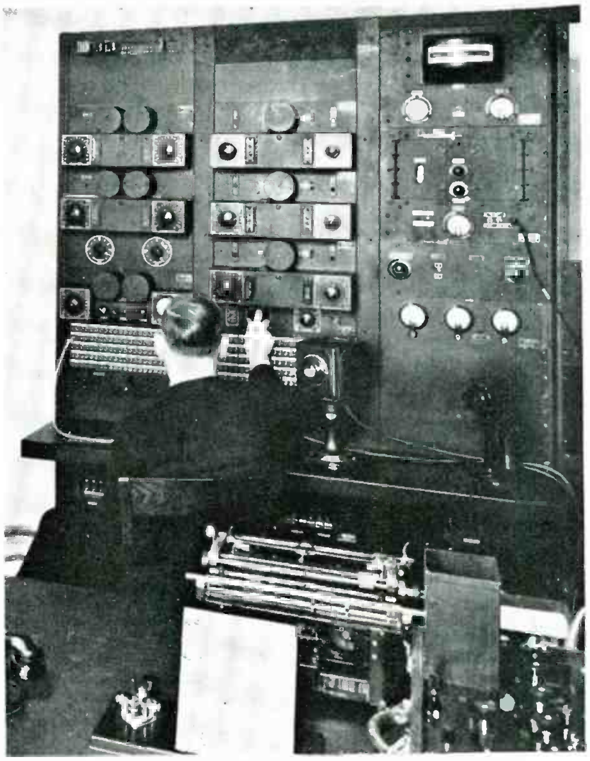
JULY, 1934

Radio Engineering



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VOL. XIV NO. 7

The Journal of the Radio and Allied Industries

"Communication and Broadcast Engineering"

(The Monthly Journal of World Communication)

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•
Radio Telephony
•
Wire and Cable Telegraphy
•
Wire and Cable Telephony
•
Broadcast Transmission
•
Carrier Transmission
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Beam Transmission
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Marine Radio
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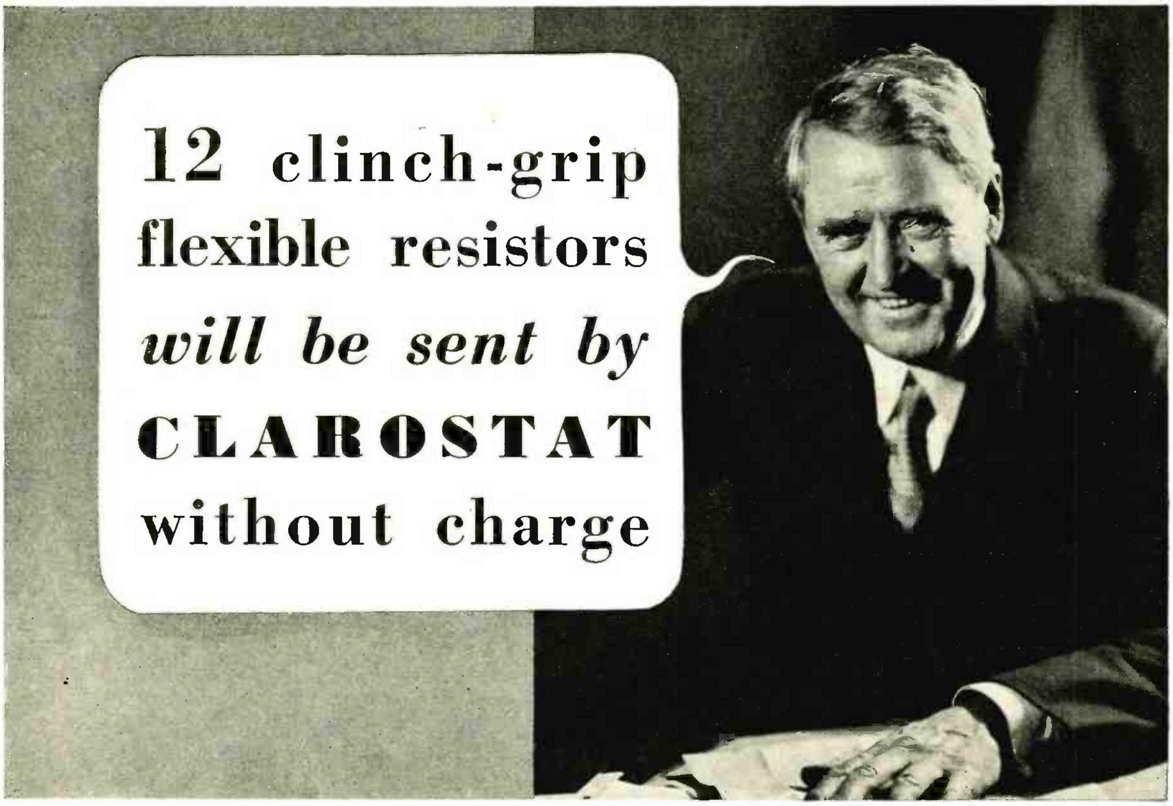

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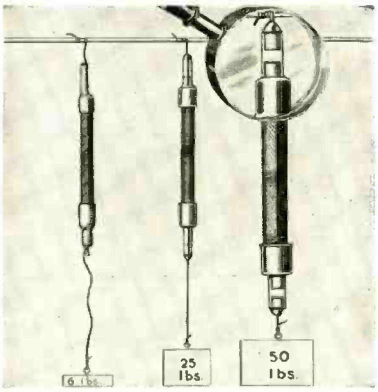

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Vol. XIV — JULY, 1934 — Number 7

CONTENTS

DEPARTMENTS

RMA CODE HEARING

THE GOVERNMENT has promptly granted the application of the Radio Manufacturers Association for formal hearing on the matter of withdrawing radio manufacturers from the NRA code for the electrical manufacturing industry and submission of a separate, independent code for the radio industry.

The formal hearing will be held by the National Recovery Administration at Washington at 10:00 o'clock, Monday, July 23, at NRA headquarters.

The RMA effort, unanimously approved by its Board of Directors and also its membership at their recent Chicago convention, to withdraw radio and television manufacturers from the present electrical code and have a separate independent code for the radio industry, will be in charge of the RMA Code Committee, of which Captain William Sparks of Jackson, Michigan, is chairman.

A strong case for the radio industry in its request for withdrawal from the electrical code and an independent code and code authority of its own is being prepared.

BRYAN S. DAVIS
President

JAS. A. WALKER
Secretary

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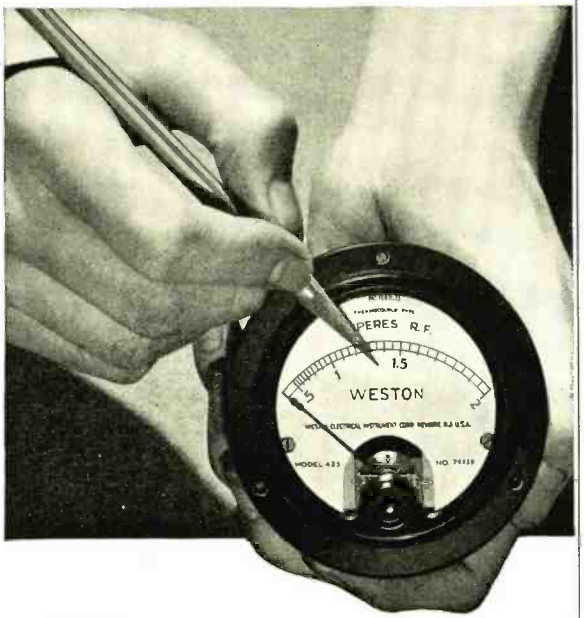

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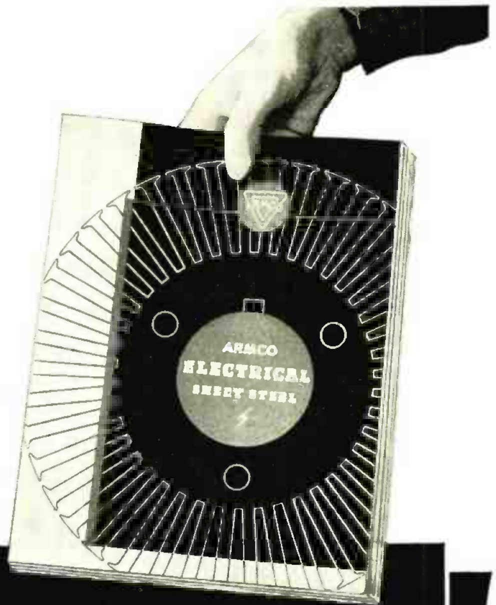

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EDITORIAL

SMALL BROADCASTERS

ARE THERE A SUFFICIENT number of broadcast stations in the United States? Highly opinionated people will tell you there are more than a sufficient number, and that it would be a good thing if a large part of them were done away with entirely. The tolerant man will reserve decision, since he is well aware that the number and locations of broadcast stations are not results of controlled social planning.

It may be a breach of good taste to haul in sociology when discussing the subject of broadcasting; be that as it may, sociological planning is worth consideration when any attempt is made to forecast the possible future of the nation's broadcast network. Sociologists think in terms of the future. It is necessary they do so in order that the population of the nation may be properly provided. Thus, for some time the sociologists have engaged the architects in a study of housing conditions and means for the distribution of commodities, so that shifts in population may be handled with the least amount of effort. The ever-increasing decentralization of population, and the possible scattering of industry into small units as a result of population shifts, calls for planned transportation arteries, power lines, housing facilities, etc., worked out almost to the final details much before the actual shift shows definite momentum.

Sociologists have had no hand in the growth of the broadcast network. The present layout is devoid of all plan for the simple reason that business, and business only, has dictated how many broadcast stations there would be, and where they would be. Since the stations have been erected in the midst of, or near, dense population, so that coverage or "circulation" would result in profit, the arrangement has all the earmarks of having been planned. One would hardly have things otherwise.

The fact remains, however, that broadcasting service is not uniform. There are sparsely settled sections of the country where the service is admittedly poor. The signal coverage is inadequate because of economics, not because of engineering barriers. Super-power broadcast stations may prove to be the solution to the problem—providing the added "circulation" will warrant the added expenditure. An increased number of low-power broadcast stations, each to cover a comparatively small area, is another possible solution.

It has been rumored that the newly installed Federal Communications Commission favors the idea of an increased number of broadcasters, with power not to exceed 100 watts. It may be that the Commission has an eye to the future; sensing, first, the social justice in providing complete, nationwide coverage; and second, the possibility of such a widespread decentralization of population that such service would eventually be demanded. Better, then, to provide the service now so that the broadcast network of the future will be adequate for all purposes.

Transmitting equipment has been improved to such an extent that a 100-watt station should be able to provide in its own service area programs of a quality equaling that of the larger stations. Economically, the stations should be able to support themselves through linkage with the large chain broadcasters for "national" programs, and the transmission of local "paid" programs during the intervals. The idea is not new, but holds possibilities of considerable extension.

There are available a number of systems whereby it is possible to restrict the transmission of a station to its own locality or, at worst, to prevent the transmission from interfering with that of another station. Therefore, the addition of a group of 100-watters appears not only feasible, but highly desirable. Besides, the day will come when such stations will be required for services other than program transmission.

RADIO ENGINEERING

FOR JULY, 1934

Directional Antenna at WMC

By C. E. BAKER, CHIEF ENGINEER, WMC

● Description of a directional transmission system employing a vertical radiator as a reflector.. The construction of the reflector mast is also dealt with.

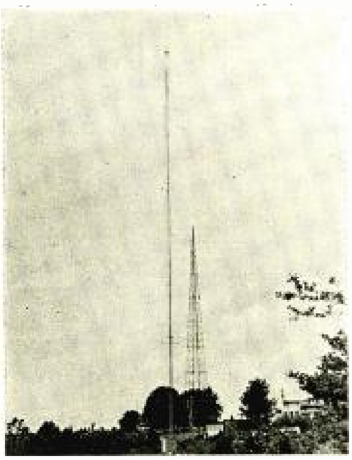


Fig. 1. View of the WMC reflector mast, and one of the vertical radiators.

THERE HAS RECENTLY been a great deal of attention given to directional transmission. In the main, this interest is probably due to the possibilities of regional stations keeping their interference ratio in the service areas of other stations down to the same level, or lower, at greater powers. Hence, by employing a directional system these stations may secure grants to increase their power.

Stations confronted with the problem of reflecting their signal in two general directions will find the type of reflection system described herein more preferable than the usual directly excited type of reflector, which reduces the reflection to a narrower area, such, for example, as is used at WFLA[1], Clearwater, Florida.

With an application pending before the Federal Radio Commission for an increase from 1000 watts day and 500 watts night to 2500 watts day and 1000 watts night, station WMC, Memphis, Tenn., set out to obtain technical data on directional transmission for the preparation of their testimony. In other words, WMC wanted facts rather than hypothetical figures. Some of the results obtained and a description of the antenna system is given in the following paragraphs.

FIELD-INTENSITY DATA

The WMC field-test car, equipped with field-intensity measuring apparatus, spent several days in the service area of station WTAR, Norfolk, Virginia, making field-intensity measurements on WMC. This Virginia station, operating on the same frequency as WMC, is at such a distance from Memphis that any increase in WMC's power would cause an increase in the interference ratio of these stations. These tests also indicated that WMC's sky wave in the Norfolk area varied almost exactly as the ground wave of WMC one mile from the latter's transmitter. With this knowledge, it was relatively simple to make subsequent measurements one mile from the WMC transmitter and have good indications of what was taking place at Norfolk. All of these results were later verified by a Jansky and Bailey field car equipped with antomatic-recording, field-intensity apparatus.

ANTENNA SYSTEM

The outstanding features of this directional-antenna system are the low cost, simplicity and ability to more than handle the job. The radiator antenna is a five-wire cage, three inches in diameter and 185 feet high, suspended vertically between two 200-foot insulated towers. These towers were formerly used to support a conventional "T" type antenna.

In the direction of Norfolk, Virginia, by the great circle route, and spaced a quarter wavelength away from the

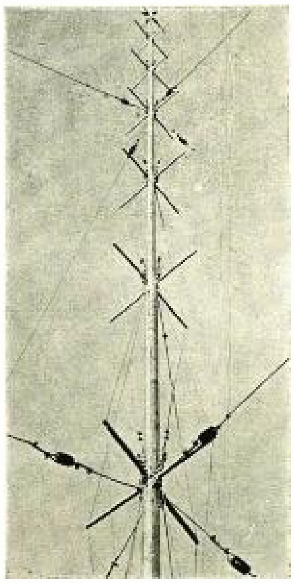


Fig. 2. Showing the wire cable trusses used to stiffen the steel pipe mast.

[1]"Directional Broadcasting," by Raymond M. Wilmotte, pp. 12, June, 1934, RADIO ENGINEERING.

radiator, is the self-excited reflector mast (see Fig. 1). It, too, is 185 feet high, and was designed and erected by the engineers of WMC, at only a fraction of the cost of the usual towers; the effectiveness probably could not be improved by the use of the more expensive units.

The mast is made of high-pressure steel pipe which is stiffened by a system of wire-cable trusses, is only six inches in diameter at the base, resulting in low capacity to ground, and tapers to two and one-half inches at the top. The pipe sizes were selected so that they would telescope snugly, the joints then being bolted and electrically welded. Three sets of guys, broken every fifty feet by strain insulators to prevent re-radiation, are used to steady the mast, while inexpensive patent anchors serve to hold them to the ground. (See Fig. 2.)

The base insulator, shown in Fig. 3, is interesting because it also is home-made. A large strain insulator, each end of which is cast in a steel cup filled with lead, supports the mast. Several insulators of this type were subjected to pressure tests in a laboratory. The pressure required to produce failure was found to far exceed the load imposed upon them. Three insulators of the same type are used as a combination anchorage and lifting arrangement to hold the base of the mast stationary, this arrangement making the load on the base insulator still lighter.

MAST ERECTION

A very unusual method was used in raising the mast. A temporary wooden derrick forty feet in height was first erected, and the pipe hoisted up through the derrick a length at a time, men at the guy anchors letting the guys off as the mast went up. This pipe would be hoisted up about twenty feet and another section put in place underneath, bolted and welded. This process was repeated until the desired height was obtained. The method was found to be easy, inexpensive, and free from complications.

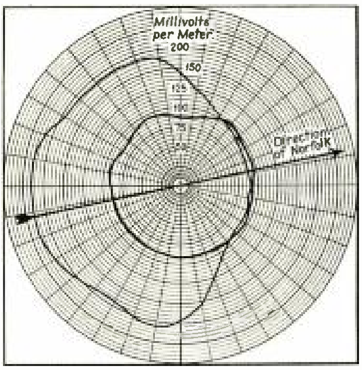


Fig. 4. Field patterns of WMC. Smaller circle is 0.5 kw unreflected. Larger circle is 1.0 kw with reflector operating.

