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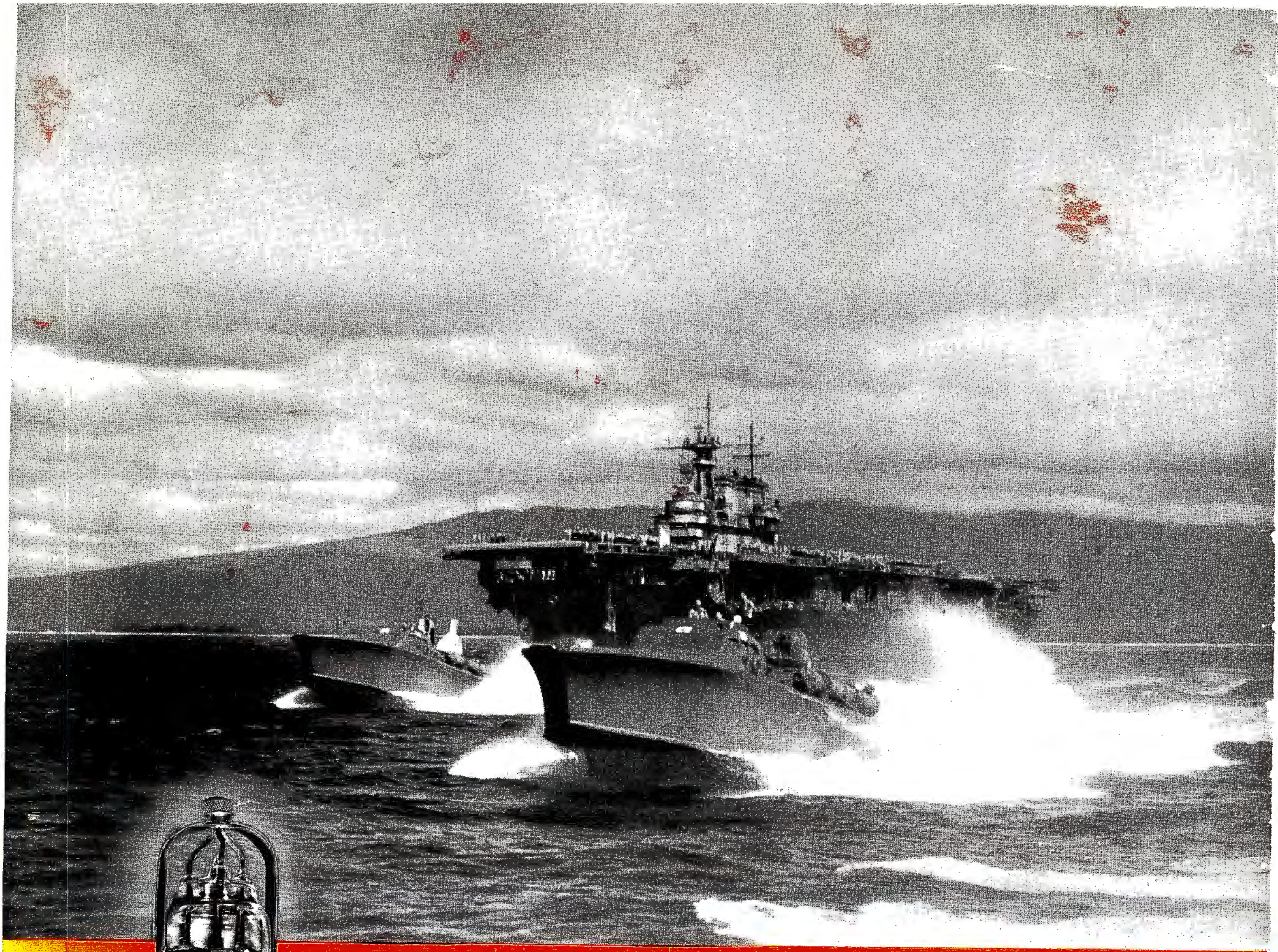

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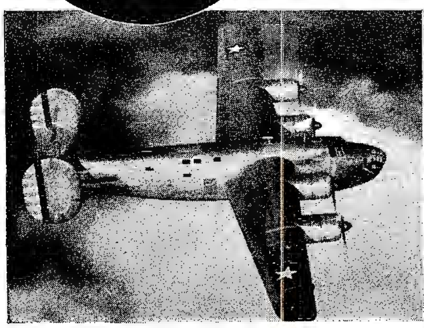

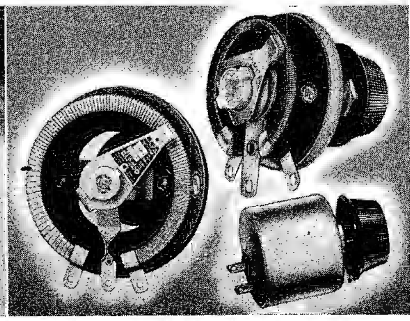

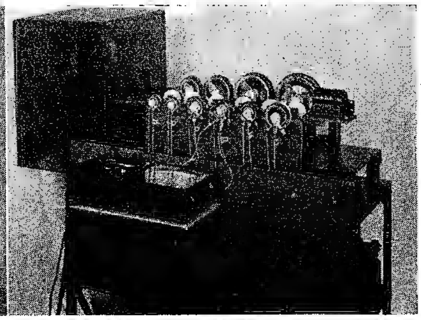

LEWIS WINNER, Editor
F. WALEN, Associate Editor

We See...

THE TUBE-PARTS CONSERVATION POOL, which is now being completed, will reveal a volume of invaluable data . . . data that in many respects will be sensational in its scope. Whether or not the report will be made public is problematical, particularly in view of present conditions. Nevertheless the information will serve to provide the government agencies with the vital gauge to determine the actual status of the industry, so that suitable allotments of materials and tubes can be made in due proportion to the requirements.

According to many station engineers, although the tube problem is not too acute at the moment, it will be, within the next few months, and thus this pool planning method should be extremely useful. Probably one of the gravest problems in the plan, oddly enough, is that of transportation. Even under ordinary circumstances, the transportation of tubes, particularly those that have seen transmitter use, prompted deep concern, notwithstanding the shock proof shipping containers and corresponding care of the truckmen. But today, with shipping facilities at a premium, with speed an essential, all that "care" cannot prevail. To insure this "care," therefore, much of the tube transfer will have to be of a local nature. If long distance transportation is essential, it may be necessary to employ government orders so that "care" will be exercised, even if it means extra space and extra handling.

ALTHOUGH MANPOWER PROBLEMS in broadcast stations have been somewhat alleviated in many sectors, in view of the relaxation rulings of the Selective Service authorities, it is still a matter of grave concern to many, too. There are still many stations that have been hit and hit hard. Take the case of the fairly large station in the South, for instance, whose chief engineer recently wrote . . . "Most of our best technical men have been called to the colors, and with the station understaffed with competent personnel, the load is pretty heavy. . . . Yesterday,

(*Continued on page* 29)

COMMUNICATIONS

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SEPTEMBER, 1942

VOLUME 22 NUMBER 9

COVER ILLUSTRATION

A two-way f-m radio communication system in one of the four emergency ambulances used by the defense units of the Commonwealth Edison Company in Chicago. These cars would go into action in case of an air attack affecting generating stations or other vital centers on the electric supply system.

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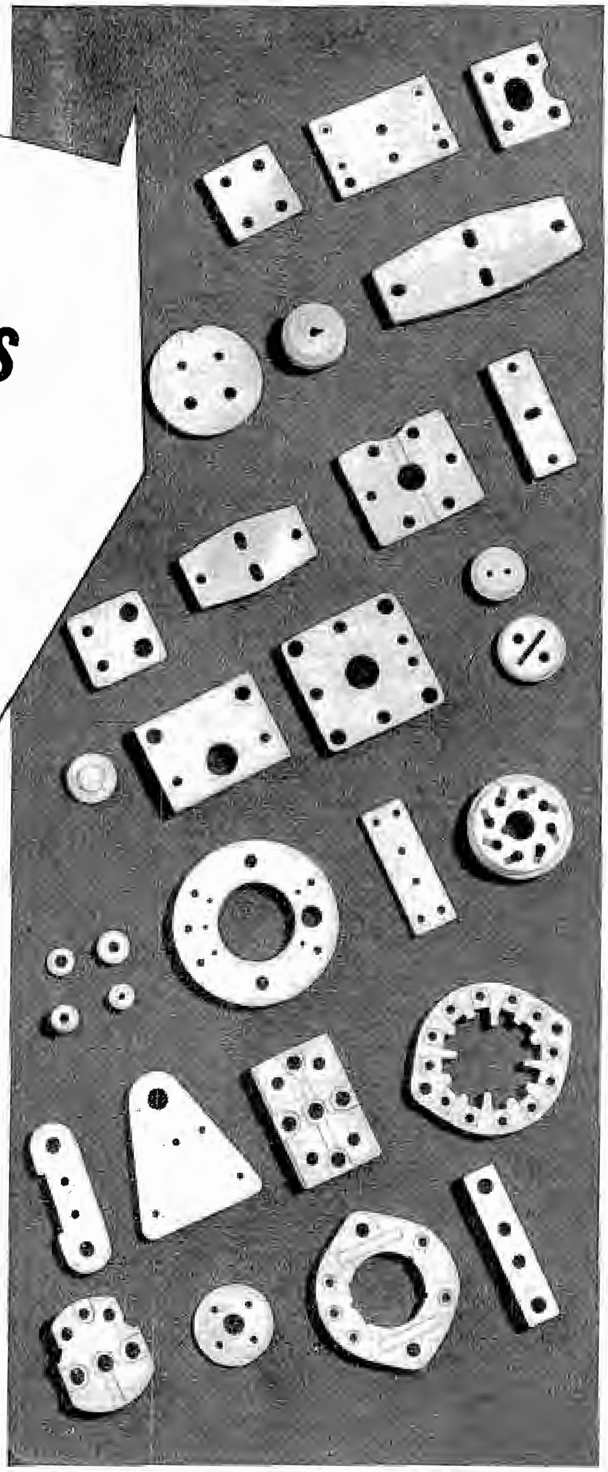
AUTOMATIC MOLDING HELPS SPEED DELIVERY OF ISOLANTITE CERAMIC PARTS



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Contributing to dependable equipment performance is a unique combination of advantages which Isolantite incorporates in a single ceramic body—uniformity of product, high mechanical strength, electrical efficiency and non-absorption of moisture—each an outstanding feature in itself.

Isolantite Inc. invites inquiries from manufacturers concerning production of small pressed parts for war applications.

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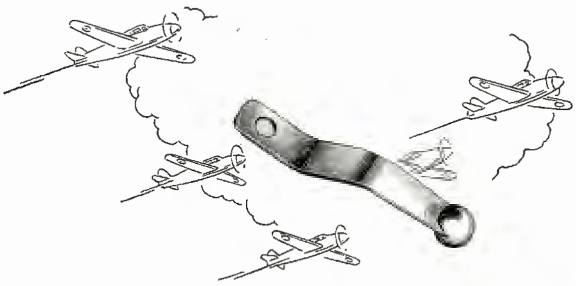
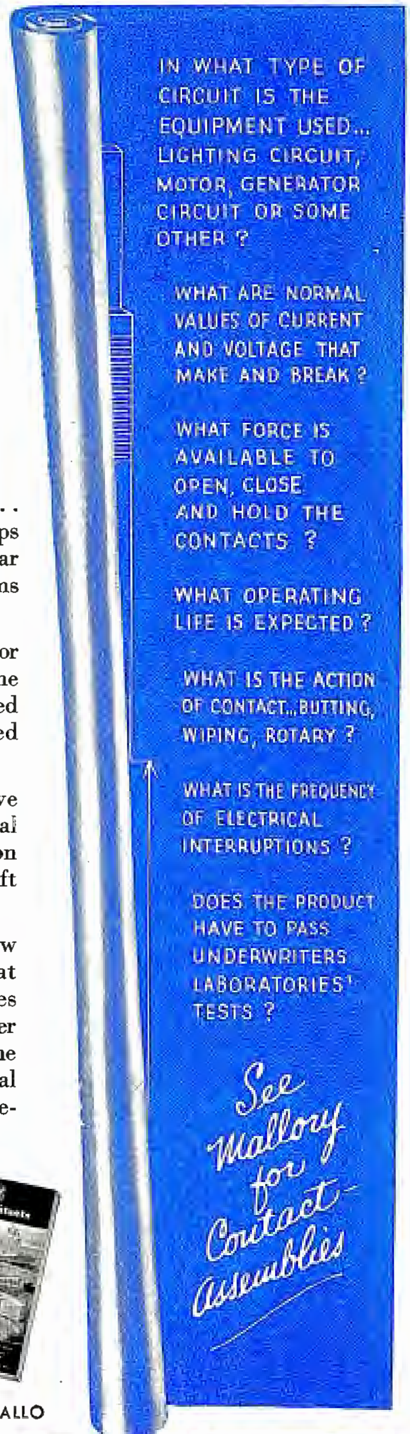


Mallory Contact Assemblies Help Keep 'Em Talking



When a squadron commander and his pilots are communicating aloft . . . or the leader of an armored column is directing his tanks, jeeps and peeps on the battlefield . . . both orders and acknowledgments must be crisp, clear and speedy. A small but vital element in military communications systems is the "send-receive" switch.

While designing a series of these switches . . . ordered in large quantity for combat use . . . the engineers of a leading electrical manufacturer came smack up against what looked like a tough problem. Specifications called for unusual contact assemblies. What to do? "Let's ask Mallory," suggested one engineer.

He had the right idea. Mallory metallurgists and production engineers have had years of experience in designing and manufacturing all sorts of electrical contacts and contact assemblies. Mallory Contacts now spark ignition systems, relays and voltage regulators for "blitz-buggies", bombers, aircraft carriers and other modern weapons.

To solve this particular problem, Mallory engineers developed no new materials nor designs . . . though they've often done these jobs, too. What they did was to devise a *production technique* for turning out large quantities of such unusual contact assemblies as the one shown above . . . with a silver ball as the actual contact. *Results:* Prompt delivery from Mallory of the contact assemblies required . . . Contacts pass rigid electrical and mechanical tests successfully . . . Finished "send-receive" switches are now on the battlefronts of the United Nations . . . *keeping 'em communicating* . . . —V.

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COMMUNICATIONS

LEWIS WINNER, Editor

The Measurement of

DECIMETRIC, CENTIMETRIC AND MILLIMETRIC WAVES

This paper, prepared prior to September 1939, describes an interesting phase of research completed at that time. Due to war conditions, it was not published. It is now presented through the courtesy of the International Telephone and Telegraph Corporation, New York.

by A. G. CLAVIER

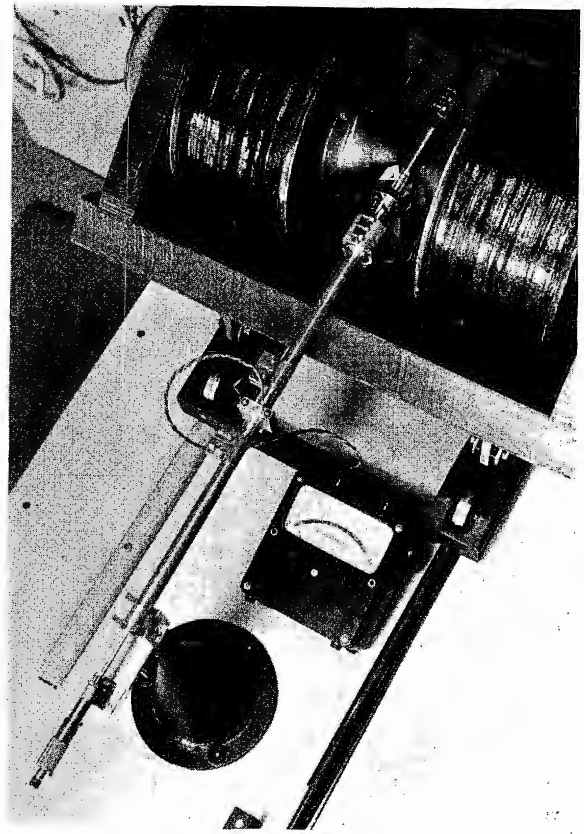


Figure 1
Measurements of wavelength have been made below a centimeter with the device shown here. The wavelength of a magnetron especially constructed for wavelengths of this order required determination. The magnetron sent a H_1 wave into a guide .5 cm radius. A crystal detector was coupled to the guide and connected to the milliameter visible in the illustration. At the end of the guide a movable piston, which had very good h-f contacts with the wall of the guide, was displaced by the micrometer lead.

THE measurement of wavelengths below about one meter presents peculiar difficulties and necessitates the construction of specialized apparatus adapted to this purpose.

Up to the present it has not been possible conveniently to measure these very high frequencies by beating them with the harmonics of an oscillator stabilized, for example, by means of a piezo-electric crystal. With increasing fundamental frequencies, thinner crystals must be used and they consequently become very fragile. If, on the other hand, a much lower frequency is used, it is difficult to produce and amplify harmonics of a sufficiently high degree with vacuum tubes at present available. In this direction a limit is set by the influence of the internal connections and the time of transit of the electrons between the electrodes.[1]

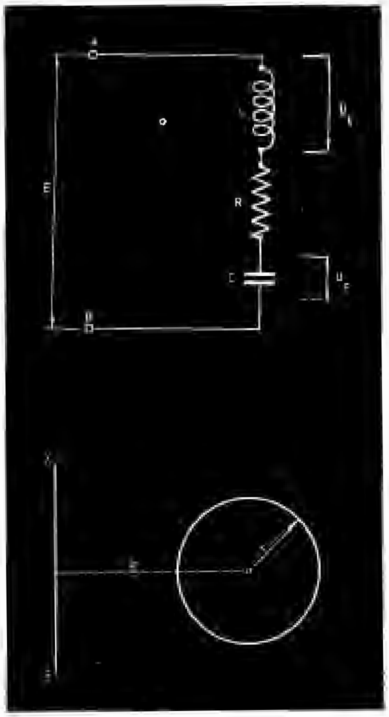
Frquency meters of this kind, nevertheless, could be constructed for the lowest frequencies in the range under consideration.[2,3] The apparatus, however, would be cumbersome and would require delicate handling. In any case, wavemeters of lesser precision are needed for making measurements readily but with adequate accuracy, considering the present state of the art.

Such wavemeters can be obtained by using a high selectivity electric circuit tunable to the frequency to be measured. Association is required with (1) an element capable of being influenced by oscillation on the frequency to be determined, and (2) a detector element arranged to deflect a measuring instrument and to indicate that the tunable circuit of the wavemeter is in resonance.

