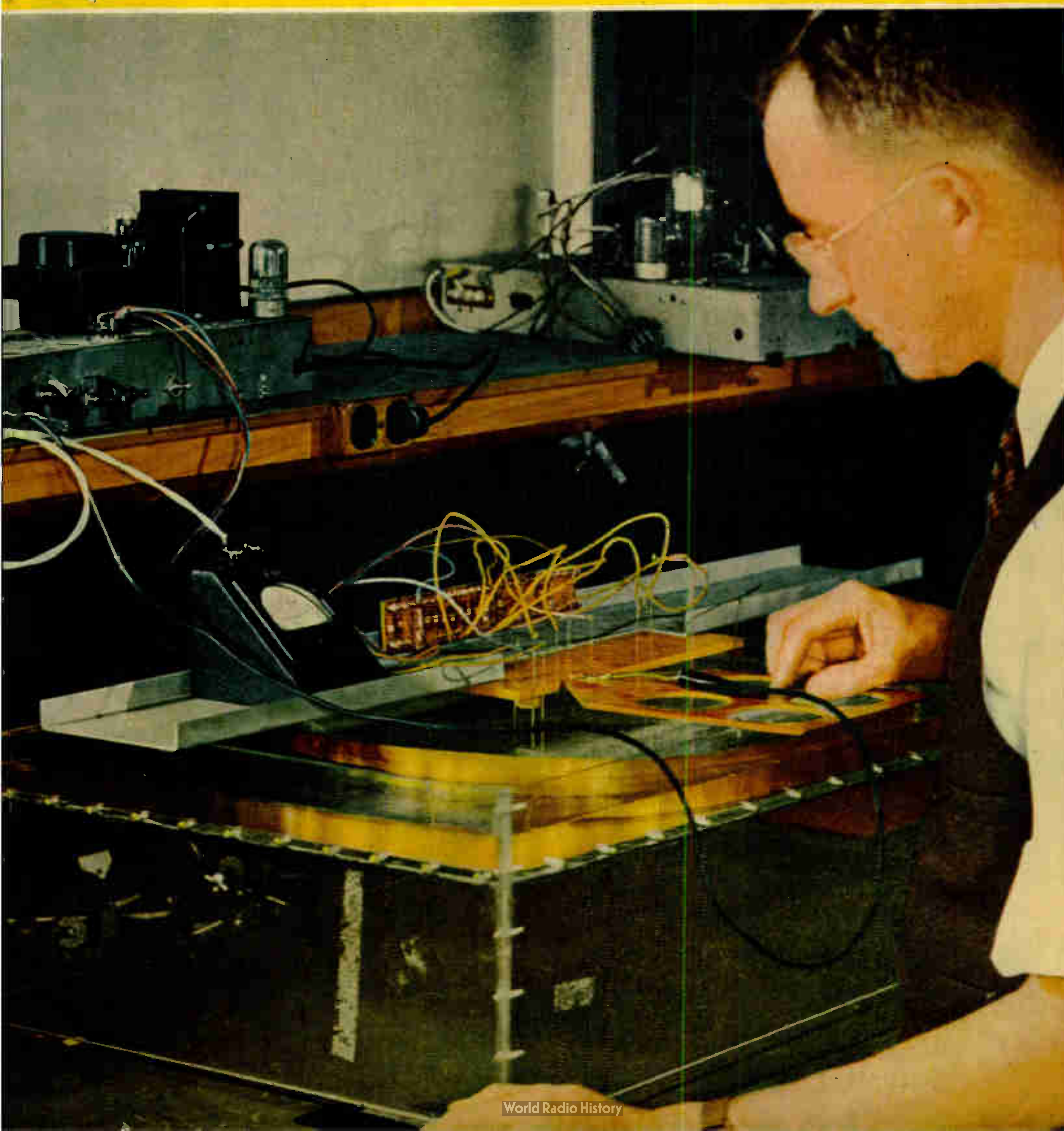
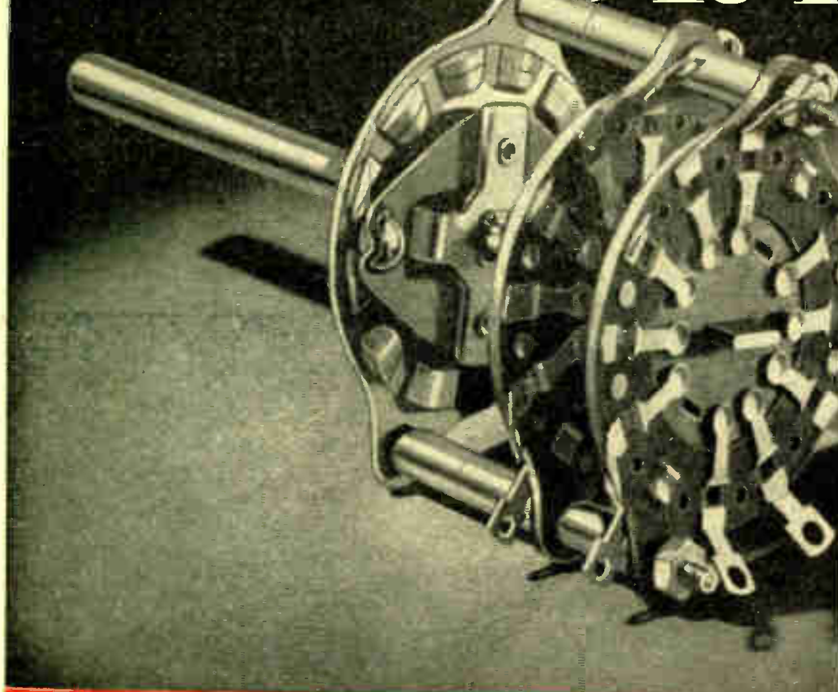
ELECTRONIC INDUSTRIES

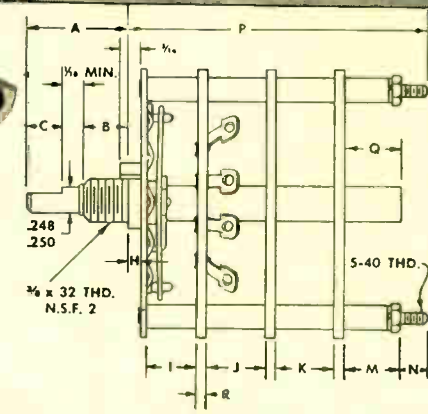
CALDWELL-CLEMENTS, INC. ★ MARCH 1946



MALLORY RL



Top Favorite Switch For Test Equipment



ELEVATION VIEW OF R L SWITCH

Ask for RL Specification-Layout Sheets

Printed on thin paper to permit blueprinting, these sectional drawings indicate standard and optional dimensions—make it easy for you to order pre-production samples of RL switches built to meet your requirements exactly. Ask your nearest Mallory Field Representative or write direct for a supply.

OF all circuit selector switches manufactured by Mallory, this RL unit is the most popular by far for low-power, industrial applications. In a class by itself, the RL switch is the answer for industrial electronic equipment requiring greater durability than provided by the conventional radio circuit selector switch. It offers from 1 to 6 circuits per section with 30 degree indexing—from 1 to 3 circuits per section when 60 degree indexing is used. But that's not the whole story by any means.

The heavy self-supporting terminals of this switch, for instance, are clinched to the stator and held firmly without rivets or staples. Contact ends are ball shaped, formed of high quality spring brass material, and heavily silver plated.

The rotor contact member is made of solid silver, insuring much lower contact resistance. The high lift of the terminals makes possible a self-cleaning action which further improves electrical contact. High quality Bakelite in the stator provides ample insulation for general applications, yet is sturdy enough to withstand rough usage.

These are only a few of many reasons why this RL switch is found in radio instruments, test equipment, and a wide variety of other applications. For full information about this Mallory "leader", ask for the RL Engineering data folder and specification layout sheets, or see your Mallory representative. Standard Mallory Switches are obtainable from your nearest Mallory Distributor.

P. R. MALLORY & CO. Inc.

MALLORY SWITCHES

(INDUSTRIAL AND ELECTRONIC)

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

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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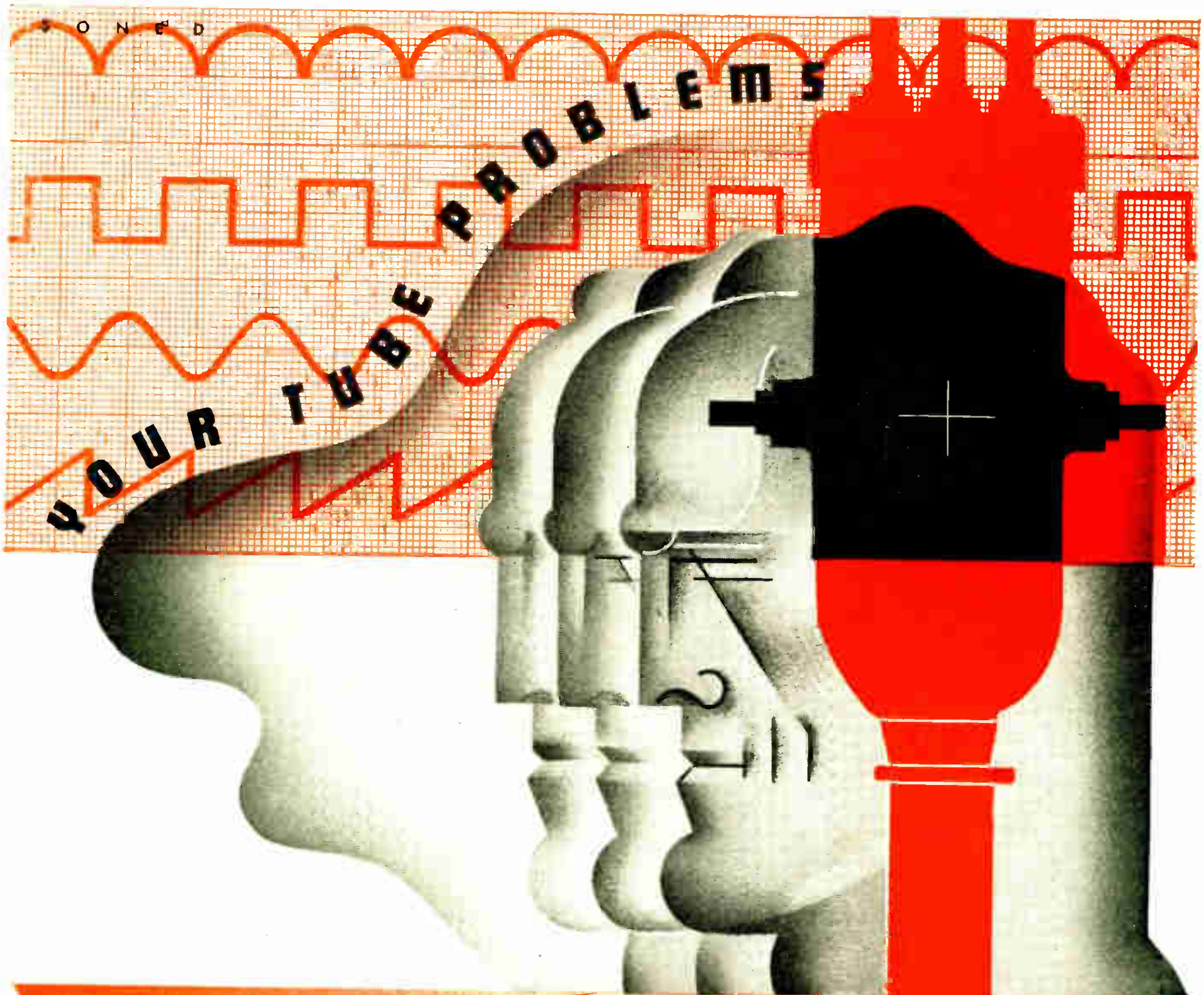

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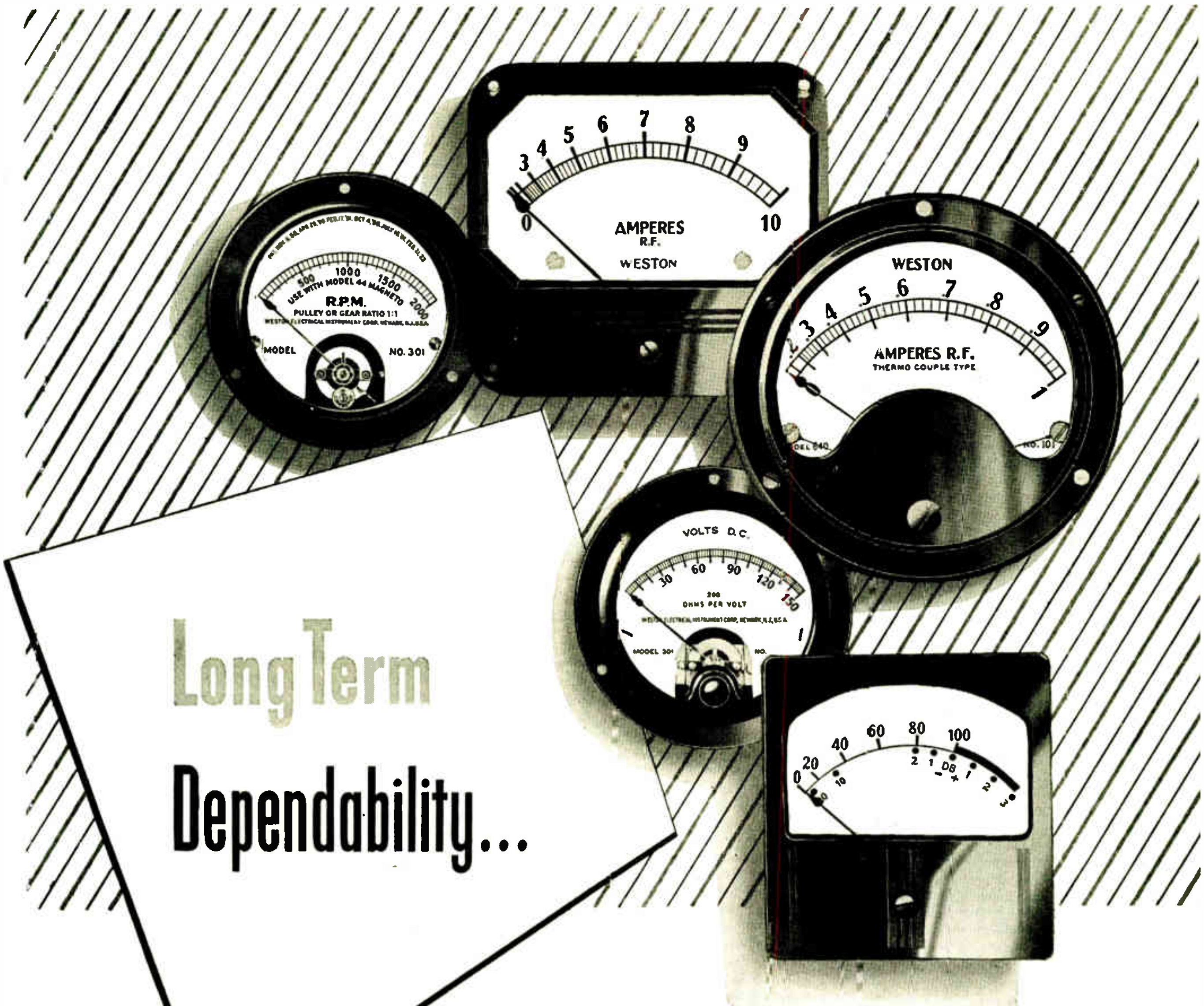

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THE COVER

(*See also page* 58)

The illustration shows an electrolytic tank used to design multistage wide band amplifiers for television receivers in the Philco Laboratories. Making use of a strange but very accurate mathematical similarity between the frequency characteristics of electrical networks and the distribution of potential in a tank of electrolytic, the method makes possible the achievement of more nearly ideal characteristics with high gain per stage. Amplifiers designed by this procedure may have very simple interstage coupling networks, all aligned somewhat differently so as cooperatively to produce an assigned overall gain and phase versus frequency response.

In the apparatus shown, a large shallow pool of slightly salted water is contained in a dielectric tray with a round strip of copper around the edge for a ground return. Equal currents are fed to the water through probes, at specific points near the center of the pool, their arrangement corresponding to the arrangement in the complex frequency plane of the resonances of the several amplifier stages. The potential in the water along a straight line passing near to the probes and corresponding to the axis of real frequencies is a measure of the gain in DB of the final amplifier, while the potential gradient transverse to the axis gives the slope of the phase versus frequency curve. The "resonances" are moved about at will until the required characteristics along the axis are obtained.

The theory of the method was worked out and applied by the Philco Research Laboratories in the course of television circuit development during 1939 and 1940. It has since been extensively used on the more exacting problems of wide band amplifier design.—W. E. Bradley, Director of Research, Philco Corp.

Inky! Woof!

Know what an "inky" is? Or a "scoop"? Or, for that matter, what "woof" means? Definitions of these, and some 250 other commonly used television terms, are included in a 64-page cartoon-illustrated "Television Talk," just published by the National Broadcasting Co.

TYPE FG-17 **$6**
. . . Peak voltage inverse, 5,000 v—peak current 2 amp—avg current 0.5 amp.

TYPE FG-95 **$16**
. . . Peak voltage inverse, 1,000 v—peak current 15 amp—avg current 2.5 amp (1,000 v, 30 amp, and 0.5 amp for ignitor firing).

TYPE FG-172 **$35**
. . . Peak voltage inverse, 2,000 v—peak current 40 amp—avg current 6.4 amp (750 v, 77 amp, and 2.5 amp for thyratron welding-control service).

Performance-plus is *built into* General Electric thyratrons! For example:

● Internal parts are strongly mounted and braced, to withstand shock and vibration. G-E tubes are *sturdy!*

● Grids are so placed as to minimize any risk of damage from current-surges.

● G-E thyratrons operate "cooler". Tube components are generously dimensioned, to give an ample temperature margin of safety.

● The base and lead-connections are solidly fastened to the tube envelope, will not loosen in service. Cement-immersion tests help to assure this dependability.

General Electric built thyratrons *first!* . . . Today G.E. builds *the most* thyratrons—builds them *best*—gets them to you *fastest!*

Thyratrons and other G-E tubes, in all commonly used sizes and ratings, are obtainable out of stock from your local G-E tube distributor or dealer. Phone this convenient supply source today! Give your factory the benefit of spot service on G-E top-quality, *warranty-covered* electronic tubes! *Electronics Department, General Electric Company, Schenectady 5, N. Y.*

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MAN HITS MOON

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THE radar experiment which resulted in the first contact with the moon is still another revelation of the brilliant advances made in electronics during the war.

The high standards of radio, radar and other war equipment for controls and communications, which called for extensive use of ALSIMAG Steatite Ceramics, will be carried forward into many peacetime products of QUALITY.

There will be no compromise with QUALITY in the production of ALSIMAG insulators for electronic and electrical uses. Write today for technical literature.

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ARMY E NAVY

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Fourth Award May 27, 1944
Fifth Award December 2, 1944

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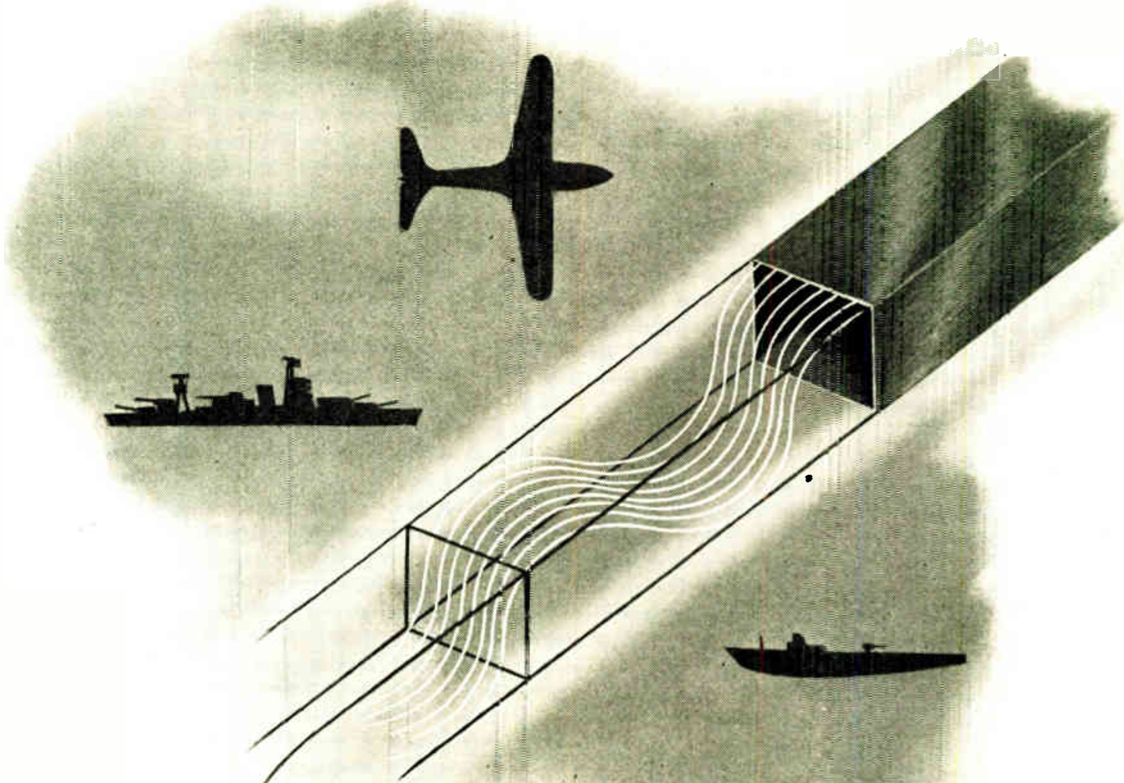


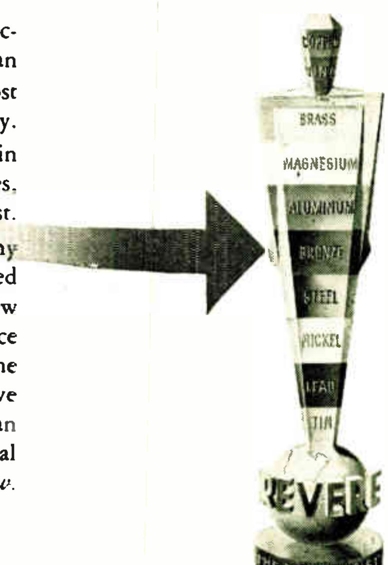
We've got the angle on metals!

Radar's miracle eye responds to no ordinary electric impulse such as that which actuates our radios. So fussy are radar signals that they must often be piped through special hollow tubes called wave guides.

Perhaps the most difficult type of wave guide called for a rectangular metal tube with no curvature in the corners . . . an assignment that any worker in metals will tell you is almost impossible! Yet it had to be done, with top wartime urgency.

So Revere devised a way to do it, on a production basis! And in addition was able to hold inside dimensions to closest tolerances, and to keep the inner surfaces of the tubes flat and free from twist.

This achievement of America's oldest metal-working company shows that, as a result of its 144 years of experience it has acquired the priceless habit of questioning the obvious, of creating new answers to new problems. Yet valuable as such Revere service can be, it is surpassed by the day-to-day help Revere offers the radio industry in the use of Revere's standard products. We have merged the science of the metallurgist with the skill of the artisan to help with your routine problems. Both the Revere Technical Advisory Service and all Revere metals are ready to serve you *now*.



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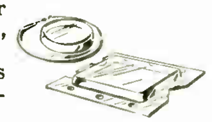

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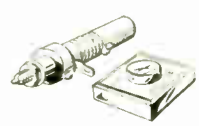
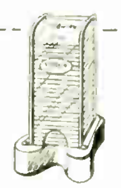


DESIGN AND ASSEMBLY



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PLASTIC FABRICATION

SYLVANIA NEWS
CIRCUIT ENGINEERING EDITION

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

TINY T-3 TUBE ASSURED A BIG SUCCESS IN RADIO

New Wonder Tube Developed by Sylvania for Midget Portables

The development by Sylvania Electric of the tiny T-3 radio tube is an important factor in making possible light weight, "vest pocket" radio sets.

Ever since the announcement of Sylvania's development of a peanut-sized electronic tube for the famous "war secret" proximity fuze, manufacturers and circuit engineers have been busy making plans for producing super-small radio sets and walkie-talkies that would capture the public's imagination. Now that the Sylvania T-3 (commercial version of the proximity fuze tube) has been perfected, these revolutionary radio ideas are becoming more and more practical.

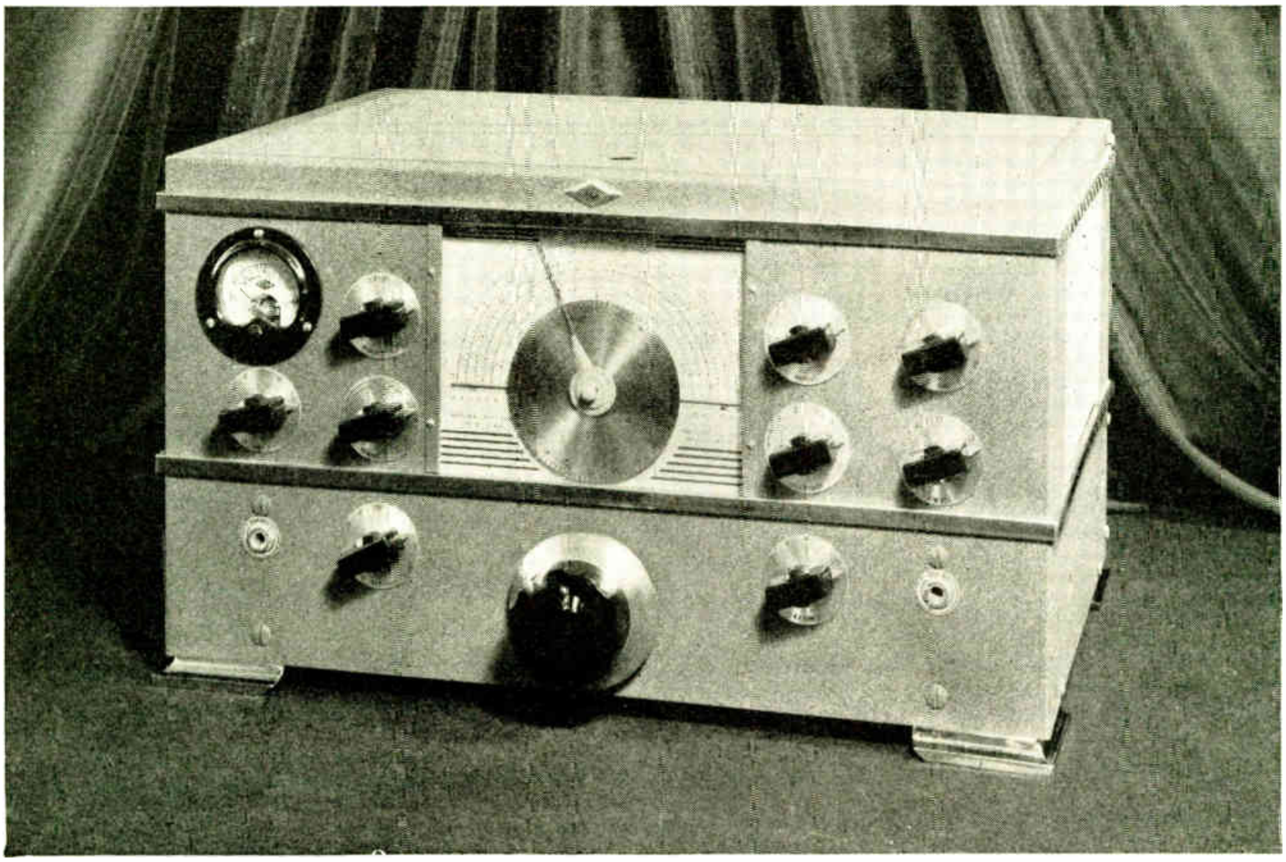
Future designs of this versatile tube will permit a wide variety of applications, ranging from sets no larger than a package of cigarettes up to deluxe farm receivers. The tiny tube features extremely small size with feather-weight. It has a life of hundreds of hours, is rugged and exceptionally adaptable to operation at high frequencies.

For further, interesting information, or for the answers to any of your questions concerning this remarkable tube, write to SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pennsylvania.

SYLVANIA ELECTRIC

Emporium, Pa.

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



THE NC-2-40C

This superb new receiver reflects National's intensive receiver research during the war period. Many of the NC-2-40C's basic design features stem from the NC-200, but to them have been added circuit and construction details that set it apart as a performer. Stability and sensitivity are outstanding. A wide range crystal filter gives optimum selectivity under all conditions. The series-valve noise limiter, the AVC, beat oscillator, tone control and S-meter are among the many auxiliary circuits that contribute toward the all-around excellence of the NC-2-40C. See it at your dealer's.

ARMY E NAVY

ARMY E NAVY

NATIONAL COMPANY, INC.
MALDEN, MASSACHUSETTS, U.S.A.

MALDEN
MELROSE
★★★★

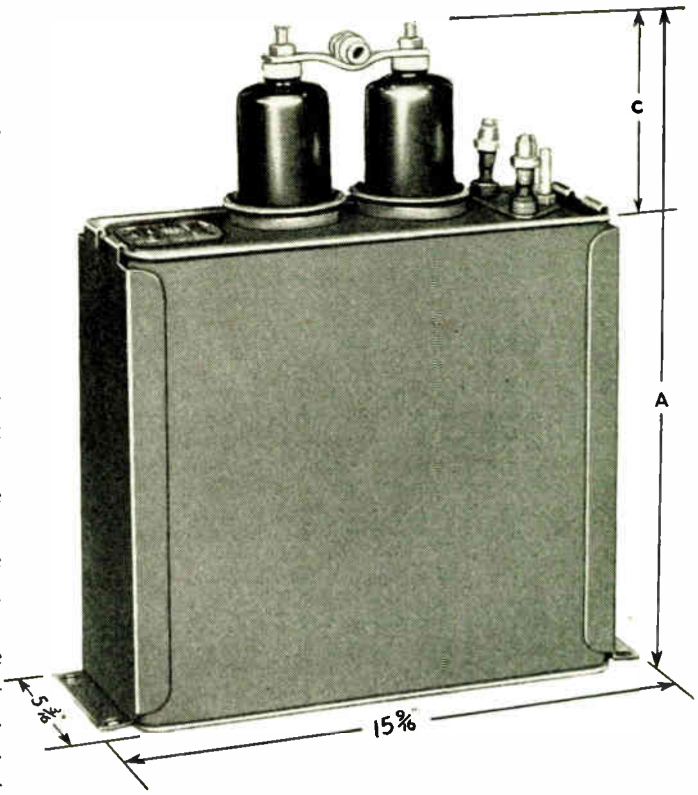
HERE 3 CAPACITORS DO TWICE THE WORK OF 25

A MANUFACTURER of induction heaters replaced 25 mica capacitors in his resonant (tank) circuit with three General Electric HFP parallel-plate, water-cooled capacitors. He saved nearly half the cost and space, and more than doubled the kva. Result: a more compact, more powerful, and more efficient heater.

Class HFP capacitors, with their two sets of heavy, sheet-aluminum plates, are specifically designed for use in resonant circuits of high-frequency oscillators, such as those employed in electronic heaters. Outstanding features of Class HFP capacitors are compact construction, and ability to operate at high voltages and to carry heavy continuous currents at frequencies from 50 kilocycles up into the megacycles. The special dielectric is a new, stable, synthetic liquid which combines the desirable characteristics of low loss, high dielectric constant, and high dielectric strength.

A coil of copper tubing, for water-cooling the capacitor, is installed inside the case in direct contact with the grounded pair of capacitor plates. Couplings are provided for connection to 3/8-in. copper tubing. The cooling feature permits a compact assembly and high current rating per unit volume.

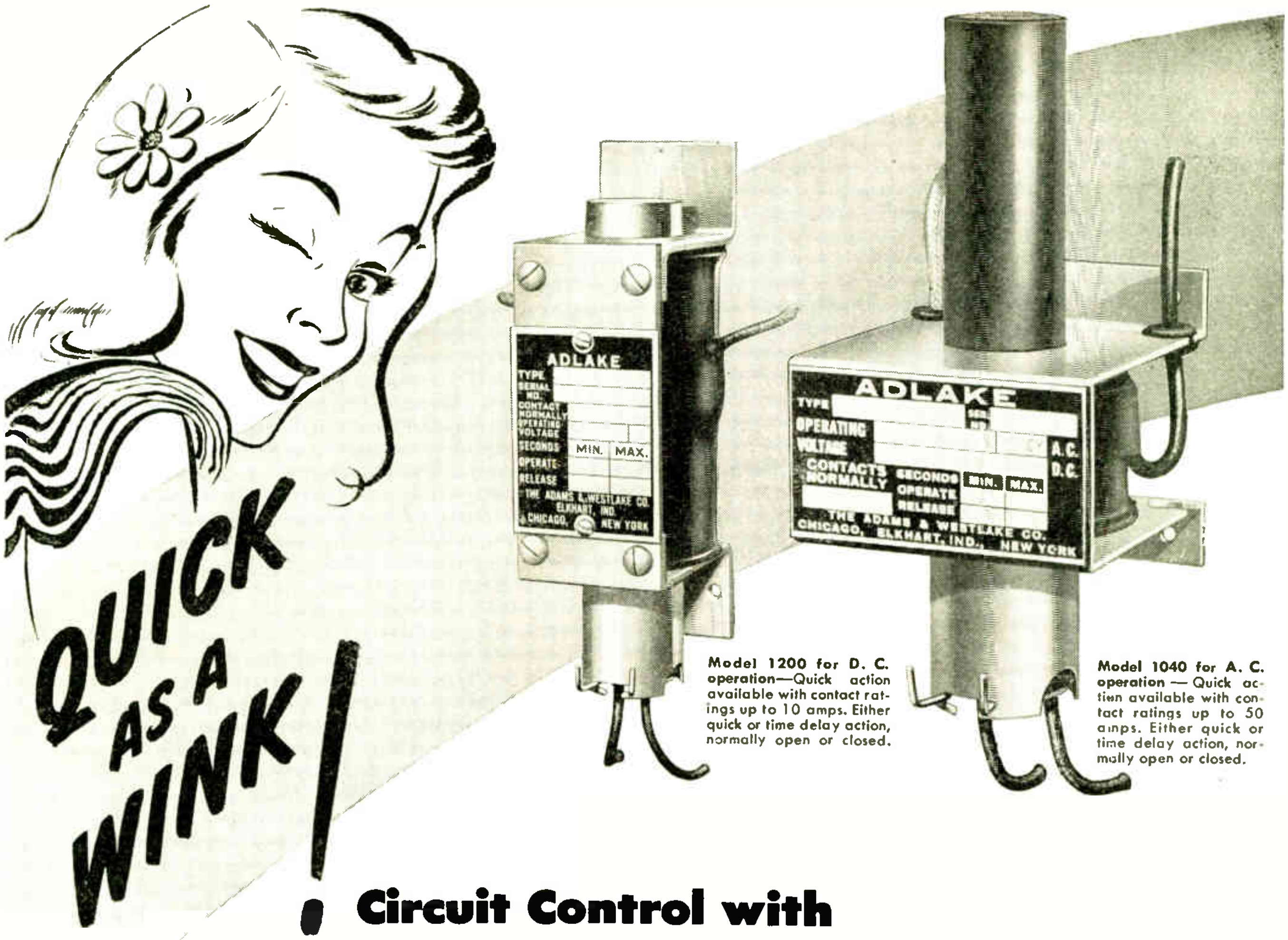
The cases are of nonmagnetic metal, hermetically sealed, and flexible enough to take care of thermal expansion of the liquid dielectric. Capacitance tolerance is from plus 5 per cent to minus 5 per cent of the rated capacitance at 25 C; Q factor is above 2000 for full load operation at frequencies from 50 kilocycles to one megacycle. Internal inductance is low, which gives resonant frequencies from 3 to 9 megacycles, depending upon the capacitance rating. Write for Bulletin GEA-4365. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



CLASS HFP HIGH-FREQUENCY, PARALLEL-PLATE, WATER-COOLED CAPACITORS

Maximum Permissible Rms Working Voltage	Microfarad Rating	Maximum Permissible Rms Working Current in Amp at 540 Kilocycles	Approximate Dimensions in Inches: A	Approximate Dimensions in Inches: C
2000	0.025	170	16 7/32	2 1/2
	0.030	204		
	0.034	230		
3000	0.0165	168	16 7/32	2 1/2
6000	0.0075	153	18 7/16	4 7/16
	0.01	204		
6600	0.009	202	18 7/16	4 7/16
9000	0.0029	88	18 7/16	4 7/16
	0.005	153		
	0.0056	171		

GENERAL ELECTRIC



Model 1200 for D. C. operation—Quick action available with contact ratings up to 10 amps. Either quick or time delay action, normally open or closed.

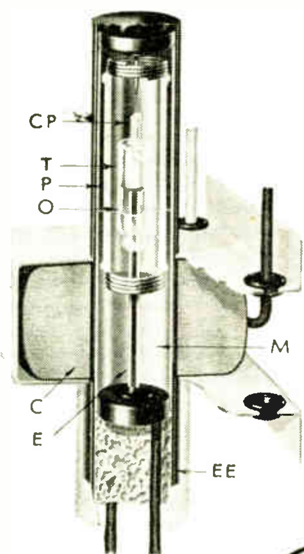
Model 1040 for A. C. operation — Quick action available with contact ratings up to 50 amps. Either quick or time delay action, normally open or closed.

Circuit Control with ADLAKE MERCURY RELAYS

HOW THEY WORK

ENERGIZED — Coil **C** pulls plunger **P** down into mercury **M.** Mercury thus displaced enters thimble **T** through orifice **O.** Inert gas in thimble gradually escapes through ceramic plug **CP,** thus producing time delay.

ENERGIZED—Mercury now fills thimble **T,** is completely leveled off and mercury-to-mercury contact established between electrodes **E** and **EE.** Degree of porosity of ceramic plug **CP** determines length of time delay.



Contacts and break-offs are as quick as a wink because Adlake Plunger-type Relays (models for A.C. or D.C.) use fast-moving, liquid metal mercury . . . positive in action; silent and chatterless; will not burn, pit, or stick.

Under the most exacting conditions . . . heat or cold, dirt, dust, or moisture they're ready and prompt to perform. Mechanisms, encased in armored glass or metal cylinders and then hermetically sealed, are impervious to the elements and oxidation.

No cleaning, no inspection, no servicing . . . relax and let an Adlake Mercury Relay work your timing, load, or control circuits—automatically and trouble-free.

Our bulletin tells the complete story, write for it today.

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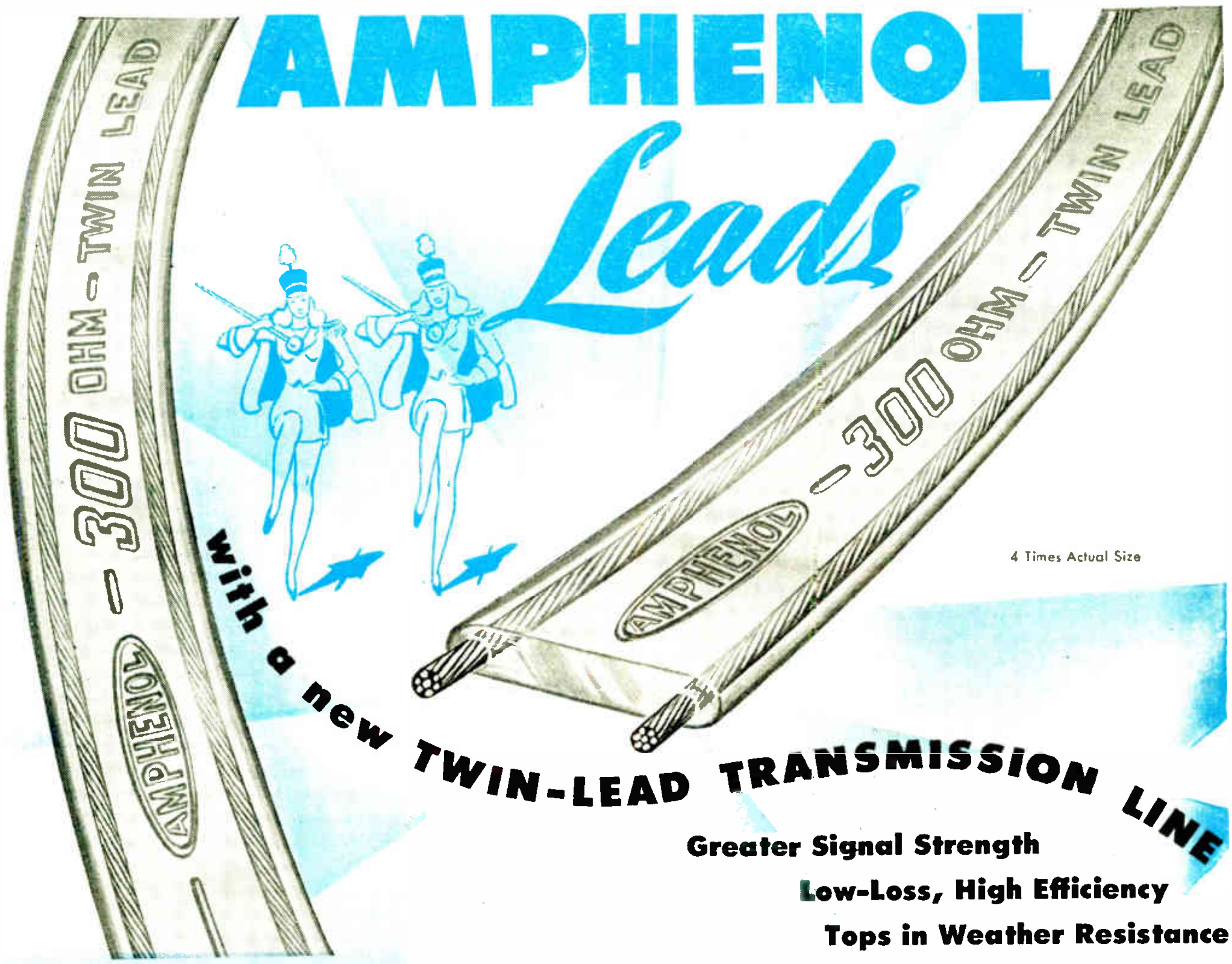


Greater Signal Strength
Low-Loss, High Efficiency
Tops in Weather Resistance

ELECTRICAL DATA

Amphenol "Twin-Lead" Transmission Line is available in 300 ohm impedance value. RMA standardized on 300-ohm lead-in line for Television as the most efficient over broadband operation.

Amphenol also supplies 150 ohm twin-lead to those interested in particular applications and experimental work.

Designed especially for amateurs who operate in very narrow bands of frequency or one particular frequency. Ideal for dipoles with a nominal impedance of 72 ohms at the frequency for which they are cut.

Dielectric constant of Polyethylene—2.29. Capacities (mmf per ft.): "300"—5.8; "150"—10; "75"—19.

Velocity of propagation (approx.): "300"—82%; "150"—77%; "75"—69%

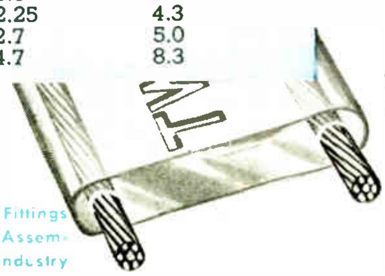
Power factor of Polyethylene—up to 1000 Mc—.0003 to .00045. Attenuation—FM and Television Band.

Megacycles	300-ohm DB per 100 Ft.	150-ohm DB per 100 Ft.	75-ohm DB per 100 Ft.
25	0.77	0.9	1.7
30	0.88	1.03	2.0
40	1.1	1.3	2.5
60	1.45	1.8	3.4
80	1.8	2.25	4.3
100	2.1	2.7	5.0
200	3.6	4.7	8.3

Amphenol's "Twin-Lead" is a solid dielectric line that transmits signals from antenna to FM and Television receivers with extremely low loss. It's tough . . . inexpensive . . . easy to install . . . repels water . . . and is unaffected by acids, alkalies and oils because the dielectric is Amphenol Polyethylene.

In temperatures as low as –70°F. Twin-Lead Transmission Line stays flexible and does not become brittle after continuous aging in sunlight. In such outstanding qualities Amphenol's "Twin-Lead" is a wire of exceptional efficiency, life and utility.

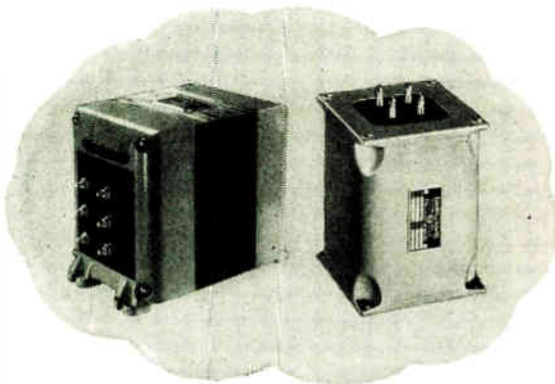
AMERICAN PHENOLIC CORPORATION
Chicago 50, Illinois
In Canada • Amphenol Limited • Toronto



Depend upon AMPHENOL Quality

U. H. F. Cables and Connectors • Conduit • Fittings • Connectors (A-N, U. H. F., British) • Cable Assemblies • Radio • Antennas • Plastics for Industry

FOR PRECISION-BUILT ELECTRONIC PRODUCTS!

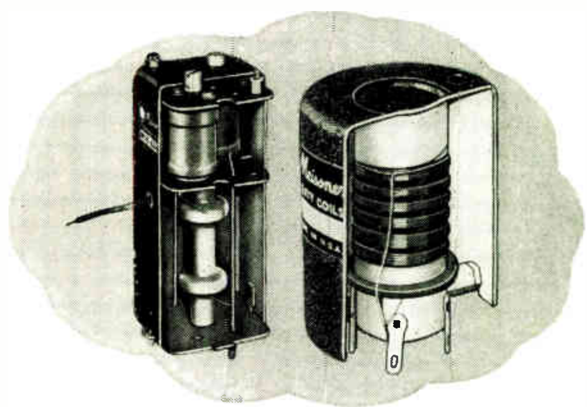


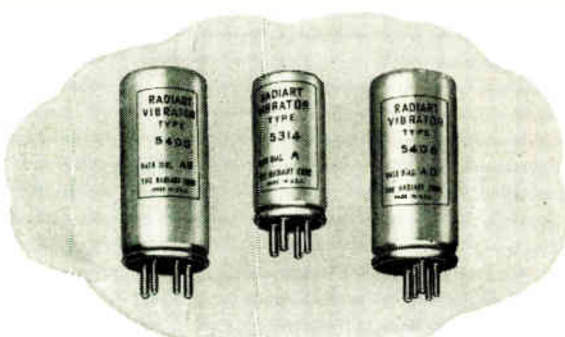
THORDARSON TRANSFORMERS

Over fifty years experience in the manufacture of quality-built transformers for all applications—replacement, communications, sound amplifier, industrial, experimental and amateur. Thordarson also originated Tru-Fidelity Amplifiers.

MEISSNER COMPONENTS

The Meissner reputation, gained and maintained by furnishing high quality components, including antenna, R.F. and oscillator coils; standard and Ferrocart transformers; windings, chokes and accessories. Meissner also makes the finest in service equipments.





RADIART VIBRATORS

Radiart Exact Duplicate Vibrators are individually engineered to meet the physical and electrical requirements of each application. This assures longer life, minimum R.F. interference, low hum level, etc. Radiart also makes rust-proof aerials to fit all cars.

WRITE FOR COMPLETE INFORMATION TODAY!

MAGUIRE INDUSTRIES, INC.

936 NORTH MICHIGAN AVENUE, CHICAGO 11, ILLINOIS

CAPACITOR *Craftsmanship*

● With tiny silvered micas, it's precision: capacitance tolerances of 1%, with temperature coefficients and stability requirements to meet the highest characteristics requirements of JAN-C-S; excellent retrace characteristics; practically no capacitance drift with time; exceptionally high Q. Yes, Aerovox *specializes* in such precision capacitors.

And at the other extreme are giant Type 26 oil-filled capacitors for high-voltage requirements such as in X-ray equipment, high-voltage test and laboratory equipment, and for carrier-current coupling. Again, Aerovox *specializes* in high-voltage oil-impregnated, oil-filled capacitors.

But how, you ask, can one organization really *specialize* in such totally different products? The Aerovox answer:

The huge Aerovox plant is really *several* plants in one. Micas are made in the Mica Department, oils in the Oil Department, electrolytics in the Electrolytic Department, and so on. Each has its OWN engineers, supervisors, trained workers.

Thus you are assured of that *specialized* craftsmanship that insures the best in highly specialized products, along with the convenience, certainty and economy of ONE outstanding source of supply.

● *Try us on that capacitance problem*

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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

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

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

OVER A THOUSAND DIFFERENT

STOCK Rheostats, Resistors, Tap Switches

AT

OHMITE

Offers a Quick Answer to Resistance Control Needs

THE Ohmite stock of power rheostats, resistors and tap switches is the largest and most complete in existence . . . in variety and number!

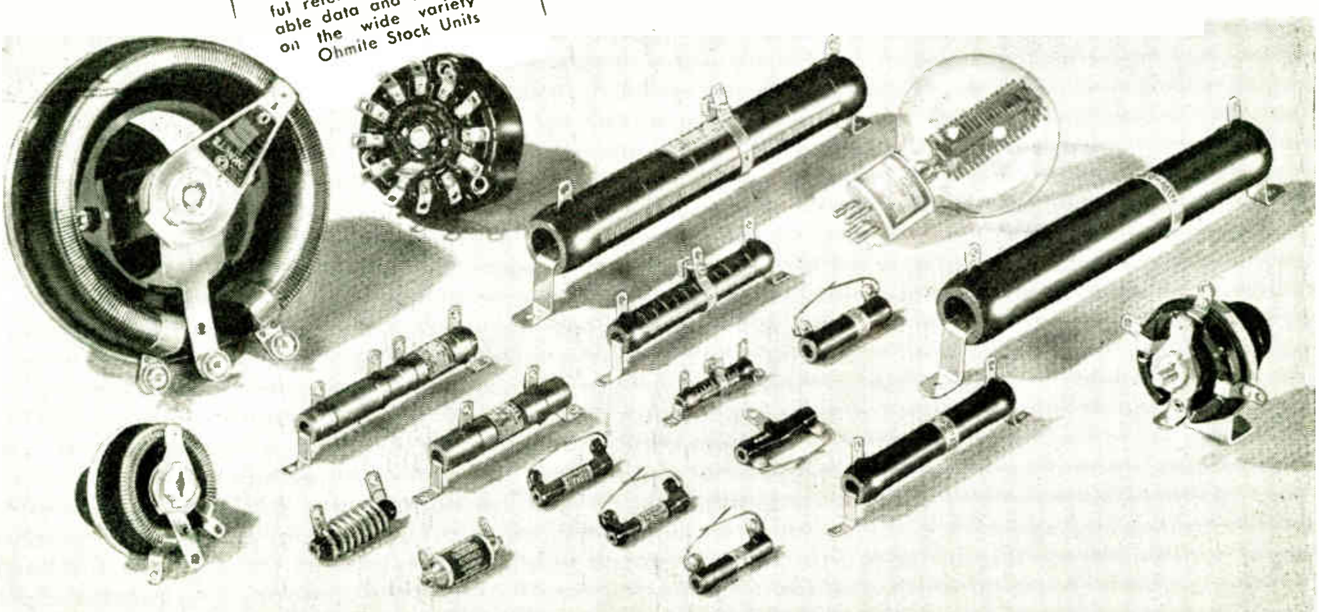
Stock model rheostats are available in six different sizes from 25 to 500 watts . . . each size carried in more than a score of different resistance values . . . some as low as 0.5 ohm and others as high as 10,000 ohms.

Among the stock resistors are eight sizes of wire-wound fixed resistors rated at 1, 10, 20, 25, 50, 100, 160 and 200 watts. Also seven sizes of "Dividohm" adjustable resistors rated at 10, 25, 50, 75, 100, 160 and 200 watts. All sizes are available in scores of resistance values, some less than 1 ohm, others as high as 250,000 ohms.

There are also three series of stock tapped resistors (ten-section "Multivolts"), three series of non-inductive resistors, two series of glass-enclosed non-inductive resistors, five series of "Riteohm" precision resistors, seven series of tap switches, nine series of radio frequency chokes, and many other units.

So great is the variety of Ohmite stock units that a combination of them can be used to obtain an endless number of resistances and wattage capacities. Special units engineered and produced to your specifications.

OHMITE MANUFACTURING COMPANY
4983 FLOURNOY STREET, CHICAGO 44, U.S.A.



Be Right with **OHMITE**

RHEOSTATS • RESISTORS • TAP SWITCHES

Quick Delivery

ON

TIN and BARE COPPER BRAIDED SHIELD TUBING

Runzel has a stock of tin copper wire to start immediate production on any size Shield Tubing as illustrated.

Runzel

C • WIRES ABLES

State size and quantity required!

RUNZEL CORD & WIRE CO.

4723-31 MONTROSE AVENUE • CHICAGO 41

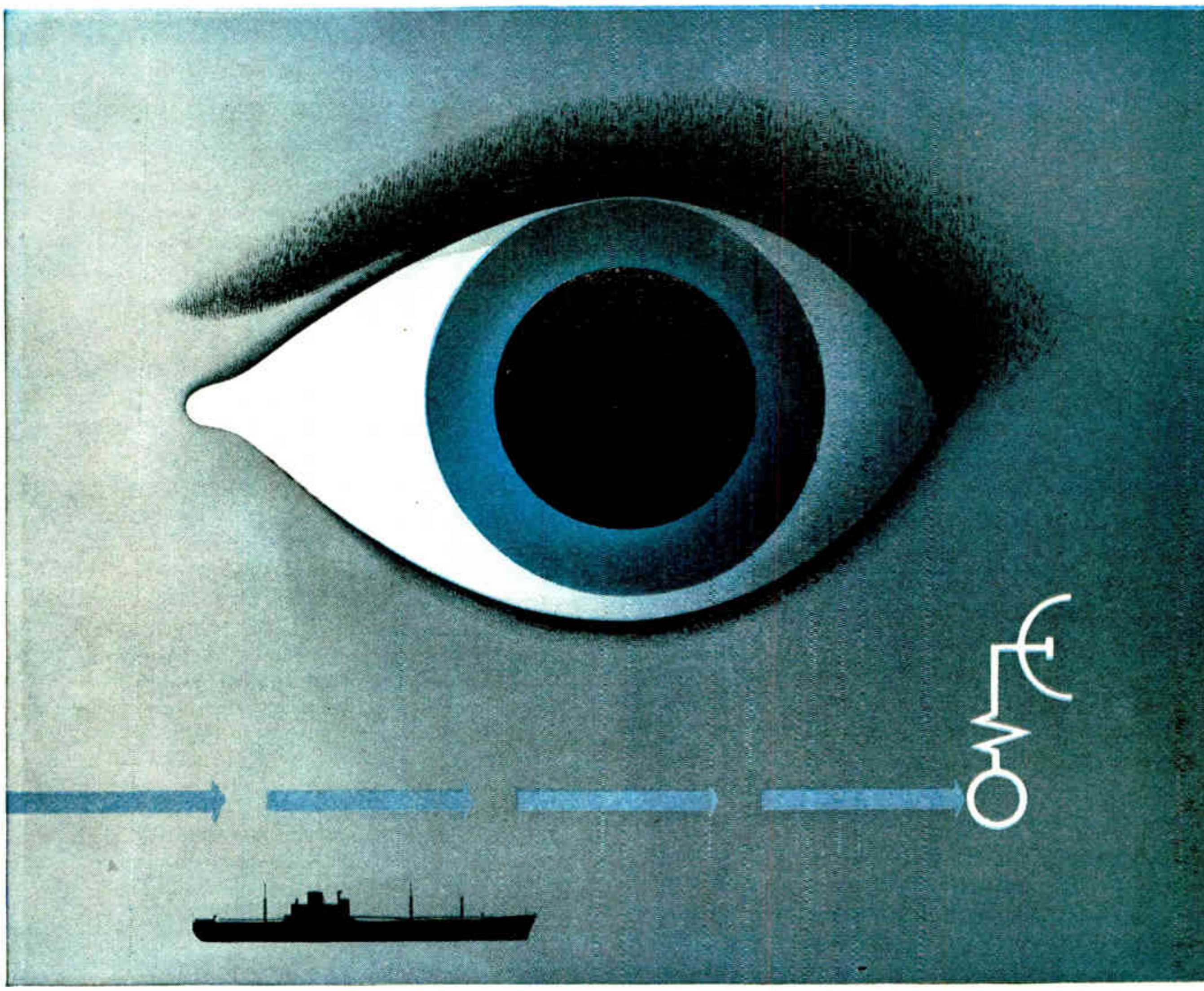
Electronic Components *by* ERIE RESISTOR

ERIE RESISTOR has developed and manufactured a complete line of Ceramic Condensers for receiver and transmitter applications; Silver-Mica and Foil-Mica Button Condensers; Carbon Resistors and Suppressors. Complete technical information will be sent on request.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND TORONTO, CANADA.



Look ahead to/with Radar by Sperry

• This year, Sperry Gyroscope Company introduces its new *Radar* equipment for marine use.

Sperry *Radar* has been conceived to function better in this fundamental service: *To enable ships to operate on schedule regardless of visibility*...through thick fog, heavy rain, dense smoke, darkness.

As an aid to navigation it picks up channel markers and buoys; assists in making landfalls with assurance; spots icebergs, floating derelicts and other hazards projecting above surface. It also permits vessels to enter harbors and proceed with all due safety and caution through fog. Another important feature: Sperry *Radar* provides a Gyro-Compass-controlled image and can be operated by bridge personnel without extensive technical background.

In design and construction, Sperry *Radar* reflects this company's many years of experience in precision manufacture of marine equipment—as well as its outstanding achievements in the field of electronics. In simplicity and dependability, this new *Radar* exemplifies again Sperry's ability to build superior products for merchant ship service.

Sperry Radar Features:

- Designed to meet all Class A specifications of the U. S. Coast Guard.
- Maximum range 30 miles—minimum, 100 yards.
- 10-inch picture on a 12-inch screen.
- Images presented in true or relative relationship at option of operator.
- Gives accurate ranges read from indicator instead of estimated from scope.
- Backed by world-wide service.

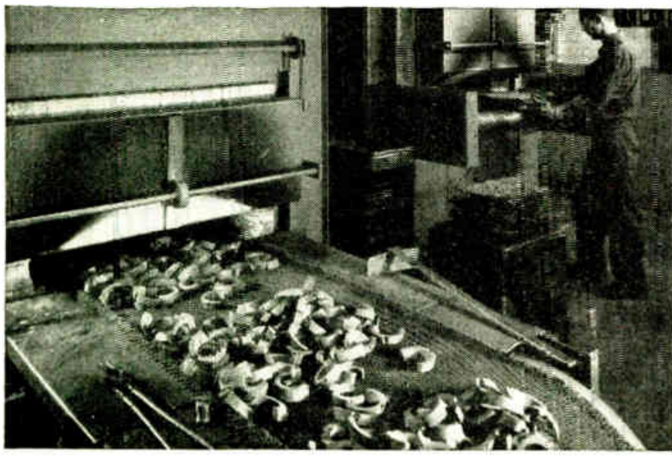
SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

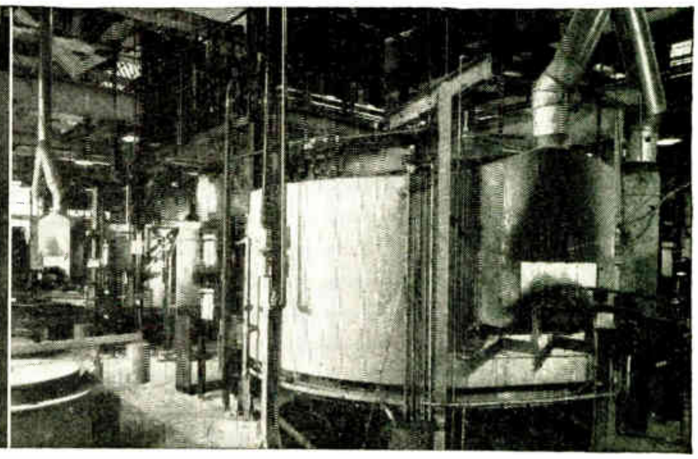
SPERRY *Division of the Sperry Corporation*

LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS
CLEVELAND • BROOKLYN • HONOLULU

GYROSCOPICS • ELECTRONICS • RADAR • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

PERMANENT MAGNETS MAY DO IT BETTER





Heat Treating for Highest Magnet Efficiency

Proper techniques of heat treatment and cooling must be applied to produce the highest magnetic qualities in the various permanent magnet materials. The Alnico alloys, for instance, require extremely high temperatures and must be cooled at a carefully controlled rate, Alnico V being placed in a strong magnetic field during cooling, after which they must be drawn at precisely controlled temperatures. Exactness is imperative in these operations.

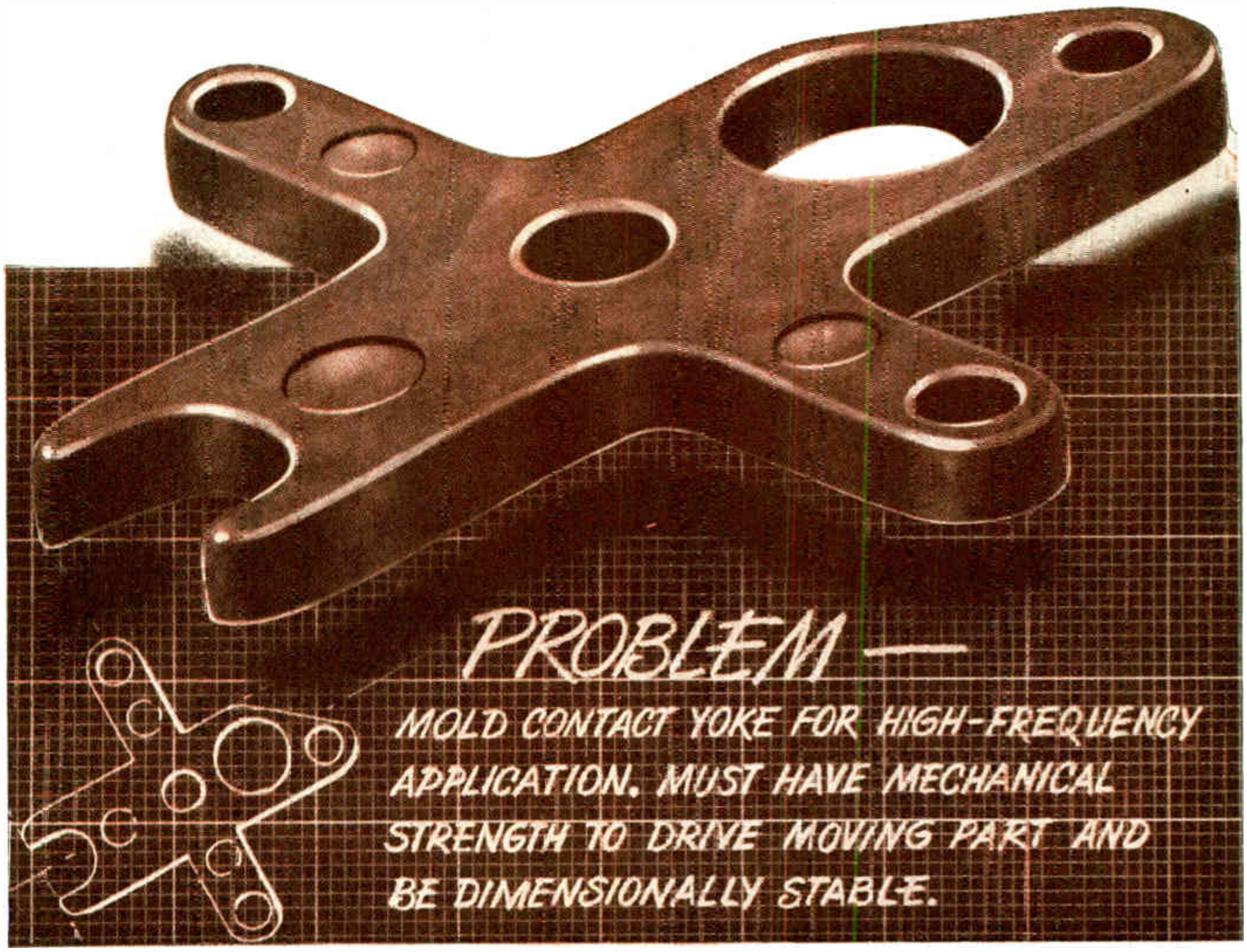
To provide the proper temperature cycles, continuous electric furnaces are utilized at The Indiana Steel Products Company. These furnaces were especially designed to provide the necessary temperature zones to produce highest magnetic quality, each one being controlled separately by an automatic pyrometer.

Our engineers will be glad to consult with you on any problems on the use and application of permanent magnets. For information on permanent magnet application, design and materials, write for the new technical "Permanent Magnet Manual." *The Indiana Steel Products Company*, 6 North Michigan Avenue, Chicago 2, Illinois.

Permanent Magnets May Do It Better

An Alnico Tachometer Magnet

DESIGNED AND ENGINEERED AT NO. 1 PLASTICS AVENUE



G-E MYCALEX . . . FOR PRECISION-MOLDED INSULATION

● This contact yoke was designed to drive a vital moving part in a high-frequency application. A flat and dimensionally stable part was required.

No. 1 Plastics Avenue was consulted. The problem was solved by specifying G-E mycalex—compound of glass and powdered mica with a unique combination of properties.

Molded in G-E mycalex by new techniques, this contact yoke has everything required of a high-frequency component—dielectric strength . . . low loss factor . . . stability . . . flatness . . . rigidity.

G-E mycalex is now available to all industry in standard rods and sheets, or molded to your own design. G-E designers and engineers will give you the benefit of their experience in molding hundreds of G-E mycalex parts. Write to Section T-8, Plastics Divisions, General Electric Company, 1 Plastics Avenue, Pittsfield, Massachusetts.

What is G-E Mycalex?

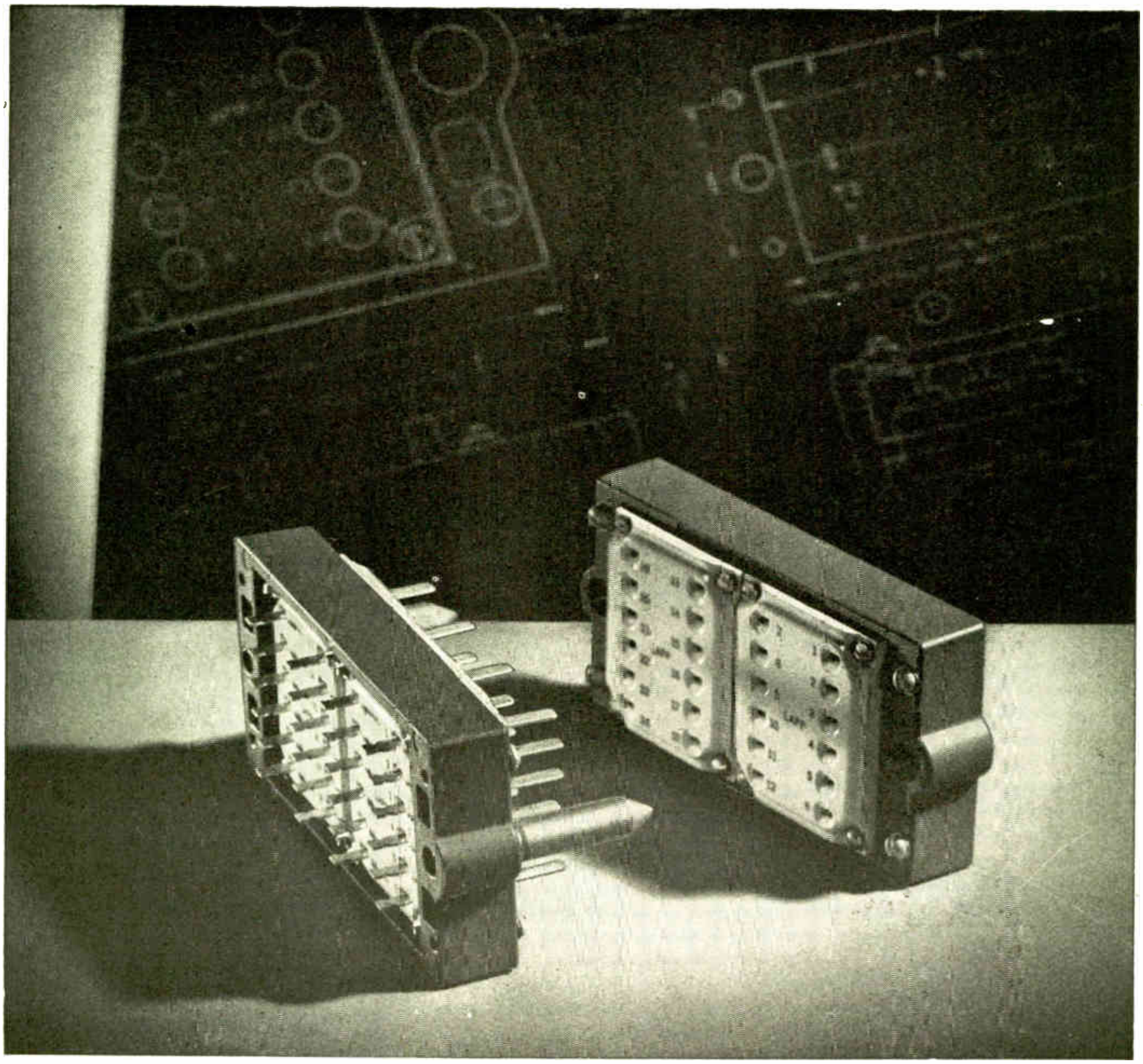
Fused glass and powdered mica produce a hard, gray-colored, stone-like material which is called mycalex.

G-E mycalex possesses a unique combination of properties for high-frequency insulation:

High dielectric strength; low power factor; prolonged resistance to electrical arcing; chemical stability—no deterioration with age; dimensional stability—freedom from warpage and shrinkage; imperviousness to water, oil, and gas; resistance to sudden temperature changes; low coefficient of thermal expansion; high heat resistance.

GENERAL ELECTRIC

CD46-M8



An Electronic Part... ENGINEERED TO A SPECIFIC NEED

This is a special-purpose electronic part. It is a plug-receptacle assembly for use with rack-panel type of mounting. Twenty-four silver-plated phospher-bronze contacts are provided, each male and female contact full floating between steatite plates. Heavy guide pins and matching holes in the frame assure perfect alignment.

We don't know that your product has any need for such a part as this. We do know, however, that this part is most exactly suited to its special requirement, just as are hundreds upon hundreds of other parts which have been created through Lapp engineering and Lapp production facilities directed to the solution of specific problems.

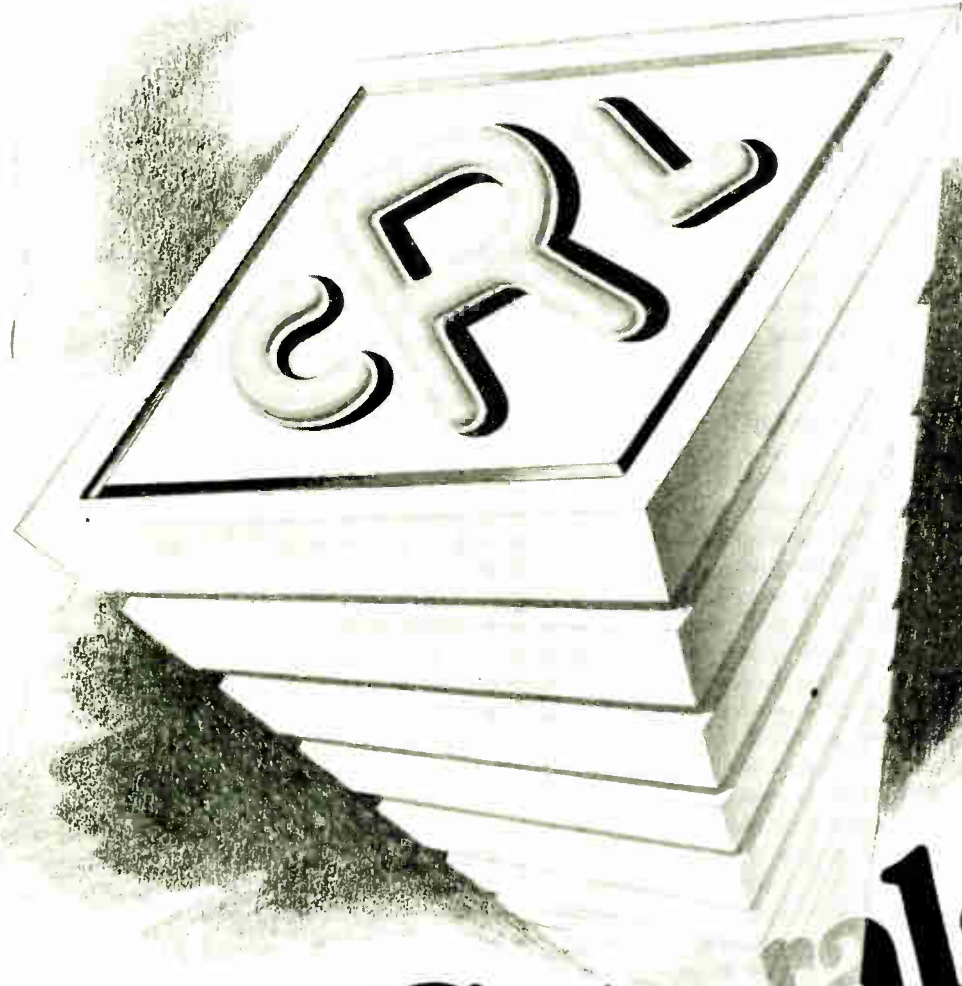
With a broad basic knowledge of ceramics—their capabilities and their limitations—Lapp has been able to simplify and to improve many types of electronic equipment through engineering and production of sub-assemblies that make most efficient use of porcelain or steatite and associated metal parts.

There may be a way you can improve performance, cut costs and cut production time through use of Lapp-designed and Lapp-built sub-assemblies. We'd like to discuss your specific requirements with you.

Lapp Insulator Co., Inc., LeRoy, N. Y.

Lapp

ARMY E NAVY



Centralab

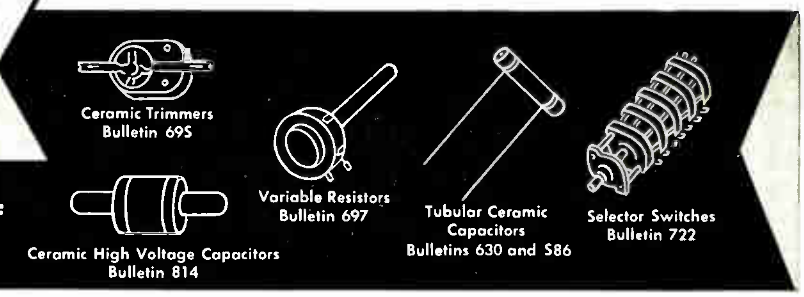
The Mark of QUALITY

The initials "CRL" in the diamond have identified Centralab products for a quarter of a century. Due to new techniques and production procedures, this hallmark of quality will continue to represent the latest developments in components for the electronic field . . . *always specify Centralab.*

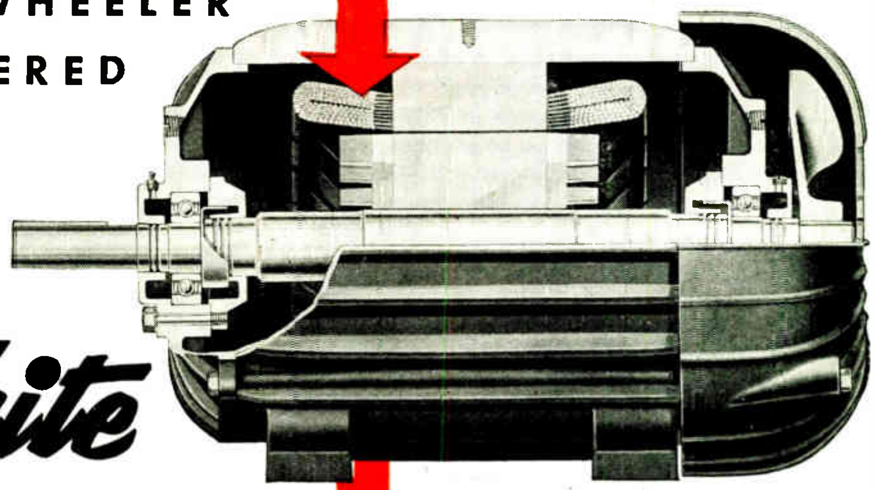
Centralab

Division of GLOBE-UNION INC., Milwaukee

PRODUCERS OF



CROCKER-WHEELER ENGINEERED



Synthite PROTECTED

Dolph's

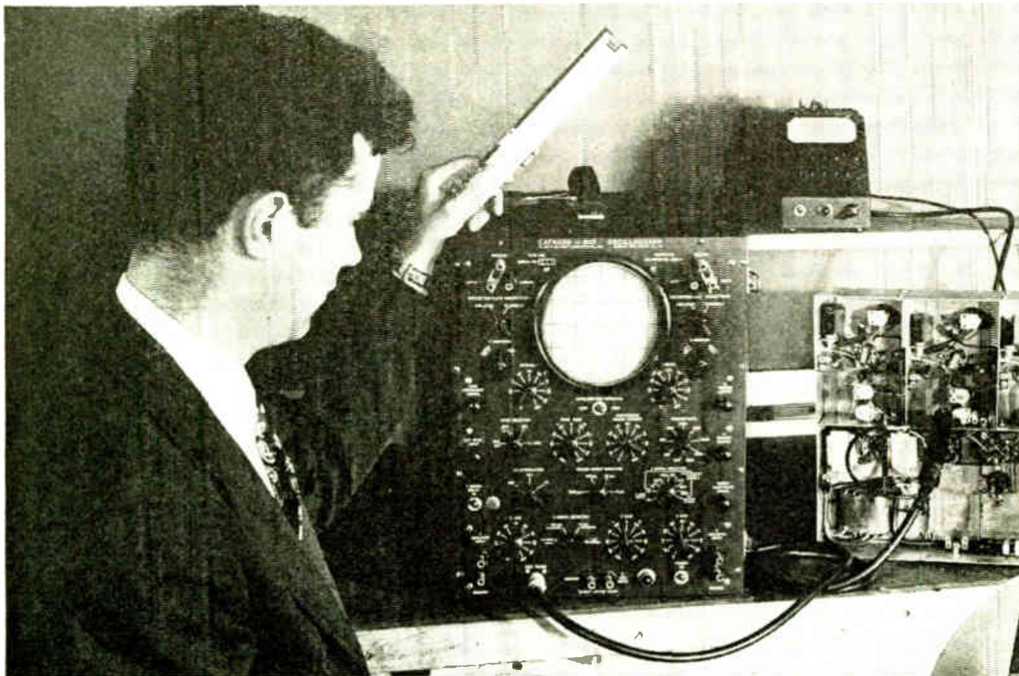
A definite achievement in the electric motor field, this **SEALEDPOWER** Motor (1 to 15 H. P.) incorporates many exceptional features in its design.

One of these features is the impregnation of the windings with a thermosetting varnish to prevent vibration of wires and lengthen the life of the insulation by reducing hot-spot temperatures. Exhaustive tests proved that DOLPH'S "SYNTHITE" afforded all the necessary and exacting requisites needed in an insulating varnish for this application. Don't overlook this important phase of motor design; insure winding protection with DOLPH'S "SYNTHITE".

JOHN C. DOLPH COMPANY

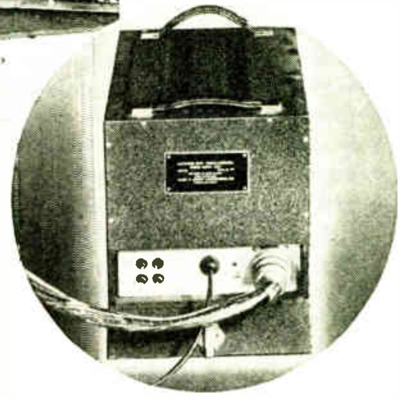
1060 BROAD STREET • NEWARK 2, N. J.

Insulating Varnish Specialists



Left Indicator Unit of Type 248 Oscillograph

Below—Power Supply Unit of Type 248 Oscillograph



PRECISION ACCURACY to the *Microsecond!*

The Du Mont Type 248 Cathode-Ray Oscillograph was developed to meet the need for a precision-measurement instrument of laboratory-standard accuracy . . . an instrument of such outstanding performance and dependability that it has no rival in the commercial field.

If your immediate or long-range program involves pulses, transient response, waveshaping circuits, video amplifiers or any problems which require the unusual combination of a cathode-ray synchroscope and oscillograph, you'll find the Type 248 the perfect answer to all your requirements . . . with accuracy to the MICROSECOND!

THE DU MONT TYPE 248 CATHODE-RAY OSCILLOGRAPH IS NOW AVAILABLE FOR IMMEDIATE DELIVERY! FURTHER INFORMATION IS YOURS FOR THE ASKING.

NOTE THESE UNUSUAL FEATURES

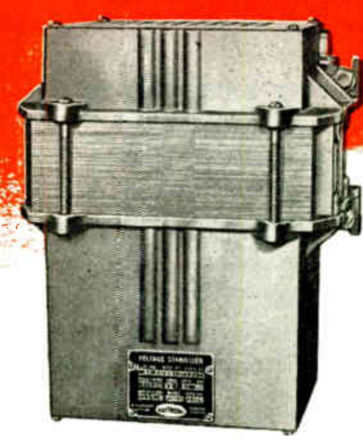
1. Driven or "slave" sweep speeds which exceed one inch per microsecond.
2. Visual display of non-repetitive transients which produce writing rates as fast as three or more inches per microsecond.
3. Better than one-half microsecond signal delay which permits observation of the initial part of a transient or pulse.
4. Self-contained trigger pulse oscillator for synchroscope applications.
5. Internally provided timing markers at 1, 10, and 100 microsecond intervals which may be superimposed upon the observed wave.
6. Separate indicator and power supply units which add to its utility as a portable instrument.

DUMONT *Precision Electronics & Television*

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

BUILD THEM IN

Your Own Equipment



ENDBELL MODEL

Raytheon Voltage Stabilizers

INCREASE SALABILITY!

When you build-in a Raytheon Voltage Stabilizer—or offer it as an accessory—you are adding an effective sales feature to your own equipment.

It stabilizes fluctuating voltage to within ±½%. Thus it improves the operation, boosts performance, steps up the accuracy of wide varieties of electrical equipment.

Inquire. There are three models to suit your installation or design requirements . . . cased, uncased or endbell. And if desired, Raytheon engineers will design special stabilizers to meet the individual requirements of your design. Write for Bulletin DL 48-537.

Get these principal operating advantages:

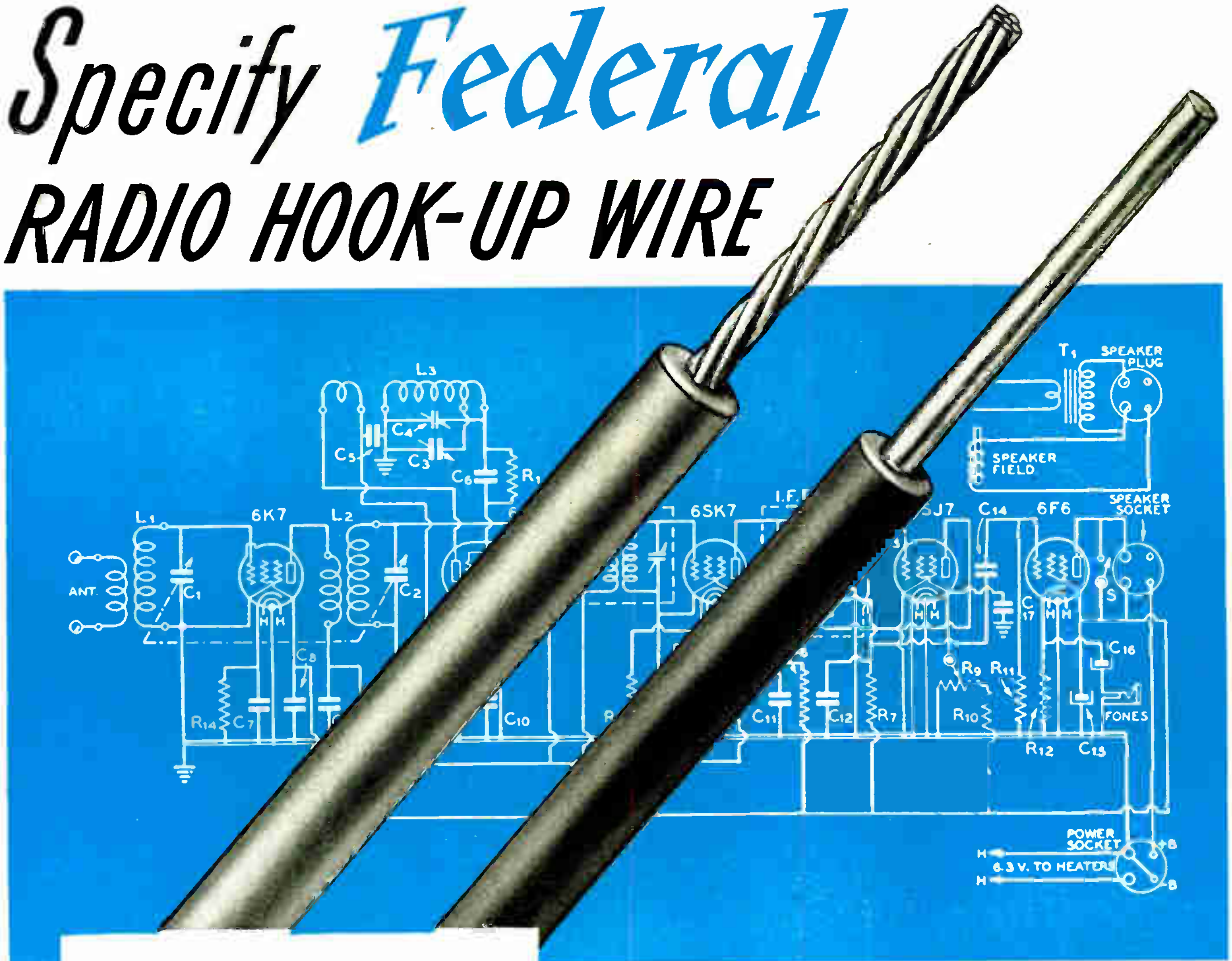
- **Control of output voltage to within ±½%.**
- **Stabilization at any load within rated capacities.**
- **Quick response. Stabilizes varying input voltage within 1/20 second.**
- **Entirely automatic. No adjustments. No moving parts. No maintenance.**

RAYTHEON MANUFACTURING COMPANY
Waltham 54, Mass.
ELECTRICAL EQUIPMENT DIVISION

RAYTHEON

Excellence in Electronics

Specify *Federal* RADIO HOOK-UP WIRE



LONG LIFE

FLAME RESISTANT

LOW MOISTURE ABSORPTION

RESISTS OXIDATION

HIGH DIELECTRIC STRENGTH

WIDE COLOR RANGE

THERMOPLASTIC INSULATION

FOR SUPERIOR QUALITY AND SERVICE

Federal's light-weight, pliable, thermoplastic insulated hook-up wire . . . fitted to your job . . . means better assembly with wire possessing superior dielectric strength and exceptional mechanical stamina.

Resistant to flame, moisture and oxidation . . . this tough but flexible thin-walled thermoplastic insulation covers all Federal's hook-up wire and combats aging, water absorption, abrasion, oils and greases.

Available in solid or stranded types . . . for high or low voltage needs in radio, electronics, appliances, communications, and allied fields . . . these labor-saving light-weight hook-up wires come in 14 brilliant colors and range in size from 24 to 14.

Whether your needs be large or small, get complete details . . . write to Federal now.

Federal Telephone and Radio Corporation

Export Distributor:
International Standard Electric Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

The RAULAND
10" Flat Face, Direct-Viewing Tube . . .

Now Available

This *Rauland* R-6025 is a 10 inch, flat face, direct-viewing electromagnetically focused and deflected tube. All necessity for Ion Trap has been eliminated. Now ready for the industry . . . operating features given at right:

TYPICAL OPERATING CONDITIONS—R-6025

Overall length	17.5"	max.
Heater voltage	6.3	volts
Grid No. 1	45	volts*
Grid No. 2	250	volts
Anode	5000-11000	volts

P4 Screen—7 pin duodecal base

*cut-off voltage

RADIO · RADAR · SOUND **Rauland** COMMUNICATIONS · TELEVISION

Electroneering is our business

THE RAULAND CORPORATION • CHICAGO 41, ILLINOIS

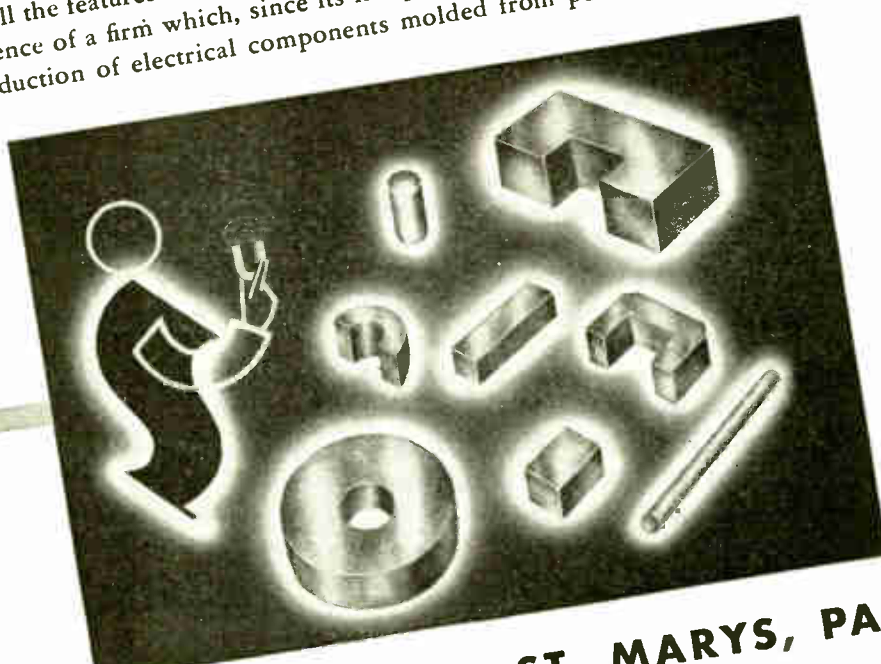
Announcing

STACKPOLE

SINTERED ALNICO II

Real economy for small magnet sizes and odd shapes
Better uniformity characteristics
Greater mechanical strength

Stackpole *sintered* Alnico II offers magnetic properties equal to those of the cast product—and with notable advantages in the production of weights up to two ounces either in standard or in odd shapes. Licensed under G. E. patents, Stackpole sintered Alnico II brings you all the features of a well-known product and the engineering experience of a firm which, since its inception, has specialized in the production of electrical components molded from powders.

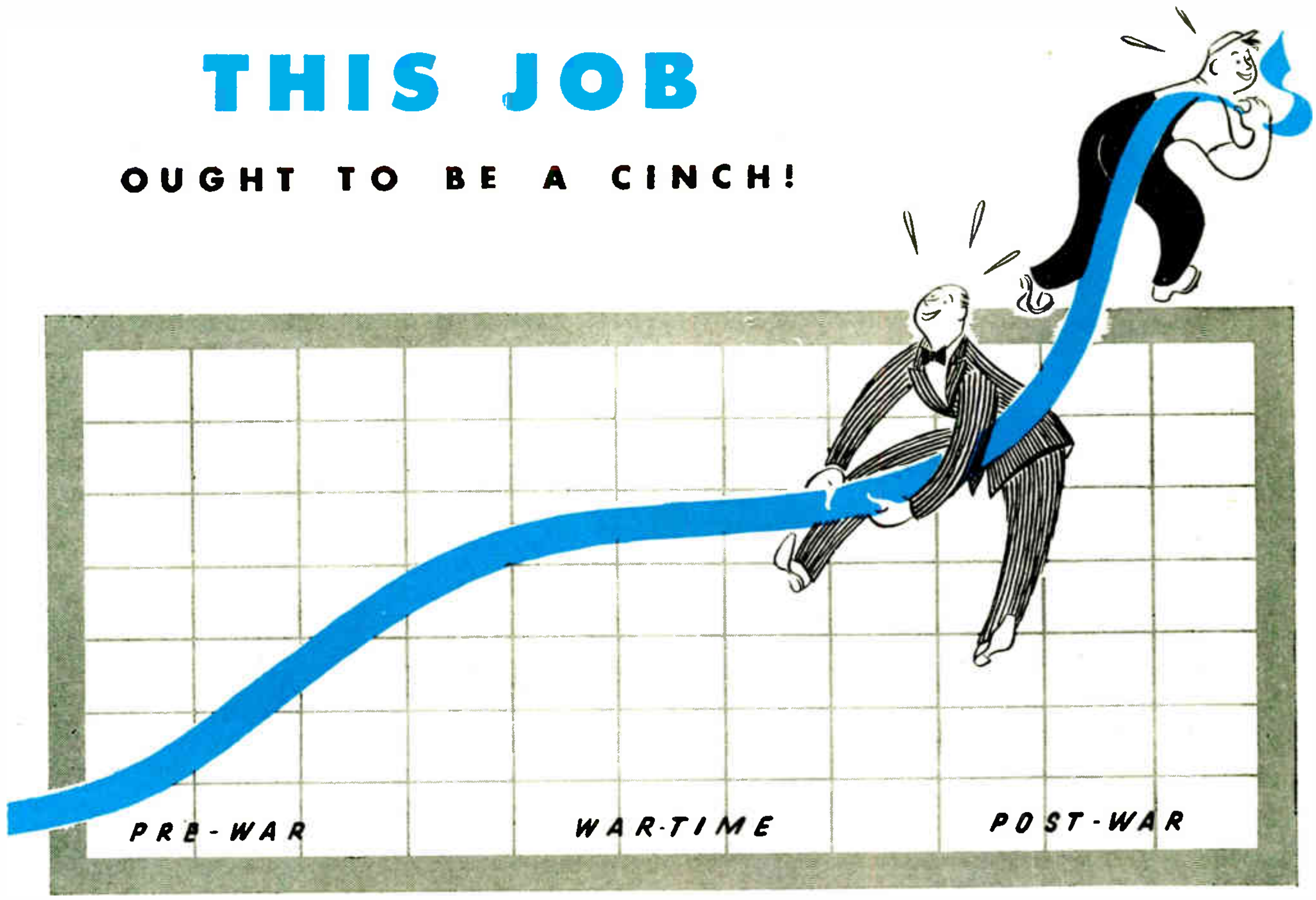


STACKPOLE CARBON COMPANY, ST. MARYS, PA.

BRUSHES and CONTACTS (All carbon, graphite, metal and composition types) • IRON CORES • POWDER METALLURGY COMPONENTS HAVING SPECIAL ELECTRICAL PROPERTIES • RARE METAL CONTACTS • RHEOSTAT PLATES AND DISCS • CARBON PIPE • ANODES AND ELECTRODES, ETC., ETC.

THIS JOB

OUGHT TO BE A CINCH!



Who was it that scared the little Austrian paper hanger to death? Who was it that busted the Bulge? Who was it that brought the son of heaven down off his white horse? Who gets the credit for V-E Day?

Why, the brass hats and G. I. Joe. The financier behind his polished desk. The nation's industrialists who converted their plants into arsenals of war. Labor working three shifts, racing against time. The housewife wrestling with ration stamps. Junior and Little Sister collecting waste paper and tin cans.

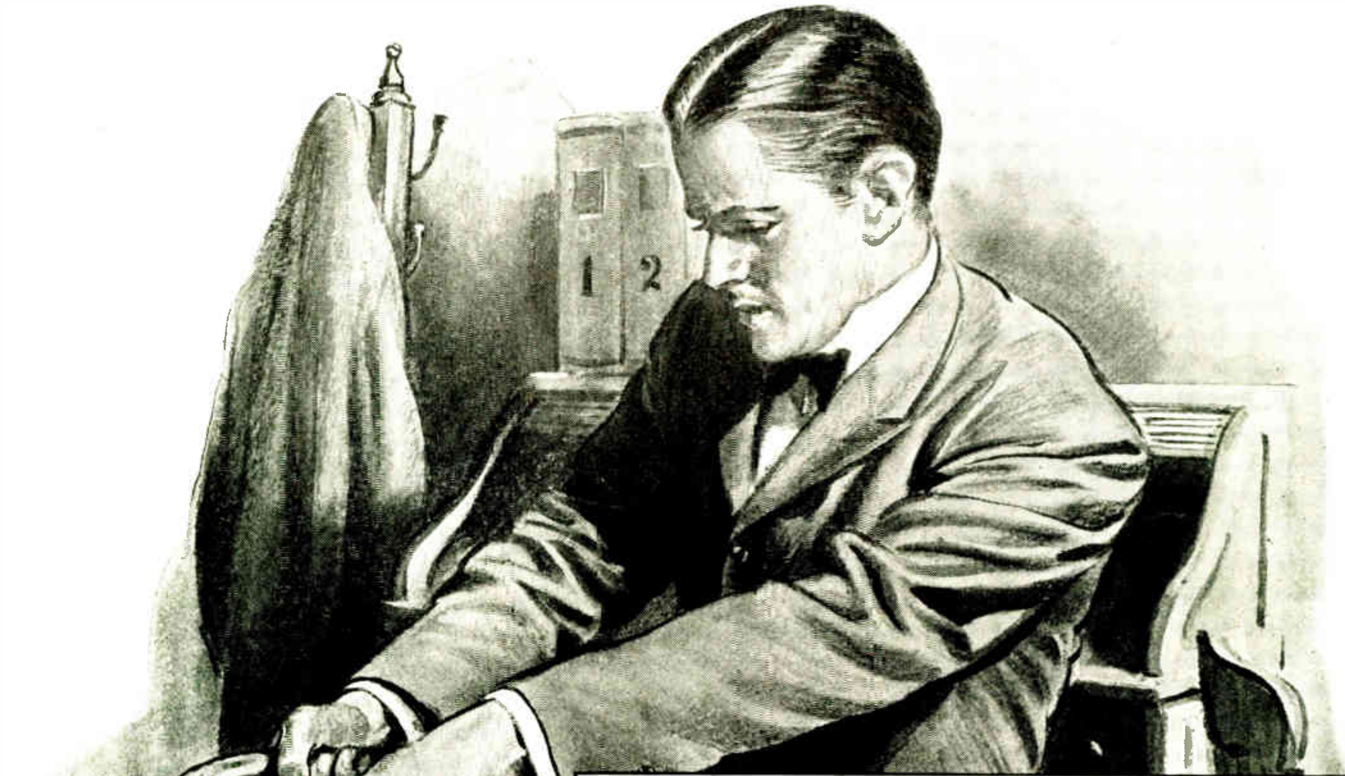
It was all of them — all America working together for a common purpose. It took a war to show us what we could accomplish when we pooled our efforts. It surprised us, and astounded our enemies, the rate we could produce and the way we could fight.

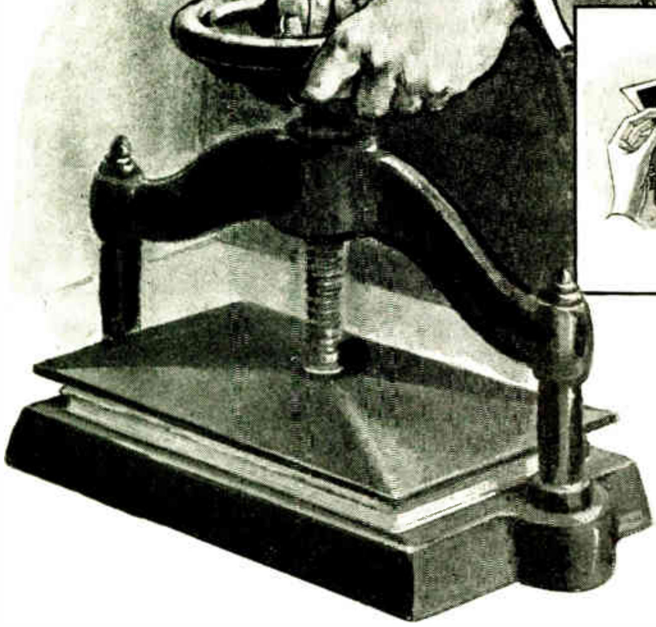
A nation that can do a job like that, can certainly solve its peacetime problems.

• VARIABLE CONDENSERS • ACTUATORS
• TUNING MECHANISMS • RECORD CHANGERS
• AND NOW—SPEAKERS

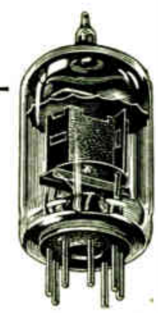
GENERAL INSTRUMENT CORPORATION

829 NEWARK AVENUE • ELIZABETH 3, N. J.





more efficient ...in miniature



ACTUAL SIZE

Many oldsters still remember the old letter copying press and long hours spent in dim light after other office workers had gone to their homes. While carbon paper was indeed an emancipator of office boys, it is but another example of the trend to greater efficiency in miniature.

And so it is with TUNG-SOL Miniature Electronic Tubes. The large type tube did do a job. But today, especially in high frequency circuits, TUNG-SOL Miniatures do a more efficient job. The shorter leads on the Miniature make for low lead inductance, low inter-element capacities, and high mutual conductance.

The smaller and lighter parts make possible a rigid construction that is more impervious to the effects of shock and vibration. The size of the Miniature makes it a factor in reducing the overall size of radio equipment.

The manufacturer who wants his equipment to be "modern" must consider the use of Miniatures. TUNG-SOL Engineers will gladly work with you in planning circuits and in selecting tubes with the sole objective of making your equipment as efficient as possible. Your confidences will be strictly respected.

TUNG-SOL

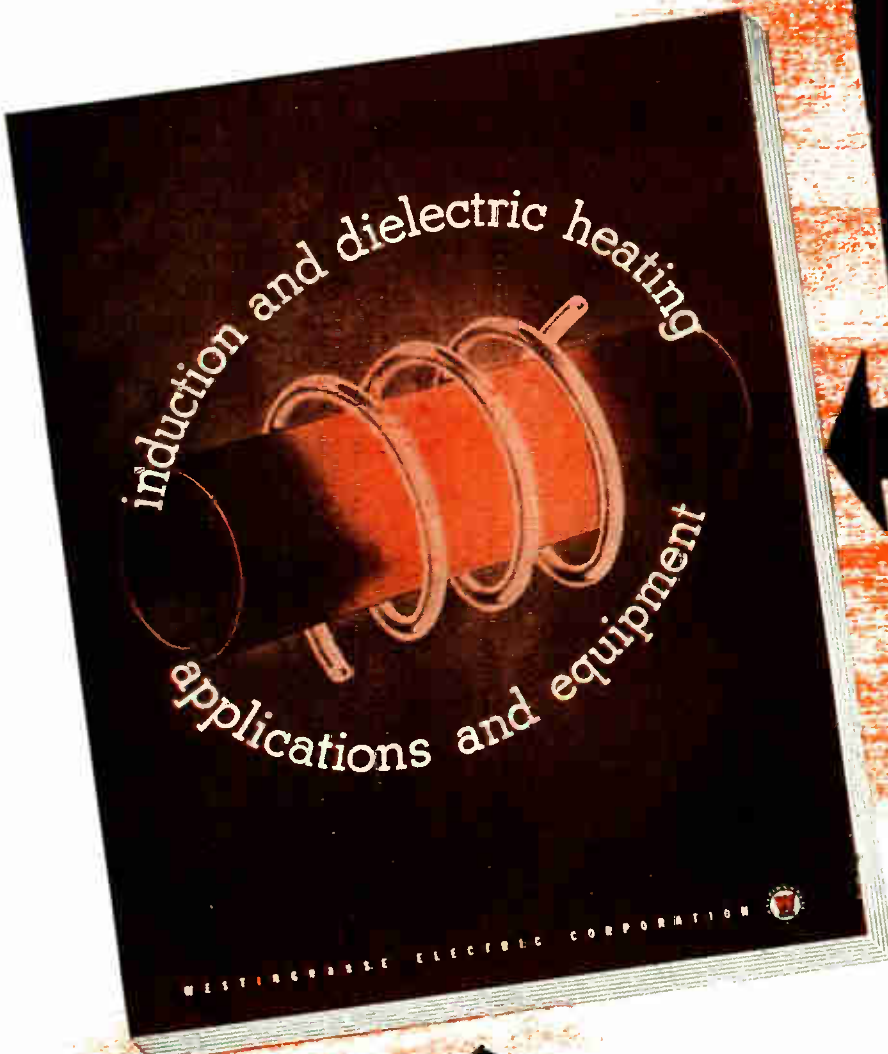
vibration-tested

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



How do induction and dielectric heating work?

What are their advantages and limitations?

Where can you use them?

How do r. f. generators compare with motor-generator and spark gap units?

Now you can get the facts with this new book

The answers are all here in this new fact-packed book by Westinghouse . . . including full-color illustrations and 14 case histories of induction and dielectric heating . . . brazing, annealing, hardening, soldering, plastic molding, rubber curing, plywood bonding. Write today for your copy on your business letterhead, please. Ask for B-3620. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-08161

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

It's no trick to get *precious metal performance at a cost slightly higher than base metals* . . . not if you use General Plate Laminated Metals.

These versatile metals . . . in sheet, wire or tube form . . . are combinations of precious metals to base metals . . . permanently bonded together. The thin layer of precious metal gives the precious metal performance requirements such as better electrical conductivity or corrosion resistance — the heavier base metal permits low cost plus workability and extra strength.

Laminated base metals, also available, give you performance and mechanical and structural properties not found in single solid metals.

Look into General Plate Laminated Metals. Our engineers will gladly show you how you can benefit by their performance and cost-cutting advantages. Write for information and engineering assistance today.

Check these General Plate Laminated Metal advantages:

- √ Economy
- √ Better Electrical Performance
- √ High Corrosion Resistance
- √ Ease of Fabrication
- √ Ease of Soldering
- √ Workability
- √ Long Life

GENERAL PLATE DIVISION

of Metals and Controls Corporation

50 Church St., New York, N. Y.; 205 W. Wacker Drive, Chicago, Ill.; 2635 Page Drive, Altadena, California Grant Bldg., Pittsburgh, Pa.

Attleboro, Massachusetts

PLEASE NOTE!

80%

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I.R.E. WINTER TECHNICAL MEETING

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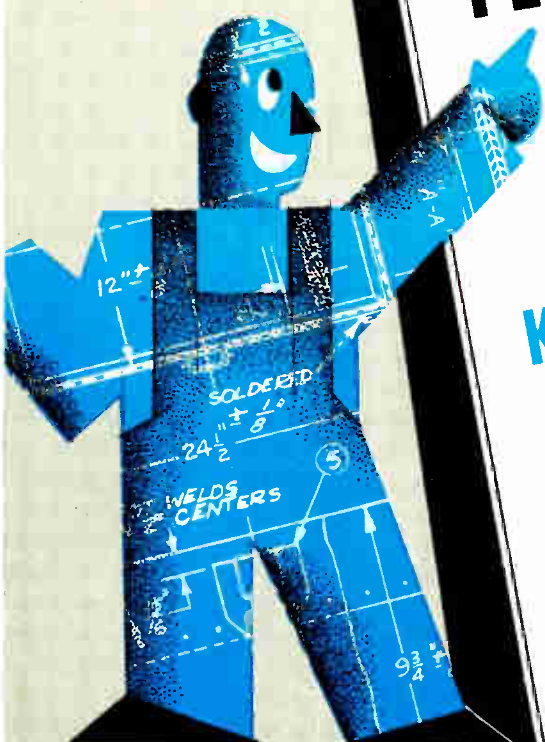

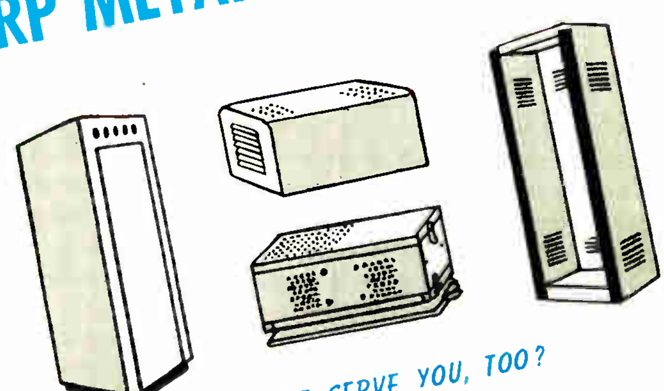

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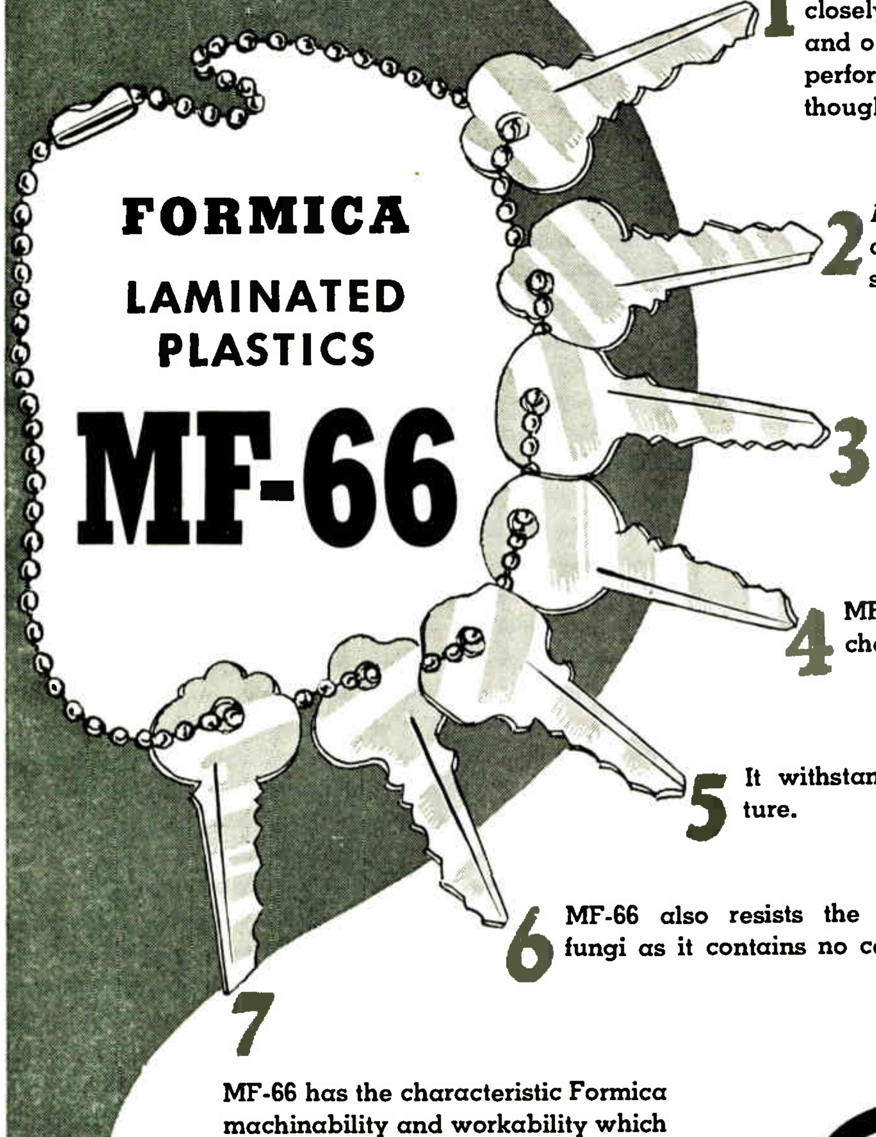

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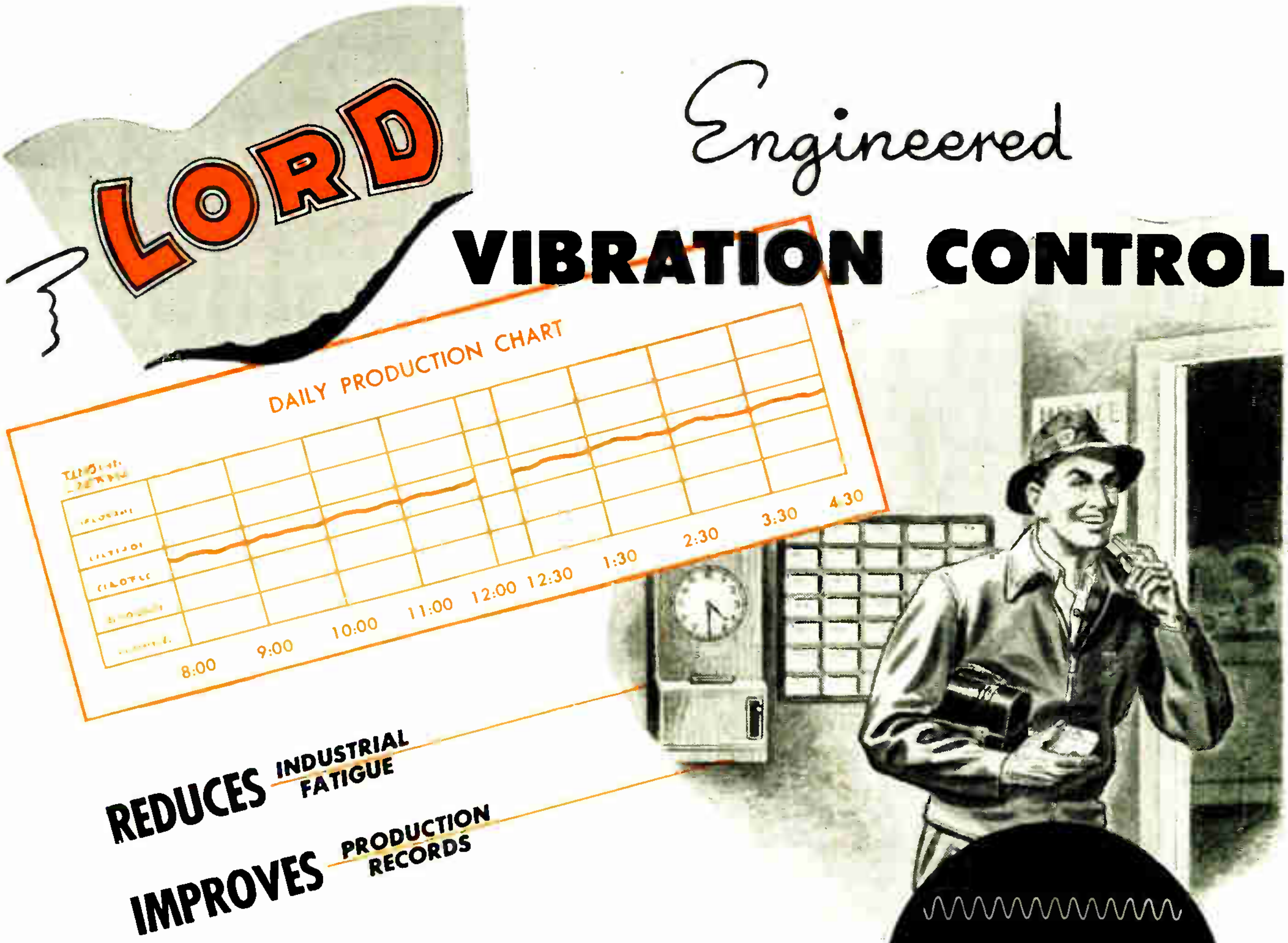

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SHEAR TYPE
Bonded Rubber
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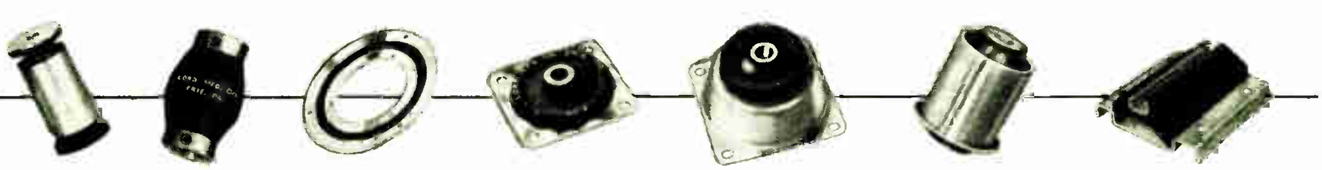
Every genuine Lord Mounting carries the name "LORD" embossed in the rubber or in raised letters on the forgings.



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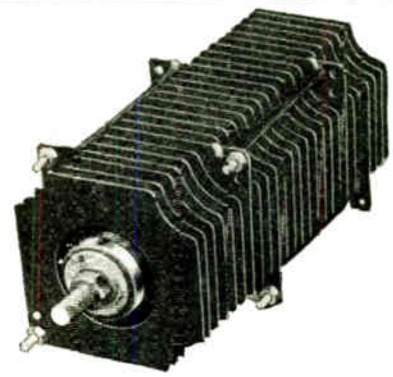
CHOOSE G-E LOW-VOLTAGE RECTIFIERS

Place your postwar products in a superior class of their own by equipping them with G-E low-voltage rectifiers. There are copper-oxide, selenium or Tungar types and sizes for practically all d-c applications. This makes it possible for manufacturers to design and build their products around the rectifier that is sure to deliver the most efficient, most dependable and most economical performance.

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 rectifiers 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 A3611-124, 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.

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GENERAL ELECTRIC

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FM

Collins FM research, begun long before the war, went into high gear immediately following VJ day. An intensive engineering program is developing a series of FM transmitters to cover the power range of 250 watts to 50,000 watts.

These transmitters will be available, beginning with the 250 watt type 731A in midyear, 1946, and the 1000 watt type 732A soon thereafter. 3, 10, 25, and 50 kw transmitters are scheduled to follow in rapid succession.

With typical Collins thoroughness, these FM transmitters are designed to specifications well within FCC and RMA requirements and recommendations.

Notable achievements in circuit design assure efficient and dependable operation. Power output can be increased as desired, with a minimum of changes. The styling is attractively modern, and will blend well with up-to-date station layout.

Collins is prepared to supply your FM transmitter and all accessories. Our engineering staff is available at all times for consultation, and will assist you in effecting early installation and operation. Write today.

Collins Radio Company

Cedar Rapids, Iowa

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FOR BROADCAST QUALITY, IT'S . . . . COLLINS

ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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

Engineering vs Sales Costs

It is time radio engineers looked more closely into the marketing methods by which their products pass to the consumer, a well-known manufacturing executive reminds us:

"Engineers devotedly work their slide rules and compute costs down to fractions of a decimal point. They apply every economy that technical ingenuity and resourcefulness can devise.

"But when the product goes to the average sales department, nobody knows—or can tell within 20 or 30 per cent—what the final costs of distribution will be for the same product that has been factory-cost-analyzed down to a hair. Through faulty sales policies or misjudging of the market, we may toss away a hundred times all the patient savings of the engineering department and factory, because market determination has not yet been put on an equivalent basis of engineering and sound knowledge."

Let's Put Color-TV to the Test

CBS in recent weeks has achieved some striking demonstrations of uhf color-television. All credit to its engineers in pioneering this new field of great promise. Hundreds who witnessed these New York presentations agree that color, when available as there shown, will tremendously increase the public's demand for TV sets.

If color-television on 490 mc, rich in detail and free of ghosts, is everything that its adherents promise for it, we would like to see a practical color-video broadcast operation carried out in some metropolitan center, without delay,—even without waiting for the industry to pow-wow and standardize. Much would be learned by all hands.

An Experiment in Public

If, say, CBS will broadcast color-television programs from its Chrysler Tower antenna several times weekly, we are sure hundreds of engineers, experimenters, and hams would quickly join in the experiment with sets of their own construction. Color telesets could possibly be supplied by local custom-builders at around $500, for laymen willing to participate. Such public experimentation would produce the answers to many questions that now bother both engineers and business executives.

And even the public, we suspect, would be quick to observe, compare, and buy—or try to buy!

Let's put color-tele to a practical public test without delay.

Keeping Things Constant

Much of the problem of delivering electrical power is in keeping the voltage constant. Of late it has been shown that tubes, making use of electrons "freed from the bondage of wires", can do a better job than can manual control at the switchboard!!

As a result, constant voltage—with its equally important brothers, constant frequency, constant speed, constant temperature, and constant-everything-else-you-can-think-of—have opened doors to countless new industries, products and jobs, so that many times the number of manual switch-throwers displaced, now have more interesting and better-paying positions. And today the power engineer deals with electronic equipment many times more complicated than the old switches and capable of doing jobs that the best of switches and the best and quickest operators could manual control at the switchboard.

New Possibilities of Control

Keeping things constant is only one effect that an electron tube can handle. Many farsighted engineers have noted that for the majority of situations, nonlinear control would be even better. Here, again, electron tubes have taken over, in jobs where human control would not be effective.

A motor driving a lathe might better have its speed controlled according to the load, delivering maximum speed consistent with its own capabilities, the heating up of the work, or the strains on the tool, so as to get most work done per hour.

A chemical mixing machine might have its temperature controlled in accordance with some intricate set of conditions inherent with the mixture.

In applications like these, electronic control performs functions no human could ever undertake.

Month After Next, Watch for Electronic Industries'

May Marketing and Directory Number

Marking the 1946 Radio Electronic Parts Trade Show, Hotel Stevens, Chicago, May 13-16

NETWORK DESIGN USING

By RICHARD W. KENYON
Electronic Industries

Relationship of function theory to potential theory simplifies design of electronic networks for television

● Gain and phase characteristics of wide or narrow band amplifiers may be obtained by use of an electrolytic tank which simulates the complex plane. This method was discovered during practical work in the design of television receivers by the Philco Radio & Television Co., between 1938 and 1941. It provided the first completely general design method of compensated multi-stage amplifiers. Tedious mathematics and experimentation have been eliminated, once the scalar quantities of the tank are established.

The complex plane tank representation is used because it bridges the gap between electrostatics and function theory. In the most elementary sense, tuned circuits have points of resonance and anti-resonance wihch are known as zeros and poles, respectively. The gain of an amplifier as a function of frequency may be handled very simply, when the complex variable solution is considered.

Mathematically speaking, every amplifier has specific complex frequencies at which the gain is infinity, and other complex frequencies at which the gain is zero. The subject of complex variables is not commonly known to engineers. An important fact of this form of mathematics is that a function is completely determined if the values of the variables which cause the function to be infinite, or zero, and one specific value of the function are known. It is possible in the complex plane electrolytic tank, to locate these poles and zeros which control the shape of a frequency-gain curve.

Relationship between electrostatics and function theory may be shown by considering a parallel resonant circuit. The admittance from A to B is the sum of the branch admittances:

$$Y = j\omega C + \frac{1}{j\omega L} + G \qquad (1)$$

The voltage across A B is:

$$E = \frac{I}{Y} = \frac{I}{\lambda C + \frac{1}{\lambda L} + G}$$

$$Z = \frac{E}{I} = \frac{\lambda}{C\left(\lambda^2 + \frac{1}{CL} + \frac{\lambda G}{C}\right)} \qquad (2)$$

Solving the denominator quadratic for:

$$\lambda_{o,p} = -\frac{G}{2C} \pm \sqrt{\left(\frac{G}{2C}\right)^2 - \frac{1}{LC}}$$

$$= -\frac{G}{2C} \pm j\sqrt{\omega_o^2 - \left(\frac{G}{2C}\right)^2} \qquad (3)$$

$$= -\frac{\omega_o}{2Q} \pm j\sqrt{\omega_o^2 - \frac{\omega_o^2}{4Q^2}}$$

$$\lambda_{o,p} = -\frac{\omega_o}{2Q} \pm j\omega\sqrt{1 - \frac{1}{4Q^2}} \qquad (4)$$

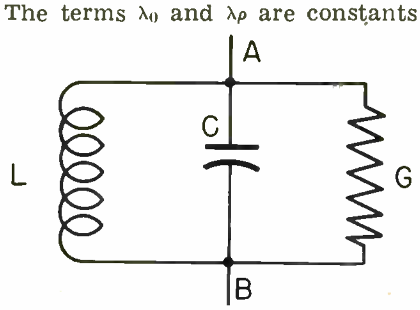
Two solutions are thus indicated.

The apparent fact that a parallel tuned resonant circuit has two poles has an interesting basis. An angular velocity may be represented by two oppositely rotating vectors whose sum is at all times equal to the cosine of the angular displacement. This may be shown by the well-known relation:

$$\cos \omega t = \frac{1}{2}\left(e^{j\omega t} + e^{-j\omega t}\right)$$

Usually the imaginary term is neglected. In complex variables, however, this term is included, and represents the second portion of the above solution.

These components of λ_o, ρ are then plotted on the complex plane. The terms λ_o and λ_ρ are constants



depending only on the "R, L, C's" of the network.

Equation 2 may be written as:

$$Z = \frac{\lambda}{C(\lambda - \lambda_o)(\lambda - \lambda_p)} \qquad (5)$$

This is in the form of the typical gain function equation:

$$A_{(\lambda)} = H\frac{(\lambda - \lambda_{o1})(\lambda - \lambda_{o2})}{(\lambda - \lambda_{p1})(\lambda - \lambda_{p1})} \qquad (6)$$

in which A is the gain, H is a constant not involving λ and $\lambda = jw$. The terms λ_{01}, λ_{02} represent zeros, while $\lambda_{\rho1}$ and $\lambda_{\rho2}$ are poles. Equation 6 shows that the product of the pole distances to the center frequency is inversely proportional to amplifier gain.

Pole and zero location

Either component or systems problems can be solved by the utilization of pole patterns. The set-up arranged in Fig. 2 is for either a double-tuned circuit or two single-tuned stages. Component pole arrangement is shown in Fig. 1, while the complete system is illustrated in Fig. 5.

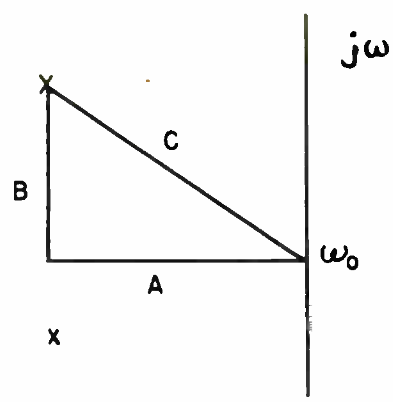


Fig. 1—Pole location coordinates

The position of the poles controls the circuit components. Distance from the jω axis represents the circuit damping. Distance measured along the jω axis is adjusted by circuit tuning constants. Real and

ELECTROLYTIC TANKS

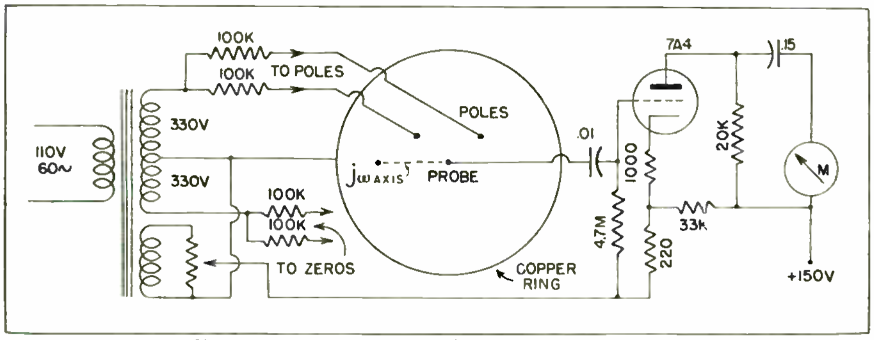


Fig. 2—Experimental set-up for electrolytic exploration

imaginary parts of λ are plotted as indicated in Fig. 1.

In a double-tuned transformer when $Q_{11} = Q_{22}$, and $\omega_{11} = \omega_{22} = \omega_o$, the coordinates have the following values: $A = \frac{\omega_o}{2Q}$, $B = \pm\frac{\omega_o K}{2}$ in which K is the coefficient of coupling. As a generalized pattern, the poles may be arranged in a line parallel to the jω axis. This form will give a good phase response. Adjustment of distance A will determine the desired circuit Q.

Basic values for pole location are as follows:

When $Q_{11} = Q_{22}$ and $W_{11} = W_{22} = W_o$

$$A = \frac{\omega_o}{2Q} \qquad B = \frac{\omega_o k}{2}$$

When $Q_{11} \neq Q_{22}$ and $W_{11} = W_{22} = W_o$

$$A = \frac{\omega_o}{4Q_{11}} \qquad B = \frac{\omega_o k}{2}$$

When $Q_{11} = Q_{22}$ but $W_{11} \neq W_{22}$

$$A = \frac{\omega_o}{2Q_{11}} \qquad B = \sqrt{\left(\frac{\omega_o k}{2}\right)^2 + \left(\frac{\omega_{11} - \omega_{22}}{2}\right)^2}$$

The dimensions A and B refer to Fig. 1.

A circle drawn of unit radius is shown in Fig. 4. Grouping in this circuit would represent either six single-tuned stages or three double-tuned stages. Final choice of the single or double transformer would resolve itself into the dimensions assigned to A and B. Experimental patterns of ellipses about the jω axis give favorable results. Relationship between gain, phase, and frequency is shown in Fig. 3. A zero may be introduced into the tank by connecting the opposite phase to an electrode. Zeros may be considered to be wave traps.

