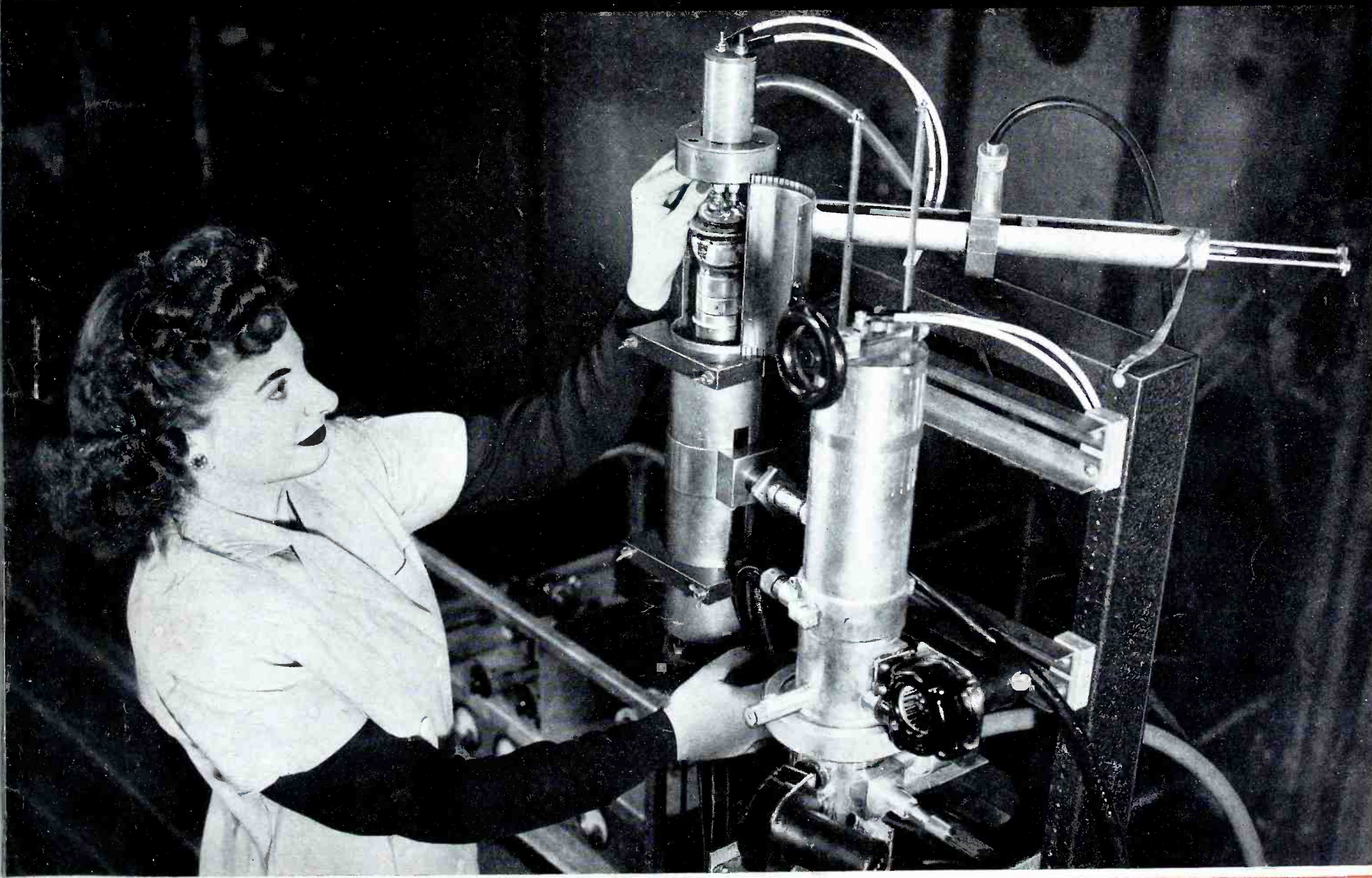
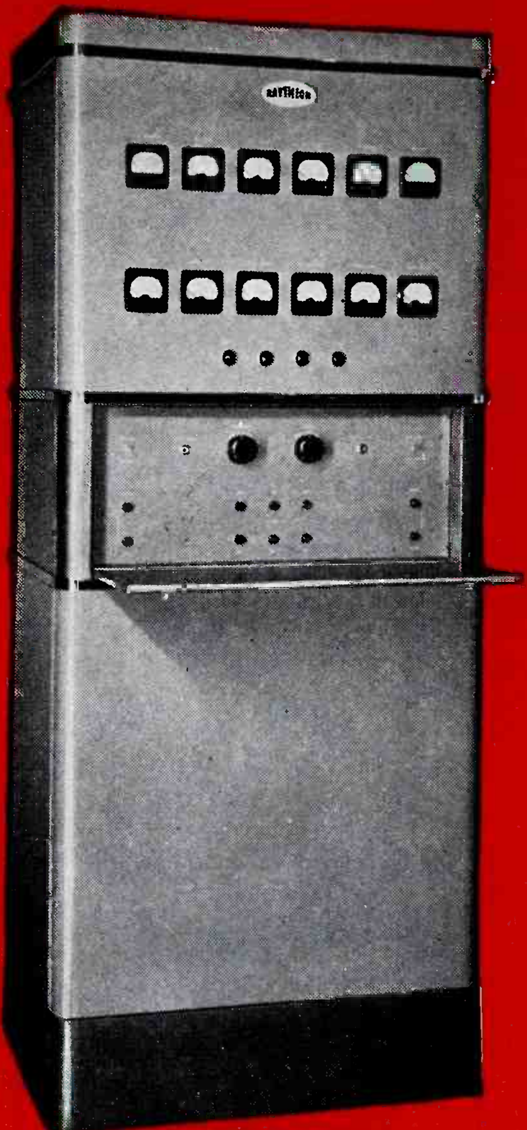
COMMUNICATIONS

INCLUDING "RADIO ENGINEERING" AND "TELEVISION ENGINEERING"



★ THE DECCA NAVIGATOR
★ TELEVISION RECEIVER R-F POWER SUPPLIES
★ DEMOUNTABLE SOUNDPROOF ROOMS
★ AERONAUTICAL COMMUNICATIONS
★ LINE SWITCHING BROADCAST SYSTEM
★ REACTANCE TUBE MODULATORS
★ SOLVING 4-TERMINAL NETWORK PROBLEMS GRAPHICALLY

MARCH 1946



HERE IS WHAT YOU WANT

In your 250 Watt AM Transmitter

Study these RAYTHEON features before you choose any transmitter, for replacement or new installation.

1. **Simple, Speedy, Accurate Tuning.** Uses only two tuned stages—RF drive amplifier and power amplifier—tuned by low-speed, clutch-equipped motor, giving micrometer control and eliminating back-lash.
2. **No Buffer Stage Tuning.** Use of Video type amplifier in buffer stage eliminates this complicated tuning.
3. **Lower Distortion Level** – *inherently* lower – due to use of Triode type tubes.
4. **Greater Dependability.** Use of Triode type tubes means that feed-back failure will not put you off the air. (Feed-back is included to improve quality of signal, but is not necessary to the circuit.)
5. **No Forced Ventilation,** therefore no excessive dust to cause arcs. Fresh, cool air circulates freely upward by convection, thanks to vertical chassis, properly vented.
6. **Silent Operation.** No fan noise. Especially important if transmitter is located in studio.
7. **Exceptional Signal Quality.** Full tonal beauty and really exceptional clarity has been obtained by careful engineering throughout.
8. **Highest Quality Components** used throughout; each part exhaustively tested before inclusion in the design.
9. **Easy Servicing.** Two full-height back doors give instant access to all wiring and components. The simpler circuits reduce servicing to a minimum.
10. **Meets all FCC Requirements.** Frequency response from 30 to 10,000 cycles ±1 DB greatly *under* FCC minimum. Transmitter operates *well under* the maximum noise level requirement.

NEW BEAUTY...Through Striking Modern Design
NEW DEPENDABILITY...Through Simpler Circuits

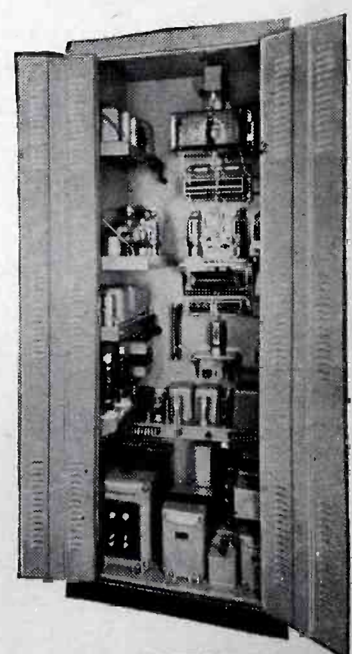
in RAYTHEON'S 250 WATT AM TRANSMITTER!

HERE IS AN UNSURPASSED transmitter design for the 250 Watt station . . . unsurpassed in modern styling—unsurpassed in engineering excellence. Its very presence in your station will add distinction and a "showplace" air. And the signal it puts on the air—clear, full, dependable—will do credit to the programs you present!

Every factor that can influence transmitter performance was carefully taken into account by Raytheon engineers in perfecting this new design. It is believed that this Raytheon 250 Watt equipment contains inherent superiorities that have never been available until now.

Before you select any transmitter, whether for replacement or new installation, you will be wise to get all the facts. Write or wire for our specification bulletin, fully illustrated, with complete technical data. Deliveries now being made.

COMING! A complete line of Raytheon high-powered AM Transmitters, FM Transmitters and speech input equipment. Watch for announcements!



RAYTHEON

RAYTHEON MANUFACTURING COMPANY

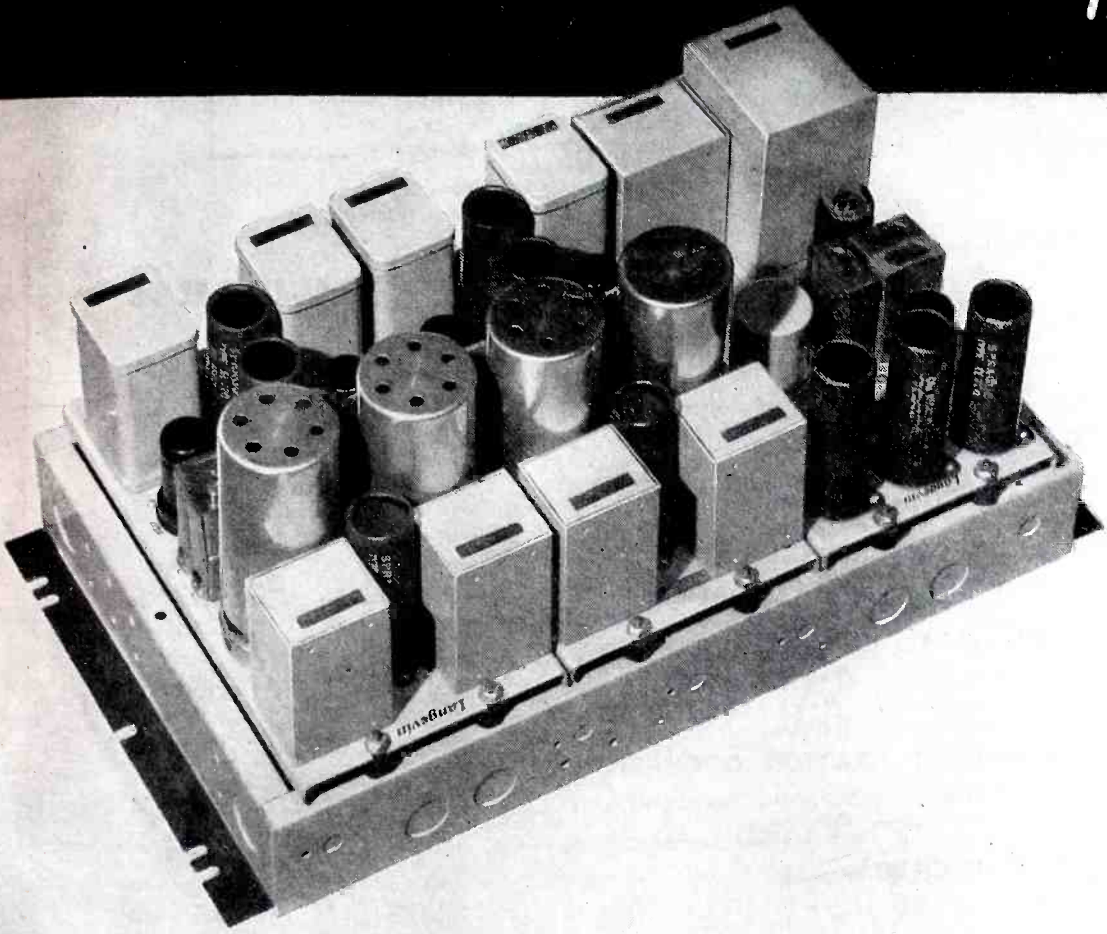
Broadcast Equipment Division, 7517 No. Clark Street • Chicago, Illinois

DEVOTED TO RESEARCH AND MANUFACTURE FOR THE BROADCASTING INDUSTRY

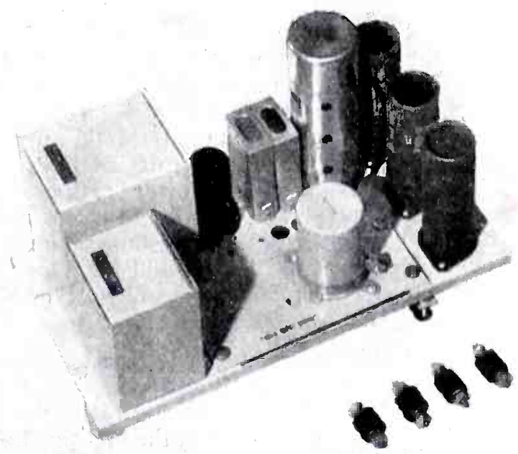
Excellence in Electronics

STUDIO AMPLIFIERS

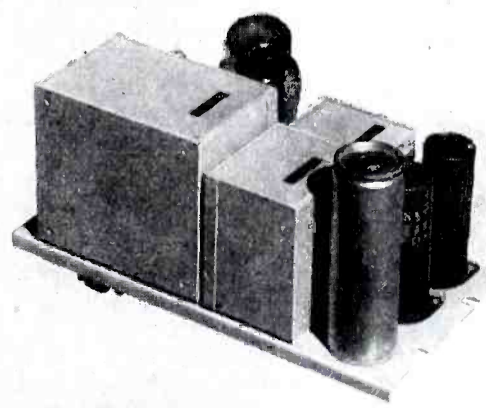
Engineered for High Quality Performance and Dependable Service



AT LEFT: Two Langevin Type 111-A Dual Pre-Amplifiers and one Langevin Type 102-A Amplifier on a Type 3-A Mounting Frame. This unit provides four pre-amplifiers and one line amplifier, or three pre-amplifiers, one booster amplifier and one line amplifier, all occupying 10½ in. of rack mounting space. An external power supply, the Langevin 201-B Rectifier, as shown below, is required. The Type 3-A Mounting Frame can be housed in a Type 201-A Cabinet, for wall mounting, if desired.



The Type 106-A Amplifier is a two-stage, fixed medium gain, low noise pre-amplifier, or booster amplifier, for use in high-quality speech input systems. The Type 106-A can be mounted on one-third of the space available on a Type 3-A Mounting Frame in combination with two Type 111-A Pre-Amplifiers, or in any similar combination.



The Type 201-B Rectifier supplies plate and filament power for the Langevin Types 102, 106, 111 and similar amplifiers from a 105-125 volt, 50-60 cycle AC source. The ripple voltage of the 201-B Rectifier is 0.04% at full power output 75MA and 0.02% at a drain of 30 milliamperes.

Langevin Audio Transmission Facilities are designed and built to have the extended frequency response, noise and distortion levels required in the F.C.C. Regulations for FM transmission.

In complying with these regulations too much emphasis cannot be placed on the quality of the transformers that are a part of the audio system. Noise, for instance, is largely associated with the input transformers—distortion, with the output transformers—and frequency response with both. Therefore, the transformers in Langevin equipment are manufactured by us—and are held to a specified tolerance—so that frequency response, noise and distortion levels of the entire system are well within requirements.

"Worthy of an Engineer's Careful Consideration"

The Langevin Company

INCORPORATED

SOUND REINFORCEMENT AND REPRODUCTION ENGINEERING

NEW YORK	SAN FRANCISCO	LOS ANGELES
37 W. 65 St., 23	1050 Howard St., 3	1000 N. Seward St., 38

LEWIS WINNER, Editor
F. WALEN, Assistant Editor

We See...

BROADCAST STATION DESIGN AND PRODUCTION, now at the highest peak of activity, will continue to speed ahead, and before the year is out, score unparalleled records. Such was the unanimous comment of executives and engineers at the recent Broadcast Engineering Conference held in Columbus, Ohio.

Discussing the increased requirements, conferees pointed out that advanced techniques of development and construction achieved in wartime manufacture, will not only accelerate equipment, accessory and component processing, but simplify their operation and maintenance.

Standardization was cited as one of the important wartime features that will continue to be applied. The RMA transmission-line standardization proposed was described as an example of this program. In this proposal transmission lines would have standardized power ratings, surge impedances, fittings, voltage ratios and air-dielectric sizes. For instance, power ratings for a ⅞" line would be 3 kw; 1⅝" line, 30 kw; 3⅛" line, 42 kw; and 6⅛" line, 166 kw.

To improve station operations, groove shapes and recording stylii may also be standardized. A proposal at the conference suggested that the present 124, 133 and 136-lines-per-inch records with 70° and 80° stylii should be standardized to perhaps a single-record type with one stylus. A suggestion that the transcription stylus be standardized at 3 mils was also offered. The use of one type of material to provide frequency standardization was also proposed; at present there are three . . . shellac, vinylite and lacquer.

THE TREND TOWARD HIGH-FIDELITY BROADCASTS has altered previous design formats, engineers declared at the conconference. For with the 15,000-kc signal out of the laboratory stage and soon to be applied to many network lines, there will be many fidelity transmission factors to watch. Distortion will have to be geatly reduced over that which was formerly considered adequate. This is particularly true in the wide f-m bands. It will be more necessary than ever to be conservative in modulating f-m transmitters so as not to exceed receiver limitations.

Round-table discussions disclosed that such check measures as intermodulation will be adopted to determine how low a distortion is permissible on the new bandwidths. Monitoring facilities, that are equal to or better than the high-quality receivers now being planned, will be used to afford careful policing on the new high standards of quality control.—L. W.

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U. S. Patent Office.
Member of Audit Bureau of Circulations.

MARCH, 1946

VOLUME 26 NUMBER 3

COVER ILLUSTRATION

Testing low-impedance u-h-f triode (6C22) in a coaxial doubler amplifier for 500-mc operation.
(Courtesy Federal Telephone and Radio Corp.)

Published Monthly by the Bryan Davis Publishing Co., Inc.

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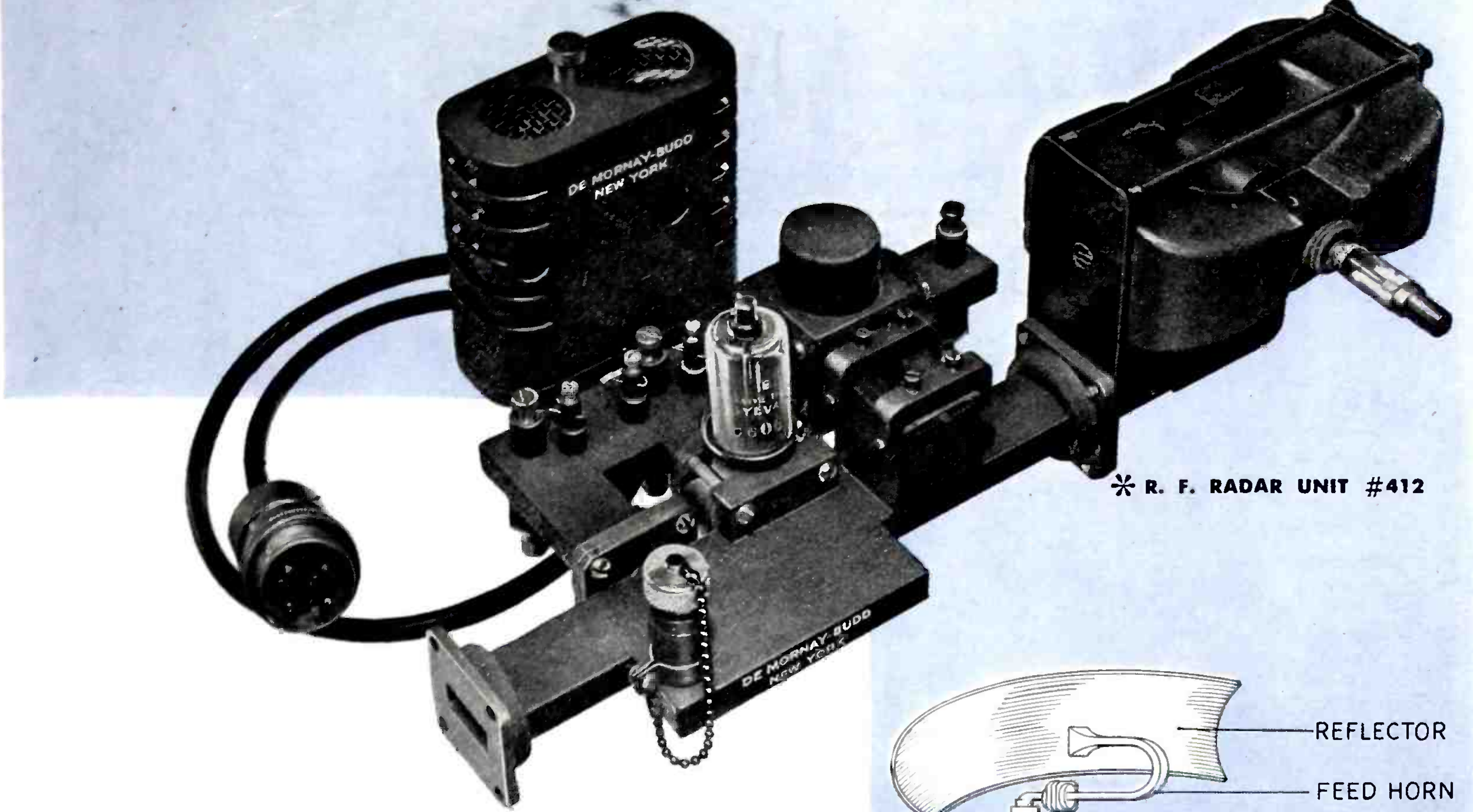
PACKAGED R. F. RADAR ASSEMBLY ELIMINATES DESIGN HEADACHES



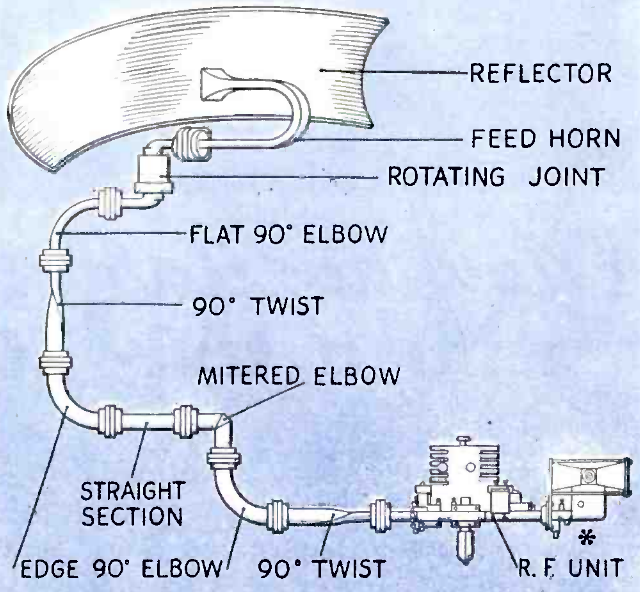
✲ R. F. RADAR UNIT #412

The DeMornay-Budd packaged R. F. Unit provides a complete R. F. assembly for microwave radar. It is now possible to obtain as standard items all the microwave R. F. components necessary in the fabrication of a complete radar—DeMornay-Budd Standard Transmission Line Components plus packaged R. F. Unit.

The R. F. Radar Unit is delivered complete and ready to operate. It is wired and contains all the necessary tubes and crystals. The unit uses a packaged magnetron capable of delivering 20 kw., peak power, at 9375 mc. Two type 2K25 local oscillator tubes are provided, one for receiver and A.F.C. and the other for beacon operation. A type 1B35 A-T-R tube, a type 1B24 T-R tube and the necessary type 1N21 crystals are included in the assembly. A 20 db. directional coupler permits accurate measurements to be made at any time with a maximum of convenience and safety.

Since the use of radar beacons is contemplated in the near future, the unit has been designed with a beacon cavity and crystal mount. The unit can be supplied without the beacon cavity and crystal mount and beacon local oscillator, and a termination supplied in their place so that it becomes a simple matter to convert to beacon operation when necessary.

We offer complete laboratory research facilities and have available such production test equipment as: Standing Wave Detectors, Calibrated Attenuators, Slug Tuners, Power Supplies, Square Wave Modulators, in addition to transmission line components shown in diagram above. Write for information or catalog.

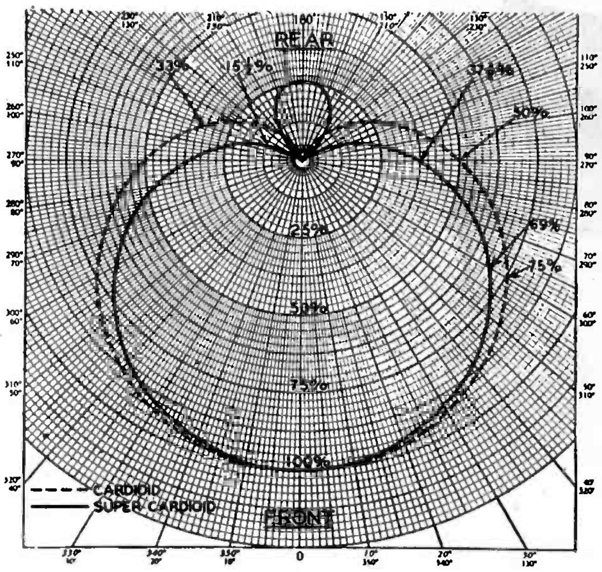


R. F. Radar unit #412 (indicated by asterisk) used in conjunction with standard DeMornay-Budd transmission line components.

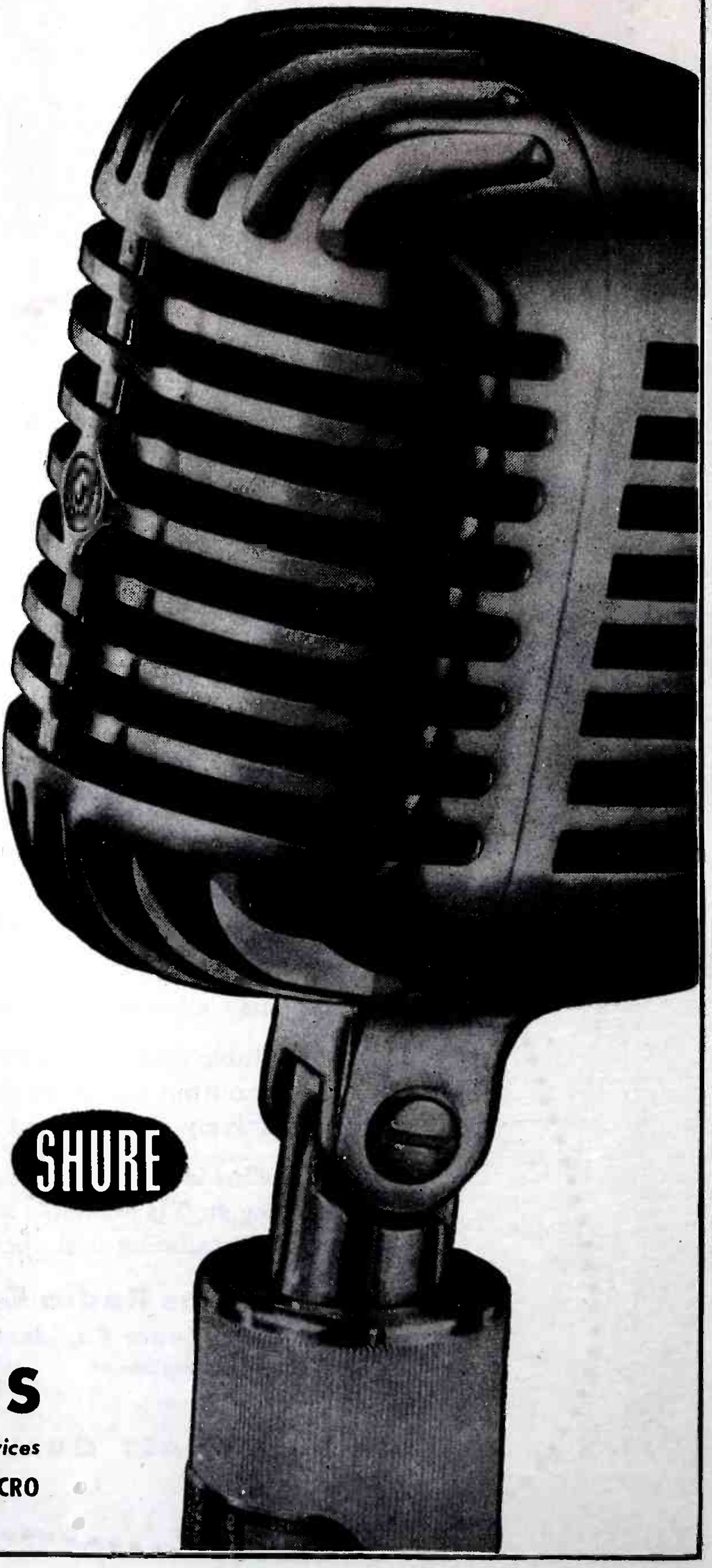
DE MORNAY BUDD

EQUIPMENT FOR 97% OF ALL RADAR SETS

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



. . . do you know these important performance advantages of the SHURE Super-Cardioid?



The improvement in unidirectional operating characteristics of the SHURE Super-Cardioid Microphone over the cardioid is indicated by the comparative pickup patterns shown above.

★ Maximum sensitivity (100%) is achieved by sounds entering the front of the Microphone.

★ A wide range of pickup is indicated by the fact that the Super-Cardioid is practically as sensitive as the cardioid at a 60° angle. (69% against 75%).

★ Beyond the 60° angle, the directional qualities of the Super-Cardioid become rapidly apparent. At 90°, the Super-Cardioid is 25% more unidirectional. At a wide angle at the back (110° to 250°) the Super-Cardioid is more than twice as unidirectional.

★ The ratio of front to rear pickup of random sound energy is 7:1 for the cardioid; 14:1 for the Shure Super-Cardioid.

For critical acoustic use, specify the Shure Super-Cardioid Broadcast Dynamic.

MODEL	IMPEDANCE	CODE
556A	35 ohm	RUDOM
556B	200 ohm	RUDOP
556C	High	RUDOR

List price . . . $82.00

Patented by Shure Brothers

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Designers and Manufacturers of Microphones and Acoustic Devices

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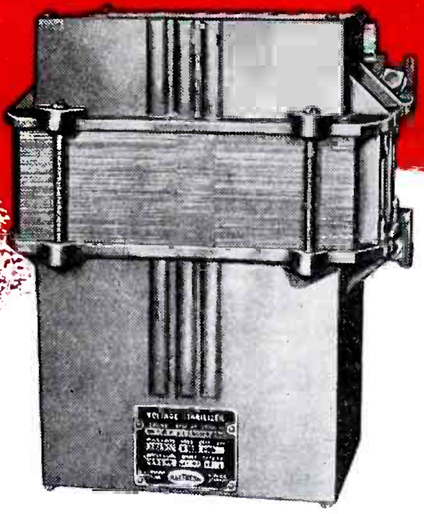
BUILD THEM IN

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.

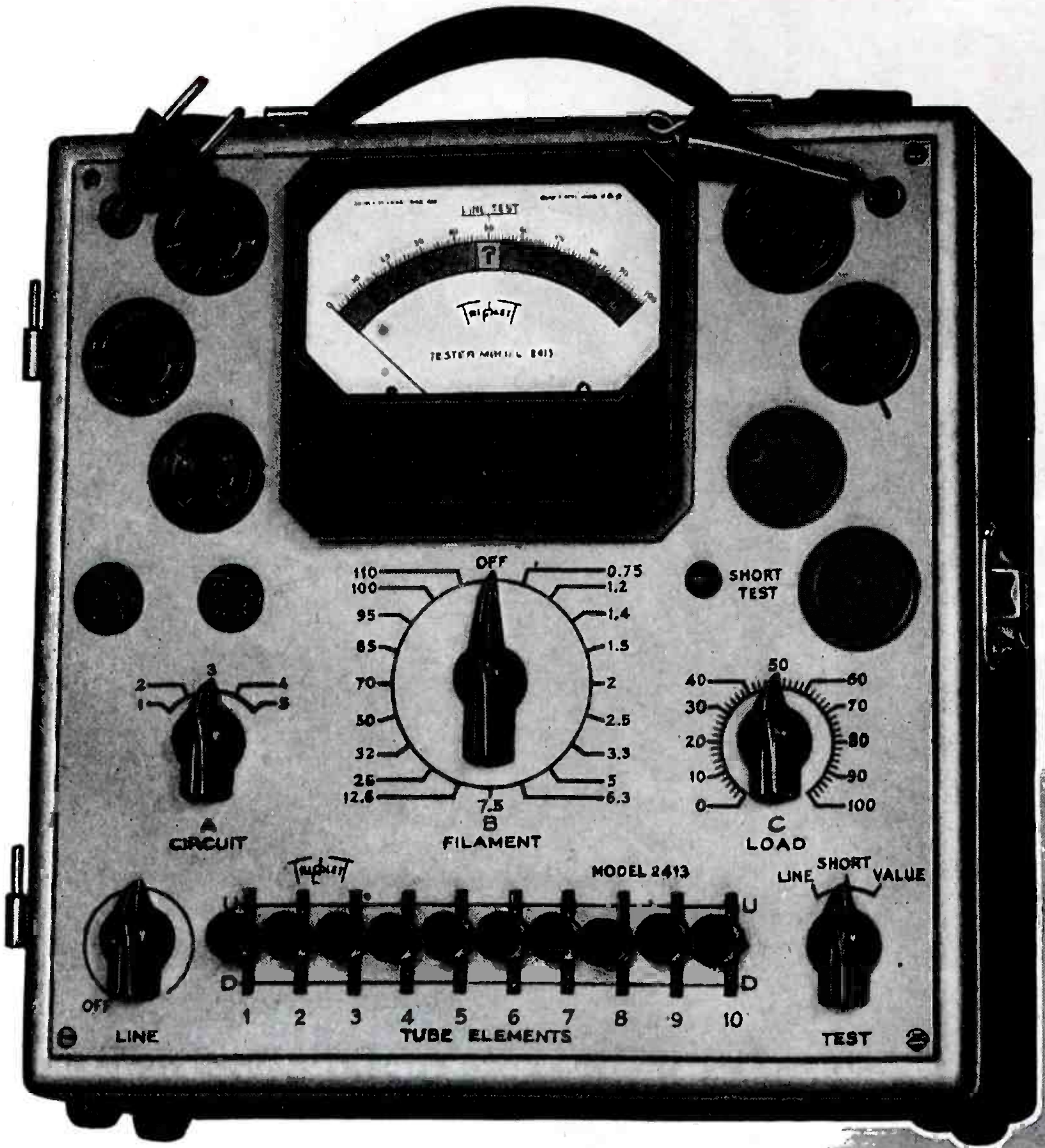
Get these principal operating advantages:

- **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



MODEL 2413

is another member of the NEW TRIPLETT Square Line

The New Speed-Chek Tube Tester

MORE FLEXIBLE • FAR FASTER • MORE ACCURATE

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

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

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

Additional Features

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

STANDARDS ARE SET BY TRIPLETT

Precision first ...to last

Triplett

ELECTRICAL INSTRUMENT CO. BLUFFTON, OHIO

AMPHENOL *Leads* with a new TWIN-LEAD TRANSMISSION LINE

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.

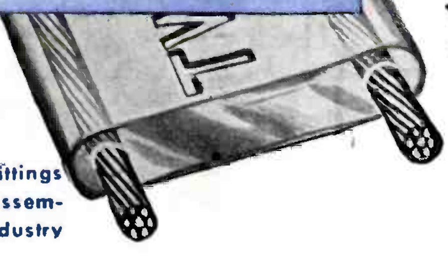
Designed especially for amateurs who operate in very narrow bands of frequency or one particular frequency. Ideal for dipoles with a nominal impedance of 72 ohms at the frequency for which they are cut.