REFLECTOR TUNING

Tuning the reflector also was accomplished in a very unique way. The field-test car, located one mile from the transmitter and in the direction of Norfolk, was equipped with an ultra high-frequency phone transmitter and receiver. Similar equipment was installed in the tuning house at the reflector. While the operator in the car watched the field-intensity apparatus, the operator at the reflector varied the tuning control. When the minimum field-intensity was noted at the car, the operator at the reflector tuning house was contacted and stopped.

The mast is tuned so as to have inductive reactance (resonant at a slightly lower frequency). Daily observations over a long period indicate that the field intensity in the protected direction was consistently the same regardless of weather conditions, ground moisture level, etc.

The phase of the currents in the radiator and reflector naturally governs the action of the system. Hence, a simple method was devised by WMC engineers to check the phase relations of these currents with a cathode-ray oscillograph.

FIELD PATTERNS

Measurements made in a circle one mile from the transmitter were used to determine the field patterns. Reference to the field pattern shown in Fig. 4 indicates that an increase of approximately 200 per cent in coverage and 100 per cent in power can be gained by the use of the reflector, while still maintaining less signal in the direction of the protected station.

The results of the directional antennae happens to be extremely advantageous for this station, since the areas covered by the large gain in field intensity are in the more densely populated districts.

NEW COMMUNICATIONS COMMISSION

FOLLOWING ENACTMENT by Congress before its adjournment of the law establishing a new Federal Communications Commission and abolishing the former Federal Radio Commission, President Roosevelt on June 30 appointed the new commissioners, choosing Judge E. O. Sykes, former chairman of the Radio Commission, for chairman of the new federal commission, with a seven-year term. Another former radio commissioner appointed was Thad H. Brown of Ohio, given a six-year term. Former Radio Commissioners Harold A. Lafount of Utah and James H. Hanley of Nebraska were not reappointed.

New members of the new Communications Commission are Paul A. Walker of Oklahoma; Norman S. Case of Rhode Island; Dr. Irvin Stewart of Texas; George Henry Payne of New York; and Hampson Gary of Texas. None were chosen from the Pacific Coast, intermountain or northwestern regions.

The new Commission has jurisdiction not only over radio, but also over interstate telephone and telegraph communication. Dr. C. B. Jolliffe of the old radio commission will continue as chief engineer of the new body.

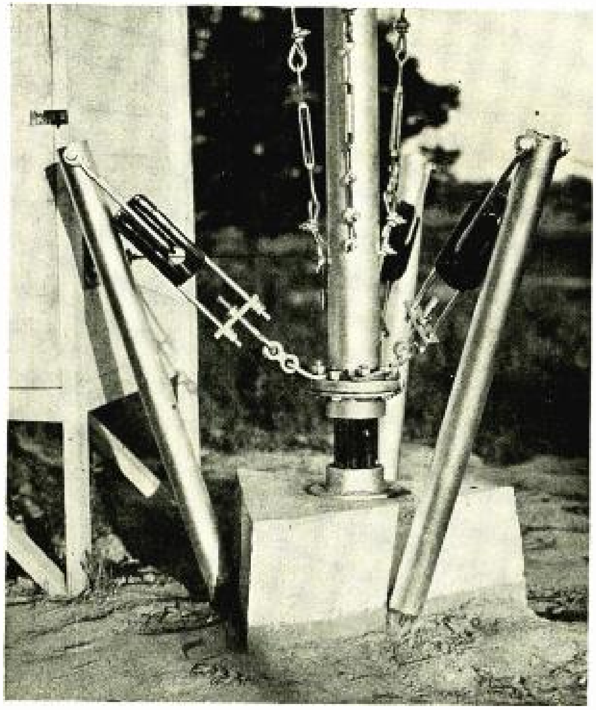


FIG. 3. VIEW OF BASE OF REFLECTOR MAST, BASE INSULATOR AND THE ANCHORAGE - LIFTING SYSTEM.

RMA TENTH CONVENTION

ROOSEVELT GREETS RMA ON TENTH BIRTHDAY • NEW RMA CODE

UNANIMOUS DECISION of the radio industry to withdraw from the NRA electrical code and operate under a radio industry code featured the tenth annual convention of the Radio Manufacturers Association at the Stevens and Blackstone Hotels in Chicago, June 11-14. An excellent, separate code for the radio manufacturing industry was drafted, approved not only by the RMA Board of Directors, but also unanimously by its entire membership in convention session and has been submitted to the National Recovery Administration at Washington.

RMA, RWA JOINT MEETINGS

More than a hundred RMA members attended the Chicago convention which was held jointly with the Radio Wholesalers Association and a pretentious national trade promotion plan was launched jointly by the manufacturers and wholesalers, meeting in many joint sessions. The industry thus presents a closely knit united front for cooperative action to promote radio.

PRES. ROOSEVELT'S MESSAGE

President Roosevelt, in a special message sent to the RMA, commended the manufacturers' organization for its public service and also supported broadcasting and other radio interests by declaring emphatically for maintenance of radio on an equality with the traditional "freedom of the press." President Roosevelt's message, addressed to former President Fred D. Williams of the RMA, was read at the tenth anniversary banquet of the Association in the Stevens Hotel Grand Ball Room on Wednesday, June 13, by Toastmaster Paul B. Klugh. It was broadcast on the national network of NBC which carried the RMA banquet program. The original draft of the President's message will be kept as an historic souvenir by Fred Williams.

"You have had many evidences of my interest in radio," said President Roosevelt in his message to the RMA. "In cooperation with the Government, radio has been conducted as a public agency. It has met the requirements of the letter and spirit of the law that it function for 'public convenience and necessity.'

"To permit radio to become a medium for selfish propaganda of any character would be to shamefully and wrongfully abuse a great agent of public service. Radio broadcasting should be maintained on an equality of freedom similar to that freedom which has been and is the keystone of the American press."

The message from President Roosevelt was undoubtedly heard by millions of listeners on the NBC network and also given wide publicity in the press.

Leslie F. Muter, President, RMA

L. F. MUTER RMA PRESIDENT

The new president of the Radio Manufacturers Association for the ensuing year is Mr. Leslie F. Muter of Chicago, president of The Muter Company, 1255 South Michigan Avenue, and for many years an officer and director of the Association. He has served two years as chairman of the RMA Parts, Cabinet and Accessory Division, also as vice president and treasurer, and is now the NRA Code Supervisory Agency for radio parts and accessories.

Mr. Muter succeeds Fred D. Williams of Indianapolis as president of the RMA following his election on June 13 by the Board of Directors. Mr. Williams, however, remains in the RMA organization having been elected treasurer following two years of service at the head of the Association.

The vice presidents of the RMA are Arthur T. Murray of Springfield, Mass., now NRA Code Supervisory Agency for receiving sets; S. W. Muldowny of New York, NRA Code Supervisory Agency for tubes; Arthur Moss of New York and Richard A. O'Connor of Fort Wayne, Indiana. They also are respectively the chairmen of the RMA Set; Tube; Parts, Cabinet and Accessory; and Amplifier and Sound Equipment Divisions.

NEW MEMBERS ELECTED

New members elected to the RMA Board of Directors are Benjamin Abrams of New York; Dr. W. R. G. Baker of Camden, N. J., and Paul V. Galvin of Chicago, newly elected by the RMA Set Division; Ben G. Erskine of New York and J. C. Warner of Harrison, N. J., newly elected from the RMA Tube Division, and N. P. Bloom of Louisville, Ky., newly elected from the RMA Parts, Cabinet and Accessory Division.

Directors Arthur Moss, Arthur T. Murray, Richard A. O'Connor, James M. Skinner and Captain William Sparks were reelected. Retiring directors include E. T. Cunningham, LeRoi J. Williams, J. Clarke Coit, George Lewis and G. K. Throckmorton.

Bond Geddes was reelected executive vice president and general manager and also secretary of the Association, and John W. Van Allen of Buffalo, New York, general counsel.

Committee chairmen for all RMA committees for the ensuing year will be appointed by President Muter at the next Board of Directors' meeting.

DIVISION MEETINGS

Many meetings of all RMA Divisions and joint meetings with RWA committees of radio jobbers were held during the four days of the industry conventions at the Stevens Hotel. There

(*Continued on page* 19)

Design of Power Amplifier

By REUBEN LEE, ENGINEER,
WESTINGHOUSE ELECTRIC and MFG. COMPANY

THE PROBLEM INVOLVED in the design of output circuits is that of so proportioning these circuits that the proper amount of power is delivered to the antenna with a minimum of distortion and harmonic content.

It is the intent of this paper to reduce this design problem to the use of charts and simple arithmetic. For the sake of conciseness, mathematical proofs are omitted; so are such circuit details as plate chokes and blocking condensers, and the discussion is thus confined to the main circuit elements. It is assumed that the question of tube complement and tube efficiency has likewise been settled before the question of the output circuits is reached.

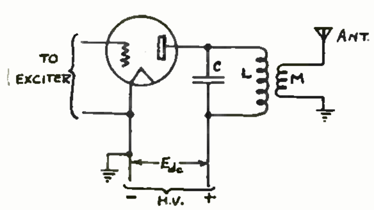


Fig. 1. Simple amplifier circuit.

AMPLIFIER CIRCUIT ACTION

Consider the simplified circuit of Fig. 1, consisting of a tube with grid excitation from a preceding stage, a plate tank circuit C and L, and coupling coil M transferring the power from L to the antenna. The plate power is furnished from a source HV at a constant voltage E_{dc}.

The action of the amplifier, with the tank circuit correctly tuned, can be seen by referring to Fig. 2, which shows the various voltage and current relations during a radio-frequency cycle. A sine-wave, grid-excitation voltage, e_g, impressed on a grid with bias voltage, E_c, swings positive each cycle during the interval indicated by the shaded area. The plate voltage e_p is a sine wave about the direct voltage E_{dc}, and is of exactly opposite phase to e_g. Grid current i_g is produced while the voltage e_g is positive, and plate current i_p is drawn from source HV over a somewhat longer interval at an average rate I_{dc}. It is this current i_p flowing through the combined impedance of L and C that produces a radio-frequency voltage across the tank circuit and induces a like voltage in coil M to energize the antenna.

For purposes of analysis, the tank circuit can be reduced to that shown in Fig. 3, where C and L are replaced by their respective reactances X_C and X_L at the operating frequency, and R is the tank equivalent of the antenna resistance plus the tank coil-resistance. This circuit may be considered as having an entering current I_p which is the radio-frequency component of i_p and which develops across the tank an effective radio-frequency voltage E_p. The total impedance looking into the circuit is Z_T. In what follows, the frequency at which this circuit operates will be taken as the fundamental operating radio frequency unless otherwise stipulated.

The peak value of the r-f voltage can be shown to be, from Fig. 2,

$$E_{pk} = \frac{4 E_{dc} \cdot \xi}{\pi} \qquad (1)$$

where ξ is the tube efficiency.

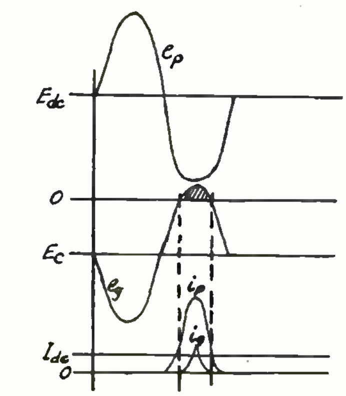


Fig. 2. Tube currents and voltages.

The effective or rms value of the tank voltage is $E_p = .707\ E_{pk}$. To obtain the currents and voltages here described, the fundamental component of I_p must be in phase with E_p; that is, the tank circuit must be tuned to the unity power-factor condition, represented by the vector diagram of Fig. 4. This diagram shows that the tank-condenser current I_C leads I_p and E_p by 90° and the tank-coil current lags I_p by an angle somewhat less than 90° because of the resistance in the coil branch. The two branch currents I_C and I_L are both greater than the total entering current I_p.

The product of E_p and I_C or I_L evidently may be (and in fact usually is) greater than the product of E_p and I_p. The ratio K_T of these two products is generally known as the $\frac{\text{volt amperes}}{\text{watts}}$ or $\frac{\text{kva}}{\text{kw}}$ ratio, the volt amperes being the apparent power and the watts the true power, including losses, in the tank circuit. The determination of the correct ratio K_T is one of the major problems of tank circuit design.

LIMITS OF RATIO

So far no limits have been placed upon this ratio. If the combination of L and C in Fig. 1 were replaced by a simple resistance, the power amplifier would still function properly, and this would be the same as making $\frac{\text{va}}{\text{w}} = 1$. However, the tube current I_p, which apparently has large harmonic components, would pass into this resistance unchanged, with the result that the output of the amplifier would be high in harmonic content. On the other hand, the condenser C in Fig. 1 allows the harmonic components to flow freely, while the coil L discriminates against them. Thus the effect of high K_T is to reduce harmonics; conversely the lowest value that this ratio may have in Fig. 1 is fixed by the allowable percentage of harmonics in the antenna circuit.

Suppose the ratio K_T be increased considerably. This means that I_C and the capacity value of C become greater. Also, I_L becomes greater and the inductance of L becomes less, requiring a costlier circuit, unless the tank losses are allowed to increase. The latter alternative cannot be chosen without reducing the output power.

Hence it appears that the upper limit of the ratio K_T is that of cost. This is true in the case of cw telegraph transmitters, but where modulation of the transmitted signal is used, there is another limitation. Because of the time interval required to store up or remove

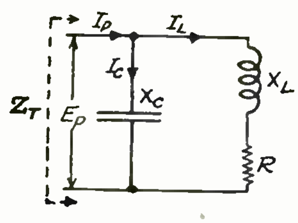


Fig. 3. Tank circuit currents and voltages.

Output Circuits

● A simple mathematical exposition of the problems involved in the design of output circuits, with references to harmonic content, modulation, distributed capacity, etc. Amplifier circuit action is first considered. A working example is given for circuit design.

energy from the tank circuit C and L, voltage E_p cannot be varied too rapidly. This is the same as saying that the upper limit of K_T is determined by the highest modulation frequency. Thus the design problem here becomes that of finding the lower limit of K_T as determined by harmonic content and the upper limit from the highest modulation frequency.

HARMONIC CONTENT

If we designate harmonic currents by primes (I'_p = any harmonic component

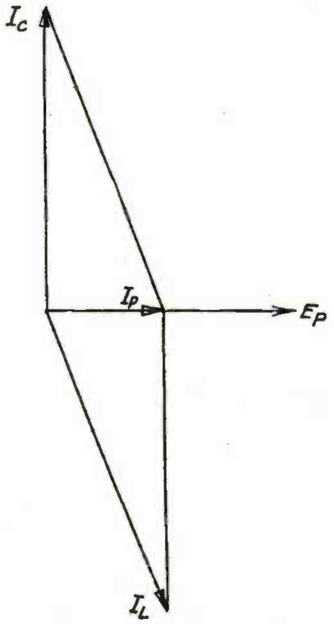


Fig. 4. Vector diagram of tank circuit with unity power factor tuning.

of plate current, I'_L = any harmonic component of tank coil current, etc.) and let the symbols without primes refer to the fundamental component as before, it can easily be shown, for values of K_T greater than 4, that

$$\frac{I'_L}{I_L} = \frac{I'_p}{I_p K_T (n^2 - 1)} \qquad (2)$$

where n is the order of harmonic (n=2 for second, 3 for third, etc.) This is the reduction of harmonics afforded by the tank circuit, since the current I'_L and I_L are both coupled directly into the antenna. The harmonics are reduced in proportion to the ratio K_T; also, the higher harmonics are attenuated by the tank circuit to a much greater degree than the second or third. These two factors are perfectly definite, but the ratio I'_p/I_p is less definite. As the tube current i_p in Fig. 2 departs from an exact half sine wave, the harmonic ratio must be determined by making a laborious plot of i_p and analyzing it to find the harmonic components.

Usually, it will be found that the ratio I'_p/I_p does not exceed 0.7 for the second harmonic and 0.3 for the third at the usual amplifier efficiencies. The higher harmonics have smaller amplitudes and are attenuated to a greater degree than the second or third; hence the latter are usually all that need to be considered. The ratio I'_L/I_L is accordingly plotted for these two harmonics in Fig. 5.

DISTRIBUTED CAPACITY

Besides the approximation for I'_p/I_p, there are two other factors that make equation (2) less accurate than could be desired. The first of these is distributed capacity, which is not directly calculable. The effect of this factor is to pass the higher harmonics between the turns of L and over to M more freely than eq. (2) would indicate, especially at the higher frequencies. For this reason, a grounded static shield is sometimes placed between coils L and M.

The other factor which equation (2) does not account for is the antenna impedance at the harmonic frequency. If the antenna should be resonant at some harmonic, the radiated field strength of this harmonic might be very high, even though the harmonic component of antenna current were in accordance with equation (2). The logical thing to do in such a case would be to adjust the antenna slightly to avoid such resonance, or else attenuate the harmonic by some other means.