Gain-frequency plot

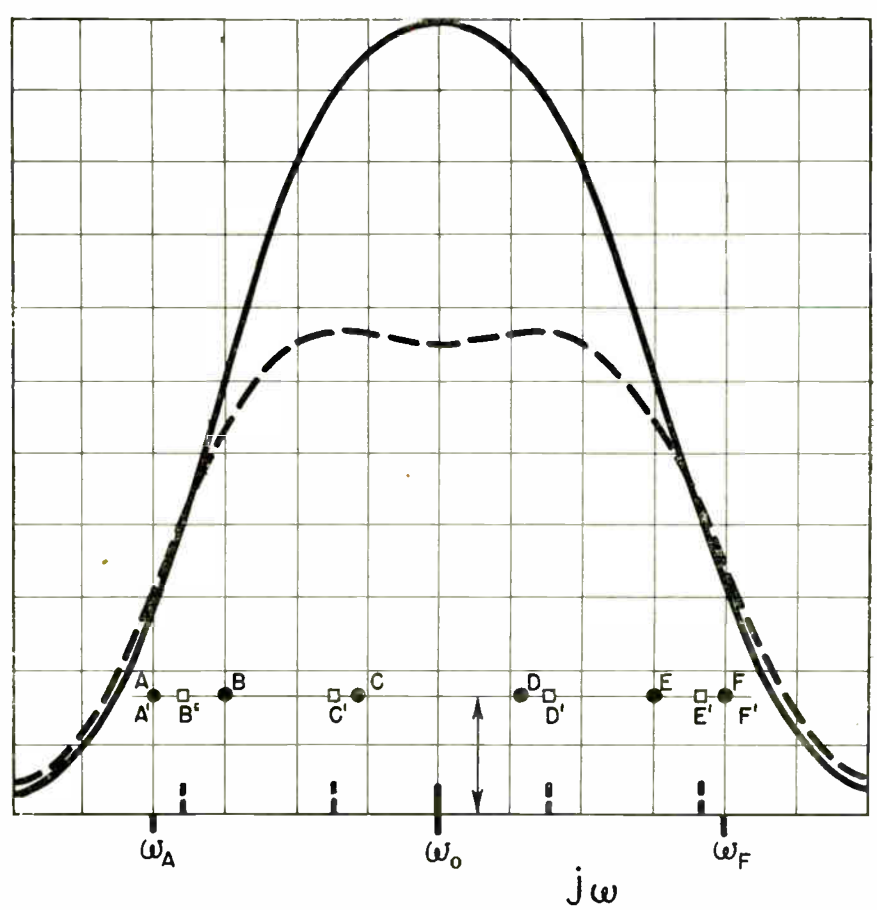
In operation, the probe electrode and associated VTVM read directly the gain of the amplifier (Fig. 2). The probe is moved along the jω axis, and voltages are recorded at frequency intervals. A gain-frequency curve for the network is the result. If the probe is set at a given frequency and then moved a unit distance perpendicular to the jω axis in the direction of the poles, an indication of the slope of the phase shift curve results. The voltage change recorded is a measure of the slope of the phase-frequency response curve. Since this information is more useful than the phase curve itself, the engineer has all the necessary amplifier design data.

It can be seen in Fig. 5 that if six poles are located at A, B, C, D, E, F, a high gain will result. Shifting poles to B', C', D', and E', causes the gain-frequency curve to broaden. This is attributed to the change in individual resonant frequencies and coefficient of couplings.

Scalar values of the results are easily obtained since the jω axis is plotted in frequency and the real axis is also a function of frequency. The voltage readings between points are therefore percentages of frequency, hence, unknown quantities can be determined.

The method outlined indicates the pole placement procedure. Thin brass rods are used as the simulated poles and zeros. As seen in Fig. 2, the poles are connected to one end of the transformer while the zeros

Fig. 5—Relationship of gain-frequency curve to pole position



Potential gradients are formed by the introduction of voltages applied to brass electrodes in an electrolytic tank. Exploration of these gradients can determine the circuit constants of any network, by relating function theory to potential theory.

The method is helpful in tying down specifications and estimating the effect of small capacitance variations. In addition it affords interesting information regarding production alignment methods.

Basically the method consists of dividing the design problem into two parts: first, the arranging of poles and zeros of the gain function of the amplifier to produce the desired type of frequency response, and second, the choice and design of individual interstage coupling networks to build up as efficiently as possible the chosen arrangement of poles and zeros. Each of these two sub-problems is readily solved although each has its special technique.

Ordinarily, an engineer has only to look through a "scrap-book" of pole patterns until he finds the nearest to the solution he desires and then, with a little experimentation with a large piece of graph paper and a slide rule, finds one exactly fitting his requirements as to shape of frequency response, attenuation outside the band, linearity of phase shift, etc.

When the placement of poles and zeros is decided, the engineer next consults a table of design data and chooses the most efficient or economical allocation of poles and zeros to the individual stages and also the detailed design of each stage. He ends up with curves showing the frequency response of each stage, knowledge of the correct Q as well as the resonant frequency of each tuned circuit, and curves of overall phase and amplitude characteristics. He also has the assurance that he has an optimum design in the sense that no other adjustment of the same tuned circuits could be better than that chosen with respect to gain and fidelity.

are connected to the other end. Ordinary tap water usually has sufficient mineral content for current conduction. Typical currents are 2.5 ma. Probe exploration along the $j\omega$ axis, will give the gain-frequency curve. Indication on the calibrated meter is directly in DB.

Merit of method

A further analogy between the electrolytic tank and radio networks is seen in the fact that the current flow surrounding the poles is uniform. Similarity to a network driven by a constant current generator is readily seen. One of the interesting by-products of this method was the discovery that two multi-stage amplifiers may have the same stage band width and amplitude characteristics and transient performance with identical tube circuit capacity and yet have very different gain from the same number of stages.

This important fact adds significance to the design system here presented because of the means it affords systematically choosing the most efficient design for a given set of requirements. The experimental method has so many degrees of freedom that there is always the question of whether or not the solution finally arrived at is optimum. The electrolytic tank method is conclusive.

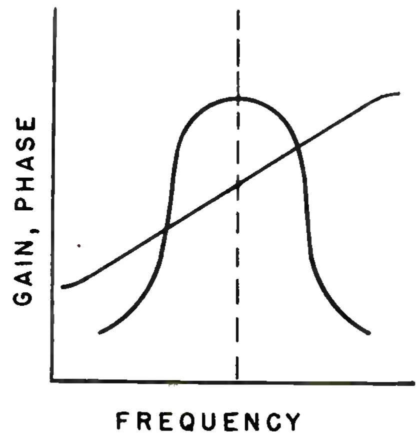


Fig. 3—Typical gain, phase curve

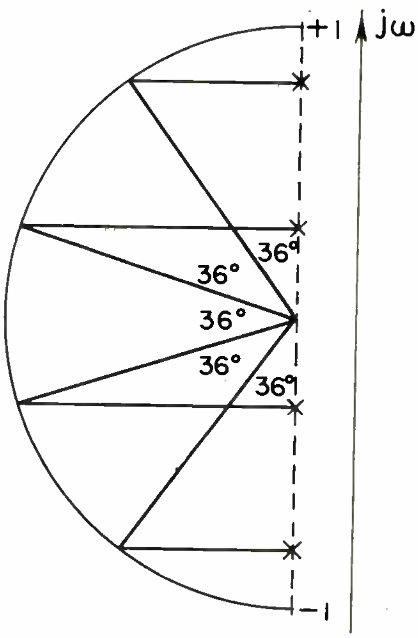


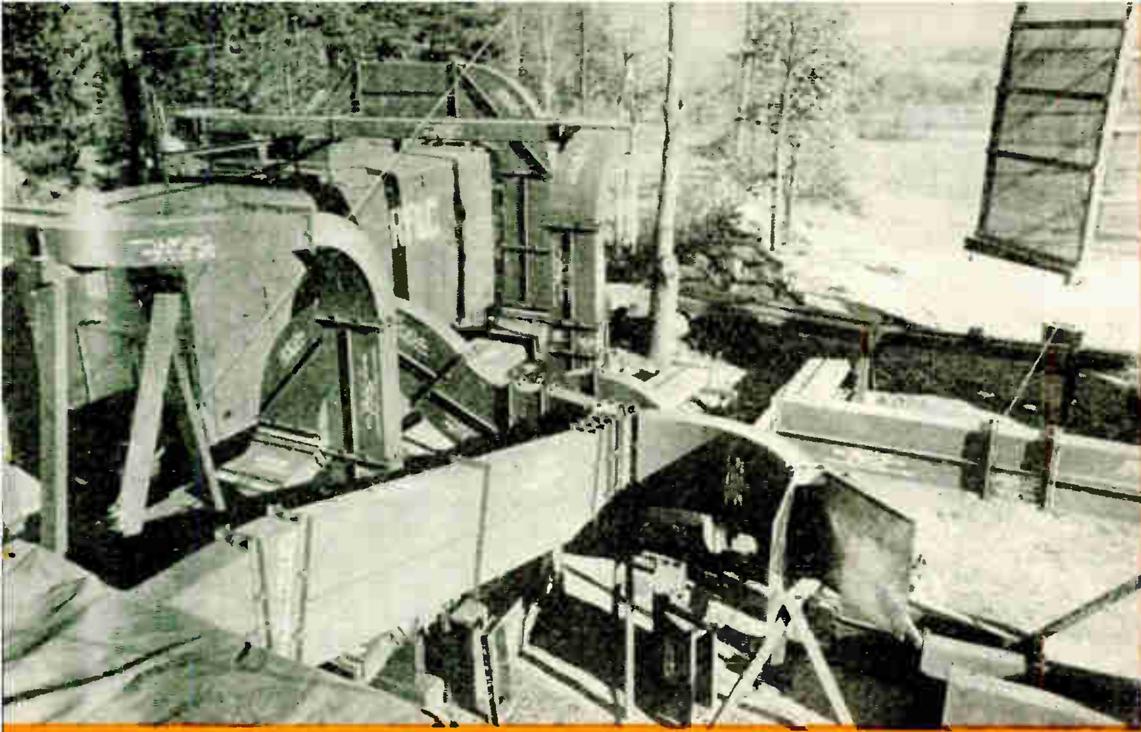
Fig. 4—Pole position circle

"NAVAR" AND "NAVAGLOBE" PROPOSED FOR AIRPLANE NAVIGATION

A new system of traffic control and navigation along airways called "Navar"—a contraction of Navigation and Radar—has been proposed to the War Department, Headquarters of the Army Air Forces, by Henri Busignies, director of the Laboratories of the Federal Telephone and Radio Corp. Coupled with this presentation was another —"Navaglobe"—a world-wide system of long range radio beacons for aircraft, strategically located around the earth.

As described, the "Navar" system would project an electronic "moving picture" on a chart in a given airport control center, showing the exact location and identity of every plane in the sky within eighty miles of the airport. In addition to the constantly moving Radar picture in the ground-based control room, the pilot of a Navar-equipped plane will see on his own scope his own and all other aircraft near his position and altitude, in relation both to each other and the ground.

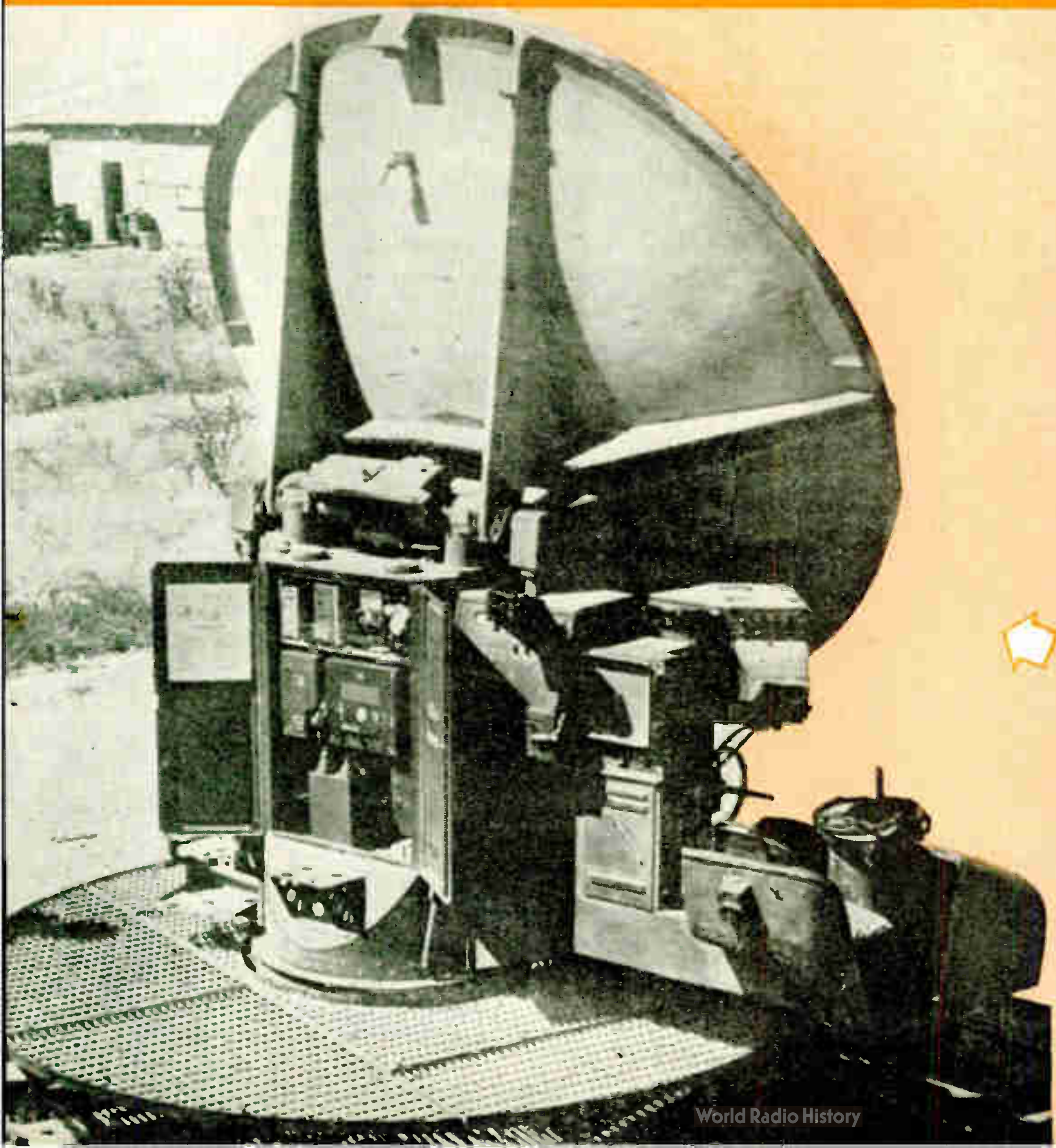
Navaglobe is a perfected application of present and long-proven technics of aerial radio navigation. The system would require 58 Navaglobe radio beacons to provide unbroken long-range airways for the entire ocean area of the earth, and 75 including continents.



Waveguide feed system for the antenna of the giant "Tuba" jammer. Is 1,000 times as powerful as previous jammers in this frequency range. Electronic system uses resnatron tetrode tunable over wide frequency range, modulated by random noise. Output power is approximately 50 kw, at typical operating frequency of 1,500 mc. Experimental model used huge parabolic antenna called "Tuba" to distinguish it from smaller "Piccolo," "Flute," etc. Resnatron tube was developed by NDRC under Signal Corps sponsorship.

RADAR COUNTERMEASURES

High power developed continuously at high frequencies by resnatron greatly reduces effectiveness of enemy equipment



Captured German "Wurzburg" anti-aircraft fire-control radar operated at 25% effectiveness because of jamming and "window". Mainstay of Nazi anti-aircraft fire control system at night and on overcast days, these radars represented billion-dollar investment. Tracking precision of "Wurzburg" radar is equal to optical precision, and 4,000 were in use in 1945; each requires ten operators. When "window" was dropped in 1943 over Hamburg, radar operators exclaimed, "The planes are doubling themselves!" In October 1943, "window" was followed by "carpet", electronic jammer carried one to a plane. Nazis countered with anti-jamming measures: shifted operating frequency of "Wurzburgs", built gadgets to distinguish between moving and stationary targets. Ninety percent of Nazi UHF engineers were working on anti-jamming projects at end of 1944, by German estimates. Prize of 700,000 Reichsmarks was offered for best anti-window device.

IRE WINTER TECHNICAL

Over 80 engineering papers discussed by record attendance as engineering exhibits of 135 manufacturers fill two floors

• Nothing but superlatives will do for the 1946 Winter Technical Meeting of the Institute of Radio Engineers. It was the largest gathering ever held, with registration slightly over 7000 which compares with some 3000-odd last year (total membership is in the neighborhood of 16,000); there were 2200 at the thirty-fourth anniversary banquet; 135 manufacturers jam-packed two floors of the hotel with 170 exhibits of electronic equipment, parts, complete transmitters; over 80 technical papers filled three meeting rooms simultaneously during the four days, January 23-26 IRE virtually took over the Hotel Astor in New York, with exhibits overflowing into other hotels.

Officially the meetings opened with a joint session participated in by members of the American Institute of Electrical Engineers and the IRE. Major General Leslie R. Groves addressed the session and talked about "Some Electrical, Engineering and General Aspects of the Atomic Bomb Project". Among matters of routine business IRE presented the Morris Liebmann Memorial Prize to Dr. Peter C. Goldmark, CBS's television expert, and the Institute's Medal of Honor to Ralph Vinton Lyon Hartley of Bell labs; awarded fellowships to 15 members: Gregory Breit, Walter C. Evans, Ronald J. Rockwell, Merle Anthony Tuve, Clarence W. Hansell, Arthur H. Samuel, Henri G. Busignies, Harold L. Kirke, Joseph Slepian, Howard A. Chinn, Elmer D. McArthur, William O. Swinyard, Thomas L. Eckersley, Harold S. Osborn and Julius Stratton.

BRIEFING THE IRE WINTER TECHNICAL MEETING PAPERS

TELEVISION

STUDIO EQUIPMENT

James J. Reeves and Peter C. Goldmark
Columbia Broadcasting System

The first portion of the technical session on television was devoted to a description of the recently-installed television transmitter using the 480-500 megacycle transmission band, and other transmitters and associated equipment being experimented with by the CBS group. The transmitter is the most powerful design for this frequency and bandwidth. The subject was introduced by Goldmark who described the problems involved in the development of the transmitter utilizing these frequencies and gave a brief survey of the results of recent tests, including experiments on color. The tests created much enthusiasm among the engineers who conducted them, by reason of the coverage of the transmitter and the freedom from ghost images experienced at receiver locations in the Metropolitan area. In regard to the design of the camera and studio control room equipment used in this system, described by Reeves, the arrangement was shown to be versatile, and will permit transmission of high definition television using the 525 line standards, now in use, as well as 1,029 line black and white images, or high definition color television.

The Federal type 6C22 tube which found use in CBS transmitter the setup of which is shown in block form on opposite page

COMBINED SIGHT AND SOUND

Kurt Schlesinger
Columbia Broadcasting System

This paper concerned the details of the method of combining sight and sound programs on a single carrier. Following a description of the various forms of multiplex modulation that are possible, pulse frequency modulation used in these experiments was described. Here, a 7.8 mc modulation signal was frequency modulated ±600 kc. These modulated pulses appear during the flyback intervals between horizontal scans. A detailed discussion of the transmitter and receiver circuits indicated that some economy results in both cases. Tests have indicated that the method has a promising future.

TELEVISION RECEIVERS

Harold T. Lyman
Columbia Broadcasting System

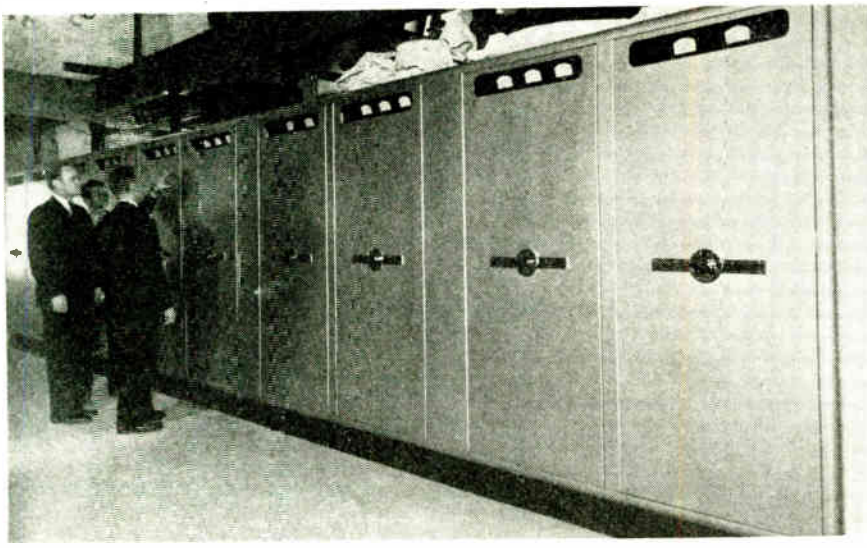
The details of the UHF television receivers operating between the frequencies of 480-920 megacycles that were developed in the CBS laboratories were disclosed. For color reception, a rotary disk carrying red (No. 25 Wratten), blue (Special No. 47 Wratten) and green (No. 57 Wratten) is rotated in front of the television screen. These receivers incorporate six single-tuned stages of if, the first and sixth being tuned to the center frequency, the second and third to the skirts of the desired band. In certain of these designs, a picture $15\frac{1}{4}$ x 21 in. was obtained using the standard projection technic. All these receivers are adapted for the reception of combined audio and video modulation on the same carrier and will receive both black and white and color.

490 MC TRANSMITTER

Norman H. Young
Federal Tel. Labs.

The final portion of this group of

MEETING DRAWS 7000

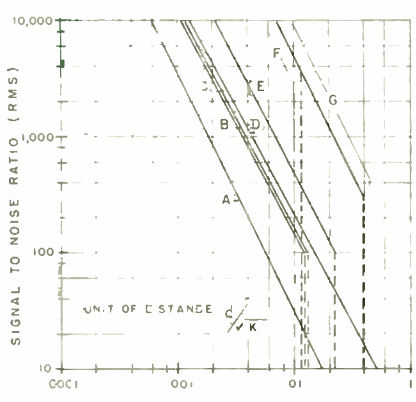


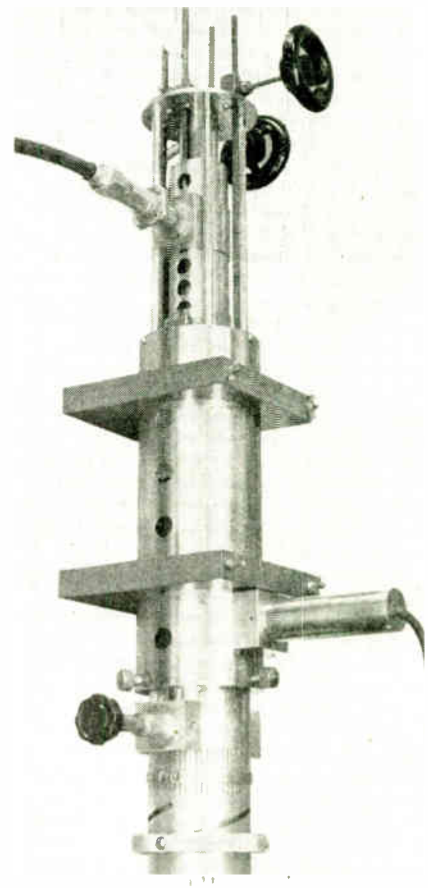
500 mc television transmitter in ten bays in the Chrysler tower (CBS)

papers described the details of the recently completed 490 mc television transmitter for use by CBS. This transmitter gives a continuous service output of a little under 1 kilowatt (peak power 1 kw), but because of the antenna gain possible at these frequencies, it was stated to have an effective output equivalent to 20 kilowatts. This transmitter was installed recently in the Chrysler Tower, and has already undergone many field coverage tests. The circuit used involves the use of UHF type 6C22 tubes in the four final stages of the rf amplifier stages and the two final stages of the video frequency amplifier. Although the development pioneered in many new fields in order to provide for the features required in this service, the transmitter was found to be capable of providing satisfactory signals even beyond the expectations of the CBS engineers.

A conventional sequence of crystal oscillator and frequency multipliers is used in the radio-frequency section. The video-frequency section is unusual chiefly in the use of direct-current coupling between amplifier stages, thus making the use of direct-current restoring circuits unnecessary. It can be modulated uniformly between direct current and 10 megacycles. The final radio-frequency amplifier is grid modulated, and the low plate resistance of the tube aids greatly in securing adequate bandwidth in the output radio-frequency current.

Signal to noise ratios for sound transmissions: A=amplitude modulated pulses; B=width modulated pulses (symmetrical); C=width modulated pulses (dissymmetrical); D=standard amplitude modulation; E=pulsed freq. modulation (fd=150 kc); F=pulsed freq. modulation (fd=1200 kc); G=standard freq. modulation (fd=150 kc)





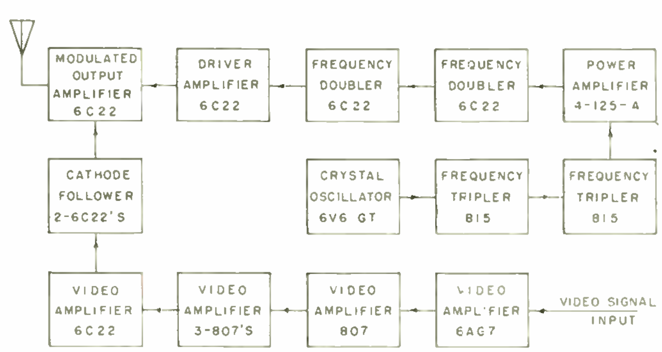
Coaxial amplifier at 500 mc (Federal incorporating the 6C22 tube in its structure

PROJECTION KINESCOPE

L. E. Swedlund
RCA Victor Division, Harrison, N. J.

This paper reviewed the development of cathode-ray tubes suitable for home projection types of television receivers. In addition to the reflective optics system, the outstanding gain in light output and improved contrast was obtained by applying an electron transparent film of aluminum to the back of the fluorescent screen. Other improvements which have been found with this screen process have been the reduction of secondary emission difficulties and the elimination of ion spots.

The fluorescent material on the inside face of the cathode ray tube screen is coated with an extremely thin ($5x10^{-6}$ cm to 10^{-5} cm) continuous film of a conductor, deposited over an intermediate layer of an organic compound which provides a better base for the metallizing. As

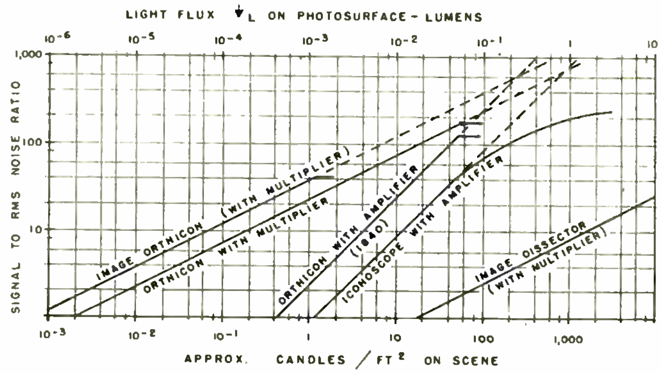


Block diagram of CBS transmitter using the Federal 6C22 tube shown in the figure, the reduction in the beam power transmitted, is negligible at the beam voltages of 20 to 30 kilovolts usually applied to these tubes. The efficiency of a tube with the aluminized coating is approximately double that of the unmetalized tube as far as the light output is concerned. In addition, the reduction of the usual effect of stray electrons in reducing the contrast and the gain in efficiency caused by the greater controlability of secondary emission increases the contrast to several times that of the ordinary tube.

TELEVISION SYSTEM CHARACTERISTICS

O. H. Schade
RCA Victor Division, Harrison, N. J.

The second portion of the television symposium disclosed details of the RCA television development program. This paper gave a basic survey of the whole television system insofar as performance standards can be established, based on the optical capabilities of vision and certain psychological aspects that have an important bearing on television viewing. In particular, this paper compared the effects introduced by various portions of the system that limits contrast and definition. These items included the limitations of the camera, the pickup tubes, transmission channels, and several factors in the reception portion of the system. When these effects are combined in curves, they show that the capabilities inherent with the 525-line system have not been reached with present equipment, and also indicated where in the system development is most needed.



Comparison of S/N characteristics of typical tele pickup tubes

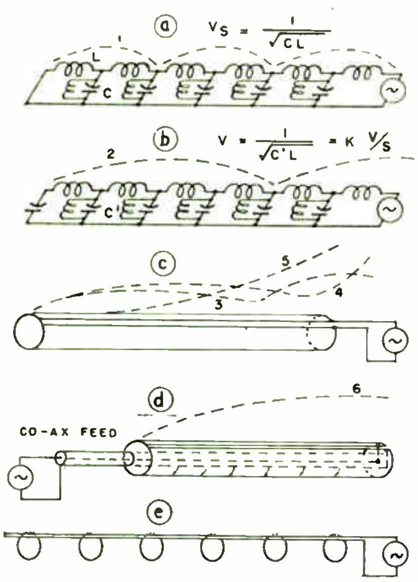
ANTENNA DESIGN

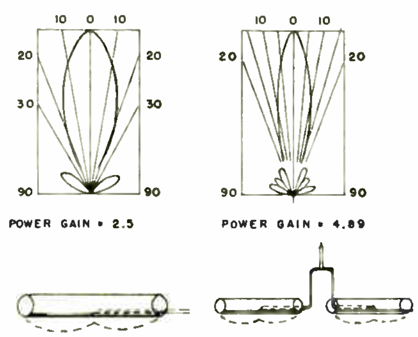
FM ANTENNA

Andrew Alford, Consulting Engineer

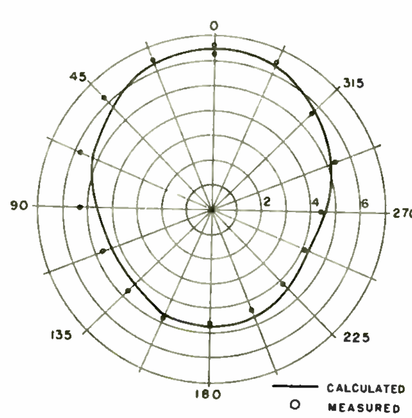
The antenna described consisted of a vertical cylinder with a slot approximately 3 in. wide running parallel to the axis. A co-axial line feeds the antenna, the outer conductor being connected to one side of the slot and the inner to the other. The slot forms a capacity while the cylinder forms an inductance in parallel with it. The entire cylinder may be thought of as a transmission line with a series of inductances and capacities in parallel running from one end to the other. By properly proportioning the diameter of the cylinder to its length the phase variation of the currents along the cylinder (it is slightly over one wavelength long) can be reduced almost to zero. In this way the entire length of the cylinder radiates in phase.

Dotted lines shown phase of currents in FM antenna. Changing width of slot, hence shunt capacity changes propagation along artificial system from a to b. Further changes shown at c. Dotted line 5 is an extreme result. By using the relations of inductance and capacity which produce 4 c and shortening the cylinder 6 d results





Radiation patterns of cylindrical antennas, center fed, split (above) and end fed (below)



BROADSIDE ARRAYS

John Ruze
Evans Signal Laboratory, Belmar, N. J.

The various factors considered in the design of broadside arrays were discussed with particular reference to radar antennas as used on the SCR-270 and the AN/CPX-1. The effect on band width as determined by pattern deterioration was mentioned. Mutual impedance between antenna elements and means of accomplishing the desired current and phase distribution were detailed. Various methods of lobing the broadside arrays with magnitudes of secondary lobes, and band widths were discussed.

BEAM-SHAPING METHODS

L. C. Van Atta
Radiation Laboratories, MIT

This paper dealt with the control of phase front to predetermine all lobe shapes, the conservation of power, and to prevent ground reflection. The angular width of an optical searchlight beam is determined by the extended light source placed at the focal point of the paraboloid reflector, and by inaccuracies in the reflector shape. The beam width of a microwave paraboloid antenna, however, is due to diffraction of the radiation at the aperture. The paraboloid will focus a beam only for a limited distance. The focusing property of the antenna system can be modified either by providing an extended antenna feed or distorting the paraboloid shape. Experimental and theoretical approaches were made available to antenna designers in this paper for a wide variety of beam shapes for special application.

BROAD BAND ANTENNAS

Andrew Alford, J. D. Kraus, A. Dorne and J. Christensen
Radio Research Laboratories
Harvard University

Methods have been developed to obtain broad-band antenna operation with low standing-wave ratio for frequency ranges used in radar, particularly those wide-band antennas for anti-jamming work. The description of the methods includes directional antennas, antennas with circular polarization, slot antennas, non-directional antennas, and also direction finders giving instantaneous visual presentation of direction for the same frequency. The DF was obtained by the rotation of a capacitor controlled by a selsyn motor. These direction finders are usable over wide frequency ranges without any antenna adjustment and have a pickup sensitivity comparable to or exceeding that of a half-wave dipole. Examples of homing devices for use on airplanes were given.

AIRCRAFT-ANTENNA MEASUREMENT

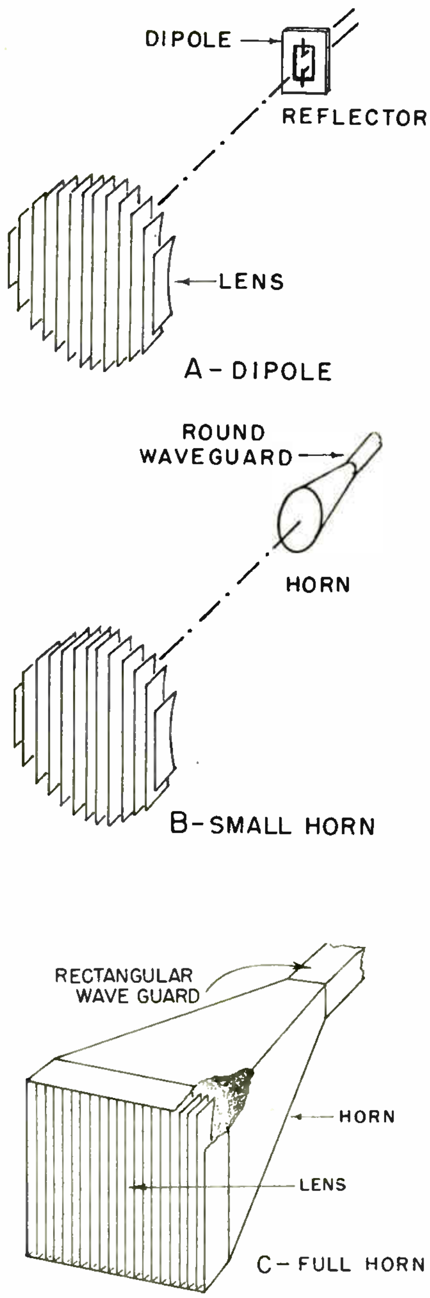
George Sinclair, E. W. Vaughan and Edward C. Jordan
Ohio State University Foundation, Columbus, Ohio

Although antenna models have been used for many years in studying radiation patterns, the measurements were severely limited as to frequency and type of antenna. It was shown how the technic may be extended to cover a very wide frequency range and a wide variety of antennas. Particular application to the study of aircraft antenna patterns were cited. The utility of models in studying special properties of antennas, such as polarization errors of direction finders, propeller-modulation effects, ellipticity of polarization, etc., were discussed. This paper gave the conditions for validity of scale models and the factors to be used. It described the type of apparatus necessary for model antenna measurement.

METAL-LENS ANTENNAS

W. E. Kock
Bell Telephone Laboratories, Inc., New York, N. Y.

A new type of antenna was described which utilized the optical properties of radio waves. It consists of a number of conducting plates of proper shape and spacing and is, in effect, a lens whose focusing action is due to the high phase velocity of a wave passing



Metal-lens applied to focus beams from dipoles, and waveguides

between the plates. Its field of usefulness extends from very short waves up to wavelengths of perhaps 5 meters or more. Application of this type antenna is recognized in repeater station work. This is due to the fact that it has superior shielding between the transmitter and receiver by the use of horn antennas with lenses. The energy from this type antenna is vertically polarized. Demonstrations were given to show the effects of this polarization. Illustrated is the metal lens applied to a dipole reflector and a round wave guide horn. The paper discusses the properties of this antenna, methods of construction, and application.

VACUUM TUBES

600 MC TRIODE

S. Frankel, J. Glauber and J. J. Wallenstein
Federal Telecommunications Laboratory, N. Y.

This paper described the L600E and the 6C22 type tubes in operation at 600 mc. A detailed description of the tube structures which included design considerations of the electrodes, operating conditions and static characteristics was given. The high peak emission currents necessary for 25 kw operation were satisfied by thorium filaments. Transit time was reduced by using high anode potentials. Effects of space charge in output limitation were noted. Type L600E was not satisfactory for CW work, therefore, the 6C22 was developed. This tube has a power gain of 2.6 as an amplifier in grounded grid circuits. The 6C22 has been used at 850 mc with 10% efficiency. Methods of testing and using these tubes as oscillators, amplifiers, and frequency multipliers were given. The L600E was known as the Pulsitron.

REFLEX OSCILLATORS

J. O. McNally and W. G. Shepherd,
Bell Telephone Laboratories, Inc.,
New York, N. Y.

Electronic tuning of reflex oscillators by variation of the repeller voltage was discussed. A number of problems encountered in the design of reflex oscillators for military applications were also taken up and a method of thermally tuning the cathode was described.

MICROWAVE TRIODES

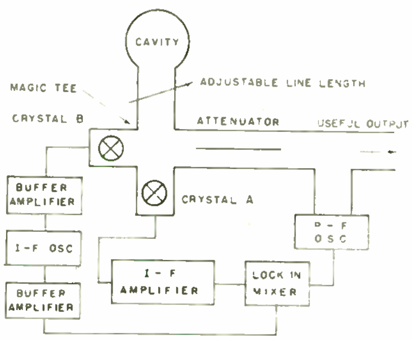
Everitt M. Goodell
Sylvania Electric Products, Inc., Emporium, Pa.

A new series of planar-grid triodes has been developed. They are adaptable to both pulse and CW operation at microwave and lower frequencies. They have been made possible by better jigging and closer tolerance of parts to reduce the internal tube capacity. Disc seal type tubes eliminate lead lengths because they may be plugged directly into a concentric line. Tubes to be used as oscillators have a probe built into the structure which gives sufficient feedback. Operation as high as 3000 mc is possible. The 2C36 tube was described in operation up to 3000 mc with 100 w output when the duty cycle was less than 2%.

MICROWAVE STABILIZATION

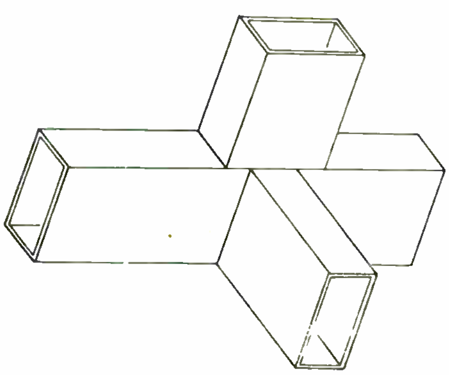
R. V. Pound
Radiation Laboratory, M.I.T.

The increasing use of microwave frequencies necessitates the design of highly stabilized oscillators for laboratory and communication use. Relative frequency can be maintained to better than one part in 10^8 by methods described in this paper. Energy from an rf oscillator is fed through an attenuator into a "Magic Tee". The impedance looking into any arm of this unit is the same. The "Magic Tee" has one arm connected to the resonant cavity which establishes the absolute frequency stability. Crystal detectors in the "Magic Tee" have their voltages amplified, which then are applied to correct the oscillator frequency. One method fed the frequency error back through the "Magic Tee," microwave discriminator, etc., to correct the relative frequency. This was accomplished by application of the error voltages to the oscillator reflector plates. High fidelity FM with deviations of the order of $f/_{110}$ about the stabilized frequency is possible.



Stabilized microwave system

"Magic Tee" network



HF POWER FOR CW

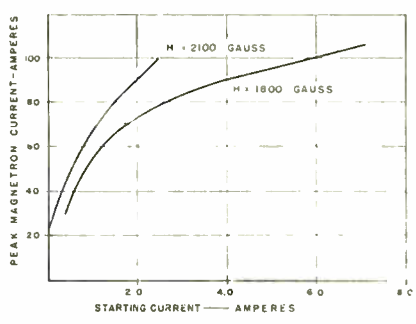
W. G. Dow, J. N. Dyer, W. W. Salisbury
and E. A. Yunker
Radio Research Laboratory, Harvard University

Radar jamming equipment required ruggedness, reliability, long life and not frequency stability. Operation of this type equipment with its necessary high power components was described in this paper. Magnetrons, resnatrons and disc triodes having tuning ranges of 1.5 to 1 were described in various circuits. Magnetrons in CW operation at 500-4000 mc developed 1000-2000 w at 60% efficiency. Equipments having wave-guides 22 in. x 6 in. mounted on a 10 ton truck were described.

MAGNETRON CATHODES

C. L. Shackelford
Westinghouse Electric Corp.,
Bloomfield, N. J.

Since the electron back bombardment of the cathode imposes undesirable limitations on a duty cycle and maximum average power of magnetrons the possibilities of cold secondary emission cathodes was investigated. Oscillations to initiate back bombardment were started by a heated emitter so arranged as to permit the transfer of the main emission to an unheated surface. Many materials were used as secondary emitters including beryllium, aluminum, nickel-barium alloy, thorium and silver magnesium alloy. Many factors were studied: first, at the Radiation Laboratory, M.I.T., and later at the Westinghouse Lamp division research dept. These included investigations of activation processes, methods of cooling, measurement of surface emission and peak emission currents obtainable for various voltages and states of activation.

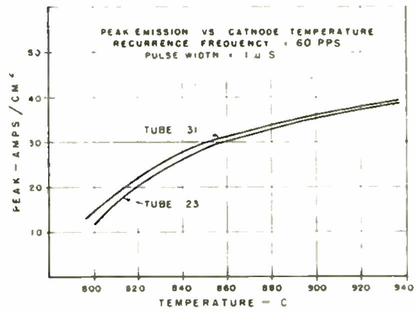


Secondary emission cathode current

MAGNETRON CATHODES

M. A. Pomerantz, Bartol Research
Foundation of the Franklin Institute,
Swarthmore, Pa.

A description was given of some of the characteristics of oxide cathodes used in magnetrons and capable of heavy current emissions per sq. cm. of surface. Other matters touched upon were decay of emission with time, cathode and anode sparking, the role of back bombardment and secondary emission and the use of thoria cathodes. M. A. Pomerantz pointed out that the success of the war developed magnetrons of high power is based on the possibility of high current emissions from small cathode surfaces.



Influence of cathode temperature on emission

HIGH-VOLTAGE RECTIFIER

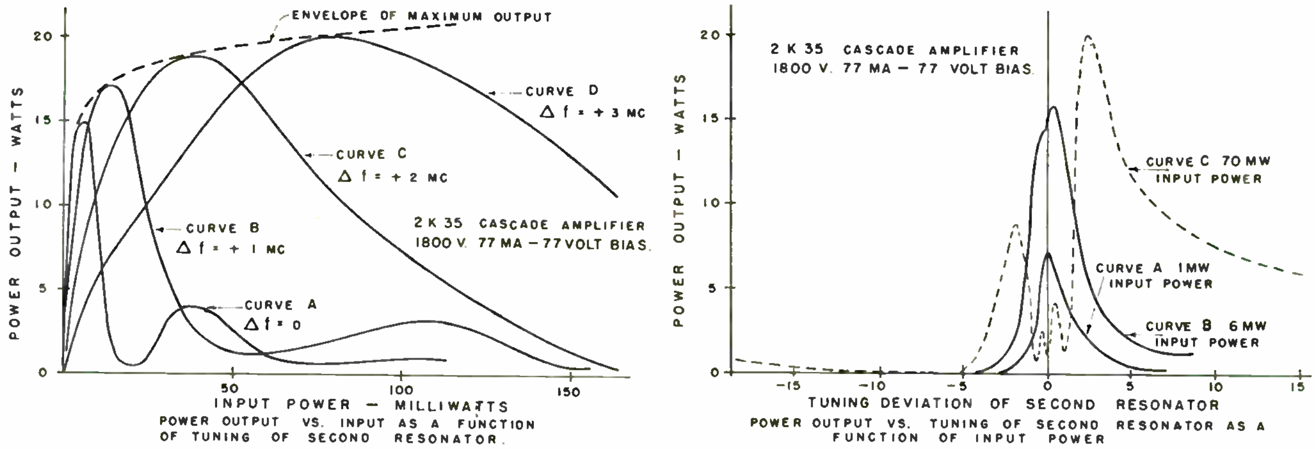
George Baker
National Union Radio Corp., Newark, N. J.

The new factors in the design of a small size, low current rectifier tube for operation at several kv were considered. Electro-static forces of 15 grams against the filament by the high anode potential limited the filament to tungsten wire. The filament was mounted slack, and was also bowed to withstand this force. It was also discovered that the glass assumed a potential, hence proper shaping of the anode was necessary. This minimized the cold field emission which, if uncontrolled, would result in large reverse current when high velocity electrons struck the glass. Minimum dielectric losses, anode shape, a highly polished anode, and filament design were the factors which made this tube successful.

MINIATURE TUBES FOR FM

R. M. Cohen, R. C. Fortin and A. M. Morris
RCA Victor Division, Harrison, N. J.

The use of a new miniature converter tube and a new miniature radio frequency amplifier tube in FM receivers covering the 88 to 108 mc. band was described. The tubes described were the 6BA6, remote cutoff pentode having less grid-plate capacitance than the 6SG7. The other was the 6BE6 which is similar to the 6SA7 except that the oscillator Gm is twice that of the latter tube. Data covering construction and performance including circuit constants, stage gain, overall gain, signal-to-noise ratios, image rejection and oscillator frequency trends were presented. The authors pointed out the following technics necessary at 100 mc FM.



Effect of tuning variations in second resonator cavity on power amplification of cascade klystron. Maximum results occur with slight detuning

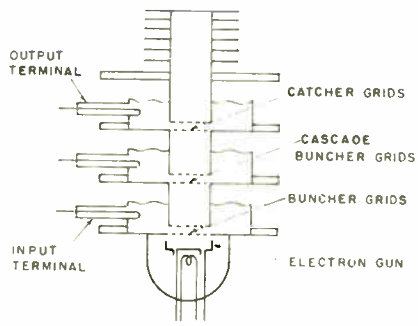
When the oscillator voltage is strong at the signal grid, tuning varied the bias on the tube. It is therefore advisable to ground the signal grid in alignment procedure. In the converter stage the oscillator frequency was set above the signal frequency.

CASCADED KLYSTRONS

E. G. Levinthal,
Sperry Gyroscope, Inc.,
Garden City, N. Y.

The theory of operation of the three-resonator Klystron amplifier was given for the case of small signal operation. An analogy between the operation of a cascade amplifier and velocity modulation by a saw-tooth voltage was demonstrated. Some calculated values of two parameters were given which yield theoretically efficiencies in the neighborhood of 74%. These amplifiers are finding extended use in the design of microwave equipment.

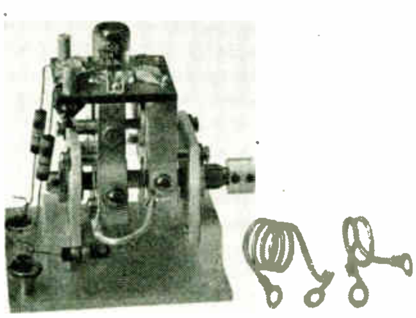
(*Continued on page* 71)



Schematic of triple cavity klystron amplifier

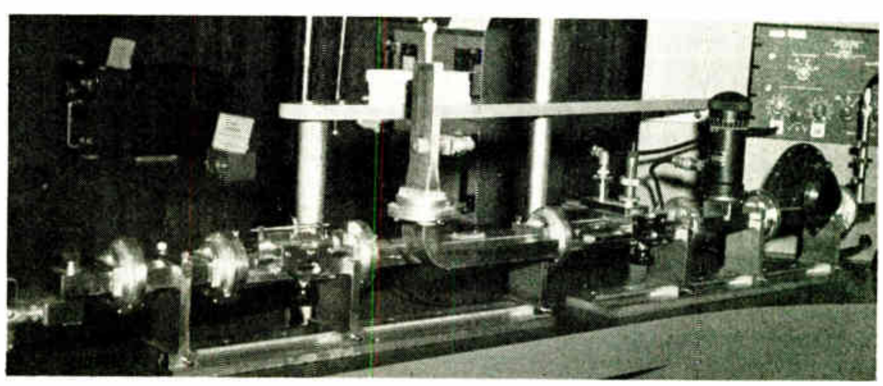
WHAT'S NEW AT THE IRE ENGINEERING EXHIBIT

● It was a tough job pushing one's way around the exhibits. Which will give a fair idea of the interest the IRE manufacturer's exhibition held for the 7000-odd Institute members and guests who jammed the exhibits and the aisles. The exhibition, largest engineering show ever held, had grown until it occupied most of two floors in the Hotel Astor, contained the parts, completed components, test equipment—even finished and in some cases operating, transmitters—and a host of other new and not so new things. Equipment having to do with microwaves, with various methods of sound recording and with the use of oscillographs for the very many purposes to which these versatile instruments now are being put, appeared to attract the greatest attention. There was plenty else that was new. Among such items were these:



VHF Oscillator

A vhf oscillator exhibited by the Allen D. Cardwell Mfg. Corp., 81 Prospect St., Brooklyn, N. Y., covers three amateur bands in the range from 100 to 1,000 mc. by use of replaceable self-supporting coils. The oscillator is essentially a conventional coil-condenser tank circuit using a 6F4 acorn tube. Due to rigid construction the frequency stability is said to be excellent. The oscillator may be used to drive a lighthouse tube as power amplifier.—Electronic Industries

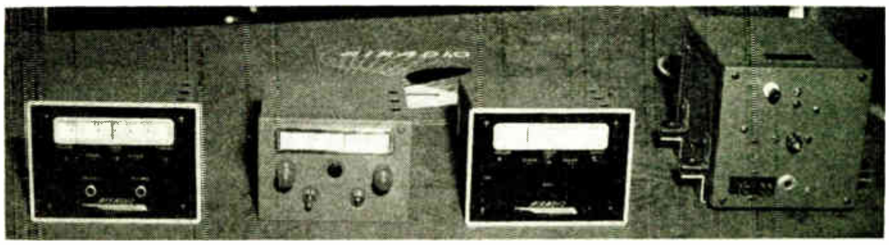


Microline Instruments

A series of Microline instruments in operation as a microwave test bench were displayed by the Sperry Gyroscope Co., Great Neck, N. Y. With the help of these instruments, power-, frequency- and impedance measurements may be carried out. Some of the instruments shown were: Cavity-, coaxial- and broadband frequency meters, various calibrated and uncalibrated variable attenuators, impedance meters, transformers and line terminations.—Electronic Industries

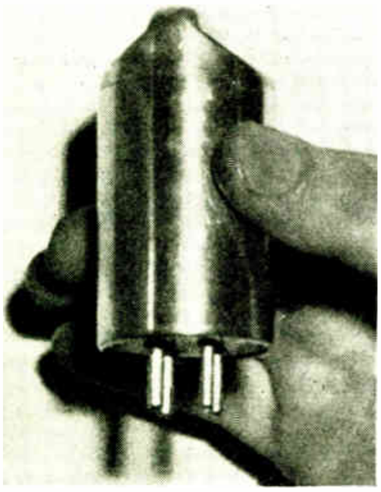
Audio Frequency Meter

A frequency meter capable of measuring the frequency of ac voltages over the entire af spectrum independent of wave form has been brought out by Communications Measurements Laboratory, 120 Greenwich St., New York. In conjunction with a "photobeam converter" the model 1800 meter becomes an electronic tachometer for measuring the speed of rotating and reciprocating mechanisms. Frequency of positive or negative pulses from a fraction of a microsecond to more than 50 microseconds duration also may be measured, accuracy is ±0.5% full scale cycles. The frequency range, 10 to 20,000 cps in six ranges.—Electronic Industries



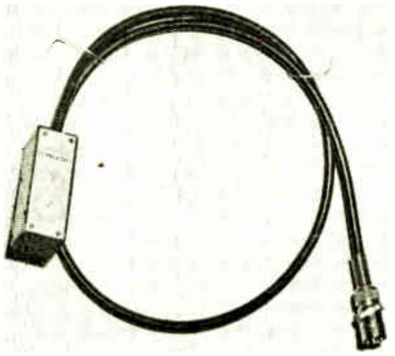
Aviation Receiver

An aid to private flying is a 2-way communication system brought out by Airadio Inc., Stamford, Conn. Weight of the complete equipment, consisting of receiver, transmitter and powersupply, is less than 11 lb. The receiver covers the broadcast band and the radio range band of 195 to 420 kc has a tuned rf stage and slide rule dial. The transmitter comprising crystal oscillator and power amplifier can be had for any frequency between 2 and 7 mc.—Electronic Industries



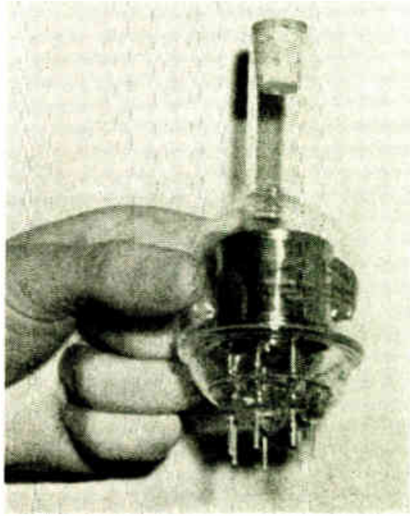
Rotary Converter

The Dynectron rotary converter manufactured by the Ohio Tool Co., Cleveland 11, Ohio, is designed to replace the standard vibrator in automobile radios. An evacuated mercury cell acting as a commutator is the heart of the new converter, for which reduced electrical and mechanical noise levels, much longer life and constant maximum efficiency is claimed.—Electronic Industries



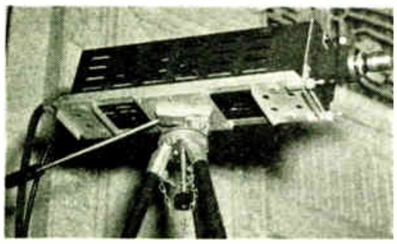
HF Probe

A new type probe for measuring voltages in VHF circuits is being made by Alfred W. Barber Laboratories, 34-04 Francis Lewis Blvd., Flushing, N. Y. Input capacity is 0.5 mmfd. Used with a Barber VM-27 vacuum tube voltmeter, no multiplier is required to measure voltages up to 1000 v.—Electronic Industries



Ionization Gage

Ruggedness and high sensitivity characterize the type 507 ionization gage exhibited by the National Research Corp., Boston 15, Mass. The gage has a plate constructed of nickel, a tungsten filament and tungsten grid. Characteristics are: Max. operating pressure air is 1 micron Hg; the sensitivity at 5 ma emission current is 100 microamperes per micron; the max. emission current is 25 ma. It is designed to be used with Universal vacuum seal, type 1304 and gage controls, types 706 and 707.—Electronic Industries



Television Camera

The Electronic Division of Remington Rand, Inc., Middletown, Conn., exhibited the "Vericon" television pick-up system, which is now available for commercial applications. Its weight of 40 lb. makes it easily portable. Two camera types are available, and are interchangeable: The standard Vericon camera, using the pick-up tube model 212 for normal lighting conditions, and the image Vericon—a highly sensitive pick-up tube—for very low lighting conditions. Provisions are made in the camera by electronically controlled adjustment of the diaphragm opening to maintain automatically optimum contrast under varying lighting conditions.—Electronic Industries

Pulse Timer

R. W. Cramer Co., Inc., Centerbrook, Conn., has a newly developed pulse-timer unit that will deliver electrical impulses of a definite duration at the end of regularly spaced and successive time intervals. The time interval may be adjusted over a wide range.—Electronic Industries

Antenna Towers

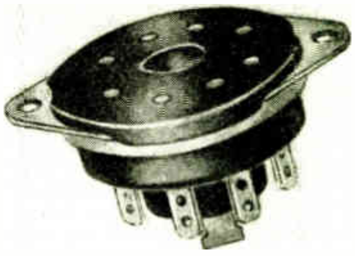
Harco Tower, Inc., 1180 E. Broad St., Elizabeth 4, N. J., produces "Easy to Erect" masts and towers. The only equipment needed for erection of its 4 ft. triangular tower is a piece of rope and a wrench. After erection of a 6 ft. section on the ground, by climbing the ladder on the inside the succeeding 6 ft. section may be erected.—Electronic Industries

Audio Transformers

A precision line of audio transformers covering mixing, bridging, input, interstage, plate to line, line to speaker and output functions has been designed by American Transformer Co., 178 Emmet St., Newark 5, N. J. These units have a frequency response from 30 to 15,000 cps, plus or minus ½ db. Characteristics are obtained by careful design and do not use shunt resistors.—Electronics Industries

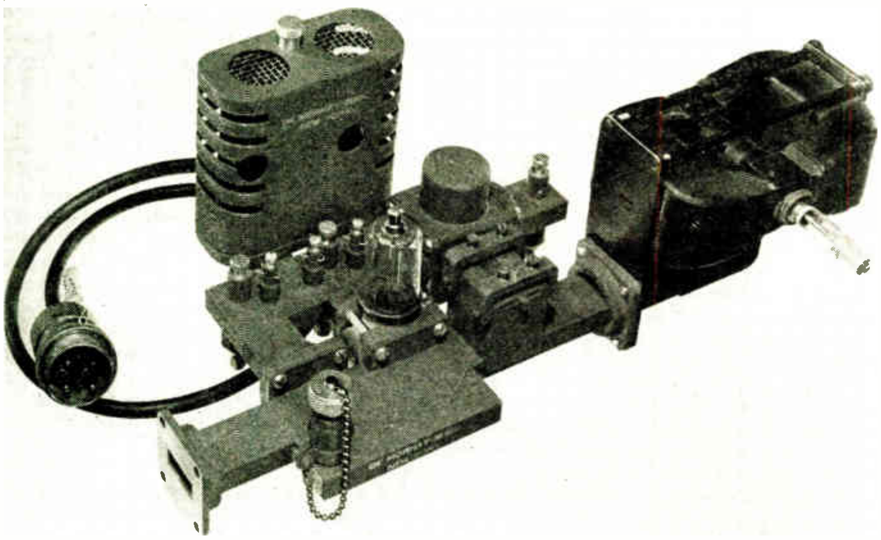
Frequency-Insensitive Resistors

Corning Glass Works, Corning, N. Y., exhibited precision resistors, which were used in radar equipment during the war. "Pyrex" brand resistors are designed to be relatively independent of frequency over a wide frequency range because their resistive elements are extremely thin—a metallic film less than 1/100,000 in. thick. Temperature coefficients are small and approximately constant between 25° and 150° C. Test resistors subjected to maximum power ratings for 1,000 hours showed a resistance deterioration of less than 0.5%.—Electronic Industries



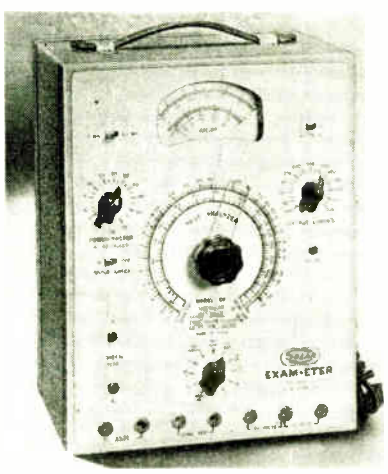
Tube Socket

The new Plexicon tube socket, developed jointly by Cinch Mfg. Co., Chicago, Ill., and Erie Resistor Corp., Erie, Pa., will be made to provide capacitive by-passing for any desired combination of tube pins. Maximum capacity of any pin by-pass is 1,000 mmfd. Silvered ceramic capacitors are used. Capacitive coupling effect between by-passed tube pin and adjacent pins is reduced by the shielding effect of outer elements of the capacitor.—Electronic Industries



Commercial Radar

De Mornay-Budd, Inc., 475 Grand Concourse, New York 5, has developed a packaged rf radar assembly designed for commercial and military radar apparatus. The complete rf radar assembly operates on 9000 mc The unit shown consists of the following components: A magnetron of 20 kw. output; one 1B35 ATR tube; one 1B24 TR tube; 2K25 local oscillator tubes; 1N21 crystals; 20 db narrow band directional coupler. A beacon cavity beacon crystal mount are optional in the event that beacon operation is desired—Electronic Industries



Capacitor Analyzer

A new test unit for checking intermittent, open-circuited and short-circuited capacitors of all types without unsoldering leads has been designed by Solar Mfg. Co., 285 Madison Ave., New York 17, N. Y. Capacitor values from 10 to 2,000 mfd. and resistors from 100 ohms to 7.5 megohms can be measured. Power factor, leakage current and insulation resistance checks are quickly made. The unit contains a vacuum tube voltmeter.—Electronic Industries

Loop Antenna

DX Radio Products Co., 1200 N. Claremont Ave., Chicago 22, Ill., has developed a pancake loop antenna which has been designed for high "Q". Loops can be wound with any size wire between No. 20 to No. 38, or any size Litz. No impregnation is necessary.—Electronic Industries

Communications Receiver

Soon available in the medium price field will be the model S-40 9-tube communications receiver to be manufactured by the Hallicrafter Co., Chicago 16, Ill. The receiver provides such as: separate bandspread tuning, covering the range 540 kc to 44 mc, in 4 bands, has permeability adjusted coils, automatic noise limiter, tone control and stand-by switch. Available for ac only.—Electronic Industries

Synchronizing Generator

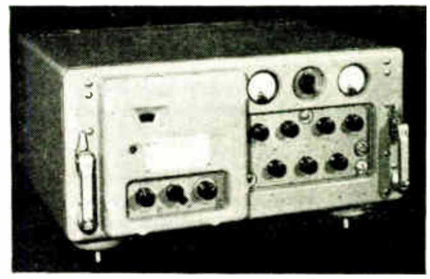
Telequip Radio Co., 1901 S. Washtenaw Ave., Chicago 8, Ill., exhibited a television synchronizing generator consisting of two regulated power supplies, timer unit, shaper unit and monitoring oscilloscope. The standard FCC-RMA signal is produced by the equipment. The timer unit uses Eccles-Jordan multivibrators for the production of timer signals. Controls are provided for the adjustment of width and position of various pulses in the shaper unit. A 7-in. cathode ray tube is part of the monitoring oscilloscope.—Electronic Industries

Distortion Analyzer

The new model 330B Distortion Analyzer developed by Hewlett-Packard Co., Palo Alto, Cal., will measure distortion at any frequency between 20 and 20,000 cps. Noise measurements can be made of voltages as low as 100 microvolts. A linear rf detector allows measurements directly from a modulated rf carrier.—Electronic Industries

Audio Oscillator

With a frequency coverage of 20 to 20,000 cps, the new AF oscillator designed by Hewlett-Packard Co., Palo Alto, Cal., has less than 1% distortion at 3 w output. Under normal temperature conditions the frequency stability is better than plus or minus 2%. Line voltage variations under 10% will not change output frequency.—Electronic Industries

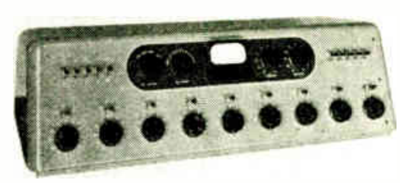


RDZ Receiving Equipment

Currently being supplied to the Navy Department is a recently designed vhf receiver being made by the National Co., Inc., Malden, Mass. Primarily intended for the reception of voice transmissions the receiver also permits use of external equipment for wide band scanning and video presentation. Crystal units enclosed in thermostatically enclosed ovens assure stability of the various frequency channels. The receiver incorporates automatic tuning by the use of an "Auto-Tune" unit.—Electronic Industries

"Glider" Pick-Up

To the field of low-priced light-weight pickups Shure Brothers, 309 W. Jackson Blvd., Chicago, Ill., adds the "Glider" pick-up which has a lever-type cartridge and low-mass tone arm. No springs or counter-weights are used. The output voltage is 1.6. The unit is designed for low needle impedance, high needle compliance and a resonance-free tone arm.—Electronic Industries



Control Console

By the use of three-position lever-type switches operational controls have been reduced to a minimum in the new studio control console designed by Raytheon Mfg. Co., Broadcast Equipment Div., 7517 N. Clark St., Chicago 26, Ill. This unit includes seven built-in pre-amplifiers, nine mixer positions and control of fourteen remote lines. Frequency response is 2 db from 30 to 15,000 cps, with distortion of less than 1%—50 to 10,000 cps.—Electronic Industries

Vacuum Capacitors

The Amperex Electronic Corp., 26 Washington St., Brooklyn, N. Y., exhibited the VC-50 line of vacuum capacitors recommended for use in the electro-medical field and for high-frequency induction and dielectric heating applications. High current rating in small space, high capacity stability at high current levels, low losses and large area glass-to-metal seals are some of their characteristics.—Electronic Industries

Vibrator Converters

A line of four radio vibrators to service 95% of all car radios now on the road will soon be available according to Electronic Laboratories, Inc., Indianapolis, Ind. These four E-L vibrators are designed to replace the units in 1,122 different radio sets.—Electronic Industries

Variable Voltage Transformer

Three new models of variable voltage transformers have been brought out by Superior Electric Co., Bristol, Conn. Type 20, with a maximum output of 3a at 135v, is less than 4 in. in its greatest dimensions. Types 11-26 and 12-26 are engineered for minimum size and are fuzed.—Electronic Industries

Signal Generator

A new frequency modulated signal generator has been developed by Boonton Radio Corp., Boonton, N. J., for use with FM and television equipment. Frequency range is 54 to 218 mc., in two ranges. Rf output is continuously variable from 0.1 microvolt to 0.2 volts. Deviation frequency is adjustable between 0 and 250 kc at audio or supersonic frequencies. Amplitude modulation, with or without simultaneous freqency modulation, is available.—Electronic Industries

Dummy Tubes

A miniature socket wiring plug was exhibited by the Star Expansion Products Co., 147 Cedar St., New York. The plugs are cast in one piece of zinc alloy and have stainless steel pins. By plugging in the dummy instead of the actual tube the accurate alignment of miniature socket contacts during wiring is facilitated.—Electronic Industries

ENGINEERING FEATURES OF RECORDING EQUIPMENT

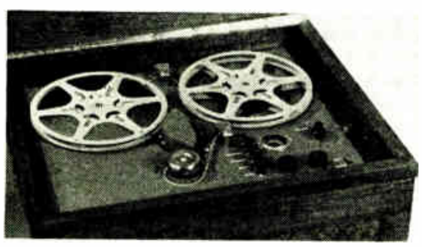
Probably no other feature of the Conventions of the AIEE and the IRE held greater interest than did the features and possibilities of the several methods now available for both home recording and transcriptions of radio program material.

The interest expressed was based on many new fields of activity and the higher levels of quality now obtainable.

The characteristics of the various methods of home recording available were disclosed in numerous papers, displays and demonstrations during the conventions. The advantages and limitations of the various recording media, such as round steel wire, paper tape which carried a magnetic material, steel magnetic tape and the mechanical methods of embossing in grooves on film, were all disclosed. It became evident that the quality necessary for the satisfactory reproduction of high quality radio programs could be obtained with any of these methods, provided that the wire or tape was moved at a sufficiently high speed. Recording speeds ranged from a little less than one foot per second for the magnetized paper tape to a speed of four to five feet per second for high quality transscription work. Speeds of the order of one foot per second, used with the tape recorders and with embossed film gave remarkable demonstrations.

One arrangement was described in a paper by Dr. S. J. Begun of Brush Laboratories, Cleveland, using a magnetized paper tape at a speed of one foot per second. The Recordograph instrument* using embossed film was also demonstrated. A wire type recorder by the Armour Research Foundation utilized speeds of from two to five feet per second. A German built magnetic tape recorder was both displayed and demonstrated during the IRE Convention. This instrument used iron oxide impregnated tape ¼ in. wide and 0.5 mils thick. The magnetic material was a dark maroon color and was apparently completely dispersed throughout the cross section of the strip. The tape developed by the Brush Laboratories consists of a blue-black coating of magnetic material on a paper strip ¼ in. wide and is supplied wound on regular 8 mm. film reels.

The paper tape can be edited simply by tearing out any undesired sections and splicing with Scotch tape adhesive. No break is detectable on playback. This assists the user to compile a home library of any type of recordings "tailor made" to his personal taste. For example, an "album" of popular songs can be compiled on one uninterrupted reel, a complete half-hour radio program can be recorded with commercials and other undesired portions neatly and undetectably removed, a series of symphonic arrangements can be compiled without introductory blurbs and comments by the radio announcer. Recordings on the tape can be "erased" at any time and new recordings made over and over again.



Above, new Brush magnetically coated paper tape recorder. Below, recorder using plated non-ferrous wire instead of stainless steel

Upon completion of a record, the rewind button is pushed and within a few seconds the recording is ready for playback. Although each reel of paper tape can accommodate a half hour of playing the required rewind time is well under one minute. It was claimed that the new coated paper tape can be produced at less cost than previous magnetic recording mediums, such as wire and metal tape.

The Brush Laboratories also perfected another wire recording medium: a magnetic layer deposited on the surface of a highly ductile metal base (such as brass). This coating is electroplated by a special process to give it the necessary magnetic properties for recording. Brush has perfected a means of plating this wire in such a way that exceptional uniformity and fidelity are obtainable. It was stated that the cost of this medium should be below that of the usual stainless steel wire.

The wire recorder was one of the

*"Multi-Channel Sound Recording on Film", Electronic Industries, April, '45, P. 92

most talked about systems during the convention inasmuch as close to thirty companies have been licensed to produce equipment using the ultrasonic biasing methods, developed by Armour. As is well known, this system uses a stainless steel wire about 0.004 in. in diameter.† The advantages claimed for magnetic wire recordings are: No needle scratch — low background noise level; no break in continuity as found with record changing; wipe off and re-use of wire; instantaneous play-back without processing; unlimited number of playbacks; extended recording time; excellent fidelity without elaborate precautions or special skills in recording; lightness, compactness, portability. In addition, any portion of a record can be erased and revised without harm to adjacent portions.

The method of recording introduced by Armour combines a fixed high frequency current with the audio signal, the high frequency component being in the order of 30 kilocycles. A series of minor hysteresis loops result. When the magnitude and frequency of the two currents are adjusted properly the final permanent value of magnetism in the wire is dependent only on the instantaneous value of the low frequency (audio) field, and is substantially linear through the origin, thus giving a straight line recording characteristic. The high frequency component does not appear in the final record. In this way all even harmonics are eliminated, and the full magnetic capabilities of the record medium are used. The quality of reproduction depends on the residual magnetization, coercive force, and energy product of the wire.

Wires that have been developed recently allow records of the same quality to be made at one-third the previously used speeds, and further improvements are very likely. The cost of a wire spool was asserted to be competitive with ordinary types of disc records having equal playing time.

The development on wire is still going on and improvements in this regard are still expected. Some work has progressed in several laboratories as in the matter of making measurements of the magnetic properties of tapes, wires and other magnetic recording materials. In a home recorder system demonstrated by the Armour Foundation, a speed of two to two and a half feet per second was utilized. At a latter speed the output was within 3 db between 80 and 8500 cycles and was down 5 db at the 65 cycle and 10,000 cycle points. The wire used had a strength of 3 lb. for a steady pull. In this regard the pull required to break the magnetic paper tape, (Brush) was stated to be 6 lb. steady pull. This is interesting in view of the fact that paper base tape might be considered to be extremely fragile.

During the week various details of wire recorder heads, magnetic characteristics and recording speed conditions were described. At a symposium on these subjects (AIEE) details of wire recording were outlined by D. W. Puxley of the General Electric Co., describing the wire recorded system using ultrasonic magnetic biasing. A new wire recorder head design was described by T. H. Long of the B. G. Conn, Ltd. These heads were developed to overcome the tendency for foreign material to accumulate across the working gap.

From the enthusiasm shown it is apparent that this field of development has an important place in many fields of application, the most notable being that of home recordings from the spoken words of members of the family, received programs of interest from the radio or re-recording from disc records. A long and imposing list of applications has been compiled where this equipment has served useful purposes.

†"Engineering Details of Magnetic Wire Recorder" by D. W. Pugsley, Electronic Industries for Jan. '44, p. 116

BRIEFING THE IRE WINTER TECHNICAL MEETING PAPERS

• *(Continued from page 67)*

PROPAGATION

PROPAGATION IN OCEAN DUCTS

M. Katzin, R. W. Bauchman and W. Binnian
Naval Research Laboratories
Washington, D. C.

In order to check the effects on three and nine centimeter transmission of low level ducts formed in oceanic air, one way measurements between a ship and a shore station were made with antenna combinations of various heights. Meteorological measurements taken from both shore and ship were described and the conditions in duct height and strength were discussed. Meteorological and radio measurements inland were made and the effect of distance back from the shore on meteorological conditions and radio transmissions were described. Three centimeter radar observations were made during the latter part of the project and the variation of echo amplitude with range of ship target was measured. Analysis of radio and radar measurements was given.

SIX MM. WAVE PROPAGATION

G. E. Mueller
Bell Telephone Laboratories, Inc., New York

The effects of rainfall and atmospheric absorption on propagation of microwaves and the methods for measuring them were described. The attenuation of 3.2 centimeter waves is slight for moderate and light rainfalls. During a cloudburst, however, the attenuation may approach a value of 5 db per mile. A wavelength of 1.09 centimeters is appreciably attenuated even by a moderate rain. Losses at .62 centimeters reach a value of 42 db per mile in a cloudburst.

RAIN EFFECT ON MICROWAVES

S. D. Robertson and A. P. King
Bell Telephone Laboratories, Inc., New York

It was demonstrated that the drop size of rain influenced the attenuation of centimeter waves. In a heavy rainfall, four to ten db per mile loss has been experienced. Data showed a definite relationship between the rainfall and path loss compared with the time of precipitation. With a wavelength of 1.09 centimeters, an attenuation of .3 db/mm/hour was experienced as compared with a wavelength of 6 mm. having an attenuation of .6 db/mm/hour.

ATMOSPHERIC DUCTS IN PROPAGATION

J. E. Freehafer
Radiation Laboratories, MIT

Experience gained during the war has shown that strong fields, at frequencies greatly exceeding the penetration frequency of the ionosphere, often are observed at several times the horizon distance. Experimental and theoretical investigations in this country and in England indicate that these effects are associated with the presence of layers in the troposphere in which the vertical gradient of refractive index exceeds numerically the reciprocal of the earth's radius. Under these conditions a duct is formed which, for sufficiently high frequencies, both reduces the rate at which the field is attenuated with range and also disturbs the normal height gain effect. Experiments were described at which aircraft plotted signal strength, temperature, and humidity at various altitudes from the transmitters. It has been found that by means of the atmospheric ducts 75 centimeter transmissions have been heard at five times the horizon distance. A 200 mc radar indicated targets 1700 miles away from Bombay, India. These atmospheric ducts change with temperature and water vapor in the air.

SKY-WAVE PROPAGATION

J. H. Dellinger and Newbern Smith
National Bureau of Standards
Washington, D. C.

The pulse method of ionosphere measurement was developed for radar. It was extremely vital to predict the radio propagation characteristics in advance, in order that the best operating frequencies might be used. The major aspects of the worldwide radio propagation program developed during the war were described in this paper. Study of atmospheric radio noise, methods for calculating sky-wave field intensities, ionospheric-storm forecasting, effects of ionosphere on direction finder indication were important studies made by the Bureau of Standards. For their purposes the world was divided into three zones, based on geometric latitude. Data collected from the many field stations of the allied nations enabled accurate forecasting of ionosphere conditions three months in advance. Bureau of Standards bulletins are available without charge to anyone interested in this subject.

ARRIVAL OF MICROWAVES

W. M. Sharpless
Bell Telephone Laboratories, Inc., New York

This paper described the method of measuring the direction from which microwaves arrive at a given receiving site. These waves travel in curved lines caused by refraction of the earth's atmosphere. This work is extremely important in the design of radio relay link antennas. Data collected on two short optical paths using a wavelength of 3¼ centimeters was presented to illustrate the use of the method. Angles of arrival, as large as ½° above the true angle of elevation have been observed in the vertical plane, while no variation greater than ±1/10° has been found in the horizontal plane. More recent work using a lens type scanning antenna operated at a wavelength of 1.25 centimeters revealed that at times as many as four distinct transmission paths were present simultaneously on a 12.6 mile circuit. Simultaneous meteorological soundings were made near both terminals of the circuit. It was observed that hot nights had caused the greatest errors in measurement. There was notably less fading on wave lengths of 30 centimeters and less effect by the atmosphere, than on shorter wave lengths. All measurement work was done by CW modulation.

TELEMETERING AND RECORDING

RADIO TELEMETERING

David W. Moore, Jr., and Frank G. Willey,
Fairchild Camera & Instrument Corp.,
Jamaica, L. I., N. Y.

The Fairchild system of radio telemetering was designed to transmit indication of aircraft instruments from plane to ground over a conventional aircraft radio transmitting and receiving equipment. Ground indication is made by an indicator which closely simulates the standard aircraft instrument in appearance and modification to the aircraft instrument in the plane in flight. Instrument indication is transferred into electrical phase angle which may be transmitted by radio equipment. This phase angle is then compared with a reference signal in the receiving station and converted to a dial indication. Provision may be made for sending a number of instrument indications over a single carrier, enabling transmission of indications of a flight group of instruments from, for example, a radio-controlled plane or missile to a distant operating point, either on the ground or in another plane.

THREE-BEAM OSCILLOGRAPH

Gordon M. Lee,
Central Research Laboratories,
Red Wing, Minn.

Transit time distortion is a fundamental limiting factor in the application of high speed cathode ray oscillographs to the recording of high frequency voltages of fast transients. A 3-beam, high speed, micro-oscillograph was described in which the transit time reduction in deflection sensitivity is calculated to be but 4% at 3,000 mc and 40% at 10,000 mc. Single-sweep oscillograms of 3,000 and 10,000 mc oscillations and 10^9 second transients were shown.

RECORDING POTENTIOMETER

V. L. Parsegian, Portable Products Corp.,
C. J. Tagliabue Division,
Brooklyn, N. Y.

A new high-speed recording potentiometer was described, having a carriage travel of 10 in. in 1 sec. and balancing to within an accuracy of 0.1% of full range. The instrument is of the photoelectric type, using a new sturdy, short period, low inertia error galvanometer, a photocell, and a phase reversing amplifier which drives a split-phase carriage motor when the photocell illumination exceeds, or is less than, an intermediate balance value. Means for cancelling the galvanometer lag is described, as well as a new thyratron circuit for printing records.

HIGH SPEED RADIOGRAPHY

C. M. Slack and D. C. Dickson,
Westinghouse Electric Corp.,
Bloomfield, N. J.

The making of ultra speed radiographs, using exposure times of the order of one millionth of a second, requires the passage of electron currents of 1,000-2,000 amperes. Such currents can be supplied by an electron source utilizing field emission from a cold cathode electrode which degenerates into a metallic arc in a high vacuum. The recording of such high speed transients was briefly discussed.

DIRECTIONAL COUPLERS

W. W. Mumford,
Bell Telephone Laboratories, Inc.,
New York, N. Y.

The directional coupler is a device which samples separately the direct and reflected waves in a transmission line. A simple theory of its operation was given and several applications were discussed.

POWER LEVEL RECORDER

A. J. Williams, Jr., and W. R. Clark,
Leeds & Northrup Co.,
Philadelphia, Pa.

The new Speedomax power level recorder is an instrument that faithfully records rapid or slow variations in power level with time, and is independent of variations in frequency within its frequency range (25 to 150,000 cycles). The recorder scale is linear in db. A 20 db change in power input can be recorded in about 1 sec. The new circuits used in this new recorder were described in detail, and its performance characteristics given.

TUBE GLASS PROBLEMS

Dr. Henry J. Miller
RCA Victor Division, Harrison, N. J.

The use of miniature tubes in military equipment made it necessary to develop stem making and stem-to-bulb sealing technics. Tubes which would withstand severe mechanical, thermal loading, shock, and vibration tests were necessary. Three factors which govern the mechanical stability of the tube stem are buffer gas, depth of insertion, and strain. Methods to control these factors were described. The stem-to-bulb sealing technic required to obtain a seal of maximum mechanical rigidity was outlined. It was shown that the resulting procedures for the mass production of tubes were successful. They withstood the severe mechanical stress of wartime use without any epidemic glass failure in the field. A life test was outlined in which the base pins were bent out 5°, the tubes were then placed in boiling water. The shock accelerated any capillary action of cracks in the tube base.

STAGGER TUNED AMPLIFIERS

Dr. H. Wallman
Radiation Laboratory, M.I.T.

In radar and television receivers, the simplicity of single tuning commends itself for wide band, band pass amplifier design. Unfortunately, present tubes preclude the possibility of building a high gain amplifier wider than 4 mc. Bandwidth decreases rapidly when single tuned stages are cascaded. Stagger tuning of individual stages makes 10 and 15 mc wide amplifier design feasible. Graphs were presented which condensed the basic design of wide band amplifiers into a simple procedure.

VELOCITY MODULATION

James F. Gordon
Bendix Radio Division, Baltimore, Md.

An FM system was described in which a crystal-controlled pulse triggered a multivibrator. This was accomplished by a crystal oscillator, blocking oscillator, clipper combination. Negative pulses triggering the MVB establish a reference time for the system. Clipping the reference pulse and differentiating the intelligence pulse, which is generated at the crossover point of the MVB cycle, produces a source of time-modulated intelligence. These pulses are used to control the phase of a continuous wave carrier.

ELECTRONIC NAVAL WARFARE

Captain R. Bennett
Bureau of Ships, Navy Dept.,
Washington, D. C.

A general survey of the use of electronic equipment in Naval warfare was given with special emphasis on the progress made during the war. It was pointed out that electronic equipment can no longer be added as an afterthought to Naval vessels. The author stated that as many as 49 different channels were operating at one time on a single vessel. The difficulties of interference between these channels were discussed. An attempt was made to show the inter-relation of military uses of equipment with commercial uses. The effect of standardization and lack of it were indicated as they applied to the military and commercial fields. In this connection some of the circuit developments made during the war were discussed briefly.

AVIATION NAVIGATION AND SAFETY SYSTEMS

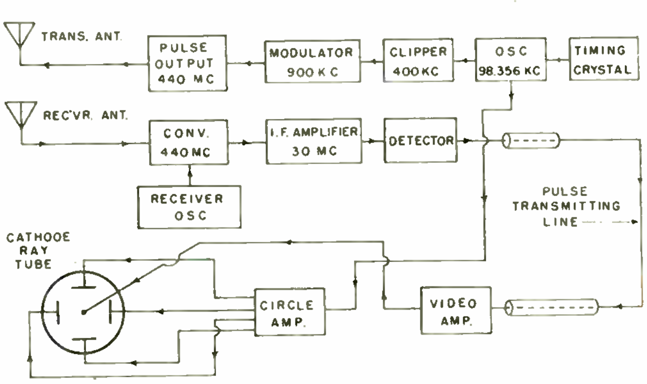
VISUAL DIRECTION FINDER

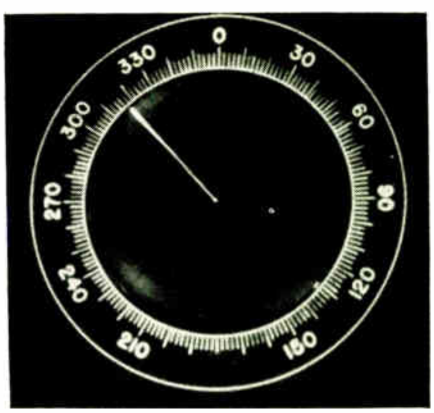
Aldo Scandurra and Samuel Stiber,
Evans Signal Laboratory,
Belmar, N. J.

Radio set AN/TRD-2 is a Signal Corps development designed to provide a portable and mobile direction finder giving instantaneous indications and automatic sense. This direction finder is unique in that the instantaneous indication on the oscilloscope is a single line generated from the center of the screen with a length proportional to the signal strength and the angular position of which indicates the direction of arrival of the signal without sense ambiguity. An additional feature is that noise and modulation are almost eliminated from the visual indication.

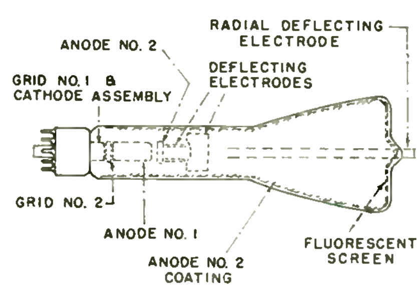
Equipments of this type were useful during the rapid advance of the Allied armies in Europe. It was impossible for the field stations to supply maps at the pace maintained by mechanized infantry. This device provided a means for accurate land navigation.

Block diagram of direction finder





CRT presentation and tube

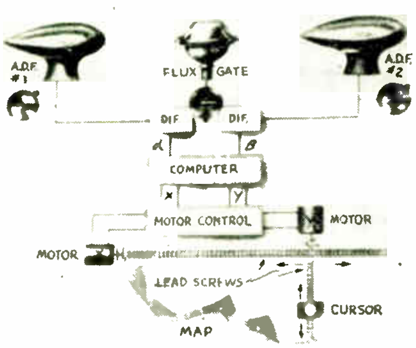


AIRCRAFT PLOTTER

A. C. Omberg and W. L. Webb,
Bendix Radio Division,
Baltimore, Md.

The authors described the development of a device for conveying information from two automatic direction finders and a magnetic heading device into a computer which changes polar coordination into rectangular coordinates. The rectangular coordinates give the position of an aircraft with respect to two ground transmitters, automatically controlling a pen which continuously plots the position of the aircraft on a chart.

Functional diagram of plotter



NAVIGATION SYSTEM

P. R. Adams, Federal Telecommunication
Laboratories, Inc.,
New York, N. Y.

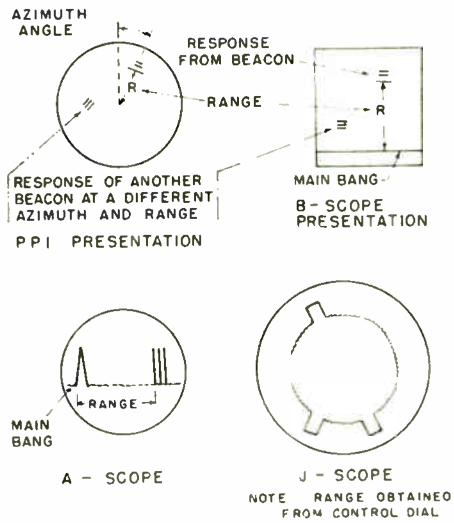
P. R. Adams gave the results of investigation over a period of several years of what kind of system would give 100% reliable communication over the entire surface of the earth. This involved distances up to about 1500 miles. Due to the tremendous variations in signal strength observable in any one frequency band during the course of a year it was finally concluded that only a system utilizing a number of frequencies which could be chosen depending upon conditions would be capable of producing the required reliability. In addition a very narrow channel should be used to reduce noise interference.

RADAR BEACONS

Capt. R. D. Hultgren and L. B. Hallman, Jr.,
Watson Laboratories,
Red Bank, N. J.

The general theory underlying the operation of radar beacons was described. These are devices which receive an interrogation signal from a distant station and automatically send out a coded signal repliyng to the interrogation. The various components such as receiver, discriminator, modulator, coder and transmitter were discussed. Other factors of importance such as operating frequencies, required receiver sensitivity and transmitter power, choice of pulse duration, cause and effect of delay in the beacon were discussed. In addition, the authors surveyed the possibilities for use of this device in aircraft homing, landing, rendezvous, identification and airport surveillance.

Types of data presentation

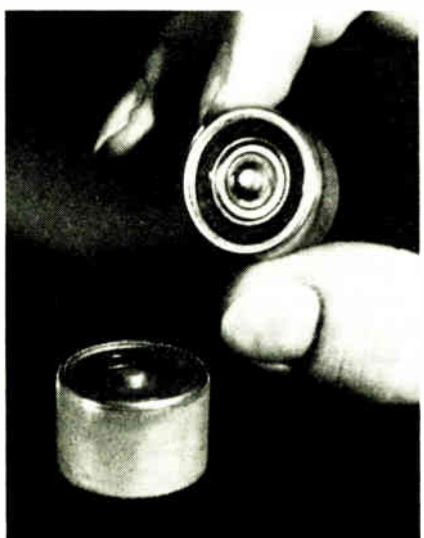


CHARACTERISTICS OF MERCURY TYPE BATTERIES

One of the few important changes in the basic construction of primary batteries was devised by Samuel Ruben, a consultant for the P. F. Mallory Co., Indianapolis, and resulted in a cell that has an ampere-hour capacity four to six times greater than that of the conventional dry cell and an output that is nearly constant throughout its service life. This characteristic is particularly valuable to portable radio and hearing aid users.

Its characteristics include several other features, among which is that it does not need rest periods, its capacity remaining the same whether the cell is used continuously or intermittently. This is because the cell is free from polarization effects. These characteristics vary from the usual dry cell since the cell operates through the chemical reaction of zinc and mercuric oxide instead of zinc and carbon.

The cell has a high capacity-to-volume ratio, initially three to four times greater than batteries of the same cubic content as conventional



dry cells at room temperature. At higher temperatures this ratio greatly increases. In addition the cells have long shelf life. They are hermetically sealed and are relatively unaffected by humidity, hot dry climates or high altitude. Temperatures up to 130°F have but little effect on the substantially flat discharge characteristic. Regulation is excellent. No-load voltage is slightly greater than 1.3 volts. Range of variation is less than .01 volt for new cells.

The battery has a sharper life cutoff and an ampere-hour capacity independent of drain. Within rated limits each cell will exhaust itself and deliver essentially the same number of ampere-hours in continuous or intermittent service.

Each cell is enclosed in a steel case which, taking no part in electrolytic action of cell, does not corrode and mess up adjacent components. For special applications the very low internal resistance makes possible high flash currents. This low and substantially constant resistance at audio frequencies is maintained throughout its life.

Because of more expensive ingredients the price per cell will be somewhat higher for Mallory cells than for typical zinc-carbon cells, but the cost per milliampere hour of service will be competitive.

CBS SHOWS ITS COLOR

High frequency transmission with sound on same carrier demonstrates their solution of color reception problems

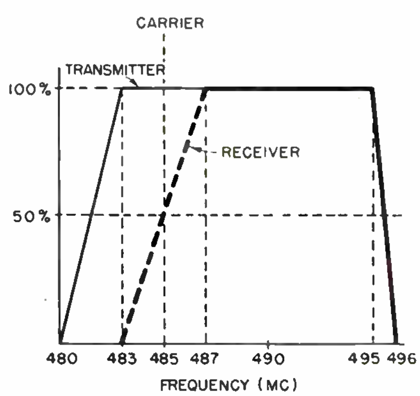
• In 1944 when CBS publicized, so boldly, its belief that higher quality color television was not only possible but immediately practicable, there was loud dissension among many groups who were at the moment concerned with the big problems still to be hurdled using "regular" frequencies. Whether or not CBS was betting on a sure thing, based on their then current investigations is not known, but they showed courage by backing their convictions, going ahead and ordering one transmitter and starting to build another in their own laboratories, together with receivers of various types, cameras and the other necessary parts of a complete system. A brief description of this transmitter is given elsewhere in these pages.

Series of demonstrations

As a result a series of rather spectacular demonstrations showing their progress has recently been conducted from which it is evident that, at least technically speaking, they have reduced the frequently-mentioned "five years at least" by a couple of years or more. Here remember the restriction "technically speaking," because with regard to quality of results and expansion of facilities, much work must still be done before UHF color television can be commercially possible. These will be mentioned later.

In these demonstrations, it was proved that a moderately powerful transmitter with completely satisfactory characteristics can be designed. It was also evident that antenna structures, resonant to these frequencies, became so small physically that multiple arrays or other gain-improving expedients could be utilized to advantage in confining the radiated signal to a horizontal blanket and thus preventing the loss of energy into the sky (where there are no receivers anyway).

In the case at hand, a horizontal slot type transmitting antenna was used which was stated to concentrate the energy from the 1 kw (peak) transmitter into such a blanket, with an improvement of 20-fold at the horizon. Here attention may be called to the characteristics of radio signals. There is no inherent magic in any frequency range of signals over any other range within line of sight distances once they have left the transmitting antenna. The well known differences found in practical experience depend on conditions at the terminal stations. It might be stated that the higher the frequency the less the signal strength picked up (an inverse relation), if a dipole resonant to the frequency in each case is utilized at the receiving position. Or in another way of thinking, all frequencies are received equally, assuming antennas or antenna arrays are used in each case having equivalent effective areas or volumes in space. Or again, with equal sincerity it is true that the higher the frequency the greater the signal, if the more complicated array mentioned in the second case (necessary to build up the antenna to the same size) is designed to increase the pickup from a single direction only.



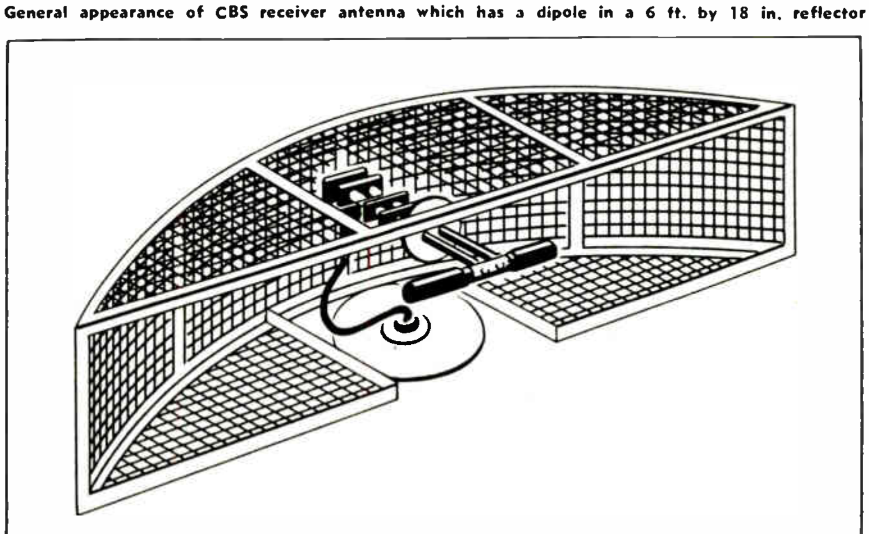
Transmitter and receiver band pass curves

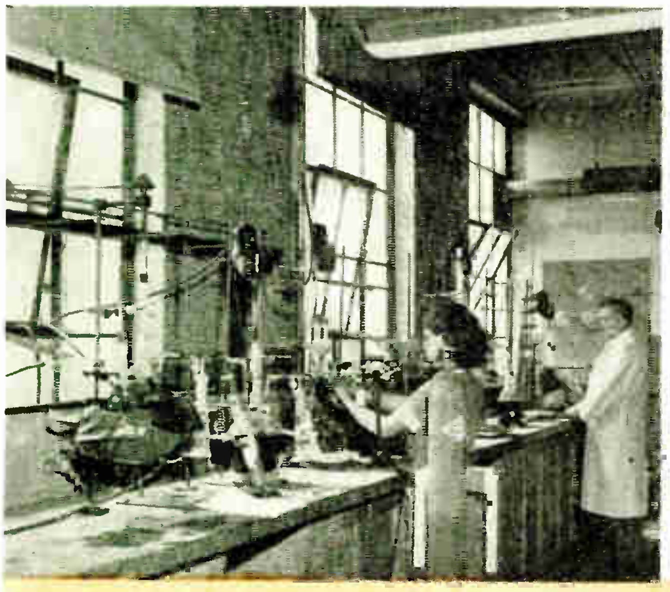
It was in this last mentioned manner that the advantages inherent with the smaller sized halfwave dipoles were utilized with CBS tests to make the higher frequencies even more effective than the lower frequencies heretofore used in the television service. A special reflector was utilized in these tests having an opening 6 ft. across and 18 in. high, providing a reception beam width of 18 deg. (on the half signal strength basis).

A wide band dipole (obtained by conical shaped members making up the dipole) placed at the center of this reflector, afforded a demonstration of directivity obtainable with a physically realizable structure. The experiments also proved that ghost-free pictures could be obtained by collecting signals that bounded off any one of several tall buildings in the area. This was

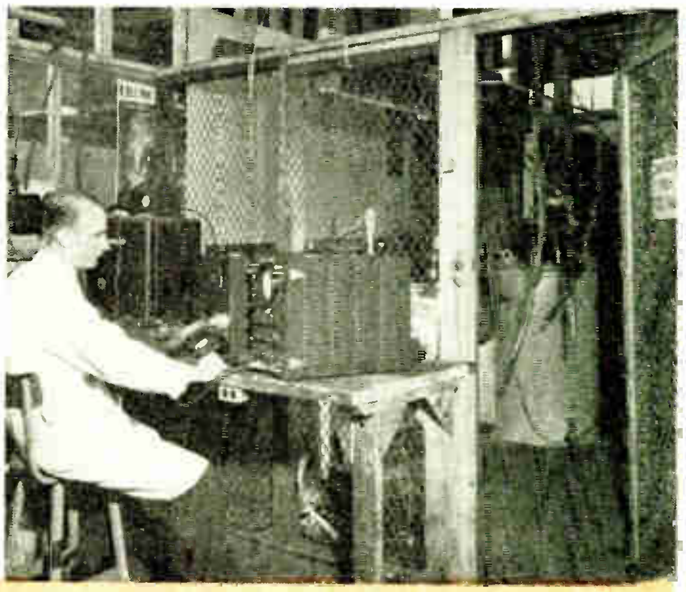
(*Continued on page* 118)

General appearance of CBS receiver antenna which has a dipole in a 6 ft. by 18 in. reflector





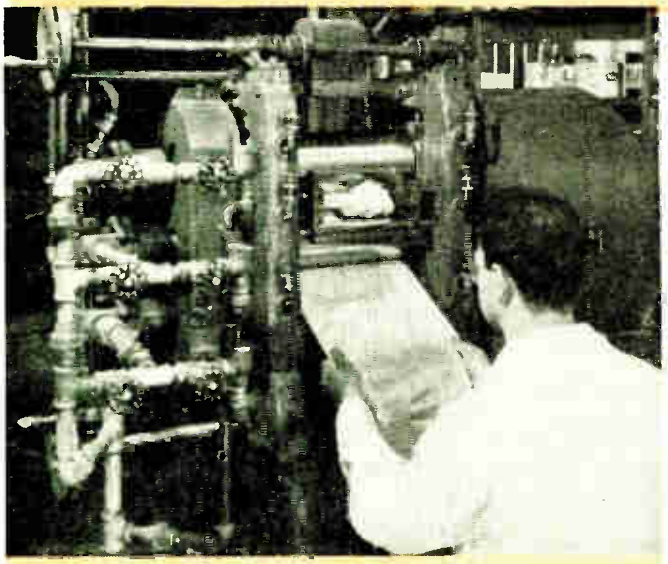
Corner of chemical laboratory carrying on fundamental and applied materials research. Several new plasticizers and synthetic insulating materials have been developed here. These and other laboratory views on this page are of Intelin labs, Federal Tel. and Radio Corp.



Latest piece of test apparatus developed in labs is designed to test surge strength of dielectrics. A standard impulse in kilovolt range is generated and fed across the sample; oscilloscope detects breakdown. New apparatus gives quantitative results and speedy operation

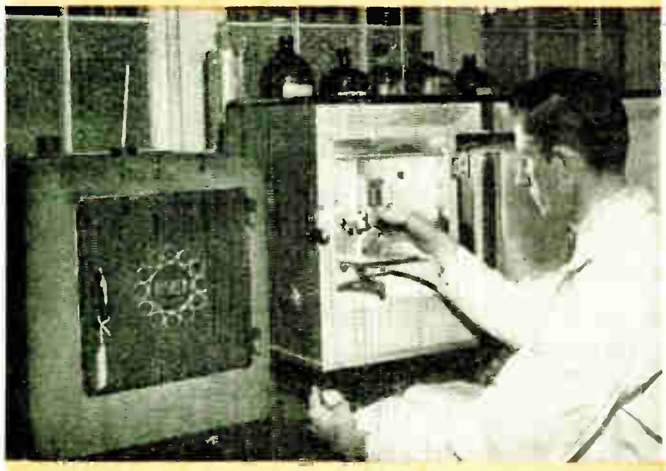
INSULATION

Fundamental and applied re-
in the development and test-

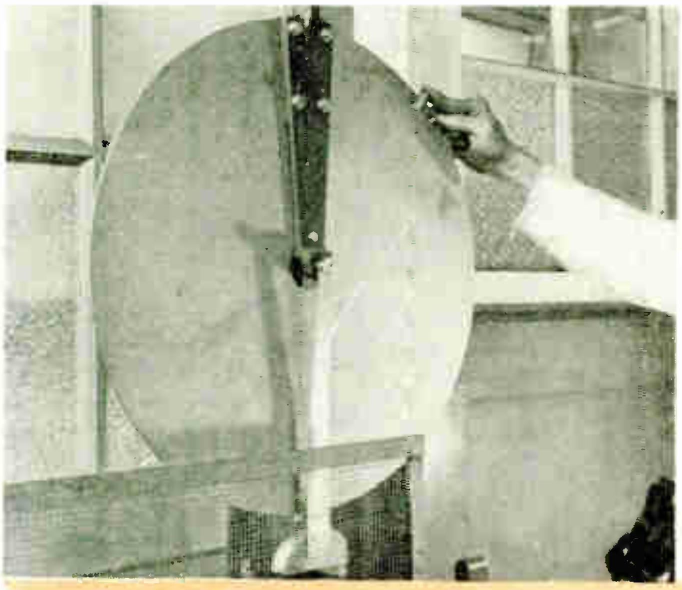


Compounds produced by the Plastics and Chemical groups are sheeted in this calender to yield a smooth, uniform sheet within small dimensional tolerances. Physical and electrical properties of prepared materials are then determined as shown in illustrations on other page

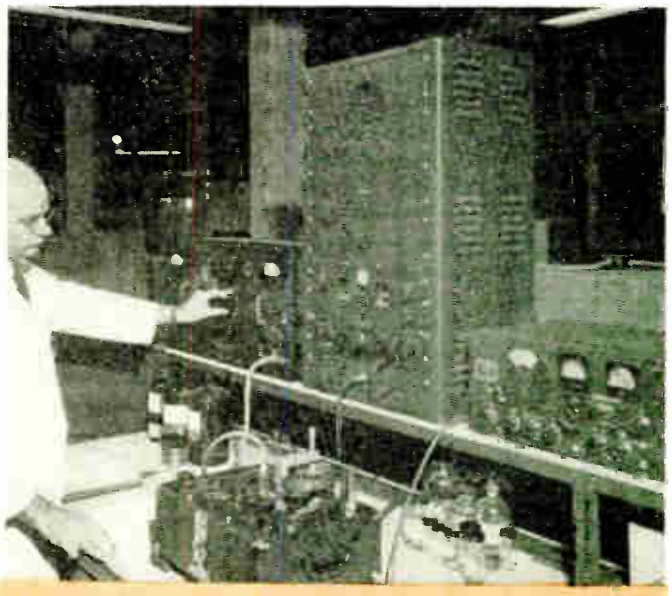
Resistivity of samples of jacketing materials is measured on megohm bridge. Oven at left and water bath at right enable dry and liquid immersion tests to be taken at desired temperatures. Temperature conditioning is frequently used in tests to establish standard condition



Hardness or resistance to indentation and penetration is one of important physical properties of plastic material used in high frequency cable. Measurement of hardness is being made with Shore Durometer, used for elastic thermo-plastics. Sample previously conditioned



Impact resistance is measured for plastic materials to be used in telephones and as electrical insulation posts. This characteristic indicates the amount of energy required to break a given sample, and is recorded in foot-pounds on the Charpy tester shown in picture above

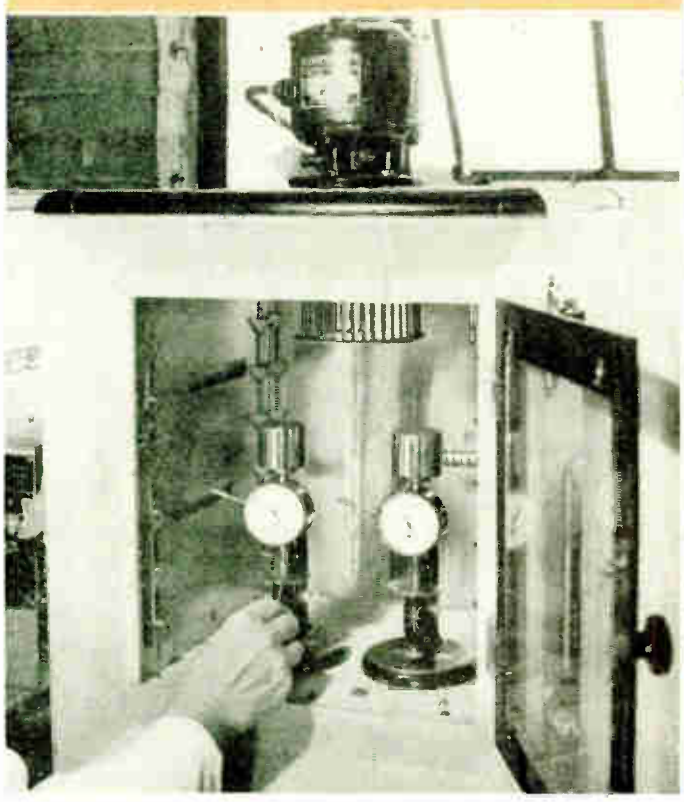


Dielectric characteristics of materials are important. Power factor and dielectric constant are measured accurately between frequencies of 500 kc and 30 mc with apparatus shown above. Set up to take liquid dielectric measurements, equipment also measures solid constants

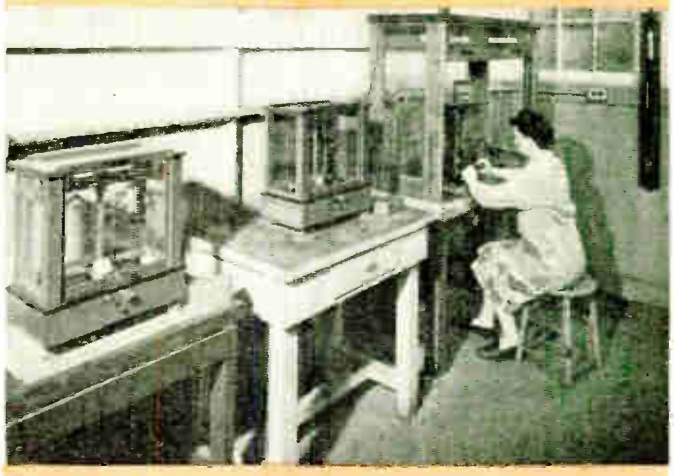
LABORATORY

search facilities required ing of high frequency cables

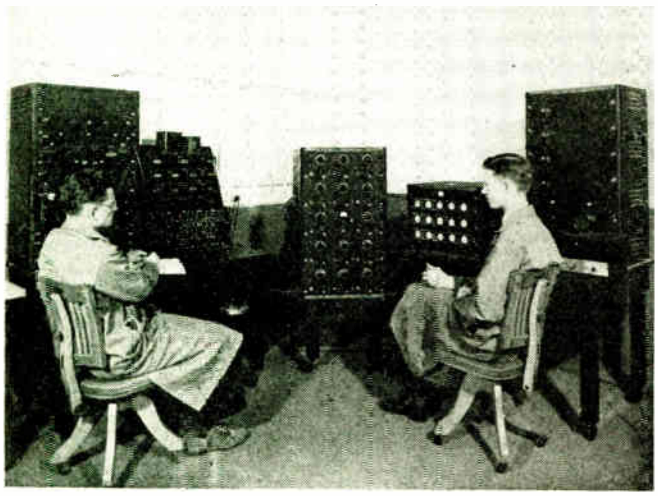
Heat deformation test must be undergone by thermoplastic compounds, particularly if they are to be used as jacketing materials. Here the thickness of the sample is measured in mils before and after it is subjected to a heat treatment; ratio of values determines deformation

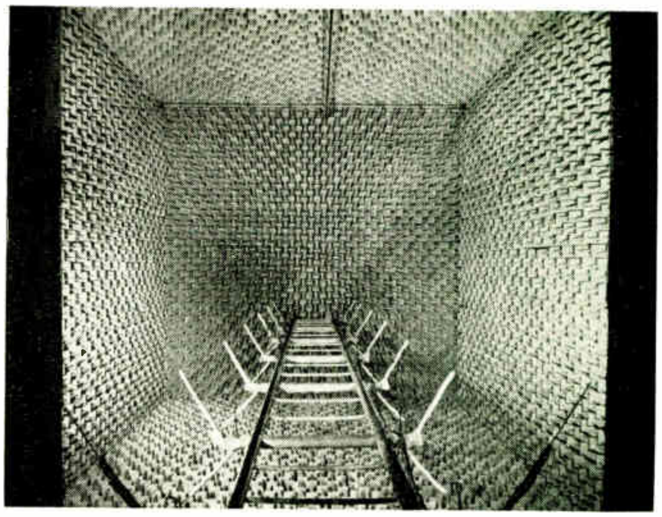


New method of measuring dielectric characteristics at UHF is shown. Using frequency determination to calculate the dielectric constant, this apparatus, which operates at 300 and 900 mc, is capable of higher degree of accuracy than heretofore possible. Technic is rapid



Highly sensitive analytical and semi-micro balances, some accurate to 0.00001 gram, are used in connection with analysis of compounds synthesized in laboratory, as well as in determination of their physical and chemical constants. This is picture of Intelin balance room





Left, the audio spectrometer, which splits sounds into 13 bands, in operation. Right, general view of the anechoic chamber showing manner in which surfaces have been treated. Equipment under test is mounted on a car and rolled in on tracks

ACOUSTIC LABORATORY

Harvard scientists and engineers design and build "Anechoic Chamber" in which 99.9% of sound wave energy is absorbed in walls

● As the electronic engineer is often up against the problem of radiating sounds in a satisfactory and undistorted manner, he will welcome the advance in this art produced at the Electro Acoustic Laboratory at Harvard during the war.

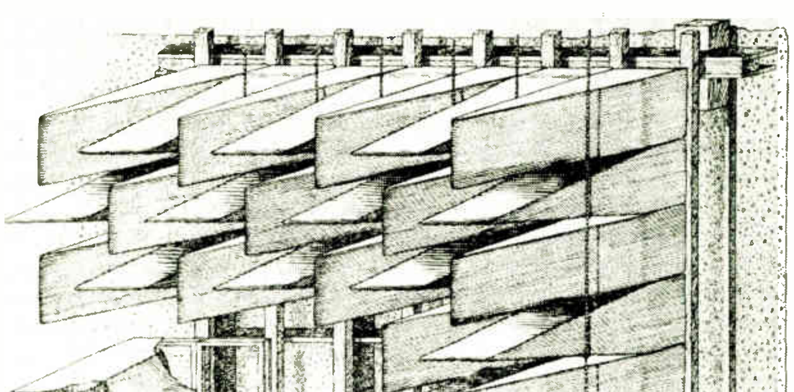
This Laboratory investigated problems of sound insulation for airplanes and other locations near high intensity sound fields and achieved some interesting results.

Under the leadership of Dr. Leo R. Beranek, the Laboratory found that the efficiency of sound insulators depended on the ratio of area to weight and developed a new material which is known in the trade as Fiberglas AA. This is made in the form of ½ in. blankets in which the glass fibers are bound by a plastic and weighs about 1/20th lb. per square foot. Two such blankets sewed to opposite sides of an asbestos paper sheet proved most effective for reducing noise on such planes as the Boeing Super Fortress.

Studies also were carried out to determine the effect of altitude and pressure variations on the intelligibility of speech. To analyze this problem an audio spectrometer was built which separates the sounds of speech into 13 different bands from low to high. Results indicated voice intensity decreased 9/10 at 35,000 ft. and the higher notes tended to be lost. Therefore, amplifiers used under such condition had to compensate for this.

In connection with these studies, the Laboratory built a remarkable room called an "Anechoic Chamber" (meaning "without echo"). In this chamber the walls, ceiling and floor all are covered with fiberglas wedges, base mounted, each alternate wedge being at right angles to its neighbor. Many loud speakers, sirens, microphones, etc., were tested in this chamber and it was found that 99.9% of the sound wave energy was absorbed in the walls at the first reflection. Another unusual room which was built consisted of walls with semi-cylindrical surfaces designed to diffuse noise perfectly.

Method used in installing Fiberglas wedges in the anechoic (echo-free) chamber, all walls and the ceiling and floor being treated in the same manner for effective sound energy absorption



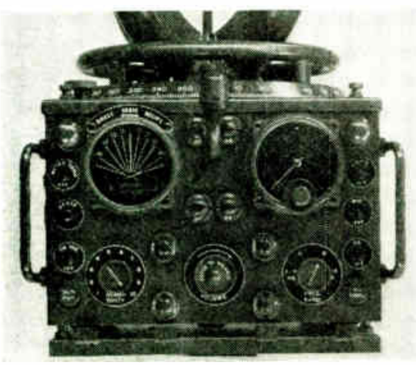
TWIN BEARING DF UNIT

Direction finding carried on simultaneously with message interception from enemy aircraft, patrol boats and tanks

• The Simon Radioguide, a variant of SCR-503-A, is a crossed-loop, twin-channel direction finder using off-null loop position to provide aural reception and visual directional indication simultaneously.

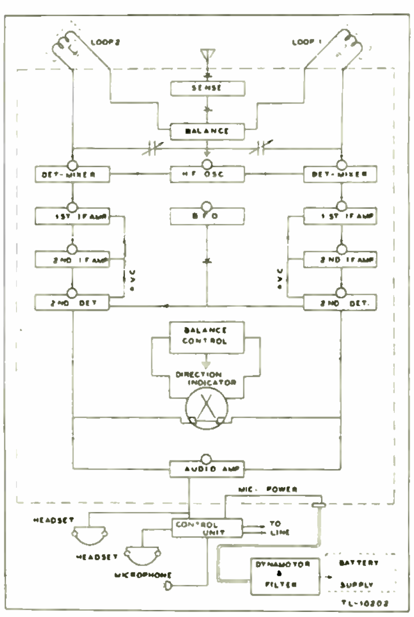
Two eight-inch right-angle loops, encased in a common electro-statically shielded frame, are used. Since the directional pattern of a vertical loop is a cosine function, the two loops respond equally when the arriving signal is in the bisecting plane at 45° to either loop.

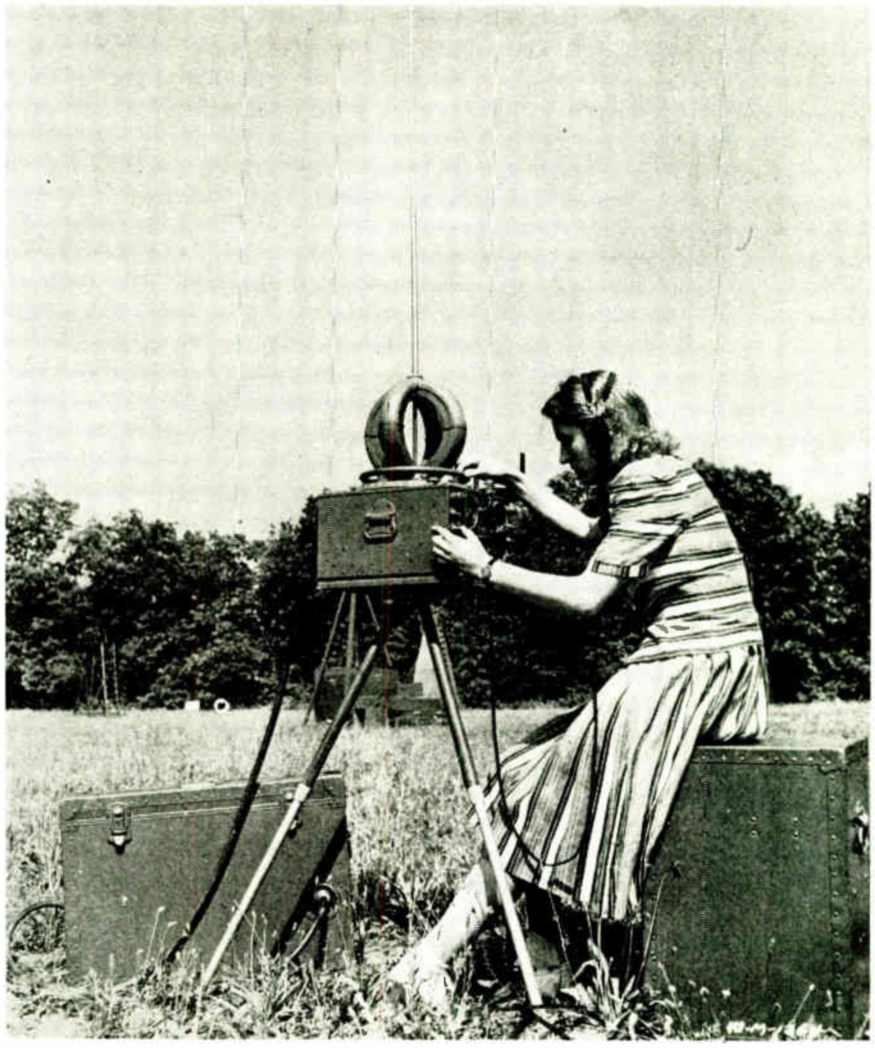
A twin-channel superheterodyne receiver is energized by the loops, the outputs deflect two crossed pointers of the bearing indicating instrument. When the loop is oriented with its bisecting plane in the direction of the incoming signal, the deflection of the crossed pointers is "equal".



View of the front of the Radioguide control

Schematic of arrangement of twin channels





General view of the Simon Radioguide as set up for operation in the field. Sense antenna projects through the axis of the shielded crossed loops. Power supply is 12-v storage battery and dynamotor

The frequency range of the equipment is from 0.1 to 1.0 mc, and from 1.0 to 3.0 mc. The two ranges are covered by individual units.

Since the instrument possesses an inherent quadrantal ambiguity, a specified procedure is used in its resolution. By pressing a balance control button, the operator determines whether the transmiting station lies ahead or behind or in a beam quadrant. This operation ungrounds the two loop return leads and connects the loops in series. The resultant signal voltage is applied to the control grids of the first tubes in each channel.

If the signal arrives from a beam quadrant, the two loop voltages will cancel, causing both pointers to fall to zero. If the signal arrives from fore or aft quadrants, the two loop voltages combine in phase, and the pointers stay at the same level.

The second step is resolution of

(Continued on page 124)

TUNABLE MICROWAVE

By J. J. GUARRERA
Engineering Department
Bernard Rice's Sons, Inc., New York

Design of line-tuned circuits for use with lighthouse tubes as local oscillators, transmitters or signal generators

• In the construction of oscillators for uhf and microwaves, it has been customary to utilize line-tuned circuits when frequencies became such that conventional circuit elements could not be used. However, the available tubes up to this time created quite a problem in adapting line-tuned circuits for use as oscillators since lead inductance and stray capacitance would frequently make the circuits impractical. The cavity resonators, that will be discussed in the following text, use the new lighthouse[1] tube, which eliminates most of the difficulties encountered when using coaxial lines as resonant circuits. This tube has been specially designed for use in the microwave and uhf region. Its physical construction is such that lead inductance is kept at a minimum and coaxial lines can be adapted quite readily as circuit elements. This can be seen in Figs. 1 and 2, which show schematic views of two different types of oscillators using this tube.

These cavities can be used as local oscillators, transmitters or signal generator oscillators in the micro-wave region.

The double coax lighthouse tube cavity resonator shown in Fig 1 uses a tuned coaxial line in both the cathode-grid and grid-plate circuits. As is indicated in the drawing, the grid line is common to both circuits as the inner conductor of the cathode-grid circuit and the outer conductor of the grid-plate circuit.

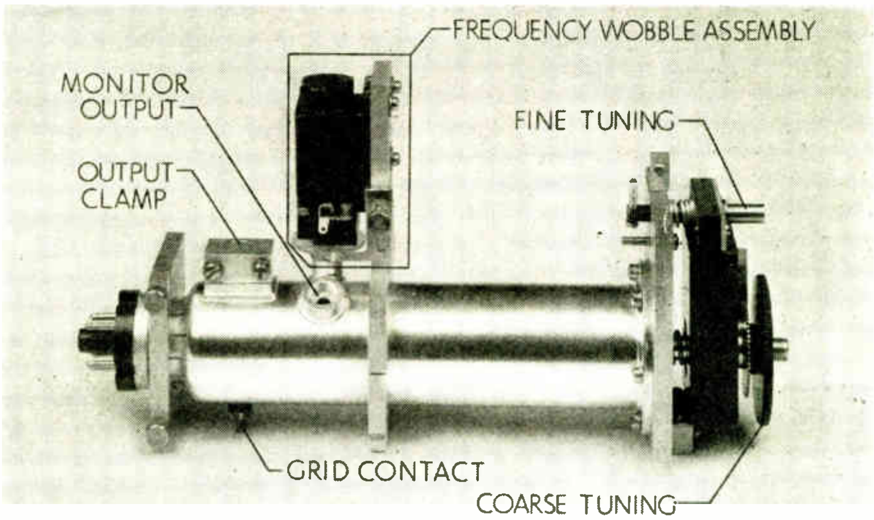
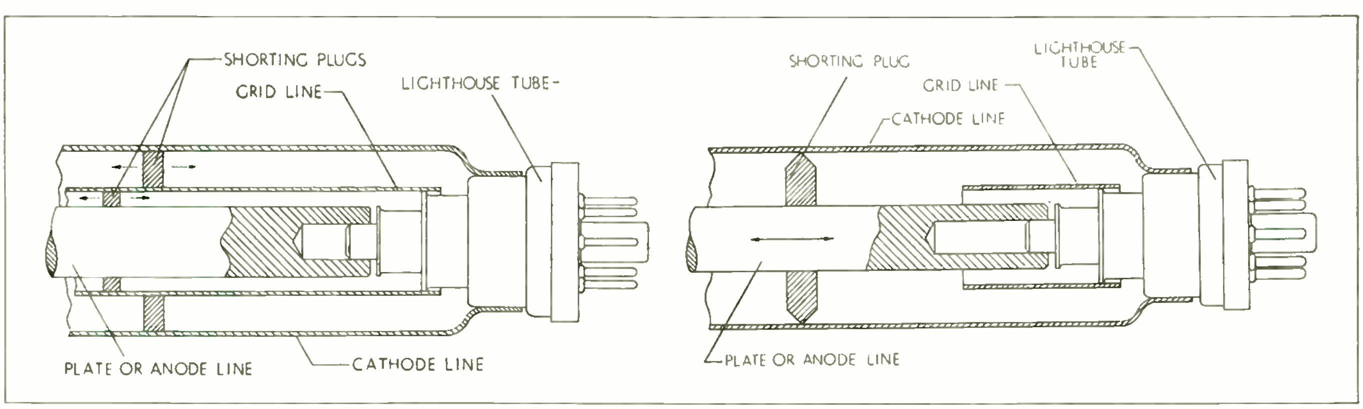


Fig. 4—Design incorporating a monitor output and "wobbler" to vary frequency slightly

The mechanical layout is such that the construction of an oscillator of this type is quite straightforward. The cathode line can be of brass tubing approximately 1½ in. in diameter with one end spun or drawn to the dimensions of the tube. This "neck" should then be slotted so the tube can slide in and out easily. Then a clamp should be used to hold it firmly in place when in operation.

For the grid line, brass tubing, having the same inside diameter as the outside of the flange of the tube, can be used and should be slotted to permit a spring contact. If more clearance is desired in the plate-grid circuit, slightly larger diameter tubing can be used with a short neck spun or drawn as in the cathode-line. Similarly, for the plate line, rod or tubing can be used and should be machined and slotted so that it grips the plate cap of

Figs. 1 and 2—Schematic drawings of two types of oscillators designed for lighthouse tubes



CAVITY RESONATORS

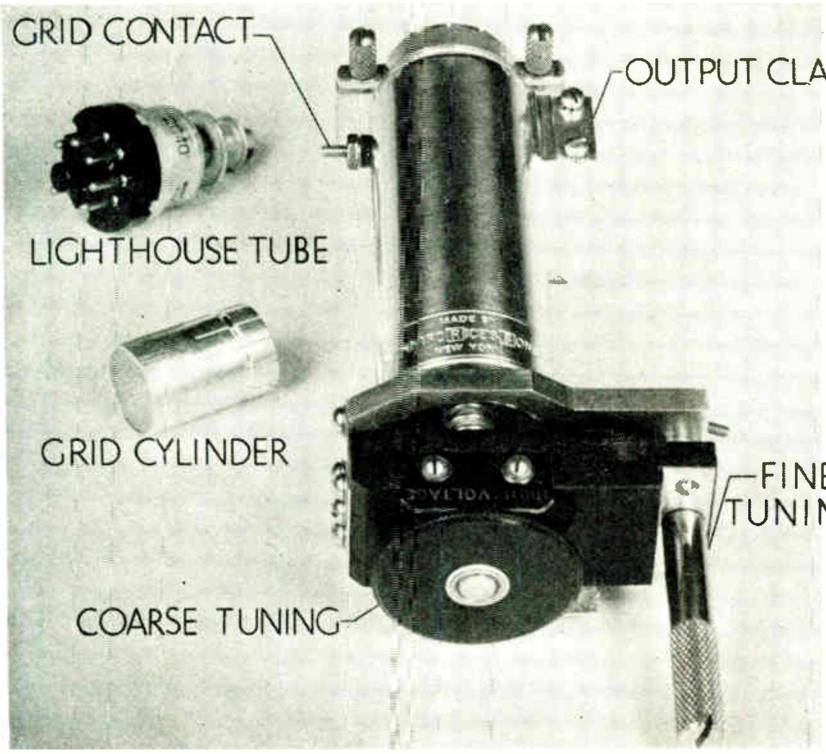


Fig. 3—Showing the Lighthouse tube and grid cylinder removed from the cavity

the lighthouse tube firmly.

The coaxial lines are tuned by means of adjustable "shorting plugs" which are fabricated so that they act as an effective short for the microwave energies without interfering with the dc circuit. Bakelite rings can be used between the lines as spacers to locate them correctly and keep them in place. The spacers should, of course, be assembled behind the "shorting plugs" so as not to interfere with the rf circuit.

The mode of oscillation of this double coax resonator is determined by the "shorting plug" position and the feedback arrangement. For example, if the feedback is such that it will maintain oscillations in the region of 10 cms, then the cavity will oscillate when the "shorting plugs" are located the proper number of quarter wavelengths back from the tube so they, too, will support the 10 cm oscillations.

For a cavity that is required to oscillate over only a limited range, a quarter-wave choke can be used as a shorting plug. (Fig. 6) It is quite evident that this is rather simple to fabricate. The spacing between the choke and the wall of the tube is determined by the amount of dc voltage applied to the plate of the tube. The smaller the spacing the more effective the "choking" or "shorting" action will be.

For a cavity that is required to oscillate over a broad band this choke type short would be impractical since the quarter-wave "choking" effect would take place only over a very limited range. To meet this requirement, a capacitance type "shorting plug" was designed as shown in Fig. 7. This "shorting plug" is quite effective and satisfactory in the microwave region. The design shown in Fig. 7 is only one of the many ways of accomplishing this capacitance type "shorting" action.

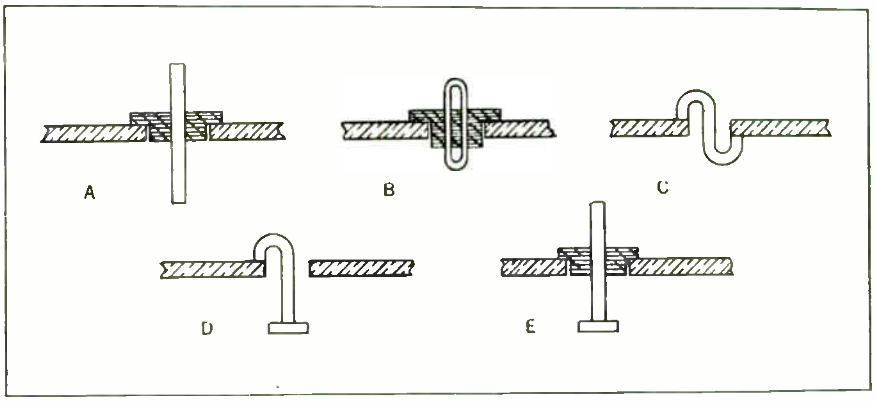
This type of resonator can be made to cover an extremely wide range of frequencies. The shortest wavelength obtainable is limited by the electrical characteristics of the tube itself and for the lighthouse tube this lower limit is in the region of 8 cms. The only limit to the longest wavelength obtainable is the physical size of the resonator. For this circuit to operate over the entire range, it is necessary to introduce proper feedback between the plate-grid and grid-cathode circuits. This can be accomplished by a number of methods. Some of the more common and simpler ones are:

(1) Introducing a loop between the cathode-grid and grid-plate circuits. This is usually satisfactory for short wavelength oscillations in the order of 10 or 12 cms when the lines are resonating in the three-quarter wave mode so that the loop can be introduced at a point of voltage minimum without interfering with the motions of the "shorting plug."

(2) Introducing a capacitance probe between the cathode-grid and grid-plate circuits. This type of feedback generally is used for the longer wave-length oscillations when the line is operating in the one-quarter wave mode, and the tube end of the cavity can be considered a point of voltage maximum.

(3) Introducing a combination of capacitance probes and loops through the wall of the grid line. This arrangement generally is used when a band of oscillations must be covered which does not fall clearly in either of the above two cases. For example, if an oscillator were desired to cover the range from 10 to 20 cms, a feedback system would

Fig. 5—Cross sectional views of various loops and probes used for feedback purposes



nave to be devised to maintain proper oscillating conditions througout this range. On the other hand if an oscillator were desired from 8 to 12 or 15, cms, it is very likely that a loop alone would suffice.

In Fig. 5 are illustrated a series of cross-section views of various loops and probes used for feedback purposes. The operating range of any given setup is limited by the feedback system, which usually is quite frequency sensitive unless elaborate and complicated mechanical arrangements are made for broad band operation. Frequently the band of operation in an oscillator can be made quite broad by the use of a combination of the loops and probes.

Since the lines in this double coax resonator are terminated with "shorting plugs," the oscillations are of an odd quarter-wave nature. For oscillations on the order of 25 cms and greater, the fundamental quarter-wave mode invariably is used in order that the physical dimensions of the cavity may be kept as small as possible. However, when oscillations in the region of 10 and 15 cms are desired, it becomes necessary to operate the cavity in the three-quarter wave mode and sometimes five quarters

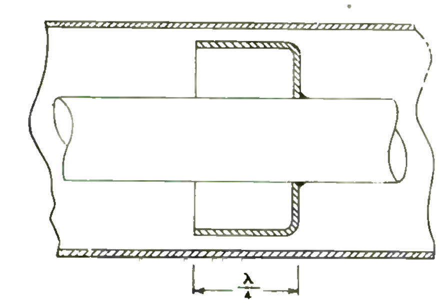


Fig. 6—Quarter wave choke used in cavity as a shorting plug

since the loading action of the tube places the first voltage minimum almost within the glass envelope.