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



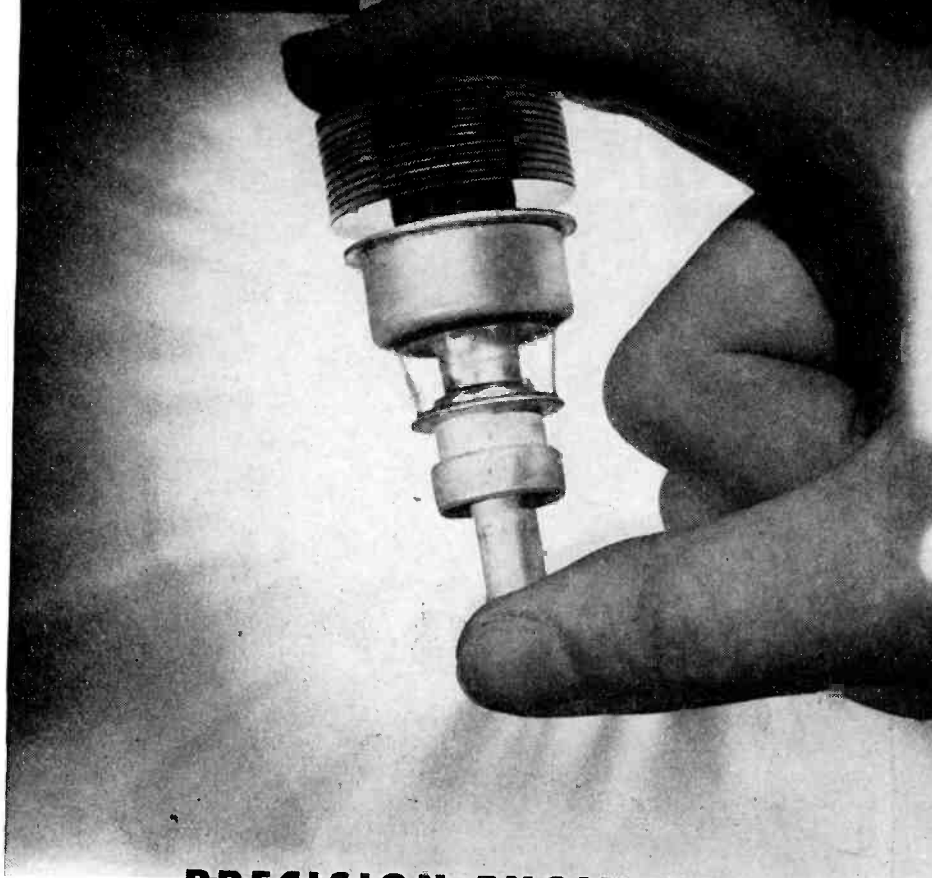
Amphenol's "Twin-Lead" is a solid dielectric line that transmits signals from antenna to FM and Television receivers with extremely low loss. It's tough . . . inexpensive . . . easy to install . . . repels water . . . and is unaffected by acids, alkalies and oils because the dielectric is Amphenol Polyethylene.

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



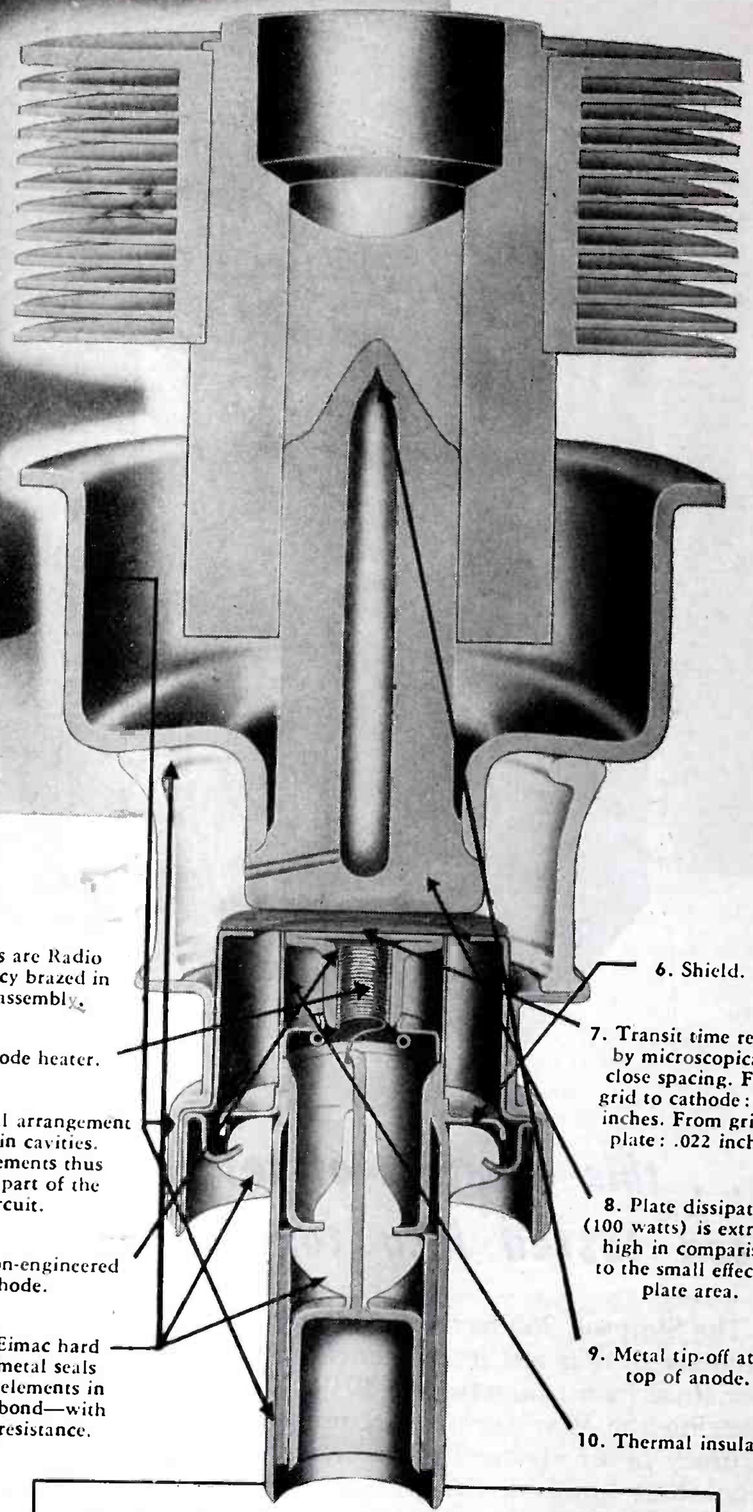
PRECISION ENGINEERING ON A MASS PRODUCTION SCALE

. . . that's the basic achievement of Eimac engineers in providing typically outstanding Eimac performance in these tiny triodes. Observe the many functions of the Eimac developed 3X100A11/2C39 triode—cross section view. Note actual size shown in photo above.

Designed for special military purposes—these tiny triodes will find valuable application in commercial fields. An indication of their high efficiency is their ability to operate on frequencies up to 2500 megacycles and their high plate dissipation (100 watts) despite the extremely small effective plate area—about the size of a dime.

By developing and improving the performance of this tiny triode Eimac has again demonstrated an extraordinary ability to accomplish outstanding results in Electronic vacuum tube engineering—an ability which has established Eimac as first choice of leading Electronics engineers throughout the world.

1148



FOLLOW THE LEADERS TO Eimac TUBES

EITEL-McCULLOUGH, INC., 1148F San Mateo Ave., San Bruno, Calif.

Plants located at: San Bruno, Calif., and Salt Lake City, Utah

Export Agents: Frazar and Hansen, 301 Clay St., San Francisco 11, Calif., U.S.A.

TYPE 3X100A11/2C39 EIMAC TRIODE

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Coated unipotential	
Heater Voltage	6.3 volts
Heater Current	1.1 amps
Amplification Factor (Average) 100	
Direct Interelectrode Capacitances (Average)	
Grid-Plate	1.95 μμfd
Grid-Cathode	6.50 μμfd
Plate-Cathode	0.030 μμfd
Transconductance (i_B=75 ma., E_B=600 v.) (Av.)	20,000 μmhos
Maximum Plate Dissipation	100 watts

MECHANICAL

Maximum Overall Dimensions

Length . 2.75 inches   Diameter . 1.26 inches

CALL IN AN EIMAC ENGINEER FOR RECOMMENDATIONS

ROYAL J. HIGGINS (W9AIO)...600 South Michigan Avenue, Room 818, Chicago 5, Illinois. Phone: Harrison 5948. Illinois, Wisconsin, Michigan, Indiana, Ohio, Kentucky, Minnesota, Missouri, Kansas, Nebraska and Iowa.

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ADOLPH SCHWARTZ (W2CN)...220 Broadway, Room 2210, New York 7, N.Y. Phone: Cortland 7-0011. New York, Pennsylvania, New Jersey, Maryland, Delaware and District of Columbia.

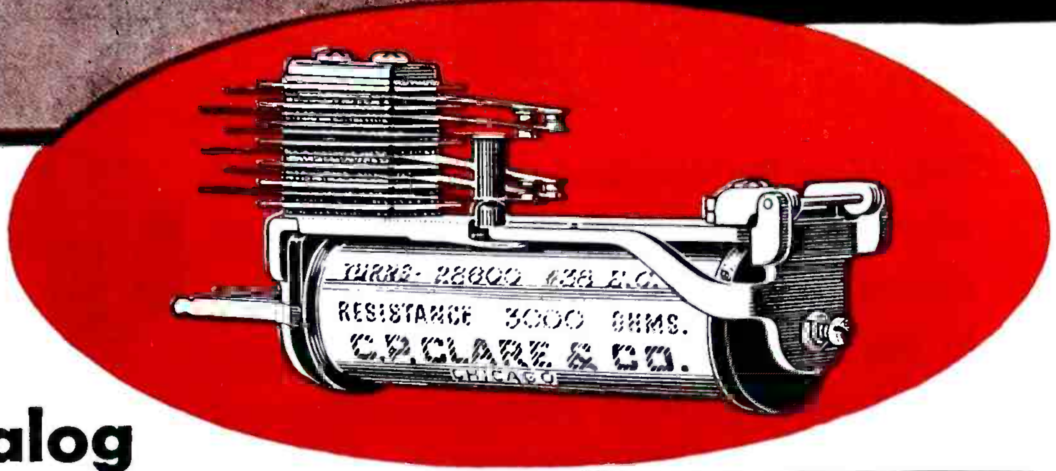
HERB B. BECKER (W6QD)...1406 South Grand Avenue, Los Angeles 15, California. Phone: Richmond 6191. California, Nevada and Arizona.

TIM COAKLEY (W1KKP)...11 Beacon St., Boston 8, Mass. Phone: Capitol 0050. Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island.

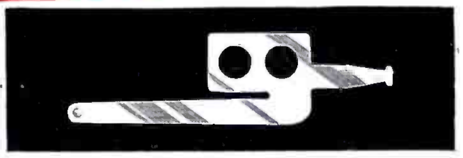
CAUTION! Look for the latest serial numbers on Eimac Tubes. Be sure you get the newest types.

New! This complete new and handy guide for proper relay selection. Your copy is ready.

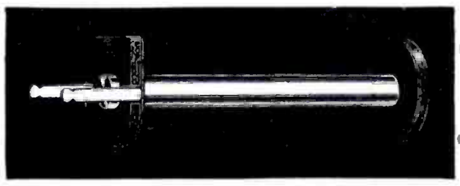
Clare Type "C" d.c. Relay. For applications where rapid operation and release are required.



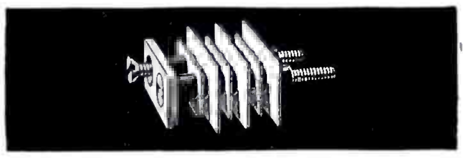
This New Clare Catalog is your guide and data book for solving any relay problem



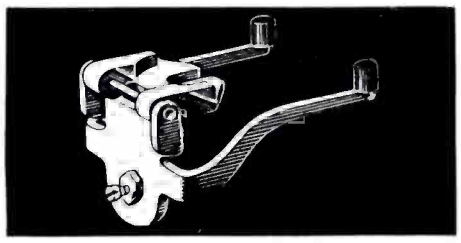
Contacts are welded to nickel silver springs by a special process. May be of precious metals or alloys in 12 different standard or special types and sizes.



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 heelpiece.



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.

• In this handsome new catalog and engineering data book, Clare gives you complete information that will help you solve any relay problem, no matter what your requirements may be.

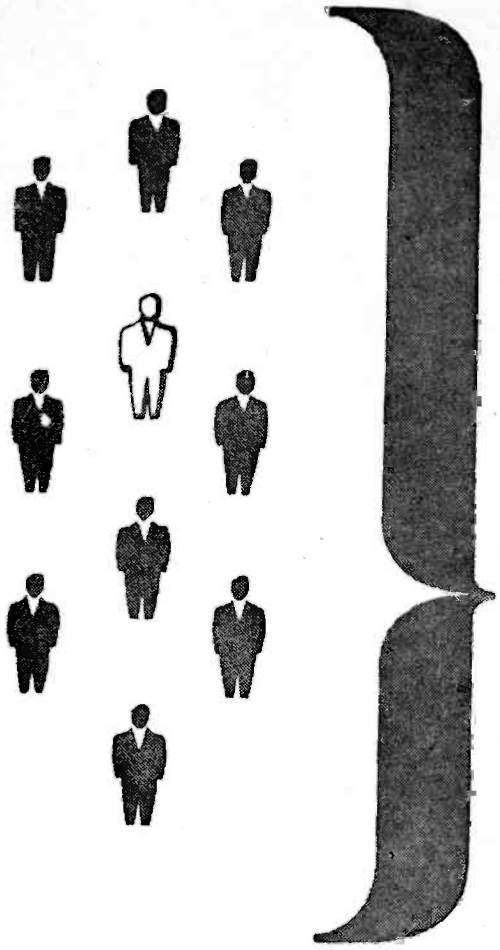
In these forty-four pages you will find the special features which make it possible for CLARE to "custom-build" a relay to fit your most exacting needs. Pictured and described are Clare Relays whose precision and dependability has been proved by use in many industrial applications. Your copy is ready. Send for it today.

Whatever your special requirement . . . you can count on Clare "custom-building" to meet it. Clare sales engineers are located in principal cities. They are ready and able to discuss your relay requirements with you . . . show you how CLARE "Custom-Built" Multiple Contact Relays are the effective answer to modern design problems.

Send for the new CLARE Engineering Data Book now. Address: C. P. Clare & Company, 4719 West Sunnyside Avenue, Chicago 30, Illinois. Cable address: CLARELAY.

CLARE RELAYS

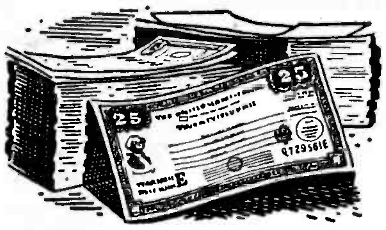
"Custom-Built" Multiple Contact Relays for Electrical and Industrial Use



9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:



A large reservoir of national savings; a strong and stable bulwark against inflation.

An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.

An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.

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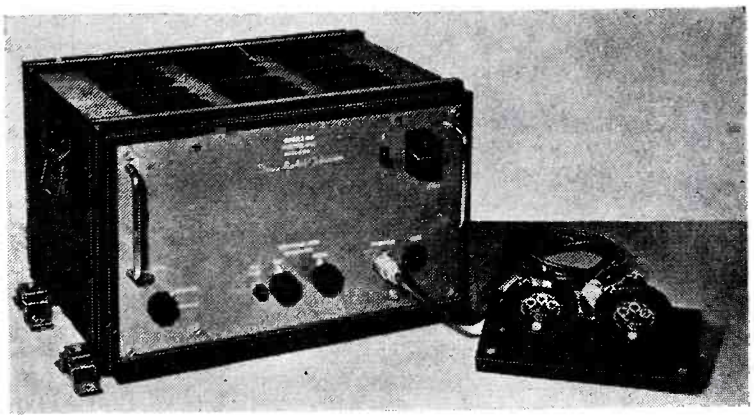
EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR THE CONTINUED IMPROVEMENT OF TELEPHONE SERVICE

COMMUNICATIONS

LEWIS WINNER, Editor

MARCH, 1946



Adjusting portable navigator preparatory to sailing. This unit weighs 27 pounds and is run off batteries.

Front view of the Decca navigator. Twin dials of the decometer for direct-position readings are at right.

The DECCA NAVIGATOR

by M. G. SCROGGIE

Ex-Squadron Leader of RAF Volunteer Reserve; at present Consulting Radio Engineer

British L-F Radio Direction-Finding System for Instantaneous Positioning Check of Ships and Aircraft, Developed by W. J. O'Brien, an American, During the War. Provides Fix by Measuring Time Differences Indirectly as Phase Difference in Waves Received from Fixed Transmitters Radiating Pure C-W. System Soon to Be Installed in Major Parts of British Isles and Europe.

THE ideal system of navigation is one which finds the exact position at all times, without special highly-trained personnel or elaborate equipment. Traditional methods depend a good deal on the weather, and demand skill and experience. The development of radio direction finding overcame most of the weather limitations, but the results took time and skill to obtain and were subject to many sorts of errors.

For wartime purposes, Gee and Loran were great advancements, since they enabled an unlimited number of craft to keep constant track of their positions without breaking radio silence. Another development, the Decca navigator, working on the same basic principle, supplied additional advantages that further simplified position finding.

One principle is common to Gee and Loran, and the Decca system; measurement of the difference in time for waves travelling from pairs of synchronized transmitters. To illustrate, suppose *A* and *B* in Figure 1 are two stations transmitting exactly in synchronism. Then if a receiver on a ship or airplane indicates that corresponding waves from both are arriving at the same time, the receiver must be the same distance from *A* and *B*. That is, it must lie somewhere on the straight line P_0 bisecting at right angles, a line joining *AB*.

If, however, a wave from *A* is received earlier than one starting simultaneously from *B*, *A* must be nearer than *B*. As the speed of the waves is always the same, the difference in distance is calculable from the difference in time. The locus of a point having a constant difference in distance from two fixed points is a hyperbola, such as *rs*.

To fix one's position on a map it is necessary to make a second observation, from another pair of synchronzied transmitters such as *A* and *C*. If the time difference from these indicates, for example, that the re-

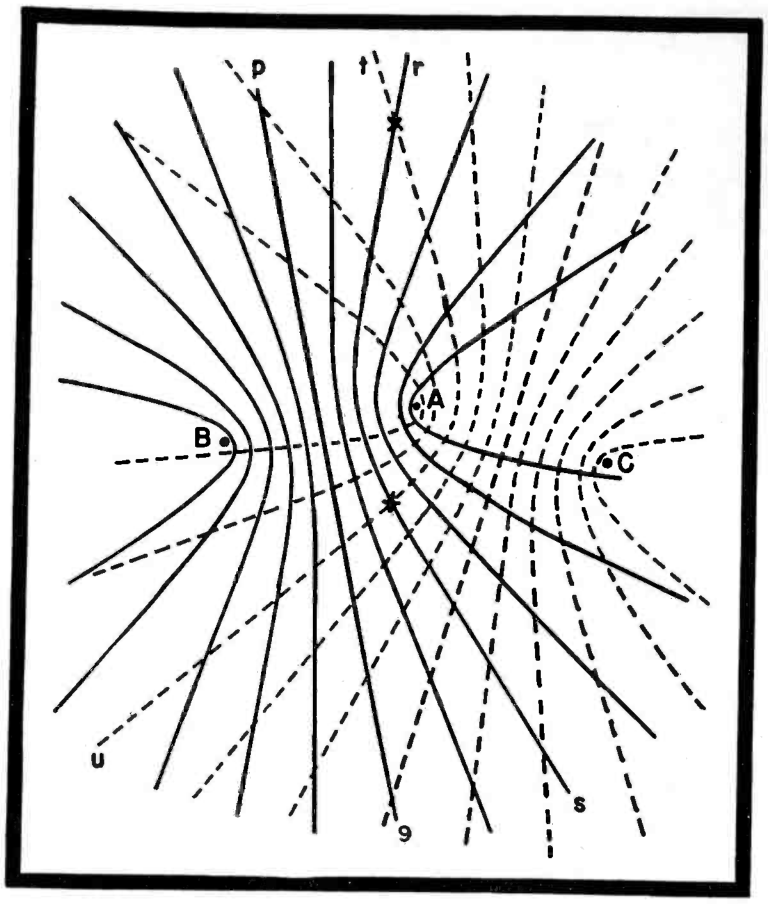


Figure 1
Plot of synchronized waves used in analysis of Gee, Loran and Decca systems.

ceiver lies on the hyperbola *tu*, then its position is at the intersection of *tu*, with the previously found curve, *rs*. To facilitate navigation by such a system, maps are overprinted with sets of hyperbolae, in colors corresponding to the pairs of stations. There are in general two points of intersection for each pair of hyperbolae, but there is seldom much risk of their being confused.

System Differences

In Gee and Loran, the waves are *marked* by radiating them in pulses, which are displayed at the receiver on calibrated cathode-ray time bases. As the time differences to be measured are of the order of microseconds, and each pulse consists of a number of r-f cycles, the frequency of the waves must be high.

In the Decca system, the time differences are measured indirectly as phases differences in the waves received from the fixed transmitters which radiate pure unmodulated c-w. To illustrate, let us now again refer to Figure 1. Along the line p_0 the waves from *A* and *B* arrive in phase. At all points, ¼ wavelength nearer *A* (and therefore ¼ wavelength farther from *B*) there is ½ wavelength difference. Thus the two arrive in opposite phase. Another ¼ wavelength nearer *A* there is one whole cycle difference, and the two again come into phase. The space between any two in-phase hyperbolae is called a *lane*. The number of lanes obviously depends on the wavelength employed. Away from the inter-station line, the lanes widen out; and the accuracy of position finding is reduced by the curves from the two pairs of stations tending to become parallel.

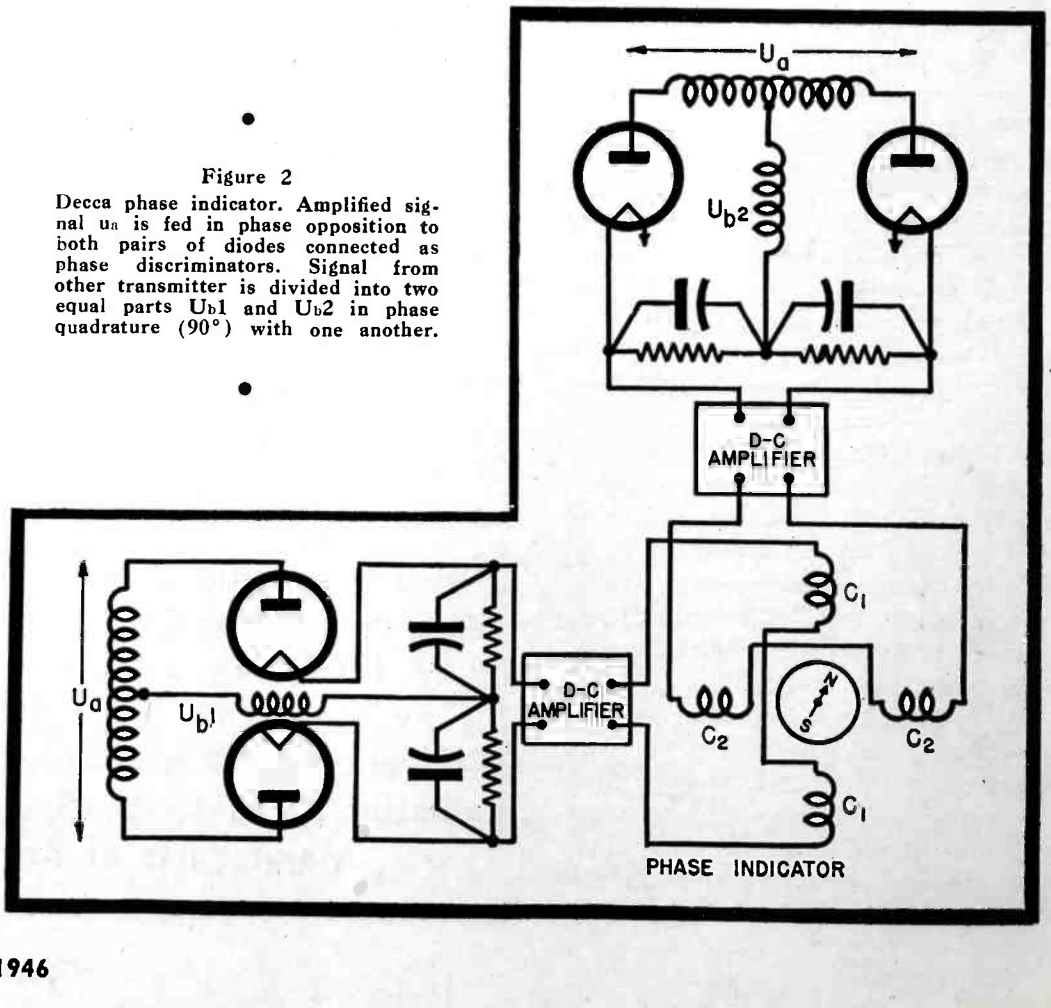
To insure accuracy and yet retain it in a practical way it is necessary to use some means of correctly indicating the phase difference, in cycles and degrees, between each pair of signals. Clearly the method must be independent of the amplitudes of the signals. The Decca phase indicator, shown in Figure 2, affords that method. The amplified signal u_a, from a transmitter is fed in phase opposition to both pairs of diodes connected as phase discriminators. By itself, this signal would give equal and opposite rectified outputs, and the inputs to both d-c amplifiers would therefore be zero. The signal from another transmitter is divided into two equal parts, U_b1 and U_b2, in phase quadrature (90°) with one another.

System Operation

Suppose U_b1 happens to be in phase with one half of U_a (and therefore opposes the other half). This upsets the balance and causes d-c to flow through coils, C_1, in the phase indicator. At the same time U_b2, being in phase quadrature with both halves of U_a, affects both rectified outputs from the other discriminator equally, and since their combined result is still zero there is no current in coils, C_2. The moving element in the phase indicator is a magnetized disc which, in the conditions just described, sets itself along the axis of the C_1 coils, and the attached pointer indicates *0*.

If now the craft carrying the receiver moves away from the in-phase position, the in-phase component of U_b1 starts to decrease, while an in-phase component of U_b2 appears. The corresponding changes in the currents in the indicator coils cause the pointer to start rotating. When the phase difference of the second transmitter sig-

Figure 2
Decca phase indicator. Amplified signal u_a is fed in phase opposition to both pairs of diodes connected as phase discriminators. Signal from other transmitter is divided into two equal parts U_b1 and U_b2 in phase quadrature (90°) with one another.



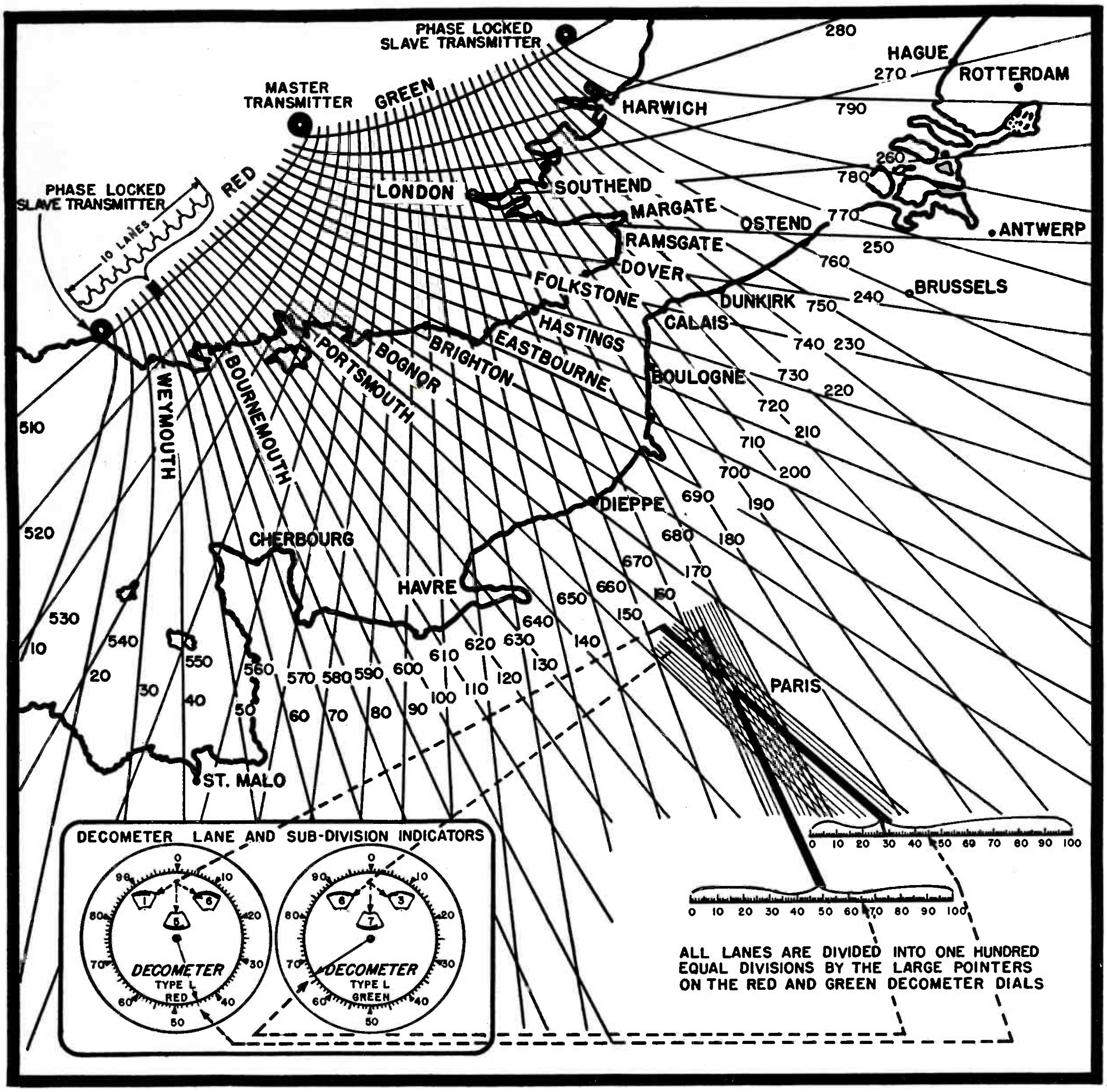


Figure 3

Two indicators with readings related to a position on map. For clarity only every tenth curve is shown (except around Paris); thus each space is ten lanes wide.

nal reaches 45° U_b1 and U_b2 are both 45° out of phase with U_a. The current in C_1 and C_2 are therefore equal, and the pointer sets itself to 45°, or 12½ on the 100-line scale actually fitted. In a similar way, any phase difference from 0° to 360° between the two incoming signals is shown.

To distinguish which lane one is in, the indicator is fitted with a train of gears, as in a gas or electricity meter, connected to units, tens and hundreds dials, from which the number of revolutions the pointer has made can be directly read.

A duplicate instrument indicates the lane and sub-divisions associated with the second pair of stations. The two indicators are shown in Figure 3, with their readings related to a position on the map. The charts actually used are, of course, on a much larger scale, and show every lane. For clarity only every tenth curve is shown here (except around Paris). Thus each space is ten lanes wide. Even if only the lane number on each indicator could be relied upon, the position would be determined throughout the English Channel region within a mile or two. But the pointer readings sub-divide the lanes by 100 and enable the position to be plotted within a matter of yards.

In developing a practical solution to the phase-indicator problem, it was ncessary to solve the following problem: The phase indicators could only work on signals of identical frequency, whereas if the transmitters all worked on that frequency it was impossible to separate their signals at the receiver into the channels necessary for feeding the phase indicators. This difficulty was overcome by making the transmitters, forming a pair, work on two different frequencies that have a common harmonic frequency. Let us suppose that one transmitter (A) radiates 60 kc and another (B), 80 kc. These signals are separately amplified in the receiver, and frequency multipliers extract the fourth harmonic of 60 kc and the third harmonic of 80 kc, providing 240 kc in each case, to be applied to one of the phase indicators. If another station (*C*) transmits on 90 kc, a third amplifier in the receiver can be used to deliver its second harmonic, 180 kc, while an extra frequency multiplier at the end of the (*A*) amplifier supplies the third harmonic of 60 kc, also 180 kc, to feed the other phase indicator.

Maintaining Phase Patterns

The next problem was to insure that the phase pattern, of which Figure 3 is an example, was accurately maintained. This obviously necessitated that the outputs from the two transmitters in any pair be not only on the right frequencies at all times, but also invariably in phase within about 1°. Obviously this is quite impossible if they transmit independently. Therefore one of them, say (*A*), is the *master*, and (*B*) and (*C*) are the *slaves*.

The 60 kc transmitter at (*A*) is crystal controlled, and its signal is picked up at (*B*) on a receiver feeding a frequency divider, providing 20 kc. This frequency is doubled twice to supply the drive for transmitter (*B*). Although its frequency is thereby bound to be 4/3 of (*A*), the phase is liable to vary over many degrees due to slight changes in the tuning circuits and aerial. Therefore a receiver installed near (*B*), extracts the common harmonics, 240 kc, from the signals put out by the *slave* and *master* transmitters and applies them to a phase discriminator. The d-c output from this discriminator is used to control a reactor tube associated with the drive to the slave transmitter, operating on the same principle as automatic tuning in broadcast receivers. Transmitter (*C*) is similarly locked to 3/2 of the frequency of (*A*).

Chain Frequencies

The actual frequencies of the chain shown in Figure 3 are:

$$\left.\begin{matrix} (A) & 85 \text{ kc} \times 4 \\ (B) & 113.3 \text{ kc} \times 3 \end{matrix}\right\} = 340 \text{ kc}$$

$$\left.\begin{matrix} (A) & 85 \text{ kc} \times 3 \\ (C) & 127.5 \text{ kc} \times 2 \end{matrix}\right\} = 255 \text{ kc}$$

To insure continuity of service, duplicate transmitters are automatically brought into action in the event of failure.

A continuous stable pattern being now provided, it was necessary that the indications of all receivers correspond exactly with it. There were two phases to this problem.

(*1*) Any resultant phase shifts in the receiver, up to the terminals of the phase discriminators, must be equal for each signal channel in any pair so that the readings of all receivers agree.

(*2*) After being adjusted to satisfy (*1*), receivers must maintain this adjustment over a wide range of temperature, etc., in spite of the fact that each amplifier contains more than a dozen tuned circuits, a drift in any one of which will introduce error.

To satisfy (*1*) each receiver was supplied with a highly stable reference oscillator having harmonics of frequencies equal to those of the signals from all three stations; for the 60, 80, and 90-kc stations, taken as example, an oscillator working on 10 kc would be suitable. To be certain that all these harmonics would be in phase and of similar amplitude, the oscillator was designed to give extremely short pulses. Thus after the receiver has warmed up, the three amplifiers are adjusted so that the pointers indicate zero on the reference oscillator signals.

The second part of the problem, the stability of the receiver, was solved by close attention to detail.

Methods of Lane Identification

Where there is a break in operation, due to failure of transmitter or receiver, or to heavy interference, the instrument pointers do not move; but when the signals get through again the dial pointers take up their correct positions. This property enables the set to function when the signal is so weak and obliterated by intermittent code or atmospheric interference that it would be useless for any other purpose. If, however, operation is interrupted long enough for the receiver to move into another lane, the indicated lane number may be wrong. To overcome this uncertainty, methods of lane identification have been devised.

Reliability

Because of the use of the longer waves, long ranges can be reliably maintained. Even with the low power transmitters used thus far, it has been possible to maintain experimental operations over a 1100-mile area.

Future Networks

It is intended to set up chains each consisting of one master station and three slaves. This arrangement removes the ambiguity due to double intersection of curves, and gives a more uniform service area. In operation, the navigator would be set to respond to the transmitters serving the area in which the destination is located, if they were within range.

Ultimately it is hoped to cover the whole world with a network providing position checks that will be accurate to within a few hundred yards.

