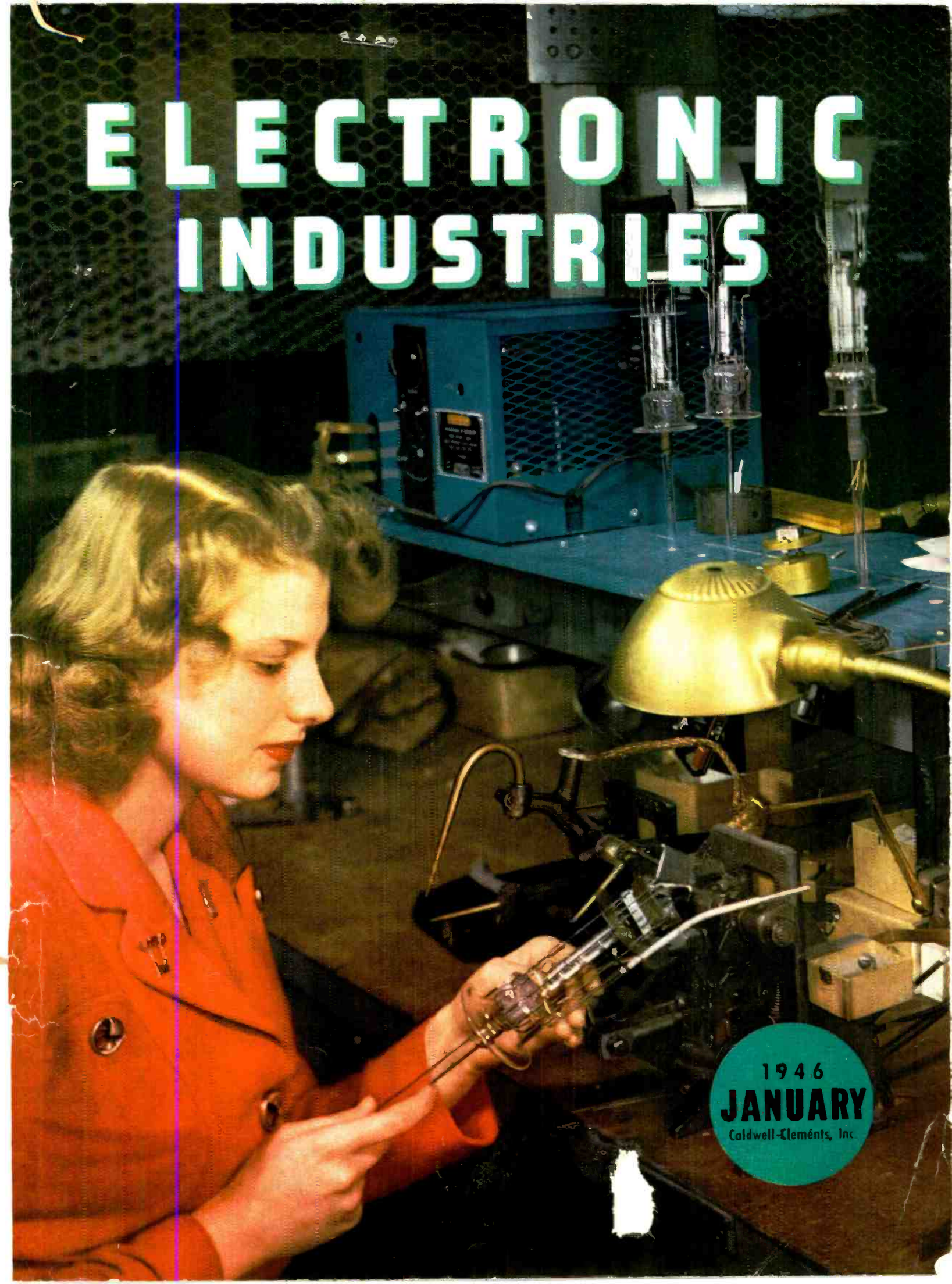
ELECTRONIC INDUSTRIES



1946
JANUARY
Caldwell-Clements, Inc

Compact Design . . .
Unlimited Circuits . . .
that's the
RS
LINE

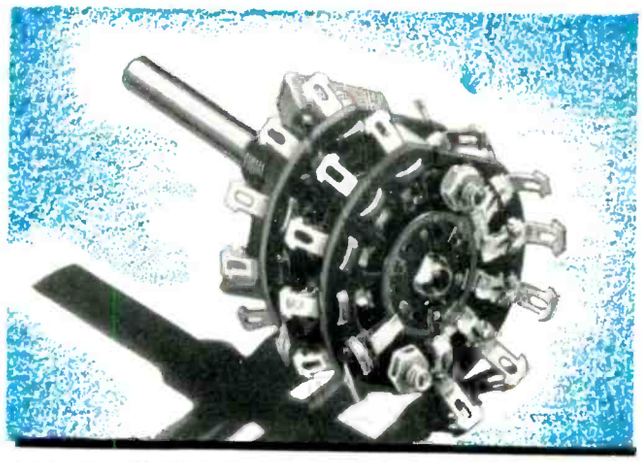
HERE is a line of single or multiple gang section switches, designed to serve RF applications, but with special emphasis on circuit flexibility coupled with unusual smallness of size.

The RS-50 and 60 are especially designed for radio receivers where low-torque indexing action is essential. The RS-30 and RS-40 are designed for high-torque, snap indexing. All embody the following features:

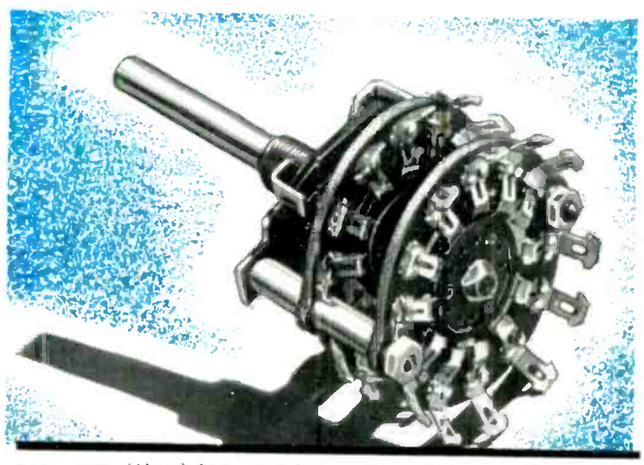
- *Unlimited circuit possibilities*
- *Compact design*
- *New, heavier staples and assembly technique, insuring tight terminals*
- *New stator design which improves rotor and contact alignment*
- *Double wiping contacts*
- *Silver-to-silver contacts*
- *Indium-treated, silver plated rotor segments*
- *Improved, low-loss phenolic insulation*

Get acquainted with these RS switches *before* your product reaches the blueprint stage. Write direct for RS Switch Data Folders and Specification Layout Sheets. Standard Mallory Switches may be readily obtained from your Mallory Distributor.

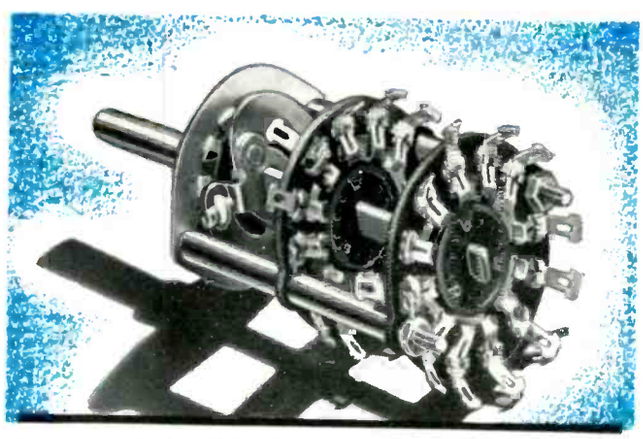
P. R. MALLORY & CO. Inc.
MALLORY SWITCHES
(INDUSTRIAL AND ELECTRONIC)
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



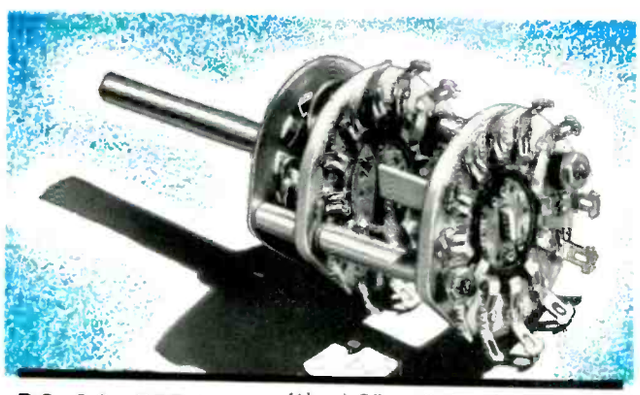
RS-60 (Above) Smallest of the RS switches—ideal for under-chassis mounting.



RS-50 (Above) Low-torque indexing features this versatile switch for radio receiver use.



RS-40 (Above) Somewhat larger than the RS-60, but still highly compact. With snap indexing.



RS-30 CERAMIC (Above) Offers all the advantages of an RS-40 switch plus maximum insulation.

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

★ IN THIS ISSUE JANUARY, 1946 ★

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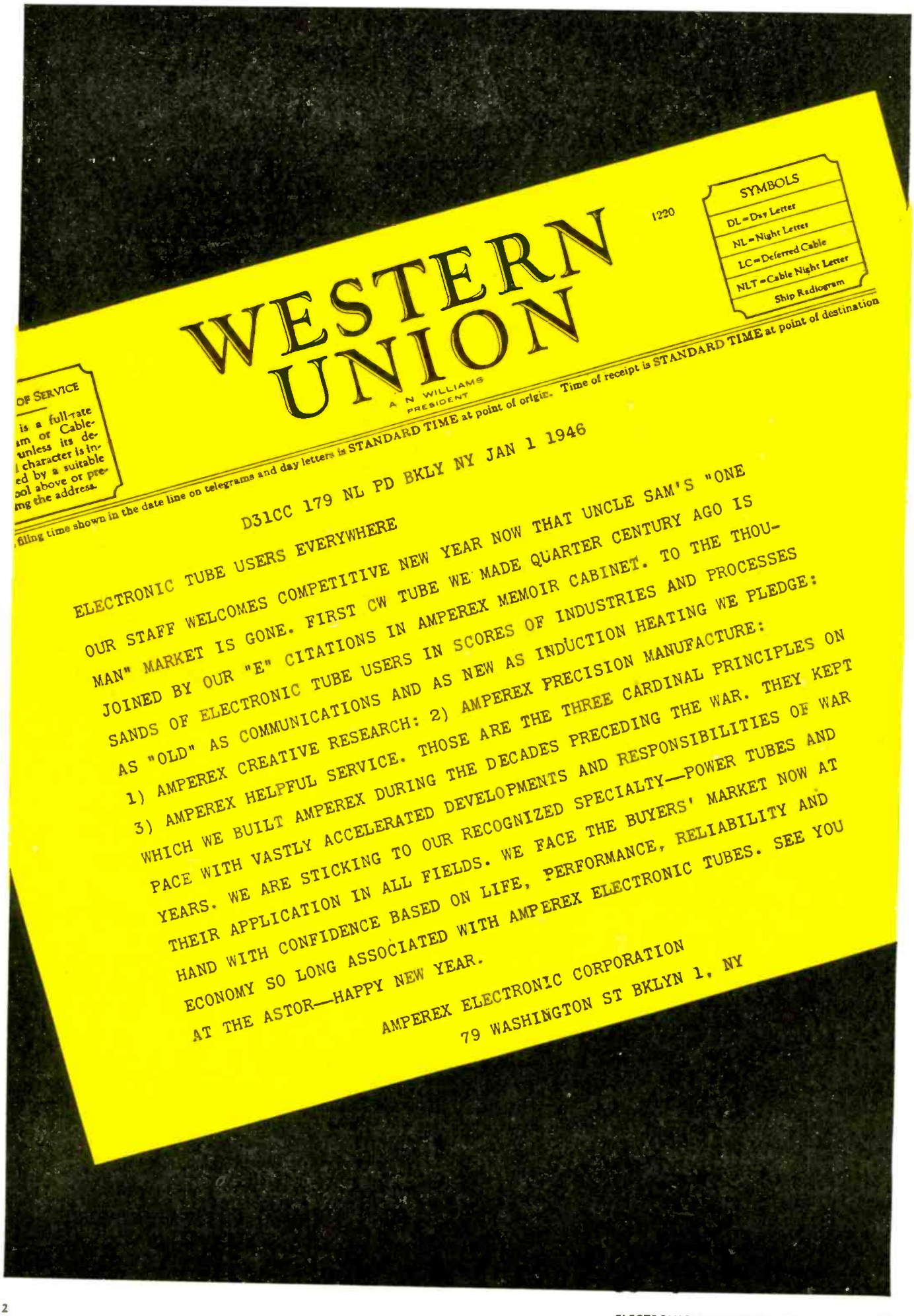

WESTERN UNION

1220

SYMBOLS
DL = Day Letter
NL = Night Letter
LC = Deferred Cable
NLT = Cable Night Letter
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A. N. WILLIAMS
PRESIDENT

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D31CC 179 NL PD BKLY NY JAN 1 1946

ELECTRONIC TUBE USERS EVERYWHERE

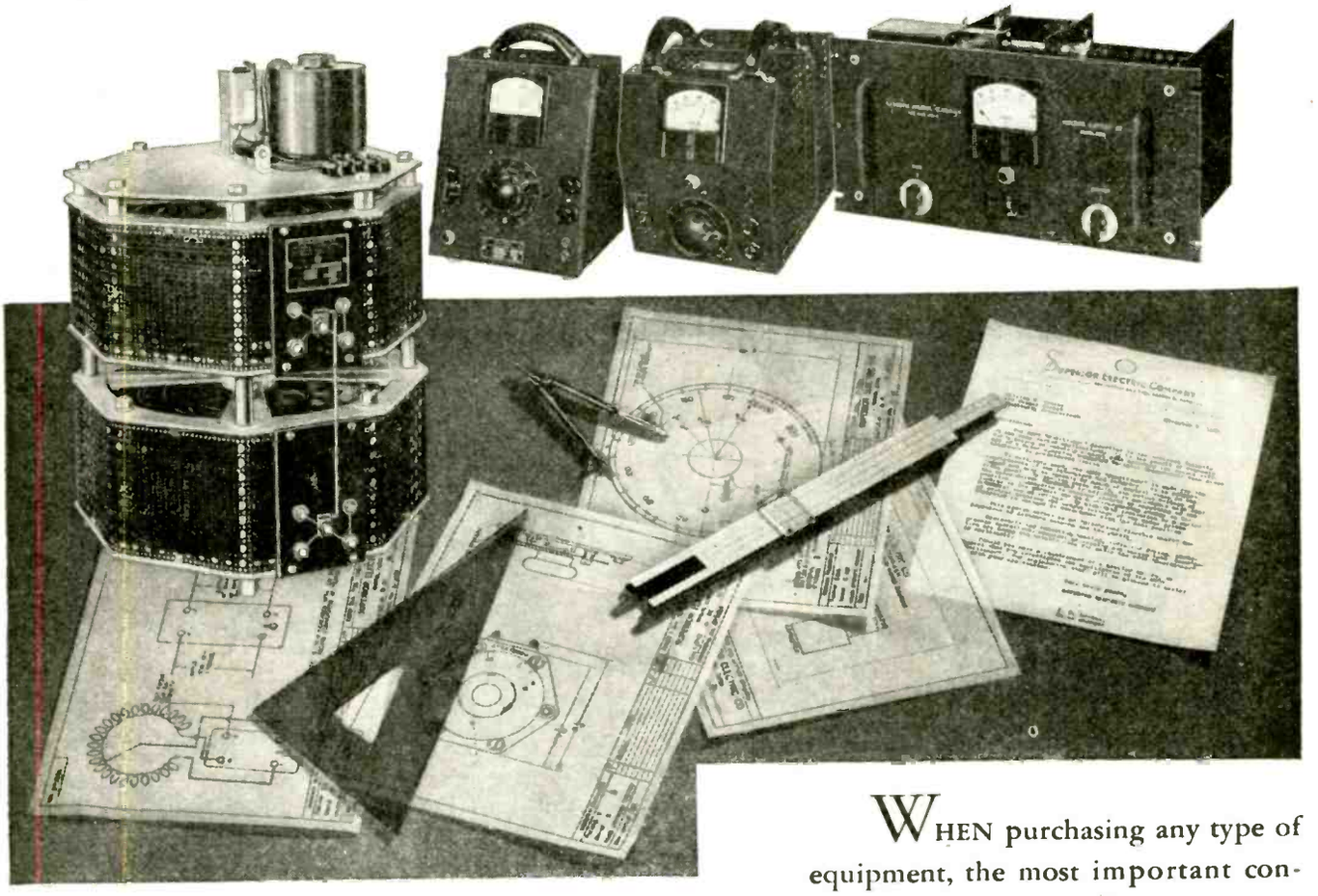
OUR STAFF WELCOMES COMPETITIVE NEW YEAR NOW THAT UNCLE SAM'S "ONE MAN" MARKET IS GONE. FIRST CW TUBE WE MADE QUARTER CENTURY AGO IS JOINED BY OUR "E" CITATIONS IN AMPEREX MEMOIR CABINET. TO THE THOUSANDS OF ELECTRONIC TUBE USERS IN SCORES OF INDUSTRIES AND PROCESSES AS "OLD" AS COMMUNICATIONS AND AS NEW AS INDUCTION HEATING WE PLEDGE: 1) AMPEREX CREATIVE RESEARCH; 2) AMPEREX PRECISION MANUFACTURE: 3) AMPEREX HELPFUL SERVICE. THOSE ARE THE THREE CARDINAL PRINCIPLES ON WHICH WE BUILT AMPEREX DURING THE DECADES PRECEDING THE WAR. THEY KEPT PACE WITH VASTLY ACCELERATED DEVELOPMENTS AND RESPONSIBILITIES OF WAR YEARS. WE ARE STICKING TO OUR RECOGNIZED SPECIALTY—POWER TUBES AND THEIR APPLICATION IN ALL FIELDS. WE FACE THE BUYERS' MARKET NOW AT HAND WITH CONFIDENCE BASED ON LIFE, PERFORMANCE, RELIABILITY AND ECONOMY SO LONG ASSOCIATED WITH AMPEREX ELECTRONIC TUBES. SEE YOU AT THE ASTOR—HAPPY NEW YEAR.

AMPEREX ELECTRONIC CORPORATION
79 WASHINGTON ST BKLYN 1, NY

BEFORE PURCHASING ANY VOLTAGE CONTROL

SEE SECO

• VARIABLE VOLTAGE TRANSFORMERS •
• AUTOMATIC VOLTAGE REGULATORS •
• TESTING EQUIPMENT •



WHEN purchasing any type of equipment, the most important consideration is to obtain the correct apparatus for each application. This is especially true in regard to voltage control equipment. A misapplication or the adaptation of a standard unit to an unusual requirement (where really a special design is necessary) can only produce faulty performance. For this reason, it is our suggestion that a SECO engineer be consulted whenever there is need for an a-c voltage controller. His complete and comprehensive understanding of all phases of voltage control is your assurance of the right equipment for the job.

By simply outlining your particular problem to one of us at SECO results in a prompt recommendation whether it involves a POWERSTAT variable transformer to vary the output voltage from a-c power lines, a SECO Automatic Voltage Regulator to maintain a constant output voltage, or test apparatus such as the VOLTBOX a-c power supply. Call or write and take advantage of the SECO KNOW-HOW.

Send for Bulletin IE

SUPERIOR ELECTRIC COMPANY

761 LAUREL STREET, • • • BRISTOL, CONNECTICUT

THE COVER

At Allen B. DuMont Laboratories, Inc., Passaic, N. J., are made the largest cathode-ray tubes in the world. The young lady on the cover is inspecting a completed gun mount for the 20-in. diameter tube used in television receivers. This mount, a precision-made assembly, performs the most important function of controlling the flow, direction and intensity of the electron beam which forms the television picture on the face of the tube. Operating voltages go up to 8000. Some dimensions and spacings in this mechanism must be exact to .0002 in. Stainless steel stamped parts together with tempered wire, ceramic spacers and glass beads, all mounted in a preformed glass space through which the air within the envelope is later evacuated, make up this completed mount. Rigid inspection routines are followed throughout the process to insure against breakdown and failure. In addition to cathode-ray tubes, DuMont manufactures oscillographs, television receivers, transmitters and allied precision electronic equipment.

L'Envoi—George Clark

For a number of years radio men have enjoyed getting the annual rhymed messages of George H. Clark, RCA old-timer and historian. This Christmas, George turned his muse to a sort of au revoir, since on Feb. 15, 1946, he is to terminate his long connection with the corporation and will then turn to literary labors which are his abiding delight. Here's the way George puts it:

On the Fifteenth Day of the Second Month
Of the Year that is yet to come,
No longer I'll *Labor* for RCA,
But will be just a tome-ic bum.
In a rustic shack, in a distant land,
Far from Official View,
I'll write Biographies hand over hand.

May I write one of You?

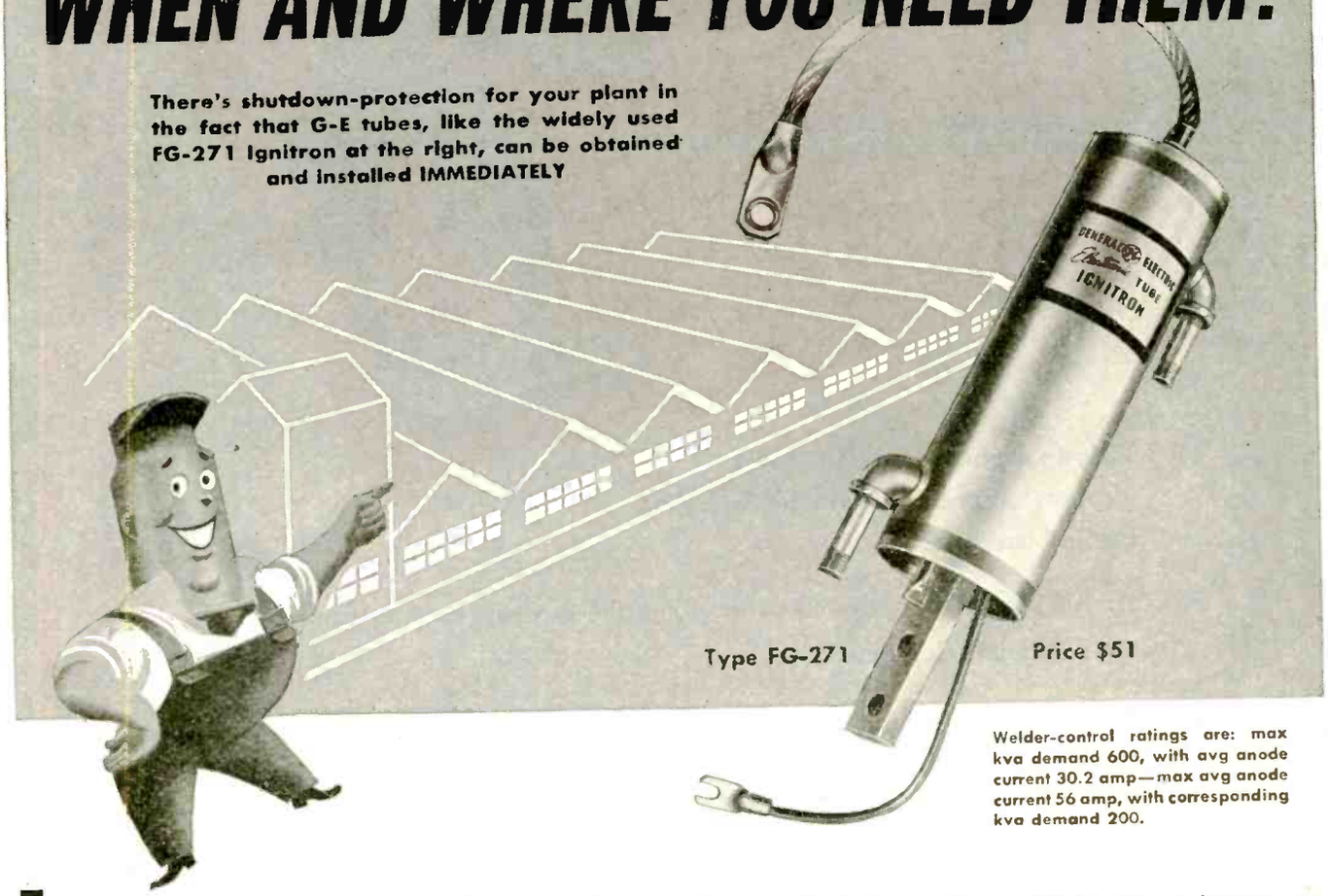
Retirement
And
Deployment
Accelerate
Regeneration

George H. Clark
25 Beaver St.
New York 4, N. Y.

Electronic tubes are available

WHEN AND WHERE YOU NEED THEM!

There's shutdown-protection for your plant in the fact that G-E tubes, like the widely used FG-271 Ignitron at the right, can be obtained and installed IMMEDIATELY



Type FG-271 Price $51

Welder-control ratings are: max kva demand 600, with avg anode current 30.2 amp—max avg anode current 56 amp, with corresponding kva demand 200.

Electronic tubes control much of the equipment in your modern factory. If a tube goes out of service, work is held up until it is replaced. Such delays are costly. G.E. can, and will, get replacement tubes to you faster—*thereby saving you production time and profit dollars.*

General Electric can deliver ignitrons, thyratrons, high-frequency-heating types, and other tubes more quickly, because G.E. has *all commonly used types and ratings conveniently available to you.* There are amply stocked warehouse, distributor, and dealer sources for G-E tubes in every area of the country.

Get to know your local G-E tube representative, who has on hand the tubes to keep your plant running full-time! Ask him about G.E.'s ironclad warranty, which fully protects your investment in electronic tubes. Also inquire about his special stock-record plan, relieving you of inventory worries.

Your factory deserves G-E tube quality, and G-E spot service to meet your day-to-day tube requirements. Your G-E distributor or dealer can supply these, and will be glad to discuss your needs. Phone him today.

Electronics Department
General Electric Company
Schenectady 5, N. Y.

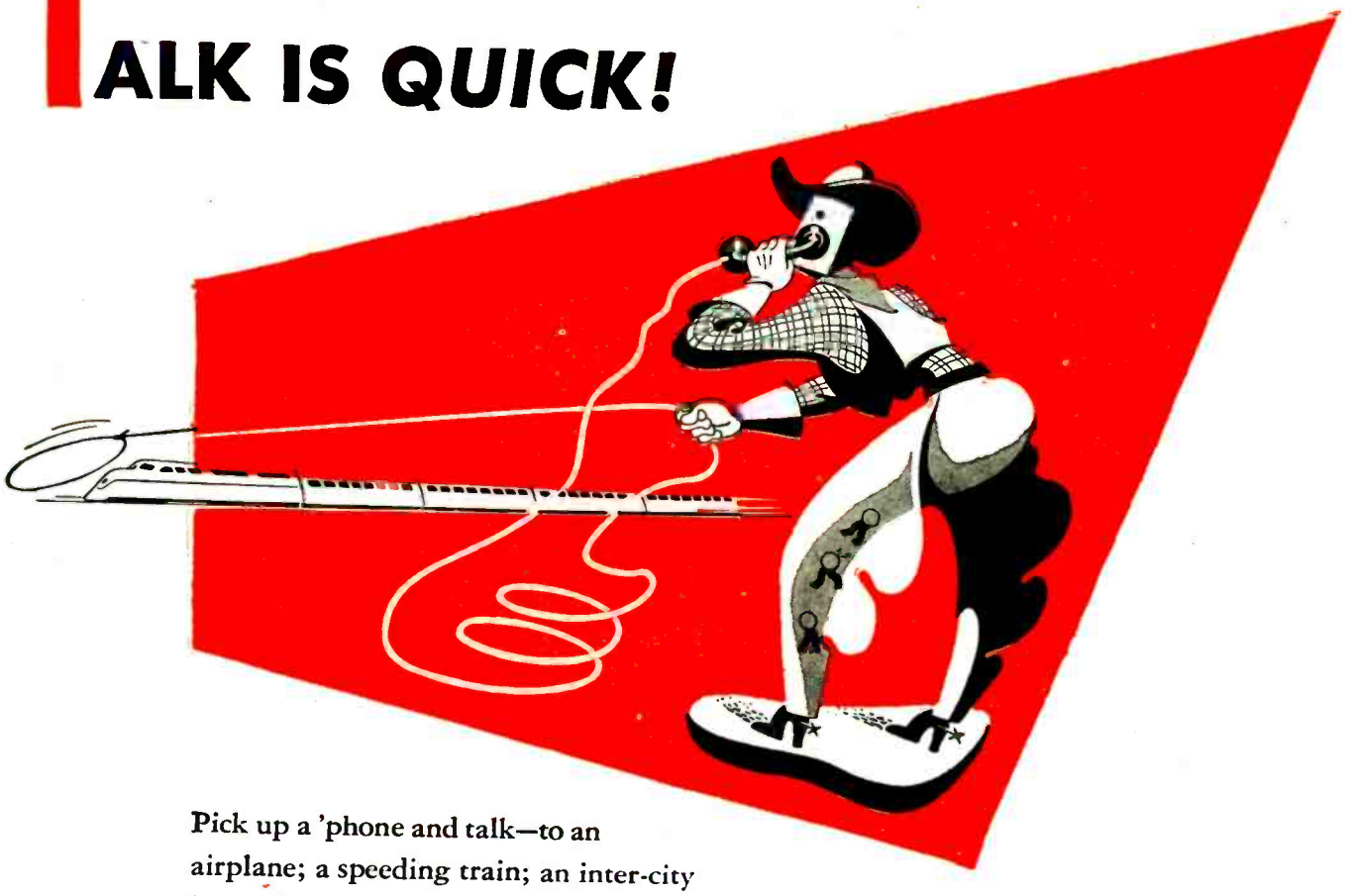
DISTRIBUTORS AND DEALERS EVERYWHERE, BACKED UP BY ADDITIONAL G-E TUBE STOCKS IN CENTRALLY LOCATED CITIES FROM COAST TO COAST

GENERAL ELECTRIC

162-E1-8850

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

TALK IS QUICK!



Pick up a 'phone and talk—to an airplane; a speeding train; an inter-city bus; a boat at sea.

Aireon's radio 'phones make this as simple, sure and easy as using a conventional telephone.

Aireon radio equipment for airlines is used by twenty domestic, four foreign companies; Aireon railroad radio, introduced under war-time restrictions, is *already in use* by four leading railroads. Aireon truck, taxi and bus communications equipment has been proved in service on the trucks of one of the nation's largest fleet operators. It's now in production. Aireon marine equipment will be available soon.

On the crowded highways and skyways of the future, radio 'phone communication will keep traffic moving under quick, efficient control.

Aireon MANUFACTURING CORPORATION

Radio and Electronics • Engineered Power Controls

NEW YORK • GREENWICH • CHICAGO • KANSAS CITY • OKLAHOMA CITY • BURBANK • SAN FRANCISCO

REVERE FREE-CUTTING COPPER ROD
. . . INCREASES ELECTRONIC PRODUCTION

SINCE its recent introduction, Revere Free-Cutting Copper has decisively proved its great value for the precision manufacture of copper parts. Uses include certain tube elements requiring both great dimensional precision, and exceptional finish. It is also being used for switch gear, high-capacity plug connectors and in similar applications requiring copper to be machined with great accuracy and smoothness. This copper may also be cold-upset to a considerable deformation, and may be hot forged.

Revere Free-Cutting Copper is oxygen-free, high conductivity, and contains a small amount of tellurium, which, plus special processing in the Revere mills, greatly increases machining speeds, makes possible closer tolerances and much smoother finish. Thus production is increased, costs are cut, rejects lessened. The material's one important limitation is that it does not make a vacuum-tight seal with glass. In all other electronic applications this special-quality material offers great advantages. Write Revere for details.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue
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Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in principal cities, distributors everywhere

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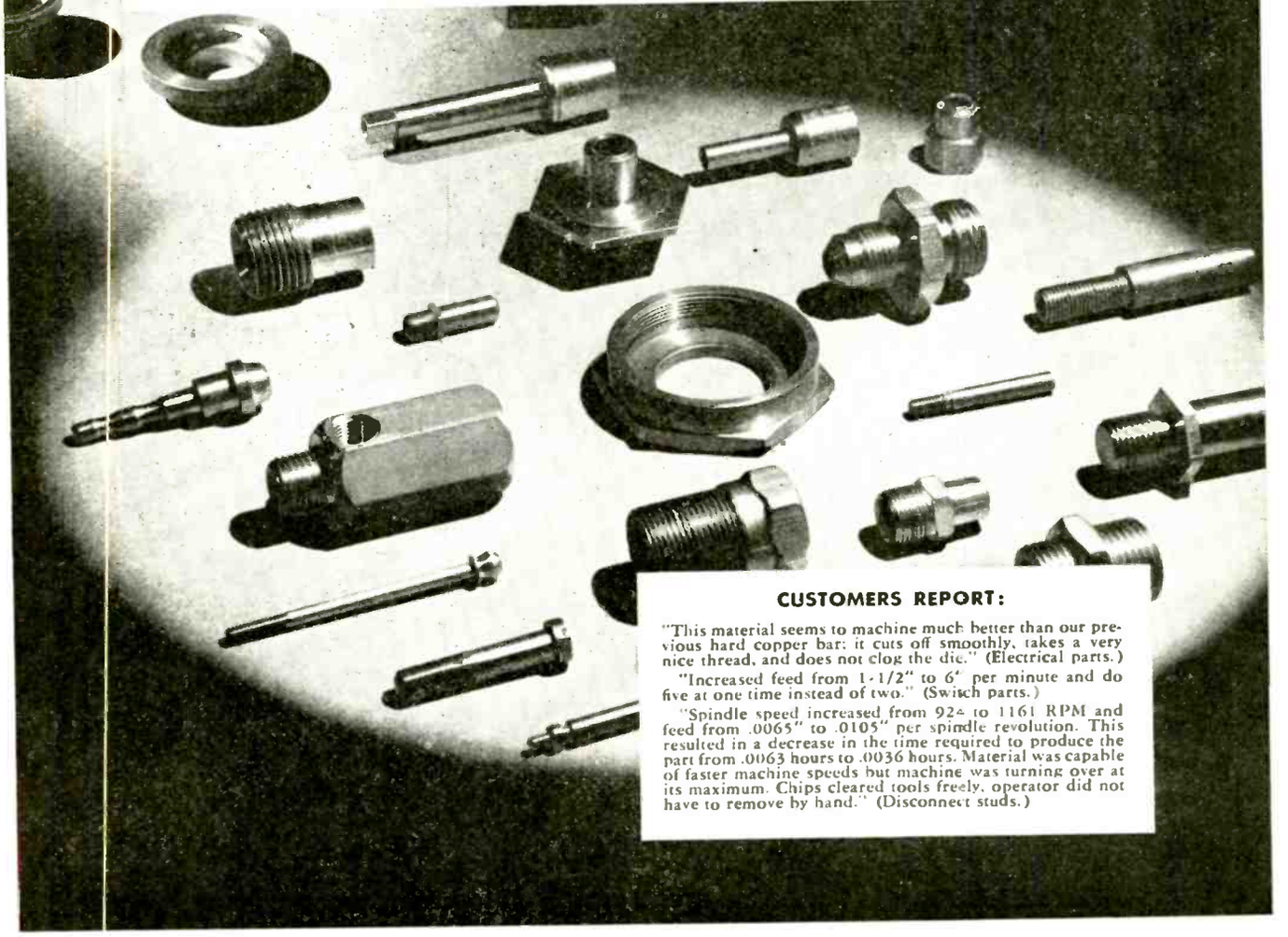


CUSTOMERS REPORT:

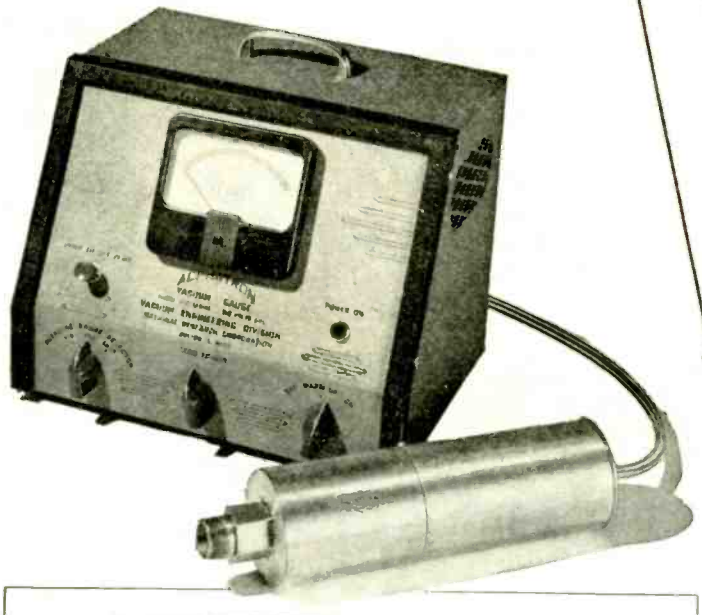
"This material seems to machine much better than our previous hard copper bar; it cuts off smoothly, takes a very nice thread, and does not clog the die." (Electrical parts.)

"Increased feed from 1-1/2" to 6" per minute and do five at one time instead of two." (Switch parts.)

"Spindle speed increased from 924 to 1161 RPM and feed from .0065" to .0105" per spindle revolution. This resulted in a decrease in the time required to produce the part from .0063 hours to .0036 hours. Material was capable of faster machine speeds but machine was turning over at its maximum. Chips cleared tools freely, operator did not have to remove by hand." (Disconnect studs.)

The Alphatron

A REALLY NEW VACUUM GAUGE FOR THE ELECTRONICS INDUSTRY



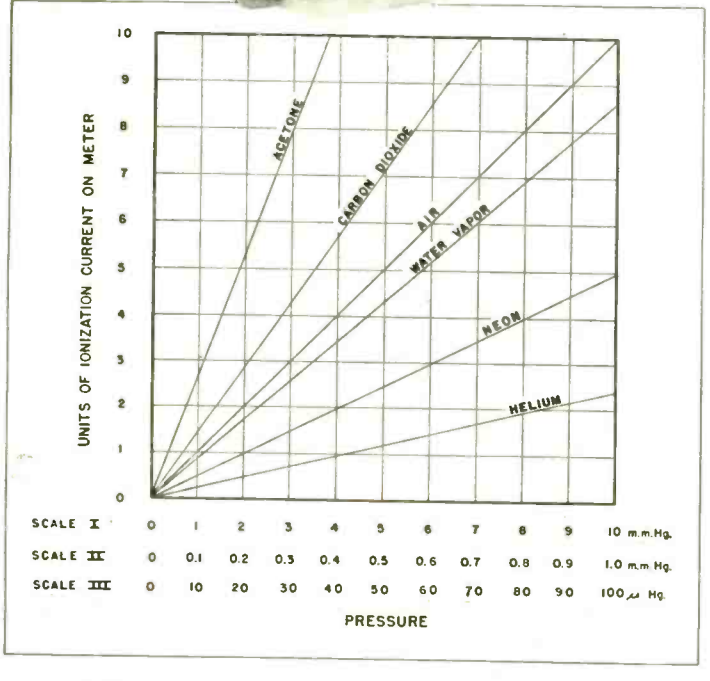
Continuous linear pressure indication for any atmosphere from 0 – 10 millimeters in three ranges: 0 – 0.1 mm., 0 – 1 mm., and 0 – 10 mm.

Simple to operate. Ideal for production gauging in the hands of inexperienced operators.

Radioactive source of ionization is undamaged by exposure to atmospheric pressure.

Contamination originating in gauging is eliminated. Instantaneous response for accurate pressure control and convenient leak detecting.

Reads pressures of gas mixtures directly.



See the Alphatron in operation at the I. R. E. Convention.

For full particulars send for Bulletin G-3

Vacuum ENGINEERING DIVISION

NATIONAL RESEARCH CORPORATION

BOSTON 13, MASSACHUSETTS, U.S.A.

High Vacuum for Industry

Sensational

ERIE TYPE 554 CERAMIC TRIMMER

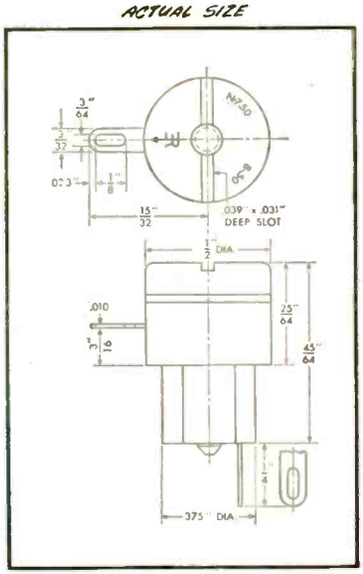
ACTUAL SIZE

Wherever shown, the new Type 554 Ceramic Trimmer has attracted the attention and admiration of the radio industry. First, its original and compact design, its obvious ease of installation and adjustment; later, its demonstrated superb performance—these qualities have not only aroused curiosity and interest, they have won immediate acceptance. Type 554 will be standard equipment on many receiving sets, from now on.

Note, in photograph and drawing, that the metal rotor completely covers the stator track. Contact surfaces of both rotor and stator are lapped, providing a high degree of stability, excluding dust, and keeping noise level to a minimum at high frequencies.

Capacity change is essentially constant per degree of rotation, and full range is covered in 180° rotation. Type 554 Trimmers will be available shortly in production quantities in the following capacity ranges: in zero temperature coefficient, 3-12 MMF and 5-25 MMF; in −750 parts/million/°C, 5-30 MMF and 8-50 MMF. They will also be available in an intermediate temperature coefficient. Trimmers are held firmly in place in a D-hole in the chassis by means of a multiple-tooth spring clip, furnished with the trimmer.

Specifications and capacity ranges are given in the table at right. For complete information, contact our nearest representative or write us direct.

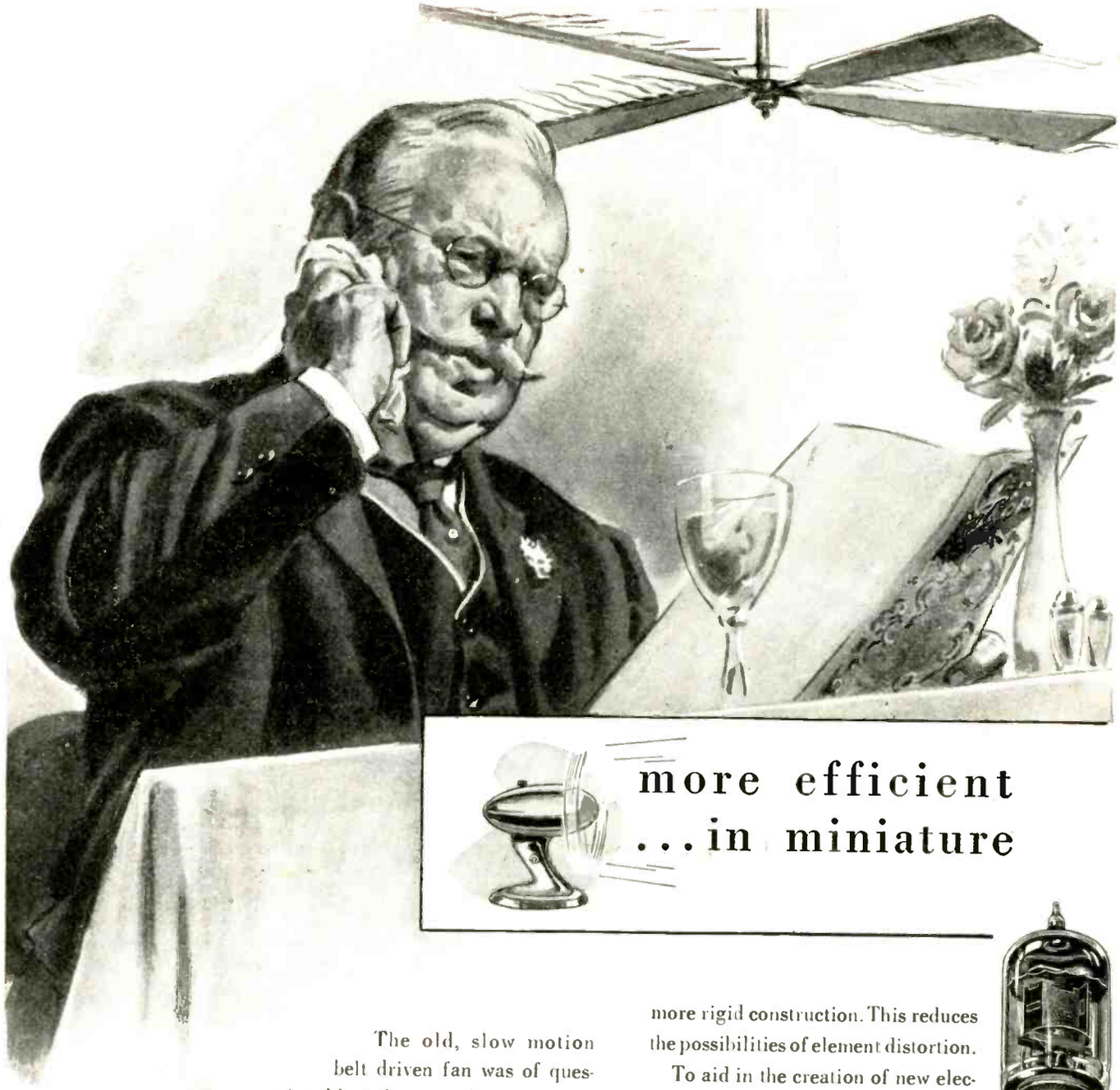


ERIE 554 CERAMICON TRIMMER
Voltage Rating: 350 volts D.C.
Flash Test: 700 volts D.C. for 15 seconds.
Initial Q Factor at 1MC: 500 minimum
Initial Leakage Resistance: 10,000 meg. min.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND TORONTO, CANADA.



more efficient ...in miniature

The old, slow motion belt driven fan was of questionable value as a breeze maker. Perhaps its best service was that of chasing flies with fluttering streamers. Then came the modern high speed electric fan. Like the miniature electronic tube, it is an outstanding example of the current trend toward increased efficiency in miniature.

TUNG-SOL Miniature Tubes are a part of the trend to smaller component parts. They are a factor in reducing the over-all size of equipment. Shorter leads with low inductance, and low capacity with high mutual conductance make the miniature tube ideal for high frequency circuits. The smaller elements weigh less, tending to reduce the effects of vibration. The smaller size also makes possible a more rigid construction. This reduces the possibilities of element distortion.

To aid in the creation of new electronic equipment and in the improvement of old, TUNG-SOL engineers will draw upon their experience and work with manufacturers in the designing of circuits and in the selection of tubes. Of course your plans will be held in strictest confidence.

ACTUAL SIZE

TUNG-SOL

vibration-tested

ELECTRONIC TUBES

TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY

Sales Offices: Atlanta • Chicago • Dallas • Denver • Detroit • Los Angeles • New York

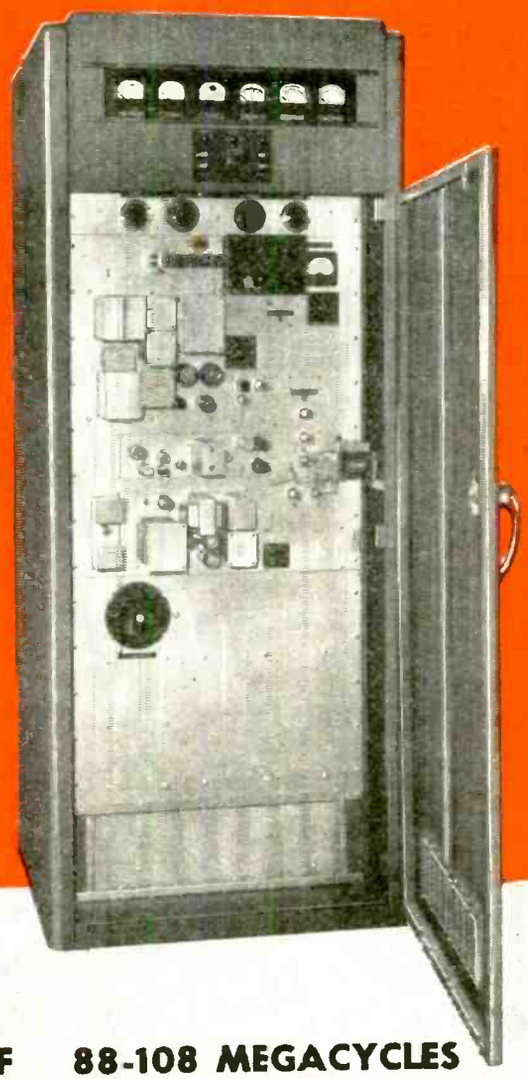
Also Manufacturers of Miniature Incandescent Lamps, All-Glass Sealed Beam Headlight Lamps and Current Intermittors

See!

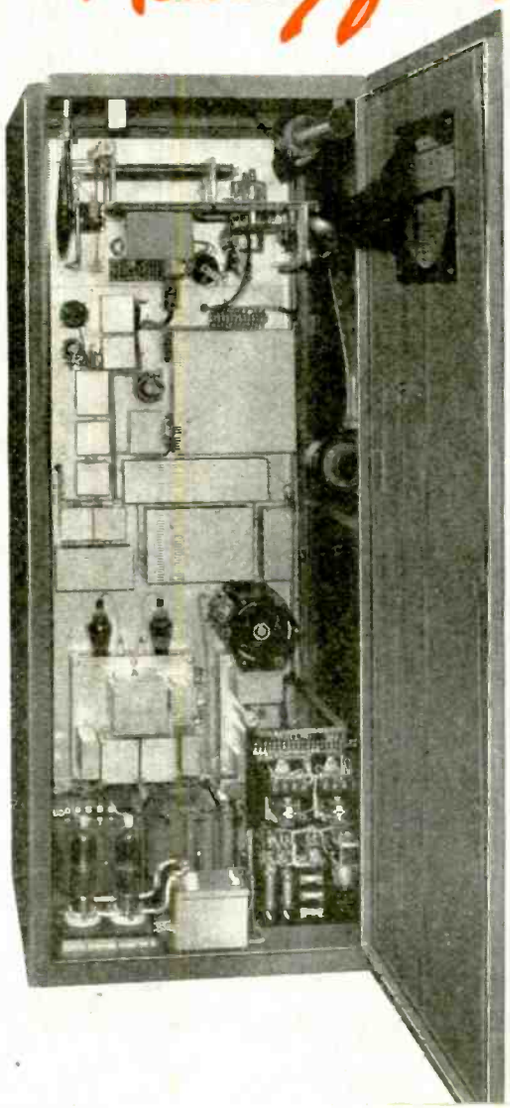
The New TEMCO

High Fidelity

FM BROADCAST TRANSMITTER



Ready for delivery*



MODEL 250 BCF 88-108 MEGACYCLES

TEMCO proudly presents this outstanding achievement in FM engineering—the result of 10 years of pioneering in custom-built, superlative communication equipment.

HIGHLIGHTS OF THE TEMCO 250 BCF

- Normal rated output power 250 watts. Maximum rated output power 375 watts.
- Continuous monitoring of the carrier frequency by a center frequency deviation meter calibrated directly in cycles.
- An exciter unit — heart of the transmitter—characterized by tuning simplicity accomplished by employing only 4 stages to raise the primary oscillator frequency to the carrier frequency.
- A new circuit of technically advanced concept which maintains a high degree of center frequency stabilization without introduction of distortion.
- Peak efficiency and great dependability are obtained by the use of new miniature V-H-F tubes in the exciter.
- Improved design in the IPA and PA stages eliminating tank radiation, feedback, radio frequency and high voltage potentials from the tank circuits and transmitter frame.

*A limited quantity of the TEMCO Model 250 BCF will be available for January delivery. Orders will be filled in rotation as received. ACT NOW. Place your order at once.

NOW ON DISPLAY FOR YOUR INSPECTION.
Phone or wire for an appointment.

TEMCO

RADIO COMMUNICATION EQUIPMENT

TRANSMITTER EQUIPMENT MFG. CO., INC.

345 Hudson Street, New York 14, N. Y.

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ELECTRONIC AND MECHANICAL DEVICES

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- ELECTRO-FORMING
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INCORPORATED

MANUFACTURERS OF QUALITY METAL PRODUCTS SINCE 1867

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WORKS: 139-145 NORTH TENTH STREET, BROOKLYN 11, N. Y.

NEW REVERSING CONTACTOR

TYPE 135CXX *Actual Size*

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TORONTO

S-D
STRUTHERS-DUNN, INC.

Much Smaller—Much Lower in Cost
Fully Dependable for Heavy Duty Service

RATING—1 HP polyphase, ¾ HP single phase, to 600 volts AC.

FEATURES—Small Size—5¾" x 4" x 1⅞".
Mechanically Interlocked.
Solid Frame—no laminations.
Simple Maintenance—all parts removable from front; all fixed contacts alike, all moving contacts alike.
Cost—appreciably lower than conventional units.

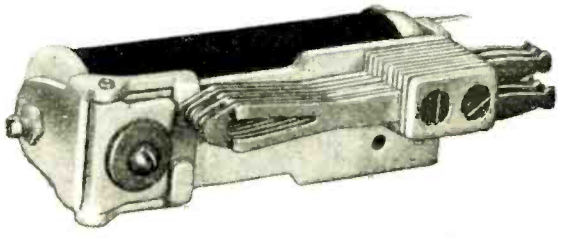
APPLICATIONS—Heavy duty reversing and jogging service such as hoists, door operators, and machine tool auxiliaries.

STRUTHERS-DUNN
5,312 RELAY TYPES

STRUTHERS-DUNN, INC., 1321 Arch Street, Philadelphia 7, Pa.

✔ SENSITIVITY
✔ CONTACT PRESSURE
✔ DEPENDABILITY
✔ COMPACTNESS
✔ VERSATILITY
✔ LONG LIFE

All these.... AND MORE OF EACH OF THEM!



AUTOMATIC ELECTRIC'S CLASS "B" RELAY

For better design for the future, check Automatic Electric's Class "B" relay. In this new relay, you'll find all six of the features you want—and the most of each of them. Field response to this new development has been so overwhelming that our entire production for many months has already been spoken for. But you'll find it well worth your while to wait for this new relay, with its unique combination of features:

Independent twin contacts for dependable contact closure... efficient magnetic circuit for sensitivity and high contact pressure . . . unique armature bearing for long wear under severe conditions . . . compact design for important savings in space and weight. Now available for coil voltages to 300 volts DC and 230 volts AC, with capacities up to 28 springs; also with magnetic shielding cover, when specified.

The Class "B" relay, and many others, are shown in Catalog 4071. Write today for your copy.

Relays by **AUTOMATIC ELECTRIC**

AUTOMATIC ELECTRIC SALES CORPORATION
1033 WEST VAN BUREN STREET • CHICAGO 7, ILLINOIS
In Canada: AUTOMATIC ELECTRIC (CANADA) LIMITED, TORONTO

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

avoid damage from "in-the-package" moisture

no rust no corrosion in this container

SHIPPERS! Your product can be seriously damaged by rust, corrosion, or mildew . . . because of "in-the-package" moisture. Avoid such damage. Include Jay Cee Silica Gel, the ideal drying agent, in the packages with your product.

Your container may be sealed "tight as a drum" against outside moisture. Yet, the vapor within can cause untold harm. Particularly, a slight drop in temperature can release dangerous moisture.

The illustration shows Mr. Otto Mueller, packaging foreman, inspecting one of his Ampro Sound-On-Film Projectors sealed tightly within a representative moisture vapor-proof barrier, ready to be placed in a shipping carton. Packed within the barrier, with the Projector, are three small bags of Jay Cee Silica Gel . . . which adsorb "in-the-package" moisture and prevent damage from rust or corrosion.

(Cellophane packaging was used in this illustration as a substitute for the actual wrapping).

Jay Cee Silica Gel keeps the air in the package dry . . . adsorbs the vapor . . . prevents moisture damage. Jay Cee Silica Gel is a crystalline substance resembling rock salt in general appearance . . . chemically inert. Has amazing power to take up moisture without its particles changing in size or shape. Packed in 1, 2, 4, 8 oz. and 1 and 5 lb. bags. Used widely with shipments of metal parts, precision instruments, electronic equipment, dehydrated foods, fabrics, and chemicals.

JAY CEE SILICA GEL

JOLIET CHEMICALS, LTD.
108 INDUSTRY AVENUE
JOLIET, ILLINOIS

Start RIGHT AND YOU End RIGHT!

with WESTONS ON ALL PRODUCTION TEST-STANDS AND INSPECTION EQUIPMENT!

With the race for markets in full swing, electrical manufacturers are eliminating costly production bottlenecks by providing *uniform dependability* in testing procedure all along the line. From the inspection of purchased components right through to final product inspection, they insure accurate testing by using instruments they can trust.

And it's easy to insure *measurement dependability* at every step, because there are WESTONS for every testing need . . . including types for all special test-stand requirements, as well as a broad line of multi-range, multi-purpose test instruments. These compact, multi-purpose testers often afford new simplicity and economies in testing procedure, while assuring the dependability for which WESTONS are renowned.

Literature describing the complete line of WESTON panel and test instruments is freely offered . . . Weston Electrical Instrument Corporation, 666 Frelinghuysen Avenue, Newark 5, New Jersey.

Weston Instruments

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • 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.

SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

JAN. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

NEW T-3 TUBE FILLS NEED FOR SMALLER UNIT IN TINY BROADCAST RECEIVERS

For any further details, or questions you may want answered about this tiny, sturdy vacuum tube, do not hesitate to write or call Sylvania Electric Products Inc., Emporium, Pa.

Commercial Version of Proximity Fuze Tube Is Rugged, Has Long Life

Following Sylvania Electric's recent announcement about the sensationally smal' vacuum tube—originally developed for the now-famous proximity fuze transceiver—have come many inquiries concerning this super-midget.

SET MAKERS ESPECIALLY INTERESTED

Since the commercial version of the "war-baby" is being produced, many set manufacturers are extremely interested in its qualities — with a view toward making radios about the size of the average wallet or package of cigarettes, miniature walkie-talkie sets and other units.

This new tube, then, is being made in a low-drain filament type and is able to operate at 1.25 volts. This takes advantage of a new, small battery developed during the war which, of course, is a further aid in the manufacture of remarkably small radio sets.

WILL BE AVAILABLE FOR ALL TYPES

Future designs of this versatile tube can be incorporated in radios ranging in size from tiny pocket sets up to deluxe receivers. It has a life of hundreds of hours, is rugged and exceptionally adaptable to operation at high frequencies.

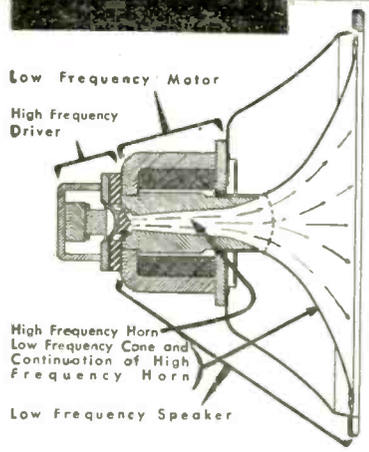
A New Jensen Coaxial

TYPE H
WITH *Compression-type* HIGH-FREQUENCY SPEAKER

The first of a new series of JENSEN Coaxial Speakers, combining in one coaxial assembly a horn-type high-frequency speaker with a cone-type low-frequency unit. By unique design, the cone of the low-frequency unit forms a part of the high-frequency horn, thereby dispensing with a separate horn. An integral two-channel network gives the desired crossover characteristics. Thus this new Coaxial Speaker provides the quality of reproduction so essential and desirable for radio receivers and phonographs for home entertainment, particularly for FM reception and high quality phonograph recordings.

The distribution characteristics of the Type H Coaxial are excellent and, when installed in a suitable enclosure such as a Bass Reflex cabinet, its performance covers the entire frequency range useful in home reproduction.*

Type H Coaxial, illustrated here with field coil low-frequency speaker and *ALNICO 5* high-frequency unit, is designed for manufacturers. Other models for more general use, incorporating *ALNICO 5* design in *both* high-frequency and low-frequency units, will shortly be announced.



TYPE H SPECIFICATIONS

Power rating 25 watts maximum, in speech and music systems. Input impedance 16 ohms. Field 14-20 watts. List price approximately $100.00.

*See No. 3 JENSEN Monograph: "Frequency Range in Music Reproduction," for discussion of useful frequency ranges.

Other Coaxials Now Available!

These Type J Coaxials, improved over prewar design, offer low-cost Coaxial performance in home radio receiver and phonograph entertainment.

JAP-60 (15-inch) with HF Control Switch. List price **$79.45**
JHP-52 (15-inch) with HF Control Switch. List price **$56.15**
JCP-40 (12-inch) HF Level Control extra. List price **$33.45**

Jensen
SPEAKERS WITH
ALNICO 5

JENSEN RADIO MANUFACTURING COMPANY • 6605 S. LARAMIE AVE. • CHICAGO 38, ILLINOIS
IN CANADA—COPPER WIRE PRODUCTS, LTD. • 137 OXFORD STREET, GUELPH, ONTARIO

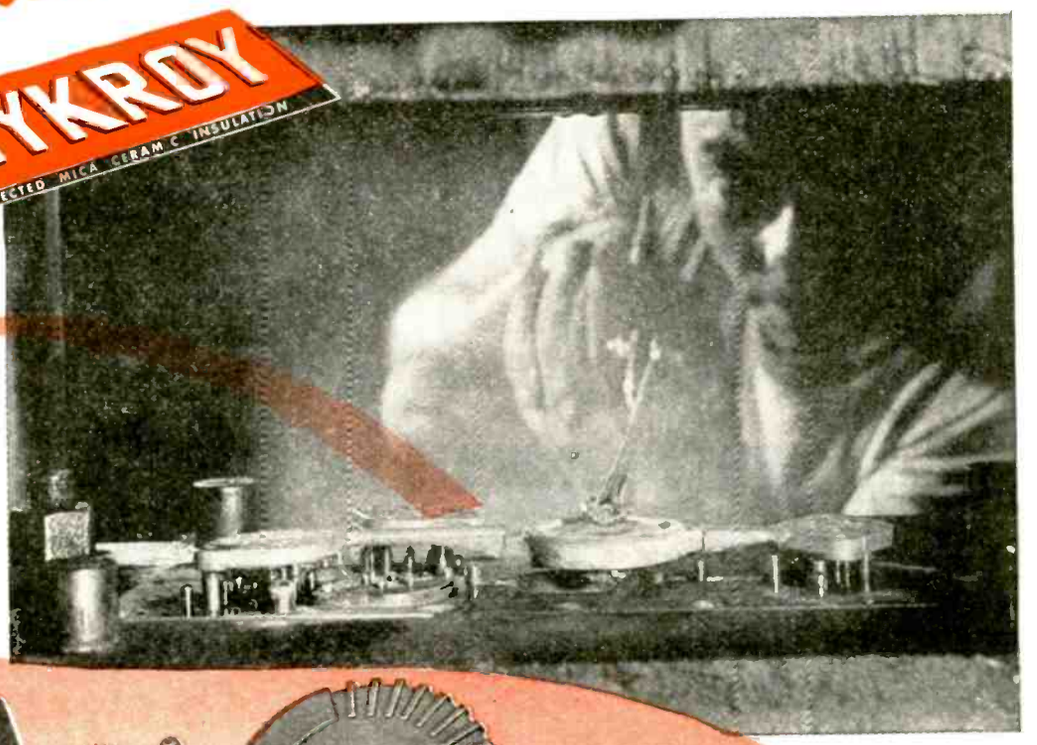
Specialists in Design and Manufacture of Fine Acoustic Equipment

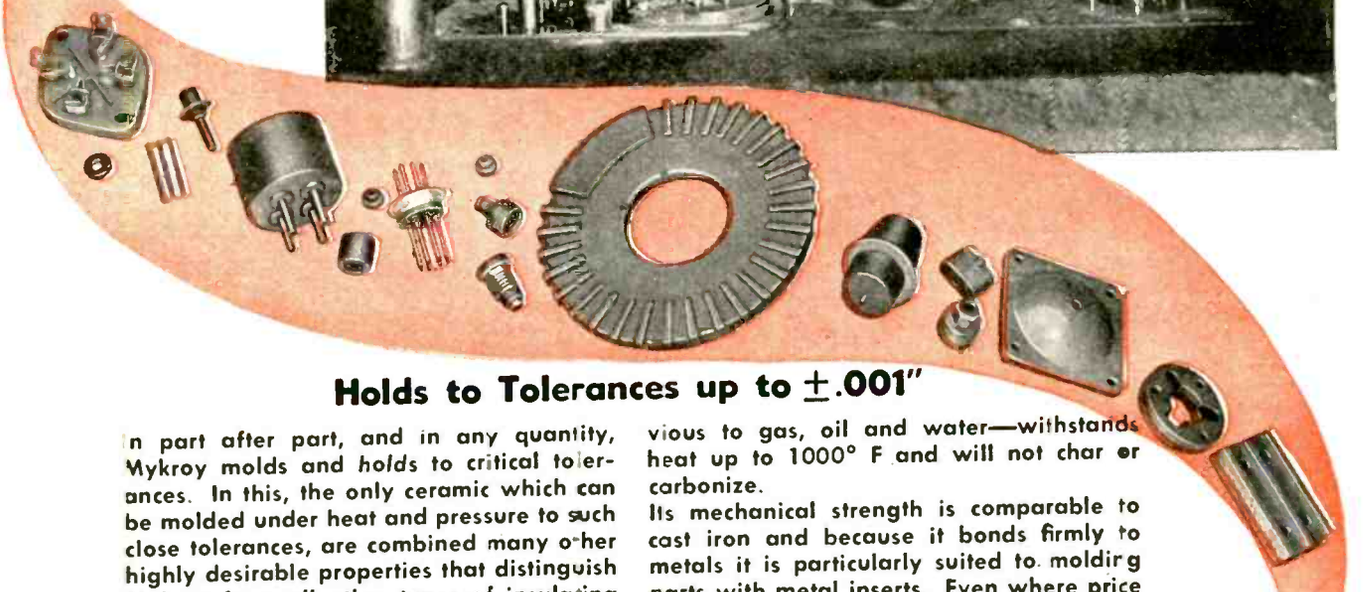
MICA CERAMIC INSULATION

Molded TO YOUR SPECIFICATIONS

MYKROY

PERFECTED MICA CERAMIC INSULATION





Holds to Tolerances up to ±.001"

In part after part, and in any quantity, Mykroy molds and *holds* to critical tolerances. In this, the only ceramic which can be molded under heat and pressure to such close tolerances, are combined many other highly desirable properties that distinguish Mykroy from all other types of insulating materials.

Unique in the class of glass-bonded mica ceramics, Mykroy possesses *electrical characteristics of the highest order* which do not shift under any conditions short of actual destruction of the material itself. Furthermore it will not warp—is impervious to gas, oil and water—withstands heat up to 1000° F and will not char or carbonize.

Its mechanical strength is comparable to cast iron and because it bonds firmly to metals it is particularly suited to molding parts with metal inserts. Even where price is a factor it competes with many standard insulating materials of lower electrical properties.

For improved performance and better quality in your new products investigate the many advantages of Mykroy. Write for samples and full information.

10th ANNIVERSARY 1935 MYKROY 1945 ELECTRONIC MECHANICS, INC.

MADE EXCLUSIVELY BY

ELECTRONIC MECHANICS INC.

70 CLIFTON BLVD., CLIFTON, N. J.

CHICAGO 47; 1917 N. Springfield Ave., Tel. Albany 4310

EXPORT OFFICE: 89 Broad Street, New York 4, New York

"Railroads . . . Like a Giant Conveyor Belt"

"The war has emphasized the importance of American railroads. Like a giant conveyor belt, they link up the industrial, agricultural and mining areas of this country with the many thousands of markets that dot our land. With reconversion a fact, far-sighted railroad management is carefully exploring many technological war developments, and, in particular, radio, with the expectation that radio will help keep American railroads the safe, efficient and modern network of transportation which has so ably served the Nation during the war."

S P Kennedy

President, Detroit, Toledo & Ironton R. R. Co.

RADIO *has* a story to tell the railroads . . . a story that will contribute to their continued safety, efficiency and economy of operation. Through its Mobile Communications Division, the Farnsworth Television & Radio Corporation is now telling its railroad radio story to railroads in all parts of the country.

Farnsworth brings to railroad radio specially designed, thoroughly tested equipment, utilizing either space radiation or induction principles . . . equipment which gives positive, unfailing voice communication between the operating units of a railroad, whether moving or stationary.

Furthermore, Farnsworth brings sound engineering, backed up by adequate facilities and by eight years of research into the problems of railroad radio . . . the experience of the Halstead Traffic Communications Corporation, whose assets and key personnel were recently acquired by Farnsworth. *For instance, the corrosive effects of coal gases on radio equipment is one of a number of problems which have been solved in the design of Farnsworth Mobile equipment.*

Write for the complete story of Farnsworth railroad radio. Address the Farnsworth Television & Radio Corporation, Dept. EI-1, Fort Wayne 1, Indiana.

FARNSWORTH TELEVISION & RADIO CORPORATION

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Halstead Mobile Communications and Traffic Control Systems for Rail and Highway • the Farnsworth Phonograph-Radio • the Capehart • the Panamuse by Capehart

It's a mark of quality in any equipment when the frequency source is a BLILEY CRYSTAL

Anyone familiar with radio frequency applications knows that the name Bliley on a crystal means original engineering for a specific job. True—Bliley builds crystals by the million—but Bliley craftsmanship was never gained through mass production.

Fifteen years of interpreting the needs of communications engineers, personalized attention to their individual problems, has provided the engineering background and experience that has made possible consistent quality production.

In the current line of Bliley Crystals all that proved good in wartime models has been retained, with important refinements for peacetime applications. New types have been added—more are on the way.

Make it a habit to consult Bliley engineers on all of your frequency control problems. You will benefit from this mark of quality in your equipment.

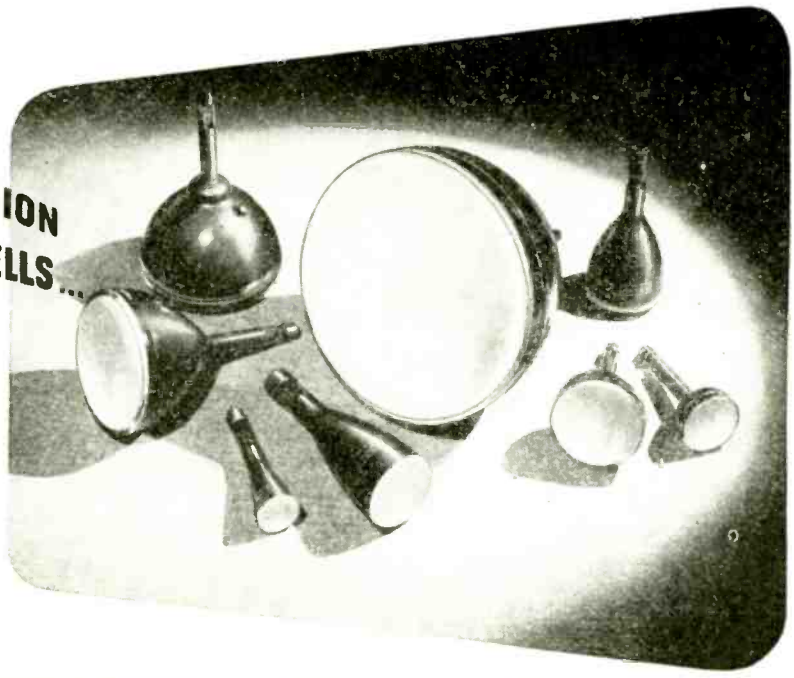
TYPE TC91—This new Temperature Stabilizer is just one of many products described in a new Bliley bulletin. Write for your copy.

Ask for bulletin EI-27

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA

DIRECT-VIEWING TELEVISION RECEPTION AT ITS BEST, SPELLS...



DuMONT TELETRONS*

WHY DIRECT-VIEWING TELEVISION RECEPTION?

Because . . .

- Excellent pictorial resolution due to minimum spot size.
- Higher brilliance and better contrast range for vivid pictures.
- Wide-angle viewing, accommodating the largest audience for given screen size.
- Lower accelerating voltage, which means less costly receiver power supply.
- Simplicity of the focusing system, since it is entirely electronic.
- Longer tube life and therefore lower operating cost.
- Previous objections to curvature of face have been overcome by design of essentially flat-faced bulbs.
- DuMont offers the larger image tubes for adequate screen sizes and the greatest receiver value.

It's *all in the tube* when dealing with direct-viewing television reception. The image is viewed directly as scanned. No mirrors or lenses; no dust or dirt to dim the image; no realignments ever required. The *complete* device for image reproduction is *permanently* set and sealed *at the plant.*

DuMont has led in the development and production of large-image cathode-ray tubes for television (Teletrons) in all sizes and types.

DuMont Teletrons make direct-viewing practical, logical, and truly economical.

• • •

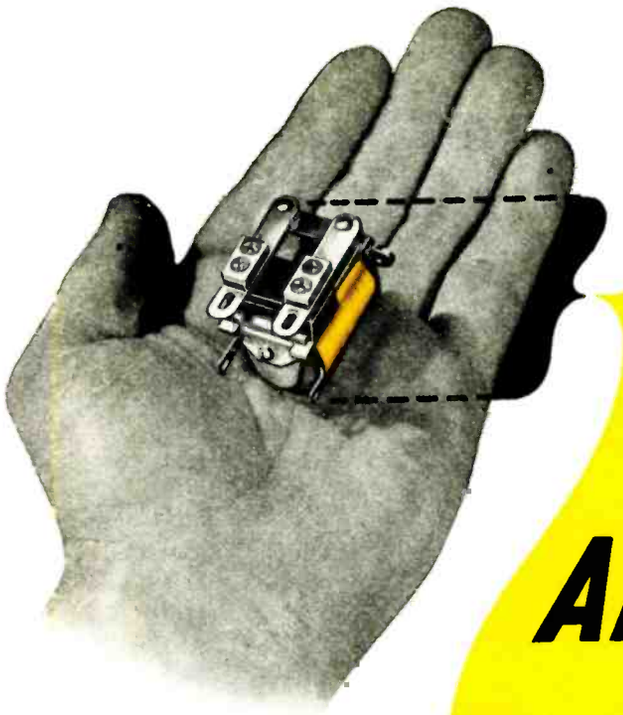
Interested? Our engineers are ready to collaborate in fitting the right Teletron to your particular problem. Technical data on request.

Remember, DuMONT also makes other types of cathode-ray tubes, oscillographs, television receivers and television transmitting equipment.

*REG. TRADE-MARK

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.



Save Space in your controls! use Allied's "CR" Relays

The "CR" relay illustrated is a single pole normally open double break arrangement. Standard insulation is molded bakelite. Contacts are silver, although alloy contacts can be supplied. Contact rating with 1/4" silver is 15 amperes at 24 volts D. C. or 110 volts A. C. Non-inductive. The arrangement shown is 1 33/64" high; 1 3/32" wide and 1 25/32" long. Weight 3 ounces.

Remarkably small for a power relay the "CR" developed by Allied will enable you to materially reduce the size and weight of your electronic controls.

Having large contacts and heavy gram pressure the "CR" performs switching operations which usually require considerably larger relays. Highly adaptable the "CR" has two, three and four pole variations. Conveniently located contact and coil terminals permit speedy and simple assembly of the relay into your unit. For severe dust and dirt conditions the "CR" can be hermetically sealed with the handy plug-in base or with solder terminals.

The "CR" is but one of many types of relays produced by Allied to the high quality standards demanded by your product. Several modern, strategically located plants are available to furnish your immediate requirements. A check with Allied engineers will help you in the selection of the correct relay for your control. Write today.

Allied Relay Types

Power, Sensitive, Telephone, Differential and others.

Also—Solenoids and Electromagnetic devices.

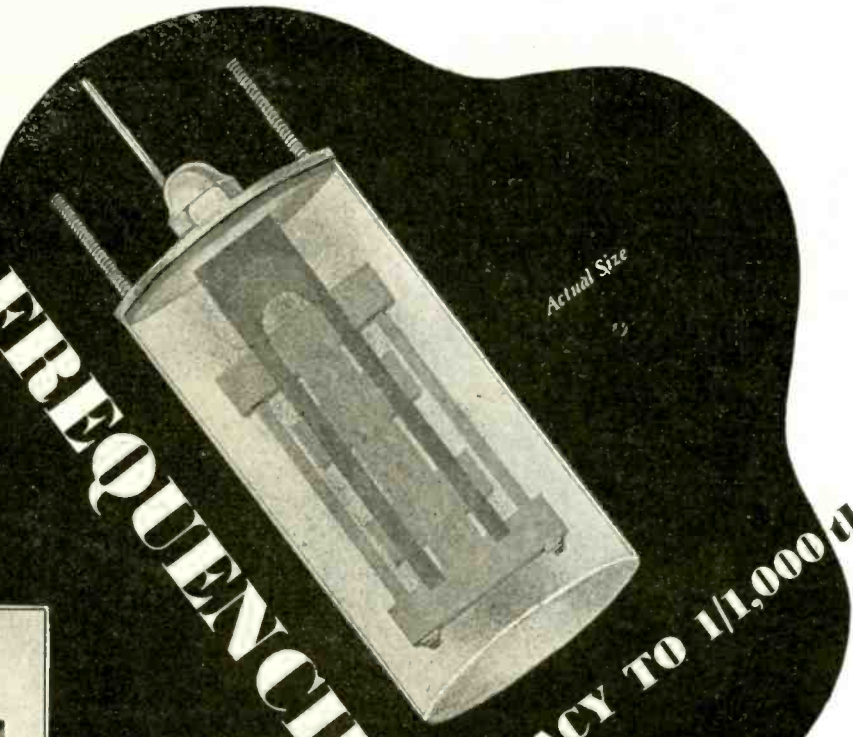
ALLIED CONTROL COMPANY, INC.

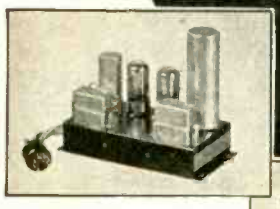
GENERAL OFFICES: 2 East End Ave. (at 79th St.) New York 21, N. Y. *Factories:* New York City (2 East End Ave.)—Plantsville, Conn. *Chicago*—4321 N. Knox Avenue, Chicago 41, Illinois. *In California:* Allied Control Co. of California, Inc., 1633 South Hope St., Los Angeles 15, Calif.

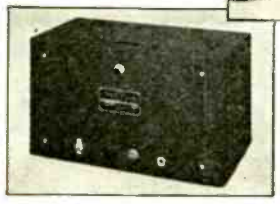
AC-1

LOW FREQUENCIES

ACCURACY TO 1/1,000th of 1%







TOP
FREQUENCY STANDARD
(60 cycle) for use with external power supply

CENTER
CHRONOGRAPH
Records time intervals with resolution to .001 second

BOTTOM
FREQUENCY STANDARD
(120 cycles) with self-contained power supply

These tuning forks which include new engineering principles, provide frequencies from 120 to 1,000 cycles directly with an unqualified guarantee of accuracy to 1 part in 100,000 over a wide temperature range. (Better than 1 second in 24 hours). Closer tolerances are obtainable on special order.

These tuning fork assemblies are available only in single or multi-frequency instruments of our own manufacture which are designed to test, measure or control other precision equipment by mechanical, electrical accoustical or optical means.

The dependability of these frequency standards is being demonstrated for myriad purposes in all climates and under all working conditions.

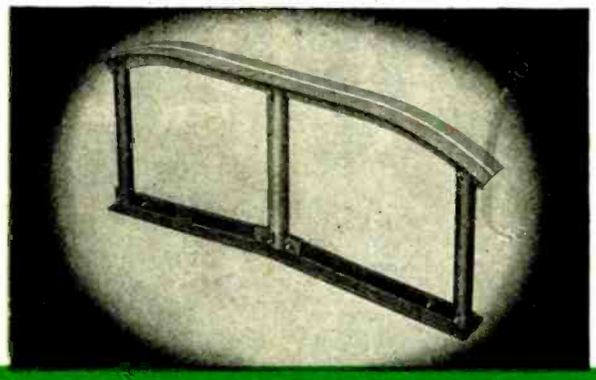
If you have need for low frequency standards of exceptional accuracy, your inquiries are invited.

