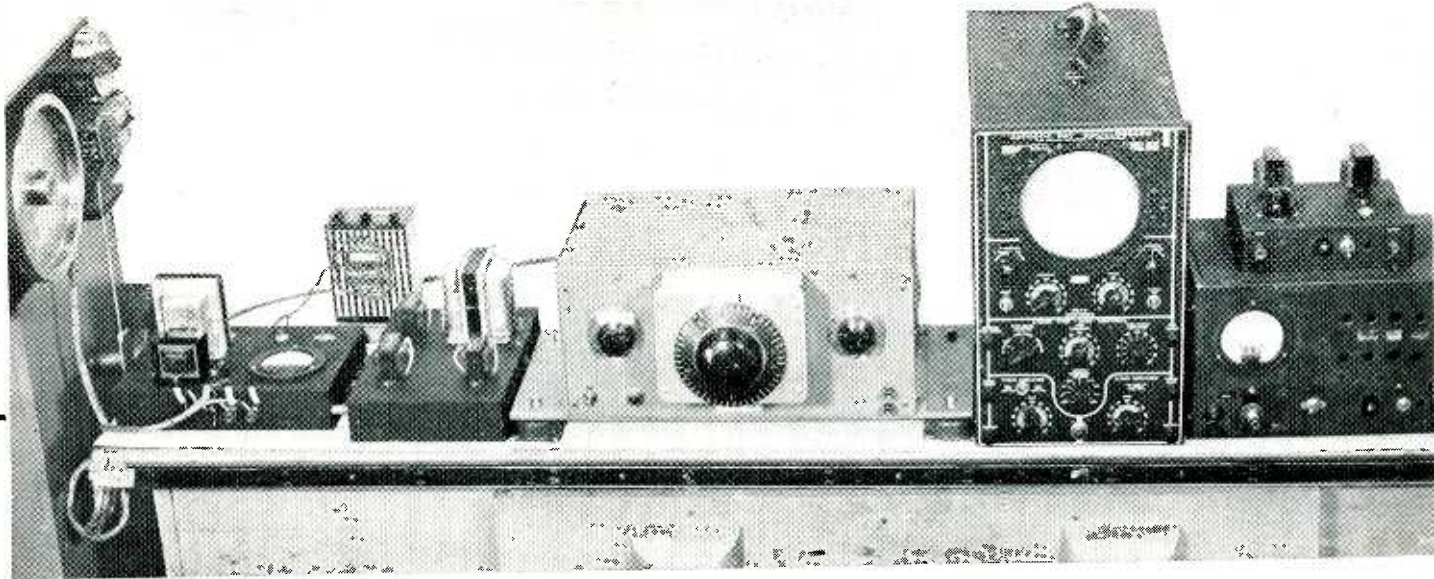
PRECISE speed measurements of a shaft revolving at approximately 30,000 rpm were required for an ordinance evaluation. Mechanical connection to the revolving quill on the end of the shaft was undesirable because of dynamic balancing problems at such high speed, so a variable reluctance generator was designed and constructed that develops 2,000 cps at 30,000 rpm.

Because commercial frequency meters are so highly damped that they cannot follow the rapid fluctuations in speed that were to be measured, it was necessary to use a more sensitive and accurate method. This was done by comparing the tachometer frequency to that of a calibrated oscillator.

To calibrate this oscillator, a harmonic amplifier producing precise audio-frequency check points spaced at 220-cps intervals and derived from the 440-cps modulation of WWV was designed. A novel frequency selective, degenerative limiter is incorporated in this amplifier. A center clipper is also employed, so a slice of the received signal is thereby utilized and noise is reduced considerably.

Tachometer

The end of the quill has four plane sides and four intervening sides that are segments of a circle (a square nut with rounded corners). A variable reluctance generator shown in detail in Fig. 1 was constructed to serve as a tachometer. It is mounted so that the end



Laboratory setup for measuring high-speed rotation consists of (from left to right) exciter and line matching unit for the tachometer, audio mixer, audio oscillator, cathode-ray oscilloscope, and full-wave rectifier and wideband amplifier

of the quill served as the generator armature, no mechanical or electrical connection being made to the quill. The tachometer is accurately located in place by dowel pins, making removal easy; it is unnecessary to remove the tachometer when changing the belt.

With reference to the two fixed poles of the tachometer, the flat sides of the quill represent wider air gaps than the rounded sides. The magnetic circuit is roughly U shaped, with a coil on each of the two opposite sides of the yoke held rigidly by a nonmagnetic insert welded into place. Direct current is supplied to one of these coils to furnish excitation. By means of a filter, the alternating current generated in this coil is prevented from reaching the d-c source, which due to its low impedance, would act as a short circuit.

A capacitor is used to isolate the d-c from the second coil. The coils are connected so that their alternating currents added. The schematic circuit of the variable reluctance generator, its excitation circuit, and its output to line matching circuit are given in lefthand portion of Fig. 2.

The excitation and output circuits are combined on a single chassis. A small capacitor across the a-c output of the tachometer reduces its high-frequency harmonic content. The resultant wave shape is nearly sinusoidal. The a-c output is differentiated to reduce 60 cycle pickup, then fed into a line-matching transformer. On the other end of the line a stepup transformer is

used, followed by a double differentiator and final transformer. The filtered output of the tachometer is thus an alternating current whose frequency is at all times proportional to the rotational speed of the quill. This frequency and its variation can be measured or recorded in several ways, depending upon the accuracy required and the magnitude and frequency of the speed variations.

Frequency Indication

Use of an electronic frequency meter would have required an amplifier to increase the tachometer output voltage to 0.25, 0.5 or 4 volts, depending upon the meter, but this method although convenient, is subject to inaccuracies. Commercial electronic frequency meters are usually guaranteed to give an accuracy of two percent of the full scale value if the power supply voltage is regulated, and the input voltage must be held to within 0.5 volt to obtain this accuracy. Although many frequency meters are considerably more accurate than the manufacturer's guarantee indicates, the possibility of errors as large as 1,500 rpm excluded their use.

The determination of whether a meter were accurate or not required the development of a means of calibration. As the indicating instrument scales of such meters are rather short and their motions highly damped, it was decided to use the necessary calibrating equipment directly.

The output of an audio oscillator

set at approximately 2,000 cps can be mixed with the tachometer frequency and fed into a headset (or an oscilloscope). A third or beat frequency can be heard (or seen). The number of beats per unit of time is equal to the numerical difference in the component frequencies over the same unit of time.

If the numerical difference is low, such as one beat per minute, an oscilloscope or electron ray tube is particularly desirable. The oscillator output can be applied to one set of plates in the cathode ray tube and the tachometer frequency to the other set, the resulting Lissajou figures are a positive visual indication of minute changes of frequency even if the beat cycle extends over a long period of time. Similarly an electron ray tube can also be used to adjust the oscillator frequency to that of the tachometer. In this instance an amplifier is needed on the output of the reluctance generator. The number of times the magic eye winks indicates the beat frequency.

To obtain aural indications of the oscillator and variable reluctance generator, a mixer unit was constructed, the circuit of which shown in the righthand portion of Fig. 2. The oscillator output was connected to a stepup transformer, then differentiated and fed into a final transformer. The line from the variable reluctance generator matching unit is also terminated in a stepup transformer, the output of which is differentiated twice and then connected to the output transformer. By means of a single pole, single throw switch, these two al-

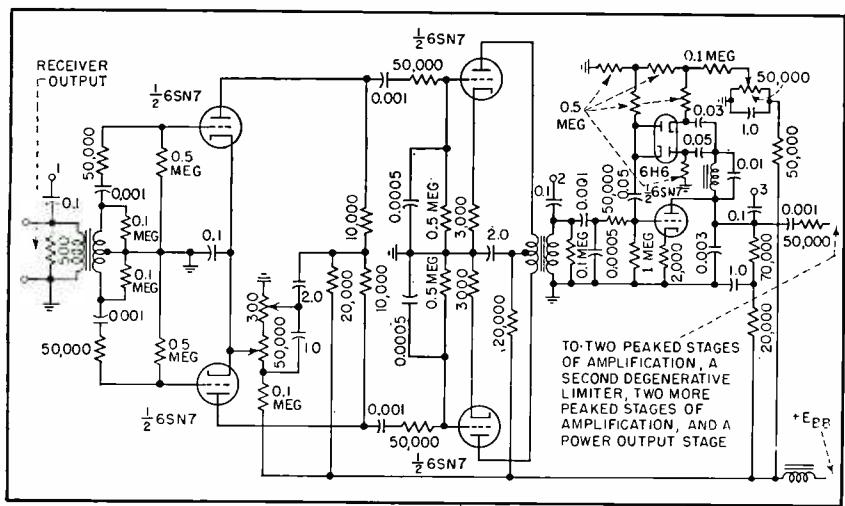
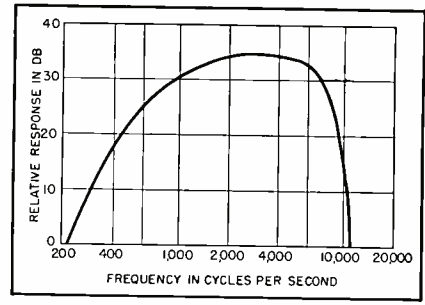


FIG. 3—Essential portions of the harmonic amplifier consists of its balanced input acting also as a center clipper, and the frequency selective, degenerative limiter

FIG. 4—Frequency response of the entire harmonic amplifier



ternating voltages can be multiplied. A difference in frequency is detected in a headset by periodic changes in amplitude or beats. When the switch is open the two voltages are not mixed and visual indicating means are then connected. If it is desired to measure a frequency difference which is too high to be counted, as above described, the mixed output can be amplified and rectified. The output of the rectifier can drive a recording galvanometer; the changes in amplitude correspond to beats.

Audio Oscillator

Accuracy of the observed data depends upon the absolute accuracy of the audio oscillator. The dial furnished by the manufacturer could not be read closely enough, so a micrometer dial (National B-189-B) and gear box (National NPW-O: 20 to 1) were installed. The number of cycles per second, per division, was thereby reduced to 14 in the vicinity of 2,000 cps. The dial graduations permit accurate reading and calibration to better than one tenth of a division, which is plus or minus 0.035 percent of the basic quill speed. The audio oscillator was modified in order to obtain the 1,760 and 2,200 cps check points on the same band. A still better dial and gear reducer combination might be used, but then the stability of the oscillator becomes the limiting factor. Similarly, the frequency range of the oscillator could have been narrowed to 450 cps.

The greatest variation of the oscillator frequency is warmup drift and it was found that the oscillator should be turned on for at least two hours prior to being used. Variations in power voltage influence the oscillator, so a voltage regulator should be used with the oscillator to insure accuracy.

Ambient temperature changes are only of minor importance in the laboratory. It was found that placing a weight on the oscillator case altered the frequency, so a rugged case assembly was constructed, and the oscillator was shock mounted to minimize the effects of vibration incurred in transporting the instrument. Moving the oscillator is always done carefully as vibration or jolting could effect the calibration.

The harmonic amplifier, described below, is connected to a radio receiver output and beat against the oscillator. Check points are obtained at 1,760 and 2,200 cycles per second corresponding to the fourth and fifth harmonics of WWV's 440 cps tone modulation. An intermediate check point is obtained at 1,980 cps. Many other check points are available between 650 cps and 5,000 cps. A curve of dial setting against frequency drawn through the various check points is used to interpolate intermediate values of frequency.

Harmonic Amplifier

The purpose of the harmonic amplifier, as stated above, is to convert one frequency, which may be

considered absolutely accurate, into a number of higher frequencies, which are equally accurate and which can be used for the calibration of an audio oscillator or other devices required for frequency or time measurement. The National Bureau of Standards provides a continuous day and night broadcast of standard radio frequencies which are modulated at 440 cps, accurate to better than 1 part in 10,000,000. This broadcast was taken as the primary standard for frequency measurement. To beat the audio oscillator against the 440 cps modulation would be of little value at 2,000 cps. It was therefore necessary to design a harmonic amplifier which would develop and amplify a number of whole and fractional harmonics of the basic 440 cps frequency and at the same time effectively suppress the original frequency to prevent its interference with the desired frequency. Frequencies of 1,760, 1,980 and 2,200 cps were particularly desired in this instance for the previously described calibration.

In the harmonic amplifier, a radio receiver output feeds into a transformer used to excite the grids of a push-pull stage as shown in Fig. 3. A differentiator is connected in each grid to reduce the response to low frequencies, yet permit the desired frequencies to pass with little attenuation. A relatively low resistance is used in each plate circuit in order to obtain the desired characteristics as a clipper stage. A variable positive bias on

the cathodes can be adjusted so that only the peaks are amplified by each grid and center clipping results.

The next stage is also push-pull, with differentiators in the grids.

The transformer coupled output is then fed through a differentiator to the first peak limiter stage. This is not a conventional limiter because only certain frequency ranges are affected and because of its degenerative action. The low frequencies are passed through a reactance coil to the dual diode, each half functioning for an alternation.

High frequencies are passed through a capacitor shunting the reactor. Thus the high and low frequencies are impressed upon the limiter. Where these have sufficient amplitude to be conducted through the limiter as determined by the setting of the bias potentiometer, the grid is excited by a potential derived from the plate, whose phase is in opposition to the incoming signal on the grid, preventing the further increase of grid potential in either direction beyond a certain point for a given set of conditions. The resulting wave might be described as a wave clipped not squarely but with ripples. The harmonic content of the output is rather high.

The remaining stages amplify the medium range of frequencies. To accomplish this, a differentiator is placed in each grid to attenuate the low frequencies, and in certain cathode circuits, parallel circuits are placed which resonate at approximately 440 cps in order to further reduce the fundamental by degeneration. Certain stages have parallel circuits in their plates to increase the selective amplification of the desired harmonics. The fundamental has been considerably reduced before the signal reaches a second limiter, but certain parts of the complex wave are of greater amplitude than others, so the limiter is employed to even out the complex wave. Because there are no appreciable low frequencies present, the limiting action is confined to the higher frequencies. The amplifier's overall frequency response is shown in Fig. 4. In some of the amplifier stages a plate resistor and capacitor are used in the load cir-

cuit. The capacitor is for the purpose of reducing the response to the excessively high frequencies.

All transformers are given resistance loading and series grid resistors are used for stability. A resistor-capacitor combination is used in all plate supply leads except in the power stage, to prevent coupling between stages through the high voltage.

To check for self oscillations, one uses various input frequencies and observes the frequencies appearing at the various binding posts (such as those numbered 1, 2, and 3 in Fig. 3) on the panel. At no point should the amplifier show a pronounced response to any one input frequency. The plate supply voltage can be from 150 to 300 volts d-c; at the higher voltage the total current drain is under 100 ma. The plate supply voltage is used to set the clipping and limiting levels, so it should be regulated. The filament transformer should be of sufficient capacity to provide current for the heaters and pilot light. It is important that this transformer be isolated physically or shielded magnetically to prevent 60-cps pickup by the harmonic amplifier. The filament leads are shielded throughout for the same purpose.

Operation

The only controls on the harmonic amplifier consist of three limiter adjustments, the first of which can serve as a gain control to supplement the receiver's control if desired. Once made, the settings of the others do not require readjustment. The first control adjusts the center clipper and the second and third adjust the peak limiters. These adjustments are not critical and can be set to operate effectively on a slice of the received signal, reducing noise. The amplitude of the signal and the degree of fading determine the amount of center clipping which can be used. The peak limiters, while adjustable, nevertheless have a slight self-regulatory feature which adjusts the limiting action according to the amplitude of the signal.

Radio receiving conditions are particularly poor at times on the West Coast, so it was necessary to calibrate the audio oscillator when

reception was somewhat improved. Fading and static combine to make calibration difficult; however, extraneous man-made noise can be reduced by moving the receiver to a location a few miles from noise generating devices. Fading can be reduced by diversity reception, the receivers preferably having a common automatic gain control so that the receiver or receivers momentarily active would desensitize the others, thereby reducing the tube hiss and noise pickup. When fading was particularly pronounced, it was found that the last two amplifier stages could profitably be used.

The output of the audio oscillator can be introduced in the output stage of the harmonic amplifier. Otherwise the output of the audio oscillator can be connected directly to the amplifier or through the mixer unit.

The oscillator is adjusted until its frequency is synchronized by aural and visual means with one of the frequencies obtained from the harmonic amplifier until no beat frequency is heard. The only visual means which is satisfactory as an aid to aural means is by using an oscilloscope whose sweep is synchronized to the desired frequency. With so many harmonics and static present, Lissajou figures or magic-eye techniques cannot be used. Sharply tuned audio filters, such as used in connection with radio range receivers can be used to great advantage. The setting of the oscillator and the corresponding frequency as derived from WWV broadcasts can thus be determined.

Numerous tests were run with the equipment described herein. The equipment was operated with different quills, with and without an idler pulley, in order to simulate different speed and speed variation conditions for analysis by the tachometer. Rapid fluctuations in speed were readily detected as were small changes in speed. The factors determining speed and causing irregularities could conveniently be studied using these techniques. The equipment provides an extremely accurate means of measuring speed and rapid variations of speed and should find many applications where accurate measurements of this nature are required.

Permeability Tuning of

Analysis of permeability-tuned series loop and transformer-coupled loop circuits. Performance is compared with that of the familiar capacitance-tuned high-impedance type.

Coil-winding data for obtaining proper pitch for oscillator tracking are also given

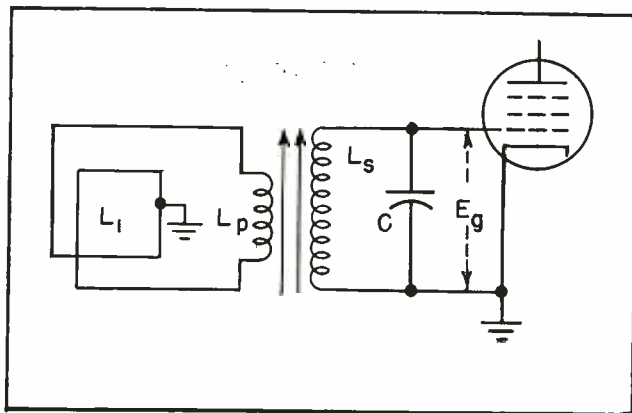


FIG. 1—Transformer-coupled loop circuit

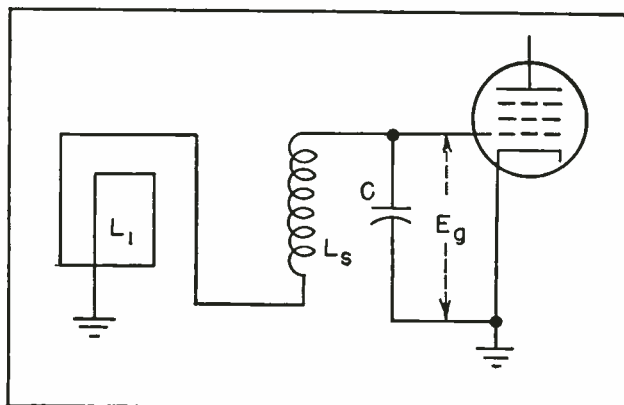


FIG. 2—Series loop circuit

PERMEABILITY tuning has been used widely in automobile receivers and has been found to be very satisfactory for such use. The advantages to be gained by this method of tuning rather than a gang capacitor are: smaller size, lower cost, and improved signal-to-noise ratio when tuning a small-capacitance antenna.

Of these advantages only lower cost would ordinarily be of great importance in the design of home receivers. Unquestionably, the greatest barrier to the wide acceptance of permeability tuning is the degradation of loop performance which is encountered, particularly in small table models.

At present there are two accepted methods of permeability tuning a loop antenna. In both cases the loop must be of the low impedance variety and is usually constructed of two to four turns of heavy copper wire or ribbon. The two methods which we will consider are:

1—The transformer-coupled circuit wherein the loop is connected to a small primary winding which is coupled to a secondary winding which in turn is tuned by an iron core. The schematic diagram appears in Fig. 1.

2—The series loop circuit wherein the loop is connected in series with the tuning coil. The schematic diagram of this connection appears in Fig. 2.

The analysis of the transformer-coupled circuit will follow very closely a previously derived method for the capacitance-tuned low-im-

pedance loop¹. The analysis of the series loop circuit will follow the method given by Polydoroff². Gain and signal-to-noise ratio will then be compared for the two circuits and a further comparison made with the usual high-impedance capacitance-tuned loop antenna.

For the purposes of these comparisons, a table model receiver having an area of 82 square inches available for the loop will be considered. Knowing the loop area and the number of turns, the effective height of the loop is found from the formula

Table I—Series Loop Circuit

Frequency in kc	Q	Loop Effective Height $\mu\text{V/m}$	Figure of Merit	Tuned Circuit Impedance, ωLQ
1,500	90	0.0093	0.836	115,000 ohms
1,000	95	0.0062	0.588	231,000 ohms
600	110	0.0037	0.408	418,000 ohms

Broadcast Receivers

By
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$$he = \frac{2\pi NA}{\lambda} \text{ in microvolts per meter (1)}$$

The effective height of the loop multiplied by the gain of the input circuit is equal to the figure of merit of the loop.

To find the thermal-noise produced in the input circuit, the tuned circuit impedance must be known, and this will be calculated for each of the three type circuits compared here.

Analysis of Series Loop Circuit

The factor which determines the gain obtainable with the series loop is the tuning range available in the permeability-tuned coil. It was determined experimentally that a linear pitch, 130-microhenry, progressive-wound coil on Bakelite tubing having dimensions of 0.206 inch I.D. and 0.226 O.D., tuned with a commercially available iron core whose dimensions are 0.200 inch diameter and 1.5 inch long, could be made to have an inductance change of 11 to 1.

Inasmuch as the dial calibration which can be obtained with a linear pitch coil was found to be somewhat more crowded at the high-frequencies than is usual with a tuning gang and since this crowding was deemed to be unsatisfactory, a variable-pitch coil having three different pitches was designed and was found to be a great improvement over ganged capacitors insofar as dial crowding is concerned. Such a coil having an initial inductance of 130 microhenries was found to have an inductance change of 10.3 to 1.

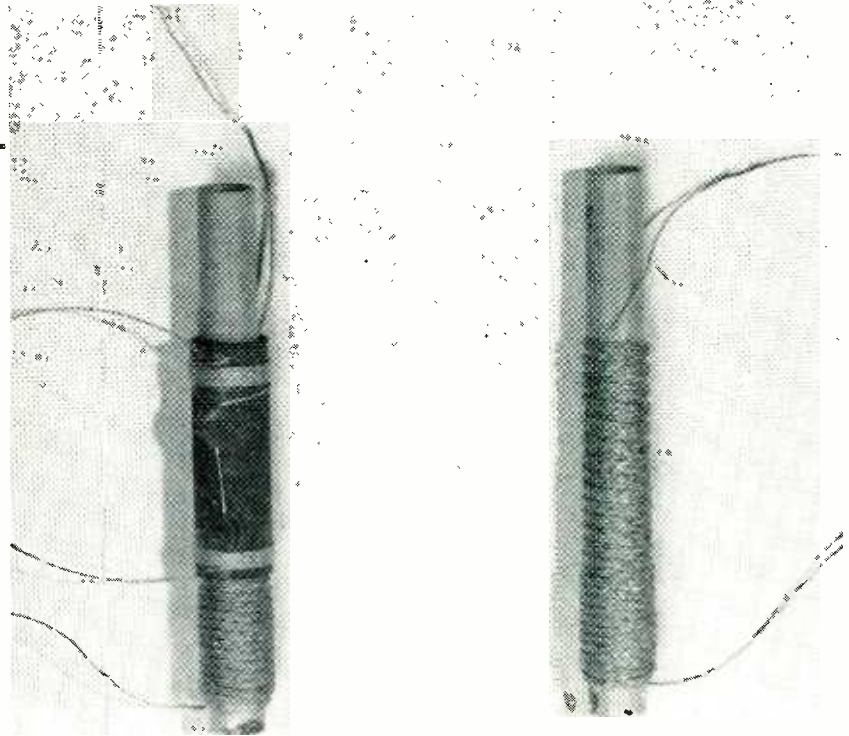


FIG. 3—Left, the primary is wound in two sections over the secondary. Full view of the secondary winding appears at right

Applying a formula² to find the size of the loop which may be tuned we have

$$L_1 = \frac{L_s \left[\mu_{\text{eff}} - \frac{(f_{\text{max}})^2}{(f_{\text{min}})^2} \right]}{\frac{(f_{\text{max}})^2}{(f_{\text{min}})^2} - 1} \quad (2)$$

where L_1 = loop inductance
 L_s = tuning coil air inductance

To tune the complete broadcast band with some allowance for drift and misalignment, f_{max} must be at least 1,610 kc and f_{min} at most 535 kc. This is a frequency range of 3.01 to 1 or the equivalent of a 9.06 to 1 inductance change. Substituting in Eq. 2 with a μ_{eff} of 10.3 for the variable pitch coil,

$$L_1 = \frac{130 [10.3 - 9.06]}{9.06 - 1} = 20 \mu\text{h}$$

For the 82 square-inch loop which is being used in this instance, it was found that 20 μh was obtainable with 5.6 turns. The effective height of this loop is calculated by the use of Eq. 1. The Q of the circuit is very nearly the Q of the tuning coil itself since it forms the greater part of the total inductance, and figure of merit equals $heXQ$.

Knowing that the total inductance at 1,610 kc is 130 + 20 or 150 μh , the inductance at other frequencies is found by multiplying 150 by the square of the frequency ratios. For example at 1,500 kc,

$$L = \frac{(1,610)^2}{(1,500)} \times 150 = 172 \mu\text{h}$$

Some of the important characteristics of this input circuit are shown in Table I.

The factors which must be known for the calculation of the transformer-coupled loop¹

- k = coefficient of coupling between primary and secondary. This value varies as the coil is tuned
- m = ratio of primary inductance to loop inductance
- L_{eqv} = total inductance as seen at the grid of the tube
- Q_{eqv} = total circuit Q as seen at the grid of the tube

While it is highly desirable to keep both m and k constant as L_s is tuned, this is not feasible. In order that k be as large as possible across the entire band, it was found desirable to wind part of the primary over the top of the secondary (top being considered the end of the secondary through which the iron core enters), the rest of the primary being concentrated at a point about half-way down on the secondary winding. Such a primary winding is shown in Fig. 3, assembled on the secondary.

Theoretically, any number of turns of the low-impedance loop can be coupled into the secondary and the same signal obtained at the grid. Actually, however, larger loop inductances result in more primary turns which yield a somewhat higher coefficient of coupling than small primaries. For this reason when dealing with table model loops, a 4-turn loop gives better results than a 2-turn loop. Also, Q is improved with the increased turns.

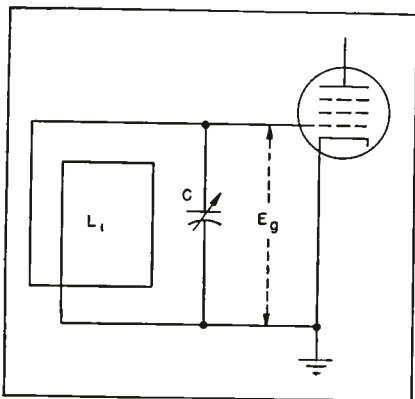


FIG. 4 — High-impedance capacitance-tuned loop circuit

TABLE II—Transformer-Coupled Loop

Frequency in kc	Transformer Gain	Loop Effective Height $\mu\text{v}/\text{m}$	Figure of Merit	Tuned Circuit Impedance $\omega L_{\text{eqv}} Q_{\text{eqv}}$
1,500	59.5	0.00664	0.395	108,500 ohms
1,000	116.5	0.00442	0.515	151,500 ohms
600	241	0.00265	0.610	217,000 ohms

TABLE III—Capacitance-Tuned Loop

Frequency	Q	Effective Height in $\mu\text{v}/\text{m}$	Figure of Merit in $\mu\text{v}/\text{m}$	Tuned Circuit Impedance ωLQ
1,500	70	0.0284	1.98	120,500 ohms
1,000	83	0.0189	1.57	95,500 ohms
600	70	0.0113	0.795	48,300 ohms

In the comparison made here, a 4-turn loop of 82-square-inch area having an inductance of 10 μh was used with the transformer-coupled input circuit.

Since the presence of the primary winding connected through the loop reduces the tuning range of the secondary, the size of the primary winding must be determined experimentally, although if the coefficient of coupling is known, the maximum size of the primary needed to maintain tuning range may be calculated. This primary inductance is usually of necessity smaller than the optimum value which should be used for the coefficient of coupling encountered. Actual values of k and m for a 130- μh variable pitch secondary coupled to a 10- μh loop are given below. These values were determined experimentally in order that the tuning range be covered.

Frequency	k	m
1,500 kc	47.%	0.28
1,000 kc	61.3%	0.34
600 kc	70.%	0.46

Purely theoretical considerations would have made $m = 0.75$ at 1,500 kc and $m = 0.47$ at 600 kc, thus¹

$$Q_{\text{eqv}} = Q_s \frac{(1 + m - mk^2)}{(1 + m + 2mk^2)} \quad (3)$$

The assumption used in deriving

this equation was that the total primary circuit Q made up of both loop and primary inductance is equal to $(\frac{1}{2}) Q_s$. This is close to being the actual case and at

$$1,500 \text{ kc, } Q_{\text{eqv}} = \frac{90 \frac{(1 + 0.28 - 0.062)}{(1 + 0.28 + 0.124)}}{90} = 78$$

$$1,000 \text{ kc, } Q_{\text{eqv}} = \frac{95 \frac{(1 + 0.34 - 0.128)}{(1 + 0.34 + 0.256)}}{95} = 72.4$$

$$600 \text{ kc, } Q_{\text{eqv}} = \frac{110 \frac{(1 + 0.46 - 0.225)}{(1 + 0.46 + 0.45)}}{110} = 71.2$$

$$L_{\text{eqv}} = L_s \frac{(1 + m - mk^2)}{(1 + m)} \quad (4)$$

Since at 1,610 kc, it was found that $k = 30.3$ percent and $m = 0.15$,

$$L_{\text{eqv}} = 130 \frac{(1 + 0.15 - 0.0138)}{(1 + 0.15)} = 128.2 \mu\text{h}$$

Knowing the tuning inductance at 1,600 kc, the inductances at other frequencies can be calculated as before for the series circuit¹

$$\text{Gain} = kQ_{\text{eqv}} (L_s/L_1)^{1/2} \left[\frac{m^{1/2}}{1 + m} \right] \quad (5)$$

From Eq. 5

$$L_s = \frac{L_{\text{eqv}} (1 + m)}{1 + m - mk^2} \quad (3)$$

Then

$$\text{Gain} = kQ_{\text{eqv}} \left[\frac{L_{\text{eqv}}}{L_1} \right]^{1/2} \left[\frac{m}{(1 + m)(1 + m - mk^2)} \right]^{1/2} \quad (7)$$

Knowing the gain of the input

TABLE IV—Comparison of Circuits

Frequency in kc	Figure of Merit	Grid noise voltage 6SG7 Input Tube μV	ENSI $\mu V/m$ 6SG7 Input Tube	Grid noise voltage 6SA7 Input Tube μV	ENSI $\mu V/m$ 6SA7 Input Tube
Series Loop Circuit					
1,500	0.836	4.06	4.86	6.62	7.9
1,000	0.588	5.11	8.73	7.35	12.5
690	0.408	7.15	17.5	8.86	21.7
Transformer-Coupled Circuit					
1,500	0.395	3.51	8.9	6.4	16.2
1,000	0.515	4.16	8.1	6.67	12.9
600	0.640	5.32	8.3	7.46	11.7
Capacitance-tuned High-impedance Loop					
1,500	1.98	3.71	1.87	6.4	3.23
1,500	1.98	3.3	2.1	6.17	3.9
600	0.795	2.35	3.0	5.75	7.25

transformer, the figure of merit of the loop system is the effective height of the loop multiplied by the gain of the transformer. Pertinent characteristics for the transformer-coupled circuit are shown in Table II.

Capacitance-Tuned High-impedance Loop

To satisfy tracking considerations, it was found that the capacitance-tuned high-impedance loop should have an inductance of 183 μh . Knowing that a 4-turn loop of this area had an inductance of 10 μh we may calculate the turns of the 183- μh loop as

$$\sqrt{\frac{183}{10}} \times 4 = 17.1 \text{ turns}$$

The figure of merit for this loop circuit is loop effective height multiplied by loop Q. Table III shows the characteristics for the capacitance-tuned high-impedance loop including the loop Q when mounted about two inches from its associated chassis. Figure 4 shows this type of loop circuit.

In most receivers sufficient intermediate-frequency gain is available so that actual gain of the antenna circuit is of minor importance compared with the signal-to-noise ratio of this circuit.

The input circuit noise^{4,5} is

$$E_t = 1.28 \times 10^{-10} \sqrt{FR} \quad (8)$$

where E_t is the noise in volts

F = receiver bandwidth in cycles (7,000 cycles in the present analysis)

R = tuned circuit impedance in ohms connected to the input tube grid plus the equivalent input noise resistance of the input tube

The equivalent input noise resistance (shot noise referred to the grid circuit) is⁶ 3,300 ohms for a 6SG7 tuned r-f amplifier. This noise resistance is negligible compared with the tuned circuit impedance. However, in the case of a 6SA7 converter tube used as the input tube, the equivalent noise resistance is 240,000 ohms and is of considerable importance in determining the signal-to-noise ratio.

If we divide the grid circuit noise as given by Eq. 8 by the figure of merit of the loop system, a measure of the signal-to-noise ratio for the receiver is obtained. In fact, by thus referring the noise to the input of the receiver, we have obtained the familiar ENSI (equivalent noise signal input) expressed in microvolts noise per meter which is usually used to express the signal-to-noise ratio of receivers. Using this method of analysis and the information previously derived for the three types of loop circuits, we

can tabulate the performance of the loop circuits for two extreme types of input tubes as shown in Table IV.

Obviously, the permeability-tuned loop is inferior to the capacitance-tuned type with respect to both gain and signal-to-noise ratio.

When input tube noise is neglected, the actual value of tuned circuit inductance has no effect on signal-to-noise ratio, although gain is nearly proportional to the square root of inductance. When a 6SA7 is used as the input tube, it is desirable to build the tuned circuit impedance to as high a value as possible to overshadow tube noise.

For the foregoing analysis, the high inductance permeability-tuned coil was not considered, for it was found that a variable pitch winding could not be wound satisfactorily above 130 μh . It was found to be quite practical, however, to wind linear pitch progressive windings on a 0.226 diameter form with 250 μh inductance. Such a coil showed an inductance range of 10.6 to 1 (this compares with the 11 to 1 range for a 130- μh linear pitch coil).

An analysis of performance with this 250- μh coil is of interest, because it represents the best which we can do for a small permeability-tuned receiver with no r-f stage. Assuming use of the series loop circuit, the loop inductance can be calculated to be 47.7 μh consisting of 8.7 turns of the same area used for the previous loops. Table V is a summary of the performance characteristics using this tuning coil and loop.

Any improvement which can be made in either iron core or coil to improve tuning range will, of course, result in better performance for any of the loop-tuning circuits, insofar as signal-to-noise ratio is concerned.

One advantage which the transformer-coupled circuit enjoys over the series type, besides improved gain at the low frequencies, is the fact that the loop may be center-tapped to ground in order to provide balance to extraneous noise pickup. This is only a slight advantage, however, since the series loop



FIG. 5—Blown up to show the three different pitches formed in the winding process, this oscillator coil is used to track with the r-f coil shown in Fig. 3

is usually of low enough impedance so that noise pickup due to capacity effects is small.

With permeability tuning in a small table model receiver, the signal-to-noise ratio will be down from two to five times depending on the circuit used, the input tube and loop parameters. With some sacrifice of dial scale linearity, the gain need not be down more than two times, and this may often be regained in the i-f portion of the receiver.

A console receiver with a large area available for a low-impedance loop may have a signal-to-noise ratio equal to or better than a gang-capacitor tuned receiver, and may be done without any impairment of dial scale linearity.

Tracking

While a mathematical approach⁶ to the tracking of a permeability-tuned oscillator coil to the r-f coils is possible, the results are invariably inconclusive. The majority of development engineers will undoubtedly prefer an experimental approach just as they have done with gang capacitor tracking in the past. By using variable pitch oscillator coils, it is possible to obtain nearly perfect tracking, and, after a little practice, the design procedure is not lengthy.

The simplest case is one which involves a linear-pitch progressive-wound antenna coil with a series loop. If all iron cores are alike and a shunt inductance padder is used, this corresponds exactly with the gang capacitor case where all sections are alike and an oscillator series capacitance padder is used. An oscillator coil consisting of a solenoid of some convenient wire size and pitch should be wound on the same size tubing used for the antenna coil. The length of the oscillator coil should be equal to that of the antenna coil. It has been found that No. 34F, Formex or Formvar, wire with sufficient pitch to give an air inductance of about 18 μ h works well. Such a coil covers too much range to track, and the range can be limited by inserting a fixed series inductance.

The alignment procedure should be as follows: With cores out of the coils by about $\frac{1}{8}$ inch, align the oscillator to the top frequency (usually about 1,610 kc). Peak antenna trimmer. Tune receiver to 1,000 kc and adjust iron core in antenna coil for maximum sensitivity. Tune receiver to about 580 kc and rock-in inductance padder for maximum sensitivity. Repeat entire procedure.

If it is found that mistracking occurs so that the antenna coil requires more capacitance (or inductance) at frequencies between 1,000 and 1,610 kc and further requires less capacitance or inductance at frequencies between 1,000 and 580 kc, the series inductance should be reduced to obtain tracking. Conversely, if it is found that the antenna coil requires less capacitance to align above the middle frequency and more capacitance to align below the middle, the series inductance should be increased.

After the correct value of series inductance has been determined, it may be measured along with the oscillator coil to find what total value of oscillator inductance is required. A new coil is then wound on a larger diameter tubing using the same wire size, pitch, and number of turns as before, but the diameter of the new coil is such that the correct total inductance is obtained.

As an example, it was found that a series inductance of 6.0 μ h was required with an 18.0 μ h-oscillator coil which had been wound on 0.226 O.D. tubing. A new coil having the same wire size and number of turns was wound on 0.260 O.D. tubing to have 24 μ h inductance. This coil tracked satisfactorily. It will be found that inductance increases as the square of the diameter, within narrow limits, for solenoids of the general configuration used for oscillator coils. If a tuned r-f coil is to be used in addition to the antenna coil, it should be wound on a suitable diameter tubing so that its inductance is equal to that of the antenna coil plus the loop.

When the antenna coil is a variable pitch winding, the oscillator

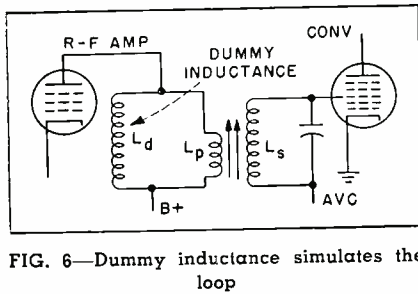


FIG. 6—Dummy inductance simulates the loop

Table V—250- μ h Coil in Series Loop Circuit

Frequency in kc	Figure of merit	ωLQ	ENSI 6SG7 tube μ v/m	ENSI 6SA7 tube μ v/m
1,500	1.28	272,000 ohms	1.35	5.5
1,000	0.915	460,000 ohms	7.9	9.8
600	0.635	885,000 ohms	15.7	17.9

coil must also have a variable pitch which corresponds. For the series loop it is only necessary that the pitch multiplying factors and proportion of turns in each section be the same for both antenna and oscillator coil. Beyond that the design procedure is the same as that previously used for the linear coils.

For example, the antenna coil consists of a progressive-universal winding of three separate pitches as follows: 83 turns at 177 turns per inch, 100 turns at 247 turns per inch, 157 turns at 363 turns per inch, for a total of 340 turns and a winding length of 1.375 inches.

Experience indicates that a convenient oscillator coil of around 20 μ h should have about 130 turns. We then divide each of the above pitch figures by a factor of 2.5 to obtain the number of turns in each section of the oscillator coil. This comes out to be 33 turns, 40 turns and 63 turns. All that remains is to find the actual pitch of each section so that the total oscillator coil length is 1.375 inches. Since turns divided by TPI, turns per inch, equal winding length, we may set up an equation for TPI as follows

$$\frac{33}{\frac{177}{247}(\text{TPI})} + \frac{40}{\text{TPI}} + \frac{63}{\frac{363}{247}(\text{TPI})} = 1.375$$

solving, TPI = 94

The oscillator coil should then be wound

$$33 \text{ turns at } 94 \times \frac{177}{247} = 67.3 \text{ TPI}$$

$$40 \text{ turns at } 94 \text{ TPI}$$

$$63 \text{ turns at } 94 \times \frac{363}{247} = 138 \text{ TPI}$$

Such an oscillator coil is wound on thin-wall tubing and the required series inductance is determined in

the same manner as was used for linear coils. A new coil of larger diameter may then be wound using the same number of turns and pitch to incorporate the necessary series inductance. An oscillator coil of this type appears in Fig. 5.

The transformer-coupled loop with variable pitch tuning coils is the most difficult type to track for the loop primary has a pronounced effect on the secondary tuning curve. Here it is best to start with an oscillator coil whose pitch variations correspond with those of the antenna coil as before, but mis-tracking will inevitably be found. The frequencies where this mis-tracking occurs as well as the direction of misalignment are noted.

As a general rule when more inductance is required in the antenna coil for alignment above the middle frequency (at around 1,200 or 1,300 kc), the oscillator coil winding pitch must be reduced (more turns per inch) at this end of the oscillator coil. When more inductance is required in the antenna coil below the middle frequency (around 700 or 800 kc) the middle pitch of the oscillator coil should be increased (less turns per inch).

To determine whether oscillator pitch must be reduced or increased at any particular frequency, 1,000 kc is used as the starting point since the iron cores are aligned there. Thus if more inductance is needed in the antenna coil at 1,200 kc for tracking, the oscillator core has moved too rapidly, up from 1,000 kc, and so the winding pitch must be reduced between 1,000 kc and 1,200 kc to correct.

Inasmuch as varying oscillator series inductance has somewhat the

same effect as changing pitch, various combinations are possible which appear to give reasonably good tracking, but one particular combination will usually be best. Lag or lead of the oscillator core with respect to antenna core must be watched. By this is meant that the oscillator core may be entering its coil sooner or later than the antenna core. This is not a desirable condition since it causes tracking errors at one end of the travel.

Very often the low-frequency pitch of the oscillator coil may be varied to correct for lead or lag, when a shunt inductance padder is used. Decreasing pitch at the low-frequency end of the oscillator coil will lower the shunt padder inductance, and this in turn will cause less oscillator core lag at 1,000 kc.

If a tuned r-f stage is used with the transformer-coupled loop, a primary winding similar to that used for the loop may also be wound on the r-f coil and a dummy inductance connected to this primary to simulate the loop. The circuit of Fig. 6 has been used quite successfully. It is also possible to use different pitch variations in the r-f coil from those in the antenna coil to obtain tracking without the necessity for a primary winding and dummy loop inductance.

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VHF LINK FOR

New utilization of vhf mobile f-m radio equipment puts a photograph on the picture editor's desk eight minutes after the event. Extension of the technique will allow nationwide picture distribution direct from the news scene



Station wagon with mobile radio and picture-transmitting equipment installed. New York Daily Mirror chief photographer, John J. Reidy uses the two-way link before engineer Charles Smith connects the Soundphoto equipment in place of the microphone

RADIO AND WIRE circuits have already established themselves as a necessary means for conveying spot news photographs from the locale of an event to newspaper plants. Recently successful experiments were completed by the New York Daily Mirror in which prints produced in an automobile immediately after exposure were transmitted to the editor's desk in less time than the negatives could have been delivered by usual motorcycle courier.

That this method will probably

become standard for pictorial news coverage is indicated by the fact arrangements are now being made for leasing permanent sites for installation of remote receiving and transmitting equipment. Application has been made to the FCC for a construction permit and complete radio and picture transmission equipment has been ordered.

The picture equipment used at both terminals of the test radio circuit was standard apparatus manufactured by International News Soundphoto. Each one comprises a

complete picture transmitter and receiver. These machines are customarily connected together in pairs or many of them may be used in multiple, using leased wire lines. Any one of the equipments can be used as the transmitter, the others serving as receivers. Clear reproducible photographs up to 8 by 10 inches in size can be sent to any point in the network of stations. A slight modification in the input and output circuits makes it possible to adapt these machines for radio service so that they can key a radio

PRESS PHOTOS

transmitter or be keyed by a suitable receiver.

In operation, the photo to be transmitted is wrapped around a cylindrical drum that is motor-driven and synchronized by means of a quartz-crystal oscillator with a comparable drum on the receiving unit. A phototube, scanning the picture in spiral fashion at the rate of 90 rpm, translates the various shades of black, gray and white into electrical currents of varying character. These currents are processed and fed over the lines in the form of an 1,800 cps amplitude-modulated signal to the receiving unit where they are inversely processed to produce the original picture. Transmission time for a 5 by 7 inch photograph is about six minutes.

The picture signal for the radio



Temporary 152-162 megacycle antenna with a power gain of 3 erected on the *Daily Mirror* building roof



Interior of the Jeep station wagon. Standard mobile f-m communications equipment is on the floor. Immediately above are the dynamotor and picture frequency standard, with the Scundphoto machine in a lead-lined box on top of the table

tests was fed to the output of a Link Radio Corp. standard mobile f-m transmitter of the type used for police, taxicab, truck and similar service. This equipment, which is crystal controlled, operates from a heavy-duty car battery that is usually supplemented by a special generator for floating the additional load and keeping the battery well charged. Frequency of operation during the test was on 158.07 mc, with a total modulation swing of 40 kc, using the Armstrong phase system. The audio response of the equipment is essentially flat from 350 to 5,000 cycles.

A thin flexible whip antenna, 18 inches long, mounted on the metal roof of the car served as the transmitting antenna. Signals at the receiving location were strong despite the low antenna elevation and the congested locations in which the equipment was used.

At the fixed location conventional vhf transmitter-receiver equipment was installed and connected to a temporary antenna with a power gain of 3 atop the *Mirror* building.



Remotely controlled f-m transmitting and receiving equipment installed in penthouse near the antenna

This equipment was remotely controlled from the dark-room operating position several floors below.

Although the initial commercial installation will use a single fixed receiving location common to the talk-jack transmitter, a much more extensive receiving system is considered necessary for eventual picture-transmission coverage of metropolitan New York. Probably as

many as five separate locations at diverse points will be required to receive good pictures from outlying areas. At these points receivers will be in continuous operation and connected by telephone lines to the central operating post.

To further extend the system, portable receiving equipment can be parked near convenient telephone facilities and within receiving range of the mobile phototransmitter. The receiver will then serve as a relay point between the radio and wire links, making it possible to put news shots into the office of every subscriber in the continental network not more than fifteen minutes after the original picture is taken.

Acknowledgements

We are indebted to John J. Reidy, chief photographer of the *New York Daily Mirror*, Robert Easson, engineer of *International News* Soundphoto laboratory, and to engineers of Link Radio Corp. for pictures and information used here.—A.A.McK.



Darkroom used as control point for the experimental picture transmission system. At a warning signal from the mobile transmitter, the picture apparatus is connected and the control man refrains from using his transmitter until conclusion of the picture

Effect of Feed on Pattern of Wire Antennas

Measured radiation patterns for straight wire antennas of various lengths from a half wavelength to three wavelengths and fed at various points are presented herewith. They show that feed point affects the number, orientation, and magnitude of the lobes

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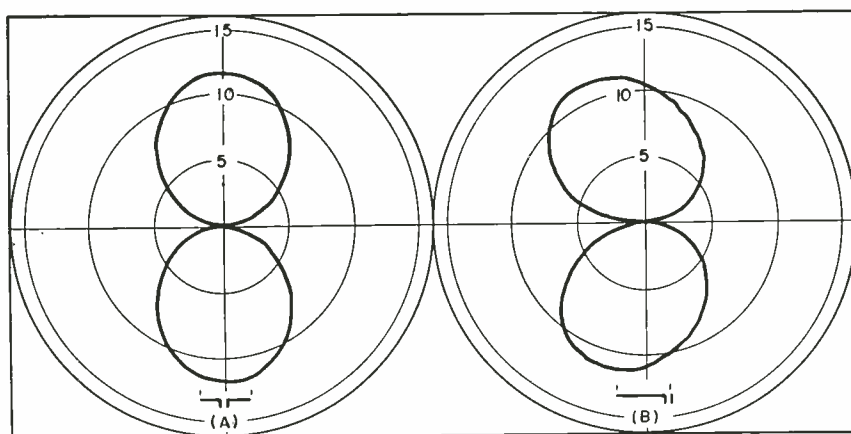


FIG. 1—Radiation from a half-wavelength antenna. Antenna outline with each pattern shows feed point; outline marked off in half wavelengths

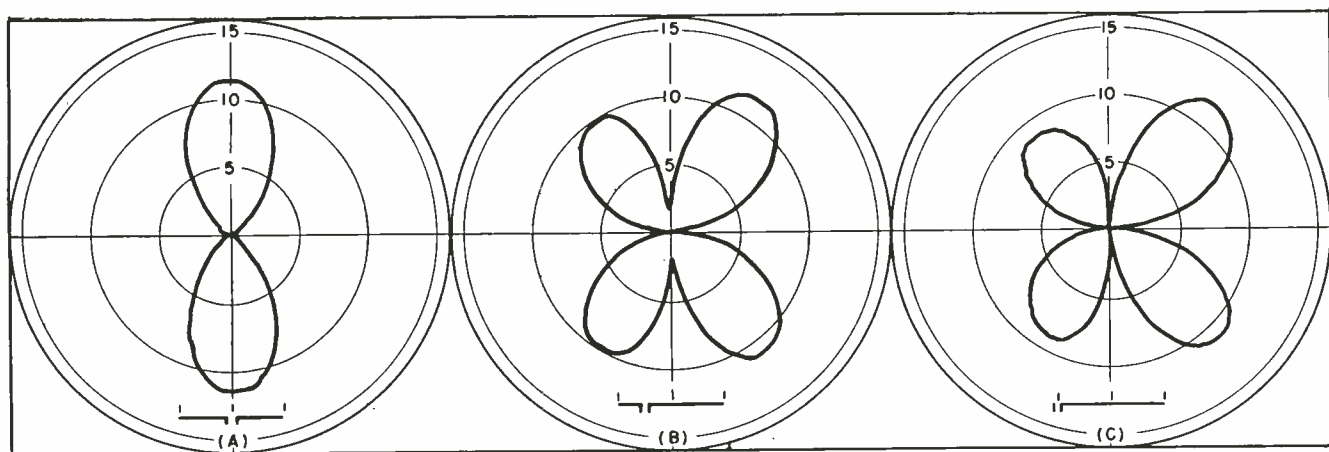


FIG. 2—Shape of field strength pattern of an antenna one-wavelength long depends on the location of the feed point

RADIATION PATTERNS of wire antennas one-half wavelength or longer are dependent on the position of feed used to excite the antenna. There has been considerable confusion in published handbooks

as to just how a certain length antenna is fed to get the desired pattern. This investigation was made to determine the effects of the position of feed upon the pattern of wire antennas.

No attempt will be made to explain the results except to state that the current distribution differs appreciably from a sinusoidal distribution for certain off-center feeds.

Because the pattern of a single

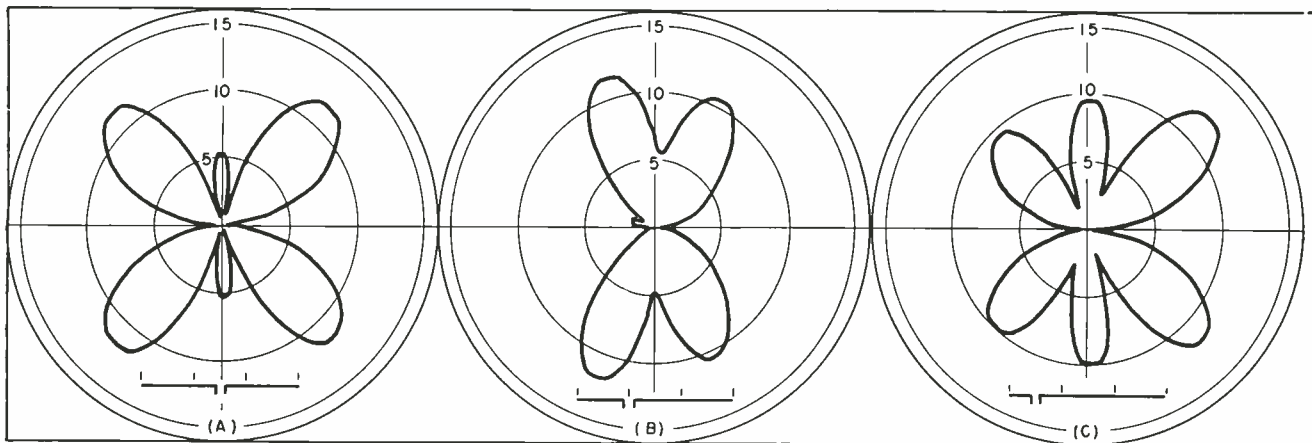


FIG. 3—Filed strength patterns of a one and one-half wavelength antenna for four different feed positions

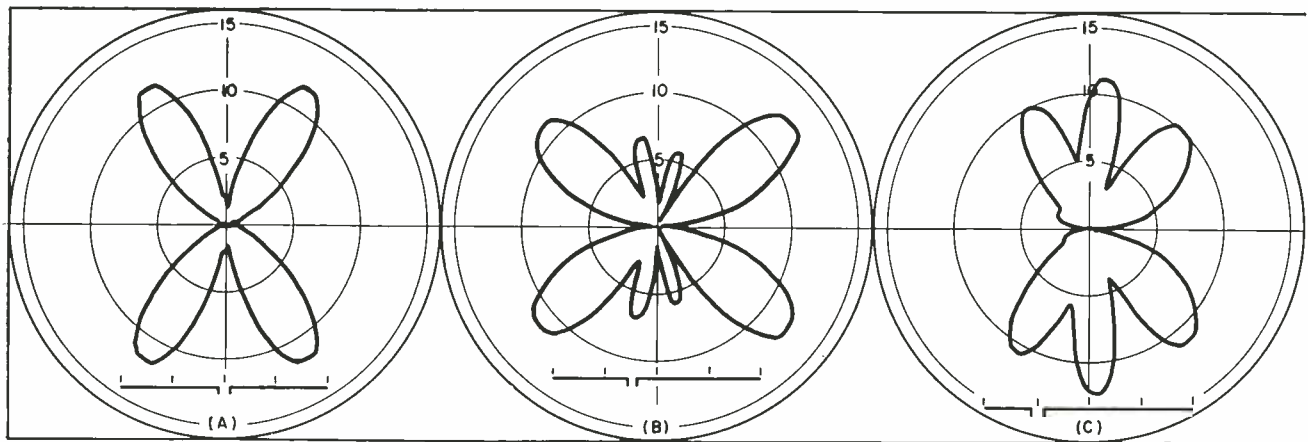


FIG. 4—Radiation patterns of a two-wavelength antenna showing effect of moving feed position from center to one end

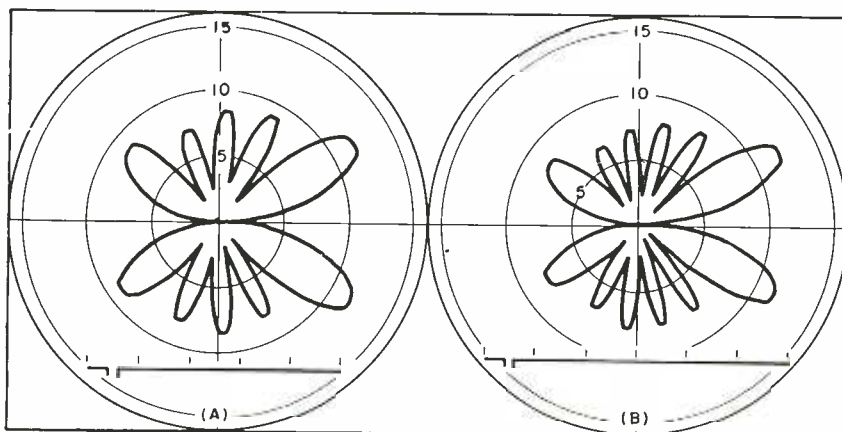


FIG. 5—Radiation from long wire antennas

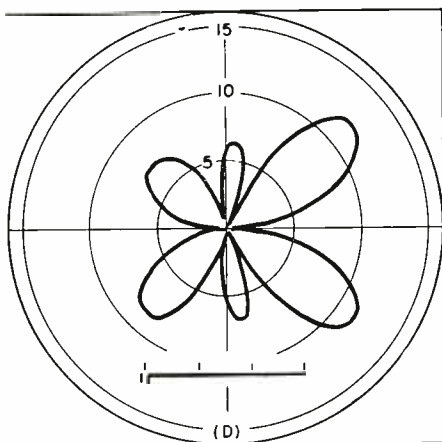
fed wire antenna is independent of the impedance match between it and the receiver or transmitter, it was not necessary to have a perfect impedance match between the antenna and the detector. However, the receiver had a coaxial feed and, therefore, a balance to unbalance trans-

former had to be used. In order to preserve the balance, it was necessary to have a partial impedance match. In the case of high impedance feeds (end feeds or feeds an even number of half wavelengths from the end) a quarter wave section of parallel wire transmission

line was inserted between the antenna and the balancing unit.

The field strength patterns that are shown in the accompanying figures were measured by using scale models of the antennas at 10 and 20 cm. This method of measuring field strength patterns was used by the Antenna Laboratory of the Ohio State University Research Foundation during World War II for the determination of aircraft antenna characteristics (see *ELECTRONICS* cover, May 1947).

The equipment used to measure these patterns consisted of an electro-magnetic transmitting horn, a rotating table upon which a hollow vertical plywood shaft was fastened, the antenna to be measured being mounted on top of the shaft and supported by polystyrene rods when necessary. The antenna to be measured was then a receiving antenna. A Littelfuse bolometer was used as the detector. The pat-



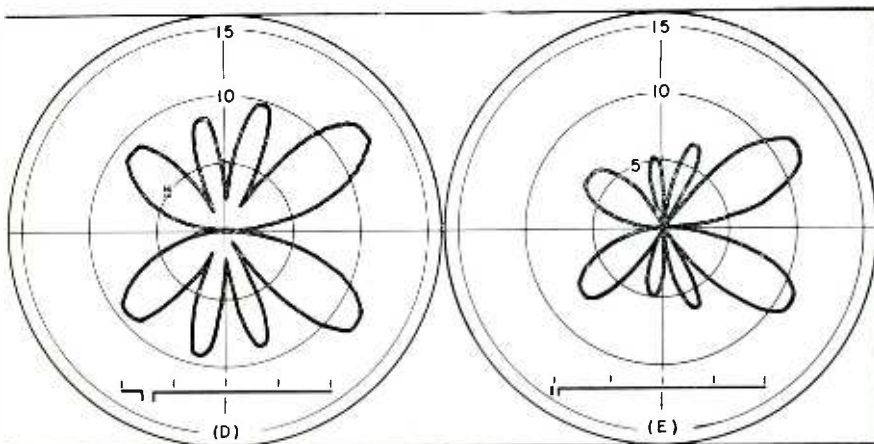
The full wavelength antenna was measured using a balanced voltage feed at the center of the antenna. The two half-wavelength portions of the antenna then have in-phase antenna currents flowing on them. The pattern obtained using this feed point is shown in Fig. 2A. The feed point was moved one-quarter wavelength off center and fed with a balanced current feed. The pattern (Fig. 2B) was nearly that which is usually published for a full wavelength antenna. However, the two lobes of energy on the same

A two wavelength wire was measured using a balanced voltage feed at the center, (Fig. 4A), a current feed one-quarter wavelength off center (Fig. 4B), a voltage feed a half wavelength off center (Fig. 4C), a current feed three-quarters wavelength off center (Fig. 4D), and end fed with a voltage type feed (Fig. 4E). Different distributions must be present on the antenna for different feeds and the current distributions apparently are not sinusoidal even for the balanced center feed since the broadside minima are not complete. The pattern with the one-quarter wavelength off center (Fig. 4B), indicates that current distributions on each half of the wire were not identical let alone sinusoidal. When the wire was fed one-half wavelength off center (Fig. 4C), the minima were not complete and of different values due to the unbalanced current distribution along the antenna.

When the wire was fed three-quarters wavelength off center (Fig. 4D), the current distribution was again different from that when the antenna was end fed (Fig. 4E), as it was for the same types of feeds using the three-half wavelengths antenna (Fig. 3). The large lobes off the free end of the wire were again closer to the wire when the two-wavelength antenna was fed three-quarter wavelength off center, (Fig. 4D), than when the wire was fed one-quarter wavelength from the end (Fig. 4E).

Also shown in Figure 5 are the patterns of longer wires, namely, two and one-half wavelengths and three wavelengths long. Time did not permit further measurements. The minima were not complete as was shown before for similar type feeds used on shorter lengths of wire. Similar effects of non-sinusoidal current distributions were present when unterminated rhombic and V antennas were measured.

This investigation was prompted by discussion between C. H. Page and G. H. Brown at the I.R.E. 1947 Winter Convention in New York City, of the effect of the diameter of the antenna on the pattern when various positions of feeds are used.



terms were continuously recorded by means of a selsyn system between the rotating table and shaft and the recording table. A concentric line lighthouse tube oscillator and a 10 cm two-cavity klystron were used as transmitting sources.

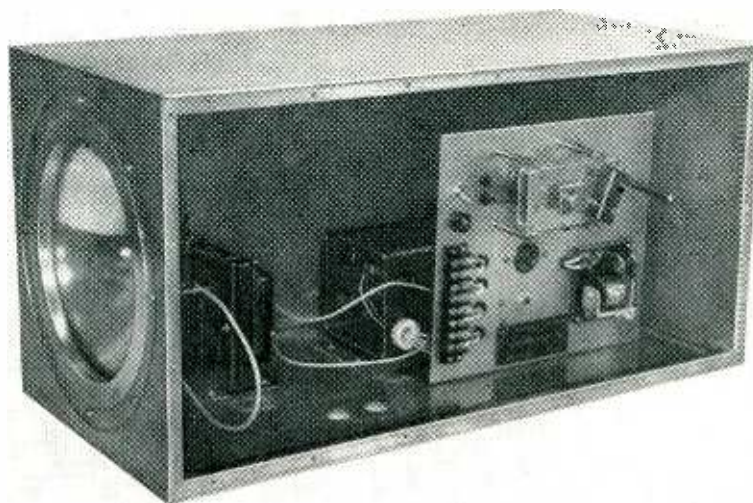
Measurements

The patterns of the half wavelength antenna shown in Figure 1 were taken using first a balanced current feed at the center of the half wavelength and then a voltage feed at the end of the half wavelength wire. (Each diagram has an illustration of its antenna, marked in half wavelengths.) It was apparent that the current distribution on the half wavelength antenna is not sinusoidal when it was end fed. With end feeding the lobes are displaced 15 to 20 degrees from their position when the half wavelength wire was center fed.

side of the wire are not equal in amplitude, but were present at about the published angle of 54 degrees. The minimum differed in amplitude from those obtained when the same length was end fed. When the full wavelength wire was end fed with a voltage feed, the lobes on both sides of the wire closest to the fed end of the antenna were reduced in amplitude even more than when the feed point was a quarter wavelength from the end of the wire, as seen in Fig. 2C.

A one and one-half wavelength wire was measured for center feed, Fig. 3A, one-quarter wavelength off center, Fig. 3B, one-half wavelength off center, Fig. 3C, and end fed, Fig. 3D. It is interesting to note the differences in amplitude of the broadside lobes and that the position of the large lobes off the free end of the end fed wire are slightly closer than the corresponding lobes for other feed points.

Transmissometer receiver. Light from the source is focused on a photoelectric tube by a lens. The receiver converts received energy to pulses, the frequency of which varies with light



By

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Visibility Measurements by

Standardized evaluation of visibility under all conditions is continuously indicated and recorded, using 350,000-cp fixed light source up to 4,000 feet from monitoring photo-tube connected to pulse generator whose output frequency varies with intensity of incident light after passage through atmosphere

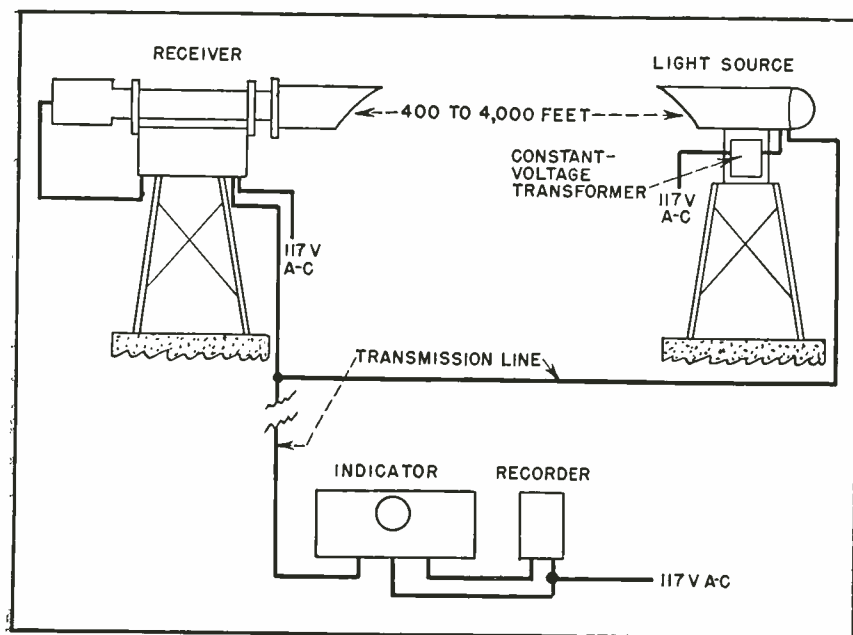
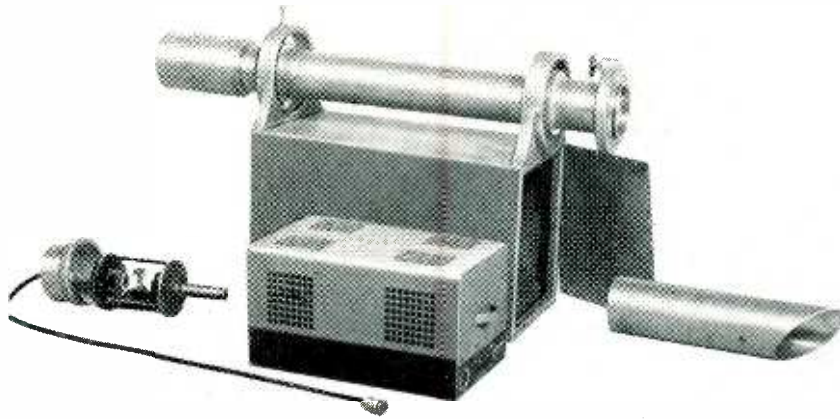


FIG. 1—Arrangement of transmissometer components. The indicator and recorder can be placed anywhere within ten miles of light source and receiver

IN EVERY FULL-SCALE TEST of the effectiveness of a concealment measure or of the visibility of a light signal, the light transmission of the atmosphere is a vital element. Frequently the transmission varies so rapidly that the effects of all other variables, including those under study, are obscured. Many thousands of man-hours have been wasted in visibility tests by attempts to take account of atmospheric transmission merely by visual estimates stated in such terms as foggy, hazy, or clear. At present, visibility data in the proximity of airports—so important in safe aircraft operation—is obtained by such periodic visual observation.

To eliminate or reduce the human factor in visual estimation, particularly in foggy weather, the National Bureau of Standards has developed an electronic instrument,



The 350,000-candlepower light source, voltage-regulating transformer, and clock that shuts off the light for calibration purposes once an hour

Transmissometer

AVIATION APPLICATIONS

PRINCIPAL APPLICATIONS of this transmissometer to aviation are to:

- Supplement periodic visual observations by a continuous record;
- Record the variations and rate of change of conditions of visual range;
- Replace visual observations where trained observers or satisfactory marks, especially lights, are not available;
- Provide a more accurate indication of visual range over a restricted area remote from an observer, particularly an approach zone;
- Provide more accurate indications of visual ranges when visibility becomes poor.

the transmissometer, which measures accurately and continuously the light transmission between two fixed points.

The transmissometer consists of a light source, a phototube receiver, an amplifier and an indicator, shown in Fig. 1. The distance between the light source and receiver may be varied, depending on the particular application; distances up to 4,000 feet have been used. The amount of light falling on the receiver from the constant-intensity light source is determined by the haze or fog density between the two points. The output of the receiver is transmitted to the indicator, which may be placed at a control station as much as several miles from the light source and receiver.

A 6-volt sealed-reflector lamp constitutes the 350,000-candlepower light source, which differs from a

sealed-beam headlight only in its cover and filament. The intensity of the light is closely controlled by a voltage-regulating transformer, insuring a light output substantially independent of line voltage. Adjustments of the intensity are made by means of a series rheostat. For a zero check of the transmissometer the light is turned off automatically once an hour, while intermediate zero checks may be made by the operator from the indicator several miles away. Burning continuously, the lamp has an expected service life of three to six months.

The Light Receiver

The transmissometer receiver consists of a lens, a diaphragm, a photo-pulse unit and an amplifier. Light from the source, focused by the lens on a pinhole in the dia-

phragm, falls on the phototube receiver and there generates pulses whose frequency is directly proportional to the intensity of light incident on the phototube. These pulses are amplified and transmitted over a signal line to the indicator.

The pulse generator circuit is shown in Fig. 2. Phototube current charges capacitor C_1 until the voltage across it is sufficient to initiate a discharge through the neon lamp. The capacitor then rapidly discharges through the neon lamp and resistor R_2 until the voltage across the neon lamp is no longer sufficient to maintain a current through the lamp. During discharge the voltage drop across R_2 supplies a voltage pulse to the grid of the 6J5 tube which causes a momentary change in the plate current of the tube. The resulting momentary change in voltage drop across transformer T_1 , when amplified, supplies the pulse signal that is transmitted to the indicator.

The time required to produce a given change in the voltage across C_1 varies inversely with the current through the phototube. Therefore, the degree to which the pulse rate is proportional to the light incident on the phototube depends on the following factors: the degree of proportionality between the phototube current and the light flux incident upon its cathode; the leakage currents across the components shunting C_1 ; the constancy of the drop in voltage across C_1 for each discharge; the degree to which the time of discharging is negligible as compared to that of charging the capacitor.

The characteristic of the type 929 phototube is such that, if the voltage across it is greater than 20 volts, the current is nearly proportional to the incident light flux falling on the cathode. The minimum phototube voltage is the difference between 105 volts (the

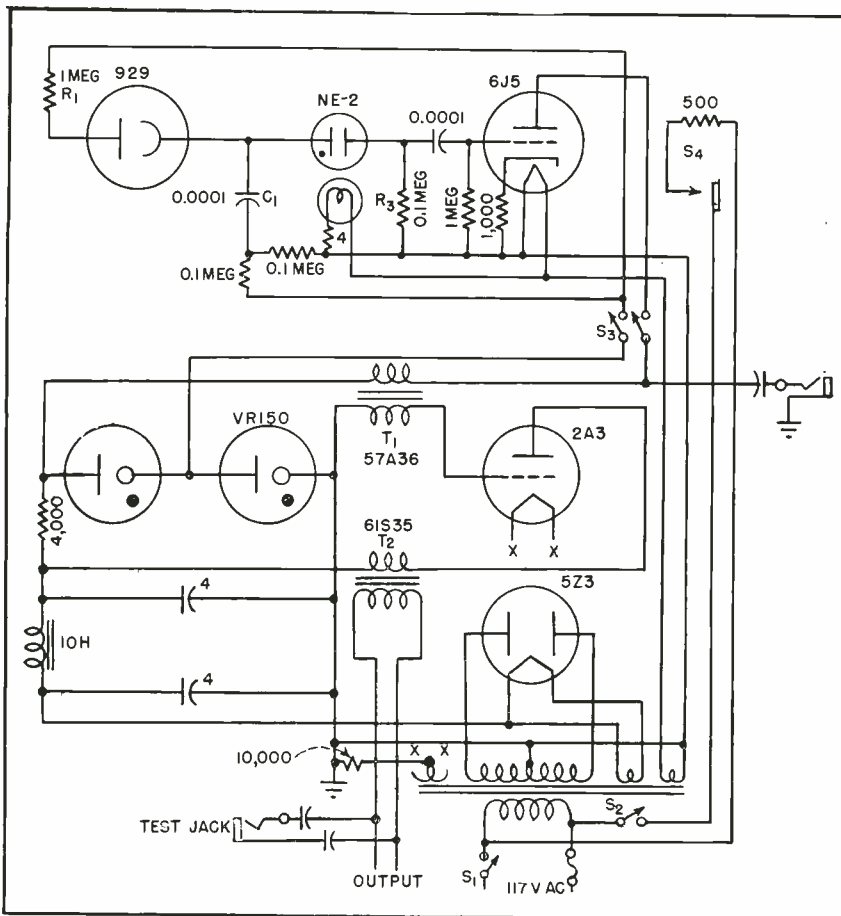


FIG. 2—Circuit diagram of the phototube receiver and pulse circuit that indicates received light intensity. The lefthand voltage regulator tube is type VR105

voltage across tube VR-105) and the breakdown voltage of the neon lamp plus the drop across resistor R_1 . The maximum phototube current—less than 1 microampere—gives a drop across R_1 lower than 0.1 volt. Since the breakdown voltage of the neon lamp is approximately 80 volts, the minimum voltage across the phototube is about 25 volts. Ceresin wax is used to insulate the component parts shunting the high leakage resistance capacitor C_1 in order to reduce the leakage current, the total of which is less than 10^{-10} ampere.

The constancy of the drop in voltage across C_1 for each discharge depends upon the behavior of the neon lamp. Since this behavior is erratic unless subjected to some incident light, an incandescent filament lamp (Fig. 2) is provided whose light intensity is adjusted to the minimum necessary for consistent operation. More light than this minimum increases the leakage current through the neon lamp when it is not discharging. The minimum charging time used in the field is 0.02 second, while the estimated time of discharge is about 0.00001 second. It is evident, therefore, that the departure from linearity should be small.

The Indicator

The indicator, a circuit diagram for which is shown in Fig. 3, consists of a two-stage amplifier, a frequency-measuring unit, and a calibrator which provides a calibration frequency of 60 pulses per second. The frequency meter levels and averages the pulses, sharpened and amplified by the amplifier, and produces a meter reading which is directly proportional to the pulse frequency and thus to the transmission of the atmosphere between the light source and the receiver. The visibility of objects or lights is a function of the atmospheric transmission. If the atmosphere is homogeneous, the maximum distance at which objects or lights can be seen can be determined from the transmissometer readings.

The two-stage amplifier, consisting of a type 6J7 and a type 6J5 tube, amplifies and sharpens the incoming pulses and reduces the effects of noise picked up on the

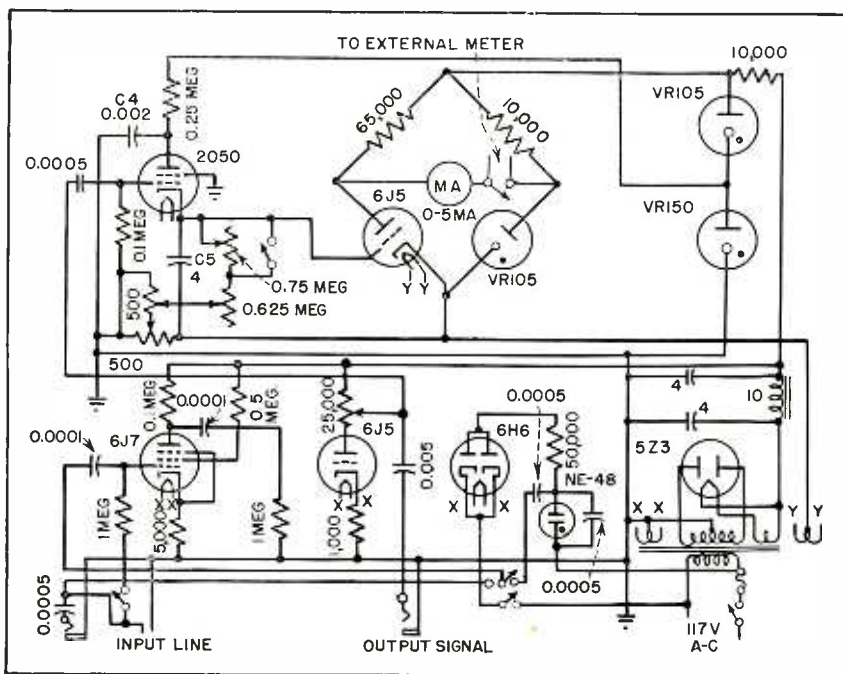


FIG. 3—Circuit diagram of the indicator, comprising a two-stage amplifier and frequency-measuring bridge circuit. The type 6H6 and neon tubes are a part of the 60-pps calibration circuit

transmission line. The amplifier also limits to a satisfactory value the maximum strength of the pulses applied to the grid of the type 2050 tube.