In the region of decimetric waves, the longest in the field herein considered, it is still possible to construct an oscillating circuit of lumped electrical constants. The selectivity of such a circuit can easily be estimated by means of its magnification factor Q, derivable from low frequency technique. Figure 2 shows a circuit consisting of an inductance L, a resistance R and a capacitance C in series. Between the terminals A and B an emf E of angular velocity ω is applied. For resonance, when $LC\omega^2 = 1$, the current is E/R. The voltage across the inductance and the capacitance are therefore:

$$U_L = \frac{E}{R} L\omega, \quad U_C = \frac{E}{R}\frac{1}{C\omega}$$

These voltages are equal and their



Figures 2 and 3
At top, a circuit for wavelength measurements. At bottom, a torroidal inductance illustration.

ratio to the emf applied to the terminals A, B of the circuit is the magnification factor Q:

$$Q=\frac{L\omega}{R}=\frac{1}{RC\omega}.$$

The magnification factor thus defined also characterizes the selectivity of the circuit. Actually, when not in resonance, the current in the circuit may be represented by the usual equations:

$$\frac{E}{R+j\left(\omega L-\frac{1}{\omega C}\right)}=\frac{E}{R}\cdot\frac{1}{1+j\frac{1}{R}\left(\omega L-\frac{1}{\omega C}\right)} \qquad (1)$$

Let ω_0 be the resonance angular velocity for which $LC\omega_0^2 = 1$. If this velocity is changed by $\delta\omega_0$, where $\delta\omega_0/\omega_0<<1$, the ratio of the current at angular velocity $(\omega_0 + \delta\omega_0)$ to the resonance current is equal to

$$\frac{1}{1+j\frac{\omega_0 L}{R}\cdot\frac{2\delta\omega_0}{\omega_0}}=\frac{1}{1+jQ\frac{2\delta\omega_0}{\omega_0}} \qquad (2)$$

The sharpness of the resonance curve may be estimated by the difference $\delta\omega_0$ for which the current falls to a value $1/\sqrt{2}$ of the resonance current. Thus,

$$\frac{2\delta\omega_0}{\omega_0}=\frac{1}{Q} \qquad (3)$$

An oscillating circuit therefore will be the more selective, the greater the value of Q. Consequently, for a given inductance L, it is necessary to reduce as much as possible the different resistances in the circuit. The preceding analysis, where it is assumed that $\omega\delta_0/\omega_0$ remains $<<1$, does not apply except where the resistance is small compared to the reactance $L\omega$.

The different resistances in the oscillating circuit are:

1)—High frequency resistance of the wire constituting the inductance;
2)—Resistance due to losses in the part of the condenser dielectric subjected to the high frequency field;
3)—Resistances due to radiation of the loop constituting the inductance and radiation of the condensers.

An examination of these different resistances shows that, for wavelengths up to 30 cm, it would be difficult for the magnification factor to exceed a few hundred. Rohde, in the wavelength range of 60-30 cm, gives as an example a factor Q of approximately 100 for a circuit consisting of a copper wire 4 mm in diameter, forming a single spiral 25 mm in diameter. This spiral is associated with a condenser, the plates of which are copper rings 8 mm in diameter; their separation is adjustable by means of micrometer screws. Such a wavementer cannot be easily coupled to the source to be measured, or to a detector suitable for use at fairly high frequencies. From this point of view the best results are obtainable with diodes constructed so that the transit time of the electrons should not be troublesome.[1]

Obviously, circuits possessing greater magnification factors and adaptability are needed.

Butterworth[5] made an investigation of the values of Q that might be expected for inductances of predetermined geometric form. His computations, however, do not allow for losses due to radiation and apply to lower frequencies than those under consideration.

To eliminate radiation, toroidal windings may be used. For a winding of

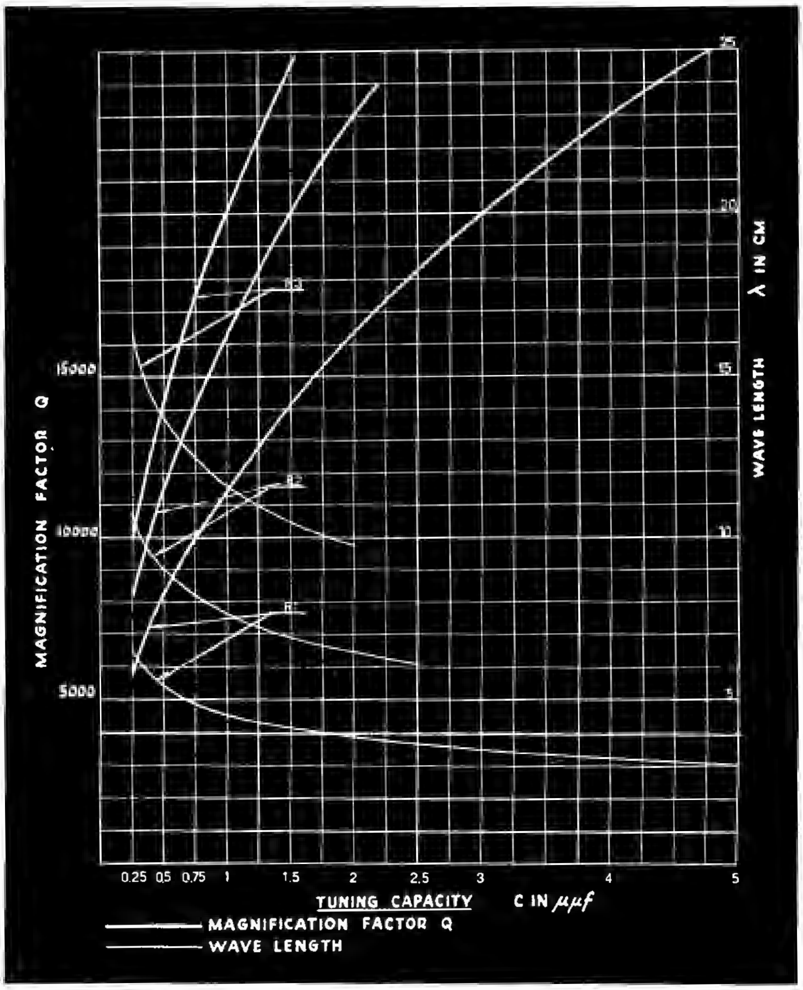


Figure 4
Resonance conditions of tuned torroidal windings.

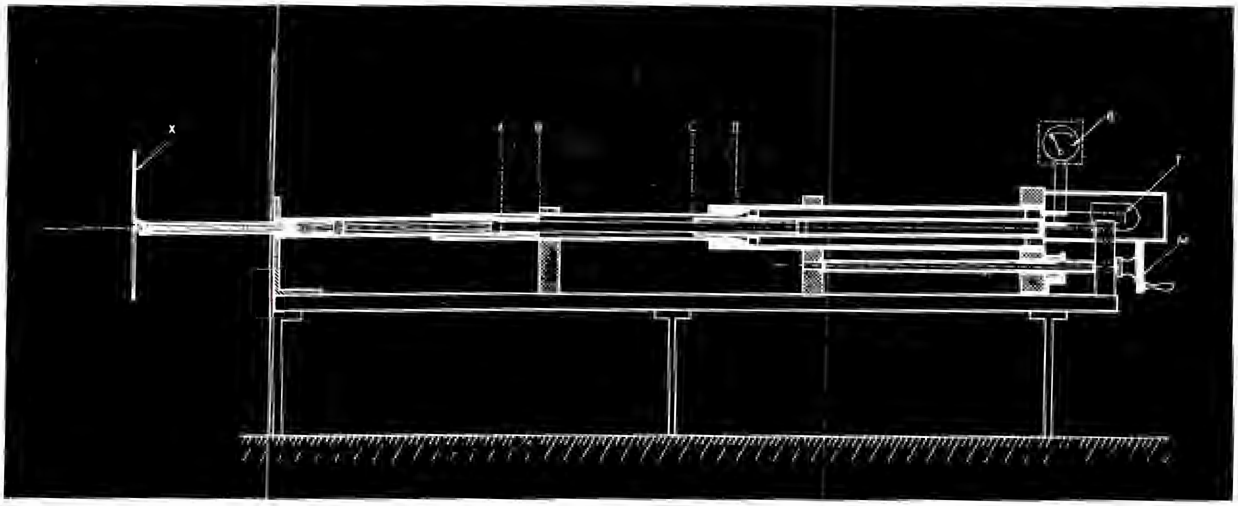


Figure 5
A wavemeter with coaxial lines.

this type, with circular cross-section and with turns touching (Figure 3), the inductance and resistance are given by

$$L = 4\pi N^2[R - \sqrt{R^2 - r^2}] \times 10^{-9} \text{ henries} \qquad (4)$$

$$R_\Omega = 2\pi\sqrt{\rho}N^2 \cdot \frac{r}{R} \cdot \frac{1}{\sqrt{1-\left(\frac{r}{R}\right)^2}} \cdot \sqrt{f} \times 10^{-9} \text{ ohms} \qquad (5)$$

where N is the number of turns and ρ is the resistivity in electromagnetic units (about 1,700 for copper).

Expressing the frequency in megacycles per second (F):

$$Q = \frac{\omega L}{R_\Omega} = 303\sqrt{F} \cdot \phi(r, R) \qquad (6)$$

The function ø, when (R + r) = b is kept constant, has a maximum for r/R = 0.707. For this value

$$Q_{opt} = 52b\sqrt{F} = 89R\sqrt{F} \qquad (7)$$

By adding the resonance condition,

$$L_{\mu H} C_{\mu F} = \frac{25200}{F^2}, \qquad (8)$$

to this equation the curves of Figure 4 result for the case of a single spiral, which is the most favorable condition for very high frequencies. These curves show that it is theoretically possible to obtain magnification factor values very much higher than those given by the circuits previously considered. In practice, however, it is difficult to attain the very low values of capacitance necessary for tuning, and it is even more difficult to vary this capacitance. Finally, difficulties of coupling to the source to be measured and procuring a suitable measuring detector remain very great. This type of circuit is consequently more suitable for very high frequency oscillators than for wavemeters and has been thus utilized in various ways by Kolster,[6] more recently by Hollmann,[7] and especially by Hansen[8,9] in his researches on velocity modulation oscillators at Stanford University.

Circuits with Distributed Constants

The foregoing considerations and the necessity of finding an easy method of calibration in terms of wavelength have led to the use of circuits with distributed constants and, in particular, transmission lines. In the first instance, transmission lines made up of two parallel wires were considered, the systems being known technically as

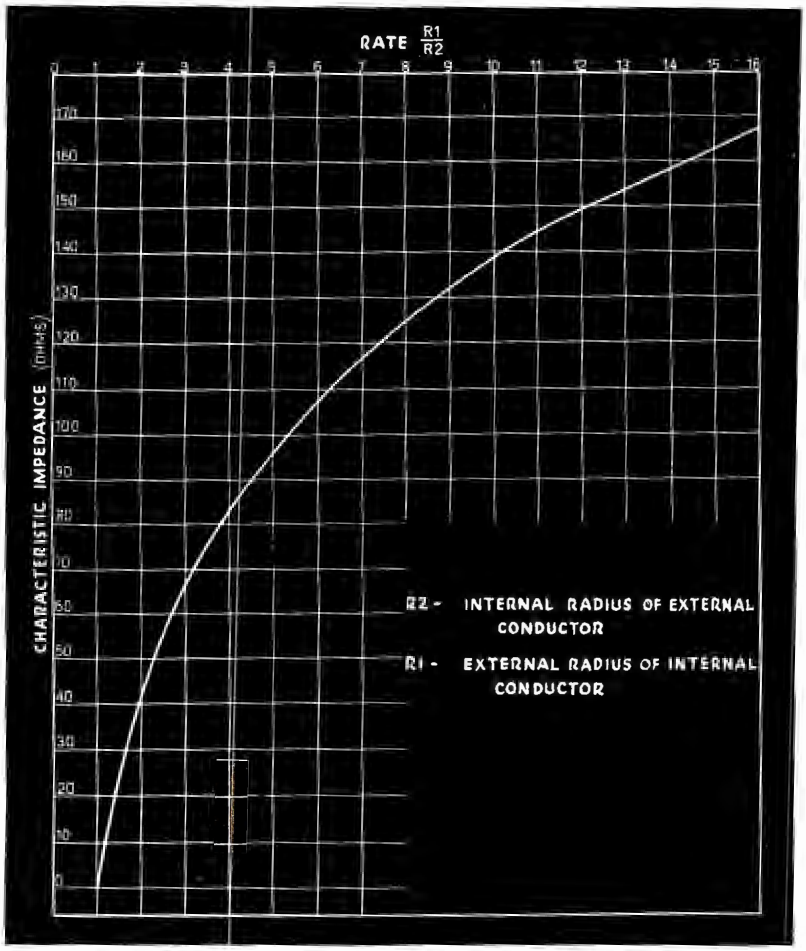


Figure 6
The impedance obtained in measuring internal and external radii.

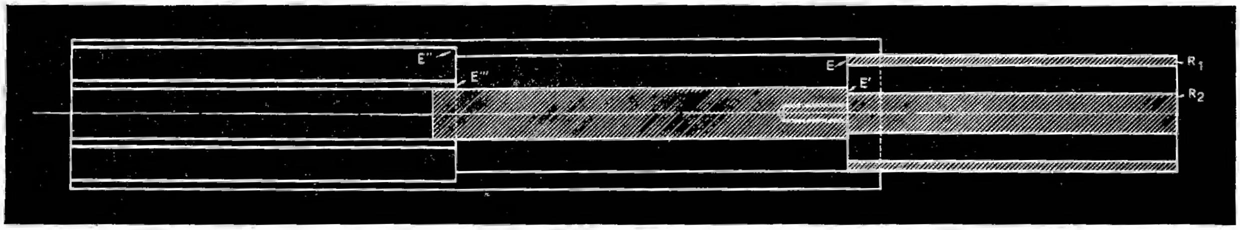


Figure 7
Adjustable line with constant characteristic impedance.

Lecher wires. In a system of this kind with separation between the wires small compared with the wavelength, radiation can as a first approximation be ignored and Kirchhoff's laws applied by assigning line constants R, L, C to the line. For very high frequencies leakage between wires may be ignored.

For such a circuit is is possible to define a coefficient Q which plays the same part, so far as selectivity is concerned, as the magnification factor in circuits with lumped constants. Considering a short-circuited line of length l, calculation gives the input impedance as

$$Z=Z_0\tanh\left(\alpha l+j\frac{2\pi l}{\lambda}\right) \qquad (9)$$

Z_0 is the chracteristic impedance of the line, equal to $\sqrt{L/C}$, and α is the attenuation constant equal to $R/2Z_0$.

The impedance is a maximum for the quarter-wave line; hence

$$Z_{\lambda/4}=\frac{Z_0}{\tanh \alpha l}. \qquad (10)$$

If the attenuation is low, the approximation

$$Z_{\lambda/4}=\frac{Z_0}{\alpha l}. \qquad (11)$$

is obtained.

This expression is not valid unless αl is sufficiently small compared with 1; for an infinite attenuation tan h αl tends to-towards 1, and $Z_{lambda/4}$ towards Z_0.

The frequency f_0 corresponds to a wavelength λ_0 for which the length of the line is a quarter wavelength; changing by δf_0 such that $\delta f_0/f_0$ is small compared with 1, the impedance becomes

$$Z=\frac{Z_0}{\alpha l}\cdot\frac{1}{\left(1+j\frac{\pi}{\alpha\lambda_0}\cdot\frac{2\delta f_0}{f_0}\right)} \qquad (12)$$

The modulus of the impedance then drops from 1 to $1/\sqrt{2}$ for a frequency difference δf_0 such that

$$\frac{2\delta f_0}{f_0}=\frac{\alpha\lambda_0}{\pi} \qquad (13)$$

The quantity $\pi/\alpha\lambda_0$ defines the selectivity of the system and corresponds to the magnification factor.

This expression becomes clearer if the expression for a circuit with lumped constants is written

$$Q=\frac{\omega_0 L}{R}=\frac{\pi}{(R/2L)T_0}=\frac{\pi}{(1/\theta)T_0} \qquad (14)$$

T_0 is the resonance period and θ the time constant of the circuit.

Conversely, replacing α by its expression as a function of the constants of the line,

$$Q=\frac{\pi}{\alpha\lambda_0}=\frac{\omega_0 L}{R} \qquad (15)$$

where L and R are constants per unit of length.

Transmission lines with parallel wires can therefore be used as circuits for the measurement of wavelengths and are especially suitable for decimetric wavelengths. The resonance positions are repeated periodically along the line and their separation gives the wavelength to be measured. Such lines, with variations have been used by numerous experimenters (see, for example, Hund[10] at the Bureau of Standards, and, in France, the theses of Mercier and Laville).

In these measurements the distance between two consecutive resonances is not exactly equal to half a wavelength in air. The phase velocity along the wires is $1/\sqrt{LC}$ and L varies with frequency. As a first approximation it is possible to take (Stéfan)

$$L=L_\infty+\frac{R_\omega}{\omega}; \qquad (16)$$

L_∞ is the inductance per unit length corresponding to a purely surface current distribution at infinite frequency. As R_{omega} is small compared with $L_\infty\omega$,

$$v=c\left(1-\frac{R}{2L_\infty\omega}\right)=c\left(1-\frac{1}{2Q}\right) \qquad (17)$$

approximately, where c is the velocity in air. The error is very small for the frequencies considered in this article.

Lecher-wire wavemeters are in current use for the measurement of decimetric waves. They, however, have the following disadvantages: the higher the frequency the more the line radiates; moreover, it is difficult to localize the excitation at one point of the line, thus making the application of the previous theory doubtful; finally, it is not easy to eliminate effects due to surrounding objects and movements of the operator. It is consequently preferable to use *coaxial lines*. A wavemeter of this type, described below, was designed in 1931 at the Laboratories L.M.T. by the author and one of his colleagues, René Darbord.[11]

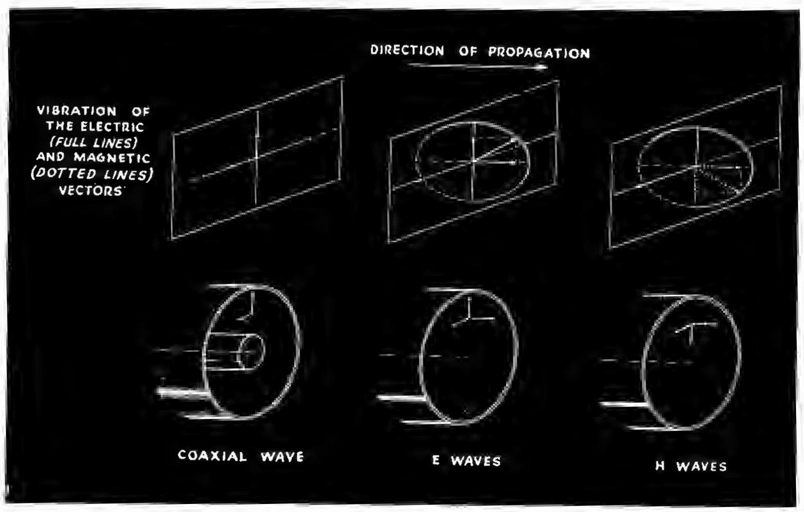


Figure 8
Principal structures of E and H waves and the coaxial wave.