American Time Products, Inc.

580 Fifth Ave. **New York, N. Y.**

Dist. of Western Electric & Watch Master Watch-rate Recorders

STRONG



Strong, lightweight National Vulcanized Fibre, serves efficiently in aircraft structural parts, as in this internal brace for self-sealing fuel cells.

resilient...lightweight

NATIONAL VULCANIZED FIBRE

may be your answer to new, profitable products

Just as National Vulcanized Fibre adds to the life and efficiency of structural parts in aircraft—this strong, durable material gives *your* products and equipment longer performance . . . at greater economy.

The unusual strength of National Vulcanized Fibre, combined with its other remarkable properties, makes it a "natural" for countless applications in every industry. Resilient and light in weight (about half that of aluminum), it has outstanding tensile and impact strength . . . excellent machinability and forming qualities . . . is high in dielectric strength . . . is extremely resistant to wear and abrasion . . . and is one of the *strongest* materials per unit weight known.

This versatile material offers you no end of profitable possibilities in your products and plant equipment. Write for complete information now. Let one of our trained technical engineers show you how National Vulcanized Fibre can serve you advantageously in your plant equipment and in your products.

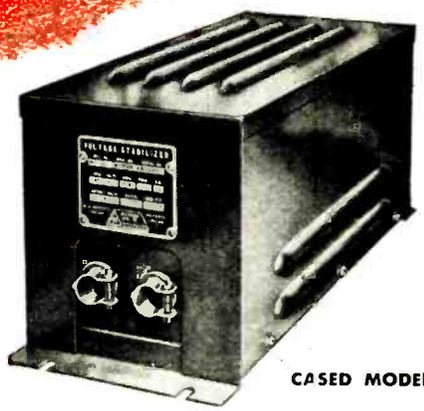
NATIONAL VULCANIZED FIBRE CO.

WILMINGTON, DELAWARE

OFFICES IN PRINCIPAL CITIES

POSITIVE CONTROL

of Varying Power Supply



CASED MODEL

Raytheon Voltage Stabilizers

DELIVER OUTPUT VOLTAGE CONSTANT TO ±½%

FLUCTUATION of line voltage need not impair the performance of your electrical equipment. Such variations are easily corrected with magnetic-type, entirely automatic Raytheon Voltage Stabilizers.

Positive control is gained. Power supply is stabilized to ±½%. Reliability and accuracy of performance are effectively improved, *and at low cost.*

Investigate. Determine how positive control of line voltage can benefit your equipment. Our Bulletin DL-47-537 gives the detailed story. Write for it today.

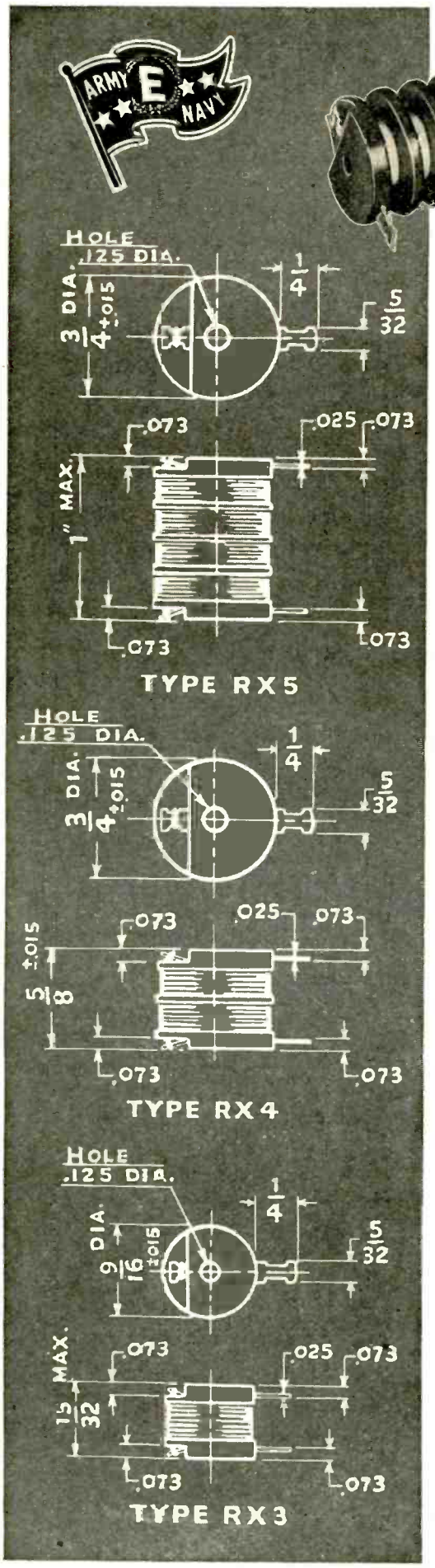
Get These Principal Operating Advantages:

- **Control of output voltage to within ±½% of 115 or 230 V.**
- **Stabilization at any load within rated capacities.**
- **Quick response. Stabilizes varying input voltage within 1/20 second.**
- **Entirely automatic. No adjustments. No moving parts. No maintenance.**

RAYTHEON
MANUFACTURING COMPANY
WALTHAM 54, MASS.

ELECTRICAL EQUIPMENT DIVISION

Excellence in Electronics



3 NEW BOBBIN TYPE RESISTORS

MAXIMUM RESISTANCE VALUES

Type RX3	Type RX4	Type RX5
100,000 ohms	300,000 ohms	500,000 ohms
(wound with 1.5 mil. dia. ceramic-insulated wire)		
25,000 ohms	75,000 ohms	125,000 ohms
(wound with 2.5 mil. dia. ceramic-insulated wire)		

MAX. POWER RATING AT 80° C. AMBIENT

1 watt — 2 watts — 3 watts

MAX. TEMPERATURE—Ambient plus rise: 150° C.

RESISTANCE TOLERANCE: ±½% to ±5%, as specified. Where close tolerances are necessary, power ratings should be reduced in order to maintain stability. For example, one-third power rating is consistent with 1% tolerance.

TEMPERATURE COEFFICIENT—Standard temperature coefficient is that of nickel-chromium wire, .017%. Lower coefficients can be provided with special alloy wires, restricting the resistance range in some cases.

STABILITY—Resistors can be current- and temperature-aged after winding to provide instrument resistor stability. When operated at ratings consistent with tolerance, stability is ±0.1% or 1/10 of tolerance, whichever is larger.

CONSTRUCTION—Resistors are wound with ceramic-insulated Sprague Koolohm resistance wire on molded, high-temperature plastic forms. The lug terminals are tinned copper inserts molded in the plastic form.

HUMIDITY RESISTANCE—Resistors are impregnated to provide protection against tropical humidity conditions.

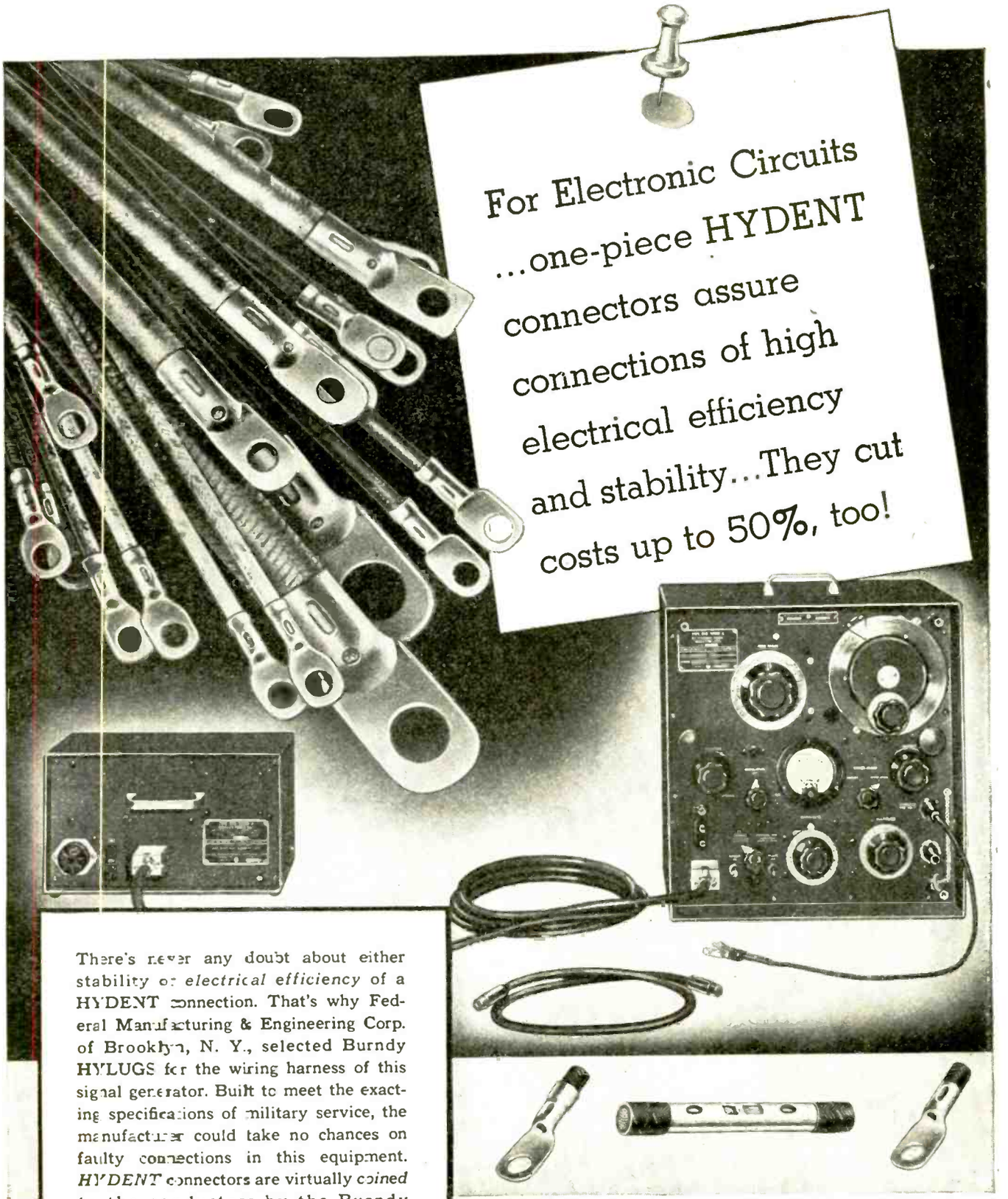
SPRAGUE KOOLOHM

Trademark Reg. U. S. Pat. Off.

WIRE-WOUND RESISTORS

FIRST with Grade 1, Class 1 Resistors; FIRST with resistors wound with ceramic-insulated wire; FIRST with glass-to-metal sealed resistors; FIRST with glazed ceramic coatings and new style end seals; FIRST with Megomax high-resistance, high-voltage resistors.

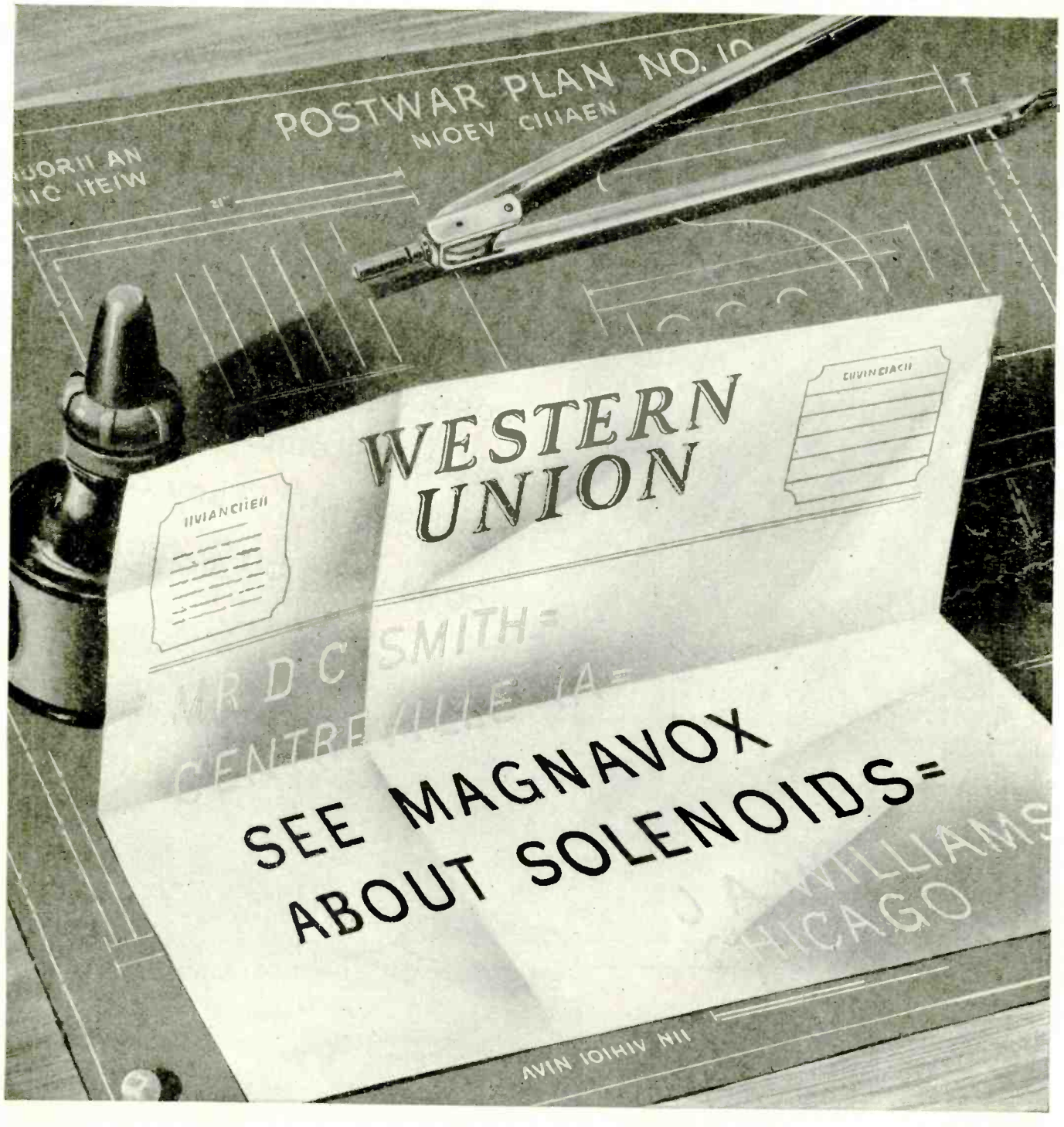
SPRAGUE ELECTRIC COMPANY, Resistor Division, NORTH ADAMS, MASS.



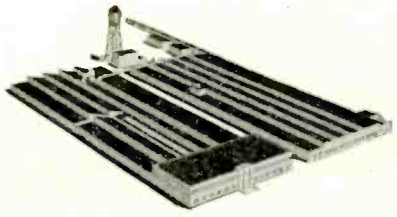
There's never any doubt about either stability or *electrical efficiency* of a HYDENT connection. That's why Federal Manufacturing & Engineering Corp. of Brooklyn, N. Y., selected Burndy HYLUGS for the wiring harness of this signal generator. Built to meet the exacting specifications of military service, the manufacturer could take no chances on faulty connections in this equipment. *HYDENT* connectors are virtually *coined* to the conductors by the Burndy HYPRESS, in one quick operation, thus eliminating costly and messy operations involved in soldering. In addition, the finished connections are easy to inspect. Why not investigate this modern, economical connecting method today. Write to... Burndy Engineering Co., Inc., 107-K Bruckner Blvd., New York 54, N. Y.

Headquarters for CONNECTORS

Burndy



EVERY solenoid used by any branch of the armed forces—firing all automatic weapons from .30 calibre machine guns to 105 mm. cannon—was developed by Magnavox. With this experience in the files and minds of our engineers, we're able to pass on to you many new developments in the design and quantity-production of solenoids. Perhaps we can help you find the answer to your solenoid questions. Our technical department is available for information and advice. The Magnavox Company, Special Devices Division, Fort Wayne 4, Ind.



Magnavox

has served the radio industry 34 years

SPEAKERS · CAPACITORS · SOLENOIDS · ELECTRONIC EQUIPMENT

First in the field... Standard for industry

Federal SELENIUM RECTIFIERS For DEPENDABLE AC to DC Power Conversion

Federal Selenium Rectifiers, the first to be introduced in the United States, are recognized throughout industry as the standard for dependable power conversion.

Made in a wide range of sizes and outputs . . . combining extreme efficiency with low first cost and phenomenal savings in space, weight and mounting requirements . . . Federal Selenium Rectifiers are engineered and built to meet exacting demands wherever DC current is needed from an AC source. These rectifiers have proved their superiority in communications, aviation, cathodic protection and in numerous other fields.

- Rugged . . . Compact
- No Moving Parts
- Low Cost . . . Long Life
- High Efficiency
- Zero Maintenance
- Wide Temperature Range

Capitalize on Federal's design and engineering leadership . . . solve your power conversion problems with Federal's Selenium Rectifiers . . . "First in the Field and Standard for Industry." Write for data now.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

Grandpa did all right . . . in '63!

Muzzle-loaders, like crudely drawn wires, were acceptable in the old days. Now, however, the stringent requirements of modern products and modern engineers demand that perfection be built into every hank, coil and spool of wire. The Spencer engineering department is staffed with capable men to produce quality steel and alloy wire of exacting standards in all fine sizes. Write Dept. EI-12 for engineering information on your fine wire requirements.

SPENCER WIRE

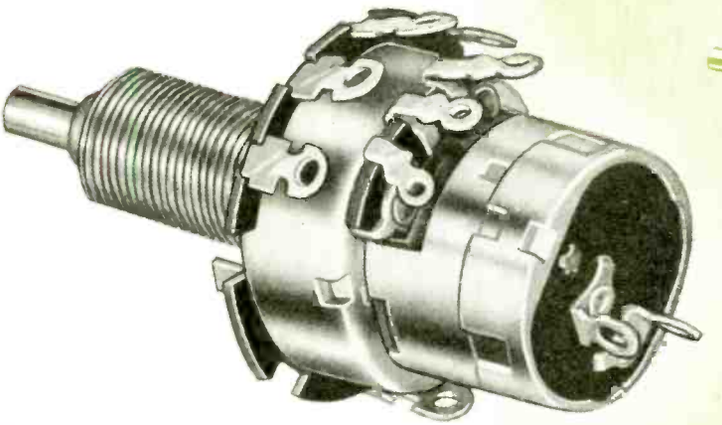
"SPECIFY SPENCER" for exact specifications

★ ★ ★ ★

SPENCER WIRE COMPANY

WEST BROOKFIELD PLANT

WEST BROOKFIELD - MASS.



1⅜ times actual size

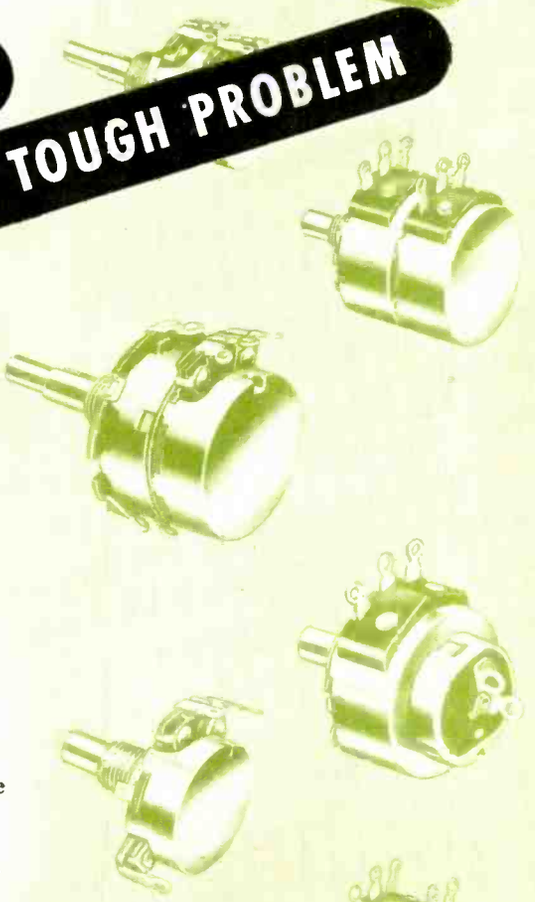
THIS 3-IN-1 ADAPTATION SOLVED ONE TOUGH PROBLEM

A certain auto radio had need of two controls and a switch but only had room on the panel for one unit. CTS solved that problem by devising the G-CIS7-45 featured here, a concentric shaft tandem tone control switch, volume control and on-off switch.

The tone control switch and volume control are operated from concentric shafts and the on-off switch is closed at the beginning of volume control rotation on the rear section. The tone control can be supplied with two, three or four positions.

The CTS reputation for dependability was acquired—and has been retained—because of their genius for solving difficult problems, and then delivering shipments which are uniform in quality and available for use at the time they are promised.

Bring *your* variable resistor problems to the CTS specialists.



REPRESENTATIVES

R. W. Farris Co.
406 West Thirty-fourth Street
Kansas City 2, Missouri
Phone: Logan 7495

Frank A. Emmet Co.
2837 West Pico Boulevard
Los Angeles 6, California
Phone: Rochester 9111

George A. Coleman
420 Market Street
San Francisco 11, Calif.

BRANCH OFFICES

S. J. Hutchinson, Jr.
401 North Broad Street
Philadelphia 8, Pennsylvania
Phone: Walnut 5389

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Cordoba 1472
Buenos Aires, Argentina
South America

Masculina 2624
Montevideo, Uruguay
South America

Avda. Conselheiro Rodrigues Alves 1057
Villa Mariana
Sao Paulo, Brazil
South America

Walter Th. Kammann Willson
Apartado 1891
Norte 6 No. 17
Caracas, Venezuela
South America

IN ENGLAND

Chicago Telephone Supply Co.
St. John's Woods
103 Grove End Gardens
London, N. W. 8, England

CANADIAN ASSEMBLY PLANT

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Manufacturers of Quality Electro-Mechanical Components Since 1896

½ ACTUAL SIZE

RAYTHEON

TYPE 1006/CK1006
A HEAVY DUTY
FULL-WAVE GAS RECTIFIER

TYPE 1006/CK1006 RATINGS

FULL-WAVE RECTIFIER SERVICE

	Ionically Heated	Heated Directly	
Filament Voltage	0	1.75	volts
Filament Current	0	2.00	amps
Maximum Peak Anode Voltage (per anode) no load	800	800	volts
Maximum Peak Inverse Voltage	1500	1600	volts
Average D.C. Voltage Drop	30	25	volts
Maximum D.C. Output Current	200	200	ma.
Minimum D.C. Output Current	70	0	ma.
Minimum Starting Peak Voltage (half wave or dc)	650	450	volts
Minimum Starting Peak Voltage (full wave)	550	420	volts
Maximum Steady State Peak Anode Current per anode	600	600	ma.

RAYTHEON MANUFACTURING COMPANY

Excellence in Electronics

RADIO RECEIVING TUBE DIVISION

NEWTON, MASSACHUSETTS NEW YORK • CHICAGO

To supply the requirements of small transmitters or other equipment where rectification efficiency must be maintained at a high level, Raytheon engineers developed type 1006/CK1006.

Utilization of an inert gas enables this tube to perform its functions through a wide range of ambient temperatures. The cathode may be directly heated as shown in the ratings—or where greater efficiency is desired, ionic heating is possible provided the specified minimum load is maintained without rapid intermittent operation. The internal drop is low even during the time rated peak current is flowing.

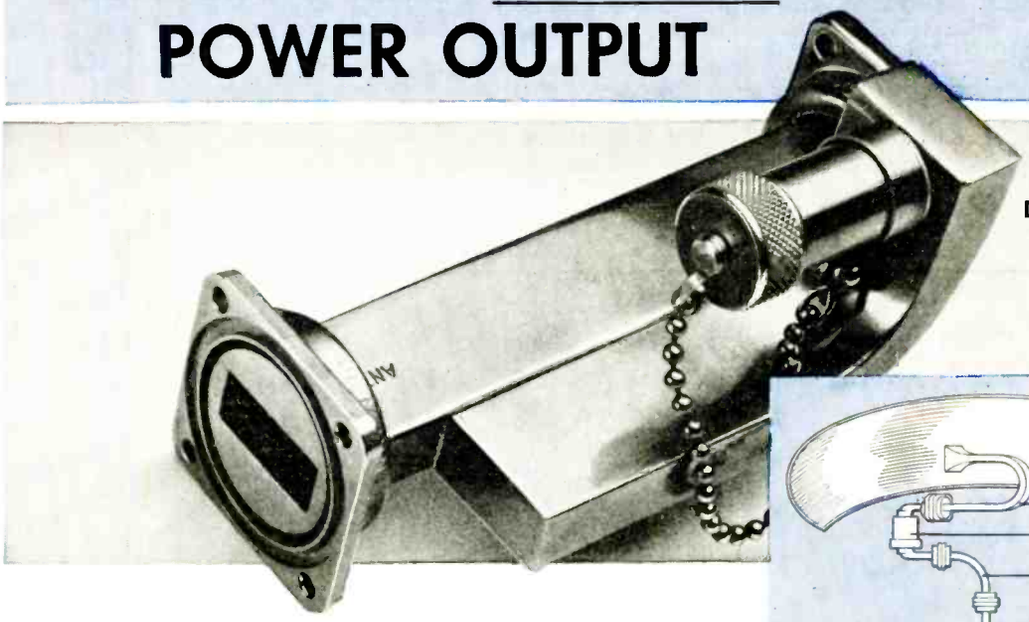
A very important feature of the 1006/CK1006 is the fact that *no cathode preheating time is required*. Full load can be handled immediately and starting is practically instantaneous.

Obviously, the foregoing electrical characteristics are applicable to many types of mobile equipment. Structurally, too, the 1006/CK1006 fits well into such service because rugged design allows it to withstand considerable shock without change in characteristics.

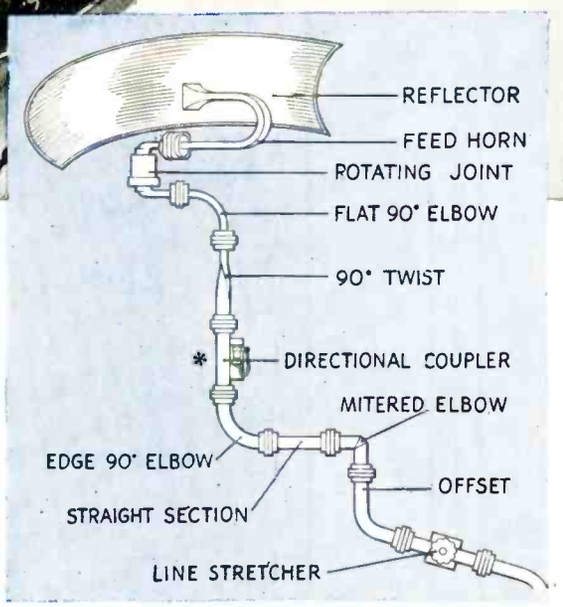
Many thousands of Raytheon 1006/CK1006 tubes have individually given hundreds of hours of reliable service in equipment subjected to adverse conditions of temperature and vibration. Another convincing "exhibit" of evidence that Raytheon builds *fine* tubes . . . tubes well worth considering for your postwar products!

BUY VICTORY BONDS

MEASURES *ACTUAL* MICROWAVE POWER OUTPUT



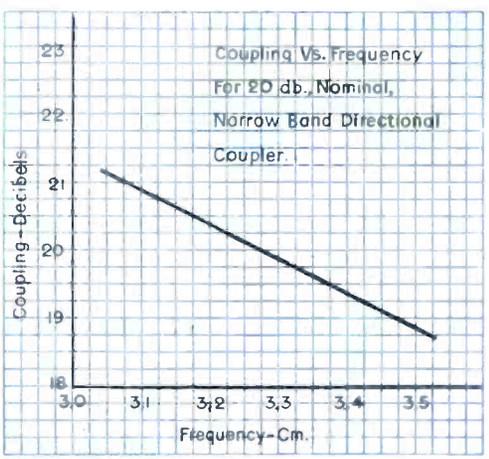
DeMornay-Budd #316 Directional Coupler *



This device insures *actual* power output measurements in microwave transmitters. The coupler can be permanently installed in any part of the transmission line. Calibrated attenuation between main and auxiliary transmission lines permits making power measurements at much lower level for greater accuracy.

The DeMornay-Budd #316 Directional Coupler has a nominal coupling of 20 decibels, which is the amount of attenuation between the energy in the main transmission line and that available at the "N" connector of the auxiliary transmission line.

Consultation on your transmission line problems is invited, without obligation. The benefit of our extensive experience with wartime radar problems is at your disposal.



The curve shows theoretical variation in coupling versus frequency for the DeMornay-Budd #316 narrow band uni-directional coupler shown above.

This plumbing arrangement indicates variety of standard items currently available. Standard couplers are available for frequencies of 2500 megacycles to 30,000 megacycles. Various couplers are also available in other frequencies and band widths:

Broad Band Couplers (10% Band Width)
Narrow Band Couplers (3% Band Width)
Uni-Directional Couplers
Bi-Directional Couplers

Special order couplers can be made to operate at any frequency from 500 megacycles upward.

DE MORNAY BUDD *inc.*

EQUIPMENT FOR 97% OF ALL RADAR SETS

475 GRAND CONCOURSE, NEW YORK, N. Y.

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FOR FASTER, BETTER AND MORE COMPLETE SERVICE
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MEISSNER DIVISION
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Precision engineered and quality built transformers for all requirements . . . replacement, communications, sound amplifier, industrial, experimental and amateur.

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In new, modern designs featuring advanced tone compensation, conservative ratings, ample ventilation, low hum level, multiple input channels and maximum flexibility of controls.

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COMPONENTS

Precision-built components including antenna, R. F. and oscillator coils; standard, plastic and Ferro-cart transformers; windings, coils, chokes and accessories.

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Meissner Analyst—operates by "signal tracing" method, fastest and most reliable—furnished complete. Signal Calibrator—a portable self-contained unit.

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VIBRATORS

Radiart Correct Replacement Vibrators are individually engineered to meet exactly the physical as well as the electrical requirements of each application.

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A complete line of newly designed aerials to fit all cars; 3 and 4 section models—cowl, fender and under hood types . . . all made of finest materials.

SEE FOR YOURSELF!

See the outstanding products of the Electronic Divisions of Maguire Industries, Inc., at the Winter Meeting of the I. R. E. at the Hotel Astor, New York on January 23 to 26.

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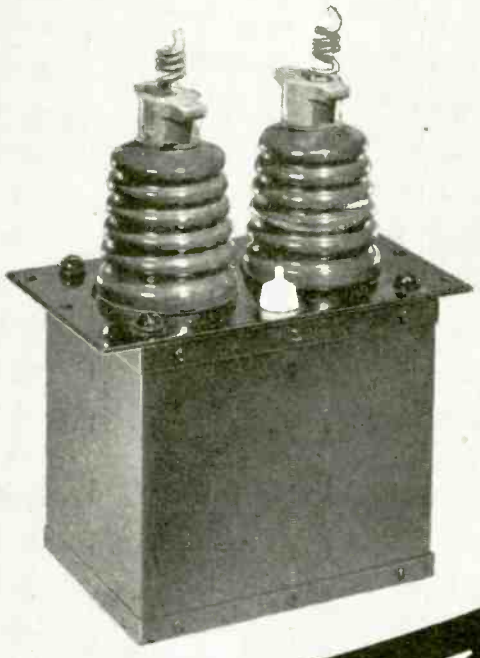
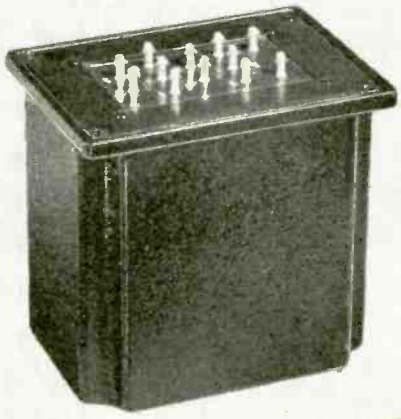
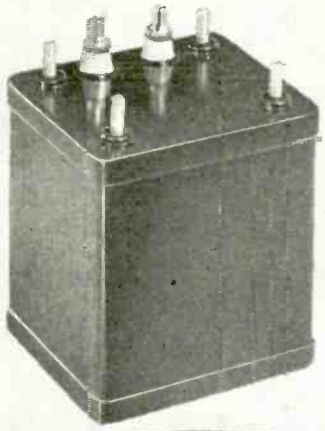
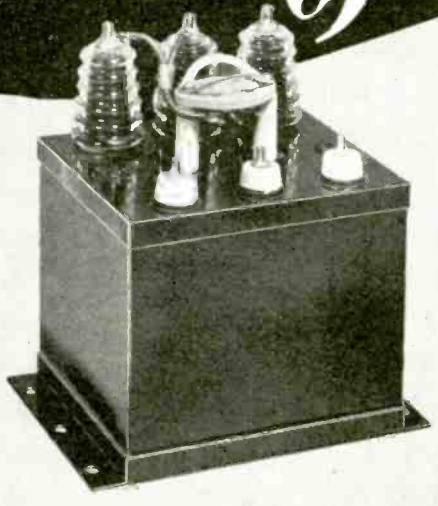


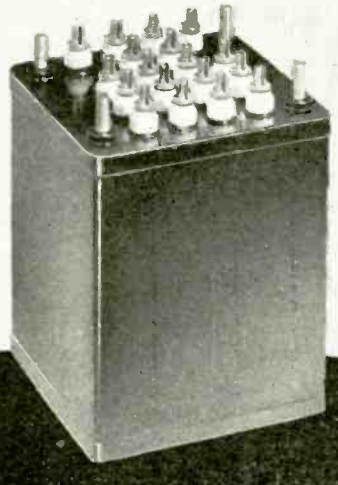


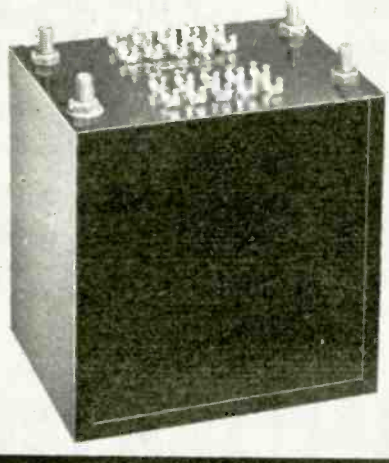


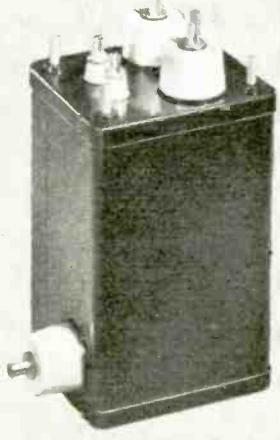
TRANSFORMERS *of Special Design*



A few of the many high quality transformers manufactured to critical specification. Rigid control of material and process—*PLUS* conservatism in design insure a dependable long-life product. We solicit your inquiries. Sizes to 5 KVA.







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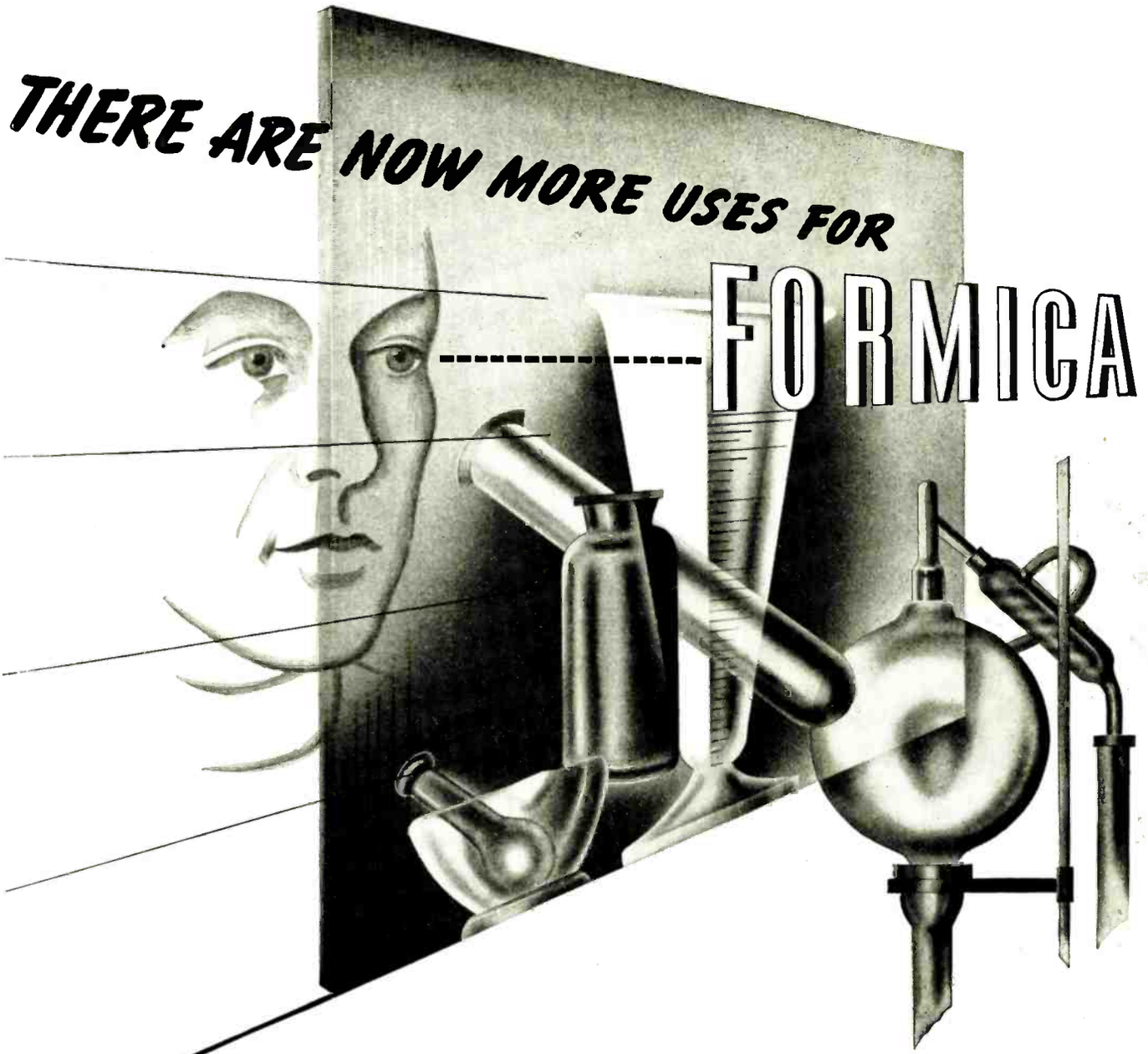

Because of what happened in laboratories during the war—our own laboratories and those of our suppliers—Formica is adapted to more uses now than ever before in its history. And it serves many of the old time uses much better and more efficiently than it has before.

New materials and new methods have improved the material as a high frequency insulator; its stability of dimensions and electrical characteristics under extremes of humidity have been stepped up; it can now be made immensely stronger and more resistant to mechanical strains than ever before; its resistance to both alkalies and acids has been improved for chemical uses.

Therefore, it follows that the material can now be used for many purposes for which it was not previously considered.

Engineering data on these new qualities and capabilities is available in the "Formica Data Book". Ask for it.

FORMICA

THE FORMICA INSULATION COMPANY

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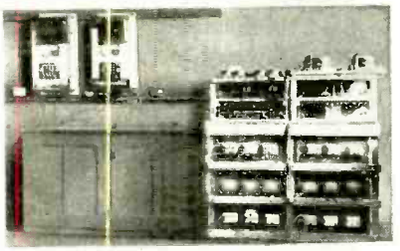
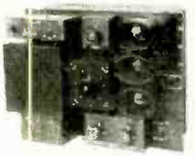


1915. World's first vacuum tube repeater, produced by Western Electric, made transcontinental telephone calls possible.

1919. Among the earliest P. A. amplifiers were these made by Western Electric and used at Victory Way Celebration in New York City after World World I.

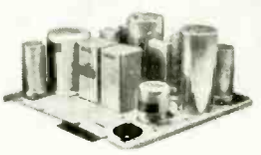


1922. First amplifier used generally in commercial broadcasting. Many of these 8-type amplifiers are still in use.

1931. Negative feedback principle introduced by Western Electric in telephone amplifiers, since applied to broadcasting and public address equipment.

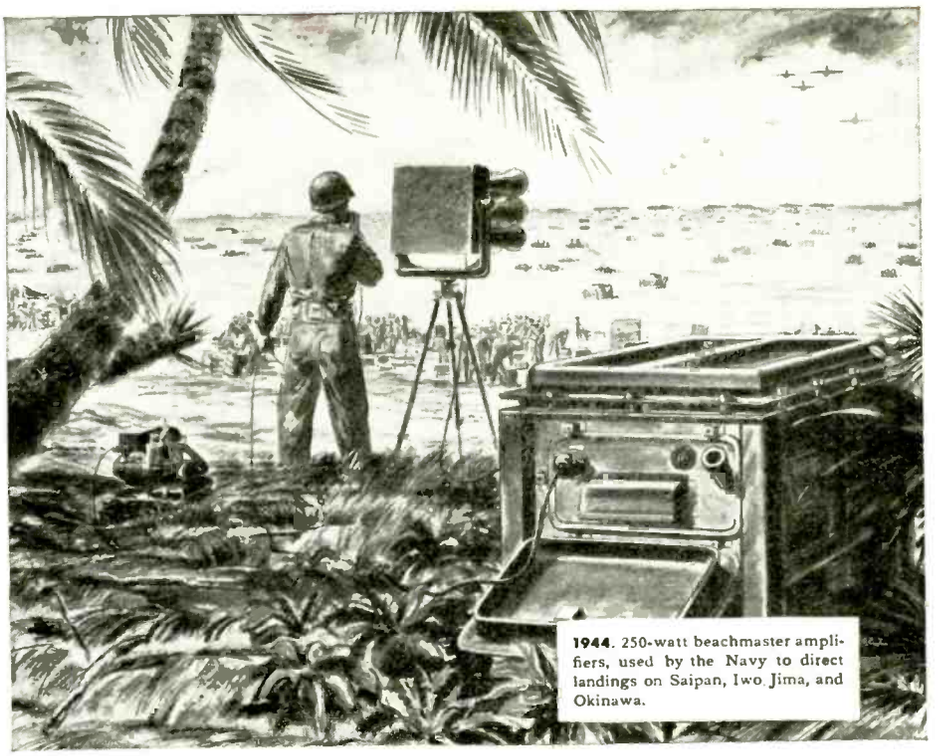
1931. Western Electric developed this first all AC amplifier unit which eliminated batteries, made equipment more compact.

1936. One of the twenty 1000-watt amplifiers used in the world's largest commercial public address system at Roosevelt Raceway on Long Island.



1937. 120-121 type Western Electric amplifiers for use in the finest audio systems for AM and FM transmission.

1942. New and improved battle announcing system amplifiers of the type that helped save the crippled carrier *Franklin*.



1944. 250-watt beachmaster amplifiers, used by the Navy to direct landings on Saipan, Iwo Jima, and Okinawa.

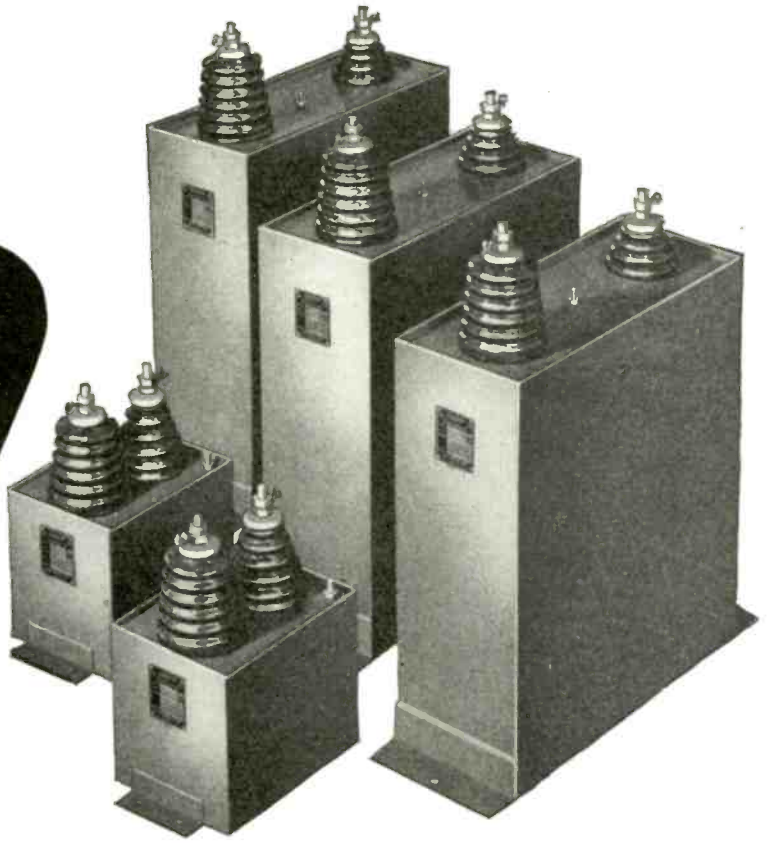
AMPLIFIER HISTORY... Made by

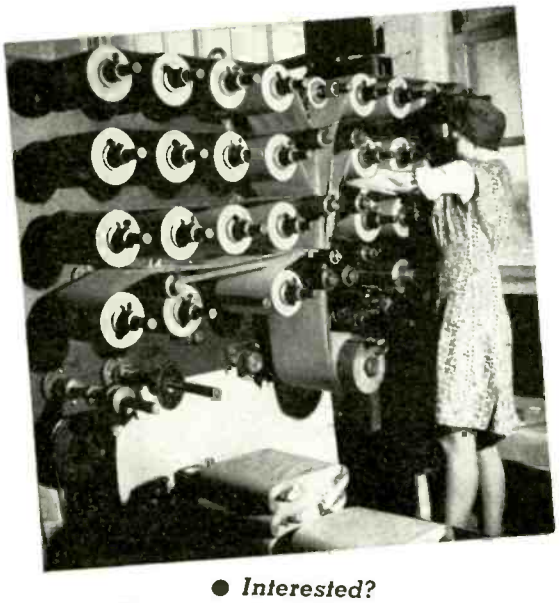
Western Electric

For more than 30 years, Western Electric has made amplifier history. The skill and ability that time alone can bring, plus experience gained producing highly specialized sound equipment for war, mean continued leadership for Western Electric in the years ahead.

Buy Victory Bonds and hold them!

CAPACITOR DREADNAUGHTS





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Write for detailed literature.

● Outstanding production equipment in the hands of Aerovox craftsmen, accounts for these veritable capacitor dreadnaughts. In exacting services such as radio transmitters, heavy-duty electronic equipment, and in the electric power field, these units have won citation after citation for exceptional ruggedness.

Such ruggedness stems from the Aerovox winding facilities second to none. Special winding machines insure that the multi-layered sections are uniformly and accurately wound under critically-controlled tension. Also, a system of impregnation tanks, pumps and control equipment guarantees the necessary drying after vacuum impregnation that is positively unexcelled by any impregnation process anywhere.

Hermetically-sealed welded steel containers; heavy-duty porcelain insulators; cork gaskets and pressure sealing; non-ferrous metal hardware; silver-soldered joints; sturdy mounting means—these are the externals of these capacitor dreadnaughts. Standard listings of Type 20 up to 50,000 v. D.C.W. Capacitances from 0.1 to 10 mfd.

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FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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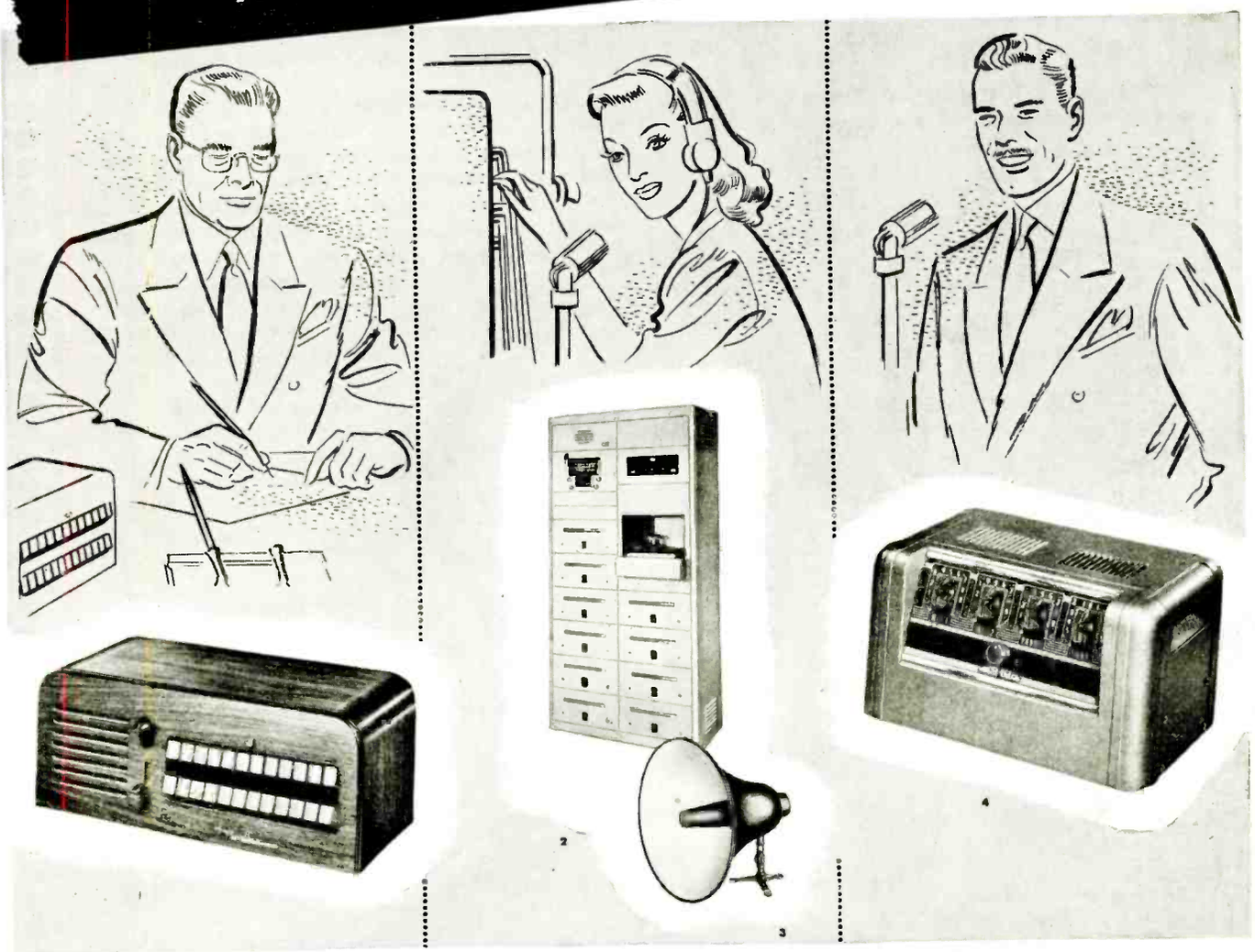

Thousands of *Rauland AMPLICALL* Systems are serving industry today with a performance dependability second to none! Engineering, quality materials and craftsmanship have been combined to insure *AMPLICALL's* dependability . . . multiple uses, flexibility of design, superb tonal quality, low maintenance cost and trouble-free operation are additional reasons for its preferred rating. Whether you need an adequate Paging, Intercommunication or Public Address System, or all three, be sure to check *AMPLICALL* . . . you'll find a system of the exact design and capacity to answer all of your requirements perfectly.

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2. **AMPLICALL** Paging Control Unit.
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4. **AMPLICALL** Audio Amplifier unit for laboratory, test equipment and general applications.

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THE PROS AND CONS OF HERMETIC SEALING

HERMETIC SEALING—A wondrous process which was a government "Must" when ordering Transformers and Reactors for war use. At that time we could take no chances on faulty equipment that might seriously hinder military operations and inadvertently cause unnecessary loss of life among our fighting men.

EXPENSIVE—yes, but added costs meant little when the only thing really important was winning the war.

IN PEACE—we at KENYON are of the opinion that such expense is not warranted. Past performance of ordinary transformers shows conclusively that sealing in a metal case with humidity proof compound along with proper mechanical design is sufficient. This conclusion is self-evident if you will weigh all cost factors involved.

SMALL AUDIO-COMPONENTS — KENYON has developed a range of case sizes (illustrated) which are adaptable to Hermetic Sealing and also to a new exclusive KENYON PROCESS. Despite the fact that the danger of moisture damage is greater in the small audio-component, we feel that our exclusive KENYON PROCESS is more than adequate. While it does not make 100% of the units proof against a five-cycle test, it does make all units impervious to salt water immersion over narrower temperature ranges —and is very much less expensive.

The saving involved by this new Process is so substantial that the cost of the few replacements that might be saved by Hermetic Sealing is more than offset by this much lower original cost.

The items illustrated are only a few of the many possibilities offered by KENYON. We will be more than happy to supply complete details on request.

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THE MARK OF EXCELLENCE

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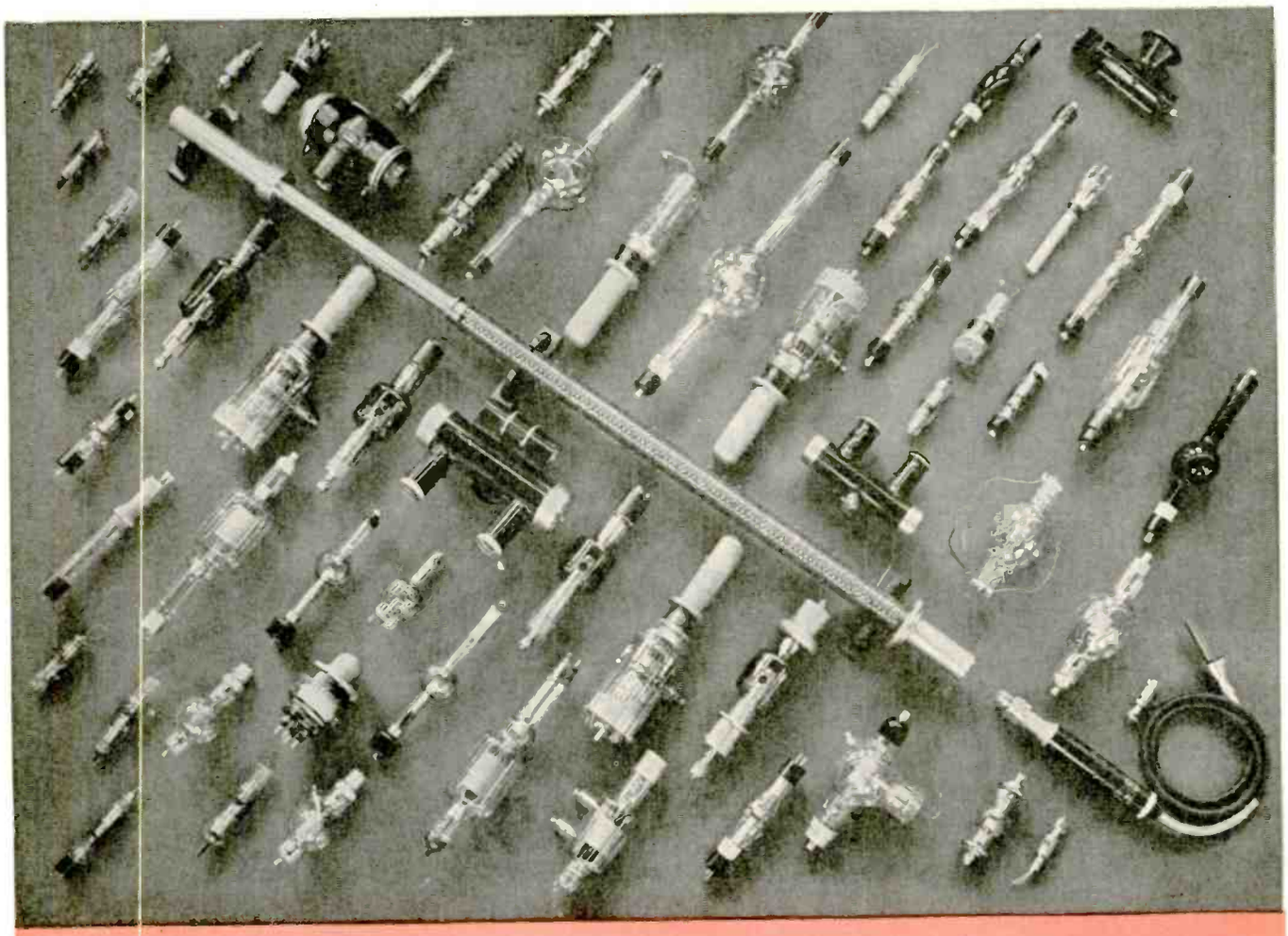
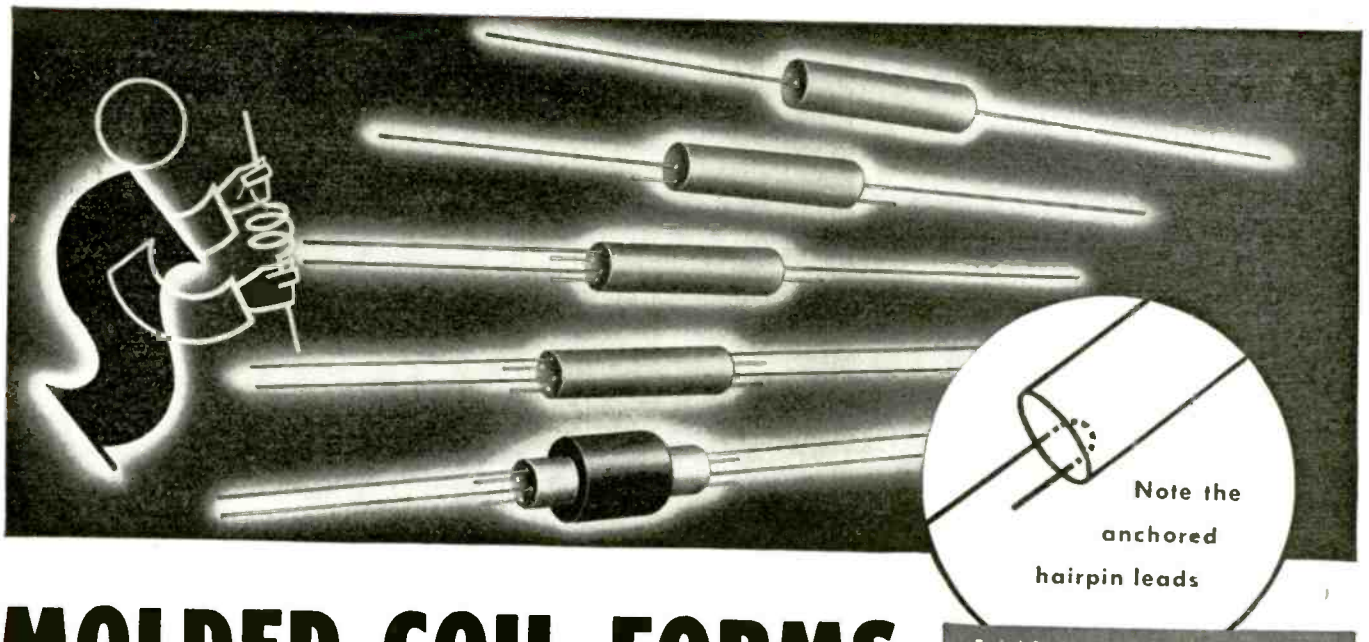


GROUPED about the widely acclaimed Two-million-Volt Precision X-ray Tube are other Machlett tubes for medical, industrial and radio purposes. In each of these tubes are incorporated the inherent skills employed by Machlett in the development of this unique tube. They are your assurance of long life, ruggedness and dependability in whatever field they are used. Machlett Laboratories, Inc., Springdale, Connecticut.

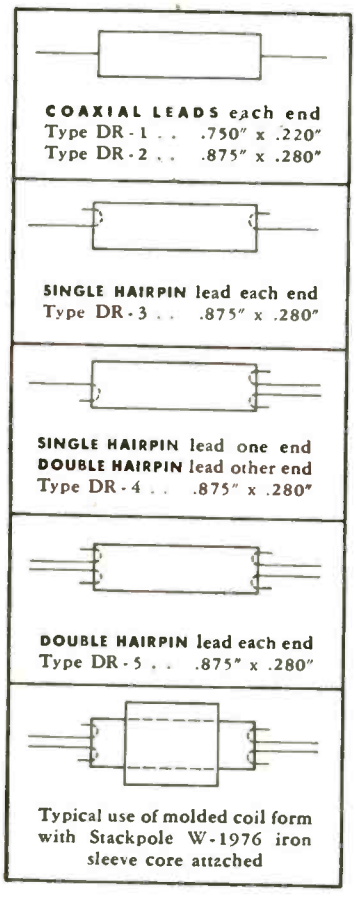
MACHLETT

APPLIES TO RADIO AND INDUSTRIAL USES
ITS 48 YEARS OF ELECTRON-TUBE EXPERIENCE



MOLDED COIL FORMS

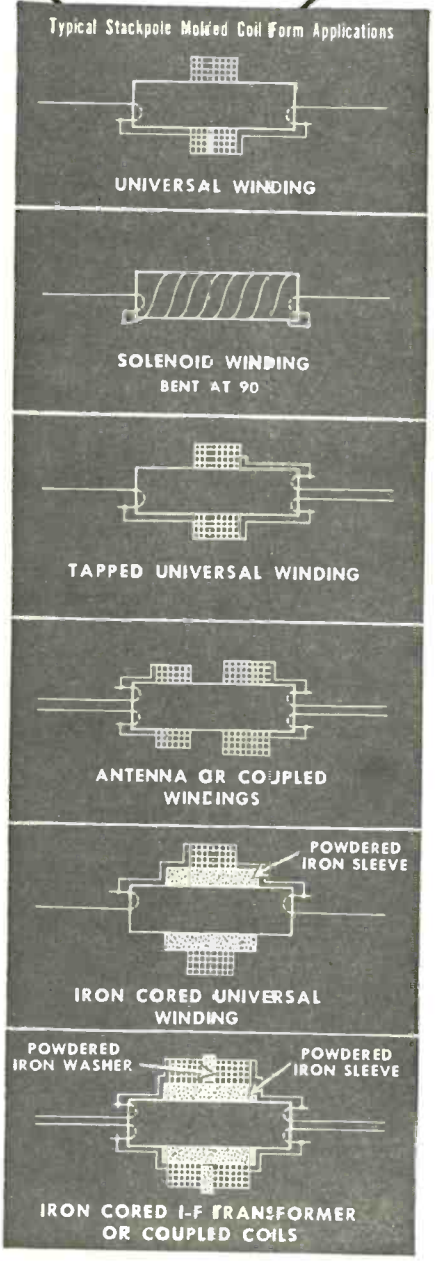
THE MODERN ANSWER TO INEXPENSIVE MECHANICAL SUPPORTS FOR WINDINGS



Reduced space factor . . . simplicity of assembly . . . point-to-point wiring . . . one third fewer soldered connections . . . extreme flexibility of application . . . absolute minimum cost

These proved advantages mean wide use for Stackpole molded bakelite coil forms in a variety of applications. Hairpin anchored leads mean that the soldered core wires are not disturbed or strained when leads are flexed or moved. The forms being smooth, coils may be wound on separate tubes and slipped over the forms—or windings may be wound directly on the forms. Where required, forms may be provided with Stackpole molded iron sleeve cores, thereby increasing Q materially, decreasing the amount of wire for a given inductance and reducing stray magnetic fields. Write for details or samples to meet your requirements.

STACKPOLE CARBON CO., ST. MARYS, PA.
Electronic Components Division



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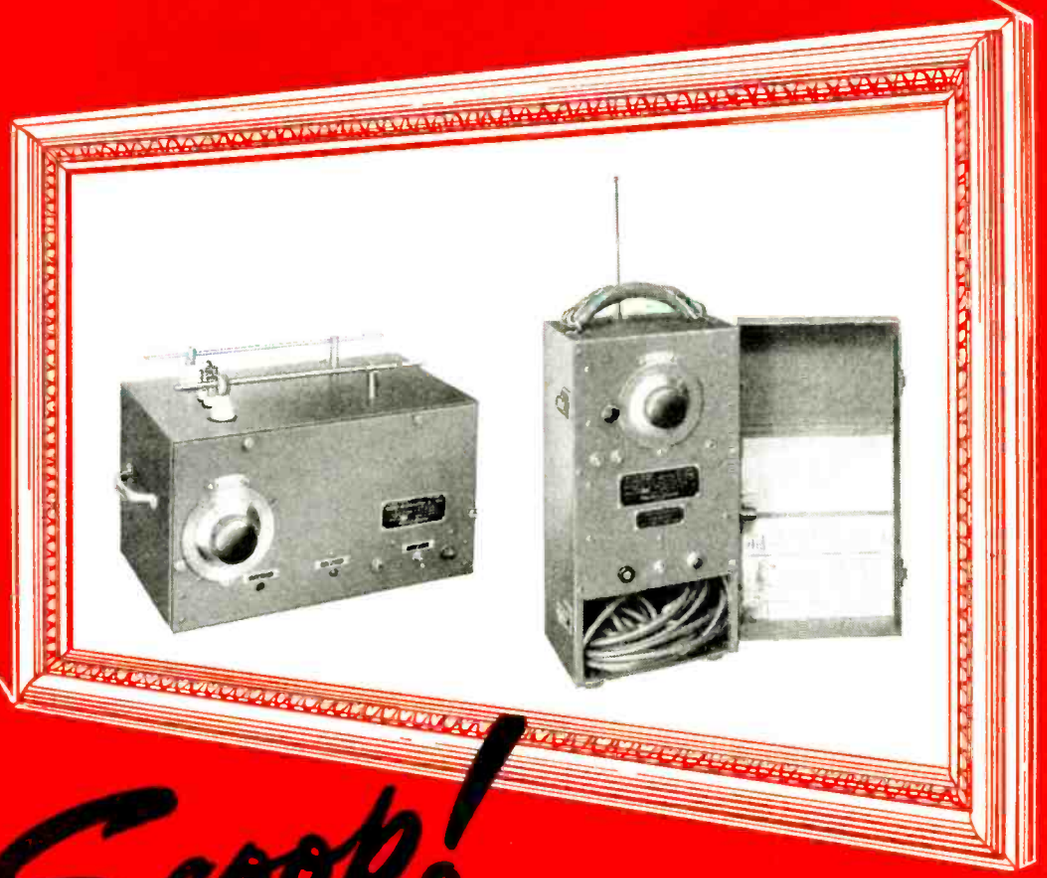

Scoop!

Left: Radio Modulator BC-423. High frequency signal generator operating from 195 to 205 mc., modulated at approximately 5000 cycles. Ruggedly built in steel case. Designed so that it can be re-adapted to many applications. Can be used as high frequency receiver, transceiver or frequency meter. Good for lab demonstrations requiring low power, ultra high frequency generator. Can be converted to 2½ or 1¼ meter receiver.

Right: Frequency Meter BC-438. Ultra-high frequency signal generator operating from 195 to 205 mc. with crysta calibration. Aluminum chassis in steel case. Removable nickel plated 19" telescopic antenna. Use as high frequency receiver or transmitter. Can be converted to cover any frequency range. Takes dry batteries for portable use. Precision tuning control make it ideal for "on the nose" ECO transmitter control unit.

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MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT

THESE VALUABLE ITEMS *Available Now* or very soon. Write, wire or phone for further information • head phones • test equipment • component parts • marine transmitters and receivers • code practice equipment • sound detecting equipment • vehicular operation police and command sets • radio beacons and airborne landing equipment.

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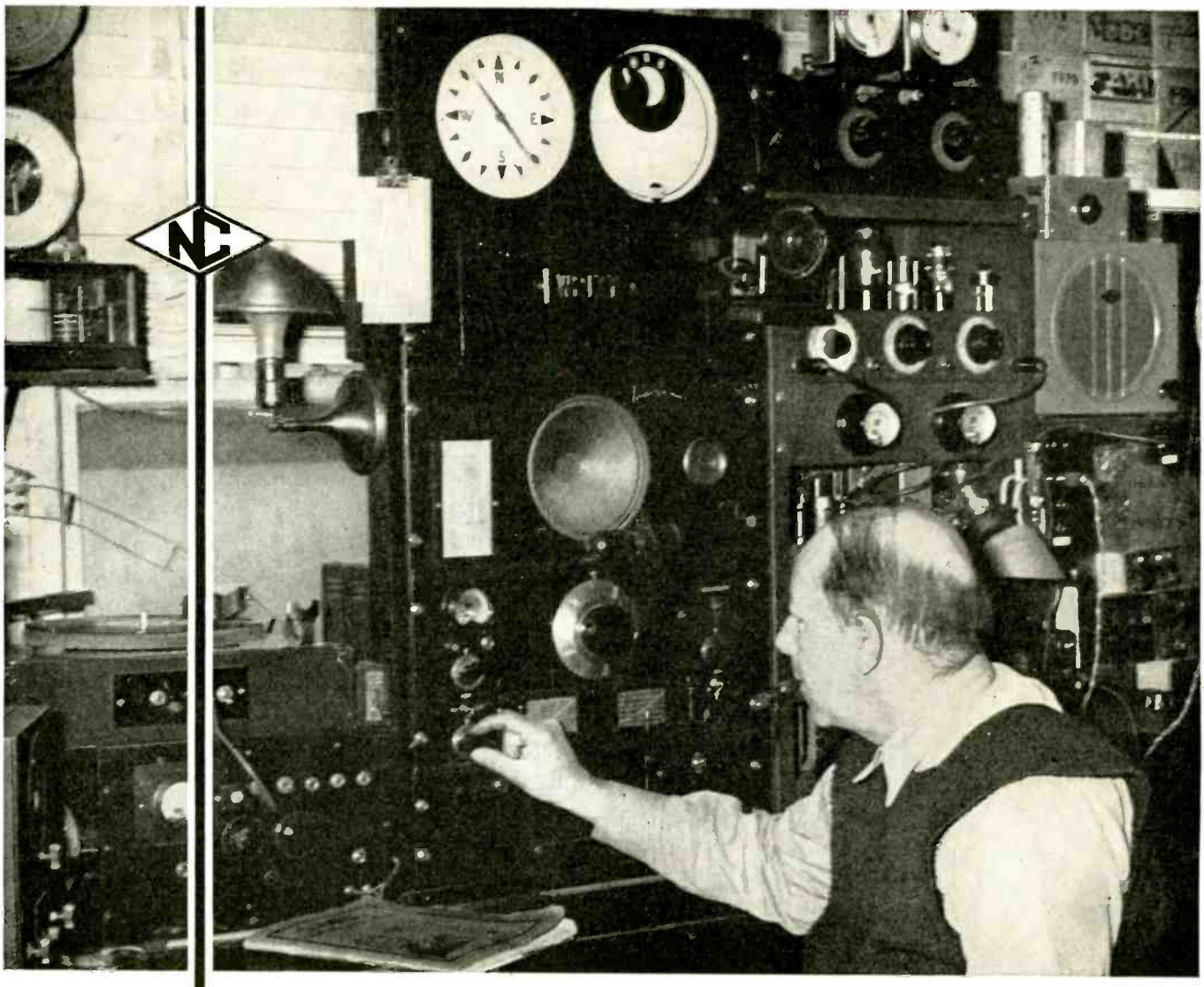

CAPTAIN HORACE L. HALL, U.S. Merchant Marine, retired, at his home in Springfield, L.I., N.Y., made daily recordings of transmissions from Australia, for more than four years, missing but four days. The apparently harmless news broadcasts kept the Australian Government in New York and Washington informed of every phase of the progress of the war, by a prearranged code.

The National HRO, used for this remarkable accomplishment is the first ever to have been shipped into the New York area and is over ten years old.

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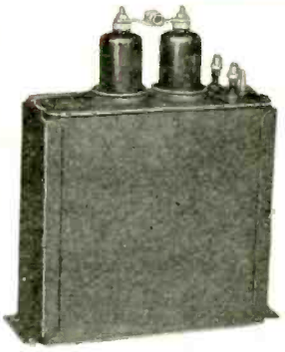
FOR HOT JOBS



Substantial savings are made possible by the small space requirements and low price of G-E high-frequency, parallel-plate capacitors. These compact, water-cooled, liquid-filled units are designed especially for use in the resonant circuit of high-frequency electronic oscillators, such as those used in electronic-heater equipments. Features include: low losses at high frequencies, uniformly high dielectric strength, and high current rating per unit volume.

Available in ratings of .0075 to .034 microfarad (capacitance tolerance 5%), and for maximum rms working voltages of 2000 to 9000 volts. Write for Bulletin GEA-4365.

MIGHTY RESISTORS OF G-E MYCALEX

Physically stronger than porcelain — except under compression — G-E mycalex has higher heat and arc resistance than organic insulating materials; at elevated temperatures its dielectric strength is also higher. It is compression-molded into plates, rods, and strips that can be readily machined to finished shapes. Simple shapes are injection-molded directly, with or without metal inserts.

Its low loss at high frequencies makes G-E mycalex particularly valuable in uhf apparatus. Impervious to water, oil, and gas, G-E mycalex neither warps nor shrinks with age. Write for Bulletin GEA-4244.

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Where production workers and foremen have a working knowledge of electronics, production steps up because there are fewer rejects, and less time is spent on repairs. Now you can teach them all the fundamentals without the monumental task of preparing such a course. General Electric offers a talking slidefilm course to teach not only the fundamentals, but also principles of combining tubes and other components into electronic circuits. It is written for easy understanding by personnel lacking a technical background.