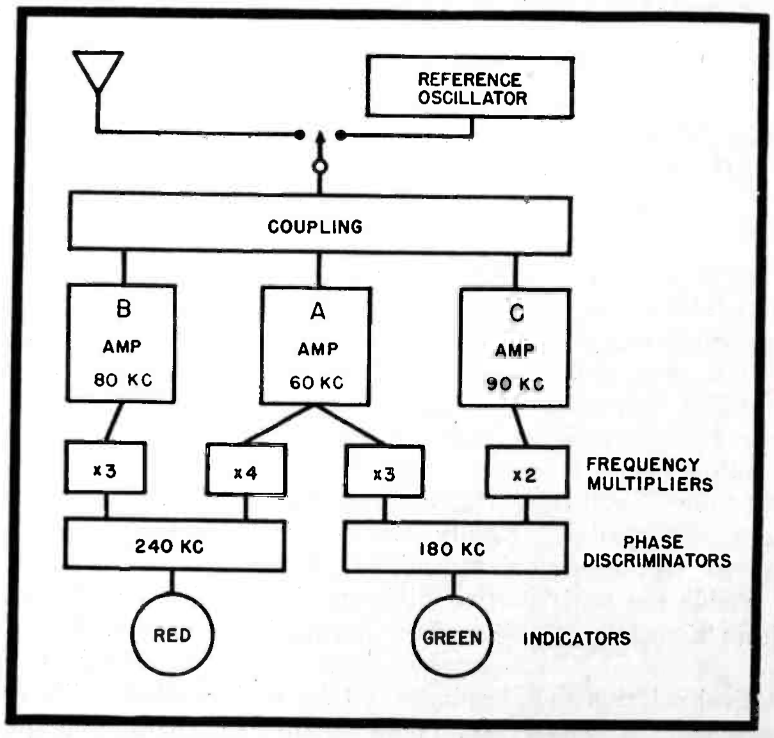


Figure 4
Block diagram of the complete receiver.

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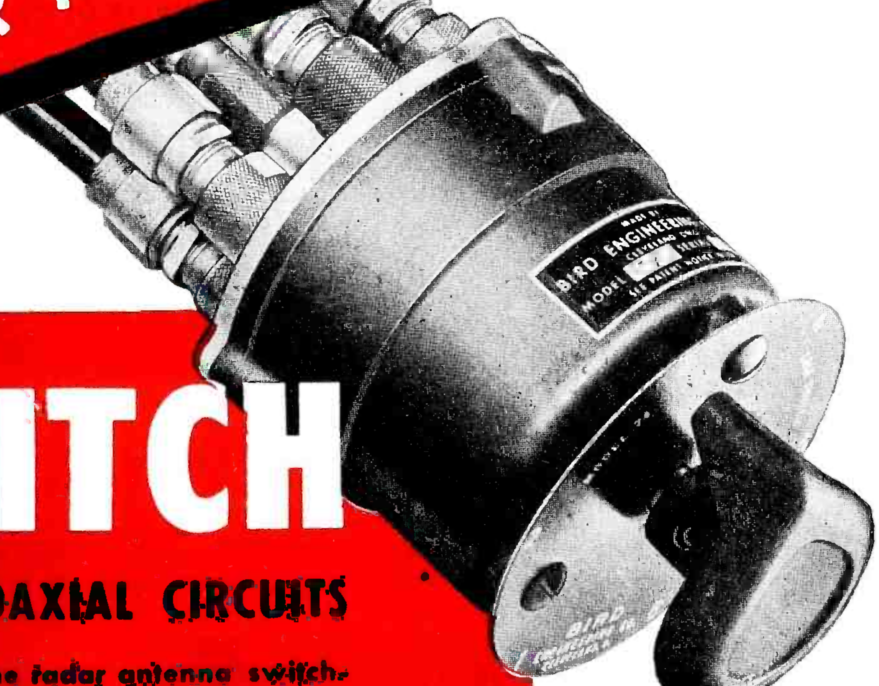

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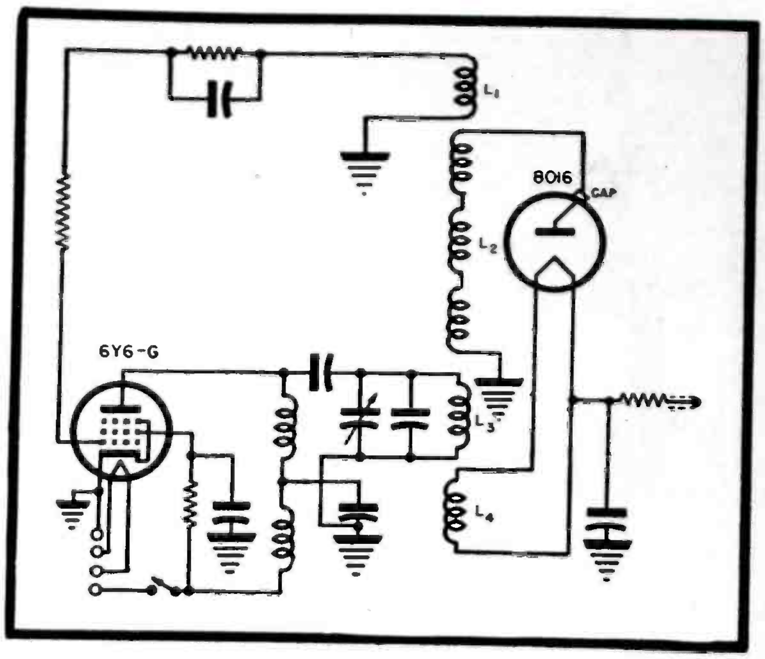
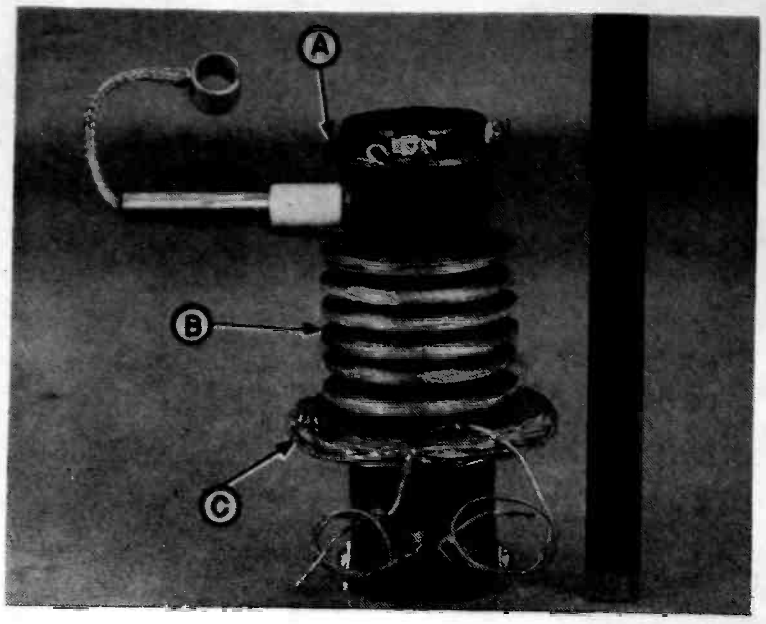


Figure 1
Schematic of a 10-kv high-frequency power supply, similar to that suggested by O. H. Schade.

Figure 2
Detailed view of a 10-kv tuned r-f step-up transformer: *A*, tickler; *B*, secondary; and *C*, primary.



Television Receiver R-F

An Analysis of the Factors Involved in Production of 10 to 50-KV D-C Power Supplies for Direct Viewing and Projection Type Receivers and Large-Screen C-R Oscillographs

by **HAROLD C. BAUMANN**

Television Engineering Department
U. S. Television Manufacturing Corp.

THE design of power supplies providing d-c voltages of from 10 to 50 kv for use with television receivers and c-r oscillographs presents many interesting problems.

For voltages up to about 5 kilovolts no serious problems are encountered, for 60-cycle type power supplies can be used. At voltages above 5 kilovolts, however, transformers operating from 60 cycles become large, heavy, expensive, and dangerous. In addition, the filament transformers supplying the rectifier filaments are subject to high insulation resistance qualities, which also make them expensive.

As an alternative means of obtaining higher voltages, we have the method using a high-frequency voltage generated by an oscillator, stepped up by a specially designed r-f transformer, and rectified. This system appears to offer a satisfactory means of supplying the high voltages required, inasmuch as the current requirements are low (250 microamperes to 1 milliampere). A power supply operating on this principle is capable of supplying up to one milliampere within the 10 to 50-kv range. Use of a special rectifier tube such as the RCA 8016, which obtains its filament supply from induction from the oscillator, eliminates the need for an expensive filament transformer.

Only a small capacity (500 mmfd) filter capacitor is required. Thus any danger of injury from shock is eliminated.

The basic schematic of a high-frequency power supply, similar to that suggested by O. H. Schade, in his April, 1943, paper in the IRE Proceedings, is shown in Figure 1.

Circuit components will depend upon the operating frequency and the output voltages required, which in turn will be governed somewhat by physical size, i.e., space limitations and corona considerations.

The range of operating frequencies

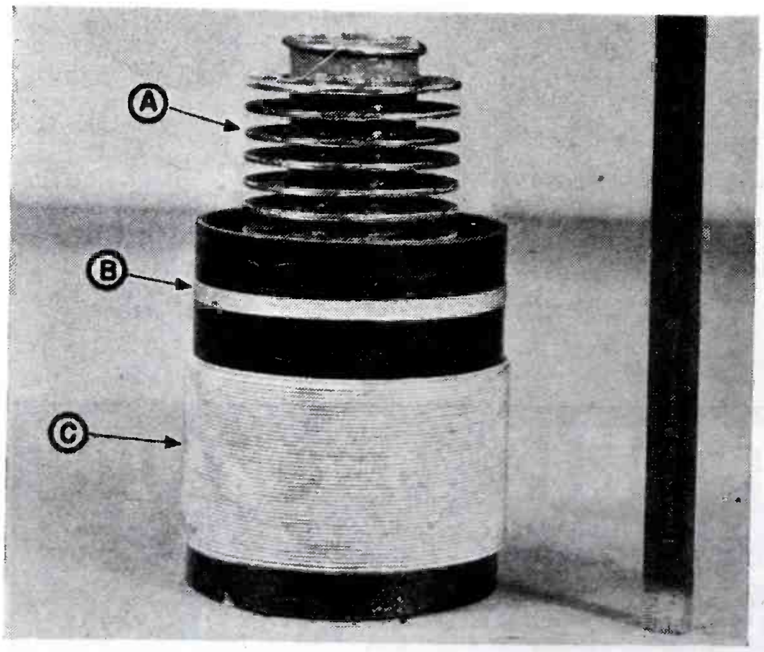


Figure 3
Coil for a 30-kv rectifier: *A*, secondary; *B*, tickler; and *C*, primary.

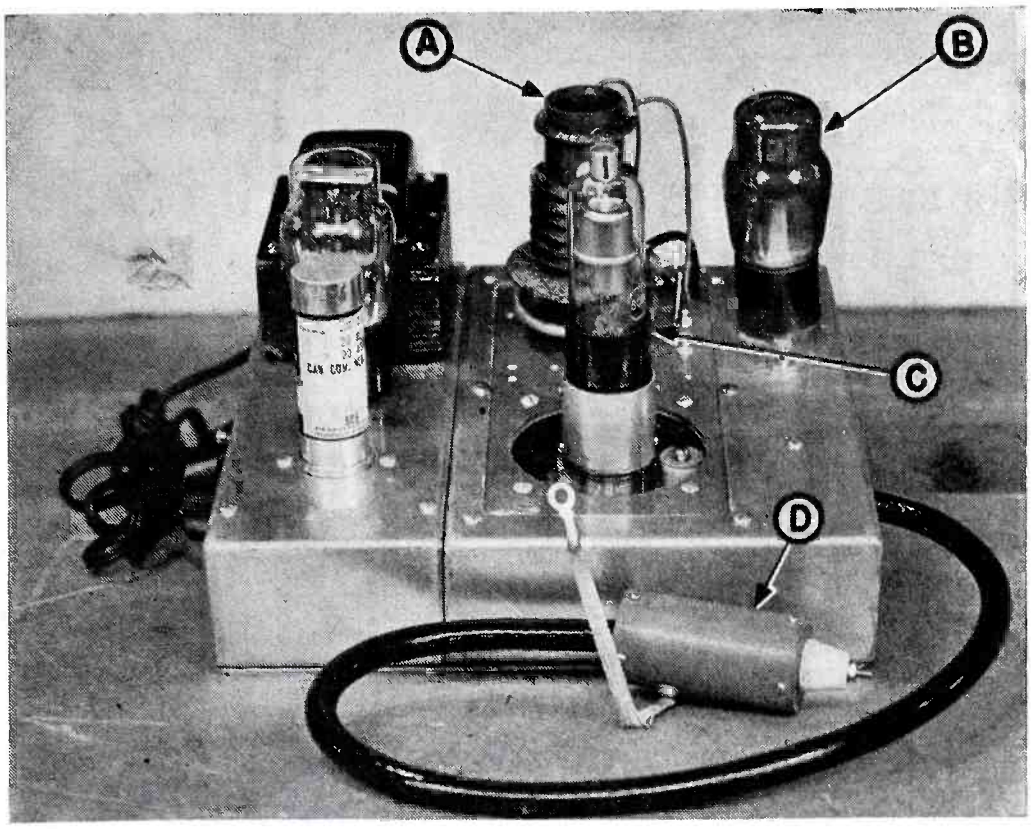


Figure 4
A completed 10-kv supply for a direct-viewing receiver, and associated 60-cycle power unit. Knob at left affords adjustment of voltage between 2000 and 10,000 to 11,000. *A* is the r-f transformer; *B*, 6Y6G oscillator; *C*, 8016 rectifier; and *D*, high-voltage output cable.

POWER SUPPLY DESIGN

which seem to give the best compromise as to stability, voltage output requirements, and physical size are from about 50 to 300 kc. The higher-voltage coils operate in the lower frequency range due to increased spacing requirements, because of danger of *arc-over* and also because of lower loss requirements prompted by increased power dissipation and higher inductance.

In the Figure 1 circuit, L_3 and L_2 comprise the primary and secondary of a tuned r-f step-up transformer. L_4 provides the filament supply being coupled to the low potential end of L_3, and L_1 is the tickler coil which is placed at a safe *arc over* distance from the high potential end of L_2 (for 10-kv coils). The oscillator *feed-back* then takes place from L_3 through L_2 to L_1.

The use of an oscillator circuit employing a *grid tickler,* L_1, is more stable than conventional oscillator circuits employing self-excitation with feed back from the primary. Such a self-excited oscillator has an unstable tuning characteristic, as pointed out by Schade.

The tuned r-f step-up transformer (Figure 2) requires considerable design and construction study. The design, relative to physical size must be a compromise between the best possible electrical performance characteristics versus practical considerations. Obviously, if this transformer were designed for the best electrical characteristics relative to copper losses, eddy currents, distributed capacity, etc., its size would be prohibitive for standard equipment use. In a compromise design, litz wire and a universal type of winding can be wound on low loss tubing, providing a coil of reasonable physical dimensions with suitable electrical characteristics. The physical dimensions are governed by the secondary winding which, in turn, depends upon the voltage and current requirements.

The coil shown in Figure 2, which is of the 10-kv size, has an overall height of 4″ and a maximum diameter of 2½″ across the primary.

30-KV Components

A coil for a 30-kv rectifier is shown in Figure 3. It will be noted that the primary of the 10-kv coil is located at the low potential end of the secondary on the same coil form, with the tickler winding at the top, while in the 30-kv coil, the primary and tickler are wound on a separate form.

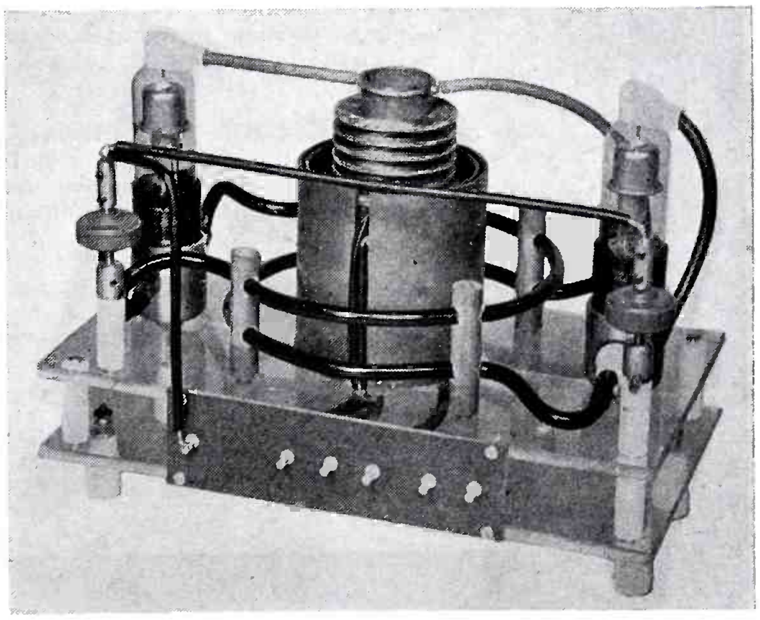
The h-f high voltage transformer is basically a tuned r-f step-up transformer whose secondary is designed to resonate with coil capacitance and diode load capacitance in order to obtain a high impedance secondary.

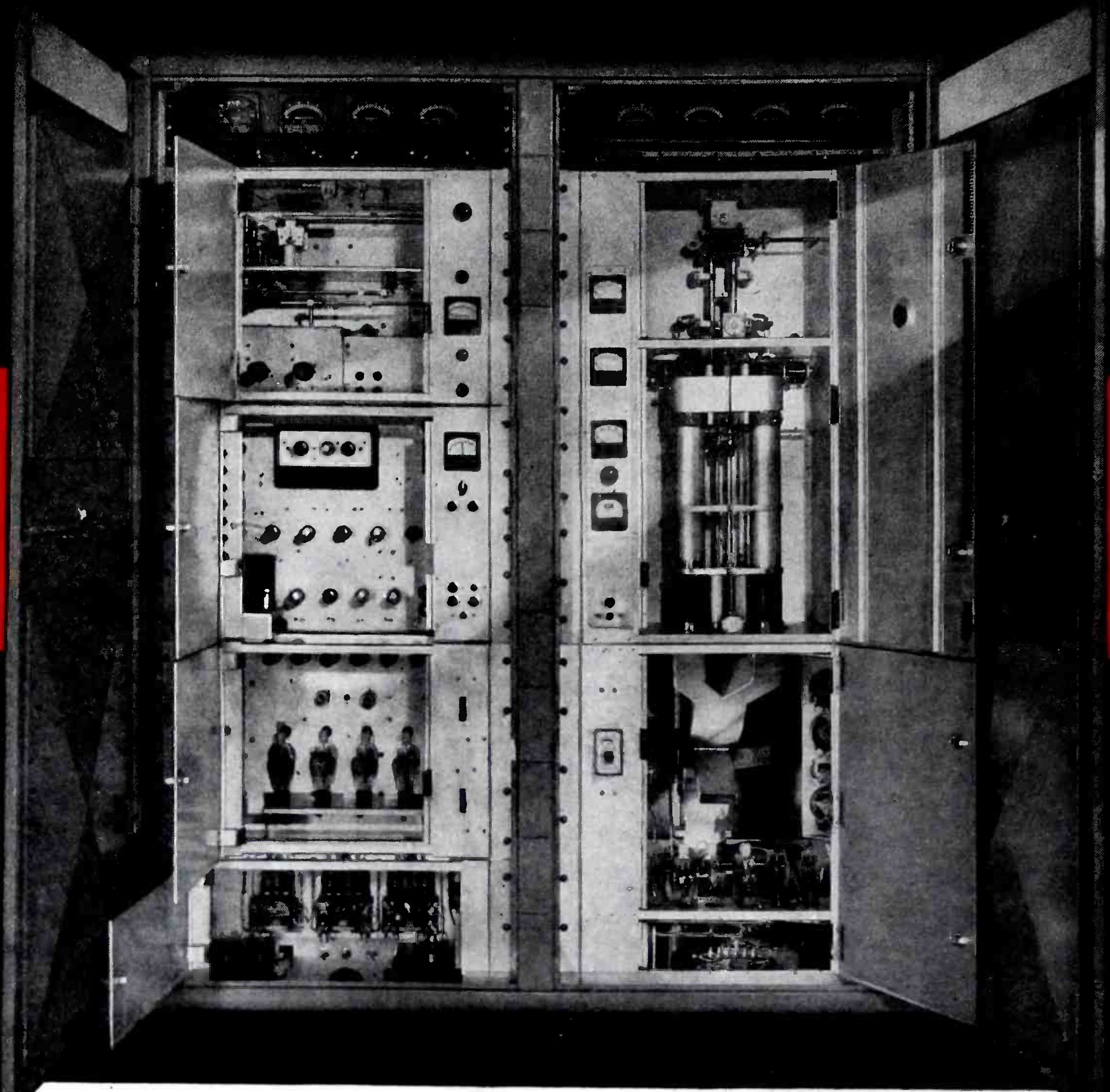
Overcoupling

Overcoupling is used to improve the stability of the secondary under load.

(*Continued on page* 70)

Figure 5
The r-f coil and rectifier doubler arrangement of a 30-kv supply for projection kinescopes.





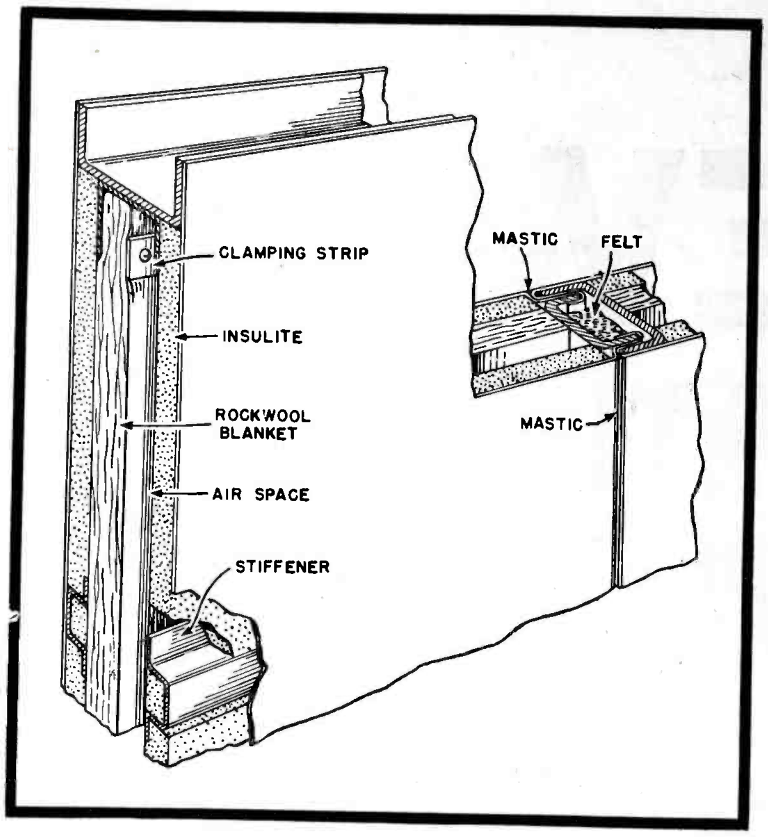
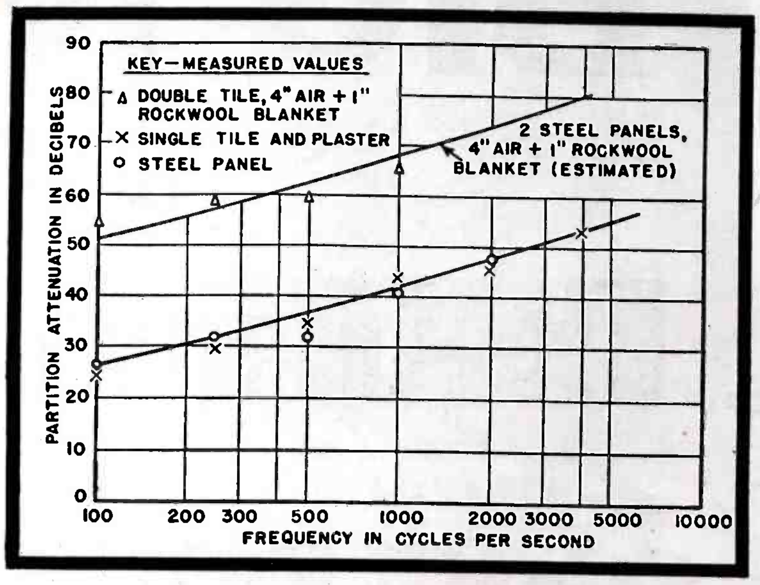


Figure 2
Panels used to construct rooms. Made of two sheets of steel, 3″ apart, with composition board cemented to their inner surfaces, and a rock-wool blanket between them.

Figure 1
Acoustic attenuation of panels used in making soundproof rooms at laboratories. The attenuation is practically the same as that of plastered tile.



Demountable SOUNDPROOF Rooms

by W. S. GORTON

Physical Research
Bell Telephone Laboratories

FOR reasons of acoustic efficiency and protection against fire, soundproof rooms have often been made of hollow tile plastered on both sides. These rooms are expensive to construct, noisy and dirty to dismantle, and have practically no salvage value. Where greater acoustic attenuation is desired a double-walled construction is employed. For reasons of space economy the separation of the two walls seldom exceeds 6″. This narrow air space makes it extremely difficult to avoid bridges between the walls caused by objects dropped into the interspace during construction. When this occurs it vitiates almost completely the effect of the air space. The great weight of this construction has also made anti-vibration support difficult.

To overcome these objections, a room with steel-composition panels was developed. The panels consisted of two composite sheets of steel cemented to composition board with the interspace filled with rock wool. Their over-all thickness was 3″. A panel with a ventilating duct attached was provided and the room was mounted on springs to reduce the effect of building vibrations. The attenuation of the room, as constructed, was limited by that of the door and the ventilation panel, but the results showed that this construction is inherently capable of giving substantially the same protection as a single hollow-tile wall.

In Figure 1 appears the acoustic attenuation of the panels plotted as a function of frequency. The steel panels weigh only 7 pounds per square foot, whereas a tile partition with ¾″ plaster on both sides weighs 31 pounds per square foot.

When plans were made for the new laboratory buildings at Murray Hill, N. J., it was decided to utilize steel panels for the eighteen soundproof rooms to be erected there. This construction had the additional advantage that it would harmonize with the partitions and other interior finish. The panel used, Figure 2, consisted of two sheets of steel, 3″ apart, with composition board cemented to their inner surfaces and a rock wool blanket between them. This construction obviated any mechanical coupling of the two components of the panel which might occur if the rock wool had been packed between them as in previous designs. The attenuation to be expected of the panel itself is consequently at least equal to that shown in Figure 1. This attenuation was attained for the room, as a whole, by careful attention to details, such as sealing all cracks with plastic compound, by using ventilating panels and doors of at least equal attenuation, and by supporting the room on rubber anti-vibration mountings.

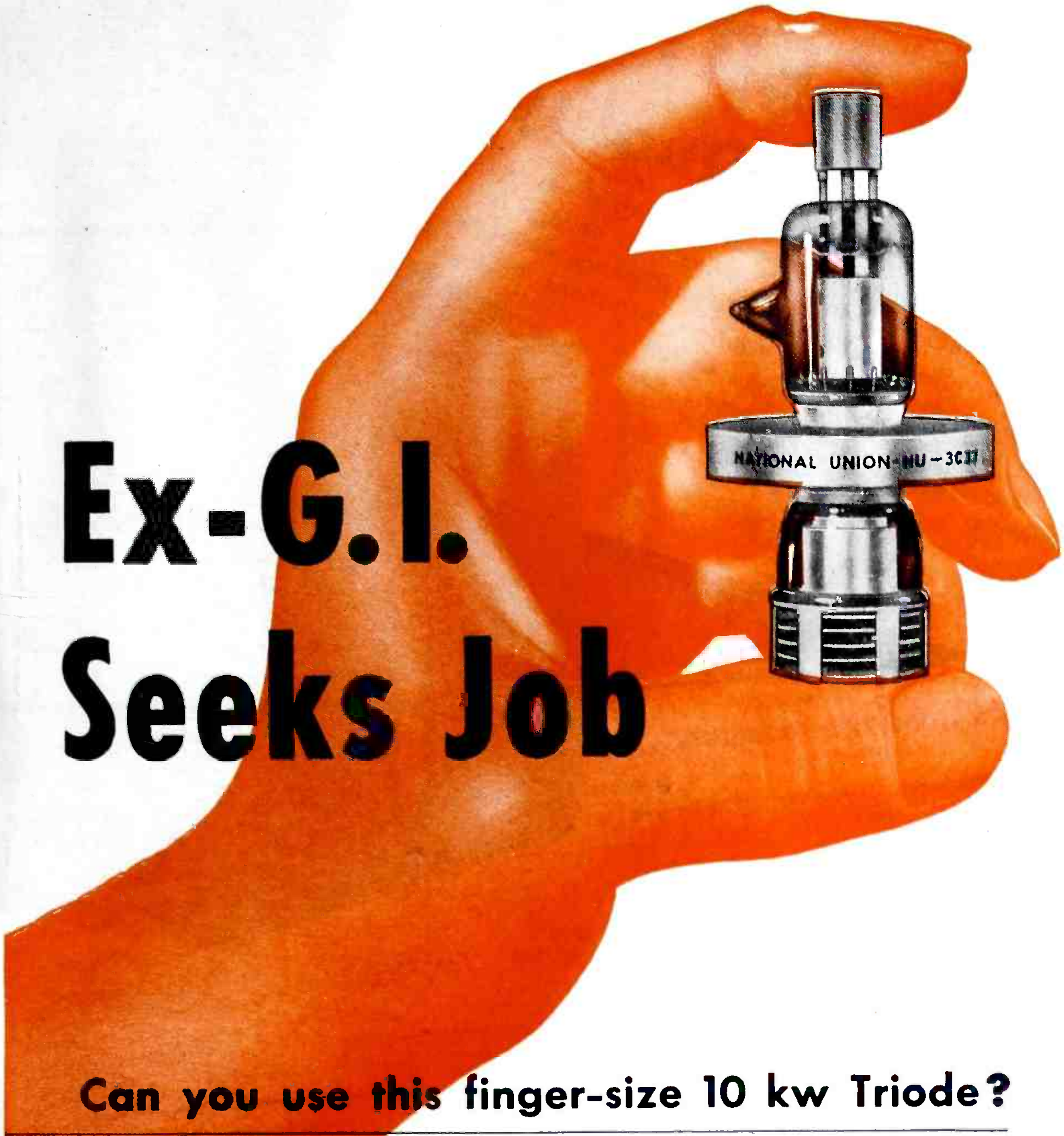
The panels for the walls were chiefly of one size, 9′ 2″ by 3′ 6″, with filler panels of half this width to completely close the sides of the room. Four standard sizes of panels were used for the floors and ceilings; lengths were 84″ and 63″; widths, 42″ and 21″. The lengths of rooms obtainable with these panels are 7′ or 10′ 6″, with increases thereafter by increments of 1′ 9″; widths begin at 5′ 3″, and increase by increments of 1′ 9″.

Rubber-in-shear mountings completely support the rooms. Most of the weight was borne by installing them under the walls, but in all except the smallest rooms they were also placed under the floor beams. The mountings were located so that each one is deflected by the same amount irrespective of its location. To permit removing them conveniently if they should sag with time, the mountings were fastened to wood members in rows. Information on hand at the time of design, however, indicated that no appreciable sagging should occur. Each mounting was designed to deflect 0.3″ under load. The natural frequency of the mounting thus loaded is about 5 cps.

Double-Walled Room

Protection against objectionable acoustic resonances was obtained by placing 3″ of sound insulation on the floor under the room and a 2″ rock wool blanket on top of the room. Essential constructional features are

(*Continued on page 33*)



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- Negligible frequency drift due to cylindrical construction and closely controlled mechanical tolerances.
- Maximum mechanical strength.

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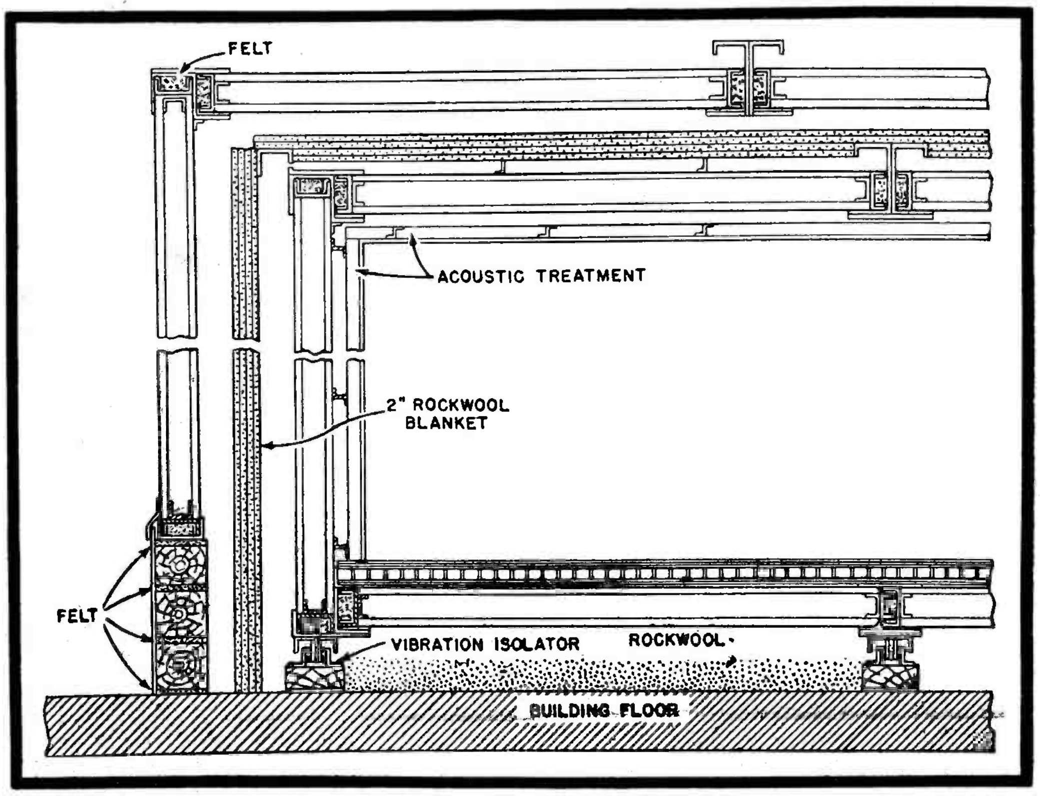
Figure 3
Constructional features of the double-walled acoustic room. Doors are of wood, 5″ thick, with large heavy composite panels mounted on rubber.



shown in Figure 3, where the room just described appears as the inner component of a double-walled structure.

Doors, of wood, are 5″ thick, and have large, heavy, composite panels mounted in rubber. There are two panels, one on each side of the door, with an air space between them. The closure is made as airtight as possible by double rubber gaskets and three-point hardware. The acoustic attenuation of these doors is about 43 db.

Ventilation panels, shown in Figure 4, are of labyrinthine design and lined with sound-absorbing sheet material. Their walls are similar to those of the structural panels and their acoustic attenuation is about 52 db.

Electric power and communication circuits enter through apertures near the edge of the ventilation panel. The space around the wires is sealed with mastic after their insertion.

For greater attenuation of sound, a room of the kind just described can be enclosed in another one built of the same or similar panels. For a moderate increase in attenuation, an extension of the panels of the enclosing room to the ceiling of the building room may suffice. This construction is effective against noise originating on the same floor, but not against that from the floor above. For the largest feasible increase in attenuation, the enclosing room has a separate ceiling of the same standard panels used for the floor and ceiling of the inner room. Since the panels are standard, the length and width of the outer room exceed those of the inner one by 1′ 9″. This provides an air space 7.5″ wide. The floor of the outer room is the floor of the building, because it was decided after careful consideration that there would probably be little benefit from trying to provide the outer room with a floor of steel panels, and that in any event the possible benefit of such construction would be far outweighed by the increased expense and bulk. The extra height necessary to permit using the same wall panels for both the inner and outer rooms was obtained by putting the walls of the outer room on a laminar structure of timbers separated by hair felt. The pile-up is 12″ high and it was covered with steel sheathing for appearance. A similar sheathing was provided to enclose the space under a single-walled room. An apron, which extends over the gap between this sheathing and the room, effectively retards the entrance of dirt and dust into the space underneath.

Single-frequency attenuation measurements have not been made in these rooms owing to the pressure of war work, but noise-meter measurements show an attenuation of 43 db for the single room and at least 57 for the double room. Their construction and demounting involve little dirt and noise, and there is practically complete salvage of the material, as has been demonstrated by experience.

Figure 4
Interior of a small single-walled acoustic room showing ventilating panels on the left wall. Panels are of labyrinthine design, lined with sound absorbing sheet material.