An antenna is rarely connected direct to the coil coupling as shown in Fig. 1, but usually some other apparatus is inserted to tune the antenna to resonance at the fundamental frequency. Nevertheless, coupling a tank circuit directly to a resistance in this way is often done, as for example a transmission line fed by the coupling coil and terminated by the antenna. For such cases, the foregoing analysis and equation hold.

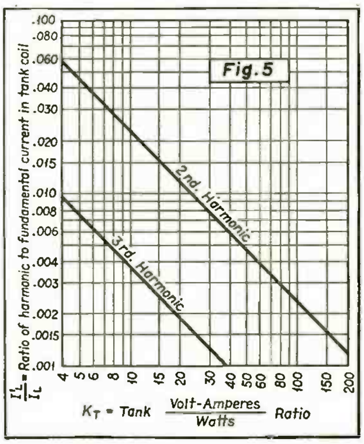
Suppose a capacitive antenna to be tuned by an inductance L_A to resonance. The output circuit could then be shown as in Fig. 6, where L_A is the total inductance of the circuit, C_A is the total capacity of the circuit, and R_A is the sum of the antenna and coil resistances. Denoting the antenna fundamental and harmonic currents by I_A and I'_A respectively, for this circuit,

$$\frac{I'_A}{I_A} = \frac{I'_p \, n^2}{I_p K_T K_A \, (n^2 - 1)^2} \qquad (3)$$

where K_A is the $\frac{\text{va}}{\text{w}}$ ratio in the antenna circuit only ($= \omega L_A/R_A = 1/\omega C_A R_A$). Equation (3) is plotted in solid lines in Fig. 7 for the second and third harmonics between the harmonic current ratio I'_A/I_A and the product $K_T K_A$ of the volt-ampere ratios in the tank and antenna circuits. Equation (3) and Fig. 7 are subject to the same general stipulations regarding tube current, capacitive coupling and antenna impedance as mentioned for the circuit of Fig. 3.

PUSH-PULL CIRCUIT

The preceding curves show the minimum ratio K_T that can be permitted in circuits like Figs. 3 and 6 for any re-



Harmonic content of tank coil current for circuit of Fig. 3.

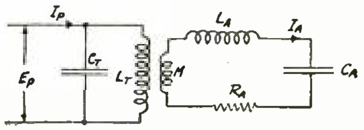


Fig. 6. Inductively-coupled antenna circuit.

quired ratio of harmonic to fundamental antenna current. If this ratio cannot be made low enough without excessive cost, the designer may resort to other schemes to keep the cost low. One of the most common is that of connecting the amplifier tubes in the well-known push-pull circuit. By this means, the even harmonics are "balanced out" or reduced to low values, so that the harmonic of greatest magnitude is the third. Figs. 5 and 7 both show the reduction in harmonic current that can be effected in this way.

If this cannot be done, or if still further harmonic reduction is necessary, the capacitively-coupled circuit of Fig. 8 can sometimes be used. The harmonic antenna current ratio in this circuit is found from

$$\frac{I'_A}{I_A} = \frac{I'_p}{I_p} \cdot \frac{1}{K_T K_A (n^2 - 1)^2} \qquad (4)$$

provided the capacity reactance of condenser C_c and the antenna resistance are low, which is usually true where this circuit is used. Equation (4) is plotted as dashed lines in Fig. 7. Note that in this circuit the effect of distributed capacity in increasing the harmonic currents is practically zero, particularly if the tank circuit is well shielded from the antenna circuit, as indicated in Fig. 8. It is evident from Fig. 7 that very low harmonic currents are possible with this circuit.

If neither a push-pull amplifier nor a capacitively-coupled antenna is practicable, various other circuit combinations may be used. To keep this discussion as simple as possible, these more elaborate schemes will be omitted, but almost any of them can be reduced to an equation for I'_A/I_A such as equations (3) and (4).

MODULATION

We have so far found what the minimum ratio of tank and antenna volt amperes to watts must be to reduce harmonics to the required ratio. In a straight cw transmitter, this is the sole requirement, but in a modulated transmitter of whatever kind of service, there is an upper limit of tank and antenna volt amperes which must not be exceeded if distortion is to be avoided. This distortion is the result of applying and removing power from a circuit at a more rapid rate than the natural time of build-up and decay of the circuit. This effect imposes a limit upon the highest modulation frequency f_m as follows:

$$\frac{f}{f_m} = QK_A \qquad (5)$$

where Q is a constant depending upon the allowable audio distortion at f_m. and f is the operating radio frequency.

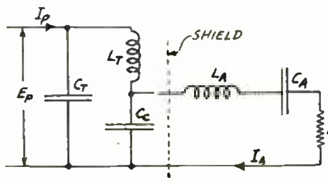


Fig. 8. Capacitively coupled antenna circuit

This equation neglects tank losses, and is accurate only for loosely-coupled antenna circuits, (or values of K_A and K_T greater than 4). It is plotted in Fig. 9 for 1, 2, 5 and 10% audio distortion (Q = 12.7, 10.2, 7.7 and 5.9), under the conditions for either inductive or capacitive antenna coupling. For the circuit of Fig. 1, the term Q in equation (5) should have values one-half of those just given, and K_A should be replaced by K_T.

EXAMPLE

To illustrate the use of the charts, let us take a push-pull modulated amplifier having the following characteristics:

Output watts, including tuning coil loss	640
Amplifier efficiency	72%
The dc plate voltage	2500
Permissible harmonic current in antenna circuit	.05%
Operating radio frequency (kc)	1000
Highest modulation frequency (cycles)	10,000
Antenna circuit resistance (ohms)	25
Antenna capacity (mfd)	.001
Permissible audio distortion...	1%

The ratio of radio to modulation frequency is 100. Hence from Fig. 9, the antenna volt amperes/watts ratio, K_A, must not exceed 8. The antenna capacity reactance is $1/2\,\pi f C_A$ = 159 ohms, and the ratio K_A is 159/25 = 6.36, which shows that the modulation will be satisfactory.

From Fig. 7 it will be seen that a third harmonic current ratio of .0005 requires a value of 84 for the product $K_T K_A$, so that the minimum tank va/watts ratio K_T is 84/6.36 = 13.2. As this is not an abnormally high figure, it is feasible to use an inductively-coupled antenna.

The peak tank voltage is, from equation (1).

$$E_{pk} = \frac{4 \times 2500 \times .72}{\pi} = 2300 \text{ volts}$$

and the tank current is

$$I_L = I_C = \frac{va}{.707\,E_{pk}} = \frac{13.2 \times 640}{1620}$$
$$= 5.2 \text{ amperes,}$$

so that

$$X_L = X_C = \frac{E_p}{I_L} = \frac{1620}{5.2} = 310 \text{ ohms.}$$

The mutual inductance M required to couple the tank and antenna circuits is found from the well-known formula

$$2\,\pi f M = \sqrt{R_A R_T},$$

where R_T is the equivalent resistance in the tank coil; that is.

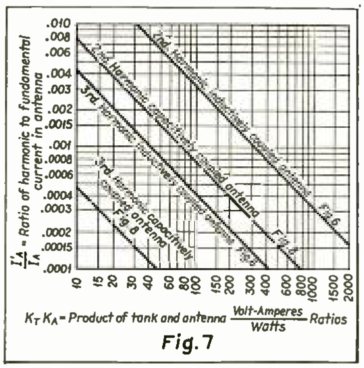
$$R_T = \frac{W}{I_L^2} = \frac{640}{27.2} = 23.5 \text{ ohms,}$$

and

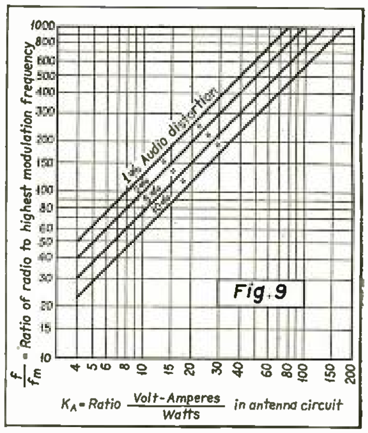
$$M = \frac{\sqrt{25 \times 23.5}}{2\pi \times 10^6} = 3.85 \text{ microhenrys.}$$

If the antenna circuit had been that of Fig. 8, the coupling capacity reactance would be

$$X_c = \frac{R_A I_A}{I_L} = \frac{25}{5.22}.$$
$$\sqrt{\frac{640}{25}} = 24.2 \text{ ohms.}$$



Harmonic content of antenna current for circuits of Figs. 6 and 8.



Upper limit of modulation frequency.

Transformers for Class B Modulators

BY
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This article deals with the design and necessary characteristics, of input and output transformers for use with Class B modulators. The important points relative to the inductance of the transformers, and the insulation requirements, are also covered.

IN CONSIDERING THE design of Class B amplifiers, it is, perhaps, just as well to take a specific case and let the reader apply the example to his own needs; and this data has been prepared with this fact in mind.

INPUT TRANSFORMERS

A good input transformer is designed by choosing a value of secondary impedance for each grid, such that a change in grid load from this value to the value obtained at maximum grid voltage maintains a voltage regulation of 10 percent or better. The driver is then chosen to provide the necessary voltage to swing the grids, using this value of impedance as the impedance of one-half the secondary.

In practice the tube companies supply this information in the form of a recommendation of a particular driver combination that will supply most economical regulation to a given pair of Class B grids. Two 2A3 tubes in a push-pull circuit is the RCA recommendation to drive a pair of 800's.

EXAMPLE

Now, given a particular driver source, two 2A3 tubes with fixed bias, and the primary of the transformer coupling the drivers to the Class B grids, the operating conditions are:

Plate volts	+ 250 v. d-c
Grid volts	— 45 v. d-c
Plate-to-plate load resistance	3,000 ohms
Power output	12 watts

Now:

$$P = \frac{E^2}{R}$$

or

$$12 = \frac{E^2}{3,000}$$

$$E^2 = 36,000$$

$$E = 190$$

E max. = 190 × 1.4 = 266 v. (peak), where E is the r.m.s. value of the signal voltage at full power output.

TURNS RATIO

Assuming the 2A3's are used to drive a pair of 800's, the turns ratio of the input transformer must be such as to bring E maximum (across the total primary) to a value E_1 on one-half the secondary, this being the voltage necessary to swing an 800 grid. However, the transfer efficiency of the transformer must also be taken into consideration here. Now assuming a practical value of 80 percent for this efficiency, we have:

$$\frac{\text{E max.} \times \text{Efficiency}}{\text{Turns ratio (total pri.} - \tfrac{1}{2}\text{ sec.)}} = E_1$$

E_1 for the 800 is 100 volts

or

$$\frac{266 \times .8}{X} = 100$$

$$\frac{212}{X} = 100$$

X or turns ratio (total primary — ½ secondary) = 2.12 : 1.

The input transformer should have a turns ratio of 2.12 : 1 to secure full power out of the driven tubes with maximum transformer regulation. For each driver source working into a given pair of Class B tubes, there is a specific ratio of primary to secondary turns which provide the best regulation.

In addition, all of the precautions necessary in the design of any high quality audio transformer should also be carefully observed in designing an input transformer of this type. In other words, the core size must be selected to prevent saturation at the lowest frequency to be passed; the leakage reactance should be kept low by interwoven windings; and the transformer should be impregnated in varnish under vacuum to prevent moisture entering the coil and causing a breakdown.

OUTPUT TRANSFORMERS

In the design of an output transformer, there are numerous important precautions to be observed. First, the core size must be sufficiently large to prevent saturation at the lowest frequency to be reproduced. However, a small core is accompanied not only by low inductance and poor low-frequency response, but it also acts as a shunt impedance across the tubes causing saturation values of plate current to be drawn, these currents resulting in transient voltages being induced in the secondary. Amplitude distortion is again the menace with unwanted harmonics being introduced throughout the frequency spectrum. The minimum inductance the primary of a good Class B output transformer should have is easily determined. Continuing to use the 800's for the purpose of illustration, we find that the plate-to-plate load impedance of this tube should be 12,500 ohms.

INDUCTANCE

Now for all practical purposes, the a-c plate resistance is approximately equal to the plate-to-plate load resistance. The inductance of the primary of the Class B output transformer should be such that its impedance at the lowest frequency to be reproduced is equal to the resultant impedance presented by the a-c plate impedance of the tube and the load impedance of the Class B amplifier reflected to the primary. This is only true, however, when the core loss is kept low and the core size and the number of primary turns kept sufficiently large to prevent saturation effects. Good Class B output transformers have a primary inductance of well over 30 henrys, so that the core size one should expect can be approximated by comparing it with the size of a power transformer whose capacity is about five times that of the output transformer. To prove this, we will assume a power transformer to have a reactive current of 10 percent of the full load current, a core density of 10,000 gausses, and an a-c permeability of 2,000. Assuming also that the d-c is passed through the secondary, equivalent in polarizing effect to the d-c in

(*Continued on page* 19)

The "Terra-Wave" Police

● A description of a new high-frequency transmitter-receiver designed to work in the band of 30 to 36 megacycles and using only the ground wave. The transmitter has an unmodulated carrier power of fifteen watts.

BY THE USE OF wavelengths below 10 meters, and a vertical antenna system for the development of strong ground waves, fading and dead spots are practically eliminated. The use of wavelengths in the vicinity of 8 to 10 meters also permits static-free reception, even during heavy thunder-storms.

These advantages hold particular importance in respect to police-radio communication since consistent, interference-free operation is a major factor in any system which must continually meet emergencies.

RCA Victor has designed an ultra-short-wave transmitter-receiver, with control unit, for the realization of the advantages enumerated. The equipment, aptly named "Terra-Wave," since only the ground wave of the transmitted signals is utilized, is self-contained and operates from any 110-volt, 60-cycle ac line. It may be used either as a telephone or telegraph transmitter and may be completely operated from a remote point. The average power consumption is but 325 watts.

THE EQUIPMENT UNITS

An illustration of the complete equipment is shown in Fig. 1. The large unit houses both the transmitter and receiver. On the front panel are three meters for reading oscillator plate current, amplifier plate current and antenna current. Below the meters are three holes through which may be adjusted the oscillator grid and plate circuits and the amplifier plate circuit. On the lower part of the front panel are toggle switches for turning on and off the power to the transmitter, the power to the receiver, and a switch for altering the receiver characteristics so that it may be used either for reception or as a monitor. A receiver phone jack is also provided.

The small unit in the illustration is the control box, which may be located a few hundred feet distant from the transmitter unit. The front panel of the control box carries an "on-off" switch which may supplement the power switch on the transmitter, a "transmit-standby" switch with which a standby "tone" may be used to modulate the carrier, a pilot light, and a microphone jack wherein may be plugged a separate single-button microphone. Insertion of a plug in this jack disconnects the microphone on top of the control box. Terminals are provided in the control box for a telegraph key. A key connected to these terminals is paralleled with the call or "tone" button so that the tone may be interrupted.

ANTENNA SYSTEM

The transmitter is normally used with a vertical, half-wave antenna with a tuned transmission line when non-directional transmission is desired. This consists of a metal pole the top section of which is the radiator and the lower section a part of the transmission line.

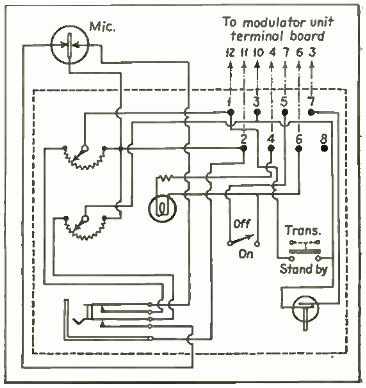


Fig. 4. Circuit of the control unit, with volume control and double-button microphone.

Where the area to be covered is small—in the order of one mile—the radiator may consist of a vertical wire held rigid by a pole.

Lightning protection of the antenna used is afforded in the construction of the transmission line.

The ultra-short-wave receiver is provided principally for monitoring purposes. When used to receive signals from another transmitter, a separate antenna is employed, having a total length of at least 25 feet, erected 30 feet or more away from the radiator. This antenna is also strung vertically.

TRANSMITTER R-F UNIT

The unit at the top of the transmitter-receiver is the r-f section, consisting of a master oscillator and power amplifier having its own power supply, as shown in the diagram of Fig. 2. A metal baffle or shield isolates the master oscillator and the r-f amplifier.

The master oscillator employs two 210 tubes with isolantite bases, in a push-pull, tuned-plate, tuned-grid circuit. The plate tank of the master oscillator is capacity coupled to the grids of the two 210 tubes, also with isolantite bases, in the power amplifier. The push-pull amplifier, being operated Class C, has relatively high plate efficiency and low power consumption, thus permitting the use of inexpensive tubes and a comparatively simple power-supply system.