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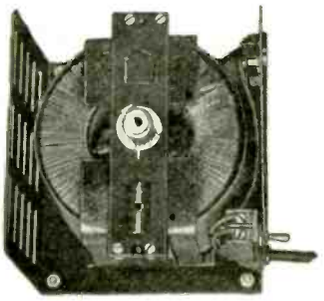

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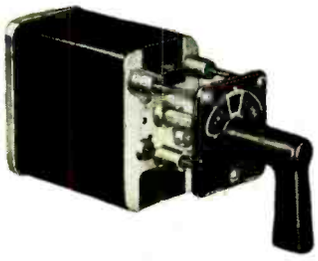

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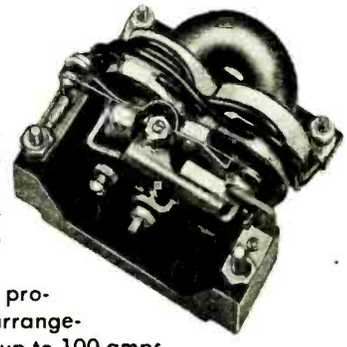

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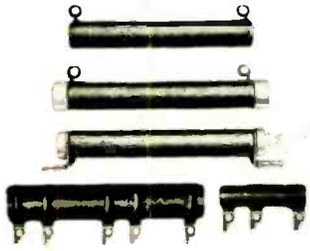

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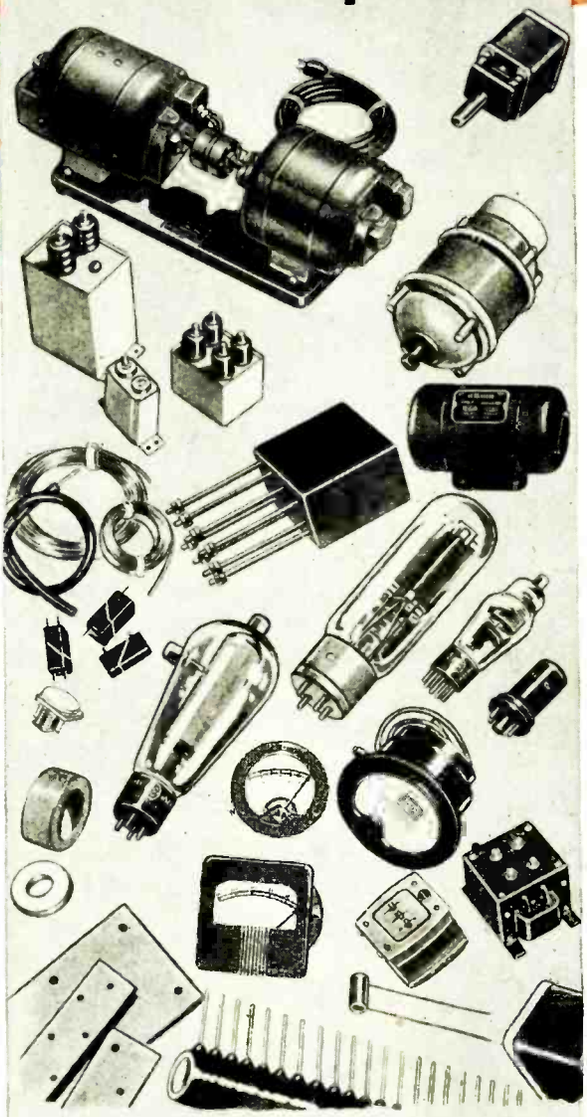

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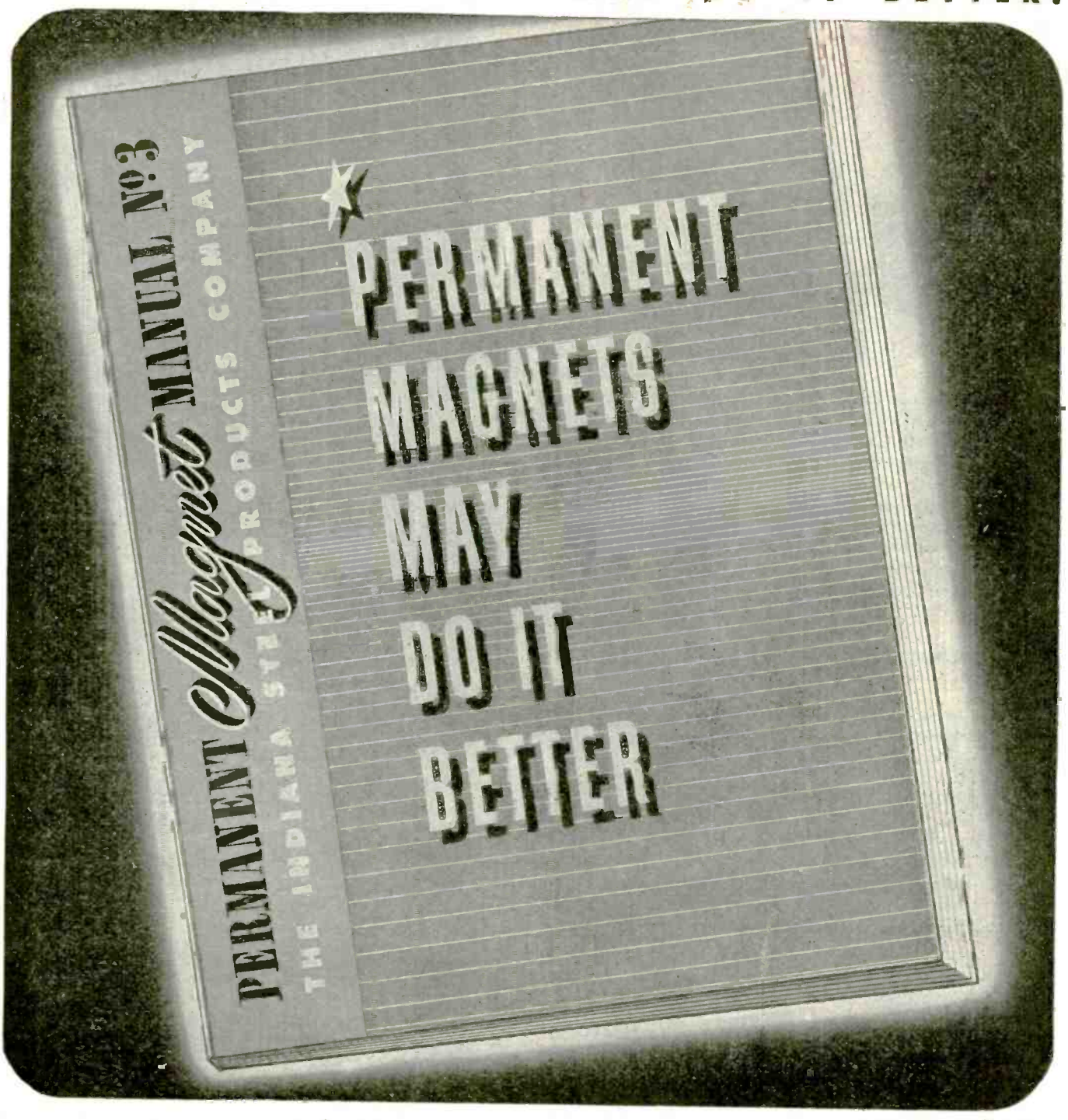

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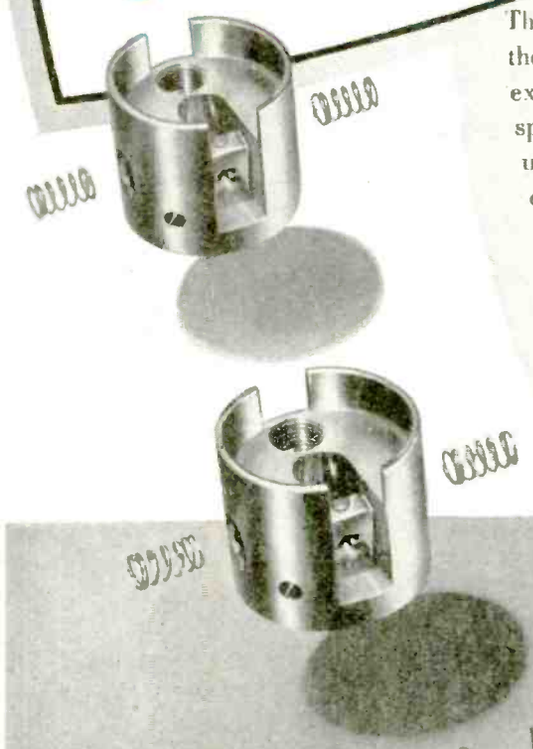

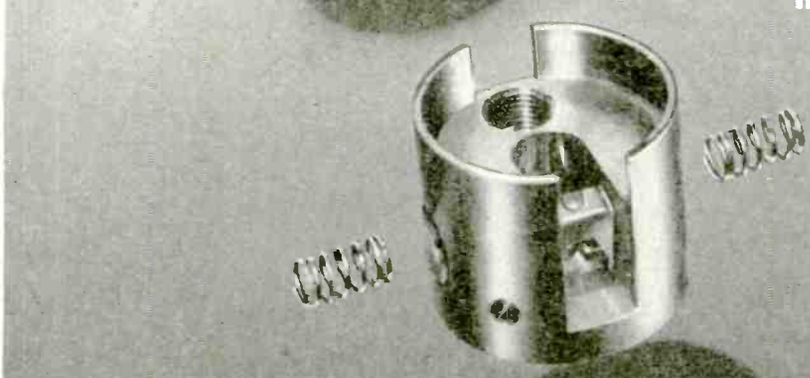

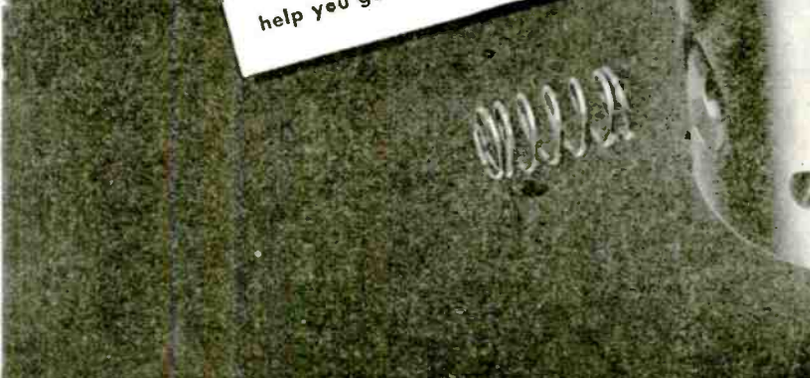

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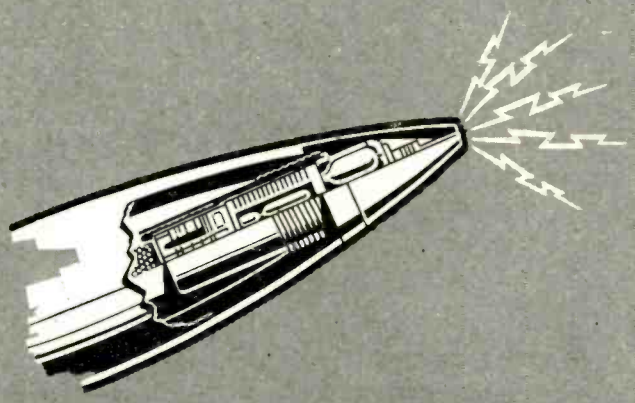

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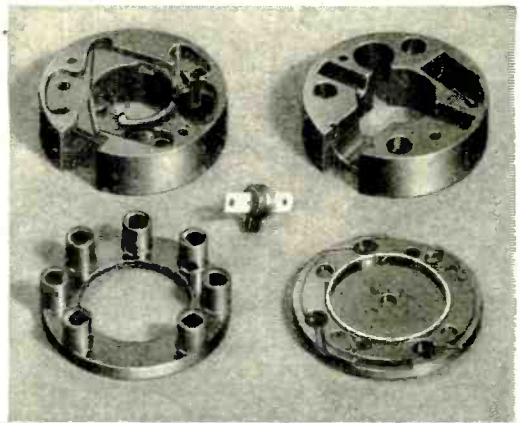

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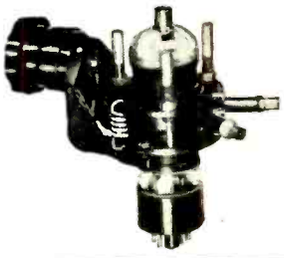

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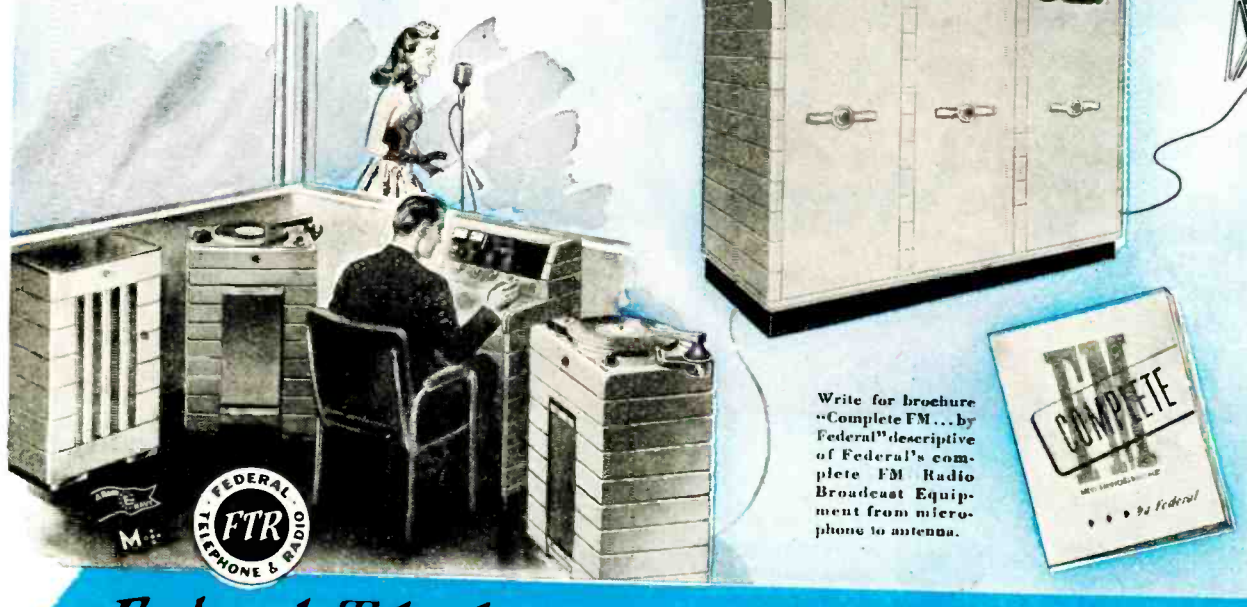

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Communications Revolution

In the older communications fields we are already witnessing an electronic revolution. Not only are telegraph wires being replaced by high-frequency beams and messenger boys by photoelectric facsimile transmission, but the electronic art is making inroads into many manual methods in the business operation of telephone and telegraph systems. These new applications include dialing equipment, automatic time-recording and bill-computing facilities, sorting of vouchers, etc. Electronic facilities will perform tomorrow many tasks in commercial telephony now undertaken by mechanical or hand means.

New Tubes for Industry

The situation in industrial-control tubes still has an element of weakness in that many of the components are of the familiar broadcast home-receiving type. Sooner or later there must be faced the issue that receiving-tube types are quite unsuited to industrial service. As soon as possible redesign programs will have to be instituted, bringing into existence more-reliable long-life tubes to improve performance at industrial specification points.

A considerable interval must elapse before such a program can be undertaken, but the primary steps have been organized.

Instruments for Process Control

A promising field for electronic engineers is that of instrumentation—dealing with the design and use of control apparatus in all of the processes for producing most of our raw materials of industry. The problems of training specialists in this field of industrial process-control instruments are now coming up for attention.

Several important differences exist between the instrumentation and the radio fields. The latter is aided by an enthusiastic game—amateur radio that turns many features of the system into a hobby. There seems to be no similar incentive in the process industries at present—although it is easy for anyone to assemble radio parts for a few dollars and try all sorts of interesting experiments—control and measuring devices that involve efficiency studies on home-heating systems, automatic control of lighting, pumps and other things.

Factory Try-Outs

Experiments are essential to instrumentation. But usually it is impossible for an instrumentation man to tinker with a factory process system in any way, since such experimentation would probably throw the whole plant into confusion. Nor can he easily and cheaply assemble air or hydraulic pressure sources, or retard instruments of various kinds, so that he can try out his ideas independently.

This is one reason why electronic methods are considered first in many places. A few small tubes may suffice for a simple test, which if successful will directly drive other tubes of sufficient power to do the big job. It also accounts for the recent trend into electronic industrial methods for more complicated services, as shown by examples continually reported in these pages.

TV Two-Up on Mm-Pix!

On Navy Day in New York, television accomplished two feats which motion-pictures, after a generation of experience, cannot yet approach.

1. A big dinner at the Waldorf was clearly pictured for the NBC television audience, using only the regular hotel lighting, which was far too dim for the taking of any movies.

2. A newsreel dropped from a blimp was hurriedly developed and the *negative* run through the television projector, without the delay necessary to print, develop and dry a positive. Yet the television audience saw a *perfect positive* by the simple expedient of *electrically* reversing the negative picture. And that's something else Messrs. Pathe and Paramount can't yet do—project blacks as whites at the flip of a switch. Next!

In This Issue—

AUTOMATIC POSITIONING

Autotune equipment used effectively for rapid readjustment of multi-frequency transmitters has industry applications

By R. W. MAY and N. H. HALE
Collins Radio Co., Cedar Rapids, Ia.

• An automatic positioner is a mechanism which is capable of repeating preset conditions of its elements at the will of an operator, but which is not dependent upon the operator for accuracy of reset. This article is restricted to those mechanisms with preset positions which can be adjusted readily. The number of such positions is limited only by practical design considerations.

In order to understand the operation of the various types of positioners, it will be helpful to consider the fundamental components of these mechanisms and the various forms which they can take. The power source may be:

a. Manual; b. Electrical; (1) Motor; (2) Solenoid; c. Mechanical.

The positioned element (the part of the mechanism that is to be set in a desired manner and which drives the external driver element) can have movement that is:

a. Continuous rotary; b. Limited rotary; c. Straight line.

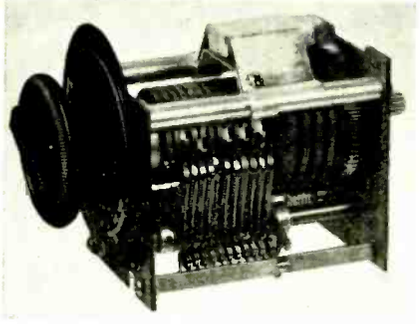


Fig. 1. Autotune head repeats preset position to high degree of precision in span of seconds

The positioning elements may be:

a. Mechanical; 1. Stop type; 2. Detent type; 3. Collector type; b. Electrical.

Most positioners may be classified according to the form these components take. Thus we can have a motor powered, limited rotary, stop type positioner (Collins Autotune, Fig. 1), or a manual, limited rotary, collector type positioner (cardioid type, Fig. 4).

The source of power used to drive any positioner is optional, and any of those mentioned can be used if the proper control means are used.

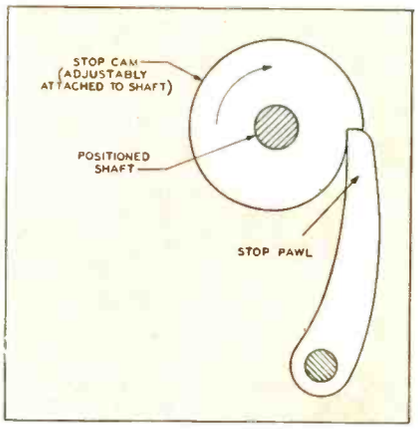


Fig. 2. "Stop" positioner mechanism is fundamentally accurate, simple, easily constructed

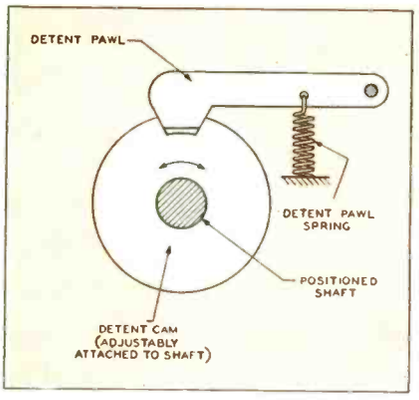


Fig. 3. Detent type of mechanism is inherently very accurate, but not adapted to remote control

The positioned element in a rotary positioner must have no limitations on rotation as it progresses in the same direction from one preset position to another. A variometer or variable capacitor which can rotate continuously could be controlled by a rotary positioner.

In the limited rotary positioner, the positioned element is restricted in its movement to a definite angle of rotation. This type would be used, for example, if the positioned element controlled a variable capacitor which had an allowable rotation of only 180°.

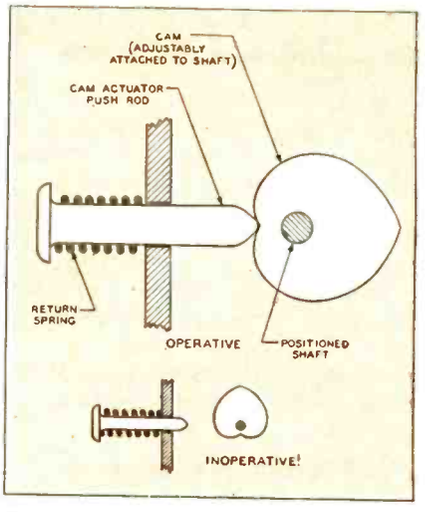


Fig. 4. Cam type of position control operates by pushing plunger against cardioid-shaped cam

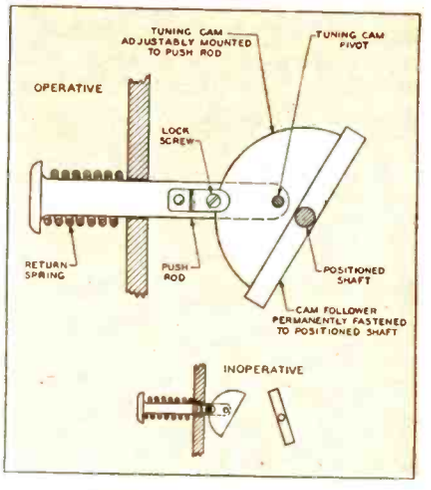


Fig. 5. Modified cam type of position control operates with cam follower and plunger action

If the driven element requires straight line motion, a straight line type of positioner can be used. This type of positioner would be useful for permeability tuned circuits.

Any combination of the positioned elements and positioning elements listed above can be used. For simplicity, the discussion of positioning elements will take into consideration only the use of rotary and limited rotary positioned elements.

The "stop" type of positioner mechanism is probably the simplest,

CONTROL MECHANISMS

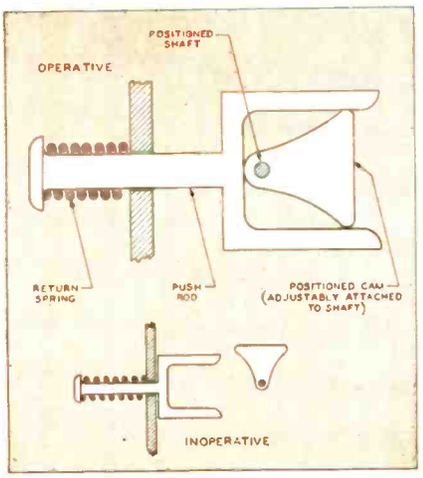


Fig. 6. Cam is carried on positioned shaft in another type of plunger action position control

and takes the form of the familiar ratchet, Fig. 2. The elements required for one preset position are shown. Each additional position will require a similar group of parts, usually assembled on the same shaft.

The operation is as follows: The pawl corresponding to the desired position is lowered against the cam, and the cam is rotated until stopped by the pawl. This type of positioner is fundamentally very accurate and is easily constructed.

The detent type is similar to a switch detent mechanism except that the detent positions are independently adjustable. This type is shown in Fig. 3. Again, the elements illustrated represent only one of several allowable preset positions. The shaft is rotated until the desired pawl has engaged its detent cam. A disadvantage of this type of positioner is that it is impractical to have two preselected positions set close together because the detent latches might be in an unstable condition. This positioner is inherently very accurate; however, it is not readily adapted for use with a remote control system.

The collector type is unique in that it always moves the shortest distance to the selected position. This could also be accomplished with most other positioners, but would require complicated control systems. There are three important designs for collector type positioners. First, there is the cam type, shown in Fig. 4. Only one group of elements is shown. Operation is accomplished by depressing the pushrod of the desired group of elements, causing the cam to rotate until the rod rests in the depression of the cardioid. The disadvantage of this design is that rotation is limited to 180°, unless the positioned element may be allowed to progress always in one direction, in which case there is some danger of stopping one of the cams on dead center.

Second is the modified cam type of positioner. The more common of the several modified cam types are shown in Fig. 5 and Fig. 6. The operation is similar to that of Fig. 4. Secondary detent latches may be used to increase the accuracy. Rotation is limited to less than 360°.

The third and most ingenious of the collector type positioners is shown in Fig. 7. Only one preset position is shown, but others may be added. It is built in two forms and is not limited to any definite angle of rotation. This mechanism is operated by the pushrod, which rotates the two gears in opposite directions. Each gear drives a lost-motion or take-up mechanism which may be composed of several washers with projecting ears, as shown in Fig. 7. One of the two lost-motion devices will drive the projection on the positioned ele-

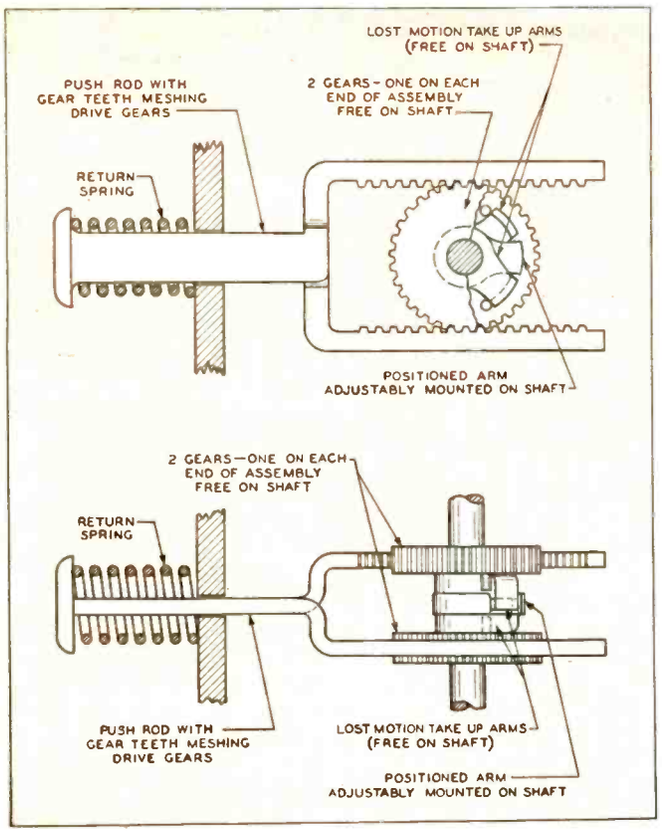
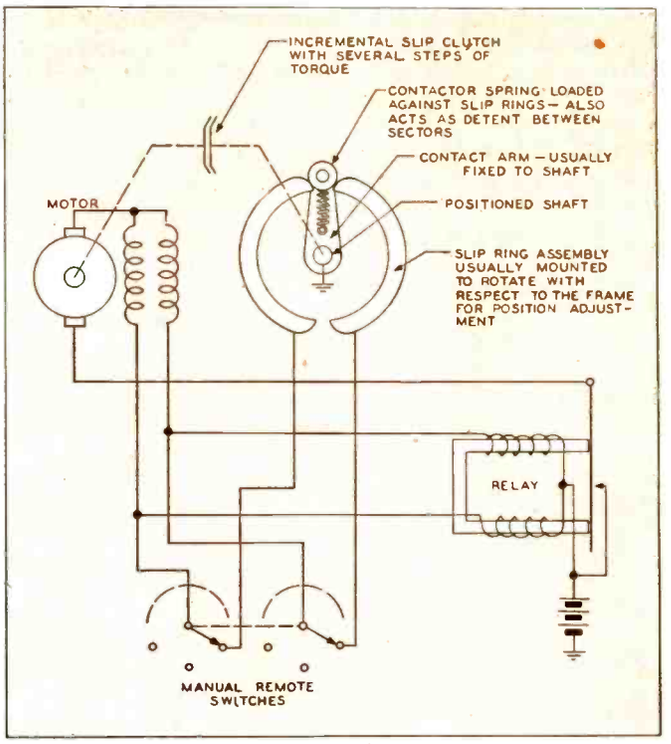


Fig. 7. Collector-type positioner is operated by pushrod, rotating two gears in opposite directions. Accuracy is limited by series of elements

Fig. 8. Electrical positioner is easy to apply, does not afford high repositioning accuracy. Remote control is simple but may tend to hunt



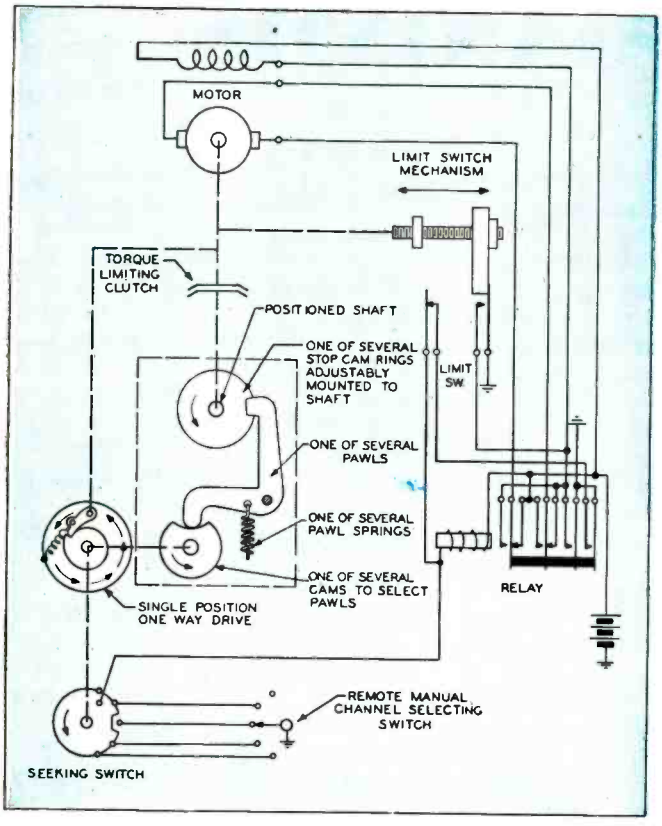


Fig. 9. Electrical control system of autotune utilizes seeking switch to find selector switch position; reversible motor and one-way ratchet used

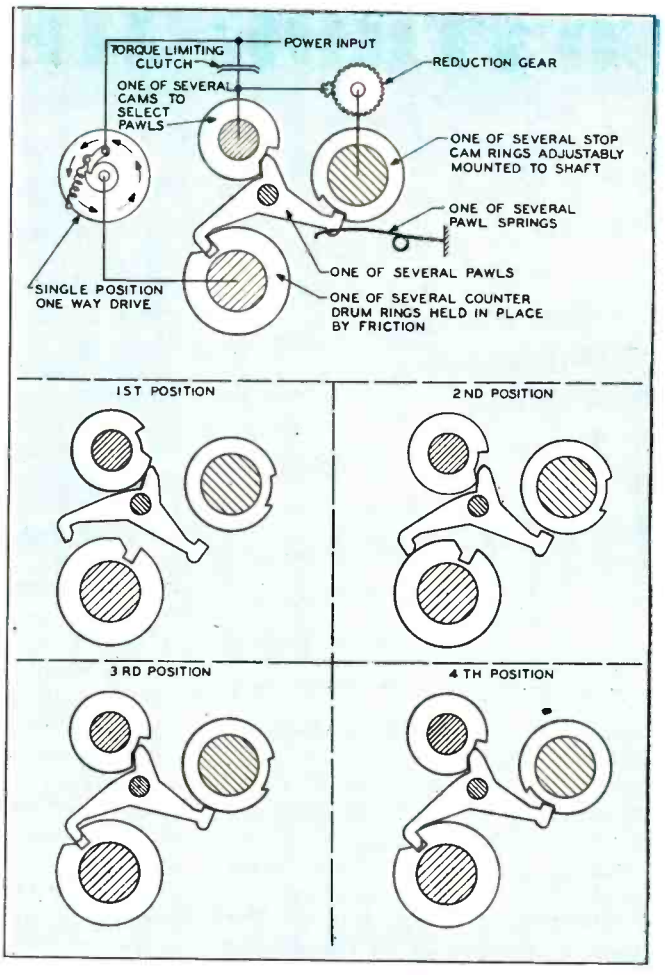


Fig. 11. (Right) Counter drum of multi-turn unit makes only one revolution during rotation of stop-ring shaft; number of stop-ring turns is preset

ment until the second has no play left in it. The projection on the positioned element is then clamped between the two gear driven lost-motion trains, thus holding it in place. A variation of this type substitutes a Geneva movement for the lost-motion mechanism. In remote control applications the push-rod usually is replaced by motor driven gears which are engaged or disengaged by solenoids. The accuracy of this positioning mechanism depends upon all elements of the mechanism acting in series, and because there are several elements, extreme accuracy is difficult to obtain.

This device has been used for many years in applications not requiring high accuracy. It is easy to apply but involves control problems, the worst of which is a tendency to hunt. Successful operation has been obtained with increased accuracy by using a secondary mechanical detent action in combination with a series of incremental clutches to eliminate hunting.

Fig. 8 shows such a device representing one preset position. The desired position is selected by a selector switch, and the motor is connected so that it drives the arm on the positioned shaft toward the detent position between the two slip ring segments. The arm can stop only when the contact touches both segments simultaneously. A separate motor is required for each driven element. This positioner has the advantage of simple remote control, but it will not accommodate high inertia loads, and would be unstable if two positions were set too close together.

Although the possible uses of automatic positioners are extensive, it is likely that their application has been most thoroughly explored in the radio communication field. Here the need is for rapid and frequent retuning of all controls, and positioners find ready application. Many military operations during the war depended for their radio communication upon the ability of the equipment to shift frequencies rapidly and accurately between transmissions.

Limited rotary positioner

The remainder of this paper will be limited to a discussion of one type of remote controlled positioner which has been widely used in radio equipment. In such equipment, it is frequently necessary to position several different shafts independently to preselected positions, since it is not always possible to gang all tuned circuits under a single control. Space is frequently at a premium, particularly in aircraft applications, and it is desirable to use only one source of motive power and one control system for all of the driven elements in an entire equipment.

Certain applications such as frequency control circuits require a high order of reset accuracy. Others, such as band switches and broadly tuned circuits, do not require such precision. For flexibility of application it is desirable to use a single type of positioner for all purposes, with resulting savings in development and manufacturing costs and simplification of maintenance.

A limited rotary positioner meets these requirements because:

1. More different types of positioned elements can be driven by a limited rotary positioner than by any other kind.
   (a) Any continuously rotatable device may be driven by a limited rotary positioner.
   (b) Straight line motion can be obtained, if needed, by use of lead screw, rack and pinion, or similar device.

2. A limited rotary positioner is capable of sufficient precision for all applications, but is not too complicated or expensive for use in circuits requiring less accuracy.
3. With electrical drive, a limited rotary positioner is easily arranged for remote control.
4. A limited rotary positioner is relatively easy to design and manufacture.

The most convenient motive power for such a positioner is an electric motor. In some specific cases solenoids and ratchet stepping motors have been used; however, they are generally very inefficient. Hydraulic power offers some interesting possibilities, particularly in the case of very large applications.

Control systems

The problem of control for the mechanical positioner is related to the question of motive power and worthy of somewhat detailed comment. There are two separate and distinct phases in the operation of a positioner. First, it must be capable of setting a shaft to a predetermined position, and must be able to repeat the operation time after time with the required order of accuracy. Second, since there are several preset positions, the mechanism must be able to select any one of those positions. The control system must tell it which of the several positions to select, and must assist it in doing so.

The accuracy required of the control system is not as high as that required of the positioner itself, because the control system merely tells the positioner which position is to be set up. If 10 positions are available, an accuracy somewhat better than 1 part in 10 is usually satisfactory.

There are three general methods of remote channel selection.

1. Mechanical. This requires a flexible shaft or a push-pull choke wire, or perhaps a cable and pulley, or shafts and bellcrank levers.
2. Hydraulic or pneumatic. This requires tube or piping and fluid.
3. Electrical. This requires only wires connected to the remote point.

The mechanical type of remote control would be the most straightforward method. A flexible shaft is a very practical, rather simple installation for short distances. However, it is not very often used due to its lack of versatility. Hydraulic or pneumatic controls are merely mentioned here as possibilities. The electrical method is probably the most adaptable for radio equipment and is used in the positioners described here.

The simplest way to apply this method would appear to be by the use of solenoids to operate the pawls corresponding to the desired channels. Solenoids have disadvantages, however, in that they are bulky and inefficient, and that each positioner would require as many solenoids as there are positions available. A practical type of electrical control system and the one which is used in the Autotune is that in which the pawls are selected by means of a rotating cam on the same shaft as a motor-driven "seeking" switch. The seeking switch selects a position corresponding to the position set manually on a "selector" switch. Hunting is eliminated by making use of the reversal characteristic of the electric motor and a one-way ratchet drive for the seeking switch.

The mechanism works as follows (see Fig. 9): The selector switch (which may be any distance from the positioning mechanism) is turned to a desired preset position. This energizes the motor control relay which starts the motor in the direction of the arrow. The motor drives the seeking switch through a one-way ratchet, and when this switch finds the selected position, the motor control relay is de-energized, reversing the motor. Because of the one-way ratchet drive, the switch is left in the desired position. The motor is stopped by limit switches.

The important factors in this control system are the speeds with which the control relay releases and the motor reverses. The relay is usually the slower of the two. It is necessary that the motor come to a halt in its original direction of rotation before the seeking switch is driven past the selected position and closes the relay circuit again. This relationship defines the maximum operating speed of the system.

The Collins Autotune system is a combination of the limited rotary

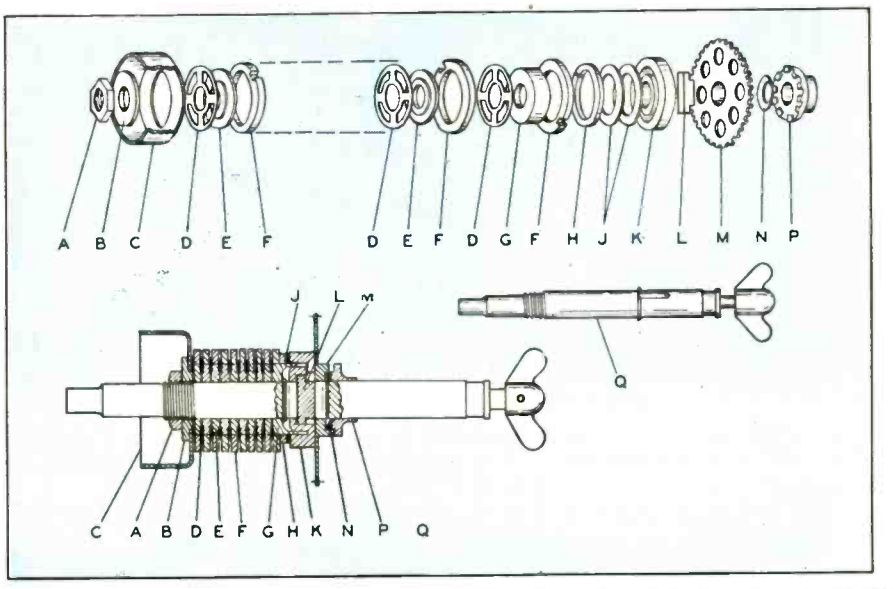


Fig. 10. Position presetting of stop-rings may be done without disturbing positions of adjacent rings, since flexible washers between rings can move axially but cannot turn on shaft

Fig. 12. Torque limiting clutch of de-energizing type protects all components from overload

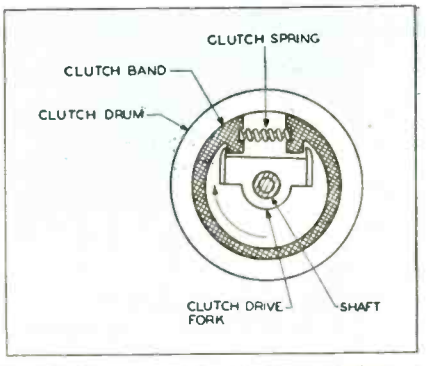
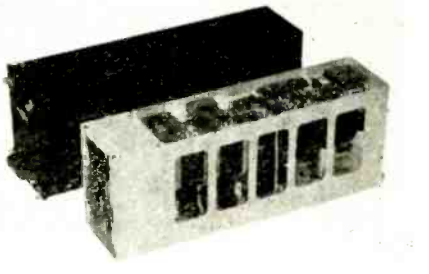


Fig. 13. Autotune found extensive use during war to tune small transmitters of type shown below



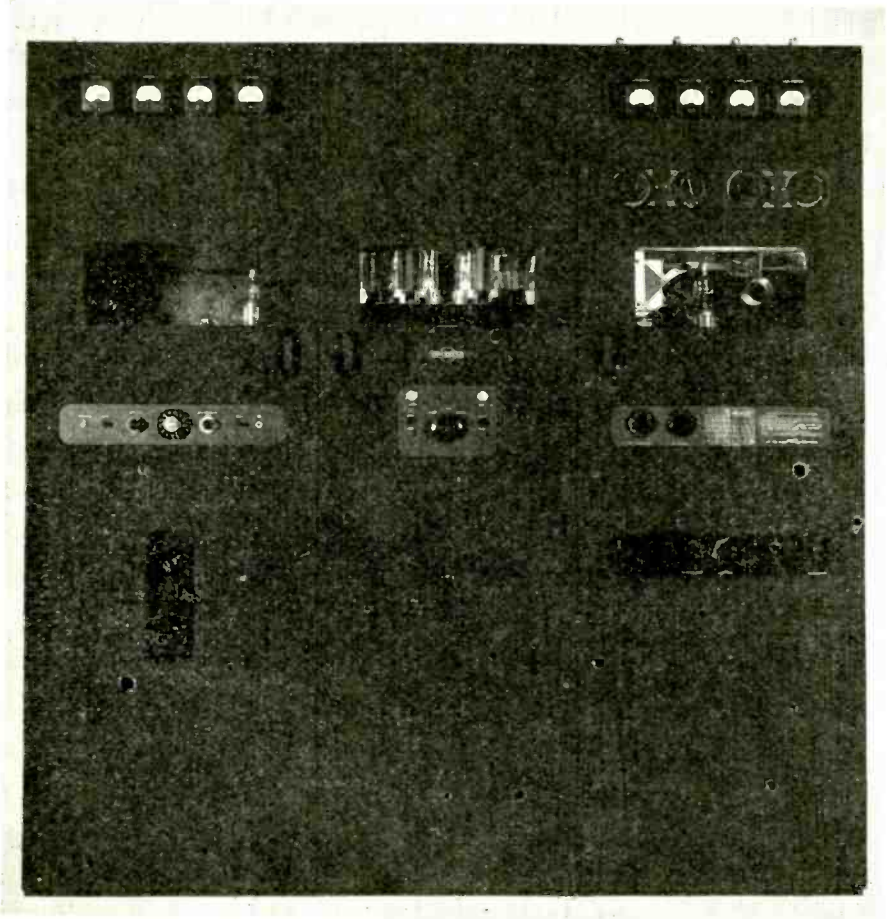


Fig. 14. Large, heavy-duty ground station transmitters may also be remotely tuned to preset frequencies with aid of singleturn and multiturn autotune heads. Tuning becomes unskilled operation

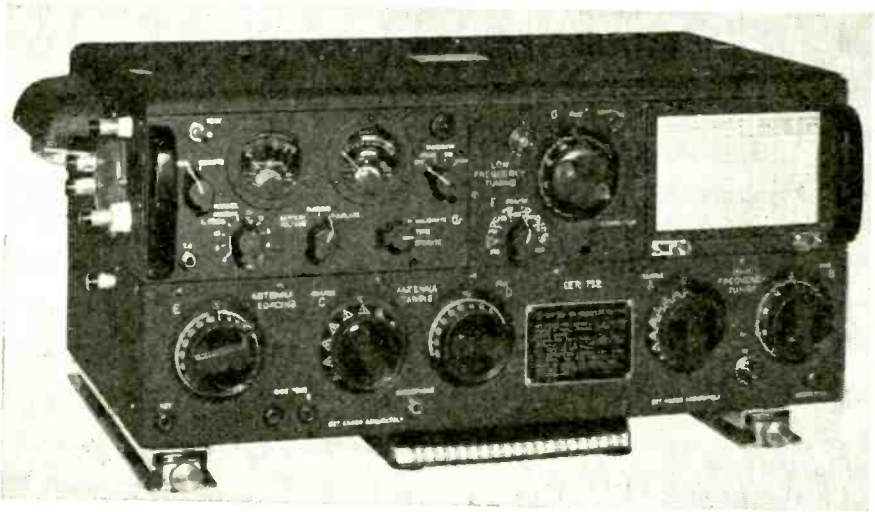


Fig. 15. Earlier model of aircraft transmitter, using autotune system. Driven devices are switches, capacitors, variometers, and a permeability-tuned oscillator. Slug is moved on rotating screw

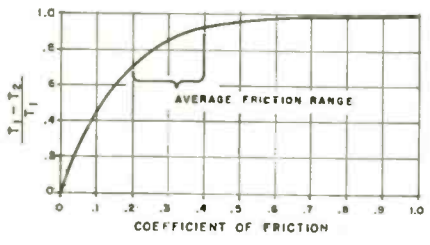


Fig. 16. Relation between torque and coefficient of friction in de-energizing type of torque clutch

stop type of positioner and the control system described above. The motor used in the control system is also used to drive the positioner, through a torque limiting clutch. The pawls are controlled by cams which are driven from the same shaft that drives the seeking switch. The cams are positioned in the same manner as is the seeking switch, and are synchronized with it. Only the pawl which corresponds to the seeking switch position is operative. The other pawls are lifted to clear their stop rings. A limit switch mechanism is added to the electrical circuit to insure that the positioned shaft will be turned far enough in each direction.

Autotune sequence

The operation of the Autotune system is as follows (see Fig. 9):

1. The selector switch (which may be at a remote point) is manually turned to a position corresponding to the desired preset position of the positioned shaft.
2. The motor starts turning the mechanism in the direction of the arrows, and by means of the ratchets drives the seeking switch and cam drum. The clutch turns the positioned shaft toward the home or reference end of its travel.
3. The shaft comes to rest against the home stop. The clutch then slips, allowing the motor to continue running.
4. The limit switch is operated, allowing the motor to reverse as soon as the seeking switch finds the selected position.
5. The seeking switch finds the selected position and releases the relay reversing the motor. The cam drum and the seeking switch remain stationary. The controls are now set and the proper pawl is in position.
6. The shaft turns until the selected pawl engages its corresponding stop ring on the shaft. The positioning is now complete. The clutch slips as the motor continues to run.
7. The other limit switch operates and stops the motor ending the cycle.

The desired number of preset positions or channels dictates the number of pawl-stop ring-cam combinations used. These components (enclosed by dotted lines in Fig. 9) are all that must be repeated for each preset position. They are located side by side on the same shafts, with spacers between them.

When more than one positioned shaft is required, the clutch, pawls, stop rings, cams, and ratchet are repeated for each shaft. This combination is called an Autotune head. All electrical components exclusive of the motor and perhaps the relay are usually collected together in a control unit. Only one control unit and one motor need be used re-

(*Continued on page* 152)

1946 RADIO STATISTICS

Radio-electronic output and complete home set census. How production and use compare during past 24 years

Presented herewith are essential statistics of the broadcasting and allied electronic industries for the past 24 years. The compilation maintains the continuity of the publication of such vital data which was originated many years ago by the present publishers of "Electronic Industries" through the compilation of annual statistics and their appearance in the January issues of "Radio Retailing" and "Radio Today."

Current statistics are interesting by reason of the picture they present to show the manner in which the radio industry changed over night from one of the greatest peace activities to one of the greatest war activities and the already rapidly apparent reconversion back to production for peace-time civilian uses.

THE RADIO-ELECTRONIC INDUSTRY

Data Covers Year Ended December 31, 1945

	Total Investment	Annual Gross Revenue	Average Number of Employes	Annual Payroll
Radio manufacturers (1200)	$ 350,000,000	$3,000,000,000	350,000	$750,000,000
Radio distributors, dealers, etc.	280,000,000	200,000,000	100,000	150,000,000
Broadcasting stations (965) including talent costs	90,000,000	300,000,000	*20,000	55,000,000
Commercial communication stations	60,000,000	.....	15,000	7,000,000
Listeners' sets in use (56,000,000)	3,500,000,000	.....	.....	†350,000,000

Note: Manufacturers' gross revenue was almost entirely for Army-Navy radio-electronic production, which reached a peak rate of $4,623,000,000 per annum in the early part of 1945.

*Regular staff—not including part-time employes, artists, etc., who number at least 25,000 more.

†Annual operating expense for listeners' sets, for tube replacements, electricity, servicing, etc.

ANNUAL BILL OF U. S. FOR RADIO, 1945

Sales of time by broadcasters, 1945	$250,000,000
Talent costs	50,000,000
Electricity, batteries, etc., to operate 56,000,000 receivers	195,000,000
500,000 home receivers, at retail value	20,000,000
30,000,000 replacement tubes	35,000,000
Radio parts, supplies, etc.	70,000,000
Phonograph records, 170,000,000	85,000,000
Radio-set repairs, servicing	60,000,000
TOTAL	$765,000,000

CIVILIAN RADIO SETS IN USE IN UNITED STATES

	January 1, 1946
United States homes with radios	34,000,000
Secondary sets in above homes	12,000,000
Sets in business places, institutes, etc.	4,000,000
Auto radios	6,000,000
TOTAL sets in United States	56,000,000

PRODUCTION OF CIVILIAN RADIO EQUIPMENT — 1922 TO 1945

	Total Civilian Sets Manufactured		Total Civilian Tubes Manufactured		Automobile Sets Manufactured		Total Reception Equipment	Auto Sets in Use	Homes with Radio Sets	Total Radio Sets in Use in U. S.	At Close of
	Number	Value	Number	Value	Number	Value	Value	Number	Number	Number	
1922	100,000	$ 5,000,000	1,000,000	$ 6,000,000	.....	.....	$60,000,000	.....	260,000	400,000	1922
1923	550,000	30,000,000	4,500,000	12,000,000	.....	.....	151,000,000	.....	1,000,000	1,100,000	1923
1924	1,500,000	100,000,000	12,000,000	36,000,000	.....	.....	358,000,000	.....	2,500,000	3,000,000	1924
1925	2,000,000	165,000,000	20,000,000	48,000,000	.....	.....	430,000,000	.....	3,500,000	4,000,000	1925
1926	1,750,000	200,000,000	30,000,000	58,000,000	.....	.....	506,000,000	.....	5,000,000	5,700,000	1926
1927	1,350,000	168,000,000	41,290,000	67,300,000	.....	.....	425,600,000	.....	6,500,000	7,000,000	1927
1928	3,281,000	400,000,000	50,200,000	110,250,000	.....	.....	690,550,000	.....	7,500,000	8,500,000	1928
1929	4,428,000	600,000,000	69,000,000	172,500,000	.....	.....	842,548,000	.....	9,000,000	10,500,000	1929
1930	3,827,800	300,000,000	52,000,000	119,600,000	34,000	$ 3,000,000	496,432.000	.....	12,048,762	13,000,000	1930
1931	3,420,000	225,000,000	53,000,000	69,550,000	108,000	5,940,000	300,000,000	100,000	14,000,000	15,000,000	1931
1932	3,000,000	140,000,000	44,300,000	48,730,000	143,000	7,150,000	200,000,000	250,000	16,809,562	18,000,000	1932
1933	3,806,000	180,500,000	59,000,000	49,000,000	724,000	28,598,000	300,000,000	500,000	20,402,369	22,000,000	1933
1934	4,084,000	214,500,000	58,000,000	36,600,000	780,000	28,000,000	350,000,000	1,250,000	21,456,000	26,000,000	1934
1935	6,026,800	330,192,480	71,000,000	50,000,000	1,125,000	54,562,500	370,000,000	2,000,000	22,869,000	30,500,000	1935
1936	8,248,000	450,000,000	98,000,000	69,000,000	1,412,000	69,188,000	500,000,000	3,500,000	24,600,000	33,000,000	1936
1937	8,064,780	450,000,000	91,000,000	85,000,000	1,750,000	87,500,000	537,000,000	5,000,000	26,666,500	37,600,000	1937
1938	6,000,000	210,000,000	75,000,000	93,000,000	800,000	32,000,000	350,000,000	6,000,000	28,000,000	40,800,000	1938
1939	10,500,000	354,000,000	91,000,000	114,000,000	1,200,000	48,000,000	375,000,000	6,500,000	28,700,000	45,300,000	1939
1940	11,800,000	450,000,000	115,000,000	115,000,000	1,700,000	60,000,000	584,000,000	7,500,000	29,200,000	51,000,000	1940
1941	13,000,000	460,000,000	130,000,000	143,000,000	2,000,000	70,000,000	610,000,000	8,750,000	29,700,000	56,000,000	1941
1942	4,400,000	154,000,000	87,700,000	94,000,000	350,000	12,250,000	360,000,000	9,000,000	30,800,000	59,340,000	1942
1943	.....	.....	17,000,000	19,000,000	.....	.....	75,000,000	8,000,000	32,000,000	58,000,000	1943
1944	.....	.....	22,000,000	25,000,000	.....	.....	85,000,000	7,000,000	33,000,000	57,000,000	1944
1945	500.000	20,000,000	30,000,000	35,000,000	.....	.....	105,000,000	6,000,000	34,000,000	56,000,000	1945

Figures for sets include value of tubes in receivers. In normal years replacement tubes have run 25% to 40% of total tube production. All figures are at retail values.

ULTRASONIC VIBRATIONS

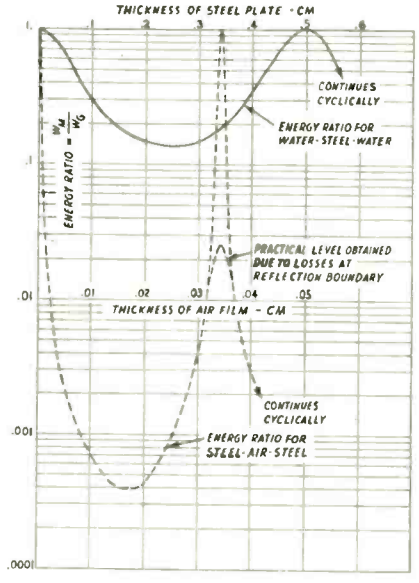
Process provides method of detecting flaws and discontinuities in wide variety of metals and extruded products

• A large field of application has been uncovered by developments during the last few years using ultrasonic vibrations. Several different principles have become useful in this work. In some places the *attenuation* of sound waves has been utilized where the losses over a certain travelled distance in normal material is compared with that found for the material under investigation. In other applications the *echo time* to the opposite surface of the media or to a fissure or obstruction is encountered. Sound travels at a fairly predictable rate in such media so that the echo time for travel to and from a reflecting surface in that media can be readily analyzed. This application has been used with good success from distances of many miles, exemplified by the sonar detection of submarines, to a matter of a few thousandths of an inch in the location of the net of a discontinuity in metallic sheets or in place of other materials. In still other tests the *travel time* of ultrasonic waves through the media is a good indication of some of the properties of the material. All of these methods offer much promise in the field of nondestructive industrial testing.

An application of the first method mentioned involving the measurement of attenuation characteristics found in the transmission of ultrasonic waves through sheet material has been disclosed by the Brush Development Company. This equipment, called the "Hypersonic" analyzer, was primarily developed for the inspection of voids, flaws or the inclusion of foreign material in the powder sticks used in rocket projectiles. The process has, however, proven of value in the inspection of flaws and discontinuity in many products and in various industrial fields.

The method is one whereby a sound generator sends a beam through a specimen. The specimen, depending on its properties, modifies the beam and the resulting energy pattern is picked up on the side opposite the generator by means of a microphone. By selecting a critical set of transmission frequencies and electro-acoustic designs of the terminal equipment the resultant beams through the material can be highly attenuated by particular types of flaws in any material having a constant cross-section, such as those obtained by means of rolling and extruding. The material is examined continuously as it traverses between the generator and its associated pickup.

Fig. 5—These curves show the energy ratio for various thicknesses of steel immersed in water



The three essential parts of a hypersonic analyzer are, one or more piezoelectric crystal transmitters, with associated source of high frequency oscillations, the same number of piezoelectric crystal receivers with amplifier systems, operating into signalling or marking devices.

A transmitter and receiver unit are usually identical in construction. A typical form is shown in Fig. 1. The transmitter produces ultrasonic waves through the material which are picked up by the receiver. A constant transmission loss is encountered until flaws, defects or a definite change in density come along as the material passes by.

Fig. 2 shows the associated oscillator and amplifier equipment. A

Fig. 3—A Brush 6-channel magnetic direct inking oscillograph showing Penmotors in position. These units give full scale deflection on 15 volts

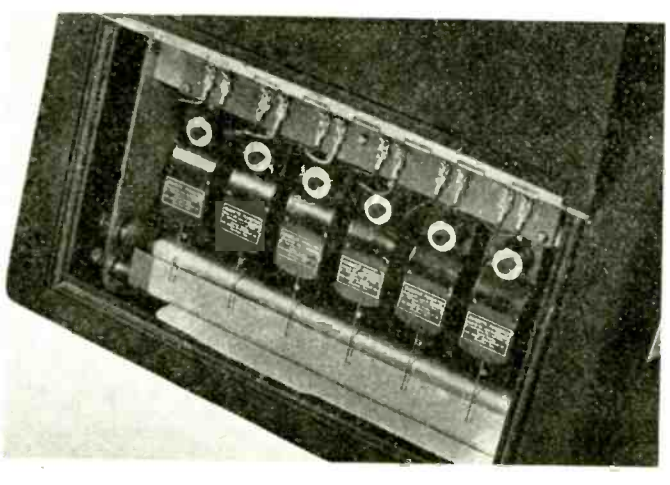
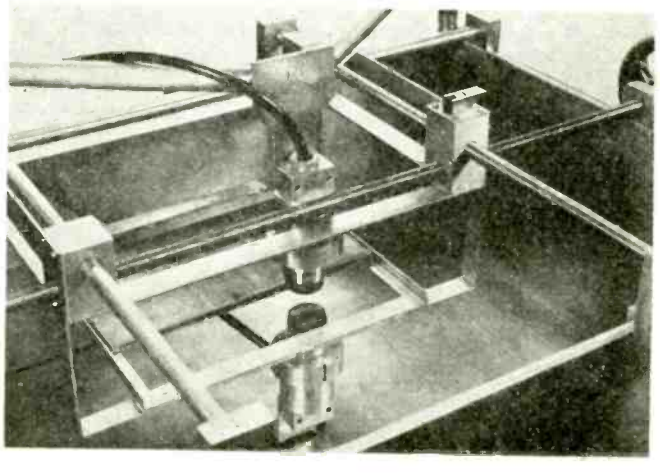


Fig. 4—Shows a test tank where position of the transmitter and receiver pair is controlled over and under the specimen by screws



REVEAL HIDDEN FLAWS

group of crystal driven pen oscillographs as in Fig. 3 are used. A given pair of units will "watch" a strip of material from a fraction of an inch wide to several inches, depending on the desired minimum size of the flaws whose positions must be exposed. A number of separate channels are, therefore, provided to cover wide strip stock. In these figures a six channel unit is depicted. A test tank setup is seen, showing two crystal units in place whose position in both coordinates can be moved by lead screws connected to hand wheels.

Changes from its normal homogeneous condition, or flaws, will change the energy level in the microphone. This in turn operates a relay which either marks or rejects the flaw or section of material. The frequency of operation normally lies in the region between 50 and 1000 kc per sec.

Generally speaking, the use of a liquid such as water as the transmitting medium is desirable in hypersonic inspection. The reason for this is that fluids such as water and oil give better impedance matching between each piezoelectric unit and the material under inspection than an air to metal junction does. However, in certain instances air or other gases make a satisfactory transmitting medium. The choice of medium depends upon the particular material being examined and also the physical possibility of exposure of the material to the medium.

The hypersonic method detects flaws associated with two physical properties of the material: an apparent change in density and/or an

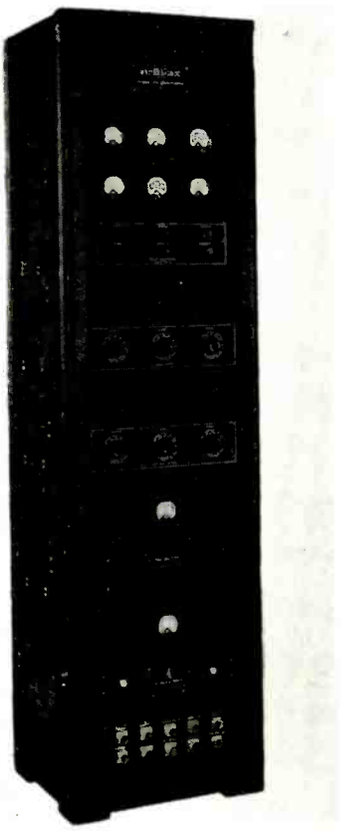


Fig. 2—A six panel "Hypersonic" analyzer control panel

apparent change in the modulus of elasticity. Since a single reading or relay operation is obtained, the method does not distinguish as to which property is changed but indicates that either one or both have changed. Since the hypersonic method is sensitive to the changes in modulus of elasticity an advantage over x-ray is found when it is necessary to search for the type of flaws which are thin slits or cracks in the material, where the change in total mass is negligible. At the separation junction the effective modulus is obviously small and the sonic method, will give sensitivity detections of this type where the thickness of the slit or crack is as small as 0.001 in.

Separations in tires are another example of this type of flaw. The rubber jacket blisters away from the cotton fabric and a thin air packet lies in between. Poor joints which occur in processes like cycle-welding are detectable by hypersonic sound beams.

When a beam of sound energy is directed through a sheet of steel immersed in water, the ratio of energy in the water on the microphone side of the beam to the energy on the generator side of the beam is.:

$$\frac{W_m}{W_g} = \frac{4\ R_1R_2}{4\ R_1R_2 + (R_1 - R_2)^2 \sin^2 Kl}$$

where

W_m = Energy on the microphone side

W_g = Energy on the generator side

$R_1 = \sqrt{E_1 r_1}$ where E_1 is the modulus of the water and r_1 is the density of water

$R_2 = \sqrt{E_2 r_2}$ where E_2 is the modulus of the steel (omitting sheer modes) and r_2 the density of steel

$K = \frac{2\pi}{\lambda}$ where λ is the wavelength of the sound in the steel

l = the thickness of the steel sheet

Two cases will be examined; namely, the transmission from water to steel to water, and steel to air to steel. In Fig. 5 the ratio of

(Continued on page 164)

Fig. 6—A typical application is an automatic scanner set up for continuous inspection of strip material

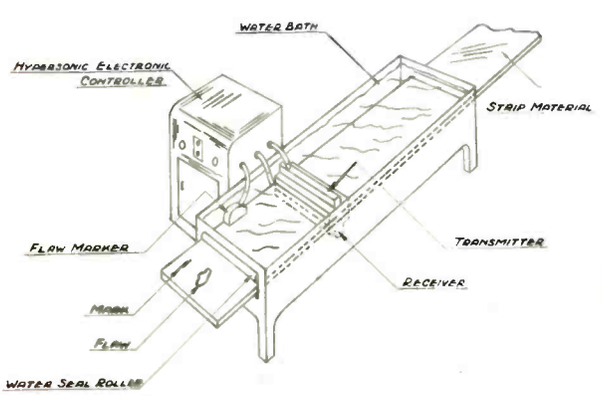
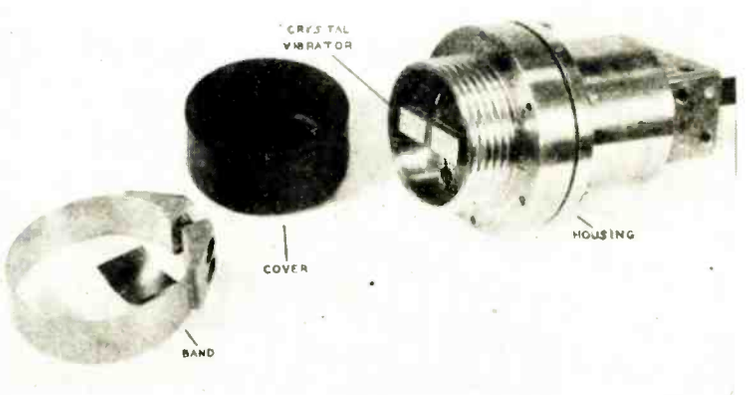


Fig. 1—A crystal vibrator in its water-proof housing. Identical units are used both to generate the vibration and to pick up the vibration transmitted



THEORY OF MAGNETRON

By H. GREGORY SHEA
Associate Editor, Electronic Industries

The action of the magnetron can be compared crudely to that of a synchronous generator with an electron rotor

● To the prewar engineering fraternity, tubes whose overall space requirements are no more than 13 in. square, capable of putting out power pulses of 500 kw or more at wavelengths of 10 centimeters would have been considered dreams of the superman school of writers.

However, such tubes actually are in use in large quantities for radar sets. In fact, at longer wavelengths, even larger tubes up to 8,000 kw have been developed. Of course it must be realized that the duty cycle is quite short, the tubes being turned on for only one microsecond in a 1,000 microsecond time interval. The tubes therefore are cooling off most of the time, and their average power output is 1/1000 of their peak pulse power.

Briefly, the cavity magnetron consists of an indirectly heated cathode sleeve placed in the center of an even number of radially disposed cavities in a copper block (Fig. 1). A high negative voltage is applied to the cathode, the cavity copper block (anode) being kept at ground potential. The cathode is heated by a filament and emits electrons which are attracted to the anode. At the same time, a constant magnetic field is applied along the axis of the cathode sleeve. This causes the electrons to follow a curved path in going from the cathode to the anode. If the magnetic field is strong enough, the electrons will not reach the anode but will curl right back to the cathode. Fig. 2 shows this condition. The lower figure is a developed view of the magnetron shown as though it were cut apart radially and flattened out. This view will be used throughout the following discussion:

Assume that there exists in the

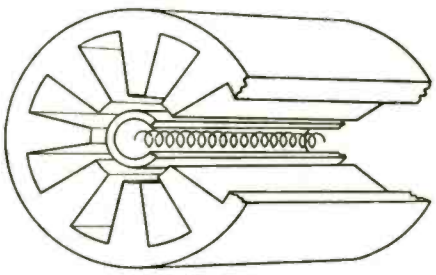
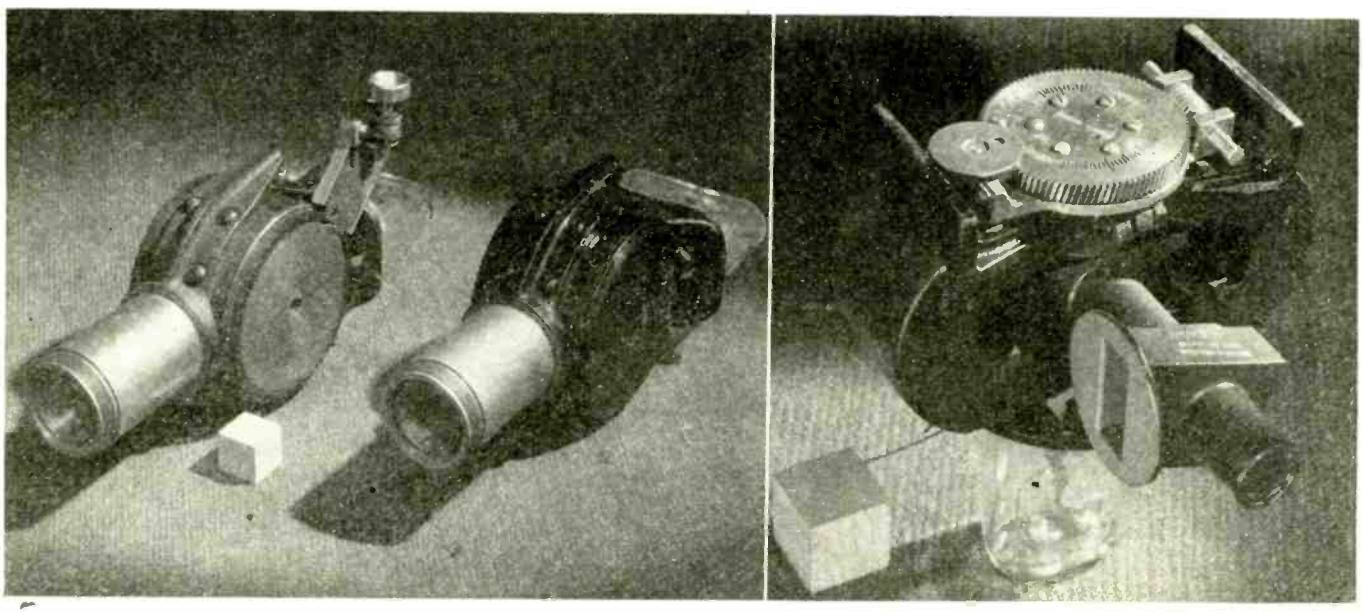


Fig. 1. Cut-away of an eight cavity magnetron

cavities shown in Fig. 3(a) a high frequency electromagnetic field whose electric component at some instant is distributed as shown in the first cavity, being strongest at the lower edge where the potential is high and dying away to zero at the back of the cavity where the current density is high and the voltage zero. Let there be a cloud of electrons moving in a curved path from the cathode surface as shown. It may be seen that the electric field in the direction shown will slow down the electrons since it exerts a force on them equal to the product of the field E and the electron charge e. Since the electrons have been slowed down, they have given up some of their kinetic energy. This energy has gone to strengthen the rf field.

Another way of looking at this process is to remember that under the influence of an electric field, electrons, in a vacuum, will be accelerated by the force of the field, thereby acquiring energy from the field. If instead of being accelerated they have a motion to begin with

Tunable types of cavity magnetrons produced by Bell Telephone Laboratories. As more microwave frequencies were used the fixed frequency tubes types became too numerous. The tuning through the vacuum seal of the tube is by a capacity ring or "crown of thorns," diaphragm actuated



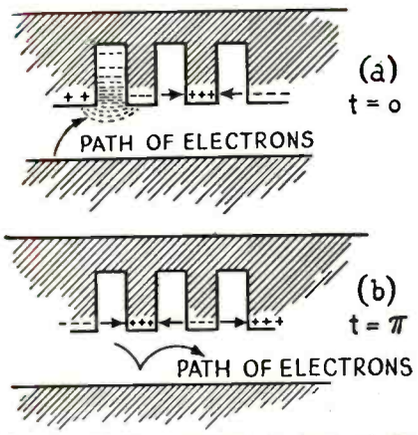


Fig. 3. Electrons crossing in front of the cavity mouths are retarded by opposing fields

and are decelerated by another and reverse electric field, they would lose energy to it.

Now if the velocity of the electrons, and the period of oscillation of the field in the cavity and the distance from one cavity to the adjacent one are such that after the electrons have passed cavity number 1 where they lose energy, they arrive at cavity number 2 just when the field has reversed from positive to negative, they will meet the same conditions at this second cavity as they met a moment earlier at the first. They will meet a field which will retard them further and to which they give up some more of their energy. This is shown in Fig. 3 where they reach the first cavity at (a) and the second ½ wavelength later at (b). Obviously not all electrons are in proper phase position to follow this path, but there is fortunately a bunching effect due to the field curvature.

The result of this process is that the electrons describe a path somewhat as shown in Fig. 4 losing energy as each cavity is passed. By this means the cavities are all set into oscillation.

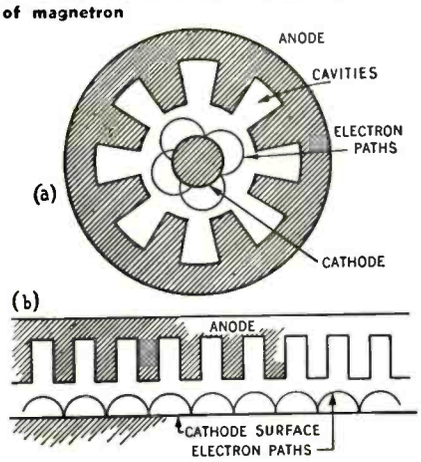
For this process to take place there must, of course, be an even number of cavities. When oscillations are set up so that each cavity is 180° out of phase with its neighbors, the oscillation is taking place in what is known as the π mode. Oscillations also can take place when the phase difference between adjacent cavities is some other number of degrees and there is any number of cavities, odd or even. In fact, if N is the number of cavities, oscillations can take place when the cavities are at phase angles equal to $2\pi n/N$, where n is called the mode number and may be any integer, positive or negative, equal to or smaller than N/2. While greater numbers are possible, the modes naturally begin repeating at 180°.

The glass tube which surrounds the heater and cathode leads, insulating them from the metal parts, is called a boot. At its outer end it sometimes terminates in a corona shield, particularly in high voltage tubes.

The tube is set into oscillation by the application of a dc pulse to the cathode sleeve. The rise and decay times of these pulses must be short, as otherwise the tube would operate too long and the cathode would burn up as in operation there is much back bombardment by the electrons returned to the cathode.

In the exploded view of tube 2J48, the output is taken off by means of a small loop placed in the right hand cavity so that the magnetic portion of the resonant electromagnetic field in the cavity passes through the loop. In this way a current is induced in the loop. The case and cylindrical tube fitting over the glass output tube at the right of the magnetron form the outer portion of a coaxial line, and the wire inside the glass tube is connected to the output loop in the cavity and forms the central coaxial conductor. This conductor lies across the open end of the rectangular wave guide shown in the middle of the photo. This is the region of greatest electric field strength for transverse electric 0, 1 waves in the guide and thus the latter is excited in this fundamental mode. The

Fig. 2. The path of the electrons curled by the magnetic field going into the page is shown at (a), while (b) is a split open view of magnetron



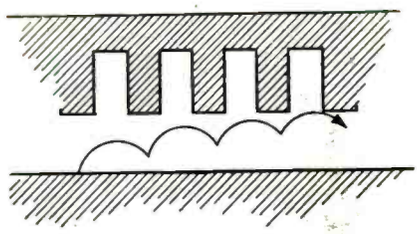


Fig. 4. Simplified version of the path of an electron as it passes successively by the anode cavities, losing energy at each cavity mouth

short cylinder at the right of the rectangular wave guide connection flange is made the correct length to match the output to the wave guide. The glass enclosures, of course, are to maintain vacuum.

One of the principal troubles encountered in the design of magnetrons is in maintaining mode stability. This leads to an investigation of the relation of mode numbers to wavelength, and such a relation can be obtained fairly easily to a good degree of approximation.

Each of the resonant cavities may be represented by an impedance Z_a as shown in Fig. 5, while the anode to cathode space between the cavities—mainly a capacity—can be represented by an impedance Z_b. The result of such an equivalent circuit is the well-known transmission line with lumped impedances.

It can be shown that the currents in any mesh K of this circuit are related to the currents in a reference mesh by the equations

$$I_k = I\epsilon^{j\Gamma k} \qquad (1)$$

$$J_k = J\epsilon^{j\Gamma k} \qquad (2)$$

$$I = I\epsilon^{j\Gamma} + J \qquad (3)$$

Taking currents around a mesh

$$Z_a\epsilon^{j\Gamma}I + Z_b\epsilon^{j\Gamma}J - Z_bJ = 0 \qquad (4)$$

$$J = \frac{Z_a\epsilon^{j\Gamma}}{Z_b - Z_b\epsilon^{j\Gamma}}I \qquad (5)$$

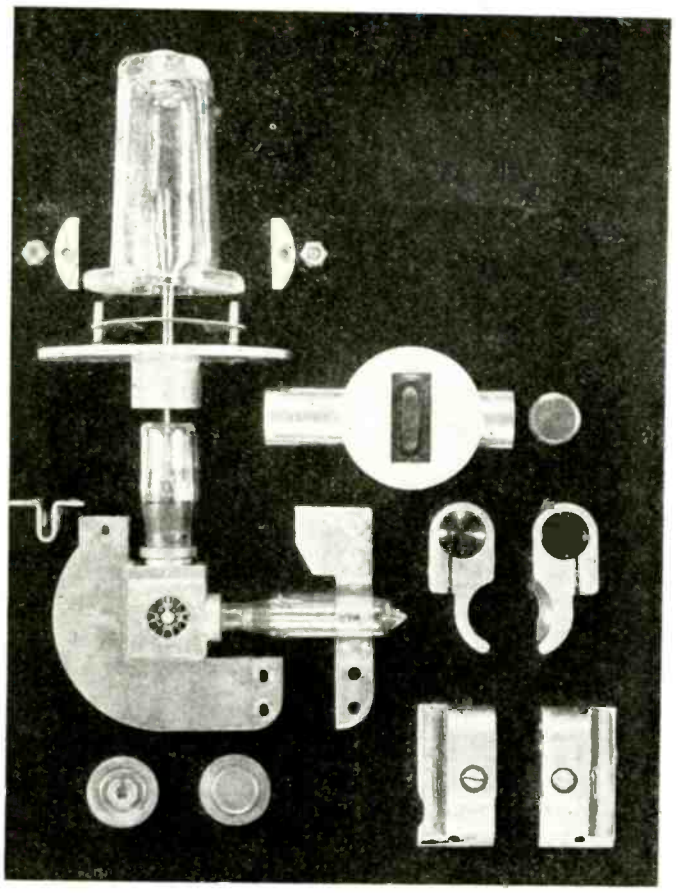
Substituting (3) in (5), one obtains

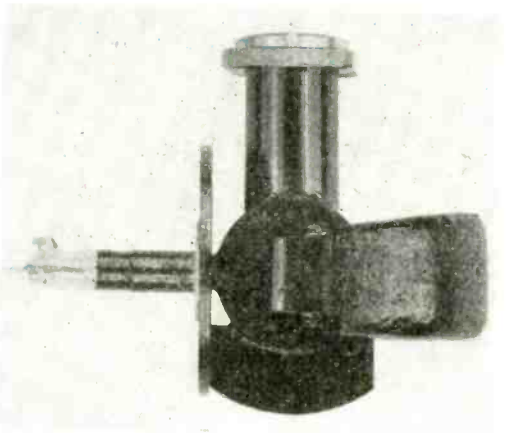
$$1 = \epsilon^{j\Gamma} + \frac{Z_a\epsilon^{j\Gamma}}{Z_b - Z_b\epsilon^{j\Gamma}} \qquad (6)$$

$$(1-\epsilon^{j\Gamma})Z_b(1-\epsilon^{j\Gamma}) = Z_a\epsilon^{j\Gamma} \qquad (7)$$

$$Z_b(\epsilon^{-j\Gamma} - 2 + \epsilon^{j\Gamma}) = Z_a \qquad (8)$$

$$1 - \cos\Gamma = -\frac{Z_a}{2Z_b} \qquad (9)$$





Type 2J39 package magnetron above. This tube is capable of delivering 12.5 kw of peak power under pulsed conditions. It has a fixed frequency within the range 3267-3333 mc and normaly has a cathode input of 5.4 kv and 5 a. It weighs 1 lb. 15 oz. including the integral magnet. At left, exploded view of type 2J48 strapped 3 cm magnetron. At the top is the glass boot, or insulator for the high voltage cathode leads to which the dc pulses are applied. Below that is the mounting flange. Then comes the cathode lead glass-to-kovar seal, and then the main body of the magnetron with the large heat radiating fin. The 12 small cavities may be seen. The cathode is in the center, with its leads directed upwards. The two circles around the cathode are the straps which connect alternate cavity barriers together thereby increasing the cavity mouth capacitance. These account for the small dimensions of the cavity. The output glass-to-kovar seal tube is shown protruding horizontally to the right, while the metal tube shown above fits over it and has the rectangular wave guide opening and flange

Now since there are N cavities or sections in this simulated transmission line, after which one returns to the starting point, the exponent gamma can be equated to

$$\Gamma = \frac{2\pi n}{N} \qquad (10)$$

where n is the mode number mentioned earlier.

As an approximation, the gap at the mouth of the cavity where the electric field is strong can be represented by a capacity C, and the rear where the field is zero, but a current circulates, can be shown by an inductance L, the two in parallel being equivalent to Z_a. On the other hand Z_b can be closely represented by a capacity C*. Then the impedances are

$$Z_a = \frac{j\omega L}{1-\omega^2 LC} \qquad (11)$$

$$Z_b = \frac{1}{j\omega C^*} \qquad (12)$$

By substitution and algebraic manipulation, the value Z_a/Z_b found in (9) results in

$$\omega^2\left(LC+\frac{1}{2}\,\frac{LC^*}{1-\cos\frac{2\pi n}{N}}\right) = 1 \qquad (13)$$

If we then let

$$LC = \frac{1}{\omega_o^2} \qquad (13a)$$

$$\omega^2 = \frac{\omega_o^2}{1+\frac{1}{2}\,\frac{C^*/C}{1-\cos\frac{2\pi n}{N}}} \qquad (14)$$

Dividing by $(2\pi c)^2$ and finding the reciprocal of both sides, or the wave length,

$$\lambda^2 = \lambda_o^2\left(1+\frac{C^*}{2C}\,\frac{1}{1-\cos\frac{2\pi n}{N}}\right) \qquad (15)$$

and n can be equal to any integral value from 0, ±1, ±2 to $\frac{N}{2}$

$$\text{if } n = 0,\ \lambda = \infty \qquad (16)$$

$$n = \frac{N}{2},\ \lambda = \lambda_o\sqrt{1+\frac{C^*}{4C}} \qquad (17)$$

A plot then of the wavelength vs. the mode number can be made as shown in Fig. 6.

It can be seen from this that the wavelength changes very little for the last few modes before the pi mode and it is in this region that instability can occur. Furthermore, since all mode numbers except $\frac{N}{2}$ can be either positive or negative, the tube tends to oscillate in two modes simultaneously with the production of standing waves. Poor efficiency results.

Fig. 6. Plot of wavelength vs. mode number

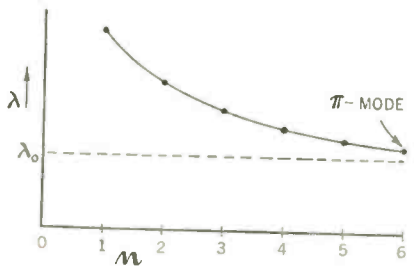
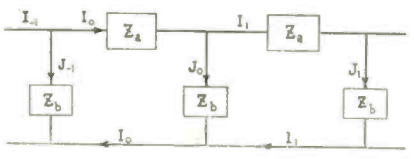


Fig. 5. The cavities are the impedances Z_a and the anode to cathode capacities are Z_b



As stated previously, the operation of the magnetron depends on field strength and applied voltage. Other parameters are also of great importance, and an equation has been developed by Hartree to relate these factors. This is stated in dimensionless quantities as

$$\frac{V}{V_o} = \frac{2H}{H_o} - 1 \qquad (18)$$

where

$$V_o = 2.5 \times 10^3 \left(\frac{D_a}{n\lambda}\right)^2 \text{ k.v.} \qquad (19)$$

$$H_o = \frac{21,400}{(1 - s^2)\, n\lambda} \text{ gauss} \qquad (20)$$

$$S = \frac{Dc}{Da} \qquad (20a)$$

Dc = Cathode diameter (20b)

Da = Anode diameter (20c)

This means that certain physical dimensions, frequency and mode number will determine a voltage and field V_o and H_o. Any change in field to a new value H will require a corresponding voltage change to V in order that frequency and mode may be maintained. The results of this equation may be plotted on a curve of voltage vs. field intensity for constant wavelength as shown in Fig. 7.

From this it is apparent that the tube should operate in the mode determined by the applied voltage. In general, best operation takes place in the pi mode. It is found however, that for instance in the 2J21 tube with 12 cavities, the pi mode is 6 but the best operation is obtained with mode 9.

The reason for this is that the field between the anode and cathode is not continuous around the circumference of the cathode, but occurs in steps with gaps at the cavity mouths. And since the shape of the field is that of a square wave whose step intensity varies when there are less than 180° between adjacent cavities, the Fourier analysis of this step field will show an infinite number of side waves of various intensities and mode numbers. Thus greater intensities may be reached at modes |n±NI| I being any integer. This is apparently what happens in the tube mentioned so that the preferred mode is |3—12| or 9.

Referring to the plot of Fig. 6 showing mode instability, it is clear that if some means could be found for making steeper the curve near the pi mode, better operation could be obtained. The scheme was therefore hit upon of connecting together alternate cavity barriers with a conducting ring or strap and having a second ring for the ones omitted by the first strap. Such a

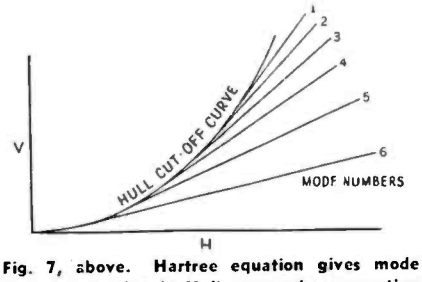
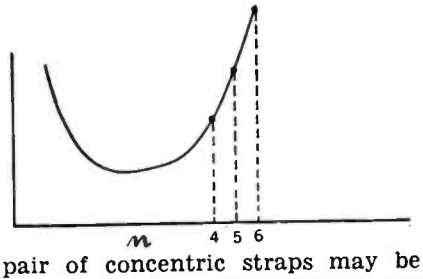


Fig. 7, above. Hartree equation gives mode lines terminating in Hull curve whose equation is $\frac{V}{V_0} = \left(\frac{H}{H_0}\right)^2$ Below, wavelength vs. mode number for strapped magnetron.



pair of concentric straps may be discerned in the picture of the 2J48 cavity. There is a similar pair at the other end of the anode.