Coaxial-line Wavemeter

The wavemeter illustrated in Figure

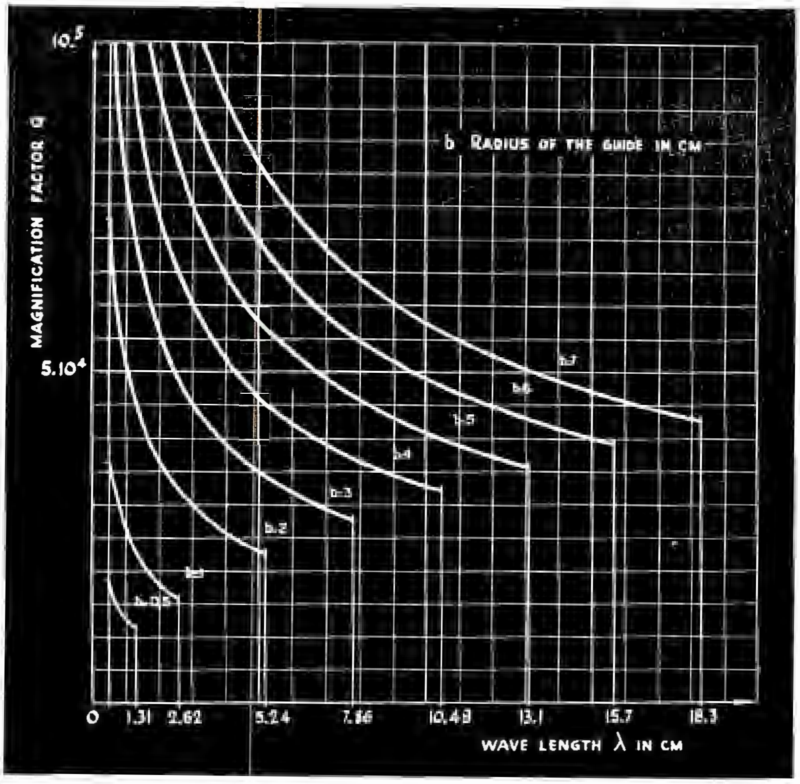


Figure 9

5 comprises essentially a test line BC of length adjustable by means of a micrometer movement M; this line is connected to the antenna X and to the thermocouple T through quarter-wave lines AB and CD. The lines in front of A towards the antenna and behind D towards the themocouple present impedances at A and D which, in order to simplify this description, are assumed to be purely resistive lines (ρ and ρ') adjusted, for example, to a halfwavelength.

Further, let it be assumed that the characteristic impedances of the quarter-wave lines are equal (Z_1) and that Z_2 is the characteristic impedance of the measuring line. Then, in order to obtain sufficient sensitivity, it will be found that the resistances introduced by the coupling with the antenna and the thermojunction are large compared with the resistance of the measuring line, which may be neglected to a first approximation. Under these conditions, if E is the emf induced in the antenna by the source to be measured, the current in the thermocouple becomes,

$$I_\alpha = E\frac{Z_1^2 Z_2}{\sqrt{(A^2\cos^2\beta l + B^2\sin^2\beta l)}}, \qquad (18)$$

where

$\beta = 2\pi/\lambda$,
l = length of the measurement line,
$A = Z_1^2 Z_2(\rho + \rho')$,
$B = Z_1^4 + \rho\rho' Z_2^2$.

The variation of I_{alpha} with l depends on (B — A) which may be written

$$(Z_1^2 - \rho Z_2)\ (Z_1^2 - \rho' Z_2) \qquad (19)$$

Several different cases may arise. In the wavemeter under consideration, Z_3 is made very much greater than Z_1^2/ρ and Z_1^2/ρ'. The current I_{alpha} is a maximum when the measuring line is a quarter wave long. It falls to $1/\sqrt{2}$ of its maximum value for

$$\sin\beta l = \pm\frac{A}{\sqrt{(B^2 - A^2)}} \qquad (20)$$

approximately,

$$l = \frac{\lambda}{2} \pm \frac{\lambda}{2\pi}\,\frac{A}{\sqrt{(B^2 - A^2)}} \qquad (21)$$

Predetermination of the accuracy of the measurement is thus possible. It is advisable to make Z_2 as large as possible, and Z_1 as small as possible.

The quantities Z_1 and Z_2 depend only on the ratio of the internal radius of the external conductor to the external radius of the internal conductor of the coaxial lines. The impedance obtained may be read from the curve of Figure 6.

In the models constructed it is possible to measure the wavelength to an accuracy of one part in 2000. This measurement, just as for Lecher wires, is subject to an error due to the phase velocity along the line not being equal to the propagation velocity in free space. This error is, however, very small at the high frequencies herein considered.

The above analysis strictly applies only under conditions of precise adjustment of all the lines which constitute the wavemeter. But the quarter-wave lines remain effective over a fairly wide wavelength band; the wavemeter operates correctly, for example, from 12-24 cm when the quarter-wave sections are adjusted for 17 cm.

To obtain a measuring line the characteristic impedance of which does not vary regardless of the length used, it is preferable to use the device illustrated in Figure 7. The shaded parts are movable en bloc. The characteristic impedance is constant along the line provided that the steps E, E′, E″ and E‴ are such that

$$\frac{R_1}{R_2} = \frac{E}{E'} = \frac{E''}{E'''}$$

In figures 11 and 12 are photographic reproductions of the coaxial-line wavemeter above described. They show the ease of coupling with the source to be measured and suggest the absence of in-

(*Continued on page* 19)

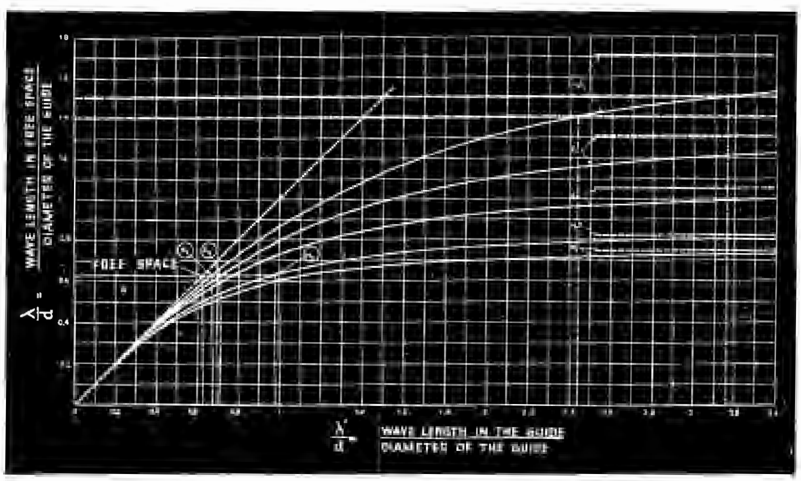
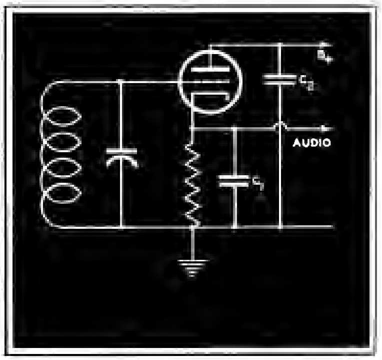
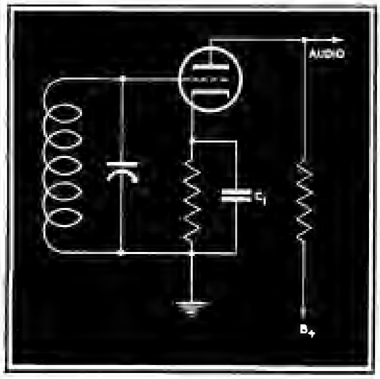
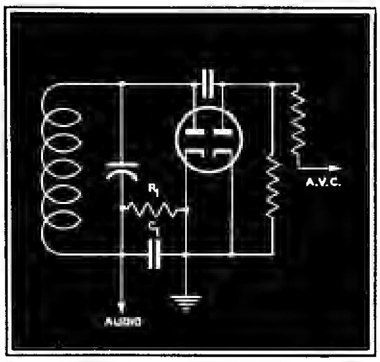


Figure 10

A NEW SECOND DETECTOR







Figures 1, 2 and 3

In Figure 1, top, we have an infinite impedance detector circuit, in which there is no load on the secondary and no avc voltage. C_1 is an r-f by-pass, while C_2 is an r-f and a-f bypass. In Figure 2, center, is a plate detector circuit, with no load on the secondary. Audio distortion is excessive, particularly with high modulation. C_1 is an r-f and a-f bypass. In Figure 3, bottom, we have a diode detector, which loads the secondary, and furnishes avc voltage.

by FREDERICK C. EVERETT
Transmitter Engineer, WTAM

THE diode detector has become quite popular because of its linearity and ability to furnish automatic volume control voltage. It does, however, have the serious disadvantage of loading the secondary of the preceding radio frequency transformer so that most or all of the gain and selectivity contributed by that transformer is lost.

Other detectors can be used, such as the plate detector and the "infinite impedance" detector, but they both have the disadvantage of failing to provide the automatic volume control voltage. This means that a separate amplifier and diode must be used for avc with the attendant complications. The plate detector is not as linear, and the infinite impedance detector is possibly slightly better than the diode, from the distortion angle.

Presented here is a detector which affords the advantages of diode detection, and is shunted across an impedance in the cathode circuit of a triode. By means of a suitable arrangement it is possible to use the regular triode-diode combination as it is available in the many prototypes, with a common cathode. This makes it possible to use a standard tube, available for many filament voltages and easily obtainable.

The gain through the triode section is one, so that no amplification is obtained through that portion of the tube, but the actual overall gain goes up because the reflected load into the plate of the preceding r-f amplifier is higher, since this detector also has an "infinite impedance" input. This means that the selectivity is also considerably increased.

The presence of two diode plates in these tubes makes it best to utilize one to deliver the audio voltage and another to supply the avc, easing the filter requirements, aiding the stability of the receiver and avoiding the loading of the diode, which would cause distortion. However, both audio and avc voltages may be obtained from a single plate if only one is available. Actually the circuit shown (Figure 4) is stable and on a receiver in which the circuit was

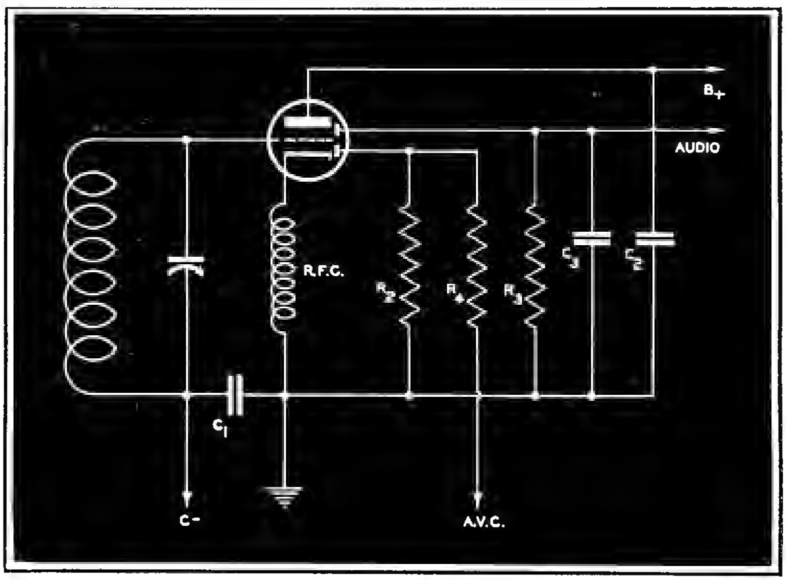


Figure 4

The new circuit, with no load on secondary. It furnishes avc voltage and affords low distortion. C_1 and C_2 are r-f and a-f bypass capacitors. C_3 is an r-f bypass. R_2 and R_3 are diode loads, while R_4 is a filter resistor.

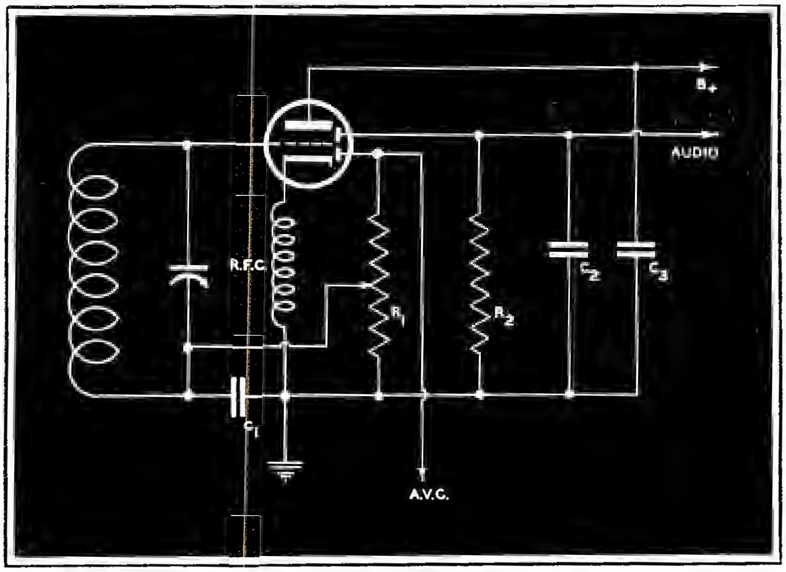


Figure 5
Obtaining the triode bias from avc voltage.

first tried it gave no difficulty whatsoever. Some were expected since the receiver had shown itself to be intolerant of several predecessors of this detector circuit. When two stages of i-f are present, the cathode choke coil has to be shielded and the other parts located with some care, as would be expected in any circuit of equivalent gain.

This circuit prevents the diode from loading the input transformer because the triode grid is kept at a negative potential greater than the incoming peak signal voltage. In the diode detector, during the time the anode is positive, electrons flow to it, representing a flow of current. This prompts the tuned circuit to deliver power, representing loading of the circuit. This is also true in the case of a "grid" or "grid-leak" detector where the grid is allowed to become positive and attract electrons. Plate detectors and degenerative plate detectors have sufficient negative bias so that the grid does not go positive. In the circuit presented, the diode is across the cathode coil and thus there is no load in the tuned circuit. However, the grid voltage is varied at a radio frequency rate and the plate current variations correspond to the grid voltage excursions and the plate current flows through the cathode impedance which provides excitation for the diode. Degeneration prevents any amplification through the tube.

Since cathode bias cannot be used without biasing the diodes, a source of negative bias must be supplied. This may be present in the receiver without any additions. Of course, a bias cell may be used or a small dry cell. A filtered resistor in the negative power supply lead will give a few volts, or part of the avc bias may be used as shown in Figure 5, although this has obvious disadvantages.

Where a separate 6H6 or similar tube is used as a detector this circuit can be substituted in an existing receiver with minor changes in the wiring. With a new design it presents no problems.

If economy of equipment is necessary to decrease cost or increase portability, it is possible to reflex the circuit and use the triode portion as the first stage in the audio amplifier at the same time, since this is the usual arrangement in receivers. A suggested circuit is shown in Figure 6. This would make it possible to adapt an existing set with a diode-triode already used as a detector first audio amplifier. The troubles usually attributed to reflex circuits would be expected, but one disadvantage may be avoided by proper design. This difficulty with reflex circuits is the propensity towards overloading of the tube when maximum values of r-f and a-f voltages are present at the same time, since the straight line portion of the negative grid voltage region is limited. However, in this type of reflex circuit, by using a tube with a triode section of the low mu type, such as a 6R7, a rather larger straight line portion is available with penalty.

The size of the cathode coil will vary with the i-f frequency; the inductance will have about the same magnitude as the i-f coil inductance for the frequency being used. Too large a value can be expected to give oscillation, although some "negative resistance" might assist the gain and selectivity where allowable.

Obviously in a new design, best results can be obtained by using a transformer designed to work into a high impedance—not a diode transformer. Then the design can be for maximum selectivity, or maximum gain, or whatever combination is desirable for the receiver application and characteristics.

A detector of this type, together with the powdered iron inductances now available may prompt a return of the radio frequency amplifier receiver at broadcast frequencies, when receivers are manufactured again. Under the former conditions, since the input was loaded by the antenna and the output

(*Continued on page* 34)

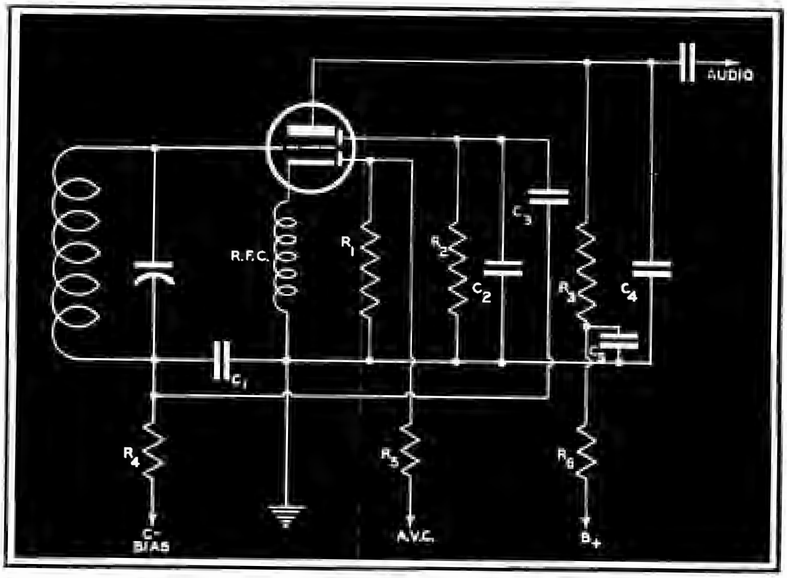


Figure 6
A reflexed detector and first audio circuit, wherein C_1 and C_2 are r-f bypass high audio impedance capacitors, and C_3 is an audio coupling unit.

AIRCRAFT COMMUNICATIONS

by CHARLES W. McKEE

Supervisor of Aircraft Radio, Eastern Air Lines, Inc.

IN view of the many vital services aircraft communication equipment must provide, many unusual developments will be found in such equipment. One of the most representative assortments of such unique developments is found in the Bendix communication unit (RTA—1 . . . ARINC, 508).

This is the first of a series of analyses of aircraft communicotion equipment and components. Serving as an advisory editor for this series is Frank Melville, world-famous transatlantic aircraft communications expert, and president of the Melville Aeronautical Radio School.

This unit is a combination ten channel 50-60 watt radio telephone transmitter and receiver, self-contained, but complete with receiver and transmitter dynamoters. Included in this unit is a ten channel frequency selector, which can be operated manually from the panel of the unit or electrically at a remote control position.