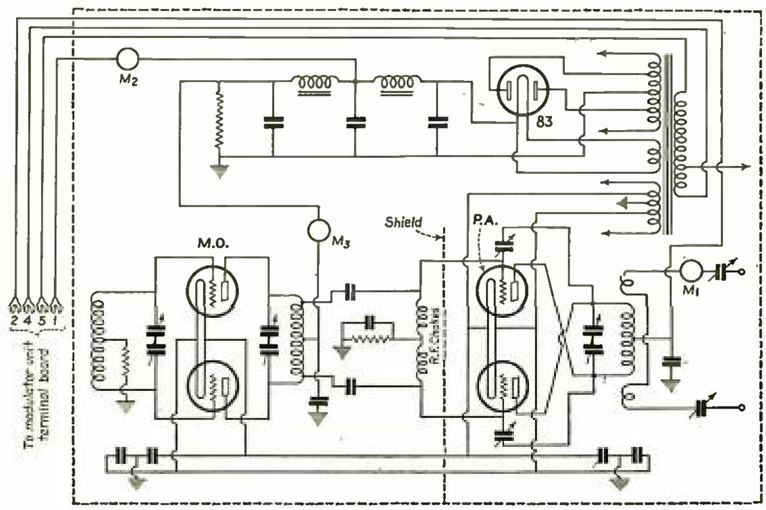


Fig. 2. Circuit of the master oscillator, power amplifier unit, with its individual power supply. Means are provided for increasing the filament and plate voltages on the four tubes.

Transmitter-Receiver

Good regulation is provided by the type 83 mercury-vapor rectifier.

Both the oscillator and radio-frequency amplifiers are self-biased, thereby reducing the number of necessary controls.

The output of the r-f amplifier is inductively coupled to the antenna circuit, which has variable condensers in series with each line so as to provide a degree of compensation for different lengths of antenna or transmission lines.

It will be noted from the diagram of Fig. 2 that the filament and high-voltage windings of the power transformer have double sets of connections. Under most conditions the low-voltage connections are used, in which case the oscillator tubes work at a plate voltage of approximately 300 and the power amplifiers at a plate voltage of about 325. When the secondary of the power transformer is connected for high voltage the respective voltages are 480 and 525 volts.

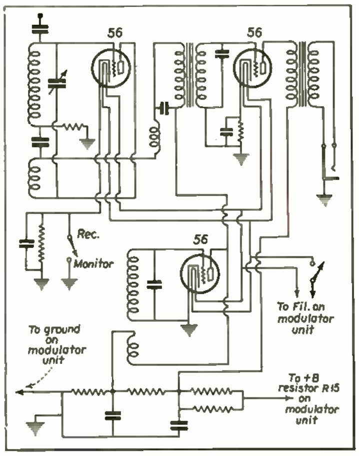


Fig. 5. Circuit of the super-regenerative receiver unit, which may also be used for monitoring.

MODULATOR UNIT

The modulator unit is housed in the lower section of the transmitter-receiver case. This unit consists of an individual power-supply with a type 83 rectifier, speech amplifier and modulator. The diagram is shown in Fig. 3.

The speech amplifier consists of a type 57 pentode resistance coupled to a type 59 driver. The driver is transformer coupled to the push-pull modulator tubes operated Class B. There is sufficient power derived from this unit to provide for high-percentage modulation with comparatively small and inexpensive tubes.

The modulator unit is designed to provide faithful reproduction of speech frequencies, and has a uniform response within 2 db from 100 to 5000 cycles.

Fig. 1. Front views of the transmitter-receiver unit, and control box with individual microphone. The transmitter-receiver adjustments are made from the front panel.

CONTROL UNIT

The circuit of the control unit is shown in Fig. 4. This unit consists of a double-button microphone—mounted atop the control box—the modulation control, pilot light, tone generator and terminal board from which connections are made to the modulator unit. If the numbered terminals are followed through to the corresponding terminal posts on the modulator unit, it will be seen that the microphone voltage is obtained through a bleeder resistor in the high-voltage output circuit. The microphone feeds the transformer in the modulator unit coupled to the grid circuit of the type 57 speech-amplifier tube.

The "on-off" switch in the control unit may be used to turn on and off the line power to the transmitter, and the condition is indicated by the pilot light which shunts the line on the cold side of the power switch. The "transmit-standby" switch connects the output of the tone generator to the input of the speech-amplifier transformer. The tone signal is used merely as an indication of a transmission to follow.

The jack shown in the diagram is provided for the use of a separate, single-button microphone in place of the double-button microphone which is a part of the control unit. When telegraphic transmission is desired, a key is connected across terminals 1 and 3. The key is then in parallel with the "standby" contacts of the tone button. A modulated carrier is thereby provided when the telegraph key is closed.

RECEIVER UNIT

The diagram of the receiver unit is shown in Fig. 5. Three type 56 tubes are used, one as an oscillating detector, one as a quenching oscillator and one as an audio amplifier. Heater- and plate-voltage supply is obtained from the power-supply system in the modulator

(*Continued on page* 19)

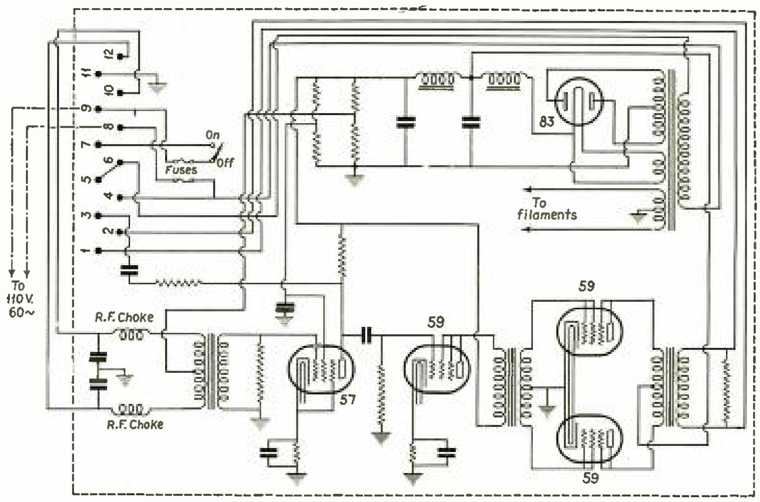


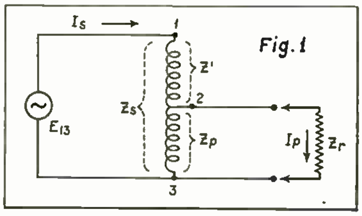
Fig. 3. Circuit of the speech amplifier and Class B modulator, with its individual power-supply unit. The three, type 59 tubes are connected to function as triodes.

Auto-Transformer

IN MANY ELEMENTARY DISCUSSIONS of the mathematical theory of transformers the authors neglect entirely or dismiss with only a casual reference the application of the theory developed to the special case of an auto-transformer; and the student as a consequence frequently finds it difficult to solve problems involving this device, particularly when the coupling between windings is appreciably different from unity as in the case of radio circuits. With a view to removing some of the difficulties confronting the student and providing alternative methods of solution, the following paragraphs give (1) a treatment based on Kirchhoff's Laws, adapted from K. S. Johnson's "Transmission Circuits for Telephonic Communication," (2) a treatment based on the "Equivalent T" network, and (3) a treatment, which the writer has not found in the literature, based on an equivalent two-winding transformer.

(1) KIRCHHOFF'S LAW METHOD

Fig. 1 shows an auto-transformer the impedance of which between terminals 1-2 is Z', that between terminals 2-3 is Z_p, and that between terminals 1-3 is $Z_s = Z' + Z_p + 2Z_m$,



AUTO-TRANSFORMER WITH GENERATOR AND LOAD CIRCUIT.

the mutual impedance, Z_m, between windings 1-2 and 2-3 being defined by the familiar relation, $Z_m = k\sqrt{Z'Z_p}$ where k is the coefficient of coupling. By Kirchhoff's Law, considering the loop from the generator to 1, to 2, thence through Z_r to 3, and back to the generator:

$$E_{13} = I_sZ' + (I_s - I_p)Z_m + I_pZ_r \quad (1)$$

Similarly, around the loop 2 to Z_p to 3:

$$(I_s - I_p)Z_p + I_sZ_m = I_pZ_r \quad (2)$$

Solving these equations simultaneously we obtain:

$$I_s = \frac{E_{13}\,(Z_p + Z_r)}{(Z_p + Z_r)\,(Z' + Z_m) + (Z_p + Z_m)\,(Z_r - Z_m)} \quad (3)$$

$$I_p = \frac{E_{13}\,(Z_p + Z_m)}{(Z_p + Z_r)\,(Z' + Z_m) + (Z_p + Z_m)\,(Z_r - Z_m)} \quad (4)$$

The impedance looking into terminals 1-3 with the load Z_r connected will be

$$Z_{13} = \frac{E_{13}}{I_s}$$

$$= \frac{(Z_p+Z_r)\,(Z'+Z_m) + (Z_p+Z_m)\,(Z_r-Z_m)}{Z_p + Z_r} \quad (5)$$

Now if the positions of the generator and load are interchanged as in Fig. 2, the circuit equations become:

$$E_{23} = Z_rI_s + Z'I_s + (I_s - I_p)Z_m \quad (6)$$

$$E_{23} + (I_s - I_p)Z_p + I_sZ_m = 0 \quad (7)$$

which when solved simultaneously yield:

$$I_s = \frac{E_{23}(Z_p + Z_m)}{Z_pZ_r + Z_pZ' - Z_m^2} \quad (8)$$

$$I_p = \frac{E_{23}(Z_p + Z_r + Z' + 2Z_m)}{Z_pZ_r + Z_pZ' - Z_m^2} \quad (9)$$

The impedance looking into terminals 2-3 with the load Z_r connected will be

$$Z_{23} = \frac{E_{23}}{I_p} = \frac{Z_pZ_r + Z_pZ' - Z_m^2}{Z_p + Z_r + Z' + 2Z_m} \quad (10)$$

This method of solution has the advantage of depending upon basic principles of circuit analysis. For some types of problems, however, a different approach is frequently desirable.

(2) EQUIVALENT T METHOD

In this method we follow the customary procedure in establishing an equivalent T network for a transformer, the shunt arm, Z_2, being the geometric mean of the impedance looking into the low side with the high side open, and the difference in impedance looking into the high side with the low side first open and then shorted. One series arm of the T, Z_1, then becomes the impedance looking into the high side with the low side open, minus Z_2; and the other series arm, Z_3, becomes the impedance looking into the low side with the high side open, minus Z_2. Referring to Fig. 1 and proceeding on this basis,

$$Z_2 = Z_p\sqrt{(Z' + Z_p + 2Z_m) - (Z' - Z_m^2/Z_p)}$$

$$= Z_p + Z_m \quad (11)$$

$$Z_1 = Z' + Z_p + 2Z_m - Z_2$$

$$= Z' + Z_m \quad (12)$$

$$Z_3 = Z_p - Z_2$$

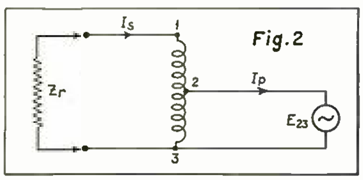
$$= -Z_m \quad (13)$$

The resulting network is shown in Fig. 3, and may be readily solved for current and impedance irrespective of the location and magnitudes of applied voltage and terminal load, the results of course being identical with those defined by equations (3), (4), (5), (8), (9), and (10).

(3) EQUIVALENT TWO-WINDING METHOD

In this method we replace the auto-transformer by an equivalent two-winding transformer having the same open-circuit impedances and a coefficient of coupling which makes the load impedances transferred from one side to the other of proper value. Let the voltage applied to coil 2—3 in Fig. 1 be E_p. Then in the case of unity coupling the voltage induced in coil 1—2 would be

SAME AS FIG. 1, WITH LOAD AND GENERATOR INTERCHANGED.



Circuit Analysis

By W. J. CREAMER
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UNIVERSITY OF MAINE

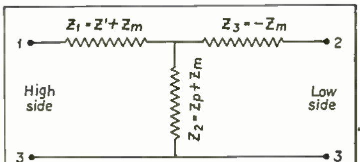


Fig.3

THE RESULTING AUTO-TRANSFORMER NETWORK.

$$E' = E_p \sqrt{\frac{Z'}{Z_p}} \qquad (14)$$

since with unity coupling the voltage-ratio varies directly with the turns-ratio, and therefore as the square root of the inductance or impedance ratios. But if the coupling coefficient is k, this relation becomes

$$E' = kE_p \sqrt{\frac{Z'}{Z_p}} \qquad (15)$$

or, since $k = Z_m / \sqrt{Z'Z_p}$,

$$E' = \frac{Z_m E_p}{Z_p} \qquad (16)$$

The total voltage from 1 — 3 will therefore be,

$$E_s = E' + E_p = E_p \left\{ \frac{Z_m}{Z_p} + 1 \right\} \qquad (17)$$

Now consider an equivalent two-winding transformer as in Fig. 4. The low side must have an impedance $Z_a = Z_p$; the high side an impedance $Z_b = Z' + Z_p + 2Z_m$; and the coupling, k_o, (and the corresponding mutual impedance, Z_o) must be such as to give a voltage ratio fixed by equation (17). On the same basis that we wrote equation (15) we may now write

$$\frac{E_b}{E_a} = k_o \sqrt{\frac{Z_b}{Z_a}} = \frac{Z_o}{Z_a} = \frac{Z_o}{Z_p} \qquad (18)$$

But since E_b/E_a must equal E_s/E_p,

$$\frac{Z_o}{Z_p} = \frac{Z_m}{Z_p} + 1$$

from which

$$Z_o = Z_m + Z_p \qquad (19)$$

Thus the equivalent two-winding transformer has its low impedance winding identical with the low impedance portion of the auto-transformer, its high impedance winding equal to the total impedance of the auto-transformer, and a mutual impedance equal to the sum of the low impedance winding and the mutual impedance between the two parts of the auto-transformer.

The impedance looking into the high side with a load, Z_r, on the low side is according to familiar coupled circuit relations,

$$Z = Z' + Z_p + 2Z_m - \frac{(Z_m + Z_p)^2}{Z_p + Z_r} \qquad (20)$$

which readily breaks down into equation (5). Similarly the impedance looking into the low side with a load, Z_r, on the high side is

$$Z = Z_p - \frac{(Z_m + Z_p)^2}{Z' + Z_p + 2Z_m + Z_r} \qquad (21)$$

which breaks down into equation (10). The generator current immediately follows from these relations; and the load current, by the usual coupled circuit relations is the generator current multiplied by the factor

$$\frac{Z_o}{Z_r + \text{Self impedance of winding on load side}}$$

The results of course check with equations (3), (4), (8), and (9).

ILLUSTRATIVE PROBLEM

Consider a single-layer solenoid with a total of 60 turns, wound 26 turns per inch on a 3-inch form, and tapped at 10 turns. From well known formulas the inductance of the 10-turn section is approximately 14 microhenries, that of the 50-turn section is 170 microhenries, and that of the whole coil of 60 turns is 220 microhenries. From these values the mutual inductance between the 10-turn section and the 50-turn section is $M = \frac{1}{2}(220 - 174 - 14) = 18$ microhenries, and the coupling coefficient is $k = 18/\sqrt{14 \times 170} = 36.9\%$. Assuming $2\pi f = 5 \times 10^6$, with a load of $-j1000$ ohms connected across the 10-turn section, determine the impedance offered to a generator connected across the whole coil, the current delivered therefrom, and the current in the load. Neglect all resistance.

Solution by first method:

Following the notation already established, $Z_p = j70$; $Z' = j850$; $Z_m = j90$; and $Z_r = -j1000$. Now by equation (5)

$$Z_{13} = \frac{(j70 - j1000)(j850 + j90)}{j70 - j1000} + \frac{(j70 + j90)(-j1000 - j90)}{j70 - j1000}$$

$$= j1128 \text{ ohms}$$

The current per volt delivered by the generator will be

$$I_s = 1000/1128 = 0.886 \text{ milliamps,}$$

CIRCUIT OF A TWO - WINDING TRANSFORMER.

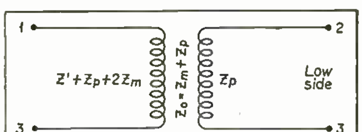


Fig.4

and the load current will be easily found by combining equations (3) and (4) as

$$I_p = I_s \frac{(Z_p + Z_m)}{(Z_p + Z_r)} = 0.886 \frac{(70 + 90)}{(70 - 1000)}$$
$$= 0.1523 \text{ milliamps.}$$

(It will be noted that without the load connected the input impedance, Z_{13}, would be $j5 \times 10^6 \times 220 \times 10^{-3}$

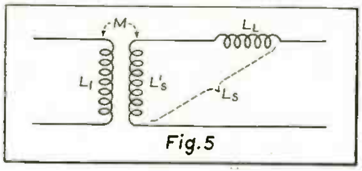


Fig. 5

RECAPITULATORY CIRCUIT OF TWO-WINDING TRANSFORMER.