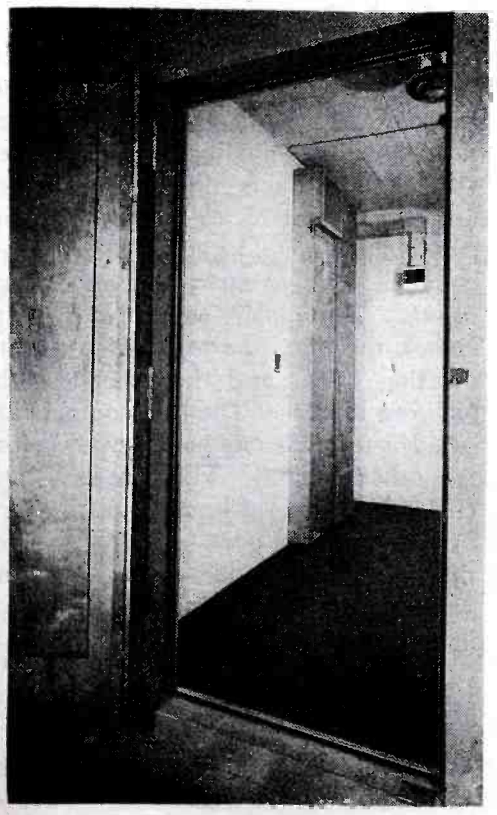
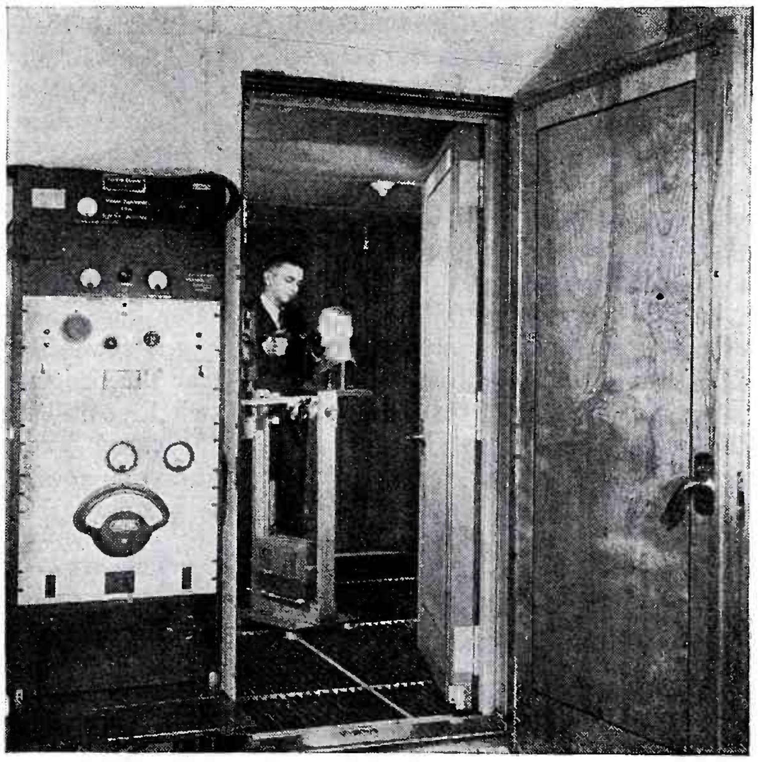


Figure 5
Interior of a double-walled acoustic room showing duct for electrical wiring.



An Interlocked LINE-SWITCHING SYSTEM

by H. E. ADAMS

Chief Engineer WIBC

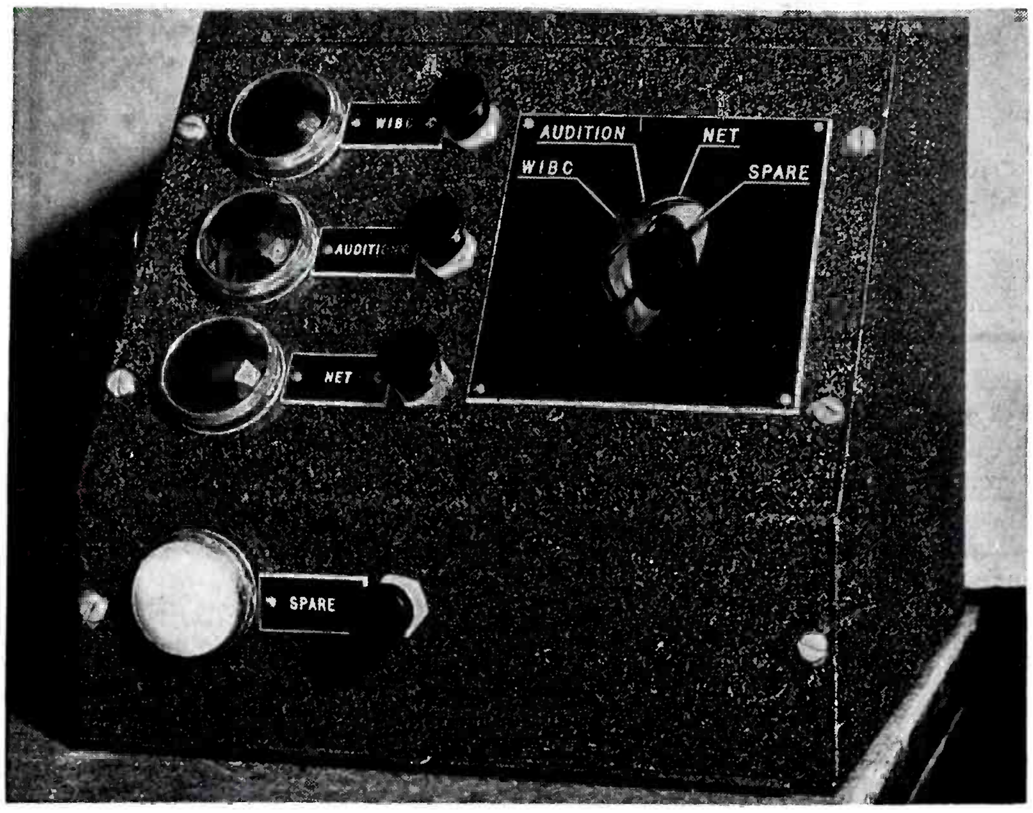


Figure 1
Front view of interlocked switching assembly. Note minimum of controls.

MOST broadcast engineers appreciate the advantages of multiple control-room layouts over the more common arrangement, where as many studios as possible are grouped around a single control room. The latter is usually felt to be economically necessary in a small or medium-size station, even when the limitations it imposes upon optimum operation convenience are realized.

It is difficult to arrange more than three studios so that they can be clearly seen and monitored from one control room. At least one will be found to be awkwardly placed, with full use of all the facilities hampered. In addition, the usual succession of recordings, auditions, etc., which must be taken care of while the smooth continuity of regular programs is preserved, often makes operation from a single control room cramped and inconvenient.

WIBC Problem

We were recently faced with the problem of making the best use of a rather narrow building for a new studio installation. We, of course, had to consider the foregoing factors and in addition we were faced with the equally-important equipment limitation. In our case the time limit ruled out any custom-built master-control system. We also had to select available components and avoid the use of critical parts.

The system finally developed used a switching-control procedure making it possible to group three studios around one control room and two at the second control room, and feed a program to any one of four lines from either control room. These two groups happen to be adjacent in our installation, but could be on different floors or separated some distance since no reliance on visual signals is necessary. Indicator lamps are used to show when a line is connected through and ready to take the program. By the addition of switch positions and relays, more lines (at least 10) could be provided. Fewer lines than four might be sufficient in some applications.

Components

The control boxes were stock items obtainable from most parts supply houses. In each box was installed a four-position four-pole selector switch, four simple push-to-break push buttons and four 1" indicator lamps, which use standard 6-watt candelebra base 120-volt lamps. Since the lamps and relays are d-c operated, we were not faced with interference problems when all circuits were included in one cable. We were fortunate in having commercial d-c available. However, the current requirements of the complete system are less than .1 ampere, so that a simple rectifier system will suffice.

Relays Used

The relays used were Advance 216, rated at 60 volts, with five double-throw poles. Although only four were needed in this application, it was felt that extra contacts might be useful for auxilliary control or indicating circuits, which could be added later. They could be used to operate studio signal lights. Two poles were wired in to switch the line, one to operate the indicating lamps and the other for the lock-out feature. The line contacts are so adjusted that one pair makes before the other breaks. This prevents any clicks which might be a result of a line instantaneously open. Tests showed that any disturbance from switching was too far below normal program level to be audible.

The relay resistance is 3,000 ohms, and in series with a 25-watt 3,000-ohm resistor, it operates properly across a d-c supply of 100 to 125 volts. The series resistor is a necessary part of

Control Method Affords Feeding of Programs to Any of Four Lines from Either Control Room, Quick Switching for Successive Programs or Portions of Programs from Any Studio, and Interlock Protection to Prevent Both Control Rooms Feeding Line Simultaneously.

the interlock system. Each line output is linked to jacks which are normalled through to the point most commonly used. Number *one*, for example, goes to the regular transmitter program circuit. The *two* line is particularly useful here, for a large number of live auditions, and auditions to be transcribed are handled. This line is designated the *audition* line, and is available like the others for sending a program to any telephone circuit. However it is normally connected to feed a line which terminates in all offices and a conference room. Each room has a monitoring amplifier and speaker which can be switched to any of several lines. It is possible, in this way, to conduct auditions and have them heard in the privacy of the various offices. Provisions are made for recording from this line at the same time by means of a bridging amplifier.

Operation of Interlock System

Two sections of the selector switch connect the line-amplifier output to the line selected. This affords connection to the proper relay, so that when that relay is not *locked out* by the other control box, it will connect through to the corresponding line. One side of each relay coil goes to the positive d-c terminal. The other side, besides going to the series resistor, goes to the third pole of the relay whose back or relaxed contact connects through the corresponding release button and selector switch at *A-control* point to the positive d-c terminal. It will be realized then, that when the relay in question is not energized, which is true when the *A control* is in that position, a short circuit is placed across the relay coil. As long as this condition exists, nothing can be done at *B control* to energize this relay and switch the line away from *A control*. The necessity for the series resistor is thus quite apparent. If *B control* is switched to the position under discussion, any of the 3,000-ohm resistors may be placed across the 120-volt d-c line, in series with the relay coil, which is now short-circuited, the resistor limiting current flow to about 40 milliamperes.

B-Control Operation

If *B control* is left in the same position as *A control*, a touch of the release button at *A control* will remove the short circuit long enough for voltage to appear across the relay coil and move the contacts to the energized position. This immediately prevents the short circuit from being reestablished by opening the third pole of the relay. Thus while *B control* maintains voltage on the relay, *A control* can do nothing to release the relay and break the line circuit established by *B control*.

Last Switching Sequence

In the last sequence of switching, whenever *A control* is placed in the same position as *B control*, assuming *B control* to have the line circuit established, a touch of the release button at *B control* will release the relay since the *B-control* release button is a part of the relay-coil series circuit. As soon as the third pole touches the relaxed contact, the short circuit is established across the relay coil and *A control* has possession of the line.

Precautions

We have found it a safe practice to avoid leaving both controls set at the same line position, other than when preparing for a switch. When this precaution is taken, accidental touching of a release button will not mean loss of the circuit. Where the control points are separated some distance, it is always possible to determine which line is in use at the other control point, by switching to each line in turn. The indicator lamps of all the available lines will light, while the light of the line in use will not. The lamp circuits are controlled by the fourth pole of the relay, and when waiting to take control of a line about to be released by the other control point, the operator need only wait until his indicator lamp lights, showing that the switch is completed. Using different color jewels for each of the lines simplifies identification.

Indicator Lamp Resistor

A 25-watt 800-ohm resistor serves to reduce the brilliance of the indicator lamps and also minimizes lamp burnouts.

Power Control

It will be seen that no power is used except for the indicating lamps when *A control* is feeding any of the lines. For this reason the *A control* should be located at the *most used* control room, if the distribution of use is at all unequal. This reduces the chance of interruptions due to failure of the power supply, since the power can be off indefinitely without limiting the use of *A control*.

Lower Voltage Relays

Lower voltage relays could have been used, but it was felt that the higher voltage and consequent lower current gave important advantages. For instance an ordinary receiver-type power supply can provide the necessary power. In addition, in cases of greater separation between control points with an attendant increase in the resistance of the connecting lines, the line resistance could approach a value suffi-

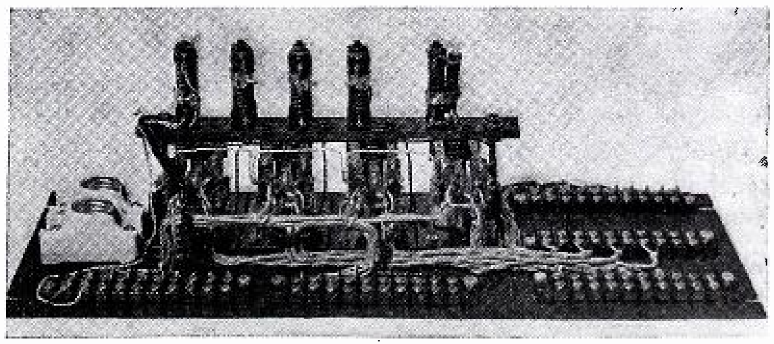


Figure 2
Interior view of line-switching unit.

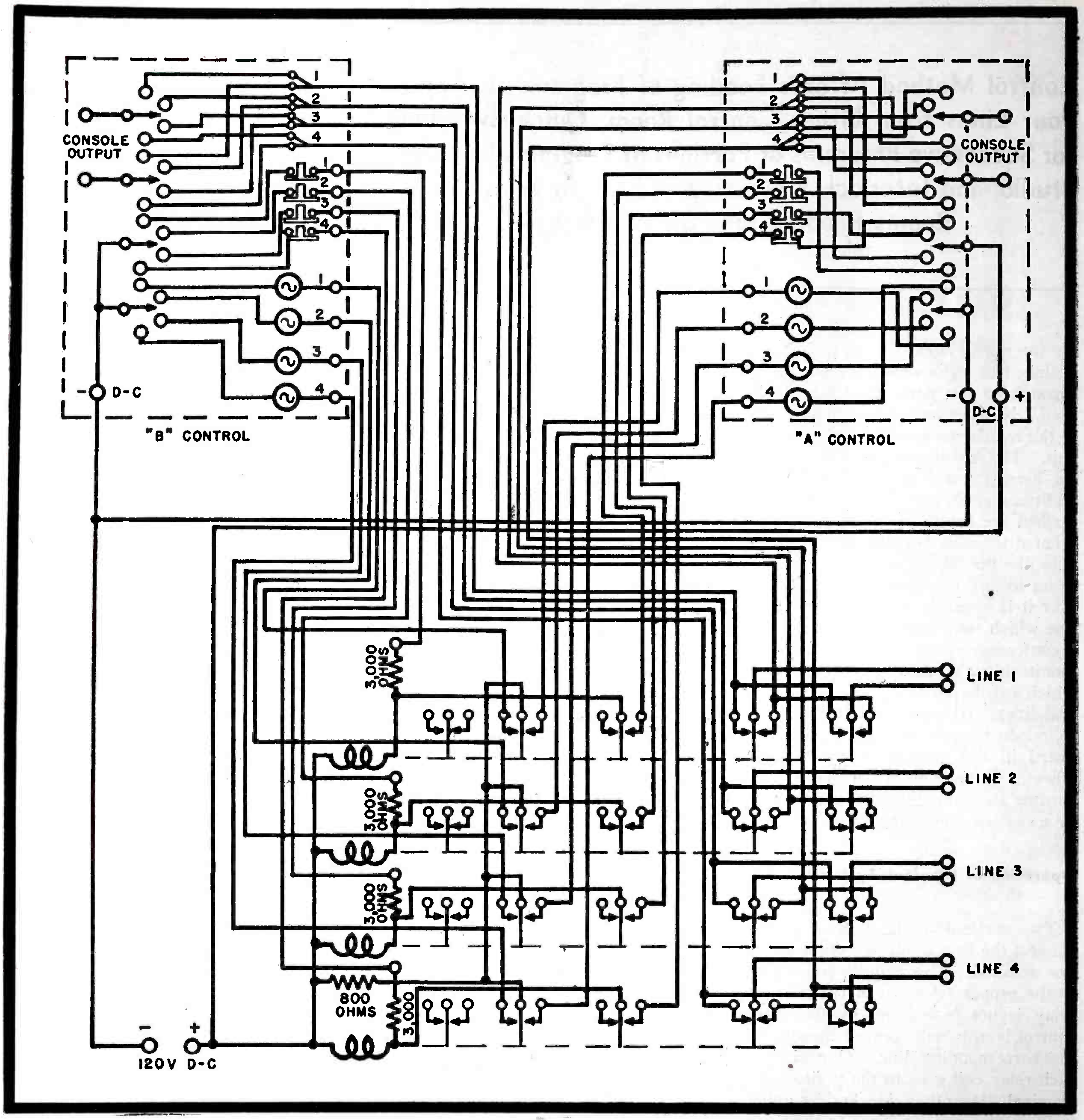


Figure 3
Circuit of line-switching control system.

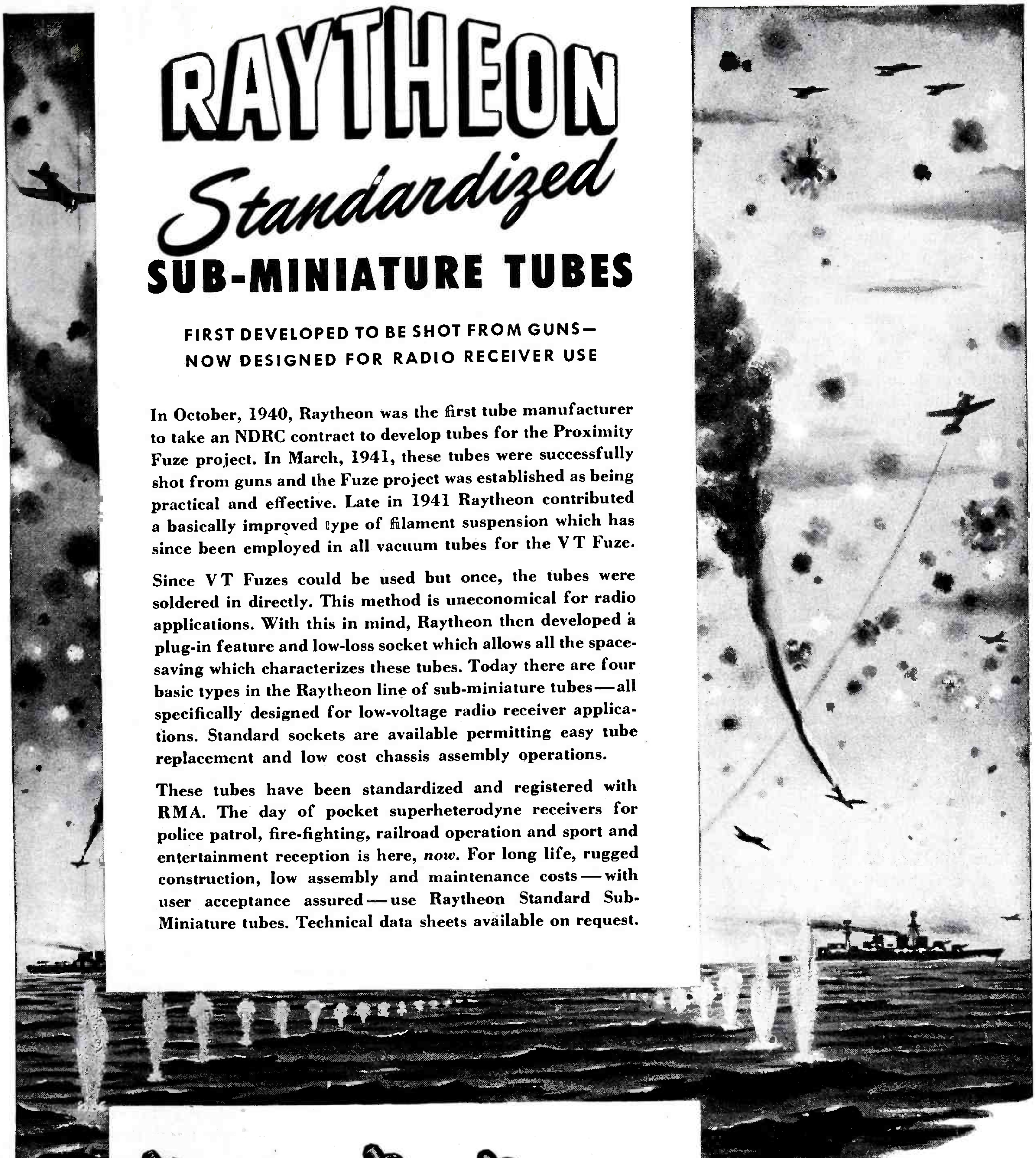
ciently high to impair the reliability of the lock-out feature, relying as it does at *A control* upon a short circuit to prevent voltage being applied to the relay coil. The same trouble could come from increased contact resistance in the lock-out circuits. Resistances as high as 10 and 15 ohms have been measured across relay contacts, and while they cause no trouble in a 3,000-ohm coil circuit, they become increasingly important as the voltage and circuit resistance are lowered.

Relay Panel

The relay panel is housed in a dust-tight cabinet, and the normal wiping action of the contacts is sufficient to keep them clean. The line contacts of each relay are checked often. During routine maintenance periods, an ohmmeter for low resistances is clipped across the line terminals of each relay in turn. Shorting clips are placed across both *A-control* and *B-control* lines for the corresponding relay and the readings are observed while operating the relay. If the resistance shown is under 1 ohm for both positions, repeatedly, there can be no doubt that the contacts are in good condition.

The flexibility of the two-control room arrangement has proven most satisfactory. Without disturbing the operation of the control room in use in any way, it is possible to rehearse a forthcoming program thoroughly before broadcast time, then put it on the air from the same studio in which it was rehearsed, and if desired, return to the original control point for the next program, all with no perceptible break in continuity of service.

RAYTHEON *Standardized* SUB-MINIATURE TUBES



**FIRST DEVELOPED TO BE SHOT FROM GUNS—
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In October, 1940, Raytheon was the first tube manufacturer to take an NDRC contract to develop tubes for the Proximity Fuze project. In March, 1941, these tubes were successfully shot from guns and the Fuze project was established as being practical and effective. Late in 1941 Raytheon contributed a basically improved type of filament suspension which has since been employed in all vacuum tubes for the V T Fuze.

Since V T Fuzes could be used but once, the tubes were soldered in directly. This method is uneconomical for radio applications. With this in mind, Raytheon then developed a plug-in feature and low-loss socket which allows all the space-saving which characterizes these tubes. Today there are four basic types in the Raytheon line of sub-miniature tubes—all specifically designed for low-voltage radio receiver applications. Standard sockets are available permitting easy tube replacement and low cost chassis assembly operations.

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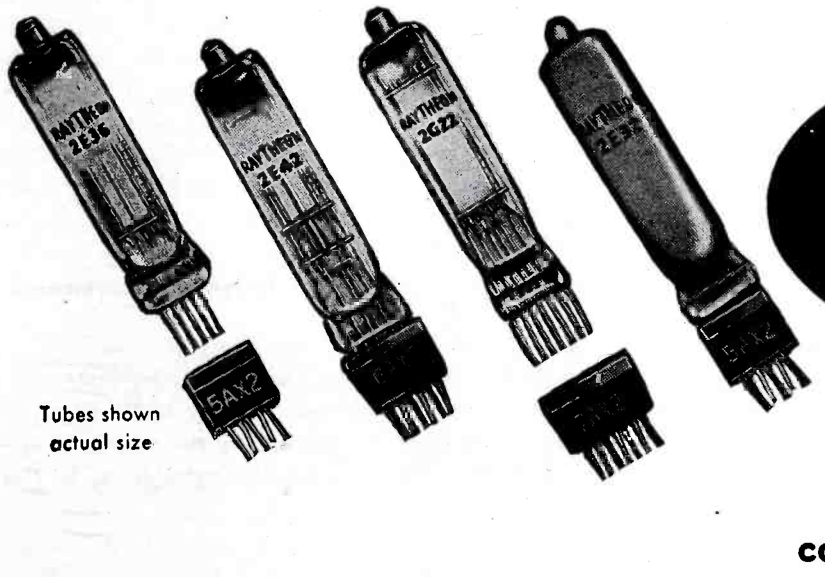

Tubes shown actual size

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Converting D-C METER to A-C V-T-V Use

Simple Circuit Converts a D-C Voltmeter for A-C Vacuum-Tube Voltmeter Application. Unit Has a Linear Scale and Practically Infinite Input Impedance. While Meter Was Not Designed for H-F Use, It Has No Appreciable Error at Input Frequencies up to Several Megacycles.

by WILLIAM M. BREAZEALE

Associate Professor of Electrical Engineering
University of Virginia

THROUGH the use of a peak-indicating circuit, it has been possible to effectively convert a 5″, 1,000-ohms-per-volt voltmeter for a-c use in a v-t voltmeter system. The peak-indicating arrangement consists of a high-impedance cathode follower which rectifies the input voltage and drives a 6AC7, also connected as a cathode follower with the d-c voltmeter, in the cathode circuit. If the gains of the cathode follower circuits were unity, then the d-c voltmeter could be made to read rms a-c volts by tapping the cathode resistor of the 6SN7 at a point 70% above the negative end. Actually, because this gain is less than one, and because there are various other circuit losses, it turns out that the tap is close to the 85% point.

This particular circuit was designed to operate with the 15- and 150-volt scales of the d-c voltmeter. The shift from one scale to the other is accomplished by using a 4-pole, double-throw switch (actually a telephone key). The four units of this switch are identified as S_1 S_2, S_3 and S_4 in Figure 1, and are shown in the 15-volt position. Protection of the 15-volt range is obtained by connecting the other half of the 6SN7 as a diode with its cathode some 18 volts above the zero-voltage level of the cathode of the 6AC7. Thus, no matter how high the input voltage may go, the grid of the 6AC7 cannot rise to more than 16 or 17 volts. When the switch is in the 150-volt position, this limitation is removed. Addition of the resistors shown in parallel with the d-c voltmeter and connected to a negative voltage point improves the linearity of the 6AC7 operation.

The relation between the input voltage and the d-c voltmeter reading can be varied by adjusting R_1. Because the gain of the 6AC7 cathode follower is less with the smaller impedance in the cathode circuit, it was found necessary to tap the cathode resistor of the 6SN7 at a higher point when the 15-volt range is in use; S_1 takes care of this.

Power Supply

The power supply is a simple, full-wave rectifier which gives 20 milliamperes at 400 volts. Regulation of the power supply is not necessary unless one wishes to smooth out very small fluctuations in the meter readings. A bleeder resistor supplies the required voltages. It is necessary for the screen grid of the 6AC7 to be some 25 volts higher than the highest voltage to be read on the d-c voltmeter. This means that point *B* should be about 175 volts positive, with respect to the zero voltage position of the 6AC7 cathode, if the full 150-volt range is to be used. Although this exceeds the manufacturer's ratings, no excessive shortening of the life of the tube has been observed.

The d-c voltmeter is zeroed with the aid of R_2, and this resistor should have a value sufficient to vary point *A* over the range plus 10 to plus 25 volts.

The capacitor *C* across the cathode resistor of the 6SN7 should be of sufficient size so that it will not discharge appreciably between a-c peaks. For a 60-cycle input, a 0.5-mfd capacitor is adequate.

Adjustment of Meter Circuit

An a-c voltmeter and a variable a-c power supply are connected across the input terminals. By adjusting R_1 and R_2 the d-c voltmeter is made to agree with the a-c meter at two points; for instance, at 20% to 90% of full scale deflection. After this adjustment is made the input terminals are short-circuited and the reading of the d-c voltmeter noted. It will probably be between one and two volts. This small deflection is due to the fact that the circuit response is not linear at the very bottom of the scale. Thereafter, the meter is zeroed by short-circuiting the input terminals and adjusting to this reading, using R_2. There is no need to readjust R_1 until tubes are changed. A calibration shows that when the circuit is properly adjusted the deviation of the d-c voltmeter readings from the input voltage is less than one volt over the 3- to 150-volt range. A calibration curve for the 15-volt scale is shown in Figure 2.

As in all meters of this type, the input tube draws a small amount of grid current even though the grid is at a negative potential with respect to the cathode. The magnitude of this current may be approximated from the fact that at low voltage 10 megohms in series with the input causes the meter to read 1 volt too high. At higher voltages the error is less. The presence of this minute grid current requires that the apparatus under test provide a continuous d-c path between the input terminals. If it does not, as is the case when a small capacitor is in series with the input, then a d-c circuit must be provided through a parallel path. This is the function of the high resistance shown on the circuit diagram, which can be connected across the input with the spst switch. When the input terminals are open this grid current charges the meter to some 50 or 75 volts, another reason why protection of the 15-volt range is desirable.

D-C Measurements

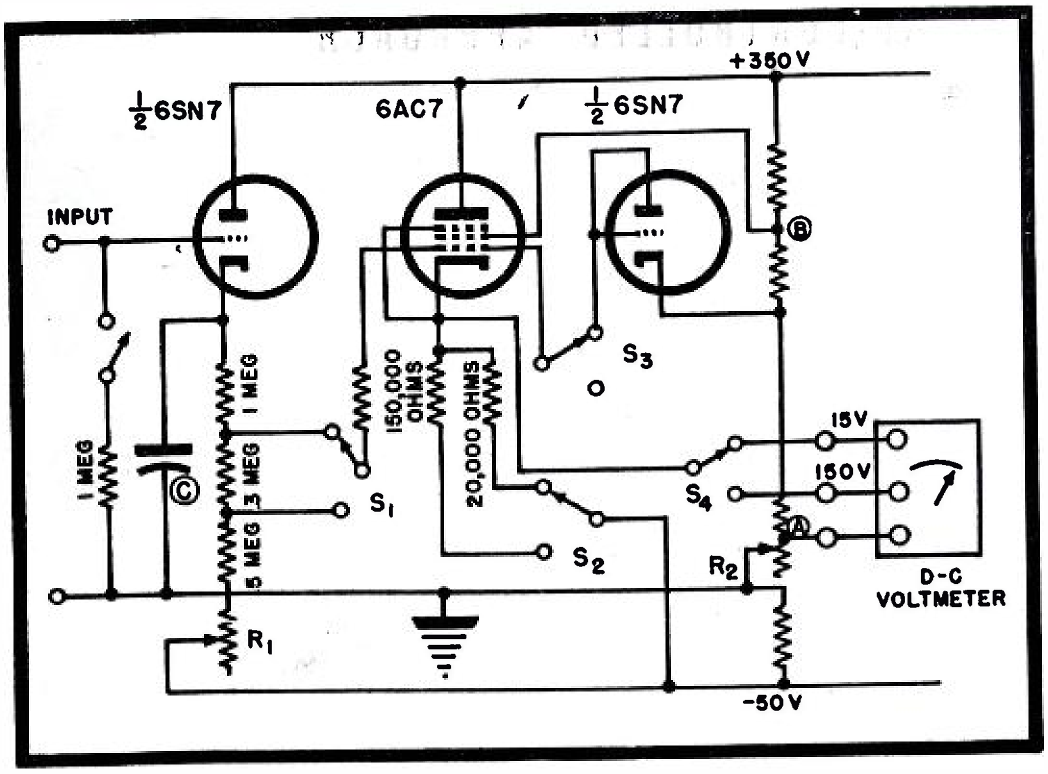
In theory, when a d-c voltage is applied to the input terminals the meter should read 70.7% of this voltage. Actually, because the 6SN7 is not a perfect detector for a-c voltages, the reading will be slightly higher. Above 20 volts this factor is about 73% and increases slightly for voltages less than 20.

Pulse Height Measurements

Under certain conditions this circuit can be used to indicate the height of a single voltage pulse to within 5%. To accomplish this, it is necessary to increase the capacity *C* in the cathode of

Figure 1

Conversion circuit. It is essentially a peak-indicating arrangement with a high impedance cathode follower.



the 6SN7 to the point where it will hold the voltage across the cathode resistor substantially constant for several seconds. Since this voltage determines the d-c voltmeter indication, this means that the pointer will remain deflected long enough for the operator to catch the maximum reading. If the capacity is increased to 10 mfd across 7 megohms then the voltage across the capacitor will fall to 95% of its initial value 3.5 seconds after the pulse. In other words, the d-c voltmeter reading is constant within 5% for some 3 seconds. Experiments show that an observer will read about 70% of the peak value of a pulse rather than the 73% indicated by the d-c calibration.

There is one limitation to the use of this circuit in this manner. Assuming that it is desired to maintain a high input impedance at all times, it is necessary that the rate of rise of voltage across the input not be so rapid as to drive the grid positive. The permissible rise is determined by the rate of charge of the cathode capacitor *C*. Ten milliamperes can be drawn from the 6SN7 and this allows a rate of rise of 10^3 volts per second across the 10-mfd capacitor. If steeper voltage pulses are to be measured it is necessary to use an additional cathode follower stage, with a smaller cathode capacitor, ahead of the one just discussed. This stage need hold its charge but the fraction of a second necessary to charge the following stage and, hence, its cathode capacitor can be considerably less than one microfarad.

Uses

Beside the usual a-c and d-c voltage measurements, determinations of high impedances,[1] etc., this type of vacuum-tube voltmeter circuit, because of its almost infinite-input impedance, is particularly suited for measuring short time intervals when these intervals can be determined as a function of the increment of charge of a capacitor.

For instance, let us consider the problem of determining the speed of a camera shutter. In addition to the vacuum-tube voltmeter this measurement requires a vacuum photocell, microammeter, d-c voltage supply of 100-150 volts, and capacitor. The procedure is as follows: First the phototube is connected in series with the battery and the microammeter, the light source focussed on the cathode of the phototube using the camera lens and the resulting current noted. Next, without disturbing the light source or the lens stop, a capacitor is introduced in the circuit in place of the microammeter. The size of the capacitor should be such that it will charge to some 25 or 50 volts during the time interval that the shutter is open. The charging current to the capacitor will be the same as that previously measured, since the current through a vacuum photocell is independent of the plate voltage above 20 or 30. The total charge will be the product of the current and the time the shutter is open, and the voltage appearing across the capacitor, the charge divided by the capacitor capacity. As an example, suppose that the microammeter shows 10 microamperes phototube current and it is expected that the shutter will be open 1/50 second. This time interval will permit a charge of 0.2×10^{-6} coulomb to flow and will charge a .005-mfd capacitor to 40 volts. It is also necessary to insure that the rate of rise of voltage is not too rapid and that the capacitor is sufficiently large so that it will not be appreciably charged by the grid current (should be .001 mfd or larger).

To continue, the vacuum-tube voltmeter is connected across the capacitor and then the rise in voltage, when the shutter is snapped, is noted. The actual voltage can be determined from the d-c calibration curve of the meter. Then the effective time the shutter was open is given by

$$t = \frac{C \cdot \Delta V}{I} \text{ seconds,}$$

where *C* is the capacity of the capacitor in microfarads, ΔV the voltage rise and *I* the photocell current in microamperes. To minimize trouble due to grid current, it may be desirable to start with an initial voltage of about 50 across the capacitor.

[1]D. L. Waidelich, Communications; December 1945.