Transmitter Features

The frequency coverage of the transmitter is from 2,500 to 13,000 kc in ten fixed crystal controlled channels. It is possible to set up any channel on any frequency within the range. The power output is 50 watts, 100% modulated carrier power minimum, between 2,500 and 13,000 kc., power measurements for rating purposes having been made with a dummy load of 20 ohms and 400 mmf.

An antenna matching system is provided to couple the transmitter to antennae of resistance 1 to 100 ohms and reactance 100 ohms inductive to 300 ohms capacitive.

The audio input impedance for the microphone is 100 ohms. Sufficient gain is provided to fully modulate the transmitter with an input of .4 volts. A d-c supply for a carbon microphone is provided.

Overall Audio Response

The overall audio response is substantially linear (plus, minus 3 db.) from 500 to 3,000 cycles and cuts off beyond these limits. The response is down at least 20 db. at 100 cycles from the 1,000 cycle value. At 1,000 cycles, the distortion is 10% mazimum at 95% modulation.

The modulation used is high-level audio applied to the Class C final r-f amplifier.

Receiver Features

As in the transmitter, the frequency range is from 2,500 to 13,000 kc. in ten fixed crystal controlled channels, and it is possible to set up any channel on any frequency within this range. The intermediate frequency is 455 kc.

The attenuation of image and all other undesired frequencies is 60 db. or greater up to 10,000 kc., and not less than 50 db. above 10,000 kc. The sensitivity is such that an input of 2 microvolts modulated 30% at 400 cycles will produce an output of 50 milliwatts at a signal to noise ratio of 6 db. Measurements were made using a dummy antenna consisting of 100 mmf. capacity in series with the signal generator.

An automatic volume control is provided which will hold the output constant within a total range of 6 db. for an input variation from 2 mv to 0.1 volt. The received does not block at any input up to 10 volts.

In the output, two independent channels supply 300 milliwatts each to a 500 ohm resistive load. The maximum permissible harmonic distortion is 15% at 1,000 cycles when supplying full rated output. Crosstalk between channels is down at least 50 db. for all frequencies (below 3,000 cycles) audible in the headphones.

The overall audio response is substantially linear (plus minus 3 db.) from 300 to 2,500 cycles.

The Turret

Positioned in the turret for each frequency channel are the crystals and

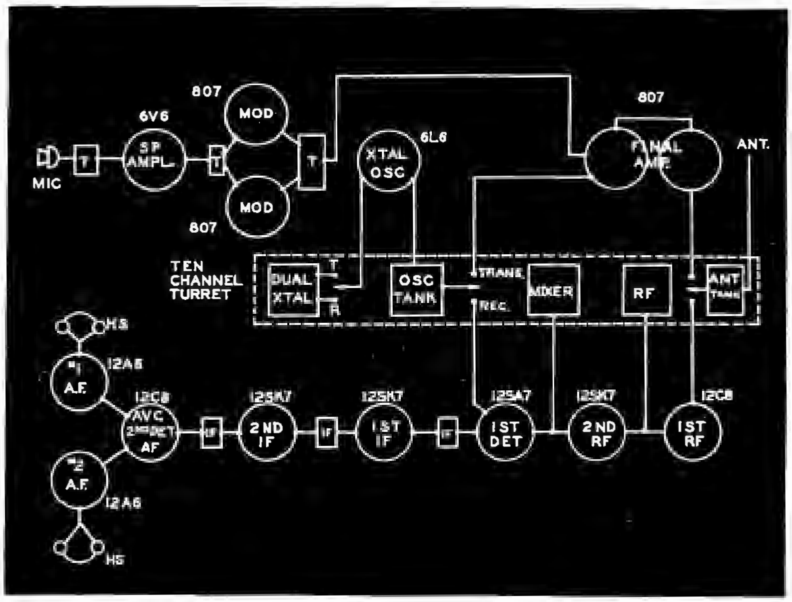


Figure 1
Block diagram of the 508 Unit.

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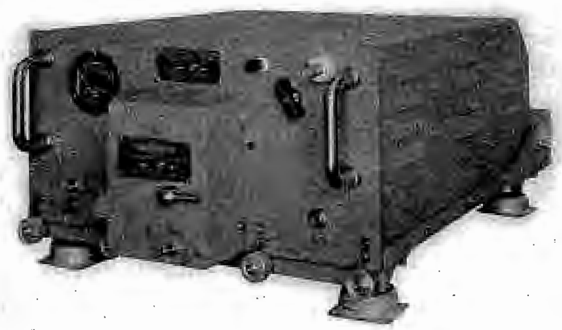


Figure 2

The RTA-1A high frequency communication unit with its apparatus mount. This is the complete transmitter and receiver. In the center of unit is the channel selector, affording ten frequencies.

coils. A dual crystal holder, containing the transmitter crystal and the receiver crystal is employed. The latter is 455 kc below the carrier frequency. The crystals used in the 2.5-7.0 mc region operate straight through on the assigned frequency. Channels that operate above 7.0 mc use a crystal one-half the transmitter carrier frequency and receiver crystals are one-half of (f-455). Located on the turret and adjacent to the crystal socket (facing the front of the unit, the associated switch is to the left of the crystal holder) is a two-position switch.

One of the two positions is marked "S" and the other "D," which designates the connection for fundamental (S) and double (D) frequency operation. The next section in the turret from the crystal section is occupied by the oscillator plate tuning coil. An iron core arrangement is used to tune the inductance. The receiver first detector (mixer) and second r-f coils occupy the next two succeeding sections and are also tuned by the use of an iron core.

The final tank coil is common to both the transmitter and the receiver. The two micalex discs (forward and rear) of the turret front section are used to support the output coils.

Receiver Analysis

The receiver, a superheterodyne, has as its first r-f and input limiter, a 12C8. The 2nd r-f has a 12SK7. In the mixer (1st. det.) is a 12SA7; 1st i-f uses a 12SK7; 2nd i-f uses a 12SK7; 2nd det. avc and 1st a-f uses a 12C8, and in the dual a-f output, are 12A6 tubes.

The Input Tuned Circuit

The input tuned circuit employs the tank coil that is used during the transmission period. A variable capacitor is provided to compensate for the difference in capacity when the antenna circuit is switched from the transmitter final stage plate circuit to the grid circuit of the first r-f stage of the receiver. The control for this adjustment is accessible underneath the chassis. The adjustment is made for maximum receiver gain after the tank circuit has been properly adjusted in the transmit position.

The first r-f stage includes an input voltage limiting circuit. Diode plates of the 12C8 are connected directly across the tuned input circuit. Normally these diodes present no load to the circuit because of the bias voltage developed in the cathode circuit. With high input signal voltages, greater than the bias voltage, rectification takes place. This provides a leveling action which greatly delays the ultimate "blocking" of the receiver. A resistor supplies the diode bias from the heater circuit, which provides a diode load of as low resistance as possible, while a mica capacitor provides the r-f by-pass. An electrolytic capacitor provides filtering which prevents dynamotor ripple or other audio that may be present on the heater circuit from modulating the received signal at the point where limiting action begins. Incorporating the signal limiting circuit feature in this receiver permits operation of the aircraft station near the ground transmitter without the receiver becoming blocked.

The second r-f and mixer stages are conventional except for the coupling elements, which are single tuned circuits in the plates. The grid bias to the 1st and 2nd r-f and the mixer tube is supplied by means of 1 megohm resistors. This arrangement is used because of its simplicity in contact requirements, flexibility in frequency range and complete freedom from troubles due to undesired primary resonance points.

The cathodes of the 2nd r-f mixer and i-f stages are grounded. Cathode resistors and capacitors are eliminated and the stability of the receiver improved by this means, in addition to requiring fewer parts.

The two i-f stages are conventional with individual filtering of each plate and grid circuit. In construction, all the radio frequency sections of these circuits, insofar as possible, have been included in the i-f shield can assemblies to minimize feed back and for sake of compactness. The i-f transformer assemblies are provided with variable coupling capacitors. Each coil of an assembly (primary and secondary) are individually a closed magnetic circuit as it uses a closed iron core. Inductive coupling is not used. With this design it is possible to realize the desired selectivity characteristics because the coupling is independent of the inductance adjustment.

Transmitter Analysis

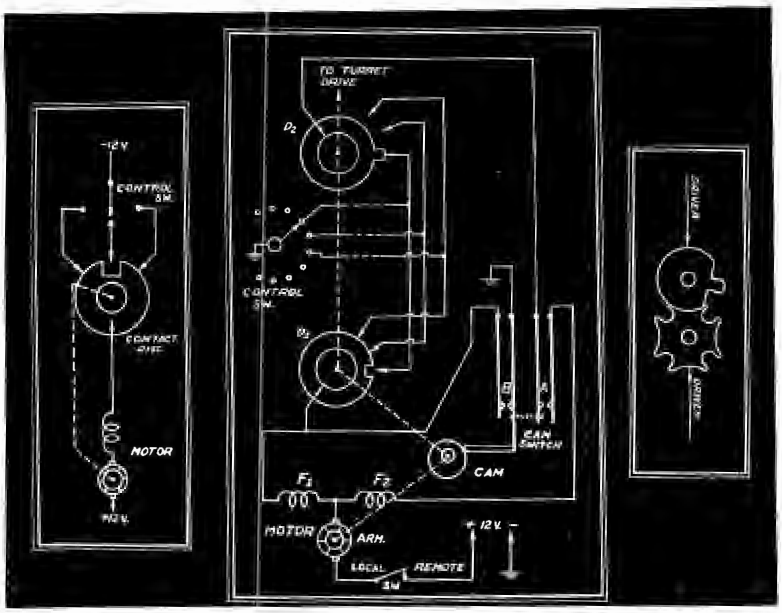
The transmitter section employs a conventional circuit. In the speech amplifier is a 6V6. The push pull modulator uses 807's; the oscillator uses a 6L6 and the final amplifier (parallel) uses 807's.

A 6V6 is used for the class "A" speech amplifier. The microphone d-c is supplied through a filter choke, with the d-c being blocked by a condenser so that microphone audio only is supplied to the input of the micro-speech amplifier transformer. The speech amplifier drives the push-pull connected Class "AB2" modulators which "plate modulate" the final "class C," r-f stage.

A series antenna condenser is provided for use at frequencies where the antenna becomes inductive. The antenna condenser is automatically used or discarded by the setting of the antenna condenser contact (on the turret)

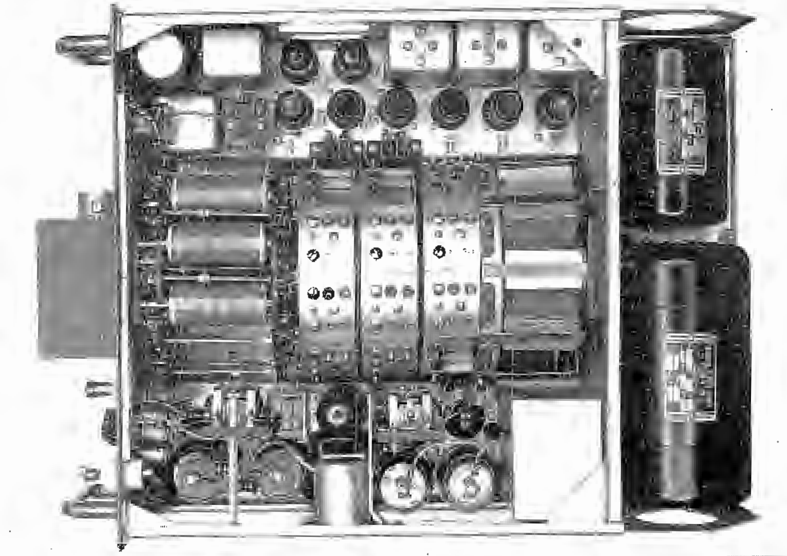
Figure 3

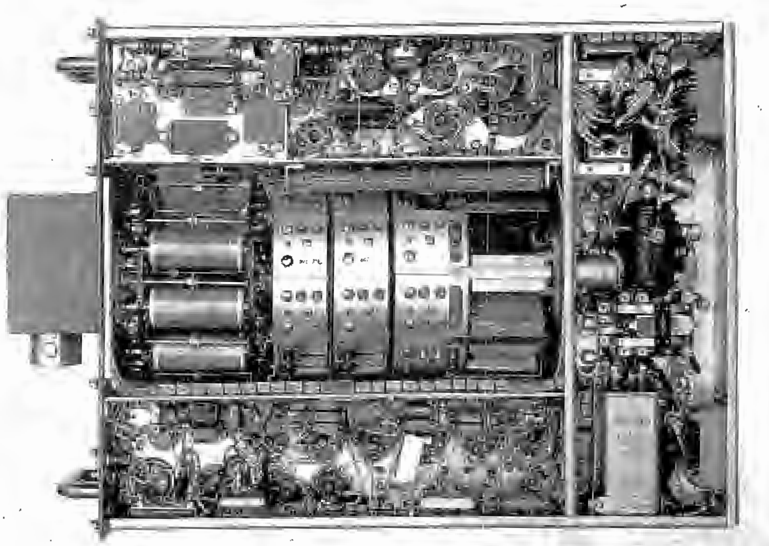
The RTA-1A communication unit front panel, with the cover of the channel selector removed. This selector may be manually operated, or from a remote point. One revolution of the handle per channel is required for manual operation.



Figures 4, 5, 6, 7 and 8

Figure 4 (extreme left) illustrates the basic principle of the frequency channel selector motor circuit. By means of a mechanical drive, through the proper gear reduction, the motor drives the contact disc. Stationary contacts are positioned about the disc. The motor circuit is broken when the open motor is in line with the contact circuit, selected by the control switch. In Figure 5 (center, left) is the motor circuit with a second disc, also a cam operated switch and split motor field. This method will correct over-ride and will cause the turret to return to its predetermined selected position. Figure 6 (left) illustrates a Geneva gear, through which the power to rotate the turret is applied. Figure 7 (below, top) illustrates a top view of the unit, while in Figure 8 (below, bottom) appears a bottom view of the compact self-contained receiver-transmitter.





for any particular channel.

A shunt plate tank coil condenser is used on the lower frequencies (usually lower than 5 mc) to change the l/c ratio for the purpose of suppressing harmonic radiation. This condenser is automatically used or discarded by the proper setting of the turret contacts on any particular channel.

The Oscillator Circuit

A 6L6 tube used in a crystal oscillator circuit serves a dual purpose; excitation for the final stage during the transmission interval and receiver heterodyne oscillator during the time of reception.

The crystal oscillator circuit is a conventional Miller type for fundamental frequency operation. For doubling a modified Pierce type is used. In the latter type the quartz plate is across the 6L6 grid and screen grid, since the cathode circuit offers a high impedance (with the cathode condenser open circuit) and the screen is at r-f ground potential.

With one side of the cathode condenser connected to ground, the quartz plate is connected across the grid and cathode, as the cathode is placed at ground r-f potential. This is a Miller crystal oscillator circuit.

A small switch is provided on the crystal mounting plate on a rotating turret which selects the type of crystal oscillator circuit to be used. The Miller circuit is used on transmitting frequencies between 2.5 and 7 megacycles where the final output frequency is the same as the crystal frequency. The modified Pierce circuit is used where the output frequency is twice the crystal frequency. The crystal oscillator plate

(*Continued on page* 30)

Broadcast Station

SAFETY, SABOTAGE—PROTECTION DATA

by DONALD PHILLIPS

IN broadcast station operation today, safety precautions must be considered as one of the essentials. It does appear as if such a phase of operation is microscopic in importance, but oddly enough it is these tiny, unimportant rules of the day that have the annoying habit of rolling up and creating major disturbances at the most vital moments.

Fortunately, most station directors have begun to sense the importance of these precautions, judging from the increasing phone calls received by operating engineers of many of the larger stations . . . phone calls asking for data on apparently petty safety bits. Many asked, however, for printed lists of codes to follow. Unfortunately no printed list of these safety notes has been available, and thus a compilation of these precautions was made after visits to many stations. This compilation appears below. Many of the rules are presented, not only because of their precaution value, but because of their organization usefulness. This is particularly true in those instances wherein police, parking and the use of firearms is concerned.

The Protection Code

(1)—It must be remembered that private officers, who are hired to protect property, are employees of the company. Therefore, they must not be allowed to wear their uniforms when they leave the property. Their jurisdiction covers the station area only. The wearing of the uniform outside this area tends to usurp the authority given to them, confuse the local authority, and create civil policing problems.

(2)—All glass panel doors should be replaced with wood doors or similarly non-shatter type material. The heavier and sturdier the material the better.

(3)—Heavy hickory, oak or metal old-fashioned drop bars should be provided for inside of all doors, particularly those doors leading to vital offices, studios or instrument rooms. Warning instructions of operation must appear on all doors, such instructions to be large type, that can be read at least two feet away.

(4)—Telephone contact between inside transmitter house and outside guard house must be established. Identifying warning signals between these two points should also be established.

(5)—All instructions should be written out—typed preferably—correctly signed and understood by all. Where instructions are involved, or concern several persons, not only should meetings or conferences of study be held, but actual rehearsals should be held, too. Don't assume that the recommended procedure will work, until you have tried it, and until it works effectively. It might sound well, but not operate as well, so be sure you give it the trial test.

(6)—A loaded sawed-off shot gun and ammunition should be provided for the staff, for use, of course, in the emergency. That rehearsals are necessary here, is evident. It is even wise to conduct tests with blanks, to be assured that everyone concerned with the use of the guns will know what to do, when the test comes. There can be no time for guessing or fumbling.

(7)—A permanent register of all persons who enter the premises, the date, time, and also the license numbers of the cars in which the visitor may be riding, should be kept. This register should be filed away and made available to only executives or other accredited personnel.

(8)—No cars of visitors should be allowed anywhere near the stations. And, of course, no parking should be allowed near the station. It is possible for a saboteur to install a fuse and time bomb under the car unnoticed, using the car as a shield.

(9)—All persons entering the station with packages must surrender such packages at the gate, unless the packages are opened and carefully inspected and checked. As a rule, this inspection procedure is a lengthy one and subject to disputes between the gate watcher and the visitor. It is prudent to require the checking of the parcels at the gate. And as an added precaution, such packages should be inspected.

(10)—Delivery of packing cases into the building proper should be forbidden. They should be inspected and checked elsewhere. This is a drastic step, but essential, since it provides a convenient way to avoid trouble.

(11)—Not only should the history of each employe be checked carefully, but data on the birth certificates should be kept on record. Check with the local authorities on the styles and types of certificates issued, to become familiarized with authentic types, particularly in large cities, where the employe-to-be, is a resident. The local government authorities can assist in instances where there is doubt of authenticity.

(12)—Beware of the activities of the charwomen and cleaners. Many are floaters that must be closely investigated.

(13)—Beware of the "beautiful woman." This is probably one of the oldest warnings ever made, but nevertheless, it requires offtime repetition, and should not be taken with a shrug of the shoulders and rapid dismissal.