This type of cavity is slightly awkward in use since it requires tuning the cathode-grid line, the plate-grid line and in addition maintaining proper feedback conditions throughout the range of oscillation. These adjustments can be quite critical, and it sometimes is necessary to use a variable feedback arrangement so that the resonator can be tuned and adjusted to give satisfactory operation over the desired band. This resonator can be used for both cw and pulsed applications.

The cw power output that can be obtained at 10 cms is approximately .1 to .5 w with 5 w of dc power supplied to the circuit. In pulsed applications where the peak of the pulse supplied to the anode is 800 v or greater, the oscillator has an efficiency of approximately 10%. As this type of cavity is adjusted for longer wavelengths, the efficiency of operation increases.

Another type of oscillator, known as a re-entrant cavity, is shown in

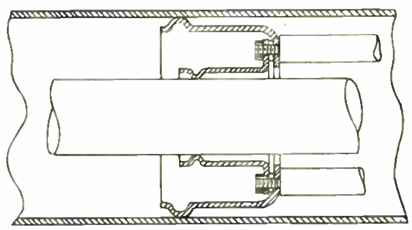


Fig. 7—Capacitance type shorting plug

Fig. 2. This unit also uses coaxial lines in both the cathode-grid and grid-plate circuit. However, these lines are not tuned in the same manner that is used in the double coax resonator. Instead of terminating the tuned circuits in "shorting plugs," the grid line is made one-half wave long and mounted directly on the flange of the tube.

The length of the grid line is fixed for any given setup, and thus becomes the frequency-determining factor in the circuit.

The "shorting plug" in the re-entrant cavity is mounted on the plate line and functions as an rf short between the cathode-plate circuit and is located an odd number of quarter wavelengths back from the end of the grid cylinder. These are the only points at which oscillations will take place.

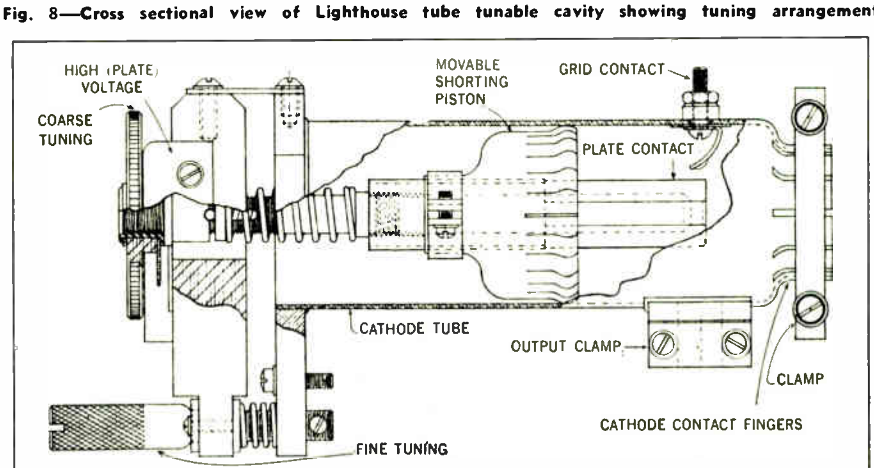
Motion of the "shorting plug" does affect the resonant frequency of the circuit, but its function is primarily to optimize conditions for oscillation with a given grid cylinder rather than to change the frequency. The grid cylinder on the other hand functions as the frequency-determining factor in the circuit, and its length, therefore, is critical. Small variances will change the band of oscillation appreciably.

By comparing Figs. 1 and 2, it can be seen that the construction of this re-entrant cavity is very similar to the construction of the double coax cavity, which was described previously. The fundamental difference between the two units is that the grid line in the re-entrant cavity is mounted directly on the tube and is supported and held in position in this manner. The "shorting plug" in the re-entrant cavity is mounted firmly to the plate line and forms a sliding contact to the cathode line. These two differences make the re-entrant oscillator simpler to construct and easier to operate.

Tuning is accomplished in this circuit by a motion of the plate rod on and off the cap of the tube, as is indicated by the arrow in Fig. 2. Motion of the plate line away from the tube effectively introduces a series inductance in the plate grid circuit, which causes the frequency to decrease or the wavelength to become longer. The amount of tuning that can be obtained by this method is approximately 1 cm in the region of 10 cms. This resonator, therefore, can be tuned over a 10% band with only one control which makes it an extremely practical and simple device for use where tuning is necessary, provided that the required tuning does not exceed the limits over which a given grid cylinder will perform satisfactorily. This unit customarily is used in the region from 8 to 12 cms, since operation at longer wavelengths proves impractical.

(*Continued on page* 120)

Fig. 8—Cross sectional view of Lighthouse tube tunable cavity showing tuning arrangement



LABORATORY KEYHOLE

Current Research that Forecasts Future Electronic Developments

5 KW AT 300 MC—Dissipating more energy per unit area than has heretofore been possible, a parallel-plane water-cooled tube developed by RCA laboratories is capable of developing 5 kw of output power at 300 mc. Principles of electron optics are used in the tube's design. The massive plate is contained within a glass envelope, and communicates to the exterior by means of a tube which encloses two smaller tubes through which water enters and leaves. Seals and stems are completely water-cooled. The tube is a double tetrode with partial internal neutralization.

ELECTRONIC BONDING—A bond is needed between the steel head of a golf club, weighing between 8½ and 10 oz., and the steel shaft. An induction heating method to secure this bond has been worked out in a testing laboratory of the Commonwealth Edison Co., Chicago. The tapered hole in the steel head was coated with polyvinyl acetate, the tapered shaft inserted in the hole, and the unit heated inductively to 350° F. in 1 sec. After cooling, the club was submitted to a very severe torsion test, and the bond pronounced unbreakable. Method has added advantage that no subsequent polishing is needed, as the heating does not in any way discolor the chromium plating.

MEASURING THIN COATINGS by X-ray absorption is reported by L. S. Birks and H. Friedman of the U. S. Naval Research Laboratory. Characteristic X-rays were reflected from the base material and the diffracted intensity measured by a Geiger-counter system. When the base material was covered with a thin coating. the X-rays were reduced in intensity according to the exponential absorption law for the coating material. Metal plating thicknesses were determined in the range from 10^{-5} to 10^{-2} centimeters. The method is generally applicable to coatings of any material or combination of materials whose X-ray absorption coefficients are known.

ELECTRONIC GRADER—C. W. Rupprecht, Long Island industrial engineer, is developing an electronic grader which will sort malleable iron castings according to their machinability and tensile strength. In the initial stage, castings travel through three successive magnetic fields. Accept and reject relays driven by degenerative amplifiers complete the grading operation. The process will be high-speed according to Rupprecht, and will not slow down the foundry production line. He points out that castings which are too hard may damage tools, while those which are too soft may not hold up in use. The electronic device will replace a slow piece-by-piece drop-test now in use.

HIGH COST OF LAB MODELS is illustrated by recent revelation of figures on hand-built color-television sets. For pioneer 10-inch direct-view color televisor cost-sheet totalled $3,150; for 18-by-24-inch color projection model, $5,900. However these costs of course have no bearing on future customer prices for production-line jobs, which will be much lower. (Early models of FM sets from same laboratory cost $2,400 each, though similar sets were later placed on market at little more than prices of ordinary radios.)

NOTE FOR ELECTRONIC GARDENERS—For the past three years, using electronic amplifiers, Dr. H. T. Stetson has been continuously measuring the flow of sap in a tree near his Needham, Mass., laboratory. In 1946, sap had already started to flow early in Januyear. In 1945, the sap started up in February, predecting the early Spring a year ago. But now, in 1946, sap has already started to flow early in January, probably as a result of the early-January warm spell. Nearby maple-sugar farmers also found the maple sap flowing in January. Does this mean another freak growing year in 1946?

RADAR MOON MAPPING—Sir Edward Appleton, in a paper presented before the Physical Society of London, proposes to use radar in measuring heights of lunar mountains, craters and plateaus. By using very short waves, Sir Edward believes that sufficient resolution could be obtained to make altitude measurements never before possible since the moon always presents the same face toward the earth; hence lunar objects are always seen from the same head-on angle.

FLAME PHOTOMETER—A new laboratory instrument has been developed for indicating concentrations of sodium, potassium and calcium in a sample. Using the well known kitchen experiment of throwing salt (sodium chloride) into a gas flame to watch the color change to a brilliant yellow, in this new flame photometer a sample of the substance to be analyzed is dissolved in water and a mist of the solution atomized into a special gas flame. The light, characteristic of the desired element, is gathered from the flame by an optical system and glass filters and then directed on a photoelectric cell. The amount of light reaching the photoelectric tube sets up a proportionate electric current in a meter circuit. The final meter reading is therefore an indication of the concentration of sodium, potassium or calcium in solution in the sample. The sensitivity of the unit is such that 1 part of sodium in 10,000,000 parts of water may be detected.

PREFABRICATING PROPELLERS—According to report, manufacturing processes in the production of large steel propellers for marine use has been facilitated through the use of induction heating. Passing a coil gradually down the blades gives the necessary heat pattern for brazing without destroying the physical properties of the metal.

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

LORAN INDICATOR

Propagation considerations that determined frequences—an analysis of design and functioning of various circuit elements

By DAVID DAVIDSON
Radiation Laboratory, M.I.T.

● In any discussion on Loran indicator circuit operation it is worthwhile at first to examine the elements of the system and then to define the requirements to be met by the navigator's instrument. Recent articles have appeared,[1,2,3,4] however, which deal with the Loran system and its development in an entirely adequate fashion, so that this paper will review only those concepts which influence Loran indicator design.

In Loran, a navigator measures the time difference of arrival of pulses from two widely-separated transmitting stations with a nominal reading accuracy of about a microsecond. Since the stations are rigidly synchronized, the contours of constant time difference are a family of spherical hyperboles having the station locations as foci.

In order to obtain a fix, a navigator will require at least one other time difference reading from a second pair of stations. As a single station may be common to two pairs, it takes at least three Loran stations to provide fixing coverage. Certain ocean areas are presently covered by chains of as many as eight Loran pairs all operating on the same radio frequency and identified by the different recurrent rate assigned to each pair.

Station synchronization may be pictured with a familiar analogy, shown in Fig. 1, that of water waves. A wave from the master appears first, and at some time after this wave has passed the slave, the latter originates a wave of its own. Consider the relative position of the waves at any instant. Since the velocity of each is equal, they will forever advance outwards with constant separation, the exact amount depending upon the position of the observer.

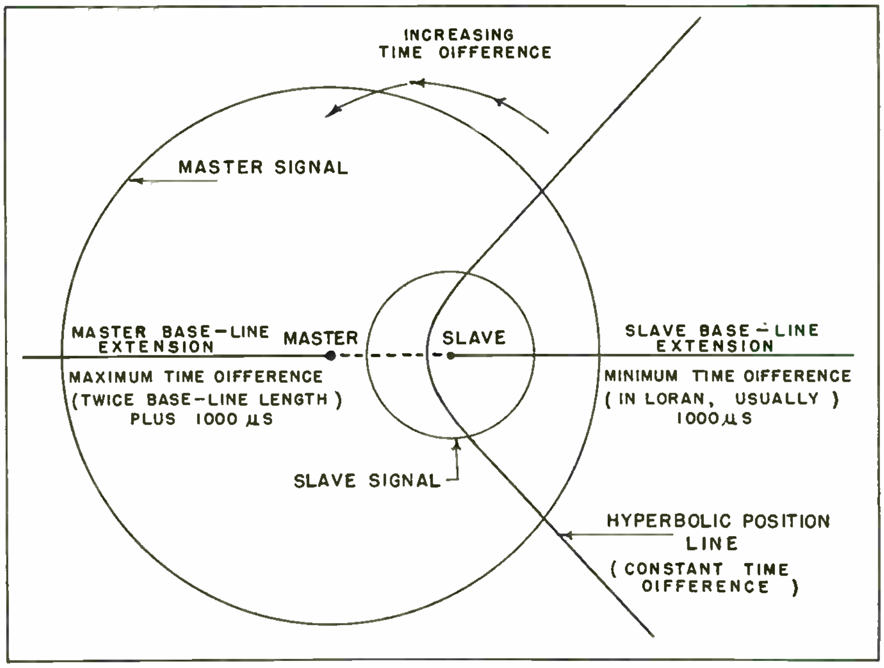
It is evident that the minimum lag of the slave behind the master will occur along a line directly behind the slave and in oposite direction from the master; this is the slave base-line extension. The maximum time difference observable will occur on the master base-line extension, with intermediate values in the area between the extensions. The range of values is clearly dependent only upon the length of the base line.

The choice of Loran frequencies, the 2 mc region, was guided by several propagational considerations, the most striking one being indicated in Fig 2. Obviously, the lower the frequency, the greater the ground wave range. But with the broadcast band being inviolate, pulse technic below this band being increasingly difficult as the frequency is lowered, and the increase in range with lower frequencies being somewhat compromised by the attendant increase in noise level, it seemed best to operate as close to the upper end of the broadcast as possible, in the region of the dip in the noise curve for daytime.

Here, the daytime absorption properties of the E-layer are optimum, resulting in such a reduced noise level that a good ground wave range is available during daylight. With present Loran transmitters, about 70 kw pulse power is radiated on the average, so that a daytime range of 700 miles over sea water is quite common. The nighttime ground wave range is perhaps reduced by 100 miles owing to the increased noise level; this is also evident from Fig. 2.

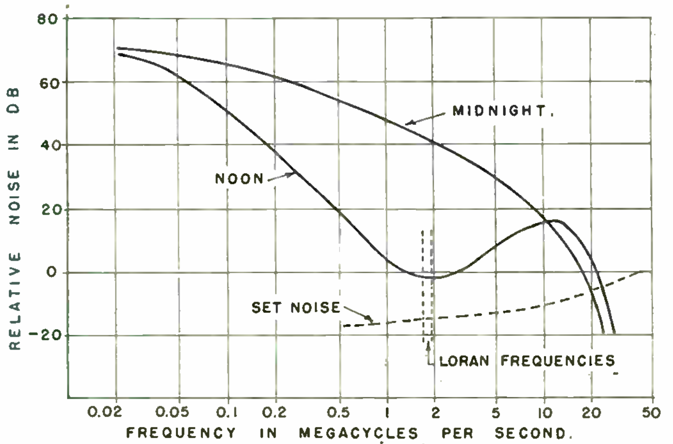
With the advent of sunset, the E-layer is reduced to a tenuous, thin, reflecting region which refracts incident radio waves of medium frequency with remarkably low loss. At 2 mc, single and multiple reflections occur from the E-layer, and these are followed by

Fig. 1—Sequence of transmission for Loran pair showing range of time difference encountered



1. Pierce, J. A., "An Introduction to Loran", Proc. I.R.E. Paper, in Press.
2. Fink, D. G., "The Loran System. Part I.", Electronics, November, 1945.
3. McKenzie, A. A., "Loran—How It Works", QST, December, 1945.
4. Watson, F. G. & Swope, H. H., "Loran", Sky and Telescope, December, 1945; and "Loran Tables and Charts", Sky and Telescope, January, 1946.

CIRCUIT OPERATION



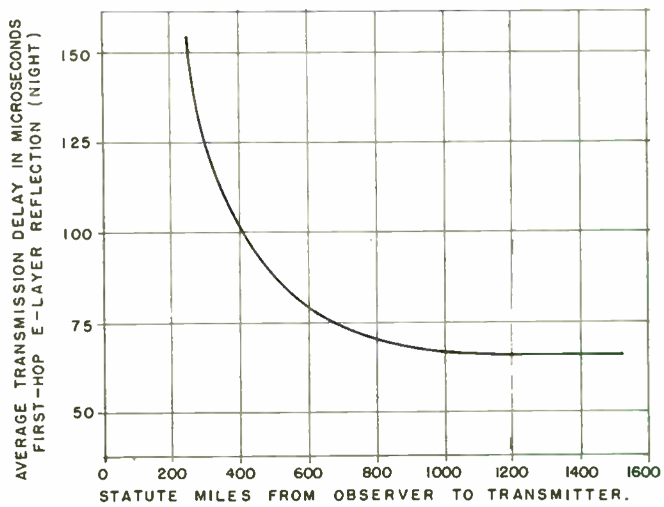
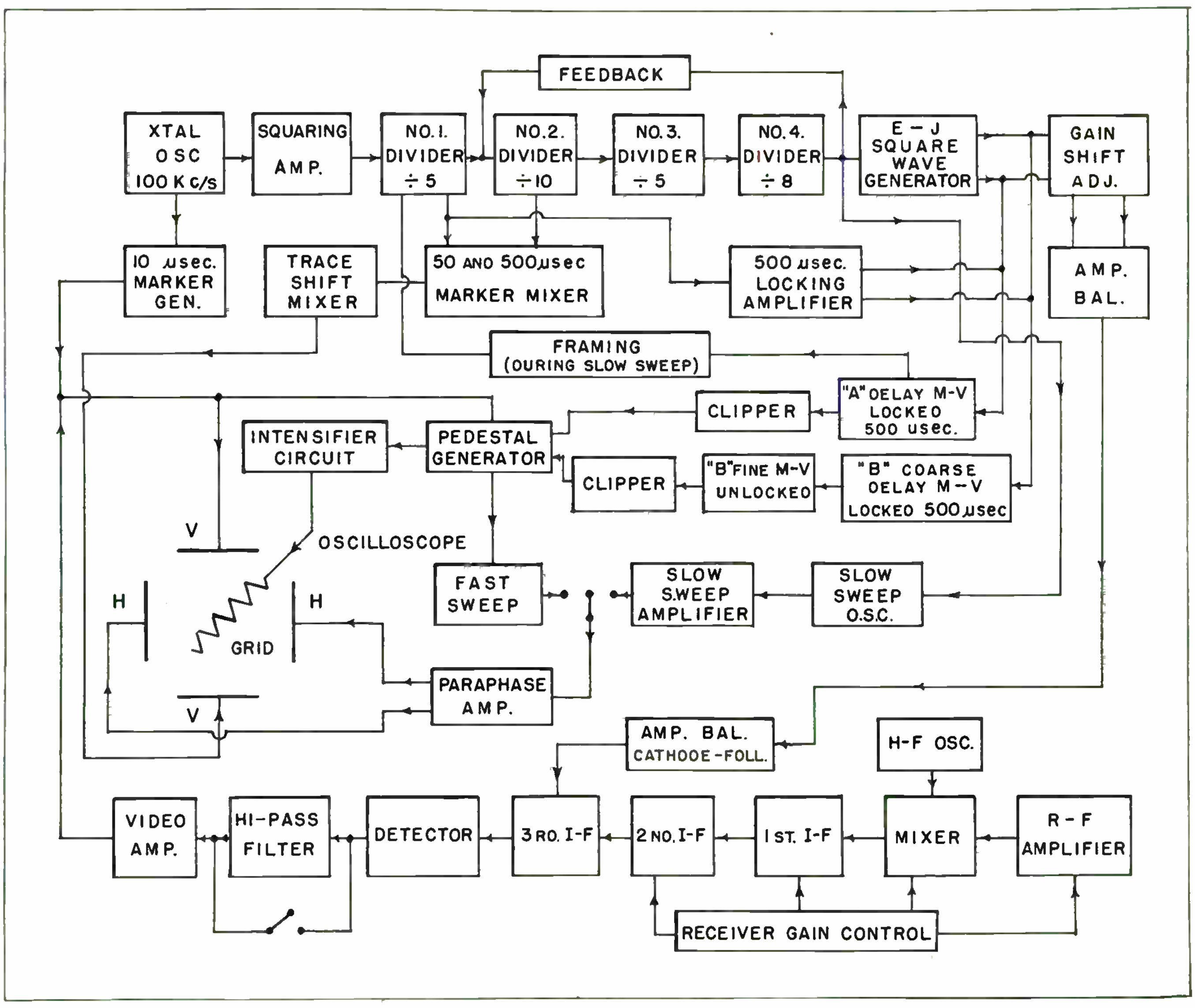


Fig. 2—Variation in noise level with frequency in the temperate zone

Fig. 3 right—Loran sky-wave delay curve during 1942-43 winter

Fig. 4—Block diagram of Model DAS-1 Loran receiver-indicator



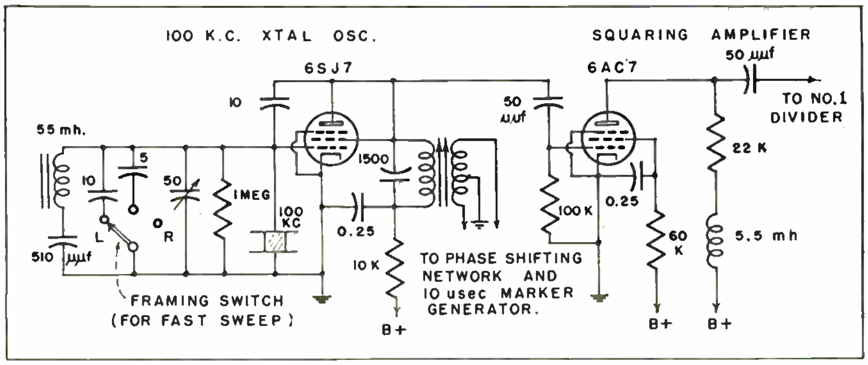


Fig. 6—Crystal oscillator and squaring amplifier circuits

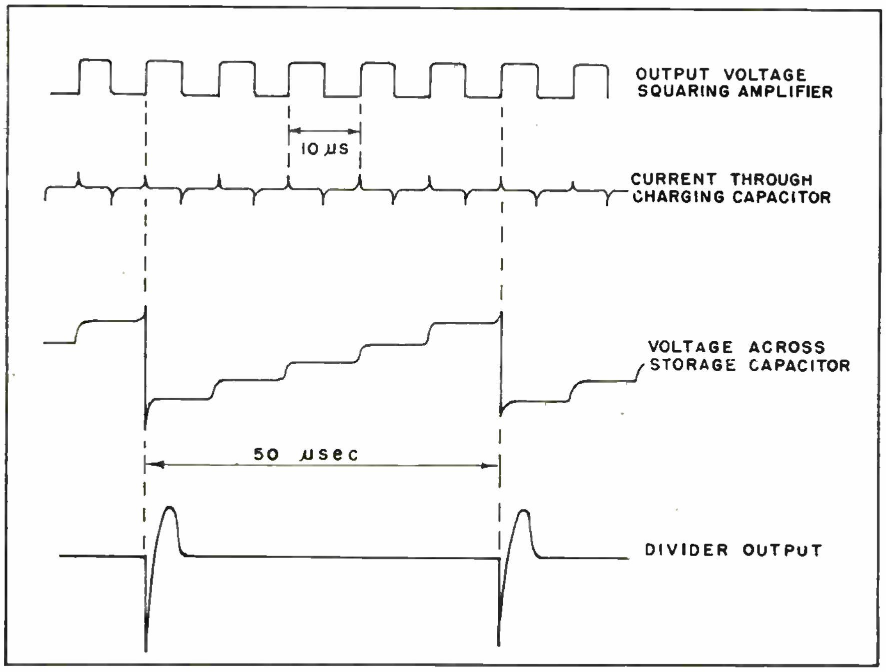


Fig. 7—Waveforms, first divider circuit

numerous reflections from the night F-layer.

Experimentally, it was determined by numerous Radiation Laboratory field observations,[5] that the stability of the singly-reflected E-layer signal is adequate for navigational purposes. This is formally expressed by stating that the transmission delay for a first-hop, E-layer reflection at night can be related to the distance of observer from a transmitter by a rather simple curve such as the one given in Fig 3. Actually, the curve is a band with greater width at short range, indicating greater probably error of the delay of the sky wave behind the ground wave. At 400 miles, the delay is roughly 100 microseconds, while at great distances it is about 70 microseconds.

Second and multiple hops of both E and F layers are too unstable for use in a navigation system. The service provided by nighttime first-hop E reflections allows the extension of Loran coverage for a pair of stations to more than double the daytime range, and the limit to this nighttime range is determined by the relation between the effective "layer height" and the curvature of the earth. In fact, the absence of first-hop E reflections beyond 1600 miles has been somewhat facetiously termed a proof of the earth's curvature!

Thus we see that ionosphere reflections result in the reception of a train of pulses for each Loran signal radiated, and these trains extend several thousand microseconds beyond the ground wave. The intensity of the latter portion of the train is rather weak on the average and so causes little difficulty. At any rate, the navigator is solely concerned with the first 500 microseconds of each pulse train, for in that portion will be found the ground wave, the first-hop E, and the second hop E; satisfactory operation of the system at night is dependent upon the proper identification of these components. The splitting of the sky-waves and their slow fading leaves little doubt as to which is the ground wave.

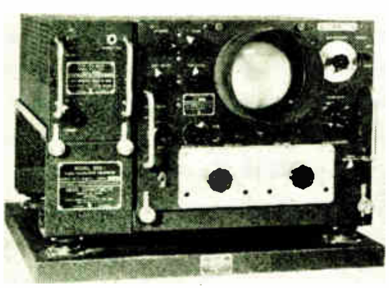


Fig. 5—Model DAS-1 Loran receiver-indicator

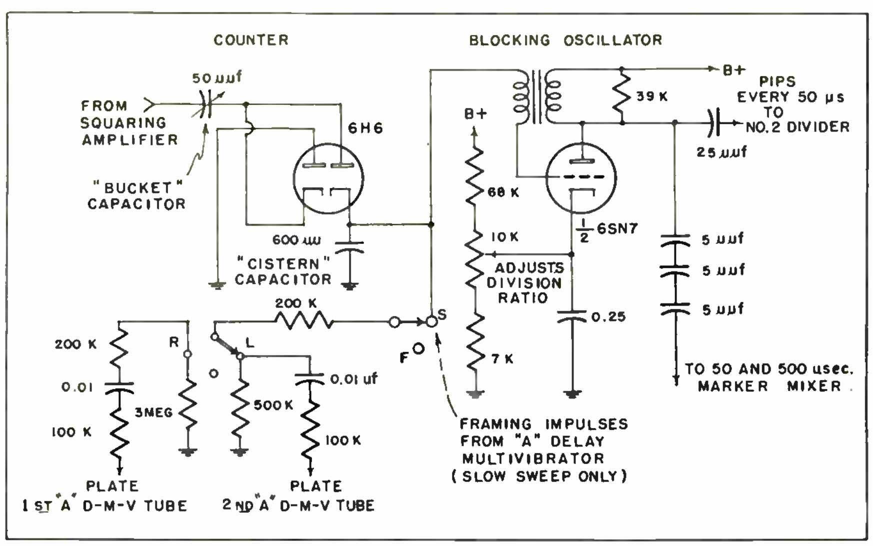


Fig. 8—First divider stage (÷5)

5. Pierce, J. A., Loran Report No. 16, Radiation Laboratory, M. I. T., January 22, 1942.

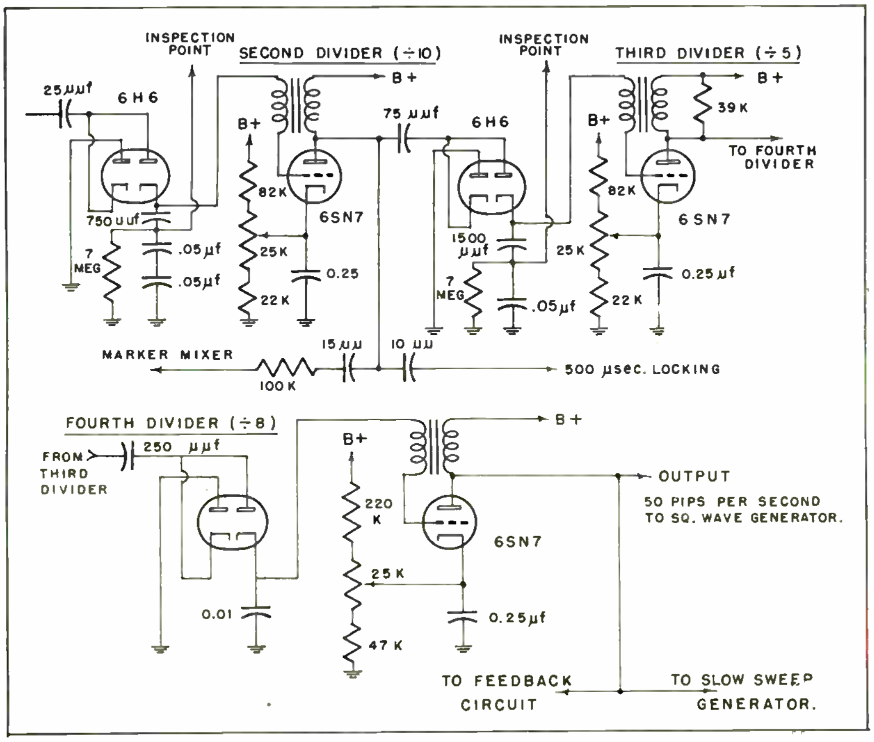


Fig. 9—Remainder of divider chain

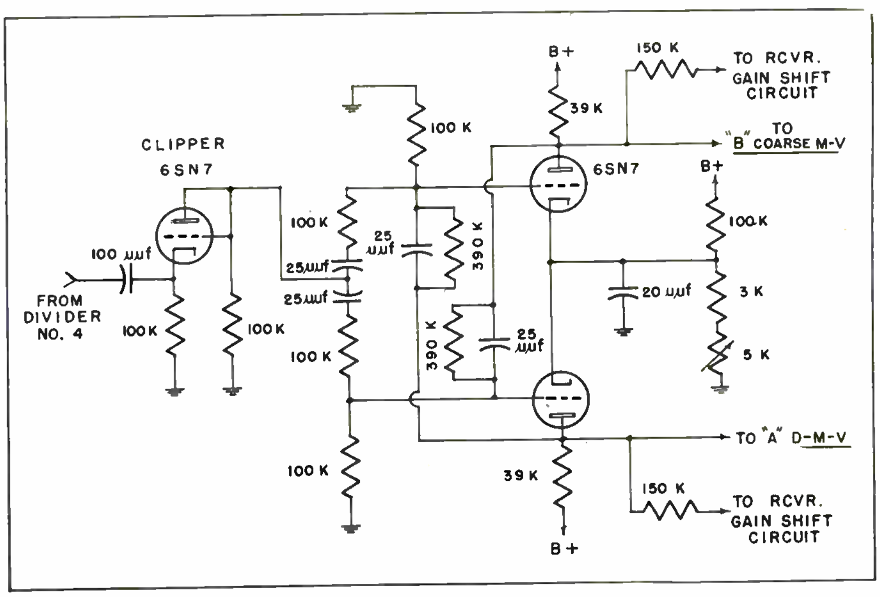


Fig. 10—Eccles-Jordan square wave generator

With the above review of a few of the elements of Loran the requirements for a Loran receiver-indicator may be formulated as follows:

(1) a *slow* time base, preferably linear, to examine the entire recurrence cycle (40,000 microseconds.);

(2) a *fast* or expanded time base (say, 200 to 2500 microseconds) to enable the identification of pulse train components and to permit a coincidence measurement of master and slave pulses;

(3) a *delay* circuit, which, by permitting one of the pulses to be delayed so that a coincidence measurement can be made, will result in a time difference reading equal to the delay;

(4) an *amplitude balance* scheme so that the two pulses, being necessarily slow rising, may be made identical in shape during measurement;

(5) an effective method for sweep calibration in order that the time difference can be read with the required precision and rapidity;

(6) a method of splitting the time base so that the pulse from one station may be brought under that of its mate for superposition;

(7) a method of identifying the recurrence rates of the station pairs in a positive manner;

(8) ample sensitivity in the receiver, perhaps to a microvolt;

(9) the receiver bandwidth should be wide enough to allow satisfactory discrimination of sky and ground wave components and yet narrow enough to keep adjacent channel interference at a minimum.

The entire idea of the Loran receiver-indicator is to permit the superposition of two originally unequal pulses of a Loran pair after they have been made equal in amplitude. During this matching process, the navigator introduces a delay into his equipment which is equivalent to the time difference of arrival of the two signals.

Typical receiver

The block diagram of a typical 1942 vintage receiver-indicator, the DAS-1 which has seen extensive service on board Allied ships, is given in Fig. 4, while the equipment is illustrated in Fig. 5. The circuit has been essentially preserved in later models of this same series. In the discussion of circuit operation which follows the individual blocks will be discussed, and the overall picture can be retained by referring each circuit back to the block diagram. The main elements of the DAS-1 are the crystal oscillator, the divider chain, the square-wave generator, the marker circuits, the receiver, and the amplitude balance circuit.

Since the 100 kc crystal oscillator is the local frequency standard, it must be sufficiently stable and adjustable for the received signals to remain stationary and have minimum drift across the screen, once the appropriate recurrence rate is selected. It is, as shown in Fig. 6, a conventional crystal-grid tuned-plate oscillator with some external plate-to-grid feedback for stable and vigorous oscillation and with capacity padding across the crystal in order to secure right and left drift. The squaring amplifier which also appears in Fig. 6 distorts the oscillator output sufficiently so that after differentiation, positive- and negative-going pips are derived to trigger the first of a series of dividers. The related waveforms are sketched in Fig. 7, and these should be studied again after examining the divider operation.

Each divider, the first one is shown in Fig. 8, consists of a double-diode integrating circuit ("counter") and a triode blocking oscillator. The pips from the squaring amplifier are fed through a "bucket" capacitor and by the action of the diode the negative portion of the pips is removed so that only the positive pips pass on to fill the "cistern", or storage, capacitor in the grid circuit of the blocking oscillator.

The cathode voltage of the triode is adjusted by means of a potentiometer to a value which determines the number of bucketsful the cistern will receive before the conduction point of the triode is reached. Viewed at the grid of the blocking oscillator (see again Fig. 7) is a familiar stairs pattern displaying the discrete charges received by the storage capacitor; and the number of steps in the flight gives the division ratio for this stage. The inspection of this pattern on the cathode ray tube of the indicator allows the operator to check the division ratio of this stage, and this technic is used with the succeeding stages as well.

Deciding stages

The sharpness of the blocking oscillator output pips is dependent almost entirely on the design of the blocking oscillator transformer. Difficulties in the production of adequate divider chains for some Loran indicator models have resulted when these transformers were of inferior design.

The first dividing stage has a division ratio of 5:1. The succeeding stages whose circuits comprise Fig. 9 are all similar to the first stage except for the variation in division ratio. The second stage divides by 10; the third, by 5; and the fourth, by 8. (If a basic rate of 33⅓ per second is to be received, the fourth divider will divide by 6.) Since the oscillator operates at 100 kc., the output of the fourth divider will recur 50 times per second.

The fourth divider output drives the slow sweep generating circuit which is of the gas tube variety. (In other Loran sets a "hard" tube is used.) A paraphase amplifier resolves the sawtooth sweep voltage into two similar sawtooth voltages out of phase with each other. These are applied to the horizontal plates of the cathode ray tube to achieve a uniform sweep.

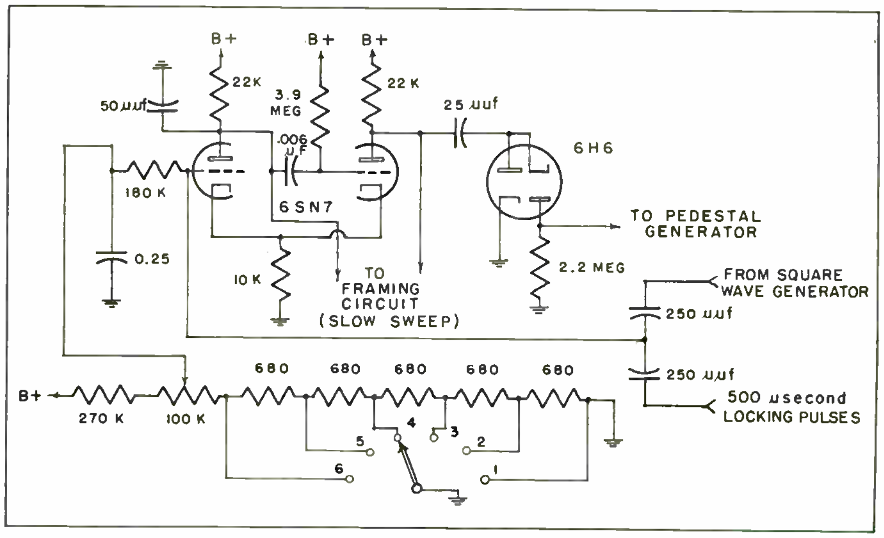
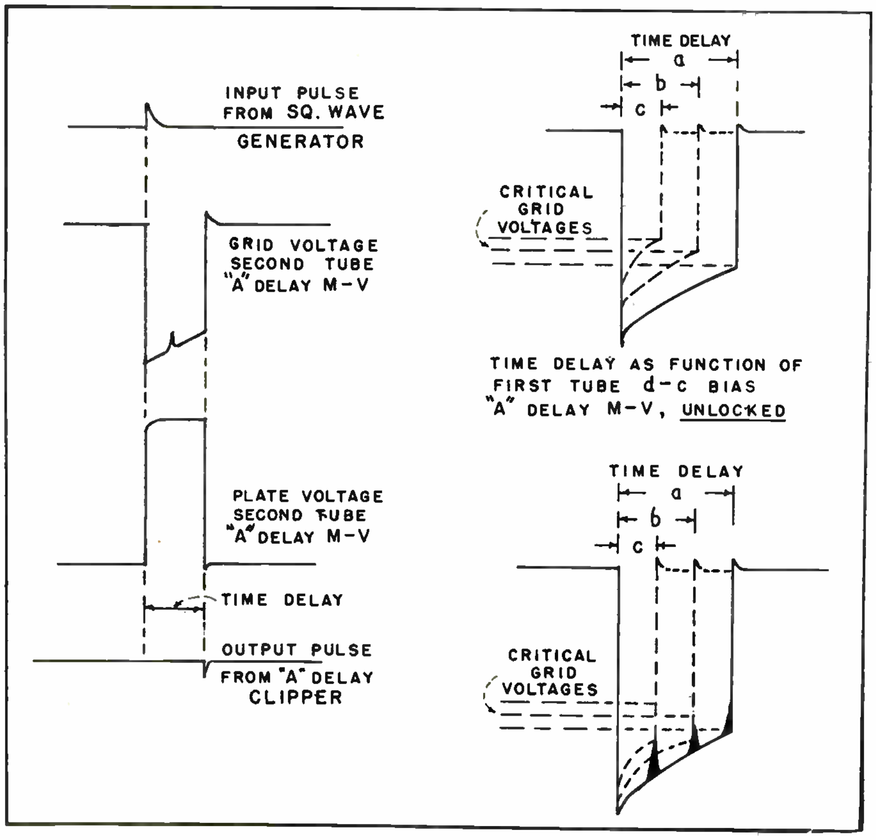


Fig. 11—"A" delay multivibrator



Waveforms and locking of "A" delay multivibrator

The split time base is achieved by the square-wave generator of Fig. 10, variously called "Eccles-Jordan," "scale-of-two," and "flip-flop" circuit.[6] This symmetrical circuit follows the last divider stage and furnishes a square wave occurring 25 times per second; thus, the total period of the square wave is exactly 40,000 microseconds. This square wave forms the reference for the A and B delay circuits, serves to initiate a controllable vertical trace shift on the oscilloscope, and drives the amplitude balancing circuit.

The A and B delay circuits are responsible for the accurate placement of signals on the slow sweep and for initiating the fast sweeps. The A delay circuit is simply a delay multivibrator driven by the differentiated output of the rising portion of the Eccles-Jordan square wave. It provides a trigger for the generation of a pedestal which will

6. Reich, H. J., Theory of Electron Tubes, P. 206, McGraw-Hill, New York, 1939.

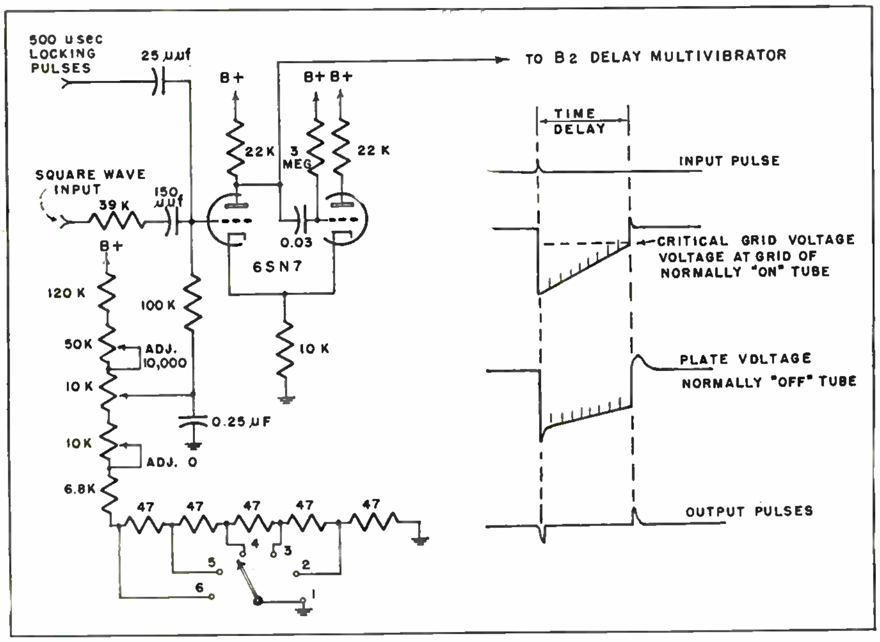
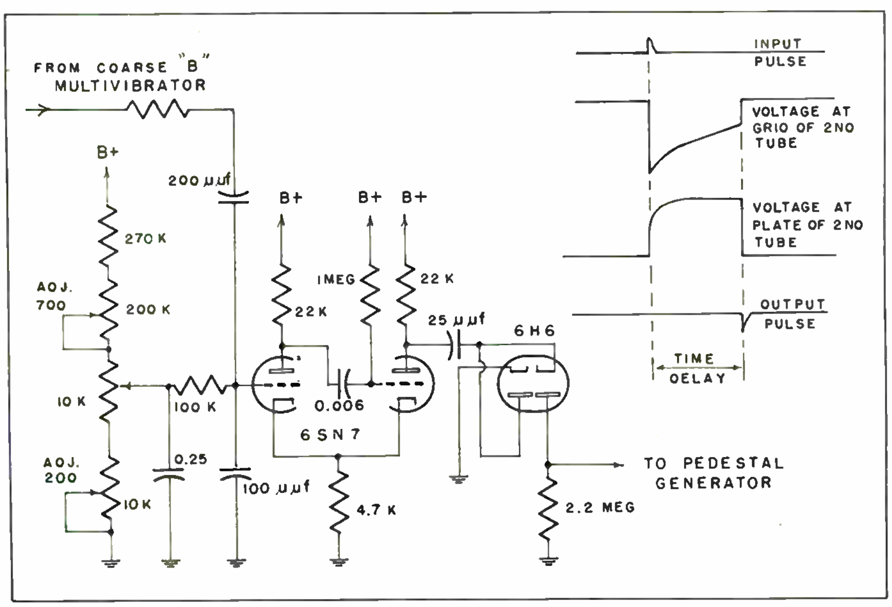
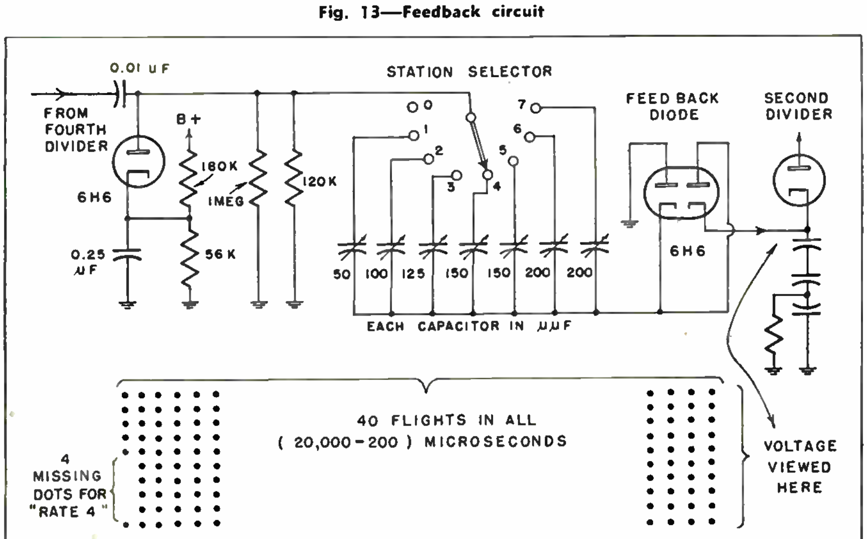


Fig. 12—"B" coarse delay circuit and waveforms



"B" fine delay circuit and waveforms

Fig. 13—Feedback circuit



occur some time after the start of the square wave and hence after the beginning of the slow sweep. In making a Loran reading, the master signal is always set astride the A pedestal. The A delay is maintained at a fixed value by being locked a few thousand microseconds after the start of the sweep. (Fig. 11)

The B delay circuit shoulders the burden of measuring the time difference in microseconds. Since the time difference to be measured will vary from the minimum to the maximum observable for a given pair of stations, a range of about 10,000 microseconds is absolutely essential. For example, if a 600-mile base line were used and the usual coding delay of 1,000 microseconds used at the slave, a reading of approximately 8,200 microseconds would be obtained on the master baseline extension, and this must be read to within one microsecond. This imposes rather strict conditions upon the B delay circuit.

In practice, stability is achieved by running the B delay as two delay multivibrators in cascade (Fig. 12), the first being adjustable in intervals of 500 microseconds out to 10,000, and the second being continuously adjustable over a range of 600 microseconds about the position established by the first. This results in two knobs being presented to the navigator—a coarse and a fine delay.

Delay multivibrator

The continuously adjustable delay multivibrator must be extremely stable and absolutely free from jitter; hence, plate decoupling is essential. The total action of the B delay circuit results in a pedestal which is variably delayed beyond the start of the second half of the Eccles-Jordan square wave, i.e., the beginning of the lower trace.

The selection of appropriate station pair is ingeniously accomplished by "feedback" in the divider chain, as indicated in Fig. 13. Loran recurrence rates bear the ratio 400:399:398 . . . 393 in the 25 per second family.

Thus, if the divider chain output occurs 50 times per second, the pips will be spaced 20,000 microseconds apart. To obtain the other recurrence rates, integral fifties of microseconds must be eliminated in the divider chain. The output of the fourth divider is fed back through a diode, and the positive pip which results is delivered to the second counter storage capacitor — where it is combined with the pips entering from the first divider. For each count of the fourth divider, the second divider has counted 40 times.

This may be best pictured by imagining 40 flights of stairs (10 steps per flight) occurring between each fourth divider output pip. In one of these flights, the one displayed immediately after the instant of the fourth counter output, the fedback process removes one step. This flight thus has only nine instead of ten steps. Since each step is worth 50 microseconds, the entire interval is shortened by that amount. As more voltage is fed back (depending on the value of feedback capacitor) more steps are removed in this flight, until a maximum of 7 steps have been removed; there are therefore 39 normal flights, and one shortened flight. If the basic recurrence rate (no feedback) be designated "0," the remaining rates are specified by the number of steps removed, so that 7 "station" rates are possible for each basic rate.

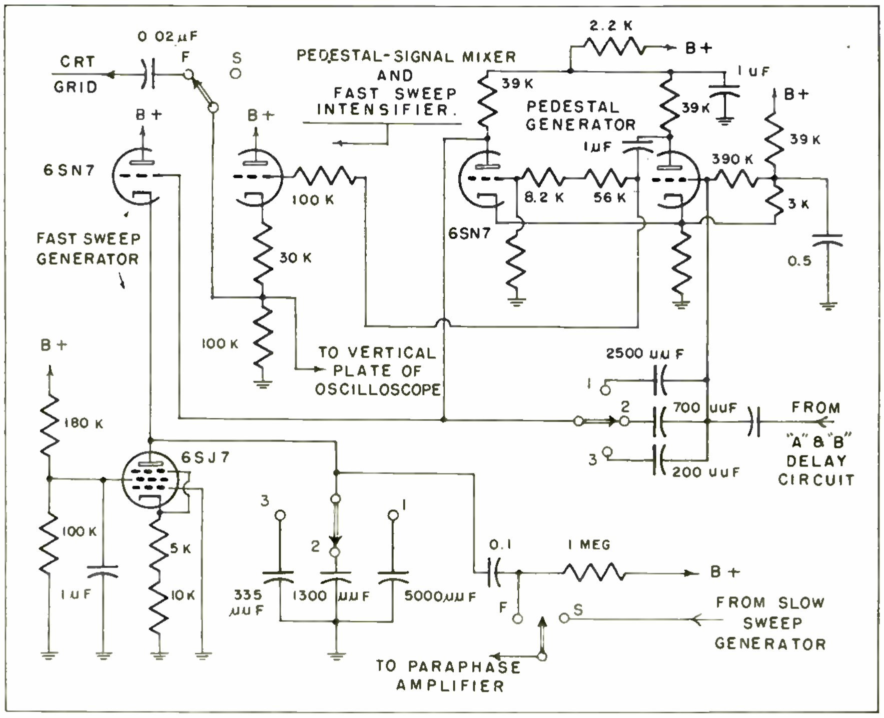


Fig. 14—Fast sweep and pedestal generators

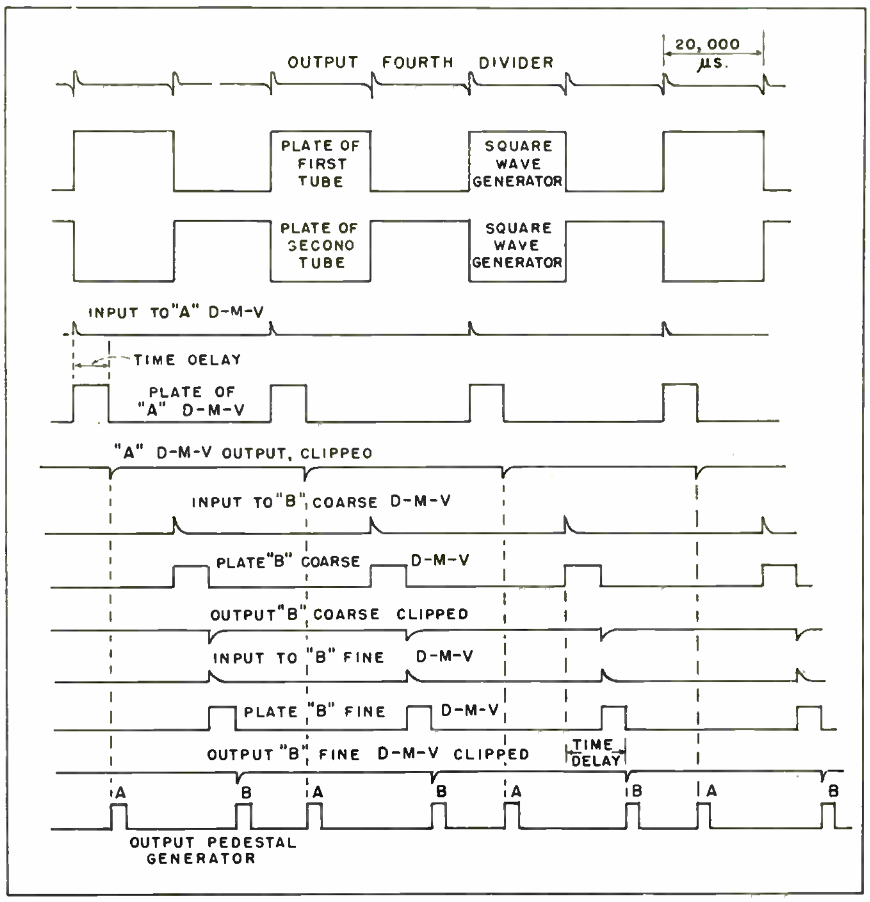


Fig. 15—Timing relations in delay circuits

Pedestal generator

The outputs of the A and B delay circuits are suitably clipped and mixed to give two trains of negative pulses of adjustable spacing. These pass on to the pedestal generator circuit of Fig. 14, a cross-coupled asymmetrical multivibrator of the delay type, which delivers a flat-topped pulse whose length is adjusted by the "fast sweep" switch. The timing relations of the divider chain, square wave generator, delay circuits and pedestal are exhibited in Fig. 15.

The fast sweep circuit generates a single, fast, linear, sawtooth wave each time the pedestal generator is triggered by the A and B delay circuits. The pentode of Fig. 14, with its usual characteristic of passing constant current, is placed in the cathode circuit of a triode. The grid of the triode is connected to the plate of one section of the pedestal generator. When a trigger from the A or B delay circuit reaches the pedestal generator, the plate potential of the first section falls, thus cutting off the triode in the fast sweep circuit.

Since the pentode plate is connected to the cathode of the triode, its current will drop, but only as permitted by the capacitors in its plate-cathode circuit while they leak off through the pentode. Thus the voltage on the pentode plate decays linearly with time and is applied to the grid of the paraphase amplifier. The voltage decay will cease abruptly when the pedestal generator returns to its quiescent condition, for then the triode conducts and the pentode capacitors are recharged. It is obvious that,

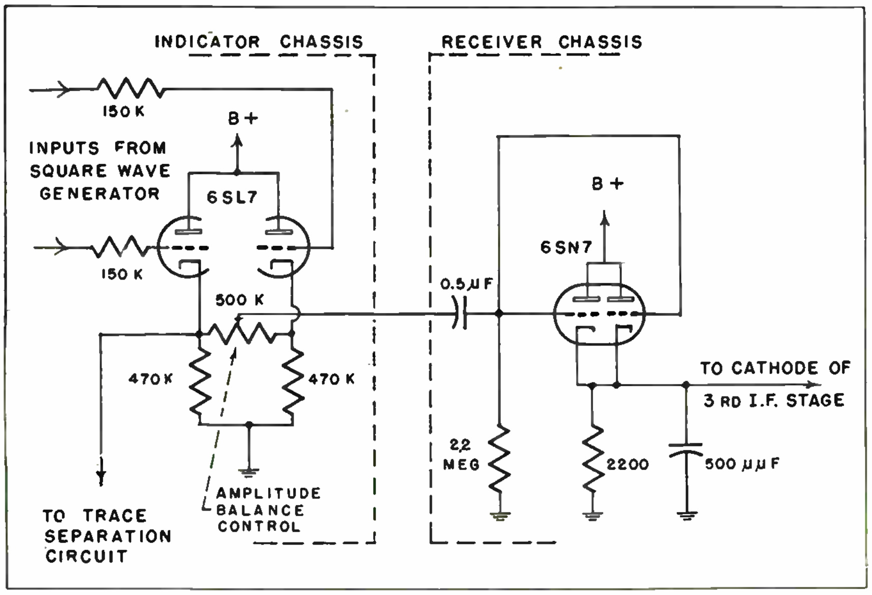


Fig. 16—Receiver gain-shift circuit

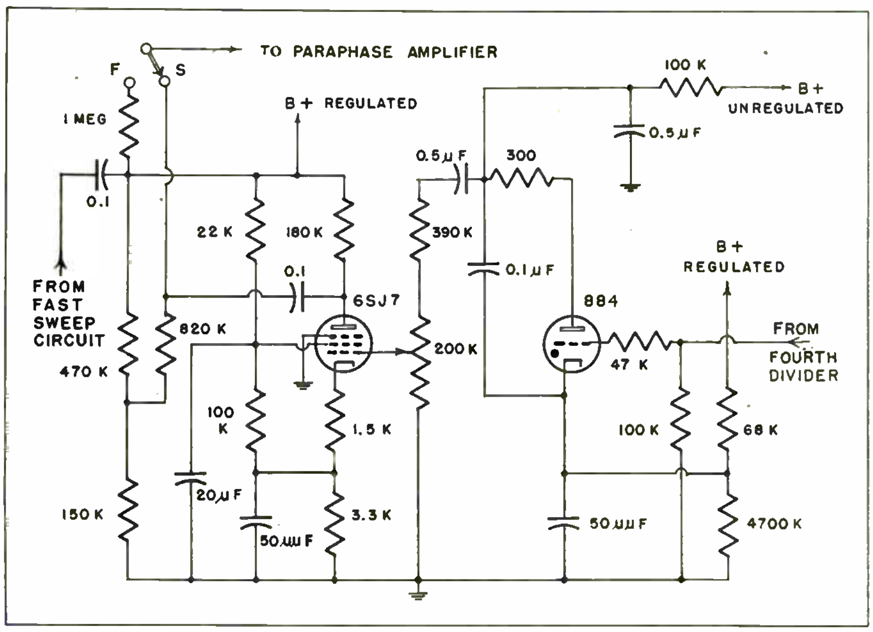


Fig. 17—Slow sweep generator

if the fast sweep is to be linear, the size of the capacitors in the pentode circuit must be adjusted to give linear decay over the period during which the pedestal generator is active.

When the slow sweep is in use, the pedestal generator output is mixed with the receiver output, since pedestals and signals both appear as vertical deflections. The positive pedestal from the generator is applied to the grid of a 6SN7 pedestal-signal mixer triode, also shown in Fig. 14. The output of this cathode follower is switched to one oscilloscope vertical plate. Since the receiver output appears across part of the cathode load, the size of the pedestals will change as the receiver output is connected or disconnected. When the fast sweep is used, the cathode follower output is connected solely to the grid of the oscilloscope through a capacitor. During the part of the sweep cycle other than the fast sweeps, this serves to blank out the traces.

The gain-shift circuit of Fig. 16 gives independent receiver gain control during the A and B traces, so that the operator may match two signals of differing intensities by equalizing their amplitudes. The main receiver gain adjusts the amplitude of the weaker signal to a desirable size, while the amplitude balance is used to reduce the size of the stronger to that of the weaker one. One portion, the amplitude balance bridge, is in the indicator unit, while the 6SN7 cathode follower which alters the gain of the if stage is in the receiver chassis.

The amplitude balance bridge contains two cathode followers, driven in push-pull by the plates of the Eccles-Jordan circuit. The

Fig. 18—Paraphase amplifier

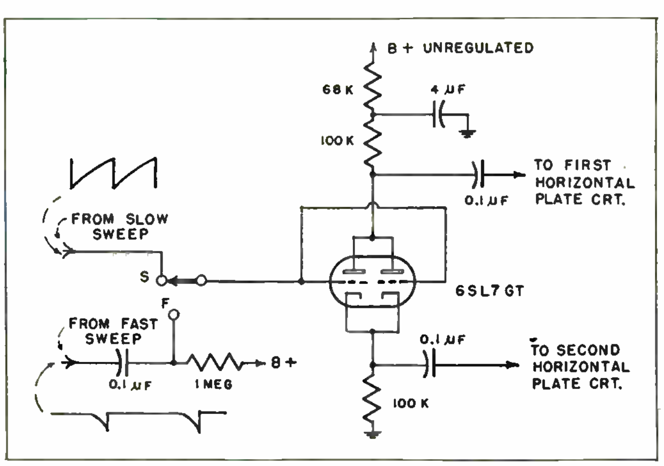
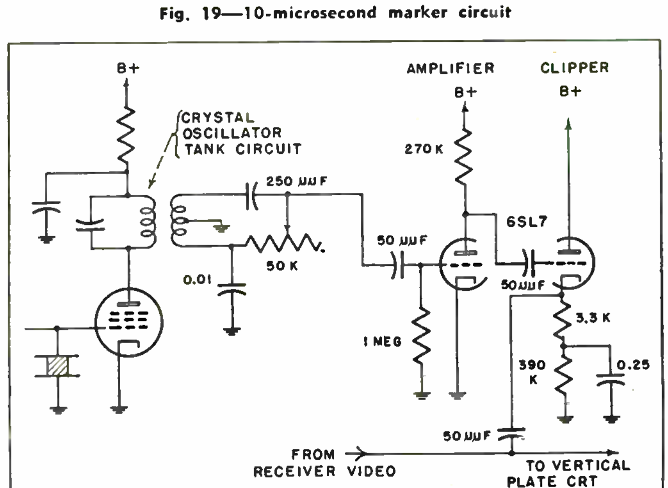


Fig. 19—10-microsecond marker circuit



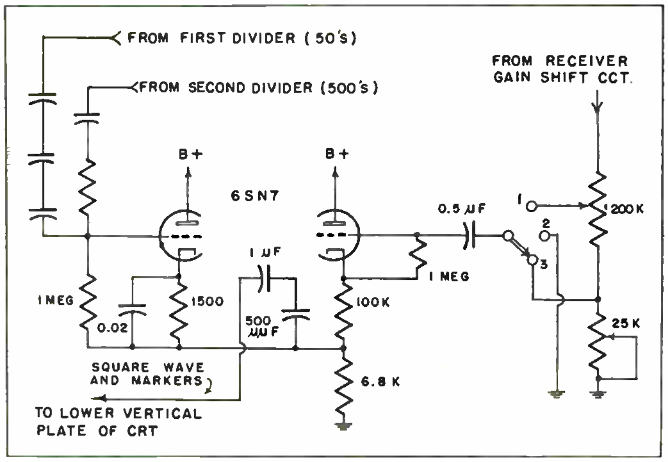


Fig. 20—Marker mixer and trace shift mixer

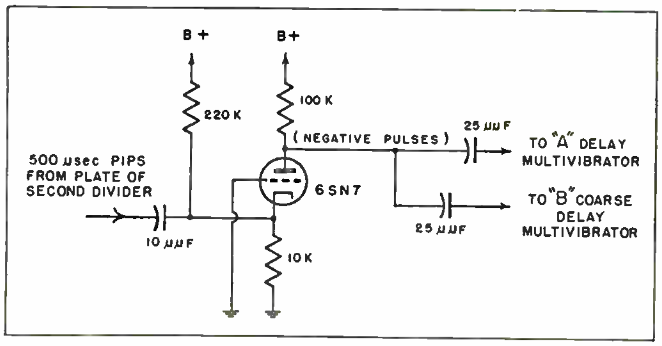


Fig. 21—500 - microsecond locking amplifier

cathodes are bridged by the amplitude balance control. During the A trace, one cathode is held at about 230 volts positive while the other is kept at about 80 volts positive by the square wave generator. This condition is reversed during the B trace period. At some point near the middle, the amplitude - balance potentiometer arm will settle at 150V above ground. If the potentiometer setting is altered, a square wave of variable height will appear, where the height is linearly dependent on the potentiometer rotation from the balance point. The phase of this square wave will reverse when the balance point is crossed.

The output of the variable arm is capacitatively fed to the joined grids of the cathode follower in the receiver, which consists of two triodes in parallel. The common cathode resistor is also the cathode resistor for the receiver's last if stage. The cathodes of the follower are driven up and down by the applied square wave, thus increasing and decreasing the gain of the last if.

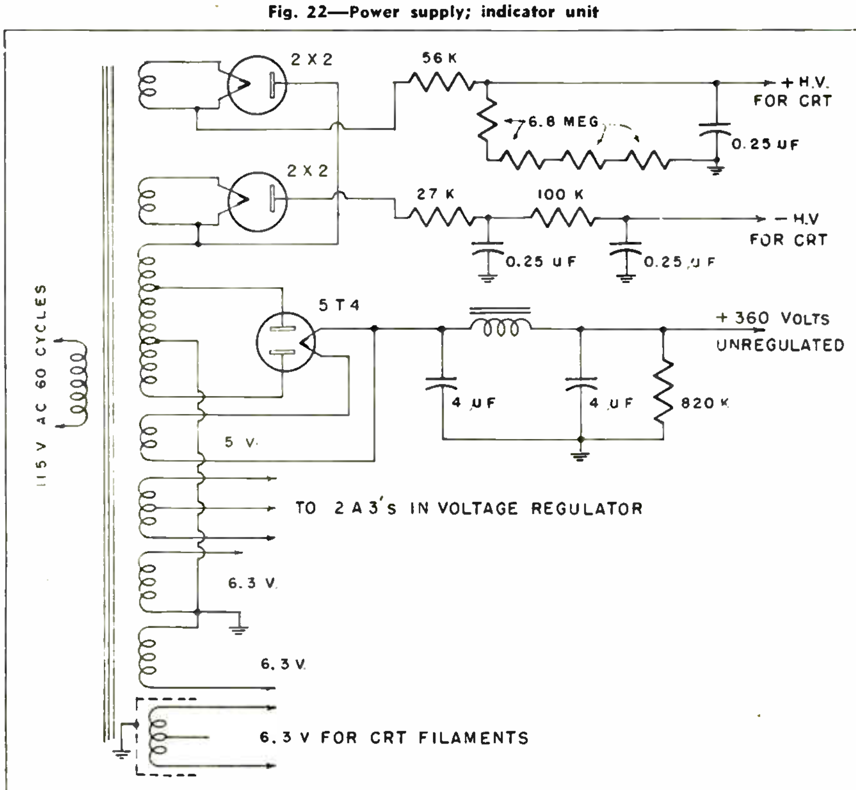
Actually, the gain of the last if cannot be increased much above that obtainable with the arm of the amplitude balance control at the balance point, for the cathode-follower cathode potential cannot be driven below that determined by the current flow through the last if tube and the cathode resistor. During the other half of the cycle, however, the receiver gain can be decreased by approximately 40:1.

The slow-sweep generator, consisting of the sawtooth oscillator and amplifier of Fig. 17, provides the linear sweeping voltage for the cathode ray tube which enables synchronization of the received pulses. The sawtooth oscillator is a gas triode which is normally biased to cut-off. A positive pulse derived from the last divider stage and occurring every 20,000 microseconds fires the grid. The plate cathode capacitor is discharged very rapidly through the tube until the tube is non-conducting, since by this time the initial pulse has been removed. The capacitor then charges slowly and essentially linearly through the resistor connected between it and B+. As the linear portion of the charging cycle is about completed another tripping pulse from the divider stage causes the cycle to be repeated. The charging portion of the cycle occupies about 19,930 microseconds. The discharge takes place in about 70 microseconds and this is the duration of the "flyback" time of the slow sweep.

A small fraction of the plate voltage swing of the gas triode is coupled to a pentode amplifier whose very linear output is delivered to the paraphase amplifier, shown in Fig. 18. Upon delivery to the paraphase amplifier, the sawtooth waves from the fast- or slow-sweep generator are transformed into push-pull sawtooth waves which are applied symmetrically to the horizontal plates of the cathode ray tube. The paraphase amplifier is a phase-splitting device and allows the input wave form to be amplified by a factor of two by the time it reaches the oscilloscope without altering the average horizontal centering voltage.

While the slow sweep sawtooth wave which is impressed upon the paraphase amplifier is positive, the fast sweep wave consists of a short duration negative sawtooth with a long interval of steady voltage. Consequently the grids of the paraphase amplifier are kept at B+ when the fast sweep is being used so that there will be ample oppor-

Fig. 22—Power supply; indicator unit



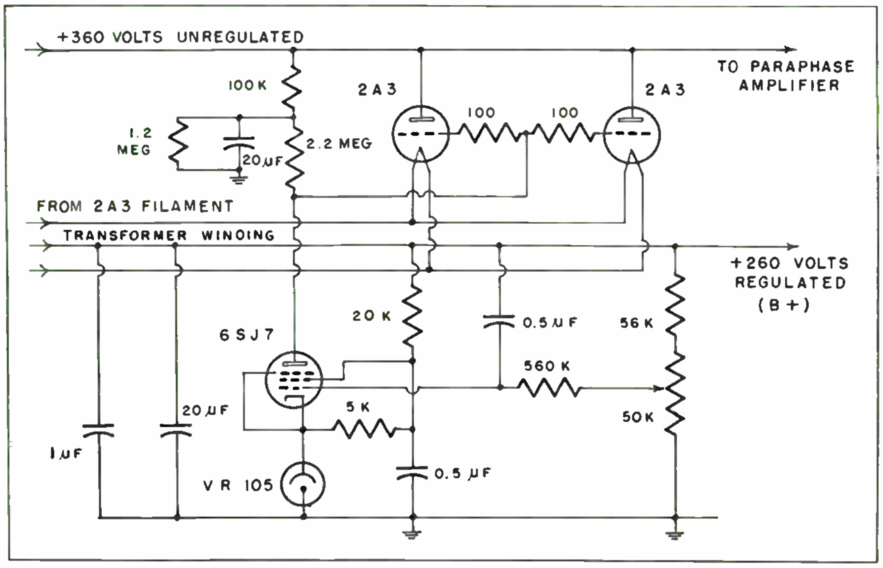


Fig. 23—Electronic voltage regulator; Loran indicator unit

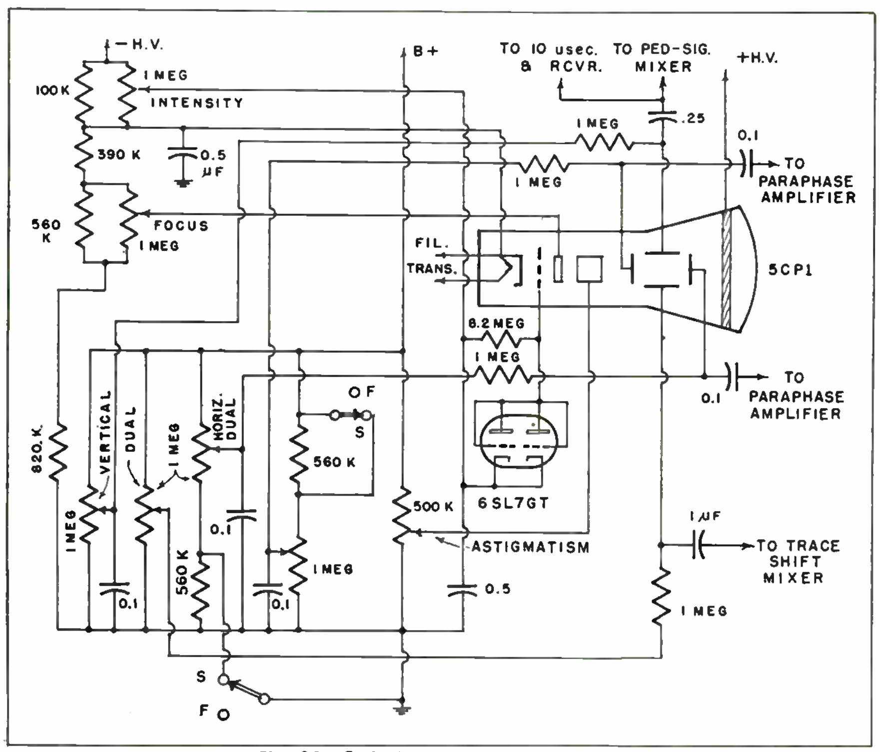


Fig. 24—Cathode ray oscilloscope circuits

tunity for the grid to respond to the range of the fast sweep drive.

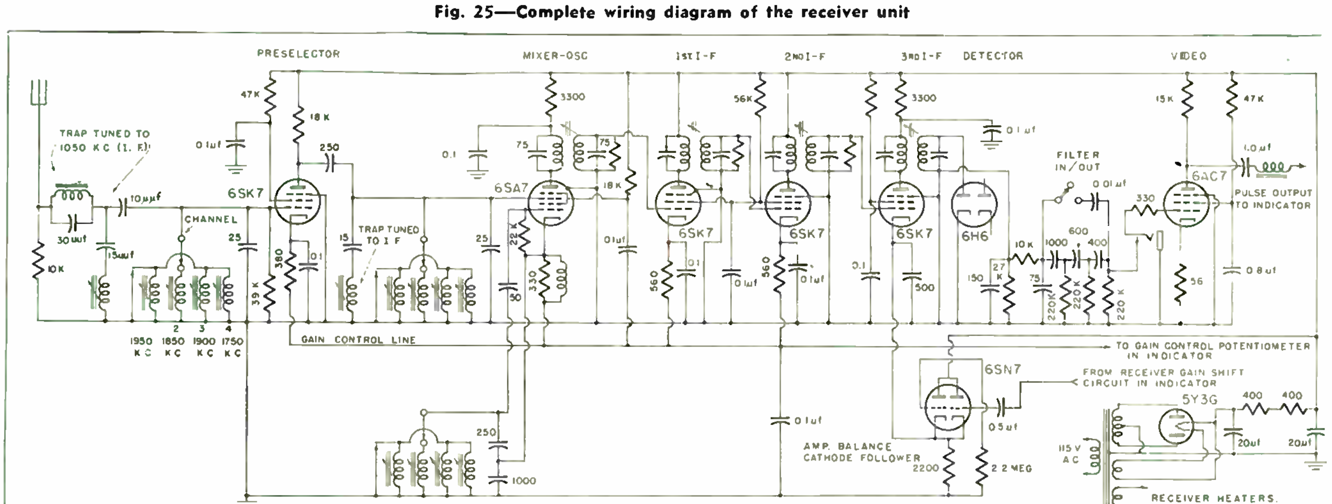
Markers are derived from the divider chain at almost every stage in order that the time base, both fast and slow, may be calibrated. Once a match has been made with the pulses of a Loran pair it becomes necessary to remove the signals and read the marker displacement upon the screen to a precision of approximately 1 microsecond. Usually, all Loran time differences are four-digit numbers, and the units used in tallying are 10's, 50's, 500's, and 2500's. The last digit, therefore, is obtained by interpolating a 10 microsecond segment upon the cathode ray screen.

Ten-microsecond markers are derived from the crystal oscillator. Since the oscillator output is a sine wave of moderate amplitude, it is amplified (the circuit is given in Fig. 19), and then, by means of a clipper, the sine wave peaks are converted to sharp symmetrical pulses about 2 microseconds long. By means of the phase shifting network which couples the crystal oscillator output to the 10 microsecond marker circuit, every fifth 10 microsecond marker is made to coincide with one of the 50 microsecond markers from the marker mixer circuit.

Marker Mixer: The marker mixer combines the output of the first and second divider stages. The size of the coupling capacitors of Fig. 20 which draw off the marker pulses from the divider are adjusted so that the 500 microsecond pulses (from the second divider) are several times larger than the 50 microsecond pulses. Both sets of pulses are applied to the grid of a self-biased cathode follower which acts as a clipper. A larger

(*Continued on page* 126)

Fig. 25—Complete wiring diagram of the receiver unit



TUBES ON THE JOB

Control for Electric Heat

The accurate control of temperature in a 75 KVA re-circulating type electric furnace used for annealing steel stampings, has in the past proven a troublesome problem at the Commercial Metal Treating Co., Bridgeport, Conn. This furnace is not only used for annealing at different temperatures but in many cases a single temperature must be maintained for successive batches of work which differ greatly in weight. These two factors plus

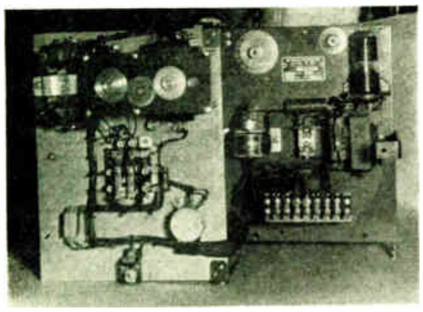


Fig. 1—Electronic relay in controller unit

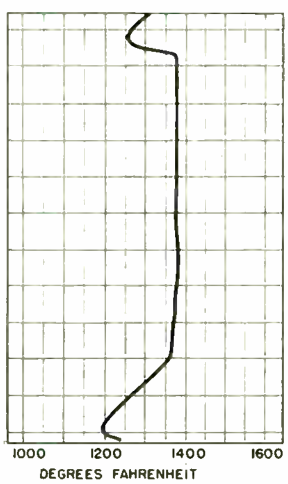


Fig. 2—Chart A. Heat control by ATC unit

the desirability for economical use of power prescribe requirements that make the effective operation of a heat control unit extremely difficult.

A new electronic balancer input controller made by Automatic Temperature Control Co., Inc., 34 E. Logan St., Philadelphia 44, Pa., has been fitted into this picture and is giving satisfactory results. This unit operates on the most advanced principle for control of furnace temperature — proportioning plus floating. Fully automatic operation is accomplished at a rate dependent on the degree of temperature variation from a control point setting on a pyrometer.

There are no saturable core reactors or control resistors in this system, the current being fed to the furnace either full "ON" or "OFF". Basically, this ATC controller is built around a Wheatstone bridge circuit and an electronic relay unit (Fig. 1). When an unbalance is set up by the slightest change of temperature in the furnace it is detected by the sensitive electronic circuit and the time periods for which power is applied to the heating elements are accurately corrected.

For all periods that the furnace temperature is more than five per cent plus and minus from the control setting, the power is "ON" or "OFF" continuously until the furnace comes within this narrow

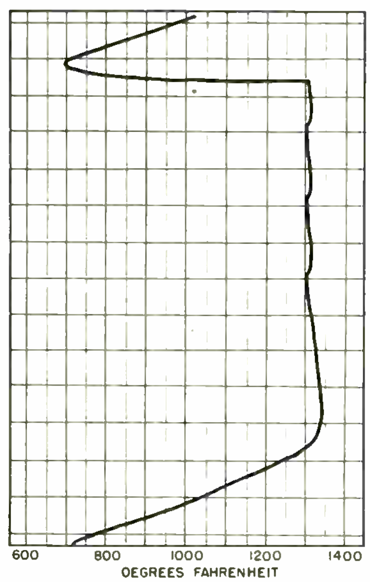


Chart B. Control by ordinary throttling unit

throttling range. At that time the heating circuit is alternately closed and opened at proper proportionate intervals so that the power delivered will bring the furnace to the correct heat setting without overshoot and from then on will compensate for the heat absorption of any particular furnace load. As the heat requirements vary because of the difference in load weights, so these proportionate on-off periods are increased or decreased by an automatic load compensator to take care of these larger or smaller furnace charges. There are two other features in this electronic heat control which are engineered for economy of power in maintaining proper furnace temperature and for convenience in showing the saturation temperature in the furnace; the maximum input switch effectively avoids temperature overshoot and the visual indicator light that shows the percentage of power input to the furnace and is illuminated during the power "ON" cycle only.

The increased accuracy of this

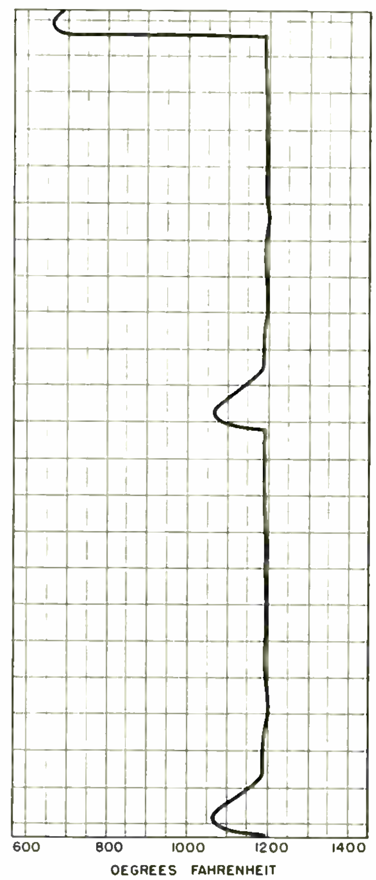


Chart C. Furnace heat recording for two loads

new unit is shown by the recordings. Chart A of Fig. 2 gives the electronic balancer input controller's results in a typical run at the Commercial Metal Treating Co., with control point set at 1380°F. There is no overshoot and the temperature is exact. Chart B records a run of identical work through the same furnace when equipped with an ordinary throttling type input controller, previously installed here, with control set at 1300°F; a 40° overshoot occurs and the furnace heat rises and falls in wave like drifts. It hits the set value of 1300° at only four short intervals. Chart C is the furnace temperature as controlled by the electronic balancer during the annealing operations for the two loadings shown in

Fig. 3—75 KVA electric furnace in left center

Fig. 3, one of these weighed 913 lb. and the second, the load which is on the lifting yoke, weighed only 420 lb. For both operations the control setting was 1195°.

Induction Soldering Unit

A portable bench type induction soldering unit developed jointly by Marion Electrical Instrument Co. and Polytechnic Research and Development Co., New York, was designed for fabricating Marion glass-to-metal hermetically sealed instruments and has now been placed on the market. The unit consists of a self-excited rf oscillator operating at approx. 450 kc and uses a low impedance link for transfer of rf energy to the work coil thus avoiding the use of tuning devices. The link is provided with a grounded center tap so that the operator is not exposed to voltages which would produce shock or burns. Operation is from the 60 cycle, 115 volts ac power line. The unit consumes 775 watts at full power output and approx. 100 watts at stand-by.

Two switches are provided on the front panel. One switch controls the filament voltages and the other the high voltage to the oscillator tubes. A foot treadle type switch instead of the toggle switch for controlling operation may be used. Some suggested applications are: Metal-to-metal soldered assemblies, small soldered seams, metal to metallized-glass assemblies, metal to metallized ceramic assemblies and small radio and radar components. Higher efficiencies result, when the material to be heated has high resistivity. By use of induction heating the speed of soldering operations in increased, cleaner work and greater uniformity with few rejects is achieved, since precise control of the temperature cycle is possible. Oxidation and scaling, the damaging of the surface finish or the exposure of adjacent parts to damaging temperatures is avoided. Local heat may be applied to parts which are inaccessible to the soldering iron.

Above—The induction soldering unit is used here for hermetic sealing of electrical meter. By applying local heat to the face of the meter, a perfect glass-to-metal seal is achieved

Below—View of portable bench type induction soldering unit with associated equipment

Meat Preservation

The use of Disinfectaire ultraviolet germicidal lamps in meat storage refrigerators has helped reduce spoilage by retarding mold growth and contamination. Higher temperatures and humidities are permissible and this reduces weight loss by moisture evaporation. This germicidal equipment is made by Art Metal Co., Cleveland 3, Ohio.

MILK CAN STERILIZER

A new U shaper Sterilamp that can be placed in a washed milk can just before filling, will kill 96% of bacteria count with only a sixty-second exposure. These Westinghouse Sterilamps are suspended on springs inside a protective cage and have a long service life even under constantly severe working conditions

SURVEY of WIDE READING

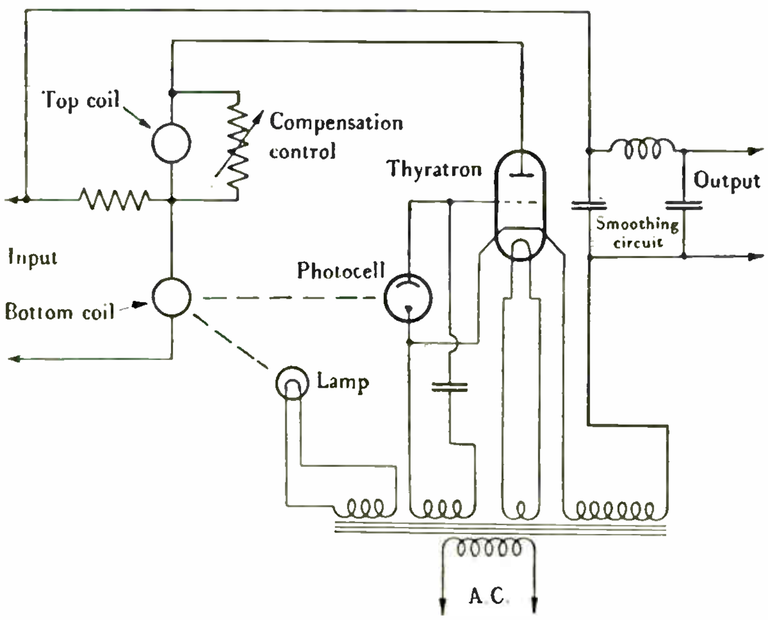
Electronic news in the world's press. Review of engineering, scientific and industrial journals, here and abroad

Sensitive Galvanometer Amplifier

By D. C. Gall and H. Tinsley (Journal of Scientific Instruments, London, November, 1945).

The sensitivity of a galvanometer increases as the restoring force of the suspension strip decreases. However, the oscillation period of the instrument will simultaneously increase, making it tedious to use, and magnetic impurities in the coil will take control and the zero become unstable. To increase the sensitivity of a galvanometer without incurring these disadvantages a double galvanometer amplifier system illustrated in the figure has been devised.

A sensitive galvanometer coil with a fairly short natural period is suspended from another but stronger galvanometer coil above it, so that the zero of the bottom coil is controlled by the position of the top coil. Thus, when a small current is passed through the bottom coil, causing it to deflect, another current is passed through the top coil which, by turning the suspension strip, removes the restoring force acting on the bottom coil, so that the latter can deflect to a greater extent. The current through to top coil is made to depend on the current through the bottom coil by a mirror attached to the bottom coil which deflects a light beam onto a photocell in the grid lead of thyratron. Negative feedback is introduced to stabilize the circuit and to provide a high effective input resistance. A voltage proportional to the current in the top coil or output circuit is applied to the input circuit of the bottom coil. The effect of this is to control the deflection of the bottom coil so that it takes up a final position where the negative feedback voltage equals the input voltage.



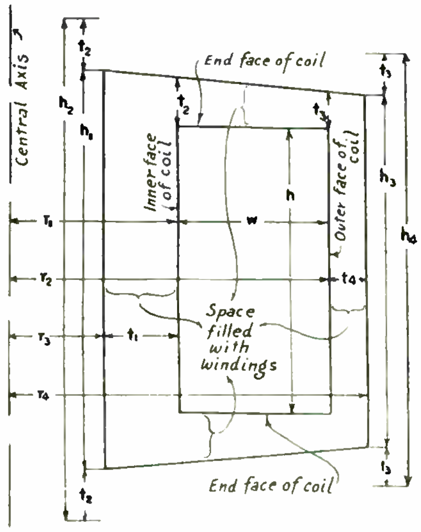
Two different galvanometers are combined with thyratron in galvonometer amplifier

The deflection of the top coil is used as the indication of the very small applied input voltage to the bottom coil. The circuit may be rearranged to operate as a current amplifier instead of as a voltage amplifier.

Self-Inductance of Toroidal Coil

H. B. Dwight (Electrical Engineering, November, 1945).

The self-inductance of a toroidal coil of rectangular cross-section and without iron is computed. The many-layer winding is assumed to fill the air-space densely. Consequently, the thickness of the wire layers on the inner side of the coil facing the central axis (t_1) is greater than the thickness of the wire layers on the outer face of the coil (t_4). The final expression for the self inductance is



Cross-section of toroidal coil explaining symbols in the expression for self-inductance

$$L_{\text{abhenrys}} = 2hN^2 \operatorname{logn}\frac{r_2}{r_1}$$

$$+2\pi^2n^2\Big[(h+qr_1)\Big(r_3^4\operatorname{logn}\frac{r_1}{r_3}-r_3^3t_1+\frac{1}{2}r_3^2t_1^2+r_3t_1^3+\frac{1}{4}t_1^4\Big)-qt_1^3\Big(\frac{4}{3}r_3^2+r_3t_1+\frac{1}{5}t_1^2\Big)\Big]$$

$$+\frac{4N^2}{3}\Big[\Big\{t_3+\frac{r_2(t_2-t_3)}{r_2-r_1}\Big\}\operatorname{logn}\frac{r_2}{r_1}-(t_2-t_3)\Big]$$

$$+2\pi^2n^2\Big[(h-q_1r_2)\Big(\frac{4}{3}r_4t_4^3+\frac{1}{5}\frac{t_4^5}{r_4}+\frac{1}{6}\frac{t_4^6}{r_4^2}+\dots\Big)\; q_1t_4^3\Big(\frac{4}{3}r_4^2-r_4t_4+\frac{1}{5}t_4^2\Big)\Big],$$

where

N = number of turns in the coil,
logn denotes natural logarithm,
n = density of turns per square cm,

$$n=\frac{N}{\pi(r_1^2-r_3^2)}=\frac{N}{\pi(r_4^2-r_2^2)}\,,$$

$$q=\frac{h_2-h}{t_1}\,,$$

$$h_2=h_1+2t_2\,,\quad h_1=h+2\Big\{t_3+\frac{(w+t_1)(t_2-t_3)}{w}\Big\}\,,$$

$$t_2=\frac{N}{2\pi r_1 n}\,,\quad t_3=\frac{N}{2\pi r_2 n}\,.$$

$$q_1 = \frac{h_4 - h}{t_4},$$

$$h_4 = h_3 + 2t_3, \quad h_3 = h + 2\left\{t_3 - \frac{t_4}{w}(t_2 - t_3)\right\}$$

The first term in the equation for the self-inductance represents the self-inductance of a one-layer coil, the second, third and fourth lines represent the contribution by the inner trapezoid of thickness t_1, the fifth line that of the two trapezoids at the ends of the coil of varying thickness (between t_2 and t_3), and the last two lines that of the outer trapezoid of thickness t_4. Dimensions are as indicated on drawing; r_3 and r_4 can be computed from the equation for n which is available for a given size wire.

High Dispersion Electron Diffraction

G. L. Simard, C. J. Burton, and R. B. Barnes (Journal of Applied Physics, December, 1945)

Electron diffraction has often been limited in its usefulness by its inherently low dispersion for high values of lattice spacings. The portion of the diffraction pattern corresponding to these long spacings occurs at small angles with the undiffracted beam. The rapid decrease in dispersion with increase in the distance between diffracting planes sets the usable upper limit of lattice spacings with present diffraction systems at about 5 Angstrom. Although sufficient for the study of most inorganic materials, such a 5-Angstrom limit is entirely inadequate for the majority of organic crystals where planar spacings of 10 to 30 Angstrom frequently occur. Not only is the measurement of longer spacings inaccurate, but often the resolution of closely lying reflections is difficult because of the finite line width and broadening of the recorded reflections by scattering within the photographic emulsion.

A method for attaining high dispersion in electron diffraction is presented. This method involves magnification of the diffraction pattern before the electrons strike the photographic plate. The degree of dispersion may thus be varied continuously; it is limited essentially only by the resolution of the original pattern. Suitable lens systems are described, particularly with a view to use a diffraction adapter for electron microscopes.

Amplitude-Modulated Pulse System

F. F. Roberts and J. S. Simmonds (Wireless Engineer, London, November and December, 1945)

Following a survey of various multichannel communication systems which make use of modulated pulse chains and considering their characteristics in some details, an experimental apparatus using amplitude-modulated pulses is described which provides seven good quality speech channels within a band of 110 kc. In all the systems considered, the whole of a relatively large frequency band is made available for consecutive small time intervals to each of the individual channels in cyclic order.

Transmitter

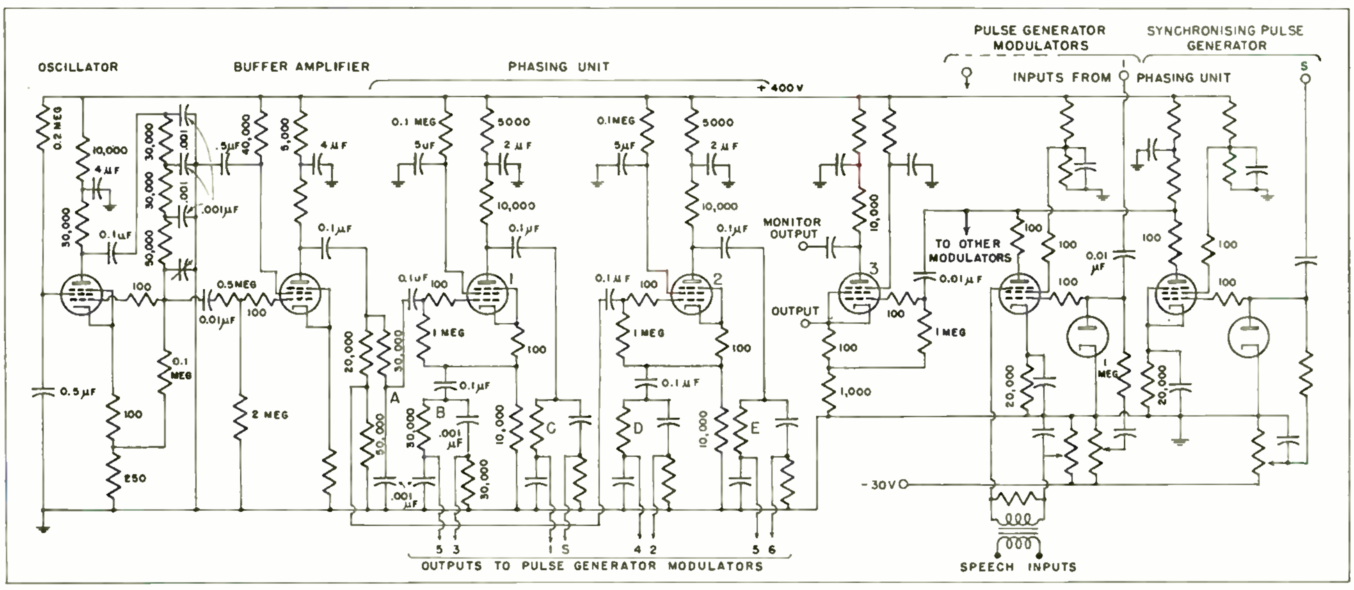
The sinusoidal, 8 kc output of a conventional resistance-capacitance type oscillator is amplified in a buffer stage. Eight pulse chains spaced at equal time intervals, i.e., 45 degrees from each other, are required for the seven channels transmitting intelligence and the synchronizing signal channel. Eight phase-shifted sinusoidal waves are derived from the oscillator output by phase shifting networks.

The buffer amplifier output is separated into two parts, one of which is shifted in phase by 45 deg. in phase splitting network A; the two parts are made the inputs to tubes 1 and 2 respectively. The use of tubes rather than transformers was indicated by the improved phase stability and lower circuit impedances possible while maintaining the desired high voltage level. The four outputs at the cathodes and plates of tubes 1 and 2 are further passed through four identical phase splitting networks B, C, D, E, delivering eight sinusoidal waves of at least 30 volt peak amplitude displaced by 45 deg. with respect to one another to terminals 1 to 7 and S. In the drawing, two terminals are erroneously marked 5, the one on the extreme right should be 7.

These eight sinusoidal voltages control the generation of the eight equally spaced pulse chains in the pulse generator section; only one unit and the synchronizing unit are represented in the drawing. Pulse generation relies upon the approximately exponential plate current vs. grid voltage cut-off characteristic of the pentodes used. The first grids are negatively biased so that they are at a negative potential even at the peak of the superposed signals at terminal 1 from the phasing circuits; the bias is stabilized by the diode in the grid lead.

(*Continued on page* 134)

Circuit diagram of experimental, amplitude-modulated pulse system. The seven communication channels are transmitted consecutively



NEWS OF THE INDUSTRY

Chicago Parts Show Scheduled For May 13-16

Manufacturers are readying exhibits for the Radio Parts and Electronic Equipment Show scheduled for the Hotel Stevens, Chicago, for the four days, May 13-16. The ex-

other officers being: Vice-chairman Prof. W. R. Abbott; Secy.-treas. Roger S. Conrad.

Federal Producing FM Transmitting Units

Federal Telephone and Radio Corp., domestic manufacturing af-

FCC Sticks by Guns On FM Allocations

For the record, there won't be any change in FM allocations. As most everyone now knows, FCC stuck by its guns. After almost interminable hearings, the latest

could be marshalled by the lower frequency proponents could be made to carry enough weight to influence FCC. The decision to make no change was released without comment or engineering reason, which, FCC says, will be forthcoming somewhat later.

Hallicrafters' FM Converter

Simultaneously with the Federal Communication Commission's final settlement of the controversy over FM broadcasting channels, the Hallicrafters Co., Chicago, has placed in volume production a new low-priced converter which can be used to adapt prewar FM sets to the new band of 88 to 108 megacycles. Using a single tube and small enough to fit inside practically any FM set cabinet, the converter is priced to sell at $15.00 retail.

U. S. Television Moves

U. S. Television Mfg. Corp. will move from 106 Seventh Ave., New York 11, N. Y., to 3 West 61st St., New York February 15. The company will commence radio production in February, and the manufacturing of television sets will begin in the spring. A new division of the company is producing television and FM test equipment including special parts for television sets. These parts and test equipment are now being delivered to other television manufacturers.

Phillips Adds Relays

Phillips Control Corp., 612 No. Michigan Ave., Chicago, Ill., has entered the relay production field. The company has acquired design, manufacturing and sales rights for relays formerly made by G-M Laboratories of the same city. John E. Mossman, co-founder and former vice-president of C. P. Clare & Co., has purchased a controlling interest in the Phillips Control Corp. The company will manufacture all types of relays under the trade name of "Phil-trol".

Philco Developing Auto Radiophones

Among other companies that are investigating and engineering portable mobile radio equipment for the use of automobile owners, Philco Corp., Philadelphia, has let it be known that this company is developing such equipment. Larry E. Gubb told about the equipment briefly but no details have been revealed.

Invention Exposition

World's Invention Exposition is scheduled to open in the Chicago Arena and run from April 11 to 22. It is planned for the exhibit to include all manner of recent inventions including electronic equipment and parts. Dr. Lee De Forest is honorary chairman of the affair which is being put on by World's Invention Exposition, 155 No. Clark St., Chicago. E. K. Green is director of the exhibits.

Bendix Marine Moves

Bendix Marine has moved to Norwood, Mass. The company produces among other marine equipment supersonic depth sounders.

Adds Small Motors

Fractional horsepower motors in standard types of split phase and capacitor start units are to be made by Automatic Control Engineers, Inc., Bedford, Ind. Manufacture of voltage regulators, synchronizers, frequency control equipment and special control apparatus will be continued.

RMA Record Roster

Membership in Radio Manufacturers Association reached an all-time record high of 307 with the election of 35 new members in January. This compares with a low of 104 during the '30-40 period. Among other business transacted at the meeting of the RMA Board in January, plans were made for that body to be enlarged through additional representation for sets, parts and possibly other divisions. A new Amateur Section has been organized with W. J. Halligan as its chairman.

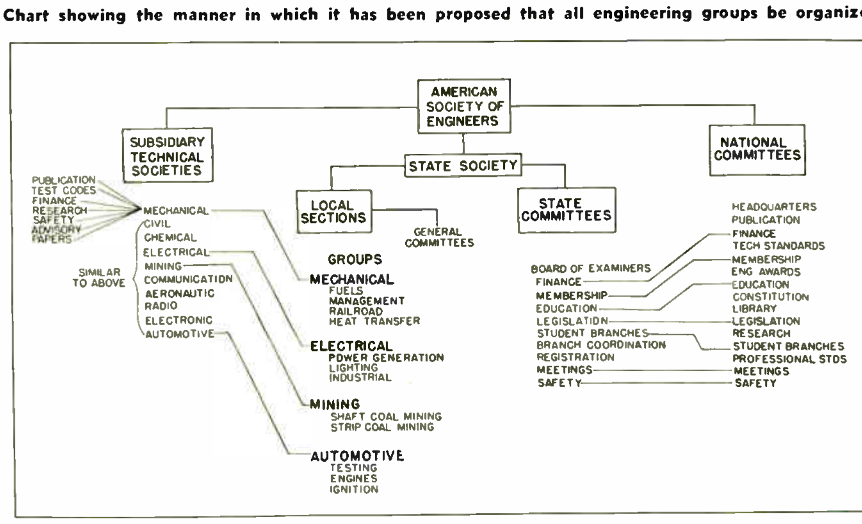
Propose Consolidating All Engineering Bodies

A new method of organizing the engineering profession was proposed at a conference on institute activities at the Winter Convention of American Institute of Electrical Engineers held in New York late in January. Four plans which would consolidate all engineering organizations were considered. One would bring together all electrical engineering societies into a new American Association of Electrical Engineers; another would have the existing engineering societies continue to function in technical matters and include an Engineering Professional Society to carry on non-technical or general activities of interest to engineers. A third proposed the federation of all existing engineering societies to form a Federated Engineering Society which would provide a single control for consideration and action on all technical and professional matters; the fourth plan would set up a new American Society of Engineers into which would be incorporated many of the existing societies. Membership would include all engineers. It was felt by the committee on planning and coordination that the adoption of one or another of these plans would permit the creation of a strong united engineering profession.

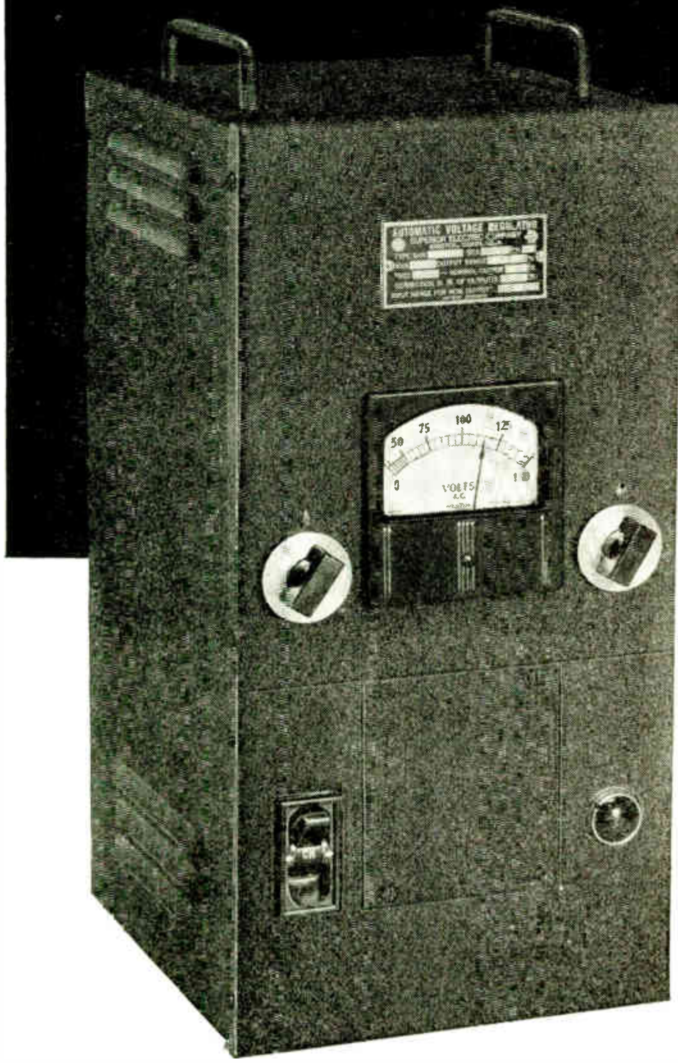
Grants for 278 FM Stations

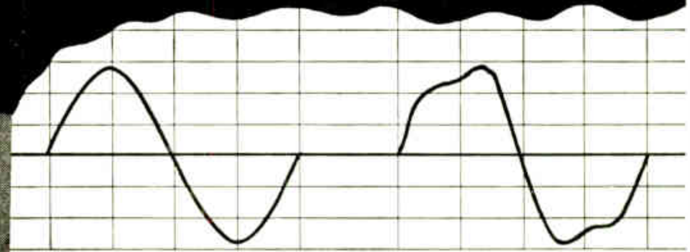
As of the middle of January, Federal Communications Commission had granted 278 conditional licenses for FM broadcasting. Under such procedure companies are permitted to proceed with preliminary plans for obtaining equipment necessary in the establishment of the proposed stations.

Chart showing the manner in which it has been proposed that all engineering groups be organized



NO WAVE-FORM DISTORTION

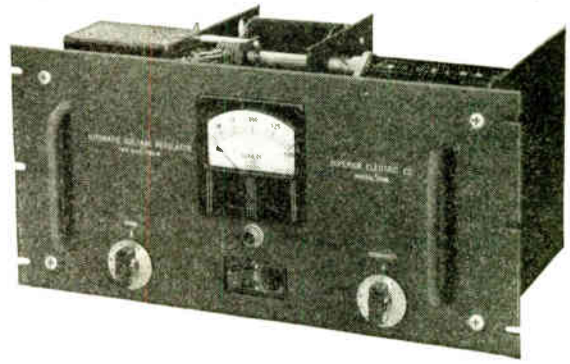




THIS ↗ NOT THIS ↗

WITH

SECO AUTOMATIC VOLTAGE REGULATORS



*I*N designing electrical apparatus, the engineer not only specifies a definite operating voltage but also assumes that the wave-form of the specified voltage will be a sine wave. If these two factors are not considered, the efficiency and utility of the equipment is drastically reduced if not completely eliminated. Although the SECO automatic voltage regulator can not manufacture a sine wave, it will maintain a constant output voltage without wave-form distortion regardless of variations in input voltage or output load current.

Such desired performance is obtained by combining an electronic detector circuit with a motor-driven variable auto-transformer. There is no dependency on saturation of core material for regulating action. In direct contrast, the variable auto-transformer together with its auxiliary transformer are designed to operate far below the saturation point assuring the zero wave-form characteristic.

This feature, plus many other decided advantages, has prompted the exclusive use of SECO regulators for countless applications. An investigation may prove it ideal for your particular requirement.

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RCA COLOR TV STATUS

Princeton Laboratories demonstration reveals progress in both color and black and white — Tube and transmitter production

Late in January, a third public demonstration of color television, by RCA had for its purpose the showing to prospective television transmitter equipment customers and consulting engineers not only RCA's research in color television, but also improvements in black-and-white television and other recent products of research in the radio field.

About 150 guests gathered at the RCA laboratories in Princeton, N. J., some coming from as far as Texas and the mid-west to witness the demonstrations. E. J. Engstrom, director, made the opening talk during which the group was shown black-and-white television pictures transmitted from the NBC New York station 44 miles away. This transmission was on WNBT's regular assigned channel No. 1, 50-56 mc. The program included a movie short of vaudeville performers, a solo by a photogenic soprano, a ventriloquist who in some ways was better than Bergen and an interpretive dance.

The following television receivers were compared in the order mentioned:

Receiver Comparison

(a) The pre-war model TRK console, selling for $600, direct viewing, 12 in. picture tube showed the picture quality fair, color dirty white, brilliancy normal by pre-war standards. This was compared with RCA's new kinescope improved by a very thin backing of aluminum film applied to the fluorescent material. This does three things: it reflects outward and therefore reinforces the light from the tube; it prevents the heavy ions from producing an undesirable brown spot in the center of the screen; and it permits the application of a considerably higher plate voltage which also produces a brighter picture. All of these taken together have considerably improved the reproduced picture in contrast and in an increase in brilliancy which allows full room illumination without destroying the picture's usefulness.

(b) Two table models were shown, one having a 7 in. tube and one a 10 in. tube. Only the latter was in operating condition. It produced an excellent picture, in fact our reporter preferred it to all the other receivers shown for certain portions of the program. For other portions the projected picture to be described was preferred. These cheaper receivers did not have aluminized screens, but in spite of this fact gave a sufficiently brilliant picture, rated approximately twice as good both in whiteness and light intensity as the pre-war standard.

Projection console

(c) Experimental projection console, a 5 in. picture tube with plate voltage about 28,000 using Schmidt optics produced on a screen illuminated from the rear a picture measuring 16 in. x 21 in. This is the set that RCA has been demonstrating for the last year. The picture brightness is equal to the pre-war direct viewing tube. The detail was satisfactory, but the resolution of the picture did not seem equal to that obtained from a direct viewing receiver. In other words, images were a trifle fuzzier than they were on the directly viewed tube. In comparison with this receiver was shown RCA's latest experimental projection model. This gave the same size picture, but due to increased plate voltage and the aluminum film on the projection tube the light intensity was, say, 40% greater. The color of the picture due to early tube production was marred by yellow streaks. Incidentally, this receiver was the only one that gave difficulty during the demonstration. It went out of synchronization slightly twice during the show. (The 7 in. table model entirely failed to operate at the very start of the demonstration). However, the visitor's impression was that great care had been taken in the arrangement, the scheduling, and the explanations throughout this entire visit to the RCA Labs.

(Continued on page 136)

RCA PRODUCTION SCHEDULE FOR EQUIPMENT

TUBES. The Image Orthicon will be in production in the second quarter of 1946. The Orthicon which is still the best for studio work is available at present. Model 1850A is an improvement over 1850 which has been used in the past in that it gives better sensitivity.

An improved iconoscope for amateur use will be available in the second quarter of 1946.

Model A51, 5-kw transmitter tube, available third quarter of 1946.

RECEIVING TUBES. For direct viewing there will be the 7 in. tube model 7GP4, 3000 v plate, a low priced tube.

Model 7DP4 will have an ion trap and be of superior quality.

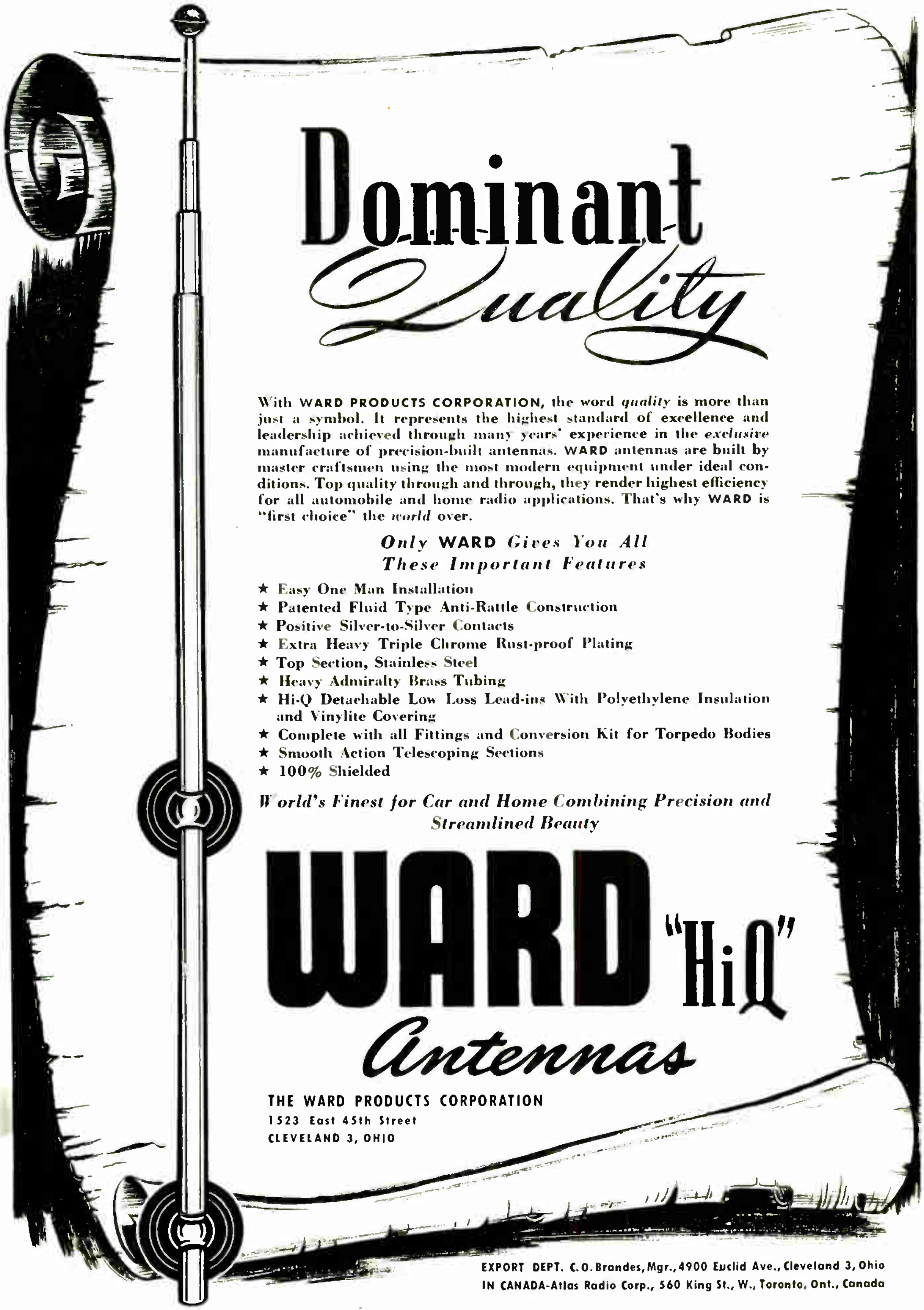
The 10 in. model 10BP4, 8000 v plate, with ion trap will be used in consoles of good quality.

A 5 in. view finder tube model 5 FP4A is planned and a 7 in. portable monitor tube 7CP4.

All of these will be available in the second quarter of 1946.

OTHER TUBES. A 15 in. direct view monitor tube and a 5 in. model 5TP4 projection tube, 30,000 v plate for use with Schmidt optics will be announced in 60 days. It will be treated with the aluminum film, but the direct view tubes will not have this because of cost and because the brightness is acceptable as is.

TRANSMITTING EQUIPMENT. RCA plans to produce portable Image Orthicon cameras for remote pickup. These together with their portable control equipment will be produced first to give customers a chance to experiment both indoors and outdoors with television while transmitters are being built. This equipment will be ready in the early summer of 1946. Next, motion picture scanners will be produced. Television transmitting equipment will follow and this should be ready for delivery in the early fall. Orders will be filled in the order of their receipt. Prices will be available in a few weeks.


Dominant
Quality
With WARD PRODUCTS CORPORATION, the word *quality* is more than just a symbol. It represents the highest standard of excellence and leadership achieved through many years' experience in the *exclusive* manufacture of precision-built antennas. WARD antennas are built by master craftsmen using the most modern equipment under ideal conditions. Top quality through and through, they render highest efficiency for all automobile and home radio applications. That's why WARD is "first choice" the *world* over.
Only WARD *Gives You All These Important Features*
★ Easy One Man Installation
★ Patented Fluid Type Anti-Rattle Construction
★ Positive Silver-to-Silver Contacts
★ Extra Heavy Triple Chrome Rust-proof Plating
★ Top Section, Stainless Steel
★ Heavy Admiralty Brass Tubing
★ Hi-Q Detachable Low Loss Lead-ins With Polyethylene Insulation and Vinylite Covering
★ Complete with all Fittings and Conversion Kit for Torpedo Bodies
★ Smooth Action Telescoping Sections
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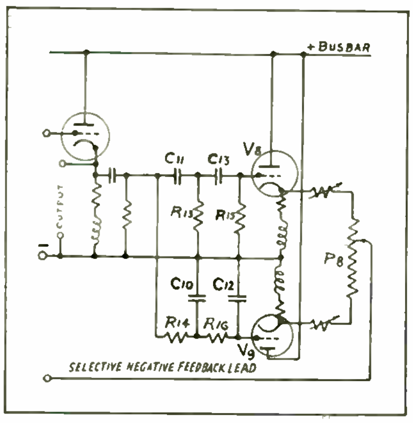
IN CANADA-Atlas Radio Corp., 560 King St., W., Toronto, Ont., Canada

NEW PATENTS ISSUED

Selective Amplifier

A frequency-selective amplifier or oscillator of the feedback type is described and claimed which permits frequency control by adjustment of one potentiometer in the feedback circuit. An approximately logarithmic frequency dependence on the potentiometer setting is achieved. Frequency selectivity is effected by the negative feedback path which feeds back no voltage at the desired frequency and provides degeneration at other frequencies.

According to the present invention the ac output voltage of the amplifier or oscillator is fed to two networks C_{11}, R_{13}, C_{13}, R_{15}, and C_{10}, R_{14}, C_{12}, R_{16}, respectively. It will be seen that the output voltage amplitudes of these two networks vary with frequency in opposite directions while always being 180° out of phase; any other suitable network supplying such voltages may replace this particular arrangement. The feedback voltage is taken between the negative terminal and

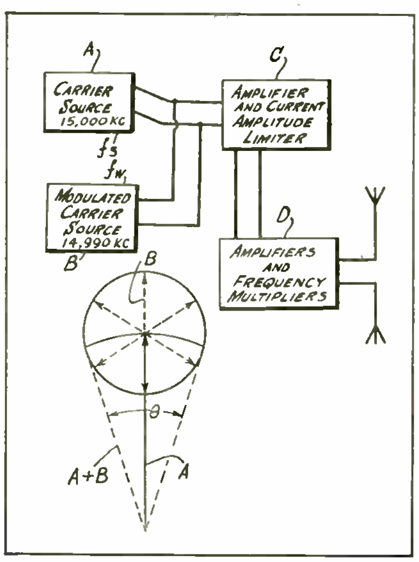


the potentiometer P_8. For a certain frequency the output will be zero at the center setting of the potentiometer but have a certain value for other frequencies. If the potentiometer is shifted, cancellation of voltages will occur for a different frequency, all other frequencies being subjected to degeneration. This provides selective feedback depending only on the potentiometer setting. The two cathode-follower tubes serve as impedance matching devices. Several variations of the basic principle are considered.

B. M. Hadfield, Automatic Electric Laboratories Inc., (F) June 5, 1942, (I) October 16, 1945, No. 2,386,892.

Diversity System

The unmodulated carrier from A has a strength considerably greater than the other carrier from B; a 2:1 ratio is satisfactory in many cases. Then the output of C will constitute a phase modulated wave having a carrier of frequency f_s and two principal side bands spaced from this carrier f_s by the frequency difference $f_s—f_w$. A frequency difference of 10,000 to 20,000 cycles is sufficient to reduce greatly the probability of both waves fading out simultaneously to a degree at which distortion results. It is proposed to use these two side bands as the two waves of a diversity system.



To explain the phase-modulating effect, consider the vector diagram at the lower left of the figure. The weaker current B is added vectorially to the stronger current A at angles varying uniformly with respect to time at a rate of 360 deg. per cycle of beat between them. The resultant vector A plus B therefore varies in amplitude and phase with respect to the stronger initial current A; amplitude and phase modulation will be present in the output. Phase variations through an angle θ will occur. Upon passage through an amplitude limiter, a phase modulated current will be passed onto the subsequent amplifiers and frequency multipliers.

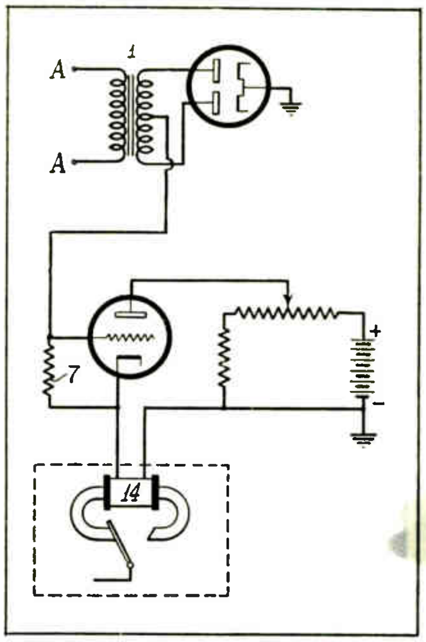
In the receiver, the two sidebands are separated by frequency selective channels, amplified, demodulated and applied to a diversity system.

C. W. Hansell, RCA, (F) June 26, 1942, (I) October 30, 1945, No. 2,388,053.

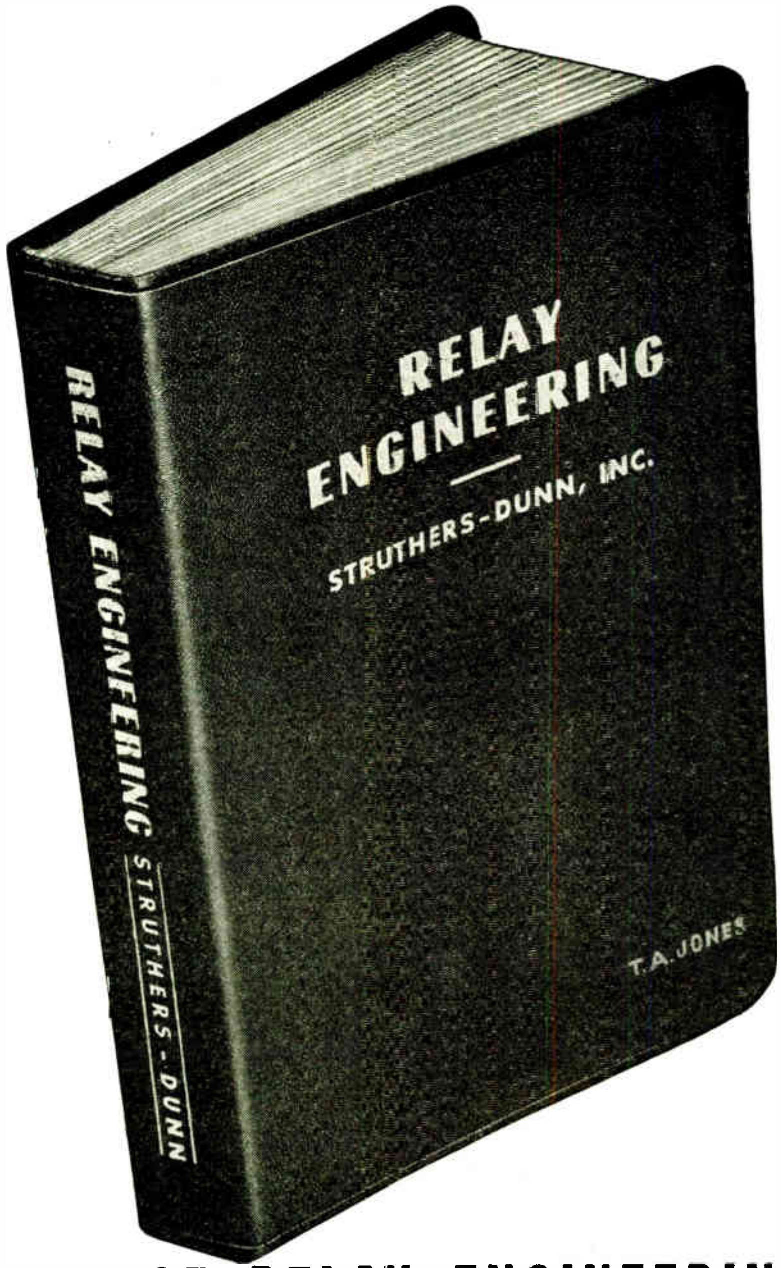
Relay Control Circuit

It is intended to reverse the direction of the current in the relay coil 14 in response to a keying signal which is applied to the terminals A,A; the input signal may convey a telegraph message.

The negative voltage generated at the center tap of the input transformer 1 upon reception of a signal is applied to the grid of the triode, preventing it from carrying current. Further this negative voltage causes a current to flow through resistor 7 and the winding of relay 14 to the ground. At no-signal condition, there will be no current through resistor 7; the grid will be at ground potential and the tube will become conductive. The current now flowing through the relay 14, which is included in the tube circuit, is of opposite polarity to the current previously flowing,



causing a reversal of the armature position. Resistor 7 may be assigned a value to make the two currents alternately traversing the relay winding of equal intensity.



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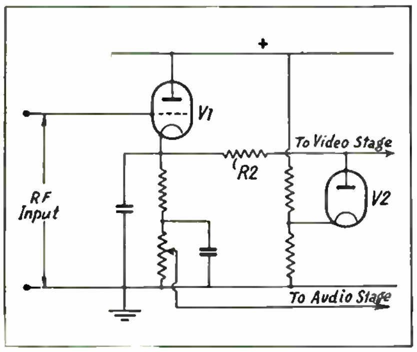
World Radio History

In an alternative arrangement, the rectifier tube and the input transformer are omitted, the center of the battery is grounded and a telegraph key is provided in a lead connecting the negative side of the battery with the grid of the tube.

W. E. Simpson, RCA, (F) September 28, 1942, (I) October 23, 1945, No. 2,387,536.

Limiter Circuit

In connection with panoramic radio receivers it is desired to provide a detector arrangement where one of several outputs, the video output, is limited, while another output, the audio output, is not limited. For this purpose, the cathode of the cathode-follower

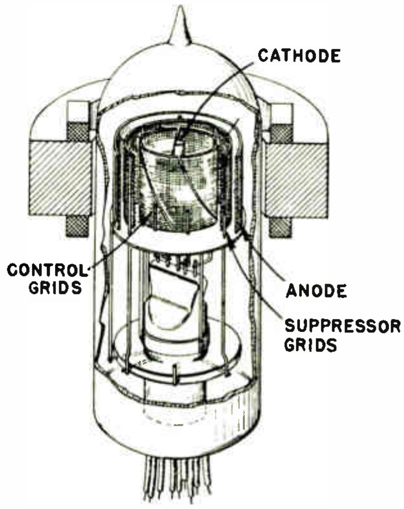


detector tube V_1 is connected to a limiter diode V_2 through a resistor R_2 which has a high resistance compared with the diode impedance.

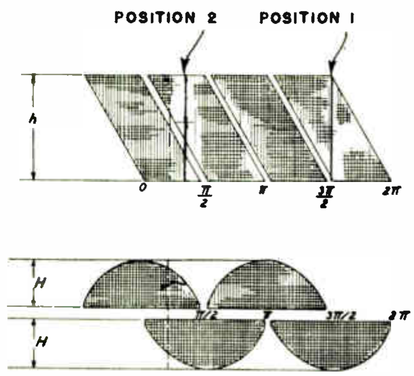
G. J. Scoles, Metropolitan-Vickers Electrical Co. Limited, (F) September 21, 1943, (I) August 21, 1945, No. 2,383,420.

Phase Shifter

The elongated cathode of the tube illustrated is surrounded by arcuate control grids and, further out, by suppressor grids, and finally by the anode which is at a positive potential with respect to the cathode. A continuously and uniformly rotating magnetic field with the lines of force normal to the axis of the cathode is generated between four poles of a magnet, the coils of which are appropriately fed by the currents from a two-phase alternator. The rotating magnetic field in combination with the radial electrostatic field between cathode and anode forces the electrons to move in a sheet extending in a radial direction between the cathode and the anode. This electron sheet will rotate so as always to follow the direction of the instantaneous maximum of the rotating magnetic field. Suppressor grids are mounted to suppress the electron sheet which would otherwise be projected in the opposite direction as seen from the cathode. This operation of the suppressor grids will obtain if the two diametrically opposite suppressor grids are connected in opposite polarity to the first phase of the alternator and the remaining two suppressor grids to the second phase; an electric field rotating synchronously with the magnetic field will be set up in the space between the suppressor grids.



An exploded view of the control grids is also shown; in the tube they are arranged in a cylinder concentric with the cathode. A phase splitting circuit supplies four equal 90 deg. out-of-phase voltages which are applied to the four sections of the control grid, respectively. In operation, if the sheet-shaped electron beam is so positioned that it passes only one of the control grid (position I on the drawing) the phase of the plate current will be identical with that of the voltage on this grid section. However, if part of the beam passes through one grid section and another part through another grid section (position II), the phase of the resulting anode current will be



determined by the proportion of the beam that traverses the respective grid sections. By this expedient it is possible to shift the phase of the resulting current.

It can be proved that if the control grids have sine shaped contours as shown in the second view, the resulting current will be of the form: $i = i_0 \cos 2\pi\ (f_1 t + x)$, where $x = f_2 t$, f_1 being the frequency of the control grid voltage and f_2 the frequency of the alternator voltage. It will be seen that for this shape of control grids, a phase shift proportional to time and equivalent to a linear frequency shift is achieved.

K. G. Jansky, Bell Telephone Laboratories, (F) November 15, 1943, (I) December 11, 1945, No. 2,390,884.

Synchronizing Rotating Beam Tube

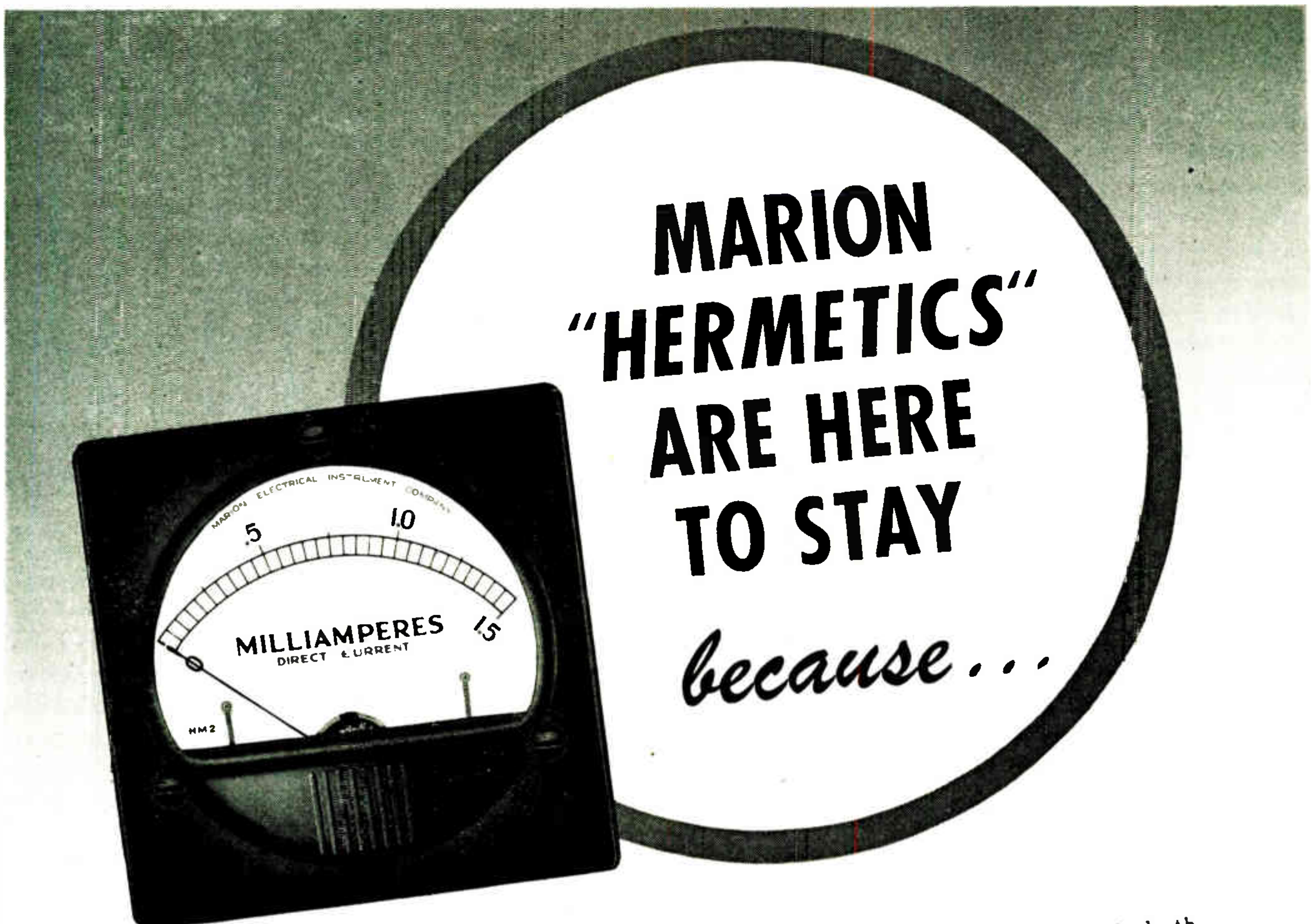
The patent describes and claims a system to synchronize the rotation of a receiving multi-anode rotating beam tube with the transmitting rotating beam tube. In this multi-anode tube the several anodes are arranged on a cylindrical surface surrounding a cylindrical cathode and a radial rotating electron beam impinges upon these anodes in succession. Grids are provided which cut off the electron beam so that a modulated output may be achieved. Details of the tube can be found in an article by A. M. Skellett in the Bell System Technical Journal, April, 1944, summarized in the July, 1944, issue of ELECTRONIC INDUSTRIES on page 222.