Naturally it is only in the pi mode that alternate cavities would be 2 π degrees apart and hence always in phase. Furthermore, the capacity between the two straps sharply increases the equivalent mouth capacity of the resonant cavities and thereby greatly raises the resonant wavelength. The relation between the strapped and unstrapped wavelength is approximately

$$\lambda_{\pi S} = \lambda_{\pi U} \sqrt{1 + \frac{C_S}{C_U}} \qquad (21)$$

where

$\lambda_{\pi S}$ = Wave length in pi mode for strapped magnetron (21a)

$\lambda_{\pi U}$ = Same, unstrapped (21b)

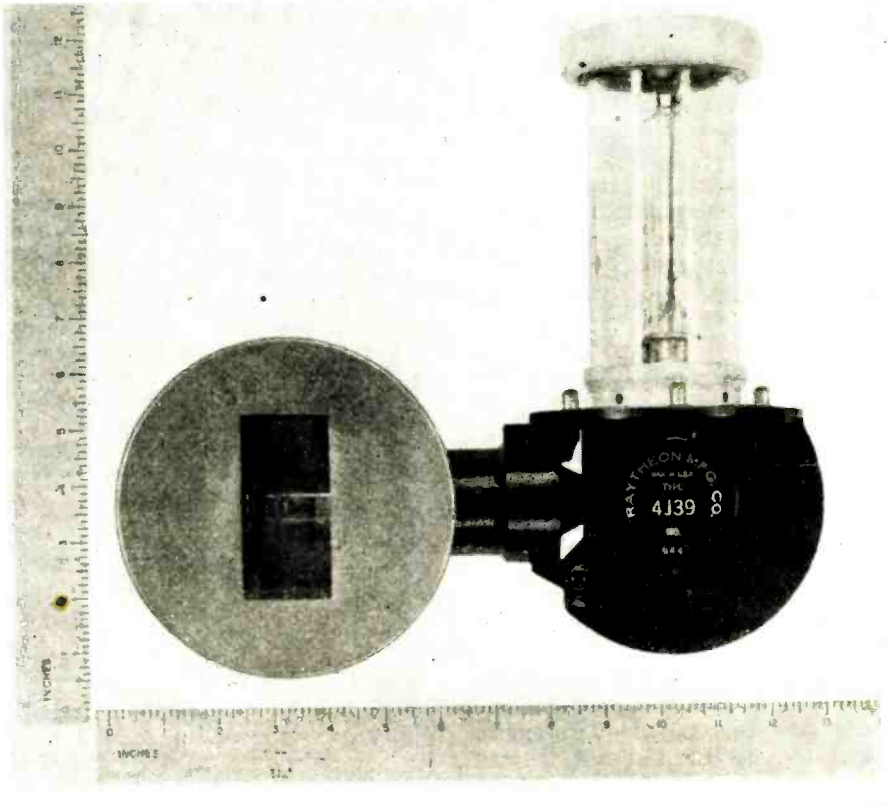
C_S = Equivalent strapped capacity (21c)

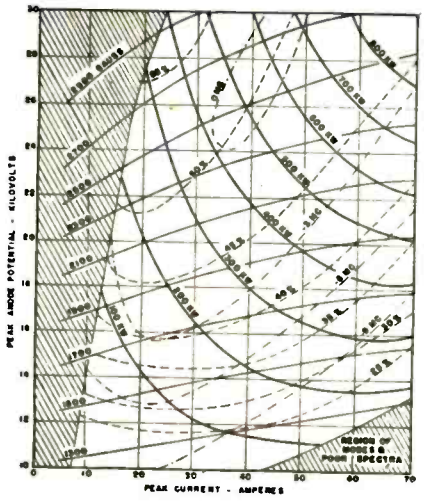
C_U = Same, unstrapped (21d)

The effect on the wavelength mode number curve is shown in Fig. 8, and it can be seen that the mode is now on such a steep curve that it may be maintained more easily. Also there results a better separation of the Hartree voltages. A difficulty is that the cavity size has to be reduced to the point where manufacturing becomes harder.

With regard to its type 4J36-4J41

Fig. C. High voltage tube able to deliver 850 kw peak pulse power with 30 kv dc pulses on the cathode. The wave guide output is at the left. Tube is provided with a corona shield at top





This diagram shows the average performance characteristics and defines the region in which the tube can be operated satisfactorily. It will be noted that the shaded portion of the diagram is marked as being a region of poor operation. The heavy horizontal lines are lines of equal magnetic field strength, while the heavy slanted lines are equi-power lines. The dot dash lines indicate lines of equal frequency deviation from normal, while the dash lines are lines of constant output efficiency. The close relationship between magnetic field strength and anode potential is demonstrated by the fact that these lines are nearly parallel. The region of high efficiency, about 50%, is near the top of the diagram and occurs with a field of from 2300 to about 2800 gauss at voltages from 21 to 29 kv. For this region the power output varies from 400 to 700 kw.

magnetron oscillator, Raytheon Mfg. Corp. States: "The Rieke diagram shows the power and frequency contours for a typical tube operating into a 1½x3x.080 in. wall wave guide with standing wave ratio and phase angle varied. The pulling figure at 1.5 ratio in voltage is 7.5 mc. It should be noted that this data is representative of average tubes and was taken under conditions simulating typical operating characteristics. Slight variations may be expected with different tubes in different systems.

"Satisfactory operation of the tube will depend largely on the waveform characteristics of the input voltage pulse and should fulfill the following conditions:

Voltage time of rise—0.1 to 0.2 microsecond
Voltage time of fall—less than 0.4 microsecond
current variation —less than ±10% of average pulse current

"A poor pulse shape may cause excessive frequency modulation and general instability.

"It is recommended that the magnetic field be produced between circular pole tips 1.5 in. in diameter separated by 1.5 in. and located concentrically along the axis of the tube. The tube should be operated with the north-seeking pole of the magnet adjacent to the cathode. Adequate forced air should be provided to keep the anode temperature of the tube less than 100°C.

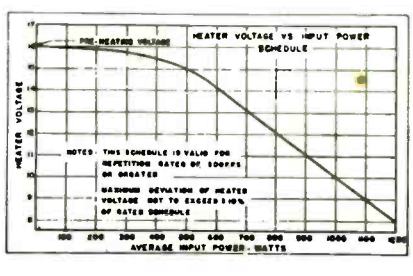
"The life of the 4J36-4J41 magnetron is limited by the usefulness of the cathode. In general, magnetron life is inversely proportional to pulse duration and duty cycle. It is therefore recommended that the tube be operated at a low recurrence rate when high peak power is required. The use of a transmission line not properly matched to the magnetron is another factor reducing the life of the magnetron. This is due to excessive cathode heating.

"The maximum ratings with respect to peak anode potential, peak anode current, and pulse duration, represent limiting values for each quantity independently. They do not form a set of values at which the tube can be satisfactorily operated.

"The 4J36-4J41 magnetrons evolve small traces of gas when stored for a period of time. This condition is particularly noticeable in tubes operating in the high voltage region. Since a temporary unsteadiness in operation may result, it is recommended that the tube be seasoned to the point where it again becomes stable, and normal operating values are obtained.

The writing of this article would have been impossible without the helpfulness and cooperation of certain eminent workers in the field whose wish it is to remain anonymous. Grateful acknowledgement is made herewith.

In the operation of a magnetron there is a considerable amount of back bombardment of the cathode by electrons which are at first attracted out by the positive anode and then curl back to the cathode. The level of energy while oscillations are taking place is quite high. As a consequence, although it is necessary to heat the cathode in order to get the tube started, it is found that once operation is under way the back bombardment tends to keep the cathode temperature up.



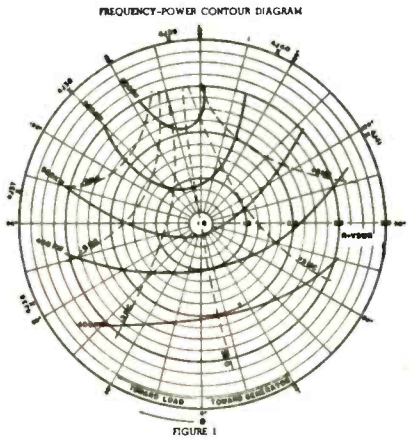


FIGURE 1

The frequency-power contour diagram usually known as the Rieke diagram contains a great deal of information about the tube. Angular measure around the diagram represents the distance in wavelength degrees from an arbitrary reference point (the output flange) to a voltage loop or node when the standing wave ratio is other than unity. The circles are lines of equal voltage standing wave ratio. The heavy black lines are equi-power lines, while the dotted lines represent lines of equal frequency deviation from the desired normal value. It can be seen that at 400 kw output the tube has great frequency stability under changes in load since mismatches of load which change the VSWR up to 2.5 only cause a frequency deviation of slightly more than 3 mc. At higher power on the other hand, the frequency change (frequency pulling) is much more rapid and reach much greater values (6 mc).

"The type 4J36-4J41 magnetron tube is a super-high frequency oscillator with internal resonant circuits, designed to operate in the 10 centimeter band and capable of delivering 850 kw of peak power under pulsed conditions. General characteristics are:

Indirectly heated, oxide coated, unipotential cathode.

Heater voltage	16.0	v
Heater current	3.1	a
Minimum heating time	2	min.

Maximum Ratings

Heater voltage	16.01±0%	v
Peak anode voltage	30	kv
Peak anode current	70	a
Maximum duty cycle product	.001	
Maximum pulse duration	2.5	microseconds
Average input power	1200	w
Frequency pulling (at a standing wave ratio of 1.5 in voltage)	10	mc
Anode temperature	100°	c.

"The tube should not be operated longer than 5 microseconds in any 100 microsecond interval."

Typical Operation

Magnetic field intensity	2300	gauss
Recurrence frequency	400	pulses per second
Pulse duration	1	microsecond
Peak anode voltage	24	kv
Peak anode current	43	a
Peak power output	490	kw
Maximum frequency change due to temperature	.07	mc./°C.

Frequency (fixed frequency in the following range):

	mc
4J36	3650—3700
4J37	3600—3650
4J38	3550—3600
4J39	3500—3550
4J40	3450—3500
4J41	3400—3450

PROPOSED TEST COILS

Tentative standards for testing permeability and Q of powdered iron core slugs 3/8 in. in diameter and 3/4 in. long

● For the testing of compressed powdered iron cores, a new set of eight standard coils covering a frequency range from 100 kc to 100 mc has been proposed to the RMA committee on standardization of this item and workers in this field have been using this set although it has not been adopted officially.

The purpose of the coils is to test the standard iron slugs of 3/8 in. diameter, 3/4 in. length to nearly their best advantage so that the Q measured, although not necessarily the highest obtainable with any coil, is largely due to the iron itself. The appended table shows the characteristics of the coils and the winding data.

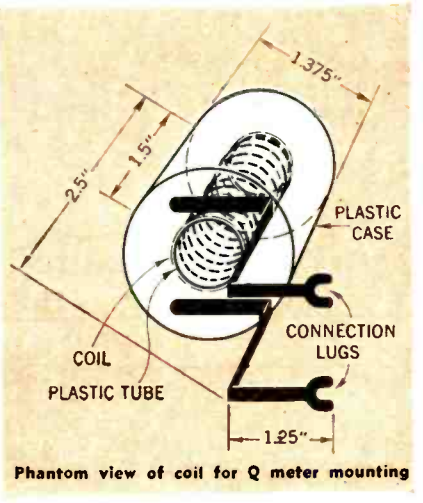
The standard coils should be accurate to 1% of inductance and 5% in Q at the listed frequencies. The following are the test frequencies for cores: 100 kc; 200 kc; 500 kc; 1 mc; 2 mc; 5 mc; 10 mc; 20 mc; and 100 mc; the latter on an ultra high frequency Q meter.

For accurate measurement of Q on the Q meter it is recommended that cores be tested on those coils which produce higher capacity readings. For instance, the "200-500 kc" coil should be used for test at 200 kc.

For determination of the effective permeability on the other hand cores should be tested with the coil producing low capacity readings. To test permeability at 200 kc, for example, coil "100-200 kc" is to be used. In this case the resulting reading is designated C_1. The core is then withdrawn and the condenser reset to C_a to resonate the coil without the core at the same frequency.

The effective permeability is $\mu_{eff} = \dfrac{C_a + C_d}{C_1 + C_d + C_{d1}}$ where C_d is the distributed capacity of the coil and C_{d1} is the increase of distributed capacity due to the iron core. The sum of $C_d + C_{d1}$ can be determined by resonating the coil with the core at half the frequency of measurement, 100 kc in the example. Then $C_d + C_{d1} = \dfrac{C_o - 4C_1}{3}$ $\mu\mu$f where C_o is the condenser setting at 100 kc.

For approximate results $\mu_{eff} = \dfrac{C_a}{C_1}$ within 5% accuracy.



Phantom view of coil for Q meter mounting

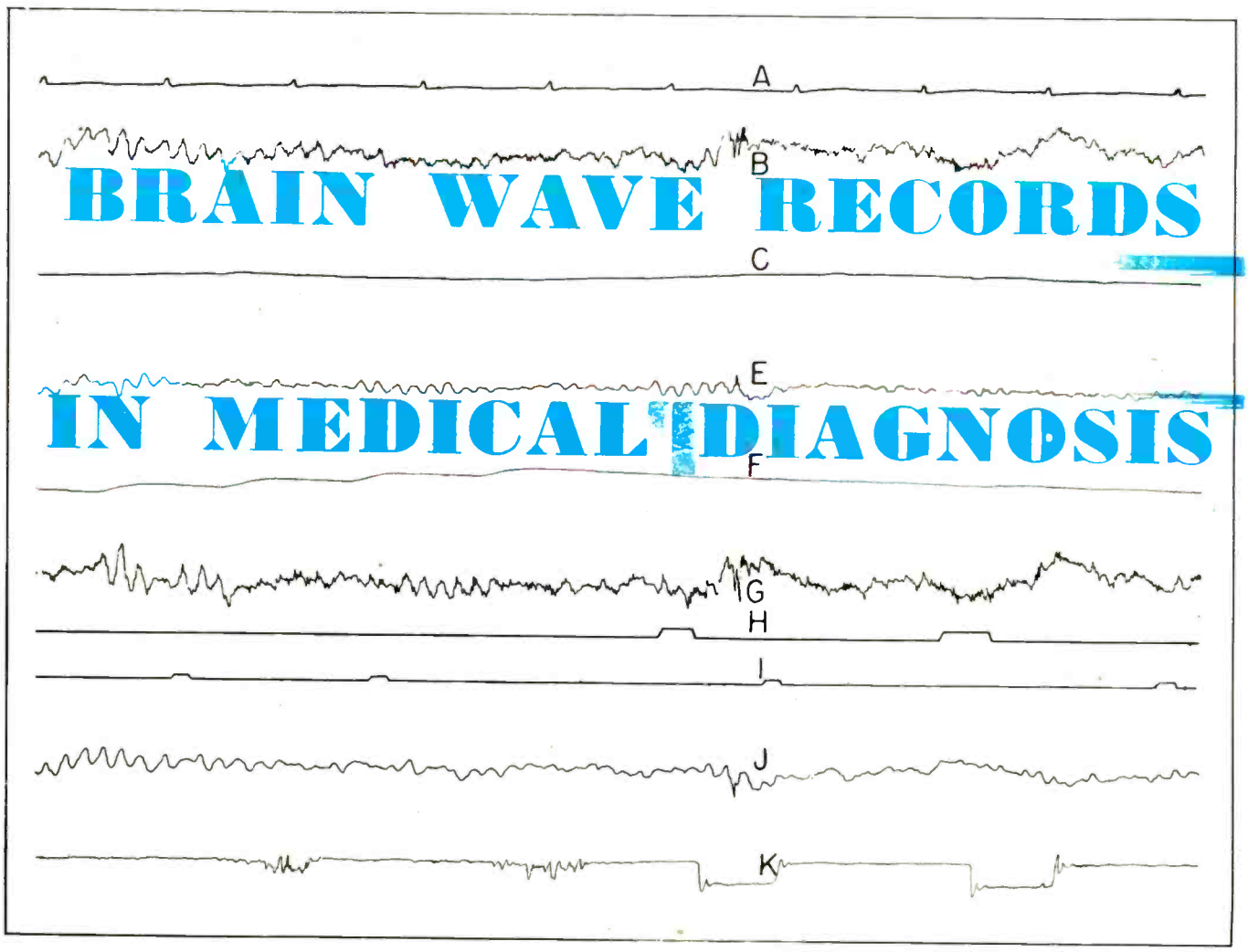
All coils are to be wound on a good quality dielectric tubing of 3/8 in. I.D. and of wall thickness .025 in. The coil windings are to be not to exceed 5/8 in. in length, bearing in mind that the longer the coil is, the more the core is utilized.

All test coils are to be provided with rigid lugs terminating in spades to fit Q meter binding posts and are to be anchored in suitable containers to provide mechanical protection. The total capacity of terminals and assembly should be kept as low as possible.

A set of six coils previously suggested was made with an outside bakelite covering and of the general design shown in the illustration.

Test frequency range with core	Air Coil Inductance in μH	Distributed Capacity (C_d) in $\mu\mu$f	Readings on Type 160A Q Meter		Windings
			Q	C	
100-200 kc	2,735	6.0	75 at 150 kc	406	3 universal pies 11/64 in. long, 200 turns of 6/42 SSE. Pies close together to length 17/32 in.
200-500 kc	446	3.7	95 at 500 kc	223	3 univ. pies 11/64 in. long, 85 turns of 6/42 SSE. Pies close together to length 17/32 in.
500-1000 kc	70.0	1.35	125 at 1000 kc	364	Progressively wound solenoid, 120 turns 15/44 SSE 5/8 in. long
1-2 mc	16.5	1.6	115 at 2 mc	385	Solenoid, 56 1/2 turns of 15/44 SSE 5/8 in. long
2-5 mc	5.0	2.8	80 at 4 mc	320	Solenoid, 28 turns of 25/41 SSE, 5/8 in. long
5-10 mc	.85	2.6	142 at 10 mc	310	Solenoid space wound 11 1/2 turns #18 enam. 5/8 in. long
10-20 mc	.338	2.3	140 at 20 mc	185	Solenoid space wound 6 1/2 turns #18 enam. 5/8 in. long
20-50 mc and 50-100 mc	.128	2.3	190 at 40 mc	110	Two parallel spaced windings each 3 1/2 turns #14 TC 5/8 in. long

BRAIN WAVE RECORDS IN MEDICAL DIAGNOSIS



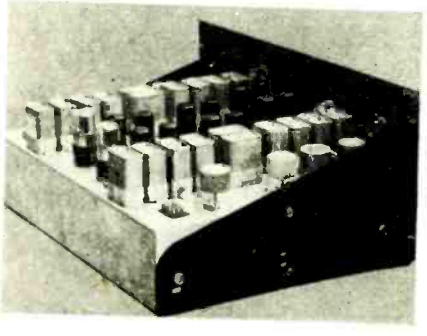
Typical record of multi-channel recordings showing records from which a correlation between brain waves and other organ functions can be made

● The term "electroencephalogram" (EEG) is generally taken to refer to a continuous record of the electrical potential variations which exist on the surface of the scalp as the result of electrical activity in the brain. The EEG voltage probably results from a synchronous and relatively slow discharge of a large number of brain cells, all located within a small region.

The voltage variations existing right at the cells themselves are quite large—perhaps as much as a tenth of a volt. However, the volume occupied by these "active" cells is so small compared to that occupied by inactive cells, connective tissue, etc., that most of the resulting electrical currents are "short-circuited" before they reach the surface of the scalp. It is probable that less than one thousandth part of the original voltage generated by the active cells is picked up by electrodes on the surface of the scalp, and recorded as an "electroencephalogram."

It will be clear that the largest electrical potentials will appear on the scalp near the region of the active cells, as there will be less "short-circuiting" of the EEG by neighboring inactive cells, etc. Thus a shift in the position of the activity within the brain will in general change the position at which the largest potentials are found. The diagnostician thus determines the active locus by "mapping" the surface of the scalp with a series of electrodes, picking up either simultaneously or alternately voltages at various points on the surface.

Fig. 1—A two-channel high-sensitivity push-pull amplifier suitable for handling the extremely low frequencies found with brain waves



Since the EEG voltage actually found on the surface of the scalp

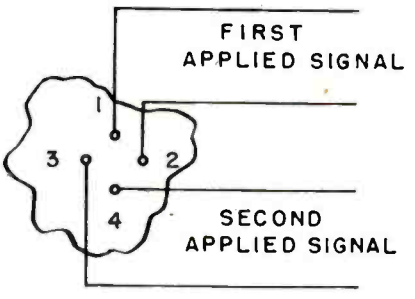
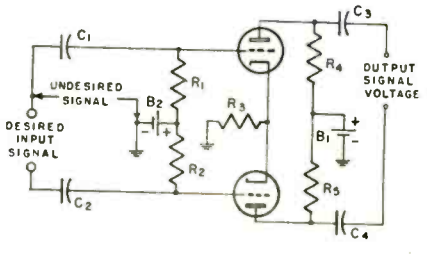


Fig. 2—Multiple contacts applied to the scalp may be used as pairs in many combinations. This means that no electrode must become the ground electrode in the amplifier, and requires push-pull amplification throughout. The first stage of such an amplifier is shown in Fig. 3 below. Balance is maintained in following stages

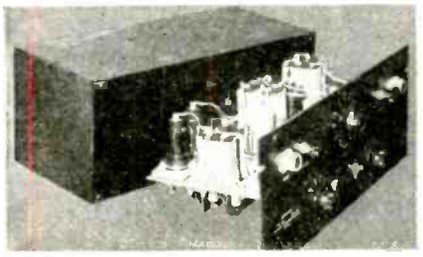


Electronic equipment for diagnosis and research provides useful tool for modernized studies of mental aberrations

By FRANKLIN OFFNER, Ph.D.,
Offner Electronics Inc., 5320 No. Kedzie Ave., Chicago

is very minute, to record it satisfactorily, it becomes necessary to use a high gain amplifier. After amplification, the result is made visible by the use of some form of electrical recorder, or indicator. Generally an ink-writing oscillograph is used, making a written record of the EEG immediately available.

In general, for each point on the scalp from which one wishes to obtain a record (or from each pair of points, in the case of differential recording, which will be described later) a separate electron tube amplifier and recording element is required. Thus by the "number of channels" in an electroencephalograph is meant the number of points from which simultaneous recordings can be taken.



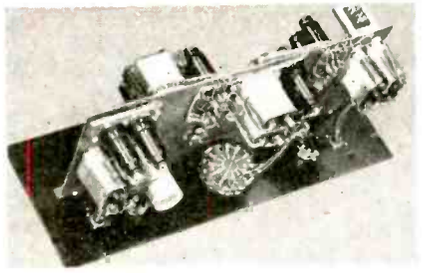


Fig. 4—Two views of a two-channel electroencephalograph amplifier. The rear cover contains shielded stalls which completely isolate the two channels and prevent feedback in the channels themselves

For electroencephalographic use it is customary to use several balanced or push-pull stages of amplification (generally four or five). Such an amplifier for two channels is shown in Fig. 1. The fact that the cathodes of all input stages (comprising inputs of several amplifiers) preferably are either grounded or kept at a constant voltage differential from ground, introduces a difficulty when voltages from various groups of electrodes are to be amplified simultaneously. This is illustrated in Fig. 2. Here four electrodes are to be used, recording in two pairs.

If now it is necessary to ground one terminal of each applied signal—for example, electrode 2 for the first applied signal and electrode 4 for the second applied signal—we are connecting together electrodes 2 and 4 and a wrong electroencephalogram would be obtained, as the signal voltage at electrode 4 would influence the signal from (2) and vice versa. It was necessary, therefore, to develop a balanced amplifier.

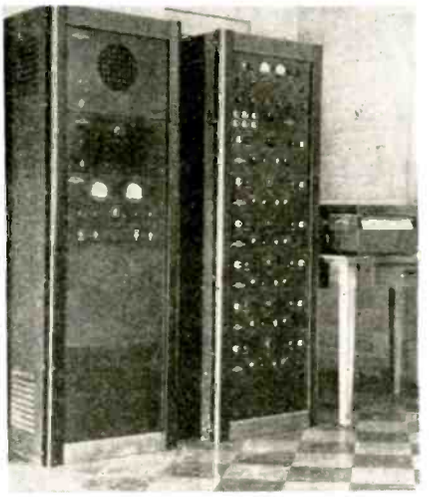


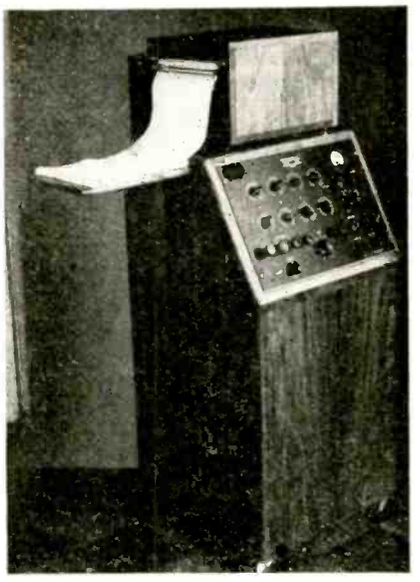
Fig. 6—The complete twelve-channel electroencephalograph suitable for diagnostic and research work as to mental and physical actions

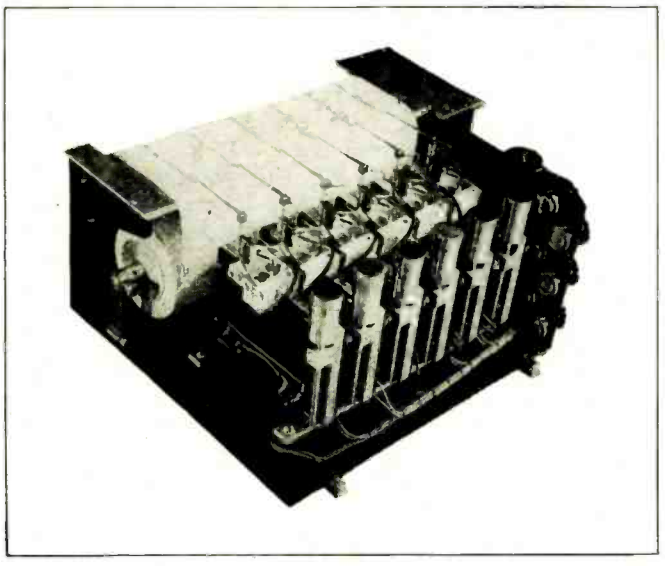
Suitable balanced amplifiers to overcome this difficulty were developed in 1936 and have now been adopted as the standard design with most all manufacturers. Fig. 3 illustrates the first stage of such an amplifier. Its operation is as follows: Coupling to the applied signal input is through an RC network which blocks dc from flowing from the scalp to the grid circuits or vice versa. If C_1 and C_2 were not used, the potential from B_2 would falsely stimulate the very cells whose output is being measured. Two tubes per stage are used, connected in push-pull with the common cathode resistor R_3.

Voltages which may appear from grids to ground are balanced out, while voltages from grid-to-grid are amplified. The effect is similar to adding equal large weights to each pan of a chemical balance. If both arms of the balance are of exactly equal length, the large weights do not affect the sensitivity of the balance to a small measured weight. However, any asymmetry in the balance (or amplifier) causes a large error in the measurement. The effect of the "in phase" current feedback through the common cathode resistor of the push-pull stage is to stabilize the amplifier. The undesired signal voltages may appear between either of the input terminals and ground. It is necessary to ground the patient to prevent undesired interference.

The design of a high-gain amplifier to cover a wide frequency band involves several problems. To pass very low frequencies, large coupling capacitors are required. To prevent interstage coupling, capacitor cases may be grounded as in the amplifier shown in Fig. 1. This unit has two complete four-stage amplifiers each with gains of approximately 10^7 (140 db). This

Fig. 7—A small four-channel self-contained unit with four-pen recorder attached





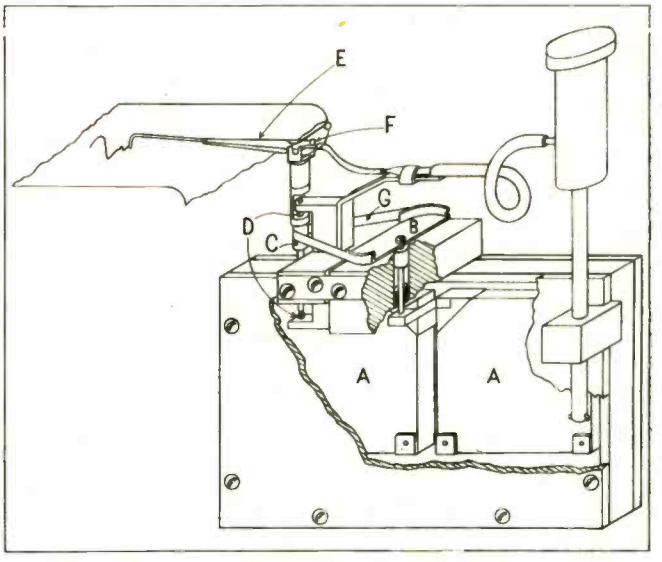


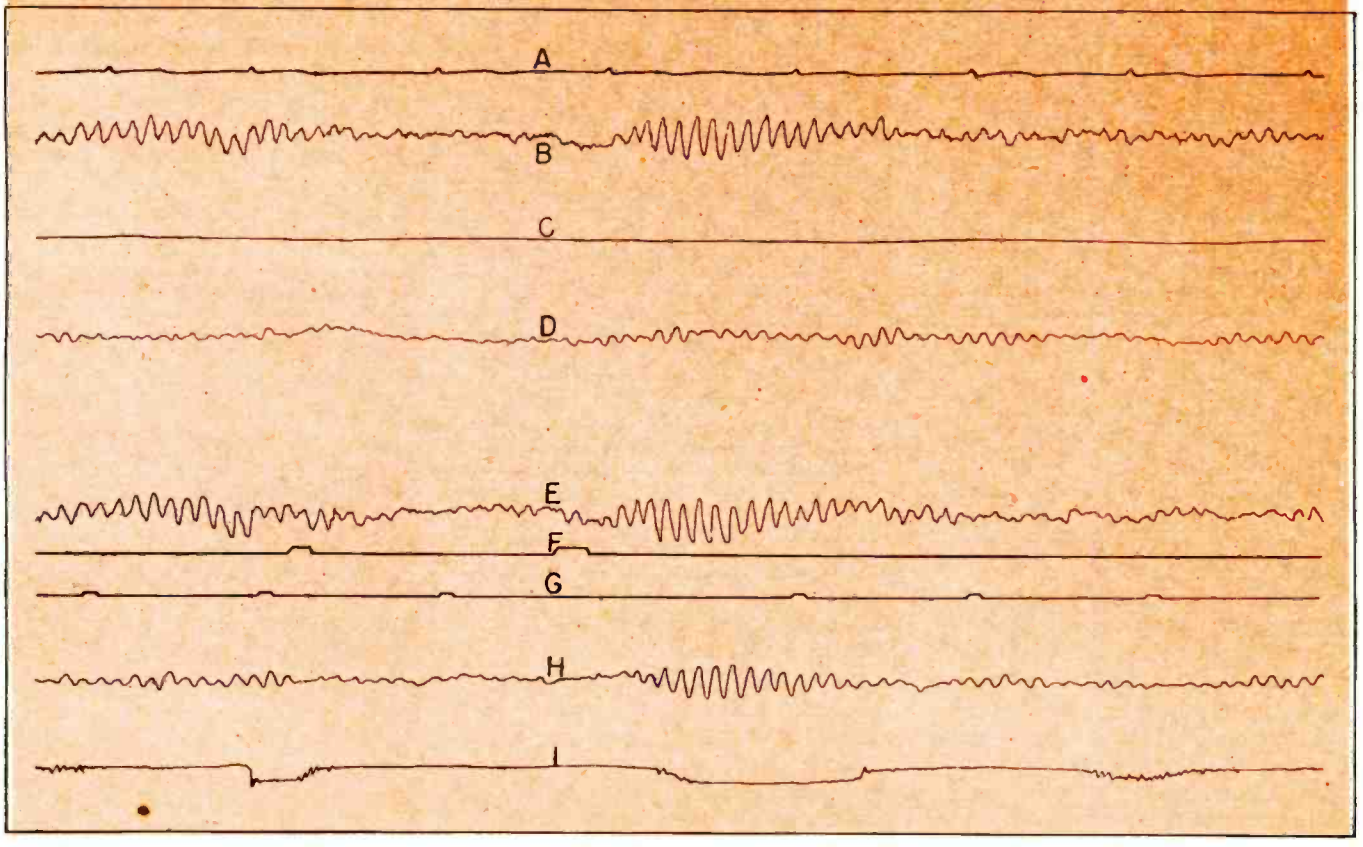
Fig. 8—(Left) A view of a six-channel piezo-electric pen recorder simulfaneously giving ink records. Fig. 9—(Right) The principle used in each of these recorder pens. Here two crystal units (A) rotate the arm (B) from whose extremities a metallic band (G) rotates the pen shaft (C). Deflections up to 2 in. are obtainable at frequencies lower than 100 cycles per second.

design has a minimum amount of shielding, but the shunt capacitance is relatively large and the frequency response falls off rapidly above 1,000 cycles. The latter, however, is not important in EEG work of the usual type.

To increase the high-frequency response, the shunting capacitances and interstage coupling must be minimized. Interstage coupling is significant at these gains since its value is effectively multiplied by the amplification between coupled points.

The amplifier shown by two views in Fig. 4, with the shield removed, is designed to minimize the effect of both types of capacitances. Coupling capacitor cases are not grounded to the chassis. Interstage leads are made "through the tubes," thus minimizing shunt capacitances. As will be noted, the shielding cabinet shown with the amplifier in Fig. 4 has baffle plates to isolate each stage, and interstage coupling is practically eliminated. High-frequency response is greatly improved by this design; the gain falls to 0.5 at 10,000 cps. A six channel electroencephalograph incorporating these amplifiers is

Fig. 5—In this section of an experimental chart curves B, D, E and H show alpha waves that exhibit certain waxing and waning. Curve A shows one-second timing pulses; the other curves indicate other movements such as respiration, breathing, heart beats, and in curve I, eye movements



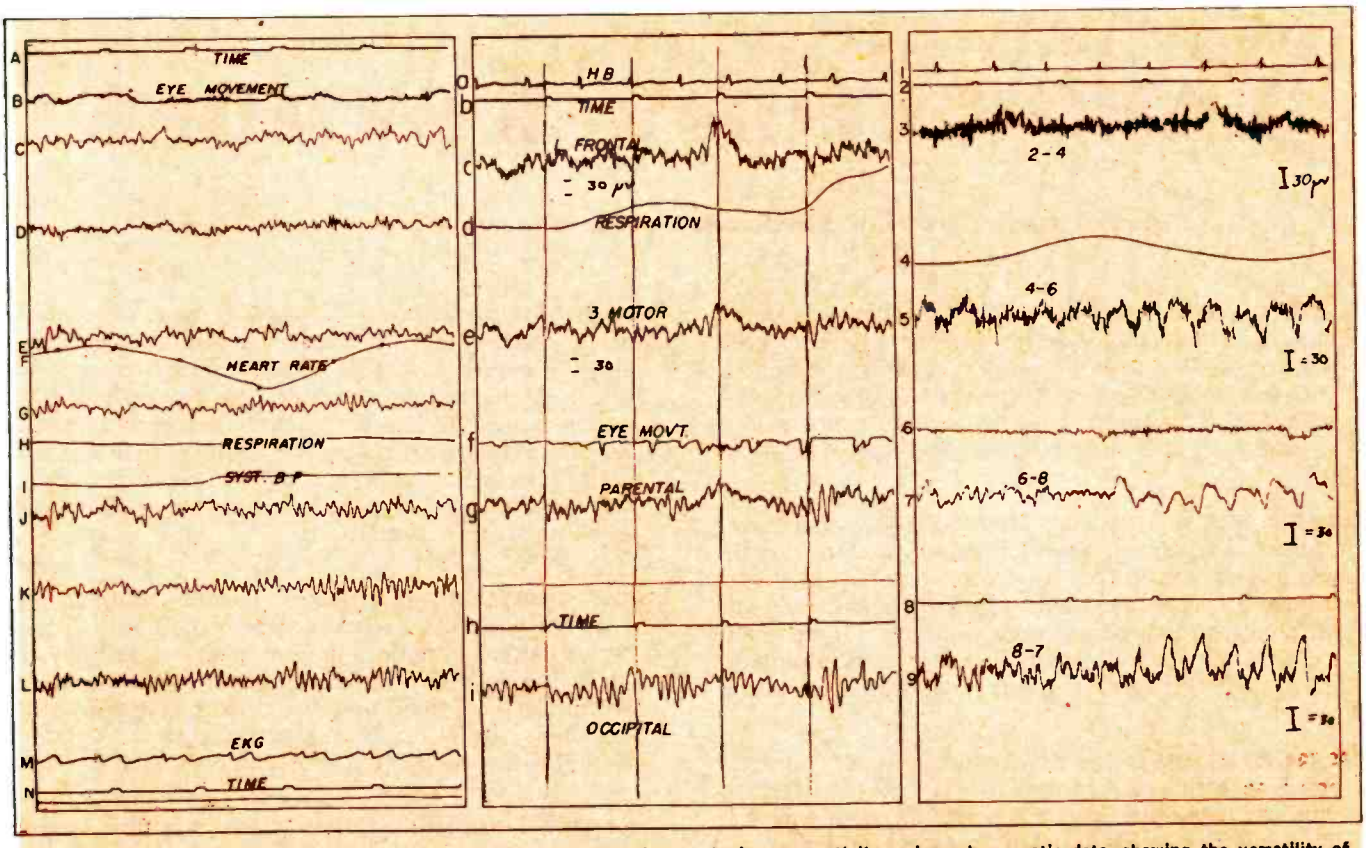


Fig. 10—These are sections of records of experimental data connecting up brain wave activity and psycho-somatic data, showing the versatility of multichannel recorders. In the first section curves A and N represent timing waves with one second intervals. Curves C, D, E, G, J, K and L are the outputs from seven electrode pairs attached to the scalp. Curves B, F, H, I and M represent movements of other body organs. In the second section and in the third section similar experimental data are simultaneously recorded. The brain wave curves in 5, 7 and 9 indicate combinations of alpha, beta and delta waves. Curve 3 probably resulted from scalp muscle movements affecting the electrode positioning. The numbers on the curves represent the electrode combination pairs. Calibration marks are shown, 30 microvolts each. These charts are each 8½ in. wide

shown in Fig. 5, with associated regulated power unit, and recorder.

How far research has proceeded in an attempt to correlate the various factors affecting the EEG may be seen from Fig. 6. Here, a record of eye movement, electrocardiogram and heart rate, respiration and systolic blood pressure are recorded along with seven EEG records. These records were made to indicate how research, especially that in the psychosomatic and related fields can be aided by versatile electronic amplifiers and multiple recorders. Simultaneous reactions in various locations can be easily correlated thereby. A simple four channel equipment permitting four independent records to be made continuously is shown in Fig. 7.

Recording problems

A number of problems must be overcome in the design of recorders handling large amplitude swings. To accomplish faithful recording of small signals requires that friction and backlash be minimized. Square-top waves can result from saturation of either amplifier or recorder where amplitude capabilities are not sufficient.

Electroencephalographic recorders may be compared in several ways: Fidelity, rate and amplitude of response, efficiency (since this affects the amount and quality of associated equipment required to supply the driving power), and reliability.

A definition of recorder fidelity, or accuracy, requires consideration of several factors. A measure of response speed is obtained from the frequency response characteristic, which indicates the relative deflections obtained with constant-voltage sinusoidal inputs as the frequency varies.

Equally important is linearity of deflection as the amplitude of signal input varies; a signal voltage with double amplitude should produce a deflection of the recording pen twice as great. Linearity applies only over a limited range in the usual recorder, but it is very necessary that the range be sufficiently great to represent adequately the wide voltage range found in the EEG.

The third consideration is transient response of the recorder. This is the most difficult point of all to test adequately, and it is therefore one which is usually ignored. However, if it is desired to represent faithfully the actual form of the electroencephalogram, which is actually not a sine wave but a combination of transients, it is necessary to give this careful consideration. It is always necessary to consider these factors together as one can always improve one of them at the expense of the other. For a given pen deflection, the pen will move twice as fast at twice the frequency; but if the amplitude is then cut in half, the pen moves at the original speed again.

Crystal driven pens

Because of the power developed by piezo-electric crystals with reasonable input powers, it is possible to obtain satisfactory speed and amplitude response using this principle. In the six channel Crystograph shown in Fig. 8, deflections up to two inches are obtained, at

(*Continued on page* 158)

LABORATORY KEYHOLE

Current Research that Forecasts Future Electronic Developments

FLOOD CONTROL—For several years rumors coming out of Philadelphia have told of an electronic method of river flood prevention being experimented with by Louis Clark of Raymond Rosen radio distributors. Laboratory work is now winding up, and actual apparatus may soon be disclosed.

WANTED: RED, YELLOW, BLUE ELECTRONS—Practical television laboratory experimenters see no early commercialization of any electronic technic for producing color television. "Trouble is electrons are all alike," explained one lab executive. "If we could only get say red, yellow and blue electrons impinging on a single screen, electronic color would be easy!"

180,000 DIAMETERS is the new limit of the electron microscope achieved by improvements in the electron gun and lens coils. Former top was 100,000 diameters. This compares with optical-microscope maximum at 2500 to 3500 diameters using ultra-violet. Human spermatazoon photographed with electron microscope reveals a curious fish-like creature nearly 3 ft. long in photograph. Hitherto unknown head structure and tail-propelling mechanism are now made known for the first time.

INFRA-RED TANK VISION—According to Dr. C. F. Green, G-E engineer, infra-red detection was used effectively by the Germans at night when opposing tank units had difficulty in spotting one another. The Germans developed infra-red filters for their searchlights and shot beams toward areas where they believed Allied tanks were lurking. Since infra-red rays are invisible, Allied tankmen did not know they were being illuminated. The infra-red rays from the filtered searchlight beams hit the Allied tanks, bounced back to a device known as a "bildwandler," or "image changer," mounted in German tank guns to transform the infra-red rays into an image of the opposing tank, whereupon the gunners opened fire.

DRAINS STATIC CHARGES—To rid its planes of electrostatic charges, TWA is experimenting with an insulated conductor system with trailing edges over which are poised small nozzles fed from a reservoir on the plane. As charges on plane accumulate, these are imparted to droplets of liquid which are attracted from nozzles to trailing conductors of opposite sign and so charges are neutralized and disposed of without any disturbance.

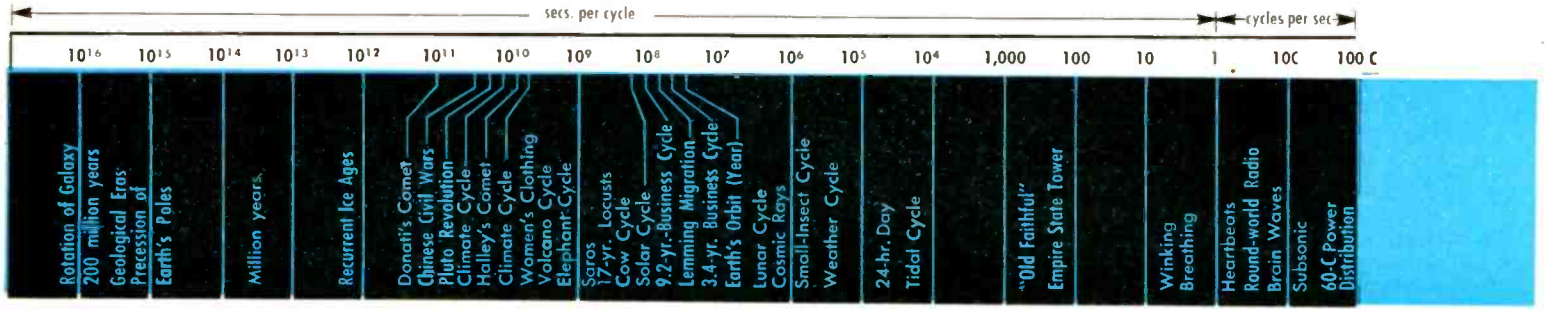
RELAY CHATTERING—High-speed movies taken at the rate of 3,000 frames a second are being used to analyze chattering action in electrical relays and to point up remedies. Such pictures, when rerun at 20 frames per second and examined by lab researchers, have the effect of "magnifying time," so that troubles can be spotted and corrected.

1,000 WORDS PER MIN.—Walter Howey, big-time Hearst exec, whose avocation is electronic research, now has his private laboratory (East 45th St., New York) working on high-speed voice-message transmission over ordinary telephone circuits. Already he has attained 600 words per minute over long-distance circuits and expects to reach 1,000 wpm. (Ordinary conversation is 100 wpm., although Floyd Gibbons, lightning-tongued commentator, used to reach 130 wpm.) Howey's lab several years ago developed portable picture-senders so his photographers could telephone in their pix from any phone pay station.

MENU SELECTOR—Colorful hash-slinger's lingo will be a thing of the past when the electronic menu selector under development at Elm Labs, Dobbs Ferry, finds final adoption in restaurants. Containing relays, a motor, and an electron tube, the customer presses buttons instead of giving his order verbally. Intantaneously, a card is punched at the stock-keeper's office, at the chef's stove, and at the cashier's cage. A recorder automatically indicates the total number of each selection ordered since a given time, so that stocks may be kept up.

SPECTRUM TO END ALL SPECTRUMS!

Longest established periodicity is time of rotation of our Milky Way Galaxy, as measured against background of distant stars, although some astronomers suspect that our great Galaxy is itself one of a group all rotating together in a still longer period. The "saros" is the 18-year period in which all eclipses of sun and moon repeat themselves



CRT WITH 10-MIN. PERSISTENCE—Recent press reports that DuMont Laboratories in Passaic, N. J., have developed cathode-ray tubes which will hold the trace for ten minutes or more, seem to be on the conservative side. For it is now pretty general knowledge that tubes with persistence for indefinite periods up to many years have been produced during recent research. And all can be wiped clean in a flash by any of several methods.

A = 912 CPS?—France's Office of Art and Creation asserts that U.S., Russia and England have set concert pitch of A far too high at 912 cycles per second, whereas French want to compromise on 880 cps. at 59° F., remembering that in 1859 Paris composers had stabilized A at 870 cps. This all represents considerable tonal inflation since 1813 when London Philharmonic set A at 847 cps., two cycles higher than George Handel's tuning fork vibrating at 845 cps.

EN GARDE ELECTRONIQUE!—A popular device among fencers is the electric epee, which rings a buzzer and lights a signal whenever either contestant's rapier touches a vital spot on the other's person. But for this each fencer must wear a cord and plug, to some extent limiting his action. What the disciples of D'Artagnan are now asking for is some kind of an "electronic epee," operating on a space-relay principle, which will signal "touche" without any connecting wires.

STALL INDICATOR FOR AIRCRAFT—In the operation of aircraft there are two factors which determine whether there is sufficient upward force to maintain the plane in the air: the angle of climb and the speed of the plane. If for a certain angle the speed decreases below a definite value, the plane will "stall." Winfield J. Trott obtained a patent on an apparatus intended to indicate whether an aircraft travels at a speed below or above the critical speed. The velocity of the air passing the aircraft is converted into pressure which controls the capacitance of a capacitor in an oscillator circuit. It is so designed that a high note is audible if the speed exceeds the stall speed of the plane, while a low tone is generated if the speed of the plane is less than the stall speed. At the stall speed the pilot hears a change in pitch advising him that this critical speed has been reached.

ANALYSIS OF CASTINGS—L. W. Ball has developed a method for the analysis of sample castings by x-ray micrographs, enabling the foundryman to establish defects. Microcavities, affecting the serviceability of the casting, are too small and too dispersed to be studied in detail by ordinary radiography or by fracture tests, but can be investigated by this new technic. Segregation in certain alloys, particularly copper-aluminum, is another characteristic readily detected by x-ray micrography. The method further facilitates identification of defects seen on ordinary industrial radiographs. In Mr. Ball's laboratory, where x-ray interpreters are trained, one part of this training is provided by the identifying library of radiographs together with corresponding x-ray micrographs.

LINGERING SPEECH—When a sound recorder is slowed down for the convenience of a typist, the sound quality delivered becomes increasingly poor. At the suggestion of ELECTRONIC INDUSTRIES, Miles Reproducer Co. will undertake development of a recorder which "lingers" at spaces and reproduces words at normal rate, thereby maintaining true voice values.

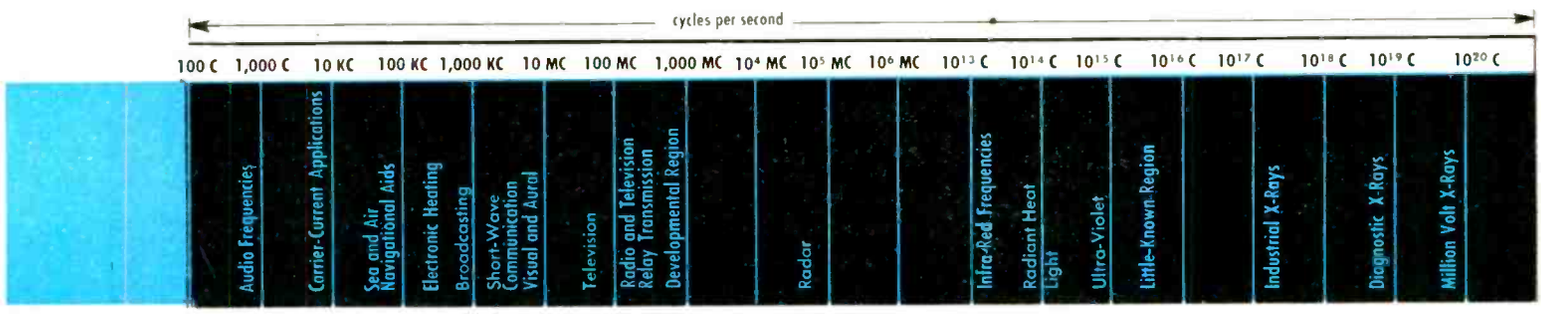
SPECTRUM GLORIOSUM—Over the years your editors have been compiling and publishing spectrums of this and that—broadcasting, sound, short-waves, X-rays, electromagnetic oscillations, etc. But until the present moment, all the spectrums so far published have been mere puny, local affairs—just minor jiggles picked from the vast rhythms of the universe. Now on these pages we go "whole hog" and "grand slam", pulling out all the stops for the whole diapason of oscillatory lows as well as highs.

VERY ULF OSCILLATIONS—For all Nature obeys the laws of oscillations, and going into lower and lower frequencies, we have such periods as heartbeats, breathing, building vibrations, geysers, animal cycles, sunspot cycle, planetary periods, returns of comets, and finally the rotation of our own Milky Way Galaxy against the framework of the universe.

PEERING INTO UNKNOWNS—After the double-barreled spectrum below had been drawn up, this interesting point revealed itself. Viewed from the middle platform of familiar human functions such as heartbeats, hearing, etc., note that the exponential interval up to high-voltage X-rays (10^{20} cycles per second) is just about the same as the opposite exponential interval from man's workaday world down to the majestic periodicity of the Galaxy (10^{16} seconds per cycle). Is man then really the center of this tremendous spectrum? We doubt it. Rather it seems likely that the two horizons seem equidistant, because men's present facilities permit him to see at the moment only about so far in either direction.

DOUBLE-BARRELLED KEY TO EVERYTHING

This end of the spectrum is more familiar to present readers, encompassing as it does all of sound, radio, light and X-rays. Originally drawn up to show man-made frequencies this chart omits the still higher frequencies of gamma rays and cosmic rays which would appear at extreme right, beyond our highest-voltage industrial X-rays



PHASITRON CONVERTS

Considerable simplification of FM transmitter circuits is achieved in one envelope by deflection of an electron sheet

• Attacking in a quite new way the problem of producing frequency modulation with frequency stability tolerance within the currently relatively narrow limits required by FCC standards of practice, General Electric Co. is producing a new type of tube which is to be built into all subsequent GE FM transmitters. The tube, styled a Phasitron, was originally proposed by Dr. Robert Adler of the Zenith Radio Corp.

Use of the new tube very considerably simplifies FM transmitter construction, permits direct crystal control using a single crystal, and provides a means of applying modulation independent of frequency control with a consequent reduction in distortion and noise. The prime purpose of the new tube is to make possible the introduction of comparatively wide phase excursions at audio rates in a crystal-controlled radio frequency carrier voltage. The audio response characteristic of the circuit is such that the output of the tube is wide-swing frequency modulation.

It has always been considered difficult to produce a frequency modulated radio wave with a crystal controlled center frequency. If frequency changes were injected into the circuit by means of a reactance tube or by some similar method, the automatic adjustment of the circuit to the deviation frequency was interfered with by the crystal holding the frequency steady.

Therefore, where center frequency control was desired by means of a crystal it has been necessary to use phase modulation and, thereafter, change to frequency modulation. In straight frequency modulation circuits, drift has been unavoidable and corrections have been made by introducing automatic frequency control. This, of course, complicates the circuit.

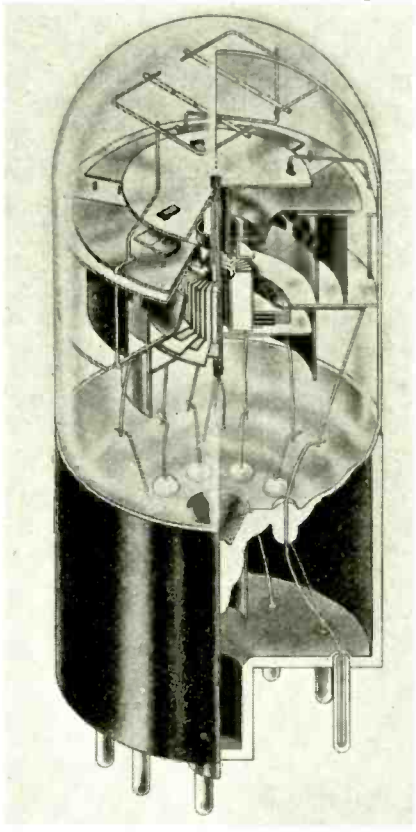


Fig. 2—Phantom photo of the new Phasitron

The simplicity of the new method is indicated by the block diagram of the circuit (Fig. 1) which has been built around the new Phasitron tube.

The basis upon which the tube itself has been built is indicated in the cut-away view (Fig. 2) showing the internal construction and arrangement of the elements. An enlarged view of those elements (Fig. 3) shows their relationship.

Anode No. 1 and Anode No. 2 are at positive dc potential and draw electrons from the cathode. By means of the two focus electrodes, these electrons are formed into a tapered, thin edge disc. This disc with the cathode for its axis lies between the neutral plane and the deflector grid structure and extends out to Anode No. 1.

The deflector grid consists of 36 separate grid wires. These wires are lettered A, B, and C in Fig. 3. All of the A wires are connected together, all of the B wires are connected together and all of the C wires are connected together. Fig. 4 is a developed view of this grid structure and the neutral plane.

The output of a crystal controlled oscillator (crystal frequency = carrier frequency ÷ 432) is amplified and fed into a phase splitting net-

Fig. 1—The startling simplicity and directness of the transmitter circuit needed to produce an FM emission is shown by this block diagram. After the Phasitron tube only a series of frequency multipliers is needed

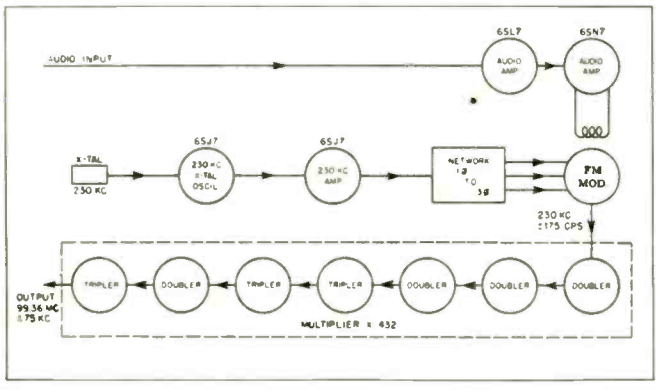
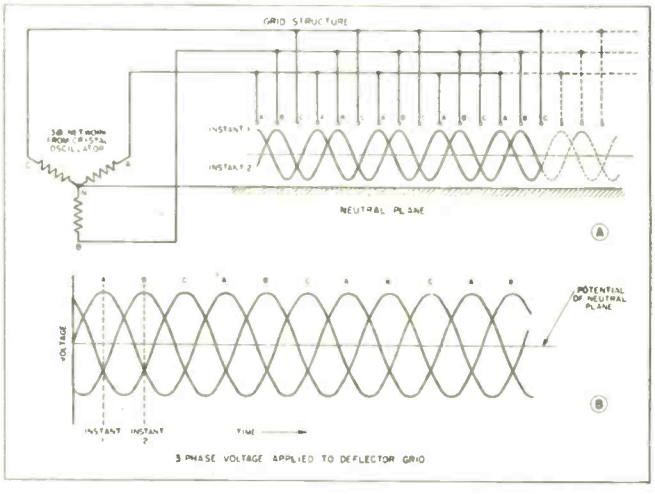


Fig. 4—A 3-phase voltage applied to the detector grid wires causes an up and down fluctuation of the electron sheet emitted from the cathode



from AM to FM DIRECTLY

work which converts the single-phase radio-frequency voltage to three phase. This three phase voltage is applied to the deflector grid as shown in Fig. 4. Phase A connects to the grid wires marked A, phase B to the B wires, and phase C to the C wires.

Referring to Fig. 4, the deflecting action on the disc of the electrons passing between the deflector grid and the neutral plant is as follows: At Instant 1 grid wires A are positive with respect to the neutral plane while grid wires B and C are negative. This results in deflection of the electron disc. Shown in perspective the disc would appear as in Fig. 5. At Instant 2, one-third of a cycle later, grid wires B are positive and wires A and C are negative. The resulting deflection would be as shown at Instant 2 Fig. 4. The fluted edge of the disc would appear to have moved the space of one grid wire during the time interval between Instant 1 and Instant 2. With the three phase voltage applied to the deflector the disc shown in Fig. 5 appears to be rotating.

Fig. 6 shows a developed view of a portion of Anode No. 1. This anode has 24 holes punched in it, twelve above the plane of the electron disc and twelve below. The oscillating fluted edge of the electron disc impinges on this series of holes. At an instant when the disc edge is lined up as shown by the solid line in Fig. 6, most of the electrons pass on through to Anode No. 2. One half cycle later the edge of the disc has moved on to the position shown by the dotted line in Fig. 5. At this instant, few, if any, electrons get through to Anode No. 2. Thus, the current flowing to Anode No. 2 varies sinusoidally at the crystal frequency. Also, it can be seen that any variation in the flutes on the edge of the electron disc will result in phase and frequency variation in this output current.

A coil is placed around the tube as shown in Fig. 7. The magnetic field resulting from a current flowing in this coil is perpendicular to the plane of the electron disc. The electrons traveling radially out from the cathode toward the anodes through this field have a force exerted on them in a direction perpendicular to their path and perpendicular to the direction of the magnetic field. Thus, an angular displacement of the flutes on the edge of the electron disc is introduced causing a phase shift in the output current.

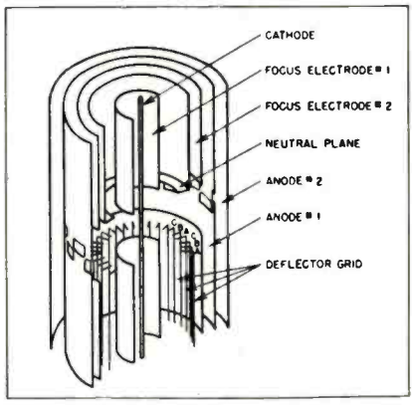


Fig. 3—Diagram of element arrangement

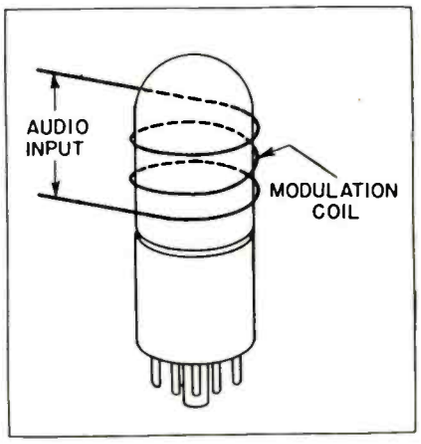


Fig. 7—Audio modulating coil shown in place

Audio frequency current flowing in this coil causes this angular displacement to take place at an audio frequency producing an audio frequency phase shift in the output current (Anode No. 2 current). This current flowing through a load impedance develops a phase-modulated radio-frequency voltage whose average frequency is that of the crystal.

Modulation method

The modulation-induced angular phase displacement of the oscillating electron disc can be compared with a similar action which is characteristic of a rotating synchronous machine. At no load, the synchronous machine rotor is aligned with the three-phase rotating magnetic field of the stationary armature winding. However, the external application of load results in a displacement of this alignment in direction and amount determined by the load. Nevertheless, for any normal load the steady-state rotor speed remains constant.

The modulation coil is driven with a push-pull voltage amplifier tube. That is, the amplitude of the audio voltage across the coil is constant with varying audio frequency. This means that the current flowing through the coil decreases with increasing audio frequency because the coil is almost a pure inductance over the audio range. The magnetic field strength, and thus the phase swing of the output current, therefore decreases (6db per octave) with increasing modulation frequency, effectively giving us frequency modulation.

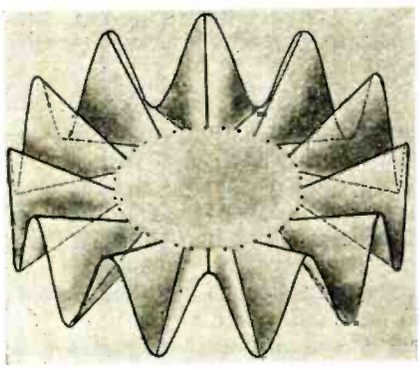
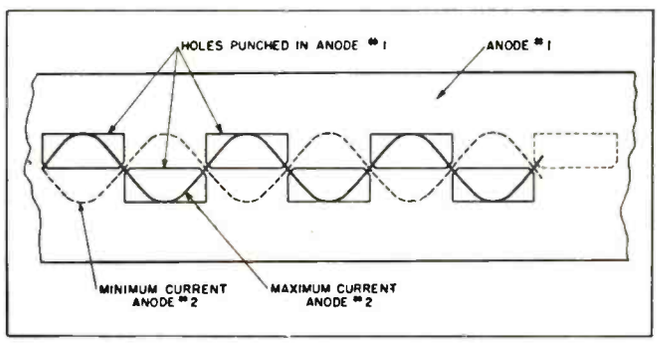
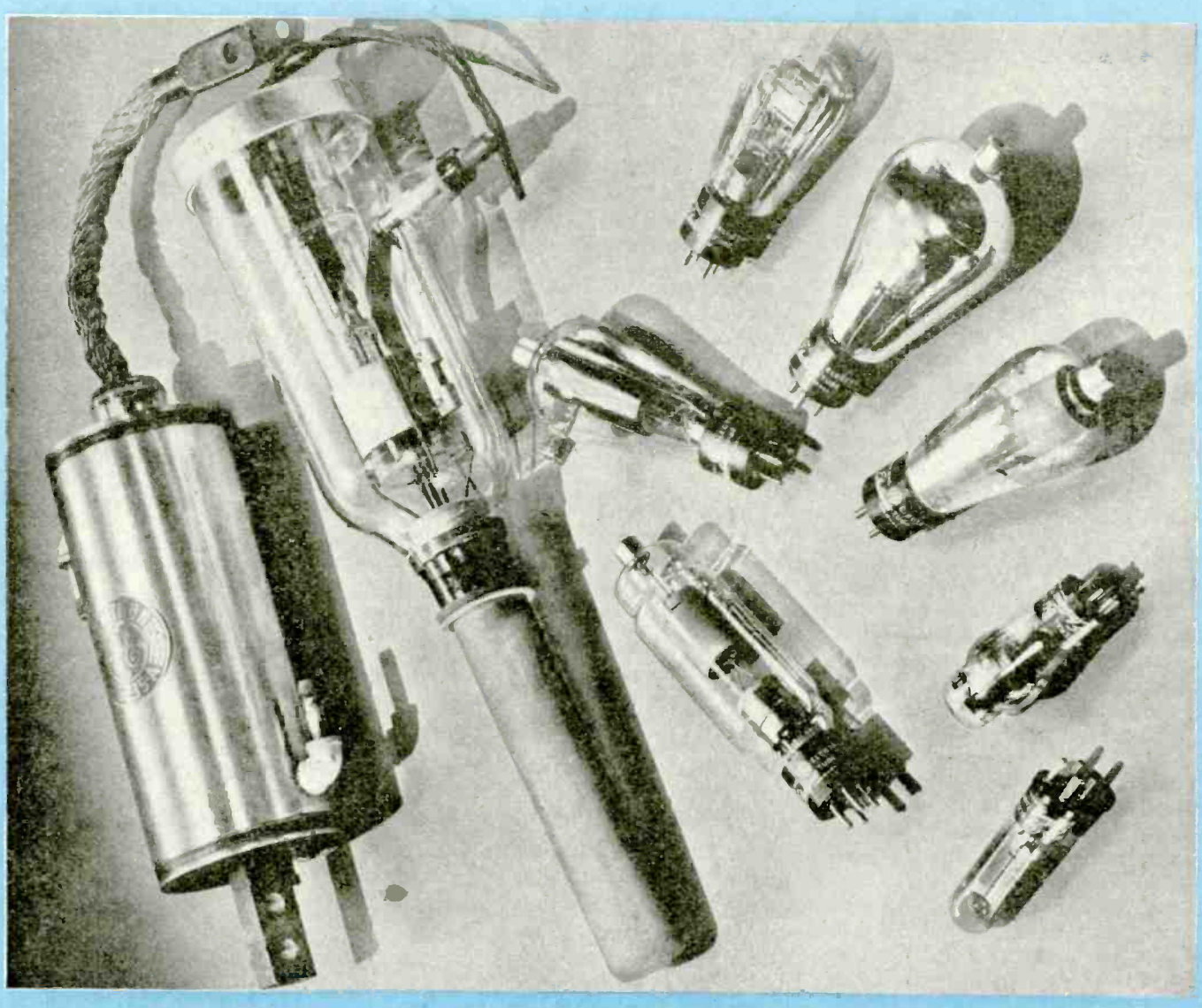


Fig. 5—(Left) Instantaneous picture of modulated electron sheet emitted from the cathode. The up and down motion of the edge of the sheet makes it appear to be rotating. Fig. 6—(Right) Anode No. 1 has square holes punched in it so that the electron sheet goes through at some instants to anode 2





THE TRON FAMILY

● The first application of the suffix "tron" for designating a type of electron tube was suggested in 1913 by the late Professor J. I. Bennett, Professor of Greek at Union College, Schenectady, N. Y. It was published in an article by Dr. Irving Langmuir, which appeared in the Proceedings of the IRE in 1915. Dr. Langmuir introduced the subject as follows:

"In order to distinguish these devices from those containing gas and in most cases depending upon gas for their operation, the name 'kenotron' has been adopted. This word is derived from the Greek kenos, signifying empty space (vacuum), and the ending, tron, used by the Greeks to denote an 'instrument.' By usage the name 'kenotron' has been applied only to the two-electrode, high-vacuum tube."

Thus, the name "kenotron" was the first of a long series of new words ending with tron. Undoubtedly these early tube names led to the remark credited to Dr. Lee de Forest that they are a "Greeko-Schenectady" product. There are some people who feel that such new words are undesirable or unnecessary. In connection with the word "audion" Dr. Pupin remarked:

"If there must be a new name for each new detector—a new name for everything that comes up in the course of development of the electrical art—pretty soon the science of electrotechnics will be a maze of new names; and the learning of the names will be much more difficult than the learning of the facts connected with the art."

Above are nine types of modern "trons": Ignitron, pliotron, kenotron, thyratron, phanotron

Trade-marked names are included in the following compilation and are identified with an asterisk. This classification is difficult to make because in a number of cases, such as thyratron, ignitron and Klystron, the trade-mark has in some cases been abandoned so as to allow the word to become a generic term and make it available for

A dictionary of many well-known and not so well-known tubes and other electronic devices having a common suffix—Compiled by W. C. White, General Electric Company

So far as the author is aware, the word "electron" represents the first use of the tron suffix derived from the same Greek root that later formed the basis for the naming of so many electronic devices. There is an old and now pretty well obsoleted Scotch word "tron" used to describe a post supporting a weight beam and this led to the use of the word to describe a crude weighing machine. It is from a different root, however. There are, of course, such words as "patron" and "matron" which again do not utilize the same Greek root.

The word "electron" first occurred in print in the Scientific Transactions of the Royal Dublin Society for July, 1891, in an article by George Johnstone Stoney, M.A., D.Sc., F.R.S. It is apparent, therefore, that the origin of the suffix "tron" is not in any way tainted with recent commercialism, but, on the contrary, is more than 50 years old and has a thorough academic origin and background.

standardization by some agency, such as the American Standards Association through the usual channels and procedures. The same procedure may in the future be followed in the case of some names now trade-marked.

From time to time, attention has been called to the fact that many of the names listed are poorly conceived because they involve a combination of roots from different languages or are erroneous in meaning. Unfortunately the need for a word to express some combination of properties to avoid the use of a long phrase plus its phonetic qualities often determines its adoption more than its origin or correctness.

The references cited are either the original article in which the tube or device was named or one recommended for its clarity of description and basic approach. Following some of the names, two references are listed. This is either because the origin and best description are in different publications or the best reference is not readily available.

Foreign language references have been avoided and the most desirable in the English language are cited.

Alphatron—A trade name for a vacuum gage of the ionization type made by the National Research Corp.—Review of Scientific Instruments, September, 1945, p. VIII.

Arcotron—A high-vacuum tube of German (Telefunken) design. Its control electrode is external to the glass envelope.—Experimental Wireless and the Wireless Engineer, October, 1930, p. 534.

Audiotron*—A trade name used by E. T. Cunningham, Inc., for the tubes it sold during the early 20's.

Augetron—A high-vacuum, multistage, electron-multiplier tube of British design.—Television and Short Wave World, September, 1939, p. 540.

Axiotron—A high-vacuum, thermionic-cathode diode. The cathode is a filament requiring such a heavy current that the magnetic field it creates controls the flow of anode current.—"The Axially-Controlled Magnetron" by A. W. Hull. Journal of the AIEE, October, 1923; v. 42, p. 1013.

Ballastron—A trade name for ballast tubes (iron wire filaments in hydrogen) made by the Mica Mold Radio Corp.—Communications, January, 1933, p. 33.

Betatron—A device for the production of very high-speed electrons. "Twenty Million Electron Volt Betatron or Induction Accelerator" by D. W. Kerst. Rev. of Sci. Instr., September, 1942, p. 387. Page 90. Electronic Industries for December.

Calutron—An electromagnetic type of mass separator of uranium isotopes. Developed at the University of California; thus the name. Page 1 of Chapter XI of the Smyth Report on the Atomic Bomb.

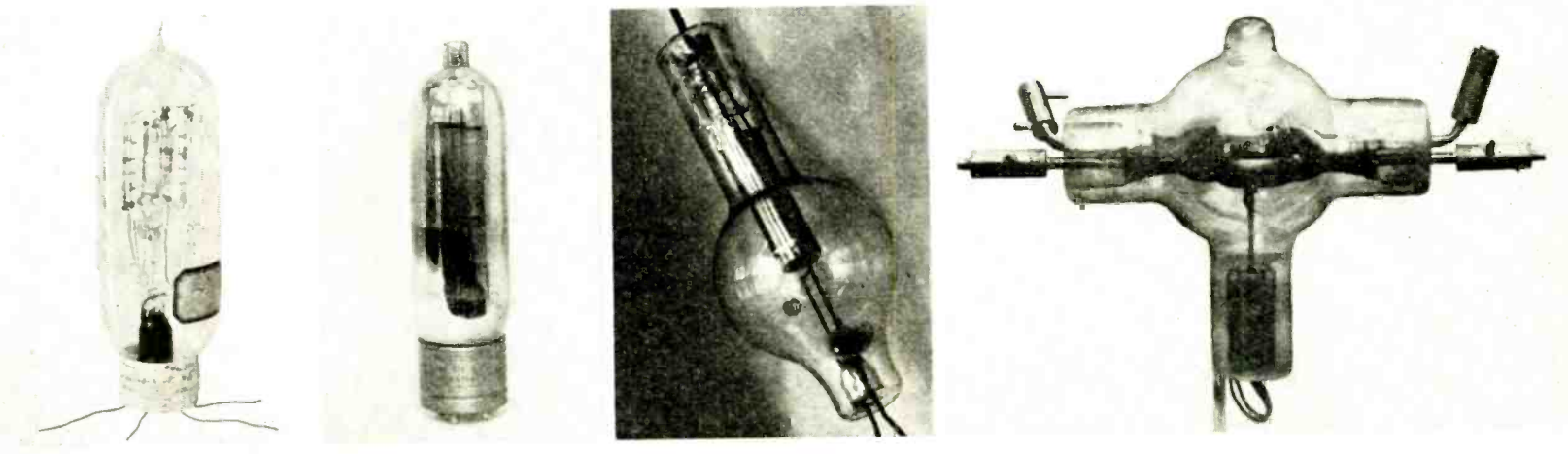
Capacitron—The name of a firm, The Capacitron Co. Electronic Industries,, July, 1945, p. 170.

Cathetron—See Kathetron.

Cetron*—A trade name for tubes manufactured by the Continental Electric Co. Electronic Industries, July, 1945, p. 205.

Clarotron—A trade name for a radio receiving tube made by a

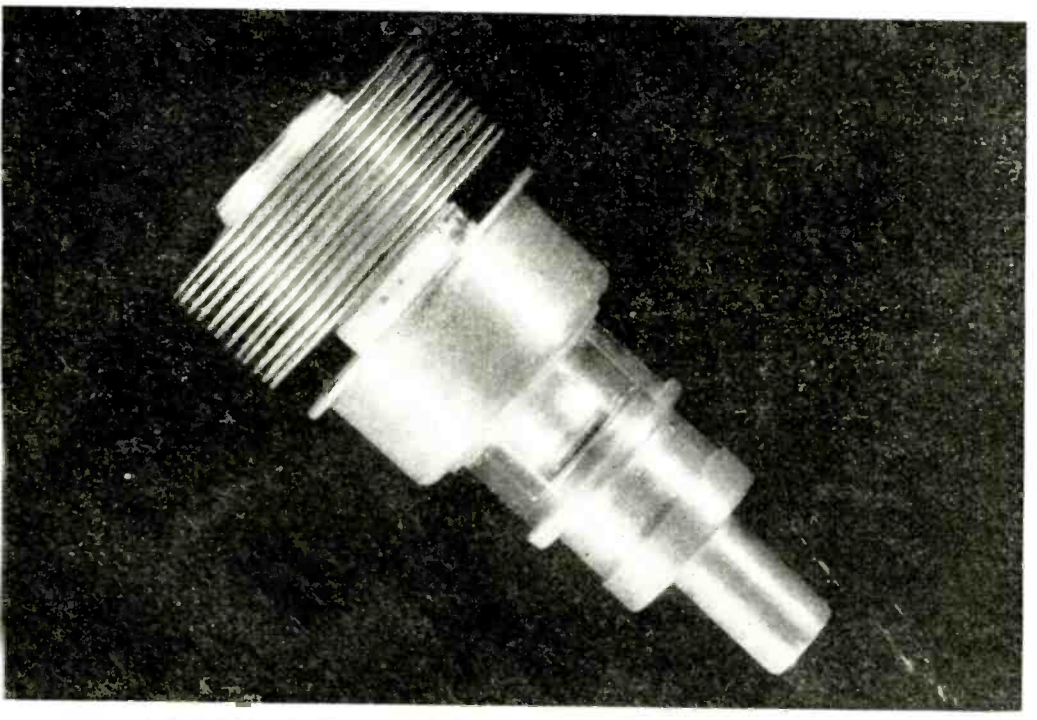
Left: Made in 1913, first pliotron was exhibit in Arnold Langmuir patent interference. Next: "Rectron" was 1926 kenotron rectifier. Right center: Laboratory model of thyratron constructed in 1926. Right: Type ZH 1 two-anode magnetron with exhaust cooling chambers first used in 1928



short-lived firm in the early 20's.

Cyclotron—A device for producing a beam of high velocity charged particles which are successively accelerated by an alternating electric field synchronized with the spiral revolution of the particles in a perpendicular magnetic field. "The Production of High-Speed Light Ions Without the Use of High Voltages" by E. O. Lawrence and M. S. Livingston. Physical Review, April 1, 1932, p. 19. "The Cyclotron" by W. M. Brobeck. Electrical Engineering, July, 1942, p. 348. "Cyclotron—Atomic Research Instrument," Electronic Industries, October, 1944, p. 86.

Detectron—A trade name for radio receiving tubes made by a short-lived firm in the early 20's.



Disk-seal pliotron with parallel-plane design for UHF application. Having proved itself on war fronts of the world, the disk-seal pliotron now finds important commercial application

Duodynatron—A form of dynatron in which the secondary electrons come from an inner grid. "The Inner Grid Dynatron and the Duodynatron" by Tatuo Hayasi. Proceedings IRE, June, 1934, p. 751.

Dynatron—A high-vacuum triode, the operation of which is based on emission of secondary electrons from a plate or cylinder. "A Vacuum Tube Possessing Negative Resistance" by A. W. Hull. Proceedings IRE, February, 1918, p. 5.

Electron—The natural elementary quantity of negative electricity. The first publication of the word was in: "On the Cause of Double Lines and of Equidistant Satellites in Spectra of Gases" by G. J. Stoney. Scientific Transac. of the Royal Dublin Society; v. IV, series II, p. 582. A more readily available reference describing briefly this early publication is: "Electron Tube Terminology" by W. C. White. Electronics, December, 1942, p. 42.

Emitron—A television camera tube. Utilizes a scanning cathode-ray beam on a photo-sensitive screen on which the picture is projected. "New Emitron Camera With Greatly Increased Sensitivity," Television (British), January, 1938; v. 11, p. 11.

Excitron—A type of mercury pool tube containing a holding anode and a special form of starting electrode. "'Excitron' Mercury-Arc Rectifiers" by O. K. Marti. Transactions AIEE, 1940; v. 59, p. 927.

Flashtron—An arrangement giving sensitive relay action. "The Flashtron; An Electronic Automatic Control Unit." Electronics, October, 1943, p. 280.

Frenotron—A diode combined with a triode in a common envelope to stabilize the latter when used as an amplifier. "The Frenotron Valve, A Vienna Novelty" by G. W. O. Howe. Experimental Wireless and the Wireless Engineer, April, 1928, p. 214.

Furnatron*—A trade name of the Westinghouse Electric Corp. to describe its resistance furnace control apparatus utilizing thyratrons and saturable reactors.—Electronic Industries, April, 1944, p. 129.

Gammatron*—A trade name for tubes manufactured by Heintz and Kaufman, Ltd. Electronic Industries, July, 1945, p. 211.

Gasomagnetron—A Russian development of a form of magnetron tube containing gas to form ion currents. Physical Review, March 1, 1941; v. 59, p. 467.

Gausitron—See Gusetron.

Gusetron—Sometimes called Gausitron. A mercury-arc pool tube. An insulated probe type electrode dips into the mercury pool to provide cyclic ignition. "A New Form of Ignitor for Mercury Pool Tubes" by K. J. Germeshausen. Physical Review, January 15, 1939, p. 228.

Hytron*—A trade name for tubes manufactured by the Hytron Corp. Electronic Industries, July, 1945, p. 119.

Ignitron—Pronounced Ig-ni'-tron. A pool tube with a single main anode in which an ignitor is used to initiate an arc spot on the cathode before each conducting period. "New Method of Starting an Arc" by J. Slepian and L. R. Ludwig. Electrical Engineering, September, 1933; v. 52, p. 605.

Illitron*—Trade name for high-frequency heating equipment made by the Illinois Tool Works. Plastic World, July, 1944, p. 7.