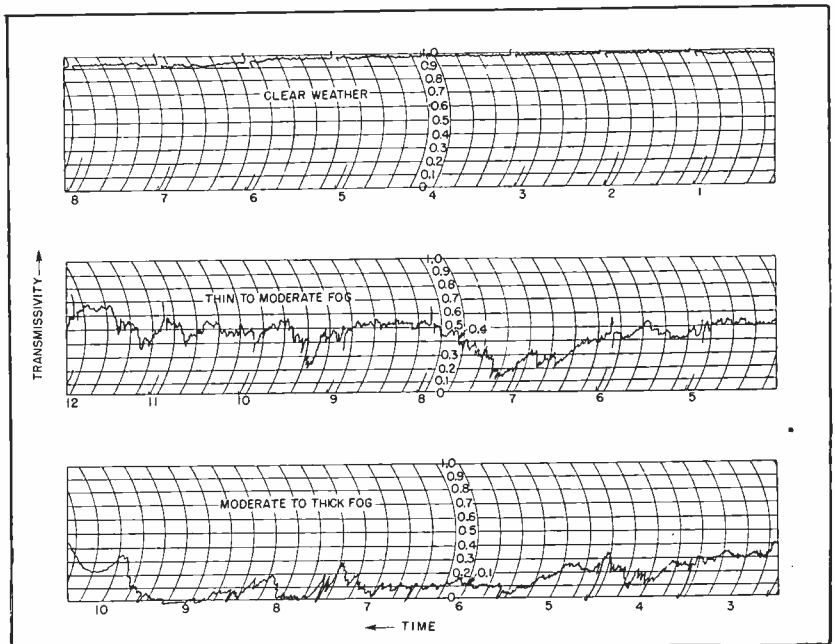
The input pulse triggers the 2050 tube, which charges capacitor C_5 . Capacitor C_1 , which supplies part of the momentary current through the tube, serves also to quench this current. As long as the strength of the pulse applied to the grid is sufficient to trigger the 2050 tube, the charge flowing into C_5 for each pulse is independent of the magnitude of the pulse. When the pulse rate is constant, the voltage across C_5 assumes a constant value which is proportional to the number of pulses per second.

The bridge circuit shown in Fig. 3 is essentially a vacuum-tube voltmeter which indicates the voltage across C_5 . Because of the voltage characteristics of the VR tubes, the current in the resistance arms of the bridge must remain substantially constant. A change in grid potential, with resulting change in the plate current of the 6J5 tube, is accompanied by an equal and opposite change in the current through the VR105 tube. The meter, therefore, measures the change in plate current of the 6J5 tube produced by a change in grid potential. As this change is a function of the voltage across capacitor C_5 , it is determined by the pulse rate. When no signal is on the grid of the 6J5 tube, the grid bias of the tube is adjusted so that current does not flow through the meter. The meter reading is, therefore, directly proportional to the pulse rate of the input signal.

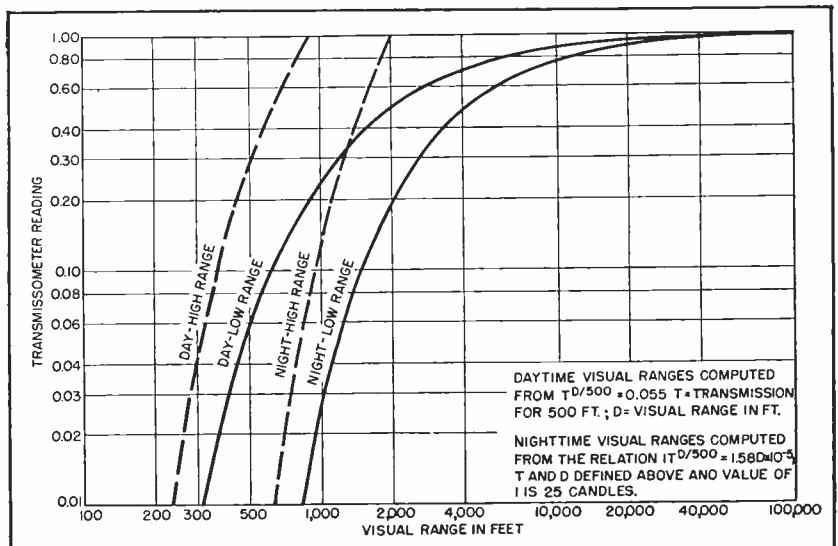
The type 6H6 tube and the neon lamp form a pulse generator which produces pulses of the same frequency as that of the input power line. When the indicator is being calibrated, the pulses from the calibrator are applied to the grid of the 2050 tube through the amplifier. Since the indicator is designed for use with 60-cycle power, the calibration frequency is 60 pulses per second. Hence, when the indicator is properly calibrated, a full-scale reading on the low range requires 60 pulses per second, and on the high range 12 pulses per second.



Indicator and recorder for converting pulse signals to a meter reading or permanent record. This unit can be remotely located from transmitter-receiver equipment



Representative records taken during clear weather, moderate, and thick fog. The time scale reads from right to left



A chart used to convert transmissometer readings to a scale of visibility. The chart is based on a 500-foot range, but the visual range is extrapolated beyond this distance. Two range positions were available in the equipment used

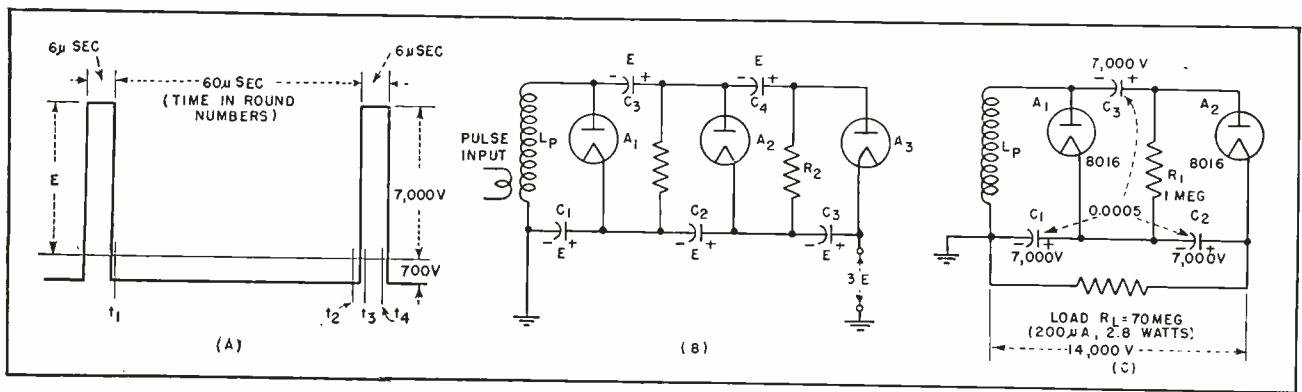


FIG. 1—(A) Pulse delivered by television receiver sweep circuit to rectifier has this idealized waveshape. (B) Pulsed cascade rectifier consists of sequence of diodes charging capacitors in cascade. (C) A typical and simple type of cascade rectifier consists of two sections with a load across the output

Pulsed Rectifiers

Brief analysis of pulsed cascade rectifiers used in television receivers indicates that no component is subjected to potentials substantially higher than those encountered per section. In a doubler, this voltage is about half the output voltage from the rectifier

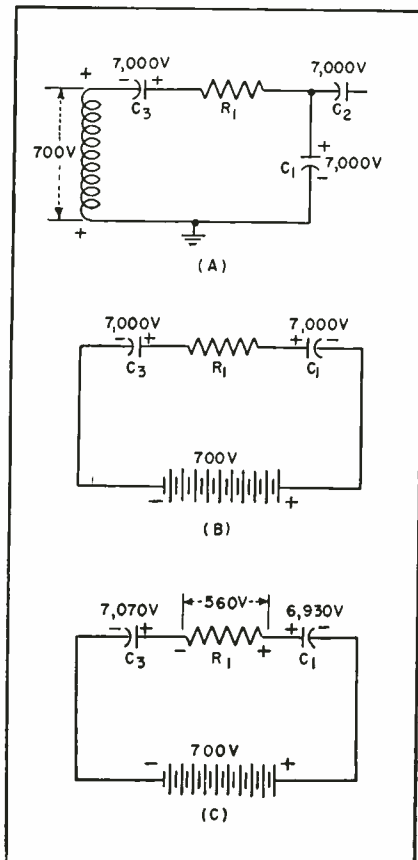


FIG. 2—During the operating cycle, voltages are redistributed about the rectifier. To simplify analyzing the action of the pulsed circuit, the input transformer is replaced by a battery

TO OBTAIN HIGH VOLTAGES for cathode-ray tubes of television receivers, the pulse produced by flyback of the scanning generator is used to excite a step-up transformer. Under ideal conditions with present television standards, the transformer will deliver a voltage having a waveshape shown in Fig. 1A. The high voltage so developed is usually rectified by cascaded diodes charging a series of capacitors connected as shown in Fig. 1B. To determine ratings for circuit components, it is necessary to first examine circuit operation to ascertain their respective functions.

Circuit Operation

For analysis, let us consider the simplest pulsed cascade rectifier, the doubler, a schematic diagram of which is shown in Fig. 1C. The time constant of the output circuit, ignoring C_3 , is $T_o = R_L(C/2) = 0.0175$ sec or approximately 300 times the duration of the trace. Therefore, except for regulation, operation of the circuit is unaffected by the load R_L .

During the trace the circuit can be represented as in Fig. 2A and

2B. The drop across R_1 (Fig. 2B) is the full battery voltage at the start of the trace. The time constant of the above circuit for $R_1 = 10^9$ ohms is $R_1(C/2) = 250$ microseconds, which means that in 60 microseconds (trace duration) the battery will change the potential on the two capacitors by 20 percent of the battery voltage, or 70 volts per capacitor. At the end of the trace, therefore, the voltages in the active part of the circuit change to those shown in Fig. 2C.

On retrace, a voltage of 7,000 volts is suddenly applied in the reverse direction by the transformer winding as at Fig. 3A. Rectifier A_1 starts conducting, in effect connecting C_1 across the high-voltage transformer secondary as at Fig. 3B. It also connects C_3 across R_1 , thereby isolating the two circuits.

Rectifier A_2 , being between C_2 and C_3 , has 70 volts more on its plate than on its filament; therefore, it tends to equalize the charges on C_2 and C_3 while the full voltage of C_3 is impressed across R_1 . The time constant of this discharge circuit being $R_1C_3 = 500$ microseconds (or approximately 80 times longer than the retrace), the loss of charge

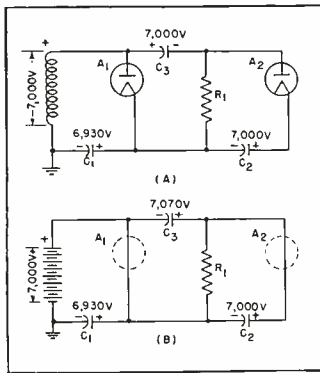


FIG. 3—The diodes act to transfer charges from capacitor to capacitor

L_P	A_1	A_2	C_1	C_2	C_3	R_1	R_L	
			Beginning of trace (t_1)					
-700	-7,700	-7,700	+7,000	+7,000	+7,000	-700	+14,000	
			Ending of trace (t_2)					
0	-6,930	-6,860	+6,930	<7,000	+7,070	-560	+13,930	
			Beginning of retrace (t_3)					
+7,000	+70	+70	+6,930	<7,000	+7,070	+7,070	+13,930	
			Ending of retrace (t_4)					
0	-7,000	-7,000	+7,000	+7,000	+7,000	0	+14,000	

Polarities of capacitor voltages as shown in Fig. 1C; for others, positive is at top. Times are indicated in Fig. 1A. All voltages approximate.

Table 1—Voltages Across Components During Operating Cycle

for Television Receivers

By I. G. MALOFF

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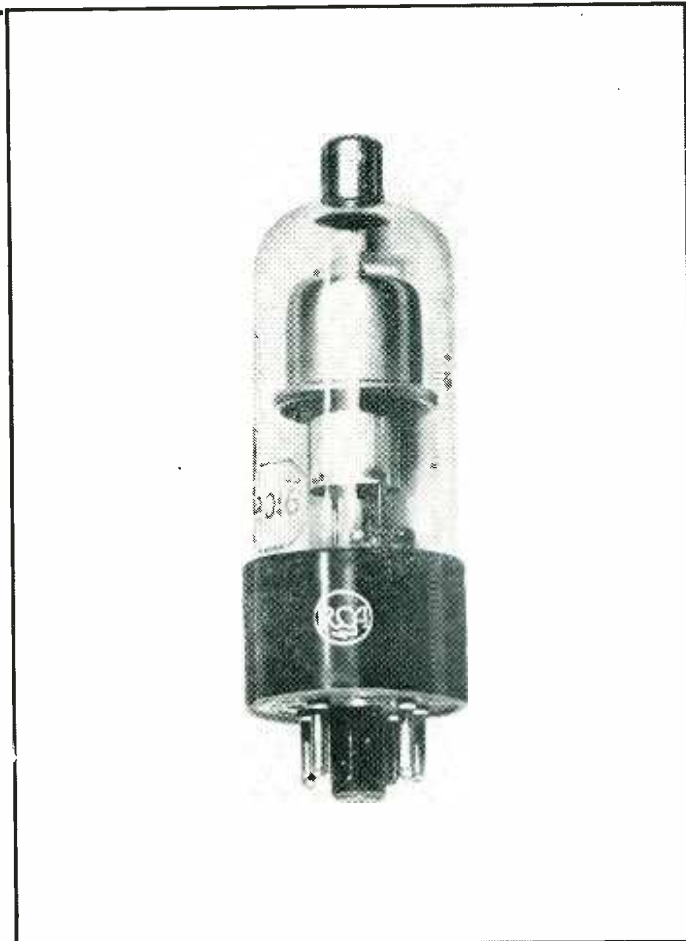
through the resistor is of the order of one percent. In other words, the circuit elements tend to come to the same potentials as those given for the beginning of the trace, because the transformer quickly brings the potential of C_1 to the initial 7,000 volts.

The remarkable thing about a cascading pulse rectifier is that the circuit elements have to stand only a few volts more across their terminals than the d-c output voltage per stage as summarized in Table I. Output capacitors C_1 and C_2 have on their terminals only the d-c output voltage per stage plus the ripple, which is of the order of one percent. Coupling capacitor C_3 has only the d-c output voltage per stage plus a small boost in voltage during trace; resistor R_1 has 10 percent of the output voltage per stage on trace and about 101 per cent of it on retrace. The peak inverse voltage on the rectifier tubes is only 10 percent higher than the d-c output voltage per stage. (Of course, some components have to withstand the total output voltage between high terminal and ground.)

The above analysis is very ele-

mentary but is sufficient to explain the operation of the circuit, which may be summarized as follows: During trace, the coupling capacitors are charged through the resistors to a voltage slightly higher

than the d-c voltage per stage; during retrace this excess voltage is transferred to the filter capacitors, except for the first stage which is directly charged by the transformer.



High-voltage rectifier tube, like other components of pulsed television receiver rectifier, is subjected to only the peak voltage per cascaded section, not to the total output voltage

Wide-Range



Controls for frequency tuning and sweep adjustment are on front panel of the wide-range sweeping oscillator. There is also a precision tunable resonant cavity for frequency measurement

By **ENGINEERING STAFF**

*Kay Electric Co.
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nearly constant amplitude but with a cyclic time variation in frequency. A sweep voltage whose amplitude variation is synchronized with the signal frequency variation is also furnished by the sweeping oscillator. With the frequency excursion approximately centered in the pass-band of the receiver, the vertical amplifier of the oscilloscope is connected to some convenient monitoring point in the audio or video section of the receiver. The sawtooth sweep voltage output available at the oscillator is connected to the horizontal amplifier of the oscilloscope, or the internal sweep of the oscilloscope, properly synchronized, is used. The pattern on the screen is a graph whose abscissa is frequency and whose ordinate is receiver response.

This method of alignment is more rapid than the point-by-point technique. What is usually more important, the effect of the adjustment

EXPANSION of the commercially useful electromagnetic frequency spectrum, accelerated by wartime developments, has made an extremely wideband sweeping oscillator a laboratory necessity. For example, the maintenance man alternately faced with servicing a standard a-m broadcast receiver and next a television receiver needs an oscillator covering a wider frequency range than provided from previously available signal generators. The research worker needs a laboratory instrument covering an even greater frequency spread.

To meet a need for such test equipment a wide-range sweeping oscillator has been developed. It has output frequencies between 50 kc and 500 mc immediately available at approximately a 50-ohm impedance level and with an amplitude of about 0.1 volt maximum.

Receiver Alignment

Frequency excursion per sweep is adjustable to a maximum of approximately 40 mc. A sawtooth sweep voltage adjustable between 50 and 100 cps is available at front panel terminals to be used either as such or as a synchronizing source for another sweep generator. A precision coaxial wavemeter is in-

cluded with the front panel controls. Thus the sweeping oscillator in combination with any cathode-ray oscilloscope provides a receiver alignment tool that is at once precise and extremely flexible. For example, a television or f-m broadcast receiver can be aligned with equal ease.

In aligning a receiver, the sweeping oscillator produces a signal of

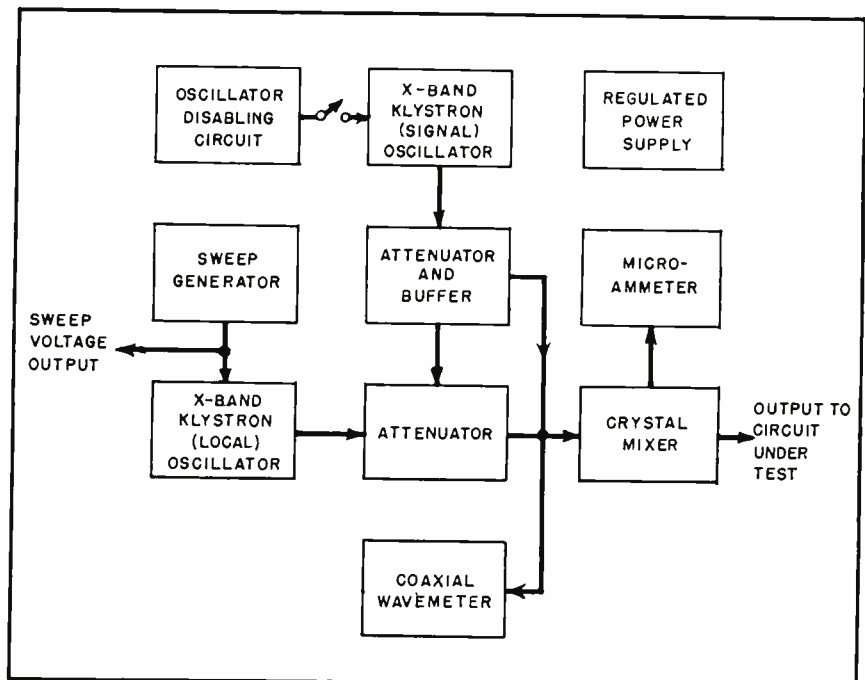


FIG. 1—Block diagram shows principle of operation

Sweeping Oscillator

Single test oscillator covers all frequencies from upper video range through standard a-m broadcast, police, aeronautical, f-m broadcast, and television bands to the citizen's band. Basically the circuit is a beat-frequency oscillator using two 3-cm klystrons

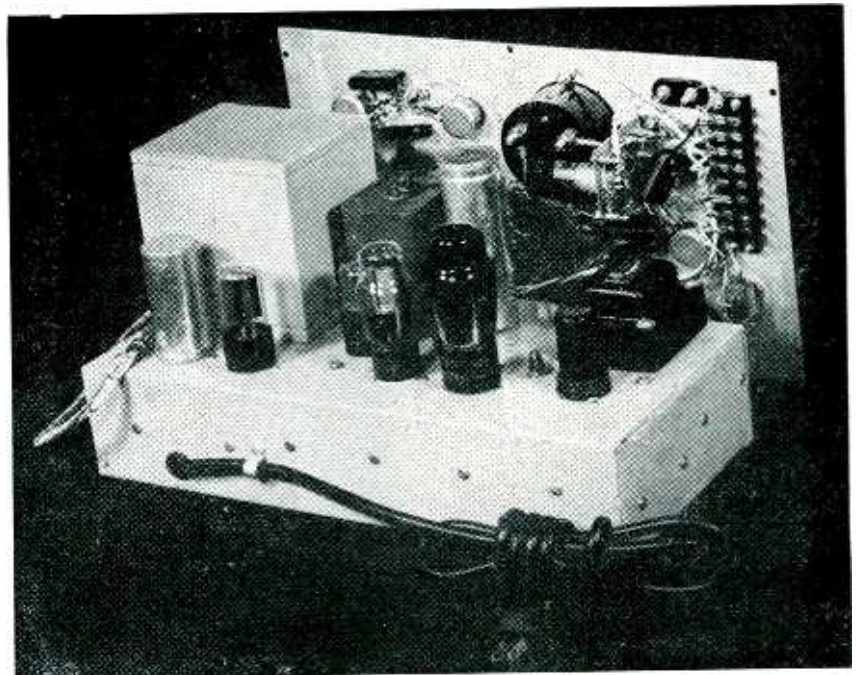
or variation of any of the receiver parameters on the response at all frequencies is immediately apparent. The possibility of missing a hump or some other asymmetry in the response is eliminated, as the output of the sweeping oscillator has no discontinuities within its particular spectrum.

Calibration of the frequency coordinate of the receiver response frequency plot on the oscilloscope screen is most conveniently accomplished by means of the precision absorption type wavemeter. When the sweeping oscillator passes through the frequency to which the wavemeter is set, there will be a dip in the response pattern, thus effecting the calibration.

Oscillator Components

Figure 1 gives the block diagram of the sweeping oscillator, which is a heterodyne-type generator combining the outputs of two X-band (3-cm) reflex klystrons (the Shepard-Pierce type) in a mixing network. One klystron, called the signal generator, is at a fixed frequency during operation of the instrument. The other, designated the local oscillator, is swept in frequency by the application of a sawtooth wave to its repeller. The two outputs are heterodyned in a microwave crystal mixer and the resulting difference frequency made available at the output terminals.

The sawtooth is generated by a gas tube relaxation oscillator and serves not only to modulate the local oscillator but also to develop sweep voltage for use in synchronization of an oscilloscope sweep. An efficient electronically regulated power supply furnishes plus 300 volts, minus 300 volts (both regulated),



Microwave parts are thoroughly shielded; regulated power supply is essential to the frequency stability of the klystron oscillators

and filament power. Ripple is kept very low so as to obtain stable klystron operation.

Sweeping Oscillator

Figure 2 shows the simplified schematic diagram of the sweeping oscillator. All adjustments are available at the front panel. The sawtooth sweep voltage generator is a conventional gas tube relaxation oscillator utilizing the miniature 2D21 gas tetrode. The sweep rate control varies the capacitor charging time-constant to make available sweep rates from approximately 50 to 100 cps. The sweep amplitude control adjusts the output frequency excursion up to a maximum of 40 mc by controlling the magnitude of the sawtooth voltage applied to the local klystron oscillator re-

pellor electrode. The use of this adjustable relaxation oscillator for the production of both frequency and oscilloscope sweep has not only added to the flexibility of the system, but has also eliminated the inconvenient phasing adjustments necessary when the line supply voltage is used for the same purpose.

It is also possible to frequency modulate the klystron from an external source by removing the 2D21 and feeding the external modulating signal into the instrument through the sweep output jacks.

Reflex Klystron Characteristics

The literature is sufficiently rich in klystron references to make any detailed review of klystron theory inappropriate. However, maximum efficiency in the utilization of this

sweeping oscillator requires that certain klystron characteristics be kept clearly in mind. Figure 3 gives two plots, both against the magnitude of negative repeller voltage, as the abscissa (repeller voltage increasing in negative value to the right); one graph is with output as the ordinate, the other with frequency as the ordinate.

The plot of output against repeller voltage indicates that oscillations can be sustained over certain ranges of repeller voltages. Note that the average magnitude of the output over the two ranges shown is greater for the higher repeller voltage. The mode with the greater output, as would be expected, is associated with the lesser time of the electron bunches in the space between the bunching grids and the repeller. The two voltage modes are only representative; there may be more or fewer depending on the electrode voltages obtainable.

The plot of repeller voltage against frequency illustrates the frequency sweeping principle of this instrument. If the repeller voltage is varied over a range within the limits imposed by a voltage mode, then the frequency will vary in magnitude as well as frequency, as between points A and B of Fig. 3. This variation in magnitude might seem to introduce an unwanted amplitude modulation characteristic in the output. Actually such is not the case, for reasons to be mentioned in the next section.

The natural resonant frequency of the cavity of either klystron is not affected by the variation of the repeller voltage; such variation

merely drives the cavity off resonance up to a limit imposed by the effective Q of the cavity. The actual resonant frequency is adjusted by changing the grid spacing and thus the physical conformation of the cavity. The grid spacing of either klystron can be changed, but only a control for the local oscillator is brought out to the front panel as the coarse tuner.

Mixing Oscillator Outputs

The principal design problem associated with mixing the outputs of the two oscillators in the waveguide system involved the efficient isolation of the oscillators from each other to minimize pulling. Furthermore, sufficient decoupling between the oscillators and their load was required. Figure 4 illustrates the waveguide system that was used. The chief feature of this system is the broadband directional coupler, which consists physically of three holes in the wall between the two waveguides.

Directional couplers are designed to provide transmission between two waveguides (or transmission lines) in one direction only. For this particular system, the directional coupler allows energy from the signal oscillator to reach the crystal mixer, but ideally no energy from this source reaches the local oscillator. Similarly a minimum amount of energy from the local oscillator reaches the signal oscillator. Transmission from one waveguide to the other is directed to the termination and is almost completely absorbed. Thus local and signal oscillators are isolated and the possibility of locking or pulling

is minimized though not entirely eliminated, as later explained.

Signal from the signal oscillator undergoes about 10 db attenuation in passing through the directional coupler and, constrained by the one-way properties of the coupler, reaches only the crystal mixer assembly. There is little reflection of this particular signal in either of the waveguides because the crystal assembly is in the shorter waveguide, and a carbon coated termination card is in the other. Both provide loads of approximately the characteristic impedance of their waveguides. The signal from the local oscillator travels directly to the mixer. The portion of the signal from this source entering the longer waveguide by way of the three-hole coupler is directed only toward the termination, where it is completely absorbed.

The two attenuators shown in Fig. 4 have somewhat different purposes. The attenuator between lo-

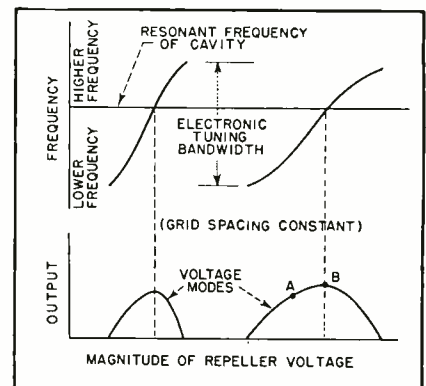


FIG. 3—Frequency and amplitude of klystron output are affected by varying its repeller voltage

cal oscillator and mixer decouples this oscillator from its load. As a matter of fact, the attenuator action is incidental, the isolating action being the primary consideration. The attenuator in the signal oscillator path is actually the output attenuator; that is, its adjustment controls the amplitude of the output from the sweeping oscillator. This action is possible because the output of the sweeping oscillator results from the heterodyning of two signals, one much larger than the other; the heterodyned output amplitude is substantially independent of the larger. The smaller of the two signals at the mixer is that of the signal oscillator, as this one

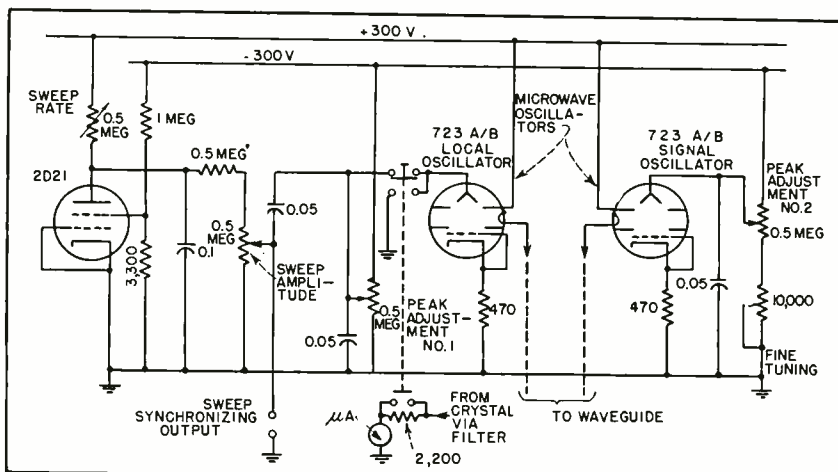


FIG. 2—Schematic of sweeping and tuning circuits

is attenuated more in passing through the directional coupler. Hence, adjustment of the transmitted amplitude of the signal oscillator controls the output of the sweeping oscillator. This arrangement also prevents the previously mentioned amplitude modulation of the local oscillator signal, associated with the frequency modulating process, from appearing in the output. With the signal oscillator producing an output of constant amplitude, the output of this instrument is therefore substantially independent of variations in the amplitude of the local oscillator.

Frequency Calibrating Circuit

The frequency calibrating circuit of this instrument is built around a precision coaxial absorption wavemeter. The outer conductor of the coaxial line is silver plated on its inner surface, and the moveable center conductor is an invar rod successively copper, nickel, and silver plated. This type of construction, together with close mechanical tolerances, insures high Q, negligible temperature coefficient, and high overall precision.

The crystal current indicated on the microammeter is a function of the rectified output of both the local and signal oscillators. Normally, however, the highly attenuated signal of the signal oscillator contributes a negligible amount to the total crystal current. Hence in order to monitor the output or measure the frequency of the signal oscillator it is necessary to deactivate the local oscillator and increase the meter sensitivity by a pushbutton switch on the front panel.

In the operation of this instrument, a reading proportional to the local oscillator frequency is taken and recorded, with the sweep amplitude at zero. The pushbutton is then depressed, and a reading is taken of the frequency of the signal oscillator. The output frequency is then the difference multiplied by a proportionality factor.

After the oscilloscope pattern is properly located and centered appropriately to the equipment under test, the calibration of the frequency axis of this pattern is accomplished by first recording the wavemeter reading proportional to

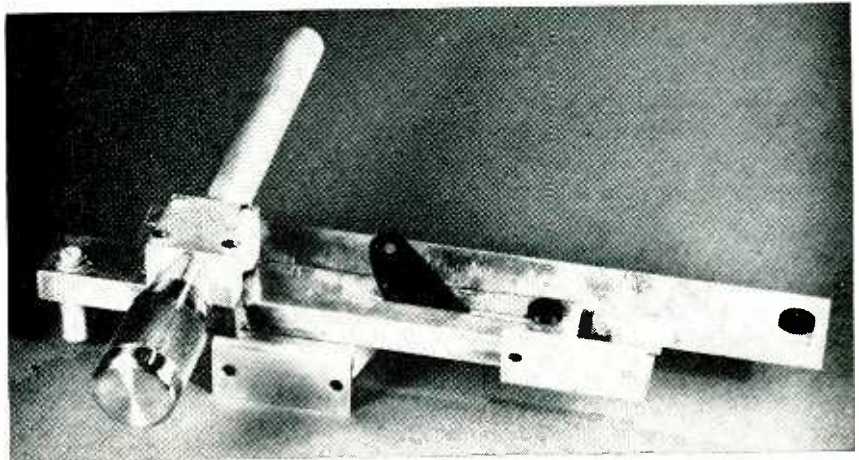


FIG. 4—Directional coupler minimizes pulling between klystrons; tunable cavity provides frequency calibration

the wavelength of the signal oscillator. This measurement involves tuning the wavemeter until the entire visible pattern decreases. The wavemeter is then varied until a moveable dip is seen on the pattern. The movable dip is an indication of the frequency of the local oscillator and is used to measure the width of the passband and, in conjunction with the signal oscillator reading, the absolute frequency. This procedure eliminates the use of any switching.

The midpoint of the frequency excursion can be readily adjusted to a maximum of 500 mc. This limit is not imposed by the frequency range of the two klystrons. Indeed, if only the range of the two oscillators were considered, a maximum midpoint frequency of nearly 1,000 mc could be reached. This last figure arises from the fact that each oscillator has a frequency range of about 1,000 mc, covering the band 8,700 to 9,700 mc. The upper frequency limitation of the instrument is determined by the properties of the output circuit. Much above 500 mc, the unavoidable capacitances in the crystal mixer output circuit take their toll and the output amplitudes fall off. If, however, a coaxial output circuit is used, it is possible to push the frequency limit up another octave to 1,000 mc.

The sweep amplitude adjustment gives continuous control of the frequency excursion per sweep from zero up to a maximum of 40 mc. This large frequency excursion, together with the frequency coverage, gives ample and flexible coverage for most if not all commercial

vhf applications, including color television.

With the local oscillator sweeping a frequency range that just or nearly includes the constant frequency of the signal oscillator, it is possible to obtain output frequencies close to the audio range. Ideally, of course, the complete audio band could be covered. This is not practically feasible, however, because even with a carefully designed waveguide system there is some pulling or interaction between the two oscillators when their frequencies are close. This interaction can be ascribed to the small departure of the waveguide terminations and crystal mixer assembly from the ideal flat waveband loading. It is this pulling which limits the low end of the frequency range.

In addition to the use of the sweeping oscillator as an aligning instrument, it is also possible to utilize the oscillator without the sweeping feature by the simple expedient of turning off the sweep amplitude. This instrument so operated becomes a c-w signal source with the above-mentioned ranges.

This instrument is well suited for instructional purposes as it produces visual indications of the frequency characteristics of receivers and transducers when used in conjunction with a suitable oscilloscope.

No complete attempt to enumerate the capabilities of this instrument has been made. It is the opinion of the designers that this instrument is intrinsically so flexible that numerous additional uses will suggest themselves to the user.

MICROWAVE ANTENNA

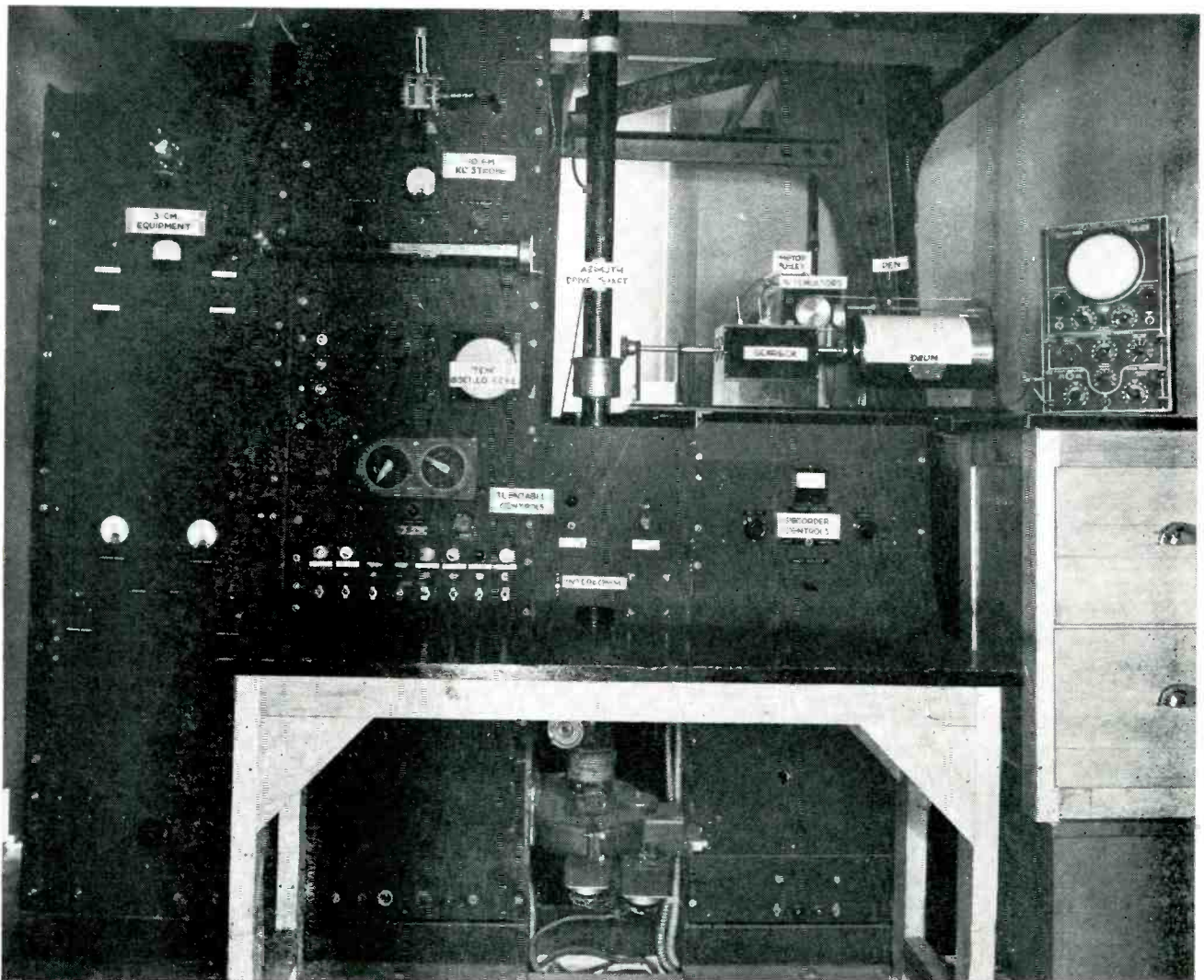
Development, adjustment, and routine maintenance of microwave antenna systems require a means for plotting the radiation pattern quickly. This system uses simple potentiometers but requires no nonlinear circuit elements. The recorded pattern is independent of transmitter power fluctuations and high sensitivity is realized without tuned amplifiers

IN THE DEVELOPMENT of high-gain microwave antennas, numerous radiation patterns are required when checking critical adjustments to feeds, radiators and reflectors before optimum conditions for beamwidth and side lobes are found. Manual pattern-taking is a slow, laborious process, as it is generally

necessary to measure received or transmitted power at each of many angles, and to calculate and plot each pattern. To speed up this type of work, an automatic recorder was developed at the National Research Council of Canada, with some unique features.

Although the recorder plots the

square root of the detected signal, only simple wire-wound potentiometers in which resistance varies linearly with angle are required. Furthermore, since no circuit elements with nonlinear amplitude characteristics are used, an accuracy of 1 percent in the trace is realized in daily operation. The



Main portion of the equipment located at the operating position. The antenna is mounted directly above and gain controls for the remote receiving antennas are easily accessible

BEAM EVALUATOR

By **H. LeCAINE** and **M. KATCHKY**

Assistant Research Physicist Junior Research Engineer
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Antenna tower and turntable used in harbor control installation at Halifax, Nova Scotia. The operating room is directly beneath the tower

pattern is made independent of fluctuations in transmitted power by an unusually simple method. The received signal is merely balanced against a monitor voltage. The recorder does not respond to, nor is it jammed by interference encountered around a radar establishment, and a high receiver sensitivity is realized without the necessity of using tuned amplifiers. These characteristics are achieved by using the pen motor in a synchronous detector circuit.

Arrangement of Equipment

All the equipment illustrated with the exception of the receiving antenna and its associated detector and amplifier, is located in a room under the antenna turntable. The block diagram of interconnections is shown in Fig. 1. Several receiving antennas for different bands and at various distances are available to increase the flexibility of the system, and all are remotely controlled from the recorder room. The receiving antennas have directional characteristics to reduce the influence of undesirable reflections.

In operation, modulated radio-frequency energy is transmitted from the test antenna, which is lo-

cated on the turntable. As this antenna is rotated, the varying field strength at the receiver is used to control the movement of a pen which traces the pattern on a rotating drum geared to the turntable drive shaft.

Field-Strength Pattern

A power pattern of a high-gain antenna is not satisfactory because the side lobes are not given sufficient prominence. Field strength patterns overcome this objection and can be used directly to represent a contour of constant power or constant field strength. As the only suitable detectors give an output proportional to the power in the received signal, a direct-recording system with a linear potentiometer would give power patterns. To obtain the desired field strength patterns, a special attenuator could be used, but this would result in a recording sensitivity which varies with pen position. Since speed and accuracy place severe restrictions on the sensitivity, such a system would be satisfactory over a small range of signals only. In the circuit to be described, field strength

patterns are obtained with constant recording sensitivity.

The transmitter most commonly used with the recorder is a klystron oscillator which is modulated by 90-cycle square waves from the multivibrator circuit shown in Fig. 2. The choice of 90 cycles was made to avoid power line frequency interference, and because there were no other users of 90-cycle frequency in the vicinity.

Part of the output from the multivibrator is amplified and applied to one field of the motor. A phase adjuster is provided to obtain the correct phase between the voltages on the two fields of the motor.

Receiving Equipment

The signal bolometer and amplifier are located near the receiving antenna. The bolometer is a Littelfuse element acting as a square-law detector. These elements have been in use for a number of years, and repeated tests by various methods and observers have proven them to be very accurately square-law up to several milliwatts. Thus the detected voltage is proportional to the radio-

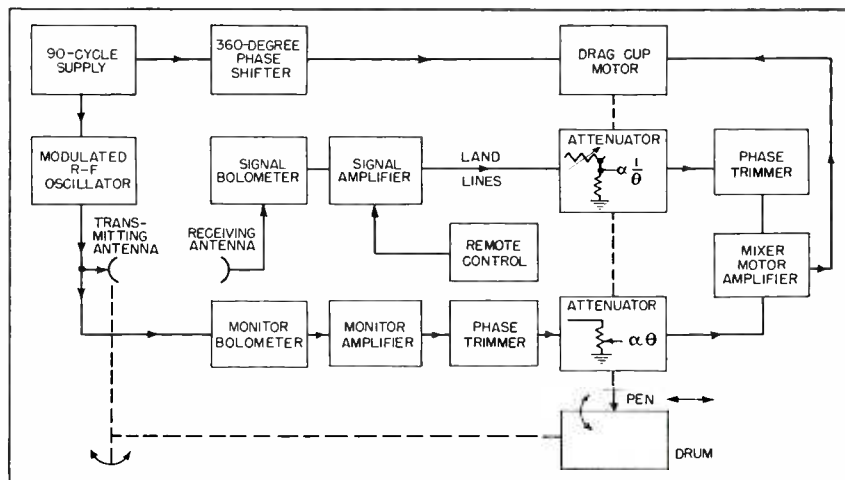


FIG. 1—Block diagram of the automatic recorder. Mechanical linkages between transmitting antenna and recording drum and between the attenuators and the recording pen are indicated by dashed lines

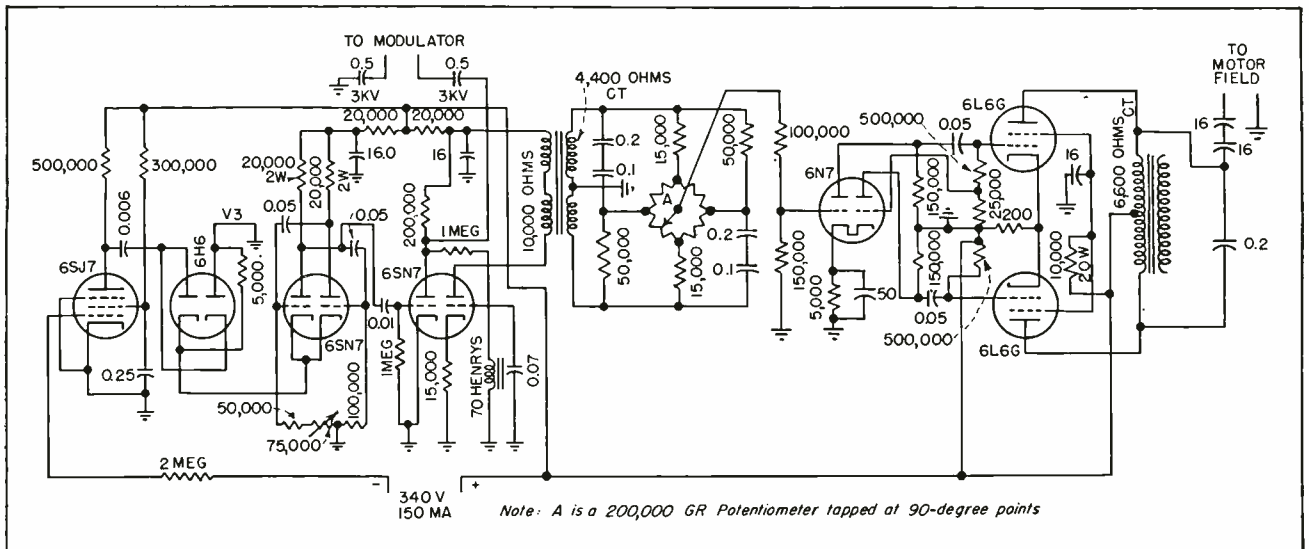


FIG. 2—The 90-cycle supply comprises a multivibrator circuit locked to the powerline frequency. Output from the unit modulates the r-f oscillator. A second output reaches the motor by way of a phase shifter and amplifier.

frequency power in the received signal.

The associated amplifier is well shielded to avoid blocking by any heavy radar interference picked up in the early stages. The synchronous detector circuit to be described makes unnecessary the use of tuned amplifiers. The overall gain can be varied from 40 decibels to 110 decibels in order to accommodate various antennas. Coarse adjustments in gain, covering a 50-decibel range in nine steps, are made at the receiving sites, while fine adjustments over a 20-decibel range are made remotely at the recording room. The gain of the amplifier is made stable by the use of inverse feedback, which also ensures a linear response. By careful design and shielding, a low noise level in the amplifier is achieved, allowing a high signal-to-noise ratio even for many low-gain antennas. Ratios of 100-to-1 in field strength, therefore, can be measured easily, and at maximum gain a receiver sensitivity of about 0.003 microvolt across 500 ohms is realized.

The output from the field amplifier is carried into the recording room by a 500-ohm line which is balanced to ground. The next stage is a cathode follower which presents the required low impedance to the attenuator.

A monitor device consisting of either a probe in the feed line, or a fixed antenna, picks up a portion of the transmitted signal. This fraction is then detected by a bolometer,

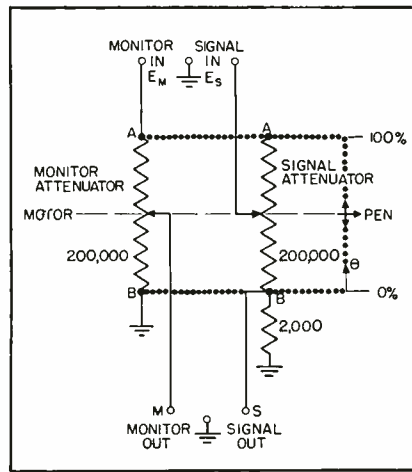


FIG. 3—One-tenth of the monitor attenuator output is compared with ten times the signal attenuator output and the resultant difference voltage drives the pen motor until the two quantities are equalized

giving an audio-frequency voltage proportional to the transmitted power. Any fluctuation in the transmitter output will affect both the signal and monitor voltages to the same extent, leaving the ratio of the two unchanged. As will be seen later, the pen position at balance is dependent on this ratio; therefore fluctuations in output do not alter the recorded pattern.

The Attenuator System

The attenuators consist of two linear potentiometers with moving contacts ganged on the same shaft that drives the recording pen. The monitor and signal voltages are applied to these attenuators in the manner shown in Fig. 3. The two

outputs from the attenuators are then added out of phase, and the resultant difference voltage is amplified and applied to one field of the motor, causing it to rotate. This moves the recording pen, and at the same time, moves the contacts in such a direction that the difference voltage is reduced to zero, at which point the motor ceases to rotate. This is the balance position. The proper direction of rotation is obtained by means of the 360 degree phase adjuster in the 90-cycle supply.

It can be shown that the pen traces out a field strength pattern which is not affected by power fluctuations in the transmitter. Let θ represent the pen position expressed as a fraction of the maximum pen displacement. It will also represent the position of the two potentiometers expressed as a fraction of their maximum displacement. Then for a monitor voltage of E_m and a signal voltage E_s at the attenuator inputs (Fig. 3)

$$\text{Output of signal attenuator} = \frac{2,000}{\theta \times 200,000 + 2,000} E_s$$

$$\text{Output of monitor attenuator} = E_m \theta$$

The circuits that follow compare one-tenth of the output of the monitor with ten times the output of the signal attenuator. When these quantities are equal

$$\frac{E_m \theta}{10} = 10 \times \frac{2,000 E_s}{\theta \times 200,000 + 2,000}$$

$$\theta(\theta + 0.01) = E_s / E_m$$

$$\theta \approx (E_s / E_m)^{1/2}$$

When the pen position is ad-

justed to be correct at full scale, the error introduced by the above approximation is negligible (within 0.1 percent full scale) down to a pen position of 1 percent of full scale. Further, since E_s and E_m are both proportional to the oscillator output power, their ratio, and therefore the pen position, is independent of the oscillator power.

At a given instant, the voltage applied to the motor is proportional to

$$V = E_m \theta - E_s / \theta$$

Taking the recording sensitivity S as being equal to the change in voltage per unit change in pen position, it is seen that

$$S = \frac{\partial V}{\partial \theta} = E_m + \frac{E_s}{\theta^2}$$

but

$$E_s / \theta^2 = E_m$$

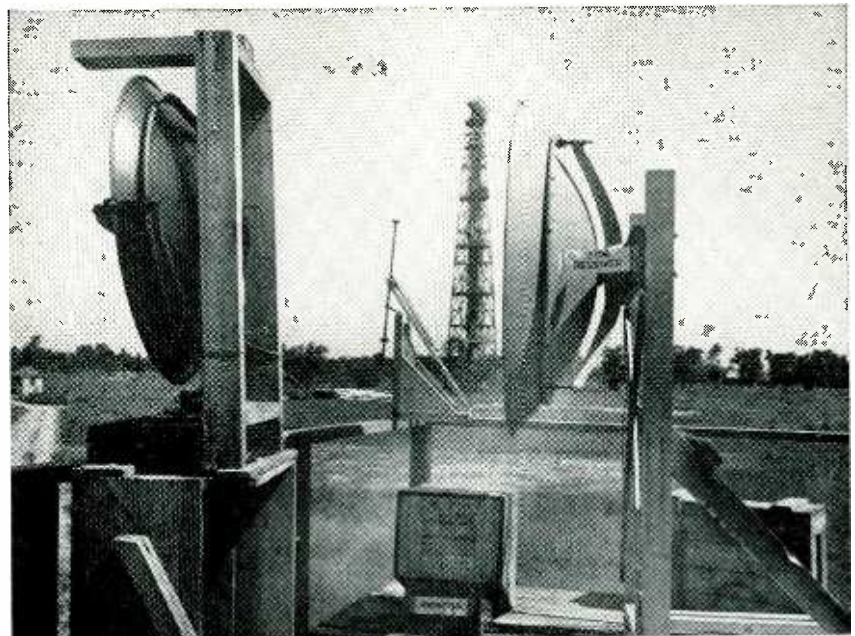
therefore

$$S = 2 E_m$$

Thus the sensitivity is independent of the pen position. It is however, proportional to the monitor voltage, but the fluctuations in output normally encountered do not produce significant changes in sensitivity.

Recording Circuits

The circuit diagram for the mixer and recording motor is shown in Fig. 4. Where it is necessary to have a transformer before the point



One of several typical receiving stations located at a distance from the transmitting antenna. Gain of the amplifier (lower center) is remotely controlled from the operating position

where the two voltages are added, great care must be taken, as it is essential that there should be no change of phase with amplitude. The first stage is a signal amplifier with cathode feedback. Following this, the two voltages are added in a circuit containing only simple resistance. Phase trimmers are provided in both monitor and signal phase relationship. The remaining stages

amplify the difference voltage before it is applied to the motor. The gain is adjusted for optimum recording sensitivity after the monitor voltage has been set at the required value.

The recording motor is a small alternating-current drag cup motor which has two field windings on the stator surrounding a cup-shaped rotor. The rotating shaft drives the ganged attenuators and also

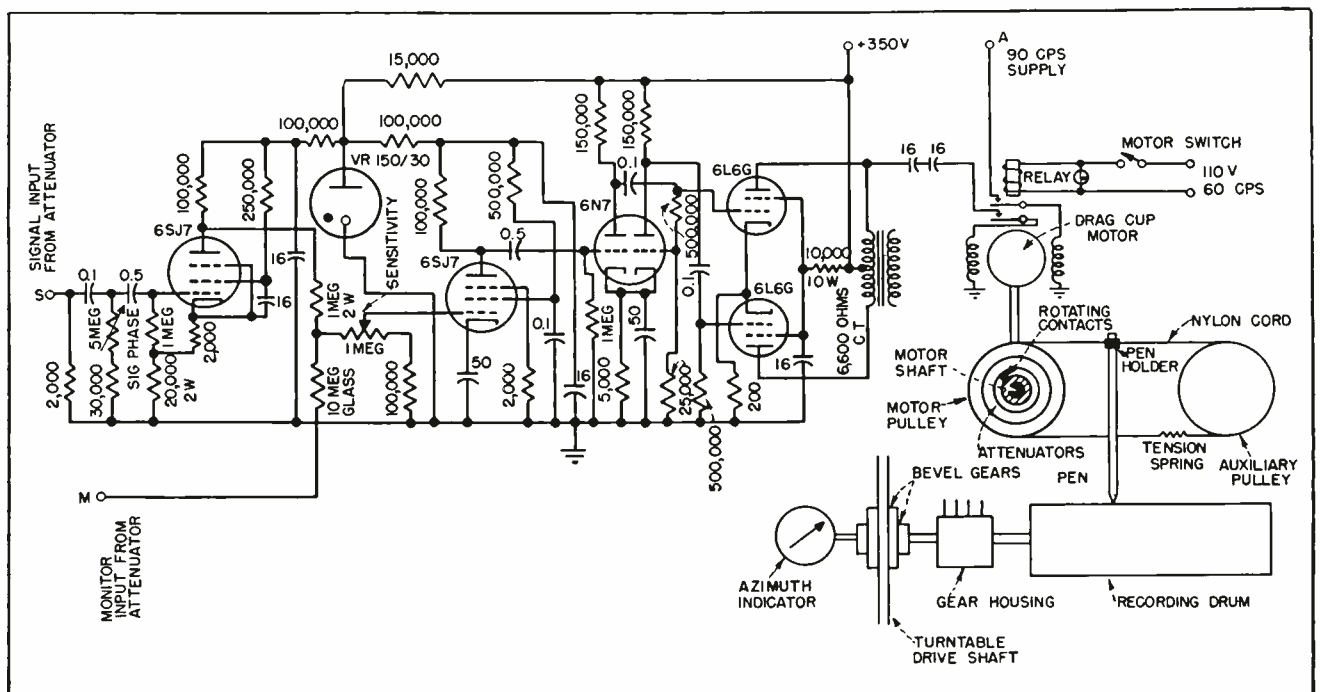


FIG. 4—The signal mixer, motor amplifier and recording apparatus are shown schematically and their interconnections to the other units are indicated

a pulley which moves the recording pen in a straight line parallel to the axis of the cylindrical drum. Great care is taken to avoid mechanical backlash between the motor and the attenuator.

One field of the recording motor is fed by a constant voltage from the 90-cycle supply; the other by a control voltage derived by adding the attenuated monitor and signal voltages out of phase. With this arrangement, the motor responds only to frequencies within ± 2 cycles per second of the modulation frequency. Even for interfering signals within this bandwidth, the motor simply oscillates about the true value, producing a slight broadening of the pen trace. This behavior has proven to be of immense value, allowing reliable operation at times when an oscilloscope on the signal lines showed a confused mass of heavy radar interference. It is, of course, necessary to be able to obtain the correct phasing of the monitor, signal, and supply voltages, but once this has been accomplished, readjustments need only be made following replacement or interchange of a major system component. Small phase errors cause sluggish movement of the recording motor, which is easily spotted and corrected.

Plotting Antenna Pattern

In order to take a pattern, a sheet of graph paper with rectangular coordinates (which is most suitable for high-gain antennas) is placed on the drum so that the abscissa is along the circumference and the ordinate is parallel to the axis of the cylinder. The abscissa is, therefore, proportional to the angular rotation of the antenna. The drum turns through an arc length of ten inches (to fit the scale of the graph paper) and by shifting gears on the gear housing, it is possible to take patterns for 20, 40, 200, or 400 degrees on this length of arc. In this manner, the operator is able to select the azimuthal expansion most suitable to the width of the radiated beam.

Before taking the pattern, the antenna under test is turned to the position of maximum gain, which is indicated by a vacuum-tube voltmeter on the signal line at the input

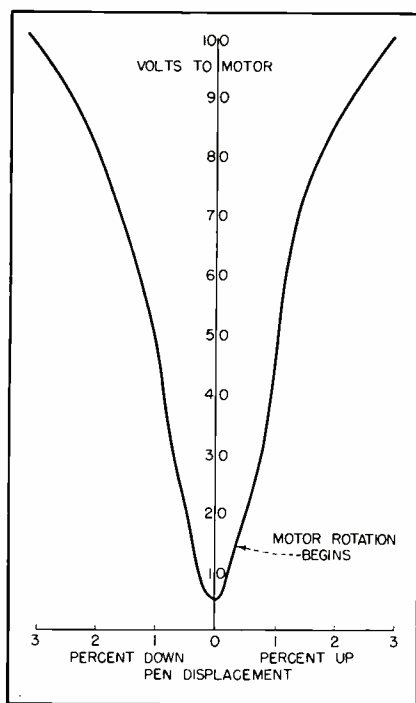


FIG. 5—The voltage at the motor terminals is shown as a function of pen position in percent of full-scale displacement from balance

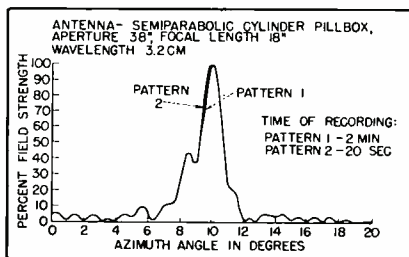


FIG. 6—The effect of increasing recording speed is shown in pattern 2, wherein a 5 percent error has been introduced by changing the field strength by 60 percent of full scale in one second

to the attenuators. The monitor and signal voltages are adjusted until the pen is on the 100 percent ordinate position, and the gain of the motor amplifier is set to give optimum recording sensitivity (this setting is determined experimentally and is rarely changed). When the preliminary adjustments are completed, the desired selection of azimuthal gearing is made, and the pattern is taken by rotating the antenna.

Accuracy of the System

It has been stated that the bolometer and amplifier make a negligible contribution to the error in the pattern. Linear wire-wound potentiometers from stock give an attenuator unit in which the sys-

tematic error never exceeds 0.5 percent. The remaining factor in the accuracy of the recorder is the response of the recording motor to changes in field strength. The motor starts rotating at 15 volts, which corresponds to approximately 0.3 percent pen displacement, as shown in Fig. 5.

If a higher recording sensitivity is used in an attempt to reduce this figure, the motor will tend to hunt at the recording speed most commonly used. This effect will necessitate a lower speed to avoid sudden changes in field strength. If a lower sensitivity is used, the percent displacement over which the recording motor will not respond is increased, thus giving less accuracy in the pattern. The sensitivity used is a compromise between these factors, and allows accuracy within 1 percent, along with a high recording speed, without hunting.

It would also be possible to feed back in phase opposition the voltage from a second motor driven by the first and acting as a generator. This would have the effect of reducing the effective inertia of the mechanical system, and increasing the permissible pen speed. The drag-cup motor has such a good ratio of torque-to-inertia, however, that the feedback was considered unnecessary.

It has been found that for accurate patterns, the rotation speed of the antenna under test should be such that the field strength does not change by more than 40 percent of full scale per second. In general, adequate recording speed has always been found available. A 20-degree pattern with a 2-degree beamwidth at 6 decibels down can be taken easily in about one minute, and a 400-degree pattern of the same antenna in five minutes. Two 20-degree patterns recorded at different speeds (one in 2 minutes, the other in 20 seconds) are shown in Fig. 6. The two patterns are practically identical, except for a 5 percent error where the field strength changed 60 percent of full scale in one second at the faster recording speed.

In actual pattern taking, the accuracy has always been within one percent at all times and under varying conditions.

Experimental Audio Output TETRODE

Low harmonic distortion is obtained from an output tetrode in which the first grid is made positive, acting as a space-charge grid, and the second grid is used as the control electrode. Tube is little affected by changes in load impedance, and is comparable to a pentode in power sensitivity

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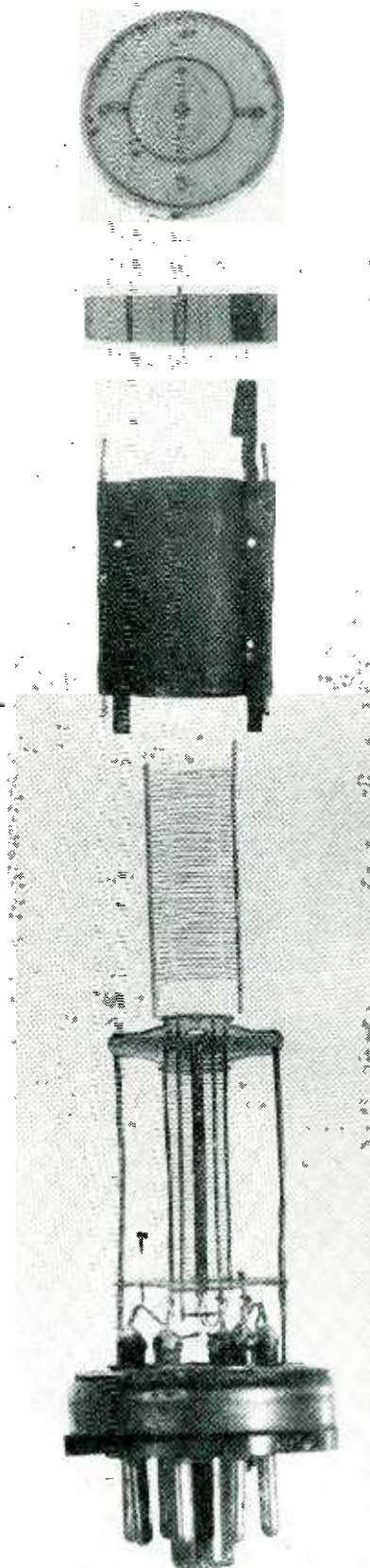
LOW DISTORTION can be obtained from a space-charge grid power tube. In such a tube the first grid is operated positively to produce a virtual cathode. The second grid is the control grid. An experimental tube designed to operate in this manner gave 2.4 watts of audio output into a 7,500-ohm load with only 1.5 percent total distortion. This distortion is lower, but the power sensitivity is less than the same quantities in a beam-power tube, as shown in Table I.

Some years ago a space-charge grid power tube was experimentally developed with the intention of producing a tube having low distortion and high power sensitivity. Although the tube that was developed does not have the high power output available from the 6V6 beam power tube, no commercially available tetrode or pentode power tube has as low an order of distortion as does this experimental space-charge grid tube, therefore its characteristics will be described so engineers can judge whether such a tube would be desirable in current uses.

Before describing the experimental tube, it is desirable to present briefly the trends in audio output tubes by way of indicating the problems encountered with them. In the early days of radio it was unimportant to have a power tube of exceptionally high fidelity because neither audio transformers, loudspeakers, nor broadcast transmitters were of high fidelity. However, high power sensitivity was desirable because of the difficulty of building high-gain audio amplifiers which necessarily followed the triode detectors at that time widely used.

Pentodes provided the required high power sensitivity. As the quality of other circuit components improved, the high harmonic distortion of these tubes became a drawback. Second harmonics could be cancelled by push-pull circuits, but third and higher order odd harmonics remained.

The beam-power tube represented a good compromise between distortion and power sensitivity. Most of its shortcomings could be nulli-



Experimental tube, cut for examination

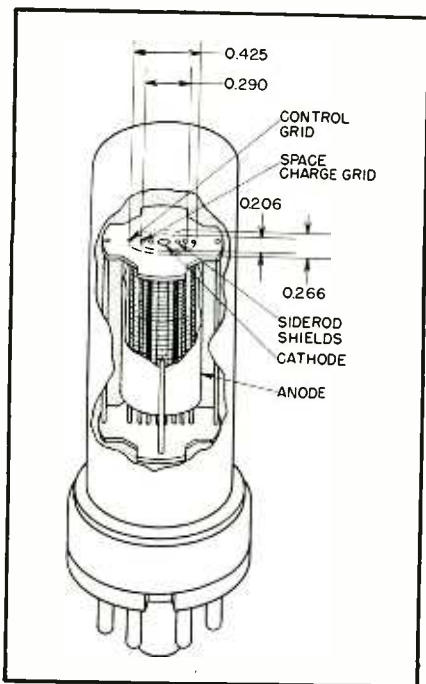


FIG. 1—Experimental space-charge grid power output tetrode dimensions

fied by selective negative feedback. Nevertheless, the triode remains the type tube preferred in high-fidelity audio systems.

These trends are well illustrated by several familiar tubes. The 45 exemplifies the triode power output tube, it being the first triode to deliver more than one watt of undistorted output (total harmonic content not greater than ten percent of the fundamental) with a rated plate potential of 250 volts. With this plate voltage, a negative grid bias of 50 volts, and a load of 3,900 ohms, the 45 gives 1.6 watts of undistorted output for an input signal of 35 volts rms. This load resistance gives the greatest power output, greater load resistance decreases the available output and decreases the distortion. The first pentode power output tube was the 47, rated at 2.7 watts output with 250 volts on plate and screen, a negative grid bias of 16.5 volts, and only 11.5 volts rms signal input. The output falls sharply, however, with lowered load resistance, and the odd harmonic distortion is high at any load. The 53 twin triode operating push-pull with 300 volts on the plates gives 10 watts output, but must be driven from a low-impedance source if the distortion is to be kept low. The

familiar 6L6 is the first beam power tube. With 250 volts on plate and screen, a negative grid bias of 14 volts, a peak signal input of 14 volts, and a 2,500 ohm load, the 6L6 delivers 6.5 undistorted watts.

In all of these tubes, the power output and, more especially, the harmonic distortion, are greatly affected by load impedance. Inasmuch as these tubes are used to drive loudspeakers, whose impedances vary widely with frequency, frequency distortion is also present. In the case of triodes, the second-harmonic distortion increases with decreasing load impedance. Pentode loads are chosen to give a compromise between high output and low third harmonics; load variations affect both factors. High outputs could be obtained from triodes operating in push-pull class-B, but only with low-impedance high-level drivers. Low distortion could be obtained from pentodes or beam-power tubes with degenerative feedback to reduce effects of changing load impedance, but only at a sacrifice of power sensitivity. In other words, the basic cause of distortion in these latter tubes is their high internal plate resistance.

Tube for High Fidelity

Figure 1 shows the construction and typical dimensions of a tube designed for space-charge grid operation. Tubes not designed for this type of operation are unsuited to it because the space-charge grid draws excessive current. In oper-

ation the first grid is made positive with respect to the cathode; its effect is to counteract the negative space charge and to produce a cloud of electrons at the plane of the first grid. This cloud acts as the virtual cathode. The operation of such a tube is similar to that of a triode with a large effective cathode area, behaving as if it were temperature limited. The second grid is then the control electrode. Screens and suppressors can be added, but as their effect will be, among others, to increase the dynamic plate resistance, which is undesirable in power output tubes driving loudspeakers, they were not used in the experimental tube under discussion.

To reduce the space-charge grid current, two siderods were introduced between the cathode and the supports of the space-charged grid. These siderods could be electrically connected to either the cathode or the control grid. By thus restricting the path of electrons to the vicinity of the lateral wires of the space-charge grid, its current was reduced about two-thirds. The spacing between space-charge grid and cathode was also adjusted to obtain an optimum between low space-charged grid current and high plate transconductance.

Figure 2A shows the characteristics of a space-charge grid tube operating at 6.3 volts and 0.7 ampere on the heater, the space-charge grid supplied from the 250-volt supply through a 10,000-ohm resistor—giving an average space-charge

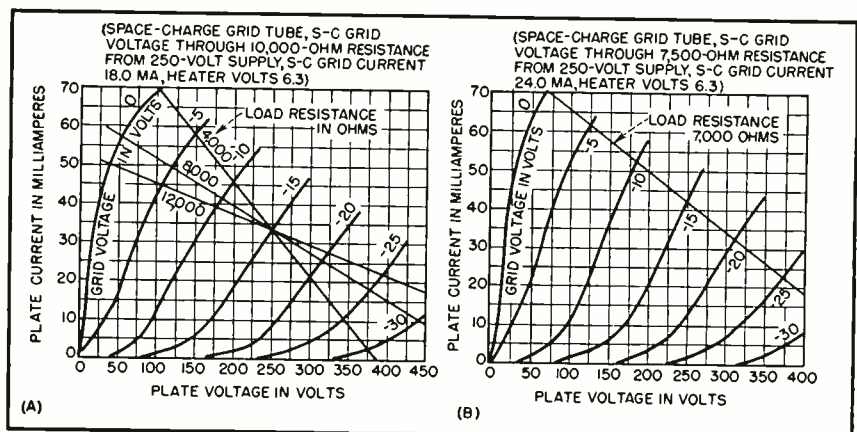


FIG. 2—Plate characteristics of space-charge grid tetrodes are similar to those of a triode. Comparing (A) with (B) shows the effect of space-charge grid bias on the plate characteristics

grid potential of 70 volts, and an average current of 18 ma, the plate supplied from the 250-volt supply through a 7,500-ohm load, and the control-grid bias at -15 volts—giving a plate current of 33 ma. Power output under these conditions is 2.4 watts with less than 1.5 percent total distortion. Varying the load from 5,000 to 12,000 ohms does not increase the total distortion to over 5 percent.

Figure 2B shows the tube's characteristics with a space-charge grid resistor of 7,500 ohms. Plate current increases to 41 ma, space-charge grid current to 24 ma, but the output power increases to only 2.6 watts, giving a much lower efficiency.

Space-Charge Grid Effect

Second-harmonic distortion was reduced by the same method that space-charge grid current was reduced. The high impedance of the space-charge grid to cathode region greatly reduced the effect of plate voltage on primary cathode current with the result that plate current at high negative grid voltage was lower than in a comparable triode. The effect is a greatly reduced even-harmonic distortion. Further harmonic reduction was obtained by tying the siderods to the control grid, thus increasing the plate transconductance at high negative control-grid voltages but having negligible effect at grid voltages near zero.

Operating the space-charge grid

Table I—Comparison of Space-Charge Grid Tetrode with Beam Tetrode

	Experimental Space-Charge Grid Tetrode	Typical (6V6) Beam Tetrode
Heater volts amps watts	6.3 0.7 4.6	6.3 0.15 2.8
Auxiliary Grid volts milliamps watts	(Space-Charge Grid) 250 18 4.5	(Suppressor Grid) 250 4.5 1.3
Control Grid bias volts volts signal swing	-15 10.6*	-12.5 12.5
Plate volts milliamps watts percent total distortion	250 33 8.3 1.5	250 45 11.3 8
Power output watts Overall % efficiency	2.4 13.8	4.5 29.2

Note: Volts listed under auxiliary grid are supply volts, which include grid voltage and voltage lost in dropping resistor. The efficiency is thus the efficiency of the circuits in toto, not of the tubes alone.
* Peak signal voltage equals operating bias, being increased until a microammeter in grid circuit indicates reversal of current.

through a dropping resistor without a bypass has three important effects: First, such operation slightly increases the output for a given average cathode current. Second, it stabilizes the output over a wide range of external load impedances. Third, it reduces odd-harmonic distortion.

Operating Conditions

To visualize the foregoing effects, compare Fig. 3A with Fig. 2. Figure 3A shows the tube's characteristics with a fixed potential of 50

volts on the space-charge grid (corresponding to well bypassed dropping resistor operation). The variation in the increment of plate current along a load line (not shown) with respect to grid voltage indicates odd-harmonic distortion.

The space-charge grid can be compared in some respects to the screen grid of a beam-power tube. The space-charge grid current is relatively high, but even so the power dissipated in it is only 1.5 watts with a 10,000-ohm dropping resistor. Although the maximum output of approximately 2.5 watts is less than that from a 6V6 beam tetrode, the power sensitivity of the space-charge grid tube does not vary with input signal level, being as high at low signal levels as at high. The effect is, in a phonograph amplifier for example, greater brilliance with less apparent needle scratch, due to the reduced higher order harmonics of the space-charge grid tube over a beam-power one. Figure 3B compares the output power and harmonic distortion of a typical beam tetrode with the space-charge grid tube. The low distortion of the latter recommend it for use in high-fidelity audio output amplifiers.

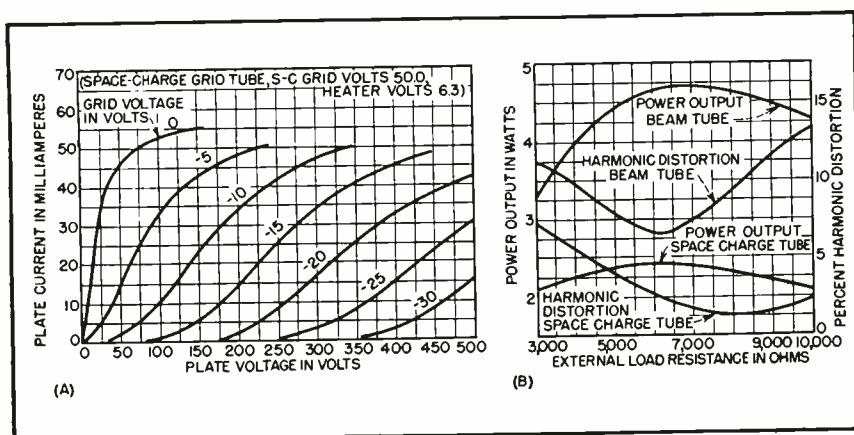


FIG. 3—(A) Without space-charge grid degeneration, characteristics are nonlinear. (B) Comparison of space-charge grid tetrode with conventional beam tetrode shows lower distortion of the former

Frequency Response of

Magnetic properties, physical dimensions and velocity of a magnetic recording medium are discussed and evaluated. Features and performance of electroplated wire and powder-coated tape are described

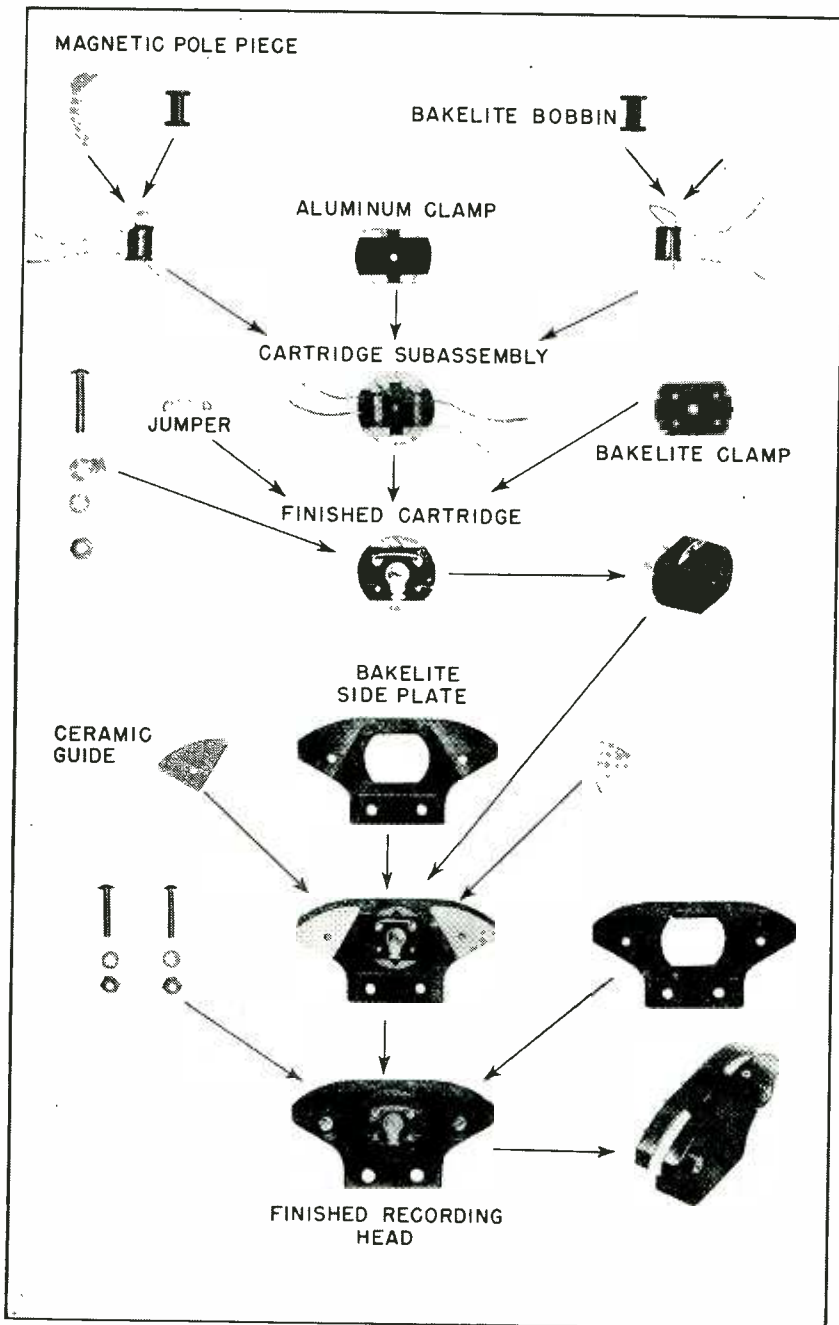


FIG. 1—Assembly details of a ring head designed for recording on wire or narrow tape. It consists of an essentially closed magnetic circuit that engages the recording medium on one side only

THE MOST REVEALING information about the mechanism of the phenomena which control any recording method may be obtained from an investigation of the reproducing process. Previous investigators have analyzed the response by empirical curve fitting¹ or theoretical considerations.^{2,3}

Assume that a sinusoidal signal has been linearly recorded with a ring head (Fig. 1) on a uniformly moving medium and that the recording was done with constant current through the recording head, independent of frequency; that is, essentially, with constant peak induction in the recording medium.