(14)—Every precaution should be taken to guard against the possibility of saboteurs transmitting messages over your own wire circuits to transmitters. There are a variety of methods than can be used. Some involve automatic warning circuit arrangements, some call for code signal warnings. There are other instantaneous warning methods that most operating engineers know thoroughly.

(15)—No confidential information should be given over the telephone, even if the wire is a private wire. Put the message in writing, or better yet, supply the information directly and confirm the conversation with a memorandum that should be directly handed to the visitor.

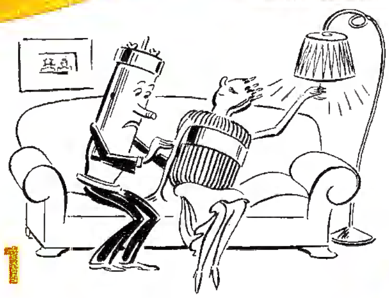
(16)—Everyone should be trained to be alert to the unusual. Such training should not only be in the form of typewritten instructions, but in the form of classroom instructions, in addition to actual demonstrations. The calling in of experts to explain various phases of possible trouble, should also be a frequent custom in the classroom procedure.

(17)—Institute checkups on the employees from time to time, by the use of test cases. This procedure is a delicate one, requiring extreme tact. It should be done under the jurisdiction of

(*Continued on page* 34)

9 WAYS to Make Your Tungsten-filament Tubes LAST LONGER

Here are a few suggestions for prolonging the life of pure-tungsten-filament tubes. Specific installation and operating instructions are available for *every* General Electric tube, as well as general instructions for water-cooled and air-cooled types. Send us a list of the G-E tubes you use. We shall be glad to furnish you with complete service information. A brief review of these instruction sheets will enable you in many cases to get thousands of extra hours from hard-to-get tubes. *General Electric, Schenectady, N. Y.*



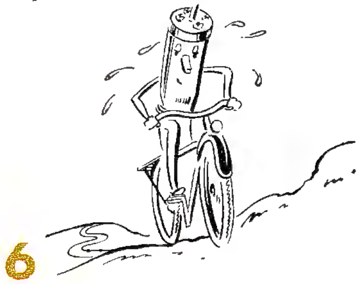
1 Keep filament voltage as low as possible consistent with output and permissible distortion.

2 Minimize anode dissipation by careful tuning of transmitter.

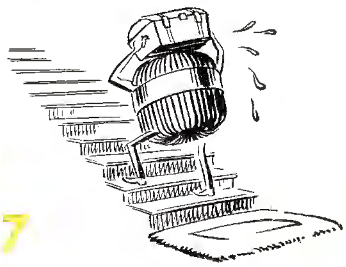
3 Be sure there is plenty of water flowing on water-cooled anodes and plenty of air on air-cooled anodes to prevent hot-spotting and gassing.

4 Keep plenty of air on the glass bulb—particularly on the seals where glass joins metal or leads go through—to reduce electrolysis and gas evolution from glass.

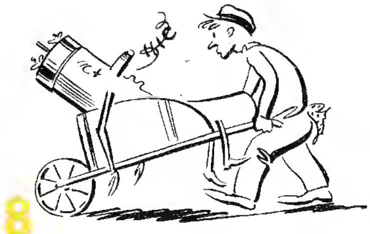
5 Switch leads every 500 hours, preferably once a week, when filaments operate on d-c.



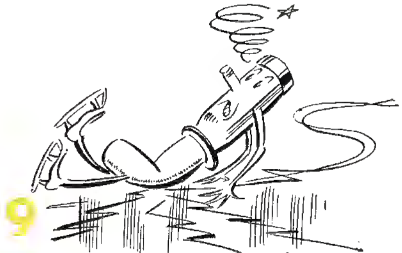
6 During starting cycle be sure the instantaneous current does not exceed 150 per cent of normal current.



7 Raise plate voltage in easy steps when starting.



8 Prevent damage caused by overloading the plate circuit. Use protective devices such as a fuse or relay.



9 Hard water (over 10 grains per gallon) should not be used for water-cooling. Distilled water will reduce scale formation on anode.

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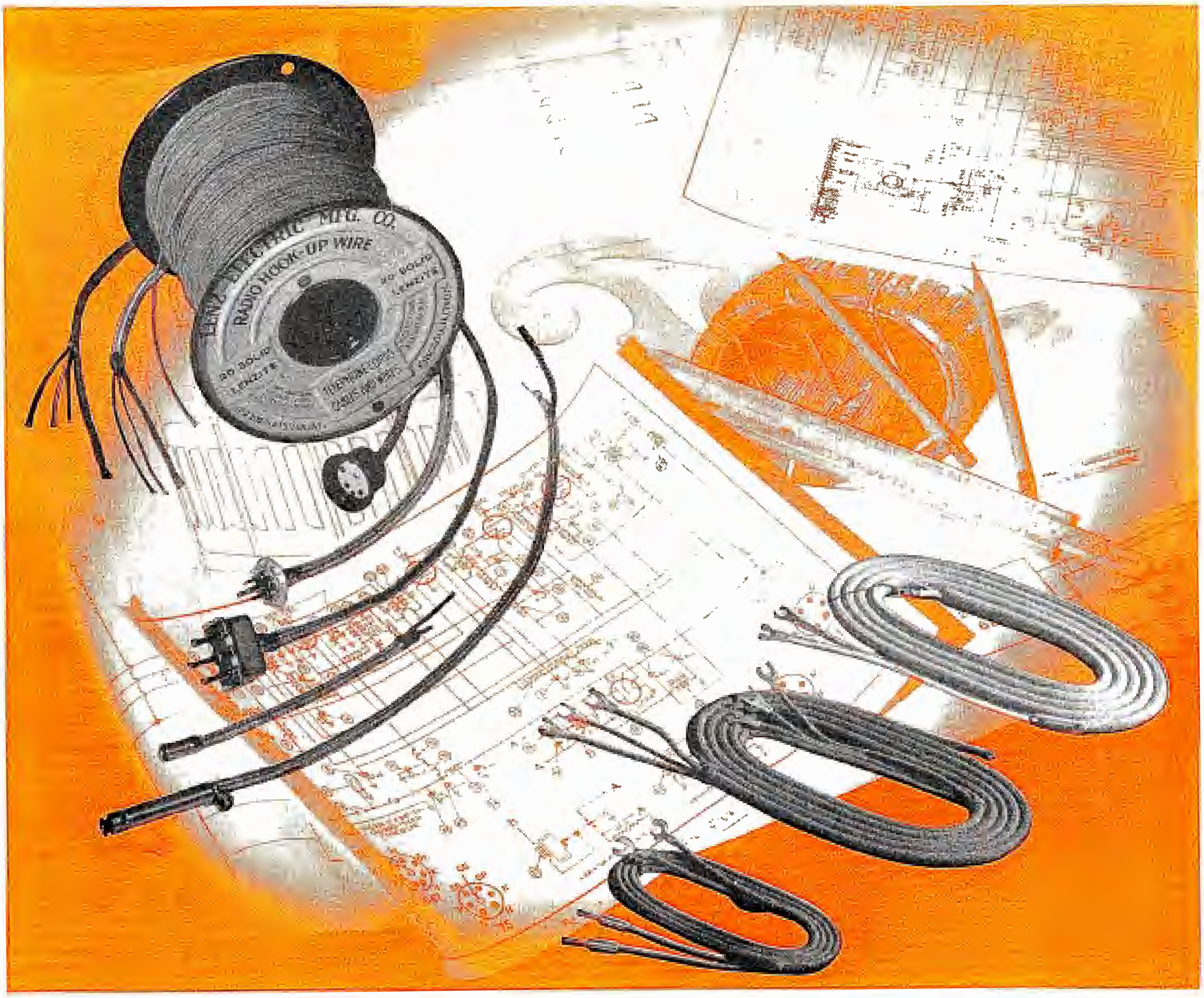

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MEASUREMENTS

(*Continued from page* 9)

terference effects due to movements of the operator when he stands behind the reflector associated with the antenna.

Coaxial-line wavemeters may be used for the measurement of wavelength up to the centimeter-waveband. For wavelengths of a few centimeters, however, the influence of the transverse dimensions of the coaxial lines causes trouble and coupling problems arise. Dielectric guides therefore become necessary.

Dielectric Guides for Centimetric Wavelengths Measurement

The simplest dielectric guides consist merely of a metallic pipe without an inside conductor. Theory and experiment show that electro-magnetic waves may be propagated through them provided that the wavelength in air is below a certain limit which is of the order of the diameter of the guide. Reference may be made to previous articles published in connection with this subject for justification of the exposition which follows (see for example, references 12, 13, 14, 15, 16 and 17).

This type of circuit does not readily lend itself to the determination of line constants, but the coefficient which plays the part of the factor Q may be defined in terms of energy. For a circuit with lumped constants

$$Q=\frac{\omega L}{R}=2\pi\cdot\frac{LI^2}{RI^2}\cdot\frac{1}{T} \qquad (22)$$

where I is the rms current and T the oscillation period. Except for 2π, this is the ratio of the average stored electromagnetic energy to the amount of energy dissipated as heat during a given period.

Applying this definition to the case of a cylindrical dielectric guide, let $\overline{W}_{tot}$ be the stored electromagnetic energy per unit of length averaged over a period of $\overline{Q}_c$ the quantity of energy lost as heat per unit of length and per unit of time (losses in the dielectric, air generally, are negligible). Then

$$Q=\frac{2\pi}{T}\cdot\frac{\overline{W}_{tot}}{\overline{Q}_c} \qquad (23)$$

But the coefficient of attenuation is related to $\overline{Q}_c$ and to the mean power $\overline{W}_z$ delivered through a cross section;[17] hence,

$$\alpha=\frac{\overline{Q}_c}{2\overline{W}_z}$$

and, consequently,

$$Q=\frac{\pi}{\alpha T}\cdot\frac{\overline{W}_{tot}}{\overline{W}_z} \qquad (24)$$

$T\overline{W}_z$ is the energy which passes through a cross-section per period. This energy occuies a guide length λ_g such that

$$T\overline{W}_z=\lambda_g\overline{W}_{tot}$$

hence

$$Q=\frac{\pi}{\alpha\lambda_g} \qquad (25)$$

Calculation shows, as might be expected that λ_g is the wavelength corresponding to the group velocity, V_g, determining the speed of transmission of energy. In dielectric guides V_g and the phase velocity V_p are such that

$$V_g V_p = v^2 \qquad (26)$$

where v is the velocity of propagation in free space. In coaxial lines, to the same approximation, $V_g = V_p = v$, which again gives the expression used above.

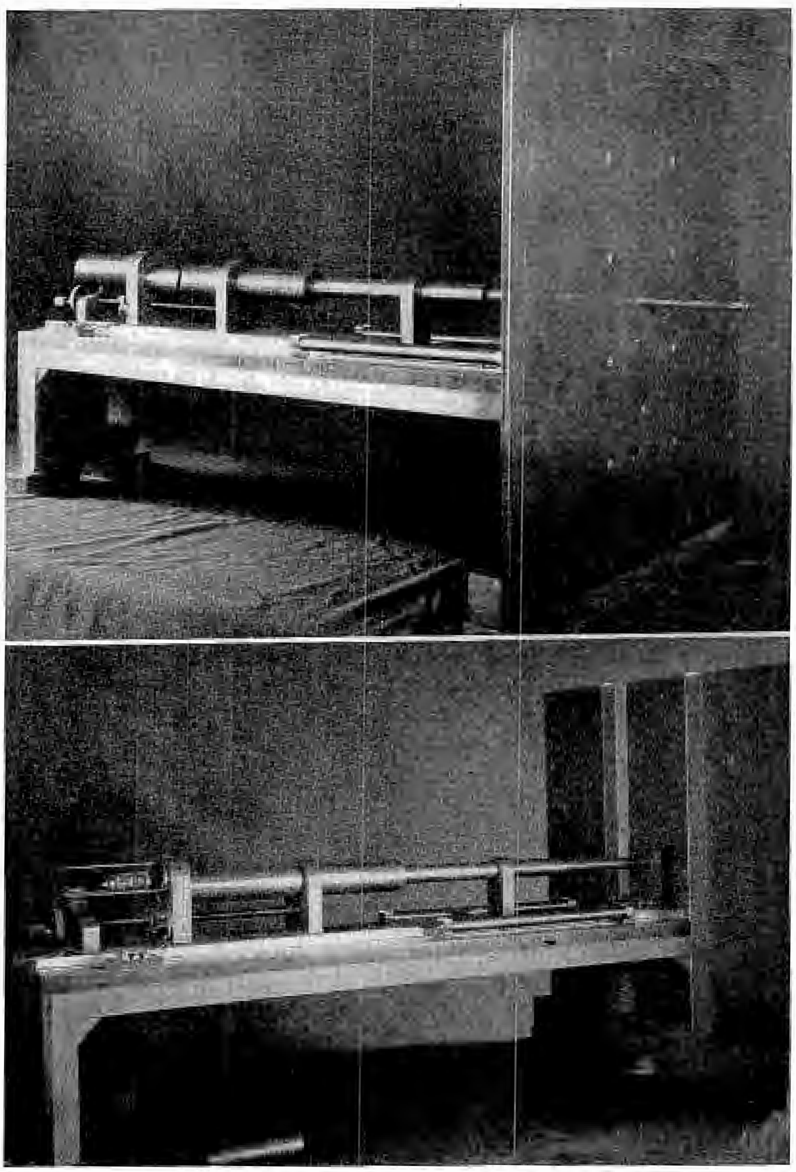
The constant $Q = \pi/\alpha\lambda_g$ may easily be computed for dielectric guides. It is, however, necessary to recognize *the different wave structures* which may be propagated and which each give different values of α and λ_g.

The principal structures are classified as E waves and H waves, characterized by the directions of the electric and magnetic vectors. This classification is shown diagrammatically in Figure. 8 where, for purposes of comparison, the directions of the vectors in the lossless coaxial line are given.

For fundamental wave structures[16,17] calculation gives:

$$E_0 \text{ Wave} \quad Q_{E0}=\frac{\pi}{2}\cdot\frac{b\sqrt{f}}{\alpha_0 v} \qquad (27)$$

(*Continued on page* 35)



Figures 11 and 12
At top we have a complete wavemeter with coaxial lines. At bottom, a rear view of the device.

NEWS BRIEFS OF THE MONTH...—

ARMY-NAVY "E" WINNERS

Several outstanding communications equipment manufacturers . . . American Lava Corporation, the Hallicrafters Inc., Galvin Manufacturing Corporation, Henry L. Crowley & Company, Inc., Western Electric, Remler and Philco Corporation have won that distinguished award . . . the Army-Navy "E" pennant . . . for war equipment production excellence, during the past weeks.

From the Hon. Robert P. Patterson, Under Secretary of War, congratulatory messages were sent to each of the winners, stating that . . . "This award is your nation's tribute to the spirit of patriotism and production effort of your plant and your employees. . . . In conferring this award the Army and Navy will present a flag to be flown above your plant and will give to every member of your organization a pin which they may wear as a symbol of their permanent contribution to human freedom. This symbol is accorded only to those plants which are exceeding all production expectations in view of the facilities at their command."

American Lava "E" Ceremonies

At the American Lava ceremonies at Chattanooga, Tennessee, Colonel Willis R. Lansford, representing the War and Navy Departments, presented the award to American Lava president, Paul J. Kruesi, who founded the company forty years ago. In accepting the award, Mr. Kruesi said to the assemblage of employees and distinguished guests . . . "Your program and your speakers will make clear that the Burgee just hoisted beneath the American Flag contains space for the addition of Service Stars. One star is offered by the Army-Navy for every period of six months in which the record of high production is continued . . . Before accepting the symbol awarded us today, I wish publicly to record our unanimous determination to earn a Service Star every 180 days. This is not at all for our aggrandizement, but as evidence of a stern resolution: 'That our brave fighting forces on the water, on the land, in the air, or under the seas shall never suffer from the lack of what we can supply.' That shall be our goal and our pledge."

Hallicrafters "E" Presentation

The presentation of the award to the Hallicrafters Inc., Chicago, Ill., was made by Colonel Thomas L. Clark,

Paul J. Kruesi

officer in charge, Chicago Signal Depot. In accepting the award, William J. Halligan, president of Hallicrafters pledged all-out continuance of the effort to surpass all records that will further inspire a high and practical patriotism in the men and women of Hallicrafters.

Galvin "E" Presentation

The employees and management of the Galvin Manufacturing Corporation of Chicago were also given extraordinary "E" recognition for their production of communications equipment in excess of quota expectations. Presentation of the award was made to Paul Glavin, president of the corporation.

Paul Galvin

Crowley "E" Ceremonies

At the Henry L. Crowley & Company, Inc., West Orange, N. J., ceremonies, Brig. Gen. A. A. Farmer, Commanding Officer of Philadelphia Signal Depot and Officer in Charge of the Philadelphia Signal Corps Procurement District, presented the "E" to Henry L. Crowley, president of the company. Mr. Crowley stressed the tremendous problems and efforts accompanying the great increase in personnel, equipment and plant buildings in the past months, and promised that the workers and management would still further multiply their efforts not only to warrant the coveted star for their pennant by the end of the next six months, but even more so as a practical token of their great appreciation for what our armed forces are doing on the many battle fronts.

Western Electric Wins "E"

The Hawthorne, Kearny and Point Breeze, New Jersey plants of the Western Electric Company received the coveted "E," with C. G. Stoll, president, accepting the award for the company. The presentation event coincided with the 25th anniversary of the first demonstration by Western Electric engineers of two-way radio telephone between an airplane and the ground.

"E" to Philco

The Philadelphia, Pennsylvania, Trenton, New Jersey, and Sandusky, Ohio, plants of Philco Corporation have also won the "E" award.

Remler Wins "E"

The Army-Navy Production "E" Award has also been won by Remler Company, Ltd., San Francisco, Calif., manufacturer of radio and sound equipment.

Colonel Ira H. Treest presented the award to E. G. Danielson, president and congratulated Remler management and workers upon their high standards of practical patriotism. He pointed out that the award was based on efficient management; avoidance of stoppages; maintenance of fair labor standards and production exceeding all expectations in view of available facilities.

Lieutenant-Colonel L. L. Wardell awarded the official "E" lapel pins to Remler employees, making symbolic presentation to Treesa Archibald and Carl A. Hemmeter, Remler's oldest workers, in point of service.

* * *

G. E. TUBE DIVISION NAME CHANGE

The Vacuum Tube Division of G. E. will henceforth be known as the Electronic Tube Division.

* * *

TUERK NEW UTAH PRESIDENT

Effective September 1, 1942, Fred B.

Tuerk became president of Utah Radio Products Company. G. Hamilton Beasley, president for the last five years, has been elected chairman of the board.

Mr. Beasley is also president of The Caswell-Runyan Company of Huntington, Indiana (wholly owned subsidiary of Utah Radio Products Company). Due to the serious illness of J. W. Caswell, Mr. Beasley will devote a greater portion of his time to the Caswell-Runyan Company.