Isotron—An ion bunching method used for the separation of uranium isotopes developed at Princeton University. See Chapter XI of the Smyth report on the atomic bomb.

Kallirotron—A British tube and circuit combination to create negative resistance and act as amplifier or oscillator. "The Kallirotron, An Aperiodic Negative Resistance Triode Combination" by L. B. Turner. Radio Review, April, 1920; v. 1, p. 317.

Kathetron*—A gas-content thermionic cathode triode having the grid external to the envelope. "The Kathetron—A Control Tube With External Grid" by Palmer H. Craig. Electronics, March, 1933; v. 6, p. 70.

Kenopliotron—A high-vacuum thermionic cathode tetrode. The anode of the rectifier element heated by bombardment is the cathode of the triode element. "Combined Kenotron Rectifier and Pliotron Receiver Capable of Operating by Alternating Current Power" by A. W. Hull. Proceedings IRE, April, 1923; v. 11, p. 89.

Kenopliotron—A high-vacuum thermionic cathode diode in which

no means are provided for controlling the current flow. "The Pure Electron Discharge and Its Application in Radio Telegraphy and Telephony" by Irving Langmuir. Proceedings IRE, September, 1915; v. 3, p. 261.

Klystron*—A high-vacuum, multi-electrode, thermionic-cathode device for converting dc energy into radio frequency energy by alternately slowing down and speeding up an electron beam, utilizing the transit time between two points to produce an alternating current which delivers power to a cavity resonator. "A High-Frequency Oscillator and Amplifier" by R. H. and S. F. Varian. Jour. Applied Physics, May, 1939; v. 10, p. 324. "Klystron Characteristics," by W. E. Moulic, Electronic Industries, June, 1944, p. 9.

Kodatron—A gas-filled discharge lamp through which a high current is passed for a very short period of time to obtain brilliant light flashes for high-speed photography. "The 'Kodatron' Speed Lamp" by G. A. Jones, Electronic Engineering, June, 1944; v. 17, p. 16.

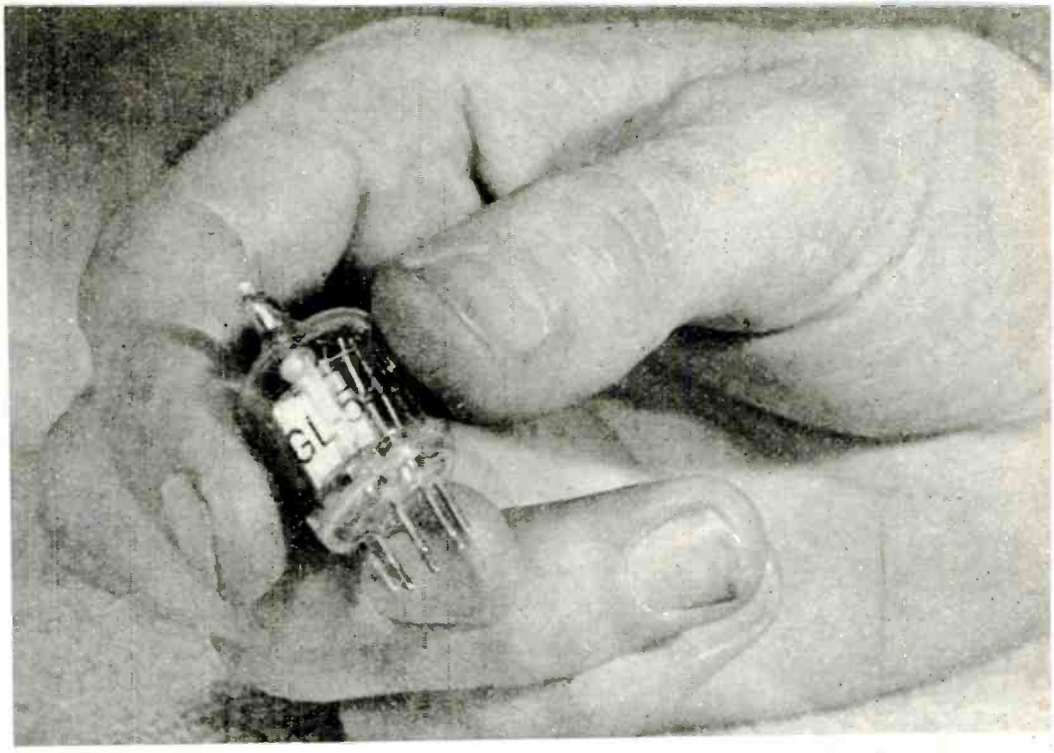
Magnetron (As Originally Applied)—A high-vacuum thermionic cathode diode with control of current by magnetic field variation. "The Magnetron" by A. W. Hull. Journal of the AIEE, September, 1921; v. 40, p. 715.

Magnetron (Oscillating)—A high-vacuum tube containing a cathode and an anode, the latter usually divided into two or more segments, in which tube a constant magnetic field modifies the space-charge distribution and the current voltage relation. The interaction of the space charge with a resonant system converts dc power into ac power. "Beam Transmission of Ultra-Short Waves" by H. Yagi. Proceedings IRE, June, 1928; v. 16, p. 715.

Mecanitron—The name of a firm (Mecanitron Corp.) and also applied as a trade name to certain of its products. Electronics, August, 1945, p. 230.

Megatron—A trade name for the disk-seal triodes of the lighthouse type made by the General Electric Co. Electronic Industries, September, 1944, p. 10. "The Lighthouse Tube. A Pioneer Ultrahigh Frequency Development" by E. D. McArthur and E. F. Peterson, Proceedings National Electronics Conference; v. 1, p. 38.

Mesotron—Name given to a charged particle. They have been detected in cosmic rays. Sometimes spoken of as a heavy electron or meson. Applied Nuclear Physics (Book) by Pollard and Davidson. Published in 1942 by John Wiley & Sons. (See appendix, page 235.)



Modern, and one of the smallest Thyratrons, type GL-546 is 1⅛ in. high, 11/16 in. diameter, carries 100 ma peak at 500 volts. Has four electrodes, control-and-shield grid type, in Xenon gas

Monotron—A trade name applied at one time to monoscope tubes made by the National Union Radio Corp. The word Videotron was also similarly used for a time.

Negatron—A high-vacuum, thermionic-cathode triode having a negative resistance characteristic when used in a certain way. "The Negatron" by John Scott-Taggart. London Electrician, September 23, 1921; v. 87, p. 386.

Neotron—A gas-filled tube designed particularly as a pulse generator. "Gas-Filled Tubes as Pulse Generators" by F. J. G. van den Bosch. Electronic Engineering, April, 1945, p. 474.

Neutron—An uncharged particle having a mass equal to a proton. "Possible Existence of a Neutron" by J. Chadwick. Nature, February 27, 1932, p. 312.

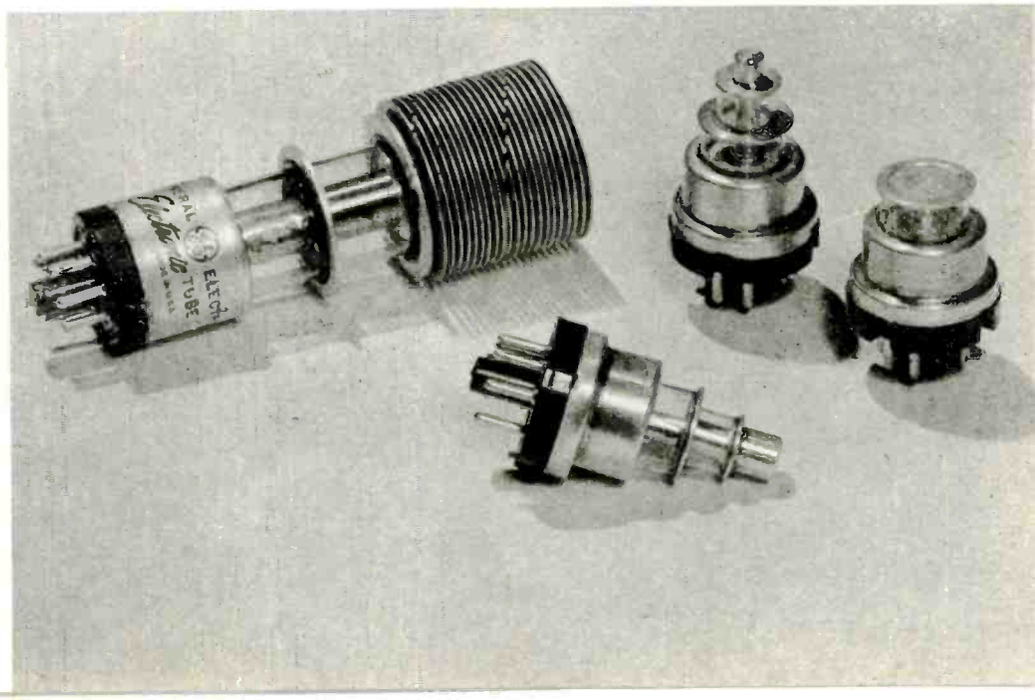
Nutron—A trade name for radio receiving tubes made by a firm in the early 20's.

Penetron—A device for measuring the thickness of sheet materials by the emergence of scattered Gamma rays from a needle containing radium. A Geiger counter is used for measurement. "Penetron Quickly Determines Steel Thickness." Oil and Gas Journal, June 30, 1945, p. 106.

Pentatron — Two-electrode structures with a common filament in one high-vacuum envelope. "A New Five-Electrode Receiving Valve" by H. Kroncke. Wireless World, June 23, 1926, p. 854.

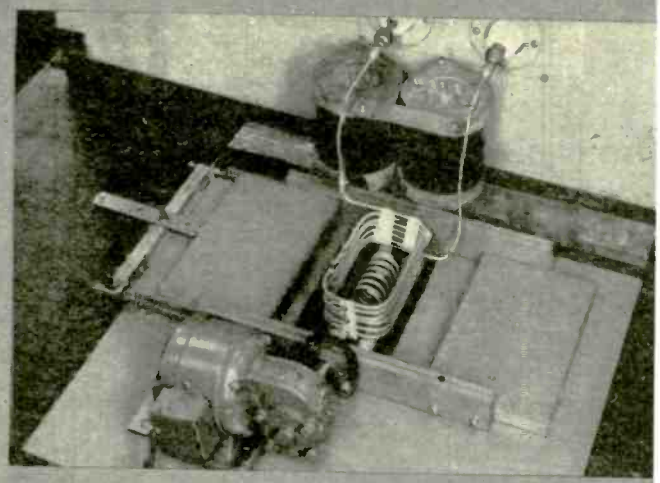
(*Continued on page* 130)

Plate power output of GL-3C22 tube at upper left is 50 w at 600 mc, with maximum plate dissipation of 125 w. Type 2C40 receiving tube has plate output of 0.075 watt as local oscillator

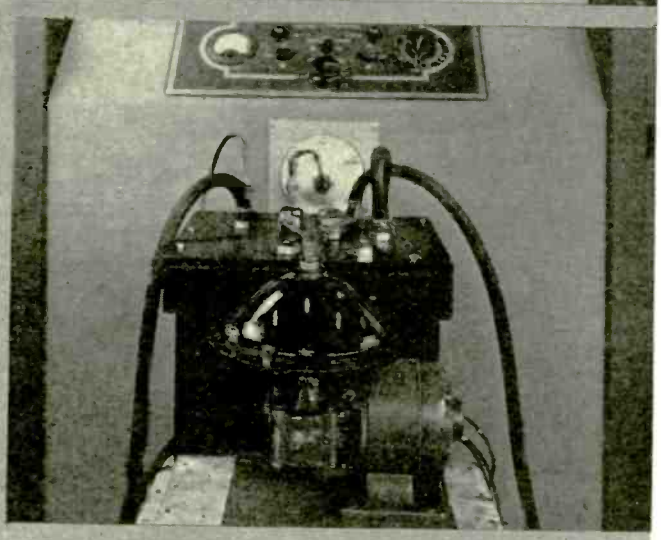


CASE STUDIES

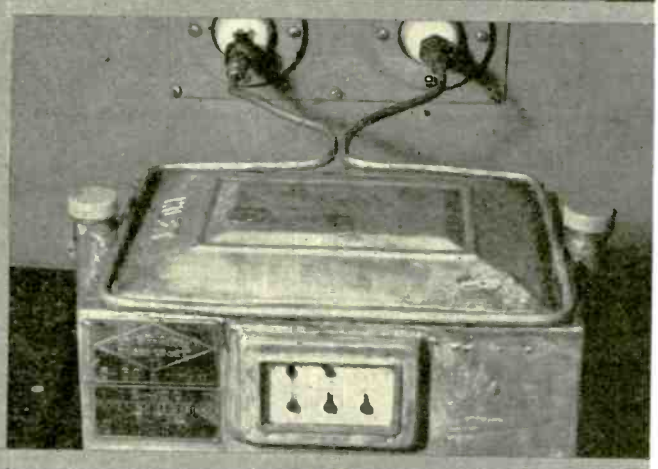
Modern methods of using high frequency heating



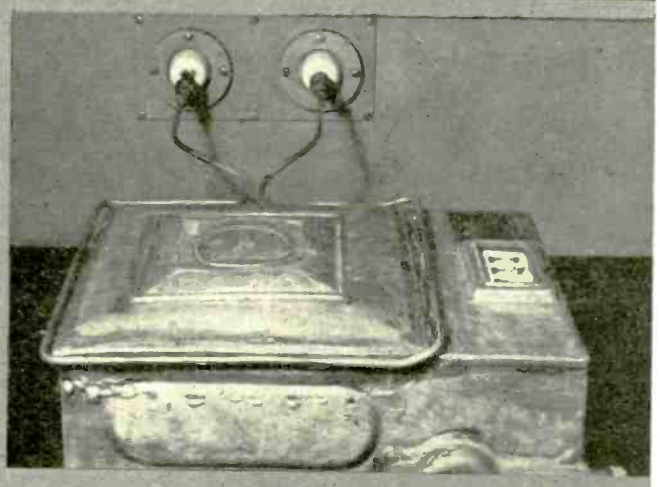
NO DISTORTION IS PERMISSIBLE when hardening this chrome-vanadium copper plated coil spring to a hardness of 55-60 Rockwell "C". A rectangular coil is used with a 20 kw 450 kc standard rf generator. The spring is scanned by rotating upon two driven alundum rollers on which it rests; one roller is arranged to slide back on being released to allow the spring to drop into an oil quench. One spring, 2¾ in. long x 1⅝ in. ID is composed of 5 turns of 1¼ in. diameter wire and weighs nearly 200 grams; this was heated in 28 seconds with a coil 6½ in. long x 3½ in. x 1¾ in. high, and comprising 6 turns of 3/16 in. tubing.



SOLDERING A BRASS LAMP BASE to a steel headlight reflector is done with a 5 kw 450 kc RF generator supplying two load coils. When a two turn coil of ⅛ in. square copper tubing is used (turn spacing 5/32 in. with the bottom turn 3/32 in. from the back of the reflector) the bulb is soldered in place in 4 seconds. Current in the work coil is approximately 200 amperes. In order to prevent reaction between the soldering paste and the reflector plating, a "neutral" flux is used.



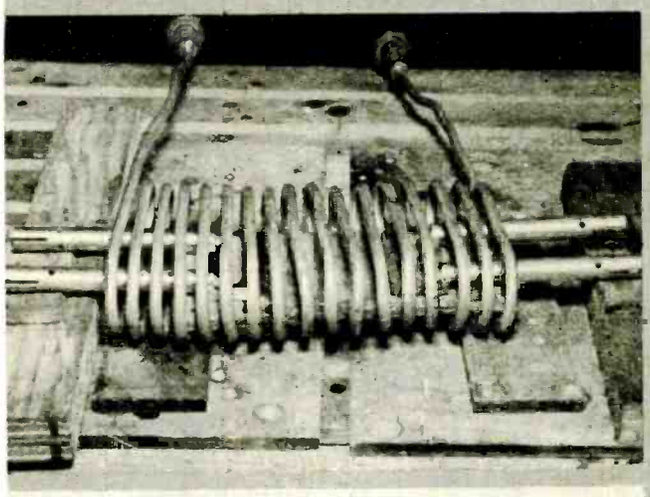
UNSOLDERING COVERS FROM GAS METERS is done in 10 seconds using a 20 kw 450 kc oscillator and multi-turn coil. For best results, the coil must closely follow the contour of the soldered edge as this concentrates the power into the desired area while isolating it from the remainder of the case. Hence, a separate coil is used for each different size of cover.



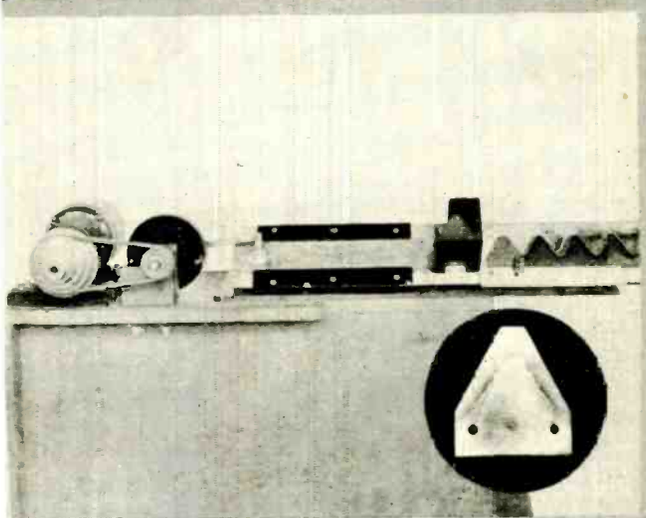
POWER IS APPLIED TO THE COIL and, at the proper instant, a screwdriver inserted at the edge to remove the cover, or an automatic fixture can be used on volume production. Resoldering, of course, is feasible, provided a fixture is used to apply pressure to the cover and the solder is properly applied. Otherwise, heat can be applied in the same manner as for unsoldering the covers.

# of RF HEATING

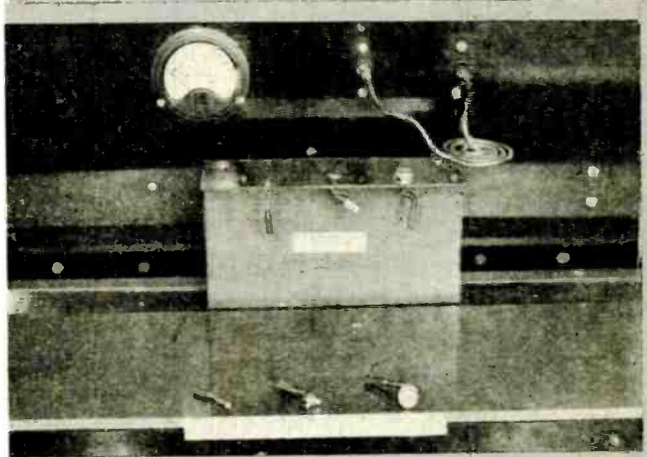
These solutions to typical production problems were worked out by the Westinghouse Electric Corp.



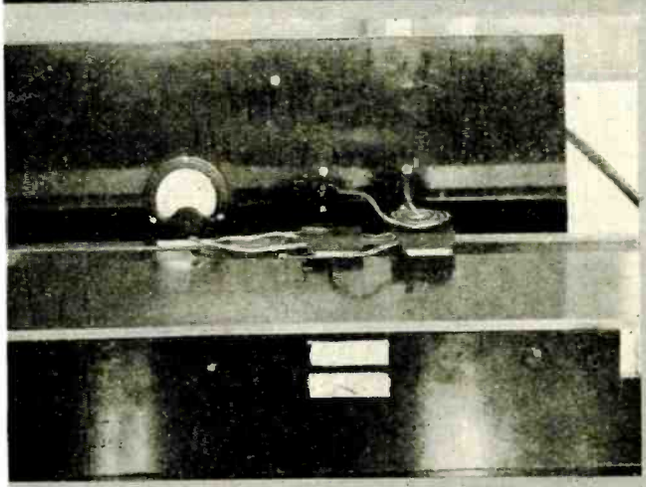
SILVER SOLDERING BRASS PARTS in a coil designed for universal use on miscellaneous small assemblies. No fixtures are required other than the transite block on which the parts are laid. Special solder rings are unnecessary since if suitable flux is used, a piece of solder placed near the center of the joint will flow evenly around the parts. By use of high frequency (450 kc), the time on this job was cut from 0.186 hours for torch to 0.045 hours.



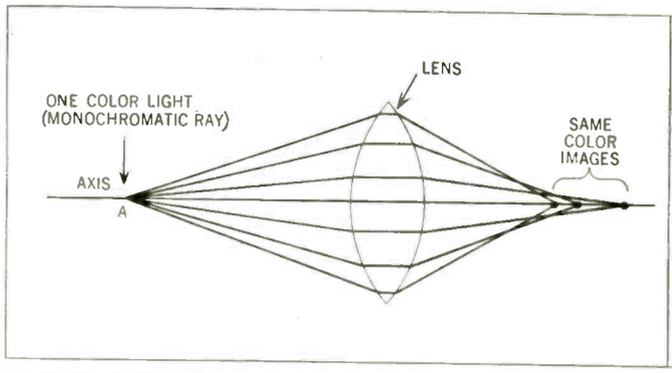
MOWER SECTIONS MUST BE HARDENED along the outer edge in order to hold sharpness, but must remain softer in the inside area for maximum strength. A 10 kw 450 kc rf generator operating in conjunction with special work handling equipment delivers one section to the quench tank every 2.8 seconds. The coil consists of a hairpin or elongated parallel sided loop bent into a shape to conform to the edges to be heated. The average width of the hardened zone (shown in insert) is approximately 3/8 in. with an Rc hardness of 62-64.



THE APPLICATION OF INDUCTION HEATING to the soldering of brass and steel clips to carbon brushes and shunt leads is an excellent adaptation for rf generators. A pancake coil is made of 3/16 in. copper tubing for a brush 2¼ in. x 1½ in. x ½ in. thick which weighs approximately 65 grams including flexible copper leads.



THESE BRUSHES ARE HEATED to proper soldering temperature in 2.5 seconds per brush at 450 kc and with a power input of about 5 kw. By using a non-corrosive (resin) type of flux and properly controlling the time of the heating cycle solder creepage can be held to a minimum.



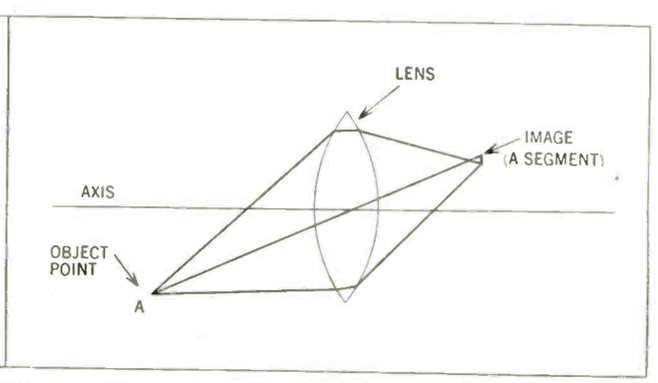


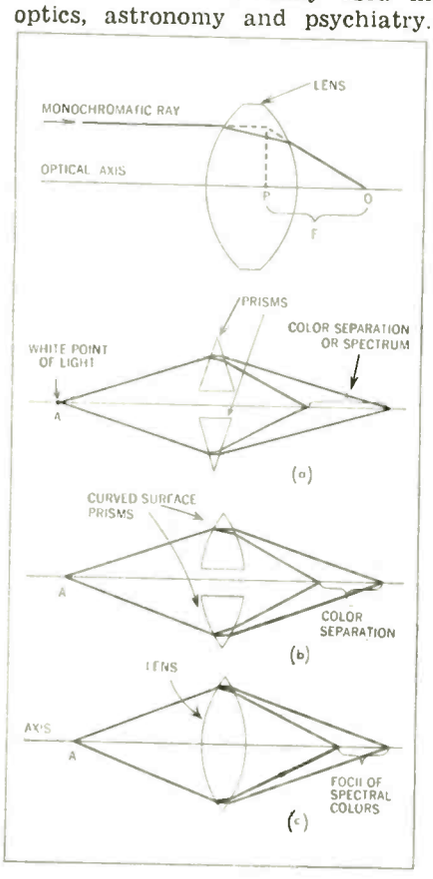
Fig. 3—In spherical aberration, rays of the same color impinging on the lens at different distances make it impossible to sharply focus A.
Fig. 4—If the object point A is moved away from the optical axis, though remaining in the same plane, another aberration, coma, results

LENS ABERRATIONS IN

By ANGELO MONTANI
Consulting Engineer, 7651 85th Road, Woodhaven, N. Y.

Fundamental principles of optics underlying methods of computing refractive systems for television equipment

• In simple English, "aberration" means defect or deviation from a normal behavior. It is with this last meaning that the term "aberration" is conventionally used in optics, astronomy and psychiatry.



Every lens, convex or concave, has a definite focal length f which is expressed by the relation:

$$\frac{1}{f} = (n-1)\left[\frac{1}{r_1} - \frac{1}{r_2} + \frac{t}{n}\,\frac{n-1}{r_1 r_2}\right]$$

In the above equation n is the index of refraction of the glass, r_1 and r_2 the radii of curvature of the two surfaces and t is the axial thickness of the lens. Fig. 1 shows the physical meaning of f and related parameters. The distance between P and O is the focal length f.

The construction on the figure clearly shows how the location of P is determined. If we now should trace some other ray impinging on the lens above or below the one represented, we would find after the ray is refracted, different locations for points P and O. Besides, if the color of the ray is varied, we would find still newer locations of points P and O.

Therefore to give an exact meaning to the above algebraic relation it has been arranged so that it applies only to rays impinging on the lens parallel to the optical axis, and so near to it that they cannot be distinguished from one another. The selected color of such rays is the yellow of the n_d spectral line. Under these conventions, the formula yields a definite focal length. All those rays which do not behave according to the equation deviate from the rule and constitute aberrations.

Fig. 1—(Top) Physical meaning of the term f and related parameters. Fig. 2—Analogy between two prisms and a spherical lens showing how point source is focused

We consider here six principal aberrations and at each instance only one aberration is considered at a time for the sake of clarity. In reality, of course, all aberrations exist at the same time and mutually interfere. The easiest aberration to grasp is the chromatic aberration or color dispersion. Every school boy knows that a prism will decompose a ray of white light into its elementary colors.

Fig. 2 shows how a lens may be thought of as two prisms with spherical surfaces joined together. The logical necessity that a lens should also decompose the white light immediately follows. Since no unique focus can be obtained, it is impossible to secure a sharp image of point A. It is understood that in the present figures only few characteristic rays are traced and the aberrations are represented qualitatively and not quantitatively.

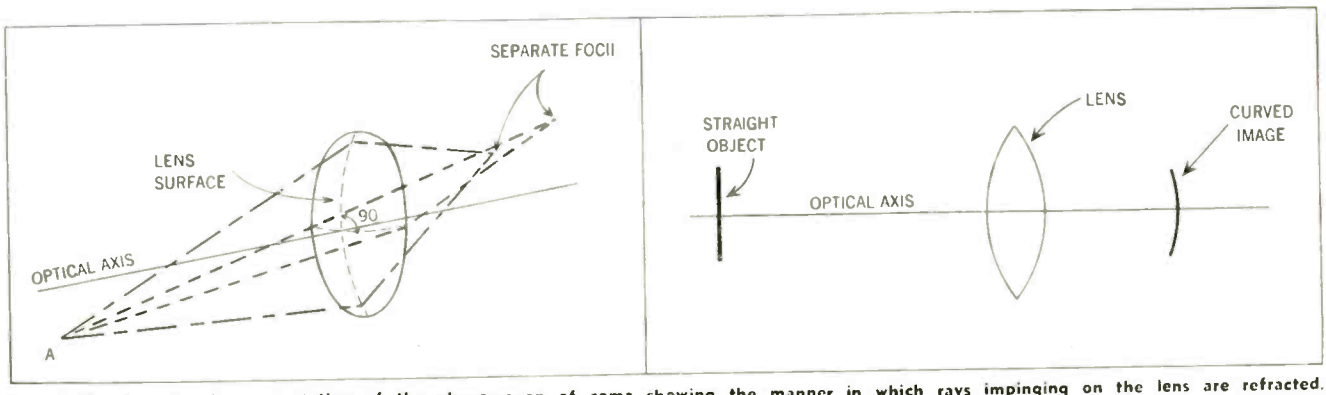


Fig. 5—Tri-dimensional representation of the phenomenon of coma showing the manner in which rays impinging on the lens are refracted.
Fig. 6—If instead of a point source of light a line image is used the resultant image will be curved in conformity with lens concavity

PICTURE PROJECTION

Fig. 3 illustrates spherical aberration. We see how rays of the same color, but impinging on the lens at different distances from the optical axis form different focii. The rays passing through the lens near the edge form the shortest focus. In this case also, it is impossible to obtain a sharp image of point A.

So far we have considered point A situated on the optical axis; let us move it away from the latter although remaining always on the same plane. Beside the above aberrations, new aberrations arise in this new position. One of these is "coma." The image of point A is no longer a point, but a short segment as in Fig. 4. If now point A is raised above the plane we get also "astigmatism" or "astigmatic aberration."

A tri-dimensional representation of the phenomenon is necessary to visualize it. Fig. 5 shows how the dashed rays emarating from point A form equal angles with the surfaces of the lens, and after refraction, form a separate focus from the dot and dash rays forming non-equal angles with the lens surfaces. The two couples of rays lie on perpendicular planes.

The science of computing lenses for various purposes is a complicated one with which few are familiar. Lens aberrations or faults are many and must be carefully corrected. Here are shown a few of the more common forms of aberrations with which lens designers are concerned. Illustrations have been simplified to help in giving an understanding of the principles involved, faults being shown qualitatively and not quantitatively. Also, while aberrations are invariably co-existent, they have not been so shown for the sake of clarity—Editors.

Curvature of field

If instead of a point we try now to obtain the image of a line, then we discover "curvature of field." Fig. 6 shows how the image of a straight line would be curved with the concavity facing the lens. Only on an appropriately curved screen could this image be focused all at one time. Fig. 7 shows the last aberration considered here which is simply called "distortion." Distortion in fact is evident in the metrical property of the image in relation to the shape of the object.

We again repeat, all of these aberrations exist at the same time. Separate figures were used for each one because should we have represented all of the aberrations together, the figure would have looked almost undecipherable.

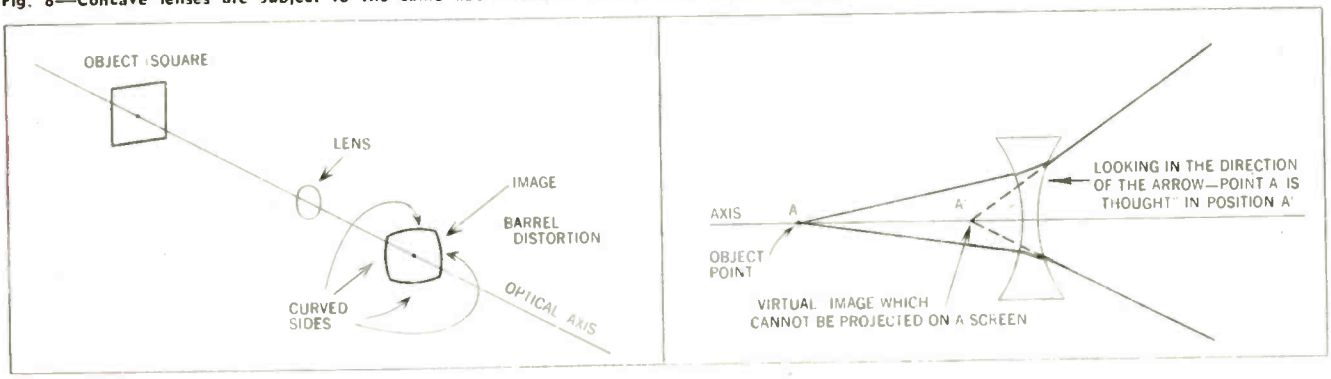
Although we are confining ourselves here to the mere description of aberrations we feel that it is legitimate to expect from the reader the spontaneous question: If a lens is really so defective, how it it possible that we use them?

Negative lenses

In our very short excursion into the dioptrical domain we did not mention at all the "negative" lenses, but only the positive ones. Fig. 8 shows this type of lens with concave surfaces which was not described because it does not form

(*Continued on page* 150)

Fig. 7—Another form of lens aberration for which corrections must be computed is distortion, in which the shape of the object becomes altered.
Fig. 8—Concave lenses are subject to the same aberrations as convex lenses, are computed to be used in reducing and correct lens faults



NEW POWER OPERATED

By DR. PAUL G. WEILLER
Consulting Engineer, 95 Broad Street, New York

Use of tube-controlled shaded pole motor drive to follow up movement of a sensitive instrument provides rapid operation

• Various methods of recording currents or voltages, or other quantities which can be converted into current, have been in use for almost half a century. Many present day recorders consist of large d'Arsonval movements to which the pen is directly connected. These movements can, however, be used only where appreciable amounts of power can be withdrawn from the circuit without introducing errors. More complex measuring and recording systems have been devised to avoid loading the circuit to be explored.

Some systems clamp the pointer periodically and explore its position by mechanically-operated feelers, which in turn operate switching devices. More recent designs couple the pointer to the recording movement by light rays and a photocell. All of these arrangements are complicated by delicate mechanisms and require careful and competent maintenance.

Continuous recording

The greatest drawback to the more common arrangements is their discontinuity: a number of seconds must elapse between two samplings of the pointer position. Only the magnitude of the variable at the instant the pointer is clamped is recorded. The desirability of a follow-up system which would faithfully and continuously follow and record the movements of an instrument pointer has always been recognized but the means for accomplishing this object became available only recently.

The procedure is to use the pointer as the arm of a double-throw switch, which starts, stops or reverses a motor, depending on whether the pointer makes contact with the down scale or up scale circuit, or floats in between and keeps the circuit open. If the up and down scale contacts are mounted on a motor-driven member with its center of rotation in line with the instrument pivot, this member can be made to follow any movement of the pointer. This mechanism constitutes a "follow-up system". A pen connected to it will trace the pointer movements on a chart.

Contact difficulties

Systems of this type have been used as an integral part of modern controls or remote positioning devices, but they are operative in this simple form only where the transmitter (in this case, the meter) could exercise some appreciable contact pressure. A device designed to follow a meter pointer must, however, be able to operate reliably on contact pressures of 1/10 milligram or less.

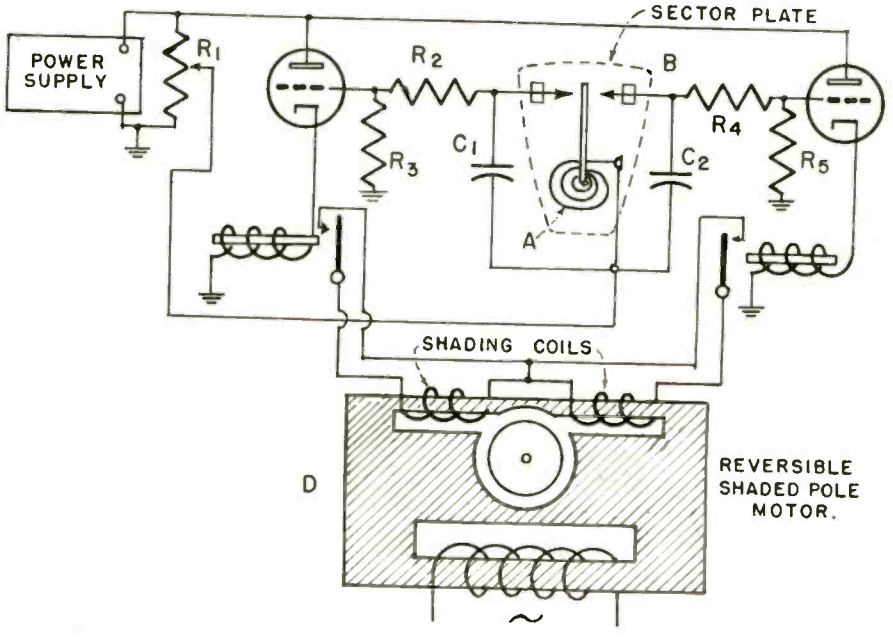
When only such minute forces are available, serious obstacles in the way of proper operation of this basic system are encountered:

1. Even at low voltages the electrostatic attraction between contacts and pointer is sufficient to cause wrong operation, unless provisions for correcting or utiling this effect are made.
2. Most contact materials will show traces of sticking with the passage of even the smallest currents when the contact pressure is low.
3. All materials operating in the atmosphere are coated with a minute layer of absorbed gas and with material particles precipitated from the air. These low contact pressures are generally insufficient reliably to pierce this insulating layer and provisions must be made for the piercing of this layer to obtain a reliable contact.

Any one of these three factors alone would be sufficient to prevent satisfactory operation. The detrimental effect of all three of them is eliminated in the following design:

To prevent sticking it is necessary to make the contact pins of a thor-

Fig. 1—Electrical design of reversible motor connections to tubes avoids contact troubles



SENSITIVE RECORDER

oughly non-welding material. Graphite is the most reliable in this respect, but any surface coating of grease or other foreign material must be eliminated after mounting by heating the contacts to red heat in a flame. Tungsten, with a graphite coating, also may be used.

The pointer of the instrument is removed and replaced by aluminum tubing .010 in. diameter (insulated from the movement) in which gold wire .005 in. is inserted. Current is admitted through a spiral of tinsel or an additional hair spring connected to the new pointer near the pivot. The gold wire operates against the graphite pins without sticking.

The electrostatic attraction between pointer and contact could not be eliminated, so it is put to use. In fact, it is found that quite appreciable voltage (50 to 100 volts) on the pointer is desirable for the operation of this recorder.

However, if the spacing between pointer and contacts is made only, say, .002 in., the system becomes unstable and the pointer will hunt back and forth between the two contacts continuously for the following reason: The pointer will be attracted to the nearest contact, the potential difference will disappear and the pointer will swing back, away from the contact, only to be attracted again. The process will repeat indefinitely.

Eliminating hunting

This action is stabilized, however, if the contacts are placed at a greater distance from the pointer. Then we have a neutral zone where the fields of the two contacts largely counteract each other so that the remaining torque is insufficient to move the pointer positioned by the opposed torques of the hair spring and the coil of the d'Arsonval movement. As soon as the pointer is moved from the neutral zone by the latter it will be attracted by the nearest contact and cause the follow-up motor to function in the proper direction. It will remain in contact until the contacts, and with them the pen, have moved to a point on the scale near the new position of the pointer.

Now the pointer again becomes unstable, and will continuously leave the contact to be attracted immediately again. However, the motor is inched forward at each new contact closure meanwhile. Through this "pecking" process, the follow-up system will slow down and approach the correct balance position in small jumps. Finally, therefore, the pointer will come to rest again within the neutral zone and the follow-up system will stop at its new position.

The "pecking" process takes the place of some damping. It reduces the speed when balance is approached so there is no over-shooting at all for small movements of the pointer. For movements of 100° on a 300° scale there is some overshooting for fast movements—for example, a full scale swing in 6 seconds. It is not too difficult to make the movement critically damped in process control where this is necessary. The neutral zone can be made quite small (about .002 in.) by proper selection of the voltage between the contacts and pointer.

The voltage applied between pointer and contacts may be between 20 and 100 volts, depending on the spacing, the torque of the meter and the sensitivity desired.

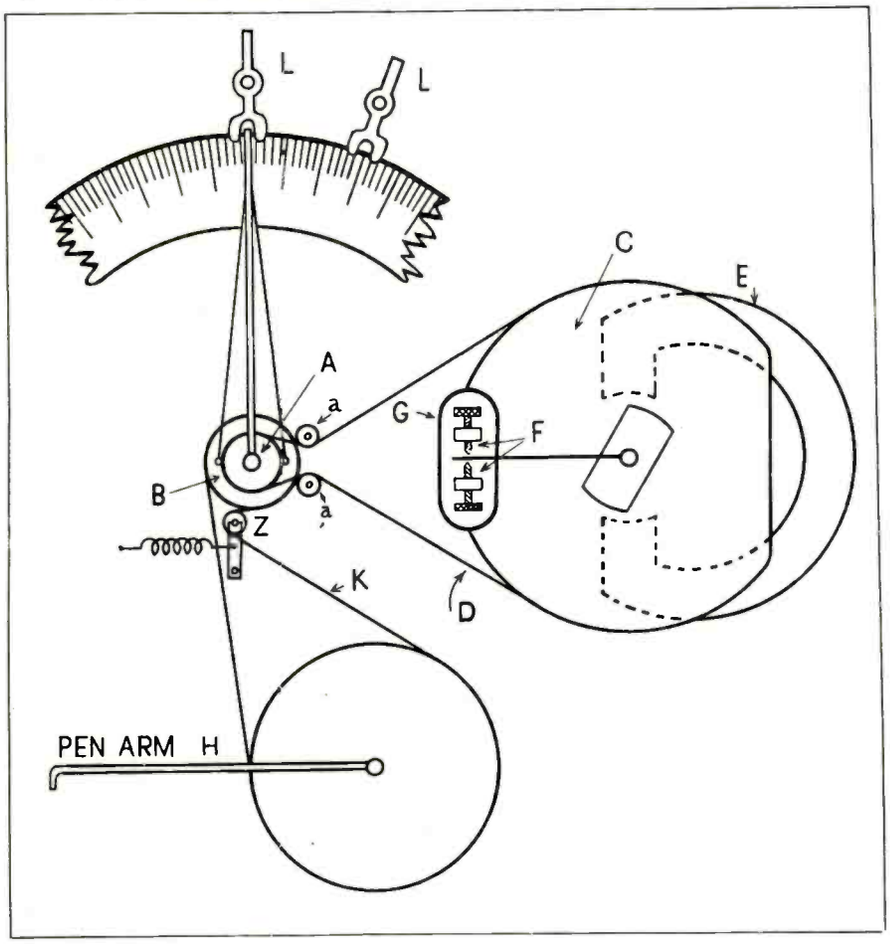
The piercing of the gas layer on the contact surfaces is accomplished easily by the comparatively high voltage, assisted by two small capacitors placed between the pointer and each contact. Just before the pointer makes contact, a minute spark from the condenser discharge, will pierce the gas layer and insure passage of the minute currents involved.

It is quite clear that such a system can handle only a small fraction of a milliampere. Since even the coil current of a sensitive relay might cause unreliable operation, the contacts are called upon to handle only the grid circuit of an electron tube.

In Fig. 1, meter A may be the movement corresponding to one in a 0-1 milliameter or a 0-50 microammeter, having high resistance and high torque. Any meter with a torque of 20 centimeter milligrams

(*Continued on page* 136)

Fig. 2—Servo mechanism gives magnified indicator scale, independent pen arm, control attachment



TUBES ON THE JOB

FM gives continuous control of RR switching

Freightyard Radio Network

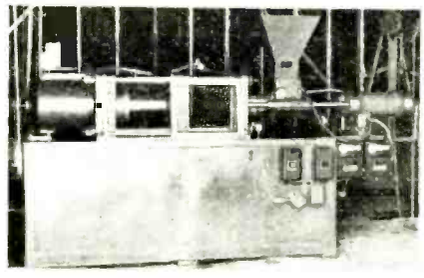
Two-way FM communication, between the yardmaster and the engineers of five switching locomotives, has resulted in a considerable speed-up of freight movement at the East Pittsburgh plant of Westinghouse. The five mobile units, installed in the engines, are industrial models of the Army's walkie-talkie. These and the main transmitter-receiver station near the yard office provide continuous control of freight traffic over all of the 25 miles of track in the yard. In spite of the fact that this installation is in the highly industrialized Allegheny River Valley, where thousands of electrical machines are operating, no static or noise interruptions are experienced.

Alloy Analysis

A direct reading spectrometer for electronically measuring the concentration of elements in alloys and automatically recording the results, has been developed and is in use by the Dow Chemical Co., Midland, Mich. Tests can be made in 40 seconds, and the entire operation is automatic from the time the metal samples are placed in the instrument until the analysis is recorded on paper. Up to 14 elements can be determined simultaneously. The speed of operation is of particular importance when in melting, alloying and casting metals, a melt must be kept at a specified temperature while waiting for analytical reports.

Steel Injection

An electronically heated and controlled injection molding press to mold stainless steel, nickel or other metals, with a melting point under 4200° F, has been developed and is in use in the Hisgen Machine Tool Works, 2047 W. 94th St., Los Angeles 44, Calif. This equipment, capable of handling individual shots up to 15 lbs., is entirely automatic in operation—closing, injection, opening the die and the ejection of the molded unit. Four injections per minute are obtainable. The material to be molded is in granular form and injected into the die with a double telescoping, triple thread plunger which sets up a pressure of about 80,000 lbs. per square inch. Using an 85 kw Megatherm generator, manufactured by Federal Telephone and Radio Corp., Newark, N. J., the heating time of a single steel injection is 2 seconds.



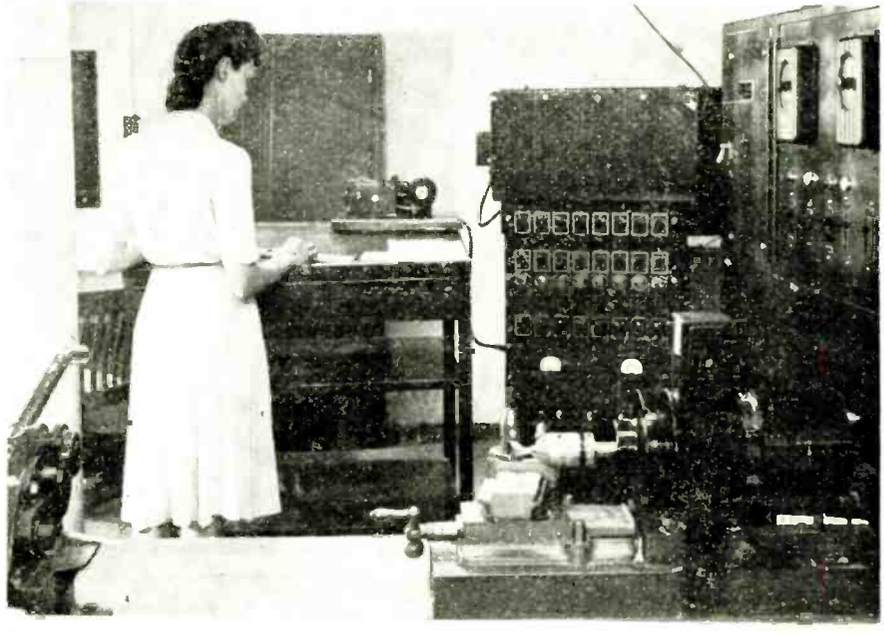
Stainless steel can now be molded electronically

Small parts on magnetic chuck ready for grinding

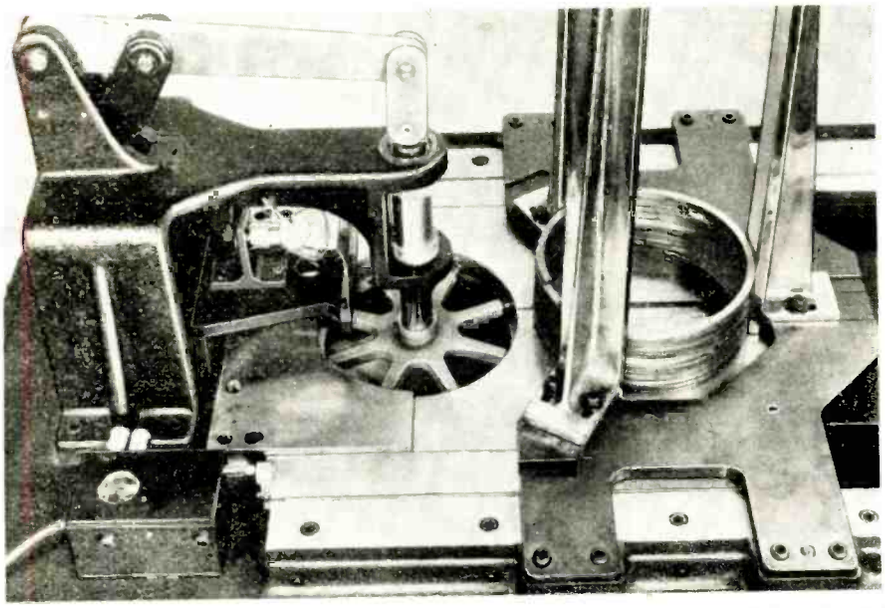
Production Grinding

A packaged industrial type tube rectifier unit has helped solve a difficult problem in handling small wafer-like component parts on a production surface grinding operation. Long set-up time and a large percentage of spoilage were reported until the Blanchard Machine Co., Cambridge, Mass., installed a grinder with a rotary magnetic chuck. In operational set-up, one surface of each of the plates are thinly coated with a suitable wax. The components are then positioned on the wax surface of one plate and the plate warmed. After cooling, the wax acts as a bond between the wafers and the support plate. The assembled plate is then centered on the magnetic chuck and locked on with necessary dc supplied from the rectifier unit.

Loadings as high as 200 pieces at one time have been handled by this method.



The fully automatic direct-reading spectrometer eliminates the need for photographic and developing equipment or a microphotometer; tests are made in less than a minute



Feed table and gaging head of piston ring inspection unit; rings are fed, checked and sorted automatically. Complete inspection cycle takes about two and a half seconds

Dielectric Drying

In addition to a saving of eight to ten hours in drying large transformer bushings, dielectric heating has also eliminated the need for bulky drying ovens and the network of steam piping previously required in the Westinghouse Electric Plant at Sharon, Pa.

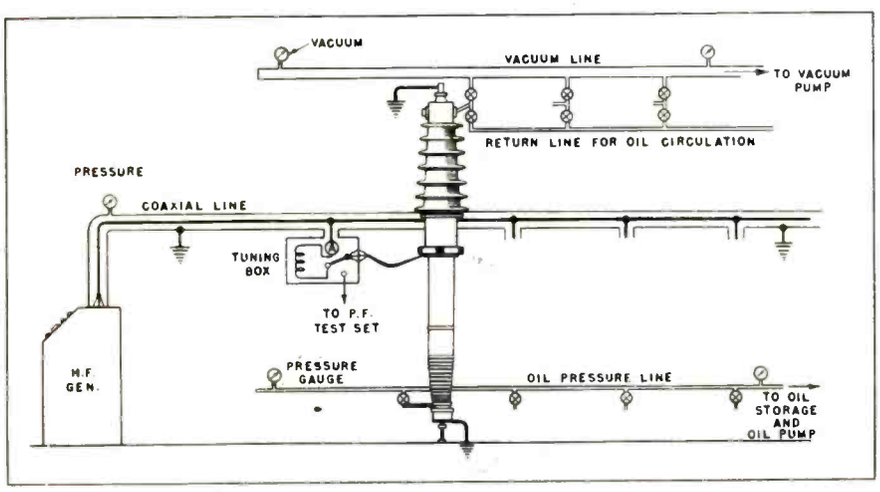
A single Westinghouse 10 kw generator supplies the heating current to a bank of drying cages, the 5 mc frequency being distributed by a nitrogen-filled coaxial line. Separate tuning boxes are installed in each cage for the proper adjustment of individual load conditions. A vacuum line and oil pressure lines also have connection valves in each drying cage. As an insulator is being dried, the moisture driven off is carried away through the vacuum line. After thorough drying, and while the heat is still being applied, oil under pressure is forced into the insulation.

Piston Ring Gage

Fully automatic equipment which will inspect and sort piston rings at a rate of 1500 per hour, uses a photo electric gaging unit for measuring both the width of the gap and the trueness of the periphery. The equipment was developed by the Sheffield Corp., Dayton, Ohio, and makes possible high speed inspection and accurate size standards with tolerances within 0.0001 in.

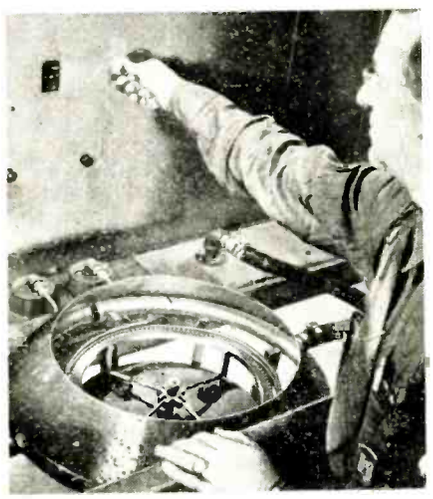
Rings are manually stacked in a vertical feed rack and in two automatic operations each ring not only is checked for gap size and outside surface roundness, but solenoid operated trap doors are tripped for proper sorting of all inspected rings. The piston rings are individually fed into the gaging position formed by the 180 degree arcs in both the feed slide and the stationary compression plate. The size of the circle formed by the two arcs is the normal working diameter of the ring and in this position the size of gap is measured. The vertical feed spider then descends and pushes the piston ring into a constantly rotating master ring. Rollers on the spider fingers assist in properly positioning the piston ring. A concentrated beam of light projected through an optical system scans the outside periphery of the ring checking its light-tightness. If either or both check operations indicate a piston ring outside of tolerance, the ring is automatically sorted into proper reject container.

Dielectric drying lay-out, showing arrangement of coaxial cable, oil and vacuum lines



Production Economics

One of the first induction heating operations to be engineered into the production lines of the Studebaker Corp., South Bend, Ind., is the hardening of teeth on the ring used as a starting gear on the flywheel. While these teeth must be extremely hard to withstand the repeated shocks of engine starting, the body of the ring should remain comparatively soft for future mechanical processing.



Ring gear ready for 20 sec. hardening operation

The 20-second electronic hardening operation is started when the ring gear is placed on a brass jig which revolves at 75 rpm inside a two-turn heating coil. Directly over the heating element is a circular water ring for quick quenching. The actual hardening process takes 13 seconds—long enough to bring the gear teeth to a temperature of 1500° F. Seven seconds are needed for complete water quenching.

As a comparison to this 20-second hardening operation, prewar case-hardening of this same type of gear required heating the ring gear in a gas oven for one hour before quenching, while tempering the body of the ring took an additional 90 minutes.

PHOSPHORS AND THEIR

By IRVING KRUSHEL
North American Philips Co., Inc., Dobbs Ferry, N. Y.

Part 2 of a study of the manufacture, applications and

Because the method by which a viewing screen is made greatly affects its characteristics some of these methods of application will be considered in some detail. Some characteristics of the screen which are affected by the screening method are optical contact, contrast, secondary emission, and efficiency. Each of the methods described below offer advantages and the final choice depends upon a number of factors such as size of bulb and screen, type of screen, thickness of screen desired, number of bulbs to be screened, etc., and other factors which will be apparent from the following description of production operation.

Spraying

In this method a suspension of the phosphor in a volatile liquid is sprayed onto a heated bulb. The volatile fluid may be acetone, water, or methyl alcohol. To the suspension may be added a binder such as nitrocellulose or sodium silicate. The particle size range which can be sprayed to form a uniform screen is approximately 0.1 to 8 microns. The density of the material must be considered as it is impractical to suspend a uniform large particle size range of a dense material such as zinc sulfide in the common suspending agents used. A "peptizing" agent such as acetic acid may be used to aid in suspension and in preventing the formation of aggregates.

About three times as much phosphor as is needed to coat the screen is sprayed into the bulb making this a fairly wasteful process. This method though lends itself to quantity production. Phosphors can be milled in the suspending agent and brought to the desired particle size range very conveniently. P1, P3, P4, and P5 screens are often made this way. The degree of optical contact of such a screen is fairly high thus adversely affecting the contrast.

Fig. 17—Making C-R tube screens by dusting. The phosphor is held by a coating of binder

Dusting

This method is probably the simplest and most flexible one. A binder such as potassium silicate or phosphoric acid is first used to coat the surface receiving the phosphor. The phosphor is then made to settle and roll over the coated surface until a uniform layer of the desired thickness is formed, see Fig. 17. As the particles roll over the binder treated surface they are themselves coated with binder, and will hold fresh particles rolling over them. In this way a very thick screen, if desired, may be built up which can receive an additional coating of binder to still further strengthen the bond between screen and glass. The particle size range for dense materials such as sulfides is from 15 to 35 microns with a preponderance of larger sizes giving a more uniform screen. For materials of lesser density such as silicates and tungstates for the best results by dusting, the particle size range should be from 5 to 15 microns. This method yields screens with very high contrast because of the low optical contact resulting from such a screening.

Settling

Particles distributed in a liquid will settle by gravity and uniformly deposit on the bottom of the container if the suspension is free from vibration and if the particles are of the correct size. The liquid can then be poured or siphoned off and a thin layer of material will be firmly adhered to the glass. A binder such as potassium silicate or phosphoric acid may be used to get better adhesion. The homogeneous distribution of the material in the liquid plus a lack of temperature difference between the liquid

BEHAVIOR IN TELEVISION

properties of phosphors in relation to television needs

and its surroundings (to prevent setting up of heat currents) are other factors upon which the uniformity of deposition depends.

A wide range of particle sizes can be used in settling. The upper limit is determined by the density of the particles and type of binder used. The lower limit is the point where colloids form or where the length of settling time makes the process impractical.

Settling lends itself to the screening of large bulbs and screens. It yields a screen of fairly high contrast because the optical contact is little.

"Flowing-on"

A suspension of phosphor material in a nitrocellulose-amylacetate solution can be made to uniformly coat or flow over the face of a bulb thus forming a thin phosphor layer or screen. The excess material is poured off and the bulb is heated till the binder and solvent are thoroughly baked out. By changing the concentration of phosphor in the binder or by changing the viscosity of the binder the thickness of the screen can be adjusted between wide limits. The degree of optical contact is very low in this method consequently aiding the contrast.

Electrostatic deposition

In this process an intense electric field is produced by a charged electrode inserted into the bulb. The air in this intense field is ionized producing charges of one kind. The particles will be charged identically and they are repelled from the electrode and deposit on the bulb which is grounded.

The application of a multi-component screen such as the P4 screen offers the peculiar problem of separation of components due to the variance in densities and particle size with the resulting color disarrangement. Also where a phosphor cannot be milled and must be used with the particle size range obtained from the crystallization process the choice of screen application method is limited.

Fig. 18—Dusting a phosphor coating on a large (10 in.) cathode ray tube

Properties of phosphors

From the foregoing discussion it can be seen that before a phosphor can be used for television cathode ray tube purposes it must meet the following requirements:

1. Resist milling deterioration of efficiency
2. Be able to withstand the high temperatures of tube processing
3. Easily give up the gas it contains.

In addition a phosphor must have qualities necessary for satisfactory tube operation. These qualities will be understood from the following description of the operation of a cathode ray tube. Electrons from a hot oxide cathode (indirectly heated) are focused into a fine beam and are accelerated through a deflecting system onto the phosphor screen. The deflecting system moves the narrow electron beam about so that the picture is traced out while a grid modulates the beam intensity and consequently the picture brightness. By processes described previously when the electron beam hits the phosphor screen light is emitted rapidly (fluorescence) or slowly (phosphorescence). The emitted light should be of a pleasant color and this color should not change under different electron beam conditions. For each electron that comes onto the screen at least one must come off otherwise a negative charge will be built up which will impair the operation of the

tube. Also for television purposes it is important that the phosphorescence of the phosphor be of such a duration that one picture will not remain to interfere with the next one. Finally it is important that a phosphor be able to withstand deterioration by bombardmen with highly accelerated electrons for a protracted period of time. The following characteristics are therefore desirable in the operation of the tube.

1. Efficiency and brightness
2. Proper color
3. Color stability under varying conditions of tube operation
4. Good secondary emission characteristics
5. Proper phosphorescent characteristics
6. Resistant to electron bombardment.

These qualities will now be considered in detail.

Resist milling

For most processes of screening a phosphor must be brought to the proper particle size range before it can be used. This can easily be done in a ball mill to which is also added the fluid in which the phosphor is to be suspended. During this milling process the phosphor undergoes a loss in efficiency due to the disturbing of the sensitive lattice structure unique to luminescent substances.

Milling will seriously reduce the efficiency of sulfide phosphors when prolonged beyond 8 hours. The phosphor system zinc cadmium sulfide, copper activated will lose most of its phosphorescence if milled for 6 hours.

Tungstates and silicates are more stable and therefore can withstand prolonged milling with but a slight loss in efficiency. Willemite and zinc beryllium silicate in fact show increased fluorescent intensity with smaller particle size in the range from 20 to 2 microns indicating that their fluorescence seems to be a surface phenomenon (16) (see Fig. 5).

Many phosphors can be prepared during the firing or crystallization process so that they have a particle size range proper for application to the bulb without milling. Thus the loss in efficiency resulting from milling is avoided. For instance zinc sulfide and zinc cadmium sulfide mixed to give a white fluorescent color can be applied to the bulb by the dusting process without milling, if the particle size range is properly distributed between 15 and 30 microns, which can easily be done during crystallization.

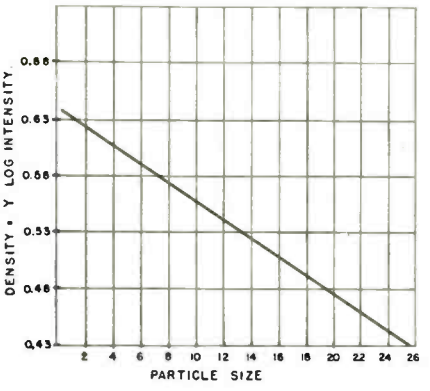


Fig. 5—Willemite and zinc beryllium silicate can stand prolonged milling as fluorescence increases with small particle size

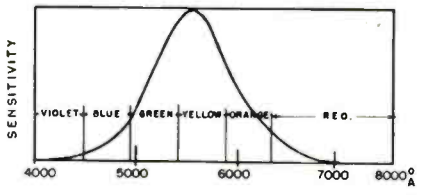


Fig. 6—Sensitivity of the eye to colors

Contrast in the picture depends to a large extent upon the optical contact between the phosphor and glass surface on the bulb. The optical contact in turn depends upon the phosphor particle size and the method of screen application. With decreasing particle size comes increased optical contact with a corresponding decrease in contrast. Sprayed screens have an optical contact of 30%, settled screens 20%, and dusted screens 15% (17).

Withstand high temperatures

The manufacture of cathode ray tubes requires that the envelope and phosphor be repeatedly heated at 400° C in air and in vacuum. This is done to drive the binder completely out of the screen and that portion of the tube.

Phosphors in general rapidly lose their efficiency when heated above 200° C. Since the crystal lattice is heat formed it is heat sensitive and may be permanently affected by excess temperature. Phosphorescence can be quenched by heating or application of infra-red as for instance in zinc cadmium sulfide copper activated. The addition of

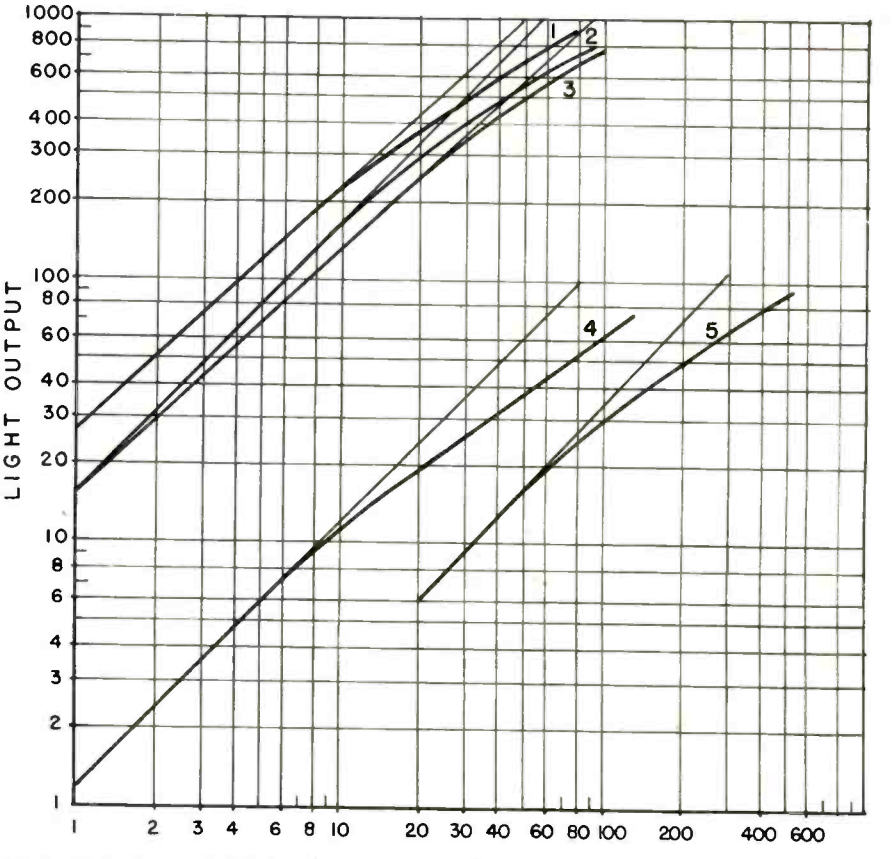


Fig. 7—Beam current density in micro-amps/cm² as abscissa vs. light output as ordinate. Curve 1., Zinc silicate (Zn_2SiO_4·Mn); 2., Calcium tungstate ($CaWo_4$); 3., Zinc cadmium sulphide (ZnCdS·Ag); 4., Zinc Beryllium Silicate ($ZnBeSiO_3$·Mn); 5., Zinc Sulfide (ZnS·Ag). At higher current densities screen saturation changes the directly proportional relation between current density and light output with resultant drop in the latter

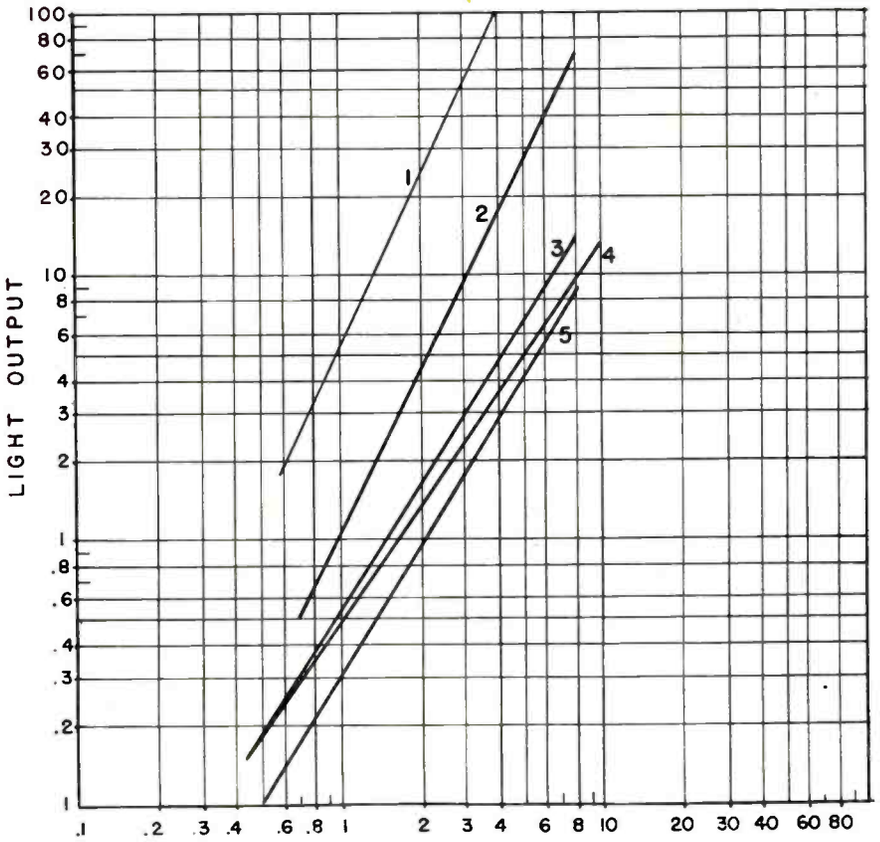


Fig. 8—Light output plotted vs. screen kilovolts relative to the cathode. Curve 1., Calcium tungstate ($CaWo_4$); 2., Zinc sulphide (ZnS:Ag); 3., Zinc Beryllium silicate ($ZnBeSiO_3$:Mn); 4., Zinc Cadmium Sulfide (ZnCdS-Ag); 5., Zinc silicate (Zn_2SiO_4:Mn). For low current densities the curves indicate linear relationships. With increased voltage, however, a point is reached where the screen can not pass off rapidly enough the negative charge imparted by the electrons, thus causing the potential to drop

energy releases electrons from the trapped states more rapidly than the normal energy transfer from the crystal lattice to these electrons. Conversely at extremely low temperatures of about —175° C, the luminescence is increased and phosphorescence can be made to persist for long periods of time.

Sulfide phosphors are much more affected by heat than silicates or tungstates. In the P4 screen the zinc sulfide often loses some of its efficiency during tube manufacture resulting in shaded areas of high efficiency zinc beryllium silicate and low efficiency zinc sulfide. When zinc beryllium silicate is heated in air and cooled from a temperature above 350° C a chemical deterioration takes place in which a brown oxide, manganic oxide (Mn_2O_3) is formed which causes discoloration of the normally white zinc beryllium silicate and loss in fluorescent brightness up to 20%. The reaction is reversible and the original phosphor (color and fluorescent brightness) may be obtained by heating the deteriorated form in a vacuum or reducing atmosphere (18).

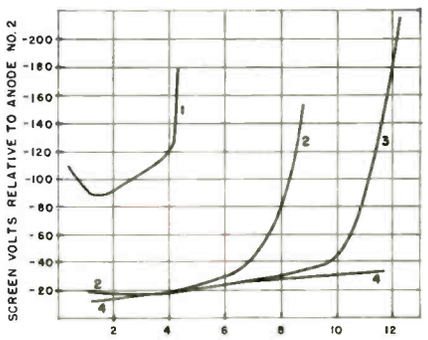
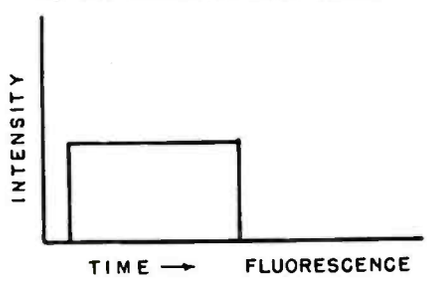


Fig. 9—Screen volts vs. anode No. 2 kilovolts. Curve 1., Calcium tungstate; 2., Zinc sulfide; 3., Zinc silicate; 4., Zinc beryllium silicate. Screen potential is limited by secondary emission. Increasing the accelerating potential will not increase the screen potential but will increase its charge

Fig. 10a—Fluorescence drops instantly



Another heating effect is due to the kinetic energy of the electron beam. As explained above, much of the exciting energy of the electron causes oscillations of ions and atoms (vibration of the crystal lattice) throughout the crystal (thermal agitation). This heating effect and resulting loss in efficiency becomes a critical problem at higher electron accelerating voltages and increasing beam densities.

Give up gases

Gases are absorbed by phosphors because of strong forces of attraction between the solid and gas molecules. The result is the formation of a thin film of condensed gas molecules which adheres very strongly. Actually there is little active space on the surface of the phosphor crystal that can, by the unbalanced attractive forces absorb gases, but in the case of a phosphor the area becomes very large because of the fineness of the material.

Phosphors moreover are somewhat porous in their structure and thus expose great interior surfaces. Capillary condensation occurs in these pores producing liquid having an abnormally low vapor pressure.

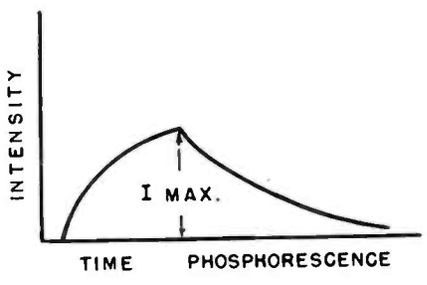
In cathode ray vacuum tube manufacture attempts are made to remove these gases by reducing the pressure and raising the temperature so that rapid stripping will occur. In many cases though absorption may be partly irreversible so that a definite amount of gas always remains absorbed.

Efficiency, brightness, color

The function of a phosphor is to convert the energy of the electron beam into visible light energy. The degree of this conversion is the efficiency of the phosphor and is the ratio of the total energy output per total energy absorbed. For practical purposes it is sufficient to measure the amount of visible light output per wattage input. This

(*Continued on page* 142)

Fig. 10b—Phosphorescence dies slowly



SURVEY of WIDE READING

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

Magnetostrictive Oscillator Coupling

H. Thiede, Atlas Werke A.-G., Bremen (Akustische Zeitschrift, Berlin, Vol. 8, No. 1).

In some instances it is not feasible to contact the medium directly it is intended to vibrate by means of a magnetostrictive oscillator. For instance, the medium may be a chemical reacting with the oscillator material or at a temperature at which the oscillator is not operative. A mechanical coupling to transmit the ultrasonic oscillations generated by the magnetostrictive oscillator to the medium has therefore been developed.

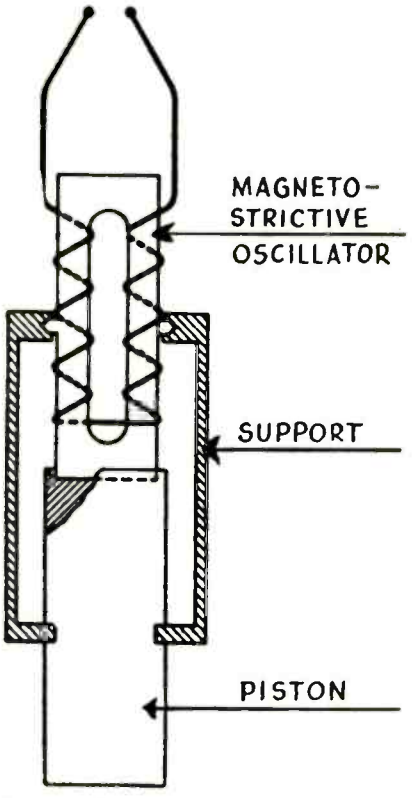
A magnetostrictive oscillator of conventional design is coupled with a piston made of material which can be readily set in oscillation. The oscillator and piston are tightly fitted at their adjacent surfaces, as indicated in the drawing. Their two centers are connected by the support so that the center zones of oscillator and piston are at constant distance from one another at all times; they are nodal planes.

Upon vibration of the magnetostrictive oscillator at its resonant frequency, it exerts pressure on the piston exciting it to oscillate in opposite phase to that of the magnetostrictive oscillator. The adjacent faces of oscillator and piston constitute a plane of maximum displacement. For correct adjustment, there will be only a small damping in the transfer of oscillations.

The material of the piston should be chosen to meet the physical and chemical requirements. Ceramics proved suitable in exciting ultrasonic oscillations in liquids at temperatures of several hundred deg. C., at which temperatures the magnetostrictive effect can no longer be used. An oscillator was constructed for engineering purposes which incorporated a water cooling system for the magnetostrictive oscillator. The piston is preferably made of a material having low thermal conductivity—for instance, porcelain. This construction also permits the maintenance of high intensity ultrasonic oscillations in air.

A demonstration of water drops up to 1 cm in diameter floating at the nodal points of an ultrasonic field in air are reported. Further, a strong emulsification of an oil-water mixture could be achieved by constantly adding the oil through an axial hole in the piston which dips into water.

Suggested applications of the coupled magnetostrictive oscillator are: generating ultrasonic oscillations in liquids up to 700° C., in strong acids or bases, or under conditions where the elimination of the accompanying heat is essential, or where strong ultrasonic fields in air or gases are needed over a long period of time, and for the preparation of strong emulsions.



Piston coupled to magnetostrictive oscillator

Formula for Ferroinductance

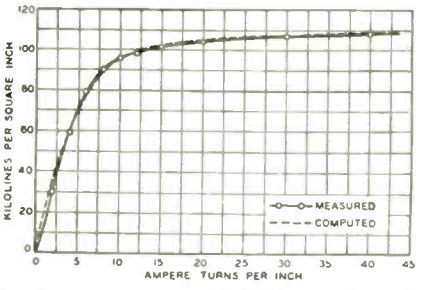
J. D. Ryder (Electrical Engineering, October, 1945).

A comparatively simple function for the magnetization curve of steel, which checks with the experimental shape, is proposed. It is the gudermannian, gd x = $\tan^{-1}$ sinh x; its derivative, sech x, is proportional to the inductance. The empirical form adopted for the magnetization curve was

$$B = B_n \mathrm{gd}\frac{aNi}{l} + \frac{cNi}{l}$$

where B_n, a and c are empirical constants to be evaluated by a trial process from experimental curves.

The formula was tested for Hipersil, Nicaloi and many other steels; close agreement was obtained in all instances (compare figure). From this expression, the



Magnetization curves illustrating agreement between measured and computed values

formula for the inductance can be derived:

$$L = \frac{aAB_nN^2}{10^8 l}\ \mathrm{sech}\ \frac{aNi}{l} + \frac{cAN^2}{10^8 l}$$

where the second term is the value if the iron is removed, leaving an air core. By the use of this equation, an inductor can be designed in advance of construction, to have a given inductance at a given value of current i, the only data required being the constants B_n, a and c of the particular steel used.

A new method has been developed by which ferroinductance can be measured at any value of current or ampere turns.

Assuming a sinusoidal applied voltage, the impedance of a series circuit of resistance, ferroinductance, which is a function of the current, I, and capacity may be found from

$$Z = \sqrt{R^2 + \left(\omega D\ \mathrm{sech}\ \frac{kaNI}{l} - \frac{1}{\omega c}\right)^2}$$

where $D=\frac{aAB_nN^2}{10^8l}$ ranging from 0.3 to 0.5, depending on the steel used. The first term in the bracket, representing the reactance of the ferroinductance, was experimentally verified. A reactance curve was measured, k computed from one particular value, and the other points of the curve calculated for this value of k.

At ferroresonance, the second term under the radical is zero, in analogy to the conventional resonance condition. The current for which this obtains can be evaluated from the above formula.

The ferroreactive voltage drop, E_L, may be written as

$$E_L=\frac{\omega AB_nN}{10^8k}\cdot\frac{k\alpha}{\cosh k\alpha}$$

where α = aNI l. From the shape of this function as plotted against $k\alpha$ it may be inferred that for $k\alpha$ smaller than unity, the reactive voltage drop is an almost linear function of the current, as is conventionally assumed for reasons of simplicity.

RC Oscillator Design

D. S. Robertson (Amalgamated Wireless of Australia Technical Review, Sidney, Vol. 6, No. 7, 1945).

Design features of RC coupled, variable-frequency audio oscillators are considered with a view to avoiding inconveniently high resistance values at the cost of frequency

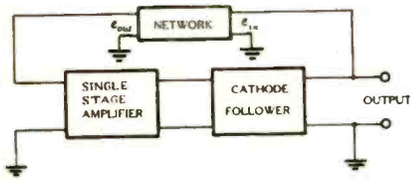


Fig. 1. Schematic diagram of RC oscillator

range. This is accomplished by varying only two capacitors in a four-capacitor network and dimensioning the constant capacitors for large capacitance so that the associated resistance values are comparatively small.