The resulting record may be looked upon as a longitudinal arrangement of bar magnets of an individual length equal to one-half of the recorded wave, sinusoidally magnetized and with like poles joining. This is schematically shown in Fig. 2.

The flux lines representing the internal magnetization B_i of these magnets must all close through the space surrounding them, thereby passing through their surface, creating there a certain surface flux density B_s . The latter determines the induction B_h in the magnetic circuit of the ring head contacting the recording medium. The reproducing voltage, e , generated in the head winding is proportional to the rate of change of the flux passing through the head.

The trend of this voltage, as a function of frequency, is derived, under simplifying assumptions, in Fig. 2 (at bottom). The reproducing voltage for very long wavelengths has theoretically a tendency to rise at a slope of 18 db per octave and this slope, with decreasing wave-

Magnetic Recording

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length, gradually changes into 6 db per octave. A very long wave is one whose length is great compared with the longitudinal extension of the zone of magnetic interlinkage between recording medium and heads; that is, roughly, the length of the contact area between the two or about the longitudinal head dimensions (see Fig. 2). This wavelength range almost always lies below the range of practical interest.

The observed shape of the frequency response curve follows this simplified prediction only to a limited extent. There is good agreement in the very low and part of the medium frequency range, but with increasing frequency the slope of the observed curve falls more and more short of the predicted 6 db-per-octave line. The curve even reverses its trend eventually and starts to fall gradually as the frequency increases further. Consequently, there must be certain effects, responsible for this deviation.

Demagnetization

The most important of these effects is the self-demagnetization of the described elementary bar magnets. It is well known that the magnetomotive force available across the ends of an open bar magnet, or the useful induction which it can generate, decreases due to its own magnetization. The figure which relates this decrease to the magnetization is called the demagnetizing factor; it depends almost entirely on the physical shape of the magnet and becomes smaller as its ratio of length to diameter increases.

Figure 3 shows the familiar graphic method of finding the decreased induction of a magnetic

structure when its intrinsic hysteresis loop and its demagnetizing factor N are known. A straight line, called the shearing line, is drawn through the origin at an angle whose tangent is proportional to the demagnetizing factor. The intersection P of this line with the hysteresis loop then gives the induction B' , effective in the magnet, as compared with the highest induction B , which would exist if the magnet were either closed or infinitely long.

The reduced induction values of all other points of the intrinsic hysteresis loop may be found in a similar manner. The locus of the new points describes the behavior of the open magnetic circuit and is called the sheared hysteresis loop. It is of importance in the investigation of all magnetic circuits containing portions of increased reluctance, including powder-coated recording media.

The demagnetizing effect is one reason for the response of a magnetic frequency record to decrease below the predicted 6 db-per-octave line. As the frequency increases, the length of the elementary bar magnets decreases which, in turn, causes an increase of the demag-

netization. The demagnetizing factors in the case of magnetic recording are not exactly predictable because the adjacent elementary magnets interact with each other and are shunted during the playback process by the reproducing head. An approach to the solution of this problem has been made by Camras.³

It was pointed out that the slope of the shearing line depended only upon the demagnetizing factor; that is, in this case, upon the recorded wavelength. The ordinate B' , at the intersection of the shearing line with the demagnetization curve is approximately proportional to the reproduced voltage and will decrease more slowly with increasing demagnetizing factor, the flatter the demagnetizing curve of the recording medium. The average flatness may be roughly defined by the ratio of coercive force to remanence. Accordingly, an improvement in the high-frequency response can be observed, with an increasing ratio of coercive force to remanence, irrespective of their absolute magnitudes.

From several materials with the same ratio of coercive force to remanence, the one with the highest

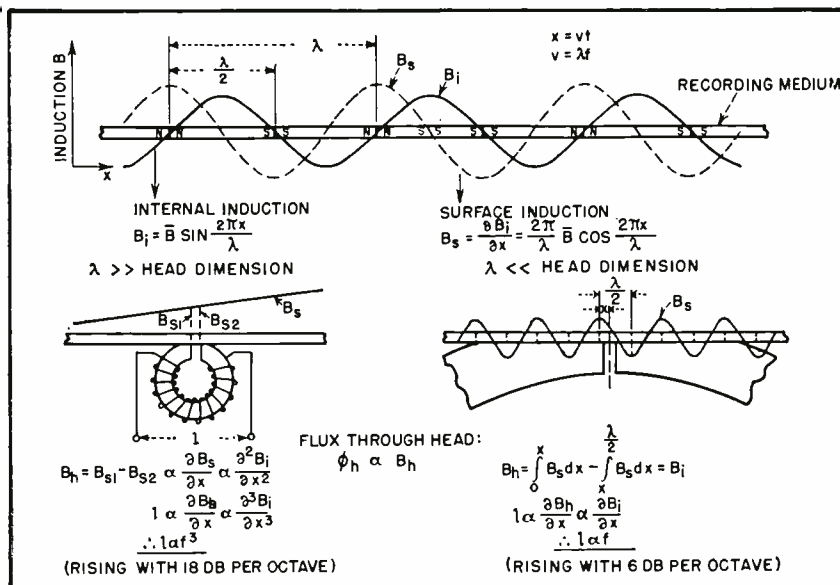


FIG. 2—Interaction between the recording magnetic medium and the reproducing ring head with a sinusoidal signal

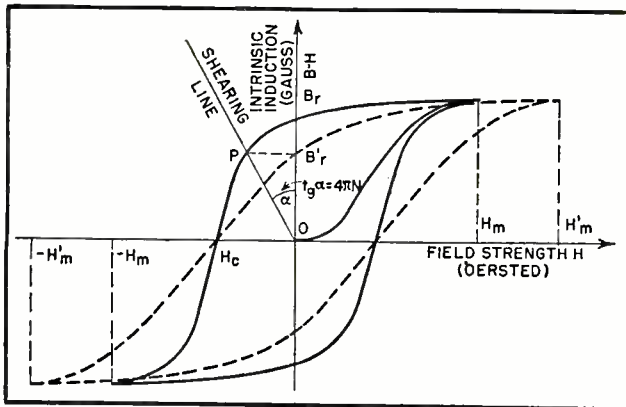


FIG. 3—Magnetization of a ferromagnetic material. The solid curves apply to a closed magnetic circuit and the dashed curves to an open magnetic circuit

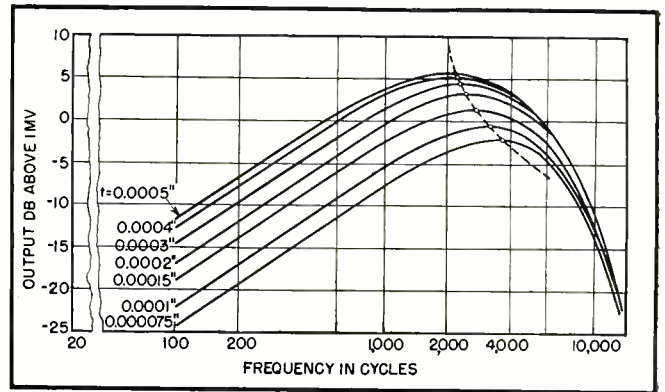


FIG. 4—Frequency response of electroplated brass tape operating at a velocity of two feet per second. Thickness is represented by t

absolute values (within practical limits) of the two quantities will still be the more desirable. The reason is that this material will yield the highest absolute reproducing level, because of its high remanence, and that it will offer the greatest resistance to accidental demagnetization by external fields because of its high coercive force.

Penetration

Based on the concept of the demagnetizing effect, the response of a thin recording medium might be expected to be superior to the response of a thicker one. However, experiment does not always verify this expectation since the response curves of all media within usual dimensions (thicknesses of a few thousandths of an inch) are found to be substantially alike, other conditions being equal. In an attempt to clarify this apparent contradiction, certain measurements were made whose results are represented in Fig. 4. Here are shown the response curves of several recording media, which differ only in their thickness. The absolute values of the thicknesses are very small.

Disregarding the absolute reproducing level, the frequency response of these very thin media actually does improve with decreasing thickness. Since all the curves have substantially the same shape, the position of the maxima of these curves forms a simple criterion for their frequency characteristic. The dotted line connecting these maxima shows that the improvement of high-frequency response is more rapid in the range of the thinnest media than in the range of the

relatively thicker ones, tending toward no change at all for still thicker media.

This peculiar behavior can be explained by the assumption that the physical depth of magnetization of the recording media is dependent upon the recorded wavelength. The phenomenon may be termed penetration effect.

All wavelengths penetrate magnetically into the recording medium only to a limited depth; the longer ones penetrate more than the shorter ones and the absolute magnitude of this penetration is normally in the order of under one thousandth of an inch. Accordingly, the frequency response of the relatively thick commercial recording media is hardly affected by limited thickness variations since most of their cross section is inactive, that is, not penetrated by useful magnetic flux. When the thickness of the medium is substantially reduced to the order of the depth of penetration, the low frequency range will be impaired first, which means that the upper frequency range will be relatively favored.

In extremely thin carriers where complete penetration can be assumed over a wide frequency range, there is no selective influence of the penetration effect any longer. The frequency response is then controlled by the demagnetizing effect alone. Because of the increasing dimensional ratio of the elementary magnets, a thickness reduction by a certain ratio should have the same effect upon the response as an increase of the medium velocity by the reciprocal ratio. The absolute reproducing level, however, will

drop by the same ratio because of the decreased cross section. This statement seems to be verified by the trend of the dashed line in Fig. 4, which approaches a slope of minus 6 db per octave for progressively decreasing thicknesses.

The penetration effect is another important factor which causes deterioration of the high-frequency response of commercial recording media since it results, with decreasing wavelength, in a gradual decrease of the effective cross section of the recording medium. (Shunting of the magnetized layer due to the presence of the inactive material does not seem to be serious.)

The penetration effect must not be confused with the magnetic skin effect since it has been found that the penetration is a function of the wavelength only, and not of the frequency. Its mechanism may be explained by the geometry of the flux lines entering the medium in the recording process. The course of these flux lines, which determines the depth of penetration, appears to depend primarily, for a given wavelength, upon the gap width and the permeability of the recording medium—greater gap width and lower permeability favoring deeper penetration.

One particular question that arises is that if the penetration decreases with rising frequency how is it possible to erase and to bias^{4,5} with very high frequencies? The answer is probably that in the erasing process the recording medium has to be carried into saturation; in this range, however, its permeability approaches unity so that sufficiently deep penetration

becomes possible for evident reasons of flux distribution. A somewhat similar condition prevails in the case of high-frequency bias. In this situation the recording medium works essentially within the toe of its normal magnetization curve where the permeability is also very low.

Gap Effect

Another effect which contributes to the loss of the reproduced level as the frequency increases is the almost purely geometric influence of the finite gap width of the reproducing head. The effect exists basically in any method of scanning a recorded signal. Figure 5 shows a representation of the function relating this loss to the ratio of gap width to recorded wavelength. It can be seen that no reproduction takes place when this ratio equals unity (or any integer).

The loss as shown describes the conditions for the reproducing process only.

It should be emphasized that the effective gap width of the reproducing head is not identical with the physical dimension of the gap. Magnetic leakage causes a certain spread of the zone of mutual influence between recording medium and gap, resulting in an effective gap width which may be determined to be up to about 40 percent larger than the physical gap width.

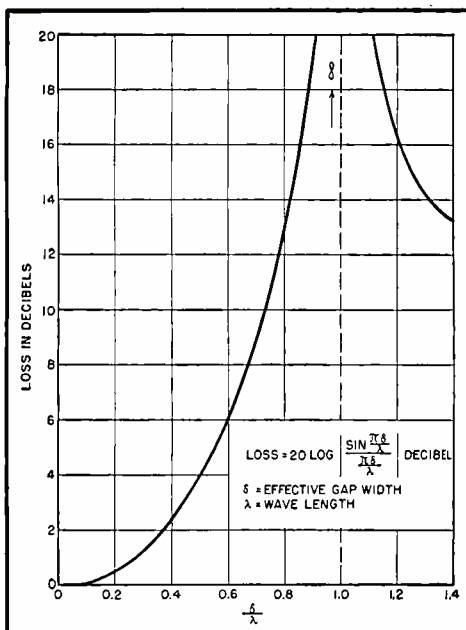


FIG. 5—Playback loss due to gap effect

Figure 6 shows, in a qualitative manner, the three discussed effects which control the shape of the frequency-response curve of magnetic recording as obtained with ring heads. The solid curve gives the general appearance of an observed response. The vertical distances between this curve, the two dotted curves, and the theoretical 6 db-per-octave line indicate the respective loss contributions of demagnetization, penetration, and gap effect.

Velocity

Figure 6 also indicates a convenient graphic method of converting a response curve established at a velocity v of the recording medium into the curve at some other velocity v' : A 6 db-per-octave line is drawn through any point P of the given curve, plotted in the conventional double logarithmic system. On this line, point P' is found by spacing it from P at a horizontal distance which equals, as a frequency ratio, the ratio of the two velocities. The new curve (dash-dotted) is then found by shifting the original curve bodily along the 6 db-per-octave line to its intersection at P' . (The points P and P' on the two curves correspond to frequencies with equal wavelengths.)

The noise originating from a magnetic recording medium is evidently generated by random flux variations picked up by the repro-

ducing head. These variations may have two different causes. The first one is the random fluctuation of the reluctance across the gap of any or all of the heads, brought about by either mechanical vibration or surface roughness of the recording medium. The second cause is the inherent grain structure of the recording material. Here, the magnetic discontinuities at the boundaries of the individual grains or domains will also cause minute flux variations.

Vibration and surface roughness of the medium can be minimized by appropriate design of the drive mechanism and by careful preparation of the medium.

The noise reproduced from a given recording medium will depend upon the magnetic state of the medium. A completely demagnetized medium will result in the least noise as evidenced by the low noise level obtained from an a-c erased in contrast to a d-c erased recording medium.

An important consequence arises from this recognition. A recording medium—after a-c erasing and subsequent recording—is demagnetized only in the portions where no signal is recorded. Wherever there is a signal, there will be magnetization corresponding to the instantaneous value of this signal. The signal itself, consequently, causes noise which follows the instantaneous sig-

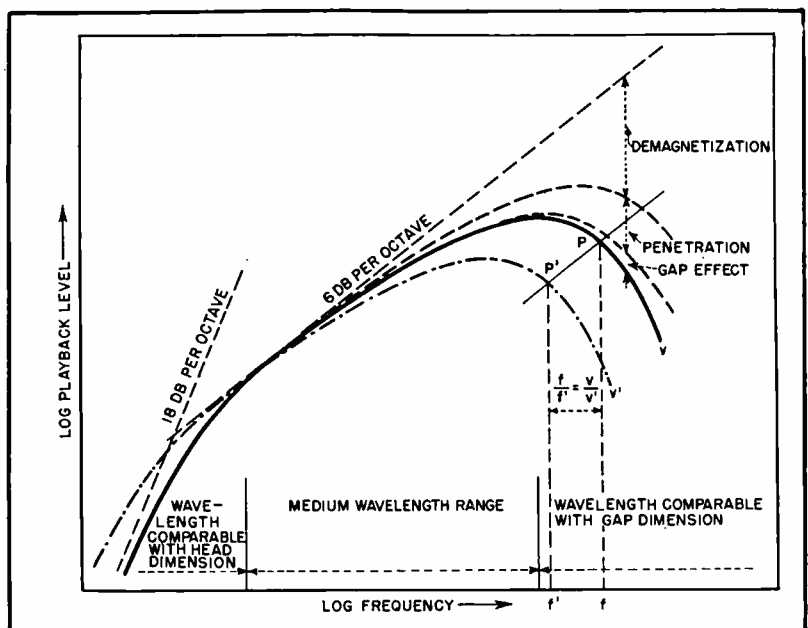


FIG. 6—Synthesis of the response curve of a magnetic recording medium

nal level in its magnitude. This type of noise, closely related to but less objectionable than the continuous noise after d-c erasing, has been termed modulation noise or noise behind the signal. Its magnitude depends on the factors discussed before and noise values up to about 15 db above the no-signal-noise have been measured at the crest of a maximum signal.

For the generation of noise it is immaterial whether the recording medium or the associated reproducing head is magnetized since the two form one magnetic circuit during the reproducing process. An accidentally magnetized reproducing head will therefore also cause noise and great care has to be taken to reduce or eliminate the remanent magnetization of the reproducing head. This can be done by proper selection of the core material, by the introduction of an additional air gap into the magnetic circuit or by purposely demagnetizing the head whenever required.

Most magnetic recording media until now have had the form of fine wires or of thin tapes. Originally, plain carbon steel was used but has been replaced by various alloy steels, particularly the ternary alloys of iron and nickel-chromium, nickel-copper or cobalt-copper. The coercivity of these materials has thus been increased from about 25 oersteds for carbon steel to about 150 to 250 for various commercial recording media and up to over 400 for some experimental media.

All these recording media are produced by rather closely controlled drawing or rolling operations combined with a suitable heat treatment to effect and maintain the desired physical and magnetic properties. These procedures are difficult and expensive, particularly since the required magnetic hardness of the materials is usually accompanied by physical hardness.

One quite successful solution to this problem has been found to be the electroplating of a ductile, non-magnetic base material with a ferromagnetic layer.⁶ The base material for plated recording media is, ordinarily, brass in the form of fine wires or tapes. However, other shapes, for instance, disks or cylinders, may be processed just as

readily which is of importance for special applications.

The plated layer usually consists of a cobalt-nickel alloy, applied to a thickness of about 0.0003 inch. This dimension provides a practical compromise between frequency response, reproducing level and production cost. The material has a coercivity of over 200 oersteds and a retentivity of about 10,000 gauss. The plating is very uniform and ductile, has a mirrorlike surface and fine grain structure, as evidenced by a low noise level. No heat treatment is required since the internal stresses, necessary in any permanent magnet material, are automatically created in the plating process.

The frequency response curves shown in Fig. 4 may be considered representative of the performance of the present plated media. Plated recording wires can now be produced at a rate of about 150 feet per minute, and up to 500 feet per minute have been experimentally obtained.

Magnetic Tape

The ability of a recording medium to exhibit a good high-frequency response depended primarily on its ratio of coercive force to remanence. This ratio determines the specific magnetic reluctance of the recording material and has definite limitations in most homogeneous materials. However, it can be artificially increased by using the ferromagnetic material as a fine powder, uniformly dispersing this powder in a suitable binder, and coating the resulting mixture on an inert base material to form the recording medium.⁷ The magnetic reluctance of such material, when measured in bulk, will be very greatly increased by the presence of the minute interstices separating the individual particles. The effective induction will, consequently, be reduced from the intrinsic value of the powder while the coercive force remains unchanged (sheared hysteresis loop), thus giving the desired result of a greatly decreased slope of the demagnetization curve. If both particle size and their separating distances are made small in comparison with the shortest wavelength to be recorded, such a dis-

perse material will behave like a homogeneous material.

The ferromagnetic powders for recording media may be produced from any suitable permanent-magnet material but experience has shown that various magnetic iron oxides are most readily and economically applicable. These powders, with a particle size of about 1 micron and an intrinsic coercive force⁸ between 100 and 250 oersteds, are now predominantly used for the commercial production of powder-coated recording media in the form of tapes or sheets. The remanence of the iron oxide coating is usually between 400 and 800 gauss, about one order of magnitude below that of the more common homogeneous recording media.

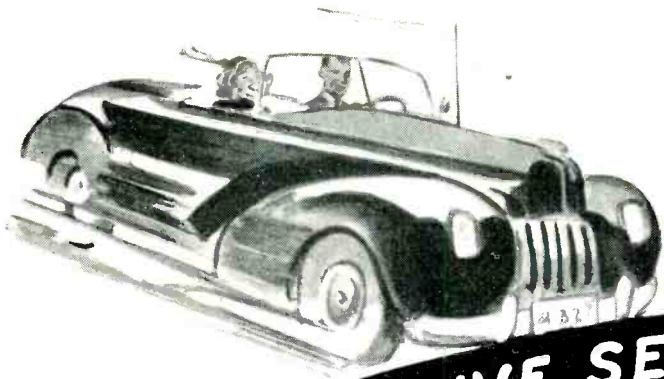
The coating, containing between 25 and 40 volume percent of magnetic powder, is applied with a thickness of about one-half thousandth of an inch to a base of paper or thin plastic. The resulting recording medium exhibits extremely low background noise and a frequency response far superior to any homogeneous medium now in use. For a given frequency response powder-coated media can be run with roughly about one-half of the speed required for homogeneous media.

The reproducing level from powder-coated media is inherently low because of their low effective induction; but this deficiency can be compensated for by using a correspondingly wider recording track.

This paper is based, in part, on work done for the Office of Scientific Research and Development under Contract OEMsr-254 with The Brush Development Company. A number of facts presented in this paper were first published, in essence, in OSRD Report No. 5325, of June 30, 1945.

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- (5) L. C. Holmes and D. L. Clark, *ELECTRONICS*, 18, p 126-136, July, 1946.
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Square-Wave Response

Nomograph correlates tilt of square wave after passage through uncompensated RC-coupled video or audio amplifier with low-frequency response of amplifier and time constant of coupling circuit

By **A. J. BARACKET**

Head, Television Studio Facilities Section
Research and Development Division
Allen B. DuMont Laboratories, Inc.
Passaic, New Jersey

WHEN USING rectangular or square waves for testing audio and video amplifiers, the output of the amplifier is compared with the input on an oscilloscope. The degree or percent of tilt of the

top of the square wave represents the amplifier's deterioration of the lower frequencies.

In the uncompensated RC-coupled amplifier stage shown, the effect of the amplifier on low frequencies is

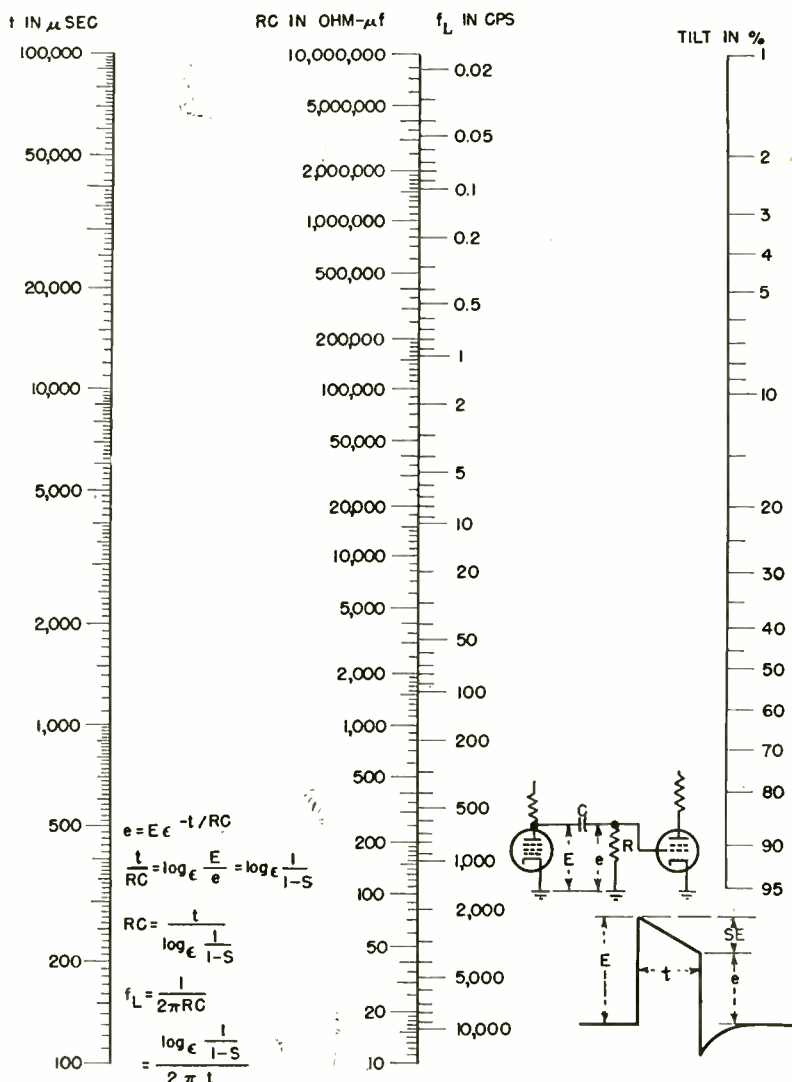
almost completely a function of the value of the RC time constant in the grid coupling circuit. The smaller the time constant, the poorer the low-frequency response and consequently the greater the percent tilt S of a rectangular wave (referred to the peak plate voltage value E , as indicated on the waveform diagram).

The accompanying nomograph is useful in computing the RC value required to give a maximum specified tilt S (expressed as a decimal part of E) for a rectangular wave having a duration t , or conversely it may be used to determine the tilt that will be obtained from a given time constant. The chart also gives the relationship between tilt and low-frequency cutoff of an amplifier coupling circuit (the frequency f_L at which the amplitude-frequency response characteristic is down 3 db).

Example of Use

The percent tilt of an uncompensated video amplifier stage is specified as 2 percent maximum on a 60-cycle square wave. What will be the required time constant of the coupling circuit and the corresponding low cutoff frequency?

By means of a straightedge, connect the 2-percent point on the tilt scale with the 8,300- μ sec point (corresponding to the half-cycle duration of a 60-cycle square wave) on the t scale. The straightedge will cross the RC scale at approximately 410,000 ohm- μ f. The corresponding low cutoff frequency f_L is found to be 0.4 cycle.



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Four-Tetrode F-M Power Amplifier

ONE apparently satisfactory solution to the problem of obtaining appreciable power output on the new 88- to 108-mc f-m broadcast band has been made by James A. Day of Radio Engineering Labora-

tories who employs four Eimac 4-1000A tetrodes in a unique tuned-line amplifier.

Although available for some time in limited numbers for experimental work, the type 4-1000A, an in-

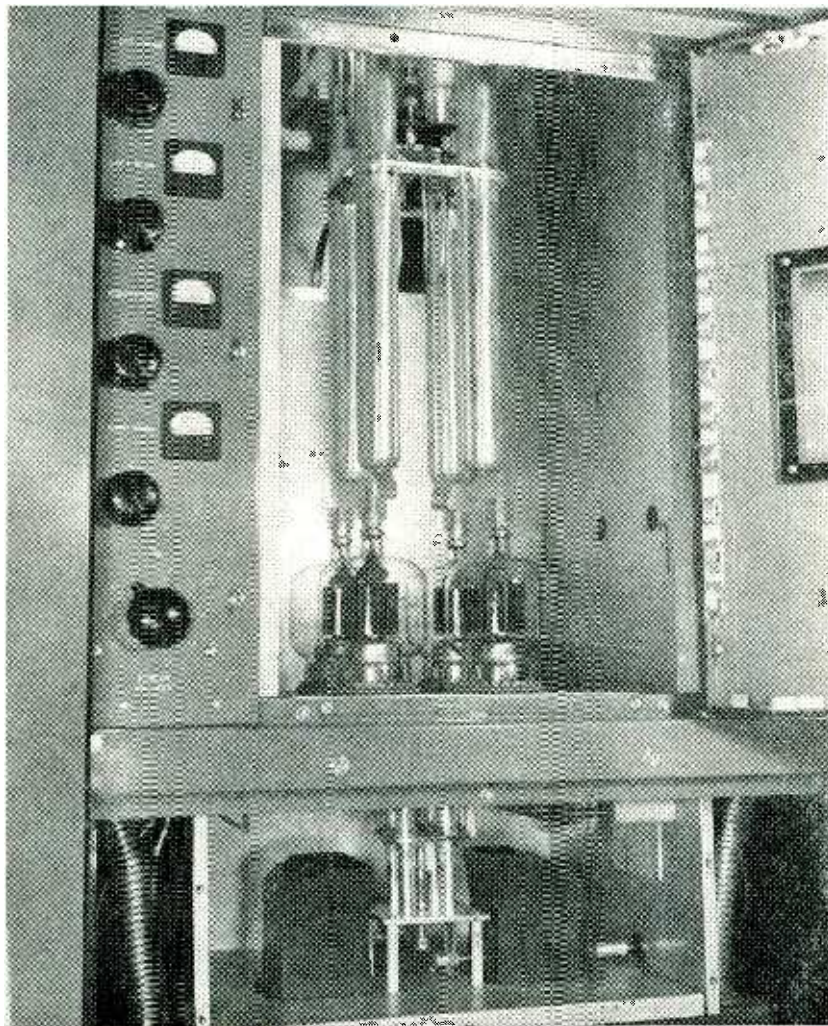


FIG. 1—Interior view of the plate and grid (lower) tuning sections of the novel 10-kw power amplifier for f-m broadcasting

ternal anode, glass-envelope tube of conventional appearance, is now going into production so that design of a commercial circuit about it is practicable.

The use of tuned quarter-wave lines has been common practice in vhf oscillator and amplifier circuits for some time. Since a quarter wavelength at 100 mc for parallel lines is in the order of 29 inches, the physical dimensions required are entirely within reason for commercial f-m broadcast amplifiers. Designs now in use employ many of the possible variations, including concentric lines. The four-wire system described here provides both a simple mechanical assembly and excellent self-shielding. A fluorescent desk-lamp tube held within an inch of the tank fails to light when the transmitter is operating at full power.

Figure 1 illustrates the mechanical simplicity, particularly in the plate-tank tuning. The four lines are attached to a square metal plate that hangs from insulators and the plate voltage is fed through the lines to the tubes. Another metal plate with the center cut out can be moved up or down and contact fingers short out the upper parts of the lines for tuning. The coupling coils for taking off power are mounted on a plate of insulating material and are let down through the aperture in the tuning device. The grid tank tuning and input coupling devices are substantially the same.

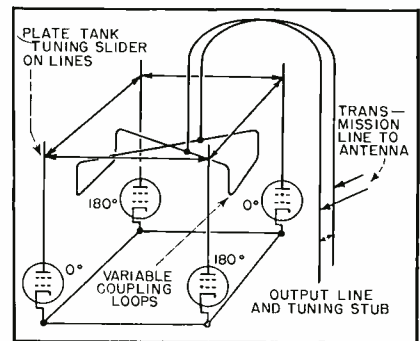
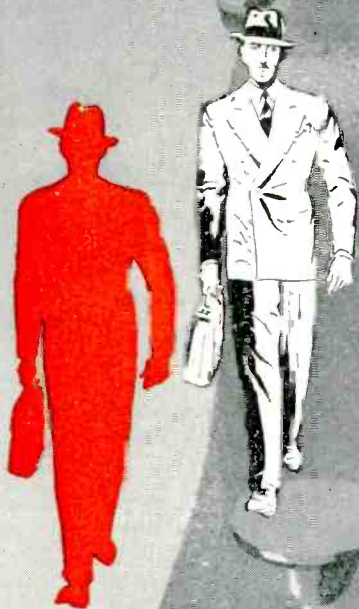


FIG. 2—Simplified sketch showing arrangement of the plate tank circuit and relative phases of the four tuning lines; coupling pickup loops and method of tapping on load are indicated

The electrical aspect of the plate tank circuit is shown in the simplified sketch in Fig. 2. As indicated, each line is relatively phased 180

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degrees from each adjacent line. The arrangement is not unlike two pairs of pushpull line-tuned amplifiers but avoids the disadvantages of normal pushpull-parallel connection. The pickup loops are cross-connected and the output line tapped in as closely as possible to the center point of the cross-over. An adjustable stub and variable taps for matching the output to the line from the transmitting antenna complete the simple circuit elements.

The tuning chains and gears not shown in Fig. 1 are on the other side of the right wall of the amplifier chamber and are driven by tuning cranks on a panel obscured in the photograph by the door. The tiny loop on the right wall picks up a small amount of energy from the amplifier for monitoring and frequency checking equipment remotely located from the transmitter. Screen-grid neutralizing is used and the two screwdriver controls that turn ganged variable capacitors can be seen on the metal cabinet strip below the tubes. A screen-grid voltage control and four individual balancing controls, one for each tube, with their associated meters appear on the panel to the left.

Owing to the grid-input characteristics of the amplifier tubes,

the grid tuning lines are shorter than those in the plate tank. There is, however, sufficient circuit external to the tube so that the grid circuit can be tuned even beyond the upper limit of the f-m broadcast band (108 mc). Driving power comes through a coaxial cable outside the right wall of the grid-tank chamber. The two neutralizing-type capacitors just visible are used for matching the driver line to the grid coupling loops and also provide d-c isolation.

Two nonconducting ventilators for the blowers mounted beneath the grid chamber direct streams of air upwards at the bases of the tubes. Holes in the metal bases, not visible in the photograph, allow the air to pass through. The tube seals are thus kept below their maximum operating temperature.

The driver illustrated is identical with the unit normally supplied as a 1-kw f-m transmitter. It uses the Armstrong dual-channel modulator (*ELECTRONICS*, p. 100, April 1945) and gives carrier frequency stability independent of modulation characteristics.

At 10-kw output, and with r-f driving power of 750 watts, an r-f to d-c power efficiency of 80 percent is obtained under the following conditions:

Plate voltage 4.95 kv
 Plate current 2.48 amp
 Grid voltage -400 v
 Grid current 400 ma
 Screen grid current 520 ma
 (total)
 Screen grid voltage 300 v

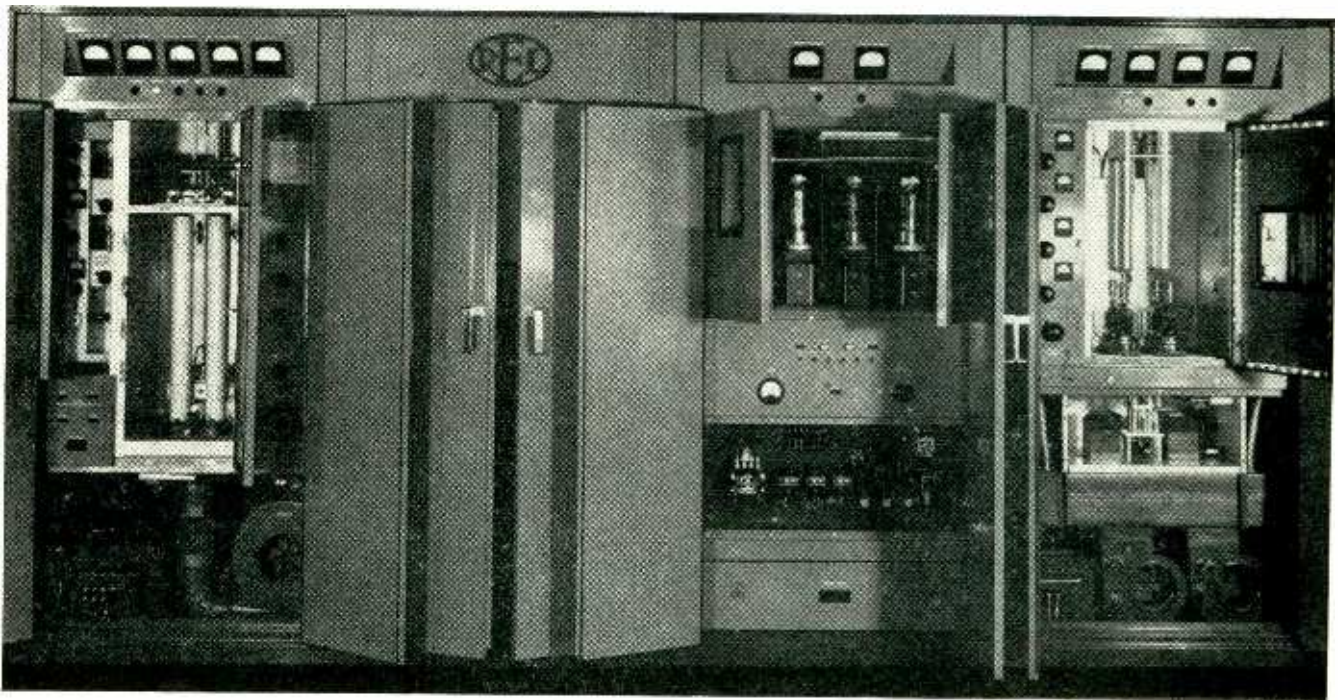
Surge Protection of Pilot and Heater Circuits

By RALPH P. GLOVER

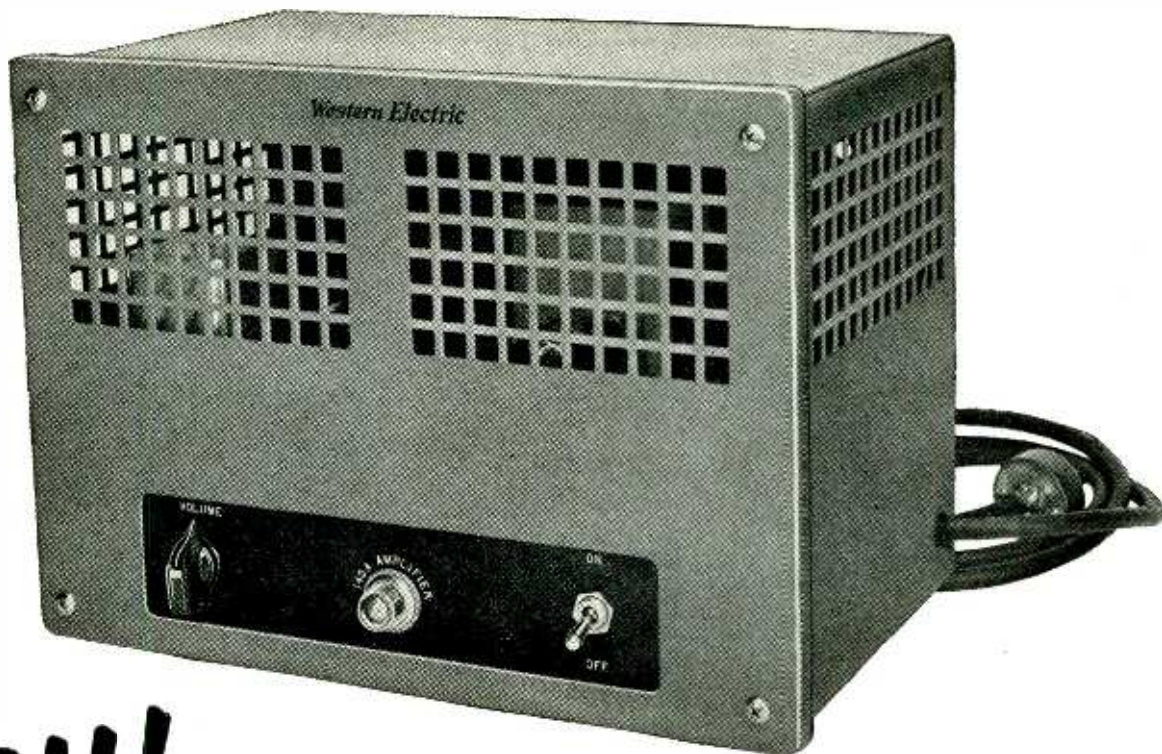
*Consulting Engineer
 Keystone Carbon Company
 St. Mary's, Pennsylvania*

ENGINEERING a satisfactory circuit arrangement for the pilot lights and heater string in transformerless radio receivers and amplifiers has always been a trying problem. Pilot lights flare up when the set is first turned on, ultimately settle down to an illumination level which is frequently either too low for a satisfactory visual effect, or too high for reasonable pilot light life. And when the pilot light burns out due to oft repeated surges or over-voltage operation, or opens due to mechanical failure, the set either operates at appreciably reduced efficiency or is totally dis-

(continued on p 148)



Complete 10-kw f-m transmitter. A standard 1-kw unit is used as driver (left) the Armstrong dual-channel modulator being mounted at the rear of the cabinet. Output amplifier is at the right with power and control units in the bay next to it. Doors under the monogram give access to the rear of the equipment



The 1140A wired program amplifier has a frequency response ± 1 db from 50 to 10,000 cycles.

NOW!

An AC-DC amplifier for 80% of all your wired program installations

Bell Telephone Laboratories designed this 1140A Amplifier especially for wired program service...and designed it so well that it will meet amplifier needs in 80% of your subscriber installations.

This three stage push-pull amplifier for AC or DC service can be used as fixed or portable equipment, and can be installed in cabinet or with mounting accessories in a rack. (Without the cabinet, the 1140A is known as the 140A.) The following four features make the 1140A Amplifier universally applicable:

1. New type of design is free of noise usual in AC-DC amplifiers and requires

no special grounding arrangement.

2. Carries Underwriters' Laboratories seal of approval and meets requirements for installations on subscribers' premises.
3. Designed to operate directly from telephone lines without the use of repeat coils.
4. Delivers 10 watts with AC power source and 6 watts with DC power source.

For complete information on the 1140A, contact your nearest Graybar Representative, or write directly to Graybar Electric Company, 420 Lexington Avenue, New York 17, N.Y.

Western Electric

— QUALITY COUNTS —



THE ELECTRON ART

Edited by FRANK ROCKETT

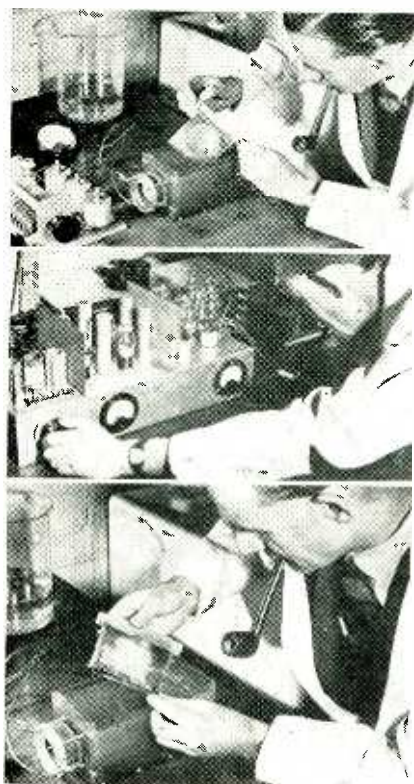
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Laundering Ultrasonically

FABRICS have been successfully laundered by scientists of the British Launderers Research Association using ultrasonic vibrations. Whereas particles loosened by soap may not be rinsed from the fabric, ultrasonic vibrations not only overcome the electrical charges holding dirt particles to fabric, but also force the particles from the fabric. The ultrasonic technique is both more effective and quicker than conventional methods of washing fabrics.

Test fabrics that have been ex-

perimentally soiled are inserted in the laboratory tank, as shown in the top frame of the picture. The driving transducer can be seen at the left on the tank. John Bold, senior electrical technician shown in the pictures, adjusts the frequency of the oscillator; tests have been carried out up to 300 kilocycles and will be continued up to one megacycle to determine the effect of frequency on cleansing. At the bottom, the test fabric is removed 10 minutes later; note the difference in color of the test cloth between the top and bottom pictures showing the cleaning action.



Laboratory tests indicate that ultrasonic laundering is feasible

Pulse Code Modulation

FREEDOM FROM NOISE and interference in long-distance telephone communication is obtained by a novel form of pulse modulation developed at the Bell Telephone Laboratories. The technique, pulse code modulation (pcm), is expected to find its greatest application with sampling types of transmission over microwave radio relay communications systems. In pulse code modulation, the continuous voice signal is sampled for roughly a millionth of a second 8,000 times a second, giving an upper frequency limit of between 3,000 and 4,000 cps. The instantaneous amplitude of the signal, as determined by the momentary sampling, is converted into one of 32 five-pulse code groups. The code groups constitute the pulse subcarrier with which the microwave radio carrier is modulated. At the

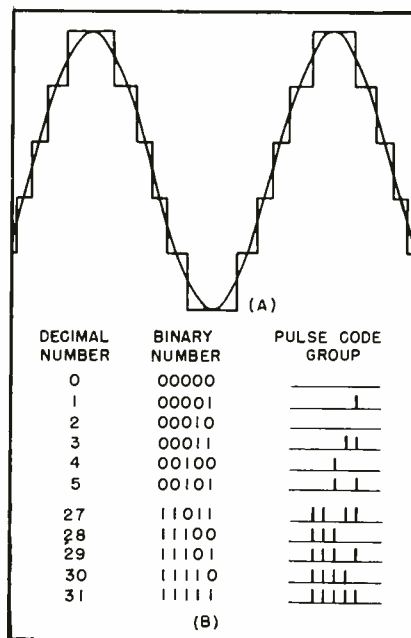


FIG. 1—Instantaneous amplitude of signal is represented by a finite number of discrete steps (A). Using 32 such steps to represent the full range from positive to negative requires a five-pulse code group (B)

relay stations the code groups can be regenerated despite considerable interference. At the receiver they are reconverted into the voice signal. Tests using an eight-channel system showed that the reconstructed voice signal loses negligible fidelity through this method of pulse modulation. Code groups with more pulses can be used if greater fidelity is required; higher sampling rates can be used if higher frequencies are to be transmitted.

Amplitude Quantization

Pulse code modulation samples the signal into discrete amplitude levels as illustrated in Fig. 1A. To

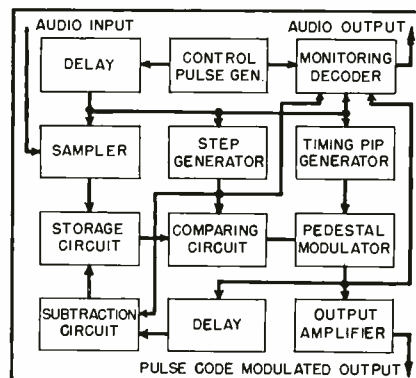
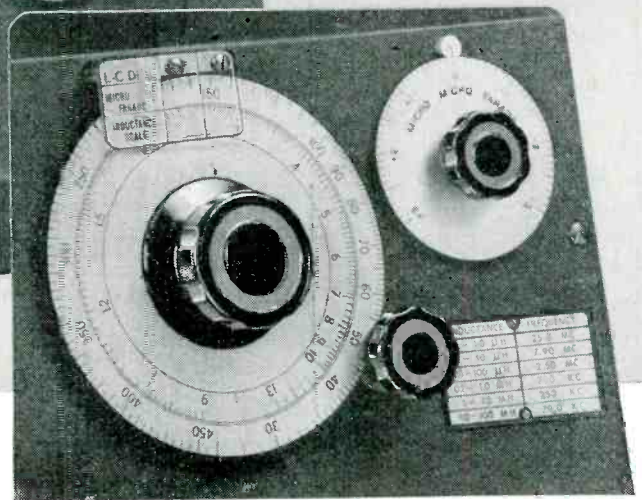
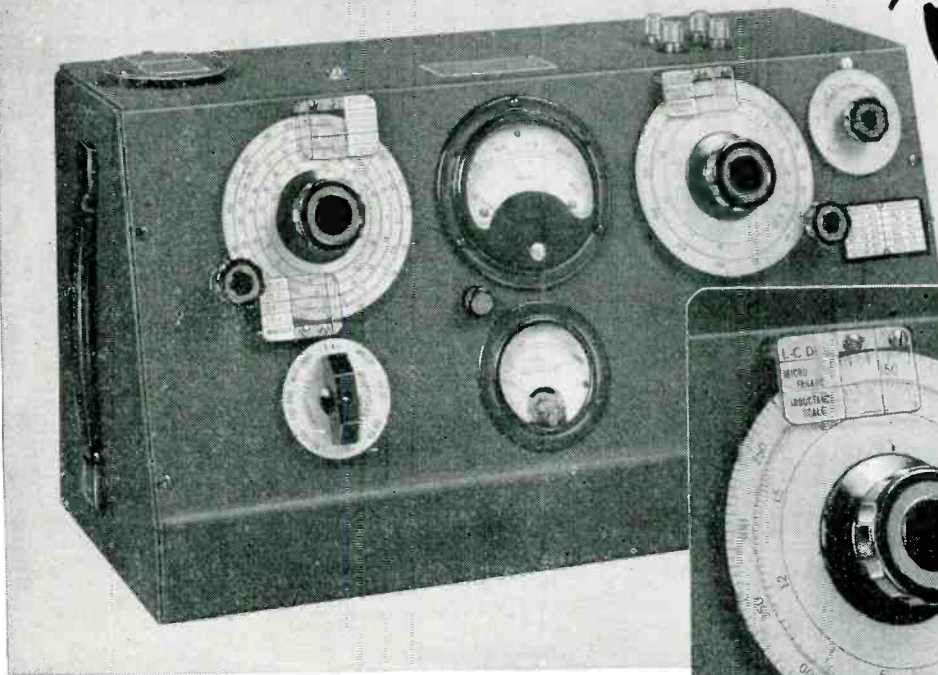


FIG. 2—Block diagram of transmitter pulse code converter

A New L-C Dial for

The **Q-METER**

TYPE 160-A



NEW INDUCTANCE SCALE ON Q-METER CAPACITOR DIAL NOW PERMITS DIRECT DETERMINATION OF EFFECTIVE INDUCTANCE VALUES BETWEEN 0.1 MICROHENRY AND 100 MILLIHENRIES.

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The 160-A Q-Meter is universally recognized as a rapid and simple means for measuring effective inductance. The customary method of measurement employed by engineers is to resonate the coil under test at a known frequency using a known capacitance, and thus obtain the effective inductance value of the coil by calculation. The use of the new L-C dial, as explained below, further increases the speed and versatility of the 160-A Q-Meter by eliminating the necessity for inductance calculations.

Since the Q capacitor of the 160-A Q-Meter has a capacitance range of somewhat more than 10:1, it is evident that inductance values over a 10:1 range can be resonated at any single frequency. It is, therefore, possible to include on the Q capacitor dial a single decade inductance scale reading directly in terms of effective inductance provided that the proper measurement frequency is selected. The new L-C dial is based on this principle.

Write for Catalog "D"

An inductance-frequency reference plate has been provided on the front panel which shows the proper frequency to which the RF oscillator should be set in order to obtain the inductance measurement range desired. Any one of six consecutive inductance tuning ranges may be selected, permitting overall inductance measurements of from 0.1 microhenry to 100 millihenries to be made.

For those 160-A Q-Meter owners who wish to equip their own instruments with the new L-C dial, a dial conversion kit, Type 560-A, is available which contains complete parts, hardware, and instructions for installing this dial without disturbing the calibration of the 160-A instrument.

L-C DIAL CONVERSION KIT TYPE 560-A

This conversion kit is available in a unit package, complete with all items required to install the L-C dial on your present 160-A Q-Meter.

Further details upon request.

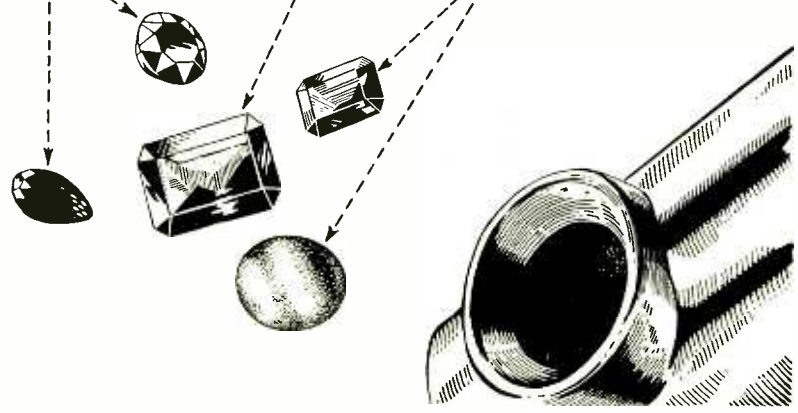


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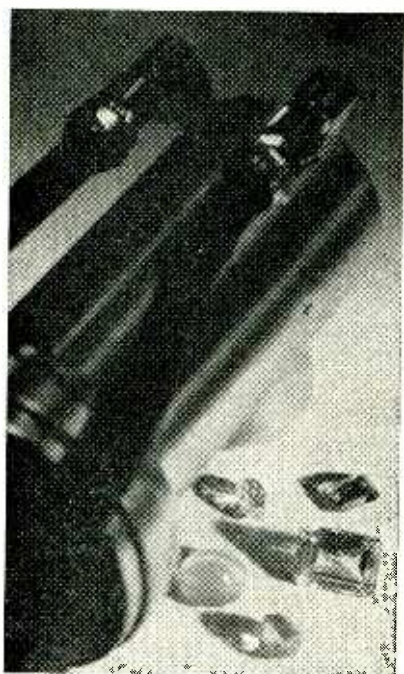


X-Ray Irradiation of Gems

INTENSE X-RAYS change colors in gem stones. A few stones so affected are identified above (see cover); some 50 are listed by F. H. Pough and T. H. Rogers in *American Mineralogist*, p 37, 32, 1947.

Although it has long been known that x-rays affected colors of some gems, extensive investigations of the effects were time-consuming until Machlett Laboratories developed a 50-kv x-ray tube with a water-cooled tungsten target, and a one-millimeter-thick beryllium window. The beryllium window transmits x-rays of longer wavelength and with less loss than conventional windows. Wavelengths from 0.4 to 4.0 Angstroms are available from this tube. The photograph below shows the water cooling ducts connected on the back of the tube head.

Coloration produced by x-ray irradiation depends on the material, origin of a particular stone, and, to some degree, its cutting. In most instances coloration is only semipermanent; it can readily be removed by heating or exposure to sunlight (infrared). The cause of coloration is associated with redistribution of electrons in the crystals of the stones by the x-rays. Migration of electrons back to their stable positions removes the coloration. If the coloration can be made permanent, it may provide a means of treating gems. In any case the technique affords a means of identifying stones and of studying the physical nature of crystals. The x-ray source has numerous other uses.



For the picture on the front cover, about eight minutes irradiation was required to produce the color changes; tube beam current was 50 ma. Actually the stones are on a glass plate, but the plate, being coated with a nonreflecting surface, is invisible. The x-ray tube lies below the glass, port toward the gems. This technique permitted a close-up of the stones to be taken despite disparity in size between stones and x-ray tube.

each level is assigned a number. These numbers are transmitted by the binary system shown in Fig. 1B. With the five-pulse code groups, about two percent distortion is introduced by the amplitude quantization technique. In the actual system, because of the nature of the voice signal, the steps or quanta levels are logarithmic, being smallest for low levels, thus giving a nearly uniform percentage precision throughout the amplitude range. Using logarithmic steps permits using far fewer steps than would be necessary for the same fidelity if uniform steps were used.

The pcm system using five-pulse groups requires slightly less than five times the bandwidth of a pulse amplitude modulation (pam) system, but is far less subject to cross-talk in a multiplex network, and tolerates a much lower signal-noise ratio.

Figure 2 shows the basic experimental circuit for pcm. The voice signal is sampled into amplitude modulated pulses. Each a-m pulse is stored on a capacitor in the storage circuit, the voltage so produced being compared to a reference voltage. If the capacitor voltage exceeds the reference voltage a positive pedestal voltage is applied to the pedestal modulator which gates the timing pulses from the timing pip generator to give an output pulse, which corresponds to the largest value digit in the binary number. This pulse is transmitted and, in addition, is fed back through the delay and subtraction circuits to subtract a charge from the storage capacitor. The remaining charge is compared to a new reference voltage equal to half the original reference, and, by the same process, a second digit generated. If the sampled pulse amplitude is less than the reference voltage, no pulse is transmitted. At the receiver, the pulse groups are reconverted into the voice signal by subtracting a locally established charge from a capacitor in accordance with the incoming pulses.

Although the system is still in the experimental stage, it has given very acceptable transmission for voice and music. Its chief ad-

(Continued on p 174)

Put This Formula To Work For You

$$I = \frac{E}{IRC}$$

The formula $I = \frac{E}{IRC}$ is a favorite and easily-remembered solution to resistance problems. Radio and electronic Engineers know that IRC offers the most complete line of resistance products in the industry . . . a fixed or variable resistor for most every requirement . . . with uniform dependability proved by years of rigorous laboratory and field tests. Purchasing Agents and material control executives like IRC's service . . . "on-time" deliveries . . . factory stock-piles of the most popular types and ranges from which they can draw in emergency . . . IRC's distributor network, providing speedy, 'round-the-corner service for small order requirements.

Put this formula to work for you . . . check below the catalog bulletins in which you are interested—tear out this page, and mail it to us today with your letterhead, giving your name and title. International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania. In Canada: International Resistance Company, Ltd., Toronto, Licensee.



**INSULATED COMPOSITION
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**FINGER-TIP
CONTROLS AND
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**WIRE WOUND
RESISTORS**
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**MATCHED PAIR
RESISTORS**



**POWER
RESISTORS**



**FLAT POWER
RESISTORS**
IRC type FRW



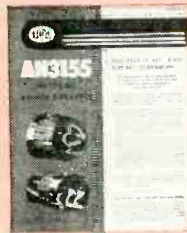
**VOLUME
CONTROLS**
IRC type DS



**WIRE WOUND
POTENTIOMETERS**
IRC type W



**VOLTMETER
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IRC types
MFA & MFB



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Power Resistors • Precisions • Insulated Composition Resistors • Low Wattage Wire Wounds • Rheostats • Controls • Voltmeter Multipliers • Voltage Dividers • HF and High Voltage Resistors

NEW PRODUCTS

Edited by A. A. McKENZIE

New equipment, components, packaged units, allied products; new tubes. Catalogs and manufacturers' publications reviewed.

Television Tube (1)

GENERAL ELECTRIC Co., Syracuse, N. Y. A 10-inch aluminum-backed, type 10FP4 with magnetic focusing and deflection has been developed for television receivers. Maximum



(anode) voltage required is 10,000 volts. Further details are obtainable from the Tube Division.

Geiger Tube (2)

GEOLOGICAL INSTRUMENT Co., 1820 N. Nash St., Arlington, Va. A new all-metal Geiger counter tube with a low background and an operating potential of about 1,000 volts is now



available in a variety of sizes from a half inch to 5 feet long and in diameters of a half inch to 3 inches. Tubes can be supplied separately or with auxiliary systems.

Dual Speaker (3)

ALTEC LANSING Corp., 250 West 57th St., New York 19, N. Y. A new loudspeaker with a frequency range of 50 to 15,000 cycles has separate woofer and tweeter in a coaxial construction. The unit is so



designed that it can be built into existing cabinets or installed in the wall of a room. The high-frequency section uses a multicellular horn.

Vibration Mount (4)

HAMILTON KENT MANUFACTURING Co., Kent, Ohio, announces a new light-duty vibration mount to isolate vibration in radios, test apparatus, and the like. These Rexon



mounts are furnished in strips twelve inches long and may be used entirely or cut into sections, depending on the load to be supported. Additional information will be furnished by the manufacturer on request.

Small-Wire Lug (5)

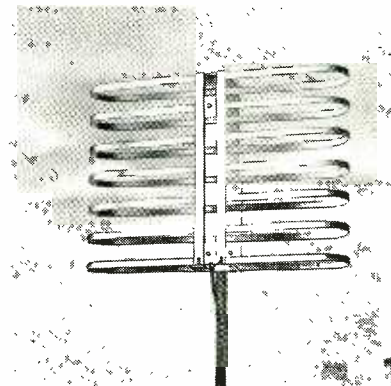
BURNDY ENGINEERING Co., Inc., 107 Bruckner Blvd., New York 54, N. Y.



The lug illustrated is handy for small wires with heavy insulation. Electrical connection is made with pressure and the tabs can be folded about the insulating material.

F-M And Television Antennas (6)

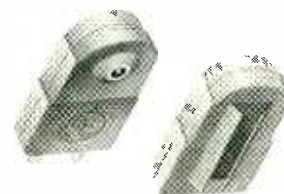
RAULAND CORP., 4245 North Knox Ave., Chicago, Ill., has released the first of a new line of f-m and television antennas to the radio industry. The model 150, with an omni-



directional pickup and high sensitivity, is designed specifically for use on the 88 to 108 mc f-m band. Constructed entirely of aluminum and small in size, it contributes to low wind resistance. Additional models will be released in the near future.

Phonograph Cartridge (7)

PICKERING AND Co., Inc., 29 West 57th St., New York 19, N. Y. A new cartridge for home phonograph use requires a pressure of a half ounce and gives a flat response from 40 to 10,000 cycles. Intermodulation and



Smart Move!



The VISALGEN (shown at left) gives a wide band FM output synchronized with a linear sweep, so that the overall frequency response of the circuit under test is seen on an oscilloscope screen.

Aligns I.F. and R.F. amplifiers in FM and AM Communication and Broadcast receivers, or broad band receivers of any type. Indispensable for FM discriminator and over-coupled circuit alignment.

Visual Alignment

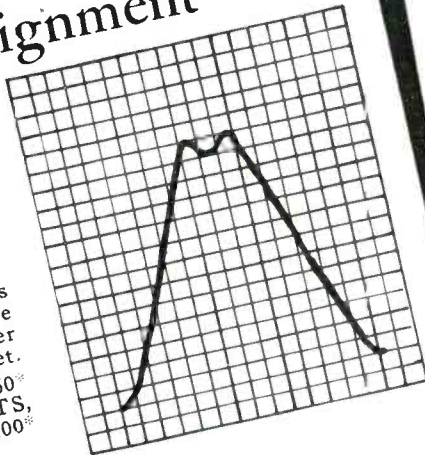
The VISALGEN saves time, because you instantly see the entire frequency response curve.

Available in two models:
205TS (500 Kc. to 20 Mc.) \$197.50*

204TS (20 Kc. to 500 Kc.) \$197.50*

A matching oscilloscope is also available in a separate cabinet or installed with either VISALGEN in a single cabinet.
188TS oscilloscope \$97.50*
204TS or 205TS with 188TS, in same case \$290.00*

*F.O.B. Cambridge, Mass.



It's Faster

You see the entire response curve at a glance



HARVEY RADIO LABORATORIES, INC.

439 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

harmonic distortion are extremely low. Output voltage for a stylus velocity of 10 centimeters a second is 70 millivolts. A permanent sapphire stylus is provided. One feature of the unit is a clip that allows attaching the cartridge to the pickup arm of practically any record player.

Synchronous Timer (8)

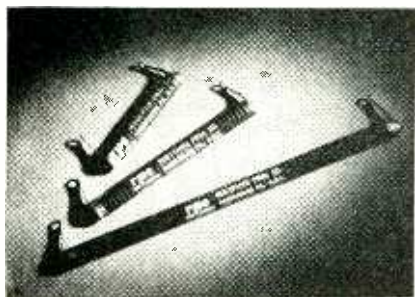
AMERICAN TIME Corporation, Springfield 1, Mass. The Chronolux, a new synchronous timer for dark-rooms, works by automatic control



of the exposure interval. Simply operated and automatically reset, it can be used on 110 volts, 60-cycle, with a 1,000-watt capacity. Retail price is \$16.78.

High-Voltage Resistors (9)

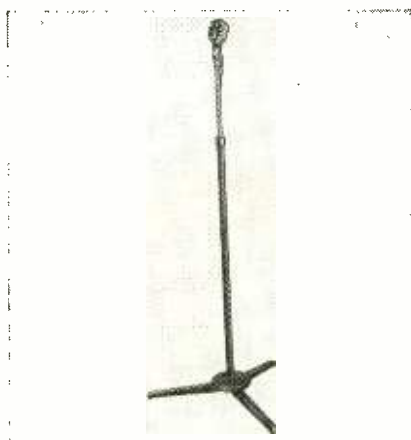
RESISTANCE PRODUCTS Co., 714 Race St., Harrisburg, Pa. Now in production, the type B high-voltage resistors can be made in resistance values as high as a million megohms.



They might be used in high-voltage probes for v-t voltmeters. Applications will be found in television, x-ray circuits, and other electronic fields.

Mike Stand (10)

ELECTRO-VOICE, Inc., Buchanan, Mich. The model 430 button-control



floor stand is easily adjusted to the desired height and the attached microphone can be rotated at will. Height adjustment ranges between 36 and 65 inches. Write for Bulletin 134.

F-M Transmitter-Receiver (11)

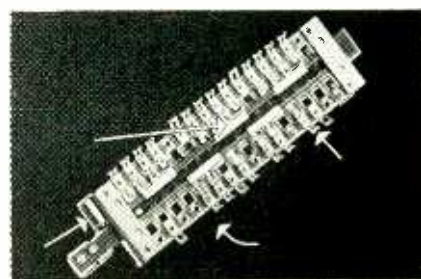
GENERAL ELECTRIC Co., Syracuse, N. Y. New 60-watt f-m transmitter-receiver combination equipment for fixed station use can be remotely operated over a single pair of tele-



phone wires. The type SC-9 uses one or two receivers for police, power, forestry and public utility service.

Slide Switch (12)

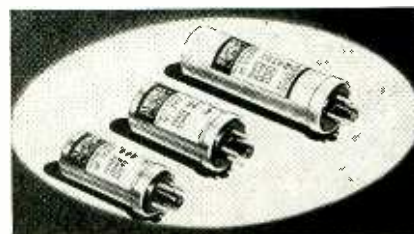
CENTRALAB DIVISION of Globe-Union, Inc., Milwaukee 1, Wis. A new slide switch is designed for improved a-m and f-m performance permitting coils to be mounted directly over the switch thereby reducing lead inductances for low and



high frequency switching efficiency. The unit is available with either two or three-position index. Double wipe clips assure constant pressure and low internal resistance. Complete technical data is contained in Bulletin No. 953.

Plug-In Capacitors (13)

CORNELL-DUBILIER ELECTRIC Corp., South Plainfield, N. J. Type QC capacitors are hermetically sealed in round aluminum containers and are provided with a four-pin octal base



mounting for easy removal. Complete specifications are given in Bulletin 100-425.

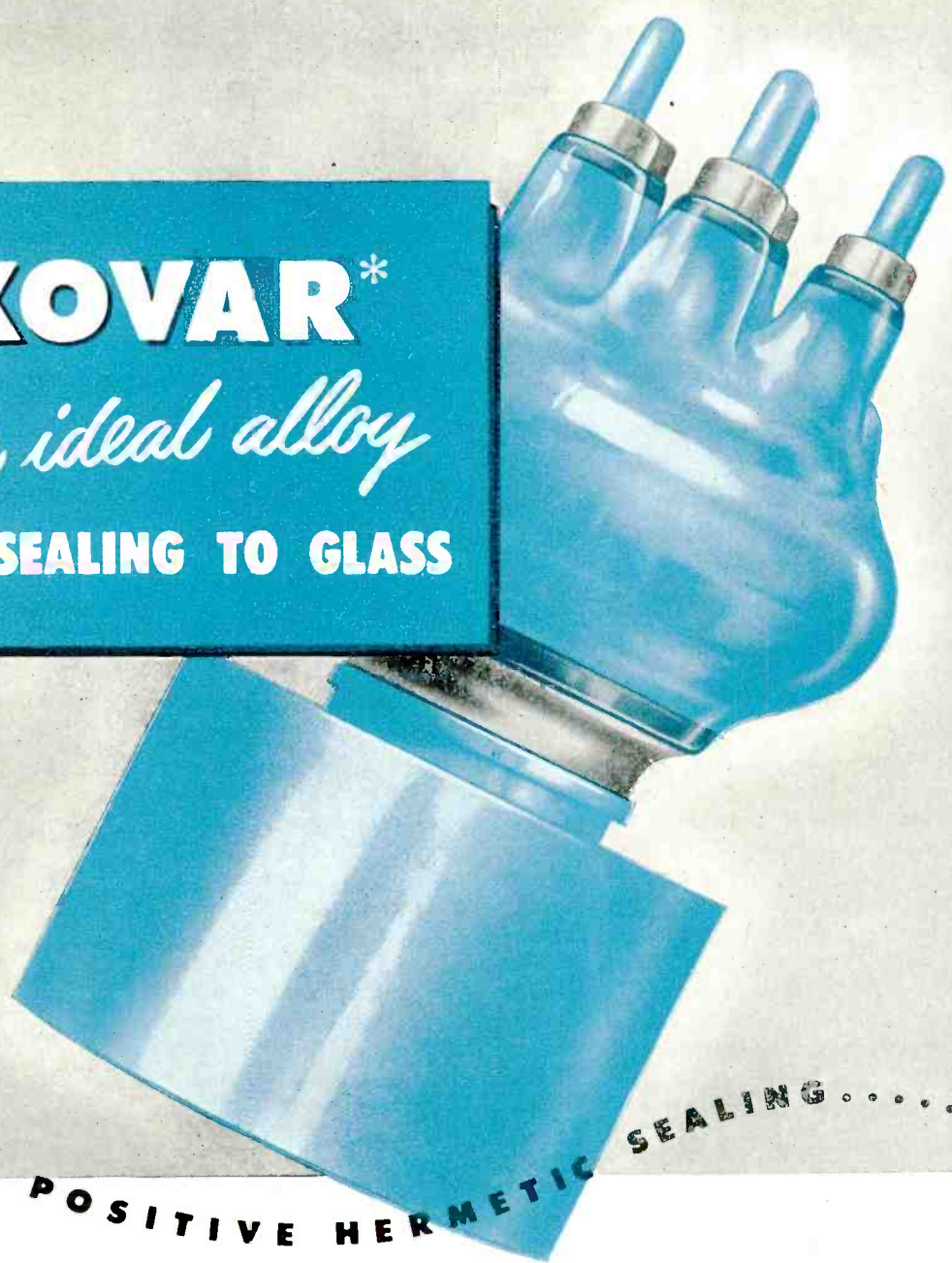
A-C Voltage Regulator (14)

SORENSEN AND Co., 375 Fairfield Ave., Stamford, Conn. The new model 150 voltage regulator has an input range of 95 to 125 volts a-c with an output of 115 volts. Regu-



(continued on p 194)

KOVAR*
the ideal alloy
FOR SEALING TO GLASS



FOR POSITIVE HERMETIC SEALING

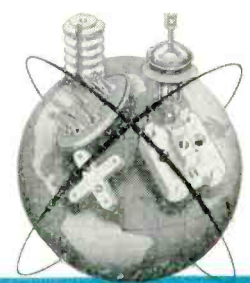
Kovar meets exacting requirements for sealing to glass. Here are a few outstanding features:

1. For use with hard glass, having high thermal shock properties and permits high temperature evacuation.
2. Matches expansivity of the glass over entire temperature range (up to the plastic state of the glass) resulting in strain-free seals.
3. Resists mercury attack.
4. Not subject to size limitations (seals have been made with Kovar 12" in diameter and 1/8" thick).
5. Readily seals with simple oxidation procedure.
6. Mechanical strength—full metal thickness without "feather edge."

Kovar has gained world-wide acceptance and is used by leading American and foreign manufacturers. It is easily machined or cold formed and is available in all desired shapes—sheet, strip, foil, wire, rod, leads, tubing, cups, eyelets and flanges.

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NEWS OF THE INDUSTRY

Edited by JOHN MARKUS

Meetings to come; new tube standards; relay manufacturers organize; experimental radar lab; index to wartime reports; business expansion

Current Status of F-M Stations

MORE THAN 500 different communities in 47 states, the District of Columbia, and Puerto Rico are in the service areas of nearly 1,000 authorized or projected frequency-modulation broadcast stations.

Some 215 f-m stations are now on the air. Construction permits or conditional grants have been issued by the FCC to nearly 800 new stations, and more than 200 applications are pending.

International Recommendations for Marine Electronic Aids

RECOMMENDATIONS and conclusions of IMMRAN—the recent International Meeting on Marine Radio Aids to Navigation where 92 representatives from 31 maritime nations gathered in New York City and New London, Conn. to discuss the application of electronic aids to navigation and pilotage—are embodied in a three-part final report covering marine radar (reported in *ELECTRONICS*, p. 144, July 1947), position-fixing, and comprehensive radio aids. The latter two sections of the report are abstracted here.

Position-Fixing Systems

Development and adoption of equipment and systems for marine navigation should be guided by the accompanying table of desired accuracies and available times for determination of position, in relation to the approximate distances off

shore and/or depths of water under the keel.

A position-fixing system is required for safe entry into the zone at which radar becomes effective, bearing in mind that the extent of such a zone varies with the adequacy of the radar targets available.

Although the system of medium-frequency d-f and associated radio-beacons may not fully satisfy the requirements set out in the table, it can continue to fulfill a useful function in making landfall and in coastal navigation, as well as for search and rescue requirements. The system should be periodically reviewed in comparison with the then existing needs of the marine user in regard to coastal areas.

Existing systems of radiobeacons provided for use in conjunction with shipborne medium-frequency d-f

should be maintained universally at a standard not below that at present provided. In certain areas, notably those where such systems are established, they should be improved and expanded.

Decca, provided it continues to give operational satisfaction and that the application of lane identification proves effective, appears to provide a position-fixing system of an accuracy which meets the mariner's requirements, and therefore should be improved and expanded in regions where the nations concerned consider it desirable.

A long-range navigational aid, while desirable for certain marine services, cannot be regarded as having the same priority as medium-distance navigational aids. The long-range aid requirements of aviation are the most pressing, but in determining the most appropriate long-range aeronautical aid it will be to the mutual advantage of both air and marine interests if due weight is given by the former to the relative advantages of the different long-range aid systems from the marine point of view.

If the effective coverage area of a system be taken as that within which the system gives a usable signal-to-noise ratio, standard loran gives higher accuracy within its effective coverage area than does Consol within its larger effective coverage area. Therefore, as a long-range navigation system, standard loran should be continued and improved.

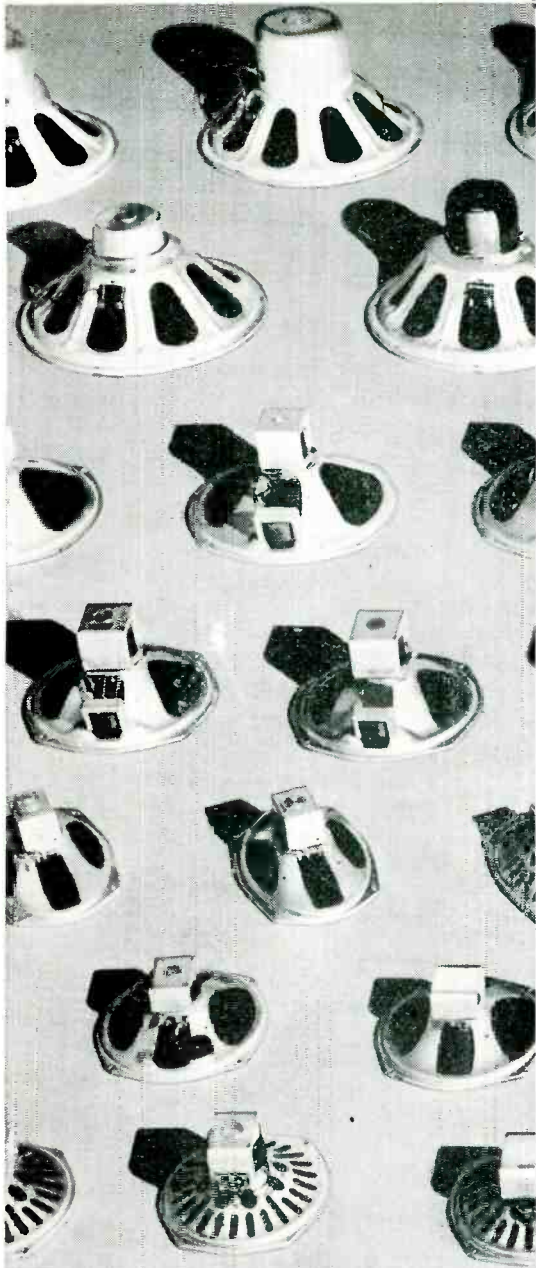
Comprehensive Radio Aids

It is recommended that an international standing committee be set up for the purpose of making information available to the user upon request, and to have such information available for an appropriate future international conference or organization. This committee would include scientific experts to obtain and coordinate numerical data on the performance of various radio navigational aids. The Governments of the United States and the United Kingdom are invited jointly to study the means of implementing these recommendations.