He will continue to take an active part in the management of Utah, whose entire production facilities are and have been for some time past concentrated on war products.

Outside of the above change, the Utah executive roster remains as it has been for many years with Henry S. Neyman as vice president and treasurer, W. Dumke, vice president and secretary, W. A. Ellmore, chief engineer, and O. F. Jester, general sales manager.

* * *

JACK GRAND NOW A REP

Jack Grand, one of radio's early pioneers, has resigned his position with Sun Radio Co., 212 Fulton Street, New York City, after 18 years, to become a member of the sales representative firm of Burlingame Associates, 69 Murray Street, New York City.

* * *

R. C. STUART NOW MANUFACTURING MANAGER

Ralph C. Stuart has been appointed manager of manufacturing to supervise production at five plants of the Lamp Division of the Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.

In his new post, Mr. Stuart will be in charge of the manufacture of all incandescent and fluorescent lamps made by Westinghouse. He will also supervise the Lamp Division's war production which includes radio transmitting tubes, x-ray tubes, and special electronics devices.

* * *

IDEAL ACCESSORY CATALOG

An eight-page catalog describing a variety of machine tool accessories, including metal etcher, variable speed pulleys, demagnetizers, etc., has been released by the Machinery Products Division of the Ideal Commutator Dresser Co., 1278 Park Avenue, Sycamore, Ill.

* * *

DUNCO RELAY-TIMER GUIDE

Details on hundreds of relays and timers for a wide variety of applications, are available in the new Dunco Relay-Timer Catalog F, just issued by Struthers Dunn, Inc., Juniper and Cherry Sts., Philadelphia, Pa.

Fully revised, greatly enlarged, profusely illustrated, and replete with detailed specifications and engineering information, the catalog is one that will prove helpful to designers, engineers, purchasing agents, production executives, and maintenance men alike.

In this new catalog, standard units are listed in detail, following which complete information is given as to the many adaptations which may be obtained. This catalog introduces a new type designation system that greatly simplifies the specifying of required special features on units which are otherwise standard. Complete electrical information, as well as base dimensions, cover dimensions, coil data, magnetic structure diagrams and dimensions, contact diagrams, and descriptions, mount-

(Continued on page 26)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. GEORGE H. CLARK, Secretary

Congratulations

THE fifth presentation of the Poor Richard Citation of Merit, annual award of the Poor Richard Club, Philadelphia advertising organization, was made to Major General Dawson Olmstead, Chief Signal Officer of the Army at a luncheon in Philadelphia August 18, 1942. We salute General Olmstead, an honorary member of our Association, and sincerely congratulate him upon this signal recognition of his meritorious service to our country. Colonel David Sarnoff, first life member of our Association, participated in the nationwide NBC broadcast accompanying the presentation.

General Olmstead, in the Army since 1906, when he was graduated from the U. S. Military Academy at West Point, is widely recognized for his grasp of the communications problems encountered by the military, particularly in wartime operations. His reputation in this line was derived from his activities both in the field and as a director of instruction in communications.

Born in Corry, Pa., on May 21, 1884, Gen· Olmstead was appointed to West Point in 1902. Continuing his schooling, specializing in communications, he was graduated in 1909 from the Army Signal School. In 1924 he was also a distinguished graduate of the Command & General Staff School, and 10 years later, in 1934, he was a graduate of the Army War College.

Before the first World War Gen. Olmstead's service was primarily in the field artillery, although he had served with the Signal Corps by detail as early as 1909, when he was helping develop telephone and wire equipment for the field artillery. During the World War he served in the Office of the Inspector General, American Expeditionary Forces and commanded the 50th and 75th regiments of field artillery. Since the war he has had many Signal Corps assignments, in the field and in the Office of the Chief Signal Officer.

In the field he served as Officer in Charge of the Signal Section of the New York General Depot, as Division Signal Officer and Department Signal Officer in Hawaii, as Officer in Charge of the Alaska Communications System,

Major-General Dawson Olmstead

and more recently as Commandant of the Signal Corps School, Commanding General, Fort Monmouth, N. J., and president of the Signal Corps Board.

In the Office of the Chief Signal Officer, before becoming the officer in charge, Gen. Olmstead saw duty as Officer in Charge of the Supply Division, as Executive Officer, and as Acting Chief Signal Officer for several periods. He was named Chief Signal Officer on Oct. 24, 1941.

Scholarships

FROM J. R. Poppele, chief engineer of WOR and chairman of our scholarship committee we learn that the winners of this year's Marconi Memorial Scholarships will be . . .

For the two year course in radio and electrical communication at RCA Institutes, Edward Lombard of 871 West Lafayette Avenue, Syracuse, N. Y.

For the one year course in aviation radio at Midland Television and Radio Schools of Kansas City, Mo., John Raymond Miller of 325 Ioluca, Orange, Calif.

The winners were selected through a nationwide contest among high school seniors throughout the country under the auspices of Science Service and the American Institute of the City of New York. The judges based their decisions on the results of a competitive science aptitude test, a treatise submitted by each contestant on "Why I Want to Be a Radio Engineer," and the school record and biographical outline of each contestant.

With J. R Poppele as chairman, the committee of judges included Dr. Zins, well known research worker and educator representing the American Institute of the City of New York and Joseph Kraus, well known in radio and aviation circles and editor of many of the features of Science Service representing that organization. Mr. McGonigle, our president, was present at the final judging and concurred in the board's findings.

Our sincere thanks to Dr. Zins and Mr. Kraus for their indefatigable efforts in conducting the contest and appreciation to the organizations they represent. Congratulations to Jack Poppele for a splendid job.

Grateful acknowledgement of their splendid cooperation goes to C. J. Pannill, president of RCA Institutes and the Radiomarine Corporation of America, a life member of our Association and to G. P. Taylor, president of the Midland Television and Radio Schools. They make these annual Scholarships possible.

Reminiscing With G. V. Willets

"THE magnetic detector on XBB (S.S. MEXICO 11) in 1917 · · . tried to replace it with a home made galina detector at sea, but still had the low resistance headphones. . . . the C.P.O. named *Williams* who met us in Balboa and gave us a 1,000-ohm set of cans. . · · difficulties of signing the skipper's name to all messages sent from XBB. It was: CZARADO LIZZARRITTURRI!

"The 'KX' boats, their distinctive semi-quenched spark sets. . . . the first Westinghouse ship-shore radiotelephone on KXI (S.S. Priscilla) in fall of 1920. . . . Chet Underhil lat WLC answering with spark. . . . passing Barren Island at dusk with wind in wrong direction.

(*Continued on page* 26)

THE INDUSTRY OFFERS

DIMMER SIGNAL LAMP

A panel dimmer type signal lamp, the Dim-E-Roid, eliminating the incorporation of transformers and resistors in electrical systems for the purpose of dimming intensity of signal lights, is now being made by American Radio Hardware Co., Inc. 476 Broadway, New York City. Polarized discs, or a mechanical shutter control the light emission intensity without interference with the electrical circuit proper.

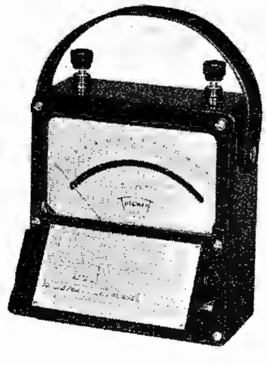
Made entirely of nonferrous materials, this new device utilizes a plastic jewel in any color desired for differential signal purposes. Two models are available. Model 1920 is constructed with a mechanical shutter, and model 1874 operates by the use of two opposed polaroid discs. Both of these models, with the exception of the dimming mechanism, are identical in appearance and mounting dimensions. A slight turn of the head of the lamp changes the light intensity from very bright to very dim. Model 1920, if desired, can be made to change light intensity from bright to total blackout.

* * *

TRIPLETT PORTABLE METERS

Two new instruments, model 625 d-c and 635 a-c have been added to the line of portables produced by the Triplett Electrical Instrument Co., Bluffton, Ohio.

These instruments enclosed in molded cases, have long 4.58" hand calibrated mirror scales. A hinged cover closes when instrument is not in use, for added protection. The d-c instrument is enclosed in a black molded case, and the a-c unit is in a red case. The size of the cases are 6" x 5½" x 2½".

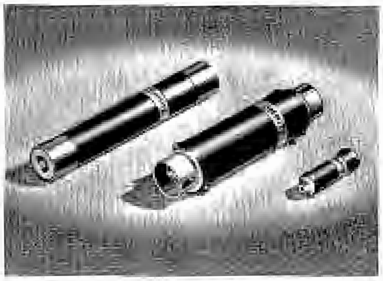


FERRULE RESISTORS BY OHMITE

A series of ferrule type resistors, designed for easy interchangeability without the use of tools is now being made by the Ohmite Manufacturing Company, 4835 Flournoy Street, Chicago, Ill. An even winding of resistance wire on a ceramic core is protected by an Ohmite vitreous enamel coating. The wire is terminated on metal bands or ferrules which permit mounting in fuse clips. Ferrules are cup, sleeve, or cartridge type.

Special ceramic cores are available which, with special coating, it is said, will withstand the temperature shock test of repeated immersions alternately from ice cold water to hot water. Protective coatings which pass salt water immersion tests are also available.

The ferrule type of resistor in a wide range of sizes is particularly applicable for use in the Navy, in the Signal Corps, on Army aircraft and on railroads.



* * *

COMPACT BLOWER

A blower particularly designed for restricted spaces and high temperatures encountered in airborn units has been designed by the L-R Manufacturing Company, Torrington, Conn.

The output of the blower is 60 cfm at 7500 rpm. It is housed in a high impact plastic capable of withstanding temperatures to 375 degrees Fahrenheit. The wheel is a turbo type, No. 00 ¼" shaft, plated, 2" in diameter. The mounting is Universal, with motor plate for any small motor. Assembled with four 10/32 screws usable as bracket supports for various methods of mounting. Any small motor such as 1/100 hp operating on following voltage supply: 6 volts d-c, 12 volts d-c, 24 volts d-c, 28 volts d-c, 110 volts 60 cycles a-c or 115 volts 400 cycle a-c, may be used as a driving motor.

RCP THREE-IN-ONE MULTITESTER

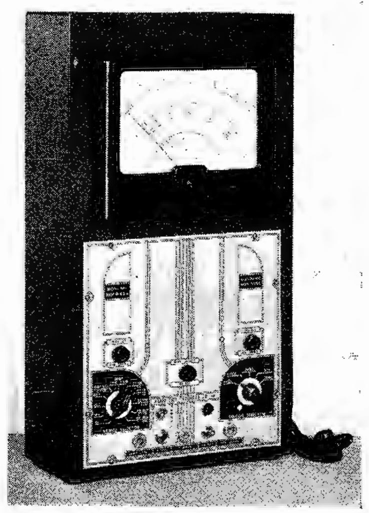
A new vacuum tube multitester model 662, has been announced by Radio City Products Co., Inc., 127 W. 26th St., N. Y. City.

This new device is said to be a genuine vacuum tube voltmeter on a-c, not a copper oxide rectifier type. It is said to furnish accurate and comprehensive capacity readings directly in microfarads, with a measurement ratio of 40,000,000 to 1.

In designing this multi-purpose instrument, RCP engineers forestalled all danger of shock on low capacity measurements. There are no test leads to short and no resetting is necessary when changing ranges. The meter cannot be damaged by checking a live resistor or by using a low range on high readings. Error due to line voltage fluctuation is eliminated by a VR105-30 regulator tube and associated circuits.

This model employs a sloping panel and 4½-inch meter. An upright-style companion model (No. 662-V-7) with a large 8½-inch rectangular meter, affording long scales for easy reading, is also available.

Both instruments have similar performance characteristics, and are complete with leads and large, readily accessible batteries, tubes and pilot light. The instruments are described in bulletin No. 126, which is free.



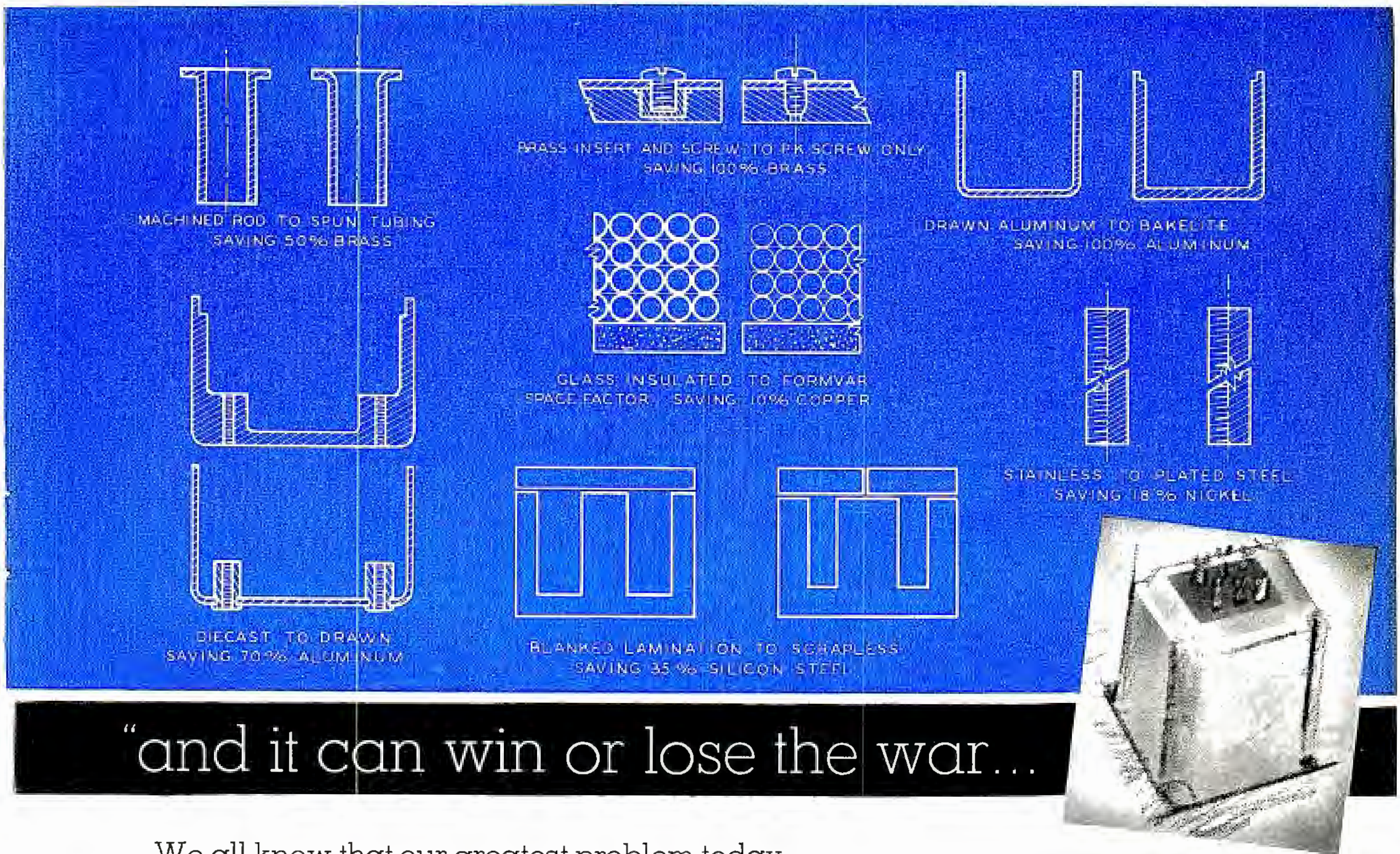
* * *

CELLULOSE ACETATE INSULATED BOBBIN COIL FORM

Much higher corrosion resistance in bobbins for coil windings is said to have been achieved by Precision Paper Tube Company, 2033 W. Charleston St., Chicago, Illinois, by a construction in which cellulose acetate is embodied in the bobbins.

Cellulose acetate is used in combination with the spiral-wound dielectric fish-paper core and vulcanized fibre flanges. Spiral wound laminations of cellulose acetate are made over a die to the o-d of the core and then with a press-fit, slipped over the core to form a spacing tube. The length of the acetate determines the winding area. The inside faces of the fibre flanges are laminated with cellulose acetate before die-cutting, the core then swaged,

(*Continued on page* 33)



"and it can win or lose the war...

We all know that our greatest problem today lies in material shortages. The bulk of this problem . . . and it can win or lose the war . . . lies in our hands. A waste of materials, particularly critical materials, in an engineering design today, is as damnable as sabotage.

Here are a few cases in our organization:

1. **On one job our redesign combined two pieces of apparatus. The resultant unit, while more efficient, is smaller than either of the individual units. On the basis of projected requirements, the saving in aluminum alone is 500,000 lbs.**
2. **On this job our delivery schedule would have been delayed five months for the nickel iron core material and shielding cases required. Redesign made possible a unit using silicon core material and silicon shields with actually 10 DB less hum pickup than the original.**
3. **In this job substitution of a drawn aluminum housing for a die casting effected an aluminum saving of 70%.**

Designs must be improved constantly. Take a look at that job you have been running and see whether an extruded rod or a spun bushing won't save the scrap involved in a screw machine part. Check with the Government Engineering Bureau involved as to whether they would not allow a change in material to something lower on the critical list. You will be surprised at their cooperation.

Only when you can say to yourself, "There isn't one of my designs left that can be reduced in amount of material or to less critical materials," can you feel that your share in the War Program is effective.

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

NEWS BRIEFS

(*Continued from page 21*)

ing styles, etc., are included. A copy will be sent upon request.

* * *

ROLLER-SMITH APPOINTS GROOMS

William N. Grooms, Salt Lake City, Utah, has been appointed district sales agent for the Roller-Smith Company, Bethlehem, Pa. Mr. Grooms will handle all Roller-Smith products in the States of Utah, Idaho, Montana and the southwest corner of Wyoming. He will maintain offices at 630 Dooly Block, Salt Lake City.

* * *

PRECISION BALANCE CATALOG

Two new Precision Balances for accurate and rapid repeated weighings of small particles ranging from less than 3 mg. to more than 50 grams are described, illustrated and listed in catalog 4550 recently issued by the Roller-Smith Company, Bethlehem, Pa.

This new publication gives information on the application of the Balances, describes how weighings are made, and shows how to select the correct range of Balance best suited to the weighing application. A complete listing of the various Balances available, their list prices and the attachments that can be furnished also are included.

Copies of this catalog can be obtained without charge.

* * *

FIRE PREVENTION WEEK

October 4th to 10th has been proclaimed

VWOA NEWS

(*Continued from page 22*)

. . . pre-war days on the 'KX' boats when romance was in flower!

"The 'pleasure' of a trip to France in 1919 on WJOO (S.S. WEST MADAKET) with a cargo of 1,200 cows from Newport News. . . . none died yet we reached La Palice with 1,249 head of cattle. . . Blessed events at the rate of several daily all the way across.