The six possible networks indicated by Fig. 2, and which may be

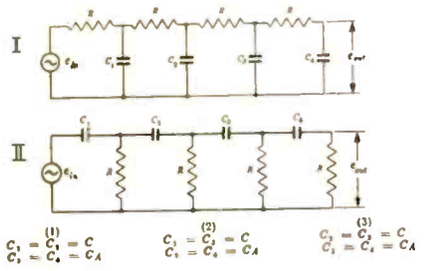


Fig. 2. Six possible RC feedback networks

Network.	ω	$\gamma\ (\beta=C/C_A)$	α = attenuation. $(\beta=C/C_A)$
I	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_1)^{\frac{1}{2}}$	$\frac{7+3\beta}{4+3\beta}=\gamma_1$	$\alpha_1=1-\frac{\gamma_1}{\beta}(\beta^2+11\beta+3)+\gamma_1^2$
I	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_2)^{\frac{1}{2}}$	$\frac{6+4\beta}{4+3\beta}=\gamma_2$	$\alpha_2=1-\frac{\gamma_2}{\beta}(2\beta^2+9\beta+4)+\gamma_2^2$
I	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_3)^{\frac{1}{2}}$	$\frac{5+5\beta}{3+4\beta}=\gamma_3$	$\alpha_3=1-\frac{\gamma_3}{\beta}(3\beta^2+10\beta+2)+\gamma_3^2$
II	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_1')^{\frac{1}{2}}$	$\gamma_1'=\frac{1}{\gamma_1}$	$\alpha_1'=\alpha_1$
II	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_2')^{\frac{1}{2}}$	$\gamma_2'=\frac{1}{\gamma_2}$	$\alpha_2'=\alpha_2$
II	$\frac{1}{R(C)^{\frac{1}{2}}(C_A)^{\frac{1}{2}}}\ (\gamma_3')^{\frac{1}{2}}$	$\gamma_3'=\frac{1}{\gamma_3}$	$\alpha_3'=\alpha_3$

inserted in the oscillator shown in Fig. 1, are studied. In all instances only two of the four capacitors are varied; the frequency is then proportional to either $1/C^{\frac{1}{2}}$ or $1/C_A^{\frac{1}{2}}$, depending on which pair of capacitors is varied. Upon plotting γ as a function of β it is seen that γ remains fairly constant for either low or high values of β (β is the ratio C/C_A as given in the table). However, attenuation is a minimum for β equal to unity and increases with decrease or increase of β. Circuit performance will be clear from the accompanying table.

It is shown that for a given amplifier gain, networks I,1 and II,1, with C_A variable give lower resistance values at a desired operating frequency, than any of the other networks considered.

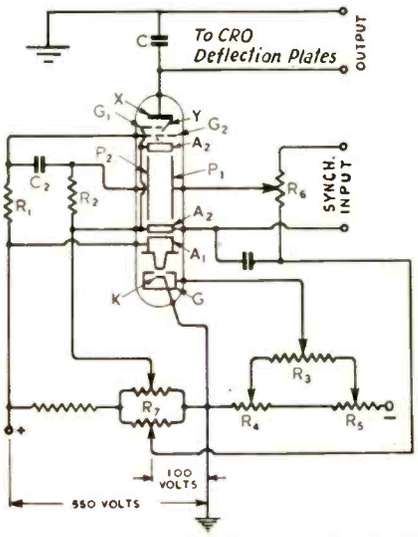
Automatic volume control is required with all types of oscillators treated.

Frequency Measurement with Deflection-Modulated CR Tube

P. Nagy and M. J. Goddard (Wireless Engineer, London, September and October, 1945).

The deflection-modulated cathode-ray tube, or signal converter, is connected as a generator to provide a calibrated time-base for direct measurements of frequency with an oscillograph. The accuracy of reading is ±1%.

By an electron optical system (G,A_1,A_2) the image of the elongated cathoded K is sharply focused at the output electrode XY. During the scanning period, the image falls on X and the output load C is negatively charged by the beam current; during the fly-back period, the image falls on Y, the output load C is positively charged. This performance is secured by means of secondary electron emission of output electrode X, Y and by provision of auxiliary electrodes G_1 and G_2.* Circuit elements R_1, R_2 and C_2 are inserted to provide regenerative feedback.



Deflection-modulated cathode-ray tube circuit

If the image falls partly on X and partly on Y, secondary electrons emitted by Y are collected by auxiliary electrode G_2; the resultant potential is fed back to P_2 deflecting the image wholly onto the positive output electrode Y. The output load C is now being positively charged until it reaches a potential close to the potential of electrode G_2. Then the current to the collector electrode G_2 decreases abruptly inducing a potential on deflecting plate P_2 so that the image

*The tube is described by P. Nagy in the Journal of the Television Society, London, June, 1944; summarized in Electronic Industries, Nov. 1944—page 112.

(Continued on page 162)

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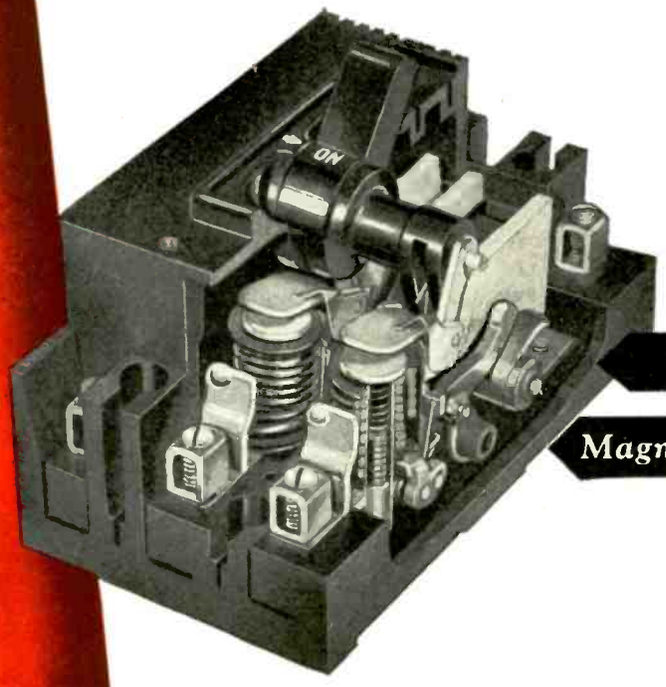

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Miessner, B. F., RFD 2, Van Beuren Rd., Morristown, N. J.
Mittelman, Eugene, 3239 W. Douglas St., Chicago, Ill.
Moulic, William E., 303 E. Locust St., Bloomington, Ill.
Mouradian H., 3254 Chestnut St., Philadelphia, Pa.
Murray, Albert F., 1616 Sixteenth St., N.W., Washington 9, D. C.
Nelson Research Laboratories, 100 S. Mitchell St., Cadillac, Mich.
Pacent, Louis G., 79 Madison Ave., New York, N. Y.
Page & Davis, 504 Munsey Bldg., Washington, D. C.
Pamphilion, L. Edward, 808 Darnell Ave., Yeadon, Pa.
Perkins, J. Hugh, 828 Conroy Rd., Birmingham, Ala.
Pickard, Greenleaf W., Perikon Cottage, Seabrook Beach, N. H.
Pitkin, Inc., Lucius, 47 Fulton St., New York 7, N. Y.
Polydoroff, W. J., 2020 Engineering Bldg., 205 W. Wacker Dr., Chicago, Ill.
Ray, Garo W., Hilltop Drive., Stratford, Conn.
Razek, Joseph, Ph.D., 202 Darby Rd., Llanerch, Pa.
Ring & Clark, Munsey Bldg., Washington, D. C.
R & T Electronics Co., 9723 Baltimore Blvd., Box 283, Berwyn, Md.
Salzberg, Bernard, Naval Research Laboratory, Anacostia, D. C.
Saslaw, M. Robert, 347 Madison Ave., New York, N. Y.
Schnell, Louis John, 1707 N. Corona St., Colorado Springs, Colo.
Sheldon, H. Horton, 80 W. 40th St., New York, N. Y.
Shepard, Frank, 31 Union Pl., Summit, N. J.
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Shore, Sidney X., 235 Seaman Ave., New York 34, N. Y.
Shybekay, Derso, Ph.D., 1166 East 61st St., Chicago 37, Ill.
Singleton, Harold C., KGW-KEX, Oregonian Bldg., Portland, Ore.
Skifter, Hector R., 12th Floor, St. Paul Hotel, St. Paul, Minn.
Sleeper, George E., Jr., 505 Crocker Bldg., San Francisco, Calif.
Smeby, Lynne C., 4801 Connecticut Ave., N.W., Washington, D. C.
Specialties, Inc., Skunks Misery Road, Syosset, L. I., N. Y.
Standard Electronics Research Corp., 345 Hudson St., New York, N. Y.
Stobbe, J. Albert, 63 Wall St., New York, N. Y.
Terpenning Co., L. H., 16 W. 61st St., New York 23, N. Y.
Tibbetts, D. Reginald, Consulting Communications Engr., Cyclotron Specialties Co., Moraga, Calif.
Toth & Lorber, 38 Park Row, New York, N. Y.
Turner, Rufus P., 16 Howland St., South Dartmouth, Mass.
United States Testing Co., Inc., 1415 Park Ave., Hoboken, N. J.
Vance, Harold C., 309 Redman Ave., Haddonfield, N. J.
Weiller, Dr. Paul G., 95 Broad St., New York 4, N. Y.
Weldon & Carr., 1605 Connecticut Ave., N.W., Washington 9, D. C.
Williams, Nathan, 20 Algoma Blvd., Oshkosh, Wis.
Williams, Ralph O., 901 Walwood Pl., Kalamazoo, Mich.
Wilmotte, Raymond M., 1469 Church St., Washington 5, D. C.
Wilson Associates, Herbert L., 1018 Vermont Ave., N.W., Washington 5, D. C.
York Research Corp., 63 Park Row, New York 7, N. Y.

TESTING LABORATORIES

Electrical Testing Laboratories, East End Ave. & 79th St., New York, N. Y.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.
New York Testing Laboratories, 80 Washington St., New York, N. Y.
Pittsburgh Testing Laboratory, 1330 Locust St., Pittsburgh, Pa.
U. S. Testing Co., Inc., 1415 Park Ave., Hoboken, N. J.

NEWS OF THE INDUSTRY

GE Reduces FM Transmitters

Low-power General Electric postwar FM broadcast transmitters will sell for less than prewar prices, in some cases as much as 10% less. Among the developments that make this possible is a new simplified circuit using a new modulator tube called the Phasitron (See page 78 this issue). Shipment of the first low-power FM transmitters is expected around March 1, and all new GE FM broadcast transmitters will employ the new circuit and tube.

Press Wireless Expands Manufacturing

Press Wireless, Inc., with headquarters at 1475 Broadway, New York, N. Y., has formed a subsidiary company to care for the company's expanding manufacturing activities. The new company will do business as the Press Wireless Mfg. Corp., and will be housed in a newly-constructed building in Long Island City. The organization will be under the direct supervision of A. Warren Norton, Press Wireless, Inc., president; Ray H. de Pasquale, who has been elected vice-president, will be director of manufacturing. Other officers are James Humphrey, Jr., treasurer, James E. Denning, secretary, and Alfred G. Greany, assistant secretary.

Globe Acquires Radiotype

Globe Wireless, Ltd., New York, has acquired the interests of the International Business Machines Corp. in Radiotype, developed by Walter S. Lemmon who has been general manager of IBM's Radiotype division and who remains with IBM as a consultant. He has, however, been made executive vice-president of Globe which is producing Radiotype equipment for airline, public utility, municipal and business systems.

RMA Favors FM Channel Numbers

Radio Manufacturers Association members are overwhelmingly in favor of the new FCC channel number designations for FM stations. Members were polled, the results showing that very few preferred designations by frequency rather than by channel numbers. It is expected that the RMA engineering department will recommend channel number designations by all manufacturers.

Bendix West Coast Plans

The Western branch of the Bendix Radio Co. in Pomona, Calif., is preparing to manufacture a line of home receivers for sale in the eleven Western states. Design and engineering is being done at the Bendix Baltimore plant, though all possible parts for the Western market will be bought in the West. Chief Engineer of the Pomona operation is George Ellis.

Conventions and Meetings Ahead

Institute of Radio Engineers (New York section, 330 W. 42nd St., New York); Symposium on the Proximity Fuze Design, Jan. 2, Engineering Societies Bldg., New York.

Society of Plastic Engineers (Fred Conley, Chairman, Publicity Committee, 510 Stephenson Bldg., Detroit 2, Mich.); National Annual Meeting, January 7 to 9, Horace H. Rackham Educational Memorial, Detroit; Plastics Exhibition, Jan. 7 to 11, Convention Hall, 4465 Woodward Ave., Detroit.

American Physical Society (Karl K. Darrow, Secretary, Columbia Univ., New York); Jan. 12, Univ. of California, Berkeley, Cal.

American Institute Electrical Engineers (H. H. Henline, 29 W. 39th St., New York), Winter Technical Meeting, Jan. 21 to 25, Engineering Societies Bldg., New York.

Institute of Radio Engineers (330 West 42nd St., New York); Winter Technical Meeting, Jan. 23 to 26, Hotel Astor, New York.

American Physical Society (Karl K. Darrow, Secretary, Columbia Univ., New York); Jan. 24 to 26, Columbia Univ., New York.

American Society for Testing Materials (260 S. Broad St., Philadelphia); 1946 Spring Meeting, Feb. 25 to March 1, Pittsburgh.

Optical Society of America (A. C. Hardy, Mass. Inst. of Tech.; Mar. 7-9, Cleveland.

National Association of Broadcasters (Bruce Starkey, Chief, News Bureau, 1760 N St., N. W., Washington 6, D. C.); Broadcast Engineering Conference, March 18 to 23, Ohio State University, Columbus.

American Institute of Electrical Engineers (H. H. Henline, 29 West 39th Street, New York); South West District Meeting, April 16 to 18, San Antonio, Tex., Northeastern District Meeting, April 24 to 25, Buffalo. Southeastern Dist. Meeting, May 13 to 16.

American Society for Testing Materials (260 South Broad Street, Philadelphia); Forty-ninth Annual Meeting, June 24 to 28. Buffalo, simultaneously, Seventh Exhibit of Testing Apparatus and Related Equipment.

American Institute of Electrical Engineers (H. H. Henline, 29 W. 39th Street, New York); Summer Convention, June 24 to 28, Detroit. Pacific Coast Convention, August 26 to 30, Seattle.

Instrument Society of America (L. Susany, Secretary, Carnegie Institute, 4400 Forbes Street, Pittsburgh); 1946 Exhibit and Conference, September 16 to 20, Pittsburgh.

Illustration from Dolph advertisement appearing in The 1916 Electrical Railway Journal

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INSULATING VARNISHES

This is a record of which we are justifiably proud. During our "span of life", we have put forth our every effort to serve the electrical industry faithfully and efficiently in the capacity of insulating varnish specialists.

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We pledge our continuance of this policy, and with our years of experience and research in the insulating varnish field, we feel fully confident that we can assist you in your own particular insulating problems. Write us; we welcome the opportunity to serve you.

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WASHINGTON

Latest Electronic News Developments Summarized
by *Electronic Industries'* Washington Bureau

"GUINEA PIG" HEARINGS ON TELE—Most important for the manufacturing industry will be the "guinea pig" hearings on television for stations in Washington to be staged Jan. 21-Feb. 1 and the FM applications for New England, to be held March 11-12 at Boston before Commissioner Durr. The television hearings, which come close on the heels of the new FCC Rules and Regulations for postwar commercial telecasting, embrace the applications of NBC, DuMont, Philco, Farnsworth and two Washington newspapers. For FM service in New England, the applications of Raytheon, CBS, Harvey Radio Laboratories, Templetone, Yankee Network and four other broadcasting concerns will come up in the March hearings in Boston.

DELAYS MAY KILL OFF OPA—The delays in the reconversion of the radio-electronic manufacturing industry through the obstacles and red tape of the Office of Price Administration processes, which the American public now well knows as having blocked substantial production of home receivers in time for Christmas, may become a big factor in defeating the OPA leadership's aim to have that agency's life continued beyond next June 30, the statutory date of its termination. If OPA had listened to the radio-electronic manufacturing industry, it would never have bogged down reconversion with the price controls. The industry leadership, both in the set and component fields, right after V-J Day had urged the natural laws of competition would have kept prices far down below any inflationary levels, but OPA would not listen to this practical advice.

ONE HEADACHE AFTER ANOTHER—First the big postwar reconversion "headache" of the radio-electronic manufacturing industry was the price control theories of the OPA (and it is still lingering), but now another, although not as important in its impact, has arisen—the government's policy of disposal of military surplus end-equipment and components and parts. As the result of a mixture of politics, patronage and theoretical thinking, a powerful clique in the Surplus Property Administration top echelon is trying to eliminate the sensible and satisfactory system of having the radio-electronic manufacturers act as the government's agents in disposing of the military surpluses. The SPA group has been cloaking its plan with grandiose pronouncements of direct sales to the public and users being better than through manufacturers, but it has been uncovered that at least two syndicates of speculators were being favored to take over the marketing program.

BEST TO USE ESTABLISHED SYSTEM—Because it would take months to establish a new procedure and set-up for the shifting of the surplus disposal to either private selling syndicates or to staffs of government "salesmen" in field offices, the RFC electronics officials who had established the manufacturer-agent disposal program have vigorously opposed the proposal of the SPA to scrap the latter method. It is admitted that the existing manufacturer-agent contracts with the Government require certain revision.

DISPOSAL DECISION DELAYED—Following the conferences between the radio manufacturing industry representatives and the SPA and RFC officials in mid-December, it was indicated definitely NO decision on the surplus policy would be forthcoming until January or February. The SPA and RFC authorities engaged after the conference in consultations with the Army, Navy, Maritime Commission and Treasury Department, all of which in general opposed the SPA plan. Different methods for the disposal of surplus bulky equipments like radar, loran, etc., are being formulated and the Coast Guard may be the major supervisor in this field.

FCC NEEDS LARGER STAFF—Because of the flood of FM and television applications, FCC is asking for funds of over $6,000,000 for its next fiscal year's functioning—this will provide for an increase in its staff of around 500 new technical and legal personnel. Congress has indicated its appreciation of the Commission's huge workload so that this fund will probably be approved pretty much at this figure next year. In a recent address, FCC Commissioner Walker declared that FM is on the verge of an expansion so great that it may soon rival, or even surpass, the present system of broadcasting. He said that television, both in local and nationwide video broadcasts, "will bring new pleasures to the American people."

TELEVISION CHANNELS PRESERVED—One of most important actions, though little publicized, at recent Bermuda Telecommunications Conference was agreement between the United States and British Commonwealth to preserve the television channels between 200 and 300 megacycles. British Civil Aviation authorities had proposed use of space in this band for "pulse" aeronautical navigation aids, but FCC vigorously opposed this move and pointed to the more efficient U. S. aeronautical developments for navigation in the 1,000 megacycle range. As a result, tests of British and U. S. developments are to be made with a report to be formulated by Jan. 31. In addition to this determination, British-U. S. frequency experts ironed out differences in aviation, marine and radar wavelengths.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

TOMORROW'S relays

1947

1946

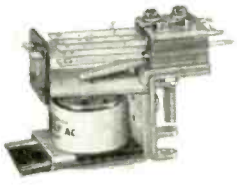
for Designs of TODAY

Relays BY GUARDIAN

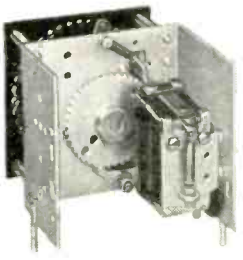
Electrical control in today's home radios and appliances—in home lighting—on the farm—in planes—on trains—for telephony—broadcasting—coin-automatic music and innumerable applications reveals a definite trend toward increased usage of *standard* Relays by Guardian. Such recognition of *standard* relays by forward thinking design engineers is the result of forward planning by Guardian to produce basic relays having a multiplicity of variations. Thus, where a "special" could have been specified Guardian invariably came through with a *standard* unit better qualified on

PERFORMANCE • PRICE • DELIVERY

For example, the Guardian Series 100 Relay is a *standard* type with replaceable coil and contacts. Operating range 3 v. to 230 v. at 60 cycles. Another unit, the Series R Stepping Relay is built for three basic types of A.C and D.C. operation: 1. Continuous rotation; 2. Electrical reset; 3. Add and subtract. Write on your business letterhead for NEW RELAY CATALOG showing many *basic* relay types, a complete line of solenoids, magnetic contactors, switch parts together with operating data, specifications, suggested applications. No cost. No obligation. Your catalog is waiting.



Series 100 A. C. Relay



Series R Stepping Relay

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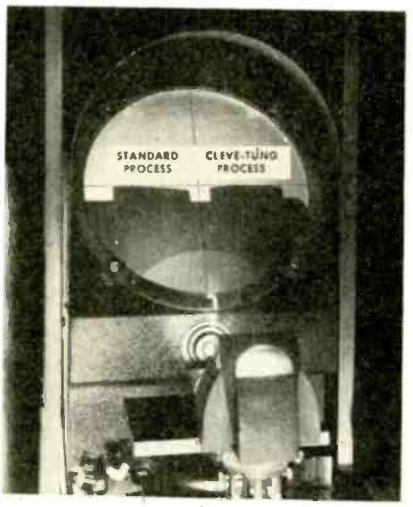
WHAT'S NEW

Devices, products and materials the manufacturers offer

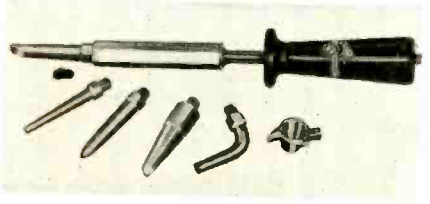


Contact Control

A new method of radius grinding for electrical contacts has been developed by Cleveland Tungsten, Inc., 10200 Meech Ave., Cleveland 5, Ohio. Floating radii are practically eliminated and this feature is of especial value in vibrator service, where the accurate adjustment of contact faces is necessary.—Electronic Industries

Water Purifier

Using ultra-violet radiation lamps, Ultra-Violet Products, Inc., 5205 Santa Monica Blvd., Los Angeles 27, Calif., has developed equipment for purifying water at the rate of 40 gal. per hour. The unit, which uses 48 ft. of quartz tubing for sterilization, is 48 in. long and 18 in. in width.—Electronic Industries

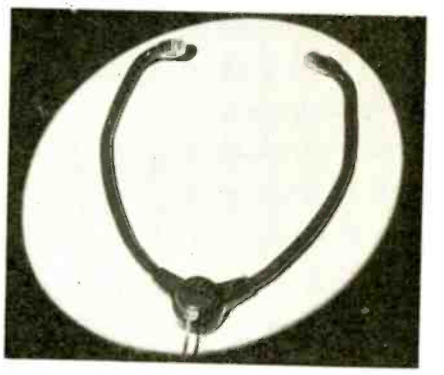


Soldering Iron

A 225 w quick heating element brings a new soldering iron to correct temperature within 90 seconds. Built-in thermostatic heat control keeps the iron at the proper degree of heat, regardless of constant or intermittent use. Six different tip styles are easily interchanged on this Kwikheat iron. Made by Sound Equipment Corp. of Calif., 3901 San Fernando Rd., Glendale 4, Calif.—Electronic Industries

PA Amplifier

The Clark Radio Equipment Corp., 4313 Lincoln Ave., Chicago 18, Ill., has developed a new PA amplifier with an almost flat response characteristic between 50 and 10,000 cycles. A special electronic equalization circuit is used which provides individual boost or attenuation of both the high and low ends of the audible spectrum without affecting middle frequencies.—Electronic Industries



Headphones

Ear pressure and head fatigue have been eliminated for the wearers of the new Telex Monoset headphones, made by Telex Products Co., Minneapolis, Minn. The unit is designed to be worn under the chin rather than over the head, and weighs about 1½ oz. The clear plastic eartips are removable and can be sterilized for use by more than one operator.—Electronic Industries

Tube Tester

Triplett Electrical Instrument Co., Bluffton, Ohio, has designed a new tube tester for checking receiving tubes, rectifiers, resistor and ballast tubes, and pilot lamps. The unit also permits observation and adjustment of line fluctuations thereby insuring greater test accuracy. Inter-element shorts and leakages can be determined while the cathodes are hot.—Electronic Industries

Sealed Terminal Cans

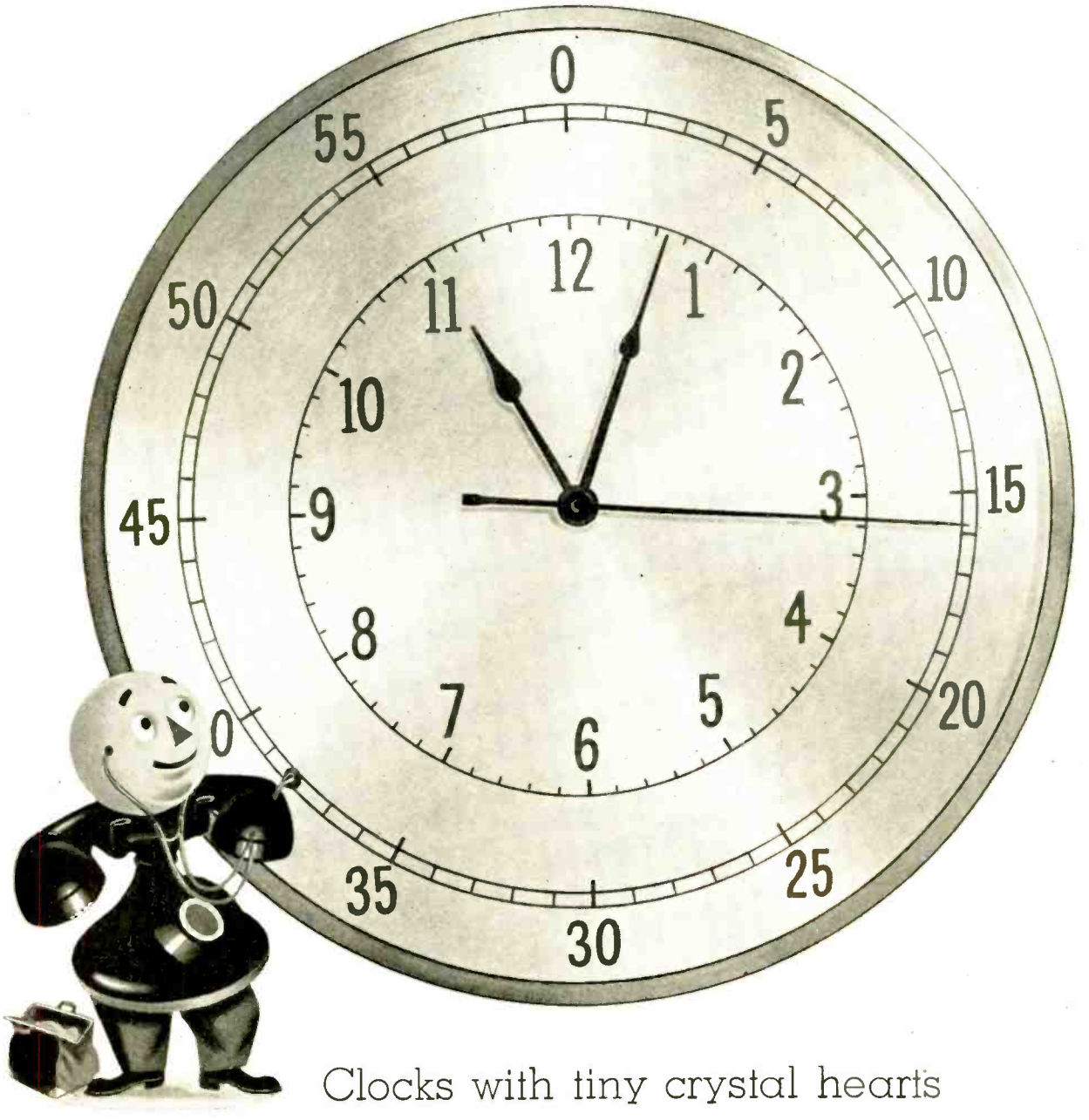
For hermetically sealed mountings of electronic and electrical components, Cincinnati Electric Products Co., Carthage & Hannaford, Cincinnati 12, Ohio, has developed a complete line of can enclosures with 26 types of glass-to-metal, fused-electro tin Fusite hermetic terminals. The cans are sealed with a manual or automatic can sealer without heat or solder, making for fast production with semi-skilled help. Containers range from 1½ to 4 in. in diameter and come in various heights. Individual Fusite terminals are also available. They can be had in either flattened pierced type electrode, a turret or double head electrode and a single terminal with a hollow tube.—Electronic Industries

Bore Gage

An electronic bore gage, utilizing direct contact to measure the diameter of tube, gun and other cylindrical interiors with an accuracy of one-half of ten thousandths of an inch, has been developed by Chrome Gauge Corp., Philadelphia, Pa. A projection rod mounted on a stabilized frame and containing a delicate, flexible point is inserted into the bore where it will check by contact all interior surfaces.—Electronic Industries

Slide Rule

A new slide rule which determines the precise location of the decimal point, is being manufactured by Pickett & Eckel, 53 W. Jackson Blvd., Chicago 4, Ill. Made of light-weight Dowmetal, the rule is not af-



Clocks with tiny crystal hearts that beat 100,000 times a second

CRYSTAL HEARTS beat time in Bell Telephone Laboratories, and serve as standards in its electronics research. Four crystal clocks, without pendulums or escapements, throb their successive cycles without varying by as much as a second a year.

Precise time measurements may seem a far cry from Bell System telephone research, but time is a measure of frequency, and frequency is the foundation of modern communication, whether by land lines, cable, or radio.

These clocks are electronic devices developed by Bell Laboratories, and refined over years of research. Their energy is supplied through vacuum tubes, but the accurate timing, the controlling heart of the clock, is provided by a quartz crystal plate about the size of a postage stamp.

These crystal plates vibrate 100,000 times a second, but their contraction and expansion is submicroscopically small—less than a hundred-thousandth of an inch. They are in sealed boxes to avoid any variation in atmospheric pressure, and their temperatures are controlled to a limit as small as a hundredth of a degree.

Bell Laboratories was one of the first to explore the possibilities of quartz in electrical communication, and its researches over many years enabled it to meet the need for precise crystals when war came. The same character of research is helping to bring ever better and more economical telephone service to the American people.

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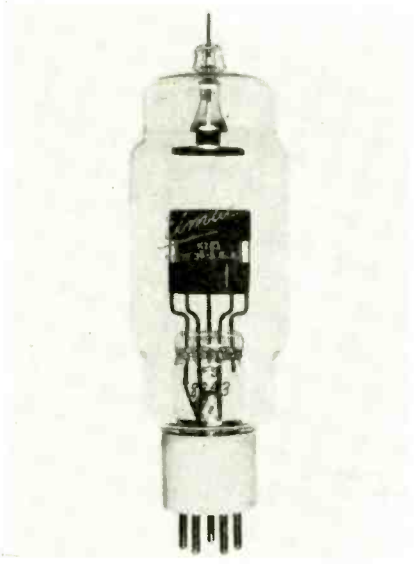
fected by climatic conditions of heat, cold or moisture. A new arrangement of scales facilitates computation of problems containing cube root, logarithmic and trigonometric factors.—Electronic Industries

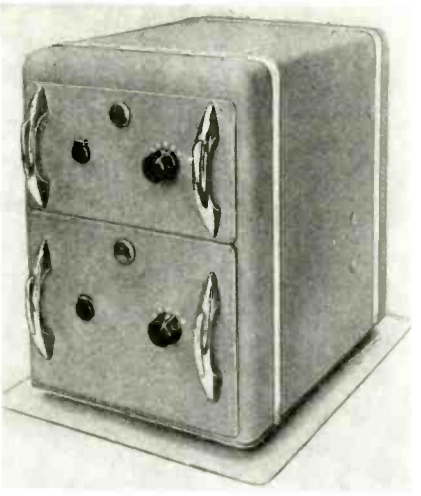


Rectifier Tube

A new grid control mercury vapor rectifier tube is being made by Eitel-McCullough, Inc., San Bruno, Calif. Advanced engineering design and more sturdy construction has created a more efficient rectifier and power control tube than was possible in previous models. This new tube uses a filament current of 10 a at 2.5 v. Maximum plate current is 3 a with a peak inverse voltage of 11,000 v.—Electronic Industries

Capacitor Block

A tapped capacitor block providing adjustable capacitance for power-factor correction, is being made by Tobe Deutschmann Corp., Canton, Mass. The block consists of dual 5 mfd units which are oil-impregnated, oil-filled and hermetically sealed in metal cases. Assemblies are available in sizes from 600 v-a to 2 kva at 230 v 50-60 cycle ac operation.—Electronic Industries



FM Telephone

A compact FM transmitter-receiver unit, primarily designed for municipal police and fire department communication use, has been engineered by Federal Telephone & Radio Corp., Newark, N. J. A feature of this equipment is the use of a tuned, vibrating reed which is placed in the receiver audio driver circuit. By proper frequency adjustment of these reeds in the units used by the police and the fire department, a single frequency channel may be used without interference. The police car receivers will only show a wanted signal when the proper audio frequency is transmitted from police headquarters at the start of each conversation. The police car receivers will not respond to the audio indicating signal which is transmitted from the main fire department unit.—Electronic Industries

Inspection Lamp

A new miniature inspection lamp which will allow examination of openings and recessing interiors as small as 5/16 in., is being made by Harmon & Co., 6 N. Michigan Ave., Chicago 2, Ill. These lamps are small, light-reflecting and glareless metal protected tungsten bulbs attached to flexible or rigid extensions, which may be had in lengths up to 32 in. They are made for operation on 110 v ac.—Electronic Industries

Mobile VHF Radio

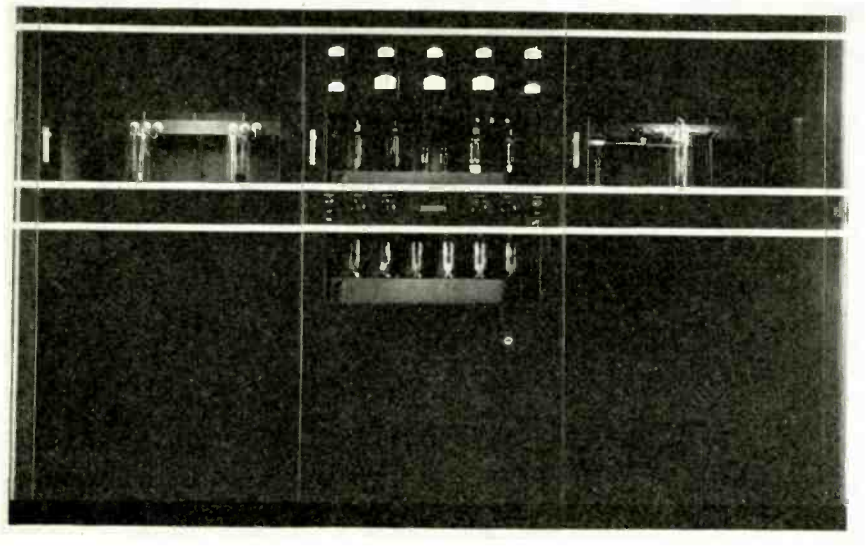
A new FM transmitter-receiver combination for use in the 30-42 mc bands, has been developed by Aireon Mfg. Corp., Kansas City, Kans. The receiver and transmitter can be powered by either conventional 110 v supply or a 6 v power supply unit. All frequency values are maintained by crystal control. Sensitivity of the receiver is 1½ microvolt with very low signal to noise ratio.—Electronic Industries

Loudspeaker

A railroad loudspeaker with a pressure neutralizing grill is being made by Operadio Mfg. Co., St. Charles, Ill. It is designed principally for exterior operation where the destructive effects of dirt, wind and water would quickly ruin unprotected units. The characteristics of the speaker produce maximum voice identification, intelligibility and volume.—Electronic Industries

Soldering Gun

A new type soldering tool, using a transformer to give the gun tip high current at low voltage, will heat to soldering temperature in five seconds. The small soldering tip permits easy access in tight corners. The current is automatically shut off when the trigger switch is released. Intermittent heat assures economical operation and prevents burning and frequent retinning of the tip. Made by Weller Mfg. Co., Easton, Pa.—Electronic Industries



Transmitter

Collins Radio Co., Cedar Rapids, Iowa, are making a 5 kw AM broadcast transmitter for use in the 540-1600 kc range. Audio response curve is flat from 30-10,000 cps within 1.5 db. Noise level is more than 60 db below 100% modulation. Carrier frequency is maintained constant to within 20 cps.—Electronic Industries

Outlet

A new two-prong electrical outlet, made by Alden Products Co., 117 N. Main St., Brockton 64, Mass., can be mounted in approximately 1 in. space. It is rated 10 a at 250 v, or 15 a at 125 v. Red, orange and green bakelite moldings are available in addition to the standard black.—Electronic Industries

Tab-type Resistor

A new vitreous tab-type resistor unit which will withstand thermo shock from 275° c to 0, is being made by P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind. This new resistor is capable of withstanding momentary voltage overloads up to ten times its rated wattage.—Electronic Industries

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● Even K & E has never devised an instrument that would make it unnecessary to *think*. But we have spent 78 years designing and producing things that make it easier to act after thinking . . . drafting instruments and related materials that give the engineering hand and eye almost the same precision as the engineering brain. How well K & E products serve as partners in creating is shown by the reliance placed in them by engineers and draftsmen throughout the world.

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Marine Telephone

A new 25 w marine radio telephone unit is being manufactured by Ray Jefferson, Inc., 40 E. Merrick Rd., Freeport, N. Y. It has five 100% crystal controlled channels, each pre-tuned, operating on bands from 1600 to 3600 kc. The five channels of the receiver unit will cover a range from 2180-3600 kc. The unit operates on 6, 12, or 32 v operation.—Electronic Industries

Midget Thyratron

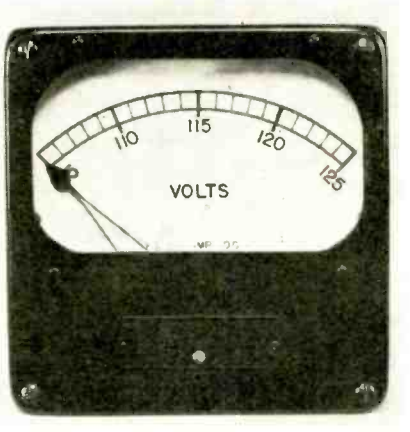
A new, all-metal small thyratron electronic tube for speed control of fractional horsepower motors, operation with phototubes, sequence timers and electronic temperature control, is being made by General Electric Co., Schenectady, N. Y. This tube is an inert, gas-filled, double grid thyratron with negative control characteristics. High sensitivity is possible because the grid current is low enough to permit the use of a high resistance in the grid circuit.—Electronic Industries

Outdoor Announcing System

A nine horn loudspeaker, generating a speech sound level of 116 db at a distance of 30 ft. from a unit, is part of an announcing system developed by Western Electric Co., 195 Broadway, New York 7, N. Y. Amplifier gain is such that normal voice input at the microphone will deliver 250 w to the speakers—Electronic Industries

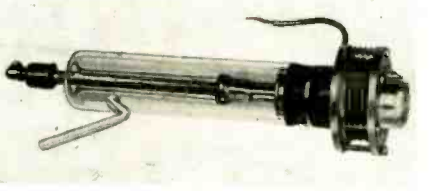
Recorder Tube

A new cold-cathode modulator glow tube to provide a high intensity point-of-light source for radio and wire facsimile receivers, portable sound-on-film recorders and many other recording instrument applications, is being made by the Industrial Electronics Div., Sylvania Electric Products, Inc., Boston, Mass. With a response to frequencies between 15 and 15,000 cps, it will produce a useful light range between 3,500 and 6,500 angstroms.—Electronic Industries



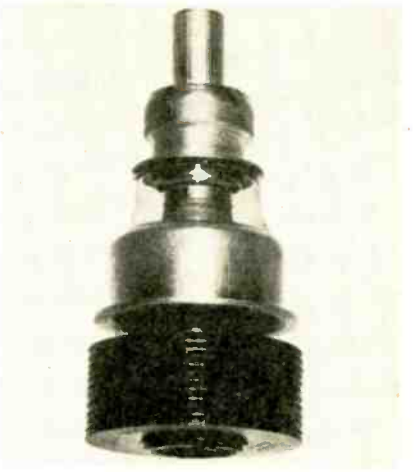
Voltmeter

An electronic mgnified-scale voltmeter has been developed by Control Corp., 718 Central Ave., Minneapolis 14, Minn. A small voltage band which is of primary interest, such as 110 to 120 v, is magnified on the voltmeter to cover the full scale range of a standard switchboard instrument. The magnified uniform scale is easy to read and the instrument is highly sensitive to very small variations.—Electronic Industries



X-Ray Tube

Machlett Laboratories, Inc., Springdale, Conn., have developed a new X-ray tube which emits X-radiation from a hemispherical window throughout the entire 180° angle. This radiation is equivalent in intensity to 86.4 lbs. of radium. The tube was developed for application in research in the field of X-ray photochemistry and biophysics.—Electronic Industries



500 MC Tube

A new miniature lighthouse triode for use at frequencies up to 500 mc is being made by Eitel-McCullough, Inc., San Bruno, Calif. This transmitter tube, with an external anode, will deliver up to 25 w of power. The cathode is indirectly heated with a 6.3 v heater.—Electronic Industries

Metal Locator

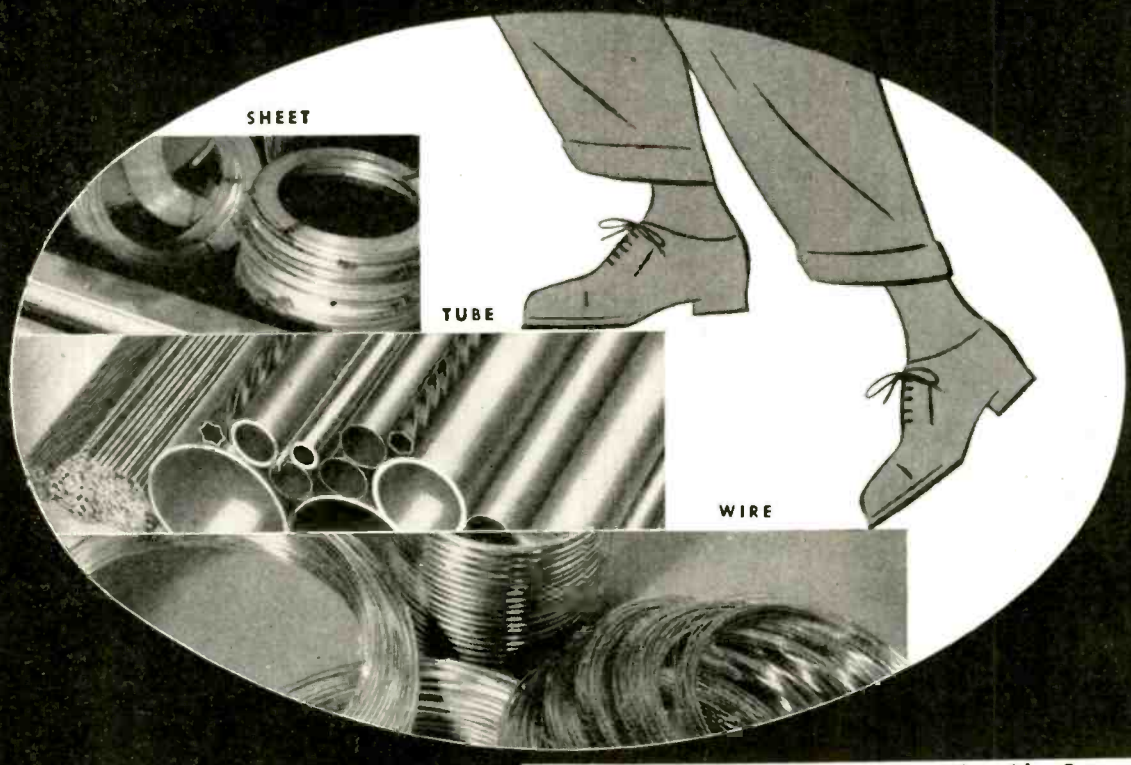
A new unit which will locate and tell the depth of cable and pipe is being made by W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill. Operation in the field is simple and the results accurate. The Stewart Cable Tester and Locator can also be used for determining the location of shorts, crosses, grounds and wet spots in cable construction.—Electronic Industries

Frequency Controlled Switch

Stevens-Arnold Co., 22 Elkins St., So. Boston, Mass., is manufacturing remote control tuned relays for operation in frequency range from 20 to 800 cps. These units can be made sufficiently sensitive so that they will operate from the output of either a crystal detector or a vacuum tube type receiver. Response time is only a small fraction of a second.—Electronic Industries

3 Easy Steps

FOR SOLVING A METAL PROBLEM



General Plate

LAMINATED METALS

General Plate Laminated Metals . . . sheet, wire and tube . . . provide many performance and economy advantages not found in single solid metals. These *permanently* bonded combinations of base metal to precious metal give you precious metal performance at a fraction of the cost of solid precious metal. Base to base metal combinations give special performance requirements not found in single base metals. Typical advantages include — better electrical performance, corrosion resistance, workability, ease of fabrication, ease of soldering, long wearing life and economy.

General Plate Laminated Metals will increase production and cut costs in such applications as electrical contacts, giant turbines, radar and radio tubes, instruments, chemical apparatus, mobile equipment.

Investigate General Plate Laminated sheet, wire and tube . . . wholly covered, inlaid, one side or both sides and stripe. Our engineers will gladly help you with your problems. Write for their services.

GENERAL PLATE DIVISION
of Metals & Controls Corporation
ATTLEBORO, MASSACHUSETTS

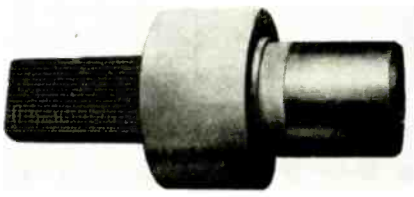
A few typical combinations produced by General Plate

S – SHEET W – WIRE T – TUBING OTHER Combinations on Request

	Platinum	Palladium	Gold	Silver	Aluminum	Brass	Copper	Beryllium Copper	Iron	Invar	Stainless Steel	Phos. Bronze	Monel	Nickel	Silver Solder	Steel SAE 1010	Nickel Silver
Platinum			SWT	SWT		SWT	SWT		SW	SW		SWT	SWT	SWT	SW	SW	SWT
Palladium			SWT	SWT		SWT	SWT		SW	SW		SWT	SWT	SWT	SW	SW	SWT
Gold	SWT	SWT		SWT	SWT	SWT	SWT	SW	SWT	SW	SW	SWT	SWT	SWT	SWT	SWT	SWT
Silver	SWT	SWT	SWT		SWT	SWT	SWT	SW	SWT	SW		SWT	SW	SW	SWT	SWT	SWT
Aluminum			SWT	SWT		S	SWT										
Brass	SWT	SWT	SWT	SWT	S				SW	SW	S	SW	SW	SWT	SWT	SWT	
Copper	SW	SWT	SWT	SWT	SWT				SWT	SW		S	SW	SWT	SWT	SWT	SWT
Beryllium Copper			SW	SW													
Iron	SW	SW	SWT	SWT		SW	SWT			S	S	S	SW	SW	S		SW
Invar	SW	SW	SW	SW		SW	SW		S		S	SW	S	S		S	SW
Stainless Steel			SW			S			S	S			S	S			S
Phos. Bronze	SWT	SWT	SWT	SWT		SW	S		S	SW			SW	SWT	SWT	SW	SWT
Monel	SWT	SWT	SWT	SW		SW	SW		SW	S	S	SW				SW	SW
Nickel	SWT	SWT	SWT	SW		SWT	SWT		SW	S	S	SWT				SW	SW
Silver Solder	SW	SW	SWT	SWT		SWT	SWT		S			SWT	S	S		S	SWT
Steel SAE 1010	SW	SW	SWT	SWT		SWT	SWT			S		SW	SW	SW	S		SW
Nickel Silver	SWT	SWT	SWT	SWT			SWT		SW	SW	S	SWT	SW	SW	SWT	SW	

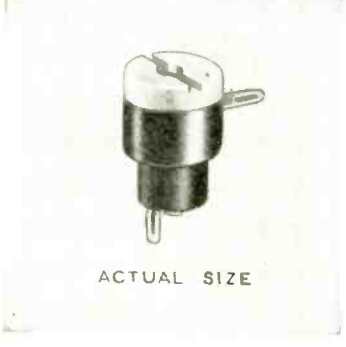
Phase Sequence Selector

An instrument to indicate the sequence of phase rotation of three-phase circuits for proper connection of synchronizers, transformers, etc., is being manufactured by the James R. Kearney Corp., 4236 Clayton Avenue, St. Louis, Mo. The three rubber-covered leads are connected to the terminals of a three-phase circuits and the brightly glowing lamp indicates the sequence of phase rotation. It consists of two neon glow lamps and suitable resistance and reactance components to operate on 200 to 480 volt circuits from 25 to 60 cps. —Electronic Industries



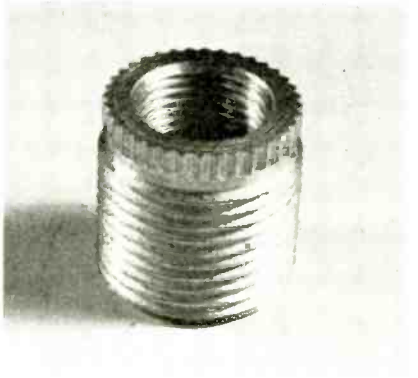
Brush Holder

A new brush holder molded from Melmac, for use in heavy duty 90, 250, and 500 v dc motors, has been developed by American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y. The design of the unit gives high flexural and impact strength, and the properties of Melmac provide high arc resistance and dielectric strength.—Electronic Industries



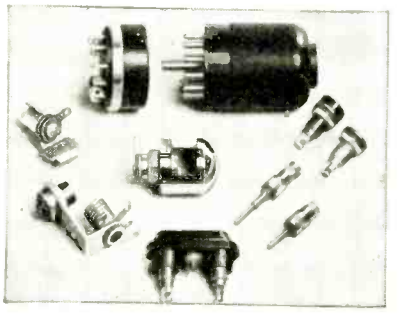
Trimmer Condenser

A very compact ceramic dielectric trimmer condenser is being made for use in the broadcasting and hf bands. Capacity change is constant over full 180° rotation. The metal rotor completely covers the stator track, giving a high degree of stability by keeping dust and dirt away from the plate surfaces. This unit is made by Erie Resistor Corp., Erie, Pa.—Electronic Industries



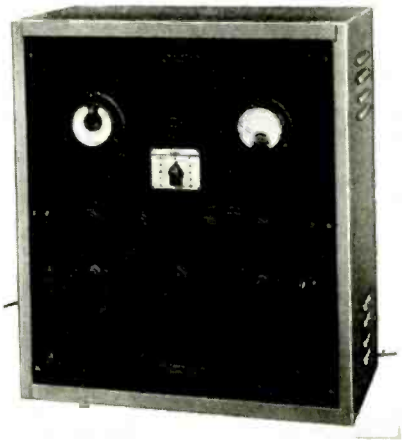
Replacable Inserts

National Screw & Mfg. Co., 2440 E. 75th St., Cleveland 4, Ohio, has designed a new molded-in-insert which provides greater torque values and strength for threads in plastics, soft metals and woods. The removal of units having damaged threads can be made with a common drill and easy out without disturbing the parent material. A companion molded-in stud is also available.—Electronic Industries



Hardware

E. F. Johnson Co., Waseca, Minn., are now manufacturing all cable connectors, pilot and dial light assemblies, tip plugs and jacks which were formerly Mallory-Yaxley products. The seven and twelve wire cable connectors are polarized and contacts clearly marked for wiring convenience. —Electronic Industries



Metal Detector

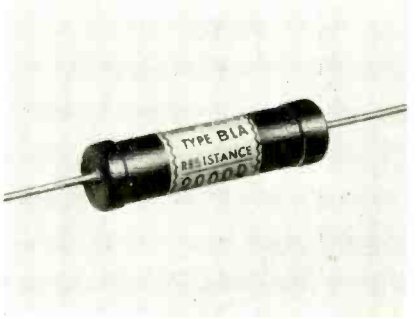
For automatic inspection of metal contamination in industrial manufacturing processes, Federal Laboratories, Inc., 185 41st St., Pittsburgh, Pa., have developed a new electronic metal locator. The unit can be placed in a belt conveyor system and will sound an alarm if small quantities of either ferrous and non-ferrous metals are hidden in the materials being checked. Liquid, plastic or solid raw materials can be handled.—Electronic Industries

Oscilloscope Calibrator

The Voltascope, a small self-contained instrument used to calibrate an oscilloscope under operating conditions has been developed by D. L. Jaffe of the Polarad Electronics Co., 135 Liberty Street, New York. Three standardized signals of sinusoidal ac voltage at line frequency are provided at 0.1, 1.0, and 10.0 volts peak-to-peak. A selector switch is used to compare the standard signals with an unknown signal. The device operates from ac power mains and its accuracy of calibration is 1% at a line potential of 115 volts. It may be used with any oscilloscope.—Electronic Industries

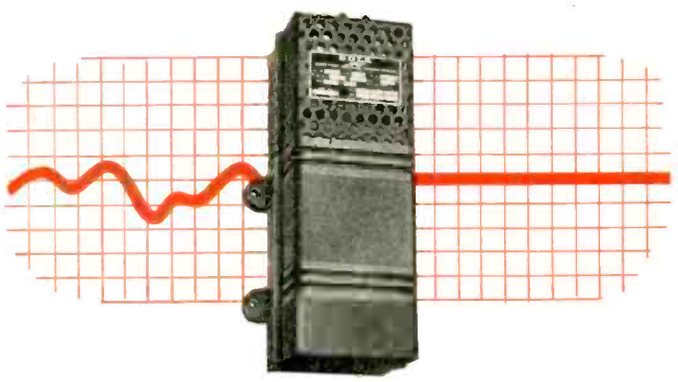
Airplane Transmitter

A VHF transmitter for the private flyer, to meet the new CAA program is being manufactured by Bendix Radio, Baltimore, Md. Design of the new equipment is along light-weight, low-cost lines, to be used in conjunction with 200-400 kc receivers already installed in many planes. Channels provided are adequate for present allocations, using two crystals; addition of three more crystals is optional. A 26-in. vertical rod antenna is used, and has a range of 50 miles at 1500 ft. altitude—Electronic Industries.



Close Tolerance Resistors

Low cost, 3 to 10 w resistors are being made by Instrument Resistors Co., 25 Amity St., Little Falls, N. J., with standard tolerances of 3%. Maximum resistance values up to 50,000 ohms are wound in units only ⅝ in. in diameter. Non-inductive types are also available.—Electronic Industries



Constant Voltage

. . . is always available to equipment protected by a SOLA CONSTANT VOLTAGE TRANSFORMER

Are you looking for new ways to—

1. Increase the efficiency of your product?
2. Lower its cost to the user?
3. Reduce maintenance expense?

Much of this can be accomplished with a SOLA Constant Voltage Transformer built into your product. Now, more than ever before, electrical equipment needs line-voltage protection.

Stable voltage, direct from supply lines, is *not* available to the users of your equipment. Voltage may vary as much as 15-20% from the rating on your label. *Your* equipment will be blamed for the inefficient operation that results.

Build a SOLA Constant Voltage Transformer into your equipment and operating voltages will always be within ± 1% of rated requirements regardless of line fluctuation as great as 30%.

There is a wide range of sizes and capacities in SOLA Constant Voltage Transformers which can be built specifically for your product. The savings you can make through the elimination of other components and anticipated service calls, plus greater operating efficiency and satisfaction to your users, merit your consideration of SOLA Constant Voltage Transformers as a component in your equipment design.

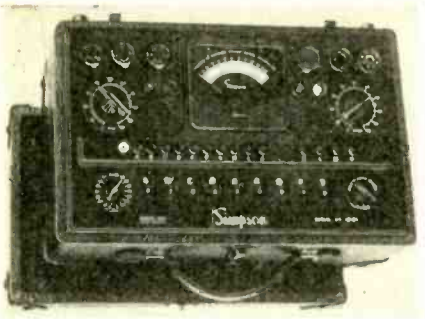
SOLA Constant Voltage Transformers are fully automatic with no tubes, or moving parts. They require no supervision or manual adjustments.

There's a new SOLA handbook that describes fully the theory, operation and use of SOLA Constant Voltage Transformers. Write for your copy.

Ask for Bulletin 10CV-102

Constant Voltage Transformers **SOLA**

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • etc. **SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois**

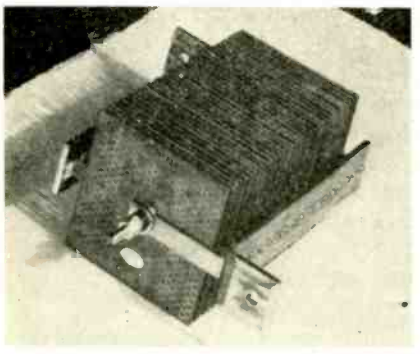


Tube Checker

A new tube tester by Simpson Electric Co., 5216 W. Kinzie St., Chicago, Ill., shows the percentage of rated dynamic mutual conductance for the tube under test. This unit permits the checking of elements under conditions very close to those met in actual operating practices. An automatic reset button returns all switches to normal after completion of the test.—Electronic Industries

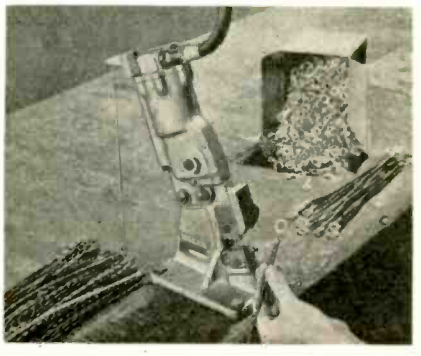
Pressure-Controlled Switch

A new electrical control switch, developed by Mu-Switch Corp., 380 Pequit St., Canton, Mass., is actuated by fluid pressures of from 10 to 20 PSI. It is a convenient means for regulating or indicating fluid pressures or controlling electrical circuits whose operation is to be coordinated with changes in the pressure of a liquid or gas.—Electronic Industries



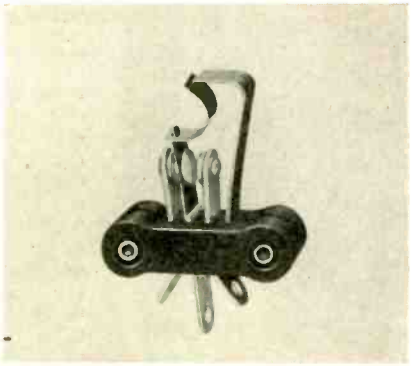
Rectifier

A new selenium metal-plate rectifying unit is being made by Horni Signal Mfg. Corp., 421 W. 54th St., New York 19, N. Y. Utilizing square plates, 20% more rectifying area is available providing greater current carrying capacity without increasing overall mounting space requirement. Eight sizes with capacities from a few milliamperes to 22 amperes per element are standard.—Electronic Industries



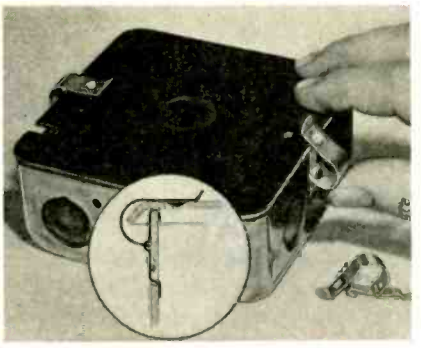
Wire Lugging Tool

A new, bench-mounted, pneumatic press for installing connectors on small electrical wire and cable has been developed by the Burndy Engineering Co., Inc., 107 Bruckner Blvd., New York 54, N. Y. The complete connection is made with one quick, automatically controlled stroke of the press. The unit will handle wire and cable sizes from Nos. 22 to 10.—Electronic



Snap Switch

A new compact, open blade snap switch is being manufactured by Acro Electric Co., 1308 Superior Ave., Cleveland 14, Ohio. Operating pressure is 6 to 10 oz. It can be furnished for single pole, normally open, normally closed and double throw circuits. It is rated at 15 a, 125 v ac and ⅓ hp, 110 v ac.—Electronic Industries



Box Cover Fastener

A steel spring fastener for holding the covers on various types of wall boxes, is being made by Tinnerman Products, Inc., 2111 Fulton Rd., Cleveland 13, Ohio. These fasteners eliminate the need for all screws, nuts and rivets, and are snapped on by hand into pre-punched holes in the side of the box.—Electronic Industries

Reversing Contactor

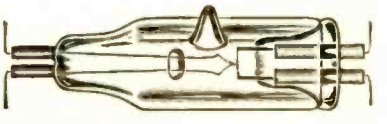
A new heavy duty reversing contactor for use with polyphase motors up to 1 hp and single-phase motors up to ¾ hp is now being made by Struthers-Dunn, Inc., 1321 Arch St., Philadelphia 7, Pa. It consists of two 3-pole contactors mechanically interlocked and is suitable for control operation on small hoists, door and window operating devices, and other applications requiring dependable, long-life reversing service.—Electronic Industries

X-ray

For use in temporary installations, General Electric X-Ray Corp., 175 Jackson Blvd., Chicago 4, Ill., has re-designed its fluorographic photoroentgen apparatus to permit quick assembly or disassembly. Automatic camera allows the making of four exposures a minute.—Electronic Industries

Test Equipment

A new unit which has been added to their line of special test equipment, has been designed by Lyman Electronic Corp., 12 Cass St., Springfield 4, Mass. This universal test set can be used for checking characteristics of vacuum tubes such as gas content, power output, g.m. constant, plate current cutoff, emission, grid plate and screen currents. The equipment is designed for rapid production testing.—Electronic Industries



Thermocouple

For making measurements at uhf, Field Electrical Instrument Co., 109 E. 184th St., New York 54, N. Y., is manufacturing a new vacuum type thermocouple. The design of this unit minimizes inductance and skin effect, and the coupling between heater and thermocouple has been reduced to a very low value. Inexpensive millivoltmeters are sufficiently accurate for uhf work when used with this thermocouple.—Electronic Industries

BIRD MODEL 63-A WATTMETER AND WIDE-BAND LINE TERMINATION

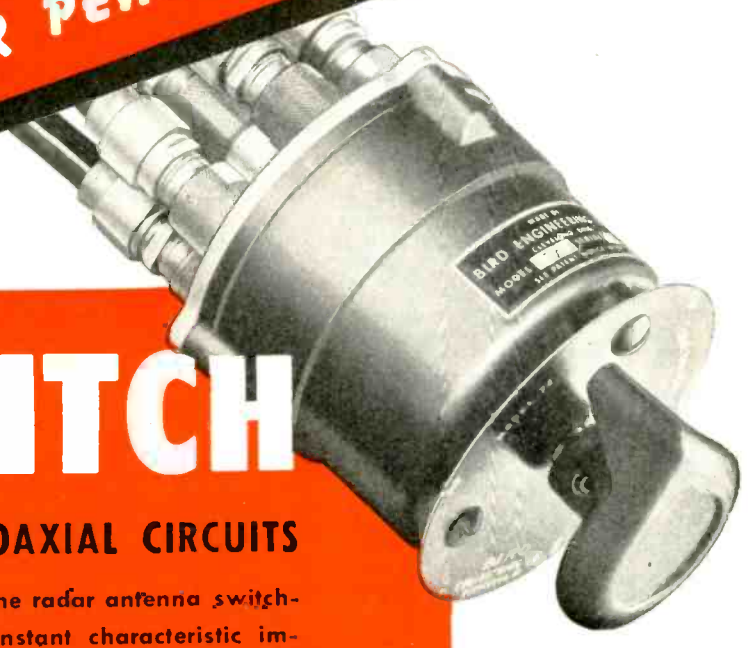
For Output Measurement

VHF-UHF

10 TO 1500 MEGACYCLES

Developed and proven under stress of war, this instrument is especially suited to equipment having 50-ohm coaxial transmission circuits. Solving the dual problem of power measurement and line termination, this constant impedance instrument supplies meter readings thru thermocouples while dissipating the r-f energy in an ingenious artificial antenna. Power range 1 to 500 watts.

NOW READY FOR PEACETIME USES!



COAXWITCH

A SELECTOR SWITCH FOR COAXIAL CIRCUITS

This new switch was developed for airborne radar antenna switching. A 50-ohm device, it maintains a constant characteristic impedance. To retain *LOW* standing wave ratios and secure maximum transfer of r-f energy, specify "Coaxwitch". Available now, in two models; Model 74 for single coaxial circuits; Model 72-2 for handling two coaxial circuits simultaneously.

Write for Catalog Pages

BIRD ELECTRONIC CORPORATION

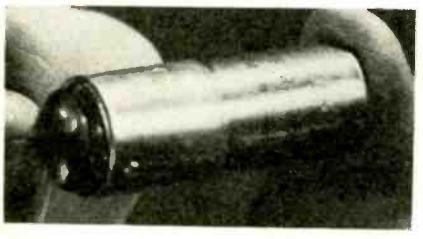
FORMERLY BIRD ENGINEERING COMPANY

Instrumentation for Coaxial Transmission

1800 EAST 38th STREET • CLEVELAND 14, OHIO

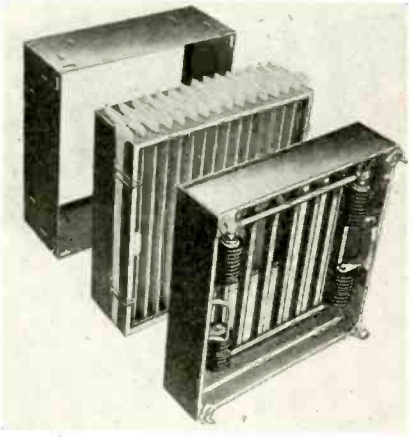
Light Source

Equipment for generating light sources for photographic exposures of approximately 2 microseconds is being made by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. This Microflash consists of a power supply which charges a condenser to a high voltage and then discharges the condenser through a special gas-filled lamp. An intense, extremely short flash is produced. The flash may be tripped by a make or break contact, by an electrical impulse or by a microphone which picks up a sound impulse from the phenomenon to be photographed.—Electronic Industries



Voltage Regulator

Miniature cold-cathode voltage regulator tubes for 65-90 v operation, are being made by Sylvania Electric Products, Inc., Boston, Mass. Current range for these tubes is 2-3 ma. Maximum voltage variation is under 3 v. Mounted in miniature polarized bayonet bases, tubes are enclosed in a metal shield which is color coded.—Electronic Industries



Air Filter

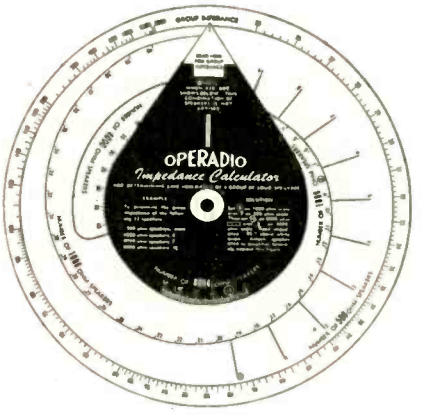
An electrostatically charged paper collector for air filtration is a new development of the American Air Filter Co., 125 Central Ave., Louisville 8, Ky. Tests show the arrestance rating of this paper to be 90% or better with atmospheric dust or smoke. The power pack energizing the paper filter uses 110 v, 60 c ac, with power consumption of approximately 220 w. The paper filter is discarded after it has accumulated its dust load.—Electronic Industries

Wire Recorder

A new unit for making recordings on wire with either a dynamic or crystal type microphone, is being made by Radiotechnic Laboratory, 1328 Sherman Ave., Evanston, Ill. Continuous recording time is about 66 min. Instantaneous playback is possible. Total weight of the unit is 28 lbs.—Electronic Industries

Motor Control

A new, single knob precision control for any type of reversible motor is being made by Yardeny Engineering Co., 105 Chambers St., New York 7, N. Y. The direction and extent of motor motion are under the complete control of the single knob. The motor may be continuously rotated or controlled for precise small movements.—Electronic Industries

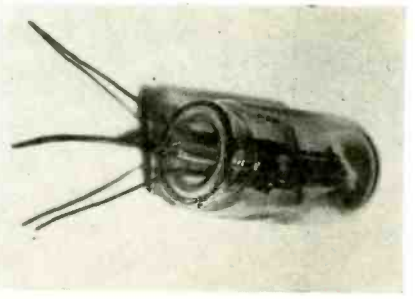


Impedance Calculator

For quickly matching impedance values of loudspeaker lines to an amplifier for any sound system covering 500, 1,000, 4,000, 8,000 or 16,000 ohm loudspeakers, a time-saving calculator has been designed by Operadio Mfg. Co., St. Charles, Ill.—Electronic Industries

Voltmeter

The new vacuum tube voltmeter, made by Instrument Electronics, 253-21 Northern Blvd., Little Neck, Long Island, has high sensitivity from 500 microvolts to 500 volts. Frequency band response is plus or minus 2% from 5 cps. to 1.6 mc. The input impedance is 2 megohms and 15 mmf.—Electronic Industries

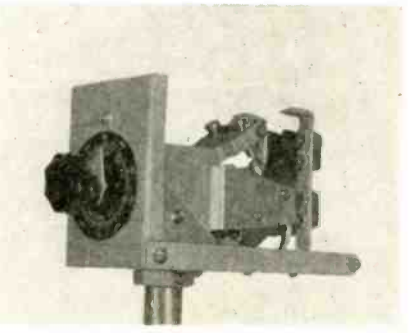


Diode

A voltage saturated or temperature limited diode for use where a constant current over wide voltage variations is required, is being made by Lynn Engineering Co., 912 Westfield Ave., Elizabeth 3, N. J. A 5 v, 1 a filamentary type cathode gives extreme stability. This tube is approximately 1¼ in. high without mounting.—Electronic Industries

Coil Winding

For checking tension of the wire in coil winding, a new unit is being manufactured by the Sipp-Eastwood Corp., Keen & Summer Sts., Paterson, N. J. This Tensometer will show directly the tension of the wire being wound, eliminating possible breakages and loose turns.—Electronic Industries



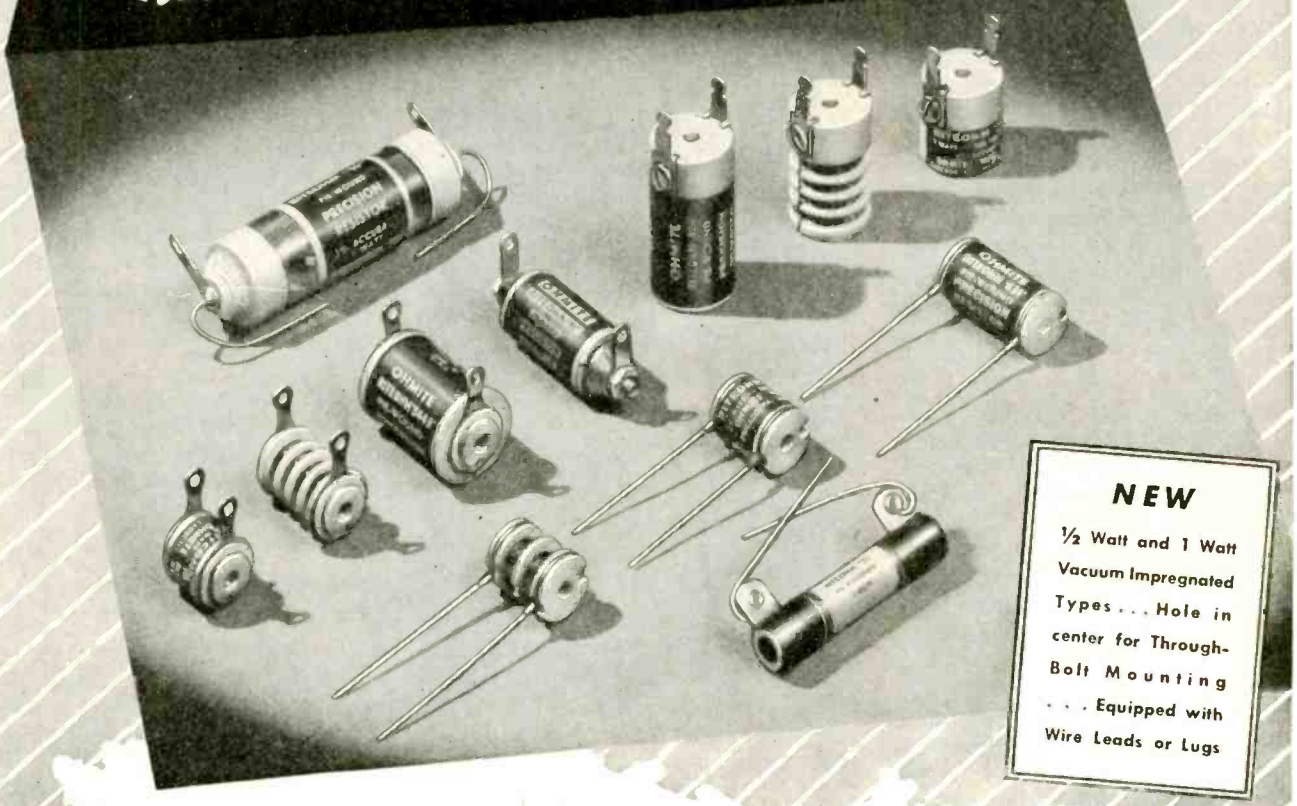
Temperature Control

A control switch for use with temperatures up to 1,000° F, is being made by Burling Instrument Co., 253 Springfield Ave., Newark, N. J. This unit is available with one, two, or three individual switches, which provide for a flexible combination of control circuit features. Maximum differential between either of the individual switches is approximately 150°.—Electronic Industries

OHMITE

RITEOHM PRECISION RESISTORS

Non-Inductive . . . Pie-Wound . . . 1% Accurate



NEW

½ Watt and 1 Watt Vacuum Impregnated Types . . . Hole in center for Through-Bolt Mounting . . . Equipped with Wire Leads or Lugs

Available from Stock . . . or Made to Order

OHMITE presents a *new* line . . . a *full* line . . . of finer precision resistors! Every type . . . every size . . . ready for every need! Each Riteohm is designed and built with all the specialized skill and experience that have made OHMITE units the standard in this field. However critical the application . . . consistent accuracy and reliability are assured. In these Riteohms, you get *time-proved protection against humidity, temperature and corrosion.*

Ideal for use in voltmeter multipliers, laboratory equipment, radio and electrical test sets, attenuation pads, and in electronic devices requiring *extremely accurate* resistance components.

AVAILABLE FROM STOCK in ½ watt and 1 watt units in a wide range of values, in various types of mountings and terminals . . . or made to order. Complete line of 6 different series includes non-inductive pie-wound vacuum impregnated units . . . single-layer wound vitreous enameled units . . . and non-inductive pie-wound hermetically glass sealed units. Some units are in a range of 0.1 ohm to 2,000,000 ohms. *Get full facts today!*

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TELEVISION TODAY*

New Developments in the Video Field

Resonance Type Power Supplies

• One of the new facts about television receiver design around which there is no controversy, is that larger and still larger pictures must be made available to satisfy the public demand. As the picture size is increased, the light available from the cathode ray tube must be spread over increased areas and the voltage that is necessary to produce the increased brilliance must increase at a rate much faster than the dimension of the picture.

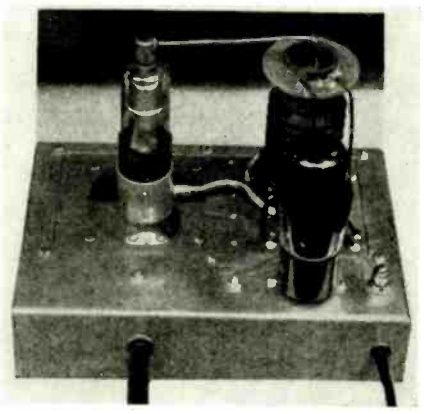
Voltages of 5 to 8 kilovolts were prevalent in prewar designs, but this has been increased by the newer size requirements to matters of 10 to 30 kv. Although it is not difficult to increase the secondary voltage of a 60-cycle transformer to give voltages of this order, or to use voltage multiplying rectifier circuits, the filtering problem is an important item in either case and large and expensive capacitors must be used.

One of the most practicable methods of obtaining rectified high-frequency voltage for television service utilizes radio frequency potentials obtained from local oscillators and built up to the required voltage by the application of the principle of resonance. At frequencies of 100 kc and above, the problem of filtering is simplified since small value high-voltage capacitors are readily obtainable. Experiments pointing out the practicability of using high-frequency sources for a high voltage rectifier circuit was pointed out by Schade.*

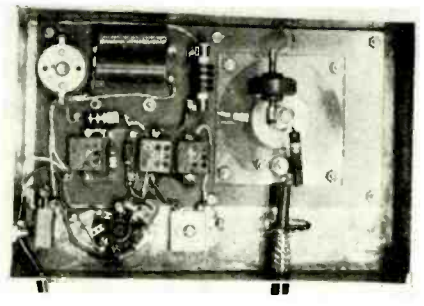
The United States Television Mfg. Corp., 106 Seventh avenue, New York, has developed a power supply using these principles, developing voltages of the order of 10 kv, and 20 kv for use with direct viewing tubes and a larger unit providing 30 kv for use with projection tubes. These power supplies are much lighter and more compact than an equivalent 60-cycle type. Reproduced are two views of a 10 kv power unit using a type 6Y6G or similar oscillator tube and a type 8016 half wave rectifier. The filament of the rectifier tube, which is at the high potential end is heated by rf current from the same source eliminating the need for expensively insulated filament transformers. This unit is entirely self-contained and in use is enclosed in a metal cover. The small physical size and the extremely low magnetic and electrostatic fields radiated permit it to be mounted close to the position where it is to be connected. This promotes the safety factor since a minimum of exposed cable results. The filter capacitor is only 500 mmf so that heavy sustained charges cannot be delivered, which reduces the hazard of injury from shock. This small capacitor gives filtering efficiency at these frequencies that is equivalent to that of a filter with a couple of microfarads capacitance at 60 cycles.

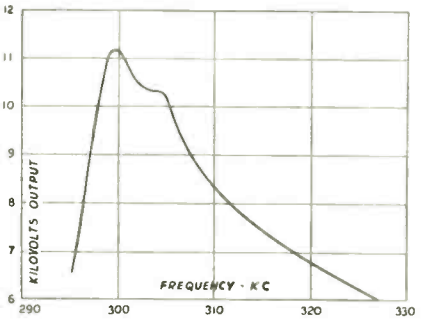
The curves show the kv output regulation curve at various loads within its range, the lower curve showing the relation between kv output and frequency.

*Proc. I.R.E., April, 1943.

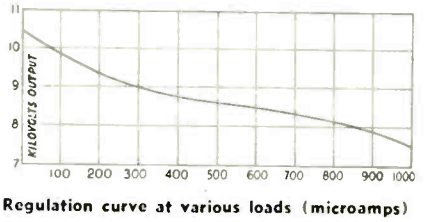


Two views of a 10 KV source for direct view television receivers with self contained oscillators





KV output characteristics with frequency changes



Regulation curve at various loads (microamps)

Sees Theater Tele Nosing Out Movies

Paul Porter, chairman of FCC, believes that when television really gets going motion pictures will no longer be in the running. He visualizes a huge influx of business into the theater television business and believes that it will represent the nation's topmost entertainment. All of these things he told members of the House Appropriations Committee when he appeared before that group to request a $785,000 deficiency appropriation to enable enlargement of the FCC staff to care for the greatly increased amount of work represented by the need for processing upward of 600 FM and 120 television license applications.

TBA Re-elects Officers

J. R. Poppele, secretary and chief engineer of Radio Station WOR, remains as president of Television Broadcasters Assn.; all other officers similarly were re-elected at the organization's annual meeting December 7. These include Vice-President F. J. Bingley (Philco); Secretary-Treasurer Will Baltin; Assistant Secretary-Treasurer O. B. Hanson (NBC); Ernest H. Vogel (Farnsworth) is a new director succeeding Lewis Allen Weiss.

ANNOUNCING

The New
HAR-CAM VISUAL ALIGNMENT SIGNAL GENERATOR

This new HAR-CAM unit provides the most efficient and effective method of aligning the IF circuit of FM receivers. By use of an oscillograph screen, the performance of the IF circuit is shown visually, and rapid, accurate alignment is easily accomplished.

SPECIFICATIONS

1. Frequency range 100kc to 20mc with direct reading dial calibrated in megacycles.
2. Linear frequency sweep deviation adjustable from zero to 900kc peak to peak.
3. Vernier frequency control of 100kc allows zero beat calibration of main tuning dial or for vernier frequency deviations about main dial frequency setting.
4. Stable rf gain control independent of frequency.
5. Five-step attenuator of rf output giving over-all voltage range of 1 microvolt to 1 volt when used in conjunction with the gain control.
6. Output impedance, 1 ohm to 2500 ohms.
7. Phone jack for aural monitoring of zero beat calibration of main tuning dial.
8. Panel jack to feed linear sweep voltage to x-axis amplifier of oscilloscope, thus synchronizing the frequency linear sweep of the generator with the spot trace on the scope screen.
9. Voltage regulated supply for internal oscillators.
10. Careful oscillator design to minimize drift.
11. Stable and proven circuit principles used throughout to insure complete reliability.
12. Size, 7" wide, 9½" high, 10½" deep. Weight, 18 pounds.