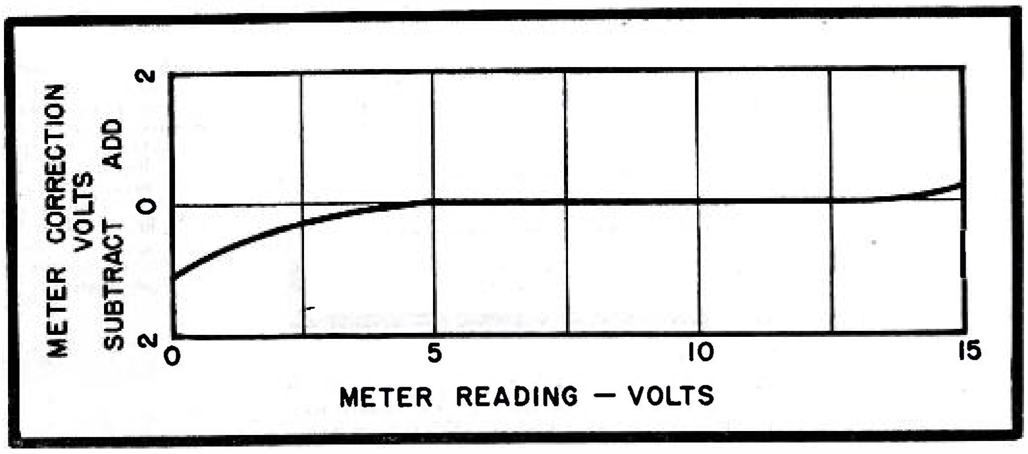
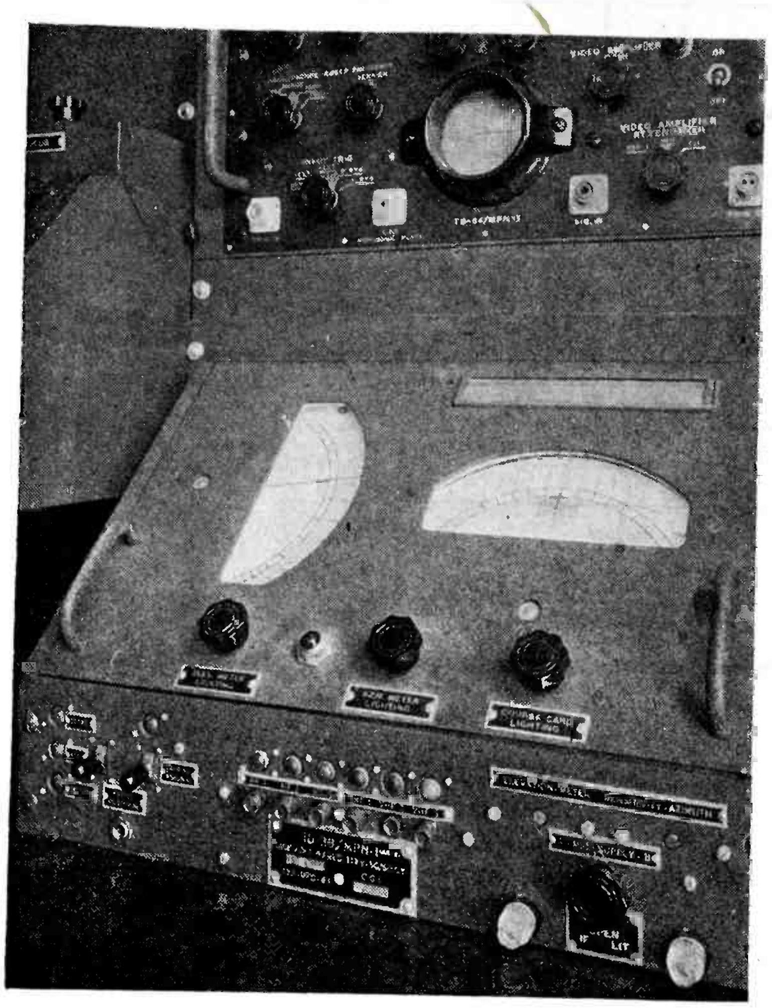
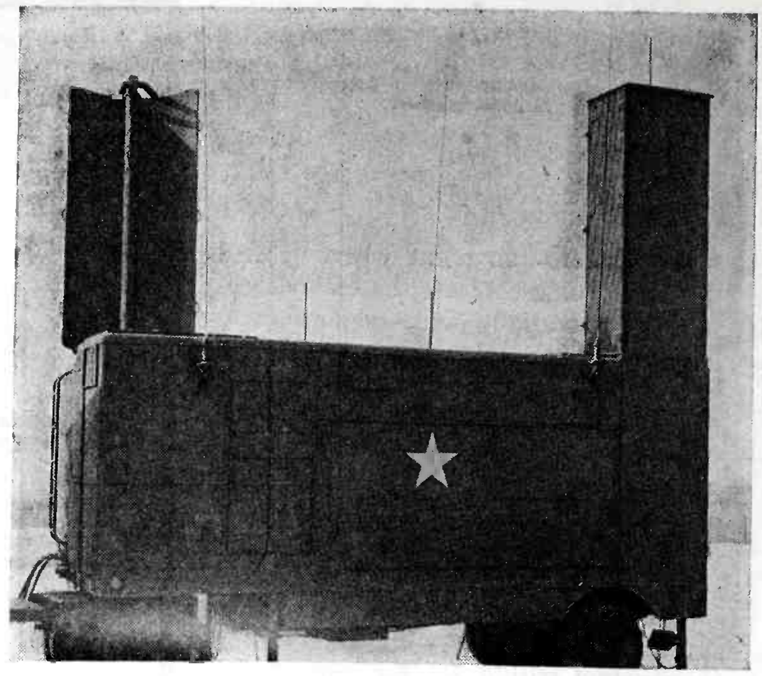


Figure 2

Voltmeter correction curve for 15-volt range.

GROUND-CONTROLLED APPROACH





Above: Outside view of complete ground-controlled approach system developed for ATSC use and currently being applied to civil aeronautical use. The model, known as the AN/MPN-1, provides visual azimuth position data relative to the glide path, visual elevation data, range data and information regarding position of other aircraft near the glidepath. The system, described by Ernest N. Storrs of Watson Laboratories, ATSC, at the recent IRE Winter Technical Meeting, uses parabolic cylindrical reflectors fed by a dipole array. Left: Controllers position, showing error meter calibrated in feet deviation from the glidepath, communications selector switches and the test oscillograph for circuit analysis.

ACOUSTIC MATERIAL EFFECTS

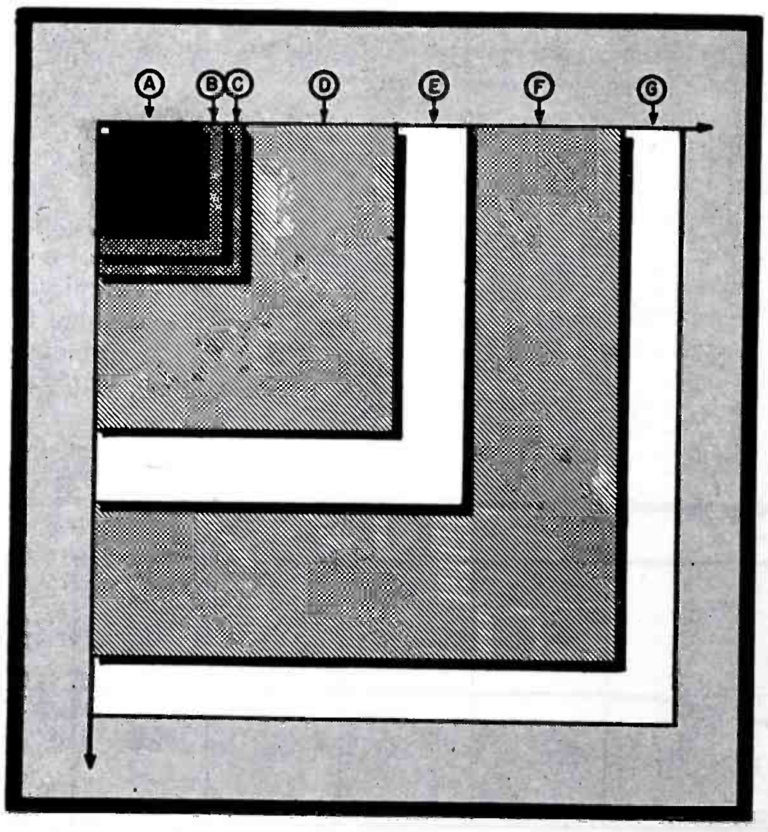
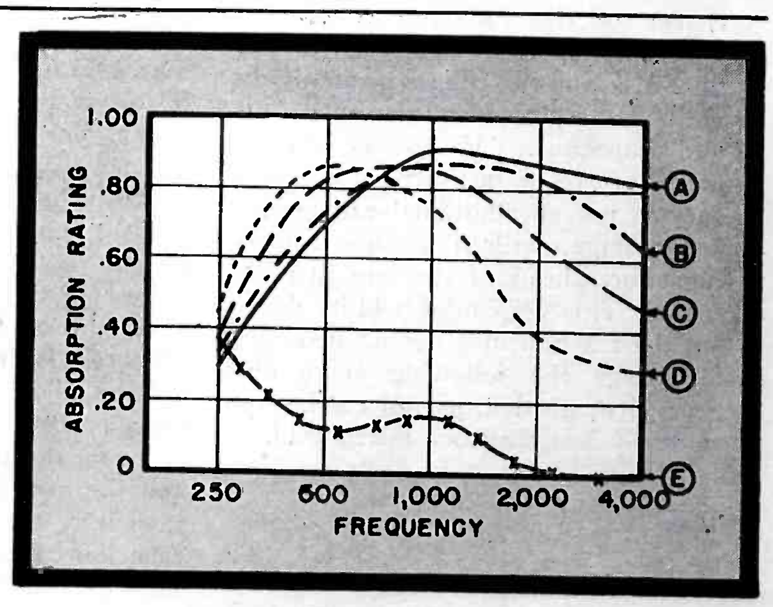


Figure 2

Surface areas of fibrous-glass basic fibres per pound of glass. A, 39 square feet; B, 52 square feet; C, 69 square feet; D, 356 square feet; E, 533 square feet; F, 1066 square feet; and G, 1371 square feet.

(All data courtesy Owens-Corning Fiberglas Corp.)



Above: Fig. 1 showing apparent effect of percentage open area in 26-gage perforated metal surfaces. (A, plain bare board; B, 18% open area, ¼" holes; C, 4.9% open area, ¼" holes; D, ½% open area, ⅛" holes; E, 0% open area not perforated).

Figure 1 shows the effect of perforated metal facings with different percentages of open area. With a high percentage of open area, such as 18%, there appears to be little effect upon the absorption curve except for slight reduction at 4000 cycles. As the percentage of open area is reduced, high-frequency values decrease and low-frequency values increase. Reducing the percentage of open area seems to sharpen the peak of the curve and move the peak to lower frequencies.

Figure 2 shows the surface areas of fiberglas basic fibers, per pound of glass, compared with the surface area of pound of glass in the form of a sphere.

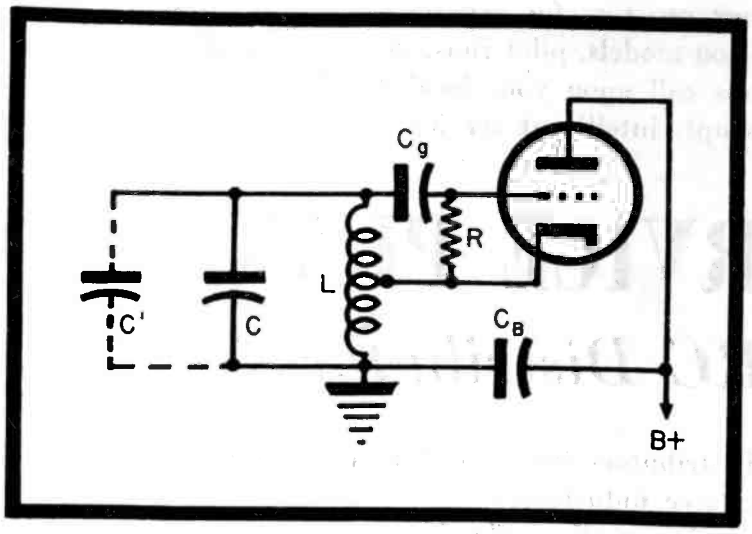


Figure 1
Simple oscillator circuit where the frequency is dependent on the inductance *L* and the total effective capacitance shunting it, designated by *C*. C^1 is a capacitance introduced in parallel with *C*, which will vary the frequency.

REACTANCE TUBE

by N. MARCHAND*

Chief Engineer
Lowenherz Development Company

IN a simple oscillator circuit, as shown in Figure 1, the frequency of oscillation is determined primarily by the inductance *L* and the effective capacitance across it, *C*. For convenience we can let *C* include all tube and other stray capacitances that may be shunting the inductance; C_g is the grid capacitor, *R* the grid resistor, and C_B a very low impedance capacitor used as a bypass capacitor. The generated frequency f_o is then given by

$$f_o = \frac{1}{2\pi\sqrt{LC}} \qquad (1)$$

Thus any variation in the values of *L* and *C* will cause the frequency to vary. If a capacitance C^1 is introduced in parallel with *C*, as shown in the figure, then the frequency will become *f*, where

$$f = \frac{1}{2\pi\sqrt{L(C + C^1)}} \qquad (2)$$

A shift in frequency will, of course, also take place if an inductance were placed in parallel with *C* instead of the capacitance C^1. These capacitances or inductances can be introduced across the tank circuit of the oscillator by using a reactance tube.

This is a tube where the current and voltage relationship of an r-f voltage impressed between the plate and cathode is the same as exists for a capacitor, coil, or any similar reactance circuit. By varying the reactance of the reactance tube it is possible to obtain very wide variations of frequency which are then directly applicable to frequency-modulation systems.

*Instructor in Graduate Electrical Engineering courses, Columbia University.

The Reactance Tube

Figure 2 illustrates one of the fundamental reactance tube circuits. A pentode is employed where B + is supplied to the plate circuit through an r-f choke. R_s is the screen resistor and the two C_B's are r-f bypass capacitors. C_1 is a small capacitor whose reactance is very much larger than R_1, the grid resistor.

The phasor diagram for this circuit is shown in Figure 3. An r-f voltage, e_p, is impressed across the r-f, input terminals of the reactance tube. This input voltage is used as the reference voltage in the phasor diagram. A current, i_{p1}, will be drawn by the tube being determined by the plate resistance R_p of the tube where

$$i_{p1} = \frac{e_p}{R_p} \qquad (3)$$

This current will be in phase with the voltage e_p. It is not the total current. To it must be added the plate current drawn by the grid voltage e_g. To determine this voltage it is necessary to obtain the current i_g through the resistor R_1. The current i_g is equal to the plate voltage e_p divided by the series impedance of R_1 and C_1. Accordingly, since C_B is a bypass capacitor and the audio input is isolated by an r-f choke, their effect may be neglected. Thus

$$i_g = \frac{e_p}{R_1 - j\,X_{c1}} \qquad (4)$$

where X_{c1} is the reactance of the capacitor C_1 at the frequency being applied. If X_{c1} is very much larger than R_1, the current i_g will lead the voltage e_p by practically 90°, as shown in the diagram. Then if R_1 is low enough so that any shunting impedances such as input capacitance may be neglected

$$e_g = \frac{e_p}{R_1 - jX_{c1}} \cdot R_1 \qquad (5)$$

However, e_g will cause a current i_{p2} to flow in the plate circuit where

$$i_{p2} = \frac{\mu e_g}{R_p} \qquad (6)$$

μ is the amplification factor of the tube. The total plate current, i_p, is made up of i_{p1} plus i_{p2}, so that

$$i_p = \frac{1}{R_p}(e_p + \mu e_g) \qquad (7)$$

which is the standard equation for

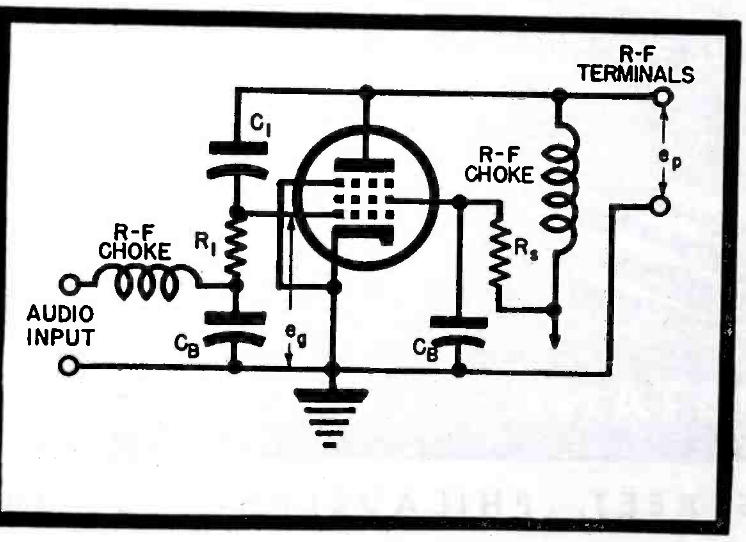
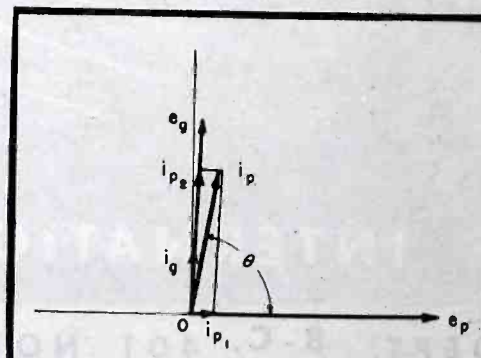


Figure 2
A reactance tube employing a grid circuit which causes the grid voltage to lead the plate voltage by 90° resulting in a capacitance reactance. $(C^1 = C_1R_1g_m)$.

Figure 3
The phasor diagram for the circuit shown in Figure 2. The resultant r-f plate current, i_p, is shown to lead the r-f plate voltage by the angle θ, very close to 90°.



MODULATORS

plate current. Substituting the transconductance g_m for μ over R_p

$$i_p = \frac{e_p}{R_p} + g_m e_g \qquad (8)$$

The actual current flowing in the plate circuit is obtained by substituting for e_g from (*6*)

$$i_p = \frac{e_p}{R_p} + \frac{g_m e_p R_1}{R_1 - jX_{c1}} \qquad (9)$$

Thus (*9*) is now the complete equation for the current drawn by the tube from the r-f source. However, some simplifications may be made. If R_p is very large, the first term may be neglected for calculation purposes. Also if the reactance X_{c1} is over 5 times the value of R_1, the R_1 in the denominator of the second term may be neglected without introducing appreciable error. This means then that i_p will now lead e_p by 90° where

$$i_p = j\frac{g_m R_1}{X_{c1}} e_p \qquad (10)$$

Thus the impedance across the plate circuit of the tube shown in figure 2, is given by

$$\frac{e_p}{i_p} = -j\frac{1}{\omega C_1 R_1 g_m} \qquad (11)$$

where ω is 2π times the frequency of e_p. Comparing (*11*) with the equation for capacitive reactance it can be seen that it is equivalent to a capacitance C^1 where

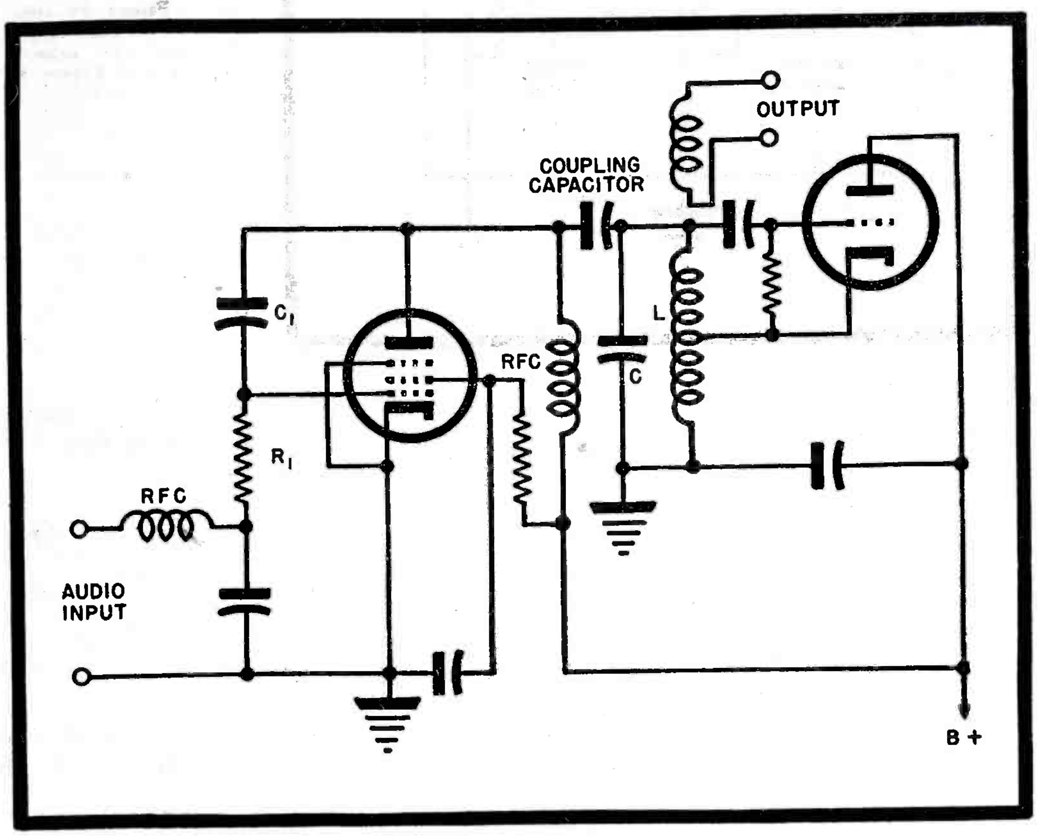
$$C^1 = C_1 R_1 g_m \qquad (12)$$

When an audio voltage is impressed across the terminals of the audio input, it will vary the grid voltage of the tube and thereby vary the g_m. When the g_m is varied, it in turn will vary the effective capacitance C^1.

Reactance Tube Modulators

In Figure 4 is shown how the two circuits are combined to form an f-m source. The reactance tube is coupled across the tank circuit by means of a coupling capacitor as shown. We note that the grid circuit of the modulator tube is also across the tank circuit. This means that the impedance of C_1 has to be large enough so that it will not load the tank circuit. Usually, of course, the impedance is so large that the current drawn by it may be neglected. The equation for the frequency

Figure 4
Reactance tube modulator circuit, showing how the reactance tube circuit is combined with the oscillator circuit to form an f-m source.



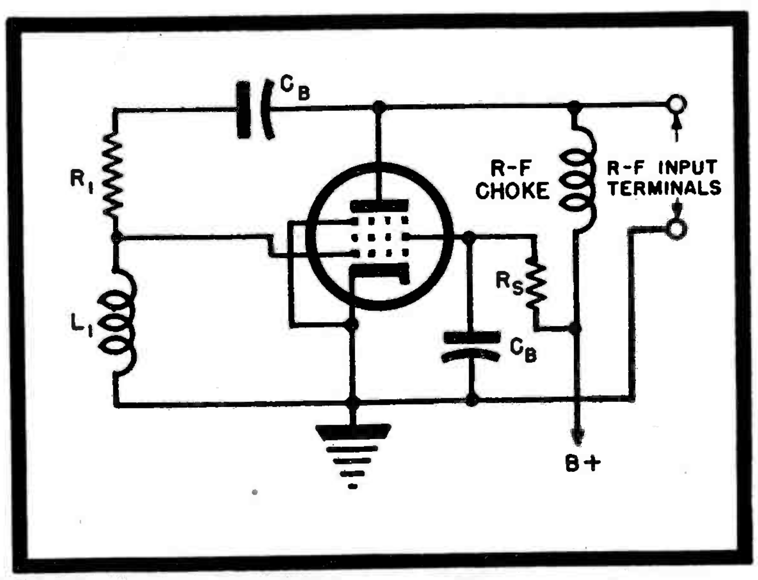


Figure 5
A reactance-tube feedback circuit consisting of a resistor, R_1, which is at least 5 times the value of the reactance of C_1. The impedance is inductive and is equal to the product of R_1 and C_1 divided by the g_m of the tube. ($L^1 = \frac{R_1 C_1}{g_m}$).

In This, the Third Installment of a Series of Papers on the Operation and Design of F-M Transmitters, Circuit Equations for the Reactance Tube Are Derived, Including Several Cases of Effective Capacitive and Inductive Inputs. The Equation for the Effect of These Circuits on a Tank Circuit of an Oscillator Is Derived Leading to the Frequency Deviation Obtained. In Addition, a Discussion of the Push-Pull Reactance Modulator Is Included.

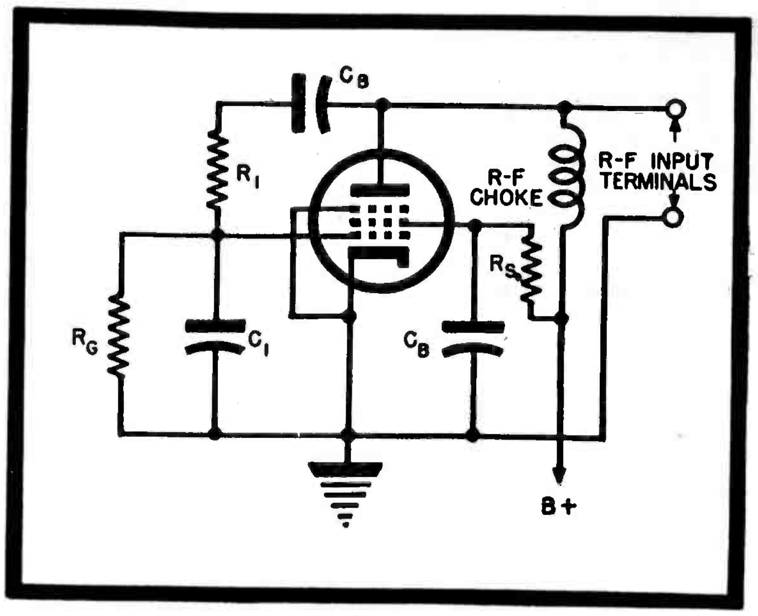


Figure 6
The reactance tube circuit obtained by substituting an inductance, L_1, for the capacitance C_1, of Figure 5, $(C^1 = \frac{g_m L_1}{R_1})$.

of this circuit is given by (*2*). Substituting for C^1 from (*12*)

$$f = \frac{1}{2\pi\sqrt{L(C + C_1 R_1 g_m)}} \qquad (13)$$

Here, f is the frequency which will be generated when the grid voltage of the reactance tube is constant so that the g_m is constant. In other words, it is the center frequency of the f-m signal. It will be noticed that it is dependent on the operating point of the reactance tube with zero audio input. It is this operating point which is varied in many systems to keep the transmitter accurately on center frequency.

Suppose we let an audio voltage be impressed so that the g_m increases by an amount Δg_m. The new frequency f^1 will be

$$f^1 = \frac{1}{2\pi\sqrt{LC + L C_1 R_1 g_m + L C_1 R_1 \Delta g_m}} \qquad (14)$$

This equation may be simplified by substituting for f, from (*13*), so that

$$f^1 = \frac{f}{\sqrt{1 + \frac{C_1 R_1 \Delta g_m}{C + C_1 R_1 g_m}}} \qquad (15)$$

To obtain Δf, the shift in frequency, we subtract f from (*15*), so that

$$\Delta f = f^1 - f = \frac{f}{\sqrt{1 + \frac{C_1 R_1 \Delta g_m}{C + C_1 R_1 g_m}}} - f \qquad (16)$$

Dividing both sides by f the ratio of Δf over f, the deviation ratio is obtained.

$$\frac{\Delta f}{f} = \frac{1}{\sqrt{1 + \frac{C_1 R_1 \Delta g_m}{C + C_1 R_1 g_m}}} - 1 \qquad (17)$$

Equation (*17*) may be simplified by assuming that the quantity $C_1 R_1 g_m$ is small compared to C and can be neglected.

$$\frac{\Delta f}{f} = \left(1 + \frac{C_1 R_1 \Delta g_m}{C}\right)^{-\frac{1}{2}} - 1 \qquad (18)$$

The expansion

$$(1 + x)^n = 1 + nx + \ldots . \qquad (19)$$

can be used for the first term. For an approximate result all terms after ***nx*** may be neglected.

The approximate result for the deviation becomes

$$\frac{\Delta f}{f} = -\frac{C_1 R_1 \Delta g_m}{2C} \qquad (20)$$

Other Types of Reactance Tube Circuits

The 90° phase shift of the grid voltage can be obtained by many *R*, *L*, and *C* circuits. In Figure 5 we have the feedback circuit of a reactance tube where the resistance and capacitance has been interchanged. R_G is a resistor of very high value, over ½ megohm, used to prevent static charges from building up on the grid. In this case the current is determined by the resistance *R*, which is very much larger, at least 5 times the reactance of the capacitor C_1 at the frequency that is employed. The impedance across the plate circuit is inductive where the value of inductance L^1 is given by

$$L^1 = \frac{R_1 C_1}{g_m} \qquad (21)$$

This circuit has the advantage that the stray capacitance and input capacitance across the grid circuit of the tube can be used as part or all of the capacitance C_1.

Another circuit, shown in Figure 6,

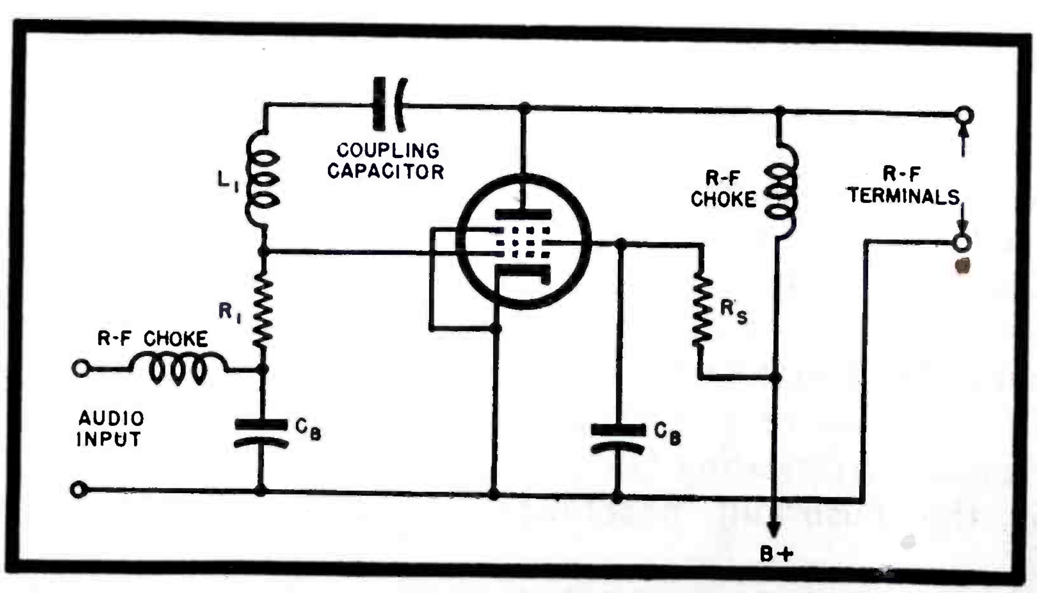


Figure 7
A reactance tube circuit employing a resistor and inductance to obtain the 90° phase shift for the grid voltage. $(L^1 = \frac{L_1}{g_m R_1})$.

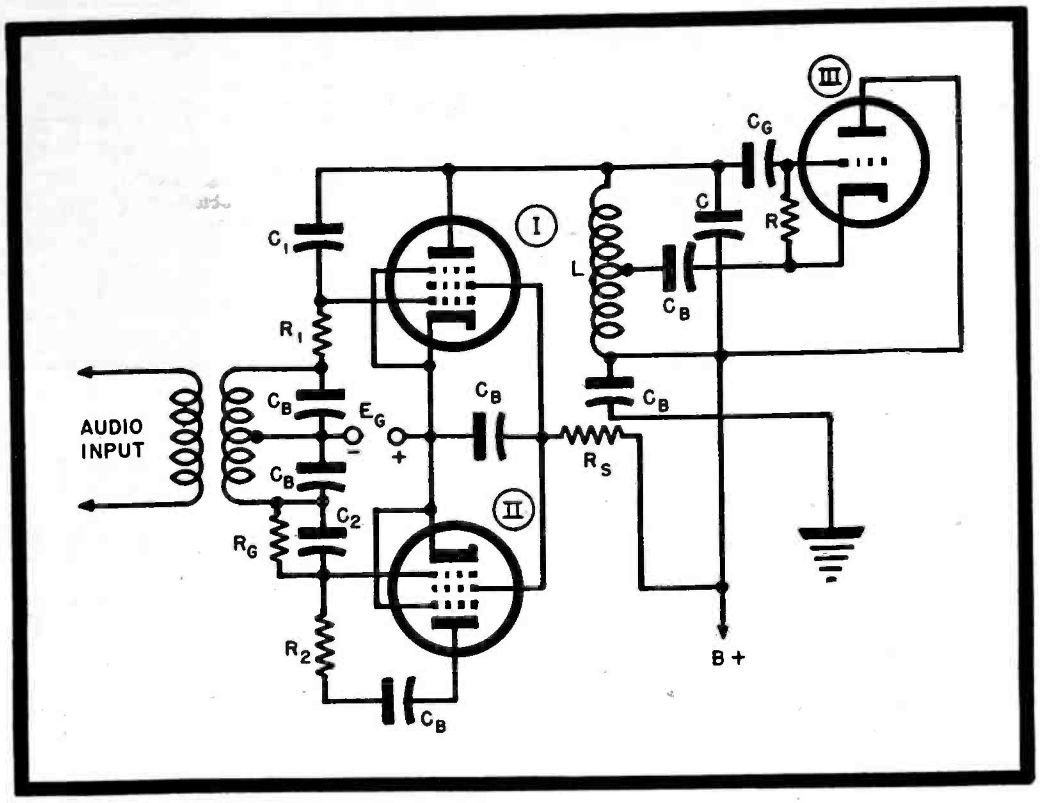


Figure 8
A balanced reactance tube modulator employing two reactance tubes in push pull, one an inductive impedance and the other a capacitive impedance.

can be obtained by substituting an inductance L_1 for the capacitance C_1 in Figure 5. Then the effective impedance across the r-f input terminals becomes capacitive where the value of the capacitance C^1 becomes

$$C^1 = \frac{g_m L_1}{R_1} \qquad (22)$$

Again the value of R_1 must be at least 5 times as great as the impedance of L_1 at the frequency being used. A coupling capacitor C_B is used to prevent the plate voltage from reaching the grid.

Similarly another variation, shown in Figure 7, can be obtained by substituting an inductance L_1 for the capacitance C_1 in Figure 2. In this case the impedance of L_1 at the frequency employed should be at least five times the value of R_1. The impedance across the r-f input terminals becomes inductive where the value of the inductance L^1 is given by

$$L^1 = \frac{L_1}{g_m R_1} \qquad (23)$$

There are numerous other combinations of inductances, capacitances and resistors that can also be used to obtain the 90° phase shift. In some cases even more than a 90° shift is employed to compensate for the current drawn by the plate resistance of the tube. It can be seen from Figure 3 that if the grid current vector i_g were shifted more than 90° from the plate voltage vector e_p, it is possible to make the angle between i_{p1} and i_{p2} great enough so that i_p will be at a 90° angle to e_p.

In any of the circuits employed, the frequency of the oscillator can be obtained by calculating the resonant frequency of the tank circuit with the reactance tube impedance in parallel, as indicated for the circuit of Figure 4. In this manner the variation in g_m may be calculated and the necessary audio voltages obtained from the characteristics of the tube. The frequencies employed are very often in the 5-mc region although they vary widely from that value. If the normal deviation of ± 75 kc at 100 mc is desired it means that a deviation of ± 3.75 kc would be necessary at 5 mc. This, of course, is easily obtainable.

Balanced Reactance Tube Circuit

In Figure 8 appears a circuit with two reactance tubes in push pull. Tube *I* employs a capacitive circuit while tube *II* employs an inductive circuit. Both plate circuits are paralleled across the tank circuit of an oscillator, tube *III*. Thus the resonant circuit consists of the capacitance C^1 of tube *I* in parallel with the inductance L^1 of Tube *II*, the combination of which is in parallel with the *L* and *C* of the tank circuit. Now as an audio voltage is impressed across the audio input, the grid voltage of tube *I*, at one instant, will go positive while the grid voltage of tube *II* will go negative. This means that the capacitive current will increase resulting in a higher effective C^1 across the tank circuit while the inductive current will decrease resulting in a higher effective L^1 across the tank circuit. Thus both the *L* and *C* will increase together causing the frequency to drop. We notice, however, that one tube is operating in the g_m region above the operating point and the other is operating in the g_m region below the operating point. As in the push-pull amplifier case this will decrease the distortion. Since it consists of two tubes in parallel, it allows the swing on each tube to be reduced and thereby also cuts down distortion.

References

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E. Williams, *Reactance Valve Frequency Modulator,* Wireless Engineer; August 1943.

C. F. Schaeffer, *Frequency Modulator,* IRE; Feb. 1940.

A. Hund, *Frequency Modulation,* McGraw Hill Book Company; 1942.

AT THE TWENTY-FIRST ANNIVERSARY VWOA DINNER — CRUISE

[Top Left]

Major-General Harry C. Ingles, Chief Signal Officer of the U. S. Army, thanking Brig. General David Sarnoff, president of RCA, for the Marconi Memorial Medal of Service presented during an NBC broadcast. Rear Admiral Joseph R. Redman (U.S.N.Ret.) at right, also received a Medal of Service.

Above: Captain Charles W. Horn, U.S.N.R., formerly with the office of the Director of Naval Communications, and John V. L. Hogan, pioneer radio inventor.

[Left]

Dr. Frederick B. Llewellyn, president of the IRE, receiving the Marconi Memorial Service Award Plaque for the IRE, for the outstanding work of radio engineers during World War II, from W. J. McGonigle, VWOA prexy.

[Below Left]

E. J. Girard, assistant vice president of FTR, with the VWOA Scroll of Appreciation awarded for his Liberty and Victory ship radio marine installation work. Looking on is R. H. Frey, radio supervisor of the Bull Steamship Lines.

[Below]

E. H. Rietzke, president of the Capitol Radio Engineering Institute and Sgt. Irving Strobing, Signal Corps, U.S.A. Sgt. Strobing, the Army radio operator who sent the last message from Corregidor, received the Marconi Memorial Medal of Service. Sgt. Strobing also received a VWOA Capitol Radio Engineering Institute scholarship recently.