"The occasional jolts we got from the compressed air condenser on KLF (S.S. METAPAN) in 1917. . . . Henri Pierre Bucheron, our Sr. on KWX (S.S. MEXICO) in July 1916 who specialized in efficiency plus. . . . Listening to the haunting spark of VCE "covering the north Atlantic" in 1919. . . . the ozone battles between WCI Newport, R. I.) and NAH just after the war as each tried to get the commercial business. . . . the rising pitch of NAI's old spark. . . . Climbing the tower at X (Port Limon, C. R.) in noon sun. . . . Busy old U S (Swan Island). . . . the insistent dash-dash of M (Havana). . . . the impeccable Mr. Short and the checker champ Duffy and the prankster Bucher of Marconi days on Duane St."

Fire Prevention Week by the President. In his proclamation, the President called upon the nation for observance of this occasion as part of the war effort and charged the U. S. Office of Civilian Defense, which is responsible for civil protection in wartime, to assume leadership in the observance.

Fire is always serious, but now, as the President pointed out in his proclamation, every loss of life, every interference with production, every loss of critical materials delays victory. Fire Prevention Week affords an opportunity to impress all the people with the present urgency of protecting our resources against destruction by fire.

* * *

ELASTIC STOP NUT WALL CHART

A wall chart, 21 by 27 inches, explaining the uses of various types of self-locking nuts, is being distributed by Elastic Stop Nut Corporation, 2322 Vauxhall Road, Union, New Jersey, to engineering departments, drafting rooms, maintenance shops, and schools.

The center of the chart is devoted to an illustrated description of the basic principle by which a self-locking action is obtained. This is followed by illustrations of some of the advantages to be obtained by the use of the nuts and, completing the presentation, there are cross-section drawings showing the method of application of the nine types most generally used, with corresponding photographs of these types.

Copies can be obtained from the manufacturer.

* * *

SPOKANE RADIO'S 15TH YEAR

The 15th anniversary of the Spokane Radio Co., Inc., 611 First Avenue, Spokane, Washington, was recently celebrated. Morris H. Willis, radio veteran, is president of Spokane.

In addition to serving as a distributor, Spokane is also manufacturing equipment for the armed forces.

* * *

CUTTING SCREW THREAD BOOKLET

"How to Cut Screw Threads in the Lathe," a 21-page booklet covering the cutting of screw threads on back-geared screw-cutting lathes, has just been reprinted by the South Bend Lathe Works. The first portion of the book is devoted to the setting up of a lathe for thread cutting. This includes use of quick change gear box to obtain the pitch of thread desired.

Complete information is given on the various types of lathe tools employed in cutting screw threads, how to grind them, and how they should be mounted and positioned. The uses of the center gauge, compound rest, thread cutting stop, thread dial indicator, taps, dies, etc., are explained. Types of screw threads commonly used are fully described with formulae and diagrams of standard screw thread forms.

This booklet (Bulletin No. 36-A) is priced at ten cents a copy, postpaid, and can be obtained from the South Bend Lathe Works, South Bend, Indiana.

* * *

HOLLISTER CRYSTAL MOVES

The Hollister Crystal Company has moved from Wichita, Kansas, to Boulder, Colorado.

* * *

J. J. KAHN NOW CHAIRMAN OF SALES CLUB

Jerome J. Kahn, president of Standard

(*Continued on page* 28)

NEWS BRIEFS

(*Continued from page 27*)

Transformer Corporation, has been elected chairman of the Sales Managers Club, Western Group. Mr. Kahn succeeds S. N. Shure of Shure Brothers. For the past several years Mr. Kahn has been one of the most active manufacturers in the radio replacement parts field. He was a member of the original Priorities Committee of the Radio Parts and Associated Industries, and chairman of the Radio Victory Dinner held at the Stevens Hotel last June. Mr. Kahn was also the original sponsor of the "Keep 'em Playing" campaign designed to bring pressure on the proper groups in Washington to make an allocation of critical materials for replacements parts for home receivers. He is now a member of the Radio Replacement Parts Industry Advisory Committee working with WPB, a director of the Radio Manufacturers Association, and chairman of the RMA Priorities Committee.

Paul H. Tartak, president of the Oxford Tartak Radio Corporation, was elected vice-chairman of the group, while Helen A. Staniland of Quam-Nichols Company and Kenneth C. Prince, Chicago attorney, continue as treasurer and secretary, respectively.

* * *

WILT RE-ELECTED APCO PRESIDENT

The 1942 conference of the Associated Police Communication Officers, Inc., elected M. A. Wilt, Police Department, Kansas City, Kans., president for 1942. Others elected were: 1st vice-president, Frank W. Walker, Michigan State Police, East Lansing; 2nd vice-president, Lawrence D. Geno, Police Department, Buffalo, N. Y.; sergeant-at-arms, J. R. Derby, Police Department, Denver, Colo.; secretary-treasurer, James H. Teeter, Police Department, St. Louis, Mo.; bulletin editor, J. M. Wherritt, Missouri State Highway Patrol, Jefferson City.

The 1943 APCO Conference will be held in Buffalo, N. Y.

* * *

C-D BULLETIN ON INCREASING OUTPUT

"Save Copper — Get more Capacity Quickly" headlines a 6-page folder on dykanol capacitors for power factor improvement, just issued by Cornell-Dubilier Electric Corporation. This bulletin weighs a familiar plant problem, overtaxed electrical systems, insufficient line, transformer and switching equipment capacity, and then presents a solution that boosts factory output while saving all-important time, materials and labor.

Indoor and outdoor type C-D dykanol capacitors are clearly described and illustrated in the new bulletin, together with actual "case-history" savings reported by nationally known Cornell-Dubilier industrial clients. Free copies may be obtained by writing the company at South Plainfield, New Jersey.

* * *

WPB RADIO DIVISIONS CONSOLIDATED

All communication equipment requirements, civilian and military, have been consolidated under the direction of the Radio and Radar Branch of the Air-Craft Production Division, WPB. Formerly two groups covered this field, the Radio and Radar Branch which handled military requirements, and the radio section of the Communications Branch which handled

(*Continued on page 35*)

WE SEE

(*Continued from page 2*)

for instance, not one man on my staff was capable of carrying out the work assigned to him. Today I am doing the work myself. In addition, I spent four hours contacting the radio supply houses here in an effort to pick up enough parts to build an air-raid alert receiver. Today conditions are pretty serious, and are destined to become worse as the war effort progresses and more and more competent men are called to the colors."

PACK TYPE COMMUNICATION EQUIPMENT again proved its worth during a recent emergency in New York City. During a violent blaze destroying some $40,000 worth of rubber fabrics, firemen brought into play a two-way radio combat system, enabling the firemen inside the smoke-filled building to communicate with their superiors outside and call for the necessary assistance—assistance that would have never reached them without radio. As a result of this use of radio, the fire was brought under control within forty minutes and with no loss of life . . . truly a proud achievement.

NEW PROMOTIONS HAVE BEEN WON by two outstanding communications specialists. Dr. Charles Byron Jolliffe, assistant to the president of RCA and chief engineer of RCA laboratories, has now been appointed vice president and chief engineer of RCA Manufacturing Company. Dr. Jolliffe, received international acclaim for his work in his various Government posts as a physicist in the radio section of the Bureau of Standards, and as chief engineer of the FCC. In addition to his posts at RCA, Dr. Jolliffe received international acclaim for his work tions committees of the Government.

Captain Carl F. Holden, the other authority we had in mind, has been appointed director of Naval Communications, replacing Captain Joseph R. Redman, who has been ordered to sea duty. Captain Holden, until this appointment, was fleet communications officer serving on the staff of Admiral E. J. King. In his new post, Captain Holden will also serve as a member of the Board of War Communications as a representative of the Navy.

Congratulations and the best of luck in your new posts, gentlemen!

A METAL CONGRESS TO BE HELD in Cleveland from October 12th to 16th, should be carried as a "must" on your calendar. Today, more than ever, metals demand close study. Those new ideas, new developments and new equipment you must know about will be discussed at this conference. Make every effort to attend.

INDIVIDUAL PRODUCTION MERIT CERTIFICATES, awarded by the WPB, have been won by many in the radio industry . . . by men and women whose suggestions have increased production of a variety of products. For instance, Benjamin Willet, a 23-year-old instructor in the crystal laboratory at RCA, designed a new jig utilizing a diamond-charged saw for slitting quartz crystals, that reduced breakage by 75%. Another contributor to this increased production effort was Edward S. Hoffman, a 22-year-old supervisor in the transformer department of RCA, and now a private in the U. S. Air Corps. Mr. Hoffman, conceived of a method of constructing transformers with silicon steel, in place of the scarce nickel steel, prescribed for the job. As a result, 3,000 pounds of nickel has already been saved and production has been maintained. Well done, "soldiers of production."—L. W.

(*Continued from page* 15)

circuit is tuned to the fundamental when the Miller circuit is used and to the harmonic when the Pierce circuit is used.

Relay Connection for Pierce Circuit

One set of relay contacts always changes the crystal oscillator to the modified Pierce circuit when receiving, regardless of the transmitter status of the crystal oscillator circuit, because the receiver crystals are not of the same frequency as the transmitter crystals. When singling, the receiver crystals are 455 kc lower than the transmitter crystals. When doubling, the receiver crystals are lower than the transmitter crystals by the frequency equal to the reception frequency minus the i-f and then divided by two. This difference is due to the receiver i-f frequency of 455 kc.

The Miller Circuit

In a Miller circuit (crystal connected grid to cathode of the tube) the plate circuit is tuned slightly to the high frequency side of crystal frequency resonance. Exact resonance of the plate circuit to the crystal frequency presents a resistive load to the plate of the tube. This point is indicated as the point of minimum plate current. When the oscillator plate circuit is tuned to a higher frequency than the crystal frequency, an increase in plate current will occur. This current gradually increases as the frequency of the tank circuit is increased until a constant current point is reached. The plate circuit must be inductive for stable operation of the oscillator.

The correct plate circuit adjustment for the modified Pierce oscillator is indicated by the plate current dip or slightly to the capacity side of crystal resonance. By using this circuit for the crystal frequency, which is 455 kc less than the transmitter frequency, the correct receiver oscillator tuning is obtained.

When using a high impedance in the cathode circuit, it is important to use reduced power to the oscillator tube during the time that the oscillator is being tuned. With manual plate supply in use while the plate is not properly tuned, high crystal current results. High crystal currents are detrimental and are apt to result in fractured crystals.

A "Tune-Operate" switch is provided which reduces the power when in the "Tune" position.

The Dynamotors

The high voltage required for the plates of the tubes is obtained from the transmitter and receiver dynamotors. The receiver dynamotor is rated at the input, 3.3 amp at 14.0 volts; at the output, 100 mils at 230 volts. The speed is 4,400 rpm.

The transmitter dynamotor is rated at 29 amp at 12.5/14 volts at the input; 450 mils at 540 volts at the output. The speed is 5,200 r.p.m.

During reception the receiving dynamotor is operating and supplies plate voltage for all receiver tubes and the oscillator. During transmission the receiving dynamotor supplies the plate voltage to receiver output tubes and the speech amplifier tube. The transmitting dynamotor supplies plate voltage to the oscillator, modulator and final amplifier.

The Frequency Channel Selector

The frequency channel selector may be manually operated from the front panel or operated from a remote location by the use of the electrical control.

For manual "local" operation, the local-remote switch is first placed in the "local" position. Then the channel selector handle is pressed "in" and rotated. One revolution of the handle per channel is required. An index is provided to designate by number the channel that is in position for operation.

Remote Operation

An electric motor with associated gear train, cam and switching mechanism is used for remote control of the turret position. Switch selector at the remote control point requires a 10 position switch with a ground return connection to the switch arm. The turret rotation through 324 degrees with normal voltage is accomplished in 8 to 10 seconds.

Self-Indexing Selector

During the channel selection (remote electrical) the receiver is muted by a relay which blocks the grid of the a-f output receiver tubes.

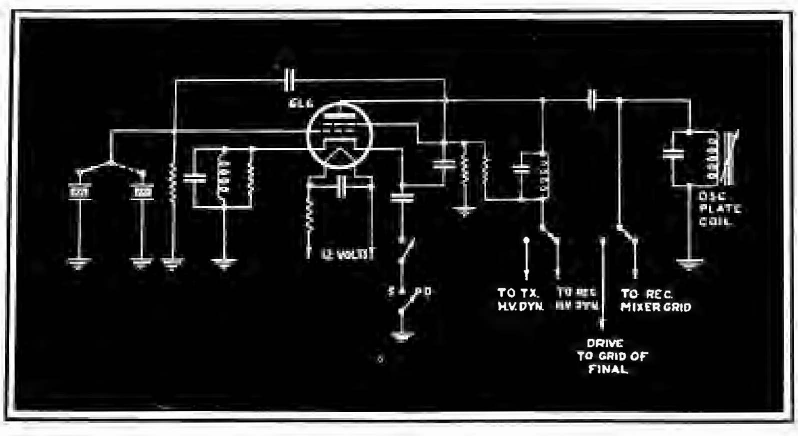
The selector is self-indexing; that is, if the channel selector switch is rotated during a period that the power is not connected, the turret will rotate to the channel selected when the power is applied.

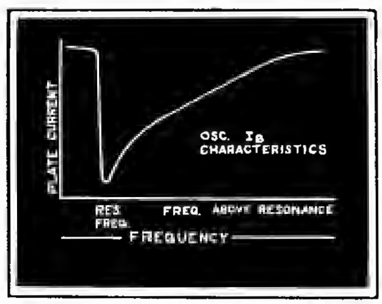
Provisions are made to safety wire "local-remote" channel switch in the remote position to avoid accidental operation of the switch.

The D-C Motor

The d-c motor that furnishes power to rotate the turret is a split field type. Only one field is energized during any one period. The one field that is energized determines the direction of rotation. The channel selector operates the

(*Continued on page* 34)





Figures 9 and 10
In Figure 9 (left) is the modified Pierce-Miller crystal oscillator circuit, while in Figure 10 (above) appears the oscillator characteristics of this circuit.

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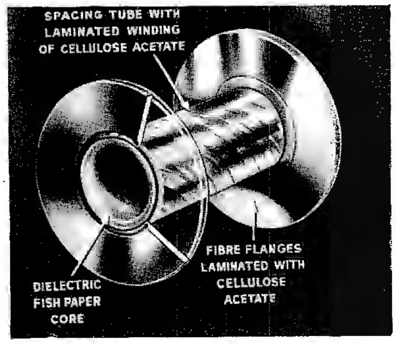
THE INDUSTRY OFFERS . . . —

(*Continued from page* 24)

locking the flanges in place onto the core carrying the spacing tube. Acetate cement is brushed over the joinings to give complete protection and to materially strengthen the bobbin.

Precision Bobbins with the new improvement, are furnished in all forms—round, square, rectangular, and special shapes to fit engineering conditions.

It is claimed by Precision that these new bobbins are the lightest bobbin type coil forms manufactured and that their space saving permits smaller coils with the same guage of wire and the same number of turns.

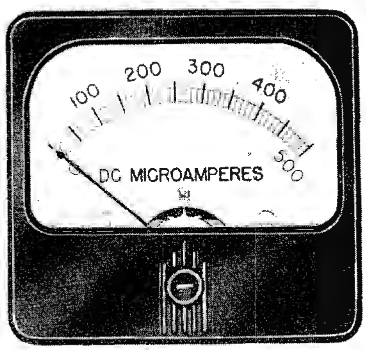


* * *

DE JUR-AMSCO INSTRUMENTS

Direct current voltmeters of 200 and 1000 ohms per volt, d-c millivoltmeters, d-c ammeters and shunts, d-c galvanometers, d-c microameters and milliameters, a-c rectifier type meters and a-c rectifier voltmeters as well as thermo ammeters are described in catalog, I-61, released by the manufacturer, De Jur-Amsco Corporation, Shelton, Connecticut.

Many of the instruments are illustrated full size. In addition, various type movements are also shown. Cross-section diagrams of the instruments are also shown.



* * *

NON-WIRE-WOUND POTENTIOMETERS

A new processing of resistive coatings resulting in potentiometers and rheostats claimed to be virtually on a par with wire-wound units in matters of resistance permanence, immunity to climatic conditions and wearing qualities, has been announced by Clarostat Mfg. Co., 285 N. 6th St., Brooklyn, N. Y.

The Clarostat series 37 controls employ the new stabilized element. This element takes the form of a resistive coating on a

(*Continued on page* 37)

AIRCRAFT COMMUNICATIONS

(*Continued from page* 30)

turret in an direction only. The motor reverse is used to correct for "over-ride."

The basic principle of the frequency channel selector electric motor circuit is given in Figure 4. By means of a mechanical drive through the proper gear reduction, the motor drives the contact disc. Stationary contacts are positioned about the disc. The motor circuit is broken when the open sector is in line with the contact circuit that was selected by the control switch. In this circuit no consideration is given for correction of motor over-ride.

Comparing the circuit in Figure 4 with circuit of Figure 5, it will be noted that a second disc has been added, also a cam operated switch and a split field motor. The scheme will correct for over-ride and will cause the turret to return to its predetermined selected position.

The cam rotates 360 degrees for each 36 degrees rotation of the turret. For normal operation, the circuit is through closed local-remote switch, motor armature, F1, D1 and to ground by way of the control switch. The circuit to D2 is open because the cam position has opened contacts "A." When "over-ride" occurs the cam completes the D2 circuit through "A" contacts thus energizing F2, which results in a reversal of the motor rotation. At this point the cam will center the D1-D2 contacts by alternating closing "A" and "B" contacts to the predetermined turret position. When the channel selection is complete, contacts "A" and "B" are open, also the D1 open segment is in line with the circuit selected by the control switch.

The power to rotate the turret is applied through a Geneva Gear. The Geneva movement gives a positive but intermittent motion to the driven shaft, but prevents this shaft from driving the mechanism is a reverse order, thereby providing a lock of the turret position. One type of Geneva Gear is illustrated in figure 6.

SECOND DETECTOR

(*Continued from page* 11)

stage was loaded with the diode, very poor results could be expected with only one stage of r-f operating at maximum gain and selectivity. However, with two or three stages operating without their selectivity and gain impaired and with both these attributes increased by higher-Q coils with a better design of band pass filters of constant, plus a better understanding of decoupling circuits, straight radio frequency stages may give the superheterodyne some competition.

Since it should be simple to gang a large number of iron slugs together for tuning purposes, a multiplicity of tuned circuits would not be too expensive or complicated. At least it would be no more complicated than the problem of maintaining a constant frequency difference between first detector and oscillator circuits in a superheterodyne. For reasons of image suppression, signal-to-noise ratio and beat note suppression, a radio frequency stage is almost imperative in a good broadcast receiver anyway.

In applying this circuit, it should be kept in mind that an increase in gain may sometimes cause a receiver to oscillate, although in the circuit applied this has not occurred. As a matter of fact, this circuit does not give much trouble, probably because the lower end of the i-f transformer is solidly by-passed to ground. However, should oscillation occur, it means merely that better shielding and decoupling must be applied. Necessarily, only rudimentary decoupling circuits have been shown here.