For complete information on the HAR-CAM Visual Alignment Signal Generator, write for Bulletin H-40.

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HARVEY OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

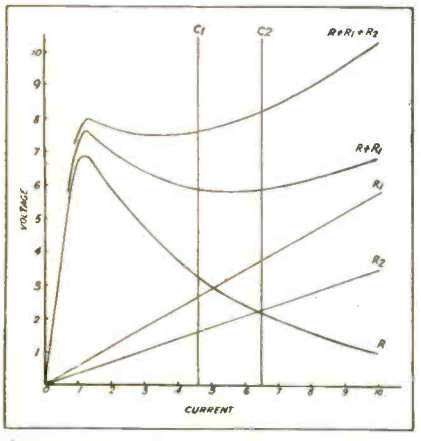
441 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

NEW PATENTS ISSUED

DC Amplifier Coupling

The dc amplifier coupling claimed transmits variations of the plate voltage to a much larger extent than the mean plate voltage. A non-linear resistance element such as a thermistor or a non-linear resistor of a carborundum basis is combined with other resistors in the interstage coupling network in such a way that the proportion of the plate voltage variation transferred to the next grid is greater than the proportion of the mean plate voltage transferred.

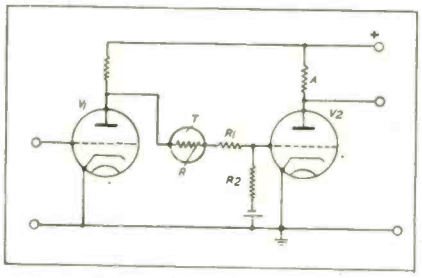
The curve designated R in the voltage-current diagram represents the resistance of the thermistor T in the coupling, part of the curve indicating a negative resistance value; R_1 and R_2 are characteristics of resistors R_1 and R_2, respec-



Voltage-current diagams of RR_1R_2 coupling network

tively. In the region between the ordinates C_1 and C_2, the sum of the voltages across resistors R and R_1, given by the curve $R + R_1$, is approximately constant. The slope of the curve $R + R_1 + R_2$ between these ordinates is, therefore, approximately identical with the slope of the curve R_2. Thus if the voltage V at the plate of amplifier tube V varies from about 7.6 to 8.2, the voltage across R_2 varies by an equal amount from about 1.6 to 2.2. However, the mean voltage across R_2, which is applied to the grid of amplifier tube V_2, is only 1.9 volts as compared with a mean plate voltage of V_1 of 7.9 volts. It will be seen that though the voltage variation is fully transmitted, the mean voltage value is considerably reduced by the provision of this coupling network.

If R_2 is reduced and R_1 increased by the same amount, the mean voltage applied to the grid of V_2 will be further reduced, but the range of variation of the voltage will also decrease. By using a thermistor having a characteristic with a steeper negative slope, the mean



RR_1R_2 coupling network permits transfer of ac component while dc component is considerably reduced

voltage may be reduced without reducing the voltage range. If R_1 is reduced and R_2 is increased by the same amount, the coupling network may be caused to introduce a voltage amplification, the variation of voltage at the grid of V_2 exceeding that at the plate of V_1. By replacing T by an indirectly heated thermistor, the characteristic R may be altered by passing a suitable current through the thermistor heating coil. A two-stage coupling network may be used, each mesh being designed as the one stage shown in the diagram.

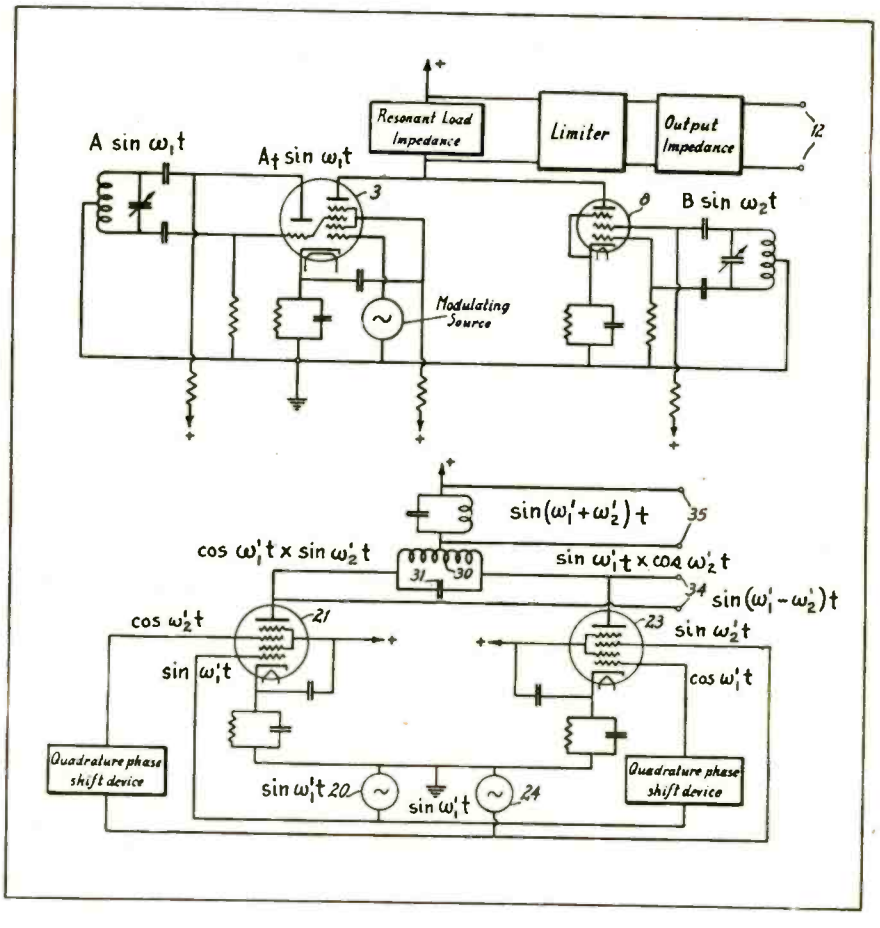
P. K. Chatterjea and C. T. Scully, Standard Telephones and Cables Limited, (F) March 10, 1944, (I) August 28, 1945, No. 2,383,710.

Frequency Modulator

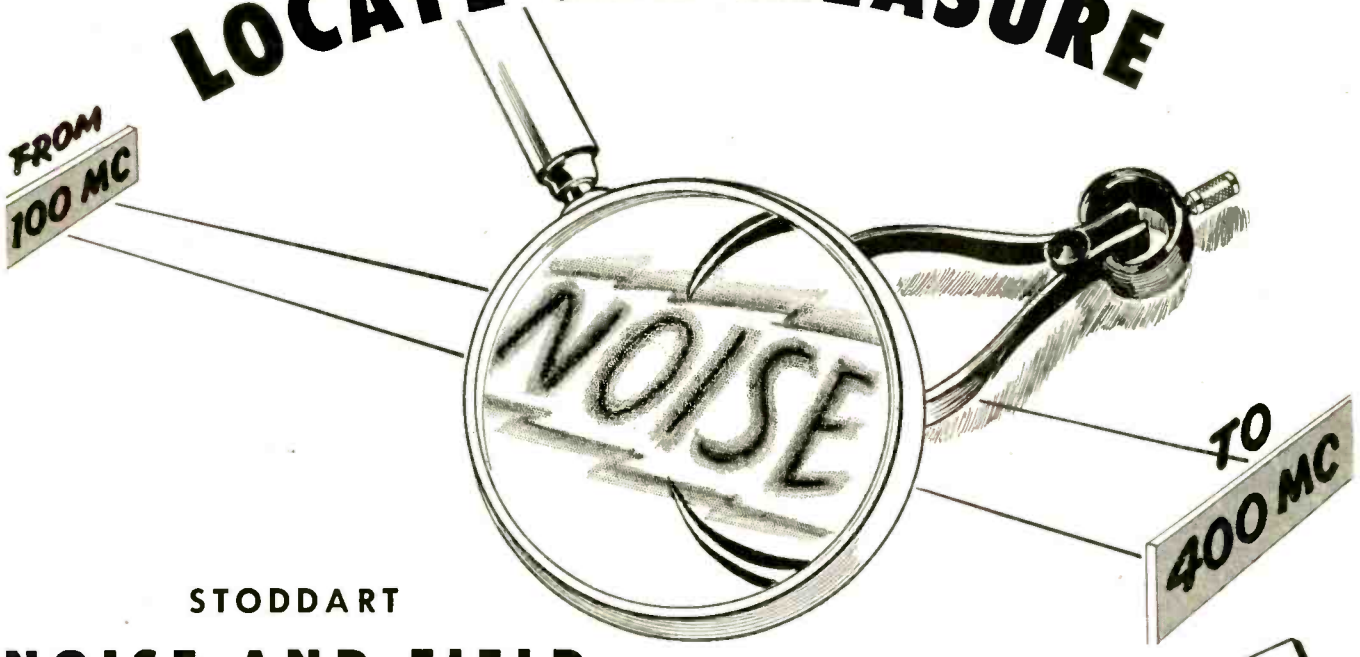
When two alternating voltages (A sin w_1t and B sin w_2t) are added and applied to a limiter, one component of the output voltage from the limiter has a frequency w intermediate the frequencies w_1 and w_2 of the applied alternating voltages depending on the amplitudes A and B as follows:

$w = w_2 + (w_1 - w_2)\, A^2/(A^2 + B^2)$.

If, therefore, one of the alternating voltages be modulated in amplitude (A or B changed) or if both be modulated in amplitude in opposite phase, the frequency w of this output component will be correspondingly modulated. For amplitude ratios A/B of 0.4 to 1.0, the frequency w varies substantially linear over a range of about one



LOCATE and MEASURE



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Model NMA-4

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- One Microvolt sensitivity.
- Direct reading in Microvolts.
- Measures conducted and radiated noise.
- Provision for External Recording Meter.
- Measures Field Strength of Transmitters in the U.H.F. Range.
- It assists in the production of noise-free products by manufacturers.
- It locates and analyzes existing noises which interfere with radio reception.
- Its stability and accuracy enable transmitter engineers to obtain dependable field strength patterns.

Write for further information and complete technical data.

STODDART AIRCRAFT RADIO CO.

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third of the difference $w_1 - w_2$ between the two original frequencies.

The top figure illustrates a frequency modulator based on this effect. The triode oscillator output A sin w_1t is applied to one control grid of the hexode section of tube 3 and the modulating potential to the other control grid. The amplitude modulated output $A_t \sin w_1t$ is combined with the oscillations B sin w_2t generated by tube 8 and its associated circuit. The two oscillations are at a frequency above and below the range of the frequency modulated voltage to be generated.

The plate load impedance is designed to resonate at the frequencies of both oscillations and over the intermediate range, while the output impedance, though resonant over the range of the frequency-modulated oscillations, is not resonant at the two frequencies w_1 and w_2. To realize the frequency modulation of the wave, as given by the above formula, and to discard amplitude variations, the wave is passed through a limiter.

A further feature of the invention is directed to the problem of separating components of sum and difference frequencies, which are generated by mixing two oscillations of different frequency, w'_1 and w'_2. The separated sum and difference frequency oscillations may then be used as the two constant frequency sources required for the frequency modulation system, $w_1 = w'_1 + w'_2$, $w_2 = w'_1 - w'_2$. Two mixers, 21 and 23 are employed in this system illustrated in the bottom figure and alternating voltages from generators 20 and 24 are applied to each mixer. Those applied to one mixer, however, are in phase quadrature with respect to those applied to the other mixer, as will be seen from the diagram. By adding the mixer output currents in opposition, a current of the sum frequency is obtained across terminals 35; by adding the currents cumulatively, on the other hand, the difference frequency is obtained across terminals 34. Phase and frequency of the currents are indicated in the figure, disregarding amplitudes. This expedient is particularly useful when it is desired to separate sum and difference frequencies which are so close together that it is difficult to separate them by means of filters. By using for the mixers either balanced modulators or mixers of substantially square law type, the input frequency components w_1 and w_2 can be eliminated as an alternative to filtering the output.

In a preferred embodiment of the invention, two oscillations are generated by the method illustrated in the second figure, the sum and difference frequencies being spaced apart a few times the frequency range of the final frequency-modulated output. Both, sum and difference frequency, are amplitude-modulated by the signal and then combined in a common resonant load impedance as illustrated in the top figure. Carrier frequency and band width can be adjusted separately. When the amplitudes of the modulating signals are equal, the resulting output is of zero amplitude and it may, therefore, be desirable to supply the carrier frequency to the limiter by a separate lead. This will, however, reduce the range of frequency modulation for a given variation of amplitude ratio.

D. A. Bell, Radio Patents Corporation, (F) February 11, 1942 (I) September 18, 1945, No. 2,384,789.

Direction Finder

According to the invention a rotating radiation pattern is frequency modulated with a frequency identical or an exact multiple of the frequency of rotation of the beam to make a phase-comparison possible. Upon amplitude and frequency demodulation, two signals are obtained in the receiver, phase comparison of which indicates the position of the aircraft with respect to the transmitter station. One carrier is sufficient for this system and no omni-directional radiation is required, the frequency-modulated rotating pattern carrying all necessary intelligence.

In the transmitter the radio frequency oscillation is frequency modulated and then amplitude modulated by half the frequency-modulation frequency in two balanced modulators, the amplitude modulating waves being 90-deg.-out-of-phase, as will be clearly seen from the diagram. The outputs of the two balanced modulators are applied to the antenna system E, W, S, and N, which will radiate a figure-of-eight pattern rotating at angular frequency f, and frequency-modulated by an angular frequency 2f.

A receiver R located an angle θ from the reference direction, for instance θ degrees from east, (see inset at upper left-hand corner of figures, T indicates transmitter) will receive a wave of the form:

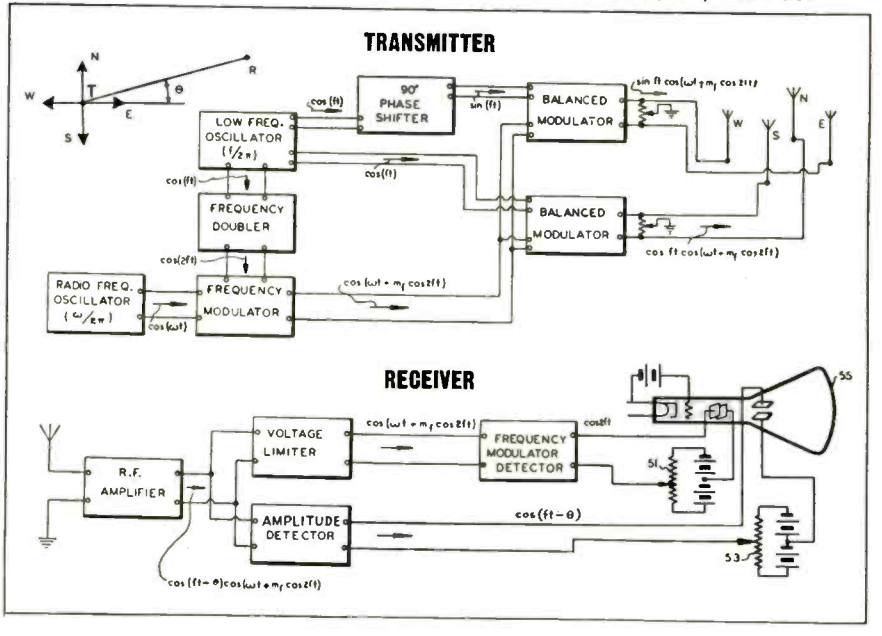
$$\cos (ft - \theta) \times \cos (\omega t + m_f \times \cos 2\ ft)$$

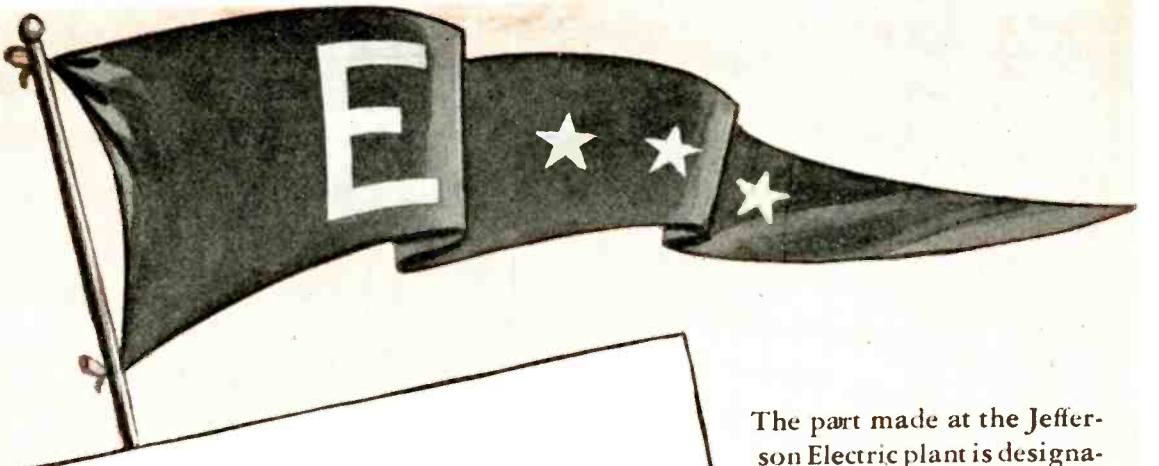
(The reference direction will be east, provided the maximum amplitude is applied to antenna E at the instant the maximum frequency deviation occurs). After amplification, the received wave is detected as to amplitude and frequency in two different channels, the two resulting waves being cos 2 ft and cos $(ft - \theta)$, respectively. The discontinuities in the frequency demodulated wave, due to the amplitude modulation, will be overcome by the flywheel effect of inductance and capacitance in the circuit so that a substantially sinusoidal wave form will be achieved.

The phase difference between the two waves may be indicated by the cathode-ray tube phase comparator or any other suitable phase comparator. In the embodiment illustrated, horizontal deflection is controlled by the FM discriminator output, vertical deflection by the AM detector output. Potentiometer 51 is adjusted so that the deflection of the cathode ray beam is symmetrical about the screen 55. Potentiometer 53 is adjusted until the beam trace is above and just touches the horizontal diameter of the tube screen

(*Continued on page* 164)

A rotating directional pattern is transmitted on same carrier as frequency modulation





ADDRESS REPLY TO
BUREAU OF ORDNANCE, NAVY DEPARTMENT
AND REFER TO

NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON 25, D. C.

September 26, 1945

P15
(Ad5)

Sirs:

It is my great pleasure to announce the award of the Bureau of Ordnance "E" to your company and to other firms who participated in one of the most important of our wartime ordnance projects — the successful development and manufacture of the VT fuze.

The Bureau of Ordnance has never underestimated the value of your services and has regretted the necessity for maintaining secrecy on your product throughout the war and even beyond that, so long as there remained any doubt that security restrictions could be lifted with safety. Maintenance of these security safeguards unfortunately has prevented the award of the Army-Navy "E" to producers of the VT fuze who otherwise would have been eligible for consideration. We have appreciated your understanding of the reasons why your excellent production job had to be performed behind a veil of secrecy.

Now that the story can be told, the Bureau of Ordnance wants to recognize publicly the importance of the part you have played. The Bureau of Ordnance "E" is being revived exclusively as a means of paying proper tribute to the Navy contractors who worked on the VT fuze.

Each plant receiving the award will be furnished with a Bureau of Ordnance flag, a Navy "E" pennant and "E" buttons in sufficient quantity to supply all workers who assisted in making the VT fuze. In the case of plants which would have been eligible for renewal awards, stars will be affixed to the pennants, one for each six months of eligibility.

Please inform the Bureau where your flags should be shipped and how many pins are desired. You will be informed of the probable delivery date of these items.

The Bureau of Ordnance is grateful for your devoted efforts and is happy to congratulate you on the excellence of your performance of a wartime task of the first magnitude. A hearty "Well Done!"

Sincerely yours,

O. F. HUSSEY, Jr.
Rear Admiral, U. S. Navy
Chief of the Bureau of Ordnance

Jefferson Electric Company
Bellwood, Illinois

The part made at the Jefferson Electric plant is designated the Mercury Unshorter Switch. This was developed to prevent muzzle bursts (premature explosion) for the protection of the gun crew and yet close the circuit quickly to operate the device. In all, 12 types or sizes of mercury switches were manufactured, and special techniques were developed to achieve huge production rates while conforming to the most precise tolerances. We are proud to have performed such an important service in this vital ordnance project.

JEFFERSON
ELECTRIC

WINTER TECHNICAL MEET

IRE schedules four-day program of engineering discussions covering wide variety of topics—Joint session with AIEE

The Institute of Radio Engineer's Winter Technical Meeting, which is to be held in the Hotel Astor, New York, will run over the three days, Thursday to Saturday, January 24 to 26, inclusive, with a preliminary joint meeting with the American Society of Electrical Engineers scheduled for Wednesday evening Jan. 23, in the Engineering Societies Building.

The joint session will be featured by an address by Major-General Groves; and the presentation of the Hoover Medal to Major-General Wm. H. Harrison.

In addition to the many technical papers on the IRE program, there is to be an extensive exhibit of radio and electronic equipment which will occupy a large display section. A total of some 120 exhibitors of parts, equipment, etc., will display their wares.

Wednesday, January 23

9:00 AM— 5:30 PM (Promenade) ....Registration and sale of tickets
9:30 AM—12:30 PM (Coral Room)....Annual Meeting of Section Representatives
12:30 PM— 2:00 PM (Rose Room).....Luncheon for Section Representatives
2:00 PM— 5:00 PM (Coral Room)..Annual Meeting of Section Representatives
4:00 PM— 8:00 PM (Eighth and Tenth Floors)..Radio Engineering Show
6:00 PM—10:00 PM (Engineering Societies Bldg.).Joint Meeting of AIEE and IRE

Thursday, January 24

8:30 AM— 5:30 PM (Promenade)....Registration and sale of tickets
9:00 AM— 7:00 PM (Eighth and Tenth Floors)..Radio Engineering Show
9:45 AM—10:30 AM (Grand Ballroom) .....Annual Meeting of IRE

Technical Sessions

10:30 AM—12:30 PM

Group A (Grand Ballroom).....Military Electronic Applications
Group B (Rose Room) .....Frequency Modulation and Standard Broadcasting
Group C (Coral Room) .....Circuits and Theory

2:00 PM—5:00 PM

Group A (Grand Ballroom) .....Television
Group B (Rose Room) .....Radio Navigation Aids
Group C (Coral Room) .....Vacuum Tubes

7:30 PM—10:30 PM (Grand Ballroom)....Annual IRE Banquet

Awarding of Medal of Honor, Morris Liebmann Memorial Prize, and Fellowship Awards. Address of Retiring President. Speaker—Dr. Frank B. Jewett, President of the National Academy of Sciences. Toastmaster—Edgar Kobak, President of the Mutual Broadcasting System, Inc.

Friday, January 25

9:00 AM— 5:00 PM (Promenade)....Registration and sale of tickets
9:00 AM—10:00 PM (Eighth and Tenth Floors)—Radio Engineering Show

Technical Sessions

9:30 AM—12:00 Noon

Group A (Grand Ballroom)..Microwave Vacuum Tubes
Group B (Rose Room) .....Antennas

12:30 PM (Grand Ballroom).....President's Luncheon, Honoring Dr. Frederick B. Llewellyn

Speaker—Paul Porter, Chairman, Federal Communications Commission. Master of Ceremonies—Lewis M. Clement, Vice President in Charge of Research and Engineering, The Crosley Corp.

Technical Sessions

2:00 PM—5:30 PM

Group A (Grand Ballroom) .....Radar
Group B (Rose Room) .....Microwave Technic
6:30 PM—8:00 PM .....Cocktail Party

Saturday, January 26

9:00 AM—3:00 PM (Promenade) .....Registration
9:00 AM—2:00 PM (Eighth and Tenth Floors)....Radio Engineering Show

Technical Sessions

9:30 AM—12:00 Noon

Group A (Grand Ballroom) .....Industrial Electronic Applications
Group B (Rose Room) ....Communication Systems and Relay Lines
Group C (Coral Room) .....Radio Propagation

2:00 PM—4:00 PM

Group A (Grand Ballroom) .....Broadcast Receivers
Group B (Rose Room) .....Quartz Crystals
Group C (Coral Room) .....Crystal Rectifiers

Committee Meetings

Wednesday, January 23 (Morning).....Antennas; Frequency Modulation, Radio Receivers, Radio Wave Propagation
Wednesday, January 23 (Afternoon)..Circuits; Membership, Railway and Vehicular Communications; Research; Television; Vacuum Tubes
Thursday, January 24 (Morning).....Standards
Thursday, January 24 (Afternoon).....Education; Public Relations

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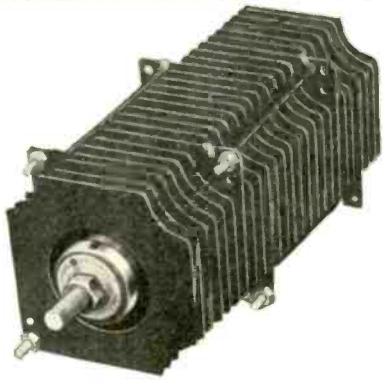
Naturally, all three differ in characteristics, basic materials and construction. Each is better than the other when accomplishing the specific job for which it is designed. Thus the manufacturer of products employing rectifiers must first determine the results to be obtained and the conditions under which the rectifier must function, before making a selection.

Since G-E makes all three — Copper-oxide, Selenium and Tungar — it has no reason to prefer one to the other. It can give you impartial advice on which type is best for your particular requirements. For further information write Section A-1611-124 Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

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

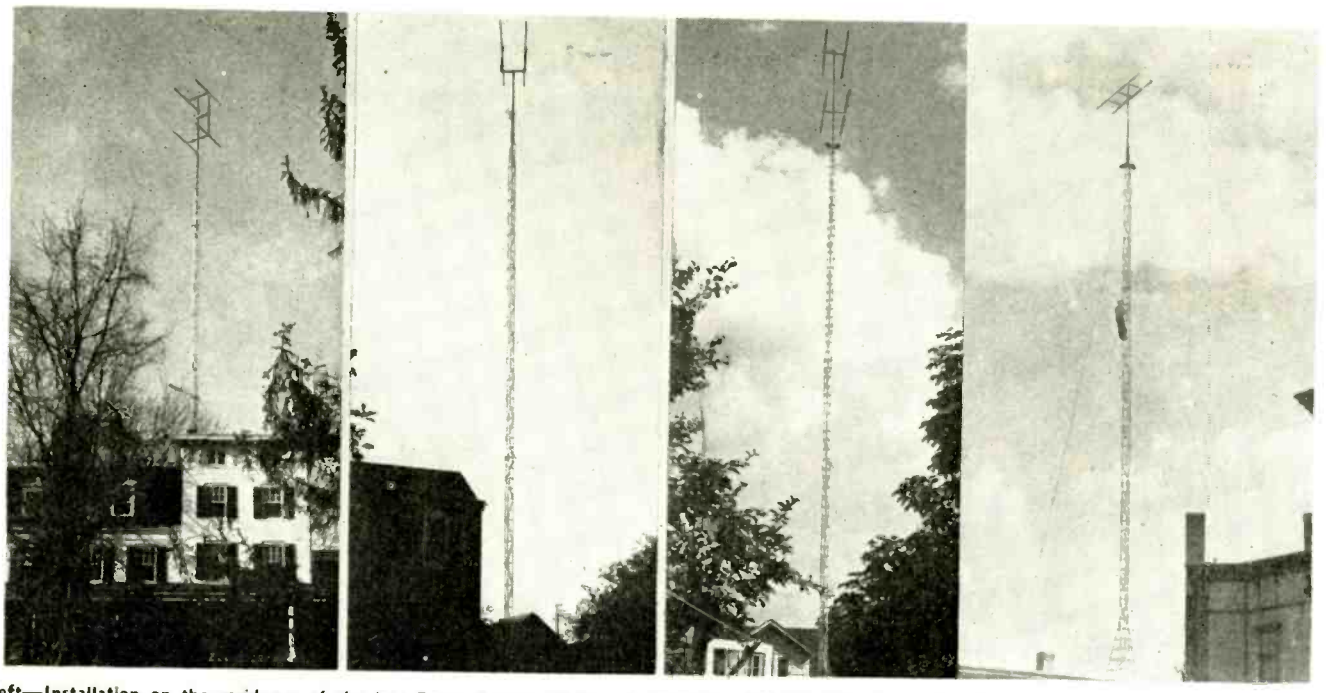


COPPER-OXIDE—Rugged in construction, provides virtually unlimited life when operated within rated capacities.

SELENIUM—Excellent for continuous operation where space is a factor and weight must be held to a minimum.

TUNGAR—Efficient and economical for low-voltage applications where life and price are determining factors.

GENERAL ELECTRIC



Left—Installation on the residence of the late David Grimes (Philco) in suburban Philadelphhia; Next—90 ft. tower with 10 ft. mast on the store of dealer Cope in Perkasie; Next—90 ft. tower and 10 ft. mast at home of James Albright (RCA) Collingswood, N. J. Right—78 ft. tower with 12 ft. mast and tunable antenna at Stromberg-Carlson dealer Harold Bent, Gardner, Mass.

Engineering Television Antennas for Home Use

"Your article entitled 'Television vs. Foliage' on page 88 of the September issue presents very well one of the problems involved in the adequate reception of television and FM radio for receiving sets and a problem many manufacturers like to ignore," writes Robert M. Weeks of The Wind Turbine Co., West Chester, Pa.

"Four photographs which show different installations are appended. All of these installations have resulted in excellent signal strength with attendant excellent reception. The antennas are sufficiently high to clear the surrounding trees and foliage. Before these were installed, we found lower antennas around 60 to 70 ft., to be inadequate in height. Consequently, the standard 90 ft. tower was developed. A 10 ft. rotatable mast is easily attached to the top where a suitable casting is placed to receive it and three feet below an adequate bearing plate. All of these installations, as far as we know, have been successful in picking up television broadcasts from the Empire State Building in New York, except Mr. Bent's.

"The increased elevation of dipole antennas has been somewhat helpful also in cutting down interference from automobiles. This was noticed not only by Mr. Bent at Gardner, where his store is adjacent to heavy traffic, but also in Newburgh where television demonstration sets were located in the middle of heavy traffic streets.

"In order to get the maximum signal strength in both television and FM, a tuned antenna is a must. If you examine the picture of Mr. Bent's antenna you will see that it is of this type. Mr. Bent exercised considerable care in balancing his antenna with the line."

IRE-AIEE ENGINEERS' RADAR SYMPOSIUM

A Radar Symposium was sponsored jointly by the New York Section of the Institute of Radio Engineers and the Communications Group of the AIEE in two sessions held in the Engineers Societies Building, New York, on December 8. The general theme of the program was the importance of radar technics in present day commercial services.

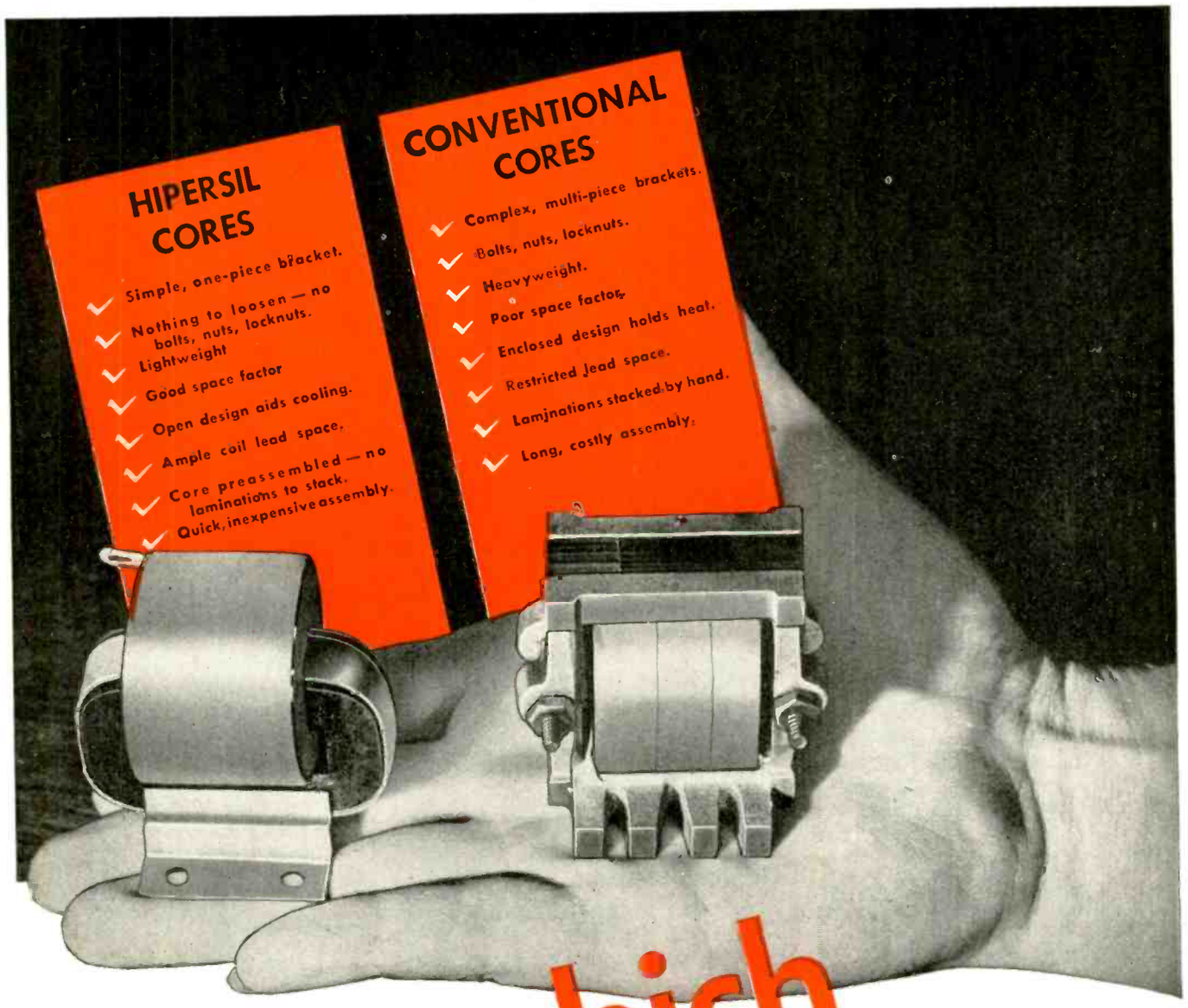
The symposium was opened with a paper on Surface Search Radar* by Henry J. Geist of the Raytheon Mfg. Co., who stressed its usefulness to marine navigators.

A description of "Doppler Radar" was given by Edward Barlow of the Research Laboratories, Sperry Gyroscope Co., Garden City, Long Island. Doppler radar, which does not use the pulsed wave technic, but a continuous wave, detects objects in motion. The slight but definite frequency change in the reflected signal is caused by the relative movement of an object which is struck by high frequency signals and the source of those signals, can be readily detected and utilized in several ways. The basic principle was demonstrated during the talk, and the effect of movements even as slow as a man walking could be heard.

A combination Radar-television system for aircraft navigation under development in the RCA laboratories, was described by P. J. Herbst, in conjunction with L. J. Jones and Irving Wolff. Complete radar installations are heavy and frequently may overload smaller aircraft. To overcome this difficulty and to allow pilots of smaller craft to enjoy the benefits inherent in radar indication, the system combines various features of television with radar technics, providing among other features, a repeater station on the ship of the indications from a large radar installation on the ground.

W. H. Doherty of the Bell Telephone Laboratories discussed the important part played by fire control radar, and pointed out the extraordinary accuracy with which these indicators operate, locating targets to within a few yards in

*See Electronic Industries, p. 98, November, 1945.



which

is a better answer to communications requirements?

Which offers the most advantages in your present—or future—applications?

If space . . . weight . . . ease and cost of assembly . . . are factors at all, the answer is plain: **HIPERSIL** Cores can make a tremendous difference in simplifying manufacture, as well as in providing important improvements in performance.

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Hipersil Type "C" Cores are available for prompt delivery in a complete range of sizes, as required, and in five lamination thicknesses: 29 gauge, 5 mil, 3 mil, 2 mil and 1 mil.

range and within a degree of azimuth.

M. R. Briggs of Westinghouse spoke on the SCR 584/784 radar, a mobile, medium-weight, gunlaying and tracking unit designed for use with anti-aircraft artillery and searchlight control. In addition to means for tracking an aircraft, it incorporates means for "identification, friend or foe," called IFF.

The afternoon session was terminated by Mr. L. R. Lynn, of the General Electric Co., with a paper "The Electronic Navigator," a simplified radar system giving indications directly to the navigator of other surface craft, buoys, shore lines, icebergs, etc., in his vicinity.

Experimental FM Antenna

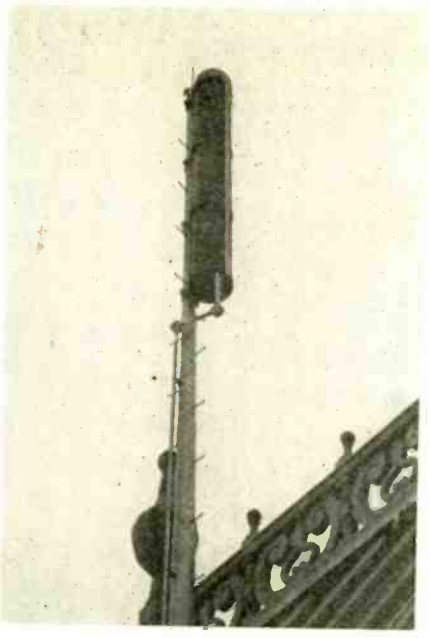
To radiate a greater proportion of energy toward the horizon, with less radiation into the adjacent area and skyward, an experimental FM antenna has been developed by Dr. Andrew Alford of the Radio Research Laboratory at Cambridge, Mass. Designed to operate in the new FM band with horizontal polarization, the antenna has been erected on the roof of station WGHF at 10 East 40th Street, New York City, owned by Capt. W. G. H. Finch.

The antenna is 11 ft., 8 in. long, and 2 ft. in diameter, with a longitudinal slot as may be seen in the picture, and is fabricated of sheet brass. The wavelength along the bent sheet is longer than a wavelength in space, so that radiation is obtained from a long vertical column. It is essentially omnidirectional, and has low input impedance; a matching stub inside the structure serves to adjust the standing wave ratio over a limited frequency range. The antenna is top-fed.

A model of the design was tested at 500 mc, and yielded the desired radiation pattern. The antenna was to be tested on 99.7 mc early in January with a power input of 100 kw. It surveys an area of 6,840 square miles. To protect the matching stub and feed line from the elements, top and slot are sealed with fiberglas structures.

FCC Studies Users

As a means of obtaining data to assist in the allocation of cleared channels for AM, subject of a hearing January 14, FCC has completed a survey of some 2,500 rural homes. Object is to find out what value listeners place on radios. The result



Construction of the experimental FM antenna installed for station WGHF, New York

shows that 77% of the women polled and 66% of the men would miss their radios "a great deal" if they lost them for a month. Result of the poll will be presented before the hearing as "Attitudes of Rural People Toward Radio Service".

Midget Radio Tells Time, Weather

Seeking to operate in the 25-35 mc band, Electronic Time, Inc., New York City, has applied to FCC for a frequency allocation and proposes to sell pocket receivers half the size of a cigarette package which would receive 15-second time and weather reports broadcast continuously from a 2,000-watt station atop the Lincoln Building in Manhattan. Radius of reception would be 25 miles. A wire recorder synchronized with Arlington time signals would "announce" 24 hours daily. Like the pocket set, a proposed desk set would also contain midget tubes and batteries, but contain additional components in a case 3 x 3½ x 2 in.

FCC Authorizes Farm FM Use

Acting on the first application of its kind, the Federal Communications Commission has authorized the Garwood Irrigation Co., Garwood, Texas, to construct a radio system to be used in the operation of its irrigation networks serving 100,000 acres of rice and other crops. The company operates 200 miles of canals and many miles of irrigation ditches for the benefit of some 100 ranches. The FCC authorization will permit the company to construct a land station and two 50-watt portable and mobile units and four 35-watt mobile units. The frequency assigned is 35.46 mc; special emission for FM.

FCC Processing AM, FM, Tele Applications

There are presently on file with the Federal Communications Commission 463 applications for new standard (AM) broadcast stations and 211 applications for changes in existing standard (AM) facilities, or a total of 674 AM applications. There are likewise on file 707 FM applications and 142 television applications.

The Commission has already made 174 conditional FM grants and designated 11 FM applications for hearing. The remaining 522 applications for FM stations are being rapidly processed and further grants will be made and others consolidated for hearing from week to week.

On November 21, 1945, the Commission issued a public notice setting forth its allocation plan and other basic rules for television in the lower bands. The text of the rules and regulations themselves and the standards of good engineering practice based upon these regulations will be issued in the immediate future. Since the number of applications in twelve metropolitan areas exceeds the allotted frequencies, it will be necessary to designate 80 applications from these areas for consolidated hearings. Orders to that end will be announced as soon as the final rules and standards are promulgated. The remaining 62 television applications will be processed with due diligence.

Lindsay Changes Style

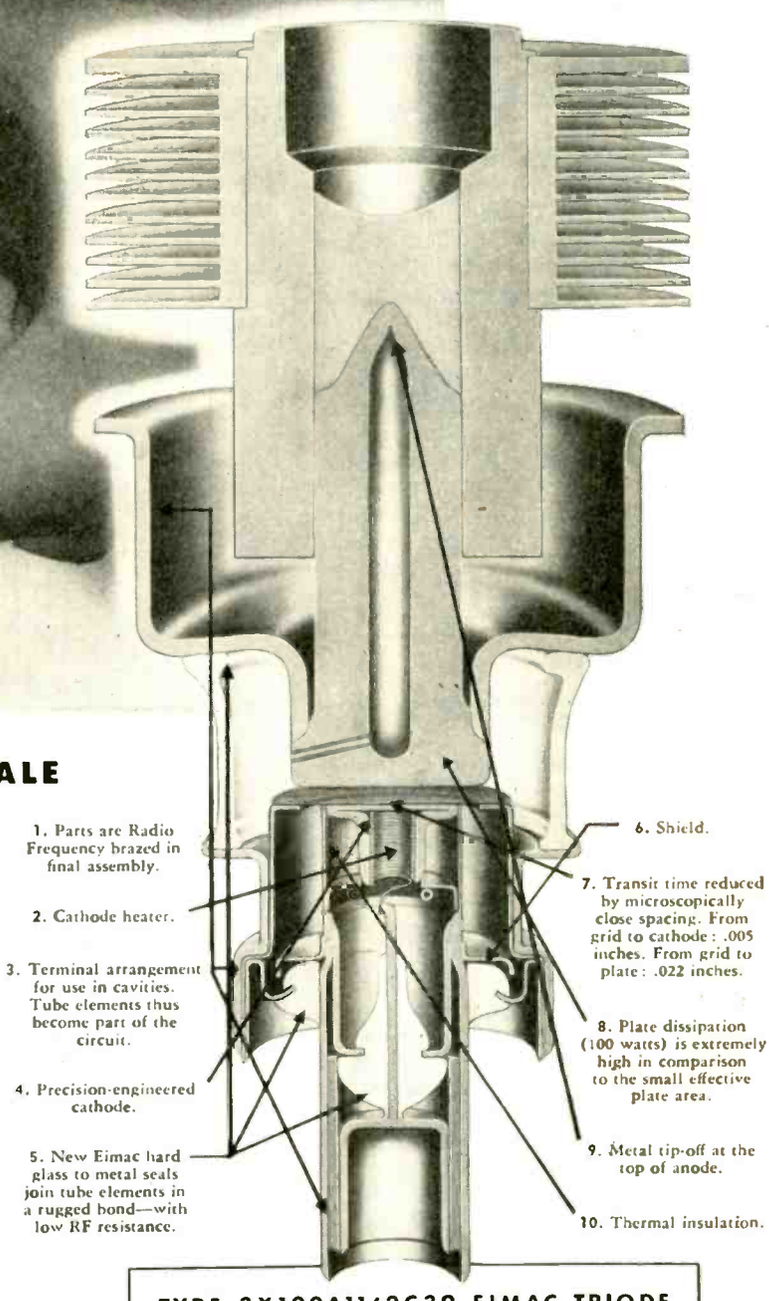
Hereafter it is to be The Lindsay Corp. instead of Lindsay & Lindsay, Chicago. The change in corporate style involves no change in the personnel or products of the organization which produces metallic structures for the radio-electronic and allied fields. Executive offices are at 222 W. Adams St.

Fairchild Moves

Fairchild Camera & Instrument Corp. has moved its general offices and all manufacturing facilities to Jamaica, L. I. The new address is 88-06 Van Wyck Blvd.

Eimac TUBES

THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT



PRECISION ENGINEERING ON A MASS PRODUCTION SCALE

. . . that's the basic achievement of Eimac engineers in providing typically outstanding Eimac performance in these tiny triodes. Observe the many functions of the Eimac developed 3X100A11/2C39 triode—cross section view. Note actual size shown in photo above.

Designed for special military purposes—these tiny triodes will find valuable application in commercial fields. An indication of their high efficiency is their ability to operate on frequencies up to 2500 megacycles and their high plate dissipation (100 watts) despite the extremely small effective plate area—about the size of a dime.

By developing and improving the performance of this tiny triode Eimac has again demonstrated an extraordinary ability to accomplish outstanding results in Electronic vacuum tube engineering—an ability which has established Eimac as first choice of leading Electronics engineers throughout the world.

1148

FOLLOW THE LEADERS TO Eimac TUBES

TYPE 3X100A11/2C39 EIMAC TRIODE

GENERAL CHARACTERISTICS

ELECTRICAL	
Cathode: Coated unitpotential	
Heater Voltage	6.3 volts
Heater Current	1.1 amps
•Amplification Factor (Average)	100
Direct Interelectrode Capacitances (Average)	
Grid-Plate	1.95 *mmfd*
Grid-Cathode	6.50 *mmfd*
Plate-Cathode	0.030 *mmfd*
Transconductance (i_B=75 ma., E_B=600 v.) (Av.)	20,000 *μmhos*
Maximum Plate Dissipation	100 watts
MECHANICAL	
Maximum Overall Dimensions	
Length 2.75 inches	Diameter 1.26 inches

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HERB B. BECKER (W6QD)...1406 South Grand Avenue, Los Angeles 15, California. Phone: Richmond 6191. California, Nevada and Arizona.

TIM COAKLEY (W1KKP)...11 Beacon St., Boston 8, Mass. Phone: Capitol 0050. Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island.

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NEW BOOKS REVIEWED

Elementary Engineering Electronics

By Andrew W. Kramer, Managing Editor, Power Plant Engineering. Published by Instruments Publishing Co., Pittsburgh, Pa., 1945. Cloth, 5 x 8¼ in., 344 pages, 259 illustrations, $2 postpaid.

This is a semi-technical book which explains how the various types of electron tubes work and how they may be applied to industrial problems. There are thirty-four short chapters and an index of six pages.

The text is prepared to give a general knowledge of electron tubes and circuits without getting involved in mathematics. It seems regrettable to this reviewer that this book should have included many of the popular concepts that place simplicity over accuracy in importance.

Basic Electrical Engineering

By A. E. Fitzgerald, published by the McGraw-Hill Book Co., New York, 1945, 441 pages, $3.75.

A text book for students majoring in engineering, covering circuits, machines and electronics. Dr. Fitzgerald is associate professor of electrical engineering at M. I. T. In this text knowledge of physics is assumed but not necessarily a previous study of alternating currents. It covers many of the technics and electrical engineering practices that have proved important in recent years. About one quarter of the book is devoted to electronic principles.

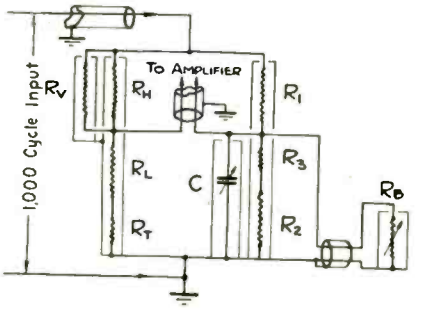
The Electronic Engineering Master Index

By Frank A. Petraglia. Published 1945—Electronics Research Publishing Co., 238 W. 44th St., N. Y. C., 318 pages, 7 x 10, price $17.50.

This is a comprehensive and painstaking subject index to electronic engineering periodicals covering, in separate sections, the two decades from 1925 to June, 1945. Approximately 16,000 entries are included, showing the title, the author and the magazine in which it appeared, the volume number, the starting page and the date. All of the readily-obtainable magazines devoted to these subjects, published in the U.S.A. and a few of the more widely read foreign publications have been analyzed and articles of radio and electronic interest have been classified. This compilation brings together many separate bibliographical lists and the annual indexes of the separate publications, making it a handy reference to provide engineers with a means for gaining ready information on any technical subject.

In most cases the reference is listed under the title that is listed in the section in which the subject is mainly concerned as judged by its title.

The book is divided into two decade sections with a cross index of topics included, permitting a search to be made in kindred fields should information be desired on some subject that might appear in several categories. It is planned to have this publication an annual affair. The pages are printed in double column style.



AC Bolometer

An alternating current bolometer for use in infra-red spectroscopy is described in a paper presented by Frank G. Brockman of North American Philips Co., Inc., and C. H. Schlesman of Socony-Vacuum Oil Company, Inc., before the session on infra-red spectroscopy at the Meeting of the Optical Society of America, held in New York on October 18, 1945.

This bolometer utilizes a nickel filament constituting one arm of a Wheatstone bridge, shown in Fig. 1. Radiant infra-red energy impinging on the nickel filament causes a rise in temperature and an associated change in resistance. The unbalance of the bridge, supplied with ac voltage, is amplified, rectified and recorded.

The paper described the performance of this device. Careful design of the bolometer bridge was essential to compensate for fluctuations in ambient temperature and in supply voltage. A permanent record of the spectrum from 2 to 14 microns can be obtained in 40 minutes; the region (7 to 14 microns) usually studied in hydrocarbon mixtures is recorded in 24 minutes. The minimum detectable temperature change is 11×10^{-6} degree C, and the sensitivity is approximately 0.06 V/watt/sq.cm.

Radio Sound Effects

By Joseph Creamer and William B. Hoffman, published by the Ziff-Davis Publishing Co., New York-Chicago, 1945, 61 pages, $1.50.

As stated in the subtitle, this is "a manual for broadcasting stations, sound effects technicians, students, and all others who use, or are interested in, modern sound effects technic."

The book teaches the mechanics of sound effects creation, such as the slam of a door, the rumbling of thunder, the sound of marching men, of mass war, or of a rattlesnake's rattle. Control room signals and the use of trick effects are explained; a list of recorded sound effects is included. Recommendations can be found in the text as to what to do and what not to do if confronted with the problem of creating sounds for a particular performance.

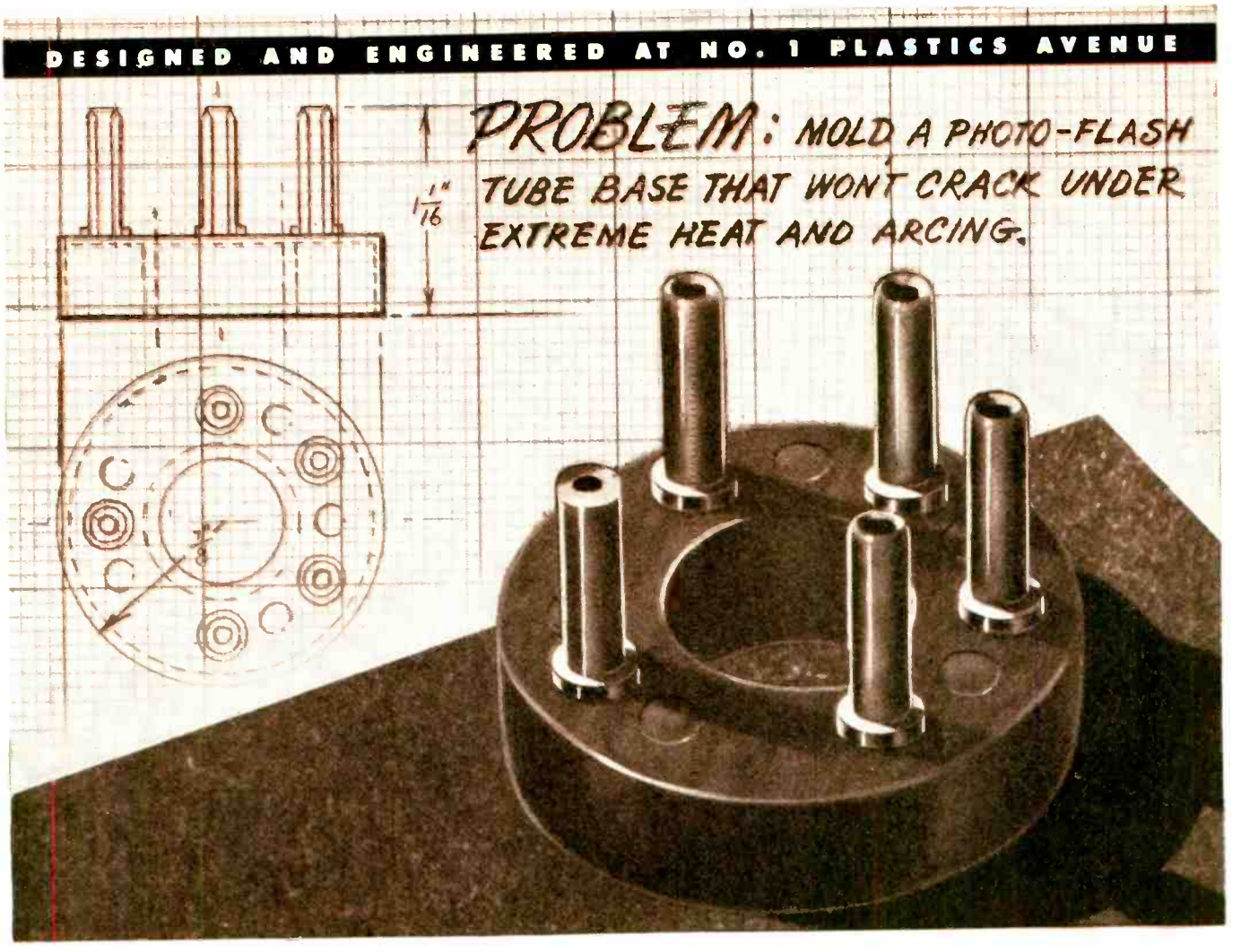
The Simple Calculation of Electrical Transients

By G. W. Carter, M.A., A.M.I.E.E., published by the Macmillan Co., New York City, 1945, 120 pages, $1.75.

The text is an elementary treatment of transient problems in lumped linear electrical circuits, by Heaviside's operational method. It is based upon a course of lectures given to engineers of the British Thomson-Houston Co., Ltd. The mathematical treatment is closely tied up with the working of the electrical circuits considered and no new step in the method has been introduced without being followed by one or more fully worked-out examples drawn from engineering practice. Little previous mathematical knowledge is required for the understanding of the text.

Crystal Research Acquires Metallic

Crystal Research Laboratories, Inc., 29 Allyn St., Hartford, Conn., has acquired the entire capital stock of the Metallic Lens Coating Corp., located in Flushing, L. I. The name of the lens coating company has been changed to Metavac, Inc. The company is engaged in the business of vacuum depositing metallic, fluoride and oxide coatings, or anti-glare film coverings, on optical lenses for the photographic and television industries.



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7. Resistance to sudden temperature changes
8. Low coefficient of thermal expansion
9. High heat resistance

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TRON FAMILY

(*Continued from page 83*)

Permatron—A gas or vapor-content thermionic cathode diode. Cyclic anode current flow is initiated by a magnetic field change. "The Permatron and Its Application in Industry" by W. P. Overbeck. Electronics, April, 1939; v. 12, p. 25.

Phanotron—A hot-cathode, gas or vapor content diode in which no means are provided for controlling the current flow. It is essentially a rectifying device. "Gas-Filled Thermionic Tubes" by A. W. Hull. Transactions AIEE, July, 1928; v. 47, p. 753.

Phonotron—A trade name for radio receiving tubes sold by a firm in the early 20's.

Photo-Augetron — A high-vacuum, photo-cathode, multi-electrode multiplier tube. Electronics and Television and Short Wave World (British), February, 1940, p. 75.

Pliodynatron — A high-vacuum, thermionic-cathode tetrode. It is fundamentally a dynatron with a control grid added. "The Dynatron Detector—A New Heterodyne Receiver for Continuous and Modulated Waves" by A. W. Hull, E. F. Hennelly and F. R. Elder. Proceedings Ire, October, 1922; v. 10, p. 322.

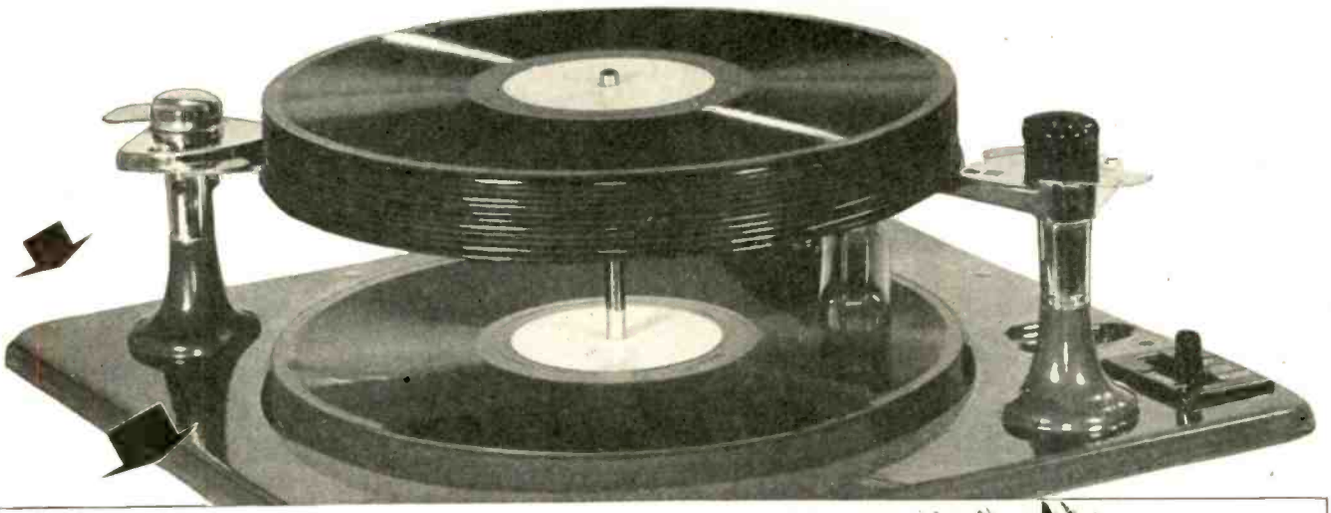
Pliotron—A high-vacuum, thermionic-cathode tube. In addition to the cathode and anode, one or more additional electrodes, usually called grids, are used to control the current through the tube. "The Pure Electron Discharge and Its Application to Radio Telegraphy and Telephony" by Irving Langmuir. Proceedings Ire, September, 1915; v. 3, p. 26.

Plomatron—A name suggested for the grid-controlled, mercury-arc rectifier. London Electrician, December 18, 1942, p. 669.

Positron—One of the fundamental particles making up the nuclei. It has the same mass and same magnitude of charge as the electron, but the charge is a positive one. "The Positive Electron" by C. D. Anderson. Physical Review, March, 1933; v. 43, p. 493.

Precipitron—The trade name used by the Westinghouse Electric Corp. for a method and apparatus for dust precipitation. The functions of particle charging and dust precipitation are carried on separately. This permits use of a lower dc voltage than in the conventional process. "A New Electrostatic Precipitator" by G. W. Penney. Electrical Engineering, January, 1937, p. 159.

Pulsatron—A double-cathode, gas-filled triode. "Gas-Filled Tubes as Pulse Generators" by F. J. G. van



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for radio manufacturers to make provisions in their circuits to accommodate the SEEBURG WIRE RECORDER. We therefore invite prompt inquiries from interested radio manufacturers.

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den Bosch. Electronic Engineering, April 1945, p. 474.

Pyrotron—Trade name of an electronic method of temperature control used by the Bailey Meter Co. Instruments, March, 1945, p. 182.

Quadraton—A four-element, thermionic-cathode, high-vacuum tube. The fourth element is a triangular plate, co-planar with the V-shaped filament. "A Departure in Radio Tube Design" by H. K. Huppert. Radio News, July, 1926; v. 8, p. 50.

Radiotron*—A trade name for the tubes sold by the Radio Corporation of America.

Rectron*—A trade name, used at one time, for rectifier tubes sold by the Radio Corporation of America.

Resnotron—A high-vacuum tetrode with built-in output and input resonance circuits and designed particularly for large outputs in the very high-frequency and ultrahigh-frequency ranges. A development started by Dr. D. H. Sloan of the University of California at Berkeley, Calif.

Rhumbatron—The name given to the resonator cavity portions of the Klystron. "A High-Frequency Amplifier and Oscillator" by R. H. and S. F. Varian. Journal of Applied Physics, May, 1939; v. 10, p. 321.

Sendytron — Japanese designation for a mercury-pool tube in which the arc is initiated by a high-voltage probe electrode. Electro-Technical Journal of Japan, August, 1938; v. 2 No. 8, p. 180. See also Wireless Engineer, November, 1938, p. 641, No. 4609.

Sentron—A Japanese form of short-wave tube. "A New Vacuum Tube for Ultrashort Waves" by Uda, Uchida and Sekimoto. Abstracted in Wireless Engineer, June, 1938, p. 330, No. 2262; also July, 1938, p. 387, No. 2772.

Skiatron—A device for the projection of television images. Electronics and Television and Short Wave World, February, 1940, p. 52.

Spirotron—A device for decelerating very high speed particles by the reverse of the cyclotron principle. "The Spirotron" by L. E. Dodd. Physical Review, September, 1944; v. 66, p. 160.

Strobotron—A cold-cathode discharge tube with control electrode designed to pass heavy currents for every short periods of time. Used for high-speed photography. "A Cold-Cathode Arc Discharge Tube" by K. J. Germeshausen and H. E. Edgerton. Electrical Engineering, July, 1936, p. 790.

Supertron—A trade name for re-

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Contents

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ceiving tubes sold by a firm in the early 20's.

Synchrotron—A device for producing a beam of high velocity charged particles which are successively accelerated by an alternating electric field synchronized with the spiral revolutions of the particles in a perpendicular alternating magnetic field. "The Synchrotron" by Edwin M. McMillan. Physical Review, Sept. 1, and 15, 1945, pp. 143-144.

Takktron—A gas-filled, cold-cathode diode designed for the rectification of low-currents at high voltage. "A Portable Instrument for Measuring Insulation Resistance at High Voltage" by F. W. Atkinson and R. B. Taylor. Electrical Engineering, April, 1945; v. 64, p, 164. "Industrial Testing with High Voltage," Electronic Industries, November, 1945. p. 106.

Teletron—A trade name used at one time for cathode-ray oscillograph tubes sold by the Allen B. DuMont Laboratories, Inc. Review of Sci. Instr., June, 1941, p. 337.

Thermatron—The trade name applied to high-frequency heating generators sold by the Radio Receptor Co., Inc. Electronic Industries, July, 1945, p. 135.

Thermotron—A trade name for radio receiving tubes sold by a firm in the early 20's.

Thyratron — A hot-cathode, gas-content tube in which one or more control electrodes initiate, but do not limit, the anode current except under certain operating conditions. "Hot-Cathode Thyratrons" by A. W. Hull. General Electric Review, April, 1929; v. 32, p. 213.

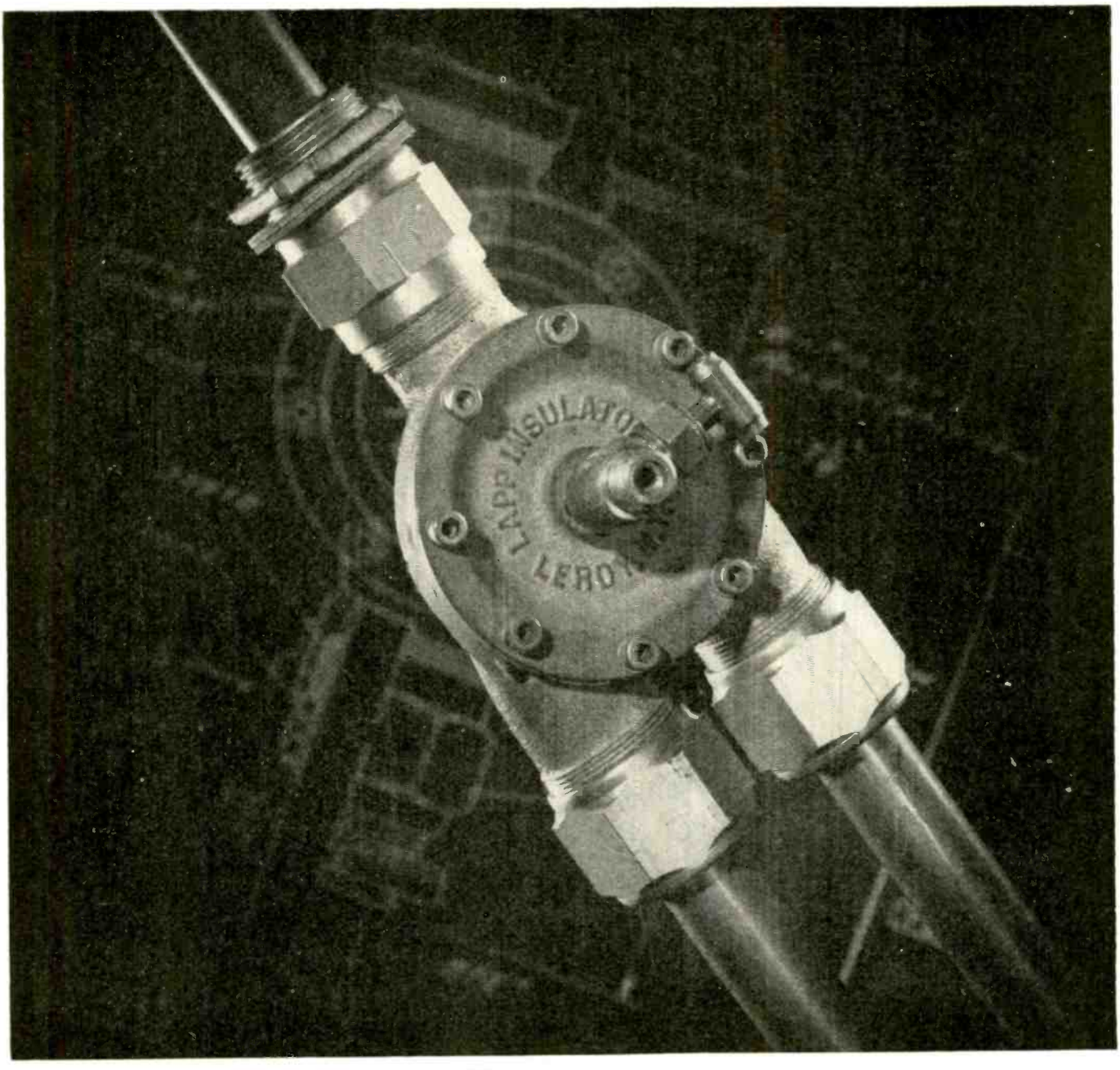
Transitron—An oscillating circuit using a tetrode operating as a negative resistance. "The Transitron Oscillator" by Cledo Brunetti. Proceedings Ire, February, 1939; v. 27, p. 88. "Transitron Oscillators by Werner Muller, Electronic Industries, December, 1945, p. 110.

Trignitron—A trade name for a mercury-pool type of tube used in a welding control device sold by the Electronic Power Co., Inc., Electronics, July, 1944, p. 58.

Vibratron—A continuously variable high Q electro-mechanical resonator using a stretched wire operating in a magetic field. "The Vibratron," by R. R. Batcher, Electronic Industries, April 1945, p. 79.

Videotron—See Monotron.

Visitron—A trade name for a projection type of television picture tube sold by the Rauland Corp., Electronic Industries, October, 1945, p. 203.



Electronic Parts: ENGINEERING AND PRODUCTION

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

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

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

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Lapp

Voltron—A trade name for radio receiving tubes made for a time by a firm in the early 20's.

Zyklotron—Trade name for a high-frequency tube development of the Brown-Boveri Co., Baden, Switzerland. Mentioned in the 40th Annual Report of the above company. This report covers a 1939-1940 period.

SENSITIVE RECORDER

(*Continued from page 89*)

for full scale deflection may be used, though for a rugged recorder 60 cm - mg is preferable.

The contacts are mounted on a rotatable carriage having a section (B) which has its shaft concentric to the pivots of meter A. This sector is connected to a reversible shaded pole motor D by a suitable gear train. The insulator pointer of the meter movement is connected to an adjustable tap on voltage divider R associated with the power supply.

The contacts are connected to the grids of the two vacuum tubes by resistors R_2, R_3, R_4 and R_5, values of which depend on the selection of tubes, relays and other factors. The tubes are biased to near cut-off by the voltage drop through the relay coils.

When the pointer is in the neutral zone and makes no contact, capacitors C_1 and C_2 are charged to full voltage which is cut-off for the tube. Both relays are released, but as soon as the pointer moves out of the neutral zone it is attracted to the nearest contact. The corresponding capacitor discharge punctures the gas layer and the electrostatic potentials disappear. The electronic relay then operates and starts the motor.

If the original unbalance was slight, requiring only a slight movement of the pointer, the latter, released by the electrostatic forces, will move away from the contact and the motor will stop.

If the motor has moved sufficiently during the intervening time interval to bring the pointer into the neutral zone, nothing more will happen. If not, however, the process will repeat several times until the contact bearing sector has moved far enough to bring the new position of the pointer into the neutral zone between contacts.

If the original unbalance was greater, the pointer will remain in contact until the sector has approached the new position, when the "pecking" process begins again

and persists until the new position is reached.

Tests have shown that this is a workable follow-up system, which will translate the movement of a light instrument pointer into that of a power-driven shaft, which will reproduce accurately the position of the pointer. Such a movement can be applied in various ways to remote indication and control:

1. It can be easily applied to a recorder controller.
2. A large pointer may be driven by the system over a circular or strip recording chart.
3. Control switches or valves may be mounted in such a way that they are operated by the passing pointer, making it feasible to have a number of control points, which may initiate various process functions as the magnitude of the variable being measured reaches various set points.

It may, for example, shut off various portions of a heater as the temperature rises, or it may admit various gases or liquids as the process progresses.

Some of the functions in (B) may be used to vary the sensitivity of the controller itself. It is possible, for example, to have a coarse scale, which covers the range from room temperature to well beyond the process temperature, but at a predetermined level the instrument is switched to maximum sensitivity so that a few degrees are spread over the entire scale.

The scale of most electrical instruments covers an arc of 100°. If a circular scale and chart are used it is desirable to use at least 300° of the circumference for the scale. The movement of the sector shaft must, therefore, be multiplied by a factor of 3. Motor, pointer, a sector and pen could be connected in conventional fashion by gear trains, although a great deal of design juggling would have to be done to locate the various gear shafts in their right positions. To reduce backlash to a minimum, high grade gears would have to be used.

However, greater flexibility of design is obtained by connecting the shafts by pulleys and flexible steel bands 0.003 in. thick, since in this way the shafts can be disposed almost at will. Fig. 2 shows diagrammatically a round chart instrument with steel belt drive. By changing their arrangement the same components may be readily adapted to a strip chart.

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Shaft A, connected by a suitable gear reducer to the shaft of a reversible motor (not shown), may be driven at a speed sufficient for its pointer to traverse the entire chart in 6 seconds. Pulley B is connected with sector C by a steel belt, which runs over idlers a a, so that 300° of the pulley can be utilized. The belt is pinned to the pulley at one point.

E is a meter movement with a special contacting pointer. The movement is rigidly connected to the instrument frame. Rotating around the axis of this meter movement and in the plane parallel with the plane of the motion of the pointer, an insulating plate G carries two contacts, F. Pen H is mounted on pulley with an independent axis. This pulley is driven from pulley A by belt K. The chart is supported and driven in conventional manner, to record movements of this pen. Each shaft carries a pulley or sector. These are connected by bands of steel .003 in. thick, rigidly fastened at one point on each pulley or sector. A spring suspended idler is included in each run to keep them tight to suppress backlash.

Since the pulleys and sectors are steel there is no temperature error due to differences in coefficient of expansion of belt and pulleys, although even with brass pulleys, errors from this cause are negligible.

In some control problems, it is often desirable to connect the main pointer shaft to a potentiometer instead of deriving the position of the pointer from the deflection of the meter. The unbalance is indicated by an electronic circuit which operates either a pair of relays or a contact making meter type of relay, or is amplified sufficiently to drive the motor directly. As before this power driven pointer can be made to perform any desired control function.

Another feature of the system is that enough power is available so that one or more toggle switches, like L in Fig. 2, may be operated successively by the pointer to initiate various functions as the process variable changes.

For throttling control the switches may be replaced by a valve positioning potentiometer. If reset is desired, the stator of the potentiometers are driven by an auxiliary motor. By other design modifications almost any combination of control function can be carried out.

PHOSPHORS

(Continued from page 95)

ratio is known as the luminous efficiency.

The useful light output is dependent upon the quantity and spectral distribution of this light and of the eye sensitivity. The light of the television phosphor should be as close as possible to the eye maximum of 5600° Å in a narrow emission band if possible or should be as much as possible within the eye sensitivity curve (Fig. 6).

There are many pairs of complimentary saturated colors which give white light but the optimum efficiency for the production of white light is best obtained with phosphors having their emission peaks at about 4590 Å (deep blue) and 5720 Å (yellow green). This can easily be done by mixing zinc sulfide (deep blue) and zinc beryllium silicate or zinc cadmium sulfide (yellow green). Since yellow and orange zinc cadmium sulfides have more absorption of blue light than zinc beryllium silicate the advantages of zinc beryllium silicate is obvious. Zinc cadmium sulfide can be used efficiently if the phosphors are deposited separately with the blue component closest to the observer (19).

Phosphor brilliancy

The brightness or brilliancy of a phosphor depends upon a number of factors some of which are: a. Screen thickness—The energy of the electron causes it to penetrate well into the phosphor crystal and this penetration increases with increased electron energy. It is important that the screen thickness be adequate considering this penetration otherwise the electrons will impinge upon the glass and their energy will be wasted. It should not be so thick that the luminous efficiency is reduced. The optimum condition is one in which the thickness of the screen is slightly thicker than the depth of penetration. The penetration of electrons accelerated by 10,000 V is 2.5 microns for zinc orthosilicate, 2.46 microns for calcium tungstate and 2.83 microns for zinc sulfide (20). This indicates that the sulfide screen should be made thicker in proportion to the increased depth of penetration.

b. Current density—For low current density the light output is directly proportional to the current density. As the current density is

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raised (accelerating voltage kept constant) screen saturation occurs with the resultant drop in the light output and the deviation of the proportionality of current density with light output (21) (Fig. 7).

c. Accelerating voltage—The light output also depends upon the energy of the electrons exciting the phosphor and for low current densities the relationship is linear. Under such conditions the potential of the screen adjusts itself with respect to the other applied potentials so that the charge of the electron beam is passed off and thus the screen is slightly negative as compared to the accelerating voltage (most positive potential). As the energy of electrons increase (increased accelerating voltage) a point is reached where the screen cannot pass off this negative charge as rapidly as it is imparted by the electron beam thus causing the screen potential to drop. (Fig. 8), (Table II).

Secondary emission

Phosphors in general are dielectrics with high resistivities. In order for the charge imparted by the electron beam to pass off the screen it must be made conductive or the charge must be passed off by a secondary emission process. This must be done so that the "floating" screen potential is such with respect to the accelerating anode that no charge will be built up on it. Under such a condition the screen potential is slightly negative with respect to the most positive anode (carrying the accelerating potential) of the tube. As the energy of the electrons is increased a limiting value of screen potential is reached at which point the secondary electrons leave the screen at such a rate that a large charge is built up on the screen. Increasing the accelerating potential will not increase the screen potential but will increase the charge on the screen (Fig. 9).

The limiting screen potential is greatly affected by impurities in the material or on its surface as getter or cathode material. The screen thickness and bulb cleanliness also affect the limiting screen potential. The limiting screen potential is decreased with increased current density or by aging of the screen (23).

Phosphorescence

With fluorescent materials the intensity of fluorescence builds up rapidly to a maximum with the

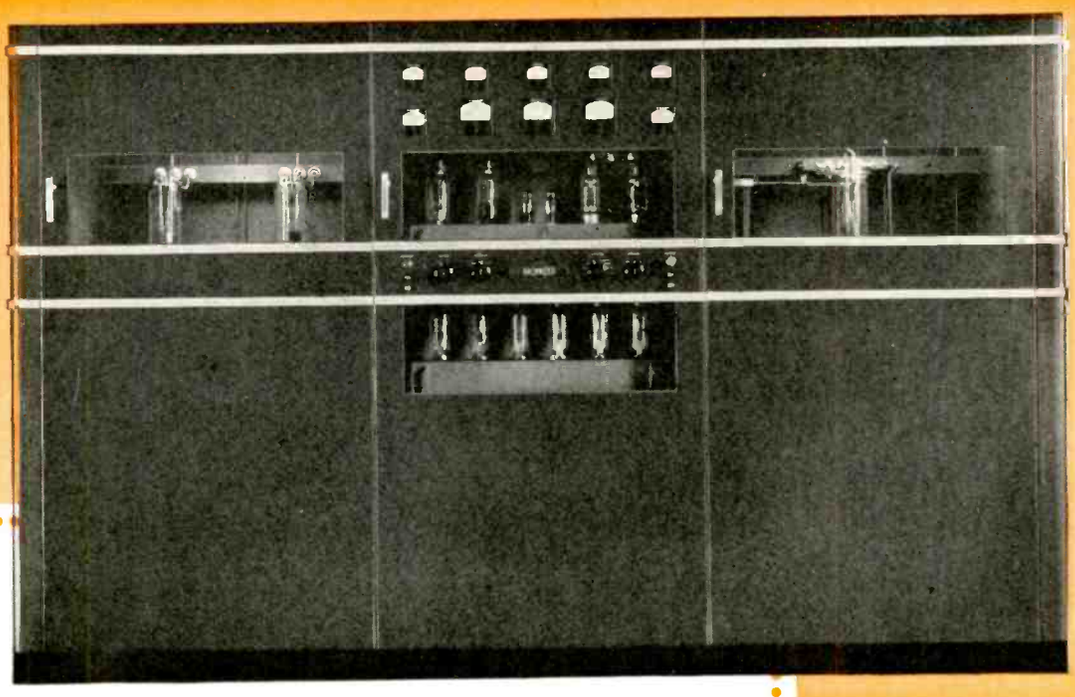
elapsed time between start of excitation and attainment of this maximum being very short. With phosphorescent materials an appreciable amount of time elapses before the maximum (saturation) is reached. Similarly when the excitation is removed the intensity of fluorescence for fluorescent materials falls to zero almost instantly after the excitation is stopped, but with phosphorescent materials the light intensity drops rapidly at first, then much slower, and this process may continue for a period of hours (Fig. 10a, b). As explained above this is due to the trapping of electrons so that their return to a normal state can only occur with the addition of energy to the phosphor crystal.

The phosphorescence of a phosphor may be increased by lowering the temperature. Also with lowered temperature the time for saturation (maximum light output) to be reached is increased. Saturation becomes more rapid with increased intensity of exciting rays. Correspondingly the decay becomes more rapid with increased intensity of excitation (24).

For television purposes it is important that phosphors have no noticeable phosphorescence otherwise the picture will be blurred. For radar purposes the phosphorescent screen is essential and elaborate saturation and decay measurements are made on such screens to obtain the necessary phosphorescent characteristics.