2. It is recommended that each administration undertake or continue studies and analyses, and pre-

Desired Specifications for Electronic Aids to Marine Navigation

Function	Depth of water	Distance from nearest danger	Accuracy required	Time available to obtain position
Aid to ocean navigation	Over 100 fathoms	Over 50 miles	± 1 percent of distance from danger	15 minutes
Aid to approaching coastal navigation and port approach	20-100 fathoms	Between 50 miles and 3 miles	± ½ mile to ± 200 yards	5 minutes to ½ minute
Aid to harbor entrance	Up to 20 fathoms	Less than 3 miles	± 50 yards	Instantaneous position and track required



Magnavox...

Component headquarters since 1915

FOR more than three decades Magnavox has served the radio industry, specializing in the quantity production of quality components for the manufacturing trade.

Manufacturers know that their finished products can be only as good as the parts they use. To insure dependability, economy and customer satisfaction, they insist upon Magnavox components—long established as the highest standard of quality.

Over 100 different speaker models are made to supply every possible production need. Capacitors and other component parts are highly perfected and standardized into container sizes right for every type installation.

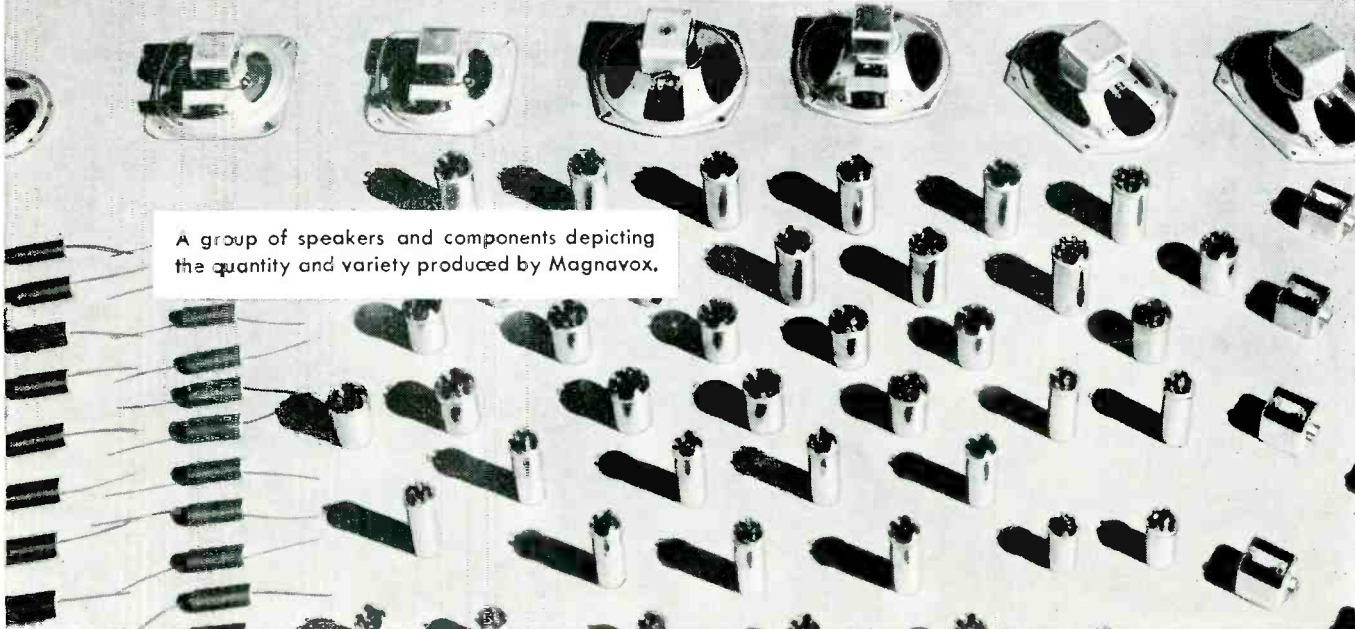
In the modern, six-acre Magnavox plant, experienced engineers and designers stand ready to apply their skills to any of your component problems. When you need loudspeakers, capacitors or other components, ask for Magnavox, and your specifications will be met exactly. There is no substitute for experience! The Magnavox Company, Components Division, Fort Wayne 4, Indiana.



Magnavox

has served the radio industry for over 32 years

SPEAKERS • CAPACITORS • SOLENOIDS • ELECTRONIC EQUIPMENT



A group of speakers and components depicting the quantity and variety produced by Magnavox.

pare proposed minimum standards, for radio aids to navigation equipment other than radar.

3. It is recommended that each Administration ensure the institution of an adequate personnel training program for efficient operation and maintenance of radio aids to navigation equipment.

Tolerance of components and design of equipment should be such that when components are interchanged no realignments become necessary which would require special apparatus or skilled personnel.

Dimensions and electrical characteristics of main components (such as magnetrons, local oscillators, crystals, tubes, and transformers) should be standardized.

In view of the importance of radio aids to safe marine navigation, adequate provision should be made to meet the requirements of mariners at the International Telecommunications Conference.

VHF radio telephony will provide the maritime service with a valuable means of navigational communication for ship to ship and ship to shore, within the range allowed by the choice of frequency.

Requirements of the maritime service for harbor control of shipping, safety, distress, and naviga-



Foremost of U. S. Maritime Commission's training vessel, AMERICAN SAILOR, showing three of the five radar scanners installed for IMMRRAN demonstrations. Those shown are Raytheon at top, Radiomarine at lower left, and Sperry at lower right. Westinghouse scanner was on aftermast, and General Electric scanner was on top of wheelhouse

tional communications on rivers and lakes as well as on the coasts of the various countries suggest that at least one two-way circuit in the 150-160 megacycle region should be adopted as standard. There should also be international standardiza-

tion respecting the type of modulation to be employed and the characteristics thereof.

If it proves desirable to standardize on two frequencies for this purpose, consideration should be given to the possibility of separating them by some difference such as five megacycles.

International agreement should be secured on allocation of frequencies for at least one two-way communication circuit. If possible, further allocations should be agreed internationally for a second such circuit, should the first prove to be insufficient in the vicinity of 160 mc.

Each country should establish appropriate machinery to coordinate air and marine interests, so that delegates to international meetings on either marine or air radio aids may speak with the interests of both in mind.

No monopolistic practices should prevent any country from manufacturing radio aids to navigation that have been agreed internationally as of proven value to the mariner.

Radio Aids to Tennis

TESTS of a radio aid for tennis instruction were authorized by the FCC in granting a construction permit for an experimental class 2 portable station, with power output of 1 watt on 27.44 mc, to Charles G. Lungren who is working at the University of Miami with tennis coach Mercer Beasley.

A student being coached would wear a small receiver attached to the small of his back and diminutive earphones resembling those employed for hearing aids. The initial use of the portable equipment will be for one-way communication with players during games to prevent interruptions of play during instruction.

RMA Elects Officers, Expands Services

EXPANDED services to help radio manufacturers readjust their operations to postwar conditions were authorized by the new RMA Board of Directors at the concluding busi-

(continued on p 234)

MEETINGS

AUG 26-29: AIEE 1947 Pacific General Meeting, Hotel San Diego, San Diego, Calif.

SEPT. 8-12: Second Annual Conference and Exhibit of The Instrument Society of America, at Stevens Hotel, Chicago.

SEPT. 15-18: Annual convention, National Association of Broadcasters, Atlantic City, New Jersey, with exhibits in Convention Hall.

SEPT. 23-25: AIEE Middle Eastern District Meeting, Dayton, Ohio.

Sept. 24-26: West Coast IRE Convention, Palace Hotel, San Francisco, Calif., Prof. Karl Spangenburg, general chairman, Stanford University, Palo Alto, Calif.

SEPT. 26-28: Third annual Electronics Trade Show, Hotel Whitcomb, San Francisco, sponsored by West Coast Electronic Manufacturers' Association, W. Noel Eldred, secretary, care of Hewlett-Packard Co., Palo Alto, Calif.

SEPT. 26-28: Hudson Division ARRL Convention, Convention Hall, Asbury Park, N. J.; technical papers and exhibits of electronic equipment for radio amateurs.

SEPT. 29-Oct. 2: Annual meeting, International Municipal Signal Association, Inc., Pantlind Hotel, Grand Rapids, Michigan; technical papers and exhibits of police and fire radio equipment.

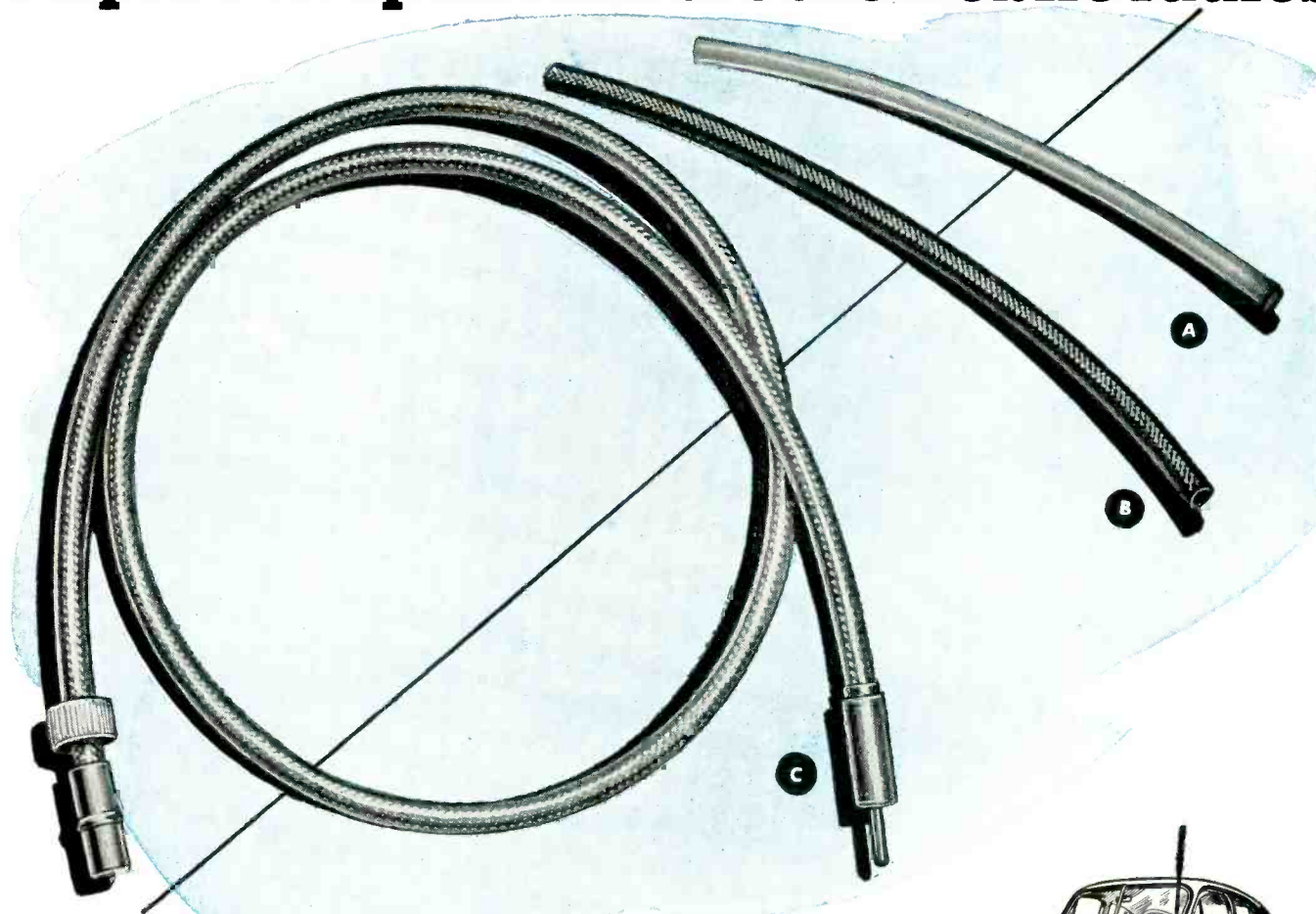
SEPT 30-Oct. 11: National Radio Exhibition, Olympia Hall, London, sponsored by British Radio Industry Council and featuring new British radio, electronic control, radar, and television equipment.

Oct. 23-25: Annual Meeting Optical Society of America, Netherland Plaza, Cincinnati, Ohio; symposium on microwave optics.

Nov. 3-5: National Electronics Conference, Edgewater Beach Hotel, Chicago.

Nov. 3-7: AIEE Midwest General Meeting, Chicago, Ill.

Improved operation of automobile radios



with radio antenna lead-in cable
insulated with

Du Pont POLYTHENE

Now, with the use of Du Pont polythene, it is possible to make a lead-in cable, from the antenna to the instrument, that helps to assure proper operation of automobile radios—a lead-in cable that is water-tight, has excellent electrical properties, is economical to assemble, and gives long service.

Du Pont polythene has been successfully used as the insulating material for the shielded lead-in tubing made by The American Brass Company, Waterbury, Conn., because it has low capacitance and is usable over a wide range of temperatures. In addition, Du Pont polythene has these other outstanding advantages:

RESISTANCE TO MOISTURE—Polythene has low moisture permeability, protects

the cable from short circuits caused by moisture.

LASTING FLEXIBILITY—Polythene withstands twisting and bending over a wide range of temperatures.

HIGH "Q"—Electrical losses within a polythene-insulated cable are negligible.

EASE OF HANDLING—Polythene has good extrusion qualities, is economical to assemble.

Your insulating problem may be solved by using Du Pont polythene. Write us for complete information on this light-weight, durable insulating material. E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept. 148, Arlington, N. J.

A Extruded tube of Du Pont polythene, Type PM-1, 0.125" I. D. x 0.200" O. D. (one of many sizes), used for inner core of shielded lead-in tubing for a radio antenna. Polythene is ideal for this core because it is easily extruded, retains electrical properties.

B Tinned copper basket-weave braid is woven over inner core of polythene to incorporate electrical properties necessary in shielded lead-in tubing.

C The outer jacket, Type PM-2 polythene, about 35 mils thick, adds neat appearance, seals out water.

Du Pont manufactures polythene molding powder.

Commercial extruders convert polythene into the forms of



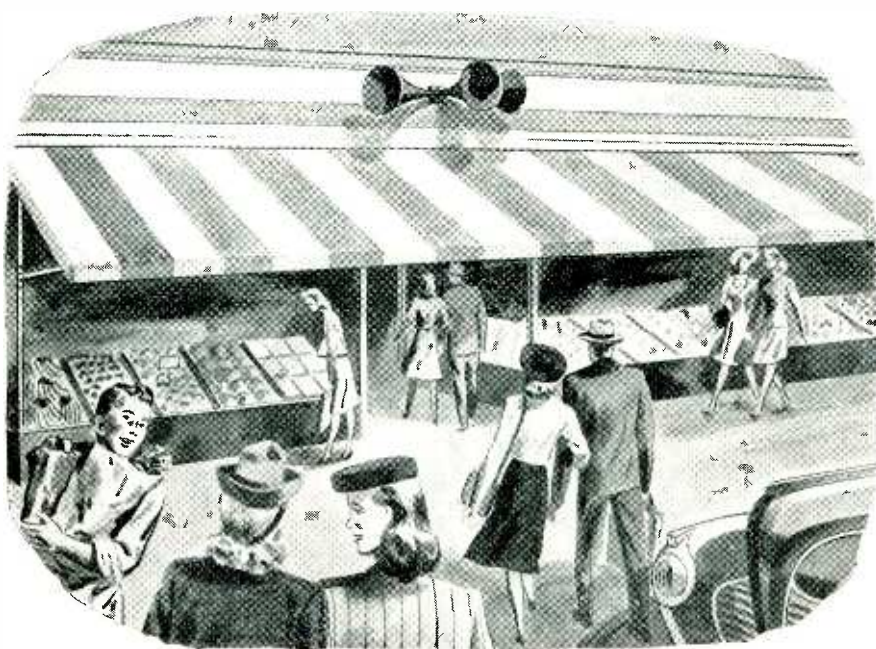


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Will you be the first to invent the "Advice"?



We mean advertising in stores by *continuous* Magnetic Recording . . . "Advice" is just a name . . .

call your instrument anything you wish! The idea is sound. Why not put grocery specials on wire recordings? Or maybe you've got a better idea.

If our thought or your inspiration prompts a design for a wire recorder, remember what Brush wire recording components offer:

Brush Plated Wire

- ✓ Constant plating thickness assures uniform signal
- ✓ Correct balance of magnetic properties assures good frequency response and high level
- ✓ Excellent surface finish assures low noise and minimum wear
- ✓ Corrosion resistant
- ✓ Easy to handle—ductile—can be knotted

Brush Wire Recording Heads

Of principal interest are their excellent electrical characteristics, extreme simplicity of design to avoid "trouble," and the "hum-bucking" characteristics, which reduce the effect of extraneous magnetic fields. When required, the head cartridge alone (pole piece and coil unit) may be supplied for incorporation into manufacturers' own head structure.

These latest developments in magnetic recording equipment can now be obtained for radio combinations and other uses. Brush engineers are ready to assist you in your particular use of magnetic recording components.

The Brush Development Co.
3405 Perkins Avenue • Cleveland 14, Ohio

TUBES AT WORK
(continued from p 134)

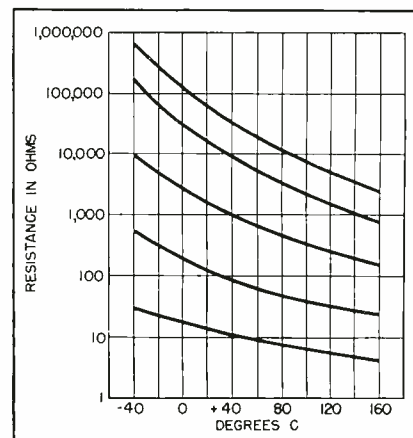


FIG. 1 — Resistance-versus-temperature curves for typical negative temperature coefficient resistors

abled by the resulting subnormal heater voltage.

The growing use of selenium rectifiers has focused attention on these problems, for the rectifier tubes which were displaced had acceptable (though operationally not too satisfactory) means for connecting the pilot light in the form of a tap on the heater.

The falling resistance-temperature characteristics of negative-temperature-coefficient resistors, also known as semiconductors, thermal resistors, or thermistors, make possible an improved solution to the pilot light-heater circuit problem, and resistors of this type have recently been designed into radio receivers for current production.

Figure 1 shows the resistance of typical one-watt Keystone NTC units as a function of temperature. The temperature coefficient of resistance is negative, is much higher than that of ordinary metallic conductors, and depends upon the temperature. The NTC units are produced from rare earth oxides in values ranging from 1.0 ohm to 1 megohm at room temperature. The size and shape of the piece may be varied over a considerable range to achieve suitable electrical and thermal properties.

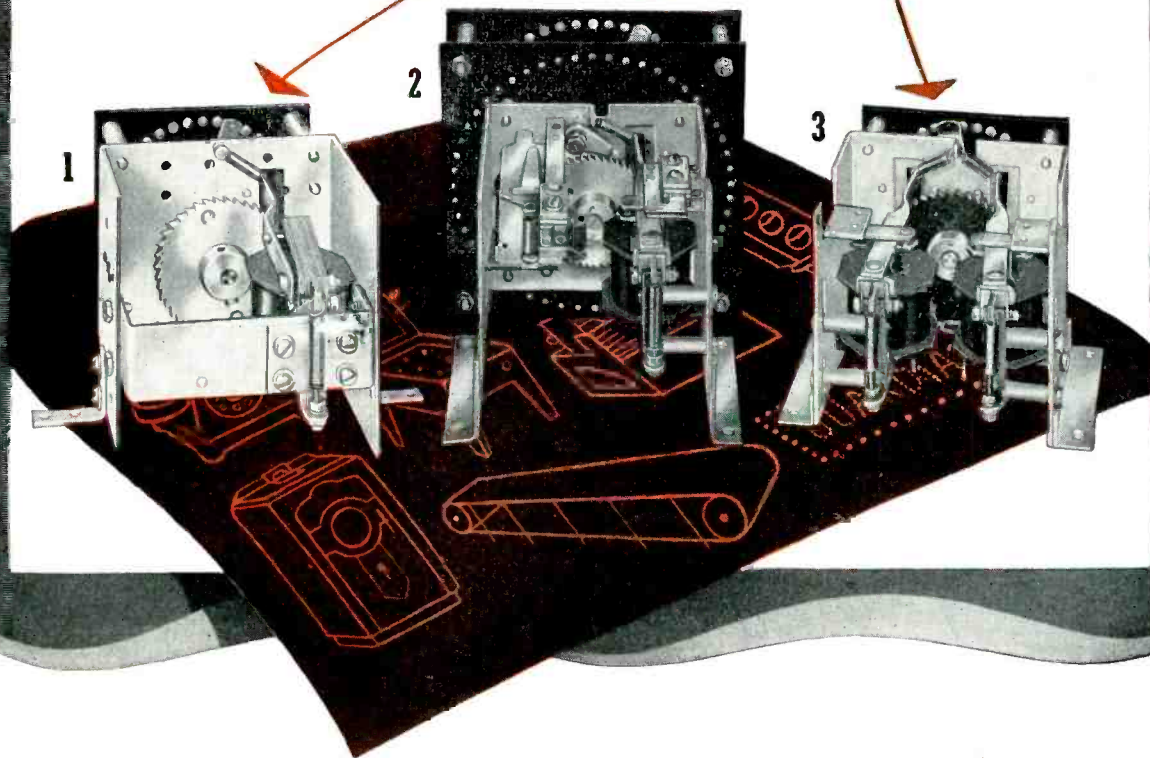
Circuit Operation

If an NTC resistor is connected in series with other circuit resistance, the initial total resistance will be the sum of those due to the unit at ambient temperature and to the remainder of the circuit. If voltage is applied across the circuit,

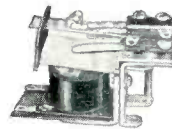


GUARDIAN stepping relays

FOR SELECTION AND CONTROL OF MULTIPLE CIRCUITS



This trio of standard Guardian Stepping Relays: (1) continuous rotation, (2) electrical reset, (3) add and subtract—will start you off with a minimum of design and keep your product operating indefinitely. The Guardian Steppers shown are adaptable to numerous applications; automatic circuit selection; automatic sequence selection of circuits; automatic sequence cross-connection of circuits. They are used in automatic business machines, production totalizers, conveyor controls, animated displays, telephony, remote tuning, with a host of additional uses you will soon discover. On each, the contact finger rotates counter-clockwise. All three Steppers follow 10 pulses per second within the rated voltage range of the relay. Special construction prohibits skipping or improper indexing of the ratchet. Available in separate units or in combination with relays, contact switches, solenoids; completely assembled and wired to terminals; mounted on special bases or in enclosures. "Special" modifications are obtainable in production quantities. Write for Bulletin SR.



Series 100 Snap-Action Relay



Guardian Featherub Switch



Series 500 Midget Relay



Series 1-A Solenoid

GUARDIAN



ELECTRIC

1625-J W. WALNUT STREET

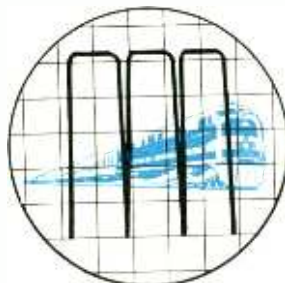
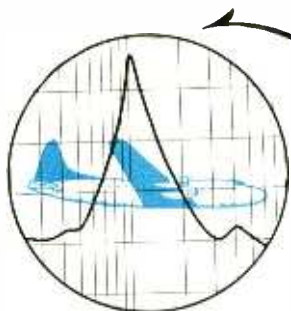
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TOROIDAL COIL FILTERS

for every application

Our toroid filters have become a by-word in every phase of electronics where only the best results are acceptable. Toroidal coils wound on MOLYBDENUM PERMALLOY DUST CORES are the primary basis for our success in producing filters unexcelled in performance.



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Multi channel filters for carrier modulation.

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Tone keying filters — wave shaping filters — discriminators — delay networks.

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Line filters—slope equalizers loading circuits.

We would be pleased to submit quotations for special filters.

Write for our catalogue.

TOROIDAL COILS

Although the demand for our toroidal coils has been increasing rapidly, we are maintaining our usual good delivery schedules.

Most available types are:

	RANGE
TC-1	500cy.—20KC
TC-2	100cy.—5KC
TC-3	10KC—100KC

Coils are available in inductances from 1 MHY to 12 HYS.

Burnell & Co.

DESIGNERS AND MANUFACTURERS
OF ELECTRONIC PRODUCTS

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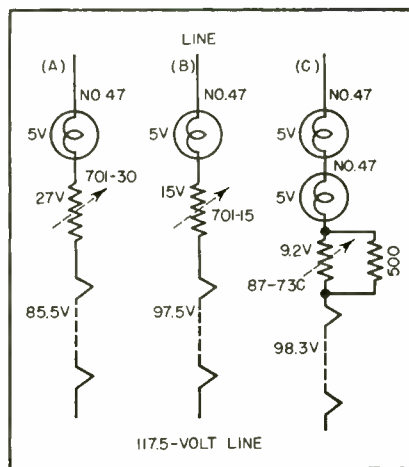


FIG. 2—For 150-ma heater tubes, the negative temperature coefficient resistors act as the only voltage dropping unit

the initial current will be that corresponding to the above initial resistance. However, the I^2R loss in the resistor unit immediately begins to elevate its temperature and there is an accompanying and corresponding fall in resistance and an attendant increase in current. These changes continue progressively until equilibrium is reached, after which the current and the temperature and resistance of the unit remain at the equilibrium value. This value may be defined as that corresponding to the condition for which the attained temperature rise of the unit above its ambient is sufficient to produce heat loss at the same rate as electrical energy is being supplied.

The cold resistance of vacuum-tube heater circuits is exceedingly low compared with the normal continuous operation value, and hence there is a heavy current surge at switch-on. The pilot light, with its relatively small and fragile filament which is continuously evaporating in service, is less well adapted to withstand surges of the order of three to four times rated current, with the result that conventional series arrangements of pilot light and heater lead to burn-outs much earlier than is the case for more nearly constant voltage operation.

Figures 2 and 3 shows a number of practical circuits for 150 and 300-ma heater strings in combination with one or two type 47 pilot lights and suitable resistor units. Many other circuit arrangements are possible with the indicated NTC units or other values; the particu-

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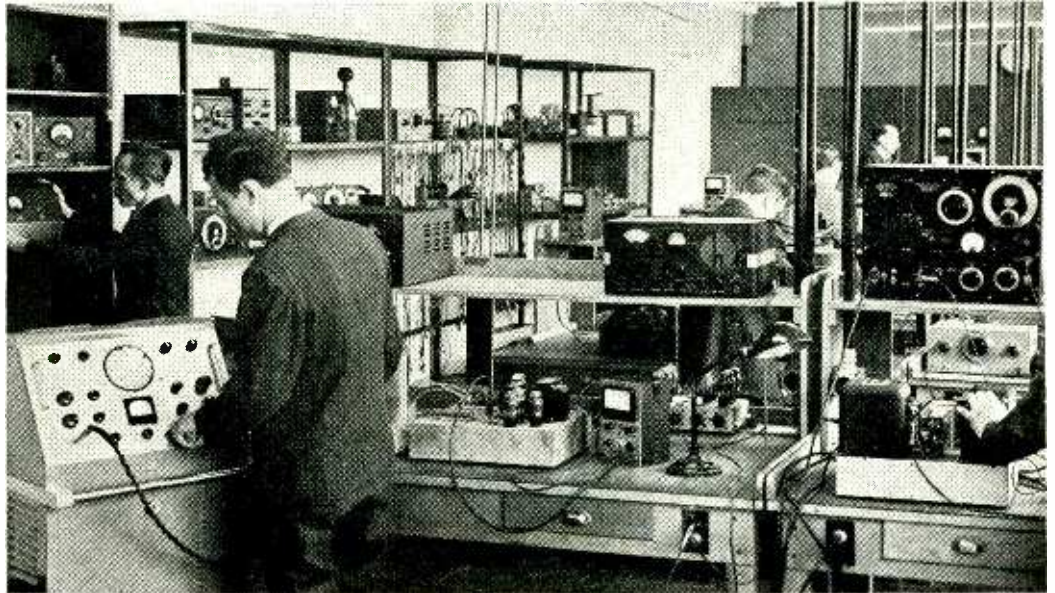
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Are your present manufacturing processes proving too costly? Are outmoded methods exacting a heavy toll in waste time, manpower, materials? You'll find Sherron's all-inclusive electronics service worth looking into.

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gineers and physicists are on hand to initiate your project. Practical, realistic, their job is to explore new ideas, track down new applications to make the tool of electronics do a better job for industry.

Their creative and fact-finding talents, meshed with the skills and resources of Sherron's manufacturing staff, can benefit you in many ways. Why not arrange for a talk with the Sherron management? You will find it worth-while and revealing.

TYPES OF CUSTOM BUILT SHERRON TEST EQUIPMENT

GENERAL TEST EQUIPMENT:

(A) Vacuum Tube Test Equipment—Automatic Production Tube Test Equipment. Electronic Reject circuits provide only positive rejects. Eliminates meters, places quality control in hands of quality control men. (B) Other characteristic test sets for receiving, small transmitting and power tubes, cathode-ray and kinescope tubes. Basic characteristic tests—dynamic and static—and bridge measurements are incorporated. Designed and manufactured to individual needs on custom built basis.

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(A) Television Signal Synthesizer. Includes gen-

erating, viewing and transmitting test equipment. Sync generators, monoscopes, shapers, timers, wide band oscilloscopes, air monitors, measuring devices and field survey equipment.

COMPONENT TEST EQUIPMENT:

(A) Focusing and deflection coils. (B) Resistor and condenser testing. (C) Wire and insulation test equipment. (D) Relays, transformers, chokes and other iron components.

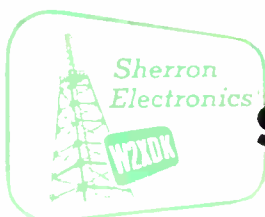
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Cathode-ray Null Detector—1 mc operation. Cathode-ray Null Detector—1000 cycle measurements. (B) D.C. Vacuum Tube Voltmeters and Ammeters: Measurements of minute voltages and currents necessary for laboratory research. (C) Multi-Wave Shape Generator: Source of several wave shapes, including negative and positive pulses and a trigger pulse; used in testing amplifiers at audio and video frequencies. (D) Computers and Calculators: Summing amplifiers—impedance matching networks. (E) Control of Measurements: Flow indicators—sorting, counting, etc.—Measurement of chemical titrations—electronic measurement of surface strains, stresses, films, non-linear surfaces.

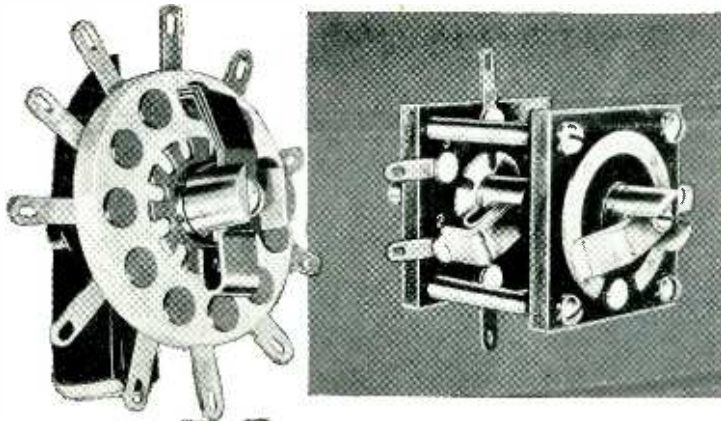
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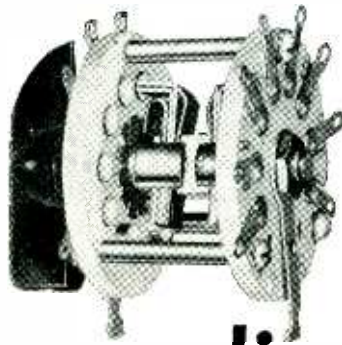
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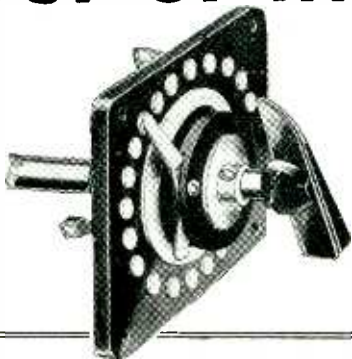


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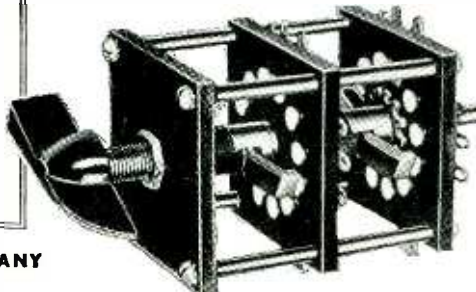
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Shallcross Switches offer a broad assortment of finely made, low contact resistance rotary selector switch types for exacting applications. Numerous standard types in single and multi-section units up to 180 contacts can readily and economically be adapted to specific requirements.

Write for Switch Bulletin C-1 and C-2



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lar types shown here, however, are likely to show advantages in cost and ready availability over special units in limited quantities.

Figures 2A and 2B are simple, basic 150-ma circuits in which the resistor unit supplies cushioning of the initial surge and acts as the sole voltage-dropping resistor. Surge voltages across the pilot light may be limited to peak values of the order of 150 percent or less of rated voltage. Figure 2C uses two pilot lights, and a low-wattage fixed resistor is shunted across the resistor unit to achieve the desired operating characteristics.

Figure 3 shows arrangements for different heater voltage require-

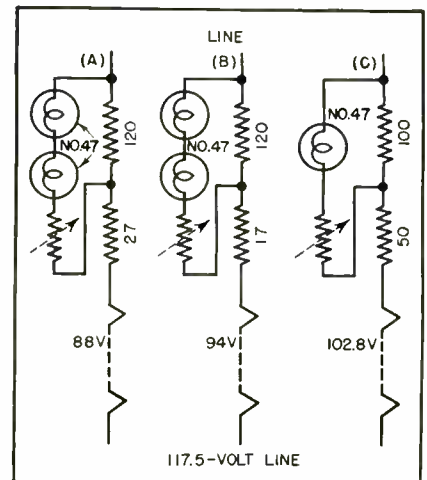


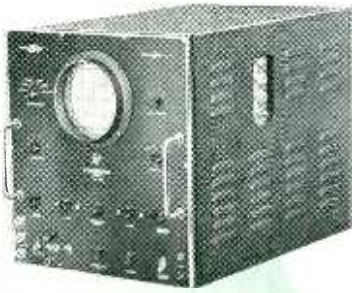
FIG. 3—Circuits for 300-ma heater stringer using type LA-701 NTC resistor units

ments with 300-ma tubes. These circuits employ the same NTC unit for the sake of standardization, the fixed resistance elements being varied to secure the desired result. It does not appear feasible to secure the total voltage drop for most 300-ma applications in the resistor unit alone, since a sufficiently large piece would have an excessively long thermal time constant.

Figure 4 shows simple and inexpensive means for automatically restoring circuit conditions upon failure of the pilot lamp, and the method is applicable regardless of the way in which the operating voltage for the lamp is secured. The resistance of the shunt protective unit is normally high compared with that of the pilot light. When the pilot fails, a substantial proportion of the total circuit voltage appears across the resistor

SYLVANIA LABORATORY EQUIPMENT

SYNCHROSCOPES



The Sylvania Synchroscope Model 5 is essentially a 5" cathode-ray oscilloscope for examining detailed structure of a portion of a periodic waveform. It incorporates a trigger generator which develops periodic pulses for synchronizing purposes. Fields of application include radar, television, pulse-time-modulation, loran, supersonics, geophysical exploration. Also available: Models 5E, P4, P4E.

THERMISTOR BRIDGES

The Sylvania Thermistor Bridge Model TBN-7SE is a radio frequency bridge providing direct reading RF power measurements. Bridge is independent of frequency; designed for continuous operation at normal laboratory ambient temperatures.

Model TBN-6SE is a radio frequency bridge providing direct reading low RF power measurements. It consists of a precision Wheatstone bridge circuit; a stabilized source of 2,000 cycle power supplying the bridge; a source of stable d-c power for substitution measurement of the RF power; and amplifier for indicating balance or degree of unbalance.

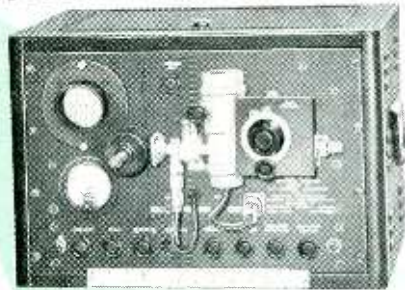
With the Model TBN-6SE, full scale meter indications from 25 microwatts to 2 milliwatts are obtainable with a high degree of accuracy.

VACUUM TUBE BRIDGE TEST EQUIPMENT

Capacitance Bridge Type 125 permits measurement of interelectrode capacitances in vacuum tubes and other multi-electrode systems. Provision is made for balancing out and measuring the direct conductance associated with the capacitance under test.

Vacuum Tube Bridge Test Set Type 129 is designed to measure the dynamic characteristics—mutual conductance, plate resistance and amplification factor—as well as the static characteristics of receiving type vacuum tubes. Several power supplies, with provision for metering them, are arranged to supply a 561-D General Radio Vacuum Tube Bridge. Operator fatigue has been minimized in this set by console-type control and meter arrangement.

SPECTRUM ANALYZERS



The Sylvania Spectrum Analyzer provides a convenient means of studying the energy spectrum of microwave generators operating as pulsed oscillators or modulated CW oscillators. Output of magnetron, klystron, rocket and similar UHF and SHF tubes can be readily investigated. Models available: TSS-4SE for 3,000 Mc region; TSX-4SE for 9,300 Mc region; TSK-2SE for 24,000 Mc region.

WRITE FOR COMPLETE TECHNICAL INFORMATION

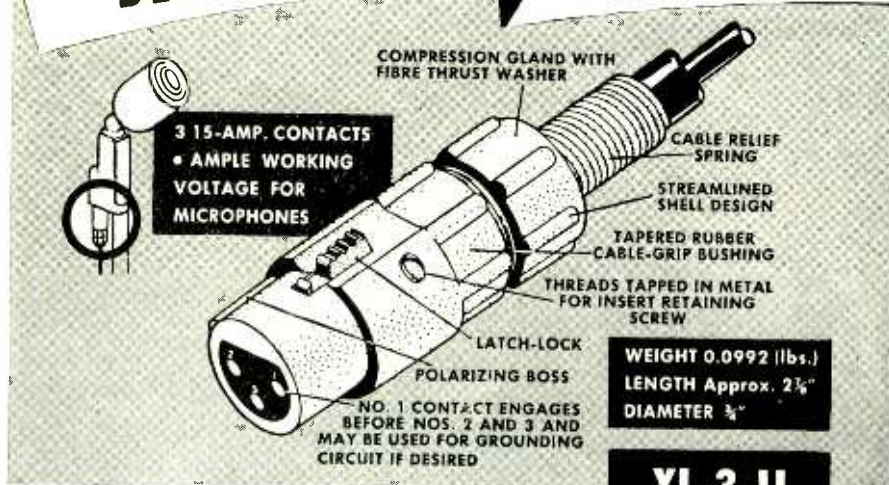
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PLUG**

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All the features noted above on the Type "XL" with one exception (the grounding contact position) are found in other leading Cannon Connectors—the result of years of development and experience. Yet no one other Cannon fitting has all these features in a shell of so small a size. This is an outstanding value in the connector field.

INTEGRAL CLAMP TYPES IN STEEL—Two integral clamp plugs (pin or socket insert assemblies) are available with rugged steel shells and, although slightly smaller in length, mate with the zinc receptacles shown at the left. Like the zinc shell types, they have a minimum flashover voltage rating of 1500 Volts (250 working voltage).

SPECIAL XL DISTRIBUTORSHIPS AVAILABLE

If you are a radio parts jobber and wish to cash in on the growing popularity of this line of connectors, write the factory or contact a Cannon Electric representative located in the following cities: Atlanta, Baltimore, Boston, Charlotte, N. C., Chicago, Cleveland, Dallas, Denver, Indianapolis, Kansas City, Milwaukee, Minneapolis, New Orleans, New York City, Salt Lake City, San Francisco, Seattle, Detroit, Pittsburgh, Ft. Smith, Ark., Buffalo.

Write for Special Type "XL-246" Bulletin, Address Dept. H-120.



XL-3-13 \$1.25 List RECEPTACLE



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unit, followed by an extremely rapid drop in resistance to a value approximating that of the pilot. This change takes place in a matter of a few seconds before the operating temperature of the heaters has had an opportunity to change appreciably. In several applications, less than 3 percent change in total heater string voltage has been observed with the pilot light in and out of the socket. The LA-701 resistor for pilot light shunting is the same as that employed for voltage dropping and compensation in Fig. 3.

For these applications, it is inherent that the NTC units attain high final operating temperatures (around 300 F) to bring about the necessary resistance change in a suitable time interval. Moreover, the high operating temperature brings the unit to a point on the characteristic curve where the temperature coefficient is relatively low, and hence the effect of normal changes in ambient room temperature with season and geographical location on operating voltages is relatively small and unimportant.

Locating in Chassis

The high operating temperature presents no special problems to the receiver designer and it is necessary to observe only a few simple precautions in applying the units to production set design. These are: (1) The resistor unit should be suspended in air and should not be in contact with any part or component; (2) Leave the resistor leads as long as is consistent with space and mechanical support considerations,

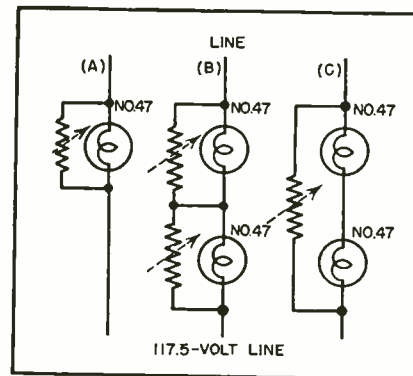


FIG. 4—Pilot lamp shunting circuits for type LA-701 units. About three percent change in total heater voltage occurs when the lamp burns out

CANNON ELECTRIC DEVELOPMENT COMPANY

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SOMETHING NEW IN THYRATRONS



It's Federal's F-5563 . . . the tube with extra "safety valve" action for controlled high-voltage rectification

DATA FOR

F-5563

MERCURY VAPOR THYRATRON

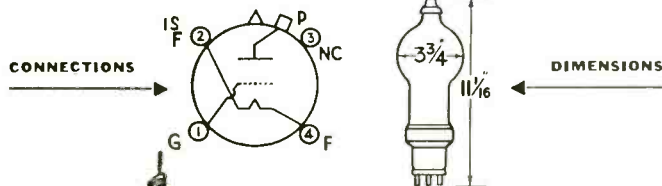
Negative-Control, Triode Type

General Characteristics

Filament Voltage	5 volts
Filament Current	10 amperes
Filament Heating Time (Minimum)	60 seconds
Typical Control Bias at Rated Voltage	-70 volts

Maximum Ratings

Anode Voltage, Peak Forward	15,000 volts
Anode Voltage, Peak Inverse	15,000 volts
Anode Current, Average	1.6 amperes
Anode Current, Peak	6.4 amperes
Temperature Range, Condensed Mercury	25°—50° C.



HERE'S a new mercury-vapor thyatron tube that's designed to take plenty of abuse—to function properly under temporary overloads in excess of those which can be safely handled by other tubes of this type. This is achieved by a unique grid design, which can block sudden overloads, yet still allow normal current flow through the tube.

To the user, this new longer-life tube means lower replacement costs—improved service continuity of electronic equipment through added protection.

Federal's F-5563 thyatron is backed by over 38 years of research and experience in tube design and manufacture. It has proved its ability to measure up to Federal's exacting performance standards—to pass Federal's rigid acceptance tests. And now it is ready to take its place on the industrial "firing line". Write for complete information, today. Dept. L613.

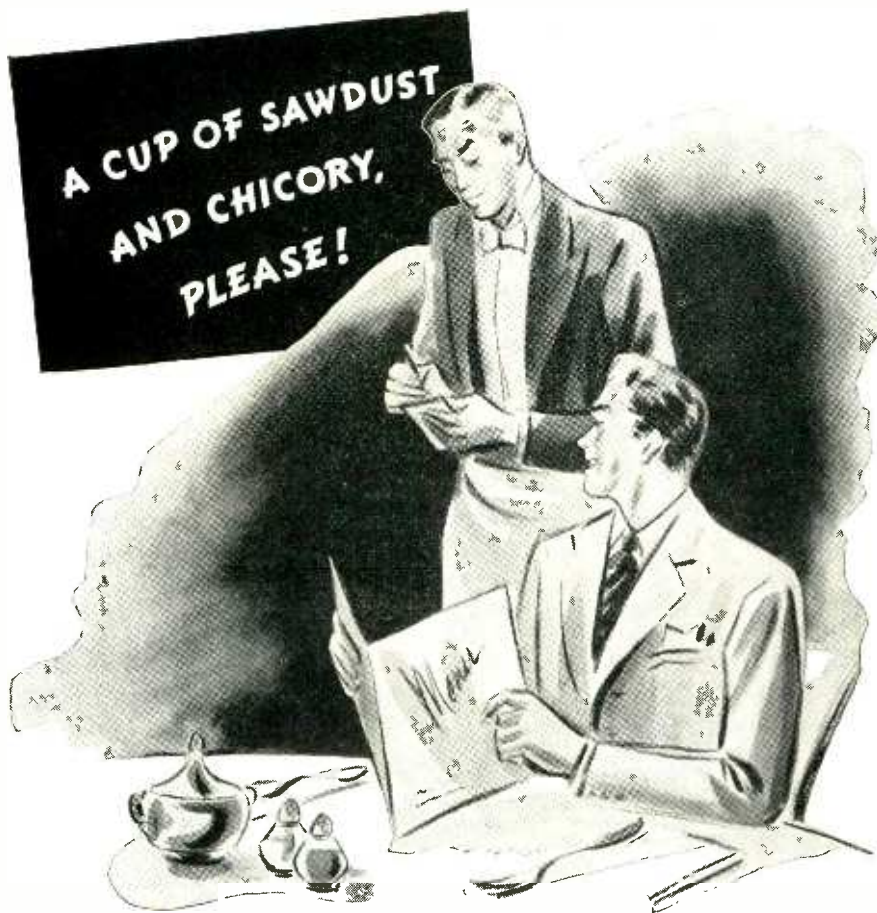


Federal Telephone and Radio Corporation

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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.

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When they couldn't get the real thing, folks turned to ersatz coffee. But they didn't like it, because any substitute is always a makeshift for something else far better and more satisfactory. Substitutes for mica are no exception. Nothing can take the place of mica wherever insulation is important. And no other mica can equal Macallen in years of experience, world-wide resources and unflinching service.

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This illustration is printed from a regular copper plate engraving made by the photographic and chemical process. The original of the illustration was printed on newspaper stock and was made from a 65-screen celluloid plate formed by the Fairchild process. The man pictured is Walter Hoey who hit on the first practical basic principle making mechanical engraving possible

attached to one cylinder. There it is scanned by a photoelectric cell in a housing just above that cylinder. On the other cylinder, a sheet of celluloid or other plastic is fastened, while on the adjacent carriage is mounted the engraving cutterhead. This consists of a heated stylus, ground to a pyramid-shaped point, driven by a magnetic armature so it penetrates the surface of the celluloid, burning small pyramid-shaped depressions in the surface.

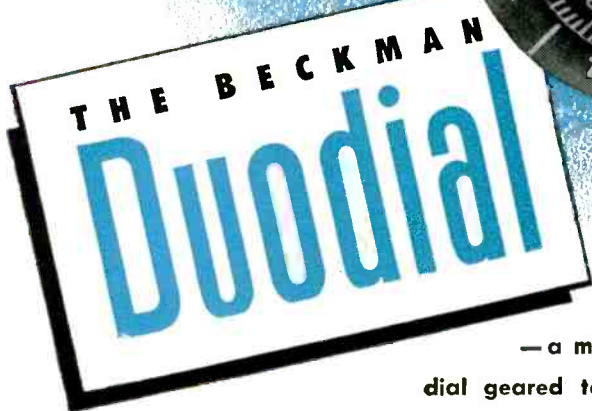
Electronic amplifiers connect the scanning system and the cutterhead so the depth of the depressions formed in the surface of the celluloid corresponds to gradations of shade of the photographic print being scanned. By tying together the frequency of the oscillation, the line advance of the cutterhead carriage, and the rpm of the cylinders, plus providing a means of back-spacing one-half a dot space for each line advanced, the conventional halftone dot pattern is produced.

The completed engraving is trimmed, scrubbed in clear water, mounted on wood or metal, and is ready for use in the form. The useful area is 8 by 10 inches. An engraving of this size with a 65-line screen can be cut in 20 minutes,

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shows exact angular position of slider contact for each revolution . . . i.e., for each turn of the helix.

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- * Provides up to 4000 scale divisions
- * Requires only 2" diameter space

HERE'S A DIAL development entirely new in operating simplicity, convenience and versatility. It's the Beckman DUODIAL — a multi-turn rotational-indicating unit consisting of a primary knob-dial geared to a concentric turns-indicating secondary dial, and the entire unit so compact it requires a panel space only 2" in diameter.

The DUODIAL permits extremely accurate vernier adjustment of driven controls and, when used with helically-wound devices such as the Beckman Helipot, it registers *both* the angular position of the slider contact on any given helix and the position of the slider along the helical winding. The DUODIAL is so designed that — as the primary dial is rotated through each complete revolution — the secondary dial moves one division on its scale.

Thus the secondary dial counts the number of complete revolutions . . . or, when used with helical potentiometers, it indicates the helical turn on which the slider contact rests.

Although developed originally for use with the well-known Helipot Potentiometer, the DUODIAL is readily adaptable to other helically-wound devices of similar nature, as well as to many conventional gear-driven controls where extra dial length is desired without wasting panel space. Its compactness and simplicity — and unique advantage of providing an accurate rotational indication from a minute fraction of a turn through as many as 40 full turns — make the DUODIAL invaluable for many applications where maximum dial accuracy is essential.

Complete information on the DUODIAL can be secured from your nearest Helipot representative . . . or write direct.

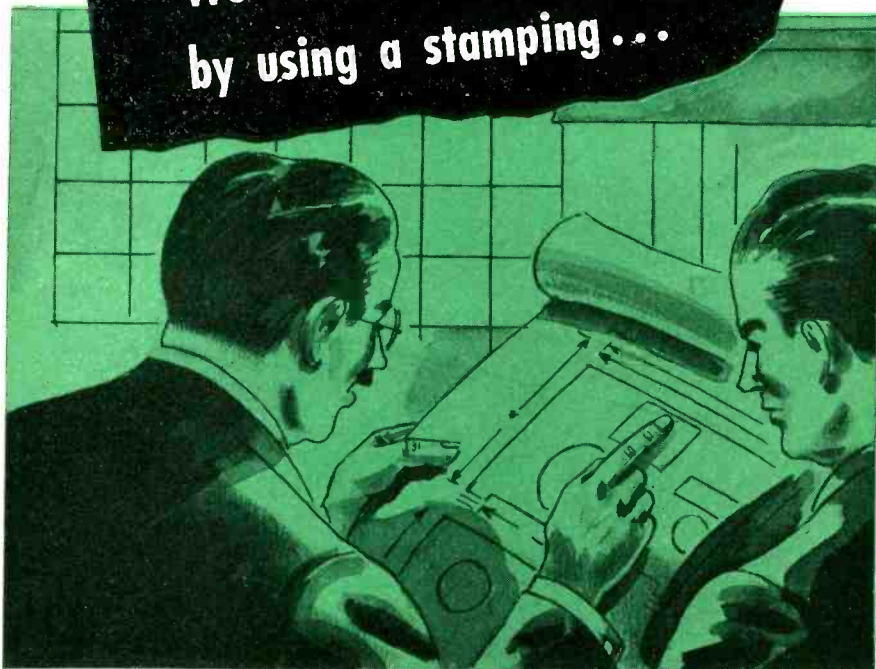
IMPORTANT DUODIAL FEATURES

- ▶ The DUODIAL contains only two moving parts. Mechanical wear and operating torque are reduced to an absolute minimum, assuring long, trouble-free life. All parts, including knob itself, are made entirely of metal for maximum strength and durability.
 - ▶ The primary scale, which indicates angular position, is an integral part of the knob, and, by means of a set-screw, is rigidly affixed to the shaft of the driven device. Thus, in contrast to most turns-indicating mechanisms, the scale readings are not subject to error from backlash of internal gears. For maximum convenience in making decimal notations, this dial is graduated 0 to 100.
 - ▶ The DUODIAL cannot be damaged through jamming of the driven unit, or by forcing beyond any mechanical stops. The dial can readily be used with power-driven devices, because, due to the absence of worm gears, it can be operated from either the shaft or knob end.
 - ▶ The DUODIAL is currently available in turns-ratios of 10:1, 15:1, 25:1 and 40:1 (ratio between primary and secondary dials). Other ratios can be provided on special order. The 10:1 ratio DUODIAL can be readily employed with devices operating fewer than ten revolutions and is recommended for the Model C three-turn Beckman Helipot. All ratio-types are identical in size and appearance except for the numbering of the secondary (turns-indicating) dial.
 - ▶ The DUODIAL is designed for mounting directly on 1/4" diameter round shaft, and in all sizes the primary dial and shaft operate with a 1:1 ratio.
- * Range for 40:1 ratio DUODIAL.

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TUBES AT WORK

(continued)

since the linear travel of the carriage is 0.5 inch per minute.

Fairchild expects to get into quantity production of the engravers early in 1948, after thorough field testing which will be done in newspaper offices ranging from a weekly shop to a large plant.

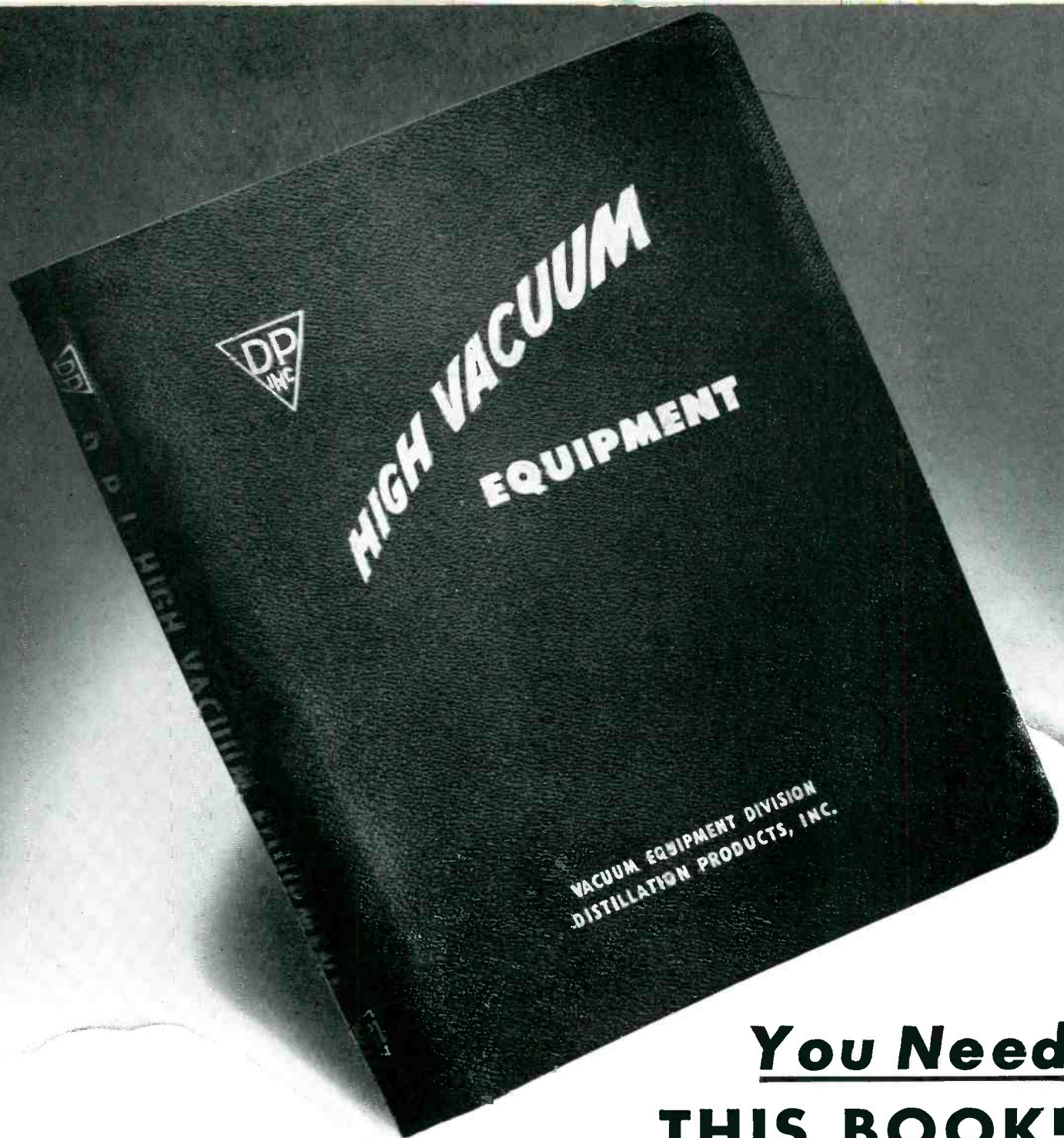
Electronic Oven for Frozen Foods

AN ELECTRONIC OVEN, for use in eating places that serve hot pre-cooked frozen meals, heats these meals in about 75 seconds to an average temperature of 160 F. Engineers in the transmitter division of General Electric Electronics Department have been eating pre-cooked frozen meals in their experiments with the oven. Such meals have included Swiss steak with gravy, potatoes and lima beans; roast sliced lamb with gravy, potato patty and lima beans; sliced turkey with mashed sweet potatoes and peas with butter sauce; beef pot roast with peas and potato patty.

Operating in the microwave region the oven is similar to the electronic canteen which the company has produced for heating hot dogs, hamburgers and cheese sandwiches. The power required to operate the



After being unwrapped, the frozen food packets are put into a partitioned tray, inserted in the oven, and heated for about one minute. During that time, the tray revolves slowly in the microwave r-f field for uniform heating



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Write for your copy of

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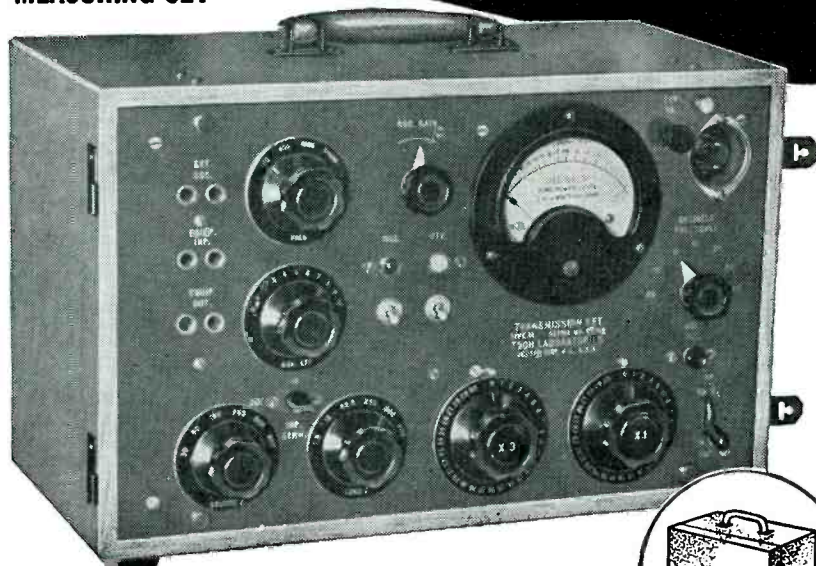


→ Vacuum Equipment Division
DISTILLATION PRODUCTS, INC.
Rochester 13, N. Y.

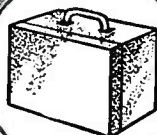
NEW
TECH-LAB
DEVELOPMENT

For **RAPID**
MEASUREMENT
OF
AUDIO FREQUENCY
GAIN or LOSS

TYPE 1A
TRANSMISSION
MEASURING SET



Completely Self-Contained
PORTABLE • AC OPERATED



With this instrument it is possible to quickly and accurately analyze and service equipment in different locations without fuss in time consuming demounting and transportation of apparatus. It will thus pay for itself in a short time and no modern radio station can afford to be without it. It can also be used to good advantage in factory checking and inspection of audio equipment.

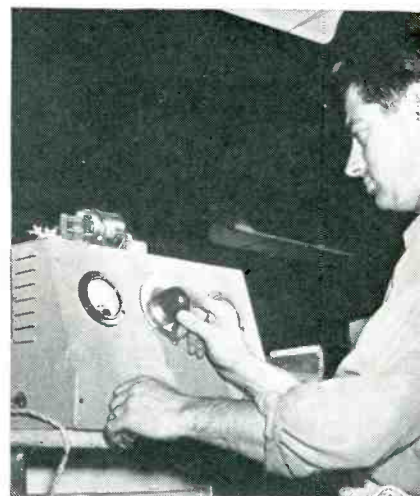
The set combines in a modern efficient manner an accurate vacuum tube voltmeter, an audio oscillator with four fixed frequencies and a precision attenuator all mounted in a handy cabinet easily carried by the operator.

SPECIFICATIONS

- GAIN: Up to 80 db.
- LOSS: 60 db. maximum.
- VACUUM TUBE VOLTMETER:
Range—40 to +40 db.
(1 mv. ref. level)
- AUDIO OSCILLATOR:
Freq. Range; 100 to
10,000.
- PRECISION ATTENUATOR:
Flat to 20 KC; 93 db.
in .1 db. steps.
- DIMENSIONS:
10 1/4" x 16 1/4" x 8 3/4"
- WEIGHT: 30 lbs.
- INPUT: 115 Volts.
60 cycles, 70 watts.

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LABORATORIES, INC.

Manufacturers of Precision Electrical Resistance Instruments
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Type 4-125A Eimac tetrode is subjected to production test for loss-creating metallic-oxide deposit inside envelope. Standard Q meter has provision for attachment of series of fixtures for various tube types

by determination of power-output decrease. Different tube types, therefore, exhibit different readings. Measurements are made at approximately 55 megacycles.

Extending Frequency Range
Of Pen-Type Recorders

by H. S. HEMSTREET
Research Engineering Department
Firestone Tire and Rubber Co.
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Test Engineer
Electronics Laboratory
The Glenn L. Martin Company
Baltimore, Md.

PEN RECORDERS in general use may be classified broadly as a-c and d-c types, depending on the kind of signal applied to the penmotor. Those that respond to d-c signals have the disadvantage of zero drift common to nearly all systems using d-c amplifiers and poor frequency and transient responses. Within these limits, varying d-c voltages and currents may be recorded. The amplitudes of a-c voltages and currents may also be recorded if rectified to produce d-c signals to which the recorder will respond. Additional inaccuracies are introduced, however, in the time delay and averaging characteristics of the rectifier.

These difficulties can be avoided by using the type of recorder which responds directly to a-c signals. Since the actual a-c voltage is recorded, there is no zero-drift prob-

WHERE INTERNAL LOCK WASHERS ARE REQUIRED, SPECIFY

SEMS *by* SHAKEPROOF

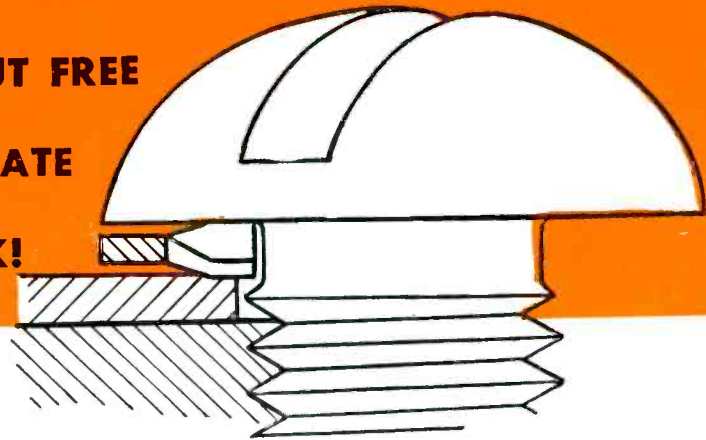


HELD BY ITS TEETH . . .

BUT FREE

TO ROTATE

AND LOCK!

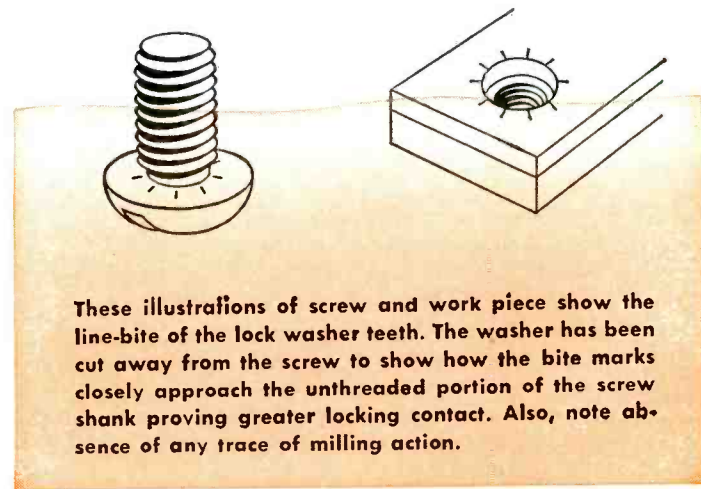


GREATER LINE BITE ASSURES MAXIMUM LOCKING EFFICIENCY!

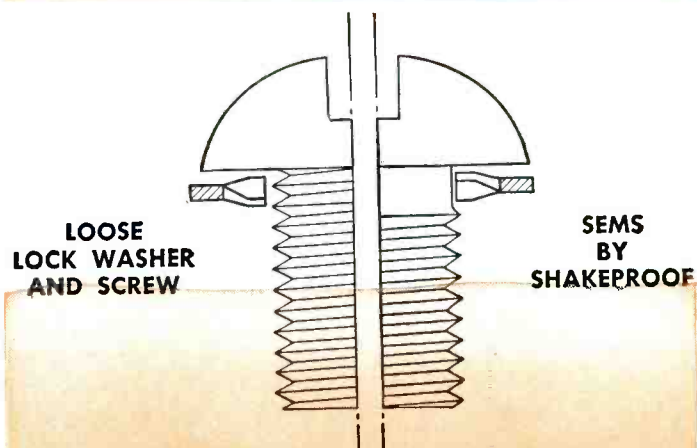
In addition to the important cost savings secured with pre-assembled washers and screws and the well known features of Shakeproof lock washers, sems by Shakeproof provide other special advantages which assure better fastening results. By making the internal diameter of the internal type toothed washer smaller than the diameter of the screw thread the lock washer is held on the screw by its teeth but is free to rotate and lock. When separate washers and screws are used, the washer has to have an internal diameter larger than the diameter of the screw thread. This means that the teeth of the internal type lock washer on a sems by Shakeproof are longer for the same overall washer diameter and thus have greater contact with the clamping surface of the screw head and consequently increased locking power.

Also, because the lock washer is held on the screw so that it is free to rotate, the line-bite of each locking tooth is utilized to its full efficiency. As the screw is driven home the teeth are positioned concentric with the screw. There is no opportunity for canting or buckling and thus full locking action starts at the instant of contact.

Specify this efficient, cost-saving fastener unit — write for complete engineering data on sems by Shakeproof!



These illustrations of screw and work piece show the line-bite of the lock washer teeth. The washer has been cut away from the screw to show how the bite marks closely approach the unthreaded portion of the screw shank proving greater locking contact. Also, note absence of any trace of milling action.



This combination cross section view shows a comparison between sems by Shakeproof and a washer put on a screw after the thread is rolled. Note the smaller internal diameter of the lock washer on the sems with the thread holding the lock washer on the screw by its teeth. Also, observe how maximum tooth engagement with minimum overall washer diameter is assured.

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Fastening Headquarters

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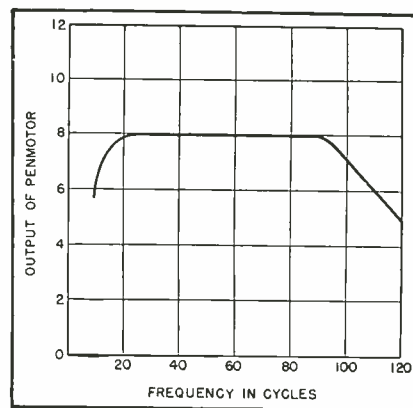


FIG. 1—Response of pen recorder with constant input voltage

lem. In addition to this increased long time accuracy, the frequency and transient responses of a-c amplifiers can be made superior to that of d-c amplifiers. The dynamic friction of the a-c penmotor is less than the static friction encountered with d-c systems.

Penmotors responding to a-c signals have a limited frequency response which nullifies their advantages when used for frequencies higher than about 120 cycles (see Fig. 1). This difficulty can be surmounted by converting the signal to a lower frequency which falls well within the upper limit to which the penmotor can respond. This conversion can be accomplished by beating the signal against a reference signal and this method was used to record 400-cycle voltages which were amplitude modulated at 0 to 30 cycles.

A block diagram of the final converter is shown in Fig. 2. The 400-cycle signal is fed in series with the reference, 460 cycles, to a diode mixer. The beat of 60 cycles together with the undesired fre-

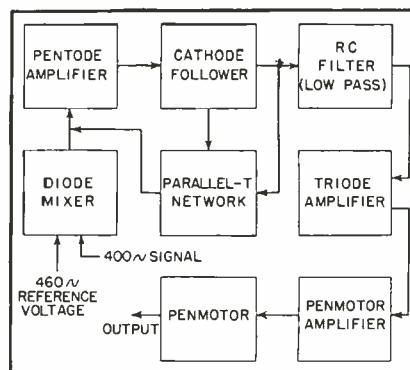
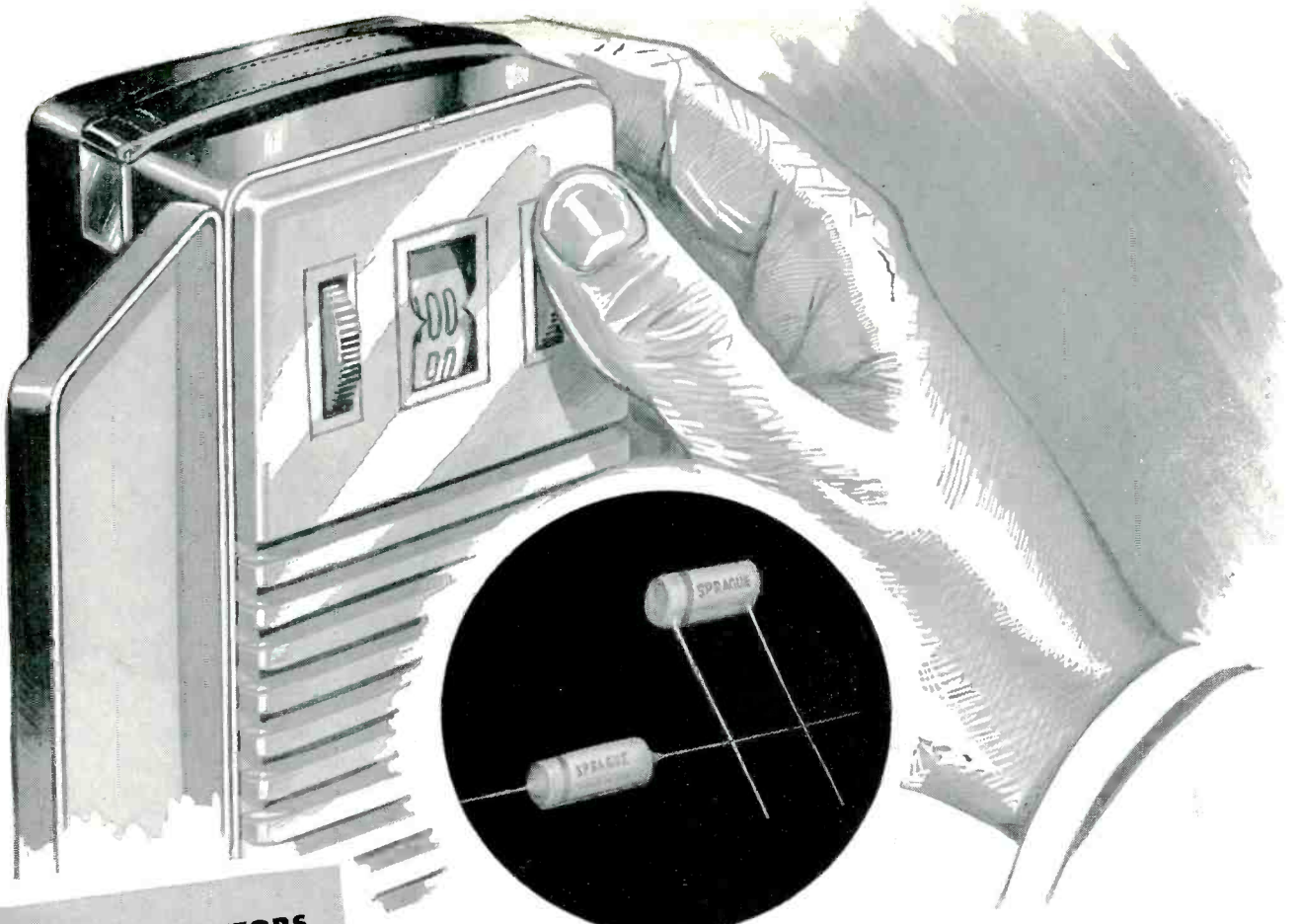


FIG. 2—Block diagram of the converter system for extending the frequency range of a pen recorder



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TUBES AT WORK

(continued)

quencies is fed to a high-gain pentode amplifier and from there to a cathode follower. A parallel-T network, driven by the cathode follower, provides a frequency-sensitive negative feedback path to the input of the pentode amplifier. Since the parallel-T is essentially a band rejection filter, using it in a feedback network causes the associated amplifier to have a gain characteristic which is a maximum at the tuned frequency of the parallel-T.

A parallel-T, tuned to reject 60 cycles without the RC filter was first tried. It was found that if the parallel-T was made sufficiently sharp to reject the 400-cycle components, the desired flat bandpass for $60, \pm 30$ cycles, was lost. If, on the other hand, the flat bandpass was obtained, the attenuation at 400 cycles was not sufficient. Therefore, the parallel-T and low pass RC filter combination was selected. The resonant frequency of the parallel-T was increased so that the attenuation characteristics would be essentially the opposite of the RC filter characteristic in the region where a flat bandpass was desired. This is illustrated in Fig. 3.

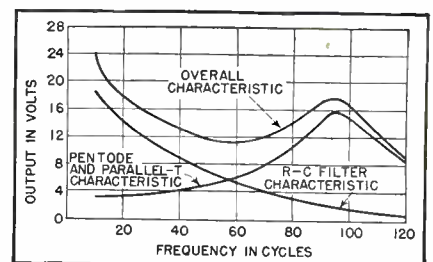


FIG. 3—Overall response of the converter

The parallel-T is such that at 95 cycles a minimum of negative feedback is applied to the pentode. As the frequency departs from 95 cycles, the amount of negative feedback increases. Thus the pentode amplifier, cathode follower, and parallel-T network function to produce a pass characteristic which has maximum gain at 95 cycles and decreasing gain for higher or lower frequencies. The output of the cathode follower is fed to the low-pass RC filter. This filter, operating in conjunction with the preceding stages, gives an overall pass band which is relatively flat from 30 to 90 cycles.