Above: Forrest Vosler, World War II hero, recipient of the Congressional Medal of Honor, who was awarded the Marconi Memorial Medal of Valor. Below: Jack Poppele, vice president and chief engineer of WOR and TBA president, with George P. Adair, FCC chief engineer.

GRAPHICAL SOLUTION of Series Circuits

by PAUL K. HUDSON

Associate Professor of Electrical Engineering
University of Idaho

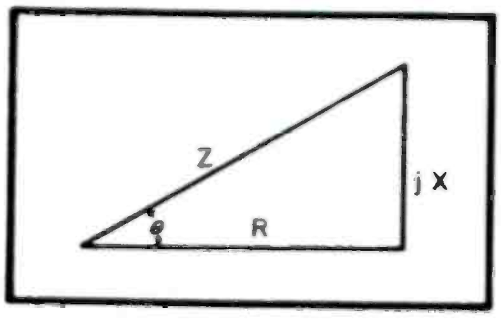

Figure 1
Vector diagram of a circuit where impedance Z at angle θ is equal to the sum of a resistance and a reactance at right angles.

If a series circuit contains both a resistance and a reactance, the absolute value of the impedance is found by adding the resistance in ohms to the reactance in ohms, at 90°.

$$|Z| = \sqrt{R^2 + X^2} \qquad (1)$$

The angle that the impedance makes with the resistance (the phase angle between the voltage across the circuit and the current in the circuit), is obtained by finding the angle whose tangent is equal to the reactance in ohms divided by the resistance in ohms.

$$\theta = \tan^{-1} \frac{X}{R} \qquad (2)$$

If j is a symbol that means *right angle*, then equations (*1*) and (*2*) can be written as one equation:

$$Z \underline{|\pm \theta} = R \pm jX \qquad (3)$$

Equation (*3*) can be interpreted as: An impedance Z at an angle θ is equal to the sum of a resistance and a reactance at right angles. Equation (*3*) does not introduce a new method of solution. It is just a simplified way of writing equations (*1*) and (*2*). The vector diagram of the circuit is shown in Figure 1.

Although equations (*1*) and (*2*) are simple algebraic expressions, they are nevertheless very cumbersome to use (even if a slide rule is available) because there are so many different operations involved in getting an answer. Particular care must be exercised in locating the decimal point when R and X are squared. Otherwise they cannot be added together correctly. To simplify this problem, a chart (Figure 2) has been prepared.

Description of the Chart

It will be noticed that the left hand member of equation (*3*) is the general form or representation of a point in polar coordinates, and the right hand member is the general form or representation of a point in rectangular coordinates. The series circuit problem is, therefore, a problem of converting points in one set of coordinates to corresponding points in the other set of coordinates.

Use of Polar Coordinates

The chart was made by superimposing polar coordinates upon rectangular coordinates. Only one quadrant is shown, but the chart can be used in any quadrant simply by rotating it to the desired quadrant.

Theory of Chart

When a point has been located in the rectangular coordinate system it has been *automatically* located in the polar coordinate system and vice versa.

Numbering System Used

The coordinates of the chart have been numbered from *0* to *10* and from *0* to *20*. Any number system can be used and the decimal point can be placed wherever desired. However, the numbers must be consistent, i.e., they must be the same in the horizontal and vertical directions.

Typical Problem

Let us suppose a resistance of 3 ohms is connected in series with inductive reactance of 4 ohms, and we want to find the impedance of the combination and the angle of the impedance.

Solution

To solve, we first locate + *3* in the horizontal direction and then move up to + *4* in the vertical direction and locate the point. We will note that the point falls exactly upon one of the large arcs (one-fourth circles on this chart). We then follow the arc around to either axis and read + *5* for the value of the impedance. We then notice that the point also ties very close to a radial line. This radial line is followed out to the edge of the chart and we find that *53°* + is the angle of the impedance.

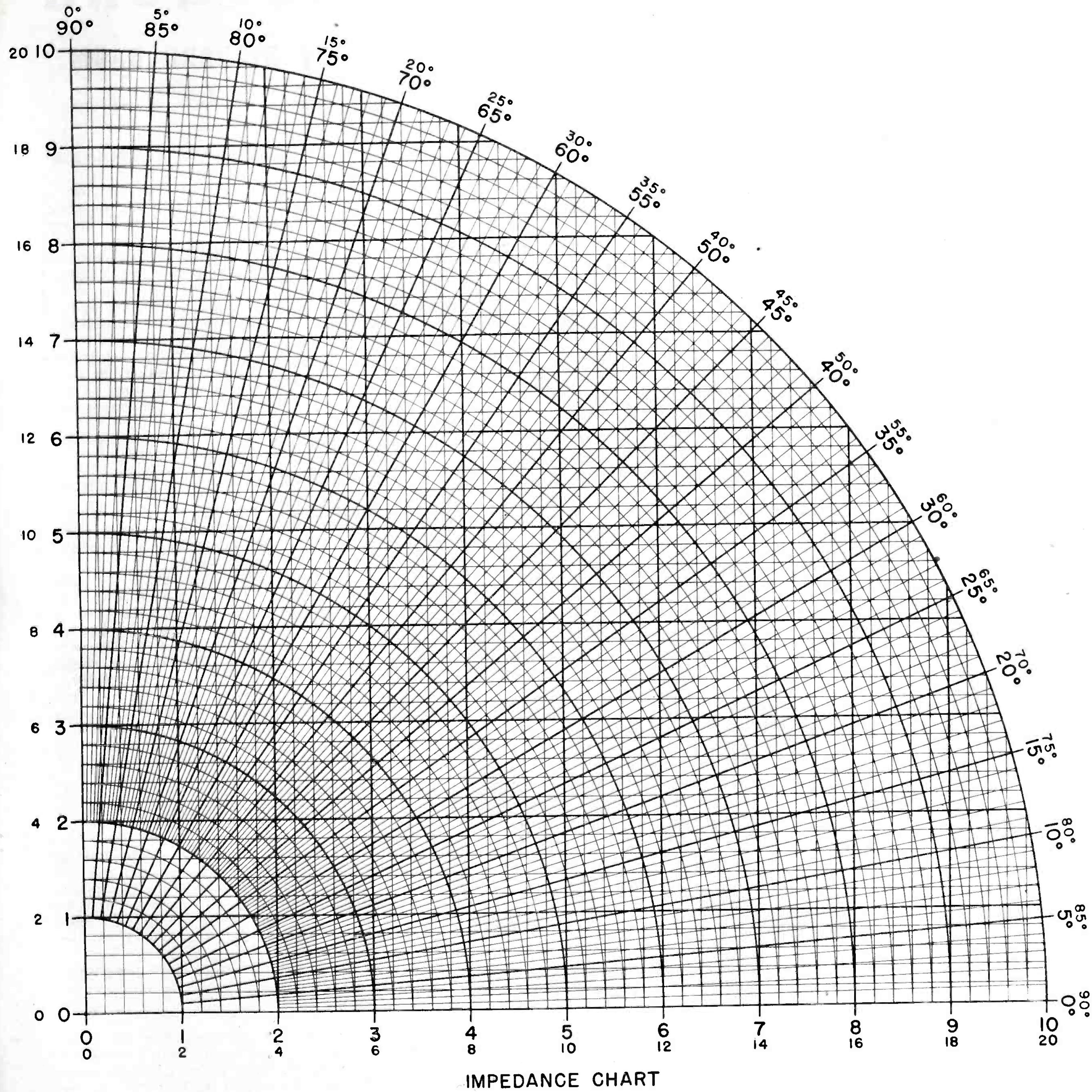

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Figure 2

Chart on impedance. The coordinates of the chart have been numbered *zero* to *ten* and from *zero* to *twenty*. However, any number system can be used and the decimal point can be placed wherever desired. If the latter system is used, the numbers must be consistent. That is, they must be the same in the horizontal and vertical directions.

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Solving 4-TERMINAL NETWORK

by RICHARD BAUM

Research Engineer
Raytheon Manufacturing Company

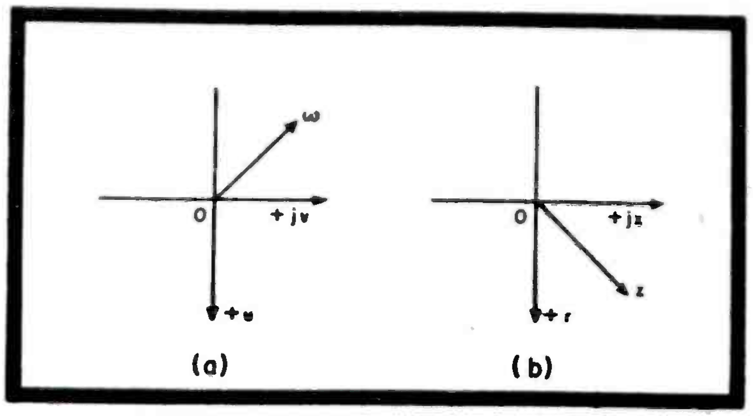

Figure 1
Two vectors ($z = r + jx$; $w = u + jv$) and two coordinate planes. The z-plane (*b*) and the w-plane (*a*) are complex planes. To each vector, z in the z-plane corresponds to vector w in the w-plane.

MEASUREMENT procedures required for the u-h-f and s-h-f regions have accented the importance of impedance and power concepts. As a result there has been a trend toward the analysis of a given system in terms of *four-terminal networks.*

At lower frequencies analysis of a network involves the well defined elements of resistance, capacitance and inductance. By application of Ohm's and Kirchhoff's laws the distribution of voltage and current can be predicted and verified.

With increasing frequencies the meaning of these concepts becomes increasingly vague. This is particularly true in the definition and measurement of current and voltage. There is but *one* exception. This is the concentric line (or straight waveguide), where voltage and current (the field components) and therefore the impedance and transmitted power, is still well defined. The two latter, furthermore, can be measured up to the very high frequencies.

This suggests the analysis of the whole system in terms of impedance and power rather than of voltage and current and splitting up of the system into parts interconnected by concentric lines (or waveguides), and to consider these parts as new elements of analysis by themselves. These parts are usually referred to as *four-terminal networks.* The whole system then consists of a series or parallel connection of *four-terminal networks.*

Nothing need be known about the internal structure of a four-terminal network, except that it does not contain any generators, rectifiers or other non-linear elements. It may, for instance, consist of a cavity with two coupling loops. Thus, if we connect any load impedance to the output loop we can measure, by connecting a line to the input loop, its input impedance with regard to the output load. All the four-terminal network does, we may say, is to transform the output impedance into the input impedance. This transformation is completed according to a definite law, the so-called linear rational transformation, which is of primary importance in u-h-f and s-h-f technique.[1]

If the transformation of three different load impedances is known the four-terminal network is specified and the transformation of any other load can be predicted.

Linear Rational Transformation

Suppose we consider two vectors $z = r + jx$ and $w = u + jv$ and two coordinate planes (Figure 1). The vector z shall be represented in the z plane, the vector w in the *w plane*. In both planes we assume the real axis in the vertical direction and positive in the downward direction from the origin O[2]. The vector z shall, in our case, represent an impedance. Its components r and x therefore, represent its ohmic and reactive series components.

Now let us assume that between z and w exists the following mathematical relation:

$$w = \frac{az + b}{cz + d} \qquad (1)$$

where *a, b, c* and *d* are given constants. For any given value of z there will be a corresponding value of w. Suppose we allow $z = r_o + jx_o$. By introducing r_o and jx_o in the right side of (*1*), and separating into real and imaginary components, we obtain the components of the corresponding vector $w = u_o + jv_o$.

Equation (*1*) gives the general form of the linear rational transformation, or circle transformation. The latter designation indicates that:

(*1*) If the end point of z describes a circle in the z plane, the corresponding vector w will describe a circle in the w plane.

Now, if z describes any other curve in the z plane, vector w will map a corresponding curve in the w plane. Two curves in the z plane correspond to two curves in the w plane. In this case it can be proven that:

(*2*) The angle between two curves (its absolute value and its direction) at their point of intersection is the same as the angle between the two corresponding curves.

Now if in (*1*) we set $z = \infty$ we find $w_\infty = a/c$ and inversely setting $w = \infty$ we find $z_\infty = -d/c$ which reveals another important fact:

(*3*) All infinite points of the z plane are *mapped* into one definite point of the w plane, and vice versa.

A straight line can always be considered as a circle of infinite diameter. The corresponding curve, therefore, is also a circle. We can assume that all straight lines (whatever their direction may be) meet in infinity in a single point $z = \infty$ (or $w = \infty$). Therefore:

(*4*) All straight lines in the z-plane can be considered being circles through the infinite point, $z = \infty$; their corresponding curves in the w plane are circles through the point $w_\infty = a/c$.

The analogue applies to the straight lines in the w plane, which are mapped into circles through $z_\infty = -d/c$.

The conception of a single infinite point is simplified if we imagine the coordinate planes extended over the earth's surface, so that they form globes of very great diameter. Then all straight lines would meet in one single point on the opposite side of the globe.

Circle transformations have many other interesting features, but for our purpose we shall make use only of the foregoing four rules.

Any point on the surface of one globe is related in an unique way to another point of the other globe, which we may consider as a map of the first one. (Circle transformations are often referred to as conformal mapping). Any point is as well defined on one globe as on the other and it really makes no difference if we follow up changes of the z vector or of its corresponding w vector. But it will prove helpful to *consider both vectors at the same time,* always asking what does one vector do if we vary the other in some definite way and vice versa.

Let us now consider two important special cases of circle transformations . . . *the Smith chart* and the *Inversion* chart.

The Smith Chart

If in (*1*) we say that $a = c = d = 1$

[1]An interesting theoretical discussion on this subject was presented by A. Weissfloch in Hochfrequenztechn. u. Elektroak; April 1943.
[2]This position has been adopted to facilitate presentation in relation to the *Smith chart.*

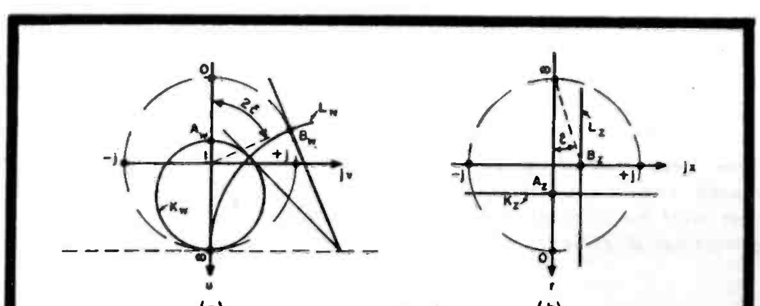

Figure 2
The Smith chart. The rectangular coordinate system in the z-plane is transformed into two families of circles in the w-plane. L_z and K_z correspond to L_w and K_w respectively. [(a) = w-plane; (b) = z plane.]

PROBLEMS Graphically

Application of a Few Simple Relations Pertinent to Linear Rational Transformations Affords a Graphical Solution of Impedance Problems. Networks Considered Are Four-Terminal Containing Either Lumped or Distributed Constants (as in Transmission Lines), with the Exclusion of Those Involving Non-Linear Devices. Use of the Smith and Inversion Charts Is Indicated and Explained in Detail. Results Are Particularly Useful in Solving Microwave Problems.

and $b = -1$ we obtain

$$w = \frac{z - 1}{z + 1} \qquad (2)$$

from which

$$z = \frac{1 + w}{1 - w} \qquad (3)$$

This transformation is represented by the Smith chart,[3] which is widely used in practice. We shall derive it as an example for the application of the four rules.

In Fig. 2 we have again drawn the z plane and w plane. From (2), we see that any real value of z, for instance $z = r_o$ will furnish a real value of $w = \frac{r_o - 1}{r_o + 1}$. In other words the real axis of the z plane is being transformed into the real axis of the w plane. In particular, for $r_o = o$ and $r_o = \infty$ we find $w_o = -1$ and $w_\infty = +1$ respectively. On the other hand, according to (3), $w = o$; $w = \infty$ is mapped into $z_o = 1$ and $z_\infty = -1$ respectively. The points in question are indicated in such a way that for points in the z plane the corresponding values of w are added and vice versa. This avoids possible confusion. The scale, in each plane, is indicated by a dashed circle of unit diameter.

Now let us try to find the curves in the w plane which correspond to the straight lines $r = r_o =$ constant, in the z plane. Obviously they go through the infinite point $z = \infty$ and they include a 90° angle with the real (r) axis. Applying rules **2**, **3**, and **4**, we find that the corresponding curves have to be circles going through one definite point $w_\infty = 1$ (from foregoing analysis) and include a 90° angle with the real (u) axis of the w plane. Evidently, then, they have the position of the circle K_w in Figure 2, which corresponds to the straight line K_z. K_w can be defined if we find just one more point on its circumference, like the point of intersection with the real axis, A_z. In this point $z = r_o$ and the corresponding point A_w lies at $w = \frac{r_o - 1}{r_o + 1}$ (equation (2)). In particular for $r_o = o$, the imaginary axis, we find the unit circle in the w plane as a corresponding curve.

As the next step, we have to plot the circles L_w, corresponding to the straight lines L_z, defined by $x = x_o =$ constant. As L normal to all other lines K, the corresponding circle L_w will include right angles with all previously obtained circles K_w. Its center, therefore, lies on a parallel to the imaginary axis of the w plane through $w = 1$. Again, only one additional point need be found for the definite location; the point of intersection with the imaginary axis, points B_z and B_w. Here $z = jx_o$ and $w = \frac{jx_o - 1}{jx_o + 1} = \exp[2\tan^{-1}(-x_o)] = -\exp 2\epsilon$.

By mapping in the w plane the whole family of lines, $r = r_o =$ constant and $x = x_o =$ constant, we obtain the Smith chart. It is now quite simple to find, to any given points in one plane, the corresponding point in the w plane by using this transformed set of coordinates. That is, we can locate the points corresponding to $z = 1$, $\pm j$ and o with $w = o$, $\pm j$ and -1.

Thus we find that the lower half of the z plane (where r, the resistance, is positive), is mapped inside the unit circle in the w plane. In particular, the positive reactance part of it is mapped into the positive side of the w plane. The points $\pm j$ do not change their position.

The importance of the transformation, equation (2), originates in its application to the theory of transmission lines. The input impedance z of a transmission line is

$$z = \frac{Z_{in}}{Z_o} = \tanh(\gamma l + \delta_o) \qquad (4)$$

where: Z_o = characteristic impedance of the line
$\gamma = \alpha + j\beta$ = propagation constant
α = damping constant
β = wavelength constant
δ_o = complex constant, given with Z_l = load impedance by $\frac{Z_l}{Z_o} = \tanh \delta_o$
l = line length in degrees, counted from load end towards generator

$$z = \frac{\varepsilon^{(\gamma l + \delta_o)} - \varepsilon^{-(\gamma l + \delta_o)}}{\varepsilon^{(\gamma l + \delta_o)} + \varepsilon^{-(\gamma l + \delta_o)}}$$

from which

$$-\varepsilon^{-2(\gamma l + \delta_o)} = \frac{z - 1}{z + 1} \qquad (5)$$

In the case of no attenuation $\gamma = j\beta$

$$(-\varepsilon^{-2\delta_o})\,\varepsilon^{-2j\beta l} = \frac{z - 1}{z + 1} \qquad (6)$$

On the right side, we find an expression defining the transformation of z we just have considered. Setting the constant factor

$$(-\varepsilon^{-2\delta_o}) = a,$$

we can say that

$$a\,\varepsilon^{-2j\beta l} = \frac{z - 1}{z + 1} = w \qquad (7)$$

The left side shows that the constant vector a, given by the load, rotates with increasing line length l by an angle proportional to twice the line length l, in clockwise direction. That is, w describes a circle in the w plane as we move along a transmission line.

Let us now study the circles of the w plane and the radii and see how they look like in the z plane, Figure 3. We must map the circles $|w| =$ constant and the straight lines $\underline{|w} =$ constant in the z plane.

One such circle is shown and designated C_w. It cuts the real axis in two points equidistant from the original point, $w_{1,2} = \pm \rho_w$ (ρ_w being the circle diameter.) The two corresponding points are, with (3):

$$z_1 = \frac{1 + \rho_w}{1 - \rho_w} \qquad z_2 = \frac{1 - \rho_w}{1 + \rho_w} = \frac{1}{z_1}$$

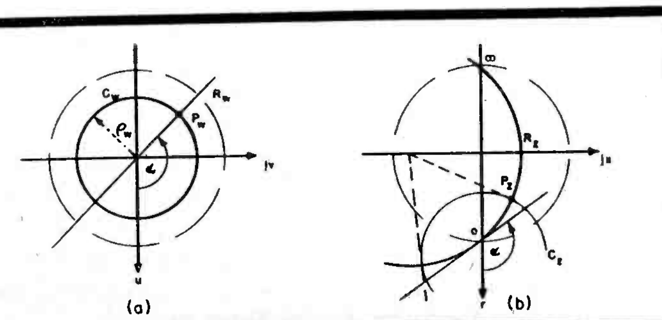

Figure 3

Transmission line analysis. The w-vector moves along circles, C_w. To the families of C_w circles C_w and radii R_w in the w-plane correspond two families of circles, C_z and R_z, in the z-plane, respectively. [(a) = w-plane; (b) = z plane.]

[3] P. H. Smith, *Transmission Line Calculator*, Electronics; Jan. 1939.

Both points are located on the real z axis in such a way that $z_2 < 1$, $z_1 > 1$ and $z_1 z_2 = 1$. The circle C_z corresponding to C_w can now be drawn, as its center has to lie on the real (r) axis. (Both C_z and C_w cut the real axis in two points under a 90° angle).

All radii R_w go through two points of the w plane; namely $w = o$ and $w = \infty$ which are mapped into $z = +1$ and $z = -1$, respectively. R_z, therefore, is a circle through these two points; its center must lie on the imaginary (x) axis. If R_w includes an angle of α_w degrees with the positive (u) axis, then the circle R_z includes the same angle α_z with the positive (x) axis. This determines the circle. R_z and C_z as well as R_w and C_w, of course, include right angles with each other.

If we observe the point P_w travelling at a constant speed along C_w, the corresponding point P_z likewise travels on a circle (C_z), but not with uniform speed. The connection is such that as the angle α_w increases, the angle α_z between circle R_z and r axis stays always equal α_w, and the circle R_z goes always through the points ± 1, intersecting C_z in P_z.

An almost identical problem is to find the circles in the w plane which correspond to the curves $|z| =$ constant (constant absolute impedance) and $\underline{|z}$ = constant (constant phase angle). The solution is given in Figure 4, with all necessary construction data. It is advantageous to draw this w- plane diagram on transparent paper in a scale of the available Smith chart. Points of equal phase or equal amplitude can then be easily located.

The circles corresponding to $\underline{|z} =$ constant $= \alpha$ go through the points $w = \pm 1$ and include the angle α with the u axis.

The circles corresponding to $|z| =$ constant $= \rho_z$ have their center on the u axis and a radius of

$$|\rho_w| = .5\left(\frac{1}{\rho_2} - \rho_2\right)$$ [4]

Let us now assume that (Figure 5) the impedance of a network at a certain point varies, at constant frequency, in such a way as to describe in the z plane a circle C_z (or a straight line), and therefore, in the w plane, a circle C_w.

If we add a constant resistance, R, in series, the circle in the impedance (z) plane just moves a corresponding distance in the direction of the positive r axis. If we add in series a constant reactance the circle moves in the direction of the positive x axis (if we added inductance) or in the direction of negative x axis (if we added capacitance). A similar case is that of the lossless transformer (represented for instance by a sudden change in the characteristic impedance of a line). Such a transformer just multiplies the impedance by a real factor f and therefore just contracts or expands the circle C_z into a new circle C^1_z, as shown in Figure 5, without changing its circular shape. In the first mentioned cases corresponding points before and after added series components move along lines $x =$ constant or $r =$ constant. In the present case they move along lines of constant phase $\underline{|z}$. The addition of a transmission line in series provokes a rotation of the C_w circle, in the w plane, around the origin

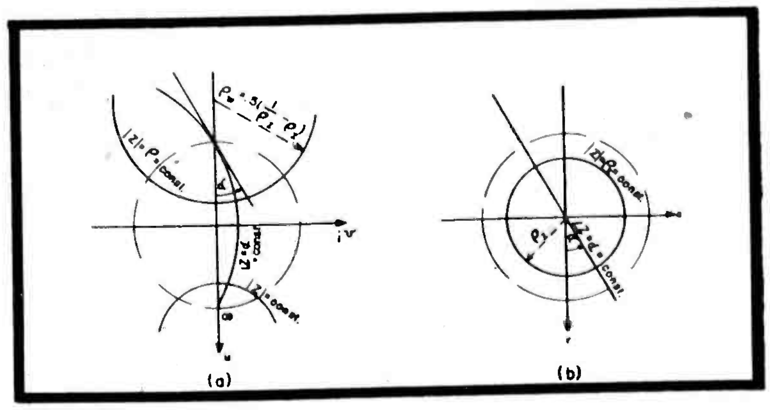

Figure 4
The Carter chart. The circles of constant impedance $|z|$ and the lines of constant phase angle $\underline{|z}$ are mapped into two families of circles in the w-plane. [(a) = w-plane; (b); = z plane.]

in the sense of the arrow (twice as many degrees as the line is long).

This shows clearly that we are able to follow up the impedance through any network consisting of series arrangements of any kind of impedances and transmission lines. However, we still have the parallel arrangement to consider.

The Inversion Chart

As an example of inversion, we may use a quarterwave transmission line. The input impedance Z_{in} and the load im-

ordinate system of the z plane into the w plane is shown.

The origin of the z and w plane corresponds to $w = \infty$ and $z = \infty$ respectively. The real axis r maps again into the real axis u and the imaginary axis $\pm x$ into the imaginary axis $\pm v$. The parallel lines R_z to the x axis are transformed into circles R_w through $w = o$, normal to the u axis. The parallels X_z to the r axis are transformed into circles X_w through $w = o$, but normal to the v axis. An additional point is necessary to define any of these circles; the point corresponding to the point of intersection of

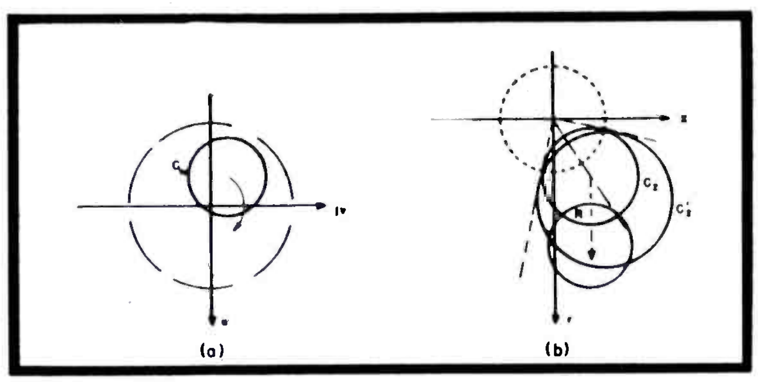

Figure 5
Series connection of resistance (or reactance) which displaces the impedance circle C_z parallel (or normal) to the r axis. A *lossless transformer* expands or contracts the impedance circle. Series connection of a transmission line rotates (in the w-plane) the corresponding circle C_w. [(a) = w-plane; (b) = z plane.]

pedance Z_l are related by

$$Z_l = \frac{Z^2_o}{Z_{in}} \qquad (8)$$

where Z_o = characteristic impedance of the line. With

$$z = \frac{Z_l}{Z_o} \quad \text{and} \quad w = \frac{Z_{in}}{Z_o},$$

$$w = \frac{1}{z} \qquad (9)$$

This relation is called inversion; it is again a special case of (1) with $b = d = o$ and $a = c = l$. Therefore, all rules derived for circle transformations apply to this case also.

In Figure 6 the mapping of the co-

R_z or X_z with the coordinate axis, using equation (9) is the best choice.

To calculate the impedance obtained by connecting two impedances Z_1 and Z_2 in parallel, we have to inverse their values, add and inverse again,

$$\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2}$$

Inversion/Smith Diagrams

Using an inversion diagram and a Smith diagram, we are therefore able to follow up networks containing parallel or series arrangements of lumped constants (L, C, R) or lines, if we leave the frequency constant and change only the output (load) impedance.

[4]See Carter diagram, Figure 14; Part II.

[*To Be Continued*]

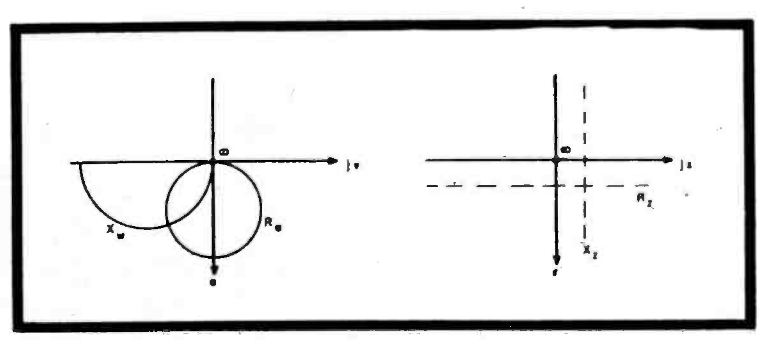

Figure 6
The Inversion chart. The rectangular coordinate system of the z-plane is mapped into two families of circles through the origin of the w-plane. Parallel connections of impedances can be reduced to conversions.

NEWS BRIEFS

JOHN F. RIDER RECEIVES LEGION OF MERIT

John F. Rider, Lt. Col. Signal Corps (retired) received the Legion of Merit medal recently for his . . . "exceptional administrative service to the Signal Corps Publication Agency."

* * *

DUMONT AND RCA OFFER TELESET CHANNEL REALIGNMENT SERVICE

The Television division of Allen B. DuMont Laboratories, Inc., and the RCA Service Company, Inc., have arranged to convert DuMont and RCA sets, respectively, for the new channels.

DuMont telesets will be changed over to receive all three New York television stations—WABD, WNBT and WCBW. This work, as well as pickup and delivery of the set, will be accomplished for a flat fee, around $30.

RCA Service shops in the New York, Philadelphia, Chicago, and Los Angeles area will, on request from a set-owner, either direct or through the RCA dealer in the area, bring in the chassis, incorporate revised circuits, and then re-install and test it in the owner's home. The service will be available at a charge of $30.

* * *

RAY BAUMGART JOINS MOTOROLA

Ray Baumgart, formerly chief engineer in charge of maintenance and construction with the Indiana State Police, has joined the staff of Motorola. He will work with sales engineer Homer Marrs.

* * *

F-M LICENSE FEES REDUCED

License fees for f-m receivers and transmitters have been reduced, according to Major Edwin H. Armstrong.

Transmitter fees are now cut in half.

Licenses issued to broadcast stations will continue to be based on the operating power of the station. Charges are from $150 for a transmitter with an operating power of 250 watts to $2,500 for a transmitter with an operating power of 50 kilowatts.

In the broadcast receiving set field, royalties have been reduced by approximately 20% from the prewar rates, resulting in an effective current royalty rate of approximately 1% of the manufacturer's gross selling price or ½ of 1% of the price paid by the ultimate purchaser of the receiver.

* * *

SYLVANIA PROMOTES ALMY, RAINIER, GILPIN, ERSKINE, GUNN & JONES

R. P. Almy has been appointed assistant general sales manager of the radio division of Sylvania Electric Products, Inc. Harold H. Rainier succeeds him as manager of distributor sales, radio division.

Harold P. Gilpin has become assistant general sales manager of the radio division in New York City.

Bernard J. Erskin is now manager of parts sales, with headquarters in Emporium, Pennsylvania.

D. W. Gunn will now make his headquarters at Cleveland, Ohio, for the radio tube division of Sylvania. Working in the East Central division, he will cover the states of Michigan, Ohio and Indiana.

Walter R. Jones has been appointed chief

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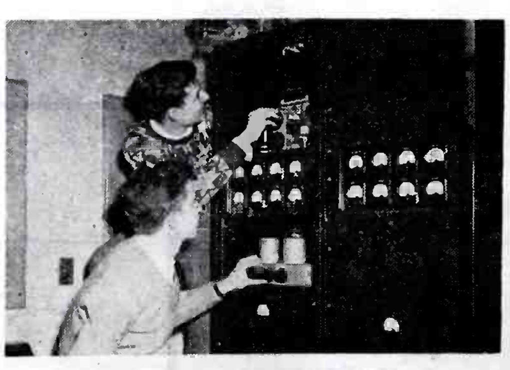
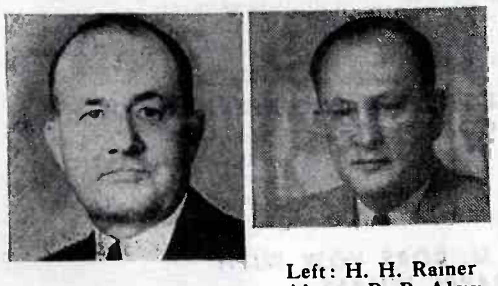
B'KLYN POLY 500-WATTER



W2BXK, 500-watt amateur station at the Polytechnic Institute of Brooklyn built by senior electrical engineering students.

engineer of the radio tube division. He was formerly general engineering manager.



Left: H. H. Rainer
Above: R. P. Almy

* * *

MILLS AND WATTS IN NEW RCA POSTS

Allan B. Mills has been named merchandise manager of the home instrument department of RCA Victor.

W. W. Watts has become general sales manager of the engineering products department of the RCA Victor division.

Mr. Watts comes to RCA after serving as a Colonel in the Signal Corps for three and one-half years.

* * *

FRANK FOLSOM AWARDED MEDAL FOR MERIT

Frank M. Folsom, executive vice president in charge of the RCA Victor Division, Camden, N. J., recently received the Medal for Merit from the Navy for "exceptionally meritorious conduct in the performance of outstanding services as Chief of the Procurement Branch of the Navy Department's Office of Procurement and Material."

* * *

BORTNICK BECOMES RAYMOND ROSEN AD MAN

Harry Bortnick has been appointed general advertising and sales promotion manager for Raymond Rosen and Company.

* * *

JAMISON JOINS PHILIPS

Dr. Noel C. Jamison, research physicist, has joined Philips Laboratories as division chief in charge of electro-acoustics.

Dr. Jamison was assistant professor of physics at Northwestern University until 1941 and during the war was at Harvard University.

* * *

KELLOGG SWITCHBOARD TO SELL PHILCO F-M MOBILE UNITS

The Kellogg Switchboard and Supply Company has arranged to furnish and install f-m mobile radiotelephone equipment, for the independent telephone field, manufactured expressly for Kellogg by Philco.

* * *

LEGION OF MERIT AWARDED TO A. B. CHAMBERLAIN

A. B. Chamberlain, chief engineer of CBS, was recently awarded the Legion of Merit by the Navy for . . . "exceptionally meritorious conduct in the performance of outstanding services . . . as Assistant Head of the Design Branch, Electronics Division, Bureau of Ships, from April to October 1945."

* * *

RICE NOW LEAR ASSISTANT CHIEF ENGINEER

Harry E. Rice has been appointed assistant chief enginer of the radio division of Lear, Inc.

George D. Rice, who had been acting assistant chief engineer recently, retains his position as service manager, home radio division.

* * *

WCEMA NAMES OFFICERS

Lew Howard was recently elected chairman of the Los Angeles council of the West Coast Electronic Manufacturers Association. D. A. Marcus was named vice chairman, and James L. Fouch was reelected treasurer.

* * *

RCA REVIEW RESUMES PUBLICATION

Publication of the "RCA Review" was resumed in March. Issues will appear on a quarterly basis.

Publication was suspended in 1942 when distribution of technical information was restricted by wartime security regulations.

George M. K. Baker is manager of the publication. Editorial offices are at Princeton N. J.

* * *

HALLICRAFTERS BUYS ELECTRONIC WINDING

The Electronic Winding Company, 5031 Broadway, Chicago, Ill., has been purchased by the Hallicrafters Company.

All facilities and personnel will be moved

(*Continued on page* 56)

NEWS BRIEFS

(*Continued from page* 55)

from the present location at 1323 South Michigan Avenue to the Broadway plant.

Irving Glerum will head the newly enlarged division as superintendent, with J. S. Patterson and Frank Mitchell as engineers.

* * *

ELECTRONIC ENGINEERING CO. INCORPORATES

The Electronic Engineering Company, Chicago, voted to incorporate recently, and will be known as Electronic Engineering Company, Inc. Edward J. Rehfeldt is president.

* * *

R. M. DORE NOW WITH SHAPPE WILKES

Robert M. Dore, for the past four years an agent of the Federal Bureau of Investigation, has joined Shappe-Wilkes, Inc., New York, as head of research and merchandising.

* * *

FINCH APPOINTS MAJ. BRICK ASSISTANT TO PRESIDENT

Major Frank R. Brick, Jr., has been named assistant to the president of Finch Telecommunications, Inc., Passaic, N. J.