Television phosphor objectives for projection

The phosphors used at the present time make satisfactory screens for direct viewing television tubes operated at moderate accelerating voltages. They give pictures with good contrast and brilliancy and operate satisfactorily over long periods of time. But for projection purposes where extremely high brilliancy and contrast is desired and where the tube is operated at very high accelerating voltages with substantial beam currents the defects and shortcomings of these phosphors become evident. These screens lack the required secondary emission characteristics, are less efficient at higher voltages and higher beam currents, and deteriorate very rapidly when operated under such conditions. Therefore, the research on phosphors is directed towards the making of phosphors for projection screens.



Why WAAT bought its new 5 kw transmitter from Collins

The Bremer Broadcasting Corp., owners of WAAT, had had previous experience with Collins equipment. Mr. Frank V. Bremer, Technical Director, puts it this way:

"It is with interest and pride that I bring to your attention the performance of the Collins 20K one kilowatt AM transmitter installed at Kearny on April 14, 1941.

"This transmitter has been on the air a total of 39,000 hours, as of October 15, 1945, with a total elapsed lost time of only fifteen minutes.

"This makes a most remarkable record, since our station is on the air twenty-four hours per day, seven days per week, and it speaks well for your transmitter.

"According to the logs checked by Anthony Castellani, transmitter supervisor, the fifteen minutes total of lost air time was caused by defective bias tubes and a coupling condenser in the audio circuit.

"At no time in the period of operation of the 20K have we had to make a refund or make up allowance to any sponsor due to lost air time.

"As director of the engineering department of WAAT and FM-WAAW, I give credit for this remarkable performance to your efficient design and to the capable operating supervision by our transmitter staff."

(*Signed*) Frank V. Bremer

With this background of satisfaction, the Bremer Broadcasting Corp. ordered a new 21A 5 kw AM Collins transmitter as soon as military restrictions were lifted in the fall of 1945. An illustrated bulletin, fully describing this transmitter, will be sent you on request.

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The luminous efficiency of cathode ray energy conversion by television phosphors is very low, less than 10%, and becomes lower at higher accelerating voltages and with denser beam currents. The efficiency of phosphors excited by ultra-violet radiation and alpha particles is many times higher than that for electrons and there is no apparent reason why the efficiency cannot be increased.

Present screens are fairly easily burned by electron beams of moderate current density and high accelerating voltages. The light output decreases substantially after a few hundred hours of operation. In projection television very high energy beam currents are used (very highly accelerated electrons) and the deterioration of such screens is much more rapid.

Another type of screen deterioration (ion burn) is caused by the bombardment of the center of the screen by negative ions with the formation of a dark spot. This defect is mainly seen in magnetic deflection tubes. More stable phosphors are necessary to prevent this. Some of this work has resulted in the coating of the phosphor crystal with silica to reduce this and other burning effects. Changes in the gun construction (addition of an ion trap to the gun) have also proved effective.

(REFERENCE 21)

	Point of Departure from Proportionality	uA/cm² for 20% loss in light	Maximum limiting Voltage
$2ZnO.SiO_2.Mn$	2 uA/cm²	10	6,500
Zn Cd S.Ag	1 uA/cm²	10	>10,000
$CaWO_4$	20 uA/cm²	30	5,000
Zn S.Ag	100 uA/cm²	200	>10,000
Zn Be SiO_3 (22)	8 uA/cm²	—	—
Zn_2SiO_4 Mn (23)	—	—	20,000

Secondary emission is a problem in projection television because only at the intermediate and high accelerating voltages needed to give very brilliant pictures does this type of defect appear. Various methods of overcoming this fault have been tried, among them being the addition of a thin conductive coating on the glass before the screen is applied, by adding an inert component to the screen to increase its conductivity, or by the skillful preparation of the screen. All are effective to various degrees.

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present time the television cathode ray tube having a phosphor screen which can reproduce television pictures satisfactorily for direct viewing conditions. For projection purposes proper screen quality is still lacking.

BIBLIOGRAPHY

1. H. Becquerel, Ann. Chim. Phys., 55 (1859)
2. G. Stokes, Phil. Trans., 143, II, 463 (1852)
3. A. Verneuil, Compt. Rend., 103, 600 (1886)
4. P. Lenard, V. Klatt, Ann. Phys., 105, 286 (1904)
5. E. Goldstein, Wein, Ber., 80, II, 151 (1876)
6. W. Crooks, Proc. Roy. Soc., 32, 206 (1881)
7. W. Rutherford, Phil. Mag., 21, 699 (1911)
8. N. Bohr, Phil. Mag., 26, 1, 476, 857 (1913)
9. Pauli, Z. Physik, 31, 767 (1925)
10. J. Frankel, Phys. Z. Sowjet, 9, 158 (1936)
11. L. Levy and D. W. West, Tans. Faraday Soc., 35, 128 (1939)
12. P. Froelich and G. R. Fonda, J. Phys. Chem., 46, 878 (1941)
13. H. P. Rookaby and A. K. McKeag, Trans. Faraday Soc., 37, 308 (1941)
14. F. Seitz and H. Leverenz, J. Applied Phys., 10, 479, 7 (1939)
15. F. E. Swindells, J. Optical Soc. Am., 23, 129 (1933)
16. M. S. Oldham and W. Kunerth, J. Optical Soc. Am. 31, 102 (1941)
17. R. R. Law, Proc. IRE, 8, 511 (1939)
18. P. Froelich, Electrochemical Soc. Preprint, 87-28
19. H. Leverenz, J. Optical Soc. Am., 30, 7, 309 (1940)
20. H. Leverenz, J. Optical Soc. Am., 27, 25, 1 (1937)
21. W. Nottingham, J. Applied Phys., 10, 73 (1939)
22. S. T. Martin and L. B. Headrick, J. Applied Phys., 10, 2, 116 (1939)
23. H. Nelson, J. Applied Phys., 9, 592, 9 (1938)
24. W. de Groot, Physica, VII, 5 (1940)
25. W. de Groot, Physica, VI, 2 (1939)

LENS ABERRATIONS

(*Continued from page* 87)

images that can be focused on a screen. This type of lens presents the same aberrations as the positive lens, but of opposite sense and therefore it is used in conjunction with the lenses illustrated above for the purpose of reducing and correcting their faults. Concurrent artifices to the lens correction are the proper shaping of the surfaces, choosing of the types of optical glass, spacing of the surfaces, axial thicknesses, etc. This proceeding, that sometimes is extremely complicated and requires years of work, constitutes what is called "lens computing."

Not Western Electric Co.

Alois W. Graf, 135 S. LaSalle St., Chicago, Ill., whose comments on incentive plans for paying engineers and inventors appeared in our November issue, page 148, has asked us to state that the mention of the Western Electric Company in his comments appeared through error and that the plan mentioned does not apply to that company.

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AUTOMATIC POSITIONING

(*Continued from page 62*)

gardless of the number of Autotune heads required. All mechanical components of the system are tied together by appropriate gears and shafts.

Design features

The problem of presetting each position independently has been solved in the following manner: The stop rings are placed axially on the shaft and are spaced by small flexible washers. The washers can move axially at their periphery but cannot rotate on the shaft. (See Fig. 10). The stack of stop rings and spacers is clamped axially by means of a locking screw, a key, and a collar at the front of the shaft. This system of isolating the individual stop rings precludes any possibility of the position of a ring being upset when the position of an adjacent ring is changed.

The stop rings have a wedge shaped notch in them into which the pawl fits, as in Fig. 9. When the pawl is engaged in the stop ring, rotation of the ring is prevented. If the stack is unlocked, the shaft can be rotated while the proper stop ring is held stationary by its pawl. All other stop rings will rotate with the shaft without disturbance to their preset position relative to the shaft. The stop rings are then locked by turning the locking screw. With this design it is possible to set the shaft accurately in either direction without lost motion.

The pawl actuating cams are placed axially on their shaft with the depressions spaced in a spiral about the shaft. (See Fig. 10). This allows only one pawl to operate at any one time. Because this camshaft occupies a different angular position for each channel, it may also be used to drive crystal selector switches, etc., thus eliminating the need of a separate Autotune head for the purpose.

The torque limiting clutch used for driving the positioned shaft is an important feature of the Autotune. In addition to its driving function, the clutch protects the Autotune and the driven components from excessive overloads. Its importance justified extensive development work, which resulted in an excellent torque limiting clutch of the de-energizing type. (See Fig. 12).

The friction band is arranged so

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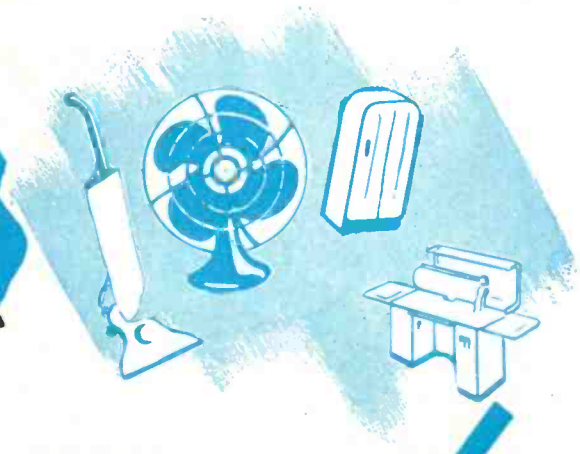

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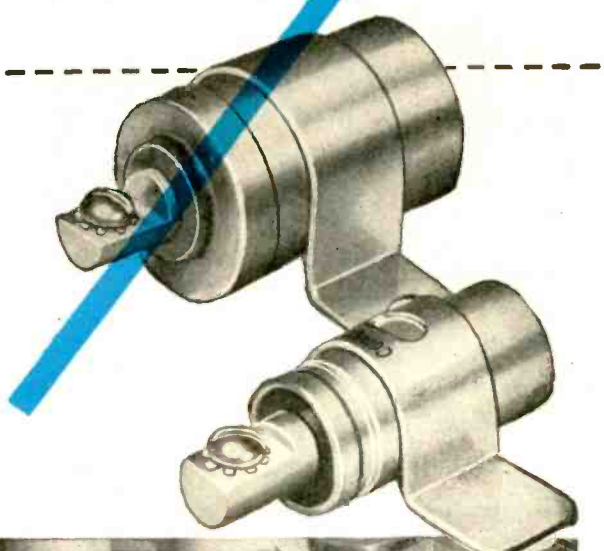

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that the force tending to slip the clutch band also tends to unwrap it from the friction surface. This tendency to unwrap the shoe from the friction surface is restricted by the spring which applies the pressure to the friction surface. As a result, the torque of the clutch is more dependent upon the spring tension than upon the coefficient of friction. This can be shown by applying the belt tension formula, $T_1/T_2 = e^{f\theta}$, where

T_1 = force applied on the periphery at one end of the clutch band, which causes the clutch to slip
T_2 = force applied by the spring to opposite end of clutch band
θ = angle of wrap of clutch band
f = coefficient of friction
e = 2.71828

The curve accompanying (Fig. 16) demonstrates the relation between torque and coefficient of friction for this particular form of clutch.

Small changes in coefficient of friction will have little effect upon the clutch operation. A large decrease in the coefficient of friction to a value approaching zero will have a marked effect on the clutch, but this is unavoidable in any friction device. A large increase in coefficient of friction will have little or no effect on torque. This is desirable because it prevents damage to the mechanism, the driven load, and the drive motor.

Multiturn operation

This clutch has proved in service to be a very reliable mechanism. In the later models it is so arranged that it is not in operation during the manual tuning of the Autotune shaft. The clutch drum is clamped in place much the same as are the stop rings. Thus when the operator unlocks the stop ring for manual tuning he also unlocks the drive to the clutch, and feels only the torque of the driven device.

For certain applications it is desirable to have a positioned element which will turn more than one complete revolution. This provides increased reset accuracy if the driven device is operated through a precision reduction gear or lead screw. No change is required in the control system, but the mechanism is changed to allow it to position accurately within a specified number of revolutions.

Multiturn operation is accomplished by adding a drum which

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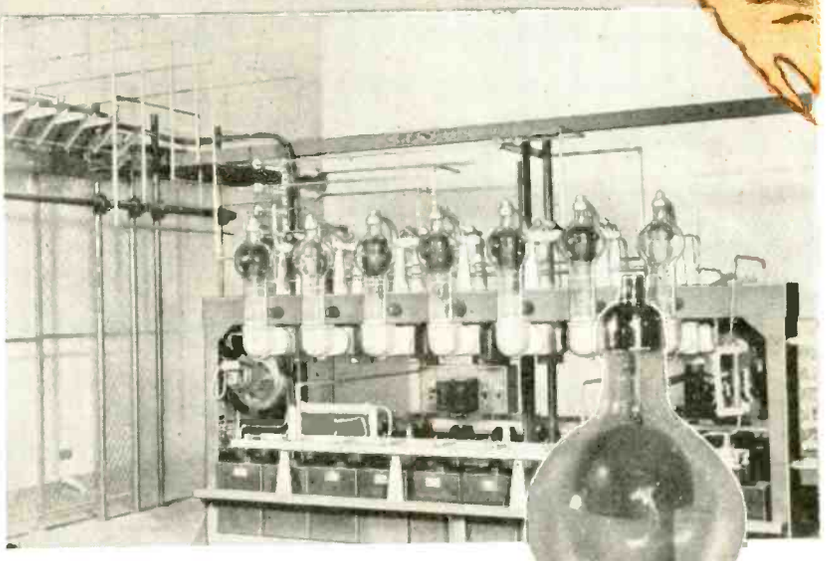
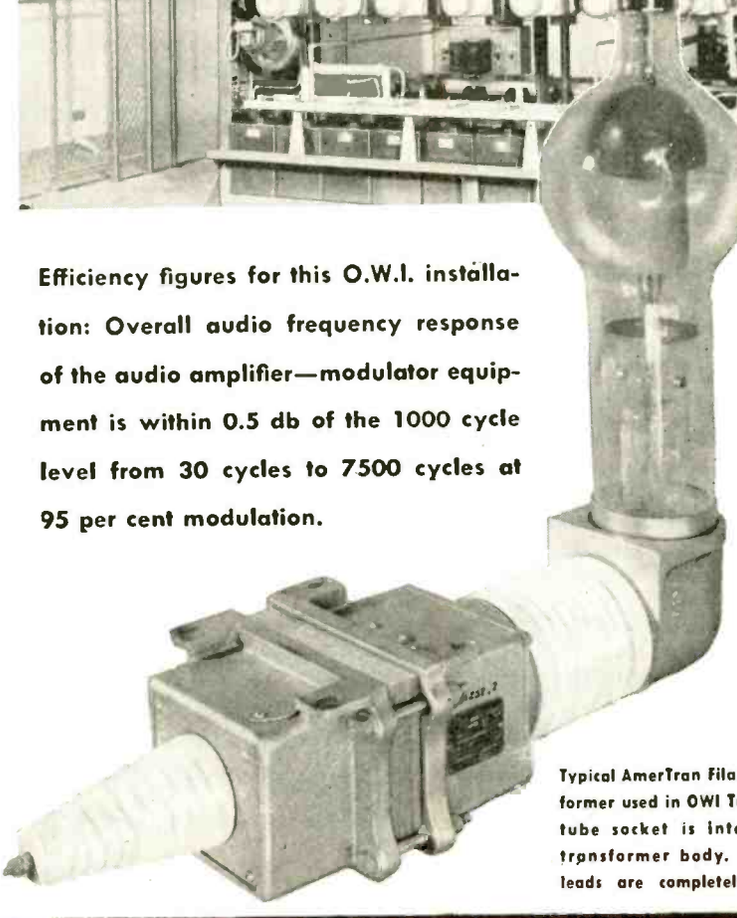


Efficiency figures for this O.W.I. installation: Overall audio frequency response of the audio amplifier—modulator equipment is within 0.5 db of the 1000 cycle level from 30 cycles to 7500 cycles at 95 per cent modulation.



Typical AmerTran Filament Transformer used in OWI Transmitters; tube socket is integral with transformer body. Secondary leads are completely enclosed.

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makes only one revolution during the full number of revolutions made by the positioned element. The additional drum (called a "counter" drum) is driven through gears by the positioned shaft, and is composed of a group of rings similar to the stop rings.

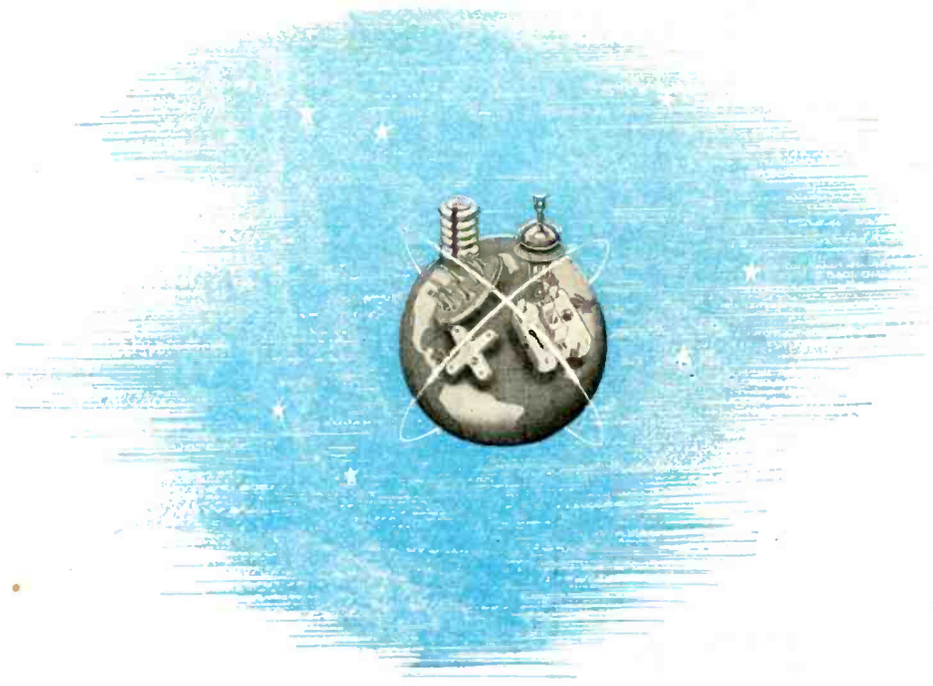
Each pawl in the multiturn Autotune head has an added projection which engages its respective ring on the counter drum. The rings on this drum are held in place by friction and when the preset position is changed, they are automatically readjusted in the same manner as are the stop rings. The arrangement of parts is such that when a pawl is selected by the cam drum, it first must engage the counter drum ring before it can engage the stop ring. Since the counter drum makes only one revolution during all of the turns of the stop ring shaft, it can select the turn of the positioned shaft during which the pawl will engage the stop ring. (See Fig. 11).

The accuracy of the Autotune is largely dependent upon the particular application. The Autotune will repeat a position to within one to three hundredths of a degree (.01° to .03°) or from ½ to 1 minute of an arc, under favorable conditions. For a ten-turn multiturn head this amounts to from 3 to 9 parts per million. It is not always possible to make full use of this accuracy because of errors in the coupling to and in the bearings in the driven device.

The torque load that can be driven is limited only by the size of the units. The largest Autotune head built to date is conservatively rated at 25 lb./in. The smallest aircraft units are rated at 4 lb./in. maximum.

The operating time of an Autotune system depends upon many complex variables. Singleturn units will perform a complete operation in 2 to 5 seconds. Multiturn heads with ten turns may take 5 to 10 seconds to operate.

In the later models much attention has been given to operator convenience so that the operator need have no special knowledge of the Autotune system in order to set up the preselected positions. The procedure is as follows: Set the selector switch to the channel to be adjusted. When the Autotune has stopped on the desired channel, unlock the mechanism by turning the locking bar in the end of the main shaft counterclockwise. Turn the shaft in either direction to the



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desired setting by means of the manual knob. Lock the mechanism by turning the locking bar clockwise. The channel is thus completely set up.

When the operator unlocks the mechanism the clutch is released by the means previously described, thus removing the clutch torque from the tuned shaft. This unlocking action also engages the manual tuning knob by means of a small jaw clutch. The elimination of the clutch drag and the provision of a geared manual tuning knob enable the operator to take advantage of the high degree of accuracy of the Autotune when setting up preset positions.

The flexibility obtained by breaking down the Autotune system into singleturn and multiturn heads, control units, and motors allows an extremely wide variety of applications.

The Autotune was used extensively during the war, and is still being used, in radio communication transmitters and receivers. The use of the Autotune enables rapid change of frequency with all circuits precisely retuned. Such radio equipment varies from small aircraft receivers (the Collins 51K-1, Fig. 13) to large heavy duty ground station transmitters (the Collins 231D, Fig. 14). The Collins 17H (Fig. 15) is a powerful aircraft transmitter using the Autotune system. In this application the driven devices are switches, capacitors, variometers, and a 20-turn permeability tuned oscillator. The Autotune heads are conveniently located with regard to both accessibility and the placement of transmitter components.

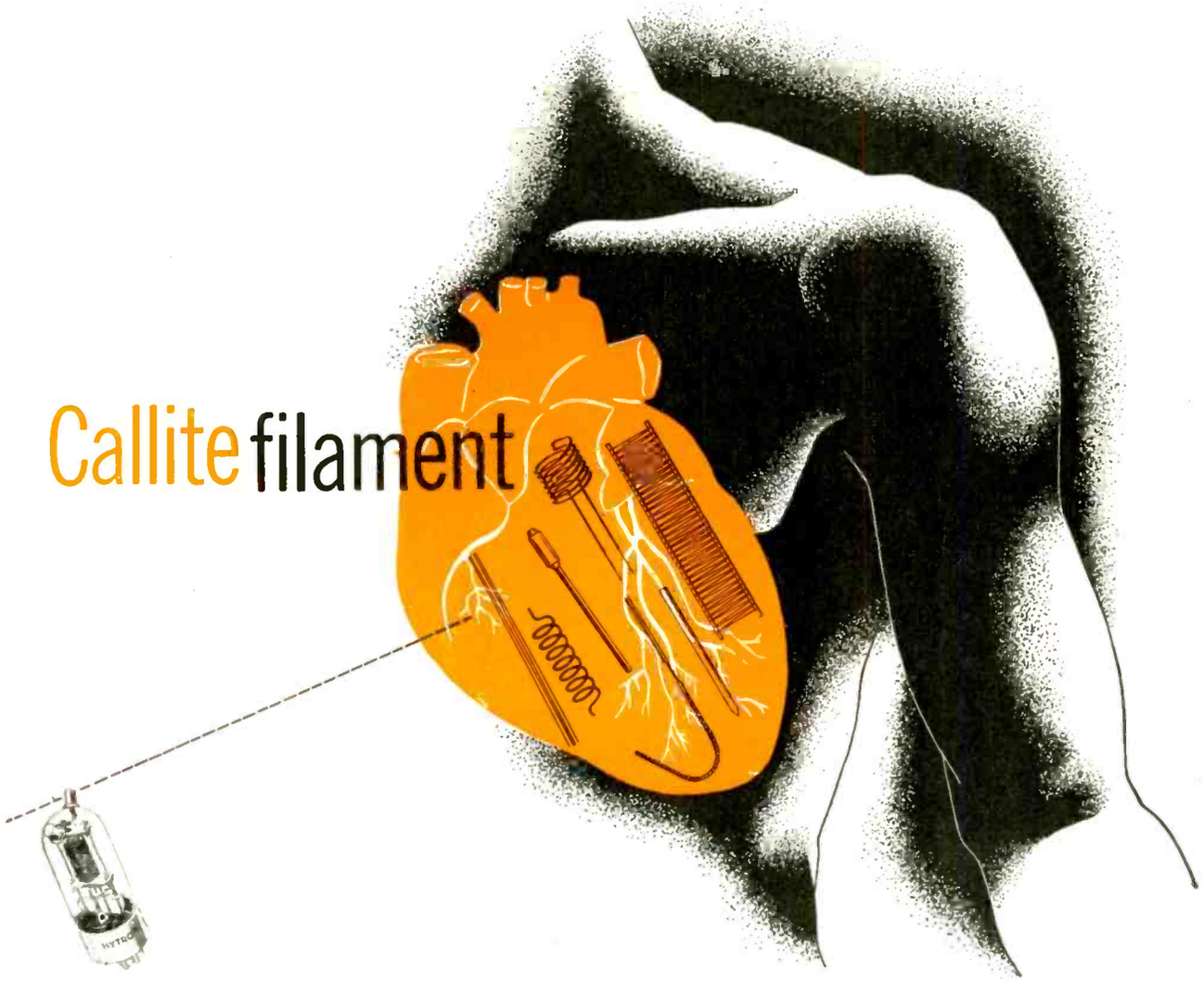
The Autotune system is a reliable automatic positioning mechanism which can be engineered into an equipment as an integral part of the design.

BRAIN WAVE

(*Continued from page 75*)

frequencies up to about 100 cycles per second.

Fig. 9 illustrates the working parts of this recorder. Two large Rochelle salt crystal plates A, rock the segment pulley B, with a push-pull action. The motion of the pulley is transmitted to the pen shaft C through a very thin brass band G. The pen shaft is supported in two jeweled bearings D, D, and the pen E rides in a cradle F, so that a light uniform pressure is maintained on the paper. A continuous, enclosed ink feed supplies



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The little HY75, medium-power triode, long a favorite of radio amateurs for its highly efficient operation at frequencies from 50 to 300 megacycles, now leads a versatile life. Widely used in War Emergency Radio Service networks, the HY75 has also found favor in Government and industrial research laboratories.

Callite supplies the Hytron Radio & Electronics Corp. with formed filament coils of 88.5 milligram thoriated tungsten wire for the HY75. Callite carefully processes tungsten wire with the right proportions of tungsten and thoria to give the required electronic emission, plus rugged strength to resist vibration and shock.

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Callite tube components

CALLITE TUNGSTEN CORPORATION CT

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

ink to the pen through the vinylite tubing from the inkwell.

While magnetically driven pens could undoubtedly be designed to have this characteristic, the lower efficiency of the magnetic driving mechanism requires too large driving power for practical purposes. Magnetic recorders in use have a frequency response of one-half to two-thirds that of the Crystograph, and an amplitude response of approximately half.

Frequencies usually desired in the EG are well below 50 cps, and by judiciously varying the amplification, amplitudes may be held within the range of faithful recording.

Threshold sensitivity

Threshold sensitivity is significant in recording very small voltages. Thus, while voltages of perhaps 10, 20 and 30 volts may produce pen deflections of 10, 20 and 30 millimeters, thus preserving the desired proportionality, one volt may fail to produce any deflection at all. This is due to friction in the mechanism, or friction of pen on paper, and results in complete masking of small signals. Threshold effect is found in all recorders and its value depends on the care taken in design and manufacture of the instrument. It is one of the figures of merit in testing a recorder.

The efficiency of the piezo-electric recorder is inherently very high. An interesting point is that the electric field from an applied voltage actuates the crystal, rather than the magnetic field from an applied current. Thus a sustained voltage across the crystal produces a sustained pen deflection; as the resistance of the crystal is practically infinite, pen deflection is maintained with practically zero power.

The crystal circuit simulates a capacitance in series with a resistance, and although more current flows as the frequency of the applied voltage increases, the crystal impedance remains high at the operating frequencies, and current drain is quite small at the top freqency of 100 cps.

The most prominent feature of the EEG is the alpha wave. This wave has a rather regular period and is frequently almost sinusoidal, and has a frequency of about 10 cps. The alpha wave often waxes and wanes with variation of stimulation and the attention of the patient, as well as respiratory conditions which modify the chemical environment of the brain. This sometimes occurs at a fairly regu-

lar rate as shown in Fig. 9.

Since the alpha wave is such a prominent feature of the EEG, there is frequently a tendency to neglect other components. The situation is emphasized because the alpha wave is in a frequency range easily amplified and recorded. The slow delta waves, indicated in Fig. 10, are found during sleep, in certain pathological conditions such as brain tumors and injury, epilepsy, and in hyper-ventilation (involving giving off of CO_2). They also arise under conditions of lack of oxygen or of blood sugar.

During sleep, delta waves have frequencies as low as a half cycle per second or less. Waves over tumorous areas may have frequencies almost as low. Faithful amplification of such waves requires a carefully designed amplifier with adequately long time constants in the coupling circuits.

The high-frequency beta and gamma waves have significant components up to 100 cps. Presence of pronounced high-frequency waves is probably indicative of increased brain metabolism, as for example, in hyper-thyroidism. A typical recording showing simultaneous alpha and beta and delta waves is shown in Fig. 11. Accurate recording of beta waves requires the use of a recorder with rapid response. These are low frequencies by usual audio-frequency standards, but the considerations of recorder and amplifier design above noted impose severe problems.

The normal range of the alpha wave is from 3 to 30 microvolts, while under certain pathological conditions the intensity may rise to 100 or 200 microvolts. Delta waves occurring during epilepsy may be several hundred microvolts in amplitude. A wide range of amplitude response must thus be afforded by the ink-writer if both low-potential alpha and beta waves are to be accurately recorded on the same chart with high potential slower waves and spikes. The electroencephalograph occupies a significant position in the field of electro-medical diagnosis, and much may be expected of it in the future.

The EEG records shown here are a few selected from a number prepared by Dr. Chester Darrow of the Institute of Juvenile Research, Chicago, to illustrate some of the possibilities of this equipment in research. These records, therefore, contain more information than do standard EEG records obtained in routine diagnostic setups.

WIDE READING

(*Continued from page 97*)

moves to the negative output electrode X and the useful linear scan commences, the constant output electrode current charging capacitor C negatively.

During this scanning period the charge on deflection plate P_2 leaks away exponentially at a rate determined by the time constant C_2R_2 and the image moves towards output electrode Y; as soon as it reaches the tip of Y, it is completely deflected onto electrode Y as explained above. If the output electrode reaches a potential close to the potential of G_1 before the image reaches the tip of electrode Y, the collector electrode G_2 starts to collect electrons which produce a negative transient applied to deflection electrode P_2 and the image is moved towards the tip of Y by this action.

All factors affecting the accuracy of frequency measurements are examined and a simple correction circuit for the elimination of the influence of supply voltage variations, and methods of circumventing the instability and aging of circuit components are described.

Control adjustments

Potentiometer R_3 controls the time-base velocity by controlling the electron current intensity impinging upon electrode X and consequently the rate at which capacitor C charges. Output load C is also adjustable so that a frequency range of from 5 to 120,000 cycles can be covered.

By altering the basis of the deflection plate P_2, the amplitude of the time-base oscillations can be varied; this is accomplished by potentiometer R_7. Further, the output electrode current vs deflection potential characteristic may be secured if R_7 is varied and the output current measured.

If it is desired to lock the time-base, a fraction of the signal under investigation is fed to deflection plate P_1. Potentiometer R_6 regulates the amplitude of this synchronizing signal. For large synchronizing signal amplitudes, the generator action is swamped, and signal converter action results.

A diagram with component values of the complete time-base generator is included. Choice of circuit constants and of supply potentials is discussed in detail and performance of the circuit is illustrated.

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PATENTS

(*Continued from page* 120)

55. A shield is then placed over the tube screen which covers it except for a narrow horizontal slit; the lower edge of the slit may be calibrated in degrees, 2θ or θ.

In operation the cathode ray will appear through the slit only at the minimum of the amplitude detector output applied to the vertical deflection plates. The horizontal position of this trace at that instance depends on the instantaneous phase of the frequency-discriminator output applied to the horizontal plates; it will, therefore, be a measure of the phase difference between the two waves and consequently of the angle θ indicating the position of the aircraft with respect to the transmitter station.

Another cathode-ray tube phase comparator is described, where the output of the frequency discriminator and a 90-deg.-phase-shifted version of it are applied to the two pairs of deflection plates respectively. A circular pattern results. The detected signal derived from the amplitude modulation is applied to the control grid of the cathode-ray tube, cutting the beam off during most of the cycle and permitting passage only during a short period of time while the signal amplitude is zero.

Obviously a cardioid pattern instead of the figure-of-eight pattern may be employed if a non-directional radiation is emitted by an additional antenna erected in the center of the four antennas marked E, W, N and S. Operation of the system will be similar. Further frequency modulation may be replaced by phase modulation without any major change in the arrangement.

M. Relson, Sperry Gyroscope Co., Inc., (F) Oct. 7, 1941 (I) June 12, 1945, No. 2,377,902.

ULTRASONIC

(*Continued from page* 65)

energy obtained versus the thickness of the material at a frequency of 500 kc per sec. is plotted. The solid line shows the effect of a steel plate in the water, and the dotted line shows the effective attenuation ratio in the case of a thin slit of air in a sheet of steel. This second case is also plotted for energy attenuation ratio at 500 kc when going from steel to air to steel.

In the first case the energy attenuation ratio never exceeds 10 to 1 at this frequency and oscillates in value from full transmission to approximately 1/10 the transmission.

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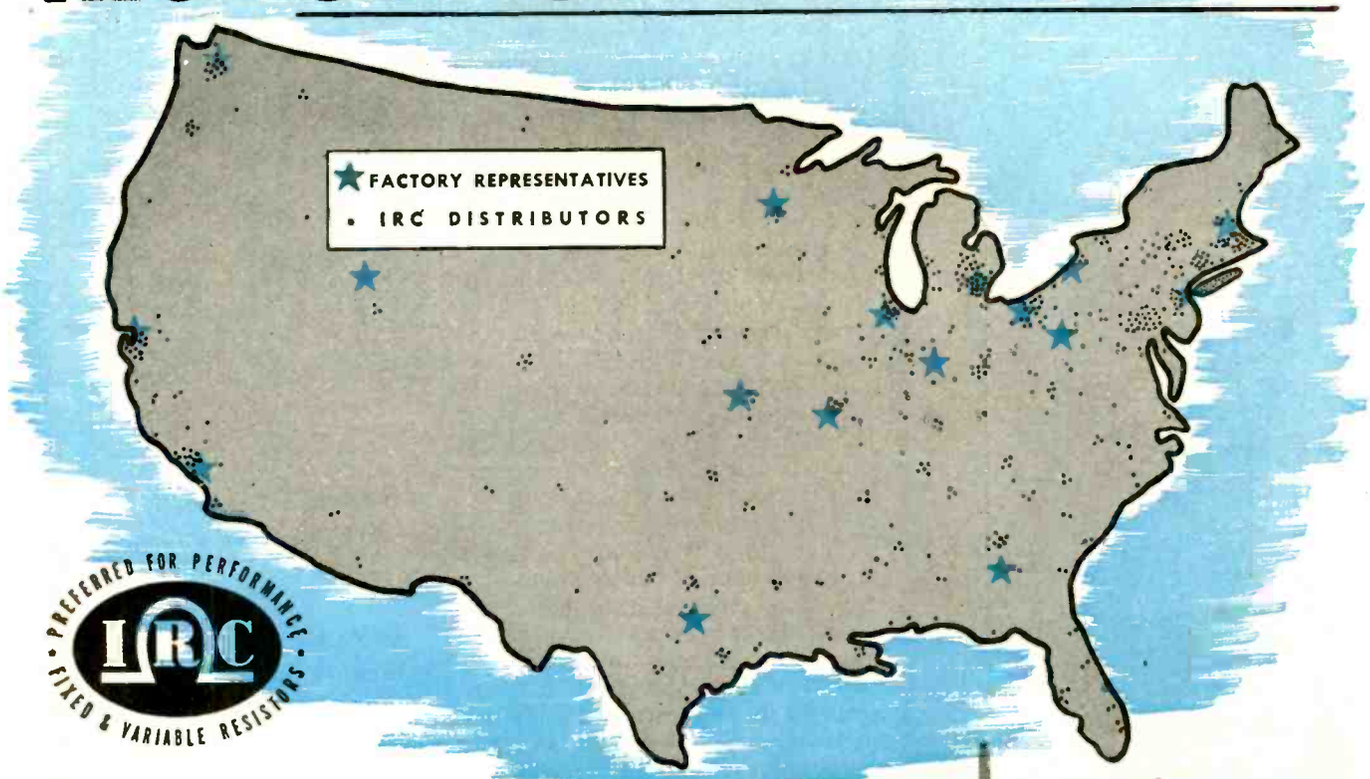

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Therefore, if a piece of steel had a thickness in the order of 1 millimeter, we would, if we operated over a narrow frequency range, expect to get reasonable transmission of energy through the plate. However, a thin air strip (of the order of a thickness of .001 cm) will give an approximate attenuation of the order of 10 to 1 as compared to 3 to 1 for the steel. Since the overall attenuation ratio is roughly the product of the two ratios, the attenuation inserted by the air slit is now predominant and a flaw is indicated.

In practice it may be necessary to check extruded shapes with irregular outlines whose cross-sectional shape does not change. Therefore, it is necessary in this case to experimentally determine the transmission properties and to select those frequencies which would give the most sensitive flaw detection. In general it is best to avoid the regions of either the dip or the peak shown in the graph unless it is desired to measure an actual change in thickness of the material. The importance of the proper selection of the frequencies and the shape of the piezoelectric units to give a desirable radiation arrangement must be carefully made. Fig. 6 shows a practical setup for checking rolled strip material stock.

This analyzer offers the same inspection possibilities for many other metals than steel. Completely satisfactory tests have already been made on aluminum, phosphor bronze, beryllium copper, brass and other metals and alloys. It is also highly sensitive to flaws in plastics and other extruded materials.

FCC Compiles Costs For FM Xmitters

The Senate Small Business Committee is launching a campaign to stimulate the birthrate of small radio stations. The Federal Communications Commission, at the committee's request, has just completed a survey of costs and delivery dates of FM broadcasting equipment.

Manufacturers' estimated costs for principal technical equipment for a 250-watt station average around $9,508, the survey indicated.

For a 1,000-watt station the average cost was estimated at $14,758; 3,000 watts, $17,858; 10,000 watts, $27,308; and 50.000 watts, $80,558.

For current orders manufacturers estimated that deliveries can be made between April, 1946, and January, 1947.

PERSONNEL

Howard S. Frazier, who has been director of engineering for the National Assn. of Broadcasters since August 1, 1942, has resigned. Frazier will open offices of his own as a radio management consultant at 1730 Eye St., N.W., Washington. Until the end of the year, he will continue with his work for NAB.

E. W. Engstrom has been elected vice-president in charge of research of RCA Laboratories Division and **E. C. Anderson** has been made vice-president in charge of the commercial department of RCA Laboratories Division. Engstrom has been director of research since 1943 and Anderson has been commercial manager during the past five years.

E. Finley Carter, a vice-president of Sylvania Electric Products, Inc., Emporium, Pa., has been advanced to have charge of his organization's engineering department. He has been in charge of industrial relations and in his new position takes the place of **Roger M. Wise** who has been vice-president in charge of engineering and the top man in Sylvania research. Wise has left Sylvania and has not made public his future plans.

E. Finley Carter

Dr. Carl F. Frische

Dr. Carl F. Frische, chief research director of the Sperry Gyroscope Co., 30 Rockefeller Plaza, New York, N. Y., has been elected vice-president for engineering. He has been a member of the Sperry organization since 1933.

Collins Radio Co., Cedar Rapids, Iowa, has made the following changes in its executive setup: **Claude T. Everson,** formerly with the U. S. Army Air Corps, has joined the research division specializing in microwave work; **Dr. Winfield W. Salisbury** has been appointed director of the research division and leaves Harvard Radio Research Laboratories to take up this work;

William W. Farley, also from Harvard, has been made an assistant director of the research division; **Francis L. Moseley** has become a member of the engineering department. He was formerly chief of the communications and navigational laboratory of the Radio and Radar Section at Wright Field.

W. P. Short

H. A. Snow

W. P. Short has been appointed chief engineer and **H. A. Snow** senior engineer of the newly created home radio receiver department of the Federal Telephone & Radio Corp., Newark, N. J. Mr. Short was formerly chief engineer of the Research Construction Co., and has been a staff member of the Radiation Laboratory of MIT. Mr. Snow was formerly connected with the Boonton Research Corp., where he was generally credited with the development of the variable mu tube.

Henri Busignies has been appointed director of the Federal Telephone & Radio Corp. laboratories in New York and Nutley, N. J. He joined the I.T.&T. System in 1928 as a member of its Paris laboratories, has been assistant director in charge of two Federal laboratories.

Henri G. Busignies

R. L. White

R. L. White has been elected president of the National Electrical Mfrs. Assn. He is president of Landers, Frary & Clark, New Britain, Conn. He succeeds A. C. Streamer, Westinghouse Electric Corp.'s vice-president.

A number of changes in the engineering department of National Broadcasting Co. involve: **George**

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McElrath, who has been appointed manager of the engineering department and will be responsible for technical operations; such work formerly handled by him has been taken over by **Edward R. Cullen** under the title of operations assistant; **William A. Clarke** has been made administrative assistant and will work with the vice-president and chief engineer on special assignments regarding policy; **James Wood, Jr.**, succeeds Clark as manager of technical services. All will function under the supervision of network Vice-President and Chief Engineer O. B. Hanson.

E. R. Nary has been made assistant to Westinghouse vice president Walter Evans with broad responsibilities for operations of the industrial electronics and X-ray divisions at Baltimore, and the home radio division at Sunbury, Pa. A veteran of more than 30 years' service with Westinghouse, he goes to his new post after three years as manager of manufacturing for Baltimore Divisions. As assistant to the vice president, he will continue to maintain headquarters in Baltimore.

E. R. Nary

George E. Davis

George E. Davis has joined Universal Research Laboratories, San Francisco, and will function as planning and research engineer. For the past year and a half he has been a field engineer with the National Defense Research Committee.

Edmund S. Winlund has been appointed industrial electronics engineer for the Pacific Region by Radio Corp. of America's RCA Victor Division. His work will include assistance to West Coast industries in the application of electronic heating equipment.

Richard P. Ballou has been appointed chief engineer of Federal Electric Products Co., Newark, N. J. He has had long experience in the electrical industry, having at various times been affiliated with Donegan Electric Co., Detroit,

Westinghouse Research Laboratories, Union Switch & Signal Co., and the Allen-Bradley Co.

Dr. C. G. Harman has been appointed head of ceramic engineering research for the Locke Insulator Corp., Baltimore. At the same time, **Carl Croskey** has been appointed process ceramic engineer.

NEW BULLETINS

Air Gaging

An attractive new catalog which illustrates and describes the Sheffield Universal Precisionaire instrument has been published by The Sheffield Corp., Dayton 1, Ohio. The Precisionaire is an air-flow gage that measures through air velocity instead of pressure. It is widely used in the checking of all types of small and long bores to very close limits. It is especially recommended for checking outside, internal and average diameters, eccentricity, bell-mouth, out - of - round, thickness, straightness, as well as the width, length, height and depth. With the use of this instrument the human element of error is eliminated and no special skill is required of the operator. Accuracy is instantaneous, and it is impossible to have any time lag. The Precisionaire is available in a wide range of amplification from 1000 to 1, to 25,000 to 1. The latter instrument is calibrated with a scale reading in increments of .000005 in.

Instruments

A catalog of indicating and recording instruments is being distributed by Electro-Tech Equipment Co., 119 Lafayette St., New York 13, N. Y. Laboratory and panel type instruments from various makers, resistance boxes, Wheatstone bridges and special purpose testers of many kinds are included.

List Equipment

Among recently issued catalogs of electronic equipment is one released for distribution to manufacturers and distributors by Keystone Electronics, Inc., 50-52 Franklin Street, New York 13. Items featured are accessories for test equipment, test tools and dial compliments.

Non-Linear Potentiometers

Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y., is distributing a folder on non-linear potentiometers with various degrees of taper. Sample curves are given. It is possible with these instruments to reproduce empirical curves.

Conveyor Units

Island Equipment Corp., 101 Park Ave., New York 17, N. Y., originators of spot conveying, have issued a comprehensive bulletin, 8½ x 11, 2 colors, profusely illustrated, on their new improved power-flex unit system. It contains much information of interest on spot conveying, as well as on the details of this particular unit, with complete specifications and data. This is a self-powered unit conveyor belt, 10 ft. or less in length, which can be moved around easily as production line requirements change.

Piercing Press

The Wiedemann Machine Co. has released a new bulletin 51 describing the Wiedemann R-5 Turret Punch Press in detail. This machine is adapted for short run piercing of outlet boxes, conduit boxes, metal enclosures, panels and sheet and plate work. Also included, is a description of the R-5 machine, built for the special purpose of piercing copper bus bar.

High Vacuum Pumps

A new booklet describing various models of this type of rotating plunger pump is being distributed by the Kinney Mfg. Co., Boston 30, Mass. Pressure readings obtainable range from 2 to 10 microns (mm of Hg) with single stage units. Two stage and compound units give pressures of 0.1 to 0.5 microns. Curves, formulas and tables are included to permit intelligent selection of sizes and models desired. There are also included descriptions of a line of liquid pumps of the rotating plunger and gear types.

American Expands

American Transformer Co., Newark, N. J., is preparing for expansion. The company has acquired a tract of land and will construct a modern plant which will permit increased production of transformers, rectifiers, amplifiers and special testing equipment.

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Quality Control Engineers Organize

With representatives of some thirteen quality control organizations in attendance, The Society for Quality Control was formed in Pittsburgh early in October and placed on a national basis. Ralph E. Wareham, 305 East 43rd Street, New York, is secretary-treasurer. Other officers elected were: President, Edward M. Shrock, Pittsburgh Quality Control Society; executive committee members, F. J. Halton, Jr., W. H. Lewis, J. Manuele and A. I. Petersen. There are 14 local chapters.

Sherman Forms Own Company

Sherman Industrial Electronics Co., has been formed by Vernon W. Sherman, formerly manager of the Industrial Electronics Division of the Federal Telephone & Radio Corp. Offices and the plant have been established at 503 Washington Ave., Belleville 9, N. J. Associated with Mr. Sherman are N. Carver, who will direct engineering and A. Noar, who will have charge of production.

Consulting Physicists

Paul Rosenberg Associates is the corporate style of a firm of consulting physicists which has been established in New York with offices in the Woolworth Building. Paul Rosenberg, formerly connected with MIT's Radiation Laboratory and Columbia University department of physics, heads the organization.

Cooperative Laboratory

General Precision Laboratory, Inc., has been formed by a group of ten companies and shortly will occupy a building in Pleasantville, N. Y. The new organization will be devoted to research and development in various fields served by its parent companies. Dr. R. L. Garman has been appointed director of research and development and will direct technical activities. Affiliated companies are: Ampro Corp., Askania Regulator Co., Cine-Simplex Corp., The Hertner Electric Co., International Projector Corp., Librascope, Inc., J. E. McAuley Mfg. Co., Motion Picture Engineering Corp., National-Simplex-Bludworth, Inc., and The Strong Electric Corp.

Fluorescent Lighting Makes Progress

Developments continue to appear in the fluorescent lamp family at the high rate consonant with still young devices. The fluorescent lamp is less than ten years old. Yet the fact that about forty million of them were made last year is indicative of their popularity.

The first important variations from the familiar cylindrical shape of fluorescent lamps have appeared. A circular lamp has been developed. It is an even foot across and is rated at 32 watts. Because of the high light ouput in a small space and its symmetrical shape, it removes the principle obstacles to its use in portable lamps in the home. The Westinghouse Circline is now appearing as the light source in floor and table lamps and in other specially-designed household lighting units.

New fluorescent lamps are longer and slimmer. Four lengths—five-eighths and one-inch in diameter—are standard from 3½ to 8 ft. long. Long lamps present a starting problem in humid air which is overcome on the "slimline" by painting a narrow silver stripe along the outside of the glass to within a short distance from each end. This metallic stripe acts as a capacitor facilitating starting.

Fluorescent lamp life and the specific effect of starting is better understood. As a result, fluorescent lamps are now rated with consideration of the number of starts. For example, the 40-watt lamp has a life of 6000 hours if it burns 12 hours per start. But if the lamp burns 6 hours per start, the life is 4000 hours; for 3 hours per start, the life is 2500 hours. The efficiencies in percent of initial lumens per watt when the lamp reaches 70% of its rated life are 70, 76, and 84% under the three conditions above.

Fluorescent lamps decline about 15% in efficiency during the first hundred hours and then at a much slower rate for the remainder of the lamp life. This initial decline has been a matter of much concern and some mystery of lamp engineers. Various theories have been set forth, such as a sort of poisoning of the phosphors by mercury vapor. Research at the Westinghouse Lamp Laboratories now definitely fixes the blame at another source. It is caused by the low-wavelength (mostly 1850A) radiation of the mercury-vapor discharge.

Smith Made Philco Vice-President

David B. Smith, director of the Philco research division since 1941, has been appointed vice-president in charge of engineering of Philco Corp. He joined Philco in 1934, after receiving the degrees of S.B. and S.M. in electrical engineering from the Massachusetts Institute of Technology. Serving first as a patent engineer on radio, television and other applications of electronics, he was later placed in charge of a special advanced studies group in the Philco research and engineering department. Smith was appointed technical consultant to the vice-president in charge of engineering in 1938, and was promoted to director of research in 1941. In this capacity, he directed the fundamental microwave and ultra-high frequency research that led to the production of many important types of airborne radar.

FCC Reorganizes Engineering Division

As a step towards expediting the handling of its sharply inrceased post-war work load, the Federal Communications Commission today ordered a reorganization of its Engineering Department.

The Broadcast Division is to be re-named the Broadcast Branch and will be headed by John A. Willoughby, who has been assistant chief engineer in charge of the Broadcast Division. The Broadcast Branch will consist of three Divisions as follows: Standard Broadcast Division, James A. Barr, acting chief; FM Division, Cyril M. Braum, acting chief; and Television Division, Curtis B. Plummer, acting chief.

There are to be three other branches in the Engineering Department; Safety and Special Services Branch, consisting of the Marine and General Mobile Division, Aviation Division, Emergency and Miscellaneous Division; Field and Research Branch, consisting of the Field and Monitoring Division, Technical Information Division, Frequency Allocation Division and Laboratory Division; Common Carrier Branch, consisting of the Domestic Division, International Division, Rate Division and the Field Division.

Charles A. Ellert was recently appointed chief of the Laboratory Division and Paul D. Miles, chief of the Allocation Division of the Field and Research Branch.

Soon . . . A New "Ham" Era

The curtain is rising on a remarkable "new era" development for the "hams" and *potential* hams of the world! It's so logical . . . so ingenious, in its use of advanced electronics and ultra-modern principles of design that we have kept the secret for showings in *all parts of the country,* at the same time. Dealers will be ready soon. Don't miss their KLUGE "Premieres" . . . It won't be long!

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RCA Demonstrates Color Television

Radio Corporation of America, which for a long time has promised color television, early in December publicly displayed its version of such home entertainment. But General Sarnoff asseverates that neither he nor his engineers care much for the system, based on a whirling tri-colored drum. He promises, furthermore, that an all-electronic method is under development, though he sees little hope of either method becoming commercially practicable for another five years.

In the meantime, RCA also lifted the veil on a new type of black and white television receiver, based on a recently developed cathode ray tube, which gives picture results far better than anything heretofore possible. The new tube, aluminized inside so as to save scattered light ordinarily lost, and coupled with use of the new image orthicon, permitted superior screen results. As a result of these developments larger projected pictures are possible and they possess a snap and sparkle heretofore unknown. In fact, pictures the size of a newspaper page may be viewed in a semi-darkened room.

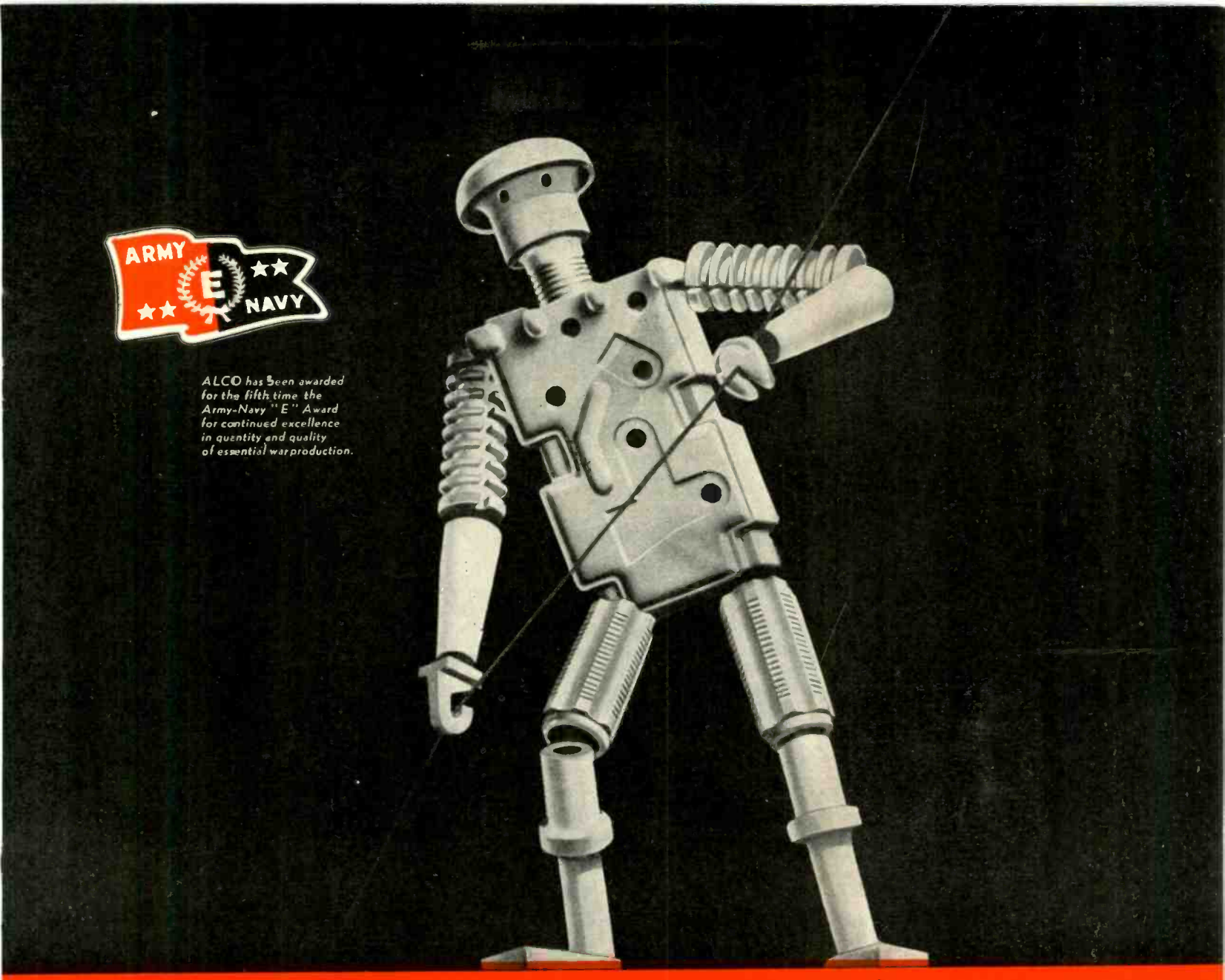
Light per unit area is up to three times greater, with blacks and whites more intense than ever, due to absence of internal reflection.

The new tube will be used in sizes from 7 in. up to 15 in., both for direct viewing and for use in the Schmidt projection system.

Using a three-color 525-line 20-frame system, Dr. Engstrom exhibited a television receiver in which sound was developed from a variable-width pulse with a repetition rate of 47,250 per second. Carrier frequency was 10,000 mc, using a bandwidth of 12 mc, with the studio located two miles distant. Transmitter output was 1/20 watt, and in addition to providing color and sound, contained stereoscopic signals.

Color made use of a filter-sequence system, in which a 12-segment color drum carrying red, green and blue panels revolved the transmitter's filter at 600 rpm. Stereoscopic presentation was accomplished by means of two polaroid discs rotating in conjunction with the color disc.

When applied to black-and-white video signals, pulse-width modulation yields a sound track with cut-off at 5000 cps. This is considered too low fidelity for television use, by RCA engineers. Hence, pulse-width



ALCO has been awarded for the fifth time the Army-Navy "E" Award for continued excellence in quantity and quality of essential war production.

MASTER OF POWER AND HEAT

MANY of the brilliant advances in electronics made during the war, including extensive use of ALSIMAG Steatite Ceramics in radio, radar, communications, controls and high frequency heating, will be carried forward into peace-time products of *quality*.

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

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sound channels will probably not find commercial application for black-and-white television, unless the scan system should be modified to include more than 525 lines.

RCA Advances Five

Five RCA Victor executives have been made vice-presidents. They are: Meade Brunet, in charge of the engineering products department; J. B. Elliott, in charge of the home instruments department; Jos. H. McConnell, general attorney of RCA Victor; J. W. Murray, in charge of the RCA Victor record department; and L. W. Teegarden, in charge of the RCA tube department.

Ionosphere Storms

The following article appeared in the August 1945 issue of the Wireless World, London:

"When a solar flare is observed on the visible disc of the sun there is very often, at the same time, a sudden ionosphere disturbance, which results in a brief fade-out of short-wave radio signals. That the one is responsible for the other has been well established, the sudden ionosphere disturbance being due to the increased emission of ultraviolet light from the solar flare."

FCC Engineers Test Low vs High Band FM

Despite claims to the contrary, FM operation in the higher band does not require higher power than operation in the low band for similar results at the listener's set according to the Engineering Department of the Federal Communications Commission. Tests made on a low band FM station and one in the higher band, both located in Washington and of comparable power, showed negligible difference in results. These facts are set forth in an FCC Laboratory Report made to settle such controversy as may exist on the subject.

The tests were made at the FCC Laboratory, approximately 20 miles from Washington and showed negligible difference in signal strength in spite of the fact that the low band station W3XO (43.2 mc) enjoys the advantage of having an antenna more than 200 ft. higher above sea level than W3XL (99.8 mc). The Commission engineers are of the opinion that if the two antennas were of the same height the field strength of the station

operating in the new high FM band would exceed that of the old low FM band station.

It is recognized that neither the Commission tests nor previously made Zenith tests are conclusive on the question of power. Subsequent tests may establish that somewhat higher power might be desirable in the new band. However, there is no warrant for any such conclusion on the basis of the limited data now available. From what is known today, it appears that power requirements for the new band will be substantially the same as requirements for the old band. The Text of the FCC Engineering Laboratory Report follows:

"In accordance with your instructions, field intensity measurements have been made at the Laboratory at Laurel, Maryland, on Station W3XL, 99.8 mc. and W3XO, 43.2 mc. Both of these are FM stations now operating in Washington.

"Station W3XO, operated by the Washington Post, uses vertical polarization, and radiates one kilowatt at 43.2 mc. Their antenna is located on top of a building which stands better than 400 ft. above sea level. Station W3XL uses a 3-bay horizontally polarized turnstile antenna, with an elevation of less than 200 ft. above sea level. The power gain of this antenna is approximately 4. Statements of the operators of this station give the estimated transmitter output as 250 watts. Using the power gain of the turnstile antenna, the radiated power along the ground is estimated at 1 kilowatt.

"Each of these stations then radiates about 1 kilowatt toward the Laurel Laboratory, which is about twenty airmiles away. There is no line of sight path, even from the higher station.

"Measurements were made on the field intensity recording equipment at Laurel for several nights. The indication was that the same fields were measured night after night. No tropospheric or other fading effects were noted during the two-hour operating periods on each night. Field intensity measurements were made with an RCA type 301-A field intensity meter at a clear point removed from buildings and wires. At an elevation of thirty feet above ground, the following field intensity readings were obtained: W3XO 43.2 mc. 51.0 Microvolts per meter; W3XL 99.8 mc. 47.3 Microvolts per meter. Proper polarization of the field in-

tensity meter antenna was used in each case.

"These measurements appear to indicate that if both transmitting antennas were of comparable height, substantially higher field intensity would be measured at 99.8 mc. than at 43.2 mc. A direct comparison, taking these heights into consideration, is not possible because they are both below the line of sight. Also, the two signals travel over somewhat different paths as a result of about four miles spacing between transmitters. The measurements made for these special conditions should not be taken too generally, but it appears that the fields predicted by the Commission are substantially correct."

Wroncke to Hallicrafters

Hallicrafters Co., Chicago, has absorbed the industrial engineering firm of Louis J. Wronke, Inc., in Chicago's Oak Park suburb. Louis J. Wronke has been made chief mechanical director of design for Hallicrafters. Prior to the amalgamation the Wronke organization had been affiliated with Hallicrafters as designers of postwar radio cabinets and has had long experience in metal, plastic and wood industrial products.

Directory Correction

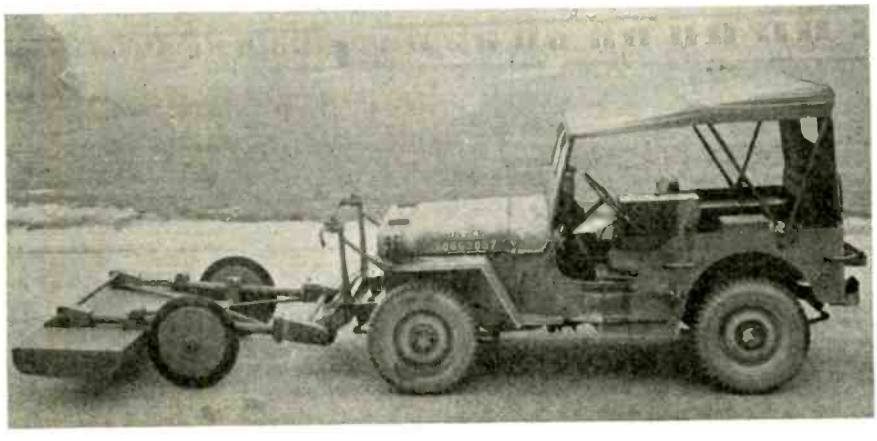
Crystal Research Laboratories, Inc., 29 Allyn St., Hartford, Conn., is a producer of quartz crystals for frequency control. The company's name should be included under the heading "Quartz Crystals" in the annual engineering directory published with the December issue of Electronic Industries.

Only One "Atlas" in Sound Equipment

In justice to Atlas Sound Corporation, we are glad to correct an error in the Annual Engineering Directory which was published in the December issue of Electronic Industries. In the cross-referencing of brand and company names, the trade name "Atlas" was erroneously applied to another manufacturer of sound equipment. The directory contains the listings of six companies using the trade name "Atlas" for a great variety of products but the only "Atlas" in the Sound System field is Atlas Sound Corporation, 1445 39th Street, Brooklyn 18, N. Y.

WAR-BORN ELECTRONIC EQUIPMENT

Held under cloak of secrecy until lately, two new forms of enemy harassing equipment are illustrated. Above, a mobile gun-laying radar. Below, a jeep-mounted mine detector



N.Y.F.D. Plans New Walkie-Talkie

Art Meyerson of the New York Fire Department is working on a new type of UHF pack set with crystal control. Experience with operation of walkie-talkies in the vicinity of burning buildings has emphasied the necessity of frequency stability. Radiated power output will also be upped from ¼ watt to ¾ watt. Steel buildings make communication difficult, and the band from 100-120 mc has been determined by Meyerson to represent the best compromise.

Design features of the new radio will include a French type handset clamped to the fireman's chest in a spring holder, so that another person may use the microphone. A single headphone will be worn by the fireman carrying the set.

Weight of the new equipment will be approximately 20 lb. Great attention is not given to compactness, since experience has taught that a fireman's equipment should be strapped on his back to leave his hands free. Antennas will be of the telescoping rod type and will not extend above the fireman's head.

Chicago-Milwaukee Microwave Relay

A series of the newest type microwave radio relay stations, designed to handle television, sound radio programs, or long distance telephone calls, is to be constructed between Chicago and Milwaukee, by the American Telephone and Telegraph Co. The Chicago-Milwaukee system will be completed prior to the time when Chicago is expected to be linked by coaxial cable with cities on the eastern coast where intercity televison transmission over coaxial cable has taken place.

Wartime Industrial Electronic Applications

As a feature of the Winter Convention of the American Institute of Electrical Engineers, scheduled for the week of January 21-25 in the Engineering Societies Building, New York, there is to be an informal technical conference under the sponsorship of its committee on electronics. General title of the conference is "New Industrial Uses of Electronics Resulting from Wartime Developments". The conference will be opened at 9:30 on the morning of Monday, January 21. The program includes:

"Hydrogen Thyratrons and Their Applications", by H. H. Heins, Sylvania Electric Products Inc.

"Recent Developments of Magnetrons in the Microwave Region", by W. C. Brown, Raytheon Mfg. Co.

"Industrial Heating at Very High Frequencies", by I. E. Mouromtseff, Westinghouse Electric Corp.

"Progress and Trends in HF Heating", by H. C. Gillespie, RCA

"Use of Pulsers of the Radar Type for High-Potential Testing", by H W. Lord, G-E.

General Instrument Acquires Sickles

General Instrument, Elizabeth, N. J., has acquired 100% of the capital stock of the F. W. Sickles Co., Chicopee, Mass. It is expected that immediately after the first of the year the Sickles company will operate under its own name but as a wholly owned subsidiary of General Instrument. It is stated that the company will continue to be operated with present management.

Only 5% of Models Officially Priced

Although Radio Manufacturers Association expects that there are between 2500 and 3000 radio set models to be priced by OPA, it is reported that only about 5% so far have had lists officially established. As of December 7, total price approvals added up to 90, covering mostly table models and 36 phonos.

Sweeny Returns to NBC

C. P. "Tex" Sweeny has returned to the NBC engineering department from the armed forces and has joined the technical staff of the television transmitter in the Empire State Building. Sweeny joined NBC in 1939 as a development laboratory engineer and was called to the Navy as a Lieut. (s.g.) in 1941. He returned to inactive duty a Lieut. Commander

Testing Hearing Aid Performance

A tentative code for measurement of performance of hearing aids is proposed by the Committee of the American Hearing Aid Association, Elmsford, New York, and reported by its Chairman, Fred W. Kranz in the October, 1945, issue of the Journal of the Acoustical Society of America. The specifications were drawn up by a technical committee including engineering representatives from most of the larger manufacturers of hearing aids as well as technical representatives from non-commercial groups who have been working in this field.

The following details are covered in the present report: 1.0 Scope of specifications—2.0 General method of measuring acoustical gain—3.0 Test room—4.0 Sound source—5.0 Measurement of the sound field—6.0 Artificial ear and associated equipment—7.0 Mounting of a hearing aid for test—8.0 Method of determination of frequency response and maximum acoustical gain—9.0 Determination of effect of battery voltage variation—10.0 Method of measuring non-linear distortion in vacuum-tube instruments — 11.0 Method of measuring acoustic in-

put - output characteristics — 12.0 Method of measurement of battery drain—13.0 Measurement of variation of gain with temperature and humidity changes.

Future Requirements of Aviation Instruments

The future requirements for instrumentation in the aviation field which I am listing reported Major G. P. Callihan, ATC, Wright Field, in addressing the recent Instrumentation Conference at Carnegie Institute of Technology, are comprised of dreams as well as problems for research and for development. I hope I can be vindicated half as well as De Vinci or Verne has been. Here they are:

1. The measurement and indication of true airspeed of aircraft from 0 to 1000 miles per hour and of missiles up to 4000 miles per hour.

2. The measurement and indication of true height of aircraft above the sea level, datum up to 80,000 ft. and of missiles up to 80 miles.

3. Means for measuring free air temperature in aircraft.

4. Light weight, accurate and reliable recorders of barometric pressure, free air temperature, and moisture content of the atmosphere for weather reconnaissance aircraft.

5. Means for insulating equipment from vibrations with a frequency of from 500 to 10,000 cycles per minute and amplitudes up to .060 in. Instruments for measuring and recording vibration characteristics.

6. A method for the determination and indication of the vertical in maneuvering aircraft.

7. Automatic drift indication.

8. A method of establishing a celestial navigation fix in aircraft using single observations.

9. A dead reckoning ground position indicator to operate in aircraft in all conditions of visibility without radio or other contact with the ground at the speeds and altitudes previously mentioned.

10. A celestial ground position indicator for use in aircraft during day and night with an accuracy of 23 miles.

11. Methods of polar navigation.

12. Methods of life raft navigation.

13. An automatic indication of balance of loaded aircraft.

14. A lubricant for gyro instruments, watches, and instruments

suitable for use within the temperature ranges of from -85°F to +200°F.

15. A simple means of alloying steel for structural use in aircraft and missiles to reduce magnetic permeability and therefore reduce effect on magnetic compass elements.

16. More definite information concerning the orientation and strength of the earth's magnetic field at altitudes up to 80,000 ft.

17. A simple remotely-indicating system for engine rpm, pressure, and temperature functions in aircraft.

18. A system for measurement of fuel and oil quantity and rate of fuel consumption in aircraft. Long range flights require accurate indications of the quantity of fuel available at all times, and particularly as that quantity becomes small.

Wabash to Sylvania

Sylvania Electric Products, Inc., Emporium, Pa., has acquired the Wabash Appliance Corp., one of the largest independent manufacturers of photoflash and incandescent lamps. Wabash, with headquarters in Brooklyn, N. Y., is to be merged with Birdseye Electric Corp., to become a wholly owned but independently operated Sylvania subsidiary. A. M. Parker remains president and general manager of Wabash.

Baker's Own Business

Frank C. Baker, Jr., formerly service and sales manager for the Scientific Glass Apparatus Co., has organized a company of his own under the corporate style, Baker Instrument Co. The business will be located at 310 Main St., Orange, N. J., and will be devoted to the sale and service of laboratory equipment as well as the production of pilot units.

DuMont Test Pattern

For the purpose of aiding designers and manufacturers of new television receivers and to facilitate the rapid conversion of DuMont and other makes of television receivers in the field from the old Channel 4 (78-84 mc.) to the new Channel 5 (76-82 mc.), DuMont television station WABD and its experimental station W2XWV will begin regular broadcasting schedules of test patterns daily on January 2. The test patten schedule is to be maintained for an indefinite period is from 10 a.m. to 12 noon and from 2:30 p.m. to 5 p.m., five days a week, Monday through Friday.

Long Distance Tele Reception

Editors Electronic Industries—Your "Foliage vs. Television" article in the September issue was interesting, and in view of this suggestion we intend to investigate this problem next spring and summer, at Lititz, Pa. Some of the trees in this vicinity are 50 feet high.

We plan to use dipole antennas 100, 50, and 25 feet high. The 100-foot antenna will clear all foliage, while the 25-foot antenna will encounter the greatest density of foliage. We are located 135 miles from New York City, 4,400 feet below line of sight. We are 1,200 feet below the Philadelphia line of sight.

In the past, using a simple dipole 50 feet high, with a 75-foot twisted pair line into three stages of preamplification followed by a 10-year-old RCA television receiver, we have obtained good reception 25% of the time from WNBT (N.Y.), as well as from Philadelphia.

The Philco signal was always usable, with little fading. Approximately 60% of the time the pictures would be termed satisfactory, and during the remaining 15% the noise level was objectionable and poor synch was observed. A faint reflection seems to be accompanying the signal both here and at the Welsh mountains 25 miles away.

WNBT fades somewhat 25% of the time, and during the remaining 50% the signal is of a rather poor quality, accompanied by poor synch, noise, and rapid fading. The N. Y. signal was frequently good when the other was poor.

Both stations afford "direct wave" quality, however, 25% of the time. Evidently the thermal theories of propagation are in error or subject to amendment. We hope to establish some definite principle in the foliage experiments. —*Harry J. Sheffy*, Engineering Division, Radio Corporation of America, Lancaster, Pa.

Editorial Contest Awards Delayed

Because of the number of manuscripts to be judged and the time required for the work, it has been impossible as yet to determine award winners in the contest which was announced in ELECTRONIC INDUSTRIES last May. However, the work is progressing and it is hoped that it will be possible to announce the names of the winners and their papers in an early issue.

Electronic Gaging

A new automatic gage with tolerance values as accurate as 0.0001 in. is being used for measurement of internal depths, external lengths and outside diameters. The unit with hopper feed is entirely automatic and will inspect, accept or reject and count small component parts of any type of material at a speed upwards of 3300 pieces per hour. The Autotron Co., Danville, Ill., originally developed this equipment for wartime ordinance work but have redesigned it for flexibility in peace time production.

Gaging is by mechanical contact of a stylus rod. Attached to the rod is a thin metal flag. The image of this flag is projected into an optical system with high magnification and is finally reflected on a panel containing two photoelectric tubes. The distance between these tubes, which can be varied by micrometer adjustment, represents the tolerance allowed on the dimension being gaged.

Over-under indicator

The position of the flag on the stylus rod controls the operation of the two photoelectric tubes. For accepted gaging the flag shadow will cover one PE tube and leave the other open. For dimensions "under tolerance" both tubes are left exposed to the light beam. For "over tolerance" measurements both PE tubes are in shadow. Relays set up by these various combinations of photo electric tube operations control the sorting of the parts after measurement, depositing them in the proper grading bin.

Precision Adds Electronic Section

L. H. Glaser and J. Raeburn, coowners of Precision Specialties, manufacturers of Revell plastic products, Los Angeles, have founded a new radio-electronic section. William F. Frankart, radio engineer, will be in charge of engineering for this section. He was formerly assistant chief engineer of the Airecon Mfg. Corp., Kansas City, Kan.

Textile Drying

Speed-ups of almost 50% in the drying of printed textiles have been achieved by the Werthan Bag Corp., Nashville, Tenn., through the use of infra-red lamps installed to supplement the usual steam drying of

fabrics. Using 144 500 w lamps with gold-plated reflectors, sufficient radiation is developed so that the necessary exposure is reduced to 3-6 seconds, dependent on the speed that the individual pattern is being run.

The textiles printed are used in the manufacture of grain and feed bags which, after their initial use as a container, are used by the farm wife for making aprons, curtains and children's dresses.

The detail and number of colors being printed determine the speed of run. Production on a fairly simple pattern jumped from 75 to 110 yds. per minute when infra-red drying was installed. The installation was made by Fostoria Pressed Steel Corp., Fostoria, Ohio.

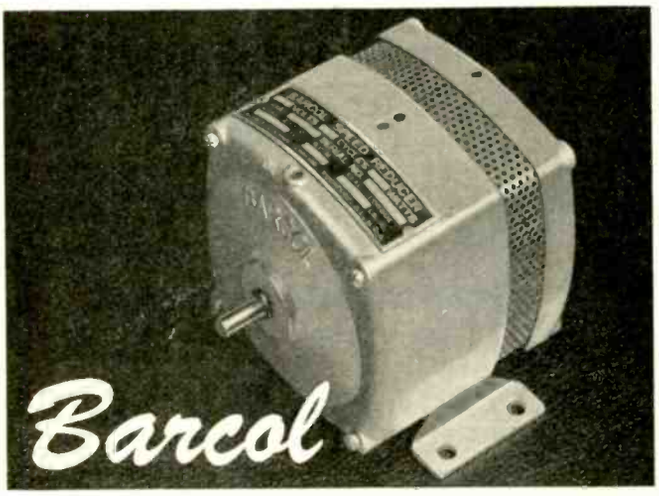
Infra-red Analysis

A new method of quantitative analysis, of particular importance to the oil, chemical and plastic industries, has been developed. In a specially designed spectroscope a beam of infra-red light is projected thru the material to be tested. This specimen may be either liquid, solid or in solution. Mirrors and special prisms guide the light along a 30-ft. long, zig-zag path to highly sensitive receivers. There the light is converted into electric current, amplified and charted with an electric pen. The peaks and dips on the chart indicate the kinds and amounts of material in the sample under test.

As is known, each kind of molecular matter vibrates at a distinctive characteristic frequency. If the infra-red beam of this new Westinghouse spectroscope is tuned to a frequency which is the same as the frequency of the material under test, the beam will be absorbed and a dip is recorded on the chart. Checking this frequency with a predetermined standard of "molecular" frequencies indicates that this particular type of matter is present in the specimen.

Swamp Communication

In an area almost entirely swampy and in some locations inaccessible except over water, the Union Sulphur Co., Inc., Sulphur, La., is using a two-way radiotelephone system for communication between its main office and seventeen 50 w portable and mobile units. The portable units are set up at semi-permanent locations such as pumping stations and drilling fields, along an hun-



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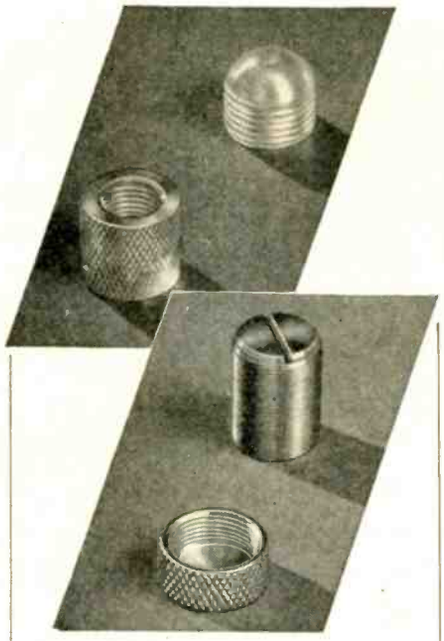

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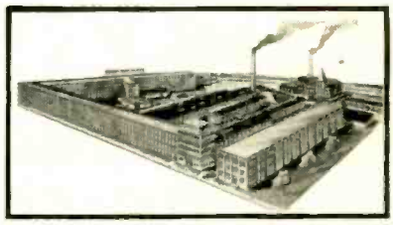

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ELECTRONIC INDUSTRIES

Advertisers, January 1946

dred mile pipeline. The mobile units are installed in cars and trucks. The main office transmitter-receiver is a 250 w FM unit operating at 33,620 kc. An interesting feature of this Motorola-Galvin system is the use of an automatic recorder for keeping the necessary station logs; this permits operation of the system with a single licensed operator. A daily average of over two hundred calls are placed over this system.

Metal Detector

An electronic mine detector did a helpful job for the United States Army and the Rankin Lumber Co., Fayetteville, N. C., recently. For many months the Rankin Co. had been curtailed in its normal operations because of the lack of suitable timber; and here almost at its doorstep the Army was clearing 6,000 acres of woodland which would provide over four million board feet of urgently needed wood. However, when actual cutting started, $300 worth of sawblades were ruined because it was found the timber was peppered with metal fragments—bullets, bits of exploded shells and such miscellaneous things which might be expected in an area under constant artillery fire. For a while it was thought that the wood was commercially unusable, but by going over the trees with an Army mine detector, the fragments of metal were located and dug out before the timber entered the sawmill. With this hazard removed, most of the lumber was salvaged and is now being used.

F M in the First Radio Equipped Bus

The nation's first radio equipped bus is in operation. The Washington, Virginia and Maryland Coach Co. plans to use this pioneer in regularly scheduled service on all of its 87 miles of coverage.

Following the grant by the Federal Communications Commission of the first license for this type of operation, General Electric engineers installed the necessary FM transmitter-receiver in the bus. This unit will tie in with the already established two way communication system now in service between the coach company's Arlington, Va., headquarters and their service and supervisor's "cruising" cars. A 250 watt FM transmitter of the type developed for wartime emergency communications is installed in the Arlington dispatcher's office.

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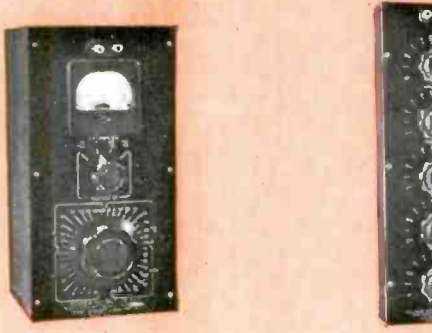
Full details gladly furnished upon request. Write to . . . THE DAVEN COMPANY, 191 Central Ave., Newark 4, N. J.



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IN TUBES, RCA MINIATURES ARE THE ANSWER for FM—for Television—for HF Communications

Consider these advantages of RCA Miniature Tubes for high-frequency applications:

HIGH GAIN—Lower inter-electrode capacitances and reduced lead inductance values improve circuit performance.

LOW LOSS—The short, low-resistance element leads serve as the contact pins; these, with the glass button seal provide a low-loss base.

LESS SPACE—Small dimensions of tubes permit closer spacing of components on a smaller chassis.

PREFERRED TYPES—Mass production is concentrated on a few types that meet all normal design requirements, resulting in higher tube quality at lower prices.

RCA tube application engineers are ready to consult with manufacturers on any problems, concerning the use of electron tubes—metal, miniature, or glass. For technical information on RCA tubes, write RCA Commercial Engineering Department, Section D-7A, Radio Corporation of America, Harrison, N. J.

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

TUBE DIVISION

RADIO CORPORATION of AMERICA

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