The output of the RC filter is fed

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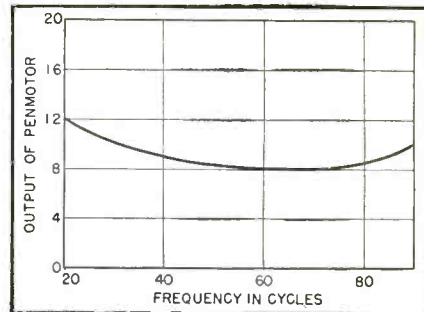
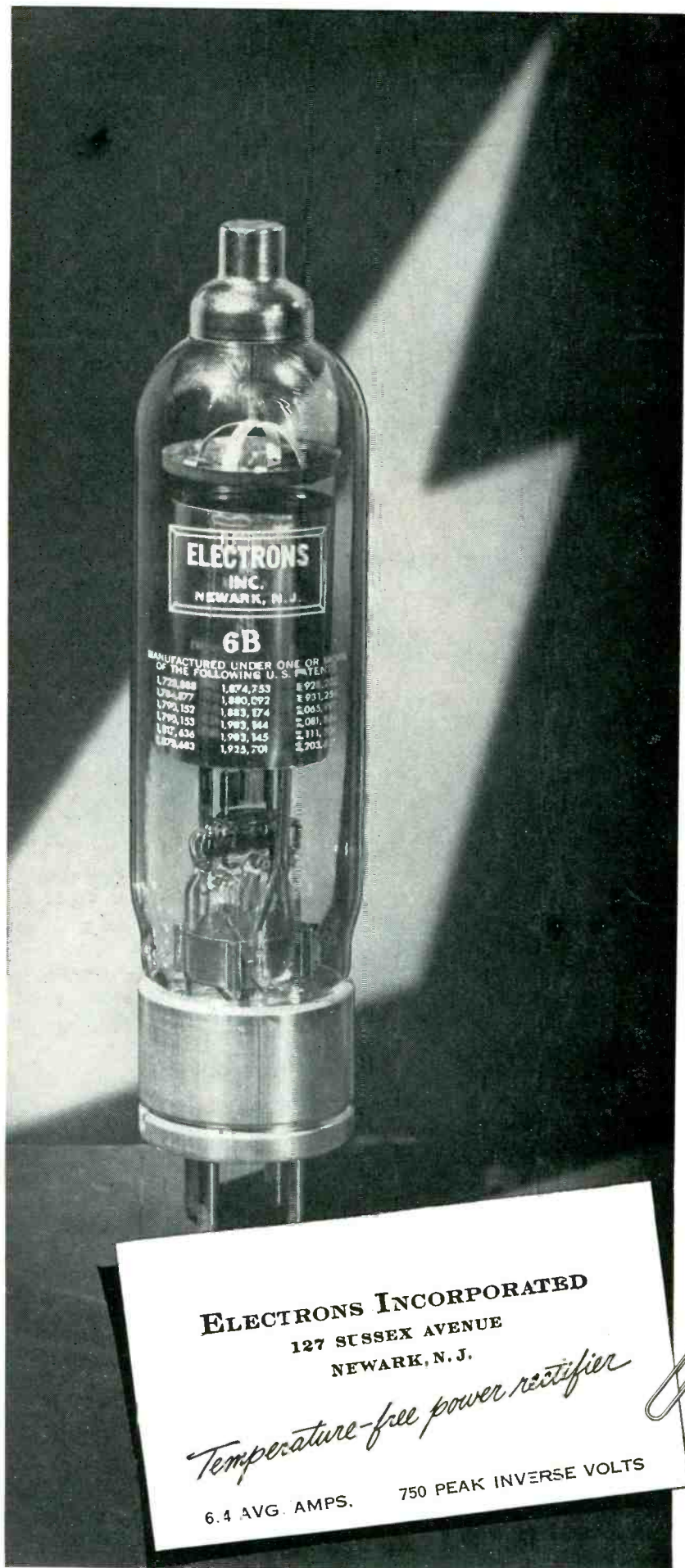


FIG. 4—Response of converter and penmotor with the input voltage held constant

to a triode amplifier to bring the signal to a more convenient level. This signal feeds the penmotor amplifier, which in turn drives the penmotor making the recordings.

The overall characteristic of the converter, penmotor amplifier, and penmotor is shown in Fig. 4. Amplitude modulation up to 20 cycles (about the 60-cycle carrier), and the resultant sidebands, are very faithfully recorded. Sidebands up to 30 cycles removed from the carrier frequency are recorded with sufficient accuracy for all but the most precise laboratory work. Actually the overall response as shown in Fig. 4 could be made still more flat by a second, suitably designed, parallel-T feedback loop. Sidebands up to 30 cycles or more could then be recorded with an extremely small amount of distortion. In the application for which the converter was originally designed the pass band of Fig. 4 provided sufficient fidelity, so the second feedback loop was not used.

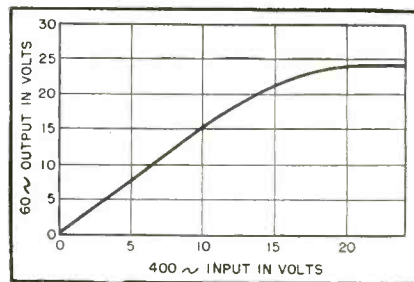
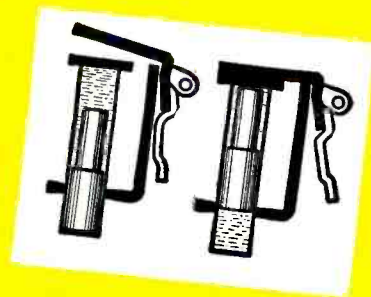
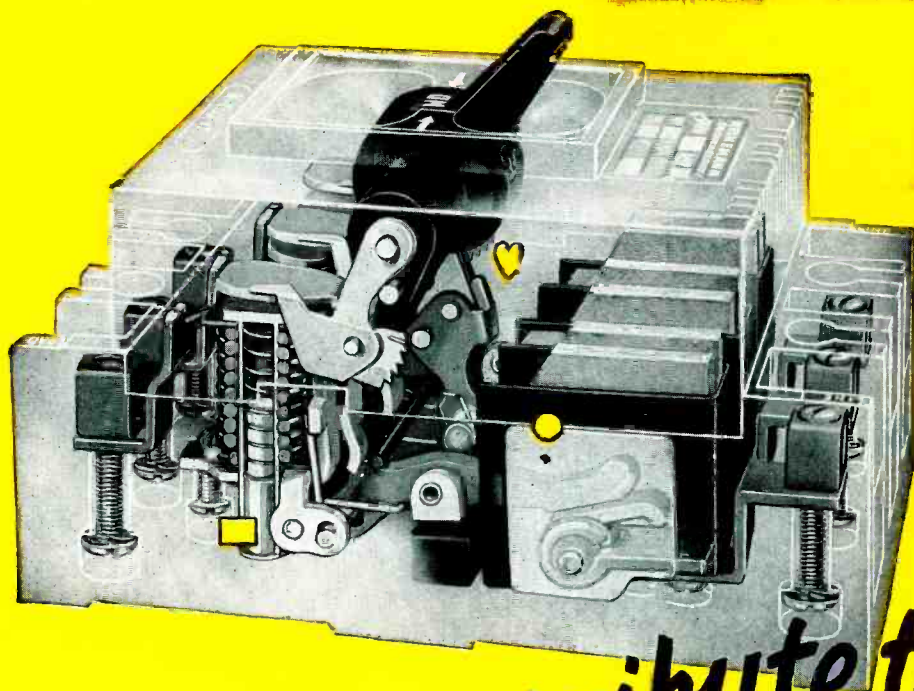


FIG. 5—Linear relation between 400-cycle input and 60-cycle output

The linear relation between the 400-cycle input voltage and the 60-cycle output voltage from the converter is shown in Fig. 5. When applying the 400-cycle voltage as a step function, the 60-cycle response is identical to the record obtained when a 60-cycle step func-



TIME DELAY ON OVERLOADS

The magnet coil surrounds a hermetically sealed liquid filled cylinder containing an iron plunger which while normally out of the magnetic field moves into it on overloads, the liquid controlling its speed. As the plunger rises to the top of the cylinder, the magnetic flux increases to its maximum. At this point the armature is attracted and operates the latch.

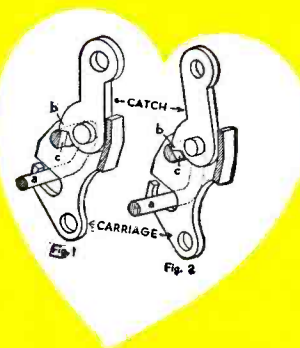
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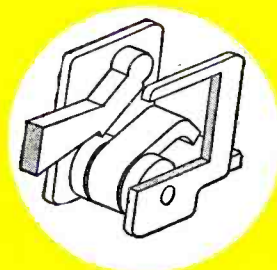
MAGNETIC

CIRCUIT BREAKERS



HIGH SPEED LATCH

The armature, on engaging the lower leg of the lock (a) rotates it so that the tooth of the catch (b) passes through the cut portion of the lock (c) and opens the contacts. Of all known latches this one acts with the least amount of friction and mechanical delay. The latch collapses only on short circuit or overload conditions even if the handle is purposely held in the "on" position.



HIGH SPEED BLOWOUT

The stationary contact is coiled around an insulated iron core connecting steel plates to form a U-shaped magnet. On overloads and short circuits, the current flowing through the contact creates magnetic lines which force the arc into the arcing chamber and blow it out. As the value of the current to be interrupted increases, the quenching effect becomes greater due to intensified magnetic field.

They employ an overload trip unit that is FULLY ELECTRO-MAGNETIC and have definite and instantaneous trip points independent of their time delay characteristics. The current carrying capacity as well as the minimum and instantaneous trip points are not affected by ambient temperatures. A true inverse time delay in the hermetically sealed unit allows the passage of inrush current. However, continued overload opens the breaker in time inverse to the ratio of the current.

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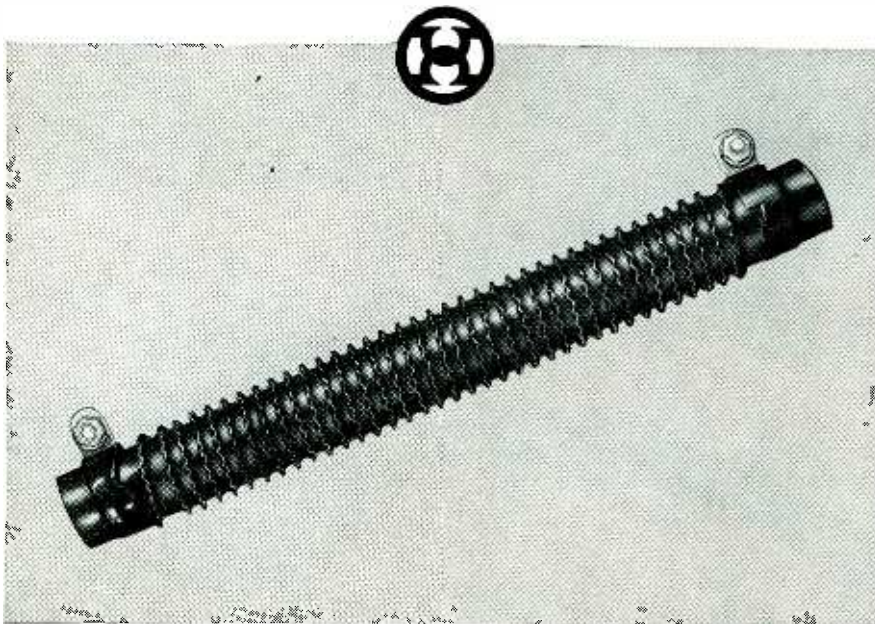
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TUBES AT WORK

(continued)

tion is applied directly to the penmotor amplifier.

This converter may very conveniently be used for any audio frequency by merely changing the reference to maintain a 60-cycle difference from the signal.

Complete freedom from pickup is afforded by electrostatic shielding alone. The commercial pen recorder used was Brush model BL 202; the penmotor amplifier was Brush model BL 905,

Tubes Find Iron in Ore

From McGraw-Hill World News

AN ELECTRONIC detector which scans broken ore on conveyor belts for tramp iron and trips the belt automatically, preventing damage to crushing mills, has been developed by Aberfoyle, Tin, N. L., at its Rossarden, Tasmania, mine. The problem was to devise a detector that would not respond to wolfram and other wildly magnetic ore.

The ore is made to traverse a magnetic flux under an electromagnet which induces poles in the core limbs of a detector magnet under the belt. As long as ore passes, no disturbance of the magnetic flux lines takes place, and no electromagnetic force is induced in the detector magnet coils. But a piece of iron, passing on the belt, upsets the magnetic field and induces a small electromagnetic force in the magnet coils.

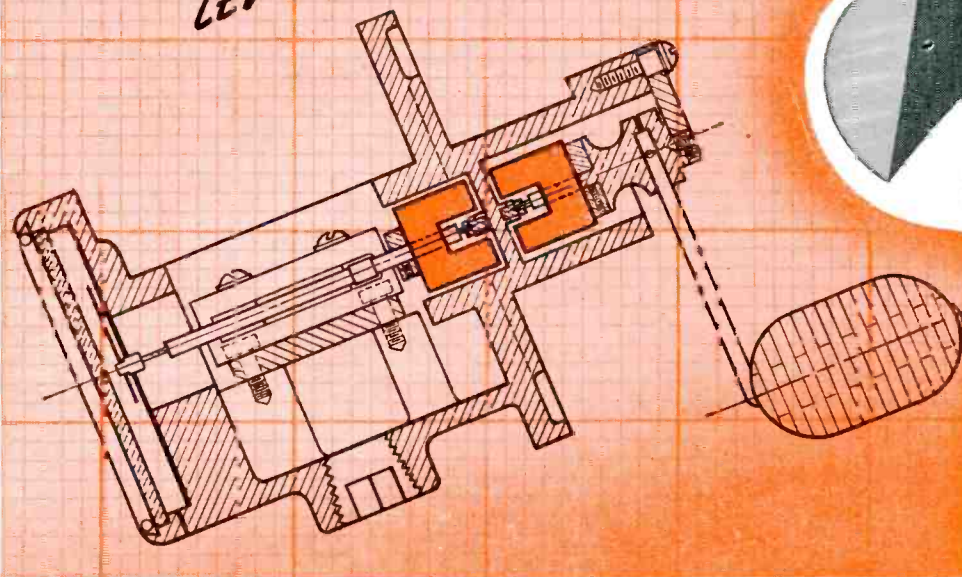
This is impressed across a grid and cathode of a vacuum tube in a three-stage amplifier, successively amplified, and finally fed into the relay circuit controlling the conveyor and ore feeder motors.

The detector operates on a 18-inch conveyor belt carrying ore at a speed of 200 feet per minute. To prevent too frequent tripping of the motors, a small tramp iron magnet first picks out all easily removable tramp iron, leaving the electronic detector to act on deeply buried metal pieces. It is sensitive enough to react on 0.75-inch iron nuts.

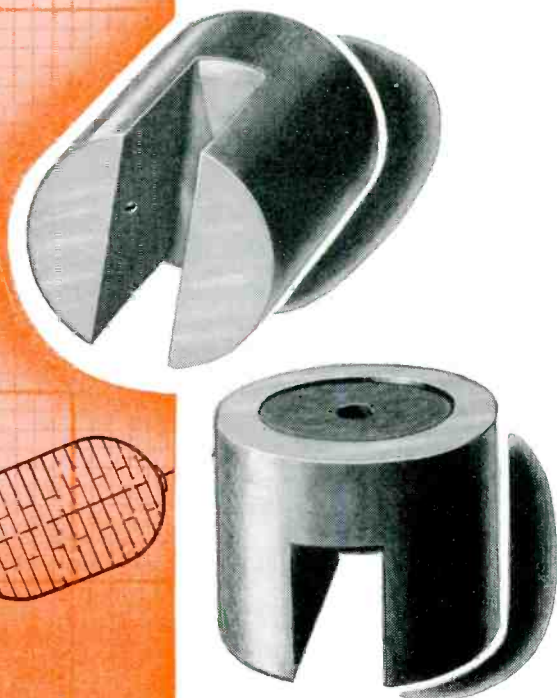
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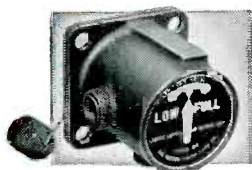
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METALLURGY DIVISION, Section FA-8
 CHEMICAL DEPARTMENT
 GENERAL ELECTRIC COMPANY
 PITTSFIELD, MASS.

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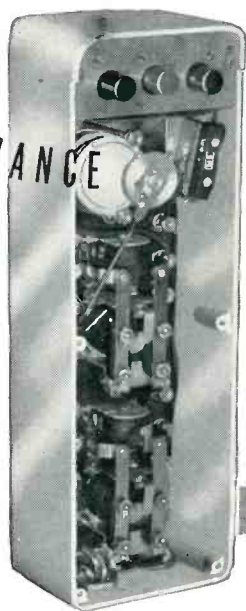
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ELECTRON ART

(continued from p 138)

vantage is its freedom from noise on long circuits requiring many repeaters.

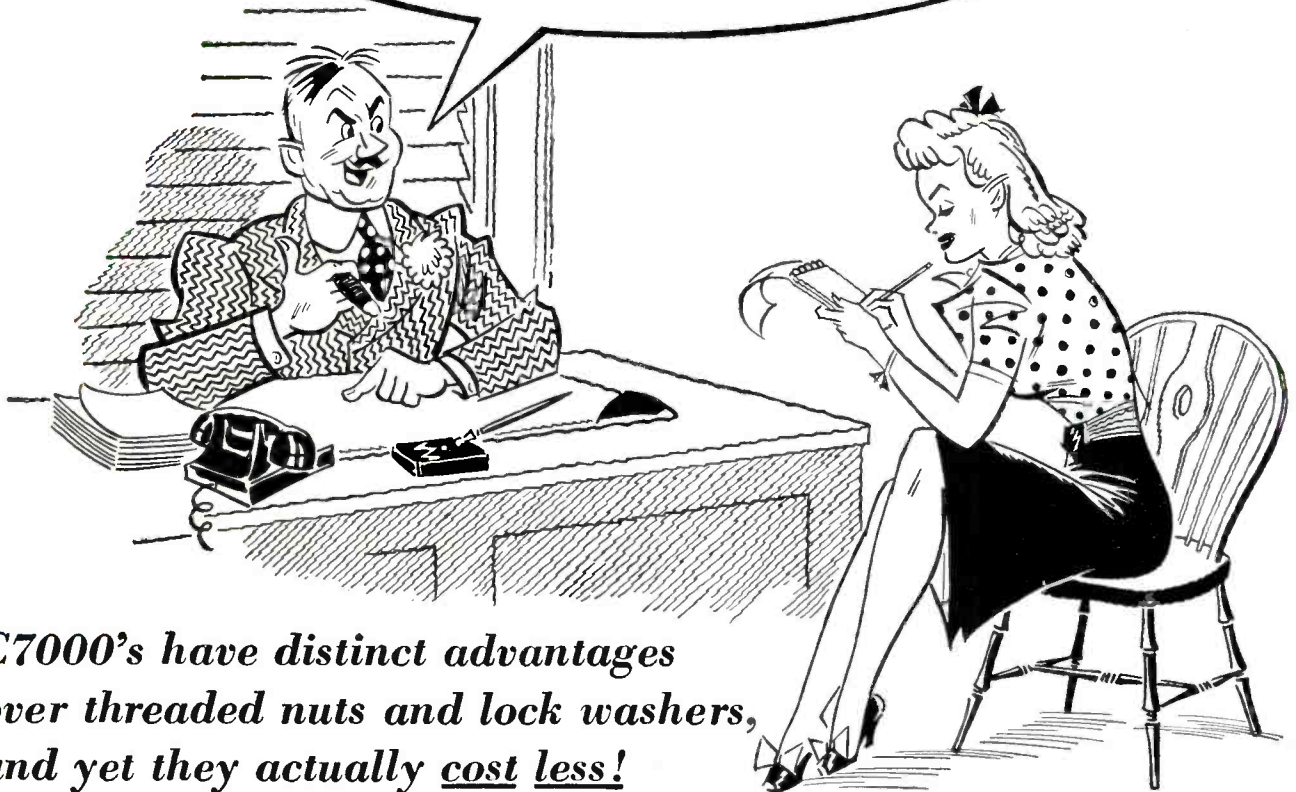
Operating Batteries at Low Temperatures

INVESTIGATIONS into the functioning of small dry batteries at temperatures between + 50 and - 60 C by J. P. Schrodt, D. N. Craig, and G. W. Vinal of the National Bureau of Standards indicate that satisfactory operation can be obtained at low temperatures by using an alternating heating current. If the battery is to be kept constantly in service, it can be heated by a small alternating current. Should the battery be used only intermittently, it can be brought to operating temperature quickly by a larger alternating current. Discharge of the battery through the heating circuit can be prevented either by interposing a capacitor, a counter emf, or by bucking the two halves of the battery against each other in the heating circuit (PB 50853).

Infrasonic Switching

READERS have commented on the article about infrasonic switching that was published in these columns (p 214 March 1946). Briefly the article by Angelo Montani reported experiments from which it was found that if continuous sounds were chopped into time sequences lasting 0.033 seconds and separated by 0.033 seconds of silence, the sounds were still perceived as continuous. Physiologically the phenomena was explained on the basis that the sound must exist for sufficient time to establish the sensation of pitch, but that sufficiently short interruptions cannot be perceived. The 0.033 period is long enough to establish a sensation of pitch for frequencies between about 200 and 10,000 cycles per second, but not long enough for the interruptions to be noticeable, being the period of a 15 cps wave, which lies below the normal audible limit. The phenomena could be applied to communication by switching two channels alternately onto one carrier either for dual channel operation or

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Readers Reply

Several readers expressed doubts about the existence of a persistence of hearing. In the hope of reconciling the conflicting interpretations, an experiment was planned to duplicate Dr. Montani's measurements. However, it was impossible with the laboratory facilities available to arrange a sound source (loudspeaker or earphone) that would abruptly switch on and off (as observed under stroboscopic light). Furthermore it became evident from observing the sound from a monitoring microphone that the experiments would have to be conducted in a completely sound absorbing room to avoid reverberation. It was also evident that, to adequately interpret the results, some study and search of collateral literature would be necessary to determine how much of the apparent persistence of hearing was due to hangover of the eardrum and associated mechanical elements of the ear and how much was due to response-relaxation time of the aural nerves. These considerations are reviewed here to indicate what factors need further experimental investigation.

Readers pointed out other difficulties. The substance of their comments and those of the author, whom we invited to elaborate on his short original note, appear below.

"Some time ago I experimented . . . with both squarewaves and sine-waves from the infrasonic to the ultrasonic . . . until I was blue in the face. The results in the infrasonic range were uniformly intolerable. The ear is not easy to fool . . . perhaps the nine-foot tube that Dr. Montani used in his experiment accounts for his results. My earlier experiments, performed with the same applications in view, proved to my satisfaction that it is not possible to chop up sound at any audible or subaudible frequency without introducing intolerable distortion.

"My experiment consisted of fixing a semicircle of copper to the wheel of a hand-operated grinder, arranging a spring contact to bear on it (forming a crude commutator)

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We maintain that the future of the plastics industry rests on applications such as these, and not on the Sunday-supplement or pipe-dream kind of application that helps neither user nor moulder—the kind developed by wartime shortages or over-enthusiasm.

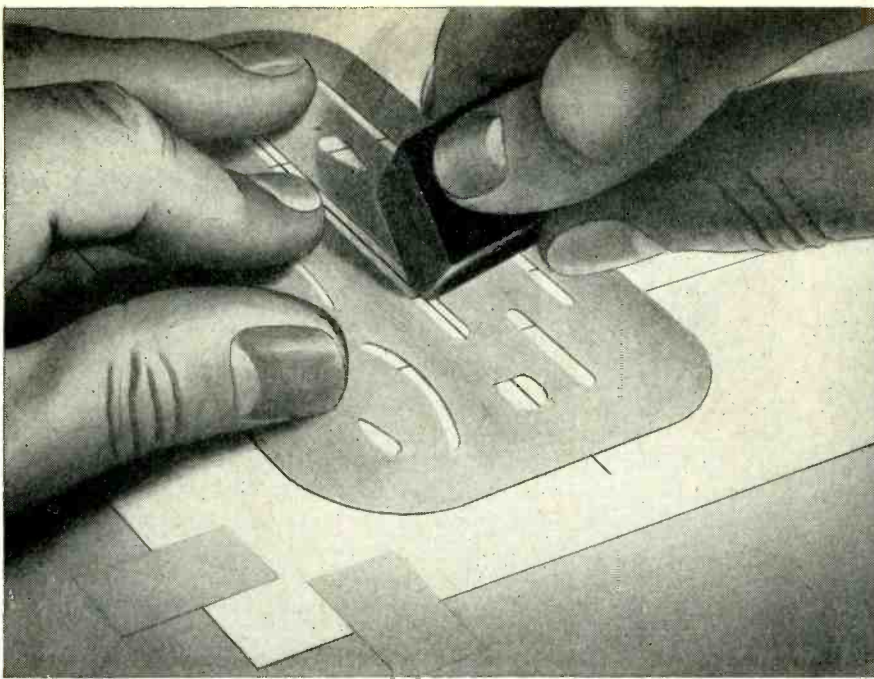
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Friend OR ENEMY?

An eraser is an important part of any draftsman's equipment. But an eraser can do plenty of damage to your drawings if lines feather when you re-ink over an erasure. That's why Arkwright Tracing Cloth is made to stand erasures and still take clear sharp lines in pencil or ink.

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drawing material
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Arkwright

TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 20 YEARS

and connecting the terminals across the voicecoil of a radio loudspeaker. By turning the crank I was able to modulate the radio program at a variable low frequency. What happened to voices shouldn't happen to a dog. I have since confirmed this result using electronic modulation. Switching of speech at any low frequency gave abnormal results, the sounds being completely unintelligible. At higher frequencies (100-1,000 cps) voices could be understood; at higher frequencies the modulation frequency is annoying. I have since confined my efforts in this line to the ultrasonic region where the technique is theoretically possible but where the practical difficulties are considerable." (signed) John R. Cooney, Waldoboro, Maine, March 4, 1946.

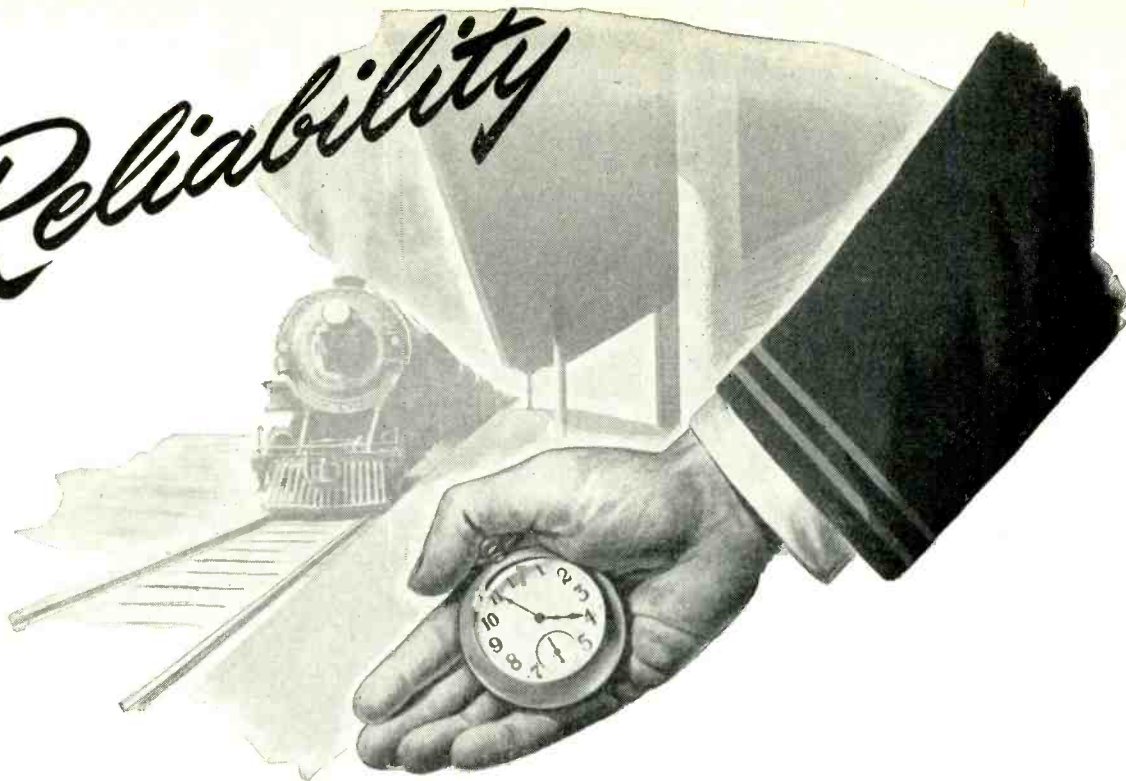
"Before making any statement about a persistence of aural image, a more carefully considered experiment than that reported by the author would be necessary. For example, consider the results obtained. At 1,000 cps the minimum duration necessary for the tone to generate the physiological sensation of pitch was found by him to be 0.012 second. There is then a 1,000 cps wave for 0.012 seconds followed by a pause of 0.012 second, these pulses of tone and silence repeating themselves as a regular sequence. If the sequence is expanded as a Fourier series, the terms will be of the form

$$\sin 2\pi 1,000 \left[\frac{1}{2} + \frac{2}{\pi} \left(\sin 2\pi 42t + \frac{1}{3} \sin 2\pi 126t + \frac{1}{5} \sin 2\pi 210t \dots \right) \right]$$

"This is, in effect, a continuous note of the original frequency (1,000 cps) but at half amplitude plus a series of notes of 958, 1,042, 874, 1,126 . . . cps, in decreasing amplitude. This spectrum of notes consists of a continuous fundamental with additional notes approximately a semitone, a tone, a third, . . . away from the fundamental. It is reasonable to suppose that such a series of tones would give the physiological sensation of pitch, but it has not been proved that there is persistence of aural image. We are dubious of the physiological deductions made in the article.

"However, we are under no doubts as to the validity of the extension of the phenomena to realiz-

Reliability

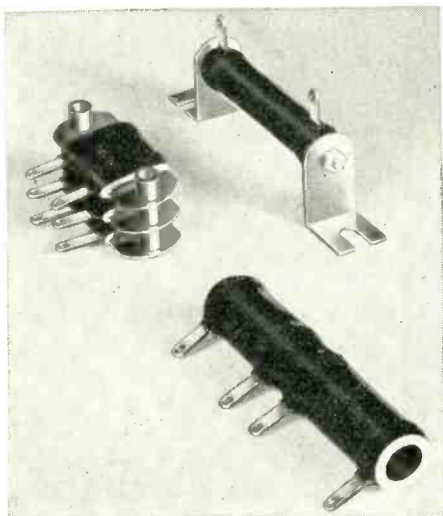


A Feature of I-T-E Power Wire Wound Resistors

I-T-E Resistors are reliable because of their inherent quality—in design, materials and construction. The purest resistance wires obtainable are uniformly wound on a ceramic tube, tied to terminals and silver soldered for a permanent positive connection. Then the resistor is locked and sealed with a coating of baked enamel. This blue black vitreous enamel produces a moisture repellent surface with high heat dissipation.

I-T-E Resistors are made fixed or adjustable, standard or special. These resistors are constructed to very close tolerances to meet critical conditions of atmosphere and usage. They are available in a number of sizes, types and ratings to meet almost any requirements. Different types of terminals are also available to meet various applications.

Complete information on I-T-E Power Wire Wound Resistors, their uses and applications, derating and size selection, together with photographs of each type and tables of values, is contained in the Resistor Catalog. Write today for your copy.



Ratings of resistors range from 2 to 215 watts in fixed and adjustable types and from 30 to 75 watts in oval types.

RESISTOR DIVISION
I-T-E Circuit Breaker Company

1898 Hamilton Street • Philadelphia 30, Pa.

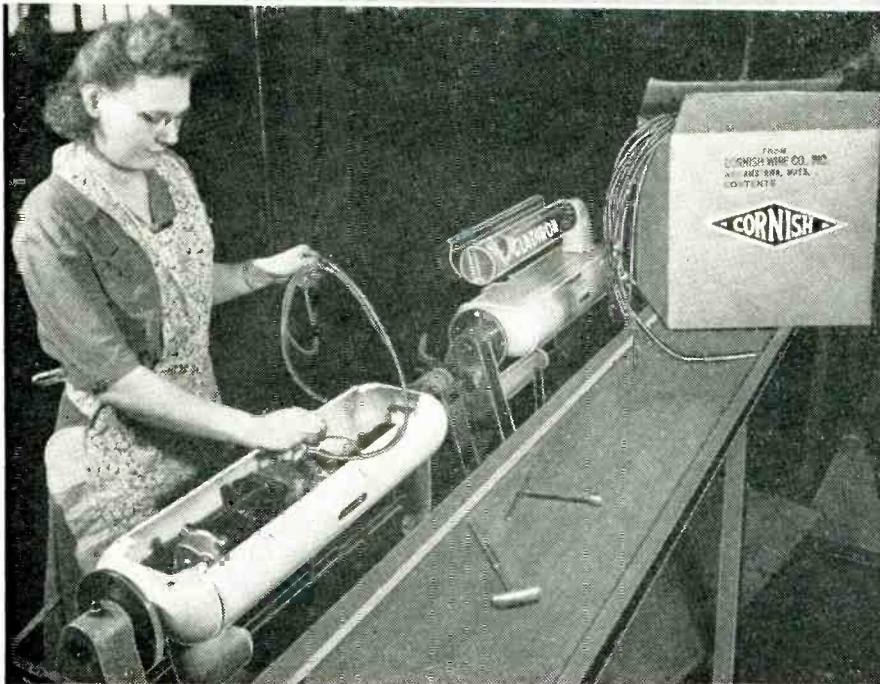


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WIRES

at work



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WHY ARE **CORNISH** WIRE PRODUCTS SPECIFIED BY THIS LARGE MANUFACTURER OF IRONING MACHINES?

- Because their **ENGINEERING** Department knows by test that they will give faithful and enduring performance . . .
- Because their **PRODUCTION** Department finds that they have those qualities essential for quick installation on their assembly line . . .
- Because their **PURCHASING** Department realizes that these Quality Products, backed by dependable service, are sold at prices that spell true economy . . .

CORNISH WIRE CO., INC.

15 Park Row • New York City, 7

ing the communication engineer's dream of obtaining two channels in the spectrum hitherto required for one. In such a dual channel system as described in the article, every speech frequency is reduced to half amplitude and a very wide band of spurious frequencies (the original frequencies plus and minus 15, 45, 75 . . . cps) is added. Although this distortion may not make speech unintelligible, it is sufficient to make it objectionable. Furthermore, for the two-way system to operate it must be free from distortion, phase delay, and time delay between microphone and loudspeaker, which limits it to relatively short distances between terminals." (signed) J. H. Holmes and A. B. Shone, East Stour, Dorset, England, July 3, 1946.

"I should like to know whether someone can furnish a detailed diagram giving values of all components for an intercommunication system of the type described which is known to work?" (signed) I. Gelles, Philadelphia, Pa., July 8, 1946.

Rebuttal

These comments were referred to the author who supplied the following additional material. "The rotating shutter has to be silent and positioned in such a way that no transients occur when opening and closing the mouth of the tube, otherwise parasitic frequencies, which fall in the audible range, will be superimposed on the intelligence.

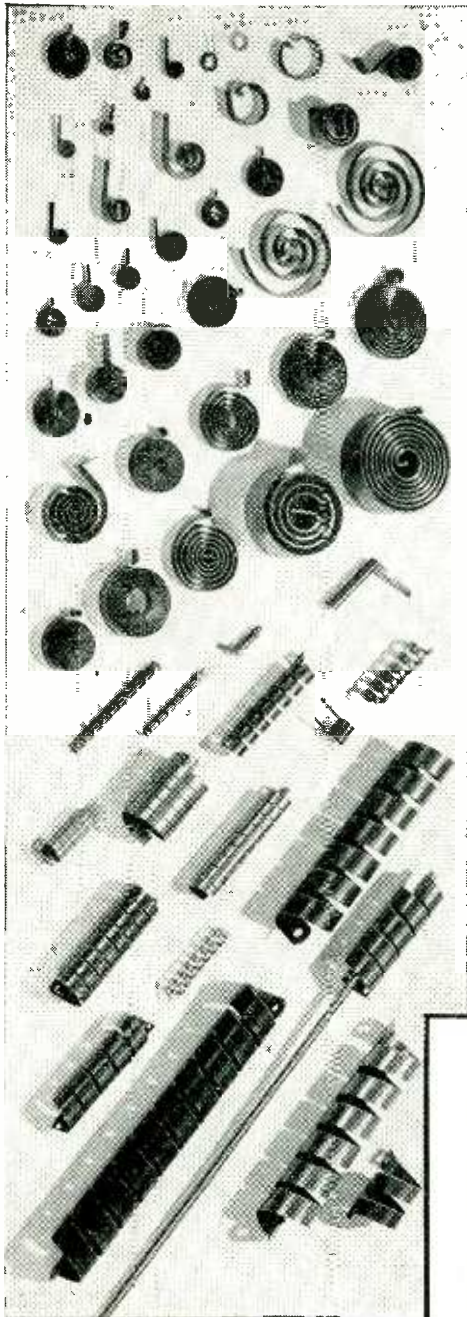
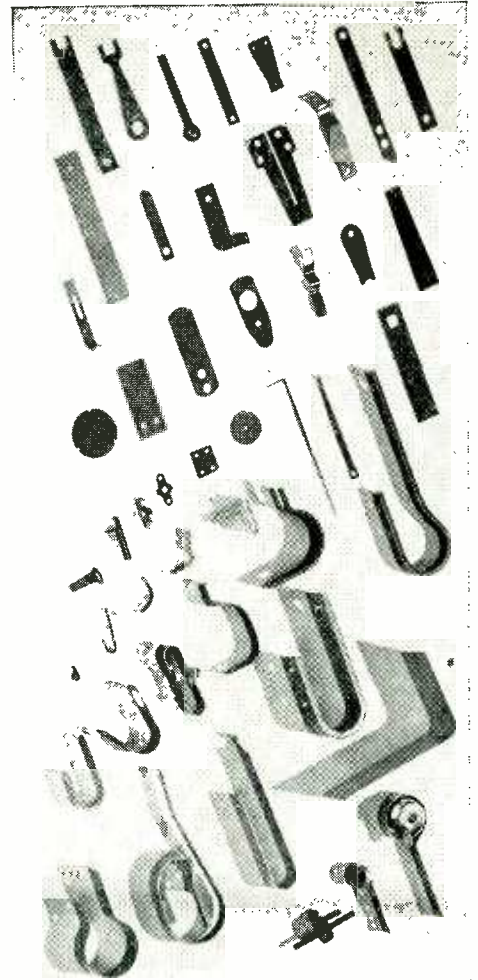
"Although the tube was nine feet long, that length is merely coincidental, but must be such that the acoustical impedance of the tube matches the aerodynamic impedance of the shutter. As the article was for the purpose of describing the phenomena, constructional details were omitted. The switch, whether acoustical or electrical, needs to be designed so as to quickly, but not abruptly, open or close the channel.

"Any frequency transmitted over such a circuit will be framed, but not accompanied, by side frequencies. Furthermore these side frequencies will occur in spurts, appearing only during the instants of switching from one steady state (open) to the other (closed). The transit time during which these

Why there are 29 WILCO THERMOMETALS

(Thermostatic Bimetals)

To help manufacturing customers meet all conditions of bi-metal application . . . all applications where response in temperature is required . . . that is the reason why the Wilco line includes 29 Wilco Thermometals.



VERSATILITY—Wilco Thermometals (Thermostatic Bimetals) are designed for a wide variety of functions including . . . Temperature Indication (thermometer) . . . Temperature Control (room thermostat or hot water heater) . . . Temperature Compensation (voltage regulators and various other instruments) . . . Control of a Function with temperature change over a range of temperatures or by auxiliary heating of the Thermometal.

CHARACTERISTICS—Wilco Thermometals cover temperature ranges of maximum sensitivity from 50° to 800° F . . . temperature deflection rates from minus 100° to plus 800° . . . and electrical sensitivities as required.

PERFORMANCE—Whether the problem is corrosion resistance . . . a device requiring *extremely high* sensitivity . . . a single circuit breaker design for various current capacities . . . or more than usual strength, stiffness and work capacity . . . Wilco Thermometals meet each requirement with the *precision performance* of products reflecting the highest standards of design and workmanship.

AVAILABILITY—Wilco Thermometals are supplied in the form of strip, straight cantilever blades, U-shapes, spirals and helices . . . or as parts of assemblies with shafts, studs, brackets, contacts, braids or springs.

Whatever your requirements for Wilco Thermometals, Wilco engineers will gladly help you meet them successfully.

WILCO PRODUCTS INCLUDE:

THERMOSTATIC BIMETAL—All temperature ranges, deflection rates and electrical resistivities.

CONTACTS—Silver-Platinum-Tungsten-Alloys-Sintered Powder Metal

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JACKETED WIRE—Silver on Steel, Copper, Invar or other combinations requested

ROLLED GOLD PLATE AND WIRE

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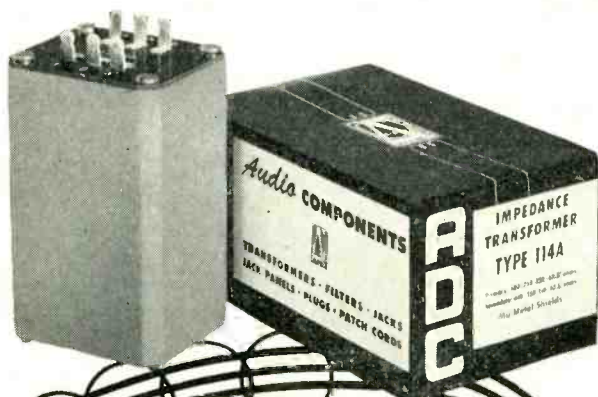
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Now **ADC** TRANSFORMERS

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To the jobber

New ADC policy provides for distribution through jobbers. If you do not already stock ADC transformers, ask for information about our new jobber set-up.

WE WELCOME YOUR INQUIRY

TYPICAL FEATURES—All units are vacuum varnish or wax impregnated, sealed with non-hygroscopic potting compound • Highest grade insulation throughout... will withstand voltages far in excess of normal requirements • Silver plated brass terminals—for sturdiness and easy soldering • Top or bottom mounting.

Two new ADC transformer lines now being handled by jobbers:

Quality-Plus Transformers. Broadcast engineers' first choice for broadcast or recording studios.

- Extremely high fidelity (Guaranteed $\pm 1/2$ db 30-15,000 cps)
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Industrial Transformers. For quality P. A. systems and high fidelity music reproduction.

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Note to User: If your jobber does not yet stock ADC audio components, ask him to write immediately. Until his stock is adequate, order direct... we'll ship the desired items.



Audio Development Co.
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"Audio Develops the Finest"

side frequencies appear is made sufficiently short so that they are imperceptible to the ear, the reflex time of the interaural muscles which control the ossicle connection in the middle of the ear being long enough to cut off sudden surges.

"The rights to the invention were acquired by the Automatic Electric Company of Chicago, but they have not, as yet, done any developmental work on equipment using infrasonic switching." (signed) Dr. Angelo Montani, October 21, 1946.

The discussion is inconclusive. We delayed publishing these comments in the expectation that the aforementioned experiment could be successfully performed giving something tangible to report. We hope the correspondents will accept our futile efforts as justification for delaying publication of their comments, for which delay we are heartily sorry.

Detection of Poisonous Gases

LETHAL GASES encountered in chemical plants, mines, and other working locations can be electronically detected. Quick detection of such gases is essential because one can inhale a deathly dose in only a few minutes without knowing it. A simple portable detector can be used to give warning of the presence of many toxic gases.

Platinum Detector

The sensing element in the gas detector is a layer of platinum black (finely divided platinum) deposited on a platinum wire with an intermediate layer of aluminum oxide. Oxidation of methyl alcohol, introduced by a capillary tube from a small reservoir into the air stream that is blown over the detector and catalyzed by the platinum black, heats the detector thereby raising its temperature to 120-150 C.

Methyl alcohol does not ordinarily combine with the free oxygen of the air because of an energy threshold which repels the molecules as they approach each other closely. However, unused forces of attraction on the corners of crystals such as those of platinum can overcome this energy threshold. Thus in the

The WORKSHOP FM "TOWER" A New Type of FM TRANSMITTING ANTENNA

Incorporates design and structural features
unique in the field of broadcasting

The new Workshop FM "Tower" Antenna is the ultimate in clean-cut design and performance. Complicated feed systems coupled with elaborate mechanical structures — costly, inefficient, troublesome — have been eliminated.

FEATURES

THE SINGLE SELF-SUPPORTING TOWER STRUCTURE IS THE ANTENNA!

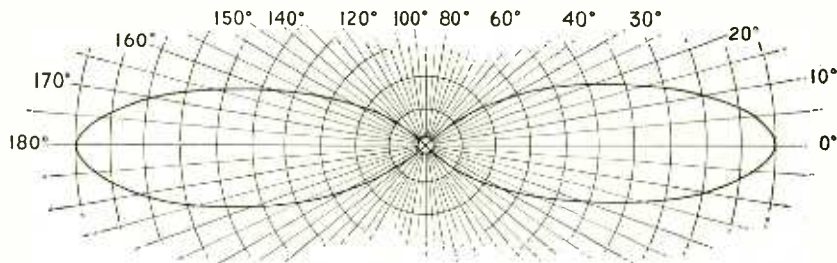
No protruding elements to increase wind and ice load.

INSTALLATION PROBLEMS CUT TO A MINIMUM.

Complete section easily handled by two men.

TOTAL WEIGHT — 183 lbs.

This allows use of lighter and less expensive supporting structures.



Vertical Pattern of Workshop "Tower" Antenna — single section.
Actual measurements in power at 101 mc.

HIGHEST GAIN PER ANTENNA HEIGHT.

Equal or superior in gain to a 3-bay $\frac{1}{2}$ wave spaced array of conventional types.

MECHANICALLY STRONG.

Four strong aluminum alloy channels rigidly mounted to reinforced circular end castings.

SECTIONS CAN BE STACKED FOR ADDITIONAL GAIN.

For higher gain Model FMT1 can be stacked on heavier lower sections—available soon.

NO DE-ICING EQUIPMENT NECESSARY.

High voltage points separated by a 15" gap. Icing effects negligible.

LESS WINDLOAD AND WEIGHT THAN ANY OTHER ANTENNA OF COMPARABLE GAIN.

LOW MAINTENANCE COST.

Simplicity of construction assures a minimum of maintenance.

HORIZONTALLY POLARIZED.

Uses a new "wave-guide" principle of radiation (patent pending). Two short wave-guide sections arranged and fed at 90 degrees.

ABSOLUTELY NON-DIRECTIONAL.

The azimuth pattern is circular to better than a ratio of 1.1 to 1 in power.

LOW STANDING WAVE RATIO AT YOUR FREQUENCY.

Antennas are pretuned at the factory. Accurate standing wave ratio carefully measured on each antenna before shipping. Complete data supplied.

EYE APPEAL.

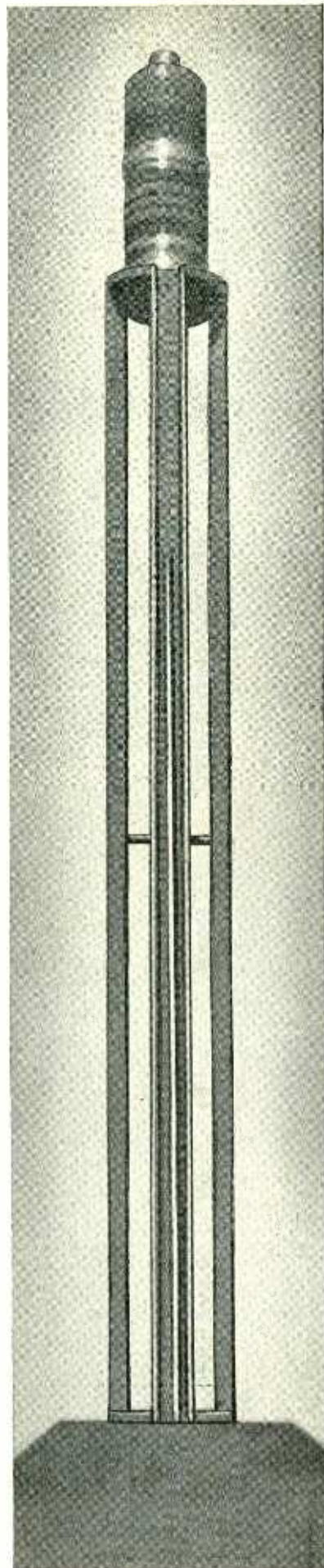
The neat streamlined appearance of the new Workshop "Tower" Antenna adds to the beauty of any building or tower rather than detracting from it.

PROVIDES A MOUNTING FOR A STANDARD 300mm BEACON.



ANTENNA LOAD DATA

LOAD R_1 , includes 300 mm beacon	409 ⁹
30° sq ft	
HEIGHT H_1	11' 8"
HEIGHT H_2	6' 11"
DIAMETER D	18 $\frac{1}{2}$ "
BENDING MOMENT AT TOP OF SUPPORTING STRUCTURE moments include 300 mm beacon	2,840 ft lbs
30° sq ft	
WEIGHT W exclusive of beacon	183 lbs



THE WORKSHOP ASSOCIATES INCORPORATED

Specialists in High-Frequency Antennas

66 NEEDHAM STREET, NEWTON HIGHLANDS 61, MASSACHUSETTS



It's Better Because It's Bendix!

Now Available!

Aviation Standard
Bendix DYNAMOTORS



Bendix*—world famous for top-flight aviation quality—now makes available to the radio industry these low-cost D.C. Transformers.

- Specially designed for long life, light weight, and low ripple.
- Standard diameters run 2¾, 3⅞, 4, 4½, 5 and 5¼ inches.
- From 12 to 1100 volts and from 15 to 500 watts output.
- Continuous duty—enclosed.
- Intermittent duty—ventilated.
- Single, dual, and triple output.
- Regulated and unregulated.

Write to the address below for detailed information on these and other Bendix Dynamotors to meet your power requirements.

*REG. U.S. PAT. OFF.

STANDARD RATINGS

Model	Frame Size	Input Volts	Output Volts	Output Watts	Approx. Weight
DA58A	2¾"	14	250	15	2 lb. 12 oz.
DA1A	3⅞"	14	230	23	5 lb.
DA77A	4"	5.5	600	104	9 lb. 12 oz.
DA1F	4½"	25	540	243	11 lb. 8 oz.
DA7A	5¼"	26.5	1050	420	26 lb. 10 oz.

RED BANK DIVISION of

Red Bank, New Jersey



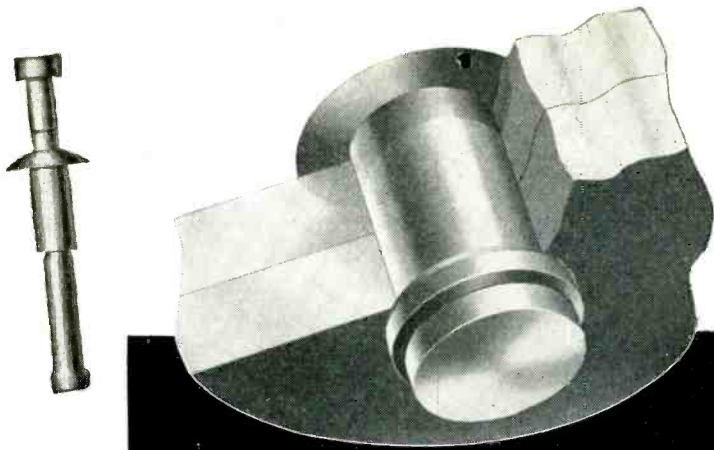
presence of a catalyst oxidation takes place.

When some gases, such as hydrogen sulphide, hydrocyanic acid, mercuric cyanide, and carbon monoxide, come in contact with the platinum black, their molecules associate with the forces of attraction thus making the catalyst ineffective. Oxidation ceases and the temperature, and consequently the resistance, of the wire falls. The wire forms one arm of a bridge which is balanced at the temperature produced during oxidation. Interruption of oxidation by a poisonous gas unbalances the bridge. The unbalance can be used to sound any desired alarm or actuate blowers or process controls through electronic amplifiers. The platinum wire is heated to 400 C for a short time to reactivate it after poisoning (too high a temperature, by causing the small crystals to combine, will reduce its effectiveness as a catalyst). Platinum is used as the catalyst because it is poisoned by most of the same gases that are toxic to personnel (Electrical Detection of Traces of Poisonous Gases in the Atmosphere, J. Boeke, *Philips Technical Review*, p 341, Nov. 1946).

Russian Research

IMPROVEMENTS in electron microscopes and other electronic equipment and components are being made in Russia. Academician A. A. Lebedev of the Soviet State Optical Institute in Leningrad has announced production of four new electron microscopes capable of resolving 40-50 Angstroms. The pictures so obtained can then be magnified an additional 50,000-60,000 times. Improvements, especially in electron gun design and use of dry disc rectifiers, make it possible to put the microscope into operation in about ten minutes against the several hours required for other such instruments. The objective table is arranged for stereoscopic photographing during examination of the object. These electron microscopes are being used in medical and biological research.

Two other projects closely parallel those of the U. S. Bureau of Standards. One, the development

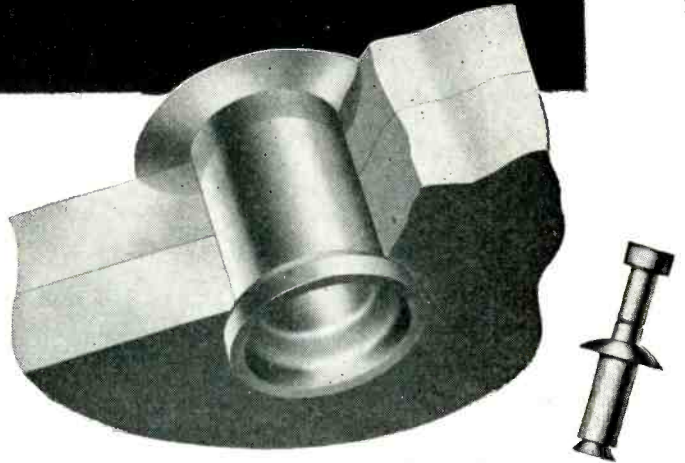


High-strength, self-plugging type Cherry Blind Rivet, showing the perfectly formed blind head and the tight stem-plug.

CHERRY BLIND RIVETING

Speed excelled by no other fastening technique

Security equalled only by conventional riveting



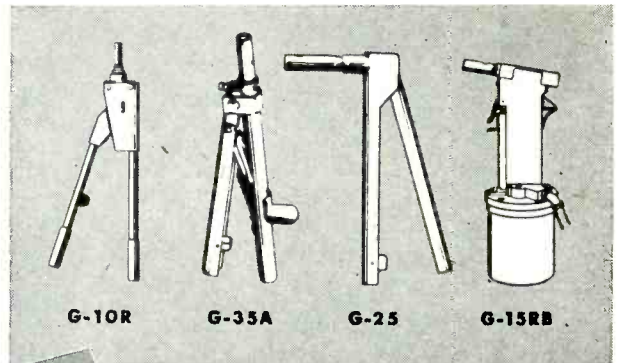
Tight-clinching, pull-through hollow type Cherry Blind Rivet, showing the perfectly formed blind head.

Cherry Blind Riveting has stirred up enormous interest since its inception during the war. This remarkable fastening technique is so fast and the results are so uniformly dependable that it has spread from industry to industry at an astonishing rate.

Installation Speed—No hammering or bucking. Cherry Blind Rivets are installed with a controlled pull from one side of the work only. Installation is a fast, one-man operation requiring only three simple steps: (1) inserting rivet in hole; (2) engaging the rivet; (3) actuating the gun. This adds up to speed, speed, speed.

Dynamic Expansion of rivet shank during installation (greater shank expansion than any other blind fastener) means tight, strong, vibration-resistant joints. Powerful controlled pull of rivet gun draws stem into rivet, forcibly expanding rivet to fill hole *tightly*. Cherry Blind Rivets don't work loose like nuts and screws.

Monel, Steel, Aluminum make up the Cherry Rivet materials classification. There are three types, two head styles, a range of diameters and lengths.



A series of special "guns," both pneumatic and hand-operated, have been designed for upsetting Cherry Blind Rivets. All are small, lightweight, easy to handle, positive in action.



Find out all about Cherry Blind Rivets and their many applications. Write Dept. H-120, Cherry Rivet Co., 231 Winston St., L. A. 13, Calif.

CHERRY RIVETS. THEIR MANUFACTURE & APPLICATION ARE COVERED BY U.S. PATENTS ISSUED & PENDING





We're Not Snake Charmers

We can't wind coils without wire . . . and of the right size. Magnet wire shortages, existing for many months, have prevented us from accepting orders for coil windings using sizes not obtainable. For your convenience we list wire sizes which we have in stock. If these sizes meet your specifications we can make prompt delivery.

PLAIN ENAMEL MAGNET WIRE
 #21 - #22 - #23 - #24 - #25
 #29 - #30 - #34 - #35 - #42

COTO - COIL CO., INC.
 COIL SPECIALISTS SINCE 1917
 65 Pavilion Ave., Providence 5, R. I.



of a capacitor dielectric by B. W. Bul, has resulted in capacitors that can be used in circuits requiring a high stability despite changes in temperature. Barium titanate, having a dielectric constant over 1,000, is used as the capacitor body. It is prepared by being calcined in a furnace, plated on both sides with silver, and again calcined. The capacitor so formed has high capacitance in small volume and withstands very high voltages; it is being used in industrial technology such as induction heating, high-frequency x-ray equipment, and electron microscopes.

The other project concerns development by physicists N. S. Akulov and N. I. Yerminev of an electromagnetic micrometer for measuring the thickness of protecting layers of nonmagnetic materials. Three coils are wound on an iron core. The outer two are connected in series to a galvanometer. The inner one is excited from a 30-kc source. The two detector coils are balanced against each other so that there is no galvanometer deflection. However, if the probe is brought near a magnetic material, the balance is disturbed by the distortion of the field about the coils, and a deflection is produced. The instrument is calibrated against known materials. It can be used either as a micrometer or as a flaw detector. If the nonmagnetic material whose thickness is to be gaged is not backed by magnetic material, a magnetic backing plate can be used.

A portable telephone station has been constructed by V. A. Nevitzky at the Chief Military Navigation Management in Moscow. The telephone set consists of a piezoelectric unit that acts both as microphone and loudspeaker. The unit is being used for the telephone to marine divers. The single element in the diver's dress is connected either to the amplifier input or output depending on whether the surface operator wishes to hear or speak to him.

SURVEY OF NEW TECHNIQUES

INSTRUMENTATION is one of the major fields of application for elec-



RADIOTELEPHONE SYSTEMS BUILT *specifically* TO MEET RAILROAD SERVICE REQUIREMENTS

The complete dynamotor-type Farnsworth mobile radiotelephone system shown above includes the Farnsworth "Firecracker" antenna, only 11 $\frac{7}{8}$ " high, the first truly practical streamlined VHF antenna for railroad use; transmitter and receiver units which are shock-mounted in a rugged weather-proof housing for complete protection; mobile control units constructed of heavy cast bronze-aluminum, and weather-resistant speakers especially designed for railroad applications. (Converter—power-rectifier-type power supply may be substituted for dynamotor power source.)

RADIO has already demonstrated its usefulness in railway operations. The design of proper specialized equipment for the practical application of this dependable communications tool in railway service is, however, dependent upon a thorough knowledge of the unique and exacting requirements of railway operation.

Because Farnsworth engineers have secured this knowledge through their pioneering accomplishments in adapting radio to railroad operations, Farnsworth is today producing VHF communications systems that have been *specifically designed and precisely developed for railway service.*

Standardized design and unitized construction are only two of many important engineering results of Farnsworth's pioneering, long-term development and field-testing program in railway radio communications.

They give Farnsworth equipment these practical features:

- The same receiver, transmitter, and in some cases, power supply and remote control unit, is usable for mobile, wayside or relay installations, thus providing complete interchangeability of basic equipment.
- Because all connections are made by a single, break-away plug, transmitters, receivers and power converters can be instantly disassociated for purposes of maintenance or relocation without manually disconnecting a single wire.
- Personnel unlicensed by the FCC and without technical training can replace all units of Farnsworth systems.

Only Farnsworth radiotelephone systems offer all these vital service and maintenance advantages. For complete information write Farnsworth Television & Radio Corporation, Dept. E-8, Fort Wayne 1, Indiana.

Farnsworth
Television · Radio · Phonograph-Radio

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Mobile Communications and Traffic Control Systems for Rail and Highway • The Farnsworth Phonograph-Radio • The Capehart • The Panamuse by Capehart



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MASTERPIECE

Soundcraft discs are the culmination of a five-year engineering search for wider dynamic range, lower surface noise, freedom from "grey-cut" and "swish" in disc recording.

Soundcraft engineers have developed a coating process that now makes possible the application of high solid content, finer grained lacquers in an unusually thick, clean and uniform coating.

Check and compare these Soundcraft qualities with other blank discs you may be using now.

- Background noise lowered 2—4 db
- Dynamic range increased
- Elimination of unpredictable "grey cuts"
- Reduction of surface "swish"
- Increase of sapphire life

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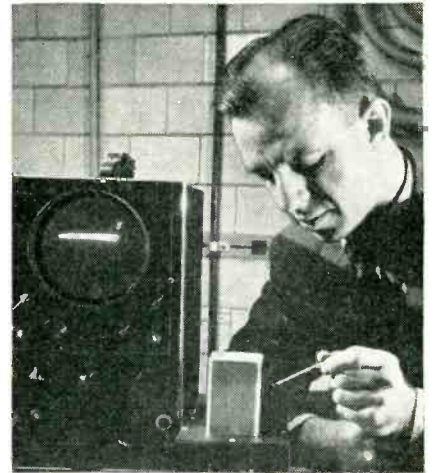
In order that you may test for yourself our claims for Soundcraft discs, a "Broadcaster" disc will be sent without charge to anyone detaching this page and sending his name and address to us.

REEVES SOUNDRAFT CORPORATION

10 East 52nd Street • New York 22, New York

tronic techniques. Electronic instrumentation is finding nuclear research an especially fertile field into which to expand.

HIGHER SPEED COUNTING of radiation particles than is possible with G-M tubes can be done using a fluorescent screen. Particles from disintegrating atoms excite the screen. Light from the screen acts on



Spikes on oscilloscope indicate particles given off from radioactive material tipping wire held by Dr. Fritt-Hugh G. Marshall of Westinghouse Research Laboratories

an electron-multiplier photo-tube producing the electrical signal. Whereas G-M counters saturate at about 2,000 counts a second, the fluorescent screen and tube enclosed in a light tight box can count at rates as high as 100,000 times a second.

BECAUSE it is strong, light in weight and easily machined, Lucite acrylic resin was used as the mount for G-M tubes at Bikini.

TO DETERMINE PROPERTIES and quality of radiation from the some 400 radioactive isotopes now being used in physics, chemistry, biology, medicine, and industrial processing especially as tracers, the National Bureau of Standards has developed an improved magnetic beta ray spectrometer. Beta rays (high speed electrons) emitted from the material under test pass through the lens and impinge on a G-M tube. The beta ray particles come to a focus at a point dependent on their initial velocity, so the focal point is an indication of their energy. Baffles prevent direct rays and gamma rays from reaching the G-M tube. The spectrometer is housed in a

need a mite

To meet requirements for weight- and space-saving rectification in small radios, General Electric engineers have developed this tiny selenium rectifier. Less than one inch square, its use has resulted in important manufacturing economies, without loss of efficiency.

This two-ton copper-oxide rectifier is one of the largest ever made. Designed and engineered by General Electric, the ten-foot-tall unit is rated at 80 kw. It will be used in an electrochemical process, to supply constant unvarying flow of electricity over a wide range of load.

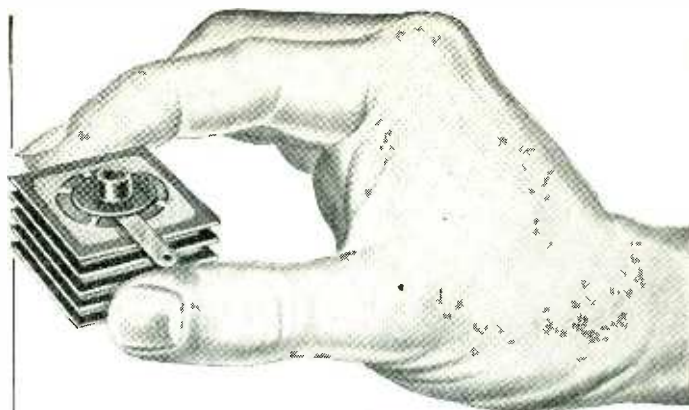
or a mammoth?

... Specify General Electric and Get the Right Rectifier for Your Designs

Mite or Mammoth? Your needs probably fit somewhere in between. But the important point is that we have a lot of experience with *all kinds and all types* of rectifiers.

This means that when you come to us with a problem involving rectification, we probably have already tackled a similar problem for some other manufacturer — and have come up with a successful solution.

Even if your application is entirely new, our engineers have a background of experience that is invaluable in selecting the type and the design of rectifier that will give you the



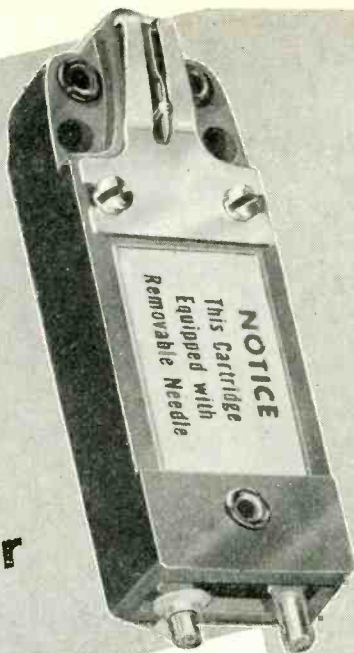
utmost in operating economy and output efficiency.

Because we make all three of the most commonly used types of rectifiers, you can be sure of unbiased recommendations for the one that is best suited to your application.

Call on us for counsel when your next project is in the planning stage. There is no obligation. Just ask a General Electric representative to call, or write to Section A72-831, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC

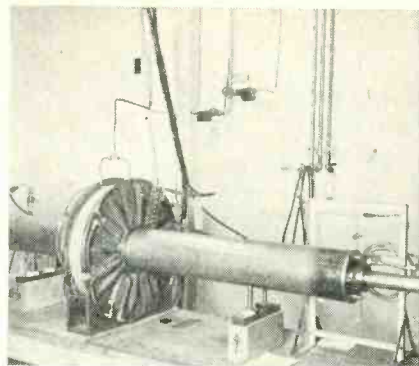
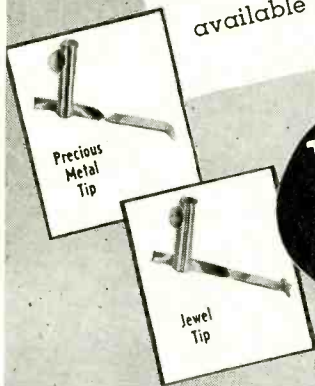
WHY IS ASTATIC'S MODEL "QT" Such a Popular Cartridge?



The Answer Is, of course, that Astatic's new model "QT" Pickup Cartridge provides exceptionally clear, clean, quiet reproduction and provides for the constancy of such quality reproduction during the life of the instrument. These are important things to every manufacturer of modern record players.

This new, Astatic "QT" Cartridge is equipped with a MATCHED Needle. This needle possesses all the qualities of a permanent Needle plus the advantage of being REPLACEABLE. This assures the manufacturer, and the ultimate user, that the quality of reproduction shall remain constant throughout the life of the Cartridge REGARDLESS of the number of times the Needle is replaced.

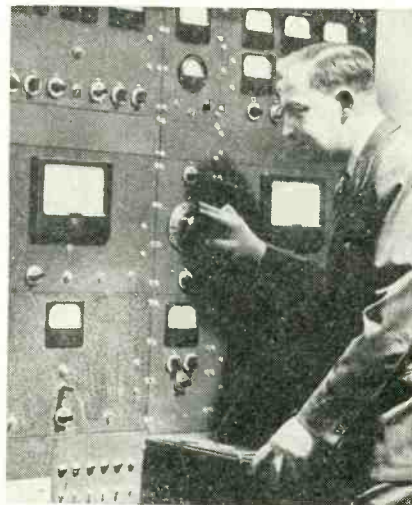
The unique design of the Needle employed exclusively in the "QT" Cartridge plus certain improved qualities of the Cartridge itself, have resulted in a quality of reproduction which is essentially free from objectionable noises radiating directly from the surface of the record. Special literature is available upon request.



Coil at center of magnetic spectrometer focuses beta rays on G-M tube

6.5-inch brass tube about 6.5 feet long with Wilson seals at both ends so that the internal vacuum need not be completely broken when radioactive samples are inserted or the G-M tube adjusted.

COMBINATION of electronic infrared, ultraviolet, and mass spectrometers at Lehigh University, which were developed by Dr. Earl Serfass, is being used to analyse volatile compounds formed during oxidation of lubricants for Army Ordnance. The



Mass spectrometer, combined with infrared and ultraviolet spectrometers, not shown, constitutes a versatile instrument for chemical analysis

versatile interlocking apparatus makes analysis as simple as tuning a communications receiver.

FRANKENSTEIN was brought to life, so Hollywood fictitiously shows it, by bolts of lightning. Dr. Arno Brasch of Brooklyn, N. Y. has found that if beams of high-voltage electrons produced by capacitron are passed through living tissue (ani-



PRACTICAL LIGHTING IS
flexible **FOR EACH INDIVIDUAL**
...FOR EACH TYPE OF WORK

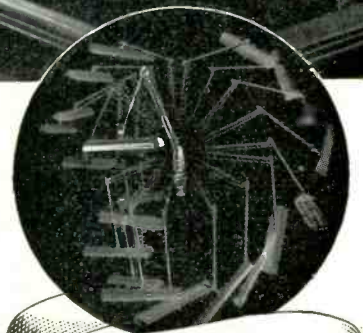
Few persons see exactly alike. Even on similar jobs they have different—and changeable—lighting needs. Consider how these variations multiply when you plan to compensate for dark locations... to provide high level illumination for precision machining, fast assembly, close inspection, drafting or accounting.

Then you'll understand why we stress the Dazor *Floating Lamp's flexibility*: its capacity for delivering the right amount of light for the *individual* at the right place for the *type of work*. Dazor's exclusive *Floating Arm* enables the user to raise, lower, push, pull or tilt the reflector anywhere within the broad area reached by the lamp. Once guided to the point selected, a patented

mechanism holds it; there's nothing to fasten.

Your choice of advanced Dazor lighting is a logical step toward improving the safety record, increasing output, curtailing errors. It also puts you in good company. Just observe as you examine photographs of progressive concerns in popular magazines, how often Dazor *Floating Lamps* appear as "part of the picture."

Phone Your Dazor Distributor for an on-the-job demonstration of Dazor efficiency. In the event you require the distributor's name, write to Dazor Manufacturing Corp., 4481-87 Duncan Ave., St. Louis 10, Mo. *In Canada* address inquiries to Amalgamated Electric Corporation Limited, Toronto 6, Ontario.

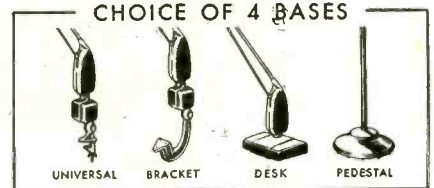


DAZOR ALONE HAS
 THE FLOATING ARM

MOVES FREELY INTO ANY POSITION
 AND STAYS PUT—WITHOUT LOCKING



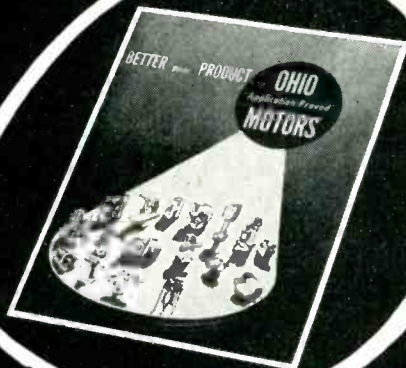
CHOICE OF 4 BASES



DAZOR FLOATING LAMPS

FLUORESCENT and INCANDESCENT

announcing



**new Ohio Electric
catalog on fractional
H. P. Motors**

* **Just out!** — A well-illustrated catalog which gives information on the high performance factors, all-purpose ratings and fine construction features of Ohio Motors . . . Oil Burner, General Purpose, Shell Type and Torque Motors.

* **New catalog describes distinctive qualities of Ohio Fractional H. P. Motors . . . vibration-free operating efficiency . . . and lists a wide variety of industrial applications.**

* **Lower your operating costs with Ohio "Application Proved" Motors . . . Send for this catalog today!**

THE **OHIO ELECTRIC MFG. CO.**

Chester Bland, Pres.

5908 Maurice Ave. • Cleveland 4, Ohio

mal or vegetable) the life process is in actuality interrupted. The technique may be useful in preserving foods or treatment of cancer (ELECTRONICS, p 180 Jan 1947).

A SYNCHROCYCLOTRON having 130-inch magnet faces, weighing 1,100 tons, and capable of producing energies between 200 and 250 million electron volts (mev) is being built at Carnegie Institute of Technology, Pittsburgh, Pa. through funds from the Buhl Foundation, the U. S. Office of Naval Research, and Westinghouse Electric Corp. In design-



The wooden man is to the same scale as the electromagnet; Joan Eccles is life size

ing the large, high quality, low carbon steel forgings for the magnet, a scale model 1/14 the size of the final magnet has been built and is being tested at 1,000 amperes to obtain data on mechanical forces produced by large electromagnets.

DIELECTRIC CONSTANT and losses over a wide range of high frequencies of ceramics, liquids, glasses, polymers, and other materials are listed in two reports prepared at MIT. (PB-4658, 205 p, and PB-4660, 97 p, Dept. of Comm.)

RADAR ON one Great Lakes steamer saved two others from head-on collision during a blinding snowstorm. Three-centimeter RCA merchant marine radar on the ore carrier A. H. Ferbert showed the impending collision, and both ships were warned by radio.

STACKPOLE



SIDE-MOLDED

... for maximum stability of permeability with respect to length.



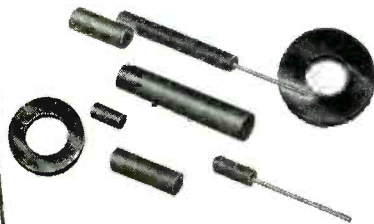
IRON SLEEVE

Paving the way to highly efficient tuning in units of smaller size and with smaller cans.



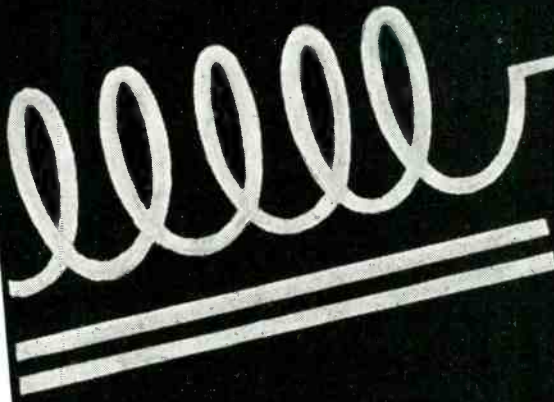
SCREW TYPE

Brass screws are eliminated from the coil field, thus greatly increasing efficiency and reducing size in many applications.



STANDARD and HIGH FREQUENCY TYPES

... Available in sizes, shapes and ranges for practically any requirement. Engineered to specific needs.



LOSSES BALANCED WITH CORRECT, EFFECTIVE PERMEABILITY

Optimum iron core efficiency calls for full consideration of all loss factors, then balancing these carefully against correct effective permeability.

To achieve this end, Stackpole offers several unique iron core types in addition to its standard lines. Frequently, these have paved the way to combining a low loss factor with engineering short cuts of proved economy and dependability—not only in the cores themselves, but likewise in the way in which they can be utilized in a circuit.

Based on an extremely broad background of practical application experience, Stackpole welcomes the opportunity to engineer iron cores for specific applications.

Write for Stackpole Electronic Components Catalog RC6

**ELECTRONIC COMPONENTS DIVISION
STACKPOLE CARBON COMPANY, St. Marys, Pa.**

RESISTORS • IRON CORES • SWITCHES

On the spot for supplies?



Get'em fast
by Air Express



You get supplies and equipment the fastest possible way when you specify Air Express. This speedy service makes hay out of shipping time—delivers you what's needed in hours instead of days.

Your shipment travels at speeds up to five miles a minute by Air Express. Because Air Express goes on all flights of all Scheduled Airlines, no time is lost waiting for loads to accumulate. Regular use of Air Express keeps your business running in high gear — helps give customers better service. Frequent flights to and from points overseas make foreign shipping problems simple, too.

Specify Air Express—it's Good Business

- Low rates — special pick-up and delivery in principal U.S. towns and cities at no extra cost. • Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.
- Direct air service to and from scores of foreign countries.

Just phone your local Air Express Division, Railway Express Agency, for fast shipping action . . . Write today for Schedule of Domestic and International Rates. Address Air Express, 230 Park Ave., New York 17. Or ask for it at any Airline or Railway Express Office. Air Express Division, Railway Express Agency, representing the Airlines of the U.S.



GETS THERE FIRST

Fastest delivery—at low rates

Engine parts (36 lbs.) picked up at Portland, Ore., factory late on 10th. Delivered to Los Angeles consignee 821 miles away, 9 AM on 11th in time. Air Express charge — \$8.84! Other weights, any distance, similarly inexpensive and fast!

1927 — 20th year of getting there first! — 1947

NEW PRODUCTS

(continued from p 142)

lation accuracy is 0.5 percent and maximum harmonic distortion 5 percent.

Card Counter

(15)

POTTER INSTRUMENT Co., 136-56 Roosevelt Ave., Flushing, N. Y., has an electronic counter which by means of a new pickup counts sheets and cards at rates of 1,000 per second. Cards are riffled by hand, and



the pickup is moved down the edges while the count is registered on the instrument. Complete details will be supplied by the manufacturer.