$= j -1100$ ohms. The addition of the load has therefore changed the value of Z_{13} about 3%.)

Solution by second method:

Setting up the equivalent T for the auto-transformer, we have referring to Fig. 3, $Z_1 = j850 + j90 = j940$; $Z_2 = j70 + j90 = j160$; $Z_3 = -j90$. With $-j1000$ ohms across terminals 2 — 3, the input impedance, Z_{13} becomes:

$$Z_{13} = j940 + \frac{j160(-j1090)}{j160 - j1090} = j1128 \text{ ohms.}$$

The current per volt delivered by the generator will be as before

$$I_s = 1000/1128 = 0.886 \text{ milliamps.}$$

This current divides at the shunt impedance of the T circuit, the portion going to the load being

$$0.886 \frac{160}{160 - 90 - 1000} = 0.1523 \text{ milliamps.}$$

Solution by third method:

Set up an equivalent two-winding transformer as in Fig. 4, with a high impedance winding of $Z' = j850 + j70 + j180 = j1100$ ohms, a low impedance winding of j70 ohms, and a mutual impedance of $Z_o = j90 + j70 = j160$ ohms. The input impedance will be

$$Z = j1100 - \frac{(j160)^2}{j70 - j1000} = j1128 \text{ ohms as before.}$$

The current per volt delivered by the generator will be $I_s = 1000/1128 = 0.886$ milliamps. The load current is obtained by multiplying this current by the ratio of mutual impedance to total impedance on the load side of the transformer, or

$$I_p = 0.886 \frac{160}{70 - 1000} = 0.1523 \text{ milliamps.}$$

An extension of these methods to problems involving resistance is readily made.

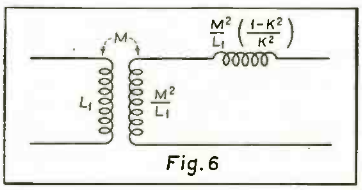


Fig. 6

RESTATEMENT OF THE CIRCUIT OF FIG. 5.

EDITOR'S NOTE:

By an extension of Mr. Creamer's line of reasoning some very interesting conclusions may be drawn. For example, let us consider the two-winding transformer shown in Fig. 5, where L_1 is the primary inductance, M the mutual inductance, and L_s the inductance of the secondary. Since the coefficient of coupling, which is given by the well known relation,

$$K = \frac{M}{\sqrt{L_1 L_s}}$$

is frequently less than unity, we may break up the secondary self inductance into two parts. One part we may consider to have unity coupling to the primary. (L'_s in Fig. 5), and the other part, (L_L), may be considered as having no coupling to the primary at all. From the above relation, we have when K = 1:

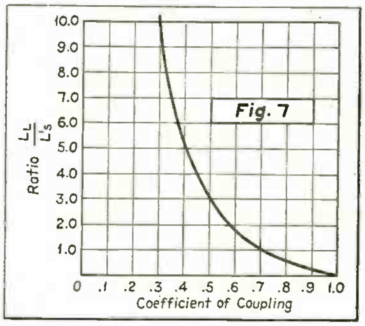
$$L'_s = \frac{M^2}{L_1}$$

$$\text{Now if } K = 1, \text{ then: } L_s = \frac{M^2}{K^2 L_1}$$

$$\text{Whence } L_L = L_s - L'_s = \frac{M^2}{K^2 L_1} - \frac{M^2}{L_1}$$

$$\text{Or } L_L = \frac{M^2}{L_1} \frac{(1 - K^2)}{K^2}$$

Fig. 5 may, therefore, be redrawn as shown in Fig. 6. This gives a very easy method of finding the leakage reactance, knowing M, L, and K.



CURVE PLOTTED FROM VARIOUS RELATIONS OF K.

In addition, we are now in a position to show the relation between the values of secondary inductance, of coefficient of coupling and the leakage inductance, thus:

$$L_L = \frac{(1 - K^2)}{K^2} L'_s$$

Now let us take a few values for K and see what happens. For K = 1, $\frac{1 - K^2}{K^2} = 0$, and for K = .5, $\frac{1 - K^2}{K^2} = 3$. That is, for the latter case, the leakage is three times the secondary inductance. A curve plotted from these relations is shown in Fig. 7, where the ordinates are values of $\frac{1 - K^2}{K^2}$ and the abscissae are values of K.

R. D. R.

RMA TENTH CONVENTION

(*Continued from page* 9)

were also two meetings of the RMA Board of Directors. All Divisions heard annual reports of important work done by the RMA during the past year and made plans for comprehensive future activities. The entire Chicago meetings were devoted to radio industry business and all exhibits and merchandise were excluded from the Stevens and Blackstone Hotels.

RWA "FIVE-POINT" PLAN

The manufacturers and jobbers launched the national radio promotion plan most auspiciously. The RWA presented what is known as the "five-point" plan providing for joint industry action with financial contributions from radio manufacturers, dealers, broadcasters and other interests. Raising of a large fund for general promotion by a separate independent industry bureau is planned. The national program was approved in principle by the RMA Board of Directors and is being worked out by a special committee, including Powel Crosley of Cincinnati as chairman, and W. S. Symington of New York and James M. Skinner of Philadelphia on behalf of the RMA. Active in presenting the "five-point" plan for the RWA were Ben Gross of New York, David M. Trilling of Philadelphia and Francis Sterm of Hartford, Conn.

At the annual RMA membership meeting Wednesday morning, June 13, the retiring Association president, Fred D. Williams of Indianapolis, reviewed the substantial work of the Association during the past year and Captain Sparks presented the new radio industry code. After a few questions on details, the proposed code, together with action to withdraw the entire radio industry from the electrical code, was unanimously approved by the membership. General Counsel Van Allen delivered an address on many vital problems facing the industry.

TENTH "BIRTHDAY"

Celebration of the tenth "birthday" anniversary of the RMA was a feature of the Chicago meetings. A "President's Dinner" was tendered to all past RMA presidents and former directors by President Fred D. Williams on Monday evening, June 11. Colonel H. H. Frost of New York, the first RMA president; Arthur T. Haugh of Jackson, Michigan; H. B. Richmond of Cambridge, Mass. and Morris Metcalf of Springfisld, Mass., were among the past presidents in attendance and there was a reunion of many pioneers of the radio industry.

The industry conventions, combining manufacturers and jobbers, formally opened Tuesday morning, June 12, with President Fred D. Williams of the RMA and President James Aitken of the RWA presiding. Mayor Edward J. Kelly of Chicago personally presented a cordial welcome on behalf of Chicago interests. An address on "Merchandise on the Business Upturn" stressing the necessities of new measures to meet new industrial conditions, was made in the Stevens Hotel Grand Ball Room at the joint conventions by Homes J. Buckley of Chicago. Another address on "The Future of the New Deal" was delivered by Judge Andrew A. Bruce of Chicago, chairman of the NRA Compliance Board of Illinois. Judge Bruce urged decentralization of NRA authority, declaring that cooperation rather than criminal prosecution would secure fullest development of NRA codes. The RMA-RWA conventions received an invitation from Governor Ruby Laffoon of Kentucky and Mayor Neville Miller of Louisville to hold the 1935 industry conventions there.

CLASS B MODULATOR TRANSFORMERS

(*Continued from page* 13)

the secondary winding of the 800 output transformer, the a-c permeability of the core material will drop to approximately 400. This means that the reactive component of the current will be five times its original value, and it will then be necessary to increase the core area to five times its original size to compensate for loss of permeability caused by the introduction of the d-c. Therefore, a 100-watt modulation transformer to carry a Class C amplifier current in its secondary would be of the same size as a power transformer of an equivalent voltage class (rated 500 watts continuous operation).

Insulation between primary and secondary, and secondary to ground are other important considerations in the design of Class B output transformers. In the primary of the transformer there is a high d-c voltage to ground, and superimposed on this is an a-c signal voltage of approximately the same peak magnitude as the d-c plate voltage. From secondary to ground there is the d-c voltage for the Class C amplifier plus the a-c signal voltage across the primary multiplied by the turns ratio of the transformer. It is common knowledge that if the current through an inductance is broken, the collapse of the magnetic field may result in tremendously high voltages in the windings. Since the signal is an irregular pulsating high voltage, it becomes almost impossible to predict the extent of the peak voltage in the transformer. We may, however, determine approximately the quantitative value of these voltages.

An experimental set-up was made using a pair of 800's, the operating conditions being . . . plate voltage, 1,000; grid voltage, 55; primary load on output transformer, 12,000 ohms; secondary termination on output transformer, 20,-000 ohms. To simulate extreme conditions, an a-c voltage of 200 volts r.m.s. was applied to the girds intermittently. With the aid of an oscillograph, peak voltages ranging from 12,000 to 15,000 volts were measured across the secondary of the output transformer.

In view of the fact that a-c voltages of 10,000 can be expected under normal operating conditions, the insulation between the windings and from each winding to ground, becomes of paramount importance. In an output transformer of this type every precaution should be taken to keep that insulation effective by making the transformer safe against humidity changes. The unit should be impregnated in varnish under vacuum to remove all moisture and then sealed in a humidity-proof compound. As an additional safeguard against breakdown, it is not desirable to use a hygroscopic material in the terminal board construction; rather it should be metallic and the windings terminated in ceramic insulators.

J. Kunz, Engineer,
KENYON TRANSFORMER CO., INC.

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"TERRA-WAVE" TRANSMITTER

(*Continued from page* 15)

unit, as indicated. A separate "on-off" switch is mounted on the receiver so that the tube heaters may be extinguished when use of the receiver is not desired. Tuning is accomplished by means of a single control on the variable condenser in the tuned-grid circuit of the oscillating detector tube. The shaft of this control is slotted so that adjustment may be made from the front of the transmitter-receiver panel by means of a screwdriver.

A shorting switch is included in the cathode circuit of the detector-oscillator tube. When closed the cathode resistor is shorted and the unit functions as a super-regenerative receiver. When the switch is open—which corresponds to the "Monitor" position, the detector is biased sufficiently to stop any oscillation and the circuit operates as a biased detector and audio amplifier for monitoring purposes only.

The output connection from the audio tube, in both cases, is for high-impedance (20,000-ohm) headphones.

Design .. NOTES AND

AUDIO EQUALIZERS

THE PAST FEW YEARS have effected a great increase in the overall fidelity of audio-amplification systems. This has been most adequately and definitely demonstrated to the engineers who were sufficiently fortunate to have seen and heard the Western Electric binaural equipment in operation. The effectiveness of this equipment is not due solely to the binaural effect but also to the ideal fidelity of the audio system. The actual overall frequency range of this system is 35 to 16,000 cycles, with a total power range of over 100,000,000 to 1.

AMPLIFIER FIDELITY

The improvement in the fidelity of audio systems has been greatest in the audio amplifier itself.

While new tubes and circuit developments have aided the progress of amplifier fidelity, the development of improved audio transformers is the keynote of this advance.

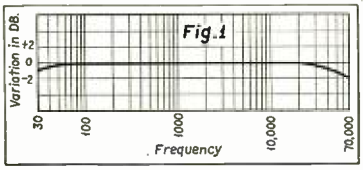


Fig. 1

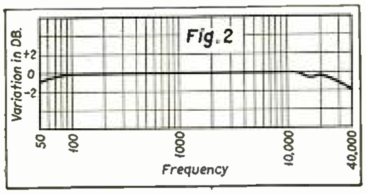


Fig. 2

Fig. 1 illustrates how linear, as to frequency, audio transformers can be made today. The transformer whose frequency characteristic this represents is an output unit from push-pull 2A3's to a broadcast line.

Fig. 2 illustrates the overall frequency characteristic of a transformer-coupled amplifier for extremely wide frequency-range operation. Specially developed transformers in this case afford response up to 40,000 cycles with but 2-db loss.

Unfortunately, sound pickup devices

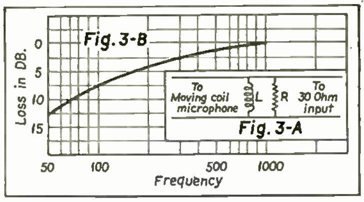


Fig. 3-B / Fig. 3-A

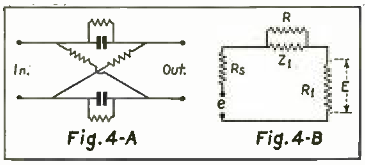


Fig. 4-A Fig. 4-B

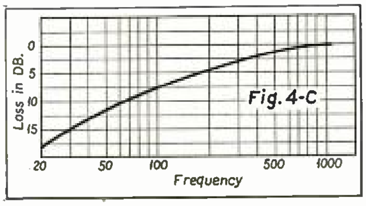


Fig. 4-C

such as microphones and record pickups and reproducing loudspeakers have not been perfected to as great an extent as the audio amplifiers associated with them. The cause of this is apparent when one considers the many mechanical features which enter into both pickup and reproducer operation. Compensation for the defects in these sound source pickups and reproducers is made possible through the use of equalizer networks.

The second major use of equalizing networks is in the equalization of telephone and other lines from pickup points to broadcast stations or similar uses.

Few engineers realize what actually can be done with equalizers to obtain linear response from non-linear devices. Most pickups or loudspeakers can be almost perfectly equalized.

FUNDAMENTAL CIRCUITS

The simplest forms of equalizers consist of a capacitor or reactor so inserted in a circuit that the attenuation obtained bears a fixed relation to frequency.

Fig. 3-A illustrates a simple form of shunt inductor used to equalize the response of a dynamic microphone at the lower frequencies. The frequency response obtained is illustrated in Fig. 3-B.

Fig. 4-A illustrates a simple network using a series condenser. The resistors shunting the condensers in this case determine the maximum attenuation possible. In other words, at the frequency where the capacitor reactance approaches infinity, the total series loss-impedance of the equalizer would not exceed the value of the resistor shunting the condenser. In simplified form. this system would appear as in Fig. 4-B. where R_s is a source impedance, R_1 is a load impedance, R is the shunt resistor, and Z_1 is the effective impedance of the capacitor at any given frequency. It is apparent that the voltage E developed across R_1 would be equal to

$$E = e \frac{R_1}{R_s + R_1 + \left\{\dfrac{1}{\dfrac{1}{R} + \dfrac{1}{Z_1}}\right\}}$$

with proper correction for the phase relationship.

The action of an equalizer of this type design for equalizing a portable recorder is shown in Fig. 4-C. These simple types of equalizers are also used very frequently for loudspeaker equalization. An interesting example of this type of correction was performed by Stuart Ballantine in his design of crystal reproducers for use in shunt with dynamic speakers. The actual circuit of this speaker with its matching transformer is illustrated in Fig. 5-A and the corresponding "T" equivalent in Fig. 5-B. By properly designing the coupling M of the transformer, the correct leakage

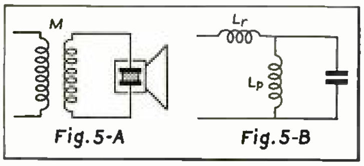


Fig. 5-A Fig. 5-B

reactance (L_r) is obtained to offset the tendency for increase in output with frequency inherent with the crystal.

SPEAKER EQUALIZATION

A complete equalizer using simple reactance and capacitance for speaker equalization is illustrated in circuit form in Fig. 6-A. Accuracy in the calculation and construction of such networks is quite important and the results should in any case be confirmed by overall frequency tests on the finished apparatus. An equalizing unit designed for this purpose provides 20 db of controllable

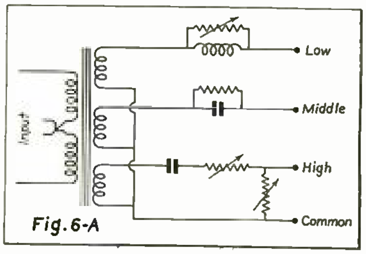


Fig. 6-A

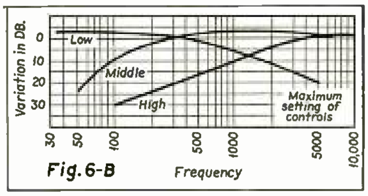
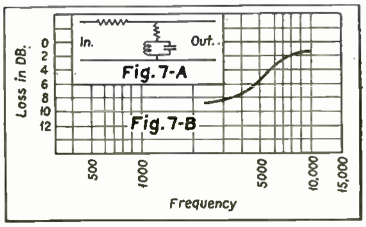


Fig. 6-B

COMMENT .. *Production*



equalization at both low and high ends, and also matches the speakers for the middle register. An equalizer of this type to control a cluster of speakers is being installed in a foreign embassy in Washington. The controlled equalization feature is a great advantage where room acoustics must be compensated for, after speaker installation has been made. Fig. 6-B illustrates the response characteristics of such a network.