The invention is concerned with an apparatus to synchronize the rotating magnetic field of the receiving tube with that of the transmitting tube. It is the purpose of the rotating magnetic field to control the rotation of the electron beam and, therefore, it is desirable that these fields be synchronized to ascertain that if the beam impinges upon a certain anode of the transmitting tube, it impinges upon a corresponding anode in the receiving tube. To obtain this feature, the output of two anodes are made to control the rotating magnetic field, initial adjustment being made by having the electron beam directed towards a preselected anode if no signal is received.

A. M. Skellett, Bell Telephone Laboratories, (F) July 17, 1942, (I) October 16, 1945, No. 2,387,045.

Makes Cord Sets

Haft & Sons, Inc., has been organized with headquarters at 79 Third Street, Brooklyn, N. Y., for the manufacture of cord sets and electrical wiring devices. Lester Haft was formerly, and for the past 30 years, treasurer and general manager of the C. D. Wood Electric Co. He is joined by his two sons, Alexander and Marshall.



. . . ***they're dustproof and moisture-proof*** – foreign matter which oxidizes pivots and attacks bearings and thus shortens the life of an instrument cannot enter.

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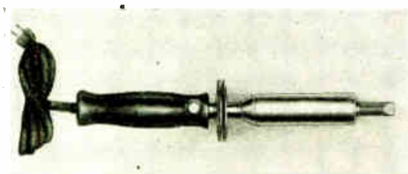
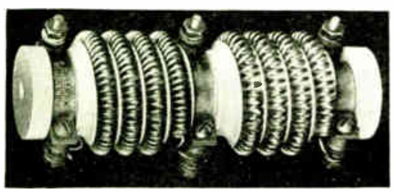


Soldering Iron

A new dual-heat electric soldering iron is manufactured by the Dual-Heat Iron Co., 4370 Sunset Blvd., Los Angeles 27, Calif. The iron provides two heats and is suitable for aluminum soldering, tinsmithing and production soldering. The high temperature reserve heat is available by pressing a button in the handle. The heating element is molded into a ceramic insulator.—Electronic Industries

Infra-Red Equipment

Heat required for various industrial applications such as drying, baking, dehydration and evaporation is supplied by portable electric infra-red equipment being made by the Carbomatic Corp., Dept. P 146, 117 West 63rd Stret, New York 23. The new R-12 model accomodates 12 lamps, either 125 watt or 250 watt size, and is equipped with three toggle switches, permitting operation of 1, 2 or 3 rows of four lamps each. —Electronic Industries

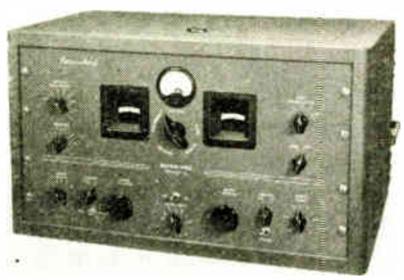


Center-Tap Resistor

A new type CAM center-tap resistor has been developed by the Regan Engineering Corp. and is marketed by Techtmann Industries, Inc., 828 Broadway, Milwaukee 2, Wis. The resistor consists of a core of solid steatite, uopn which is wound a helical resistance wire element. If a unit overloads or burns out, the coil can be replaced by removing two nuts without disturbing connections or supporting assembly.—Electronic Industries

Street Lighting Control

A new automatic unit for turning street lights, exterior lighting of public buildings and outdoor advertising signs has been designed by Ripley Co., Torrington, Conn. This electronic "Sun Switch" consists of a photoelectric cell, standard amplifier tubes and a relay. Under normal conditions light is provided from 25 minutes after sunset to 25 minutes before sunrise. The unit is inexpensive enough that individual installations on each light pole can be made.—Electronic Industries



Communications Receiver

Hammarlund Mfg. Co., 460 W. 34th St., New York, has developed the Series 400 Super-Pro communication receivers. Two models are available, the SP-400-X with a tuning range of .54 to 30 mc in 5 bands, and the SP-400-SX, tuning from 1.25 to 40 mc in 5 bands. Continuous bandspread is available for three hf bands. Six-position crystal filter, AVC over four stages and low impedance antenna input for balanced transmission are provided.—Electronic Industries

Switch

A 50 ohm switch designed by Bird Electronic Corp., 1800 E 38th St., Cleveland 14, Ohio, is made for selector use in coaxial circuits below 4000mc. To provide for switching of antennas, receivers, low power transmitters and other intra-equipment functions these units maintain good impedance characteristics and low standing wave ratios are realized.—Electronic Industries

Precision Fork

A vacuum-tube precision fork for standardization at low frequencies is being produced by the General Radio Co., Cambridge 39, Mass. The type 816 tuning fork has a frequency stability of 0.001% and a maximum output of 2 watts is supplied with either sinusoidal or peaked waveform. The fork is housed in a temperature-controlled chamber and drives a synchronous clock. It is available in two models, type 816-A with a 50-cycle fork and type 816-B with a fork frequency of 60-cycles.—Electronic Industries

Iconoscope Yoke

Iconoscope yokes built to exacting specifications are being manufactured by the United States Television Mfg. Corp., 106 Seventh Avenue, New York. The yoke has a vertical inductance of 2 millihenrys and a horizontal inductance of 100 microhenrys, both measured at 1000 cycles. The crosstalk ratio in voltage is 1000 to 1, measured from horizontal to vertical coils. An improved horizontal output transformer also is available for the yoke.—Electronic Industries

Colored Flanges

The Marion Electrical Instrument Co., Manchester, N. H., has a new line of round or square interchangeable colored flanges for 2½ in. and 3½ in. hermetically sealed electrical indicating instruments. The flanges are available in 12 different iridescent colors. —Electronic Industries

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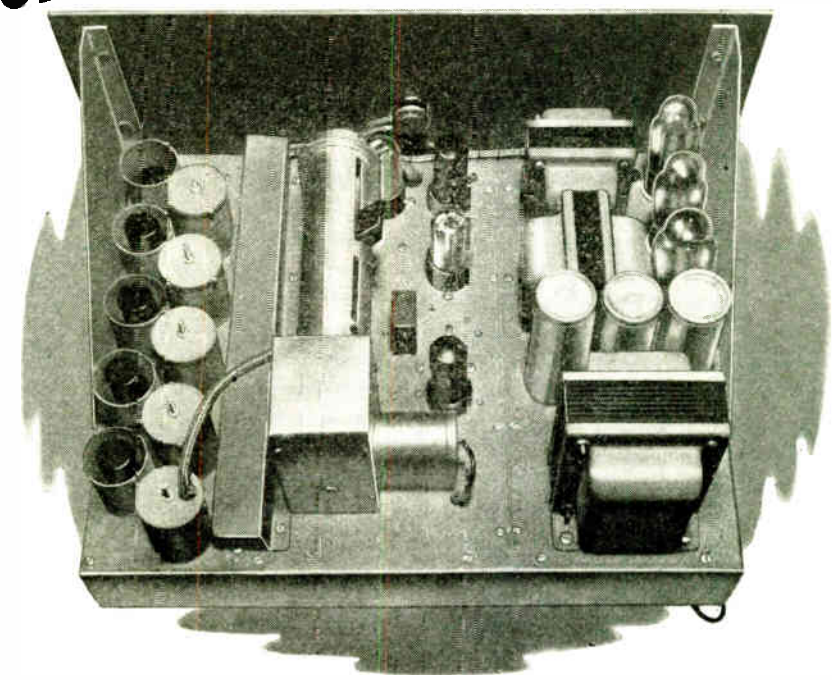

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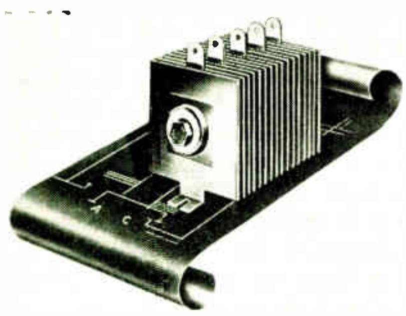
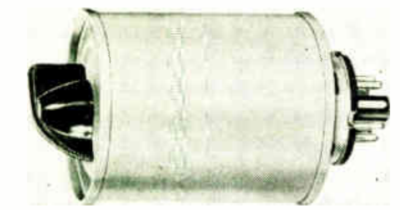


Copper Sulphide Rectifier

Benwood-Linze Co., St. Louis, Mo., has developed a copper sulphide rectifier unit which will carry 50a without forced air cooling. This unit was designed for 6-volt storage battery taper charging.—Electronic Industries

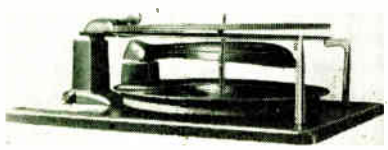
Sound Projector

Infinite baffle housings for 8 and 12 in. cone speakers are being made by University Laboratories, 225 Varick St., New York 14, N. Y. They will provide complete 360 degree sound diffusion without undue concentration under the speaker unit. The 12 in. model will handle frequencies down to 50 c.p.s. -Elecrtonic Industries



Self Timing Interrupter

A unit with either a fixed predetermined rate or an external adjustable rate of interruption is being built by Electronic Controls, Inc., 44 Summer Ave., Newark 4, N. J., for service in warning and blinking signals, industrial controls and process timing. Timing range is from 1 to 12 pulses a second. Control contacts are either SPST or DPST. -Electronic Industries

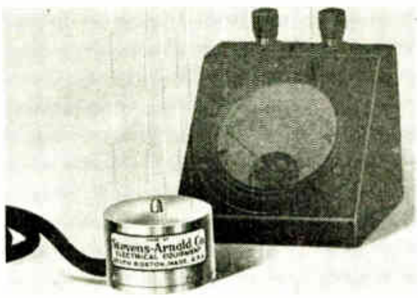


Record Changer

Chipping and the enlarging of the center hole in records is minimized in the Velvet Action record changer being made by Farnsworth Television and Radio Corp., Fort Wayne, Ind., by the use of three record shelves in place of the usual one or two. The unit uses a rim driven turntable. Any standard pickup cartridges can be fitted in the pickup arm.—Electronic Industries

Wheatstone Bridge

A portable Wheatstone bridge unit for Murray, Varley, Hilborn, and Fisher loop testing and straight resistance measurements is being made by Winslow Co., 9 Liberty St., Newark 5, N. J. Resistances in excess of 100,000 ohms are measured with an external battery Galvanometer is a replacable unit.—Electronic Industries



Pressure Pick-Up

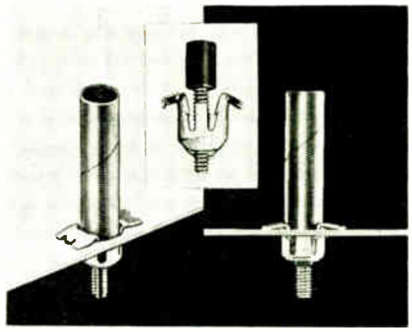
A pressure and deflection pick-up, which translates minute deflections or pressure variations into linear changes in its dc output voltage, has been designed by the Stevens-Arnold Co., 22 Elkins Street, South Boston, Mass. The pick-up may be connected directly to standard indicating instruments and accurate readings are obtained in the range of 0.0005 in. to 0.1 in. movement of the plunger up to 100 cps.—Electronic Industries

Multimeter

A new combination volt-ohm-milliammeter is now in production by Triplett Electrical Instrument Co., Bluffton, Ohio. Using 40 microampere as full range meter deflection, the unit has exceptional sensitivity; dc voltage ranges use resistance values of 25,000 ohms per v. Long 5½ in. scale provides easy meter readings.—Electronic Industries

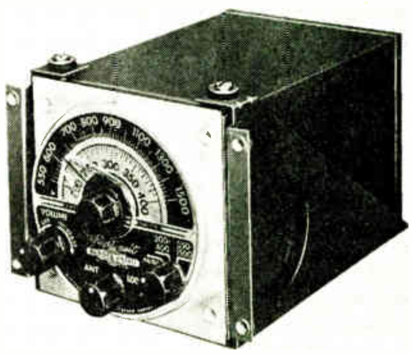
Contacts

A new series of silver tungsten and silver tungsten carbide contacts is being made by Gibson Electric Co., 8362 Frankstown Ave., Pittsburgh 21, Pa. These new contacts have high current carrying capacity, greater non-welding characteristics and longer life. In an air circuit breaker a contact with less than 1/6 sq. in. contact area will repeatedly break 15,000a at 600v without excessive wear, sticking or welding.—Electronic Industries



Coil Tube Mounting

A new Speed Nut fastener which will securely mount coil tubing to the radio chassis and also provide an accurate vibration-proof adjustment for the iron tunnig core, is being made by Tinnerman Products, Inc., 2111 Fulton Road, Cleveland 13, Ohio. These fasteners are available for 9/32 and ⅜ in. O.D. tubings.—Electronic Industries



Aircraft Receiver

Bendix Radio, Baltimore 4, Md., is making a personal aircraft receiver that weighs under 5 lbs. Two tuning bands are provided. Reception on the 200-400 kc band allows pickup of airport control towers, civil airway stations and range stations. Regular broadcast programs can be used on the other band for navigation or entertainment With a loop the receiver will allow aural null homing guidance.—Electronic Industries

Signalling Timer

The Series S signalling timer has been redesigned to give both visual and audible alarm at the completion of a time interval. Elapsed is shown on the dial. Models of the timer can be had for 115 to 230 volts ac, 25, 50, or 60 cycles. It is made by the Industrial Timer Corp., 117 Edison Place, Newark 5, N. J.—Electronic Industries

Wave Makers

"A leaping trout awakens the still pool to life in waves that move in silent rhythm."

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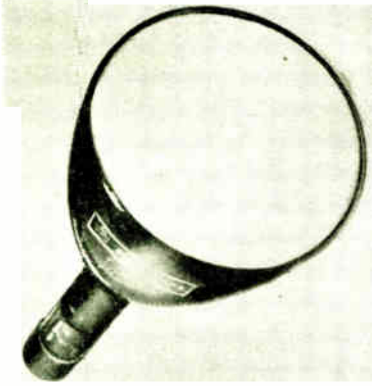
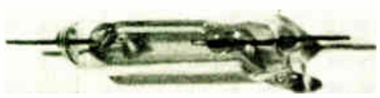


Cathode-Ray Tube

Allen B. Du Mont Labs., Inc., of Passaic, N. J., has developed a cathode-ray tube providing an image of high luminosity for television receivers. The type 7EP4 is a 7 in. tube with a normal screen image of 5¾ in. wide by 4¼ in. high and requires an operating potential of 2500 volts allowing the use of a low-cost power supply.—Electronic Industries



Bolometer

A new vacuum type bolometer for use in UHF bridge circuit measuring equipment is being manufactured by Lynn Engineering Co., 912 Westfield Ave., Elizabeth 3, N. J. Sensitivity is about 1% change of resistance for each 4.5 microwatt variation in power. Smallest unit shows 200 ohms at 0.5 ma.—Electronic Industries

Range Callibrator

For use in calibrating the sweep speed of a synchroscope or triggered sweep oscilloscope in commercial radar and television test work, United Cinephone Corp., Torrington, Conn., is making a new B sweep calibrator model 8127. Switch permits selection of four different time intervals. Markers have choice of polarity. Trigger pulses also with a choice of polarity have repetition rate variable from 2000 to 3000 cps. Gate duration is 20 to 3000 microseconds.—Electronic Industries

Switch

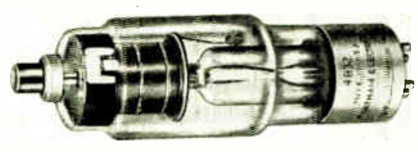
A new Micro switch featuring "make before break" contacts has been introduced by First Industrial Corp., Freeport, Ill. This action is obtained by the use of two spring members. The new switch is mounted in the standard size bakelite case and is, when necessary, interchangeable with the regular types.—Electronic Industries

Field Intensity Meter

Now ready for civilian distribution is a new noise and field intensity meter designed to locate sources of radio interference. The model NMA-4 is produced by the Stoddart Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif. It locates and indicates in microvolts the amplitude of noise causing disturbance to radio reception in aircraft, landcraft, seacraft, etc. Frequency range 100-400 mc, voltage range 1 to 100,000 microvolts, field intensity range 5 to 100,000 microvolts per meter.—Electronic Industries

Compact Crystal Diodes

Germanium crystal diodes suitable for use as detectors, frequency discriminators, low frequency oscillators and such kindred applications have been developed by Electronics Div., Sylvania Electric Products, Inc., Boston, Mass. These units are about the size of a small resistor and may be wired directly into various circuits. No heater supply is required. Average anode current is 22 ma.—Electronic Industries



Xenon Rectifier

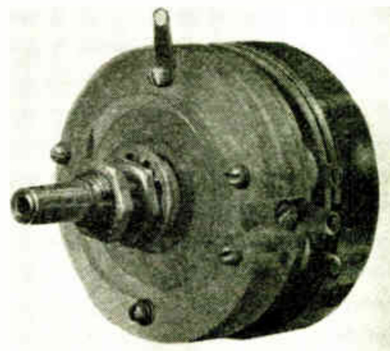
With only a 10 v drop, an Xenon filled rectifier tube is in production by Chatham Electronics, 475 Washington St., Newark 2, N. J. Tube will carry an average anode current of 1.25 a at an inverse voltage peak of 10,000 v. Filament operates at 5 v ac at 7.5 a.—Electronic Industries

Beam Tetrode

A new uhf beam tetrode, the Taylor TB-35, has been added to the line of Taylor Tubes, Inc., 2312 Wabansia Avenue, Chicago, Ill. The tube operates with full power input up to 250 mc and at half-power input to 400 mc and provides a power output of over 125 watts in class C telegraphy applications. The plate connection is brought at the top of the envelope and the tube is mounted on a four-pin ceramic base.—Electronic Industries

Terminal Block

A space saving assembly with the flexibility of one to twenty-four individual terminals has been designed by Curtis Development & Mfg. Co., 1 N. Pulaski Rd., Chicago 24, Ill. In addition to quantity orders of a single type, kits are available containing individual terminals and various length mounting channels which can be used on special and experimental equipment.—Electronic Industries

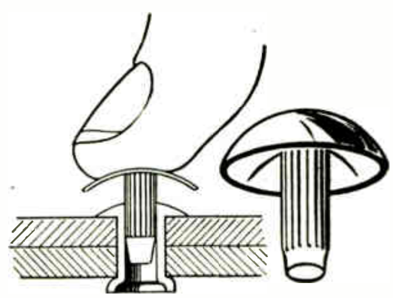


Ring Tuner

The Caltron Co., Los Angeles 34, Calif., has developed a new 145 mc ring tuner, which consists of a complete variable tuning unit in a compact assembly for single hole mounting. The unit has a tuning range of 140 to 160 mc with 3.5 mmf tube capacity and a rotation of 180 degrees. A stationary ring comprising a 2-turn inductance and a rotary ring of 1 turn together form the plates of a variable condenser, thus making up the tuning unit.—Electronic Industries

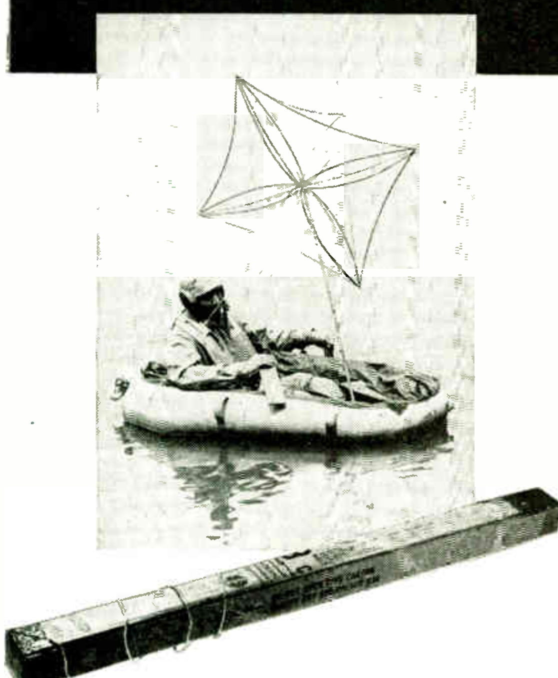
Dial Light

A small tubular lamp is being made by Westinghouse Electric Corp., Bloomfield, N. J., for the illumination of radio panels and phonograph compartments. These lamps are also made with black light phosphors coating so that while no visible light is generated, specially treated control knobs and dials will fluoresce with easy visibility.—Electronic Industries



Umbrella Plug

The umbrella plug matches or harmonizes with the surface color or texture of the material being fastened. The plug fits into the center of the hollow type Cherry rivets and furnishes a smooth cap completely covering the head of the rivet. These plugs are available in aluminum, copper or plastic. Made by the Cherry Rivet Co., 231 Winston Street, Los Angeles 13, Calif.—Electronic Industries



The reflector in use...and as it is packed

Eleven different "spider webs" of Monel mesh in the Vendo reflector catch radar beams approaching from any quarter. The mesh, knit from 0.0035-inch Monel wire, is furnished by Metal Textile Corp., Orange, N. J.

One of the problems was to make the reflector compact enough to fit in the smallest life raft pack. By using easily-folded Monel mesh, the unit can be stowed in a waxed cardboard carton, only 25" long and 1¾" square.

Peacetime possibilities include use as an aerial for home radios. One report cites tremendously improved reception.

In 1942, Eddie Rickenbacker and his companions crash-landed in the Pacific. For 22 days, airplanes combed the sky before sighting them.

Three years later, airmen forced down at sea were being found in a matter of hours . . . on blackest nights . . . in roughest weather.

. . . for radar was being used to locate friend as well as foe!

A metal reflector, developed by the National Defense Research Committee, turned the trick.

Known as the "Corner Reflector," it enabled life rafts to be easily detected by radar-equipped rescue craft.

To make the reflector, 4 ounces of wire mesh are formed into 11 triangular webs and stretched out on a collapsible framework. It is this mesh which reflects the radar waves and sends them back to appear as spots on the radar scopes of searching airplanes or ships.

Working with the Army and Navy, Vendo Company of Kansas City tested many metals for the mesh.

The metal had to offer just the right electrical and electronic characteristics. The metal had to be strong, so that the delicate mesh would not be ripped apart by winds. And *(of greatest importance)*, it had to resist corrosion by salt spray. For the slightest corrosion would set up high resistance at the thousands of mesh contacts, and seriously cut down over-all conductivity.

Of all the materials tested, only one was found to possess all the properties needed.

That was knit Monel mesh.

Remember Monel and other INCO Nickel Alloys whenever you need a "hard-to-find" combination of properties for electrical or electronic applications. For more information on metals that fight . . . corrosion . . . wear . . . fatigue . . . heat . . . stress . . . write for "Tremendous Trifles."

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WASHINGTON

Latest Electronic News Developments Summarized by Electronic Industries' Washington Bureau

GOVERNMENT WATCHING ELECTRONIC DEVELOPMENTS—Official government leaders in Washington from President Truman down, now are coming to full realization that the radio-radar-electronics industry holds the promise of very great potentialities—possibly the industry with the greatest prospects—in the Nation's future prosperity. The new developments, which are daily being unfolded, as the cloak of military secrecy is lifted, with their promise of public acceptance and value, have impressed topmost government officialdom tremendously. Television with immediate public service of black-and-white and color video around the immediate corner; FM as the new sound broadcasting service and its huge numbers of stations planned; radar with almost limitless possibilities in air and sea and land navigation control and safety; the new many-sided radiocommunications uses in railroads, marine and highway mobile fields; and electronic industrial requirements (exemplified in one small illustration in the Army's huge electronic computer and calculator)—these are the new wonders attracting most intense governmental interest.

PRICE DETERMINATIONS—Just as in business and industry, because of the labor and price situations, the reconversion period in government activities has been one of confusion and seeming rudderless course, particularly with regard to price determinations and labor disputes. The government agencies having to deal with affairs related to radio and electronics can greatly aid the reconversion progress. Chief governmental cog is the FCC, but the Commission has found its load of work in regard to the new radio art developments, particularly television and FM, too much for its present staff. Fortunately FCC is getting some relief in additional technical employes with an increased appropriation of $585,000. Government aid is further exemplified in the Bureau of Standards with its ionosphere and propagation studies under its well known radio chief. Dr. J. H. Dellinger.

FCC CHANGES—Shift of Commission Chairman Porter to the helm of the OPA meant another upward rung for that able official to participation in government's cabinet deliberations, but was a loss to FCC. For the radio manufacturing industry, however, it was important because a man, knowing its problems, was heading the price control agency. Youthful Commissioner Charles R. Denny Jr., exceptionally able, was (at this writing) projected as Porter's successor as FCC chieftain. This will mean a greater ascendancy for the Commission's Law Department, because Denny was FCC General Counsel before being elevated. On the engineering side of the FCC's functioning, Commissioner E. K. Jett, the most respected technical government official in radio, will keep the reins on all engineering and allocations problems.

NO 2-BAND FM RECEIVERS—FCC, in rejecting the proposal for two bands for FM broadcasting, has now finally determined troublesome allocations matters, and manufacturers have been able to make final design and production planning as a result of this decision on the basis of the single-band "upstairs" assignment for this service. The Commission felt that the high-band coverage by FM in urban communities and surrounding area will be better than present Standard broadcasting service throughout the entire Eastern area of the nation and a very large portion of the West. Before the war there were only 300,000 to 400,000 sets capable of FM reception and almost all were combination AM-FM, so the listening public will not be hurt. The conference method of FCC, instead of staging hearings, to determine service areas of FM station applicants to determine metropolitan and rural coverage, will expedite authorizations of construction permits.

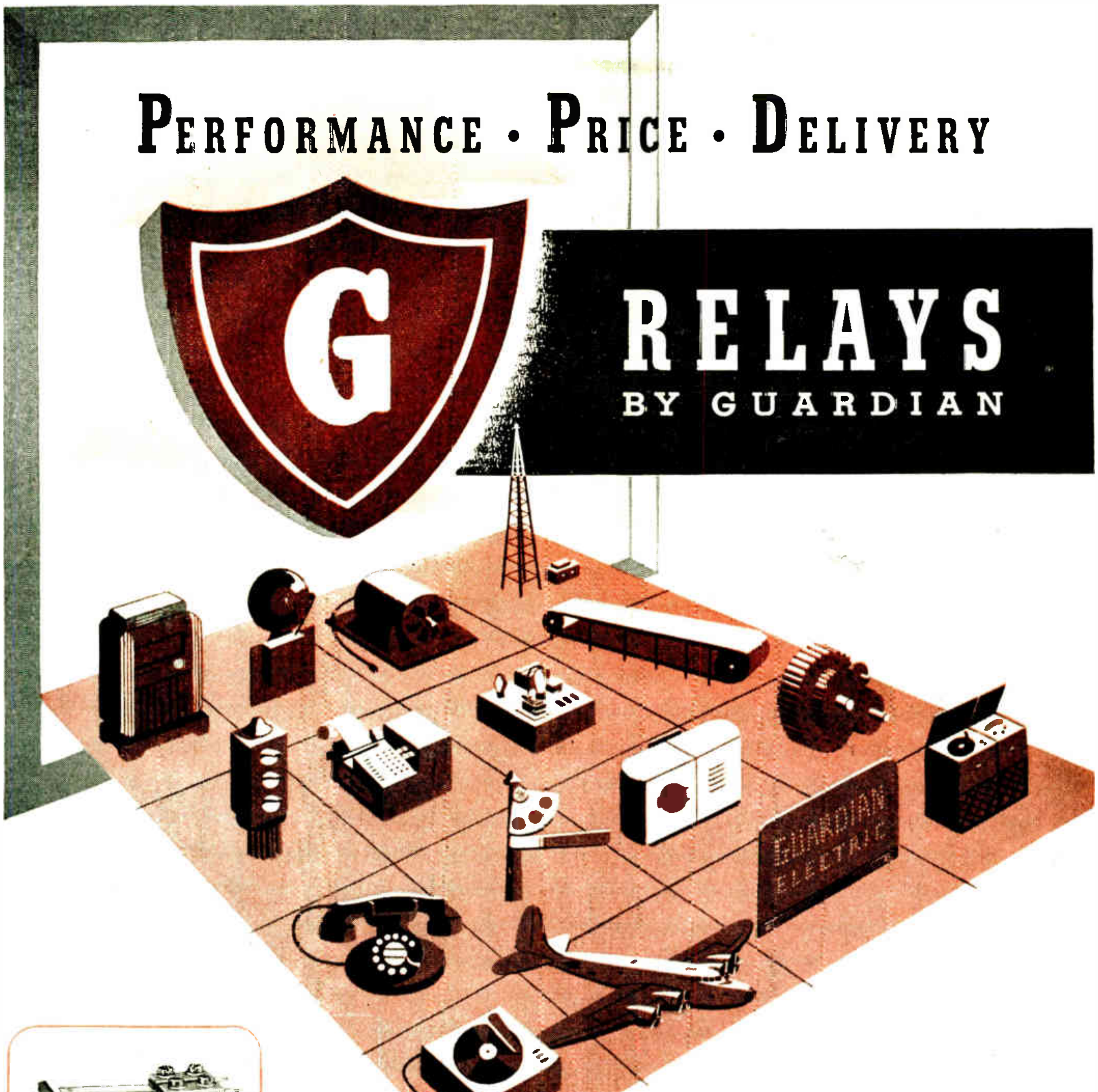
PRIVATE AIRPLANES TO HAVE VHF SOON—Prediction of CAA Administrator Wright of VHF becoming standard for private fliers in next few years—with 500,000 private planes to be flying in next decade—presents interesting outlook for radio manufacturing industry. Even though switch may be gradual, the CAA Administrator sees future for radio manufacturers. To cut down expense for private fliers who want minimum apparatus, portable 5-channel sets can be installed in planes with addition of new crystals in existing transmitters and receivers.

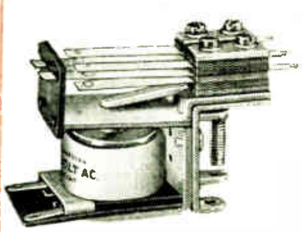
ANSWER TO UNIONS' CHARGE OF MANUFACTURING "SIT-DOWN"—Civilian Production Administrator Small has refuted labor union accusations of excessive inventories held by radio manufacturers of sets. Out of fifteen major radio manufacturers surveyed up to the end of 1945, three had not got into production because of difficulties in obtaining components and the twelve producing companies had made 160,155 sets in the last quarter of 1945 and only had an inventory of 18,299.

MISCELLANY—Broadcasting "Facsimile", with the goal of newspapers being produced in the home receivers, considered the "sleeper" of the new radio services, is to be launched in Washington by Cowles Broadcasting interests with plan pushed by former FCC Commissioner "Tam" Graven, now Cowles executive vice president . . . Discoveries of German electronic developments, uncovered by Army Technical Industrial Intelligence Board investigators (just shifted to Commerce Department), worth watching by American industry; paper capacitors and selenium rectifier processes may be particularly helpful. Address Publications Board TIIB, Commerce Department.

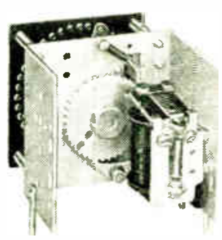
National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor





Series 100 A. C. Relay



Series R Stepping Relay

More and more of today's instruments, appliances and machines start, stop, see, hear, measure, count, time, record, talk, fly, with Relays by Guardian. Manufacturers who designed these products thought they needed "specials", yet found Guardian *standard* Relays better qualified on performance—price—delivery. For example, the Guardian Series 100 Relay is a standard type with replaceable coil and contact combinations available. Has a wide operating range from 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. These and other Guardian controls and Guardian's speed and flexibility of manufacturing can make things easier for you. Send for NEW RELAY CATALOG showing 43 basic types of relays, a complete line of solenoids, magnetic contactors, switch parts, together with operating data, specifications, suggested applications. Your catalog is waiting. No cost. Write.

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1622-C W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

Electran Corp. Officers

Frank J. Strassner is president of the newly organized Electran Corp., 207 Railroad Avenue, Harrison, N. J. The concern manufactures rectifier unit and power transformers in sizes up to 100 kva. Other officers are: Vice-president, Robert Carlson; secretary, Frederick E. Strassner, and treasurer, John Fernicola. Frank J. Strassner is an E.E. graduate of Purdue University, class of 1907, and his son Frederick was graduated from MIT in 1938. The older three members of the firm have been associated together for the past 20 years, with the American Transformer Co. and the Newark Tranformer Co.

Mepco Expands

Madison Electrical Products Corp., Madison, N. J., is now set up to produce standard and special types of resistors, if and rf transformers, oscillator and antenna coils, coordinated loop antennae trimmers and meter multipliers, as well as special production assemblies such as vacuum tube voltmeters, oscilloscope testing equipment, circuit analyzers, audio and radio frequency oscillators, etc.

Clare Eastern Offices

C. P. Clare & Co., Chicago manufacturers of relays, has opened new engineering and sales offices at 420 Lexington Avenue, New York, and in the Commercial Trust Building, Philadelphia. J. W. Concagh, with a background of fifteen years' experience in the relay and electrical equipment field, will be in charge of the New York office. Frazier O. Stratton will be in charge at Philadelphia.

Cinch Buys Jones

Cinch Mfg. Corp. has purchased the assets of the Howard B. Jones Co., both of Chicago. The employes of the latter company will be retained for the most part, and Howard B. Jones will be connected with Cinch in a consultant capacity on the Jones products. All incompleted orders remaining on the books of the Jones company at opening of business on the day of transfer of assets will be manufactured and shipped and it is planned to continue the production of all the Jones products.

LONG SCALE, WIDE RANGE VOLT-OHM-MILLIAMMETER

DOUBLE SENSITIVITY D. C. VOLT RANGES

0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.

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

A. C. VOLT RANGES

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

OHM-MEGOHMS

0-400 ohms (60 ohms center scale)
0-50,000 ohms (300 ohms center scale)
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DIRECT READING OUTPUT LEVEL DECIBEL RANGES

−30 to +3, +15, +29, +43, +55, +69 DB

TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES

0-50 Microamperes, at 250 M.V.

D. C. MILLIAMPERES

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

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0-10 Amperes, at 250 M.V.

OUTPUT READINGS

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

ATTRACTIVE COMPACT CASE

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

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Precision first ...to last

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ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

CBS DEMONSTRATES ITS COLOR TELE

(*Continued from page 75*)

done by pointing the axis of this dipole reflector directly toward that building.

This test, while it could be equally well applied to the 50- to 90-megacycle waves would require such a large reflector at the receiver as to be unwieldy. It gives assurance that, while the extreme facility whereby these radio signals are reflected off building structures is in no means altered, a means is available of making use of such signals when direct path reception is not possible. This test was one of the most interesting parts of the demonstration.

Combined sight and sound

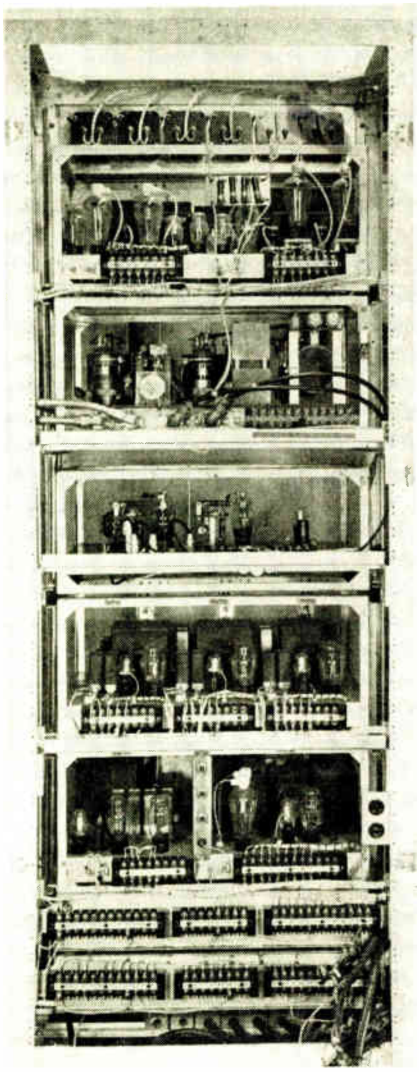
In these tests a receiver having the following characteristics was used covering the reception frequency of 480-500 megacycles, with a pass band of 9 megacycles, as shown in curves. This receiver had a combined sight and sound IF channel with the sound signal picked off at the second detector as a series of frequency modulated carrier pulses occurring during the scanning flyback intervals. These pulses are demodulated and integrated into a regular audio signal with circuits that were not disclosed. In the present system 31,500 of these pulses occur each second permitting an audio fidelity of 10 or 12 kilocycles.

The receiver had a sensitivity of $8\mu V$ at the unity S/N ratio point and gave a satisfactory picture with $150\mu V$ input. The first "tube" was a silicon detector followed by a six-stage IF amplifier operating at 105 megacycles. This amplifier utilized stagger tuned coupling, with 6AK5 tubes. Extreme precautions were taken to secure sufficient image rejection and avoid direct pickup at the intermediate frequencies. Following this was the second detector and two video stages modulating a 10 in. cathode ray tube with a P4 screen, operating at 8 kv.

The color definition was excellent and there was no apparent separation of colors on fast moving objects. Also there was no noticeable flicker at the illumination level shown. However, the light output was considerably under that generally deemed necessary for viewing in a subdued-light room, although the illumination was more than adequate for a darkened room. The amount of flicker at greater brilliancies was not demonstrated.

As is usual in all presently-workable color television systems, a succession of three colored films (here mounted on a rotating disc) pass between the cathode ray tube screen and the observer, each imparting its own color to the portion of the frame then being scanned. By a systematized order of scanning, the twenty complete frames are broken up into 120 fields per second, so that each color appears 40 times per second. This same system having been applied at the studio camera, all colors are reproduced in correct order and correct intensity. At the studio, however, particular color intensities can be modified or intensified if it is desired to correct for inaccurate intensities of the viewed scenes (as with filmed pictures) or to make drab scenes more vivid.

Rear view of Federal-CBS tele transmitter modulator unit, one of the ten bays



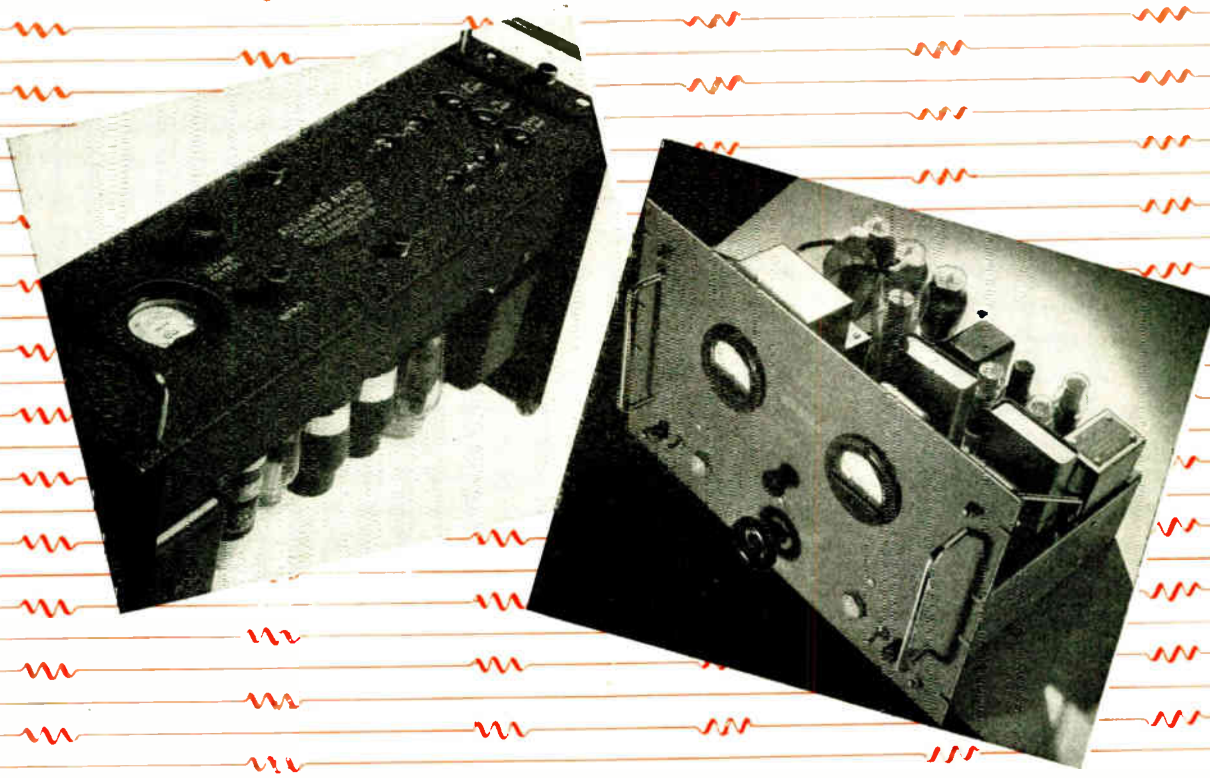
The rotating color wheel operated noiselessly and at a 1200 RPM speed carried six color film sectors, two reds, two greens and two blues. Non-mechanical color systems (such as full electronic color methods) are still in the realm of wishful hoping, it would seem from all reports.

Coverage problems

The problems still to be studied are those of coverage. Frequencies of this order do not produce a utilizable signal behind hills or around obstructions, and locations in a valley may be without signals unless other obstructions are strategically located to "radar" a signal into the valley. The possibility of using elaborate multiple arrays at a receiver to reduce reflected path multiple signals is not always a complete advantage since simple dipoles alone that prove satisfactory at the present television frequency range, are generally inadequate. These, and other factors make it difficult to answer the question everyone is asking—will color television supersede black and white immediately. On the practical side, these proposals are those of a single organization and while quite unusual demonstrations were made, the final system must be proved in many other equally important ways to avoid the repetition of the accusation that the present black and white system was settling down on

(*Continued on page 124*)

*Title registered U. S. Patent Office.



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The HARVEY Regulated Power Supply 106-PA meets every need for a controllable, dependable source of laboratory D.C. power between 200-300 volts. Operates from 115 volts A.C. . . . output remains constant even though line voltage varies between 95 and 130 volts. Ripple content is better than 10MV . . . two separate filament voltages available . . . 6.3 volts, 5 amps. each . . . paralleled operation possible making 6.3 volts at 10 amps. available. D.C. voltmeter for measuring output.

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For complete specifications on the HARVEY 106-PA, write for Bulletin No. 25; on the HARVEY 206-PA, Bulletin No. 26. We'll be pleased to send you either or both. Write:

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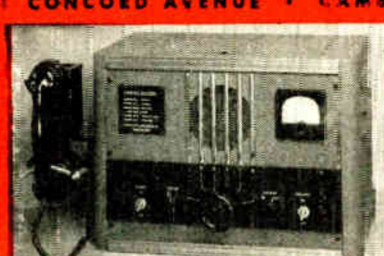

HAR-CAM
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Typical HARVEY products: Above left: The HAR-CAM Visual Alignment Signal Generator Model 205 TS; center: The HARVEY Marine Radio Telephone Model M-25; right: The HAR-CAM Model MFT-25 FM Transmitter. Write for Bulletins.

CAVITY RESONATORS

(*Continued from page 82*)

This is because at these very high frequencies in the vicinity of 3000 mc, the transit time in the tube is an important consideration in the setting up of proper conditions for oscillation. In this re-entrant cavity, the transit time in the lighthouse tube is such that the conditions for oscillation are satisfied in the region from 8 to 12 cms.

In this band the re-entrant resonator can be used as a cw or as a pulsed oscillator with power output and efficiency about the same as for the double coax circuit. This type of oscillator has been produced during the war, and photographs of two production cavities are shown in Figs. 3 and 4. In Fig. 3 the lighthouse tube and grid cylinder are shown removed from the cavity to illustrate the shape of the tube and the construction of the grid cylinder.

Tuning controls

The production cavities were made with two tuning controls. One was a coarse tuning control, which tuned approximately 60 mcs per 360° turn, and the other a fine tuning control, which tuned approximately 20 mcs per 360° turn. In use, the coarse tuning would be set up on the bench, and then the fine tuning control would be brought to the panel so that minor adjustments could be made in operation. The unit in Fig. 4 has a monitor output. This was used to take out power at a very low level so that the frequency could be monitored constantly. In this way the set could always be kept in tune, and with the wavemeter used, the frequency output could be held to approximately 1 mc. This unit was designed to operate in the five-quarter mode, and its overall length is aproximately 8½ in. It has an additional feature of frequency wobble.

This frequency wobble was needed to vary the frequency output of the cavity over a given range, determined by the amount of drift the transmitter would experience in use. In this way some energy at the proper frequency would always be available even though it would not be available 100% of the time.

Frequency wobble is introduced into the cavity by means of a probe mounted on a small dc motor.

When in use this probe acts as a variable load on the transmission-line tuned circuit and thereby varies the frequency output of the oscillator. The speed of the dc motor is controlled by varying the voltage applied to it. As can be seen, there is an adjustable stop on this probe so that when constant frequency output is desired the probe can be clamped in position.

The unit in Fig. 3 was designed to operate in the three-quarter mode and had an overall length of aproximately 6½ in. This overall length does not include the fine tuning control, which in this case was brought out through a hole in the panel of the set for which this cavity was designed. Power is taken from both of these units with a capacitance probe, which is inserted in the output clamp and adjusted for maximum power output, then locked in place.

Operating range

The operating range of both of these cavities is approximately the same, and with the use of three grid cylinders and three shorting plug positions, the cavities can be made to operate from 8.9 to 11.1 cms. These cavities were both designed for pulsed ouput. The peak power available from these units was from 50 to 100 w. Each of these cavities also could be used for cw operation providing the necessary adjustments were made in grid cylinder length and in shorting plug position.

The tuning mechanisms in both of these units are spring loaded, and since tuning is accomplished by sliding contacts on the plate cap of the tube and on the wall of the cathode line, the spring loading must be strong enough to overcome the friction of both these contacts in order to make smooth, accurate tuning possible.

In production it was found necessary to use a beryllium copper plate-line and a beryllium copper shorting plug. This was necessary so that accurate jig heat treating could be performed after fabricating to maintain the close, accurate dimensions and spring necessary for uniformity in tuning of all the cavities. Similarly it was found that beryllium copper was needed in the fabrication of the grid cylinder so that this item would have a firm, tight grip on the flange of the tube and yet be removable without breaking the glass structure.

Dc contact was made to the grid by means of a beryllium copper finger insulated from the wall of the cathode line. This finger is designed so that it makes contact to the grid as near a point of voltage minimum as possible so as not to interfere with the operation of the oscillator.

To maintain a uniform production so that all the cavities produced would perform alike, it was necessary to electrically test them very carefully. The following are some of the more important tests performed on the production units:

1. Band Coverage—In this test the production cavity was tuned over its full range to check the limits of oscillation to guarantee that the required frequencies were covered satisfactorily.

2. Power Over Band—This test was performed to insure that sufficient power output was available over the required frequency range.

3. Back Lash—This test indicated whether or not the spring loading was sufficient to overcome the friction due to sliding contact.

4. Breakdown Test—The insulation of the plate line was tested at 3000 v dc to insure proper operation. The grid contact insulation was tested at 500 v to insure proper operation.

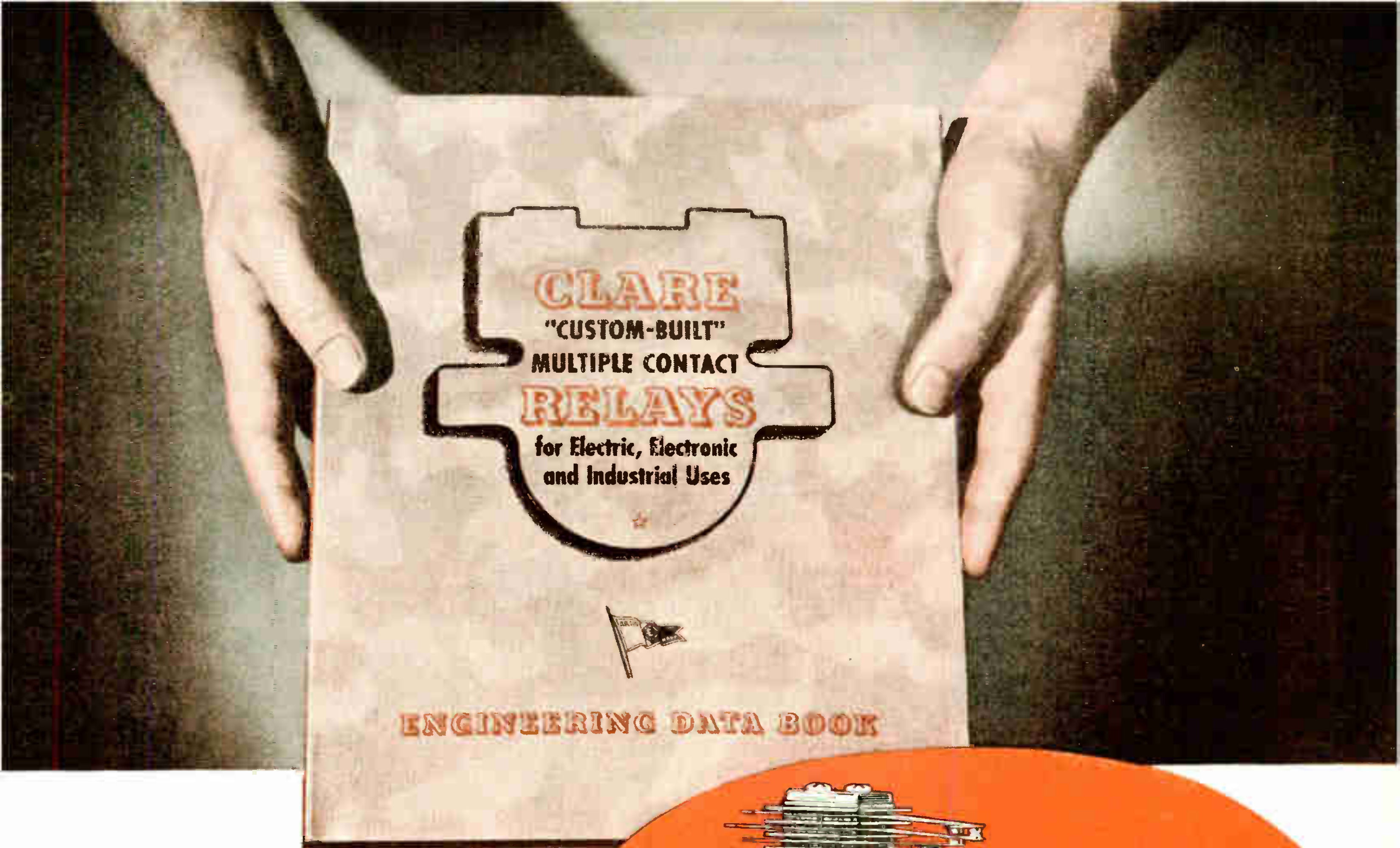
5. Frequency Wobble—The frequency wobble of each cavity produced was set electrically and adjusted so that the wobble of each cavity was within a tolerance of 1 mc.

An important requirement for these units was that they pass the salt spray corrosion test specified by the Armed Services. In order to meet this specification, it was necessary to minimize differences in finishes on parts which came into contact with one another. This was done by using a fairly heavy plate of silver wherever it was practical and possible. It was necessary to change the coil springs from steel to beryllium copper in order that the silver plating could be applied more effectively. All the aluminum parts were anodized, such finish being limited only to those parts where it was considered essential. All the machine screws and bolts used in the assembly of the unit were changed from brass to stainless steel.

---

*Lighthouse tubes have become known by this name because of their peculiar shape. Representative of lighthouse tubes are the types 2C40, 2C43, 446, 464.

Much of the research work on cavities for lighthouse tubes was done at Massachusetts Institute of Technology, Radiation Laboratory, Cambridge, Mass.



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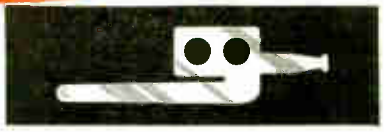

Contacts are welded to nickel silver springs by a special process. May be of precious metals or alloys in 12 different standard or special types and sizes.

Coil core on d.c. relays is solid rod of magnetic iron, the ends machined to give an absolutely flat surface. One end is drilled and tapped for fastening to heel-piece.

High voltage spring pile-up insulators of special heat-treated Bakelite. Have minimum cold flow properties, low moisture absorption content. Permit punching without cracks or checks.

Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly of magnetic metal.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use

DF UNIT

(*Continued from page* 79)

the 180° ambiguity. A sense button is pressed, introducing voltage from the sense antenna differentially into the combined loop circuit. This causes the resultant voltage from the loops and the sense antenna to increase or diminish depending on the vector direction of the signal.

For the reception of CW signals, a separate BFO is included. The BFO operating switch controls a relay, applying plate voltage to the oscillator and coupling its output to the screen grids of the two pentode rectifiers. The resultant audio beat has a frequency equal to the difference between the if signal frequency and the BFO frequency, and is fed to an af amplifier which energizes the headset.

The visual bearing indication is also obtained from the rectified signal in each channel, from one diode in each of the duo-diode pentode tubes, and applied to the respective windings of the twin-bearing indicator through suitable load resistances.

COLUMBIA'S COLOR

(*Continued from page* 118)

a basis that was preventing improvement.

The standards selected by the RTPB and adopted by FCC do not cover operation in this region and certainly are, for the most part, not adaptable thereto. Several methods of combining sight and sound are known to be applicable, in addition to that used by CBS. It certainly would be unwise to select any major standards just now without careful analysis of all proposed methods of full electronic color control that will eliminate mechanically rotating parts, so that those standards would not handicap worthwhile developments along that line. So while some of the fears formerly heard (that predicted years of experimentation to get a satisfactory color system on the air) have been proved unfounded, the commercialization of any system to the point of getting FCC sanction that it is the system, requires much experimental field test verification. If past history can be used as a guide, a great many political and legal barriers will be thrown up as well, which can be surmounted in a slower fashion than the purely technical system difficulties that are so rapidly being solved by enthusiastic engineers and their ingenious ideas.

This demonstration consisted of the following setups. A film scanner was located on the tenth floor of the CBS building at 51st Street and Madison Avenue, New York City, capable of scanning 8 mm color films and larger sizes of colored slides. The output of this scanning system was transmitted to the new transmitter at the top of the Chrysler Building on 42nd Street by coaxial cables. There the signal was broadcast in all directions and was picked up by an antenna on the ninth floor of the CBS building approximately one-half mile away and conducted to the demonstration receivers on the sixth floor below. These receivers were equipped with the usual controls and had a magnification lens between the viewer and the color disc. This lens gave a small degree of magnification (about 20%) so that the picture was equivalent to that of a 12 in. tube.

Tickets For Hams

The Federal Communications Commission has resumed issuance of new amateur radio station licenses for the first time since the Japanese attack on Pearl Harbor, Dec. 7, 1941.

The action of FCC will clear the way immediately for issuance of station licenses to thousands of men and women who received their radio training in the nation's armed forces and desire to continue their war gained radio experience as a civilian hobby.

In addition, approximately 8,000 persons who took the FCC examination for amateur radio operator licenses during the war, despite the fact that it was impossible to obtain a station license, now will be able to obtain licenses to operate amateur radio stations. Prior to Pearl Harbor, there were 60,000 amateur radio station licenses in the United States. It is estimated that this number will increase to 250,000 in the next five years due to the tremendous upsurge of interest in radio created by the war.

New Machlett Plant

Machlett Laboratories, Inc., long established in Norwalk, Conn., has moved its offices and laboratories to Springdale, Conn. A newly equipped and enlarged plant has been occupied and is in operation.

LORAN

(Continued from page 93)

pulse output is derived from this circuit than from the 10 microsecond marker clipper and only the positive pulses from the divider outputs receive attention in this circuit.

The 10 microsecond markers and the 50 and 500 microsecond markers are all positive, but since the 50's and 500's are applied to the lower vertical plate of the cathode ray tube, they will appear as a downward deflection, while the 10 microsecond markers which go to the other plate will appear as an upward deflection.

In practice there is no attempt made to achieve coincidence between the 50 and 500 microsecond markers. The broad 500 microsecond marker always appears delayed behind its associated 50 microsecond marker, and serves only as a tag and not as a measuring point.

Markers every 2,500 microseconds are not derived directly from the third divider stage for the oscilloscope, but are displayed automatically as a slight decrease in every fifth 500 microsecond marker caused by the loading of the third divider stage on the previous stage.

Manual control

The trace shift mixer, included in Fig. 20, takes the square wave output of the receiver gain shift circuit and combines it with the 50 and 500 microsecond markers passing the entire assembly to the cathode ray tube. The amplitude of the square wave on the grid of the trace shift mixer triode is adjustable, and this allows manual control of the trace separation. Three positions are available corresponding to three desired separations during the Loran reading. The first is the normal 1 to 1½ in. spacing for the selection and vertical alignment of the received pulses, while the second removes the trace separation during the actual match. The third separation achieves a slight displacement of the bottom from the top trace in order that the interpolation of markers be possible.

500 Microsecond Marker: Amplifier pips from the second divider, which occur every 500 microseconds, are used as a means of locking the A and B coarse delay

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ELECTRONIC INDUSTRIES

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multivibrators. The 6SN7 triode in Fig. 21 is normally biased to cut-off. The divider output, consisting of negative and positive going pips, is applied to the cathode with the result that only the negative portion reduces the bias enough to permit the flow of plate current. The negative pulses at the plate are then passed on to the delay multivibrators. In other Loran indicator models, the A delay multivibrator is locked on to a 2,500 microsecond marker and in that case the locking is obtained directly from the third divider.

The Framing Circuit: During the process of matching Loran pulses, it is necessary to slide the received signals into their proper positions both on the slow and on the fast sweeps. When the slow sweep position is used, the square wave from either plate of the A delay multivibrator of Fig. 10 may be fed to the first divider storage capacitor. The waveform at one plate is a positive square wave occurring at the recurrence rate of the indicator (i.e., once per sweep) so that it precipitates the charging of that capacitor in a manner similar to the feedback circuit; hence, the first divider will divide at something less than the normal value of 5 as the framing switch is placed in the "right" position, and this will cause the signals to slide to the right. In the "left" position, a similar waveform, but negative, is used; and this slows down the charging of the capacitor so that the signals are drifted to the left.

When the framing switches operate during the fast sweep, the connection to the A delay multivibrator is broken, no change in the recurrence rate is made, and only the slight padding of the crystal oscillator frequency is utilized to position the signals.

Power supply

The indicator power supply of Fig. 22 consists of two sections; one a high-voltage supply for the cathode-ray tube and the other, a regulated low-voltage supply for the timing circuits. Approximately 1,400 volts positive is developed by one half-wave rectifier and this is applied only to the post-deflection intensifier anode on the cathode-ray tube. The negative half cycles from the power transformer are rectified in a similar manner and the developed voltage is about 1,100 volts negative. This forms the prin-

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BLILEY ELECTRIC COMPANY • UNION STATION BUILDING, ERIE, PENNSYLVANIA cipal high-voltage source of the electron gun in the oscilloscope.

In the low-voltage supply, about 360 volts unregulated is furnished to the electronic voltage regulator circuit illustrated in Fig. 23. Here two 2A3 type tubes, acting essentially in parallel, are in series with the load. A dc control amplifier consisting of a 6SJ7 pentode with a glow regulator tube (VR105) is placed between the 2A3 grids and ground. Any changes in the output voltage, nominally 260 volts, is reflected as a change in the potential at the plate of the pentode and consequently as a change in the effective series resistance of the 2A3 tubes. This operates to maintain the output voltage remarkably constant under variations of line voltage so that as much as 15-20 volts variation may be tolerated. The capacitor between the output voltage line and the grid of the pentode makes the regulator action equally good in the case of sudden input changes such as unfiltered ripples.

Scope circuits

The oscilloscope circuits (Fig. 24) used in the indicator are quite conventional and follow those of prewar commercial test oscilloscopes. A wide-neck cathode ray tube, the 5CP1, is used and the use of a post-deflection intensifier anode achieves excellent brilliance. A limiting diode is connected to the grid of the cathode ray tube so that the tube may be turned off during retrace time when the equipment is in the fast sweep position. It will be remembered that the circuit which originates this blanking action is the pedestal generator. The limiting diode is essentially a dc restorer for the application of the pedestal generator square wave to the cathode-ray tube grid.

The receiver, which is contained with its own power supply in a separate chassis, is a wide band superheterodyne having the gain balance feature in the third if stage. It is shown schematically in Fig. 25. There is one preselector stage, a pentagrid frequency changer, three if stages, a simple diode detector, and a single stage of video frequency amplification. The intermediate frequency used is 1,050 kc.

Four fixed channels in the neighborhood of two megacycles are provided, and these are adjusted to

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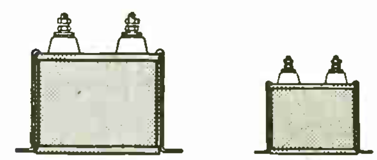

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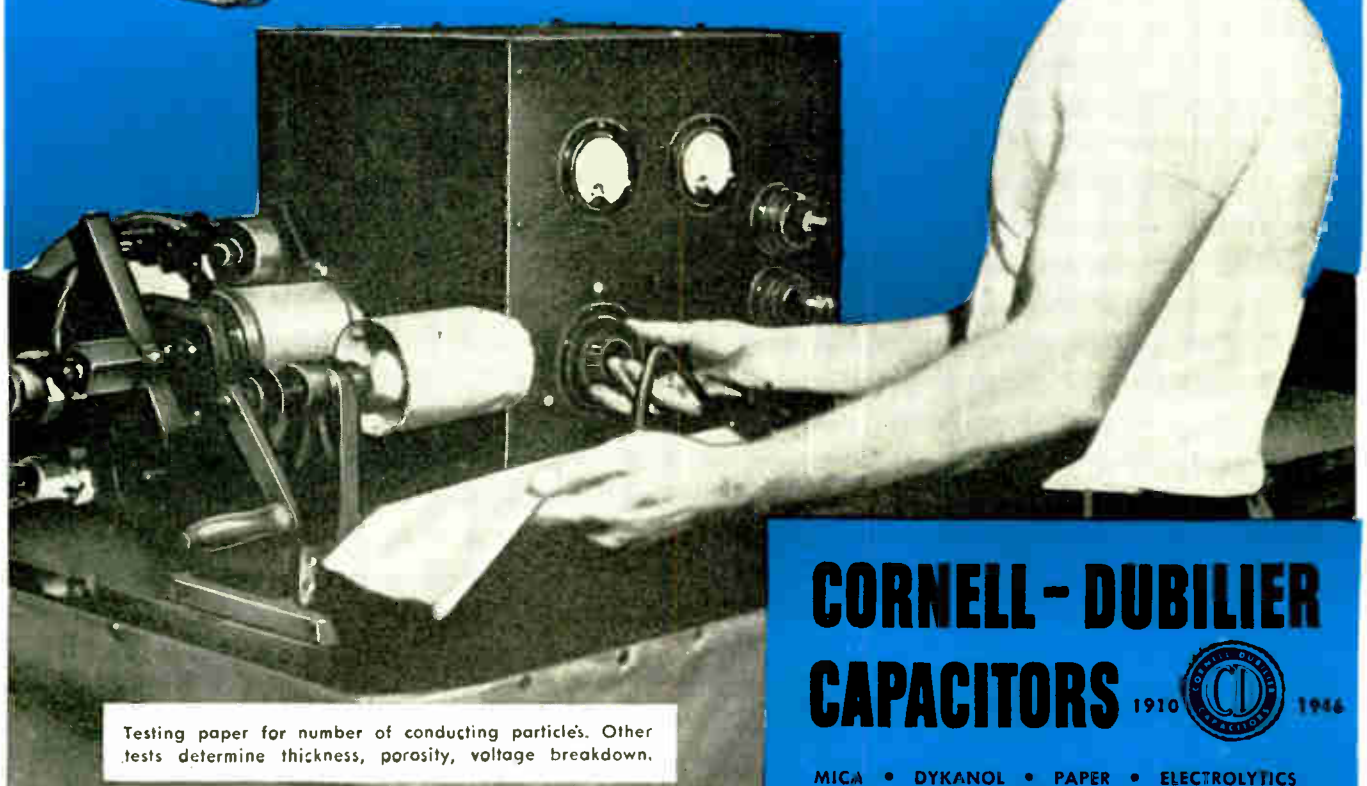

Testing paper for number of conducting particles. Other tests determine thickness, porosity, voltage breakdown.

CORNELL-DUBILIER CAPACITORS 1910 1946

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the desired Loran frequencies by means of permeability-tuned inductances. The overall band width of the receiver is about 60 kc at the half-power points. This band width is necessary if sufficiently sharp pulses are to be received and if sufficient resolution of the pulse train components is to be secured. The overall gain of the receiver is better than 10,000,000, and it is possible to distinguish signals of less than 2 microvolts through the receiver noise.

The video amplifier has an essentially flat response from about 500 cycles to about 20 kc. A high-pass filter is available at the input to the video amplifier for reducing the deleterious effects of keyed cw and most radio-telephone signals. The use of the filter, however, distorts the received pulses considerably but does not greatly reduce the reading accuracy.

The input to the receiver is at low impedance, approximately 50 ohms. The receiver-indicator is usually mounted in the chart room of the vessel so that it is under custody of the navigator. A vertical antenna, anywhere between 30 and 100 feet in length, is preferred and this is rather easily obtained by running a wire from the chart room to the nearest yard-arm. A loading unit consisting of a small inductance with appropriate taps is mounted on the bulkhead and inserted between the antenna and the input to the receiver.

Since the appearance of the DAS-1 indicator, other models produced by a variety of manufacturers have been pressed into service. An airborne set, designated as AN/APN-4, was distributed and used in large quantities by the air forces of the USA and the British Empire during the war. In its early versions, the AN/APN-4 differed chiefly in the sweep generator circuit, where a single pentode performed the duties of both fast and slow sweeps, and in the consolidation of switching into one master switch, so that the process of taking a reading was streamlined. Later models of the APN-4 contained in addition a six-stage divider chain,[7] no stage being permitted to count greater than 5. However, this feature led to an unduly complicated system for incorporating feedback into the divider chain.

Later in the war, a lightweight, single-chassis airborne indicator, known as the APN-9, appeared. It possessed a simplified divider chain and delay circuits, a three-inch cathode-ray tube with magnifier, a non-linear fast sweep so that several of the steps in the matching process could be combined, and a decimal system of counting markers. This equipment weighs about 40 lb. with cables and is at present the primary airborne set available for commercial use.

The DAS-1 has been through several revisions, known as the DAS series, some of which contained a pentode sweep, improved systems of switching, and more rugged construction in view of their use aboard naval vessels. At the close of the war, a direct-reading instrument, the DBE, ideal for deck mounting, was made available. It dispenses with the necessity of reading markers, so that once the Loran match has been made, the reading appears on a mechanical counter. It has a novel method of introducing the time difference, all delays being referred to the crystal oscillator sine-wave output by suitable phase shifting.

In the future, Loran indicators may be expected to be even more streamlined for airborne use and undoubtedly will incorporate direct-reading features. The development of lightweight components during the war will make this possible. Simultaneous presentation of two pairs of stations may be expected, too, so that the navigator will no longer need to advance position lines in allowing for the short interval between readings on different rates. Later on, right-left indicators for homing along position lines and for tying in with the automatic pilot may become available. In the event that a low-frequency Loran system becomes operational three-trace indicators may become popular, for the low-frequency system will not contain the disadvantages of long sky-wave trains.

7. Fink, D. G., "The Loran System, Part II", Electronics, December, 1945.

Press Wireless Engineers Move

Although headquarters for actual operations remain in Hicksville on Long Island in New York and executive offices are at 1475 Broadway, New York, engineering personnel of the Press Wireless Mfg. Corp. has practically completed moving into the company's new headquarters at 35th Ave. and 38th St., L. I. City.

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WIDE READING

(*Continued from page 97*)

ized by the diode in the grid lead.

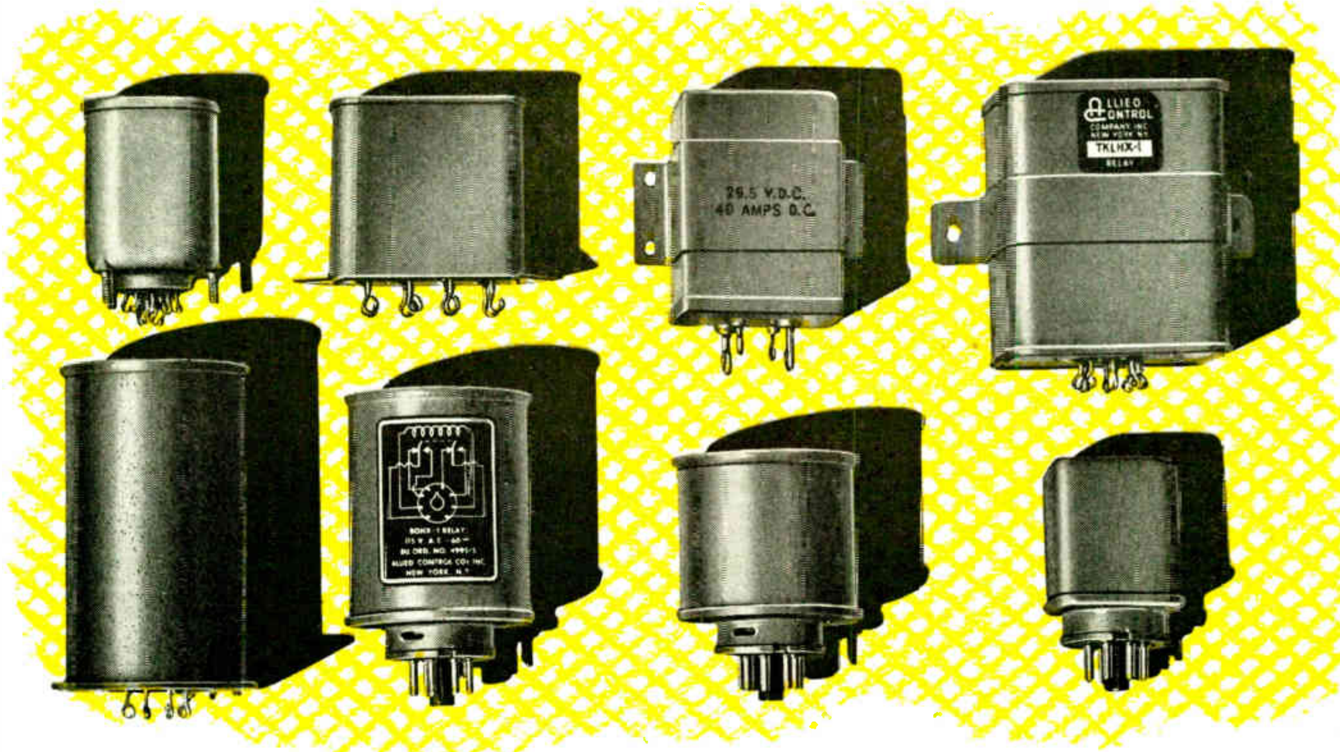
The first grid controls the intensity of the tube current, while the third grid determines the portion of this current reaching the plate. This grid is therefore biased to the center of its linear operating characteristic and the audio frequency signal superposed to effect modulation, resulting in a fairly linear amplitude modulation of the plate current pulse chain. The outputs of all modulator tubes are applied to the grid of cathode follower tube 3.

The synchronizing pulse generator is controlled by the sinusoidal signal from terminal S. Zero bias is applied to the third grid of the synchronizing signal tube so that its plate current pulses are at least twice as large as the channel pulses when the latter are not modulated. In order to provide a margin between the peak values of the synchronizing pulses and of a 100 per cent modulated channel pulse, the screen grid potentials on the channel-modulator tubes are made appreciably lower than on the synchronizing pulse generator. The synchronizing signal is also applied to the cathode follower 3 which is connected to a 75-ohm output socket. A plate load on the cathode follower provides a convenient point for taking off a monitor signal.

Receiver

The receiver synchronizing circuit is essentially an oscillator whose phase is controlled by the incoming synchronizing pulses by a system similar to the one described by K. R. Wendt and G. L. Fredendall in an article entitled "Automatic Frequency and Phase Control of Synchronization in Television Receivers" published in the "I. R. E. Proceedings," 1943, p. 7. Eight 45 deg. phase shifted sine waves are generated by a circuit similar to the phasing unit incorporated in the transmitter. Seven of these sinusoidal waves are applied to the control grids of seven channel-separating pentodes, respectively, operating under similar bias conditions as the pulse generators at the sending end.

All the third grids, however, are fed in common from the incoming composite pulse waveform; each received channel pulse chain coincides with one of the sinusoidal waves derived from the synchronizing signal. Under these conditions the plate output from each of these



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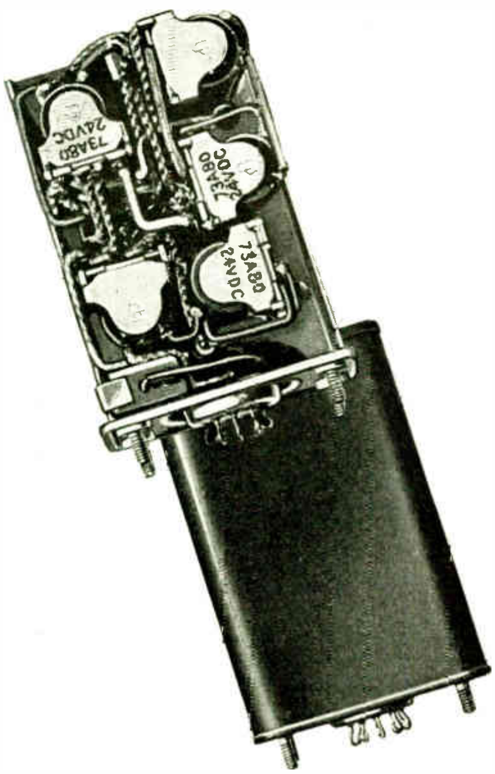

The photo above shows a cut-away view and completed assembly of Allied type TKHX-26 sealed relay with ten soldered terminals individually color marked.

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channel-separating pentodes consists of the amplitude modulated pulses of a single channel only. Pulse harmonics are eliminated by filtering and the seven pulse chains are then amplified and made audible in a conventional manner.

In speech tests, independent observers found it impossible to distinguish transmission through the equipment from that passing directly at audio frequency from the transmitting micro-telephone. Cross talk was just audible on the adjacent channel, but unintelligible. The effective audio band was from 200 to 3,500 cycles.

RCA COLOR TV

(*Continued from page* 102)

Delivery of receivers is planned in the third quarter of 1946. Prices: Old model pre-war TRK sold for $600; the new table model with 7 in. tube giving television sight and sound only, $150. The same with a 10 in. tube, $195. (This model will be available first.) Console with 10 in. model and a 12 in. loud speaker, $250; the same with FM and AM reception added, $295; with Victrola added, $395. A 15 in. direct view receiver with FM and AM, $400. Projection receiver, picture size 16 in. x 21 in. with FM and AM, $495. These are not firm prices.

To summarize up to this point, it was the belief of several present that the 10 in. direct view picture gives most value for the money. Projection receivers are definitely in the de luxe class and actually will not give the purchaser, if his family group is less than 20, any more than the smaller receivers, except pride of ownership.

Image Orthicon camera

In another laboratory R. D. Kell explained and showed the Image Orthicon camera which will operate not only on very low light values, but without manual adjustment will accept a very wide range of illumination satisfactorily. A young lady was seated in front of the camera, illuminated by two very large spotlights. The picture was shown in the same room on a projection receiver. The illumination was then reduced to one 60 w lamp. The next step was to reduce it to four paraffin candles, and finally all but one of these candles were extinguished. The remaining picture was quite distinguishable and, of course, for demonstrating purposes very striking. Surprisingly, the audience did not applaud or seem moved.

Next it was pointed out that RCA was transmitting the voice signals which go with the television picture not by using a separate FM transmitter as is common practice, but by transmitting these signals at the edge of the picture—in other words, during the time of the return trace of the television scanning beam. This was shown also on the projection receiver where at the edge of the picture the sound waves could be seen "wiggling".

While in this laboratory the group was told to look at the experimental studio arranged in one corner for color television demonstrations because it would be used during the afternoon when the visitors were at the receiver observing the picture. The temporary studio occupied about 20 x 30 ft. of floor space. This was illuminated from overhead by fluorescent lamps arranged in curved reflectors side by side so the whole ceiling was practically covered by fluorescent lamp tubes. Also about 20 of these arranged in an arc were placed on both sides of the stage for front illumination. The fluorescent lamps were arranged alternately, "daylight" type and "white" type. The illumination was bright, but not dazzling. There was practically no heat. The nearest flourescent lamp was probably 8 ft. from an actor's face. The camera used for color pick-up was an Image Orthicon to which had been added a color scanning drum with a similar drum at the receiver revolved in synchronism.

Color television

After luncheon the visitors were taken to the Princeton Inn located about 2 air miles from the laboratory. Here they assembled in a downstairs darkened room before an experimental receiver in which a direct viewing tube 12 in. in diameter was used.

A color chart was first placed before the camera and then a young lady, wearing a light green dress on which vari-colored flowers made of cloth were printed, sang. She had auburn hair and her cheeks looked highly rouged; a performer-master of ceremonies put on an act of blowing up colored balloons and forming them into the shapes of different animals; two girls, one blonde, one brunette, appeared to select colored scarves and to drape them on their shoulders so as to show the various color contrasts. This program was repeated three times to give all of the audience a chance to move in turn into the front seats. The demonstration was carried out without a hitch. It was transmitted on a frequency of 9500 mc. The pictures had 525 lines, three colors. The picture repetition rate was 40 per second. The modulating band width 12 mc; sound was transmitted with the television picture.

At the conclusion of this demonstration Dr. Engstrom made a statement setting forth to the visitors RCA's viewpoint on color. Briefly, it was this. RCA's color research had now advanced about as far as their black and white television was in 1930. There have been no field tests, no standards have been set. RCA will join with others when the time comes to try to fix these standards. RCA is vigorously carrying on improvements in color television. The time needed to make it commercial is at least five years. Color does add something to television. However, at the present time black and white television has been developed to the point where it is ready for commercial exploitation.

Stereoscopic television

At the conclusion of the color television demonstration a brief showing of stereoscopic television was made. The observer, who had to stand close to the television receiver, was given Polaroid glasses. The method by which stereoscopic vision was afforded was identical with that used in the motion picture industry. The several guests with whom our reporter talked did not think that stereoscopic television was worth while. RCA made no comments as to its value.

Makes Rotary Switches

Grigsby-Allison Co., Inc., has been organized in Arlington Heights, Ill., to manufacture equipment for radio band switching and for use in instrument manufacture. Initial production will be concentrated on rotary switches with push-button switches and tuners to follow. R. J. Grigsby, who heads the company, was formerly vice-president of the Oak Mfg. Co., Chicago, and later vice-president and sales manager of Allied Control Co., New York. He is also chairman of the board of the Grigsby-Grunow Co. K. C. Allison was for 13 years production engineer for the Oak Mfg. Co. B. J. Grigsby is treasurer and a director of the company.


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3. 1946 Engineering Directory—revised, double-indexed. All part of the regular May issue—no extra cost of a thirteenth number. Use the 18,293 circulation to buy and to sell. It's concentrated in buying circulation. Deadline for advertising is April 1—no fooling.
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NEW BULLETINS

Variable Rectifiers

A color folder issued by Richardson-Allen Corp., 15 W. 20 St., New York 11, N. Y., explains the advantages of variable rectifiers and lists some suggested applications for custom built units. In the standard models the dc output is variable from no load to full load. The units are small, compact and permit easy moving if necessary.

Marine Equipment

The many electronic units developed by General Electric Co., Syracuse, N. Y., for marine navigation and communication are shown in a color booklet just issued. The Electronic navigator, a radar instrument; two way radiotelephone transmitter-receivers; depth finder and a small ship direction finder are among the navigational aids described.

Infrared Ovens

Constructional details and the heating characteristics of Raymersion pre-fabricated infrared ovens are shown in a pamphlet by Trumbull Electric Mfg. Co., Plainville, Conn. Lamp mounting angles in these insulated units are engineered to provide complete product immersion in the infrared radiation and circulating convection heat.

Punching Equipment

A complete catalog, covering descriptions of the individual units used in this hole punching equipment, has been issued by Wales-Strippit Corp., 345 Payne Ave., N. Tonowanda, N. Y. The re-use of interchangeable self-contained punching units permits the development of unlimited punching designs.

Kovar-Glass Seals

Of particular interest to companies engaged in glass working operations, a new bulletin. No. 145, published by Stupakoff Ceramic and Mfg. Co., Latrobe, Pa., gives detailed technics for making glass seals with Kovar. Characteristic properties of Kovar and its available standard shapes and sizes are included. Stupakoff has also prepared special literature for those wanting to purchase finished Kovar-glass assemblies to be used as terminals in hermetically sealed units.

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This Dilatometer is one of many electronic devices pioneered by Sylvania Electric. Inquiries are invited.

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Timing Units

Covering many of the standard models and special designs of repeat and interval timers, time delay relays, contactors, interrupters and other timing devices a new bulletin has been issued by Haydon Mfg. Co., Inc., Forrestville, Conn. The basic timing motor unit with proper gear trains will provide shaft speeds of from 450 rpm down to 1 revolution in 1,000 hours. Haydon engineering service will help design special units for any specific timing problem.

Airplane Radio

A four-page folder describing a new personal plane radio transmitter and receiver has been issued by Electronics Dept., General Electric Co., Syracuse, N. Y. The complete unit weighing only 12 lb. transmits on a frequency of 3105 kc and the receiver tunes from 200-420 and 550-1500 kc.

Selenium Rectifiers

Electrical characteristics and physical dimensions of some of the models of the selenium rectifiers made by Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y., are included in an 8-page booklet. A page is devoted to normally used rectifier circuits and the operating responses of typical rectifiers under these conditions.

Precision Castings

The Austenal Laboratories, Inc., 224 E. 39th St., New York 16, N. Y., pictures the various steps in the Microcast precision casting process in a new booklet. Many finished castings and suggested uses are shown, together with the physical and chemical properties of vitallium when cast by the Microcast process.

Coaxial Connectors

A folder illustrating twelve types of connectors and two low pass filters for use with coaxial cables has been issued by Diamond Instrument Co., North Ave., Wakefield, Mass. This Company also manufactures many precision parts for special diversified applications in the radio and electronic industry.

Polyvinyl Materials

A 16-page booklet showing the properties and suggested industrial applications of Geon resins, plastics and latices has been published by

B. F. Goodrich Co., Rose Building, Celveland 15, Ohio. These materials are suitable for compression or injection molding, and for dipping and spreading. They provide satisfactory characteristics for wire and cable insulation, electrical conduits, storage battery cases and fuse boxes.

Fluorescent Products

The many uses and colors of fluorescent satins, lacquers, paints, powders and writing materials made by Switzer Bros., 1220 Huron Rd., Cleveland 15, Ohio, are listed in a new folder. "Black Light" equipment and accessories for both permanent and portable installations are shown.

FM Broadcast Equipment

With brief descriptions and pictures of all needed equipment, a new brochure issued by Federal Telephone and Radio Co., 200 Mt. Pleasant Ave., Newark 4, N. J., explains the company's engineering service for the design and installation of a complete FM broadcast station. This engineering supervision covers full responsibility for the design, delivery, installation and tune-up of the complete station. Included are prices and illustrated descriptions of all needed studio equipment items.

Constant Voltage

A bulletin of 32 pages issued by Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill., gives a detailed explanation of how Sola constant voltage transformers work and where they can be used to advantage. Illustrations and technical data for each of the standard units are included. The information should be of interest to manufacturers of electronic and electrical equipment which is designed for operation at a specified voltage.

C R Screen Characteristics

Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J., has issued descriptive sheets of P-11 and P-5 cathode ray screens. These coatings were developed primarily for photographic recording applications. P-11 covers cases where extremely short persistence is not required; the P-5 material has short persistence. Graphs showing average screen and average visual screen efficiency and the spectral distribution of the emission radiation are included.

Radio Components

Alden Products Co., 117 N. Main St., Brockton 64, Mass., has issued a 44-page booklet explaining how its experience in design, engineering and manufacturing complete sub-assembly and special single components will be a help in electronic equipment production problems. The booklet is intended to replace a personal visit to the Alden factory so that the many development specialties available at Alden may be understood.

Radio Station Equipment

Illustrating the modernistic style trend of their television transmitter, studio control console, master control board and audio control console, Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y., has just issued a new two-page folder. Sherron design provides for easy unit additions as requirements grow, covers all equipment from complete transmitters to studio consoles and monitors, etc.

Custom Built Motors

A 32-page color brochure shows many of the special design motors, generators and alternators that Electrical Engineering and Mfg. Corp., 4612 W. Jefferson Blvd., Los Angeles 16, Cal., has developed for specific applications. These cover power generation, pumping, aircraft and marine fields. Several types of gear boxes, actuators and dual rotation motors also are included.

Switch Manual

A catalog, in color, giving electrical and mechanical characteristics and outside dimensions of various types of switches, has been issued by Mu-Switch Corp., Inc., Canton, Mass. Among the special models listed are those for heavy duty dc, special leaf-spring actuators and bracket-type spring plunger actuators for extra rigidity.

Small Motors, Generators

A color brochure issued by Electric Indicator Co., Stamford, Conn., gives mechanical details and operational curves of permanent magnet dc generators and motors, permanent magnet ac generators, series and universal motors and shunt wound dc motors. The company also engineers and builds motors and generators for special applications.

Chicago Engineers Discuss Television

The one-day engineering conference held by the Chicago section of the Institute of Radio Engineers February 9 in the Merchants and Manufacturers Club, Chicago, featured important papers on radio and electronic subjects.

Radio subjects included "Deflection-type High-Voltage Supplies for Television Receivers" by Madison Cawein (Farnsworth); "Aspects of F-M Receiver Design" by Frank C. Gow (RCA Laboratories); "Radio Applications for T-3 Sub-miniature Tubes" by Walter R. Jones (Sylvania); "The Practical Aspects of Intermodulation and Application to Design, Testing, and Maintenance of Audio Systems" by J. K. Hilliard (Altec Lansing); "Radio Receiver Response Trends" by H. S. Knowles (Jensen).

Papers presented before the Electronic section included "VT or Radio Proximity Fuzes" by John M. Pearce (Johns Hopkins Univ.) and Dr. Cledo Brunetti (National Bureau of Standards); "The Loran Navigation System" by Donald G. Fink, Electronics magazine; "Developments in Atomic Energy" by Dr. Robert J. Moon (Atomic Scientists of Chicago); "Interesting Applications of Induction and Dielectric Heating" by John Callanan, and Dr. Eugene Mittleman (Illinois Tool Works); "Human Relations in Engineering" by W. D. Kelsey (Dale Carnegie Institute).

Television HV supplies

In his paper, "Deflection-type High-Voltage Supplies for Television Receivers," Madison Cawein described a simplified, compact combination horizontal deflection oscillator and high voltage supply for cathode ray picture tubes. The circuit described used a single 6L6 as a relaxation oscillator with screen-grid injection for the synchronizing pulses. In the plate circuit of the 6L6 is a special transformer designed to present an inductance of approximately 60 millihenries by reflection of the deflection coil inductance. In the particular application of this circuit, the deflection coils (horizontal) had an inductance of 3 mh, thus the impedance ratio of the transformer was 20:1. This value of 60 mh in combination with the effective resistance of the 6L6 forms an LR circuit which, with a tightly coupled feedback winding operating the control grid, produces a relaxation oscillation of suitable deflection properties to operate a 10BP4 tube. A variable cathode resistance adjusts the frequency of oscillation while a variable resistance in the control grid adjusts the linearity. A third variable resistance controlling both plate and screen voltage on the 6L6 control the size of the sweep.

A synchronizing pulse of approximately 20 volts is required on the screen grid. In practice, this is obtained by direct connection of the screen grid of the 6L6 to the plate of a 6AC7 synch amplifier. The 6AC7 and screen of the 6L6 draw power through a common load resistance.

The special transformer has twin hypersil cores. The plate winding is 500 turns of No. 34 wire in pies. The grid feedback winding is 100 turns jumble wound. An additional winding of 300 turns in series with the 500-turn plate winding forms an auto transformer to deliver about 4000 volts to a conventional voltage doubler using two 8016 tubes. Filament power for the 8016 tubes is obtained by two single turn windings on the transformer. A suitable secondary to match the deflection coil inductance is also required.

The power supply delivers about 10 kv at no load, about 7.5 kv at 0.4 ma. load and a maximum of 1.2 ma. with short circuit. With a 1500-ohm load, the current is 0.6 ma. which is well within the 15 ma. limit considered safe by Underwriters.

Cawein said no corona troubles were experienced if wire size was greater than No. 38, laminations were free from burrs and winding voltage was limited to about 5000 volts. Retrace time with the circuit was 12%. Peak voltage on the 6L6 is 2400 volts.

FM design problems

Outlining the problems in receiver design for FM, Frank C. Gow compared performance, advantages and disadvantages of pentagrid converters, separate oscillator and pentode mixer, and triode mixers. Conversion systems were compared on the basis of input conductance, input capacitance, oscillator feedback to antenna and signal input required for satisfactory operation. IF systems were discussed with regard to bandwidth and stabilization of tube input impedance changes resulting from AVC by use of cathode degeneration in various tube types.

An important fact presented by Gow was the distortion produced ahead of the detector in the form of phase shifts caused, as an example, by loading of tuned circuits if grids should be driven positive. Resulting loading will produce amplitude and phase shifts with the phase shifts becoming an inseparable part of the signal.

The intermodulation analysis as a means of determining audio system performance as well as suitable equipment for making the tests was presented by J. K. Hilliard. In this test method, two signals of known frequency and controlled amplitudes are fed into an audio system and the output examined for intermodulation factors of these two original frequencies. The fewer and weaker the intermodulation products, the better is the system.

Dielectric preform heater

John Callanan described a continuous dielectric preform heater built for the Firestone Tire Co. to heat 35 lb. tank treads in 1.5 minutes with a 20 kw. 27 mc. oscillator. Synchronized conveyor belts fed 12 preforms into oscillator cage. Automatic coupling control maintained uniform power flow. Equipment is now adapted to preheat washing machine rollers, cutting curing time from 50 minutes to 17 minutes.

Dr. Eugene Mittelman described high frequency heating equipment which he had recently inspected in Europe. He spoke of the more common usage of 100 kw and larger units in England and Switzerland. Units are elaborately engineered and are special jobs rather than designed for production in quantities. Germans appear to have done little work with dielectric and induction heating apparatus was principally rotary generators. One unit of 600 kw was in service in a Berlin factory. Compact, high power induction heating equipment using mercury tubes with external exciter electrodes was mentioned.

Frank M. Davis

Frank M. Davis, General Manager of the Research and Engineering Division of the Collins Radio Co., Cedar Rapids, Iowa, died of coronary thrombosis February 4, 1946. Associated with the Collins company since 1934, he was widely known for his research and development work in the field of radio communications.

PERSONNEL

A number of changes in the engineering organization of Philips Laboratories, Inc., Irvington, N. Y., recently organized by North American Philips Co., Inc., involve: **Dr. James G. Black** who will be chief of the organization's division of miscellaneous products and its analytical laboratories, moving over from the University of Michigan; **Carol M. Veronda** who comes from the Naval Research Laboratory will be assistant engineer in the microwave section; **Frank Grace,** leaves Sound Laboratories to occupy a similar post in the microwave section; **George A. Espersen** who has been tube division engineer becomes an associate physicist in the microwave section; **Dr. Victor Wouk** joins the laboratory staff at Dobbs Ferry, was formerly with Westinghouse Electric Corp.

Dr. James G. Black

Alexander Norden, pioneer radio manufacturer and founder in 1921 of the Norden Hauck Co. in Philadelphia, has been elected president of the Interstate Mfg. Corp., 125 Sussex Ave., Newark 4, N. J. The company will engage in the production of home and automobile antenna systems among other electrical devices.

Alexander Norden

William E. Bradley

William E. Bradley has been made director of research for the Philco Corp., Philadelphia. He succeeds David B. Smith recently named vice-president in charge of engineering. Bradley, who joined Philco in 1936, becoming a research engineer a year later, is credited with having developed the new Philco advanced FM system and has contributed largely to the development of a new amplifier theory coming into use in the television industry. He has been assistant director of the Philco research division since early in 1945.

Lt. Daniel S. Karp, son of Milton J. Karp, who is president of the Karp Metal Products Co., Inc., 120 30th St., Brooklyn 32, N. Y., has rejoined the organization as vice-president in charge of engineering and sales. He served 4 years in the U. S. Navy.

Lt. Daniel S. Karp

Fred E. Dole

Fred E. Dole has been appointed research consultant for the J. M. Ney Co., Hartford, Conn. Until recently he was engaged in war research work in the Radiation Laboratory at M.I.T.

Roger T. Furr has been made chief technical service engineer in charge of drafting and physical testing laboratory and the engineering procurement section for Stromberg-Carlson Co., Rochester, N. Y. Other changes in the organization involve **Benjamin Olney** who is to be director of research in the instrument laboratory; **Howard H. Brauer** who moves from the instrument laboratory to the company's engineering staff organization; **Oliver L. Angevine, Jr.,** becomes chief sound equipment engineer.

J. K. Poff has been made service engineer of the jobber sales division of the Astatic Corp., Conneaut, Ohio. During the war he was Chief Naval Inspector of electronic equipment.

A. L. Atherton has been appointed advisory engineer and **Fred C. Heyl,** manager of the quality control department of the Westinghouse Electric Corp., E. Springfield, Mass.

G. Emerson Pray has been placed in charge of management for the Tuck Electronic Corp., with headquarters at 41 Park Row, New York, and 1 Exchange Pl., Jersey City, N. J. The company manufactures testing equipment, radio and television receivers and dielectric heat sealing apparatus.

Paul H. Reedy has been appointed chief engineer of the engineering research and development department of Columbia Broadcasting System, New York. He joined the department in 1944, will be responsible for the execution of various engineering problems in the laboratories.

Samuel Gubin, formerly with the Radio Corp. of America, Camden, N. J., has joined the staff of Spectrum Engineers, Inc., a newly organized engineering and consulting firm with laboratories located at Preston & Filbert Sts., Phila., Pa.

J. D. Schantz has been promoted to assistant manager of the research department of the Farnsworth Television & Radio Corp., Ft. Wayne, Ind. He came to Farnsworth in 1939 from a predecessor company, Farnsworth Television Inc. of Philadelphia, which he joined in 1936, and where he conducted research on circuits and television terminal equipment.

George D. Clark has been appointed chief engineer of the Russell Electric Co., Chicago. Formerly, he was chief motor engineer for the Packard Electric Division of the General Motors Corp.

George D. Clark

Herbert C. Florance

Herbert C. Florance has been appointed chief engineer of radio station WGHF, New York. He goes to WGHF from the Bureau of Ships, electronic division, before that was connected with NBC and New York's municipal station WMCA.

Frank H. R. Pounsett has been named chief engineer of the Stromberg-Carlson Co., Ltd., Toronto, Ontario. He was formerly chief engineer of the radio division of Research Enterprises Ltd., the crown company which made the radar apparatus in Canada for use by the armed forces. Prior to this connection he was chief engineer of the radio division of the Stewart-Warner-Alemite Corp., Belleville, Ont., and before that was employed by the DeForest Crosley Radio Co.

Technology Instrument Co.

Technology Instrument Corp., Waltham, Mass. (1058 Main St.), has been organized for the development and manufacture of electronic and laboratory equipment. The three directors of the firm, H. H. Scott, R. W. Searle and L. E. Packard, represent 46 years of experience in engineering and manufacturing in this field.

H. H. Scott, who will serve as president, will have charge of technical development. A member of the Class of 1930 of the Massachusetts Institute of Technology, he received his S.M. degree the following year and since that time has been associated with General Radio Company as executive engineer. He has worked on the development of sound and vibration-measuring equipment, FM and broadcast station monitoring equipment, and other measuring instruments.

H. H. Scott

L. E. Packard

L. E. Packard is treasurer and in charge of sales engineering activities. After receiving his S.B. degree in electrical engineering in 1935 from the Massachusetts Institute of Technology, he joined the engineering staff of General Radio Co. He spent four years doing development and sales engineering work after which he was successively district manager in GR's New York and Chicago engineering offices. He has specialized in the study of sound and vibration-measuring technics and non-destructive testing of insulation, dielectrics, and bridge methods.

Raymond W. Searle is secretary and production manager of the organization. He has been a member of the production department of General Radio Co. for the past 21 years, the last 15 of which were in a supervisory capacity. He has specialized in the study of labor management and production methods. During the recent war he has been in charge of the Company's branch plant which produced Variacs and precision rheostat potentiometers as well as heading the department in the main plant producing transformers, audio and rf coils, and other parts.

Radio Circuits Printed on Ceramic

Born of development work on the Navy's proximity fuse, and now revealed for the first time, radio circuits can be "printed" on ceramic plates to take the place of the usual wiring. Dr. Cledo Brunetti of the National Bureau of Standards told a meeting of IRE at the Marquette University this about the process:

"On a ceramic plate," he said, "is laid a silk mask with a pattern cut in it. Over this mask is drawn a plastic bar, like the rollers of a printing press, with a thick paste of dissolved silver. The impression left on the plate is like the wiring of the circuit, only instead of copper wires we have silver lines.

"Next another mask is placed over the plate and sprayed with a carbon solution. When the mask is removed there are all of the resistors assembled in a circuit. Thin condensers are attached to the circuit and the wiring is completed."

New Radio Design Eliminates Wiring

The Promenette Radio & Television Corp., Buffalo, N. Y., will manufacture home radio receivers which, the firm claims, are revolutionary in design. All connecting wires are eliminated by means of bare metal sprayed into channels of a plastic chassis. According to Bede B. Berger, president, this method will speed production tenfold, reduce operating costs, permit considerably lower prices, improve set performance.

New Clarostat Officers

New officers and directors have been elected to direct the Clarostat Mfg. Co., Inc., Brooklyn, N. Y., following the retirement of the three Mucher brothers who founded the company a quarter-century ago. Former general manager Victor Mucher is now president; George Mucher, in addition to holding the post of chief engineer which he has held for many years past, is vice-president; William Mucher is the treasurer; and Charles Burnell, who has long handled the legal, patent and labor-relations activities of the company, is secretary. These Muchers are the younger generation of the family of the founders and have grown up in the business. The new directors are the officers, together with B. G. Cantor, a New York financier.

NEW BOOKS

Major Instruments of Science and Their Applications to Chemistry

Edited by R. E. Burk and O. Grummitt. Vol. IV in series, Frontiers in Chemistry. Published by Interscience Publishers, Inc., 215 Fourth Avenue, New York 3. 1945. 151 pages, price $3.50

This book is the fourth of a series by these editors on "Frontiers of Chemistry," all of which have been prepared under the auspices of Western Reserve University by distinguished scientists in particular fields of research and industrial chemistry to prepare technical reviews on some subjects in their field of activity.

The subjects covered in this volume are:

(1) "Electron Diffraction," by L. H. Germer of the Bell Telephone Labs., who reviews the development of this technic, describes the process and explains its utility in crystallography.

(2) "The Electron Microscope," by L. Marton of Leland Stanford University, taking up the theory, construction and applications of these instruments.

(3) "X-ray Diffraction," by M. L. Huggins, Eastman Kodak Co., Rochester, N. Y. In addition to a discussion of the principles involved and instruments used, a review of methods of molecular structure analysis both inorganic and organic, is included.

(4) "Chemical Spectroscopy," by W. R. Brode, Ohio State University, describing chemical analysis by emission spectra.

(5) "Application of Absorption Spectra to Chemical Problems," also by Dr. Brode, which adds details of absorption and resonance forms of spectrographic analysis.

(6) "The Infrared Spectrometer" section by R. B. Barnes of the American Cyanamid Company of Stamford, Conn., describes the history, development, apparatus details and its operation of this form of spectrography.

In each section a selected bibliography is included, and a general reference index covering all sections.

Two-Way Radio

By Samuel Freedman, Commander U.S.N.R. Published by Ziff-Davis Publishing Co., Chicago, 1946, 506 pages, illustrated. Price $5.00.

This book deals with the systems utilized in two-way or point-to-point radio communications and the equipment used in the process.

Various applications of radio to fixed, mobile and portable communication system are described. The book is "enthusiastically" written and covers the advantages and disadvantages of various basic systems, a description of the equipment and accessories needed and the problems encountered in the different applications of point-to-point communications.

Radio Test Instruments

By Rufus B. Turner. Published by Ziff-Davis Publishing Co., New York-Chicago, 1945. 228 pages, 216 illustrations, $4.50.

Of particular interest to amateur radio operators and experimenters, this book describes how to construct the great majority of instruments commonly used in the design and testing of electronic equipment. Since the text is mainly concerned with the construction and basic operation of the various instruments, no generalized theory is provided and there is no attempt to discuss applications and operating technics in detail. Nevertheless, this small volume forms a very complete and concentrated source of information on a neglected subject. The illustrations consist of wiring diagrams and photographs of the completed instruments.

A.S.T.M. Standards on Electrical Insulating Materials

Prepared by A.S.T.M. Committee D-9 on Electrical Insulating Materials, published by American Society for Testing Materials, 260 So. Broad St., Philadelphia 2, Pa. 545 pages, $3.25.

This compilation gives more than 75 specifications and test methods on insulating materials and numerous others on related products.

Fastener Installation

A booklet describing a new installation procedure which reduces by fifty per cent the time required to install Dzus fastener studs has just been issued by the Dzus Fastener Co., Inc., Babylon, N. Y. Use of a newly developed grommet eliminates separate operations for inserting, setting and clinching the grommet formerly required. The new time-saving procedure may be used with practically all types and sizes of Dzus fasteners. In addition to achieving marked savings in time costs, the quicker, simpler installation procedure greatly facilitates use of Dzus fasteners in mass production operations. It also simplifies the replacement of fastener studs in the field.

Washington-N. Y. Telecast

The Lincoln Memorial ceremonies in the nation's capital were the occasion for the first regularly-scheduled inter-city television broadcast from Washington to New York on Tuesday, Feb. 12. Using the Bell System's coaxial cable, the television systems of the National Broadcasting Co., the Columbia Broadcasting System and the Allen B. DuMont Laboratories joined in bringing this special program to viewers in New York and Washington.

Television cameras operated by crews of all three broadcasters were located in front of the Capitol, in the studios and at the Lincoln Memorial. The television images traveled from the cameras over specially equipped telephone wires to the Washington terminal of the coaxial cable, and thence over the cable 225 miles to New York. From the terminal in the Long Lines building in New York the images traveled again over specially equipped wires to the television transmitters of station WNBT (NBC) and WCBW (CBS). The images were fed direct to station W3XWT from the Washington terminal. Each of the three broadcasters will have use of the cable two nights a week for experimental use of the intercity television facilities. For the present, direction of transmission will be from Washington to New York.

N. Y. Public Library to Feature Tele

Six television receiving sets are being installed in branch libraries of the New York Public Library. These have been provided by the Dumont Laboratories, Inc., and the Farnsworth Television and Radio Corp., and will represent an experiment with a new technique in adult education.

In addition, Farnsworth is installing a complete telecast studio in one branch library—$200,000 worth of equipment including an electronic television camera, control equipment, receiver, lighting, scenery and properties. The College of the City of New York is providing courses in television to be given in this laboratory which will also serve as a demonstration open to the public.

"The Library, for its part, is attempting to build up its book collection in this field of greatly increasing interest," explains F. R. St. John, chief of the Circulation Dept., who requests donations of standard television volumes for the branch libraries which will have television sets. Each branch collection will serve as a model library for students and others who are developing television libraries of their own. In addition a reading list, including gifts, will be printed for distribution.

Intra-Store Television

Intra-store television experiments carried on by the Gertz department store, Jamaica, Long Island, were demonstrated recently. Simplified equipment, especially designed for the purpose by William B. Still, head of Jamaica Radio & Television Co. and operator of station W2XJT, was used to present merchandising and entertainment features to the store's customers. The programs were shown via six coaxially connected receivers strategically located about the store to catch shoppers' interest. The installation is proving valuable as a demonstration of what can be done to make small scale, limited budget television practical for stores, schools, etc.

Television Applications Filed For 187 Stations

As of the first of the year there were 19 licensed television stations in the United States, six of them commercial stations and 13 operating under experimental licenses. At the same time, reveals Federal Communications Commission, construction permits have been issued for three more commercial and 13 experimental stations. Complete data on the television situation follows:

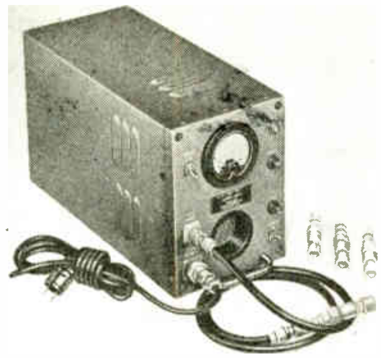
Lic. Comm. Stations	6
Lic. Exp. Stations	13
Lic. Exp. Relay Stations	29
Const. Permits for Comm. Stations	3
Const. Permits for Exp. Stations	13
Comm. Const. Permit Applications	142
Exp. Const. Permit Applications	9
Exp. Relay Const. Permit Applications	20

NARBA Conference Opens

FCC Commissioner E. K. Jett, who was elected permanent Chairman of the Conference, and Francis C. DeWolf, Chief, Telecommunications Division, Department of State, were the key figures in the opening of the North American Regional Broadcasting Engineering Conference which began in Washington Feb. 4 and was expected to end Feb. 15. The conference was held to determine extent of the NARBA agreement signed by six countries in 1937 and which expires March 29, 1946.

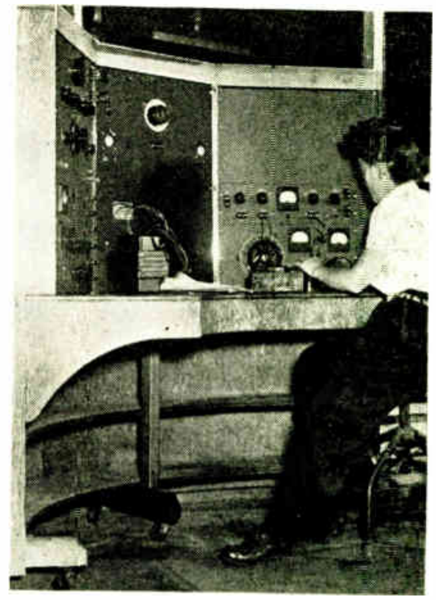
UHF Wattmeter

Designed to measure the uhf power output of inductivity coupled transmitters, a new type of wattmeter has been developed by the Bird Electronic Corp., Cleveland, Ohio, for use from 20-750 mc, and from 5-100 w. Its essential features are a series-type thermocouple, a 50-ohm high loss line, and an 0-1 ma dc meter to read the drop across the terminating resistor. Calibration charts are provided to relate transmitter frequency and effective power output. Calibration is obtained by comparison methods. A schematic diagram of the equipment reveals that current heats the thermocouple junction, resulting in direct current through the line proportional to the square of the rf current. Deflection of the dc meter is proportional to thermocouple dc, indicating the amount of uhf transmitter power. Skin effect and other conditions cause the resistance of the thermocouple wires to increase with frequency. The transmitter frequency may be determined within 2%, from the calibration curves. Power is dissipated partly in the high loss line and partly in the terminating resistor. A blower serves to dissipate this heat. At 160 mc about 90% of the power is dissipated in the line and 10% in the resistor. At higher frequencies more power is dissipated in the line and less in the resistor. The line attenuation of 9-1/2 db at 160 mc serves to reduce the magnitude of error resulting from possible standing waves.



Inspection Booths

Improved types of inspection booths have been developed and are in use at the Aireon Mfg. Corp., Kansas City, Kans. These booths were designed for quality testing of purchased products. It has been found that four different types of booths were sufficient to provide the voltages and meters needed to test the whole line of products used by the company. Only spot-checks



View of inspection booth used for testing of products received by the manufacturer. Operator is shown testing the performance of a transformer with the provided meters.

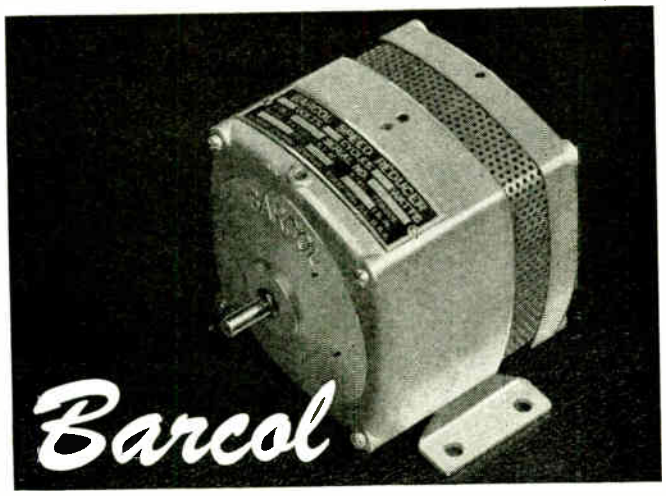
are made, since the standards of manufacturers of component parts have been set at a high level in the last few years. A high chair insulated from the floor by rubber wheels has been provided. The individualization of inspection permitted by the compartments results in a considerable saving of time in the testing of a large number of component parts.

Organization to Administer Patent Rights?

A joint Army-Navy Committee has filed recommendations that a cooperative non-profit organization be established to administer electronic patents resulting from the radar program and to license manufacturers to take advantage of these developments.

A committee report explained that: "The secretaries of both departments have recognized that uncertainty as to ownership and scope of patent rights, and particularly as to the methods under which the government-owned patents were to be administered, might seriously delay further development in electronics, and prevent the application of new techniques to production for both military and civilian use. . . .

"There have been and are now before Congress various pending bills prescribing the methods of ad-



ENCLOSED GEARED-HEAD MOTORS

350 r.p.m. to 1 revolution in 7 hours

Since their introduction 5 years ago, these motors have proved extremely satisfactory in service and have been applied successfully to such exacting jobs as locating telescopes, directing radio beams, for voltage controllers, and many other uses. Practically any gear ratio from 7.2/1 up to 1,098,632/1 can be furnished. Furnished with either shaded-pole induction or synchronous motor. Shaft is centrally located. Accurate, durable construction throughout.

Write for Data and Prices

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wanted by large manufacturer of radio parts

Will be trained for territorial office management. Should have background of broadcast receiver design engineering experience, pleasing personality and desire to learn overall sales and business management. The position will be remunerated by salary plus bonus. In reply give historical background and minimum acceptable income to start.

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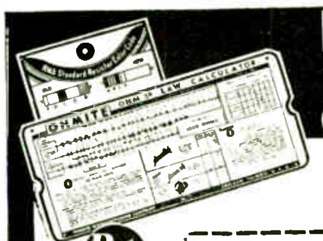

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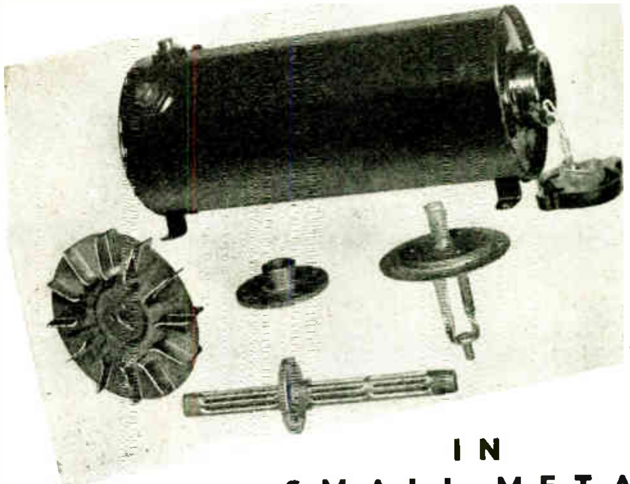

IN SMALL METAL ASSEMBLIES

No single factor will have greater influence on postwar products than their small parts and assemblies. Improving these products — devising ways to make them faster, better, at lower cost, will determine the success of many a product now being planned.

Atmosphere Furnace Brazing offers the fast, low-cost solution to the assembly of many of these small parts. It is fast, saving some 60% to 75% of the time required by other methods. It is economical, frequently saving as much as ¾ of the man hours ordinarily required. It is flexible —castings, forgings, stampings or screw machine parts may be joined in any combination.

FEICK Atmosphere Furnace Brazing methods and the FEICK reputation for experience and know-how have solved the small assembly problem for many well known manufacturers.

FEICK facilities for metal fabrication cover every step from raw material to finished product . . . preparation of the metal, shaping to intricate forms, assembly by gas, spot or electric welding and by Furnace Brazing. They include all finishing operations; plating to give better appearance or protection, painting (using infra-red drying), packaging and shipping to customer's order.

If your products involve metal assembly, write or phone us. An experienced engineer will be glad to discuss your requirements with you.

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ministration and disposition of government-owned patents and inventions. Some of the pending legislation calls for granting licenses under such patents, while other bills would dedicate them to the public. Until Congress settles which of these conflicting principles is to prevail, no official detailed Army-Navy proposals can be promulgated without danger of their being made inconsistent with governmental policy by the passage of general legislation."

The committee found that "privately held electronic patent rights are so widely dispersed in ownership, so interrelated in subject matter, and so numerous that obtaining licenses on an individual basis is practically impossible, either to industry or to the government.

"Patents in the electronic field can therefore best be handled by a cooperative non-profit organization which would administer substantially all patents in the field for the benefit of their owners, the industry at large, and the public. Anyone could then obtain all rights necessary for manufacture by taking a single license from such an organization."

Production Tools

A new loose-leaf reference book shows the various types of dummy tubes, pin straighteners, masking plugs, testing fixtures and gages and special production tools made by Robert L. Stedman Machine Works, Oyster Bay, Long Island, N. Y. A section of graphical symbols for telephone, telegraph, radio and electronic use also is included, making this book a valuable help for production planning and methods work.

Photoelectric Control

A new folder showing some of the uses of Photo-troller automatic control equipment is available from the Westinghouse Electric Co., Pittsburgh, Pa. Charts are included giving maximum distances and minimum light intensities necessary for the proper operation of the various models. An infrared filter to make the light beam invisible, a solenoid valve for controlling drinking fountains and a magnetic counter for counting operations also are covered.

Broadcast Engineering Conference, March 18-23

Plans have been completed for a resumption of the Broadcast Engineering Conference, suspended during the three war years. The sixth annual gathering will be held in Campbell Hall on the Ohio University Campus at Columbus during the week of March 18-23. In addition to a long program of technical reports there is to be an exhibition of new broadcast equipment. Following is the program:

Monday, March 18

9:00 am to 11:00 am—Contributions of War Developments to Broacasting—A. B. Chamberlain, Chief Engineer, Columbia Broadcasting System.

11:00 am to 1:00 pm—Symposium on Broadcast Maintenance Problems—A. J. Ebel, Chief Engineer, University of Illinois Radio Service, Chairman.

2:30 pm to 4:30 pm—Design of Broadcast Studios with Irregular Boundary Surfaces.

Tuesday, March 19

9:00 am to 11:00 am—Antenna Patterns and the Antennalyzer—George H. Brown, Research Engineer, Radio Corporation of America.

11:00 am to 1:00 pm—Symposium on Recording Technics—Lynne Smeby, Associate Director, Operational Research Staff, Office of the Chief Signal Officer, U. S. War Department.

2:30 pm to 4:30 pm—General Acoustical Problems in Broadcasting—E. J. Content, Station WOR.

8 pm—Popular Scientific Lecture.

Wednesday, March 20

9:00 am to 11:00 am—Symposium on VHF Antenna and Coupling Circuits—E. C. Jordan, Department of Electrical Engineering, University of Illinois, Chairman.

11:00 am to 1:00 pm—Symposium on Tele-

Glass-to-Metal Seal

An improved method of making Kovar seals has been developed by the Westinghouse Lamp Division. The surface of the Kovar—the metal with the same coefficient of expansion as common glass—is first correctly oxidized by heating it in a temperature controlled oven. Then powdered glass is sprayed on the cooled oxidized Kovar. The glass is fused by reheating. A glass-to-glass seal may now be made in the ordinary manner not requiring a highly skilled operator

vision Station Operation—Robert E. Shelby, National Broadcasting Company, Chairman.
2:30 pm to 4:30 pm—Radio Relays, for FM and Television.

Thursday, March 21

9:00 am to 11:00 am—Stratovision—Ralph Harmon, Westinghouse Electric Corp. and representatives from Glenn L. Martin Aircraft Co.

11:00 am to 1:00 pm—Symposium on Field Question Box—A. D. Ring, Consulting Engineer, Chairman; John Willoughby, Assistant Chief Engineer, Federal Communications Commission, in charge of Broadcasting; also representative chief engineers from broadcasting stations.

2:30 pm to 4:30 pm—Interconnecting Facilities for FM and Television Broadcasting—H. I. Romnes and W. E. Bloecker, American Telephone and Telegraph Co.

6:30 pm—Banquet, F. N. Hayes Hotel.

Friday, March 22

9:00 am to 11:00 am—High Powered Tubes for VHF Operation—W. W. Salisbury, Collins Radio Co.

11:00 am to 1:00 pm—Symposium on FM Operating Problems—Phillip B. Laeser, Milwaukee Journal Co., Chairman.

2:30 pm to 4:30 pm—Symposium on FM Monitors—R. C. Higgy, Director WOSU, Ohio State University, Chairman; D. B. Sinclair, General Radio Co.; Frank Gunther, Radio Engineering Laboratories; H. R. Summerhayes, Jr., General Electric Co.

Saturday, March 23

9:00 am to 11:00 am—Symposium on PM Modulation Methods—W. L. Everitt, Head, Department of Electrical Engineering, University of Illinois, Chairman.

11:00 am to 1:00 pm—Round Table and Experiences in VHF Propagation—Raymond M. Wilmotte, Consulting Engineer, Chairman

Germany's UHF Tubes

Some information on German equipment has been released by the U. S. Department of Commerce (Publication Board) based on personal reports by the members of the Combined Intelligence Objectives Sub-Committee, who are making studies of German industrial and military equipment and the status of research. During the next few months, digests of reports on the most interesting items relating to electronic matters will be published here. The complete reports are available from the U. S. Department of Commerce, Washington, D. C. —Editors.

• Much curiosity has been exhibited about radar technics in Germany. Some of the reports were concerned with attempts at counter measures.[5] In one laboratory, research was conducted on methods and materials capable of absorbing electromagnetic radiation. One of

[5] Report Index Number, 69.

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these materials consisted of spiral steel shavings imbedded in paraffin, which was named Eisenspaene. Another material tested was called Moltspren, both developed for the concealment of submarines.

In 1943, measurements of reflection coefficients of submarines and aircraft were made at a wavelength of 6.8 cm. Measurements were made to determine the effect of varying the width of strips of "window", a name given the metal strips dropped by Allied aircraft to confuse German radar indications.

Split beam antenna

Other work concerned an antenna system to give a narrow beam in the vertical plane and broad in the horiontal plane, and to scan in elevation, for use with a PPI indication. In order to obtain DF in azimuth, a split beam system was used in conjunction with a rotating color filter in front of the CRT. Signals from the two beams are given different colors—red to port, and green to starboard. If a target is ahead (in both beams) the signal appears to be a combination of red and green.

The DF system, known as "Susel", was an attempt to produce a high frequency version of the well-known low frequency "sum and difference" principle of measuring the rf phase difference between received voltages from two similar antennas. The indicator system is a CRT, and a straight line (collapsed Lissajous figure) is produced at an angle θ to the time base, where $\theta = na$, a being azimuth angle for target station and n depending on antenna characteristics.

Anti-window receiver

Systems were developed using range time base for anti-window work, and also a search receiver version with swept frequency of the receiver locked to the time base. It should be noted that the receiver is rf throughout. A centimeter version of the equipment was demonstrated; this used two polyrod antennas for 10 cm, and a double if of 30 and 7 mc. Much difficulty was experienced in obtaining accurate balance of the two mixers (the local oscillator is, of course, common). The system provides for fast DF and has anti-window possibilities.

A warning receiver "Hela" covered the range 10 cm to 2 meters.[6]

[6]Report Index Number, 78.

Three dipole systems were used, each covering a 3:1 frequency range. The German Navy apparently produced an additional antenna system which had directional properties.

The receiver has a crystal detector and an amplifier which covers the band from 30 to 300 kc. CRT indication used with this receiver involved a triggered time base with five sweep speeds made available and suitable for pulse recurrence frequencies from 15 per second to 2 or 3 kc. The gain of the amplifier was such that noise could be observed, but the overall sensitivity was very low.

Some directional finding work was done for the German Navy using special 4- and 8-segment electrometers of very high sensitivity.[7] A major problem, drift of the DF minimum, was thought to be due to antenna interaction, but it was impossible to establish this experimentally. Several methods of introducing sense into the system were tried, both with artificial targets and by producing asymmetry artificially by loading one of the segments with a capacity to earth.

Radar receiver

A 1.5 meter radar receiver and indicator described had one rf stage, a tuned circular Lecher wire oscillator and 3 intermediate frequency stages on 23 mc. The indicator consisted of an oscilloscope with a 150 km time base on which were added large calibration pips every 50 km and small pips every 10 km. The first 50 km portion of the time base could be expanded and an accuracy of plus or minus 30 meters obtained. This accuracy was realized by triggering a multivibrator through a delay line portions of which were tapped off by a double contractor arrangement in 30 meter steps.

Another receiver indicator setup included expansion of any one of the three 50 km sections of the time base. A 75 cm Lecher-tuned receiver used acorn tubes similar to 954 and 955 types are tuned oscillator and mixer respectively, followed by three intermediate frequency stages at 23 mc. The indicator used could also expand any of the three 50 km sections of the time base.

A PPI tube using rotating magnetic deflection, a long persistence screen, intensity modulation, black-

[7] Report Index Number, 93.

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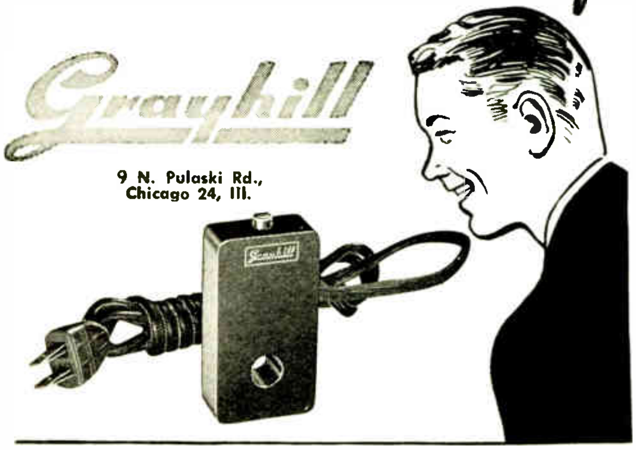

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ing out of the main pulse at the center of the tube was found. Experiments were conducted on automatic sector scan using electrostatic deflection. It happened that these developments in a French laboratory (LMT) were unknown to the Germans.

A pulse altimeter also was developed and found satisfactory consisting of an acorn tube transmitter with a 0.3-microsecond pulse at 3,000 volts on the plate of the tube, transmitting on 2 meters at a pulse recurrence frequency of 1800 pulses per second. The receiver used the same type of construction as the 75 cm receiver.

A radio frequency bridge was developed to work at frequencies between 2 and 4 meters, the need for which arose because Allied use of window had effectively jammed the German 50-60 cm radio chain but had little effect on radar operation in the 2-4 meter band. Consequently the Germans decided to expand the 2-4 meter coverage to put into service new stations with six push-button frequencies between 2 and 4 meters. The stations were equipped with broad-band antenna systems and the bridge was necessary to facilitate a rapid matching of the complicated Wasserman antenna. The original model of the bridge used a crystal detector, but this had to be changed to a diode because the sole German crystal manufacturer, a small specialist in Berlin, had his plant destroyed by British bombing.

There were three types of Wasserman stations, each identical except for the towers. Heights information was obtained by a shifting of the vertical polar diagram with hand control, by varying the relative feed lengths to the upper and lowed bays of dipoles in the Wasserman antenna. Reflector switching at 50 cycles per second was used to secure a form of split on the horiontal beam to assist in more accurate DF.

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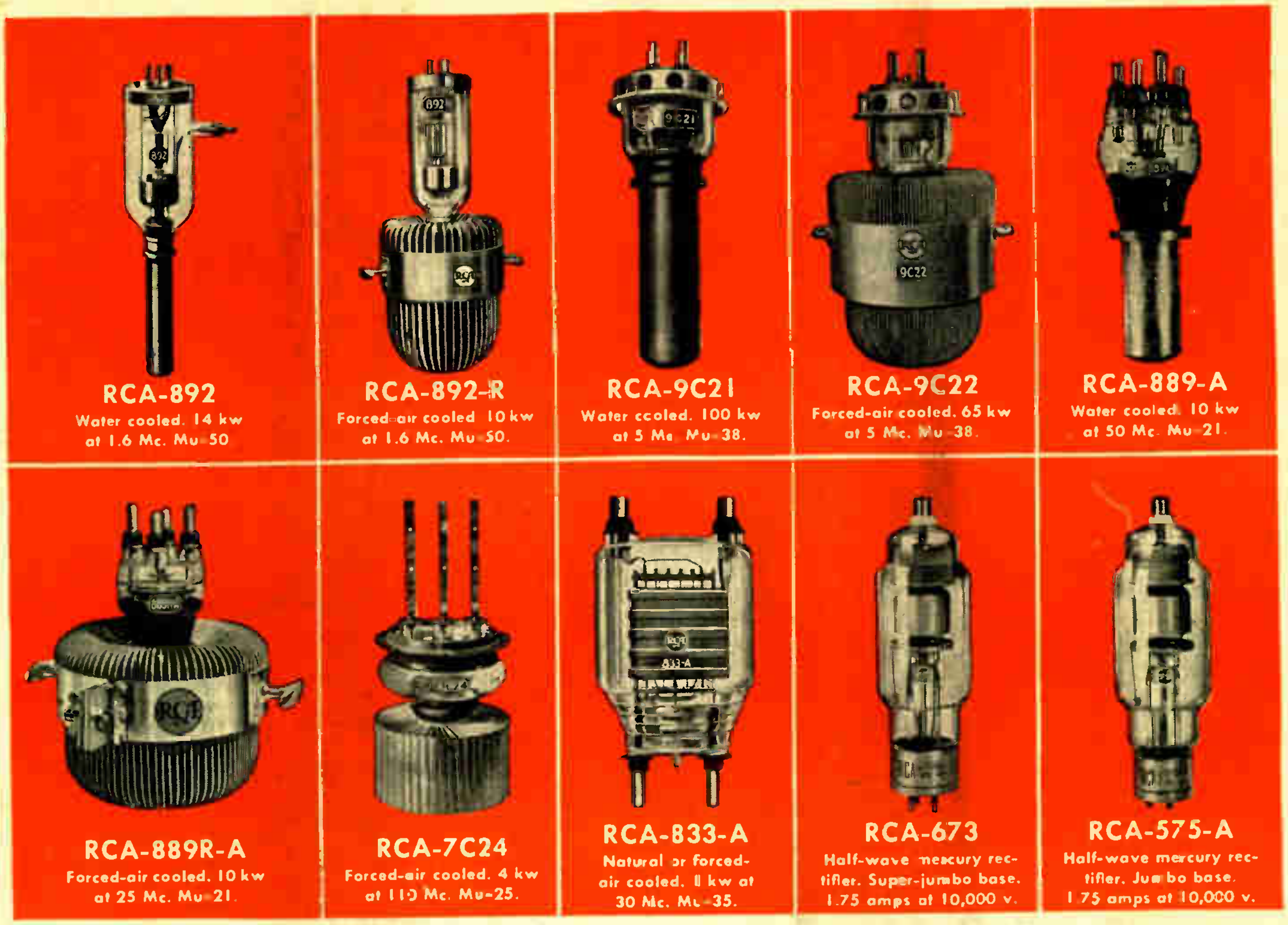

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THE 3 water-cooled and 5 forced-air cooled RCA power triodes illustrated range in output from 1 to 100 kw. Higher outputs are readily obtained by using the tubes in push-pull or push-pull parallel. Operation at higher than quoted frequencies is practical at slightly reduced ratings. Most types are in the medium-mu class, resulting in good stability under changing load, and have moderate excitation requirements. The forced-air cooled types permit simplified designs having the advantage of complete mobility.

The RCA 575-A and 673 half-wave mercury-vapor rectifier tubes have coated filaments of a special alloy that provide higher thermal efficiency. Zirconium-coated anodes provide increased radiation and are shaped to reduce arc-back and confine glow-discharge bombardment.

The large demand for RCA tubes in broadcasting and industrial applications has resulted in production economies that are passed on to you in the form of lower prices and higher quality.

RCA tube application engineers are ready at all times to co-operate with circuit engineers in the design of radio and electronic equipment using these or other RCA tube types. If they can be of aid, or if you wish additional data on any specific RCA tube types, write RCA, Commercial Engineering Department, Section D-7C, Harrison, N. J.