SAFETY DATA

(*Continued from page* 16)

a well trained specialist who is completely familiar with station management and operation.

(18)—No instructions should be accepted by telephone, unless there is complete confidence of knowledge as to the person transmitting. And even then, it is best to issue written instructions, as suggested heretofore.

(19)—Metal screens should be installed over all outside windows to prevent a saboteur throwing in dangerous missles.

(20)—All of the prescribed property defense rules should, of course, be adhered to, as quickly as issued. The necessary equipment prescribed by these rules should be purchased without hesitation, and if problems of availability prevail, substitutes should be installed immediately, pending arrival of the required material. Don't stall or straddle this issue. Preparation is vital. Your station is not only a valuable asset to you, but to the public, too. Be on the job!

DESIGN TODAY

Not only does design today involve critical material control, but instrument control as well. There are instruments today that will weigh specks of matter as light as one millionth of a gram.

NEWS BRIEFS

(*Continued from page* 28)

civilian needs. The latter section has been transferred to the Radio and Radar Branch under the name, Civilian Radio Section.

Frank H. McIntosh, who was chief of the section under the Communications Branch, will continue as chief under the Radio and Radar Branch under the name, Civilian Radio and Radar Branch.

* * *

N. A. MEARS, RCA V-P, DIES

Norton A. Mears, vice-president and general purchasing agent of the RCA Manufacturing Company, died recently in a Philadelphia hospital after an illness of several weeks.

* * *

I R C WINS "E" AWARD

The coveted Army-Navy Production Award has been won by International Resistance Company of Philadelphia. In announcing the citation it was pointed out that the honor was conferred for the "quality and quantity of production in light of available facilities."

Official presentation of the "E" Flag took place at an impressive ceremony held at the 103rd Engineers Armory adjacent to the company plant.

Brigadier General A. A. Farmer, Commanding Officer of the Signal Depot and Officer in Charge of the Philadelphia Signal Corps Procurement District made public investiture of the insignia from the platform while simultaneously a huge duplicate banner was raised to the plant masthead.

Sterling silver "E" lapel pins to be worn by all I R C employees were presented by Lieutenant Commander Joseph L. Tinney.

MEASUREMENTS

(*Continued from page* 19)

$$H_0 \text{ Wave} \quad Q_{H_0}=\frac{\pi}{2}\cdot\frac{b\sqrt{f}}{\alpha_0 v}\cdot\frac{f^2}{f_c^2} \tag{28}$$

$$H_1 \text{ Wave} \quad Q_{H_1}=\frac{\pi}{2}\cdot\frac{b\sqrt{f}}{\alpha_0 v}\cdot\frac{1}{0.44+(f_c^2/f^2)} \tag{29}$$

In these expressions b is the radius of the guide, f_c the cut-off frequency, v the velocity of propagation in free space and α_0 a coefficient which depends on the materials employed. If μ_1 and μ_2 are the permeabilities of the dielectric and of the conductor, ε_1 the dielectric constant of the dielectric, and σ_2 the conductivity of the conductor,

$$\alpha_0=\frac{1}{4}\cdot\sqrt{\frac{\mu_2\varepsilon_1}{\sigma_2\mu_1}} \tag{30}$$

Put in the same form, the coefficient of the coaxial cable becomes

$$Q_c=\frac{\pi}{2}\cdot\frac{b\sqrt{f}}{\alpha_0 v}\cdot\frac{2}{\left(1+\frac{b}{a}\right)\Big/\left(\text{logh}\,\frac{b}{a}\right)} \tag{31}$$

a maximum occurring when the ratio b/a of the radii is equal to 3.6 (minimum attenuation). This coefficient takes account only of the copper losses;[7] in the E_0 case, it is lower in the ratio of 1 to 1.8.

The expression $\pi/2\cdot b\sqrt{f}/\alpha_0 v$ may also be put in the form $\mu_1/\mu_2\cdot b/\delta$, where δ is the skin thickness at the frequency used;[8]

$$\delta=\frac{1}{\sqrt{(2\pi\sigma_2\mu_2\omega)}} \tag{32}$$

It can be shown that the above expressions are applicable at the cut-off frequency. This is the case with which Hansen deals. The tuning of the circuit then no longer depends on the length of the guide sections but only on the radius. Propagation in the strict sense along the axis does not really take place; the circuit may be likened to one with lumped constants. The coefficient Q may therefore be given the form

$$Q_{E_0}=\frac{\pi}{\left(\frac{Rl}{2\mu_1 l}\right)T} \tag{33}$$

where l is the axial length, and the circuit may be considered as having an inductance per unit length equal to μ_1.

Hansen[8] allows for losses in the terminal walls, which multiply the above factor Q by $1/(1 + b/l)$.*

The order of magnitude of the factor Q_{E_0} to which theory points is shown by the curves of Figure 9.

To measure wavelengths with dielectric guides, it is necessary to transform the wavelength measured along the guide into the wavelength in air. Experiment indicates that it is possible, in the present state of the art and with transmitter frequency stability available, to rely on the theoretical relationships established between these wavelengths. This relationship is given by the curves of Figure 10 for the principal wave structures which require consideration.[18] It will be appreciated that it is advisable to work fairly closely to the cut-off wavelength since in this region a relatively small variation in the frequency causes a considerable variation in the wavelength along the axis of the guide.

Measurements of wavelength have been made below a centimeter with the equipment illustrated in Figure 1. The wavelength of a magnetron especially constructed for wavelengths of this order required determination. The magnetron sent an H_1 wave into a guide of 0.5 cm radius. A crystal detector was coupled to the guide and connected to the milliammeter visible in the figure. At the end of the guide a movable piston, which had very good high frequency contacts with the wall of the guide, was displaced by a micrometer lead. Accuracy was increased by taking measurements at a certain number of half wavelengths.

Other methods of measurement have been utilized. In particular, the quasi-

(*Continued on page* 36)

MEASUREMENTS

(*Continued from page* 35)

optical properties of these oscillations suggest the adaptation of interferometers and gratings. Thus, as might be expected, there is a tendency towards the technique of measurement used at the long end of the infra-red spectrum.

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FLUORESCENT ACCESSORIES CATALOG

A new 16-page catalog on G-E fluorescent accessories has been announced by G. E., Bridgeport, Conn. Included with the catalog is a 2-page insert on the new G. E. manual reset master no blink starter.

THE INDUSTRY OFFERS . . . —

(*Continued from page* 33)

bakelite base, being practically as smooth and hard as glass. The element is chemically-treated during processing to eliminate all further changes in its composition. It is likewise heat treated to stabilize its temperature and humidity characteristics.

* * *

LOW-RADIATION RECEIVER

A low-radiation radio receiver is now being made by the E. H. Scott Radio Laboratories, Inc., Chicago, Illinois. Unlike ordinary radios, this specially designed set is said to give off no signal detectable by enemy direction finders, and it thus foils subs and ships which have heretofore been able to track down our boats from distances of 100 miles or more away simply by listening to the constant oscillator radiations sent out by the entertainment radios aboard them.

The new receiver, marine model SLR-12-A, is said to have the full approval from the FCC for use at sea on both broadcast and shortwave bands.

TUBE CHECKERS

Two new radio tube checkers, one a portable model in a wood case with brown leatherette cover, the other a counter model enclosed in a metal case, grey in finish, have been announced by H. J. Mandernach of the Renewal Tube Sales Section, Bridgeport, Connecticut. They are available only on orders carrying at least an A-1-J preference rating.

These new tube checkers, known as Models TC3 and TC3P, will take care of all present tubes and any tubes that may be announced in the future. This is made possible through the use of a special switching system that provides any voltages that may be necessary to test the tubes. The instruments also provide a triple test for output and a thorough check for short.

* * *

MICROPHONE SWITCH

The Universal Microphone Co., Inglewood, Cal., has announced that its standard microphone switch SW 141 will hereafter be produced with the option of cases of either injection or compression mouldings. Both types are, of course, approved by the U. S. Army Signal Corps procurement division. The SW 141 is available in quantity lots to government contractors for various types of communications devices. Its construction is said to provide for cable strain relief. The switch can be used as press-to-talk type, or the locking button may be used on the "on" position.

BOOK TALK . . .

NEW PLASTIC BOOKLETS

Many interesting booklets on plastics have been released during the past few weeks.

Among these are an eight page booklet prepared by Durez Plastics and Chemicals, Inc., Walck Road, North Tonawanda, New York. A description of the process of manufacturing plastics from raw materials to finished products is a featured item. Described and illustrated, too, are methods or compression molding, uses of phenolic plastics and resins. In addition, a brief review of recent books and suggested sources of information on plastics, is also included.

Another new booklet, this one issued by G. E., covers "Designing Molded Plastics Parts."

The booklet is an assembly of an informative series of ads carried in trade papers over a period of several months, each ad dealing with some technical phase of designing molded plastics parts.

Subjects covered are inserts, shrinkage, tolerances, wall thickness, holes and undercuts, ribs, bosses and fillets. The material is intended for product engineers and designers.

Copies are available from General Electric Plastics Dept., One Plastics Avenue, Pittsfield, Mass.

Extruded industrial plastics in war production is discussed in a booklet issued by R. D. Werner Co., Inc., 380 Second Avenue, New York City.

The book, prepared for use by war contractors, describes and illustrates the variety of plastic units that are available today. General properties of plastics, such as cellulose acetate, ethyl cellulose, methylmethacrylate, styrene, etc., are also shown, in chart form. Various shapes of plastic pieces, with their properties, are described and illustrated.

From the Taylor Fibre Company, Norristown, Pa., has come a new 56-page handbook on vulcanized fibre and phenol fibre.

Covered in this book are laminated plastics for electrical insulation, radio, electronics, aircraft, (including the new laminated plastics construction of air-foil sections), silent gears and railroad and automotive industries.

There are many helpful tables and other data to guide designing and production engineers in the selection, fabrication and application of the material best suited to the particular purpose. It is profusely illustrated.

Available on request if made on business or official stationery.

In addition to these booklets, a new book, "Plastics," by J. H. DuBois, G. E. plastics engineer, has just been published by the American Technical Society, 850 East 58th St., Chicago.

The book which is well illustrated, begins with a general introduction to plastics, defining fundamentals and terminology. The author then takes up the various types of materials separately, indicating their sources, manufacture, variations, properties, and applications. These materials include phenolics, ureas, cellulose, acrylic vinyl and styrene, cast phenolic and protein plastics, mycalex, nylon, lignin, resin-bonded plywood, etc. There is also a discussion of some of the older cold-molded and shellac plastics and a chapter on laminated plastics describing the composition, properties, fabrication and uses of them.

Subsequent chapters deal with the methods of manufacture of plastics products including molding, finishing and decorating. The final chapter on the design of plastics molded products describes the practices resulting in most satisfactory moldings at minimum cost. The cost of the book is $3.00.

• • •

ELECTRICAL INSULATION DATA

A compilation of design, production and price data on untreated tapes, sleevings, tying cords, fibreglas base laminated materials, varnished fibreglas cloths and tapes, varnished fibreglas tubings and saturated sleevings, mica and fibreglas combinations and fibreglas adhesive tapes, appears in a catalog issued by Insulation Manufacturers Corporation, 565 West Washington Blvd., Chicago, Illinois.

In another catalog issued by this company, technical data on pedigree insulating varnishes and compounds are provided. These varnishes include those of the finishing and baking types. Protective sealers, machinery enamels and insulating paints, shellacs, are also described.

• • •

RECEIVING-TRANSMITTING TUBE MANUALS

A 16 page booklet on receiving tubes and allied special purpose types, and a 72-page 1942 guide for transmitting tubes have just been issued by RCA.

The booklet contains three charts. Chart I classifies the tubes according to their cathode voltages and function. Chart II gives characteristics of each of 329 receiving types arranged in numerical-alphabetical sequence. The types included in the War Production Board's Limitation Order L-76 discontinuing the manufacture of certain receiving types for general civilian use are also shown. Chart III includes information on certain tubes closely allied to receiving tubes but customarily tabulated separately and identified as "special purpose." These tubes are particularly of interest for applications involving special performance requirements. Socket connections are shown with RMA designations where assigned.

The 72-page, 1942 guide for transmitting tubes retains the same general appearance as the 1941 edition but it has been completely revised and much new material has been added. New information includes a special reference chart cataloging air-cooled and water-cooled transmitting tubes, transmitting and television rectifiers, cathode-ray tubes, phototubes, voltage-regulator tubes, and special purpose tubes.

As in the previous edition, the 1942 RCA Guide contains three major sections, as follows: (1) TRANSMITTING-TUBE DATA . . . a 37-page section with pertinent data, basic circuits, and socket connections for popular power tubes. Also included are gas-triodes, gas-tetrodes, and the u-h-f acorn and midget types. Supplementing these data, 5 pages are devoted to the special reference chart. (2) TRANSMITTING-CIRCUIT FACTS . . . a 6-page section with data on the design, adjustment, and operation of transmitters. (3) TRANSMITTER CONSTRUCTION . . . a 20-page section with the layout, adjustment, and operation of equipment, illustrated by descriptions of several rigs.

The receiving tube manual is available free, while the transmitting guide sells for 35c.

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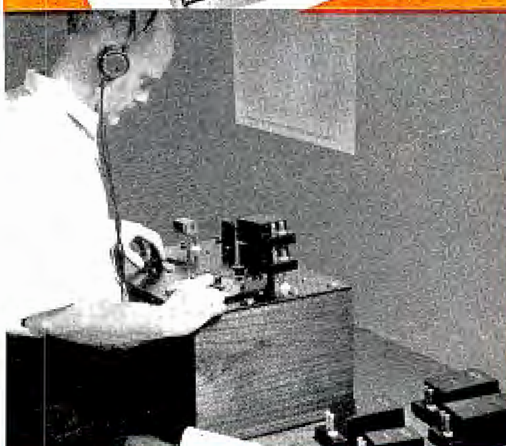
Capacitance Standards

General Radio air and mica condensers are widely used as standards of capacitance. For this reason, the General Radio Company maintains a careful supervision of the calibration standards in its own standardizing laboratory. These fixed standards cover a range of capacitance from 1000 µµf to 1 µf in values of 1, 2 and 5 for each decade.

These standards are kept in a temperature-controlled room. A complete intercomparison of units to detect drift of one unit relative to the others is made at least twice a year; additional measurements of selected groups are made more frequently. To detect drifts of the system as a whole, a complete set of mica standards is checked once in two years by the National Bureau of Standards, and any necessary corrections in the recorded capacitance values are made. Discrepancies are seldom as great as 0.02%. This capacitance standardization system is, therefore, internally consistent at all times to 0.02% or better.

The guaranteed accuracy of commercial standards calibrated in the General Radio laboratories is limited to 0.1% for capacitance, which is the accuracy to which the National Bureau of Standards certifies capacitance calibrations.



The technique of comparing capacitances in our laboratories has been developed to the point where the inherent errors in the comparison process are negligible in terms of the accuracy of the standards. The overall precision of measurement is 0.02% for capacitance and 0.000050 for dissipation factor.

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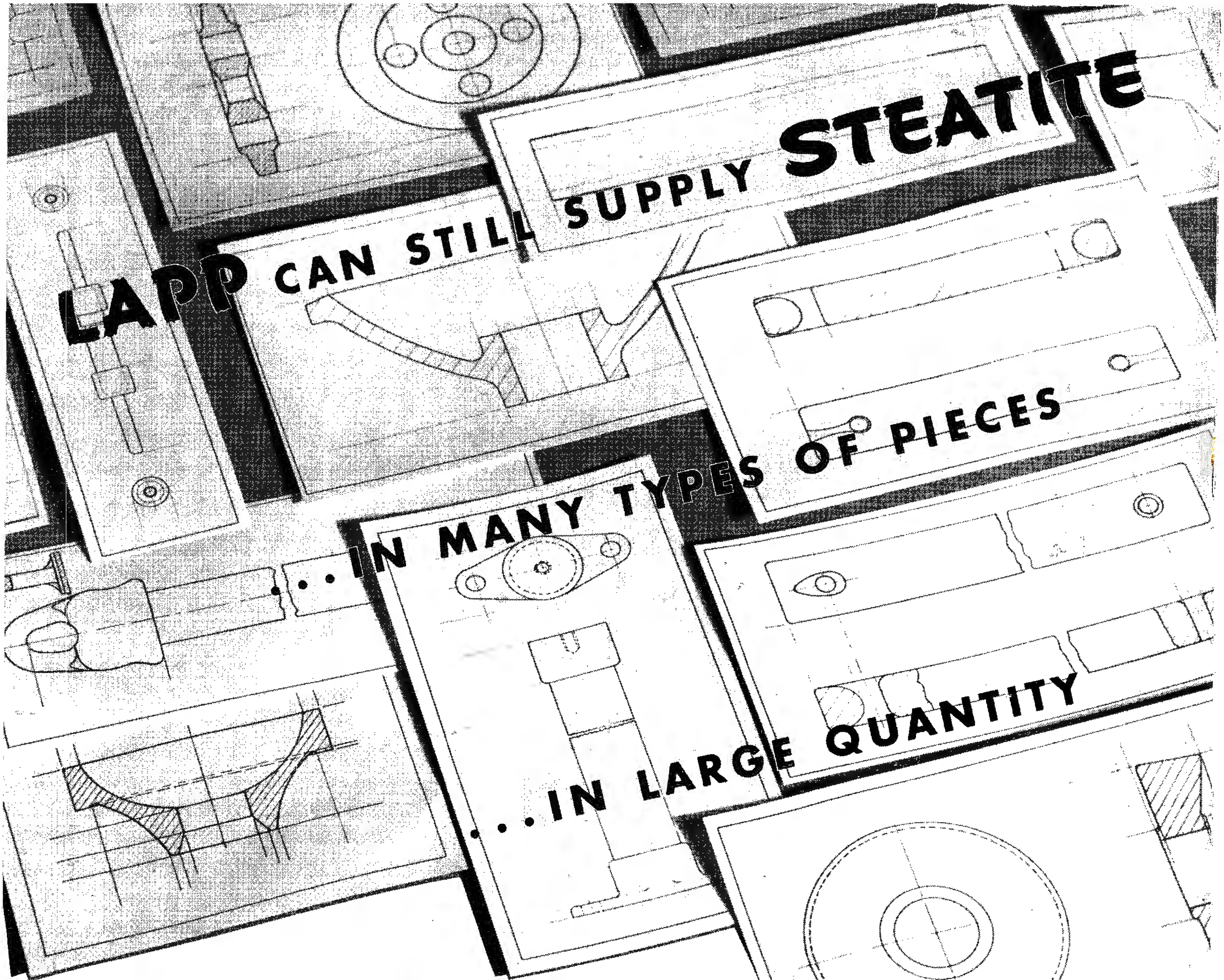

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