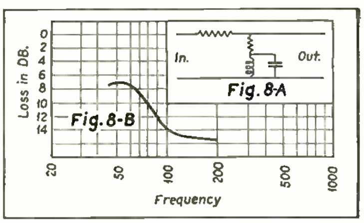
The second type of equalizer which is more commonly used and is generally more effective, consists of a capacitor and reactor tuned to resonance at the frequencies at which equalization is desired. If such a network is placed in shunt with a line, voltage will be built up appreciably at the point of resonance.

LOW- AND HIGH-FREQUENCY EQUALIZERS

Figs. 7-A and 7-B illustrate a simple network of this type used for film-recording, high-frequency equalization and shows the curve obtained. The reactor and capacitor of such a unit can be housed in a case only 1-1/2 x 3 x 3 inches.

A low-frequency equalizer of similar type is illustrated with its frequency characteristic in Figs. 8-A and 8-B. This equalizer is used for disc recording and for loudspeaker equalization. This same resonant circuit, when placed in series with the line instead of in shunt, forms in effect an absorption circuit, and may be employed to attenuate a narrow band of frequencies. This equalizer is frequently used.

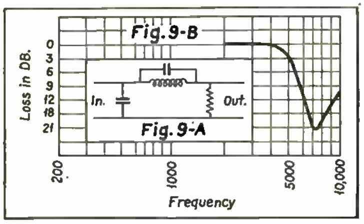
Figs. 9-A and 9-B illustrate this type of equalizer and its corresponding frequency characteristic as applied to surface noise reduction. Where extremely sharp cutoff is desired, a modified type of low-pass filter such as Figs. 10-A and 10-B is used. Another form of resonant equalizer is the type where reactor



and capacitor are connected in series. This tends to produce sharp attenuation at the resonant frequency if the units are connected in shunt with the line. If connected in series, attenuation is obtained at all frequencies but the resonant frequency. One of the more elaborate types of equalizer covering both high and low end and involving both the shunt-resonant circuit and series-resonant circuit is illustrated in Fig. 11-A with the corresponding frequency characteristic obtained in Fig. 11-B.

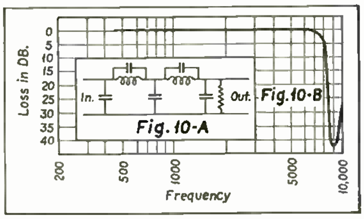
EQUALIZER DESIGN

The actual design of equalizing networks is too complex to be included in

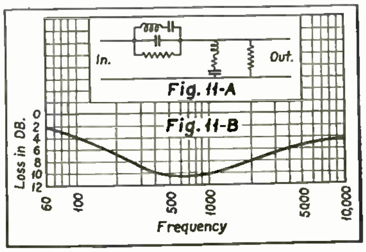


an article of this type. However, it is apparent that equalization can be effected for the various losses obtained in our electro-acoustic devices.

It is imperative in the design of these equalizers that the reactor coils have a very high "Q." The actual amount of build-up of voltage and sharpness of attenuation depends upon this. Coils with a "Q" as high as 50 to 100 at audio frequencies have been made possible through the development of special nickel-iron dust core materials. Ordinary audio reactors laminated with nickel-iron laminations would have a "Q" in the vicinity of 2 at the higher audio frequencies.

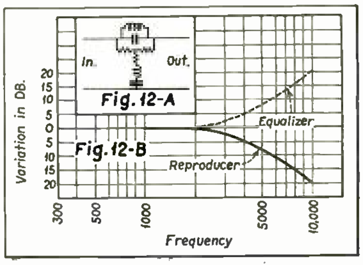


The necessity of these equalizers is not as greatly appreciated on paper as it is when one actually hears the comparison between normal devices and properly equalized devices. The frequency characteristic of a typical sound-on-film reproduction, for example, may appear as shown in Fig. 12-B. Properly equalized with equalizer characteristics as shown in the dotted line, the output can be made practically linear as to frequency. In many cases, the attenuation may be as much as 18 or 20



db at 6000 cycles. The difference in intelligibility and sound quality is really tremendous when compared with an equalized system. Another interesting example of the application of equalizers is to a sound pickup. Fig. 13 illustrates a better than average phonograph pickup showing losses as great as 10 db at both high and low end. When properly equalized, as shown with the dotted line, the actual response becomes practically linear.

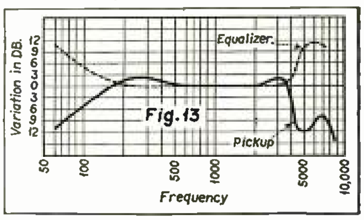
It is the writer's opinion that a demonstration of unequalized and equalized sound sources would convince any man that equalizers will be the keynote of our audio progress in the future.



LOSS IN GAIN

One of the main disadvantages of equalization is the attendant loss in gain. It is apparent from the frequency characteristics shown that the overall loss becomes quite appreciable, particularly if equalization is desired at both low and high frequencies. However, with modern amplification equipment, an additional 20 or 30 db of gain is relatively simple to obtain, though the importance of linear response in the amplifier should not be forgotten.

I. A. Mitchell,
Chief Engineer,
UNITED TRANSFORMER CORP.



A Chronological History
of electrical communication
—*telegraph, telephone and radio*

This history began with the January 1, 1932, issue of RADIO ENGINEERING. The items are numbered chronologically, beginning at 2000 B.C., and will be continued down to modern times. The history records important dates, discoveries, inventions, necrology and statistics, with numerous contemporary chronological tie-in references to events in associated scientific development. The material was compiled by Donald McNicol.

PART XXXI

1909 (*Continued*)

(1205) Melvin L. Severy and George B. Sinclair, of Boston, exhibit a new electrical musical instrument, called the Choralcelo. In performance it resembles a pipe organ.

(1206) The Saskatchewan provincial government, in Canada, purchases the lines and plant of the Bell Telephone Company of Canada, in that province. The price paid is $367,000. There are 470 miles of long distance circuits and thirteen exchanges.

(1207) Gimbel Brothers' new department store, New York, is to be equipped with fifty electric elevators.

(1208) The United Wireless Telegraph Company establishes direct communication between their New York and Chicago offices (May 2.)

(1209) The Western Union Telegraph Company is said to own about $10,000,000 stock of the New York Telephone Company. The latter company is capitalized at $50,000,000.

(1210) E. F. W. Alexanderson, of Schenectady, N. Y., is granted U. S. patent number 920,809 covering the invention of an induction generator to run at double synchronous speed.

(1211) The United Wireless Telegraph Company, also the Radio Telephone Company of New York (De Forest and Stone systems) begin the erection of a number of radio stations in the Central and Western states.

(1212) The Ohio State University plans a regular course of instruction in radio telegraphy and radio telephony.

(1213) H. G. Webster, of Chicago, and C. D. Enochs, of La Crosse, Wis., take out several patents each covering inventions in telephone apparatus and systems.

(1214) Dr. W. R. Whitney patents a process of manufacturing hard fiber for electrical insulation.

(1215) Frank W. Frueauff, of Denver, Colo., is elected president of the National Electric Light Association.

(1216) G. W. Pierce, of Cambridge, Mass., is granted a patent covering the invention of a tuning system for radio signaling.

(1217) The directory of the New York Telephone Company contains the names of 310,000 subscribers.

(1218) The expense budget of the New York Central and Hudson River Railroad includes $8,477,682 for electrification of suburban lines and New York terminals.

(1219) The Westinghouse Storage Battery Company is incorporated with a capital of $1.750,000.

(1220) The Appellate Division of the Supreme Court, New York, denies the appeal of the New York Independent Telephone Company for permission to place telephone wires under the streets of New York City. In 1905 the telephone company merged with the Mercantile Electric Company, a concern organized to do a burglar alarm business.

(1221) Captain Couade, in France, develops at the Pathé Phonograph works a combined moving-picture and phonograph apparatus.

(1222) The College of the City of New York, recently completed, installs a complete, up-to-date electrical laboratory.

(1223) During the Hudson-Fulton celebration in New York, September-October. in addition to the regular lighting of the city, 1,500,000, incandescent lamps, 7,000 arc lamps. 3.000 flaming arc lamps and twelve powerful searchlights are placed in service for a period of eight days.

(1224) E. Burlingame, of Laporte, Ind., procures U. S. patent No. 923,581 for a printing telegraph system.

(1225) Electrical exports from the United States during the year amount to $45,000,000.

(1226) Charles L. Krum. of Chicago, is granted U. S. patents 929,602 and 929,603 covering the invention of telegraph transmitters for printing systems.

(1227) The Wireless Institute, New York, appoints a committee to compile radio standardization rules and to frame definitions for radio engineering terms.

(1228) C. D. Babcock, of New York, procures a number of U. S. patents covering inventions in radio signaling apparatus.

(1229) Middleton Brothers, of Chicago, bring out a magnetic fault-finder for testing lead-covered cables.

(1230) The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., reports net earnings for the year ending June 30, of $144,688.

(1231) T. Commerford Martin resigns the co-editorship of the *Electrical World*, New York, to become general secretary of the National Electric Light Association (September).

(1232) Philip C. Kullman and John Firth. minority stockholders of the International Telegraph Construction Company, Jersey City, N. J., apply for a receivership for the company. 70 per cent of the stock of the company is owned by the United Wireless Telegraph Company.

(1233) The Chicago Telephone Company has 248,669 connected subscribers' telephones, including city and suburban.

(1234) The Ohio Brass Company, of Mansfield. Ohio, produces a 110,000-volt porcelain insulator. The insulator is selected for use by the Hydroelectric Power Commission of Ontario, Canada.

(1235) H. E. Shreeve, New York. is granted U. S. Patent No. 937,189 for a telephone repeater system.

(1236) Alfred N. Goldsmith reads an important paper before the Wireless Institute, New York, November 3, on the subject of Wireless Telephony.

(1237) George C. Cummings and John A. Kick, of the Chicago, Burlington and Quincy Railroad. Chicago, organize the Charter Electric Company. with a capital of $250,000, to manufacture a printing telegraph system invented by them. Others identified with the enterprise are J. G. Wray and T. M. Haston.

(1238) E. T. Greenfield. of Kiamesha, N. Y., procures a U. S. patent for a spirally formed metal tubing for electric conductors.

(1239) C. F. Elwell. of San Francisco. returns from Europe where he purchased the American rights to the Poulsen system of wireless telegraphy.

(1240) The dividend on Mackay Companies common stock is increased from 4 to 5 per cent. The dividend on the preferred shares continues at 4 per cent. (December.)

(*To be continued*)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

The Veteran Wireless Operators Association made the following awards thus far this year:

ANNUAL GOLD MEDAL

To Mrs. Anne Morrow Lindbergh for her outstanding accomplishments in radio communication on the recent flight on which she accompanied Colonel Charles A. Lindbergh, acting in the capacity of radio operator, navigator and co-pilot. The flight covered four continents and for no part of the flight were they out of communication with the outside world for more than a few hours.

It will be remembered that on his epochal first trans-Atlantic crossing to Paris, Colonel Lindbergh did not carry radio equipment. It is a tribute to the efficacy of radio communication in aviation that it should have played such a large part in the success of Lindbergh's most recent pioneering flight.

In a signed letter to the Association, Colonel Lindbergh says in part: "I want you to know that the action of the Veteran Wireless Operators Association in honoring my wife has given me a great deal of pleasure. During our last flight she never failed to make contact when it was needed, and I feel that few people realize the value of radio in the type of flying we did. Part of it would have been impossible without regular radio communication."

In accepting the Gold Medal, Mrs. Lindbergh addressed President Muller as follows: "I want to ask you as President of the Veteran Wireless Operators Association to express my sincere thanks to the Association for their Gold Medal which I am very proud to receive. I appreciate the great honor which they have given me. I am very happy to have such an award from the Association—perhaps I should say particularly from this Association, for I already have the greatest admiration and gratitude toward such operators as make up this organization for their help to me in these past flights. The cooperation I received from the radio operators wherever we went contributed tremendously to the success of our flight."

TESTIMONIAL AWARDS

Lieut. G. B. H. Hall, U. S. N., Communications Officer for the Navy massed flight of VP Squadron Ten, from San Francisco to Pearl Harbor, Hawaii. The following article, quoted in part from the Daily News Bulletin of the U. S. S. Wright, will indicate the importance of radio to the success of the flight.

". . . I desire also to express my appreciation for the part played by Lieut. Hall and the other officers and men of the radio organization of this command. Through them the work of the entire flight organization was coordinated. The swift collection and dissemination of meteorological intelligence to the widely scattered units of the aerological services, and the accurate and prompt communication of orders and information to the planes and Naval vessels guarding the flight, were duties of far reaching importance which could not have been satisfactorily accomplished but for the indefatigable though inconspicuous efforts of the radio personnel."

Lieutenant Colonel Mario Infante, Communications Officer of the Balbo massed flight from Rome to Chicago and return. This flight squadron comprised twenty-four airplanes. Some indication of the thoroughness with which communications preparations were made is revealed by the fact that Colonel Infante and several of his aides made an automobile trip over the entire route to be flown between Cartwright on the Labrador Coast, Shediac in New Brunswick, Montreal and Chicago, and between Chicago and New York, to make certain that communication with headquarters in New York and the squadron would be reliable all the way. This was ascertained definitely by means of a mobile short-wave radio set with which they contacted Mackay Radio.

Military men and communications experts were unanimous in their praise of the efforts and efficiency of Colonel Infante in the enterprise and it was generally agreed that credit for the great achievement belonged, in no small part, to him.

John Dyer, Columbia Broadcasting System Engineer, in charge of the South Pole Broadcasts from the Byrd Expedition II to the outside world. The broadcasts have been of a weekly nature starting before the expedition reached their base. It goes without saying that this is one of the most remarkable achievements in the art of modern broadcast communication. When the award was made to Mr. Dyer, early this year, a radiogram was dispatched to him by the Association congratulating him on the success of the broadcasts and wishing him the best of luck in future efforts.

Harry Sadenwater—"For meritorious service in his line of duties as radio operator on the NC-1 during the long overseas flight from Newfoundland to the Azores in in May, 1919." It will be remembered that the NC-1 was one of three Navy planes to attempt the then most hazardous crossing of the Atlantic; hazardous because of the poorly developed state of aviation at the time and the pioneering nature of the flight. Mr. Sadenwater was awarded a Navy Cross by the President for his work in the NC-1. He is at present with the RCA Victor Company, Inc., at Camden, N. J., in the capacity of Manager of the Engineering Products Division.

V. W. O. A. GOLD MEDAL

This beautifully designed Gold Medal has been awarded annually to the Wireless Operator who renders the most outstanding and conspicuous services in the line of duty. There is no higher distinction in the radio world than this award and only ten Gold Medals have so far been presented by the Association. Those who have received the awards are: Joseph E. Croney (1927), Guiseppe Biagi (1928), Michael J. O'Loughlin (1928), Nunzio Digangi (1929), Malcolm Hanson (1929), Frank N. Davidson (1930), Fritz E. Larson (1931), Guglielmo Marconi (1931); Ray Meyers (1933), Mrs. Anne Morrow Lindbergh (1934).

"HERE AND THERE"

The door-bell rings twice . . . sure thing . . . it's the postman . . . a letter . . . an unfamiliar looking stamp . . . closer scrutiny discloses it to be a Byrd Antarctic Expedition II three-cent postage stamp . . . rather odd . . . what's the postmark? . . . sure enough . . . Little America, Antarctica . . . addressed to the V. W. O. A., care of the Pres. and Sec'y . . . whom is it from? . . . none other than Carl O. Petersen. Carl is with the Byrd Expedition for Paramount Sound News with John Herrmann as partner. He says: "Just a few lines from the South Polar regions which will be our home for the next 14 months like it was in 1929-1930. Have participated in three great flights so far, as radio operator and camera man, and expect to get much more flying here this time. Best wishes to all." Carl was with the first Byrd expedition as radio operator and was awarded a Testimonial by the Association for his work in that capacity.

Members who visited New York recently: K. Anthony, Radio Electrician, U. S. S. Chicago, in with the fleet; formerly stationed at Pearl Harbor, Hawaii. We gained an appreciation of the importance of radio communication from Mr. Anthony, who informed us that his ship carried five radiomen to maintain the equipment and approximately thirty in the operating personnel. We understand the equipment consists of ten main transmitters ranging in size from a few watts output to a 5-kilowatt job. Ten auxiliary transmitters are likewise provided. Simultaneous communication can be maintained on all transmitters. Considering the large number of antennae necessary to accomplish this feat, it was indeed a surprise to note the neat appearance of the radiating system. Navy regulations prohibit visiting the radioroom. However, we enjoyed viewing the torpedo tubes, gun turrets, airplane catapults and the many other interesting features of the new 10,000-ton cruiser.

Uda B. Ross, formerly Technical Radio Editor of the New York *Telegram* before it merged with the *World*, who was in

(*Continued on page* 28)

NEWS OF THE INDUSTRY

TRIMBLE JOINS IRC

The appointment of Francis C. Trimble as assistant to the president of the International Resistance Company, 2100 Arch Street, Philadelphia, Pa., has been announced.