The Fountainhead of Modern Tube Development is RCA

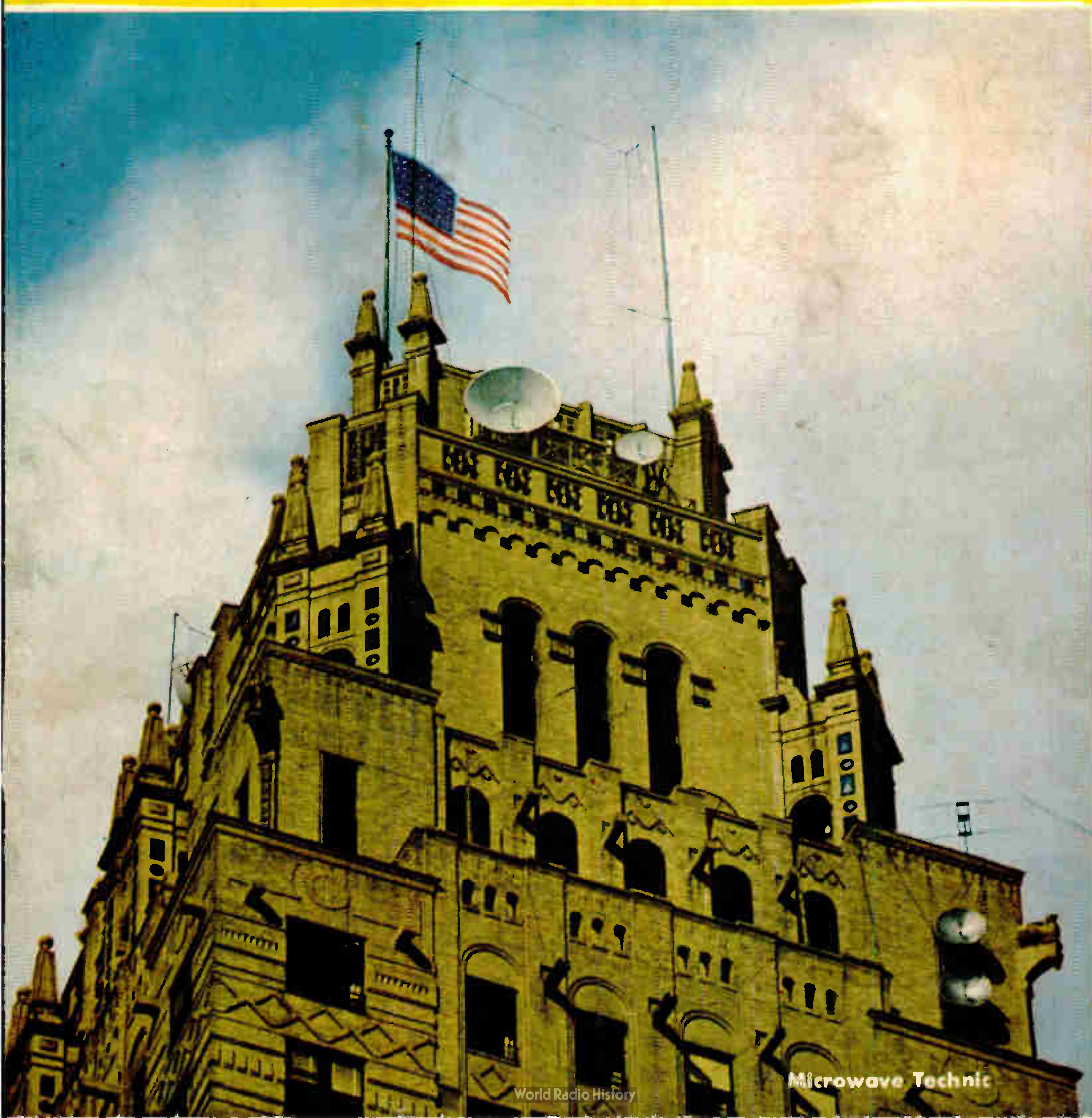
TUBE DIVISION

RADIO CORPORATION of AMERICA

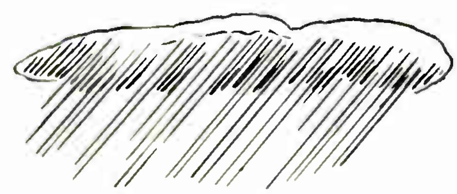
HARRISON, N. J.

ELECTRONIC INDUSTRIES

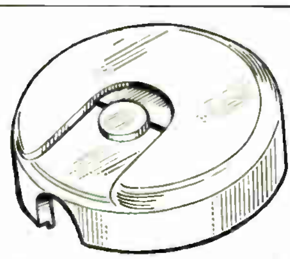
CALDWELL-CLEMENTS, INC. ★ FEBRUARY 1946



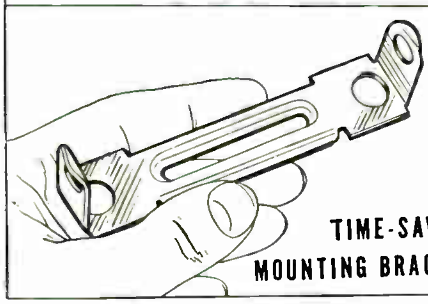
You've Got To Hand It To This Mallory Motor-Starting Capacitor



MOISTURE-PROOF CASE



SPLASH-PROOF END CAP



TIME-SAVING MOUNTING BRACKET

ONE trouble with ordinary motor-starting capacitors is that they're not too well insulated—the cardboard sleeves get soggy in time. *Not so with this plastic encased Mallory Type P capacitor!*

Then, too, many manufacturers have trouble with tight fitting end caps — or with padding expedients that are intended to stop rattling. *Not true of this Mallory Type P AC capacitor with its lock-in end cap!*

Finally, most AC capacitors are troublesome to mount — they need all kinds of expensive and extraneous gadgets. But Mallory Type P has its own mounting bracket. *Only two screws are needed to put it in place!*

For eliminating replacement headaches, improving appearance, speeding up assembly time—you've got to hand it to this Mallory Motor-Starting Capacitor. We'll be glad to send you specification sheets — write for form #746-C.

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(ELECTROLYTIC, FILM and PAPER)

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ELECTRONIC INDUSTRIES

Including INDUSTRIAL ELECTRONICS

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TUBE SPECIALISTS SINCE 1925 — AMPEREX*

WHETHER IT BE A "STANDARD" TUBE OR A SPECIAL DEVELOPMENT TO VITALIZE THE PLANS OF EQUIPMENT MANUFACTURERS, AMPEREX IS THE SOURCE TO WHICH ENGINEERS TURN WITH CONFIDENCE. TWO DECADES OF CREATIVE RESEARCH, PRECISION MANUFACTURE AND HELPFUL SERVICE HAVE GIVEN AMPEREX A UNIQUE POSITION IN THE POWER TUBE FIELD. THIS MEANS A BACKLOG OF EXPERIENCE AND A FORWARD-LOOKING VIEWPOINT WHICH NATURALLY TRANSLATES ITSELF INTO TUBE ORIGINALITY, PERFORMANCE, RELIABILITY AND ECONOMY.

POWER TUBES IN ALL THEIR APPLICATIONS

AMPEREX ELECTRONIC CORPORATION

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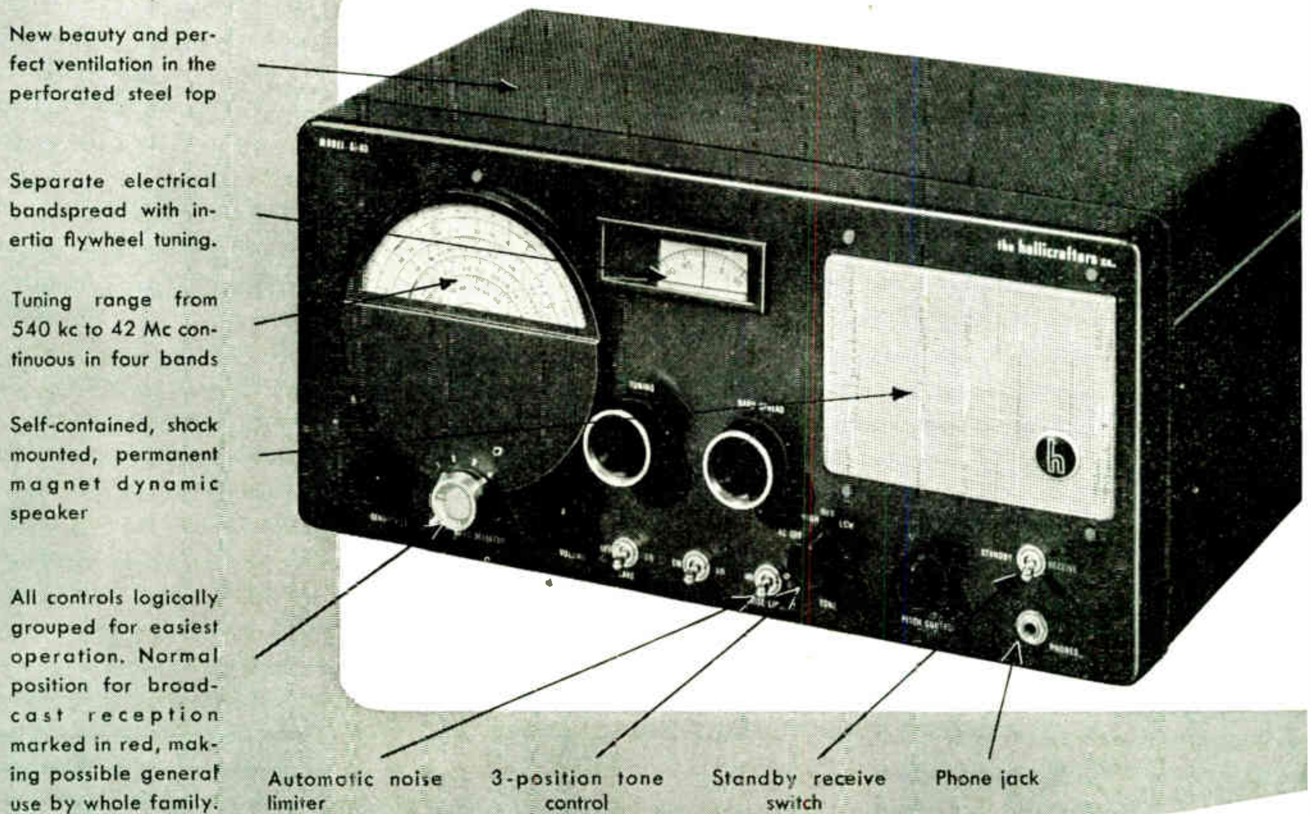
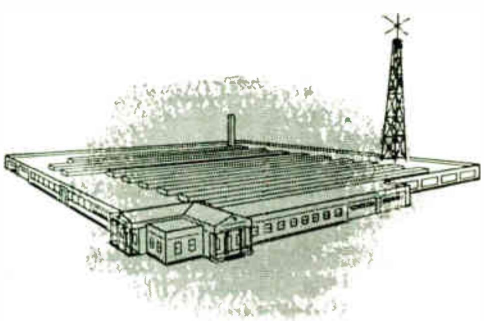
hallicrafters *new Model* S-40



New design, new utility in a great new communications receiver . . . (APPROXIMATELY) **$79.50**

Here is Hallicrafters new Model S-40. With this great communications receiver, handsomely designed, expertly engineered, Hallicrafters points the way to exciting new developments in amateur radio. Read those specifications . . . it's tailor-made for hams. Look at the sheer beauty of the S-40 . . . nothing like it to be seen in the communications field. Listen to the amazing performance . . . excels anything in its price class. See your local distributor about when you can get an S-40.



INSIDE STUFF: Beneath the sleek exterior of the S-40 is a beautifully engineered chassis. One stage of tuned radio frequency amplification, the S-40 uses a type 6SA7 tube as converter mixer for best signal to noise ratio. RF coils are of the permeability adjusted "micro-set" type identical with those used in the most expensive Hallicrafters receivers. The high frequency oscillator is temperature compensated for maximum stability.

From every angle the S-40 is an ideal receiver for all high frequency applications.

hallicrafters RADIO

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

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THE COVER

Parabolic transmitting and receiving reflectors, located atop the headquarters building of the International Telephone and Telegraph Corp., 67 Broad Street, New York, beam single microwave carrier for radio-telephone circuits permitting 24 simultaneous two-way conversations. This station is one in a network set up by the Federal Telephone and Radio Corp., International Telephone and Telegraph associate, between New York, Telegraph Hill, near Hazlet, New Jersey, and Nutley, New Jersey, utilizing the pulse time modulation system developed by Federal laboratories and described in Electronic Industries for November, 1945.

Pulse time modulation communication, in which intelligence is conveyed by varying the time between short pulses, constitutes a multiplex system whereby a number of separate two-way conversations with high audio fidelity can be carried on simultaneously over the same carrier. The present system has 24 channels. The system has a high signal-to-noise ratio and provides the additional advantages of transmission of DC for dialing or bell-ringing, and elimination of cross-talk and other interferences. Further, any noise which enters the system is not cumulative in the repeaters and so the number of repeaters which may be used in a system does not appreciably affect its efficiency of operation.

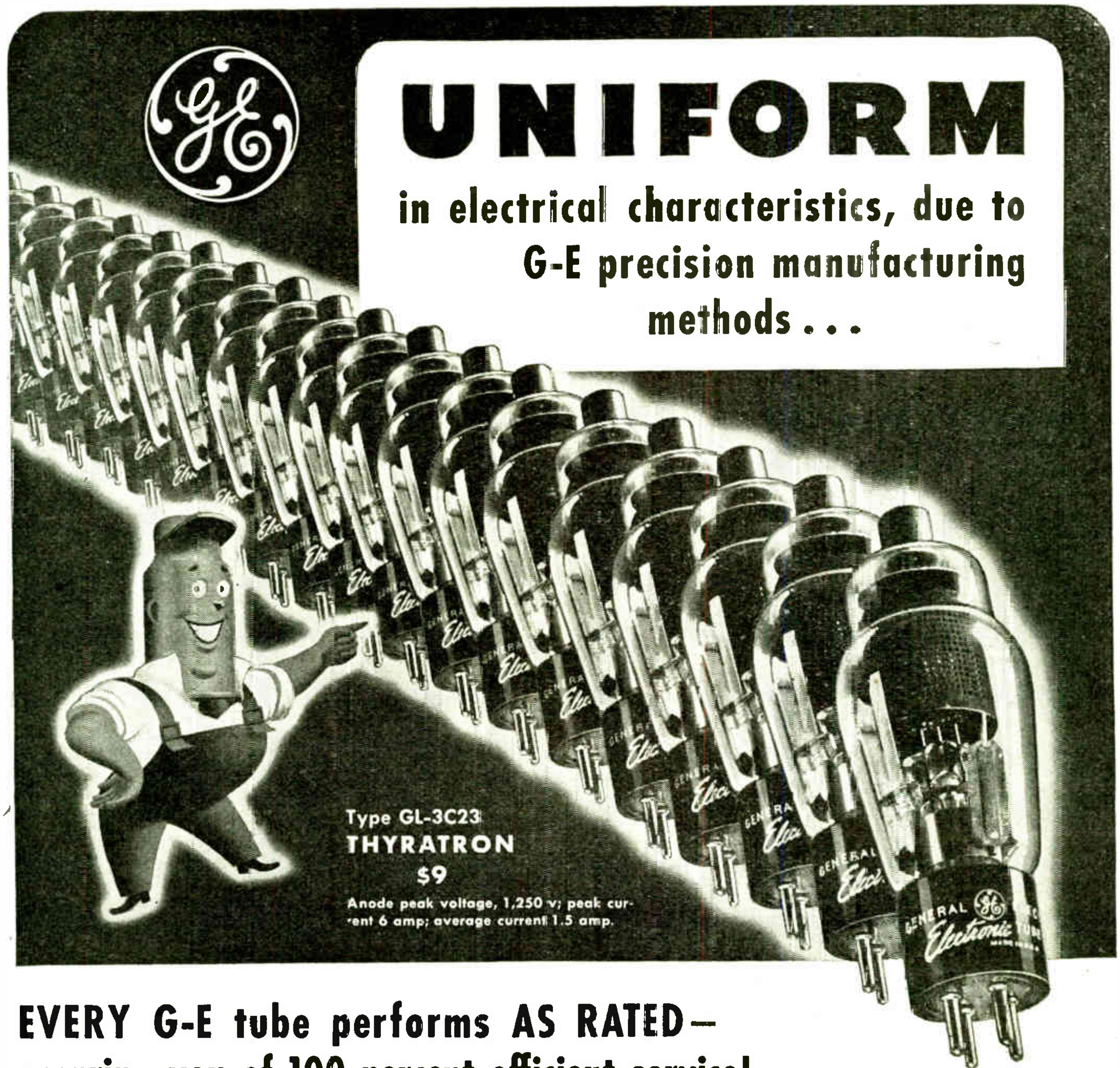
"What, No Pressure Cookers??"

Wartime shortages and the general scarcity of certain consumer goods reared its head again this week in the form of human interest at The Daven company, manufacturers of the Daven potentiometers and attenuators.

The Daven company recently received a strange request from a non-priority source. A young bride-to-be wrote:

"Gentlemen:

I've heard that you made or carried aluminum pots and pans. I expect to get married soon, and I can't seem to find any more aluminum pots. If by any chance you may have any in stock, I would appreciate it very much if you could let me know what you have and the price of them. Thank you."



EVERY G-E tube performs AS RATED— assuring you of 100-percent efficient service!

TUBES carrying the G-E monogram, when you place them in their sockets, will do exactly what they were designed to do. Reasons are: (1) the most modern high-precision equipment is used in their manufacture, (2) G-E tubes are pretested for service by methods which safeguard and enforce the correct rated performance.

This high level of efficiency is supported by a strong written warranty, which further assures you of full dollar-value from every G-E tube you purchase and install.

Furthermore . . . G-E thyratrons, ignitrons, pliotrons, and other types are easy to obtain, as well as dependably efficient! There is a G-E tube distributor or dealer near you, equipped to make quick deliveries.

Telephone this G-E tube supply source! Learn how his fast local service, given out of stock, can prevent machine shutdowns due to unexpected tube failures. Knowing your nearby G-E tube distributor or dealer, and his facilities, is a real stride toward the full-time performance of your plant. *Electronics Department, General Electric Company, Schenectady 5, New York.*

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

GENERAL ELECTRIC

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

A NEW AND DIFFERENT

SWEEP GENERATOR

Needed in

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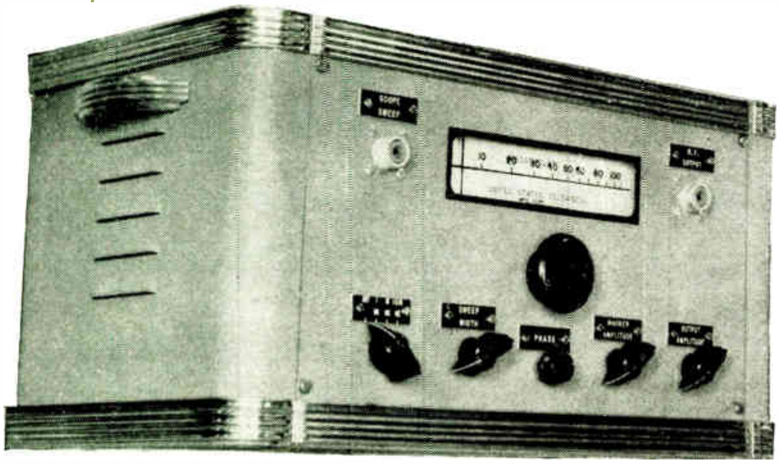

.1 Volt, Max., 500 Kc to 110 Mcs; 100 Ohms, 10 Mc. Sweep Width

SAVES TIME
—In Production and in Testing

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—Only 16 lbs.

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—14½" x 8" x 8"

$395.00 APPROXIMATE PRICE

For your work in television, FM, radar, high frequencies, etc., you will need one of these newly developed electronic frequency modulated signal generators covering a continuous range between 500 Kc and 110 Mc. Designed primarily for use for field, laboratory, or production alignment of wide band r.f., i.f., or video amplifiers used in radar, direction finders, television, or other wide-band systems.

Sweep range is adjustable from 10 Mc. down to 5,000 cycles at any frequency within the above range for alignment of narrow-band receivers or amplifiers. Self-contained power supply. Input 110 V., 50-60 cycles. A.C. 60 watts. Two internal "markers" are provided, one at intervals of 10 Mc., the other at intervals of 1 Mc. for band-width measurement. The amplitude of these markers is adjustable from the panel. The main dial is marked in megacycles/sec. and when set at any frequency the sweep is plus and minus 5 Mc. from this setting.

An attenuator is provided which reduces the output signal of .1 V. to about 30 microvolts, which is well below the gain control region of most receiver or amplifier systems.

Also Available Immediately In Sample Quantities

HIGH VOLTAGE RF POWER SUPPLIES
(10 KV, 24 KV, or 30 KV) for 7, 10, 12, or 14 inch direct-viewing Kinescopes and for projection sets

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Federal 134 Transmitting Tube. 200 KW oscillator and amplifier; length, 54-3/8".

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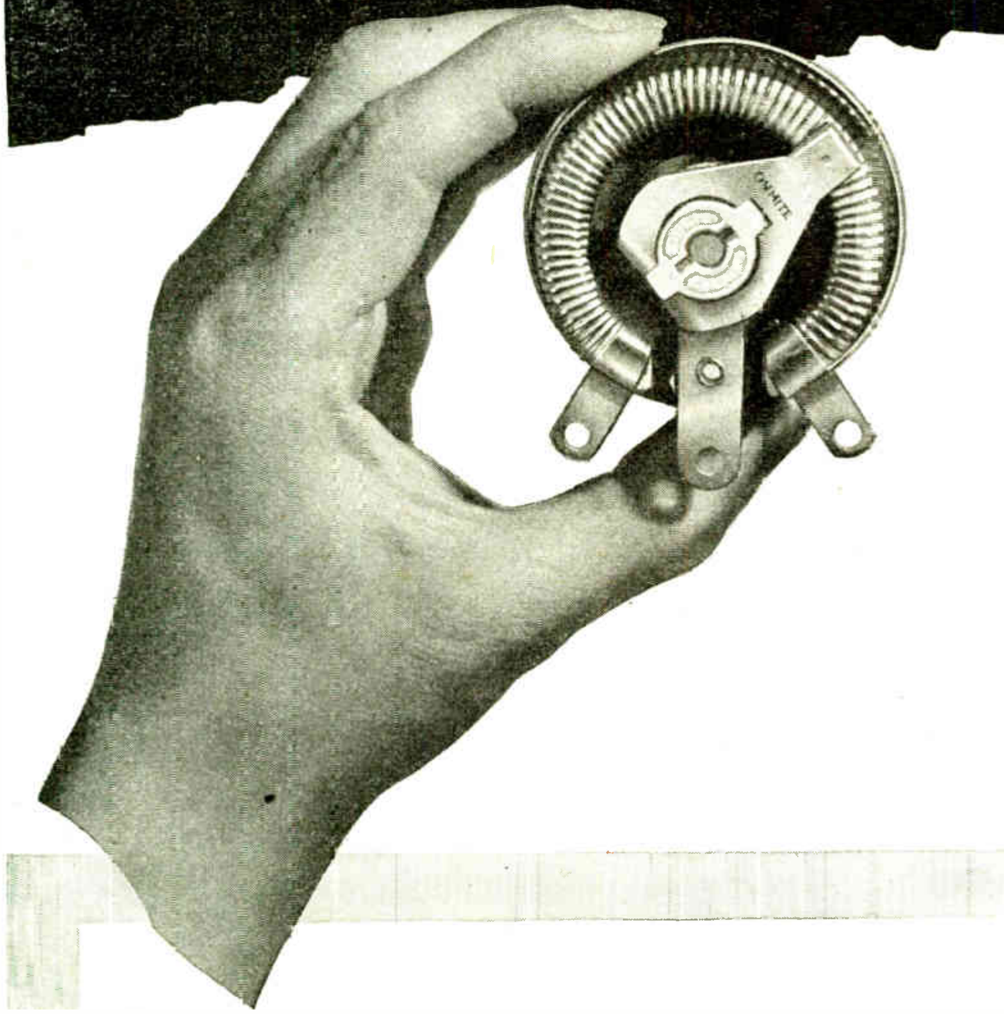
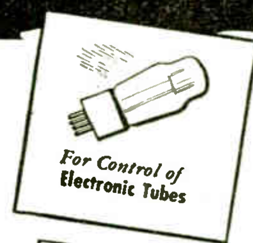
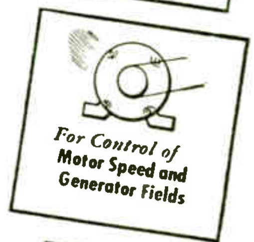
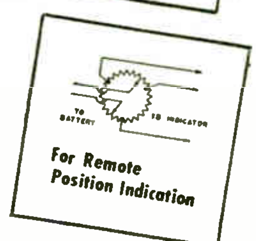
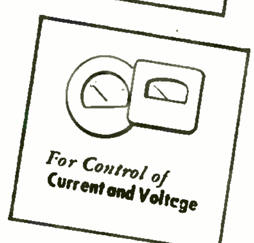
FOR THE RIGHT RHEOSTAT CONTROL

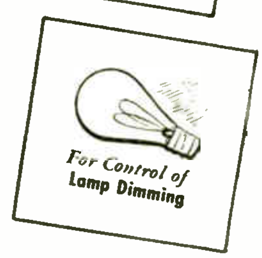












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You get these advantages: (1) Ohmite experience with countless rheostat applications. (2) Service-proved Ohmite features that assure permanently smooth, close control. (3) Extensive range of sizes and types for easy, economical selection of the best unit for every application.

There are ten wattage sizes ranging from 25 to 1000 watts—from 1$\frac{9}{16}$" diameter to 12" diameter—in uniform or tapered winding—in single or tandem units—in regular or special designs. Stock models from 25 to 500 watts, in many resistance values.

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Write on company letterhead for this helpful guide in the selection and application of rheostats, resistors, tap switches, chokes and attenuators.

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ONE SALES SOURCE...ONE MARKETING RESPONSIBILITY
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Meissner *precision built* components include Antenna, R.F. and Oscillator Coils; plastic, standard and Ferrocart Transformers; Cartwheel and replacement Windings; Coils, Chokes and Accessories.

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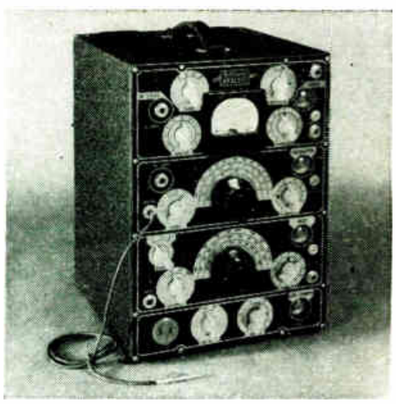

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SERVICE INSTRUMENTS

Meissner Analyst operates by the "signal tracing" method, fastest and most reliable. Furnished complete, ready to go to work. *Portable Signal Calibrator* designed for accurate checking and adjusting of radio equipment.

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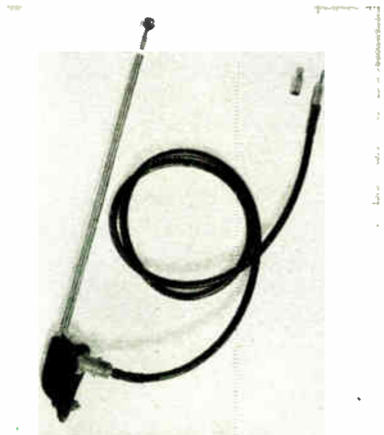
RADIART

RUST-PROOF AERIALS



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A complete line of newly designed aerials to fit all cars; cowl, fender and under hood types. Featuring water-proofed leads, "static muffler" magic ring and permanent all metal anti-rattler.

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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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TRANSFORMERS

Quality built and precision-engineered for all requirements; replacement, communications, sound amplifier, industrial, experimental and amateur. Tropex-impregnated for protection against moisture, salt air and humidity.

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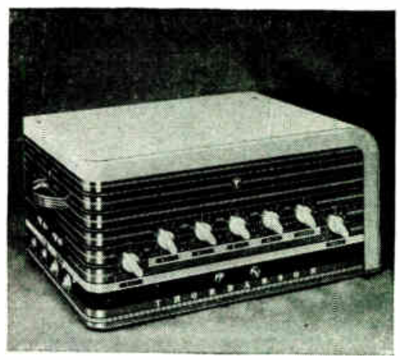

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True-Fidelity Amplifiers, in new modern designs, feature advanced tone compensation, conservative ratings, ample ventilation for continuous operation, low hum level, multiple input channels, and maximum flexibility of controls.

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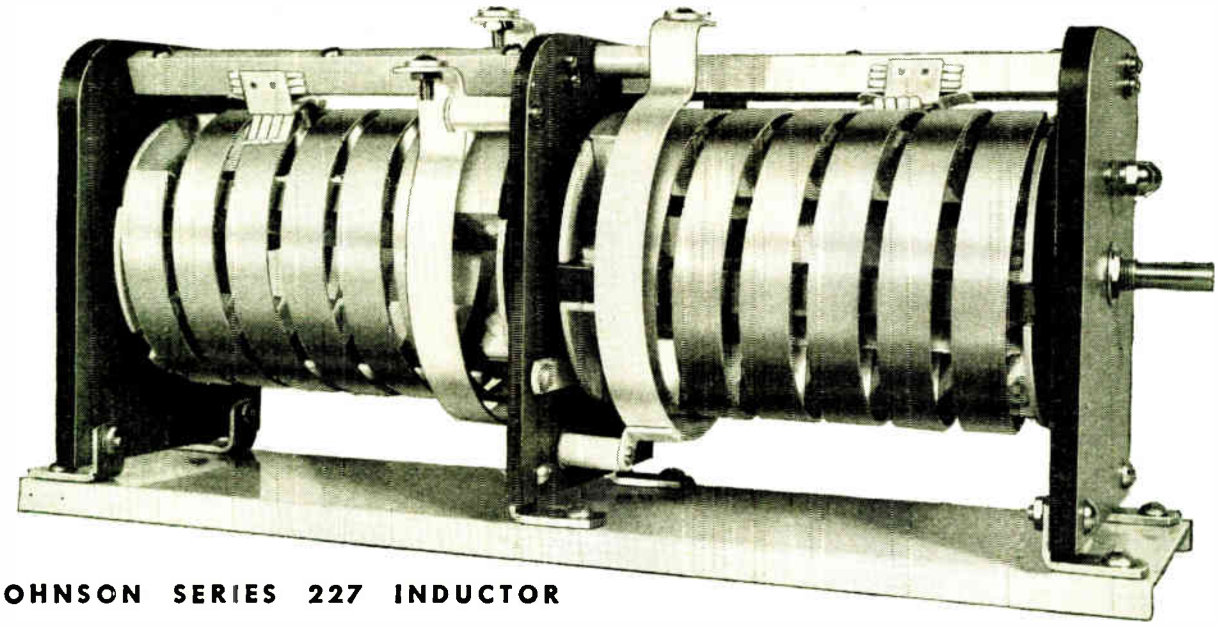
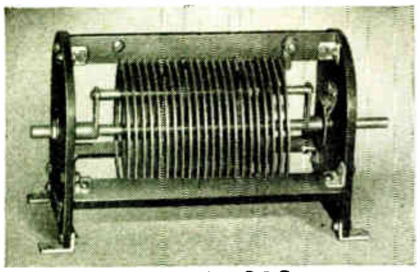
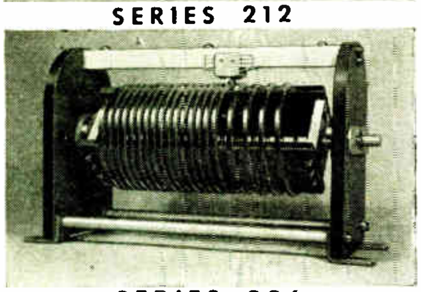
VARIABLE INDUCTORS



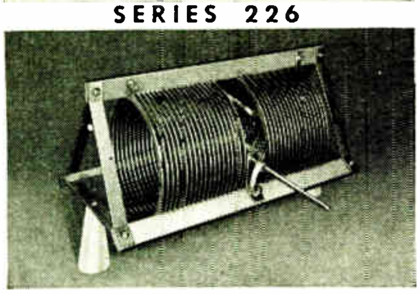
JOHNSON SERIES 227 INDUCTOR



SERIES 212



SERIES 226



SERIES 204

ELECTRONIC HEATING—Designed for high current, the variable inductor shown above is especially adaptable for electronic heating installations. Available in single and dual models, with or without coupling links, the series 227 inductors are engineered to meet the rigid requirements of electronic heating circuits. Wound with heavy copper ribbon, conductor and contact surfaces may be heavily silver plated for minimum R.F. resistance. The dual model features counter-rotating coils, providing automatic balancing for push-pull circuits. Machined Mycalex is used for end frames and supporting bars. For lower power electronic heating applications the Johnson series 212 variable inductor, shown at left, is designed to give maximum efficiency. Conductor surfaces are of edge-wound copper strip, frames and supporting bars are of machined Mycalex.

TRANSMITTERS—The series 227 variable inductor shown above, is also engineered to meet demands of high-power transmitter tank designs, while the series 212 is recommended for applications at lower frequencies in medium power transmitters. The Johnson series 226 variable inductor is applicable for high-frequencies and for a wide frequency range by means of its variable pitch design. The Johnson series 204 inductor is widely used for tank coupling and other transmitter applications and can be supplied with either a variable coupling rotor or as a variometer.

VARIABLE INDUCTORS—Offer many important advantages to the electronic engineer and manufacturer. They provide close control and adjustment of fixed and limited frequency range circuits and allow the use of smaller, lower-cost, fixed capacitors. In series filters or networks where it is desired to simulate high-capacity, low-impedance conditions variable inductors again serve as desirable means of control.

Whether you need inductors for electronic heating equipment or transmitters, you will find Johnson's engineering and production facilities ready to meet your needs. Johnson fixed and variable inductors range in size from small, wire-wound units for oscillator and low-power stages to the large, high-power models where copper tubing acts as the conductor for both radio-frequency current and liquid for cooling.

TUBE SOCKETS • VARIABLE CAPACITORS • INSULATORS • BROADCAST COMPONENTS

Write for Specific Information

JOHNSON

a famous name in Radio

E. F. JOHNSON COMPANY • WASECA • MINNESOTA

Engineered
Especially for HEAVY DUTY Industrial Applications

This high power industrial tube built by Federal is the result of the widening use of induction heating for heavy applications...especially designed for the purpose...built to meet the exacting demands of severe operating conditions.

Federal's 9C23 is a tube that can stand the gaff...with extra ruggedness for stamina...heavy duty filament for long life and high power output . . . and with the inherent reliability and exceptional qualities that characterize every tube in the extensive Federal line.

Here is another instance where Federal's long experience and leadership in tube design and construction contribute to electronic progress. And it is a good reason to see Federal first for industrial power . . . rectifier . . . transmitting tubes.

Remember—"Federal Always Has Made Better Tubes."

Technical Data for Type 9C23

Maximum Ratings for Maximum Frequency of 20 Megacycles

D C Plate Voltage	15,000 volts
D C Plate Current	4.0 amperes
Plate Dissipation	25 kilowatts
Filament Voltage	22 volts
Filament Current	82 amperes
Overall Length	19½ inches
Type of Cooling	water

ARMY NAVY E

FEDERAL FTR TELEPHONE & RADIO

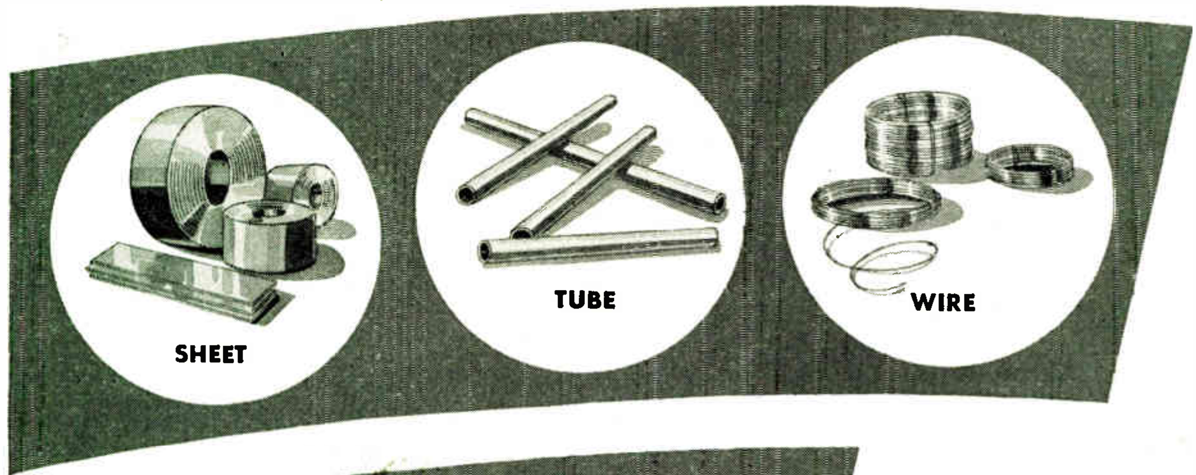
Federal Telephone and Radio Corporation

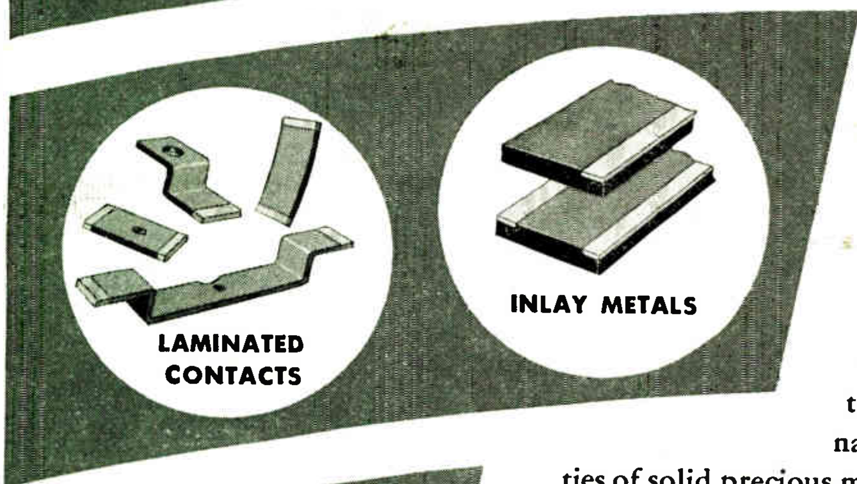
AN IT&T ASSOCIATE

Newark 1, N.J.

GENERAL PLATE
Laminated Metals

Give Solid Precious Metal Performance at Low Cost





If you are looking for better electrical performance, corrosion resistance, ease of workability, long life . . . and exceptionally low cost, then look into the advantages provided by General Plate Laminated Metals.

By permanently bonding base metals to precious metals, General Plate Laminated Metals give you all the properties of solid precious metals at a fraction of the cost of solid precious metals. In addition, the base metal adds strength and rigidity not usually found in precious metals. You'll find General Plate Laminated Metals ideal for use in such applications as electrical contacts, chemical apparatus, radar and radio equipment, mobile equipment and instruments. They'll help you cut costs, increase production and improve product performance.

General Plate Laminated Metals are available in sheet, tube and wire or as fabricated parts. Base to base metal combinations . . . providing physical and structural properties not found in single base metals . . . are also available. Write for information today.

GENERAL PLATE DIVISION
of Metals & Controls Corporation
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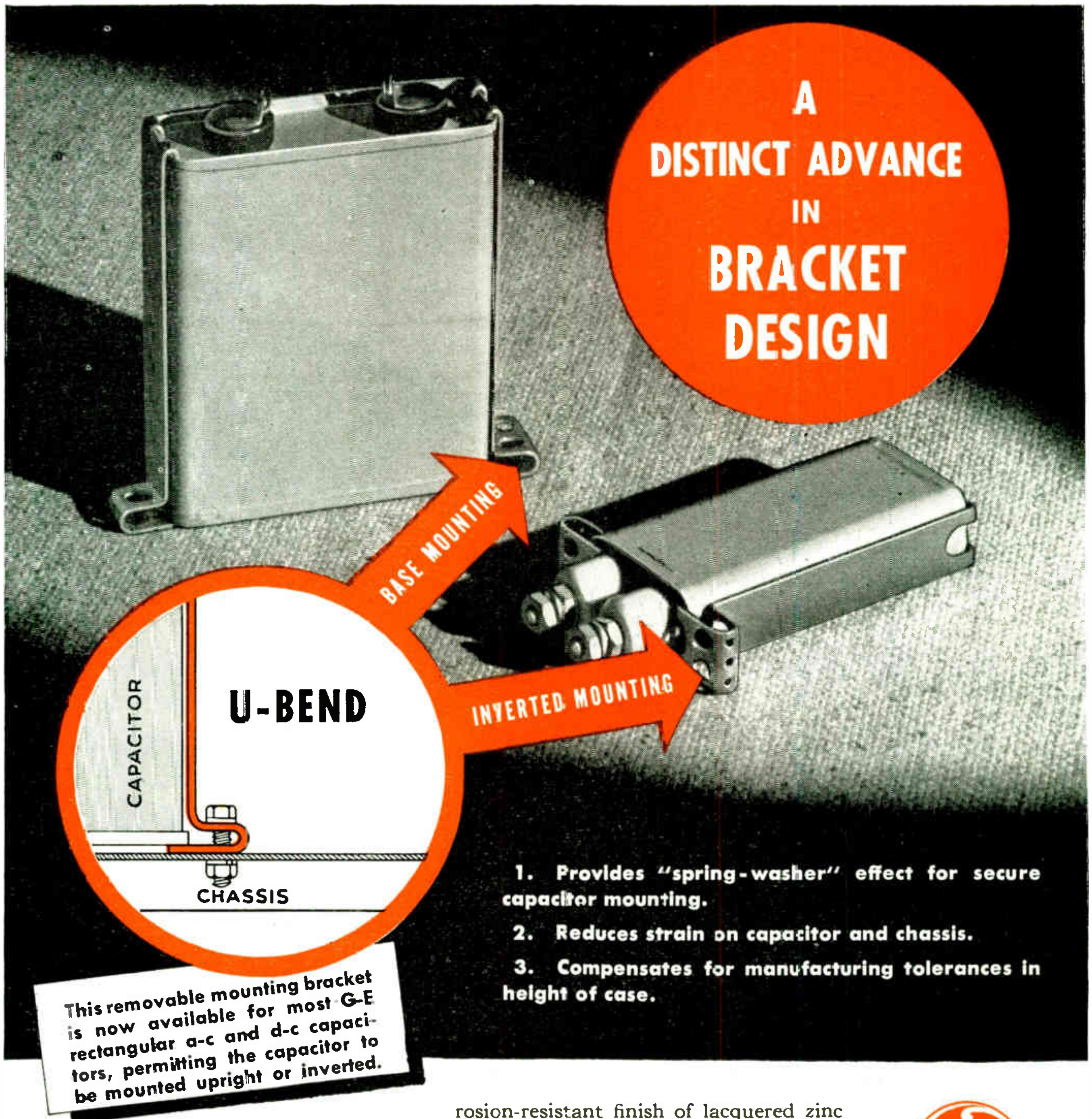
Grant Bldg., Rm. 603, Pittsburgh, Pa.
ATTLEBORO, MASSACHUSETTS



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

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

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

CAPACITORS

GENERAL ELECTRIC

407-96-8700

TURNER Microphones
present a *New* concept
in microphone application

THE TURNER COLORTONES

Microphones in Color

DESIGNED BY ARTHUR C. HAGGSTROM, INDUSTRIAL DESIGNER, ROCKFORD, ILLINOIS

BLAZING new trails in the field of practical microphone application, Turner introduces the Colortones. . . . New Crystal and Dynamic Microphones in a choice of rich color finishes. Conceived to meet the demands for functional color, their sparkling, streamlined beauty blends with modern electronic communications equipment. Executed in tough, rugged plastic, they incorporate all those sound engineering principles which have won Turner's world-wide reputation for faithful performance under difficult acoustic and climatic conditions. Now in the final stages of manufacture, Turner Colortones will be available soon. Write today for particulars and specifications.

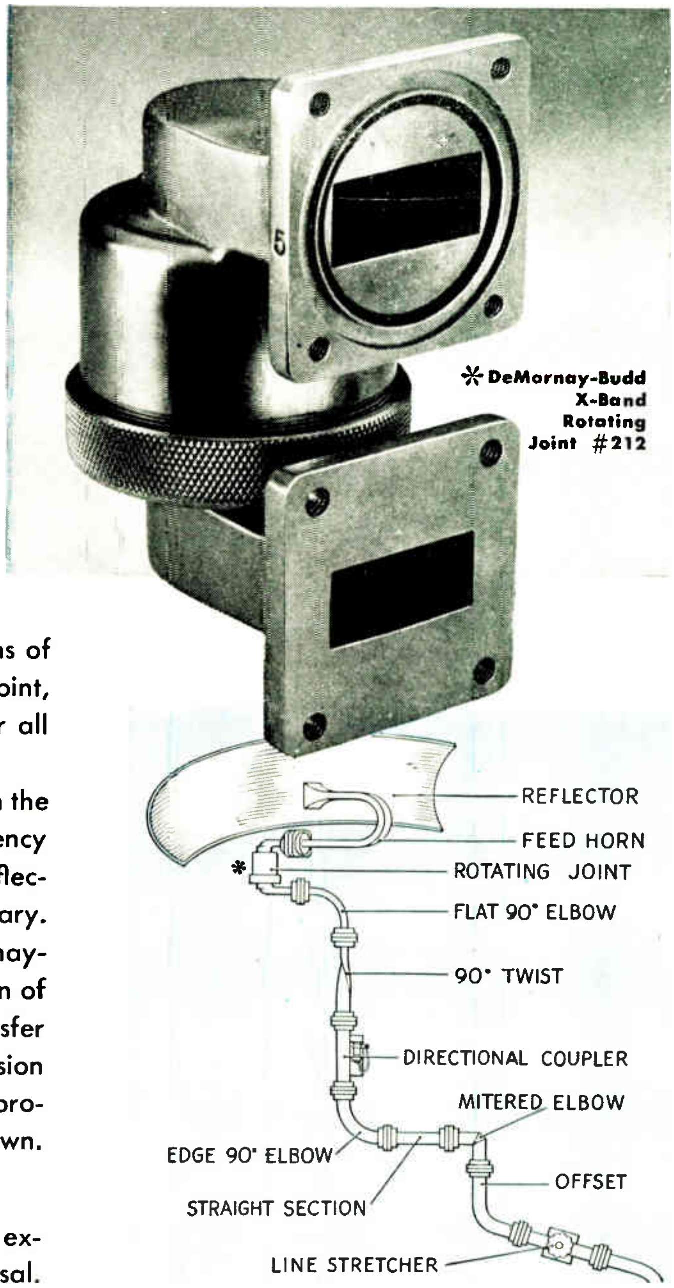
THE TURNER COMPANY — Cedar Rapids, Iowa

PIONEERS IN THE COMMUNICATIONS FIELD

Licensed under U.S. Patents of the American Telephone and Telegraph Company and the Western Electric Company, Incorporated. Crystals licensed under Patents of the Brush Development Company.

ASSURES CONSTANT IMPEDANCE

for all positions of rotating element



Asterisk indicates position of #212 Rotating Joint in above plumbing arrangement. In broad band joints it is necessary to include impedance matching devices such as tuning plugs or irises to keep the Voltage Standing Wave Ratio to a minimum and the mode constant.

DeMornay-Budd Rotating Joints are available with either choke or plain flange coupling or any combination.

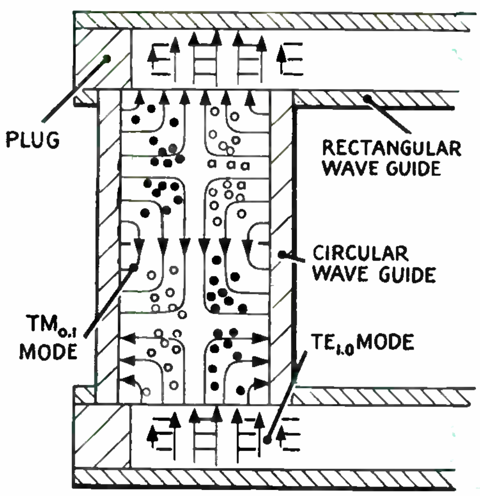
When two transmission lines, the relative positions of which are variable, are coupled by a rotating joint, it is essential that the impedance be constant for all positions of the rotating element.

Varying impedance will have a pulling effect on the R. F. oscillator and produce a variation of frequency and power output due to a changing load. The reflection coefficient of the transmission line will also vary.

The Voltage Standing Wave Ratio of the DeMornay-Budd Rotating Joint is the same for either direction of power transfer, providing balanced energy transfer for both directions. Careful engineering and precision finishing eliminate sharp corners or small radii projections which would cause arcing and breakdown.

★ ★ ★

Our extensive engineering and manufacturing experience with wartime radar is at your disposal. Consult us on any of your transmission line problems, without obligation.



Sketch illustrates a method employed by DeMornay-Budd in designing a rotating joint. The $TE_{1,0}$ mode in the rectangular wave guide is changed to a $TM_{0,1}$ mode in the circular wave guide and, as a result, a 360° rotation can be obtained without any theoretical variation in V.S.W.R.

DE MORNAY BUDD

EQUIPMENT FOR 97% OF ALL RADAR SETS

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

For tubes of Uniform Performance . . .

BEAT THE HEAT

with SPEER GRAPHITE ANODES

In manufacturing transmitter and rectifier tubes that are truly uniform in performance, the high heat dissipation value of SPEER Graphite Anodes is an important factor. It's one of the many reasons why SPEER Anodes are consistently specified by so many leading tube manufacturers and tube users.

Tubes containing SPEER Graphite Anodes can handle greater plate power dissipation as they disperse the heat of operation faster, and because SPEER Anodes minimize heat transfer to other component parts of the tube. SPEER Graphite Anodes will withstand any temperature up to 3500° F. without warping—temperatures at which many anode materials may soften and distort.

SPEER Anodes are carefully processed and are 99.9% pure electro-graphite. They can be machined to extremely close tolerances to conform with your tube design. Internal face spacings of SPEER Graphite Anodes can be held to .002 inch.

The many advantages of SPEER Graphite Anodes listed here are available to manufacturers and users of almost every type of electronic tube. Write today for further details, without obligation.

Do You Know?

SPEER GRAPHITE ANODES

- *Lower temperatures of associated tube parts.*
- *Withstand severe overloads.*
- *Defy warping.*
- *Prevent hot spots or fused holes.*
- *Minimize bulb darkening and insulator leakage.*
- *Improve degassing qualities.*
- *Decrease gas troubles.*
- *Enhance tube appearance.*
- *Provide precise anode dimensions.*
- *Produce uniform tube characteristics.*
- *Retain original dimensions in service.*
- *Maintain normal tube characteristics.*
- *Allow wide latitude of anode design.*

595

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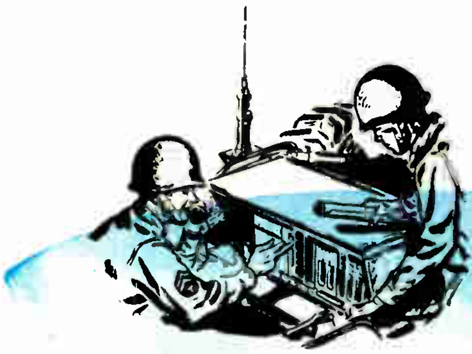


Bell Laboratories designed and Western Electric furnished more than 139,000 multi-channel FM receivers and 74,000 multi-channel FM transmitters for use by the Armored Forces and Artillery.

Bell Laboratories and Western Electric furnished revolutionary carrier telephone terminal equipment in great quantities—all "packaged" for quick installation in the field.

war jobs like these

with no immediate prospect of an application in the communications field. Time after time, their discoveries have eventually brought about fundamental scientific advances.

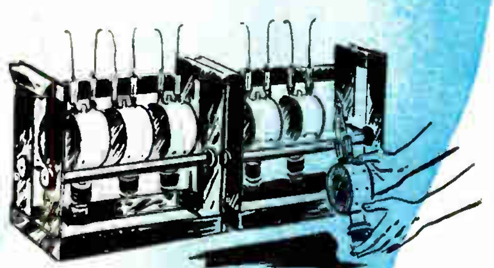
Applying new discoveries

As new discoveries have reached the stage of application, Western Electric manufacturing engineers have always worked closely with Bell Laboratories men to assure a final design suited to quantity production of highest quality equipment.

During the war, the capabilities of this unique research-production team expanded rapidly. New techniques were explored—new methods were developed—new ideas were born, rich with possibilities for the future.

What this means to YOU

Today Bell Laboratories and Western Electric are once more applying their facilities and their philosophy to the development and production of electronic and communications equipment for a world at peace. Depend on this team for continued leadership in AM, FM and Television broadcasting equipment.



Bell Laboratories and Western Electric played outstanding roles in the design and production of magnetrons and other essential vacuum tubes for use in radar and communications.

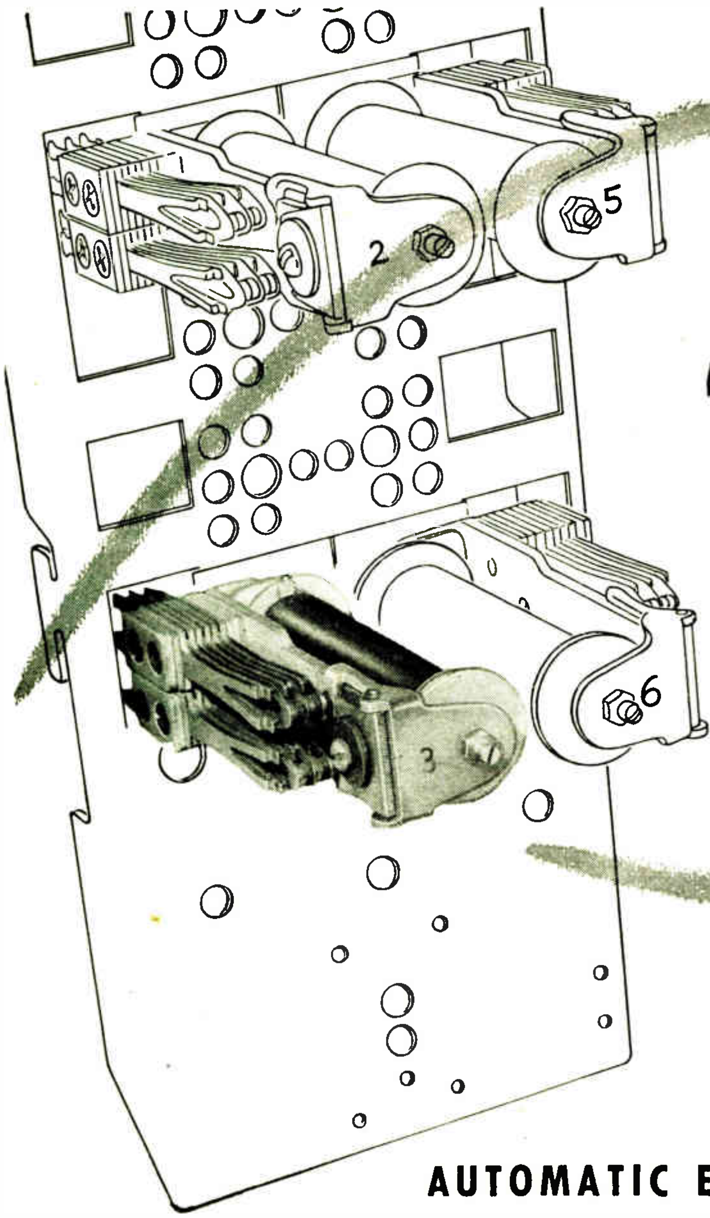
BELL TELEPHONE LABORATORIES

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

Western Electric

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

WHY ARE THESE BUSHINGS



More THAN 300,000,000 OPERATIONS

AUTOMATIC ELECTRIC'S CLASS "B" RELAY

Want real proof of relay ruggedness? Many months ago, several Class "B" relays, taken from regular production, were placed on "life test." Today, with no attention except for occasional lubrication, they are still functioning satisfactorily—and every one has hung up the amazing record of more than 300,000,000 operations! For ruggedness—for all the other features you need, specify Automatic Electric's Class "B" relays.

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

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

Relays by

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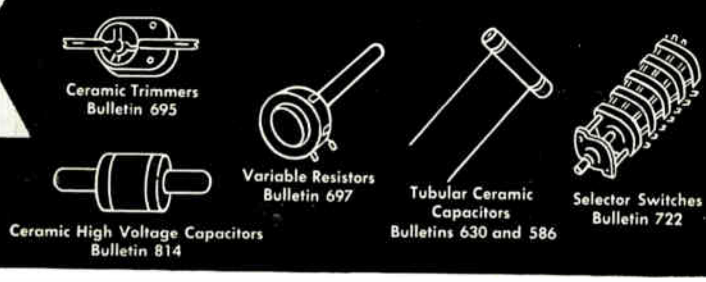

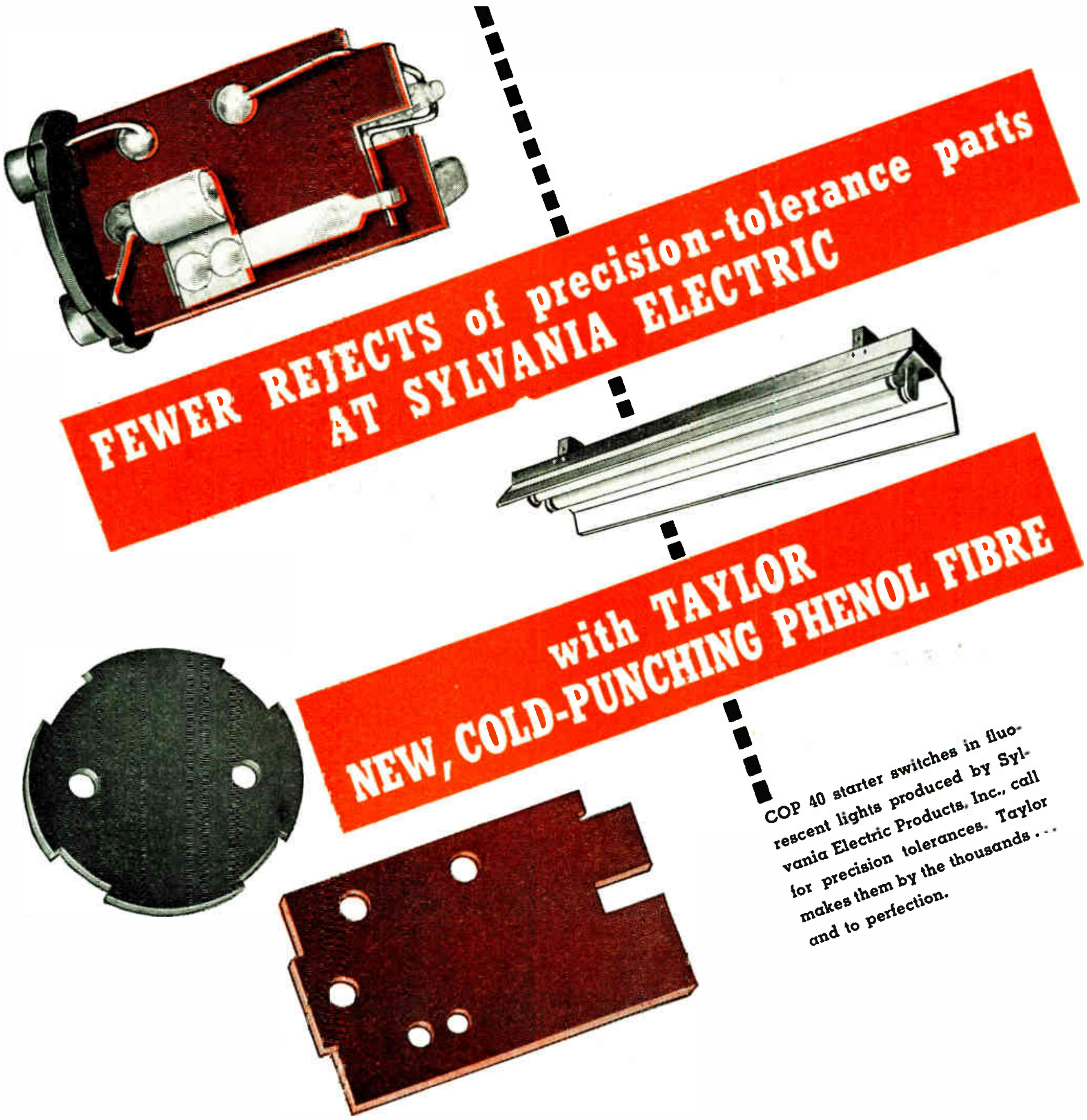

Wherever Laminated Plastics are called for, Taylor Fibre engineering skill is equal to the task of producing any fabricated part—no matter how complicated the design or how close the tolerances. Such parts can be mass-produced and speedily delivered. With Taylor fabricated parts, you can be assured of uninterrupted production, for our own inspection eliminates rejects in advance.

Sylvania Electric's experience is duplicated in hundreds of other plants where production engineers have discovered that "no one can turn out accurate parts like Taylor." If you fabricate your own parts, you will have better success if you start with Taylor sheets, rods, or tubes, particularly the newly developed, cold-punching, paper base Phenol Fibre that handles satisfactorily in any kind of punch and die.

Tell us what you're interested in and we'll gladly send you completely descriptive folders or technical data concerning any Vulcanized Fibre or Phenol Fibre product. Our Engineering Department is available for free consultation.

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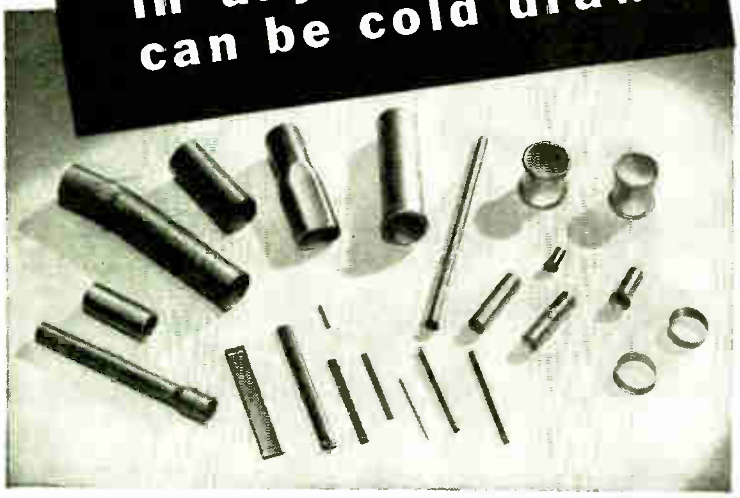
SUPERIOR
SMALL SHAPED TUBING
in any metal that can be cold drawn



Made to Specification for any Industrial Application

SUPERIOR Shaped Tubing — made to your specification, cut to the exact size you need, or in random lengths. Squares, ovals, ellipses, rectangles, etc.

Consult **SUPERIOR** about additional forming operations to your individual requirements. **SUPERIOR'S** experience and facilities are at your disposal.

For the Electronics Industry

Cathodes and anodes by **SUPERIOR**, the pioneer in design and production in this specialized field. Send your specifications to **SUPERIOR** for anodes and cathodes of standard or new design.

SEAMLESS — Nickel of electronic quality in random lengths, or Nickel Cathode Sleeves to exact lengths. Plain or Beaded (embossed), and also to *Shaped* specifications.

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* Produced under Superior's Patents.

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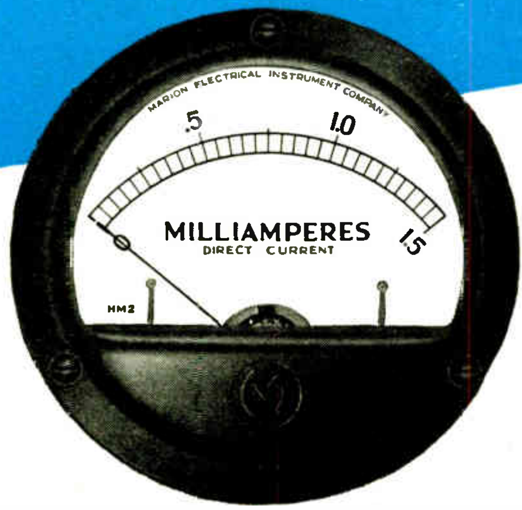

Marion Glass-to-Metal Truly Hermetically Sealed Electrical Indicating Instruments are 100% guaranteed for six months. After this period we will replace any 2½" or 3½" type, ranging from 200 microamperes upward, for a flat fee of $1.50, regardless of whether the instrument has been overloaded, burned out, or in any way mistreated, provided the seal has not been broken. We will replace, for a flat fee of $2.50, any 2½" or 3½" instrument, with sensitivity greater than 200 microamperes, under similar circumstances.

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For the user of electrical indicating instruments, this guarantee is highly significant. It precludes the need for him to maintain his own repair department, and it minimizes the correspondence and red tape that formerly enmeshed most replacement transactions. Moreover, he is assured of receiving his replacement within a reasonably short period at a saving of considerable time and money. It is our faith in the quality and performance of Marion "hermetics" that prompts us to make this guarantee which is offered to customers in all parts of the world. You can buy and use them with confidence.

Marion Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

Ready soon — the new Marion Catalog, containing information of value to all users of electrical indicating instruments. Reserve your copy now.

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MANCHESTER, NEW HAMPSHIRE
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CABLES: MORHANEX


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Two-Way Communication, Paging and Public Address Systems
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When it was necessary to save not only hours but minutes and even seconds, AMPLICALL "came through." Its complete day-in-and-day-out dependability, multiple uses, flexible design, trouble-free operation and tone quality make it the preferred communications system. "AMPLICALL" is another way of saying "efficiency"... learn how it can bring about a greater efficiency for your business.
AMPLICALL Intercommunication unit, available for two-way communication between multiple stations.
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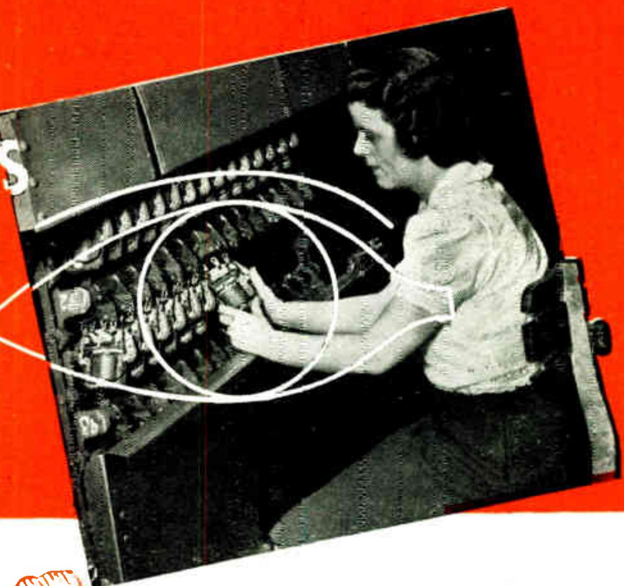
We look at magnet wire

THROUGH A USER'S EYES

That's why we know FORMEX means faster winding of trustworthy coils



There are no magnet-wire customers more exacting than our own G-E people who use it to make motors and refrigerators and other equipment in which a small coil-flaw can cause a big servicing headache. These men right in the G-E family have user experience which verifies our claim that FORMEX magnet wire will take the abuse of high-speed winding, high-temperature baking, and extreme deformation.

Every foot of FORMEX wire we ship — inside the Company or out — must meet the tests and performance standards required by the world's biggest user of magnet wire for its own protection. So, you and every other FORMEX user can have the same peace of mind as to coil performance that we have.

For full information on FORMEX* magnet wire (round and rectangular) ask for our Bulletin GEA-3811. Or, see your G-E representative. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

*Trade-mark reg. U. S. Pat. Off.

FORMEX
MAGNET WIRE

GENERAL ELECTRIC

503-26-1200

They wanted MIDDAY VIEWS ...AT MIDNIGHT!

Night aerial photo of St. Lo in Normandy on D-Day. Taken with the new "super" flash tube.

During the closing stages of the war, many a lone plane, traveling fast at medium altitudes, would roar over enemy territory in the dead of night.

As it winged over certain areas, an intermittent series of blindingly brilliant flashes would dart like lightning from its belly.

Then, the plane would speed away.

Such planes were on photo reconnaissance. Each was equipped with a "super" flash tube a thousandfold brighter than a news photographer's strongest flash bulb. In its split-second bursts of dazzling light, nocturnal troop movements were easily filmed from altitudes as high as 10,000 feet.

How the "Super" Flash Tube Works

The source of light is a 4,000-volt discharge between two electrodes in a coiled quartz tube filled with a rare gas. The outer container is a cylinder of Pyrex.

A single discharge gives plenty of light *...and plenty of heat.* It is this intense heat that has made Inconel the choice for the springs, clips and wire used to support the quartz coil within the Pyrex cylinder.

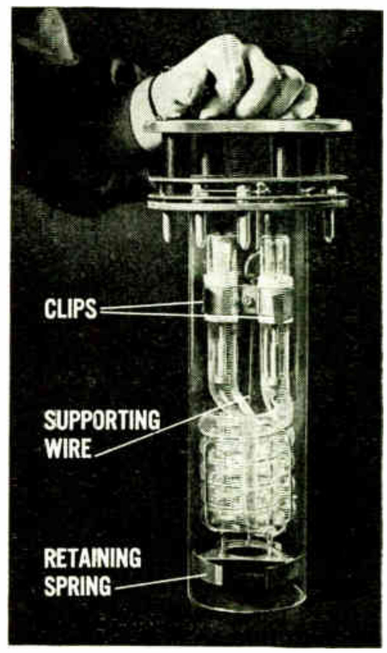
No other metal could stand up under such extreme temperatures. Before Inconel was used, previous supporting metals either lost their springiness or became distorted.

With Inconel on the job, there has been no trouble. This high-Nickel alloy retains its properties at elevated temperatures... doesn't scale away... never rusts.

Thermally durable Inconel is used on many jobs where high heat is a problem. Perhaps in your product, too, you can use Inconel in some form *"to build-in the performance you plan."*

Detailed information on this INCO Nickel Alloy is given in Technical Bulletin T-7, "Engineering Properties of Inconel." For your copy, write:

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.



The "super" repeating flash tube built by General Electric's Lamp Department, Nela Park, Cleveland, Ohio. Arrows indicate the metal supporting parts.

Possible peacetime uses for the flash tube's sudden bolts of sun-like radiance include aerial beacons, marine lighthouses, and scientific photography.

NICKEL INCO ALLOYS

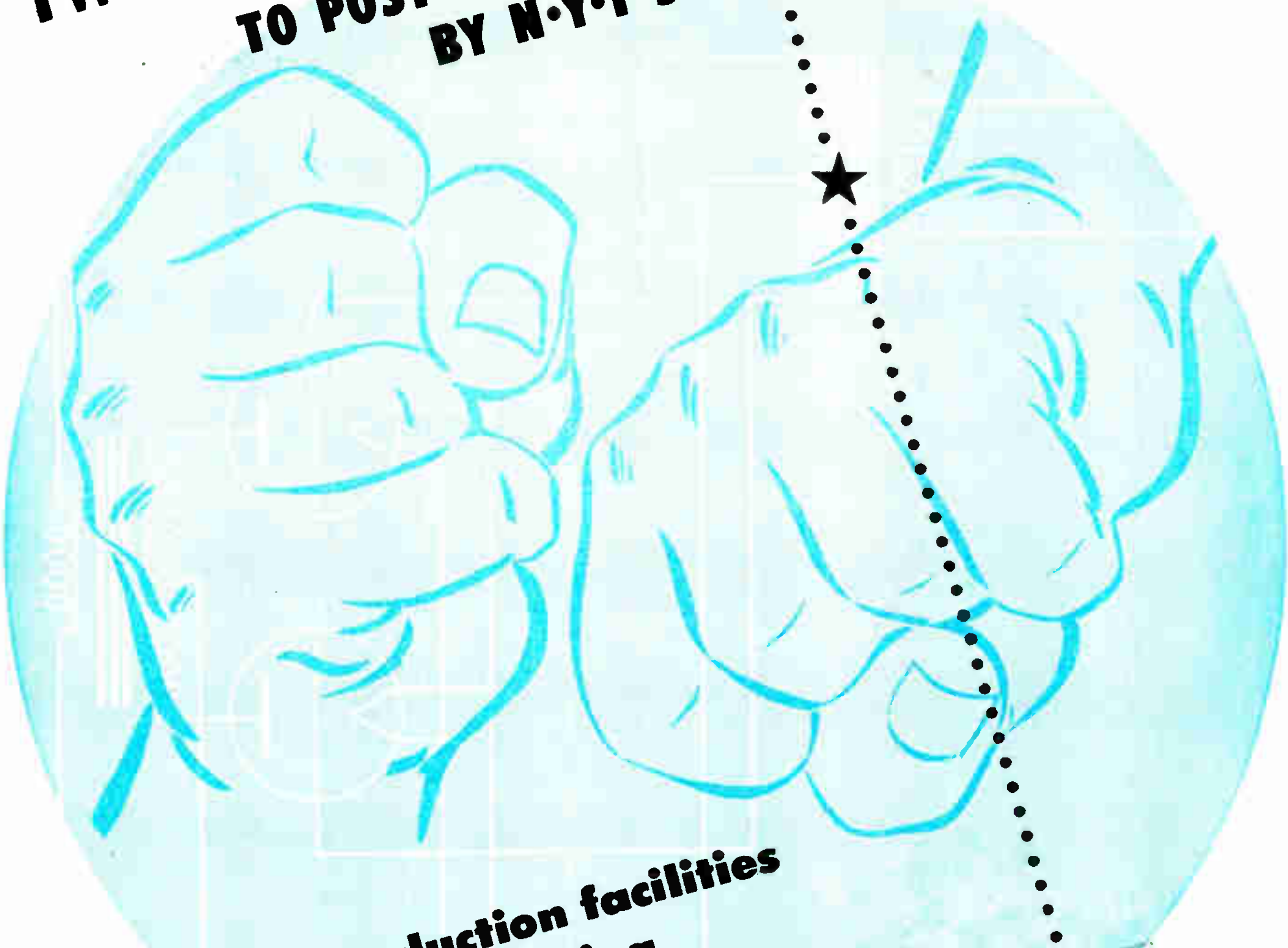
TRADE MARK

MONEL* • "K" MONEL* • "R" MONEL* • "KR" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL* • *Sheet... Strip... Rod... Tubing... Wire... Castings... Welding Rods (Gas and Electric)*

*Reg. U. S. Pat. Off.

Two-fisted solutions...

TO POST-WAR TRANSFORMER PROBLEMS BY N·Y·T SAMPLE DEPARTMENT!



1. Specilized production facilities
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There are two good reasons why N-Y-T facilities "crack" transformer, choke and filter design and production bottlenecks.

ONE: Extensive, modern, single-purpose manufacturing method, geared for economical production under rigid quality-control.

TWO: Experienced specialized-engineering linked to the accelerated tempo of new developments. Engineering capable of effecting economies in design and manufacture.

This is what we mean by "two-fisted" N-Y-T problem solutions — production that follows thru, ever under labor and material shortages; engineering that lowers costs and betters product.

NEW YORK TRANSFORMER CO.

Address inquiries to Dept. N

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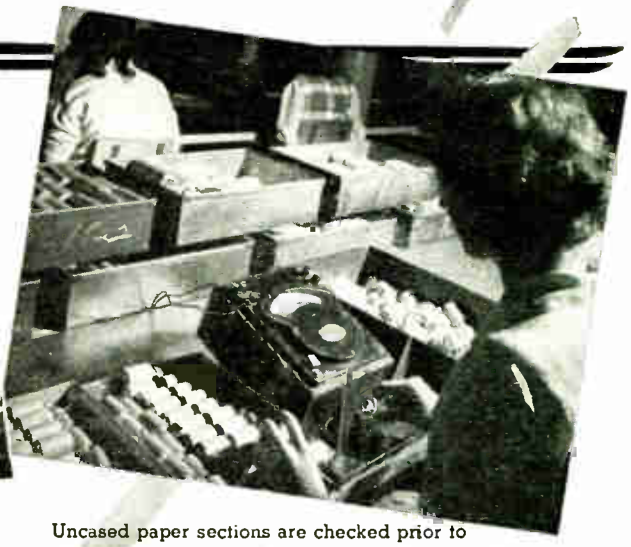
✓✓✓✓ from START to FINISH insures AEROVOX

PAPER-CAPACITOR *Craftsmanship*

To determine suitability of aluminum foil for capacitor use, every lot is tested for thickness, unit weight and electro-chemical characteristics.



Uncased paper sections are checked prior to impregnation. Completed units are tested for capacitance, power factor, insulation resistance, terminal-to-terminal and terminal-to-can, as well as for dielectric strength and tightness of seal.

The porosity of paper dielectric is important. This porosity test is made on each roll of paper.

Production control of impregnating materials. Electrical test is preceded by careful checking of temperature of oils.

● **A paper capacitor can be no better than its several layers of paper dielectric, the quality of the impregnant, and the thoroughness of the impregnation and sealing.**

That is why there are so many routine check-ups in Aerovox paper capacitor production. Paper tissues, metal foils, oils and sealing compounds, are critically checked. Sections are checked before impregnation and casing. Completed units are subjected to a final check-up and inspection.

"Individually-tested" is no idle boast as applied to Aerovox capacitors. It means precisely what it says. And to the capacitor user, it is a guarantee of dependable and long-lasting and economical service for the smallest and cheapest quite as well as the largest and costliest of types that bear the Aerovox label.

● ***Write for engineering literature. Submit your capacitance problems.***

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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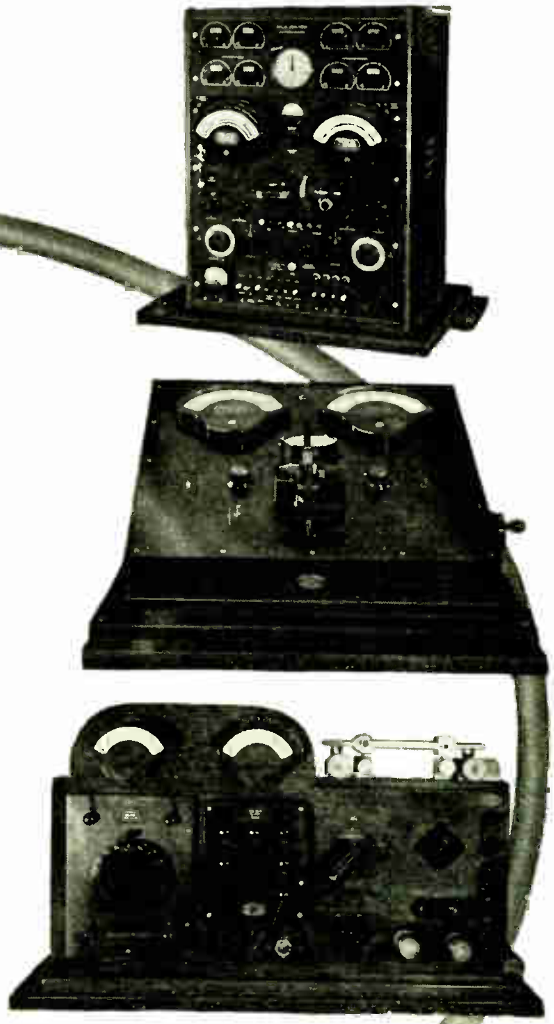
Start RIGHT AND YOU End RIGHT!



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
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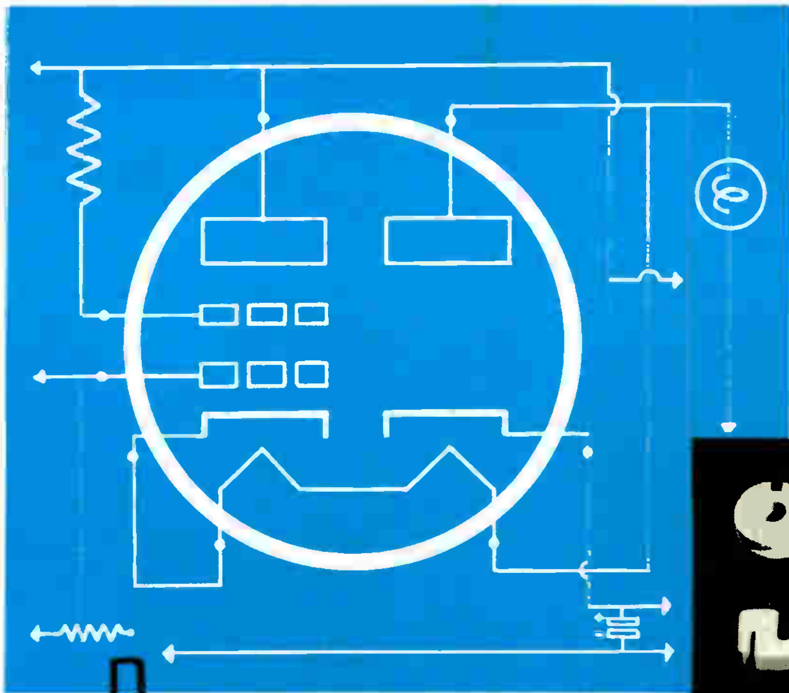
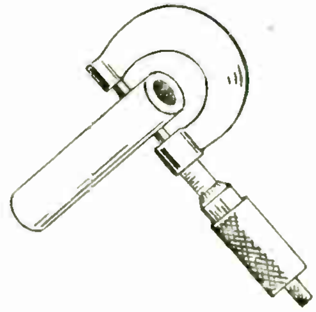
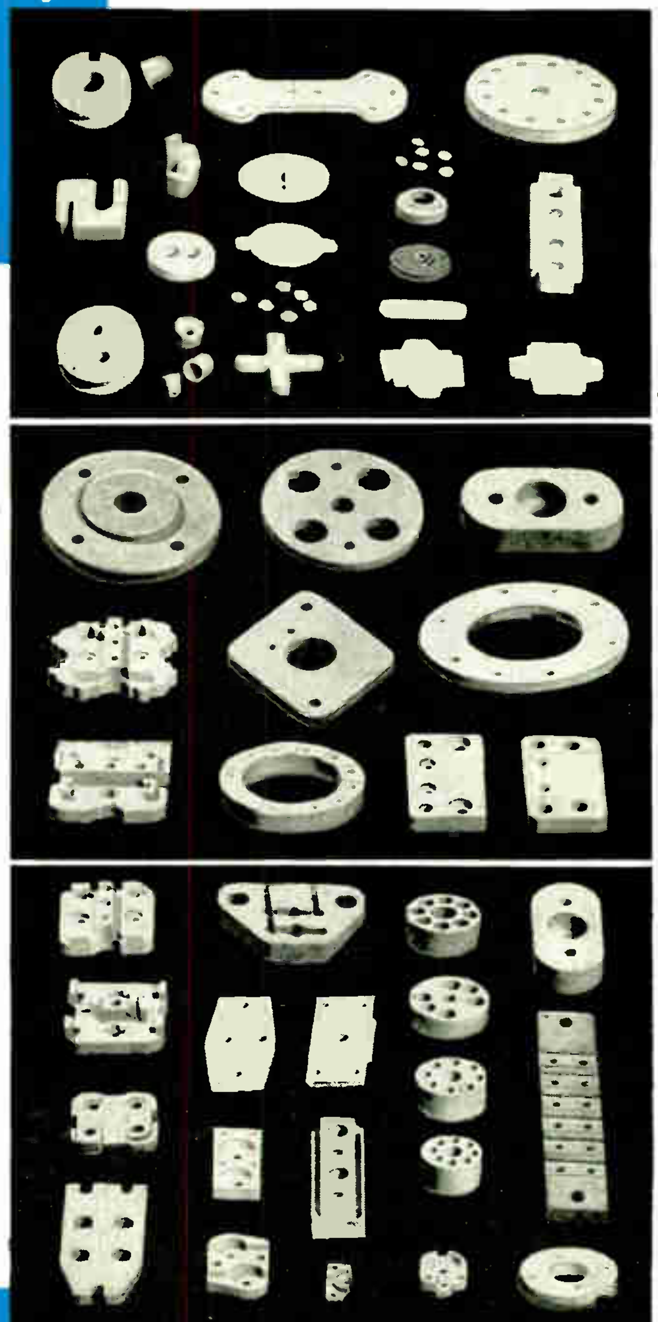




Precision quality control makes

STUPAKOFF CERAMICS

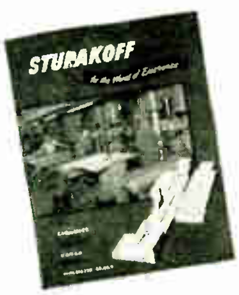
....your best choice



Stupakoff quality control means . . .

1. Strict adherence to your specifications—
2. Uniform, dimensionally-accurate ceramic insulators that minimize production losses—
3. Maximum mechanical strength—
4. Maximum electrical protection.

These advantages of Stupakoff Ceramics are gained through carefully selected and laboratory controlled materials . . . competent engineering, backed by years of experience and research . . . plus modern manufacturing facilities and constant inspection. For the finest ceramic insulators...specify Stupakoff.

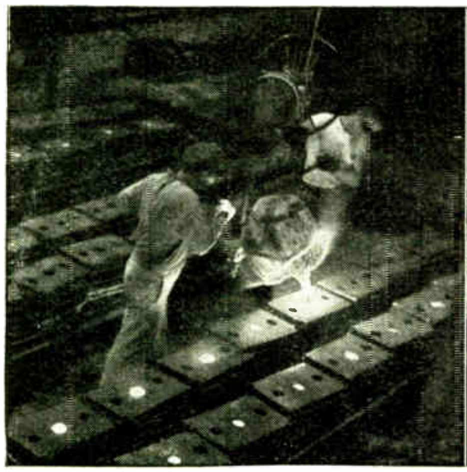


Write for Bulletin 245 describing Stupakoff Ceramic Products and Hermetic Seals.

STUPAKOFF CERAMIC and MANUFACTURING CO.

LATROBE, PENNSYLVANIA

PERMANENT MAGNETS MAY DO IT BETTER



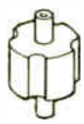
Perfection in a Permanent Magnet Foundry

All melting of permanent magnet materials at *The Indiana Steel Products Company* is done in a battery of coreless induction furnaces to avoid any contamination of the pure metals.

For each furnace charge the materials are weighed individually on an automatic scale, which prints the weight of each constituent on an individual heat record, copies of which accompany the castings from each heat to the laboratory, production departments and permanent file. Chemical analyses and tests for magnetic characteristics are conducted in our chemical and magnetic laboratories to insure uniform high quality.

The perfection of permanent magnets has been our specialty for over 35 years. Manufacturers having problems in the use and application of permanent magnets are invited to consult our engineers. For information on permanent magnet application, design and materials, write for new technical "Permanent Magnet Manual" prepared by *The Indiana Steel Products Company*.

Permanent Magnets May Do It Better



An Alnico Tachometer Magnet

THE INDIANA STEEL PRODUCTS COMPANY

6 NORTH MICHIGAN AVENUE, CHICAGO, 2 ILLINOIS

SPECIALISTS IN PERMANENT MAGNETS SINCE 1910

DOING ONE THING WELL

Thirty-six years ago, in one small plant, we set out to do just one job—and do it well. Today, in six large plants—we're still at it—doing one thing well.

We like to feel that it is for this reason that more engineers specify C-D Capacitors. And for this reason too, that there are more C-D's in use today, than any other make.

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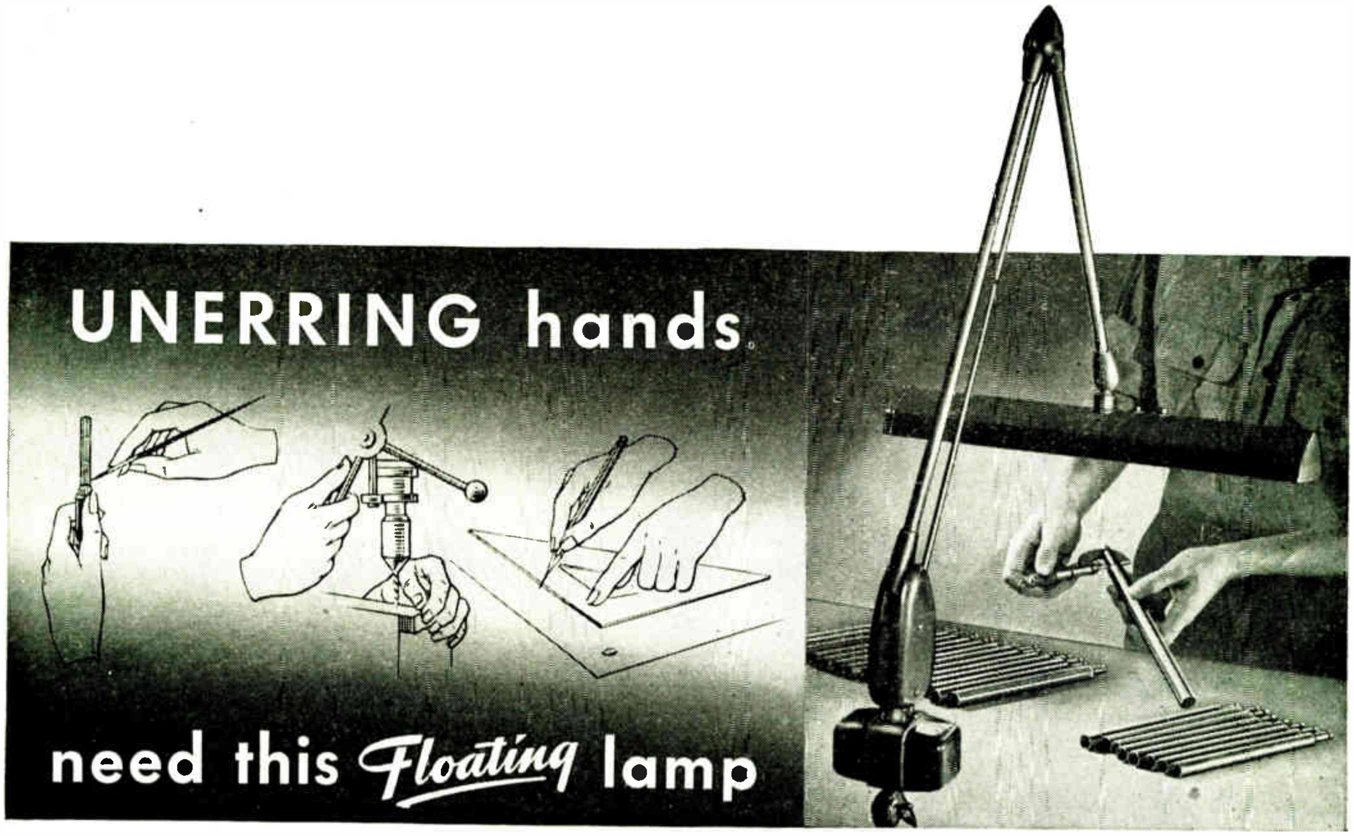

Precision engineering and manufacture call for unerring hands. But hands, unfortunately, can do well only what the eyes see clearly.

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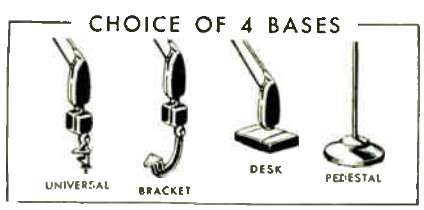

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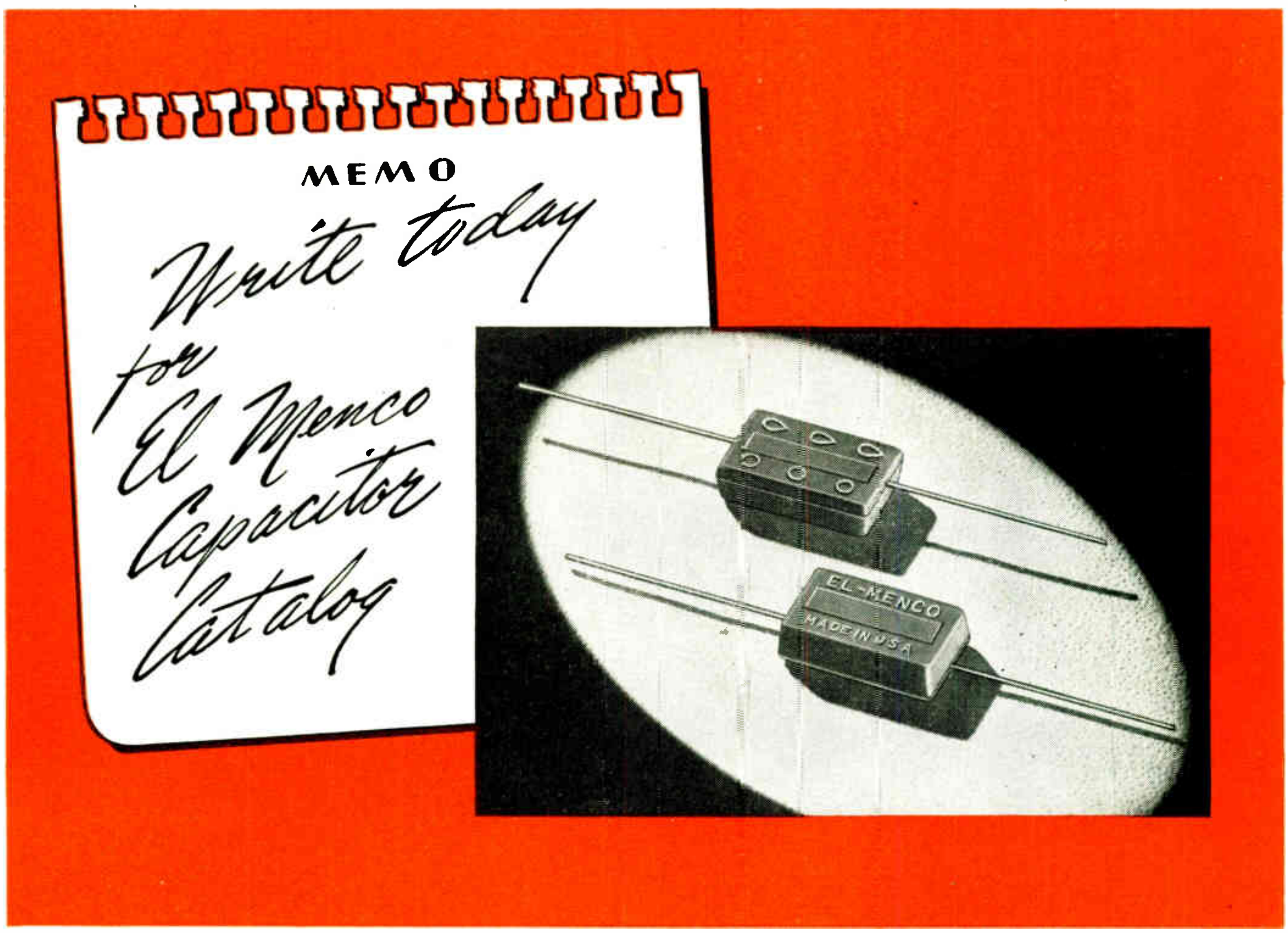

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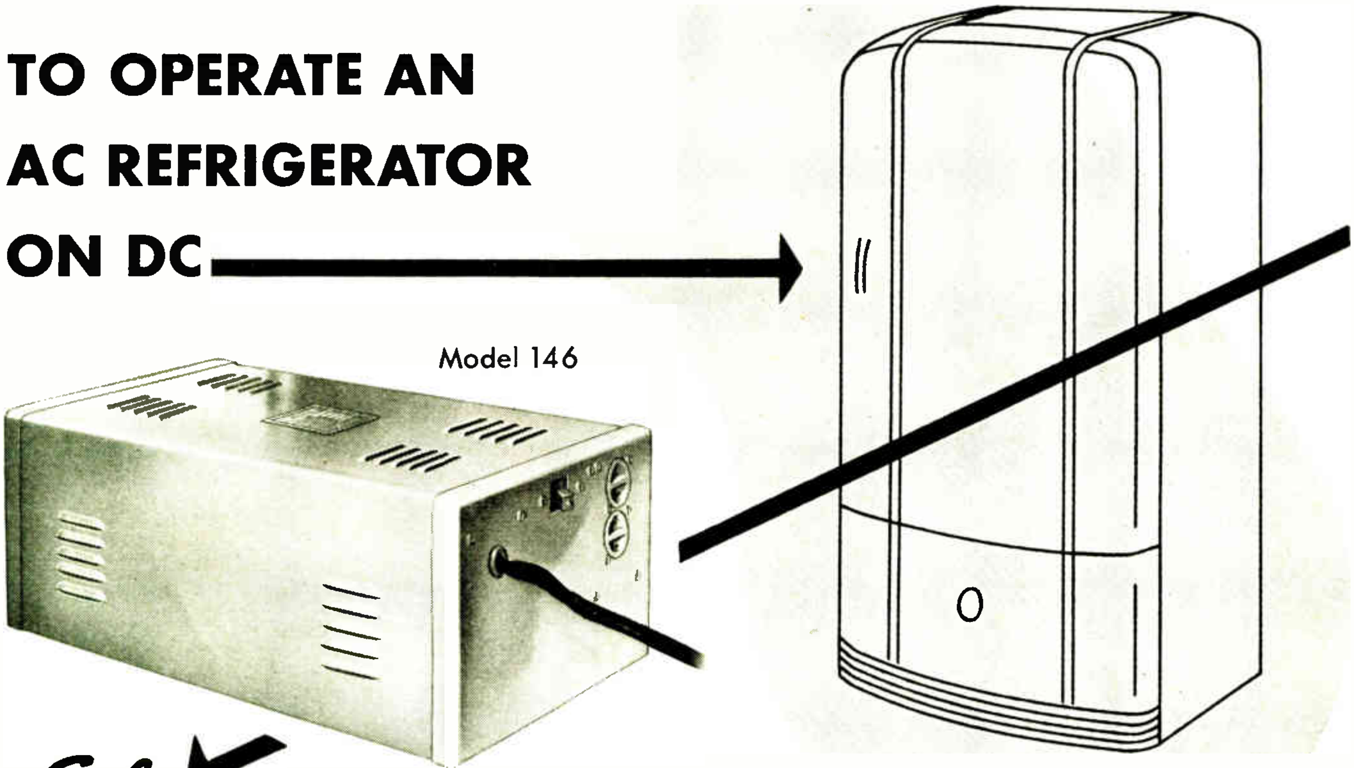

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507	12	115	150	80-100	10¾x7½x8¼	25	Radio Receivers, Transmitters, Appliances
146	32	115	350	80-100	16x10x8⅜	48	Receivers, Transmitters, Coin Phonographs
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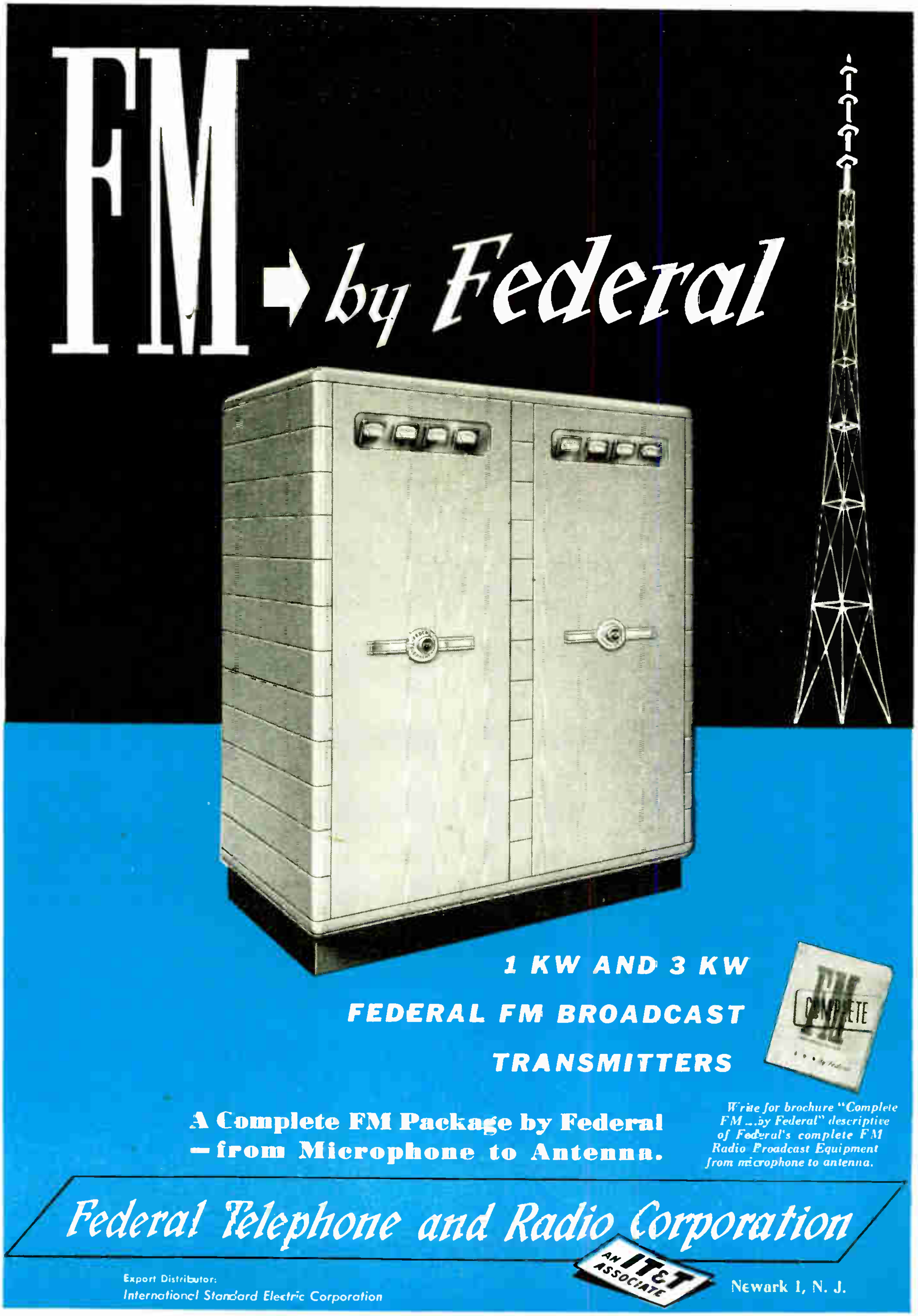
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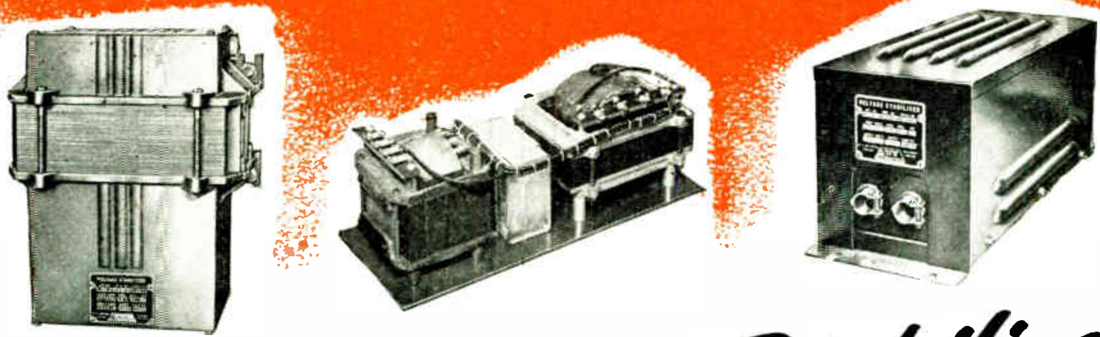

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G-E mycalex proved to be an excellent insulating material to meet exacting requirements of dimensional stability . . . rigidity . . . high-frequency insulation.

You, too, may find that molding G-E mycalex to your design will solve an insulation problem of yours. G-E mycalex is also available in standard sheets and rods. Write to Section T-7, Plastics Divisions, General Electric Company, 1 Plastics Avenue, Pittsfield, Mass.

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President

Atchison, Topeka and Santa Fe Railway

AM or FM? Which to use on railroad radio? This question has long troubled engineers in both the railroad and the radio fields.

To determine the comparative operating characteristics of AM and FM radio equipment, The Atchison, Topeka and Santa Fe Railway, in conjunction with the Farnsworth Television & Radio Corporation, recently conducted an exhaustive series of tests.

As a result, railway men the nation over have for the first time a thorough evaluation of both types of modulation for railroad service. Of equal importance is the fact that the information derived now enables Farnsworth to design better railroad radio equipment. Efficiency will be increased; the way has been opened to reductions in purchase price and maintenance cost.

Such tests add one more milestone to the development of railroad communications. The engineers of Farnsworth's Mobile Communications Division have pioneered many other important achievements. Backed by Farnsworth's ample production facilities, these engineers are now prepared to offer practical radio assistance to all the railroads of America.

The Farnsworth Television & Radio Corporation, Dept. EI-2 Ft. Wayne 1, Indiana.

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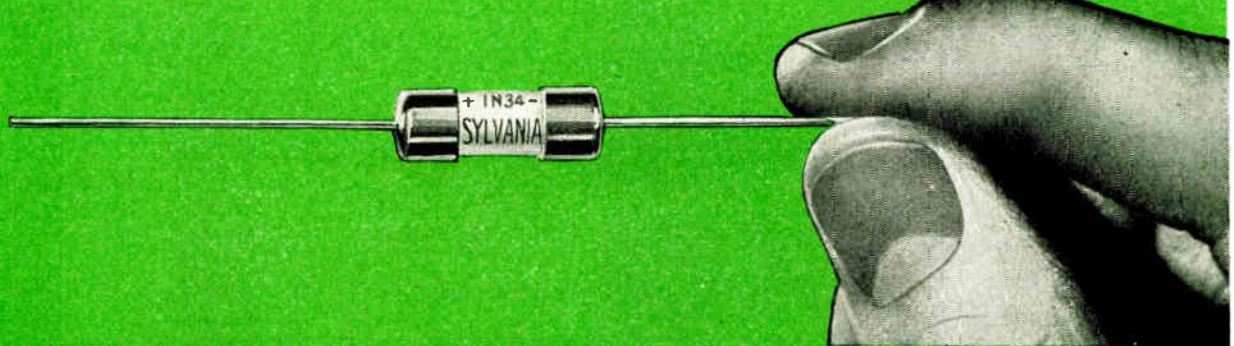
HERE'S A NEW CIRCUIT ELEMENT

that displays non-ohmic characteristics



Tentative Characteristics of the 1N34

Peak Inverse Anode Voltage	50 volts
Average Anode Current	0-22.5 ma.
Peak Anode Current	60 ma. max.
Surge Current	200 ma. max.
Back Conduction at 50 volts	2 ma. max.

(Surge current refers to transient values; peak current refers to the maximum value of an applied AC signal.)

IMAGINE a circuit element that *violates* Ohm's Law. One that exhibits *polarized* non-linear current-voltage characteristics.

Such an element has now been made commercially available for the first time . . . Sylvania Electric's 1N34 G_x metal Crystal Diode. This tiny unit (shown full size in illustration) opens up many interesting potentialities in circuit design. Withstanding relatively high voltages, it is extremely useful as a circuit element.

Light in weight and equipped with pigtail leads, it is conveniently soldered into place . . . no sockets required. No heater supplies are needed — eliminating hum and noise, permitting both terminals to be connected far above ground potential.

The 1N34 Diode gives superior performance at high frequencies and with low values of load resistance.

Where Can You Use an Element Like This?

Among the expected applications of the 1N34 Diode are: DC restorors in television receivers; frequency discriminators in FM sets; peak limiters; video detectors; meter rectifiers; bias rectifiers; modulators and demodulators.

Perhaps *you* can see many other ways in which you can put this revolutionary circuit element to work. We'll be glad to send you further technical information to assist you in planning applications, and to discuss specific uses with you.

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The Menace of "Power"

For most of the reception difficulties in radio—whether AM, FM, or television—transmitter power is the effective cure.

Yet "power" has always been a fearsome word in Washington. There the official attitude invariably holds to keeping power down, rather than letting stations increase their kw output to the limits which will insure good reception and best service to the public. Instead of regarding power increase as a merit, as something distinctly in the public interest,—radio power (along the Potomac, at least) is viewed as a kind of vice or plague to be held in check or resolutely slapped down!

Technical Gobbledegook!

Most of the official alarm about "power", we suspect, comes from our own lamented engineering use of this 5-letter word which (as engineers sometimes overlook) also has sinister political implications. If radio engineers from the beginning had only wiped the word "power" from their vocabularies when in Washington,—talking instead about "500 kilowatts" or "100 kilowatts", or even citing received field-strengths in terms of "microvolts per meter", the confused politicians would never have interposed any objection to letting engineers have what they wanted.

Something They Understood—and Feared

But when the engineers thoughtlessly lugged in the simple, understandable, one-syllable term "power", the political mind at last had a gleam of understanding—and fear!

And ever since, radio power has been something to be throttled and checked, instead of used and increased in the true public interest.

Yet high power at the transmitter is still the best insurance of good reception. at lowest cost, at the customer's receiver,—whether AM, FM or TV!

Mass Production

Rapid automatic output has always been the aim of manufacturing executives. Electronic methods fit well into such continuous processes, although tubes have not been used as much as might be expected. But the possibilities of automatic electronic production are shown by a new brazing unit using induction heating, soon to appear. Parts are poured in its hoppers twice a day; and twice a day cans of the finished joints are tucked away, ready for the next operation—each finished part exactly alike. We note this here not because this new equipment with its automatic features, is revolutionary, but because it is a logical combination of good electronic engineering and sound mechanical development.

Also it is a signpost that the industrial electronic field is going to have a place for small flexible engineering design groups who can develop equipment for highly specialized applications and also for mass production.

Market for New Ideas

A number of radio manufacturers are now busily engaged in trying to find products they can make in their idle plants. This is a nice idea but unfortunately it suffers from too much competition.

We think the best way to solve the idle plant problem is by new product development. New applications of known electronic art for public, commercial and industrial consumption. must be found and marketed. Original advances should be exploited! The engineering brains in the country have been enriched, not consumed by the many miraculous war inventions. The nation is in a buying mood. Let us bring the trained intellects to market. That is the road to business building!

Electronic Anticipation

The war has buried the old bugaboo about fragility and short life of electronic tubes. For tubes have been used by the millions under conditions thousands of times more strenuous than those in industry. Tubes today have no more glamour than a circuit fuse or a battery. Concerns that used to point with pride to a circuit with a photo-tube in it or a one-stage amplifier, will now have to compete with complete electronic systems that will combine effects of all kinds, compute the required control variation needed and then initiate the corrective factor instantly. Process lags will be reduced in many places, with a resulting improvement in the product, because of closer limits. This will be done largely by anticipating what will happen to the process by changes in flow, temperature, demand, etc., actuating complementary changes elsewhere. It will no longer be necessary to wait for these changes to show up in the output before making a correction.

In This Issue—UHF BLIND-LANDING SYSTEM—Page 60

MICROWAVE INSTRUMENT

Two beams, independently modulated, alternately turned on and off at 60 times per second, prevents interference

● The important advantages of microwaves in producing sharply defined beams and in permitting the concentration of nearly all available radiation energy in exactly the desired space regions have been applied to a new instrument landing system.

The general principle of operation is the same as originated by Diamond and Dunmore of the Bureau of Standards in 1928 and successfully applied at much lower frequencies.* Briefly a glide path is established in space at a glide angle of about 2.5 deg. by the plane of intersection of two beams of energy. These beams both originate at the same spot close to the landing runway and one is directed upward at a slightly greater angle than the other. In the new system developed by engineers of the Sperry Gyroscope Co., the two beams are identical and the lower edge of the bottom beam is ½ deg. above ground at the half power point while the upper edge is 3 deg. higher. The beam center lines being 2 deg. apart, the plane of intersection is 2½ deg. above level ground.

Position in azimuth is determined by a similar beam intersection. This one, called the localizer beam, is produced in a vertical instead of a nearly horizontal plane.

The intersecting beams are audio modulated, in the glide path, the lower being sine wave modulated 70% at 600 cycles and the upper at 900 cycles. The same scheme is used for the right and left beams of the localizer. At the receiver, preponderance of 900 cycle signal causes

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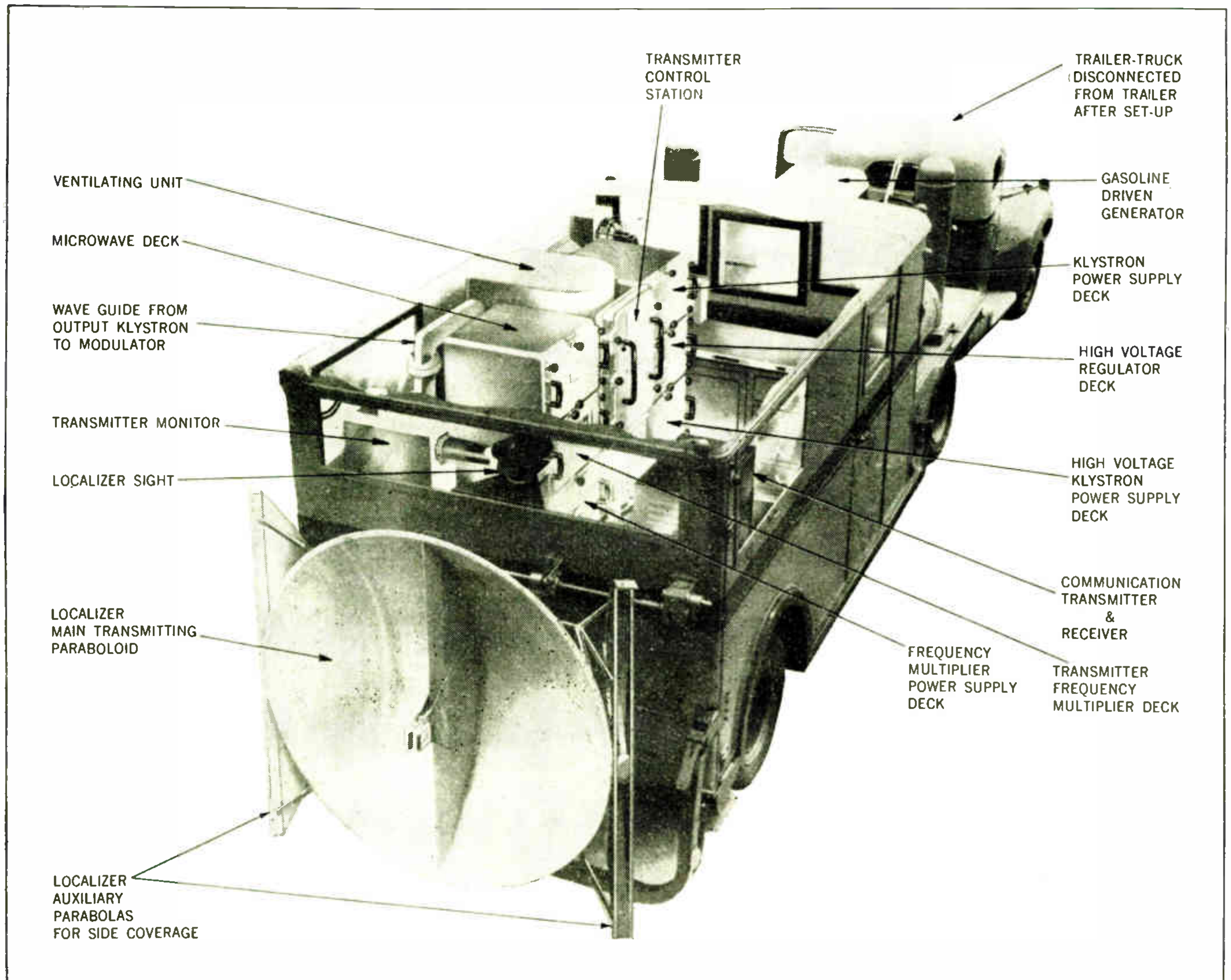
*Latest type AAF Blind Landing Equipment, M. E. Montgomery, Federal Telephone & Radio Corp., Electronic Industries, Jan. 1945, pp. 100.

Phantom view of localizer trailer showing the disposition of equipment and the radiating surfaces, the paraboloid and the half-cheeses



BLIND LANDING SYSTEM

the needle on a pointer to move to one side, while a stronger 600 cycle signal has the opposite effect.

The pilot, watching a two-movement meter, flies his plane so as to bring the center of the meter toward the interesections of the two pointers. These are at right angles to each other, one being associated with glide path signals and the other with localizer signals. The meter used is different from that in general use as the needles are mutually perpendicular regardless of the signals applied. In the common meters this condition exists only when "on course", and as a result erroneous interpretations of the indications can be made.

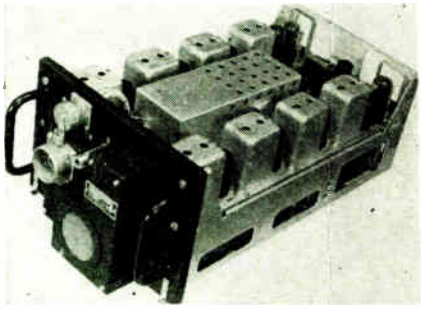
The glide path is established by 2617 mc radiations from a half-cheese antenna mounted on the back of a special mobile trailer. The high frequency energy is fed to the antenna by a pair of wave guides terminating at the focus of the parabolas. Only one parabola is used in the glide path. Two beams are formed because two points of introduction of energy are used.

Thence the radiation irrigates the reflecting surface which forms it into beams of the desired shapes.

The parabola being many wavelengths long in the vertical plane forms a sharp beam with the slight vertical thickness of 2.2 deg. In the horizontal plane however the reflector mouth shape is such as to produce a very broad beam.

It should be noted that the two wave guide openings feeding the antenna are respectively immediately above and below the parabolic focus. The effect of such a displacement of the radiation source is familiar to every automobile driver who has a low and a high headlight beam at his command. It is this displacement

Compact receiver installed in plane



The recently developed Sperry microwave instrument landing system operates at a wavelength about 11½ cm and gives extremely sharp and well-defined beams both in the horizontal and vertical planes. The scheme used is to produce an intersection of radiated energy in two planes at right angles to each other and to have a meter in the airplane which indicates position to right or left, above or below the track.

which is used to produce the upper and lower beams.

Modulator

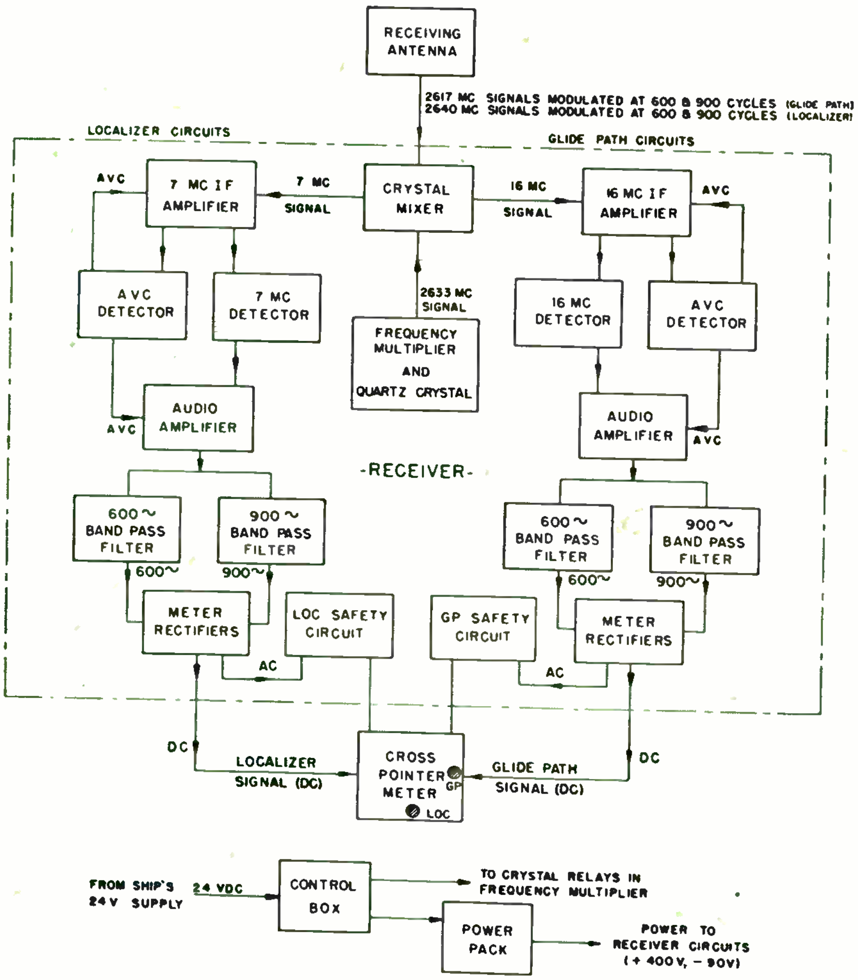
A feature of this system is that the upper and lower beams are turned on and off alternately 60 times per sec. to prevent any interference patterns between the two. This is accomplished in the modulator which is a purely mechanical device.

Energy in the transmitter output wave guide is split into two parts. Immediately beyond the split each guide is cut and the edge of a motor-driven metal disk passes through the cut. The disk is slotted and when the slots appear in the cut, energy is radiated. At other times it is interrupted. The slot width determines the modulation frequency (600 or 900 cps) and the slots are disposed so that the upper and lower wave guides are excited alternately. The shape of the slots is such as to produce sine wave modulations.

To prevent leakage at the cuts in the guides and in fact at all guide connections, flanges are mounted on the guides. These have an annular slot whose depth is ¼ of a wavelength. This slot, called a choke in wave guide practice, presents infinite impedance to the radial flow of surface currents across it and hence effectively stops energy leakage.

The glide path antenna is fixed

View of rear of glide path trailer showing half-cheese antenna fed by wave guides



Block diagram showing the general arrangement of the circuits in the receiving set

to the body of the trailer, but the latter is adjustable to provide a change of glide path angle up to 4 deg. by means of screwjacks. The trailer is a self-powered unit containing its own generator and all equipment required to produce the ultra high frequency energy.

The localizer is also housed in its own self-powered trailer. In this trailer, in view of the importance of having the beam coincide exactly with the centerline of the runway, an optical sighting telescope is provided. This telescope is accurately aligned with the electrical course and is used in installation of the equipment. Also a traversing screw is provided whereby the whole trailer can be rotated slightly in azimuth for final precise adjustment.

In this case the rf energy is split into four parts which are turned on and modulated seriatim by the same method as the glide path beams. As may be seen in the illustration, the paraboloid is partitioned down the center and each half is wave guide fed, the guides passing out through the thickness of the partition and then making 180 deg. turns so as to direct their openings toward the reflecting surfaces.

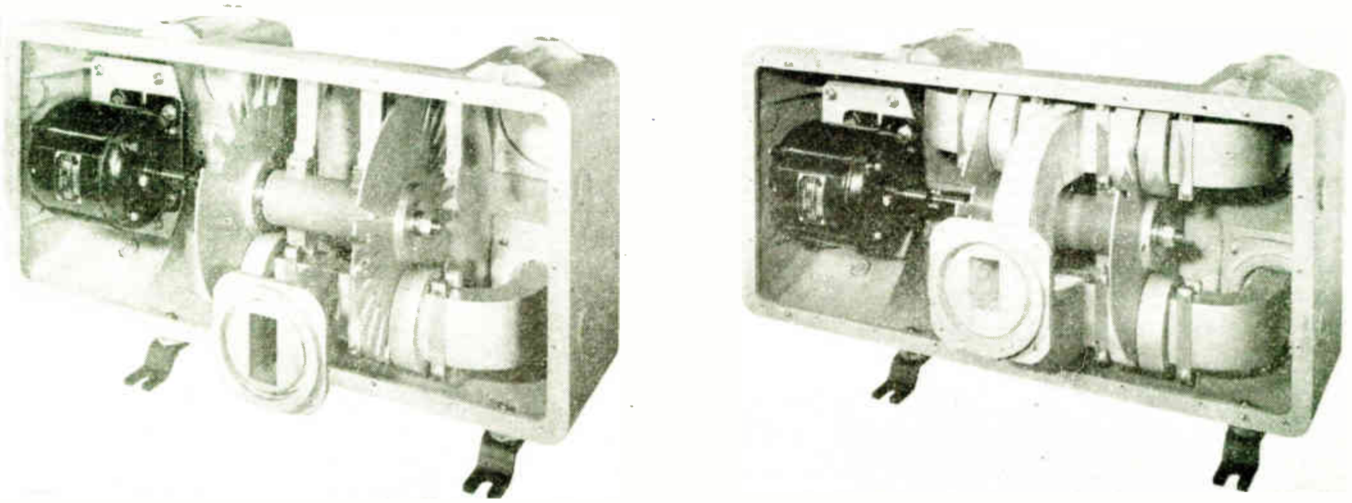
The two separate half-cheese antennas at the sides produce wide side beams whose function is to provide an energy field to catch planes seriously off course. This gives a 180 deg. coverage out to 20 miles (40 deg. to 50 miles).

The localizer frequency is 23 mc higher than that of the glide path, being 2640 mc. As a consequence there are no interference problems between the two. In cases where there are nearby airports, the system provides frequencies for them called B and C frequencies which are ½ mc lower than the standard glide path and localizer frequencies.

As the plane approaches a landing the angular width of the beams producing maximum deflection on the meter pointers is so slight (glide path ± 0.3 deg., localizer ± 1½deg.) that the flier would have difficulty in preventing the pointer from flopping suddenly from top to bottom or right to left. To make it easier for the pilot, the sensitivity of the meter response is halved gradually as the beam signals build up to high intensity, thus "softening" the course.

Noteworthy is the heavy cast

Mechanical modulators used to apply 600 and 900 cycle tones to the carriers. Left is for the glide path, right for the localizer beams

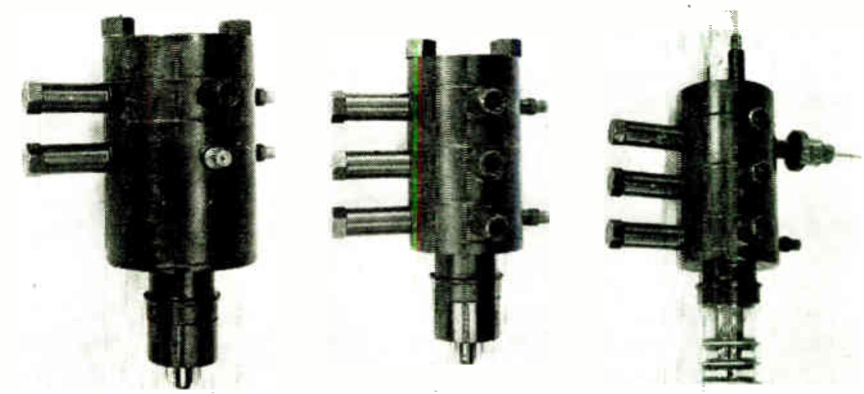


Antenna structure mounted on airplane

"marine" type of construction used in housing the transmitter chassis. Reasons are durability and prevention of rf leakage—a matter of extreme importance in this type of work. The chassis slide in and out on file drawer type roller slides, and the entire chassis, when extended, can be pivoted for easy bottom access.

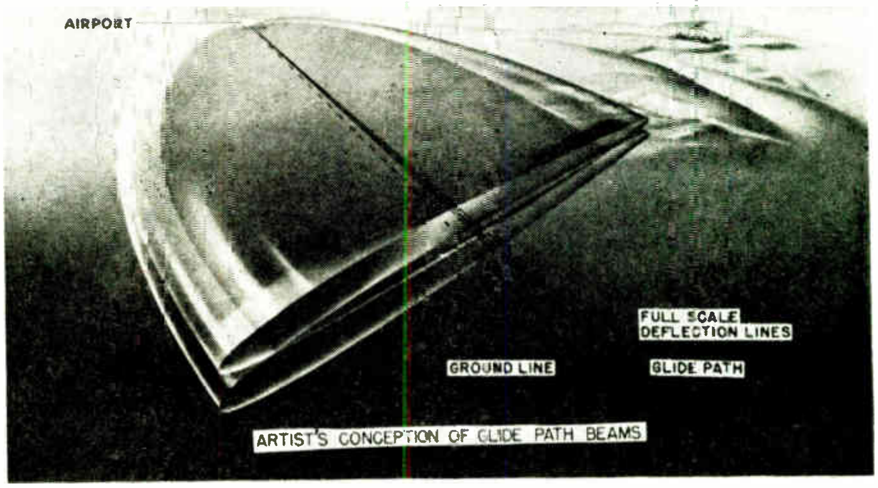
Heart of the transmitter is the crystal maintained in a temperature controlled oven. The "A" frequency crystal resonates at 4,846.296 kc. and controls a 6SG7 oscillator. This is followed by a 1614 buffer stage. Then the frequency is raised to 10 mc in a T-21 doubler, to 30 mc in a T-21 tripler and to 90 mc in a push-pull tripler using an 829 tube. A third tripling to 270 mc in a push-pull stage having a pair of 826 tubes provides energy to feed a klystron multiplier in the microwave deck. For operational supervision and trouble tracing, meters are provided together with multipoint switches.