Induction Heating Unit

(16)

OHIO CRANKSHAFT Co., 3800 Harvard Ave., Cleveland, Ohio, announces a new induction heating machine. Suitable for both automatic and manual operation, the



unit operates from a 115-volt single-phase 60-cycle current source, and requires no water connections. The power output is 750 watts and it has a 450,000 cps frequency.

New Antennas

(17)

INTERSTATE MANUFACTURING Corp., 138 Sussex Avenue, Newark 4, N. J. Designed for fast, easy installation, the new wide-band high-gain f-m

How this "VIBRATION DETECTIVE" can help you put out a better product

AN MB VIBRATION PICKUP detects vibration for you—or turns it into a useful yardstick for quality-control.

In inspecting a line of air-conditioning equipment, for example, you tell at a glance whether vibration is *within acceptable limits*. Or in operational tests of machines or engines, you can check them for smoothness—or determine their *variations*. In short, MB Pickups help you *locate trouble before* your product gets into the field to cause extra expense and loss of good will.

And it's an idea for process-control, too. Take the case of a ball-mill grinder, for instance. The MB Pickup could show you when material was properly milled by *changes in the pattern* of produced vibrations.

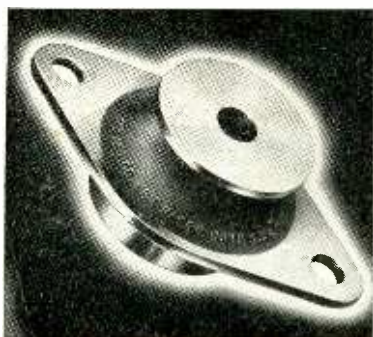
If you would like to know whether this sensitive pickup can be used in your own plant, why not let us hear from you? As foremost specialists in vibration, MB may have the answer to your problem. There's no obligation.



PARTIAL TECHNICAL DATA

- Coil which moves between permanent magnets, transforms velocity changes into voltage changes.
- Convertible for horizontal or vertical operation.
- Electrically damped.
- Dimensions: 2-13/32 x 1-19/32 x 1-19/64". Weighs 8-1/2 oz.
- Range: velocity response flat from 10 to 1000 cps. Usable to 5 cps.
- Sensitivity: about 21 mv. per .001 inch double amplitude per 100 cps. No practical lower limit on amplitude.

HOW TO REALLY ISOLATE VIBRATION AT THE SOURCE



MB's flexible, Type 5 Isomode* mount has remarkable isolation-efficiency. For it was engineered with an equal spring rate in all directions—to absorb vibrations in *all six* possible modes of motion! (That's why you can also mount it at *any angle!*) It has softness *plus* stability; large load capacity *plus* compact size.

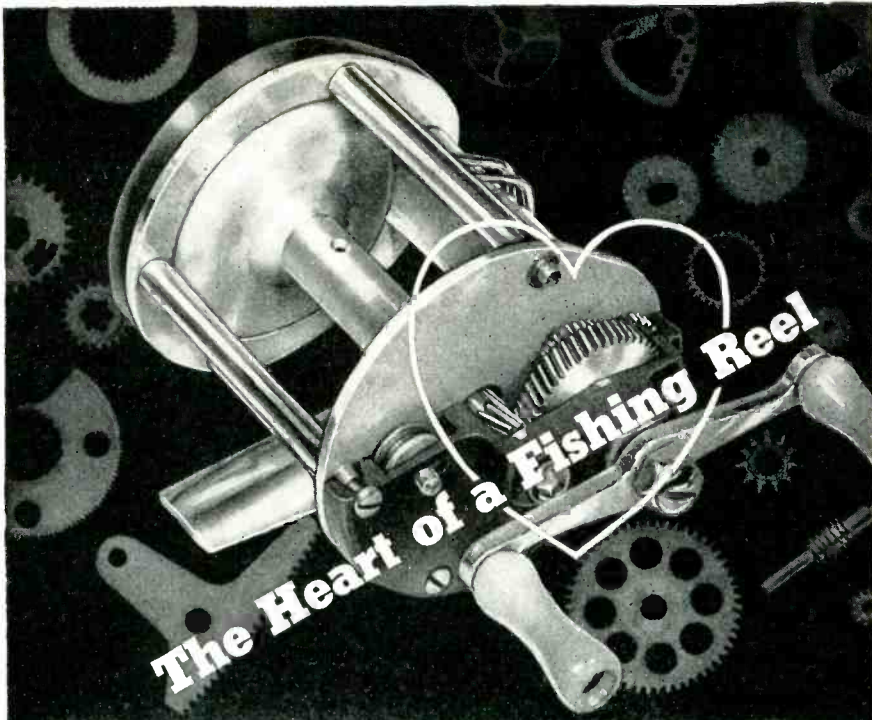
You can make vibration end at an Isomode-supported design—and with surprising simplicity! Get acquainted with the Isomode design chart which locates your best support points for you. Write for reprint of technical paper.

*Trade Mark Reg. U.S. Pat. Off.

SEND FOR FREE BULLETINS

No. 124A gives further details on Pickup. No. 4-5 provides helpful design information on mountings. Reprint of Technical Paper describes Isomode Simplified Design Method. No. 405 describes economical mounting of industrial machinery. Write Dep't. A6.

THE
MB MANUFACTURING COMPANY, INC.
1060 State Street
New Haven 11, Conn.
VIBRATION ISOLATOR UNITS • VIBRATION TEST EQUIPMENT



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

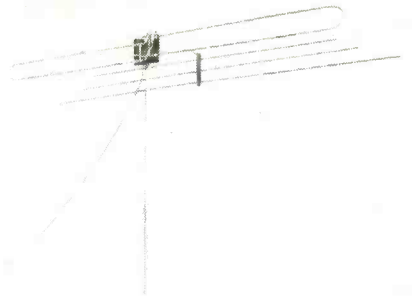
The heart of the Outdoorsman Customatic reel illustrated above is but one of many gear trains developed by our engineers and produced in our fully equipped plant.



Quaker City Gear Works

INCORPORATED

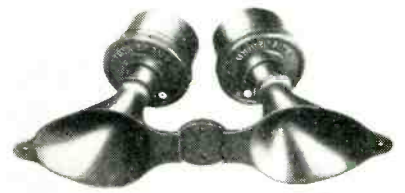
1910 N. Front Street, Philadelphia 22, Pa.



and television receptor has a blanket coverage of 44-216 mc. Reflectors are available for the elimination of ghosts and for special directional effects.

Twin High-Frequency Speaker (18)

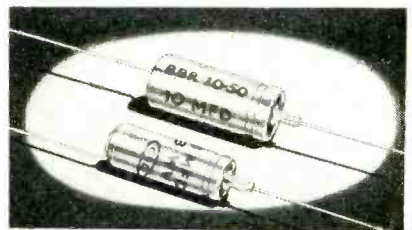
UNIVERSITY LOUDSPEAKERS, Inc., 225 Varick St., New York, N. Y. Built for use with any good low-frequency



speaker, a new twin unit has a frequency response from 2,000 to 15,000 cycles and requires no dividing network. Horizontal distribution from the horns is 100 deg and vertical coverage is 50 deg.

Electrolytic Tubulars (19)

CORNELL-DUBILIER Electric Corp., South Plainfield, N. J. Low-voltage, high-capacitance units designated



type BBR are now available and are completely described in Bulletin 100-424.

Timing Motor (20)

A. W. HAYDON Co., 111 West Main St., Waterbury 32, Conn. An ac-

ENGINEERING...



SERVICING...

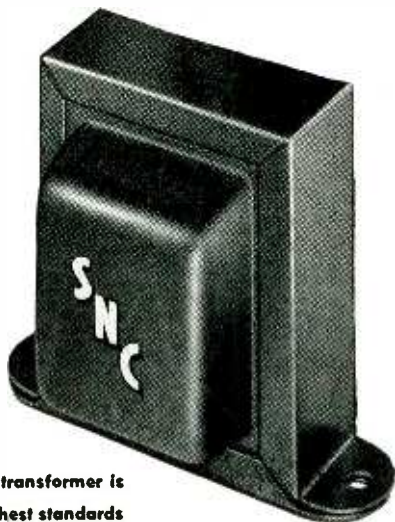
is easier with SNC quality transformers

Here's Why!

Comprehensive research done by SNC in the field of transformer requirements has produced a line outstanding for its sturdy quality, superior design, simplicity and wide range of usefulness.

Both engineers and servicemen, particularly those in the radio field, find their work made easier due to the absence of duplication or overlap in SNC transformer specifications. And balanced design, skilled workmanship, and finest materials practically eliminate the problem of rejects.

It will pay you to investigate SNC! Write for free catalog, today.

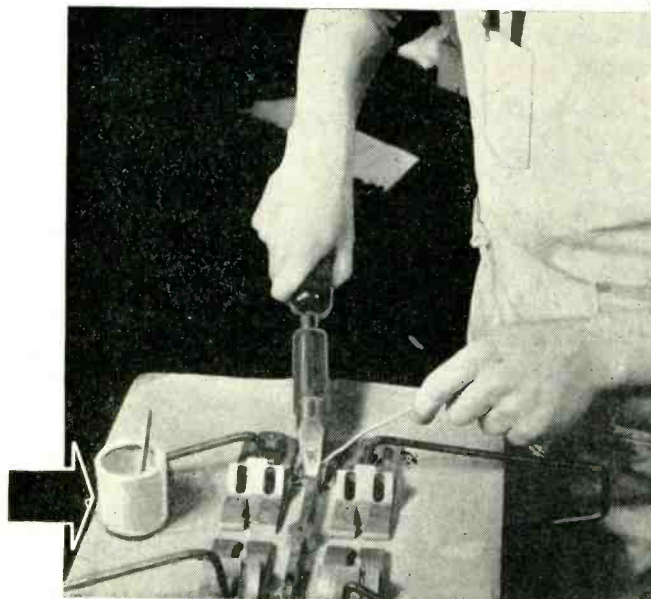


Every SNC transformer is built to highest standards for finest performance.

Remember! SNC gives MORE applications with SMALLER inventories for GREATER profits!

SNC MANUFACTURING CO., INC.
Quality Transformers
WEST LAKE AVE. NEAR LEHIGH • GLENVIEW, ILLINOIS

A KESTER FLUX for Every Soldering Job!



- For every soldering operation that requires a separate flux, there's a Kester Flux in the exact formula to do the best job. Kester Fluxes are laboratory tested, and manufactured to eliminate the risk of failure in any solder requirement.
- Nearly half a century of research in the laboratory and practical experience in the plants of industrial users have provided Kester engineers with the basis for the scores of flux formulas Kester manufactures for industry today.
- This huge fund of flux and solder knowledge is at your disposal. Write fully at any time for prompt assistance on any solder question. There is no obligation.



KESTER SOLDER COMPANY

4204 Wrightwood Ave., Chicago 39, Illinois

Eastern Plant: Newark, N. J.

Canadian Plant: Brantford, Ont.

KESTER

Solder Fluxes

STANDARD FOR INDUSTRY

NEW PRODUCTS

(continued)



curate, reversible, variable speed timing motor that operates on direct current with current consumption of less than 100 ma is suitable for connecting to the output of an amplifier. Speeds up to 1,800 rpm are possible as well as one revolution an hour.

New VFO (21)

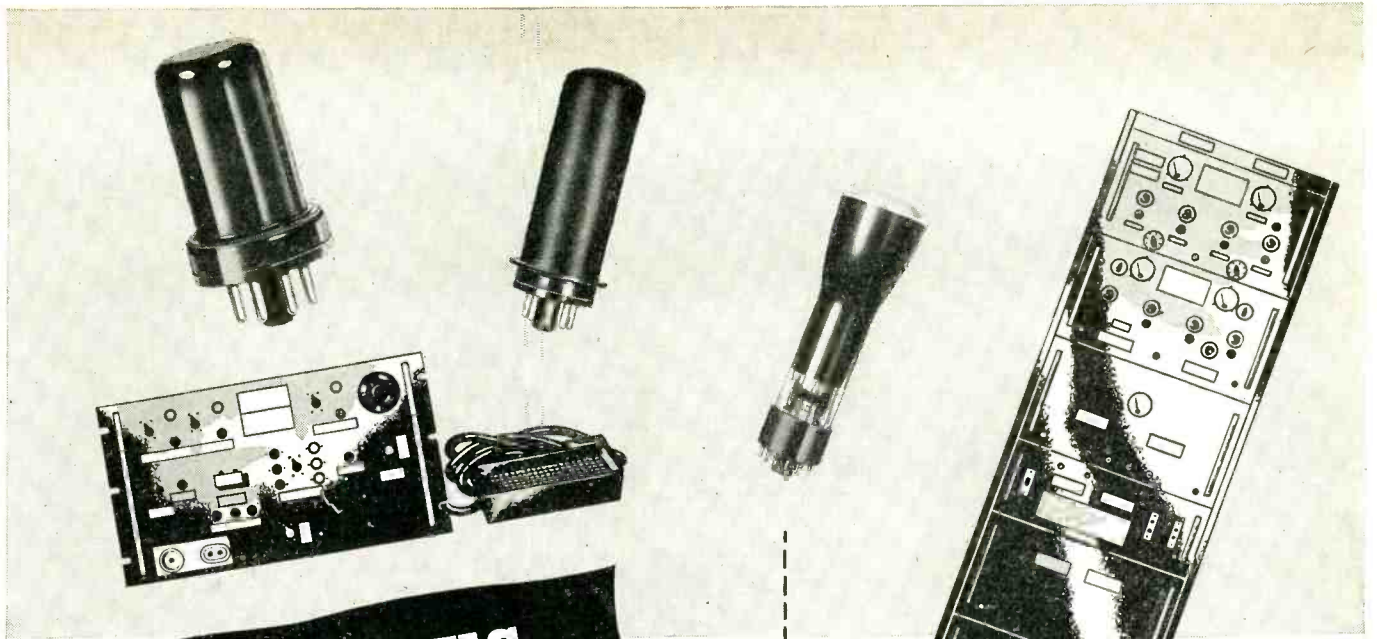
BEACH MANUFACTURING, Inc., Inglewood 3, California, has a new model 1700 variable frequency oscillator. Using an improved type of electron coupled circuit, it maintains the cathode at ground potential and almost completely eliminates frequency shift due to voltage varia-



tions. Simple and safe to use, it is also mechanically rugged. Power supply requirements are standard 115 volts, 50-60 cycles, and output is approximately one watt over the entire range. The unit, measuring 6 x 5 x 5½ inches, retails for \$32.50.

Dial-Illuminated Meter (22)

MARION ELECTRICAL INSTRUMENT Co., Manchester, N. H. Applicable to all but the Hermetic line of in-



**SURPLUS
ELECTRONIC
EQUIPMENT**

**MANUFACTURERS
JOBBERS
WHOLESALEERS**

The War Assets Administration, through its network of Approved Distributors, is offering electronic tubes, devices and equipment which were declared surplus by the Armed Forces. Take advantage of this great opportunity to fill your present and future needs at fraction-of-cost prices. Most inventories still permit wide selection.

Purchasing of this equipment has been simplified to a high degree. The WAA Approved Distributors listed at right were appointed on a basis of their ability to serve you intelligently and efficiently. Write, phone or visit your nearest Approved Distributor for information concerning inventories, prices and delivery arrangements. You'll find you can "Save with Surplus."

OFFICE OF AIRCRAFT AND ELECTRONICS DISPOSAL

WAR ASSETS ADMINISTRATION



Offices located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Fort Worth • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Tulsa

1282

BOSTON, MASS.
Automatic Radio Mfg. Co.,
Inc.
122 Brookline Ave.
Technical Apparatus Co.
165 Washington St.

BUCHANAN, MICH.
Electro-Voice, Inc.
Carroll & Cecil Sts.

CANTON, MASS.
Tobe Deutschmann Corp.
863 Washington St.

CHICAGO, ILL.
American Condenser Co.
4410 N. Ravenswood
Ave.
Belmont Radio Corp.
3633 S. Racine Ave.

EMPORIUM, PENNA.
Sylvania Electric Products,
Inc.

FORT WAYNE, IND.
Essex Wire Corp.
1601 Wall St.

HOUSTON, TEXAS
Navigation Instrument Co.,
Inc.
P.O. Box 7001,
Heights Station

LOS ANGELES, CALIF.
Cole Instrument Co.
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Hoffman Radio Corp.
3761 S. Hill St.

NEWARK, N. J.
National Union Radio Corp.
57 State St.
Standard Arcturus Corp.
99 Sussex Ave.
Tung-Sol Lamp Works, Inc.
95—8th Ave.

NEW ORLEANS, LA.
Southern Electronic Co.
512 St. Charles St.

NEW YORK, N. Y.
Carr Industries, Inc.
1269 Atlantic Ave.,
B'klyn.
Electronic Corp. of America
353 W. 48th St.

**Emerson Radio &
Phonograph Corp.**
76—9th Ave.
General Electronics, Inc.
1819 Broadway

Hammarlund Mfg. Co., Inc.
460 W. 34th St.
Johanns & Keegan Co., Inc.
62 Pearl St.

Newark Electric Co., Inc.
242 W. 55th St.
Smith-Meeker Engineering
Co.
125 Barclay St.

NORFOLK, VA.
Radio Parts Distributing Co.
128 W. Olney Road

ROCHESTER, N. Y.
W. & H. Aviation Corp.
Municipal Airport

SALEM, MASS.
Hytron Radio & Electronics
Corp.
76 LaFayette St.

SCHENECTADY, N. Y.
General Electric Co.
Bldg. 267, 1 River Road

WASECA, MINN.
E. F. Johnson Co.
206—2nd Ave., S. W.

Pick



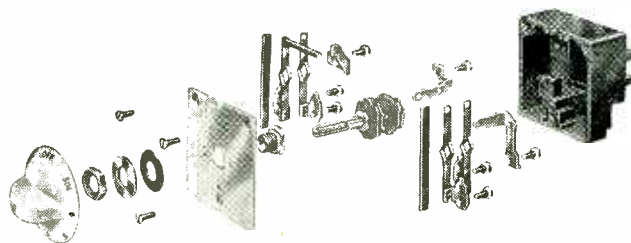
SWITCHES

**FOR
RUGGED, POSITIVE
ACTION**



Sturdy construction for dependable performance . . . *positive action every time* . . . through years of use and abuse. Top appearance, too — on the beam for sales appeal to the ultimate consumer. That's "Diamond H" electrical equipment.

The switch illustrated was designed principally for day-in, day-out service on household ranges. It has however, a host of other applications — from glue pots, corn poppers and hot plates to ovens, sterilizers and steam tables.

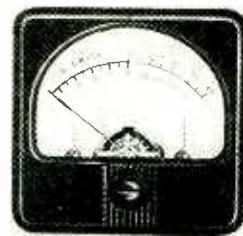


Eight position switch with heavy silver contacts. 15 A. 115 V. or 15 A. 230 V. A.C. Other range-type switches with 4 and 6 positions, or designed to meet your requirements.



Let us talk switches in terms of *your* requirements. We make a complete line. Ask about "Diamond H" pilot lights, convenience outlets and thermostats.

**THE HART MANUFACTURING COMPANY
202 BARTHOLOMEW AVENUE, HARTFORD, CONN.**



struments, a new Lucite insert makes possible the uniform illumination of meter dials in all 2½ and 3½ inch round and square types. White translucent dials are used in the new line.

Television Generator (23)

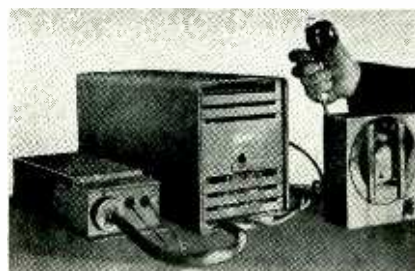
ALL POWER TRANSFORMERS, Ltd., 8A Gladstone Road, Wimbledon SW 19, England. The model 200 television generator was designed for research and developmental work and gives a complete television test signal, available either as



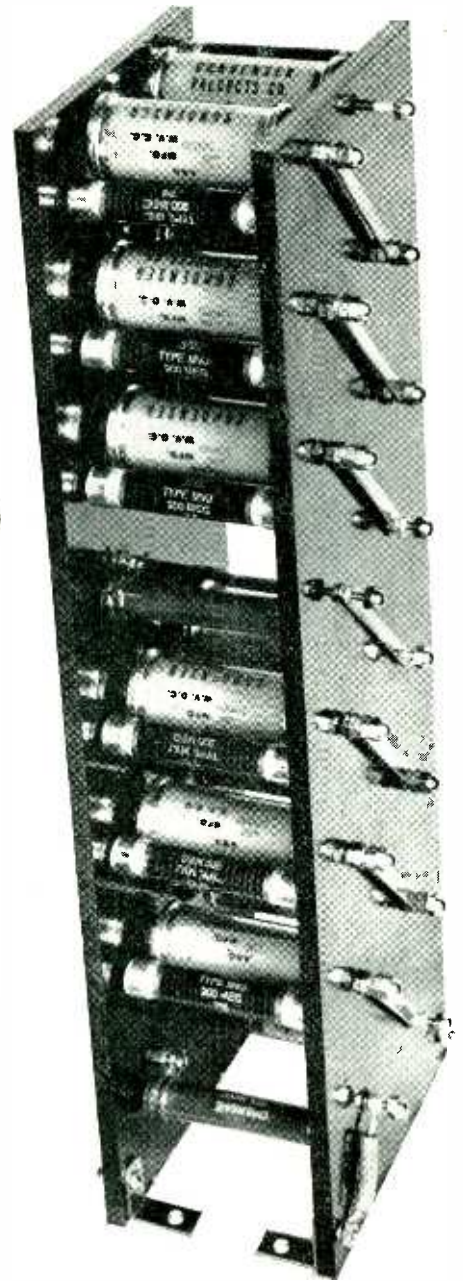
a video signal or as a modulated 45-megacycle carrier. The equipment sells in Britain for 1,500 pounds Sterling. A less expensive model for factory testing is now in production, also.

Mine Radiophone (24)

FARMERS ENGINEERING and Mfg. Co., 549 Brushton Ave., Pittsburgh



100,000 VOLT .01 Microfarads Filter CAPACITOR Unit for the Princeton University CYCLOTRON



Built with
PLASTICON* ASG
Silicone-Filled GLASSMIKES

Part of oil-filled power supply built by Beta Electronics Co.

NOW AVAILABLE!

New illustrated technical booklet on uses of PLASTICON* GLASSMIKES

Obtain from your local distributor or enclose ten cents for handling and mailing when ordering direct.



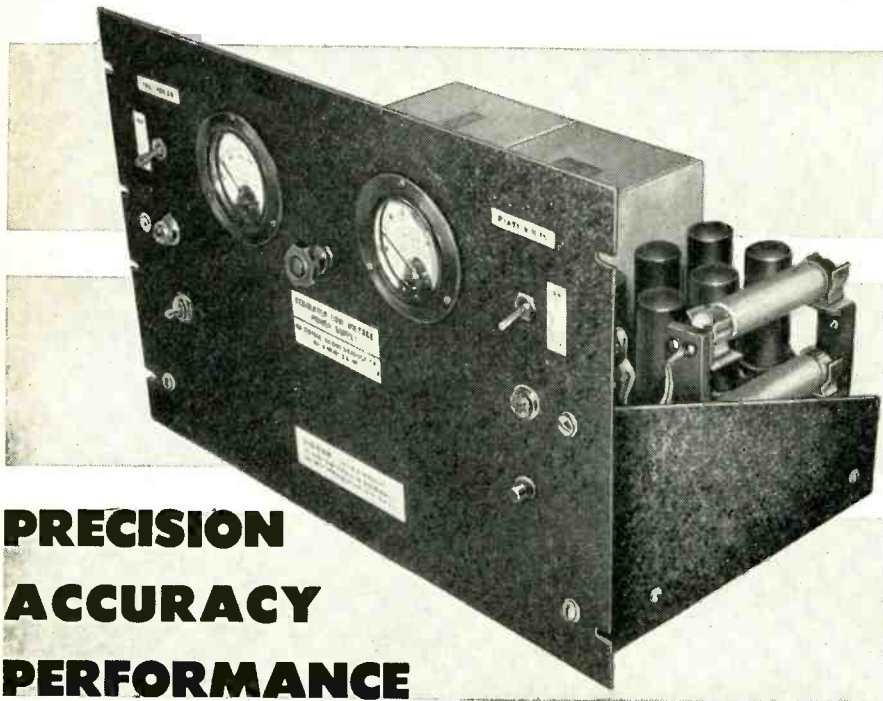
*PLASTICONS—Plastic Film Dielectric Capacitors

Order PLASTICONS* from your jobber. If he cannot supply you, order direct.

Condenser Products Company

1375 NORTH BRANCH STREET • CHICAGO 22, ILLINOIS

Electronic Regulated POWER SUPPLIES



**PRECISION
ACCURACY
PERFORMANCE**

Built to rigid U. S. Government Specifications

SPECIFICATIONS

INPUT—115 v. 56-60 cycle

REGULATIONS—Less than 1/20 volt change in output voltage with change of from 100-140 V.A.C. input voltage & from NO-LOAD to FULL-LOAD (over very wide latitude at center of variable range)

RIPPLE—less than 5 millivolts at all loads and voltages

DIMENSIONS—Fits any standard rack or cabinet (overall: 19 in. wide; 12¼ in. high; 11 in. deep; shipping wt.—100 pounds)

TYPE A—VARIABLE FROM 210 TO 335 V. D. C. @ 400 M. A.

TYPE B1—VARIABLE—TWO RANGES: 400-600 V. D. C. @ 125 M. A. and 600-890 V. D. C. @ 125 M. A.

CONSTRUCTION FEATURES

Weston model 301 (or equal) milliammeter and voltmeter • Separate switches, pilot lights, and fuses for FIL and PLATE VOLTS • All tubes located on shockmount assemblies • Fuses mounted on front panel and easily accessible • Can vary voltage by turning small knob on front of panel. Can easily modify Type B1 from POSITIVE to NEGATIVE output voltage • Individual components numbered to correspond with wiring diagram. Rigid construction: components designed to withstand most severe military conditions—physical and electrical; were greatly under-rated.

All units checked and inspected at 150% rated load before shipment.

Tube complement: { Type A: 2-836; 6-6L6; 2-6SF5; 1-VR150; 1-VR105
Type B1: 2-836; 2-6L6; 2-6SF5; 1-VR150; 1-VR105

IMMEDIATE DELIVERY

NET PRICES—F. O. B. BALTIMORE, MD.

TYPE A—\$189.00

TYPE B1—\$185.00

Complete with tubes and ready to plug in—Prices subject to change without notice

NATIONAL RADIO SERVICE CO.

Reisterstown Rd. & Cold Spring Lane

Baltimore 15, Md.

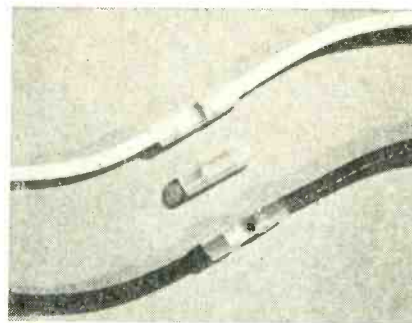
NEW PRODUCTS

(continued)

21, Pa. A rugged f-m carrier-current telephone using power from a mine trolley wire can be used successfully up to about 6 miles. The system uses a frequency of 100 kc and employs standard tubes. All units plug in for ease in servicing. Descriptive literature is available.

Pressure Connectors (25)

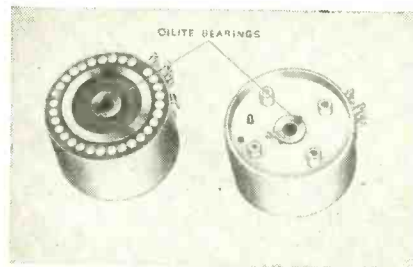
THE THOMAS & BETTS Co., Inc., 36 Butler St., Elizabeth 1, N. J. Development of the No. 25 insulated splice has been announced as the latest addition to the company's line of pressure connectors. Made of



seamless bronze, it is protected with a translucent high dielectric plastic insulation that is impervious to oil, grease, water, chemicals and acids.

Attenuators (26)

THE DAVEN COMPANY, 191 Central Avenue, Newark, N. J. announces an improved feature in its line of attenuators. Two oilite bearings are



provided on each unit, one at the switch end and the other at the detent end, made of an oil-impregnated metal. The unit is free-turning, nonbinding. There is no additional cost for this new feature.

Photoelectric Actuator (27)

GLOBE INDUSTRIES, INC., 125 Sunrise Place, Dayton 7, Ohio. Weighing less than 3½ pounds, a portable pho-

THE ICEBERG REFRIGERATED LOCKER COMPANY'S equipment for frozen food storage is made up in combinations of basic units like this 8-section (10 six-cubic-foot drawers to a section) locker.

"Save us \$50 worth of Assembly Time per unit" ... says THE GLOBE WERNICKE CO.

Summary of report by James O. Peck Co., independent investigators, of assembly savings made with Phillips Screws . . . another in the series of assembly studies at prominent plants.

"We manufacture these units for the Iceberg Refrigerated Locker Systems, Inc." explained the assembly head of The Globe Wernicke. "Our engineering department specified Phillips Screws throughout, and we're glad they did.

"Save us \$50 worth of assembly time per unit. We can take full advantage of power drivers with Phillips Screws. No finder is needed and there's no fumbling such as we'd have with slotted screws. Since each unit requires thousands of screws, \$50 is a conservative estimate of how much we save per unit by using Phillips Screws.

"Upside down or sideways . . . Makes no difference. Screws are driven with the unit in one position so that much of the driving is sideways or upside down. Difficult with slotted screws but very easy with Phillips Screws.

"No gouging or burring. Before we settled on Phillips, we tried out a lot of other type screws and found the driver would jump out and gouge the Masonite panels or burr the heads. Phillips Screws ended that, gave us better driving time with our power drivers."

Help yourself to money-saving ideas for your assembly operations. Write for the full report on The Globe Wernicke Co. and other assembly studies . . . covering metal, wood and plastic products. Use the coupon.

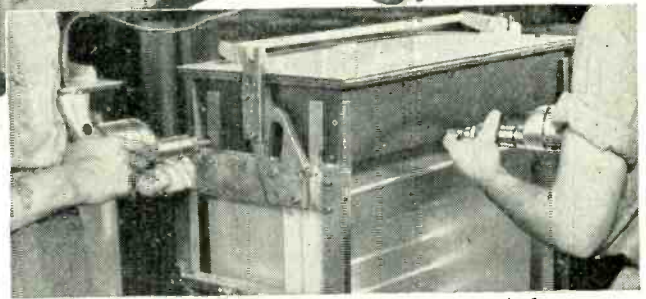
PHILLIPS Recessed Head SCREWS

Wood Screws • Machine Screws • Self-tapping Screws • Stove Bolts

American Screw Co.
Central Screw Co.
Continental Screw Co.
Corbin Screw Div. of
American Hdwe. Corp.
Elo Tool & Screw Corp.
The H. M. Harper Co.
International Screw Co.
Lamson & Sessions Co.
Milford Rivet and Machine Co.
National Lock Co.

24 SOURCES

Pheoil Manufacturing Co.
Reading Screw Co.
Russell Burdall & Ward
Bolt & Nut Co.
Scovill Manufacturing Co.
Shakeproof Inc.
The Southington Hardware Mfg. Co.
The Steel Company of Canada, Ltd.
Sterling Bolt Co.
Stronghold Screw Products, Inc.
Wolverine Bolt Company



The complicated assembly of the drawer of the ICEBERG REFRIGERATED LOCKER . . . made without driver skids to injure work or hands, thanks to Phillips Screws. Most of the thousands of Phillips Screws used in this assembly are Type "A", self-tapping, and are power driven up, down, and sideways.



Report No. 19
ASSEMBLY SAVINGS
WITH PHILLIPS SCREWS
Company
The Globe Wernicke Co.
Cincinnati, Ohio

Phillips Screw Mfrs., c/o Horton-Noyes
1800 Industrial Trust Bldg.,
Providence, R. I.

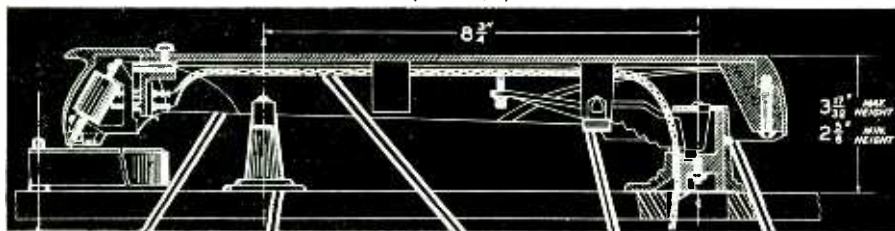
Send me reports on Assembly Savings with Phillips Screws.

Name
Company
Address

20-E

NEW, IMPROVED TONE ARM FOR PARA-FLUX REPRODUCERS

(Trade-Mark)



Flexible wire leads shielded throughout with special grounded bond between arm and swivel base.



Frictionless horizontal fulcrum floated on Neo-Prene for silent non-resonant movement.



Simple, single locking set screw (in the swivel base above the turntable base) allows quick, convenient height adjustment of tone arm level.

All parts cast from aluminum by new, precision dies, under high pressure.

Tone arm resting stand supplied with each arm matching design, equipped with durable, spring clip which prevents arm from being knocked on to turntable.

Here's a new, improved Tone ARM, model A-16, now available to users of PARA-FLUX REPRODUCERS. It's a clean-cut, highly engineered job that embodies unique features for finer, smoother operation. All parts are now die-cast. Embodies new Arm Stand for ease in handling.

Doing one thing well . . . specialized engineering in the design and manufacture of PARA-FLUX REPRODUCERS . . . has enabled us to achieve this most efficient TONE ARM and interchangeable REPRODUCERS for affording the most realistic reproduction of transcriptions.

Our old tone arm offered many advantages as evidenced by more than 1500 now in service at AM and FM stations. Users can now exchange these old arms for the new Model A-16 Arm at a cost of only \$15.00 . . . and can have the advantages of these latest refinements by returning the old arm either to us, or any jobber, listed below, and immediately obtain a new Arm, without delay.



Universal Reproducer



Lateral Only Reproducer



Vertical Only Reproducer

R-MC AUTHORIZED STOCKING JOBBERS:

Albany, N. Y.—E. E. Taylor Co.
 Allentown, Penna.—Radio Electric Service Co.
 Asheville, N. C.—Freck Radio, Refrigeration & Supply Co.
 Atlanta, Ga.—Specialty Dist. Co.
 Augusta, Ga.—Prestwood Electronics Co.
 Binghamton, N. Y.—Federal Radio Supply
 Boston, Mass.—DeMambro Radio Co.
 Boston, Mass.—Radio Wire Television Co.
 Buffalo, N. Y.—Dymac Inc.
 Charleston, S. C.—Radio Laboratories
 Chattanooga, Tenn.—W. B. Taylor Co.
 Chicago, Ill.—Concord Radio Corp.
 Chicago, Ill.—Tri-Par Sound Systems
 Chicago, Ill.—Walker-Jimieson, Inc.
 Chicago, Ill.—Newark Electric Co.
 Los Angeles, Calif.—Radio Products Sales, Inc.
 Los Angeles, Calif.—Radio Specialties Co.
 Milwaukee, Wis.—Radio Parts Co. Inc.
 Madison, Wisc.—Satterfield Radio Supply Co.
 Philadelphia, Penna.—Algene Radio and Sound Co.
 Portland, Ore.—Unified Radio Supply
 Quincy, Ill.—Gates Radio Co.
 Roanoke, Va.—Leonard Electronics
 Rochester, N. Y.—Rochester Radio Supply
 San Diego, Calif.—Coast Electric Co.
 San Francisco, Calif.—San Francisco Radio Supply Co.
 Scranton, Pa.—Fred P. Pursell
 Topeka, Kansas—John A. Costelow Co.
 Tuckahoe, N. Y.—Electronicraft
 Washington, D. C.—United States Recording Co.
 Winston-Salem, N. C.—Dalton Hege

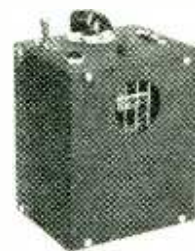
Descriptive, Illustrated Bulletin PR6, upon request

RADIO-MUSIC CORPORATION

EAST PORT CHESTER, CONN.

NEW PRODUCTS

(continued)

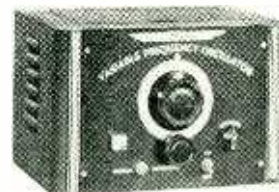


toelectric unit comprises photoelectric tube, miniature amplifier and a sensitive relay. Batteries are self-contained and a control to adjust for ambient light conditions is furnished. A receptacle at the top of the unit makes it useful as a light operated switch for other appliance.

VFO

(28)

BUD RADIO, INC., 2118 East 55th St., Cleveland, Ohio. The VFO-21 is a variable frequency oscillator unit

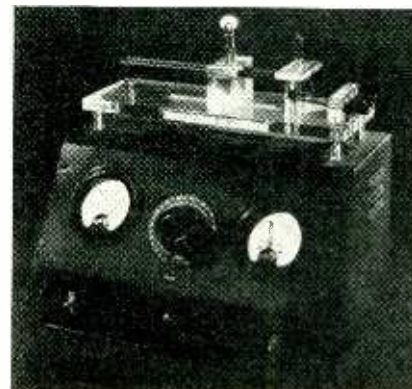


with plug-in coils, high stability and provision for switching to crystal operation.

Subminiature Triode

(29)

RAYTHEON MFG. Co., 60 East 42nd St., New York 17, N. Y. The type CK608CX subminiature triode has a high mutual conductance and a



DON'T LET
I.I.* **SLOW
YOU
DOWN!**



Turn your special instrument
problem over to Marion's
new **SHORT RUN SHOP**
for a fast, economical, precise solution

* INSTRUMENT IMPROVISATION

Now— you can get the improved performance possible only with *custom-engineered* electrical indicating instruments, at moderate cost . . . without having to buy in production quantities! Marion's highly specialized facilities can help you to improve your product's performance and sales appeal.

**HERE'S HOW MARION CAN
OFFER YOU THIS SERVICE...**

We have opened our **SHORT RUN SHOP** for the production of *special* instruments to meet your specifications — precision-built units that you can buy in *sample* lots with a minimum of red tape.

If you've been developing instruments with special characteristics in your own workshop or laboratory you'll appreciate the savings in time, money and materials that our modern, completely equipped **SHORT RUN SHOP** can achieve for you. And you'll enjoy working with fine, precision instruments developed by one of the nation's leading manufacturers of electrical indicating instruments. Your Marion *specials* will give the utmost in satisfaction, service and value . . . the same high standard of performance that has identified the regular line of Marion instruments for years.

**Here's
HOW THE SHORT
RUN PROGRAM WORKS...**

Just fill in our simple **SHORT RUN Specification Questionnaire** and return it to us . . . through your jobber or direct. Within *two days* we will send you a quotation: within an *average time* of two weeks after we receive your order, it will be shipped.

Should your **SHORT RUN** instrument be specified for production quantities, we will be in a position to fulfill your requirements at low cost in our regular production plant. For additional details on our **SHORT RUN PROGRAM**, and for copies of the Marion **SHORT RUN Specification Questionnaire**, see your jobber — or write direct. A copy of the Marion catalog will also be sent upon request.



MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

EXPORT DIVISION 458 BROADWAY NEW YORK 13, U. S. A. CABLES: MORHANEX

IN CANADA: THE ASTRAL ELECTRIC COMPANY, SCARBORO BLUFFS, ONTARIO

THE NAME "MARION" MEANS
THE "MOST" IN METERS

**Subminiature
electrometer tubes**

Twin hearts to the circuit requirements

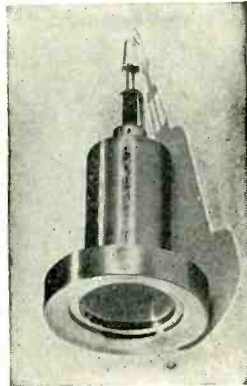
**Geiger-Mueller
Counters**

Sharing the problem of nuclear measurement



Consider these factors for research
laboratory production:

1. Low filament drain 10 milliamperes.
2. High input resistance 10^{10} ohms.
3. Versatility in instrumentation for chemical, oil, nuclear physics research, etc.
4. Ideal for electrometer applications.
5. Extreme portability—low battery drain.



The VG series mica window Geiger-Mueller Counters are of precision workmanship and superior design. Exacting production controls assure a counter held within close tolerance limits. Designed to meet the ever increasing demand for reproducibility of tracer measurements.



Victoreen hi-megohm resistors are specially designed for the hard applications where stability with long life is required. Designed for laboratory use and fine instrumentation. Vacuum sealed in glass to cover a range of 100 to 10,000,000 megohms.

Write for technical data booklet on tubes and resistors.

Model
337



**Complete
Geiger-Mueller
Counting
System**

A complete Geiger-Mueller counting system and a top ranking laboratory instrument. It utilizes a scale of 64 with provisions for switching to a scale of 8. A built-in a.c. power supply provides voltages continuously variable from 0 to 2000 volts. Two new Victoreen gaseous voltage regulator units and a reliable impulse register are included. Complete and convenient front panel switching and control.

THE VICTOREEN INSTRUMENT CO.
5806 HOUGH AVENUE
CLEVELAND 3, OHIO



NEW PRODUCTS

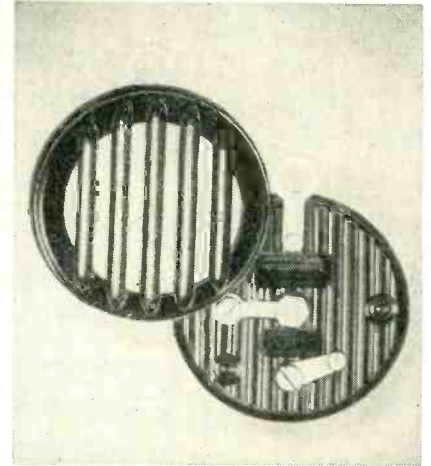
(continued)

200-ma 6.3-v heater. It will put out a watt of radio-frequency power at about 25 percent efficiency in the band between 460 and 470 megacycles. Reduced output can be obtained up to 800 megacycles. The oscillator is illustrated atop the power supply.

Carbon Mike

(30)

UNIVERSAL MICROPHONE CO., Inglewood 2, Calif. The A174 cartridge-type carbon microphone is light in



weight, uses a single-button construction and has a high output level. Impedance rating is 200 ohms.

I-F Converter

(31)

MEASUREMENTS CORP., Boonton, N. J. The model M-275 converter is designed for use with the model 78-FM standard signal generator.



The converter makes available frequencies in the ranges 4.5, 10.7, 21.7 megacycles by the beat-frequency method. Modification of the model 78-FM is made externally.

Latching Snap Switch

(32)

UNIMAX SWITCH CORP., 460 West 34th St., New York 1, N. Y. Two new snap-action switches establish

THE INDIANA STEEL PRODUCTS COMPANY

Announces

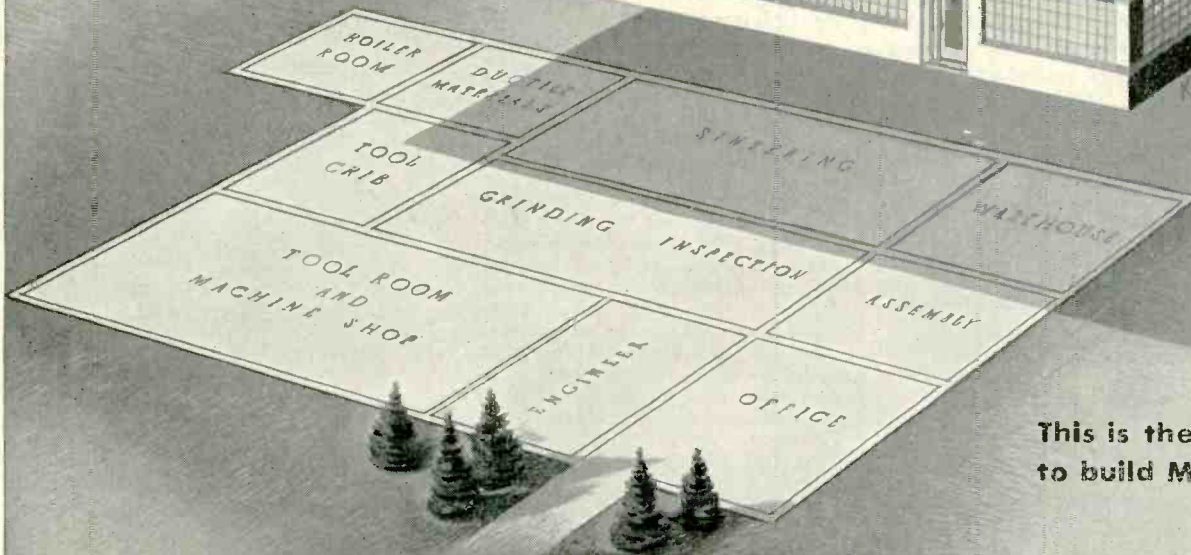
THE OPENING

of the World's Newest and Most Modern Plant
for the Production of Special Magnetic Materials

Sawmill River Plant
Chauncey, Westchester County, N. Y.

This is the house
that Magnets built

THE INDIANA STEEL PRODUCTS COMPANY



This is the house
to build Magnets

Built to meet the growing needs of an Electronic Era, this new plant was planned from the ground up for the exclusive production of special magnetic materials such as Cunife, Cunico, Vectolite, Silmanal, Indalloy, sintered Alnico and permanent magnet assemblies. Because of the vast developmental facilities involved in their production, these modern high-energy magnetic products provide industry of today with a flexible and advanced component which expands the scope of the widely effective cast Alnicos.

See early advertisements for specific information regarding these materials.

©1947, The Indiana Steel Products Co.

* The designing of this plant was no less specialized than the designing of a magnet itself for special use. The experience gained in nearly one-half century as the world's largest sole producer of permanent magnets was utilized in the creation of this plant at Chauncey, Westchester County, New York.

THE INDIANA STEEL PRODUCTS COMPANY

PRODUCERS OF "PACKAGED ENERGY"

6 NORTH MICHIGAN AVENUE • CHICAGO 2, ILL.

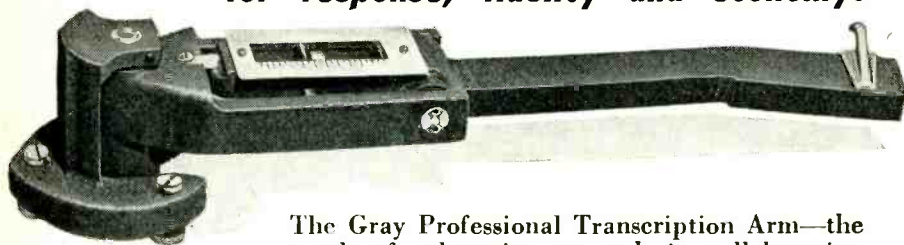


SPECIALISTS IN PERMANENT MAGNETS SINCE 1910

PLANTS { VALPARAISO, INDIANA
CHAUNCEY, N. Y.

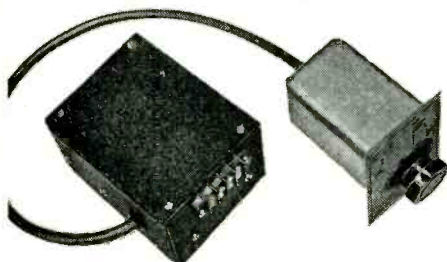
FM and STANDARD BROADCASTERS

...compare this low-mass playback arm for response, fidelity and economy!



The Gray Professional Transcription Arm—the result of exhaustive research in collaboration with nationally recognized authorities on pick-up design and audio reproduction—meets all critical requirements of high compliance reproducers. It represents the only professional arm, regardless of price, that was capable of perfectly tracking the warped records used in a recent test. The Gray Playback arm has already been adopted by two of the nation's four largest broadcasting networks as standard equipment. It is furnished with or without a cartridge, yet is designed to accommodate all modern reproducers of standard make—G. E. Variable Reluctance, the new Pickering, and the better crystal types by Shure, Astatic, etc. Stylus pressure is adjustable over a wide range. This feature allows regulation for optimum pressure for the particular cartridge in use and greatly reduces record wear and surface noise. Price (without cartridge) \$35.00.

Gray High-Fidelity Equalizer for Radio Station Use—



The Equalizer illustrated is specially designed for use with the Gray Playback Arm and G. E. Variable Reluctance Cartridge. It is a four position, high-quality unit of commercial broadcast station type and matches the pick-up to a 250 ohm microphone channel. This equalizer has also been adopted by the radio networks mentioned above and is priced, complete with indicating dial, at \$42.50.

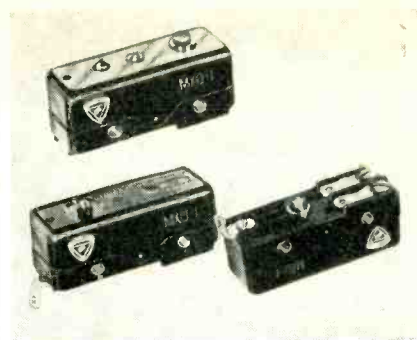
2-Speed, Synchronous Gear Drive Recording and Transcription Table —



Gray Transcription and Recording Tables incorporate a two-speed, synchronous gear drive of exclusive design. This highly perfected direct drive effectively eliminates the inaccuracy, slippage and excessive wear usually associated with indirect drive. Speed selection is instantaneous; speed is absolute. A unique record lift allows the table to rotate while the record remains stationary; makes it possible to start a record at full speed, instantly, without inertial lag. An Overhead Recording Drive with continuously variable pitch, automatic two-speed scroll and selective direction of cut completes the Recording Table.

SOUND EFFECTS EQUIPMENT includes a Variable Speed Turntable, 15-160 rpm; an Automatic Precueing Spotting Device; a Sound Effects Arm with Stylus light, plug-in cartridge, etc.; and a Dial Groove Indicator.

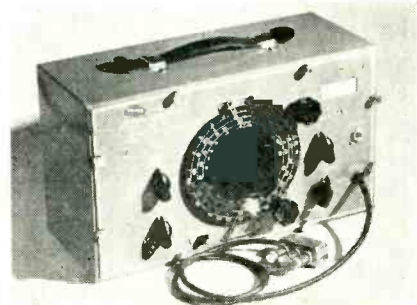
GRAY RESEARCH & DEVELOPMENT CO.
ELMSFORD • WESTCHESTER COUNTY • NEW YORK



the circuit by momentary application of force and maintain it until a restoring force is provided. Regular electrical ratings of 15 amp and 125 volts at 60 cycles are provided.

A-M and F-M Signal Generator (33)

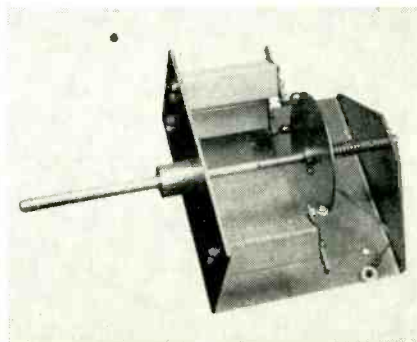
MCMURDO SILVER Co., 1249 Main St., Hartford 5, Conn. The model 906 signal generator covers the frequencies between 90 kc and 170 mc on fundamental output. Amplitude modulation at 400 cycles is pro-



vided. Frequency modulation output between 90 kc and 210 mc can be made to swing (twice deviation) from zero to 500 kc. Output from less than a microvolt to 1 volt is provided.

Safety Switch (34)

J. H. BUNNELL AND Co., 81 Prospect St., Brooklyn 1, N. Y. Switches designed to break 10,000 and 20,000



electronics READER SERVICE . . .

LITERATURE and NEW PRODUCTS

Manufacturers' Literature as well as further information on New Products described in this issue are important "working tools" for design and production departments. To make it easy to keep up to date, ELECTRONICS will request manufacturers to send readers the literature in which they are interested. Just fill out card as shown in the filled-in sample (right), being particularly careful to write out in full all the information called for in each section of each card that is used.

Write in circle number of item describing one item wanted → (14) Your Company Name <u>Jones Mfg Co.</u> Address <u>3217 Lewis Ave</u> <u>Chicago 13, Ill.</u> Your Name <u>Geo. Smith</u> Your Title <u>Chief Engineer</u> ELECTRONICS, 330 W. 42nd St., N. Y. 18	Write in circle number of item describing one item wanted → (32) Your Company Name <u>Jones Mfg Co.</u> Address <u>3217 Lewis Ave</u> <u>Chicago 13, Ill.</u> Your Name <u>Geo. Smith</u> Your Title <u>Chief Engineer</u> ELECTRONICS, 330 W. 42nd St., N. Y. 18
Write in circle number of item describing one item wanted → (37) Your Company Name <u>Jones Mfg Co.</u> Address <u>3217 Lewis Ave</u> <u>Chicago 13, Ill.</u> Your Name <u>Geo. Smith</u> Your Title <u>Chief Engineer</u> ELECTRONICS, 330 W. 42nd St., N. Y. 18	Write in circle number of item describing one item wanted → (19) Your Company Name <u>Jones Mfg Co.</u> Address <u>3217 Lewis Ave</u> <u>Chicago 13, Ill.</u> Your Name <u>H. S. Towne</u> Your Title <u>Adv. Mgr.</u> ELECTRONICS, 330 W. 42nd St., N. Y. 18

**SAMPLE
CARD
SHOWING
CORRECT
FILL-IN**



PLACE 1¢ STAMP ON CARD • DO NOT USE AFTER NOVEMBER 1

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1. There are two postcards, each divided into four parts. Each of the four parts contains a box. You must write in this box the number that appears in this issue over the literature or new product item in which you are interested. Place one number only in each box.

2. Fill out completely (name, address, etc.) for each piece of literature or new product information you desire.

Do not say "same" in lieu of writing out full information called for when requesting more than one item.

3. This service applies only to literature and new product items in this issue. It does not apply to advertisements. Write directly to the company for information on its advertisements.

PLEASE NOTE: Requests for unnumbered items must be made direct to the manufacturer.

In the event this copy of ELECTRONICS is passed along to other members of your company, please leave this sheet in for their convenience. This assures everyone in your plant the opportunity to fill in their requests. When the round is completed, cards can then be detached along perforated lines and dropped in the mail. Each individual request will be mailed by us to the company offering the information and for that reason must be completely filled out.

Write in circle number of item describing one item wanted →

Your Company Name.....

Address.....

Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

Write in circle number of item describing one item wanted →

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Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

Write in circle number of item describing one item wanted →

Your Company Name.....

Address.....

Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

Write in circle number of item describing one item wanted →

Your Company Name.....

Address.....

Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

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Address.....

Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

Write in circle number of item describing one item wanted →

Your Company Name.....

Address.....

Your Name.....

Your Title.....

ELECTRONICS, 330 W. 42nd St., New York 18, N. Y.

An electronics service designed for READERS and MANUFACTURERS

FOR THE READER . . . ELECTRONICS fundamental policy has always been to supply its readers with all the pertinent and timely industry news. The ELECTRONICS Reader Service supplements this policy by offering the reader an easy and effective means of obtaining complete, up to the minute data on new products and of maintaining at his fingertips comprehensive, practicable information on "who's doing what" in the industry.

In every issue of ELECTRONICS there's complete coverage of the month by month development by manufacturers of new materials, components and equipment, as well as brief mention of all the important, new, manufacturers' technical pamphlets and catalogs. Some of these items will be of particular interest to specific design and plant engineers, buyers, executives and others of our readers. They will want to make further inquiry concerning the new products described or they will want to read and make a permanent part of their industrial library some of the manufacturers' literature and catalogs.

ELECTRONICS Reader Service makes it easy for them to obtain in readily accessible and usable form the information they desire.

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FOR THE MANUFACTURER . . .

ELECTRONICS Reader Service will also be welcomed by manufacturers who are desirous of placing the complete news of their product developments as well as their technical bulletins and catalogs in the hands of those members of the electronic industry . . . including design, electrical and production engineers, researchers, physicists, executives, and buyers—who have a particular interest in, or represent a potential buying power for, their products.

SUGGESTIONS FOR THE IMPROVEMENT OF OUR READERS' SERVICE ARE INVITED

ELECTRONICS is constantly seeking new and improved ways of providing its readers with the news and information they want and need, and of assisting the manufacturer in effectively delivering his message to electronic markets. If you have any ideas for us, send them along. They will receive prompt consideration.



ELECTRONICS

330 WEST 42nd STREET

NEW YORK 18, N. Y.

8-1-47



ELECTRONICS

330 WEST 42nd STREET

NEW YORK 18, N. Y.

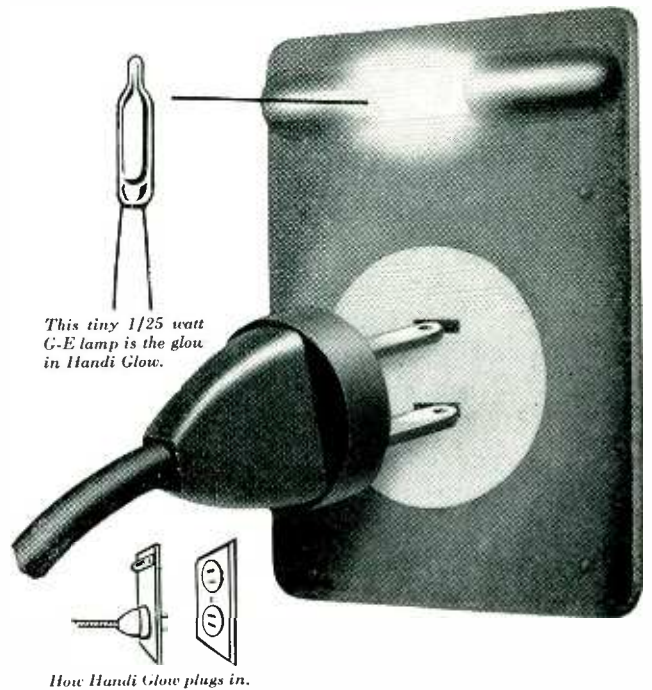
8-1-47

ELECTRONICS—August 1947

Good news for bad memories

WHAT housewife hasn't put a strain on her husband's good nature by occasionally forgetting to turn off electrical appliances? Industrial Devices, Inc., Edgewater, N. J., has an answer to that universal problem. It's Handi Glow — a simple pilot light attachment that jogs the memory with a visual reminder that the appliance is "on." Fits any standard 2-prong plug. Transfers easily from one plug to another. Also can be used as a voltage test light.

Like many other successful wiring devices, the Handi Glow is equipped with a G-E Neon Glow Lamp—"the glow that lets you know."



This tiny 1/25 watt G-E lamp is the glow in Handi Glow.

How Handi Glow plugs in.

...and it's profit news to you!

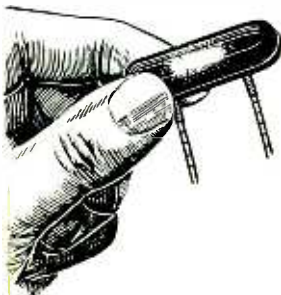
TYPICAL WIRING DEVICES USING G-E GLOW LAMPS



SAFETY PILOT PLUG combining nite-lite, 2-way plug and electric cord cap.



LIGHTED SWITCH PLATE ends fumbling. Light stays on when room is dark.



MIDGET PILOT LIGHT for permanent attachment to instrument panels and electrical apparatus.



CIRCUIT TESTER uses G-E Glow Lamps to give quick visual indication.

THESE few wiring devices merely hint at the hundreds of ways G-E Glow Lamps are used to add sales appeal to appliances, instruments and electrical equipment of many kinds. The following G-E Glow Lamp advantages may suggest a valuable profit opportunity for you, too:

1. Distinctive orange-red glow—high visibility.
2. Dependable long life—in some types up to 25,000 hours.
3. Low current consumption—as little as 1/25 watt.
4. Low brightness, low heat.
5. High resistance to shock and vibration.
6. Can be installed in small space.
7. Variety of sizes and wattages.
8. Operate directly from regular 105-125 and 210-230 volt circuits, AC or DC.

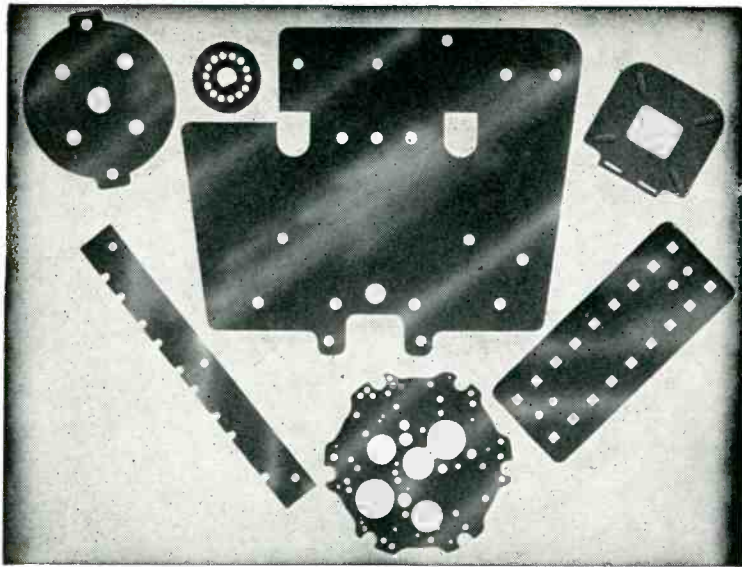
REMEMBER—Every electrical device should have a live circuit indicator. G-E Glow Lamps are ideal for this purpose.

SEND FOR free bulletin containing full information on G-E Neon Glow Lamps and their application to your product.

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GENERAL ELECTRIC

Nela Specialty Div. Lamp Dept., 1 Newark St., Hoboken, N. J.



• PLASTIC FABRICATING •

PUNCHED AND FABRICATED PARTS, SPEED AND ACCURACY IN TOOL CONSTRUCTION AND PRODUCTION REQUIREMENTS

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Over 20 years of fabricating experience

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12 VESTRY ST.,

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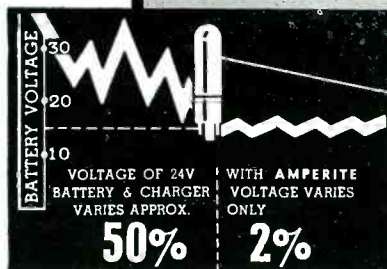
THERMOSTATIC METAL TYPE DELAY RELAYS

PROVIDE DELAYS RANGING
FROM 1 TO 120 SECONDS

FEATURES:—Compensated for ambient temperature changes from -40° to 110° F . . . Hermetically sealed; not affected by altitude, moisture or other climate changes . . . Explosion-proof . . . Octal radio base . . . Compact, light, rugged, inexpensive . . . Circuits available: SPST Normally Open; SPST Normally Closed.

PROBLEM? Send for "Special Problem Sheet" and Bulletin.

AMPERITE REGULATORS



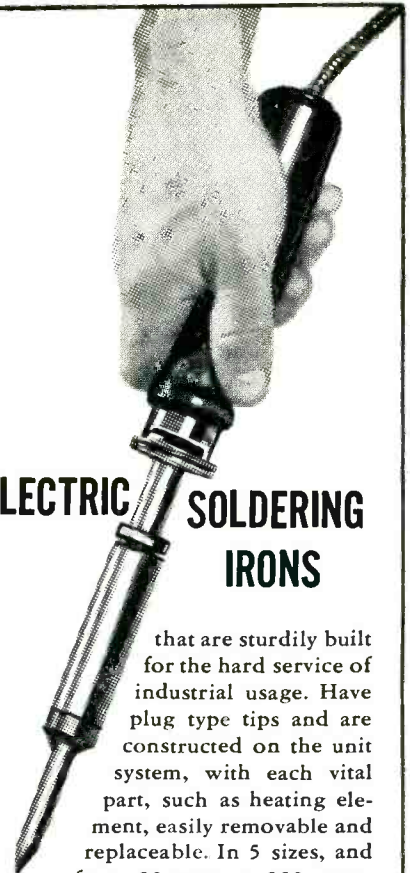
Amperite REGULATORS are the simplest, lightest, cheapest, and most compact method of obtaining current or voltage regulation . . . For currents of .060 to 8.0 Amps . . . Hermetically sealed; not affected by altitude, ambient temperature, humidity.

Write for 4-page Illustrated Bulletin.

AMPERITE CO., 561 Broadway, New York 12, N. Y.

In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto

ELECTRIC SOLDERING IRONS

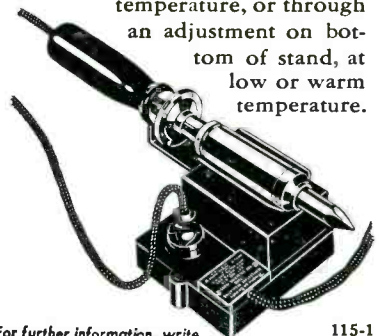


that are sturdily built for the hard service of industrial usage. Have plug type tips and are constructed on the unit system, with each vital part, such as heating element, easily removable and replaceable. In 5 sizes, and from 50 watts to 550 watts.

American Beauty

TEMPERATURE REGULATING STAND

This is a thermostatically controlled device for the regulation of the temperature of an electric soldering iron. When placed on and connected to this stand, iron may be maintained at working temperature, or through an adjustment on bottom of stand, at low or warm temperature.



For further information, write

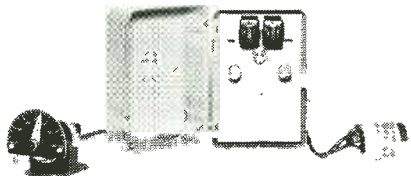
115-1

**AMERICAN ELECTRICAL
HEATER COMPANY**
DETROIT 2, MICHIGAN
established 1894

volts in one to three circuits are being manufactured for door-interlock and similar use. Special units for higher voltages are available on order.

Positioning Control (35)

GENERAL ELECTRIC Co., Schenectady, N. Y. A new electronic positioning control available in packaged form consists of a control sta-



tion, follow-up device (either a selsyn or potentiometer), and a control panel. The system can be used as it stands for drives up to 1½ horsepower.

Crystal Cartridge (36)

THE BRUSH DEVELOPMENT Co., 3405 Perkins Ave., Cleveland 14, Ohio. The new BR-903 PN crystal phonograph pickup cartridge has



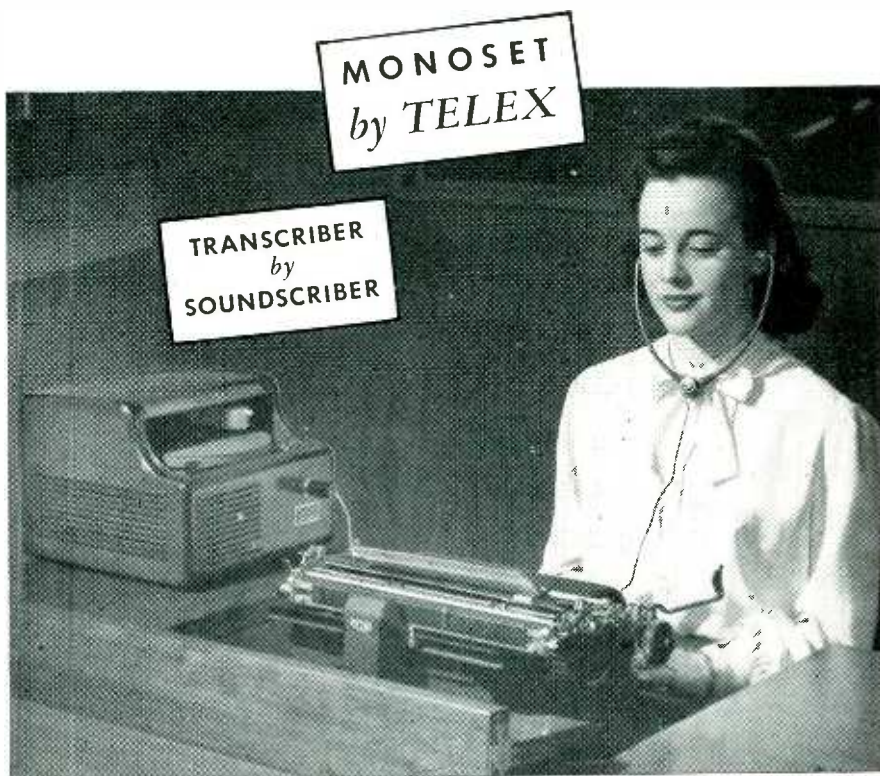
been engineered to withstand heat and humidity to a much greater extent than the standard line of crystal pickups, even to the extent of being servicable after boiling in water.

Photoelectric Counter (37)

RIPLEY Co., Inc., Middletown, Conn. The No. 153 photoelectric counter, operating on a 115-volt, 60-cycle cur-



TEAMED FOR
PERFECT HEARING COMFORT



• Here's beautiful efficiency: the TELEX MONOSET teamed with the SoundScriber to increase transcribing speed and comfort!

The TELEX MONOSET is the modern answer to many similar headphone requirements because:

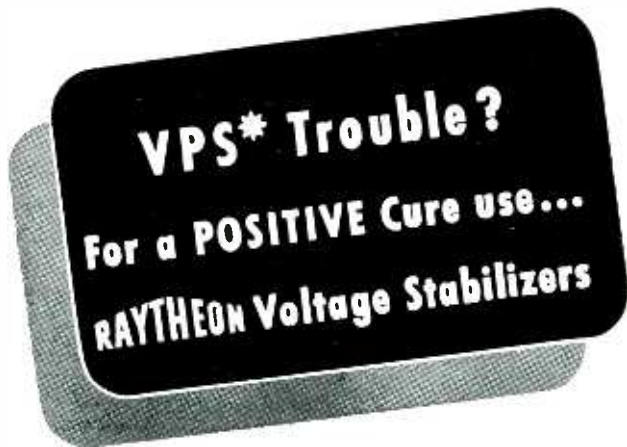
- The MONOSET ends ear fatigue by sensible under-the-chin design.
- The MONOSET can be worn comfortably for hours—it weighs only 1.2 oz.
- The MONOSET's new built-in volume control allows convenient adjustment of signal to user.

Precision engineering gives the TELEX MONOSET excellent fidelity. Its rugged design invites a wide variety of commercial and laboratory applications.

Write Department AO for information and quotations. We'll be happy to show you how the TELEX MONOSET can become part of your team for perfect hearing comfort.

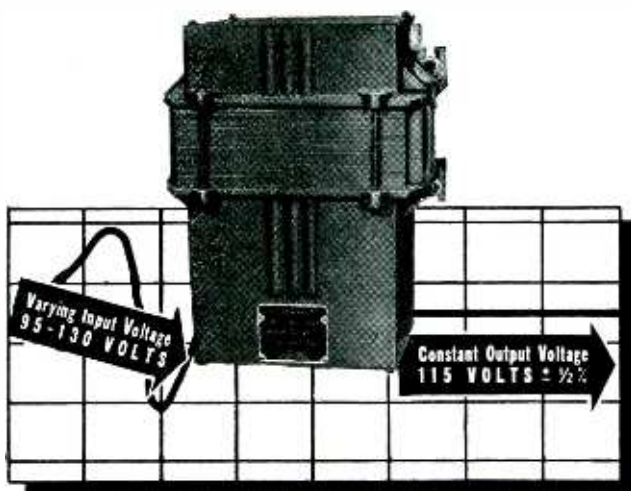
Canadian Distributors:
Addison Industries, Ltd., Toronto





***Varying Power Supply** need *not* prevent efficient, reliable and accurate performance of electrically operated equipment. A Raytheon Voltage Stabilizer of correct characteristics and capacity built into new equipment, or installed on old, provides constant output from varying input. Assure reliable and accurate performance of *your* equipment through *positive control* of power supply. Ask about Raytheon Voltage Stabilizers to meet *your* requirements.

Write for illustrated Bulletin DL-47-537



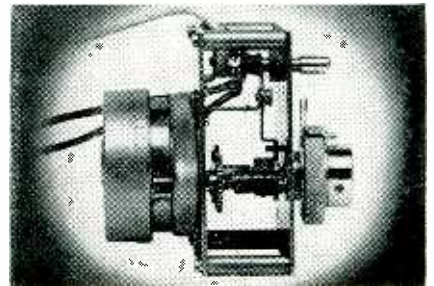
- OUTPUT VOLTAGE CONTROLLED to within $\pm 1/2\%$.
- STABILIZATION AT ANY LOAD within rated capacities.
- QUICK RESPONSE...varying input voltage stabilized within 1/20 second.
- ENTIRELY AUTOMATIC...no adjustments, no moving parts, no maintenance.



rent, is designed to meet industry's need for a compact, easily installed, packaged unit. An aperture in the housing permits setting for various light intensities.

Industrial Reset Timer (38)

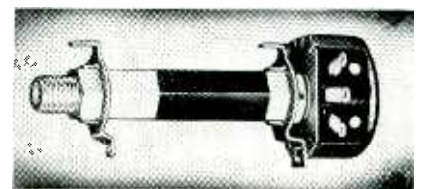
AMERICAN TIME CORP., Springfield 1, Mass. The P 147-60 panel mounted reset timer can be furnished in time cycle ranges from 15 seconds to 30 minutes and has a



1,500-watt control capacity directly on its contacts. The synchronous motor used to drive the timing mechanism can be made to shut off before the maximum time interval for which the switch is designed, by means of an adjustable stop.

Standoffs (39)

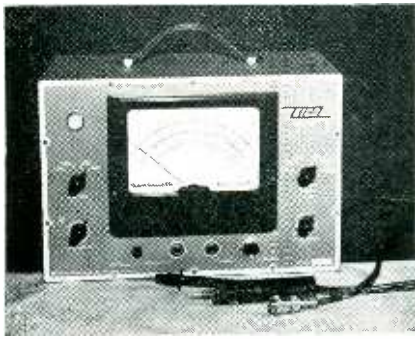
THE WINCHESTER CO., 6 East 46th St., New York 17, N. Y. A complete line of small standoff terminals designed to replace more cumbersome mounting boards is now available,



as well as 4-contact miniature connectors and the mounting control illustrated for high-voltage circuits. The type 401 control standoff fits all standard variable resistors.

V-T Voltmeter (40)

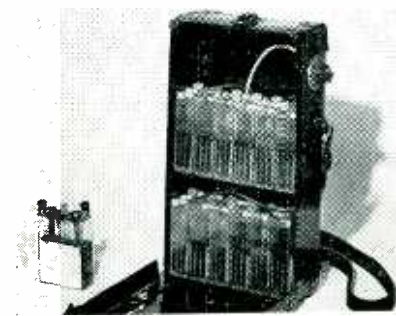
ELECTRONIC INSTRUMENT Co., 926 Clarkson Ave., Brooklyn 3, N. Y. The model 210 vacuum tube voltmeter and visual signal tracer measures d-c up to 5,000 volts and a-c up to 1,000 volts. Resistance



from 0.1 to 1,000 megohms is measured in six ranges. A new type uhf diode is used for a-c rectification and one probe is employed for all a-c readings.

Nonspill Storage Battery (41)

ELECTRONIC BATTERIES, INC., Bush Terminal Bldg. No. 4, 28-34 Thirty Fifth St., Brooklyn 32, N. Y. The Sturges 24-volt power pack illustrated contains two 12-volt Type 125-S batteries in series. They are



entirely spill-proof and do not spray acid. Such assemblies are particularly designed for use with electronic equipment in the field.

Three-Band Portable (42)

BENDIX RADIO, Baltimore 4, Md. A new portable receiver is now avail-



RACON

Speakers — Horns — Horn Units

are the finest and most dependable for every conceivable PA installation



PM HORN UNIT

RACONS leadership in sound reproducer engineering has been recognized for almost three decades. RACON driver units have a rated output for peak and continuous performance far in excess of any other brands — continuous operating capacity 30 watts, peak capacity 60 watts. RACON speakers and driving units require less energy input yet they deliver more efficient sound reproduction output.



RE-ENTRANT TRUMPET

All claims made by RACON as to cutoff frequencies and acoustic lengths of speakers, power handling capacity, efficiency and frequency range of driver units are substantiated by tests made at laboratories recognized as the foremost in the industry.

Only RACON makes speakers with Racon Acoustic Cloth which is processed by a patented method giving a non-vibratory wall, thereby increasing the output of the horn without loss due to wall vibration. Supplied as a part of all re-entrant horns, and on all straight horns when so ordered. Stormproof types are guaranteed for life in all kinds of weather and temperature, regardless of climatic conditions.



There is a RACON driving unit, trumpet or speaker for every conceivable sound application—also the accessories (brackets and housings) that may be required for special purposes. It pays to choose and use a speaker line that is complete.

Send for Our Free Catalog which Describes Our Line Of:

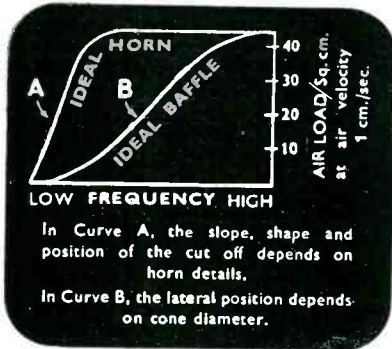
- | | | |
|---------------------|-------------------|-------------------------|
| Alnico PM Units | Standard PM Units | Straight Trumpets |
| Armoured Projectors | Radial Horns | Reentrant Trumpets |
| Demountable Horns | Cellular Horns | High-Frequency Tweeters |

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VOIGT

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FOR VERY VERY EXPENSIVE HORN LOADED LOUDSPEAKERS WHEN NEXT IN LONDON, ENGLAND

It will be noted that with a baffle, the air load varies throughout the scale. With an ideal HORN (is there such a thing?) the load presented to the diaphragm can be CONSTANT over most of the scale.