Mr. Trimble, who joined IRC early in June, will devote himself primarily to the requirements of the set manufacturing trade. He brings to his new connection a broad background of experience in this and other lines.

The appointment of Mr. Trimble entails no changes in the present IRC organization, being a move to insure more highly concentrated service in the specialized fields in which the company is engaged. Sales manager Dan J. Fairbanks and his assistant Harry A. Ehle will continue to direct IRC activities in the replacement parts and industrial fields.

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RICHARD CARLISLE JOINS BRUNO LABORATORIES

Richard W. Carlisle, well known member of the Institute of Radio Engineers, and formerly with the engineering and research divisions of the RCA Victor Company, has joined the staff of the Bruno Laboratories, 20 West 22nd Street, New York City, in the capacity of Chief Engineer, in the sound and electronics division.

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GENERAL RADIO OPENS NEW YORK OFFICE

In order that engineering information may be more readily available to clients in the New York Metropolitan area, the General Radio Company have opened an office at 90 West St., New York City. The telephone is COrtlandt 7-9382.

While Mr. Myron T. Smith of the general engineering staff at Cambridge will be at the New York office a large part of the time, other engineer members of the Cambridge staff will be there from time to time.

Correspondence regarding general matters should continue to be sent to Cambridge, Mass.

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CLAROSTAT SAMPLE CARD

The Clarostat Manufacturing Company, Inc., Brooklyn, N. Y., now have available sample cards of the Clinch Grip Flexible Resistors. Each sample card has fastened upon it one of each of some 12 resistors of the FX and FY types. At the bottom of this card is given mechanical and electrical data, their code, and an illustrative diagram.

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DELTA CO. JOINS RAYTHEON

The Delta Manufacturing Company, formerly of Cambridge, Massachusetts, makers of Acme-Delta Transformers, Chokes, and Power Equipment for radio amateurs, Delta High Voltage Rectifiers for broadcast stations, Delta Voltage Regulators, and other special power-conversion equipment, has joined the Raytheon Manufacturing Company. The activities of the combined companies will be carried on under the name of Raytheon Manufacturing Company, Electrical Equipment Division, in a newly acquired plant at 190 Willow Street, Waltham, Massachusetts.

There has been no change in the Delta organization and all products formerly made by them will now continue to be manufactured by the same personnel and sold by Raytheon's Electrical Equipment Division. In addition, new types of rectifying apparatus for converting ac into dc are being designed to permit the use of rectifiers in industrial applications where previously only motor generators or storage batteries could be used.

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"SIMPLIFIED DISC RECORDING"

"Simplified Disc Recording," with one diagram and other useful information on the subject, has just been published by the Universal Microphone Co., Inglewood, Cal., as a 12-page leaflet.

The making of high-quality recordings by stations, agencies and individuals for air checks, audition records and other uses, has opened up an entirely new field in the sales and service of recording apparatus.

The Universal booklet subdivides its publication by discussing the amplifier, hum and volume levels, turntable, recording heads, types of record material, playback, mounting the lead screws, the pickup, weight on the recorder, playing time of records and a general discussion.

It was compiled by E. E. Griffin, chief engineer of the company. A small service charge of ten cents has been placed on the booklet to take care of the mailing and clerical expense.

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BAKELITE BOOKLET

The Bakelite Corporation, Bound Brook, N. J., have prepared an interesting 24-page booklet on "Bakelite Synthetic Resins For Paints and Varnishes," copies of which will be sent free upon request. This booklet gives a brief history of the product bakelite, a description of some of the numerous tests it has undergone and the uses to which it may be put when incorporated in a varnish or paint.

It is written in a non-technical style and should prove of interest to its readers.

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SHEET STEEL BOOK

A book on Electrical Sheet Steel, printed by the American Rolling Mill Company, Middletown, Ohio, has just come to our attention. This book includes core-loss guarantees and properties; data on Tran-Cor 60, 66, 72, Intermediate Transformer, Special Electric, Electric and Armature grades, and a core-loss factor table. Data on Radio Grades 2, 3, 4, 5, and 6 are also included. All inquiries should be addressed to the Middletown, Ohio, offices.

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SYNTHANE SAMPLE BOOK

The Synthane Corporation, of Oaks Pennsylvania, announces an interesting new Laminated Bakelite Sample Book. The book is a handy pocket size and is profusely illustrated with excellent reproductions of sheets, rods, tubes, fabricated parts and possible machining operations.

A distinctive feature is the presentation of actual samples of the material. Samples of Synthane have been slipped into paper envelopes on the right hand pages from which they can be easily removed for inspection.

On the opposite, left hand pages, the properties, characteristics, colors, sizes, grades and thicknesses are condensed to short paragraphs that can be read in a few moments. Standards of quality and test values are in the back.

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WESTINGHOUSE LE PHOTO-RELAY

A new publication describing the Westinghouse Type LE Photo-Relay has recently been published. It describes the application, construction, operation, specifications, advantages, and list prices of these relays. These relays are applicable to all types of industrial control, light control, grading, counting, etc. The relay is available for either ac or dc circuits. Copies may be obtained from the nearest district office or direct from the advertising department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

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WESTINGHOUSE SG AUXILIARY RELAYS

A four-page publication describing the Westinghouse Type SG Auxiliary Relays has recently been issued. This simple, low-cost, sturdy relay designed for opening or closing two independent circuits is especially applicable for use in industrial plants. The publication includes applications, distinctive features, application tables, dimensions, wiring diagrams and list prices.

Copies may be obtained from the nearest district office of the Westinghouse Electric and Manufacturing Company or direct from the Advertising Department at East Pittsburgh, Pa.

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"CONVENTION AND GENERAL RADIO REGULATIONS"

The International Telecommunication Convention of Madrid, 1932, and the General Radio Regulations annexed thereto, have now been formally ratified by the United States Government and became effective on June 12, 1934, superseding the International Radiotelegraph Convention and General Regulations of Washington, 1927.

A number of changes affecting all classes of stations are made in the new Convention and General Radio Regulations. These changes are of importance to all persons engaged in the operation of radio stations and should be given careful consideration and study.

In order to assure compliance with all the provisions of the new Convention and General Radio Regulations, a copy of this Convention and General Radio Regulations should be available in each radio station. This is mandatory in the case of ship stations.

The International Telecommunication Convention of Madrid, 1932, and General Radio Regulations annexed thereto, may be purchased at the Superintendent of Documents, Government Printing Office, Washington, D. C., at thirty cents per copy.

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REDMOND JOINS RADIO RELEASE, LTD.

W. J. Redmond, for several years with the technical staff of the RKO Hollywood studios, has joined the technical department of Radio Release, Ltd., transcription producers, as sound effects man.

NEW PRODUCTS

WESTON DB METERS

Weston Electrical Instrument Corporation, Newark, N. J., has developed two new db meters, so that these instruments are now obtainable in three classes, differing in pointer action, namely; high speed, general purpose, and slow speed. The new high-speed instruments are so designed that indications of peak values are available with a negligible amount of overswing of the pointer. As contrasted to the high-speed instrument, the slow-speed type tends to indicate average values, the pointer being slow enough in its action to avoid indications of sharp peaks or valleys.

The basic scale is one with limits of —10/0/6 db and is furnished on all standard stock meters. Common usage has fixed the power level at 6 milliwatts. Also, the instruments are furnished for a line resistance of either 500 or 600 ohms. Standard instruments are adjusted to an internal resistance of 5000 ohms at "0" db. Stock instruments with adjustment down —10 db at 0 on scale are adjusted to a resistance of 1581 ohms at the 0 point.

All special meters are subject to correspondence which should be addressed to the Electronic Sales Division of the above company.

IRC VOLUME CONTROLS ANNOUNCED

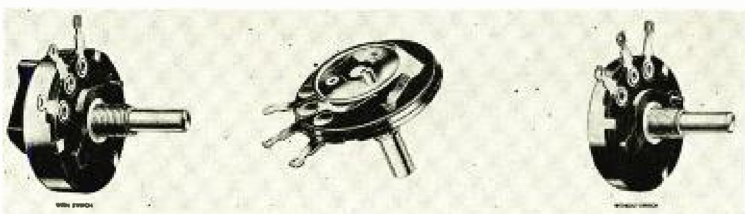
The principle of applying resistance coatings to insulating bases, used so successfully in Metallized Resistors, has now been applied to IRC Volume Controls introduced by the International Resistance Company, 2100 Arch St., Philadelphia, Pa. In these controls, the resistance coating is permanently bonded to a moisture-proof base by baking at a high temperature. The result is a resistance element that is unusually stable, durable and permanent under all conditions of use and one that is particularly effective in combating the effects of humidity, it is stated.

Quiet operation and smooth resistance variation are obtained in IRC Controls by three contact fingers with spherical-convex surfaces. These glide directly over the resistance element, never deviating from their course and avoiding any shifting of the points of contact with resulting jumps in resistance as the slider is rotated. The hard resistance coat reduces wear to a negligible quantity.

Standard IRC Volume Controls are available with or without switches in the range of 200 ohms to 2 megohms. Special units can be made as high as 10 megohms. Although not designed as power controls, the IRC units can handle up to 1 watt if the power is dissipated over the entire element.

In addition to exhaustive laboratory tests, it is said that IRC Volume Controls were actually used by radio manufacturers for more than a year prior to their general announcement to the trade.

A new bulletin "IRC Volume Controls" contains complete details and will be sent upon request.



TRUSCON ANTENNAS

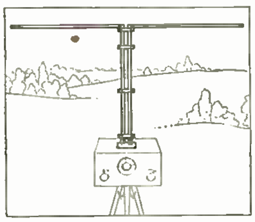
A new development of the Truscon Steel Company, Youngstown, Ohio, a self-supporting radio antenna, is said to have the following outstanding features: high effective radiation, low shunt capacity, exceptionally rigid construction, safety cage ladder throughout entire height, low overturning moment, conservative safety factor, mechanical reliability, and maximum overall efficiency.

A unique feature is the radial reduction in overturning moment at the base, due to wind load on the structure, as compared to conventional tower design. Smaller mechanical load on the insulation results in a narrower base, and minimum insulator and shunt capacity.

NEW 5-METER ANTENNA

A unique high-efficiency antenna for 5-meter transmission and reception has just been announced by the E. F. Johnson Company of Waseca, Minnesota, manufacturers of radio transmitting equipment. It is said that the efficiency of the unit is approximately 3 db above that of a simple, current-fed antenna due to accurate impedance matching secured through a properly designed quarter-wave line section which also serves as a support.

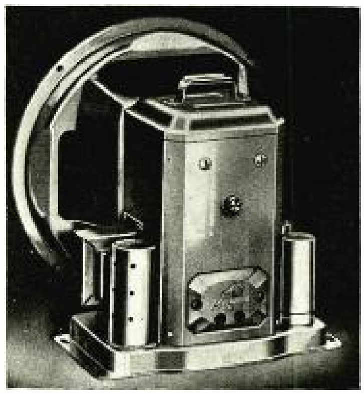
The Johnson antenna is designed for convenient installation either at a fixed station or under a variety of conditions encountered in portable work. Thus it is possible to mount the antenna directly on a transceiver or portable transmitter case, or the antenna may be suspended in the air between convenient supports (for increased optical range) with a transposed transmission line back to the main equipment. Impedance remains accurately matched regardless of the method of use. With the aid of plug-and-jack fittings, the change from direct plug-in mounting on case to overhead suspension may be made quickly and easily without tools. No internal wiring changes or transmitter readjustments are necessary.



The antenna may be installed horizontally as illustrated or vertically by providing simple supports. It can be quickly set up and dismantled and weighs only 1-3/4 pounds net. Two models are available with either low-loss glazed porcelain or Mycalex insulation.

MAGNAVOX HIGH-FIDELITY SPEAKERS

The Magnavox Company, Fort Wayne, Indiana, are now presenting high-fidelity speakers for use in amplifying equipment, radio receivers, and the like. The Magnavox high-fidelity speakers, Models 512



and 522, have been designed and produced to make commercially available such high-quality and high-efficiency reproduction as has hitherto been found only in elaborately constructed laboratory models.

The manufacturer states that the low-frequency response is such that the average level is maintained down to approximately 50 cycles. The response has a generally rising characteristic toward the higher frequencies, with its peak occurring in the neighborhood of 4,000 cycles, and the sound output at 6,000 cycles is equal to the average value. Nearly complete cutoff occurs slightly above 7,000 cycles.

The new Model 512 high-fidelity speaker is the dc type, available with field resistance as specified by the purchaser, but provided in standard resistance values of 7,500 ohms and 640 ohms. Optimum field excitation is made available when a power of 17 watts is supplied to the field coil. A lower value of field power produces a higher degree of efficiency than that commonly met with in speakers of this type, they state, so that the field power lies between 10 and 25 watts. Field power in excess of 25 watts gives very little increase in speaker output.

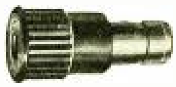
The model 522 speaker is provided with a Universal power supply operating on dc line voltages of 125, 150 and 240. Frequency may be any value from 25 to 133 cycles.

NEW ERIE SUPPRESSOR

The Erie Resistor Corporation, Erie, Pa., has recently placed on the market a new suppressor resistor to reduce ignition interference on radio-equipped automobiles.

(Continued on page 26)

Known as type A-1, it takes up very little more installation space than an ordinary spark-plug nut, which it replaces. Overall dimensions are 29/32" in length and 29/64" in diameter.



This unusual compactness is made possible by the development of an extremely short resistance pin that is only 17/32" in length. In spite of its size, the unit will not break down under the high voltages used in ignition systems, it is said.

Comparative tests and performance curves show that the new A-1 Suppressor is on a par with the larger types of Erie Suppressors. Life tests operating under load of 1/4" spark gap and at 300° F. show less than 6% change in resistance after 250 hours.

A feature of the new suppressor is that there are no soldered connections anywhere in the assembly, thus eliminating any danger of open circuiting due to engine heat or vibration. It is designed to fit on No. 8, 8-1/2 and 9 spark plug threads.

The Type A-1 Suppressor can be supplied in any desired resistance value up to 50,000 ohms. Further information and data can be obtained by writing the manufacturer.

MANUFACTURERS' MODEL 6-VOLT POWER SUPPLY

A new, economical and more compact Pioneer Gen-E-Motor for supplying all "C" and "B" voltages from a 6-volt storage battery has just been announced by the Pioneer Gen-E-Motor Corp., of 464 W. Superior Street, Chicago, Ill.

Models are available with any desired maximum and intermediate voltages. Each type is individually designed for the desired output, assuring maximum efficiency which holds battery drain to a minimum.

Additional Gen-E-Motor designs are available for auto-radio, air-craft, and 32-volt power systems.

G-M PHOTOELECTRIC RELAY

G-M Laboratories, Inc., announces a new Photoelectric Relay capable of operating at greatly increased distances. This new type of Photoelectric Relay will operate reliably on changes in illumination

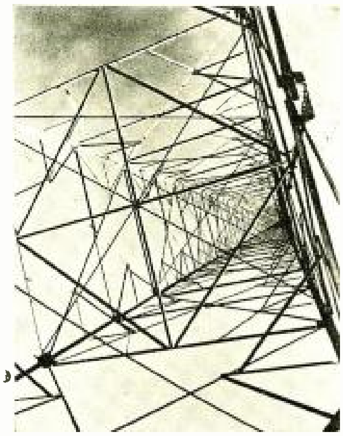
as small as one foot candle or less, and when used in conjunction with the G-M No. 1217 Light Source can be operated at distances as great as 90 feet with white light and up to 40 feet with an infra-red invisible beam, it is said.

The No. 1217 Light Source can be furnished with a 6-volt lamp having a rated life of 3000 hours, and uses a condensing lens with an adjustable focus lens tube. At 10 feet this Light Source provides an illumination of 30 foot candles white light, and at 90 feet approximately one foot candle.

The new Photoelectric Relay operates on 110-volt, 60-cycle ac and is normally supplied with contacts having 2 amps, ac non-inductive load capacity. The unit illustrated shows but one of the cases that can be supplied for housing this new unit, the proper case depending on the nature of the application. A speed of 600 operations per minute can be consistently maintained. The circuit can be so arranged that no plate current is drawn from the amplifier tube except while the light beam is interrupted, thus increasing the life of the amplifier tube at slow or medium speeds.

INTERNATIONAL-STACEY VERTICAL RADIATOR

The International-Stacey Corporation, with headquarters at Columbus, Ohio, have played an important part in the development of the self-supporting type vertical radiator.



The new KOA 50,000-watt transmitter at Denver, Colorado, installed by the General Electric Company, is used in conjunction with a 470-foot tower functioning as a vertical radiator. A view of this tower, which was constructed by the International-Stacey Corporation, is shown in this column.