* * *

DU MONT C-R TUBE AND OSCILLOGRAPH BULLETIN

Two catalogs, one describing eight cathode-ray tubes, the other covering six oscillographs, are now available from Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

* * *

COLONEL SOSTHENES BEHN RECEIVES MEDAL FOR MERIT

The Medal for Merit was recently awarded to Colonel Sosthenes Behn, president of International Telephone and Telegraph Corporation. Presentation was made by Major General Harry C. Ingles, Chief Signal Officer of the Army.

* * *

C-D RECEIVES NAVY AWARD

The United States Navy recently awarded the Certificate of Achievement to the Cornell-Dubilier Electric Corporation in recognition of the supplying of capacitors for the radio proximity fuzes.

* * *

WARD LEONARD OPENS NEWARK SALES OFFICE

Ward Leonard Electric Co., Mount Vernon, N. Y., has opened an office in the Industrial Office Building, Newark 2, New Jersey. R. W. Vonasch, formerly attached to the home office sales engineering department, is district manager.

* * *

SPARKS, LEEDOM AND ALGER JOIN SPRAGUE

George R. Sparks and John N. Leedom have been appointed field engineers of the Sprague Products Company, North Adams, Mass. Both men will work under the direction of research engineer Leon Podolsky.

P. B. Alger, former Lieutenant Commander in charge of naval inspection at the Stromberg-Carlson plant in Buffalo, has joined the Sprague Electric Company, North Adams, Mass., as an application engineer.

Ernest L. Ward, formerly a partner of the Boston investment banking firm of F. S. Moseley and Company, has joined the executive staff of Sprague Electric.

G. R. Sparks J. N. Leedom

* * *

ECA NAMES MOUNTJOY V-P

Garrard Mountjoy has been elected vice president in charge of engineering of the Electronic Corporation of America, 45 W. 18 Street, N. Y.

Mr. Mountjoy was formerly director of radio research and development and director of the New York laboratories of Lear, Inc.

* * *

JENSEN NAMES 5-MAN PLANNING COMMITTEE

Postwar planning and sales for Jensen Radio Manufacturing Company, Chicago, have been placed in the hands of a five-man committee. Serving on the committee are: Ralph T. Sullivan, eastern district sales manager; Charles A. Hansen, Western district sales manager; Sherman K. Hughes, sales office manager; Harold S. Hoffman, city salesman; and Bayard H. Clark, advertising and sales promotion manager (left to right in the photo).

* * *

ALLIED CATALOG

A postwar catalog covering parts, test units, batteries, radios and phonographs, public address and intercommunication equipment, recorders and accessories, communications receivers, kits, record changers, phonograph motors, tools, books, diagrams, etc., has been released by Allied Radio Corp., 833 West Jackson Blvd., Chicago 7, Illinois.

* * *

POVLSEN JOINS MAGUIRE

Paul K. Povlsen has been named vice president and general manager of Maguire Industries, Inc.

Mr. Povlsen will supervise all manufacturing operations of the company.

Mr. Povlsen was formerly vice president in charge of production for the J. I. Case Co. of Racine, Wis.

Walter B. Scott, industrial engineer, also formerly with the J. I. Case Co., has joined Maguire Industries, Inc., as an assistant to Mr. Povlsen.

* * *

GRIGSBY-ALLISON OPEN COMPONENT PLANT

The Grigsby-Allison Company, Inc., have opened a new plant at 407 North Salem Avenue, Arlington Heights, Illinois. Initial production will be on rotary switches, to be followed by push button switches, tuners and other electrical and mechanical devices.

R. J. Grigsby is president of the new company, and K. C. Allison is vice president. Mr.

(*Continued on page 60*)

Airport Tower AUDIO BOOSTER

SOME types of airborne radio equipment can be effectively adapted to control-tower use with but a few changes. In an installation at an aircraft manufacturer's airport, a v-h-f airborne system was recently modified to serve as a monitor in the control tower. The alteration involved the addition of an amplifier to provide a more consistent signal and adequate monitoring facilities.

In this installation, it was desired to monitor two receivers simultaneously to provide maximum intelligibility. Figure 1 illustrates the circuit developed from a prototype which utilized a single 8″ speaker and avc. The single speaker was found to be ineffective on low volume and not much better on real high volume. Thus two small speakers which, incidentally, used the restricted space more efficiently, were installed.

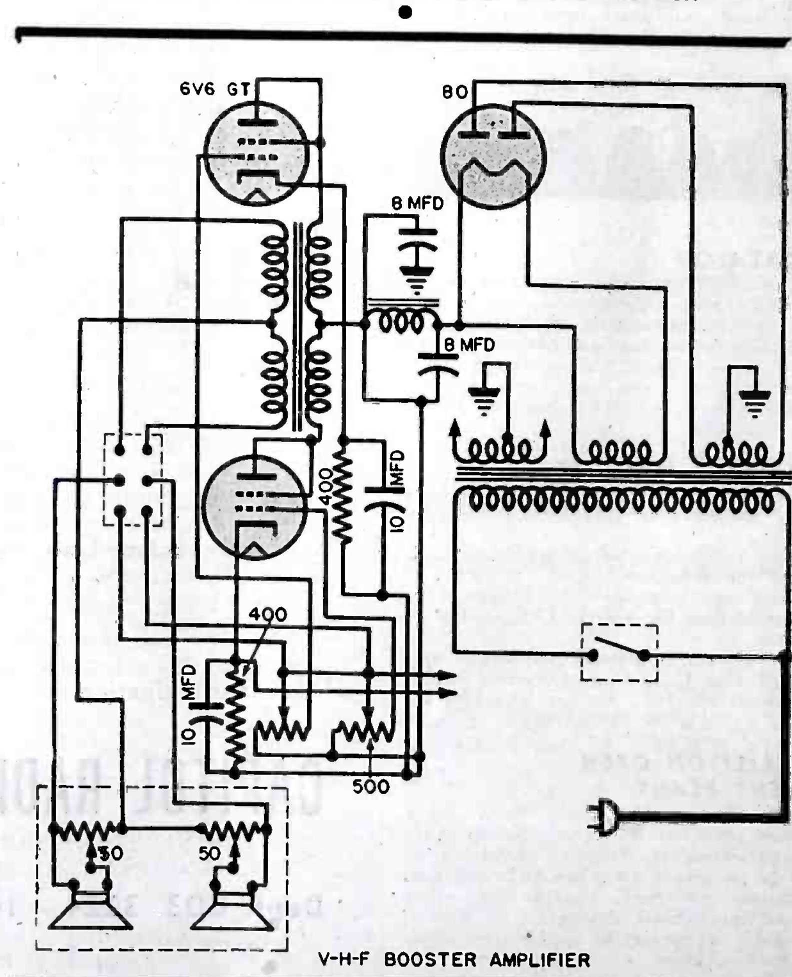
The gain of the system is adjusted first by the volume control on the two receivers so that the maximum signal experienced will not block the receiver. A 50-ohm potentiometer then establishes the maximum level at which the loudspeakers are desired to operate in a *non-boost* position set by a switch. A 500-ohm volume control is adjusted for *boost* loudspeaker output.

This procedure causes some change in *non-boost output*. However, by trial some setting of the 500-ohm control can be found to accommodate both *boost* and *non-boost* operation. This operation obviates the necessity for a volume control, which, to be effective in this set would have to be amplified.

As a result of these adjustments, it was found that a signal blasting the speakers in *boost* operation would be at a normal level when fed directly to the speakers by the switch mounted on the traffic controller's table. In normal operation, with the switch in the *boost* position, occasional blasting does not reduce intelligibility below a safe level. On receipt of strong signals, the operator has the choice of throwing the switch into a manually-held, spring-return, position for short messages, or into a mechanically-held position for messages of longer duration. This manual operation is the only penalty for omission of avc which, to be effective, originally consisted of a 2-tube circuit, complicating design and service.

(F. Albrecht-Glenn L. Martin Co.)

Figure 1
Circuit of converted airborne unit for control-tower use.



NEWS BRIEFS

(*Continued from page 57*)

Grigsby was formerly vice president of Oak Manufacturing Company, Chicago, and later was vice president and sales manager of Allied Control Company, Inc., New York City. Mr. Allison had been with Oak Manufacturing Company for thirteen years as production engineer.

D. J. Grigsby, formerly chairman of the board of the Grigsby-Grunow Company, is treasurer and director.

* * *

CLAROSTAT CATALOG

A catalog, No. 46, describing wire-wound power resistors and glass-insulated flexible resistors; composition-element and wire-wound rheostats and potentiometers; tapped and tapered controls and switches; constant impedance input and output controls and attenuators; tube-type wire-wound resistors, automatic-line voltage regulators and replacement line ballasts; power rheostats and power resistor decade boxes, has been released by Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

* * *

NEWARK ELECTRIC OPENS ADDITIONAL N. Y. STORE

Newark Electric Company has opened a new branch at 212 Fulton St., New York 7, N. Y. Managing the new store will be Hy Kahn.

Other Newark Electric stores are located at 323 W. Madison St., Chicago 6, Ill., and 115-117 W. 45th St., New York 19, N. Y.

* * *

BOWERS BECOMES AIREON V-P

Walter A. Bowers has been elected vice-president and treasurer of the Aireon Manufacturing Corporation, Fairfax and Funston Roads, Kansas City 15, Kans.

Mr. Bowers was formerly with the Lawrance Aeronautical Corporation, Linden, N. J.

* * *

AMERICAN LAVA TO OPEN FIELD ENG. OFFICE

A N. Y. City field engineering office will be opened soon by the American Lava Corporation, Chattanooga, Tennessee. Samuel J. McDowell will be in charge.

* * *

G. R. NAMES ADAMS MANAGER OF CHICAGO OFFICE

Kipling Adams has been appointed manager of the Chicago office of General Radio, succeeding Lucius E. Packard, who has resigned. He was formerly assistant manager of the service department.

* * *

MEDAL FOR MERIT TO W. S. GIFFORD

Walter S. Gifford, president of the American Telephone and Telegraph Company received the Medal for Merit recently.

Presentation of the medal and accompanying citation was made by Major General Harry C. Ingles, Chief Signal Officer of the Army.

* * *

I. C. BROWN NOW WITH RAYTHEON

Irving C. Brown has been appointed sales manager of the industrial electronics division, Raytheon Manufacturing Co., Waltham, Mass.

Mr. Brown was formerly sales manager of Thomson-Gibb Electric Welding Co., Lynn, Mass.

* * *

CARSON M. WHEELER JOINS AMPEREX

Carson M. Wheeler, formerly with FTR, has joined the Amperex Electronic Corporation, 25 Washington Street, Brooklyn 1, N. Y., as chief engineer in charge of tube development.

* * *

REYNOLDS NOW W. E. PUBLICATIONS MANAGER

Walter M. Reynolds, formerly A. T. & T. information manager, has been named W. E. publications manager.

R. I. Johannesen, editor of the New York Telephone Review, succeeds Mr. Reynolds as A. T. & T. information manager.

* * *

JACK SIEGEL NOW STAMFORD TRANSFORMER V-P

Jack R. Siegel has been elected vice-president in charge of sales and advertising, of the Stamford Electric Products Co., Inc., Sunnyside Avenue, Stamford, Connecticut. Mr. Siegel was formerly west coast manager of Philharmonic Radio Corporation of New York.

* * *

COMMANDER A. F. VAN DYCK AWARDED LEGION OF MERIT

In recognition of . . . "exceptionally meritorious conduct in the performance of outstanding services . . . as Officer-in-Charge of Navigational Aids," Commander Arthur F. Van Dyck, U. S. N. R., assistant to Dr. Charles B. Jolliffe, recently received the Legion of Merit. Rear Admiral Monroe Kelly, Commandant of the Third Naval District, made the presentation.

* * *

SIGMON RETURNS TO KMPC

Lt. Col. Loyd C. Sigmon has returned to KMPC as chief engineer.

Lt. Col. Sigmon received the Legion of Merit for his work with "SigCIRCUS," the 60-kw portable transmitter assembled in seventeen trucks and trailers.

* * *

PRINCE BECOMES HALLICRAFTERS GENERAL COUNSEL

Kenneth C. Prince has been appointed general counsel for the Hallicrafters Company, Chicago.

* * *

GRAYBAR APPOINTS COLE COMMUNICATIONS S-M

Burton R. Cole has been appointed communications sales manager of the Graybar Electric Company, New York City.

* * *

F. M. DAVIS OF COLLINS DEAD

Frank M. Davis, general manager of the research and engineering division of the Collins Radio Company, Cedar Rapids, Iowa, died recently.

* * *

ALLEN REJOINS PHILCO

Armin E. Allen, following two years service with the Navy as Procurement Officer, has rejoined Philco as a product manager in the radio division.

* * *

CLARE RELAYS OPEN N. Y.-PHIL. OFFICES

C. P. Clare & Co., 4719 W. Sunnyside Avenue, Chicago 30, Illinois, have opened engineering and sales offices at 420 Lexington Avenue, New York City, and in the Commercial Trust Building, Philadelphia, Pa.

J. W. Concagh will be in charge of the New York office. Frazier O. Stratton will be in charge at Philadelphia.

* * *

WULFSBERG, HOLLISTER AND STEPHENS JOIN COLLINS

Arthur H. Wulfsberg has joined the Collins Radio Company, Cedar Rapids, Iowa, as a member of the research division. He was formerly with Sylvania Electric Products, Inc.

Robert H. Hollister, formerly Chief Inspector in the Office of the Resident Inspector of Naval Material at Cedar Rapids, has become service department manager of Collins.

Thomas C. Stephens is now with the Collins research division. He was formerly an instructor in radio and electrical engineering at the University of Iowa.

Above: A. H. Wulfsberg
Above, right: R. H. Hollister
Right: T. C. Stephens

* * *

INSULINE CATALOG

The Insuline Corporation of America, 36-02 35th Avenue, Long Island City, N. Y., has published a catalog, describing a line of antennas and antenna accessories.

* * *

E. N. CLARK NAMED RCA INTERNATIONAL MANAGING DIRECTOR

Edwin Norman Clark, former Deputy Assistant Chief of Staff for Supply, Supreme Headquarters, A. E. F., has been named managing director of the RCA international division.

* * *

V. L. HAAG APPOINTED AEROVOX V-P

Vernon L. Haag, formerly assistant general manager of the Illinois Watch Case Company, has been appointed vice president of Aerovox Corporation, New Bedford, Mass.

* * *

SECOND GROUP OF NOMOGRAPHS ISSUED BY FTR

The second in the series of u-h-f nomographs have been issued by the Federal Telephone and Radio Corporation, Newark, New Jersey.

The set now being offered, sixteen in number, makes a total of forty, twenty-four being issued in the first group.

Ten of the new nomographs cover wave guides. Other nomographs cover a shunt peaking method of range extension in wide-band

(*Continued on page* 62)

NEWS BRIEFS

(*Continued from page 61*)

amplifiers, and the dissipation of power in water-cooled devices.

* * *

CANNON PLUG CATALOG

A 12-page catalog, type AP, listing five plugs and three receptacle types which, with six insert arrangements, make possible 48 different fittings, has been issued by the Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

* * *

NEAL TURNER PROMOTED BY HALLICRAFTERS

Neal Turner, former engineering sales manager for the RFC project in the Clearing, Ill., plant of Hallicrafters, has become quality control chief.

* * *

RCA COMMUNICATIONS NAMES BRIG. GEN. S. M. THOMAS INTERNATIONAL TECHNICAL REP.

Brig. General Samuel M. Thomas has been appointed international technical representative of RCA Communications, Inc. General Thomas was Director of the Communications Division, Office of Military Government, U. S. Army, with headquarters in Berlin.

* * *

CHEMICAL PUBLISHING CATALOG

A catalog of technical books has been issued by The Chemical Publishing Co., Inc., 26 Court Street, Brooklyn 2, N. Y. Discussed are books on chemistry, physics, science, technology, engineering, metals, technical dictionaries, etc.

* * *

J. S. KEHRER NOW TURNER CHIEF PRODUCTION ENGINEER

John S. Kehrer has been appointed chief production engineer of the Turner Company, Cedar Rapids, Iowa.

Lt. Comdr. Carl W. Kirwin has returned to Turner after thirty-four months service with the Navy.

He has resumed his duties as comptroller. William A. Baldwin, comptroller during Mr. Kirwin's absence, has been named purchasing agent.

* * *

RADIO RECEPTOR BULLETINS

Three bulletins describing h-f and v-h-f receivers and transmitters have been released by the Radio Receptor Company, Inc., 251 West 19th Street, New York 11, N. Y.

The h-f receiver bulletin describes a 12-tube receiver, type RH 1A, that can be supplied for any single fixed frequency from 1.7 to 11 mc. The v-h-f receiver data describes the type RV 1A unit available for any single frequency from 100 to 162 mc. A 50-watt v-h-f transmitter, type TV 50 A, described in the last bulletin, is available for any frequency from 100 to 162 mc.

* * *

WESTINGHOUSE GRANTED MANUFACTURING LICENSE FOR CBS COLOR TELEVISION

First licenses to use CBS u-h-f color inventions in television receivers and studio apparatus have been granted to Westinghouse. Arrangements, on a patent royalty basis, are for five years and provide for an extension of the agreement.

Royalties to CBS range from 25 cents to one dollar on receiving sets, depending on the retail price, and one per cent of the net selling price of complete color television transmitter studio apparatus.

* * *

NEMCO AUTO ANTENNA CATALOG

A 4-page bulletin describing single stanchion, side cowl, fender and cowl mount underhood and concealed antennas, and suppressors and capacitors has been released by the National Electronic Manufacturing Company, 22-78 Steinway Street, Astoria 5, L. I., N. Y.

* * *

TWT TRANSMITTER DATA

A 24-page brochure describing portable transmitters, remote pickup amplifiers, mixers, control consoles and turntable combinations, has been released by the Taylor Western Transmitter Co., Inc., 6127 South Western Avenue, Los Angeles 44, California.

* * *

SCHMIT AND WILSON BECOME RCA VICE PRESIDENTS

D. F. Schmit has been elected vice president in charge of the engineering department of the RCA Victor division. Fred D. Wilson was named vice president in charge of the personnel department of RCA Victor.

* * *

JO TORQUE TOOL DATA

A 12-page bulletin covering torque wrenches has been published by the Jo Manufacturing Company, South Gate, California.

* * *

EIMAC TUBE, SWITCH, CAPACITOR BULLETIN

A bulletin listing and illustrating transmitting tubes, rectifiers, vacuum capacitors, vacuum switches and diffusion pumps, has been released by Eitel-McCullough, Inc., San Bruno, California.

* * *

RADIOTONE FOLDER

An 8-page folder describing combination receiver, p-a and phono recording units made by Radiotone, Inc., Hollywood, California, has been published.

* * *

GENERAL RADIO POSTWAR CATALOG SUPPLEMENT

A 68-page supplement to catalog K, discussing resistors, capacitors, inductors, bridges, oscillators, signal generators, meters, etc., has been released by General Radio, Cambridge, Mass.

* * *

G. E. PROMOTIONS

J. M. Lang has been appointed manager of the tube division of G. E. Mr. Lang formerly was manager of the Ken-Rad division.

Walter C. Kirk has been named designing engineer of the Ken-Rad division of G. E., Owensboro, Ky.

J. E. Nelson is now sales manager of industrial and transmitting tubes for the G. E. tube division.

Above: J. M. Lang

Above, right: W. C. Kirk

Right: J. E. Nelson

* * *

JEFFERSON-TRAVIS BUYS GUILD RECORDS

Jefferson-Travis Corporation, 245 East 23rd Street, N. Y. 10, N. Y., has bought Guild Records Incorporated.

The Guild purchase provides a phonograph

(*Continued on page 64*)

NEWS BRIEFS

(*Continued from page* 63)

record pressing plant in South Norwalk, Connecticut.

* * *

G. E. PRAY NOW WITH TUCK ELECTRONIC

G. Emerson Pray has become manager of the Tuck Electronic Corporation, 41 Park Row, N. Y. 7, N. Y.

Mr. Pray was formerly chief engineer and assistant vice president of Airplane and Marine Instruments, Inc., Clearfield, Pennsylvania.

* * *

EMELOID CATALOG

A 24-page catalog, "Plastic Advertising Specialities of Distinction" has been issued by the Emeloid Co., 286 Laurel Ave., Arlington, N. J.

* * *

HORWICH APPOINTED SHURE AD MAN

Howard T. Horwich has been appointed advertising manager of Shure Brothers, Chicago.

* * *

CEDAR RAPIDS SECTION OF IRE NAMES NEW OFFICERS

T. A. Hunter was named chairman of the Cedar Rapids section of the IRE.

Prof. W. R. Abbott is now vice chairman, and Roger S. Conrad, secretary-treasurer. There are now 157 members and associates in the group.

* * *

WESTINGHOUSE ELECTS G. A. PRICE PRESIDENT

Gwilym A. Price has been elected president of Westinghouse, succeeding George H. Bucher, who has resigned.

Mr. Bucher was elected vice-chairman of the board of directors and will continue to serve as chairman of the Westinghouse Electric International Company.

* * *

T. KARLIN GOES TO PHILHARMONIC

Theodore Karlin has joined the Philharmonic Radio Corporation, N. Y. City, as director of purchases.

* * *

FORMICA OPENS PHILADELPHIA BRANCH OFFICE

The Formica Insulation Company, Cincinnati, has opened a direct factory branch office in Philadelphia, Pa., with Albert Lesberil as branch manager.

Fred C. Walter has been promoted to be assistant sales manager of Formica.

* * *

HORNBOSTEL JOINS NATIONAL CO.

Lt. Col. Charles C. Hornbostel has joined the National Radio Company of Malden, Mass., as controller.

* * *

F. T. HEGEMAN BECOMES ELECTRONIC LAB S-M

F. Theodore Hegeman has become sales manager of the distributor division of the Electronic Laboratories, Indianapolis, Ind.

* * *

DON WEIR NOW INSL-X S-M

Don Weir has been named sales manager of Insl-x Co., 857 Meeker Ave., Brooklyn, N. Y. B. B. Schneidermann is now technical service manager.

* * *

F. M. MURPHY BECOMES CHICAGO REP. FOR MEASUREMENTS CORP.

Frank M. Murphy has been appointed Chicago representative for Measurements Corporation, Boonton, N. J. Offices are at 21 E. Van Buren Street.

* * *

G. R. LARSEN JOINS MARION

George R. Larsen has joined the Marion Electrical Instrument Company, Manchester, N. H., as development engineer.

* * *

G. E. PORTABLE A-C TEST SET BULLETIN

A 24-page bulletin, GEA-4477, containing data on portable a-c test sets from 2,000 to 150,000 volts, has been announced by G. E.

Portable equipments covered in the bulletin include small insulation testers, oil testers, and larger general-purpose test sets, with ratings up to 25 kva.

* * *

F. J. FEELY PROMOTED BY W. E.

Frank J. Feely, manager of Western Electric specialty products shops in New Jersey, has been appointed manager of electronic components manufacture. These manufacturing operations will be moved into a new plant, to be constructed during the coming year at Allentown, Pa.

* * *

McCOY, HOPPER AND SLOAN TO REPRESENT ACME ELECTRIC

William E. Hopper and H. H. McCoy of Hopper and McCoy Company of Atlanta, Georgia, have been named Acme Electric & Mfg. Co. representatives in Florida, Georgia, Alabama, South Carolina, eastern Tennessee, and North Carolina.

Loren W. Sloan of the L. W. Sloan Company, has been appointed St. Louis, Mo. representative for Acme.

* * *

G. E. WILLIAMS BECOMES G-M OF DuMONT INSTRUMENTS AND TUBE DIV.

C. Edwin Williams has been appointed general manager of the cathode-ray oscillograph and tube division of the Allen B. DuMont Laboratories, Inc.

Mr. Williams was formerly chief of the transformer unit of the WPB radio and radar division.

* * *

NEWCOMB AUDIO CATALOG

A 24-page catalog with data on fixed and portable amplifiers, speakers, horns, microphones and cases, has been prepared by the Newcomb Audio Products Company, Los Angeles, Calif.

* * *

FREED TRANSFORMER LIMIT BRIDGE BULLETIN

A 4-page bulletin describing the Freed comparison and limit bridge has been published by the Freed Transformer Company, 72 Spring Street, New York 12, N. Y.

* * *

AIREON PROMOTES WELCH

Arthur E. Welch has been appointed vice president in charge of sales of Aireon Mfg. Corp., Kansas City, Kansas.

Mr. Welch was formerly vice president and treasurer.

* * *

RANGER AIRCRAFT BOOKLET

A 16-page booklet describing radiotelephone procedure on aircraft has been published by the Ranger aircraft division of the Electronic Spe-

•

JAPANESE ACORN TUBE COPY

The first captured Japanese "Chinese copy" of an acorn tube given to Dean Babbitt (left), president of Sonotone Corporation by Louis G. Pacent, Sonotone consultant.

ciality Company, 3456 Glendale Boulevard, Los Angeles 26, Calif.
Transmitter and receiving equipment are also described.

* * *

MAHER NOW HALLICRAFTERS ASS'T S-M

William R. Maher has been appointed assistant sales manager of the Hallicrafters Company.

* * *

AIRADIO NAMES AIR ASSOCIATES AS DISTRIBUTORS

Air Associates, Inc., Teterboro, New Jersey, have been named world-wide distributors for Airadio, Inc., Stamford, Conn.

* * *

L. G. SNYDER BECOMES ASSOCIATED RESEARCH S-M

L. G. Snyder has been appointed sales manager of Associated Research, Inc., 231 South Green St., Chicago 7, Illinois.

* * *

ED COHEN JOINS PERLMUTH ON WEST COAST

Edward J. Cohen, formerly vice president and general manager of the Insuline Corporation of America, has become co-partner of J. J. Perlmuth & Associates, Los Angeles.

* * *

KELLY JOHNSON NOW CONSULTING ENGINEER

J. Kelly Johnson, formerly with Hammarlund Manufacturing Co., has opened a radio and electronic consultant office at 55 West 42nd Street, New York 18, New York.

* * *

R. E. SAMUELSON BECOMES RMA MARINE SECTION HEAD

R. E. Samuelson, vice president in charge of engineering for the Hallicrafters Company, Chicago, has been named chairman of the marine section of the RMA transmitter division.

* * *

W. G. H. FINCH GRANTED C-R FACSIMILE PATENT

Captain William G. H. Finch has received a patent (2,394,435) covering a cathode-ray facsimile receiver.

* * *

WHITNEY BLAKE WIRE DATA

A 4-page bulletin describing Telepene drop wire has ben released by the Whitney Blake Company, New Haven, Conn.
Wire has an outer casing of neoprene.

* * *

PRECISION SPECIALTIES TO HAVE RADIO DIV.

A radio-electronic section has been formed by Precision Specialites, Los Angeles, California.
William F. Frankart will be in charge. Mr. Frankart was formerly assistant chief engineer of Aireon.

* * *

AIREON 50 WATT STATION BROCHURE

A four-page brochure describing a 50-watt ground station, type RS-1, for small airports, airlines, and communication systems, has been published by the Aireon Manufacturing Corporation, Kansas City, Kansas.

* * *

GENERAL CEMENT CATALOG

A catalog, No. 146, containing listings of radio cements, chemicals, hardware, cabinet repair kits, repair parts, tools and other service accessories, has been released by General Cement Manufacturing Co., 919 Taylor Avenue, Rockford, Illinois.

THE INDUSTRY OFFERS . . .

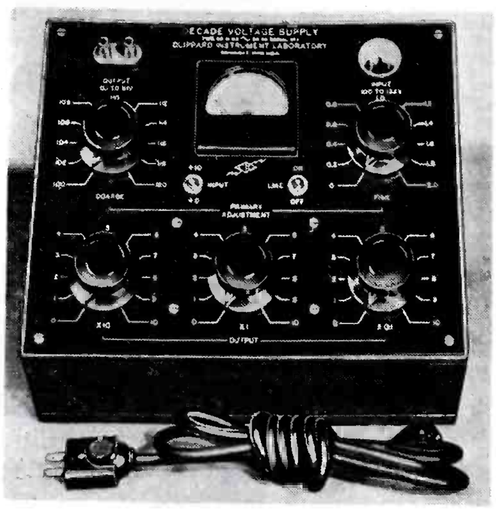
CLIPPARD DECADE VOLTAGE SUPPLY

A 60-cycle decade voltage supply, type D.S. 111, supplying a-c potentials in 1/10th-volt steps from 0 to 111 has been announced by the Clippard Instrument Laboratory, 1440 Chase Ave., Cincinnati, Ohio.

Instrument incorporates isolating type transformer with a primary tapped to adjust within .1 volt of line voltages from 100 to 132.

A Weston meter, model 476, is used in the secondary circuit to indicate proper primary voltage adjustment. When the primary is adjusted to 100 volts the instrument may also be used as a variable ratio transformer provided input voltages do not exceed calibration settings.

Output is rated at 30 va; 0.1 to 1 volt, 5 amperes permissible current; .01 to 11 volts, 2 amperes; 0.1 to 31 volts, 1 ampere; 0.1 to 111 volts, 0.3 ampere.



* * *

SYLVANIA TUNABLE MAGNETRONS

Tunable magnetrons (interdigitated magnetrons) for pulsed transmission within the 6 cm to 7 cm range and f-m applications where deviations up to 500 kc are desired, have been announced by the Research Laboratories of Sylvania Electric Products, Inc., Flushing, N. Y.

Heater voltage (a-c or d-c), 6.3; anode voltage, 1.5 kv; anode current (average), 50 ma; field strength of magnet, 1,050 gauss; power output (for 10% duty factor), 80 watts peak.

* * *

COLLINS 5-KW TRANSMITTER

A ten-channel, 2 to 18.1-mc, 5-kw communications-type transmitter, type 231D, has been announced by the Collins Radio Company of Cedar Rapids, Iowa.

It embodies the Collins autotune system, by means of which the carrier can be automatically shifted to any of ten preselected frequencies.

Maximum power output is 3 kw on phone or m-c-w, or 5-kw on c-w. Only one set of tuning elements is used for the entire frequency range.

Keying speeds of up to 200 wpm can be used. Frequency response is said to be flat within 3 db from 150 cps to 3,500 cps. A compression circuit is incorporated to raise the average modulation level. Harmonic distortion is said

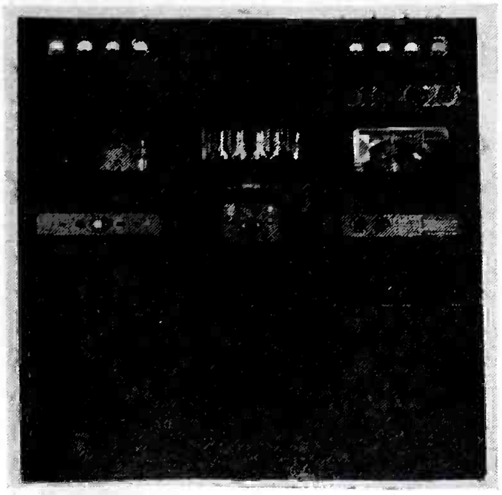
FTR NATIONAL SALES GROUP N. Y. MEETING

Left to right (sitting): H. Harrison; L. White; H. McElroy; Norman E. Wunderlich, FTR radio sales director; F. Wamble; R. Rennaker; and E. Sweeney. Standing: A. W. Rhinow, FTR assistant vice president; R. Guildford; W. Albright; R. Freeman; C. J. Harrison; J. Chatfield; J. Callahan; G. Scott; W. Maynard; R. Boyter; and E. Giguere.

to be less than 10% up to 100% modulation at 1,000 c.p.s.

Crystal or sealed master oscillator frequency control is available.

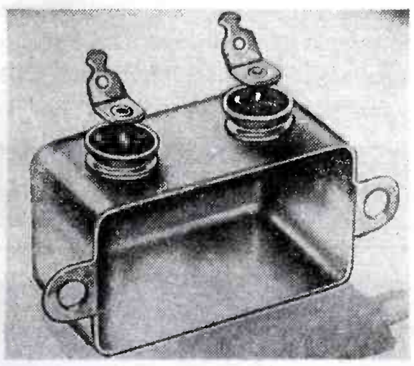
A 230-volt, 50/60-cycle three-phase, and a 115-volt, 50/60-cycle single-phase power source are required.



* * *

CINCINNATI ELECTRIC GLASS-TO-METAL HERMETIC CAPACITOR TERMINALS

Glass-to-metal hermetic terminal, No. 110 RTHL Fusite, has been announced by the Cincinnati Electric Products Company, Cincinnati, Ohio. It is a single terminal equipped with a hollow tube and copper connecting lug.



* * *

KURMAN MIDGET SENSITIVE RELAYS

Midget relays, series 13, featuring .035-watt sensitivity in a 1-ounce unit, have been produced by the Kurman Electric Company, 35-18 37th Street, Long Island City 1, N. Y.

The contacts are single-pole, double-throw, and are rated to carry ¼ ampere, 110 volts a-c non-inductive load. The approximate dimensions of the relay are 1½" long, 1⅛" wide and 1" high overall.

Coils may be selected for any d-c input voltage between .04 and 40 volts.

* * *

FLEXIBLE MICROWAVE WAVEGUIDES

Flexible microwave waveguides, "Waveflex," have been developed by Titeflex, Inc., 500 Frelinghuysen Avenue, Newark 5, New Jersey.

Constructed of an all-metal flexible tubing. Flexibility is said to permit confinement in very small spaces without distortion of the critical dimensions of size and shape.

* * *

CINEMA ENG. SELF-CLEANING ROLLER MIXER CONTROL CONTACTS

Self-cleaning contacts for mixer controls have been developed by Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif. Uses a wedge-shaped roller, riding on a plastic arm and shaft. Said to have a brush noise characteristic below the noise level of amplifiers.

Design provides for passing of current from

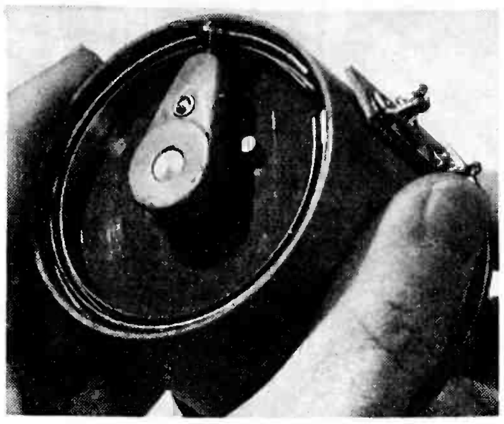
(*Continued on page 68*)

THE INDUSTRY OFFERS . . . —

(*Continued from page 67*)

the coil to the collector ring directly through the roller, eliminating any bearing surface as a conductor.

Contact arrangement is available with models 3182 and 1047 mixer controls, supplied with a conventional ladder circuit, any conventional input and output impedance, and either of two attenuation characteristics.



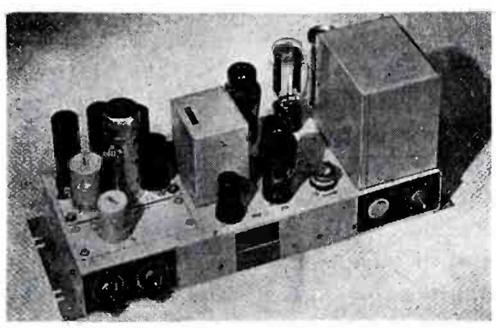
* * *

LANGEVIN AMPLIFIERS

A series of amplifiers, type 108, 20-watt medium to high-gain master power, on which small input panels may be mounted to change the overall gain of the amplifier, has been announced by the Langevin Company, Inc., 37 West 65th Street, New York 23, N. Y.

The 108 series consists of types A, B, C and D. Type A is designed to be employed as a high-power monitoring amplifier and has a bridging and 600-ohm input; B is a high-gain amplifier designed to operate from a source impedance of 30 to 250 ohms; C is a combination of the A and B and the D supplies with two high-gain input stages.

Frequency characteristics are said to be better than ±1.5 db, 30/15,000 cps; power output is + 43 vu (20 watts), with less than 3% rss harmonic content.

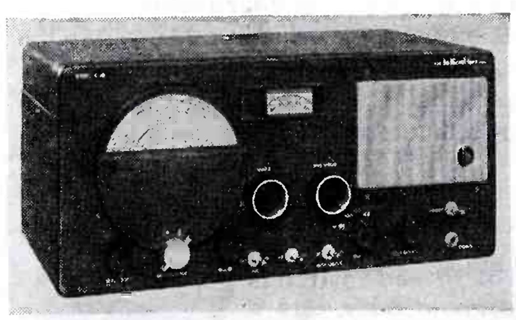


* * *

HALLICRAFTERS COMMUNICATIONS RECEIVER

A 4-band (550 kc to 44 mc) communications receiver, S-40, styled by Raymond Loewy, has been announced by the Hallicrafters Company, 2611 Indiana Avenue, Chicago 16, Illinois.

The receiver has nine tubes with rectifier.