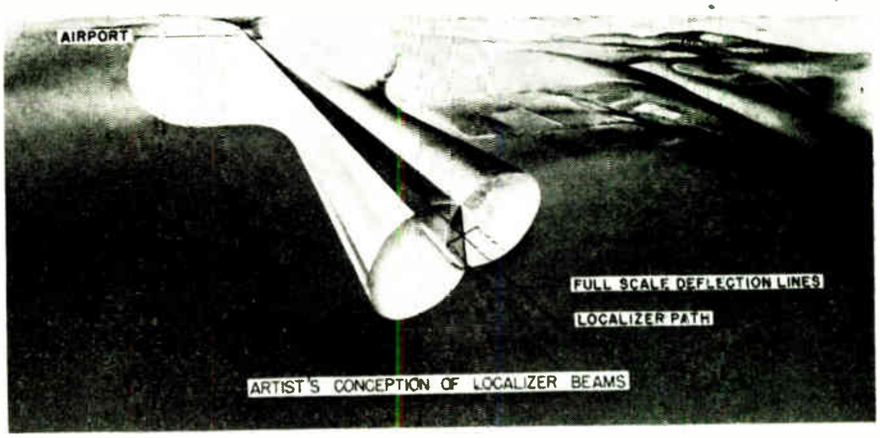
In the microwave deck there are three liquid cooled klystrons. The first one, Type XE 8531, raises the frequency exactly 10 times, while the second, an X2F8534, amplifies the carrier to about 2 watts, and the third power cascade amplifier Type X2F8529 raises the power to an output level of about 70 watts. The output X2F8529 couples directly into the output wave guide

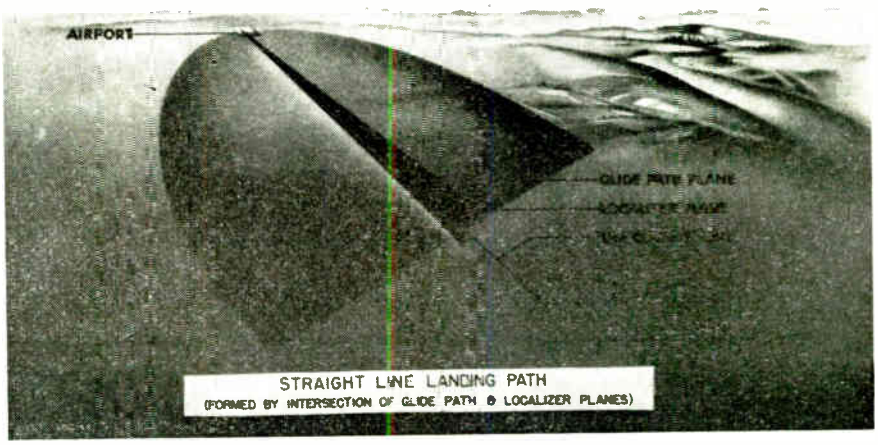


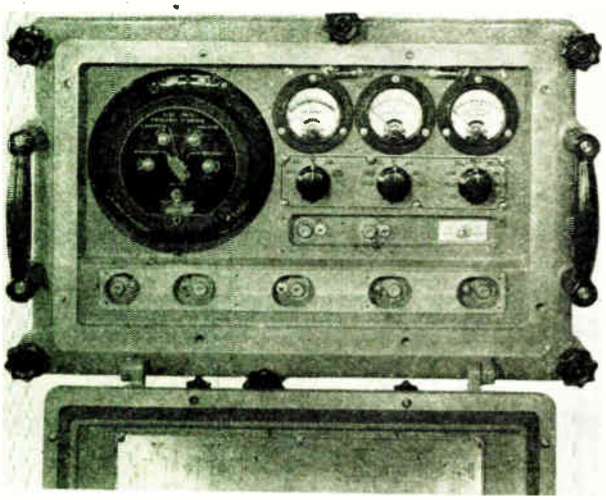
Klystron multipliers and amplifiers used in the microwave instrument landing system

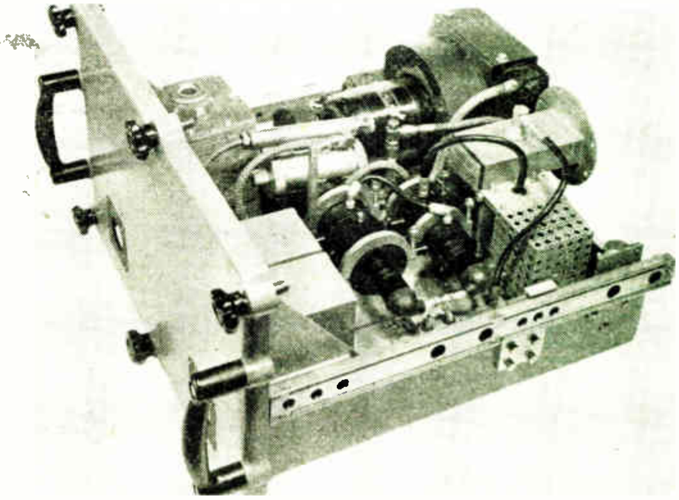
Drawings showing the glide path and localizer beams as they would appear in space









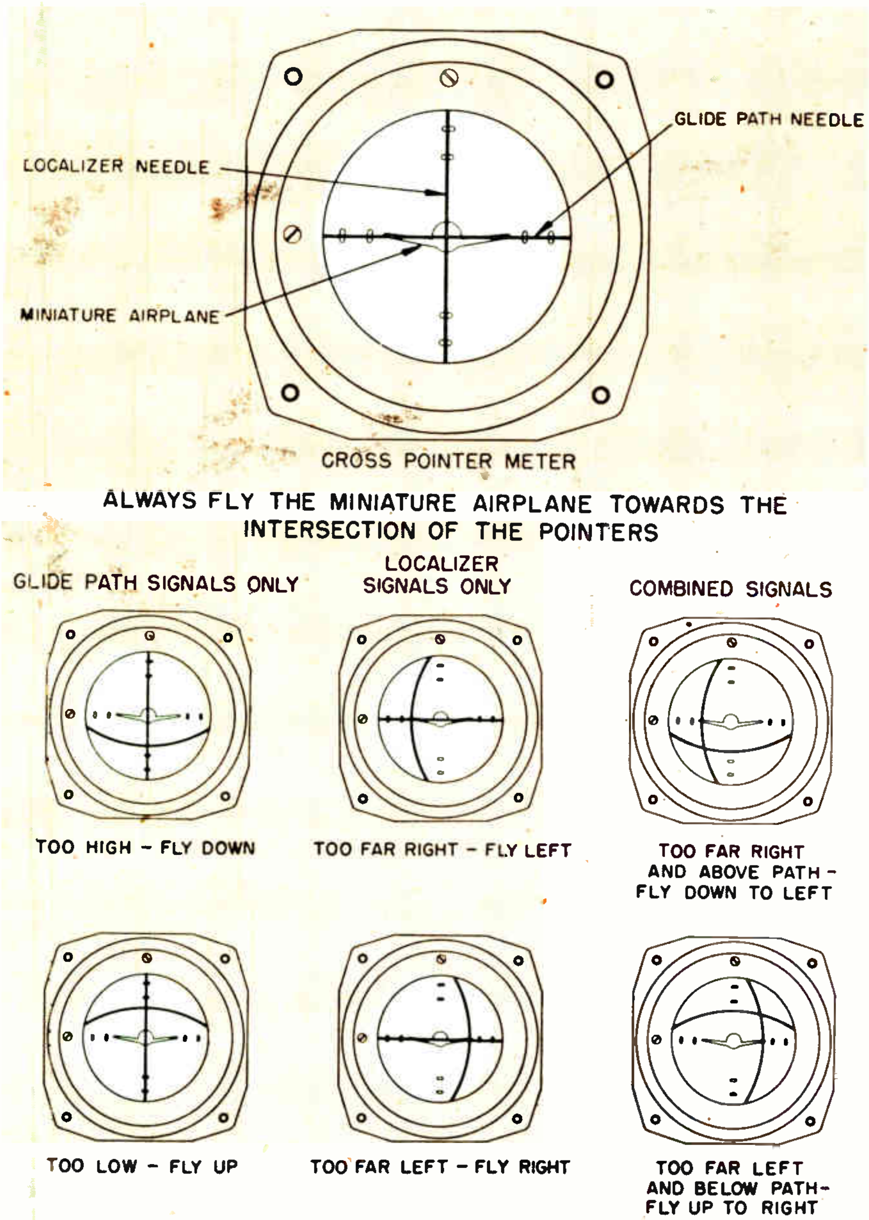


Oscillator deck (left) showing crystal oven and microwave deck at right

whence the energy is piped by rectangular tubing to the mechanical modulator described previously.

The generating equipment is identical for the glide path and localizer. Operation is completely automatic, one button starting the ac gasoline driven generator and a bat handle switch the transmitter.

Indications observed by pilot. Due to their design, needles are always at right angles



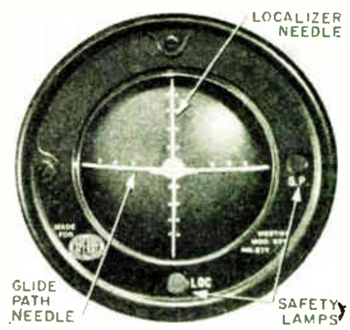
A 2K46/416 klystron multiplier is the last tube in a crystal controlled multiplier chain which serves as a local oscillator in the airplane receiver. This provides 2633 mc which combined with the transmitted signals in a crystal mixer delivers 7 mc intermediate frequency to the localizer and 16 mc to the glide path circuits.

The rest of the circuit is clearly shown in the appended block diagram. The pilot has no adjustments to make and for operation needs only to turn the receiving equipment "on" and to select the proper channel depending on the transmitting channel at the desired airport. Neon bulbs are connected to each of the meter circuits and glow when the set is functioning. Any failure in transmitting or receiving causes the bulb to go out giving warning to the pilot.

The reception antenna is a triple triple dipole in a streamlined housing on top of the plane. It has a 6 db gain over a plain dipole. The aircraft equipment has a total

(*Continued on page* 136)

Face of course indicator in airplane



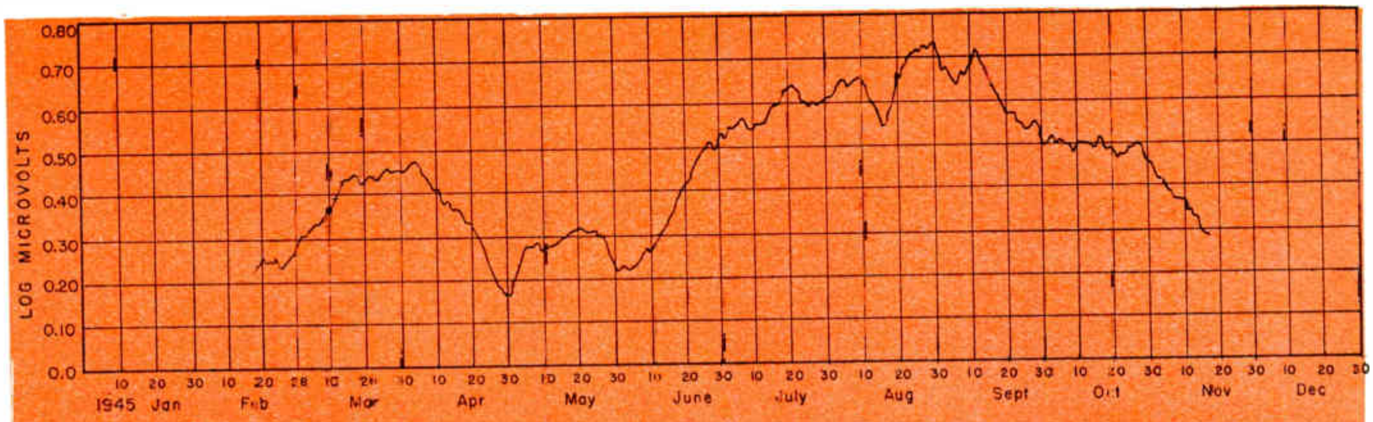


Chart showing field intensities measured and recorded at Cosmic Research Laboratory, Needham, Mass., of transmissions from FM station W2XMN

PROPAGATION EFFECTS

Scientists report on ionospheric and tropospheric transmissions and their relation to reception of FM broadcasts

● The relative merit of FM transmission on the 40-50 mc band and the 90-100 mc band was one of the topics discussed at a conference on the ionosphere and radio wave propagation held at the Cosmic Terrestrial Research Laboratory at Needham, Mass., on December 11th. Evidence was presented to indicate that the new allocations may prove less satisfactory from the listener's point of view than the 40-50 mc band now destined to become obsolete.

The conference was called by Dr. Harlan True Stetson, Director of the Laboratory, a member of M.I.T.'s staff of researchers and also Chairman of the Special Committee on Cosmic Terrestrial Relations of the American Geophysical Union, under the National Research Council. The purpose of the meeting was to bring together experts from universities, communication companies, radio industries, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the National Bureau of Standards, and the Federal Communications Commission for an informal discussion of cosmic effects influencing radio wave propogation. Among those participating in the discussions were: Major E. H. Armstrong, Dr. H. H. Beverage, C. F. Brooks, C. W. Carnahan, P. A. deMars, H. B. Marvin, F. A. V. Meinesz, H. R. Mimno, Dr. G. W. Pickard, V. Regener, Dr. H. T. Stetson, J. A. Stratton, O. G. Villard, H. W. Wells, G. Worsley, and others. Dr. Meinesz, noted Dutch geophysicist, represented the interests of his government in an "all out" post-war program for the development of the sciences in the Netherlands.

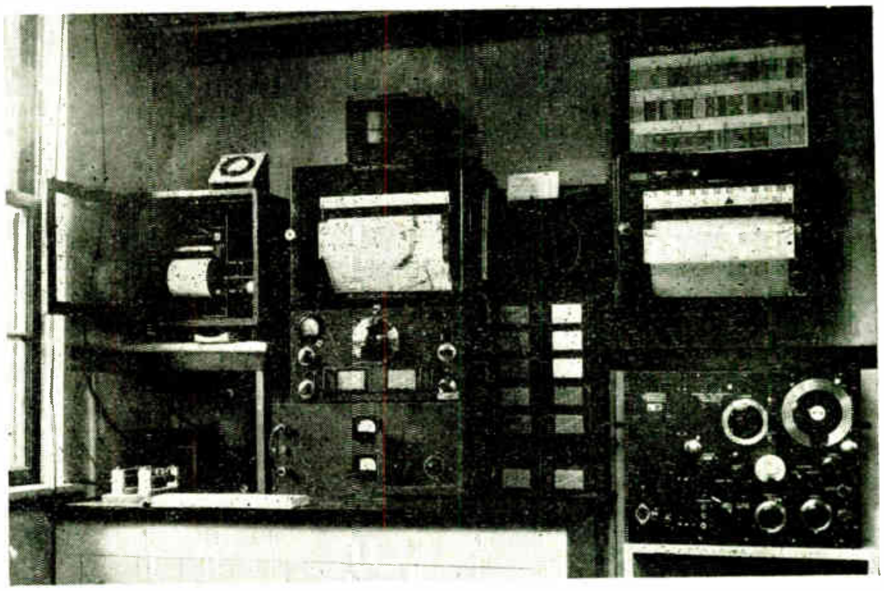
The topics for discussion, which was informal, were grouped into two general classifications, ionospheric transmission gaining attention for the morning session, while tropospheric or short wave transmission beyond the line of sight occupied the program in the afternoon. Those attending were guests of the Laboratory at luncheon.

Cosmic factors in the ionization of the atmosphere, from sunspots to meteors, introduced the morning session. The importance of the relationship between critical frequencies and the sunspot curve is well recognized in predicting wavelengths in world-wide communications. The importance of field intensity measurements made over a long period of time as a test of performance and a check on the success of predictions was made evident from exhibits presented.

The attenuation factor in long distance communications is a function of both ionic density at the reflection layer and the integrated ionization throughout the wave

(*Continued on page 140*)

One of the field intensity recording equipments at the Cosmic Terrestrial Research Laboratory of the Massachusetts Institute of Technology used in making the measurements recorded above



POWER MEASUREMENTS

By D. L. WAIDELICH
Naval Ordnance Laboratory
Navy Yard, Washington, D. C.

Development of two simple laboratory methods for the measurement of audio frequency power

● Power may be measured at audio frequencies by means of uncompensated commercial wattmeters within the limits of 15 to 133 cycles per second; compensated wattmeters may be obtained now that are usable in the frequency range of 25 to 3000 cycles per second. Below 15 cps and above 3000 cps, there are no commercial wattmeters available, and it is the purpose of this paper to describe two methods of measuring power that are usable down to 1 cps and up to at least 20 kilocycles per second.

The first method of measurement is the three-voltmeter method as given by Laws,[1] and it has been changed to make it more accurate and convenient. The circuit diagram used is shown in Fig. 1 where

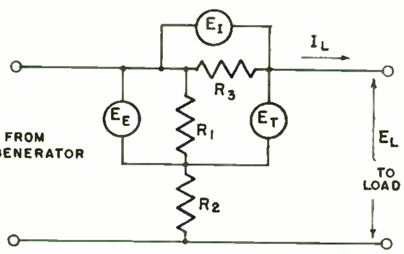


Fig. 1—Schematic diagram of the three voltmeter method

E_E, E_I and E_T are the three voltmeters. If simultaneous readings are not necessary, one voltmeter will serve to make all three readings by means of a simple switching arrangement.

The resistor R_3 is chosen to be much smaller than the impedance of the load so that the series voltage drop is small. Similarly R_1 and R_2 in series are chosen so that they are a good deal more than the impedance of the load and so that the current in R_1 and R_2 is very small compared to the load current.

The relative values of R_1 and R_2 should be so selected that the three voltages E_E, E_I and E_T are of approximately the same magnitude because this will produce the best accuracy. The voltmeters are assumed to have a high enough impedance so that the voltmeter current is negligibly small in every instance. Vacuum tube voltmeters are very useful in this connection, and it was found to measure power at one cycle per second that a new low frequency vacuum tube voltmeter incorporating the slide-back principle was quite advantageous.

[1] "Electrical Measurements", by F. A. Laws, McGraw-Hill Book Co., Inc., 1938, page 328.

Sinusoidal waveform

It is essential that the waveforms be sinusoidal, and to this end, the load voltage and perhaps the load current should be monitored by means of a cathode ray oscilloscope. If it is assumed that the series voltage drop in R_3 is small, the load voltage E_L is

$$E_L = \frac{R_1 + R_2}{R_1} E_E, \tag{1}$$

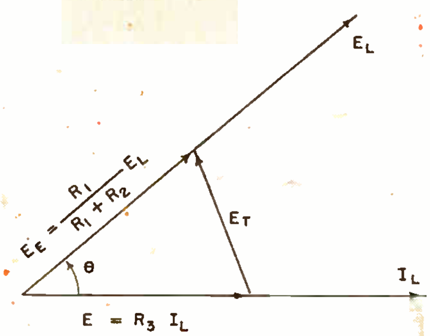
and the load current

$$I_L = \frac{E_I}{R_3} \tag{2}$$

The vector diagram of these voltages and currents is drawn in Fig. 2, in which θ is the power factor angle, i.e., the angle between the voltage and current. The power factor, cos θ, is then

$$\cos\theta = \frac{E_E^2 + E_I^2 - E_T^2}{2E_E E_I}, \tag{3}$$

Fig. 2—Vector diagram of the three voltmeter method



and the power P is

$$P = \frac{R_1 + R_2}{2R_1R_2}(E_E^2 + E_I^2 - E_T^2). \tag{4}$$

By the use of an algebraic manipulation, it is possible to change the equation of the power into the form:

$$P = \frac{R_1 + R_2}{R_1R_3} E_E E_I \left[1 - 2\frac{(S - E_E)(S - E_I)}{E_E E_I}\right] \tag{5}$$

where

$$S = \frac{E_E + E_I + E_T}{2}.$$

As an example, a circuit was set up using the resistances, $R_1 = 100$ ohms, $R_2 = 9900$ ohms, and $R_3 = 0.5$ ohm. At a frequency of 25 cycles per second, the following readings were taken: $E_I = 0.57$ volt, $E_E = 1.09$ volts, and $E_T = 0.70$ volt. From (1) and (2) the current into the load is 1.14 amperes, and the voltage across the load is 109 volts. By the use of (4) or (5), the power was found to be 101.2 watts, and this compares with 100 watts measured on a standard wattmeter. From the calculated voltage, current and power values, the value of the load impedance and phase angle may be obtained, and these are 95.7 ohms and 35.6 degrees. The sign of the impedance phase angle can not be determined by this method without further information or tests, although in the example used the impedance actually was capacitive.

This method has its greatest accuracy at power factors approaching zero and its least accuracy near unity power factor. A modification of this method can be used if high accuracy is wanted at or near unity power factor. This modification consists of replacing the resistance R_2 with a capacitor of about the same reactance. A different vector diagram and a new equation for the power are necessary in this case, and this modification has the

AT AUDIO FREQUENCIES

disadvantage that it is suitable for use only at one frequency.

The second method of power measurement is the thermocouple wattmeter method. Sharpe[2] describes a partly compensated wattmeter that is usable at frequencies well above audio frequencies. Other thermocouple wattmeters[3] have been built for use at radio frequencies.

The circuit of the wattmeter to be described here has been changed from the ones used in these references so that complete compensation is achieved. Compensation becomes necessary in some cases, particularly at low voltages, low currents or low power factors.

The basic circuit used is shown in Fig. 3 where R_x and R_y are the two compensating resistances. The resistance R_y was used by Sharpe,[2] but for complete compensation R_x must also be used. In the following analysis of this circuit a sinusoidal waveform will be assumed throughout, although this same analysis can be carried through without this assumption. The thermocouple constant will be defined as the ratio of the output dc generated voltage from the couple to the square of the rms current in the heater.

For all practical purposes this quantity is constant except for currents above the rated values of the thermocouples. The equivalent circuit of the wattmeter is given in Fig. 4, and the currents indicated in the figure are solved for in terms of the load voltage and current, E_0 and I_0. If r_1 and r_2 are the heater resistances of No. 1 and No. 2 thermocouples, respectively,

$$I_1 = \left(\frac{R_c + r_2}{A}\right)E_o + \left[\frac{R_c(r_2 + R_v)}{A}\right]I_o \qquad (6)$$

where

$$A = (r_2 + R_v)(R_y + r_1) + (R_c + r_2)R_{vx}\left[1 + \frac{R_y + r_1}{R_x}\right], \qquad (6A)$$

and

$$I_2 = \frac{R_y + r_1}{A}E_o - \frac{R_cR_v\left(1 + \frac{R_y + r_1}{R_x}\right)}{A}I_o. \qquad (7)$$

Let K_1^2 and K_2^2 be the thermocouple constants for No. 1 and 2 thermocouples, respectively, and then

$$E_1 = K_1^2|I_1|^2; \quad E_2 = K_2^2|I_2|^2 \qquad (8)$$

where E_1 and E_2 are the dc generated output voltages of the couples. Assume now that the load has the power factor angle θ and that the vector load voltage and current are

$$\bar{E}_o = E_o\cos\theta + jE_o\sin\theta;$$
$$\bar{I}_o = I_o + j0 \qquad (9)$$

By the use of (6), (8) and (9) it can be shown that

$$E_1 = \frac{K_1^2}{A^2}[(R_c + r_2)E_o^2 + R_c^2(r_2 + R_v)^2I_o^2 + 2(R_c + r_2)(r_2 + R_v)R_cE_oI_o\cos\theta] \qquad (10)$$

and from (7), (8) and (9)

$$E_2 = \frac{K_2^2}{A^2}\left\{(R_y + r_1)^2E_o^2 + R_c^2R_1^2\left[1 + \frac{R_y + r_1}{R_x}\right]^2I_o^2 - 2(R_y + r_1)\left[1 + \frac{R_y + r_1}{R_x}\right]R_cR_vE_oI_o\cos\theta\right\}. \qquad (11)$$

From Fig. 3 it may be seen that the two couples are connected in opposition and that the generated voltage available to actuate the microammeter is the difference of (10) and (11). This difference should be proportional to the product (E_0 I_0 cos θ) which is the power consumed by the load. This difference contains terms in E_0^2 and I_0^2 unless the following two conditions are satisfied:

1. For the term in E_0^2 to be zero

$$K_1(R_c + r_2) = K_2(R_y + r_1) \qquad (12)$$

2. For the term in I_0^2 to be zero

$$K_1(R_v + r_2) = K_2R_v\left[1 + \frac{R_y + r_1}{R_x}\right] \qquad (13)$$

With these two conditions satisfied, the generated voltage for the meter is

$$E_{meter} = E_1 - E_2 = \frac{K_2^2R_cE_oI_o\cos\theta}{(R_c + r_2)(R_v + r_2)} \qquad (14)$$

and

$$A = 2(K_1/K_2)(R_c + r_2)(R_v + r_2).$$

The current flowing in the meter is equal to this generated voltage divided by the sum of the resistances of the two couples and of the meter itself.

Using the design equations given above an actual 300-watt full scale wattmeter was designed with commercially available thermocouples. The thermocouples used had a nominal heater resistance of 15 ohms, a couple resistance of 12 ohms and gave 10 millivolts dc for a current of 22 milliamperes ac with a maximum heater current of 44 milliamperes. This corresponds to a thermocouple constant of 20.6 which was found to hold up to the maximum current.

The wattmeter was rated nominally at 2 amperes and 150 volts.

[2] "Note on the Construction and Use of the Thermal Wattmeter" by B. A. Sharpe, Journal of Scientific Instruments, Vol. 10, pages 318-321, October 1933.

[3] "Direct Reading Wattmeters for Use at Radio Frequencies" by G. H. Brown, J. Epstein and D. W. Peterson, Proceedings of the Institute of Radio Engineers, Vol. 31, pages 403-410, August 1943.

Fig. 3—Schematic diagram of the thermal wattmeter

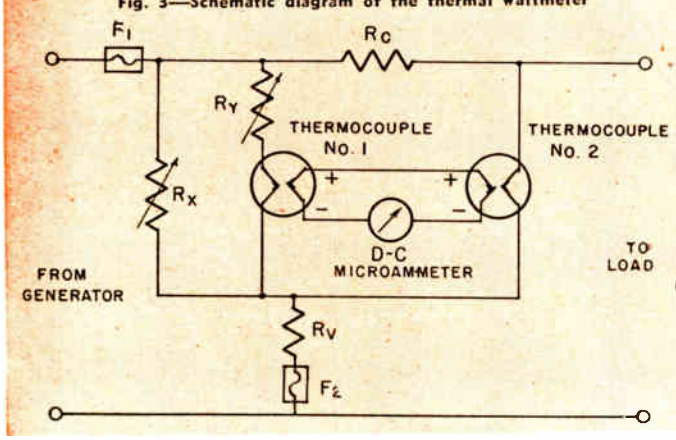
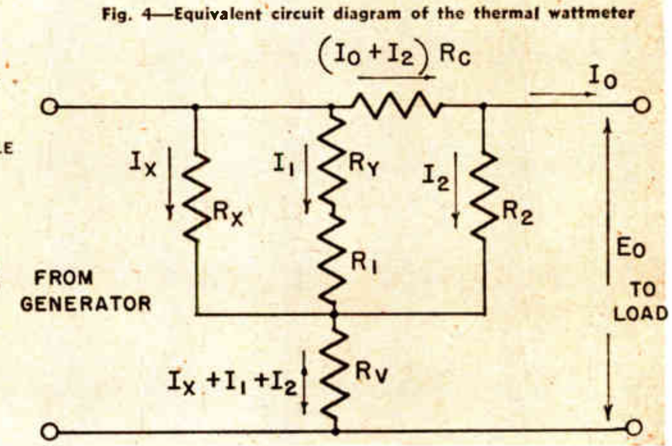


Fig. 4—Equivalent circuit diagram of the thermal wattmeter



With a current of 2 amperes flowing through R_c and no voltage across the load, the current through the thermocouples should be one-half the maximum value or 22 milliamperes. This corresponds to a resistance $R_c = 0.33$ ohms which was found experimentally to be higher than needed. The value used was $R_c = 0.15$ ohm and consisted of a length of resistance wire.

Similarly if the load current is zero, but the rated voltage of 150 volts is across the load, the current through each thermocouple should again be 22 milliamperes corresponding to $R_v = 34{,}200$ ohms. This was a precision wound resistor and had approximately this value of resistance although it was adjusted slightly to make the meter scale read exactly 300 watts full scale.

The thermocouples should be insulated for best results, although it is possible to use one insulated and one uninsulated thermocouple. From the analysis it may be noted that neither the heater resistance nor the thermocouple constant need be matched, and hence it is possible to use any two unmatched thermocouples providing that their ratings are approximately the same. The thermocouples having the smaller heater resistance should be chosen for $\sqrt{}_1$ since the compensating resistance R_y is approximately equal to $(\sqrt{}_2 - \sqrt{}_1 + R_c)$. This was chosen to be a wire wound rheostat of 10 ohms. The other compensating resistance R_x was practically equal to R_v and was chosen as a 200,000 ohm rheostat.

The microammeter used had a 30 microampere full scale and 50 ohms resistance. The selection of this meter was dictated by the voltage available as calculated from equation (14) and the combined resistance of the two couples and of the meter itself. Two fuses were used to protect the thermocouples from overloads as shown in Fig. 3. Fuse F_1 was a three-ampere size, while F_2 was a 1/16-ampere instrument fuse.

To satisfy the two conditions (12) and (13) so that the microammeter reading is proportional to the wattage taken by the load, it is necessary to adjust R_x and R_y. The resistance R_y should be adjusted first, and this is done by open-circuiting the load, applying rated voltage, and adjusting R_y until the microammeter reads zero. If it will not reach zero, the trouble may be that R_y is not large enough or that the thermocouple with the larger heater resistance is in the No. 1 position rather than the No. 2 position.

Next, to adjust R_x, the load should be short-circuited and only enough voltage applied to the input terminals of the wattmeter to cause rated current to flow in the load. The resistance R_x should then be adjusted until the microammeter again reads zero. Adjusting R_y to satisfy the first condition is particularly important for a high voltage, low current wattmeter, while for a low voltage, high current wattmeter, satisfying the second condition by adjusting R_x is more important.

The wattmeter was tested on a variety of loads with leading, lagging and unity power factors, and the errors were always less than two per cent. It is believed that with more care in the selection of the components, maximum errors under one per cent may be achieved. Frequencies between one and 20,000 cps were employed, but it is believed that the wattmeter would be usable at much higher frequencies limited principally by the inductance and capacitance of the various circuit elements.

This wattmeter has the advantage that it may be made into a recording wattmeter through the use of a suitable amplifier and recording voltmeter or milliammeter.

The advantages and disadvantages of the two methods may be summarized as follows:

Three voltmeter method:

Advantages

1. Usable at all frequencies.
2. Can be improvised easily.
3. Stands overloads well.
4. Measures voltage, current and power at the same time.

Disadvantages

1. Three readings plus a calculation necessary.
2. Not direct reading.
3. Lowest accuracy at unity power factor.

Thermal wattmeter method:

Advantages

1. Direct reading.
2. Usable over wide frequency range.
3. Thermocouples need not be matched in any way.
4. Can be used as a recording wattmeter.

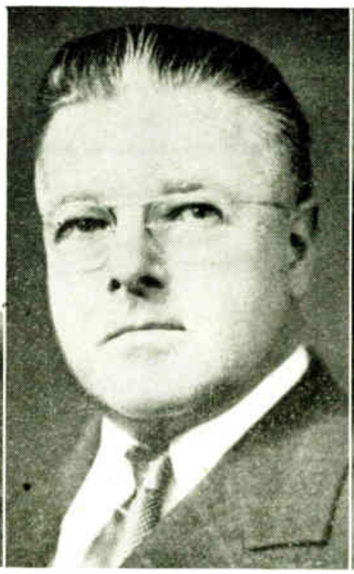
Disadvantages

1. Sluggish response.
2. Microammeter used is not rugged.
3. Will not stand overloads well.

ENGINEERS WHO ADDRESSED IRE WINTER TECHNICAL MEETING

DR. FRANK B. JEWETT
President National Academy of Sciences

EDGAR KOBAK
President Mutual Broadcasting System, Inc.



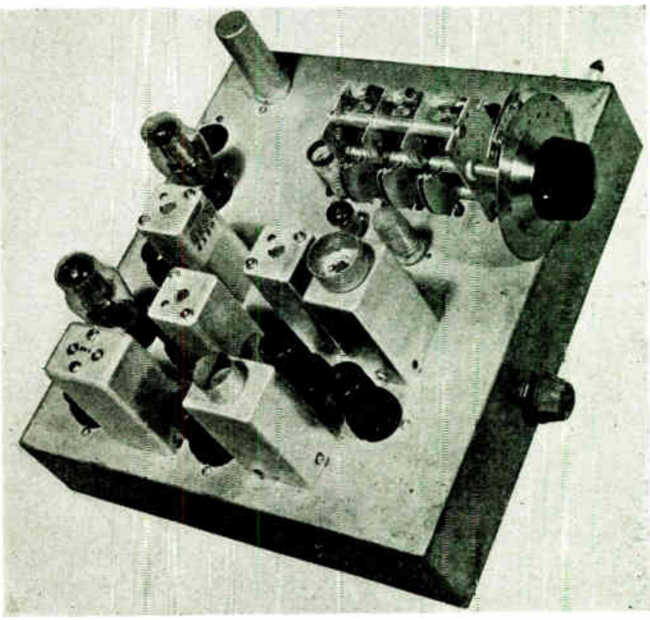
LEWIS CLEMENT
Research-Engineering V-P Crosley Corp.

PAUL PORTER
Chairman Federal Communications Commission

LABORATORY RECEIVER

By WM. F. FRANKART
Radio Design Engineer
1429 East 125th Street, Crompton, Calif.

Providing extreme stability and sensitivity for rapid and accurate checks of high and low frequency FM and AM



Top view of the AM-FM high stability receiver showing arrangement

● The purpose in building this laboratory receiver was to have on hand a receiver that could be used for a number of purposes. A receiver was needed in the VHF range that was suitable for the determination of maximum frequency and maximum phase deviation and of the mean carrier frequency tests as suggested by Crosby.* Since no commercial combination AM-FM communications receiver is selective enough on the AM side to be useful in determining maximum frequency deviations this receiver was built.

A receiver was needed for field tests in conjunction with transmitting equipment. This receiver had to be stable, that is, no frequency drift, of known sensitivity, selectivity, and provide for rapid change-over from FM to AM for communications reliability comparisons. That is, tests were being conducted to directly compare FM and AM for reliability of communications over actual operating conditions.

A receiver was also needed to receive WWV on 15 mc for frequency measurement purposes. This accounts for the low frequency receiving end of this design.

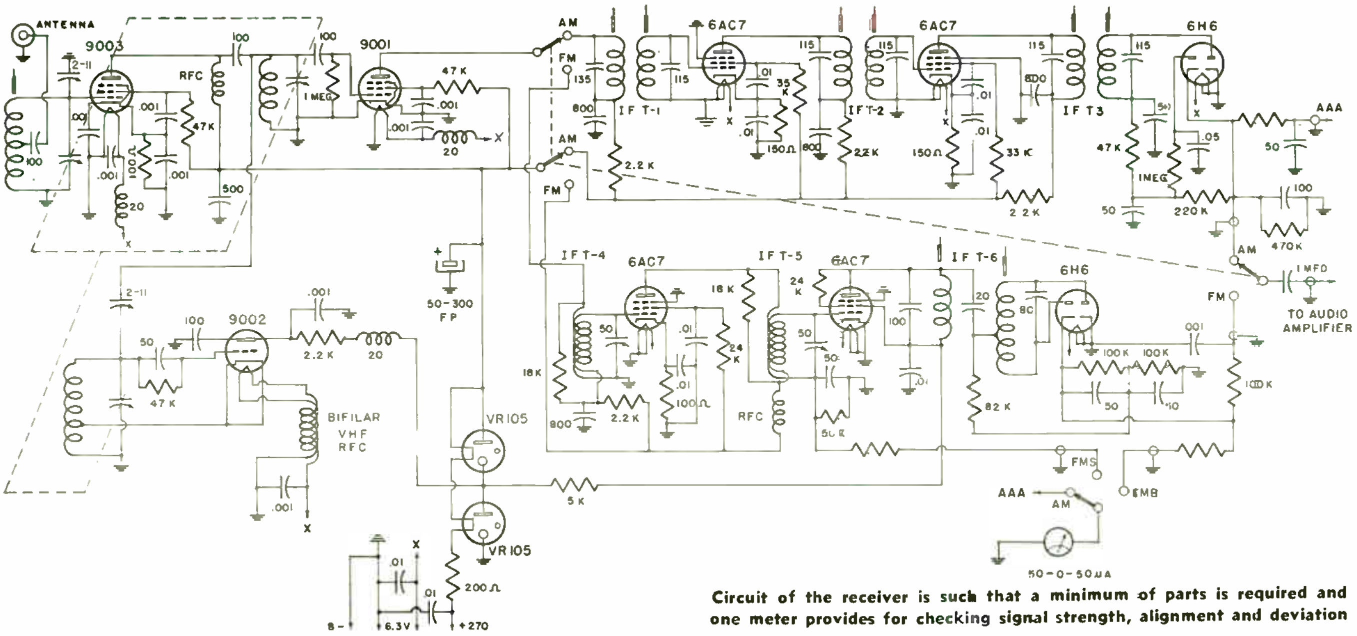
This receiver was used in field tests over the Los Angeles area. Its performance was satisfactory and much was learned as to the AM-FM question. The purpose of this article is not to discuss the relative merits of the two types of modulation but to give a little data on a receiver that proved its worth and in this way, it is hoped, bring about some good ideas.

As cost was no item, all capacitors possible were either silver mica, or mica, plug-in coil forms were polystyrene, sockets were ceramic and some were mica filled bakelite. All insulations were at least equivalent to mica filled bakelite. Along with these high quality parts, proper circuit isolation was obtained as can be seen from the schematic. The above reasons were largely responsible for the stable characteristics of this unit.

The FM-if transformers are of particular interest. The first two are bifilar wound. By using this type of winding certain advantages

(*Continued on page* 144)

*Pages 85-87 Hund, Freq. Mod.



Circuit of the receiver is such that a minimum of parts is required and one meter provides for checking signal strength, alignment and deviation

PROGRESS DEPENDS ON

By DR. JOHN ALBERT STOBBE
Electronic Consultant
63 Wall Street, New York

The coming race for the survival of the fittest emphasizes the importance of putting engineering up at the head

• Engineering can make or break a company. Any electronic manufacturer's management will agree with that statement. I sometimes wonder, though, how well most of them have thought it through. Before the war different companies paid varying degrees of attention to engineering and, although the operating results of any particular company did not always show profits directly in proportion to its engineering budget, it usually was found that a company's permanency was related to the wisdom of its engineering expenditures.

Engineering in our industry covers a lot of ground. Of course, prewar, wartime and postwar conditions differ sharply. I believe they differ even more sharply in more ways than most people realize. For instance, a man used to go out and hire a secretary and an "engineer" and start to make radio sets. While he was doing this—and quite often profitably — another company was doing its engineering job all the way through from physical and pure research to sales engineering and field technical assistance.

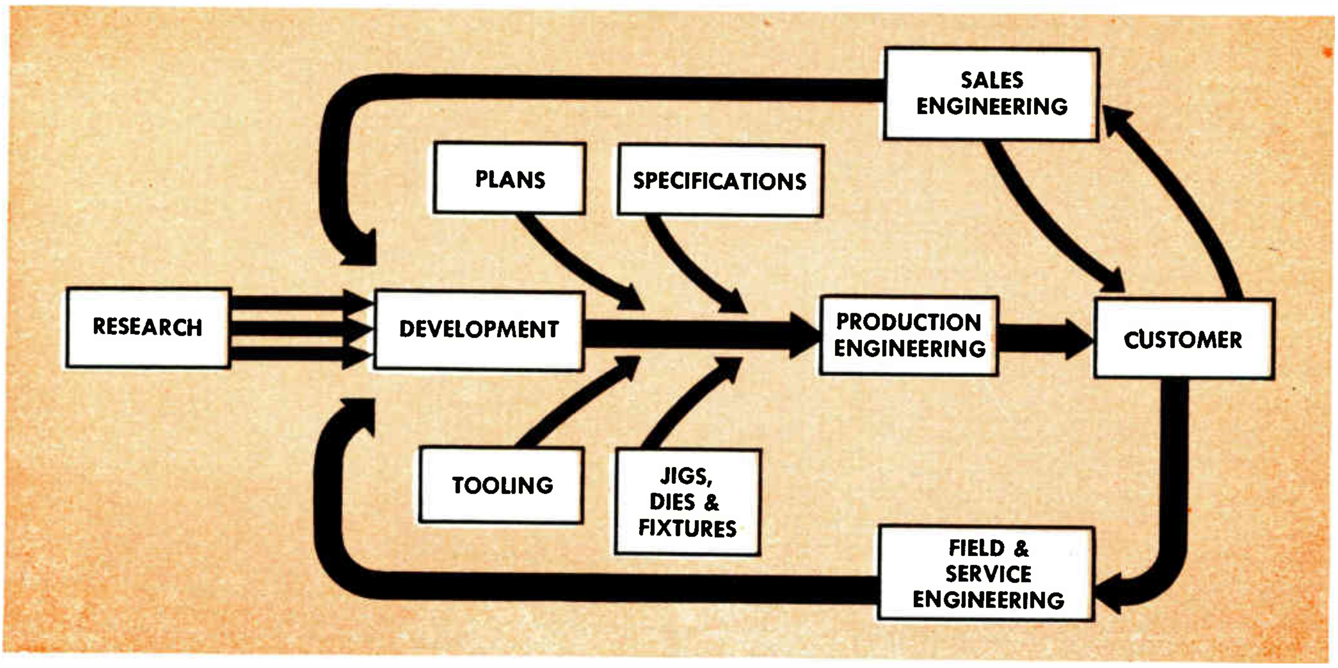
A full study will show that business mortality in our industry, barring dishonest practices and quasi-insane expansions, of which we have had enough of both, occurred quickest in those enterprises which had inadequate, faulty or unbalanced engineering. The few instances of survival among the "hole in the wall" units were the result of special abilities and talents.

The rules change

Now when the war came along the rules were changed. Certain laboratories did basic design work. The team of university laboratory, industrial research and development section, and government or service branch technical group has been basically a new method of attack. The designed equipment, reasonably completely specified and turned over to a production company, has provided an opportunity for a manufacturer with only "production engineering" to prosper greatly. But this situation is a war time phenomenon and cannot last except in specialized fields such as Civil Aeronautics Authority equipment, etc. It is not the postwar high road to profits in our industry.

For example, before the war a few companies made a few quartz crystals. Airlines, broadcasting stations and some amateurs were the customers. The amateurs with their advanced stable variable frequency oscillators had all but abandoned the piezoelectric control method. Came the war with its heavy crystal demands and the expansion measured in thousands of per cent. The Signal Corps and a few notable old line manufacturers produced, by detailed guidance and specification work, an industry of more than one hundred companies grossing in the $100,000,000 region.

Some of these companies now



SOUND ENGINEERING

think they have engineering, but have they? More important, will a dozen or twenty survive and, if so, what can be their market unless they become engineering conscious? This is an example. We could add on and on—for instance, transmitting tubes, cathode ray tubes, patented connectors—all to show the abnormalities existing and as any thinker knows, much plunging ahead heedless of the danger signs.

As the saying "a better mousetrap" so goes our future. No one is going to play Santa Claus in postwar competitive markets. What a company builds and sells must be better to give its seller a permanent future. A big bass boom and lots of advertising flash and sales drive may sell sets for a few years, but unless sound thinking exists underneath, the newcomers with the wonderful plans will go broke just as quickly and completely as the big bass booms of the late '20s fared by the cold appraisals of the '30s. And that was only a repetition of '24-'25.

Base for permanency

The radio names of the teens are as completely gone as the automobile names of a decade earlier. Even the big names of '20, '21 and '22 are dead. Only one real base for permanency exists and that is sound, realistic and advanced engineering. That, all other things being equal, will make or break any company.

It would be impossible in an article even to outline what engineering should do for a medium-sized company. That would take a book with divisions and chapters, such as, the broad objective, the budget, pure and applied research, development, pre-production, production, field, sales, management, and interdepartmental cooperation. What can be done in an article is to stimulate thinking and to hit a few neglected broad ideas.

To me, the two biggest things that an engineering department in one of our companies should do are to keep ahead of the parade and to design for low cost manufacture. If we take each of these objectives apart a little it will be worthwhile.

How simple it sounds to say "to keep ahead of the parade." It isn't simple to do but the more you try the closer you come. It is all right to study the competitor's product, but if you have to copy—even one little screw—you have been lagging. Your customer, not your competitor should design your product!

SEVEN ENGINEERING STEPS TO WATCH

1. Look your engineering over.
2. Strengthen it even if you have to go to extremes.
3. Bring in trained ex-service men.
4. Get your engineering together with your customers and distributors.
5. Get after those cost reduction programs now.
6. Standardize with and for your customers and not your competitors.
7. Work hard and be honest—and survive.

Right here we stand at the point where management of the largest companies can take one direction, but medium and smaller companies must plan differently. The largest companies sometimes can afford to design a product and then let the customers see it. This is because enough advertising and sales razzle-dazzle actually can cover inferior engineering. But it is an expensive and dangerous gamble at best as any honest advertising agency will attest.

Development lags demand

The medium or smaller company must avoid this sort of thing or share the fate of the phonograph companies of two decades ago. The very thing we are writing about, then was neglected—not only by a company but by an industry, to its wrecking. There is no basic reason why today's radio phonograph could not have been developed by one of the big phonograph companies of the early twenties. They were designing what they wanted to sell and not what the public wanted—each being very careful not to get too far ahead of competition. Engineering content of a spring-wound diaphragm type phonograph was ludicrous in its absence. And the industry—and public security holders—paid.

The approach must be different for a producer of components for use in further manufacture than for a producer of consumer goods sold directly—or through jobbers and dealers—to the public.

The producer of components should have his engineering group practically haunt his present or potential customers. The producer knows what he can or maybe can't make and can guess what it will cost. The assembling company customer's engineers know what they want but sometimes—often—by ignorance or bliss don't seem able to realize about things like standardization, costs and efficiency of adaptation. The producer plus customer engineering team can't be beaten by an ivory tower dreamer.

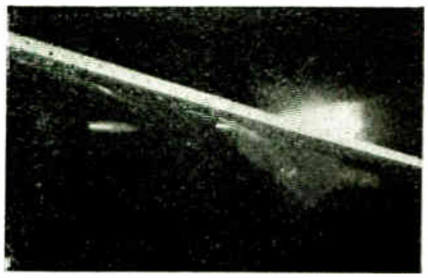
Build on quality

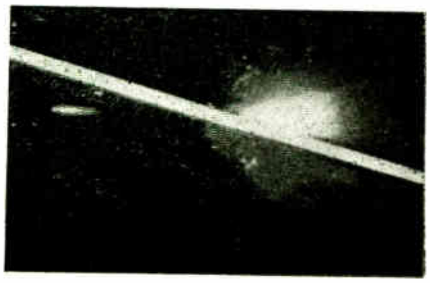
Get your engineers out in circulation and see how fast they learn some production practicalities and see how much less they know than before they talked it over with George out in Chicago. If you have the kind of engineers who know too much or too little to do that then hire some more quickly—because life and the hereafter depend on it.

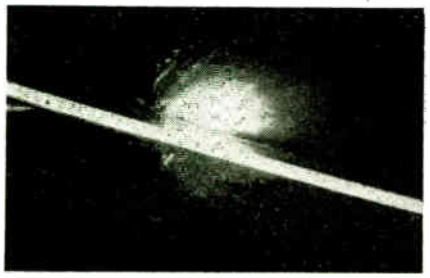
The old line producer for the consumer knows all about customer reaction from what his advertising agency with its "test area" technic tells him. The new aspirant for the "rainbow" market does, too. The difference is that the old line man did a lot of dumping in the "thirties" and believes less than half of what he is told. Maybe that's why he survived. Anyway get around and look, and at least get one or two sales engineers who have been through the mill. Distributors and dealers are coyly cute when things that look like shortages exist. Only a firm base of quality will ride the inevitable storm. Unless building on that base begins now, it may be too late.

"Design for low cost manufacture" is the other part of it. Do it yourself, the work I mean. Industrial designers and engineers may look like a happy solution because "we're too busy" but how many times do they turn out even as good a job as half the cost spent on in-plant engineering.

ELECTRONIC TIMING OF







Sequence of flashes of a .50 cal. projectile stream being fired from a machine gun through a plate mounted at an angle. The extremely short time of the flash effectively "stops" the motion so that a clear picture is obtained. In 2 microseconds a projectile going 2,400 ft./sec. only travels .058 in.

By CHARLES H. COLES
Captain, Air Corps, Wright Field, Dayton, Ohio

High intensity flashes of 2 microseconds duration are triggered in sequence by unblocking amplifier tubes

● In an effort to measure velocity changes in projectiles, the necessity for a flexible and rapid sequence timer arose. This was required to trigger flash lamps for a series of photographs which show the position of a flying bullet at known intervals of time. A device was required that would produce pulses in a set of six circuits in rapid sequence. At first a high speed commutator was built, but the inflexibility of this method led to the construction of an electronically controlled instrument.

The sequence timer as developed in the laboratory of the engineering division of the Army Service Forces Material Command is capable of firing from two to six microflash lamps. The time interval between the first and last flash may be adjusted from 0.57 seconds to 0.00035 seconds. During this time interval all six lamps may be fired in any kind of sequence desired with either equal spacing between flashes or irregularly spaced flashes. At the highest speed, the timer will permit six pictures to be taken of a 50 caliber projectile before it has moved more than four times its own length.

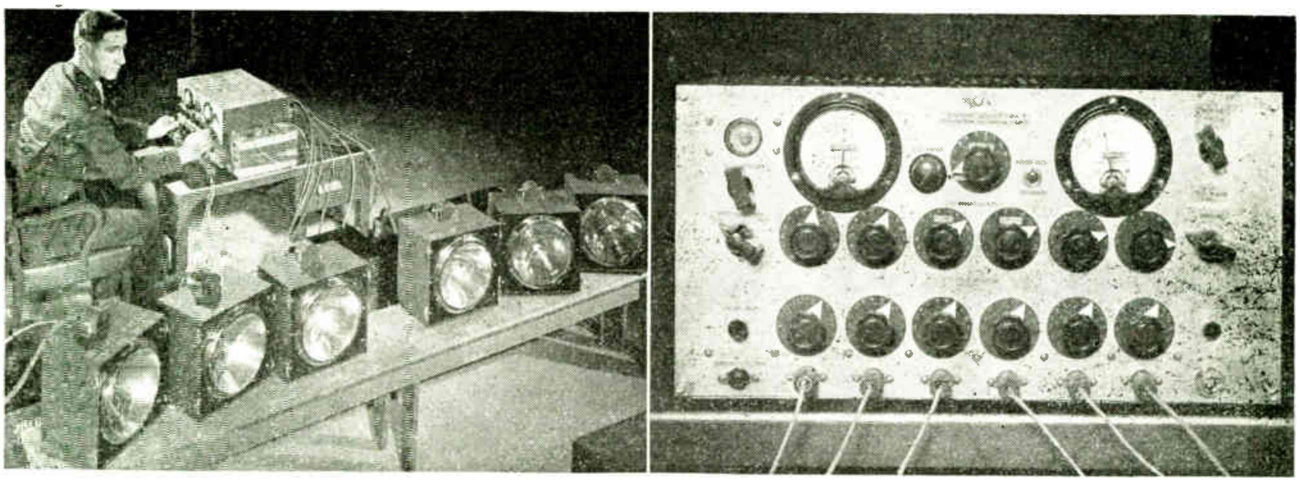
Microflash units are vacuum-tube flash lamps which produce a flash of light of extremely short duration by means of a condenser discharge. The flash is used as a light source to photograph bullets in flight or any other high-speed mechanical action. While a single flash will show any particular stage of an action, such as a projectile entering armor plate, several successive photographs are essential when determining the velocity of a projectile, before and after penetrating the armor plate. Successive stages of the bursting of a turbo-supercharger rotor are also within the range of possibilities of such a sequence picture apparatus.

The circuit that was used as a basis for the timer was published in the Review of Scientific Instruments, February, 1941, by R. G. Loeffel of Washington University. The relaxation oscillator used a neon lamp in the original circuit as published, but this was changed to use a strobotron, a more controllable form of discharge tube. For purposes of calibrating the dial settings, a vacuum tube voltmeter was added to measure the grid bias applied to the first tube of each of the amplifiers. Six channels were built into the timer to trigger six microflash units.

The basic circuit is essentially a triangular wave generating circuit connected to six amplifiers whose sensitivity can be adjusted by grid bias control. When each amplifier is set to a successively lower voltage response, the outputs will be activated in turn as the triangular wave voltage rises across the input grids.

The output of each amplifier

Set up used by the author in making pictures in rapid sequence. The six microflash lamps are shown at the left and the panel at right



SEQUENCE PHOTOGRAPHS

feeds into the thyratron control grid of a microflash unit. These units produce a flash of light with a duration of about two microseconds. The flash is used to photograph a bullet in flight. By making one flash from each of six units, a bullet may be photographed in six successive phases of its flight. If the time between the flashes is known, measurements of distance on the photographs will determine the velocity of the bullet between images.

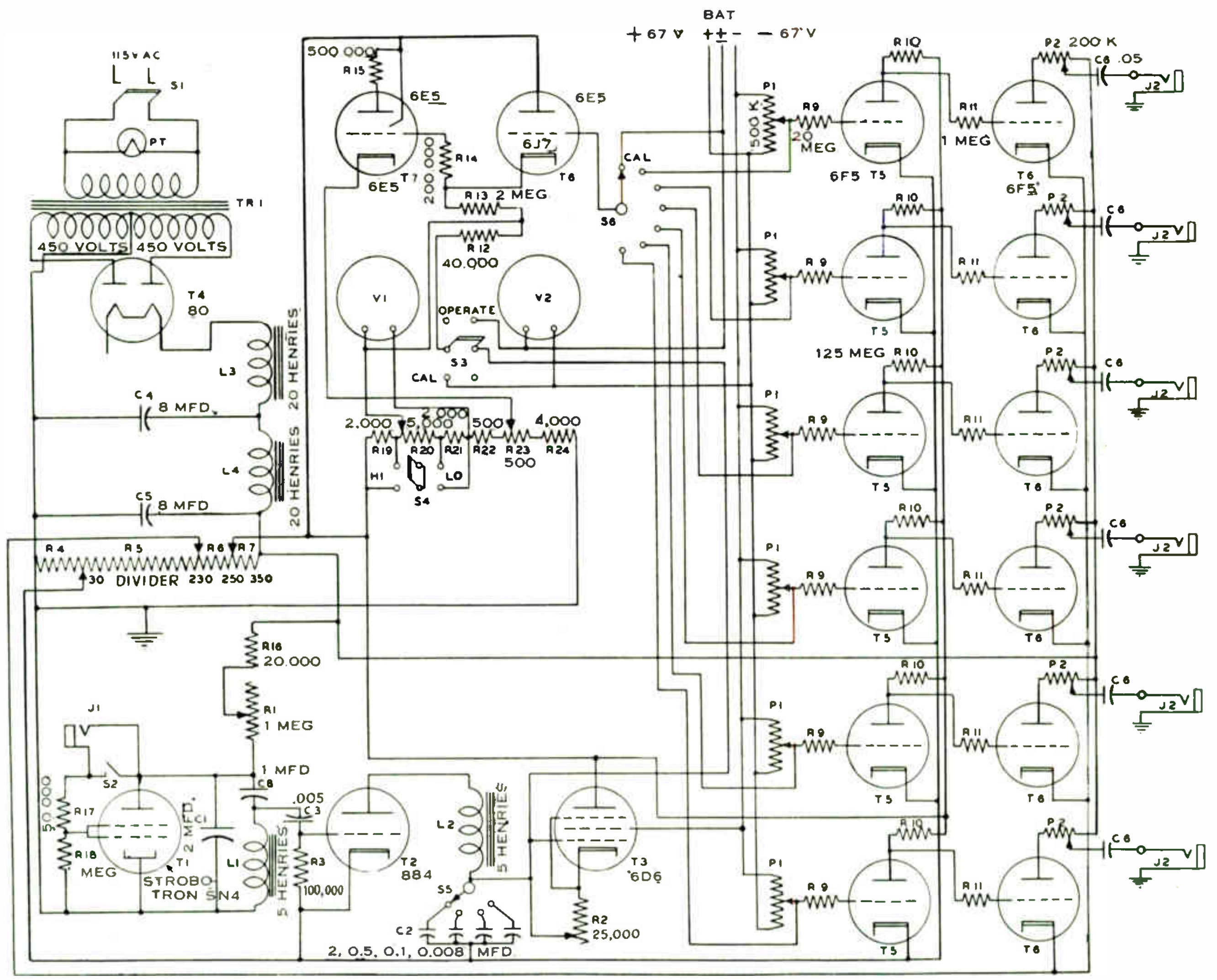
To make the photographs, the units are grouped near the target. An ordinary press camera is set up near the target and focused on the position where the bullet is to be photographed. When all is in readiness, the lights are extinguished on the enclosed gun range and the shutter of the camera opened. When the gun is fired, the bow wave of the bullet crossing a microphone initiates the action of the sequence timer. The timer fires the lamps in succession, six flashes of light illuminating the bullet in six successive positions.

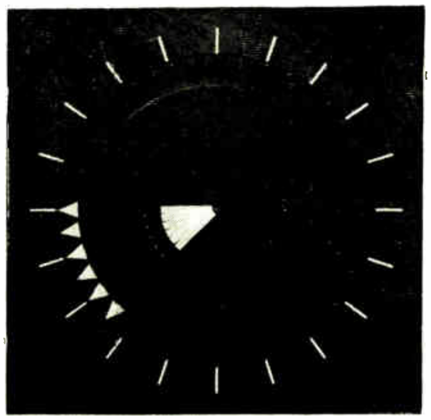
Referring to the circuit diagram, a capacitor C_2 is charged linearly through the pentode T_3 to a voltage dependent upon the plate voltage applied to the pentode. When the capacitor is charged, it remains so until the strobotron T_1 fires, whereupon the grid of the gas triode T_2 is made positive, causing the tube to become conducting and discharging the capacitor C_2. The capactor C_2 starts to charge again, causing the voltage across it to rise at a rate determined by the resistance R_2 and the size of the capacity C_2. The same voltage is applied to the grids of the six amplifiers.

These grids are biased negatively at various voltage levels by means of the batteries connected to —±+ and the potentiometers P_1. When the rising voltage reaches the critical point where it causes a particular amplifier tube T_5 to become conducting, the amplifier produces a pulse in the output circuit to its microflash unit. By imposing a different grid bias voltage on the tube of each amplifier, the amplifiers will produce pulses successively as the voltage rises.

When making pictures of high speed mechanical action, the equipment must be used in a darkroom or out-of-doors at night because the camera shutter is left open during the action. The exposure time is determined by the duration of the flash which is fixed at 2 microseconds. Only one flash from each unit is utilized because it

Circuit diagram used for controlling six lamps. Rising positive voltage across C_2 as it charges successively fires differently biased 6F5 tubes





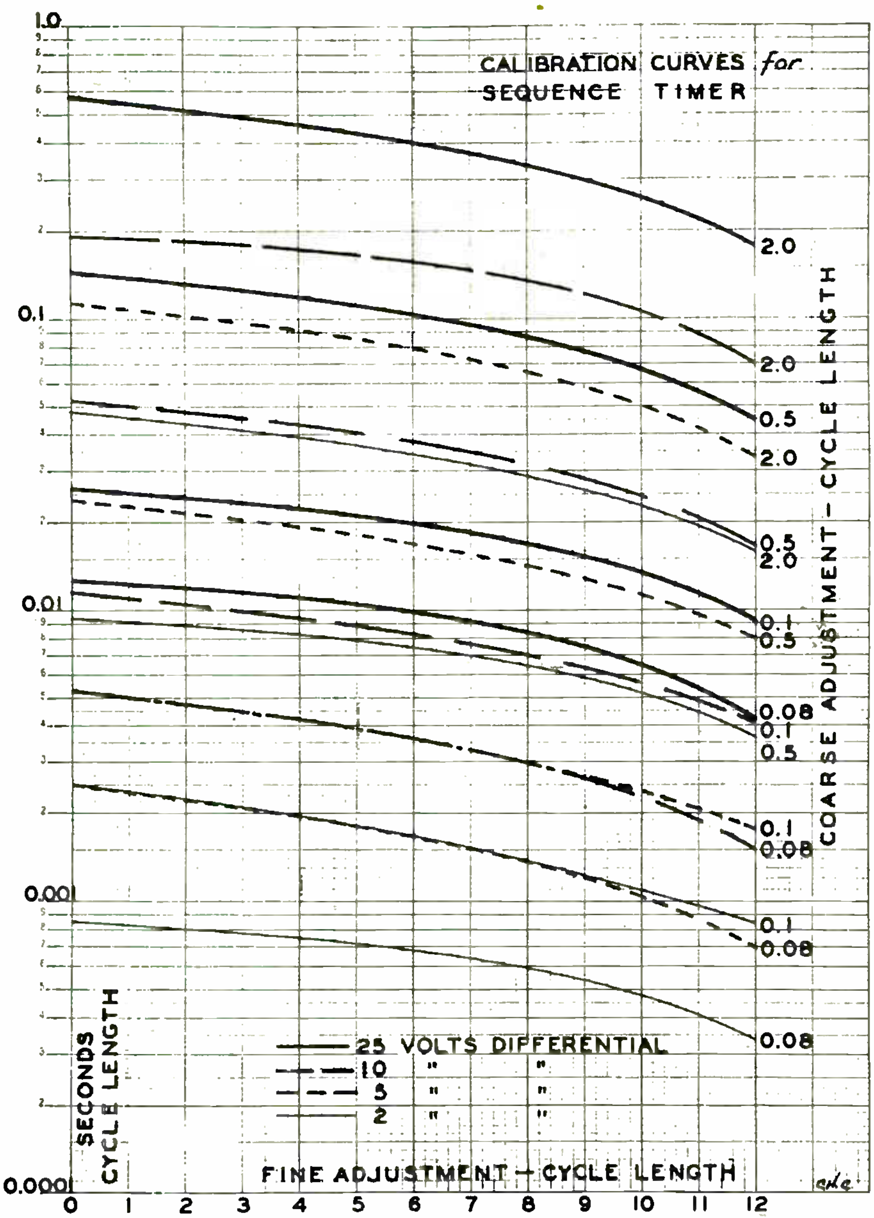
By taking pictures on one film of a rapidly revolving wheel the unit can be calibrated

takes two or three seconds for the microflash units to recharge, a time usually far in excess of the phenomena being recorded.

The calibration curves of the sequence timer were obtained from experimental determinations. The flash units were directed toward a disk driven by an electric motor. The disk revolved at 1770 rpm and had an arrow painted near the edge. The stationary ring surrounding the disk was divided into 20 parts. By observing the position of the images as revealed by the flash, the time between flashes may be determined.

The curves were made by observing the time spacing between the first and last flash of the series of six. Five points were taken for each curve. The setting of the coarse adjustment — cycle length used for each individual curve is indicated at the right hand end of each curve as the size of condenser in the circuit. The time in seconds between the first and last flashes is indicated along the left side of the chart.

Calibration curves can be drawn for a unit based on information obtained with the disc



After the time interval required between the first and last flash has been decided upon by reference to the speed of the phenomenon to be photographed, this figure is found along the left side of the chart. Following this horizontal line to the right to where it intersects a curve, the number at the end of the curve is noted for the setting of the coarse adjustment — cycle length. By dropping down at the point of intersection to the bottom of the chart, the setting of the fine adjustment— cycle length may be read. Usually more than one combination may be set up, but it is advisable to use those in the mid-range of voltage differentials: i.e., 5 or 10 v. These settings produce more easily controllable results.

By means of the vacuum tube voltmeter, the various grid voltages of the amplifiers are set at successively higher voltages as indicated by the calibration curve in use. With the setting of the cycle length adjustments, the sequence of flashes within the required time will follow upon the closing of the initiating contact.

The disk pictured is 12 in. in diameter but there is actually only one arrow-head painted near the edge of the disk and one radial line painted from the center. The disk, a camera pointed at it, and the lamps also directed at the disk, were set up in a darkened room. After the disk started revolving, the camera lens was held open while the sequence timer was set into operation. The successive flashes of the microflash lamps recorded six images of the single arrow-head.

The disk is revolved by an electric motor at 1770 revolutions per minute. Each revolution represents $\frac{60}{1770}$ or 0.0339 second. Each of the 20 divisions represent $\frac{0.0339}{20} =$ 0.0017 second.

In the photograph the first and last flash are 2½ divisions apart or 2.5 x 0.0017 = 0.0042 second. The time interval between flashes is 0.5 x 0.0017 = 0.0009 second. For the shortest time spaces, a 10,000 rpm motor may be used.

The greatest difficulty encountered with the operation of the instrument was not with the timer but with the excessive sensitivity of the microflash lamps. The negative grid bias on the thyratrons was increased considerably before stable operation was obtained.

REMOTE TUNED ANTENNA

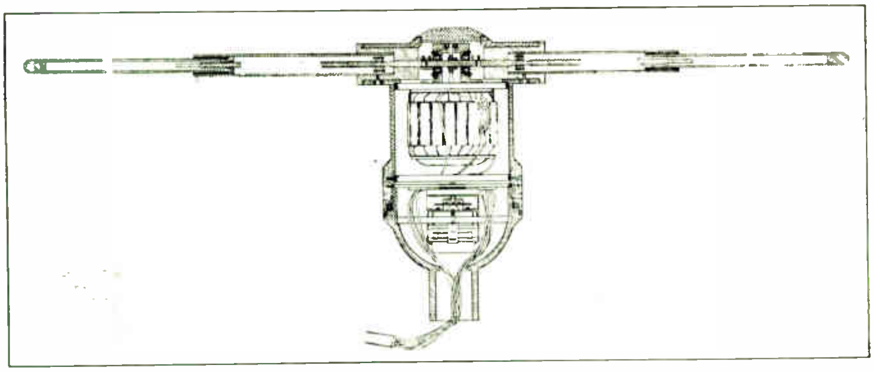
Motor-operated extensible members of rotatable dipole provide for covering range between 46½ and 215 mc

Television receiver engineers know that installation of antennas in metropolitan areas presents difficult problems, which are daily becoming more complex.

Technical opinion is largely agreed upon the conclusion that it is not possible to set up a dipole antenna in mid-town New York which will receive satisfactorily from more than one station without adjustment. However, if provision is made for orienting the antenna when desired, reception may be realized from the three stations.

A major complication encountered with fixed antennas is reflection, leading to ghost images, which can be largely eliminated by proper antenna orientation. It has been determined that in special cases, it is of advantage to tune the antenna for optimum reception.

Such an antenna, which may be both oriented and tuned by remote control has been developed, and is



Above is a cross sectional view of the tunable rotable antenna showing location and connection of the two motors. Right is a general view of the antenna as it appears when installed

illustrated. It is a horizontally polarized assembly, containing two motors and associated mechanical trains.

In operation, the antenna is rotated in azimuth, and the dipole arms extended or retracted until the strongest direct signal is received with the reflected signals attenuated to the greatest possible extent.

The antenna has a three-section arm extension with a frequency range of two and one-half to one, from 46½ to 117 mc has been developed by Farnsworth Television and Radio Corp., Fort Wayne, Ind. Extensible members of the dipole are designed as three sections of telescopic tubes, controllable from 26 to 66 in.

Motor assemblies have been specially designed for the application, and mechanical details of the design of a two-section antenna are illustrated. Four push-buttons on a control board allow the operator to control motor rotation from a remote position. An automatic stop limits the angle of rotation to plus or minus 190°, so that the antenna cable will not be twisted beyond its elastic limit.

The smaller antenna has two sections of telescoping tubes, with a frequency range of 1.8 to 1, from 46½ mc to 85 mc. Length of the antenna may be varied from 36-in. to 66-in. Should a greater frequency range be desired, additional telescopic sections may be installed. A five-section antenna, for example, affords a frequency range of 3.6 to 1, from 46½ to 167 mc.

With N sections to the extensible member of length L, with mechanical overlap b, the approximate tuning range is to be:

$$R = NL/(N_b + L)$$

and substitution of values for the three-section antenna gives:

$$R = 3 \times 26/(3 \times 1.5 + 26) = 2.56$$

The number of sections required to cover a tuning range greater than this goes up quite rapidly with the range. The top frequency determines the value of the section L. For example, it requires four sections for a tuning range of three, if the top frequency is approximately 215 mc.

A simpler antenna design features orientation control alone, since the tuning control may constitute unnecessary complication in some installations.

The theoretical resistance of the antenna varies from 36 to 160 ohms, and works into a 95-ohm twinax line. Using 170 feet of line to the receiver, matching has been found satisfactory for all channels in group A.

Receivers having various input impedances not matched to the line have been used, with good results. Experiment shows that orientation is a far more important factor in "ghost-free" reception, than mismatch between dipole, transmission line, and receiver input.

CONCENTRIC LINE FM

Use of miniature tubes and push pull circuits simplifies frequency multiplication, stability and modulation problems

• First of the new FM transmitters, unveiled at a time when the engineers of FM stations all over the country are wrestling with problems involved in converting to the recently newly designated 88-108 mc band, reveals a number of features uncommon in such equipment and for which considerable advantage is expected:

1—In order to obtain efficient operation in all stages at the higher frequencies, linear elements of the concentric line type are used in tank circuits.

2—Easily obtainable miniature and other forms of high frequency tubes have been used.

3—An electro-mechanical means is provided to insure exact maintenance of center frequency control.

In designing the transmitter, which carries a rating of 250 w output, engineers of the Transmitter Equipment Mfg. Co., New York, have had in mind the difficulty of finding tubes which could be operated at about 100 mc and still would be capable of furnishing the desired power. Since 250 w tubes are available, this power was selected for the transmitter with the thought that it could serve as a driving unit for future larger tubes if more output were needed.

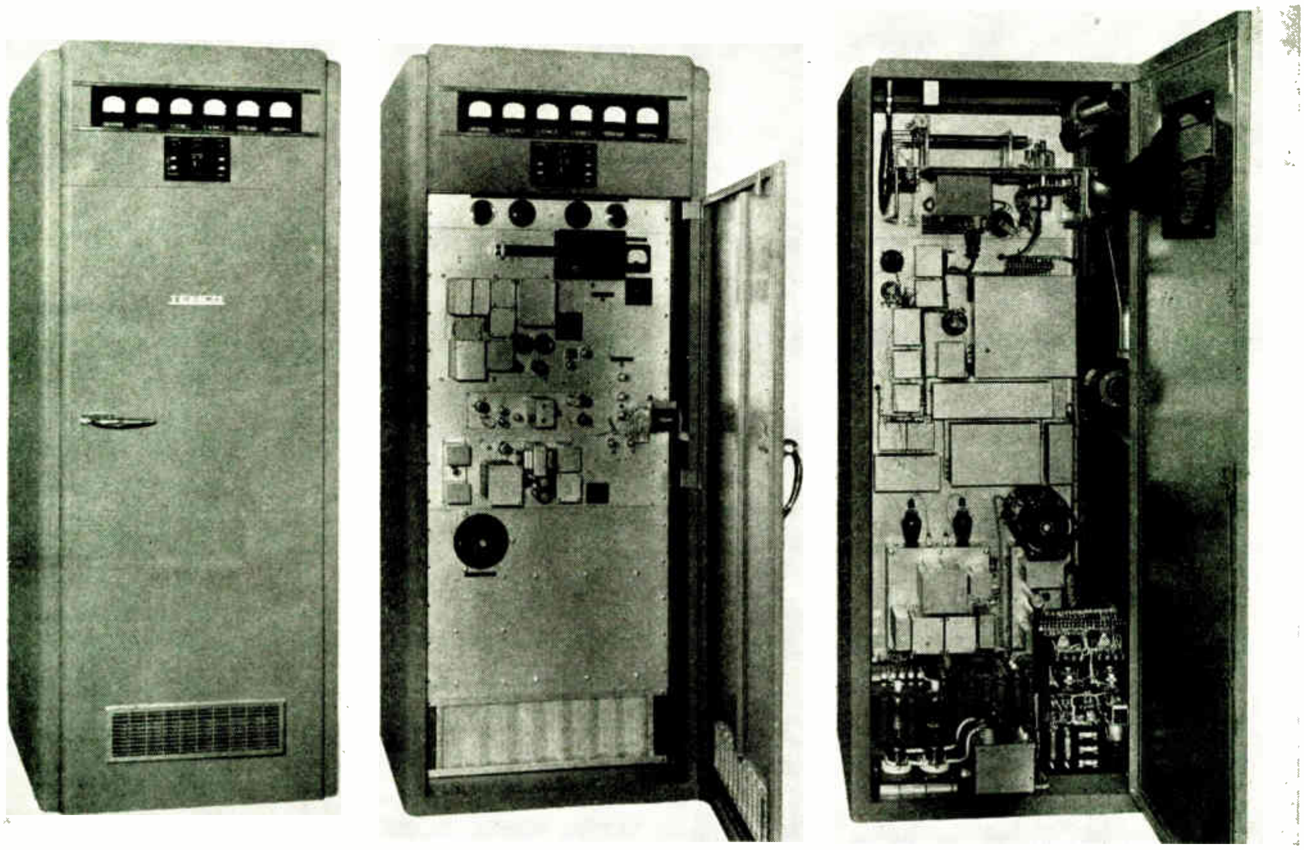
Consistent, stable, center-frequency control of the primary oscillator is a prime consideration. The method used is to incorporate in the set the usual crystal controlled oscillator as a reference standard. The primary working oscillator, the source of the frequency modulated carrier, is continuously monitored by the crystal oscillator.

This supervision of the center-frequency is effected by an electro-mechanical system which makes use of the fact that two carriers differing in frequency by a small amount may be considered to phase-modulate one another. The amount of phase modulation of either carrier is determined by the relative amplitudes of the two carriers, and the value of the beat difference between them.

Outputs of the primary oscillator and the standard crystal oscillator are fed to two mixer stages. One mixer yields the AM audio components; the output of the other mixer is fed through limiters and is followed by a discriminator from which FM audio components are recovered. These AM and FM voltages are applied to a phase detector.

Relative phase of AM and FM audio voltages depends upon the sign of the beat difference between the standard crystal oscillator ref-

These three views of the new Temco model 250BCF 250-watt FM transmitter for the 88-108 mc band show its appearance with the front door closed, with the door open revealing essential tuning controls, and from the back which gives access to the oscillator circuits, modulators, etc.



TRANSMITTER FOR 250 W

erence carrier and the primary oscillator carrier. The level of the dc output voltage from the phase detector is directly proportional to the beat difference between the two carriers, and the sign of that voltage is a function of the sign of the beat between the carriers.

Output voltage from the phase detector is applied to a dc amplifier, which in turn controls the grids of a pair of thyratron tubes. AC voltage of proper phase to operate a two-phase motor is obtained from the output circuit of the thyratrons; the motor is mechanically coupled to the primary oscillator tuning capacitor. In this manner continuous monitoring of the center-frequency of the primary oscillator is provided.

Direct indication of the primary oscillator frequency in cps with respect to the standard crystal oscillator frequency is also provided for. DC output voltage from the phase detector is used as a measure of the beat difference between the two carriers; a zero-center dc voltmeter having a high internal resistance is placed across the phase-detector output, indicating both the value of the difference frequency and its sign.

Grids of the modulator tubes have no correcting voltage fed back as a result of drift in the primary oscillator, which eliminates the possibility of distortion arising from operation on improper portions of their characteristics.

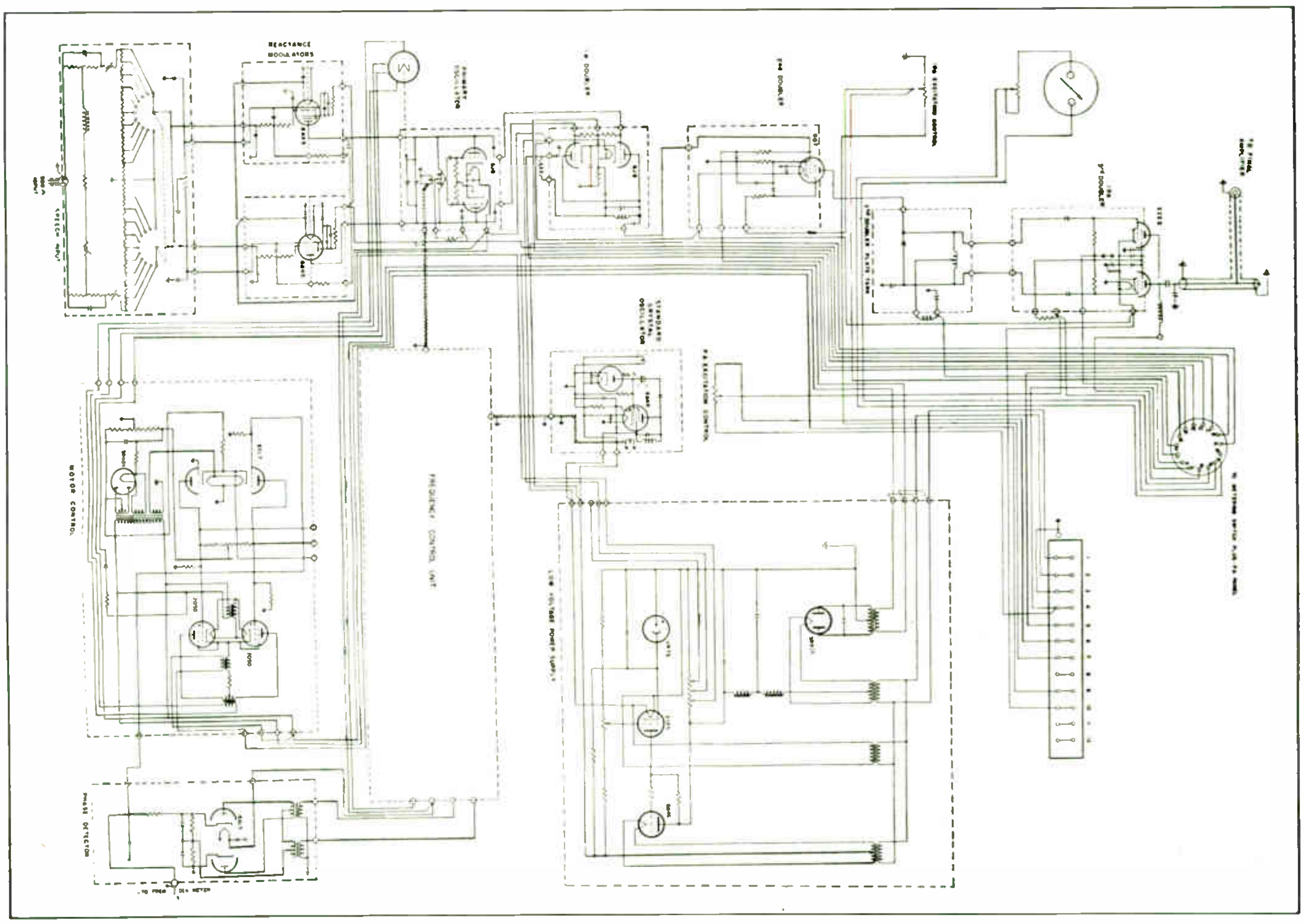
The power supply for the standard crystal oscillator, primary oscillator, and modulator was carefully designed for constant output voltage with respect to load changes and line variation. Undesired FM modulation of the primary oscillator would occur if the power-supply voltage should vary.

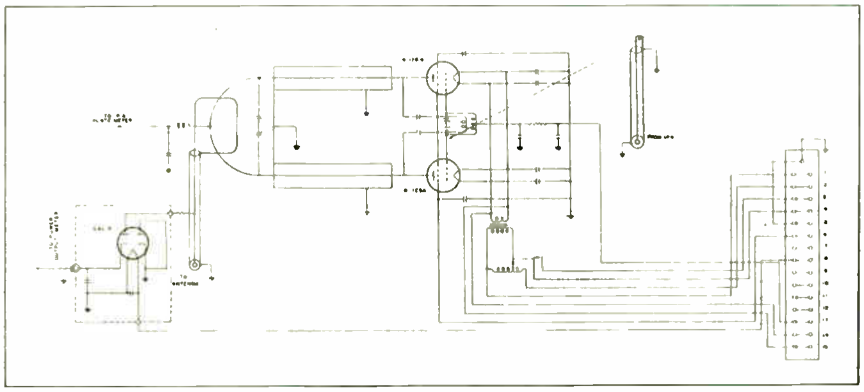
For the same reason, ripple must be kept within a few millivolts to avoid hum modulation of the carrier. A high degree of regulation of the voltage supply for the standard crystal oscillator is provided by means of the 6B4 high-G_m control tube; the amplifier tube is a high-mu 6SF5 triode, the cathode of which is maintained at a constant reference level with a VR-75 voltage-regulator tube.

The primary oscillator operates within the frequency range of 11-13.5 mc. Use of balanced modulators and a push-pull oscillator provides twice the FM swing of oscillator frequency that is obtainable with a single modulator, and permits use of a multiplication factor of only eight to raise the oscillator frequency to the carrier frequency. Since the push-pull circuit eliminates even-order harmonics which would otherwise arise due to curvature of the transfer characteristic, this further advantage is afforded.

Reference to the schematic diagram shows the potentiometer circuit for balancing the cathode cur-

Schematic diagram of the Temco 250-watt transmitter showing arrangement of the frequency stability control equipment and linear tanks





Schematic of the concentric line final amplifier for the 250-watt FM transmitter

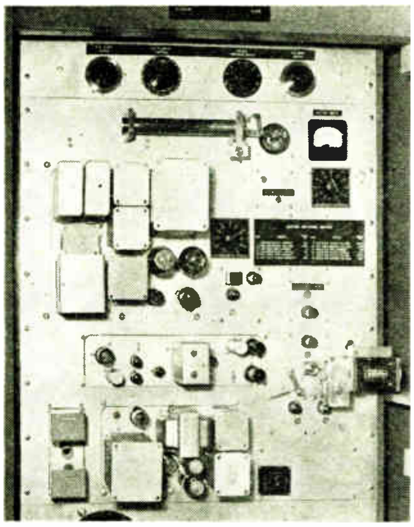
rents of the 6AK5 modulator tubes; variable capacitors are provided for adjusting the value of the quadrature voltage fed back to each grid. Quadrature voltages fed to modulator grids are in phase; if the grids are connected together and a modulating voltage of the same phase is applied, reactive currents flowing through the push-pull oscillator tank as a result of modulator plate currents, will be effectively zero.

Means are thus provided of adjusting the cathode currents of the modulator and values of quadature voltages fed to each grid so that no FM modulation of oscillator frequency takes place when modulating voltage is applied to modulator grids. Balancing of the modulators can then be carried out at various input levels of modulating voltage, insuring that both modulator tubes are operating on the same portion of their G_m characteristics; with this condition a symmetrical shift of oscillator frequency about its center value results.

With modulating voltages of opposite phase applied to each modulator grid, reactive currents now flowing in the oscillator tank coil will be of the same sign and opposite phase, resulting in a double total net effect on the oscillator frequency.

Type 6AK5 miniature pentode tubes were purposely selected as modulators because of low internal capacitances and high G_m. Grid and plate circuits of each modulator tube are separately shielded to avoid relaxation oscillation.

Audio modulating voltage fed to modulator grids is carried through a 500-ohm line, across which is placed a series RL network having a high-frequency pre-emphasis characteristic; its slope may be adjusted to lie between the FCC specified limits. The time constant of the pre-emphasis network is 75 microseconds; its frequency characteristic is within ±1 db of the normal curve of the circuit.



Close-up view of front of the exciter units

Plates of the modulator tubes are connected directly to the plates of the 6J6 dual miniature triode used in a push-pull Hartley circuit; it is required that the oscillator tube have low C_{gk}, low C_{pk}, and high G_m. The low interelectrode capacitances are necessary to keep the shunt capacitance of the tank down; high G_m is required to enable the tube to oscillate readily at 11-13.5 mc.

To obtain a minimum deviation of ±10 kc, it is necessary that the reactive currents developed by the modulator constitute a considerable portion of the total tank current. Thus, constants of the tank circuit have to be chosen to insure stable oscillator operation, while permitting specified modulation of the oscillator frequency.

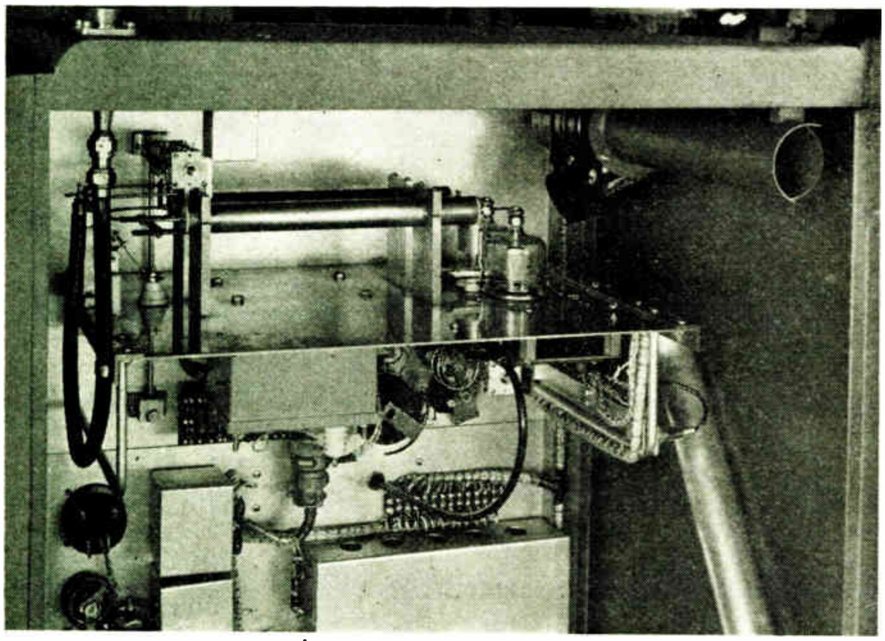
Sufficient power is likewise developed by the oscillator to drive the first doubler; approximately 3½ watts are available. The grid-cathode capacitance of the doubler tube is effectively in shunt to the oscillator tank, which requires that it be kept low. A 6J6 miniature twin triode is used as the first doubler for this reason, in a push-push circuit. Three watts of second-harmonic power are developed.

Considerable power must be developed from the second doubler to insure saturation of third-doubler grids; an 807 tube is used for the purpose. Its input capacitance of 11 mmf, while relatively high, is not prohibitive since plate-cathode capacitances of the parallel-connected 6J6 are only of the order of 0.8 mmf.

Use of lumped parameters in the first doubler plate circuit is still feasible, as it is operating in the 22-27 mc region. To obtain considerable second-harmonic voltage from the 807 plate tank, a large

(*Continued on page* 146)

Close-up view of the rear of the final amplifier showing mounting of the 4-125A Eimac tubes



GERMANY'S UHF TUBES

American engineers and scientists investigate and report on design of water-cooled klystrons and various magnetrons

Some information on German equipment has been released by the U. S. Department of Commerce (Publication Board) based on personal reports by the members of the Combined Intelligence Objectives Sub - Committee, who are making studies of German industrial and military equipment and the status of research in the Axis controlled countries. During the next few months, digests of reports on the most interesting items relating to electronic matters will be published here. The complete reports are available from the U. S. Department of Commerce, Washington, D. C.—Editors.

● Along with other items, the UHF tubes developed during the war were investigated and a number of interesting items were turned up. For example: A water cooled Klystron[1], with a double internal resonator and inductive coupling between the two sections was developed. Using a voltage of 5 kv, an output of 100 w, and an efficiency of 10% was reported. Provision was made for modulating the accelerating grid of the tube (200 v modulation). Noise modulation (spectrum 1 to 3 mc/s) was used, variously a hexode mixer tube, a gas discharge tube, and a resistance as sources of noise. The few tubes made were used by the Luftwaffe in the Feuerball jammer, for jamming H2X, the frequency range being 8.6 to 9.3 cm.

A corona discharge tube for stabilization of voltages up to 10,000 v (mainly for Klystron operation) was started but was dropped in favor of neon stabilizers in production at Philips.

Some of the tubes developed by Dr. Oskar Heil[2] gave electron efficiencies of 50% (theoretical maximum 65%) and an over-all efficiency of around 25%. These tubes had magnetic focusing. A newer tube, using electric focusing, operated at 3 cm and gave 20 w average power when pulsed with 1/10 to 1/20 duty cycle.

The RoE/4 101 tube appears to have two especially interesting features: the cavity design and the electron focusing. The cavity of this tube can be operated at 3 cm, 4.8 cm, or at 7 cm with different drift times for each mode. The center discs for each mode actually are of different shapes, and the supporting legs are attached at different places. The disc and the legs are those used for the second mode at 4.8 cm. The tube will operate best with a particular shape of the disc, designed to give the shortest possible drift time for each mode. By altering the shape and position of the disc for a given mode, the the ratio of bunching to catching voltages may be controlled in design.

[1]Report Index Number, 78.
[2]Report Index Number, 95.

Dr. Heil stated that the most desirable beam is one having a uniform charge density in cross section. In such a beam, although the electrons diverge, they appear at any point along the beam to be all diverging from the same point in space, giving a converging beam of uniform density and a uniform field at the surface of the cathode. A beam of uniform density avoids lateral oscillations which cause a reduction in useful beam current.

A cone-shaped electrode between the ring and the opening into the bunching space (called the "control space"), operated at 20 to 30 volts above the cavity potential, arrests the longitudinal drift of the positive ions before they reach the cathode. In practice, there are enough gas molecules present to permit the formation of a positive space charge. The geometry of the system is such that, neglecting space charge, the electrons would cross over at the position of this conical electrode. The positive space charge partially neutralizes the electron space charge and reduces the spreading of the beam.

The tube is so designed that the neutralization of the electron space charge is almost complete for the dc beam. This means that the neutralization is incomplete in a bunch, and that there is a net positive charge in the region between bunches. The limiting sine-wave modulation frequency at which this focusing effect can be observed is around 10 kc. This implies that about 100 microseconds is required for the positive ion space charge to form.

The beam at the entrance to the bunching region is about 1.9 mm in cross-section. With gas focusing it is 2.2 mm, at the exit from the space, and without gas focusing 4 mm. These beam measurements were made at dc. Because of the inexact space charge neutralization of the modulated beam the corresponding rf figures would not be as favorable, and were not. In the newest tubes, ratios of cathode diameter to diameter of the beam at its smallest point have been as large as 85, for 1,000 v 70 ma beams.

It was reported that for the greatest efficiency in a velocity-modulated oscillator the electron bunch should be disc-shaped although this ideal has not as yet been attained. There is an optimum charge density of the disc, above which the disc life time is too short to be useful.

An oscillator of this type could be tuned either by deforming the cavity or by inserting metal slugs through ceramic glass tubes. No mechanically tunable tubes were built, but tuning was accomplished by changing the accelerating voltage. A change of 1.2 mc at 2,000 mc was obtained on an older model as the voltage was changed from 975 to 1180.

Electron optics

Unusual technics were employed for studying electron optics. For example, Dr. Heil set up an electron gun in a vacuum tube, and placed a piece of carbonized filter paper in the beam. Where the beam strikes the paper, the paper gets hot and glows. This method was found necessary because the beams being investigated are so intense that fluorescent screens are burned very quickly.

The various components of the guns used in experimental tubes are mounted on wires in such a way that they may be slid longitudinally along the tube in order to alter the spacing between components. They are made to slide simply by tapping the tube; their positions are measured with a traveling microscope. The screen used to observe the cross-section of the beam may itself be moved in the same way. By making two components have different frictional resistances, a series of tests may be made in which one component has a fixed position while that of another is varied.

The carbonized screen is prepared by placing a piece of filter paper between metal plates and heating this assembly at fore-vacuum pressure. Next the metal plates are removed, and usable bits (of the order of 1 cm square) are clamped tightly between molybdenum plates and heated in an induction furnace in a high vacuum.

An oscillographic method of measuring the energy spectrum of the electrons in the beam was reported where a probe was placed in the collecting region of the oscillator tube, and an audio frequency voltage applied to it. The same voltage is applied to one pair of deflecting plates of a CR tube, while the other pair of plates is controlled by the current picked up by the probe, giving a trace which is a measure of the energy spectrum of the beam.

Transit time resonance

An effect which might be called transit time resonance (TTR) has been utilized in tube design. Suppose we have two parallel metal plates to which a high frequency voltage is applied, assuming that some free electrons are present in the space between the plates. At certain voltages and spaces, an electron starting from near one plate at an instant of zero voltage will be accelerated toward the other plate and arrive there at the next instant of zero voltage. The electron will then have acquired energy which it loses by collision with the second plate, from which secondary emission may be released. The latter is accelerated toward the first plate. Since they start at an instant of zero voltage they too acquire energy and release still more secondaries when they hit the first plate. The process is cumulative and relatively empty space absorbs energy.

This is of importance in the design of HF tubes, because a region in which the necessary conditions hold may easily be unintentionally built into a tube, causing, among other things, dead spots in tuning. Improved working efficiency of some of the tubes was made by discovering and eliminating such regions. The area over which we might have resonance at a given frequency can be reduced by using cone-shaped elements in the tubes. The amount of secondary emission may be reduced by cutting away the metal, leaving teeth having a net area not less than 1/10 that of the unmodified electrode. The effect may also be reduced by giving attention to the secondary emission characteristics of the surfaces involved although oxide-coated cathodes have the tendency for the oxide to evaporate and contaminate the surface. (This effect is similar to that used in the Farnsworth multiplier.)

In a tube which is built along the lines of these with which Heil first worked, in which the beam is projected across a coaxial line, electronic tuning may be obtained by projecting a second beam across the line normal to the first. The drift time of the tuning beam must differ by about one-half period from that of the working beam. The frequency is changed by altering the current in the tuning beam.

Magnetrons

Several magnetrons also were investigated.[3,4] For example the LMS 10 had a peak output power of 15 to 20 kw. In a circuit rf buildup time was reported to be 1/100 miscrosec. The frequency ranged 8.9 to 9.1 cms as the tube happens to come from production.

Thus the magnetron used in a 10 cm equipment, was a copy of the allied one. The 3 cm tubes produced were claimed to be their own development. The LMS 10 was 30% efficient.

The LMS 100 (up to 100 kw) also on 10 cm was 10% efficient and had a field of 1,500-2,000 gauss, 30% greater than critical. It was air-cooled and was suitable for space/mark of 1,000. The LMS 12 on 3 cm had 18 splits, the LMS 32 was 3 cm tunable, and water-cooled, with 2 kw loss. Small receiver magnetrons are the RD2MG (3 cm, 6 or 8 splits, 50 w output, short life), the RD2MH, and the RD4MG. This series contains about 10 other types. They have used copper magnetron anodes only, have had trouble with glass-sealing (usually nickel-iron soldered to the copper with silver - solder was preferred). Most of the tunable magnetron work was done on 3 cm, using a metal ring supported on a flexible membrane and moved towards the circle of gaps.

[3]Report Index Number, 58.
[4]Report Index Number, 59.

Tubes in the 2.0 to 1.6 cms range were in the experimental stage. A magnetron LMS 13 was used giving a peak power of about 1 kw with a 1-microsec pulse. For some reason, a waveguide feed was abandoned here, and a concentric used. The LMS 13 was a scaled down model of LMS 100. It used about 3000 Gauss at 15 Kv. In general, electromagnets are used to produce these fields as Germany has no cobalt to make good permanent magnets.

The modulation system was a copy of the British. The modulator is an LG 201 and later, an LG 201 A (a better model). A 1-microsec pulse is used, at a pulse rate frequency of 1500. The antenna system used 4 to 8 dielectric rods giving a beam width 10° (total to half amplitudes). This antenna had a scanning speed of 300 to 400 per minute, and was fed by a coaxial line. The standing wave tolerance allowed on the feeding line is 1.3 to 1, in amplitude. The receiver had an if of 30.5 mc, 2 mc wide. At the video stage output the leading edge of the pulse rises in 1/3 microsec, and the trailing edge falls in about ½ microsec. The crystal for the mixer is of "vapored" silicon.

The 3 cm technic—"Berlin-D"—was said to be almost an exact copy of the American H2X as far as the magnetron, antenna and mixer are concerned. All the rest was taken from the 9 cm Berlingeret. For Naval use a 1½ m parabola was used, stated to give a ¾° beam (total to half amplitudes).

Power measurement

In another research program magnetrons for use in search receiver design and in frequency measuring experiments were developed.[5] They claim to have operated magnetrons as high as 3.7 mm wavelength. They obtain a S/N ratio of 100:1 using horn antennas and crystal detectors at 3.7 mm. They can accurately measure power output down to 3 cm. Their frequency measuring apparatus permits measurement with the following accuracy:

Down to 5 meters..........±2 parts in 100 million
Down to 8 cm..................±20 parts per million
Down to 0.8 cm..±0.1%

A magnetron also was developed[6] which could be operated at any of several discreet wavelengths be-

(Continued on page 122)

[5]Report Index Number, 69.
[6]Report Index Number, 78.

LABORATORY KEYHOLE

Current Research that Forecasts Future Electronic Developments

WEATHER-SENSITIVE TUBE—J. Rothstein of the Belmar, N. J., labs has developed a microphonic electronic tube highly sensitive to external pressure changes. This tube may be calibrated to indicate static pressure, and used as a barometer. Because air pressure varies with altitude above the earth, it may be calibrated directly as an altimeter. Reinforced and made rigid, the tube may be used as a piezometer. Properly calibrated, it can be installed on submarines to give precise readings of depth. The tube also will measure and record temperature, measure wind velocity through dynamic pressure, record air speed and water flow, register pressure changes in a wind tunnel and measure minute changes in the stress of metals.

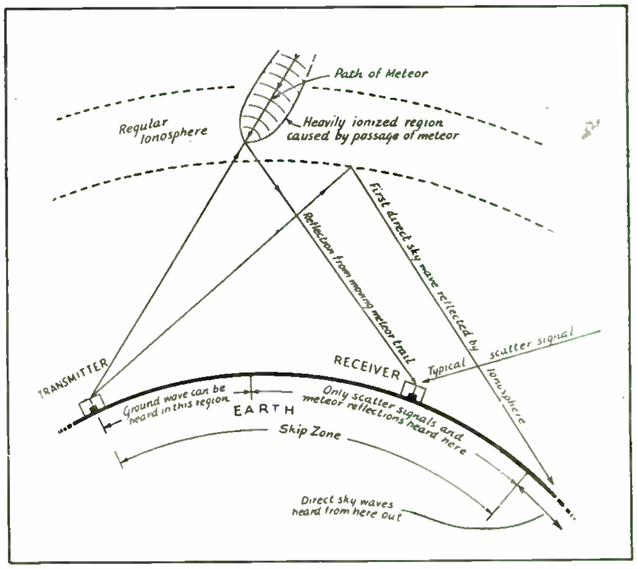
HIGH FREQUENCY HEARING—Using extended range audio systems in services where high fidelity is possible (FM and television), a certain research group has found that it was necessary to supress transformer lamination vibration, which in one instance occurred at about 15 kc and was annoying to a few people with unusually keen hearing response in these higher ranges.

FOLLOWING BULLET IN GUN BORE—In military science it is of considerable importance to study the movement of the bullet within the gun barrel. Suggestion has therefore been made that strain gages fastened to the outside of the gun barrel at various positions along its length might be used to indicate the passage of the bullet down the bore. According to a report by C. M. Slack, C. T. Zavales and E. R. Thilo, some preliminary work along these lines has been carried out at the Frankford Arsenal Laboratories in Philadelphia. An attempt was made to determine the reliability of the gages in recording the position of the bullet. Excellent pictures have been obtained.

CATALYSIS CONTROL BY X-RAY DIFFRACTION—The catalytic agent used in the Fischer-Tropsch process for the synthesis of hydrocarbons from H_2 and CO consists of Ni or Co or both, with activating materials such as alumina, thoria or other difficultly reduceable metal oxides; kieselguhr has been used as a carrier.

The particle size of the nickel can be determined from the width in X-ray diffraction pattern. The phase of MnO_2 present can also be identified and controlled by previous conditioning. The activator may possibly contain substances that would act as catalytic inhibitors; their presence may be detected by X-ray investigations and they can be eliminated by chemical methods. The kieselguhr carrier has to be previously prepared by suitable chemical and thermal treatments to achieve uniformity and the absence of harmful impurities. This treatment can be followed closely by X-ray powder diagnosis so that optimum conditions are employed. Extensive studies of catalytic processes indicate particle size to be of primary importance suggesting many further applications of X-ray diffraction controls in this field.

METEORS CAUSE RADIO WHISTLES, with tone indicating the speed component toward observer. Effect is analagous to that observed on television screen where illumination periodically brightens and blacks out, as airplanes fly overhead, reflecting waves alternately in phase with or opposing the regularly received waves. With meteor travelling at 40 kilometers per second and reflecting a 20-meter radio wave, says O. G. Villard, Jr., in QST, this results in meteor traversing 2,000 wavelengths per second, producing 4,000 complete cancellations and additions per second, which receiver reports as 4,000-cycle note. Changes in meteor speed are revealed by changes in tone.



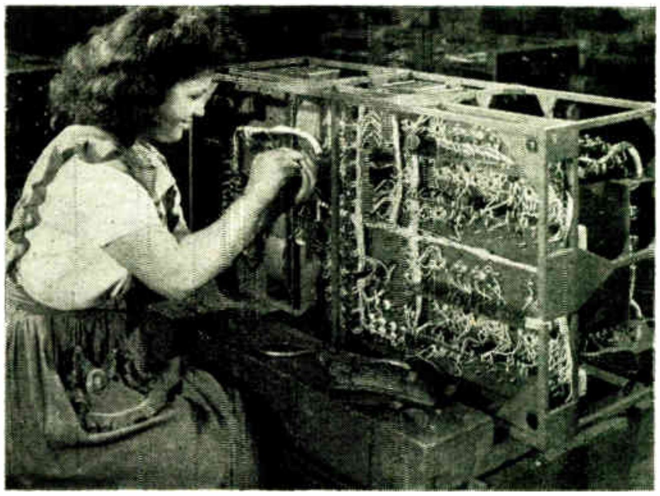
ELECTRONIC DEPILATORY—Violet Arnold of Detroit has been granted a patent on an electronic depilatory unit consisting of a 65-kv X-ray tube, rays from which are filtered through a laminated filter consisting of spaced aluminum sheets with water between. Several treatments are required to remove hair, permanently, it is stated in the patent.

"WEATHER SLEUTH" was a wartime project of Signal Corps and Farnsworth laboratories, which measures the direction and velocity of wind aloft, and also provides information on humidity, temperature and pressure at altitudes up to 60,000 ft. With additional forecasting ability of instrument, device is expected to aid pilots in selecting levels which will provide helping tailwinds instead of delaying headwinds, explains Farnsworth's B. R. Cummings.

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

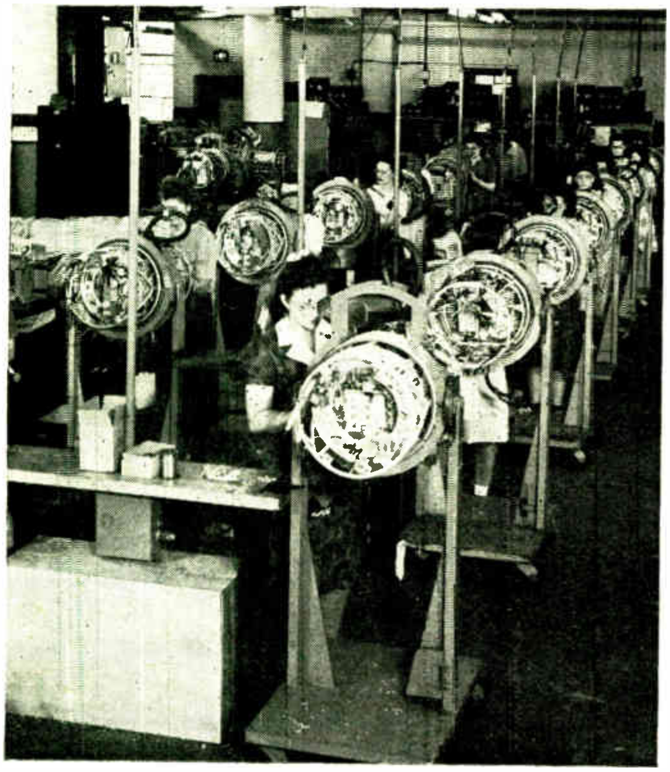
RADAR ASSEMBLY AND

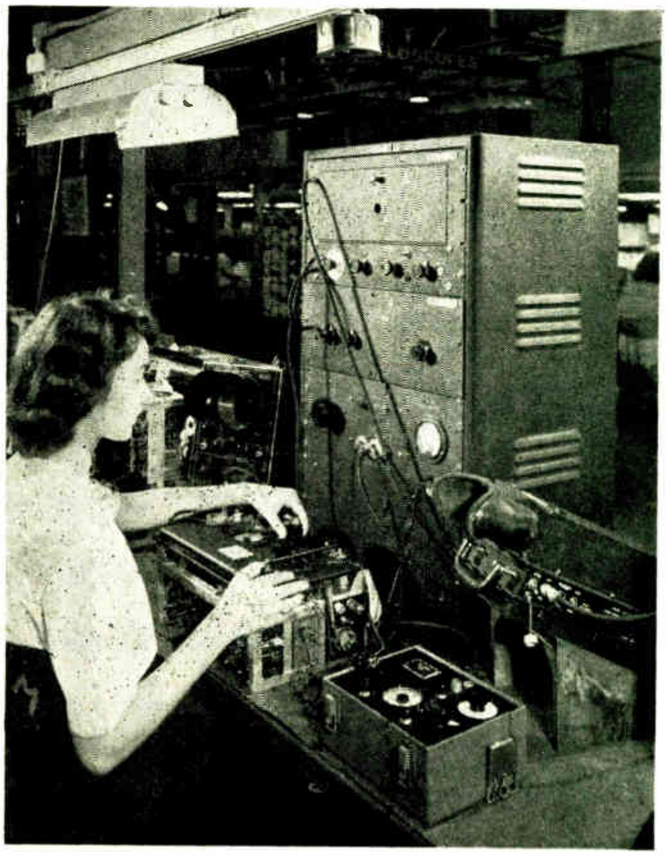
Production engineering of mass production of radar



Synchro-Step Converter in process of assembly. It operates searchlight controls through selsyns and automatically feeds location data supplied by radar searchlight controls. Frame is aluminum tubing

Assembly and inspection line of the step-by-step converter associated with Mark XX Radar. Below: Intricate radars designed to be slung beneath night-fighters to pin-point targets through darkness. Bomb-shaped housings enclose the radars, shown on next page, lower left

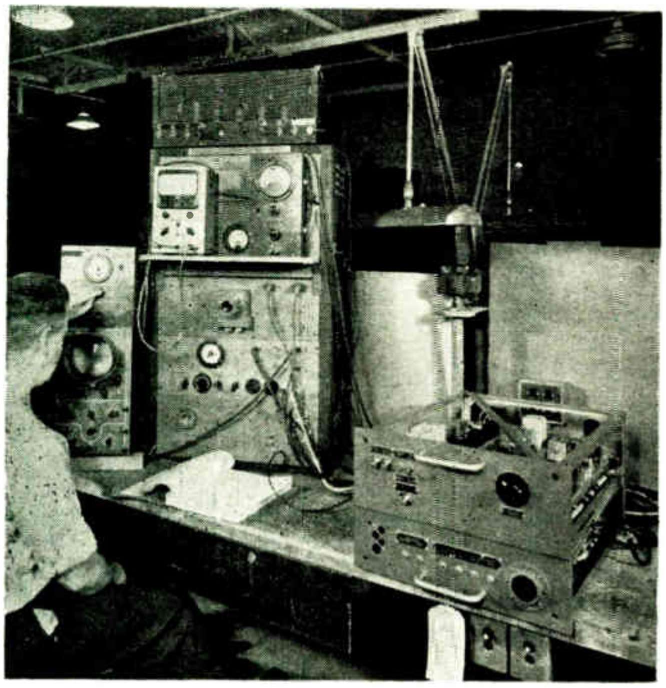




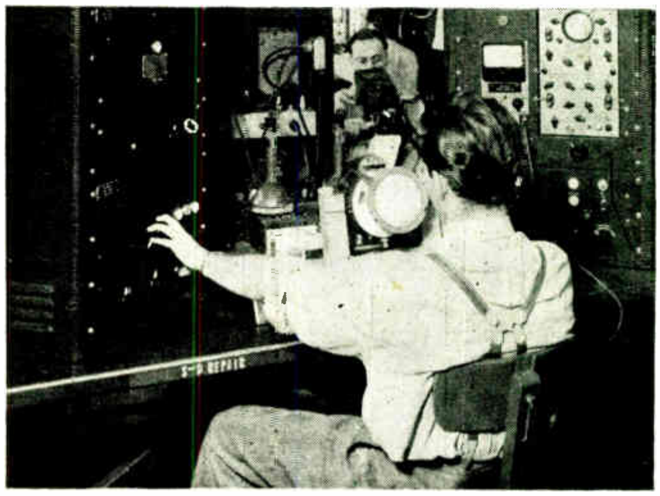
Testing the test equipment; a signal generator receives final operation test before going into the field to check radar performance. A radar is no better than its associated test equipment. When no target appears on the screen, either no target is within range or the electronic equipment is not functioning properly. Test sets tell tale.

TESTING OPERATIONS

highest type is required in equipment on assembly lines

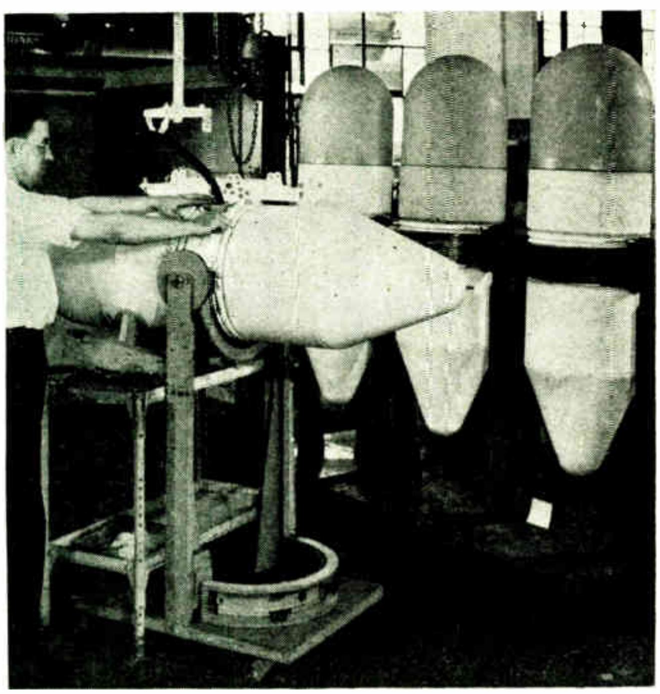


Radar elements which helped to aim big guns that mowed 'em down. With high precision test set, expert radar technician makes final tests of fire control radar prior to installation aboard a U. S. battlewagon

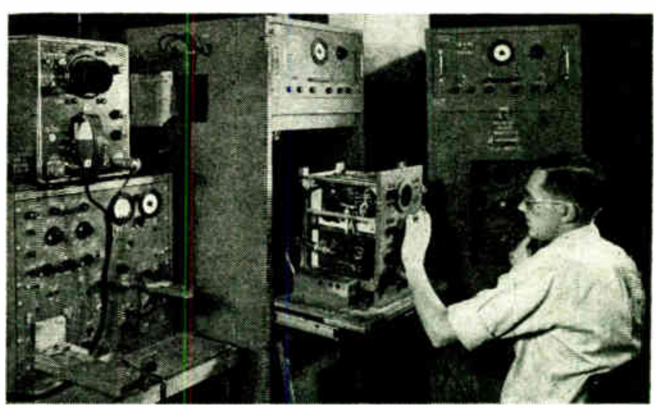


Above is shown one section of the component testing unit at Western Electric Company's 11th Avenue plant, where essential parts receive rigid tests by skilled technicians. See also picture at lower right

Here Western Electric experts give radars final check before sending them out to battle with Navy's subs, trimmed for ultimate precision



Not bombs but radar equipment; interior shown on preceding page, lower left. Attached to wings of Navy carrier-based planes, bomb-like plastic case reduces wind resistance, protects equipment from the elements. The operator is attaching a sway brace to the unit, in final assembly



Before radar can pinpoint targets, accuracy must be built in at the factory, as shown above and in foregoing illustrations. Test sets, more precise than radar itself, groom vital elements for Navy equipment

TEST OSCILLATOR FOR

By WERNER MULLER
Consulting Engineer, New York

Reallocation of FM and television channels accelerates development of versatile obsolescence-proof test equipment for lab and factory

• With industry rapidly returning to the manufacture of civilian goods among which radio is a major item, consideration must be given to the new ideas which will be incorporated in receiver design. The biggest design change has been necessitated by the re-allocation of some of the transmitting channels, specifically those for FM and television.

It is with such new designs in mind that a study has been made for a test oscillator that will readily cover all the new requirements and have features which anticipate later developments in the field. Obsolescence can be eliminated, and the instrument described is almost fool-proof and obsolescence-proof.

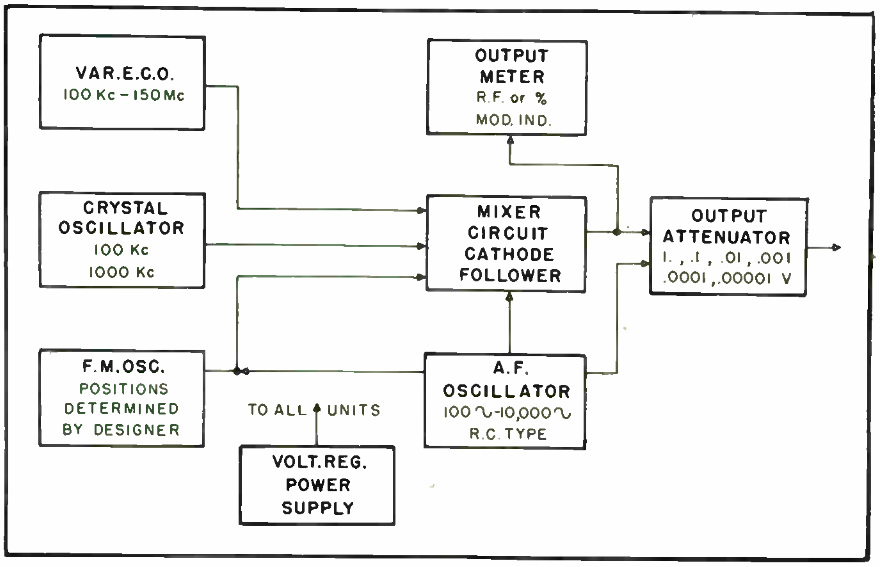
Desirable functions of a universally useful instrument would include:

1—Continuously variable oscillations from 100 kc to 150 mc.
2—Crystal oscillator for 100 kc and 1000 kc.
3—FM oscillator for three frequencies, to be selected by designers.
4—Variable AF oscillator from 60 to 15,000 cycles.
5—Output indication of AF, and RF voltages.
6—Per cent modulation on AM and bandwidth for FM.
7—Complete attenuation of AM, FM, AF and RF output.

These functions are basic. In addition, the following features should be incorporated:

1—Variable RF alone.
2—Variable RF, AM modulated up to 40% by AF.
3—Variable RF plus FM.
4—Variable RF plus crystal frequencies.
5—Crystal plus AF modulation up to 40% or more.
6—FM at bandwidth or deviation frequency predetermined.
7—AF to modulate all RF positions.
8—AF available externally through attenuator.
9—Provision for external modulation for any RF frequency by frequencies from 60 to 15,000 cycles.
10—Low impedance output for RF and AF.

Fig. 1—Block diagram of test oscillator to afford flexibility of operation. Complete attenuation of AM, FM, AF and RF outputs is provided. Frequency range is from 100 kc to 150 mc.



The RF attenuator network should have the following provisions:

1—One volt RMS maximum output fixed.
2—Continuously variable output from 100,000 microvolts to 1 microvolt. Intermediate steps to be in multiples of ten. A variable potentiometer should provide control for setting the output indicator to 1 volt.
3—The output meter should permit ready switching from RF or AF volts, to modulation percentage or Frequency Swing. A meter—and diode or "magic eye" indicator tube can be used.
4—The AF attenuator also should be continuously variable and preferably so arranged as to control either AF output or AF modulation voltage calibrated in percent or deviation for the RF positions and to act also for controlling the magnitude of any external AF signal.
5—The stability of all oscillators should be such as to permit good operation under normal conditions; that is, frequency drift should be a minimum due to line voltage changes. Effects from temperature changes cannot be very well incorporated. except for a very small range.

In Fig. 1, the block diagram shows a suggested arrangement. The RF oscillator, mixer and FM oscillator circuits use the 6J6 tube, a twin triode of excellent characteristics. The crystal circuit uses a 6C5. The AF generator an RC circuit, utilizes a 6SJ7 and a 6SN7 tube. The power supply uses a 6X5 and 1-VR-90 and 1-VR-150.

The continuously variable oscillator circuit using a 6J6 tube, is shown in Fig. 2. The circuit is a

NEW AM-FM-TELE NEEDS

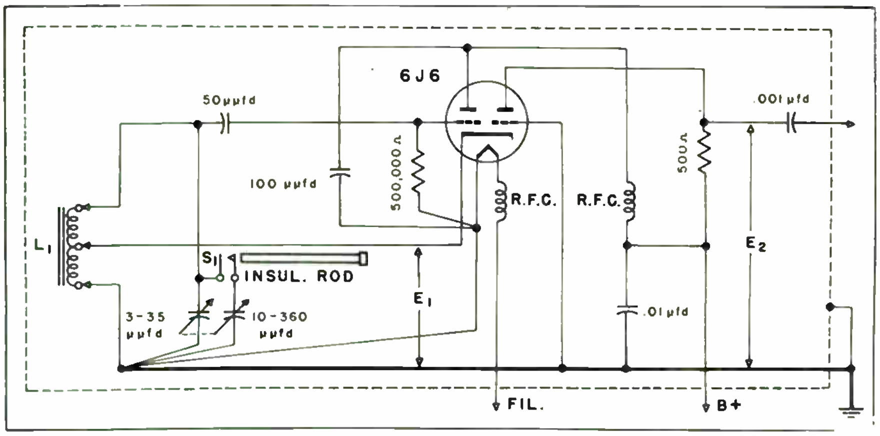


Fig. 2—Continuously variable oscillator. Oscillator is cathode-coupled to grounded-grid amplifier working into low-impedance load. Ten volts rms is developed at 150 mc, with good stability

Hartley with the addition of some new features.

Oscillations are produced in the first section of the twin triode tube 6J6. Since the cathode is common to both sections, the resultant voltage E will operate the second triode section. The second section of the 6J6 operates as a grounded grid amplifier, with the plate circuit operating purely resistive (500 ohms in the example). The oscillator voltage generated in the first section can thus be taken off across the plate load of the second section with the advantage of reflecting a very small load on to the oscillator circuit, thus improving stability.

With a plate supply of 150 v dc and a 15% feedback, an output voltage of 10 volts RMS easily can be developed at 150 mc across the 500 ohms plate load. At lower frequencies the voltage output is slightly higher. Since the plate output circuit feeds into a cathode follower mixer tube (Fig. 3), and the total requirement calls for one volt RF maximum, no trouble will be experienced from the cathode follower mixer due to the loss in gain associated with this form of circuit. The output voltage will be well in excess of the one volt desired. This will hold for the entire operating range.

Particular attention must be paid to the band switching arrangement. The suggested arrangement utilized eight coils to cover the band, using a two-section variable capacitor, section 1 having 330 mmfd and section 2 having 35 mmfd, with 10 mmfd and 3 mmfd being the respective minimums. The capacitors operate in parallel over the first six bands. When using band seven and eight the first section is switched out by a contact arm operated from the front panel.

A few words regarding the oscillator coil arrangement may be of value. To cover the entire range 100 kc to 150 mc, particularly the last two ranges, 45-75 mc, 75-150 mc, calls for exceedingly fine skill, since every mmfd in the tuning circuit counts, and the fight to hold tolerances becomes difficult.

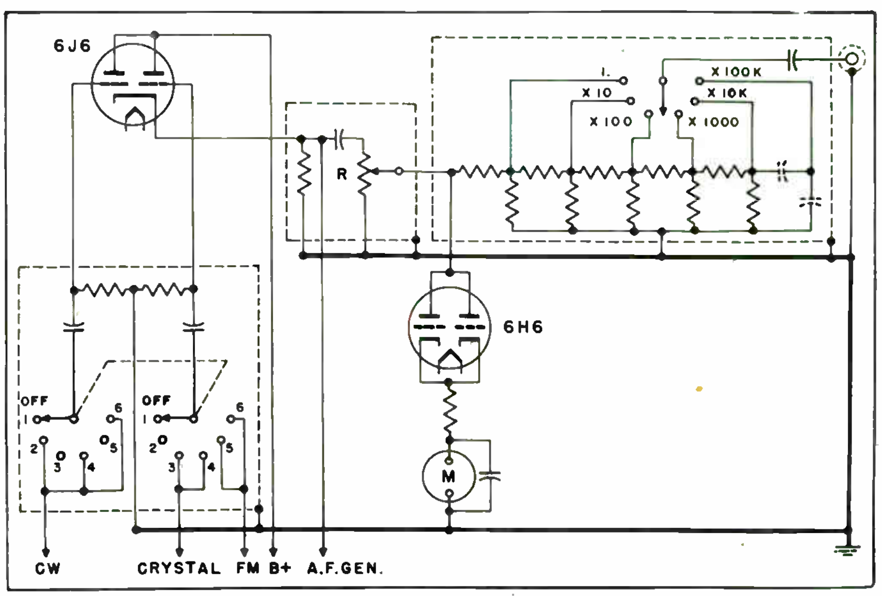
The use of a rotary coil system as shown in Fig. 4 will provide a fairly easy method, which can be adopted for production, with excellent assurances of good performance. As can be noted from the sketches, tube and wiring, switch leads, etc., have been reduced to a minimum without sacrificing operating efficiency. Exact mechanical details are omitted, since they are beyond the scope of this article.

The crystal oscillator uses a 6C5 tube or similar triode in conjunction with a dual frequency crystal operating at 100 kc or 1000 kc. The plate circuit is tuned and the output is capacity fed into the mixer tube as shown in Fig. 5. No particular comments for this circuit are necessary, as it is commonly used.

The FM oscillator circuit in Fig. 6 is a repetition of the oscillator in Fig. 1 with a slight modification. It is this modification which pointed to the possibility of using this circuit for FM. When the 6J6 tube was operated as a normal ECO at 50 mc, a grid resistance of 50,000 ohms was inserted in series with the second section grid. When audio voltage is applied across this resistor, modulation is obtained as noted on an FM receiver tuned to the oscillator frequency.

Two types of modulation are present, AM and FM. The FM modulation observed was checked by a beat note method using a 15 kc audio modulation signal and the BFO in the receiver. The $\triangle$ F, or

Fig. 3—Mixer circuit uses cathode follower. Total requirement is one volt RF, maximum, which is maintained throughout entire range. Cathode follower reflects small load on earlier circuits



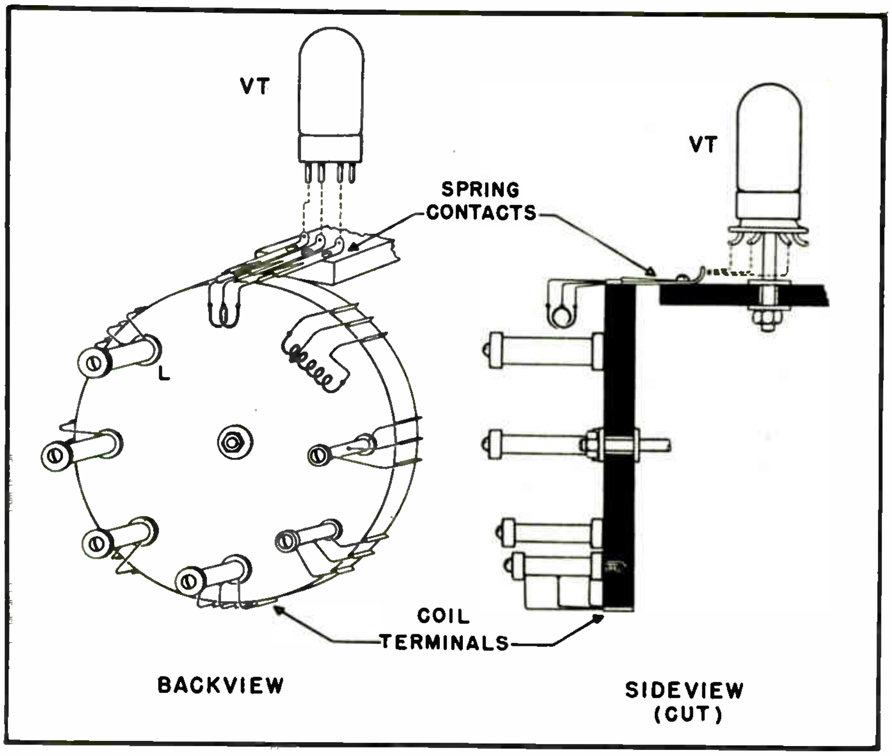


Fig. 4—Turret-type coil mount is preferred from mechanical and electrical standpoints; is a practical production design which maintains low stray capacitances with controlled tolerances

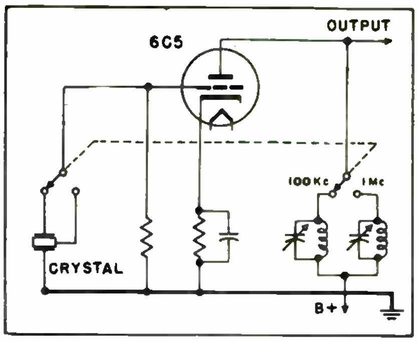


Fig. 5—Dual frequency crystal is used, operating at 100 kc or 1000 kc. Plate mesh is tuned

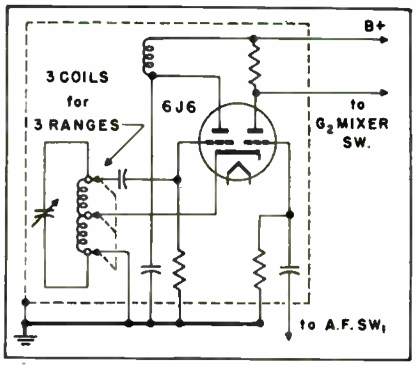


Fig. 6—FM oscillator has AF signal impressed on grid of second section. Is simple, flexible

deviation, as measured showed 750 kc swing, with a given audio voltage impressed on the grid of the second 6J6 section. Varying this audio voltage had a decided influence on the frequency swing, making it smaller or larger as desired. AM was present, but how much was not determined nor were distortion measurements made.

Irrespective of the AM present, the possibility of the circuit warranted further investigation. Should the AM be too great, a limiter can be included at little cost. The most interesting point seemed to be the ease with which any degree of band width could be obtained, by varying only the AF modulation voltage.

The three FM frequencies are of course switched in a normal manner. The desired FM signals are selected by the designer. At the desired signal point, the amount of AF voltage impressed on the second grid of the 6J6 will determine the frequency swing. As mentioned earlier, any AM present possibly can be limited through the addition of a circuit designed for this purpose or if the FM signal impressed on the mixer input is large enough it may be feasible to utilize the mixer tube as the limiter.

Fig. 3 shows the mixer circuit using a 6J6 as a cathode follower and mixer. The two grids are switched to the desired positions providing the following: 1—OFF; 2—CW; 3—crystal; 4—continuous wave and crystal; 5—FM; 6—FM and CW.

Modulation of the CW and crystal positions can be combined or provided for separately; in the suggested circuit the modulation operation is made separate.

The AF circuit suggested is shown in Fig. 7. It is an RC type using tandem resistance controls for changing frequency. The tandem control is cheap and presents a more compact arrangement with some sacrifice in accuracy. The output of the AF oscillator is a cathode follower coupled to the desired circuit, as shown in the diagram.

In one position (SW_1) it causes FM as described earlier; in the other position the AF voltage is developed across the cathode resistor of the cathode follower mixer tube. External and off positions are also provided.

The degree of AM or FM is controlled by the setting of the control in the cathode follower circuit of the AF generator. The wave form of the AF generator is excellent for its range and the amplitude output is constant. This circuit arrangement permits another function, that of utilizing one attenuator network for all operations AM, FM, crystal and AF.

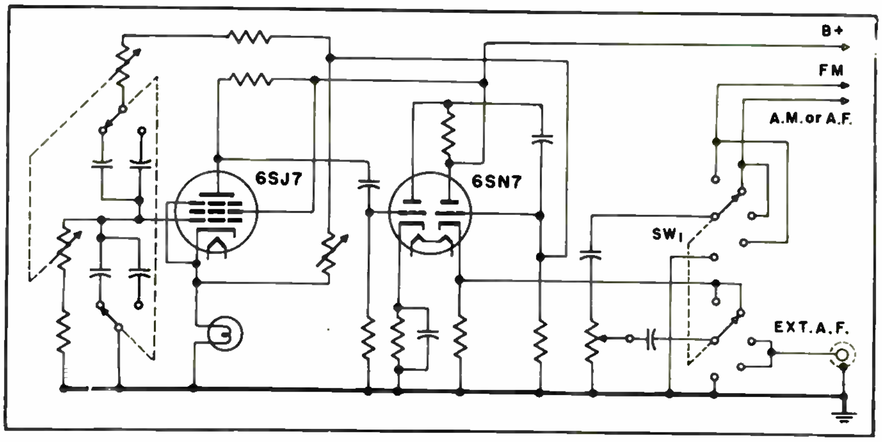


Fig. 7—AF circuit suggested by author. Tandem resistance controls are used in RC oscillator section; design is economical at price of some frequency precision. FM or AM yielded by 6SN7

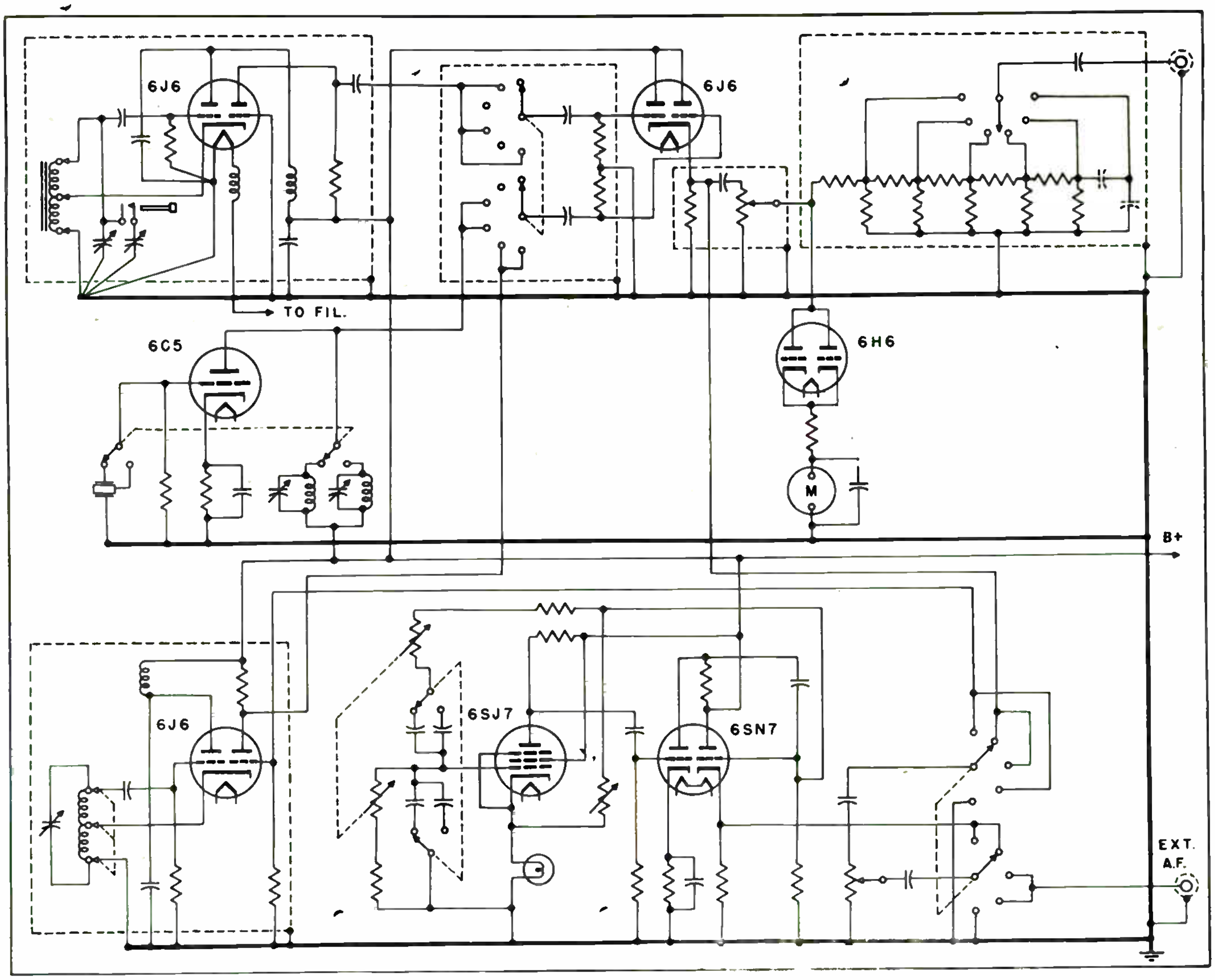


Fig. 8—Complete schematic diagram for the proposed test generator. Indicator is diode rectifier with milliammeter or magic eye tube. Output impedance preferred is 100 ohms. Capacitance network for attenuator to obtain proper operation at high-frequency end, is recommended

The combined circuits of the proposed test generator are shown in Fig. 8.