The design and construction of radio tower installations is supervised by Mr. Charles E. Schuler, Manager of the Electrical Department of International-Stacey, who has made a study of antenna systems in conjunction with Professor John F. Byrne, of the Ohio State University.

BUD IMPROVED PORTABLE P-A SYSTEM

The new Bud Portable P-A System has many outstanding and exclusive features which are of special interest to the Service Man, Radio Dealer, and the individual or organization specializing in the rental and sale of public-address equipment.

Perhaps the most outstanding feature of this newly designed portable P-A system is its ready adaptability to such a wide variety of uses, *both in and out of doors*. Used in a large theatre or auditorium, and employing the two speakers which are furnished as standard equipment, this highly efficient and extremely portable sound system will easily cover a 3,500 gathering. For outdoor political meetings, picnics, carnivals, sporting events or religious gatherings, this portable P-A system will reach every person of the 3,500 present.

To guarantee the utmost in pick-up efficiency and frequency response, a laboratory-built condenser microphone, many of which are now being used in America's finest equipped radio stations, is furnished as standard equipment. The buyer of this new and improved system is given his choice of floor-stand type, desk model, suspension type, or hand model.

The power supply and amplifier for this new P-A system are housed in one small and attractive metal case. To eliminate any possibility of incorrect hook-up, all plugs are polarized.

The speakers employed in this portable P-A system are housed in newly designed all-aluminum baffles which allow for better coverage and greater efficiency than the old square-type baffles ordinarily featured as standard equipment with systems of this kind. The speaker baffles are mounted on their own adjustable standards, and can be easily removed for mounting on walls if necessary. The speakers can be swiveled from side to side, and can be raised and lowered on their adjustable stands, which stands are designed exactly like the floor stands ordinarily used with all types of standard microphones.

The manufacturer recommends it for use in schools, for both in and outdoor events, churches, funeral homes, sporting events of all kinds, in theatres, auditoriums, night clubs, and any place, in or outdoors, where highly efficient coverage of crowds not to exceed 3,500 people, is required.

This new system is the latest development of the Bud Speaker Company, 1131 Jackson Street, Toledo, who will be glad to send you full descriptive literature on request.

FERROCART

Ferrocart is a magnetic core material for use in antenna coils, r-f transformers, and i-f transformers. It is made in two forms: laminated and molded. A wide variety of shapes and sizes may be had in either type. The permeability can be definitely controlled to meet any requirements from 10 to 13.9, and due to the elimination of eddy-current and hysteresis losses, it is possible to take advantage of this permeability and thereby reduce the copper losses, due to a much smaller amount of wire being required for a given inductance value. Accompanying this is increased selectivity and sensitivity by a ratio of approximately 2 to 1, it is stated.

This material has been in commercial use for two years and is absolutely stable both from a chemical and electrical standpoint. The uniformity of cores made after this process is excellent and exceeds all requirements for commercial use.

Ferrocart can be supplied in any quantity by the Ferrocart Corporation of America, 12 East 41st St., New York, N. Y. It may be had either in cores or in complete coil units to suit practically any circuit design. Engineering services of the best known high-frequency laboratories are available to assist set or coil manufacturers in the design or application of any unit.

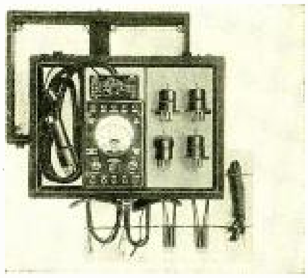
SCREW-HOLDING SCREW DRIVER

A patented, non-magnetic, screw-holding screw driver, the "Jiffy-Tite," made of chrome vanadium alloy steel, is announced by George W. Kufahl, manufacturers' representative, 5037 S. Michigan Ave., Chicago, Ill.

Model No. 1 has an overall length of 9¾" and a blade size of 5/16"; Model No. 2 has an overall length of 8½", a blade size of 3/16" and in addition is equipped with an insulated shock-proof handle; Model No. 3 has an overall length of 12½" and a blade size of ⅜".

NEW WESTON FIELD SET SERVICER

A new and inexpensive Selective Set Servicer has been developed by Weston. This Selective Set Servicer assures the owner of a life-time of profitable, trouble-free service, it is stated.



The Servicer, a Weston Model 698, employs the new Weston method of selective analysis; a simplified method which, through the use of the improved Socket Selector Set, banishes servicer obsolescence for all time.

This application of an independent Socket Selector unit enables the owner to modernize his Servicer at small cost. Changes in tube base design cannot affect the efficiency of the Servicer as the Selector Unit is designed with the purpose of accommodating these new tube bases.

The voltage, current and resistance ranges are adequate for all practical requirements of field servicing.

•

BELDEN RESISTANCE CORD

A new radio power supply cord which incorporates a line cord with a voltage drop resistor, is announced by the Belden Manufacturing Company, 4689 W. Van Buren St., Chicago, Ill.

The new cord is made with three resistances for all a-c or d-c radios using this kind of power supply:

Belden No. 8920—total resistance 135 ohms; total filament drop 25.2-31.5.

Belden No. 8921—total resistance 165 ohms; total filament drop 56.5-68.9.

Belden No. 8922—total resistance 290 ohms; total filament drop 68.9-75.2.

These cords are six feet long and attached with the handy midget type Belden Unbreakable Soft Rubber Plug.

•

GRIPWELL DUKTEX AND CEMENT

To eliminate slippage on belt driven machinery and to improve the efficiency, a scientific method for preventing belt-slippage has been developed by the Gripwell Manufacturing Company, 105 West 40th Street, New York.

This method is an improved fabric which is a specially processed, waterproof-treated covering known as Gripwell Duktex with belt preservative qualities in the Gripwell Cement which firmly secures the fabric covering direct to the pulley and to coat the outer surface. The cement is a synthetic vegetable and oil compound whose main characteristic is quick-drying, a product of great tenacious power. It is suitable for applying the fabric covering to the surface of iron, steel, wood or paper pulleys.

The cement is available in 5- and 10-pound cans. The Duktex fabric is furnished to correct lengths and widths for the pulley to be covered.

•

NATIONAL ELECTRICAL EXPOSITION

In Manhattan's mammoth Madison Square Garden arena the second annual combined National Electrical and Radio Exposition will hold forth this fall during a period of eleven days, September 19 to 29. The coming show will celebrate the tin wedding anniversary, so to speak, of the two gigantic industries, according to Joseph Bernhart, general manager.

Mr. Bernhart stated that with the 1934 National Electrical and Radio Exposition more than ten weeks away from its opening date, more space had been sold up to June 30 than was contracted for in the entire 1933 show, which proved to be such a marked success.

•

NEW SPRAGUE CAPACITY INDICATOR

The Sprague Capacity Indicator recently introduced by the Sprague Products Company, North Adams, Mass., is an instrument designed to enable the Service Man

to tell the correct condenser capacity for a circuit, enabling a wide variety of capacities to be cut in until the right one is obtained. Besides giving the correct capacities for those that have actually broken down, the indicator makes it possible to check the efficiency of all the condensers in the set, it is stated.

These units are equipped with the new patented Sprague "Surge-Arrester" which, by "chirping" on overloads, automatically indicates voltages of 475 and above. The indicator is 7½ inches high by 4 9/16 inches wide and 3⅛ inches deep.

•

SHERWOOD IGNITION FILTER

The Sherwood Ignition Filter, manufactured by C. M. Sherwood & Co., 1015-1021 Forty-eighth Avenue, Long Island City, N. Y., has been designed to replace the high-resistance suppressors in automobile radio installations, eliminating the interference from the high-tension circuit of the ignition system in any make or model of automoble.

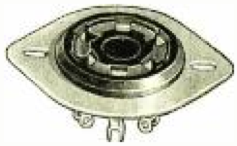
This unit is made up of a copper-wound inductance unit of 120 ohms resistance enclosed and insulated in a bakelite cover, which also furnishes ample protection against moisture. In addition, the mechanical construction makes the filter practically vibration proof.

Further features of the Ignition Filter given are: full power of motor, less gasoline consumption, perfect motor idling, quick acceleration, clean spark plugs, more speed, easy starting.

•

ALL-PURPOSE REPLACEMENT SOCKET

The Amphenol molded bakelite "cliptite" socket with universal adapter plate can be used to replace any wafer socket without drilling new holes in the chassis. It can also be mounted in any position and allows shield to be added to any tube without riveting or drilling the chassis base.



Made by the American Phenolic Corp., 509 South Throop Street, Chicago, Ill.

This company has made further refinements and improvements in assembly methods for Amphenol sockets and chassis.

For large scale production both foot and power presses for assembling sockets to the chassis are available.

Tube shield bases are held onto the chassis by the socket flange and are assembled without any extra labor.

For smaller production, hand tools for assembling retainer rings which hold the socket to the chassis are furnished. These new hand tools are light weight and the socket assembly is very quickly accomplished.

•

NEW "EASTERN COIL" LINE

The Eastern Coil Company, 56 Christopher Ave., Brooklyn, New York, manufacturers of a high grade line of microphone stands and quartz crystal holders, announce the following additions to their 1934 line of merchandise:

A coupling device which permits removal of the microphone from the stand without removing the springs or disconnecting of wires. To remove the microphone it is only necessary to unscrew the cap of this device and in an instant, the ring, microphone, springs and wire are lifted from the stand. Electrical contact is made through a three-wire connector.

A telescopic floor stand comprising three non-removable sections, a feature which allows the stand to be raised to full height in an instant. It also eliminates accidental dropping of the microphone when raising stand by preventing the movable rods from becoming disengaged. The standard model is furnished with a light base for extreme portability. Where weight is not a factor, two heavier models are available.

An improved type of quartz crystal holder of the same high grade quality as their standard type but designed to plug into a standard UY tube socket.

Additional information and circular may be had upon request to the manufacturer.

•

CONDENSER MICROPHONE KIT

A new type of condenser microphone kit for radio amateurs, experimenters and manufacturers of sound equipment, is announced by Shure Brothers Company, 215

(*Continued on page 28*)

West Huron Street, Chicago. The Shure Model 40K Condenser Microphone Kit includes a broadcast-type condenser head which is fully assembled and laboratory-tested at the factory. Thus even a relatively inexperienced person can construct a condenser microphone unit with performance equal in every respect to that of the factory-built commercial product, it is said. A fully illustrated instruction sheet is included with each kit.

In addition to the precision condenser head (which is the same unit used in the Shure Model 40C Studio Type Condenser Microphone), the kit includes coupling and isolation resistors, bypass and coupling condensers, output transformer and tube sockets for a two-stage head amplifier using type '30 tubes. The amplifier case (not furnished) may consist of a standard shield-can readily obtainable from radio supply houses or the user may design a housing which best suits his particular purpose. The special split-winding transformer may be connected to give either 200- or 50-ohm output. Battery requirements are 180 volts at 5 m.a. or less and 6 volts at 60 m.a.

ALPHA WIRE CATALOG

The Alpha Wire Corporation has just issued their new Fall Radio Jobbers Catalog, which is complete in essential detail and information on all types of hookup wire—pushback, colored rubber and busbar, aerial wire, battery cable, bronze dial cable, microphone cable, shielded lead-in, plain rubber lead-in, shielded and plain auto ignition cable, braided tinned shielding, annunciator wire, ac-dc antenna lead wire, electric wire of all sizes and kinds, radio accessories such as transposition blocks, plain and Navy type insulators, standoff insulators, porcelain and bakelite screw eyes, lead-in strips, ground clamps, lightning arresters, glass insulators, varnished spaghetti tubing.

Copies of this complete data may be had by addressing, Alpha Wire Corporation, 50 Howard Street, New York, N. Y.

UNIVERSAL AIRPLANE MICROPHONE

The need for an airplane microphone which will damp out propeller and motor frequencies has been met by the new model just put on the market by the Universal Microphone Co., Inglewood, Cal.

It is for use in the intercommunicating system wherein the pilot holds conversation with the passengers, or vice versa, and also for the airplane transmitters.

The airplane microphone comes in either one or two button models, with option of rubber or silk covered cord, and the on-and-off switch is in the handle. The mouth-piece is of ventilated rubber.

It weighs less than one pound and comes equipped with hook for hanging when not in use.

Manufacturers of the item predict a wide distribution for the airplane microphone, though its use will necessarily be restricted by the number of airplanes as potential users of the special model.

Though not a regular catalog item, Universal Microphone has already gone into production with the airplane microphone and will distribute in August.

FLECHTHEIM ENTERS RESISTOR FIELD

A. M. Flechtheim, president of A. M. Flechtheim and Co., Inc., this city, makers of Flechtheim Superior Electrolytic and Paper Condensers, announces that his organization is now prepared to deliver to the trade Flechtheim Superior Resistors and Suppressors.

According to Mr. Flechtheim his organization has devoted more than six months to the development of carbon units which are cold-molded and heat-treated to secure absolute stabilization. It is claimed that when subjected to the most rigid life tests, Flechtheim carbon resistors will prove constant over long periods of time and under operating conditions of extremely high temperature. The further assurance is given that these units will meet the most exacting tests for temperature and voltage coefficient and are extremely quiet under all conditions. The method of contact insures a long life of quiet and trouble free operation as the contacts are actually soldered to the body of the resistor, it is stated.

Flechtheim Carbon Resistors are being supplied in all values and sizes and Flechtheim Suppressors can be had in all types.

H-P-M HYDRO-POWER PLASTIC MOLDING PRESS

The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, has recently developed a new line of molding presses with individual electric motor drive, through the patented H-P-M "Dual-Speed" Hydro-Power Transmission. Each press is compactly self-contained with press cylinder and control valve equipment enclosed within a pedestal, which also contains the supply of operating oil.

However, the outstanding feature of the H-P-M Molding Press of most vital importance to the molder is the unusually complete H-P-M System of Controls. These not only provide adjustable automatic pressure control, but also regulation of speed of ram movements and an entirely new patented control principle, especially developed by H-P-M for plastic molding, whereby the rate of pressure increase is automatically governed according to pre-determined adjustment. The latter H-P-M Control principle introduces a new concept in the application of pressures to the molding art, superseding the "stair-step" method of changing pressures.

The press is, of course, arranged for rapid closing of the molds as a means of saving time. However, the speed of both closing and opening ram movements are controlled independently of the rate of pressure application mentioned above.

The Company has issued an interesting bulletin relative to these new presses, entitled—"The Modern Way of Plastic Molding"—which will be sent on request.

NEW OHMITE CATALOG

D. T. Siegel, General Manager, Ohmite Manufacturing Company, 636 N. Albany Avenue, Chicago, announces a new Rheostat and Resistor Catalog No. 10. This catalog has eight pages of helpful information concerning the use of these items in both radio and electrical work. It lists many new types of resistors, power rheostats, and replacement units.

This Catalog will be sent free to any one writing for it.

V. W. O. A. NEWS

(*Continued from page 2[illegible]*)

York on his honeymoon and vacation from Santiago, Chile, and Lima, Peru. We met him at the Hudson Division A.R.R.L. Banquet at the Pennsylvania, at which function he was fortunate enough to obtain about five prizes—one for being the amateur who traveled the greatest distance to attend. Mr. Ross has his headquarters in the Sud America Building in Santiago, Chile. He is Manager for both Chile and Peru for the Western Electric Companies of Chile and Cuba, handling all the sound motion-picture equipment for the Electrical Research Products Company in both countries. He expects to have a "ham" transmitter on the air in the near future. It will please him if his many friends make efforts to contact him.

J. G. McCoy of the Radio Department of the U. S. S. Detroit, also in with the fleet. Mr. McCoy was until recently stationed at the Naval Radio Station at Cavite in the Philippine Islands. We trust that JG has fully recovered from his recent illness.

Otto H. Endres, Radio Department U. S. S. Concord, who also came around with the fleet. San Diego is the home port of the Concord.

We sincerely hope that each and every member of the communications section of the fleet had an enjoyable visit in the metropolis.

(Editor's Note: *Communications to the Veteran Wireless Operators Association should be addressed to William J. McGonigle, Secretary, 112 Willoughby Ave., Brooklyn, N. Y.*)

In addition to the Annual Gold Medal award, the V. W. O. A. presents a hand engrossed Testimonial Scroll to radiomen who have rendered services of merit in line of duty and who have carried out the glorious traditions of the radiomen

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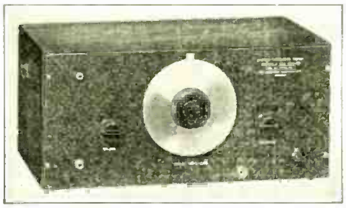

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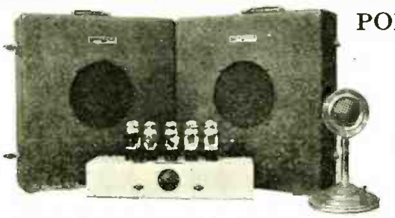

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