THE WISE MAN REMEMBERS



Just one reason why Voigt speakers (even the domestic types) have always been HORN LOADED

We are not yet in post war production. Don't write now—just remember the full name.

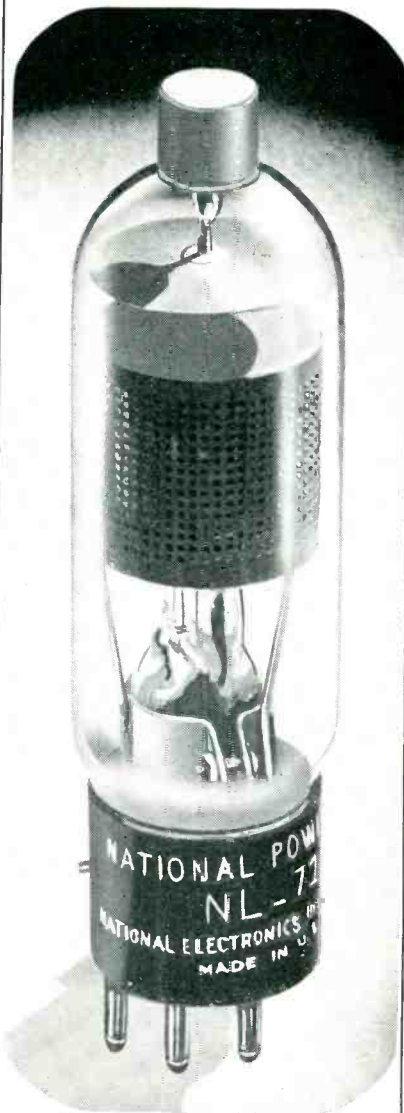
VOIGT PATENTS LIMITED



Design registered at British Patent Office in 1935 No. 802581

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NL - 710

2.5 amps dc - 30 amps peak

Also a complete line of Thyratrons and gaseous rectifiers, 1/2 to 20 amperes, full-wave and half-wave.

WRITE FOR TECHNICAL DATA BOOK

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Materials for potting, dipping or impregnating all types of radio components or all kinds of electrical units. • Tropicalized fungus proofing waxes. • Waterproofing finishes for wire jackets. • Rubber finishes. • Inquiries and problems invited by our engineering and development laboratories.

Zophar Mills, Inc. has been known for its dependable service and uniformity of product since 1846.

ZOPHAR MILLS, Inc.

ESTABLISHED 1846

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able for operation from a self-contained battery pack or 115-volt a-c or d-c supplies. The receiver covers the frequency ranges 195 to 410, 540 to 1620, and 2,000 to 5,800 kc. A range filter is built in for reception of weather reports in the aircraft band.

I-F Transformers (43)

SPECIAL PRODUCTS Co., Silver Springs, Md. Specoils are a specialized line of i-f transformers designed particularly for f-m and television receivers. Optimum gain



is attained with flat bandwidth and steep skirts. They are housed in cans $1\frac{1}{2}$ inches in diameter and $1\frac{1}{8}$ inches high.

Folded Dipole F-M Antenna (44)

WARD PRODUCTS Co., 1523 E. 45th St., Cleveland 3, Ohio. Both the folded and straight dipole f-m antennas for use in the 44-88 mc tele-



vision range are available with or without the reflector kit. Complete information can be obtained from the company.

Vacuum Capacitor (45)

UNITED ELECTRONICS Co., Newark, N. J. The type CAP 50/-60/-30 vacuum capacitor is the first of a series for high-frequency application. All metal parts are copper and all junc-

NOW... Electrical Impulse Measurement from D. C. to 100 Cycles per Second!

Brush Single-Channel Magnetic Oscillograph with amplifier. Especially suited for strain gauge, temperature and similar recordings.

Brush Oscillographs make direct-inking recordings

Brush Magnetic Oscillographs may be used for making detailed recordings of electrical impulses for an almost limitless number of applications. The Magnetic Pen Motor is capable of recording a D.C. signal. Used with the BL-905 amplifier, the frequency range is from .2 to 100 cycles per second. Recordings are direct, instantaneous, ink-on-paper graphs. Can be used for recording strains, pressures, vibrations, temperatures, light intensity and countless other phenomena.



Brush Double-Channel Magnetic Oscillographs for use where two simultaneous recordings are desired — as in synchronizing problems.

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CURRENTLY FROM
SORENSEN
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 Manufacturers of
 VOLTAGE REGULATORS, NOBATRONS & ELECTRONIC APPARATUS



POWERFUL NEWS!

SORENSEN SYSTEM NOW APPLIED TO DC VOLTAGE REGULATION

The Sorensen system of AC electronic voltage regulation provides quick, accurate response to even the smallest voltage change with a minimum wave distortion and a regulation accuracy of 1/2 of 1%.

Arrange now to receive your personal copy of the Sorensen electronics journal "Currently", published bi-monthly.

This same electronic regulation system has been incorporated into the Nobatron, providing a source of regulated DC voltage at currents and stabilities that, in the

past, was available only with batteries.

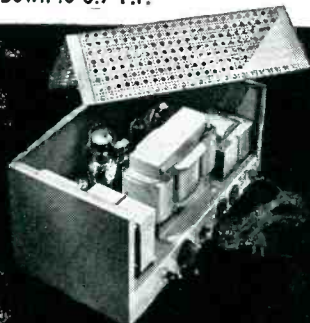
This new source of stabilized DC voltage is obtainable in six standard models operating on a 95-125 AC source of 50 to 60 cycles.

Among the more important uses for Nobatrons are DC ammeter calibration in experimental and quality control laboratories, testing of components in the automotive and aircraft industries in battery-operated relays and in other applications where it is desirable to replace a battery to guarantee continuous regulated power supply.

GENERAL AC REGULATOR SPECIFICATIONS

Input Voltage Range	(-1 model) .. 95-125
	(-2 model) .. 190-250
Output Voltage Range	(-1 model) .. 110-120
	(-2 model) .. 220-240
Load Range 25-30,000 V. A.
Regulation Accuracy 1/2 of 1%
Harmonic Distortion 5% Max. (2% in "S" Models)
Input Frequency Range 50-70 cycles
Inductive Power Factor Range Down to 0.7 P.F.

For standard voltage regulation, Sorensen Model 500 is a proven leader in its field—compact, accurate and dependable. This model typifies the Sorensen line of AC and Nobatron all-purpose voltage regulators. Let a Sorensen engineer help you with your next voltage regulation problem.



SORENSEN & COMPANY, INC.
375 FAIRFIELD AVENUE • STAMFORD, CONNECTICUT



tions are hard-brazed. Large cylindrical electrodes give low inductance. End caps are goldplated. Overall dimensions for the 50-micromicrofarad, 30-kilovolt type are 2 1/2 by 6 1/2 inches.

Mike Stand

(46)

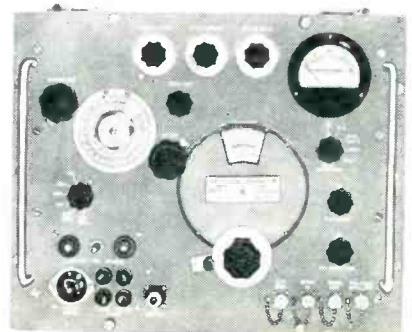
ATLAS SOUND CORP., 1451 39th St., Brooklyn, N. Y. The model CS-1 microphone stand can be collapsed



to a total length of 23 inches. Leg braces are above the legs themselves to avoid obstruction.

Kilomegacycle Generator (47)

HEWLETT-PACKARD Co., Palo Alto, Calif. The model 616A uhf signal generator is a laboratory standard for use in the range between 1,800 and 4,000 mc. It provides direct-reading frequency and voltage scales, with c-w, f-m, pulsed or de-



laid pulse output. It utilizes a resonant-cavity reflex klystron oscillator. Output from 0.1 volt to 0.1 microvolt r-f can be obtained.

Geiger Counter Battery (48)

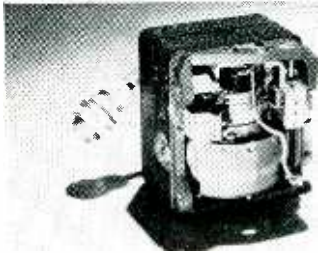
NATIONAL CARBON Co., New York, N. Y. The model 493 battery has been expressly adapted as a source of energy for Geiger counter radia-



tion measurement devices. It supplies 300 volts, and with nominal use during four hours each day will give service for about 350 hours.

D-C Rate Gyro (49)

FAIRCHILD CAMERA AND INSTRUMENT CORP., 88-06 Van Wyck Blvd., Jamaica 1, N. Y. A precision d-c rate gyro now available is an angular rate-measuring device for appli-

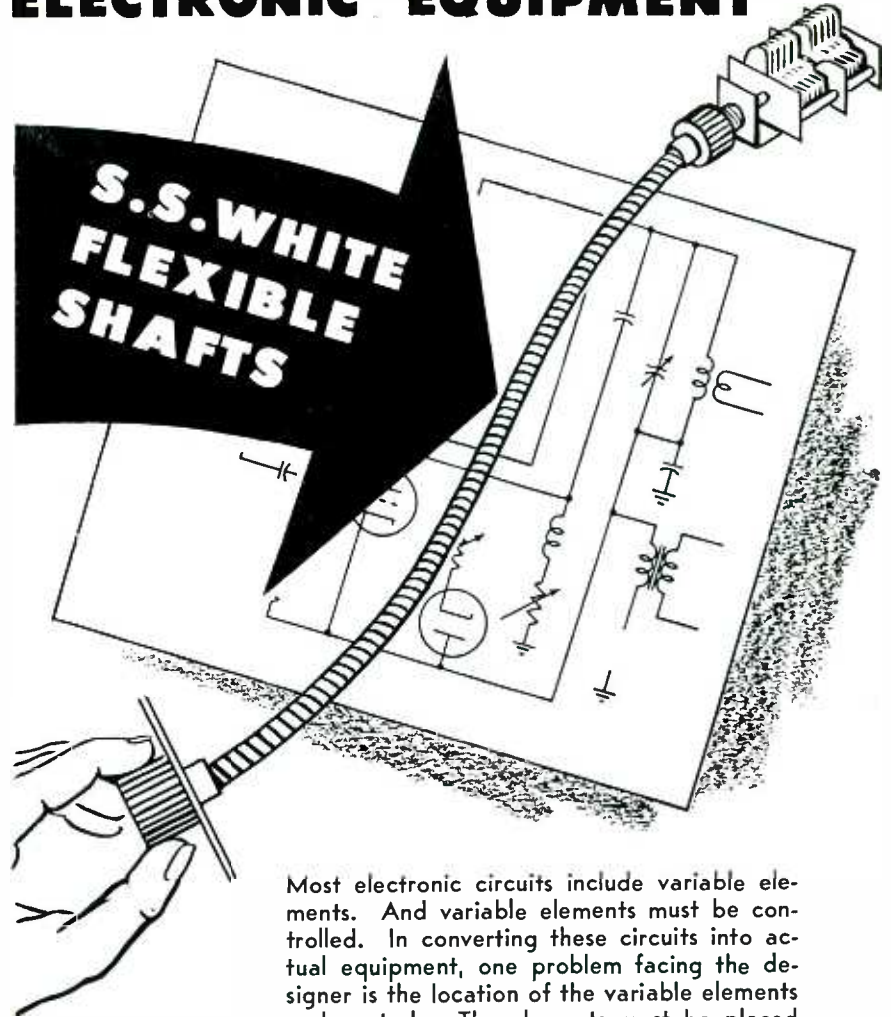


cations in which accurate measurements are required for control purposes. Such applications include telemetering, speed control, and computing systems. Full information on the device is available.

Mobile Communications (50)

ECKSTEIN RADIO AND TELEVISION Co., 914 La Salle Ave., Minneapolis 2, Minn. The model 80A receiver is designed for amateur use, but will receive the standard broadcast band. Model 80B covers the ranges 190 to 450 kc, the broadcast band,

THEY EASE THE DESIGN OF ELECTRONIC EQUIPMENT



Most electronic circuits include variable elements. And variable elements must be controlled. In converting these circuits into actual equipment, one problem facing the designer is the location of the variable elements and controls. The elements must be placed for optimum electrical efficiency and ease of assembly and wiring—the controls, for operating convenience and harmonious panel arrangement.

Engineers will find a ready answer to this problem in S.S.White remote control flexible shafts. Simply use these shafts as couplings between the variable elements and their control dials. Then you are free to place both the elements and the dials where you want them. And as for performance, these shafts operate as easily and smoothly as a direct connection. They're engineered expressly for the job.

WRITE FOR THIS FLEXIBLE SHAFT HANDBOOK

260-pages of facts and technical data about flexible shafts and how to apply them. A copy sent free if you write for it on your business letterhead and mention your position.



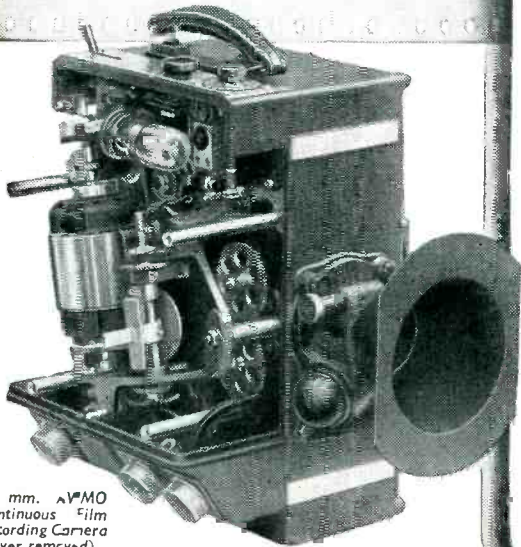
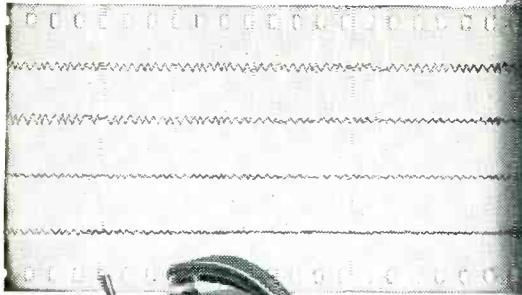
S.S. WHITE INDUSTRIAL
 THE S. S. WHITE DENTAL MFG. CO. DEPT. E 10 EAST 40th ST., NEW YORK 16, N. Y.



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4 Oscillograph traces on 76 mm. paper.



35 mm. AVIMO Continuous Film Recording Camera (cover removed).

9016E

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The behaviour of moving parts under actual working conditions may be studied by means of standard commercial oscillographs, which translate mechanical or electrical variations into evanescent traces on a fluorescent screen. Avimo cameras record these traces on continuous film or paper, so that they may be subsequently checked, examined, and measured.

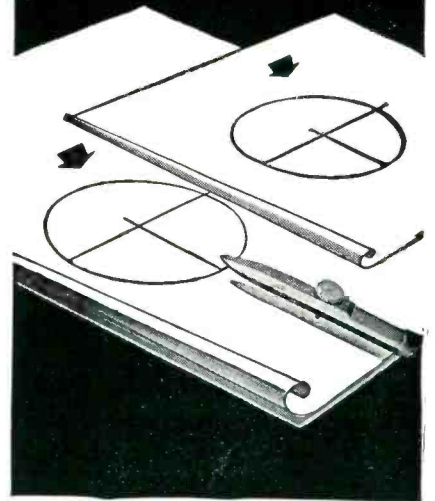
Write for full details of AVIMO Cameras including types with built-in cathode ray tubes.



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● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.



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● Much of the success of this Hudson Wire product is due to a new coating method that gives a smooth, permanently-adherent enameling. Mercury-process tests guarantee perfect uniformity; great tensile strength assures perfect laying even at high winding speeds. Especially adaptable for reduction in coil dimensions without sacrificing electrical values.

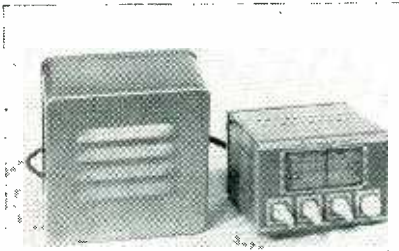
Our engineering and design facilities are at your disposal—details and quotations on request.

HUDSON WIRE COMPANY

Winsted Division

WINSTED

CONNECTICUT



2.4 to 6.8 mc, and is therefore suitable for aircraft use. Another model is available for commonly used broadcast frequencies in foreign countries. The equipment is specifically packaged for car use and has a sensitivity of better than 5 microvolts for 0.5 watt output on all frequencies.

Artificial Ear (51)

MASSA LABORATORIES, Inc., 3868 Carnegie Ave., Cleveland 15, Ohio. The model M-112 artificial ear coupler is a two-piece stainless steel structure providing either a 2 or 6



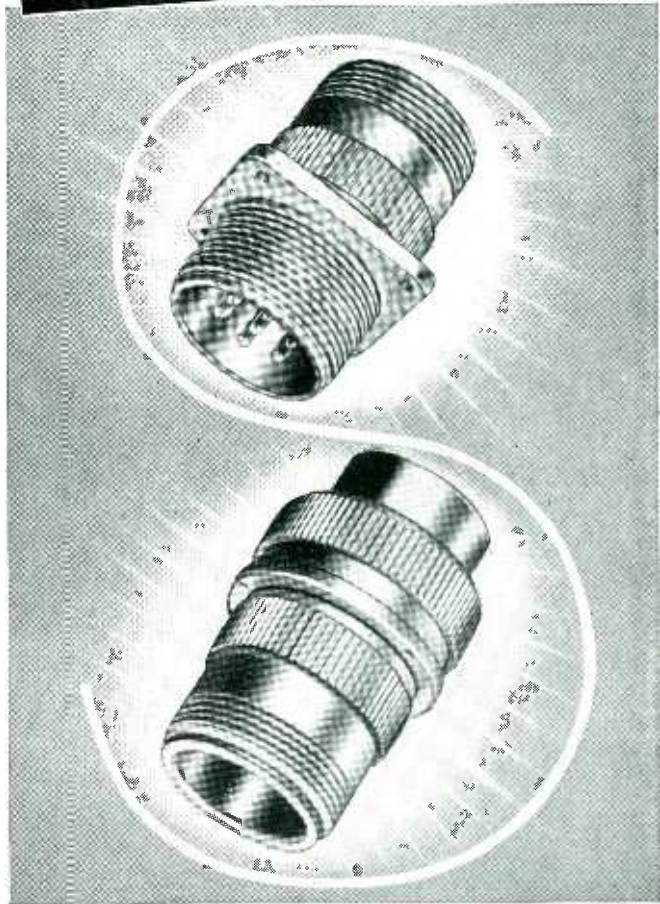
cubic centimeter chamber for obtaining response characteristics of earphones. It has been designed to fit the microphone end of the GA-1002 sound pressure measurement equipment.

Cordless Soldering Tool (52)

KWIKHEAT DIV., Sound Equipment Corp. of Calif., Glendale, Calif. The pencil-type cordless soldering tool illustrated holds its temperature for useful work about a minute and re-



THE SECRET IS
SCINFLEX



Bendix-Scintilla Electrical Connectors

The Finest Money Can Build or Buy!

Wherever quality is called for, Bendix-Scintilla* Electrical Connectors are the logical choice. These precision-built connectors set a new standard of efficiency with their remarkable simplicity and low electrical resistance. The secret is Scinflex—a new Bendix-Scintilla-developed dielectric material. It lessens the tendency towards flash-over and creepage, and makes possible efficient performance from -67° F. to $+300^{\circ}$ F. Dielectric strength is not less than 300 volts per mil. The contacts, made of the finest materials, carry maximum currents with the lowest voltage drop known to the industry.

*TRADEMARK

- Moisture-proof, Pressure-tight
- Radio Quiet
- Single-piece Inserts
- Low Electrical Resistance
- Vibration-proof
- Minimum Weight
- High Arc Resistance
- Easy Assembly and Disassembly

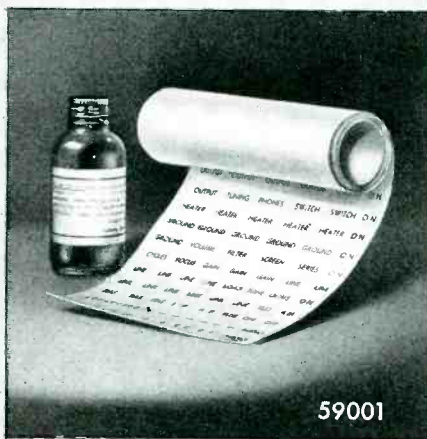
SCINTILLA MAGNETO DIVISION of
SIDNEY, NEW YORK



Designed for



Application



59001

**The No. 59001
PANEL MARKING
TRANSFERS**

The panel marking transfers have 1/8" white block letters. Special solution furnished. Must not be used with water. Equally satisfactory on smooth or wrinkle finished panels or chassis. Ample supply of every conceivable word or marking required for amateur or commercial equipment.

**JAMES MILLEN
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MAIN OFFICE AND FACTORY
MALDEN
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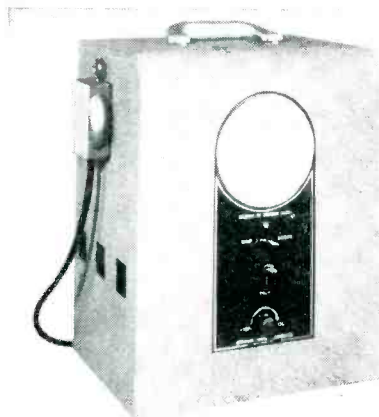
NEW PRODUCTS

(continued)

heats in 20 seconds after reinsertion in the heater receptacle. The receptacle can be screwed into any Kwikheat soldering iron.

Marine Radiophone (53)

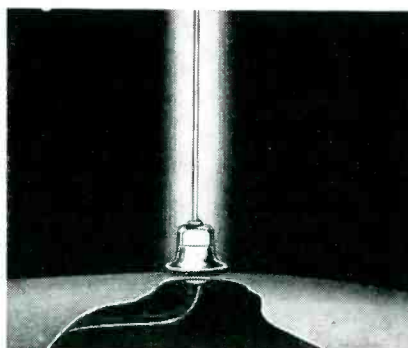
JEFFERSON-TRAVIS, Inc., 111 Eighth Ave., New York 11, N. Y. The model 52 portable marine radiotelephone has a carrier power output of over 5 watts in the frequency range 2 to 3 mc. Both the two



transmitter channels and the receiver are crystal controlled. A non-spillable 6-volt storage battery is furnished and charging apparatus for use on 117 volts 60 cycles is built in.

Mobile Antenna (54)

H. H. BUGGIE AND Co., Toledo 1, Ohio. A new antenna for mobile radio service requires only a single-hole mounting for a waterproof seal



and is designed so as to minimize mismatch between cable and antenna.

Small Motor (55)

GLEASON-AVERY, INC., Auburn, N. Y. A new 4-pole single-phase shaded



Here's the
**INSIDE
STORY**

★ Clarostat originated and pioneered the tube-type or plug-in resistor widely used in radio-electronic and other compact assemblies. And Clarostat is still the only one offering these features:

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- GLASOHMS FOR MAIN LOADS
- POSITIVELY CENTERED SUPPORT
- WINDINGS CANNOT SAG OR SHORT
- POSITIVELY CHAR-PROOF
- ADEQUATE SAFETY FACTOR

Remember this inside story when buying or specifying tube-type resistors. Don't be satisfied with less! Bulletin No. 107, with complete engineering data, sent on request.

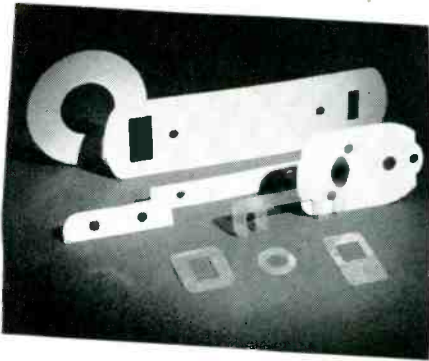


CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N. Y.

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PLASTICS



**QUALITY and SERVICE
AT A PRICE
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*

Years of experience in fabricating parts and products of plastics make Silcocks-Miller an ideal source for developing practical and economical answers to your individual needs.

These specialists in precision-fabrication can serve you in four ways: *First*, in working out your own ideas. *Second*, in developing new ideas for you. *Third*, in counseling with you on the most practical and economical methods of fabrication. *Fourth*, in selecting the plastic material best-suited to the job. You couldn't select a more dependable source for quality and service, at a price that's right.

Write for illustrated booklet or phone South Orange 2-6171 for quick action.

THE SILCOCKS-MILLER CO.

10 West Parker Avenue, Maplewood, N. J.
Mailing Address: South Orange, N. J.

**SPECIALISTS IN HIGH QUALITY, PRECISION-MADE
PLASTICS FABRICATED FOR COMMERCIAL,
TECHNICAL AND INDUSTRIAL REQUIREMENTS.**

ELECTRONICS — August, 1947

ELECTRIC GLUE POTS

ALL ALUMINUM

by

VULCAN

WATER JACKET TYPE

THERMOSTAT CONTROL

Heavy cast aluminum with attached base.

Inside pot or bowl also aluminum

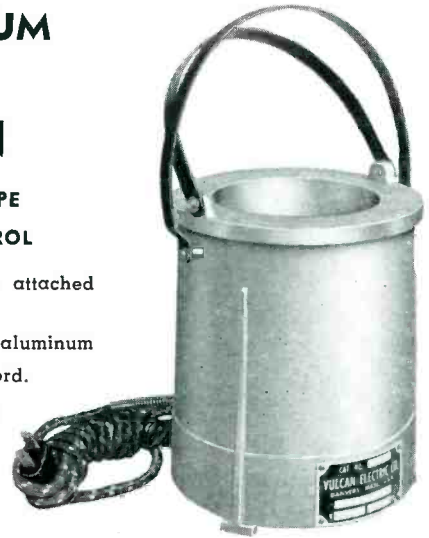
Underwriters' listed heater cord.

110-125 OR 220-230 VOLTS

AC OR DC

FOUR SIZES

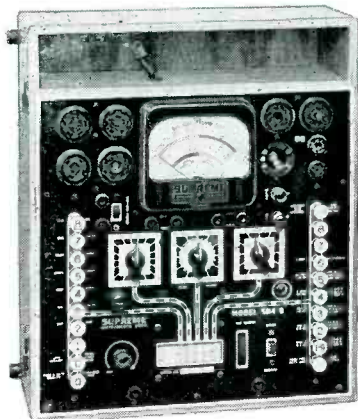
One Pint to Four Quarts



**VULCAN ELECTRIC COMPANY
DANVERS MASS.**

Makers of a wide variety of Heating Elements for assembly into manufacturer's own products and of Heating Specialties that use electricity.

MORE, BETTER JOBS PER DOLLAR.



SUPREME 504-B TUBE AND SET TESTER—

the portable lab that gives you everything.

**ASK YOUR SUPREME
JOBBER FOR A FREE
DEMONSTRATION**



**WRITE
TODAY FOR
New
CATALOG**

HERE'S WHY AND HOW

- **METER**—large 4-inch square-face meter, 500 microampere.
- **SPEED**—push-button operated.
- **FLEXIBLE**—simple, yet Universal Floating Filaments feature insures against obsolescence.
- **SIMPLICITY**—roll chart carries full data for tube setting. No roaming test leads when using multi-meter—only push a button.

SPECIFICATIONS

DC VOLTS—1000 Ohms per volt: 0-5-25
100-250-500-1000-2500.
AC VOLTS—0-5-10-50-250-1000.
OUTPUT VOLTS—0-5-10-50-250-1000.
OHMMETER—0-200-2000-20,000 Ohms.
0-2-20 Megohms.

Condenser Check:

Electrolytics checked on English reading scale at rated voltages of 25-50-100-200-250-300-450 volts.

Battery Test:

Check dry portable "A" and "B" batteries under load.

SUPREME

EXPORT DEPT.: The American Steel Export Co., Inc.
347 Madison Ave., New York 17, N. Y., U. S. A.

SUPREME INSTRUMENTS CORP., Greenwood, Miss., U. S. A.



**SPECIALLY DESIGNED TO MEET
INDIVIDUAL STATION NEEDS!**

Western Electric CUSTOM-BUILT CONSOLES

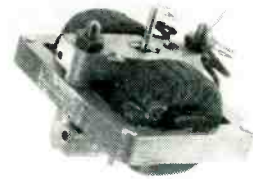
Western Electric specialists will work closely with your station engineers to provide speech input consoles tailored to your *exact* needs. Standard Western Electric components are combined into the circuit arrangements and cabinet designs you want—assuring a new high in utility, versatility, and attractive appearance. For details, write Graybar Electric Co., 420 Lexington Ave., New York 17, N. Y., or ...

WHAM
Rochester, N. Y.
has four like this.

ASK YOUR LOCAL **GraybaR**
BROADCAST REPRESENTATIVE

NEW PRODUCTS

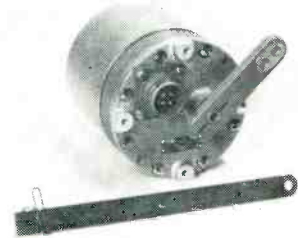
(continued)



pole induction motor, type B-30-A is a standard item for 24-volt, 60-cps use but it can also be furnished for 115-volt operation. Further details on this 1 inch-ounce torque unit are available from the manufacturer.

Rotary Actuator (56)

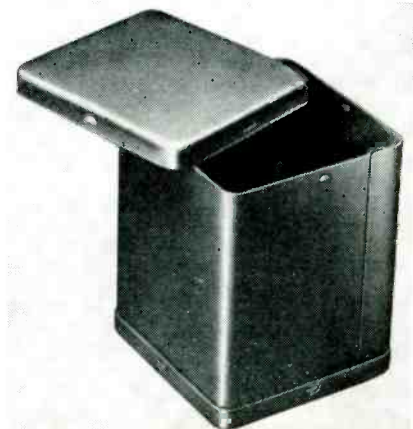
GLOBE INDUSTRIES, INC., 125 Sunrise Place, Dayton 7, Ohio. Built to deliver high torque at low speed, the Rotary Actuator weighs less than 2 pounds and is available in 24, 12 or



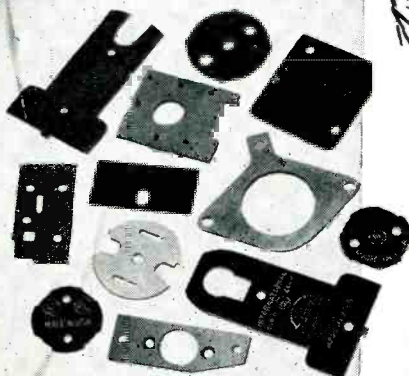
6-volt d-c sizes. The motor used is a permanent magnet type which facilitates dynamic braking and reversal.

Transformer Cans (57)

OLYMPIC TOOL & Manufacturing Co., Inc., 39 Chambers St., New



Baer*
offers accurate fabrication of
phenol and vulcanized fibre!



**SEND BLUEPRINTS
AND SPECIFICATIONS—
NO OBLIGATION!**

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.

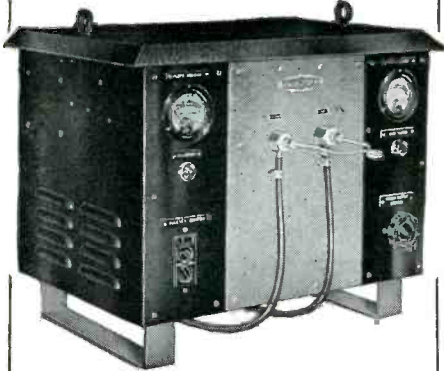
LITERATURE ON REQUEST

**N. S. BAER
COMPANY**

MONTGOMERY ST., HILLSIDE, N. J.

* Baer facilities are unexcelled for stamping, punching, drilling, tapping, shaving, milling shearing and sawing.

NOW— A QUALITY 2-KW INDUCTION HEATING UNIT



For Only **\$650.**

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . .
Economical Standardization of Unit
Makes This New Low Price Possible

This compact induction heater saves space, yet performs with high efficiency. Operates from 110-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 \$650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following range of Power: 1-3-5-7½-10-12½-15-18-25-40-60-80-100-250KW.—and range of frequency up to 300 Megs. depending on power required.

*Scientific
Electric*

Division of
"S" CORRUGATED QUENCHED GAP CO.
107 Monroe St., Garfield, N. J.

MODEL No. 300-A

**MILFORD
FASTENING
EQUIPMENT**

**FOR EXTRA
HEAVY DUTY**

sets semi-tubular or split rivets
in such diverse assemblies as
**WASHING MACHINES
STEAM PUMPS
SKATES • SAWS
REFRIGERATORS
CHAINS, etc.**

Here is another of Milford's 15 standard models of rivet-setters for assemblies ranging from wrist-watch bracelets to refrigerators. Every single Milford rivet-setter has more than paid for itself either in cutting costs of assemblies or completing them faster. For any fastening need, check with Milford—for ideas to save time or cut costs.

**THE MILFORD RIVET
& MACHINE CO.**

859 Bridgeport Avenue, Milford, Conn.
1002 West River Street, Elyria, Ohio
Inquiries may also be addressed to our subsidiary:
THE PENN RIVET & MACHINE CO., PHILADELPHIA 33, PENNA



YOU SEE IT

This new Signaling Timer electrically controls time intervals of industrial processes with laboratory exactness. When the interval is started, a red pilot light goes on. During the interval a pointer shows the exact time elapsed.



YOU HEAR IT

At the end, the controlled circuit is automatically opened or closed and a buzzer sounds. Sockets allow additional lights or buzzers in remote locations.

If you need accurate timing—plus visual and audible signal attention, write us today for literature on the versatile new Series S Signaling Timer. There is a model for your particular interval, voltage and frequency requirements.

INDUSTRIAL TIMER CORPORATION
111 EDISON PLACE • "KNOWN THE WORLD OVER" NEWARK, N. J.
Over 400 Types of Timers for Industry





Harvey has the NEW Rek-O-Kut developments. The NEW "Master-Pro" overhead mechanism with a mechanical spiraling device. This foolproof mechanism enables you to cut a spiral up to 3/16" pitch with no danger of making an overcut due to the two over-running clutches.



MODEL M-5S with magnetic cutter. \$215.00
MODEL M-5, less spiraling device. \$175.00

NEW Portable Case

Here is the new portable case for Rek-O-Kut recording equipment. Drilled for the Model V recording turntable, with a special drawer for storing the overhead mechanism when not in use.



MODEL P-11 Portable Case.....\$ 59.00
MODEL V Standard Turntable..... \$165.45
V-DELUXE Turntable with Mastermatic speed shift.....\$195.45

NEW Cabinet Console

Here is a cabinet console for transcriptions, designed to take the Rek-O-Kut Model G turntable, and with capacity for storing approximately 100 16-inch records. It has four leveling legs and a unique method of mounting to reduce rumble.



MODEL C-7 Console Cabinet\$129.00
MODEL G-2 Transcription Turntable \$125.00
MODEL G-2 Deluxe with Mastermatic Speed Shift.....\$155.00

NOTE: All prices FOB N.Y.C. and subject to change without notice.

Telephone: **hrc** LO. 3-1800



NEW PRODUCTS

(continued)

York 7, N. Y. A new feature, the snap-lock, has been added to the company's standard transformer cans. This improvement allows more space inside the can, and also saves much assembly time for the user.

Traffic Radar (58)

AUTOMATIC SIGNAL DIVISION, Eastern Industries, Inc., Norwalk, Conn. Compact and portable equipment weighing only about 45 pounds is used in traffic surveys to check car



speeds from 0 to 100 miles an hour to an accuracy of 2 miles. The device uses a microwave radar transmitter-receiver and can be employed to measure the speed of any object that has appreciable area and motion.

Improved Sweep Oscillator (59)

KAY ELECTRIC Co., East Orange, N. J. The Mega-Sweep oscillator, Model 2, incorporates several new features, such as carrier frequency increase to 1,000 megacycles; low



amplitude modulation while sweeping, less than 0.1 db per megacycle; a wave meter provides metering from 1 to 1,000 megacycles.

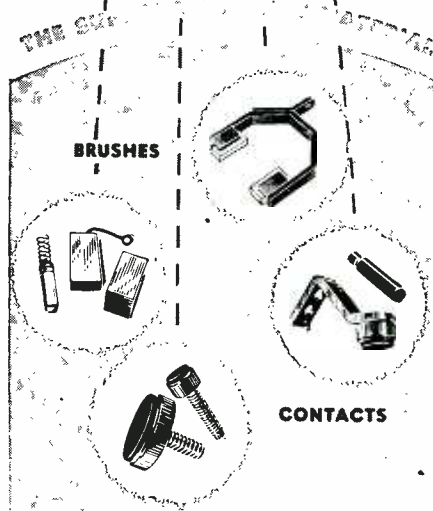
Ceilometer (60)

GENERAL ELECTRIC Co., Schenectady, N. Y. A complete ceilometer system consists of a mercury-arc projector, photoelectric detector, and a recorder that keeps a continu-



For extraordinary electrical performance

Use SILVER GRAPHALLOY*



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

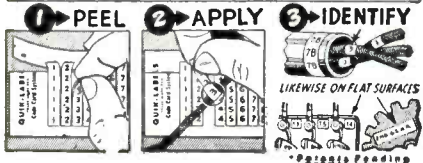
GRAPHITE METALLIZING CORPORATION

1055 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

QUIK-LABELS CODE CARD SYSTEM



**FREE
SAMPLES**



QUIK-LABELS

Mark Your Wires Faster

QUIK-LABELS code Wires, Leads, Circuits, Relays, Parts, etc., faster and cheaper. • Pre-cut to exact size, QUIK-LABELS come on handy cards. • Ready to use, they stik-quick without moistening, replace slow and costly string tags, roll tapes, decals, stencils, metal tabs, etc. • Silicone plastic coated to resist dirt, grease, abrasion. • *Self Starter strip automatically expose ends of Labels for you to grasp instantly — no more finger-picking.

Write for Folder and FREE Sample Cards.

W. H. BRADY COMPANY

Established 1914

Manufacturers of Self-Sticking Tape Products
240 W. Wells St., Milwaukee 3, Wisconsin
Factory—Chippewa Falls, Wisconsin

Linde

SYNTHETIC SAPPHIRE

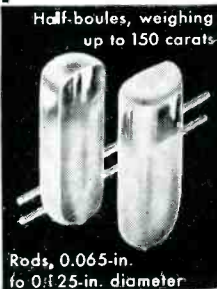
Has High Electrical Resistance

LINDE synthetic sapphire offers specific advantages for electronic uses. Sapphire maintains these properties at elevated temperatures.

Dielectric Constant 7.5 to 10
T_g Point 1,214 deg. C. to 1,231 deg. C.
(Temperature at which resistance becomes 1 megohm)

Melting Point 2,030 deg. C.
Thermal Conductivity 0.015
(cal. sec.⁻¹ cm.⁻¹ deg. C.⁻¹ at 500 deg. C.)

Thermal Expansion Coefficient 8.3 to 9.0
(per deg. C. x 10⁶ at 1,000 deg. C.)



Write for the LINDE Synthetic Sapphire Technical Data Sheet No. A-1.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street New York 17, N. Y.

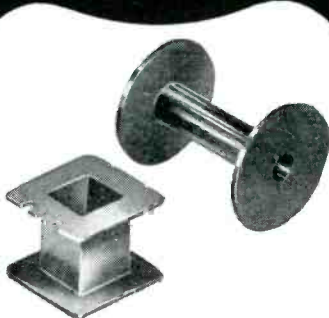
In Canada:

Dominion Oxygen Company, Limited, Toronto

The word "Linde" is a trade-mark of The Linde Air Products Company

Molded Phenolic

COIL FORMS • BOBBINS



You can save on mold and piece charges at Mayfair

Coil forms or bobbins, made to your specifications. Our mold charges are lower than were formerly considered possible.

Send print for prompt quotation

Mayfair

MOLDED PRODUCTS CORPORATION
4440 Elston Avenue • Chicago 30

New Line

KENYON

ISOLATION TRANSFORMERS

TYPE	VA	WT (lbs.)	L	W	H	ML	MW	FIG	LIST PRICE
I-10	25	2½	3⅝	2⅞	3¾	3⅝	2	A	8.30
I-14	100	7½	5⅞	3⅝	4¾	4⅞	2½	A	14.00
I-18	250	14	6⅞	5½	5	5⅝	4½	A	22.50
I-22	750	50	9¾	7⅞	6⅞	4¾	6⅞	B	59.00

Isolation Transformers with electrostatic shields. (Ratio 1:1) 115 Volts, 50/60 Cycles. Supplied with cord, plug and receptacle.

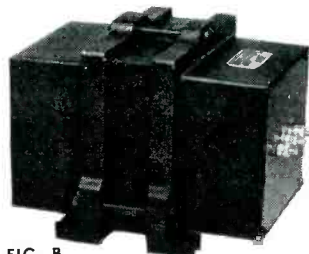


FIG. B



FIG. A

AUTO TRANSFORMERS

Auto Transformers 230/115 Volts, 50/60 Cycles.

Write for details today on KENYON's new line.

TYPE	VA	WT (lbs.)	L	W	H	ML	MW	FIG	LIST PRICE
I-40	50	2½	3⅝	2⅞	3¾	3⅝	2	A	7.95
I-44	100	3½	4⅞	2⅞	3¾	4⅞	2	A	9.55
I-48	250	8	5⅞	3⅝	4¾	4⅞	2½	A	14.90
I-52	500	14	6⅞	5½	5	5⅝	4½	A	22.00
I-56	1000	40	8½	7⅞	6⅞	3½	6⅞	B	43.00

KENYON TRANSFORMER CO., Inc.

840 BARRY STREET NEW YORK, U. S. A.

HEXACON

is helping to do the job at

SPERRY

HATCHET TYPE IRON
for better balance and
less operator fatigue



(PATENT PENDING)

Offering even greater ease in handling than the light-weight irons now used for difficult, intricate soldering, the Hatchet Type iron is especially engineered and designed for operator comfort. Non-tiring even after hours of continuous use, these soldering units have all the extra advantages included in every HEXACON iron — replaceable elements of highest grade nickel-chromium wire, tips of hard-drawn copper, hexagon-shaped barrels for maximum heat dissipation during intermittent use, Underwriters' Laboratories approval, etc.

WRITE FOR ILLUSTRATED BULLETINS

The complete diversified range of HEXACON soldering irons is described in detail in fully-illustrated literature. Ranging from 40 to 700 watts, and with tip diameters $\frac{1}{4}$ " to $1\frac{1}{4}$ ", HEXACON irons are available to meet every requirement. Write today—there is no obligation.

HEXACON ELECTRIC CO.

130 W. Clay Ave., Roselle Park, N. J.

HIGH-QUALITY
LONG-LASTING
SOLDERING IRONS

HEXACON

TRIODE PERFORMANCE

The superiority of a triode amplifier is most apparent in the final test... listening



★TRIODE TUBES used throughout. 2—6B4G, 4—7A4, 2—7N7, 1—5U4G, 1—5Y3G.

★Three push-pull stages preceded by an inverter stage.

★Interstage transformer insures good push-pull balance.

★Flat within 1 db to 25 cycles at full power and to 4 cycles at reduced power.

★Flat within 0.2 db to 30,000 cycles.

★0.6% harmonic distortion and 0.2% intermodulation distortion at 5 watts.

★Rated power—30 watts at $2\frac{1}{2}$ % total distortion.

★AUTOMATIC BIAS CONTROL greatly increases undistorted power at moderate cost.

★Gain—55 to 120 db in various models.

★Bass and treble compensation—Two-stage tapped condenser-resistor networks.

★Input—38, 150, 500/600 and 500,000 ohms. Output—1.5 to 30 ohms and 500 ohms.

★Power available for other units—250 volts, 0.090 A DC; 6.6 volts, 5 A.

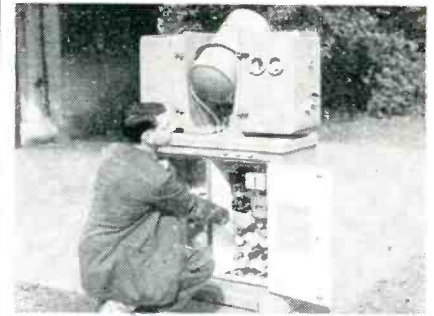
★Fuses—Main power and 6B4G plate line.

★Attractively finished chassis. High quality components. Finest workmanship.

The BROOK HIGH QUALITY AUDIO AMPLIFIER

Designed by LINCOLN WALSH

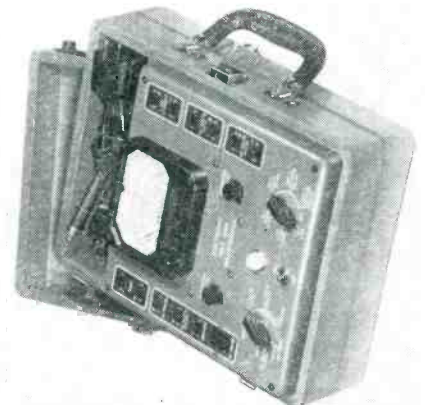
BROOK ELECTRONICS, Inc., 34 DeHart Place, Elizabeth 2, N. J.



ous record of cloud variations. In practice, a pulsed light beam is cast vertically into the sky. The detector located about 1,000 feet from the projector and tuned to the same frequency as the light pulses, measures light scatter from the clouds.

Volt-Ohm-Milliammeter (61)

WESTON ELECTRICAL INSTRUMENT Corp., Newark 11, N. J. The new Electronic Analyzer, model 769, comprises a stable high frequency vacuum tube voltmeter for frequencies up to 300 megacycles in the range of 3 to 120 volts. A special

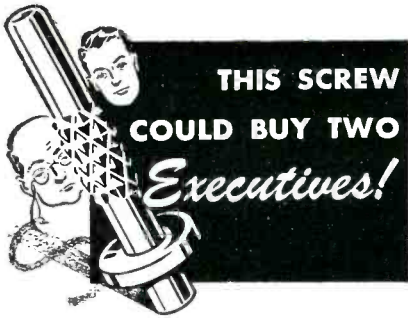


d-c probe containing a 5-megohm resistor is furnished for measuring d-c potentials with a minimum insertion effect. Resistance to 200,000 ohms and current up to 600 milliamperes can also be measured.

Literature

(62)

Export Catalog. British Radio Component Manufacturers' Federation, 22 Surrey St., London, W. C. 2, England. A comprehensive guide to the British radio component industry is the 184-page volume issued for distribution among overseas customers. The text, in



**THIS SCREW
COULD BUY TWO
*Executives!***

It's a fact! Figuring the yearly salary of a top-flight executive at around \$15,000, this screw could actually buy two of them and have some change left over. Because this screw saves more than \$32,800 every year for a prominent parts manufacturer (name on request) who brought his problem to our Engineering Department. Our research resulted in this screw, and the screw resulted in the saving. Perhaps we couldn't save as much as that for you, but it would be worth a three-cent stamp to find out.

NEW ENGLAND SCREW CO.
Manufacturers of Special Screws
KEENE, NEW HAMPSHIRE

JONES SHIELDED TYPE PLUGS and SOCKETS



P-101-1/4"



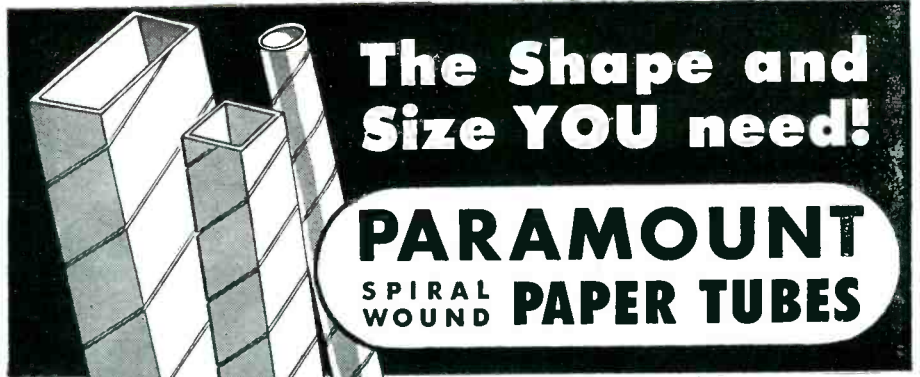
S-101

Low loss Plugs and Sockets suitable for high frequency circuits. Ideal for antenna connections, photo-cell work, microphone connections, etc. Supplied in 1 and 2 contact types. The single contact type can be furnished with 1/4", .290", 5/16", 3/8", or 1/2" ferrule for cable entrance.

Knurled nut securely fastens units together.

All metal parts are of brass suitably plated to meet Navy specifications. No. 101 Series Plugs have ceramic insulation and Sockets have XXX Bakelite. For complete listing and information write today for your copy of catalog No. 14.

HOWARD B. JONES DIVISION
CINCH MFG. CORP.
2460 W. GEORGE ST. CHICAGO 18



**The Shape and
Size YOU need!**

**PARAMOUNT
SPIRAL WOUND
PAPER TUBES**

All Sizes in

Square and Rectangular Tubes

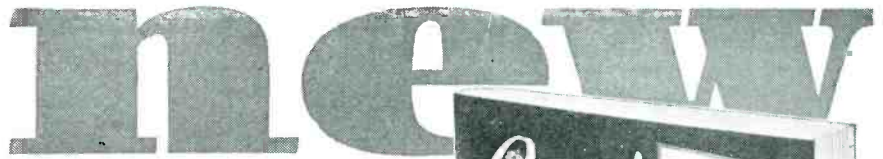
Leading manufacturers rely on the quality and exactness of PARAMOUNT paper tubes for coil forms and other uses. Here you have the advantage of long, specialized experience in producing the exact shapes and sizes for a great many applications. *Hi-Dielectric, Hi-Strength.* Kraft, Fish Paper, Red Rope, or any combination. Wound on automatic machines. Tolerances plus or minus .002". Made to your specifications or engineered for YOU.

**SEND FOR ARBOR LIST
OF OVER 1000 SIZES**
Inside Perimeters from
.592" to 19.0"
Convenient. Helpful. Lists
great variety of stock ar-
bors and tube sizes. In-
cludes many odd sizes.
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PARAMOUNT PAPER TUBE CORP.

616 LAFAYETTE ST., FORT WAYNE 2, IND.

Manufacturers of Paper Tubing for the Electrical Industry



**CONCORD
Radio
Catalog**

**INDUSTRIAL ELECTRONIC
and TEST EQUIPMENT • RADIO
PARTS • SETS • AMPLIFIERS**

This is it—the new 1947 Concord Catalog—a vast, complete selection of everything in Radio and Electronics—thousands of items available for IMMEDIATE SHIPMENT from CHICAGO or ATLANTA—hundreds now available for the first time—featuring new, latest 1947 prices. See new LOWER prices on RADIO SETS, PHONO-RADIOS, RECORD CHANGERS, RECORD PLAYERS, PORTABLES, AMPLIFIERS, COMPLETE SOUND SYSTEMS, TESTERS. See latest listings of standard, dependable lines of radio parts and equipment—tubes, condensers, transformers, relays, etc. Mail coupon for FREE COPY—NOW!

TIME PAYMENTS: Write us for details of time payment plan on Communications Receivers, Amplifiers, Test Equipment, Radios, Phono-Radios, etc.

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901 W. Jackson Blvd. 265 Peachtree St.



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Yes, rush FREE COPY of the comprehensive new
Concord Radio Catalog.

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Address.....
City..... State.....

BRADLEY

COPPER OXIDE RECTIFIERS

IMPROVE INSTRUMENTS AT LOW COST



Vacuum-processed, gold-coated Bradley instrument rectifiers increase equipment efficiency. Especially designed for use where stability and permanence of calibration are important, "CoproX" rectifiers meet the most exacting requirements. Yet they cost no more than ordinary rectifiers — in most cases, less.

Temperature error is exceptionally low with Bradley rectifiers. Aging is practically nil. Pre-soldered leads. Rating of CX-2E series up to 4.5 volts A. C., 3 volts and 5 milliamperes D. C.

Illustrated literature, available on request, shows more models of copper oxide rectifiers, plus a line of selenium rectifiers and photocells. Write for "The Bradley Line."

BRADLEY LABORATORIES, INC.

82 Meadow St. New Haven 10, Conn.

NEW PRODUCTS

(continued)

English, French and Spanish is followed by a classified index according to products.

(63)

Technical Bulletin. Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J. Bulletin No. 778 deals with the importance of the adjustment of pH of wool fabrics, yarn or raw stock prior to dyeing. Copies may be had by writing the company.

(64)

Control Components. American Relay and Controls, Inc., 2555 Diversey Ave., Chicago 47, Inn. A 4-page 2-color brochure is now ready showing the line of relays, switches, and leaf-spring combinations that find their way into electronic equipment.

(65)

Plastic Knobs. Kurz-Kasch, Inc., 1424 So. Broadway, Dayton 1, Ohio. A 12-page booklet describes in detail the latest in standard radio and instrument plastic knobs and control balls. Copies are now available.

(66)

Receiving Tubes. Radio Corp. of America, Harrison, N. J. Application Note 118 estimates the input admittance of receiving tubes. Values of short-circuit input conductance and capacitance for a number of r-f pentodes at frequencies of 50 to 125 mc are given.

(67)

Mica Capacitors. Aerovox Corp., New Bedford, Mass., recently issued inserts 30A and 30B showing engineering details of two new mica capacitors. Type 1690 is designed for use in uhf circuits and is ideal for aircraft application. Type 1780 handles up to 2,000 kva, exceptional for its size.

(68)

Instruments. North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y. Form No. R-1066 is a 2-page ready reference chart covering the basic characteristics of fifteen industrial laboratory instruments, with a diagram accom-



ALL THESE TOOLS
IN A
KIT THAT FITS
IN THE PALM
OF YOUR HAND

INTERCHANGE-
ABLE BITS FOR
PHILLIPS, HEX
AND SLOTTED
HEAD SCREWS

HALLOWELL

"SOCKET SCREW" KIT

A handy, useful set of high-grade steel tools—all contained in a convenient tread-grip, hollow, red plastic handle—for most all purposes where Phillips, Hex and Slotted Head Screws are used. Handles are corrosion-resistant, non-conductors of electricity and light in weight. Kits are available in 2 sizes: #25, medium and #50, large. Each has a swivel bit-chuck that locks securely in any one of five positions.

Obtainable at Industrial Distributors and Hardware Dealers throughout the country. If there is no Supplier in your locality, or he is sold out, send us his name, along with yours, and you will be taken care of promptly.

AN IDEAL GIFT,
PREMIUM OR PRIZE.

Kits: Pat's. Pend. Over 44 Years in Business

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ELECTRIC WIRES

CONDENSER PLATES
SMALL METAL STAMPINGS

in accordance
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Modern Equipment and Factory
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MR. RADIO RETAILER

A MUST for NOISE-FREE STORE DEMONSTRATION

BRACH PURATONE* SIGNAL BOOSTER

CARRIES AM, FM and TV ANTENNAS ALL ON THE SAME MAST

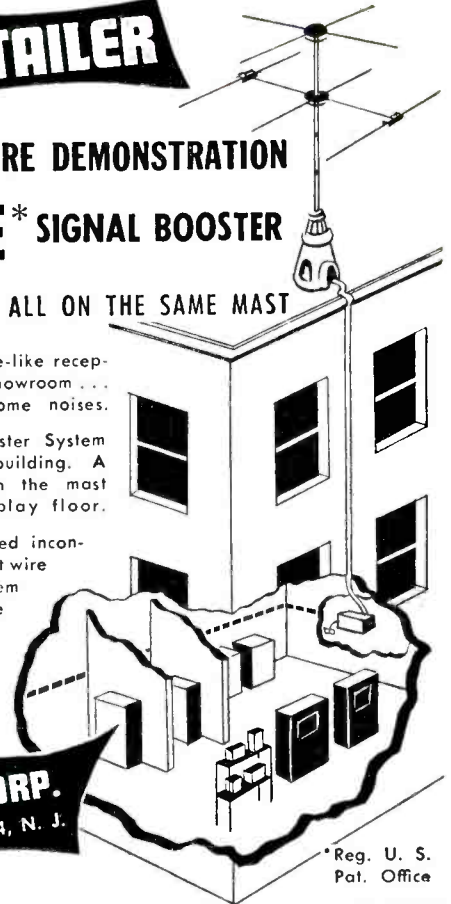
Increase your radio sales by bringing home-like reception to any AM, FM and TV set in your showroom... eliminating all interference and bothersome noises.

HERE'S HOW: The Puratone Signal Booster System is easily installed on the roof of your building. A shielded coaxial cable runs directly from the mast to the concealed amplifier on the display floor.

From the amplifier a radiating wire is placed inconspicuously around the display space. No direct wire connection to radio sets required. One system serves any number of floor models. Dual wave traps in the video-type AM-FM amplifier bring in all stations on an average tone-level. 30-40 DB gain on FM; 40-60 DB gain on AM. Effective for any radio department layout.

Write for illustrated circular.

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*Reg. U. S. Pat. Office

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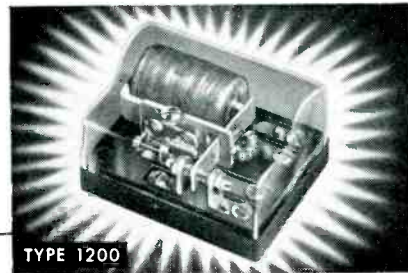
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JOHN F. RIDER Publisher, Inc.

404 FOURTH AVENUE, NEW YORK 16, N. Y.

Export Division: Rocke-International Corp.
13 E. 40th Street, New York 16, N. Y.

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TYPE 1200

- Transparent Plastic Enclosed
- 2½ to 5 Milliwatt Operation

Sensitivity, durability, compactness . . . Transparent plastic cover protects contacts from dust, dirt, and accidental operation . . . permits instant visual inspection without removal. The Type 1200 gives positive performance on only 5 milliwatts of power. With light contact load and careful adjustment, only 2½ milliwatts are required.

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15 to 25% make-break current differential SPDT contacts of pure Silver . . . rated at 1 Amp. noninductive . . . Palladium, Platinum or other type contacts on special order • Vacuum varnish impregnated coils furnished in resistances from 1 to 40,000 ohms • Armature is counter-balanced to permit operation in any position . . . to prevent vibrations from closing contacts.

- Size 2" x 2 9/16" x 1 1/2" • Weight 6 1/4 oz.

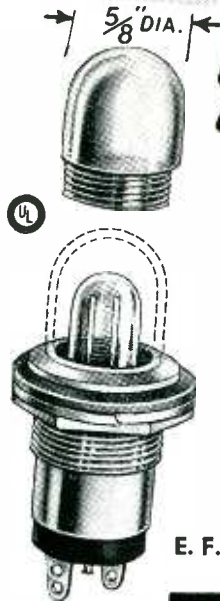
Write today for May, 1947 catalog

Advance Relays

ADVANCE ELECTRIC & RELAY CO.

1260 West 2nd St., Los Angeles, California • Phone Michigan 9331

RESISTOR EQUIPPED for 115 V. Neon Lamps



Gothard

Models 147-1143 and 147-1144
INDICATOR LIGHTS

You have a choice of Model No. 147-1143 (with 200,000 ohm, built-in resistor) for dim glow; Model No. 147-1144 (with 100,000 ohm, built-in resistor) for bright glow; or Model No. 147-1142 (without resistor) for Nos. 42, 313 and 1815 Mazda lamps. All models are equipped with a colored lucite protecting cap which encloses the lamp. All metal parts are ruggedly precision made. This Gothard Indicator Light assembly radiates a quality appearance that will be a definite asset to any product you have in mind—and it is the last word in utility and economy.

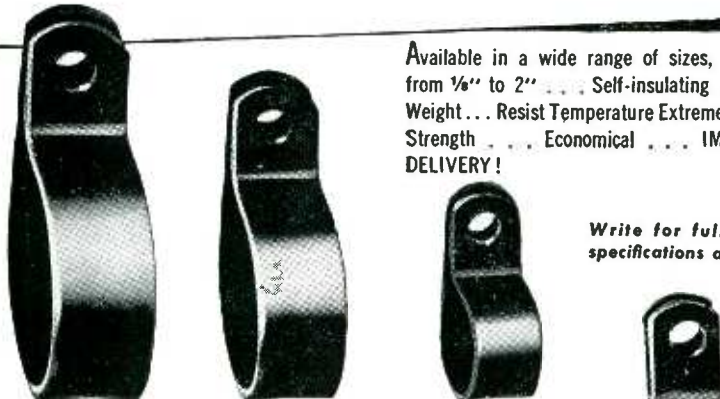
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E. F. JOHNSON COMPANY
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JOHNSON
a famous name in Radio

Ask for the Johnson-Gothard Catalog, illustrating and describing a complete line of Indicator Light assemblies of varied sizes and duties.

for neat, speedy wiring VERSIFLEX PLASTIC WIRE AND CABLE HANGERS



Available in a wide range of sizes, diameters from 1/8" to 2" . . . Self-insulating . . . Light Weight . . . Resist Temperature Extremes . . . High Strength . . . Economical . . . IMMEDIATE DELIVERY!

Write for full details, specifications and prices.

BURNDY NEW YORK 54, N. Y.

CANADA: Canadian Line Materials, Limited, Toronto 13
FOREIGN: Philips Export Corporation, New York 17, N. Y.

panying each case. Copies may be had gratis.

(69)

Facsimile. Alden Products Co., 117 N. Main St., Brockton 64AF, Mass. An interesting catalog, in the form of a file of reprints, describes the background as well as the latest equipment in the field of facsimile for the home, business and communications in general.

(70)

Electrical Contacts. Alloymet Mfg. Corp., 3 Grand St. Extension, Brooklyn 11, N. Y. Monthly data sheets are especially prepared to aid research and development engineers with the proper selection of electrical contact materials for specific circuit applications.

(71)

Marine Communications. Graybar Electric Co., 420 Lexington Ave., New York 17, N. Y. The Western Electric 248A furnishes powerful, dependable, radiotelephone communication on the high seas. A complete description is found in bulletin T2376.

(72)

Cathode Press. Machlett Laboratories Inc., Springdale, Conn. This quarterly publication reports news of interest to the electronic industry at large, the development of new products, improvement of current models and their application. Copies are mailed free of charge on request.

(73)

Antennas. Premax Products, Division of Chisholm-Ryder Co., Inc., Niagara Falls, N. Y. Six pages cover the chief features of f-m and television antennas. Included are dimension charts and drawings to aid in installation.

Tubes. Radio Corp. of America, Harrison, N. J. A 16-page pamphlet (CRPS-102) is now available at ten cents a copy. It is crammed with useful technical information on 113 types of phototubes, c-r

New WHEAT LIGHTWEIGHT BATTERY CHARGER

MODEL
563



FOR HIGH-SPEED BATTERY PHOTOFLASH UNITS

- ★ Size 5 $\frac{1}{4}$ " x 4 $\frac{3}{4}$ " x 3 $\frac{3}{4}$ "
- ★ Weight approximately 60 oz.
- ★ Uses long life dry disc rectifiers
- ★ Pilot lamp indicates when charging
- ★ Standard model adapted to 110-120 Volt 50-60 Cycle A.C. Current. Designed for 2 cell 4 volt battery. Charging rate up to 1 AMP.

KOEHLER MANUFACTURING CO.
MARLBORO, MASS., U.S.A.

PREMAX

RADIO ANTENNA

FOR MOBILE UNITS

High-tempered steel Antennas and specially designed mountings that will meet every need for mobile installations in police, fire and other municipal and governmental services. Get the new Premax Antenna Catalog from your radio jobber.

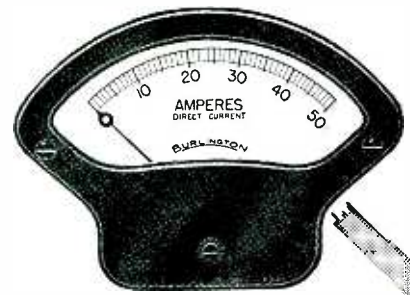


Premax Products

Division Chisholm-Ryder Co., Inc.
4721 Highland Ave. Niagara Falls, N. Y.

- RUGGED
- DEPENDABLE
- ACCURATE

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MAGNETS

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MAGNETIC CORPORATION



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RESISTANCE WIRE

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Jelliff resistance alloys are used extensively for industrial, radio and electronic equipment; domestic appliances; instruments; transportation apparatus and materials handling equipment.



For specific engineering data applying to your problem, refer to the new and complete 56 page Jelliff Resistance Alloys Catalog.

Write Dept. L201 for Catalog No. 46

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SOUTHPORT, CONN.

WIRE PRODUCTS SINCE 1880

NEW PRODUCTS

(continued)

tubes, and special tubes. The more important types are illustrated.

Tube Registry

The information furnished by the RMA Data Bureau has been abridged and only the more significant dimensions are given.

Type 6AS6G

Pentode voltage amplifier, heater type, integral glass envelope-base; T-5½ bulb, miniature 7-pin button base; maximum bulb temperature 120 C. Maximum power output, 1.7 watts.

$$E_f = 6.3 \text{ v}$$

$$I_f = 0.175 \text{ amp}$$

$$C_{in} = 3.9 \mu\mu\text{f}$$

$$C_{out} = 3.0 \mu\mu\text{f}$$

$$C_p = 0.01 \mu\mu\text{f}$$

Typical Operation

$$E_b = E_{c2} = 120 \text{ v}$$

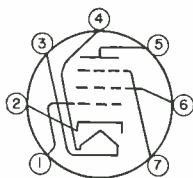
$$I_b = 5.2 \text{ ma}$$

$$E_{c3} = 0 \text{ v}$$

$$I_{c2} = 3.5 \text{ ma}$$

$$E_{c1} = -2 \text{ v}$$

$$I_m = 3,200 \mu\text{mbos}$$



6AS6G

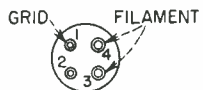
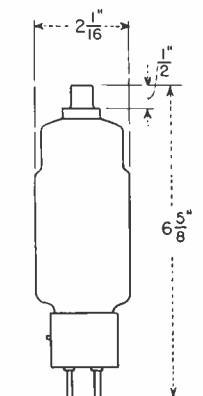
Type 5594

Triode xenon-filled thyratron, filament type; deionization time, approximately 1 millisecond; filament heating time, 5 seconds; temperature range -75 to -90 C.

$$E_f = 2.5 \text{ v}$$

$$I_f = 5 \text{ amp}$$

$$E_{drop} = 10 \text{ v}$$



BOTTOM VIEW
5594

Control (referred to filament center tap)

$$E_c (E_b = 2,500 \text{ v}) = -8 \text{ v}$$

$$E_c (E_b = 100 \text{ v}) = -2.25 \text{ v}$$

$$\text{Critical } E_b \text{ at } 1,000 \text{ v} = 6.5 \text{ v}$$

Maximum Ratings (to 500 cps)

$$E_{100} = 5 \text{ kv}$$

$$I_b = 2 \text{ amp (peak)}$$

$$E_b = 2.5 \text{ kv}$$

$$I_b = 0.5 \text{ amp}$$

(average 30 seconds)

SUPERIOR ELECTRONIC PRODUCTS

used in the

GUN STRUCTURE OF TELEVISION TUBES

ANODE AND GRID CYLINDERS—
Straight cut, angle cut or rolled edge
Tubing produced to very close tolerances.

DISC CATHODE ASSEMBLY—
Precision made and laboratory controlled to assure correct emission and cut-off characteristics.

The expanding television industry has turned to Superior's Electronic Division for the conception and production of these vital parts within the television tube.

THE BIGGER NAME IN SMALL TUBING
Superior

TUBE COMPANY

ELECTRONIC DIVISION
2500 GERMANTOWN AVENUE
MORRISTOWN, PENNA.



new NZ-10 NEUTRALIZING CONDENSER

The improved design of the NZ-10 features smooth micrometer capacity adjustment and positive locking. Suitable for either single ended or push pull stages the NZ-10 has particular application in high frequency circuits where very fine capacity adjustment is required.



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MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

THERE'S A DRAKE SOLDERING IRON FOR EVERY TYPE OF ELECTRONIC WORK

From that mighty mite



the Drake No. 400 to the high-speed production "honey"



the Drake No. 600-10 there is a high quality Drake Soldering Iron "just right" for the job.

Drake Heat Controls and the Drake "Magic Cup" Stand are important soldering aids.



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THE GENERAL ELECTRIC VARIABLE RELUCTANCE PICKUP

RECORD enthusiasts are critical customers—whether they be devotees of Bach or boogie-woogie. Better and better reproduction of their favorite recordings is an insistent demand that must be met.

The General Electric Variable Reluctance Pickup can help you to meet that demand. It will appeal immediately to the technical mind due to its simplicity and direct resolution of difficulties often associated with phonograph pickups.

Check this list of major features:

- Low Needle Talk
- Negligible needle scratch
- Low Distortion
- Permanent sapphire stylus
- Minimum record wear
- Frequency response 30-10000 cycles
- Not affected by adverse climatic conditions

For complete information write to:
General Electric Company, Electronics Department, Syracuse 1, N.Y.

GENERAL ELECTRIC

160-PT

LAMINATED PLASTICS

Phenol Fibre . . . Water-, oil-, and chemical-resisting sheets of high dielectric strength. Supplied in black and natural color. Standard sheets approximately 49 x 49 inches. Thicknesses from .010 to 9 inches. Rods and tubes.

Vulcanized Fibre Remarkably uniform, high-grade, hard fibre in sheets 56 x 90 inches to save waste in cutting. Smaller sheets if desired. Also in standard-size rods.

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We're ready whenever you are. Send blueprints.

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PAMARCO DE-REELING TENSION

PAMARCO tensions are the perfect answer to lower coil winding costs!

- * FINGER-TIP TENSION CONTROL
- * OPERATOR MAKES OWN ADJUSTMENTS
- * NO TOOLS OR ACCESSORIES NEEDED
- * FITS ALL COIL WINDERS

The free-running action of the PAMARCO tension practically eliminates defective coils. Their compact size permits more simultaneous coil winds on any machine. Operator makes all adjustments for any gauge wire with simple thumbscrew.

Write for literature today

SHORT CUT TO
PERFECT COILS!



PAPER MACHINERY & RESEARCH, INC.
1014 OAK STREET • ROSELLE, NEW JERSEY



from **FLAT SURFACES**

TO **INTRICATE SHAPES**

with the New **DI-ACRO BRAKE**

- **ROK-LOK**—new sensitive material clamp increases accuracy
- **DOUBLE-EDGED FORMING BLADE** allows close reverse bends
- **NEW PRECISION STOPS** accurately control angularity of bends

This versatile metal forming machine was developed for use in model shops, experimental laboratories and production departments where it often replaces dies for all types of precision forming operations. Di-Acro Brakes will form a great variety of materials including bronze, stainless steel, aluminum and bi-metals.

WRITE FOR CATALOG. New edition of 40-page Di-Acro Catalog contains detailed information on all Di-Acro Brakes, Shears, and Benders and illustrates how these precision machines can be used individually or cooperatively for "DIE-LESS DUPLICATING".

← DI-ACRO is Pronounced "Die-Ack-Ro"



O'NEIL-IRWIN MFG. CO.

321 8TH AVE., LAKE CITY, MINNESOTA



Outside View
Cross-section View

THE HANDY WAY TO MAKE CO-AX CABLE CONNECTIONS-RIGHT!

A light-weight water-tight assembly

Here's the quick, easy and **FULLY DEPENDABLE** way of terminating a coaxial line where it joins the center of a half-wave doublet antenna—the B & W CC-50 Connector. Made of cast aluminum and weighs only 12 ounces. Steatite insulation. Forged zinc dipped steel eye bolts provide handy soldering connections. Designed for all coaxial cables such as RG11/U, RG34/U or similar types with either single or twin leads. Makes an absolutely watertight seal. Ideal for use as center insulator for a half-wave doublet.

AIR INDUCTOR HEADQUARTERS

B & W "Air-Wound" Inductors come in types, shapes and sizes for almost every coil application.

BARKER & WILLIAMSON
237 Fairfield Avenue, Upper Darby, Pa.



NEWS OF THE INDUSTRY

(continued from p 146)

ness session of the 23rd annual RMA convention at the Stevens Hotel, Chicago.

New president is Max F. Balcom, vice-president and treasurer of Sylvania Electric Products Inc., of Emporium, Pa., succeeding Ray C. Cosgrove, general manager of the Crosley Division, Cincinnati, who concluded three years of service as RMA head.

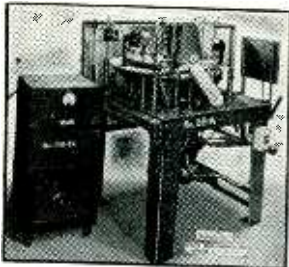
Treasurer Leslie F. Muter, of the Muter Co., Chicago, was reelected for his thirteenth term. The Board of Directors also elected two new vice-presidents, reelected three others. Four new directors were added to the board, and eleven directors were reelected. Two new division chairmen were elected by their respective divisions, and three division chairmen were reelected. Reappointed director of the RMA Engineering Department, Dr. W. R. G. Baker, vice-president of General Electric Co., Syracuse, N. Y., remains a member of the Board of Directors.

Among the new industry services authorized by the newly organized RMA Board of Directors was the expansion and modernization of RMA statistical services to cover the movement of radio and television receivers through distribution channels and their retail sales. A special committee was appointed by president Balcom to set up the machinery by which a monthly panel survey of the movement and sale of radio sets can be made. The board appropriated \$10,000 to fi-



New RMA head, Max F. Balcom of Emporium, Pennsylvania, has been active in association affairs for the past 12 years

**EISLER
ELECTRICAL & ELECTRONIC
EQUIPMENT
ELECTRONIC TUBE EQUIPMENT**



**24 HEAD
RADIO TUBE
EXHAUSTING
MACHINE**

We Make Complete Equipment For The Manufacture Of Incandescent Lamps Radio and Electronic Tubes.

TRANSFORMERS OF ALL TYPES

For LIGHTING POWER FURNACES PHASE CHANGING DISTRIBUTION 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

EISLER ENGINEERING CO., INC.
751 So. 13th St. (Near Avon Ave.), Newark 3, N. J.

**SPECIAL
OFFER
RUBYFLUID
SOLDERING FLUX**



An opportunity for you to learn the advantages of famous Rubyfluid Soldering Flux. Special offer includes 1 pt. of liquid, 1/2 lb. paste flux and helpful booklet, "How to Solder"—all three for only \$1.

Send your \$1 today to . . .

RUBY CHEMICAL CO.
59 McDowell St.
Columbus, Ohio

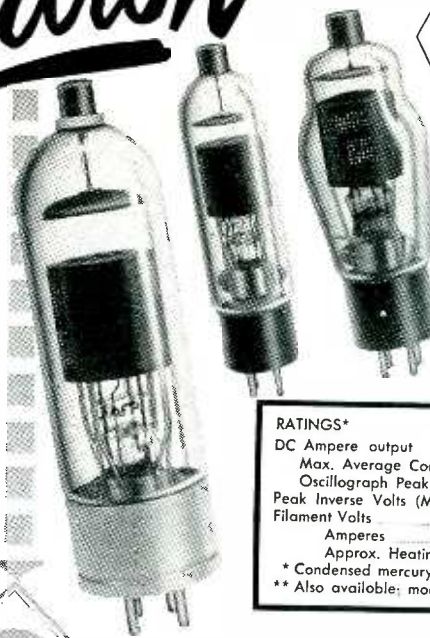


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GRID CONTROL RECTIFIERS



LONG LIFE

HIGH EFFICIENCY

QUICK START

These inexpensive rectifier tubes are designed for industrial applications such as welding control, motor control, etc., at ambient temperature limits of approximately -40° to +80° C.

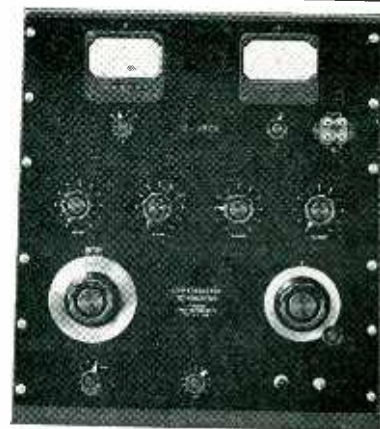
RATINGS*	CE-311**	CE-320	CE-322
DC Ampere output			
Max. Average Continuous	1.5	2.5	6.4
Oscillograph Peak	6.0	30.0	80.0
Peak Inverse Volts (Max. Inst.)	1000	1250	1500
Filament Volts	2.5	2.5	2.5
Amperes	6±1	9±2	20±3
Approx. Heating Time (in sec.)	15	30	45

* Condensed mercury temperature 40-70° C.
** Also available: modified types CE-323A and CE-393A.