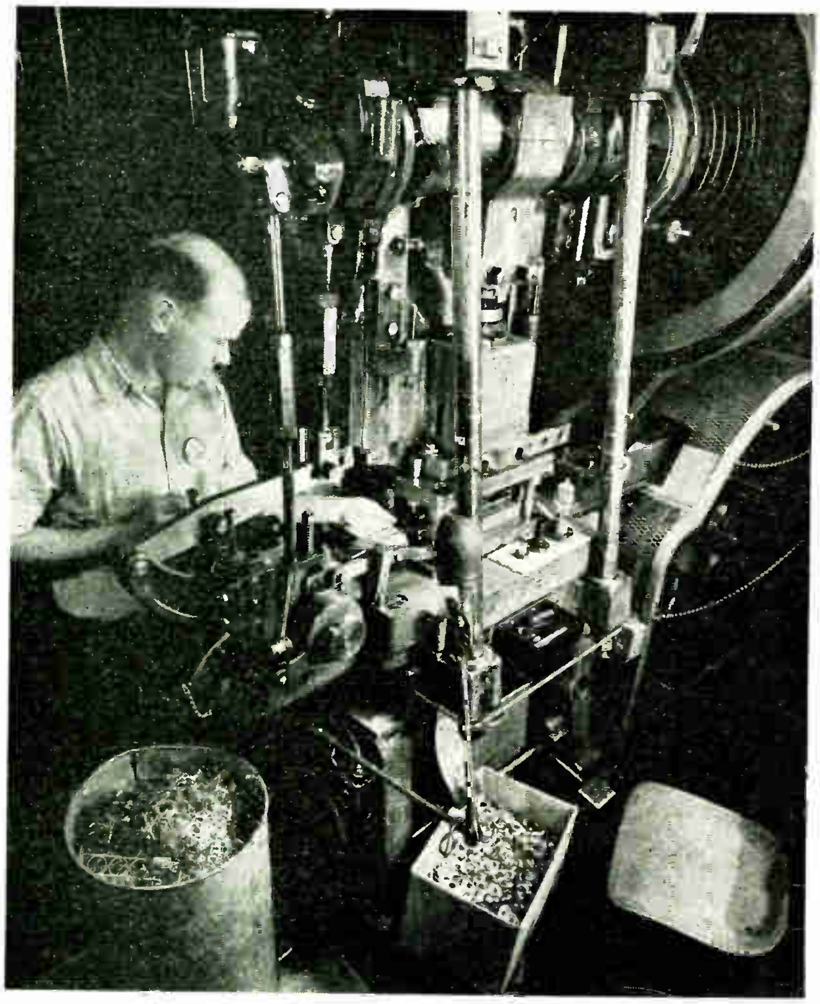
The indicator can be a diode rectifier with diode and meter or "magic eye" type, with calibrations provided. This circuit measures any output voltage directly. R is the rough control,—the attenuator network with points brought to a switch provides variations by factors of ten. The output impedance should be around 100 ohms or less. For the point of greatest attenuation, a capacity network should be used particularly for the high frequency end.

For measuring FM band width the indicator should be switched to measure the AF voltage necessary to produce the given swing for a desired frequency. Once the voltage is determined, this calibration should hold good for general work.

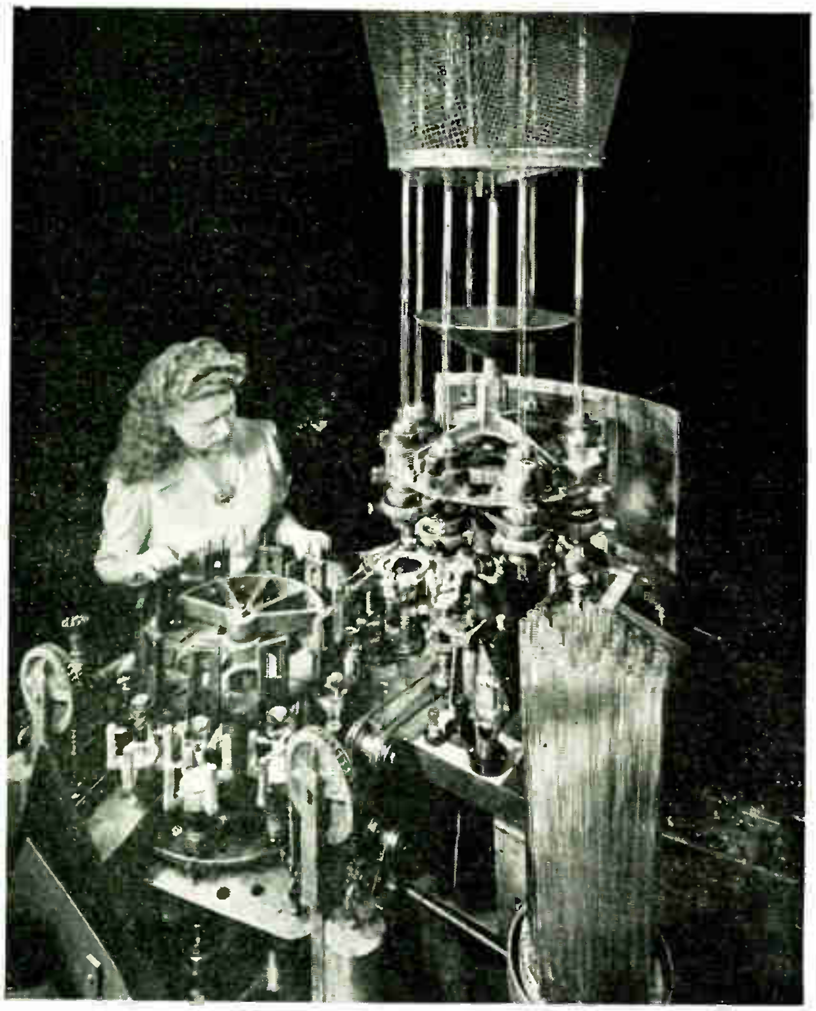
The power supply is conventional and no comments are necessary.

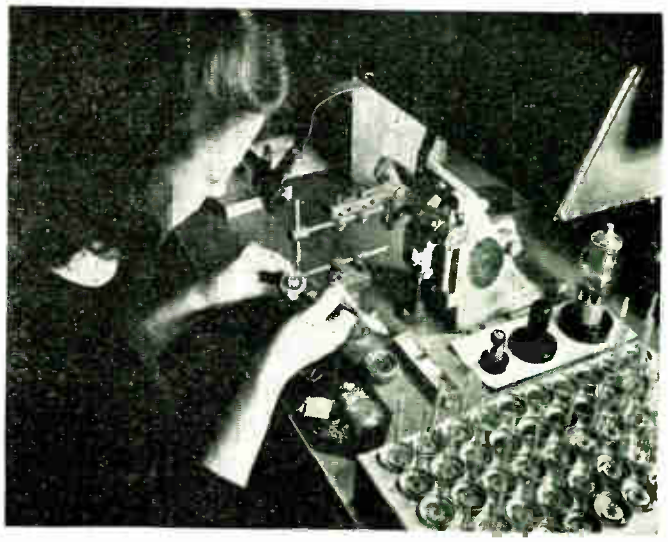
New G E "Brain" for University of California

Highly sensitive polaroid photoelectric systems in this mechanical brain will permit the handling of differential equations with fourteen simultaneous integrations.



Above, automatic feed punch presses turn out a stream of accurately-dimensioned metal parts for RCA tubes. Below, an Acorn bulb machine. Glass in cane shape is fed into rack at top and is cut and formed into the half shells used in Acorn tubes





A skilled operator is mounting the electrode structure of an RCA-6H6 twin diode. A good weld at each point is assured by precision electronic control of the welding operation

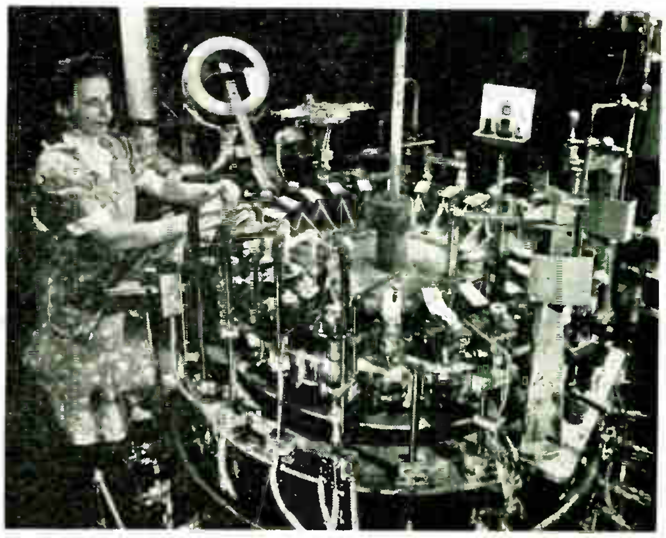
MODERN

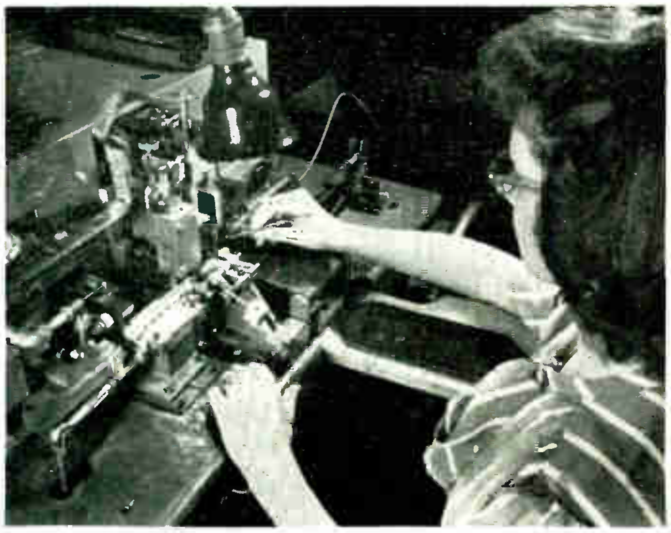
The use of automatic feed in punch presses for the manufacture of millions of small metal parts is obvious, but it requires imagination to visualize, and skilled arts and crafts to fabricate a device like the miniature tube stem machine developed by RCA.

In this machine, seven lead wires are automatically placed in position and held while two glass beads are softened, sealed to the wires, and formed into a "button." The button stems are then supplied to mounters, trained young women, who weld the electrode structure to the stem to form a mount.

In the filament tabbing machine, fine coated filament wire is folded and a small section of metal is attached to each end to facilitate welding to the stem lead wires. The mica

Stems for miniature tubes are made in this machine. As compared with its predecessors, the apparatus incorporates automatic feed of both lead wires and glass parts at once





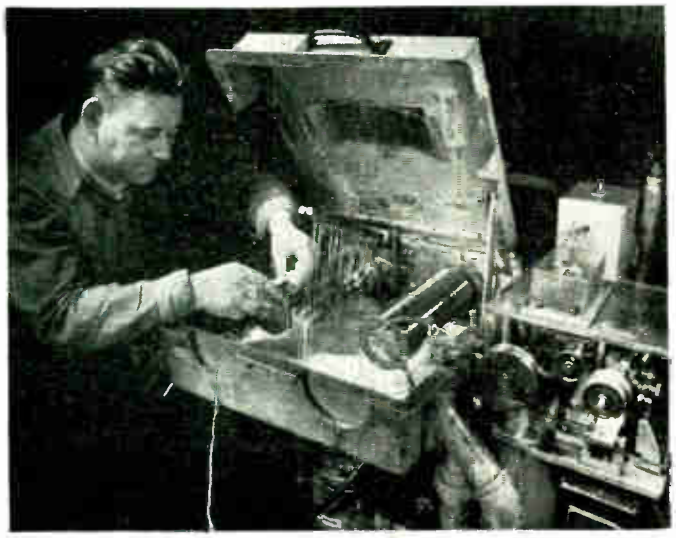
This machine folds very fine coated filaments and attaches a tab to each end of the folded filament for use in 1.4-volt miniature tubes. Tabs are welded to the stem lead wires

Above, a metal-tube test equipment group consists of preheaters, shorts and electrical test set, and an audio frequency noise set. Below (right), Mica insulators often are sprayed with an insulating material to decrease electrical leakage

MIRACLE

spacers used in tube mounts have their electrical characteristics improved by coating both surfaces uniformly with an insulating material which reduces the surface leakage. This operation is performed in a machine having twin rotating drums and oscillating spray guns. The manual operations consist only of loading and starting. The correct amount of coating is determined by an adjustment of the apparatus. The drawing of very fine wire is done in a machine having a graduated series of dies through which the wire is taken in succession. Wire of a few mils diameter is reduced to half the original size in this device. These three machines represent operations in which mechanisms are producing with greater accuracy and speed, and with less operator fatigue than is possible by hand methods.

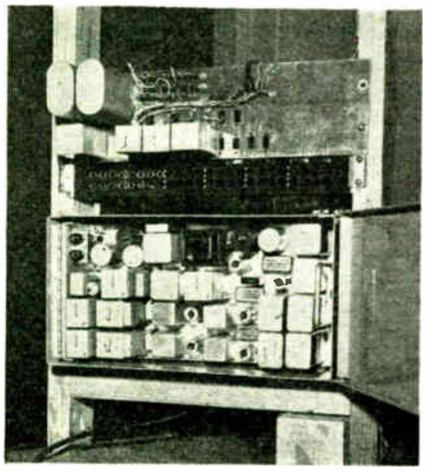
Fine wires are drawn through a series of progressively smaller dies in one operation. The dies are individually lubricated from the manifold to be seen just above the operator's hand



TUBES ON THE JOB

Carrier Telephone

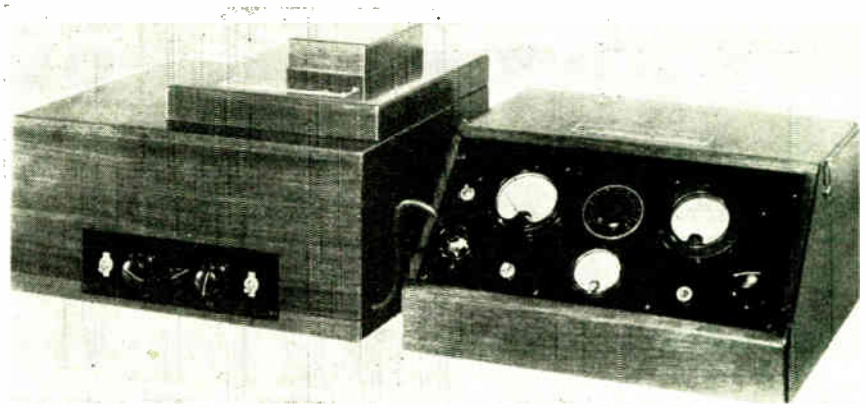
The installation of the first carrier telephone exchange, in which local telephone service is provided to rural subscribers over electric power lines, has just been completed by the Rural Electrification Administration and the Southwestern Bell Telephone Co. While this new carrier central office is of an experimental type and handles only four customers—a general store, one residence and two farms—it is operating under the conditions that will be experienced in permanent installations. Regular dial telephone instruments are used and the telephone speech modulates a carrier of radio frequency which is superimposed on the power conductors. Transmitter-receiver equipment is used at both the main switchboard of the Telephone Co., in Jonesboro, Ark., and at the subscriber's end of the power line.



Terminal equipment for wired radio system which REA and Southern Bell Telephone have installed to provide subscribers with local telephone service by carrier

Uranium Prospecting

The development of atomic energy has made accurate methods for the location and testing of uranium deposits very important. The U. S. Bureau of Mines has designed a fluorescence test which quickly determines the presence of uranium and does not waste the material being checked. A small quantity of ore is broken down and then exposed to ultraviolet radiations of equipment made by Ultra Violet Products, Inc., Los Angeles 27, Cal. If uranium is present a greenish-yellow glow fluoresces.



Visual indications of paper density and uniformity are shown directly on the milliammeter

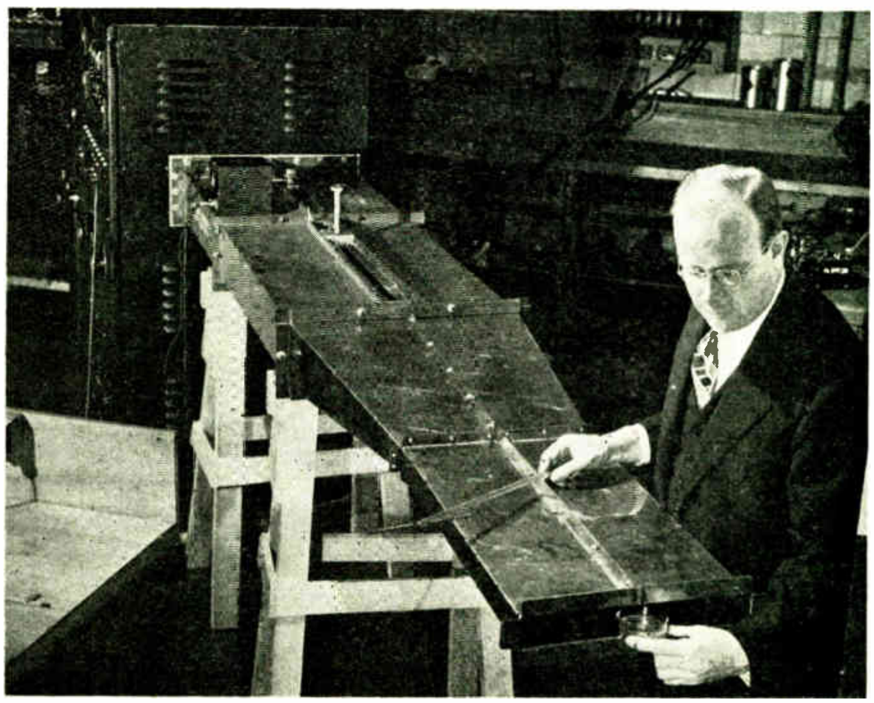
Paper Tester

A photo-electric cell which responds to varying light values transmitted through a paper sample is the heart of new paper testing equipment being used at Kimberly-Clark Corp., Neenah, Wisc.

An 8 in. paper sample is inserted between two horizontally-mounted glass discs. These plates are motor driven for circular motion. Attached to a supporting arm over the sample is a light source with an adjustable diaphragm and an associated lens system; under the paper is a photo-electric cell. This supporting arm is also motor driven to have an oscillating motion across the glass discs. These combined motions provide a scanning area which covers a large portion of the sample under test. Comparison with pre-determined standards will quickly show the average compactness or openness of the sheet structure of the paper under test. Unstable needle movement in the dial indicates irregularities in the uniformity of the paper sheet.

In addition to the scanning unit, the paper tester uses a specially designed three-tube amplifier. The equipment is made by Thwing-Albert Instrument Co., Phila., Pa.

Beamed UHF Is Electronic Blowtorch

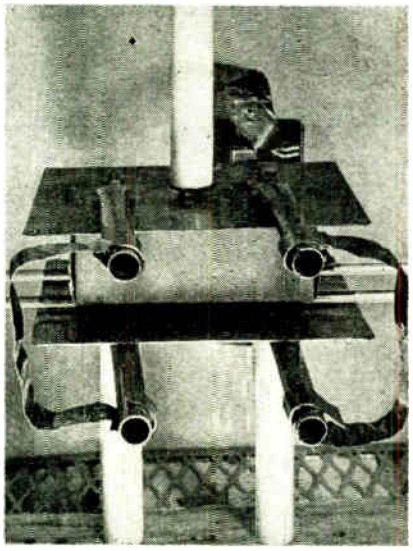


To focus electronic heat on restricted areas for many industrial jobs, Westinghouse is developing a new dielectric heating unit which projects high frequency heat at work. This method shows promise in eliminating scorching or burning in work consisting of irregularly shaped forms

Vegetable Processing

In order to add to the reserve stock of the nation's food, the New York State agricultural experiment station, Cornell University, has been doing research developing improved methods for freezing or dehydrating fruits and vegetables. With either type of these preservation methods, vegetables are exposed to a brief heat treatment to inactivate the enzymes which are thought to be responsible for the deterioration of flavor and the destruction of ascorbic acid and carotene during storage. The use of steam or boiling water for this heat treatment damages the texture of the vegetable and leeches out the vitamin C and members of the vitamin B complex.

Substituting dielectric heating for the steam or water treatment resulted in an almost negligible loss of ascorbic acid and only a small nutrient loss. A frequency of 1750 mc finally was found to give the best heating with an exposure of about 2.5 minutes. The RCA electronic heating equipment had an output of 750 w. The two copper heating electrodes were mounted in an electric air oven, which was maintained at a temperature of 100 degrees C., to prevent condensation of moisture on the electrodes. Tuning stubs were attached to the heating elements to eliminate standing waves and improve coupling. Electronic heating has another important commercial advantage in that the vegetables can be packed in the regular frozen food container right after washing and then pass through the dielectric field just before it is passed in the freezing compartment.



Frozen food package ready for heating cycle

One hot dog with roll ready for the eating; and a second being cooked in the electronic oven

Automatic Furnace Discharge Indicator

An application of the photoelectric cell, amplifier, relay combination giving an automatic indication when a charge traveling through a 100 kw roller hearth furnace (General Electric, Ltd.), arrives at a position near the door and is ready to be discharged.

The unit is ac mains operated and incorporates a C.M.G. 8A photocell which controls the plate current of an Osram L. 63 tube, in the plate circuit of which is a telephone type relay. As the light beam of a projector lamp unit mounted on the opposite side of the furnace is intercepted by the charge passing through the furnace, the tube becomes conducting. The relay operates and causes a warning buzzer or bell to sound indicating that the furnace is ready to be discharged.

In an alternative scheme the photocell unit operates through relays and contactors to stop the movement of the furnace hearth until the charge is withdrawn. The interior of the furnace is capable of being raised to a temperature of 1000 deg. C. but suitable heat resisting glass windows adequately protect the photocell from being adversely affected.

Hot Food Canteen

A new dispensing unit which serves hot dogs, cheese sandwiches and hamburgers—all piping hot, is being installed by Automatic Canteen Co., of America. Dielectric heat is used to re-heat the frankfurters and hamburgers after their initial cooking in sanitary kitchens before they are placed in the canteen. The electronic equipment which was developed by General Electric Electronics Department required considerable experimentation with various frequencies before one was found that would heat the meat and roll uniformly. Some frequencies cooked the frankfurter but would burn the roll. Others would heat the bun but not the meat.

INDUSTRIAL RELAY

By RALPH R. BATCHER
Consulting Editor, Electronic Industries

Many complex industrial control problems find use for tube circuits combined with relay technics borrowed from telephone switching practices

● In many applications of electronics to industrial control it frequently happens that the item to be regulated is not nearby to the source of the controlling effect. Therefore, in setting up electronic systems, numerous methods must be considered before selecting the best system to be assembled. The important methods in use are the systems depending on:

1. The level of a current or voltage.
2. The number of electrical pulses in a sequence.
3. The duration of pulses in a sequence.
4. Phase shifts.
5. The polarity of the operating current.
6. Frequency variations.
7. Wave front or rate-of-change discrimination.

To these may be added miscellaneous methods where non-electrical transmission mediums are used; light intensity, pressure of a fluid, sound waves, etc., which frequently serve as a link in an electronic system.

In some signalling systems it is customary to use more than one of these basic methods over a single channel in order to get a greater number of simultaneous control signals.

Suppose that only a single control circuit is available over a path of several miles, but that several functions are to be recorded or utilized to control local equipment. The circuit which represents a single channel of communication may be a radio transmitter-receiver combination when one end of the system is mobile—a car, ship, plane, etc. The primary effect to be transmitted must first be converted to some form of signal variation the simplest being amplitude modulation.

Signal converter

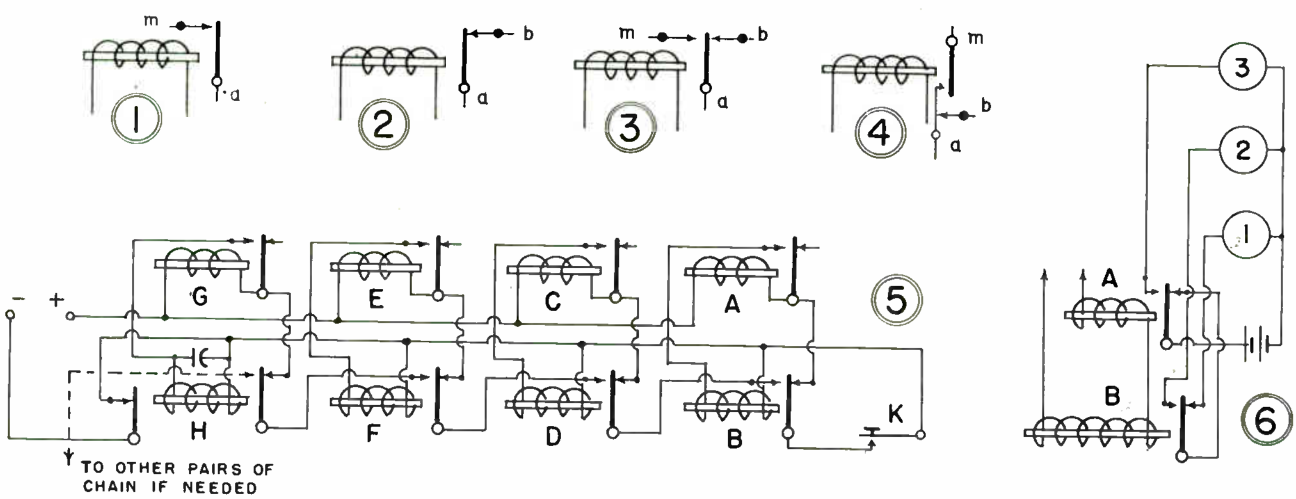
It is, of course, possible to install conversion elements that will take note of changes of the effect under observation. This method is usually not advisable over such distances when more than two levels of signal amplitude are to be handled. In other words, we would then have three conditions only—(off, light current and heavy current) to convey the control intelligence. Moreover, these three conditions cannot be run simultaneously on the same channel.

For short test runs a variable current having a continuous range of levels can be used, which applied to a suitable circuit will give a smooth range of operation. It is not recommended that variable-current signalling be used for precise regulation unless the channel is known to have amplitude constancy.

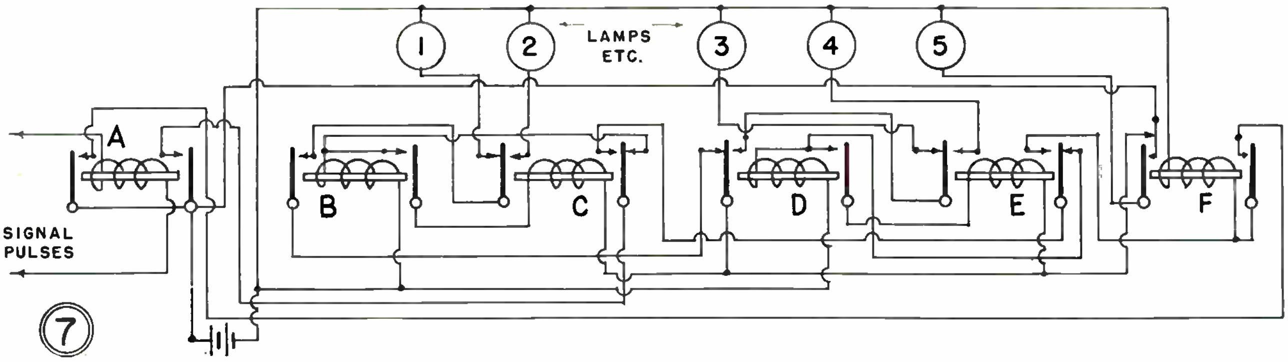
When a more complicated control effect must be transmitted, the simple "on" and "off" control principle can be enlarged by using a series of pulses of equal or unequal duration and by arranging the receiving equipment to take note of their number. The pulse method of controlling circuits is one of the oldest and most used of the circuits in use, as it is found in the dial telephone, teletype, telegraph sytems and others. One finds in use:

1. Simple "on-off" signalling systems.

Complicated timing and sequence effects are built up by combining several simple relay circuits. Relays frequently gain a dozen or more contact combinations in this way. Examples of this procedure are shown here. Item 5 shows the circuit for the pulse counting relay chain



CONTROL CIRCUITS



Multiple selection is accomplished by signals arriving during intervals associated with a group of three pulses

2. Two effects controlled alternately, first pulse operates circuit A, second pulse circuit B.
3. A fixed series of circuits are operated in succession by an assigned series of pulses.

There is more than one method whereby each of these problems can be carried out: a multiple contact switch (ratchet-driven by electrical pulses actuating a solenoid), an "all-relay" system, and an all electronic method, using gas-filled tubes. Nearly all remote control systems find use for one or more relays.

In most of the following arrangements special relays are needed, but these are now obtainable from several supply sources. The relay contact combinations are emphasized in the circuits here described, it being assumed, for the present, that the windings are in accordance with the current levels available for the job.

Complex problems are solved by combinations of simple relays, and a knowledge of a few of the basic principles used in this connection will prove an advantage. The principles described are among those which have found universal application in automatic telephone switching service, and are typical of a few of the common arrangements developed by the Bell system.

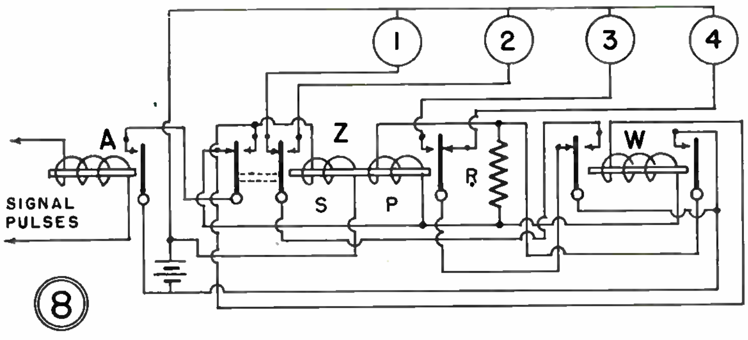
Contact combinations

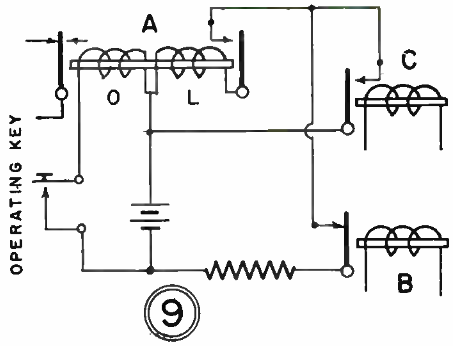
Item (1) shows a simple relay with a "make" contact. The diagram symbolizes a movable armature "a" which is pulled toward the magnet core when the winding is energized, whereupon it contacts "m" and closes a circuit. Using this symbol in a diagram the contacts may be shown at either end of the coil, or if the relay closes several contact combinations at once, the contacts may appear at both ends of the winding core on the wiring symbol. In either case the armature or swinging contact is assumed to move toward the coil in illustrating which contacts open and which close when the relay is magnetized.

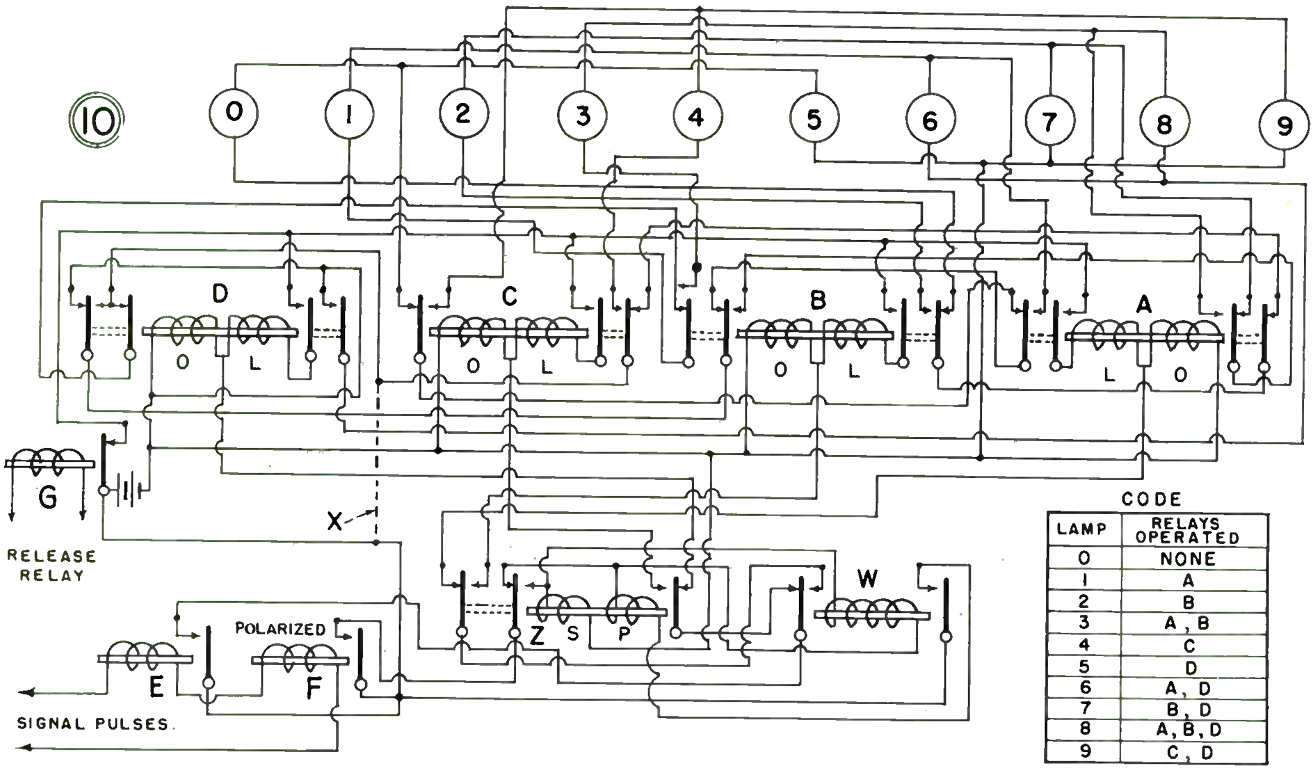
Obviously the contacts may be broken when the relay is operated, which is indicated by item (2) in this figure. A "make-break" or a "transfer" contact is shown in (3) which symbolizes a contact (a) which breaks away from contact (b) and moves over to (m) when the relay is energized. A design sometimes requires that the "make" contacts close before the "break" contacts open. In (4) the magnet pulls the contact (m) against (a) when energized, and both (m) and (a) move in farther so that (a) ultimately pulls away from (b). This is called a "make before break" combination. When the winding releases, (m) and (a) fall back, so that (a) reconnects with (b) before (m) moves far enough back to disconnect from (a). A circuit wired through (m) and (b) would be only momentarily closed while the relay is operating or releasing, giving a momentary closure interval.

Item (5) shows a counting relay chain containing two or more pairs of similar relays. A closure of the contacts at K (which may result from some remote agency by means of relays operated from lines or

A pulse distribution circuit whereby four circuits are selectively operated by presence or omission of pulses during timing interval are shown in circuit (8). At right (9) two methods of releasing a relay held operated through self-locking contacts







CODE

LAMP	RELAYS OPERATED
0	NONE
1	A
2	B
3	A, B
4	C
5	D
6	A, D
7	B, D
8	A, B, D
9	C, D

Circuit whereby ten different signalling or operating functions can be selected by operating particular groups of relays by a series of pulses. A typical circuit used in telephone call indicator service, adaptable to a wide variety of industrial applications involving multiple control

radio circuits) operates relay (A). This relay stays operated as long as K remains closed. When K opens relay (B) operates in series with A, so that (A) and (B) are then both separated. This connects the operating circuit from K into the next relay.

The next time K closes relay (C) operates followed by the operation of (D) at the end of the second pulse duplicating the operation of A and B in all particulars through any other pairs in the chain on succeeding pulses. The last relay in the chain (relay H in circuit shown) releases all relays so that on the next pulse the whole action is started again, beginning with relay (A).

The relay H may be made slow release (one method is to shunt its winding with a large capacitor) so that all relays have time to drop back before H does. In the usual circuit other contacts are added to particular relays in this chain to perform the circuit functions of counting or control.

In (6) a simple marginal control is illustrated. The two relays have different sensitivities, so that with a light pulse only (B) operates, whereas with a heavy current pulse both relays operate. When (A) operates it nullifies the circuit through the contacts of (B), however. In the circuit, (B) is closed with a light current pulse, closing circuit through device (2). When (A) operates with a heavy pulse, device (2) is de-energized and (3) is operated. When both relays are non-operated device (1) is energized.

It is evident that a similar circuit could be used with polarized relays so that a change in the polarity of the current would operate either (A) or (B).

Pulsing methods

Circuit (7) represents how relay combinations can be built up to produce different control effects by transmitting various combinations of pulses. Here relay (A) operates from the remotely initiated pulses, and operates relay (B) which operates device (1). The latter may be a control valve, solenoid, and indicating lamp, a motor, etc. When relay (A) releases after the first pulse ends, relay (C) operates in series with relay (B), whereupon device (1) is released or stopped and (2) operated. When the next pulse comes along relay (D) operates, releasing device (2) and operating (3). At the end of the second pulse relay (E) operates also in series with D, releasing (3) and operating (4). At the start of the third pulse, relay (F) operates, releasing all other relays and device (4) as well. However, (5) is energized along with relay (F) for the full length of the third operating pulse. At the end of the third pulse, relay (F) falls off and the circuit is restored to the initial condition. The whole cycle of events repeats during successive groups of three pulses.

Another system is the W-Z combination which operates four lamps or other devices from pairs of pulses, shown in item (8). Here when the relay (A) closes, relay W operates first. The relay (Z) is sensitized by current flowing through (S) winding at this time but this current is not strong enough to operate it. At the end of the first pulse (Z) now operates since its (P) and (S) windings are both energized the (P) winding having been shorted previously by the contacts of A. At the start of the second pulse, (W) releases since its winding is now short-circuited by this pulse reoperating (A). Relay (Z) holds up however until the second pulse ends. When (Z) releases the circuit is in the same condition as at the start. The next pair of pulses will cause the whole cycle to repeat. In actual use the relays have additional contacts which operate lamps or control devices (1) (2) (3) (4). These operate in succession, (1) throughout the du-

(*Continued on page* 132)

DISCONTINUITY EFFECTS

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

By locating the position of the voltage minimum on each side of a discontinuity, the impedance effect can be found

• The standard transmission line measuring technic is based on the uniformity of a transmission line connecting the source and the load. In practice, however, it often occurs that at least two physically different sections (in dimensions, dielectric, etc.) of transmission lines are used as a link between the source and the load. The junction point of these two sections constitutes a "discontinuity". That is, the usual electromagnetic behavior of uniform transmission line is not valid at that point and the reflection of the principal wave and the apparition of the higher order waves take place. More precise mathematical analysis, including the effect of the electromagnetic waves of higher orders, shows that such a discontinuity always can be replaced by some equivalent lumped four terminal network.[1]

From the engineering point of view, we would like to have simple means of checking the magnitude of the disturbing effect introduced by a given discontinuity and a method of measuring the load impedance even though the effect of discontinuity is present. The modification of transmission line measuring technic as described here seems to be the simplest way of getting the required information.

To check the magnitude of the discontinuity effect we can proceed as follows. Let us introduce the slotted measuring sections (physically similar to the respective transmission lines) to the left and to the right of the point of discontinuity and let us locate the short-circuiting plug (if coaxial lines are used) at some point of the right section.

If the lines to the left and to the right were physically the same, there would be no discontinuity present and the shift of the short-circuiting plug on the right section

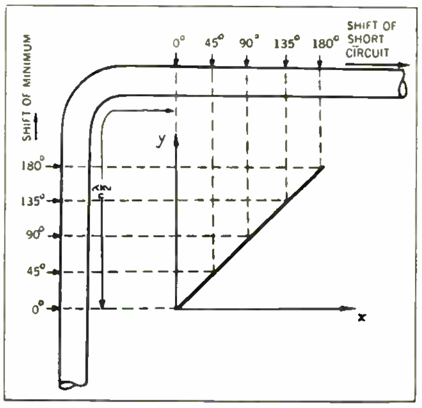


Fig. 1—On a uniform line, the movement of the short circuit point along X shifts the position of any voltage minimum by an amount Y

from some arbitrary zero position to the right would produce equal shift of the voltage minimum on the left section (Fig. 1). The graph of the position of the voltage minimum γ on the left section (vertical on Fig. 1) versus the position x of the short-circuit on the right one (horizontal on Fig. 1) would be a straight line with 45° slope as shown on the graph in the same figure.

S-curve

Since actually the lines are physically different and discontinuity exists (Fig. 2), the shift of the voltage minimum versus shift of the short-circuit will differ from the straight line and will appear as an S-shaped curve shown on the same figure.

Hence the existence of any appreciable discontinuity can be simply detected by plotting a γ versus x curve in the way explained above. As far as the author knows this peculiar shape of γ versus x curve was first noticed by R. W. King and used for the purpose of measurement of the dielectric constant at ultra high frequencies.[2]

The physical explanation of the appearance of the S-shaped curve is simple. The simplest discontinuity is equivalent to some lumped impedance bridged across the uniform transmission line. The shift of the short-circuit can be also interpreted as the shifting of the point at which this discontinuity impedance is connected across the line permanently short-circuited at the given point. For a given amount of the discontinuity the effect will be proportional to the input impedance of the line at the point of connection of the discontinuity impedance. For example, the discontinuity impedance has a negligible effect when connected at the short-circuit or any multiple of a half-wave therefrom. On the contrary, the effect of the discontinuity is the greatest when it is connected at a distance from the short-circuit of ¼, ¾ or any subsequent half wave multiple therefrom.

Having thus determined qualitatively the existence of a discontinuity, the next step is to find the means of determining quantitatively the influence of the existing discontinuity on the value of measured impedance.

Applying the law of transformation of impedance of a uniform transmission line by the insertion of a general four-terminal network, it can be shown[3] that

$$Z_{o1} \tan(\gamma - \gamma_o) = k Z_{o2} \tan(x - x_o) \quad (1)$$

$$k = \frac{Z_{o1}}{Z_{o2}} \cot^2(x_1 - x_o) \quad (2)$$

where Z_{o1} & Z_{o2} are characteristic impedances of the left and right sections respectively.

x_o & γ_o are the coordinates of the point of inflection on the S-curve (Fig. 3).

[1] J. R. Whinnery, H. W. Jameson and T. E. Robbins—Coaxial Line Discontinuities Proc. I.R.E., Vol. 32, p. 695 (Nov. 1944).

[2] R. W. King—Absolute Method for Measuring Dielectric Constants of Fluids at Uhf. Rev. Sc. Instr., Vol. 8, p. 201 (June 1937).

[3] A. Weissfloch—Ein Transformationssatz uber verlustlose Vierpole und seine Anwendung auf die experimentelle Untersuchung von Dezimeter—und Zentimeterwellen—Schaltungen. Hochfr. u El-ak., Vol. 60, p. 67 (Sept. 1942).

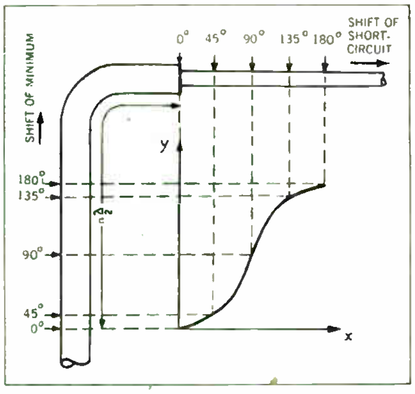


Fig. 2—On a non-uniform line, the movement of the short circuit point X shifts position of voltage minimum by a different amount Y

x_1 is the abscissa of the upper point of minimum slope on the S-curve (Fig. 3).

The equation (1) can be interpreted also as meaning that the discontinuity together with the sections of transmission lines up to γ_o (to the left) and x_o (to the right) are equivalent to a transformer with transformation ratio

$$t = \sqrt{k} \qquad (3)$$

Therefore, any impedance Z_2 connected at x_o appears at γ_o as an impedance $Z_1 = k\,Z_2$.

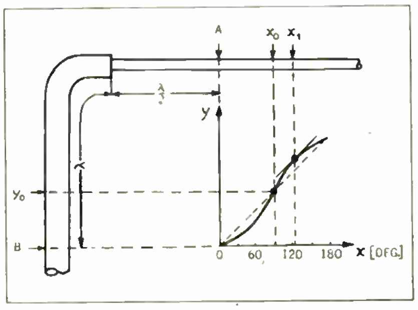


Fig. 3—Effect of discontinuity produced by shift from 35 ohm to 75 ohm characteristic impedance line

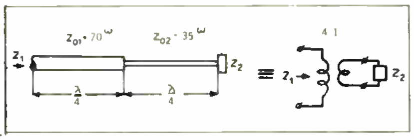


Fig. 4—Equivalent circuit on Fig. 3

As we see the determination of the S-curve together with its points x_o and x_1 gives a simple means for quantitative determination of the effect of the discontinuity.

The S-curve plotted in Fig. 3 refers to the simple case of a 35 ohm characteristic impedance coaxial line (right) connected to a 70 ohm characteristic impedance coaxial line (left). The frequency used is such that the effect of higher order waves is negligible. The shift of short-circuit is counted from the position A, half-wavelength from the location of the discontinuity. The shift of minimum is counted from the position B, one wavelength from the location of discontinuity. From the curve: $x_o = 90°$; $x_1 = 125°$. Hence $k = \frac{70}{35} \cot^2 (125\text{-}90) = 4$. Therefore any impedance Z_2 connected at x_o appears at γ_o as an impedance $Z_1 = 4Z_2$ (Fig. 4). In the case considered, the correctness of the above result can be easily verified. Since x_o and γ_o are quarter-wave points, the impedance Z_2 is transformed by the quarter-wave section of characteristic impedance 35 ohms into the impedance $\frac{35^2}{Z_2}$. This impedance is in turn transformed by the quarter-wave section of characteristic impedance 70 ohms into the impedance $\frac{70^2}{35^2/Z_2} = 4Z_2$, which checks the previous result.

Equations for Resonators

L. S. Goddard (Proceedings of the Cambridge Philosophical Society, London, Vol. 41, Part 2).

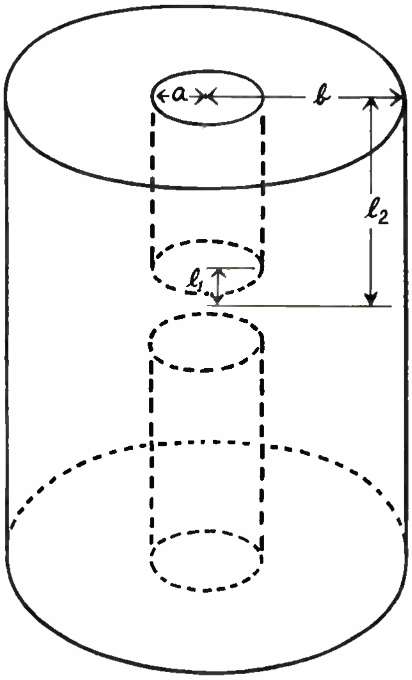
Recently developed mathematical formulas are used for calculating the electromagnetic field inside an axially symmetrical cavity resonator of the general shape illustrated; the fundamental mode of oscillation is considered. It is assumed that the length $2 \times l_2$, is smaller than resonant wavelength, λ, and that the radius b, is larger than twice the radius a.

Relationships, involving first and second order Bessel functions, are given between the dimensions of the resonator a, b, l_1 and l_2 and the resonant wavelength λ; a comparatively simple method of the evaluation of b from the other variables is suggested.

For l_2 much larger than l_1, or for small gaps, the formula for the resonant wave length may be simplified to the expression:

$$\lambda = \pi a \left[2(\ell_2/\ell_1) \log (b/a)\right]^{\frac{1}{2}}$$

An expression for the figure of merit, Q, involving only knowledge of the magnetic field strength within the resonator and at its boundaries is given; the magnetic field strength can be found by the computations proposed in the article.



It is further suggested that the method developed be used in the treatment of problems involving the transmission and reflection of energy along wave guides or transmission lines when there is a discontinuity in the cross-section.

Determining RF Resistance of Wires

By Chandler Stewart, Jr. (Journal of Applied Physics, October, 1945).

A method was developed for measuring the resistance of wires at frequencies between about 200 kc and 40 mc. The test specimen is strung down the center of a metal pipe about ten to a hundred feet in length, depending upon the test frequency, to form a coaxial transmission line. One end of the line is short circuited and the other connected to a commercial Q-meter.

The formulas required for the measurement are derived and the device, the method used, and the precautions to be taken are described in detail. Curves for determining the resistance from the Q-meter reading are included.

This method appears to be more reliable than the use of coils where the proximity effect and the effect of distributed capacitance cannot be determined accurately. For round wires known to consist of homogeneous material, calculated values of rf resistance appear to be just as reliable and accurate as experimental values, and are much more easily obtained; this is no longer true if copper clad steel and flexible wire types are considered.

SURVEY of WIDE READING

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

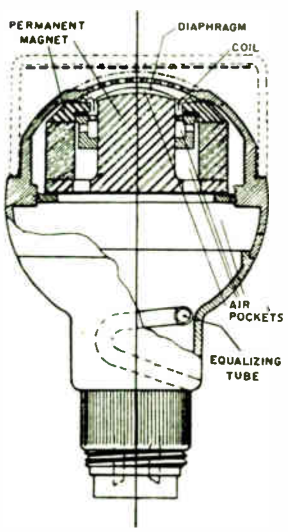
Dynamic Microphone

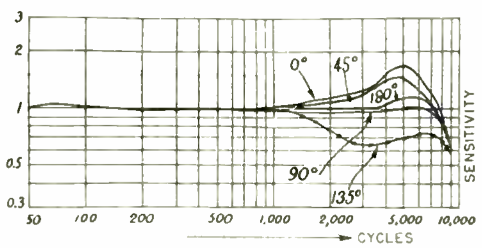
Walter Baer, Laboratorium der Reichs-Runfunk-Gesellschaft (Akustische Zeitschrift, Leipzig, Vol. 8, No. 4).

The design of a moving coil microphone installed at the German Reichs - Rundfunk - Gesellschaft (Government Radio Association) is described. High sensitivity and comparatively constant frequency response are obtained by the provision of air pockets behind the diaphragm (Fig. 1). These are responsible for resonances at 450 cycles, 2,500 cycles and 8,000 cycles. The sensitivity at these frequencies otherwise would be undesirably low. Frictional forces on the air are provided by special damping materials in the narrow channels connecting the air cavities. The narrow, long equalizing tube connects the largest air pocket with the outside space; it increases the sensitivity at the low frequency end.

The directional characteristic of the microphone is carefully considered. For the reception of diffuse sounds, a constant frequency response at a 90 deg. angle of incidence, i.e., from the sides, is desirable. A sound screen (as described by Marshall and Romanow in the Bell System Technical Journal of January, 1936) is used. A single layer of fabric reinforced at the edges by a circular piece of material proved most satisfactory as the ratio of reflected sound at 180 deg. incidence to absorbed sound at 0 deg. incidence was thereby increased as compared with an evenly dense screen. In Figs. 2 and 3 are plotted average values of the directional frequency characteristics obtained for a series of microphones.

The acoustic sensitivity of the microphone, i.e., the ratio of output voltage to sound pressure at the diaphragm, is at least 100 microvolt/dyne per square centimeter for an output resistance of 200 ohms at 800 cycles and for a noise level of 54 decibels referred to 1 dyne per square centimeter. The overall efficiency of the microphone is approximately 0.4%; the efficiency of the transducer system is 2%. The mechanical input resistance is evaluated as 660 gram/square centimeter/sec. At a pressure of 100 dynes per square centimeter the diaphragm displacement amounts to 5 microns or 2×10^{-4} inches at a frequency of 50 cycles; non-linear distortion is not to be expected for such small movements, nor has it been observed.





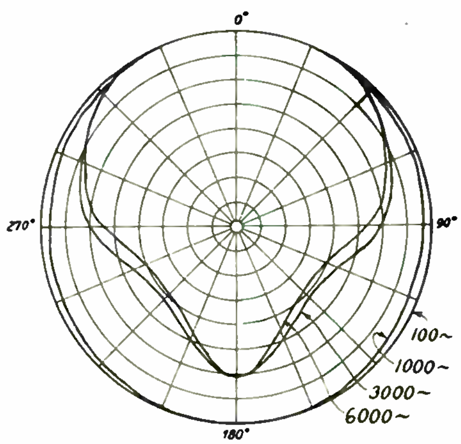


Fig. 1, left: Dynamic microphone. Figs. 2 and 3, center and right: directional frequency response curves

Portable Electrometer

By D. Bulgin (Journal of Scientific Instruments, London, August, 1945).

A vacuum tube voltmeter with associated circuit (Fig 1) is adapted for measurements of electrostatic voltages, electrostatic charges, ac voltages and resistances to ground; the portable instrument is particularly designed for testing insulators.

The instrument measures voltage by the induction of a small voltage, proportional to that of the source under examination, onto the grid system of the electrometer tube. Capacitive coupling between the voltage to be measured and the grid of the tube is used: one plate of the coupling capacitor is indicated in the drawing, the other plate is constituted by a surface of the system under investigation.

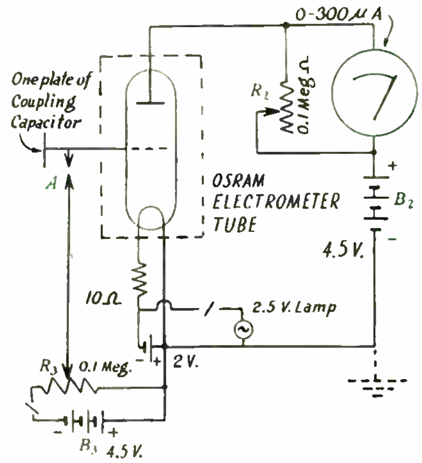


Fig. 1: Portable voltmeter for testing insulators

While fundamentally a voltmeter, the apparatus may be used either to read the potential of the surface if the additional capacity to ground introduced by the proximity of the instrument is small, or as an indicator for the charge if at a small separation from the object the capacity of the capacitor formed by the instrument and the surface is large compared with other capacities of the surface to ground.

Zero adjustment for the meter in the plate lead of the electrometer tube is made by variation of R_2; R_3 and battery B_3 enable a voltage negative to the filament to be applied to the grid by making contact A. The input to the grid depends on the size of the aperture in front of the coupling capacitor plate as well as on the distance of the voltage source from this plate. The electrometer tube is enclosed in a shielding tube (Fig. 2) having

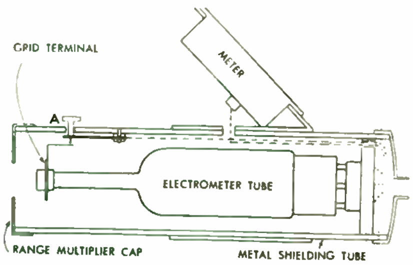


Fig. 2: Details of voltmeter within dashed line of Fig. 1 showing range multiplier mounting

an adjustable circular aperture, the diameter of which can be changed by the insertion of different size caps. This permits the operating range of the instrument to be varied. The meter scale is calibrated in 100 v steps to 1500 v per ft. for a plane source, with the end of the shielding tube open. Two caps, or range multipliers, are provided which cover the end of the shielding tube except for central apertures 0.95 in. for the ten times range multiplier and 0.45 in. diameter for the hundred times range multiplier. In this way voltages from 50 v 6 in. away to 10^6 v 7 ft. away can be read.

For the measurement of surface charges, it is practicable to provide a probe to explore details of the charge distribution. Reversal of charges occurring within 2 mm distances on an insulated surface have been examined. Calibration in coulombs per sq. cm is available by the provision of a capacitor cap of known capacitance.

The resistance measurement is carried out by observing the time required for a voltage of 4.1 v across a known capacitor to decrease to 2.5 v; a range of capacitors is provided to cover resistances from 10^7 to 10^{11} ohms.

Filament Vibrations

By R. W. Carlisle and H. W. Kaoren (Journal of the Acoustical Society of America, July, 1945).

A method of testing undesired tendency to vibrations in vacuum-tube filaments was developed wherein the vacuum tube, mounted in a suitable vibrator, was actuated by an oscillator. When the tube and mounting was placed in a magnetic field, a voltage is generated which is proportional to the vibration amplitude. This voltage is amplified and detected with headphones and an ac meter. Vibrations may be investigated with filaments either cold or hot, in open mounts or in sealed bulbs. Due to expansion, the resonance frequency of the strands when hot is lower than when cold. The tension spring is not heated by filament current, hence the corresponding resonance frequency is constant. The two resonance conditions can thus be distinguished.

Measuring Balanced-Pair Cables at HF

By J. C. Simmonds (Journal of the Institution of Electrical Engineers, Part III, London, June, 1945).

Apparatus has been developed which enables the characteristics of balanced-pair cables and feeders to be determined at high frequencies and on short lengths of cables (not more than one to two wavelengths long). The apparatus consists essentially of the parallel tuned L,C circuit energized from some suitable source S, and a standard variable resistor represented by the diodes D_1,D_2 and associated variable cathode resistors R_1,R_2 each shunted by a large capacitor. The voltage developed across the circuit is monitored by a high-impedance vacuum tube voltmeter VTVM.

The unknown impedance is measured by connecting it across the circuit to terminals T,T and determining the change required in the tuning capacitor C and the diode resistors R_1,R_2 to restore the resonance condition and the voltmeter to its former reading. The diode-capacitor-resistor combination used as variable resistor element is equivalent to approximately half the resistance of the resistor in the cathode lead.

Calibration of the diode variable resistor and of the variable capacitor is described and procedures for measuring the open and the short circuit impedance of cable lengths less than a quarter wavelength and cable lengths a multiple of a quarter wavelength are explained. In the first instance an accuracy of ±3% over a frequency range from about 100 kilocycles to 7 megacycles can be obtained; in the second instance the error will not exceed ±2% up to 10 megacycles.

Indicating Changes in Concentration

G. G. Blake, University of Sidney (Journal of Scientific Instruments, London, September, 1945).

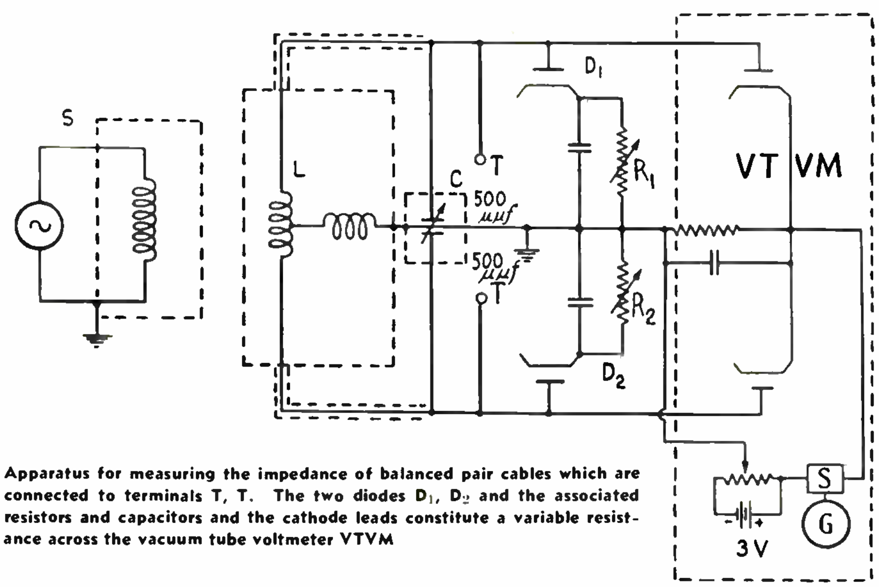
A liquid column containing the solution of an electrolyte is connected across the tank circuit of an oscillator. Changes in concentration of the electrolyte cause impedance variations of the liquid column which are indicated by a microammeter in the plate supply of the oscillator. The apparatus may be adapted for relay operation which permits control of liquid flow, stopping it if the concentration deviates from a desired value. Details of the apparatus are given.

Current Distribution Between Coaxial Cylinders

By L. Page and N. I. Adams, Jr. (Physical Review, September, 1945).

Solutions of the space charge equation for coaxial cylindrical electrodes are obtained which apply in cases where the radius b of the outer electrode (plate) is large

(Continued on page 124)



Apparatus for measuring the impedance of balanced pair cables which are connected to terminals T, T. The two diodes D_1, D_2 and the associated resistors and capacitors and the cathode leads constitute a variable resistance across the vacuum tube voltmeter VTVM

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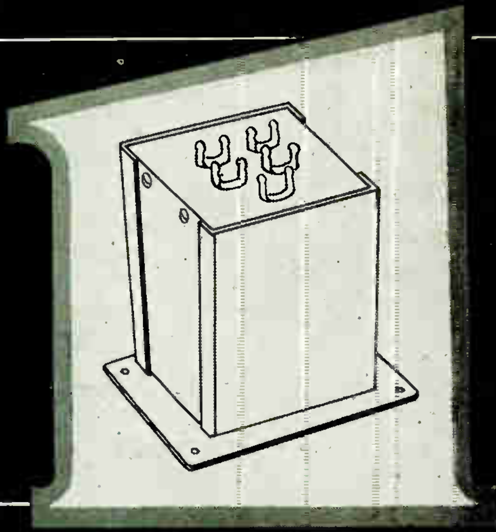

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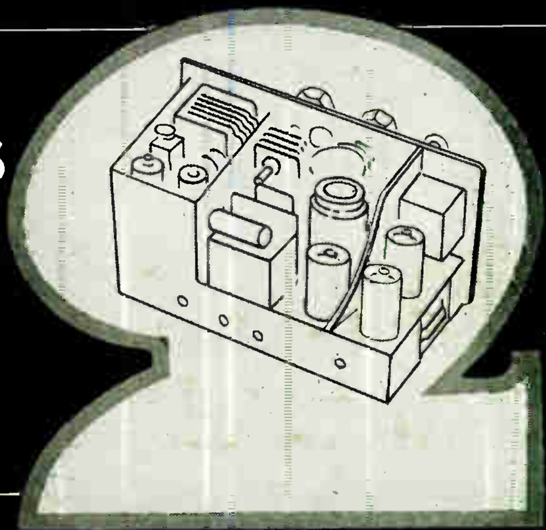

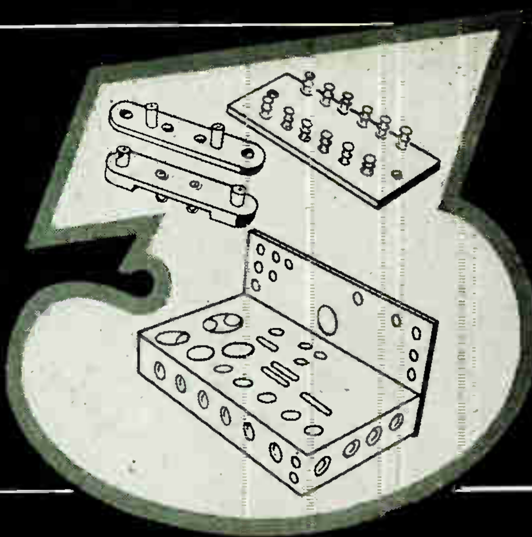

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WASHINGTON

Latest Electronic News Developments Summarized by Electronic Industries' Washington Bureau

DECISION ON ADDITIONAL FM BAND—FCC was slated to set the last of January or early February on proposal of Zenith's Commander MacDonald for enlargement of FM broadcasting space to give wider rural coverage for that new service. Zenith tests in old band, 42-50 megacycles, in Wisconsin proved highly interesting in presentation at the FCC hearing Jan. 18, in which a number of manufacturers and licensees of FM and television stations participated. Despite FCC previous adamant stand for placing FM upstairs, 88-108 mc band, because of Sporadic E interference, use of the lower band appeared a good possibility. FCC was likely to give new FM space of 44-50 mc for Area II (outside heavily populated Eastern states). This space, now the Community Television Channel, would be utilized for Television in Area I (Eastern states). FCC realizes there may be need for providing rural FM service (a radius of about 25 miles beyond the primary FM range), which even if subject to interference, would be better than nothing.

FCC STRONG FOR PERMANENT UPSTAIRS SPOT FOR FM—Commission still adheres to "upstairs" assignment for FM broadcasting. Insists that 1% interference from Sporadic E during the season from May to October when it is concentrated would result in defective FM service if left in lower band. FCC experts point out that interference in FM is different from standard broadcasting because it would mean blotting of station being heard by another program from a far-distant FM station.

FM TRANSITION TO BE EVOLUTIONARY—Plans of transmitter manufacturers are to produce FM transmitters in moderate numbers so that transition from AM to FM broadcasting will be evolutionary and NOT revolutionary in the sense of dumping several thousand station equipments on the market at once. Of course, the labor unrest and walkouts have affected the plans of the major manufacturers to start this orderly program of production. Designs have been completed by nearly all manufacturers for their FM home receivers so that production is geared to start with either the single "upstairs" FM set or two-band sets. Pending determination of the frequency situation by the FCC, manufacturers of receivers have been badly handicapped, but are set for the "starting gun" for full production.

TELEVISION DELAYED IN WASHINGTON INAUGURAL—Decision of President Truman not to make a personal appearance before Congress with his annual message on Jan. 15 was disappointing to television broadcasters as the three TV groups with stations in Washington had planned an outstanding video presentation via coaxial cables to New York. Television therefore is awaiting another outstanding opportunity to launch this important intercity service. The hearings from Jan. 21 to Feb. 1 on Washington television stations gave the industry a good guide to FCC thinking in regard to this new service. The Commission and Washington radio consultant engineers also were greatly interested in the CBS color television demonstration in advance of the annual IRE sessions.

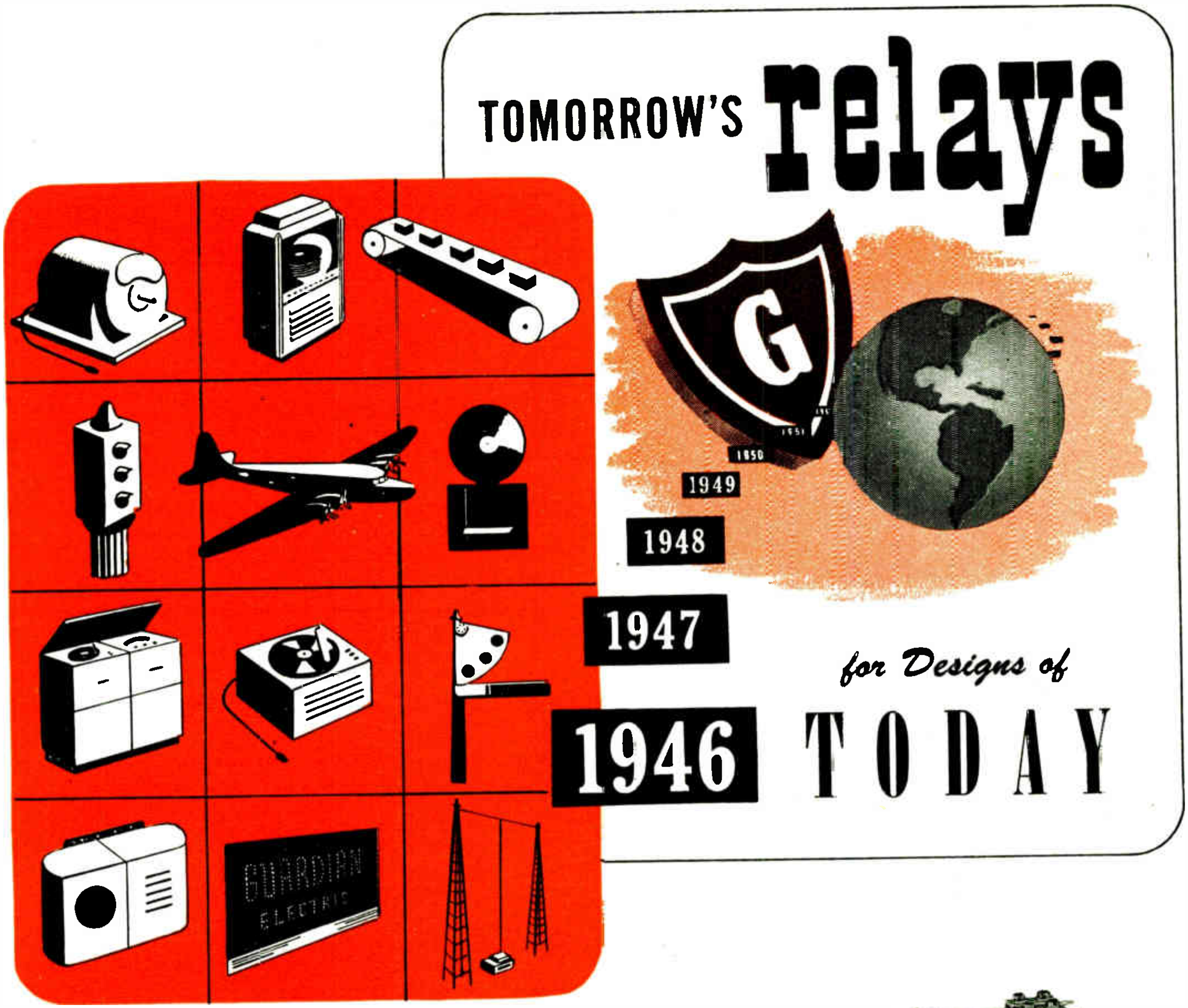
INTERNATIONAL CONFERENCES—1946 is witnessing a series of highly important international radio conferences which are to be especially significant for the industry's engineers and manufacturing planners because of determination of permanent frequency assignments. First is the comparatively tiny conference on the North American Regional Broadcasting Agreement which starts Feb. 4 in Washington and is to iron out the clear channel and allocation engineering standards for AM, FM and television in the North American sphere. In March, or possibly later in early summer, will come the projected meeting of the "Big Five" countries (United Nations) on frequency and radio engineering standards. This is likely to be in the United States, close to Washington, according to present plans and it will be the preview for the World Telecommunications and Radio Conferences.

SURPLUS DISPOSAL AGENTS—Despite the efforts of certain cliques in the Washington governmental setup, probably urged by some speculator groups, Surplus Property Administration has agreed not to change drastically—or, more important, not to scrap—contracts with manufacturers to be the Government's agents in disposing of military surplus in the radio-electronics field. This decision was reached in Mid-January by Surplus Property Administration top officials after meeting with industry—a five-member RMA committee composed of Sylvania's Balcon, Hallicrafters' Halligan, General Electric's Henyan, International Resistance's Searing and Stromberg-Carlson's Gibson. Contracts are being refined to have agreements to fit manufacturers who are specialists in distribution and companies highly qualified for testing and renovation work; non-productive agents are to be weeded out on basis of RFC questionnaire.

RADAR RULES AND STANDARDS—FCC is continuing to issue experimental licenses in radar, but is delaying formulation of its Rules and Standards for Radar and Loran until it has consulted the Army and Navy as to what technics still must be kept secret. A determination must be made as to how far radar developments by the military during the war can be disclosed for public usage. The U. S. Coast Guard under the leadership of Commodore E. M. Webster, Chief Communications Officer, recently paved the way for stimulation of the use of Radar by merchant marine and aviation in its conferences and in a booklet, just issued, on Loran-Racon-Radar.

National Press Building
Washington, D.C.

ROLAND C. DAVIES
Washington Editor



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

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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.

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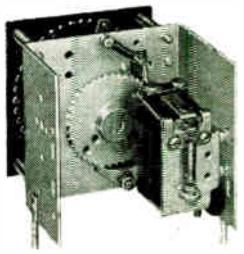

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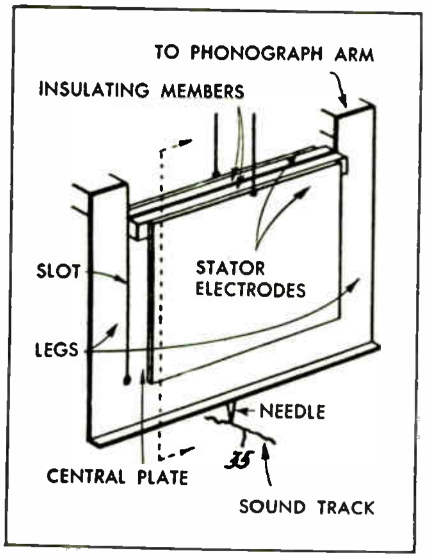
NEW PATENTS ISSUED

FM Phonograph Reproducer

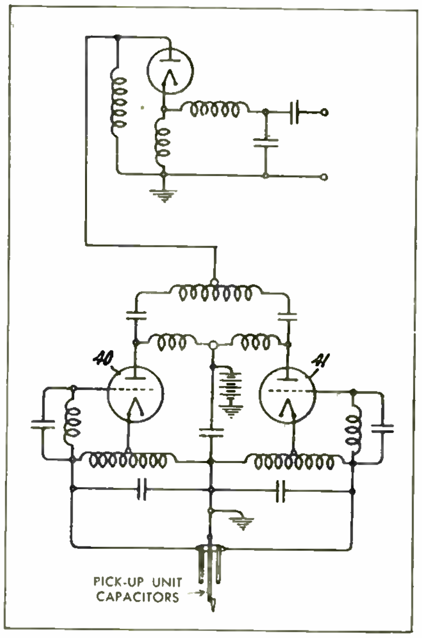
The pick-up unit designed for use in the frequency-modulated reproducer does not respond to very low frequencies which may be caused by eccentricities in the recording. Excessive resonance in the useful frequency range is avoided and the driving force of the record on the pick-up unit is maintained at a low value.

In the capacitive pick-up unit, the central electrode which carries



the needle is carried by a pair of legs which are attached to the phonograph arm. The stator plates are supported by isolating members made of a material which, when deformed, returns to its previous shape with a minimum of oscillations. These members are connected to the two sides of the central plate.

Movement of the needle along the track causes the central plate to vibrate at audio frequencies. Preferably, the mass of the stator plates plus the insulating members is such that the natural frequency of vibration of this combination in conjunction with the central plate occurs below the audio frequency range. Consequently at audio frequencies, this portion of the apparatus will remain at rest while the lower part of the central plate is vibrating. However, application of a very low frequency force to the needle is effective to move the whole unit avoiding response of the



unit to this type of force which may be caused by off-center records or other eccentricities in the recording. In the operating range, the only mass moved by the vibrating needle is the mass of the needle plus the mass of a small lower section of the central plate keeping the driving force at low value. Further, at frequencies considerably above the natural frequency of the assembly, a constant needle amplitude results in a constant percentage change in capacitance of the two capacitors at both sides of the central plate.

The electronic circuit associated with this pick-up unit is a frequency-modulated push-pull connected oscillator and a diode rectifier. Tubes 40 and 41 and their associated circuits generate high frequency oscillations of different frequencies. These frequencies are frequency-modulated in opposite sense by the two capacitors formed by the pick-up unit. Push-pull connection of these two capacitors eliminates even harmonics. Detection is accomplished in the diode, only the difference frequency being passed through the following filter which difference frequency is frequency-modulated in accordance with the signal on the record.

W. Hausz, General Electric Co., (F) March 9, 1943, (I) October 2, 1945, No. 2,386,049.

Stabilizing Frequency in LF Crystal Oscillators

In low-frequency (about 1 to 10 kc) flexure mode types of piezoelectric crystals, the natural frequency of the crystal increases as a result of an increase in vibration amplitude which in turn may be caused by a change in supply voltage or oscillator tube characteristics. It is therefore proposed to incorporate a compensating network in the oscillator circuit to stabilize the frequency against variations of supply voltage or tube characteristics.

The low-frequency flexure mode type crystal may be a duplex crystal body consisting of two thin flat quartz plates bonded or soldered together in major face to major face relation vibrating in a fundamental flexure mode of motion bending in the thickness direction at a desired frequency within a range of frequencies which are practical down to a few hundred cycles per second. These piezoelectric crystals of the low frequency flexure mode type which inherently have a relatively large magnitude of vibratory motion may considerably increase their natural resonant frequency with an increase in

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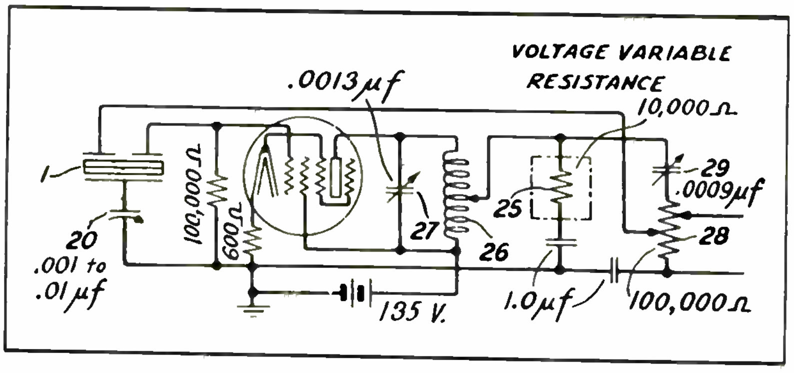

NEWS OF THE INDUSTRY

New Wire Recorders

Two new magnetic wire sound recording equipments have been developed by the Armour Research Foundation of the Illinois Institute of Technology. Both units were revealed at a meeting held in Chicago early in January. The first of these is a small, inexpensive recorder, which will be styled Camras Transitional Model and is designed for installation in home receiver sets. The device includes a high speed rewind and despite the fact that it occupies only about half the space of a standard disk recorder measuring about 6 x 12 in. nevertheless it is so arranged that the large take-up spool can be used as a turntable for a disk record if desired.

The other development is a Demonstrator model which also incorporates a high-speed rewind and has been engineered to provide fidelity equal that of electrical transcriptions. To date, some twenty-five manufacturers have been licensed by the Wire Recorder Development Corp., 135 South LaSalle Street, Chicago, which handles the entire licensing program.

Enters Radio Field

The Asco Corp. has been formed in Cleveland with a factory at 874 East 140th Street for the manufacture of radio, television, electronic, mechanical and electrical components. The company is headed by John Altmayer. Associated with him as secretary and treasurer of the company is E. E. Slabe, who was president of the Slabe Machinery Products Co., Cleveland, a manufacturer of screw machine parts. A. R. Keskinen formerly with the Engineering Department of Bendix has been retained as a project engineer.

N. Y. Transformer Moves

The New York Transformer Co. has changed its location. Since the first of the year the company has occupied new headquarters at 62 William Street, New York 5, N. Y.

FCC Names Engineers

Following the reorganization of the engineering department of the Federal Communications Commission made public about a month ago, engineers who will have charge of the various divisions have been named. Under the Field and Research Branch headed by Assistant Chief Engineer George E. Sterling there are to be four divisions as follows: Field and Monitoring Division (George S. Turner); Technical Information Division (Dr. Lynde P. Wheeler); Laboratory Division (Charles A. Ellert); Allocation Division (Paul D. Miles).

The Safety and Special Services Branch which is headed by William N. Krebs consists of three divisions as follows: Marine and General Mobile (Howard C. Looney, acting chief); Emergency and Miscellaneous Division (Glen E. Nielsen); Aviation Division (George K. Rollins, acting chief pending return of Edwin L. White).

IRE Buys Home

The Institute of Radio Engineers has completed arrangements for the purchase of the permanent home for which it has been working during the past many months. The Institute has acquired the four-story residence originally built by Isaac V. Brokaw more than half a century ago and located at 980 Fifth avenue, New York.

Allied Buys Miller

Allied Control Co., Inc., New York, manufacturers of relays and electronic devices has acquired the B. F. Miller Co., Trenton, N. J., which since 1910 has been a manufacturer of transformers. It is planned to enlarge the facilities of the company. B. F. Miller remains executive vice president and general manager.

Philco Re-names Subsid

Philco Radio & Television Corp. which is a wholly-owned subsidiary of the Philco Corp., Philadelphia, and has handled national distribution of Philco products in the United States, henceforth is to be styled Philco Products, Inc. The change in corporate style has been made to better identify the expanded operations of the corporation.

Price Changes Name

Henceforth it is to be the Price Electric Corp. instead of Price Brothers Co. by which name the company has been known heretofore. The organization manufactures relays and controls. Its plant is in Frederick, Maryland. Aside from the change in name there has been no other change in ownership or management.

Hotel Tele

It begins to look a little as though hotels would go for television in their rooms, at least to some of the extent that they now provide guests with radio reception. Some time ago the Hotel New Yorker in New York surveyed its guests and got an almost overwhelming response for pictures. Now it is reported that the Statler chain of hotels is seriously considering installation of video equipment.

Sprague Advances Two

The Sprague Electric Co., No. Adams, Mass., has made two changes in its executive personnel. Julian K. Sprague and Dr. Preston Robinson have been elected vice-presidents of the company.

Conventions and Meetings Ahead

Institute of Radio Engineers, New York Section (330 West 42nd Street, New York); February 6, paper on 5RP-multiband tube, I. E. Lempert and R. Feldt, DuMont Labs.

Institute of Radio Engineers, Chicago Section (135 So. LaSalle Street, Chicago 3, Ill.), February 15, March 15, April 19, and May 17.

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 21 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.

★ TELEVISION TODAY* ★

New Developments in the Video Field

FCC Allocates Metropolitan Frequencies

It appears likely that there may be a considerable gap in the television situation between the time when existing stations must go off the air for a change in frequency and the time when they may return to the air on the newly assigned frequencies just released by Federal Communications Commission.

According to the present schedule, existing stations that must change frequencies will be required to go off the air on or before March 1 and to return to the air on the new frequency on or before July 1.

As it stands at present, the amateurs are still allotted the frequencies between 50 and 54 mc. and will not be required to move from 56-60 mc. until March 1. This, of course, ties up channel 2 until after March 1.

Late in December FCC made public a list of assignments for the present commercial television licensees and licensees of ten existing experimental television stations. These are all Metropolitan stations with their existing powers and antenna heights. Below is FCC's complete assignment of frequencies.

Argentine Experts Study US Tele

Two distinguished television experts from south of the border have been visiting in the United States. They are Dr. Eduardo E. Grinberg and Alejandro Ubertini. Grinberg is president of the Centro Argentino de Television (Argentine Television Society), founder of the Instituto Experimental de Television (Experimental Television Institute), and a director of the Primera Cadena Argentina de Television (Argentine Television Network). Ubertini is a director and engineer of the Argentine Television Network. The two Argentinian experts have been spending a considerable amount of time in the General Electric Television Station WRGB in Schenectady.

Commercial Television Broadcast Stations

Location	Licensee	Call Letters	New Channel No.
Chicago	Balaban & Katz	WBKB	4 (66-72 mc)
New York	Columbia Broadcasting System, Inc.	WCBW	2 (54-60 mc)
New York	Allen B. DuMont Labs., Inc.	WABD	5 (76-82 mc)
New York	National Broadcasting Co.	WNBT	4 (66-72 mc)
Philadelphia	Philco Radio & Television Corp.	WPTZ	3 (60-66 mc)
Schenectady	General Electric Co.	WRGB	4 (66-72 mc)

Experimental Television Broadcast Stations

Location	Licensee	Call Letters	New Channel No.
Chicago	Balaban & Katz	W9XBK	4 (66-72 mc)
Cincinnati	Crosley Corp.	W8XCT	4 (66-72 mc)
New York & Passaic, N. J.	Allen B. DuMont Labs., Inc.	W2XVT W2XWV	5 (76-82 mc)
Los Angeles	Don Lee Broadcasting System	W6XAO	2 (54-60 mc)
Springfield Twp. Pa.	Philco Radio & Television Corp.	W3XE	3 (60-66 mc)
Los Angeles	Television Productions, Inc.	W6XYZ	5 (76-82 mc)
Chicago	Zenith Radio Corp.	W9XZV	2 (54-60 mc)
Camden, N. J.	Radio Corp. of America	W3XEP	6 (82-88 mc)
Iowa City, Ia.	State Univ. of Iowa	W9XUI	1 and 13 (44-50 mc) and (210-216 mc)

Institute Honors Hartley, Goldmark

Among other matters of routine business, the Institute of Radio Engineers presented special awards to two engineers at its Winter Meeting annual banquet, held at the Hotel Astor, New York, late in January. The first of these awards, the Institute's Medal of Honor, went to Ralph Vinton Lyon Hartley, Bell Telephone Laboratories engineer. The award was made "For his early work on oscillating circuits employing triode tubes and likewise for his early recognition and clear exposition of the fundamental relationship between the total amount of information which may be transmitted over a transmission system of limited bandwidth and the time required."

The other award, the Morris-Liebmann Memorial Prize, was presented to Dr. Peter C. Goldmark, engineer of the Columbia Broadcasting System and long-time exponent of color television. The award was presented "For his contributions to the development of television systems, particularly in the field of color."

WBKB Ups Schedule

Chicago's pioneer television station WBKB, operated by Balaban & Katz, shortly after the first of the year added substantially to its broadcasting schedule. Starting January 2nd WBKB added five hours of weekly telecasting to its regular schedule. The present schedule calls for hour-long programs daily Monday through Friday from 4 to 5 P.M. The station is operating exclusively on "live talent" and expects eventually to reach a peak of approximately eleven hours a week.

*Title registered U. S. Patent Office.

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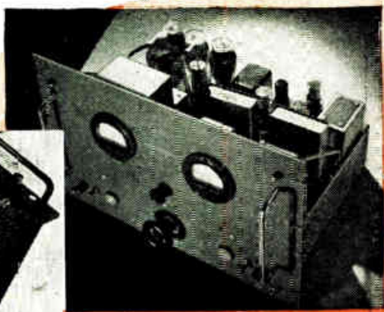

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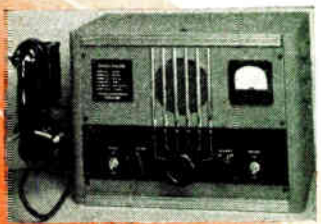
For Laboratory D.C. Source — Ranges 500-700 at 250 ma., 700-1000 at 200 ma.

REGULATED POWER SUPPLIES



HARVEY MARINE 25
A 6-Channel Marine Radio Telephone

MARINE TELEPHONES

HAR-CAM
HARVEY OF CAMBRIDGE

RADIO AND ELECTRONIC EQUIPMENT

HAR-CAM GALVASCOPE
An AC Electronic galvascope for visual detection of 1000-cycle bridge balance

GALVASCOPES

HAR-CAM MFR-15
FM-AM RECEIVER

EMERGENCY COMMUNICATIONS EQUIPMENT

HAR-CAM 250 WATT FM BROADCAST TRANSMITTER

FM BROADCAST TRANSMITTERS

And Now The HAR-CAM VISUAL ALIGNMENT SIGNAL GENERATOR

A precision unit designed and developed by HARVEY OF CAMBRIDGE for swift, accurate, *visual* alignment of IF circuits in FM Receivers. Write for new bulletin.

The HAR-CAM products shown above are representative of the type and calibre of apparatus HARVEY OF CAMBRIDGE has specialized in manufacturing through years of war and peace. Each is a precision product designed and developed by HARVEY. Into each has gone months, often years, of painstaking research, testing, proving and design refining until HARVEY OF CAMBRIDGE'S able engineering staff has been thoroughly convinced that it offers a maximum of efficiency and dependability. Then, and only then, is a new HAR-CAM development released.

This strict HAR-CAM policy of proving every product, plus the skill and experience gained through years of development of this and other closely related equipment, is your guarantee of absolute satisfaction from *every* HAR-CAM unit.

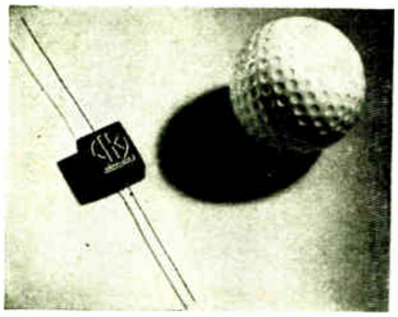
HAR-CAM
HARVEY OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

441 CONCORD AVENUE · CAMBRIDGE 38, MASSACHUSETTS

WHAT'S NEW

Devices, products and materials the manufacturers offer

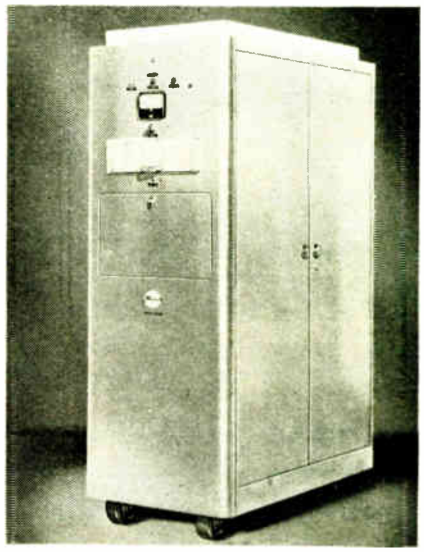


Midget Crystal

Available in a frequency range from 3 to 15 mc., a new small size shock-proof crystal is being made by James Knights Co., Sandwich, Ill. Total weight with phenolic holder is less than 1/5 oz. Dustproof and moisture resistant it has a frequency tolerance of 0.01% over a temperature range of 0 to 70 degrees C.—Electronic Industries

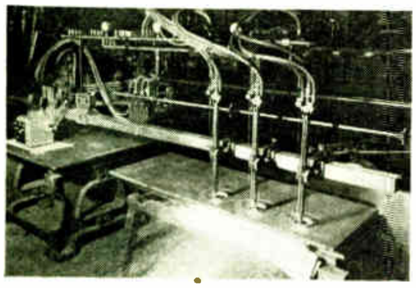
Battery Eliminator

A new unit designed to replace two dry cells is being manufactured by Electrox Div., Schauer Machine Co., 2077A Reading Rd., Cincinnati 2, Ohio. It will deliver a smooth, noiseless dc utput of 3 v 150 ma. Outside dimensions are 3 in. high by 2½ in. in diameter. Electronic Industries



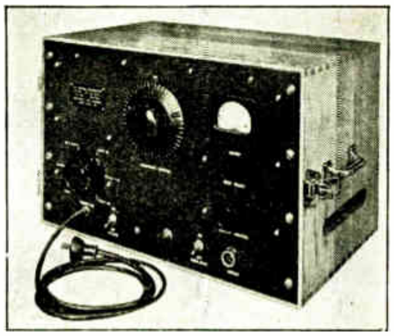
Electronic Heating Unit

A new high frequency dielectric heating unit, Model 88XO has been developed by Thermex Division, The Girdler Corp., Louisville, Ky. With an output of 5 kw at 20 mc, it will raise the temperature of four pounds of average material 170° in one minute. Entire operation is controlled by sliding drawer in which work is placed for heating.—Electronic Industries



Electronic Pantograph

Using a photoelectric cell, which traces outline drawing templates, as a line control guide for oxyacetylene cutting machines, Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., has developed a unit that puts intricate metal design cutting on a production basis. The General Electric tracing head faithfully follows the complex angles and curves.—Electronic Industries

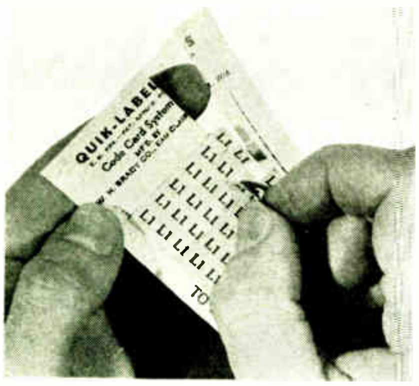


Signal Generator

A high-level rf signal generator covering the range from 400 kc to 60 mc is being manufactured by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa. Output is 3v. A 30%, 1000 cycle modulated signal is optional. Calibration is better than half of 1%.—Electronic Industries

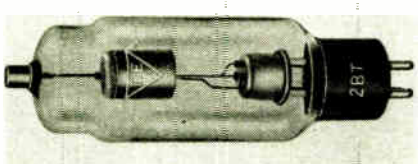
Switch Cover

Bat handled toggle switches can now be sealed against water and moisture by a new type of waterproof switch cover. Made by Waterproof Electric Co., 72 E. Verdugo Ave., Burbank, Cal., this Neoprene boot requires no tools for installation.—Electronic Industries



Labels

Identification of wires, motor leads, terminal boards and other components are made easy with a new strip label. Special mounting of labels make them ready for instant use. Over 200 codes are available including 14 colors for complex wiring requirements. Made by W. H. Brady Co., 2902F E. Linwoode Ave., Milwaukee 11, Wisc.—Electronic Industries



Rectifier Tube

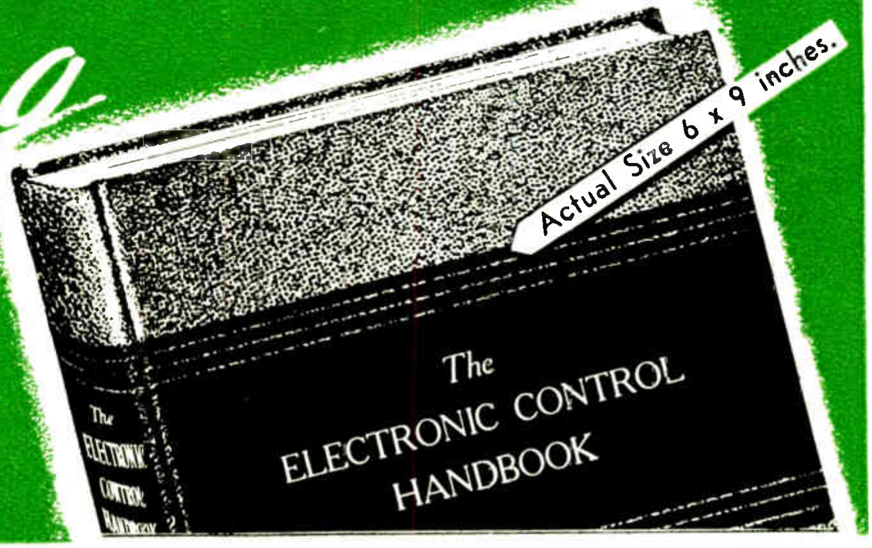
A new type high vacuum rectifier tube designed for use in video receivers is being manufactured by Electronic Enterprises, Inc., 67 Seventh Ave., Newark 4, N. J. It will handle 12,700v at an average anode current of 5 ma. Peak inverse voltage rating is 40 kv.—Electronic Industries

Push Switch

Heavy duty jack switches that will carry 5 or 10a ac are being made by Donald P. Mossman, Inc., 612 N. Michigan Ave., Chicago 11, Ill. They can be had in locking or non-locking build-ups. These switches are also available as a heavy duty jack taking a standard phone plug.—Electronic Industries

Coming

THIS *NEW* IMPORTANT REFERENCE BOOK



The ELECTRONIC CONTROL HANDBOOK

Written by
RALPH R. BATCHER, E.E.
and
WILLIAM MOULIC

More than 350 pages. Hundreds of Charts, Diagrams, Tables, Drawings, Photographs, Completely Indexed for Reference Purposes.

FIRST AND ONLY volume to give you the *fundamentals* of electronic control principles used in industry. Here is all the essential data you must have to accurately estimate the worth of an electronic control device. With the fundamental facts about circuits, which this Handbook will give you, you can correctly specify the type of electronic control best adapted to your needs.

All known electronic control devices are broken down to show you the basic components of these devices and the circuits used to effect the control desired. Correctly applied, electronic control of industrial processes can cut costs, speed production, improve quality, make previously difficult and costly tasks simple, routine processes. To know *when, how* and *where* to apply electronic controls you must have the basic data in the ELECTRONIC CONTROL HANDBOOK.

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ELECTRONIC CONTROL HANDBOOK

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ELECTRONIC INDUSTRIES

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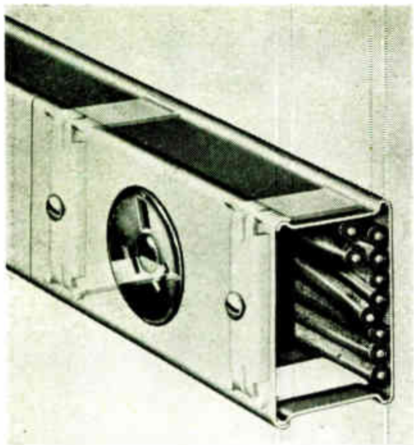
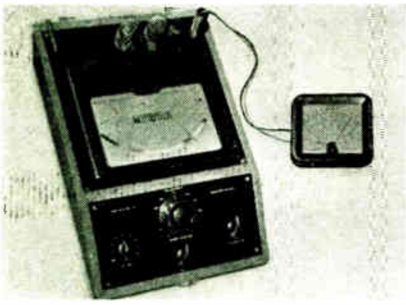


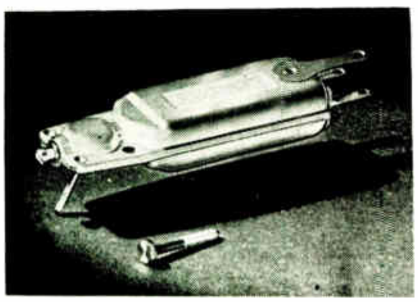
Conduit

A new type of duct for convenient power wiring layouts has been designed by National Electric Products Corp., Pittsburgh, Pa. A patented bridge within the raceway locks the snap-on cover and also provides a method of installing necessary outlet units. Fittings are available for hooking in to any existing wiring system.—Electronic Industries



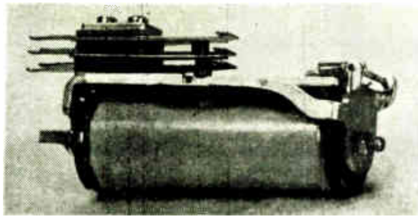
Meter Checker

Marion Electrical Instrument Co., Manchester, N. H., has designed a new Meter-tester for the calibration of dc meters. It has a self contained power supply working off 110v ac. Full scale readings of 25 microamperes to 10 ma and 100v are provided. Accuracy is better than one half of 1%.—Electronic Industries



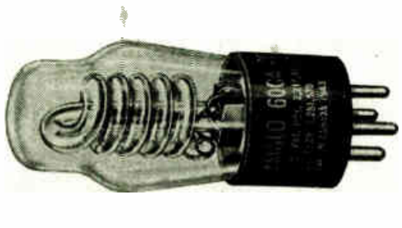
Pickup

A crystal phonograph pickup cartridge made by Shure Bros., 225 W. Huron St., Chicago 10, Ill., uses a lever that considerably improves the transmission of needle chuck torque into the crystal. This new lever action reduces needle point impedance and absorbs the impact of sudden jars and shocks. Minimum needle force of under 9/8 oz. is now attainable with an output voltage of about 3v.—Electronic Industries



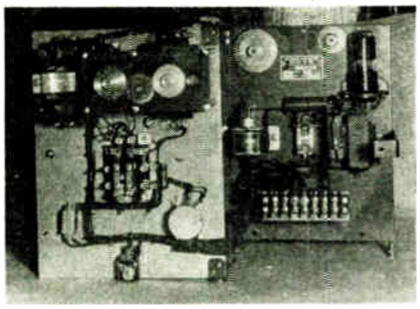
Telephone Type Relay

Operating up to 20 springs, a new relay developed by Control Corp., 718 Central Ave., Minneapolis 14, Minn., can be adjusted for either slow or fast release. Bobbin windings can be single or double wound for control from two independent circuits. —Electronic Industries



Lamp

A new cold light lamp for industrial and commercial use is manufactured by Amglo Corp., 4234 N. Lincoln Ave., Chicago. Light is produced by the direct ionization of inert gas by a concentrated electron stream flowing through the closely wound spiral. It can be used as a photoflash, or for stroboscopes, traffic and railway signals, buoys and aviation lighting.—Electronic Industries



Heat Control

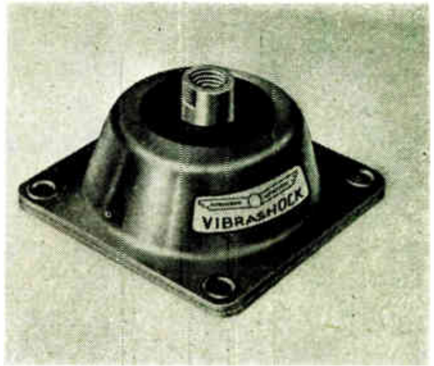
A new control for the exact temperature regulation of electric furnaces, using proportional plus floating control, has been developed by Automatic Temperature Control Co., Inc., 34 E. Logan St., Philadelphia 44, Pa. Heating power is conserved because no current is dissipated in rheostats or transformer type controls and overshooting is reduced to a minimum.—Electronic Industries

Motors

A new line of fractional hp motors is being made by Eastern Air Devices, 583 Dean St., Brooklyn 17, N. Y. Improvements in noise reduction and bearing lubrication have been made. Capacitor, shaded pole and synchronous types in 3 5/16 in. and 1 3/4 in. diameter frames are available.—Electronic Industries

Insulation

Fiberglass sleeving which is non-fraying, non-burning and non-stiffing is being made by Bentley, Harris Mfg. Co., Conshohocken, Pa. It comes in all standard colors and sizes and is available in 36 foot lengths and 500 foot rolls.—Electronic Industries

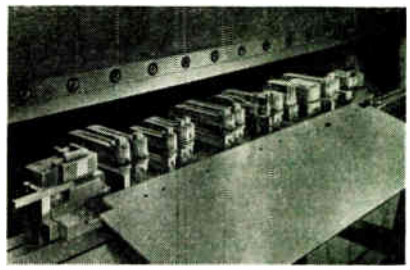


Vibration Mount

Using a stainless steel spring and a built-in damping mechanism and limiter snubbers, a new unit mount to absorb vibration from any direction is being made by Robinson Aviation, Inc., Teterboro Air Terminal, Teterboro, N. J. Made in three sizes and with a wide range of load carrying capacities.—Electronic Industries

Pillow Speaker

An electro magnetic sound reproducer designed primarily for use as a pillow speaker has been developed by Telex Products Co., Minneapolis, Minn. 5 milliwatts electrical input gives normal volume through the average pillow. With minor internal modifications speaker can be used as an all weather recording microphone.—Electronic Industries



Metal Punching Units

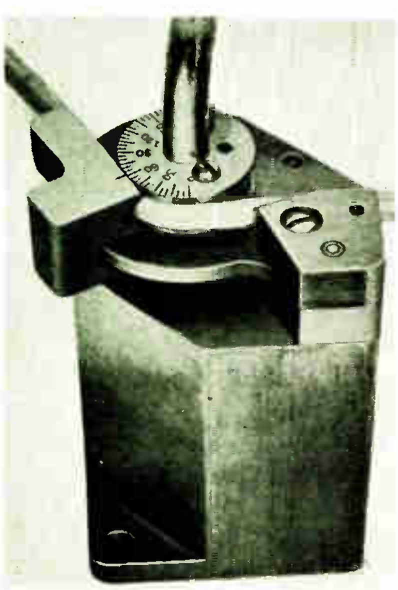
New individual hole punching and notching units have been developed by Wales-Strippit Corp., North Tonawanda, N. Y. Design permits mounting these units on single or multi-slotted base plates. This entire per-set assembly is then placed in a stamping press or press brake and is ready for production operation with the first stroke of the ram. Units are available in seven holder widths with a maximum punch diameter of 2 in. Will handle metal up to 1/8 in. thick—Electronic Industries

Regulated Power Supply

A unit for supplying 6.3v at an unregulated and regulated dc voltage up to 500v at 300ma is being made by Electronic Measurements Co., Red Bank, N. J. Regulation is within 1% for voltages between 30 and 500 from no load to full load. At 10v regulation is better than 2%. Hum voltage is less than 10 millivolts at any voltage and load.—Electronic Industries

Sweep Generator

Designed primarily for use with television, FM and high frequency equipment, this new sweep generator has a continuous output range between 500 kc and 110 mc. Sweep range is adjustable from 10 mc down to 5 kc. 1 mc and 10 mc interval markers are provided. Output signal can be controlled from about 30 microvolts to 0.1v. Made by United States Television Mfg. Corp., 106 Seventh Ave., New York 11, N. Y.—Electronic Industries

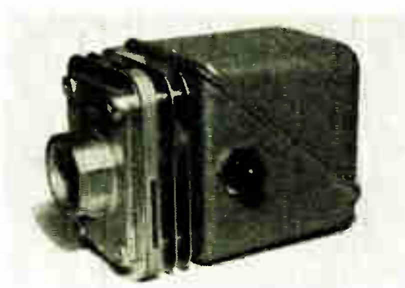


Bending Tool

A new hand-bender for working with tubing or electrical cables has been developed by Glenn L. Martin Co., Baltimore 3, Md. Equipped with a scaled bend roll, production bending requiring identical bends can easily be made.—Electronic Industries

Test Oscillator

For use with equipment designed for the 40-500 mc frequency bands, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y., is making a test oscillator which covers this frequency range in two bands. Output is controlled by an adjustable pickup loop. Either an unmodulated, a short regulated pulse or a 1000 cycle modulated signal can be obtained.—Electronic Industries



Flame-failure Alarm

Using a photoelectric unit to watch the fire in industrial and commercial oil and pulverized coal burners, Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., is making a new automatic alarm that will shut off the fuel when the flame fails. The unit is mounted on the furnace wall and observes the fire through a 2 in. pipe connection.—Electronic Industries

Electronic Wiring

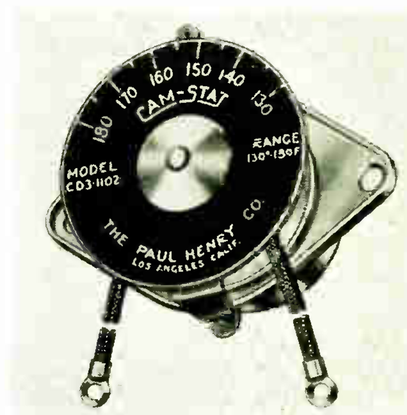
Frederick Lissau, operating Micron Machine Co., 29 Junel Place, New York, has patented a rapid method of chassis wiring utilizing template die-stampings and multiple-electrode spot welding. Three subassemblies are used, two of which are insulating panels; the third is a conducting panel. In the final stage, the subassemblies are sandwiched together and "wired" in a carbon-soldering press. Placement and tabbing of stampings is automatically carried out as a part of the template die operation. —Electronic Industries

Varnish

An extremely flexible, oilproof finishing varnish with high wet and dry dielectric strength is being made by John C. Dolph Co., 168 Emmett St., Newark 5, N. J. This black varnish has a non-fading opacity and will air dry in 6 hours. Slow initial set provides easy brushing, dipping or spray application.—Electronic Industries

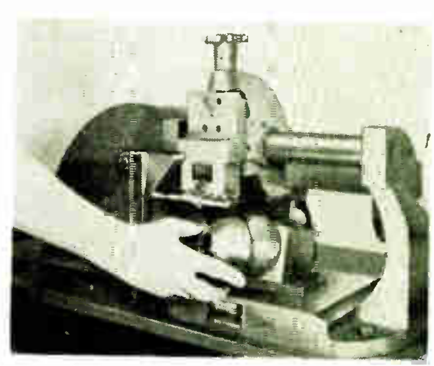
Power Supply

The Porta-power unit, made by General Transformer Corp., 1250 W. Van Buren St., Chicago 7, Ill., will supply 1.5v at 200 ma and 90v at 13 ma for the operation of farm and portable radios. Hum-free output is obtained by the use of heavy filter components.—Electronic Industries



Temperature Control

With a wide choice of adjustable temperature ranges, a new control unit is being made by Paul Henry Co., 2037 South La Cienga, Los Angeles 34, Cal. Differentials as close as one degree can be had. A variety of mountings make this CAM-Stat adaptable for the temperature control of air, gas, liquids or solids.—Electronic Industries



Marking attachment

A new cup shaped marking attachment is being made by Acromark Co., 309 Morrell St., Elizabeth 4, N. J., for imprinting half spherical, spherical and cup shaped metal and plastic components. The marking head carries both fixed and consecutive numbering identifications.—Electronic Industries

A rugged performer with a big voice and keen ear!

Collins AN/ARC-2 Autotune transmitter-receiver

Remote Control Box

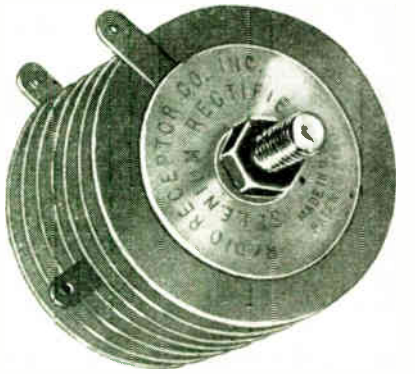
The AN/ARC-2 Autotune transmitter-receiver was designed and is built by Collins for two place and larger military aircraft. It is an example of the experience, design ingenuity and manufacturing skill also available, in the Collins organization, to commercial users of communication equipment.

Transmitter, receiver and dynamotor are all contained in the same case. The weight and space requirement of the AN/ARC-2 is considerably less than that of the equipment it replaces. Any one of eight pretuned channels is immediately and automatically available by means of the Collins Autotune, operated either at the main panel or by remote control. The transmitter and receiver operate on the same frequency and are tuned simultaneously by a single set of controls.

This equipment, including its Autotune mechanism, functions reliably at all temperatures from —58° to +140° F, all altitudes from sea level to 40,000 feet, and all conditions of humidity up to saturation.

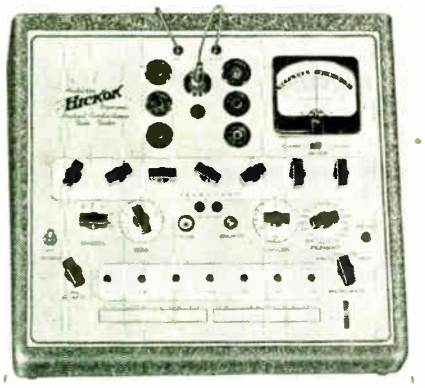
The Collins organization specializes in fulfilling exacting requirements. We will welcome an opportunity to make recommendations regarding your needs in the field of radio communication equipment. Collins Radio Company, Cedar Rapids, Iowa; 11 West 42nd Street, New York 18, N. Y.

IN RADIO COMMUNICATIONS, IT'S . . . COLLINS



Selenium Rectifiers

By using aluminum in place of iron and similar metals, Radio Receptor Co., 251 W. 19th St., New York City, have reduced the weight and increased the heat dissipation of their new rectifiers. Current capacities are from 25 ma to several hundred amperes.—Electronic Industries



Tester

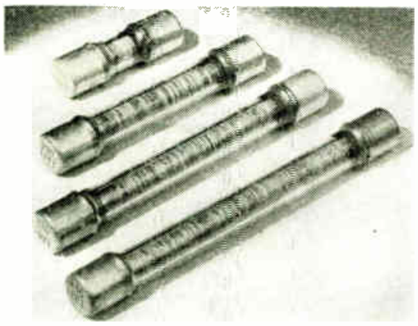
A new tube tester for checking the performance of all types of receiving tubes including octal, loktol and miniatures; ballasts and magic-eye tubes has been designed by Hickok Electrical Instrument Co., 10528 Dupont Ave., Cleveland 8, Ohio. Meter indicates directly the condition of the tube under test.—Electronic Industries

Soldering Iron

A new type soldering iron, the Eject-O-Matic, trigger feeds solder that is reeled within its handle. The amount of solder can be varied by a thumb screw adjustment. A special replacable, grooved tip guides the solder to the point of use. Nine cooling vanes protect the handle from the heat of the heating element. Made by Multi-Products Tool Co., 123 Sussex Ave., Newark, N. J.—Electronic Industries

MC Transmitter Tube

Lewis Electronics, Los Gatos, Cal., has a new high frequency tetrode in production. Operation is possible up to 250 mc with fullpower input and up to 44 mc with half power input. The tube has unusually low inter-electrode capacities, using a top plate connection and ceramic base. Maximum power output is 130 w. It can be used as a radio power amplifier, oscillator or amplified doubler.—Electronic Industries



Glassed Selenium Stacks

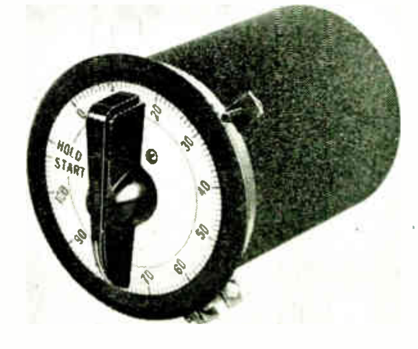
New type selenium rectifiers hermetically sealed in glass are being made by Federal Telephone and Radio Corp., Newark, N. J. No larger than a fountain pen and constructed like a cartridge fuse, the stacks can be mounted in 30 ampere fuse clips. Units are available to 4000v.—Electronic Industries

Blanket

A new electronically controlled, electrically heated blanket for personal sleeping comfort has been designed by Simmons Co., 383 Madison Ave., New York City. Flexible conductors are spaced throughout the interior of the blanket for distributing the heat and acting as a feeler for the temperature control. This three tube control unit will automatically regulate the warmth of the blanket within one degree of any pre-set temperature.—Electronic Industries

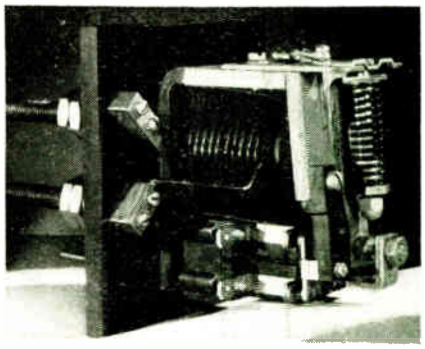
New Plastic

Styraloy, a new Dow Chemical Co., Midland, Mich., product is the lightest in weight of all that company's plastics. Its properties place it in the field between rigid plastics and rubber. It has good flexibility at low temperature. Combined with synthetic rubber, it will improve electrical properties, lower water absorption, impart greater flexibility.—Electronic Industries



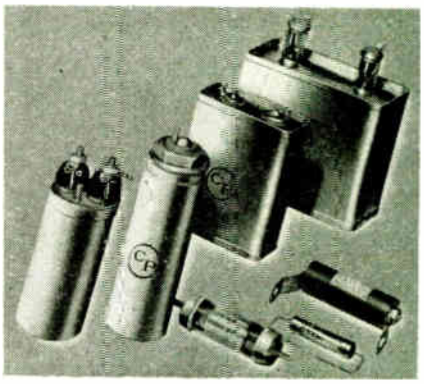
Timing Unit

A compact, waterproofed self-contained motor-driven switch for exact timing of intervals from one minute to two hours is made by American Time Corp., Springfield, Mass. Special dials and knobs can be provided for specific requirements. Unit will control up to 20a ac.—Electronic Industries



Overload Relay

Providing an almost instantaneous magnetic overload protection for general purpose and mill motor applications, Westinghouse Electric Corp., Pittsburgh 30, Pa., has developed a new dc relay known as AYJ. Contacts will carry 5 a. Coils and coil studs are available for currents ranging from 75 to 625 a.—Electronic Industries



Capacitors

The new plastic film dielectric capacitors made by Condenser Products Co., 1373 N. Branch St., Chicago 22, Ill., can be supplied in tolerances of plus or minus 1%. Available in metal containers and glass tubes these units can be had in capacities from .0005 to 35 mfd., with voltage ratings from 100 to 100,000v.—Electronic Industries

HERE IS THE NEW WESTINGHOUSE FAMILY OF

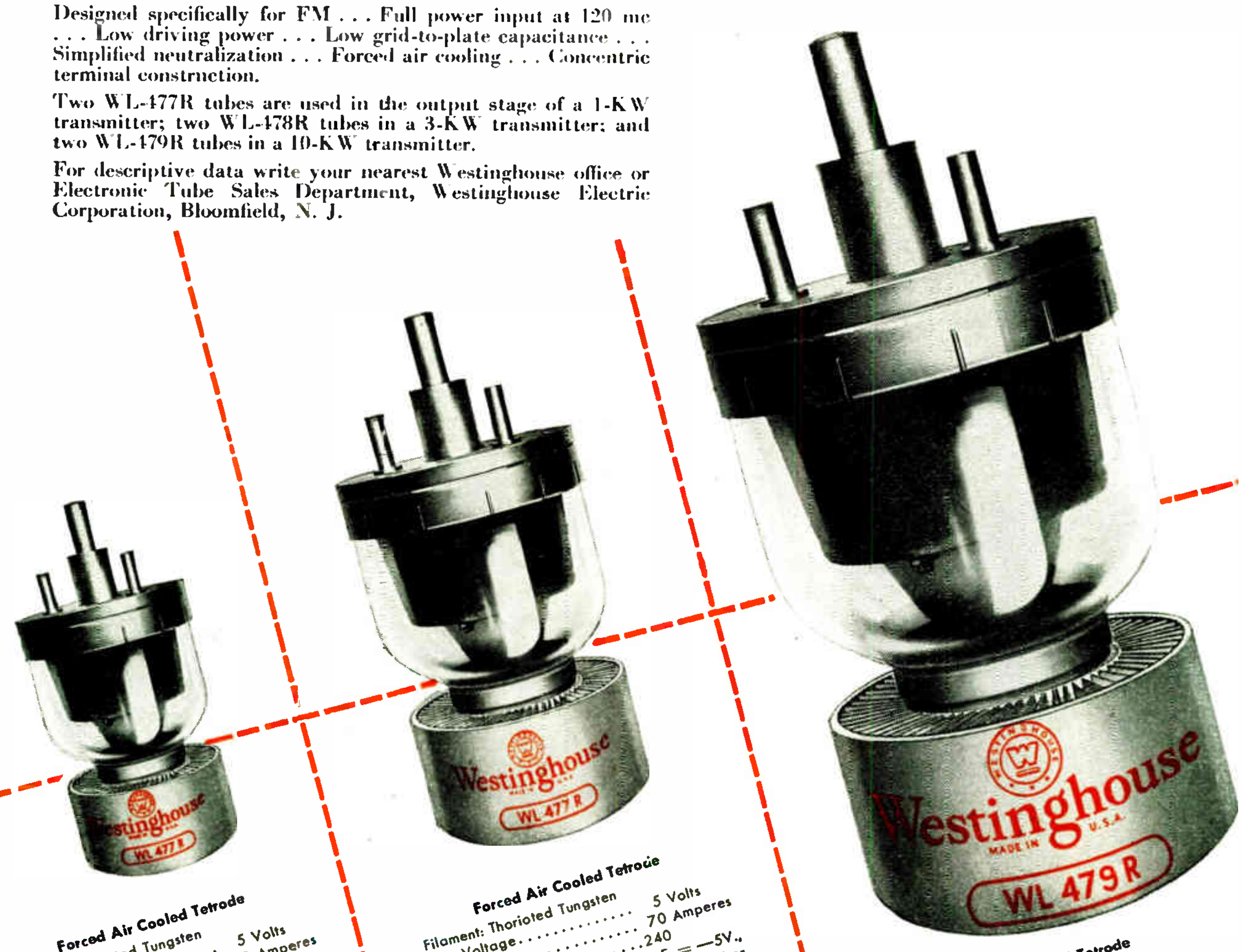
POWER TETRODES

FOR FM TRANSMITTERS

Designed specifically for FM . . . Full power input at 120 mc . . . Low driving power . . . Low grid-to-plate capacitance . . . Simplified neutralization . . . Forced air cooling . . . Concentric terminal construction.

Two WL-477R tubes are used in the output stage of a 1-KW transmitter; two WL-478R tubes in a 3-KW transmitter; and two WL-479R tubes in a 10-KW transmitter.

For descriptive data write your nearest Westinghouse office or Electronic Tube Sales Department, Westinghouse Electric Corporation, Bloomfield, N. J.



Forced Air Cooled Tetrode

Filament: Thoriated Tungsten
Voltage . . . . 5 Volts
Current . . . . 23 Amperes
Amplification Factor 240
Transconductance (I_B = 300 ma. E_c = —5V., E_{c2} = 500 V.) 13000 umhos
Max. Screen Valtuge . . . . 750 Volts
Max. Anode Voltage . . . . 3000 Volts
Anode Dissipation (Max.) . . . . . 700 Watts
Approximate Anode Power Output (Class C) . . . . 1000 Watts

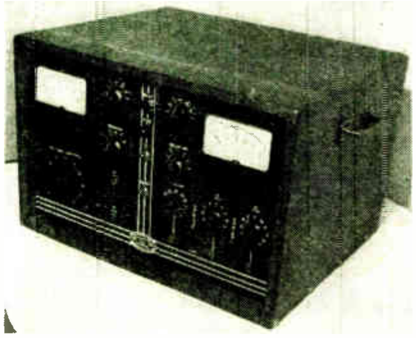
Forced Air Cooled Tetrode

Filament: Thoriated Tungsten
Voltage . . . . 5 Volts
Current . . . . 70 Amperes
Amplification Factor 240
Transconductance (I_B = 330 ma., E_c = —5V., E_{c2} = 500 V.) 14800 umhos
Max. Screen Voltage . . . . 1000 Volts
Max. Anode Voltage . . . . 5000 Volts
Anode Dissipation (Max.) . . . . . 2500 Watts
Approximate Anode Power Output (Class C) . . . . 3000 Watts

Forced Air Cooled Tetrode

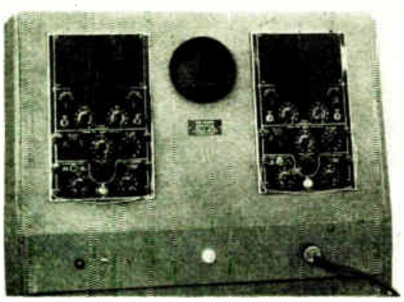
Filament: Thoriated Tungsten
Voltage . . . . 5 Volts
Current . . . . 206 Amperes
Amplification Factor 140
Transconductance (I_B = 914 ma., E_c = —5V., E_{c2} = 750 V.) 33200 umhos
Max. Screen Voltage . . . . 1000 Volts
Max. Anode Voltage . . . . 6000 Volts
Anode Dissipation (Max.) . . . . . 6000 Watts
Approximate Anode Power Output (Class C) . . . . 7500 Watts

Westinghouse *Electronic Tubes at Work*



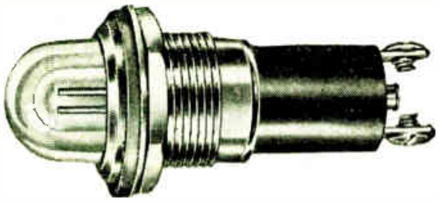
Multi-Power Supply

Moulic Specialties Co., 105 W. Washington St., Bloomington, Ill., has in production a new multi-power supply unit MS-1 which is specifically designed to deliver all necessary voltages for the operation of electronic tubes. With a voltage regulation of better than 1% over the output range of 50 to 300 v., this unit is particularly suited for determining tube characteristics and the performance of experimental circuits in school and industrial laboratories. Model MS-1 has three dc channels, the first for supplying grid bias voltages has a range of —75 to +25 v. at 5 ma.; channels 2 and 3 for plate and screen supply each have a range of 0-300 v. at 100 ma. A center-tapped adjustable ac range of 0-20 v. at 3.5 amperes is also provided. Both dc and ac supplies are separately metered and selector switches permit the reading of any voltage or any current in any channel.—Electronic Industries



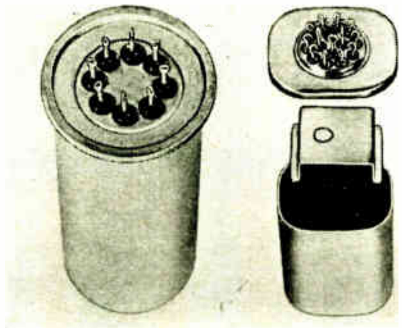
Dual Oscilloscope

A new two channel oscilloscope using a dual gun type cathode ray tube is being made by Electronics Tube Corp., 1200 E. Mermaid Ave., Philadelphia 18, Pa. This unit provides for simultaneous investigation of two independent phenomena or of a single study with a timing trace, such as ignition, pressure and torque studies in connection with automobiles and aircraft engines.—Electronic Industries



Pilot Light

New Pilot Light assemblies featuring a built-in resistor for direct connection to 115 or 220v circuits have been developed by Dial Light Co., of America Inc., 900 Broadway, New York 3, N. Y. Integral resistor unit eliminates the possibility of short circuits. Units are designed to use Neon bulbs.—Electronic Industries



Component Cans

Electrical Industries, Inc., 42 Summer Ave., Newark 4, N. J., is making a new line of can enclosures for relays, coils and transformers. Terminals are brought out through sealed headers in the base. Along with protection from dirt, dust and moisture, these enclosures provide a quick method of servicing and replacement.—Electronic Industries

Resistor

New 1.5 w hermetically sealed Akra-Ohm resistors are now being made by the Shallcross Mfg. Co., Jackson & Pusey Aves., Collingdale, Pa. They are approximately 2 in. long and 7/8 in. diameter. Wound with nickel chromium wire, maximum resistance values are 1 megohm.—Electronic Industries

Coaxial Cable

A new coaxial cable for high frequency transmission lines is being made by Boston Insulated Wire & Cable Co., Boston, Mass. This cable has a fixed alignment and may be gassed in either the flexible or rigid sheath. The special construction permits greater flexibility with less danger of cracks on bending or physical shock.—Electronic Industries

Portable Power

Homelite Corp., Port Chester, N. Y., is manufacturing a new 2,000 w, 120 v dc generator which was designed as a portable power source for many industrial or communication needs. Total weight of these units is slightly over 100 lbs., and the overall dimensions 24 in. long, 17 in. wide.—Electronic Industries

Silicone Greases

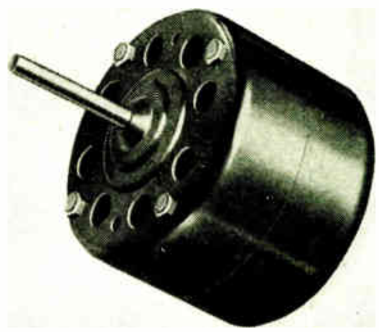
Two new silicone greases for lubrication at abnormally high or low temperatures are being made by Dow-Corning Corp., Midland, Mich. These greases were developed for ball-bearing lubrication at speeds up to 10,000 rpm and their low volatility and very slight tendency to bleed particularly recommend them for sealed-in lubrication units. They will stand temperatures up to 345° F.—Electronic Industries

Marine Radio

A 25w radiotelephone using a five channel, crystal controlled transmitter-receiver is being made by Jefferson-Travis Corp., 245 E. 23rd St., New York 10, N. Y. With an interchangable self-contained power supply the unit is adaptable for operation on 12, 32 or 110v dc or 115v ac.—Electronic Industries

Distortion Meter

For the direct reading of distortion, noise and hum in audio frequency systems, the General Radio Co., Cambridge 39, Mass., have developed their Type 1932-A Meter. A continuous frequency range of 50 to 15,000 cycles is covered by a single dial and push-button multiplier.—Electronic Industries



Small Motors

Two new four pole shaded pole motors with ratings from 1/10 to 1/100 hp are being made by Small Motors, Inc., 1308 Elston Ave., Chicago 22, Ill. Suitable for moderate torque requirements, they have laminated field and rotor cores and either ball or oilless bearings. Can be wound to stand locked rotor conditions.—Electronic Industries

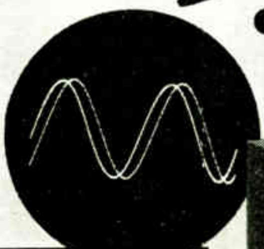
SEE *Two* PHENOMENA AT ONCE

on your Oscillograph Screen with the

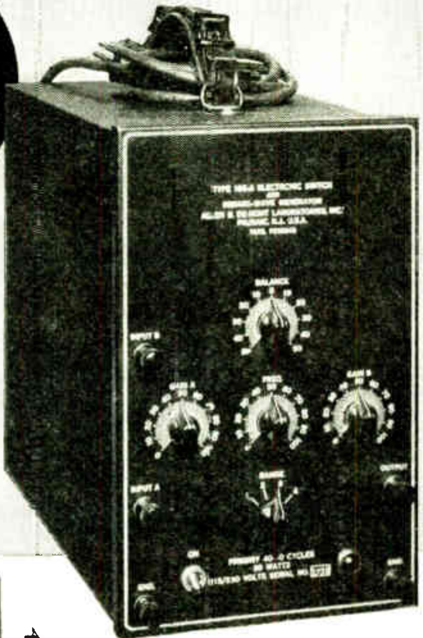
DUMONT

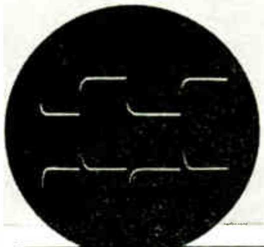
Type 185A

Electronic Switch



Phase shift introduced through an R-C network.



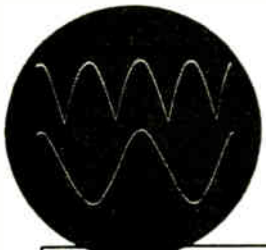


Square-wave input (top) to differentiator network, showing differentiated output (below).

The utility of any oscillograph can be greatly increased by operating it in combination with a Du Mont Type 185-A Electronic Switch!