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HEWLETT-PACKARD DISTORTION ANALYZER

A distortion analyzer, model 330B, featuring resistance-tuned circuits has been announced by Hewlett-Packard, Inc., Palo Alto, Calif. Model is said to be capable of measuring distortion at any frequency between 20 and 20,000 cps; noise measurements to 100 microvolts. A linear r-f detector makes it possible to measure these characteristics directly from a modulated r-f carrier.

The voltmeter section of the instrument consists of a two-stage high gain amplifier, a rectifier, and an indicating meter.

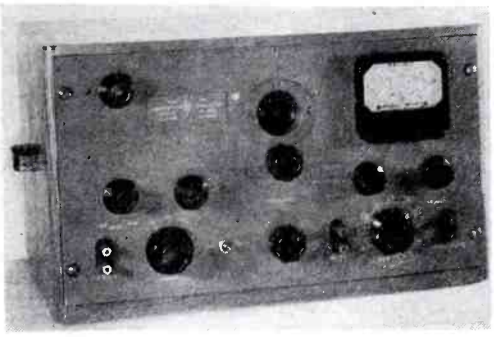
Frequency coverage is: 20 to 200 cps (band x1); 200 to 2,000 cps (band x10); and 2,000 to 20,000 cps (band x100).

Circuit is said to eliminate the fundamental by more than 60 db and will attenuate the second harmonic and higher harmonics by less than 10%; distortion measurements accurate within ±3% for distortion levels to 0.5%.

Nine ranges are provided on voltmeter with sensitivities of .03, .1, .3, 1.0, 3.0, 10, 30, 100, 300. A calibration from +2 to −12 db is also provided, and the ranges are related to each other in 10-db steps.

When used to measure hum or noise the meter will give a full scale deflection on a signal of 300 microvolts.

Front panel size: 19"x10½", depth 13".



* * *

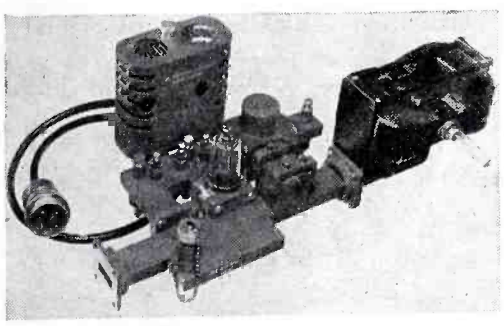
DE MORNAY BUDD R-F RADAR UNITS

A complete r-f radar unit using a packaged magnetron capable of delivering 20 kw, peak power, at 9,375 mc, has been produced by De Mornay Budd, Inc., 475 Grand Concourse, New York 51.

Two 2K25 local oscillator tubes are provided, one for receiver and afc and the other for beacon operation. A 1B35 A-T-R tube and 1B24 T-R tube are also included, as are type 1N21 crystals.

A 20-db narrow band directional doupler is also included.

The unit has been designed with a beacon cavity and crystal mount. Can be supplied less the beacon cavity and crystal mount and local oscillator.



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MAGUIRE AIRCRAFT RECEIVER

An aircraft range receiver, model ARR-1, has been announced by the electronics division of Maguire Industries, Inc., Bridgeport, Conn.

The set, complete with tubes and batteries, is said to weigh 3 pounds 10 ounces. Size: 4⅛"x 4½"x6¾". In addition to weather and tower, the receiver covers the 190 to 420 kc band.

* * *

GRAYHILL EXPERIMENTAL MOLDINGS

Facilities to mold small phenolic pieces on a basis of two to three thousand of a unit per

(*Continued on page 72*)

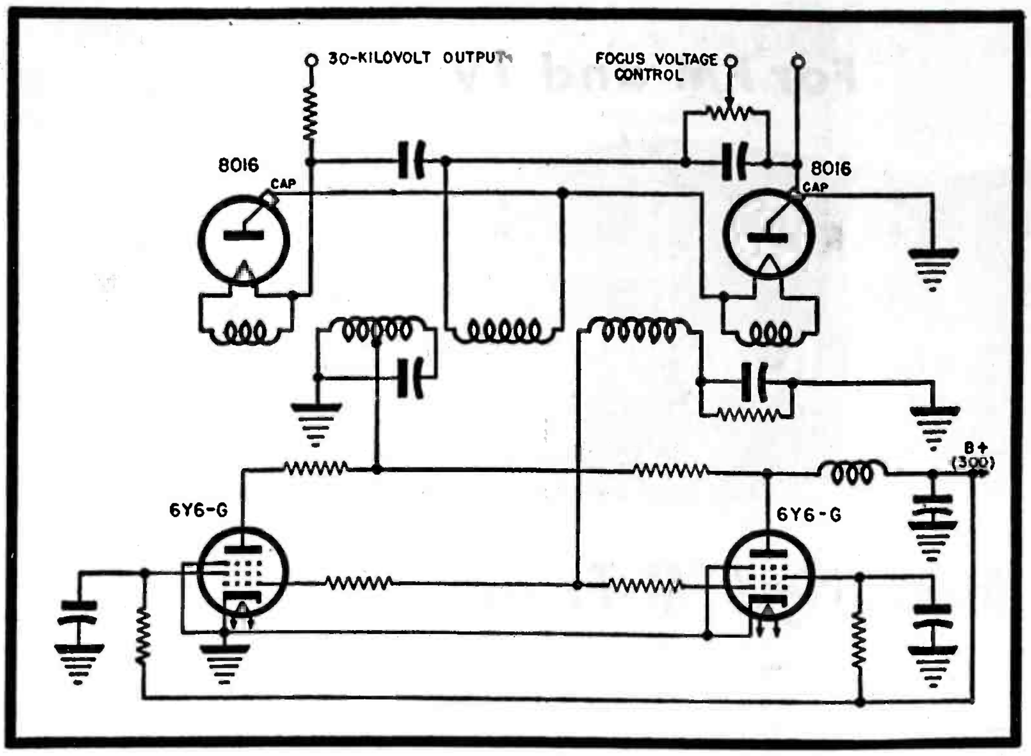


Figure 6
Schematic of the oscillator and r-f section of a 30-kv supply.

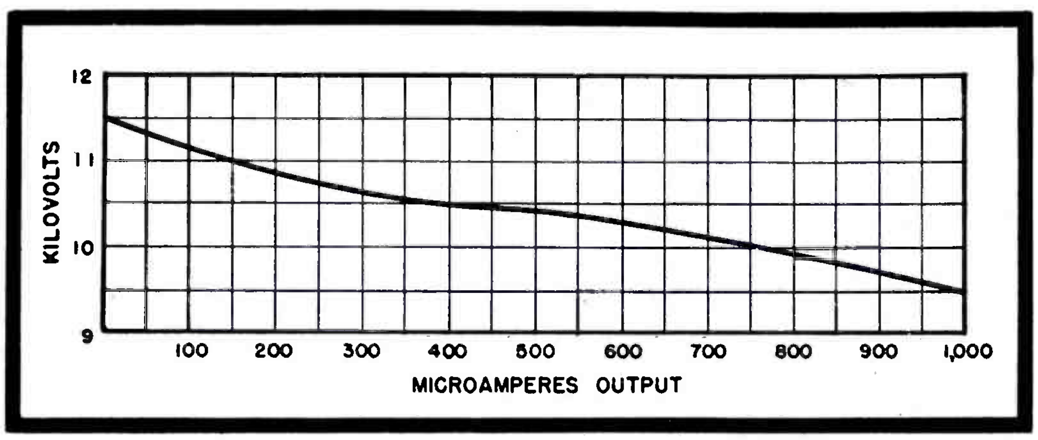


Figure 7
Plot of regulation versus output characteristics of a 10-kv power supply.

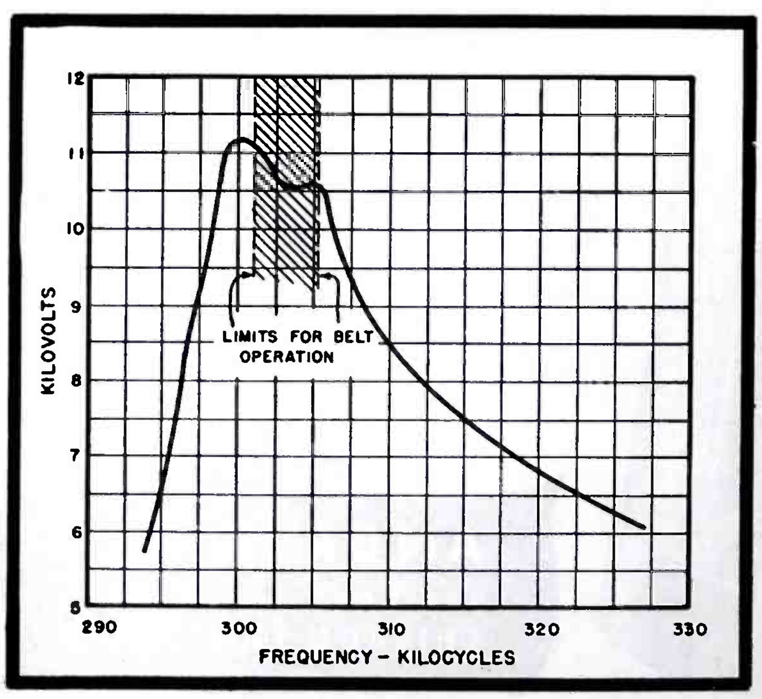


Figure 8
Frequency characteristic of a 10-kv supply.

TELEVISION R-F POWER SUPPLIES

(*Continued from page 27*)

Because of this feature, the maximum voltage obtainable is somewhat less than under critical coupling conditions, but the improvement in stability justifies the loss of voltage.

Requirements for R-F Transformer

The coupling factor $K >>$ than K_c (critical coupling),

$$\text{where } K_c = \frac{1}{\sqrt{Q_1 Q_{11}}}$$

$$\text{and } K = \frac{M}{\sqrt{L_1 L_2}}$$

Measured values of $\omega \frac{L}{R}$ of primary and secondary, K for a 10 and 30-kv coil are:

10-kv Coil

Primary (with 2000 mmfd tuning capacity) .... $Q = 130$
Secondary (with 30-mmfd tuning capacity) .... $Q = 100$
$K = .26$

30-kv Coil

Primary (with .01-mmfd tuning capacity) .... $Q = 90$
Secondary (with 30-mmfd tuning capacity) .... $Q = 95$
$K = .28$

The values given are the unloaded coil values as measured on a Q meter.

THE INDUSTRY OFFERS . . . —

(*Continued from page 69*)

year, have been announced by Grayhill, 1 North Pulaski Road, Chicago 24, Illinois.

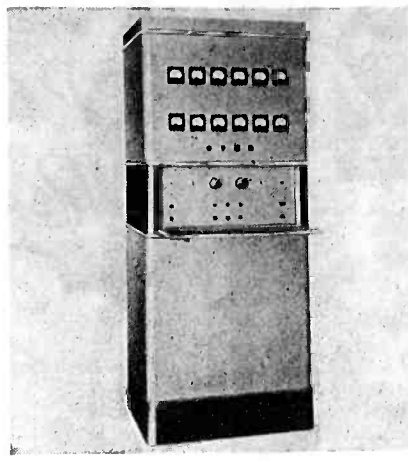
* * *

RAYTHEON 250-WATT BROADCAST TRANSMITTER

A 250-watt a-m broadcast transmitter with two tuned stages, the r-f drive amplifier and power amplifier, has been announced by Raytheon Manufacturing Company, Waltham, Mass. Stages are tuned by a low-speed motor, equipped with a clutch.

Uses a video-type amplifier in the buffer stage. Triode-type tubes are in both the modulator and amplifier.

Frequency response is said to be from 30 to 10,000 cycles ±1 db.



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NYT INDUCTANCE DECADES

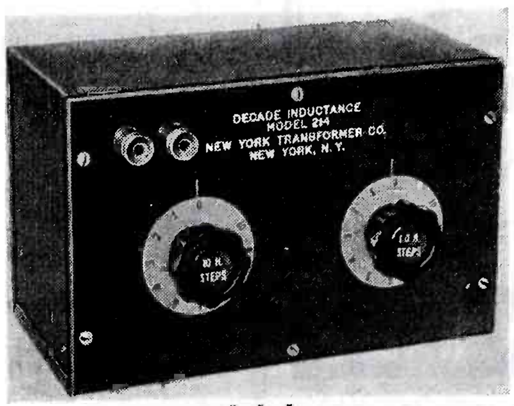
Inductance decades for bridge and low-level filter circuits, have been developed by the New York Transformer Company, 62 William Street, New York 5, N. Y.

Inductance ranges are from .001 henry steps to 100 henries total.

Decades are said to be adjusted to within 2% at 1,000 cycles, except for the 100-henry decade which is adjusted at 200 cycles. Useful frequency range of these units is from 30 to 20,000 cycles.

The .01- and .1-henry decades are said to have a Q of 40 to 45 at 4,000 cycles, dropping down to approximately 15 at 400 cycles and 15,000 cycles; 1- and 10-henry decades have a Q of 35 to 40 at 1,000 cycles, dropping down to approximately 15 at 200 and 10,000 cycles; 100-henry decade has its maximum Q around 200 cycles.

Four models are available: model 211, 0.11 henries in steps of .001 henry; 212, 1.1 henries in steps of .01 henry; 213, 11.0 henries in steps of 0.1 henry; 214, 110 henries in steps of 1.0 henry.



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HAMMARLUND SUPER-PRO

A 5-band communications receiver, series 400 Super-Pro, has been announced by the Hammarlund Manufacturing Company, Inc., 460 W. 34th St., N. Y. City.

Tuning range of SP-400-X: .54—1.24 mc; 1.24—2.86 mc; 2.85—6.3 mc; 6.3—14 mc; 13.4—30 mc.

Tuning range of SP-400-SX: 1.25—2.5 mc; 2.5—5 mc; 5—10 mc; 10—20 mc; 20—40 mc.

Continuous band-spread coverage on all five bands on the SP-400-SX; on 3 h-f bands of SP-400-X.

Tubes used are: 6K7, first tuned r-f; 6K7, second tuned r-f; 6L7, mixer; 6J7, h-f oscillator; 6K7, first i-f amplifier; 6SK7 second i-f amplifier; 6SK7, third i-f amplifier; 6H6, second detector; 6N7, noise limiter; 6SK7, avc driver; 6H6, avc diode; 6SJ7, b-f oscillator; 6J5, first

a-f amplifier; 6F6, second a-f amplifier; 2-6F6, third a-f amplifier (push-pull); 5U4G, high voltage rectifier; 5Y3GT/G, c-bias rectifier.

Low impedance antenna input for balanced transmission lines, 100 ohms approximately.

Three-stage i-f amplifier with variable bandwidth transformers.

Six-position crystal filter, three for phone reception and two for cw code reception, plus "off" position.

Automatic volume control operates on two r-f stages and two i-f stages.

* * *

DUAL-HEAT SOLDERING IRON

A two-heat electric soldering iron has been announced by Dual-Heat Iron Company, 4370 Sunset Blvd., Los Angeles 27, Calif. Dual-heat irons have a regular 150-watt heat for aluminum soldering, and production soldering. High temperature reserve heat is available by pressing a button in the handle.

Heating element is molded into a thermal shock resisting ceramic insulator. Weighs 18 ounces.

* * *

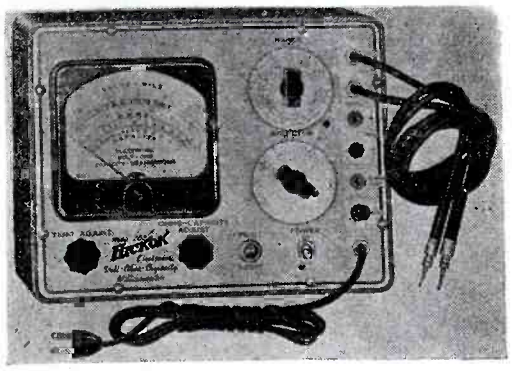
HICKOK VOLT-OHM-CAPACITANCE-MILLIAMMETER

A test instrument, model 203, for measurement of capacity, resistance, a-c and d-c (current and voltage) and inductance has been announced by the Hickok Electrical Instrument Co., 10529 Dupont Ave., Cleveland 8, Ohio.

Ranges: volts (a-c) . . . 0-3, 12, 30, 120, 300, 1,200; volts (d-c) . . . 0-3, 12, 30, 120, 300, 1,200; mils (d-c) . . . 0-3, 12, 30, 120, 300, 1,200; capacity and inductance . . . 0-10,000 mmfd in 2 ranges; 0-1,000 mfd in 5 ranges; 50 mh-100 henries; ohms . . . 1.0 ohm to 10,000 megohms in seven ranges.

Frequency: Up to approximately 5 mc. Meter sensitivity, 350 microamperes. Input impedance: Volts (d-c) . . . 15 megohms; volts (a-c) . . . 12 megohms shunted by 100 mmfd.

Tubes: 2 6X5GT as a-c rectifiers; 1 6SJ7 as a cathode follower; 1 6SN7GT as a vacuum-tube voltmeter; 1 OD3/VR150 as a voltage regulator.



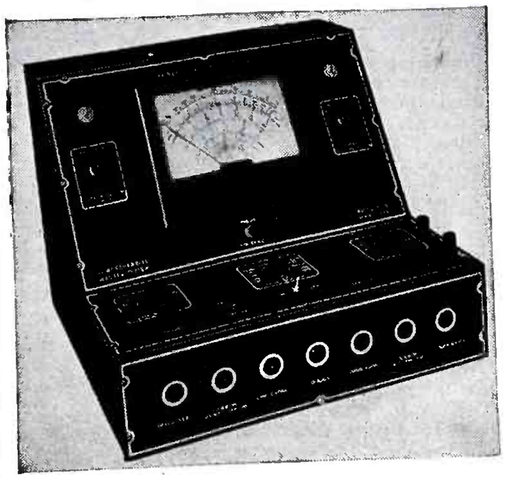
* * *

REINER MASTER TESTER

A master tester, model 456, for both laboratory and production testing, has been announced by Reiner Electronics Co., 152 West 25th St., New York.

Tester acts as an insulation tester; capacity meter; ohmmeter; a-c voltmeter; d-c voltmeter; a-c ammeter; d-c ammeter; and impedance-inductance meter.

Ranges are: A-c. 6-15-30-60-150-300-600-1,500-3,000-6,000-15,000-30,000 ma; d-c. 6-15-30-60-150-300-600-1,500-3,000-6,000-15,000-30,000 ma; a-c volts, 3-6-15-30-60-150-300-600-1,500-3,000-6,000; d-c volts, 6-15-30-60-150-300-600-1,500-3,000-6,000; ohms, .0-1,000-10,000-100,000-1 meg-10 meg-100 meg-1,000 meg; insulation tests 500 volt/0-10,000 meg; 1,000 volt/0-20,000 megohms; capacity high, 5-2,000/.5-200/.05-20/.005-2/.0005-.2/.00005-.02 mfd; capacity low, 1-100 mmfd. Frequency range without probe a-c volts, 10 cps to 100 kc. Input capacity, 25 mmfd. With probe (10 kc to 500 mc), 1 mmfd input capacity. Insulation testing at 500 volts to 10,000 megohms; at 1,000 volts to 20,000 megohms. Resistance measurements, 0.1 to 1,000 megohms.



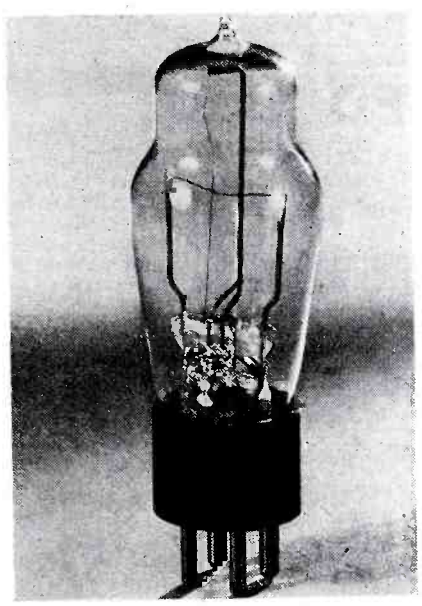
* * *

SYLVANIA THERMOCOUPLE TUBE

A tube with a hot junction of a thermocouple element centered on a filament heater and designed to measure gas pressure changes through variations in thermal conductivity of the gas has been announced by Sylvania Electric Products, Inc., electronics division, Boston 15, Mass. Used with a microammeter it is said to be possible to record pressures of 10^{-1} to 10^{-6} millimeters with plus or minus 5% accuracy.

Operated in a three-volt battery and resistance circuit, it may be sealed directly into evacuating apparatus by means of tabulation provided on top of the bulb. Direct measurement may be made with a 0-250 microammeter which may be calibrated for each gas measured.

The tube, 4 7/16" long over pins and 1 9/16" maximum bulb diameter, is supplied with small 4-pin base and may be operated in any position. Maximum value electrical ratings are: filament resistance, 3.0 ohms; thermocouple resistance, 5.0 ohms; filament current, 125 milliamperes; and thermocouple current, 250 microamperes.



* * *

INSTRUMENT RESISTOR RESISTORS

Four resistors, ALA, ACA, BLA, BCA, have been announced by Instrument Resistors Company, 25 Amity Street, Little Falls, New Jersey.

Type ALA, 3 watts; maximum resistance, 25,000 ohms (nichrome); maximum resistance, 5,000 ohms (manganin); body size, 1⅛"x⅜"; mounting, axial leads. Type ACA, 6 watts (same as ALA except coated with high temperature cement).

Type BLA, 5 watts, maximum resistance, 50,000 ohms (nichrome); maximum resistance, 10,000 ohms (manganin); body size, 1⅝"x⅜"; mounting, axial leads. Type BCA, 10 watts (same as BLA except coated with high temperature cement).

* * *

PRICE ELECTRIC TIME DELAY RELAY

A relay of synchronous motor-operated type to provide for a predetermined time delay of from one to ten minutes between actuation of relay coil and operation of relay contacts, has been developed by Price Electric Corporation, Frederick, Md.

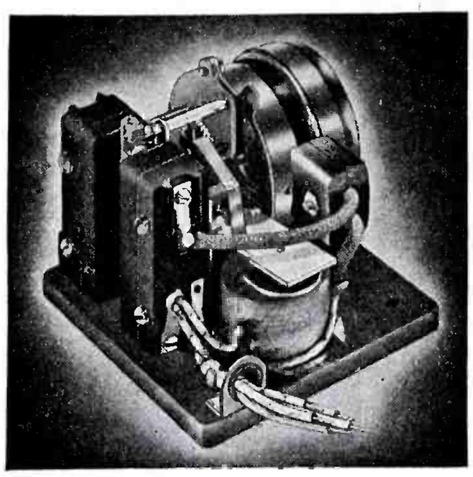
When relay coil is energized, synchronous motor that drives the mechanism functions and

(*Continued on page 74*)

continues to run until delay period elapses, whereupon the motor is disconnected.

Standard relay is equipped with two snap-action switch units, one being used to control the motor, and the other providing up to a single pole double throw contact combination. Available in front connected type, or with 6-32 threaded studs on underside for back connection use.

Standard relay operates on 115 volts, 60 cycles, a-c. Requirement of 7 volt-amperes during delayed action period. Contacts rated up to 10 amperes at 115 volts, a-c, non-inductive load.



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FTR AVIATION GROUND STATION TRANSMITTER

A general-purpose ground station transmitter, type 184, designed for low, high and very high frequency voice and c-w transmission, has been announced by Federal Telephone and Radio Corporation, Newark, New Jersey.

Operates in the bands 200-540 kc, 2-20 mc, and 108-140 mc.

R-f units in the 2 to 20-mc band are rated at 500 watts output; 108 to 140-mc band, output is 200 watts. Operates from a 220-volt, 50-60-cycle single-phase line and is capable of being keyed up to 500 words a minute.

A typical installation permitting simultaneous operation of two r-f units on c-w or one

THE INDUSTRY OFFERS . . .

(*Continued from page 73*)

unit on voice consists of cabinet with keyer and interunit wiring, power supply, a modulator, a local and remote control, and from two to four r-f units according to local operational requirements.

The remote control unit permits channel selection by dialed impulses over a telephone line at a point up to 15 miles away.

* * *

DIAL LIGHT PILOT LIGHT ASSEMBLIES

Pilot light assemblies, series PL-849, featuring built-in resistors, have been announced by Dial Light Co. of America, Inc., 900 Broadway, New York 3, N. Y.

The resistor enables direct connection to 115-volt circuits. Ratings for the resistor are: 100,000 ohms for bright glow; 200,000 for dimmer glow; 270,000 ohms for 220-volt circuits.

Units are approximately $2\frac{3}{16}''\times1\frac{1}{8}''$ overall. Housing is of molded bakelite. Full-view plastic jewel cap permits visibility of glow from all angles. Jewel caps available in 7 colors.

Units are made to house neon NE-51 bulbs. Radio panel bulbs, 47, 44, etc., may also be used.

* * *

KATO BATTERY CHARGING SET

A battery-charging engine generator set using a Briggs and Stratton model VP engine having 2" bore, 2" stroke, one-gallon fuel tank, float feed carburetor, and a gravity feed sensitive fly-ball governor, has been announced by the Kato Engineering Company, Mankato, Minnesota.

On 6 volts, charger charges a maximum of about 80 amperes. Four sets of brushes with two all-brass brush holders on each stud. Charger also available for 12 and 32 volts.

Plant is self-cranking. Engine can be cranked by hand in case batteries are too low. Engine has magneto ignition.

* * *

G.E. V-H-F TRANSMITTING TUBE

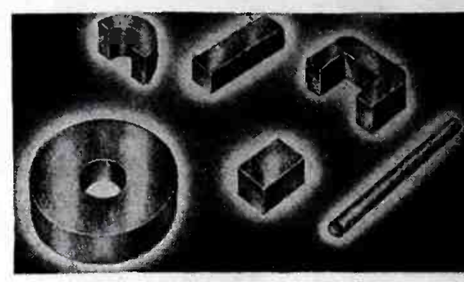
A v-h-f transmitting tube, GL-592, has been announced by the tube division of G. E.

Maximum ratings apply up to 110 mc. Maximum d-c plate voltage rating of 3,500. Maximum plate dissipation rating of 200 watts under class C r-f amplifier and oscillator conditions. Under these conditions the maximum plate input rating is 600 watts.

* * *

STACKPOLE SINTERED ALNICO II COMPONENTS

Sintered Alnico II (licensed under G. E. patents) in a variety of small magnet sizes and odd shapes have been announced by the Stackpole Carbon Company, St. Marys, Pa.



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AIRESEARCH ELECTRICAL CONNECTOR

An electrical connector providing a pressure contact has been announced by the AiResearch division of The Garrett Corp., 9851 Sepulveda Boulevard, Los Angeles 43, Calif.

Employing the WilliamsGrip principle, the connector is said to develop a pressure contact by means of expansion or contraction actuated by a special thread. Expansion or contraction is obtained through the medium of a metal body having the same special thread. When tightened a quarter turn it climbs the connector thread pitch, thereby actuating the male or female shield. This causes a gripping action along the entire contact area.

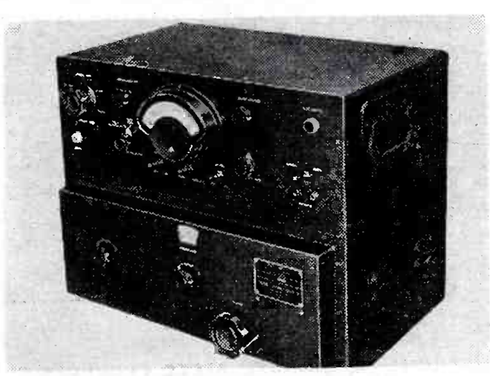
At 100 amperes contact is said to have a maximum millivolt drop of 1.9.

* * *

STODDARD NOISE FIELD INTENSITY METER

A noise and field intensity meter, model NMA-4, with a 100 to 400 mc range, is now being made by Stoddart Aircraft Radio Co.,

6644 Santa Monica Boulevard, Hollywood 38, California.
The r-f amplifier, mixer and oscillator circuits use butterfly circuits.
Stability of calibration is determined by shot noise developed in the plate circuit of the r-f amplifier. Voltage range, 1 to 100,000 microvolts. Field intensity range, 5 to 100,000 microvolts per meter. Size, 15 3/16" high x 21½" wide x 14 9/16" deep; weight, 56 pounds.



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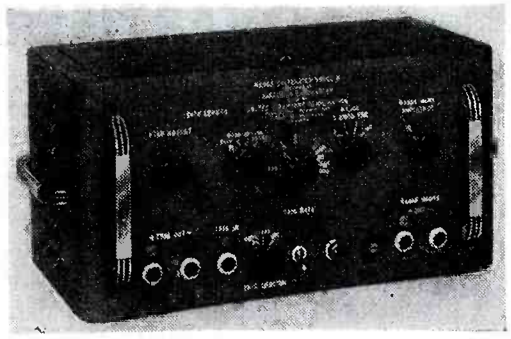
REGAN CENTER-TAP RESISTOR

A center-tap resistor, type CAM, developed by the Regan Engineering Corporation, with a core, machined from a solid piece of steatite, upon which is wound a helical resistance wire element has been announced by the Techtmann Industries, Inc., 828 North Broadway, Milwaukee 2, Wisconsin.

* * *

UNITED CINEPHONE SWEEP CALIBRATOR

A sweep calibrator, model 8127 has been announced by United Cinephone Corporation, Torrington, Connecticut.
Switch permits choice of four different time intervals between calibration markers: 2.5, 10, 50, and 100 microseconds.
Markers have an amplitude of 40 volts, with choice of polarity.
Positive trigger has an amplitude of 120 volts; negative 65 volts. The repetition rate is continuously variable by means of a calibrated control from 2000 to 3000 cps.
Gate is continuously variable duration of 20 to 3000 microseconds. Height, 8" x 16" length, x 7⅞" depth; weight, 23 pounds.



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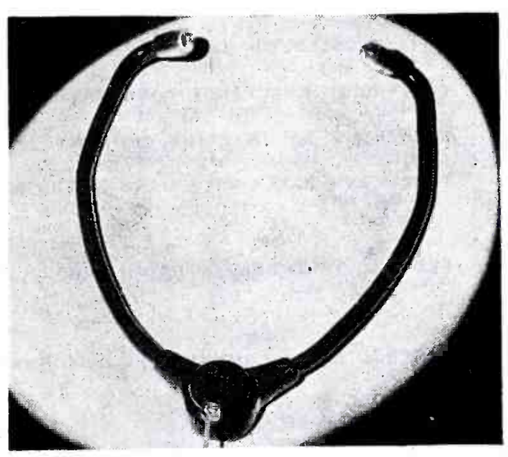
LEWIS POWER TRIODES AND TETRODES

An air-cooled, power triode, 4C32, and v-h-f tetrode, 3023, have been announced by Lewis Electronics of Los Gatos, California, a subsidiary of the Aireon Manufacturing Corporation.
The 4C32, in use as an unmodulated class C r-f amplifier, typical operating conditions are . . . d-c plate voltage, 2000; power output 400 watts. Upper frequency limit of the tube with maximum power input is 60 mc.
Plate and grid connections are made at the top and side of the bulb respectively through heavy copper terminals. Has a 4 pin jumbo bayonet base (metal) with pins extending through a ceramic disc. Overall length is approximately 10½"; maximum dimension along the grid lead axis is approximately 4½".
The 3D23 permits operation up to 2.0 mc with full power input and up to 400 with half power input. Maximum power output is 130 watts (35 watts plate dissipation). May be used as an oscillator or amplifier doubler.

* * *

TELEX MONOSETS AND PILLOW SPEAKERS

Earphones designed to be worn under the chin instead of over the head, have been announced by Telex, Inc., Minneapolis, Minn.
Constructed of tenite, weight, 1.2 ounces. Has removable clear plastic eartips.
The standard unit has an impedance of 128 ohms per receiver and a sensitivity of 18 dyns per square centimeter for 10 microwatt input per receiver.
A pillow speaker using electromagnetic driving has also been announced by Telex.
Magnetic unit said to be capable of handling power inputs in excess of one watt without distortion.
Standard impedances for the speakers are about 100 ohms or 1500 ohms at 1000 cycles.
Speaker diameter, 3⅝"; maximum thickness, 1 3/32". Weight, 5 ounces.
Impedance, model B 2236, 2,000 ohms; model B 2243, 100 ohms.
Sensitivity said to be 5 milliwatts, electrical input.



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CURTIS DEVELOPMENT TERMINAL BLOCKS

Terminal blocks using a metal channel have been announced by the Curtis Development and Mfg. Company, 1 North Pulaski Road, Chicago 24, Illinois.
To insure against terminal screw grounding, the screw holes are not completely through the block.
Kits are being made up of individual terminals together with various length mounting channels.

ADVERTISERS IN THIS ISSUE

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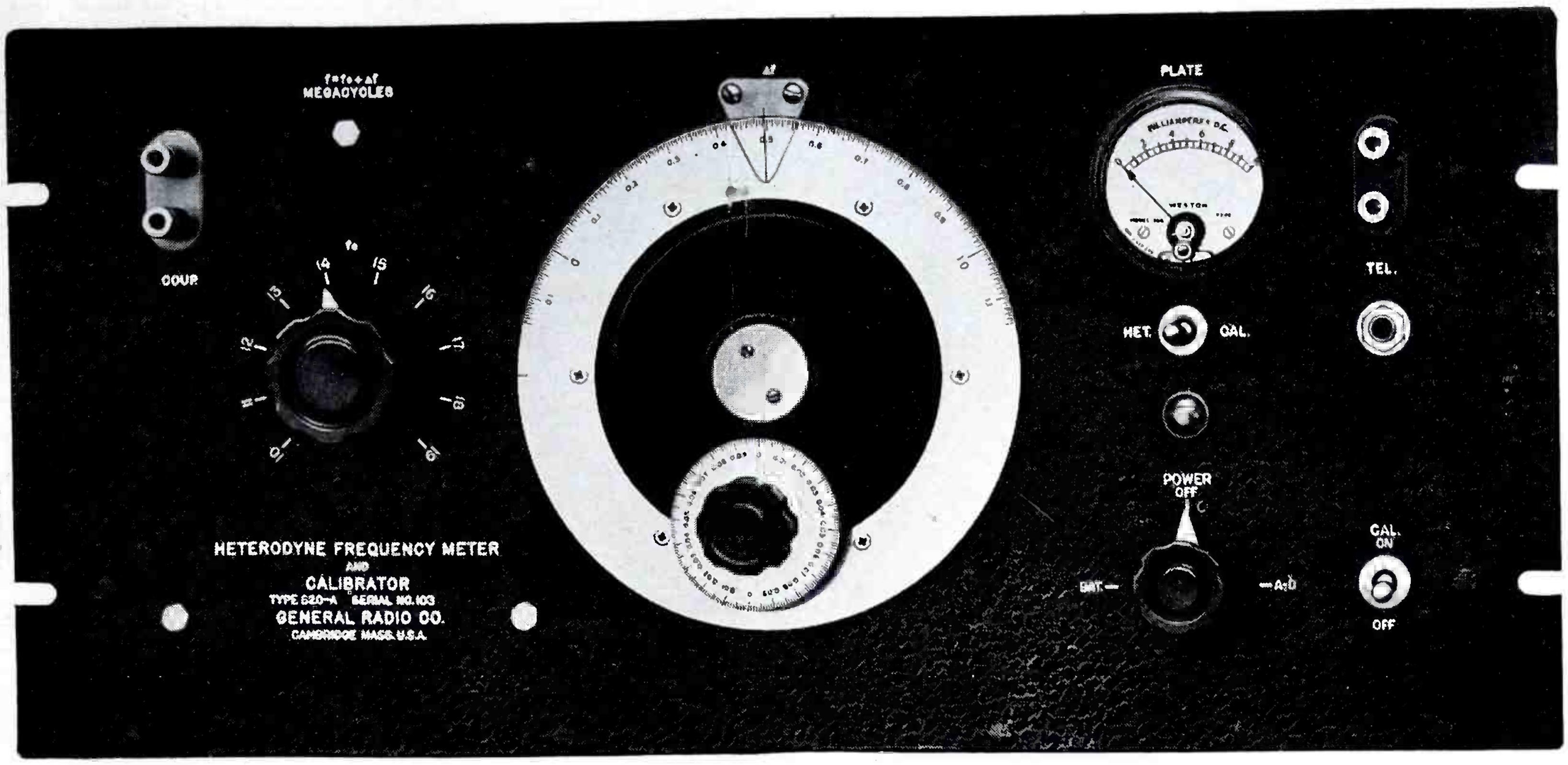
MEGACYCLES
COUP
PLATE
TEL.
HET.
CAL.
POWER
OFF
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HETERODYNE FREQUENCY METER
AND
CALIBRATOR
TYPE 620-A SERIAL NO.103
GENERAL RADIO CO.
CAMBRIDGE MASS. U.S.A.