For technical data and special information write to

CONTINENTAL ELECTRIC CO.
Geneva, Illinois



**FREED Low Frequency
"Q" INDICATOR**

Type No. 1030. Frequency range 20 to 200,000 cycles, "Q" range from .5 to 500. "Q" of inductors measured with up to 50 volts across the coil.

INDISPENSABLE INSTRUMENT FOR MEASUREMENT OF:-

"Q" and inductance of coils
"Q" and capacitance of capacitors Dielectric losses and power factor of insulating materials

FREED TRANSFORMER CO., INC.
Instruments Division
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To your Specifications
QUADRIGA**

QUALITY WASHERS

Make sure with washer precision matching your engineering. Half a century of experience. Facilities for quick production, any quantity, small or large. Also wire terminals, and SMALL STAMPINGS, any design. Without obligation advise us of your needs for prompt estimate. Ask for QUADRIGA Catalog.



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**NEW UNDERWRITER'S APPROVED
125 VOLT—CANDELABRA
BAYONET SOCKET ASSEMBLIES**

NOW you can get fine *Underwriter's Approved* candelabra Dial Light Socket Assemblies by **DRAKE!** The No. 900 series is designed for radio use, and the No. A900 series for general use. Both are double contact, candelabra, bayonet Assemblies housing 115V household type lamps, available from 5 to 25 watts. They are U.L. approved for 75W-125V service. Can also be used with 6V automotive lamps.

The bayonet type eliminates vibration-loosened lamps and requires less space than screw type. Can be supplied with any type mounting bracket. Lead-in wires from 2 1/2" to 60". Made to traditional **DRAKE** standards of precision and rugged dependability. Check with our engineers on your requirements, *today!*

**ASK FOR OUR NEW
CATALOG • NO OBLIGATION!**



**Socket and Jewel
LIGHT ASSEMBLIES**

**DRAKE
MANUFACTURING CO.
1713 W. HUBBARD ST., CHICAGO 22**

nance the establishment of this new service.

The directors also voted to expand the RMA headquarters staff to provide additional administrative services for transmitter and parts manufacturers.

Uniform f-m receiver dial marking, using megacycle listings instead of FCC channel numbers, was recommended for the RMA Set Division by Chairman Paul Galvin. This recommendation concurs with that of the RMA Engineering Department.

An appropriation of \$20,000 for the preparation of National Radio Week promotion material was made by the retiring Board of Directors.

Publication of a report on recommended basic standards for school sound recording and playback equipment was made by the board upon recommendation of the School Equipment Committee. This published report, prepared in cooperation with the U. S. Office of Education, will supplement the "School Sound Systems" brochure published by the RMA last fall and distributed to schools and colleges by the Office of Education.

An intensification of the RMA "Radio-in-Every-Room" set sales promotion campaign was reported to the Board of Directors and the Advertising Committee. The committee approved a slide film "Let's Get Personal", which will be available to retail trade groups.

New AIEE Officers

BLAKE D. HULL, chief engineer of Southwestern Bell Telephone Co., St. Louis, Mo., has been elected president of AIEE for the year beginning August 1, 1947, as announced at the annual meeting of the Institute held in Montreal. The other officers elected were: Vice-Presidents: G. W. Bower, Haddonfield, N. J., J. H. Berry, Norfolk, Va., I. M. Ellestad, Omaha, Nebr., D. I. Cone, San Francisco, Calif., D. G. Geiger, Toronto, Ontario; Directors: W. L. Everitt, Urbana, Ill., A. C. Monteith, East Pittsburgh, Pa., Elgin B. Robertson, Dallas, Tex.; Treasurer, W. I. Slichter, New York, N. Y. (re-election).

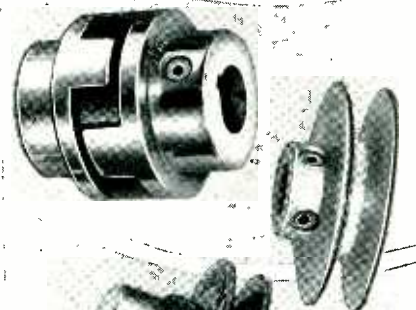
The annual report of the Board of

ALLEN

HEX-SOCKET SET

SCREW

Applications



In collars, pulleys, couplings of all types, **ALLEN Hex-socket Screws** grip with never a slip. Formed and threaded by Allen-perfected processes, applied selectively to produce the strongest precision screw in a given size. High Class 3 fit standard; Class 4 on special order. Call your local Allen Distributor for samples or demonstration.

**THE ALLEN MFG. COMPANY
HARTFORD, CONNECTICUT, U. S. A.**

BAACH-INTERNATIONAL



EIGHT HEAD HOT CUT FLARE MACHINE

Automatic throughout.
Can be synchronized
with automatic Stem
machine.

Cuts off and flares in
one operation.

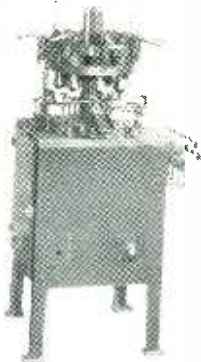
Production 1250 flares
per hour. For mini-
ature flares, fluo-
rescent starters, stand-
ard size lamps, fluo-
rescent and radio
tubes.

RANGE OF MACHINE
Glass tubing
27 to 45 gauge

Length of flares
5 mm. to 80 mm.

Forms flares up to
47 mm. diam.

Net weight, 960 lbs.
Gross weight
1450 lbs.



Dimensions
24"x24"x72" high

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Manufacturers of High Vacuum Pumps, Auto-
matic Machinery for Incandescent Lamps,
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Established in 1935

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U. S. A.

Crystals for the Critical

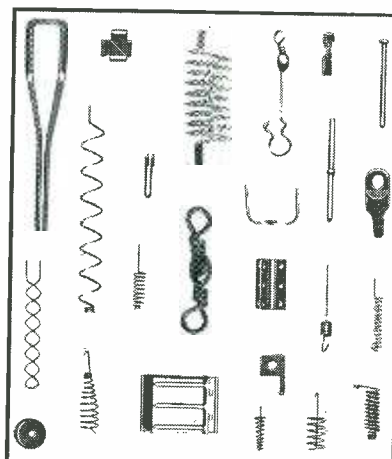
"STABILIZED"

IF6 CRYSTAL FILTER WITH HIGHER Q

The "Stabilized" IF6 filter crystal has become standard with many of America's leading receiver manufacturers—and for good reason, too. Our "Stabilizing" process materially raises the Q—permits sharp signal discrimination. The holder has lower capacity and the crystal is free from spurious frequencies within ± 0 —10 KC of operating frequency. Normally supplied in 455 KC, but can also be supplied in a wide frequency range.

Catalog On Request Or Write Us
About Your Crystal Problems

The JAMES KNIGHTS CO.
SANDWICH, ILLINOIS



SMALL PARTS

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.

LUXON fishing tackle accessories.

Inquiries will receive prompt attention.

ART WIRE AND STAMPING CO.

227 High St.

Newark 2, N. J.

**JUST ANOTHER TRANSFORMER?
OR GUARANTEED
TERMINAL PERFORMANCE!**

TRANSFORMERS - COILS

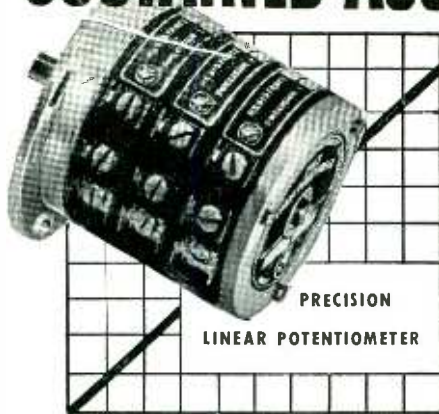
Any or all Types built to individual specifications
RESEARCH-DESIGN-PRODUCTION
Single Items or Quantity Production

GOSLIN ELECTRIC AND MANUFACTURING CO.

2921 WEST OLIVE STREET

BURBANK, CALIFORNIA

SUSTAINED ACCURACY



OVER
1,000,000
CYCLES
AT
30 rpm

(Single units or ganged as illustrated)

NEW! Fairchild's *new* Linear single-turn Potentiometers are small precision instruments—that out-perform conventional potentiometers. Sustained accuracy and long service are assured by Fairchild construction that includes contacts composed of gold, platinum and silver alloys. Performance includes a guaranteed linearity accurate to 0.15% (2" size); 0.1% (3" size) . . . less than one ounce-inch torque and 4 or 5 watt power dissipation . . . 100 to 100,000 ohm resistance range . . . single or ganged flexibility . . . 351° and 355° angles of electrical rotation. Available in 2" and 3" sizes. Engineered for quantity production. For further information address: Dept. 'E', 88-06 Van Wyck Boulevard, Jamaica 1, New York.



Fairchild CAMERA
AND INSTRUMENT CORPORATION

CUTS RECORDS UP TO 10" DIAMETER

PLAYS RECORDS UP TO 12"

ONE BUTTON CONTROLS SPEED
78 or 33 1/3 R.P.M.

JUST LOWER CUTTING ARM TO START RECORDING

MODEL G1-R90
DUAL-SPEED HOME
RECORDING AND
PHONOGRAPH ASSEMBLY

Smooth Power . . . FOR HOME RECORDING

Your customers will be delighted with the high-quality home recordings they can make on this GI Dual-Speed Home Recording and Phonograph Assembly. Equipped with ample *Smooth Power* for recording or reproducing, it's simple as ABC to operate. It's sturdily built to stand up under hard use . . . and it's remarkably low-priced for volume sales.

Send for details on this fine unit, and for complete information on the complete *Smooth Power* line of Phonomotors, Recorders and Combination Record-Changer Recorders.

 **THE GENERAL INDUSTRIES CO.**
DEPT. ME • ELYRIA, OHIO

Directors, presented at the meeting, showed a total membership on April 30, 1947, of 26,478.

Tube Standards

FOUR NEW standards covering the design and construction of electron tubes have been published as joint RMA-NEMA standards and are available from National Electrical Manufacturers Association, 155 E. 44th St., New York 17, N. Y.

Standards for Electron Tube Bases, Caps, and Terminals; NEMA Publication No. 500; dimensional characteristics for electron tube bases, caps and terminals; letter and number designations for bases, caps, and such other parts as mate with sockets or connector attachments; 19 pages, \$1.50.

Standards for Dimensional Characteristics for Water-cooled Transmitting Tubes; Publication No. 501; 4 pages, \$.25.

Standards for Dimensional Characteristics of Electron Tubes; Publication No. 502; outline dimensions of electron tubes, such as acorn types, miniature types, metal types, metal-enclosed glass types, locking-in glass types, and other various glass types, classified by group numbers; 10 pages, \$.80.

Standards for Gauges for Electron Tubes; Publication No. 503; specified dimensions and tolerances for ring gages for checking maximum and minimum base and sleeve diameters. It also covers alignment gages used to govern the spacing and alignment of base contacts and such other factors as may be important to interchangeability; 5 pages, \$.50.

Relay Manufacturers Form Association

THE NATIONAL ASSOCIATION OF RELAY MANUFACTURERS was formally organized in Chicago in May when representatives of leading relay manufacturers from all parts of the country drew up a charter of aims and elected Ralph T. Brengle, of Potter & Brumfield Sales Company, Chicago, as the first president. Also named to the executive panel at the time were: C. P. Clare, of

★ STAR

VITAL AIDS

FOR THE

Manufacturers of 7-pin and 9-pin miniature tube—radios and equipment



#JE-9 (9-pin)—#JE-10 (7-pin)—Star Miniature socket wiring plugs for accurate alignment of miniature socket contacts during wiring. Precision cast of zinc base alloy—pins of stainless steel.

#JE-15 (9-pin)—#JE-13 (7-pin)—Star Miniature tube pin straighteners (with stainless steel insert) to obtain a perfect fit when the tube is placed in the equipment.



Scientifically designed—Precision made
READY FOR IMMEDIATE DELIVERY
IN ANY QUANTITIES

STAR EXPANSION PRODUCTS CO. INC.
147 Cedar St. New York 6, N. Y.

MOLDED S.S. White RESISTORS

The "All-Weather" Resistors



- Noiseless in operation
- Strong and durable
- Good performance in all climates

STANDARD RANGE
1000 ohms to 10 megohms

• NOISE TESTED •

At slight additional cost, resistors in the Standard Range are supplied with each resistor noise tested to the following standard: "For the complete audio frequency range, resistor shall have less noise than corresponds to a change of resistance of 1 part in 1,000,000."

HIGH VALUES

15 to 1,000,000 megohms

S.S. WHITE INDUSTRIAL

THE S. S. WHITE DENTAL MFG. CO. DIVISION

DEPT. R, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING



One of America's AAAA Industrial Enterprises

KIRKLAND PILOT-LIGHTS

ARE DISTRIBUTED
NATIONALLY BY

GENERAL ELECTRIC
SUPPLY CORPORATION.

Graybar
ELECTRIC COMPANY, INC.

WESTINGHOUSE
ELECTRIC SUPPLY COMPANY



One of
Many
Kirkland
Units

No. 600 Unit
Underwriters' Approved heavy duty
unit for 120V service. S6 bulb.
Single hole mounting in 1-3/8"
diameter hole. Overall length of
threaded area 1-7/16". Also ideal
for building Lamp Annunciators
(furnished with flat lens for letters
or numbers). Write for Catalogue.

THE H. R. KIRKLAND CO.
Morristown, N. J.

FINE INDICATING LIGHTS SINCE 1930

OVER 300 OFFICES... COAST TO COAST

TIMER & CONTACTOR

FOR	440 V 10 KVA
LOW CAPACITY & LABORATORY	220 V 5 KVA
SPOT WELDERS	110 V 3 KVA

Timer Graduated from 2-80 Cycles in Two Ranges.
Accurate to $\pm 2\%$ at Any Setting.
Time Delay & Thermal Overload.

DELIVERY 3 WEEKS

PRICE \$350

SEQUENCE TIMING

GBH PRODUCTS CO.

& HEAT CONTROL

180 DAVISON ST.

SUPPLIED ON REQUEST

LYNBROOK, N. Y.



CUP WASHERS
for Binding Screws

Preferred

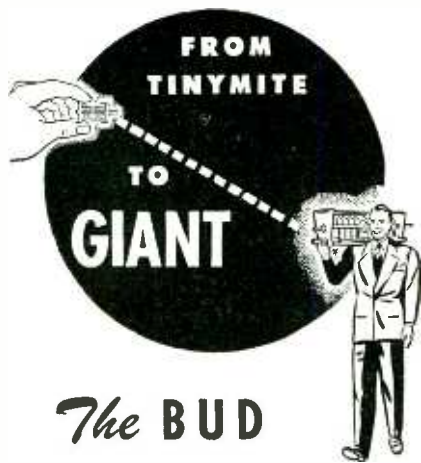
as a source of pre-
cision - made
WASHERS and
STAMPINGS
manufactured to
your specifications



WHITEHEAD STAMPING CO.

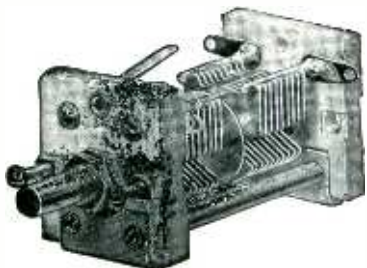
1691 W. Lafayette Blvd.

Detroit 16, Michigan

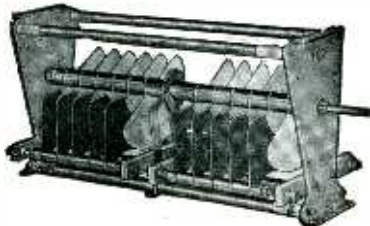


The BUD CONDENSER LINE

covers all your needs
for quality condensers



The TINY MITE condensers include a complete line of padders and single and dual section tuning condensers. When space or weight are limiting factors . . . these condensers will "fit the bill".



Modern design, plus precision production methods makes BUD GIANT transmitter condensers the choice of critical engineers for use in such applications as broadcast transmitters, high-powered trans-oceanic communication equipment and many other highly specialized electronic devices.

And *this isn't all!* Have your local distributor show you the complete BUD Condenser Line and see for yourself its many exclusive advantages!

BUD Can Supply All Your Needs! . . .

. . . with the latest types of equipment including: condensers—chokes—coils—insulators—plugs—jacks—switches—dials—test leads—jewel lights and a complete line of ultra-modern cabinets and chassis.



C. P. Clare and Company, Chicago, vice-president; and J. J. Rowell, of Guardian Electric Manufacturing Company, Chicago, secretary-treasurer.

The initial goal of the organization is the establishment of a code of standards by which electrical relays may be tested and rated so that buyers do not receive widely differing relays from two manufacturers even though published specifications in the past have been identical. Other mutual problems to which solutions will be sought are material specifications, general characteristics, classifications, government and underwriters' specifications, and more effective metallurgical research for improvement in performance and durability of products.

The relay industry comprises some 80 manufacturers including those who build relays in addition to other types of electrical equipment. Latest estimates show that the total annual business of the industry amounts to more than \$100,000,000.

Firms representing the industry at the organization meeting were: Advance Electric and Relay Co., Los Angeles; Automatic Electric Manufacturing Co., Mankato, Minn.; C. P. Clare and Co., Chicago; Control Corp., Minneapolis; Guardian Electric Manufacturing Co., Chicago; Leach Relay Co., Los Angeles; Potter & Brumfield Manufacturing Co., Princeton, Indiana; Price Electric Corp., Frederick, Md.; Struthers-Dunn, Inc., Philadelphia; Phillips Control Corp., Chicago; R. B. M. Manufacturing Co., Logansport, Indiana; and Allied Controls, New York City.

Radar Laboratory

A NEW experimental radar laboratory at Air Materiel Command headquarters, Wright Field, is constructed almost entirely from wood so as to offer a minimum of interference to radar equipment under test inside. The 100 by 200 foot structure reaches to a height of 75 feet, and is located on a hilltop affording maximum radar coverage of the Wright Field area. It is to be used for testing operation of new ground and airborne radar equipment as well as for calibrating

BRADLEY PHOTO ELECTRIC CELLS



Reduce Production Costs

Bradley Luxtron* photocells improve control over manufacturing operations, reducing your costs. They meet the most exacting requirements. Advanced manufacturing techniques make light-actuated Bradley cells the choice all over the world.

Luxtron photocells convert light directly into electrical energy. No external source of voltage is required. Besides the housed model shown with its plug-in contacts, Bradley also offers tube socket, nut-and-bolt types and pigtail contact mountings. In addition, Luxtron unmounted cells are available in many different sizes and shapes.

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

Illustrated literature, available on request, shows more models of Bradley photocells, plus a line of copper oxide and selenium rectifiers. Write for "The Bradley Line."

BRADLEY LABORATORIES, INC.

82 Meadow St. New Haven 10, Conn.

Specify MYCALEX

LOW LOSS INSULATION

Where high mechanical and electrical specifications must be met.

For Complete Catalog and Specifying information on MYCALEX 400, K, & 410 refer to pages 84-85 in the 1947 Mid-June

**BUYERS' GUIDE ISSUE
OF ELECTRONICS.**

27 years of leadership
in solving the most
exacting high frequency
insulating problems.

**MYCALEX CORPORATION OF
AMERICA**

"Owners of 'MYCALEX' Patents"

Plant and General Offices: Clifton, N. J.
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New York 20, N. Y.

It's

● **Legri S**
for

● **RESISTORS**

Half - One - Two Watt

- INSULATED
- ANY TOLERANCE
- WE CALIBRATE RESISTORS within 1 and 2% Tolerance.
- ANY QUANTITY
- ANY MAKE

Immediate Delivery!

WE SHIP THE SAME DAY YOUR
ORDER IS RECEIVED

Inquire Today!

LEGRI S COMPANY, Inc.

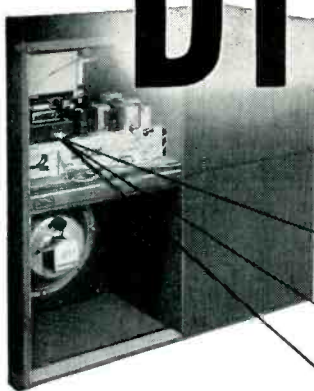
ELECTRONIC PARTS AND COMPONENTS

846-850 Amsterdam Ave.
NEW YORK 25, N. Y.

AC 2-0018

STROMBERG-CARLSON *uses-*

DINION

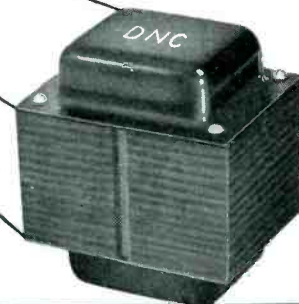


*Transformers
and Coils*

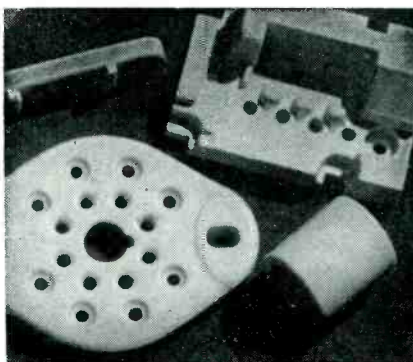
- Photo Flash Control
- Instrument
- Television
- Radio
- Electronics and Industrial Applications
- Electrical Coil Windings

The stringent requirements of a radio of distinction call for high calibre transformers and electrical coil windings. For superior quality and production, manufacturers use Dinion Transformers and Coils.

Specialists in Difficult Designs



DINION COIL COMPANY, INC. CALEDONIA
NEW YORK



Lavite STEATITE
CERAMIC

Properties and Characteristics of Our
LAVITE S1-5 Steatite Ceramic Body

Compressive Strength	96,000 lbs. per square inch
Tensile Strength	7,200 lbs. per square inch
Flexural Strength	10,500 lbs. per square inch
Modulus of Rupture	20,000 lbs. per square inch
Dielectric Strength	235 volts per mil
Dielectric Constant	6.42
Loss Factor	2.90
Power Factor	446
Bulk Specific Gravity	2.664%
Density (from above gravity)	0.096 lbs. per cubic inch
Hardness (Mohr scale)	7.0
Softening Temperature	2,350 F.
Linear Coefficient of Expansion	8.13x10 ⁻⁶
Moisture Absorption (ASTM D-116-42-A)	0.009%

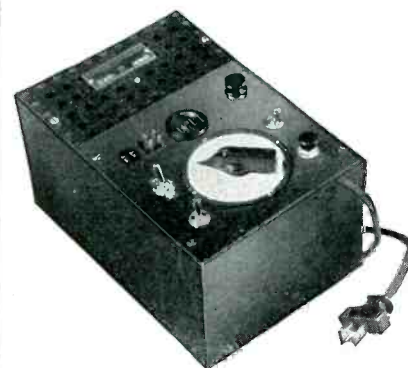
Design engineers and manufacturers in the radio, electrical and electronic fields are finding in LAVITE the precise qualities called for in their specifications . . . high compressive and dielectric strength, low moisture absorption and resistance to rot, fumes, acids, and high heat. The exceedingly low loss-factor of LAVITE plus its excellent workability makes it ideal for all high frequency application.

We will gladly supply samples for testing.

D. M. STEWARD MFG. COMPANY

Main Office & Works: Chattanooga, Tenn.
Needham, Mass. • Chicago • Los Angeles
New York • Philadelphia

PHOTOVOLT Electronic PROCESS TIMER



An adjustable timing relay for timing periods 1/20 to 50 sec.

- for welding, process timing, printing, control of machinery, and protection of electronic tubes
- for single actuation as well as sequence timing and recycling in continuous operation
- for AC of any frequency and for DC

Write for Bulletin #950

PHOTOVOLT CORP.

95 Madison Ave. New York 16, N. Y.

CAPITOL RADIO ENGINEERING INSTITUTE

—Where the Professional Radioman Studies



Which Will Get The Better Job?

The Radioman Who Looks
Ahead Will Get Ahead

Don't play blind man's bluff with your future! Look at the successful radioman. You'll find that he's the fellow who looked and planned ahead. Today, as a member of the great radio-electronic industry, you too, have opportunities that few men ever enjoyed in the past. Your future success can be assured by the plans you make today.

The radio industry is expanding so fast, that it is doubtful any radioman can truthfully say he has kept pace with all the major developments. Thousands of new men have joined the ranks of the radio industry creating new competition. New developments, create demands for more advanced technical ability. You must "re-tool" your technical knowledge in order to keep pace.

If you are wise, you will look ahead and start now to increase your technical ability with the thorough, practical technical training for which thousands of professional radiomen have enrolled with CREI since 1927. In our proved method of instruction, you learn not only "how", but "why". This is real, honest-to-goodness practical engineering training that leads to better jobs and security in the knowledge that you are capable of coping with tough problems of communications and industrial electronic equipment.

It costs you nothing to read the interesting facts. Please write today.

Veterans!

Crei Training Available Under "G. I." Bill.

MAIL COUPON FOR FREE BOOK

If you are a professional radioman and want to make more money, let us prove to you we have the training you need. To help us intelligently answer your inquiry—please state briefly your background of experience, education and present position.



Capitol Radio Engineering Institute

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Washington 10, D. C.

Gentlemen: Please send me your free booklet, "CREI Training for Your Better Job in RADIO-ELECTRONICS", together with full details of your home study training. I am attaching a brief resume of my experience, education and present position.

Check Practical Radio Engineering
Course Practical Television Engineering

Name

Street

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

I am entitled to training under the G.I. Bill

NEWS OF THE INDUSTRY

(continued)



A minimum of metal is being used in construction of this few field radar laboratory at Wright Field, to permit operation of radar equipment inside with all the comfort and efficiency of a heated lab

radar equipment in nearby aircraft.

Facilities of the laboratory will also be used in other aircraft calibrations, including speed measurement, determination of radius of turn at various speeds, and analysis of traffic procedures in conjunction with instrument approach systems.

Index to Wartime Reports

A COMPREHENSIVE index guide to the tens of thousands of reports on wartime technological developments in the United States, Germany, and other countries has been prepared by the Office of Technical Services, Department of Commerce.

The index is intended for use with *Bibliography of Scientific and Industrial Reports*, published weekly since January 1946 and containing a brief abstract of each report acquired by OTS.

The new *Index to the Bibliography of Scientific and Industrial Reports*, available from the Superintendent of Documents at 50¢, contains about 45,000 cross-reference entries classified under major subject headings, including electronics. With the index and a file of the *Bibliography* at hand, a researcher may readily determine the number of reports available from OTS in a special subject field and examine the abstracts.

BUSINESS NEWS

YARDENEY ENGINEERING COMPANY, New York, now working on remote control devices, pilotless aircraft



ATR
"A"

BATTERY ELIMINATORS

For Demonstrating and Testing
Auto Radios

New Models . . . Designed for Testing D.C. Electrical Apparatus on Regular A.C. Lines. Equipped with Full-Wave Dry Disc Type Rectifier, Assuring Noiseless, Interference-Free Operation and Extreme Long Life and Reliability.

- Eliminates Storage Batteries and Battery Chargers.
- Operates the Equipment at Maximum Efficiency.
- Fully Automatic and Fool-Proof.
- Type 60-ELIA . . . Rated Output 6.3 Volts at 6.5 Amperes. Net Price \$22.80
- Type 120C-ELIO . . . Rated Output 6.3 Volts at 14 Amperes. Net Price \$37.20



ATR
AUTO
RADIO
VIBRATORS

Designed for Use in Standard Vibrator-Operated Auto Radio Receivers. Built with Precision Construction for Longer Lasting Life. Prices are app. 15% lower.

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.

Write for New ATR Catalog—Today!

AMERICAN TELEVISION AND RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA — U. S. A.

and guided missiles, has been awarded a certificate of achievement from the U. S. Navy.

ADMIRAL CORPORATION recently opened its new assembly plant for small radios in Harvard, Ill.

SOLA ELECTRIC Co. recently moved all branches into its new plant at 4633 W. 16th St., Chicago 50, Ill.



New Sola Electric Co. plant

PYROFERRIC Co., manufacturer of powdered metal cores, is now located at its new and larger headquarters, 621 E. 216th St., New York 67, N. Y.

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass., now has a Commercial Products Division, comprising the broadcast equipment division and what was formerly known as the industrial electronics division.

BITTERMAN ELECTRIC COMPANY, Brooklyn, N. Y., moved last month to its new headquarters at Sauger-ties, N. Y.

A. L. NELSON & Co., radio transformer manufacturer, is now owned by the Nelson Electric Corp. of Santa Monica, California.

E. F. JOHNSON COMPANY, Waseca, Minnesota, purchased the Speedx line of semi-automatic and hand keys, practice sets and buzzers from the Les Logan Company, San Francisco, California.

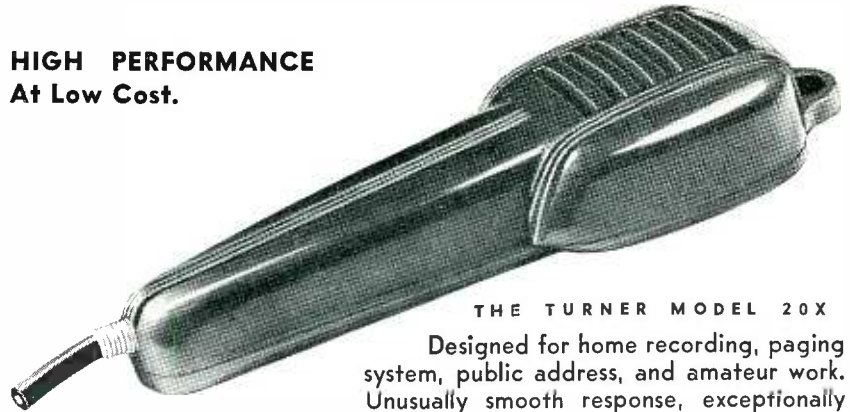
PERSONNEL

A. M. WIGGINS, research director of Electro-Voice, Inc., Buchanan, Michigan, has just returned from a survey of electro-acoustic developments in Germany.

SAMUEL M. THOMAS received the appointment of vice-president and general superintendent of RCA Communications, Inc., after serving as assistant chief engineer since February 10, 1947. Prior to retir-

NEW Crystal Hand Microphone

**HIGH PERFORMANCE
At Low Cost.**



THE TURNER MODEL 20X

Designed for home recording, paging system, public address, and amateur work. Unusually smooth response, exceptionally high level. Features a Metalseal crystal. Light in weight and natural to hold. Hangs on hook when not in use. Baked brown enamel finish.

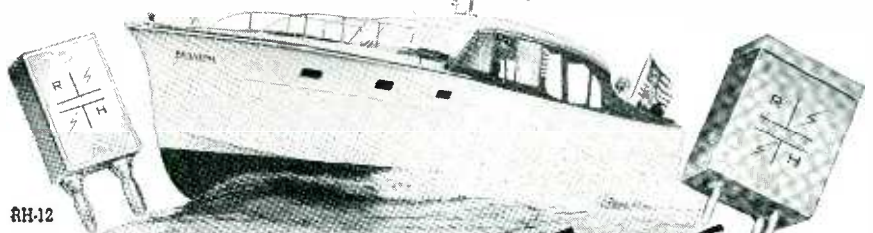
- CONDENSED SPECIFICATIONS**
- Response: \pm 5db from 50 — 7000 c.p.s.
 - Level: 54db below 1 volt / dyne/sq. cm.
 - Cable: 7 ft. attached, shielded.
 - Dimensions: 6/4" long x 1" thick x 2/8" wide.
 - Weight: 8 oz.

Microphones **BY TURNER**

For complete information write
THE TURNER COMPANY

905 17th Street N. E. Cedar Rapids, Iowa

DEPENDABLE



MARINE CRYSTALS

Manufacturers of marine radio receivers and transmitters report thousands of R-H Marine Crystals in use without a single failure. R-H Marine Crystals provide the reliability necessary for safety at sea.

R-H Marine Crystal Units are made to the **marine radio manufacturer's** specifications, to fit the **marine radio manufacturer's** circuit.

Illustrated are RH-12 for single unit installations and RH-53 in double units for both transmitting and receiving.

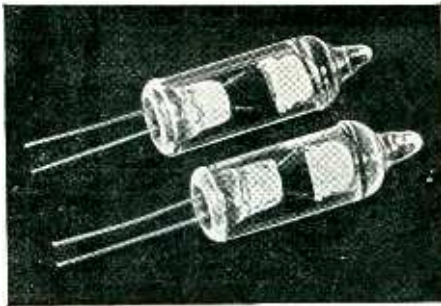


REEVES-HOFFMAN Crystal Units Catalog RHC-1 lists standard crystal units complete with specifications. It also gives valuable information on how to order crystals.



REEVES-HOFFMAN CORPORATION

SALES OFFICE: 215 EAST 91 STREET, NEW YORK 28, N. Y.
PLANT: 321 CHERRY STREET, CARLISLE, PA.

MINIGLASS* QUARTZ CRYSTAL UNITS†

SHOWN ACTUAL SIZE

Compact — hermetically sealed — high performance — for multiple applications in the range of 2,500 to 10,000 kilocycles with a tolerance of ± 250 cycles at room temperature . . . MINIGLASS* crystals are designed for your low cost quantity production items. Immediate delivery.

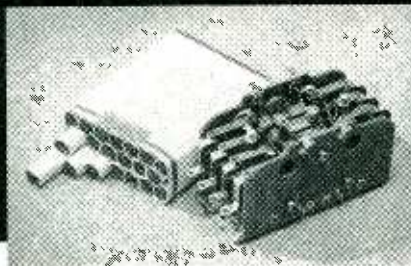
Manufacturers of Radio Quartz Crystals.

MELVIN L. SMITH LABORATORIES
KANE, PENNSYLVANIA

*Trade Mark †Patent applied for

SIGMA 3 POSITION OUTPUT RELAY

**FOR
CONTROL SYSTEMS
AND
SERVOMECHANISMS**

**SIGMA TYPE 6 FX8A RELAY**

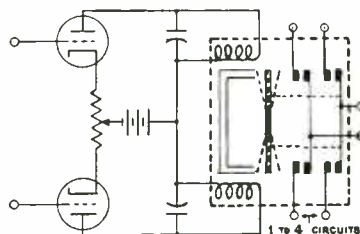
Weight 8 Ounces

(Available Hermetically Sealed.)

This new relay by Sigma, already proven in months of development by prominent manufacturers of control and guiding equipment, overcomes many shortcomings previously inherent in relay-output control systems.

SPECIFIC ADVANTAGES

1. Positive snap centering or detent — no gradual motion.
2. True magnetic cancellation at balance — not affected by variations in standby current.
3. Exceptional sensitivity — approximately .005 watt differential power required per contact circuit.
4. Polarized magnetic circuit increases speed of action and facilitates discrimination as to polarity of error.
5. Fully balanced moving system withstands vibration to exceptionally high degree.
6. Flexible contact structure (maximum shown above) with substantial load handling ability (nominal rating 5 amp 110 Volts A.C. per contact).



Sigma Instruments, INC.
Sensitive RELAYS
62 Ceylon St., Boston 21, Mass.

ing from the Army as Brigadier General, he was Chief of Staff to the Commanding General of the Persian Gulf Command.

GEORGE F. METCALF, manager of General Electric's Electronics Laboratory at Syracuse, N. Y., was appointed an Honorary Officer of the



Colonel Metcalf (right), being decorated in Washington, D. C. by Lord Inverchapel, British Ambassador, for contributions to airborne radar while in the War Department and while serving as head of the Aircraft Radar Laboratories, Wright Field

Military Division of the Most Excellent Order of the British Empire.

G. TAYLOR STANTON, formerly chief engineer of TelAutograph Corporation, New York, has been appointed manager of engineering of Holtzer-Cabot, specialized electric motor manufacturers.

JAMES D. MCLEAN, with General Electric in the radio, television, and radar fields for the past nine years, has recently been appointed manager of Philco television station WPTZ.

B. W. KENDALL, research consultant at Bell Telephone Laboratories, was elected second vice-president of the New York Electrical Society for the 1947-1948 term.

GEORGE C. W. BROWNE has just been appointed Controller of Radio, Department of Transport, in Ottawa, Canada.

DALE H. NELSON joined the Tele-register Corp., New York City, as consulting engineer to the Teleregister Laboratories Division. He was formerly research engineer at the

Water Mill Laboratories of The Western Union Telegraph Co.

C. W. HENDERSON, former standards engineer at RCA, has joined Clarostat Mfg. Co., Inc. as sales engineer in the Philadelphia area.

DENNISTOUN W. VER PLANCK, professor of electrical engineering at Carnegie Institute of Technology, has been named head of the department of mechanical engineering and professor in that department. For his work during the war in degaussing of ships he was an honorary member, Order of the British Empire, and received the Commendation and Ribbon Bar from the Secretary of the Navy.

W. AUSTIN ELLMORE has been appointed chief engineer and sales manager of Crescent Industries Inc. Formerly vice-president in charge of engineering and sales at Utah Radio, he is active on seven RMA committees.

EDWIN G. SCHNEIDER, formerly assistant to the president for research at Stevens Institute of Technology, was appointed director of research on controlled flight, including flight at supersonic speeds at the Institute. He was research physicist for both Farnsworth Television Co. and Philco in turn before joining Stevens Institute in 1938. During the war, at MIT Radiation Lab, he led a group which directed the development of ground radar for control of aircraft and for early warning. From 1944 to October 1945 he was expert consultant to the Office of the Secretary of War.



E. G. Schneider



J. D. Woodward

JOHN D. WOODWARD, promoted to manager of the RCA Aviation Equipment Engineering Group, will supervise the development and engineering of aviation radio communication and navigation equipment



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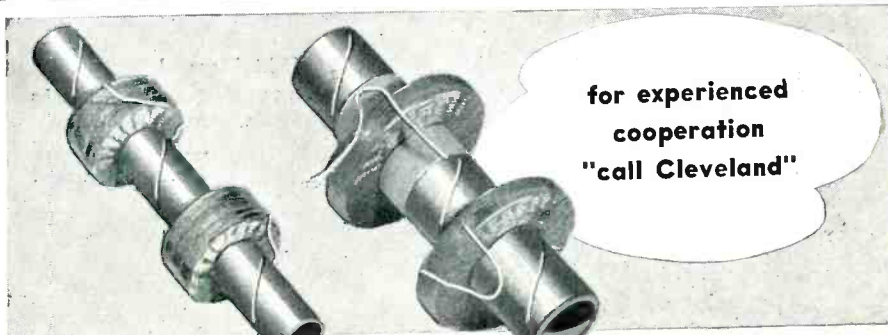
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for both commercial and military aircraft. Before joining RCA in 1945 he was chief engineer of the Radar Navigation Group in the AAF Radar Laboratories at Wright Field, where he had the responsibility for the technical development of shoran and airborne loran.

DAVID D. COFFIN, chief engineer of Raytheon Manufacturing Co.'s new Commercial Products Division in Waltham, Mass., has been with the company since 1934.

EVERETT G. FRAIM, identified with the Boston-New York microwave experimental communication system, is now engineer in charge of speech input equipment and microwave applications at the recently formed Commercial Products Division of Raytheon Manufacturing Co., Waltham, Mass.

JAMES N. NYE, engineer in charge of broadcast transmitter equipment at Raytheon's new Commercial Products Division, spent five years with Federal Telephone and Telegraph Co. working on the development of f-m transmitters.

EDWARD F. CAHOON has rejoined TelAutograph Corporation as chief engineer. He assumes full responsibility for engineering research and development on tele-scribing systems for instantaneous communications in writing.

FULTON CUTTING, former president and chairman of the board of directors of Colonial Radio Corporation, has been appointed assistant to the president for research and professor of physics at Stevens Institute of Technology. He organized the Colonial Radio Corp., Buffalo, N. Y., in 1924. As a member of the Operational Research Staff in the Office of the Chief Signal Officer during the war, he worked on radar countermeasures and counter-countermeasures (antijamming), guided missiles, and countermeasures against guided missiles, and was a member of the ALSOS Mission.

GEORGE L. BEERS, assistant director of engineering of the RCA Victor Division in Camden, N. J., received the honorary degree of Doctor of Science from Gettysburg College, Gettysburg, Pa.

NEW BOOKS

The Radio Amateur's Handbook

By the HEADQUARTERS STAFF OF THE AMERICAN RADIO RELAY LEAGUE. Published by the American Radio Relay League, Inc., West Hartford, Conn., 1947, Twenty-fourth Edition, 632 pages, \$1.25.

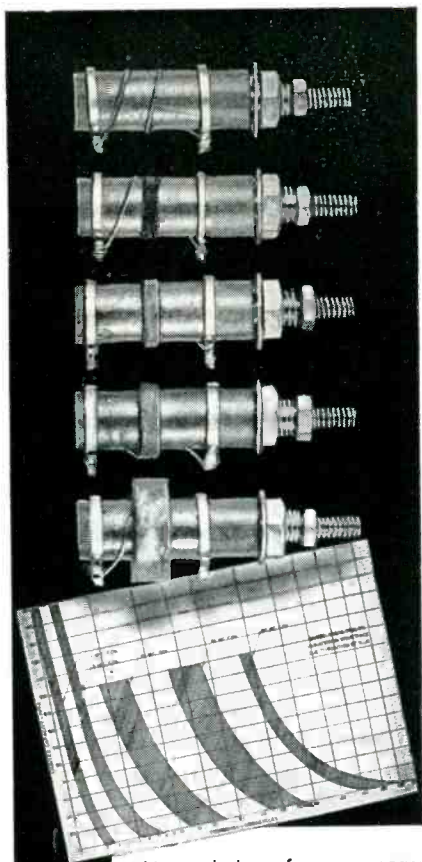
THE STANDARD manual of amateur radio communication has undergone its yearly revision and emerged, as usual, a source of handy and valuable information not only for the amateur but also for the engineer interested in practical radio applications. While the engineer might prefer to see revisions of a type that would eventually upgrade the book out of the amateur class, the editors wisely keep their volume in conformity with the subject matter contained in the amateur magazine *QST*. As an example, the lead-off article under receiver construction describes a two-tube super-heterodyne, probably no more difficult to construct than the two-tube regenerative receiver that occupied a similar position in last year's Handbook. The single-tube transmitter is replaced by a crystal oscillator and amplifier combination that is little more expensive and a better performer. The sections on vhf equipment are likely to change most as techniques of using the higher frequencies are developed.

The fifty pages of vacuum-tube characteristics and data include base diagrams for socket connections covering more than a thousand tube types. This information alone is well worth the price of the entire volume.—A.A.MCK.

Tables of Spherical Bessel Functions

MATHEMATICAL TABLES PROJECT, NATIONAL BUREAU OF STANDARDS. Columbia University Press, New York, 1947, 375 pages, \$7.50.

THE MAIN table gives the functions of orders $\pm(n + \frac{1}{2})$, where $n = 0(1)13$ and $x = 0(0.01)10(0.1)25$, as required for solution of problems of potential, heat conduction, and wave motion for a domain bounded internally or externally by a sphere, circular cone, or spheroid. The majority of entries are to seven or eight significant figures. The



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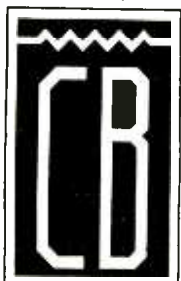
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Electric Contacts

By RAGNAR HOLM. *Published by Hugo Gebers Forlag, Stockholm, Sweden, 1946, 398 pages.*

CIRCUIT breakers, relays, terminals, and microphones all operate with electric contacts. This volume has been written to describe the physics of contacts, to arrange fundamental formulas, and to present characteristics of materials in tabular form for use with the formulas. Friction has been treated in some detail because wear in sliding is fundamentally important in many types of contact. Descriptions of circuit-breaker phenomena have been limited to weak currents, partly because the long arcs experienced with heavy currents modify the general problem considerably.

The greater part of the work described was done while the author was employed as a physicist on the staff of the Research Laboratory of the Siemens Works in Berlin. The present volume owes much to a previous work by the author published in Berlin in 1941. —A. A. MCK.

Unified Calculus

By E. S. SMITH, M. SALKOVER, and H. K. JUSTICE. *John Wiley & Son, Inc., New York, N. Y., 1947, 507 pages, \$3.50.*

FIRST course in calculus, at college level, uniquely combining differential and integral calculus in early chapters to create an appreciation of the unity of the subject.—J.M.

Six-Place Tables

Edited by EDWARD S. ALLEN, *Professor of Mathematics, Iowa State College. McGraw-Hill Book Co., Inc., New York 18, N. Y., Seventh Edition, 1947, 232 pages, \$2.50.*

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RADAR ENGINEERING

By DONALD G. FINK, Editor, *Electronics*, Formerly Staff Member, Radiation Laboratory, M.I.T., 644 pages, 6x9, 471 figures, 12 tables, \$7.00.

BRINGS together all the essential information the engineer needs in order to understand and design radar equipment. Each phase of the subject is covered comprehensively, from first working principles to the equations upon which practical designs are based. Hundreds of clear diagrams, charts, drawings and photographs illustrate the technical details of the various radar systems.

SERVOMECHANISM FUNDAMENTALS

By HENRI LAUER, ROBERT LESNICK, and L. E. MATSON, All of the Engineering Department, RCA Victor Division, Radio Corporation of America. 277 pages, 6x9, 165 figures, \$3.50.

THIS book provides the practical information necessary for the solution of problems in the design of automatic control devices. It presents the operating features of servomechanisms, sets forth systematic procedures for their design, demonstrates how amplifiers, motors, gears, and other component elements, are coordinated into efficient and smoothly operating systems.

ELECTRONICS IN INDUSTRY

By GEORGE M. CHUTE, Application Engineer, General Electric Company, Detroit. 461 pages, 6x9, 292 figures, \$5.00.

This valuable manual supplies the man who uses electronics in plants with a complete, non-technical description of electronics circuits and equipment—without using long words or difficult mathematics, and without demanding a special technical background from the reader. Dozens of examples show you how tubes and tube-operated circuits work in motor control, welding control, and many other ways in industry. The book supplies detailed explanations of a large number of electronics equipment in commercial use today.

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place accuracy. The introduction gives instructions for using the tables, along with several excellent examples of uses for logarithms.

—J.M.

Relativity

By ALBERT EINSTEIN. *Hartsdale House, New York* 18, N. Y., 168 pages, \$2.50.

REPRINT of a book written in 1916 explaining Einstein's theory of relativity in simple words with a minimum of mathematics, and that essentially at the high-school level. This English translation, made in 1920 by R. W. Lawson, is offered as an atomic age source book.—J.M.

An Introduction to Engineering Plastics

By D. W. BROWN AND W. T. HARRIS. *Murray Hill Books, Inc, New York* 16, N. Y., 274 pages, \$4.00.

OF PARTICULAR interest to the electronic engineer are highly readable chapters on x-ray examination of plastics, (4 pages), metal coating of plastics by electroplating and by spraying molten metal (11 pages) machining of plastics (20 pages) high frequency heating for processing plastics and welding thermoplastics (11 pages) and welding plastics.

—J.M.

Electronic Engineering Patent Index

Edited by FRANK A. PETRAGLIA, *Electronics Research Publishing Co., New York*, 1946, 467 pages, \$14.50.

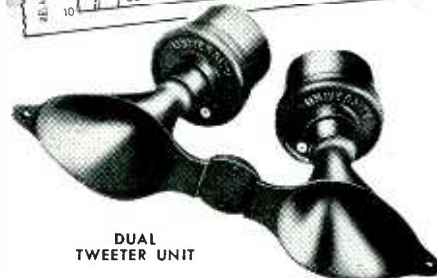
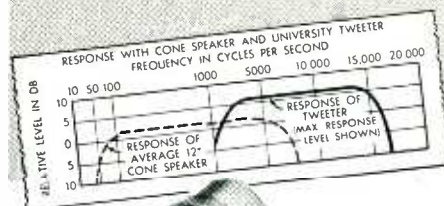
PATENT abstracts of electronic devices as they appeared in the weekly *Official Gazette* of the U. S. Patent Office during 1946 have been arranged by type of subject device under some 90 classifications. The index forms a convenient guide for engineers to the latest techniques and devices.—F. R.

Employees Are People

By HARRY K. TOOTLE, *Personnel Director, New York Times. McGraw-Hill Book Co., Inc., New York, N. Y., 1947*, \$3.50.

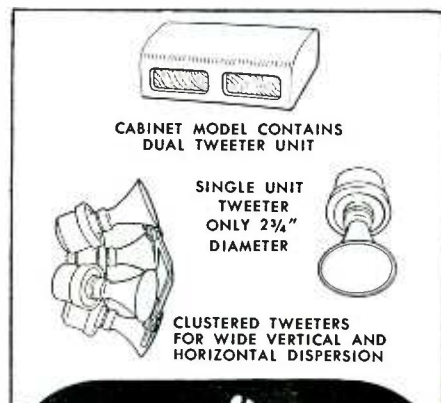
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Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which **ELECTRONICS** has published.

Television Herald

Dear Editor:

THIS LETTER is written in response to your recent editorial calling attention to the need for a simple device to warn television set owners that a special program is about to be offered.

Why not permit stations to use their f-m transmitters for commercial broadcasting during the hours when they are not transmitting pictures? Television receivers should be equipped with switches which would permit turning off the video portion of the receiver. Thus, the station would merely make an announcement that a special picture program would be transmitted at a certain time.

If this system were instituted it would provide more incentive for more people to spend more money in purchasing a combination receiver since they could get more use from it. This plan would also provide an added incentive to potential broadcasters of television programs since they could probably increase their station income sufficiently to break the economic bottleneck which currently is impeding the progress of television.

It is my opinion that people will pay a fair sum for a television receiver if some means can be found by which television stations can be placed on the air with fair programming and without bankrupting the station operator.

MERLE V. HOOVER
Susquehanna University
Selinsgrove, Penna.

Pentode as Cathode Follower

Dear Sir:

IN THE CATHODE FOLLOWER Nomograph, p 136, June issue of **ELECTRONICS**, unless the negative screen return (not shown) is made to the

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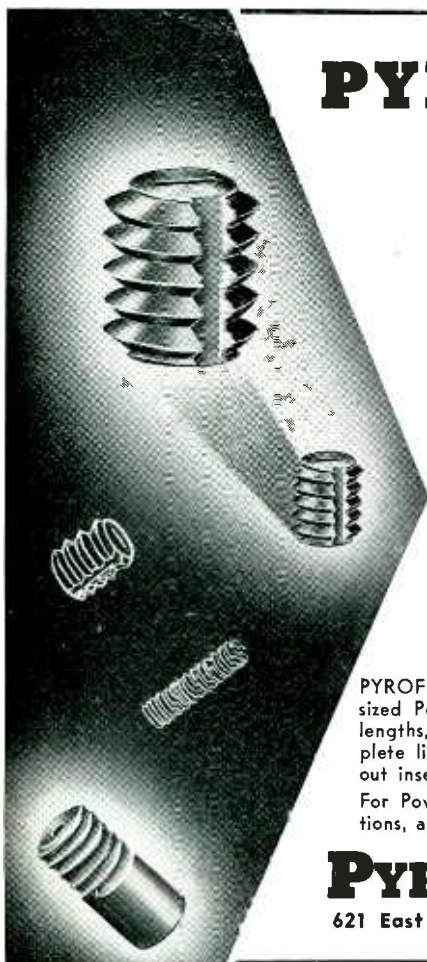
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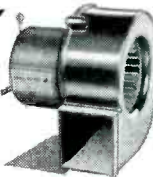


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This CONTACTS Section

supplements other advertising in this issue with these additional announcements of products essential to efficient and economical production and maintenance. Make a habit of checking this page, each issue.

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cathode, rather than to ground, the equations and nomograph do not hold for a-c signals whose voltage swing is an appreciable portion of the d-c screen voltage.

This is because the tube ceases to be a pentode if the cathode to screen voltage is allowed to vary with the signal. If such variation is allowed, the manufacturer's tube parameters, particularly the mu and the dynamic plate resistance, are no longer valid.

For a-c amplifiers with relatively small signal voltage, this point is probably of small importance. For d-c amplifiers, it becomes so important that it is necessary to use a separate screen supply, connected between the floating cathode and the screen, if it is desired to obtain a value of *A* approaching 0.99 with any standard pentode.

The writer has designed much electrochemical equipment using an input buffer stage of this type to reduce grid current. It has been necessary to get the voltage gain as near to unity as possible in this stage for the sake of linearity of the instrument. This has required that the screen return be connected to the cathode, with a separate screen supply.

P. M. HACKETT,
Manager
Niagara Electron Laboratories
Andover, N. Y.

Lines for Tanks

Dear Mr. Fink:

I SHOULD like to report the following errors, besides the immediately obvious ones, in "Design of Transmission Line Tank Circuits," published in the May 1947 issue of **ELECTRONICS**.

(a) Equation 4—letter *l* is missing in *l/λ* term.

(b) Figure 2—ordinate should be labeled from 1×10^4 to 1×10^6 .

(c) The right-hand side of Eq. 19 should be multiplied by 2.

(d) Citizen's Band Class-C Amplifier—Substitute *R_c* for *Q*. The final numerical answer is 4,520.

I should like to thank you and your staff for the excellent presentation, which I truly appreciate.

WALTER C. HOLLIS
Project Engineer
Sperry Gyroscope Co.
Great Neck, N. Y.

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(Continued on page 254)

ADDITIONAL EMPLOYMENT ADVERTISING ON PAGE 254



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(Continued from page 253)

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Fully equipped and assembled—Just connect to your headphone, etc., and plug into your power line.

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INPUT 115 volt D.C., 4.1 Amperes, 3600 R.P.M.

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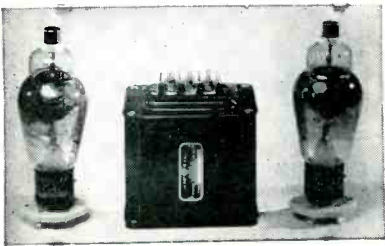
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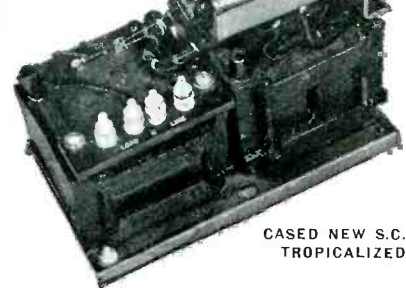
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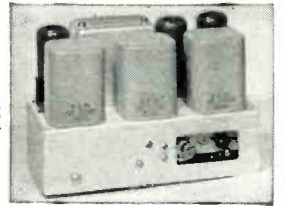
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IF STRIP 30mes/85DBgm 8/6AK5 & 1/6AL5, dim 2x11x2-3/4" H, 12mes bnd width outpt JACK & CO AXIAL inpt plug..... \$ 4.99
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WE DYNAMIC MIKE 20FT CABLE..... 7.95

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DYNAMIC OR CARBON MICROPHONE OR LINE INPT: Output 1P class "B" GRIDS. Noise Level down—55DB. INCLUDES INPT TRANSF, 1st AUDIO to 1P Grids MODULATOR TUBES, 6V6 Sidetone adj Audio osc AMP & Ildphone monitoring Jack. Wt 5LBS. DIM 7-3/4" L 3-3/4" W 5" H. minus tubes & powr supply "TAB" SPECIAL WITH INSTRUCTIONS..... **\$4.95**

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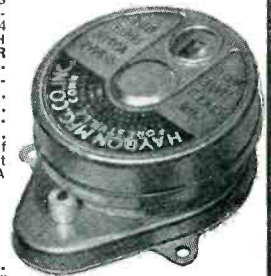
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Mfgrd A. G. Redmond

W. E. Stern Electric KS-5868-L03

Input 28VDC 1.4Amp. Output 250V 60ma. Duty Continuous

Wgt—2 lbs. Qty 1800

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Works as 110VDC Motor Can be used on 12VDC input by paralleling field coils. Air Corps Dy.-2B/ARR-2

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MODEL G101

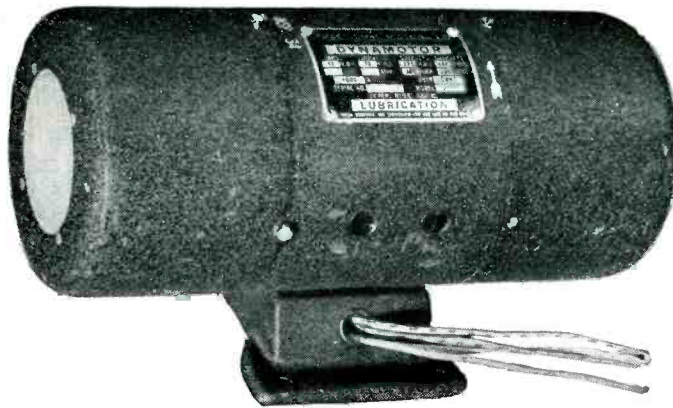
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Input 3/16 HP Motor 430VDC 3450 RPM Output 180ma Duty Continuous

Dim. 8"L 5"Dia/SHAFT 2 3/8"x1/2"D Wgt—17 lbs. QTY 200

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Can be used as DC 110V Motor



Illustrated Unit

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Mfgrd Fractional Motors

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Wgt. 21 lbs. Dim. 11" L 5" Dia. Qty., 1500

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Mfgrd. Bendix & Webster

INPUT 28VDC 10.5Amp RPM 4700 Duty Continuous Output #1 300VDC 260ma Output #2 150VDC 10ma Output #3 14.5V 5Amp

Wgt—21 lbs. Dim. 12 1/2" L 5" Dia., Qty. 1500

"TAB" SPECIAL PRICE \$3.85

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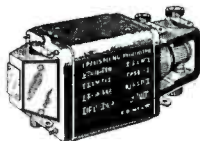
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Aircraft Completely Cased Inpt & Outpt Filters, Voltage Regulators & Relays

Input 24-28VDC 13Amps RPM 6000 Duty Cont. Output #1 300VDC 260ma Output #2 150VDC 10ma Output #3 14.5V 5Amp

Wgt—34 lbs. Qty. 100

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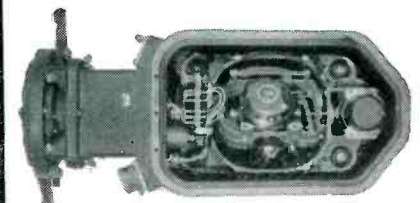
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Two G.E. Model S.Q. sets new in original portable carrying cases, 90-130 volt, 60 cycle, 320 watts. Choice A, B, or P.P.I. Presentation. 300 yards minimum range, max. 3, 15, 45 miles. 10 cm. Ideal for schools, laboratories, small boats, etc.

S.G. Radar, brand new spares and component units.

SO-1 complete antenna assemblies, brand new packed for export.

SO-3 brand new spares and component units.

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G.E. selsyn Control Transformers 115-55 volt, 60 cy., model 2J5FB1, brand new in original sealed containers.

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Two B.C.-325 types B & C. Freq. range 1.5 to 18 mcs. Output 400 watts C.W. or 50 watts phone. 110 V. 60 cy., used but in excellent operating condition.

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Five MD1/FRC Modulator units consisting of two complete 500 watt audio channels. Everything from microphone input to modulation transformer output built into metal cabinets. 110 v. 60 cy. Brand new.

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75 Westinghouse NX35 D.C. Milliammeters 0-800, 3 1/2" round bakelite cases.

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55 J.B.T. 30-FX, 100-130 volt 46-64 cycles frequency meters, 3 1/2" bakelite cases.

22 Marion Instrument D.C. Kilovolt meters for use with 1 meg. external resistor, round 2 3/4" bakelite case.

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Brand new. Built by Allis Chalmers to rigid specifications of the U. S. Navy.

K.V.A. output 1.250	R.P.M. 3600
K. W. output 1.	Cont. Duty Ph. Single
P. F. .80	Cycles 60
Volts input 115. D. C.	Volts output 120. A. C.
Amps. input 14	Amps. output 10.4

Length 26"; width 12 7/8"; height 13". Compound accumulative A.C. and D.C. fields. Centrifugal starter. Splashproof covered, frequency adjustable to load, plus or minus five cycles.

PRICE \$87.50

Identical machine, but 230 volts D.C. input \$125.00

Prices f.o.b. Tuckahoe, New York

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24 Hour Delivery

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50-100-200-500 microamps. High Resistance Voltmeters Vacuum Thermo-Couple Meters 3/2" & 4/2" Round & Rectangular

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BD-71: 6 line; local battery, mon-ocord, W/CT, repeating coils on 2 lines to permit simplexing telegraph circuit. New.

Price \$40.00 each

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1500 V.—5 amps. Reasonably priced. Slightly used. Complete with transformers, tubes, General Radio #50B variacs, switches, meters, controls, etc. For further information contact:

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12 position standard stepping unit. 360° rotation. Designed for one step indexing for each current impulse. 24V DC Solenoid. Individually boxed. New \$1.50 each, 4 for \$5.00

NATIONAL ACN Planetary dial drive; mechanism only. Ratio 5:1. New; Boxed..... \$1.00

Flexible shaft coupling 3/16" diameter; brass bushing on each end. 5" long; 12 for \$1.00; \$50.00 per thousand

UTC-S-11 Matching Transformer, 10,000 ohms; 500/200. New \$1.70

Pulse Transformer, cylindrical; 2 1/2" H. x 3 1/4" D. 18.5 ohms—107 MH. tapped at 16.2 ohms—52 MH. tapped at 2.3 ohms—12.7 MH. 50c each; 3 for \$1.00

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COAXIAL CABLE RG8/U.... 1,000 feet for \$35.00

SPECIAL WIRE CLOSEOUT

15,000 feet on 27" reels; #19—7 strand 3 Copper—4 Steel

BLACK VINYLITE COVER. O.D. 1/8"

CLOSEOUT PRICE

15,000 feet for \$33.57

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VILLAGE RADIO EQUIPMENT

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SURPLUS BARGAINS

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Volt-Ohm-Milliammeter

Model 663 is widely used for general industrial and experimental work where a broad range of resistance measurements, with D.C. voltage and current ranges is required.

Ranges
Resistance: 6 ranges 1 ohm to 10 Megohms
Voltage : 6 ranges 2.5 volts f.s. to 1000 volts
M.A. 4 ranges 1, 5, 25, 100 M.A.
Comes complete with batteries, test leads, and in an Oak Carrying Case.
Old List Price \$71

Your Cost \$29.50

WESTON MODEL 528 DOUBLE RANGE A.C. AMMETER



A double range Ammeter 3 and 15 Amps A.C. Comes complete in Leather Case. Slightly used and guaranteed.

Your Cost \$9.50

WESTON MODEL 269 FAN SHAPED METER



One of the Weston popular fan shaped line. Exceptionally long scale for size of instrument. Accuracy—within 1%. Scale length—4".

Spade pointer. Here is a good movement for special purpose instruments. Comes with blank scale with arc drawn in. Ready for plotting calibration points. Can be used to make up any range of volts, amps, MA., etc.

Full scale deflection—5 M.A.—40 M.V.
List \$29.83
Your Cost \$8.95
10 for \$75.00

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A small but rugged built-in spur gear reducer motor. Three wire reversible, condenser start. Type KC1-22. 115 volts — 60 cycles — 3.7 R.P.M. 7.5 watts—85 inch ounce torque.

Your Cost \$7.50

SPECIAL METERS

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Resistance Thermometer 30° F. to 230° F.
with res. bulb. Weston #727..... 4.95
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MILLIAMPERES D. C.

0-1 Mills—3" Rd. G. E. DO-53.....\$4.75
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0-1 Mills—2" Rd. G. E. DW-41 (special scale) 1.95
0-5 Mills—2" Rd. Dejur S-210 2.15
0-15 Mills—2" Rd. Weston 506 3.25
0-500 Mills—2" Rd. G. E. AW-41.... 2.50
1-0-1 Mills—3" Rd. Western Electric Surface (scale 100-0-100) 1.35

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0-1 Amp. 3" Rd. Weston 301.....\$5.95
0.15 Amps—4" sq. Triplett #421.... 2.95
0-3 Amps 4" sq. Triplett #421..... 2.95
0-10 Amps—3" Rd. Simpson #25.... 4.95
30-0-30 Amps 3" Rd. Simpson #25.. 4.95
0-80 Amps—2" Rd. Weston #506 (charging Amp caption) (with ext. 50 MV shunt) 3.25
0-300 Amps 3" Rd. Roller-Smith Type TD (with ext. 50 MV shunt)..... 4.95
0-300 Amp. same as above (without shunt) 2.50
0-300 Amp. 4" Rd. Weston 643 (flush metal case) Black scale—with ext. shunt.. 8.50
0-300 Amp. same as above (without shunt) 6.00

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0-10 Volts 3" Rd. EelectroTech.....\$3.75
0-20 Volts 3" Rd. Weston 506-1000 Ohms/V 3.50
0-50 Volts 4" Rd. Weston NX-37 200 Ohms/V 6.00
0-150 Volts 3" Rd. G. E. D-41..... 4.75
0-150 Volts 3" Rd. Weston 301-200 Ohms/V. (black scale)..... 4.95
0-150 Volts 4" Rd. Weston 643 (flush metal case—black scale) 6.75

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0-300 Volts—4" Weston 642 (surface metal case) 9.00

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Portable D.C. Voltmeter — 0-3/15/150 Volts — Triple Range.

Used as a reference standard. Accuracy unaffected by wide changes in temperature.

Accuracy: 1/4 of 1%. Knife edge pointer—mirror scale.
Scale length: 5.18". With genuine leather case. List: \$117.13.

Your Cost \$57.50

PORTABLE VOLTMETER



Westinghouse PX-14

A rugged instrument of medium accuracy. Magnetically shielded, bakelite case. Mirror Scale.

Accuracy ±1%. Scale Length: 3.2". Size: 5-3/4" x 4-3/4" x 1-3/4".

List Price \$46.00

Your Cost \$17.50

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Portable D.C. Voltmeter. 0-15 Volts—100 Ohms per Volt, Accuracy: 1/2 of 1%. Mirrored scale—5.18" long. Knife edge pointer. Dimensions: 6"x6"x4".

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STEPDOWN TRANSFORMER



Made by General Electric. Heavy duty stepdown transformer, with considerable overdesign. Ideal for rectifier applications, low voltage heating, general laboratory use, etc. Open frame type.

Input: 115 Volts—60 Cycles
Output: 15 Volts (at full load)
Capacity: 180 V.A.
Size: 3-1/2" x 3-1/2" x 4".

Your Cost \$3.75

Quantity prices available

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0-5 Amps. 4" Sq. Triplett #431 (flush bakelite case. Scale: 0-150/300 V.)... 2.95
0-30 Amps. Triplett 3"Rd..... 3.25

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ELECTRONICS — August, 1947

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10 mfd 100V 10c	100 mfd 150V	20c

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45° Twist; 6 Inches Long	5.00
Pressurized Unit; 4" Long; Valve & Meter	9.00
Crystal Mount; Broad-banded; VSWR 1.1 max. over 8500 to 9400 megacycles	20.00
Directional coupler; 21 Db.; 8 in. long Part of AN/CPN-6; Govt. Inspected	20.00
Waveguide conn.; Flange; UG-39/U 12 for	5.00
Waveguide conn.; Choke; UG-40/U 12 for	7.00
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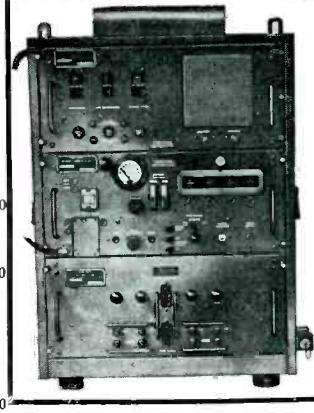
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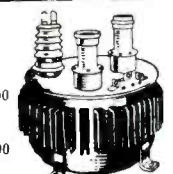
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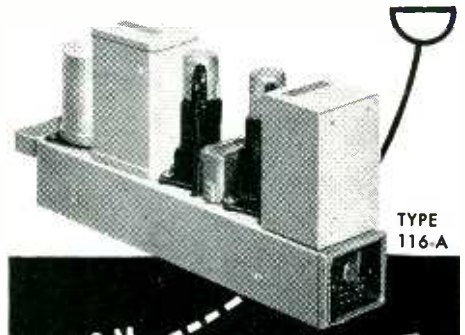
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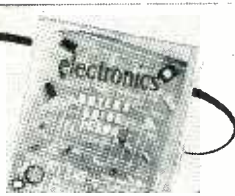
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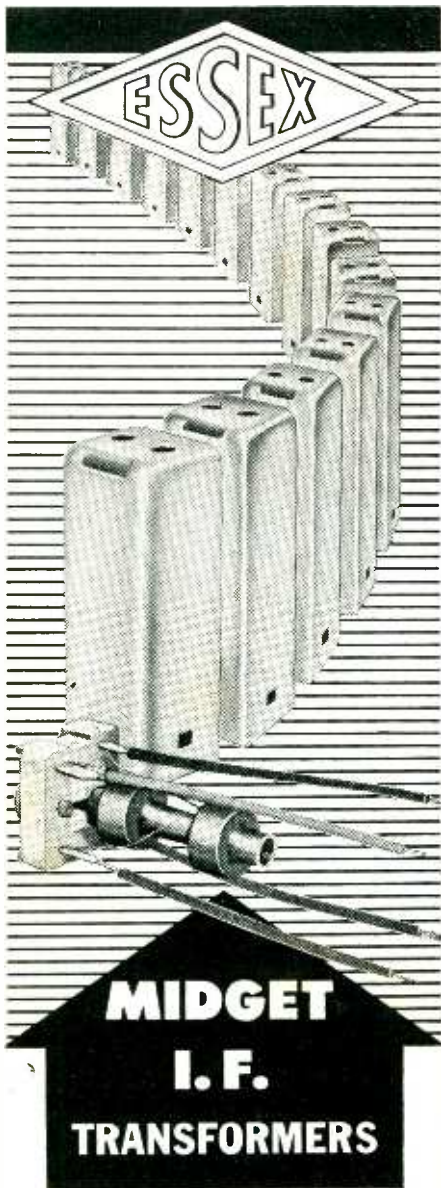


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Refer to the 1947-48 Issue of
ELECTRONICS BUYERS' GUIDE





**MIDGET
I.F.
TRANSFORMERS**

for all types of
RADIOS

Performance equivalent to larger I.F.'s.

3/4" x 3/4" x 2" high

We are in full production on this item. When inquiring, please designate type of radio considered.

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**20,000 and 1,000 ohms
per volt**

High speed, 54 range, dual-high sensitivity AC-DC de-luxe multi-range test set. Ranges to 6,000 volts — 600 megohms — 12 amperes — 70 DB — 60 microamperes.



Automatic push button range and function selection. A supersensitive test set particularly engineered for reliable, high speed measurements in modern electronic circuits. Easy reading, 4 1/2" meter. All standard functions at only two tip jacks. 600 megohm insulation resistance test range. Recessed 6,000 volt safety jacks. Etched-Anodized aluminum panels.

RANGE SPECIFICATIONS

- * 8 triple duty voltage ranges to 6,000 volts. Initial range 0-3 volts.
20,000 AND 1,000 ohms per volt D.C., 1,000 ohms per volt A.C.
 - * 8 D. C. current ranges from 0-60 microamps to 12 amps.
 - * 6 ohmmeter ranges to 600 megohms.
 - * 8 D.B. ranges from -26DB to +70 DB
 - * 8 output ranges to 6,000 volts.
- Model 858-L; modern, shallow, bakelite laboratory type case, size 7 3/8 x 8 3/8 x 3 \$47.94
- Model 858-P; portable, hardwood case with tool compartment and cover, size 8 3/4 x 10 x 4 1/2 \$49.94
(complete with batteries and High Voltage test leads)

ASK to see the "Precision" line of Quality Test Instruments on display at all leading radio parts and equipment distributors. Signal Generators, V.T. V.M'S Tube Testers, Multirange Test Sets, etc.

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FOR HIGH Q TOROIDS

U. T. C. Permalloy dust core toroid coils combine the optimum type of core for each application with special U. T. C. winding methods to insure a maximum of Q and stability of characteristics. Having specialized in this field for many years, U. T. C. has developed a number of standardized types of coils and filters suited to virtually every application.

UTC HIGH Q TOROID COILS



HQA REACTOR

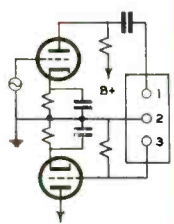
These reactors are designed for audio frequency operation with high Q and excellent stability. For a typical coil, (.14 Hy.), inductance varies less than 1% from .1 to 25 volts ... Q is 120 at 5,000 cycles ... hum pickup is low (toroidal structure), 70 Mv. per gauss at 60 cycles ... variation in inductance less than 1/3% from -60° C. to +85° C. ... hermetically sealed in drawn case 1-13/16" diameter x 1-3/16" high ... weight 5 ounces ... available in inductance values from 5 Mhys. to 2 Hys.



HQB REACTOR

The HQB reactors are similar to the HQA series, but provide higher Q. For a typical coil, (.45 Hy.), inductance varies less than 1% with applied voltage from .1 to 50 volts ... hum pickup twice that of HQA ... variation of inductance less than 1/3% from -50° C. to +85° C. ... Q is 200 at 4000 cycles ... hermetically sealed in steel case 1 1/8" x 2 3/8" x 2 1/2" high ... weight 14 ounces ... available in any inductance value from 5 Mhys. to 12 Hys.

UTC TOROID COIL INTERSTAGE FILTERS

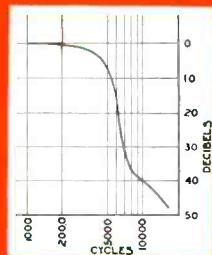
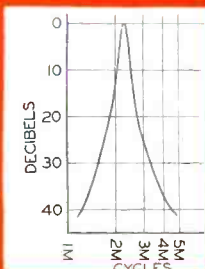
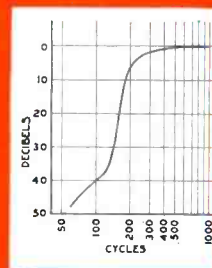


U. T. C. toroid interstage filters are designed to operate between vacuum tube stages and have a nominal impedance of 10,000 ohms. They are not stocked but are available from standardized components for any frequency from 200 to 30,000 cycles. Dimensions, including dual alloy shielding, are same as the HQB reactors.

BPI units have 2:1 gain. They are sharply peaked, having approximately 2 DB attenuation at plus or minus 3% from mean frequency and attenuations of approximately 40 DB per octave. They are adjusted to zero phase shift at mean frequency.

HPI units have loss of less than 6 DB at cutoff frequency. At .67 cutoff frequency the attenuation is 35 DB and at .5 cutoff frequency, 40 DB.

LPI units have loss of less than 6 DB at cutoff frequency. At 1.5 cutoff frequency the attenuation is 35 DB and at twice cutoff frequency, 40 DB.



For further details write for Bulletin PS-407

United Transformer Corp.

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Announcing

THE RCA-5527 TELEVISION CAMERA TUBE

FEATURES: Low Cost • Good Resolution • Electrostatic Focus and Deflection • Small Size • Complete Coverage of Visible Spectrum • Simple and Inexpensive Subsidiary Equipment

The new RCA-5527 Iconoscope is a practical application of television to industry. Its small size, low cost, good resolution, and simple circuit requirements make it equally desirable for experimental, educational, and industrial use.

The RCA-5527 has a resolution capability of approximately 250 lines. It provides a satisfactory picture with an incident light level of 500 to 1000 foot-candles. The increased sensitivity has been achieved by an improved technique of processing the mosaic which results in greater transmission of light to the photosensitive surface, the response

of which covers the entire visible spectrum.

The equipment required for operation of the RCA-5527 is relatively simple and inexpensive. Magnetic deflection coils are dispensed with, keystoneing and shading circuits are not required, and an inexpensive short-focal-length lens can be used in the camera unit.

RCA Tube Application Engineers are ready to co-operate with you in adapting this or any other RCA tubes to meet your equipment needs. For their specialized help, as well as for a bulletin on the RCA-5527, write RCA, Commercial Engineering, Section R-40H, Harrison, N. J.

CHARACTERISTICS

GENERAL:

Heater Voltage	6.3 Volts
Heater Current	0.6 Amp.
Image Size (4 x 3 aspect ratio)	1.4" Diagonal
Mounting Position	Any

TYPICAL OPERATION:

Signal-Electrode Voltage	800 Volts
Grid-No. 4 and Grid-No. 2 Voltage	800 Volts
Grid-No. 3 Voltage for Focus	125 to 250 Volts
Grid-No. 1 Voltage	Adjust for best picture
Max. Grid-No. 1 Voltage for Picture Cutoff	-75 Volts
Max. Deflecting Voltages (Peak to Peak)*	
DJ ₁ and DJ ₂ (Vertical)	120 Volts
DJ ₃ and DJ ₄ (Horizontal)	100 Volts
Min. Peak-to-Peak Blanking Voltage	30 Volts
Signal-Output Current (Approx.)	0.025 Microampere
Output Resistor (Approx.)	1 Megohm

*To scan picture of 1.4" diagonal (4 x 3 aspect ratio)

RCA Laboratories, Princeton, N. J.



THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA



TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.