Imagine the convenience and the time saved in being able to view simultaneously TWO or MORE related signals and readily compare them for amplitude, waveform, and frequency or phase relationship. Sound, light, heat, mechanical motion—in fact, any quantity which may be translated into an electrical function may easily be compared with a standard signal. A balance control makes it also possible to separate or superimpose the signals at will. By operating two Du Mont Type 185-A Switches in cascade, three independent channels are provided for the study of signals from three different sources . . . all THREE signals appearing AT ONE TIME on the SINGLE SCREEN of the cathode-ray oscillograph.

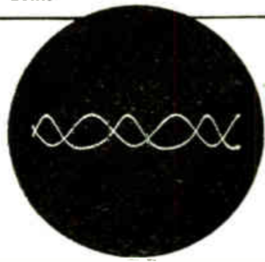
This versatile but inexpensive Du Mont instrument may also be used as a square-wave generator with an output range of from 5 to 500 cycles . . . suitable for many uses including the testing of audio amplifiers.

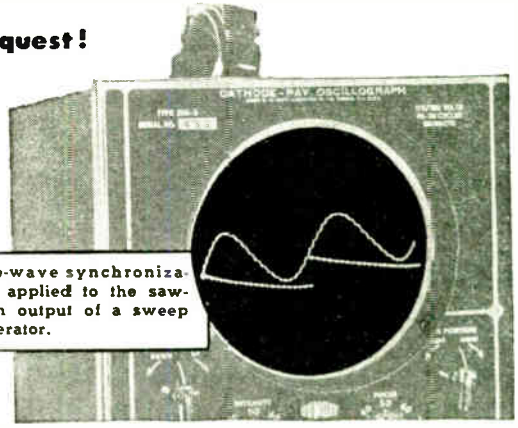


Sine-wave input (bottom) to full-wave rectifier showing rectified output (top).

Descriptive literature on request!

Comparison of input and output of phase inverter. Distortion in phase inverter is evident.





Sine-wave synchronization applied to the saw-tooth output of a sweep generator.

DU MONT "Cathode-Ray Headquarters" also offers oscillographs and cathode-ray tubes in a wide range of types and sizes to meet all requirements. Ask for information.

DUMONT *Precision Electronics & Television*

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

Miniature Tube

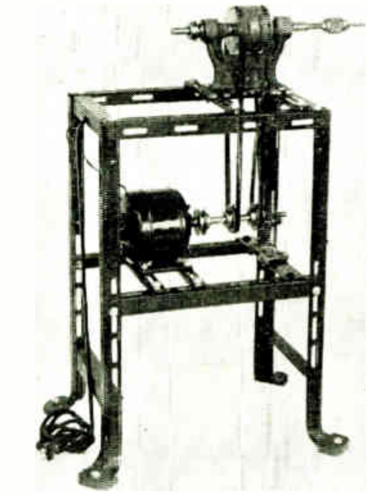
A new half-wave vacuum rectifier tube that will handle 20,000 v is only 2½ in. high. Its small size and low filament power consumption make it of value where space limitations are important. Made by National Union Radio Corp., 15 Washington St., Newark 2, N. J.—Electronic Industries

Diversity Receiver

New triple diversity receiving equipment for use on transoceanic and airways point-to-point communications has been developed by Schuttig & Co., Ninth and Kearny Sts., N. E. Washington 17, D. C. It is designed for voice, telegraph and printer operation. —Electronic Industries

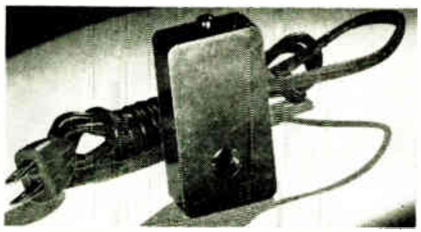
Plastic Pliers

Speco plastic pliers are being made for special needs. They are shock-proof, non-magnetic, will withstand 6,000 v breakdown, heat resistant to 300 degrees and weigh only 1½ oz. Will not short when working around live circuits. Special Products Co., Silver Spring, Md.—Electronic Industries



Reversing Spindle

A friction drive, that runs clockwise or anti-clockwise depending on the pressure of the work, is being made by Samual S. Gelber, 32 S. Jefferson St., Chicago 6, Ill. Used for a tapping operation a slight pressure of the work starts the tap into hole. when the required depth has been reached a light pull on the work reverses the spindle direction removing the tap from the work.—Electronic Industries



Demagnetizer

A new unit primarily designed for demagnetization of small tools is being made by Grayhill, 1 N. Pulaski Rd., Chicago 24, Ill. The component to be demagnetized is simply passed through the 7/16 in. hole while the button is held down. Screwdriver blades can be magnetized by pushing the switchbutton, inserting the blade and releasing the button before removing the blade.—Electronic Industries

Terminals

Midget lugs either individually or set in terminal boards are being made by Cambridge Thermionic Corp., 445 Concord 38, Mass. Quick soldering and of precision construction they are of particular value where space is limited.—Electronic Industries

Vacuum Tube Voltmeter

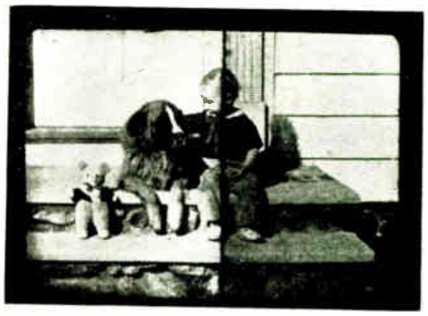
A new portable, vacuum tube multi-range tester is being manufactured by Precision Apparatus Co., 92-27 Horace Harding Blvd., Elmhurst, N. Y. Direct reading megohmmeter, milliammeter, ammeter, output and decibel scales are included on the 7 in. rectangular meter face. A stabilized bridge circuit using 3 vacuum tubes is incorporated in the unit and readings remain constant over a wide range of line voltage variations. A vacuum tube probe for supersonic rf and uhf voltages is available as an optional accessory.—Electronic Industries

Conduit Support

A new type tubing or conduit support that enables easy removal or insertions of individual lines is made by Double T. Fairlead Co., 301 Acacia Ave., Hawthorne, Cal. Supports are made to handle either a single size of conduit or any combination of sizes.—Electronic Industries

Transmitting Triode

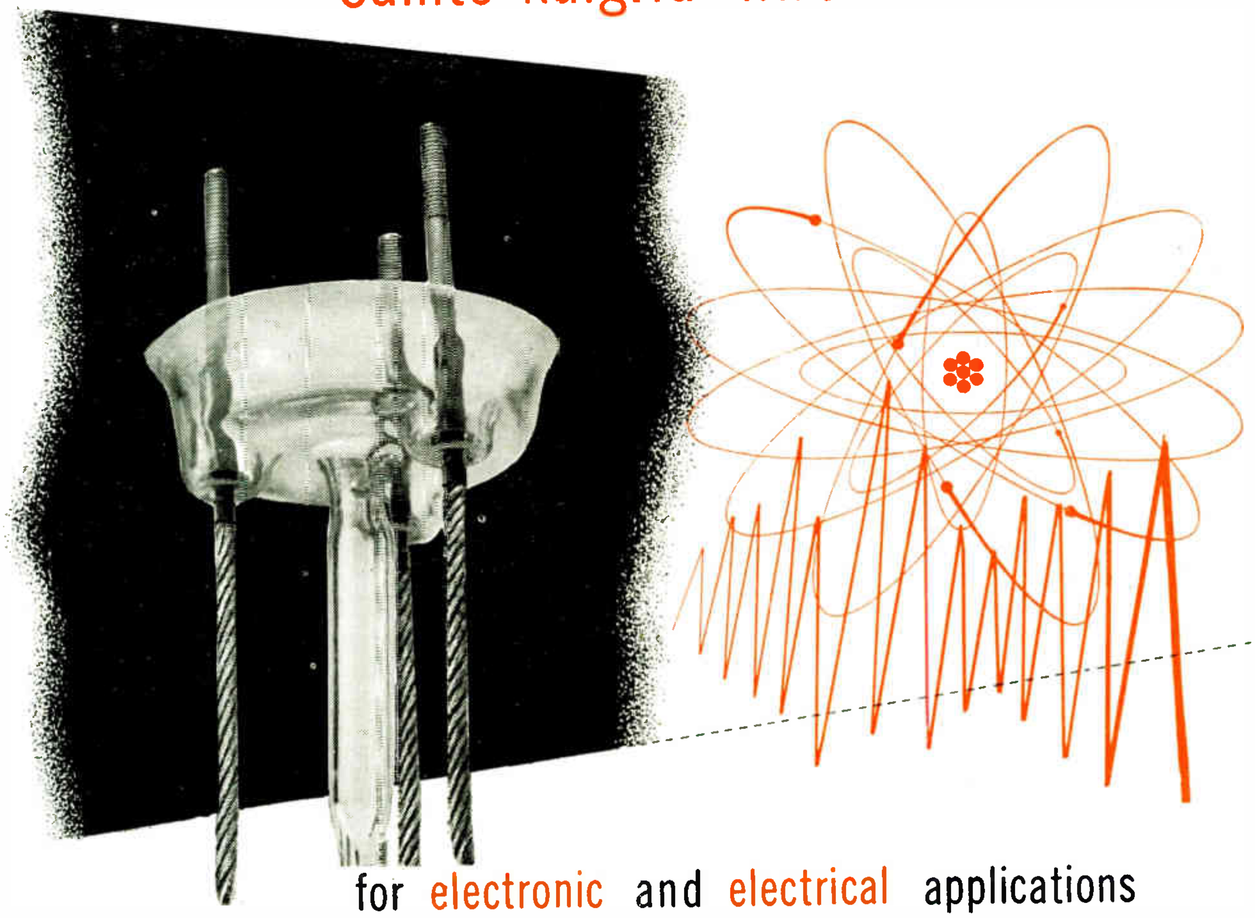
With an rf output of 5000w at low frequencies and 3500w at 110 mc, a new medium mu, external anode tube made by Eitel-McCullough, Inc., San Bruno, Cal., is of compact construction. Grid terminal is a ring interposed between the plate and filament permitting easy use of the triode as a grounded grid amplifier at high frequencies. Forced air cooling is a design feature.—Electronic Industries



Special Glass

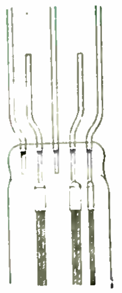
An improved color-transmitting, heat-absorbing glass is being made by American Optical Co., Southbridge, Mass., for use in television and photographic projection. The new glass absorbs approximately 90% of the infrared (heat) radiations and will transmit up to 90% of available light if reflections are reduced by glare-removing methods.—Electronic Industries

Callite kulgrid* wire and strand



for electronic and electrical applications

Callite developed Kulgrid to meet the needs for a stranded wire that does not oxidize nor flake under the high temperatures of beading, stem-making, sealing-in and exhaust operations. Kulgrid is a composite wire having an inner core of copper alloy bonded to a nickel sleeve. It has 70% of copper's conductivity, plus all of nickel's strength and resistance to oxidation. Kulgrid is widely used for lead-in wires, welds and grid supports in electron tubes.



KULGRID LEADS IN A TYPICAL STEM.

FEATURES OF C-T KULGRID* WIRE

1. Does not become brittle;
2. Strands stay welded, remain flexible, offer lower resistance;
3. No oxide flakes in the tube press because of nickel sleeve;
4. Not nickel-plated but "clad"—both copper core and nickel sleeve drawn down together;
5. Welds readily to itself and to nickel, copperclad, tungsten, molybdenum, and other related metals

(*Kulgrid is covered by U.S. and foreign patents.)

Because of its special characteristics, Kulgrid is gaining popularity as a connector from terminals to heating elements in electrical appliances. We will be glad to discuss applications of Kulgrid and furnish samples. Callite Tungsten Corporation, 544 Thirty-ninth Street, Union City, New Jersey. Branch offices: Chicago, Cleveland.

CALLITE TUNGSTEN CT

Callite

KULGRID AND OTHER "CLAD" WIRES

also fine alloy wires in aluminum, phosphor bronze, silicon bronze, commercial bronze, stainless steel, silver, nickel silver, monel, brasses and special alloys. Precision diameters down to .002" or smaller.

GERMAN HF TUBES

(Continued from page 82)

tween 2.6 cm and 6.3 cm. The anode is a closed cylinder, the interior of which forms the oscillator cavity. The desired mode of oscillation is selected by adjusting the anode voltage, and the intensity and direction of the magnetic field. For some anodes, the angle between the magnetic field and the cathode may be as much as 3°. A small hole in the surface of the anode permits the insertion of a coupling loop, which is extended outside the anode but within the envelope, to form an antenna. The operating voltage is 2 to 3 kv, and the magnetic field 2000 to 5000 gauss. The efficiency of the tube for which the power output is not known, is said to be 0.5%. This tube has been used as a continuous wave oscillator for testing research receivers.

NEW PATENTS

(Continued from page 106)

their vibration amplitude. This amplitude - frequency effect may amount to some 20 cycles per million as a result of supply voltage variations or changes in tube characteristics.

The frequency-stabilizing means comprise a voltage-variable resistance (varistor or thermistor) and either a capacitor in series or a tapped inductance; the latter arrangement (25, 26) is represented in the drawing. It is proposed to use a varistor of the silicon carbide Thyrite type as the voltage-variable resistor 25 to secure quick response. Its resistance decreases with an increase in applied voltage and, in the circuit shown, it will tend to operate as a voltage limiter, equalizing the amplitude of the voltage fed back to the crystal.

The variable resistor-coil combination 25, 26, also introduces a change in phase with a change in applied voltage because the resistance value varies and therefore the ratio of the reactive to the resistive component of the impedance is a function of the voltage amplitude. This phase shift reduces the frequency as the voltage increases and vice versa, correcting for the variations in the natural quartz frequency with changes in voltage amplitude. The frequency may be made stable to a few parts in ten million even with tube gain changes of several decibels.

It is often convenient to choose

TRANSTATS

used by The International Nickel Co., Inc. for "...close electrical temperature control"

In this research laboratory at Bayonne, N.J., Transtats are used to control elevated temperatures in "creep testing" of alloys for high temperature applications. Since these tests are continuous over long periods, a high degree of reliability and accurate control are essential. The Transtats in conjunction with automatic controllers, connected to resistance heaters, keep the temperature at the required degree within close limits.

For a continuously adjustable voltage or a constant voltage from a fluctuating source, specify Transtats.

6 TRANSTAT "EXTRAS"

1. **Potentiometer smoothness** with transformer efficiency (93-99%)
2. **High turn-to-turn insulation** and solid insulating material between commutator bars—a combination of extra wire insulation and varnish impregnation of core and coil.
3. **Broad, Uniform Commutating Surface** ground from the evenly spaced outer wires of the coil.
4. **Smooth Commutating Surface.** Velvety action—no arcing—every turn a perfect contact.
5. **Longer Brush—more contact area,** reducing current density and providing greater area for heat dissipation.
6. **Balanced Collector Arm** maintains brush setting at any degree of mounting.

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK N. J.

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

AMERICAN TRANSFORMER COMPANY
178 Emmet Street • Newark 5, New Jersey

a standard coil 26 and to adjust its effective inductance at the oscillator frequency by trimming capacitor 27. Potentiometer 28 and capacitor 29 are dimensioned to provide proper phase shift in the feedback circuit. Adjustable capacitor 20 permits tuning over a small frequency range of the order of one cycle per second. The component values indicated on the figure refer to an operating frequency of 4 kc.

L. R. Cox, Bell Telephone Laboratories, Inc., (F) April 30, 1943, (I) September 18, 1945, No. 2,385,260.

WIDE READING

(Continued from page 100)

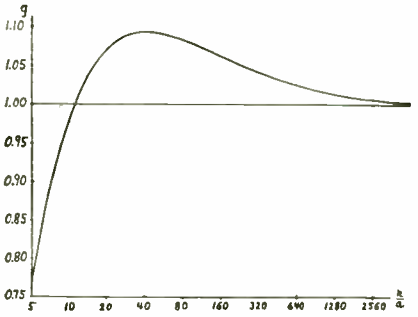
compared with the radius a of the inner electrode (cathode). The current I_i per unit length of the coaxial electrodes is given by the expression

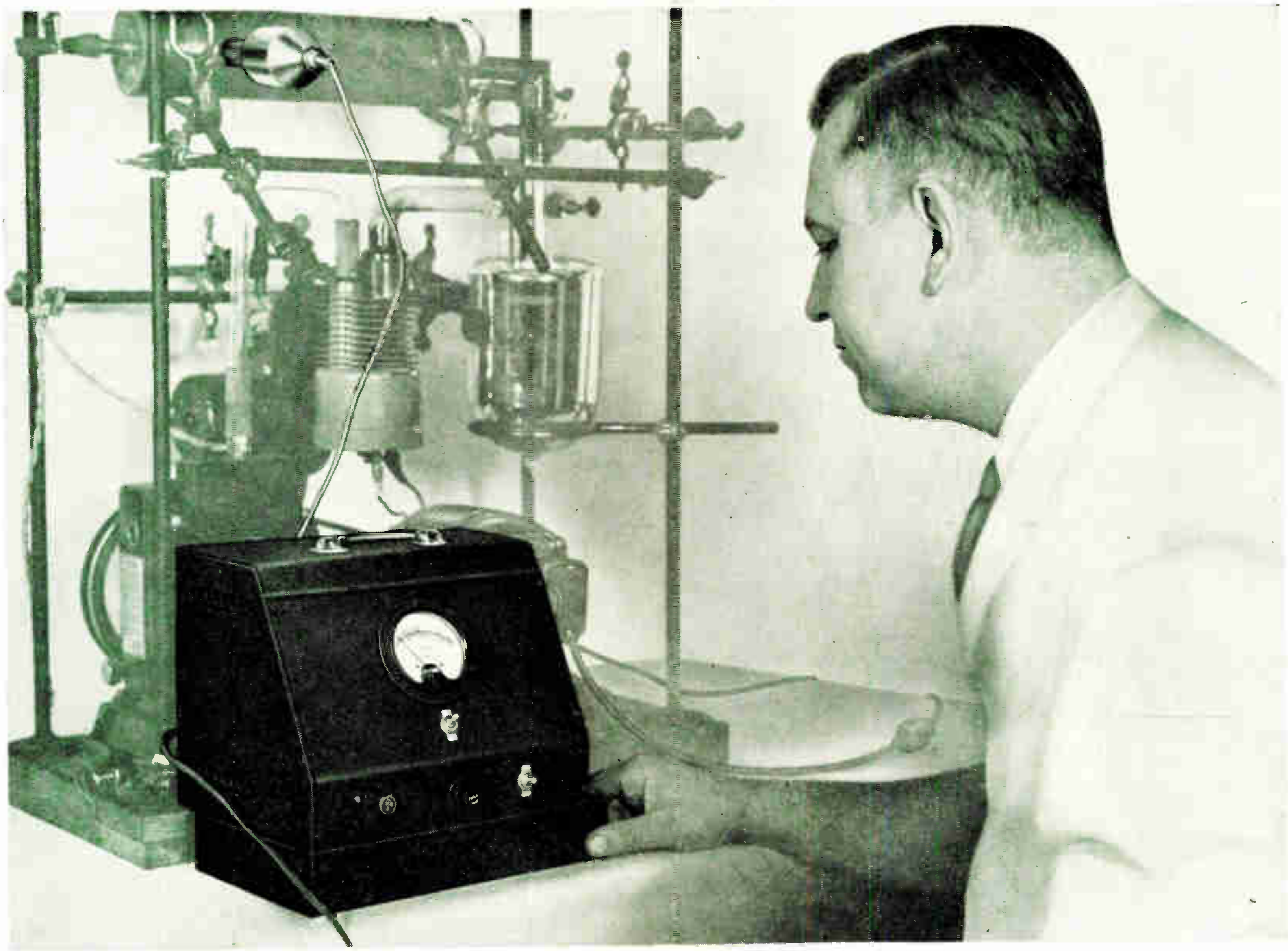
$$I_i = \frac{8\pi}{9}\left(\frac{2e}{m}\right)^{\frac{1}{2}} \frac{(-V)^{\frac{3}{2}}}{rg(a,r)}$$

where V is the voltage between the point considered and the cathode, r is the radial distance of the point from the common axis of the electrodes, and g, the solution of a nonlinear differential equation, is a function of the ratio a/r. A rather complicated mathematical derivation leads to the numerical values for g listed in the table and plotted on the graph.

r/a	g	r/a	g
1	0	40	1.0947
2	0.2793	80	1.0846
3	0.5171	160	1.0634
4	0.6670	320	1.0422
5	0.7667	640	1.0253
6	0.8363	1280	1.0135
7	0.8870	2560	1.0060
8	0.9254	5120	1.0019
9	0.9549	10240	0.9998
10	0.9782	20480	0.9991
11	0.9970	40960	0.9990
12	1.0123	81920	0.9991
20	1.0716		

Table and curve giving values of g in the formula for the current as function of r/a





Measure Vacuum Accurately

WITH THE D.P.I. PHILLIPS GAUGE

These are the essential features of this versatile gauge:

- Stable, accurate readings within a convenient, wide range (approximately 25 microns or 0.025mm. to 2 x 10^{-5} or 0.00002mm. Hg).
- Internal elements are not damaged by sudden upsurges in pressure.
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HIGH VACUUM HEADQUARTERS

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ROCHESTER 13, N. Y.

Instantaneous D/F Units Located Submarines

Seaborne and land-based high frequency direction finding equipment was demonstrated early in January by Federal Telephone and Radio Corp. engineers. It was similar to the previously released SCR-291 radio direction finder used by the AACS. The SCR-291 was used to give bearings to military aircraft on world-wide routes.

The Navy used HF-DF in its war against enemy U-boats. It was demonstrated that bearings on radio transmissions could be taken in one-tenth of a second. It was further shown that the transmitted intelligence could be received without any interference to the bearing determination. This effective counter-measure located submarines whenever they surfaced for communication or radar work. The enemy unknowingly gave away his position despite the fact that he used Kurier, or "squirt" type transmissions. This method compressed all information into split-second bursts. Reception was accomplished by playing back the recorded message at a reduced speed.

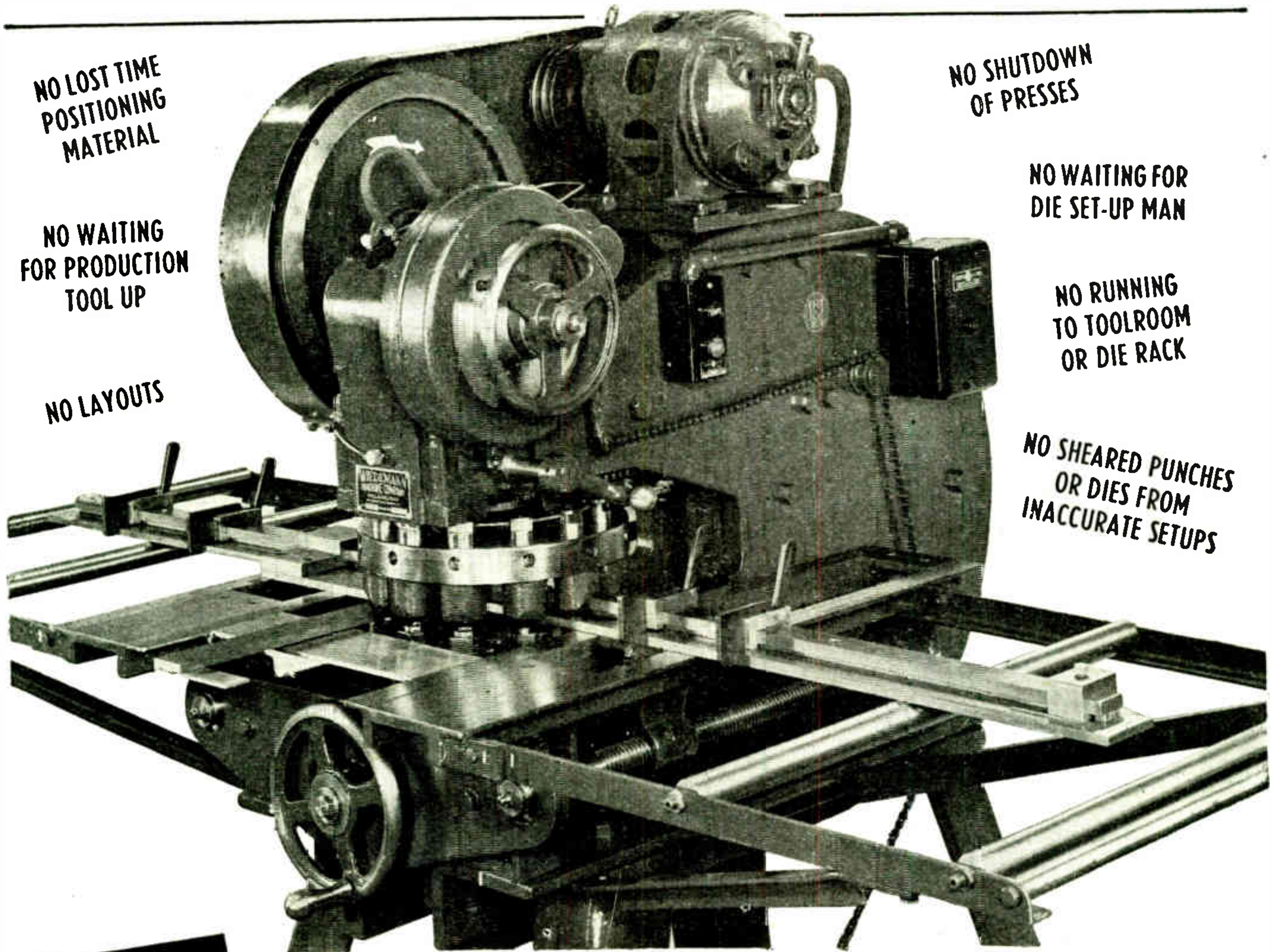
The frequency spectrum used in HF-DF extended from about one to thirty megacycles. This range was covered by four receivers of the usual communication type. Panoramic receivers were an aid in first determining the frequency of the broadcast. Enemy transmissions were consistent in their use of fixed frequencies, hence detection was easy. The effective range of the DF depends upon the frequency used, but there is almost no limitation. Indication of bearing direction and sense were read in azimuth on a calibrated CRT.

Future uses of this equipment include position-locating for air-sea rescue work by the Coast Guard, and the furnishing of bearings for air navigation. It has been considered as a counter-measure against V bombs, and radio controlled atomic bombs.

Smell Television

Among the research that is being carried out to provide greater realistic appreciation of future television programs, is the unique development work of Hans E. Laube, 2 East End Ave., New York city, in perfecting synchronized scent control to go along with the picture and sound. While the technical control features are not yet ready

CUT *MAN HOURS* TO *MAN MINUTES* ON SHORT RUN PIERCING WORK



WIEDEMANN TURRET PUNCH PRESSES

ONE USER REPORTS . . . "We solved *the problem of punching the great variety of holes required by installing a battery of Wiedemann turret presses. The relatively small runs do not justify making complete dies, and the large dimensions of many of the pieces would require enormous presses.*

"We save both time and tool costs by using turret presses. Experience shows a tremendous saving from the use of these presses in runs up to 800 or 1000 as well as in making one or two pieces for experimental work."

TRUE ECONOMY IN TIME AND MONEY!

A type for every plant and shop — capacities from 8 to 80 tons.

Get the facts — write for Bulletin 92 — The Story of Short Run Piercing Economy.

WIEDEMANN MACHINE COMPANY

1833 SEDGLEY AVENUE, PHILADELPHIA, PA.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES

for publication, a demonstration of Laube's Smell Television equipment reveals that smell response was synchronized and controlled by motion picture projection. Laube claims only a few hours' work would be required to adopt his present motion picture control to actual television.

The demonstration picture opened with a walk through a rose garden and as the EI reporter stooped to smell the flowers, the gentle scent of the roses seemed to envelop the area. The scent disappeared immediately, leaving no lingering after smell. In rapid succession the picture visited a butcher shop and the smell was the distinctive one of smoked hams and bacon; a carpenter shop gave the fragrance of fresh mahogany being worked; in a kitchen, the aroma of steaming coffee; then see peaches, oranges, the ether in a hospital operation and finally the good solid smells of tanbark and animals during a circus parade. All of the scents fitted in with the picture and each disappeared quickly as the picture faded. After the demonstration, Mr. Laube explained that any one of 500 different scents can be controlled instantly and in any sequence. The receiving set response controls are electronic and the only small replacement maintenance is a small unit about the size of a flashlight battery which must be renewed every two years at the cost of five dollars. Both the studio control and the receiving set equipment is simple and should not add materially to the costs of television receivers.

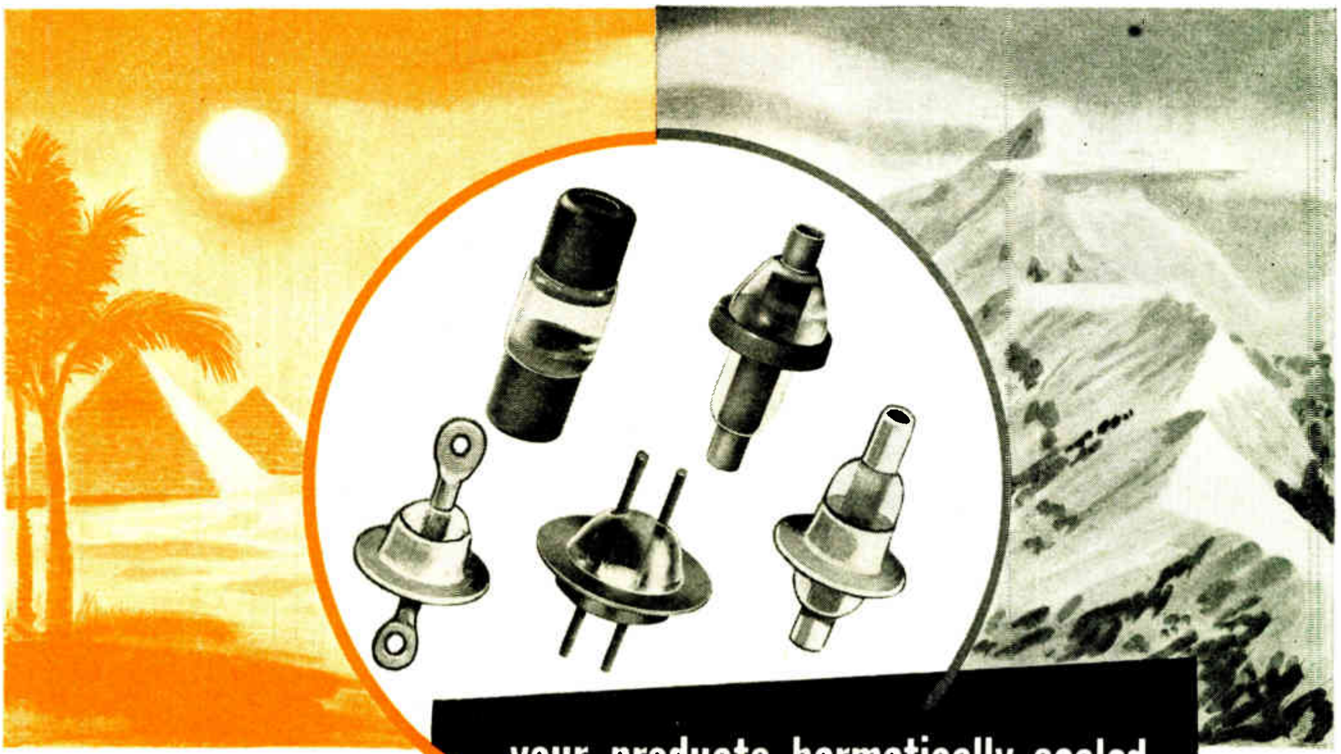
Radio Club Elects

Alan Hazeltine (Stevens Institute of Technology) was elected president of the Radio Club of America at that organization's annual meeting early last month. Other officers elected were: Treasurer Joseph T. Stantley; Corresponding Secretary Harry Sadenwater (RCA); Recording Secretary John Bose (Columbia University).

Vibration Fatigue Test Equipment

The products of the L.A.B. Corp., Summit, N. J.—vibration fatigue testing equipment or vibration test tables—as fully described on page 128 of the December issue, was incorrectly listed in the Engineering Directory Section of that issue. The correct listing is shown in the heading above.


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



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against Extreme Climatic Conditions

..with STUPAKOFF KOVAR*-GLASS SEALS

Stupakoff metal-glass terminals form permanent pressure-tight seals, without cement or gaskets. They protect your products under most adverse climatic conditions and guard against humidity, fungus and other elemental hazards.

Stupakoff Kovar-glass seals are made in standard shapes and sizes or to your exact specifications for electronic tubes, transformers, resistors, capacitors, condensers, vibrators, switches, relays, instruments, gauges, transmitters, meters, receivers and other components . . . with single, multiple, solid or tubular electrodes.

Write today for Bulletin 145
for complete data on Stupakoff Kovar-glass seals.

* Trade Mark 337962 Reg. U.S. Pat. Off.

STUPAKOFF

CERAMIC AND MANUFACTURING CO. · LATROBE, PA.

Claude Neon Buys Reeves-Ely

Claude Neon Lights, Inc., 545 - 5th Ave., New York, has acquired Reeves-Ely Laboratories, Inc., 25 West 43rd St. Subsidiaries of Reeves-Ely are the Waring Products Corp., American Transformer Co., Hudson American Corp. and the Winsted Hardware Mfg. Co. American Transformer Co., 178 Emmet St., Newark 5, N. J., manufactures power transformers for radio and industrial applications. The Hudson American Corp., (25 West 43rd St.), with office and plant in New York, has developed a marine radio telephone and other electronic equipment. It also manufactures various types of ship-to-shore radio-telephones.

West Coast Engineers Form Instrument Company

H. H. Carey, for many years vice-president and director of research of the National Technical Laboratories and George W. Downs formerly chief electrical engineer of the William Miller Corp. are, respectively, president and vice-president of the newly formed Applied Physics Corp. at 40 South Oak Knoll Avenue, Pasadena, Cal. This new firm will manufacture instruments and do a development and consulting business as well.

E. L. Adds Cabinets

Electronic Laboratories, Inc., Indianapolis, Ind., best known for its vibrator inverter products, has added a wood products division at Harbor Springs, Michigan. The new division will manufacture radio cabinets and other wood products.

RUNYON BEMEDALED

To Carman Randolph Runyon, Jr. has gone the Radio Club of America's Armstrong Medal. Here, Runyon (right) receives the award from Fred. A. Klingenschmitt (Amy, Aceves and King)

INDUSTRIAL RELAYS

(*Continued from page* 96)

ration of first pulse, (2) during the interval between pulses, (3) while the second pulse is taking place, and (4) after both pulses have passed. Device (4) is operated normally all the time between the pulse groups. The resistor R is used to adjust the sensitivity of the P winding on relay Z.

One operating feature that can be utilized to advantage in any of the circuits shown here is that the operated devices, designated lamps in some cases, can be the windings of other relays. These relays can become locked up through auxiliary windings on their own cores so they stay operated when the operating pulse ends, and are released at some later period by another circuit functioning. While a momentary pulse will operate a relay, they can be made to stay operated for as long a period as desired.

For example, in circuit (9) relay (A) is operated from a short closure of a circuit from another point (indicated here by a key) but remains operated even at the termination of this pulse through its winding (L). It will stay up until either relay (B) operates and opens the holding circuit or relay (C) operates short-circuiting the locking winding. Both release methods find frequent use.

Combine basic details

To illustrate how combinations of relays can be assembled, circuit (10) is arranged to let a combination of four pulses in sequence light one of 10 lamps or start one out of 10 control functions of some other nature.

Assume circuit (8) is rearranged to close the operating circuit to four other relays in succession during or between the pulses, instead of the four lamps. This is shown in circuit (10). Each of the relays (A) (B) (C) or (D) may or may not operate, however, depending upon whether an auxiliary circuit is also closed during the same time that each is connected in by the W-Z relay combination. To get this auxiliary closure one can use the marginal relay combination of circuit (6) or a polarized relay in series with relay (A) of circuit (8). The idea is, that relay (E) closes only when the strength of the received pulse is high enough to operate it, while another relay in

Original Award July 27, 1942
Second Award February 13, 1943
Third Award September 25, 1943
Fourth Award May 27, 1944
Fifth Award December 2, 1944

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series is added (F) which is of the polarized type which may operate during the pulse periods or the spacing intervals between them, from an auxiliary pulse of correct polarity is provided at those times. That is, a light pulse of this polarity will operate (F) but not relay (E), while a strong pulse of this polarity will operate both. A reversed heavy pulse will operate only relay (E).

Pulse distribution

To those accustomed to telephone circuit procedure this circuit is straightforward and much less complicated than any others in common use. To others a description of its operation will be in order. Suppose that the line pulse polarity that will operate relay (F) is called positive. Suppose the following signal is transmitted over a line: first a heavy positive pulse, followed by a spacing interval, then a light positive pulse, and then a heavy negative pulse. When the heavy positive pulse starts both relays (E) and (F) operate. Relay (F) can be designed to operate a little faster than (E), and operates relay (W). Then (E) closes a circuit to relay (A), which latter operates and locks up. At the end of this pulse, relays (E) and (F) both fall back and relay Z operates. At the start of the second pulse relay (F) operates but not (E) and (Z) remains operated, but (W) falls back. At the end of this pulse (Z) releases. The heavy negative pulse then starting operates (E) relay, which in turn operates relay (D). The latter relay locks up.

Thus relays A and D are left operated, and lamp No. 6 is lighted until the release relay (G) is operated by some kind of local signal or timing device. The operation of (G) releases all relays and permits a new set of signals to function. Other combinations of pulses light other lamps as shown in the code table in circuit (10).

In general relays (A) (B) (C) and (D) operate whenever a heavy pulse appears during the respective time periods represented by the two operating and two release periods of the polarized relay (b) comprising one operating cycle. Should the short flashing of lamps of wrong denominations that occurs while the correct group is being set up, prove troublesome it is possible to open up dotted lead X to the D relay, and close it through a delayed action relay.

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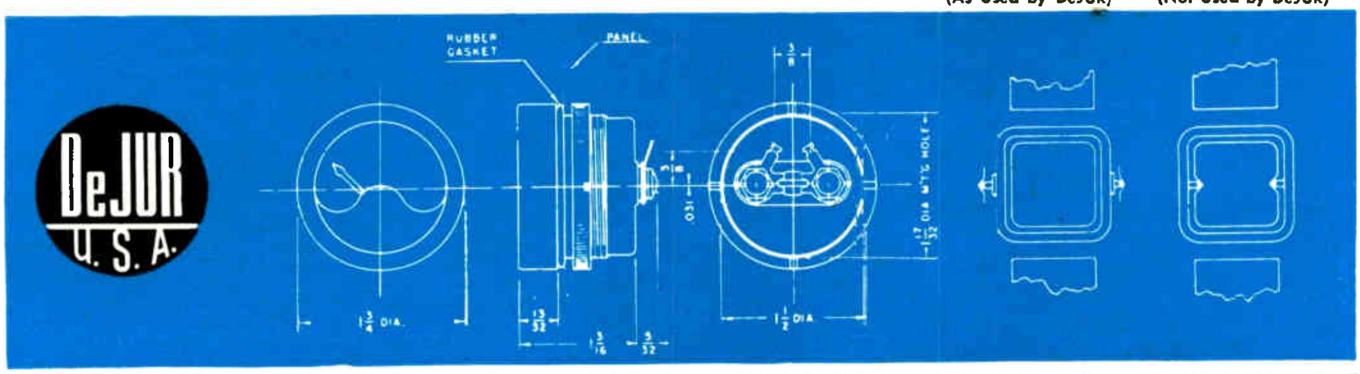


Model 120 . . . Exploded View
Black Anodized Aluminum Case . . . Ring-mounted

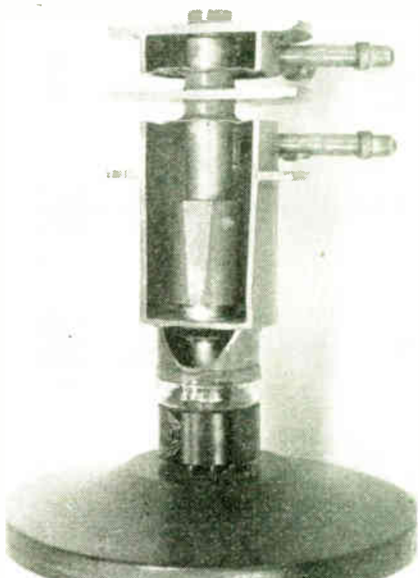
AMMETERS . . . VOLTMETERS . . . POTENTIOMETERS

LANDING SYSTEM

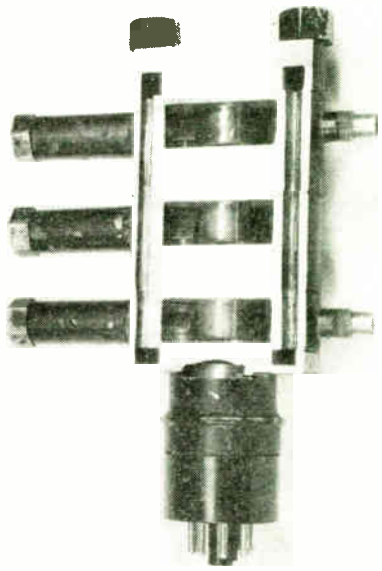
(*Continued from page 64*)

weight of 68.5 lbs.

Advantages claimed for this system are that the beams are not affected to any practical extent by reflections from stationary or moving objects near the runway. In addition no ground reflections are used, making the system independent of terrain and obviating necessity for local adjustments and radio checks. Furthermore, weather variations are said to have no affect as indicated by about 1000 flights made in all types of weather.



Cutaway view of Klystrons, multiplier above, triple cavity amplifier below



Installation is made by optical means and the equipment can be quickly moved from one runway to another to accommodate wind shifts.

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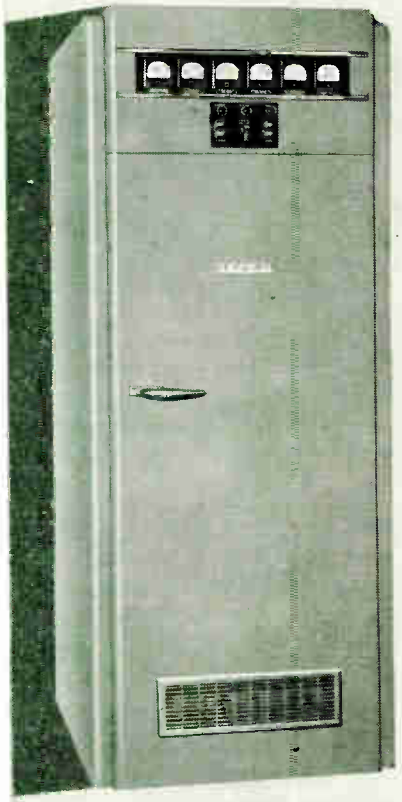
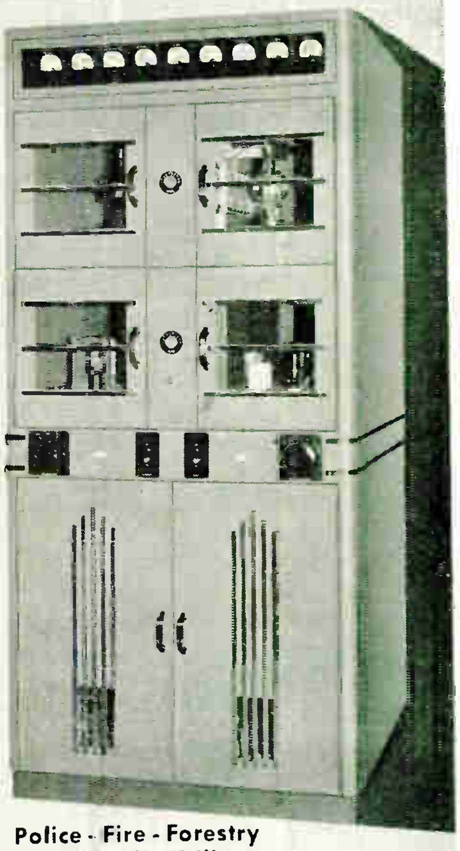
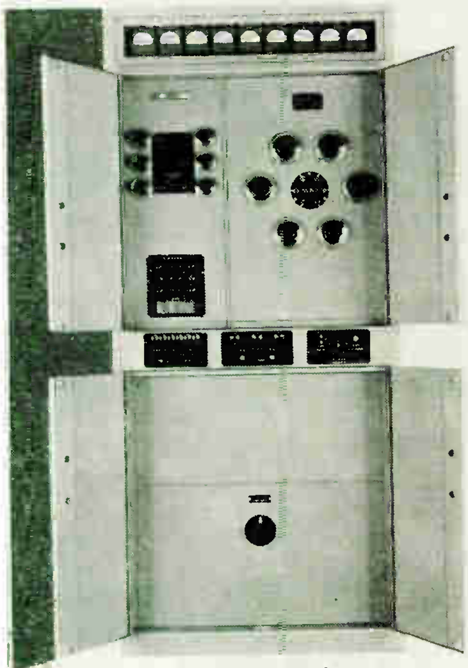


FM and AM Broadcasting



Police - Fire - Forestry and Public Utility



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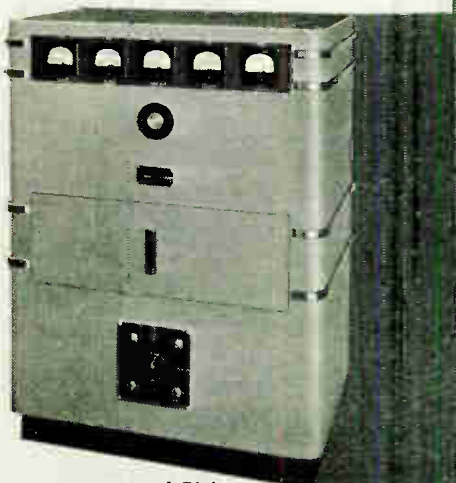

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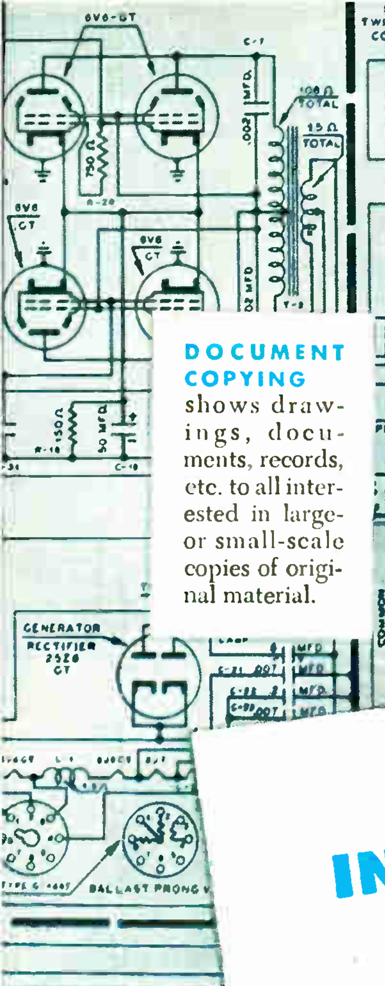
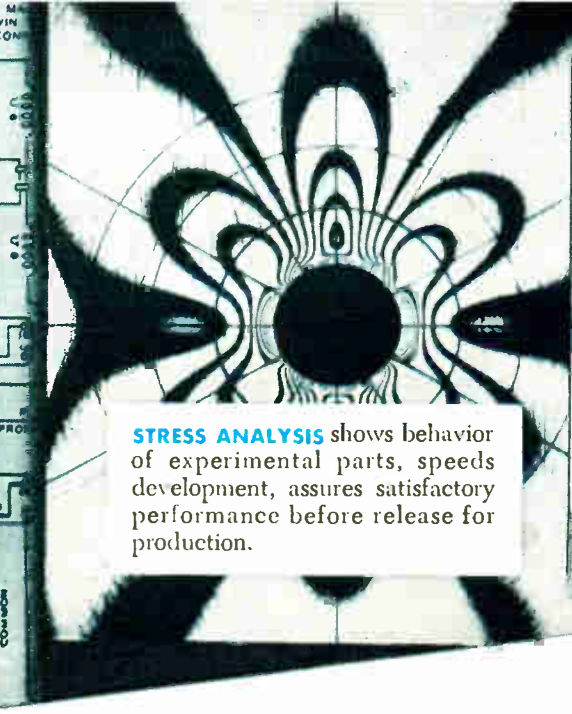
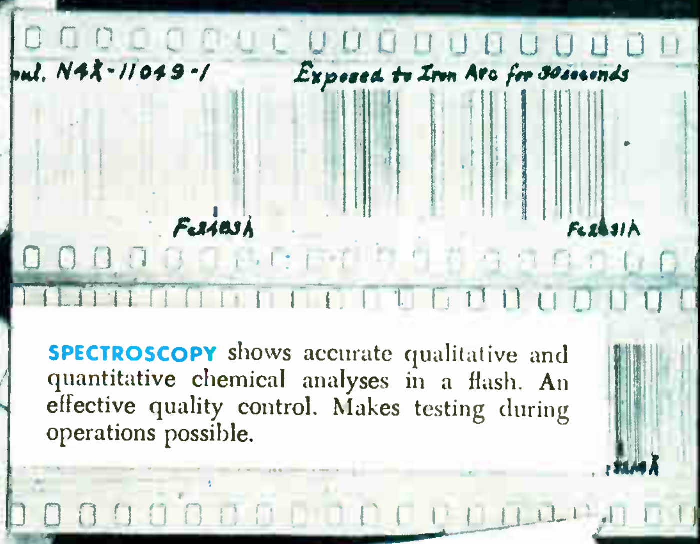


DOCUMENT COPYING shows drawings, documents, records, etc. to all interested in large- or small-scale copies of original material.



STRESS ANALYSIS shows behavior of experimental parts, speeds development, assures satisfactory performance before release for production.



SPECTROSCOPY shows accurate qualitative and quantitative chemical analyses in a flash. An effective quality control. Makes testing during operations possible.

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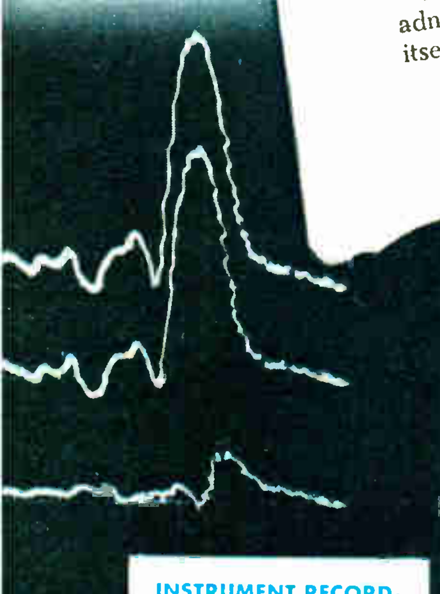
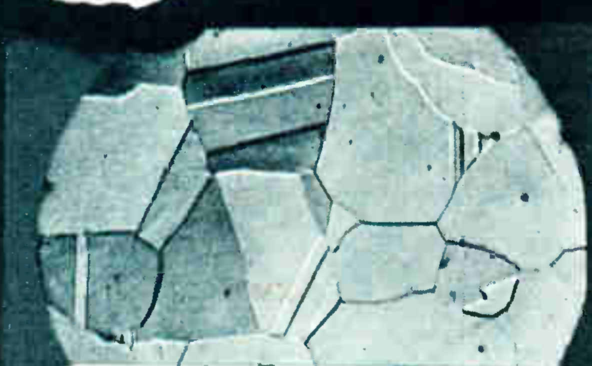


INSTRUMENT RECORDING shows electrical or mechanical phenomena too rapid for the eye to follow. Provides a record for reference.



PHOTOMICROGRAPHY shows changes in grain structure caused in material by metal-working, heat-treating, etc. at magnifications up to 5,000 diameters.

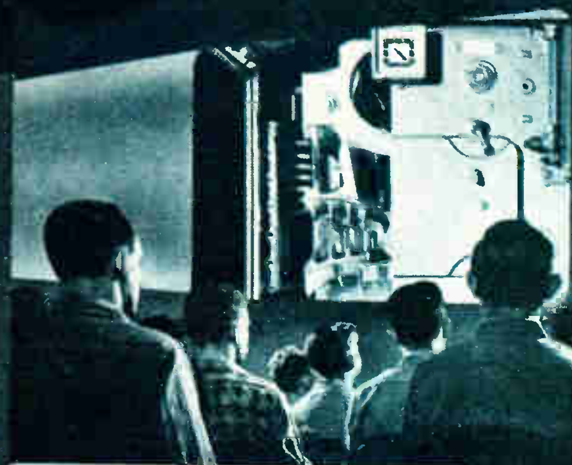
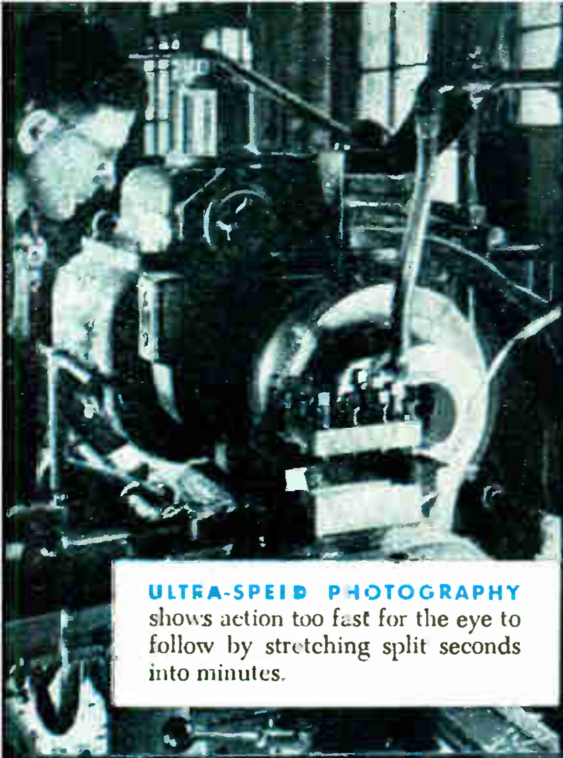
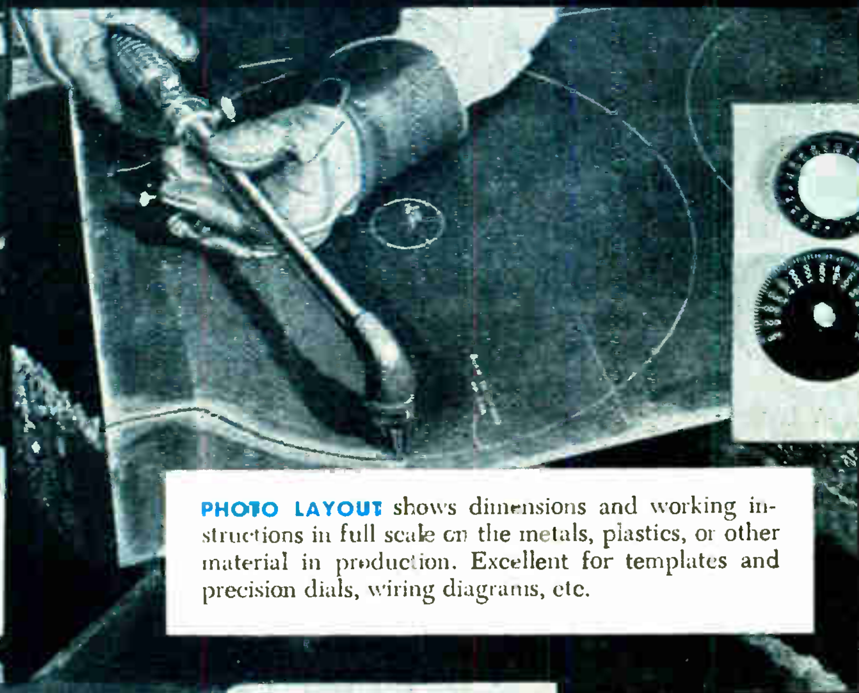


PHOTO-VISUALS show workers how to perform production operations graphically, quickly, and inexpensively.



ULTRA-SPEED PHOTOGRAPHY shows action too fast for the eye to follow by stretching split seconds into minutes.



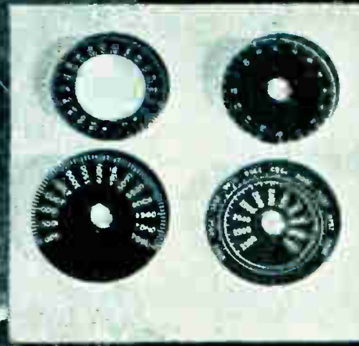
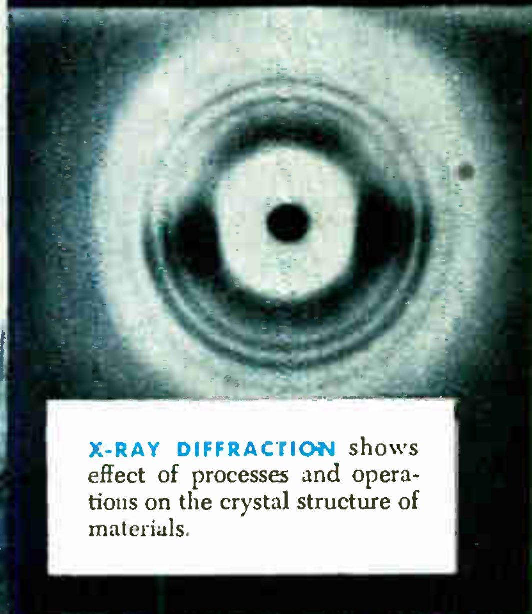
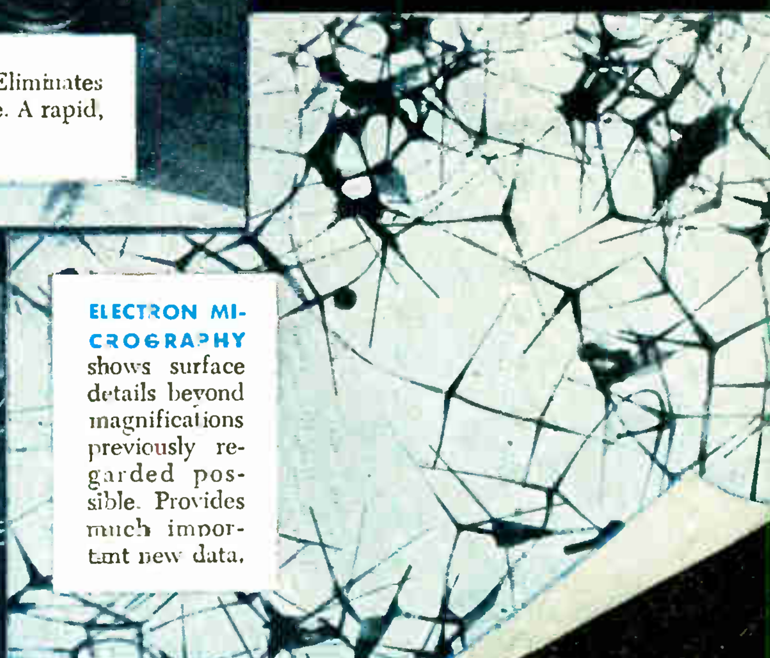


PHOTO LAYOUT shows dimensions and working instructions in full scale on the metals, plastics, or other material in production. Excellent for templates and precision dials, wiring diagrams, etc.

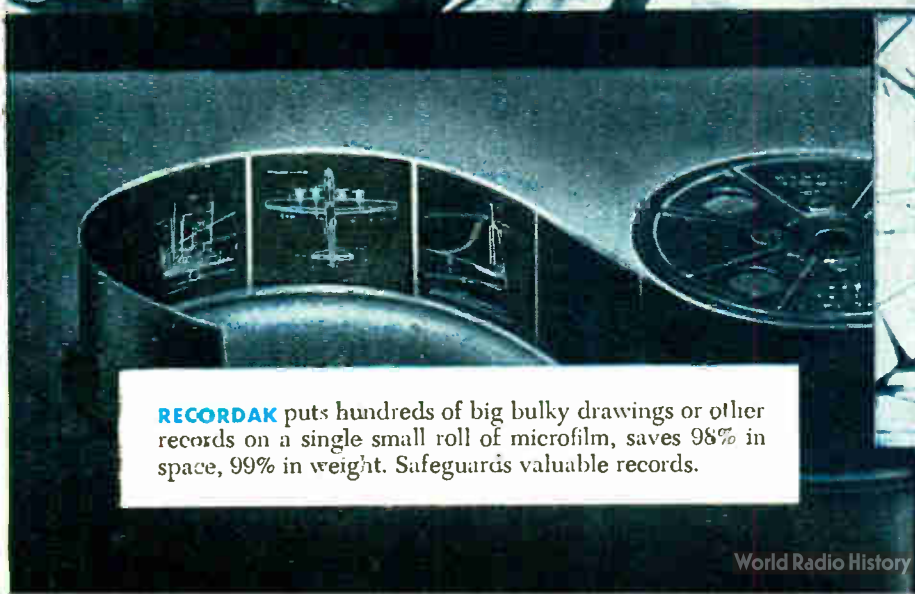


X-RAY DIFFRACTION shows effect of processes and operations on the crystal structure of materials.

RADIOGRAPHY shows condition of internal structure. Eliminates questionable parts before they reach the production line. A rapid, dependable non-destructive production control.



ELECTRON MICROGRAPHY shows surface details beyond magnifications previously regarded possible. Provides much important new data.



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PROPAGATION

(*Continued from page 65*)

path which is responsible for the absorption. The Needham Laboratory maintains continuous field intensity recordings of seven distant stations from the broadcast band to television frequencies. This material was available for discussion of the interpretation of variations in fields of one and two hop paths and for evaluation of the effects of sporadic "E" on reception.

Need was shown for additional stations throughout the world capable of broadcasting continuously well controlled standard frequency signals such as are emitted from the National Bureau of Standards station at Beltsville, Maryland. Continuous field intensity records of such signals around the world would provide needed supplementary information to ionospheric soundings now being made. It was also suggested that a coordinated program of absorption measurements at ionospheric stations should be made as soon as facilities become available.

Scatter effects

Following a discussion of sporadic "E" and high night "E" fields in the 5 mc records of the Needham Laboratory, H. W. Wells introduced a report of scatter effects observed at the Hawaiian Islands. Carrier waves broadcast from station KQF at Oahu on a frequency of 13.45 mc were received at Maui as though reflected from an ionic cloud lying off the California coast, the region toward which KQF's transmitter was beamed. "It was impossible", said Wells, "to obtain an accurate bearing of the source of scatter, although the mean direction of the widely swinging reflected beam indicated a bearing of 94° as a center of the scatter source."

The afternoon session was devoted to a discussion of VHF transmission from 30 mc up. Stetson and Pickard exhibited the results of field intensity measurements of W2XMN, Alpine, New Jersey, 42.8 mc, as received during the year at Needham. These showed a marked seasonal variation with the maximum field recorded in September, 1945. Pickard called attention to the fact that this was consistent with measurements taken by him-

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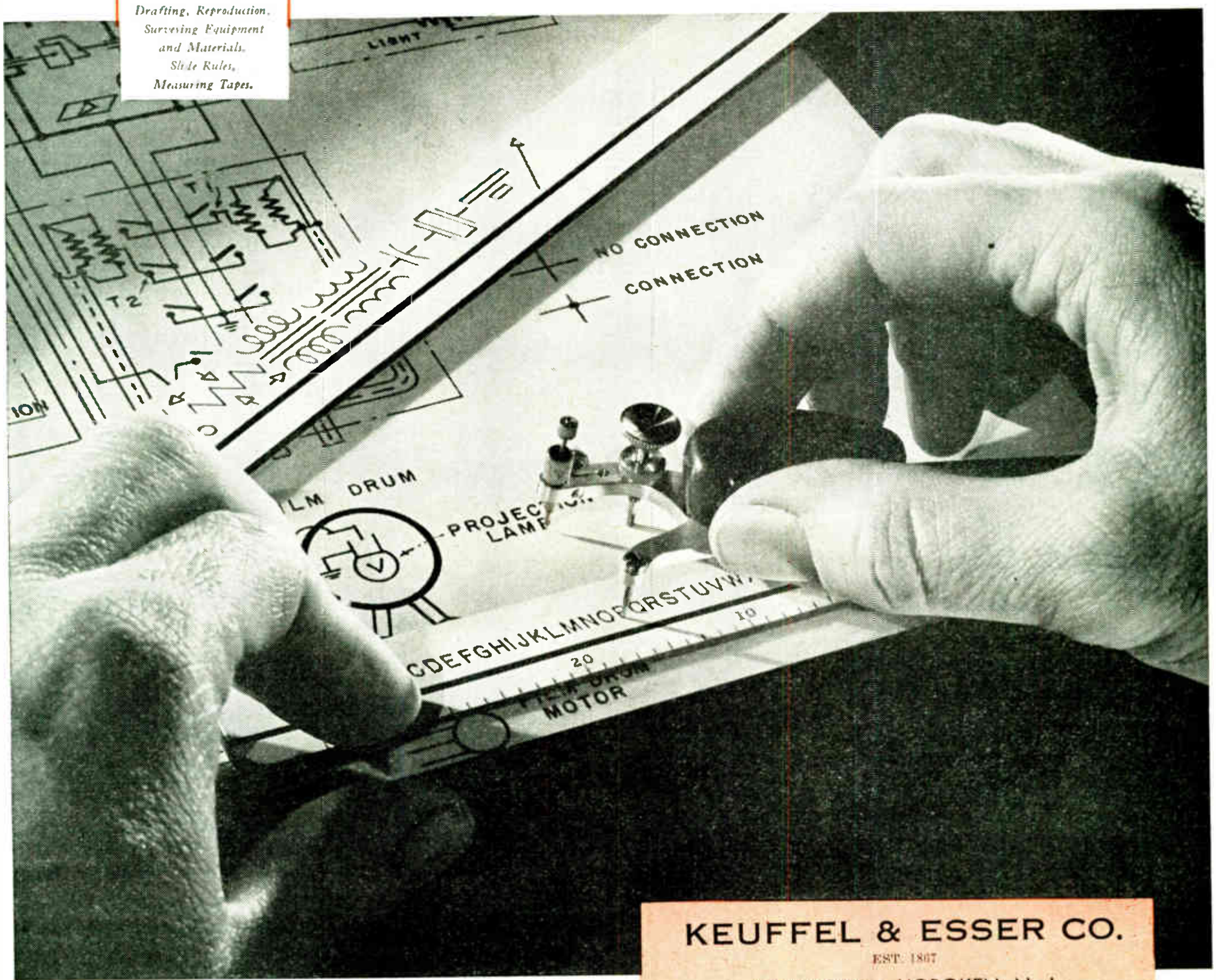

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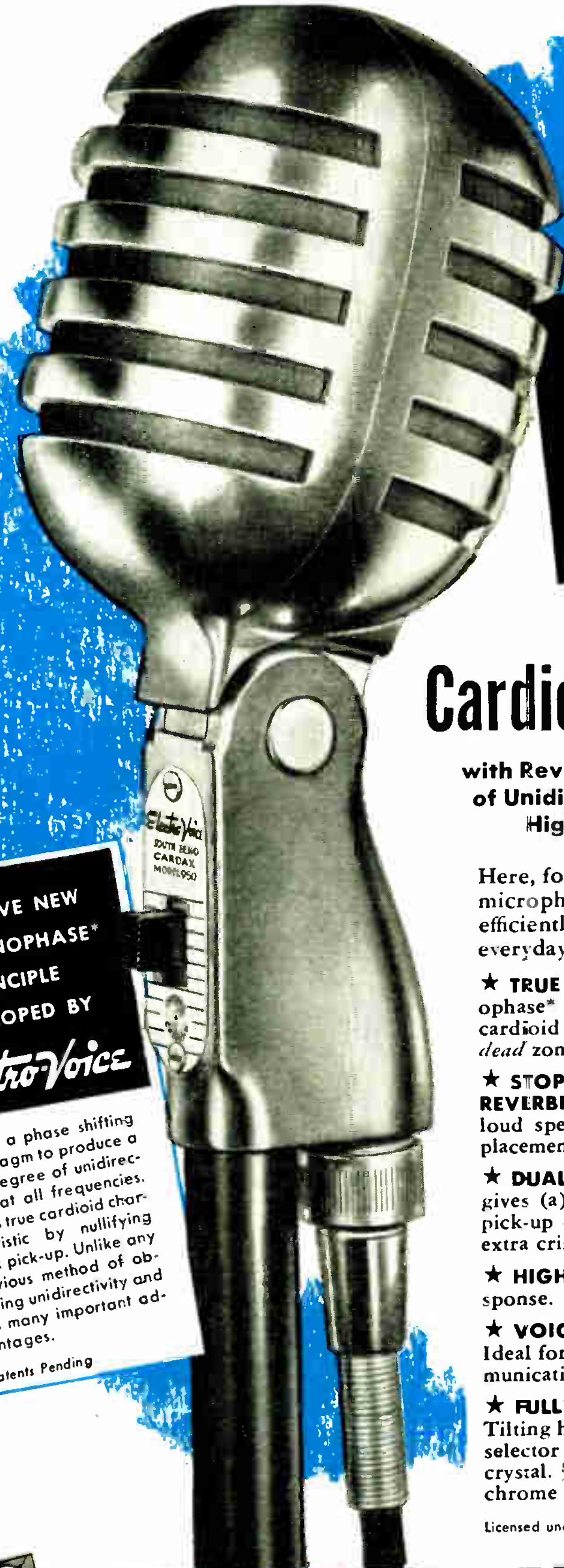
self at Seabrook Beach for WGTR, 44.3 mc, in 1941. It has been suggested that sporadic "E" may be of some importance in FM reception beyond the line of sight. Pickard showed, however, that a study of sporadic "E" occurrences showed no significant correlation with the Alpine reception at Needham over the 150 mile path.

A comparison of Alpine's reception with upper atmospheric data provided by the Weather Bureau showed important relations to temperature gradients and humidity; the approach of a warm air mass being conducive to higher fields. Dr. Brooks suggested an explanation for the higher fields in September as being due to the more stabilized condition of the troposphere at that season. In the discussion it was brought out that probably the chief atmospheric effects involved occur below the 5000-ft. level. The meteorological effects on Alpine reception were accentuated in reporting the reception of WRGB's television frequency, 71.7 mc, from Schenectady as received at Needham.

Tropospherics

The subject of tropospheric transmission led to the question of the relative reception at the lower and upper ends of the VHF band. At this point Major Armstrong was called to the chair and recapitulated early experiences in FM reception on 110 mc and 40 mc. He reported that over a three-and-a-half year period extended fade-outs occurred on the 110 mc frequency at distances of 70 miles and that transmission was greatly improved when his station was allowed the 40-50 mc frequency. The differences in opinion that have arisen as to the soundness of conclusions in favor of the 100 mc region must in the end be settled by performance records.

At this point Mr. Carnahan, of the Zenith Radio Corporation, Chicago, summarized the results of recent experimental transmission between Richfield, Wis., and Deerfield, Ill. The transmissions were from WMFM's transmitter at 45.5 mc and W9XK experimental transmitter at 91 mc. Signal strength was recorded continuously for two months at Deerfield, Ill., 76 miles distant. A full report of these experiments was subsequently published in *Electronic Industries* (December, 1945).



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LAB RECEIVER

(Continued from page 71)

were noted, the first being stage gain. The gain in the one stage is considerably more than two stages of the conventional type. Along with this high gain, absolute stability was obtained and much wider pass band characteristics. The limiter will operate or limit with an input to the receiver of four microvolts, which is remarkable with only one if stage. This if system, as can be realized, has remarkable possibilities in commercial receivers. The following points should be food for thought:

1—Only one stage of if necessary.
2—Very high degree of stability.
3—Less components needed.
4—Only one circuit to align.
5—Wider pass band characteristics.

For obvious reasons this extremely close coupled transformer (bifilar winding) cannot be used for the discriminator (see pages 160-161 and 163 Terman, Radio Eng. Handbook). However, it does have distinct advantages when used with the G. L. Beers system of FM reception. (Electronic Industries, November, 1944.)

Single meter

As there are no trick methods of alignment or adjustment I will pass this by saying alignment should be done with the minimum signal possible, and a 50 microampere zero center meter is incorporated in the circuit. It is used for signal strength, stage alignment, and frequency deviation. In Los Angeles I could receive WWV on 10 mc, by connecting the antenna to the grid of the mixer, or by pulling out the oscillator coil when receiving 15 mc, to check the if alignment. A typical signal generator was used for BFO for heterodyne purposes when required.

The AM-if pass band is 4 kc and is sufficient to make the tests mentioned earlier in this article. The receiver sensitivity on AM is four microvolts. AVC is not used as can be seen from the schematic because its worth at VHF is nil. The AM-if transformers are Aladdin 12 mc with additional shunt capacity to bring them down to 10 mc. They are loosely coupled and temperature corrected by the use of NTC ceramic capacitors and silver mica ZTC capacitors.

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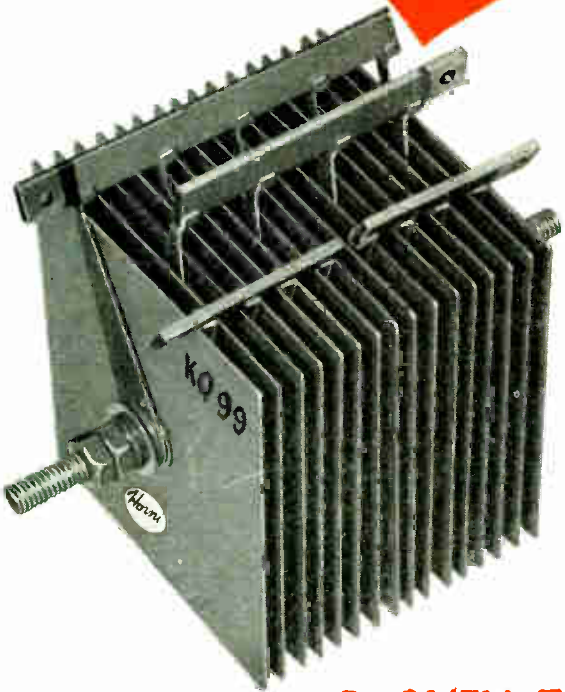

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Even though high Gm tubes (type 6AC7) are used, extreme stability is obtained, one point that adds to this stability being a socket shield that shields tube input from its output pins. This shield takes the form of a Cinch solder lug No. 4406 soldered to No. 1 pin and bent to form a half circle around pin No. 8 and its other end soldered to pin No. 7.

The FM-if pass band is 300 kc, this being wide enough for wide band FM reception. The discriminator transformer is a reworked Bendix 12 mc, rewound and shunted with the capacities shown on the schematic. The discriminator was linear over the range of 200 kc. This transformer, being loosely coupled and slug tuned, was very stable and would stay put.

The power supply and audio amplifier being on a separate chassis was another factor contributing to the overall results obtained. The amplifier and power supply used was a 6J5 voltage amplifier, 6N7 phase inverter and a pair of 6L6G's in class A. The rectifier is a 5R4GY with the power transformer incorporated in an electrostatic shield; line by-pass capacitors were used.

FM TRANSMITTER

(Continued from page 80)

value of grid resistance is required, necessitating considerable driving power from the first doubler.

The third doubler is the driver for the two 4-125A's in the final amplifier. To develop sufficient third-doubler power to supply transmission losses between the output tank circuit and 4-125A grid circuit, an 829B push-pull beam-power amplifier is used. Used as a push-push doubler, total output capacitance of the plates connected in parallel is approximately 14 mmf, which prohibits use of lumped parameters in the 88-108 mc plate tank circuit.

A linear concentric line element is therefore used with the outer conductor grounded. This concentric line construction was chosen to prevent external coupling between grid and plate circuits by suppressing tank-circuit radiation. An added advantage of the grounding is to provide greater safety for the operator.

Mechanical layout features vertical construction in order to obtain shorter leads, to minimize radiation losses from the various circuits, and to afford maximum accessibility to individual components.

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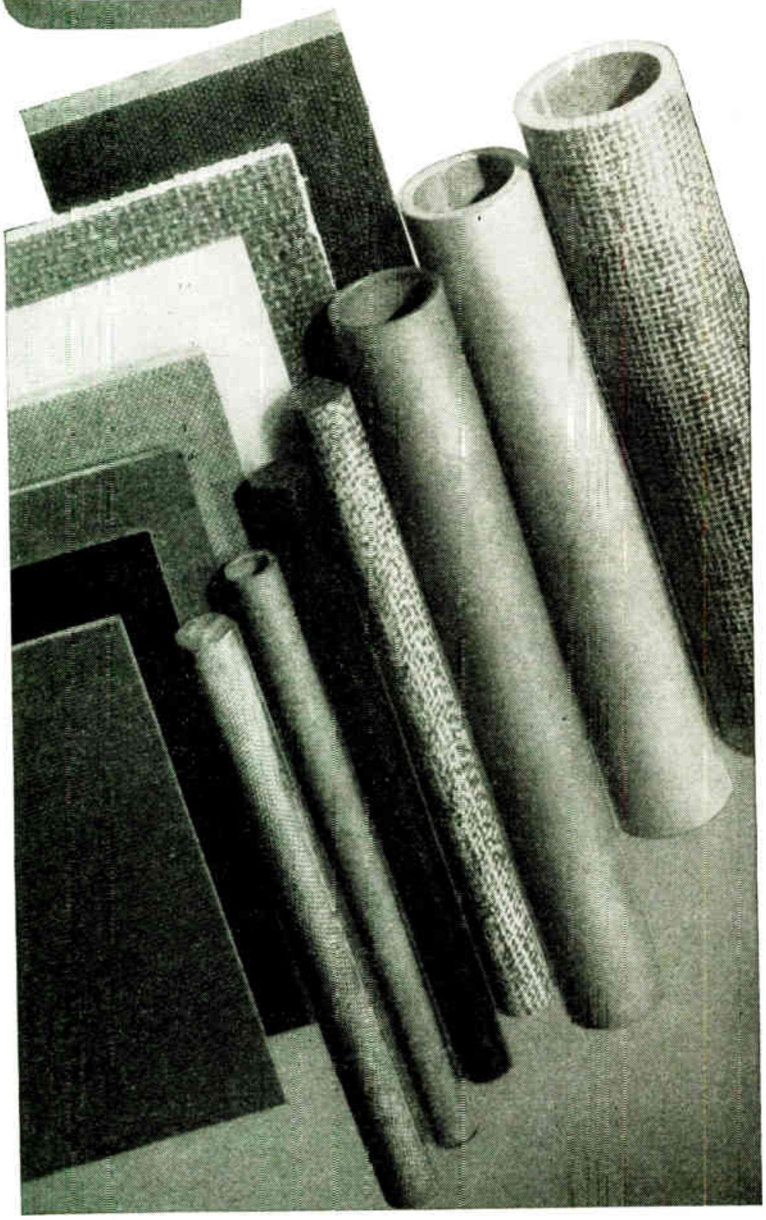
MANY JOBS
GOOD JOBS



G-E Textolite sheets, tubes and rods are manufactured in over fifty grades; consequently their versatility as a laminated plastics material is broad. This versatility leads to many new applications . . . applications where G-E Textolite fills the bill better than other types of materials. And also since each grade has an individual combination of properties, a wide range of applications is covered . . . Textolite is used for many purposes, and every grade is formulated to do a specific job well.

If you are looking for a laminated plastics material—one that must have a special set of properties for your needs . . . electrical, chemical, mechanical, thermal—investigate the many grades of G-E Textolite; if one of these grades won't meet your requirements, we'll do our best to engineer one that will.

For further information write to Section T-1, Plastics Divisions, General Electric Company, One Plastics Avenue, Pittsfield, Mass.

EVERYTHING IN *Plastics*

G-E TEXTOLITE
IS SUPPLIED IN THE FOLLOWING FORMS:

Sheets, Tubes, and Rods	Molded-Laminated Parts
Fabricated Parts	Post-Formed Laminates
Nameplates	Translucent Laminates

Low-Pressure Molded Parts

GENERAL ELECTRIC

CD46-E1

PERSONNEL

William S. Paley has been elected chairman of the board of the Columbia Broadcasting System, **Paul W. Kesten** was elected vice-chairman and **Frank Stanton** was elected president of the company, at the regular January meeting of the Directors.

At the same time Adrian Murphy, long CBS' champion on color television, returns to the company from the Army. As a Lt. Colonel in the Signal Corps he took over Colonel Paley's work in Europe when the latter returned. Murphy rejoins CBS as vice-president, and television will be one of his main over-all management responsibilities.

Paley, continues as senior executive, served as president since September 1928. Kesten joined the company in 1930 as director of promotion, became a vice-president in 1934, general manager in 1942, and executive vice-president in 1943. Stanton, who joined CBS in 1935 as director of research, became a vice-president in 1942 and general manager in 1945. Both Kesten and Stanton are Directors of the company.

Leonard F. Cramer who has been a vice-president and director of the Allen B. Du Mont Laboratories, Inc., Passaic, N. J., has been elected a director of the newly established Television Broadcasting Division. He will assume responsibility for the company's expanding telecasting operations.


Leonard F. Cramer


R. C. Longfellow

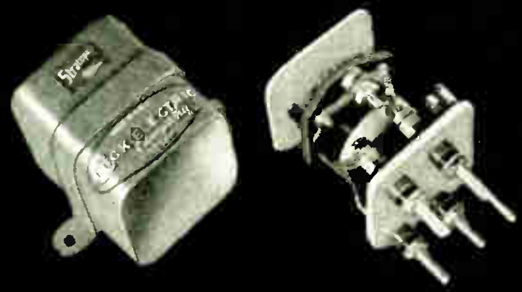
R. C. Longfellow has been appointed engineer of the specialty division of General Electric's Electronics Department. His headquarters will be at the Wolf Street Plant in Syracuse, N. Y., where he will have charge of all engineering activities for the division.

C. Edwin Williams has been appointed general manager of the

Here are the advantages when you Stratopax your electrical devices and components -

The science of Stratopax is the sealing of electrical devices in metal enclosures in an inert pressurized gas atmosphere. Stratopax, a service of Cook Electric Company available to all manufacturers of electrical devices and components, is the modern concept of the hermetic seal, with new and greatly improved techniques in sealing, inert gas filling and tightness testing.

Illustration of Stratopax relay used with a machine control unit ready for plug-in connection (left) and with cover removed before gas filling and sealing (right).



Contactor ready for Stratopaxing before covering. Wrap around mounting bracket, blister on cover for adequate terminal clearance, and binding post terminals meet specifications for unit.

Two typical Stratopax enclosures showing fill tube protectors, glass seal terminals and variations of design and mounting to meet requirements.

Here are the five basic features of Stratopax

1. PREVENTS CORROSION resulting from atmospheric changes, chemical conditions and fungus, by the use of specially compounded inert Nithelon gas.
2. PREVENTS EXPLOSION where gas and dust atmospheres are present.
3. PREVENTS ARCING AND BREAKDOWN in high altitudes for aircraft applications.
4. ADDS TO LIFE OF INSTRUMENT by permitting maximum service from contact points and through improved heat dissipation.
5. PREVENTS TAMPERING with factory adjusted equipment, and provides easy replacement if necessary.
6. RELAXATION OF SPECIFICATIONS and consideration of discontinuance of plating metal parts, insulation of coil windings, complete removal of coil winding wrappings, moisture and fungus proofing, design features for appearance only, and numerous other factors that become superfluous when Stratopax is used.

While the packing and sealing of instruments may at first seem relatively simple, the steps involved in Stratopaxing already existing equipment are, however, more complex. How Cook engineers adapt existent equipment to Stratopax with consideration of present mounting and space limitations, and the steps taken in preparation of Stratopax are completely described in the Cook Stratopax Engineering Report. Fully illustrated, it explains thoroughly the need for, and features of, Stratopax techniques used in filling, sealing, testing and selection of gases. A request on your letterhead will bring you a copy immediately.

A service of the Stratopax Division of

COOK ELECTRIC Company

CHICAGO 14, ILLINOIS

cathode-ray oscillograph and tube division of the Allen B. Du Mont Laboratories, Inc., Passaic, N. J. He joined Du Mont after completing three years' war service in Washington, as chief of the transformer unit of the Radio and Radar Division of the War Production Board.

Ivan G. Easton has been advanced to be manager of the New York engineering and sales office of the General Radio Co., Cambridge, Mass. He succeeds Martin A. Gilman, manager of the office for the past two years, who returned to the engineering staff at the Cambridge office. Easton is a senior member of the IRE and for the past two years has been program chairman for the Boston Section.

Ivan G. Easton

Walter C. Kirk

Walter C. Kirk has been appointed designing engineer of the Ken-Rad division of the General Electric Co.'s Electronics Department, with headquarters at Owensboro, Ky. In this capacity, he will represent tube division engineering at Ken-Rad and will be responsible for the design engineering of receiver tubes there.

Paul Peckar has joined the engineering staff of Tenney Engineering, Inc., 26 Avenue B, Newark, N. J. He was formerly assistant senior division engineer of the Reconstruction Finance Corp. The company manufactures automatic temperature humidity and pressure control equipment.

R. E. Samuelson, vice-president in charge of engineering for the Hallicrafters Co., Chicago, has been named chairman of the Marine Section of the Radio Manufacturers Association Transmitter Division.

Thomas Ryan Warner has been appointed assistant communications engineer for the Greyhound Corp., bus operating affiliate of the New York Central Lines. He will be in charge of engineering the two-way radio communication equipment soon to be installed on buses of the Greyhound Lines and two other intercity carriers operating into Chicago. He has recently left the Army with the rank of Lieutenant-Colonel.

Samuel C. Avallone has been appointed chief metallurgist of the Spencer Wire Co., West Brookfield, Mass. He will also function as General Sales Manager.

George R. Larsen has been appointed development engineer by the Marion Electrical Instrument Co., Manchester, N. H. During the war he was associated with the Signal Corps Engineering Laboratories at Fort Monmouth, N. J.

Two changes in the executive personnel of the American Transformer Company, New Jersey, involve; **A. A. Emlen,** who as a vice-president henceforth is to have charge of engineering and related activities; Vice-president **Walter Garlick, Jr.,** has been placed in charge of sales and its related activities.

William R. McMillin has rejoined the engineering department of the National Broadcasting Co. He will be associated with the Radio Facilities Group as a broadcast engineer, has just returned after 3½ years service in the United States Navy.

Nat Gada has been appointed sales manager of emergency communication equipment at the General Electric Co.'s Transmitter Division of the Electronics Department. A graduate of MIT, Gada's headquarters will be at the GE Thompson Road Plant in Syracuse.

Commander G. Robert Mezger has rejoined the Allen B. Du Mont Laboratories, Inc., Passaic, N. J., after a spell of 4½ years with the U. S. Navy. He originally joined Du Mont in 1936.

Porter Turner who has been a sales engineer with the Alliance Mfg. Co., Alliance, Ohio, for the past eight years, has been appointed field engineer for the New York and Philadelphia territories. His headquarters will be at 401 Broadway, New York.

Paul M. Reyling has been appointed manager of production and engineering of Freeland & Olschner Products, Inc., 611 Baronne Street, New Orleans 13, La., manufacturers and rebuilders of transmitting tubes. In his new capacity, Reyling will manage the New Orleans tube plant and supervise the company's tube development projects. He comes to Freeland & Olschner directly from the Tennessee Eastman Corp., where he was senior engineer in charge of all phases of the vacuum tube program for the Oak Ridge atomic bomb project.

Howard K. Morgan, formerly director of engineering for TWA, Inc., has joined the engineering staff of Bendix Radio Division of Bendix Aviation Corporation in Baltimore. He has been assigned to engineering programs related to long range planning of product development.

John N. Cage, former University of Colorado associate professor of electrical engineering and previously industrial electronics chief of Allis-Chalmers, has been appointed manager of the Industrial Electronics division of Raytheon Mfg. Co.

George D. Rice who had been in charge of the home radio service group for Lear, Inc., has been advanced to the post of acting assistant chief engineer of the radio division. He will make his headquarters in the company's Grand Rapids office and will have complete responsibility for all radio engineering projects.

Captain Adolph B. Chamberlain has resumed his post at the Columbia Broadcasting System's general engineering department as chief engineer. Prior to more than three years of war service with the U. S. Navy he had previously held this same position for eleven years.

R. H. Mecklenborg has returned to the Automatic Temperature Control Company, Inc., Philadelphia, as an instrumentation specialist. He returned to ATC after two years of European service with the Signal Corps.

Dr. James R. Downing has been appointed director of research at Cook Electric Co., Chicago. Since 1942 his major work has been on the atomic bomb project of the Manhattan Engineer District, and in the development of high vacuum equipment for industry.

Ralph A. Powers has been named engineer-in-charge of electronic engineering at the Allis-Chalmers Mfg. Co., Milwaukee. Powers, formerly was with the Bundy Tubing Co., Detroit.

Frazier Vice-President Freeland & Olschner

Howard S. Frazier, former director of engineering, National Association of Broadcasters and vice-chairman of the Radio Technical Planning Board, was elected vice-president of Freeland & Olschner Products, Inc., 611 Baronne Street, New Orleans 13, La., at the annual stockholders meeting held December 14.

Frazier's appointment is in line with the Company's expansion program and reconversion to the manufacture of new tubes. During the war, F & O was devoted exclusively to the rebuilding of large transmitting tubes. He will be in charge of sales and financing of the company, operating from offices at 1730 Eye Street, N.W., Washington 6, D.C. In addition to his duties with F & O, Frazier is conducting a radio management consulting practice for broadcast stations and manufacturers of broadcast equipment.

Transformer Engineers

A new company, Transformer Engineers, has acquired the assets of the Hollywood Transformer Co. They are located at 389 South Arroyo Parkway, Pasadena, Cal. E. E. Hoskins is president, E. O. Woodward is vice-president and Ray Olesen is chief engineer. The company will specialize in the design and construction of high grade transformers and inductors and is ready to supply research laboratories with special jobs in small quantities to specification.

Decalcomania Service

The Meyercord Co., Chicago, manufacturer of decalcomanias, has revitalized its technical consultation service and reconverted its research laboratories from Army to civilian work. The consultation service is again available through the Meyercord branch offices in thirty cities in the United States.

Test Equipment

The illustration of the special vacuum tube testing unit which appeared in the "What's New" section of the January issue was designed and is being used by the Raytheon Mfg. Co.; though built by Lyman Electronic Corp., Springfield, Mass., it was constructed to meet specifications and is not available for general sale.

NEW BULLETINS

Industrial X-Ray

North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y., has issued a new booklet describing the specifications and features of Norelco Searchray industrial x-ray equipment, spectrometer and diffraction units. X-ray inspection applications which have speeded up production and provided better quality safety checks are shown. The various models, including one for conveyor belt operation, are illustrated.

Thermoplastics

Many suggested uses and a listing of the properties and advantages of vinyl compounds, cellulose acetate, ethyl cellulose and polystyrene plastics are shown in a new booklet issued by Chemaco Corp., Berkeley Heights, N. J. This information should prove helpful to anyone interested in plastic fabrication. The several commonly used molding methods are briefly described.

Transmitting Tube Data

New or revised description and rating sheets for the "Radio Transmitting Tube Handbook" have been issued by the tube division, Electronics Dept., General Electric Co., Schenectady, N. Y. Information on ten tube types has been revised, while seventeen new tubes have been added. Three types—GL-846, GL-860 and GL-861—have been dropped. Seven revised installation and operation instructions are included in this issuance.

Fluorescent Ballasts

A four-page folder gives complete information about Amertran ballasts for fluorescent lighting. Fifteen types for 1, 2 and 3 lamp operation are included. Ballasts are made for both 50 and 60 cycle circuits. Issued by American Transformer Co., 178 Emmet St., Newark 5, N. J.

Corrosion Protection

A new folder—Hastelloy Facing for Corrosion Resistance—describing a new process for protecting chemical-plant and oil-refinery equipment from corrosion, has been issued by Haynes Stellite Co., Kokomo, Ind. Two methods of equipment surface protection are given; the use of Hastelloy welding rods for covering small areas and welding thin sheets of Hastelloy alloys as a lining. Corrosive media and possible protection are included.

Ceramic Capacitors

A new folder giving the specifications and construction details of their Hi-Q silver electrode ceramic capacitors is being distributed by Electrical Reactance Corp., Franklinville, N. Y.

Plastic Fabrication

Illustrating many of the various types of work in the field of plastics, Emeloid Co., Inc., 287-291 Laurel Ave., Arlington, N. J., has issued an anniversary booklet — 25 Years of Progress in Plastics. It covers the many kinds of plastic services the company renders, including molding, laminating, printing, stamping, embossing, etc.

Plastics

A 20-page booklet in color—Plastics Newsfront — explains some of the uses that have been made of American Cyanamid Company's plastics. Included is a two-page illustrated spread giving hints which should be remembered when product design is being developed for plastic fabrication. The book is distributed by American Cyanamid Plastics Division, 30H Rockefeller Plaza, New York 20, N. Y.

Components

Illustrating a portion of the 500 different items they make, Alden Products Co., 117 N. Main St., Brockton 64, Mass., has issued a new four-page folder. Many types of connectors, sockets, coil housings, stampings, etc., are described.

Miniature Ball Bearings

Along with some general informative data on the application and selection of correct bearing types, the new catalog of Landis & Gyr, Inc., 104 5th Ave., New York 11, N. Y., shows a complete line of standard and precision ball bearings. Several types of radial bearings not available before this time, are shown.

Ceramics and Kovar Seals

An 8-page folder describing the use of ceramics for padder and trimmer bases, resistors, strain and spreader insulators and metallized ceramics has been prepared by

Stupakoff Ceramic and Mfg. Co., Latrobe, Pa. Many components using kovar metal-glass seals are also illustrated.

Marking Equipment

A new bulletin just issued by Acme Marking Equipment Co., 2222 W. Fort St., Detroit 16, Mich., describes units and equipment for marking all types of material from hard steel to soft rubber. Such items as steel stamps, machine stamps, hobs and molds, embossing dies, numbering heads, branding irons, etching equipment, rubber stamps are shown.

Self-lubricating Bushings

An 8-page pamphlet giving the properties and engineering data necessary for the effective use of Graphalloy bushings has just been issued by Graphite Metallizing Corp., 1050 Nepperhan Ave., Yonkers 3, N. Y. This type of bushing will operate for long periods of service, without attention, at either low or high temperatures. They also provide long life lubrication when submerged in water, gasoline and many chemicals.

Hermetic Terminals

An 8-page pamphlet giving complete engineering data about Fusite hermetic terminals and Hermeti-Cans has been prepared by Cincinnati Electric Products Co., Cincinnati 12, Ohio. Details of design construction are shown for eight different series of terminals. Specifications of HermetiCans for enclosing electric and electronic components and the Fusite automatic HermetiCan sealer are also covered.

Germicidal Equipment

A new booklet—Disinfectaire Electronic Air Disinfection—issued by Art Metal Co., Cleveland 3, Ohio, gives concise data on the advantages of germicidal equipment and the correct installation of ultraviolet apparatus. Industrial, institutional and residential uses are covered. Specifications and radiation distribution curves are shown for each of the model types.

Temperature-Pressure Controls

A 40-page booklet, in color, gives the complete story of Thermoswitch and Pres-Sure-Switch controls. Issued by Fenwal Inc., Ashland, Mass., specifications and suggested applications are shown for the various unit types. Special models for flame control, fire detection and railway journal box heat indicators are included. Fenwal also makes accessories and modifications of standard equipment for installations operating under special conditions.

Phenolic Resinoid Coatings

Complete laboratory and actual usage reports along with practical applications of Heresite plastic coatings, synthetic resins and molding compounds are contained in a new booklet issued by Heresite and Chemical Co., Manitowoc, Wisc. Designed as corrosive resistant coatings for industrial equipment requiring protection against chemical liquids and fumes, these Heresite materials now have many uses in the home appliance, packaging, food and textile industries.

Special Transformers

A 4-page folder by Red Arrow Electric Corp., 100 Coit St., Irvington 11, N. J., illustrates seven transformer types built for special applications in the radar and other electronic fields. The company is equipped to develop and build transformers and reactors up to 1 kva.

Precision Resistors

A 16-page loose leaf booklet just issued by Precision Resistor Co., 334 Badger Ave., Newark 8, N. J., gives the electrical specifications and physical dimensions of 26 resistor types. Wattage rating vary from ½ to 50w. Resistance values up to 1 megohm can be had in both inductive and non-inductive windings.

Liquefied Gases

Superior Air Products Co., 132 Malvern St., Newark 5, N. J., have two new booklets. One shows their line of liquid air containers. The second explains in non-technical language the features and equipment necessary for the preparation of liquid air, liquid nitrogen or liquid oxygen in the user's plant.

Air Capacitors

Specifications for a complete line of air dielectric capacitors, both variable and fixed, are contained in a new bulletin issued by Allen D. Cardwell Mfg. Corp., recently absorbed by Grenby Mfg. Co., Plainville, Conn. Couplings, dials and miscellaneous accessories for use with Cardwell capacitors are also covered.

Recording Equipment

Presto Recording Corp., 242 W. 55th St., New York City, has prepared a twenty-two page booklet on sound recorders, transcription turntables, automatic equalizers, amplifiers and associated equipment. Considerable informative matter on the general art of sound recording is included.

Speakers

Racon horns, horn units and cone speakers are described in a new booklet issued by Racon Electric Co., Inc., 52 E. 19th St., New York 3, N. Y. Models for many special speaker applications are shown.

Crystals

A new bulletin — Piezoelectric Crystals — issued by Aireon Mfg. Corp., Kansas City, Kans., shows the company's many types of crystals and mountings, together with frequency coverage and suggested uses. Principal types described: Octal, with cylindrical metal shield and standard eight pin base; three pin, two channel, aircraft type; standard two pin phenolic holders for various kinds of mobile and stationary installations (banana or pin plugs); variable air-gap mounting with screw top electrode.

Frequency Meters

James G. Biddle Co., 1211 Arch St., Philadelphia 7, Pa., in Bulletin 1770 shows many models of Frahm vibrating reed meters for frequency indication. Mechanical construction and operating characteristics of this type of instrument are covered, as are several special applications of the vibrating reed principle for tachometers and harmonic analyzers.

Diversity Receivers

Schuttig & Co., Ninth & Kearny Sts., N.E., Washington 17, D. C., has a 35-page booklet describing diversity receiving equipment developed for circumventing signal fading in commercial communication systems. The information is presented in non-technical language.

Vacuum Pumps

Supplementing the detailed descriptions of high vacuum and liquid pumps, a new bulletin issued by Kinney Mfg. Co., Boston 30, Mass., gives suggestions for the selection of proper pump types and necessary accessories.

Service Tools

The entire line of Xcelite screw and nut drivers is shown in a new color pamphlet issued by Park Metalware Co., Orchard Park, N. Y.

Buyers' Guide

Walker-Jimieson's 1946 Radio and Electronic Reference Book & Buyer's Guide will soon be ready for delivery. Published as an aid to users of industrial electronics, the volume has been designed to assist in the proper selection of radio and electronic parts and replacements. The handy 6 x 9 in. reference book contains listings of over 10,000 parts, including complete sections devoted to public address and inter-communication systems, tubes, batteries, test equipment, and electrical maintenance supplies.

Featured in its compact 100 pages are clearly illustrated products developed through wartime research in the field and in the laboratory. Aviation, communications, electrical, and industrial engineers should find this book valuable in solving electronic equipment problems. The technical data contained will assist engineers in the improvement of inspection, production, maintenance, and research facilities. Publisher is Walker-Jimieson, 311 S. Western Avenue, Chicago 12, Ill.

Organize Electronic Development Labs

Michael T. Harges and Joseph Lorch, formerly chief engineer and research engineer respectively of Harvey-Wells Communications, Inc., have organized Empire Laboratories, specializing on electronic consultation and the development of aircraft and communication equipment, marine telephones, television receivers, industrial electronics and other radio equipment. These laboratories are located in the Chamber of Commerce Building, Flushing, N. Y.

Electronic Calculator for Weather Forecasting

Scientists of Princeton University and the Radio Corporation of America Laboratories are developing plans for an electronic supercalculator that will solve problems running into 400 correlated stages. Officials of the Weather Bureau and the Navy and Air Forces are interested because they feel that apparatus of this type might have a revolutionary effect in solving the mysteries of long-range weather forecasting. One of the present handicaps to accurate future weather forecasting is the lack of mechanical means of solving the many mathematical variables within the time limit that such information is necessary and useful.

Proposed calculator

The proposed electronic calculator, capable of performing a multiplication in eleven micro-seconds, would solve 100,000 equations in about one minute. The equipment would use over 2,000 tubes and require up to twenty operators to guide its results. An alarm bell would sound if an error developed in any calculation. Because the largest of the existing calculators will only handle equations involving twelve or fourteen integrations, it is expected that it will be at least two years before even a practical working model of these advanced plans can be made.

NEW BOOKS

Principles of Industrial Process Control

By D. P. Eckman, John Wiley & Sons, New York, 240 pages, 1945, $3.50.

This book is an introduction to the science of automatic control. It is intended to treat the important laws of operation of industrial automatic control systems and to provide a practical background of theory.

Chapter 1, The Art and Science of Control, outlines the general terms, applications and advantages of automatic control. Chapter 2, Measuring Means of Industrial Controllers, discusses principal process variables, the pressure thermometer, thermal-electrical elements, basic potentiometer systems, the flowmeter, mechanical type pressure gages, liquid level meters, and miscellaneous controllers. A part of the chapter covers transmission of measurement and compares the pneumatic and electric systems.

Chapter 3, Characteristics of Measuring Means, deals primarily with the response lag in thermal and mechanical pressure measuring elements. The effects of time lags in response due to protecting wells on thermal elements is shown in curves and equations. Response under both step-function and cyclical variable changes is shown. A lag coefficient table for pressure and resistance thermometers, thermocouples, pressure gages, flowmeters, and potentiometers is included.

Chapter 4, Modes of Automatic Control, differentiates between two-position, single-speed floating, proportional-speed floating, proportional, proportional reset, and proportional-reset rate systems of controller operation. Included under the description of each mode of operation are curves and equations giving the characteristic response of the variable to demand changes.

Chapter 5, Final Control Elements, covers only liquid and gas flow valves. Flow equations, curves and port shapes are discussed.

Chapter 6 covers process characteristics, including process variables, transfer lags, storage capacity, and dead time. Chapter 7, Theory of Automatic Control, extends the basic ideas presented in earlier chapters, showing the effects of various process characteristics, as dead time, on controller response.

Chapter 8 covers the quality of automatic control, discussing such factors as stability and adjustment of controllers.

Chapters 9, 10, and 11 are Application of Control Engineering, Automatic Control Systems, and maintenance of Exact Control, respectively.

The book is extended with a number of references at the end of each chapter and a glossary of automatic control terms is included at the end.

Aviation Radio

By Henry W. Roberts, published by William Morrow & Co., 1945, 637 pages, $5.

A complete study of the subject usable both by the novice and the professional. The language is clear and concise, the text accurate but not technical. Anyone can read it and understand it well. The author gives a bright promise for the future when he says: "Most of the aviation radio apparatus now in existence, on the ground and in the air, will need to be changed to the new very high frequencies as soon as possible. That need will exist even if not one single airplane be built in the next ten years to come."

TELEVISION—Eyes of Tomorrow

By Capt. William C. Eddy, U. S. Navy (retired). Published by Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y., 1945. Cloth. 9 x 6 inches. 330 pages, 136 illustrations. Price $3.75.

Television's many-sided genius, Bill Eddy, here presents the whole story of television-studio production, both technical and program—with side excursions into television history, tele receivers, color television, television economics, and finally "tall tales from the studios."

Capt. Eddy is best identified, of course, as television director for Balaban & Katz, Chicago, whose station WBKB he built, "out of second-hand police transmitters, clothes-pins and rubber cement," although WBKB already ranks among the top stations of the country. Before going to Chicago in 1940, he was chief of video effects for NBC at New York and a leading television figure in the East.

Following Pearl Harbor, Capt. Eddy created and then commanded the Navy's huge radio and radar school at Chicago. In the course of this work, he invented and developed the famous "Eddy Test" for electronic students, which has been used nation-wide to examine hundreds of thousands of applicants.

A graduate of Annapolis, Eddy was one of the youngest officers ever to command a submarine. During this period Eddy turned over to the Navy many inventions in submarine and underwater sonics. Submarine rigors, however, eventually led to the loss of his hearing, causing his retirement. Today stone-deaf, he nevertheless gets along easily in everyday life by a combination of lip-reading and the use of a concealed mike in his pipe, with bone-conductor attachment, so that few people ever suspect his hearing difficulties.

Six-foot-six Bill Eddy is also a practicing cartoonist with an original style of his own, and several cartoon characters to his credit. A number of special cartoons drawn by him, are used to illustrate his present volume on television.

Capt. Eddy's "Television" is the second book he has turned out in the wartime rush of instructing thousands of radar students for the Navy. The other was an erudite volume on higher mathematics made simple in the characteristic Eddy way under the title "Wartime Refresher in Fundamental Mathematics."

Fundamental Theory of Servomechanisms

By LeRoy A. MacColl, Ph.D., member of the Technical Staff, Bell Telephone Labs., Inc., published by D. Van Nostrand Co., Inc., New York, $2.25.

This is a thorough technical and mathematical study of the subject, suited to the use of persons familiar with the theory of the functions of a complex variable. It is scholarly and will well repay the expert or would-be expert for its study.

Principles of Radio for Operators

By Ralph Atherton, published by Macmillan, 1945. 344 pages, illustrations. Price $3.75.

This book resulted from the material prepared for a 16 weeks training course for radio operators, service technicians and maintenance personnel in a Navy training program and is based on the author's extensive experience in training men for communications work in the Armed Forces. The book is a highly practical, expertly organized, thoroughly illustrated training manual and handbook for radio operators, maintenance men, and those constructing equipment for transmitting, receiving and testing.

It covers basic electrical principles and the theory of the commoner radio components and circuits, tubes, power supplies, receivers, transmitters, and antennas, and descriptions of commercial equipment now in use. It is written for those with no previous training, and contains all the materials needed either for classroom or self instruction. There are more than 500 illustrations in all. An Appendix includes a review of the necessary mathematics, characteristics of vacuum tubes, diagrams and other practical information on trouble-shooting a modern receiver.

Electric Circuits and Machines

By Eugene C. Lister, Supervisor of Electrical Theory Instruction, Iowa State College, published by McGraw-Hill Book Co., Inc., New York, 1945, 358 pages, $4.00.

In an effort to make the subject easily understandable, this very elementary introduction to practical electricity avoids mathematics beyond expressions involving fractions, nor are precise definitions of most concepts given. The book apparently presupposes a knowledge of many of the basic concepts and their interrelation.

The text deals with fundamental units, direct-current circuits, batteries, dc and ac motors and generators, electrical instruments and a 14-page chapter on electronic tubes, starting with thermionic emission and ending up with the cathode-ray oscillograph.

STRATOVISION ANTENNA

Shown upside down here, this 10-ft. shaft of aluminum will be hinged to the underside of one of the Stratovision planes from which Westinghouse will broadcast FM and television

Alignment Charts, Construction and Use

By Maurice Kraitchnik, published by D. Van Nostrand Company, New York City. 94 pages. Price $2.50.

This book reviews the basic methods for laying out nomographic charts and follows up their construction using the system of determinants. The first chapter briefly summarizes the mathematics involved in this work. Other chapters discuss the problem from the viewpoint of the appearance of the final chart, rather than by the formula upon which it is to be based. The illustrative charts serving as examples of the processes apply to the fields of chemistry, engineering, manufacturing and banking.

Weather and the E Layer

For many years Dr. Charles G. Abbot, of the Smithsonian Institution, has studied the apparent connection between fluctuations in the solar constant and the weather. Changes in the solar constant are small and difficult to measure, whereas variations in the thickness of the radio-reflecting "E" layer of the earth's atmosphere are easy to measure with modern radio techniques.

According to Science Service, Dr. Abbot believes that approximate predictions of peaks and troughs of local temperatures can be made a week in advance, provided daily reports of the E layer are obtained from a sufficient number of stations, and if means can be found to anticipate by a few days the date of the next approaching change in the solar constant. "There is," said Dr. Abbot, "a fair hope that such important dates as heavy frosts may become predictable a week in advance from solar observations by this method."

LONDON LETTER

Television Pattern Generator

E. K. Cole, Ltd., Southend-on-Sea, England, has developed a portable pattern generator to enable radio service engineers to check television receivers when there is no transmission. The rf range is 40-50 mc and the maximum output is 2 mv obtainable either via a short rod antenna or an 80-ohm cable. The antenna system, video and audio circuits may all be tested. The pattern appearing on the screen is composed of two vertical black bars, crossed by a horizontal grey bar, on a white background and enables the present controls, etc., of the video circuits to be adjusted correctly. Contained in a metal case, 12½ x 9½ x 8 ins., the instrument has a 7-tube circuit.

Supersonic Detection

The oscilloscope range-display familiar in radar technic has been applied to routine detection of cracks in metals. Henry Hughes & Son, Ltd., Illford, London, after three years development, has produced a compact equipment similar in appearance to a portable oscilloscope. The supersonic transmitter and receiver are an identical pair of 2.5 mc quartz crystals, about 2 cm diameter and 0.1 cm thick. For steel and most aluminum alloys the pair of crystals are in-

RADAR UMBRELLA

Westinghouse's version of the lightweight, portable "Beach Umbrella" radar antenna clined slightly by wedges to give an included angle of about 16° in the beam. The crystals and metal surfaces are tightly coupled by films of oil or amalgam.

Pulse and mark intervals are adjustable to suit the thickness of the specimen. The time displacement between transmitted and reflected vibrations is indicated on the oscilloscope trace, and the depth of a crack or hole estimated by the scale length of the distinctive reflection from the far wall of the specimen. In very thick objects the pulse may be about 20 μsecs long and the marking time 20,000 μsecs. In steel the wavelength is 0.24 cm. Flaws can be detected at depths ranging from 0.5 in. to 12 ft., and an echo can be obtained from a crack less than 0.00001 in. thick, which is too small to be detected by X-ray examination.

Dielectric Heating

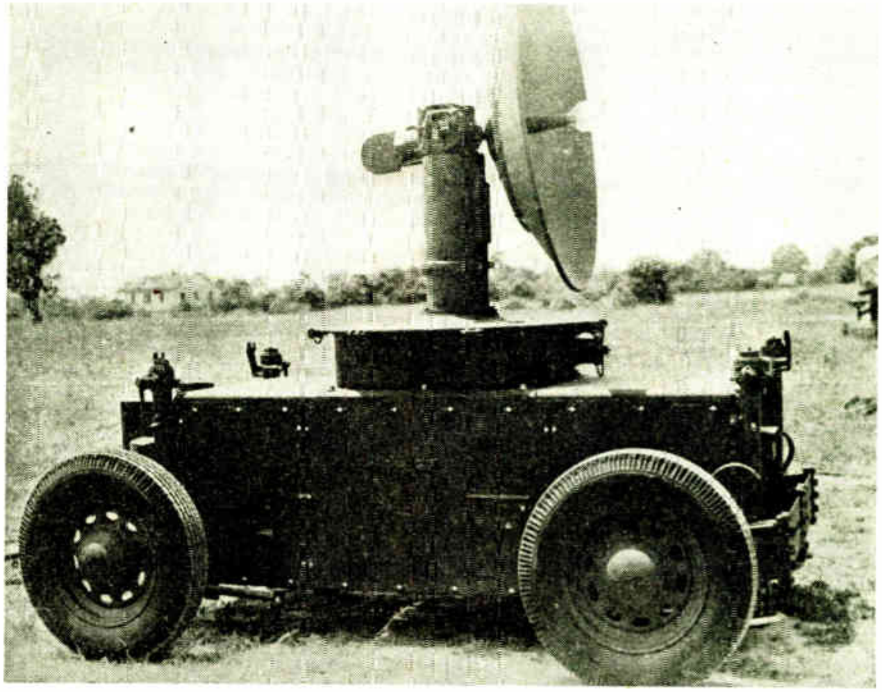
The general price of radio frequency heating equipment in Great Britain is put at about $400 per kilowatt of rf output for large sets, and about double this figure for small sets. In a report entitled "Capacity Current Heating" by T. H. Messenger and D. V. Onslow the published information is reviewed under three sections; theory, applications and equipment costs. About 240 literature references are given. The report is published by the British Electrical and Allied Industries Research Association, London, W.C.2.

Most of the available British equipments operate at frequencies of 10-20 mc, and above 10 mc; tubes are not at present available for ratings greater than 50 kw. Tube life is said to average 5000 hours, and the overall cost of rf energy is likely to be 2½ cents per kilowatt-hour under continuous operation, with electricity at about a cent per kilowatt-hour. Examples of applications include the continuous vulcanizing of rubber covered wires and cables, and the manufacture of polyvinylchloride covered cables. The vulcanizing process for one eight-inch rubber-bonded abrasive wheel was reduced from 20 hours to 20 minutes, and the molding of a phonograph record from 20 minutes to 2 minutes.

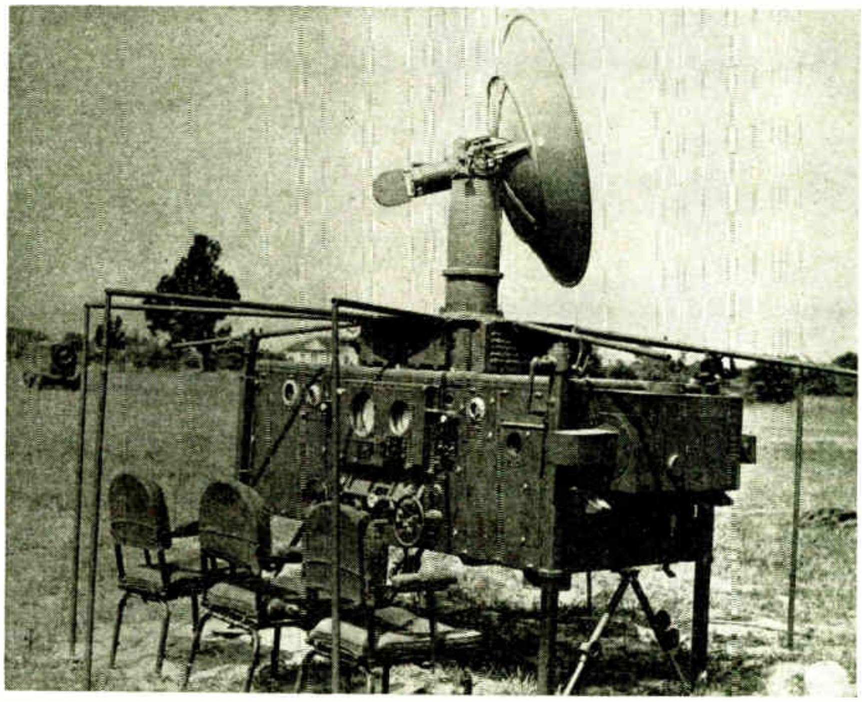
Bell System Readies Television Networks

The Bell System is planning a nation-wide network of over 7,000

PORTABLE SEARCHLIGHT CONTROL RADAR



Lightweight radar equipment (AN/TPL-1) as it is rolled into operating position and below a view of the set with wheels removed and panels opened, shelter removed, ready for operation



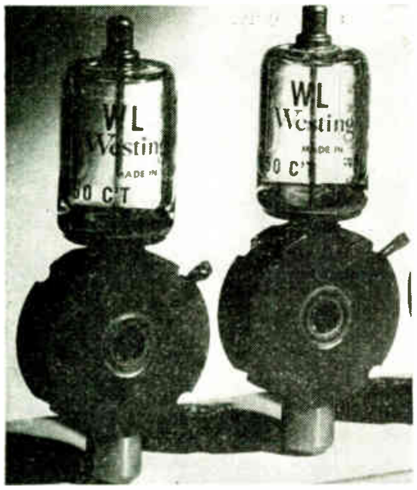
miles of coaxial cables, with tie-in radio relay systems, that will bring television programs to all parts of the country. Experimental transmission of programs on the New York-Washington link of this proposed network is planned for early 1946 and construction work on the remainder of the network will be pushed as rapidly as possible. Work is also under way on a seven repeater station, microwave radio relay system between New York and Boston. These facts are graphically illustrated in a new booklet—Bell System Television Networks—just issued by American Telephone and Telegraph Co., New York City. Several interesting television milestone dates are shown, too;—back in 1927, the Bell Telephone Laboratories were transmitting television by radio between Whippany, N. J., and New York City and in 1941, Bell engineers were sending television programs over a demonstration circuit of 800 miles of coaxial conductors with very satisfactory results.

Electronic Research in the USSR

On July 6-9, 1944, a meeting on electronic problems was held in Moscow by the Physical Mathematical Department of the Academy of Sciences of the USSR, jointly with the All-Union Scientific Council for Radio Physics and Radio Engineering. Titles of papers listed below and read at this meeting are taken from the Journal of Physics, Vol. IX, No. 1, 1945.

(1) P. Lukirsky (Physical Technical Institute, Academy of Sciences of the USSR). Field-Emission of Electrons. The intensity of the field-emission current. The energy distribution of the field electrons. Field-emission from single crystals. (2) V. Vertzner (State Optical Institute). Electron Microscope of the State Optical Institute. (3) A. Andrianov. The Emission of Oxide-Coated Cathode under Impulse Excitation. (4) A. Vlasov (State Optical Institute). A Short Magnetic Lens with a Minimum Spherical Aberration. Calculation of Fields of the Simplest Electrostatic Lenses. (6) V. Lukoshkov. Some Electrostatic Properties of Grid Electrodes. (7) P. Timofeev (All-Union Electrotechnical Institute). The Role of Surface Charges in Electron Devices. (8) V. Sorokina (All-Union Electrotechnical Institute). Mechanism of the Operation of Kenotrons with Cold Emission. (9) P. Aranovich (All-Union Electrotechnical Institute). Electronic Devices with Effective Emitters of Secondary Electrons. (10) D. Zernov (Institute of Automatics and Telemechanics, Academy of Sciences of the USSR). On the influence of Strong Electric Fields on the Secondary Electronic Emission of Dielectric Films. (11) S. Lukianov (Physical Technical Institute, Academy of Sciences of the USSR). On the Secondary Electron Emission of Solid Bodies. (12) L. Kubetzky (Institute of Theoretical Geophysics, Academy of Sciences of the USSR). Some Results of the Application of Principle of Secondary-Electron Transformation. (13) E. Kormakova (All-Union Electrotechnical Institute). Electron Multipliers. (14) A. Vlasov (Moscow State University). Generalization of the Conception of Electronic Plasma (Vibration Properties, Crystalline Structure and Their Spontaneous Appearance in a "Gas"). (15) A. Kaptzov (Moscow State University). Variation of the Mobility of Negative Ions in

Strong Fields and the Influence of This Variation on the Characteristics of the Corona Discharge. (16) G. Spivak and O. Repkova (Moscow State University). Behavior of a Plasma in a Magnetic Field. (17) G. Gvosdover (Moscow State University). The Passage of High-Frequency Currents through Electronic Devices. (18) N. Khlebnikov. Complex Photoelectric Cathodes. (19) P. Morozov and M. Butslov. Physical Properties of Silver - Caesium - Oxide Cathodes. (20) A. Pyatnitzky (All-Union Electrotechnical Institute). Energy Distribution of the Electrons and Dependence of Photocurrent for Caesium-Oxide Cathodes on the Angle of the Incidence of Light. (21) N. Khlebnikov and A. Melamid. New Sb—Cs Photocells.



High Speed Switch

An electronic switch developed for transmitter-receiver antenna switching in radar completes its operational cycle in less than one millionth of a second; and it will repeat this switching job many times a second. The unit is a needle spark gap in a confined space containing gas at a definite pressure. When a pulse is sent from the radar transmitter into the antenna the high voltage causes the gap to break down, short-circuiting the receiver. When the transmitted pulse stops the low pressure gas space de-ionizes in about four millionths of a second removing the short across the receiver input permitting pickup of echoed signals. The gap being hermetically sealed eliminates variations in discharges that might be caused by altitude or humidity changes. These high speed electronic switches are made by Westinghouse Electric Co., Pittsburgh 30, Pa.

Measures "Ceiling" at Wichita Airport

Doing a spectacular job at the Municipal Airport at Wichita, Kansas, is the electronic "ceilometer," one of the few instruments of its kind in the country. It provides an automatic reading, in feet, of the night-time flight ceilings at the field, in any kind of weather.

A tiny but powerful (30,000 candlepower) light source sends a small beam skyward—a shaft of modulated light focussed so that its "spread" is negligible until it reaches 10,000 ft. At its side, a photo-electric mechanism on an automatic swivel "follows" the modulated beam upward by its tone, detecting its illumation on cloud formations. Thus by a process of triangulation the PE cell indicates the critical altitude.

The junior-sized light, which has only about the dimensions of an ordinary automobile headlight lamp, except for its artificial cooling system, enjoys considerable fame in the Wichita airport area because its thin blade of light can be seen for miles around.

Humidity Recording

The ideal of "bone dry" air to protect metallic and non-metallic materials from deterioration resulting from corrosion, mold, mildew, tarnish and other effects of humidity or moisture in the air has been a long-sought goal of air-conditioning scientists and engineers.

It has not yet been achieved—this perfect and perpetual "Sahara of air"—but recent progress in the field of "dehumidification"—the "dehydration" of air—is now playing an important part in plans for the economic and efficient preservation of America's sea power.

At the close of the first World War no adequate scientific equipment existed for protection of ships and their equipment and cargoes against the inevitable onslaught of humidity.

Shelter alone was not enough to prevent the water vapor in the air from seeping into the holds of ships to corrode metal surfaces, tarnish moving parts and "bright work."

Grease, liberally smeared over engines, exposed metal surfaces and ordnance equipment was generally employed as a major preventative of corrosion and rust.

As a result of this liberal use of heavy grease, the job of preparing the inactive naval vessel for return

to active status was a long and costly one, involving many thousands of man-hours spent mainly in removing the grease, and replacing deteriorated equipment.

This laborious and costly refitting process was necessary in the case of the 50 over-age destroyers, which were re-commissioned in 1940 and traded to Great Britain.

Since the early 1920's, the Navy Bureau of Ships, in continuous research and tests with industrial companies specializing in air-conditioning systems and devices for recording and controlling humidity, has sought efficient, economical methods for checking or eliminating deterioration caused by humidity.

Air drying

The most advanced "air-drying" methods, equipment and controls yet perfected are now being successfully incorporated by the Navy in the greatest ship preservation program in world history.

As a result of progress made in dehumidification, the Navy now is able to put into effect preservation measures which will economically maintain hundreds of ships in a "reserve fleet" that will be in a constant state of readiness for emergency action over a long period of years, perhaps 20 or longer.

Preservation by dehumidification means removal of moisture from the atmosphere. This is done by two methods: dynamic dehumidification, which employs machines to remove water vapor; and static dehumidification, which employs dessicants such as silca gel to take up moisture. Both methods have been tested and found effective by the Navy.

To insure that humidity in ships would remain below a constant "safe" level of 30%, an accurate controller-recorder was needed. Tests had determined that a relative humidity of less than 30% would keep atmosphere dry enough to resist rust and corrosion. How to take continuous remote recordings of relative humidity in many "drying stations" remained the major problem which had to be solved.

At the request of the Navy, the Friez division of Bendix Aviation Corp., with a background of more than 70 years of experience in the development and production of controls and meteorological equipment, tackled the problem more than a year ago. Successful joint experiments were conducted aboard the Navy's experimental ship, *AVC*-v, in the Philadelphia Navy Yard, as part of lengthy tests of many preservation systems, materials and methods.

Friez engineers developed a controller-recorder which takes accurate humidity readings from 8 locations and transmits them to a central recorder station. Instead of being recorded on a graph, the humidity readings, station numbers, dry bulk temperature and times of readings are printed in numerals on a tape so that they can be easily understood by clerical workers. The printed numerals also form a permanent file record of air conditions within a ship. The Friez automatic controller-recorder also computes the relative humidity values of all 8 remote stations to indicate the average humidity within all areas recorded.

If the average humidity climbs above 30% , the "safe" level, the device then exercises its control functions by starting the dynamic dehumidifying machines. When an average humidity below 30% has again been achieved, the controller stops the dehumidifying equipment and resumes its continuous function as an automatic recorder.

Dielectric Heat Solves Bread Mould Problem

Uniform electronic heating to a temperature of 140 deg. kills instantaneously any mould spores that may be present in loaves of bread, yet does not affect vitamin or other food factors, according to Dr. William H. Cathcart, laboratory head of the Great A. & P. Tea Co.

Equipment used in the experiment was a standard Megatherm dielectric heating unit. Brown bread, particularly susceptible to mould, was treated for five seconds. At the end of three weeks, electronically heated loaves had developed no mould, although kept in moist, warm air. Control loaves, from the same batch of dough, showed signs of mould within three days. As a result, mould-proofing equipment will be installed at A. & P. bake-plants and the use of chemical retardants will be discontinued. An annual saving of $100,000,000 for all types of baked foods is forecast.

Electronic mould control is the outcome of experiments successfully conducted by Dr. Cathcart for the rapid defrosting of frozen foods. dielectric heating was found to re-

ELECTRONIC INDUSTRIES

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duce defrosting time from days and weeks to a matter of minutes and hours.

In the final installation, the process will begin after the bread is wrapped and on the conveyor belt. Five seconds of exposure will be used, as in the experimental runs. One hundred and fifty million pounds of bread will be saved per year, according to Dr. Cathcart.

Tube Exciters for Generators

Six ignitron tubes now are being used to supply complete field excitation for a large turbine generator installed at the Springdale station of the West Penn Power Co. This is the first time that electronic tubes have been used for such service and it is expected that the generator time out necessary for repairs and maintenance will be reduced to a minimum. The ignitron tubes are energized from a six phase diametrically connected rectifier transformer getting power from the generator busses themselves. Primer excitation, to be used in starting, is obtained from a separate motor-generator set.

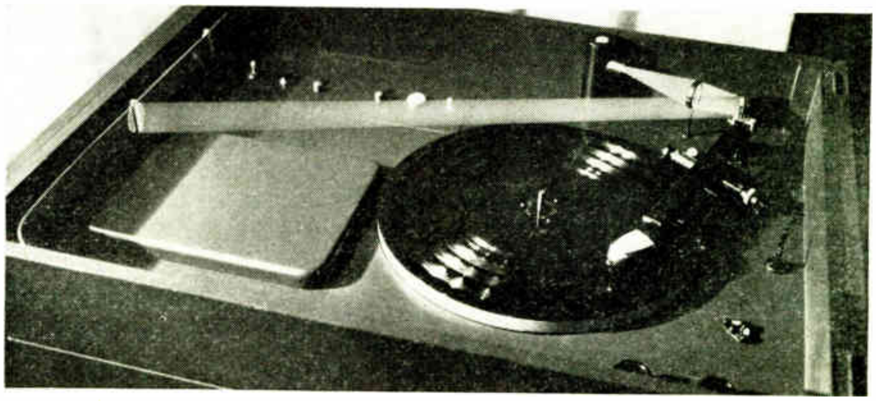
Regulation of the generator output voltage is fast and sensitive with electronic field supply. Line to line voltage between all three busses is stepped down by potential transformers and converted into dc through rectox units to operate Silverstat regulators. These in turn vary the bias on thyratron tubes to control the firing time on the main ignitrons. A constant ac voltage is superimposed on this variable bias voltage. As this dc component is increased, the ac wave rides higher to cut the critical curve of the thyratrons earlier in each cycle, thus making the ignitrons pass current over longer portions of time. This increases the main generator field current to raise the generator output voltage.

Ignitron tubes can be replaced while the unit is in operation; in fact, any two diametrically opposite tubes can be removed simultaneously and the unit will continue functioning while new tubes are being installed.

Visual Signals for Accurate Cueing

A new optical system which permits visual signals to be set up for accurate cueing of recorded music and speech has been developed. Details were presented to the Technical Conference of the Society of Motion Picture Engineers by Garland C. Misener. A small light source is mounted back of the turntable, feeding a light ray through a condenser and objective lens to a mirror which is affixed to the pickup arm at its pivotal point. This mirror reflects the light beam against a signal bar installed on the opposite side of the turntable compartment. Movable signals with hairline indicators are slid along this bar to show the exact groove that the playback is to be started or stopped. Details of the light system provide that the horizontal travel of the light beam on the signal rail is five times greater than the horizontal movement of the pickup needle. Even in a recording disk using 100 lines to the inch, the movement on the rail is 0.05 in., for each groove of operation. No heavy attachments are made to the pickup arm and there is nothing to interfere with the easy handling of the disks. The visual signals are placed in correct position at the time of the first playing of the transcription. A horizontal micrometer screw under the pickup arm allows proper placement of the arm for spot cueing.

Schematic arrangement of the precision optical cueing equipment



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ATTENUATION NETWORKS

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DAVEN Series 690 Attenuation Networks comprise 20 models, designed for general laboratory and production testing at audio frequency levels. DAVEN plug-in type Fixed Attenuators are employed for matching source and load impedances with the base impedance of the network. A high degree of flexibility is thus achieved with an absence of mis-match, reflection loss and switching noises.

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*Balanced "H" type may be used as an unbalanced network of one-half the base impedance.

OTHER SPECIFICATIONS

ACCURACY: Resistors calibrated within ±1%

PLUG-IN PADS: Octal tube base, panel mounting, in wide range of impedances and losses.

FREQUENCY RANGE: 0-17,000 c.p.s.; at higher frequencies, slight reduction in accuracy.

OPERATION LEVEL: +20DB (0.6w) maximum input.

SIZE: 2 dial portable: 5"x10"x5"; 3 dial portable 6"x11½"x5"; rack: 3½"x19".

Daven Attenuation Standards, types 740 and 742 (resistor accuracy ±½%), are designed for applications requiring greater accuracy. See your DAVEN Catalog or write for details.

PORTABLE TYPES

"T"	BAL "H"	DB RANGE	BASE Z
T-690-A	H-690-B	0-110	500
T-690-C	H-690-D	0-110	600
T-692	H-692	0-111	500
T-693	H-693	0-111	600
T-694	H-694	0-111	135

RACK TYPES

"T"	BAL "H"	DB RANGE	BASE Z
T-690-AR	H-690-BR	0-110	500
T-690-CR	H-690-DR	0-110	600
T-692-R	H-692-R	0-111	500
T-693-R	H-693-R	0-111	600
T-694-R	H-694-R	0-111	135

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